Kaveh´s forefathers

نیاکان کاوه آهنگر

Traces of protohistorical metallurgical activities during the 3rd millennium BCE in Eastern Iran with a special focus on the case of Shahdad in the Dasht-eh Lut (Kerman province)

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Eidesstattliche Erklärung

Hiermit versichere ich, die vorliegende Dissertation selbständig und ohne unerlaubte Hilfe angefertigt zu haben.
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Berlin, den

David M.P. Meier

Abstract:

This dissertation will deal with the metallurgical developments in eastern Iran during the Bronze Age with a particular focus on the Middle Bronze Age finds from Shahdad.

To begin with all relevant archaeological sites and their finds are presented to give an overview of the current state of research. In the course of the essay the geographical situation of Shahdad and its surrounding area will be described and another attempt will be made to give an explanation for the site´s formation processes according to geomorphological aspects. Thereafter the cupriferous deposits of eastern Iran will be presented in a new compilation with respect to current reports on the regional situation of the mineral deposits. Thereby current mining archaeological data will also be included in this analysis. In the next stage all archaeological investigations about the so called "metal workshop" at Shahdad will be critically evaluated and summarized. Following that hypotheses regarding the different room units and their supposed usage will be formulated. In this context cultural ties and relationships will not be forgotten, to point out similarities with the contemporary geographical neighbours. In a scientific archaeometric approach to the actual subject of the technological state of metallurgy in eastern Iran, several metallurgical samples of different types which all derive from the site of Shahdad were investigated, evaluated and referenced with further data from other relevant investigations. On the basis of these results an attempt to give answers regarding the state of metallurgical knowledge in the sense of the raw materials used and the pyrotechnological developments during the Bronze Age. Finally all metal objects which derive from the Middle Bronze Age cemeteries at Shahdad and are kept in the National Museum of Iran in Tehran will be classified typologically and presented in their entirety for the first time.

چکیده :

پایان نامهً دکتری پیش رو فلزشناسی شرق ایران در دوره برنز و به ویژه یافته های باستانشناسی از شهداد در دورهً برنز میانی را بررسی می کند . نخست با معرفی برجسته ترین محوطه های باستانشناسی و اشیا پیدا شده از این محوطه ها, تصویر کلی از پیشینه پژوهشی باستانشناسی (منطقه) ارائه می گردد. سپس محوطه باستانی شهداد از لحاظ جغرافیایی معرفی وبه چگونگی پیدایش آن ازدیدگاه ژئومرفولوژی پرداخته می شود. در ادامه پراکندگی لایه های مس در منطقهً شرق ایران با جمع آوری و ارزیابی دوباره گزارش های باستان شناسی مربوط مورد بررسی قرار می گیرد. در این بررسی مشاهدات باستانشناسی معدن نیز در نظر گرفته می شود. در مرحله بعدی مطالعات علمی دربارهً محل معروف به کارگاه در شهداد به طور دقیق مورد ارزیابی قرار گرفته، نظریه هایی در مورد کاربری پیشین اتاقک ها ارائه می شود. همچنین (در ارائه این نظریه ها) روابط و مناسبات فرهنگی منطقه با مناطق جغرافیایی همسایه در نظر گرفته می شود

در مرحله بعد گزیده ای از یافته های محوطه شهداد با یک روش علمی آرکومتری تجزیه و تحلیل وبا نتایج بررسی های مشابه مقایسه می شوند. نتایج این بررسی امکان پاسخگویی به پرسشهایی درباره مواد خام مصرفی و همچنین موقعیت پیروتکنیک را فراهم می کند. در پایان، تمامی اشیا فلزی به دست آمده از گورهای شهداد که در موزه ملی ایران نگهداری می شوند از لحاظ ریخت شناختی طبقه بندی شده ،برای نخستین بار به صورت یک مجموعه معرفی می گردد

Kurzdarstellung:

Die hier vorliegende Promotionsschrift beschäftigt sich mit einer Untersuchung zur Metallurgie Ostirans während der Bronzezeit mit einem besonderen Fokus auf den mittelbronzezeitlichen Funden von Shahdad. Zu Beginn wird anhand einer Vorstellung der prominentesten archäologischen Fundorte sowie derer Funde ein Überblick zum bisherigen Forschungsstand gewährt. Im weiteren wird der geographische Raum von Shahdad vorgestellt sowie ein Versuch unternommen, dessen Entstehung nach geomorphologischen Gesichtspunkten zu erklären. Darauffolgend wird die Verteilung der kupferführenden Schichten in der Region Ostirans anhand einer Zusammenstellung und Neubewertung von lagerstättenkundlichen Berichten vorgenommen, wobei ebenfalls diverse montanarchäologische Beobachtungen in die Auswertungen miteinbezogen werden. In einem weiteren Schritt werden die bisherigen Abhandlungen zu der sogenannten „Metallwerkstatt“ von Shahdad kritisch evaluiert sowie Thesen zur ehemaligen Nutzung der Raumeinheiten formuliert. Dabei wird ebenfalls nicht versäumt die Beziehungen, bzw. kulturellen Verhältnisse zu geographischen Nachbarregionen darzulegen. In einer naturwissenschaftlichen-archäometrischen Annäherung des ursprünglichen Themas zum Stand der Metallurgie werden ausgewählte metallurgische Proben, die in Shahdad gesammelt wurden, analysiert und mit Ergebnissen vergleichbarer Untersuchungsreihen in Relation gesetzt. Anhand dieser Ergebnisse wird versucht Fragen zu den verwendeten Rohmaterialien sowie zum Stand der Pyrotechnologie zu beantworten. Zum Abschluss dieser Untersuchung werden sämtliche Metallobjekte, die aus den mittelbronzezeiltichen Gräberfelder von Shahdad stammen und im Iranischen Nationalmuseum in Tehran aufbewahrt werden, typologisch klassifiziert und in einem Katalog erstmals in ihrer Gesamtheit vorgestellt.

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Table of content

List of Figures

List of Tables

List of Maps

Chapter 1: The Eastern Iranian plateau and Kerman Province as a core area for metallurgical innovation

1.1. Introduction

Since the first part of the last century, one of the main tasks of archaeological research has been to understand and reconstruct the technological adaptation and forms of development of ancient cultures.[1] Concepts of adaptation, technical choice, change, cultural transmission, or even “progress”, have been variously defined and applied to different archaeological cultures and contexts, building new frames of reference and posing new methodological challenges to field and laboratory research.

Whatever specific line of research might be selected, pyrotechnologies, used for heating and preparation of food as well as for transforming a culture’s environment, for the production of ornaments, tools and containers, is a crucial issue, in that it involves not only the transformation of a single base material, but the organization of complex, parallel activities, such as the collection and preparation of fuel and of the construction of ovens and kilns, activities that make the “operational sequence” or “châine operatoire” more and more elaborate.[2]

By now there is little doubt that within pyrotechnologies the production of metal artefacts was an eminent function, both for the rarity of copper and other metals and the intensive investment of multi-step human labour, not forgetting the strategic relevance of metal artefacts as ornaments and status symbols and items for exchanging, distributing and storing wealth. Metallurgical process steps, moreover, may be widely distributed in wide territories: they may involve acitivities like mining ores, the procurement of other raw materials such as fuel and even the search for competent craftpersons. Besides direct procurement, these technologies, as a consequence, may require and promote increased levels of land control and organized security. These factors, and many others, fully explain why the development of metallurgy is directly linked to the development of complex societies and early state organization.

This thesis deals with the investigation of metallurgical production in Shahdad, an important early urban site of southeastern Iran during the 3rd millennium BCE. The copper

1 Childe, 1936, 1956, 1958; Leroi Gourhan 1943, 1964; Sahlins, 1972; Brumfiel & Earle 1987; Lemonnoier 1993; Wailes 1996; Wenke 1999: 331-437; Schortman & Urban 2004; Costin 2005, 2007; Flad and Hruby 2007; Feinman 2008; and many others.

2 Lemonnier 1983; Pelegrin et al. 1988; Geneste 1989; Miliken & Vidale 1998; Djindjian 2013.

processing areas that are discussed in this work, investigated through surface surveys or direct excavation by different archaeological teams, were active between the end of the 4th millennium BCE and the last centuries of the 3rd millennium BCE, with a particular focus here on this later period, corresponding to the maximum expansion and articulation of the early urban centres.

This protohistoric settlement was chosen as a case-study due to its relevance for understanding the development of metallurgy in a macro-region so far poorly explored[3], but distinguished, as we have known of evidence for half a century of early and indigenous copper ore processing technologies.[4] In fact "...the Iranian Plateau is not only a vast area of land (1.5 million km^2), but also an archaeometallurgical terra incognita. Scholars have not yet even managed to map all of the ore deposits to be found in Iran, let alone attempted to find metalworking sites in these regions. Our understanding of this important highland zone remains limited to certain key sites, probably constituting less than 1% of all prehistoric archaeological sites that have ever been mapped, not to mention those that remain unsurveyed.... The Iranian Plateau served as one of the early 'heartlands' of metallurgy, and to understand its development is to tap into the earliest stages of human engagement with metals".[5] These remarks are even more appropriate for the almost totally unexplored south-eastern fringe of the Iranian Plateau.

In this light, the reasons why Shahdad was selected are manifold. First, in the rich graveyards so far excavated a unique collection of copper and copper alloy artefacts have been discovered that is to date one of the largest metallic assortments of protohistoric artefacts found in eastern Iran. Although generally in the available publications these objects are not always illustrated according to contemporary required standards, these artefacts are typologically very distinctive, with few matches in contemporary sites (with the possible exception of the Oxus centres of the Murghab delta).

Secondly, previous surface surveys at Shahdad[6] revealed that large areas of the settlement's surface were selectively covered by copper slag and other metal processing waste; thus, Shahdad was definitely – at least in some phases of its long chronological sequence – a metalworking settlement.

A recent survey by M. Vidale, F. Desset and others resulted in the gathering of an important collection of ore samples, slag, kiln linings and crucible fragments from the

3 Petrie 2013; Pitman 2013.
4 Caldwell 1967.
5 Thornton 2009a: 320.
6 Salvatori & Vidale 1982.

surface of the main cluster of industrial debitage found in the visits of the 1970s; these samples were made available to me and were the subject of a preliminary set of archaeometric studies.

Following the first surveys, an Iranian team investigated an architectural complex, Site D, which due to its infrastructures and inner finds had been identified as a “copper (smelting) workshop”.

I will critically review this archaeological context in detail, making clear how far this claim is supported or not. This would be so far the only scientifically examined metallurgical context in eastern Iran, and one of the few ever found across the whole Iranian plateau.

Third, and no less important, comes the richness of ore deposits of the areas surrounding the Dasht-eh Lut, that still bear traces of ancient and modern exploitation.

Thus, different sources of information, from economic geological reports, mainly from the 19th and 20th century, to historical reports and more recent observations and collections made by archaeologists will be combined together to enhance the role played by Shahdad in the development of early metallurgy of eastern Iran, and its importance in the long distance transport chains that linked Central Asia to the Gulf of Hormuz, and the western stretch of the Plateau to the first reliefs of Baluchistan. Crucial comparisons will be made with the nearest and most relevant metallurgical centres, Tappeh Hesar and Shahr-eh Sukhteh, in an attempt to define the patterns of difference and convergence between the general record of Shahdad and the technical traditions of these two other cultural and technological poles. These two sites, although they are often implied to be located in a closer vicinity to Shahdad, are actually situated in quite distant areas. The misunderstood relationship is due to the limitation of our knowledge of prehistoric settlement distribution in eastern Iran. Tappeh Hesar is located to the north of Shahdad at a distance of approximately 1000 km in the foothills of the Alborz Mountain range and Shahr-eh sukhteh about 500 km to the East in the Border-Triangle between Iran, Afghanistan and Pakistan.

Before entering into the specific discussion of the archaeological record of Shahdad, I will briefly review, in the following section 1.2., the surrounding contemporary sites, summarizing what is known so far of their metallurgy in terms of craft areas, copper processing waste and finished products. Although archaeological information will still appear extremely partial and our maps (see Map 1) still contain large voids, the summary will show why, hence the title of this chapter, the macro-region is useful when considered an important cradle of early metallurgical experiments and technological innovation.

1.2. Sites with significant traces of metallurgical material from Eastern Iran.

In the following review I refer to the study area as “Eastern Iran”. This geographical definition is purely conventional, as the concept of ”Iran” was totally extraneous to the cognitive background of the 3rd millennium BCE cultures of the Plateau, and modern political boundaries have little to do with ancient cultural spheres. Nonetheless this *ad hoc* choice, on the whole, appears pragmatic, as my study of the copper/bronze materials from Shahdad failed to reveal any substantial link between sites like Mundigak (Kandahar, Afghanistan) to the east or any other immediately contiguous early urban site complexes. In fact ‘Eastern Iran’ could be a conventional solution that ultimately enhances the unique cultural and economic characteristics of the defined study area. (see Map 1)

1.2.1. Tall-eh Eblis / Tall-i Iblis (29° 57´ N/ 56° 35´ E)[7]

Tall-eh Eblis (engl.: "Devil´s mound") lies in South-eastern Iran in the Bardsir valley in Kerman Province, about 2300 m.a.s.l. It originally measured ca. 180 x 100 m and is situated at a distance of 17 km to the south east of the modern town of Bardsir. This site, like others in the region, was first discovered by Sir M. Aurel Stein in 1932.[8]
He collected some surface finds and documented “... [a] few shapeless fragments of copper...” and began the excavation of a sondage to investigate the sequence of the settlement´s history.[9] More than 30 years later, in 1964, Joseph R. Caldwell from the Illinois State University “rediscovered” [sic!] the site.[10] The archaeological investigations started immediately and lasted until 1966.[11] In the course of the excavations Caldwell recorded an exceptional amount of artefacts related to metallurgical activities, including fragments of crucibles as well as slag, pieces of ore and finished copper objects. The

7 The site of “تل ابليس “ was wrongly transliterated as “Tal-i Iblis“ and repeatedly mentioned without regard to accurate transliteration conventions. All further transliterations are according to the Encyclopedia Iranica (http://www.iranicaonline.org/pages/guidelines)
8 Stein 1937: fig.55.
9 Stein 1967: 165ff.; Pigott & Lechtmann 2003: 291.
10 Caldwell 1967.Stein 1937: 165ff.;
11 In the period between M.A. Stein´s first investigations and Caldwell´s rediscovery that the site had seen heavy damage by the local farmers who removed the fill of the mound to reuse it as fertile soil on their fields (Caldwell 1967: 9). But due to these „damages“ Caldwell was almost instantly able to distinguish six cultural layers which could be dated in the time-range from the mid 6th millennium BCE to the late 2nd millennium BCE. Datings are based upon uncalibrated radiocarbon analyses first published by J. Caldwell (Caldwell 1967) and later on revised with calibration by Voigt & Dyson 1992.

range of ores smelted at the site included carbonates, sulfides, arsenates, and chlorides, which were available in a radius of 50-100 km from the settlement.[12] The majority of the pottery crucibles were encountered in Level I (5290-4420 BCE) and II (5205-4685 BCE).[13] The general evidence, as well as a copper-processing oven found at the site, suggested to Caldwell that in the late 6th-early 5th millennium BCE Tall-eh Eblis might have been a copper production area for a local trade network. At the site different kinds of cupriferous material were collected such as lumps of native copper and rich oxidic ores, primarily Malachite and Azurite as well as a piece of Chalcocite.[14] Further ores which were collected by D. Heskel at Tall-eh Eblis show evidence of copper arsenates (Erinite, Lindackerite) and a copper selenide (Klockmannite) as well as Azurite and Atacamite.[15] But Caldwell also realistically admitted that one single hearth does not provide substantial evidence for extensive pyrotechnological activities. He rather pleads the case for a "household-based cottage industry."[16]

In Level III (4460-4400 BCE) other copper artefacts were found. Level IV (4415-3365 BCE) also contained evidence of copper metallurgy in the form of more copper objects, malachite ore and further fragments of crucibles. Caldwell hypothesized that copper technology continued and flourished at the site in the later phases. During the last season of excavation, the site was visited by scientists from the "Metallurgical survey through the Persian Desert" who also carried out small scale metallurgical experiments to investigate the degree of pyrotechnological know-how at Tall-eh Eblis.[17] For this reason, one of the team´s members, Ms. H. Wulff, made a replica of the Level I/ Level II-type crucible out of 'local clay' fired at low temperatures. Later on, the crucible was filled with fragments of malachite ore from local sources. The prepared crucible was covered with charcoal and placed into a simple bowl-shaped hearth similar to the one which had been discovered on site in Level II.[18]

12 Pigott & Lechtman 2003; Weeks 2013.

13 More detailed information is fully reported in Thornton 2009: 310: „In 'Area G' (or 'House G'), in a fill layer between a Period I floor and an early Period II floor, was found a 'shallow fire pit' filled with crucible fragments, malachite fragments, and charcoal. The floor below this 'fire pit' and the floor of a different Period I building both gave a 2-sigma date range of 5470–4760 Cal BC, while two other roughly contemporary buildings gave C-14 date ranges of 5030–4330 and 4950–4250 Cal BC. A large dump (100 m long, 60 cm deep) containing 'hundreds' of slagged crucible fragments and domestic refuse, called 'Period II' but with C14 dates in the range of Periods I and early II (c. 5200–4400 BC), attests to the long-standing presence of cottage-level metalworking at this site. Crucible fragments described as 'much larger and deeper' as well as pieces of malachite were also found in late fourth millennium Iblis IV contexts."

14 Caldwell 1967: 19f.

15 Heskel 1982.

16 Caldwell 1967: 35, Pigott & Lechtman: 296.

17 Wertime 1968: 934; Pleiner 1967: 340; Pleiner 2004;

18 Unfortunately precise technical data after recent standards about the composition of the crucible's clay, firing

At that time, Caldwell´s main question - if the crucibles from Level I and II had actually been used for smelting or melting of copper - could not be answered. The first investigation on a crucible fragment by R. Dougherty in 1966 showed that the object would not have tolerated temperatures above 1000°C.[19] This means that it was possible to reduce rich oxidic ores to metallic copper but not native copper which has a melting point of around 1100°C. The humble presence of slags at the site would support the idea of crucible smelting of rich oxidic ores which produces just minimal amounts of slag. While Caldwell makes literally no mention of any amount of ancient copper slags, T. Berthoud collected just a single piece at site.[20]

However, the analytical results on material from Tall-eh Eblis were systematically reviewed and re-checked on archaeometric grounds, and critically presented in 2004 by Leslie Frame in her BA thesis. This work is a competent and exhaustive study of archaeological and replica crucibles carried out by Thin Section Analysis, X-Ray Diffraction Bulk Chemical Analysis and Differential Thermal Analysis of archaeological and replica crucibles. Frame concluded that “...the early inhabitants of Tal-i Iblis had developed a crucible-based extractive metallurgical process for reducing local copper carbonate ores to metallic copper... With dates falling unequivocally within the 6th millennium BCE, these laboratory analytical and experimental results make Tal-i Iblis the earliest site in Western Asia and in the world whose archaeological remains indicate the development of a copper extractive metallurgy....this analysis will enable archaeologists to understand more clearly the early development and spread of this technology throughout the Old World...”.[21] Even more clearly, Thornton and Lamberg-Karlovsky state that the precocious beginnings of smelting at Tall-eh Eblis and other sites of the macro-region “...may explain the early appearance of copper-base alloys in this region relative to the rest of the Near East...”.[22] Recent research perspectives enhance the probability that the 5th millennium BCE metallurgy of Tall-eh Eblis did incorporate the capability of melting copper and casting simple objects.[23]

temperature, quality of the malachite ores, etc.etc... has not been properly documented. (Frame 2004: 38f.)
19 Dougherty & Caldwell 1966.
20 Pigott & Lechtman 2003: 296; Berthoud 1979: Annexe tbl.7;
21 Frame 2004: 127.
22 Thornton & Lamberg-Karlovsky 2002: 1451; see also Roberts et al. 2009.
23 Weeks 2013.

1.2.2. Tappeh Yahya / Tepe Yahya (28.33083 N/ 56.86750 E)

The settlement mound of Tappeh Yahya (engl.: "Yahya´s mound") has a base diameter of ca. 190 m, and is located in the Soughan valley at a distance about 20 km to the East of Doulatabad, ca. 220 km south of the city of Kerman and 130 km to the north of the Straight of Hormuz. It was accidentally discovered by an American team that was prevented from going to Israel by the outburst of the Six-days war in June 1967. The investigations of the prehistoric settlement happened during a regional survey conducted under the supervision of Carl Clifford Lamberg-Karlovsky from the Peabody Museum of Harvard University between 1967 and 1975.[24] At Tappeh Yahya occupation layers stretch from late Neolithic to Sasanian periods. However, because of poor stratigraphic definition and broad standard deviations in the 14C dates, the chronology of Tepe Yahya has been for a long time a bone of contention among different scholars, so that not less than five or six chronological frameworks have been proposed and used approximately at the same time. The various views are gradually converging towards a scheme stretching from the late neolithic (Yahya VII-VI, from the late 6th to the first half of the 5th millennia BCE) to the mid fourth (Yahya VC), then to the latter centuries of the same millennium (Yahya VB-VA). This sequence has a wide overlap with that of Tall-eh Eblis outlined in the previous section.[25] Further, the Yahya sequence encompasses periods IVC-IVA, variously attributed by scholars to be from the late 4th to the early 2nd millennium BCE. Small objects of hammered native (pure) copper were found in the earliest levels of Tappeh Yahya, but the first artefact of smelted and cast copper is dated to period VIA, in the mid 5th millennium BCE, a date roughly contemporary with the appearance of crucible smelting at Tall-eh Eblis. This artefact, a pin, bears significant amounts of arsenic (about 1.4%). In this period, a common technique for the extraction of copper from the ores might have been a “co-smelting” process, where different ores like oxides and sulphides were first roasted to reduce the sulfur and humidity, then simultaneously smelted within crucibles containing ore powders and charcoal, heated

24 Lamberg-Karlovsky mentions the study of M.A. Stein´s pottery collection from the Peabody Museum as the initial phase for the further project. It seems also plausible to postulate that Tappeh Yahya was already recognized and visited by M.A. Stein during his surveys.

25 Lamberg-Karlovsky & Potts 2001; Lamberg-Karlovsky and Thornton 2002; Petrie 2013: 130-132; Ascalone 2006: 46-54.

from above[26]. This method is the same as replicated by Frame for Tall-eh Eblis[27], and possibly as other early metallurgical sites on the northern edge of the Iranian Plateau.[28] Lamberg-Karlovsky and Thornton, after a general survey of a series of copper-based artefacts in the Peabody's collection, argue that Tappeh Yahya witnesses a long exploitation of local ores bearing limited amounts of arsenic, smelted and cast in crucibles, that does not fully supersede the older tradition of working native copper until ca. 3000 BCE. After this threshold, artefacts with significant amounts of arsenic coexist with ones of pure copper and with others bearing traces of lead and even the earliest minor artefacts of tin, signalling a progressive enlargement of the procurement network of copper-bearing ores within a continuous technical scope. Lamberg-Karlovsky and Thornton ultimately propose that "... the arsenical copper ''trinkets'' were part of a localized ''cottage'' industry at Yahya that was unaffected by shifts in the socio-political structure of the site".[29] The copper used at Yahya might derive from deposits with arsenical ores, possibly from the Faryab area.[30] It has been suggested that such a long-lasting "conservative" tradition of co-smelted arsenical copper may partially explain why South-Eastern Iran, as a whole, seems to largely ignore the gradual introduction of tin bronzes, while these latter alloys became more and more common in Mesopotamia, in the Elam sphere and in the indus valley during the last centuries of the 3rd millennium BCE.[31]

1.2.3. Tappeh Hesar / Tepe Hissar (36° 9' 16" N / 54° 23' 1" E)[32]

Tappeh Hesar (engl.: "Castle hill") is a complex of archaeological mounds stretching for originally been much larger), inhabited ca. from the 5th to the 2nd millennium BCE. The complex is situated to the south of the modern town of Damghan in the Semnan province. Tappeh Hesar is the largest prehistoric-protohistoric site in the Damghan river basin with a size of 10-12 ha, and so far one of the largest early urban compounds in the Bronze age of

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26 "...many early copper smelting sites show evidence for the use of oxidic and sulphidic ores (such as chalcocite or bornite), whether mixed intentionally by the metalworker or naturally mixed by geological processes, smelted under mildly oxidising conditions. Even in such an oxidizing environment, the combination of oxidic and sulphidic ores will lead to the production of copper via the so-called 'co-smelting' process, whereby the sulphur removes the oxygen from the ore at sufficiently high temperatures." (Roberts *et al*. 2009: 1017).

27 Frame 2004.

28 Lamberg-Karlovsky & Thornton 2002.

29 Thornton & Lamberg-Karlovsky 2002:1458.

30 Beale 1973: 137-141.

31 Helwing 2009.

32 This site also was incorrectly transliterated as "Tepe Hissar" by E.F. Schmidt. The transliteration used here of "تپه حصار" which was already used by Dyson & Howard 1989 is more appropriate according to recent conventions.

eastern Iran. The first archaeological discoveries were presumably made by General Sir A. Houtum-Schindler while investigating some tumuli.[33] Erich Schmidt, as a representative from the University Museum of Pennsylvania, started the first systematic excavations between 1931 and 1932.[34] After this expedition the stratigraphical sequence was set up and the main area mapped. In 1956 the site was re-visited by Robert H. Dyson, and in 1972 the site was briefly surveyed by G. M. Bulgarelli of IsMEO. In 1976 R. H. Dyson from the University of Pennsylvania and Maurizio Tosi on behalf of the University Museum, Turin University and the Iranian Centre for Archaeological Research (ICAR) undertook the "Tappeh Hesar Restudy Project" to focus on a new site survey as well as a regional survey of the Damghan plain; limited excavations, the collection of new 14C samples and a re-examination of Schmidt´s trenches were also conducted.[35] In 1995 E. Yaghmaiee started rescue excavations at the site due to the Tehran-Mashhad railroad construction and opened some new trenches to study the Sasanian remains. Finally, in 2006 K. Roustaei as a representative for the ICAR undertook deep soundings in the outskirts of the settlement to investigate the actual site´s extent.[36]

According to Dyson and Tosi, at Tappeh Hesar "...the most suitable location for subsistance production was also the central one for almost all the biological and mineral resources necessary for a wide and varied diet, as well as for the manufacture of prestige articles. Most of the metals and stone used occur within a radius of 50 km from the site – a two or three day journey on foot for a man with a backpack".[37] Published data from a recently conducted survey in the adjacent Shahroud and Bastam plains supports this statement.[38] This strategic location easily explains why almost 10% of the surface of the mounds, for a total of ca. 11.000 m^2, was covered by variously clustered metal slag and other metal processing waste that survived the disturbance of intensive ploughing. While these industrial occupations were dated by the associated pottery to Schmidt's IIA, IIIB and IIIA of the city's general sequence, roughly corresponding to periods Jemdet Nasr-EDIII of Mesopotamia (ca. 3100-2400 BCE), later reconsideration of the context of some slag samples analyzed by Thornton dated the materials from mid 4th millennium to the early 3rd millennium BCE (3600-2800 BCE).[39] Thick scatters of copper smelting slag were

33 Polak 1882. In the report exclusively "General Schindler" is quoted. But it seems quite likely that "General Schindler" was meant as "A. Houtum-Schindler". see also Houtum-Schindler 1877.
34 Schmidt 1937.
35 Dyson & Tosi 1989: 1-6.
36 Roustaei 2010.
37 Dyson & Tosi 1989: 4.
38 Roustaei 2012a,b.
39 Thornton 2009b.

observed at the mounds called “Twins” as well as on the surface of the South Hill and in other spots of the compound, while litharge and other residues of lead/silver ore smelting were identified both on the Twins and on South Hill.[40] Such massive evidence of metal smelting and processing is matched by the abundance of artefacts in copper, tin, lead, silver and gold found in the dig of the settlement and the city’s graveyards.

Thornton describes the 4th millennium BCE slag as containing very little entrapped copper and ‘fayalitic’ (i.e. rich in iron combined with silica, perhaps added as a flux) in their crystal structure.[41] They derive from a direct smelting process of copper-iron sulfides (like for example bornite) with impurities of lead and arsenic. These copper-iron sulfides, possibly smelted with a gangue of iron-oxide, apatite, and talc-schist, were mixed with oxidic copper ores for removing the sulfur. In fact, steatite-hosted arsenic-bearing ores are considered a possible source of some of the smelted ores, such as the nearby deposits at Taknar or Kuh-e Zar.[42] Recently conducted archaeological surveys by K. Roustaei with a focus on mining and other metallurgical sites at the northern fringes of the Dasht-eh Kavir are also increasing our knowledge of sites with traces of ancient working in the vicinity of Tappeh Hesar.[43]

By the late 4th millennium BCE, at least the area of South Hill looks like it was a specialized craft neighbourhood with abundant and varied metallurgical workshop residues, although smelting and casting was still practiced in household contexts on the Main Mound, suggesting that the metalsmith communities were functionally specialized and spatially segregated. In fact, while the South Hill slags indicate activities such as lead production (and perhaps cupellation for silver refinement), and the casting of objects in leaded copper (probably activities solely for the elite), lead is absent in the Main Mound, where arsenical alloys were exclusively produced. By the beginning of the third millennium at Tappeh Hesar the intensification of metal production and technical improvement explains the appearance of tapping and plate slags, and larger slag cakes. One of these tapping slags appears in section in a recent paper by A. Hauptmann;[44] the liquefied and cooled phase is identified as fayalite, including or carrying on top quartz and ore grains. More detailed information on this and other types of slags are published by Thornton.[45]

Moving to the middle of the 3rd millennium BCE, further improvements are witnessed,

40 Tosi 1989: 14; see also Weeks 2013: 279.
41 Thornton 2009b: 314.
42 Weeks 2013: 281; see also Bazin & Hübner 1969: 72f.; 87ff.
43 Roustaei 2009 and Roustaei 2012a, b.
44 Hauptmann 2014: fig. 5.4;
45 Thornton 2009b.

argues Thornton, by the common find of round slag cakes, trapeze-like in section, that were cooled within crucibles or crucible-like cavities with ceramic linings. The bottom of these slags show that disks of matte and/or round, small pure copper ingots were separated by gravity and were easily detached from the upper silicatic mass. These slags may be very low in arsenic, suggesting the smelting of relatively pure copper, whereas the finished artefacts contain, as a rule, variable amounts of arsenic, a solid argument to support the hypothesis of the intentional addition of arsenic after the primary smelting steps. In fact, based upon comparisons with the evidence of the Shahr-eh Sukhteh slag material (and with contemporary slag from other western sites like Arisman/ Siah Boum)[46] Thornton also argues for the intentional production in the household-workshops of Tappeh Hesar of arsenic-rich speiss (an iron-arsenic alloy) from well smelted arsenic- and iron-rich sulfidic ores, which was then used as a direct alloying agent in the production of arsenical copper. Thornton ultimately proposes that the described techniques such as co-smelting and possibly even direct arsenic alloying with speiss are important metallurgical innovations indigenous to eastern Iran which led to the invention of new metals such as tin-bronze, later spreading to other civilization cores of Bronze age Eurasia, and eventually leading to the 'revolutionary' invention of brass during the 3rd millennium BCE.[47]
Such distinctive slag cakes – with apparently quite similar chemical compositions - are known at Tappeh Hesar, Shahr-eh Sukhteh, and at Omani smelting sites.[48] In this comparative framework, these slags are important because as we will see they are similar to the distinctive type of mixed ore smelting residue found also at Shahdad, where they also appear (probably from the 4th millennium BCE) in large amounts of the dumps localized on surface. Thornton´s view that "By this stage (*the 3rd millennium BCE*), metal production at certain key sites on the Iranian Plateau is standardized, industrial-scale, and probably controlled by central 'elite' authorities..." needs to be verified, because at present it is not supported by unequivocal independent evidence.[49]

46 Analytical investigations on slags from Arisman have been recently conducted by N. Nezafati.
47 Thornton 2007.
48 Weisgerber 1980, 1981; Prange 2001.
49 Thornton 2009a: 316.

1.2.4. Tappeh Bazgir (37° 15 ' 7'' N / 55° 21' 15'' E)

Tappeh Bazgir is the name of an archaeological site which is situated on the bank of the seasonal water-bearing river "Tarkoulu" next to an eponymous farming community. It lies on top of an ovale shaped mound of 160 X 140 m size at an approximate height of 6 m. It is located in the modern province of Golestan at a distance of 2 km to the north of the regional administration central city of Minoudasht in the north of the Alborz-mountain range and on the eastern area of the fertile Gorgan plain. It lies at a distance of almost 120 km from the southeastern coast of the Caspian sea and in the vicinity of other prominent archaeological sites, such as 65 km to the northeast of Torang Tappeh[50], 90 km to the northeast of Shah Tappeh[51] and 140 km to the north of Tappeh Hesar[52]. In the year 2000, while digging for a new well, a local peasant accidentally discovered at a depth of approximately 8 m a great number of corroded metal artefacts with blue and greenish colouration. During a first rescue excavation by the I.C.H.T.O. Gorgan[53] a total number of 264 metal artefacts with a total weight of about 500 kg and several pieces of broken pottery vessels were discovered. Typological parallels are to be seen with metal objects from the Hesar IIIC horizon.[54] The first preliminary analytical investigations on selected samples of this hoard were conducted by M. Ghazian from the R.C.C.C.R. (Tehran) on stains of corrosion and showed contents of malachite, azurite and cuprite.[55] Another analytical investigation was conducted on 171 samples which were obtained from selected objects in 2006.[56] The archaeometric investigations involved EDXRF and ICP-MS analysis. Apart from two metal knobs which were made of a tin-bronze alloy all other artefacts evidenced the use of arsenic bronze. According to the homogeneous composition no groups could be ascertained within the metal objects which makes the intentional alloying of arsenic bronze rather unlikely.

In 2010 an archaeological excavation project on behalf of the I.C.H.T.O. Gorgan was initiated and started to investigate the archaeological remains of the site. The information about the recent discoveries is kept to a minimum but promises unique results.[57]

50 Deshayes 1969, 1977; Wulsin 1932
51 Arne 1945.
52 Schmidt 1933, 1937; Dyson & Howard 1989; Yule 1982
53 The team members were J. Nokandeh, G.A. Abbasi, H. Omrani-Rakavandi and M.Shahi Poudineh.
54 Nokandeh et al. 2006.
55 Ghazian 2003: 5, tabl.1.; Shadkam 2005
56 Lorenz 2008
57 Following recent correspondence with J. Nokandeh, the director of the archaeological mission at Tappeh Bazgir, I have learned that the amount of bronze artefacts increased during the last years of research up to a total of more than 2(!) tons of bronze alloy artefacts.

1.2.5. Shahr-eh Sukhteh / Shahr-i Sokhta (30° 35' 43'' N / 61° 19' 35'' E)

This site of Shahr-eh Sukhteh (engl.: "burnt city") was first recognized and superficially investigated by Sir M.A. Stein in 1903.[58] It is situated in the north of the modern Iranian province of Sistan and Baluchistan, approximately 40 km to the south of the city of Zabol, not far from the present Afghan border. The ancient settlement, about 80 ha at maximum extension in the second half of the 3rd millennium BCE, grew on the ancient shores of the endoreic lake, the Hamun-eh Hermand. It was founded around 3100 BCE and according to a consistent series of 14C datings, might have been abandoned after destructive events around 1800 BCE.[59] This time span is divided in an unbroken sequence of four main settlement periods (I to IV) and about 10 archaeological phases.
After the first reconnaissances, systematic archaeological investigations were carried out by the Italian IsMEO-expedition from 1967 until 1976 under the directorship of Maurizio Tosi, then later from 1976 to 1978, under the joint direction of Sandro Salvatori and Marcello Piperno. After the Iranian revolution the fieldwork at Shahr-eh Sukhteh was interrupted and re-started in 1997 by the ICAR under the supervision of Seyed Mansour Seyed Sajjadi.[60] These investigations are still in progress. During this long period of research there came to light a huge amount of burial and architectural remains; in the urban stratigraphies, the excavators encountered small quantities of finds including pottery, semiprecious stones, metal and unusually well preserved organic materials. An original study by Tosi demonstrated that copper-processing areas that in the first half of the 3rd millennium BCE were evenly scattered in private houses and courtyards of the Eastern Residential Area, in the second half of the same millennium migrated in mass towards the outskirts of the city in peripheral open grounds or in specialized craft production outer-networks.[61] Impressive heaps of copper slag datable to the late 3rd millennium BCE, falling from mounds dissected by wind erosion were described and photographed by G. Dales in the Afghan portion of the southern Sistan basin, not far from Chehel Koureh, one of the most important copper-bearing deposits in the region. During this period the craft activities abandoned domestic spaces and reached peripheral spaces and sites like the dried courses of the Rud-eh Biyaban and the Gardan-eh Rig area where traces of intesive

58 Stein 1928.
59 Tosi 1968a, 1968b, 1969a, 1969b, 1970a, 1972; Biscione 1973; Lamberg-Karlovsky and Tosi 1973; Biscione 1974; Biscione et al. 1974; Tosi 1974a, 1974b; Tosi 1983; Piperno and Salvatori 1983; Salvatori and Vidale 1997; Salvatori and Tosi 2005; Piperno and Salvatori 2007, Vidale 2008b and many others.
60 Sajjadi 1986, 2004, 2007, 2008.
61 Tosi 1984.

copper and pottery production were observed.[62] Recent fieldwork on Iranian soil in the region of the Rud-eh Biyaban was conducted by the Institute of Archaeology of the University of Sistan and Baluchistan Zahedan and the ICHTO Sistan and Baluchistan. During the survey several sites of archaeological relevance were discovered. The fieldwork was conducted by local archaeologists and students between 1385(2006) until 1387(2008). Thereby, remains of metallurgical acticivties such as large amounts of slags, furnace linings and other pyrotechnological installations were registered which are attesting to metallurgical activities. The results were compiled in 28 volumes of ca. 15.000 pages and are accessible exclusively in Zahedan in the libraries of the ICHTO Sistan and Baluchistan and in the University of Sistan and Baluchistan.[63]

So far at Shahr-eh sukhteh, no metallurgical area has been detected or excavated. The abundant record of copper processing at Shahr-eh Sukhteh is made of ore fragments, slag pieces, prills and kiln linings, and a few copper ingots or ingots' fragments loosely recovered in the houses' ruins, or, more commonly, gathered on the surface from the late metallurgical peripheral sites. The copper slags of the site, apparently identical, as stated above, to similar specimens found at Tappeh Hesar, in Oman and at Shahdad, have been thoroughly analyzed and discussed by A. Hauptmann[64] and other German colleagues.[65] They interpret these slags, as discussed for Tappeh Hesar, as residues of a multiple steps segregation process within ceramic crucibles, for obtaining matte disks and then round, disk-shaped ingots from charges of charcoal and mixed ores, originally – they state – copper sulphides.

A section of one of these crucible co-smelting slag is discussed in detail by Hauptmann: it shows the three-phase results of a cooling and segregation process, where the upper part of the melt is formed by amorphous cooled glass, rich in gangue or ore particles, neo-formed magnetite and gas bubbles. The intermediate layer, more crystallized, is made of neo-formed minerals such as the iron-calcium silicate hedenbergite and other iron silicates, with residual gangue inclusions; the lower surface retains small particles of the matte and copper disk that cooled below, onto the ceramic bottom of the crucible.[66]

Rather than sulphides, recent X-Ray Diffraction studies indicate that the smelted ores were mainly mixtures of carbonates like malachite and chlorides like atacamite and paratacamite. In fact, about 30 fragments of green rocks, most of which bear copper, were

62 Fairservis 1961; Dales 1972, 1992.
63 Pers. com. by M. Mishmastnehi.
64 Hauptmann 1980, 2014.
65 Hauptmann & Weissgerber 1980; Helmig 1986; Helmig et al. 1991; Hauptmann et al. 2003.
66 Hauptmann 2014: fig.5.3.

preliminary analyzed by the means of X-Ray Diffraction.[67] The ores on record include mainly atacamite, paratacamite and malachite, suggesting that in the ancient city copper was extracted by co-smelting in ceramic crucibles mixed minerals such as carbonates and chlorides, rather than sulphides (chalcopyrite, in fact, was not detected in this sample).
In the meantime, hundreds of finished copper artefacts are being preliminarily analyzed by G. Guida, A. Lazzari, C. Giardino and other members of the Shahr-eh Sukhteh project by means of semi-quantitative XRF analysis at Rome. Although the results are still completely unpublished, the picture suggests the use of copper with arsenic in various percentage, often below 1-2%, but in some cases ranging above 5-7% (arsenical bronzes seem to have been commonly used for certain categories of objects, such as pins). In rare cases, copper silver alloys were also used. Tin bronzes are completely absent;[68] as at Tappeh Hesar, small amounts of arsenic are recorded in the slags, but as one moves towards the finished objects the percentages of arsenic are noticeably increasing.

1.2.6. Konar Sandal B / "South" (28° 27´ 48´´ N/ 57° 46´ 45´´ E)

The archaeological site of Konar Sandal South (hereafter KSS) is situated in the mid Halil Rud Basin, some 15km south of the regional center of Jiroft and 240 km to the south of the city of Kerman in the eponymous province. KSS forms with Konar Sandal North, ca. two km away, and other nearby settlements and funerary locations, an enormous archaeological compound of unknown size, as it has never been systematically surveyed.[69] However, preliminary estimates suggest an extension (not necessarily synchronous, between the 3rd and 2nd millennia BC) exceeding by far 100 ha.[70] The site was initially recognized by Sir M.A. Stein.[71] The recent investigations of this site and it neighbouring areas started after the disastrous Halil Roud flood in 2001 under the directorship of Y. Madjidzadeh. The following decade of field campaigns revealed, just below the surface, the presence of a tightly packed network of private dwellings dated to the second half of the 3rd millennium BCE, a “Citadel” or palatial compound of approximately the same age, with a large-sized polychrome human figure in unbaked clay and the ruins of an administrative facility with hundreds of clay tags with stamp and

67 Artioli et al. 2005.
68 Pers. comm. M.Vidale.
69 Madjidzadeh 2003, 2008a.
70 Pers. comm. M. Vidale.
71 Stein 1937: 148ff., fig.45.

cylinder seals impressions. Dumps were found near large urban defences or partitions of mud bricks that were rich in broken lithic tools and waste from semi-precious stone bead production. Piotr Steinkeller identifies this urban capital and its ancient polity with the state-like unit of Marhashi, the most powerful enemy and political partner of Mesopotamia in Akkadian and Ur III times.[72]

During the second season of excavation at KSS, which lasted from the end of 2004 until early 2005, Trench IX (15 x 20 m) was opened at a distance of almost 550m to the southeast of the so called Citadel. Several mudbrick structures like walls and plattforms were discovered. Platforms supported or flanked not less than eight furnaces of ovoid or cylindrical shape which had been built re-using large pottery vessels. These vessels had been sunk into the ground to a depth of 0.3 m and are supposed to have been used for metallurgical activities.

The site was definetly used for casting complex objects; it is not known if copper ores were also smelted there, nor the mineralogical identity of the locally exploited ores. The excavation inventories included a total amount of five kilograms of metallurgical copper slags and spills, as well as fragments of ingots and complex moulds. Further copper and bronze objects and tools as well as stone vessels and stone tools were found during the excavation.[73] Unfortunately, at present, further information concerning this important industrial area is not available. Many metal artefacts illegally excavated and recovered by the Iranian security forces are currently stored in the Harandi Museum in Kerman as well as in the Archaeological Museum of Jiroft. They include a rich repertory of pots, seals, weapons, pins, inlaid copper and lead weights, and even large power insignia such as decorated inlaid sceptres.[74] The richness of this collection, still completely unpublished is matched only by the repertory of metal finds in the Shahdad cemeteries.

72 Steinkeller 1982, 2012; Potts 1994.

73 Madjidzadeh 2008a: 86f.

74 The majority of the published artefacts come from confiscated material with no precise information on the origibnal finds’ location and contexts. "Several hundred of the excavated objects were confiscated by the Pasdaran in the cities of Bardsir, Jiroft and a few others" after the Halil Rud flood from early 2001 (Madjidzadeh 2003: 6). The finds are just loosely connected to Jiroft by the close distance to the sites of Mahtoutabad, Konar Sandal A & B as well as Qal´eh Kuchek which were under scientific examinations in the following years, until 2009. So at least in some cases the provenence of the artefacts should be considered with caution. But what we can certainly state are the close formal relations between the metallurgical artefacts from Jiroft area and Shahdad, in the sense of typology. There should be no doubt about an interregional exchange system between these two areas.

1.2.7. Khinaman (30° 27' 5" N/ 56° 27' 32" E)

The modern settlement of Khinaman lies approximately halfway between Kerman and Rafsanjan. In the summer of 1900 a local khan, while extending his private garden, uncovered an unknown number of inhumation burials with archaeological artefacts and contacted Major Sir Percy M. Sykes for further assessment. Sykes himself, who was at those days the highest British official at the Bristish consulate in Kerman and interested in archaeology, visited the site and examined some artefacts.[75] The known inventory included some copper/bronze pots, pins, bangles, and a two elaborated axes, one with eyes on the shaft (identical to specimens from Shahdad) and another with feline figurines on top. Later, in 1913, he donated his collection of metal objects to the British Museum in London.[76] The last scientifical investigations on these artefacts was published by J. Curtis[77] and K.R. Maxwell-Hyslop[78] who focused on archaeometallurgical analysis. The Khinaman bronzes witness the presence of another rich burial ground, certainly belonging to an unknown settlement similar and contemporary to the ancient Shahdad, and demonstrate the extreme sophistication of the metallurgical traditions of the protohistoric societies of the north-western edge of the Dasht-eh Lut in the second half of the 3rd millennium BCE.

1.2.8. Bampur, the Jazmurian depression and the edge of Kech-Makran

This region is archaeologically speaking an almost complete blank. At Bampur, one of the few settlements of the region that was scientifically excavated, the record of metal artefacts is quite unimpressive, being limited to a corroded copper pin, a fragmentary ring in the same metal and a fragment of galena ore.[79] The richness of the local copper/bronze grave inventories, however, is demonstrated by the furnishing of a single grave recovered at Damin, containing a knife, three axes of various forms and size, and a chisel.[80] Other tombs containing large amounts of copper axes, knives and daggers, pots, large seals in copper and silver and other metallic artefacts have been recently plundered and partially rescued at the sites of Chegardak and Espidej by the Iranian colleagues of Miras-eh

75 Sykes 1902: 167f.; Greenwell 1907.
76 Wynn 2003: 95f.
77 Curtis 1988.
78 Maxwell-Hyslop 1988.
79 De Cardi 1973: 331.
80 Tosi 1970b.

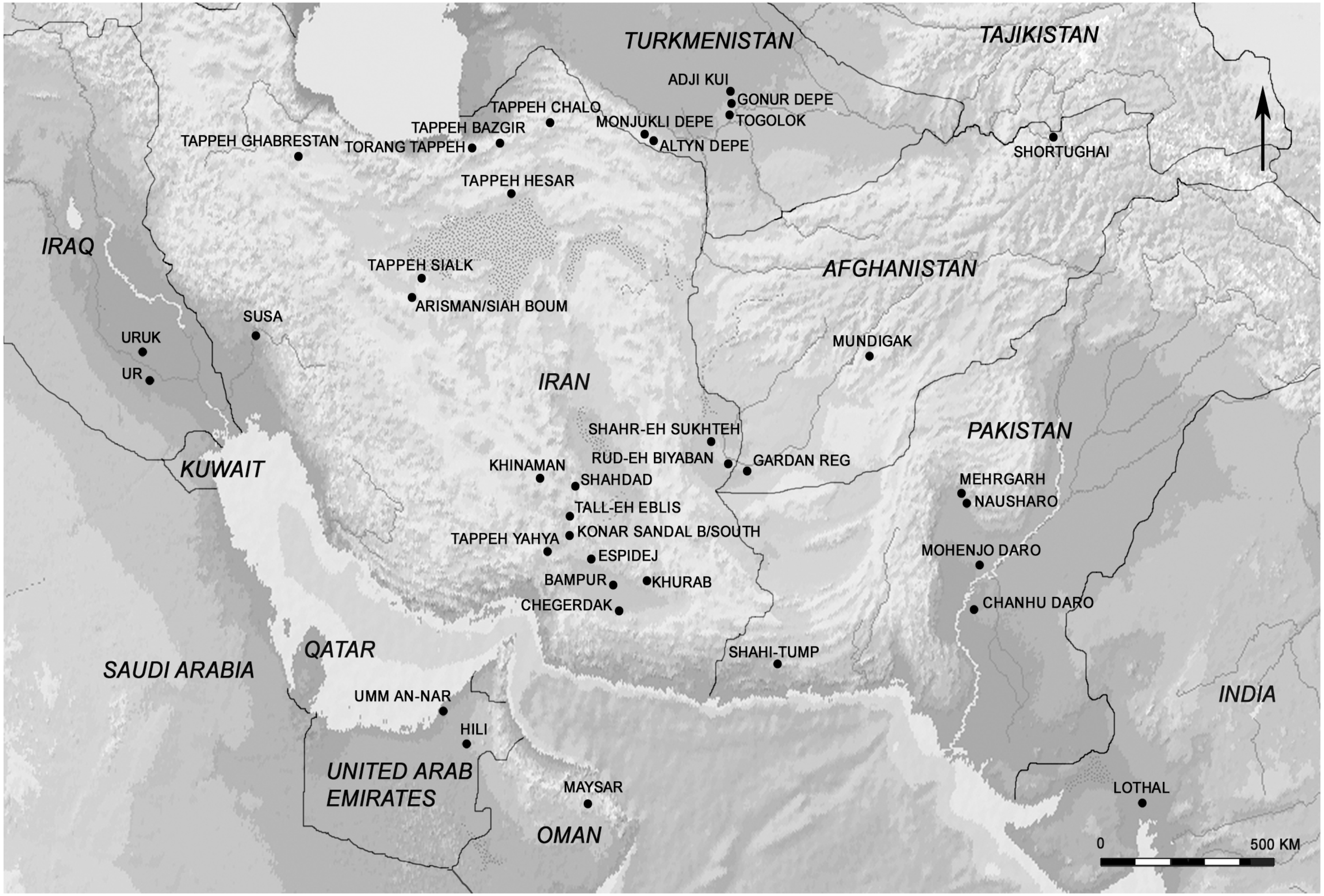
Farangi, Zahedan along the piedmont strips of the Jazmurian depression.[81] These materials, at present unpublished, will spread in the future a new and unexpected light on the high standards of the protohistoric metallurgy of the region. The roots of this technical tradition are to be searched for in exceptional artefacts found in the Shahi Tump cemetery assemblage dating to ca. 3000 cal. BCE, in first place the sophisticated „Leopards' weight". It is presumed that the source of metals used in these artefacts (copper and lead) should be first searched for in the adjacent region of Southeast Iran or the Chagai chain and in the nearby valleys.[82]

1.3. On the present state-of-art

As stated above, any general comment on the state of art of archaeological studies in the protohistoric metallurgy of eastern Iran is composed more of blanks and cautionary statements than of sound evidence. The picture is extremely partial and quite debatable. In fact, the generalized looting of archaeological sites that started in northern Afghanistan after the Russian aggression (1979) spread quickly to many other regions of eastern Middle Asia; if hundreds of ancient graveyards have been turned into archaeological nightmares, the remnants of entire, unknown civilizations were suddenly thrown on to the surface: discovered, but to a large extent damaged beyond hope of recovery. In this framework, in Eastern Iran, a recurrent paradigm is that the types of copper ores and their distinctive polymetallic associations were an important factor of technological and social evolution, as they might have lead the communities of the Plateu to experiment, after the early and generalized use of native copper, with new and more innovative ways of crucible smelting. This thesis will contribute to validating this paradigm by inserting into the discussion the ancient metallurgy of Shahdad. Its rich graves have preserved hundreds of valuable and sophisticated copper artefacts, that S. Salvatori linked to the early urban centres of the Oxus Civilization, explicitly suggesting that Shahdad was a "Karum"-like outpost of the northern, Central Asian civilization in the core of the Iranian Plateau, dictated by the importance of the rich local copper mineralizations.[83]
Besides testing this view with a general typological study of the Shahdad's production, I will summarize the archaeometric information on the copper-based materials of the

81 Pers. Comm. M. Heydari.
82 Mille et al. 2004, 2005.
83 Ligabue & Salvatori 1979; Salvatori 2010.

Shahdad´s production thus far available, provided by different authors, adding to the overall picture a new set of preliminary analytical studies. Another new set of preliminary analytical investigations, in fact, have been recently carried out in Rome (IsCR) by myself and Italian colleagues on a set of slag and ore fragments collected by M. Vidale in 2009 on the surface of an important copper smelting site that had been discovered in 1977 in the core of the settlement. The collected ore fragments, analyzed by the means of X-ray Diffraction (XRD) revealed for the first time the range of copper ores transformed on the edge of the Dasht-eh Lut in the second half of the 3rd millennium BCE. As far as slags and other metal processing waste is concerned, although these analyses, on the whole, provided semi-quantitative and not fully quantitative information, they can be integrated into and provide detail of the preliminary picture we are developing.



Map 1: Geographical Map of Iran and its neighbouring countries (arranged by E.Cortesi, Source: Microsoft Encarta)

Chapter 2: Geographical and geological situation at Shahdad and the Takab-plain

2.1. Site description

The modern city of *Shahdad* lies on the western margins of the *Dasht-eh Lut* at an estimated altitude of between 420 and 520 m.a.s.l.[84] This area, which is also called Takab-plain, is situated in Southeastern Iran in the modern province of *Kerman* at a distance of approximately 80 km to the eponymous province´s capital. During the last ten centuries when the city was known as “*Khabis*“ it was an important trading place on the so called “silk road“ connecting the seaports on the Persian Gulf with Middle Asian regions and also the distant regions to the East and West.[85] Aside from its important geographical position it was and is still famous for its local production of several vegetable goods such as dates, tamarisks, several citrus fruits, cereals and hemp as well as henna.[86] The agricultural diversity is caused by Shahdad´s location inside an oasis on top of an alluvial fan with fertile soils which is sloping towards the desert and is well supplied with water by Qanat irrigation systems and two perennial streams, the *Rud-e Derakhtangan and Rud-e Bisheh.* Both originate in the *Heynaman* area which is located in the mountainous area to the west of Shahdad and are aquiferous/ water-bearing throughout the year.[87] On their way towards the plain they carry sediments and also cut into the alluvial fan (see Figure 1).

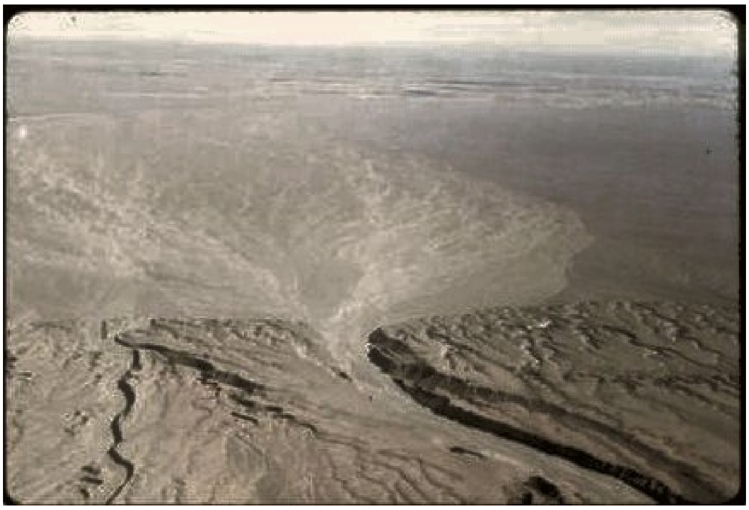


Figure 1: Bifurking Derakhtangan river cutting through the alluvial fan (Photo: J. Dresch).

84 There is dissent about the exact elevation of the city of Shahdad where values between 420 to 520 m.a.s.l. were published (Gentelle 2003: 19; Hakemi 1997: 28; Meder 1979: 76f., Abb.29; Meteorological yearbook 1960-1970).
85 Adamec 1988: 236f.; Hakemi 1997: 30f.
86 Kaboli 1983: 60f.
87 Mostofi 1973: 243; Mireskandari 1993; Hakemi 1997: 25f.

In addition, many rows of qanats which were fed with high amounts of groundwater caused by the annual snowmelt of the adjacent mountains were supplying the gardens and groves around *Shahdad*.[88] As the qanats have been providing water supply during the last centuries until quite recently, nowadays the majority of qanats are abandoned and not any more in use due to the complex and difficult maintenance.[89] Most were replaced by simple irrigation canals which are run with the help of diesel pumping stations which causes a higher risk of salinisation of the fertile sediments.

Traces of the ancient dwelling and production areas at *Shahdad* can be observed on the Eastern outskirts of the modern town as far as they are not eroded by the heavy local winds. The different settlement remains from the fifth millennium site to the modern occupation can be traced down a length of about 2.4 km. The fifth millennium occupation is situated in the far East next to the kaluts and is followed by the remains from fourth, third and second millennium occupations until the islamic *Qal´eh* and the ruins of the selcukian settlement which are situated just to the East of the modern town.[90]

88 Mahmoudi 1970: 57ff.; Kaboli 1983; Gentelle 2003: 20ff.

89 Meder 1979: 69. While Oskar Meder was visiting Shahdad in 1976 the maintenance of the qanats was already neglected.

90 Tomaschek 1972: 122. Tomaschek already mentions the discovery of ancient settlement remains 2 miles to the south of the recent settlement in his reports at the end of the 19^{th} century. This description probably fits with the location of the bronze age settlement but might also be identical with the islamic Qal´eh. Meder 1979: 81.

2.2. Lut Desert: Climate, geographical and geological setting

As previously mentioned the modern town of *Shahdad* is situated on the Western fringes of the *Dasht-eh Lut* on an alluvial fan.[91] Nowadays the *Dasht-eh Lut* is known as one of the Earth´s hot spots with temperatures between 68° and 70°C measured during the summer months between 2003 and 2009.[92] The appearance of the *Dasht-eh Lut* is characterized as an asymmetric closed basin with a size of at least 54.000 km^2 , composed largely of different oval shaped depressions and other geological formations.[93] The whole area can be subdivided into three main parts: 1) the *Northern Lut*, 2) the *Central Lut* and 3) the *Southern Lut* which is also known as *Lut Zangi Ahmad*.[94] The landscape was shaped during the Late Tertiary. In addition massive folding and destructive tectonic movements created its isolated character (see Map 2).[95]

The so called "*Lut block"* is composed of a volcanic substructure which is separated from the adjacent mountain ranges by the *Nehbandan fault* to the East, the *Nayband fault* to the West and by the *Shotori range* in the North.[96] At the Western fringes an alluvial fan slopes from a depth of about 300m next to the Kaluts up to more than 1200m at the piedmonts/foothills. It is shaped by several formations like salt pans called *Namakzar*[97]*, Sanddunes* and areas of *Yardangs* called *Kalut.* All these features were formed by the interaction of different factors like Aeolian winds and seasonal floods. Another important factor is the evaporation in closed, shallow-water basins which is influenced by the extreme climatic conditions and causes sun-dried thick salt layers. The last to mention are the *Kaluts.* Their formation is a result of continuous heavy blowing winds in a Northwest-Southeastern direction which formed narrow alleyways of huge vertical eroded

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91 There is also a great disagreement between the scholars in the different academic disciplines about how to name the "*Lut*"in a standardised way. *Lut* itself means "empty, naked" (Maleki, O. 2003: 1185). The commonly used expressions for "desert" are "*Dasht*", "*Kavir" and "Biyaban"* which are derive from the Persian language and are all describing different degrees of desertifications which all can be observed in the "*Lut*". A short report of the different opinions and their statements is given by Alaee Taleghani 2005: 305. It is also summarized in the article about „desert" in the Encyclopaedia Iranica (http://www.iranicaonline.org/articles/desert). In the following the term *Dasht-eh Lut* will be used exclusively due to its general meaning as "*Lut Plain*".

92 Mildrexler et al. 2011: 857. The exact positioning of the temperature reading is located at *Gandom Beryan* ("roasted wheat") some 60 km North of Shahdad where the highest value of 70.7°C was taken. Similar thoughts were already remarked by other scholars more than 50 years ago (Gabriel 1960: 121; Stratil-Sauer 1952a: 70; Stratil-Sauer 1934).

93 Alaee Taleghani 2005: 303. In regard of published data from different scientists who all claim exact, but differing data about the same matter there are at least three more different measurements between 54.000 and 200.000 km^2 concerning the size of the Dasht-eh Lut (Bobek 1969: 159; Kardavani 1977:115; Hakemi 1997: 3f.;).

94 Mostofi 1969: 25ff.; Monod 1971: 79ff.

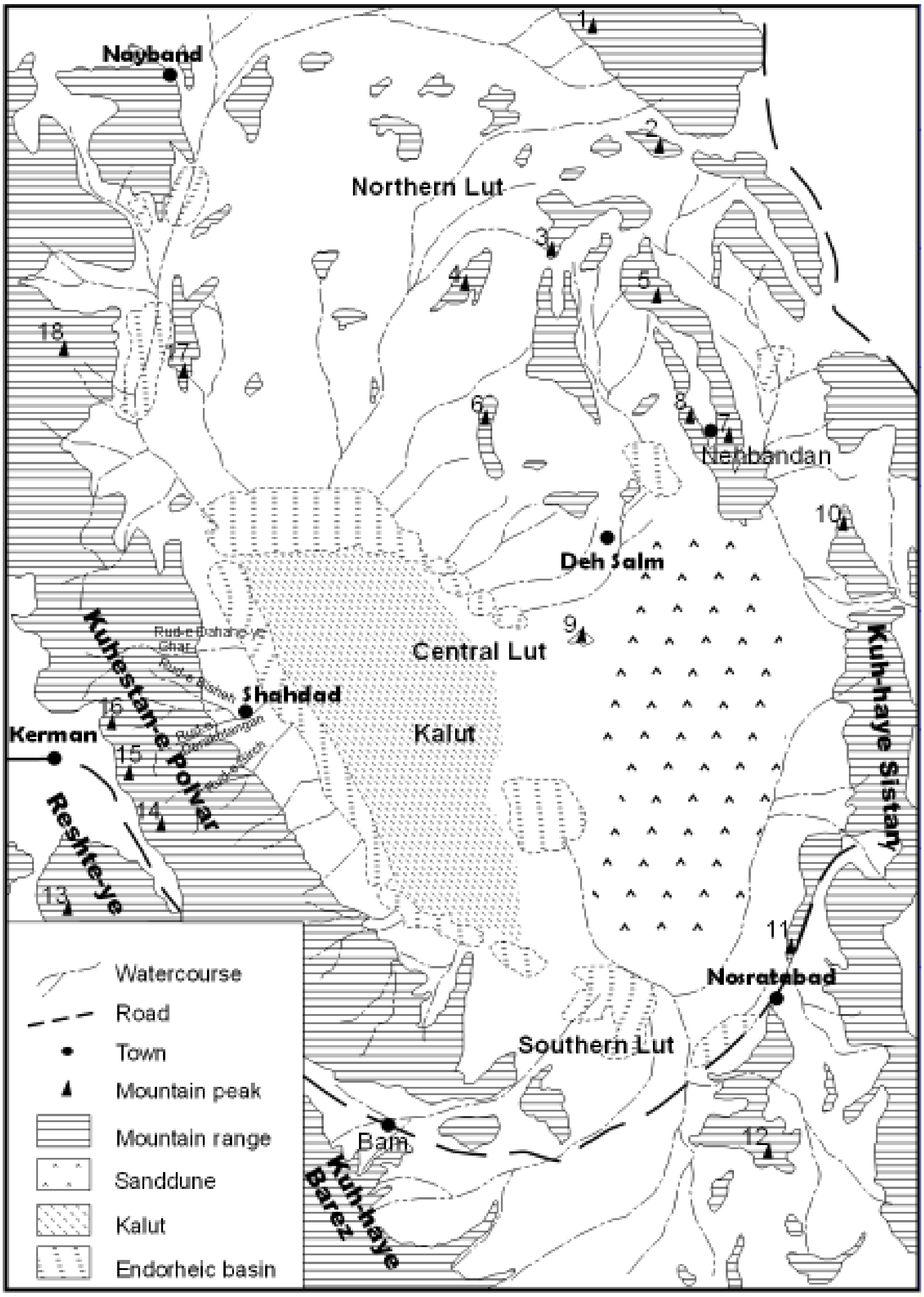
95 Bobek 1969; Mostofi 1973; Meder 1979: 66.

96 Stöcklin 1968: 1253; Darvishzadeh 1991: 186.

97 Behruzizad 2008: 499f.

sediments.[98] These winds are a regional characteristic feature called the “wind of 120” days or “Sistan wind” which usually blows between June and September, sometimes with extreme wind speeds of 150 km/h.[99] The *Dasht-eh Lut* also represents the lowest point on the Iranian Central Plateau with a minimum of 187 m.a.s.l.[100] The local plant growth, due to the physical and climatic characteristics, is limited to a minimum so that just xerophyte shrubs such as *Anabasis*, *Cornulaca*, *Seidlitzia, Salsola, Haloxylon* and *Calligonum* or trees like *Prosopis* and *Tamarisk* are able to survive in some parts of this largely hostile, abiotic area.[101] All these plants represent typical Turanian, Middle Asian shrubs and weeds.[102] But at the Western fringes of the Dasht-eh Lut, on top of the alluvial fan, it is possible to cultivate fields with the help of qanats and irrigation channels. This is the Shahdad's situation. This alluvial fan is sloping from an altitude of almost 1200 m next to the Western mountains to around 350 m next to the *Dasht-eh Lut* basin in the East.
The alluvial fan originates from the Lower Tertiary which was generated by humid conditions and continuously waterbearing streams. These water streams macerated the sediments on the highland after millions of years and were flowing into the lower plain, the Dasht-eh Lut, during Gelasian period of the Quarternary. This caused the sedimentation of alluvial material on the Western finges of the Dasht-eh Lut and formed the alluvial fan of the Takab plain (see Figure 2).[103]

98 Hallier 1976: 111ff.; Meder 1979: 76; Alavi Panah et al. 2007: 212f.
99 Gabriel 1938; Stratil-Sauer 1952b; Weickmann 1960; Mostofi 1973; Hallier 1976, Meder 1979;
100 Karadvani 1977: 115. He also postulated some years later that the lowest point on the Central Iranian plateau to be at a depth of 56 m.a.s.l.(Kardavani 2008: 5f.); But there is also the postulated deepest point on the Iranian Plateau of 205 m.a.s.l. by Jean Dresch (Dresch 1968) and 187 m.a.s.l. by Stratil-Sauer and Weise (Stratil-Sauer& Weise 1974: 7). Exceptionally they have presented coordinates (30°46´30´´N/ 58°4´30´´E).
101 Monod 1971: 70ff.; Meder 1979: 79ff.; Hakemi 1997: 12f. Monod and Dresch estimate the extension of the abiotic area at about 20.000 km² (Schiffers 1971: 58-65).
102 Zohary 1963.
103 Ramesht et al. 2008.



1: Kuh-e Bagheran, 2: Kuh-e Sorkh, 3: Qal´eh-ye Zari, 4: Kuh-e Bakhtu, 5: Shah Kuh , 6: Kuh-e Abdallahi ,7: Kuh-e Chahruyi, 8: Kuh-e Gar-e sefid, 9: Kuh-e Simorgh,10: Kuh-e Palangan,11: Kuh-e Nosratabad, 12: Kuh-e Pirshuran, 13: Kuh-e Hezar, 14: Kuh-e Chupar,15: Kuh-e Sirch, 16: Kuh-e Joftan, 17: Morghab Kuh,18: Kuh-e Darband,

Map 2: Geological map of the Dasht-eh Lut with its highest surrouding peaks (rearranged by DYM & DMPM)

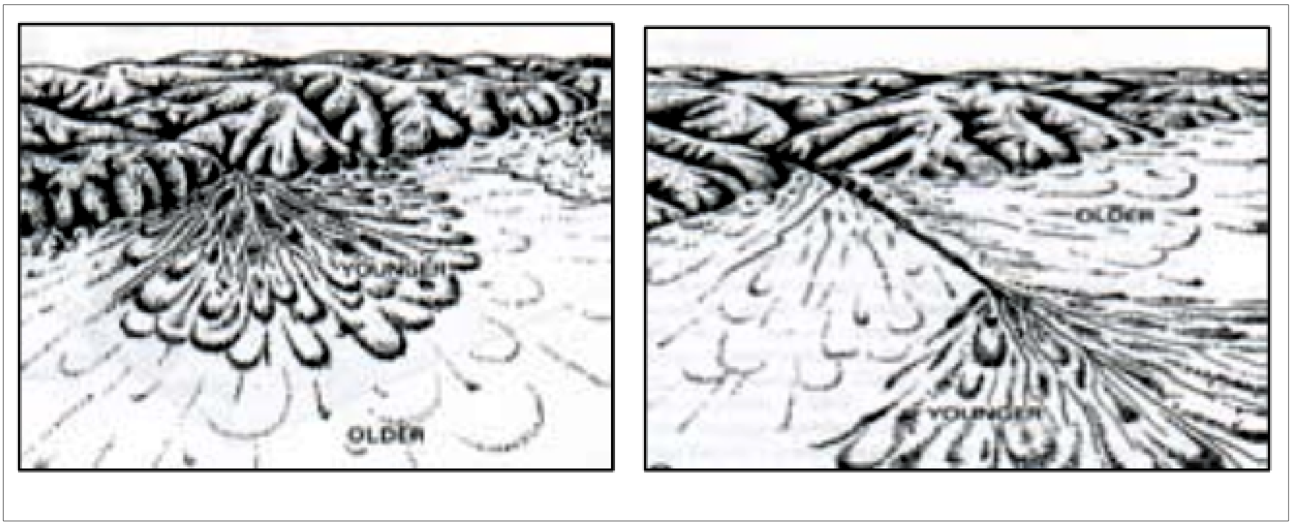


Figure 2: Schematic view of the development of an alluvial fan (after Ramesht et al. 2008: fig.2).

In addition to the sedimentation of the alluvial fan there are also the neogene konglomerates of the *Derakhtangan* alluvial fan which are composed of fertile soils and are moved by floods of seasonal snow melt.[104] These movements can appear slowly or suddenly and are uncontrollable. Hakemi recognized during his excavation fine, greenish horizontal sediments which he identifies as traces of these seasonal floods in ancient times.[105] Such observations of alluvial sediments were also documented during the excavations of the graveyards as well as of the different architectural features at the site.[106]
A final, very striking proof is also to be observed in the distinct riverbed changes to the South and East of Shahdad.[107] There, because of fundamental changing water masses after the snow melt, further vaying amounts of sediments reach the plain. This affects the water courses which take alternative routes and cause in the worst cases large scale floodings of the plain as evidenced by the observations during excavations.
The periodical rainfall during the winter months is regularly limited to an average maximum of around 50 mm at Shahdad which also influences the extreme arid character of the Dasht-eh Lut nowadays.[108] In the Western mountains seasonal rainfalls of 200-300 mm are not unusual.[109] It remains as snow until early summer and the snow melt provides fresh

104 Meder 1979: 65ff.; Ramesht et al.33ff.
105 Hakemi 1972: 4f.; Meder 1979: 82f.; Kaboli 1995: 111f.; Hakemi 1997: 15ff.
106 Bayani: 1979; Hakemi 1991; Kaboli 1997.
107 Mostofi 1973: 7ff.
108 Data published by Kardavani concerning the precipitation mentions a 5 year measurement of 29mm and a 10 year measurement of 63 mm at Shahdad (Kardavani 1977a: 117). In another place he published a 14 years average precipitation measurement of 64.1 mm (Kardavani 1977b: 13f.).
109 Hakemi 1997: 11f.

sweet water by qanat and natural springs. A few of these sources are getting saltier on their way towards the Lut plain and are of no further use for subsistence. There are also however perennial waterways which provide the gardens on the Western fringe of the Dasht-eh Lut with water of a suitable quality for irrigated agriculture.[110]

It is also important to point out that the rainfalls are only during the period of November until June. The remaining time of the year is completely dry (see Table 1).

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1960	-	-	-	-	-	-	-	-	-	-	-	-	-
1961	-	-	-	-	-	-	-	-	-	-	-	-	-
1962	10	10	11	95	0	0	0	0	0	0	11	65	**202**
1963	10	19	14	5	49	2	0	0	0	0	16	0	**115**
1964	149	225	15	0	0	0	0	0	0	0	0	15	**404**
1965	22	9	0	0	0	0	0	0	0	0	0	0	**31**
1966	-	-	-	-	-	-	-	-	-	-	-	-	**-**
1967	8	28	0	0	0	0	0	0	0	0	0	0	**36**
1968	16	16	0	0	0	18	0	0	0	0	0	0	**50**
1969	3	10	0	0	0	0	0	0	0	0	0	0	**13**
1970	0	0	7	2	4	0	0	0	0	0	0	0	**13**

Table 1: Annual precipitation (mm) at Shahdad in the period between 1960 and 1970 (compiled after: Meteorological Yearbook 1960-1970)

But there is always the possibility of temporary heavy rainfall in summer due to the local barometric uniqueness.[111] These distinct barometric characteristics are the so called "*wind of 120 days*" which is actually known from *Zabolistan*, the Iranian-Afghan borderland and blows from june until september.[112] But it is also occurring in a similar form in the *Dasht-eh Lut*. These sandstorms are arising during summer from meteorological high pressure zones which are coming from *Sistan* in the Eastern / Southeastern direction. While arriving at the *Dasht-eh Lut* it meets the local low pressure zone which is heated by the bare character of the surface and causes heavy winds.[113] It blows in summer from a North to Northwestern direction and carries sands to the inside of the *Dasht-eh Lut*.[114]

The southern winds blows exclusively in the end of the winter and the beginning of spring. It start from a Southwestern direction, changes to a South-Northern direction and carries immense quantities of sand and dust with it.[115]

110 Mahmoudi 1970; Gentelle 2003.
111 Stratil-Sauer 1952b; Weickmann 1960: 35f.; Stratil-Sauer & Weise 1974: 17.
112 This wind is also called "*Lewan*" by the local people of Zabolistan (Stratil-Sauer 1952b: 137).
113 Weickmann 1960.
114 Stratil-Sauer 1952b: 137.
115 Gabriel 1938: 194. According to Gabriel 1938 this feature is called "*Bad kasif*" by the locals which means "dirty

According to the results of extensive research about the Dasht-eh Lut, aeolian and fluvial actions were important factors throughout all of the ages for the development of the Dasht-eh Lut. As nowadays the area is characterized by its bare and hostile character there are also observations that in prehistoric period the environment was more intensively covered with a vegetable carpet. From the archaeological point of view there is the depiction on the so called *Standard of Shahdad* which shows an anthropomorphic seated couple in central position. Around this central couple different motives are displayed like other anthropomorphic characters, wild and domesticated animals, a date palm and a grid like structure which is interpreted as an irrigated garden (see Figure 3).[116]

Figure 3: Different views of the Shahdad´s Standard (a: from Hakemi 1997: 649, Gt.; b: photography taken by D.M.P. Meier).

This can be seen as a proof for a differing landscape of the Dasht-eh Lut and the Shahdad plain during the Bronze Age.

Besides this observation also the abundant presence of metal artefacts and slags inside of the boundaries of the prehistoric settlement remains leads to the assumption that in ancient times the area must have been more covered more densely with vegetation. A very strong evidence for this hypothesis can be observed at some of the *Nabkas,* sandy mounds, which are covered with shrubs or trees. Especially the *"Dead Nabkas"* are of

wind" because of its abundant aeolian sediments which are distributed in its path.

116 Meder 1979: 79f.; Kaboli 1983: 62ff.

particular interest (see figure 4). Nowadays due to the loss of their vegetation the aeolian erosion removes the sediments easily.[117] In some cases vertical, wind-cut profiles were created which show the course of vertical root channels of an ancient vegetation which were refilled with fine sediments in earlier times. Today these fine sediments are cemented and display an image of a past environmental situation. This also can be seen as an indicator for the ancient extensive plant growth in this region.

Figure 4: Dead Nabka in the vicinity of Shahdad with traces of root channels (Photo by M. Vidale).

So presumably the continuous desertification of the area around Shahdad can be seen as a result of extensive pyrotechnological activities which evidently have been conducted there to a larger extent. Metallurgical residues like vast slag fields as well as remains of at least one copper smelting furnace are documented in the area of the prehistoric settlement of Shahdad.[118]

According to *Weise* periodical heavy rainfalls along with other factors are responsible for the dynamic movementss of pedimentations which causes the desertification.[119] So finally

117 Mahmoudi 1977: 319f.
118 Meder 1979: 79.
119 Weise 1974: 38ff.

it can be remarked that the deforestation was one major factor for the spreading desertification of the area around Shahdad which was caused by intensive exploitation of wood for satisfying the growing demand for building material and fuel.[120] The increased deforestation was also supported by heavy seasonal winds and temporary floods.[121] These erosive processes had a high influential impact on the development and shaping of the Dasht-eh Lut´s topography. The already mentioned seasonal winds caused both the aeolian erosion as well as the accumulation of sediments.[122] And further developments like fluvial accumulation and abrasion were initialised or supported by the seasonal floodings of the rivers.

Meder, during his time at Shahdad at the end of 1976, documented different geological sections.[123] He recorded two vertical sections, one of which was situated next to the excavation site and the other was located in the river bed of Derakhtangan (see Tables 2 and 3).

At the first section he documented a complete stratigraphy of 5.30m high, from the recent surface to the bedrock. Within he distinguished different sized layers of fine sands of 150cm to 10cm thickness with varying degrees of clayey intermixtures. He states that these sands are probably deriving from aeolian origin. He also identified alluvial sediments which are residues of seasonal floods. Further, he also identified diverse cultural remains in two of the horizontal layers. At a depth of 130 cm underneath the Dasht-surface he identified a possible archaeological layer of 90cm thickness. Similar to this archaeological record he also documented at a total depth of 500cm another layer of 30cm thickness with traces of pottery fragments which he identifies as residues of another prehistoric cultural usage (see Table 2).[124] Hakemi is also describing in his final report the difficult situation on site where sometimes the burials of the younger phase were situated on or directly underneath the modern surface.[125]

These two different observations stated by Hakemi and Meder again show to what extent the annual abrasion and accumulation are influencing the sedimentation in different ways and how difficult it is to make a statement about the past topographical situation. After

120 There are known deposits of blue coal as well as of bitumen slate to the North and North east of Kerman near Bazargan and Deh Tagui but at the moment there are no links or evidence that the people at Shahdad might have used this fuel for their aims (Houtum-Schindler 1881: 173).

121 Hakemi 1997: 31f.

122 Mahmoudi 1977.

123 O. Meder visited the excavations at Shahdad in the period between October and December of 1976.

124 Meder postulates that these two layers with cultural remains are representing the different burial layers with 280cm of sediments in between. He sees these sediments as the actual depth the graves were dug into the soil (Meder 1979: 82).

125 Hakemi 1997: 41.

several years of research in and around the Dasht-eh Lut it is still not possible to evaluate a secure average value for the different accumulative and erosive transformational activities during the past.[126]

Elevation	Feature/ Characteristics
Dasht/Surface	
110cm	Sandy, silty clay; less stratified; friable texture; excretions of carbonate;
20cm	Fine sand; no angle of filling detectable;
90cm	Sandy, silty clay with root channels, friable texture, excretions of carbonate, pottery shards, probable cultural horizon;
50cm	Alternating layers of clay and sand; sand probably from aeolian origin; narrow bands (1cm) of clay;
20cm	Horizontally layered clay deposits;
150cm	Alternating layers of clay and sand; sand probably from aeolian origin; narrow bands (1cm) of clay;
10cm	Aeolian, windblown sands;
40cm	Smooth layered horizons of clay deposits;
10cm	Alternating layers of clay and sand; sand probably from aeolian origin; narrow bands (1cm) of clay; vertically crossed by ancient root channels filled with fine clay sediments;
Peneplain/Peneplane	
30cm	Layered clay sediments with root channels and inclusion of pottery sherds;
Outcrop/Bedrock	
Total	
530cm	

Table 2: Geological section next to the archaeological excavation site at Shahdad (after: Meder 1979: 74).[127]

126 Pers. Comm. M. Maghsoudi.
127 Due to Meder's notes it seems plausible to localise this section next to cemetery A.

Elevation	Feature/ characteristics
Dasht-surface	
20cm	sandy gravel; silty clay
20cm	Light brown/ beige coloured, sandy, silty clay; friable texture;
5cm	Gray-greenish, silty sand with excretions of carbonate;
30cm	Light brown/ beige coloured, clayey silt; excretions of carbonates and chlorites;
4cm	Smooth gray-greenish, silty layers; excretions of carbonates;
30cm	Light brown/ beige coloured, clayey silt; excretions of carbonates;
20cm	Gray-brown coloured, sandy silt; excretions of carbonates;
30cm	Gray-greenish coloured clay; excretions of carbonates;
10cm	Light brown coloured, fine sand;
Outcrop/Bedrock	
Total	
169cm	

Table 3: Geological section at Derakhtangan river near Shahdad (after: Meder 1979: 73).

2.2. History of archaeological research

The first traces of prehistoric remains at Shahdad were identified by a joint French-Iranian research group of the so called Lut-project under the supervision of Jean Dresch, the head of the Geographical Institute of the University of Paris and Ahmad Mostofi, the director of the Geographical Institute of the University of Tehran.[128] During their first campaign of geographical surveys in 1967 a lot of evidence of human activities was detected. After these unexpected discoveries a group of archaeologists from the University of Tehran´s Insitute of Archaeology and from the Iranian Center for Archaeological Research (ICAR) under the supervision of Ali Hakemi, in the spring of 1968, began the systematic archaeological research. In the initial phase they conducted a preliminary survey for a period of 20 days at the eastern margins of the Chaleh-yeh Takab/ Takab plain to underline the archaeological importance of this site. After this first assessment the archaeological expedition returned under Hakemi´s supervision in the winter of 1969 and surveyed three further areas located at a distance of 5 km east of the modern city of Shahdad. A vast number of artefacts such as decorated pottery vessels, beads made of semiprecious stones as well as different metal objects deriving from burial contexts were collected. Thus these areas were chosen for further archaeological excavation where the test trenches "A, B and C" were set up. Test trench A was renamed Cemetery A after wide scale exposures. Test trench B, located at a distance of 300m to the North of test trench A, as well as test

128 Mostofi 1973.

trench C, at a distance of 600m to the northwest of Area A, revealed further burials with grave goods of different types.[129] Later, the test trenches B and C were also renamed to Cemetery B and Cemetery C.

The first archaeological excavations at Shahdad were conducted for seven seasons between 1968 and 1977 during which time the three graveyards (Site A-C) and one architectural feature (Site D) were uncovered and studied. After the Islamic revolution Mir Abedin Kaboli, who previously had been a member of Hakemi´s team, continued excavations at Shahdad between 1994 and 1996 for three seasons. His main work focused on the examination of a residential area which was neglected during the first seasons of excavation (See Figure 5).[130] The most recent archaeological investigations at Shahdad were conducted by the ICHTO Kerman under the supervision of Nasir Eskandari in 2011 with surveys where 87 sites from the5th millenium to the islamic period were registered. Following, in 2013, small scale excavations were conducted in which two features dating to the period between 5th and 3rd millenium BCE, called *Tappeh Dehno* and *Tappeh Dehno East*, were investigated.[131]

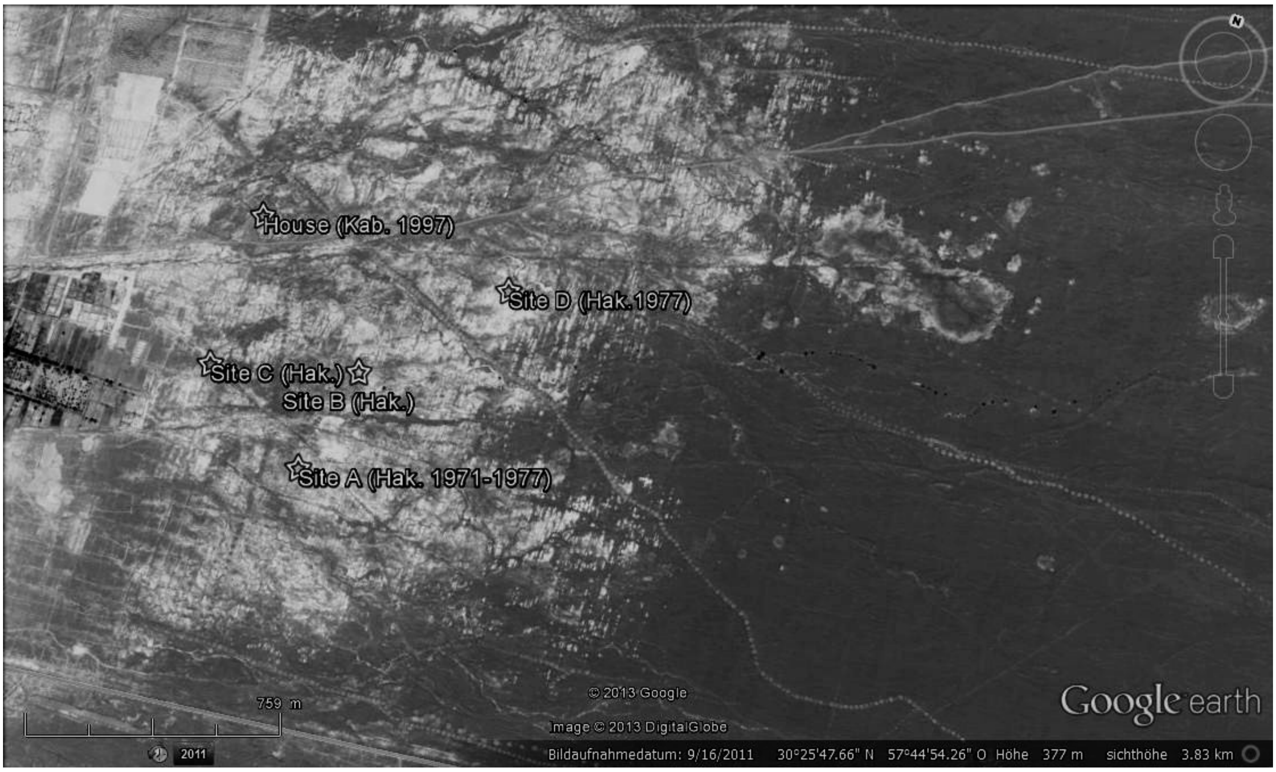


Figure 5: Satellite image of the archaeological sites at Shahdad (taken from GoogleEarth).

129 Hakemi 1997: 39ff.
130 Kaboli 1997, 2001, 2002.
131 Pers. comm. by N. Eskandari at the "*A new look at old routes in Western Asia: rethinking Iran in the 5th millenium BCE*" workshop in *Berlin* on the 2nd of June 2013; Eskandari in prep.

2.3. Trade routes around Shahdad

Although Shahdad is nowadays situated in an abiotic, remote environment it has always been in an important strategic position. Due to its location on the Western fertile fringe of the Dasht-eh Lut the area of Shahdad was from early historical periods onwards always an important station on the caravan tracks which connected the far distant region from Central Asia with the harbours at the Straight of Hormoz to access the seaways of the Persian Gulf. But it also connected the far Eastern and Western regions during prehistorical and historical periods as G. Le Strange already noted at the begin of the 20th century.[132] His assumptions were already proven by the results of several international archaeological missions in this area which documented the wide distribution of artefacts. A commendable compilation of numerous roads and tracks was presented by A. Mostofi in his fundamental geographical monography about Shahdad and the Dasht-eh Lut (see Map 3).[133]
Stratil-Sauer and Weise have described the main connecting route to Pakistan running from Kerman via Bam and Nosratabad to Zahedan as Khanikof and others had before.[134]
Towards the north Shahdad is connected to Birjand in Southern Khorasan via Shafiabad, Rud Shur, Tabasain, Bala Houz, Sar Chah and Khusf. According to Tomaschek the way between Shahdad and Sar Chah is about 246 km (i.e. 152 mi. / 44 Farsakh) long and takes a seven days journey by a daily hike of 35 km (i.e. 21 mi. / 6 Farsakh).[135]
From Shahdad to Nayband there are at least two ways. There is the track running from Shahdad via Godar Barut running to the East of the Morghab Kuh by Seh Chungi and Haft Gud where after several kilometers to the north it hits the old connection road between Kuh-eh Sikh to Nayband.[136] The second road runs via Godar Barut, Tabasain to Bala Houz where after a few kilometers to the north it hits again the Kuh-eh Sikh - Nayband road.
Another important route which is mentioned by Stratil-Sauer and Weise as well as earlier by K.E. Abbott and by Tomaschek runs from Shahdad via Rud Shur and Kouche to Deh Salm where important mineral deposits are situated further towards Goud No and Neh(bandan).[137] Further, the old road from Deh Salm crossing the Central Lut via Kuh Malek Mohamad, Shurgaz Hamun and Cheshmeh Baluch Ab towards Bam has recently been used by smugglers. The main road between Zahedan and Bam follows the old

132 Le Strange 1905: 308.
133 Mostofi 1973.
134 Abbott 1855; Khanikof 1865; Stratil-Sauer & Weise 1974: 5f.; Ratnagar 2004: 60.
135 For the length of a farsakh see: Houtum-Schindler 1888;
136 Mostofi 1973: 205ff.
137 Tomaschek 1972: 120ff.

caravan routes crossing Nosratabad, Shurgaz and Fahraj.[138]
A. Hakemi points out that some of the connnecting roads are identical with the old caravan routes between the plain and the western adjacent mountains. Some of the tracks are still in use by modern motorways and some others have completely disappeared. But it is still possible to identify them by the remains of old fortresses which are situated next the old routes. According to Hakemi three main roads connected *Shahdad* with distant regions:[139]

1. The Western road leads from Shahdad along the Rud-e Konaran to Chahar Farsakh. There the road is branching in different directions which connect Shahdad with different localities in its close vicinity such as Kerman, Ravar and Kubanan as well as Rayen on the way towards Jiroft.[140] It is of particular interest that all these roads mentioned by Hakemi are impassable for automobiles which emphasizes the fact that here we are most probably dealing with old caravan tracks. It seems that here we have an exclusive local road network which connected Shahdad with the next settlements to the Western Mountains and further to Kerman. From there the connection routes further to the West began.

2. The Southern road connected Shahdad with the city of Bam and further with the Halil Rud valley.[141] From there the seaports at the Persian Gulf coast, presumably at the Straight of Hormuz next to the Modern towns of Bandar Abbas and Minab, could have been reached.[142]

3. The Northern route connected Shahdad with Khorasan, Sistan and the Central plateau of Iran. At Rud-eh Shur the road is forking in a Northern direction which leads to Khorasan and further on to Western Central Asia via Tabasain, Khusf and Birjand. The other road goes in a north-eastern direction to Dehsalm, Nehbandan and connects to Western Afghanistan and Northern Baluchistan.[143]

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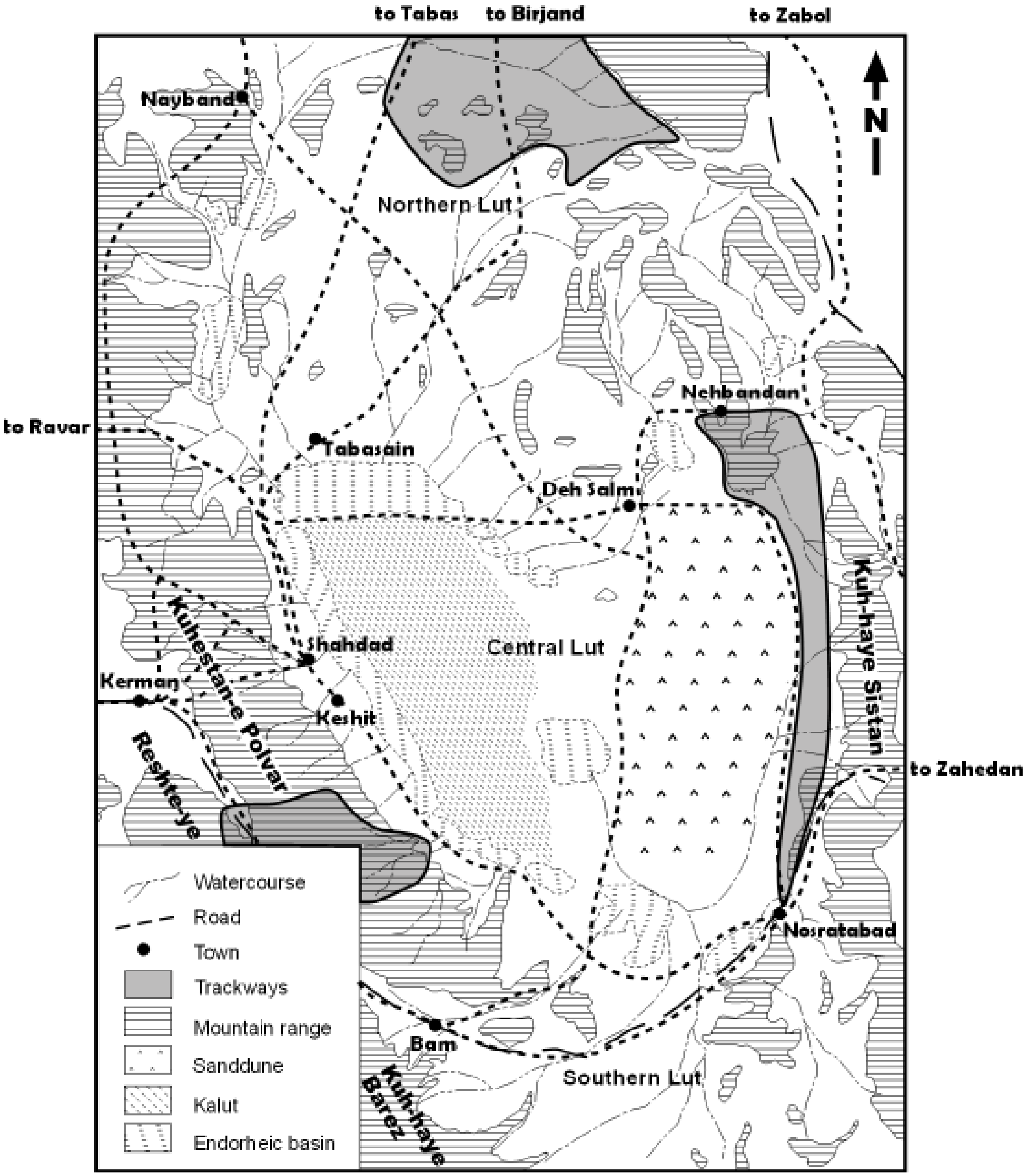
138 Stratil-Sauer & Weise 1974: 6.
139 Hakemi 1997: 30f.
140 Mostofi 1973: 252ff.; Hakemi 1997: 30.
141 Mostofi 1973: 313ff.
142 A survey project by IANES (University of Tübingen) has been initialized to investigate the hinterland of Minab on this question. But unfortunately so far no fieldwork has been conducted.
143 Mostofi 1973: 216ff.; Hakemi 1997: 30.



Map 3: Topographical map of the Dasht-eh Lut and its roads and water ways (after Mostofi 1973).

Chapter 3: Copper ore deposits in eastern Iran

3.1. History of research

According to the discovery of abundant metal artefacts at Shahdad and other eastern Iranian archaeological sites it is beyond controversy that copper deposits must have been well known in the region and the adjacent areas from the early phases of metallurgy. The first written records mentioning mining and further metallurgical activities are from early Islamic travellers from the 4 century A.H./ 10th Christian century onwards such as for example the Geographers al-Muqadasi and al-Mostofi of Arabian origin[144] or Khajeh Nasir al-Din Tousi, Ibn Hawqal and al-Istakhri.[145] But their descriptions are focusing more on the local handcraft workshops.[146] There are for example several descriptions about the production of zinc and zinc-oxide, a strong disinfective agent, which are located near Kuhbanan in the Northwest of the city of Kerman. In his memoires the Venetian merchant Marco Polo also attests to extensive metallurgical activities in the area of Cobinam which can be identified with the modern Kuhbanan (engl. “Mount of wild pistachios”).[147] He mentions the production of zinc oxide which he calls “Tootiya” and describes it as “...a zinc oxide which is produced from zinc oxidic mineral ores which are heated over an open fire”.[148] The vapours/fumes with high concentrations of zinc oxide are condensating on small finger-shaped clay rods.[149] “Tootiya” has been used as an antiseptic ointment for eyes and open wounds.[150] Furthermore, it is linked to the production of brass in later reports. Polo also mentions the production of “spodium”, another zincic product, which might have been used as a polishing agent[151] and the manufacture of high quality iron and steel.[152]

But the most significant reports about the numerous mineral deposits in Southeast Iran are deriving from Western Scholars and other investigators who were surveying this area for several reasons during the last 150 years.

During the reigns of Mohamad Shah Qajar and his son Naser al-Din Shah Qajar from the

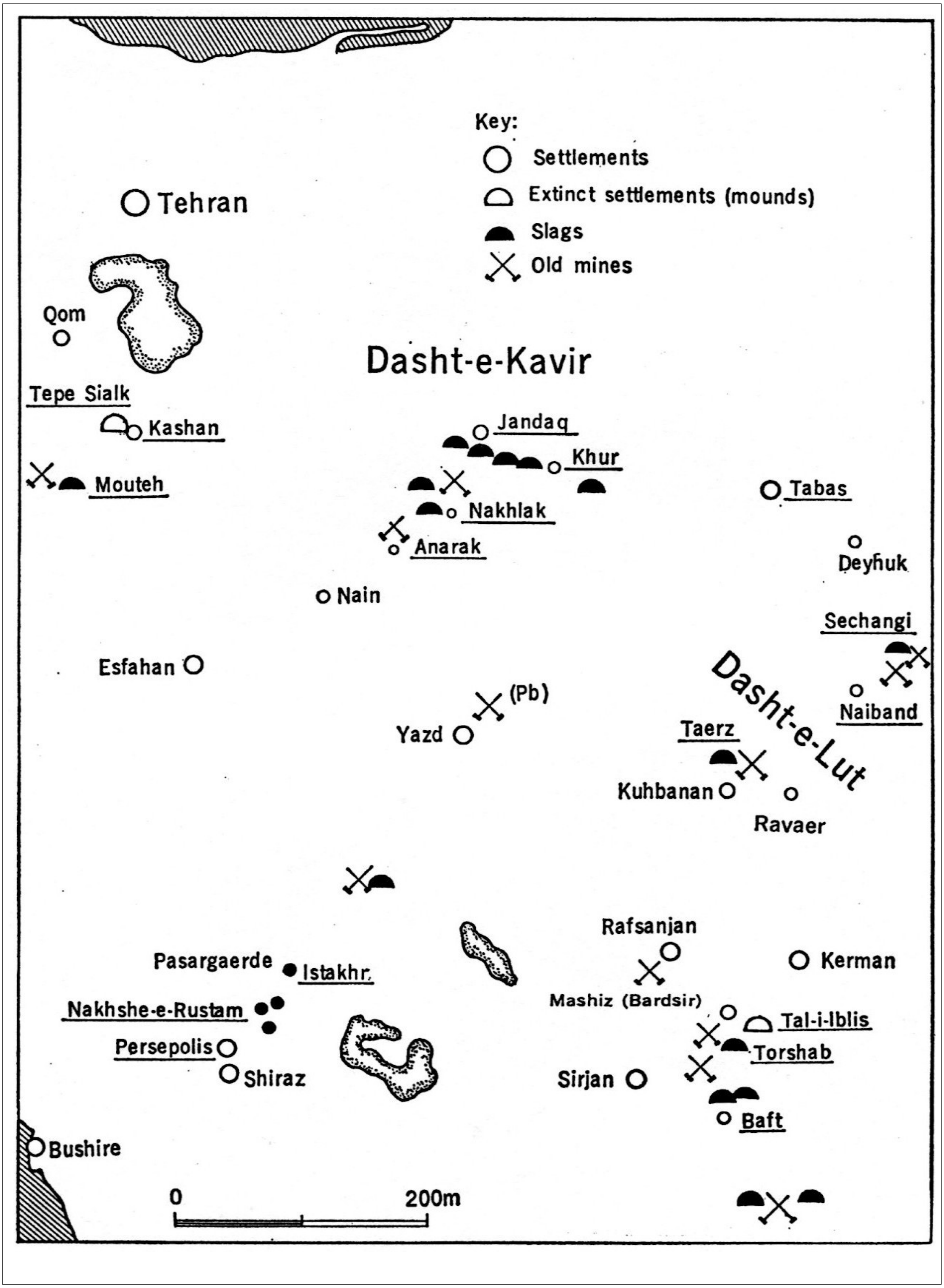
144 Wertime 1968: 929.
145 Abasnejad 1994: 31f.; Momenzadeh 2003: 12.
146 Mostofi 1972: 175ff.; Allen 1979; Moshiri 1997: 22ff.
147 The coordinates of Kuhbanan are 31°24'37.0"N 56°16'57.0"E. In Marco Polo´s report it is named Cobinam/ Cobinan/ Cobiam/ Gobiam (Polo 2008: 53).
148 Etymologically is "tootiya" deriving from "dood / دود" (engl. smoke).
149 Allen 1979: 39ff.; Wertime 1968
150 Ghorbani 2014: 75f.
151 Yule 1926: vol.2., 125f.
152 Thereby he is refering to "andanico / andanique" as a special type of steel. http://dsr.nii.ac.jp/toyobunko/III-2-F-c-104/V-1/page/0057.html.en

early 19th century onwards the Persian mining engineer Mohamad Salah Tabrizi undertook geological surveys and published his observations on the mineral situation.[153] The initial phase started for Western scholars in the mid 19th century when the Persian empire assigned foreigners such as the Russian Nicolas de Khanikof to prospect the land for valuable mineral deposits. His mission was reportedly the first European expedition which crossed the Lut area where they focused on the geographical and geological description of Kerman Province.[154] Another mineralogical survey report which was published in 1879 by E. Tietze also mentions a great number of important mineral deposits as well as traces of ancient copper mining and smelting sites which he recorded during his travels in the vicinity of Kerman. Furthermore he described the habit of some locals of collecting cupriferous slags, presumably residues of pre-islamic metallurgical activities, to extract the copper prills for reselling it.[155] In the late 19th century an engineer of Dutch/German(?)-Iranian parentage, Sir A. Houtum-Schindler[156], explored on behalf of the Persian Government the Eastern provinces and explicitly describes the compositions of copper and other mineral deposits as well as the occurrence of fossil fuels in the vicinity of the Dasht-eh Lut.[157] A.F. Stahl conducted similar expeditions in Iran and published similar observations in his essential geological reports.[158] In the first half of the 20th century several small scale surveys were conducted and published by Swiss geoscientists to contribute to A.F. Stahl´s research.[159] After another decade of hiatus from the late 1950s until the Iranian revolution the geological survey activities then increased once more. During this period several expeditions were conducted. There, besides mineral deposits in the Kerman province, traces of ancient mining and smelting activities were also observed.[160] And finally the compendium on the copper deposits in Iran was published in 1969 by the Geological Survey of Iran (GSI) which included all previous works and its own research results.[161] Besides all of the mentioned economic enterprises which focused on the values of mineral deposits for their industrial exploitation there were also a few scientific expeditions with the goal to investigate the early traces of ancient mining and

153 Momenzadeh 2003: 12ff.
154 Khanikof 1864.
155 Tietze 1879 : 638f.; "...in der Gegend von Kerman Mancher sein Brot damit verdient, dass er die Kupferschlacken (crasses cuivreuses) zusammenliest, welche sich noch in Menge in den Gebrigen dieser Provinz fänden und wahrscheinlich die Reste von Bergarbeiten aus vorislamischer Zeit seien..."
156 http://www.iranicaonline.org/articles/houtum-schindler-albert
157 Houtum-Schindler 1881.
158 Stahl 1896; Stahl 1897; Stahl 1911.
159 Boehne 1929; Diehl 1944; Ladame 1945.
160 Walther & Kürsten 1958; Venzlaff et al. 1960; Ruttner & Thiele 1969.
161 Bazin & Hübner 1969.

pyrotechnology. The first small scale enterprises were organized and carried out by T.A.Wertime during the early 1960s. During the famous “Metallurgical expedition through the Persian Desert” in 1966 (see Map 4) he was accompanied by a group of international scholars through Afghanistan, Iran and Turkey.[162] This expedition was also conceived to be a supplement study for the archaeological investigations at Tall-eh Eblis, Tappeh Yahya in the Kerman Province and Cayönü Tepesi in Southeast Turkey.[163] In 1975 a French team of the “Unite de recherche archéologique no.7” of the CNRS surveyed several mining areas in the Kerman province.[164]

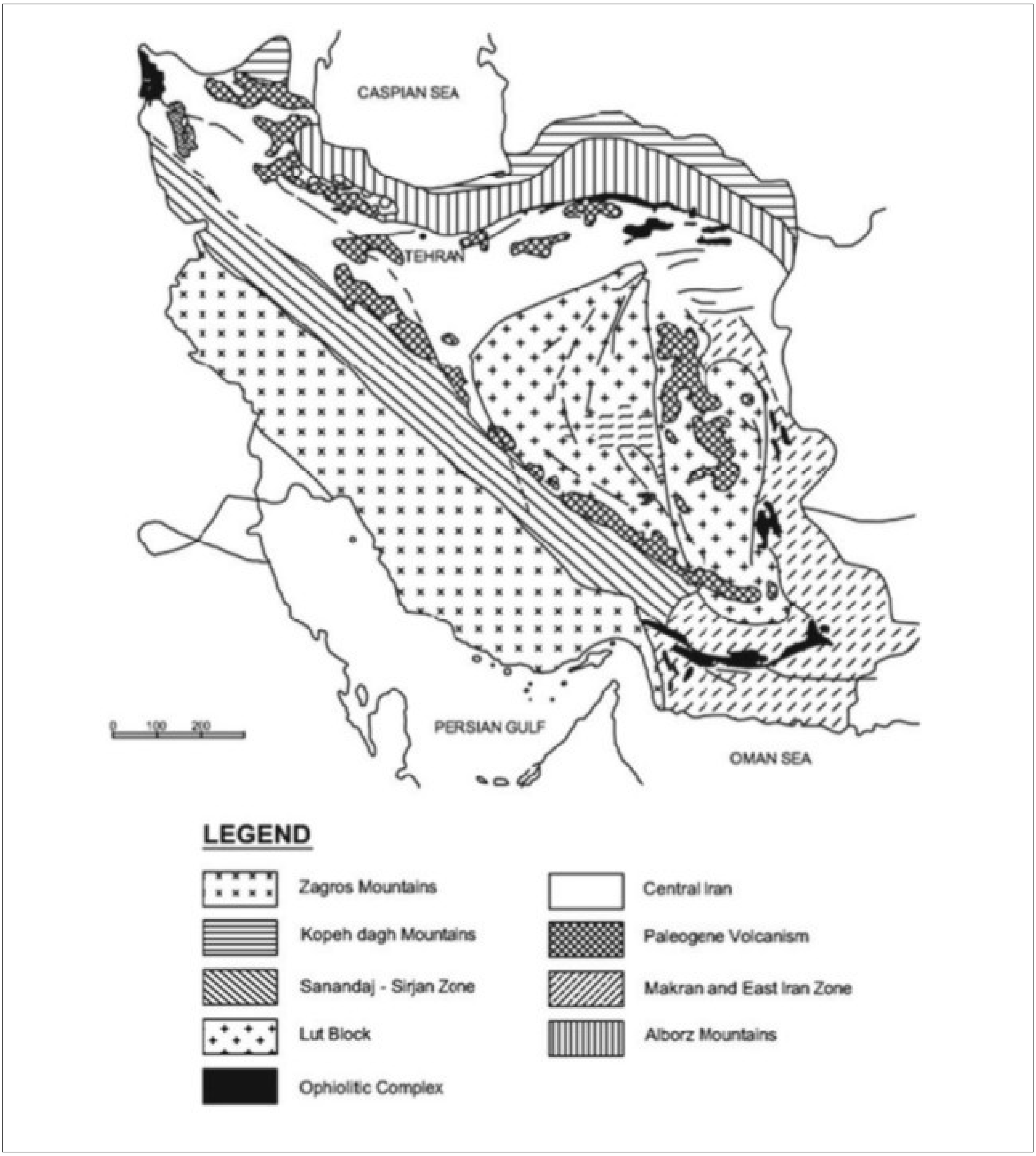
162 Smith et al. 1967; Wertime 1968; Pigott & Lechtman 2003; Rehren & Arab 2004; http://ucl.ac.uk/iransurvey/index.php .
163 Pleiner 1968: 2.
164 I am deeply indebted to T. Berthoud for discussions and providing me with copies of the unpublished reports. Berthoud et al. 1975, 1976; Berthoud 1979.



Map 4: Sketchmap of the visited sites during the "Metallurgical Survey through the Persian Desert" (Wertime 1968: 929, fig.2).

Further regional scientific investigations in Southeastern Iran were conducted after the Iranian revolution, for example by M. Momenzadeh[165] with a metallogenic focus as well as by A. Sarfaraz and R. Abasnejad[166] on archaeometallurgical questions.
Nowadays more than 400 sites with copper mineralisations of different types are known which are mainly to be detected in volcanic substrata from Tertiary origin all over Iran. They can be subdivided into five main areas which are all to be seen in dependency to the so called Orumieh-Dokhtar-Volcanic-Belt-Zone which is crossing from the Northwest to the Southeast: The Northern parts of East and West Azarbaijan, the Tarom-Taleghan-Hashtjin-Belt to the East of the Caspian Sea, the area between Kashan and Anarak in Central Iran, the Abbasabad-Torud area to the South of the Alborz-mountains towards Northeast Iran and last but not least the Kerman area (see Map 5).
Further areas known for their richness of copper and other metallogenic minerals are the regions between Sabzevar in Northern Khorasan along southwards via Birjand in Southern Khorasan to the region of Iranshahr in Sistan and Baluchistan.[167] Finally it needs to be emphasized that according to T. Stöllner it is impossible to gain a differentiated overview of ancient mining sites in Iran by surveys as traces of old workings are detected at almost every cupriferous deposits which can belong to prehistoric as well as to Islamic times.[168] Only with the documentation of archaeologically found material can secure contexts be identified.

165 Momenzadeh & Rashidnejad Omran 1989; Momenzdeh 1989; Momenzadeh 2002; Momenzadeh 2003; Momenzadeh 2004.
166 Abasnejad 1994: 6ff.
167 Abbasnejad 1994: 136ff., Vatandoust 1999; Momenzadeh et al. 2004; Ghorbani 2014.
168 Stöllner 2004: 59.



Map 5: Geological map of the tectonic zones in Iran (after: Stöcklin 1968).

3.2. Situation of copper deposits in East Iran

As a result of the different scientific and economic surveys during the last 170 years it can be stated that in the area of the modern provinces of Kerman, Khorasan Rajavi, Khorasan Jonoubi as well as in Sistan and Baluchistan a large number of important mineral deposits are situated which nowadays are exploited after modern mining standards. Several sites were possible to identify due to initial etymological studies which was helped by the determination of their mineralizations (see Table 4).

Part of the Name	Mineral	Localities of mines
Zar (Au)	Au	Ghaleh Zari, Zarin, Zarshouran, Kuh-eh Zar, Zargaran
Mes (Cu)	Cu	Tal Mesi, Meskani, Kan Mes, Chah Mesi, Kuh Mes, Kuh Sang Mes
Zangar (Cu)	Cu	Zangalou, Zanghalou
Ahan / Asen (Fe)	Fe	Kalat Ahani
Rui(Zn)	Zn	Chah Rui
Gel (Clay)	Clay	Meh Geli, Gelmandeh, Gelkan, Gelou

Table 4: Etymological table for metalliferous/mineral deposits (compiled by DMPM after Ghorbani 2014: 75, Table 3.1).

There, traces of ancient copper mining and smelting activities were also identified at a large number of sites, for example at open cast pits, shafts and further remains of penetrating techniques as well as on base of agglomeration of slags like slag heaps and remains of pyrotechnological installations.

This evidence from the discoveries of numerous copper alloy artefacts from scientific archaeological expeditions which were untertaken in this region leads to the question where are the used raw materials originating from.

In the case of arsenic bronze artefacts it was hypothesized by several scholars that due to the significant amounts of domeykite and algodonite, two rare copper arsenides which are located in large quantities close to the surface at the mines of Tal Mesi and Meskani in the Anarak mining district, that these mining sites may have been the sources for these metal objects.[169] Without a doubt Tal Mesi and Meskani were of exceptional importance for the

169 Wertime 1968; Heskel & Lamberg-Karlovsky 1980; Heskel 1982; Pigott: 2004;

procurement of cupriferous raw materials which might have began in the earliest periods onwards, but unfortunately up until now there has not been any archaeological evidence presented to prove this hypothesis. The following compilation will show that there is other evidence for mining and smelting activities at local sites in eastern Iran.

Several scientific mission have surveyed the area with a focus on the remains of ancient mining and smelting activities.

In the course of early geological surveys a few traces of old activities were discovered and described without any proposals concerning the chronological position. Tietze for example observed extensive slag fields next to Miandasht to the West of Abasabad where he also noted the occurrence of native copper, cuprite and chalcopyrite.[170] Similar occurrences were also described by A. Houtum-Schindler in the area between Abasabad and Sabzevar as well as the area next to Miandasht where he described several traces of old working at the Gurchani-coppermines.There he observed over 300 old shafts as traces of ancient mining. He further described the mines of Zargan where he noticed deposits of cupriferous ores like chalcopyrite and bornite. On his journey he also recognized vast slag fields in this area.[171] Besides the documentations of mineral deposits there are further descriptions from late 19th century observations of slag fields in eastern Iran which might derive from ancient activities and contained minimal copper remains which were extracted, collected and resold.[172] Traces of ancient exploitation of copper mines were identified around Bashkan to the South of Kuhbanan by Houtum-Schindler and Stahl.[173] Hakemi also remarks that there is a high possibility that the copper and its production residues which were found at Shahdad might derive from the adjacent rich mineral deposits.[174]

A total of 119 mineral mines with copper deposits were collated that according to several major publications on this subject show traces of ancient activities.

In the following section all mineral deposits with cupriferous occurrences will be presented and described in order of a subdivision by the modern political provinces of the Islamic Republic of Iran. A further classification of the sites is based on the published descriptions in sense the of observations of traces of ancient mining activities, sites with ancient slagfields and sites which contain traces of both metallurgical activities.

170 Tietze 1879: 637.
171 Houtum-Schindler 1881: 174.
172 Tietze 1879: 638f.
173 Houtum-Schindler 1881: 146; Stahl 1896: 33; Stahl 1911: 36f.
174 Hakemi 1973c : 66.

3.2.1. Khorasan

3.2.1.1. Ancient mining evidence:

Kalat Ahani (001):

Traces of old workings were observed at the site which lies about 30 km southeast of Gonabad.[175] Galena, pyrite and chalcopyrite were idenitfied here.[176]

Kakh (002):

The site of Kakh which is also known as Kakh-eh Alimansour is situated about 30 km to the South of Gonabad and also shows traces of old mining activities.[177]

Shekasteh Sabz (004):

The site of Shekashteh sabz (engl. Broken green) lies at a distance of 11 km to the North-Northwest of Khur. Malachite and scattered traces of Cu-carbonates[178] were identified as well as remains of ancient working.[179]

Hous Rayeez (005):

The old workings at Hous Rayeez are situated 7,5 km to the north of the Seh Changi mining area (014).[180] The mineralization testifies to occurrences of malachite, chalcocite, sphalerite and galena (see Figure 6).[181]

Laftabad (006):

The site shows traces of old workings and is situated in the East of Birjand.[182] Chalcopyrite and malachite are attested for at this site.[183]

175 Bazin & Hübner 1969: 98;
176 http://www.gsi.ir/Images/WEBMINE/cu/cu.htm
177 Bazin & Hübner 1969: 98.
178 http://www.ngdir.ir/MiningInfo/CopperMIO.asp?PDataType=
179 Bazin & Hübner 1969: 108ff.
180 Bazin & Hübner 1969: 103.
181 Abasnejad 1994: 147.39.
182 Bazin & Hübner 1969: 98; Abasnejad 1994: 146.33.
183 Ladame 1945: 248; http://www.gsi.ir/Images/WEBMINE/cu/cu.htm

Darmiyan (007):

Darmiyan also shows traces of old workings and is located next to Laftabad (006).[184] The mineralizations are also of similar quality.

Deh Salm (010):

The mining site of Deh Salm is located on the Northern part of the Dasht-eh Lut in the vicinity of the eponymous village and at a distance of approximately 50 km southwest of Nehbandan. Abasnejad describes old workings with occurrences of lead (Galena, wulfenite, cerrusite), zinc and tin. As present Cu-minerals he notes malachite, chalcopyrite and azurite. He also describes it as one of the possible sites where the Shahdadians obtained some of the metallic raw materials. Furthermore he describes the presence of pyrotechnical installations and slag heaps which are situated next to the cupriferous mines.[185]

3.2.1.2. Ancient (?) slagfields:

Ghaleha/ Gholehah (009):

The mining site of Ghaleha/ Gholehah is situated on an altitude of 1220 m.a.s.l. on the northeastern fringe of the Dasht-eh Lut and at a distance of ca. 200 km to the South-southeast of Birjand. The mineralized zone contains hematite, malachite and chalcopyrite. Besides a shaft of 20 m length a dyke was identified at the site. At a distance of 7 km to the West of Ghaleha/ Gholehah old slagfields were observed.[186]

3.2.1.3. Positive evidence of ancient mining and slagfields:

Mirkhash (003):

The site lies 25 km northwest of Khur and shows positive evidence for malachite[187] which was mined in open cast pits.[188]

184 Ladame 1945: 248; Bazin & Hübner 1969: 98; Abasnejad 1994: 146.32.
185 Abasnejad 1994: 113, 127f.; Abasnejad 2003: 68f., tab.1
186 Bazin & Hübner 1969: 98; vast slagfields are situated 7 km to the West of it;
187 http://www.gsi.ir/Images/WEBMINE/cu/cu.htm http://www.ngdir.ir/MiningInfo/CopperMIO.asp?PDataType=
188 Bazin & Hübner 1969: 108ff.

Ghaleh Zari (008):

The mining area of Ghaleh Zari (engl. Golden fort) is located at an altitude of 1450 m.a.s.l. and a distance of 153 km to the South of Birjand and 19 km to the South of Basiran.[189] The site was visited in 1853 by Goebel, the Geologist of Khanikof´s first expedition through Persia, who for the first time identified the ancient mining traces which were described later by N. de Khanikof.[190] E.Tietze also mentions the site to have been visited during his travels in the 19th Christian century.[191] Furthermore, in 1899 P.M. Sykes visited the site and describes in one of his reports early traces of copper production which are evidenced by shaft galleries and remains of copper smelting near the site. He also underlines that the smelting process seems to be of “primitive” technique by extracting the copper mainly from slags. This observation made him hypothesize about traces of pre-islamic mining activities.[192] In April of 1933 when G. Stratil-Sauer and his wife visited the site not one of Sykes´ observed mining traces from 35 years earlier were mentioned.[193] Further, U.W. Hallier recorded already known architectural remains of fortificational character in the vicinity which he identified as of pre-islamic origin.[194]According to Bazin and Hübner the old working areas were distributed at a length of 2 km and covered with dumps and slags.[195] Abasnejad also hypothesed that the ancient mining sites might be a possible source for the protohistoric metallurgical activities at Shahdad.[196] There, Cu-mineral occurrences of chalcopyrite, chalcocite, malachite, azurite, and chrysocolla were detected as well as Fe-bearing minerals like limonite, specularite, hematite and pyrite.[197] The ancient mining traces were observed at open cast pits with depths of up to 10m and horizontally dug shafts.[198] Next to some of these sites no further fragments of pottery vessels were recorded.[199] Noteworthy agglomerations of metallurgical slags were also detected on the foothills next to the dwelling zone. It was proposed that due to major architectural evidence from protohistoric to Sasanian periods in the adjacent regions of Sistan that these metallurgical residues might be seen as contemporaneous. Therefore it is hypothesized that this might have been a raw material supplier for the site of Shahr-eh sukhteh during

189 Ladame 1945: 248; Walther & Kürsten 1958: 108; Bazin & Hübner 1969: 103ff.; Berthoud et al. 1976: 25ff.
190 Khanikof 1864: 169." ...des chambres des mine, des galéries spacieuses des dimensions colossales taillées dans le roc...."
191 Tietze 1879: 639, ("Kaleizeiri").
192 Sykes 1902: 155f. He refers to this site as "Kala Zarri" and "Kala Gabr".
193 Stratil-Sauer 1956: 130ff, Skizze no.19.
194 Hallier 1973.
195 Bazin & Hübner 1969: 104f., fig.47.
196 Abasnejad 1994: 113, 126..
197 Walther & Kürsten 1958: 108. http://www.gsi.ir/Images/WEBMINE/cu/cu.htm
198 Bazin & Hübner 1969: 106, fig. 47;
199 Berthoud et al. 1976: pl. VII.

the Early Bronze Age.[200]

Zanghalou (011):

The site of Zanghalou is situated 14 km to the Northeast of Dahaneh Siyah and 100 km northwest of Gonabad. There ancient activities are evidenced by an old open cast pit with ore mineralizations of cuprite, chrysocolla, malachite and chalcocite.[201]

Kal Firouzeh (012):

Kal Firouzeh is situated on the Shotori range at a distance of 45 km to the Northwest of Deyhouk. The mining site has evidence of traces of open cast mining.[202] Mineralizations of Mo, Zn, Co were detected as well as malachite.[203]

Shurab (013):

The copper deposits of Shurab are situated in the vicinity of the Pb-Zn-mine and 60 km southeast of Ferdous.[204] Chalcopyrite, chalcocite, malachite, bornite and native copper were detected at this site.[205]

Seh Changi (014):

The site of Seh Changi lies at 850 m.a.s.l. and is located 230 km southeast of Tabas. Several traces of old workings were observed in the area.[206] The mineralization contains pyrite, arsenopyrite, galena, chalcopyrite, tetrahydrite, bornite, cerrusite, malachite, azurite, chrysocolla, chalcocite, diaboleite, wulfenite, limonite, iranite and covellite.[207] Wertime also notes that remnants of different sized furnaces were observed at the site and in the vicinity. Further he mentions that these examples were possibly also used to smelt copper (see Figure 6).[208]

200 Berthoud et al. 1976: 26, pl.no.13.
201 Bazin & Hübner 1969: 95.
202 Bazin & Hübner 1969: 108ff.
203 http://www.gsi.ir/Images/WEBMINE/cu/cu.htm
204 Bazin & Hübner 1969: 98.
205 http://www.gsi.ir/Images/WEBMINE/cu/cu.htm
206 Bazin & Hübner 1969: 99ff.
207 Abasnejad 1994: 147.38.
208 Wertime 1968: 933.

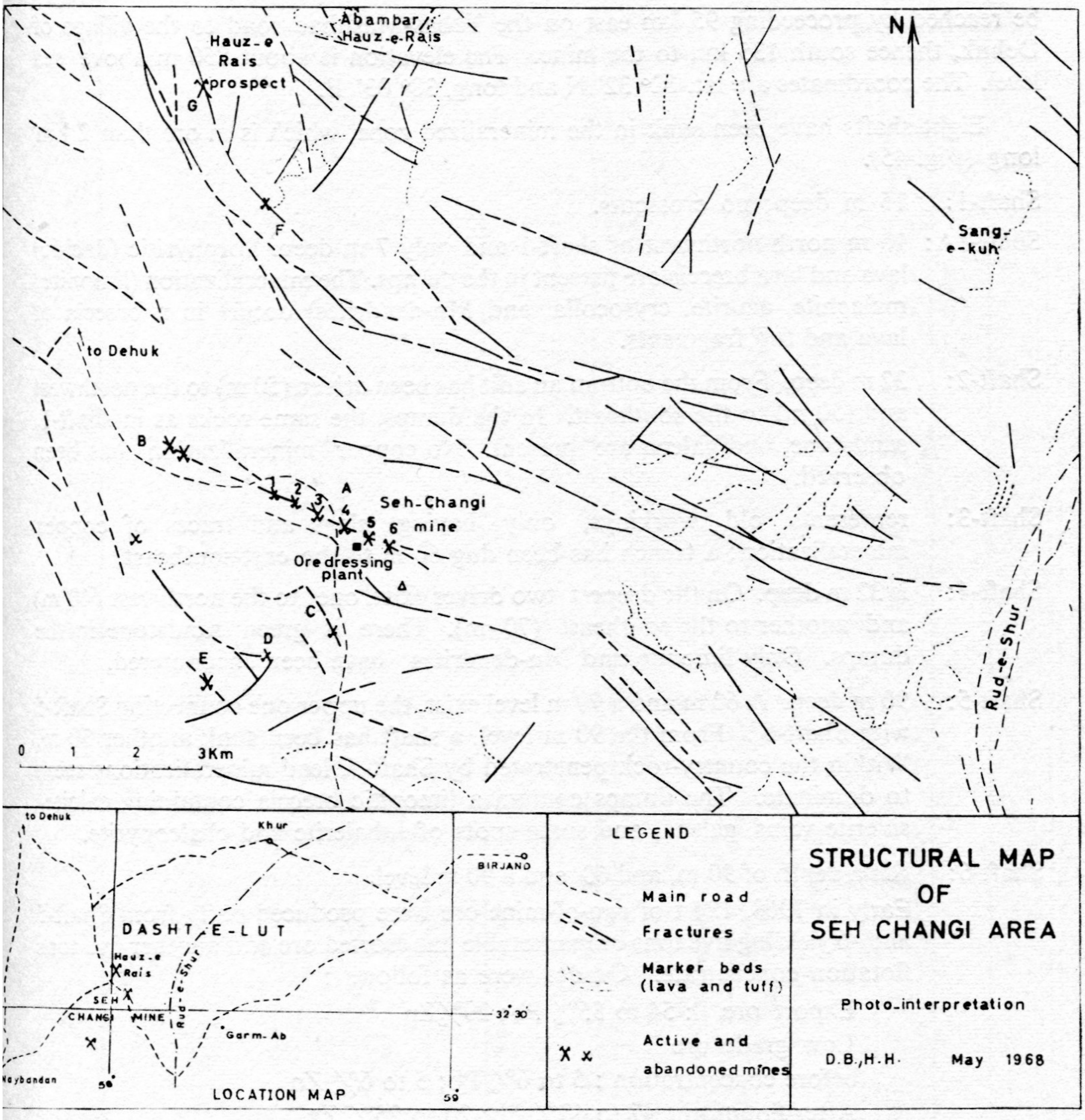


Figure 6: Overview of the Seh Changi mining area (014) with the localisation of Hous Rayeez (005) (Bazin & Hübner 1969: fig.44).

Chah Kalap (015):

The site of Chah Kalap, which is also known as “Chah Kalapi”, is located approximately 70 km south of Birjand. Traces of ancient mining activities were detected there.[209] The main mineralization are malachite and chalcopyrite.[210]

Ma´dan Roughani (016):

Ma´dan Roughani is located ca. 100 km to the West of Nehbandan and ca. 150 km southwest of Birjand.[211] Chalcopyrite and galena are known to be apparent at site.[212]

Shah Kuh (017):

The site is situated on the Northeastern fringes of the Dasht-eh Lut, some 20 km south of Nehbandan.[213] Due to its close vicinity to already known sites with evidence of Cu-mineralizations and old workings like Chah Rui (018), Deh Salm (010) and Madan Roughani (016) it seems plausible to add this site although there is no positive evidence published yet.[214]

Chah Rui (018):

The site (engl. Zinc well/ shaft) is located on the Northeastern fringes of the Dasht-eh Lut in the foothills of the Kuh-eh Chah Rui.[215] There are tin occurrences stated but without giving references.[216]

Godar Ghoureh Ahan (019):

The mine of Godar Ghoureh Ahan is situated at a distance of ca. 10Km to the North of Tabas, in the vicinity of Dahaneh-yeh Shirgasht.[217] Besides old workings indications of different mineralizations were identified.[218]

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209 Abasnejad 2003: 68, tab.1.
210 http://www.ngdir.ir/MiningInfo/CopperMIO.asp?PDataType=
211 Abasnejad 1994: 146.37.
212 Ladame 1945: 248; http://www.gsi.ir/Images/WEBMINE/cu/cu.htm
213 Mostofi 1973: Addendum I.
214 Shah Kuh belongs to the same mountain range as Chah Rui (018) and is situated in the northern part of it.
215 Mostofi 1973: Addendum I.
216 Hakemi 1997: 15.
217 Abasnejad 1994: 145.27.
218 http://www.gsi.ir/Images/WEBMINE/cu/cu.htm

3.2.2. Kerman

3.2.2.1. Ancient mining evidence:

Gardokulu (022):

The old mining area of Gardokulu is situated ca. 5 km to the South southeast of Baqoray village.[219] There, minerals like chalcopyrite, pyrite, chalcocite, malachite and covellite were identified.[220] (see Figure 9)

Kamadoran (023):

This site, which is also known as Sard-eh Ab, lies 4km to the West of Baqoray village[221] and shows mineralizations of chalcopyrite and malachite.[222] Traces of old working are evident at site.[223]

Tal Ma´dan (025):

Tal Ma´dan is located just to the North of Baqoray (021). Shaft and open cast pits were identified with mineral traces of pyrite, chalcocite, azurite and malachite.[224]

Kuh Panj (030):

The Kuh Panj mining district is situated 100 km West southwest of Kerman and lies also on the extension of the Band-eh Manzar. It is distributed over an vast area with elevation from 2600 to 3200 m.a.s.l.[225] Traces of old mining activities were identified and minerals like pyrite, chalcopyrite galena, sphalerite and bornite were detected (see Figure 7).[226]

Sar Cheshmeh (032):

The important modern mining area of Sar Cheshmeh which is locally also known as Band-eh Manzar lies on an altitude between 2500 and 2700 m.a.s.l.[227] Traces of old workings are noted by Abasnejad without further descritptions. Pyrite, chalcopyrite, galena,

219 Bazin & Hübner 1969: 147ff.
220 http://www.gsi.ir/Images/WEBMINE/cu/cu.htm
221 Bazin & Hübner 1969: 149, tab.11.
222 http://www.ngdir.ir/MiningInfo/CopperMIO.asp?PDataType=
223 Abasnejad 1994: 156.98.
224 Abasnejad 1994: 155.90.
225 Bazin & Hübner 1969: 132f.
226 Abasnejad 1994: 152.76.
227 Bazin & Hübner 1969: 122ff.

sphalerite, chalcocite, bornite, covellite, malachite, native copper, molybdenite, azurite, cuprite, chrysocolla limonite and turquoise are the most promintent identified minerals.[228] Hakemi also empahsizes the importance of this area for prehistoric metallurgy (see Fig.7).[229]

Deh Siyahan (033):
The mining site is situated 12 km to the East northeast of the village of Sar Cheshmeh.[230] Old working traces were identified at shafts where also traces of malachite, chalcopyrite and pyrite were detected (see Figure 7).[231]

Khanouk (035):
The ancient mining area is situated in an area, 60 km to the North of Kerman[232] which were already known to earlier visitors.[233] Primarily Cu-carbonates were detected.[234] Traces of mining activities were also observed at site.[235]

Chah Mesi (036):
The mine of Chah Mesi (engl. Copper well) is located 32 km north of Shahr-eh Babak and 2.5 km south-southwest to Lachar (051).[236] The mineral content of the mine shows pyrite, chalcopyrite and galena as the major minerals as well as sphalerite, enargite, lazulite, marcasite, chalcocite, covellite, bornite, hematite, native gold, limonite and azurite.[237] Old working traces were observed by Abasnejad without further description (see Figure 11).[238]

228 Abasnejad 1994: 151.71.
229 Hakemi 1997: 15.
230 Bazin & Hübner 1969: 129f.
231 Abasnejad 1994: 152.73.
232 Bazin & Hübner 1969: 112.
233 Houtum-Schindler 1881: 146.
234 http://www.gsi.ir/Images/WEBMINE/cu/cu.htm
235 Walther & Kürsten 1958: 113f.; Abasnejad 1994: 147.40.
236 Bazin & Hübner 1969: 141.
237 http://www.ngdir.ir/MiningInfo/CopperMIO.asp?PDataType=
238 Abasnejad 2003: 68, tab.1.

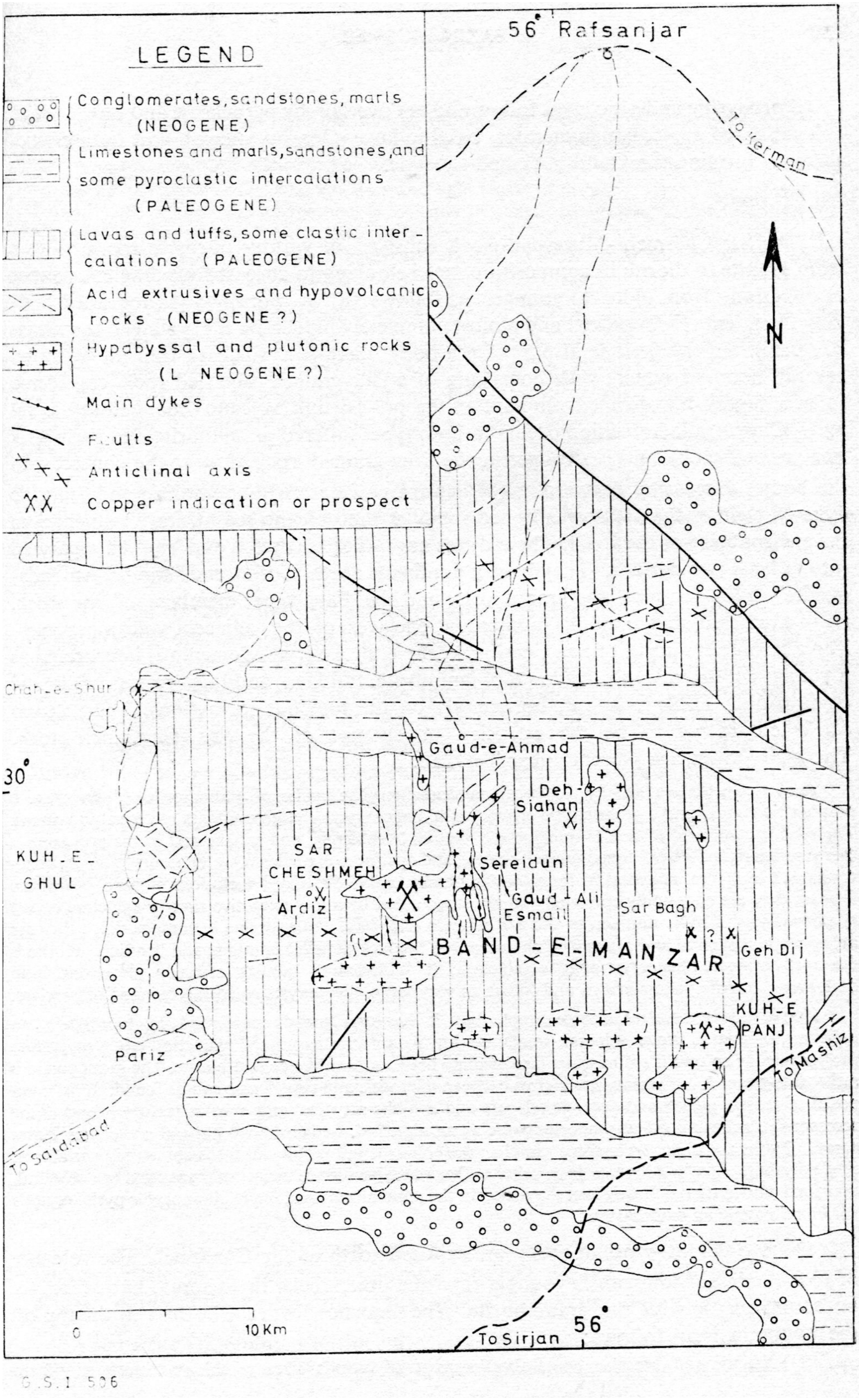

Figure 7: Geological map of the Sar Cheshmeh mining area (032) with the localisations of Kuh Panj (030), Deh Siyahan (033), Geh Dij (059) and Sar Bagh (056) (Bazin & Hübner 1969: fig. 55).

Darbidou (037):

The prospected area lies on the Southern slopes of the Kuh-eh Sara at a distance of 48 km south-southwest of Anar and 12 km to the Southeast of Javazm.[239] The attested mineralization shows bornite, galena, chalcopyrite and malachite.[240]

3.2.2.2. Ancient (?) slagfields:

Zaqdar (020):

This site is situated at a distance of 18 km to the Northeast of Doulatabdad and in the vicinity of Tappeh Yahya. Traces of small scale mining activities were observed at small shafts. But the more interesting observations are the vast slagfields which bare no relation to the minor mining evidence. In addition to the fact that the vicinity of Zaqdar is densely covered with trees and bushes it can be assumed that the major activities that were conducted at this site were concentrating in extractive exothermic activities such as smelting and that therefore the Copper ores must have been imported to the site.[241]

Avruz Morqi (024):

At the site of Avruz Morghi which lies at a distance of 5 km west northwest of Baqoray village[242] traces of metallurgical activities were observed without further descriptions. At the site also further unspecified Cu-carbonates and chalcopyrite were identified (see Figure 9).[243]

Chahar Gonbad (029):

The copper mine area of Chahar Gonbad is situated to the Northwest of the city of Baft at a distance of ca. 25 km and an altitude of 2300 m.a.s.l. While Bazin & Hübner detected no traces of ancient mining, Berthoud et al. observed scratchings on the surface and further marks which made them hypothesize to see these traces as of ancient origin.[244] According to several analytical investigations native copper, chalcopyrite, malachite, azurite, chalcocite, covellite, pyrite, limonite, hematite, galena, sphalerite, marcasite and

239 Bazin & Hübner 1969: 142.
240 Abasnejad 1994: 151.67.
241 Abasnejad 1994: 116.
242 Bazin & Hübner 1969: 149, tab.11.
243 Abasnejad 1994: 156.99.
244 Bazin & Hübner 1969: 134ff.; Berthoud et al 1975: 25f.

tetrahydrite were identified.[245] There is an explicit note about a site named Takht-eh Baneh which is located at an average altitude of 2200 m.a.s.l. and a distance of ca. 3 km to the East of Chahar Gonbad. There minerals like chalcopyrite, malachite, bornite and native copper and some old working traces were detected. Furthermore, residues of pyrotechnological activities like ash, charcoal and metallurgical slags were recorded at the neighbouring site of Kolahak-eh Ahani which might have been the smelting zone of the ancient mine (see Figure 8).[246]

245 http://www.gsi.ir/Images/WEBMINE/cu/cu.htm; http://www.ngdir.ir/MiningInfo/CopperMIO.asp?PDataType=
246 Berthoud et al. 1975: 27f.

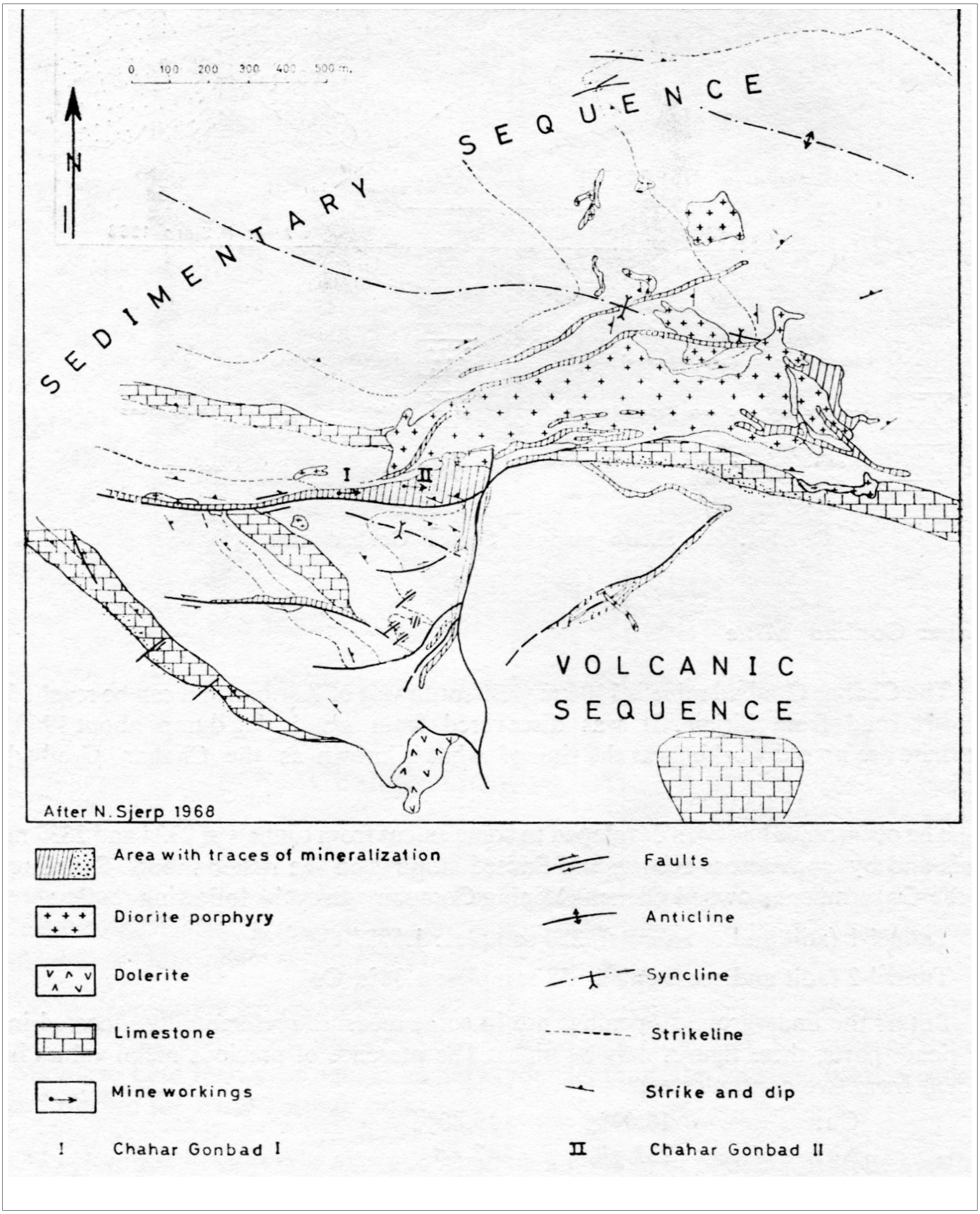

Figure 8: Localisation map of the Chahar Gonbad mines (029) (Bazin & Hübner 1969: fig.62).

Zangalou (031):

This site is not to be confused with Zanghalou (011) which lies in the northern province of Khorasan Razavi. Zangalou is situated next to the road between Rafsanjan and the Sar

Cheshmeh mining district. Several traces of old workings were observed at several pits of approx. 2 m depth and 4 m length as well as slagfields in the adjacent vicinity which evidenced pyrotechnological activities. According to the observation of A. Sarfaraz there were also pottery fragments recorded which show great similarity to finds from Tall-eh Eblis and also a large occurrence of shrubs called “Kolah-eh Ghazi”. This type of shrub possess a high content of resin and a dense wood structure and is described as perfectly suitable for pyrotechnology.[247]

3.2.2.3. Positive evidence of ancient mining and slagfields:

Baqoray (021):

Baqoray / Bagrai is located 30km to the Northwest of the site of Tappeh Yahya and 1 km southwest of the Baqoray village.[248] At this site traces of ancient metallurgical and mining activities were observed and further mineral occurrences of chalcopyrite, malachite and chalcocite were identified (see Figure 9).[249]

Darbini (026):

The site lies at a distance of ca. 30 km northwest to the old mining site of Baqoray. Traces of old workings and further metallurgical actvities were identified.[250] Chalcocite and Cu-carbonates are evident at the site (see Figure 13).[251]

Allahabad (027):

The mine of Allahabad is located in the vicinity of the mining site of Ghale Narp, ca. 30 km to the Southeast of Tall-eh Eblis.[252] The site bears several traces of mining and further metallurgical activies.[253] The mineral deposits show traces of chalcopyrite which appears often in small concentrations as well as pyrite and malachite in great fibres which were identified inside of quartz druses in the presence of limonite (see Figures 10 and 13).[254]

247 Abasnejad 1994: 115.
248 Bazin & Hübner 1969: 149, tab.11.
249 Abasnnejad 1994: 155.96.
250 Abasnejad 2003: 68, tab.1.
251 Abasnejad 1994: 155.92.
252 Bazin & Hübner 1969: 145.
253 Abasnejad 2003: 68, tab.1.
254 Berthoud et al. 1976: 20f.

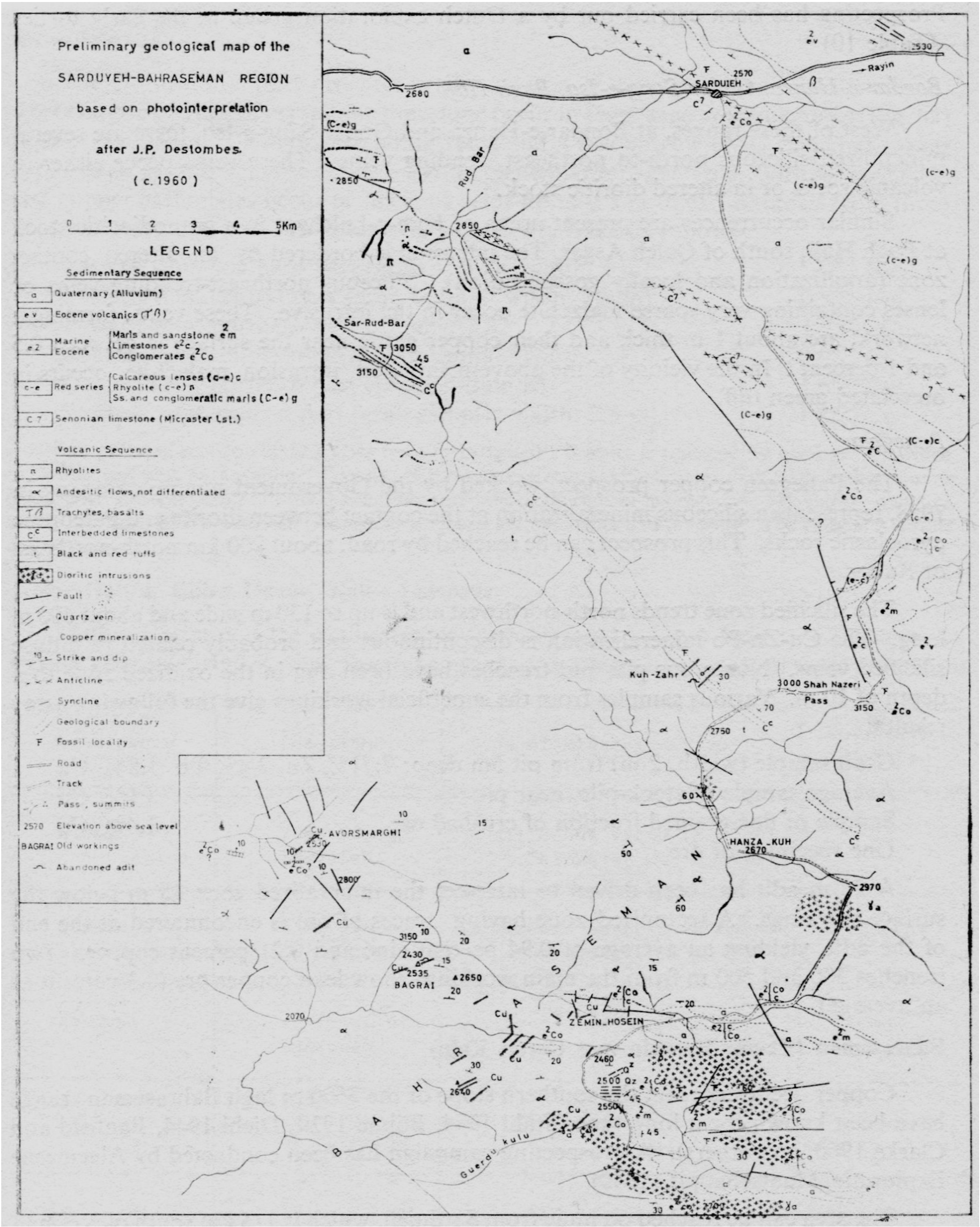

Figure 9: Geological map of the Sarduyeh district with the sites of Gardokulu (022), Avours Morqi (024) and Baqoray (021) here: Bagrai (Bazin & Hübner 1969: fig.69).

Bolboly (028):

This site is located in the Chahar Gonbad area and also shows remarkable mineralizations.[255] Chalcopyrite, malachite, azurite, magnetite, hematite, martite are named as the major occurrences.[256] Another site located in this vicinity is called Takht.[257]

Amirabad (034):[258],

Amirabad lies ca. 30 km west of Kerman and 20 km from Tall-eh Eblis.[259] Traces of ancient mining and remains of ancient heaps were reported which are located next to Jevezin and Kurun. There are also mentions of large slag fields on the way from Rafsanjan to Sirjan.[260] Further evidence of old activities are reported for the area between Kuhbanan and Ravar, explicitely Kuh Nasreh, and the Badamou-region.[261]

Dashtou (038):

Dashtou lies approximately 100 km north of Minab.[262] Remains of old workings were observed as well as mineralizazions of pyrite, chalcopyrite, azurite and malachite.[263]

Bondar Hanza (039):

The mining site is located to the West of the Kuh-he Hezar, Kuh-eh Lahezar conglomerates where several Cu-occurrences were detected.[264] The identified minerals are chalcopyrite, malachite, pyrite and magnetite.[265]

Ghaleh Asgar (040):

The site of Ghaleh Asgar lies at a distance of ca. 35 km to the Northeast of Baft. Mineral occurrences like pyrite, chalcopyrite and Cu-carbonates like malachite are detected.[266] Old working traces were noted (see Figure 10).[267]

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255 Bazin & Hübner 1969: 137f.
256 http://www.gsi.ir/Images/WEBMINE/cu/cu.htm; http://www.ngdir.ir/MiningInfo/CopperMIO.asp?PDataType=
257 Bazin & Hübner 1969: 138.
258 Bazin & Hübner 1969: 133.
259 Abasnejad 1994: 153.80.
260 Walther & Kürsten 1958: 110.
261 Walther & Kürsten 1958: 113f.
262 Ladame 1945: 248.
263 Abasnejad 1994: 158.111.
264 Bazin & Hübner 1969: 147.
265 http://www.gsi.ir/Images/WEBMINE/cu/cu.htm; http://www.ngdir.ir/MiningInfo/CopperMIO.asp?PDataType=
266 Abasnejad 1994: 154.87; http://www.ngdir.ir/MiningInfo/CopperMIO.asp?PDataType=
267 Abasnejad 2003: 68, tab.1.

Panegeen (041):

This site is also situated in the Rayen area in close vicinity to Ghaleh Asgar (040) and shows Cu-Pb-Zn- mineralizations.[268] Pyrite, galena, sphalerite, arsenopyrite, malachite, azurite and chalcopyrite were identified.[269]

Ghanat Marvan (042):

Ghanat Marvan lies in the Baft region at a distance of 25 km northeast of Baft. Instances of old mining activities were observed where pyrite, galena, chalcopyrite and sphalerite were detected.[270]

Sang Isk (043):

The mining site is located in the vicinity of Panegeen (041) in the area of Rayen.[271] Traces of Cu-carbonates were identified at the site.[272]

Dozarktar (044):

The mining site of Dozarktar is situated approximately 20km to the East of the mining sites of Allahabad (027) and Ghale Narp (060) on the Northern slopes of the Kuh-eh Ahurak. At the site different Cu-minerals were identified like chalcopyrite, sphalerite, bornite, covellite and malachite. There frequent occurences of chrysocolla[273] and chalcocite[274] are described, but also other metallic minerals like pyrite were detected.[275] There are no documented traces concerning ancient mining activities but Walther and Kürsten mention small slag heaps which they observed at a neighbouring site called Sarzeh which also shows mineralisations comparable to Dozarktar (see Figures 10 and 13).[276]

Kuh Kat o Kav (045):

5 km to the Southeast of Kerman the site of Kuh Kat o Kav is situated and shows traces of old activities without further descriptions.[277]

268 Bazin & Hübner 1969: 147.
269 Abasnejad 1994: 155.89.
270 Abasnejad 1994: 155.88.
271 Bazin & Hübner 1969: 147.
272 Abasnejad 1994: 155.91,
273 Berthoud et al. 1976: 21.
274 Walther & Kürsten 1958: 110f
275 Bazin & Hübner 1969: 146;
276 Walther & Kürsten 1958: 111.
277 Abasnejad 1994: 153.82.

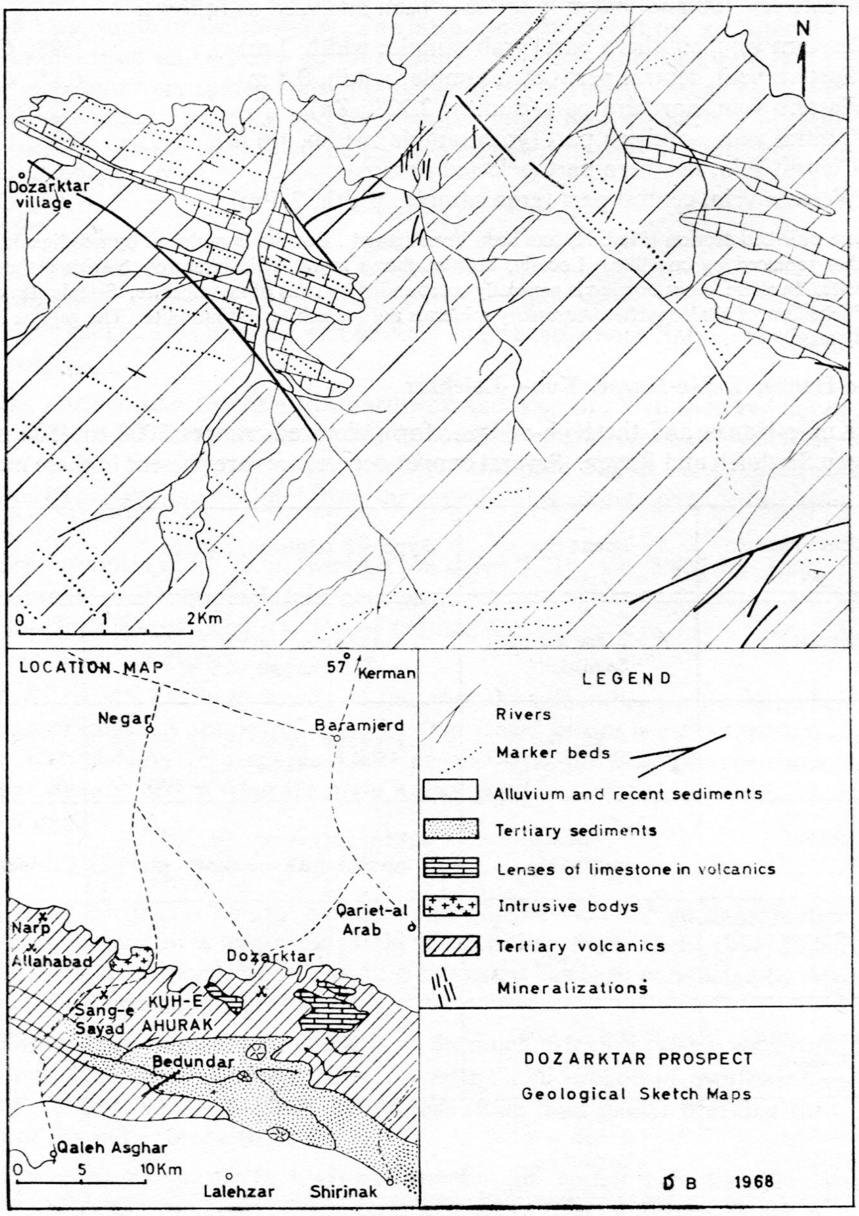

Figure 10: Location map of the Dozarktar prospect (044) with the localisations of Ghaleh Narp (060), Allahabad (027), Ghaleh Asgar (040), Sang-eh Sayat (119) (Bazin & Hübner 1969: fig.68).

Badamou (046):

Badamou is situated at a distance of 30km to the North of Kerman.[278] Malachite[279] as well as limonite, chalcopyrite and specularite were identified at site.[280]

278 Bazin & Hübner 1969: 112.
279 Walther & Kürsten 1958: 113.
280 Abasnejad 1994: 147.41.

Cheshmeh Sefid (047):

In the vicinity of Chah-eh Allah, to the Northeast of Rafsanjan the mining site of Cheshmeh sefid is located and shows mineralizations of chalcopyrite, chalcocite and bornite which are similar to the observations at Chari (055).[281]

Chah Shur (048):

The mineral deposit is located 25 km northwest of Sar Cheshmeh and 3 km to the North of the village of Hosseinabad.[282] There, malachite and other not further specified Cu-carbonates were identified.[283]

Palangi (049):

This prospected site is located 35 km to the West southwest of Rafsanjan.[284] No traces of old workings are known so far. But mineraliziations of malachite, chalcopyrite, chrysocolla, azurite, chalcocite, pyrite, covellite, tenorite and bornite were identified.[285]

Tezerg (050):

The Kuh-eh Tezerg prospect lies 33 km to the south-southwest of Anar and 4.5 km east of the eponymous village. Traces of old workings are distributed to the East of the site.[286] Limonite and different not further specified Cu-mineralizations were detected.[287]

Lachar (051):

The old mining site of Lachar lies 37 km north of Shahr-eh Babak and gives evidence of old activities by trenches and shafts.[288] The mineral occurrence shows malachite, chalcopyrite, pyrite, azurite, christoballite, chalcocite and covellite (see Figure 11).[289]

281 Bazin & Hübner 1969: 112.
282 Bazin & Hübner 1969: 132.
283 Abasnejad 1994: 151. 69.
284 Bazin & Hübner 1969: 138f.
285 Abasnejad 1994: 151.68.
286 Bazin & Hübner 1969: 142.
287 Abasnejad 1994: 150.63.
288 Bazin & Hübner 1969: 139f.
289 http://www.gsi.ir/Images/WEBMINE/cu/cu.htm

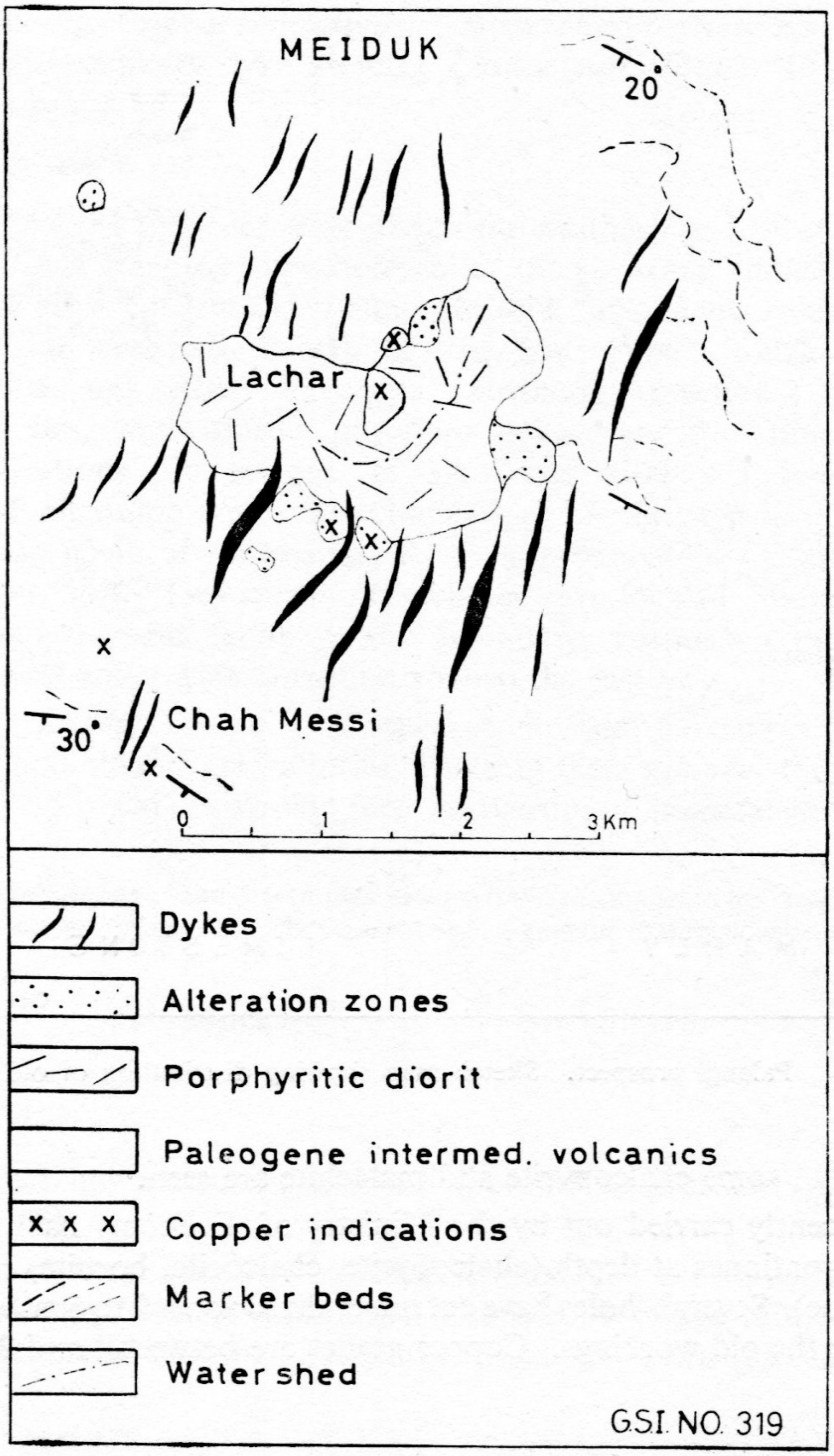

Figure 11: Geological map Lachar (051) and Chah Mesi (036) (Bazin & Hübner 1969: fig.64).

Adibagh (052):

The site of Adibagh lies in the vicinity of Shahr-eh Babak. Traces of old workings were not observed so far, but malachite was identified. Besides this, turquoise was mined at this site.[290]

Abdar (053):

This copper occurrence is located 8 km west southwest of Javazm and 1 km to the North of the eponym village.[291] There, Cu-minerals like malachite, azurite and chalcopyrite were identified (see Figure 12).[292]

Nahrou (054):

Nahrou lies 60 km to the Southwest of Anar and 5 km west of Khabr.[293] It also shows almost identical mineralizations to the site at Kuh-eh Tezerg (050).[294]

Chari (055):

The site of Chari is situated in close vicinity to Cheshmeh Sefid (047) and shows a mineralization of chalcopyrite.[295]

Sar Bagh (056):

The mining place is located to the North of Kuh panj (030) and to the South of Geh Dij (059) at a distance of ca. 30 km west of Tall-eh Eblis.[296] The evidenced mineralization contains occurrences of magnetite, hematite, martite, pyrite, covellite, sphalerite and chalcopyrite (see Figure 7).[297]

God Kolvari (057):

The mining site of God Kolvari lies on an elevation of 2300 m.a.s.l. and 60 km to the north-northwest of Shahr-eh Babak.[298] Malachite, azurite, chrysocolla, limonite and specularite are the identified minerals at site. [299]

290 Bazin & Hübner 1969: 142.
291 Bazin & Hübner 1969:142f.
292 Abasnejad 1994: 150.60; http://www.ngdir.ir/MiningInfo/CopperMIO.asp?PDataType=
293 Bazin & Hübner 1969: 142.
294 Abasnejad 1994: 150.59.
295 Huckriede et al. 1962: 146; Bazin & Hübner 1969: 112.
296 Bazin & Hübner 1969: 133.
297 http://www.gsi.ir/Images/WEBMINE/cu/cu.htm
298 Bazin & Hübner 1969: 142f.
299 Abasnejad 1994: 150.61.

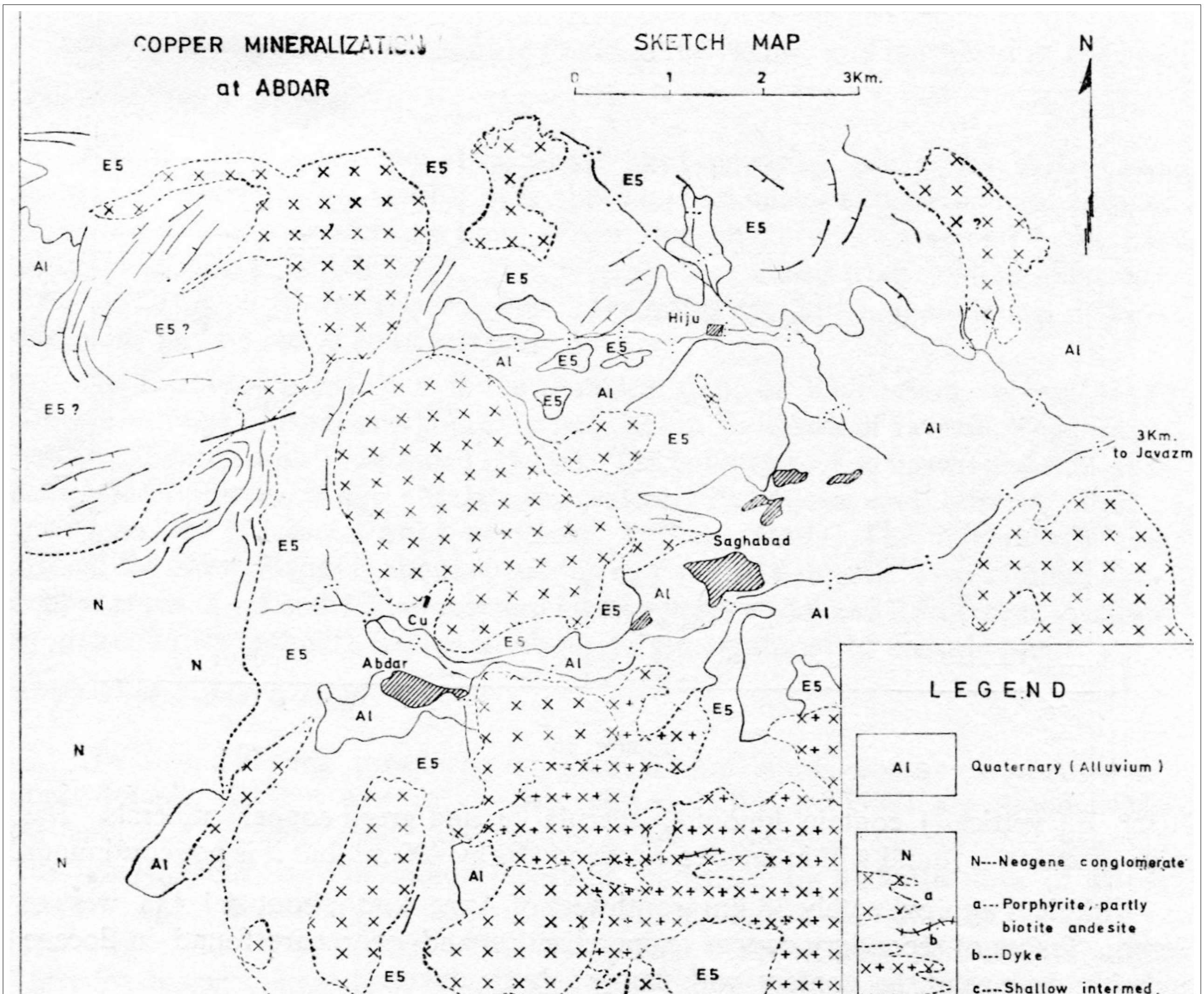

Figure 12: Location map of the Abdar area (053) (Bazin & Hübner 1969: fig.67).

Tirkuh (058):

Tirkuh lies ca. 38 km to the Southwest of Javazm and 10 km west of Kuh-eh Tezerg mine. No traces of old workings and only secondary Cu-mineralizations are known so far.[300]

Geh Dij (059):

This site is located to the North of Sar Bagh (056)[301] and shows indications of Cu-mineralizations (see Figure 7).[302]

Ghale Narp (060):

The mine of Ghale Narp is situated in the vicinity of the mining sites of Allahabad, Sang-eh Sayat and Dozarktar.[303] It lies at an altitude of 2190 m.a.s.l. on the northern slopes of the Kuh-eh Ahurak, one of the mountain ranges of the Kuh-eh Lalehzar. An eponymous village is located at a distance of 6km away. The Cu-minerals like chalcopyrite, chalcocite and malachite are imbedded in quartzous rock. The minerals were exploited by surface collections, small pits and galleries. Unfortunately there were no indications observed concerning the chronological position of these traces (see Figure 10).[304]

Sarsou (061):

The site of Sarsou is situated to the East of the village of Rameshk where also traces of old workings are postulated.[305] Malachite, azurite and chrysocolla were identified there.[306]

Tankashku (062):

Tankashku lies also to the East of Rameshk. According to Momenzadeh further traces of ancient activities were also observed at Kalle Gun, Konar Gabon and Kish Patiel.[307] The mining activities are abandoned but for the Western Gossan, where a mineralization of malachite, chrysocolla, geothite and limonite is attested to.[308]

300 Bazin & Hübner 1969: 142f.
301 Bazin & Hübner 1969: 133; It seems plausible to propose that the original name of this site is Rageh Dij (رگه دیج) as Abasnejad is mentioning. (Abasnejad 1994: 152.74.)
302 http://www.gsi.ir/Images/WEBMINE/cu/cu.htm
303 Bazin & Hübner 1969: 145, fig.68.
304 Berthoud et al. 1975: 20ff.
305 Momenzadeh et al. 2004: 12, Abb.3.75. (Sarsow)
306 http://www.ngdir.ir/MiningInfo/CopperMIO.asp?PDataType=
307 Momenzadeh et al. 2004: 12, Abb.3.76. (Tangashkun)
308 http://www.gsi.ir/Images/WEBMINE/cu/cu.htm; http://www.ngdir.ir/MiningInfo/CopperMIO.asp?PDataType=

Tall-eh Homi (118):

This mining site is located on the promontory of the Kuh-eh Cheheltan in the Bardsir-valley, approximately 11 km southwest of Torshab-eh payin and 3 km from the village of Bagh-eh Sergh. Primarily chalcocite but also djurleite were detected at the mining site as well as small amounts of malachite and azurite at the next located spoil heaps.[309] Other noteworthy finds are further agglomerations of slag and pyrotechnical installations which are situated 2 km downhill from the mining site in the valley. These metallurgical residues were observed by R. Pleiner while attending the excavations at Tall-eh Eblis (see Figure 13).[310]

Sang-eh Sayat (119):

The mining site is located in an altitude of 2500m.a.s.l. next to Ghaleh Narp (060) and Allahabad (027). Similar to their mineral occurences, here the Cu-minerals like cuprite, sphalerite,malachite, azurite and chalcocite are also imbedded in quartzous rock. Besides the different Cu-minerals galena was also detected. Some of the open cast pits are surrounded by spoil heaps. But there are also indications of surface collection. Further mining sites in the neighbouring area are Dozarktar and Darbini as well as Tall-eh Homi where also pyrotechnical installations were observed. To the Northeast on the foothills of the Kuh-eh Joupar there were also several residues of metallurgical activities visible. Therefore it seems plausible to hypothesize that the site of Sang-eh Sayat and other neighbouring sites might have been supplying Tall-eh Eblis with raw cupriferous materials (see Figures 10 and 13).[311]

309 Berthoud et al. 1976: 19f.; similar observation concerning malachite and azurite are attested at Tall-eh Eblis.
310 Pleiner 1966: 23; Pleiner 1967: 372ff.
311 Berthoud et al. 1975: 23f.

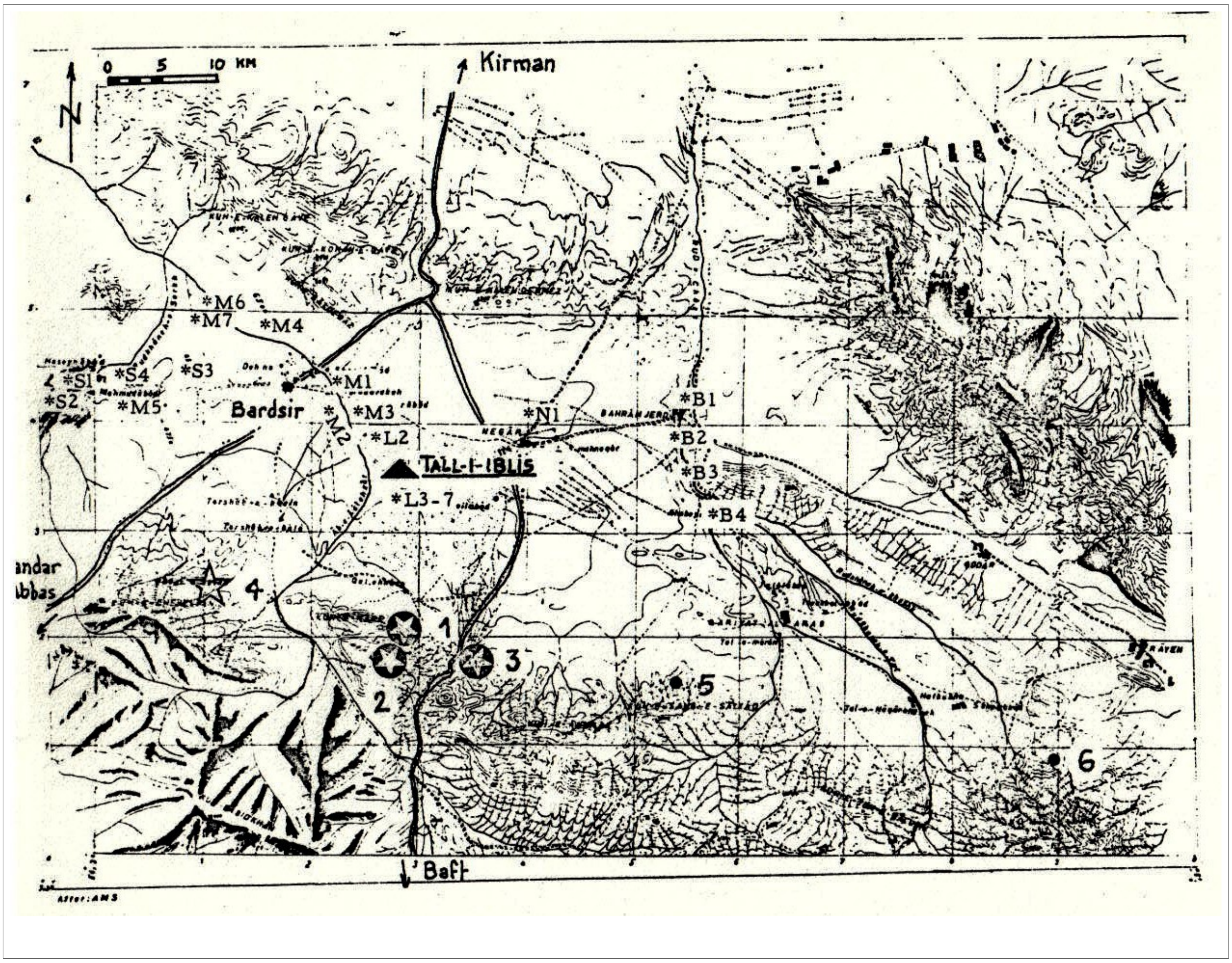

Figure 13: Localisiation map of the mining sites in the next vicinity of Tall-eh Eblis, 1: Ghaleh Narp (060), 2: Allahabad (027), 3: Sang-eh Sayat (119), 4: Tall-eh Homi (118), 5: Dozarktar (044), 6: Darbini (026) (Caldwell 1967:, 74, fig. 1).

3.2.3. Sistan and Baluchistan

3.2.3.1. Ancient mining evidence:

Siyah Jakoul (066):

This site lies 25 km to the East of Nosratabad. Here several traces of old workings were identified with mineralizations of malachite.[312]

312 Bazin & Hübner 1969: 156;

Haji Koshteh (067):

The old mining site of Haji Koshteh is situated 17 km to the North of Zahedan. There several traces of old activities were identified at Shafts and open cast pits.[313] On the surface mineralizations of malachite and azurite were detected.[314]

Sheykh Ahmad (069):

The site of Sheykh Ahmad shows similar working traces to Haji Koshteh (067) and lies 85 km south of Zahedan and 25 km east of Mirabad.[315]

Chah Doust (070):

Chah Doust lies at a distance of ca. 90 km south southwest of Zahedan and 15 km west southwest of Mirabad.[316] Inside the old workings malachite and chalcanthite were detected.[317]

3.2.3.2. Ancient (?) slagfields:

Geraqe (065):

The site is situated to the East of the Dasht-eh Lut on the route between Nosratabad and Zahedan. Traces of ancient activities were attested to due to the observed slag heaps which were also covered by undecorated monochrome pottery. Abasnejad also sees the site due to its metallurgical remains and proximity to Chehel Koureh (064) and Dargiyaban (068) as a possible production center for the procurement of the ancient metal workers at Shahr-eh sukhteh.[318]

Ishpash (072):

Ishpash is located in the vicinity of the Pirouzaki mine. Mining activities have not been traced but large numbers of metallurgical remains have.[319]

313 Bazin & Hübner 1969: 156.
314 Abasnejad 1994: 157.106
315 Bazin & Hübner 1969: 156.
316 Bazin & Hübner 1969: 156.
317 Abasnjead 1994: 158.108.
318 Abasnejad 2003: 68, tab.1, 70.
319 Abasnejad 1994: 156.101.

3.2.3.3. Positive evidence of ancient mining and slagfields:

Pourchangi (063):

The site lies to the East of the Dasht-eh Lut on the road between Nosratabad and Zahedan. Traces of ancient mining activities were recorded but without any further information about the kind of work and its chronological position.[320]

Chehel Koureh (064):

The old mining site of Chehel Koureh (engl.: 40/forty furnaces) is situated in a remote area on the Eastern boundaries of the Dasht-eh Lut. It lies at a distance of almost 45 km to the north-northeast of Nosratabad on the eastern slope of Kuh-eh Lonkeh.[321] Traces of ancient mining were observed at an altitude of 1300 m.a.s.l. where on an area of 100 to 300 m several open cast pits of different sizes were observed. In the foothills, located next to the tributary waters of the Masileh-yeh Nakhl-eh Ab, metallurgical remains are distributed over a large area and are evidence of extensive smelting activities.[322] This site belongs among the oldest known ancient metallurgical sites and was already mentioned by P.M. Sykes.[323] The identified mineralisations contain lead, zinc and Iron-bearing rocks as well as different cupriferous minerals like chalcocite, malachite, chalcopyrite, sphalerite, chalcosine, azurite and chrysocolla.[324] Berthoud also mentions occurrences of cuprite, atacamite and paratacamite.[325] According to Abasnejad this might be also a possible mining site where the inhabitants of Bronze Age Shahdad aquired their raw materials.[326] Fragments of different pottery vessels were observed next to the mining sites as well as in the context of the slag heaps (see Figure 14).[327]

Dargiyaban (068):

The ancient metallurgical site of Dargiyaban which is also known as “Dar Giyaban Hari” is located at a close distance to the Boarder of the Islamic Republic of Pakistan and ca. 25 km southeast of Zahedan.[328] Abasnejad notes traces of old workings and further

320 Abasnejad 2003: 68, tab.1.
321 Bazin & Hübner 1969: 153ff.; Berthoud et al. 1976: 22.
322 Bazin & Hübner 1969: 155; Ghorbani 2014: 66.
323 Sykes 1902: 158.
324 http://www.gsi.ir/Images/WEBMINE/cu/cu.htm
325 Berthoud et al. 1976: 23.
326 Abasnejad 1994: 113, 126f.
327 Berthoud et al. 1976: pl.VII.
328 Ghorbani 2014.

metallurgical activities without detailed descriptions.[329]

Pirouzaki (071):

The site is situated in the Bazman district at a distance of 50 km northwest of the site of Bampur. Old workings were observed where mineralization of pyrite, chalcopyrite and malachite were identified.[330]

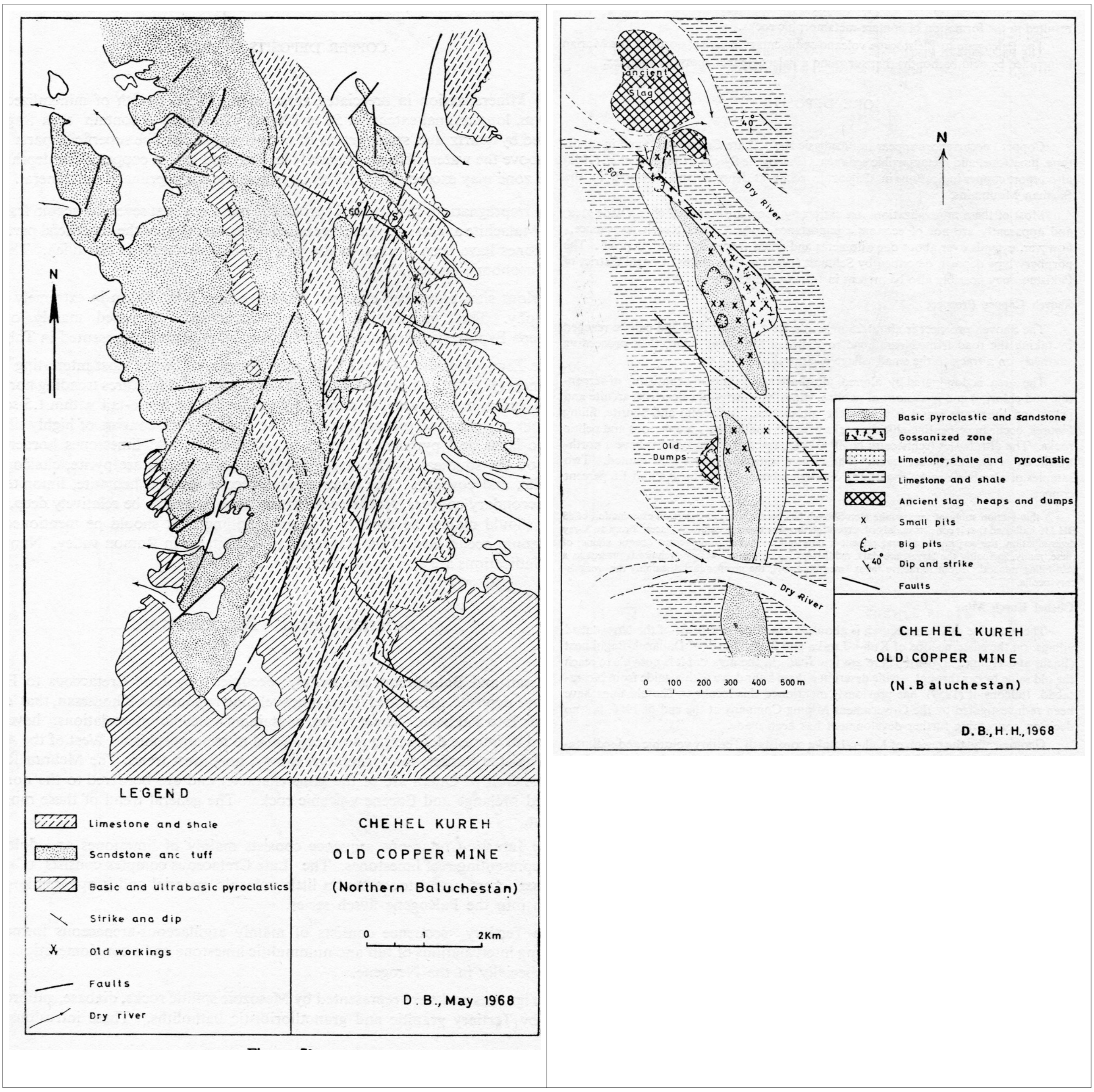

Figure 14: Geological maps of Chehel Kureh (064) (Bazin & Hübner 1969: fig.71, fig. 72).

329 Abasnejad 2003: 68, tab.1.
330 Abasnejad 1994: 156.100.

Meh Geli (073):

Meh Geli is of comparable evidence to Pirouzaki (071). It is situated west of Ishpash (072).[331]

Ghiravan (074):

Ghiravan is situated ca. 100 km south of Iranshahr. Old workings are evident and Cu-carbonates and Fe-oxides were detected there.[332]

Shouveh (075):

The prospected site at Shouveh is situated 25 km southeast of Nosratabad in the vicinity of the eponymous village.[333] It was possible to identify malachite and azurite in old workings.[334]

3.2.4. Hormozgan

3.2.4.1. Positive evidence of ancient mining and slagfields:

Sheykh Ali (076):

The ancient mines of Sheykh Ali are lying 25 km to the Southwest of the archaeological site of Tappeh Yahya and 3 km to the East of the eponymous village.[335] The site is located at an altitude of 1900 m.a.s.l.[336] Several oxidic and sulphidic Cu-ores as well as Cu-carbonates were identified like malachite, chalcanthite, chalcopyrite, chalcocite, chrysocolla, brochantite, bornite, covellite and further noteworthy minerals like sphalerite, limonite, melanterite, copiapite, magnesite, bruntite and specularite.[337] Traces of ancient mining activities and vast slagfields are evident but without further chronological descriptions.[338] The presence of pottery fragments comparable to Tappeh Yahya IVC[339] and the Sasanian period (Tappeh Yahya I) were observed next to the mining site.[340] The

331 Abasnejad 1994: 156.102.
332 Abasnejad 1994: 158.109.
333 Bazin & Hübner 1969: 153.
334 Abasnejad 1994: 157.105.
335 Abasnejad 1994: 115.
336 Berthoud et al. 1975: 30ff.
337 Bazin & Hübner 1969: 161f.; Berthoud et al. 1975: 30f.; Berthoud et al. 1976: 16f.; Rastad et al. 2002.
338 Walther & Kürsten 1958: 13f.
339 Momenzadeh 2003: 11.
340 Berthoud et al. 1975: 34; Berthoud et al. 1976: pl.IV-VI.

slagfields are accompanied by Arsacid-Sasanian to Early Islamic pottery.[341] There are further architectural remains described in the vicinity which seem to be of archaeological value (see Figure 15).[342]

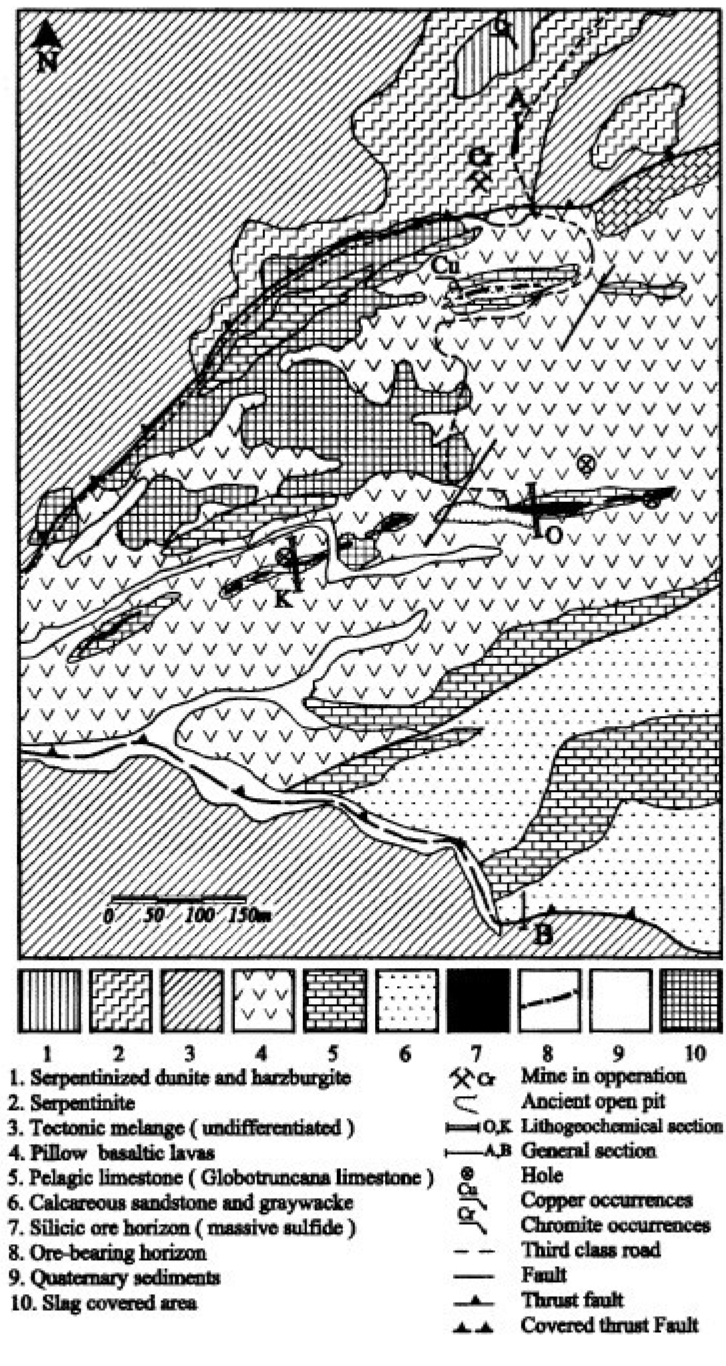

Figure 15: Geological map of the Sheykh Ali deposit (076) (Rastad et al. 2002: fig. 3).

341 Abasnejad 1994: 115.
342 Berthoud et al. 1975: 30f.; Berthoud et al. 1976: 17f.

3.2.5. Fars

3.2.5.1. Positive evidence of ancient mining and slagfields:

Rouniz (077):

The site of Rouniz which is also known as "Kohn-eh Mes" is located ca. 30 km to the Northwest of Neyriz. Malachite, azurite and traces of turquoise were detected there.[343] Traces of old workings are also evidenced at the site.[344]

Kuh Mes (078):

Kuh-eh Mes (engl. Copper mountain) is situated 25 km to the Northwest of Neyriz and less than 10 km to the North of Rouniz (077). According to its name which implies a connection to copper and its close vicinity to Rouniz which has evidence of ancient metallurgical activities it seems plausible to state that maybe this place was involved in the copper production process. Unfortunately no analytical or archaeological data has been presented to date.

3.2.6. Yazd

3.2.6.1. Ancient mining evidence:

Mehdiabad (080):

This mine is primarily known for his Pb-Zn-occurrences. It is located to the North of Chari (055). There, besides hematite, limonite, galena and cerussite[345] also anglesite, calamine, sphalerite, chalcopyrite and malachtite were identified.[346]

Behabad (081):

The mining site is situated next to the eponymous village at a distance of 180 km to the East of Yazd.[347] Copper occurrences were detected as well as traces of old workings like

343 Abasnejad 1994: 158.114.
344 Abasnejad 2003: 68, tab.1.
345 Bazin & Hübner 1969: 115.
346 http://www.gsi.ir/Images/WEBMINE/cu/cu.htm
347 Bazin & Hübner 1969: 112.

dumps where chrysocolla and limonite were identified (see Figure 16).[348]

Nerigan (082):[349]

The prospected site of Nerigan is situated at an altitude of 1700 m.a.s.l. and 3 km west of the eponym village, almost 100 km to the East of Yazd and 40 km northeast of Bafq.[350] Malachite and limonite were detected with easy accessibility.[351] Traces of old working are also evident (see Figure 16).[352]

Tang Chenar (083):

The mining site lies 1 km to the Southwest of the eponymous village and 50 km to the South of Yazd.[353] There, traces of open mining and galleries were observed and minerals like limonite and malachite were identified.[354]

Khoshoumi (085):[355]

Khoshoumi is located to the Southwest of Saghand and in close proximity to Nerigan (082).[356] Besides traces of old workings minerals like malachite, limonite and a few chalcopyrites were identified.[357] According to Huckriede, Khoshoumi and the neighbouring site of Nerigan are two copper deposits, which were probably exploited a "long time ago" (see Figure 16).[358]

Mazrae Mirha (086):

The mining site of Mazrae Mirha is located 20 km northwest of the site Mazrae Haji Hasan (092) and lies on an altitude of 1875 m.a.s.l.[359] There, inside an old shaft minerals like chalcopyrite, pyrite, malachite, limonite, hematite, azurite and chalcocite were identified (see Figure 16).[360]

348 Huckriede et al. 1962; http://www.gsi.ir/Images/WEBMINE/cu/cu.htm
349 There is also the transcription "Narigan" existing in several reports. Both versions are adequate.
350 Ladame 1945: 259; Bazin & Hübner 1969: 110ff.
351 Walther & Kürsten 1958: 113.
352 Abasnejad 2003: 68, tab.1.
353 Bazin & Hübner 1969: 114f.; Berthoud et al. 1976: 10f.
354 http://www.ngdir.ir/MiningInfo/CopperMIO.asp?PDataType=
355 There is also another transcription existing with "Koshami". Maybe we are dealing here with a proper transcription. But the only existing original written evidence in Farsi is "خشومی" / Khoshoumi.
356 Walther & Kürsten 1958: 113.
357 Bazin & Hübner 1969: 110ff.
358 Huckriede et al. 1962: 146.
359 Ladame 1945: 246.
360 Bazin & Hübner 1969: 114. http://www.gsi.ir/Images/WEBMINE/cu/cu.htm

Kheranagh (087):

The mining site of Kheranagh is located in the foothills of the Badamou-Range 3 km to the East of the eponymous village on the road between Yazd and Tabas.[361] Copper minerals like chalcopyrite, chalcocite and Cu-carbonates were detected.[362] According to Berthoud et al. several traces of modern mining dating back to the reign of Reza Shah Pahlavi were identified as well as tunnels, galleries and shafts which might be from a much earlier date. There are also small eroded hills mentioned which are located to the West of the modern village and presumably are dating back to the Abasid period.[363] Abasnejad also notes further unspecified traces of ancient mining activities (see Figure 16).[364]

3.2.6.2. Positive evidence of ancient mining and slagfields:

Khout (084):

The ancient mine is located about 85km to the West of Yazd in the Zarang mountains at an altitude of 2600 m.a.s.l. Traces of mining activites like open cast pits, shafts and galleries which may belong to different eras were recorded. Further traces of pyrotechnical installations, dwellings and some pottery fragments were observed too.[365] According to Abasnejad slagfields are also present at the site.[366] There, copper-oxidic ores of unknown type as well as copper-sulphidic ores like chalcocite and chalcopyrite were identified (see Figure 17).[367]

Gazou (079):

Gazou lies on the Kuh-eh Esfandiyar mountain at an altitude of 1260 m.a.s.l. and at a distance of 1.5 km to the West of the eponymous village. It is located on the Shotori range at a distance of 60 km southeast of Tabas and 14 km to the Southwest of Deyhouk.[368] The mineral occurrences at the site contain chalcopyrite, malachite, chalcocite, azurite, turquoise and chrysocolla as well as hematite.[369] It was extracted at site as evidenced by a

361 Bazin & Hübner 1969: 112; Berthoud et al. 1976: 13ff.
362 http://www.gsi.ir/Images/WEBMINE/cu/cu.htm
363 Berthoud et al. 1976: 14f.
364 Abasnejad 2003: 68, tab.1.
365 Bazin & Hübner 1969: 60f.; Berthoud et al. 1976: 11ff., plan no.6, pl.III.
366 Abasnejad 2003: 68, tab.1.
367 http://www.gsi.ir/Images/WEBMINE/cu/cu.htm ; http://www.ngdir.ir/MiningInfo/CopperMIO.asp?PDataType=
368 Bazin & Hübner 1969: 107f., fig.48
369 http://www.gsi.ir/Images/WEBMINE/cu/cu.htm ; http://www.ngdir.ir/MiningInfo/CopperMIO.asp?PDataType=

large number of old workings which are distributed over an area of 1 km^2.[370]

Chah Khatab Nodushan (088):

The site is situated almost 50 km to the West of Khout (84) and ca. 130 km west of Yazd. Cu-mineralizations and traces of old workings are attested to at this site.[371]

Kalut Chah (089):

It is located in close vicinity to Anarg and at a distance of 15 km to the West of Posht-eh Badam. Trenches, adits and pits are evidence of old workings.[372] Chalcopyrite and unspecified Cu-carbonates as well as sphalerite and galena were identified.[373]

Gelmandeh (090):

To the South of Anarg, Kuh-eh Gelmandeh shows limited traces of old workings[374] and positive evidence for different Cu-carbonates (see Figure 16).[375]

Sarbala (091):

The copper deposit of Kuh-eh Sarbala is situated in the area to the East of Anarg. There, further un-described remains of ancient mining as well as traces of malachite were observed (see Figure 16).[376]

Mazrae Haji Hasan (092):

This mining site is situated at an altitude of 2100 m.a.s.l. and lies at a distance of 24 km northeast of Kheranagh.[377] Chalcocite and different Cu-carbonates are attested to at this site.[378] No traces of old workings were detected (see Figure 16).

370 Stöcklin et al. 1965.
371 Bazin & Hübner 1969: 61.
372 Bazin & Hübner 1969: 110, fig.50.
373 http://www.gsi.ir/Images/WEBMINE/cu/cu.htm
374 Bazin & Hübner 1969: 110, fig.50.
375 http://www.gsi.ir/Images/WEBMINE/cu/cu.htm
376 Bazin & Hübner 1969: 110, fig.50.
377 Ladame 1945: 246; Bazin & Hübner 1969: 112ff.
378 http://www.gsi.ir/Images/WEBMINE/cu/cu.htm

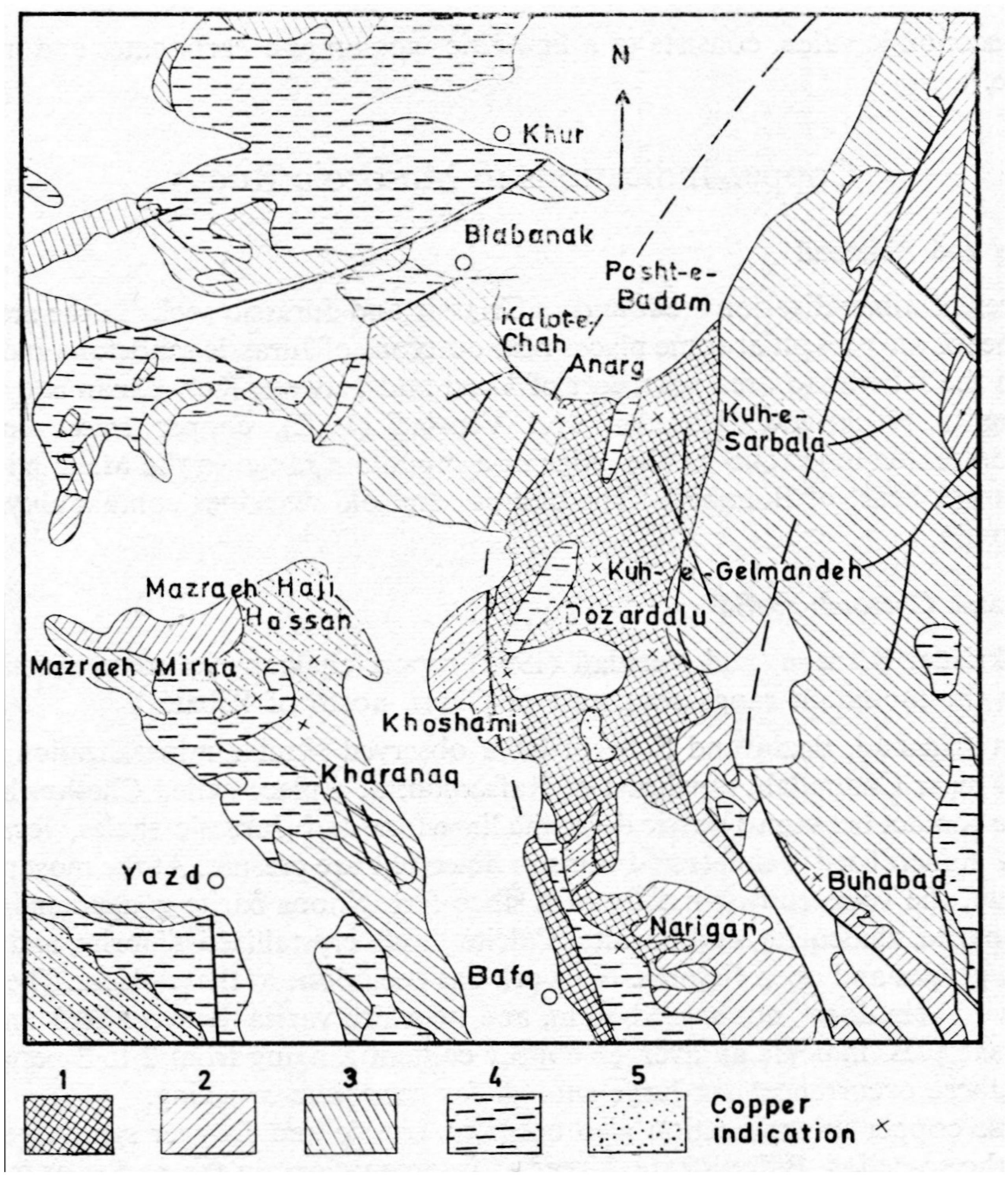

Figure 16: Geological map with the localisations of Behabad (081), Narigan (082), Khoshami (085), Mazrae Mirha (086), Kheranaq (087), Gelmandeh (090), Sarbala (091) and Mazrae Haji Hasan (092) (Bazin & Hübner 1969: fig. 50).

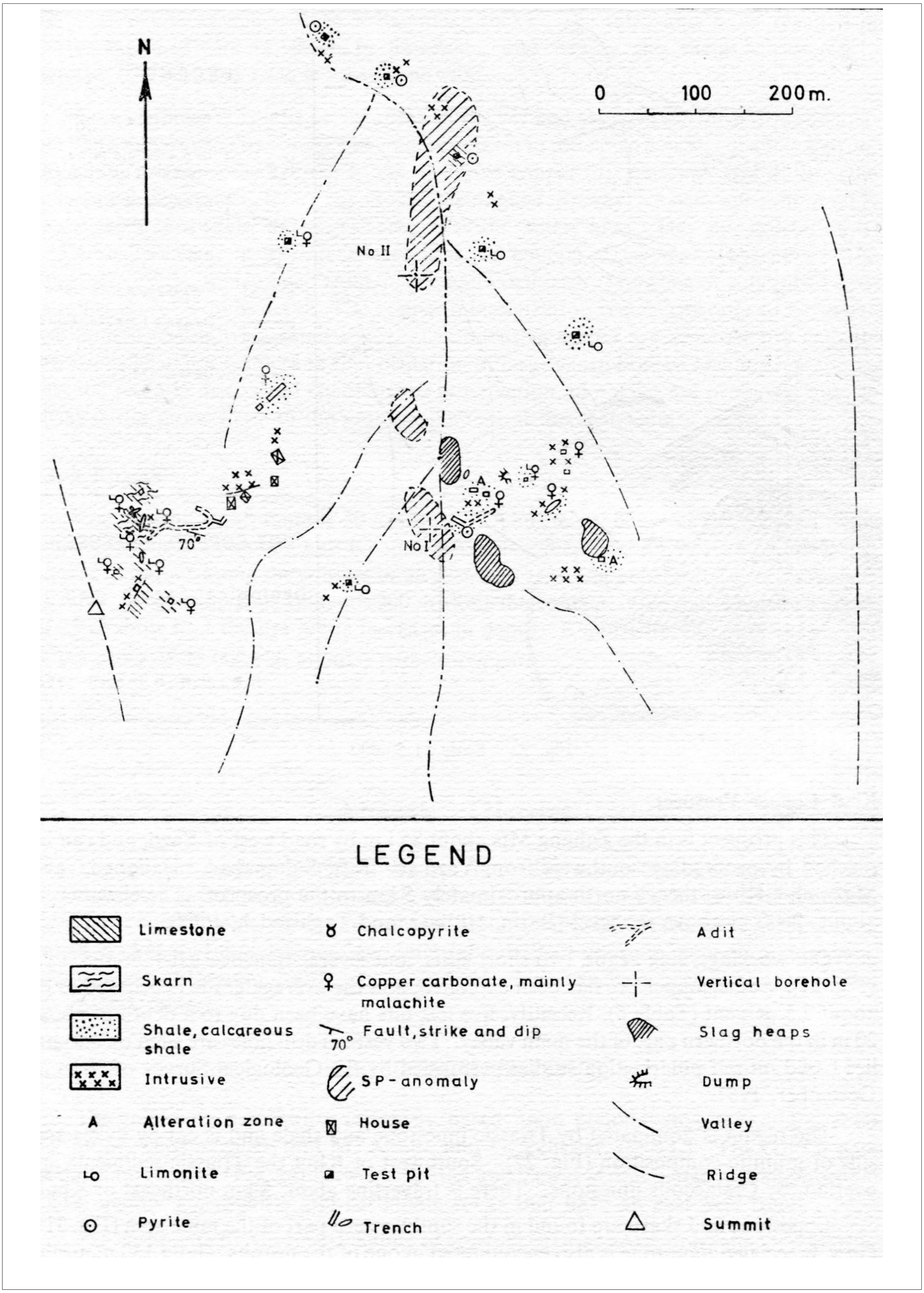

Figure 17: Geological map of the Khut mine (084) (Bazin & Hübner 1969: fig. 21).

3.2.7. Esfahan

3.2.7.1. Ancient mining evidence:

Chah Palangi (093):

The ancient mining site, which is also known as “Chah Palang”, is located at an altitude of 1340 m.a.s.l. to the West of Kal Kafi (109) and ca. 45 km southwest of Anarak.[379] Pyrite, covellite, chalcopyrite, chalcocite were identified at the old workings.[380]

Chah Mileh (094):

This site shows traces of old mining activities.[381] It is located in the Anarak region in a close distance to the West of Tal Mesi (096). Galena, sphalerite, bornite, malachite, chalcopyrite, chalcocite and cuprite were identified at the site (see Figure 18).[382]

Kopeh Halvayee (097):

This site is situated at an altitude of 1250 m.a.s.l. and a distance of 15 km to the Northeast of Kan Mes (106) and 84 km northwest of Anarak.[383] There besides traces of old workings native copper, chalcopyrite, chalcocite, malachite and cuprite were documented.[384]

3.2.7.2. Ancient (?) slagfields:

Tal Mesi (096):

Tal Mesi (engl. Copper hill) is situated at an altitude of 1350 m.a.s.l. and in an area 25 km to the West of Anarak.[385] The mining area which is still in use today possesses mineralization over an estimated area of 45.000m². The major Cu-minerals which are present at Tal mesi are native copper, chalcocite and malachite. Furthermore copper-arsenates like algodonite, domeykite, bornite, chrysocolla, covellite and chalcopyrite were also detected in considerable concentrations. A full list of the thus far identified minerals

379 Ladame 1945: 244.
380 Abasnejad 1994: 144.23.
381 Bazin & Hübner 1969: 71; Abasnejad 2003: 68, tab.1.
382 Abasnejad 1994: 143.15; http://www.ngdir.ir/MiningInfo/CopperMIO.asp?PDataType=
383 Ladame 1945: 244.
384 Abasnejad 1994: 142.12; Abasnejad 2003: 68, tab.1.
385 Ladame 1945: 238; Bazin & Hübner 1969: 65ff.; Berthoud et al 1975: 11f.

was compiled by P. Bariand and H. Schürenberg.[386] Due to its enourmous size and good accessibility of high quality Copper ores it has been hypothesized that this site together with the neighbouring site of Meskani (103) might have been one of the major supplier of raw cupriferous materials in the Old World (see Figure 18).[387]

3.2.7.3. Positive evidence of ancient mining and slagfields:

Talkheh (095):

Talkheh is located on an altitude of 1380 m.a.s.l. at a distance of 22 km west of Anarak[388], where Abasnejad notes the observation of traces of ancient mining and smelting activities.[389]

Bagh Ghorough (117):

The mining site of Bagh Ghorough/ Baqeroq lies at an altitude of 1250 m.a.s.l. and is situated on an isolated agglomeration of hills which is surrounded by the sands of the Dasht-eh Kavir. It is located approximately 35 km to the North-northeast of Anarak and 4 km to the Northwest of Nakhlak.[390] The detected Cu-minerals are malachite, chrysocolla, azurite, chalcocite and cuprite. Old workings were identified by Ladame at several pits and shafts, one adit and further traces of metallurgical residues like agglomerations of slags (see Figure 18).[391]

Sebarz (098):

The site of Sebarz lies at a distance of 12km to the Northwest of Anarak and traces of ancient mining activities are located on an altitude between 1600 and 1800 m.a.s.l.[392] Cupriferous minerals like chalcopyrite, chalcocite, malachite, azurite, diaboleite, dioptase, fornacite, iranite and atacamite are identified in different concetrations as well as further minerals like specularite, annabergite, pyrite, galena, willemite, sphalerite and nickeline.[393] Some traces of ancient mining are occurring with small vertical working places with

386 Bariand 1963; Schürenberg 1963.
387 Maczek et al. 1952; Heskel & Lamberg-Karlovsky 1980: 258f.; Pigott 1999: 110ff.; Pernicka 2004: 234f.; Stöllner 2004: 46.
388 Ladame 1945: 243.
389 Abasnejad 1994: 142.7; Abasnejad 2003: 68,tab.1.
390 Bazin & Hübner 1969: 67ff.; Berthoud et al 1975: 13ff.
391 Ladame 1945: 241f.
392 Bazin & Hübner 1969: 69ff.;
393 Berthoud et al. 1975: 9.

diameters of ca. 5 m (see Figure 18).[394]

Kayaz (099):[395]

This site is located in the Ardestan province at an altitutde of 2410 m.a.s.l. and a distance of 7 km southwest of Kuh Sang Mes (101).[396] Malachite, cuprite, chalcopyrite and azurite are the detected Cu-minerals.[397]

Fatemeh Alishah (100):

Fatemeh Alishah is situated in the direct vicinity of the South of Kayaz (099) where similar mineral occurences were identified.[398]

Kuh Sang Mes (101):

Kuh Sang Mes (engl. Copper ore mountain) lies on an altitutde of 2110 m.a.s.l. and some 20 km east of Ardestan.[399] Occurrences of pyrite, chalcocite and malachite were detected there.[400] The site´s name implies a not to be underestimated importance in metallurgical activities although no old working traces are known so far.

Senjedou (102):

Senjedou is located 35 km to the Northwest of Nain and directly to the South of Kuh Sang Mes.[401] The mineralization attested the occurrence of chalcopyrite, malachite, cuprite, azurite, galena and sphalerite at the site.[402]

Meskani (103):

The site of Meskani (engl: copper ore) is situated on the foothills of the Kuh-eh Daramgil at an altitude of 1500 m.a.s.l. and 8 km to the South of the other major mineral deposit of Tal mesi (096).[403] The mineralizations were observed in an area of approximately 50.000m².[404]

394 Berthoud et al 1975: 10f.
395 According to the different reports it is still debatable about the site´s pronounciation. There are at least two options like "Taktakeh (Kiaz)" according to http://www.ngdir.ir/MiningInfo/CopperMIO.asp?PDataType= and "Gayaz/Giaz (Taktak)" after Abasnejad 1994: 141.1..
396 Ladame 1945: 234. Ladame notes this site with the name Tektekeh
397 http://www.gsi.ir/Images/WEBMINE/cu/cu.htm
398 Abasnejad 1994: 141.2.
399 Ladame 1945: 234.
400 http://www.gsi.ir/Images/WEBMINE/cu/cu.htm
401 Abasnejad 1994: 141.3.
402 http://www.gsi.ir/Images/WEBMINE/cu/cu.htm
403 Ladame 1945: 238; Bazin & Hübner 1969: 65ff.; Berthoud et al 1975: 12f.
404 Maczek et al. 1952; Bazin & Hübner 1969: 66.

Chalcopyrite, pyrite, sphalerite, galena, covellite, cuprite and arsenic nickel were detected which is also comparable to the mineralization of Tal Mesi.[405] Based on the richness of the deposit it was hypothesized by many scholars that this site might have been one of the important copper extracting areas from prehistoric periods onwards.[406] However, due to continuous metallurgical activities at the site the old working traces have probably already disappeared. The only archaeological evidence are pottery finds which are attesting to the earliest metallurgical activities having been during the early Sasanian time (see Figure 18).[407]

Ghebleh (104):

Ghebleh/ Qebleh lies in the area of Anarak, 20 km north of Meskani.[408] Chalcocite, chalcopyrite, malachite are the most important Cu-minerals which were identified at this site (see Figure 18).[409]

Cheshmeh Chah Sefid (105):

The site is located 15 km northeast of Ghebleh (104)[410] and shows mineral occurrences of hematite, malachite, chalcocite.[411]

Kan Mes (106):

Kan Mes/ Kon-e Mes (engl. Copper vein) lies in the direct vicinity north of Tal Mesi (096).[412] Chalcopyrite, chalcocite, malachite and pyrite are so far the only detected minerals at site (see Figure 18).[413]

Jameni (107):

Jameni is located in the area of Anarak next to the mine of Bagh Ghorough (117) and Talarji (112).[414] The attested minerals are limonite, cerrusite and malachite.[415]

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405 Berthoud et al. 1975: 12.
406 Maczek et al. 1952: 65; Smith 1968.
407 Heskel & Lamberg-Karlovsky 1980: 232f.
408 Bazin & Hübner 1969: pl.XVI; Abasnejad 1994: 142.8.
409 http://www.gsi.ir/Images/WEBMINE/cu/cu.htm ; http://www.ngdir.ir/MiningInfo/CopperMIO.asp?PDataType=
410 Bazin & Hübner 1969: pl.XVI; Abasnejad 1994: 142.11.
411 http://www.gsi.ir/Images/WEBMINE/cu/cu.htm ; http://www.ngdir.ir/MiningInfo/CopperMIO.asp?PDataType=
412 Bazin & Hübner 1969: pl.XVI; Abasnejad 1994: 142.9.
413 http://www.ngdir.ir/MiningInfo/CopperMIO.asp?PDataType=
414 Bazin & Hübner 1969: pl.XVI
415 Abasnejad 1994: 143. 18; Abasnejad 2003

Rasour (108):

The mine is situated about 20 km to the North of Anarak at an altitude of 1300 m.a.s.l. Cu-sulphidic ores of chalcocite were identified there (see Figure 18).[416]

Kal Kafi (109):

Kal Kafi lies at an altitude of 1300 m.a.s.l. and a distance of 50 km east of Anarak and in close vicinity to Chah Palang (093) and Khouni (113).[417] It shows mineralizations of pyrite, malachite, wulfenite, limonite, molybdenite, galena and chalcopyrite.[418]

Sar Godar Sorkh (110):

This mine is located in the Biyabanak district, 15 km west of Bayazeh. Several traces of old workings are evident, for example an open pit of 25m length where malachite was also identified.[419]

Jafari (111):

The site of Jafari is located at an altitude of 1450 m.a.s.l. in the northern vicinity of Talarji (112) and 70 km to the East of Anarak.[420] There, chalcocite and malachite were detected.[421]

Talarji (112):

The abandoned copper mine of Talarji which is located in the Anarak area shows traces of mineral occurrences like limonite, malachit, cerrusite and gold.[422]

Khouni (113):

This abandoned mining site is situated at an altitude of 1250 m.a.s.l. and 55 km east-northeast to Anarak.[423] Limonite was detected in abundancy as well as cerrusite, chalcopyrite, galena, malachite and azurite.[424]

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416 Ladame 1945: 244; Bazin & Hübner 1969: pl.XVI.
417 Ladame 1945: 268, 275, 287;
418 Bazin & Hübner 1969: pl.XVI; Abasnejad 1994: 144.22.
419 Bazin & Hübner 1969: 114.
420 Ladame 1945: 245; Abasnejad 1994: 143.16.
421 Bazin & Hübner 1969: pl.XVI; http://www.ngdir.ir/MiningInfo/CopperMIO.asp?PDataType=
422 Bazin & Hübner 1969: pl.XVI; http://www.gsi.ir/Images/WEBMINE/cu/cu.htm
423 Ladame 1945: 275; Bazin & Hübner 1969: 71.
424 http://www.ngdir.ir/MiningInfo/CopperMIO.asp?PDataType=

Konjiroud (114):

Konjiroud is located next to the West of Do Chah Hu (115) and shows mineralizations of chalcopyrite, pyrite, hematite, limonite. [425]

Do Chah Hu (115):

The mining site Do Chah Hu is located at an altitude of 1450 m.a.s.l.[426] It shows traces of old workings where chalcopyrite, limonit, hematite and pyrite were identified.[427]

Tal Siyah (116):

This site is situated in the vicinity of Sar Godar Sorkh (110) and possesses mineralizations of chalcopyrite, different unspecified Cu-carbonates and limonite.[428]

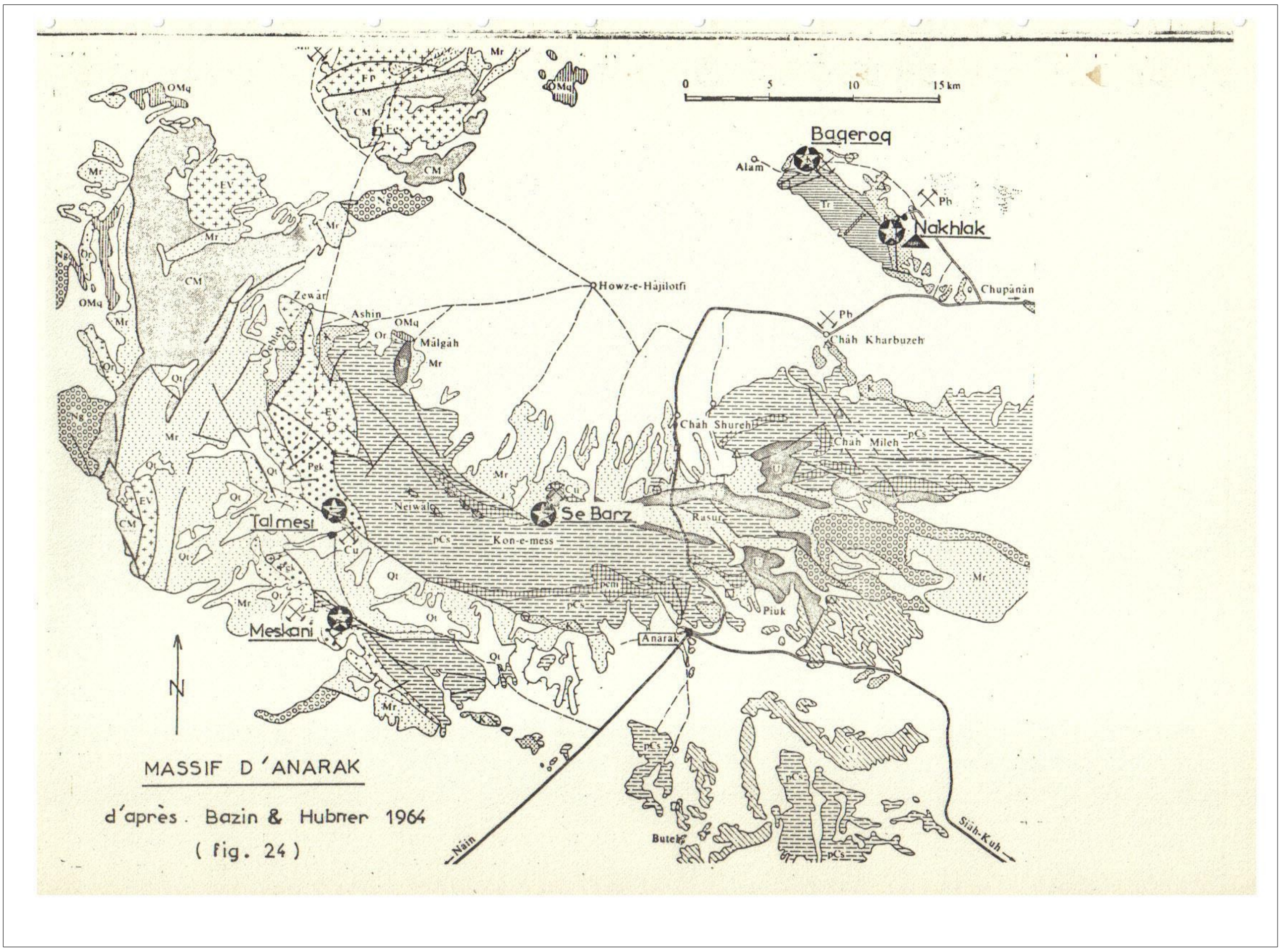


Figure 18: Geological map of the Anarak district with the localisations of the copper deposits of Tal Mesi (096), Meskani (103), Sebarz (098), Rasour (108), Kon-e Mes (106), Chah Mileh (094), Qebleh (104), Baqeroq (117) (Berthoud et al. 1975).

425 Bazin & Hübner 1969: pl.XVI; Abasnejad 1994: 144.21

426 Ladame 1945: 245; Bazin & Hübner 1969: 71.

427 Abasnejad 1994: 143.20.

428 Bazin & Hübner 1969: 114.

3.3. Summary: Evidence of ancient metallurgical activites in Eastern Iran

The appearance of various metal objects in Eastern Iran which were produced from different metals and their alloys are giving an opportunity to hypothesize that the ancient local residents had a good technological knowledge and access to different raw materials by interregional trade and local mineral deposits.

The presented compilation of mineral deposits in eastern Iran is mainly based on reports which were published over the last 170 years. The majority of reports are of geological-exploitatory – commercial character, such as for example the reports of A.F. Stahl, E. Tietze or A. Houtum-Schindler. Some other publications which are mainly representing the results of different metallurgical expeditions are showing a distinct archaeological approach with more specific descriptions of working traces and other archaeological material which were observed on site. Therefore it needs to be emphasized that all presented results concerning the traces of ancient mining and further metallurgical activities in eastern Iran are not the results of a recent field project but rather a summary of previous expeditions. Unfortunately not all of the information can be verified in the sense of accuracy. Some of the earlier reports are lacking in precise data and descriptions due to the different scientific questions. But they give the earliest modern proof of mineral occurences for this area. The majority of early islamic reports and travel diaries from the periods between the 8th and 13th century AD were not included in this research. The later reports which were produced mostly by archaeological research enterprises offer more useful data, but in most cases we are dealing with the preliminary results of expeditions which unfortunately were never continued.

As already shown in the preceding paragraphs there is a large number of mineral deposits distributed over eastern Iran which, besides the mineral occurrences, also frequently bear traces and residues of ancient metallurgical activities. At some of the sites diagnostic pottery fragments were found which were used for dating to determine loosely the chronological position of the archaeological contexts. But in most cases the pottery fragments were not observed in stratified layers but on the recent surface. Unfortunately these facts weaken the archaeological value to a certain degree.

To gain a better knowledge about the developments of the ancient metallurgical process it is desirable for future research projects to restart investigations on the mining areas according to recent technological standards by using these different compiled sets of data.

In the province of Khorasan jonoubi especially the area around the modern town of Nehbandan is of particular interest because for example Ghaleh Zari (008), one of the first identified sites with traces of old activities, Ghaleha (009) and Deh Salm (010) are situated in this area. Furthermore, the mining area of Seh Changi (014) which is located to the West of Birjand shows similar remains of old workings.
The Kerman province has evidence of the majority of cupriferous deposits in modern eastern Iran and therefore also the majority of old traces of mining and further metallurgical activities. In general it can be stated that the whole area between Kuhbanan and Jiroft as well as from the Western fringes of the Dasht-eh Lut to Shahr-eh Babak is covered with a dense distribution of mineral deposits which show traces of old activities. Especially the areas around the archaeological settlements like Tall-eh Eblis, Tappeh Yahya, and Shahdad indicate intensive metallurgical activities which might date back to the early maybe earliest phases of metallurgy. But these observations might also be biased by the self conditioned, exclusively archaeological observations on the sites´ periphery.
Here by name is the the site of Zaqdar (020) which is located in the Northern periphery/ hinterland of Tappeh Yahya and has evidence of vast slagfields. Furthermore the Sarduyeh – Bahr Aseman region is of particular interest with the mining sites of Baqoray (021), Gardokulu (022), Kamaduran (023), Avruz Morghi (024), Tall Madan (025) and Darbini (026) which are also attesting to different metallurgical activities. A. Hakemi mentions that this mining district which bears traces of ancient mining and smelting activities were so distinctive that already islamic geographers and travellers had knowledge of this area for its mineral abundance.[429] To the South of the archaeological settlement of Tappeh Yahya there is also the mining site of Sheykh Ali (076) which lies in the Hormozgan province.
In the area to the West of Tall-eh Eblis the large mining area of Chahar Gonbad (029) is located with the neighbouring copper deposits of Bolboly (028) and Kuh Panj (030). There are also the sites of Takht-eh Baneh and Kolahak-eh Ahani where according to T. Berthoud ancient mining and smelting activities were conducted.[430] Here Zangalou (031) is also located where further un-described pottery but somehow similar to prehistoric Tall-eh Eblis material was observed as well as traces of mining and smelting. Not to forget also are the deposits of Tall-eh Homi (118) where according to R. Pleiner indisputable evidence for old activities were identified.[431] To the East of Tall-eh Eblis the deposits of Dozarktar (044),

429 Hakemi 1997: 15.
430 Berthoud et al. 1975: 27f.
431 Pleiner 1967: 371ff.

Ghaleh Narp (060), Allahabad (027) and Sang-eh Sayat (119) are to be mentioned which lay at a close distance to each other and show traces of different metallurgical activities. The Southern Area next to the Modern town of Rameshk also shows occurrences of cupriferous deposits like Sarsou (061), Tankoshku (062), Kalleh Gun, Konar Gabon and Kish Patiel.[432]

In the most Southeastern province of Sistan and Baluchistan the most interesting sites of Pourchangi (063), Chehel Koureh (064) and Geraqe (065) can be found which are situated on the Eastern fringes of the Dasht-eh Lut. These sites are located in close proximity to each other and bear traces of old mining and smelting activities. Dargiyaban (068) is situated to the Southeast of Zahedan and next to the boarder to the Islamic Republic of Pakistan and also shows traces of both activities.[433] This site lies in Western Baluchistan and can be also seen in correspondence with and a dependency upon the major copper mineral deposits in Eastern Baluchistan which are situated nowadays in the territory of the Islamic Republic of Pakistan. Further relevant sites of this cluster are situated in adjacent Afghan Sistan. For that reason it needs to be emphasized that the arbitrary demarcations of modern national states does not correspond with the original boundaries of the settlement areas of ancient cultural regions. In Eastern Baluchistan there are major copper deposits in the Chagai district where Cu-minerals like malachite, chalcocite as also large gold deposits are found. The most prominent site known so far is the mining area of Saindak with mineralizations of Gold and other mineral occurrences like 10 porphyry type copper deposits as well as pyrite, molybdenite and magnetite,[434] which lies at a distance of approximately 100km south-southeast of Zahedan.[435] Another important cluster of copper deposits of this area is situated next to Reko Diq which lies at a distance of about 70 km south of Saindak.[436]

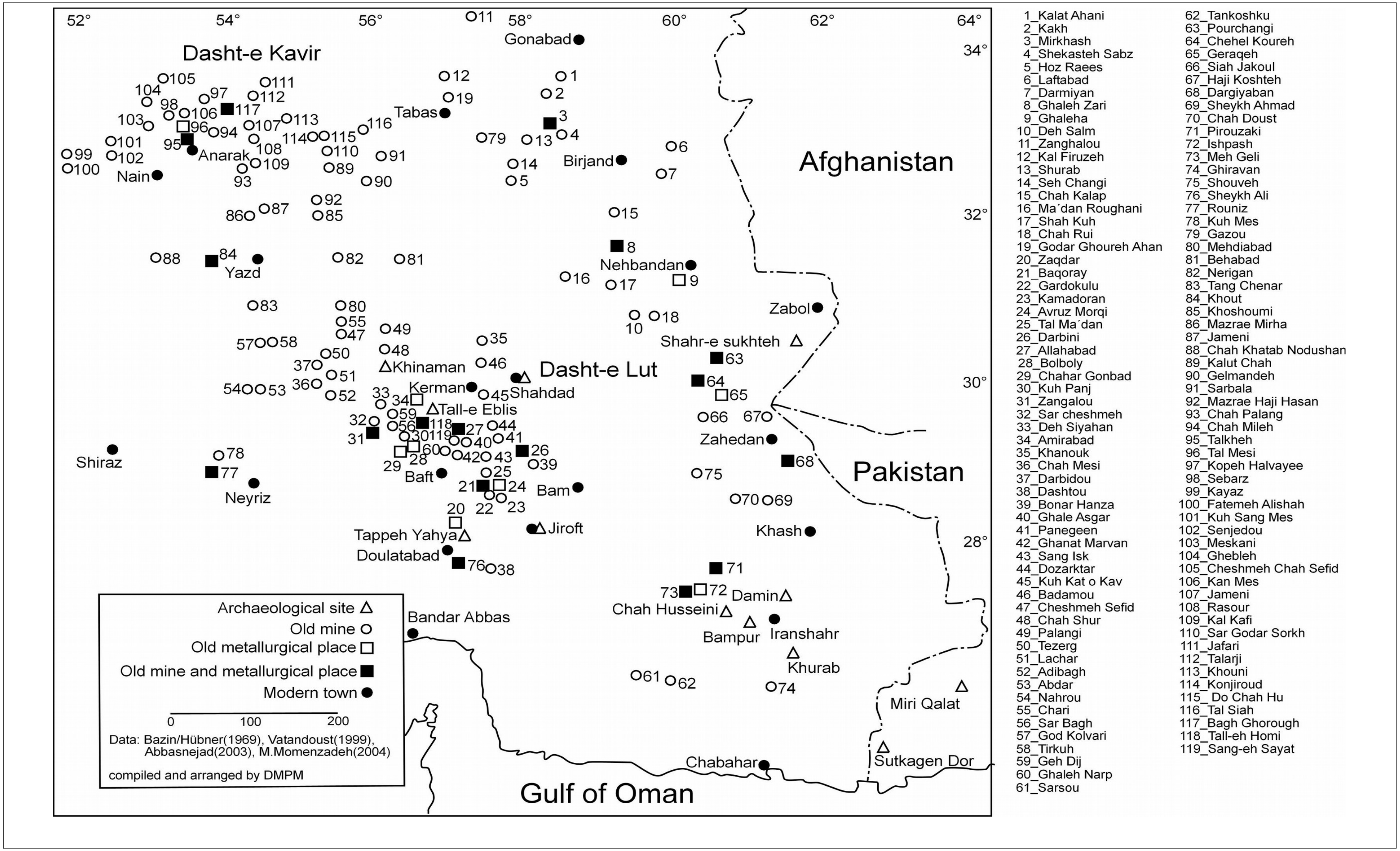
In the Afghan Sistan area the previously mentioned important areas of Gardan-eh Reg and Rud-eh Biyaban where visible traces of ancient pyrotechnological activities were observed.[437] Unfortunately there is no further precise data about of the chronological position of these in an archaeological context.[438] A recent comprehensive study on the

432 The last three sites are exclusively mentioned by Momenzadeh et al. 2004: 12, Abb. 3.77-79.
433 Taghizadeh 1975.
434 Bizanjo 1986: 13ff.
435 Law 2008: 693ff.
436 Pers. Comment by Seyed Shakir Ali Shah from the Exploration and Excavation branch of the Department of Archaeology and Museum (DOAM) of the I.R. of Pakistan. He recently conducted fieldwork in the Chagai district where he focused on archaeological relics but also observed several traces of metallurgical activities.
437 See chapter 1.2.5. footnote 61.
438 Fairservis 1961; Dales 1972.

situation of the mineral deposits in Afghanistan was presented by T. Köster.[439] Unfortunately it was not possible to include more data about the mining situation of the Afghani or Pakistani part of Sistan and Baluchistan. Due to the political and military implications during the last 40 years in this region the geological and archaeological activities were limited to a minimum or not realizable.[440]

The provinces of Yazd and Fars are showing less traces of ancient copper metallurgical activities according to the published data.
At Fars province there are the sites of Rouniz (077) and Kuh Mes (078) to be mentioned which are situated in the next vicinity to each other and evidencing traces of mining and smelting activities. In Yazd province a similar situation was reported for the sites of Khoshoumi (085) and Mazrae Haji Hasan (092).
In the Esfahan province there is a high density of cupriferous mineral deposits reported especially in the area around the town of Anarak. There, a great number of deposits with copper-bearing minerals were documented in a limited area. Especially the sites of Tal Mesi (096) and Meskani (103) need to be emphasized which according to several scientists must have played an extraordinary role in procurement and production of copper and its alloys already during the archaeological periods. Further sites which display the aforesaid remains are Chah Mileh (094), Talkheh (095), Sebarz (096), and Bagh Ghorough (117) which are located in close proximity to each other.
One thing in common with all of the mentioned sites is the fact that besides the occurences of different copper-minerals all bear to a certain degree traces of mining and smelting activities as well. It is desirable for future archaeological missions in East Iran to trace the developments and limitations of the East Iranian metallurgical province in comparison to the other contemporary metallurgical provinces.

439 Köster 2008: 242ff., 497ff.
440 Recently the Eurasia Department of the German Archaeological Institute (DAI) and the Institute of Archaeology from the Ministry of Information and Culture of the I.R. of Afghanistan started the initial phase of a cooperative archaeological project on "Ancient mines and mining in Afghanistan".



Map 6: Distribution map of copper deposits in Eastern Iran

Concordance list of all mentioned Copper deposits in East Iran

No.	Name	B&H	Aba.	Vat.	Mom.	Longitude (*/ **)	Latitude (*/ **)	Province	Mineralization (*/ **/*****)
1	کلات آهنی Kalate Ahani** Kalateh ahani**	127	1	94	30	*58.29.30 **58.40.20 **58.50.00	*33.53.00 **34.06.00 **34.06.00	Khorasan jonoubi	*Pb,Cu,galena,pyrite,chalcopyrite
2	کاخ Kakh(Ali Mansur)** Kakhe Ali Mansur** Kakhe ali mansore1**	128	2	95	31	*58.20.00 **58.40.20 **58.20.40 **58.40.20	*33.42.00 **34.07.00 **34.07.00 **34.07.00	Khorasan jonoubi	*chalcopyrite
3	میرخاش Mir khashe (1-2)** Mirkhash**	133	3	97	33	*58.20.00 **58.30.00 **58.16.00 **58.16.00	*33.16.00 **33.30.00 **33.07.50 **33.07.50	Khorasan jonoubi	*malachite **malachite **malachite
4	شکسته سبز Shekasteh sabz** Shekasteh sabz(1-2)**	134	4	98	34	*58.28.00 **58.22.00(1)(2)	*33.17.00 **33.02.30(1)(2)	Khorasan jonoubi	*Cu-carbonate **malachite(2)
5	حوض راییز Hoz Raees* Hoze Raies2** Huz-e Raes**	142	6	102	37	*58.00.00 **58.01.00 **58.01.00	*32.37.30 **32.41.30 **32.41.30	Khorasan jonoubi	*Cu,Zn,Pb,galena,sphalerite,chalcocite, malachite
6	لفت آباد Laftabad* Loft abad (1-2)**	136	7	100	36	*59.50.00 **59.30.00 **59.52.00	*32.59.00 **33.30.00 **33.02.00	Khorasan jonoubi	*malachite **malachite
7	درمیان Dar Miyan** Darmian (1-2)**	135	8	101	35	*59.41.00 **59.44.30 **59.30.00	*32.44.00 **32.47.00 **32.30.00	Khorasan jonoubi	*chalcopyrite
8	قلعه زاری Qaleh Zari (1-4)* Ghalahe zary(1-11)** Qaleh Zari1**	137	9	105	46	*58.57.30 *58.45.00 *59.05.00 *59.00.00 **59.30.00(1) **59.45.00(2) **57.30.00(3) **58.55.15(4) **58.57.00(5) **58.59.00(6) **59.58.00(7) **58.55.15(8) **58.58.00(9,10,11) **58.55.15	*32.21.30 *31.58.00 *31.51.30 *31.48.30 **31.30.00(1) **31.25.10(2) **31.30.00(3) **31.49.43(4) **31.20.00(5) **31.15.00(6) **31.20.00(7) **31.49.43(8) **31.48.20(9,10,11) **31.49.43	Khorasan jonoubi	*Cu+? *indication *chalcopyrite,pyrite,chrysocolla,specularite, malachite,azuirte,chalcocite(?),limonite *chalcopyrite,hematite **chalcopyrite(1)(2)(3)(5)(6)(7)(8)(9)(10)(11) **malachite(4)

No.	Name	B&H	Aba.	Vat.	Mom.	Longitude (*/ **)	Latitude (*/ **)	Province	Mineralization (*/ **/*****)
9	قله ها Kaleha* Ghalaha(1-2)** Qoleha1**	139	10	107	47	*59.52.00 **59.30.00(1) **59.20.30(2)(1)	*31.24.00 **31.30.00(1) **31.24.00(2)(1)	Khorasan jonoubi	*hematite,chalcopyrite,malachite **chalcopyrite
10	ده سلم Deh Salm		11					Khorasan jonoubi	Cu-, Pb-, and Sn-minerals
11	زنگالو Zangalou* Zangalo** Zangholu** Zangholu(1-2)** Zanqalu(1-2)**	120				*57.35.30 **57.25.00 **57.26.00 **57.30.00 **57.36.00 **57.36.00	*35.29.00 **36.21.00 **35.29.00 **35.30.00 **35.29.00 **35.29.00	Khorasan rasavi	*Cu+(?) **chalcopyrite **native copper **chalcopyrite
12	کل فیروزه Kal Firuzeh* Kul Firuzeh**	131	92	93		*57.10.00 **57.15.40	*33.48.30 **33.33.40	Khorasan jonoubi	*Mo,Co,Zn,malachite
13	شواب Shurab** Shurab1**	129	93	96		*57.59.00 **58.34.33 **58.03.00(1)	*33.30.00 **33.34.33 **33.34.00(1)	Khorasan jonoubi	*Pb,Cu,bornite,chalcopyrite,pure copper,malachite,azurite
14	سه چنگی Seh Changi (1-3)** Seh changi**	141	94	103	38	**53.36.00 **58.30.00(1) **58.03.00(2) **58.03.00(3) **58.03.00	**32.22.00 **32.30.00(1) **32.22.00(2) **32.32.00(3) **32.32.00	Khorasan jonoubi	**chalcopyrite(1)(2) **malachite(3) *****pyrite,arsenopyrite,galena,chalcopyrite, tetrahydrite,bornite,cerrusite,malachite, azurite,chrysocolla,chalcocite,covellite,
15	چاه کلاپی Chah Kalap * Chah Kalapi* Chah-e Kalap** Chahe kalpe(1-2)**	138	95	104		*57.06.30 *59.10.00 **59.31.20 **59.30.00(1) **59.31.20(2)	*31.02.00 *32.04.00 **31.58.00 **32.30.00(1) **31.58.00(2)	Khorasan jonoubi	*malachite *Cu,Zn,W,(Ge,Sn,Cd) **malachite(1) **chalcopyrite(2)
16	معدن روغنی Madan Roughani* Madane roughany(1-2)**	140	96	106		*58.51.00 **59.30.00 **59.15.50	*31.16.30 **31.30.00 **31.15.00	Khorasan jonoubi	*chalcopyrite,galena **chalcopyrite
17	شاه کوه Shah Kuh		97	156				Khorasan jonoubi	
18	چاه رویی Chah Rui		98	157				Khorasan jonoubi	

No.	Name	B&H	Aba.	Vat.	Mom.	Longitude (*/ **)	Latitude (*/ **)	Province	Mineralization (*/ **/*****)
19	گدار قوره آهن Godar Ghoreh Ahan Godarqu Ahan**	130	104			*57.10.00 **57.09.00	*34.05.00 **34.08.30	Khorasan rasavi	*indication
20	زاغدر Zaqdar*****		24					Kerman	
21	باقرای Baqoray**	196	25	146	60	**57.12.20	**29.08.00	Kerman	cuprite,malachite,chalcocite
22	گردوکولو Gardokulu**	197	26		61	*57.18.00 **57.23.39	*28.58.00 **29.14.53	Kerman	*chalcopyrite,pyrite, chalcocite,malachite, covellite **chalcopyrite
23	کمادورن Kamadoran** Kamadorn**	198	27	147	62	*57.24.00 **57.10.30 **57.10.30	*28.58.00 **00.00.00 **29.07.30	Kerman	*chalcopyrite,malachite **chalcopyrite,malachite
24	آورس مرغی Avruz Morqi**	199	28			**57.10.30	**29.09.30	Kerman	cuprite,Cu-carbonates
25	تل معدن Tal Madan** Taleh madan** Tall madan*****	190b	29		59	**56.57.40 **57.04.14	**29.22.00 **29.20.17	Kerman	pyrite,galena,arsenopyrite,chalcopyrite
26	دربینای Darbini* Dar Biny*	192	30	144	63			Kerman	*chalcocite, Cu-carbonates
27	الله آباد*/** Allahe Abad (1-3)**	185	31	136	58	*56.42.00 **56.42.20 **56.46.38(1) **56.42.20(2-3)	*29.39.00 **29.39.50 **29.38.47 (1) **29.39.50(2-3)	Kerman	*Cu,malachite, azurite ** **chalcopyrite(1-3)
28	بلبلی Bolboly ** Bolboly (2-3)**	179	32	137	56	*56.15.30 **56.15.30 (2-3)	*29.35.00 **29.34.00 (2-3)	Kerman	*Cu,Mo,Pb,Zn,Fe,Pyrite, magnetite, martite,hematite, chalcopyrite,malachite, azurite,... **chalcopyrite

No.	Name	B&H	Aba.	Vat.	Mom.	Longitude (*/ **)	Latitude (*/ **)	Province	Mineralization (*/ **/*****)
29	چهار گنبد Chahar Gonbad(1-2) Chahar Gonbad 2* Chahar gonbad** Chahar Gonbad** Chahargonbad(1-3)**	178	33	138		*56.11.00 *56.12.30 **56.11.00 **56.20.00 **56.12.21 **56.11.00	*29..35.30 *29.35.00 **29.35.30 **29.30.00 **29.32.54 **29.35.30	Kerman	* Cu,Fe,Mo,Au, Zn,Ag,Mg,Pb, pyrite, chalcopyrite, native copper,tetrahydrite, marchasite,... *Cu,Au,Ag,Fe,Pb,pyrite,covellite,gold, galena,hematite,limonite, malachite,chalcocite **chalcopyrite,pyrite,tetrahydrite,native Au,marcasite,chalcocite,covellite,galena, sphalerite,hematite,malachite,azurite,limonite **chalcocite(?) **chalcopyrite(1-3)
30	کوه پنج KuhPanj(1-4)** Kuh Panj(Band Manzar)** Kuhe Panje(1-2)** Kuh-ePanj1**	177	34	135		*/**56.04.00 **56.00.00 **56.04.00 **56.02.30 **56.02.00 **56.06.00 **56.04.00	*/**29.53.00 **29.54.00 **29.50.00 **29.49.40 **29.51.15 **29.48.24 **29.51.00	Kerman	*Cu,Mo,Sb,Ag,Hg,Fe,pyrite,turquoise, malachite,azurite,chalcopyrite,molybdenite, tetrahedrite **malachite azurite **chalcopyrite
31	زنگالو Zangalou*****		35					Kerman	
32	سر چشمه Sar cheshmeh**	172	36	134	55	*55.52.00 **55.52.20	*29.57.00 **29.56.40	Kerman	*Cu,Mo,Au,Ag,Pb,Zn,pyrite,chalcopyrite, sericite,biotite
33	ده سیاهان Deh Siyahan* Deh Siyahan (1-2)* Deh Siahan** Deh Siahan (Bondar Baghu)**	174	37	129	54	*56.00.30 *55.59.30 *55.59.00 **55.58.20	*30.01.00 *29.59.30 *30.00.30 **29.59.00	Kerman	*Cu,Mo,Fe,Zn,pyrite,chalcopyrite,molybdenite ,pyrhotite,marchasite hematite,magnetite, sphalerite *Cu,Fe,Pb,Zn,Ti,Ag,Hg,chalcopyrite,bornite, sphalerite,galena,tetrahydrite,covellite,rutile **pyrite,pyrhotite, marcasite,chalcopyrite,sphalerite,bornite, hematite,tetrahydrite
34	امیر آباد Amirabad (1-2)**	181	38	132		*56.23.30 **56.07.00 **56.24.00	*30.02.00 **30.02.00 **30.17.30	Kerman	*ore
35	خانوک Khanuk**	143	39	118	45	*57.13.00 **56.46.30	*30.52.00 **30.44.00	Kerman	*Cu-carbonates

No.	Name	B&H	Aba.	Vat.	Mom.	Longitude (*/ **)	Latitude (*/ **)	Province	Mineralization (*/ **/*****)
36	چاه مسی Chahe Mesy 1**	166	41	124	52	*55.09.30 **55.10.00	*30.25.00 **30.24.30	Kerman	*Cu,Pb,Zn,Ag,Au,Hg,B,pyrite,chalcopyrite, galena,sphalerite,tetrahydrite,marchasite, chalcocite **pyrite,chalcopyrite,galena,sphalerite,enargite,lazulite,marcasite,chalcocite,covellite,bornite, hematite,native gold, malachite, azurite, limonite
37	داربیدو Darbidou* Darbido** Darbidu**	168	42	122	50	*55.12.00 **55.12.00 **55.07.30	*30.32.00 **30.27.00 **30.29.00	Kerman	*chalcopyrite,bornite,galena,malachite **chalcopyrite
38	دشتو Dashtou	209a	59	149		*57.31.00	*27.44.00	Kerman	*Cu,Ni,Zn,malachite,hematite,limonite, magnetite
39	بن در هنزا Bondar Hanza** Bon Dar Honza** Bun Darhanza**	193	60	145		*57.13.00 **57.15.00	*29.23.00 **29.20.00	Kerman	*Cu,Mo,Fe,pyrite, chalcopyrite,magnetite **malachite **chalcopyrite
40	قلعه عسگر Ghale Asgar1** Qaleh Asgar**	188	62	140		*56.41.30 **56.46.36 **56.41.20	*29.31.00 **29.27.28 **29.28.00	Kerman	*pyrite,chalcopyrite,Cu-carbonates **malachite
41	پانگین Panegeen*****	190a	63	142				Kerman	*****pyrite,galena,arsenopyrite.chalcopyrite
42	قنات مروان Qanat Marvan** Ghanat Marvan1**	189	64	141		**56.46.30	**29.20.00	Kerman	**chalcopyrite
43	سنگ ایسک Sang Isk*/** Sang-e Isq***	191	65	143		*57.15.00 **57.08.00	*29.18.30 **29.28.00	Kerman	*indication *****Cu-carbonates
44	دوزرکتر Dozarktar Dozaraktar** Do Zard Akhtar** Duzaradoktor**	187	66	139		*56.51.00 **56.51.20 **56.58.04	*29.40.00 **29.40.00 **29.41.00	Kerman	*Fe,Zn,Cu,pyrite,chalcopyrite,sphalerite,bornite,covellite,malachite **chalcopyrite

No.	Name	B&H	Aba.	Vat.	Mom.	Longitude (*/ **)	Latitude (*/ **)	Province	Mineralization (*/ **/*****)
45	کوه کت کاو Kuh Cat o Cav*****	183	67	133		*56.46.00	*30.02.00	Kerman	*indication
46	بادامو Badamou*****	144	68	131		*56.51.00 **56.45.20	*30.20.00 **30.20.00	Kerman	*specularite,limonite,malachite, chalcopyrite
47	چشمه سفید Cheshmeh Sefid	145b	69	130		**56.28.40	**30.31.20	Kerman	*indication
48	چاه شور Chah Shur Chahe Shor**	170	70	128		*55.41.30 **55.14.20	*30.02.00 **30.01.30	Kerman	*mineralization of secondary copper **malachite
49	پلنگی Palangi(1-2)(Tal Dozi)* Palangi(Talduzi)** Palangi(1-2)**	169	71 72	126 127		*55.38.00 *55.38.30 **55.39.00 **55.40.36	*30.20.30 *30.20.00 **30.20.00 **30.16.30	Kerman	*Cu,Si,Fe,Ca,pyrite,chalcopyrite,bornite, malachite,azurite,chrysocolla-silicates, chalcocite **chalcopyrite(1-2)
50	تزرک / تی زرک Tezerg(Tizark)***/*****	164	73	121	49			Kerman	secondary Cu-mineralization,limonite
51	لاچار Lachar Lachah (Meyduk)** Lachahe(1-2)**	165	74	123	51	*55.10.00 **55.10.00 **55.10.00	*30.26.30 **30.24.30 **30.25.00	Kerman	*Cu,pyrite,chalcopyrite,malachite,azurite, cristoballite,chalcocite,covellite **chalcopyrite **malachite
52	آدیباغ Adeabagh Adar Bagh* Adibaghe**	167	75	125	53	*55.19.00 **55.13.25	*30.19.30 **30.18.00	Kerman	*indication **malachite
53	آبدار Abdar	161	76	120		*54.46.30 **55.18.00 **55.19.00	*30.28.00 **30.18.28 **30.18.00	Kerman	*malachite, azurite **chalcopyrite
54	نحرو Nahrou (Khabr) Nahru** Nahrud (Gaz)**	160	77	119		*54.39.30 **54.44.25	*30.33.00 **30.32.40	Kerman	*secondary Cu mineralization,limonite
55	چاری Chari** Chari (Cu)**	145a	105			*56.30.00/ **56.28.30 **56.28.40	*30.24.30/ **30.31.30/ **30.31.20	Kerman	*Pb,Ba,Cu,chalcopyrite

No.	Name	B&H	Aba.	Vat.	Mom.	Longitude (*/ **)	Latitude (*/ **)	Province	Mineralization (*/ **/*****)
56	سرباغ Sar Bagh Sarbaghe** Sarbaghe3** Sarbaq** Serbaghe1**	176	106			*56.02.00 **56.02.43 **56.02.43(3) **56.02.43 **56.02.43	*29.59.30 **29.59.20 **29.59.20(3) **29.59.20 **29.59.20	Kerman	*Fe,Cu,Zn,Pb,As,Sb,Ag,Hg,magnetite, hematite,martite,pyrite,covellite, chalcopyrite,sphalerite **chalcopyrite **chalcopyrite(3)
57	گود کلواری God colvari** Gode Kulvary** Gode Kulvary(1-2)** Gude Kulvari**	162	111			**54.58.00 **55.03.10(1) **55.00.00(2) **55.00.00	**30.36.00 **30.30.00(1) **30.36.00(2) **30.36.00	Kerman	**chalcopyrite **malachite(1) **chalcopyrite
58	تیرکوه Tirkuh	163	112			*55.01.00 **55.04.56	*30.35.30 **30.29.24	Kerman	*indication
59	گه دیج Geh Dij Gahdij* Gahdij** Kah Dij**	175	113			*56.03.30 **56.03.30	*29.55.00 **29.55.00	Kerman	*indication
60	قلعه نارپ Qale narp Ghale Narap(1-2)** Qaleh-e narp**		116		57	**56.46.50 **56.41.30	**29.40.48 **29.42.00	Kerman	**chalcopyrite
61	سرسو Sarsou Sarsoo**		118		75	**58.49.09	**26.43.35	Kerman	**malachite
62	تنکاشکو Tankoshku* Tankashku**		119		76	*58.48.00 **58.48.54	*26.45.00 **26.45.16	Kerman	*western gossan: Cu,Au,Ag,Ni,Co,Pb,Zn, malachite,crysocolla,geothite,limonite **malachite
118	تل حومی/ تل هومی Tall-eh Homi							Kerman	
119	سنگ صیط/ سنگ صیاط Sang-eh Sayat							Kerman	

No.	Name	B&H	Aba.	Vat.	Mom.	Longitude (*/ **)	Latitude (*/ **)	Province	Mineralization (*/ **/*****)
63	پورچنگی Pourchangi*****		12					Sistan&Baluchistan	
64	چهل کوره Chehel Koureh* Chehel Koureh Zahedan* Chehel Kureh**	201	13	150	65	*59.58.00 *60.07.30 **60.08.10 **60.08.00	*30.16.00 *30.18.00 **30.18.20 **30.16.00	Sistan&Baluchistan	*Cu,Pb,Zn,chalcocite,malachite *Cu,Pb,Zn,Fe,malachite,azurite,chrysocolla, chalcopyrite,anglesite,galena,pyrhotite, sphalerite **chalcosine,malachite
65	گراغه Geraqe*****		14					Sistan&Baluchistan	
66	سیاه چکول Siah Jakul* Siah chakul** Siajkul**	202	15		66	*60.04.30 **60.18.20 **61.13.00	*29.44.30 **29.53.00 **28.47.00	Sistan&Baluchistan	*malachite
67	حاجی کشته Haji Keshteh** Haji Kosteh** Haji Koshteh1**	204	16		67	*60.45.00 **60.50.00 **60.49.59 **60.50.00	*29.42.00 **29.42.27 **29.42.47 **29.47.00	Sistan&Baluchistan	*malachite,azurite,limonite
68	در گیابان هری Dar Giyaban*****		17					Sistan&Baluchistan	
69	شیخ احمد Sheykh Ahmad Shykh Ahmad**	205	18		69	*60.42.00 **59.56.00	*28.39.00 **28,45,50	Sistan&Baluchistan	*indication
70	چاه دوست Chah Doust Chah-e dust1**	206	19		68	*60.21.00 **60.41.00	*28.46.30 **28.40.30	Sistan&Baluchistan	*malachite,chalcanthite
71	پیروزکی Pirouzaki (Bazman) Pizuki** Pizuki(Bazman)**	200a	20	152	72	*59.59.00 **59.16.59 **59.54.30	*27.53.00 **27.45.20 **27.56.40	Sistan&Baluchistan	*pyrite,chalcopyrite,malachite
72	ایشپاش Ish Pash** Ish Pash1** Ishpash Copper**	200b	21	153	70	*59.35.30 **59.42.39 **59.17.10 **59.42.40	*27.41.00 **27.45.29 **27.45.20 **27.45.30	Sistan&Baluchistan	*indication **malachite,Cu-carbonate

No.	Name	B&H	Aba.	Vat.	Mom.	Longitude (*/ **)	Latitude (*/ **)	Province	Mineralization (*/ **/*****)
73	مه گلی Meh Geli Meh Guly* Mehguii	200c	22		71	*59.42.30	*27.41.00	Sistan&Baluchistan	*indication
74	قیراوان Giravan Jiravan**	207	57	154		*60.50.30 **60.42.00	*27.03.00 **27.01.35	Sistan&Baluchistan	*Cu-carbonate,Fe-oxide
75	شووه Shoveh	203	58	151		*59.58.00	*29.23.00	Sistan&Baluchistan	malachite,azurite
76	شیخ عالی Sheykh Ali	210	23	148	64	*56.45.30	*28.08.00	Hormozgan	****malachite,pyrite,chalcopyrite,sphalerite
77	رونیز Rouniz (Kohneh Mes) Roniz** Ronyz1**	211	40			**53.39.00 **53.30.00	**29.22.00 **29.30.00	Fars	**malachite
78	کوه مس Kuh Mes		115		48	**53.42.00	**29.18.42	Fars	
79	گازو Gazou Gazo(1-3)** Gazu** Gazu**	132	5	99	32	*57.21.30 **57.30.00 **57.23.30(1-3)	*33.10.00 **33.30.00 **33.12.20(1-3)	Yazd	*chrysocolla,malachite,turquoise,chalcopyrite, chalcocite,magnetite **malachite,chalcocite,magnetite,chalcopyrite, azurite,hematite,chrysocolla,
80	مهدی آبد Mehdiabad Mahdiabad1** Mehdyabad**	146	43	117		*55.24.30 **55.01.00	*31.16.00 **31.30.30	Yazd	*calamine,cerrusite,anglesite,sphalerite,galen a,pyrite,chalcopyrite,hematite,limonite, malachite
81	به آباد Buhabad Bahabad* Bahabad** Bahabad1**	147	44	111(?)		*56.10.00 **56.56.00 **56.55.20	*31.50.00 **31.55.00 **31.54.30	Yazd	*chrysocolla,limonite

No.	Name	B&H	Aba.	Vat.	Mom.	Longitude (*/ **)	Latitude (*/ **)	Province	Mineralization (*/ **/*****)
82	نریگان Nerigan Narigan** Narygan**	148	45		44	*55.25.00 **55.45.30	*31.52.00 **31.45.30	Yazd	*indication **limonite,malachite
83	تنگ چنار Tang Chenah/r Tang Chenah**	156	46	116	42	*54.19.00 **54.22.00	*31.20.00 **31.22.30	Yazd	*malachite,azurite,limonite
84	خوت Khut* Khut**	158	47	113	41	*53.43.30 **53.42.30	*31.53.30 **31.53.00	Yazd	*/**Cu-oxide,Cu-sulphor,chalcocite, chalcopyrite
85	خشومی/ خشامی Koshami Khoshomy*	149	48		43	*55.09.30	*32.24.30	Yazd	*Cu+ (?),malachite,azurite,pyrite,hematite,limonite, jarosite
86	مزرعه میرها Mazrae Mirha Mazrae Mira* Mazraeh-e Mirha1** Mazra-e Mirha** Mazra-e-ye Mirha**	157	49	110		*54.35.00 **54.16.00 **53.44.00	*32.37.00 **32.26.00 **31.57.00	Yazd	*Cu+(?),pyrite,chalcopyrite,chalcocite, malachite,azurite,limonite,hematite
87	خرانق Kheranagh Kharanaq1** Kharanegh**	155a	50			*54.40.00 **54.44.00 **54.43.00	*32.20.00 **31.51.20 **32.21.00	Yazd	*chalcopyrite,chalcocite,Cu-carbonates
88	چاه ختاب ندوشن Chah Khatab Nodushan Chah-e Khatab**	159	78	112		**53.13.00 **53.20.00	**31.49.00 **31.50.00	Yazd	
89	کلوت چاه Kalute Chah*	152	91	109		*55.22.00	*32.57.00	Yazd	*chalcopyrite,sphalerite,galena,Cu-Carbonate
90	گل منده Gelmandeh(1-2) Jelmandeh**	150	107			*55.27.00(1) *55.27.30(2) **55.27.00	*32.41.30(1) *32.42.00(2) **32.40.00	Yazd	*Cu+(?) *Cu-carbonates
91	سربالا Sarbala*	151	108			*55.45.00	*32.52.00	Yazd	*Cu-carbonates

No.	Name	B&H	Aba.	Vat.	Mom.	Longitude (*/ **)	Latitude (*/ **)	Province	Mineralization (*/ **/*****)
92	مزرعه حاجی حسن Mazrae Hadji Hasan** Mazrae Hadji Hasan1**	155b	110			*54.44.00 **54.16.00 **54.44.30	*32.10.00 **32.26.00 **32.32.00	Yazd	*chalcocite,Cu-carbonates
93	چاه پلنگ Chah Palang1** Chahe palange(2-3)**	97	51	68	29	*54.12.00 **54.11.30 **54.31.00 **54.30.00	*32.58.00 **32.59.00 **32.31.00 **33.59.00	Esfahan	*indication **chalcopyrite **chalcocite
94	چاه میله Chah Mileh Chahe Milah(1-3)**	89	52		27	*53,49,00 **53.32.00 **53.48.30 **53.30.00	*33,25,00 **33.31.00 **33.26.00 **33.31.00	Esfahan	*indication **chalcopyrite (1)(2)(3)
95	تلخه Talkh* Talheh (Anarak)** Talkhah(1-4)**	81	53		24	*/**53.35.00 *53.38.30 **53.35.00 **53.30.00 **53.34.39 **53.34.36	*/**33.20.00 *33.22.00 **32.20.08 **33.30.00 **33.20.10 **33.20.18	Esfahan	*Cu,Ni,Co **malachite(1)(2)(3)(4)
96	تل مسی Talmesi** Talmesi(1-3)**	80	54	60	26	*53.27.00 **53.32.00(1) **53.27.30(2) **53.26.54(3)	*33.23.00 **33.30.00(1) **33.22.40(2) **33.23.30(3)	Esfahan	*Cr,Cu,Ni,Co,Bi,U,Pb,Ag,Fe,Mn,Au, nickeline,almatine,cobaltite,native copper, terbernite **malachite(1) **chalcopyrite(2)(3)
97	کپه حلوایی Kopeh halvaee*****	86	55	63		*53.33.00 **53.32.52	*33.48.00 **33.46.59	Esfahan	malachite, chalcopyrite,cuprite,native copper
98	سبرز Sebarz*****	84	61					Esfahan	pyrite,chalcopyrite,chalcocite,galena, arsenopyrite,chrysocolla,Ni-arsenides
99	کیاز تکتکه Kayaz (Tekteke)***** Taktakeh (Kiaz)**	76a	79	55		**52.42.30	**33.09.30	Esfahan	chalcopyrite,cuprite,malachite,azurite
100	فاطمه علیشاه Fatemeh Ali Shah	76b	80	56		**52.48.30	**33.05.00	Esfahan	*chalcopyrite, malachite, azurite
101	کوه سنگ مس Kuh Sang Mes Kuh-e Sang-e Mes**	77b	81	58		*52.54.00 **52.45.20	*33.05.00 **33.11.00	Esfahan	*pyrite, chalcocite, malachite

No.	Name	B&H	Aba.	Vat.	Mom.	Longitude (*/ **)	Latitude (*/ **)	Province	Mineralization (*/ **/*****)
102	سنجدو Senjedu**	77a	82	57		*52.55.30 **52.50.00	*33.12.30 **33.10.30	Esfahan	*Pb,Zn,Cu, chalcopyrite, galena, sphalerite, malachite, azurite,cuprite
103	مسکنی Maskany(1-2)**	79	83	59	25	*53.33.00 **53.30.00 **53.28.00	*33.24.00 **33.30.00 **33.19.00	Esfahan	*ore *Cr,Cu,Ni,Co,U,Bi,Au,Pb,Zn,Ag,Fe,SB,Mn, Cu-minerals,pyrite,chalcopyrite,chalcocite **chalcopyrite
104	قبله Qeblah(1-3)** Qebleh**	82	84	61		*53.26.00 **53.30.00 **53.26.00 **53.25.26 **53.26.13	*33.28.00 **33.30.00 **33.27.00 **33.28.12 **33.28.13	Esfahan	*Cu,Ag,Au,U,As, chalcocite, malachite, calcite **malachite(1)(2) **chalcocite(3) **chalcocite, chalcopyrite
105	چشمه چاه سفید Cheshmeh Chah Sefid Chahe sefid1** Chahe sefid2** Chahe sefid3**	85	85	62		*53.31.00 **53.30.00 **53.31.00	*33.33.00 **33.30.00 **33.36.30	Esfahan	*hematite, malachite **malachite(1)(3) **chalcocite
106	کان مس Kan Mes Mes Kani(?)* Kan Mes(1-3)**	83	86	64		*53.33.00 **53.30.00 **53.33.40(2)(3)	*33.24.00 **33.30.00 **33.24.00(2)(3)	Esfahan	*Cr,Cu,Ni,Co,U,Bi,Au,Pb,Zn,Ag,Fe,SB,Mn, Cu-minerals,pyrite,chalcopyrite,chalcocite **chalcopyrite(1)(2) **malachite(3)
107	جامنی Jameni Jameny**	92	87	67		**54.13.40	**33.26.35	Esfahan	**chalcopyrite,malachite
108	رسور Rasour Rasor(1-3)** Rasur**	88	88	65		*53.43.00 **53.30.00 **53.43.20 **53.43.57	*33.24.00 **33.30.00 **33.23.30 **33.23.36	Esfahan	*Cu,Ni,Co, chalcocite, chalcopyrite, malachite bornite, Fe hydroxide **chalcocite **chalcopyrite(2)(3)
109	کل کافی Kale Kafi Kal kafi** Kal kafi(1-2)** Kalkafi**	96	89	66		*54.13.00 **54.14.00 **54.30.00 **54.31.00	*33.25.00 **33.24.00 **33.30.00 **33.30.00	Esfahan	*Cu/Mo **chalcopyrite(1)(2)
110	سر گدار سرخ Sar Gudar Sorkh(1-2)	153	90	108		*54.57.00 *55.00.00	*33.19.00 *33.18.00	Esfahan	*malachite(2)

No.	Name	B&H	Aba.	Vat.	Mom.	Longitude (*/ **)	Latitude (*/ **)	Province	Mineralization (*/ **/*****)
111	جعفری Jafari Jafari(1-2)**	90	99			*54.08.00 **53.32.00 **54.09.00	*33.32.00 **33.30.00 **33.23.00	Esfahan	*ore **chalcocite **malachite
112	تالارجی Talarji	91	100			*54.06.00	*33.31.00	Esfahan	*limonite, cerrusite, malachite, gold
113	خونی Khouni(1-2) Khoni1** Khuni (Copper)**	93	101			*54.01.00 *54.11.00 **53.31.00 **54.14.00	*33.28.00 *33.27.00 **33.30.00 **33.26.00	Esfahan	*Cu, Pb, Au **limonite, galena, pyrite, chalcopyrite, cerrusite, malachite **chalcopyrite
114	کنجیرود Konjirud*****	95	102					Esfahan	*****chalcopyrite,pyrite,hematite,limonite, galena,molybdenite,malachite,wulfenite
115	دو چاه حو Do Chah*****	94	103					Esfahan	*****pyrite, chalcopyrite
116	تل سیاه Tall Siah Tal Siah**	154	109			*54.57.00 **54.58.59	*33.23.00 **33.24.11	Esfahan	*ore **chalcopyrite
117	باغ قروغ /باقروق Bagh Ghorogh Baghroghe(1-3)** Bakruk** Baq Qoruq** Baghrough*****	87	114 56		28	*53.48.00 **53.32.00 **53.48.00 **53.45.23 **53.37.00	*33.34.00 **33.31.00 ** 33.35.20 **33.35.45 **33.35.00	Esfahan	*ore **malachite(1)(2)(3) **chrysocolla,azurite,malachite,chalcocite, cuprite

Baz./Hüb. Bazin Hübner 1969 **Aba.** Abasnejad 2003 **Vat.** Vatandoust 1999 **Mom.** Momenzadeh 2004
*http://www.gsi.ir/Images/WEBMINE/cu/cu.htm **http://www.ngdir.ir/MiningInfo/CopperMIO.asp?PID=13&Submit=Go&PDataType=&offset=0
****Bazin & Hübner 1969 ****Rastad et al. 2002 *****Abasnejad 1994*

Chapter 4: Metallurgical workshop areas at Shahdad

4.1. The so-called "Metallurgical workshop"

4.1.1. History of the dig

After the first seasons of archaeological work and due to the apparent lack of architecture on the dissected alluvial fan of the Derakhtangan river, it was generally assumed that cemeteries A, B and C belonged to a nomadic, non-sedentary community.[441] Comparable information, in fact, was given for the graveyards in the Posht-e Kuh and Pish-e Kuh regions in the Luristan province (western Iran): for example, for the EBA graveyard of Bani Surmah.[442] During the last field season, Sandro Salvatori and Massimo Vidale, two members of the Italian team who worked at that time at Shahr-e Sukhteh in Iranian Sistan, joined the team at Shahdad in January 1977 and for more than a month conducted an intensive surface survey of the surroundings of the main cemetery sites.[443] Thus they identified Site D, an area located northeast of the excavated graveyards where the action of the wind had naturally excavated a cluster of mud-brick rooms. The walls, here, emerged from the eroded sandy subsoil for ca. 3-4 courses of bricks; parts of the buidings had evidently collapsed as complete walls of fallen mud bricks lay on the ground, still retaining their original lay-out. In some rooms, rows of coarse cylindrical mud jars (hereafter called *tapou*-jars) were visible, one of which retained, beside it, its clay lid.[444] The surface was densely covered with gravel, residual lenses of sand, many pottery shards and lithic debitage; a white marble cylinder seal with an eagle with spread wings and two unfinished cylindrical rough-outs in chlorite were collected on the spot. At the time, contrary to what is frequently reported, on the surface there were no indicators of metallurgical activities evident, with the exception with a few slag fragments that are uniformily scattered by alluvial processes and erosion all across the site.[445] Following these discoveries, Site D was chosen by the colleagues of ICAR for immediate excavations; these were directed by A. Hakemi and M.E. Bayani. According to the excavators, by the

441 Vidale 2008a: 535f.
442 Haerinck & Overlaet 2006.
443 Salvatori 1977, 1978: 6; Salvatori & Vidale 1982.
444 Salvatori & Vidale 1982: fig.10, fig.11.
445 Salvatori 1977: 3 (Point 8).

end of this campaign, a house composed of five units, or perhaps an irregular cluster of smaller dwellings, for a total of 29 to 30 rooms was exposed.[446] (see fig.19, 31, 32)

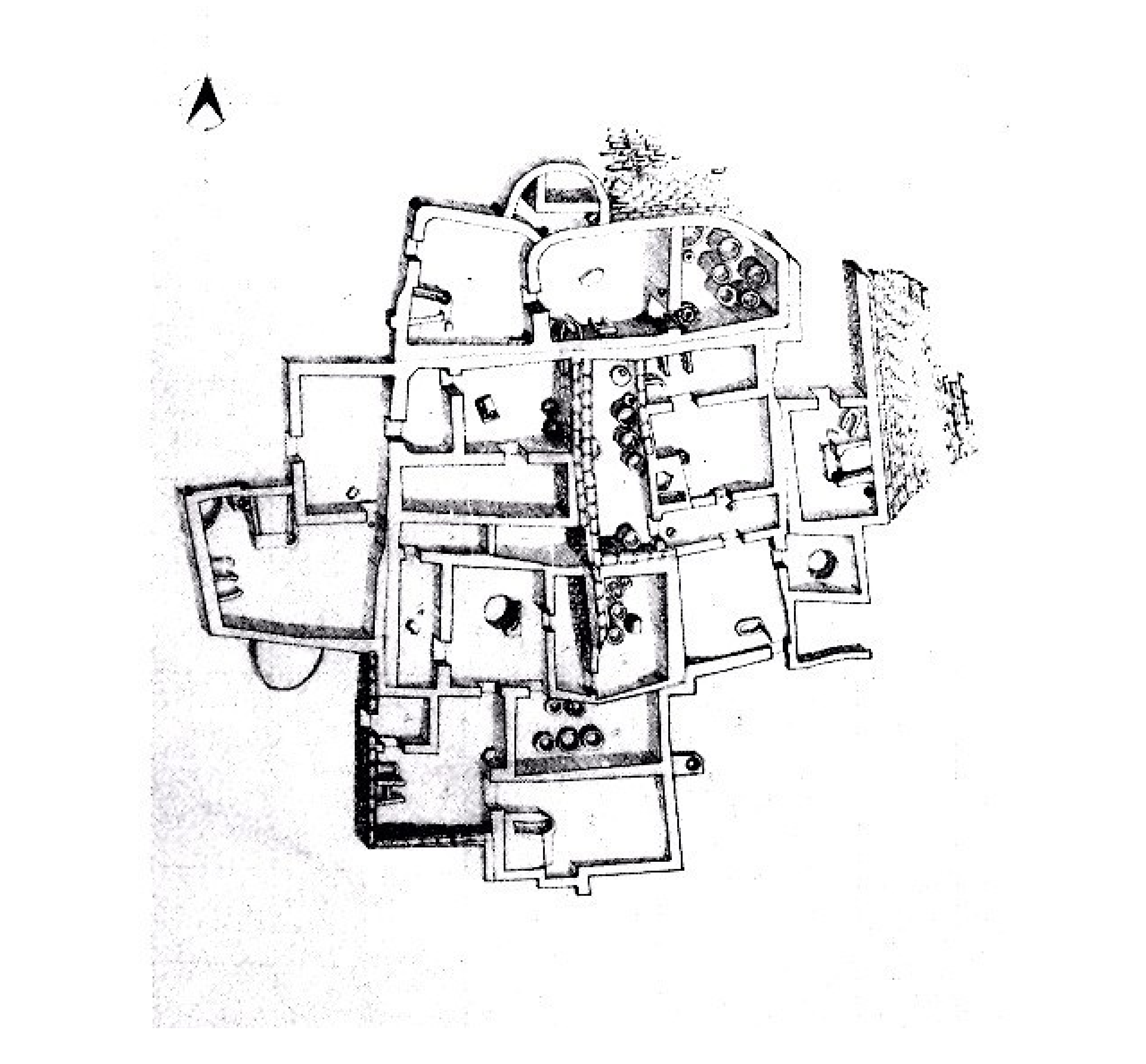


Figure 19: Architectural plan of the Site D at Shahdad by Taj al-Dini (1977)

446 While Bayani in his thesis mentions an amount of 29 rooms (Bayani 1979: 37f.), Hakemi first identifies a total of 29 Rooms in his SAA 1991 report (Hakemi 1992: 119) and then 30 rooms in the final report (Hakemi 1997: 85ff.).

4.1.2. Documenting and interpreting the architectural complex[447]

As stated above, the so-called workshop appears to be composed of five units of different size, labeled Units 1-5.[448] The walls are constructed with different techniques: by using blocks of rammed earth called in farsi *chineh* and/or with mud bricks of different size. The basic ground plan of each unit is rectangular; one exception is the erection of small rounded walls in the northern and southwestern parts of the building, as though these units were added or renewed in a later phase. It is also noteworthy that all entrances into the building are opening to the south and west, possibly to keep windblown sands out of the living spaces. This adaptation may have been due to the constant heavy winds during the hot summer months from the north-northwest.[449]

In the following sections, different descriptions of the “metallurgical workshop” will be presented and critical evaluated. This review required a painstaking work of recording and matching every single bit of information from different reports written in English, Farsi and Italian. The results, here presented in forms of text accompanied by different architectural and distributional maps for the same contexts, will therefore demand noticeable attention from the reader.

In fact, the original report by M. Bayani, the excavator, was written in Italian and is still unpublished, as it was an MA thesis submitted to the University of Rome, “La Sapienza”, in 1979 under the tutorship of A. Palmieri. The versions that have been published, in contrast, are due to the director of the Shahdad project, engineer A. Hakemi, who, in later works, summarized and systematized the evidence, re-drafting the map and promoting his interpretation of the excavated complex as an important specialized urban workshop for intensive copper smelting and melting.

In this chapter, A. Hakemi’s version and documentation will be presented first, as they are the information corpus that has so far entered and influenced the archaeological bibliography (mainly through the monographic volume edited by IsMEO, now IsIAO, Rome). There is an immediate terminological problem in Hakemi’s as well as Bayani’s descriptions, because both Authors, given the methods available at the time, somehow freely used different terms (among which kiln, furnace, primary or secondary melting, first and second step kilns, crucible, melting pot, cast copper and/or oxidized copper

447 Preliminary note: Some of the artefacts mentioned in the different reports, like pottery vessels found insie other containers or bigger vessels are not reproduced in the gereral map for the purpose of clarity.

448 Bayani 1979: 39ff.; Hakemi 1992: 121f., fig. 15.3, 15.4.

449 Meder, 1979: 66f. 77;

fragments, granulated slag, etc. are found). These labels, today, do not appear particularly informative because, in spite of their strict technical implications, at the time they were generally used by everybody without the necessary details and not out of firmly set or archaeometrical evidence, thus adding uncertainty to the available records. In particular, it is hard to understand exactly what the excavators meant with "pulverized copper" and similar expressions. It might be crushed copper ore but also ground slag material, assuming the theoretical possibility of the recycling of older slag as a source of copper or flux. As we shall see, the metallurgical site sampled in 2009 (see Figures 50 to 52) was most probably used for smelting copper ores, whose residues are analyzed in Chapter 5, but in principle the recycling of slag in this "workshop", given the absence of samples of the worked material, cannot be excluded.

As a second step, such versions will be compared with the written and drawn observations of M. Bayani, the original excavator; then, information provided by both reports will be evaluated critically, to be later combined into a final hypothesis of reconstruction. As we shall see, although the two versions, in general, are consistent and to a great extent have a good match, there are some omissions and discrepancies that may suggest an opportunity for new interpretations.

4.1.2.1. Hakemi´s model[450]

4.1.2.1.1. Unit 1/I ("Complex A")

Unit I, in Hakemi's interpretation, is composed of five rooms (R. 1-4 and 30) located in the north of the construction (see Figure 20). The unit´s main entrance is by an opening in the Western wall of R. 1. The walls were erected with *chineh*, covered inside with a plaster of *kahgel*, a chaff-tempered clay coating. A pyrotechnical installation of rectangular shape attached to the western wall, another small "furnace" located on the Northern wall and some granite blocks or slabs were found inside this room.[451] In R. 2, a large slab of granite was found in central position on the floor; probably the large stone was used for crushing

450 The following description is based on the two reports and general information published twice by Ali Hakemi (Hakemi 1992, 1997).

451 In this Room, Hakemi also mentions a crucible and mudbrick debris (Hakemi 1992: 124, fig. 15.5 and 10). However, these finds are not reported in the report's excavation plan nor in his report of 1997. The smaller oven or furnace is only described in the 1997 report but it does not figure on the general plan or in any included photograph (Hakemi 1997: 91). But as it is lacking of vitrification on the inner surface it seems debatable if it was used in pyrotechnical activities.

and/or grinding ores. To the south, directly attached to the wall, were found the remains of two ovens or small furnaces, next to each other. The inventory of the finds in this room record fragments of coarse red and buff ware pottery, a clay seal as well as a piece of carnelian, but the objects were not precisely located in the map.[452] R. 4 can be accessed by a narrow opening in the southern part of the eastern wall of R. 2. The inventory of R. 4 is composed of a storage container in the north western corner, six big jars of unbaked clay sunk into the floor, two decorated vessels and another mud storage container in the northwestern corner.[453] These jars might be identical with the so called *tapou*-style storage vessels also discovered by M.A. Kaboli during his excavation of another part of the settlement in the 1990s.[454] Inside at least some of the storage vessels fragments of copper ore (mineralogically not identified) and a orange-coloured agate bead were found.[455] Further metallurgical waste was also found on the room´s floor and inside both of the decorated vessels.[456] Next to a large vessel distinguished by a snake-like decoration Hakemi mentions a “...rounded stone with a hole...”.[457] Due to its position next to the entrance, this artefact can be interpreted as a temporarily displaced door-socket. R. 3, the northernmost room of this unit, is located to the north of R. 1 and R. 2. While the room´s curved outer wall is made of *chineh*, the inner separating walls are made of mudbricks. Because of its limited extension, and the reported presence of copper ore fragments, R. 3 is interpreted by Hakemi as another storage area.[458] The last room of this unit, R. 30, is located to the west of R. 1. Due to its strongly eroded state, the reconstruction of its original shape was partially conjectural. On the floor were found two elliptic cavities of different size. As the larger one contained “copper fragments” both cavities were interpreted as small furnaces for secondary melting and casting processes.[459]

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452 Hakemi 1997: 91f.
453 Hakemi 1997: 92f.
454 Kaboli 1997: This installations are interpreted as storage containers that were used as bins for storing cereals or other vegetable foodstuffs (Maleki 2003: 361 "تاپو").
455 Hakemi 1997: 93.
456 According to Hakemi, these residues were "oxidized copper” and "iron slag" (Hakemi 1997: 92).
457 Hakemi 1997: 92.
458 Although mudbrick debris is visible on the photography of R. 4 (Hakemi 1997: 93, fig.57) it is not reproduced on the general map.
459 Hakemi 1997: 93.

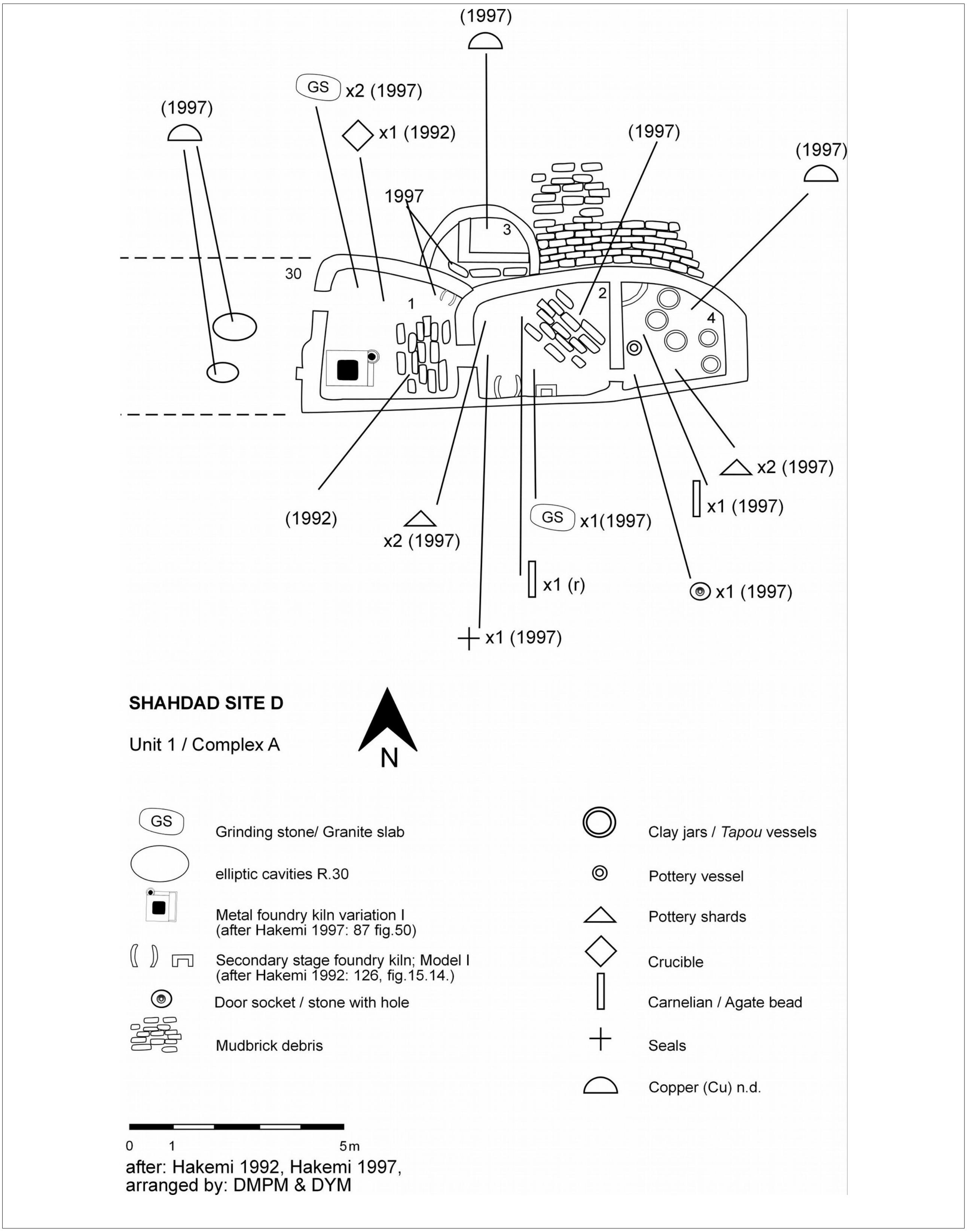


Figure 20: Unit 1, Rooms 1 to 4 and 30 (according to Hakemi 1992 and 1997).

4.1.2.1.2 Unit 2/II ("Complex B")

The second unit is formed by Rooms 5, 6, 7, 8, 24, 25 and 29 (see Figure 21). It is located to the south of R. 2 and R. 4 of Unit I. In rectangular R.5 the walls are made of mud bricks lain flat. In the southwestern corner there is a small area paved with pebbles and partly enclosed by a curved small *chineh* wall; this space is interpreted as a storage unit. A "...short high bench..." appears along the eastern wall.[460] The remains of a small installation are also mentioned. It consisted of two parallel north-south oriented narrow *chineh* walls attached to the northern wall on the opposite side of the storage area.[461] Next to it a red ware vessel was found. The doorway leading to R. 6 opens in the southern wall. R. 6 is almost square, and in its south-eastern corner the excavators unearthed the remains of another pyrotechnical installation similar to the examples in R.1, R. 13, R. 27 and R. 28.[462] The small narrow space between this installation and the southern wall was closed by a small wall, thus creating, according to Hakemi, a fuel storage space. Nearby, a plain jar was set on the floor[463], together with another crucible.[464]

R. 7 was accessed by a doorway in the southern wall of R. 6. This room´s inventory lists a narrow mouthed jar, a red ware jar, a rectangular stone tool (probably another grinding stone) and a crucible.[465] This room can be seen as a passage way to R. 8 to the east and to R. 24 to the South. R. 8 is a rectangular, north-south oriented narrow room described by Hakemi as another storage facility due to many *tapou*-style clay vessels and other containers of red and buff ware pottery.[466] On the floor residues of the different stages of

460 This bench is only mentioned in the text and unfortunately not clearly recognisable in the photography (Hakemi 1997: 95, fig.59).

461 This installation is reproduced on the general plan and appears in the photograph of fig. 59, but in Hakemi 1997a written description is missing. It was casually mentioned as a furnace during the SAA conference contribution in 1989 (Hakemi 1992: 124).

462 Hakemi describes this installation as a "first stage (smelting) furnace/kiln" or a "metal foundry kiln" (Hakemi 1992: 125, fig.15.11, 12; Hakemi 1997: 87, fig. 50; fig.54).

463 Hakemi 1997: 95.

464 Hakemi 1992: 124.

465 Hakemi 1997: 95. Hakemi 1992 only mentions the crucible at p. 124. Another interesting artefact, neither mentioned on the general map nor in the report, is a small cylindrical bowl of incised grey ware bearing a "hut-motive" decoration. On the photograph one sees the cyndrical shape of the pot, while it is mentioned as having a "...rectangular cubic shape..." (Hakemi 1997: 558, 707, Wa.4, Obj. No. 4449). There are also legitimate doubts concerning its base material. In Hakemi´s catalogue it is described as a "... grey colour chlorite vessel...". The information cannot be verified on the base of the photograph. In Bayani´s dissertation the same item is described as "...un frammento di un recipiente in ceramica grigia incisa..." and a reproduction can be found in the attached pottery report (Bayani 1979: 45, 75, fig. 6). An almost identical piece, also made of ceramic, is known from Bampur, Layer 12 (Sajjadi 2005: 380 پ). For the moment there is no way to prove this specific statement.

466 The different vessel types vary from a list of eight vessels of indefinable shape on the general map (Hakemi 1997; 90, fig.54) to "...five clay jars...(and)...some samples of red and buff pottery vessels..." in the report (Hakemi 1997: 98).

copper metallurgy such as oxidized copper and copper slags were recorded.[467] Attached to the Western wall in a central position a curved installation similar to the storage facility in the north western corners of R. 3 as it was documented in the earlier of Hakemi´s reports.[468] The next room of this unit is R. 24, just south of R. 7. Like R. 6, it is almost square. To the north-east there is a doorway to R. 25, and to the south-east a passage way to R. 29. Inside R. 24 an elliptical oven or furnace was excavated next to the southern passage way. A painted red ware vessel was found nearby. Under the northern wall, three buff ware jars laid on a layer of ash and charcoal.[469] R. 25 is located to the east of R. 24. It contained quantities of ash, copper fragments and painted pottery around an inverted jar set in the centre of the floor.[470] The last space of this unit, R. 29, is visible south of R. 24. Its southern wall was damaged heavily by the erosive action of the local winds. The room ´s inventory consists of a "...short high bench with two holes..." in the south western corner, an unknown amount of "...melting pots in the northern corner..." and two pottery jars of tapou vessels.[471]

467 Hakemi 1992: 128. In the later report fragments of oxidized copper are mentioned as the only finds of metallurgical activities in this room (Hakemi 1997: 98).

468 Hakemi 1992: 121, fig.15.3. It is only reproduced on the general plan without any further description.

469 Hakemi 1997: 98. Perhaps we are dealing here with smelting crucibles similar to Bayani´s description (Bayani 1979: 46). An unknown number of crucibles is also mentioned in Hakemi 1992: 124 as belonging to this Room's inventory.

470 Hakemi 1992: 128; Hakemi 1997: 99.

471 Hakemi 1997: 99. All information concerning the room´s inventory are only mentioned in the report, while the precise location of the objects is not marked on the general map (Hakemi 1997: 90, fig.54). The only exception is the "...short high bench with two holes..." which is marked on the plan but just with one hole and its position was set outside of Room 29. On the general map of Hakemi 1991 there is only a bench with one hole reproduced. The course of the southern wall of Room 29 is missing (Hakemi 1992: 121, fig.15.3) and just one crucible is recorded for this room (Hakemi 1992: 124).

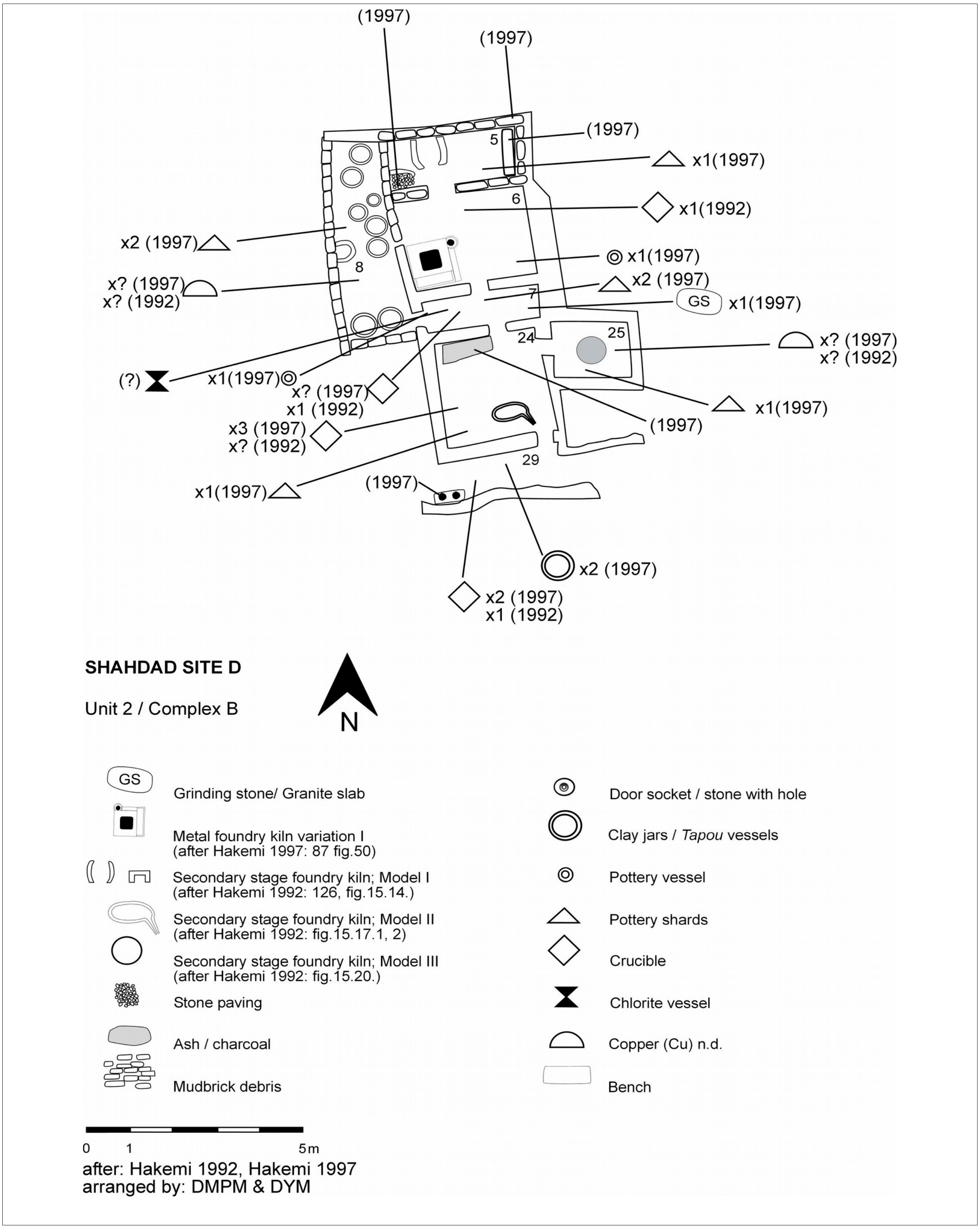


Figure 21: Unit 2, Rooms 5 to 8, 24, 25 and 29 (according to Hakemi 1992 and 1997).

4.1.2.1.3. Unit 3/III (complex C)

This unit is composed of the rooms 9 to 13 (see Figure 22). The access to this complex is provided by an entrance in the western wall of room 12. R. 12 and R. 13 were added at a later phase to the Rooms 9 through 11. The Room´s inventory enlists a “...smoothed stone...” found near the southern wall; this is the only item marked on the general map.[472] Other artefacts, like a crucible or a pottery jar are only mentioned in the reports.[473] To the south-east of the Room, a doorway opens into R. 13. The latter has an irregular layout. Attached to the northern wall there are the remains of a rectangular pyrotechological installation similar to the one excavated in R. 6. A crucible was found next to it. Nearby, there was a small bench covered with pottery fragments, charcoal and ash; another storage area appears in the north-western corner, comparable to that of R. 6. Along the western wall there are a ”... narrow rectangular shaped space...(and)...another small kiln...” next to each other. Inside the former a rounded stone tool and a buff ware vessel were found.[474] Unfortunately both items are not mapped, though they are clearly identifiable on the photograph.[475] The “...small kiln...”, described as a “secondary melting kiln” consists of two high wide walls connected by a roof.[476] Further south, another enclosed storage area covers the south-western corner of this same Room; it looks similar to the installation in R. 3. Next to this “kiln” were recorded fragments of granite tools and a buff ware vessel.[477] Lastly, a red ware pot was found in the centre of the room.[478] Outside this southern Room was a curved bench. R. 11 can be entered through a doorway on the western wall that can also be seen as the eastern limit of R. 12. According to the general map of 1992, nothing was found inside this room. In contrast, the 1997 report mentions mudbrick debris, “...plain and painted buff ware …“ and two pottery plugs[479] for “...plugging the flues for molten metal”, but it is not clear which flues exactly are in question. Due to their shape such items are also comparable to plugs for axe moulds, also missing in this

472 Hakemi 1992: 121, fig.15.3; Hakemi 1997: 90, fig.54. It is plausible to identify the “...smoothed stone...“ as a granite tool for grinding or crushing copper ore.
473 For the crucible see Hakemi 1992: 124; for the pottery jar see Hakemi 1997: 101.
474 Hakemi 1997: 101ff.
475 Hakemi 1997: 102, fig.68.
476 Hakemi 1997: 102.
477 One of the stones is described as of elliptical shape (Hakemi 1997: 102). This might be an indicator for its identification as a grinding stone too. Unfortunately it cannot be proven because there are no photographs or mentions on the general map.
478 In contrast to the report it is clearly visible on the photograph that this vessel was dug into the floor (Hakemi 1997: 102, fig.68).
479 Hakemi 1997: 101,707, Wa.2.

case.[480] The first of Hakemi´s reports states that a crucible was the only find.[481] Access to R. 9 was provided by a doorway in the northern part of the eastern wall. This room is of an almost square shape. The general map here shows a “secondary stage foundry kiln, model IV”[482] and two clay jars. Furthermore, here an axe mould comparable to a specimen found at Arisman/ Siyah Boum[483], another *tapou* and pottery fragments were found.[484] The doorway towards R. 10 opens in the centre of the southern wall. This room is narrow and rectangular, and according to the general plan was void of finds; while the text, besides red and buff ware shards, mentions some polished stone tools accompanied by residues of copper ore, “flint implements” and a small bi-partite chlorite vessel.[485] A layer of ash came to light along the southern wall towards its eastern corner.[486]

480 See for comparison from Tappeh Ghabristan: Madjidzadeh 2008b: 178, pl.20c
481 In contrast, the 1997 report is naming mud brick debris, “...plain and painted buff ware …“ and two pottery plugs (Hakemi 1997: 101). The plugs (Hakemi 1997: 707, Wa.2) are explained to been used for „...plugging the flues for molten metal“. Where flues need to be plugged, stays unanswered. (Hakemi 1992: 124).
482 Hakemi 1992: 127, figs..15.16 & 15.17.1.2 (R.9).
483 Helwing 2011: 317, fig.89 (287). Siyah Boum (engl. “black soil”) is the local name of the archaeological site. (Malek Shahmirzadi 2004: 359f.)
484 Hakemi 1992: 127, figs.15.18 & 15.19.a.b. (R.9); Hakemi 1997: 100.
485 For the chlorite vessel see Hakemi 1997: 560, 707, Wa.3 (Obj. Nr.4472).
486 Hakemi 1992: 128.

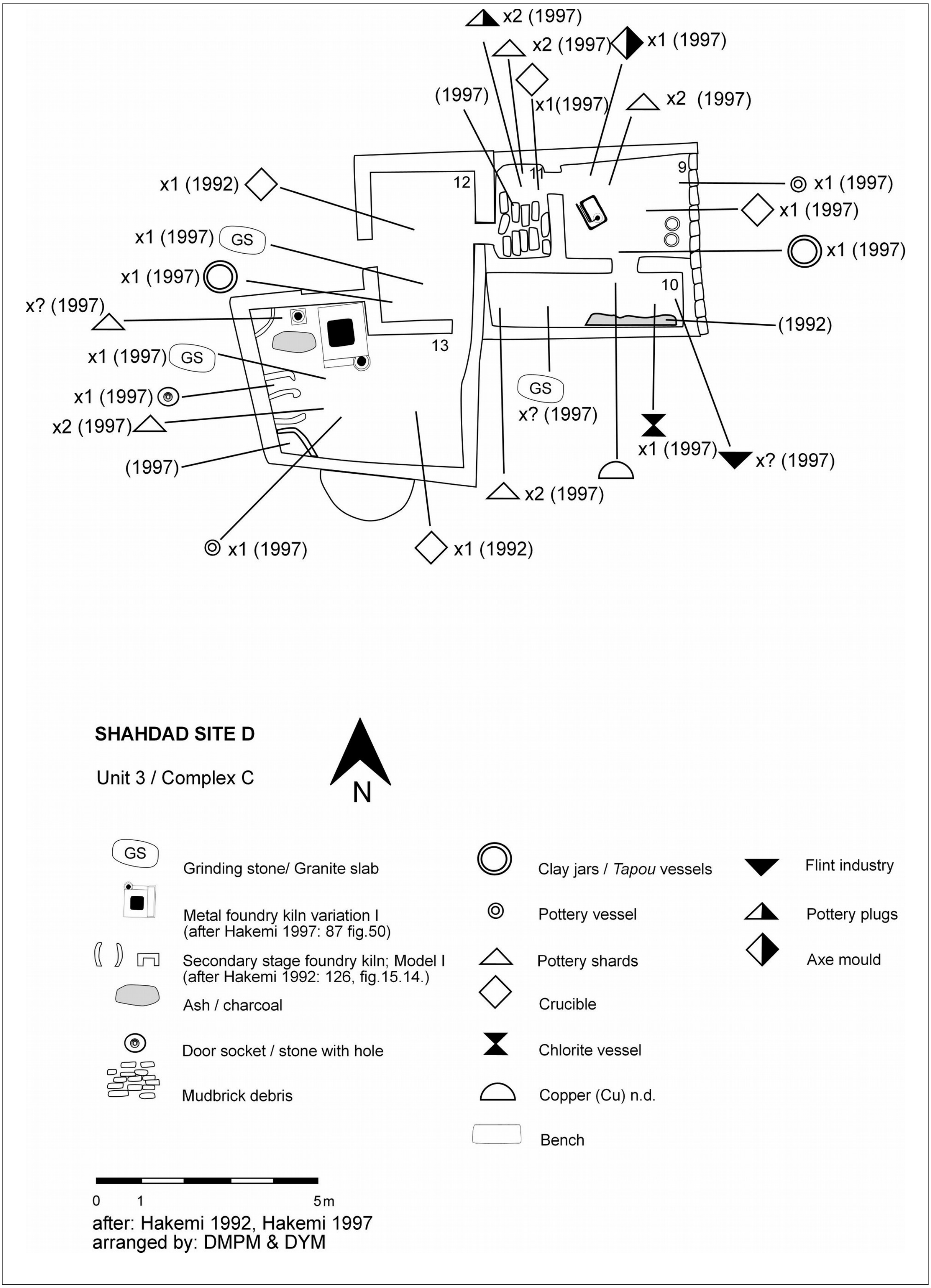


Figure 22: Unit 3, Rooms 9 to 13 (according to Hakemi 1992 and 1997).

4.1.2.1.4. Unit 4/IV (complex D)

As the largest architectural complex, Unit 4 is composed of 11 rooms in total, identified by numbers 14 to 23 and 27 (see Figure 23). It can be also divided artificially into a northern and a southern part, the northern consisting of R. 14 to R. 18 as well as of R. 23; and the southern of R. 19 to R. 22 and R. 27. Rooms 14 and 17 are the northernmost ones of this unit. They are narrow, rectangular and have an almost identical east-west orientation. Both Rooms were empty. The only remarkable feature is their small separating wall. R. 17 has no access, while R. 14 is connected to R. 15 by a narrow doorway to the south-west. The walls of R. 15 are made of mud bricks. While the only item recorded on the general map is a big granite slab[487] the report mentions some coarse red ware vessels, fragments of painted pottery and an ashy accumulation along the western wall.[488] The adjoining R. 16 was accessed by a doorway on the eastern wall. This central Room, along the western wall, contained collapsed mud brick debris, while in its centre a “...small kiln for secondary...melting, similar to the kiln on R. 9 was found”.[489]

On its eastern wall there is a little opening giving access to R. 18, a narrow rectangular space built with mudbricks. On the floor fragments were discovered of buff, red and painted pottery as well as beads of chlorite and carnelian. Although not positioned on the general map, such finds are listed in Hakemi’s report.[490] Southeast of this Room, another narrow doorway connects it to R. 23, also built with mud bricks. On the general map here appears a total of six clay containers, three of them unmistakably *tapou*-jars. This evidence is contradicted by the mention in the report of “...five clay jars with covers and buff ware jars and a cylinder seal...”.[491] Further “...unidentified clay artefacts...” similar to plugs are in the same list.[492]

The small-sized rectangular R. 19 has two doorways on the western and southern walls. The western one leads outside of the compound, while the southern one opens onto R. 21. Its walls are built with mudbricks.[493] R. 20, to the east of R. 19, contained a small

487 This granite slab can be identified properly by the photography (Hakemi 1997: 103, fig.70)

488 Hakemi 1997: 104.

489 Unfortunately this statement cannot be proven positively by the comparison with the published photography where just a circular pit can be identified (Hakemi 1997: 104f., fig.71).

490 Hakemi 1997: 104.

491 Hakemi 1997: 107. There is some inconsistency concerning the inventory. Although buff ware jars are described in the report the only pottery object which is reproduced in the catalogue is one“...large red ware bowl...“ which is not of any similarity to the described buff ware jars (Hakemi 1997: 706, Vl.2, Obj. no. 4495). Likewise any reproduction of a “cylindrical seal“ is missing which would help for the identification.

492 Hakemi describes these artefacts as being “...used to plug kiln flues...“ (Hakemi 1997: 107).

493 “...a bench...with a round hole in its centre...“ which was situated on the northern Wall is also described without any mention on the general map (Hakemi 1997: 104).

bench to the south-east and some plain buff ware vessels. To the south-west it leads to R. 21 where another “...secondary stage...kiln...” was discovered near the western wall. To the north, one sees another enclosed narrow installation. Due to its proximity to the “kiln” and because of its shape this installation might have been used as a fuel storage facility; it was partially filled by abundant mud brick debris. In Hakemi 1992 there is also the description of a crucible found inside this Room.[494] It is possible that R. 19, 20 and 21 originally were a single square space, later subdivided into three rooms by adding partition walls. R. 27 was entered from a door in the south-eastern corner of R. 21. This room´s only recorded installation is a “...first stage...kiln” with an attached fuel storing facility on a small bench in the south-western corner, beside the entrance. Just to the north there is R. 22, rather similar in shape. Its door is visible in the north-western corner; it joins this space to the central R. 16. Inside R. 22 five *tapou*-style storage vessels were precisely mapped, while the reported inventory mentions “...fragments of plain and painted buff ware,...polychrome pottery,...oxidized copper, granite, a piece of lead, a copper hook, a chlorite vessel and a stone bead...“ [495].

494 Hakemi 1997: 104. A single crucible, situated next to the “kiln“, is only mentioned in Hakemi 1992: 124.
495 Hakemi 1997: 107.

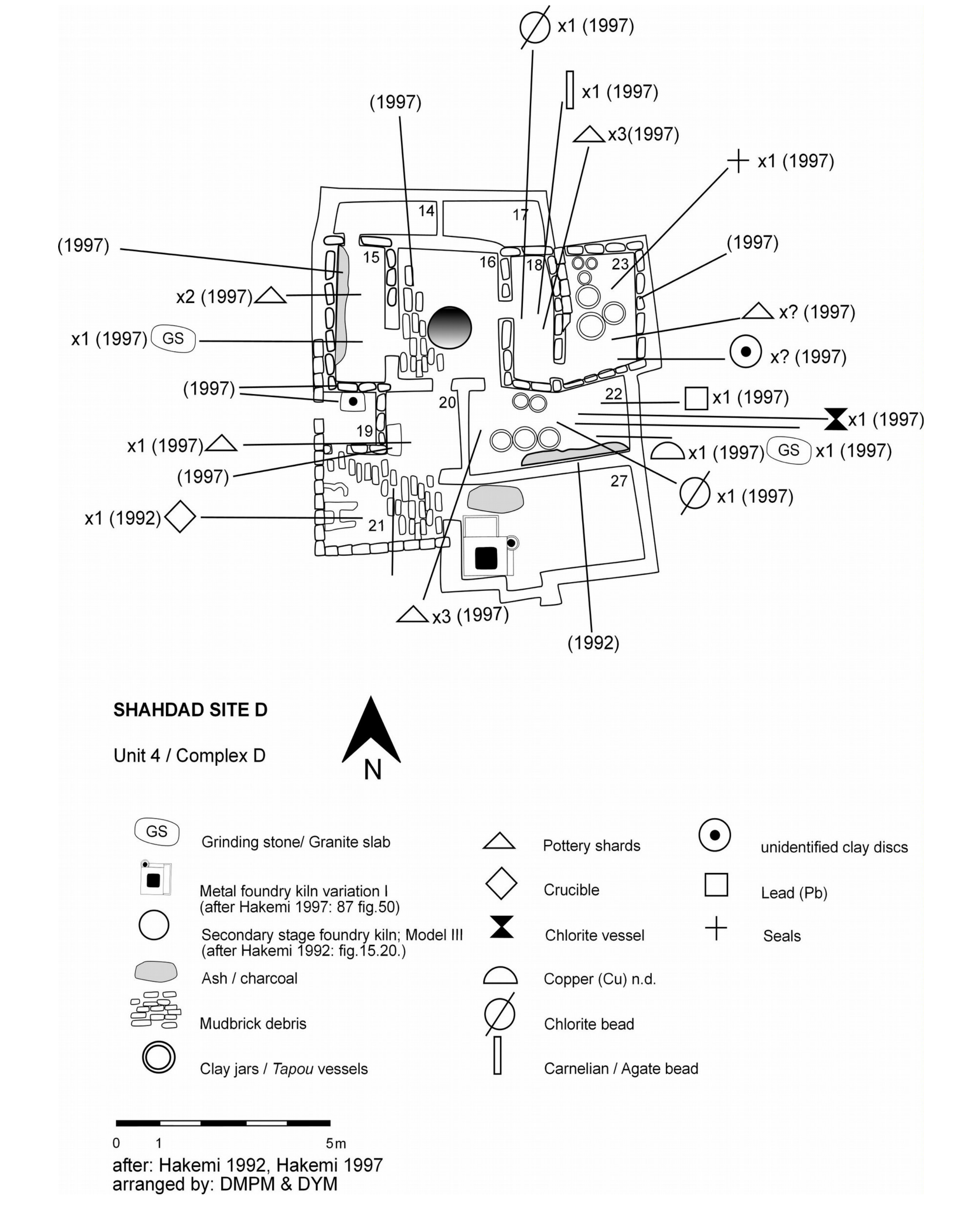


Figure 23: Unit 4, Rooms 14 to 23 and 27 (according to Hakemi 1992 and 1997).

4.1.2.1.5. Unit 5/V (complex E)

This last complex, east of Unit 1 (complex A) and Unit 2 (complex B), was severely damaged by seasonal floods and erosive winds. Just two rooms, R. 26 and R. 28, were intensively explored (see Figure 24). Outside these Rooms, on the eastern side, there was a mud brick wall that had suddenly collapsed as a whole. The rectangular R. 26 was built with the same mud bricks. On its northern wall, a doorway opens into R. 28. Along the eastern wall the remains of a “first stage smelting kiln” and of a “secondary stage smelting kiln” were excavated.[496] Another infrastructure, on the right side of the main kiln, is described as a “...small cubical shaped bench with a hole, with another hole on the right had side of this bench...”. Another hole was sunk into the floor just next to this bench.[497] Hakemi seems to refer to another “secondary stage smelting kiln” but without offering more detailed information.[498] In the report and in the general map there is no mention of these finds.[499] R. 28, north of R. 26 has an irregular shape. Its northern limits were not detected. According to Hakemi´s description this room contained “...alluvial sand,...a pottery vessel, fragments of pottery and iron...”.[500] Two crucibles, too, seem to have been found in this room.[501]

496 “...Inside the kiln an elliptical shaped hole was dug and on the right hand side a....flue was built...“. The description of the elliptical shaped hole seems to be authentic due to the kiln´s shape. The existence of the flue cannot be verified due to the lack of proper reproduction of these mentioned installations. Further he is describing “...a triangular shaped surface...“ which was situated “...next to the flue...“. This statement is lacking evidence too. (Hakemi 1997: 107ff., fig.77)

497 Hakemi 1997: 107.

498 Unfortunately this installation is also not clear to identify on the photograph (Hakemi 1997: 109, fig.77). Residues of metallurgical activities are not quoted which would support his interpretation. But there are some formal similarities between this installation and an almost identical one in room 13. One main difference is that the one from room 13 is mentioned in connection with remains of ash and charcoal which leads to an interpretation as a pyrotechnical installation.

499 Another crucible was quoted as inventory for room 26 (Hakemi 1992: 124) but without any mention in the later report nor on any general map.

500 As it is not described in a more precise way it seems doubtable that “...iron...” was found there (Hakemi 1997:107). Maybe it was the remains of some iron enriched mineral which was used for decoration or other activities or it might have been of copper which was not identified properly during excavation. There are already published observations of iron use during the Bronze Age by the identification of meteoric iron on a chlorite hand-bag application which probably derives from Southeast Iran (Vidale & Micheli 2012).

501 These two crucibles are neither mentioned in the report, nor noted on the general map. There is just a reproduction of two crucibles in the catalogue marked as Vm.3 and 4 (Hakemi 1997: 707). In contradiction to this quote there is just one single crucible mentioned in the former report (Hakemi 1992: 124). Both statements cannot be proven by comparison with the general map or other reproduction.

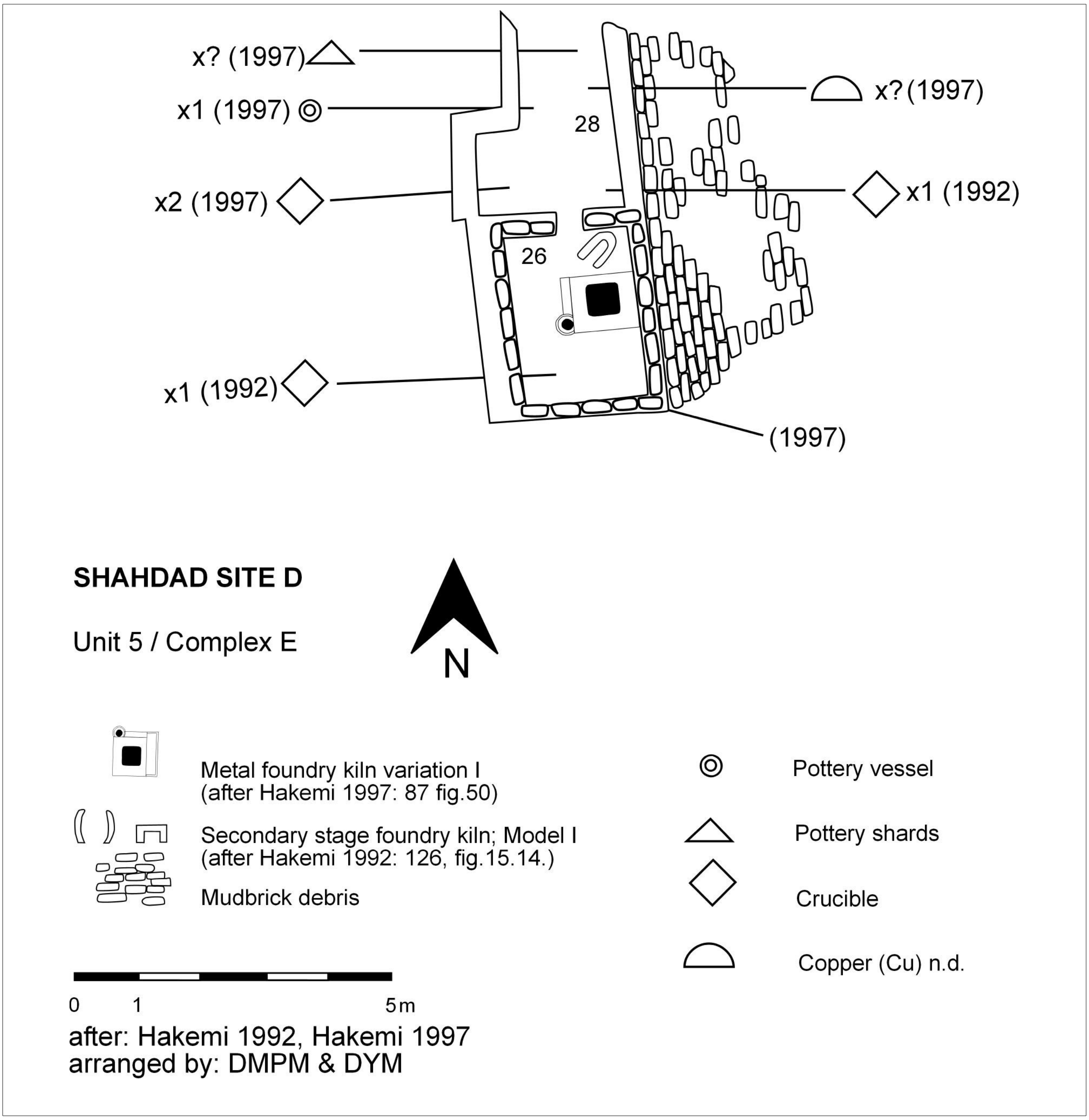


Figure 24: Unit 5, Rooms 26 and 28 (according to Hakemi 1992 and 1997).

4.1.2.2. Bayani´s Model[502]

4.1.2.2.1. Unit 1/I (*Unità* I)

In contrast to Hakemi's version, this first Unit is composed of Rooms 1 to 4 (see Figure 25). The Unit was built with *pisé*. Inside R. 1 there is a rectangular pyrotechnological infrastructure.[503] The inventory of R. 2 includes two unmovable installations (defined as metallurgical facilities without any further description) on the southern wall and a stone tool. A slab of granite with traces of use appears in the centre of the room. In combination with the discovery of a "hammer stone" nearby, this space looks like it would have been used, at the moment of the site's sudden abandonment because of the flood, for grinding copper ores – i.e. for the preparation of the ores' powder (and slags?) by crushing and grinding as a preliminary step before smelting in crucibles. The adjacent room, accessed through a threshold in the east wall is called R. 3. This room is charachterized by its inventory as a storage room, as it contained a total number of six *tapou*-like unbaked clay storage vessels, some of them reportedly still containing small amounts of mineral residues. These vessels are partially sunk into the Room's clay floor.[504] Another storage installation was discovered in the north-western corner. It is enclosed by a curved wall of clay and its floor was covered with pebbles. To the south there were two ceramic vessels. The taller one, a globular vessel with a winding snake in relief on the shoulder, stood next to the entrance; this jar contained some fragments of "cast copper", as did the other pot found to the north.[505] The last room of this first unit, R. 4, is not well described in Bayani´s report, nor is any find mentioned. The excavator just mentions the inner stone paved floor and the curved outer wall, build with *pisé*.

502 This report is based on M.E. Bayani´s Master thesis "Primi risultati dello scavo nel quartiere artigiano di Shahdad (Kerman, Iran). *Aspetti della produzione metallurgica alla fine del terzo millennio in Iran*" which was submitted in 1979 at "La Sapienza" in Rome. The layout of the workshop and its accesses are not differing in Bayani´s and Hakemi´s graphical representations. Therefore another repetitive description is not presented and the main focus will be held on the description of the room inventories.

503 Bayani 1979: 39. "una fornace rettangolare....per il fusione del rame..."

504 Bayani 1979: 40ff.

505 Bayani 1979: 44.

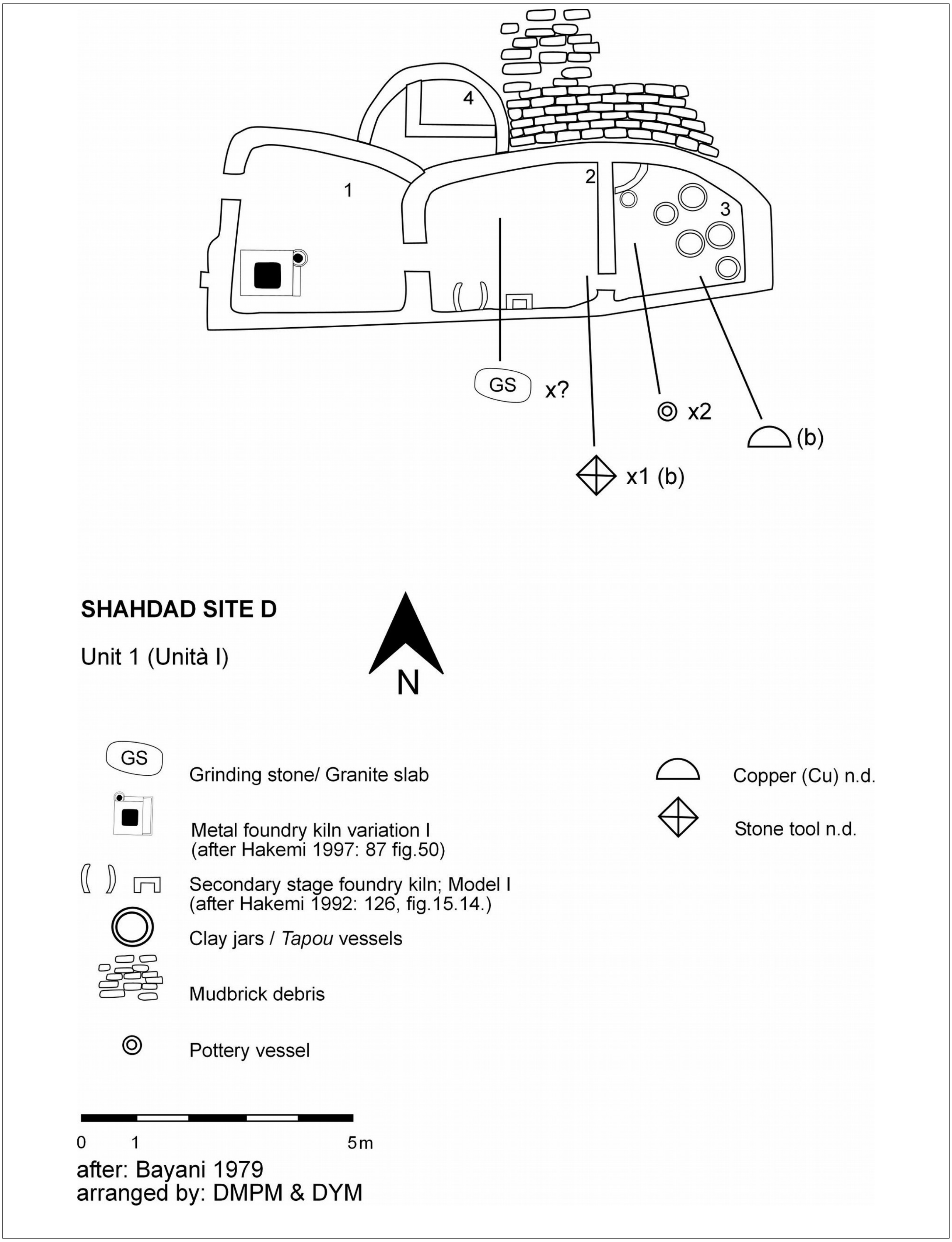


Figure 25: Unit 1 with Rooms 1 to 4 (according to Bayani 1979).

4.1.2.2.2. Unit 2/II (*Unità* II)

The cluster of Rooms 5 to 8, 24, 25 and 29 is designated as the second Unit of the "workshop" (see Figure 26).[506] The rectangular R. 5 is located to the north of this Unit. On its northern wall there is an infrastructure similar to the one found in R. 2. A nearby layer rich in ash and charcoal supports its interpretation as a pyrotechnological facility.[507] Another installation encloses the room´s south western corner with a curved clay lining; it is considered a storage unit similar to examples of R. 3 and R. 13. R. 6, the proposed main room of this Unit, could be accessed through a doorway in the southern wall of R. 5. In the south-western corner of this room, right next to the doorway leading to R. 7, there is another rectangular installation viewed as a "first stage metal kiln/(type I)". Furthermore, one notices here two granite slabs with a concave, saddle-like surface. R. 7 is a corridor connecting R. 8 at the west and R. 24 to the south. The room´s inventory includes granite slabs, a fragment of an incised grey ware container[508] and a poorly described ovoid ceramic vessel.[509] R. 8, accessed through a narrow doorway to the south-east is described as another storage room. Its layout is narrow, elongated and oriented north-south. Inside there are four *tapou*-style storage vessels and two pottery jars partially sunk in the north-east part of the floor. The general map records another installation against the western wall of this room. Due to this setting, it was probably built out of clay like comparable containers described in R. 3, 5, and 13. Besides such storage containers, remains of "granulated copper slag" were recorded on the floor.[510] The next R. 24 was entered through an opening in the southern wall of R. 7. It is square and to the northeast is linked to R. 25, while to the southeast it leads to R. 29. Next to the doorway leading to R. 29 there is another pyrotechnological installation. It is oval and built with a thin clay lining tapering to the southeast.[511] Against the western walls were found ashy layers and charcoal; four ovoid small ceramic vessels are next to the northern wall.[512]

506 Bayani remarks that this unit originally consisted of the rooms 5 to 8. During a later phase the rooms 24, 25 and 29 were added (Bayani 1979: 46).

507 Bayani 1979: 44.

508 According to the description of Bayani´s pottery report (Bayani 1979: 75, fig. 6) this particular fragment can be identified as the "vessel with the hut motive" (Hakemi 1997: 508 (Obj.no.4449), 707(Wa.4).

509 Bayani 1979: 45.

510 There is no information concerning the content of the different containers. Bayani 1979: 45f.

511 Traces of heavy firings are evidenced by the visible remains of the red burned floor (Bayani 1979: 46). According to Hakemi´s characterization we are dealing with Model II of the "secondary stage metal furnaces" (Hakemi 1991: 127, fig. 15.17).

512 Bayani does not describe these vessels as copper smelting crucibles eplicitly. But his description as " ...giare a corpo ovoidiale..." in comparison to Hakemi´s explanations (Hakemi 1992: 124; Hakemi 1997: 98) can be seen as a positive proof for the identification as crucibles. There are also representations of crucibles in his thesis but without any direct references to their provenance (Bayani 1979: 88ff., fig.14).

The groundplan of R. 25 is an irregular square; it hosts another installation in the centre, built with a reverted ceramic jar partially sunk into the floor. It is thought to have been used for pyrotechnological activities because it was surrounded by charcoal. This Room contained three crucibles and two globular jars of grey ware. Against its proposed eastern limits there are the much eroded remains of a pyrotechnological installation, described as a small rectangular platform with a circular depression in the centre, with abundant ash and burnt clay lumps. On the whole, this Room, according to the excavator, might have hosted a “metal furnace”.[513]

513 “...livello di ceneri ed argilla arrossata...l´allocazione del fuoco, addossata al muro occidentale; era composta da un piccolo ripiano rialzato di forma rettangolare...una depressione circolare...“(Bayani 1979: 48)

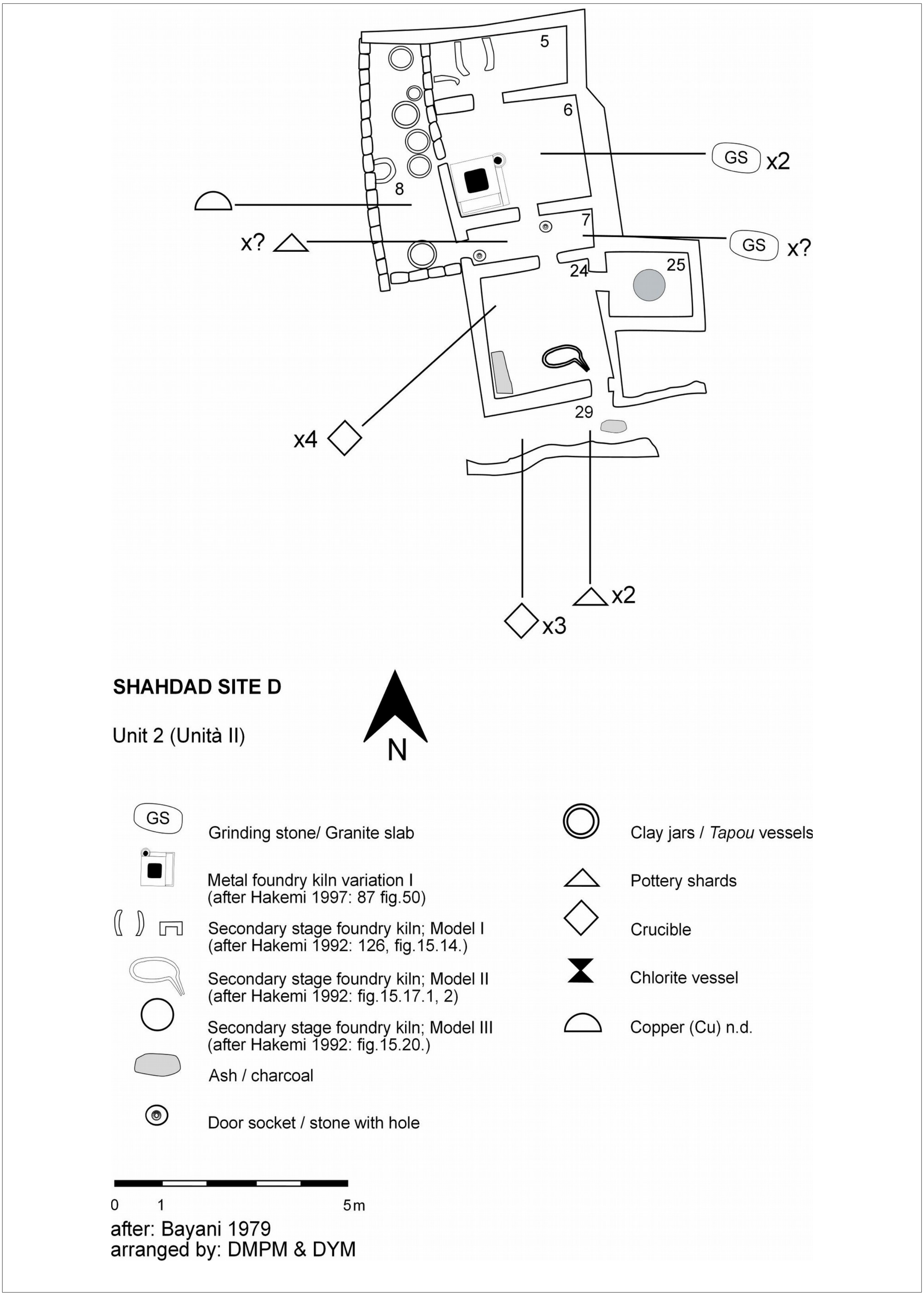


Figure 26: Unit 2 with Rooms 5 to 8 and 24, 25, and 29 (according to Bayani 1979).

4.1.2.2.3. Unit 3/III (*Unità* III)[514]

Rooms 26 and 28 are located in the north-eastern part of the buildings cluster (see Figure 27). The northern limits have not been detected, as they were removed by heavy erosive alluvial and aeolian processes. The northern room of this Unit, R. 28, has an irregular shape. According to Bayani´s general map, nothing would have been found inside. However, the report mentions a buff ware vessel with a brown painted *zig-zag* decoration and some fragments of an iron ore.[515] Moreover, some grey ware pots, comparable to examples from Bampur and Shahr-eh sukhteh, as well as two crucibles are listed as finds from this Room.[516] R. 26, the next, adjacent one to the south, was accessed through a narrow doorway in the southern wall of R. 28.[517] Inside three infrastructures, all located along the eastern wall were excavated: two pyrotechnological installations and a small platform. The main one is a "first stage furnace" identical to the examples from R.1, R. 6, R. 13 and R. 27. Immediately south of the furnace there is a small platform with a visible depression on the upper surface.[518] At west, one sees an ovoid structure with a central depression. Red firing traces were visible on the adjacent wall. Further north, between the northern wall and the main furnace an ovoid shaped installation with a pebbled pavement was discovered. It is identified by the excavator as a "secondary stage metal furnace" with close similarities to examples from Rooms 2, 5, 13 and 21.[519]

514 According to Hakemi rooms 26 and 28 are representing Unit 5 / Complex E (Hakemi 1997: 107).

515 Bayani mentionings "...minerale ferroso..." without any further description. Besides this he is also mistakenly addressing the northern room as Room 26, although it is noted on the general map as Room 28 (Bayani 1979: 49, 61).

516 "...lato orientale dell´ unita I...due giare a corpo globulare, in ceramica nero su grigio...e due crogioli in ceramica..." (Bayani 1979: 48). This short description states that to the East of Unit I (i.e. Room 28?) the mentioned artefacts were documented without any further localisation. As noted before there are also two crucibles deriving from Room 28 according to Hakemi´s catalogue (Hakemi 1997: 707, Vm.3,4). Their identification is still doubtable/doubtful because of the lack of mention in his report. And still the question remains if in this case the crucibles might be identical why the grey ware pottery vessels are not mentioned by Hakemi.

517 Again, Bayani confuses Room 28 with Room 26 (Bayani 1979: 49ff.).

518 The composition of the furnace and the platform is almost identical to a comparable situation inside of Room 13.

519 Bayani 1979: 49ff.

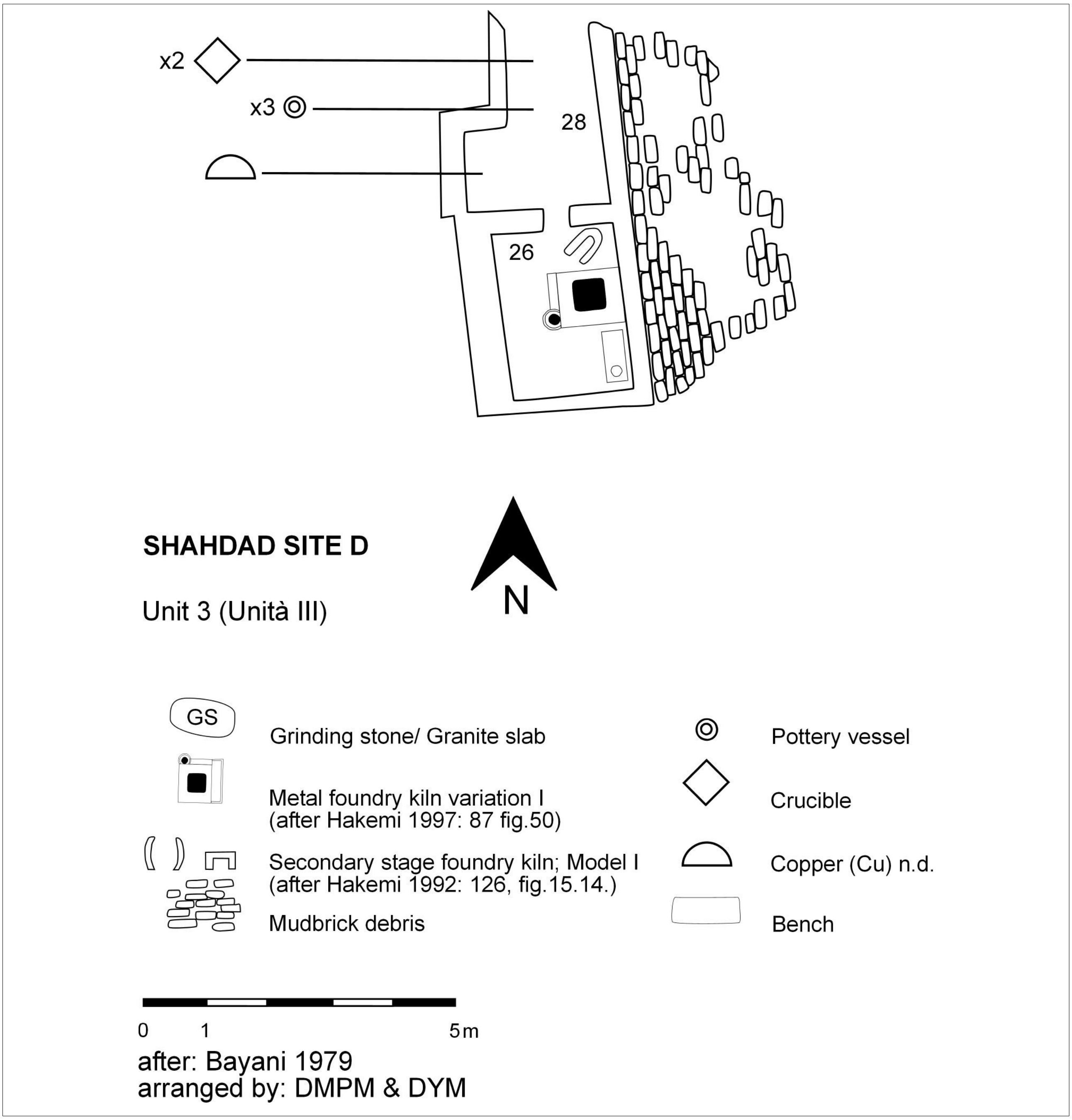


Figure 27: Unit 3 with Rooms 26 and 28 (according to Bayani 1979).

4.1.2.2.4. Unit 4/IV (*Unità* IV)

This is the westernmost Unit of the building complex, including Rooms 9 to 13 (see Figure 28).[520] The main entrance is provided by a doorway in the eastern wall of R. 12. According to the general map, just a granite slab fragment was found next to the southern wall. The report also mentions traces of ground copper ore right next to the granite grinding slab, which supports the hypothesis of an installation for the preparation of metallurgical raw materials.[521] R. 13 can be accessed by a narrow doorway in the southern wall of room 12. This room has a L-shaped layout. Remains of a “first stage metal furnace” identical to the examples in R. 26 were unearthed along the northern wall. To the west a small platform or pedestal with parts of three ceramic vessels was found and in the north-western corner came to light another storage device, distinguished by the usual curved clay wall and its pebble stone pavement. Inside there was a pottery vessel surrounded charcoal and ash.[522] To the south, along the western wall, there are further clay infrastructures, presumably used for storage. One of them, a small space, is limited by a thin clay wall to the north. It contained a round stone object with a central depression, described as a door socket stone.[523] At the south-western corner there is another enclosed storage device, and pottery jar sunk completely into the floor appears in the centre. Outside R. 13 there is a small semicircular platform attached to the southern wall.[524]

The following R. 11, a passageway to R. 9, can be accessed by a narrow doorway on the eastern wall of R. 12. Although there are no finds marked on the general map, the report mentions fragments of buff and red ware vessels, cylindrical clay objects[525], some hammer stones and a fragment of a flint blade.[526] R. 9 was presumably the original main room, because of the pyrotechological installation found there just next to the doorway to R. 11.[527] Inside traces of heavy firing as well as charcoal and ashes were observed. Nearby an axe mould and a paving of pebbles were also recorded.[528] In the eastern part of the

520 It seems like that this unit was composed of two parts. Rooms 9 to 11 which is the original part due to its central position on the ground plan. Rooms 12 and 13 are situated on the western limits. This part seems to have been added in a later phase.
521 Bayani 1979: 52.
522 Bayani 1979: 52f.
523 According to Bayani´s report, another door socket stone, a pottery jar, as well as another granite slab with wear traces were recorded next to it. Traces of burned chaff and wood are also evident in the vicinity.
524 Bayani 1979: 53.
525 Maybe these cylindrical clay objects are identical to the “unidentified clay artefacts“ mentioned by Hakemi (Hakemi 1997: 107).
526 Bayani 1979: 54.
527 Due to its features it is characterized as Model IV of the “secondary stage...furnace“ (Hakemi 1992: fig.15.17, 1, 2)
528 This mould in combination with the pyrotechnical installation are seen as an evidence for the proposed activities which were taking place there (Bayani 1979: 54).

room two *tapou*-like clay containers and another vessel were discovered. The two storage vessels contained pieces of raw clay and “pulverized copper”.[529] Another two vessels (without any further description) are mentioned in their vicinity.[530] The last partition of this Unit is R. 10, a rectangular space accessed through the doorway in the southern wall of R. 9. According to the general map, this Room hosted several granite slabs, some pebbles with highly worn surfaces and an un-described pottery vessel; moreover, Bayani’s report witnesses the find in this location of three pieces of unknown copper minerals, several lithic tools and a two-partite chlorite vessel.[531] This important information is absent in Hakemi’s summaries. Following such inventory, this Room can be seen as having been used for the processing of copper-bearing base materials like ores (or possibly recycled slags) during the last phase of the Room´s use, immediately before the disastrous flood that erased the local settlement. The most crucial evidence is obviously the presence the granite slabs and the hammer stones used for grinding the base material.

529 Concerning this and similar terms, see the cautionary statements at the beginning of this chapter.
530 Bayani 1979: 54.
531 Bayani 1979: 55.

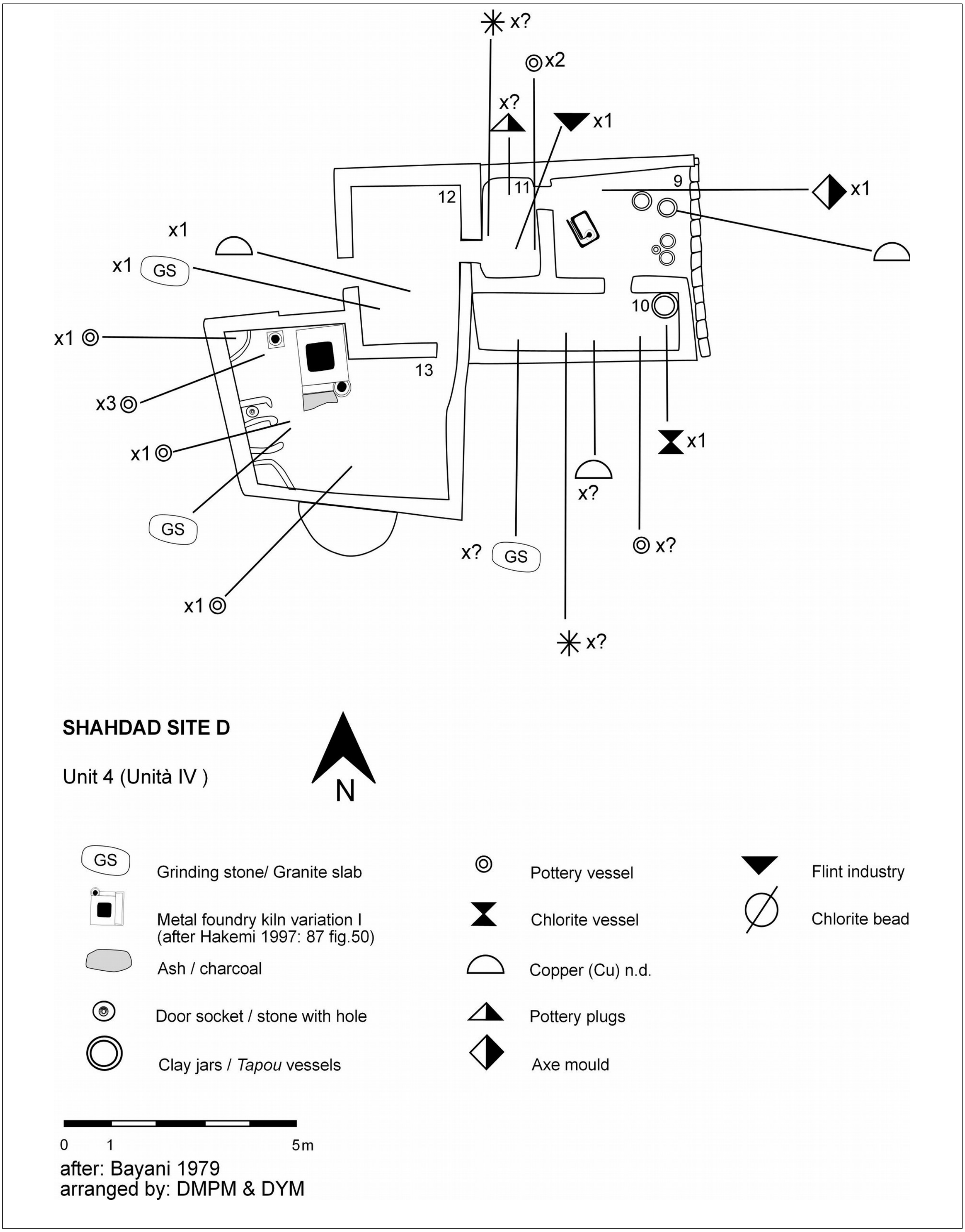


Figure 28: Unit 4 with Rooms 9 to 13 (according to Bayani 1979).

4.1.2.2.5. Unit 5/V (*Unità* V)

As the largest section of the so-called “workshop”, Unit V is composed by the cluster of Rooms 14 to 21, 22 and 27 (see Figure 29). R. 14 and R. 17 are situated in the north of this Unit. Bayani, like Hakemi, notes that these two rooms of almost identical shape were originally one original room which was divided by the erection of a separation wall.[532] Both were devoid of artefacts, like Rooms 16, 19, 20 and 21. R. 16 and R. 21, after their inner infrastructures, are interpreted like R. 10 as used for preparation activities. Next to the doorway from R. 20 to R. 16, a door socket was found *in situ*.[533] In R. 15, Bayani noted a single granite slab[534], some undefined pottery shards as well as a layer of ash along the western wall. R. 18 is located east of R. 16 and is interpreted as a passage way towards the storage area R. 23. Inside R. 18 several vessels of undefined types, a stamp seal with an irregular geometric pattern and a group or hoard of chalcedony beads of cylindrical and oval shape in different stages of manufacture came to light. A possibly revealing observation recorded in Bayani’s report is that traces of “copper powder” still adhered to the surfaces of the beads. Along the western wall of R. 23 a total of 5 *tapou*-like containers[535] with their lids fallen right beside them and a granite slab are on record. There are also a black-on-red ware vessel of ovoid shape, a ceramic bowl as well as a truncated-cone shaped cylindrical seal with a geometric zig-zag motif, and an amount of clay disks was mentioned. The next storage area of this Unit, R. 22, is situated to the south. It has a total of five *tapou*-like storage clay containers, an unidentified bowl, a copper hook, a fragment of lead and a sub-trapezoidal chlorite bead.[536] Another “first stage metal furnace” was discovered in R. 27. Just to the north of this installation there was a thick layer of ash, burnt clay and charcoal, and a brown-on-buff jar came to light.[537]

532 Bayani 1979: 58.
533 Bayani 1979: 56.
534 The granite slab is not mentioned in Bayani´s report. But it is represented on Bayani´s as well as on Hakemi´s general map (Bayani 1979: 61; Hakemi 1997: 90, fig. 54). The presence of this items is also positivley verified by a photography in Hakemi´s report (Hakemi 1997: 103, fig.70).
535 On Bayani´s general map a total of just four storage vessels is represented.
536 Bayani 1979: 59.
537 Bayani 1979: 57. Maybe this brown on buff pottery vessel is identical to the item with the object number 4496 from Hakemi´s catalogue which is also documented as inventory from Room 27 but without any mention in the workshop´s report (Hakemi 1997: 565, 702, Ve.5., Obj.no.4496).

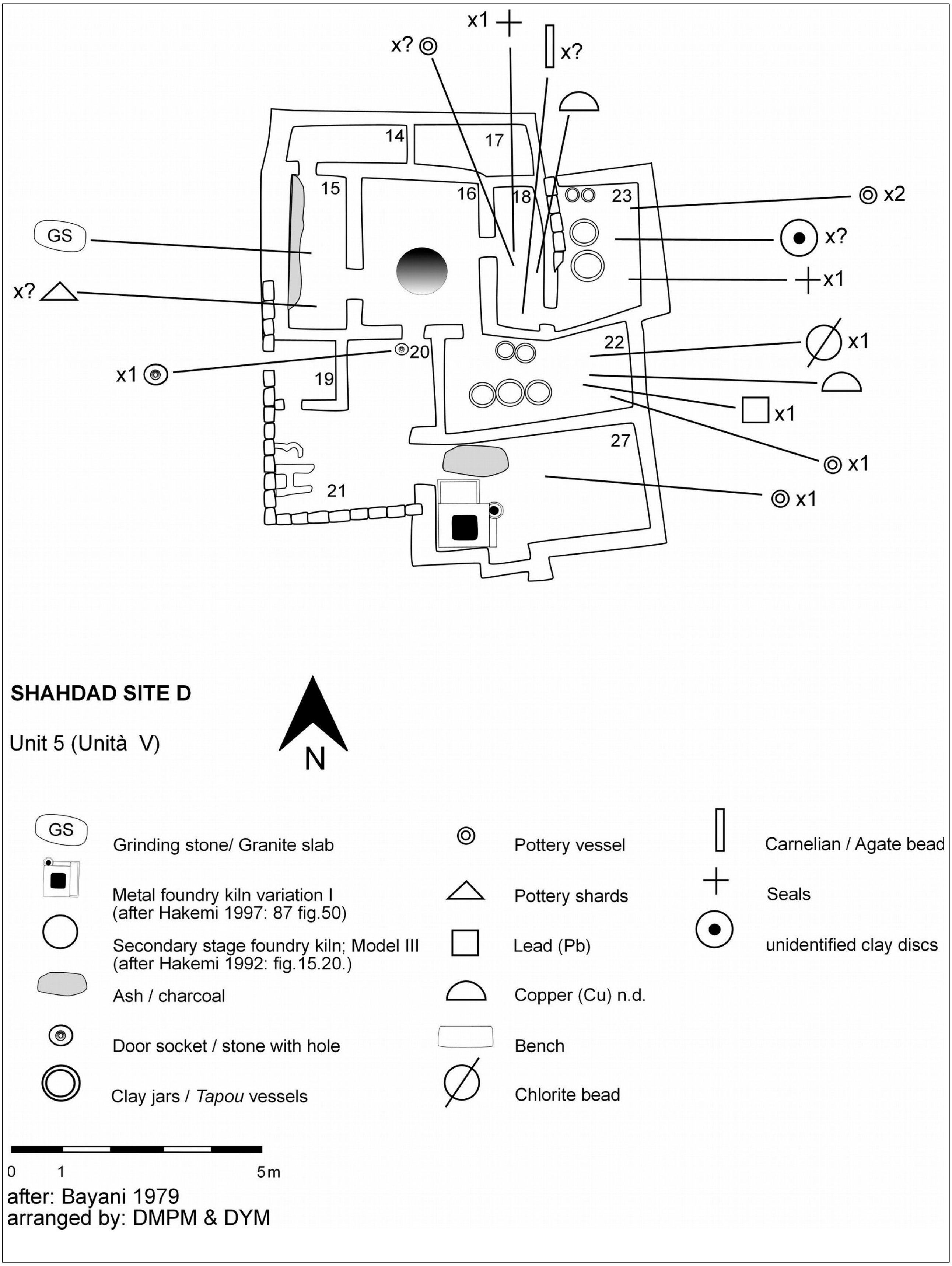


Figure 29: Unit 5 with Rooms 14 to 23 and 27 (according Bayani 1979).

4.2. An attempt at reconstructing the “metal workshop” activity areas according to the reviewed data – a critical re-evaluation

As already discussed in the preceding sections, there are some differences (sometimes crucial) concerning the finds and the excavated contexts as reported by M.E. Bayani and A. Hakemi. Based on a cross-matching of these differing data sets, on the published photographies and on the motion pictures from a 45 m documentary movie by Hosain Rasael from 1977 that I was given in Tehran, entitled “Shahdad (Khabis)- Gozareshi az hafari-hayeh bastan shenasi (Shahdad/Khabis - a report of archaeological excavations)”, showing some excavation details and its progress, I will attempt to objectively reconstruct what was actually happening in the complex before the flood impacted and erased it.

Both Authors consistently distinguished five Units in the settlement cluster, and their partitions are reasonable, even if the labeling of the various Rooms was different (see Figures 30 to 32). Most probably, all five Units can be seen as hosting independent activity areas. This is supported by the presence of at least one pyrotechnological installation in every Unit and apparently similar metallurgical indicators which also have been recorded across all Units. Further, there are no direct connecting passage ways between the different units. A detailed reconstruction of the proposed activitiy areas within each Unit will be presented as follows.

4.2.1. Unit 1 / I:

This unit seems to have been added later to the north side of Units 2 and 3 due to its position and irregular ground plans. The walls have been erected with a *pisé*- technique, as observed by both authors. According to the permanent installations in R. 1 and R. 2, and the metallurgical indicators observed by Hakemi in R. 1, R. 3 and R.4 and R. 30, it seems plausible that metallurgical activities were conducted to an uncertain extent. The documentation of granite slabs, which are exclusively mentioned by Hakemi, lead to the assumption that cupriferous material like mineral ores (or slags) might have been processed here for further metallurgical activities. The reused immovable tapou-jars in R.4 which were partially filled with cupriferous material identify it as a storage room. This evidence can be seen as an indicator of preparational and storing activities inside this unit.

4.2.2. Unit 2 / II:

The second unit was accessible from the south via R. 29 and R. 24. Its layout is formed by two central, almost square Rooms, R. 6 and R. 24, both endowed with pyrotechnological installations. These rooms are accompanied by adjacent rectangular rooms for storage and preparation work according to their find inventories of granite slabs, ashy layers, charcoal and further remains of processed cupriferous material. According to the described observations it cannot be distinguished for which kind of pyrotechnological actions these installations were used, with the function of the oval shaped installation from R. 24 especially remaining enigmatic. There is also a number of small open vessels which were found in R. 24 and R. 29. In regard of their shapes they share similarities to melting crucibles as Hakemi pointed out. This assumption is also supported by the published drawing and photographs. But unfortunately the published data is lacking in accurate information concerning their precise localization.[538]

According to the observations which were presented in the preceding paragraphs the installation of R.6 seems to have originally been of domestic use. But there is still the possibility that this type of installation was reused for other purposes.

The presence of different immovable containers for storage in combination with the observed installations and pyrotechnological metallurgical material demonstrate the proposed metal works as a last activity before the building was destroyed by a flood. Besides this it can hypothesized that the passage way R.7 at the final stage of usage before the destruction might have been temporarily used as a place where, due to the documented granite slabs preparation labours were conducted for further metallurgical activities.

4.2.3. Unit 3 / III:

The access to the inside of Unit III was provided from the Western wall of R. 12. There were also remains of metallurgical activities observed like pyrotechnological installations of different shape, grinding and hammer stones as well as crucibles, a fragment of a mould and different pottery vessels. Further, different stages of copper bearing material were observed in several rooms. Especially R. 10 is of interest where hammer and grinding stones as well as traces of copper were documented. This observation leads to the assumption that this room might have been used for preparation works like grinding

538 Bayani 1979: 88ff., fig.14,fig.15; Hakemi 1992: 124, 126, fig.15.15; Hakemi 1997: 98, 505.Vm.2 (Obj.no.4448), 560.Vm.1 (Obj.no.4462),565.Vm.3 (Obj.no.4499), Vm.4 (Obj.no. 4498), 707,Vm.

cupriferous material. But as there are also descriptions about not-further-specified lithic implements as archaeologically found material of Room 10 it can be also hypothesized that at a distinct point in time other non-metallurgical activities were conducted there too. Finally it also needs to be stressed that these remains of different activities might be a proof that this Room could have also been used as a temporary storage for tools of different labours.

4.2.4. Unit 4 / IV:

This southernmost part of the whole building is composed by eleven rooms which are predominantly showing indications of metallurgical activities like a granite slab for grinding, two different types of pyrotechnological installations as well as ashy layers and further residues of copper metallurgy. But unfortunately, on account of the limited published data the activities cannot be more specifically described. Another interesting feature are the beads of semiprecious stones like carnelian which were found inside storeroom R. 23 in different stages of production. This observation enables us again to hypothesize another activity such as bead cutting was conducted inside this unit. This context inside of a storeroom suggests that the beads were stored while the metallurgical activities were undertaken. This might also be further evidence for multifunctional activities inside of several parts of the compound. The chronological order of the different activities remains unknown but there are at least two different ideas dealing with this problem. As the metallurgical melting process is a time-consuming activity with some free time windows of longer duration it seems plausible to hypothesize that during the melt a handy greensmith or other specialized artisans may have processed the beads and stored them in R.23. This would be an idea for concurrent activities. Another hypothesis states that with seasonal shifts during the cold months the raised humidity makes it rather ineffective to work on semiprecious stones, as their working qualities are reduced rapidly in a moist environment.

4.2.5. Unit 5 / V:

This last remains of two rooms represent the easternmost unit of the whole compound. According to the pyrotechnological installation it is plausible to propose fire-based activities. To say what extent metallurgy activities were conducted here is not an easy task due to the contradiction of the published reports and demands further research. The pyrotechnological installation in the southern room shares similarities with the examples from R. 1, R. 6, R. 13 and R. 24. The appearance of melting crucible-like open vessels is attested by all reports. But as stated before due to the contradictory statements of the published data there is for now no way to prove this hypothesis.[539]

Just to the side of the pyrotechnical installation another clay structure is visible which is also identified as a pyrotechnological installation. But unfortunately its description is lacking of any reference data like traces of firings, ashy layers, charcoal or other fuels.[540] Therefore it remains uncertain precisely which activities were conducted.

539 Bayani 1979: 48; Hakemi 1992: 124; Hakemi 1997: 707.Vm.3 and 4.
540 Bayani 1979: 49ff.; Hakemi 1997: 107ff., fig.77.

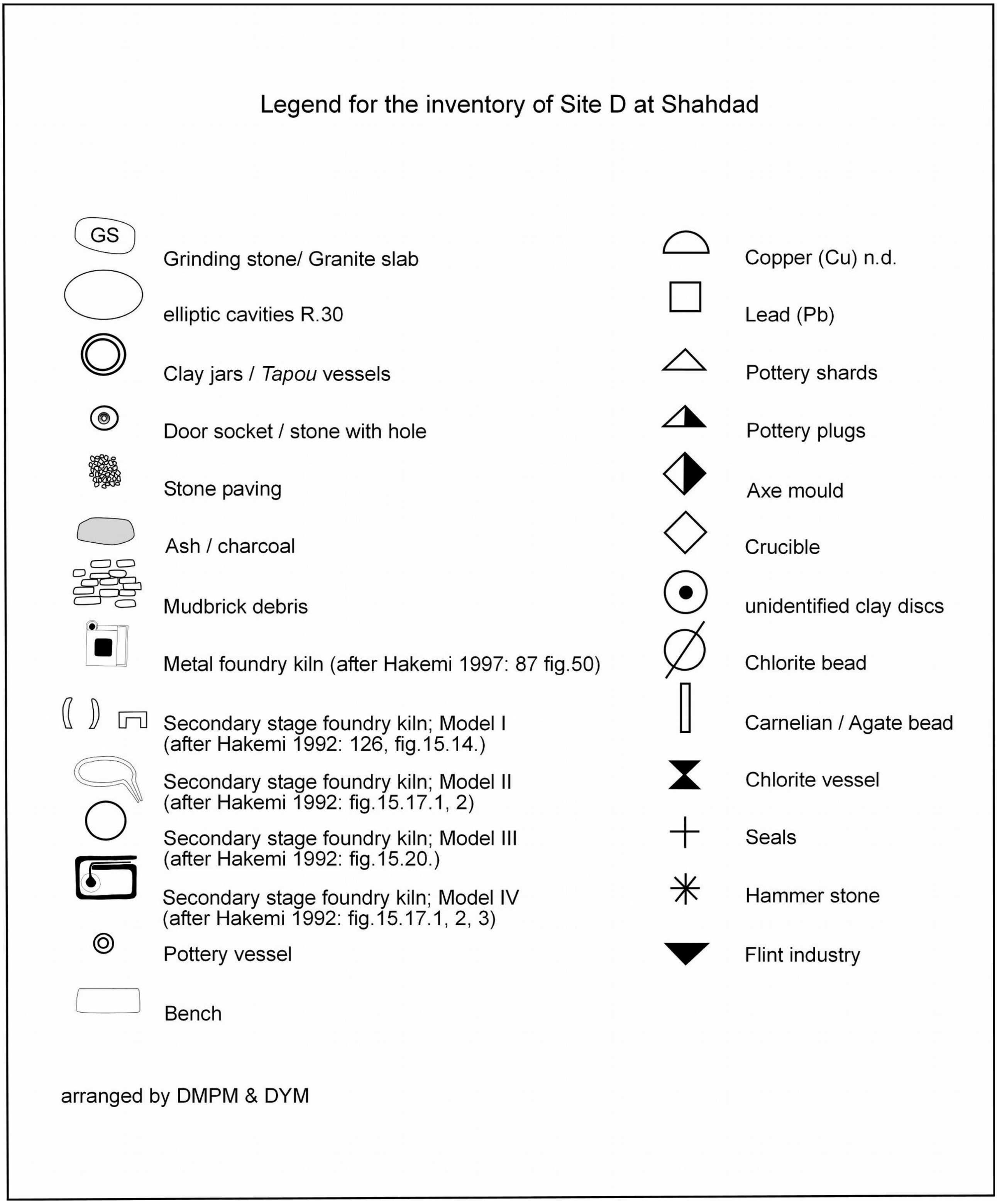


Figure 30: Legend.

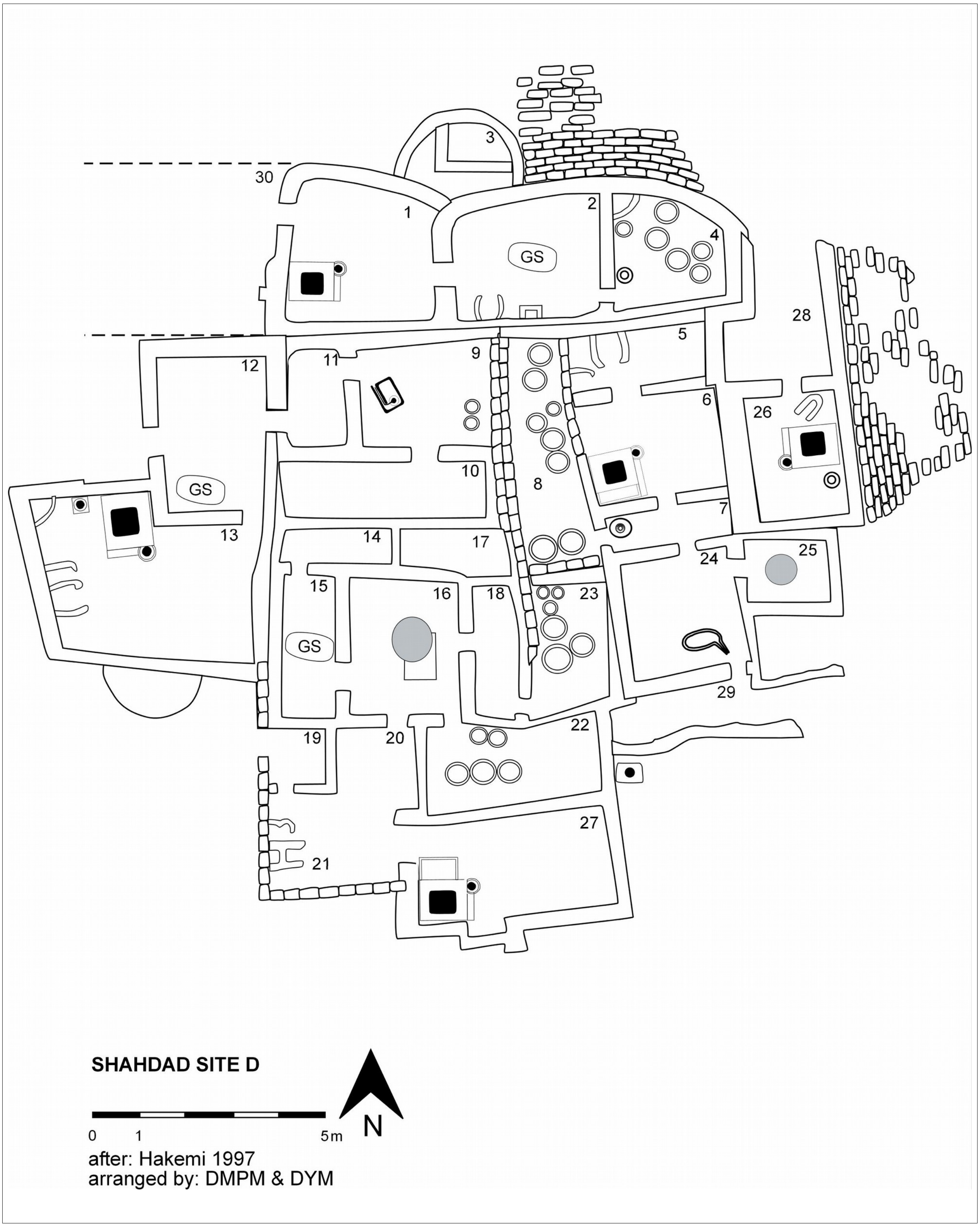


Figure 31: General map of Site D after Hakemi 1997.

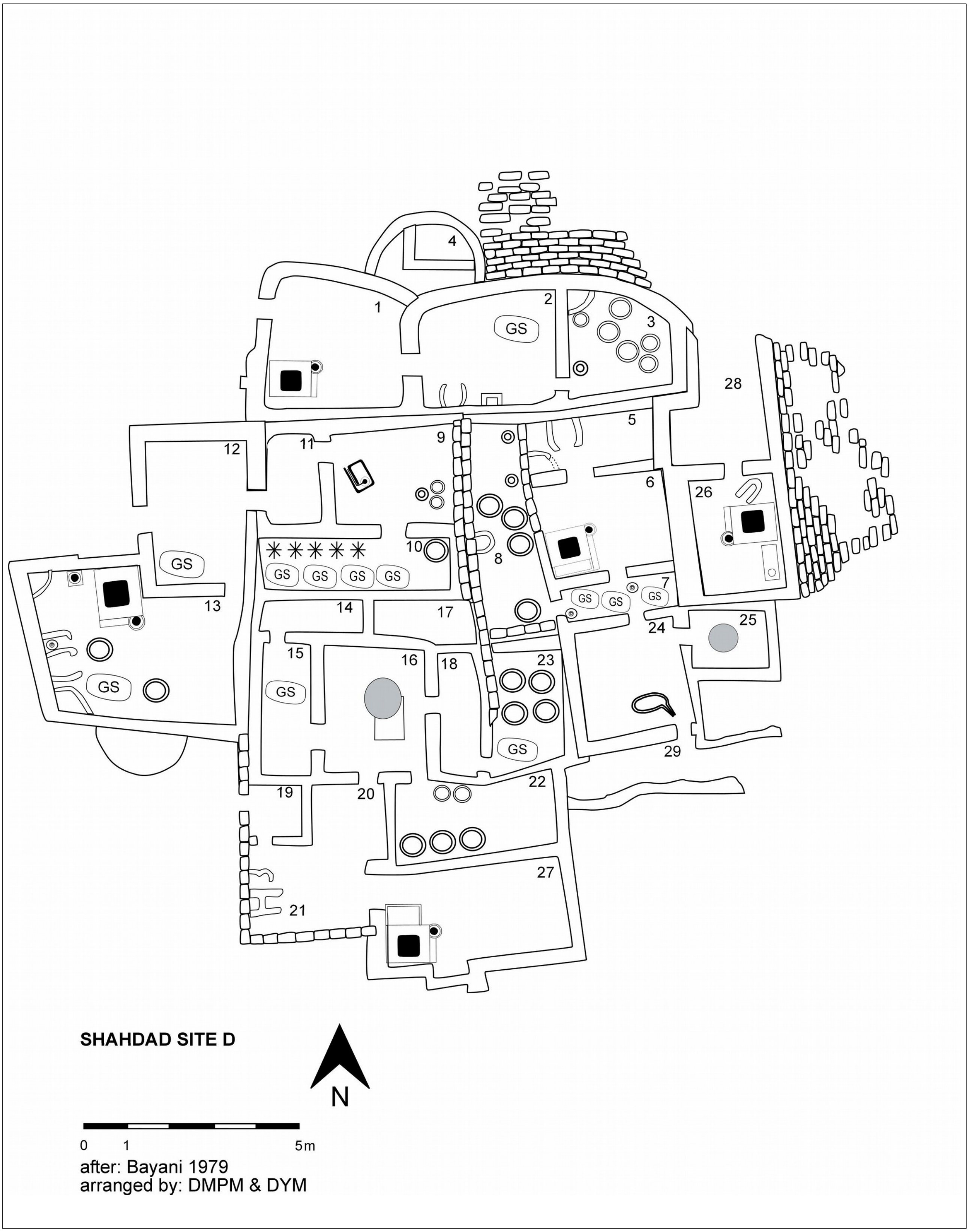


Figure 32: General map of Site D after Bayani 1979.

4.3. A case study in the "Pompeii premise" debate?

The “Pompeii premise” is a “delicate” archaeological theory that was first formulated in the early 1960s by Robert Ascher after he observed the tensions of numerous archaeologists to identify their investigated archaeological contexts with a “petrified”, frozen scene of a final activity period in the past. He describes it as “an erroneous notion, often implicit in archaeological literature...the remains of a once living community stopped, as it were, at a point in time...” and criticizes the notion of a lack of regard for the possibility of depositional formation processes of artefacts.[541] Then later, with the development of Behavioural Archaeology, M.B. Schiffer[542] after several years of lively debates with L.R. Binford[543] summarized the dispute with the following words: “...on one point Binford and I emphatically agree: most sites are not little Pompeiis. We can cope with this reality by treating housefloor assemblages as if they were sytemic inventories,[ ],...or we can use the principles and methods of Behavioral Archaeology to identify the formation processes at work,...”[544]

R. Newell renames it as a “neutron bomb notion”[545] to emphasize the artificially heterogeneous character after a singular disastrous event like the one that happened at Pompeii after the volcanic eruption and the accumulation of pyroclastic surges and ashfall deposits. U. Sommer refers to it accurately, introducing it as “Dornröschen-Prinzip” where the Prince (Archaeologist) waits in the castle of the sleeping beauty for the repeated animation of the petrified picture of the past.[546] In a later publication she entirely deconstructs the term “Pompeii premise” as inappropriate, since the settlement of Pompeii was not left all at once but gradually abandoned weeks before the volcanic eruptions and later on revisited by the former house owners and looters looking for precious goods after the catastrophy.[547] In the case of Shahdad we are dealing with a settlement which is situated on top of an eastward sloping alluvial fan in the piedmont of a mountain range with peaks up to 4000 m.a.s.l. The area is in parts irrigated by regional waterstreams which are seasonally fed by vast quantities of snowmelt and additional Qanat irrigation. After numerous events of enormous movements of sediments, exactly like those that the fan itself originated from, the water streams were searching for new waterways to effuse to

541 Ascher 1961: 324.
542 Schiffer 1972, 1976, 1977, 1985;
543 Binford 1981.
544 Schiffer 1985: 38.
545 Newell 1987: 136.
546 Sommer 1991:
547 Sommer 2012: 20ff.

the lower plains. Thereby sometimes old waterways were blocked by large amounts of sediment which caused the waterways to arise to accidental floods. Thereby, at one point in ancient times, Site D, the architectural feature which is presented in this monography was destroyed and completely covered by thick layers of alluvial sediments as already pointed out in Chapter 3. According to the orientation of the mud-brick rubble in eastern and north-eastern directions that were observed all over the structure close to the surface a sudden flood must have reached the site from western to south-western direction and caused the destruction. Collapsed mud-brick walls were observed inside several rooms (R. 1, 2, 3, 11, 16 and 20) as well as on the outside in the northern and eastern directions (see Figure 33). Unfortunately this evidence was not marked in its entirety on the maps for the final publication but only mentioned in the report.

On account of the lack of precise data of the formation processes inside the building there are still uncertainties. Maybe the building was not in use anymore and abandoned for a short period before its final destruction by the disastrous flood. But there are f.e. the find inventories from R. 7 and R.10 which are suitable for an attempt at interpretation of a hypothetical final use of these areas. R.7 is a narrow passageway connecting the adjacent rooms R.6, R.8 and R.24. According to Hakemi inside R.7 several artefacts like a crucible and a large granite slab were found.[548] Therefore it can be interpreted as a zone where preparational labours for pyrotechnological activities which evidently could have been conducted in the adjacent Rooms R.6 and R. 24. R. 8 is a storage are for the direct access and supply of raw materials. Bayani presents a similar distribution of artefacts mainly composed of several granite slabs and a not-further-specified pottery vessel of ovoid shape which can be seen as a smelting crucible.[549]

In R. 10 A.Hakemi describes a similar situation with some polished stone tools accompanied by residues of “copper ore”, “flint implements” and vessels of different types.[550] Bayani’s report also witnesses the situation there with several granite slabs, some pebbles with highly worn surfaces and an undescribed pottery vessel as well as three pieces of unknown copper minerals and several lithic tools.[551] According to the in Situ-character of these finds it seems also plausible to reconstruct the last activites conducted in here with more preparation labour for metallurgical activites. Whether these activities

548 Hakemi 1997: 95.
549 Bayani 1979: 45.
550 Hakemi 1992: 128.
551 Bayani 1979: 55.

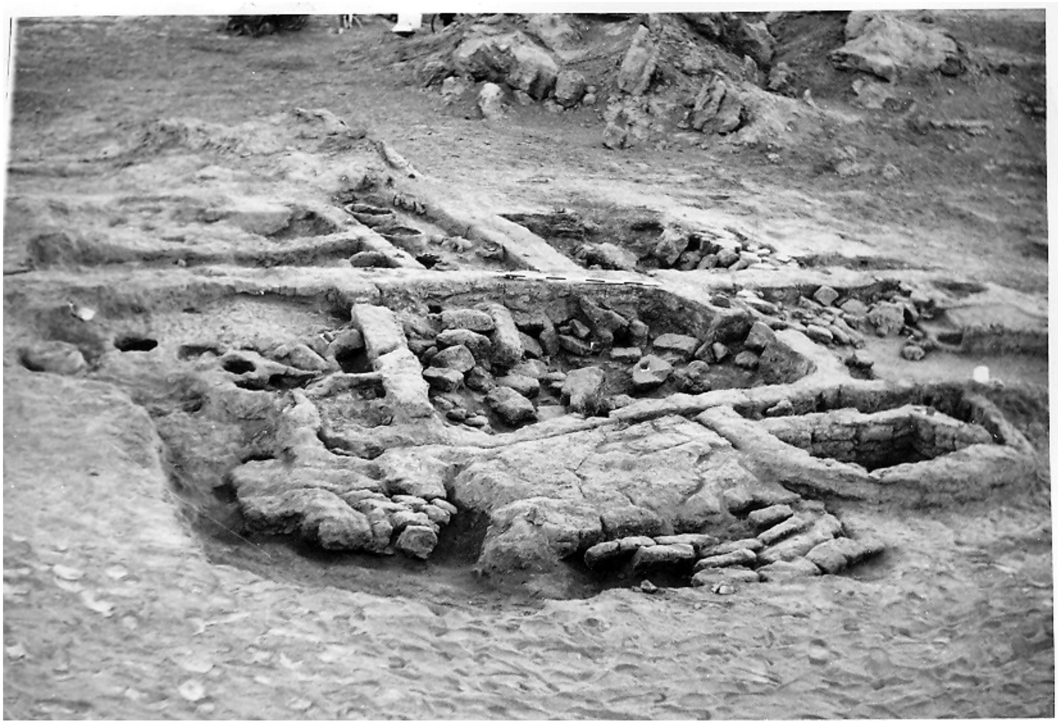


Figure 33: Photograph of Site D after excavation viewed from North-eastern direction. (by courtesy of S. Salvatori).

were conducted inside of the building remains unanswered due to the lack of appropriate record of observations. Due to the abandoned character of the presented room inventories and their find compositions an image is coming to mind as though the former inhabitants were following their daily labour in the first half of the year when suddenly they were surprised by an unexpected accidental flood which sealed the complex under thick alluvial sediments.

Therefore, Site D at Shahdad can be seen as an example for a suddenly abandoned site which was sealed by alluvial sediments for millennia before its discovery in the late 1970s.[552] Unfortunately there is no data of comparable relevance available for the second architectural feature at Shahdad, the “private house”, which might underline the hypothesis.

552 Comparable find situations after a singular disastrous event are known from many archaeological contexts. (see f.e. Webb & Hirth 2000)

4.4. A closer look at the workshop and its pyrotechnological installations and their description from site D: a new attempt at reconstruction

Besides the find situation inside the building which undoubtedly shows evidence of metallurgical activities there are also noteworthy observations which were made in the sense of the architectural layout.

There are distinct parallels between the architectural remains at Shahdad which were discovered under Bayani and Hakemi and another feature which was excavated by M.A. Kaboli. In the sense of the architectural layout several observations were made at both features which will be described at this point.

Both buildings are of an almost rectangular shape and roughly similar size.[553] Hakemi as well as Bayani reconstructed the ground-plan of the "Site D – workshop" as covering an area of approximately 225m². The building, which was excavated during Kaboli´s activities in the 1990s is of a comparable size with side lengths of roughly 15X15m. So far there is no published evidence for Kaboli´s "private house" of metallurgical activities which may have been conducted there. But the comparison of the different ground plans shows similarities among the different units. Hakemi´s building "Site D" shows distinct separated units counted A-E /I-V with the entrances exclusively accessible from the outside and no connecting paths between the different units.

Kaboli´s "private house" building is divided into seven units (A-G). But according to the published ground plan the building was exclusively accessible by a single main entrance which was located in the southern wall in a central position. Inside the building there were doorways documented between the different units. Only the units to the East and West of the building, namely Unit E and G, had no direct connections to the inside of the compound. Unit F, which is attached to the south-west, is also situated outside of the main compound but its entrance is in direct vicinity to the main entrance.

Similarities in the sense of the architectural layout between both features are evidenced by the central square rooms which are surrounded by rectangular rooms of a smaller size, f.e. Hakemi´s Units B (R.6) and D (R.16) in comparison with Kaboli´s Units A (loc.1034) and D (loc.1091). In both buildings there are also pyrotechnological installations of an identical layout which are located in the central rooms next to doorways. Further, in

553 It was hypothesized by Hakemi, Bayani and Kaboli that the buildings were erected not at once but successively. But unfortunately their statemtents are lacking any evidence. They remark that the walls of both buildings were constructed by rammed earth "chineh" and mudbrick unanimously.

Hakemi´s building the rooms 8 and 18 are identified as having been used for storage similar to the rooms loc.1051 and loc.1103 from Kaboli´s building (see Figure 35).[554] This observation leads to the assumption that both buildings or better the already mentioned units were used as similar activity zones in their initial phase of usage (see Figure 34 and 35).

554 Kaboli 1997: pl.42-43.

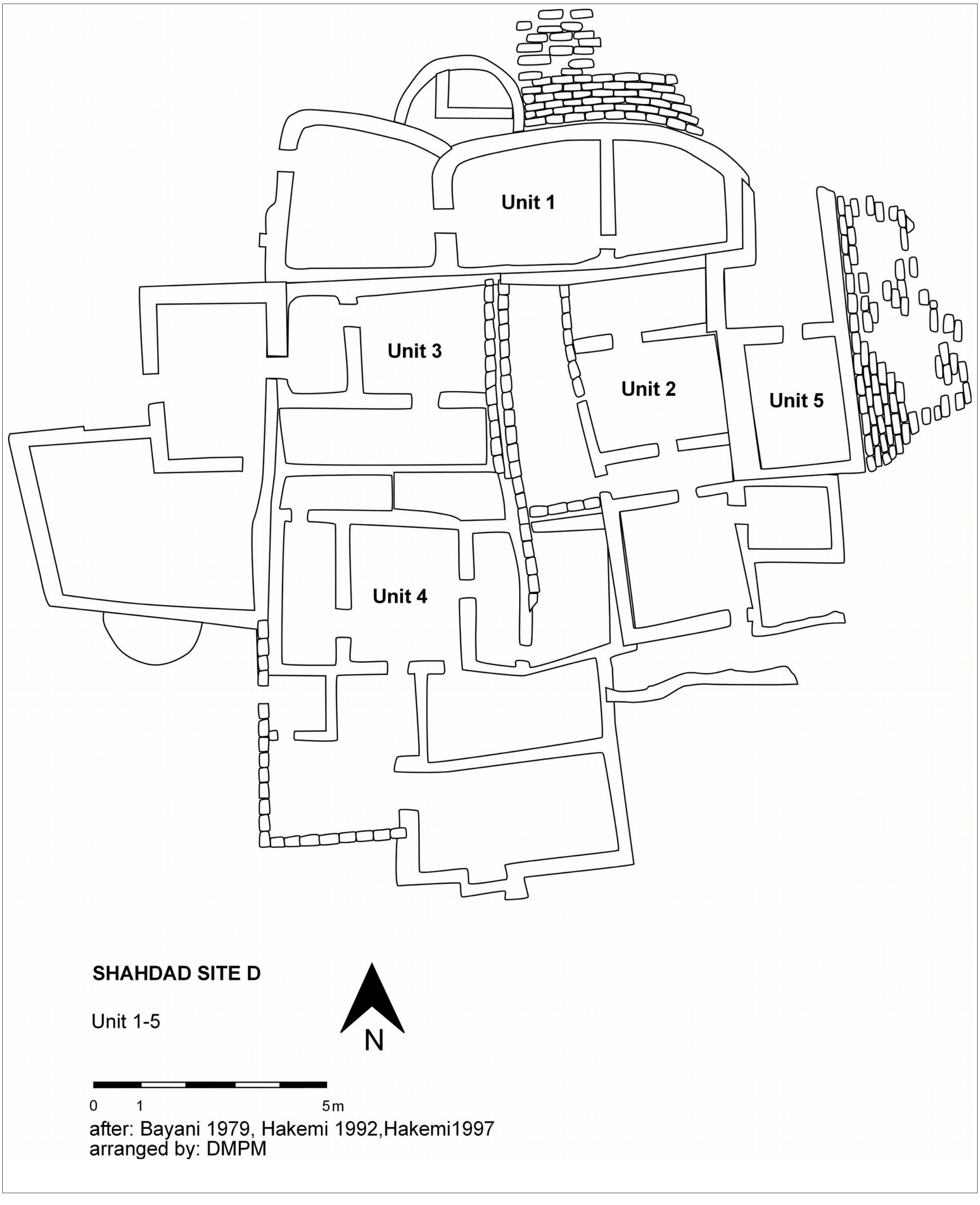


Figure 34: Groundplan of Site D with the subdivision of Units 1 to 5 (Bayani 1979, Hakemi 1992: 122, fig.15.4, Hakemi 1997: 90, fig. 54).

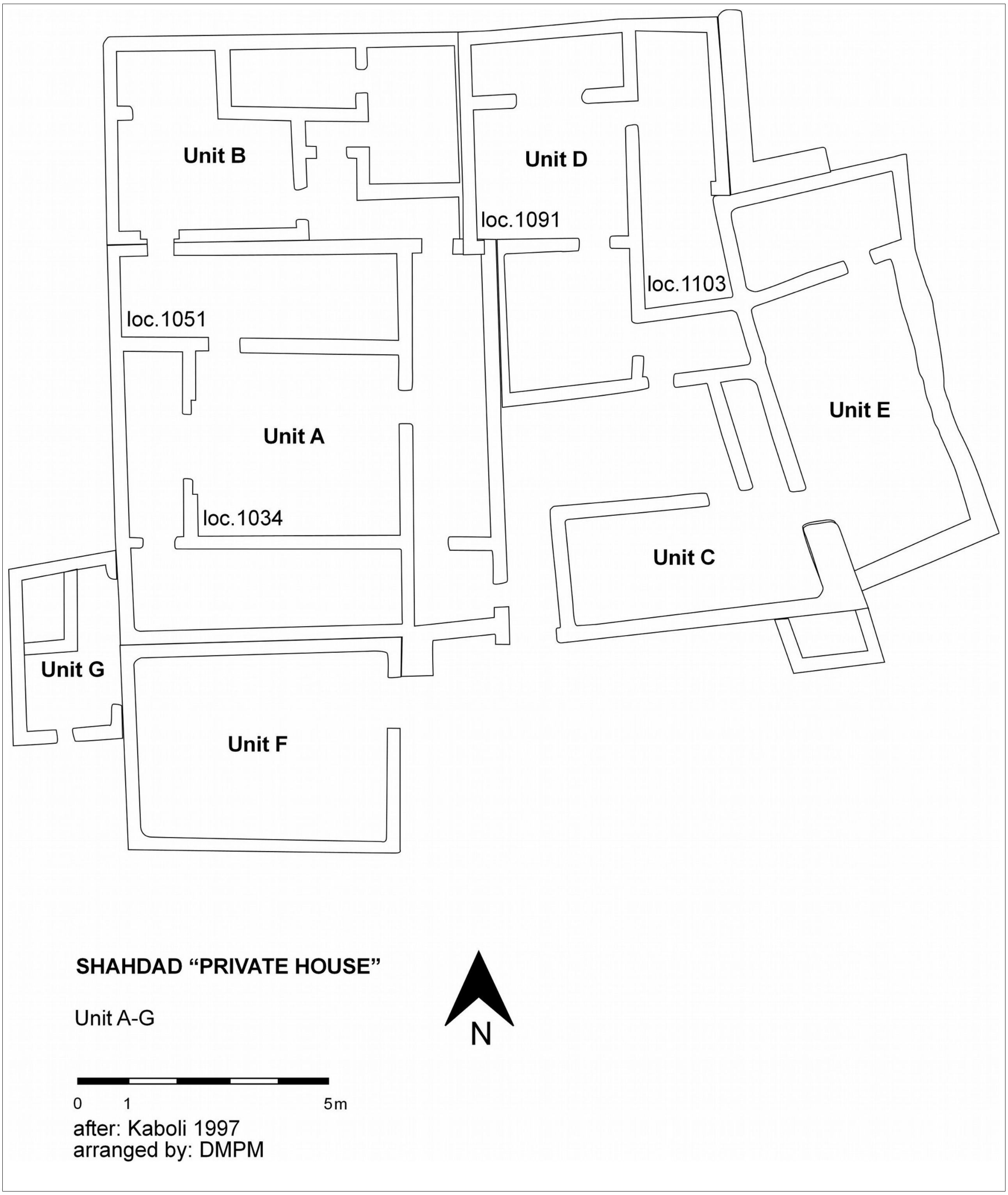


Figure 35: Groundplan of Kaboli´s house with the subdivision of the Units A to G (Kaboli 1997: 124, fig. 43).

4.4.1.The different types of pyrotechnological installations at Shahdad

Other noteworthy observations were made regarding the pyrotechnical installations at Shahdad. According to Hakemi and Bayani several types of pyrotechnical installations were identified at the workshop “site D”. The different types of mentioned installations will be explained in detail in the following:

4.4.1.1. Type I:

This version which was exclusively observed in a fragmentary state was documented inside the Rooms 1, 6, 13, 26 and 27. Based on the find situation they were named as “first stage (smelting) furnace”[555] and “metal foundry kiln”[556] by Hakemi and as “fornace”[557] by Bayani. The best preserved example is located in R.6 with a preserved height of 1.3X0.85X0.28. According to their reconstruction they were composed of a central mould on the top where the copper ore and the fuel were heated. After the metal liquefied it would have reached a shallow enclosed depression to the right hand side by a narrow channel. This reconstructed channel with a 45° degree angle led the molten copper towards the enclosed depression.[558] Another example of this type that was documented in R.26 shows an elevated plattform to the left on the inside of the installation which is accompanied by a narrow lower part to the right which ends in a circular round depression in front of the installation.[559] It seems also that just in front of the installation there was also a small step attached.[560] The arched front wall of the installation was not described in any of their reports. The actual height of the installation is reconstructed at about 0.3m which interestingly matches the preserved height of the adjacent eroded walls. It seems that the proposed height of the installation this low height due to the eroded state (see Figures 36 and 37). It is rather more likely to reconstruct the heavily weathered feature to a higher level similar to the examples that were found inside of Kaboli´s building with a preserved height of ca. 1 m.[561] There are also similarities to earthen installations known from the contemporary Murghab delta sites of Gonur Depe and Adji Kui in the sense of the

555 Hakemi 1992: 122.
556 Hakemi 1997: 87, fig.50.
557 Bayani 1979: 45.
558 Hakemi 1992: 122ff.
559 Hakemi 1997: 109, fig.77.
560 Hakemi 1992: 124, fig.15.9. Although it is not easily identifiable in the photography it seems that the other example from R.1 was of a similar layout (see Hakemi 1992: fig. 15.10 and Hakemi 1997: 91, fig. 55) as well as the ones from R.13 (Hakemi 1997: 101, fig.67) and from R.27 (Hakemi 1997: 108, fig.76).
561 Kaboli 1997: 124, pl. 43 (loci 1035, 1092 & 1126).

architectural layout as well as from several architectural remains which were discovered at Susa/Shush (See following paragraphs 4.5.2. and 4.5.3.).

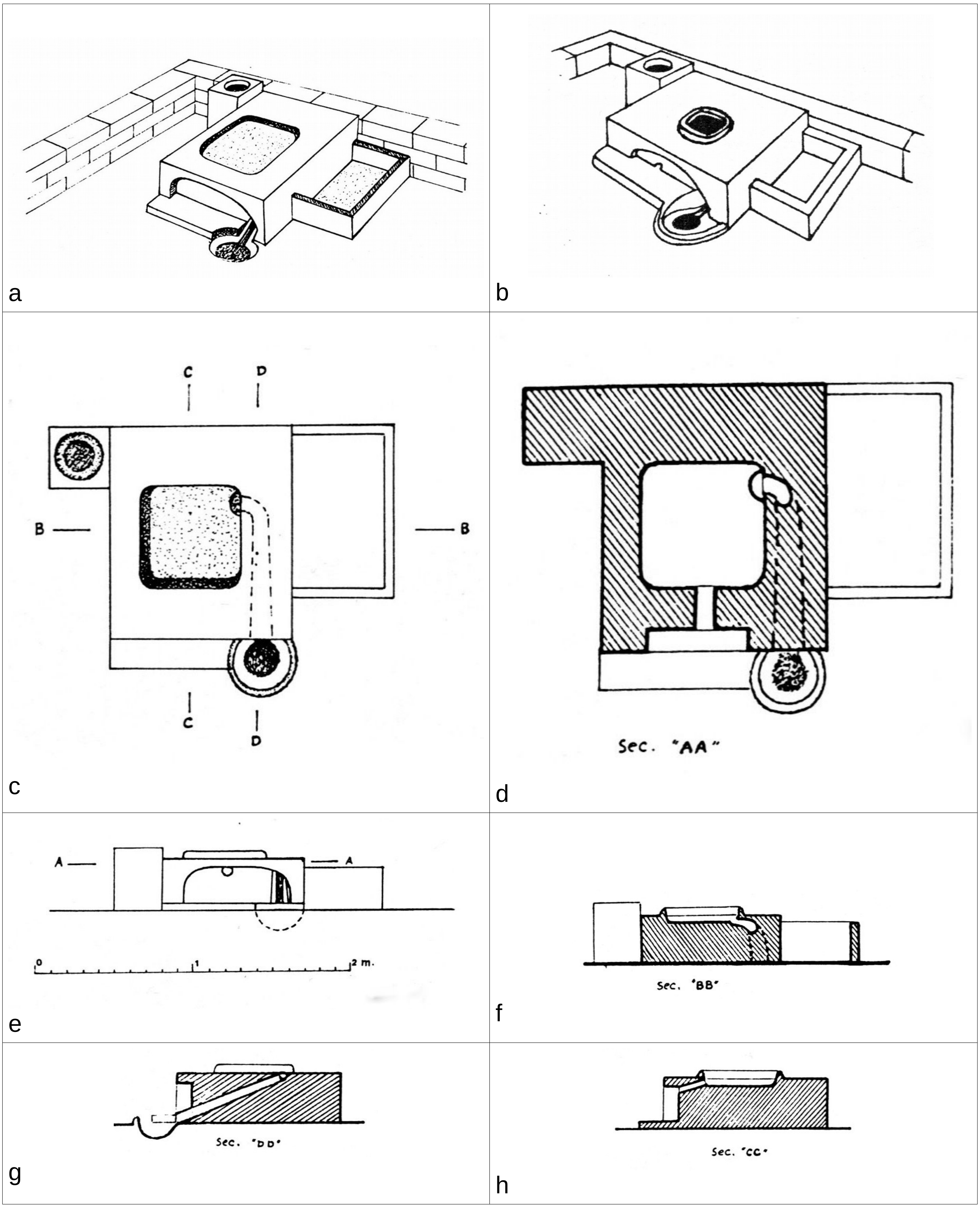
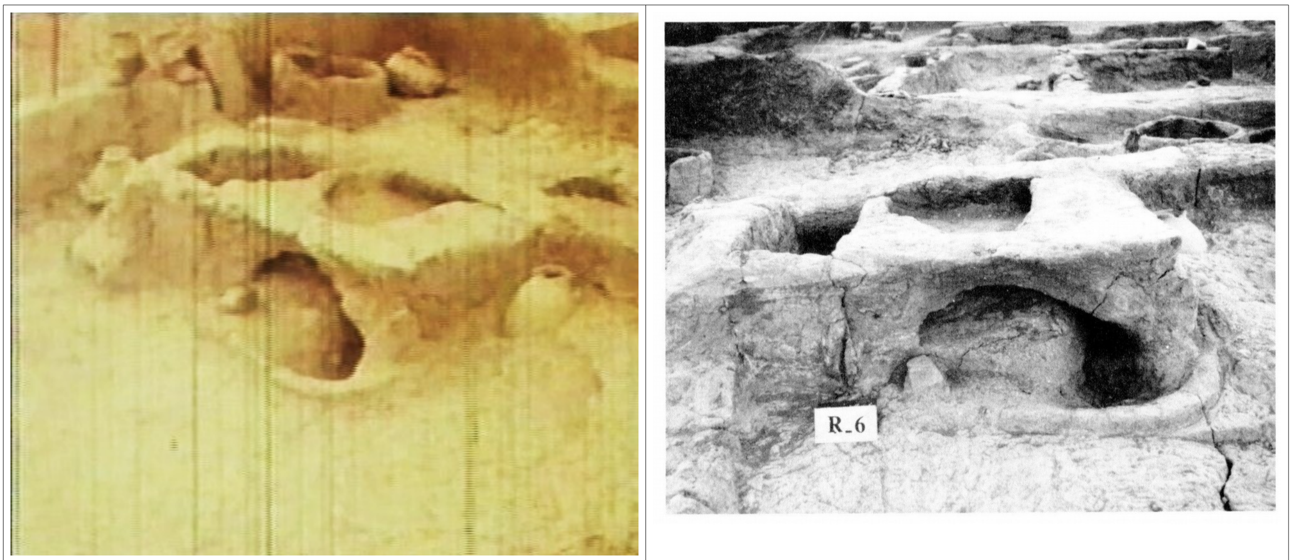
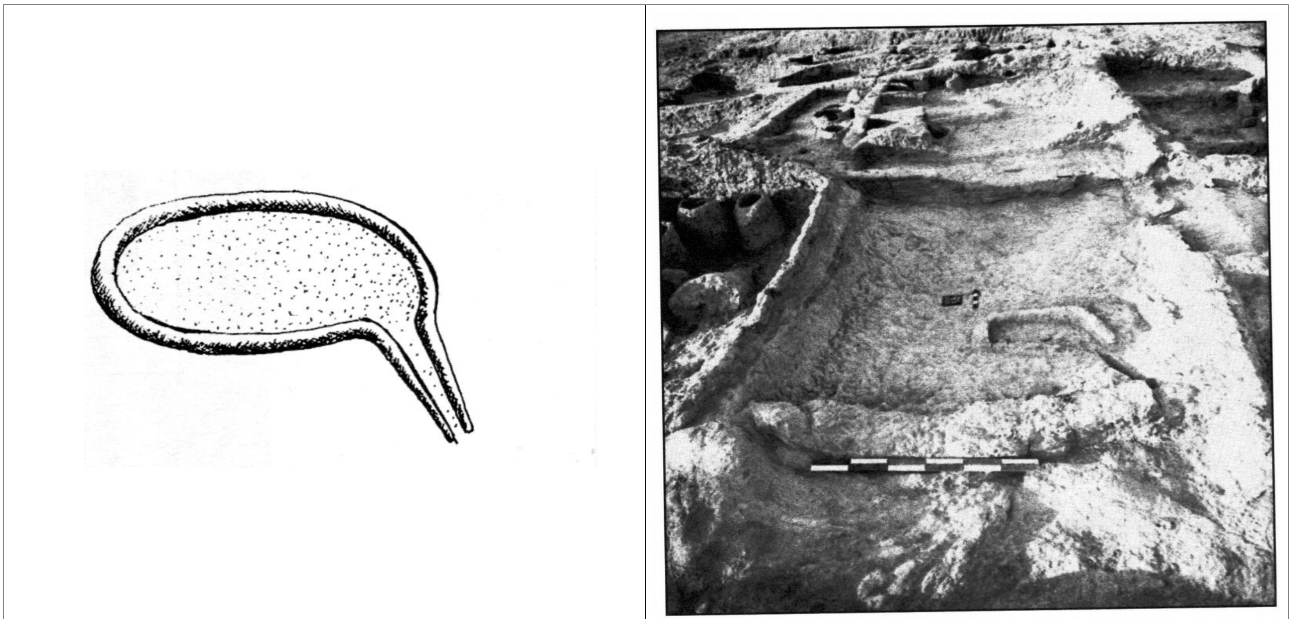


Figure 36: Reconstruction of the Type I "metal foundry kiln" (a, c to h after Hakemi 1992: 125, fig.15.11/12; Hakemi 1997: 87f., fig 50, fig.51.4 to 7; b after Bayani 1979).



a b

Figure 37: Different views of the Type I "metal foundry kiln" from R. 6 (a: taken from the documentary movie by H. Rasael, b: Hakemi 1992: 123, fig.15.8).



a b

Figure 38: Pyrotechnical installation Type II, Site D, R. 24 (a: Hakemi 1992: 127, fig.15.17.1-3; b: Hakemi 1997: 97, fig.63).

4.4.1.2. Type II:

Here we are dealing with an installation of a shallow height which was observed inside of the workshop´s room 24 (see Figure 38).[562] As visible on the images it is of an elliptic

562 In the first international presentation of site D this installation was named as "moulding furnace IV" and misleadingly mentioned to be discovered in r. 26. he also mentions that the low height might be caused due to

shape with a low enclosing rim and a shallow depression on the inside and has been interpreted as a “simplest moulding furnace”. To the Southeast is a small tapering channel which is constructed to “direct the flow of molten metal” outside of the installation. Interestingly none of the excavators observed a sloping character of the feature which would support the interpretation of a channel to enable the molten metal to be separated. Both authors describe a varying amount of open coarse pottery vessels which can be seen as crucibles.[563] Further, Hakemi reports the presence of a red ware pottery vessel[564], while Bayani and Hakemi describe ashy layers but at different positions.[565] According to the archaeological record and the find situation it seems quite doubtful to reconstruct specific metallurgical actions basing on the published data. Here we are also dealing with a singular feature with no known comparison from an archaeological context so far.

4.4.1.3. Type III:

According to the published data type III was discovered at Site D inside R.1[566], R.2, R.5 and possibly in R.26.[567] Due to the preserved open shape which would not support an efficient smelting of metallurgical products it seems plausible that this type of installation must have been closed, possibly with a dome-shaped cover. Furthermore, the record of metallurgical residues inside or next to the installations also supports the interpretation that some kind of metallurgical activities were conducted here. But it remains undetermined precisely which metallurgical step was performed. Bayani compares the features from R.2 (see Figure 39a) and R.5 according to their shapes and proclaims a similar usage.[568] He remarks in R.2 the discovery of metallurgical tools like a big granite slab and several pebble stones of different size with visible wear traces and anvil and hammer stones to prepare ores or other metal bearing material[569], while in R.5 he

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“filling in the bottom of the chamber“. (Hakemi 1992: 124f.) In the final publication it is interpreted as a “second stage foundry kiln“ (Hakemi 1997: 88, fig.51) and “...melting kiln...“ (Hakemi 1997: 98)

563 Bayani: 1979: 46; fig. 14; Hakemi 1992: 126, fig. 15.15; Hakemi 1997: 98; The only precise description of crucibles is according to Hakemi 1992. In Hakemi 1997 they are only described as “...three buff ware jars...“. It seems plausble to identify these vessels according to there find location with some of Bayani´s “crucibles“.

564 Hakemi 1997: 98.

565 Bayani 1979: 46. “...l´angolo sud oveste accumulo di carbone e ceneri...“; Hakemi 1997: 98 “...under the northern wall...ash and coal were found“.

566 This example is exclusively mentioned by Hakemi as “...most likely used for secondary smelting...“ but unfortunately it is neither well identifiable on the photography (Hakemi 1997: 91, fig.55) nor reproduced on the general map (Hakemi 1997: 90f.). So it remains doubtable if this feature in R.1 can be identified as of Type III.

567 The different reports are regrettably contradictory in the sense of the interpretations of the similar shaped installations and their find contexts.

568 Bayani: 44.

569 Bayani 1979: 40.

mentions the discovery of charcoal remains.[570] But the presence of charcoal does not necessarily imply metallurgical activities.

Hakemi on the contrary does not even mention a pyrotechnical installation in R.5. So the intention of the installation remains an uncertainty. The example of R.26 seems to also be in a bad state of preservation, but a shallow elliptical depression was observed on the inside as reported by Hakemi[571]. Bayani however identifies this installation with a pebbled floor on the inside as a small storage feature comparable to examples which were also discovered in the rooms 2, 5, 13, 21. So it seems possible also to hypothesize that these installations may have been used as storage facilities for charcoal as already noted for R.5.[572] Strong evidence such as vitrified surfaces of the clay installations which normally remain after heavy firings are not described. A comparable installation is also known from Kaboli´s site (see Figure 39b).[573]

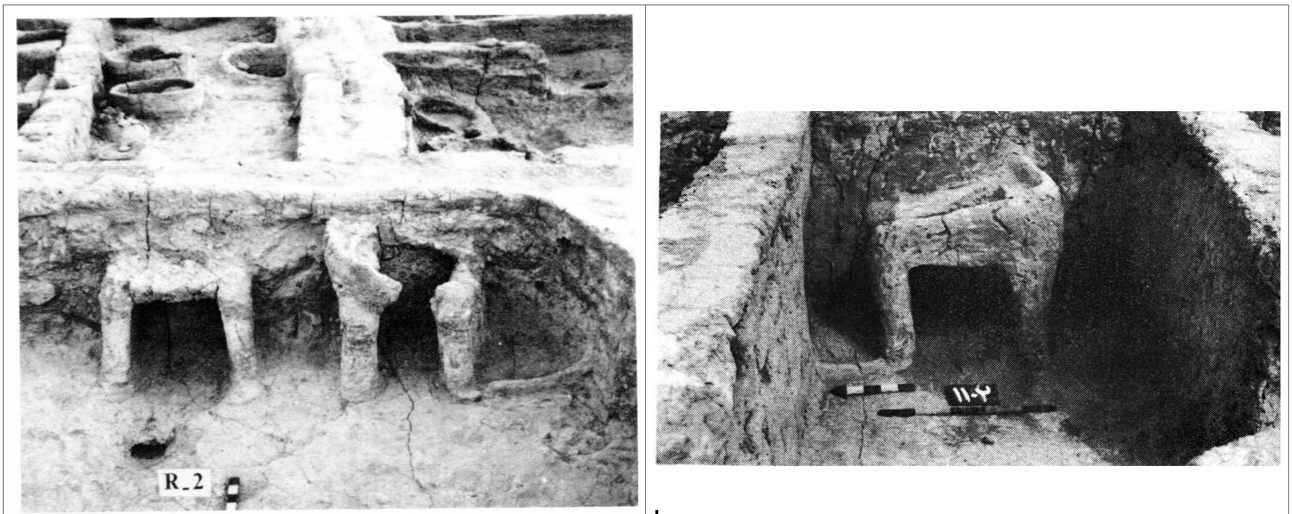


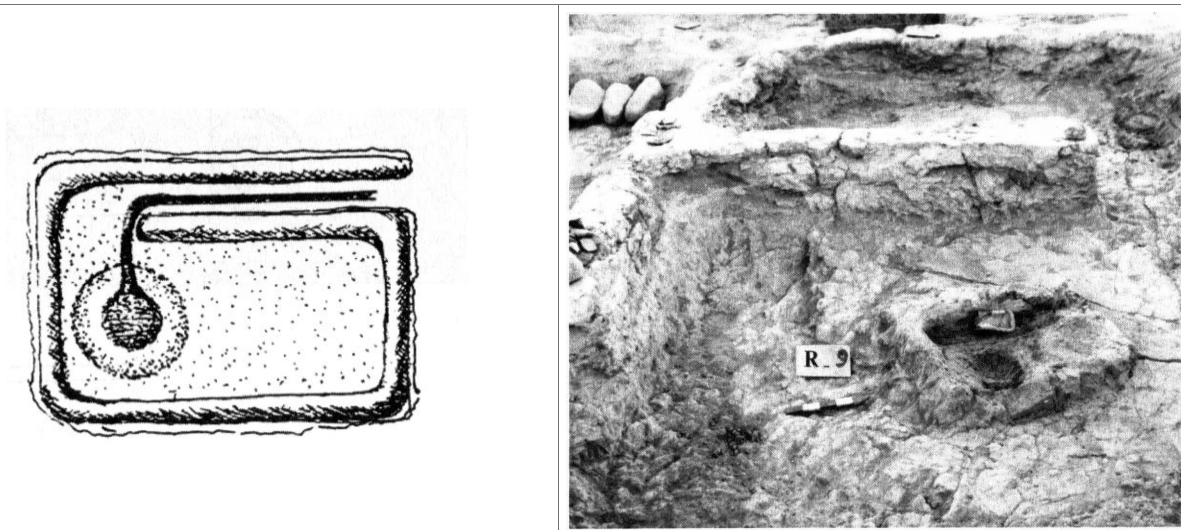
Figure 39: Pyrotechnical installation Type III, Site D, R. 2 (a: Hakemi 1992: 126, fig.15.14; b: Kaboli 1997: 119, pl.38).

4.4.1.4. Type IV:

This is an installation of a distinguished shape and special character due to the published descriptions. It stands out as a unique feature with no known parallels so far. According to Hakemi it is a “Model II molding furnace” of almost rectangular shape and was situated in Room 9 (see Figure 40). Its dimensions are 0.47X0.28X0.12m and “...the interior surface was (situated) 0.09m (higher)...” than the room´s floor. It is also described with a round

570 Bayani 1979: 44.
571 Hakemi 1997: 107, fig.77.
572 Bayani: 1979: 44.
573 Kaboli 1997: 119, pl.38

hole in a central position “...for the second stage of smelting copper...” and a “...short ledge with a height of 0.03m”. Furthermore, a steep channel is mentioned which was used to direct the liquified metal. According to Hakemi a fragment of an axe mould was found inside the installation.[574] The presence of the mould is also attested to by Bayani.[575] Two conical clay pegs are also mentioned to have been found in the Western adjacent R. 11 which are described as “spigots” or “plugs” to be used for controlling the metal flow.[576] There is no doubt that these artefacts could have been used in metallurgical activites but according to comparable finds from similar metallurgical contexts, e.g. at Tappeh Ghabrestan[577] and Arisman/Siyah Boum[578], it seems rather more likely that these truncated cone-shaped pegs were used as plugs for the shaft holes during the casting of metal tools. All these previously mentioned observations are also attested to in the final report.[579] There is also the presence of copper ore in different states of process as well as descriptions of pyrotechnical remains such as ashes which supports the interpretation that metallurgical activities were conducted here.[580] But due its singular character there seems to be no possibility of a convincing and adequate reconstruction of this pyrotechnical installation.



a

b

Figure 40: Pyrotechnical installation Type IV, Site D, R. 9 (a: Hakemi 1997: 88, fig.51.8; b: Hakemi 1992: 127, fig.15.16).

574 Hakemi 1992: 124, 127, fig.15.18 & 19 (R_9 a, b); Hakemi 1997: 560 (Obj.no. 4463), 707, Wa.1.
575 Bayani 1979: 52f.
576 Hakemi 1992: 128, fig.15.19 (R_9 a, b); Hakemi 1997: 707, Wa.2.
577 Madjidzadeh 2008b: 125, fig.57.9,10.
578 Helwing 2011: 317, fig.89.288-307.
579 Hakemi 1997: 99ff.
580 Bayani 1979.

4.4.1.5. Type V:

Examples of this last type were observed in R.16 and R.25 (see figure 41). Both share similarities in shape but also show differences in the layout and size. The one from R.16 is described as a “round pit with a depth of 0.65m” and is presented as “Model III molding furnace”. On the inner surface traces of a clay mortar plaster were documented.[581] Hakemi also mentions a small kiln in the centre of this room. But unfortunately due to the missing drawn record and the low detailed photographs this statement cannot be verified.[582]
Bayani also identifyies a round pit structure with a depth of 0.9m, a clay enclosure and an airduct. He further notes a filling of sand inside the pit.[583] Hakemi observed a hole with a sand filling but without any detailed description.[584]
The second example is located in R.25 and also has a round shape. Bayani describes the installation as a pottery vessel which was sunk upside down into the floor. He further describes remains of burnt clay as well as traces of ash.[585]

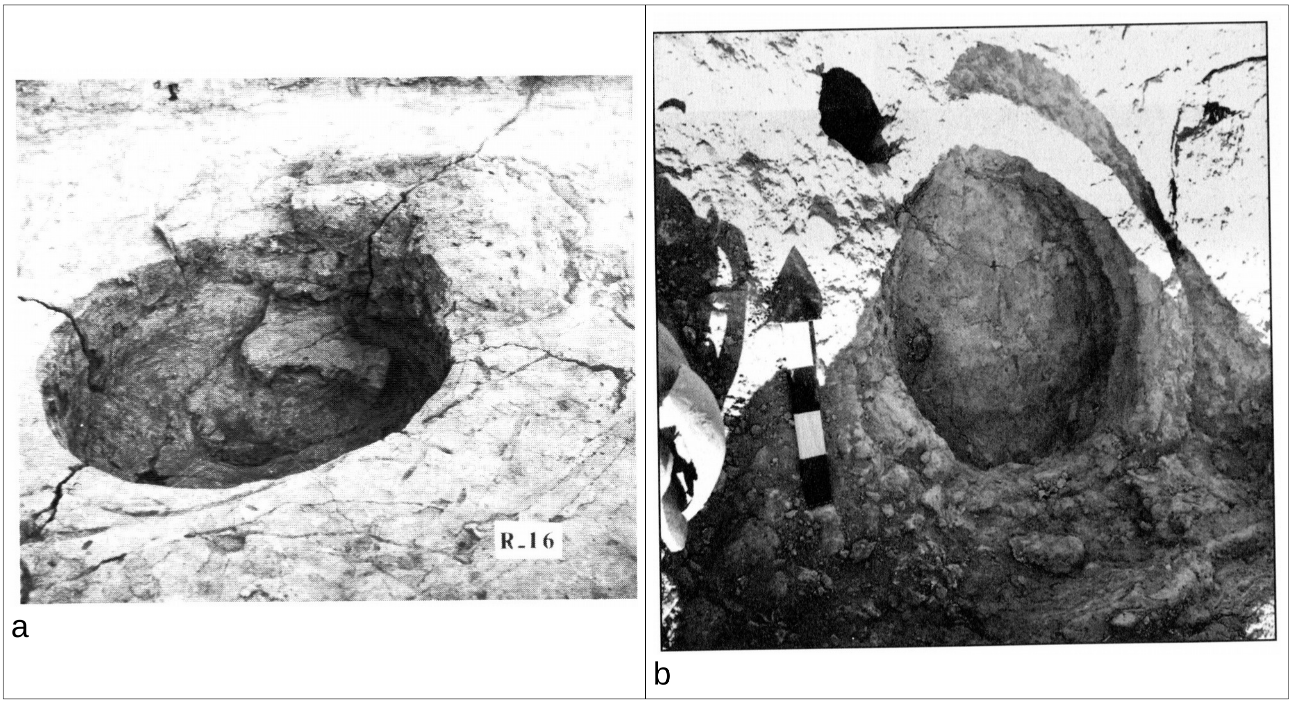


Figure 41: Different types of metal smelting furnaces Type V, Site D, R. 16 (a) and R. 25 (b) (a: Hakemi 1992: 128, fig.15.20, b: Hakemi 1997: 98, fig.64).

581 Hakemi 1992: 124, 128, fig.15.20.
582 Hakemi 1997: 104. “...a small kiln for secondary stage smelting, similar to the kiln in room no.9...“
583 Bayani 1979: 57f.
584 Hakemi 1997: 104.
585 Bayani 1979: 46.

Hakemi also notes the inverted jar with a preserved height of 0.65m but goes on to mention remains of metallurgical activities such as “...considerably amounts of ash and fragments of oxidized copper...”.[586]
In conclusion it needs to be stressed that here in R.25 we have the only in situ-context where finds of metallurgical slags are indicated and documented.

4.4.1.6. Conclusion:

Although traces of heavy firings like ashes, slags, charcoal and red burnt clay which are unquestionable indicators of pyrotechnological activities were observed all over the workshop it is still unknown which specific type of metallurgical activities were conducted there. Strangely not a single tuyere or even a fragment of one was found which would be expected inside of a Bronze Age metal workshop or around the building. Furthermore, the absence, or better the missing descriptions of highly molten and vitreous furnace linings does not support the interpretation that the workshop was used for the smelting of copper ores which would have been at a temperature of 1084.62°C, the melting point of copper, or at ca. 950°C, the melting point of copper alloys/ bronze. But maybe this interpretation is down to the heavy eroded state of the architectural remains.
Further doubts were also mentioned by V.C. Pigott and D. Steiniger.[587] But it needs to be gainsaid to Steiniger[588] that Type I was not build for smelting reasons. According to further archaeological data from the last 20 years e.g. the “private house” at Shahdad which was discovered by M.A. Kaboli[589] and several examples from the Murghab Delta in modern Turkmenistan it seems that these installations with an average height of 1m were used for domestic actions as ordinary heaters and ovens. The latter examples will be presented and described in the following:

586 Hakemi 1997: 85ff., fig.52, 98f.; Hakemi 1992: 128, fig.15.22.
587 Steiniger 2011: 90f.; Pigott 2004: 31.
588 “...Some features of furnace construction in Arisman can be found at Shahdad as well, for example, the rectangular, raised mudbrick platforms with furnace remains that display a kind of extension at one side and an open front...“ Steiniger 2011: 90f.
589 Kaboli 1997: 124, pl.43. (loc.1035, 1076, 1092, 1126)

4.5. Comparisons from the site of Shahdad and abroad

4.5.1. The private house at Shahdad

Between 1372 and 1374 (1992-1994) an archaeological research group from the I.C.A.R. under the directorship of M.A. Kaboli excavated several architectural features at Shahdad which one is known by the name “private house”.[590] The complete building is composed of 26 rooms of different sizes which are segmented in to seven units named A to G.[591] According to the published survey data from S. Salvatori this place was recorded as point 23 and must have already been known after the activities in January of 1977.[592] During the excavations pottery vessels of different sizes as well as stamp seals were discovered according to the published data. Besides these small finds there were also several architectural features unearthed. Of special interest for this research are the pyrotechnical installations which will be described in the following.

According to Kaboli two types of pyrotechnical installation can be distiguished. The first one is of round shape and low height and is identified as “ojāgh”.[593] Several examples of this type were inside the building and designated as loc. 1036, 1077, 1127 and 1128. It is also noteworthy that the majority of the ovens were situated in close vicinity to the second type of pyrotechnical installation.[594] Unfortunately there are no further descriptions of its composition.

590 Kaboli 1997, 2000, 2001.

591 The units are actually named with the equivalent seven first letter of the Persian alphabet (Kaboli 1995: 114).

592 Salvatori 1977; Salvatori & Vidale 1982: fig.1.

593 Kaboli 1997: 105-110. He describes this type with the Persian word “اجاق" which is synonymous with “oven“. (Maleki 2003: 50.)

594 Only the “oven“ loc. 1060, which is of rectangular shape was situated in a central position in the main room of Unit B (Kaboli 1997: 123f., pl.42, 43).

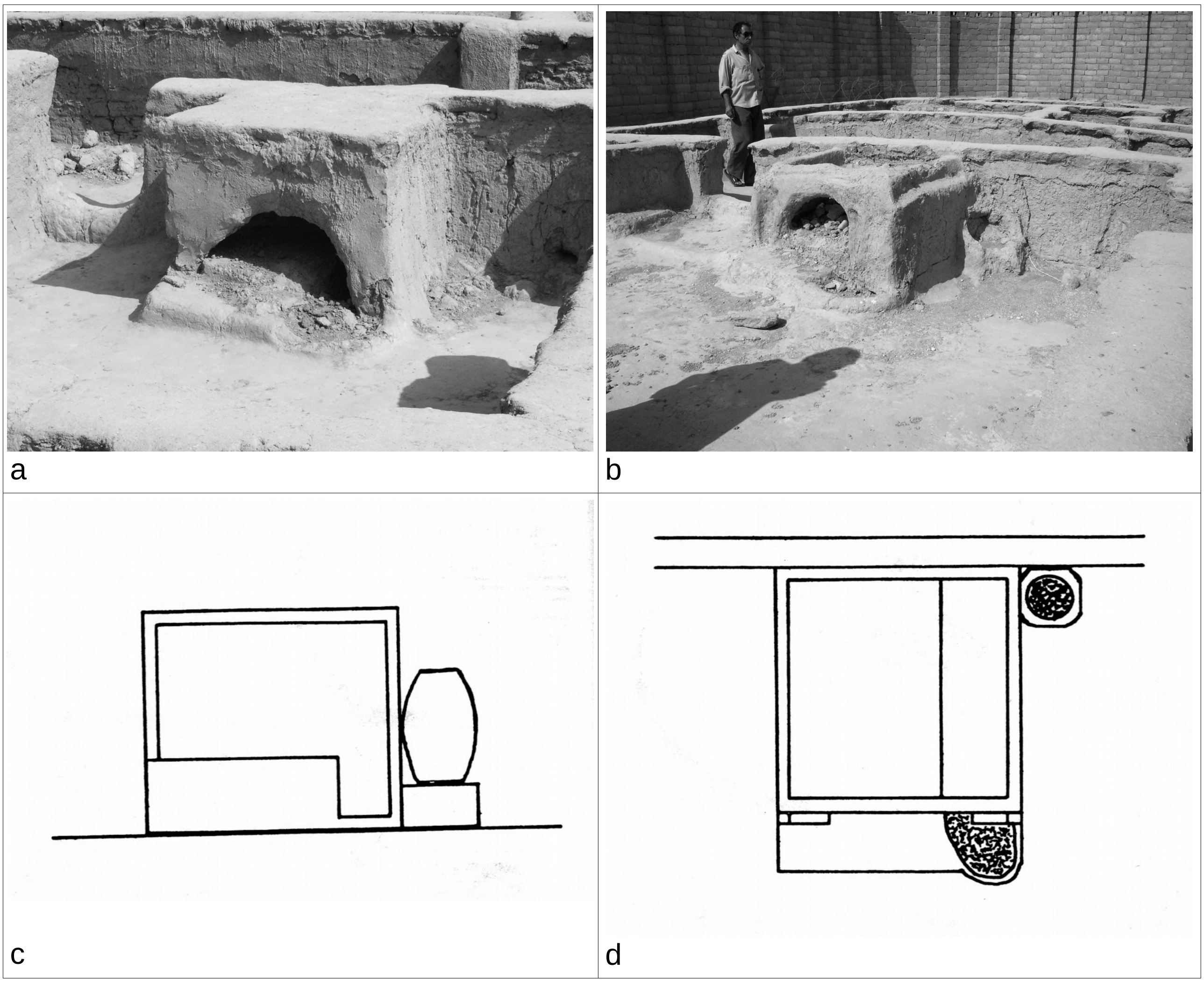


Figure 42: Images of the pyrotechnical installations from the "Private House" at Shahdad, a) loc. 1092, b) loci 1035 and 1036 "bokhari, tanur" (by courtesy of E. Cortesi), c) and d) schematic reconstruction drawings of installations loc.1035 and 1036 (Kaboli 1997: 111, pl.30).

The second type also appears inside the building and is throughout situated attached to the walls. They are an almost cubic shape of 1X1m with an arched opening in the front as well as a small bench and a small lower circular depression situated right next to the bench. On top of this feature there was a square surface with a small cut-out. The installations are referred to as heaters and were tagged as loc. 1035, 1076, 1092 and 1126.[595] Kaboli heterogenously describes them as "bokhāri"[596] or "tannur"[597]. According to the published schematic representations this type was hollow on the inside and

595 Kaboli uses the Persian expressions "بخاری" (Maleki 2003: 192) and "تنور" (Maleki 2003: 444f.) to name the installations. It needs to be stressed that actually the first term is used for installations to raise temperature inside of closed rooms. For this reason they can be also used to heat meals. The second term is of unknown origin and presumably derives from a Sumerian term. In every instance it was used to describe installations for cooking and baking (Tkáčová 2013: 4ff., fig.1, 2).

596 Kaboli 1995: 115; Kaboli 1997: 105-110, pl.

597 Kaboli 2012: 563, fig.3. This example is presumably identical to loc. 1076.

subdivided into two parts: a raised platform and another lower section placed right next to it which was ending in a shallow round depression just in front of the installation. Both segments were not separated from each other inside the installation (see Figure 42).

In reference to other protohistoric architectural features from the Murghab-Delta in modern Turkmenistan, which will be presented and explained in the following paragraph the segments can be described as a platform and a lower situated combustion chamber (see Figure 42c).[598] The platform might have been used to heat meals or other goods, while the combustion chamber might have been suited to burn fuels to ensure the proper heating of the installation. The small cut-out on top of the feature therefore can be seen as a flue to reduce the annoying fumes from the room in which the installation was located. There are legitimate reasons why the installations from Shahdad´s Site D, which are labelled here as "pyrotechnical installation Type I", can be seen as identical to these installations that were discovered during Kaboli´s work. Although the examples discovered during Hakemi´s mission are reconstructed to a lower height there are several doubtless similarities in the details. For instance there is the open arched front, the shallow round-shaped depression in front of it as well as the small bench which was situated right next to the depression. These are all identical characteristics which can be observed at both features at Shahdad. Due to the eroded condition of the examples from Hakemi´s[599] and Bayani´s[600] publications the hollowness of the installations was impossible to observe in the same way asKaboli could (see Figure 43). For this reason it is difficult to review/evaluate their observations. But according to their reconstruction drawings and photographs there was a lowered space on the top in a central position which can be seen as corresponding to the hollow inside. It seems also questionable if there was a steep and narrow channel to separate the molten metal from the slag by gravity as proposed. Several arguments for this view were already discussed in the previous paragraphs of this chapter. Finally it needs to be emphasized that the reconstruction from Kaboli seems more plausible because of the better state of the installation´s preservation in comparison to the previous reconstructions.

598 Orazov 2007: 203f.
599 Hakemi 1997: 87, fig.50.
600 Bayani 1979: 103.

a b

Figure 43: Different examples of Type I installations from Site D, R. 1 a: view from above, b: view to the North (with the courtesy of S. Salvatori).

4.5.2. The pyrotechnological installations from the Murghab delta and the Kopet Dagh-piedmont

During recent decades there were several other pyrotechnical installations discovered in this region which according to V.I. Sarianidi are interpreted as hearths or heaters[601], similar to Kaboli´s interpretation of his finds. They can be observed as attached to or installed into the walls as well as in isolated positions. Sarianidi emphasizes that according to his observations some of these installations, due to their position and enormous size, as having been of cultic use.[602] The majority of the examples he refers to are from the site of Gonur Depe. As visible on Figure 44 there are numerous pyrotechnical installations at Gonur Depe North which are of similar character to the already known examples from Shahdad (see Figure 48). They are also composed of a bipartition with an elevated platform and a lower combustion chamber.

a b

Figure 44: Pyrotechnological installations from Gonur Depe North (a, b: by courtesy of S. Winkelmann).

Besides the evidence from Gonur Depe North there are further examples from the sites in the Adji Kui Oasis. The excavations there were conducted by the Italian-Turkmenian "Margiana Archaeological Mission" between 2003-2012 under the directorship of G. Rossi-Osmida[603] and from 2013 on by B. Cerasetti and M. Cattani.[604] In the course of the excavation at Adji Kui 9 (AK9) two types of pyrotechnical installations which are described

601 Besides this he also names a type of "double-furnace" which he sees as having not been used for domestic activities(Sarianidi 2006: 120).
602 Sarianidi 2006: 120, fig.27; 143ff., fig.34, Sarianidi 2008: 66, fig.11, 252-261.
603 Rossi-Osmida 2007, 2011.
604 http://www.turkmenistan.os-culture.org/11-archaeological-activity/23-turkmenistan-mission-october-2013.html

as oven-fireplaces[605] were possible to distinguish: The first type with two chambers and the second with one chamber. The first type which is of particular interest to this study has been documented and studied intensively inside the Rooms 38, 82 and 180 at AK9.[606] Orazov describes them as domestic features of cubic to rectangular shape which consist of a combustion chamber with a fire plane. This part was also a little extended to the front of the installation and enclosed by a low clay lining, as has already been attested to in the examples from Shahdad and Gonur Depe (see Figure 48). On the inside of this part the fire was prepared and due to the good accessibility fuel and its remains could have been added or removed continously. This part was separated from the adjacent plateau by a low bench. The plateau itself was slightly elevated and also extended to the outside. It was hypothesized that this plateau was primarily used for heating/preparing meals. On top there was also the small cut-out for observation which might have been used as a flue to educe the fumes. Of particular interest are the different examples of the first type according to their positions. The one from R. 38 (see Figure 46) seems to be completely set in the wall while the ones from R. 82 and R. 180 (see Figure 47) were built into the wall in a way that the installation's back reached into the next adjacent rooms. This observation shows the high degree of technical knowledge about energy efficiency to heat two adjacent rooms with just one installation. This is a technical improvement which so far has not been observed in other contemporary neighbouring cultures. It seems that the installations were in use for long periods and also restored during periodical maintenance work.[607] In view of their size it is noteworthy to remark that the examples of the first type have a height of approximately 1m which is identical to the examples from Kaboli´s site as well as from Gonur Depe.

Reconvened excavations at Monjukli Depe in the northern piedmont region of the Koppe Dagh mountains in southwest Turkmenistan revealed further examples of these two-chambered ovens in neolithic contexts which are dated in the 5th millennium BCE[608] and were found during the first investigation in the early 70s (see Figure 45).[609]

605 Orazov 2006: 112, fig.20-29.
606 Orazov 2007: 203.
607 Orazov 2007: 207.
608 Pers. comm. By R. Bernbeck and J. Schönicke. The best preserved example (loc.475) is located in Unit D, Haus X. http://monjukli.net/architektur.html
609 Berdiev 1972: 13, fig 1. R.7.

Figure 45: Two chambered oven from Monjukli Depe, Haus X (by courtesy of R. Bernbeck).

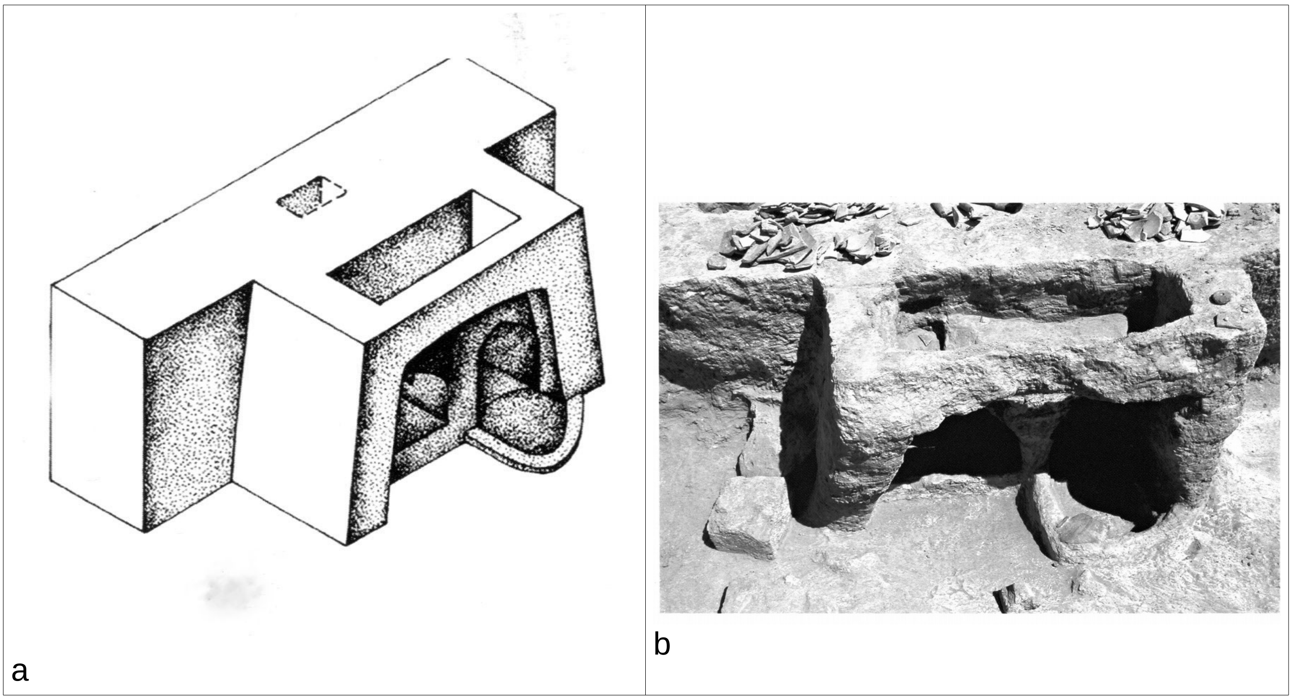


Figure 46: Pyrotechnical installation from Room 38 (a,b) at Adji Kui 9 (from Orazov 2007: 204, 206f.).

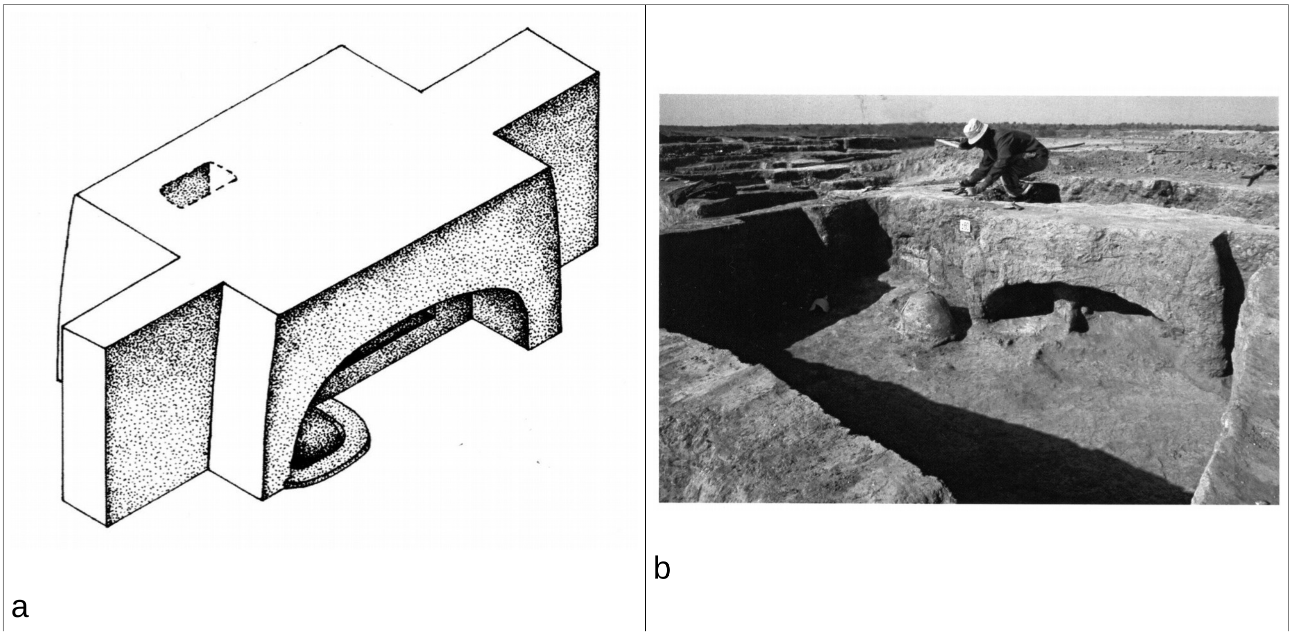


Figure 47: Pyrotechnical installation from Room 180 (a,b) at Adji Kui 9 (from Orazov 2007: 204, 206f.).

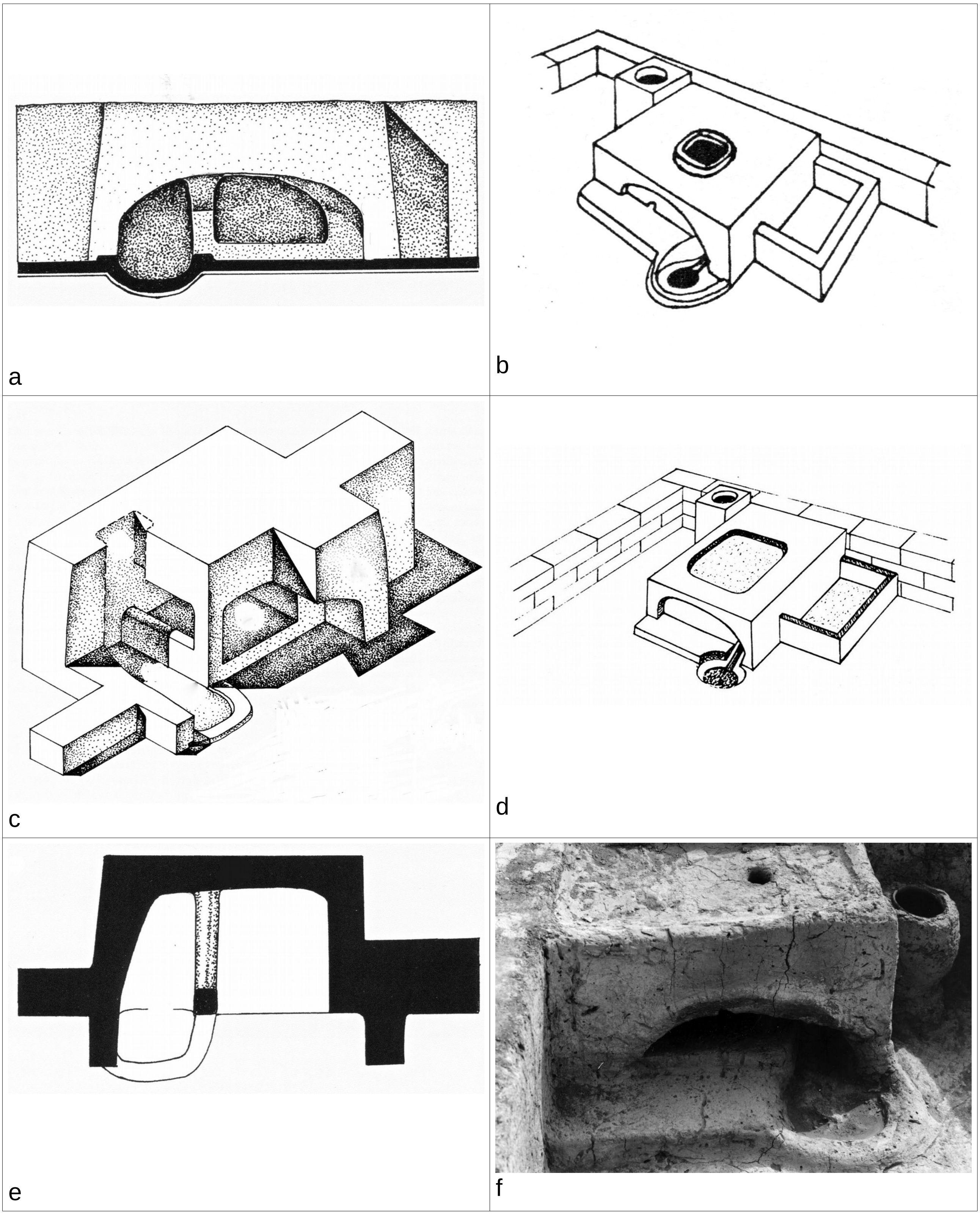
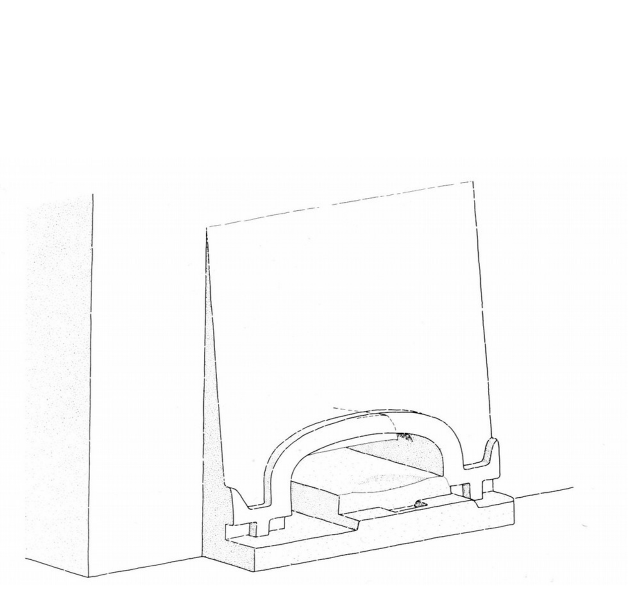


Figure 48: Technical and reconstructional drawings of the pyrotechnical installation of R. 180 from AK 9 (a, c, e) (Orazov 2007) and from Shahdad (b, d, f)(Bayani 1979: 103; Hakemi 1992: 125, fig.15,11.1; Kaboli 2012: 563, fig.3).

4.5.3. Pyrotechnological installations “cheminées” from Susa (Khuzestan / I.R.I):

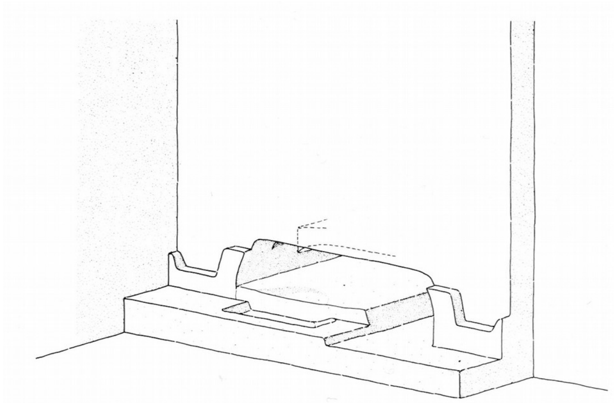
At the end of R.Ghirshman´s work at Susa between 1965 and 1967 he was supervising the excavations of an area of particular interest concerning the domestic life in Susa during the reign of the Šimaškian Dynasty[610] to the Sukkalmah period.[611] It provided us with an extraordinary opportunity to study the Susian town planning on the basis of a composition of discovered written sources, daily life objects as well as major crossroads and numerous examples of domestic, workshop and public architecture.[612] At that time several examples of oven-hearthplaces called “cheminées” were also discovered at Chantier A and B, belonging to the Periods Susa A XV-XIII (see Figure 49).[613] Some of them were in such a good state of preservation that their layout and design was possible to investigate and document. All presented examples here have the bipartition of the installation in a elevated platform and a lower combustion chamber in common. Furthermore there are significant and clear similarities in the sense of positioning and decoration to the already presented examples from the Murghab-Delta and Southeastern Iran to be emphasized. It is also noteworthy that the features were observed inside monuments of communal character like the “cella de la maison du culte” in loc.124 AXV[614], as well as in room of domestic use like f.e. loc.66 AXIV[615], loc.34 BIV (See Figure 49 a, b) and loc.96 AXV (See Figure 49 c, d)[616]. Another feature has been described by L. Trümpelmann at A XIII loc.35[617] in the so called “Kneipe” at Susa.

610 Potts 1999: 130ff.
611 Ibid: 160ff.
612 Carter & Stolper 1985: 146ff.
613 Gasche 1986.
614 Ghirshman 1967: 7f., fig.11-13, 16-19; Gasche 1986: 89
615 Ghirshman & Steve 1966: fig.7; Gasche 91
616 Gasche 1986: 88f.
617 Trümpelmann 1981.

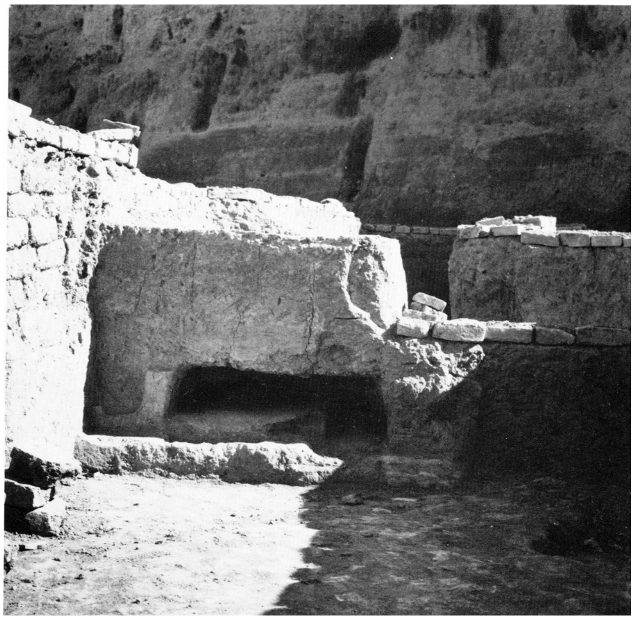


a

b



c



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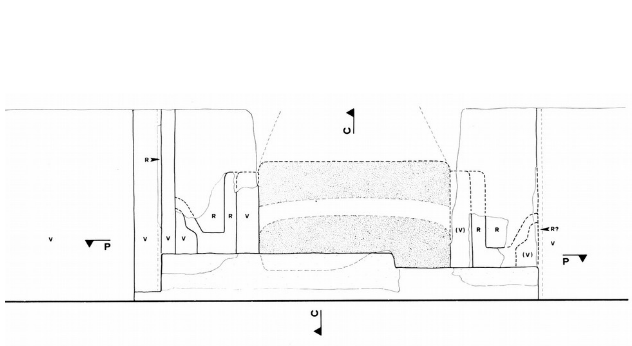

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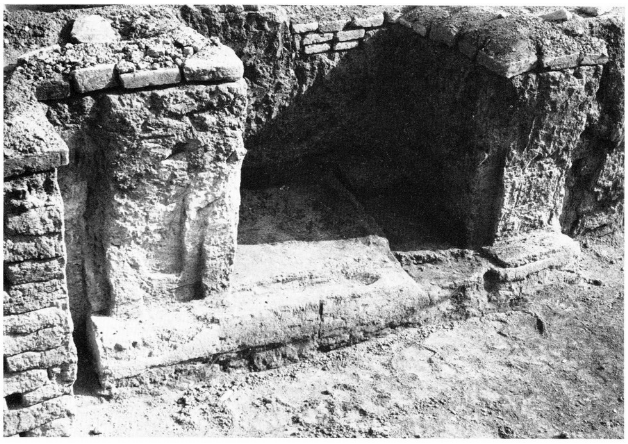

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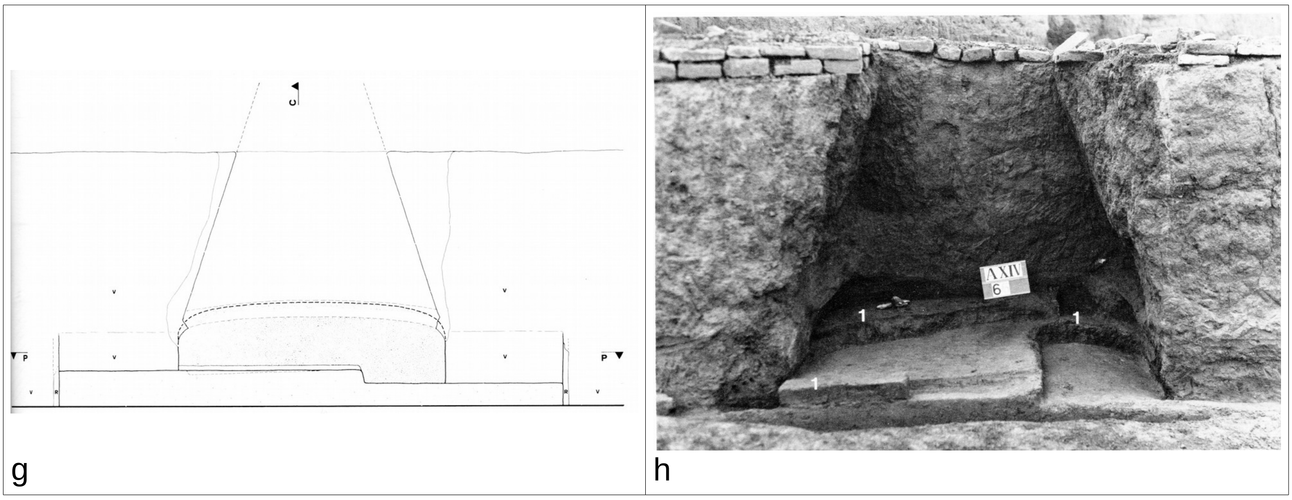


Figure 49: Examples of different “cheminées” from Susa (Gasche 1986).

4.5.4. Conclusion:

The obvious visual similarities between the pyrotechnological installations which were regularly observed in domestic architectural contexts as presented in the previous paragraphs lead one to the assumption that there may have existed more than merely regular trading contacts between these distant areas. The emergence of aesthetic as well as technical characteristics observed in artefacts and architectural features leads to the assumption that there was maybe a trading network comparable to already known examples like the Old Assyrian Karum-system as proposed by S. Salvatori.[618]
In addition the previously attested supra-regional trade relationships are to be considered which are already evidenced by the high amount of artefacts and the regular appearance of significant objects distributed over a widespread area. Besides the economic trading contacts there is also the possibility of stronger fundamental cultural ties having existed during the Bronze age.[619] As proven by the dimensions of the monumental sites like Gonur Depe, Adji Kui, Taip Depe and the settlements of the Togolok Oasis, which are all located in the Murghab Delta in modern Turkmenistan, this region must have been an influential political and economical power to subsist in this period. Furthermore the distribution of artefacts of similar characteristics at archaeological sites in modern Iran like Tappeh Chalo[620], Shahdad[621], Tappeh Yahya and the Jiroft Region, the “Marhašian trajectory” as

618 Ligabue & Salvatori 1979, Salvatori 2010.
619 Potts 2008
620 Biscione & Vahdati 2011. pers. com. by A. Vahdati.
621 Ghorbani emphasizes the outstanding trading position of Shahdad in the 3rd millennium BCE (Ghorbani 2014: 66).

pointed out by S. Salvatori[622] and as a “Šimaški outpost” by E. Carter[623], along the Persian Gulf and even further to Northern Mesopotamia, such as the discovery of an amulett-seal at Tall Mozan, the ancient center of Urkeš[624], indicates the great radius of contact during the Middle Bronze Age period. There is also the question arising about the different trading routes at the time which somehow must have crossed in the area between Kerman and Shahdad: The East-West route over the Iranian Central Plateau towards Mesopotamia[625] and the North-South route towards the Persian Gulf, the most important sea route of the Old World. This route started from the Murghab Delta via Khorasan and the Western Fringes of the Dasht-eh Lut via Shahdad and Bam to the Jiroft Area and reached the Straight of Hormoz between the modern towns of Bandar Abbas and Minab. Both routes were also known and in regular use during the Period of the Silk Road during the 13th century as reported by Marco Polo.[626]

4.6. The 3rd millennium metallurgical / metal working area

In 1977, preliminary surveys by S. Salvatori and M. Vidale brought them to map in discrete areas of the surface of the 3rd millennium settlement two wide possible “craft quarters”, respectively interpreted as a semiprecious stone (carnelian) working location and a copper working one.[627] The first area was marked on the surface by dumps containing thousands of chert drill heads and unfinished carnelian disk beads. It was preliminarily circumscribed in a strip measuring about 600 x 100-150 m, therefore spreading for about 6-8 ha, and occupied the centre of the settlement with a north-west to south-east trend. Another cluster of bead-making indicators was found about 400 m west of the main distribution, and another two discrete locations were found further south, bringing the total of the surface occupied by dumps and possible workshops where carnelian beads were manufactured to a presumed total extension of about 10-12 ha. These estimates were preliminary and need to be substantiated by more proper quantitative research.

The copper working area, in the first and only map so far published of the craft quarters of Shahdad, is apparently more segregated. It was located in a surface of about 500 x 200 m, therefore amounting, roughly speaking, to about 10 ha. On the map, the copper working extension is almost surrounded by locations were carnelian and chert debitage were

622 Salvatori 2010: 251.
623 Carter & Stolper 1985: 196f.
624 Schmidt 2005: 104, Abb.4.
625 Carter & Stolper 1985: 139ff.
626 Polo 2008
627 Salvatori 1977: fig.1, fig.6; Salvatori 1978: fig.III; Salvatori & Vidale 1982: fig. 2;

mapped (see Figure 50).

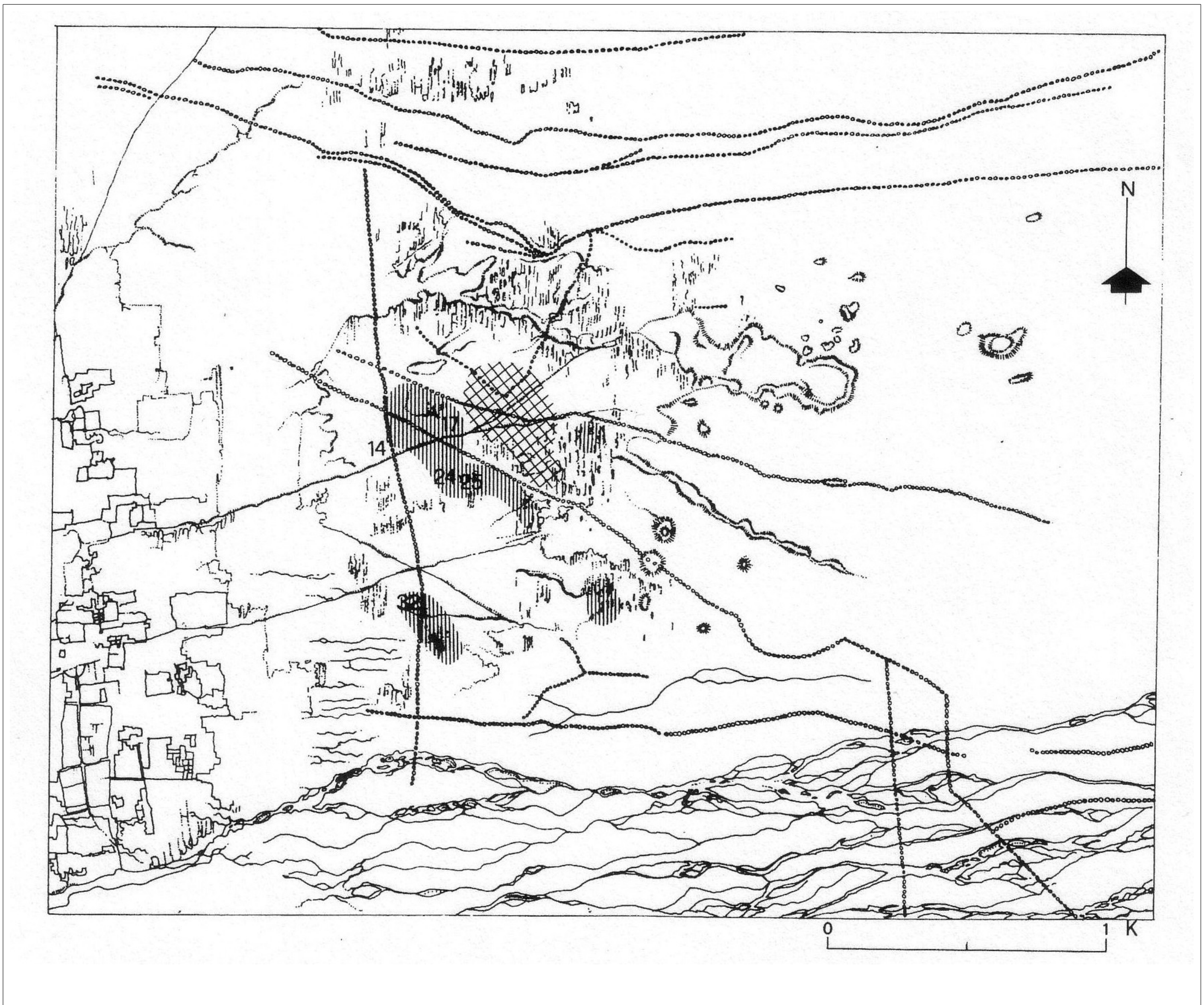


Figure 50: Location of the different surveyed working areas at Shahdad (Salvatori & Vidale 1982: fig.2).

Within this wider space, the sample of 3rd millennium slag and other pyrotechnological indicators discussed in this research were collected from the surface of a well-distinguished topographical feature, a low, elongated hummock immediately south of the dirty road that crosses the archaeological compound from west to east. The hummock (see Figures 51) is about 100 m long (from west to east) and ca. 60 m wide in the opposite direction. Its surface is entirely covered by dark green fragments of copper slag, usually more clustered on the top and scattered downslope on the sides. On top, at least 3 round clusters (1-1.20 m of diameter) of slag fragments and highly fired clay linings are the evidence of the use of many furnaces, possibly used to smelt copper ores (see Figure 52).

Figure 51: Hummock of the 3rd millennium BCE metallurgical site, view to the North (with the courtesy of M. Vidale).

On the presented photograph the metallurgical area of Shahdad is shown, characterized by a large amount of greenish stained copper slags. Actually, in a short visit, made difficult by extreme climatic conditions, in May 2009, M. Vidale and F. Desset were able to collect a dozen fragments interpreted as flakes and particles of copper ore. Also on the surface were visible fragments of thick and large slag cakes being the mold of ceramic containers or furnace bottoms where the slag itself had sagged (see Figure 53).

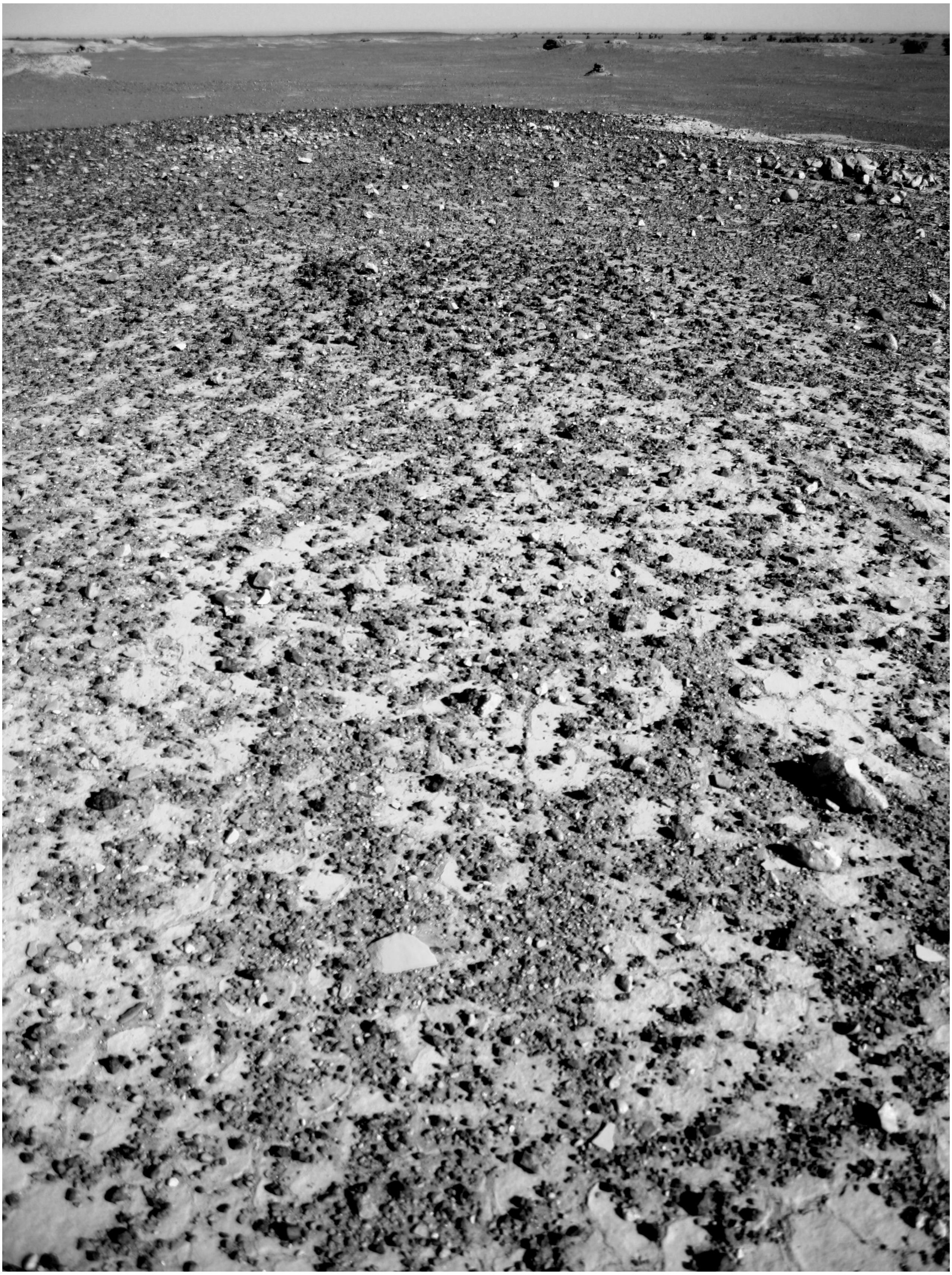


Figure 52: Detail view of the metallurgical area with a darker circular formation in the upper half, view to the North (with the courtesy of M. Vidale).

Figure 53: Several bottom fragments of crucible slags from the 3rd millennium BCE metallurgical site at Shahdad (with the courtesy of M. Vidale).

These slag cakes were very heavy and hard, frequently contained prills of solid copper and are visually identical to the slag cake fragments from the copper smelting areas of Shahr-eh Sukhteh already described, chemically analyzed and commented by A. Hauptmann, D. Helmig as well as by G. Guida, A. Lazzari, M. Vidale et al.[628]
The co-occurrence of the relatively large round furnaces and thick, heavy slag cakes evidently left by a smelting or refining process probably involving the use of a crucible or crucible-like clay-coated cavity, is the first relevant piece of paleotechnological information provided by this craft site. The surveyors kept the collection to a minimum, to avoid any serious disturbance at the site. The collected samples range from the ore fragments described above, fragments of slag cakes, other slag fragments, some pieces of furnace linings and a single crucible fragment. The following chapter of this dissertation focusses on the chemical analysis of ore and slag samples to provide data concerning the mineralogical compostion to gain answers about the mining sites where identical mineral occurrences are evident to attempt a reconstruction of the smelting process.

628 Hauptmann 1980; Hauptmann & Weisgerber 1980; Hauptmann et al. 2003; Helmig 1986; Helmig et al. 1991; Artioli et al. 2005;

Name	Chemical formula
Atacamite	$Cu_2Cl(OH)_3$
Paratacamite	$Cu_2(OH)_3Cl$
Cuprite	Cu_2O
Connellite	$Cu_{19}(OH)_{32}(SO_4)Cl_4{\cdot}3H_2O$
Malachite	$Cu_2CO_3(OH)_2$
Delafossite	$CuFeO_2$
Delafossite	$CuFeO_2$
Digenite	Cu_9S_5
Brochantite	$Cu_4SO_4(OH)_6$
Chalcanthite	$CuSO_4$ $5H_2O$
Caledonite	$Cu_2Pb_5(OH)_6CO_3(SO_4)_3$
Wüstite	FeO
Hematite	Fe_2O_3
Magnetite	$Fe^{2+}Fe^{3+}{}_2O_4$
Fayalite	Fe_2SiO_4
Goethite	α-FeO(OH)
Massicot	PbO
Anorthite	$CaAl_2Si_2O_8$
Calcite	$CaCO_3$
Labradorite	$(Ca,Na)(Al,Si)_4O_8$
Anhydrite	$CaSO_4$
Bytownite	$(Ca,Na)[Al(Al,Si)Si_2O_8]$
Gehlenite	$Ca_2Al[AlSiO_7]$
Dolomite	$CaMg(CO_3)_2$
Aragonite.	$CaCO_3$
Akermanite	$Ca_2Mg(Si_2O_7)$
Augite	(Ca,Na)(Mg,Fe,Al,Ti)
Diopside	$MgCaSi_2O_6$
Forsterite	Mg_2SiO_4
Amesite	$Mg_2Al_2SiO_5(OH)_4$
Enstatite	$MgSiO_3$
Halloysite	$Al_2Si_2O_5(OH)_4$
Albite	$NaAlSi_3O_8$
Quartz	SiO_2
Cristobalite	SiO_2
Tridymite-O	SiO_2
Chamosite	$(Fe^{2+},Mg)_5Al(AlSi_3O_{10})(OH)_8$
Maghemite	γ-Fe_2O_3
Illite	(K,H_3O)
Cohenite	(Fe, Ni, Co)3 C
Pigeonite	(Ca,Mg,Fe) (Mg,Fe) Si_2 O_6

Table 5: List of all minerals and their chemical formulae mentioned in the text

Chapter 5: Analytical information on the collected materials

5.1. Archaeometric information on ore and slag samples

5.1.1. Description of Wavelength Dispersive X-Ray Flourescence analysis

Wavelength dispersive X-ray Flourescence (hereafter WDXRF) is another method applied in archaeometric research. WDXRF is based on the principle that individual atoms, when excited by an external energy source, emit X-ray photons of a characteristic wavelength or energy. By counting the number of photons emitted by a sample, the elements present can be quantitated and identified. The identification of elements by X-ray methods is possible due to the characteristic radiation emitted from the inner electronic shells of the atoms under certain conditions. The emitted quantity of radiation are X-ray photons whose specific energies permit the identification of their source atoms. When an electron beam of high energy strikes a material, one of the results of the interaction is the emission of photons which have a broad continuum of energies. This radiation, called "Bremsstrahlung" is the result of the deceleration of the electrons inside the material. Another result of the interaction between the electron beam and the material is the ejection of photoelectrons from the inner shells of the atoms making up the material. These photoelectrons leave with a kinetic energy (E-φ) which is the difference in energy between that of the incident particle (E) and the binding energy (φ) of the atomic electron. This ejected electron leaves a "hole" in the electronic structure of the atom and, after a brief period, the atomic electrons are rearranged with an electron from a higher energy shell filling the vacancy. As a result of this calming the atom becomes fluorescent, or emits an X-ray photon whose energy is equal to the difference in energies of the initial and final states. Detecting this photon and measuring its energy enables us to determine the element and specific electronic transition from which it originated.[629]

Herein lies the basic principles for XRF spectrometry, where elements may be quantitated based on the rate of emission of their characteristic X-rays from a sample that is being

629 Jenkins 1999: ch.1.

excited (see Figure 54).[630]

The WDXRF data presented here are the results of investigations which were conducted in 2013 by G. Guida at the archaeometric laboratories in the “Istituto superiore per la Conservazione ed il Restauro” in Rome (Italy).[631] This series of WDXRF investigations were carried out with a portable Spectrometer XRS 38 P/N 0211 by 350 KV at 0.15 mA from EIS S.r.L. Roma

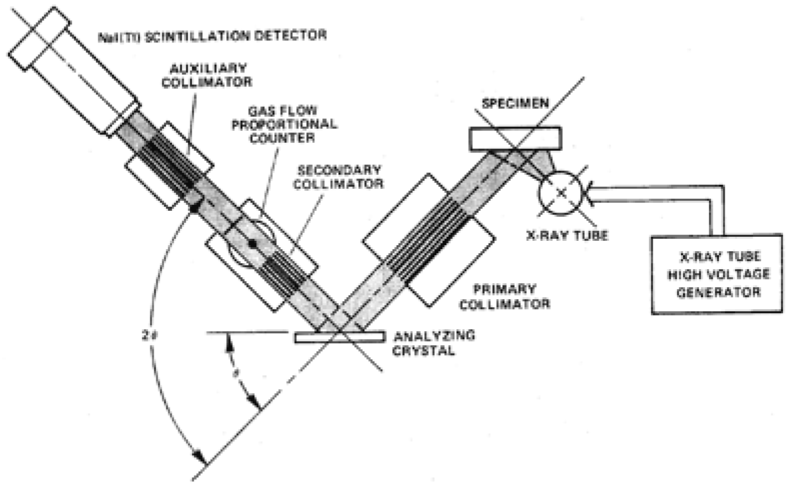


Figure 54: Schematic illustration of the WD XRF analysis (from Jenkins 1995: 88).

5.1.2. Description of the X-ray diffraction analysis

X-ray Diffractometry (hereafter XRD) is an applied method to detect and determine minerals. With the help of XRD we are able to investigate and present the structural crystallographic compositions of rock samples like ores and other conglomerates of mineral structure and it can also be used for pottery analysis. For the “classic/ traditional” X-ray powder diffractometry a small amount of the sample is ground to powder with the help of a pestle and mortar made of agate. The use of this tools is of fundamental importance to grind solids into fine powders but under conditions that are highly controlled so as to not produce any heating effects and to minimize and control any effects due to stretching of sometimes deformable materials. This is probably the most ancient device one is likely to find in a modern scientific laboratory or kitchen. After the preparation the sample is excited by an X-ray radiation of known wave length. Depending upon to the different crystalline structures of the samples the X-rays are diffracted in certain directions

630 Mommsen 1986; Jenkins et al. 1995; Pollard et al. 2006; Wagner 2007; Hauptmann & Pingel 2008; Rapp 2009.
631 The author visited in 2013 the laboratories and attended the final series of analytical work.

which are dependant on the crystal structure of the specimen. This phenomenon is called “Bragg´s law” and plays a basic role which identifies the angles for coherent and incoherent scattering from a crystal lattice. It can be summarized that X-ray diffraction uses X-rays of known wavelengths to determine the lattice spacing in crystalline structures and therefore identify instantly the chemical compounds (see Figure 55).[632] The results give precise information about the mineral composition of the samples which enables us to approach an understanding and to clarify questions about several aspects like f.e. manufacturing techniques, the trade and procurement of certain raw materials and their distribution. Further it is possible to determine the mineral composition of slags, a by-product of the metallurgical process, and thereby also the degree of metallurgical and pyrotechnological progress.

The following presentation of XRD-results is the conclusion of several series of XRD-analyses which were conducted by Maurizio Mariottini between 2011 and 2013 at the archaeometric laboratories in the “Istituto superiore per la Conservazione ed il Restauro” in Rome (Italy).[633] For the whole series of analysis a SEIFERT XRD3000P was used with an copper tube of 40 KV by 35mA with a measurement of 5-65° angles.

The analytical results of the measurements were calculated and graphically displayed with the software “Analyze Rayflex (Version 2.370 – Seifert & Co)” from GE Inspektion Technologie GmbH Germany. All data concerning the mineral contents of the samples are according to Strunz´s mineralogical tables.[634]

632 Mommsen 1986; Jenkins 1999; Pollard et al. 2006; Wagner 2007; Hauptmann & Pingel 2008; Rapp 2009.
633 The author visited in 2013 the laboratories and attended the final series of analytical work.
634 Strunz & Nickel 2001.

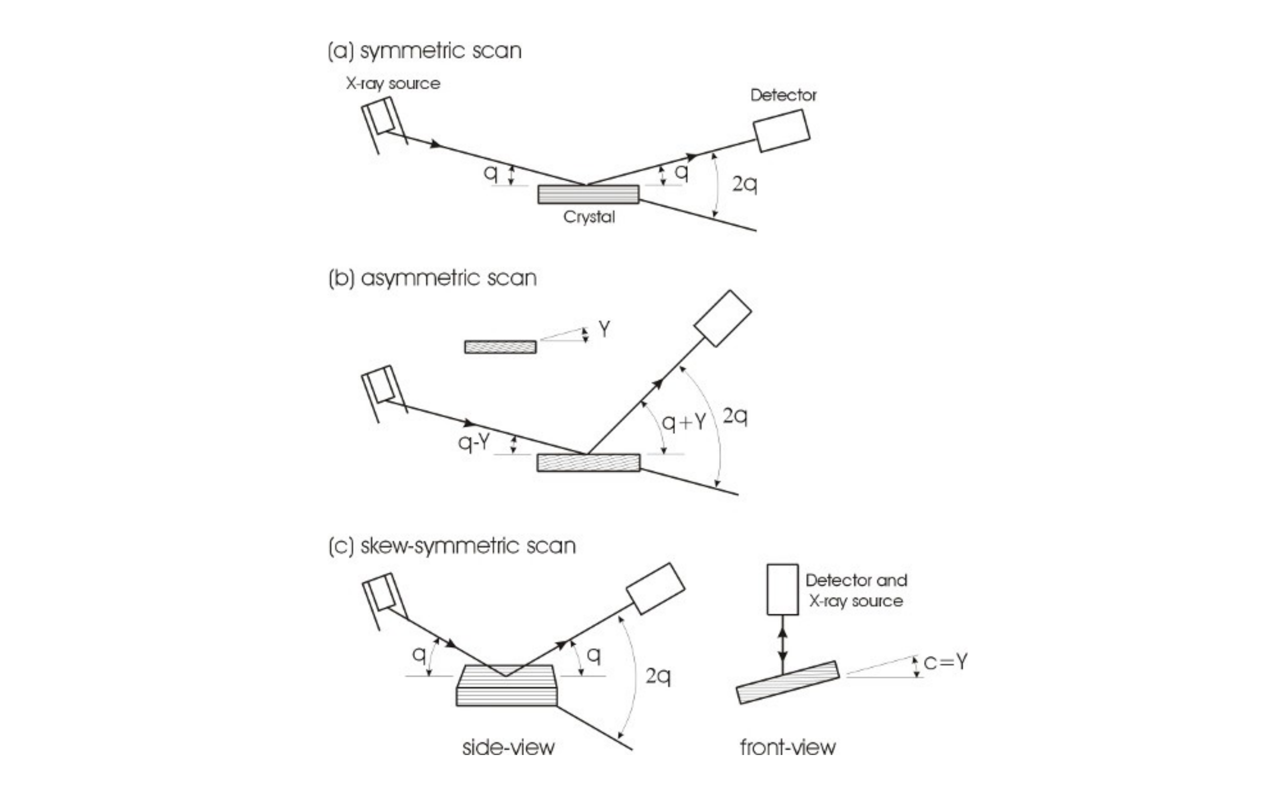


Figure 55: Schematic illustration of X-ray Diffractometry (from: https://fys.kuleuven.be/iks/nvsf/experimental-facilities/x-ray-diffraction-2013-bruker-d8-discover).

5.1.3. The properties of ancient metallurgical slags

The metallurgical slag itself is a glassy mass and composed of silicate enriched minerals and other oxides which originate from the smelting of metal ores. While the metal ore is heated in a pyrotechnological process the gangue of the ore´s host rock and the metallic components of the ore become separated.[635] According to the "Goslarer Bergrecht", a German mining law from 1360, a slag is an already molten product with different amounts of metal whereby it is seen as waste- but also as a by-product.[636] In some cases there is only a small amount of silica and other various oxides in the gangue. For that reason sand, ground slags or other siliceous fluxes are added to the charge to improve the process of slagging. This effects a better quality of the smelting process where the molten metal with a higher density is protected from possible contamination in a reducing atmosphere by the slag positioned above. In the case of ancient slags which were produced under firing with limited control in small furnaces and crucibles it was impossible to segregate the metallic

635 Bachmann 1982
636 Frölich 1953

and the non-metallic phase in a way known in todays blast-furnace techniques. As one result ancient slag bodies still possess considerable amounts of metallic traces due to the adsorptive properties of slags. Sometimes these metallic traces were impossible to extract during the first smelt due to the primitive pyrotechnology. For that reason further extraction of cupriferous remains, coupled with the slag's good properties as a siliceous flux metallurgical slags may have been already reused in early third millennium BCE smelting processes.[637] As we already know fragments of ground slags were also used as a prefered temper for vessels due to its refractory characteristics, comparable to grog, which were involved in pyrotechnology such as cooking pots, smelting/ metling crucibles and casting moulds. One example of a slag-tempered crucible is SHA 20. However the slags were primarily ground to extract the small metal prills manually, in our case copper prills. The ground slag which consists largely of silicates, oxides and still cupriferous traces, was then added to new smelting charges to improve the smelt and the slagging by the already mentioned components. Thereby it was also possible to dissolve the metallic components out of the non-metallic phases which were still enclosed inside of the slags.[638] During certain of these smelting processes charges other cupriferous by-products like matte and speiss were also produced (see Figure 56).[639]

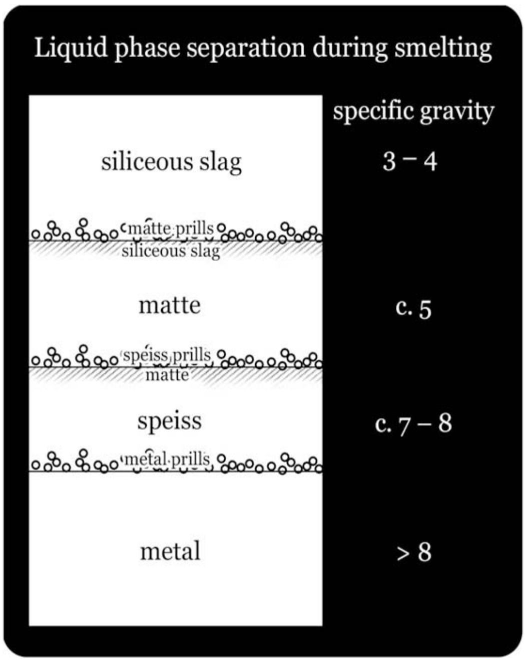


Figure 56: Schematic Illustration of the liquid phase separation during smelting (by courtesy of Thornton & Rehren 2009, fig.1).

637 Hauptmann 2007
638 Mihailova & Mehandjiev 2010; Hauptmann 2014;
639 Thornton & Rehren 2009.

In the following paragraphs the results of a total number of 36 different XRD- and 21 WDXRF-analytical series are presented. The different analytical series were carried out on a total of 15 samples which were collected in 2009 at the metallurgical area of Shahdad (see Paragraph 4.6. and Table 6).

Sample No.	Comments
SHA 01	Metallurgical slag
SHA 02	Slagged furnace lining
SHA 03	Metallurgical slag
SHA 06	Casting spill
SHA 09	Mineral
SHA 10	Cu-ore
SHA 12	Cu-ore
SHA 13	Cu-ore
SHA 14	Cu-ore
SHA 15	Cu-ore
SHA 16	Cu-ore
SHA 18	Crucible slag
SHA 19	Crucible slag
SHA 20	Crucible fragment
SHA 21	hammered Cu frg.

Table 6: Compilation all samples from the survey at Shahdad in January 2009.

5.2. Description and archaeometric information on slag and ore materials from the surface collections at Shahdad

5.2.1. WDXRF analysis:

The analytical WDXRF- investigations were conducted on 20 samples. Except Sample SHA 6 all samples were included in this series. Therefore every single sample or pre-prepared fragments of it were taken and excited by a portable Spectrometer XRS 38 P/N 0211 by 350 KV at 0.15 mA (from EIS S.r.L. Roma). Table 7 shows the qualitative results. The samples SHA 1A to SHA 7 throughout represent slag apart from SHA 6 which is a fragment of a casting spill. All of the samples (SHA 1A-7) were collected on the surface of the 4th millennium BCE site at Shahdad. All slags show abundant Fe-content as well as considerable amounts of copper. SHA 4 exclusively bears traces of arsenic, were SHA 1A, A2 and 7 show remains of zinc. Also lead and calcium attested to in the majority of these samples.

All of these results lead to the assumption that a co-smelting process as also evidenced by Thornton and Rehren for 4th millennium BCE metallurgy at Tappeh Hesar and proposed by Pigott for the 3rd millennium BCE settlements at Tappeh Hesar, Shahr-eh sukhteh and Shahdad did exist.[640]

SHA 8 to SHA 17 are samples of different Cu-ores which were collected on the surface of the 3rd millennium metal working area at Shahdad in early 2009. They all have in common high amounts of cupriferous minerals such as malachite, cuprite, atacamite, paratacamite and delafossite as well as traces of iron. Some also shows traces of lead such as SHA 10 to 13, 15 and SHA 17. SHA 18A and SHA 19A are remains of crucible slags. They are characterized by minor ammounts of copper in direct comparison to iron which was detected in high concentrations. SHA 18A also bears traces of arsenic.

SHA 20A is a fragment of an open smelting crucible with traces of Copper and an abundance of ferrous remains. SHA 21 is a hammered piece of copper which from now on is addressed as “ingot” and obviously shows high concentrations of copper as well as traces of iron and lead. The precise description of all mineral components is given in the subsequent presentation of the XRD-analysis.

640 Thornton & Rehren 2009; Pigott 1999b.

Sample no.	Cu	Fe	As	Zn	Pb	Ca	Mn	K	Ti	Sr	Rb
SHA 1A	++	+++		+	+	+					
SHA 2A	±	+++		±		+	±	±	±	+	
SHA 3A	++	+++			±	±			±	±	
SHA 4A	+++	+++	±		±				±	±	
SHA 5	+++	+++			++	±	±				
SHA 7	++	+++		±	±	±				±	
SHA 8	+++	+								±	
SHA 9	+++	+				±				±	
SHA 10	+++	±	±(?)		±						
SHA 11 (surface)	+++	±	±		±						
SHA 12	+++	±			±						
SHA 13	+++	±			±						
SHA 14	+++	±									
SHA 15	+++	±			±						
SHA 16	+++	±									
SHA 17	+++	±			±	±					
SHA18A	+++	+++	±(?)		±	±	±				
SHA 18A (core)	+	+++	±		±	±	±		±		
SHA 19A	++	+++			±	±					
SHA 20A	±	+++								±	±
SHA 21 (surface)	+++	±			±						

+++ very abundant, ++ abundant , + present, ± traces

Table 7: Results of the qualitative WDXRF-analysis conducted on samples from Shahdad (04.07.2013).

5.2.2. XRD analysis:

In total, a series of 36 different analyses were carried out on a total of 14 samples. Some of the samples were prepared manually under the stereo microscope by the separation of parts with different components. Subsequently the separated parts were ground to powder with an agate mortar. The different minerals were identified after the XRD measuring with the help of Strunz Mineralogical Tables and calculated by Analyze Rayflex (Version 2.370 – Seifert & Co).

SHA 1:

SHA 1 is a slag sample which was collected on the surface of the 4th millennium BCE site (see Figure 57). For further analytical investigation the sample was divided into two fragments, SHA 1A and SHA 1B. The first sample which was obtained randomly from SHA 1A shows concentrations of diopsite, magnetite and cupriferous minerals like cuprite and paratacamite (see Figure 66).

On the second fragment, SHA 1B, two analyses were conducted: The first was of the quartz-enriched filling and shows the chemical content of the following components: quartz, anorthite, calcite , magnetite and cuprite (see Figure 67). The second fragment of SHA 1B shows contents of malachite, amesite, illite, quartz, anorthite, calcite and enstatite. Another analysis on this samples shows quartz, anorthite, calcite, magnetite, cuprite and chemical copper (see Figure 68).

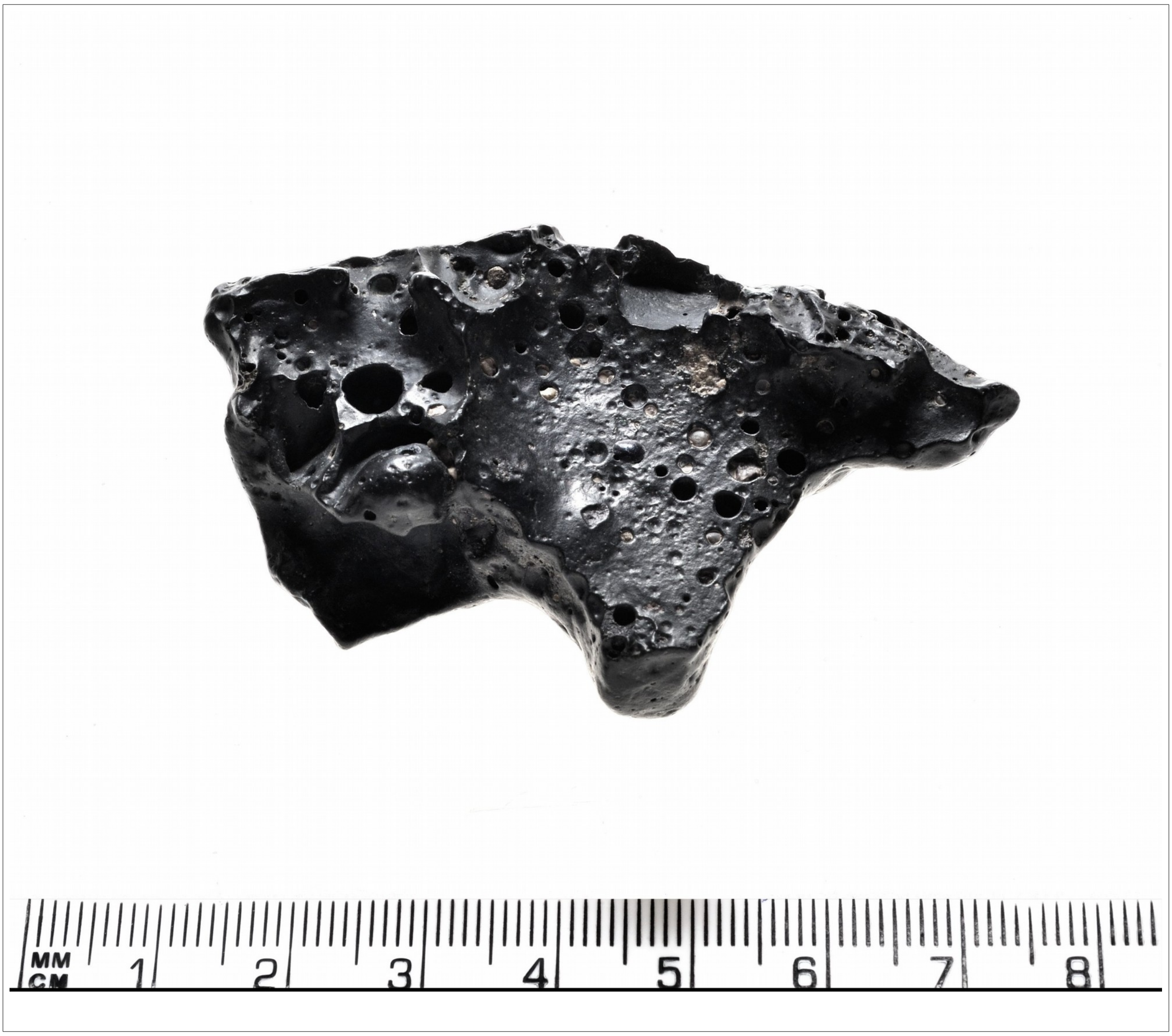


Figure 57: Slag sample SHA 1 (Photo by E. Loliva).

SHA 2:

This sample is a slagged furnace lining from the 4th millennium BCE site (see Figure 58). Two fragments were prepared to investigate the different mineral components. From the first fragment of SHA 2A a piece of the reddish crust was obtained which shows concentrations of diopside, cristobalite, magnetite, cuprite, quartz, anorthite, fayalite, hematite and lime (see Figure 69).

The first sample of SHA 2B was taken from the bubbly, glassy part with a yellowish colouration and bears traces of diopside, quartz, bytownite, enstatite, forsterite and gehlenite (see Figure 70). The second sample of SHA 2B derived from the reddish coloured surface and shows contents of cuprite, wüstite, augite, forsterite, quartz and delafossite (see Figure 71).

Figure 58: Fragment of a furnace lining SHA 2 (Photo by E. Loliva).

SHA 3:

SHA 3 is another slag fragment which was obtained from the 4th millennnium BCE site (see Figure 59). The results of a single analysis shows contents of chemical copper, cuprite, atacamite, maghemite, magnetite, diopside, quartz and iron (see Figure 72).

SHA 6:

This sample is a casting spill from the 4th millennium BCE site. A random sample was obtained and showed contents of a Cu-Sn composition, caledonite and djerfisherite (see Figure 73).

Figure 59: Slag sample SHA 3 (Photo by E. Loliva).

SHA 9:

SHA 9 is a rock sample which was collected at the 3rd millennium BCE metallurgical area (see Figure 60). From the sample´s crust gray coloured particles were obtained for analytical work. The results are showing contents of quartz, chamosite and calcite (see Figure 74, Table 8).

SHA 10 (copper ore):

This sample was also found at the 3rd millennium BCE metalworking site at Shahdad and represents a copper ore (see Figure 60). Particles from the green stained surface were obtained and analysed. The first analytical investigation shows a content of atacamite , quartz, cuprite, malachite. The second analytical layer evidenced paratacamite, atacamite, halloysite, quartz, amesite and malachite (see Figures 75 and 76, Table 8).

SHA 12:

SHA 12 is another fragment of a Cu- ore (see Figure 60). Two analyses were conducted on parts of this sample. The first shows a content of malachite and amesite, the second contains malachite, amesite, illite, quartz and anorthite.The detected traces of anorthite belong to an unidentified feldspar (see Figure 77, Table 8).

SHA 13:

Chamosite, atacamite, quartz and malachite were detected in fragments of black colouration which were obtained from SHA 13, another copper ore sample (see Figures 60 and 78, Table 8).

SHA 14:

From SHA 14, another fragment of a copper ore from the 3rd millennium BCE metallurgical site, a black coloured particle was prepared for analysis. The results identify malachite, chamosite, atacamite, quartz and dolomite (see Figures 60 and 79, Table 8).

SHA 15:

SHA15 is another copper ore fragment which was collected at the 3rd millennium BCE metallurgical site (see Figure 60). A series of three analytical investigations were conducted. The first sample derived from a greenish particle which showed a mineral composition of atacamite, quartz, malachite, cuprite and paratacamite (see Figure 80). The second sample was taken randomly and contains albite, atacamite, paratacamite, quartz, goethite, diaspore and malachite (see Figure 81). The third sample from SHA 15 shows a content of malachite, atacamite, labradorite, paratacamite and quartz (see Figure 82). Labradorite stands for an unidentified feldspar (see Table 8).

SHA 16

This sample which also derives from the 3rd millennium BCE site contained no cupriferous components that were possible to detect during the analysis (see Figure 83). The only minerals are the plagioclase feldspar of albite as well as quartz and calcite which seem to enable us to identify the sample as metallurgical slag (see Figure 60, Table 8).

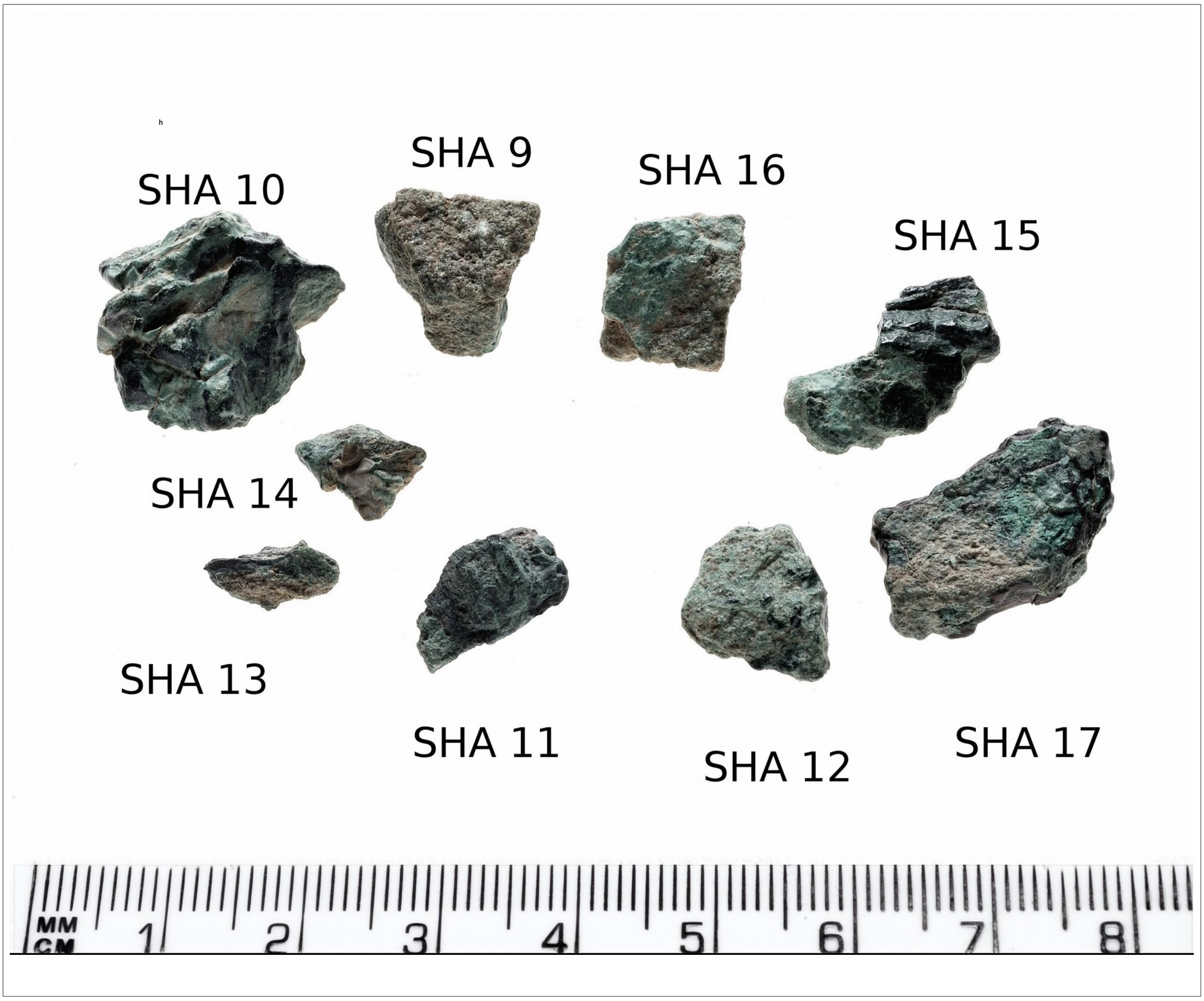


Figure 60: Photography of the sample collection from the 3rd millennnium BCE metallurgical area, (Photo by E. Loliva)

Sample code	Cu-mineral occurrences	No. of different XRD-analysis
SHA 10	Atacamite, paratacamite, malachite, cuprite, halloysite, amesite-2H,Quartz	x2
SHA 12	Malachite	x1
SHA 13	Atacamite, malachite	x1
SHA 14	Atacamite, malachite, chamosite	x1
SHA 15	Atacamite, paratacamite, malachite, cuprite	x2
SHA 16	Albite, quartz, calcite	x1

Table 8: List of sampled Cu-ores from the 3rd millennium BCE site at Shahdad

SHA 18

This sample is a fragment of a crucible slag with a circular impression on the bottom. The sample was divided in to two fragments, SHA 18A and SHA 18B. From SHA 18A a random sample was obtained, SHA 18B was taken from a mineral inclusion inside ff the matrix that looked similar to metallurgical slag already known from Shahr-eh Sukhteh (see Figure 61, 84 and 85).[641] Similar to the analytical data from Shahr-eh sukhteh SHA 18 is evidence of a smelting of sulfidic ores. The siliceous phase of the sample consists of diopside, anorthite and delafossite, the sulphidic phase (matte) is shown by digenite. It seems that there was also a copper regulus produced underneath the matte phase. The decomposition phase shows contents of goethite and Cu-minerals like, chalcanthite, brochantite, cuprite and atacamite (see Table 8).

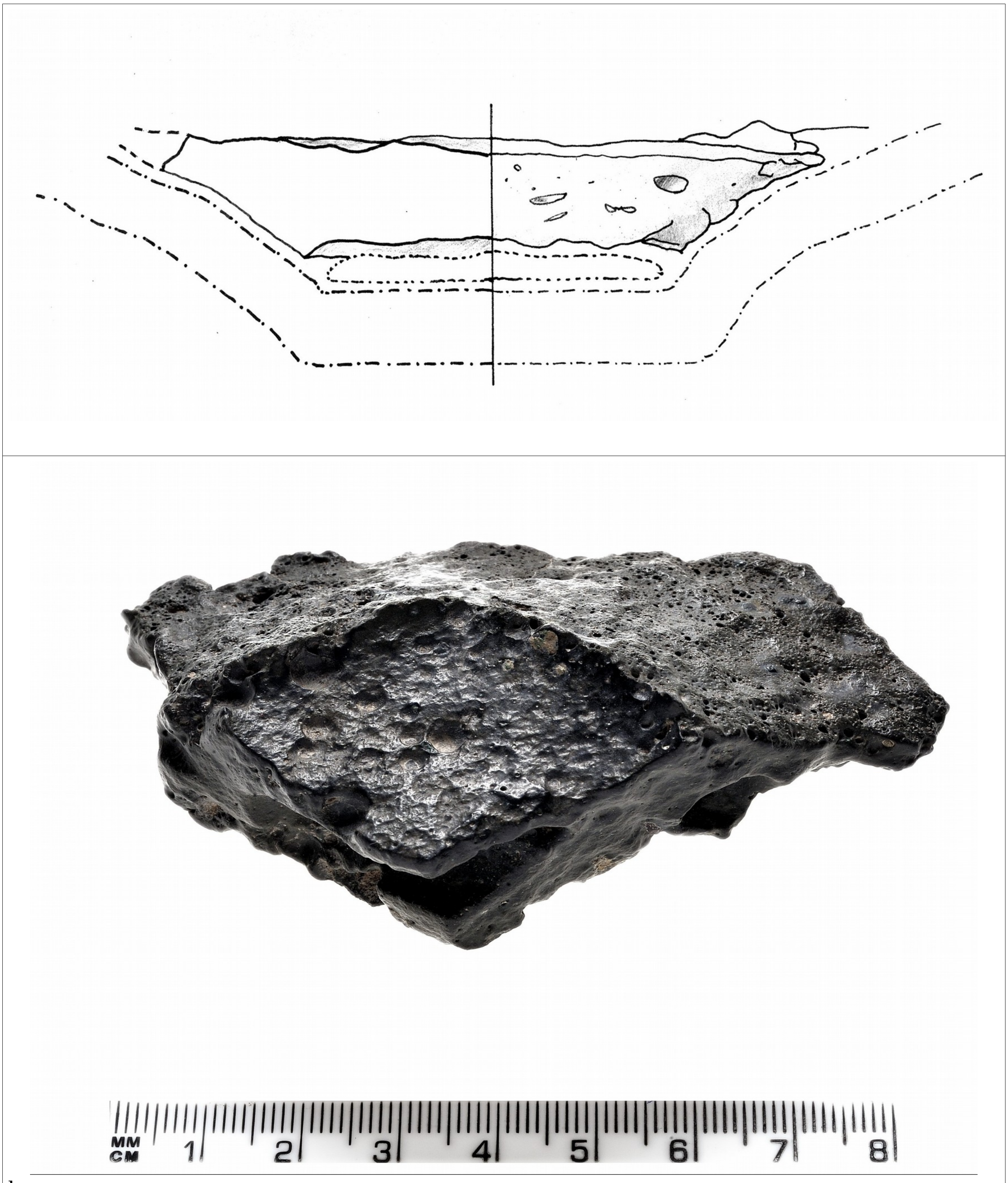
SHA 19:

SHA 19 is a fragment of a crucible slag from the 3rd millennium BCE metallurgical area (see Figure 62). The sample was prepared for the analytical work by cutting it in to two pieces SHA 19A and SHA 19B. On SHA 19A a total of 6 analyses were conducted on different particles which were prepared separately. The first specimen derives from the top surface and is of black colouring with portions of atacamite, augite, gehlenite, albite, massicot, cuprite and chemical copper (see Figure 86). The second analysis was conducted on gray material from the bottom of the crucible slag and shows a content of ferrous diopside, gehlenite, quartz, anorthite, atacamite, hematite and calcite (see Figure 87). The third analysis was conducted on a greenish bubbly filling and shows atacamite,

641 Hauptmann & Weisgerber 1980; Hauptmann et al. 2003.

chamosite, calcite, chemical copper and cuprite as its content (see Figure 88). The results of the fourth investigation on SHA 19A come from a white coloured component of the bubbly filling and showed concentrations of cohenite, diopside, quartz, anorthite and aragonite (see Figure 89). Diopside, akermanite, chemical copper, atacamite and tridymite are the components of a blackish crystalline particle which was obtained from the matrix for the fifth analysis (see Figure 90). The sample of the sixth analysis derives from the filling of a large cavity with yellowish-grayish colouring and shows diopside, quartz, cristobalite, calcite, anorthite, and a Cu-chloride hydroxide hydrate ($Cu_{11}Cl_8$ $(OH)_{14}$ $6H_2O$) (see Figure 91).

From the prepared fragment SHA 19B just a single analysis was conducted on a random sample which shows a composition of akermanite, quartz, anorthite, chemical copper, maghemite, diopside and cuprite (see Figure 92).



b

Figure 61: Reproductions of a crucible slag with the visible imprint of matte (SHA 18), a) Drawing by M.Vidale b) Photo by E. Loliva.

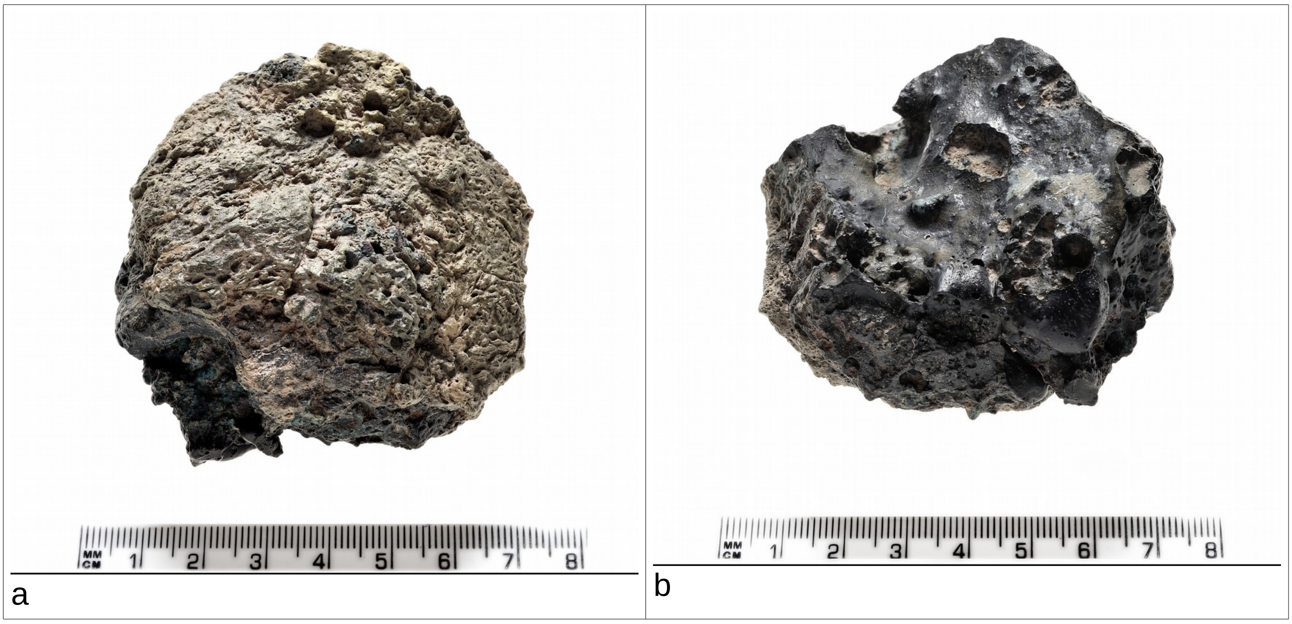


Figure 62: Different views of the metllurgical slag SHA 19, a: top, b: bottom (Photo by E. Loliva).

SHA 20:

This sample is a fragment of a crucible from the 3rd millennium BCE metallurgical area (see Figure 63). In preparation for the different analytical investigations of this sample the crucible fragment was separated in to two pieces, SHA 20A and SHA 20B.

On SHA 20A a total of 5 different particles were prepared for XRD-analysis.

The first investigation on SHA 20A was carried out on extracted carbonate crystals from a cavity and showed contents of quartz, anorthite, anhydrite and goethite (see Figure 93).

The second analytical measurement was conducted on another white coloured crystal and showed components of quartz, calcite, anorthite as well as remains of iron oxides like maghemite and delafossite (see Figure 94). The third analysis was carried out on a random sample which was taken from the core of SHA 20A and showed a high siliceous composition with quartz, illite, anorthite and pigeonite (see Figure 95).

The fourth sample is a black coloured slag fragment which was extracted from inside the crucible fragment. This shows that for reasons of improving the heat resistance of the Crucible non organic components like slag and grog were added. The results of this investigation showed a composition of quartz, atacamite, anorthite, malachite and illite (see Figure 96).

The final analysis showed again concentrations of siliceous components and Fe-oxides like quartz, labradorite, delafossite, illite and hematite (see Figure 97).

From SHA 20B two prepared samples which were taken from the inner and outer surface were analysed. The sample from the exterior is of reddish colour and its results show quartz, anorthite, hematite, calcite, goethite and enstatite (see Figure 98). The second sample taken from the interior is of black colour and displays a composition of quartz, anorthite, pigeonite, fayalite and cuprite (see Figure 99).

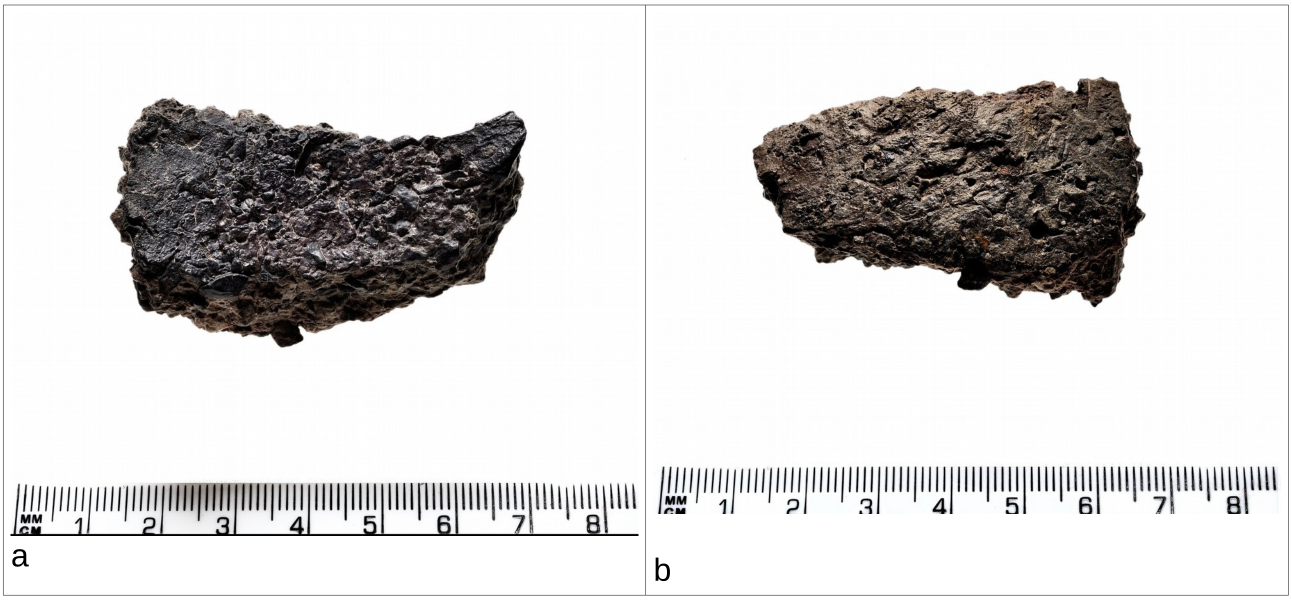


Figure 63: Photograph (a)and detail view (b) of sample SHA 20 with a magnification factir of 20X (Photo by E. Loliva).

Besides the different XRD-analysis on SHA 20 there were also optical investigations carried out by a stereo microscope and by SEM. The SEM microscopy (a) at a magnification by factor X150 shows a particle in the upper left corner of the image which is a pottery fragment of grog/chamotte (see Figure 64a). This component was intentionally added to the crucible's temper to improve its heat resistance similar to the slag fragment which was observed by SHA 20.
There is also a bright spot in central position recognizable as metallic copper which is also identifiable on (b) at a magnification of X20 (see Figure 64b).

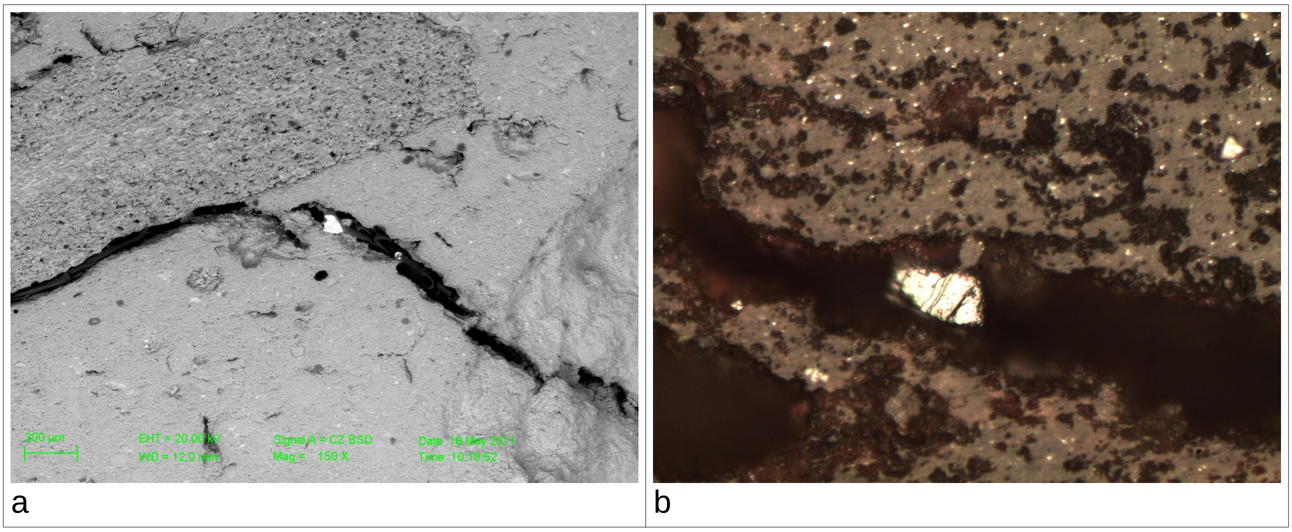


Figure 64: Stereo microspcopy and SEM at X20 (b) and X150 (a) magnification from SHA 20A (a) and SHA 20B (b) (with the courtesy of G. Guida).

SHA 21 hammered copper fragment:

The final object which was investigated from the collection of metallurgical residues from the 3rd millennium BCE metallurgical area at Shahdad is a lump of metallic copper which according to the microscopical investigation was identified and named as a hammered ingot fragment. XRD Analysis on this artefact was conducted on a greenish-reddish particle from the crust and shows a high concentration of cupriferous minerals like cuprite, quartz, atacamite and connellite (see Figure 100). A second analysis of the identical greenish-reddish crust shows a slightly different composition with cuprite, atacamite, pure copper and the rare copper mineral connellite as well as the plagioclase feldspar anorthite and quartz (see Figure 101).

The following microscopy conducted at a magnification of factor X50 are showing the typical “annealed twin”-structures of hammered metals where the mineral bonds are destroyed and reordered (see Figure 65a). In comparison there is sample SHA 11 which is identified as a unworked piece of casted copper (see Figure 65b). The homogeneous appearance of small dendrites show that the sample was only casted and not further reworked by annealing.

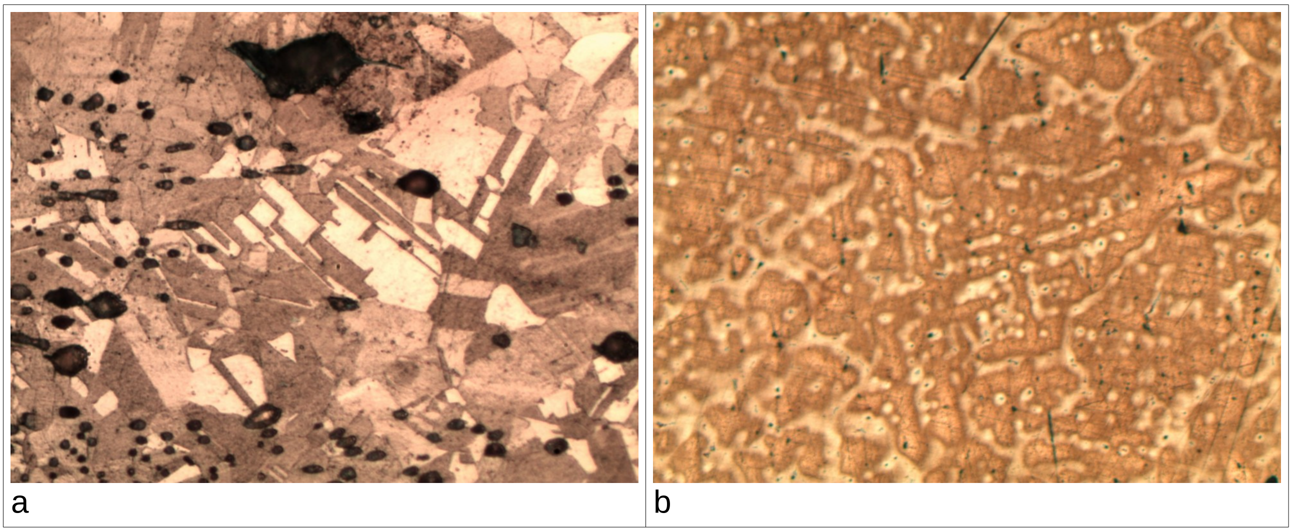


Figure 65: SHA 21 (a) Ingot(?)/ lump of casted and hammered copper Magnification of 50X and SHA 11 (b) an unworked fragment of casted copper (by courtesy of G. Guida).

5.2.3. Conclusion:

The collected samples from the proposed 4th millennium BCE metallurgical site at Shahdad were identified as two fragments of two different Copper-slags (SHA 1 , SHA 3), on fragment of a furnace lining (SHA 2) and the other a fragment of a casting spill (SHA 6). The results of the XRD-analysis on the slag fragments show remains of Cu-ores with oxide-, carbonate- and chloride-compounds. But also chemical Copper and a Cu-Sn compound (Cu327.92 Sn88.08) were detected. These results, in addition to the presence of oxidic and ferrous oxidic ores in the furnace lining, indicate a smelting practise of non-sulphour Cu-ores. Contrarily the casting spill shows the Cu-sulfate caledonite and djerfisherite as another sulphourous mineral.

The following ore samples of the 3rd millennium BCE site are SHA 10, SHA 12, SHA 13, SHA 14 and SHA15. The analytical data shows rich Cu-carbonates (Malachite), Cu-chlorides (Atacamite, Paratacamite) and Cu-oxides (Cuprite) in different compositions and concentrations. SHA 9 and SHA 16 are rock fragments with contents of silica based minerals. The collected ores from the proposed 3rd millennium BCE site show evidence of the presence of non-sulphourous Cu-ores which may imply an exclusive use of this material (see Table 8). Similar observations have already been made by Hakemi & Vatandoust during their investigations.[642] In contrast are the XRD analytical results of SHA 18, a fragment of a crucible slag which contents show evidence of the sulphourous Cu-

642 Hakemi & Vatandoust 2011: 3f.

minerals digenite, brochantite and chalcanthite but also of cuprite, atacamite and delafossite. These results are somehow suggesting a kind of a co-smelting metallurgical process with the production of sulphourous matte at Shahdad which is also known from Shahr-eh sukhteh. This evidence implies a smelting temperature of ca. 900°C.[643]

The analytical investigation from the other slag sample SHA 19 is of particular interest as it shows no traces of sulphur but contents of metallic copper, atacamite and cuprite which seems rather to suggest a different smelting technique of Cu-oxides and Cu-chlorides. This technique is should be conducted at a temperature of around 1200°C.[644]

The analysis of SHA 20 a crucible fragment, shows pieces of crushed slags and grog as temper particles as well as spills of metallic copper inside of the matrix.

The single fragment of a hammered ingot fragment, SHA 21, still shows the presence of the cupriferous minerals like cuprite, atacamite and connellite which are still imbedded as inclusion inside the metallic copper. This suggests that the ingot was still raw in quality and awaited further treatment to reduce the mineral impurities to a minimum.

643 Hauptmann 2014: 102f.
644 Ibid.: 101.

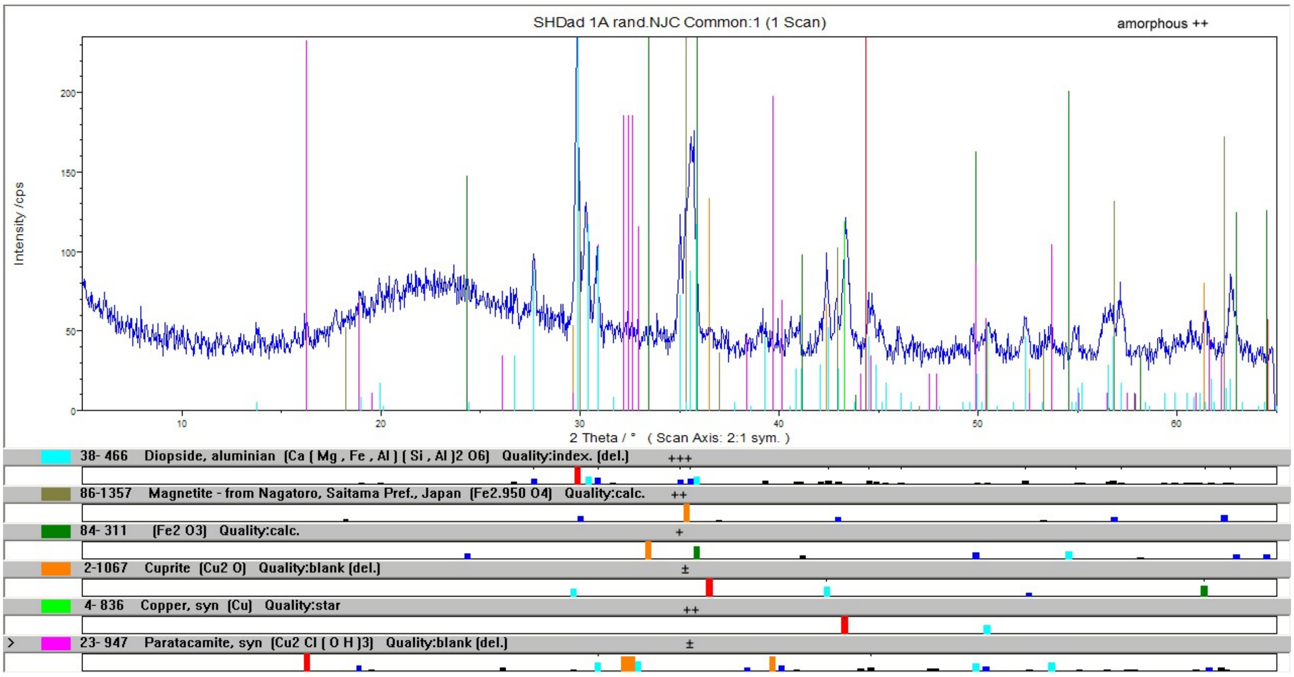


Figure 66: Mineral composition of a random sample from SHA 1A according to XRD.

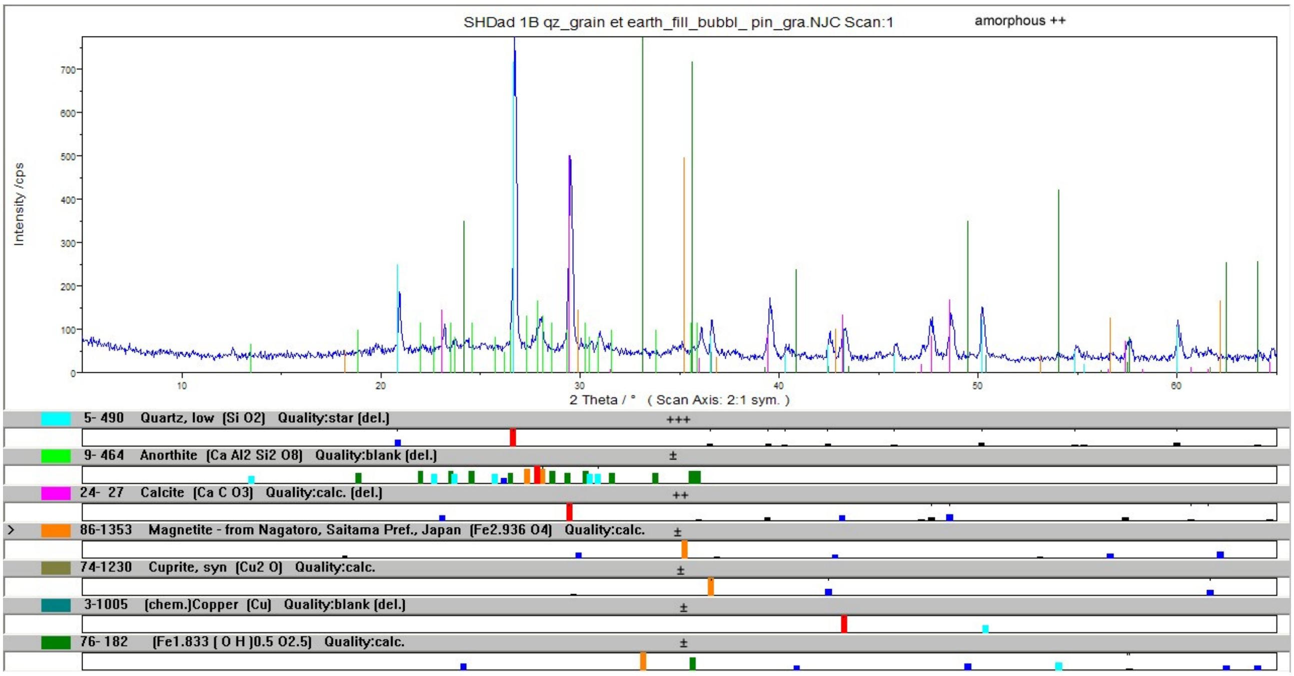


Figure 67: Mineral composition of a sample from SHA 1B according to XRD.

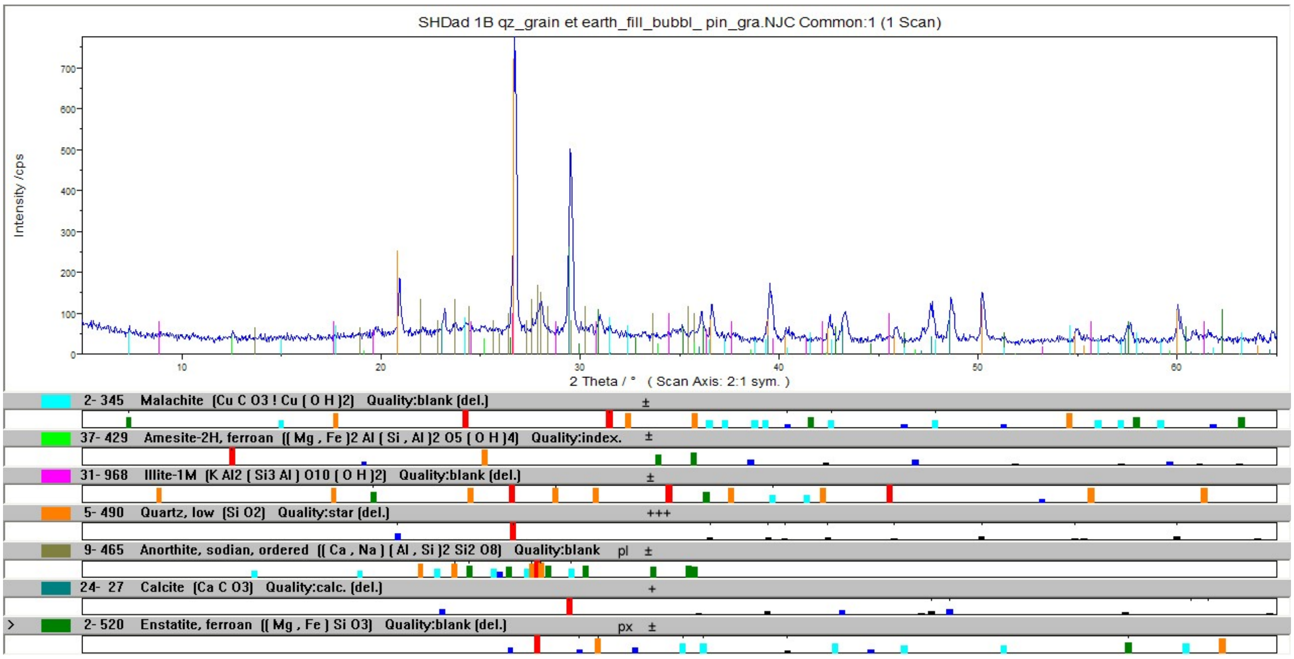


Figure 68: Mineral composition of a sample from SHA 1B according to XRD.

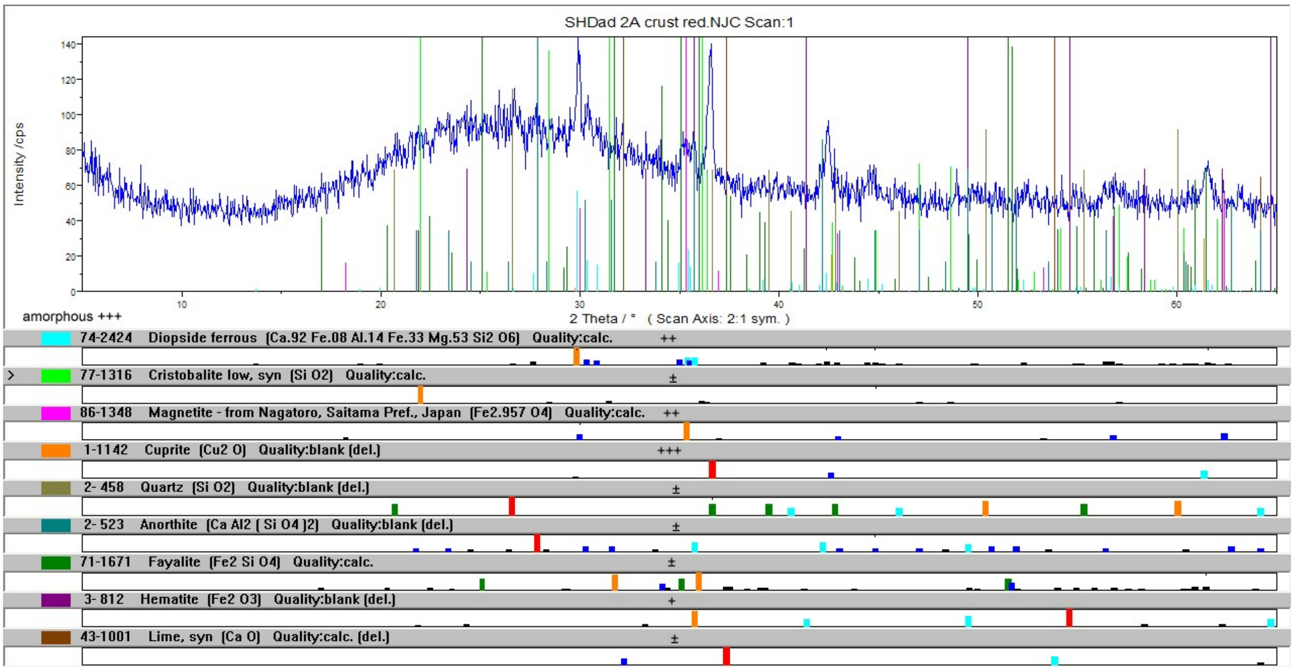


Figure 69: Mineral composition of a sample from SHA 2A according to XRD.

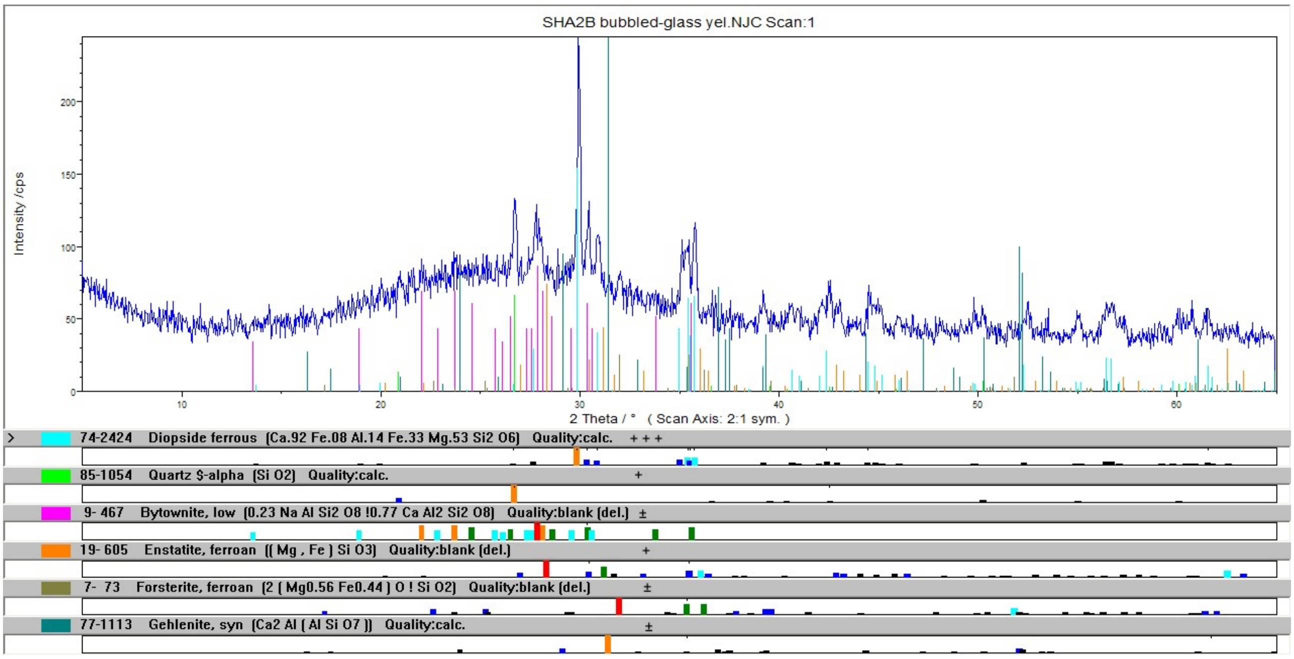


Figure 70: Mineral composition of a sample from SHA 2B according to XRD.

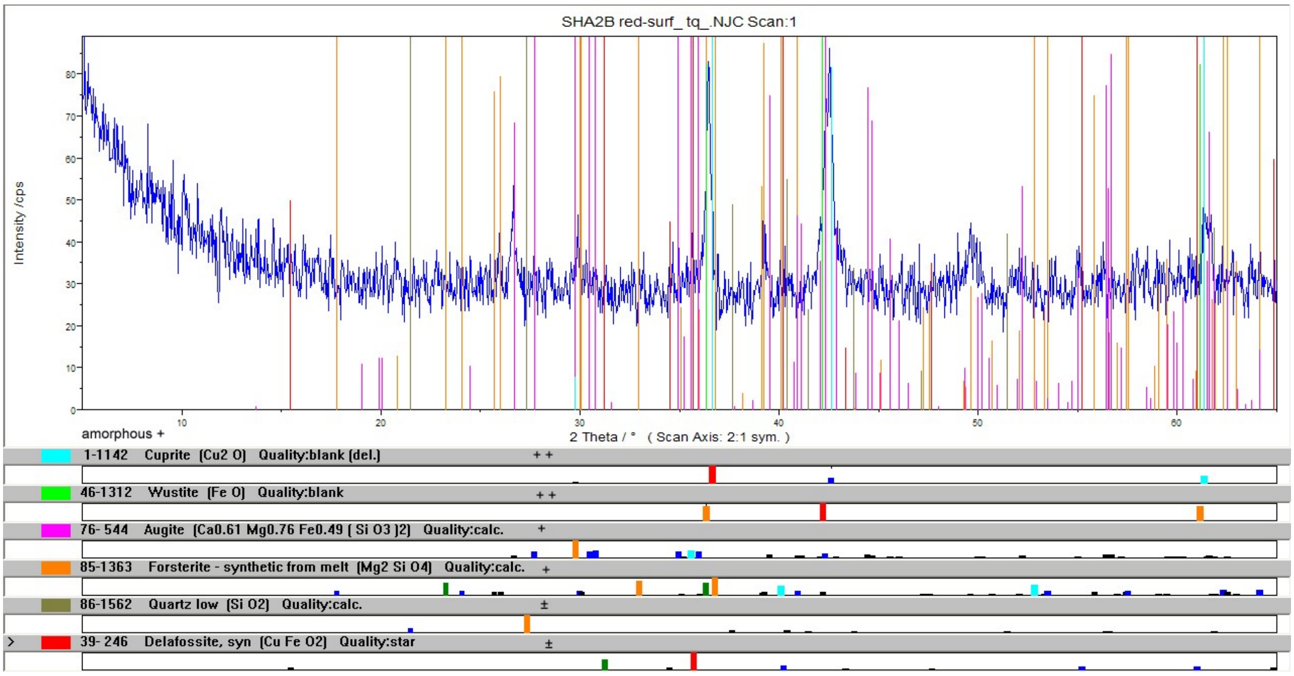


Figure 71: Mineral composition of a sample from SHA 2B according to XRD.

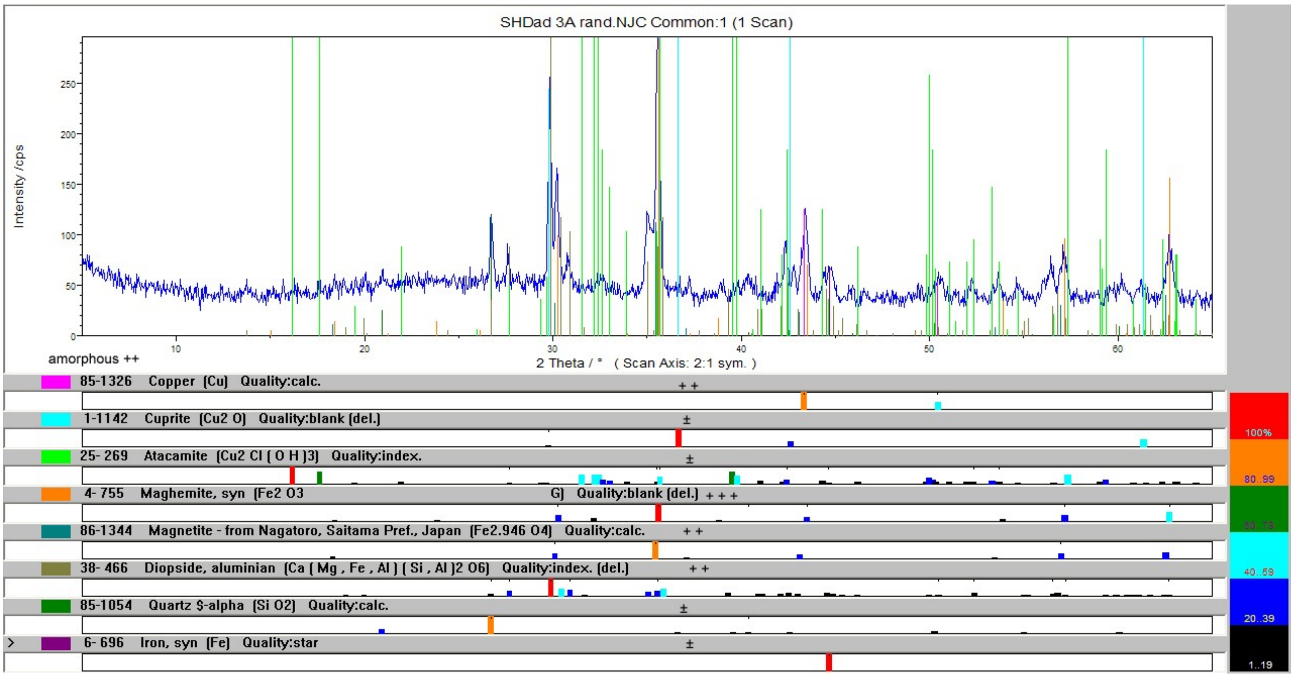


Figure 72: Mineral composition of a random sample from SHA 3A according to XRD.

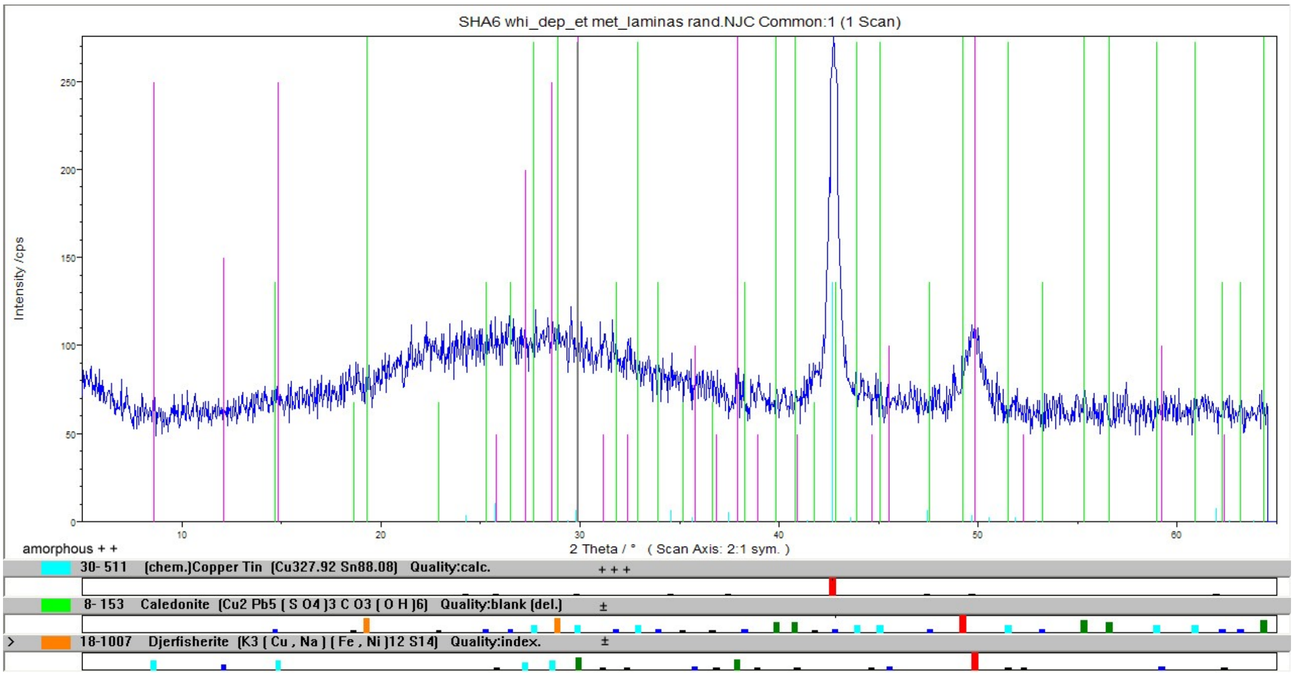


Figure 73: Mineral composition of a sample from SHA 6 according to XRD.

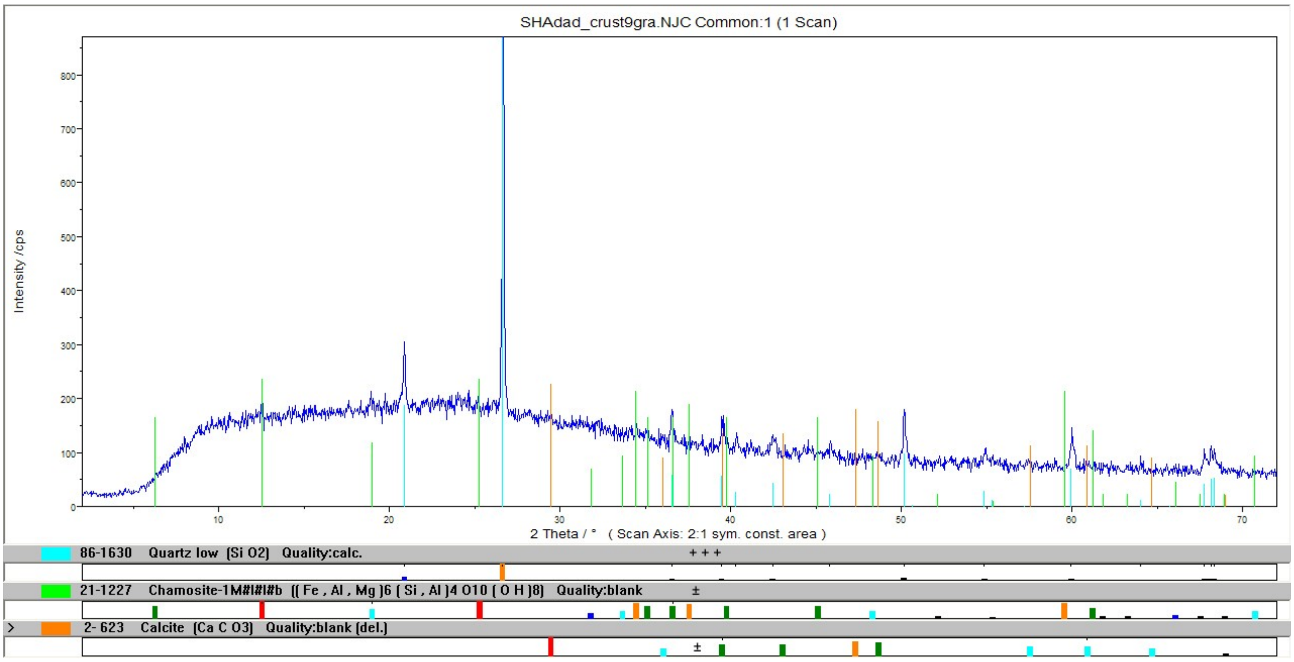


Figure 74: Mineral composition of a sample from SHA 9 according to XRD.

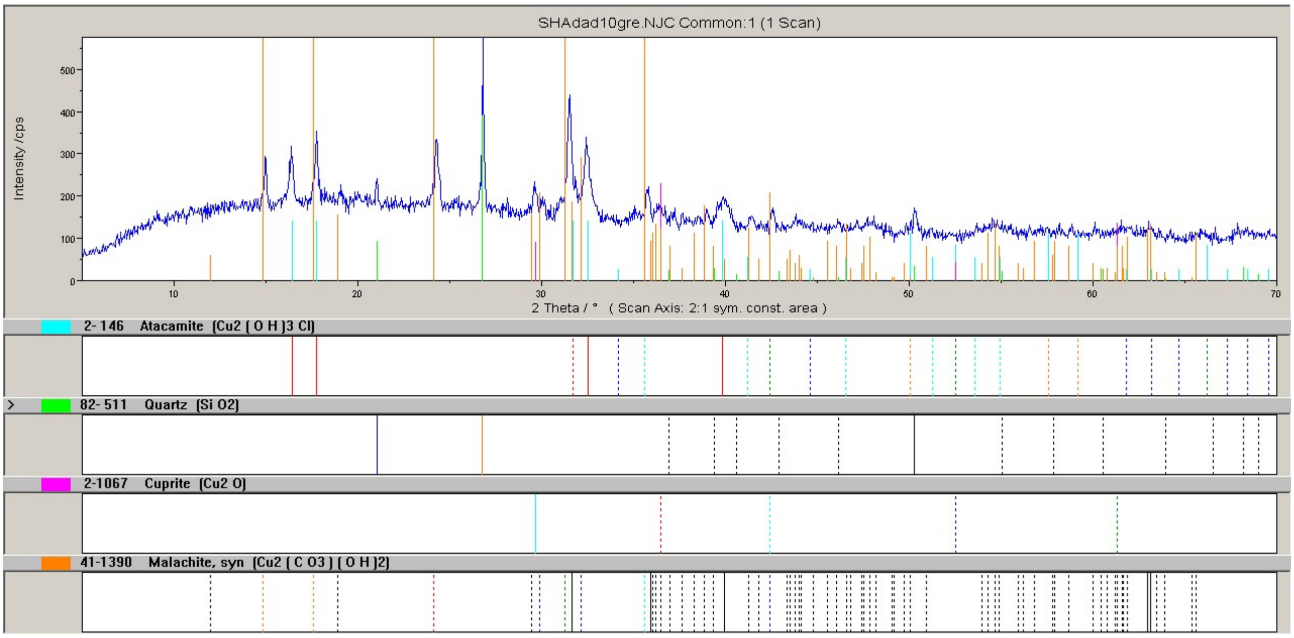


Figure 75: Mineral composition of a sample from SHA 10 according to XRD.

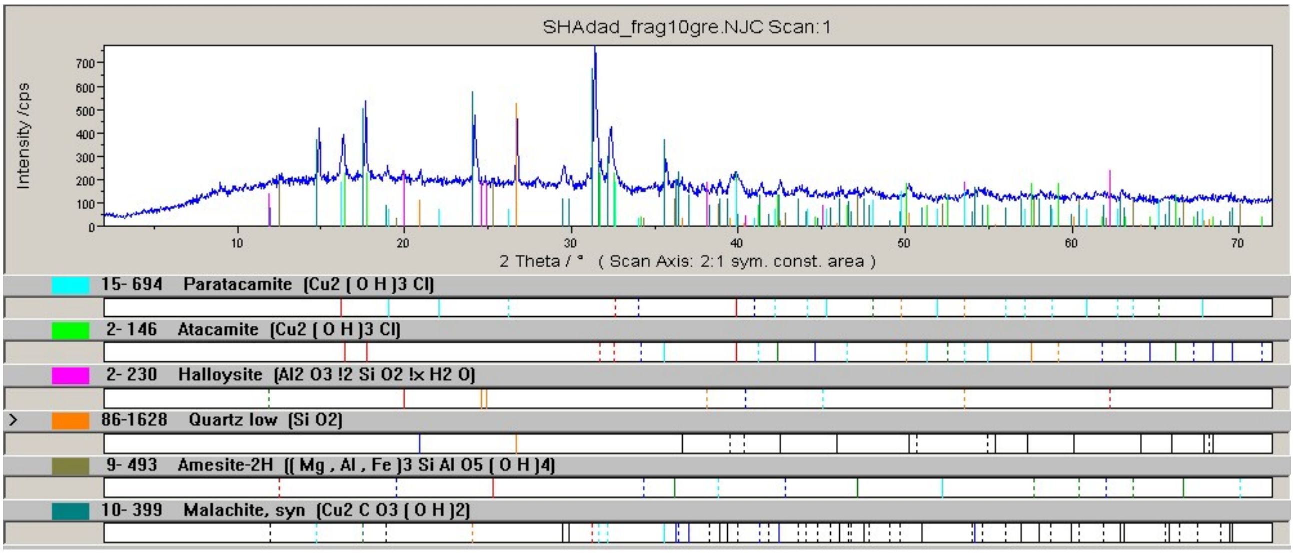


Figure 76: Mineral composition of a sample from SHA 10 according to XRD.

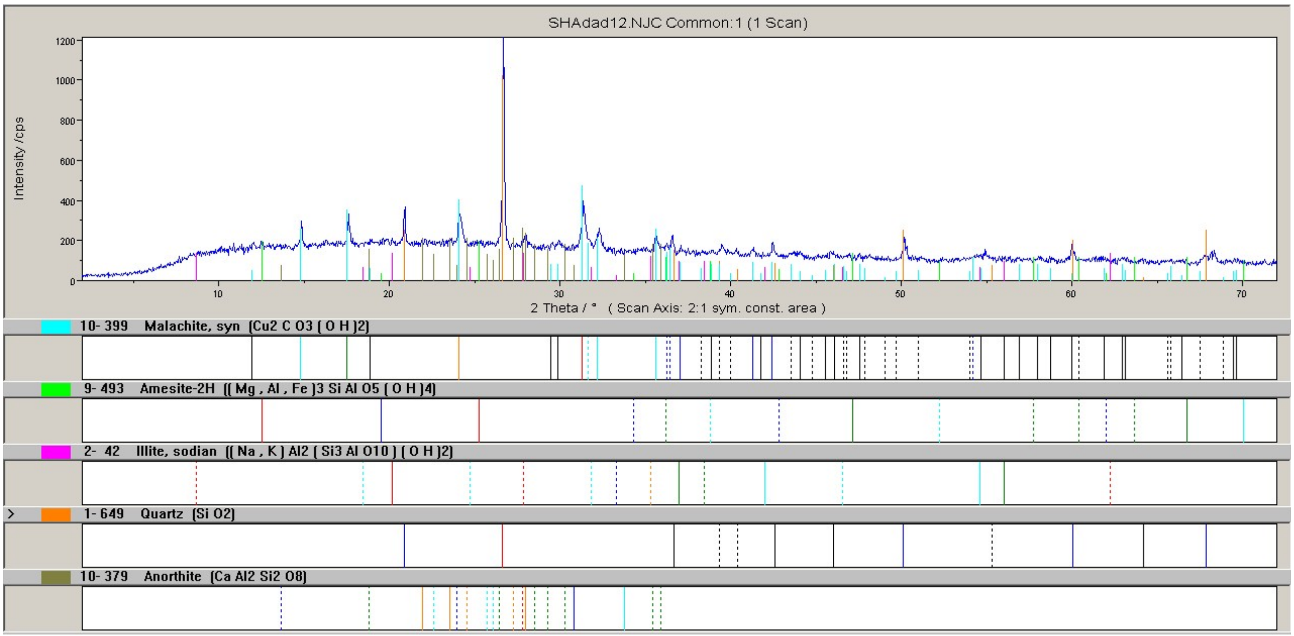


Figure 77: Mineral composition of a sample from SHA 12 according to XRD.

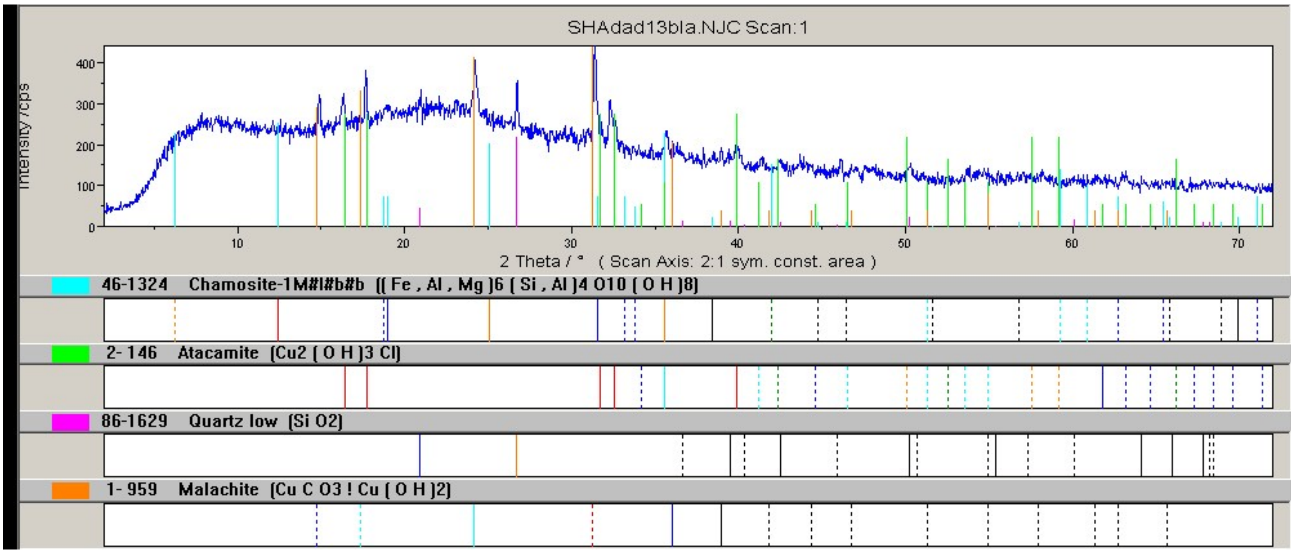


Figure 78: Mineral composition of a sample from SHA 13 according to XRD.

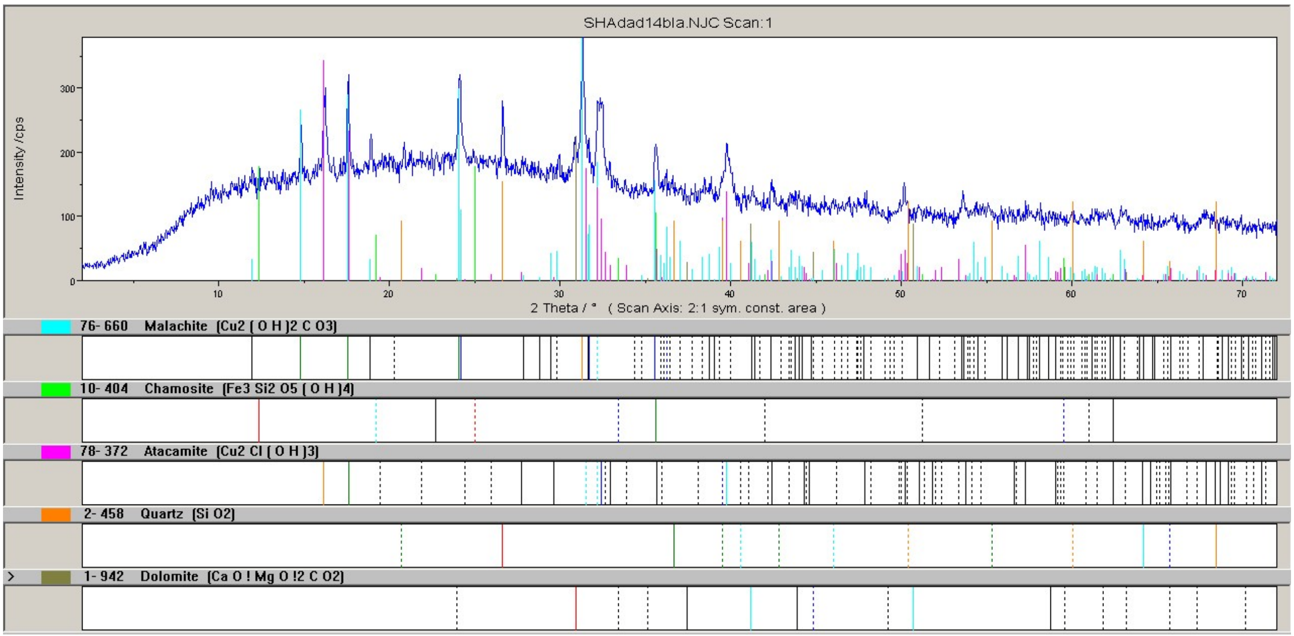


Figure 79: Mineral composition of a sample from SHA 14 according to XRD.

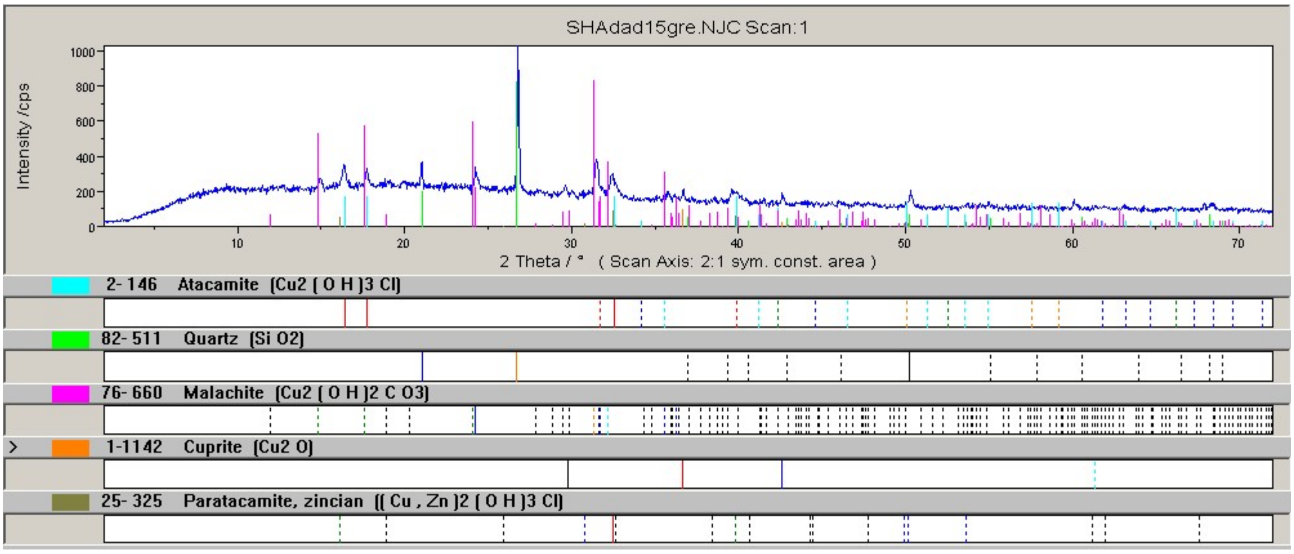


Figure 80: Mineral composition of a sample from SHA 15 according to XRD.

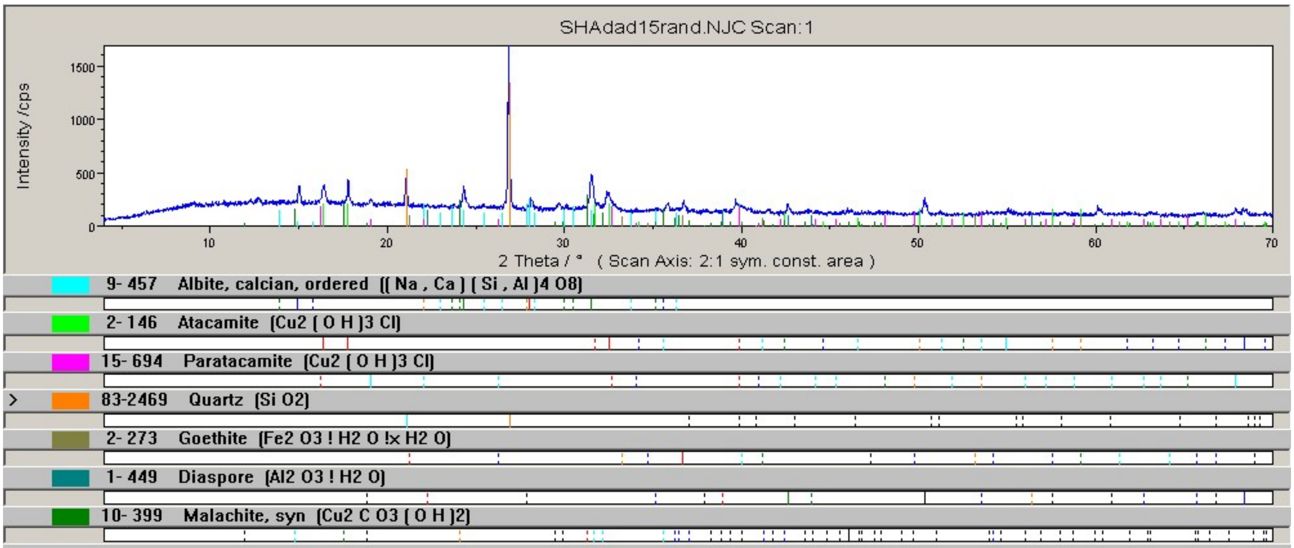


Figure 81: Mineral composition of a random sample from SHA 15 according to XRD.

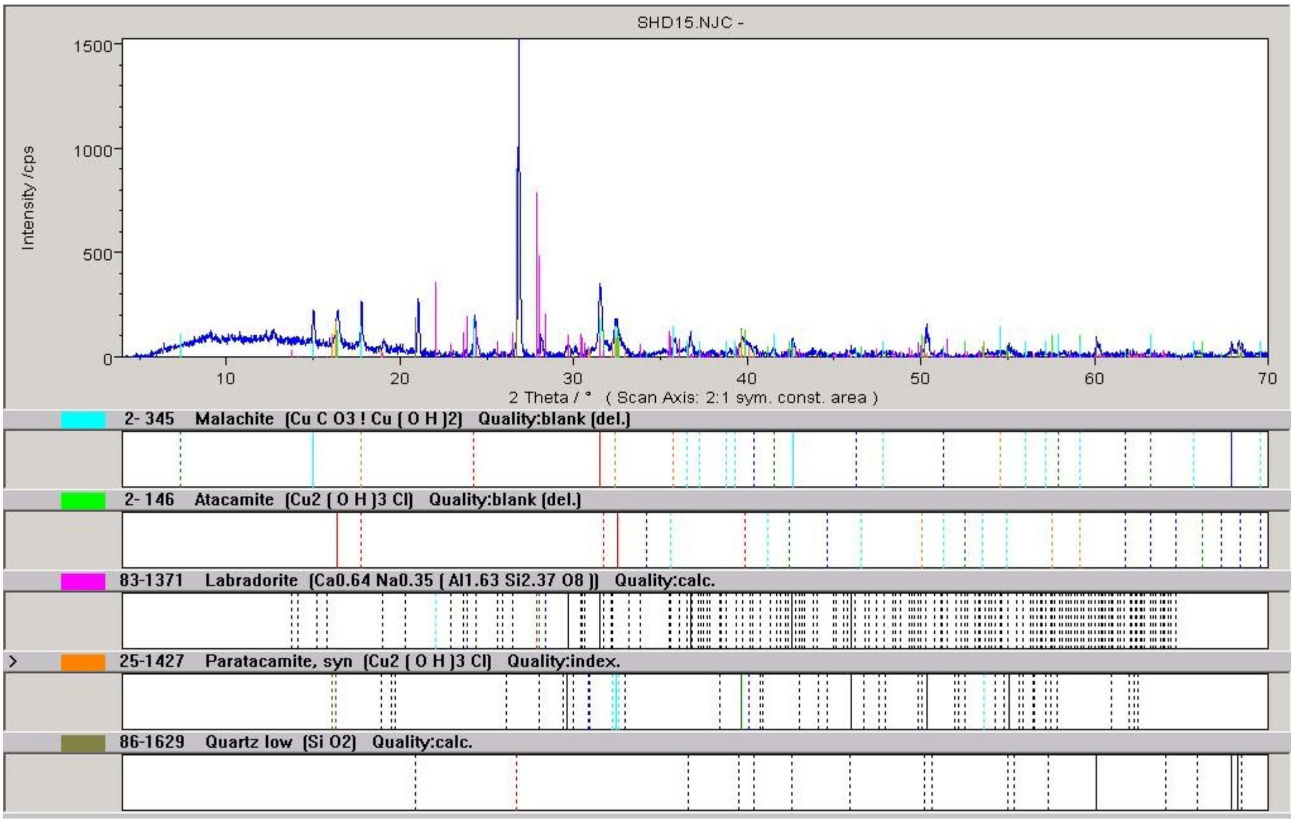


Figure 82: Mineral composition of a sample from SHA 15 according to XRD.

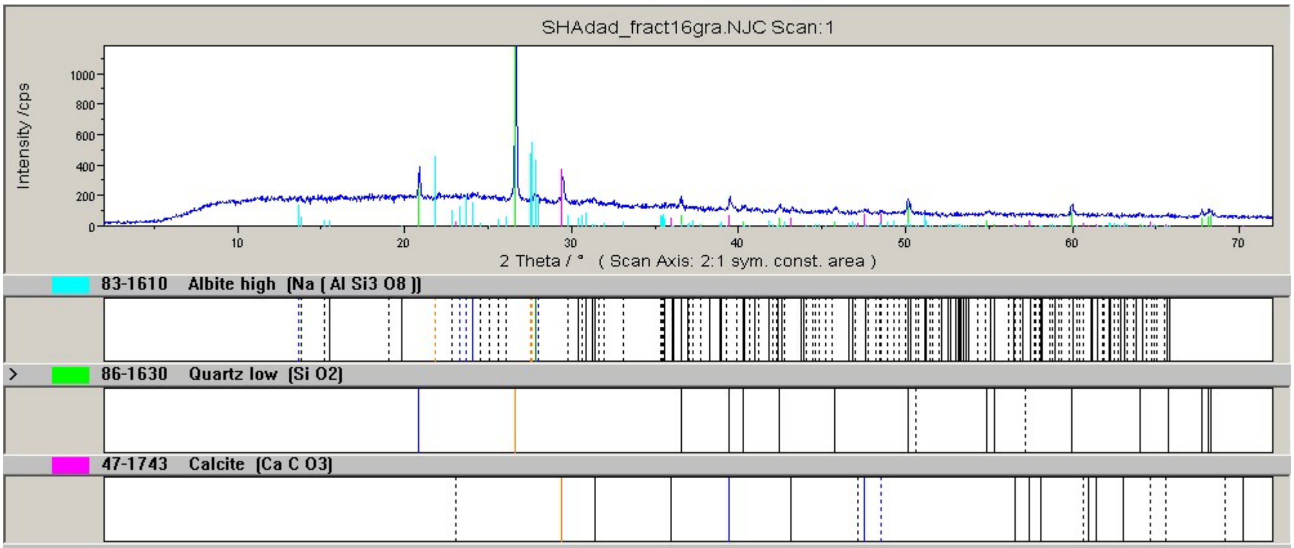


Figure 83: Mineral composition of a sample from SHA 16 according to XRD.

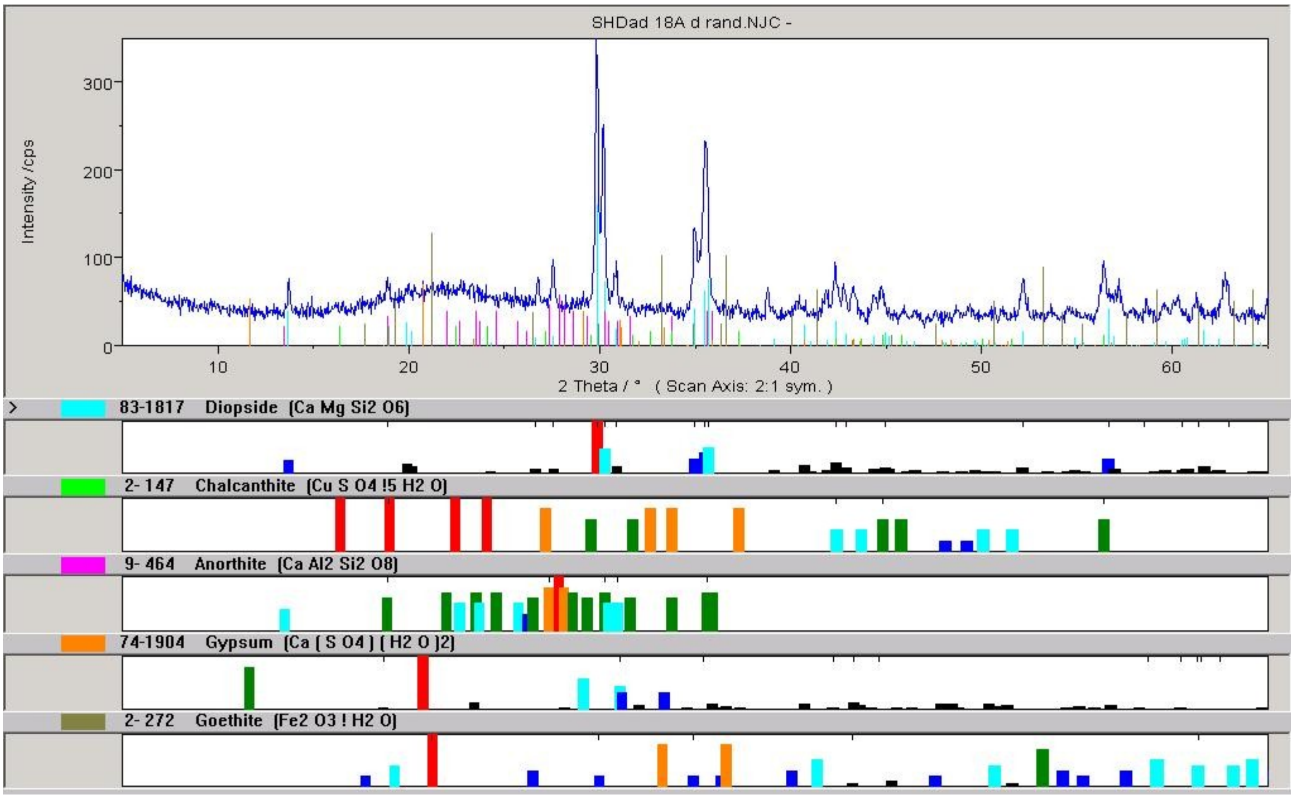


Figure 84: Mineral composition of a random sample from SHA 18A according to XRD.

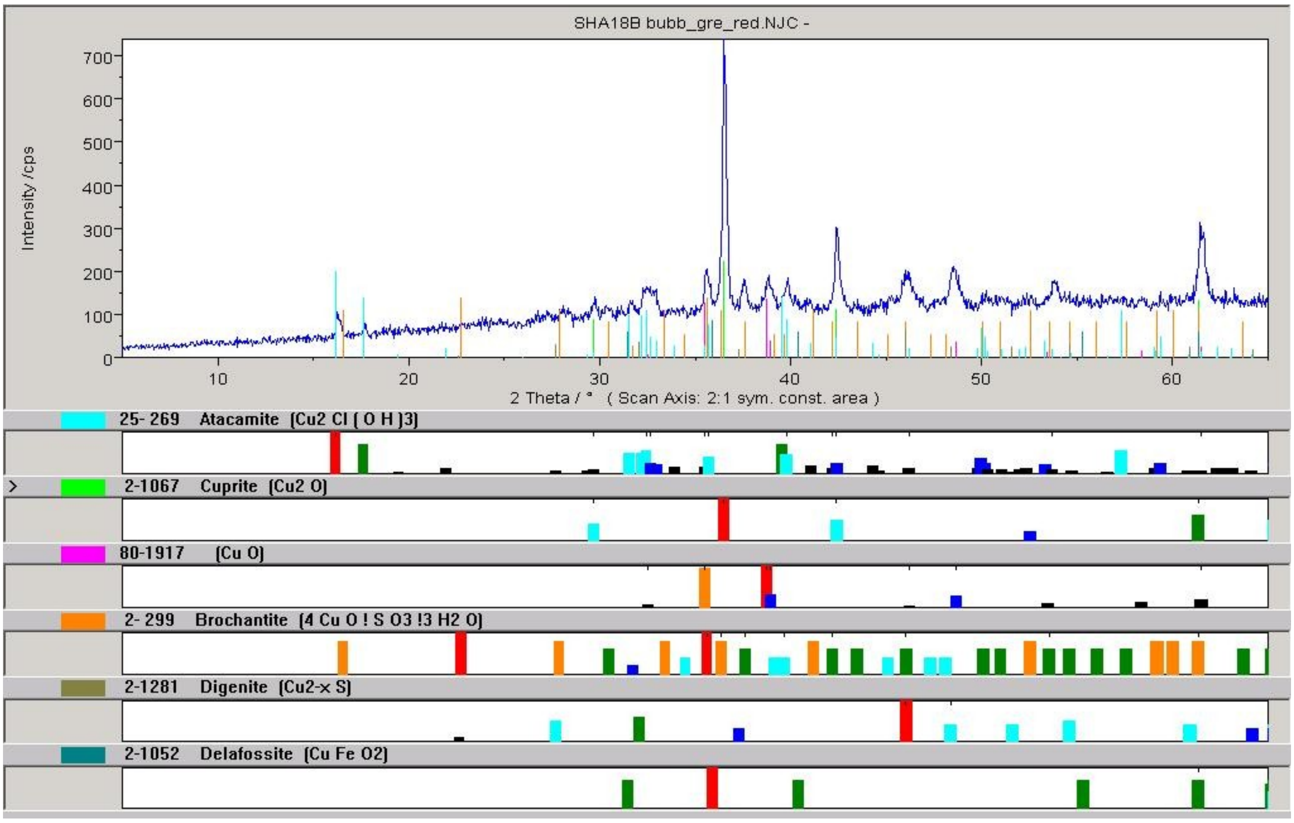


Figure 85: Mineral composition of a sample from SHA 18B according to XRD.

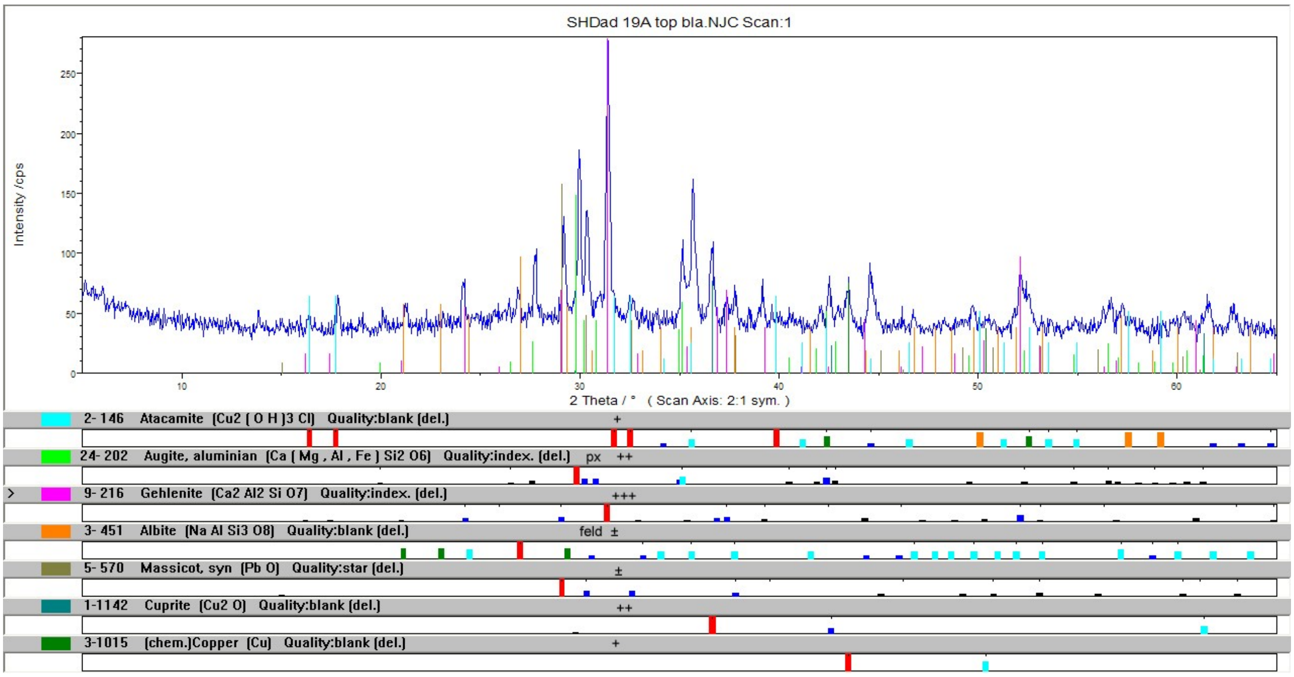


Figure 86: Mineral composition of a sample from SHA 19A according to XRD.

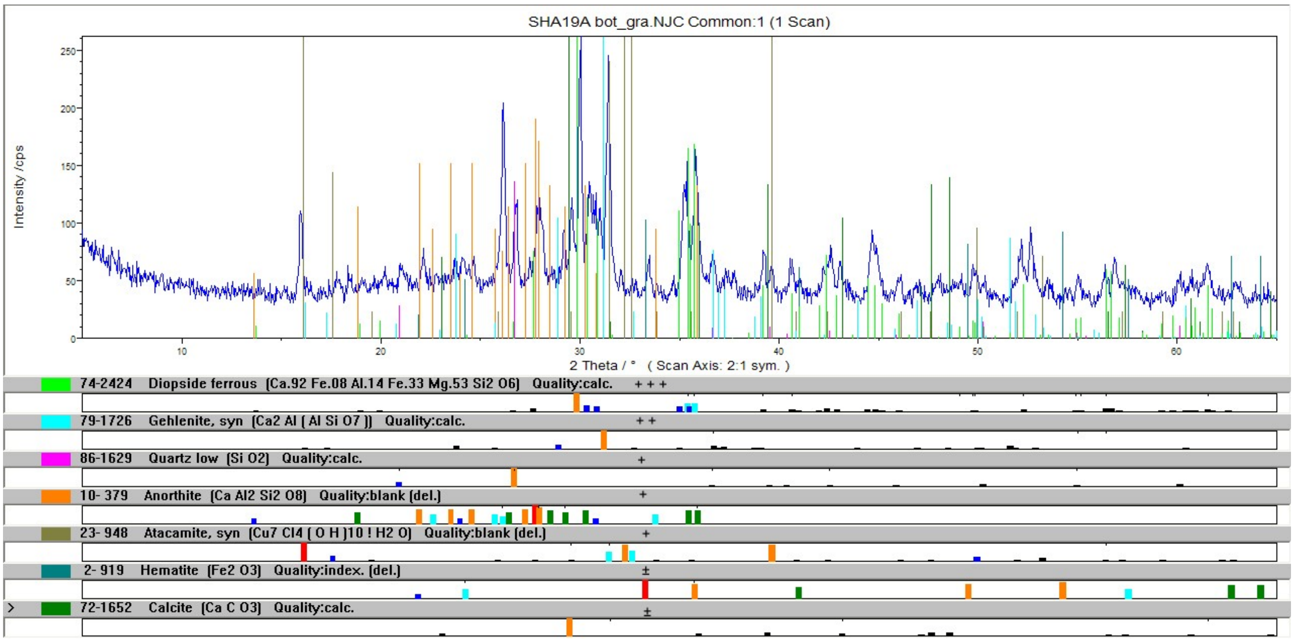


Figure 87: Mineral composition of a sample from SHA 19A according to XRD.

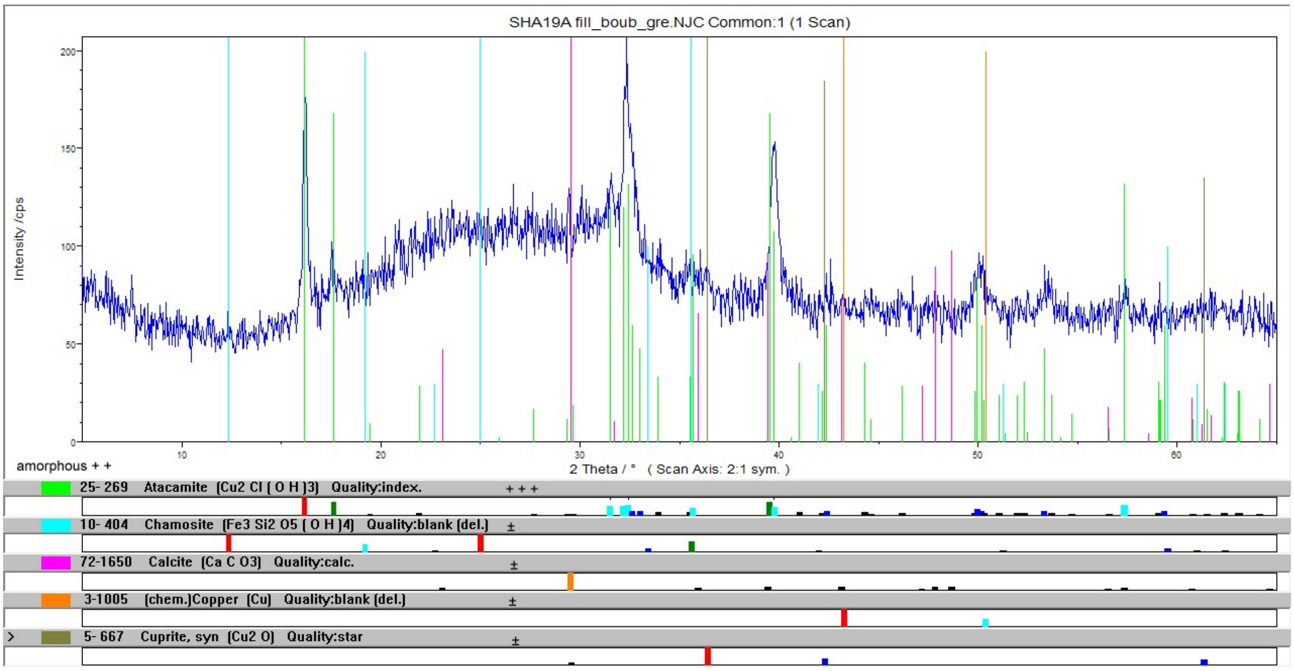


Figure 88: Mineral composition of a sample from SHA 19A according to XRD.

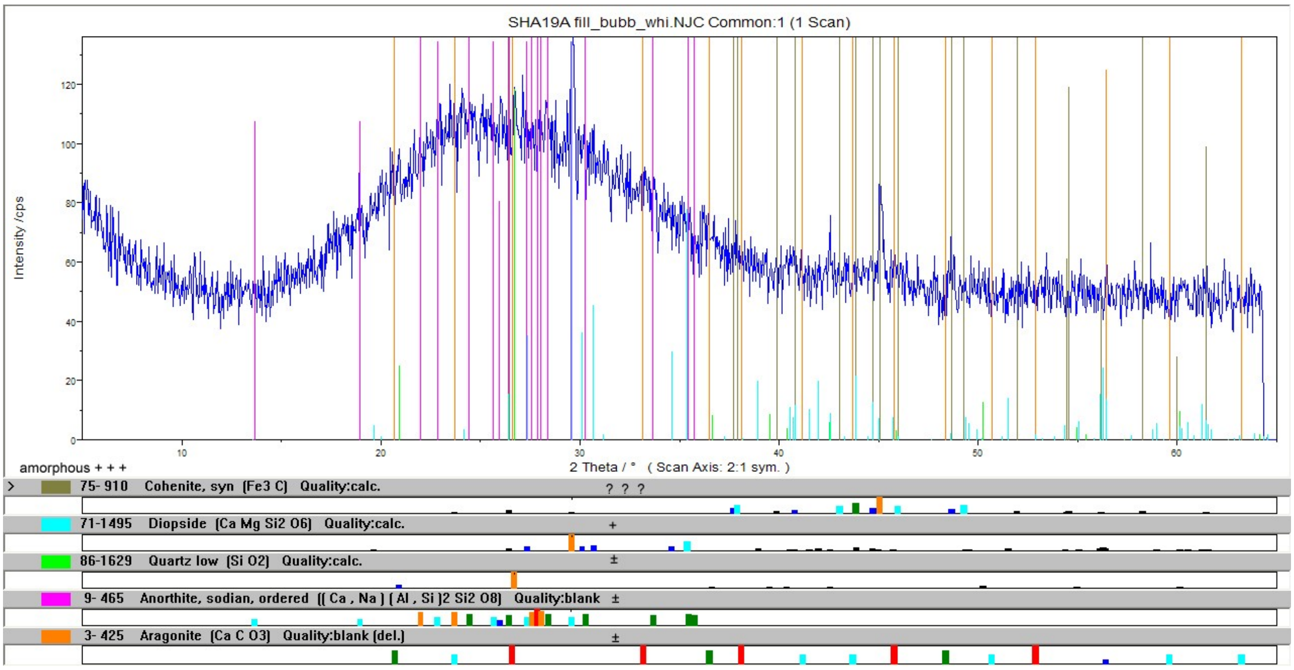


Figure 89: Mineral composition of a sample from SHA 19A according to XRD.

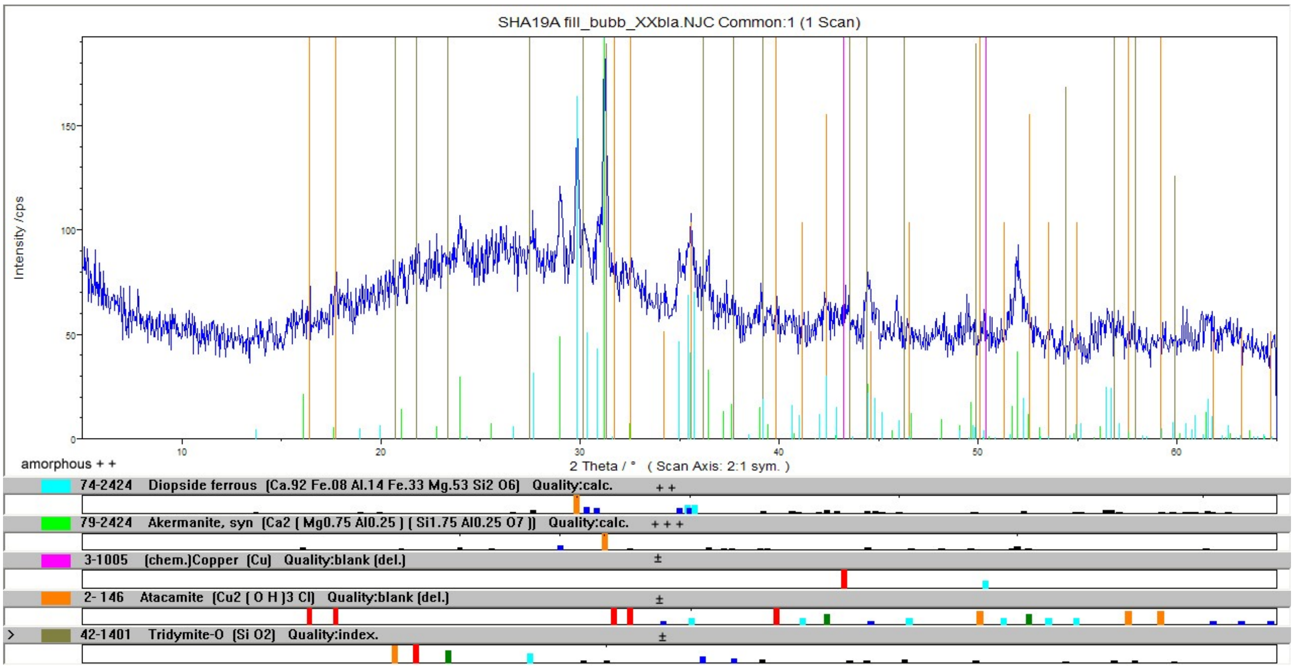


Figure 90: Mineral composition of a sample from SHA 19A according to XRD.

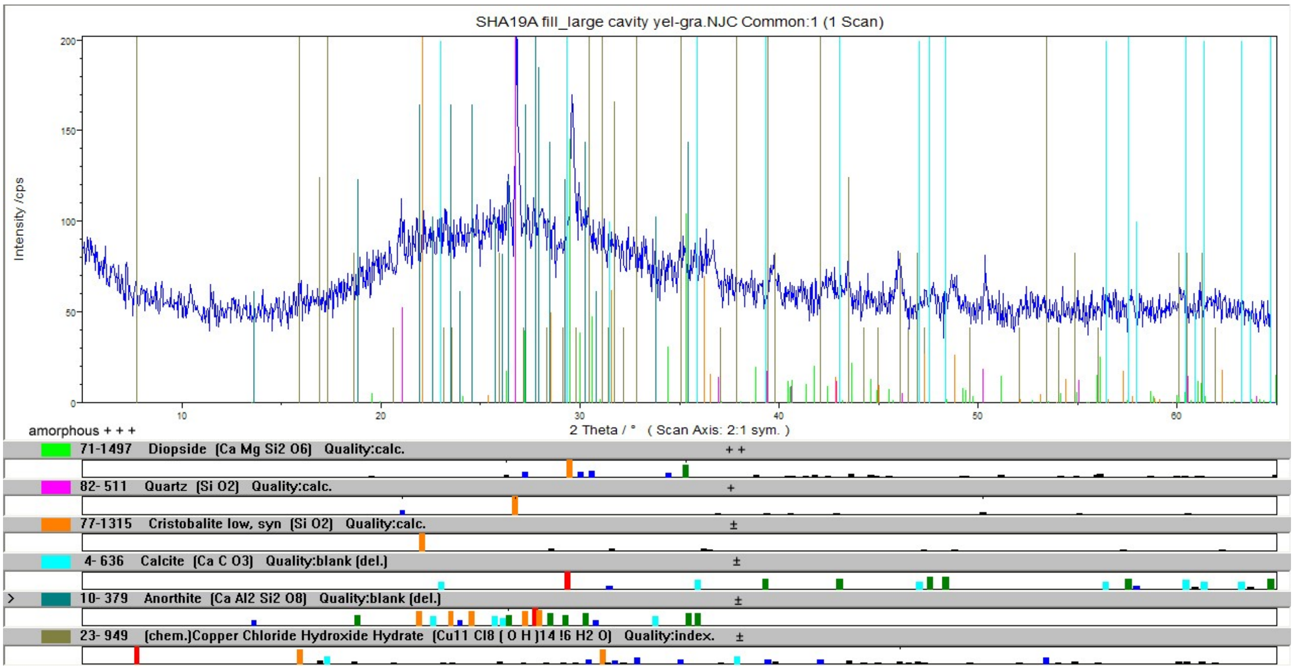


Figure 91: Mineral composition of a sample from SHA 19A according to XRD.

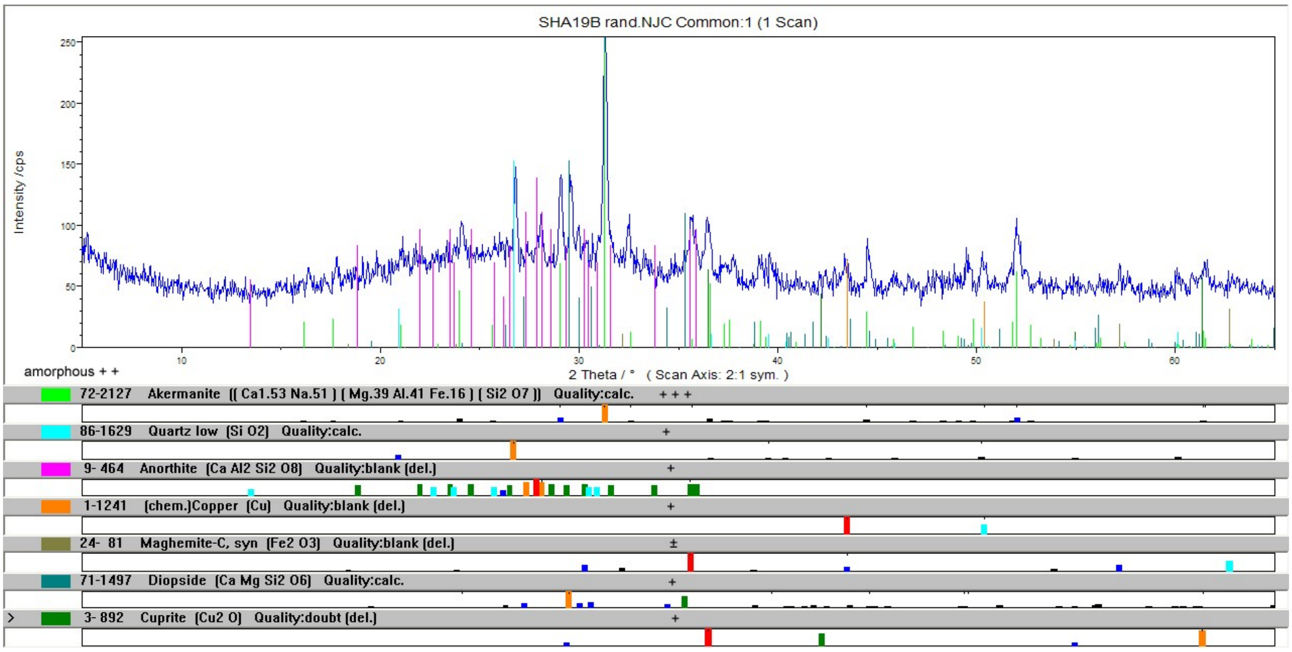


Figure 92: Mineral composition of a random sample from SHA 19B according to XRD.

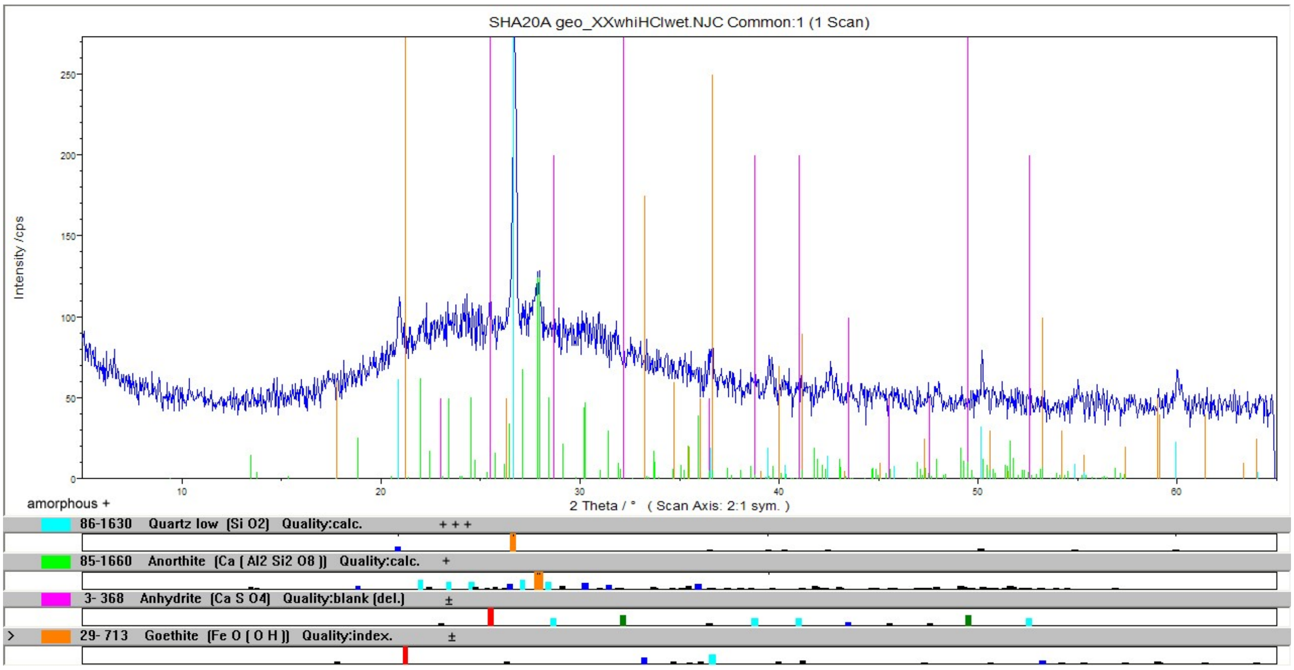


Figure 93: Mineral composition of a sample from SHA 20A according to XRD.

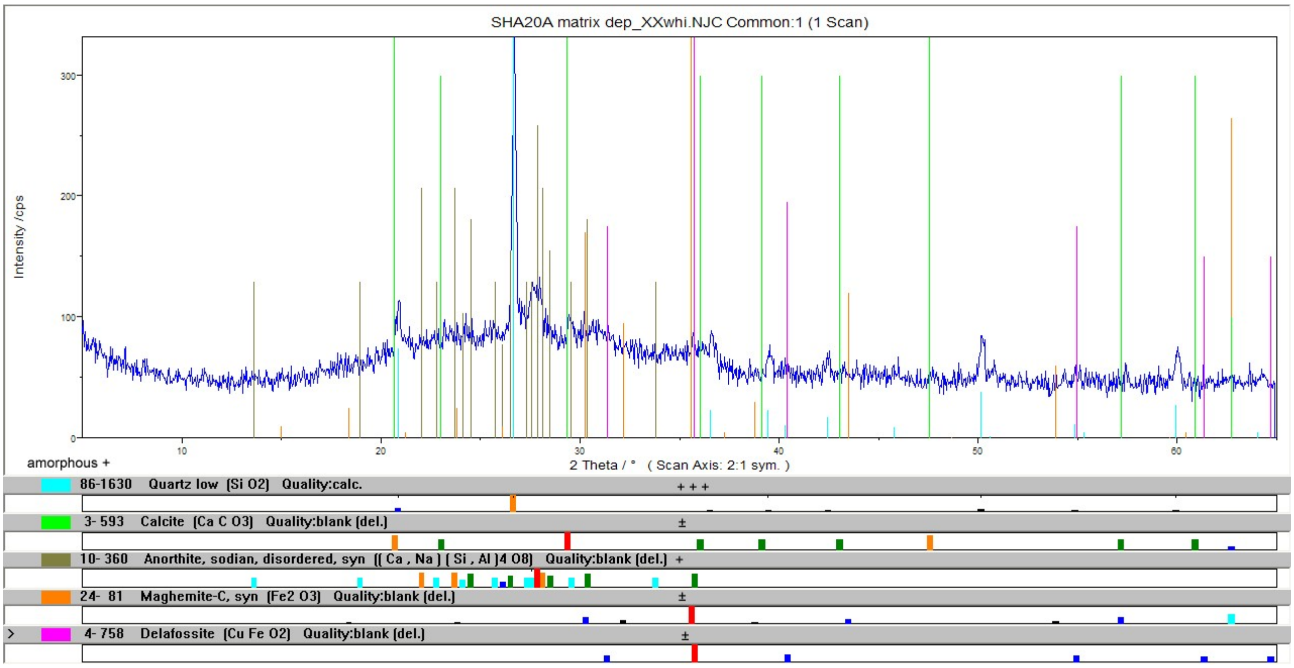


Figure 94: Mineral composition of a sample from SHA 20A according to XRD.

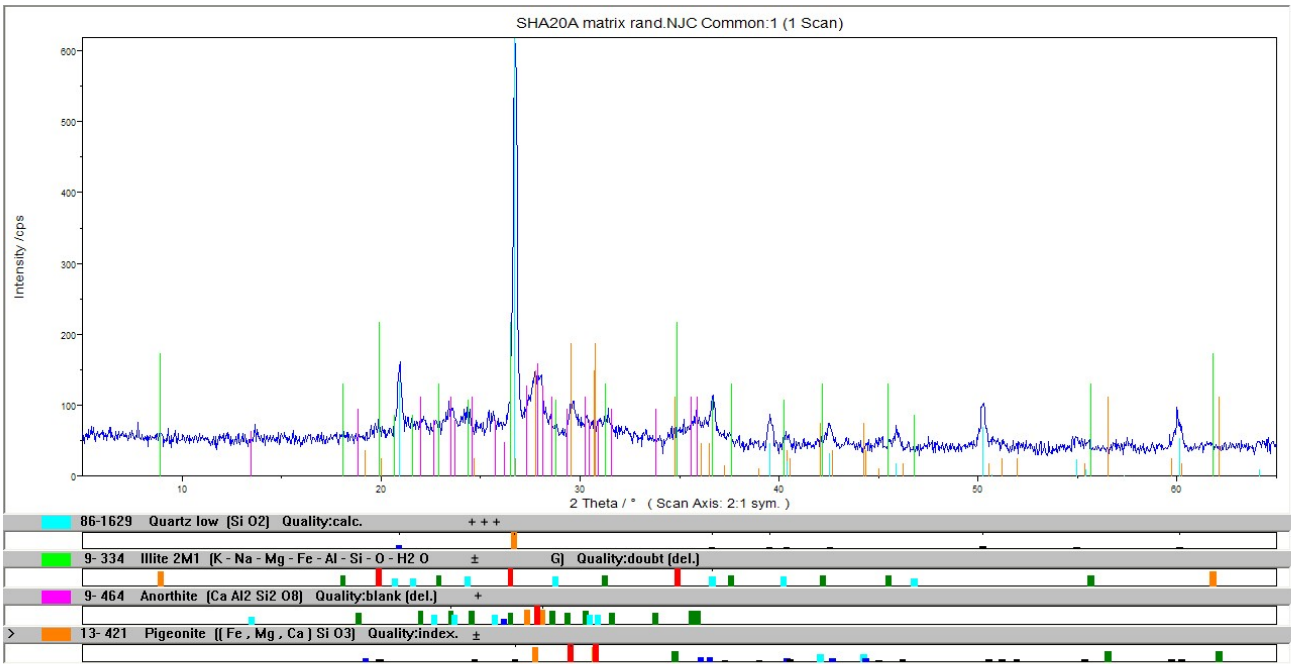


Figure 95: Mineral composition of a random sample from SHA 20A according to XRD.

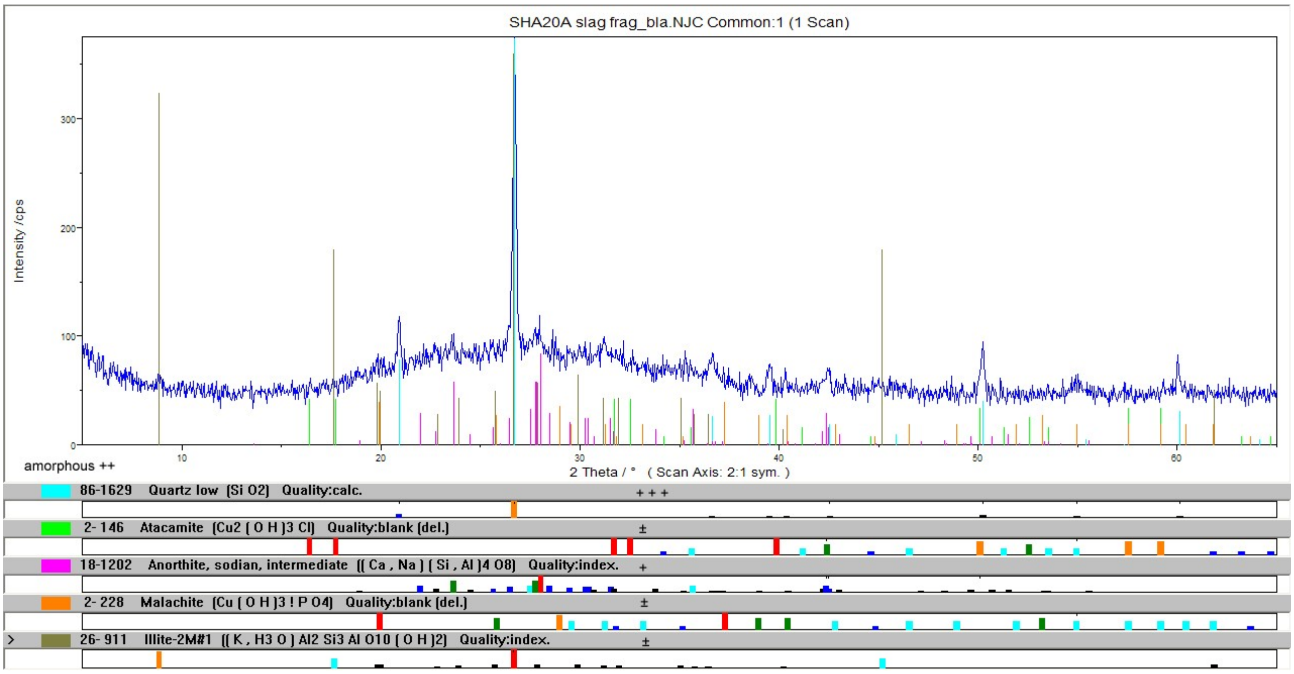


Figure 96: Mineral composition of a sample from SHA 20A according to XRD.

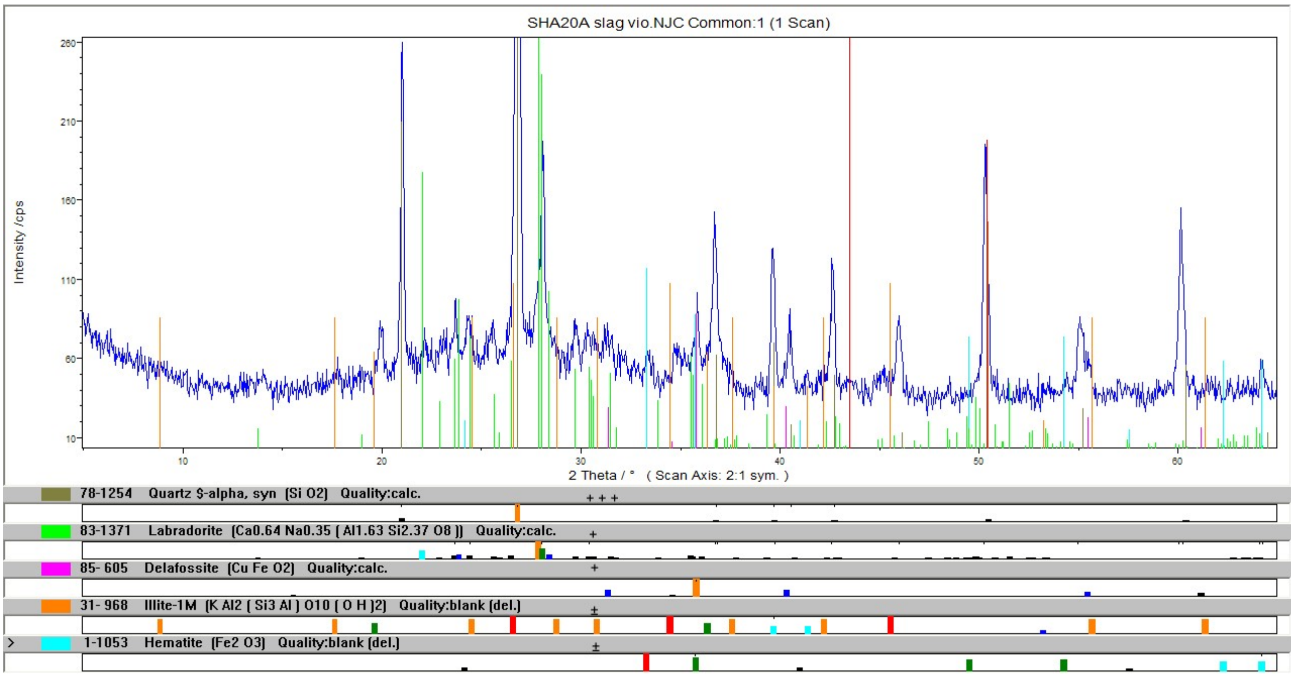


Figure 97: Mineral composition of a sample from SHA 20A according to XRD.

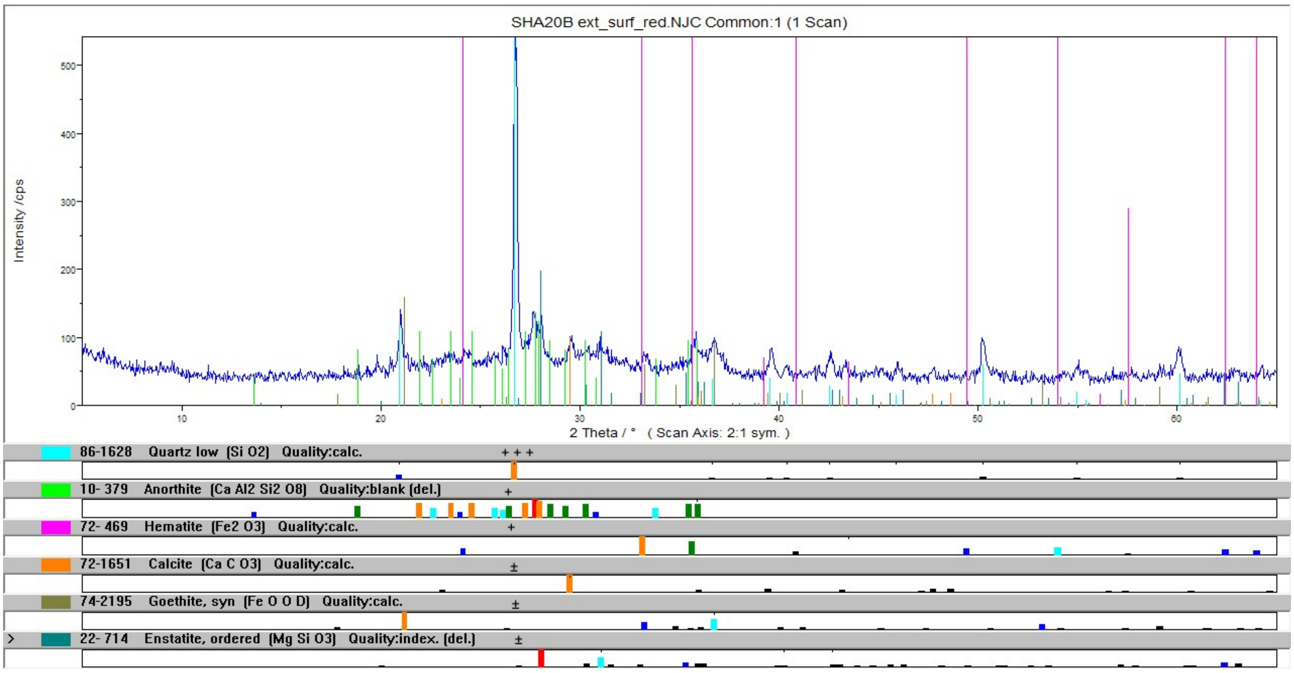


Figure 98: Mineral composition of a sample from SHA 20B according to XRD.

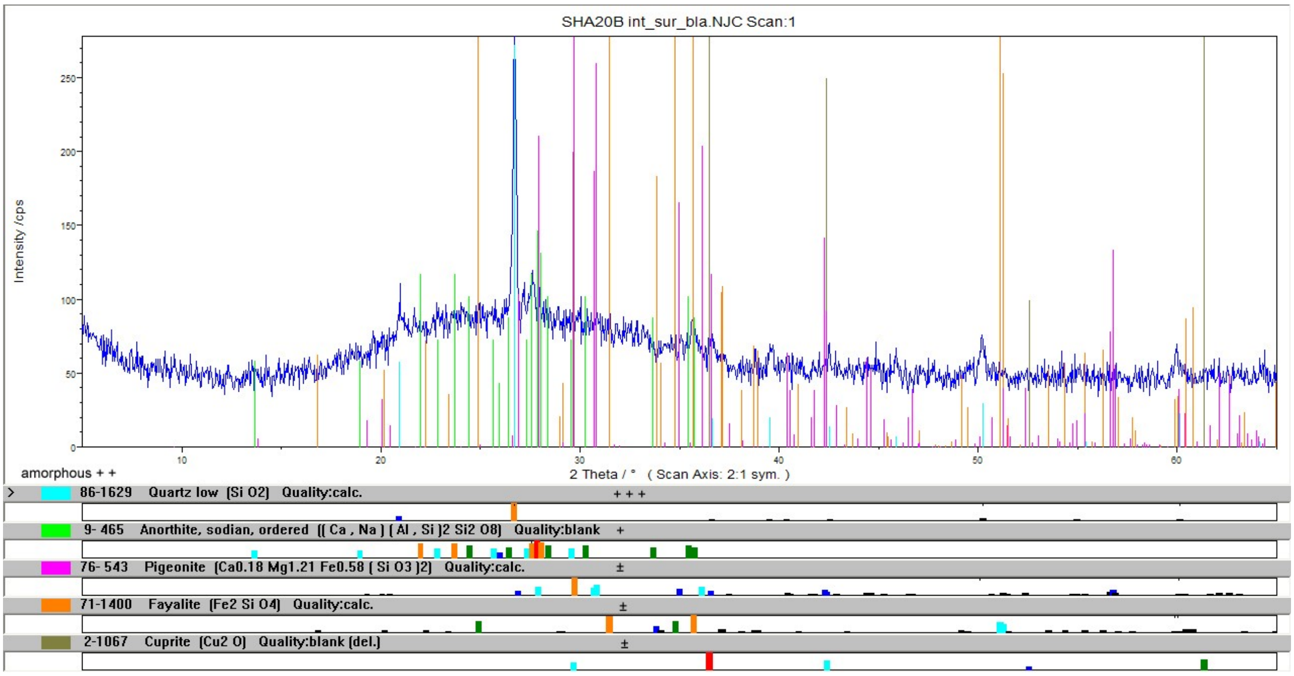


Figure 99: Mineral composition of a sample from SHA 20B according to XRD.

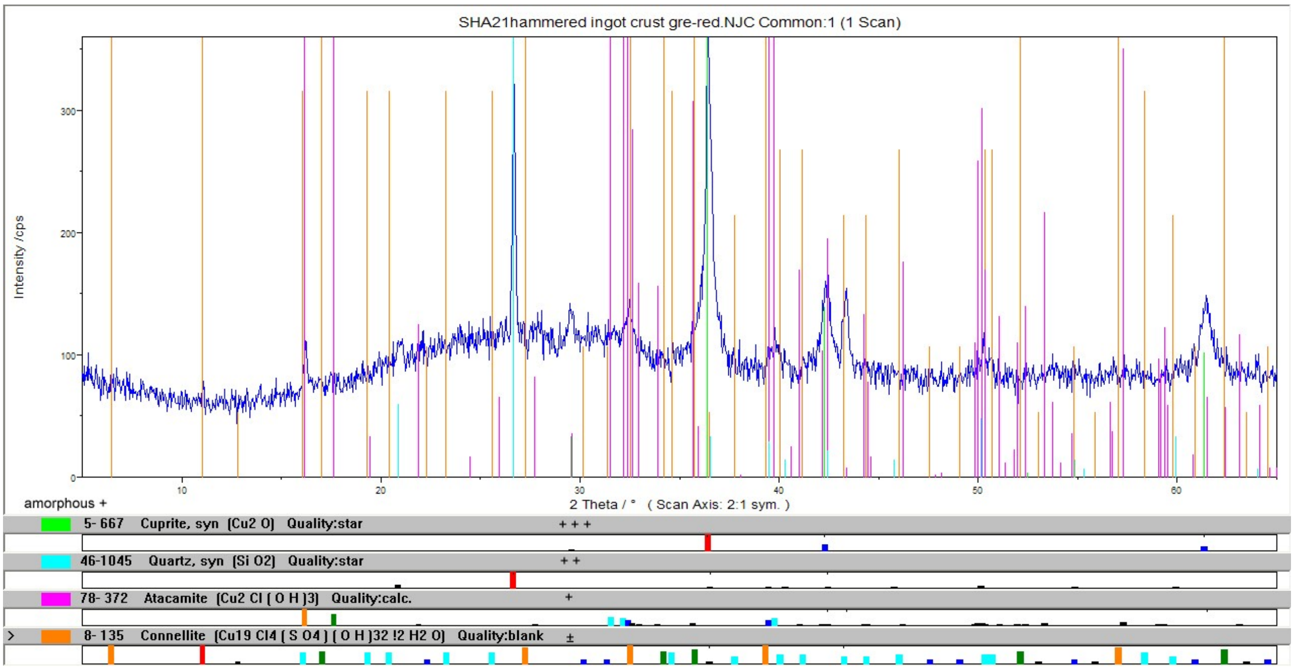


Figure 100: Mineral composition of a sample from SHA 21 according to XRD.

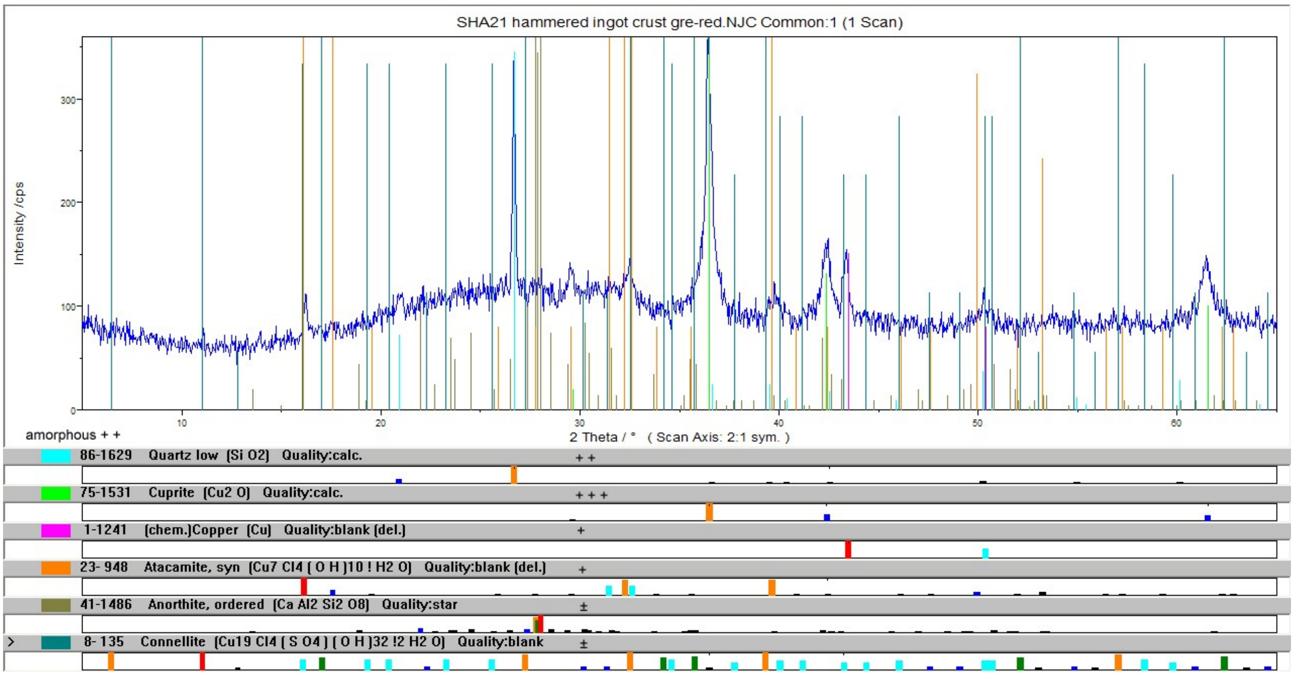


Figure 101: Mineral composition of a sample from SHA 21 according to XRD.

6.1. Introduction to the catalogue

The majority of data compiled in this catalogue (see chapter 9: Catalogue) derives from activity as a visiting researcher at the National Museum of Iran in Tehran in May-June 2006. In the course of this six week project almost all of the metal artefacts from the archaeological site of Shahdad which are kept in the depots of the National Museum of Iran in Tehran were investigated.[645] This catalogue represents metal artefacts from the archaeological expeditions at Shahdad which were conducted between 1969 (1348) and 1977 (1356) under the directorship of Dr. Ali Hakemi (1969-76) and Mirabedin Kaboli (1977). These artefacts are kept in the find depot of the National Museum of Iran in Tehran and are presented in this catalogue with 504 different numbers (**cat.no.**) which were given according to the corresponding number of artefacts. It is quite obvious that this is not the whole corpus of artefacts from Shahdad which is kept at the museum as there is a total amount of 736 items which were already mentioned in Hakemi´s final publication.[646]

Concerning the different registration numbers in this catalogue there are several points to consider:

First, there is the **excavation no.** which was given straight after the excavation. In some cases handwritten label-cards still exist, in other cases there were handwritten labels put directly on the body of the items.[647] Unfortunately some artefacts are lacking both kinds of identification marks. These kinds of artefacts are designated as “پژوهشی “ (pazuheshi) which means **still in restoration (s.i.r.)**. Finally a **museum inventory no.** was given in most of the cases by the scientific staff of the National Museum of Iran in Tehran.

Summarized it can be stated that there are three different kinds of registration marks. Unfortunately there is also a wide inconsistency in the different states of registration which were observed during the compilation of the catalogue. In some cases different systems of registration were observed which will be presented in the following descriptive part of the catalogue. Furthermore there were also frequent difficulties in identifying significant

645 Unfortunately not all of the metal artefacts which are already known from Hakemi 1972 and Hakemi 1997 were available to investigate at that time. This was caused by several reasons such as restoration works which were undertaken at this point. Unfortunately the objects cat.no. 151 and cat.no. 498 were the only inaccessible metal objects. Some other previously published pieces were missing completely from the museum´s collection but other artefacts which had not been published in the above mentioned monographies were examined.

646 Hakemi 1997. There is still a huge collection of objects of different raw materials such as pottery, metal and stone which most probably derive from A.Hakemi´s and M.A.Kaboli´s investigations which are still kept at a depot in Shahdad. (Pers. comm. by E. Cortesi in October 2008 and by R. Riyahiyan in December 2008.)

647 Unfortuntately the present status and whereabouts of the original excavation documentation was unknown during this investigation. But in 2016 the excavators´ manuscripts and documentations were localized and thankfully handed over by Hassan-Ali Hakemi to the central library of the I.C.H.H.T.O. Maybe future investigations of these sources will help to clarify some of the mentioned issues.

artefacts from the museum´s depot with information from already published data in Hakemi 1972 and Hakemi 1997. In several cases multiple given excavation numbers as well as transposed digits were observed. There were also cases where artefacts of significant shape were recorded in the museum´s depot but were not even mentioned in one of the major publications on Shahdad. It has been attempted to solve these problems in as many cases as possible.

Another problem with the metal artefacts from Shahdad concerns their state of preservation. As it can be observed on the photographical reproductions which are presented in the catalogue there is only a relatively small amount of artefacts which were already cleaned and restored according to modern conventions. The majority of the artefacts are still showing traces of soiling and corrosion which remain since their first discovery. This was one of the reasons why precise technical drawings were not yet conducted. This also meant a modified methodology for the typological studies was required.

The scientific parameters on which this classification of the metal artefacts is based on are according to macroscopic observations. First measurements and the weight was taken of the objects. Afterwards a precise description of the shape was made. On that basis the typological subdivision was conducted.

The whole collection of bronze metal artefacts is separated in to two major groups. The first major group, “containers“, is characterized as bronze metal vessels which were all produced to collect and save goods. The second group, “tools“, consists of several groups of artefacts which were used for achieving aims.

These two main groups are further subdivided into variation groups named A to T and their variations (see Table 9).

If possible, typological parallels and similarities to other find objects from different archaeological sites and areas were noted.

Type	Description	Groups	Amount
A	Bowl with nozzle	A.01 A.02 A.03 A.04	1 1 1 1
B	Cylindrical beaker	B.01 B.02	3 1
C	Spouted bowl	C.01 C.02	3 3
D	Tall beaker	D.01 D.02	3 1
E	Small beaker	E.01	2
F	Beaker/chalice/vase	F.01 F.02 F.03 F.04 F.05	1 2 1 1 4
G	Small bowl (diam_<15cm)	G.01 G.02 G.03 G.04 G.05 G.06 G.07 G.08 G.09 G.10 G.11 G.12	6 1 1 11 7 23 4 10 8 7 1 1
H	Plate(undecorated)	H.01 H.02 H.03	3 1 1
I	Plate(decorated)	I.01 I.02 I.03	1 1 2
K	Small plate(undec.)	K.01	5
L	Large bowl (diam_>15cm)	L.01 L.02 L.03 L.04 L.05 L.06	7 1 1 1 1 1
M	Axe	M.01 M.02 M.03	5 1 9

		M.04	1
		M.05	3
		M.06	4
		M.07	1
N	Blade, adze, point	N.01	1
		N.02	2
		N.03	1
		N.04	6
		N.05	1
		N.06	1
		N.07	1
		N.08	6
		N.09	1
		N.10	1
		N.11	1
		N.12	2
		N.13	1
		N.14	1
		N.15	1
		N.16	1
		N.17	1
		N.18	1
		N.19	1
		N.20	1
		N.21	2
		N.22	1
O	Macehead	O.01	1
		O.02	1
		O.03	1
		O.04	1
P	Ring	P.01	1
		P.02	16
		P.03	1
		P.04	18
Q	Disc, mirror	Q.01	7
		Q.02	1
		Q.03	1
R	Needle, pin	R.01	16
		R.02	34
		R.03	79
		R.04	1
		R.05	1
		R.06	14
		R.07	2
		R.08	8
		R.09	16
		R.10	2
		R.11	5

		R.12 R.13 R.14 R.15 R.16 R.17 R.18 R.19 R.20 R.21 R.22 R.23 R.24 R.25 R.26 R.27	1 1 1 2 1 1 1 5 9 1 7 15 3 2 1 4
S	Special types	S.01 S.02 S.03 S.04 S.05 S.06 S.07 S.08	1 1 1 1 3 2 2 1
T	Unidentified	T.01	6

Table 9: Quantitative representation of all artefact groups

6.2. Individual artefact descriptions and comparisons

6.2.1. Container

This group contains different types of vessels which are all made of bronze metal. The different examples were all produced with Bronze metal sheets by forging as there are no visible traces of casting burrs. In the following all of the different types of Bronze metal containers which were discovered at the Cemeteries of Shahdad will be presented.

6.2.1.1. Group A: Bowl with nozzle (A.01-A.04)

A.01 (cat.no.001):

The bowl is of a round shape similar to the bowl of Type G.11. The base is more of a flat, rounded shape. On the upper outside of the body a straight nozzle is attached at a 45° angle. A compararable artefact is known from Gonur Depe.[648]

A.02 (cat.no.002):
This variant is of carinated shape with a profiled edge, separating the upper and lower part of the body. Parallels in sense of shape can be seen in G.06, G.07 and G.10. The nozzle was attached at a 45-50° angle just on the upper part of the carination. The base is flat-rounded.

A.03 (cat.no.003):
This version is comparable to the shape of cat.no.001. Differences can be seen in the irregular rounded body, the almost straight neck as well as the straight nozzle in a steep 50-55° angle. Formal parallels can also be identified with the above mentioned clay artefact from Gonur Depe.[649]

A.04 (cat.no.004):
The artefact with a carinated shape is comparable to Type G.06, G.07 and G.10. The nozzle is of a bent shape and attached just above the carination.

6.2.1.2. Group B: Cylindrical beaker (B.01-B.02)

B.01 (cat.no.005-007):
This type´s shape is characterized by its tall cylindrical shape and its chiselled horizontal edge which is positioned in the centre.

B.02 (cat.no.008):
A small cylindrical beaker-type with undecorated surfaces.

6.2.1.3. Group C: Spouted bowl (C.01-C.02)

C.01 (cat.no.009-011):
The artefacts cat.no. 009 and 011 seem to be of almost identical shape in the sense of

648 Sarianidi 2006: 191, tabl.60.
649 same.

their narrow elongated spout. The vessel cat.no.010 is different because of a larger spout. Comparable finds were observed in Bactria[650] as well as in Gonur Depe in burial no.1999.[651]

C.02 (cat.no.012-014):
These small vessels are characterized by a small bowl-like shape and an elongated spout. Comparable artefacts are known from Susa[652], Bactria[653] and Gonur Depe in burial no.2900.[654]

6.2.1.4. Group D: Tall beaker (D.01-D.02)

D.01 (cat.no.015-017):
This type D.01 is characterized by its bell shape where the rim diameter is double the size of the flat round base. These artefacts are the only examples of this shape within the Shahdad metal artefacts.

D.02 (cat.no.018):
The characteristics of this type are similar to the above mentioned beakers. The only difference to D.01 are the vertically chiselled segments.

6.2.1.5. Group E: Small beaker (E.01)

E.01 (cat.no.019-020):
A small beakers of similar shape to D.01. The only remarkable difference is the round profiled flat base.

6.2.1.6. Group F: Beaker / Chalice/ Vase (F.01-F.05)

F.01 (cat.no.021):
This beaker type is characterized by a narrow high round base. The body itself is of slightly

650 Pottier 1984: 36, no.243; 167, fig.33.243; 211, pl.XXIX.243; Sarianidi 1986: 193.
651 Sarianidi 2007: 85, fig. 89.
652 Amiet 1978: 154, fig.1 (AO26455); Tallon 1987: 223f., 800 (vases en plomb).
653 Pottier 1984: 36, no.243; 167, fig. 33.243; 211, pl.XXIX.243.
654 Sarianidi 2007: 149, fig.14.

concave shape with a horizontally chiselled band in the lower part of the of vessel. Comparable metal finds are known from Susa[655], as “Metal vessel Type 99” at Ur[656], and at Gonur Depe.[657]

F.02 (cat.no.022-023):
A chalice type of concave shape with a high open mouth and a round flat base. The shape is also common in clay at Bactria.[658] Of particular interest are the almost identical examples in silver, bronze and clay from burial no.1999 at Gonur Depe.[659]

F.03 (cat.no.024):
A vase with a slightly biconcave upper body, a horizontally chiselled band in the lower part and a round flat base. A vessel of similar shape was discovered at Gonur Depe in burial no.555.[660]

F.04 (cat.no.025):
A small beaker with a profiled rim and biconcave upper part. The lower part, which is separated by a chiselled profile horizontal ring, ends in a flat base. An almost identical object is known from the Adam collection.[661]

F.05 (cat.no.026-029):
A type of a beaker of straight to curving convex shape and a short pedestal.

6.2.1.7. Group G: Small bowl (max. height ≤ 15cm) (G.01-G.14)

This group contains 13 variants of similar shape. But the unifiying parameters are that they are of an open shape and an average height smaller than 15 cm. The characteristics of the different subgroups are explained in the following:

G.01 (cat.no.030-035):
The bowl is of small size with a excurving concave rim and a short neck. It is separated by

655 Tallon 1987: 206, 756 (vase à panse droite...variante B1b').
656 Hauptmann & Pernicka 2004: 51.1109, Taj 66.1109. This beaker derives from an ED IIIa dated grave from the Royal Cemetery of Ur (Pokal H, metal vessel type 99, U10452).
657 Sarianidi 2007: 58, 3.13.
658 Pottier 1984: 97, no.249; 169, fig.35.249, pl.XXX.248. Ligabue & Salvatori 1991: 212, 77;
659 Sarianidi 2006: 234f., fig.94. Sarianidi 2007: 84f., fig.85, 88 (type 6.41-47).
660 Sarianidi 2006: 234f., fig.94. Sarianidi 2007: 85, fig.86 (type 21.48).
661 Moorey 1974: 143.127.

a small profiled edge from the almost globular shaped body.

G.02 (cat.no.036):

This bowl is of larger proportions than G.01 but but of comparable shape. The main difference is the edge which is not profiled.

G.03 (cat.no.037):

A variant of a small bowl comparable to G.01. The difference is to be seen in the body shape, which is more globular. Comparable artefacts are known from Susa[662] and further places on the Mesopotamian alluvial plain like Kish[663], Tall al-Ubaid[664] and Ur[665].

G.04 (cat.no.038-048):

The typical shape of this variant is half globular with a round flat base. But there are also some examples with more and less globular bodies. Comparable shapes are known from many Bronze Age sites in Mesopotamia, on the Iranian Central Plateau and in Central Asia. All variants of this group share similarities with forms from Susa[666] and further parallels from sites situated on the Mesopotamian alluvial like Tall Asmar[667], Kish[668], Tall al-Ubaid[669] and Ur.[670] There is also a comparable item known from Khinaman[671] with which almost identical to cat.no.48.   A Central Asian example dated to LBA Ia context was found at Sapalli Depe in Southern Uzbeskistan.[672] All comparisons mentioned here derive from Early Dynastic II to Neo-Sumerian contexts according to Mesopotamian chronology.

G.05 (cat.no.049-055):

The examples of this variant are of globular shaped body with a slightly narrower rim. A similar shaped comparable artefact is known from Susa.[673]

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662 Tallon 1987: 221f. 788-789 (vase carénés...form fermé...variante G1a).
663 Mackay 1929: pl.LVII:1
664 Hall & Wolley 1927: pl.XLVIII
665 Woolley 1934: pl.237.74
666 Tallon 1987: 199f., 704-706, 708 (vase à panse convexe...form fermé...variante A1b).. The parallels are seen due to the height and body shape, but the bases of the Susian examples are not flat.
667 Hauptmann & Pernicka 2004: 5.56-59, Taf.6.56-59.
668 Ibid.: 23.459.461, Taf.30.459.461.
669 Ibid.: 30.859, Taf.50.859.
670 Ibid.: 44.945-46.1000, Taf.55.945-58.1000. “Metal Vessel Type 4“ according to Woolley 1934.
671 Curtis 1988: 112, fig.5.10, pl.IIIa.
672 Kaniuth 2006: 83.48, Sap.081, HMT253-075; 84.56, Sap.054, HMT 253-076.
673 Tallon 1987: 216, 783 (vase à panse convexe...form fermé...variante E3b). The main difference is to be seen in the attached long spout which is missing in all examples of G.05.

G.06 (cat.no.056-078):

The characteristics of this variant are to be seen in the carinated shape and the round flat base. Almost identical shapes are known from Susa[674] as well as from Ur, Tall al-Ubaid and Kish.[675]

G.07 (cat.no.079-082):

This variant can be described as a small open bowl with a straight to globular body and a flat base. Cat. no.079 to 081 share common features according to the given characteristics which can be compared with similar examples from Susa[676], Khafaji and Ashur[677]. Cat.no.081 and 082 also share similarities with finds from Khinaman.[678] But cat.no.082 is showing parallels to an item from Susa[679] and to another bowl from Ur[680] as well as to an almost identical bowl from Burial 2900 from Gonur Depe.[681]

G.08 (cat.no.083-092):

All items which were summarized in G.08 are characterized by their carinated shape and their almost flat rounded base. Examples with almost identical shape which were discovered at Susa for example in the hoard of the "vase à la cachette".[682]

G.09 (cat.no.093-100):

The vessels of this group are of identical shape with the ones from G.06 and therefore can be compared to "variante G1 a/a'" from Susa.[683] The distinguishing mark is the different height and weight.

G.10 (cat no.101-107)[684]:

The characteristics of these items are the open mouth, the slightly carinated body and the flatened base. They are comparable with vessels from Susa[685] and therefore also similar to

674 Tallon 1987: 221f., 790 (vase carénés...form fermé...variante G1a'); Benoit 2003: 252f.
675 Hauptmann & Pernicka 2004: 24.466, Taf.30.466.
676 Tallon 1987: 199f., 700, 703, 705 (vase panse convexe...form fermé...variante A1b).
677 Cat.no. 079 and 081 share similarities with artefacts from Khafaji and Ashur (Hauptmann & Pernicka 2004: 19.348 (Kh.IX184), 23.348; ibid.: 7.81-82, Taf.7.81-82).
678 Cat.no.081 is comparable to the vessel from Curtis 1988: 112f., fig.5.10. Cat.no. 082 shares common features with Curtis 1988: 112f., fig.5.12.
679 Tallon 1987: 201, 723 (vase...form fermé...variante A2b')..
680 Hauptmann & Pernicka 2004: 46.1004, Taf.58.1004.
681 Sarianidi 2007: 149.15.
682 Tallon 1987: 222f., 795-798 (vase carénés...form fermé...sous variante G1b'); Benoit 2003: 252f.
683 Ibid.: 221f., 790 (vase carénés...form fermé...variante G1a').
684 The object cat. no. 107 is not reproduced photographically in the catalogue due to its bad state of preservation.
685 Ibid.: 221f. 788-789 (vase carénés...form fermé...variante G1a).

G.06 and G.09. Further comparable shapes are known from Lagash[686] and Ur.[687]

G.11 (cat.no.108):

This variant represents a single find at Shahdad so far. It is characterized by the small bowl-like shape and its elongated narrow spout. The nearest located comparable find derives from Khinaman.[688] Other parallels were identified from the Bronze Age Sites of Kurada in Gujarat, India[689] and in Bactria.[690] But there are further known comparisons in sense of formal characteristics from Susa[691], Bazigr[692] and Tappeh Hesar[693] with the only differences to be seen in the dimensions.

G.12 (cat.no.109):

Cat.no.109 is a small open bowl with a flat base that shows similarities to items from Khinaman.[694] There are other comparable finds but without precise knowledge about their provenance. The are described to be of the Bactrian style.[695]

6.2.1.8. Group H: Plate (undecorated) (H.01-H.03)

This group consists of 5 undecorated bronze plates from Shahdad. These are for the moment the only examples of this shape. Further there are no comparable finds known from other sites.

H.01 (cat.no.110-112):

This plate with a convex shaped body is known from three items which were discovered at the cemetery of Shahdad.

H.02 (cat.no.113):

In contrast to the examples from H.01 there is a narrow horizontal band in a central position

686 Hauptmann & Pernicka 2004: 17.328, Taf.21.328.
687 Ibid.: 51.1119-1129, Taf.67.1119-1120.
688 Curtis 1988: 116, fig.6.20.
689 Yule 1985: 208, pl.9.
690 Sarianidi 1986: 172.
691 Tallon 1987: , 780-783 (vase...forme fermé...variante E 3 b); Benoit 2003: 252f. (vase à la cachette).
692 Nokandeh et al. 2006: 125, fig.8.
693 Schmidt 1937: pl LVII, H 4883; Yule 1982: 25, Abb.17.1, 4.
694 Curtis 1988: 113, fig.5.11.
695 Ligabue & Rossi-Osmida 2007: 220.

on the outer surface of the plate. It seems that this feature was chiselled into the bronze metal sheet.

H.03 (cat.no.114):
This piece is of a very unique shape. It is composed of an opened rim-shape, and a flat base. In a central position on the inside of the plate the is a rounded chiselled knob.

6.2.1.9. Group I: Plate (decorated) (I.01-I.03)

Large plates with chiselled naturalistic zoomorphic depictions are compiled in Group I. They are all of an open shape with an average diameter of 30 cm and decorative attributes in a central position. All the plates are of an identical style but with different chiselled motives which are well-known from different areas between Central Asia and Southeastern Iran.[696] One of the first examples was found at Tappeh Hesar[697] with a representation of a feline placed next to the body of a hunted bovide. Other comparable artefacts were discovered during illegal excavations in the Jiroft area, presumably at the cemetery of Mahtoutabad. One had a filigree full body depiction of an eagle[698] and the other a feline motive which also shows close similarities to the example from Tappeh Hesar.[699] Recent fieldwork at the site of Deh Dumen in Kuhgilouyeh va Buyerahmad Province in Southwest Iran also revealed a similar object.[700]

Figure 102: Decorated plates from the Jiroft area (by the courtesy of F. Desset and the Harandi Museum Kerman).

696 Hakemi 2000.
697 Schmidt 1937: 190f., fig.112, H2252; Yule 1982: 19, Abb.11.8
698 Madjidzadeh 2003: 156;
699 Both plates are kept in the gallery of the Harandi Museum in Kerman (Iran).
700 Pers. comm. by R. Naseri (University of Zabol).

I.01: (cat.no.115)

This plate is characterized by its full body depiction of a serpent in a coiled position with the head resting on the body.

I.02: (cat.no.116)

The distinguishing mark of this plate is the circular pattern with a ring motive in a central position and two rows of different sized fish that are oriented in opposite directions around it.[701]

I.03: (cat.no.117-118)

This variant is characterized by the depiction of two bovides, presumably gazelles, which are symmetrically placed opposite each other.[702]

6.2.1.10. Group K: Small plate (undecorated) (K.01)

K.01: (cat.no.119-123)

This collection of small plates is composed of five examples with an average diameter of 15 cm. Some of them bear traces of a chain-link pattern running around the thin hammered lip.

6.2.1.11. Group L: Large bowl (max.height ≥ 15cm) (L.01-L.06)

L.01: (cat.no.124-130)

This variant of large bowls is characterized be the globular shape of the body and the wide open mouth with a single lip oriented to the outside.

L.02: (cat.no.131)

Cat. no. 131 is characterized by its round flat base, the carinated shape of the body and an outer oriented rim.

701 A second variant of this type with a depiction of a crustacean is only known from Hakemi 1997: 645, Gs.4 . Unfortunately the item was available for examination in 2006.

702 During the work at the depot of the National Museum of Iran in Tehran two almost identical copies of this variant were documented while in Hakemi 1972 and Hakemi 1997 just one of the copies (298-50) is presented. The second example (750-55) is briefly mentioned in Hakemi 2000: 950.

L.03: (cat.no.132)
This example´s distinguishing marks are the flat round base, the straight, slightly inverted body and the elaborate rounded rim.

L.04: (cat.no.133)
Large bowl of hemispherical shape with an open mouth and a profiled round rim.

L.05: (cat.no.134)
The characteristics of this variant are the open mouth with the globular body and the neck which is separated from the body by an applied horizontal narrow ring decoration.

L.06: (cat.no.135)
This bowl is composed of an open thickened rim, a short neck which is separated from the body by a rounded carination. The body is of a convex inverted shape and ends in a flat round base.

6.2.2. Tools:

6.2.2.1. Group M: Axe (M.01-M.07)

M.01: (cat.no.136-140)
Adze-shaped tools are compiled under the variant M.01. They all show similarities in the sense of a tool with a horizontal blade and a vertical shaft. Comparable metal artefacts are known from the “Vase à la cachette”-hoard from Susa[703], different sites in Bactria[704] as well as from Mesopotamian sites like Abu Salabih[705] and Ur.[706]

M.02: (cat.no.141)
This single find, which shows all the characteristics of a mattock, a double-headed axe with a vertical and horizontal blade, is of particular interest as there are numerous comparable finds which are distributed over a wide area from Central Asia to the Indus

703 Tallon 1987: 174ff., 532-548 (herminettes...sous-type B1 & B2); Benoit 2003: 252f., fig.109.
704 Pottier 1984: 93, no.88, 89; 195, pl.XIII.88, 89; Casal 1961: fig.139.9.
705 Hauptmann & Pernicka 2004: 2.22, Taf.2.22 (AbS 2694).
706 Ibid.: 59.1330-41, Taf.88.1330-41.

valley. The most prominent sites to mention are Daina[707] and other Bactrian sites[708] as well as Torang Tappeh[709], Bazgir[710], Tappeh Hesar[711] and the example from the "Sumerian treausure" of Astarabad[712] in Northern Iran. There is also a prominent appearance of identical examples in Naosharo-IV dated layers from Sibri[713] in the Kachi plain and Mohenjo Daro[714] in the Indus valley. There are also miniature mattocks of comparable shape known from Tappeh Hesar phase IIIB and IIIC burials[715] and Dzarkutan and Sapalli Depe[716].

M.03: (cat.no.142-150)

In this group axeheads are compiled with elongated shafts and curved cutting edges. These examples share distinctive similarities with finds from Susa[717], Espidej[718], Chegerdak[719], Mundigak[720], Chanhu Daro[721], Surkotada[722], Ur[723].

M.04: (cat.no.151)

This type is of an identical shape to M.03. It was separated from this previous group because of the full body depiction of a feline which is placed in seated position on the neck of the object. A comparable piece derives from a grave in Khurab.[724] Similar artefacts are known from the area between Southeastern Iran and Central Asia. Unfortunately the majority of these finds derive from unverified archaeological contexts.[725]

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707 Masson 1988: 121, fig.30f; Sarianidi 1998: 60, fig.25.10.
708 Pottier 1984: 149, fig.15.85; 225, pl.XII.86-87; Sarianidi 1986: 212f.
709 Deshayes 1963: pl.24.4.
710 Nokandeh et al. 2006: 123, pl.7, 129, pl.22; these artefacts are of identical shape but of larger dimensions.
711 Schmidt 1937: 173, fig.97 (plan of Hoard I); 205, fig.120, pl.LII.H.2710, H3247; Yule 1982: 20, Abb.12.1: 24, Abb.16.1-2. These examples were documented in Hissar IIIB and IIIC contexts.
712 Rostovtzeff 1920: pl.III.13.
713 Santoni 1984: 53, fig.8.1.E; Jarrige et al. 1995: 326, 361, fig.7.32b.
714 Mackay 1938: 457, pls. CXX.27, CXII.12.
715 Schmidt 1937: pl.LII.H2869, H2793.
716 Kaniuth 2006: 147.476-479 (Variante M-3-1).
717 Tallon 1987: 95, 72 (haches á collet...variante G4a). Cat no. 152 shows similarities to no.79 and 82, cat.no.153 to no.76 and cat.no.154 to no.81, 82 and 88.
718 Pers. Comment by M. Heydari in 2006.
719 Pers. comment by M. Heydari in 2006.
720 Casal 1961: fig.139.10/a.
721 Mackay 1943: pl.LXXII.25.
722 Joshi 1990: 268, fig.68.3.
723 Woolley 1934: pl.223, U 15314.
724 Lamberg-Karlovsky 1969: pl.Ia,b; IIa,b; Instead of a feline this examples shows the naturalistic depiction of a camelid.
725 Pottier 1984: 92, no.81, 147, fig.13.81, 193, pl.XI.81; Ligabue & Salvatori 1985: 181, fig.103, fig.96; Ligabue & Rossi-Osmida 2007: 228; Stutzinger 2001: 54f., no.34.

M.05: (cat.no.152-154)

This type is characterized by the fact that it is made from a single bronze metal sheet with a small cutting edge on one side and a bent part which seems like a horizontal shaft on the opposite side. Due to their shape it is more appropriate to name these items as “adzes” instead of “axes”. Artefacts of similar characteristics are known from Susa[726] as well as from Ur, Fara and other Mesopotamian sites. Cat.no. 153 also shares similarities to a tool from Tall as-Sulaima.[727]

M.06: (cat.no.155-158)

In this group examples of the so called “Bactrian axes” are compiled. Their characteristics are as following: the decorated cutting edge with blades in different stages of shapes, the shaft-hole in a central position with an almond shaped eye decoration on the outside as well as the more or less wing-shaped end. Cat.no.155 to 157 are of particular interest because of their incised decoration of geometric and zoomorphic patterns. The geographically closest finds of almost identical shape derive from Khinaman[728]. Another almost identical example was discovered in Cenotaph 41 in the Southern Settlement of Gonur Depe.[729] Further examples of unknown provenance are kept in private collections[730] or museums[731] and are sometimes still sold on the antiquity market as examples which are supposed to have been found in Lorestan.[732] Due to their elaborate shape and decoration it seems rather more likely that these artefacts were used for representative actions as status symbols like sceptres or “ceremonial axes” and not as tools.

M.07: (cat.no.159)

This artefact is composed by a long cylindrical shaft an a narrow blade which ends with a vertical cutting edge. Due to its well made character it is also rather to be seen as a status symbol or maybe as a weapon. Comparable finds are known from Susa[733], Tappeh Mousiyan[734], Lorestan[735] and Ur.

726 Tallon 1987: 99, 76-90 (haches à languette repliée...sous type A1).
727 Hauptmann & Pernicka 2004: 36.762, Taf. 45.762.
728 Sykes 1902: 167 (right); Greenwell 1907: pl.XXI, fig. 3; Curtis 1988: 102, pl.Ia,b.
729 Hiebert 1994: 162f., fig.9.26.6.
730 Pottier 1984: 92, no. 71; 146, fig.12.71; 192, pl.X.71; Mahboubian 1997: 54f., no.114-15;
731 Ligabue & Salvatori 1985: 164, fig.101; Amiet 1986: 164, 196-197, 515, no.167; Sarianidi 2002: 102-107; Ligabue & Rossi-Osmida 2007.
732 Godard 1931: pl.XXIV.70. http://www.oriental-arms.com/item.php?id=2061; http://www.itemview.com/item_pages/images/full_size/36460.jpg
733 Tallon 1987: 71ff., 12-16,18-19 (haches à collet...sous type A1).
734 Godard 1931: pl.XIV.43.
735 Haerinck & Overlaet 2006: pl.13. A2-2, 8, 9, pl.14.A3-2; Godard 1931: pl.XIV.44, pl.XV.45.46;

6.2.2.2. Group N: Blade/ Adze/ Point (N.01-N.22)

N.01: (cat.no.160)

This artefact is a pointed blade with sharp profiled edges and a short hidden tang. Comparable finds are known from Altyn Depe[736], Anau[737], Adji Kui[738] and further places in Bactria[739], Susa[740] and other Mesopotamian sites like Ashur[741] and Ur[742] as well as from Mohenjo Daro[743] and Chanhu Daro.[744]

N.02: (cat.no.161-162)

This type is similar to the previous one. The differences are the blade with the rounded edges and the nail like hidden tang. Similar blades were observed in a large area whose most prominent sites are Susa[745], Ur[746], Adji Kui[747] and Shortughai[748] as well as other unknown places of Bactrian provenance[749] along with Chanhu Daro[750] and Mohenjo Daro.[751]

N.03: (cat.no.163)

The characteristics of this artefact is similar to N.01. The distinguishing mark is the full tang. Comparable finds have been documented at Susa[752], Bactria[753] and the Indus valley.[754]

N.04: (cat.no.164-169)

These artefacts show comparable characteristics to N.02. The distinguishing mark is the

736 Masson 1988: Pl.XIV.2 (Namazgah IV?); Pl.XXIX.1 (Namazgah V).
737 Pumpelly 1908: pl.38.1.
738 Rossi-Osmida 2011: 212.
739 Pottier 1984: 91, no. 15; 137, fig.3.15; 185, pl.III.15.
740 Tallon 1987: 122., 138,139 (poignard...lame triangulaire...variante A4a).
741 Hauptmann & Pernicka 2004: 8.119,Taf.10.119 (Ass.16317).
742 Ibid.: 63.1457, Taf.97.1457 (U.17956).
743 Mackay 1938: pl.CXIII.7, pl.CXXIX.1.
744 Mackay 1943: pl.LXIV.3.
745 Tallon 1987: 123, 146 (poignard...lame triangulaire...variante A4c).
746 Hauptmann & Pernicka 2004: 63f..1459-60, 1471-72, Taf.97f..1459-60, 1471-72 (U.9715, U.9097, U.8066, U. 19149, “dagger type 7“).
747 Rossi-Osmida 2011: 212.
748 Francfort 1989: Pl.78.2, pl.XXXIX.2 (SHBB 78, niv.2r).
749 Pottier 1984: 91.no.14; 185, pl.III.14.
750 Mackay 1943: LXIV.2
751 Mackay 1938: pl.CXIII.7, pl.CXXIX.1.
752 Tallon 1987: 116f., 106, 110, 117 (poignard...lame plate...sous type A1); Benoit 2003: 252f. (vase à la cachette).
753 Pottier 1984: 91, no.81; 137, fig.3.18; 185, pl.III.18.
754 Mackay 1938: pl.CXXIX.4; Mackay 1943: LXII.17, LXIV.4. there are formal parallels by the blades.

full tang. Comparable finds have been documented at Susa[755], Ur[756] and Tappeh Yahya.[757]

N.05: (cat.no.170)

A pointed small blade with rounded edges and a full tang. Similar shapes are known from Susa[758], Hait Qasim I[759] and Togolok 1.[760]

N.06: (cat.no.171)

This exceptional artefact is so far the only documented example from archaeological excavation. Its shape is characterized by its quadrangular head and the round, slightly narrower flat plain. Due to its large size it is described as a tool for metal lworks as a punch or a tapering bar.

N.07: (cat.no.172)

A small blade of elaborate shape. The blade is sickle-shaped and is ending in a knob like handle. Due to its unique fine appearance it might be seen as a razor blade. Similar blades were also recorded at Susa but without the profiled handle.[761]

N.08: (cat.no.173-178)

The artefacts of this group are desiganted as adzes due to their trapeziodal shape with a cutting edge of a larger size. Archaeological comparisons are known from a broad area at the mayor sites such as Susa[762], Espidej[763], Chegerdak[764], Jemdet Nasr[765], Kish[766], Lagash[767], Ur[768], Bactria[769] and different sites in the Indus valley.[770]

755 Tallon 1987: 116f., 108, 118 (poignard...lame plate...sous type A1).
756 Hauptmann & Pernicka 2004: 64.1471, Taf.98.1471-72 (U.8066, U.19149).
757 This item is kept in the National Museum of Iran in Tehran with the Museum inventory no. 2183.
758 Tallon 1987: 114, 118, 138-139 (poignard...lame plate...sous type A1...variante A4a)
759 Hauptmann & Pernicka 2004: 20.393, Taf. 25.393.
760 Hiebert 1994: 162, fig.9.26.3 (b. 10).
761 Tallon 1987: 595, 605-609 (couteaux... type B/ faucille et serpette... sous type A2).
762 Ibid.: 161f., 432-438 (Hache à talon trapezoidal); Benoit 2003: 252f. (Vase à la cachette).
763 Pers. Comment by M. Heydari in 2006.
764 Pers. Comment by M.Heydari in 2006.
765 Hauptmann & Pernicka 2004: 15.290, Taf.19.290.
766 Ibid.: 25.496, Taf.32.496
767 Ibid.: 39.843, Taf.49.843; 93.2305, Taf.142.2305.
768 Ibid.: 59.1321-22, Taf.86.1321-22.
769 Pottier 1984: 93, no.93-94; 250, fig.16.93/94; 196, pl.XIV.93
770 Mackay 1938: pl.CXIII.4-5, pl.CXXII.7-9,13; Mackay 1943: pl.LXII.20.21.23; pl. LXXI.9-11.

N.09: (cat.no.179)

A leaf-shaped blade with a hidden tang. Similar blades are known from Susa[771], Ur[772], Chanhu Daro[773] and Mohenjo Daro.[774]

N.10: (cat.no.180)

A pointed blade with profiled edges and a hidden tang. Comparable finds were observed at Susa[775], Altyn Depe[776], Togolok 21[777], Chanhu Daro[778] and Mohenjo Daro[779].

N.11: (cat.no.181)

This blade is characterized by the rounded edges and the hidden tang. Almost identical comparisons are known from Ur[780], Hait Qasim I[781] Susa[782] and Togolok 1.[783]

N.12: (cat.no.182-183)

A small blade of a leaf-like shape with a hidden tang. Similar shapes are known from Susa[784] and Khinaman.[785]

N.13: (cat.no.184)

From the first impression this item seems more like an adze than a tanged blade. Comparisons are abundant at Susa.[786]

N.14: (cat.no.185)

This small blade with rounded edges is pointed with a hidden tang. Parallels are known from the Indus valley[787], Susa[788] and Kish.[789]

771 Tallon 1987: 139f., 198, 200 (point de lance... variante A1a/b).
772 Hauptmann & Pernicka 2004: 67.1556, Taf.104.1556 (spear type 5a)
773 Mackay 1943: LXVII.20, pl.LXXVI.1.
774 Mackay 1938: pl.CXXIX.1.
775 Tallon 1987: 147f., 272-275 (point de flèche...sous type A2).
776 Masson 1988: pl.XIV.1 (Namazgah V).
777 Hiebert 1994: 162, 9.26.1 (b. 52).
778 Mackay 1943: pl.LXVIII.15.
779 Mackay 1938: pl.CXXIII.8, pl.CXXXIII.34.
780 Hauptmann & Pernicka 2004: 67.1560, Taf.104.1560.
781 Ibid.: 20.391, Taf.25.391.
782 Tallon 1987:147, 222, 224 (point de flèche...sous type A1).
783 Hiebert 1994: 126, fig.9.26.3 (b. 10).
784 Tallon 1987: 147, 218-222 (point de flèche...sous type A1).
785 Curtis 1988: 196f. Fig.3.4, pl.IIa.
786 Tallon 1987: 439-444 (hache...talon droit...).
787 Mackay 1938: pl.CXXVII.3, pl.CXXIX.4-5; Mackay 1943: pl.LXXII.3, pl.LXII.17.
788 Tallon 1987: 147f., 220-223.(point de flèche...variante A1a/b).
789 Hauptmann & Pernicka 2004: 26.534, Taf.34.534.

N.15: (cat.no.186)

This item is characterized by its leaf shaped blade and solid handle. Comparable shapes were found at Susa.[790]

N.16: (cat.no.187)

The distiguishing marks of this type are the hidden tang and the irregular shaped blade. Exact comparison are not known besides one irregular blade with a missing point from Susa.[791]

N.17: (cat.no.188)

This item´s characteristics are the full tang handle, the rounded edges and the curved blade. Artefacts of similar shape were discovered at prominent sites like Susa[792] but also in the Indus valley at Mohenjo Daro[793], Surkotada[794] and Chanhu Daro.[795] Comparable finds also derive from Bactria.[796]

N.18: (cat.no.189)

This example is distinguished by its full tanged handle and the broad blade with rounded edges. There are similarities to other specific types of blade in this group but the direct comparison will verify the separate categorisation. Comparable finds were discovered at Susa[797], Mohenjo Daro[798] and Chanhu Daro.[799]

N.19: (cat.no.190)

Unfortunately the upper part of this point is missing. But there are still some visible remains of the actual shape which show similarities to finds from Susa[800] and Bactria.[801]

N.20: (cat.no.191)

This single find's characteristics are the long hidden tang and the rounded point. Artefacts

790 Tallon 1987: 147, 220-221 (point de flèche...sous type A1).
791 Ibid.: 188, 649 (Lame losangique...lame à sois courte).
792 Tallon 1987: 116f., 115 (poignard...lame plate...sous type A1).
793 Mackay 1938: pl. CXXVII.4, pl.CXXIX.8, pl. CXXXIII.28.
794 Joshi 1990: 268, fig.89.11.
795 Mackay 1943: pl.LXIV.5; pl.LXXIV.17.
796 Pottier 1984: 91, no.22; 138, fig.4.22; 185, pl.III.22.
797 Tallon 1987: 116f, 115-118 (poignard...lame plate...sous type A1).
798 Mackay 1938: pl.CXXIII.5.
799 Mackay 1943: pl.LXXV.9.
800 Tallon 1987: 147, 222-224 (point de flèche...sous type A1).
801 Pottier 1984: 91, no.3; 135, fig.1.3.

of a similar shape were discovered at Susa.[802]

N.21: (cat.no.192-193)
Cat. no. 192 and 193 are tanged leaf-shaped blades. The blade is a regular oval shape. Comparisons were found at Susa.[803]

N.22: (cat.no.194)
This tool consists of a long blade and long narrow tang. One of the edges shows all the properties of a saw. Comparable finds are documented at Ur[804] and Susa.[805]

Group O: Maceheads (O.01-O.04)

The group of maceheads contains four items. Three of this group (cat.no.195-197) are made of lead. They are plain on the surface without any decoration. Cat.no.196 is the only item that shares similarities with finds from Bactria.[806] The last item of this group cat.no.198 is made of a copper alloy and shows various decorations on the outside. The body is of cylindrical shape which shows different motives which are oriented in three horizontal segments. This example is of a unique character with no comparison.

6.2.2.3. Group P: Ring (P.01-P.04)

P.01: (cat.no.199)
This item is described as a narrow bronze metal rod which was bent to an almost circular shape. A similar shape is known from Susa.[807]

P.02: (cat.no.200-215)
The artefacts of this group are small bronze metal rings with an average diameter of 1.5cm. Due to its minor size it seems that thee artefacts are rather to be seen as jewellery such as earrings or other decorative pendants. Similar shapes so far are only known from

802 Tallon 1987: 185, 624, 629 (Scies...sous-type A2).
803 Ibid.: 139f., 198-199 (point de lance... variante A1a).
804 Hauptmann & Pernicka: 70.1654, Taf.109.1654 (U.2592).
805 Tallon 1987: 185, 623 (scies...sous-type A2).
806 Pottier 1984: 92, no.40,; 142, fig.8.40; 188, pl.VI.40.
807 Tallon 1987: 252f., 1078-1079 (bracelet...A3).

the Southern settlement of Gonur Depe[808]

P.03: (cat.no.216)

This piece is characterized by its spiral shaped body. It is made of a long narrow copper rod which was bent several times to create a spring-like appearance. A comparable find was documented at Gonur Depe[809]

P.04: (cat.no.217-234)

This type´s distinguishing marks are the bent shape of the thick Bronze metal rod with an average thickness of 0.5cm and a diameter of 7cm. The distribution of this shape is observed in a wide area which covers Central Asia, the Iranian Central Plateau to the Mesopotamian Alluvial. The most prominent find sites in this area are Tappeh Hesar[810], Sapalli Depe[811], Dzarkutan[812], Togolok[813], Khinaman[814], Susa[815], Ur[816], Lagash[817], Ashur.[818] These finds are dated to the period from EBA to LBA and can be identified as bangles.

6.2.2.4. Group Q: Disc / Mirror (Q.01-Q.03)

Q.01: (cat.no.235-241)

This type is characterized as circular flat metal discs with a thickness between 0.1-0.2cm. The diameters are ranging from 6 to 9 cm. Similar objects are also known over a wide area with prominent sites such as Susa[819], Shahr sukhteh[820], Tappeh Hesar[821], Altyn Depe[822],

808 Hiebert 1994: 162, fig.9.26.13; Sarianidi 2007: 95, 123.
809 Sarianidi 2007: 95, 126-128.
810 Schmidt 1937: pl.LV.H3564.
811 Kaniuth 2006: 132f., 300-305.
812 Ibid.: 133, 306.
813 Hiebert 1994: 162, fig.9.26.16-17.
814 Curtis 1988: 110f., fig.4.9, pl.IIb.
815 Tallon 1987: 253f., 1089-1090 (bracelet sous-type A2).
816 Hauptmann & Pernicka 2004: 80.1995.1998, Taf.123.1995.1998 (U.8964, U.9641).
817 Ibid.: 18.340, Taf.22.340.
818 Ibid.: 8.141, Taf.12.141 (Ass.20504).
819 Tallon 1987: 1230-1231 (miroirs de type A).
820 Sajjadi 2007: 315, fig.58.3 (b.1605-14, b.1400.58); Piperno & Salvatori 2007: 152, fig.113 (G111/1 Inv.no.6584), 254, fig.581 (G712/41 Inv.no.7641), 271, fig.627 (G725 Sup./3 Inv.no.8015), 349f., fig.834 (G1102/9 Inv.no.8210).
821 Schmidt 1937: pl.LIV.H3192.
822 Masson 1988: pl.XXXVIII.3 (burial 845).

Gonur Depe[823], Adji Kui 9[824], Shortughai[825], Dzarkutan[826], different sites in the Vachsh valley[827], Mundigak[828] and Chanhu Daro.[829]

Q.02: (cat.no.242)

Artefacts of a similar shape are interpreted as mirrors according to their composition of a circular flat disc with an elongated handle. Comparable finds are known from the “ vase à la cachette”-hoard from Susa[830], Tappeh Hesar[831], Vachsh-valley[832] , Bactria[833], Mundigak[834], Gonur Depe[835], Adji Kui 9[836], Dzarkutan[837] and Mohenjo Daro[838] and Lothal[839]. Some of these exmaples show higher degrees of elaboration than others.

Q.03: (cat.no.243)

This type is similar to Q.01. The main difference seen is due to the minor diameter of 2.6 cm in comparison to Q.01. It is more likely that this piece would have been a jewellery pendant.

6.2.2.5. Group R: Needle / Pin (R.01-R.27)

R.01: (cat.no.244-259)

This first group of pins is characterized by the horizontal flat disc head with a conical to biconical shaped part right underneath with another pattern of parallel rings following in continuation. Some objects of comparable shape are known from Susa.[840]

823 Hiebert 1994: 162, fig.9.26.18.
824 Rossi-Osmida 2011: 224.f.
825 Francfort 1986: 148, pl.78.1 (SHAC 79,31), pl.LX.
826 Kaniuth 2006: 73.15-20 (Variante A-2-2). Comparable artefacts with enthickened erected rims are also known from this site. Kaniuth 2006: 70ff. (Variante A-2-1).
827 P´jankova 1986: 51,Abb.73.10-11.
828 Casal 1961: fig.139.17.
829 Mackay 1943: pl.LXXIV.5,
830 Tallon 1987: 291, 1240-1246 (miroirs du sous-type B2); Benoit 2003: 252f., fig.109.
831 Schmidt 1937: pl.LIV.H4872; Yule 1982: 25, Abb.17.19.
832 P´jankova 1986: 51, Abb.73.12.
833 Pottier 1984: 98, no.265; 172, fig.38.265; Sarianidi 2008: 281, 165.
834 Casal 1961: fig.140.21.
835 Sarianidi 2007: 87, 93-94.
836 Rossi-Osmida 2011: 225.
837 Kaniuth 2006: 66ff. (Variante A-1-1 to VarianteA-1-3)
838 Mackay 1938: pl.CXIV.1; pl.CXXX.25; pl.CXXXII.24.
839 Rao 1985: pl.CCXLVI.A.
840 Tallon 1987: 237, 954 (épingle à tête fondue...variante E1b).

R.02: (cat.no.260-293)

The distinguishing mark of this type is the tripartite head with a vertical inverted cone-shaped top which is sitting upon another horizontal cone just above the pattern of parallel rings. Objects with comparable marks are so far unknown outside of Shahdad.

R.03: (cat.no.294-382)

With a total amount of 88 examples this is the largest group of needle/pins that was discovered at Shahdad. It is also characterized by its tripartite head which is composed of a horizontal flat disc head which sits upon a vertical inverted cone. Just in continuation another horizontal disc is following also sitting on a horizontal cone. The head decoration is finished by a pattern of horizontal rings. This type is also of a very distinct shape of which distribution is limited to close surrounding area. Some identical finds of uncertain provenance are kept in the collections of the Museum Harandi in Kerman and the Archaeological museum Jiroft which presumably derive from a wider area around Jiroft.[841] Another singular example is known from burial B.64 of Pit X in the Royal cemetary at Ur in Mesopotamia.[842] This is so far the only well known stratified published example of this type which was documented outside of Shahdad and within the whole of Iran and dates to the Akkadian/ Neosumerian period.[843]

Figure 103: Identical objects to R.03 from the collection of the Museum Harandi, presumably deriving from Jiroft (a to c), and from the Royal cemetery of Ur (d) (a to c: by courtesy of F. Yavari, d: from Hauptmann & Pernicka 2004: Tf.120.1864).

841 Madjidzadeh 2003: 155.
842 Hauptmann & Pernicka 2004: 76, 1864, Tf. 120.1864.
843 Woolley 1955: 77ff., 131 (B.64), pl. 29 (U 19190).

R.04: (cat.no.383)

Needles with mushroom shaped heads are distributed over a large area during the whole Bronze age. There are some parallels recognizable to Late Bronze Age examples from the Middle-European urnfield culture. But due to the great geographical and historical divide these finds are not further referenced. Other parallels were identified with examples from the Early Bronze Age layers from Gözlü Kule[844] in Cilicia. Geographically the nearest contemporary finds were discovered at Tappeh Hesar[845], Gonur Depe[846] and Dzarkutan[847] and presumably at other sites of the BMAC.[848] There are also comparisons deriving from burials in Western Iran at Tappeh Giyan, Tappeh Djamshidi, Bad Hora[849], several other places in Lorestan[850] as well as at Tappeh Ghabristan[851] and Tappeh Sialk.[852]

R.05: (cat.no.384)

This specimen has a decoration of horizontally oriented parallel rings directly on the tapered head.

R.06: (cat.no.385-398)

The head of this type is characterized by two ovale to globular-shaped segments which are separated by a horizontally oriented pattern of parallel rings from the plain straight needle shaft.

R.07: (cat.no.399-400)

The feature of this type is the single globular-shaped head with the horizontally oriented parallel ring pattern. Similar objects are known from Tappeh Giyan.[853]

R.08: (cat.no.401-408)

Thiy type´s characteristics are the single globular-shaped head without the horizontally oriented parallel ring pattern and a plain shaft. Comparable finds are known from Tappeh

844 Goldman 1956: pl. 429.114; pl. 430.164, 167, 169, 173. Müller-Karpe 1974: Taf. 290.1-3 (Bd.III).
845 Schmidt 1937: pl.XVI.H4495, pl.XXIX.H2876; Yule 1982: 18, Abb.10.5 (below).
846 Sarianidi 2007: 90, 109 (b.2029).
847 Kaniuth 2006: 117, 197-199.
848 Pittman 1984: 48, 19a.
849 Contenau & Ghirshman 1935: pl.74, tombe 3.13; pl. 77, tombe 9.3, pl.82, tombe 2.12; Müller-Karpe 1974: Taf. 695, M3 (Bd.III).
850 Moorey 1971: pl.43. 243, 247.
851 Madjidzadeh 2008b: 128, fig.67.13.
852 Ghirshman 1938: 141, pl.LXXXIV.S168.
853 Contenau & Ghirshman 1935, pl.10, tombe 12.3; pl.12, tombe 20.6; pl.18, tombe 53.4.

Giyan.[854] Another example was discovered in Bard-i Bal but in an Iron Age related context.[855]

R.09: (cat.no.409-424)

This specimen can be simply named as the “snakehead”-type. Its shape is composed of two components: 1) the vertically flat head which reminds of an inflated hood of a cobra and 2) a small protruding curved element which is attached on top of the head. This is also somehow calling a snake´s curved features to mind.

R.10: (cat.no.425-426)

According to similarities to anthropomorphic stone idols from Tappeh Hesar[856] this is the so called “anthropomorphic”-type. The head is vertically flattened and of an irregular parallel shape. A parallel form is known from Mir Vali in Lorestan.[857]

R.11: (cat.no.427-431)

The distinguishing mark of this type is the head with vertically parallel oriented wings which also create a cruciform cross-section. According to Hakemi´s final report this type is represented as Pa.5 and Pa.6 at Shahdad.[858] Almost identical objects were observed at Susa[859] and Gonur Depe.[860] Further examples are described to be of Bactrian provenance.[861] There are also shapes which were discovered at Chanhu Daro[862] which also remind of R.11.

R.12: (cat.no.432)

This type was determined due to an unique object which was found during terrestrial surveys at Shahdad.[863] The needle is composed of a vertically oriented triangular flat head which is similar to a spatula. However there is an incised elaborat scene of

854 Ibid.: pl.21, tombe 66.8.
855 Vandenberghe 1973: 24, fig.11.61; Schmidt et al. 1989: pl.168d (Sor.877); Overlaet 2003: pl.208.18.
856 Schmidt 1937: pl.XLVII.H3500, H5178; Yule 1982: 23, Abb.15.8, Abb.24.5, Abb. 25.40.
857 Schmidt et al. 1989, pl.119e (MV30).
858 Hakemi 1997: 691f. A small confusion is arising concerning cat.no.427 which was recorded as 81-48 presumably right after discovery. According to Hakemi 1997 the excavation no. 81-48 belongs to bowl Oa.5. It can be hypothesized if the two different objects were recorded as belonging to the same context. A similar situation can be also observed with cat.nos.428-431 which all bear the same excavartion no. 89-48. This is an interesting observation as Pa.5 was published by Hakemi as 115-48 and Pa.6 as 73-47.
859 Tallon 1987: 238, 960-962 (épingles à tête fondue...variante E1c).
860 Sarianidi 2007: 88, no.98 (b. 560); 95.123.
861 Pittman 1984: 48,19b.
862 Mackay 1943: pl.LXXII, 18-19.
863 Meier & Vidale in press.

anthropomorphic and zoomorphic motives which excludes the object´s use as a tool. The needle´s shaft is of a straight and plain shape. There are formal parallels existing to another object from Shahdad[864] and further comparisons from Susa[865] and Gonur Depe.[866]

R.13: (cat.no.433)
A flat rounded head of vertical orientation is the main characteristic of this type. There are no other marks besides the shaft´s plain surface. A comparable object is from Gonur Depe with the same vertically oriented flat head.[867]

R.14: (cat.no.434)
This type is composed of a bronze needle and a disc-shaped head. The needle´s characteristics are a plain surface and a horizontally oriented ring pattern underneath the head and a slim tang on top of the needle. The head disc, presumably made of silver, is decorated with geometrical patterns on the front and back. The disc itself has a narrow vertical channel which is set directly on the needle´s tang and thereby attached to the needle.[868]

R.15: (cat.no.435-436)
This type´s distinguising marks are similar to R.14. The difference is the different material of the head disc which is made of semiprecious stone, in this case of Lapislazuli.[869] Cat.no.435 bears a rosette-decoration, cat.no.436 a regular dotted pattern.

R.16: (cat.no.437)
A plain straight shaft and a head which is shaped like a bone joint are the main characteristics of this needle which is only represented in one single example.[870]

864 See cat.no. 480, 481.
865 Tallon 1987: 189, 656 (spatule...sous-type B2); 235, 906 (èpingle à tête martelée en triangle...la variante D3b).
866 Sarianidi 2007: 86, no.92 (b. 806).
867 Ibid.: 90, 110 (b.1320). This examples got a triangular shaped head.
868 Hakemi 1997: 653, Gu.17. This is actually one of the few examples of objects from Shahdad which has been recorded in the NMI´s depot and is also published with the exact identification no. in the final report.
869 Ibid.: 652, Gu.12. Both examples which are presented here are not mentioned in Hakemi´s final report. But due to their characteristics the are counted to Gu.12
870 There is again unaminity between the different data sets. While in the NMI´s depot the object cat.no.437 was registered with the excavation no. 181-50, there is the same excavation no. in Hakemi´s final report associated with Gu.3 (Hakemi 1997: 650, Gu.3). The precise circumstances for this setting are unknown.

R.17: (cat.no.438)

This object seems to have been cast in one turn. The straight plain shaft is topped by a naturalistic ornithomorphic depiction.

R.18: (cat.no.439)

This unique object is characterized by different elements. First there is the straight plain shaft. On top of the needle there is a vertically oriented flat head of trapeziodal shape with the upper part just underneath the vertically erected trapezoid which is separated by a horizontally oriented parallel ring pattern.[871]

R.19: (cat.no.440-444)

The plain tapered shape of the needle and the rectangular shaped head are the visible marks of this type. Maybe there were some attachments of a different material which could have been added to the head. But unfortunately there is no record of this.[872]

R.20: (cat.no.445-453)

Similar to the examples of R.19 this type has also a plain straight shaft. The head is characterized by its ovoid to globular shape without any decorations. Here, it is also appropriate to hypothesize that there was some kind of attachment which was set on top of this long needle. A similar object is known from Tappeh Yahya in phase IVB5.[873]

R.21: (cat.no.454)

There a no signs of any decoration on the needle. The shaft is plain and straight. The head is thickenend of round shape with a small cavity of unknown function.

R.22: (cat.no.455-461)

This type is characterized by its small height and its elaborate fine work. Similar objects were especially found in the Northern regions of Shahdad. Due to their small size and good condition it can assumed that they might have been used for cosmetic activities. Therefore they can be called “Sormehdan” which is a small slim needle used for applying

871 This unique object is also not mentioned in Hakemi 1997.

872 A further confusing fact is again concerning the records from the NMI in contrast to the final publication. Cat.no. 440 has been recorded with the excavation no. 318-50 at the NMI and shares again the same excavation no. with Gu.12 which is evidently of a completely different shape. Again, the origin of this mismatch is still enigmatic.

873 Lamberg-Karlovsky & Potts 2001: 128, fig.4.20 (SF 3363).

traditional ocular cosmetics. Comparable objects were also discovered at Gonur Depe[874], Adji Kui[875] and Altyn Depe.[876]

R.23: (cat.no.462-476)

Here, several tools are compiled which were presumably used for metalworking activities such as engraving, chiseling and further actions. Objects of a similar shape are known over a wide area[877] as well as in recent traditional metalwork without many modifications to the shape.[878] From the archaeological record there are comparable objects from Uruk[879], Susa[880], Tappeh Sialk[881], Tappeh Ghabrestan[882], Tappeh Hesar[883], Adji Kui[884], Espidej[885] and Tappeh Yahya.[886]

R.24: (cat.no.477-479)

This type is of plain a character with no traces of decoration or other aesthetic marks. At the head there is a needle eye. Presumably these objects were used for sewing fabrics.

R.25: (cat.no.480-481)

The plain triangular head and the cylindrical shape of the shaft are the elements of the so called “spatula”. Similar objects have been found at Gonur Depe[887] as well as from Susa[888]

R.26: (cat.no.482)

This singular find is characterized by its simple appearance and its enourmous height of over 70cm. The object has an almost quadrangular shaft which is tapering and ending in a point. Concerning the function there are varying ideas ranging from a flagpole to a skewer.

874 Sarianidi 2007: 87, no.96 (b. 1354).
875 Rossi-Osmida 2011: 222.
876 Masson 1988: pl. XL.no.6.
877 Müller-Karpe 1994: Taf. 65.17, Taf. 67.10, Taf. 70.28, Taf. 73.33-34.
878 Hamzelu 2004: 61ff., fig. 40-41. Wulff 1966: 35ff.
879 van Ess & Pedde 1992: Taf. 30.194-196; Pedde et al. 2000: Taf. 18.221, 225-226.
880 Tallon 1987: 169ff., 506-507 (ciseaux propement dits), 514 (bédanes), 658-661 (petit poinçon symmetrique).
881 Ghirshman 1938: pl. LXXXIV, S252, S383, S1698, S1700, S1781.
882 Madjidzadeh 2008: 128, fig. 67.9-12.
883 Schmidt 1937: pl. XVI, H3658, H3743.
884 Rossi-Osmida 2011: 218ff.
885 According to a lecture held by M. Heydari in 2006 in Tehran.
886 Lamberg-Karlovsky 1970: 68, pl. 20.C; 129, pl. 27D; 103, pl. 36.
887 Sarianidi 2007: 86, no.92 (b. 806).
888 Tallon 1987: 189, 656 (spatule...sous-type B2); 235, 906 (èpingle à tête martelée en triangle...la variante D3b).

R.27: (cat.no.483-486)

This is the final group of all pin/needle-like objects which due to their fragmentary state are not determinable.

6.2.2.6. Group S: Special types (S.01-S.08)

S.01: (cat.no.487)

This object has an open funnel shape. The bottom part which is flattened also bears a perforation, so it is therefore identified as a colander. There are several similar objects known from Ur[889]and other Mesopotamian sites as well as from the “Vase à la cachette”-hoard from Susa[890] and Lorestan.[891] However the only identical comparison was discovered at Gonur Depe.[892]

S.02: (cat.no.488)

This type is represented by Gr.2 and Gr.3 according to the final report.[893] The distinguishing marks of this object are the closed pear shape and a regular vertical channeling on the body which runs around the whole body. According to the already published data the cylindrical opening on top of the vessel was covered with a semiglobular lid.[894] Further there are remains of a six-string bronze band suspension which was attached to the upper rim. This element also shows that the vessel was originally suspended. Its actual usage still remains an uncertainty. There are however some indications that it might have been used for storing liquids or to prevent any special goods from easy accessibility.

S.03: (cat.no.489)

This object is characterized by an open shallow plate with two suspensions positioned

889 Woolley 1934: 302, pl. 238 (type 96.31; type 97:2).
890 Ibid.: 226, 808 (passoire); Benoit 2003: 252f., fig.109.
891 Haerinck & Overlaet 1998: pl.65.
892 Sarianidi 2007: 86.90; Sarianidi 2008: 268.197. According to Sarianidi this type of colander was used in ritual practice to filter cultic beverages.
893 Hakemi 1997: 642f., Gr. 2, Gr. 3. Here is another case where the already published data does not match with the data which was recorded at the NMI. Artefact cat.no. 488 was identified as excavation no. 539-50. On the contrary is cat.no. 488 in Hakemi 1997 presented as Gr. 2 with the excavation no. 399-50. A second variant Gr. 3 is displayed as excavation no. 539-50. But from the published photographs where Gr.2 (Hakemi 1997: 272f.) and Gr.3 (Hakemi 1997: 280f.) are presented in presumably the correct order it is obvious that the confusion is only deriving from the catalogue where the drawings were inadvertently swapped.
894 Unfortunately the lid was not present during the inventory study in 2006.

opposite each other on the rim where another bronze band is attached. The plate itself is attached to a concave cylinder which seems to be made of a bronze metal sheet. According to the open shape and its unique shape it seems plausible to hypothesize that this object also might have been used for special occasions.
Objects of almost identical shape derive from Gonur Depe and were discovered in burials 3200[895] and burial 3900.[896] Sarianidi is identifying it as a light source where flammable ingredients were burned. But for the same reason it can be also assumed that these object were used as an incense burner.

S.04: (cat.no.490)
This vessel has a wide mouth, a cylindrical neck and an ovoid shaped body with a flat round base. Therefore it can be called a bottle or jar.

S.05: (cat.no.491-493)
Under S.05 several types of golden jewellery pendants are compiled. Cat.no. 491 is characterized by small round beads, cat.no. 492 by two biconical golden beads and cat.no. 493 by a combination of two biconical beads with one cylindrical bead.

S.06: (cat.no.494-495)
There are two bronze metal stamp seals. Cat.no. 494 is a specimen of small dimensions and a triangular shape. There is also a small cavity in the central position with a unidentifiable abstract motive. Cat.no. 495 is of an almost round shape. The seal itself shows a round element in central position which is surrounded by a leaf-like pattern above it. Underneath there seem to be a single elongated field which is closing the motif.[897]

S.07: (cat.no.496-497)
At this point the well known and unique “Standard of Shahdad” is represented. It consists of a bronze metal sheet with figurative incisions (cat.no.496)[898] and a flagpole which is decorated with the full body depiction of a bird of prey on the top(cat.no.497).[899] Similarities

895 Sarianidi 2008: 181, 89 (b. 3220).
896 Sarianidi & Dubova 2010: 11, fig.9 a (b. 3900), b (b. 3200).
897 Hakemi 1997: 717, Xn. Due to the unadequate reproduction of this object it is still doubtable if cat.no. 495 and Xn. are identical.
898 Hakemi 1972: 9f.; Masoumi 1976: 163.
899 Originally there was also a solid stone base where the flagstone was attached. But during inventory in 2006 the object could not be located.

to other full body depictions of birds of prey are documented at Gonur Depe[900] and the Archaeological Museum of Jiroft.[901]

S.08: (cat.no.498)

This is another object of unusual shape. It is of conical shape with a small opening and another wide opening on the opposite side. There are also decorative attachments around the neck with the depiction of human faces. This combination is already well known from different artefacts which derive mainly from the Northern neighbouring areas[902] with the most prominent sites being Tappeh Hesar[903], Astarabad (modern Gorgan) [904], Gonur Depe[905] and Adji Kui 9.[906] There are also some artefacts of unknown provenance which were documented as Bactrian examples.[907] A few comparable objects are also made of gold and silver. According to its open horn-like shape it is seen as an wind instrument such as a horn, shawm or trumpet. A recent study of this artefacts was conducted by B. Lawergren who determined the example from Shahdad as a F2-type trumpet.[908]

6.2.2.7. Group T: Unidentified (T.01)

T.01: (cat.no.499-504)

This last group´s aim is to compile every remaining metal object which was not yet recorded in the museum´s inventory. Cat.no.499. is a collection of numerous semi globular bronze metal pendants of different sizes. Cat.no. 500 shows a collection of different metal tools. Cat.no. 501 and cat.no. 502 are fragments of metal sheets. Two fragments of copper slags are compiled under cat.no. 503. Similar shaped copper slags are known from the "Vase à la cachette"-hoard at Susa.[909] Finally another group of metal sheet fragment is recorded as cat.no. 504.[910]

900 Sarianidi 2006: 218, 80.
901 There are at least three examples which are on display in the museum, but still unpublished. In contrast to the metallic specimen from Shahdad these examples are all made of soft stone, presumably chlorite. But there are also still legitimate doubts if all of these finds are deriving from archaeological contexts of if there are some bogus, recently made artefacts.
902 Lamberg-Karlovsky & Hiebert 1992: 136f.
903 Schmidt 1937: 210., fig.121; Yule 1982: 25, Abb.17.31-32.
904 Rostovtzeff 1920: pl.III.4.
905 Sarianidi 2007: 81, 73 (b. 516); Sarianidi 2008: 188, 99 (b. 3210).
906 Rossi-Osmida 2011: 216.
907 Pottier 1984: 99, no.313-315; 225, pl.XLIII.313-315. Sarianidi 1986: 191.
908 Lawergren 2003: 47,fig.3.
909 Benoit 2003: 252f., fig.109.
910 Due to its bad fragmentary state of preservation the object cat.no. 504 is not reproduced photographically in the catalogue.

6.3. The copper production of Shahdad in the general framework of Middle Asian cultures and societies

The collection of metal artefacts from Shahdad are characterized by a large variety of types and shapes. Altogether 117 types of different shape were chosen for this study. Especially the mattock (cat.no. 141) gives evidence that the protohistoric settlement at Shahdad was connected to a trade community that ranged from the MBAC to the Indus valley. The wide distribution of this particular shaped object and also the spread of other valuable goods all over the area are contributing to the idea of a possible North-South connection between MBAC cultures and the Persian Gulf to participate in the 3rd millennium BCE sea-trade between the regions from Mesopotamia to the Indus valley. Other exceptional objects which were found at Shahdad are the “Bactrian” axes and the “Horn, Trumpet”. These two groups are dominantly distributed in the region of Northern Iran and Southern Turkmenistan, and also a large number of these finds derive from Afghanistan where they were presumably discovered during illegal excavation activities. The majority of all metal artefacts which are included in the catalogue show greater similarities in sense of identical shapes and a variety of different types to objects from the neighbouring northern regions. This can be seen as an evidence to underline the strong cultural bonds between the Takab plain and MBAC sites such as particularly Gonur Depe and Adji Kui which also share similarities in sense of architecture and pyrotechnology.(see Chapter 4) Also to be mentioned are the observed tendencies of and intended continuation of an arsenical bronze metallurgical tradition at a time when tin bronze metallurgy was already widespread and in common use in the neighbouring Bronze Age cultures. This also contributes to the idea of an Eastern Iranian metallurgical province which has already been stated by Chernykh and Pigott.[911]

911 Chernykh 1980, 1992; Pigott 1999a, b.

Chapter 7 Conclusions

7.1. Was there an "Eastern Iranian Metallurgical Province" in the 3rd millennium BCE?

More than 30 years ago E.N.Chernykh presented his definition regarding the subdivision of ancient metallurgical developments as the following:

“A metallurgical province is understood as a system of kindred metallurgical and metal-working foci or centers, limited in space and time. A metallurgical province could exist for a few hundred years to three thousand years. Sometime it embraced huge territories of up to several millions of square kilometers. The metallurgical foci were the principal production centers of a metallurgical province. Their production was characterized first of all by its metallurgy, by its types of alloys, and by the forms of metallic tools it produced. Metallurgical foci were, as a rule, located in copper ore zones where it was possible to both mine copper ore and melt the copper. Metal working foci were mainly situated in zones without ore, and were dependent on the former for supplies of metal. The craftsmen in metal-working foci [sic] very often imitating the forms of metallic tools and decorations produced in the metallurgical foci. Like the metallurgical provinces, metallurgical and metal-working foci were characterized by temporal and spacial limits. Foci of both types, particularly in the fifth-third millennia B.C., were associated, for the most part, with a definite archaeological culture or its variant. At some later stages of development, however, metallurgical and metal-working foci often grew into super-cultural phenomena and embraced several cultures and their variants. Territorially and chronologically a metallurgical province was, as a rule, larger than even the largest prehistoric community... In the foci of such communities, metallurgical production was part of a metallurgical province only as a component of the more extensive system of production and its tradition...”[912]

According to this definition and the published data from archaeological investigations V.C. Pigott began in 1999 to justifiably label several archaeological sites in Iran such as Tappeh Ghabrestan, Tappeh Sialk, Tappeh Yahya and Tall-eh Malyan as metallurgical foci for the period of late fourth/ early third millennium BCE.[913]

During the last 40 years of archaeological research our knowledge about developed societies in eastern Iran during the 3rd millennium BCE with widespread contacts towards Mesopotamia, Central Asia, the Indus Valley and the Persian Gulf area has increased fundamentally by the discoveries of a large variety of different artefacts which have been documented all over the region. To mention but a few of the major discoveries in Iran are the Jiroft Area in the Halil Roud Basin with the sites of Konar Sandal A and B, Espidej in

912 Chernykh 1980: 320f.; see further Heskel 1982 and Kroeber 1946 for “oikoumene“.
913 Pigott 1999b.

Iranian Baluchistan and Tappeh Bazgir in the Golestan Province. Besides numerous examples of the material culture found at all three mentioned sites distinctive remains of metallurgical activities were also observed there. These new discoveries, in addition to the already known 3rd millennium BCE sites, can be counted as archaeological evidence for the nomination of a metallurgical province in eastern Iran. Furthermore, these discoveries, which are undoubtedly an important indicator for applied technological knowledge, the enormous distribution of Cu-mineral deposits in eastern Iran and the adjacent areas further to the East which frequently bear traces of old workings and smelting activities also supports the importance of this metallogenic zone (see chapter 3). This evidence also contributes to the hypothesis of a developed “metallurgical province” in eastern Iran during the 3rd millennium BCE. In addition there are also the observations of the usage of arsenic copper alloy in eastern Iran which should be seen as another distinctive metallurgical traditional still in use when tin bronze was already known about and widely used.(see 7.2.) E.N. Chernykh has already postulated the existence of an “Irano-Afghan” metallurgical province for the Late Bronze Age.[914] This idea is also supported by V.C. Pigott who mentioned in 1999 the sites of Tappeh Hesar and Shahdad as metallurgical foci in eastern Iran during the Bronze age.[915] Since then, several archaeological expeditions have been conducted in this region and further evidence is coming forward which confirms his ideas.[916] At a distance of approximately 200 km to the Northeast of Tappeh Hesar on the opposite side of the Alborz Mountain Range lies the provincial centre of Minoudasht with the ancient settlement mound of Tappeh Bazgir in its vicinity. Since 2000, when a hoard of over 250 different shaped bronze artefacts were discovered haphazardly, several field seasons of archaeological excavations have been conducted. The majority of the objects show formal similarities to artefacts from Hesar IIIC contexts which are dated unequivocally in the transitional phase from the third to the second millennium BCE. The total weight of the so-far published artefacts of the “Bazgir-Hoard” is about 500 kg of copper-alloy.[917] Just to illustrate the outstanding position of the hitherto unsatisfyingly published collection from Tappeh Bazgir, the total weight of all bronze artefacts from Shahdad is about 130 kg of metallic copper. These enormous contexts are so far the largest collection of Bronze Age metal artefacts which were discovered in Iran and are supporting the theory of another highly developed metallurgical province in eastern Iran

914 Chernykh 1992: 271ff.
915 Pigott 1999b: 110.
916 Abasnejad 1994, 2003; Köster 2008; Nezafati et al. 2008, 2011; Roustaei 2009, 2010, 2012a,b.
917 Recent excavations at the site yielded another even larger collection of bronze alloy objects with a total weight of more than 1000 kg. (Pers.comm. by J.Nokandeh in May 2015).

during the Bronze Age.
The archaeological contexts are further testimony that in the region of eastern Iran at sites like Tappeh Hesar, Konar Sandal B and Shahdad extensive metallurgical activities were conducted as evidenced by the presence of finished metal objects as well as slag, furnace linings, crucibles, mineral ores and other metallurgical remains. However the different procedures which were involved in the metallurgical processes are still uncertain. In the case of the “workshop” at Shahdad, which was chosen for detailed investigation in this monograph, there is evidence that it was probably used for multiple handicraft activities such as the preparation of cupriferous material by grinding and the finishing of copper artefacts as indicated by a mould-fragment and different crucibles. Also the discoveries of processing residues of semi-precious stones and half-worked beads provide evidence of an involvement in the bead-making process. Further evidence at Shahdad such as the metallurgical area with its multifaceted metallurgical remains on the surface leaves no doubt of the ancient activities (see Chapter 4).

7.2. The deliberate use of arsenic in copper objects in the 3rd millenium BCE

The earliest artefacts found in Iran are from the site of Ali Kosh and are made of native copper which presumably derived from the area of Tal Mesi (096) or near-by Meskani (103) according to Smith. He also states that in the case of Tal Mesi and Meskani occurrences of native copper are accompanied by deposits of cupro-arsenic minerals which might explain the small amounts of arsenic in the artefacts.[918]
Pigott mentions that the deliberate production of arsenical copper was perhaps realised by adding charges of copper arsenates like f.e. domeykite (Cu_3As) and algodonite (Cu_6As) to the molten native copper where they “....dissolved like sugar in water and released their high arsenic content to the melt”.[919] The published evicence for early use of arsenical copper at Tappeh Yahya also supports the idea of the use of native copper and arsenic Cu-minerals.[920] This is also stated by T. Berthoud about the copper artefacts from Susa during the fourth millennium BCE.[921] In addition the earliest evidence for the smelting of copper ores on the Iranian Plateau is to be found at Tall-eh Eblis.[922] The published data of

918 Smith 1968
919 Pigott 1999a: 78.
920 Heskel 1982; Heskel & Lamberg-Karlovsky 1980: 232.
921 Berthoud 1979.
922 This might also be the earliest evidence of copper smelting in the whole Old World, although there is also evidence

copper ores which were collected at the site show that with the exception of the chloride ore all of the others are evident in the Anarak-district.[923]
For the Bronze Age metallurgy Pigott mentions that "... at sites such as Hissar (Tappeh Hesar) and Shahdad, where the smelting of the copper sulpharsenides- enargite and arsenopyrite- may have been practised...sulphur bearing fahlores can be reduced to arsenical copper in a one step process at temperatures greater than 1300°C in a crucible or a furnace..." He further states that "...the smelting of fahlore results to "matte", a copper sulphide or copper iron sulphide mixture..." might have been known and practised at the sites.[924] This hypothesis cannot be confirmed as the analytical results of the XRD-investigation on the ore samples from Shahdad show no traces of sulphur (see Chapter 5). Furthermore from the analytical data of the crucible slag SHA 18 there is further contradictory information about the chemical contents. While the collected ore samples imply no use of sulphurous minerals the crucible slag SHA 18 contains Cu-sulphides, Cu-carbonates and Cu-oxides which recall the properties of co-smelting metallurgical slags to mind.[925] The siliceous phase is composed of diopside, anorthite and delafossite, the sulphidic phase (matte) is indicated by digenite and the decomposition phase of goethite, chalcanthite, atacamite, cuprite and brochantite. The co-smelting-process of sulphidic ores requires temperatures of ca. 900°C.[926] The slag itself, which is of aconical shape with an almost circular concave imprint on the bottom, has the distinct shape of an open reduction vessel. The imprint may therfore derive from Cu-sulphidic "matte" and/or the actual copper regulus. Similar observations on metallurgical slags concerning the shape and the chemical content are already known from Early Bronze Age contexts at Shahr-eh sukhteh.[927]
In contrast to the results of SHA 18 stands SHA 19, another metallurgical slag, which does not bear evidence of the use of Cu-sulphides. Exclusively Cu-oxides and Cu-chlorides as well as traces of lead, Fe-oxidic minerals and siliceous minerals were detected. This indicates another smelting technique for the extraction of copper.

Another attempt to substantiate the idea of an eastern Iranian metallurgical province is

for copper producing activities in the Balkans and in the Wadi Arabah near the Red Sea. But the answer to this question remains for future research.
923 Bazin & Hübner 1969: 67; Heskel 1982.
924 Pigott 1999b: 115.
925 Pigott 1999a,b.
926 Hauptmann 2014: 102f.
927 Hauptmann et al. 2003.

made by the following results of XRD-analysis of 38 copper objects from Shahdad and other relevant origins (see Table 10).

The samples MT03-MT19 and VAT1-VAT16d derive from two series of investigations on Bronze objects from Shahdad which were conducted by Vatandoust in 1977 and by Meier in 2007.[928]

MH 112 and MH 131, samples from two Bronze Age “Bactrian” axes from the H. Mahboubian collection were sampled and analyzed by P. Northover in 1997.[929]

The sample No.34 is from a Bronze axe with a full body depiction of a sitting lion positioned on the neck of the axe and is almost identical to the example from Shahdad (see cat. no.151). This artefact is from the Grawert collection of the Archaeological Museum at Frankfurt am Main and was aquired from the Antiquity market. The XRD-analysis was conducted by J. Riederer.[930]

1864 is a bronze pin (U 19190) from the Royal cemetary at Ur.[931] The WDXRF-results were published by Hauptmann & Pernicka.[932] This object shows formal typological parallels and further similarities in the chemical compositions to identical finds from Shahdad and Jiroft. Another recently submitted Ph.D. thesis by F. Yavari from the University of Mazandaran in Sari (Iran) on bronze age metal objects from the Jiroft area and Shahdad alsoreports moderate contents of arsenic in Bronze objects.[933]

Here, the analysis of bronze artefacts from Shahdad show copper contents from 92% to 98%. The average arsenic contents is at 3 % and ranges from 0.09 to 5.63 %. This is not an unusually high concentration but it can be seen as an indicator for intentional addition of arsenic minerals to the raw copper.

928 Vatandoust 1977, 1999; Meier 2008, 2011.
929 Northover 1997.
930 Riederer 2001: 78
931 Woolley 1934.
932 Hauptmann & Pernicka 2004.
933 Pers. com. by F. Yavari.

Sample	Object	Exc. No.	Dating (B.C.)	Fe %	Co %	Ni %	Cu %	Zn %	As %	Pb %	Bi %	Ag %	Sn %	Sb %	S %
MT 04	Adze head	54-1356	2300-1800	0,39	0,01	0,02	96	0,2	2,84	0,36	0,01	0,015	0,005	0,031	
MT 05	Adze head	298-1355	2300-1800	4,7	0,03	0,15	95	0,2	0,41	0,02	0,01	0,047	0,005	0,010	
MT 06	Dagger	169-1350	2300-1800	0,23	0,01	0,03	96	0,2	3,2	0,16	0,01	0,047	0,010	0,011	
MT 07	Tap.bar	170-1350	2300-1800	0,1	0,01	0,04	97	0,2	3,1	0,16	0,01	0,061	0,005	0,021	
MT 08	Axe head	512-1350	2300-1800	0,18	0,01	0,06	96	0,2	3,8	0,26	0,01	0,063	0,005	0,017	
MT 09	Blade	522-1350	2300-1800	0,18	0,01	0,05	95	0,2	4,1	0,23	0,01	0,040	0,005	0,045	
MT 10	Chisel	525-1350	2300-1800	0,2	0,02	2,31	94	0,2	2,41	0,13	0,01	0,014	0,84	0,119	
MT 11	Pin	378-1350	2300-1800	1,03	0,05	0,52	96	0,2	1,12	0,79	0,01	0,018	0,071	0,045	
MT 12	Pin	515-1350	2300-1800	0,32	0,01	0,16	96	0,2	3,3	0,10	0,01	0,046	0,029	0,025	
MT 13	Pin	509-1350	2300-1800	0,45	0,01	0,09	95	0,2	4,3	0,02	0,02	0,049	0,005	0,005	
MT 14	Pin	405-1350	2300-1800	1,35	0,01	0,01	92	0,2	6,5	0,13	0,01	0,079	0,005	0,008	
MT 15	Pin	282-1350	2300-1800	0,91	0,01	0,03	94	0,2	4,5	0,05	0,01	0,005	0,005	0,005	
MT 16	Pin	242-1352	2300-1800	0,16	0,01	0,01	96	0,2	3,4	0,24	0,01	0,002	0,008	0,006	
MT 17	Pin	250-1352	2300-1800	0,25	0,01	0,13	94	0,2	5,0	0,13	0,01	0,103	0,006	0,010	
MT 18	Chisel	220-1352	2300-1800	0,75	0,01	0,03	97	0,2	2,45	0,09	0,01	0,009	0,005	0,012	
MT 19	Axe head	208-1352	2300-1800	0,17	0,01	0,01	98	0,2	1,13	0,41	0,02	0,34	0,012	0,094	
VAT 1	Axe head	232-1349	2300-1800	0,025	n.d.	0,13	96,76	n.d.	2,47	0,018	n.d.	0,033	0,54	0	
VAT 2	Axe head	86-1351	2300-1800	0,015	n.d.	0,38	97,00	n.d.	2,02	0,34	n.d.	0,014	0,19	0	
VAT 3	Axe head	164-1351	2300-1800	0,03	n.d.	0	96,77	n.d.	3,10	0,021	n.d.	0,054	0	0	
VAT 4	Axe head	71-1351	2300-1800	0,038	n.d.	0,12	97,56	n.d.	2,02	0,017	n.d.	0,012	0,21	0	
VAT 5	Axe head	113-1351	2300-1800	0,17	n.d.	0,033	95,55	n.d.	3,71	0,064	n.d.	0,019	0,32	0	
VAT 6	Adze head	297-1351	2300-1800	0,022	n.d.	0,047	95,15	n.d.	4,58	0,17	n.d.	0,016	n.d.	0	
VAT 7	Adze head	?	2300-1800	0,015	n.d.	0,083	96,94	n.d.	1,88	0,75	n.d.	0,01	0,28	0,011	
VAT 8	Adze head	180-1351	2300-1800	0,041	n.d.	0,025	97,11	n.d.	2,36	0,32	n.d.	0,019	0,12	0	
VAT 9	Mace head	299-1350	2300-1800	0,025	n.d.	0,016	90,36	n.d.	4,66	0,17	n.d.	0,27	0,24	4,14	
VAT 10	Pickaxe	86-1348	2000-1800	0,1	n.d.	0,015	97,91	n.d.	0,09	0,62	n.d.	0,17	0,18	0	
VAT 11	Pickaxe	87-1348	2000-1800	0,13	n.d.	0,011	92,84	n.d.	2,31	4,27	n.d.	0,086	0,31	0,015	
VAT 12	Tap. bar	170-1350	2300-1800	0,014	n.d.	0,061	96,56	n.d.	3,15	0,14	n.d.	0,061	0	0	
VAT 13	Pin	288-1349	2300-1800	0,014	n.d.	0,01	94,31	n.d.	5,63	0	n.d.	0,03	0	0	
VAT 14	Pin	477-1349	2300-1800	n.d.	n.d.	0,046	95,78	n.d.	4,00	0,089	n.d.	0,064	0	0	
VAT 15	Pin	283-1351	2300-1800	0,018	n.d.	0,026	93,76	n.d.	5,09	0,69	n.d.	0,044	0,34	0	
VAT 16a	Standard	296-1350	2300-1800	0,024	n.d.	0,06	95,34	n.d.	3,92	0,47	n.d.	0,038	0,107	0,012	
VAT 16b	Standard	296-1350	2300-1800	0,036	n.d.	0,056	95,21	n.d.	3,91	0,37	n.d.	0,039	0,37	0	
VAT 16c	Standard	296-1350	2300-1800	0,18	n.d.	0,014	97,76	n.d.	1,19	0,202	n.d.	0,02	0,54	0,085	
VAT 16d	Standard	296-1350	2300-1800	0,018	n.d.	0,066	94,73	n.d.	4,16	0,62	n.d.	0,032	0,34	0,025	
MH112	Axehead		2500-2000	0,05	0	0,07	98,13	0,05	0,16	0,01	0,08	0,01	1,22	0,02	0,12
MH131	Axehead		2500-2000	0,16	0,04	0,35	97,9	0,01	0,71	0,23	0,01	0,16	0,13	0,04	0,26
No.34	Axehead		2500-2000	0,02	<0,005	0,07	94,74	0	5,06	0,1	<0,025	0,05	<0,25	<0,02	
1864	Pin	U.19190	2500-2000	0	0	0,08	98	0	1,38	0	0	0,15	0,03	0,21	

Table 10: Compilation results of XRD-analysis from Bronze objects from the sites of Shahdad and Ur and artefacts of unknown provenience from Bactria and East Iran (Meier 2011, Vatandoust 1977, Northover 1997, Riederer 2001, Hauptmann & Pernicka 2004)

The published analytical data of the decorated axe NO.34 has evidence of an arsenic content of over 5 % which may be explained by the better casting qualities of copper alloys in comparison to pure copper. The analytical data of the Bronze Age axe heads from Shahdad shows minor arsenical concentrations of between 2 and 3 %. This difference might be explained by the observation of a minor degree of elaborated decorations on the objects from Shahdad which are also of simpler shape. But the colouring properties of arsenic enriched copper alloys can also be seen as an explanation for the intentional use of arsenic. The copper content of No.34 is at ca.95 %.
The comparison of the data from the needle/pin 1864 (U19190), which was found at the royal cemetery at Ur, with the pins from Shahdad shows noteworthy similarities. Besides the already mentioned formal typological similarities the example from Ur is also comparable according to its chemical content. It shows a high concentration of copper at 98% and arsenic at 1.4 %.

The tin content of the majority of the bronze objects from Shahdad never exceeds 0.6 %. Exceptionally the mace head (cat.no. 198) contains a remarkable 4.14 % of antimony, while all other artefacts show content of up to 0.01 %. The addition of antimony improves the ductility of the molten copper which enhances the casting.[934] The elaborate decoration of the object might answer the question of the unusually high amount of antimony.
From the bronze hoard of Bazgir 171 samples were obtained. The content of arsenic ranges from 0,15% to 5,7% which is similar to the observations at Shahdad. Only two knobs of tin bronze alloy show concentrations of 7.6% and 8.4% of tin-content. This might be explained by a desire for a different, possibly golden-like colouration of the objects.[935]
Last but not least information about the metallurgy in the MBAC should not be neglected. Unfortunately there is literally no published data except one article dealing with the analytical results of investigation on objects from Altyn Depe and Namazga Depe. This investigation showed that the Bronze Age metallurgy of the Kopet Dagh was primarily based on the usage of pure copper with minimal contents of tin or arsenic.[936] However there are also noteworthy amounts of arsenic in the copper artefacts from Gonur Depe.[937]

7.3. Future research perspectives

Through the course of this monograph it was attempted to provide an insight into the metallurgical development in eastern Iran during the Bronze Age. There are various aspects to investigate and several questions about ancient metallurgical activities. It also showed that on some other major points our current knowledge is unsatisfying. First to be mentioned is the question of the procurement of raw materials and their production. Several attempts have been made in the past to investigate this point,[938] but besides the invaluable preliminary reports and a few other publications our knowledge is very limited. Another aspect deals with the demand for fuel. A research project on this task would need to involve studies of the different kinds of organic and inorganic fuels, their production and usage as well as their provinience and distribution. Next, understanding the pyrotechnological process is one of the major issues. The identification of the pyrotechnological activities at Shahdad proves their usage but unfortunately does not

934 Junk 2003: 26
935 Lorenz 2008: 33ff.
936 Egor´kov & Shchetenko 2004. Exceptionally one object from Altyn Depe shows a tin content of 7,7% (tabl.1.).
937 Pers. com. by N. Boroffka during the international conference “A millennium of history-the Iron Age in Central Asia (2nd and 1st millennium BC)“ which was organized by the Eurasia department of the DAI in June 2014.
938 Berthoud et al. 1975, 1976; Abasnejad 1994, 2003; Roustaei 2009, 2010, 2012a,b.

support the earlier interpretation of “smelting furnaces”. It seems rather that the installations were initially used for domestic activities. Exclusively the remains of a furnace situated at the metallurgical site at Shahdad directly witnesses the presence of copper production on site. As a consequence intensified Survey activities are desirable as well as further archaeological excavations.[939] A recently published paper by N. Eskandari about the remains of Keshit, another 3rd millennium BCE site situated on the Western fringes of the Dasht-eh Lut, affirms the importance of this remote area as he also noted the traces of pyrotechnology on site.[940] Another very promising context which evidences metallurgical activities is known from the excavations at Konar Sandal B (South). Nothing has been yet published but the excavated finds such as large amounts of metallurgical slag and casting moulds in different states of preservation are substantiating the suspicion of intensive metallurgical activities.

939 Relevant activities were conducted under the supervision of N. Eskandari in 2013 and 2014 (unpubl. I.C.A.R. report).

940 Eskandari et al. 2014

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9. Find Catalogue

Table 1

cat.no. 001
Provenance: Shahdad
Excavation no.: 404-50
Museum inventory no.: 9285
Object group: bowl with nozzle
Material: Cu/Br-alloy
Measurements:
max. height: 9.4 cm
Diameter: 9 cm (rim); 11.2 cm (body)
Weight: 258 gr
Type: A.01
Dating: 2200-1750 BCE
References: Hakemi 1972: 32, 273, pl.XIX B; Hakemi 1997: 634, Gm.5, 1477, Gr.141; Bellelli 2002: 107.146, Taf. 24.146.

cat.no. 002
Provenance: Shahdad
Excavation no.: 393-50
Museum inventory no.: 9284
Object group: bowl with nozzle
Material: Cu/Br-alloy
Measurements:
max. height: 12.4 cm
Diameter: 10 cm (rim), 7.6 cm (body)
Weight: 443 gr
Type: A.02
Dating: 2200-1750 BCE
References: Hakemi 1972: 32, 276; Hakemi 1997: 634, Gm.4, 1506, Gr.143.

cat.no. 003
Provenance: Shahdad
Excavation no.: 205-52
Museum inventory no.: 9909
Object group: bowl with nozzle
Material: Cu/Br-alloy
Measurements:
max. height: 13.6 cm
Diameter: 11 cm (rim), 7 cm (base)
Weight: 579.7 gr
Type: A.03
Dating: 2200-1750 BCE
References: Hakemi 1997: 634, Gm.1, 3555, Gr.294.

Table 2

cat.no. 004
Provenance: Shahdad
Excavation no.: 538-50 / s.i.r.
Museum inventory no.:
Object group: bowl with a nozzle
Material: Cu/Br-alloy
Measurements:
max. height: 14 cm
Diameter: 13.5 cm
Weight: 827.9 gr
Type: A.04
Dating: 2200-1750 BCE

cat.no. 005
Provenance: Shahdad
Excavation no.: 534-50
Museum inventory no.: 9291
Object group: cylindrical beaker
Material: Cu/Br-alloy
Measurements:
max. height: 10.4 cm
Diameter: 11.3 cm
Weight: 405 gr
Type: B.01
Dating: 2200-1750 BCE
References: Hakemi 1972: 33, 298, pl.XVIII C (?); Bellelli 2002: 61.54, Taf. 14.54 (?).

cat.no. 006
Provenance: Shahdad
Excavation no.: 534-50
Museum inventory no.: 9307
Object group: cylindrical beaker
Material: Cu/Br-alloy
Measurements:
max. height: 10 cm
Diameter: 10.9 cm (body)
Weight: 305 gr
Type: B.01
Dating: 2200-1750 BCE
References: Hakemi 1972: 33, 298, pl.XVIII C (?); Bellelli 2002: 61.54, Taf.14.54 (?).

Table 3

cat.no. 007
Provenance: Shahdad
Excavation no.: 236-51
Museum inventory no.: 9655
Object group: cylindrical beaker
Material: Cu/Br-alloy
Measurements:
max. height: 10.3 cm
Diameter: 11 cm (rim)
Weight: 327.7 gr
Type: B.01
Dating: 2200-1750 BCE

cat.no. 008
Provenance: Shahdad
Excavation no.: 32-52
Museum inventory no.: 9908
Object group: cylindrical beaker
Material: Cu/Br-alloy
Measurements:
max. height: 5.4 cm
Diameter: 7.6 cm (rim), 7.6 cm (base)
Weight: 117 gr
Type: B.02
Dating: 2200-1750 BCE

cat.no. 009
Provenance: Shahdad
Excavation no.: 376-50
Museum inventory no.: 9313
Object group: spouted bowl
Material: Cu/Br-alloy
Measurements:
max. length: 14.9 cm (spout)
max. height: 13.8 cm
Diameter: 12.2 cm (body)
Weight: 506 gr
Type: C.01
Dating: 2200-1750 BCE
References: Hakemi 1972: 32, 272, pl.XX B; Hakemi 1973c: 66; Hakemi & Sajjadi 1988: 146; Bellelli 2002: 102.140, Taf.23.140 (?).

Table 4

cat.no. 010
Provenance: Shahdad
Excavation no.: 237-49
Museum inventory no.: 8921
Object group: spouted vessel
Material: Cu/Br-alloy
Measurements:
max. length: 16 cm (spout)
max. height: 14 cm
Diameter: 8 cm (rim), 13 cm (base)
Weight: 487.5 gr
Type: C.01
Dating: 2200-1750 BCE
References: Hakemi 1972: 32, 272, pl.XX B; Hakemi 1973c: 66; Hakemi & Sajjadi 1988: 146; Hakemi 1997: 630, Gf.1, 0816, Gr.084; Bellelli 2002: 102.140, Taf.23.140.

cat.no. 011
Provenance: Shahdad
Excavation no.: s.i.r.
Museum inventory no.:
Object group: bowl, spouted vessel
Material: Cu/Br-alloy
Measurements:
Weight: 900.3 gr
Type: C.01
Dating: 2200-1750 BCE

cat.no. 012
Provenance: Shahdad
Excavation no.: 230-51
Museum inventory no.: 9667
Object group: spouted bowl
Material: Cu/Br-alloy
Measurements:
max. length: 7.5 cm (spout)
max. height: 7.3 cm
Diameter: 8 cm (rim)
Weight: 221.3 gr
Type: C.02
Dating: 2200-1750 BCE

Table 5

cat.no. 013
Provenance: Shahdad
Excavation no.: 231-51
Museum inventory no.: 9664
Object group: spouted bowl
Material: Cu/Br-alloy
Measurements:
max. length: 3 cm
max. height: 8.5 cm
Diameter: 5.1 cm (rim), 8 cm (base)
Weight: 203.5 gr
Type: C.02
Dating: 2200-1750 BCE

cat.no.014
Provenance: Shahdad
Excavation no.: 211-55 / s.i.r.
Museum inventory no.:
Object group: spouted bowl
Material: Cu/Br-alloy
Measurements:
max. height: 9.4 cm
Diameter: 6.5 cm
Weight: 135.9 gr
Type: C.02
Dating: 2200-1750 BCE

cat.no. 015
Provenance: Shahdad
Excavation no.: 392-50
Museum inventory no.: 9312
Object group: beaker
Material: Cu/Br-alloy
Measurements:
max. height: 9 cm
Diameter: 10 cm (rim), 4.5 cm (base)
Weight: 324 gr
Type: D.01
Dating: 2200-1750 BCE
References: Hakemi 1972: 31, 254;
Hakemi 1997: 631, Gg.3, 1874, Gr.168.

Table 6

cat.no. 016
Provenance: Shahdad
Excavation no.: 531-50
Museum inventory no.: 9311
Object group: beaker
Material: Cu/Br-alloy
Measurements:
max. height: 11.4 cm
Diameter: 10.5 cm (rim), 5 cm (base)
Weight: 267.8 gr
Type: D.01
Dating: 2200-1750 BCE
References: Hakemi 1972: 31, 260, pl.XVII A; Hakemi 1997: 632, Gh.1, 1395, Gr.135; Bellelli 2002: 71.77, Taf. 17.77.

cat.no. 017
Provenance: Shahdad
Excavation no.: 296-51
Museum inventory no.: 9661
Object group: beaker
Material: Cu/Br-alloy
Measurements:
max. height: 11.8 cm
Diameter: 10.4 cm (rim), 5 cm (base)
Weight: 446.8 gr
Type: D.01
Dating: 2200-1750 BCE

cat.no. 018
Provenance: Shahdad
Excavation no.: 744-55
Museum inventory no.: 7747
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 10 cm
Diameter: 11.6 cm
Weight: 385 gr
Type: D.02
Dating: 2200-1750 BCE

Table 7

cat.no. 019
Provenance: Shahdad
Excavation no.: 532-50
Museum inventory no.: 9309
Object group: beaker, goblet
Material: Cu/Br-alloy
Measurements:
max. height: 10 cm
Diameter: 6 cm (rim),
4.2 cm (base)
Weight: 109.7 gr
Type: E.01
Dating: 2200-1750 BCE
References: Hakemi 1972: 32, 274.

cat.no. 020
Provenance: Shahdad
Excavation no.: 370-50
Museum inventory no.: 9308
Object group: beaker, goblet
Material: Cu/Br-alloy
Measurements:
max. height: 7.8 cm
Diameter: 5 cm (rim),
3.5 cm (base)
Weight: 86 gr
Type: E.01
Dating: 2200-1750 BCE
References: Hakemi 1972: 31, 257.

cat.no. 021
Provenance: Shahdad
Excavation no.: 388-50
Museum inventory no.: 9310
Object group: beaker, goblet
Material: Cu/Br-alloy
Measurements:
max. height: 8.8 cm
Diameter: 8.5 cm (rim),
5 cm (base)
Weight: 144.2 gr
Type: F.01
Dating: 2200-1750 BCE
References: Hakemi 1972: 32, 279; Hakemi 1997: 632, Gh.6, 1441, Gr.139 (?).

Table 8

cat.no. 022
Provenance: Shahdad
Excavation no.: 408-50
Museum inventory no.: 9293
Object group: chalice
Material: Cu/Br-alloy
Measurements:
max. height: 11.4 cm
Diameter: 11.5 cm (rim), 5 cm (base)
Weight: 153.4 gr
Type: F.02
Dating: 2200-1750 BCE
References: Hakemi 1972: 32, 282; Hakemi 1997: 632, Gh.8, 1744, Gr.160.

cat.no. 023
Provenance: Shahdad
Excavation no.: 240-49
Museum inventory no.: 8924
Object group: chalice
Material: Cu/Br-alloy
Measurements:
max. height: 10.6 cm
Diameter: 11.8 cm (rim), 4.5 cm (base)
Weight: 119.5 gr
Type: F.02
Dating: 2200-1750 BCE
References: Hakemi 1972: 30, 232, pl. XVIII D; Hakemi 1997: 632, Gh.7, 0799, Gr.082; Bellelli 2002: 92.125, Taf. 21.125.

cat.no. 024
Provenance: Shahdad
Excavation no.: 371-50
Museum inventory no.: 9292
Object group: vase
Material: Cu/Br-alloy
Measurements:
max. height: 19.2 cm
Diameter: 8.6 cm (rim), 6.4 cm (base)
Weight: 421.9 gr
Type: F.03
Dating: 2200-1750 BCE
References: Hakemi 1972: 31, 259, pl.XVIII D; Hakemi 1997: 632, Gh.9, 1022, Gr.112.

Table 9

cat.no. 025
Provenance: Shahdad
Excavation no.: 62-48
Museum inventory no.: 8569
Object group: beaker
Material: Cu/Br-alloy
Measurements:
max. height: 8.2 cm
Diameter: 7.4 cm (rim),
6 cm (base)
Weight: 195.7 gr
Type: F.04
Dating: 2200-1750 BCE
References: Hakemi 1972: 30, 227; Hakemi 1973b: 86; Hakemi & Sajjadi 1988: 146; Hakemi 1997: 632, Gh.5, 0299, Gr.036.

cat.no. 026
Provenance: Shahdad
Excavation no.: 353-51
Museum inventory no.: 9652
Object group: beaker, goblet
Material: Cu/Br-alloy
Measurements:
max. height: 11.8 cm
Diameter: 13.6 cm (rim),
8.8 cm (base)
Weight: 469 gr
Type: F.05
Dating: 2200-1750 BCE

cat.no. 027
Provenance: Shahdad
Excavation no.: 230-49
Museum inventory no.: 8917
Object group: beaker, goblet
Material: Cu/Br-alloy
Measurements:
max. height: 10.2 cm
Diameter: 14 cm (rim),
7.8 cm (base)
Weight: 474.3 gr
Type: F.05
Dating: 2200-1750 BCE
References: Hakemi 1972: 30, 228, pl.XVI D; Bellelli 2002: 89.119, Taf.21.119.

Table 10

cat.no. 028
Provenance: Shahdad
Excavation no.: 234-49
Museum inventory no.: 8918
Object group: beaker, goblet
Material: Cu/Br-alloy
Measurements:
max. height: 10.9 cm
Diameter: 12.4 cm (rim), 7.6 cm (base)
Weight: 296.7 gr
Type: F.05
Dating: 2200-1750 BCE
References: Hakemi 1997: 632, Gh.3, 0898, Gr.096.

cat.no. 029
Provenance: Shahdad
Excavation no.: 777-55
Museum inventory no.: 7777
Object group: beaker, goblet
Material: Cu/Br-alloy
Measurements:
max. height: 7.8 cm
Diameter: 10.6 cm (rim), 6.8 cm (base)
Weight: 161 gr
Type: F.05
Dating: 2200-1750 BCE

cat.no. 030
Provenance: Shahdad
Excavation no.: 537-50
Museum inventory no.: 9288
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 8.9 cm
Diameter: 9.5 cm
Weight: 404 gr
Type: G.01
Dating: 2200-1750 BCE

Table 11

cat.no. 031
Provenance: Shahdad
Excavation no.: 535-50
Museum inventory no.: 9282
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 8.5 cm
Diameter: 9.1 cm (rim), 10.4 cm (body)
Weight: 257 gr
Type: G.01
Dating: 2200-1750 BCE
References: Hakemi 1972: 32, 278.

cat.no. 032
Provenance: Shahdad
Excavation no.: 230-50
Museum inventory no.: 9305
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 9 cm
Diameter: 10.2 cm (rim), 10.4 cm (body)
Weight: 302 gr
Type: G.01
Dating: 2200-1750 BCE
References: Hakemi 1997: Gq.12/Gq.20 (?).

cat.no. 033
Provenance: Shahdad
Excavation no.: 289-51
Museum inventory no.: 9646
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 9.2 cm
Diameter: 8.8 cm (rim)
Weight: 273.5 gr
Type: G.01
Dating: 2200-1750 BCE

Table 12

cat.no. 034
Provenance: Shahdad
Excavation no.: 231-49
Museum inventory no.: 8916
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 10.7 cm
Diameter: 9.8 cm (rim)
Weight: 336.2 gr
Type: G.01
Dating: 2200-1750 BCE

cat.no. 035
Provenance: Shahdad
Excavation no.: 216-55 / s.i.r.
Museum inventory no.:
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 9 cm
Diameter: 8.4 cm
Weight: 281.1 gr
Type: G.01
Dating: 2200-1750 BCE

cat.no. 036
Provenance: Shahdad
Excavation no.: 229-50
Museum inventory no.: 9286
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 12.9 cm
Diameter: 13.8 cm (rim), 15.4 cm (body)
Weight: 564 gr
Type: G.02
Dating: 2200-1750 BCE
References: Hakemi 1997: 628, Gc.5, 1044, Gr.114 (?).

Table 13

cat.no. 037
Provenance: Shahdad
Excavation no.: 373-50
Museum inventory no.: 9283
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 11.4 cm
Diameter: 11.2 cm (rim),
14.4 cm (body)
Weight: 359 gr
Type: G.03
Dating: 2200-1750 BCE
References: Hakemi 1997: 628,
Gc.4, 1150, Gr.119 (?).

cat.no. 038
Provenance: Shahdad
Excavation no.: 375-50
Museum inventory no.: 9301
Object group: large bowl
Material: Cu/Br-alloy
Measurements:
max. height: 9.3 cm
Diameter: 12.6 cm (rim), 5.7 cm (base)
Weight: 329 gr
Type: G.04
Dating: 2200-1750 BCE

cat.no. 039
Provenance: Shahdad
Excavation no.: 530-50
Museum inventory no.: 9302
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 10.8 cm
Diameter: 14 cm (rim), 6.5 cm (base)
Weight: 435.5 gr
Type: G.04
Dating: 2200-1750 BCE
References: Hakemi 1997: Ge.2 (?).

Table 14

cat.no. 040
Provenance: Shahdad
Excavation no.: 533-50
Museum inventory no.: 9277
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 8.4 cm
Diameter: 12.2 cm (rim), 6.2 cm (base)
Weight: 329.6 gr
Type: G.04
Dating: 2200-1750 BCE
References: Hakemi 1972: 31, 258, pl.XIX A.

cat.no. 041
Provenance: Shahdad
Excavation no.: 372-50
Museum inventory no.: 9275
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 6.7 cm
Diameter: 10.8 cm (rim), 5.8 cm (base)
Weight: 217.6 gr
Type: G.04
Dating: 2200-1750 BCE

cat.no. 042
Provenance: Shahdad
Excavation no.: 50 / 828 / 1356 (?)
Museum inventory no.: 10035
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 9.7 cm
Diameter: 15.5 cm (rim), 5 cm (base)
Weight: 412.1 gr
Type: G.04
Dating: 2200-1750 BCE

Table 15

cat.no. 043
Provenance: Shahdad
Excavation no.: 247-51
Museum inventory no.: 9658
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 8.5 cm
Diameter: 10.2 cm (rim)
Weight: 183.8 gr
Type: G.04
Dating: 2200-1750 BCE

cat.no. 044
Provenance: Shahdad
Excavation no.: 291-51
Museum inventory no.: 9660
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 10.5 cm
Diameter: 14.5 cm (rim), 6.6 cm (base)
Weight: 377 gr
Type: G.04
Dating: 2200-1750 BCE

cat.no. 045
Provenance: Shahdad
Excavation no.: 292-51
Museum inventory no.: 9659
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 8.2 cm
Diameter: 12.6 cm (rim), 4.2 cm (base)
Weight: 269 gr
Type: G.04
Dating: 2200-1750 BCE

cat.no. 046
Provenance: Shahdad
Excavation no.: 229-51
Museum inventory no.: 9663
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 10.4 cm
Diameter: 15.4 cm (rim), 4.6 cm (base)
Weight: 317.1 gr
Type: G.04
Dating: 2200-1750 BCE

cat.no. 047
Provenance: Shahdad
Excavation no.:
Museum inventory no.: 9662
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 11.4 cm
Diameter: 15.2 cm (rim), 6.2 cm (base)
Weight: 551.2 gr
Type: G.04
Dating: 2200-1750 BCE

cat.no. 048
Provenance: Shahdad
Excavation no.: 302-49
Museum inventory no.: 8925
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 10.5 cm
Diameter: 14 cm (rim), 7 cm (base)
Weight: 421.1 gr
Type: G.04
Dating: 2200-1750 BCE

Table 17

cat.no. 049
Provenance: Shahdad
Excavation no.: 374-50
Museum inventory no.: 9306
Object group: large bowl
Material: Cu/Br-alloy
Measurements:
max. height: 8.6 cm
Diameter: 9.5 cm (rim), 10.6 cm (body)
Weight: 228 gr
Type: G.05
Dating: 2200-1750 BCE

cat.no. 050
Provenance: Shahdad
Excavation no.: 536-50
Museum inventory no.: 9276
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 7.2 cm
Diameter: 8.2 cm (rim)
Weight: 139.8 gr
Type: G.05
Dating: 2200-1750 BCE
References: Hakemi 1972, 31, 256.

cat.no. 051
Provenance: Shahdad
Excavation no.: 52-56 / 825 / 1356 (?)
Museum inventory no.: 10034
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 7.2 cm
Diameter: 8 cm (rim)
Weight: 196.1 gr
Type: G.05
Dating: 2200-1750 BCE

Table 18

cat.no. 052
Provenance: Shahdad
Excavation no.: 234-51
Museum inventory no.: 9657
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 9 cm
Diameter: 9.2 cm (rim)
Weight: 257.5 gr
Type: G.05
Dating: 2200-1750 BCE

cat.no. 053
Provenance: Shahdad
Excavation no.: 216-52
Museum inventory no.: 9906
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 9.4 cm
Diameter: 10.2 cm
Weight: 389.9 gr
Type: G.05
Dating: 2200-1750 BCE

cat.no. 054
Provenance: Shahdad
Excavation no.: 401-50 / s.i.r.
Museum inventory no.:
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 7.8 cm
Diameter: 6 cm
Weight: 83 gr
Type: G.05
Dating: 2200-1750 BCE

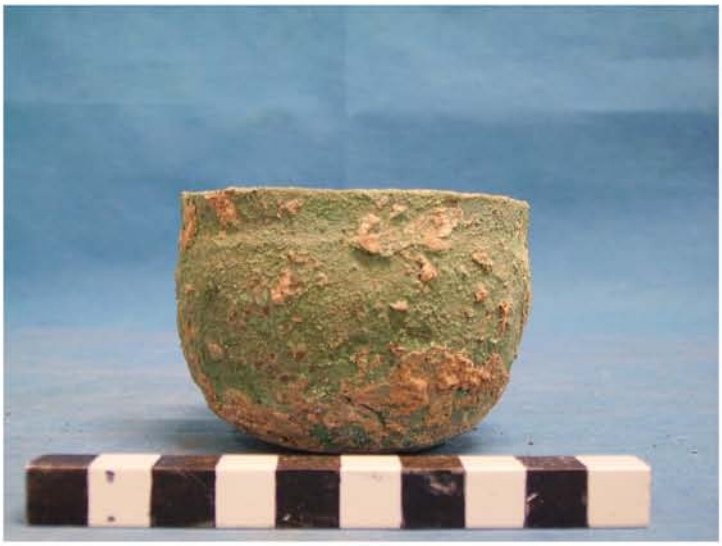


Table 19

cat.no. 055
Provenance: Shahdad
Excavation no.: 391-50 / s.i.r.
Museum inventory no.:
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 7.2 cm
Diameter:8.9 cm
Weight: 129.4 gr
Type: G.05
Dating: 2200-1750 BCE

cat.no. 056
Provenance: Shahdad
Excavation no.: 381-50
Museum inventory no.: 9281
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 12.9 cm
Diameter: 13 cm (rim), 9 cm (base)
Weight: 644.3 gr
Type: G.06
Dating: 2200-1750 BCE

cat.no. 057
Provenance: Shahdad
Excavation no.: 403-50
Museum inventory no.: 9280
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 11.4 cm
Diameter: 10.2 cm (rim), 9.6 cm (base)
Weight: 414.5 gr
Type: G.06
Dating: 2200-1750 BCE

cat.no. 058
Provenance: Shahdad
Excavation no.: 378-50
Museum inventory no.: 9300
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 10.8 cm
Diameter: 10.6 cm (rim), 8.6 cm (base)
Weight: 535.7 gr
Type: G.06
Dating: 2200-1750 BCE
References: Hakemi 1972, 32, 267.

cat.no. 059
Provenance: Shahdad
Excavation no.: 402-50
Museum inventory no.: 9279
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 10.3 cm
Diameter: 10.4 cm (rim), 6.8 cm (base)
Weight: 389.4 gr
Type: G.06
Dating: 2200-1750 BCE

cat.no. 060
Provenance: Shahdad
Excavation no.:
Museum inventory no.: 9278
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 8.8 cm
Diameter: 8.7 cm (rim), 7 cm (base)
Weight: 265.9 gr
Type: G.06
Dating: 2200-1750 BCE

Table 21

cat.no. 061
Provenance: Shahdad
Excavation no.: 377-50
Museum inventory no.: 9298
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 8.8 cm
Diameter: 9.5 cm (rim), 5.4 cm (base)
Weight: 221.5 gr
Type: G.06
Dating: 2200-1750 BCE

cat.no. 062
Provenance: Shahdad
Excavation no.: 544-50
Museum inventory no.: 9299
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 11.4 cm
Diameter: 10.4 cm (rim), 8.8 cm (base)
Weight: 490.6 gr
Type: G.06
Dating: 2200-1750 BCE

cat.no. 063
Provenance: Shahdad
Excavation no.: 545-50
Museum inventory no.: 9297
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 9.2 cm
Diameter: 9.8 cm (rim), 5.8 cm (base)
Weight: 348 gr
Type: G.06
Dating: 2200-1750 BCE

Table 22

cat.no. 064
Provenance: Shahdad
Excavation no.: 385-50
Museum inventory no.: 9296
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 10.8 cm
Diameter: 10.2 cm (rim), 7.4 cm (base)
Weight: 426.3 gr
Type: G.06
Dating: 2200-1750 BCE

cat.no. 065
Provenance: Shahdad
Excavation no.: 48-56 / 815 / 1356 (?)
Museum inventory no.: 10033
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 10 cm
Diameter: 11.4 cm (rim), 7.2 cm (base)
Weight: 484.6 gr
Type: G.06
Dating: 2200-1750 BCE

cat.no. 066
Provenance: Shahdad
Excavation no.: 49-56 / 813 / 1356 (?)
Museum inventory no.: 10032
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 10.4 cm
Diameter: 11.5 cm (rim), 7 cm (base)
Weight: 504.6 gr
Type: G.06
Dating: 2200-1750 BCE

Table 23

cat.no. 067
Provenance: Shahdad
Excavation no.: 47-56 / 862 / 1356 (?)
Museum inventory no.: 10031
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 10.4 cm
Diameter: 10.4 cm (rim), 7 cm (base)
Weight: 360.1gr
Type: G.06
Dating: 2200-1750 BCE

cat.no. 068
Provenance: Shahdad
Excavation no.: 290-51
Museum inventory no.: 9647
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 9.8 cm
Diameter: 10.6 cm (rim), 7.6 cm (base)
Weight: 345.1 gr
Type: G.06
Dating: 2200-1750 BCE

cat.no. 069
Provenance: Shahdad
Excavation no.: 27-52
Museum inventory no.: 9900
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 10 cm
Diameter: 10.6 cm (rim), 6.8 cm (base)
Weight: 355 gr
Type: G.06
Dating: 2200-1750 BCE

Table 24

cat.no. 070
Provenance: Shahdad
Excavation no.: 337-49
Museum inventory no.: 8912
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 9.5 cm
Diameter: 9 cm (rim), 7.2 cm (base)
Weight: 299.8 gr
Type: G.06
Dating: 2200-1750 BCE

cat.no. 071
Provenance: Shahdad
Excavation no.: 294/394(?)-49
Museum inventory no.: 8913
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 9.4 cm
Diameter: 8.3 cm (rim), 7.2 cm (base)
Weight: 308 gr
Type: G.06
Dating: 2200-1750 BCE

cat.no. 072
Provenance: Shahdad
Excavation no.: 236-49
Museum inventory no.: 8911
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 9.6 cm
Diameter: 9.5 cm (rim), 7.5 cm (base)
Weight: 291.9 gr
Type: G.06
Dating: 2200-1750 BCE

Table 25

cat.no. 073
Provenance: Shahdad
Excavation no.: 291-49
Museum inventory no.: 8914
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 8.6 cm
Diameter: 10.6 cm (rim), 7 cm (base)
Weight: 316.1 gr
Type: G.06
Dating: 2200-1750 BCE

cat.no. 074
Provenance: Shahdad
Excavation no.: 239-49
Museum inventory no.: 8910
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 12.4 cm
Diameter: 13.2 cm (rim), 9 cm (base)
Weight: 462.8 gr
Type: G.06
Dating: 2200-1750 BCE

cat.no. 075
Provenance: Shahdad
Excavation no.: s.i.r.
Museum inventory no.:
Object group: bowl
Material: Cu/Br-alloy
max. height: 9.6 cm
Diameter: 11.6 cm
Weight: 259.6 gr
Type: G.06
Dating: 2200-1750 BCE

Table 26

cat.no. 076
Provenance: Shahdad
Excavation no.: 409-50 / s.i.r.
Museum inventory no.:
Object group: bowl
Material: Cu/Br-alloy
Measurements:
Weight: 369.7 gr
Type: G.06
Dating: 2200-1750 BCE

cat.no. 077
Provenance: Shahdad
Excavation no.: 214-55 / s.i.r.
Museum inventory no.:
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 9.7 cm
Diameter: 8.2 cm
Weight: 506.4 gr
Type: G.06
Dating: 2200-1750 BCE

cat.no. 078
Provenance: Shahdad
Excavation no.: 210-55 / s.i.r.
Museum inventory no.:
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 9.4 cm
Diameter: 10.5 cm
Weight: 377.3 gr
Type: G.06
Dating: 2200-1750 BCE

Table 27

cat.no. 079
Provenance: Shahdad
Excavation no.: 309-1350 (?)
Museum inventory no.: 9273
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 5.3 cm
Diameter: 7.5 cm (rim)
Weight: 71.2 gr
Type: G.07
Dating: 2200-1750 BCE

cat.no. 080
Provenance: Shahdad
Excavation no.: 226-50
Museum inventory no.: 9274
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 6.5 cm
Diameter: 8.7 cm (rim), 3.45 cm (base)
Weight: 124 gr
Type: G.07
Dating: 2200-1750 BCE

cat.no. 081
Provenance: Shahdad
Excavation no.: 55-48
Museum inventory no.: 8567
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 8 cm
Diameter: 11 cm (rim), 5 cm (base)
Weight: 240 gr
Type: G.07
Dating: 2200-1750 BCE
References: Hakemi 1997, 698, Ta.5, 54-48 (?).

Table 28

cat.no. 082
Provenance: Shahdad
Excavation no.: 63-48
Museum inventory no.: 8565
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 9.1 cm
Diameter: 15.4 cm (rim), 5 cm (base)
Weight: 362.3 gr
Type: G.07
Dating: 2200-1750 BCE
References: Hakemi 1972, 29, 224, pl.XXI A; Hakemi 1997, Gg.4; Bellelli 2002, 60.53, Taf.14.53.

cat.no. 083
Provenance: Shahdad
Excavation no.: 237-51
Museum inventory no.: 9651
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 11 cm
Diameter: 8.6 cm (rim), 5.6 cm (base)
Weight: 470.1 gr
Type: G.08
Dating: 2200-1750 BCE

cat.no. 084
Provenance: Shahdad
Excavation no.: 242-51
Museum inventory no.: 9656
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 12.6 cm
Diameter: 10 cm (rim), 9.5 cm (base)
Weight: 447 gr
Type: G.08
Dating: 2200-1750 BCE
References: Hakemi 1997, Gd.2 (?).

cat.no. 085
Provenance: Shahdad
Excavation no.: 239-51
Museum inventory no.: 9650
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 9.6 cm
Diameter: 9.8 cm (rim)
Weight: 278.7 gr
Type: G.08
Dating: 2200-1750 BCE
References: Hakemi 1997, Gd.4 (?).

cat.no. 086
Provenance: Shahdad
Excavation no.: 206-52
Museum inventory no.: 9904
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 10.5 cm
Diameter: 10 cm (rim), 9 cm (base)
Weight: 319.4 gr
Type: G.08
Dating: 2200-1750 BCE
References: Hakemi 1997, 627, Gb.1, 3227, Gr.269.

cat.no. 087
Provenance: Shahdad
Excavation no.: 204-52
Museum inventory no.: 9907
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 9 cm
Diameter: 9.2 cm (rim), 8 cm (base)
Weight: 383.9 gr
Type: G.08
Dating: 2200-1750 BCE

Table 30

cat.no. 088
Provenance: Shahdad
Excavation no.: 315-51
Museum inventory no.: 9903
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 9.6 cm
Diameter: 8cm (rim), 5 cm (base)
Weight: 459.2 gr
Type: G.08
Dating: 2200-1750 BCE

cat.no. 089
Provenance: Shahdad
Excavation no.: 217-52
Museum inventory no.: 9901
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 10 cm
Diameter: 10 cm (rim), 9 cm (base)
Weight: 404.4 gr
Type: G.08
Dating: 2200-1750 BCE

cat.no. 090
Provenance: Shahdad
Excavation no.: 358-49
Museum inventory no.: 8915
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 10.4 cm
Diameter: 9.8 cm (rim), 10 cm (base)
Weight: 319.6 gr
Type: G.08
Dating: 2200-1750 BCE

cat.no. 091
Provenance: Shahdad
Excavation no.: 259-55 / s.i.r.
Museum inventory no.:
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 9.7 cm
Diameter: 9 cm
Weight: 225.5 gr
Type: G.08
Dating: 2200-1750 BCE

cat.no. 092
Provenance: Shahdad
Excavation no.: 261-55 / s.i.r.
Museum inventory no.:
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 9 cm
Weight: 314.7 gr
Type: G.08
Dating: 2200-1750 BCE

cat.no. 093
Provenance: Shahdad
Excavation no.: 246-51
Museum inventory no.: 9654
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 8.2 cm
Diameter: 8.4 cm (rim), 6.8 cm (base)
Weight: 259.7 gr
Type: G.09
Dating: 2200-1750 BCE

Table 32

cat.no. 094
Provenance: Shahdad
Excavation no.: 248-51
Museum inventory no.: 9653
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 9.6 cm
Diameter: 9.5 cm (rim), 7.6 cm (base)
Weight: 239.2 gr
Type: G.09
Dating: 2200-1750 BCE

cat.no. 095
Provenance: Shahdad
Excavation no.: 252-52
Museum inventory no.: 9648
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 7 cm
Diameter: 7.5 cm (rim), 4.6 cm (base)
Weight: 186.2 gr
Type: G.09
Dating: 2200-1750 BCE

cat.no. 096
Provenance: Shahdad
Excavation no.: 33-52
Museum inventory no.: 9899
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 8.2 cm
Diameter: 8 cm (rim), 7 cm (base)
Weight: 229.9 gr
Type: G.09
Dating: 2200-1750 BCE

Table 33

cat.no. 097
Provenance: Shahdad
Excavation no.: 218-52
Museum inventory no.: 9898
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 8.5 cm
Diameter: 8.6 cm (rim), 6.5 cm (base)
Weight: 272.1 gr
Type: G.09
Dating: 2200-1750 BCE

cat.no. 098
Provenance: Shahdad
Excavation no.: 79-52
Museum inventory no.: 9897
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 10.2 cm
Diameter: 8.5 cm (rim), 6 cm (base)
Weight: 295.1 gr
Type: G.09
Dating: 2200-1750 BCE

cat.no. 099
Provenance: Shahdad
Excavation no.:
Museum inventory no.: 9910
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 11 cm
Diameter: 11 cm (rim), 8 cm (base)
Type: G.09
Dating: 2200-1750 BCE

cat.no. 100
Provenance: Shahdad
Excavation no.: 70-48
Museum inventory no.: 8568
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 8 cm
Diameter: 10 cm (rim), 5.2 cm (base)
Weight: 306.5 gr
Type: G.09
Dating: 2200-1750 BCE

cat.no. 101
Provenance: Shahdad
Excavation no.: 238-51
Museum inventory no.: 9649
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 9 cm
Diameter: 9.2 cm (rim), 3.4 cm (base)
Weight: 346.6 gr
Type: G.10
Dating: 2200-1750 BCE

cat.no. 102
Provenance: Shahdad
Excavation no.: 207-52
Museum inventory no.: 9905
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 9.2 cm
Diameter: 9.5 cm (rim), 4.6 cm (base)
Weight: 300.8 gr
Type: G.10
Dating: 2200-1750 BCE

Table 35

cat.no. 103
Provenance: Shahdad
Excavation no.: 412-50 / s.i.r.
Museum inventory no.:
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 8.6 cm
Diameter: 8.4 cm
Weight: 150.7 gr
Type: G.10
Dating: 2200-1750 BCE

cat.no. 104
Provenance: Shahdad
Excavation no.: 25-52
Museum inventory no.: 9902
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 7 cm
Diameter: 8.6 cm (rim), 3.6 cm (base)
Weight: 304.3 gr
Type: G.10
Dating: 2200-1750 BCE

cat.no. 105
Provenance: Shahdad
Excavation no.: 207-55 / s.i.r.
Museum inventory no.:
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 7.4 cm
Diameter: 6.8 cm
Weight: 226.3 gr
Type: G.10
Dating: 2200-1750 BCE

Table 36

cat.no. 106
Provenance: Shahdad
Excavation no.: 217-55 / s.i.r.
Museum inventory no.:
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 7.4 cm
Diameter: 7 cm
Weight: 178.1 gr
Type: G.10
Dating: 2200-1750 BCE

cat.no. 107
Provenance: Shahdad
Excavation no.: 212-55 / s.i.r.
Museum inventory no.:
Object group: bowl
Material: Cu/Br-alloy
Measurements:
Weight: 473.7 gr
Type: G.10
Dating: 2200-1750 BCE

cat.no. 108
Provenance: Shahdad
Excavation no.: 60-48
Museum inventory no.: 8571
Object group: spouted bowl
Material: Cu/Br-alloy
Measurements:
max. length: 6.5 cm (spout)
max. height: 5.5 cm
Diameter: 10.2 cm (rim)
Weight: 137.9gr
Type: G.11
Dating: 2200-1750 BCE
References: Hakemi 1972, 33, 231; Bellelli 2002, 99.136, Taf.23.136.

Table 37

cat.no. 109
Provenance: Shahdad
Excavation no.: 59-48
Museum inventory no.: 8566
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 7.4 cm
Diameter: 10cm (rim), 6 cm (base)
Weight: 430.9 gr
Type: G.12
Dating: 2200-1750 BCE

cat.no. 110
Provenance: Shahdad
Excavation no.: 227-50
Museum inventory no.: 9665
Object group: deep plate
Material: Cu/Br-alloy
Measurements:
max. height: 7.2 cm
Diameter: 24 cm (rim), 24.4 cm (base)
Weight: 850.8 gr
Type: H.01
Dating: 2200-1750 BCE

cat.no. 111
Provenance: Shahdad
Excavation no.: 226-51
Museum inventory no.: 9668
Object group: deep plate
Material: Cu/Br-alloy
Measurements:
max. height: 9.4 cm
Diameter: 22 cm (rim)
Weight: 1049.6 gr
Type: H.01
Dating: 2200-1750 BCE

cat.no. 112
Provenance: Shahdad
Excavation no.: 69-48
Museum inventory no.: 8570
Object group: deep plate
Material: Cu/Br-alloy
Measurements:
max. height: 8.4 cm
Diameter: 21.6 cm
Weight: 1028.5gr
Type: H.01
Dating: 2200-1750 BCE
References: Hakemi 1972, 30, 226.

cat.no. 113
Provenance: Shahdad
Excavation no.: 225-51
Museum inventory no.:
Object group: deep plate
Material: Cu/Br-alloy
Measurements:
max. height: 8.6 cm
Diameter: 27.2 cm
Weight: 1153.7 gr
Type: H.02
Dating: 2200-1750 BCE
References: Hakemi 1997, 633, Gi.4, 2440,Gr.204.

cat.no. 114
Provenance: Shahdad
Excavation no.: 235-49
Museum inventory no.: 8922
Object group: deep plate
Material: Cu/Br-alloy
Measurements:
max. height: 6.4 cm
Diameter: 29 cm (rim)
Weight: 946.5 gr
Type: H.03
Dating: 2200-1750 BCE
References: Hakemi 1972, 30, 294, pl.XVII B; Hakemi 1997, 633, Gi.2, 0807, Gr.083; Bellelli 2002, 43.6, Taf.4.6.

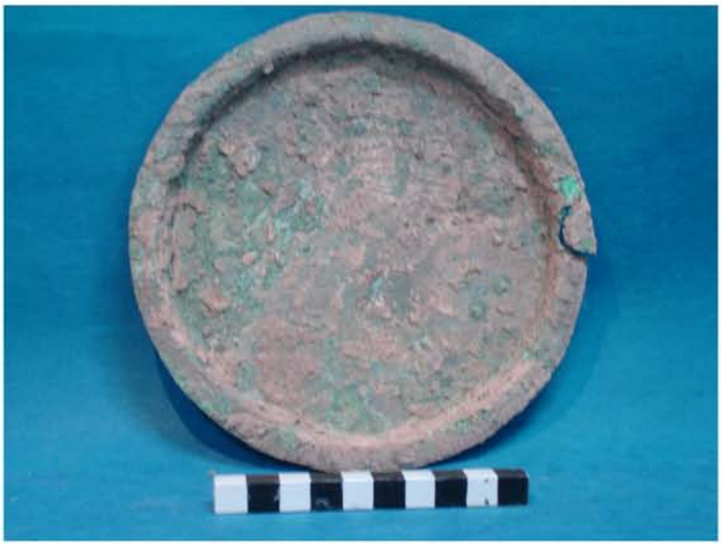
cat.no. 115
Provenance: Shahdad
Excavation no.: 294-51
Museum inventory no.: 9376
Object group: deep plate
Material: Cu/Br-alloy
Measurements:
max. height: 6 cm
Diameter: 33 cm (rim), 26.8 cm (base)
Weight: 656.8 gr
Type: I.01
Dating: 2200-1750 BCE
References: Hakemi & Sajjadi 1988, 147; Hakemi 1997, 648, Gs.7, 2890, Gr.232; Hakemi 2000, 952, Fig.5; Bellelli 2002, 43.4, Taf.3.4.

cat.no. 116
Provenance: Shahdad
Excavation no.: 293-50
Museum inventory no.: 9737
Object group: deep plate
Material: Cu/Br-alloy
Measurements:
max. height: 6.6cm
Diameter: 39.8 cm (rim), 31.4 cm (base)
Weight: 1747 gr
Type: I.02
Dating: 2200-1750 BCE
References: Hakemi 1972, 31, 252; Amiet 1973, 27; Hakemi 1973a, 82; Hakemi & Sajjadi 1988, 147, fig.3; Hakemi 1997, 646, Gs.5, 1219, Gr.122; Hakemi 2000, 949, fig.3; Bellelli 2002, 43.3, Taf.2.3.

cat.no. 117
Provenance: Shahdad
Excavation no.: 298-50
Museum inventory no.: 9375
Object group: deep plate
Material: Cu/Br-alloy
Measurements:
max. height: 3.4 cm
Diameter:27.4 cm (rim), 22.4 cm (base)
Weight: 723.2 gr
Type: I.03
Dating: 2200-1750 BCE
References: Hakemi 1972, 31, 253 (298-50); Hakemi 1997, 647, Gs.6, 1070, Gr.115; Hakemi 2000, 951, fig.4; Bellelli 2002, 43.1, Taf.1.1.

cat.no. 118
Provenance: Shahdad
Excavation no.: 750-55
Museum inventory no.: 7744
Object group: deep plate
Material: Cu/Br-alloy
Measurements:
max. height: 4.4 cm
Diameter: 36.4 cm (rim), 26.8 cm (base)
Weight: 1317 gr
Type: I.03
Dating: 2200-1750 BCE
References: Hakemi 2000, 950.

cat.no. 119
Provenance: Shahdad
Excavation no.: 228-51
Museum inventory no.: 9714
Object group: plate
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.2 cm
Diameter:16.7 cm
Weight: 116.7 gr
Type: K.01
Dating: 2200-1750 BCE
References: Hakemi 2000, 947, fig.1.



cat.no. 120
Provenance: Shahdad
Excavation no.: 383-50 / s.i.r.
Museum inventory no.:
Object group: plate
Material: Cu/Br-alloy
Measurements:
Diameter: 15 cm
Weight: 69.7 gr
Type: K.01
Dating: 2200-1750 BCE

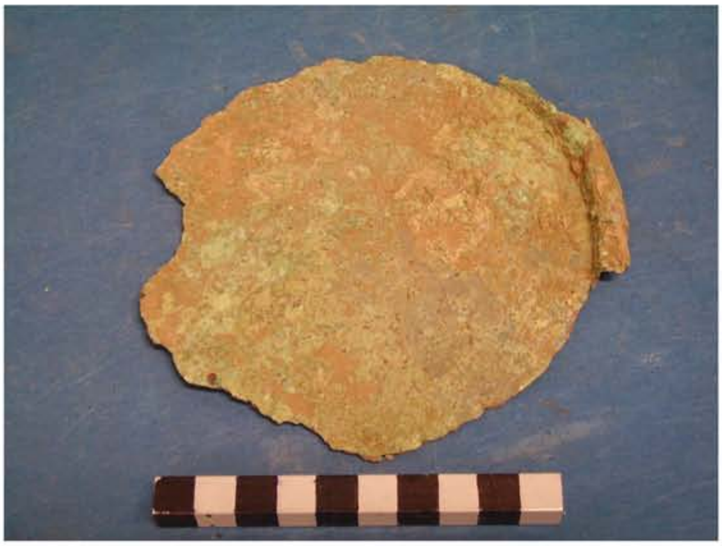
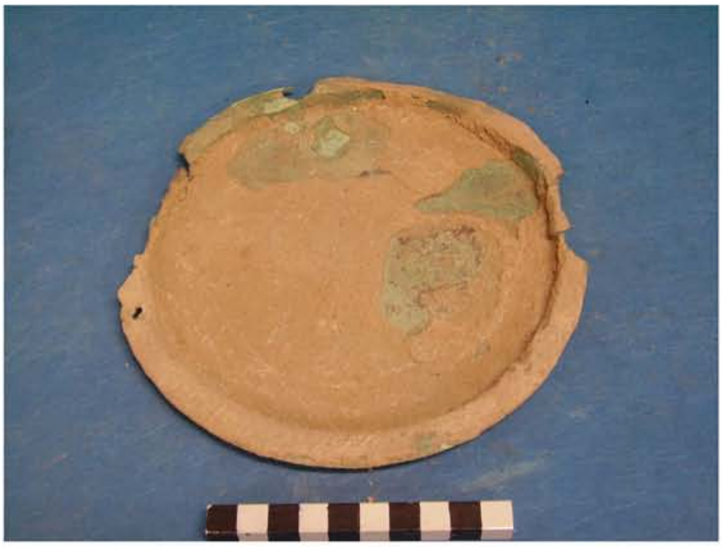


Table 41

cat.no. 121
Provenance: Shahdad
Excavation no.: 411-50 / s.i.r.
Museum inventory no.:
Object group: plate
Material: Cu/Br-alloy
Measurements:
Diameter:14.5 cm
Weight: 89.1 gr
Type: K.01
Dating: 2200-1750 BCE
References: Hakemi 1997: 644, Gs.2, 1701, Gr.158,(?).

cat.no. 122
Provenance: Shahdad
Excavation no.: 396-50 / s.i.r.
Museum inventory no.:
Object group: plate
Material: Cu/Br-alloy
Measurements:
Diameter: 18.4 cm
Weight: 193.7 gr
Type: K.01
Dating: 2200-1750 BCE



cat.no. 123
Provenance: Shahdad
Excavation no.: 213-55 / s.i.r.
Museum inventory no.:
Object group: plate
Material: Cu/Br-alloy
Measurements:
Diameter: 14.5 cm
Weight: 98 gr
Type: K.01
Dating: 2200-1750 BCE

Table 42

cat.no. 124
Provenance: Shahdad
Excavation no.: 225-50
Museum inventory no.: 9303
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 17.4 cm
Diameter: 21.5 cm (rim), 26 cm (base)
Weight: 1850 gr
Type: L.01
Dating: 2200-1750 BCE
References: Hakemi 1972, 33, 286, pl.XIX D; Hakemi 1997, 633, Gj.2, 1218, Gr.122(?); Bellelli 2002, 86.112, Taf.20.112.

cat.no. 125
Provenance: Shahdad
Excavation no.: 400-50
Museum inventory no.: 9289
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 17.2 cm
Diameter: 20.2 cm (rim),22.8 cm (body)
Weight: 1144 gr
Type: L.01
Dating: 2200-1750 BCE

cat.no. 126
Provenance: Shahdad
Excavation no.: 241-50
Museum inventory no.: 9666
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 18.5 cm
Diameter: 19.6 cm (rim), 24.6 cm (base)
Weight: 2022 gr
Type: L.01
Dating: 2200-1750 BCE
References: Hakemi 1997, 633, Gj.4, 2352, Gr.193.

Table 43

cat.no. 127
Provenance: Shahdad
Excavation no.: 227-50
Museum inventory no.: 9304
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 14.5 cm
Diameter: 15.6 cm (rim), 19.2 cm (base)
Weight: 825.2 gr
Type: L.01
Dating: 2200-1750 BCE

cat.no. 128
Provenance: Shahdad
Excavation no.: 224-50
Museum inventory no.: 9287
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 17 cm
Diameter: 18.8 cm (rim), 22.5 cm (base)
Weight: 1395 gr
Type: L.01
Dating: 2200-1750 BCE
References: Hakemi 1972, 32, 271; Hakemi 1997, 633, Gj.1, 1492, Gr.142.

cat.no. 129
Provenance: Shahdad
Excavation no.: 386-50 / s.i.r.
Museum inventory no.:
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 11.3 cm
Diameter: 14.4 cm
Weight: 598.2 gr
Type: L.01
Dating: 2200-1750 BCE

cat.no. 130
Provenance: Shahdad
Excavation no.: 215-55 / s.i.r.
Museum inventory no.:
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 17.5 cm
Diameter: 21.4 cm
Weight: 1295 gr
Type: L.01
Dating: 2200-1750 BCE

cat.no. 131
Provenance: Shahdad
Excavation no.: 228-50
Museum inventory no.: 9290
Object group: large bowl
Material: Cu/Br-alloy
Measurements:
max. height: 15.7 cm
Diameter:25.4 cm (rim), 12.2 cm (base)
Weight: 963.8 gr
Type: L.02
Dating: 2200-1750 BCE
References: Hakemi 1972, 32, 288; Hakemi 1997, Gd.5 (?).

cat.no. 132
Provenance: Shahdad
Excavation no.: 293-49
Museum inventory no.: 8919
Object group: large bowl
Material: Cu/Br-alloy
Measurements:
max. height: 15.2 cm
Diameter: 24 cm (rim), 10.5 cm (base)
Weight: 1045.7 gr
Type: L.03
Dating: 2200-1750 BCE
References: Hakemi 1997, Ge.1.

Table 45

cat.no. 133
Provenance: Shahdad
Excavation no.: 290-49
Museum inventory no.: 8920
Object group: large bowl
Material: Cu/Br-alloy
Measurements:
max. height: 17.5 cm
Diameter: 29 cm (rim), 11.5 cm (base)
Weight: 1770 gr
Type: L.04
Dating: 2200-1750 BCE
References: Hakemi 1997: 627, Ga.1., 0801, Gr.082.

cat.no. 134
Provenance: Shahdad
Excavation no.: 397-50 / s.i.r.
Museum inventory no.:
Object group: large bowl
Material: Cu/Br-alloy
Measurements:
max. height: 19.6 cm
Diameter: 18.8 cm
Weight: 1250 gr
Type: L.05
Dating: 2200-1750 BCE
References: Hakemi 1997: 628, Gc.3., 1759, Gr.161.

cat.no. 135
Provenance: Shahdad
Excavation no.: 231-50 / s.i.r.
Museum inventory no.:
Object group: bowl
Material: Cu/Br-alloy
Measurements:
max. height: 16.4 cm
Diameter: 20 cm
Weight: 1105.6 gr
Type: L.06
Dating: 2200-1750 BCE
References: Hakemi 1972, 32, 281, pl.XVI B.

cat.no. 136
Provenance: Shahdad
Excavation no.: 54-56 / 815 / 1356 (?)
Museum inventory no.: 10036
Object group: hoe, adze
Material: Cu/Br-alloy
Measurements:
max. length: 19.5 cm
max. width: 9 cm
max. thickness: 1-2 cm
Diameter: 3 cm (shafthole)
Weight: 1215 gr
Type: M.01
Dating: 2200-1750 BCE
References: Meier 2012, 28, Tab.1, MT04.

cat.no. 137
Provenance: Shahdad
Excavation no.: 298(?)-2535 / 1355
Museum inventory no.: 9711
Object group: hoe, adze
Material: Cu/Br-alloy
Measurements:
max. length: 24 cm
max. width: 11.5-8.5 cm
Weight: 2215 gr
Type: M.01
Dating: 2200-1750 BCE
References: Meier 2012, 28, Tab.1, MT05.

cat.no. 138
Provenance: Shahdad
Excavation no.: 180-51(?)
Museum inventory no.: 10110
Object group: hoe, adze
Material: Cu/Br-alloy
Measurements:
max. length: 13.4 cm
max. width: 6.5 cm
max. thickness: 5.4 cm
height: 5 cm (shaft)
Weight: 621 gr
Type: M.01
Dating: 2200-1750 BCE
References: Vatandoust 1977, 86, 8; Hakemi 1997, Gp.13.

Table 47

cat.no. 139
Provenance: Shahdad
Excavation no.:
Museum inventory no.: 10111
Object group: hoe, adze
Material: Cu/Br-alloy
Measurements:
max. length: 13.7 cm
max. width: 5.9 cm
max. thickness: 0.5-1.4 cm
height: 4.5 cm (shaft)
Weight: 362 gr
Type: M.01
Dating: 2200-1750 BCE

cat.no. 140
Provenance: Shahdad
Excavation no.: 297-51
Museum inventory no.: 10109
Object group: hoe, adze
Material: Cu/Br-alloy
Measurements:
max. length: 16.2 cm
max. width: 6.3 cm
max. thickness: 0.2-1.7 cm
height: :5.2 cm (shaft)
Weight: 513.4 gr
Type: M.01
Dating: 2200-1750 BCE
References: Vatandoust 1977, 84, 6;
Hakemi 1997, 638, Gp.12, 2844, Gr.229.

cat.no. 141
Provenance: Shahdad
Excavation no.: 523-50
Museum inventory no.: 9363
Object group: mattock
Material: Cu/Br-alloy
Measurements:
max. length: 10.5 cm
max. width: 3.4 cm
max. height: 4.2 cm
Diameter: 2.4 cm (shafthole)
Weight: 228.7 gr
Type: M.02
Dating: 2200-1750 BCE
References: Hakemi 1972, 32, 275;
Amiet, 1973, 26; Hakemi 1997, 636, Gp.2, 1726, Gr.159.

cat.no. 142
Provenance: Shahdad
Excavation no.: 521-50
Museum inventory no.: 9362
Object group: axehead
Material: Cu/Br-alloy
Measurements:
max. length: 8.6 cm
max. width: 4-4.5 cm
max. thickness: 1.5 cm
Weight: 299.6 gr
Type: M.03
Dating: 2200-1750 BCE
References: Hakemi 1972, 33, 283; Amiet, 1973, 26.

cat.no. 143
Provenance: Shahdad
Excavation no.: 209-52
Museum inventory no.: 9968
Object group: axehead
Material: Cu/Br-alloy
Measurements:
max. length: 9 cm
max. width: 5 cm
max. thickness: 0.7- 0.9 cm
Weight: 197.9 gr
Type: M.03
Dating: 2200-1750 BCE

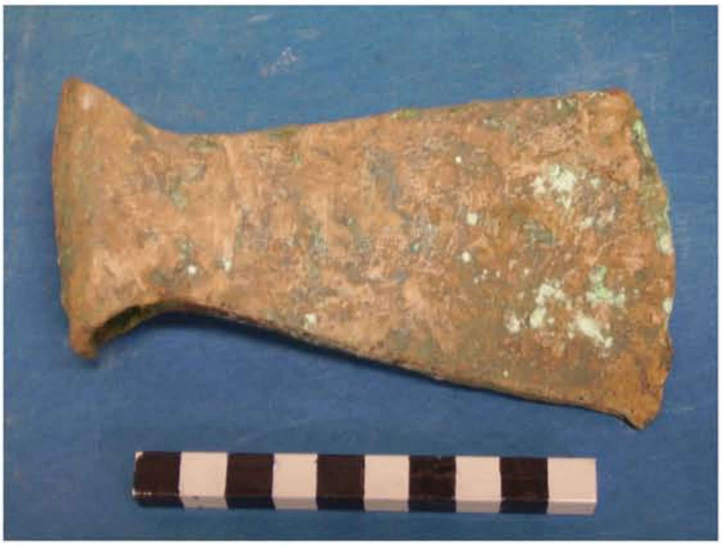
cat.no. 144
Provenance: Shahdad
Excavation no.: 522-50
Museum inventory no.: 9361
Object group: axehead
Material: Cu/Br-alloy
Measurements:
max. length: 13.5 cm
max. width: 6.7 cm (blade), 3.7 cm
max. thickness: 0.9-2.4 cm
Diameter: 3 cm (shafthole)
Weight: 780.7 gr
Type: M.03
Dating: 2200-1750 BCE
References: Hakemi 1972, 32, 277; Amiet 1973, 26, Meier 2012, 28, Tab.1, MT09.

cat.no. 145
Provenance: Shahdad
Excavation no.: 208-52
Museum inventory no.: 9967
Object group: axehead
Material: Cu/Br-alloy
Measurements:
max. length: 11.6 cm
max. width: 5.9 cm
max. thickness: 1.1 cm
Weight: 373.3 gr
Type: M.03
Dating: 2200-1750 BCE
References: Hakemi 1997, 636, Gp.1, 3416, Gr.282, Meier 2012, 28, Tab.1, MT19.

cat.no. 146
Provenance: Shahdad
Excavation no.: 232-49
Museum inventory no.: 10108
Object group: axehead
Material: Cu/Br-alloy
Measurements:
max. length: 11.7 cm
max. width: 5.4 cm
max. thickness: 0.4-1.7 cm
Height: 5.1 cm
Weight: 371.7 gr
Type: M.03
Dating: 2200-1750 BCE
References: Vatandoust 1977, 81, 1.

cat.no. 147
Provenance: Shahdad
Excavation no.: 164-51
Museum inventory no.: 10107
Object group: axehead
Material: Cu/Br-alloy
Measurements:
max. length: 13.3 cm
max. width: 5.7 cm
max. thickness: 0.2-1.5 cm
Height: 6 cm
Weight: 366.5 gr
Type: M.03
Dating: 2200-1750 BCE
References: Vatandoust 1977, 84, 3; Hakemi 1997, 638, Gp.10, 2595, Gr.213.

cat.no. 148
Provenance: Shahdad
Excavation no.:
Museum inventory no.: 10106
Object group: axehead
Material: Cu/Br-alloy
Measurements:
max. length: 14.2 cm
max. width: 7.8 cm
max. height: 6.2 cm
Weight: 662.7 gr
Type: M.03
Dating: 2200-1750 BCE



cat.no. 149
Provenance: Shahdad
Excavation no.: 113-51
Museum inventory no.: 10105
Object group: axehead
Material: Cu/Br-alloy
Measurements: axehead
max. length: 14.6 cm
max. width: 7.8 cm
max. height: 7 cm
Weight: 898.2 gr
Type: M.03
Dating: 2200-1750 BCE
References: Vatandoust 1977, 84, 5; Hakemi 1997, 638, Gp.11, 2421, Gr.203.

cat.no. 150
Provenance: Shahdad
Excavation no.: 71-51
Museum inventory no.: 10104
Object group: axehead
Material: Cu/Br-alloy
Measurements:
max. length: 10.9 cm
max. width: 5 cm
max. height: 5 cm
Weight: 258 gr
Type: M.03
Dating: 2200-1750 BCE
References: Vatandoust 1977, 83, 3; Hakemi 1997, 636, Gp.3, 2444, Gr.204.

Table 51

cat.no. 151
Provenance: Shahdad
Excavation no.: 164-51
Museum inventory no.: 7745
Object group: axehead
Material: Cu/Br-alloy
Measurements:
max. length: 14 cm
max. width: 1.8-1.9 cm (shafthole)
Weight: 318 gr
Type: M.04
Dating: 2200-1750 BCE
References: Hakemi 1997, 540ff., Gp.9, Gr.323; Bochum 2004, 591, 65.

cat.no. 152
Provenance: Shahdad
Excavation no.: 391-51
Museum inventory no.: 9716
Object group: hoe, adze (?)
Material: Cu/Br-alloy
Measurements:
max. length: 10 cm
max. width: 3-4.4 cm
max. thickness: 0.2 cm
Weight: 71.6 gr
Type: M.05
Dating: 2200-1750 BCE

cat.no. 153
Provenance: Shahdad
Excavation no.: 185-51
Museum inventory no.: 9715
Object group: hoe, adze (?)
Material: Cu/Br-alloy
Measurements:
max. length: 7.5 cm
max. width: 4.4-5.5 cm
max. thickness: 0.2 cm
Weight: 53.4 gr
Type: M.05
Dating: 2200-1750 BCE
References: Hakemi 1997, 637, Gp.6, 2889, Gr.232.

Table 52

cat.no. 154
Provenance: Shahdad
Excavation no.: 211-52
Museum inventory no.: 9969
Object group: axehead, sātur (?)
Material: Cu/Br-alloy
Measurements:
max. length: 13.3 cm
max. width: 5 cm
max. thickness: 0.15 cm
Weight: 76.2 gr
Type: M.05
Dating: 2200-1750 BCE
References: Hakemi 1997, 636, Gp.5, 3244, Gr.270.

cat.no. 155
Provenance: Shahdad
Excavation no.: 85-48
Museum inventory no.: 10112
Object group: axehead
Material: Cu/Br-alloy
Measurements:
max. length: 19.8 cm
max. width: 10 cm
max. thickness: 0.1-0.5 cm
Weight: 274.8 gr
Type: M.06
Dating: 2200-1750 BCE
References: Hakemi 1972, 29, 221; Hakemi & Sajjadi 1988, 146; Hakemi 1997, 637, Gp.8.

cat.no. 156
Provenance: Shahdad
Excavation no.: 87-48
Museum inventory no.: 8661
Object group: axehead
Material: Cu/Br-alloy
Measurements:
max. length: 15.8 cm
max. thickness: 0.4 cm
Weight: 145.7 gr
Type: M.06
Dating: 2200-1750 BCE
References: Hakemi 1972, 30, 243, pl.XX A; Amiet 1973, 27; Hakemi 1997, 693, Qa.1, 0402, Gr.047; Bochum 2004, 591, 64.

cat.no. 157
Provenance: Shahdad
Excavation no.: 86-48
Museum inventory no.: 10114
Object group: axehead
Material: Cu/Br-alloy
Measurements:
max. length: 13.2 cm
max. thickness: 0.2 cm
Weight: 81.9 gr
Type: M.06
Dating: 2200-1750 BCE
References: Hakemi 1972, 30, 242; Hakemi 1973c, 66; Hakemi 1973b, S.88; Hakemi 1997, Qa.2, 0393, Gr.45.

cat.no. 158
Provenance: Shahdad
Excavation no.:
Museum inventory no.: 10113
Object group: axehead
Material: Cu/Br-alloy
Measurements:
max. length: 14.5 cm
max. thickness: 0.2-0.5 cm
Weight: 131.5 gr
Type: M.06
Dating: 2200-1750 BCE

cat.no. 159
Provenance: Shahdad
Excavation no.:
Museum inventory no.: 10103
Object group: axehead
Material: Cu/Br-alloy
Measurements:
max. length: 15.6 cm
max. width: 3.6 cm
max. height: 7 cm
Weight: 296.8 gr
Type: M.07
Dating: 2200-1750 BCE

cat.no. 160
Provenance: Shahdad
Excavation no.: 516-50
Museum inventory no.: 9369
Object group: shafted blade
Material: Cu/Br-alloy
Measurements:
max. length: 19.5 cm
max. width: 0.9-3.75 cm
max. thickness: 0.1 cm
Weight: 52.4 gr
Type: N.01
Dating: 2200-1750 BCE

cat.no. 161
Provenance: Shahdad
Excavation no.: 171-50
Museum inventory no.: 9367
Object group: shafted blade
Material: Cu/Br-alloy
Measurements:
max. length: 23 cm
max. width: 2-4.8 cm
max. thickness: 0.1 cm
Weight: 86.2 gr
Type: N.02
Dating: 2200-1750 BCE

cat.no. 162
Provenance: Shahdad
Excavation no.: 172-50
Museum inventory no.: 9368
Object group: shafted blade
Material: Cu/Br-alloy
Measurements:
max. length: 18.5 cm
max. width: 1.2-3.6 cm
max. thickness: 0.1 cm
Weight: 41.9 gr
Type: N.02
Dating: 2200-1750 BCE

cat.no. 163
Provenance: Shahdad
Excavation no.: 169-50
Museum inventory no.: 9364
Object group: dagger
Material: Cu/Br-alloy
Measurements:
max. length: 35.4 cm
max. width: 1.6-5.4 cm, 1.4 cm (hilt)
max. thickness: 0.5 cm
Weight: 158.2 gr
Type: N.03
Dating: 2200-1750 BCE
References: Hakemi 1997, 639, Gq.2, 1494, Gr.142; Meier 2012, 28, Tab.1, MT06.

cat.no. 164
Provenance: Shahdad
Excavation no.: 524-50
Museum inventory no.: 9366
Object group: dagger
Material: Cu/Br-alloy
Measurements:
max. length: 30.7 cm
max. width: 2-4.5 cm, 1 cm (hilt)
max. thickness: 0.4 cm
Weight: 97.4 gr
Type: N.04
Dating: 2200-1750 BCE
References: Hakemi 1972, 33, 290; Hakemi 997, 639, Gq.1, 1816, Gr.165.

cat.no. 165
Provenance: Shahdad
Excavation no.:
Museum inventory no.: 9365
Object group: dagger
Material: Cu/Br-alloy
Measurements:
max. length: 20.6 cm
max. width: 2-3.5 cm, 0.8 cm (hilt)
max. thickness: 0.4 cm
Weight: 40.7 gr
Type: N.04
Dating: 2200-1750 BCE

cat.no. 166
Provenance: Shahdad
Excavation no.: 219-51
Museum inventory no.: 9705
Object group: dagger
Material: Cu/Br-alloy
Measurements:
max. length: 33.4 cm
max. width: 2-4 cm
max. thickness: 0.2 cm
Weight: 139 gr
Type: N.04
Dating: 2200-1750 BCE
References: Hakemi 1997, 640, Gq.10, 2555, Gr.193 (?).

cat.no. 167
Provenance: Shahdad
Excavation no.: 221-52
Museum inventory no.: 9961
Object group: dagger
Material: Cu/Br-alloy
Measurements:
max. length: 34.5 cm (compl.), 9 cm (hilt)
max. width: 1-4.6 cm
max. thickness: 0.1 cm
Weight: 144.5 gr
Type: N.04
Dating: 2200-1750 BCE
References: Hakemi 1997, 640, Gq.17, 3469, Gr.288

cat.no. 168
Provenance: Shahdad
Excavation no.: 224-52
Museum inventory no.: 9959
Object group: dagger
Material: Cu/Br-alloy
Measurements:
max. length: 33.4 cm
max. width: 1.4-4.4 cm
max. thickness: 0.1 cm
Weight: 118.5 gr
Type: N.04
Dating: 2200-1750 BCE

cat.no. 169
Provenance: Shahdad
Excavation no.: 226-52
Museum inventory no.: 9960
Object group: dagger
Material: Cu/Br-alloy
Measurements:
max. length: 38.6 cm
max. width: 1-5 cm
max. thickness: 0.1 cm
Weight: 213.5 gr
Type: N.04
Dating: 2200-1750 BCE
References: Hakemi 1997, Gq.16.

cat.no. 170
Provenance: Shahdad
Excavation no.: E5 Gr.856
Museum inventory no.: 10044
Object group: knife
Material: Cu/Br-alloy
Measurements:
max. length: 11.7 cm
max. width: 1.1 cm (blade), 0,5 cm (hilt)
max. thickness: 0.1 cm
Weight: 9.9 gr
Type: N.05
Dating: 2200-1750 BCE

cat.no. 171
Provenance: Shahdad
Excavation no.: 170-50
Museum inventory no.: 9815
Object group: tapering bar
Material: Cu/Br-alloy
Measurements:
max. length: 13 cm
max. width: 1.8-3 cm
Weight: 594.5 gr
Type: N.06
Dating: 2200-1750 BCE
References: Hakemi 1972, 32, 270; Vatandoust 1977, 92, 12; Bochum 2004, 591, 63; Meier 2012, 28, Tab.1, MT07.

cat.no. 172
Provenance: Shahdad
Excavation no.: 525-50
Museum inventory no.: 9356
Object group: blade
Material: Cu/Br-alloy
Measurements:
max. length: 15.3 cm
max. width: 2.2 cm (blade)
max. thickness: 0.1 cm (blade),
1.2 cm (hilt)
Weight: 58.3 gr
Type: N.07
Dating: 2200-1750 BCE
References: Meier 2012, 28, Tab.1, MT11.

cat.no. 173
Provenance: Shahdad
Excavation no.: 128-50
Museum inventory no.: 9341
Object group: adze
Material: Cu/Br-alloy
Measurements:
max. length: 22.4 cm
max. width: 2.5-4 cm
max. thickness: 0.5 cm
Weight: 240.5 gr
Type: N.08
Dating: 2200-1750 BCE

cat.no. 174
Provenance: Shahdad
Excavation no.: 378-50
Museum inventory no.: 9342
Object group: adze
Material: Cu/Br-alloy
Measurements:
max. length: 23.9 cm
max. width: 2.3-3.6 cm
max. thickness: 0.6 cm
Weight: 258 gr
Type: N.08
Dating: 2200-1750 BCE
References: Hakemi 1972, 32, 267; Meier 2012, 28, Tab.1, MT10.

cat.no. 175
Provenance: Shahdad
Excavation no.: 220-52
Museum inventory no.: 9971
Object group: adze
Material: Cu/Br-alloy
Measurements:
max. length: 23.5 cm
max. width: 2.5-4.1 cm
max. thickness: 0.5 cm
Weight: 277.3 gr
Type: N.08
Dating: 2200-1750 BCE
References: Hakemi 1997, 637, Gp.7, 3467, Gr.288; Meier 2012, 28, Tab.1, MT18.

cat.no. 176
Provenance: Shahdad
Excavation no.: 222-52
Museum inventory no.: 9970
Object group: adze
Material: Cu/Br-alloy
Measurements:
max. length: 23.2 cm
max. width: 2.8-4.3 cm
max. thickness: 0.6 cm
Weight: 380 gr
Type: N.08
Dating: 2200-1750 BCE

cat.no. 177
Provenance: Shahdad
Excavation no.:
Museum inventory no.: 8589
Object group: adze
Material: Cu/Br-alloy
Measurements:
max. length: 23.4 cm
max. width: 4.7 cm
max. thickness: 0.7 cm
Diameter:
Weight: 372.6 gr
Type: N.08
Dating: 2200-1750 BCE

Table 60

cat.no. 178
Provenance: Shahdad
Excavation no.: 747-55
Museum inventory no.: 7749
Object group: adze
Material: Cu/Br-alloy
Measurements:
max. length: 24.1 cm
max. width: 3.2 cm
max. thickness: 0.6 cm
Weight: 290 gr
Type: N.08
Dating: 2200-1750 BCE

cat.no. 179
Provenance: Shahdad
Excavation no.: 225-52
Museum inventory no.: 9962
Object group: shafted blade
Material: Cu/Br-alloy
Measurements:
max. length: 21.8 cm
max. width: 4.1 cm
max. thickness: 0.1 cm
Weight: 73.4 gr
Type: N.09
Dating: 2200-1750 BCE
References: Hakemi 1997, Gq.13.

cat.no. 180
Provenance: Shahdad
Excavation no.: 228-52
Museum inventory no.: 9963
Object group: shafted blade
Material: Cu/Br-alloy
Measurements:
max. length: 17 cm
max. width: 2.5 cm
max. thickness: 0.1 cm
Weight: 38.4 gr
Type: N.10
Dating: 2200-1750 BCE
References: Hakemi 1997, Gq.14.

cat.no. 181
Provenance: Shahdad
Excavation no.: 229-52
Museum inventory no.: 9964
Object group: shafted blade
Material: Cu/Br-alloy
Measurements:
max. length: 15.7 cm
max. width: 2 cm
max. thickness: 0.1 cm
Weight: 28.4 gr
Type: N.11
Dating: 2200-1750 BCE
References: Hakemi 1997, Gq.11.

cat.no. 182
Provenance: Shahdad
Excavation no.: 278-52
Museum inventory no.: 9965
Object group: shafted blade
Material: Cu/Br-alloy
Measurements:
max. length: 8.8 cm
max. width: 2.3 cm
max. thickness: 0.1 cm
Weight: 11.8 gr
Type: N.12
Dating: 2200-1750 BCE

cat.no. 183
Provenance: Shahdad
Excavation no.: 284-52
Museum inventory no.: 9966
Object group: shafted blade
Material: Cu/Br-alloy
Measurements:
max. length: 7.3 cm
max. width: 2 cm
max. thickness: 0.1 cm
Weight: 10.1 gr
Type: N.12
Dating: 2200-1750 BCE
References: Hakemi 1997, Gq.19.

Table 62

cat.no. 184
Provenance: Shahdad
Excavation no.: 75-48
Museum inventory no.: 8590
Object group: blade, adze(?)
Material: Cu/Br-alloy
Measurements:
max. length: 17.7 cm
max. width: 4.8 cm
max. thickness: 0.1 cm
Weight: 93.6 gr
Type: N.13
Dating: 2200-1750 BCE

cat.no. 185
Provenance: Shahdad
Excavation no.: 153-48
Museum inventory no.: 8634
Object group: shafted blade
Material: Cu/Br-alloy
Measurements:
max. length: 12.3 cm
max. width: 2.5 cm
max. thickness: 0.1 cm
Weight: 17.5 gr
Type: N.14
Dating: 2200-1750 BCE

cat.no. 186
Provenance: Shahdad
Excavation no.: 155-48
Museum inventory no.: 8633
Object group: shafted blade
Material: Cu/Br-alloy
Measurements:
max. length: 7.5 cm
max. width: 2 cm
max. thickness: 0.3 cm
Weight: 11.1 gr
Type: N.15
Dating: 2200-1750 BCE

Table 63

cat.no. 187
Provenance: Shahdad
Excavation no.: 154-48
Museum inventory no.: 8632
Object group: shafted blade
Material: Cu/Br-alloy
Measurements:
max. length: 14.6 cm
max. width: 3 cm
max. thickness: 0.1 cm
Weight: 46.7 gr
Type: N.16
Dating: 2200-1750 BCE

cat.no. 188
Provenance: Shahdad
Excavation no.: 359-49
Museum inventory no.: 8907
Object group: dagger
Material: Cu/Br-alloy
Measurements:
max. length: 21 cm
max. width: 4.3 cm
max. thickness: 0.1 cm
Weight: 60.5 gr
Type: N.17
Dating: 2200-1750 BCE
References: Hakemi 1972, 30, 238.

cat.no. 189
Provenance: Shahdad
Excavation no.: 233-49
Museum inventory no.: 8906
Object group: dagger
Material: Cu/Br-alloy
Measurements:
max. length: 26 cm
max. width: 6.4 cm
max. thickness: 0.1 cm
Weight: 125.6 gr
Type: N.18
Dating: 2200-1750 BCE
References: Hakemi 1997, 640, Gq.8, 0789, Gr.081.

cat.no. 190
Provenance: Shahdad
Excavation no.: 177-50 / s.i.r.
Museum inventory no.:
Object group: shafted blade
Material: Cu/Br-alloy
Measurements:
max. length: 7.8 cm
max. thickness: 0.2 cm
Weight: 9.7 gr
Type: N.19
Dating: 2200-1750 BCE

cat.no. 191
Provenance: Shahdad
Excavation no.: 205-50 / s.i.r.
Museum inventory no.:
Object group: shafted blade
Material: Cu/Br-alloy
Measurements:
max. length: 12 cm
max. width: 2.6 cm
max. thickness: 0.2-0.4 cm
Weight: 30.7 gr
Type: N.20
Dating: 2200-1750 BCE

cat.no. 192
Provenance: Shahdad
Excavation no.: s.i.r.
Museum inventory no.:
Object group: shafted blade
Material: Cu/Br-alloy
Measurements:
max. length: 23.9 cm
max. width: 3.9 cm
max. thickness: 0.1 cm
Weight: 50.9 gr
Type: N.21
Dating: 2200-1750 BCE
References: Hakemi 1997, 639, Gq.4 (223-52 (?).

Table 65

cat.no. 193
Provenance: Shahdad
Excavation no.: 219-55 / s.i.r.
Museum inventory no.:
Object group: shafted blade
Material: Cu/Br-alloy
Measurements:
max. length: 32.4 cm
max. width: 5 cm
Weight: 130.1 gr
Type: N.21
Dating: 2200-1750 BCE

cat.no. 194
Provenance: Shahdad
Excavation no.: 369-50
Museum inventory no.: 9370
Object group: shafted blade, saw (?)
Material: Cu/Br-alloy
Measurements:
max. length: 50.2 cm (compl.),
39.8 cm (blade)
max. width: 4.5-8.5 cm
max. thickness: 0.1 cm
Weight: 289.8 gr
Type: N.22
Dating: 2200-1750 BCE
References: Hakemi 1972, 32, 268,
pl.XX C; Hakemi 1997, 639, Gq.7, 1046, Gr.114.

cat.no. 195
Provenance: Shahdad
Excavation no.: 484-50
Museum inventory no.: 9371
Object group: macehead
Material: Pb-alloy
Measurements:
max. height: 5.7 cm
Diameter: 4.4 cm (head), 2.6 cm (neck)
Weight: 399.6 gr
Type: O.01
Dating: 2200-1750 BCE
References: Hakemi 1997, 635, Go.1,
1558, Gr.147.

cat.no. 196
Provenance: Shahdad
Excavation no.: 482-50
Museum inventory no.: 9372
Object group: macehead
Material: Pb-alloy
Measurements:
max. height: 4.6 cm
Diameter: 4.6 cm (head), 2.6 cm (neck)
Weight: 345 gr
Type: O.02
Dating: 2200-1750 BCE
References: Hakemi 1997, 635, Go.2, 1334, Gr.131.

cat.no. 197
Provenance: Shahdad
Excavation no.: 485-50
Museum inventory no.: 9373
Object group: macehead
Material: Pb-alloy
Measurements:
max. height: 3.6 cm
Diameter: 3 cm (head), 2.8 cm (base)
Weight: 124.8 gr
Type: O.03
Dating: 2200-1750 BCE
References: Hakemi 1997, 635, Go.3, 1443, Gr.139.

cat.no. 198
Provenance: Shahdad
Excavation no.: 299-50
Museum inventory no.: 8660
Object group: macehead
Material: Cu/Br-alloy
Measurements:
max. height: 9.2 cm
max. thickness: 0.5-0.8 cm
Diameter: 3.7 cm
Weight: 387.9 gr
Type: O.03
Dating: 2200-1750 BCE
References: Hakemi 1972, 31, 261 (399-50(?)); Amiet 1973, 23; Vatandoust 1977, 88.9; Hakemi 1997, 635, Go.4, 1344, Gr.132.

Table 67

cat.no. 199
Provenance: Shahdad
Excavation no.: 301-50
Museum inventory no.: 9403
Object group: ring
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.4 cm
Diameter: 4 cm
Weight: 8.4 gr
Type: P.01
Dating: 2200-1750 BCE

cat.no. 200
Provenance: Shahdad
Excavation no.: 305-50
Museum inventory no.: 9395
Object group: ring
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.6 cm
Diameter: 1.5 cm
Weight: 3.4 gr
Type: P.02
Dating: 2200-1750 BCEt

cat.no. 201
Provenance: Shahdad
Excavation no.: 304-50
Museum inventory no.: 9396
Object group: ring
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.6 cm
Diameter: 1.4 cm
Weight: 4.5 gr
Type: P.02
Dating: 2200-1750 BCE

cat.no. 202
Provenance: Shahdad
Excavation no.:
Museum inventory no.: 9399 a,b
Object group: ring
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.6 cm (a), 0.5 cm (b)
Diameter: 1.7 cm (a), 1.8 cm (b)
Weight: 7.1 gr (a), 7.5 gr (b)
Type: P.02
Dating: 2200-1750 BCE

cat.no. 203
Provenance: Shahdad
Excavation no.:
Museum inventory no.: 9402 a,b
Object group: ring
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.5 cm (a), 0.6 cm (b)
Diameter: 1.5 cm (a), 1.3 cm (b)
Weight: 2.3 gr (a), 4.4 gr (b)
Type: P.02
Dating: 2200-1750 BCE

cat.no. 204
Provenance: Shahdad
Excavation no.:
Museum inventory no.: 9401 a,b
Object group: ring
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.5 cm (a), 0.2 cm (b)
Diameter: 1.9 cm (a), 1.5 cm (b)
Weight: 2.1 gr (a), 0.9 gr (b)
Type: P.02
Dating: 2200-1750 BCE

Table 69

cat.no. 205
Provenance: Shahdad
Excavation no.:
Museum inventory no.: 9400 a,b
Object group: ring
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.5 cm (a), 0.4 cm (b)
Diameter: 1.6 cm (a), 1.7 cm (b)
Weight: 4.1 gr (a), 4.1 gr (b)
Type: P.02
Dating: 2200-1750 BCE

cat.no. 206
Provenance: Shahdad
Excavation no.: 415-51
Museum inventory no.: 9736 a,b
Object group: ring
Material: Cu/Br-alloy
Measurements:
max. width: 1.9 cm (a), 1,8 cm (b)
max. thickness: 0.7 cm (a), 0.6 cm (b)
Weight: 4.8 gr (a), 3.6 cm (b)
Type: P.02
Dating: 2200-1750 BCE

cat.no. 207
Provenance: Shahdad
Excavation no.: 412-51
Museum inventory no.: 9724
Object group: ring
Material: Cu/Br-alloy
Measurements:
max. width: 0.5 cm
Diameter: 1.5 cm
Weight: 2.1 gr
Type: P.02
Dating: 2200-1750 BCE

cat.no. 208
Provenance: Shahdad
Excavation no.: 411-51
Museum inventory no.: 9723
Object group: ring
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.5 cm
Diameter: 1.6 cm
Weight: 4.3 gr
Type: P.02
Dating: 2200-1750 BCE

cat.no. 209
Provenance: Shahdad
Excavation no.: 413-51
Museum inventory no.: 9725 a,b
Object group: ring
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.7 cm (a), 0.7 cm (b)
Diameter: 1.4 cm (a),1.6 cm (b)
Weight: 2.8 gr (a), 1.8 gr (b)
Type: P.02
Dating: 2200-1750 BCE

cat.no. 210
Provenance: Shahdad
Excavation no.: 142-48
Museum inventory no.: 8630 a,b
Object group: ring
Material: Cu/Br-alloy
Measurements:
Diameter: 2.1 cm (a), 2 cm (b)
Weight: 8.1 gr (a), 6.8 gr (b)
Type: P.02
Dating: 2200-1750 BCE

cat.no. 211
Provenance: Shahdad
Excavation no.: 142-48
Museum inventory no.: 8631 a,b
Object group: ring
Material: Cu/Br-alloy
Measurements:
Diameter: 1.9 cm (a), 1.9 cm (b)
Weight: 6 gr (a),4.7 gr (b)
Type: P.02
Dating: 2200-1750 BCE

cat.no. 212
Provenance: Shahdad
Excavation no.: 547-50 / s.i.r.
Museum inventory no.:
Object group: ring
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.8 cm
Diameter: 1.8 cm
Weight: 3.1 gr
Type: P.02
Dating: 2200-1750 BCE

cat.no. 213
Provenance: Shahdad
Excavation no.: 550-50 / s.i.r.
Museum inventory no.:
Object group: ring
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.9 cm
Weight: 7.8 gr
Type: P.02
Dating: 2200-1750 BCE

cat.no. 214
Provenance: Shahdad
Excavation no.: 751-55
Museum inventory no.: 7660 a,b
Object group: ring
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.6 cm (a), 0.6 cm (b)
Diameter: 2.1 cm (a), 2.1 cm (b)
Weight: 7.6 gr (a), 7.6 gr (b)
Type: P.02
Dating: 2200-1750 BCE

cat.no. 215
Provenance: Shahdad
Excavation no.: 787-51
Museum inventory no.: 7661 a,b
Object group: ring
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.4 cm (a), 0.4 cm (b)
Diameter: 1.9 cm (a), 2.1 cm (b)
Weight: 2.5 gr (a), 3 gr (b)
Type: P.02
Dating: 2200-1750 BCE

cat.no. 216
Provenance: Shahdad
Excavation no.: 747-55
Museum inventory no.: 7626
Object group: ring
Material: Cu/Br-alloy
Measurements:
max. height: 1.6 cm
Diameter: 2.1 cm
Weight: 6.4 gr
Type: P.03
Dating: 2200-1750 BCE

Table 73

cat.no. 217
Provenance: Shahdad
Excavation no.: 276-52
Museum inventory no.: 9911
Object group: ring
Material: Cu/Br-alloy
Measurements:
max. length: 22.5 cm
max. thickness: 0.4 cm
Diameter: 7.9 cm
Weight: 39.1 gr
Type: P.04
Dating: 2200-1750 BCE

cat.no. 218
Provenance: Shahdad
Excavation no.: 138-49
Museum inventory no.: 8580
Object group: ring
Material: Cu/Br-alloy
Measurements:
max. length: 20.4 cm
max. thickness: 0.35 cm
Weight: 20.8 gr
Type: P.04
Dating: 2200-1750 BCE

cat.no. 219
Provenance: Shahdad
Excavation no.: 131-48 (?)
Museum inventory no.: 8582
Object group: ring
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.4 cm
Diameter: 7.6 cm
Weight: 79.6 gr
Type: P.04
Dating: 2200-1750 BCE

Table 74

cat.no. 220
Provenance: Shahdad
Excavation no.: 134-48
Museum inventory no.: 8581
Object group: ring
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.6 cm
Diameter: 6.6 cm
Weight: 19.1 gr
Type: P.04
Dating: 2200-1750 BCE

cat.no. 221
Provenance: Shahdad
Excavation no.: 129-48
Museum inventory no.: 8584
Object group: ring
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.6 cm
Diameter: 7 cm
Weight: 59.4 gr
Type: P.04
Dating: 2200-1750 BCE
References: Hakemi 1997, 691, Pa.1, 0383, Gr.044 (?).

cat.no. 222
Provenance: Shahdad
Excavation no.: 131-48
Museum inventory no.: 8583
Object group: ring
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.8 cm
Diameter: 7.6 cm
Weight: 73 gr
Type: P.04
Dating: 2200-1750 BCE

Table 75

cat.no. 223
Provenance: Shahdad
Excavation no.: 135-48
Museum inventory no.: 8586
Object group: ring
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.5 cm
Diameter: 6.2 cm
Weight: 20.7 gr
Type: P.04
Dating: 2200-1750 BCE

cat.no. 224
Provenance: Shahdad
Excavation no.: 129-48
Museum inventory no.: 8585
Object group: ring
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.6 cm
Diameter: 9.7 cm
Weight: 63.6 gr
Type: P.04
Dating: 2200-1750 BCE
References: Hakemi 1997, 691, Pa.1, 0383, Gr.044 (?).

cat.no. 225
Provenance: Shahdad
Excavation no.: 135-48
Museum inventory no.: 8587
Object group: ring
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.5 cm
Diameter: 7 cm
Weight: 21.3 gr
Type: P.04
Dating: 2200-1750 BCE

cat.no. 226
Provenance: Shahdad
Excavation no.: 136-48
Museum inventory no.: 8577
Object group: ring
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.65 cm
Diameter: 6.4 cm
Weight: 44.9 gr
Type: P.04
Dating: 2200-1750 BCE
References: Hakemi 1997, 699, Ua.4, 0408, Gr.048.

cat.no. 227
Provenance: Shahdad
Excavation no.: 130-48
Museum inventory no.: 8576
Object group: ring
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.5 cm
Diameter: 6 cm
Weight: 34.2 gr
Type: P.04
Dating: 2200-1750 BCE
References: Hakemi 1997, 691, Pa.2, 0391, Gr.045.

cat.no. 228
Provenance: Shahdad
Excavation no.: 130-48
Museum inventory no.: 8577
Object group: ring
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.5 cm
Diameter: 6.5 cm
Weight: 42.2 gr
Type: P.04
Dating: 2200-1750 BCE
References: Hakemi 1997, 691, Pa.2, 0391, Gr.045.

Table 77

cat.no. 229
Provenance: Shahdad
Excavation no.: 132-48 (?)
Museum inventory no.: 8578
Object group: ring
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.5 cm
Diameter: 6.8 cm
Weight: 27 gr
Type: P.04
Dating: 2200-1750 BCE

cat.no. 230
Provenance: Shahdad
Excavation no.: 132-48
Museum inventory no.: 8579
Object group: ring
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.6 cm
Diameter: 6 cm
Weight: 36.2 gr
Type: P.04
Dating: 2200-1750 BCE

cat.no. 231
Provenance: Shahdad
Excavation no.: 133-48
Museum inventory no.: 8582
Object group: ring
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.6 cm
Diameter: 7 cm
Weight: 49.7 gr
Type: P.04
Dating: 2200-1750 BCE

Table 78

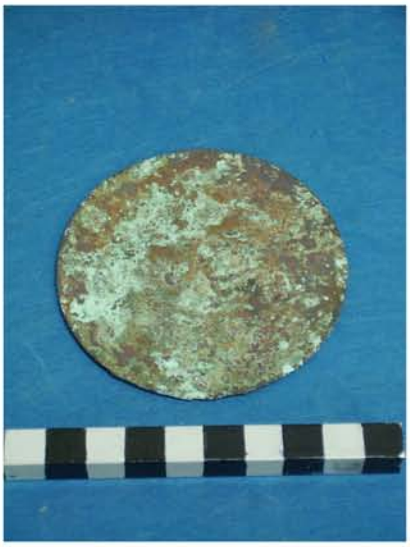
cat.no. 232
Provenance: Shahdad
Excavation no.: 133-48
Museum inventory no.: 8583
Object group: ring
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.5 cm
Diameter: 7 cm
Weight: 36.9 gr
Type: P.04
Dating: 2200-1750 BCE

cat.no. 233
Provenance: Shahdad
Excavation no.: 137-48
Museum inventory no.: 8574
Object group: ring
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.5 cm
Diameter: 6.7 cm
Weight: 52.8 gr
Type: P.04
Dating: 2200-1750 BCE

cat.no. 234
Provenance: Shahdad
Excavation no.: 137-48
Museum inventory no.: 8575
Object group: ring
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.7 cm
Diameter: 7 cm
Weight: 57.2 gr
Type: P.04
Dating: 2200-1750 BCE

Table 79

cat.no. 235
Provenance: Shahdad
Excavation no.: 382-50
Museum inventory no.: 9359
Object group: disc
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.1 cm
Diameter: 8 cm
Weight: 24.8 gr
Type: Q.01
Dating: 2200-1750 BCE
References: Hakemi 1972, 32, 264;
Hakemi 1997, 654, Gv.2, 1099, Gr.116.



cat.no. 236
Provenance: Shahdad
Excavation no.: 389-50
Museum inventory no.: 9360
Object group: disc
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.1 cm
Diameter: 6.7 cm
Weight: 16.4 gr
Type: Q.01
Dating: 2200-1750 BCE
References: Hakemi 1972, 31, 263.

cat.no. 237
Provenance: Shahdad
Excavation no.: 232-51
Museum inventory no.: 9713
Object group: disc
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.1 cm
Diameter: 7.9 cm
Weight: 32.8 gr
Type: Q.01
Dating: 2200-1750 BCE

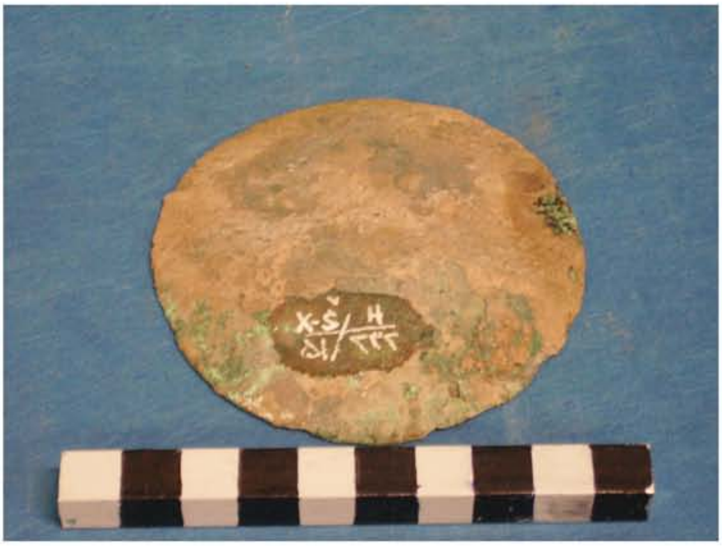
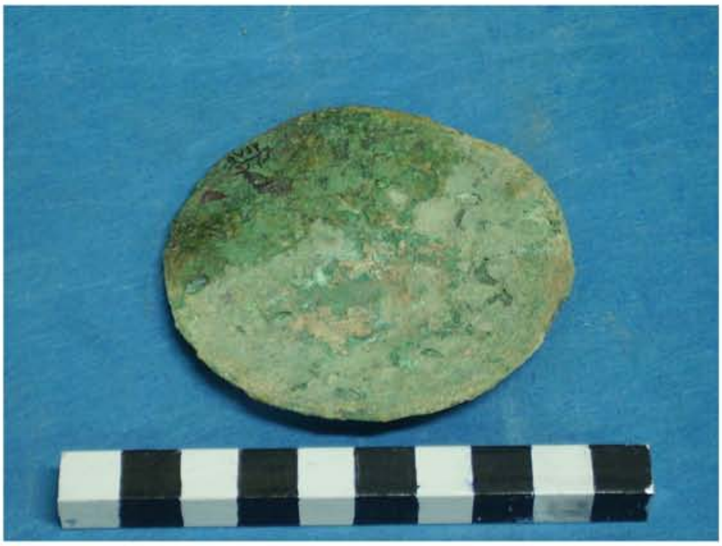
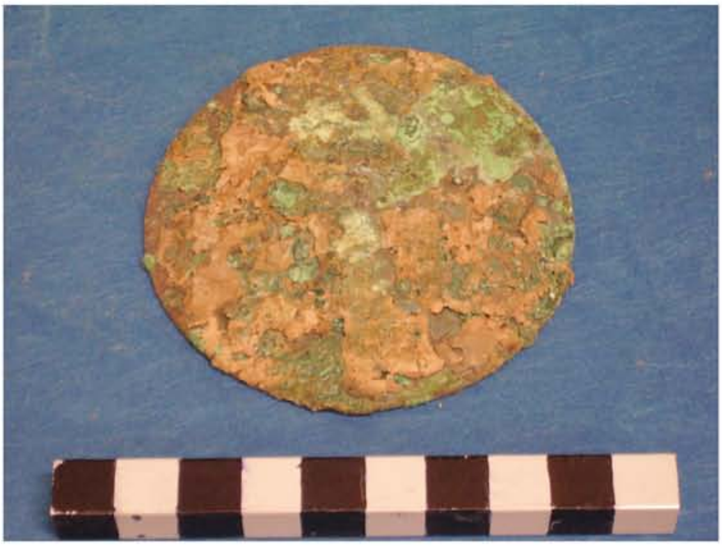


Table 80

cat.no. 238
Provenance: Shahdad
Excavation no.: 233-51
Museum inventory no.: 9712
Object group: disc
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.1 cm
Diameter: 7.4 cm
Weight: 44 gr
Type: Q.01
Dating: 2200-1750 BCE



cat.no. 239
Provenance: Shahdad
Excavation no.: 288-52
Museum inventory no.: 9973
Object group: disc
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.2 cm
Diameter: 7.5 cm
Weight: 32.6 gr
Type: Q.01
Dating: 2200-1750 BCE



cat.no. 240
Provenance: Shahdad
Excavation no.:
Museum inventory no.: 7748
Object group: disc
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.1 cm
Diameter: 6.5 cm
Weight: 36.1 gr
Type: Q.01
Dating: 2200-1750 BCE

Table 81

cat.no. 241
Provenance: Shahdad
Excavation no.: 203-52
Museum inventory no.: 9972
Object group: disc
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.2 cm
Diameter: 8.7 cm
Weight: 65.5 gr
Type: Q.01
Dating: 2200-1750 BCE

cat.no. 242
Provenance: Shahdad
Excavation no.: 74-48
Museum inventory no.: 10102
Object group: mirror
Material: Cu/Br-alloy
Measurements:
max. length: 22.2 cm
max. thickness: 0.1 cm
Diameter: 13.6 cm
Weight: 100.1 gr
Type: Q.02
Dating: 2200-1750 BCE
References: Hakemi 1972, 30, 240, pl. XXI C; Ashtana 1984, 355, fig.39.2.2; Hakemi 1997, 692, Pa.4, 0388, Gr.045.

cat.no. 243
Provenance: Shahdad
Excavation no.: 315-50 / s.i.r.
Museum inventory no.:
Object group: button, disc
Material: Cu/Br-alloy
Measurements:
max. thickness: 0.1 cm
Diameter: 2.6 cm
Weight: 1.6 gr
Type: Q.03
Dating: 2200-1750 BCE

cat.no. 244
Provenance: Shahdad
Excavation no.: 749-55
Museum inventory no.: 7752
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 24.1 cm
max. thickness: 0.4-1.4 cm
Weight: 95.6 gr
Type: R.01
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 245
Provenance: Shahdad
Excavation no.: 796-55
Museum inventory no.: 7773
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 28.5 cm
max. thickness: 0.25-0.9 cm
Weight: 80.4 gr
Type: R.01
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 246
Provenance: Shahdad
Excavation no.: 264-49
Museum inventory no.: 8870
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 20.9 cm
max. thickness: 0.4-0.9 cm
Weight: 37.2 gr
Type: R.01
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 247
Provenance: Shahdad
Excavation no.: 365-49
Museum inventory no.: 8876
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 16.7 cm
max. thickness: 0.3-0.7 cm
Weight: 33.3 gr
Type: R.01
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 248
Provenance: Shahdad
Excavation no.: 280-49
Museum inventory no.: 8886
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 25.3 cm
max. thickness: 0.5-0.9 cm
Weight: 79.5 gr
Type: R.01
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 249
Provenance: Shahdad
Excavation no.: 200-51
Museum inventory no.: 9670
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 35.7 cm
max. thickness: 0.3-1.2 cm
Weight: 162.3 gr
Type: R.01
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 250
Provenance: Shahdad
Excavation no.: 300-51
Museum inventory no.: 9672
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 33.1 cm
max. thickness: 0.4-0.9 cm
Weight: 91.4 gr
Type: R.01
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 251
Provenance: Shahdad
Excavation no.: 287-51
Museum inventory no.: 9676
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 22.1 cm
max. thickness: 0.2-0.8 cm
Weight: 39.9 gr
Type: R.01
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 252
Provenance: Shahdad
Excavation no.: 212-51
Museum inventory no.: 9688
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 22.5 cm
max. thickness: 0.4-0.6 cm
Weight: 37.1 gr
Type: R.01
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 253
Provenance: Shahdad
Excavation no.: 512-50
Museum inventory no.: 9689
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 20.7 cm
max. thickness: 0.4-0.6 cm
Weight: 40.4 gr
Type: R.01
Dating: 2200-1750 BCE
References: Hakemi 1997, Gk.2; Meier 2008, 50-55.

cat.no. 254
Provenance: Shahdad
Excavation no.: 216-51
Museum inventory no.: 9692
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 13.7 cm
max. thickness: 0.4-0.6 cm
Weight: 21.9 gr
Type: R.01
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 255
Provenance: Shahdad
Excavation no.: 251-52
Museum inventory no.: 9936
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 26.4 cm
max. thickness: 0.4-1.2 cm
Weight: 77.7 gr
Type: R.01
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

Table 86

cat.no. 256
Provenance: Shahdad
Excavation no.: 241-52
Museum inventory no.: 9946
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 29.5 cm
max. thickness: 0.4-1.2 cm
Weight: 11.6 gr
Type: R.01
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 257
Provenance: Shahdad
Excavation no.:
Museum inventory no.: 10037
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 29.8 cm
max. thickness: 0.4-0.8 cm
Weight: 85.8 gr
Type: R.01
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 258
Provenance: Shahdad
Excavation no.: 252-55 / s.i.r.
Museum inventory no.:
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 20.2 cm
max. thickness: 0.4-0.9 cm
Weight: 64.4 gr
Type: R.01
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 259
Provenance: Shahdad
Excavation no.: 234-55 / s.i.r.
Museum inventory no.:
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 27.5 cm
max. thickness: 0.4-1.2 cm
Weight: 94.3 gr
Type: R.01
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 260
Provenance: Shahdad
Excavation no.: 741-55
Museum inventory no.: 7755
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 22.5 cm
max. thickness: 0.2-0.7 cm
Weight: 61.8 gr
Type: R.02
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 261
Provenance: Shahdad
Excavation no.: 719-55
Museum inventory no.: 7767
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 19.7 cm
max. thickness: 0.2-0.6 cm
Weight: 55.1 gr
Type: R.02
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

Table 88

cat.no. 262
Provenance: Shahdad
Excavation no.: 761-55
Museum inventory no.: 7770
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 32.4 cm
max. thickness: 0.3-0.9 cm
Weight: 87.8 gr
Type: R.02
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 263
Provenance: Shahdad
Excavation no.: 787-55
Museum inventory no.: 7772
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 30.4 cm
max. thickness: 0.3-0.9 cm
Weight: 74.7 gr
Type: R.02
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 264
Provenance: Shahdad
Excavation no.: 96-48
Museum inventory no.: 8591
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 27.6 cm
max. thickness: 0.4-0.9 cm
Weight: 90.6 gr
Type: R.02
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 265
Provenance: Shahdad
Excavation no.: 91-48
Museum inventory no.: 8594
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 33.7 cm
max. thickness: 0.4-1.1 cm
Weight: 182 gr
Type: R.02
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 266
Provenance: Shahdad
Excavation no.: 93-48
Museum inventory no.: 8595
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 28.9 cm
max. thickness: 0..5-1.1 cm
Weight: 190.1 gr
Type: R.02
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 267
Provenance: Shahdad
Excavation no.: 102-48
Museum inventory no.: 8603
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 20.4 cm
max. thickness: 0.3-0.7 cm
Weight: 52.3 gr
Type: R.02
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

Table 90

cat.no. 268
Provenance: Shahdad
Excavation no.: 110-48
Museum inventory no.: 8605
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 16.6 cm
max. thickness: 0.2-0.7 cm
Weight: 51.6 gr
Type: R.02
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 269
Provenance: Shahdad
Excavation no.: 103-48
Museum inventory no.: 8607
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 19.2 cm
max. thickness: 00.4-0.8 cm
Weight: 60.5 gr
Type: R.02
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 270
Provenance: Shahdad
Excavation no.: 99-48
Museum inventory no.: 8609
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 14.8 cm
max. thickness: 0.6-0.8 cm
Weight: 50.8 gr
Type: R.02
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

Table 91

cat.no. 271
Provenance: Shahdad
Excavation no.: 107-48
Museum inventory no.: 8611
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 15.2 cm
max. thickness: 0.3-0.6 cm
Weight: 52.4 gr
Type: R.02
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 272
Provenance: Shahdad
Excavation no.: 260-49
Museum inventory no.: 8879
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 20.6 cm
max. thickness: 0.3-0.8 cm
Weight: 71.3 gr
Type: R.02
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 273
Provenance: Shahdad
Excavation no.: 282-49
Museum inventory no.: 8882
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 26.7 cm
max. thickness: 0.4-0.7 cm
Weight: 80.4 gr
Type: R.02
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 274
Provenance: Shahdad
Excavation no.: 363-49
Museum inventory no.: 8884
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 23.9 cm
max. thickness: 0.3-0.9 cm
Weight: 90.3 gr
Type: R.02
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 275
Provenance: Shahdad
Excavation no.: 272-49
Museum inventory no.: 8885
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 25.5 cm
max. thickness: 0.6-1 cm
Weight: 123.7 gr
Type: R.02
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 276
Provenance: Shahdad
Excavation no.: 340-49
Museum inventory no.: 8889
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 34 cm
max. thickness: 0.3-0.9 cm
Weight: 140.1 gr
Type: R.02
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

Table 93

cat.no. 277
Provenance: Shahdad
Excavation no.: 517-50
Museum inventory no.: 9321
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 23.6 cm
max. thickness: 0.3-0.7 cm
Weight: 42.6 gr
Type: R.02
Dating: 2200-1750 BCE
References: Hakemi 1997, Gg.2; Meier 2008, 50-55.

cat.no. 278
Provenance: Shahdad
Excavation no.: 193-50
Museum inventory no.: 9355
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 16 cm
max. thickness: 0.2-0.7 cm
Diameter: 1.9cm (head)
Weight: 49.9 gr
Type: R.02
Dating: 2200-1750 BCE
References: Hakemi 1997, 651, Gu.9, 1280, Gr.126 (?); Meier 2008, 50-55.

cat.no. 279
Provenance: Shahdad
Excavation no.: 205-51
Museum inventory no.: 9671
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 31 cm
max. thickness: 0.4-0.9 cm
Weight: 108.5 gr
Type: R.02
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

Table 94

cat.no. 280
Provenance: Shahdad
Excavation no.: 209-51
Museum inventory no.: 9674
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 22.5 cm
max. thickness: 0.3-0.8 cm
Weight: 44.3 gr
Type: R.02
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 281
Provenance: Shahdad
Excavation no.: 256-51
Museum inventory no.: 9675
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 24.9 cm
max. thickness: 0.4-1 cm
Weight: 65.1 gr
Type: R.02
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 282
Provenance: Shahdad
Excavation no.: 201-50/51 (?)
Museum inventory no.: 9678
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 31.8 cm
max. thickness: 0.15-1.3 cm
Weight: 146.7 gr
Type: R.02
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 283
Provenance: Shahdad
Excavation no.: 259-51
Museum inventory no.: 9690
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 35.2 cm
max. thickness: 0.2-1.2 cm
Weight: 177 gr
Type: R.02
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 284
Provenance: Shahdad
Excavation no.: 258-51
Museum inventory no.: 9691
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 29 cm
max. thickness: 0.4-1.3 cm
Weight: 93.2 gr
Type: R.02
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 285
Provenance: Shahdad
Excavation no.: 204-51
Museum inventory no.: 9693
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 21.6 cm
max. thickness: 0.3-1 cm
Weight: 83.1 gr
Type: R.02
Dating: 2200-1750 BCE
References: Hakemi 1997, Gu.6 (?); Meier 2008, 50-55.

cat.no. 286
Provenance: Shahdad
Excavation no.: 254-52
Museum inventory no.: 9914
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 19.2 cm
max. thickness: 0.4-1 cm
Weight: 45.7 gr
Dating: 2200-1750 BCE
Type: R.02
References: Meier 2008, 50-55.

cat.no. 287
Provenance: Shahdad
Excavation no.:
Museum inventory no.: 9915
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 13.2 cm
max. thickness: 0.5-1 cm
Weight: 50.9 gr
Type: R.02
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 288
Provenance: Shahdad
Excavation no.: 257-52
Museum inventory no.: 9916
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 21.1 cm
max. thickness: 0.3-0.6 cm
Weight: 54.4 gr
Type: R.02
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

Table 97

cat.no. 289
Provenance: Shahdad
Excavation no.: 269-52
Museum inventory no.: 9917
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 17 cm
max. thickness: 0.5-1 cm
Weight: 50.2 gr
Type: R.02
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 290
Provenance: Shahdad
Excavation no.: 244-52
Museum inventory no.: 9938
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 20.6 cm
max. thickness: 0.4-1.4 cm
Weight: 101.1 gr
Type: R.02
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 291
Provenance: Shahdad
Excavation no.: 250-52
Museum inventory no.: 9939
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 20.5 cm
max. thickness: 0.4-1 cm
Weight: 46.3 gr
Type: R.02
Dating: 2200-1750 BCE
References: Meier 2012, 28, Tab.1, MT17.

cat.no. 292
Provenance: Shahdad
Excavation no.: 249-52
Museum inventory no.: 9940
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 20.9 cm
max. thickness: 0.4-1 cm
Weight: 65 gr
Type: R.02
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 293
Provenance: Shahdad
Excavation no.: 388-49
Museum inventory no.: 10100
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 20.4 cm
max. thickness: 0.4-0.9 cm
Weight: 43.2 gr
Type: R.02
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 294
Provenance: Shahdad
Excavation no.: 749-55
Museum inventory no.: 7753
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 32.5 cm
max. thickness: 0.4-0.8 cm
Weight: 78.5 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 295
Provenance: Shahdad
Excavation no.: 747-55 (?)
Museum inventory no.: 7756
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 24.9 cm
max. thickness: 0.4-0.9 cm
Weight: 63 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 296
Provenance: Shahdad
Excavation no.: 708-55
Museum inventory no.: 7760
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 37.4 cm
max. thickness: 0.4-1 cm
Weight: 152.2 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 297
Provenance: Shahdad
Excavation no.: 786-55
Museum inventory no.: 7761
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 43.2 cm
max. thickness: 0.4-1.4 cm
Weight: 177.7 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 298
Provenance: Shahdad
Excavation no.: 785-55
Museum inventory no.: 7766
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 24.7 cm
max. thickness: 0.4-0.7 cm
Weight: 70.3 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 299
Provenance: Shahdad
Excavation no.: 762-55
Museum inventory no.: 7768
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 35.7 cm
max. thickness: 0.4-0.9 cm
Weight: 105.6 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 300
Provenance: Shahdad
Excavation no.: 729-55
Museum inventory no.: 7771
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 23.2 cm
max. thickness: 0.4-0.6 cm
Weight: 65.6 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 301
Provenance: Shahdad
Excavation no.: 94-48
Museum inventory no.: 8596
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 33.2 cm
max. thickness: 0.4-1 cm
Weight: 91 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 302
Provenance: Shahdad
Excavation no.: 90-48
Museum inventory no.: 8597
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 40.3 cm
max. thickness: 0.4-0.9 cm
Weight: 127.9 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 303
Provenance: Shahdad
Excavation no.: 101-48
Museum inventory no.: 8601
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 21.4 cm
max. thickness: 0.5-0.7 cm
Weight: 67.3 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 304
Provenance: Shahdad
Excavation no.: 109-48
Museum inventory no.: 8604
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 18 cm
max. thickness: 0.5-1 cm
Weight: 63.6 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 305
Provenance: Shahdad
Excavation no.: 97-48
Museum inventory no.: 8606
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 23.6 cm
max. thickness: 0.4-0.8 cm
Weight: 83.6 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 306
Provenance: Shahdad
Excavation no.: 104-48
Museum inventory no.: 8608
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 20.8 cm
max. thickness: 0.3-0.7 cm
Weight: 50.9 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 307
Provenance: Shahdad
Excavation no.: 98-48
Museum inventory no.: 8613
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 22.8 cm
max. thickness: 0.3-0.6 cm
Weight: 43.9 gr
Type: R.03
Dating: 2200-1750 BCE
References: Hakemi 1972, 31, 268 (?); Meier 2008, 50-55.

cat.no. 308
Provenance: Shahdad
Excavation no.: 281-49
Museum inventory no.: 8869
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 17.9 cm
max. thickness: 0.5-0.7 cm
Weight: 57.9 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 309
Provenance: Shahdad
Excavation no.: 265-49
Museum inventory no.: 8871
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 20 cm
max. thickness: 0.4-0.8 cm
Weight: 64.8 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 310
Provenance: Shahdad
Excavation no.: 283-49
Museum inventory no.: 8872
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 16.7 cm
max. thickness: 0.2-0.7 cm
Weight: 53 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 311
Provenance: Shahdad
Excavation no.: 276-49
Museum inventory no.: 8873
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 15.4 cm
max. thickness: 0.4-1 cm
Weight: 70.3 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 312
Provenance: Shahdad
Excavation no.: 287-49
Museum inventory no.: 8874
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 18.1 cm
max. thickness: 0.2-0.5 cm
Weight: 28.1 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 313
Provenance: Shahdad
Excavation no.: 284-49
Museum inventory no.: 8875
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 17 cm
max. thickness: 0.4-0.8 cm
Weight: 49.3 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 314
Provenance: Shahdad
Excavation no.: 278-49
Museum inventory no.: 8880
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 25.9 cm
max. thickness: 0.3-0.6 cm
Weight: 38.4 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 315
Provenance: Shahdad
Excavation no.: 258-49
Museum inventory no.: 8881
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 29.7 cm
max. thickness: 0.2-0.7 cm
Weight: 55 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 316
Provenance: Shahdad
Excavation no.: 285-49
Museum inventory no.: 8883
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 26 cm
max. thickness: 0.3-0.8 cm
Weight: 69.5 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 317
Provenance: Shahdad
Excavation no.: 279-49
Museum inventory no.: 8887
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 30.5 cm
max. thickness: 0.2-0.9 cm
Weight: 98.3 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 318
Provenance: Shahdad
Excavation no.: 339-49
Museum inventory no.: 8888
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 32.4 cm
max. thickness: 0.2-0.9 cm
Weight: 103.7 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 319
Provenance: Shahdad
Excavation no.: 266-49
Museum inventory no.: 8890
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 38.5 cm
max. thickness: 0.4-0.9 cm
Weight: 101.5 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 320
Provenance: Shahdad
Excavation no.: 271-49
Museum inventory no.: 8891
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 41.1 cm
max. thickness: 0.3-1 cm
Weight: 170.2 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 321
Provenance: Shahdad
Excavation no.: 275-49
Museum inventory no.: 8892
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 38.5 cm
max. thickness: 0.4-1.1 cm
Weight: 182.7 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 322
Provenance: Shahdad
Excavation no.: 201-50
Museum inventory no.: 9314
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 23.2 cm
max. thickness: 0.3-0.7 cm
Weight: 91.2 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 323
Provenance: Shahdad
Excavation no.: 515-50
Museum inventory no.: 9315
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 27 cm
max. thickness: 0.3-0.8 cm
Weight: 111.4 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2012, 28, Tab.1, MT12.

cat.no. 324
Provenance: Shahdad
Excavation no.: 194-50
Museum inventory no.: 9316
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 28 cm
max. thickness: 0.3-0.5 cm
Weight: 51.1 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 325
Provenance: Shahdad
Excavation no.: 195-50
Museum inventory no.: 9317
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 26.4 cm
max. thickness: 0.3-0.6 cm
Weight: 55.9 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 326
Provenance: Shahdad
Excavation no.: 192-50
Museum inventory no.: 9318
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 27.1 cm
max. thickness: 0.3-0.6 cm
Weight: 52.7 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 327
Provenance: Shahdad
Excavation no.: 200-50
Museum inventory no.: 9319
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 24.5 cm
max. thickness: 0.3-0.7 cm
Weight: 54.4 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 328
Provenance: Shahdad
Excavation no.: 516-50
Museum inventory no.: 9320
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 26.2 cm
max. thickness: 0.3-0.6 cm
Weight: 51.9 gr
Type: R.03
Dating: 2200-1750 BCE
References: Hakemi 1997, Gd.1 (?); Meier 2008, 50-55.

cat.no. 329
Provenance: Shahdad
Excavation no.: 191-50
Museum inventory no.: 9322
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 21.2 cm
max. thickness: 0.4-0.9 cm
Weight: 50.4 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 330
Provenance: Shahdad
Excavation no.:
Museum inventory no.: 9323
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 20 cm
max. thickness: 0.2-0.8 cm
Weight: 50.8 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 331
Provenance: Shahdad
Excavation no.: 186-50
Museum inventory no.: 9324
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 19.4 cm
max. thickness: 0.2-0.4 cm
Weight: 31.8 gr
Type: R.03
Dating: 2200-1750 BCE
References: Hakemi 1997, Gu.7; Meier 2008, 50-55.

cat.no. 332
Provenance: Shahdad
Excavation no.: 190-50
Museum inventory no.: 9325
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 15.3 cm
max. thickness: 0.5-1.0 cm
Weight: 58.4 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 333
Provenance: Shahdad
Excavation no.: 513-50
Museum inventory no.: 9328
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 50.8 cm
max. thickness: 0.5-1.5 cm
Weight: 383.7 gr
Type: R.03
Dating: 2200-1750 BCE
References: Hakemi 1997, Gc.1; Meier 2008, 50-55.

cat.no. 334
Provenance: Shahdad
Excavation no.: 198-50
Museum inventory no.: 9329
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 40 cm
max. thickness: 0.5-1.5 cm
Weight: 254.4 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 335
Provenance: Shahdad
Excavation no.: 380-50
Museum inventory no.: 9330
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 42.7 cm
max. thickness: 0.3-1.7 cm
Weight: 239.8 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 336
Provenance: Shahdad
Excavation no.: 196-50
Museum inventory no.: 9331
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 44.1 cm
max. thickness: 0.5-1.2 cm
Weight: 169.5 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

Table 113

cat.no. 337
Provenance: Shahdad
Excavation no.: 204/207(?)-50
Museum inventory no.: 9332
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 40.4 cm
max. thickness: 0.4-1 cm
Weight: 177.6 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 338
Provenance: Shahdad
Excavation no.: 514-50
Museum inventory no.: 9333
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 42.7 cm
max. thickness: 0.4-1.2 cm
Weight: 182 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 339
Provenance: Shahdad
Excavation no.: 215-50
Museum inventory no.: 9334
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 41 cm
max. thickness: 0.4-1.4 cm
Weight: 249.2 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

Table 114

cat.no. 340
Provenance: Shahdad
Excavation no.: 509-50
Museum inventory no.: 9335
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 36.2 cm
max. thickness: 0.4-1.3 cm
Weight: 189.2 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2012, 28, Tab.1, MT13.

cat.no. 341
Provenance: Shahdad
Excavation no.: 405-50
Museum inventory no.: 9336
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 37.5 cm
max. thickness: 0.3-0.9 cm
Weight: 161.2 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2012, 28, Tab.1, MT14.

cat.no. 342
Provenance: Shahdad
Excavation no.: 199-50
Museum inventory no.: 9337
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 38.9 cm
max. thickness: 0.4-0.9 cm
Weight: 134.6 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 343
Provenance: Shahdad
Excavation no.: 508-50
Museum inventory no.: 9338
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 30.3 cm
max. thickness: 0.5-0.9 cm
Weight: 100.7 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 344
Provenance: Shahdad
Excavation no.: 197-50
Museum inventory no.: 9339
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 32.5 cm
max. thickness: 0.4-0.8 cm
Weight: 95.8 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 345
Provenance: Shahdad
Excavation no.: 203-50
Museum inventory no.: 9340
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 47.5 cm
max. thickness: 0.3-1.1 cm
Weight: 223.8 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 346
Provenance: Shahdad
Excavation no.: 203-51
Museum inventory no.: 9673
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 31.4 cm
max. thickness: 0.3-0.9 cm
Weight: 82.4 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 347
Provenance: Shahdad
Excavation no.: 285-51
Museum inventory no.: 9677
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 24 cm
max. thickness: 0.4-1.2 cm
Weight: 100.6 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 348
Provenance: Shahdad
Excavation no.: 204-51
Museum inventory no.: 9679
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 37.8 cm
max. thickness: 0.3-0.8 cm
Weight: 86.2 gr
Type: R.03
Dating: 2200-1750 BCE
References: Hakemi 1997, Gu.6 (?); Meier 2008, 50-55.

cat.no. 349
Provenance: Shahdad
Excavation no.: 260-51
Museum inventory no.: 9680
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 38 cm
max. thickness: 0.4-1 cm
Weight: 232.1 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 350
Provenance: Shahdad
Excavation no.: 257-51
Museum inventory no.: 9681
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 27.7 cm
max. thickness: 0.6-1.3 cm
Weight: 116.3 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 351
Provenance: Shahdad
Excavation no.: 278-51
Museum inventory no.: 9682
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 36.3 cm
max. thickness: 0.5-1.3 cm
Weight: 123.4 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 352
Provenance: Shahdad
Excavation no.: 286-51
Museum inventory no.: 9683
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 33.8 cm
max. thickness: 0.3-1.2 cm
Weight: 91.5 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 353
Provenance: Shahdad
Excavation no.: 208-51
Museum inventory no.: 9685
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 27.6 cm
max. thickness: 0.4-0.7 cm
Weight: 60.7 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 354
Provenance: Shahdad
Excavation no.: 199-51
Museum inventory no.: 9686
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 49.2 cm
max. thickness: 0.4-1.5 cm
Weight: 346.9 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 355
Provenance: Shahdad
Excavation no.: 261-52
Museum inventory no.: 9912
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 19 cm
max. thickness: 0.5 cm
Weight: 29.4 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 356
Provenance: Shahdad
Excavation no.: 258-52
Museum inventory no.: 9913
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 24 cm
max. thickness: 0.4-0.6 cm
Weight: 58.9 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 357
Provenance: Shahdad
Excavation no.: 242-52
Museum inventory no.: 9937
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 20.2 cm
max. thickness: 0.5-1.2 cm
Weight: 82.5 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2012, 28, Tab.1, MT16.

cat.no. 358
Provenance: Shahdad
Excavation no.: 253-52
Museum inventory no.: 9941
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 30.2 cm
max. thickness: 0.4-0.8 cm
Weight: 56.1 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 359
Provenance: Shahdad
Excavation no.: 255-52
Museum inventory no.: 9942
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 23 cm
max. thickness: 0.6-0.9 cm
Weight: 66.6 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 360
Provenance: Shahdad
Excavation no.: 252-52
Museum inventory no.: 9943
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 31.2 cm
max. thickness: 0.3-0.9 cm
Weight: 85.1 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 361
Provenance: Shahdad
Excavation no.: 242-52
Museum inventory no.: 9944
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 25.1 cm
max. thickness: 0.3-1.2 cm
Weight: 122.4 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 362
Provenance: Shahdad
Excavation no.: 246-52
Museum inventory no.: 9945
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 31.9 cm
max. thickness: 0.3-1 cm
Weight: 98.4 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 363
Provenance: Shahdad
Excavation no.: 247-52
Museum inventory no.: 9947
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 34.7 cm
max. thickness: 0.2-0.6 cm
Weight: 86.9 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 364
Provenance: Shahdad
Excavation no.: 237-52
Museum inventory no.: 9948
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 42.2 cm
max. thickness: 0.5-1.2 cm
Weight: 204.5 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 365
Provenance: Shahdad
Excavation no.: 240-52
Museum inventory no.: 9949
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 27.4 cm
max. thickness: 0.2-1.1 cm
Weight: 109.3 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 366
Provenance: Shahdad
Excavation no.: 235-52 (?)
Museum inventory no.: 9950
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 40.4 cm
max. thickness: 0.5-1.1 cm
Weight: 159.9 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

Table 123

cat.no. 367
Provenance: Shahdad
Excavation no.: 238-52
Museum inventory no.: 9951
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 42.9 cm
max. thickness: 0.3-1.4 cm
Weight: 172.7 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 368
Provenance: Shahdad
Excavation no.: 245-52
Museum inventory no.: 9952
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 37 cm
max. thickness: 0.5-1 cm
Weight: 112 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 369
Provenance: Shahdad
Excavation no.: 235-52 (?)
Museum inventory no.: 9953
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 43.5 cm
max. thickness: 0.4-1.2 cm
Weight: 183.7 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 370
Provenance: Shahdad
Excavation no.: 282(?)-52
Museum inventory no.: 9954
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 50.7 cm
max. thickness: 0.5-1 cm
Weight: 310.9 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 371
Provenance: Shahdad
Excavation no.: 236-52
Museum inventory no.: 9955
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 29.1 cm
max. thickness: 0.3-1.2 cm
Weight: 124.9 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 372
Provenance: Shahdad
Excavation no.: 234-52
Museum inventory no.: 9956
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 51.6 cm
max. thickness: 0.4-1.6 cm
Weight: 352 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 373
Provenance: Shahdad
Excavation no.: 233-52
Museum inventory no.: 9957
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 35.4 cm
max. thickness: 0.6-1.2 cm
Weight: 186 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 374
Provenance: Shahdad
Excavation no.: 232-52
Museum inventory no.: 9958
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 41.7 cm
max. thickness: 0.3-1.2 cm
Weight: 182.9 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 375
Provenance: Shahdad
Excavation no.:
Museum inventory no.: 11039
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 14.8 cm
max. thickness: 0.3-0.8 cm
Weight: 45.1 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

Table 126

cat.no. 376
Provenance: Shahdad
Excavation no.: 288-49
Museum inventory no.: 10101
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 24 cm
max. thickness: 0.4-1 cm
Weight: 45.5 gr
Type: R.03
Dating: 2200-1750 BCE
References: Vatandoust 1977, 92.13; Meier 2008, 50-55.

cat.no. 377
Provenance: Shahdad
Excavation no.: 204-50 / s.i.r.
Museum inventory no.:
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 31.6 cm
max. thickness: 0.8-1.2 cm
Weight: 144.1 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 378
Provenance: Shahdad
Excavation no.: 235-55 / s.i.r.
Museum inventory no.:
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 30.4 cm
max. thickness: 0.4-1.1 cm
Weight: 103.5 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 379
Provenance: Shahdad
Excavation no.: 254-55 / s.i.r.
Museum inventory no.:
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 22.7 cm
max. thickness: 0.4-0.9 cm
Weight: 57.6 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 380
Provenance: Shahdad
Excavation no.: 240-55 / s.i.r.
Museum inventory no.:
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 28.1 cm
max. thickness: 0.3-1 cm
Weight: 87.6 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 381
Provenance: Shahdad
Excavation no.: s.i.r.
Museum inventory no.:
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 45.9 cm
max. thickness: 0.4-1.2 cm
Weight: 186.2 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 382
Provenance: Shahdad
Excavation no.: 237-55 / s.i.r.
Museum inventory no.:
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 40.4 cm
max. thickness: 0.3-1.2 cm
Weight: 181.2 gr
Type: R.03
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 383
Provenance: Shahdad
Excavation no.: 121-48
Museum inventory no.: 8612
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 16 cm
max. thickness: 0.4-1 cm
Weight: 61.7 gr
Type: R.04
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 384
Provenance: Shahdad
Excavation no.: 362-49
Museum inventory no.: 8900
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 25.1 cm
max. thickness: 0.6-1 cm
Weight: 81.5 gr
Type: R.05
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 385
Provenance: Shahdad
Excavation no.: 113-48
Museum inventory no.: 8592
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 26 cm
max. thickness: 0.3-0.9 cm
Weight: 71.2 gr
Type: R.06
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 386
Provenance: Shahdad
Excavation no.: 111-48
Museum inventory no.: 8598
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 21.2 cm
max. thickness: 0.3-0.6 cm
Weight: 38.8 gr
Type: R.06
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 387
Provenance: Shahdad
Excavation no.: 112-48
Museum inventory no.: 8599
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 19.3 cm
max. thickness: 0.2-0.6 cm
Weight: 34.4 gr
Type: R.06
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 388
Provenance: Shahdad
Excavation no.: 114-48
Museum inventory no.: 8600
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 24 cm
max. thickness: 0.2-0.9 cm
Weight: 84.3 gr
Type: R.06
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 389
Provenance: Shahdad
Excavation no.: 116-48
Museum inventory no.: 8602
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 22.3 cm
max. thickness: 0.3-0.9 cm
Weight: 64.9 gr
Type: R.06
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 390
Provenance: Shahdad
Excavation no.: 115-48
Museum inventory no.: 8610
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 9.8 cm
max. thickness: 0.2-0.6 cm
Weight: 23.5 gr
Type: R.06
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

Table 131

cat.no. 391
Provenance: Shahdad
Excavation no.: 159-48
Museum inventory no.: 8622
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 7.2 cm
max. thickness: 0.35 cm
Weight: 4.4 gr
Type: R.06
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 392
Provenance: Shahdad
Excavation no.: 257-49
Museum inventory no.: 8877
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 18.8 cm
max. thickness: 0.3-0.7 cm
Weight: 46.8 gr
Type: R.06
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 393
Provenance: Shahdad
Excavation no.: 366-49
Museum inventory no.: 8878
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 13 cm
max. thickness: 0.2-1 cm
Weight: 58.1 gr
Type: R.06
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

Table 132

cat.no. 394
Provenance: Shahdad
Excavation no.: 189-50
Museum inventory no.: 9326
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 15 cm
max. thickness: 0.3-1.0 cm
Weight: 37.6 gr
Type: R.06
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 395
Provenance: Shahdad
Excavation no.: 187-50
Museum inventory no.: 9327
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 15.1 cm
max. thickness: 0.2-0.6 cm
Weight: 26.1 gr
Type: R.06
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 396
Provenance: Shahdad
Excavation no.: 288-51
Museum inventory no.: 9702
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 16.4 cm
max. thickness: 0.4-0.8 cm
Weight: 56.5 gr
Type: R.06
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 397
Provenance: Shahdad
Excavation no.:
Museum inventory no.: 10040
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 17.4 cm
max. thickness: 0.4-0.7 cm
Weight: 36.3 gr
Type: R.06
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 398
Provenance: Shahdad
Excavation no.: 225-55 / s.i.r.
Museum inventory no.:
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 18 cm
max. thickness: 0.4-1 cm
Weight: 42.9 gr
Type: R.06
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 399
Provenance: Shahdad
Excavation no.: 213-51
Museum inventory no.: 9703
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 11.6 cm
max. thickness: 0.4-1.3 cm
Weight: 39.7 gr
Type: R.07
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

Table 134

cat.no. 400
Provenance: Shahdad
Excavation no.:
Museum inventory no.: 10041
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 9.7 cm
max. thickness: 0.3-0.7 cm
Weight: 13.2 gr
Type: R.07
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 401
Provenance: Shahdad
Excavation no.: 265-52
Museum inventory no.: 9919
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 12.4 cm
max. thickness: 0.2-0.5 cm
Weight: 12.2 gr
Type: R.08
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 402
Provenance: Shahdad
Excavation no.: 281-52
Museum inventory no.: 9920
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 12 cm
max. thickness: 0.3-0.6 cm
Weight: 10 gr
Type: R.08
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

Table 135

cat.no. 403
Provenance: Shahdad
Excavation no.: 768-52
Museum inventory no.: 9921
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 11 cm
max. thickness: 0.3-0.6 cm
Weight: 7.8 gr
Type: R.08
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 404
Provenance: Shahdad
Excavation no.: 266-52
Museum inventory no.: 9922
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 11.7 cm
max. thickness: 0.4 cm
Weight: 10.3 gr
Type: R.08
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 405
Provenance: Shahdad
Excavation no.: 279-52
Museum inventory no.: 9923
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 11.2 cm
max. thickness: 0.3-0.5 cm
Weight: 8.3 gr
Type: R.08
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

Table 136

cat.no. 406
Provenance: Shahdad
Excavation no.: 280-52
Museum inventory no.: 9924
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 11.5 cm
max. thickness: 0.3-0.5 cm
Weight: 10.6 gr
Type: R.08
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 407
Provenance: Shahdad
Excavation no.: 282-52
Museum inventory no.: 9925
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 10.9 cm
max. thickness: 0.3-0.5 cm
Weight: 6.4 gr
Type: R.08
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 408
Provenance: Shahdad
Excavation no.: 275-52
Museum inventory no.: 9926
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 9.4 cm
max. thickness: 0.2-0.4 cm
Weight: 4.7 gr
Type: R.08
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 409
Provenance: Shahdad
Excavation no.: 120-48
Museum inventory no.: 8615
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 20.7 cm
max. thickness: 0.3-0.6 cm
Weight: 34.9 gr
Type: R.09
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 410
Provenance: Shahdad
Excavation no.: 284-49
Museum inventory no.: 8903
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 21.4 cm
max. thickness: 0.3-0.4 cm
Weight: 24.4 gr
Type: R.09
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 411
Provenance: Shahdad
Excavation no.: 259-49
Museum inventory no.: 8904
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 21 cm
max. thickness: 0.2-0.8 cm
Weight: 25.2 gr
Type: R.09
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 412
Provenance: Shahdad
Excavation no.: 263-49
Museum inventory no.: 8905
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 20.5 cm
max. thickness: 0.2-0.5 cm
Weight: 20.7 gr
Type: R.09
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 413
Provenance: Shahdad
Excavation no.: 379-50
Museum inventory no.: 9343
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 12.8 cm
max. thickness: 0.2-0.5 cm
Weight: 8.1 gr
Type: R.09
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 414
Provenance: Shahdad
Excavation no.: 179-50
Museum inventory no.: 9344
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 21.8 cm
max. thickness: 0.1-0.5 cm
Weight: 20.4 gr
Type: R.09
Dating: **2200-1750 BCE**
References: Meier 2008, 50-55.

Table 139

cat.no. 415
Provenance: Shahdad
Excavation no.: 182-50
Museum inventory no.: 9345
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 14 cm
max. thickness: 0.2-0.5 cm
Weight: 10.9 gr
Type: R.09
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 416
Provenance: Shahdad
Excavation no.: 184-50
Museum inventory no.: 9346
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 22.5 cm
max. thickness: 0.3-0.4 cm
Weight: 23.8 gr
Type: R.09
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 417
Provenance: Shahdad
Excavation no.: 185-50
Museum inventory no.: 9347
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 13.1 cm
max. thickness: 0.3 cm
Weight: 9.6 gr
Type: R.09
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 418
Provenance: Shahdad
Excavation no.: 178-50
Museum inventory no.: 9348
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 14.6 cm
max. thickness: 0.1-0.3 cm
Weight: 7.4 gr
Type: R.09
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 419
Provenance: Shahdad
Excavation no.: 307-51
Museum inventory no.: 9694
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 18.9 cm
max. thickness: 0.2-0.6 cm
Weight: 23.8 gr
Type: R.09
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 420
Provenance: Shahdad
Excavation no.: 279-51
Museum inventory no.: 9695
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 25.4 cm
max. thickness: 0.4-0.5 cm
Weight: 31.4 gr
Type: R.09
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

Table 141

cat.no. 421
Provenance: Shahdad
Excavation no.: 256-52
Museum inventory no.: 9918
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 23.5 cm
max. thickness: 0.3-0.8 cm
Weight: 41.7 gr
Type: R.09
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 422
Provenance: Shahdad
Excavation no.: 264-52
Museum inventory no.: 9927
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 14.7 cm
max. thickness: 0.4-0.5 cm
Weight: 12 gr
Type: R.09
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 423
Provenance: Shahdad
Excavation no.: Gr. 825 (?)
Museum inventory no.: 10042
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 20.6 cm
max. thickness: 0.3-0.7 cm
Weight: 30 gr
Type: R.09
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

Table 142

cat.no. 424
Provenance: Shahdad
Excavation no.: E4 Gr.852 (?)
Museum inventory no.: 10043
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 25cm
max. thickness: 0.3-0.8cm
Weight: 40.3gr
Type: R.09
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 425
Provenance: Shahdad
Excavation no.: 124-48
Museum inventory no.: 8614
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 19.1 cm
max. thickness: 0.4-0.6 cm
Weight: 20.4 gr
Type: R.10
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 426
Provenance: Shahdad
Excavation no.: 183-50
Museum inventory no.: 9350
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 17 cm
max. thickness: 0.2-0.4 cm
Weight: 12.2 gr
Type: R.10
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

Table 143

cat.no. 427
Provenance: Shahdad
Excavation no.: 81-48
Museum inventory no.: 8617
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 18.4 cm
max. thickness: 0.5-0.6 cm
Weight: 41.9 gr
Type: R.11
Dating: 2200-1750 BCE
References: Hakemi 1997, 691, Oa.5, 0376, Gr.043 (?); Meier 2008, 50-55.

cat.no. 428
Provenance: Shahdad
Excavation no.: 89-48 (?)
Museum inventory no.: 8618
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 16.6 cm
max. thickness: 0.4-0.6 cm
Weight: 37.2 gr
Type: R.11
Dating: 2200-1750 BCE
References: Hakemi 1972, 31, 246, 247, 249 (?); Meier 2008, 50-55.

cat.no. 429
Provenance: Shahdad
Excavation no.: 89-48 (?)
Museum inventory no.: 8619
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 18.9 cm
max. thickness: 0.2-0.9 cm
Weight: 45.6 gr
Type: R.11
Dating: 2200-1750 BCE
References: Hakemi 1972, 31, 246, 247, 249 (?); Meier 2008, 50-55.

cat.no. 430
Provenance: Shahdad
Excavation no.: 89-48(?)
Museum inventory no.: 8620
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 17 cm
max. thickness: 0.6-0.7 cm
Weight: 34.7 gr
Type: R.11
Dating: 2200-1750 BCE
References: Hakemi 1972, 31, 246, 247, 249 (?); Meier 2008, 50-55.

cat.no. 431
Provenance: Shahdad
Excavation no.: 89-48 (?)
Museum inventory no.: 8621
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 18.1 cm
max. thickness: 0.5-0.9 cm
Weight: 54.5 gr
Type: R.11
Dating: 2200-1750 BCE
References: Hakemi 1972, 31, 246, 247, 249 (?); Meier 2008, 50-55.

cat.no. 432
Provenance: Shahdad
Excavation no.: 297-50
Museum inventory no.: 9374
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 20.2 cm
max. thickness: 0.3 cm
Weight: 20 gr
Type: R.12
Dating: 2200-1750 BCE
References: Hakemi 1972, 32, 269; Hakemi 1997, 715, Xf., 4506; Meier 2008, 50-55; Meier & Vidale 2014

Table 145

cat.no. 433
Provenance: Shahdad
Excavation no.: H4 Gr.824 (?)
Museum inventory no.: 10045
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 18.6 cm
max. thickness: 0.4-0.5 cm
Weight: 32.4 gr
Type: R.13
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 434
Provenance: Shahdad
Excavation no.: 88-48
Museum inventory no.: 9357
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 39.2 cm
max. thickness: 0.2-0.7 cm
Diameter: 3,2 cm (head)
Weight: 85.5 gr
Type: R.14
Dating: 2200-1750 BCE
References: Hakemi 1972, 31, 250; Hakemi 1997, 653, Gu.17, 0265, Gr.035; Meier 2008, 50-55.

cat.no. 435
Provenance: Shahdad
Excavation no.: 749-55
Museum inventory no.: 7754
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 15.6 cm
max. thickness: 0.2-0.4 cm
Weight: 17.3 gr
Type: R.15
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 436
Provenance: Shahdad
Excavation no.: 202-50
Museum inventory no.: 9704
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 27 cm
max. thickness: 0.6 cm
Weight: 32.5 gr
Type: R.15
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 437
Provenance: Shahdad
Excavation no.: 181-50
Museum inventory no.: 9352
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 17.9 cm
max. thickness: 0.2-0.5 cm
Weight: 17.9 gr
Type: R.16
Dating: 2200-1750 BCE
References: Hakemi 1997, Gu.3; Meier 2008, 50-55.

cat.no. 438
Provenance: Shahdad
Excavation no.: A4 Gr. 801 (?)
Museum inventory no.: 10036
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 28.5 cm
max. thickness: 0.4-1 cm
Weight: 84.9 gr
Type: R.17
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 439
Provenance: Shahdad
Excavation no.:
Museum inventory no.: 8593
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 45.4 cm
max. thickness: 0.1-0.3 cm
Weight: 11.9 gr
Type: R.18
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 440
Provenance: Shahdad
Excavation no.: 318-50
Museum inventory no.: 9349
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 19.7 cm
max. thickness: 0.3-0.7 cm
Weight: 44.9 gr
Type: R.19
Dating: 2200-1750 BCE
References: Hakemi 1972, 33, 292; Hakemi 1997, Gu.12; Meier 2008, 50-55.

cat.no. 441
Provenance: Shahdad
Excavation no.: 176-50
Museum inventory no.: 9353
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 21.3 cm
max. thickness: 0.4-0.8 cm
Weight: 49.6 gr
Type: R.19
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

Table 148

cat.no. 442
Provenance: Shahdad
Excavation no.: 284-51
Museum inventory no.: 9696
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 22 cm
max. thickness: 0.5-1 cm
Weight: 63.2 gr
Type: R.19
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 443
Provenance: Shahdad
Excavation no.: 210-51
Museum inventory no.: 9697
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 22.6 cm
max. thickness: 0.3-1.2 cm
Weight: 58.5 gr
Type: R.19
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 444
Provenance: Shahdad
Excavation no.: 214-51
Museum inventory no.: 9701
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 15.1 cm
max. thickness: 0.2-0.3 cm
Weight: 18 gr
Type: R.19
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 445
Provenance: Shahdad
Excavation no.: 790-55
Museum inventory no.: 7764
Object group: needle, pin, ghalam (?)
Material: Cu/Br-alloy
Measurements:
max. length: 16.6 cm
max. thickness: 0.2-0.7 cm
Weight: 25.4 gr
Type: R.20
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 446
Provenance: Shahdad
Excavation no.: 702-55
Museum inventory no.: 7776
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 24 cm
max. thickness: 0.3-0.7 cm
Weight: 51.1 gr
Type: R.20
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 447
Provenance: Shahdad
Excavation no.: 125-48
Museum inventory no.: 8616
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 21 cm
max. thickness: 0.3-0.6 cm
Weight: 34.2 gr
Type: R.20
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 448
Provenance: Shahdad
Excavation no.: 175-49
Museum inventory no.: 8896
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 21.3 cm
max. thickness: 0.3-0.6 cm
Weight: 34.5 gr
Type: R.20
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 449
Provenance: Shahdad
Excavation no.: 262-49
Museum inventory no.: 8898
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 17.2 cm
max. thickness: 0.4-0.6 cm
Weight: 31.1 gr
Type: R.20
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 450
Provenance: Shahdad
Excavation no.: 518-50
Museum inventory no.: 9354
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 19.6 cm
max. thickness: 0.2-0.6 cm
Weight: 20.8 gr
Type: R.20
Dating: 2200-1750 BCE
References: Hakemi 1997, Gb.3; Meier 2008, 50-55.

cat.no. 451
Provenance: Shahdad
Excavation no.: 215-51
Museum inventory no.: 9698
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 25 cm
max. thickness: 0.3-0.6 cm
Weight: 31.1 gr
Type: R.20
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 452
Provenance: Shahdad
Excavation no.: 211-51
Museum inventory no.: 9699
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 30 cm
max. thickness: 0.4-0.9 cm
Weight: 79.5 gr
Type: R.20
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 453
Provenance: Shahdad
Excavation no.: 259-52
Museum inventory no.: 9928
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 18 cm
max. thickness: 0.3-0.7 cm
Weight: 26 gr
Type: R.20
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 454
Provenance: Shahdad
Excavation no.: 261-49
Museum inventory no.: 8899
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 25.4 cm
max. thickness: 0.2-0.3 cm
Weight: 36.6 gr
Type: R.21
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 455
Provenance: Shahdad
Excavation no.: 159-48
Museum inventory no.: 8623
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 6.85 cm
max. thickness: 0.2-0.4 cm
Weight: 3.6 gr
Type: R.22
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 456
Provenance: Shahdad
Excavation no.: 165-48
Museum inventory no.: 8624
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 7.4 cm
max. thickness: 0.2-0.4 cm
Weight: 2.7 gr
Type: R.22
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 457
Provenance: Shahdad
Excavation no.: 159-48
Museum inventory no.: 8625
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 6.8 cm
max. thickness: 0.2-0.4 cm
Weight: 4.2 gr
Type: R.22
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 458
Provenance: Shahdad
Excavation no.: 145-48
Museum inventory no.: 8626
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 7.4 cm
max. thickness: 0.3 cm
Weight: 4.1 gr
Type: R.22
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 459
Provenance: Shahdad
Excavation no.: 145-48
Museum inventory no.: 8627
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 7 cm
max. thickness: 0.2-0.4 cm
Weight: 3.5 gr
Type: R.22
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 460
Provenance: Shahdad
Excavation no.: 145-48
Museum inventory no.: 8628
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 6.8 cm
max. thickness: 0.2-0.4 cm
Weight: 3.7 gr
Type: R.22
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 461
Provenance: Shahdad
Excavation no.: 127-48
Museum inventory no.: 8629
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 12.6 cm
max. thickness: 0.4-0.6 cm
Weight: 19.5 gr
Type: R.22
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 462
Provenance: Shahdad
Excavation no.: 341-49
Museum inventory no.: 8894
Object group: needle, pin, ghalam (?)
Material: Cu/Br-alloy
Measurements:
max. length: 11.5 cm
max. thickness: 0.3-0.4 cm
Weight: 15.1 gr
Type: R.23
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

Table 155

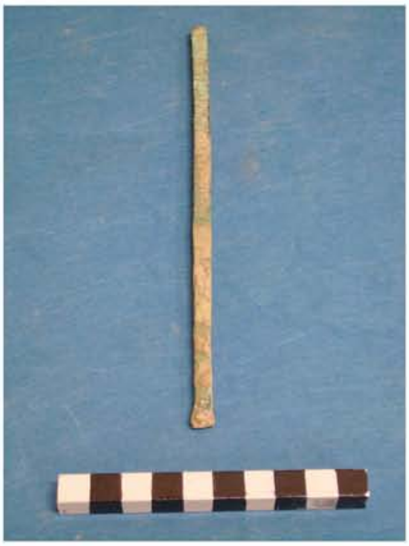
cat.no. 463
Provenance: Shahdad
Excavation no.:
Museum inventory no.: 8895
Object group: needle, pin, ghalam (?)
Material: Cu/Br-alloy
Measurements:
max. length: 15.4 cm
max. thickness: 0.3-0.6 cm
Weight: 22 gr
Type: R.23
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 464
Provenance: Shahdad
Excavation no.: 364-49
Museum inventory no.: 8897
Object group: needle, pin, ghalam (?)
Material: Cu/Br-alloy
Measurements:
max. length: 13.4 cm
max. thickness: 0.3-0.4 cm
Weight: 10.5 gr
Type: R.23
Dating: 2200-1750 BCE
References: Hakemi 1972, 30, 237; Meier 2008, 50-55.

cat.no. 465
Provenance: Shahdad
Excavation no.: 273-49
Museum inventory no.: 8902
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 8.5 cm
max. thickness: 0.1-0.3 cm
Weight: 3 gr
Type: R.23
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

Table 156

cat.no. 466
Provenance: Shahdad
Excavation no.: 172-50
Museum inventory no.: 9351
Object group: rod, ghalam (?)
Material: Cu/Br-alloy
Measurements:
max. length: 19.9 cm
max. thickness: 0.7 cm
Weight: 58.9 gr
Type: R.23
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.



cat.no. 467
Provenance: Shahdad
Excavation no.: 180-50
Museum inventory no.: 9404 a
Object group: rod, ghalam (?)
Material: Cu/Br-alloy
Measurements:
max. length: 9.9 cm
max. width: 0.4 cm
Weight: 9.2 gr
Type: R.23
Dating: 2200-1750 BCE
References: Hakemi 1972, 33, 293; Meier 2008, 50-55.

cat.no. 468
Provenance: Shahdad
Excavation no.: 429-51
Museum inventory no.: 9700
Object group: needle, pin, ghalam (?)
Material: Cu/Br-alloy
Measurements:
max. length: 14.7 cm
max. thickness: 0.7 cm
Weight: 18.8 gr
Type: R.23
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 469
Provenance: Shahdad
Excavation no.: 270-52
Museum inventory no.: 9929
Object group: needle, pin, ghalam (?)
Material: Cu/Br-alloy
Measurements:
max. length: 11.5 cm
max. thickness: 0.2-0.5 cm
Weight: 17.9 gr
Type: R.23
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 470
Provenance: Shahdad
Excavation no.: 263-52
Museum inventory no.: 9930
Object group: needle, pin, ghalam (?)
Material: Cu/Br-alloy
Measurements:
max. length: 15.6 cm
max. thickness: 0.3-0.5 cm
Weight: 17.4 gr
Type: R.23
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 471
Provenance: Shahdad
Excavation no.: 272-52
Museum inventory no.: 9931
Object group: needle, pin, ghalam (?)
Material: Cu/Br-alloy
Measurements:
max. length: 13.5 cm
max. thickness: 0.4-0.5 cm
Weight: 14.6 gr
Type: R.23
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

Table 158

cat.no. 472
Provenance: Shahdad
Excavation no.: 273-52
Museum inventory no.: 9932
Object group: needle, pin, ghalam (?)
Material: Cu/Br-alloy
Measurements:
max. length: 12 cm
max. thickness: 0.1-0.3 cm
Weight: 11.5 gr
Type: R.23
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 473
Provenance: Shahdad
Excavation no.: 274-52
Museum inventory no.: 9933
Object group: needle, pin, ghalam (?)
Material: Cu/Br-alloy
Measurements:
max. length: 9.7 cm
max. thickness: 0.5 cm
Weight: 9.7 gr
Type: R.23
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 474
Provenance: Shahdad
Excavation no.: 271-52
Museum inventory no.: 9934
Object group: needle, pin, ghalam (?)
Material: Cu/Br-alloy
Measurements:
max. length: 8.2 cm
max. thickness: 0.5-0.9 cm
Weight: 13.3 gr
Type: R.23
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

Table 159

cat.no. 475
Provenance: Shahdad
Excavation no.: 260-52
Museum inventory no.: 9935
Object group: needle, pin, ghalam (?)
Material: Cu/Br-alloy
Measurements:
max. length: 17.5 cm
max. thickness: 0.7 cm
Weight: 60.6 gr
Type: R.23
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 476
Provenance: Shahdad
Excavation no.: 174-1348-50 (?)/ s.i.r.
Museum inventory no.:
Object group: needle, pin, ghalam (?)
Material: Cu/Br-alloy
Measurements:
max. length: 14.1 cm
max. thickness: 0.4 cm
Weight: 20.1 gr
Type: R.23
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 477
Provenance: Shahdad
Excavation no.: 272-49
Museum inventory no.: 8901
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 16.5 cm
max. thickness: 0.1-0.2 cm
Weight: 4 gr
Type: R.24
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 478
Provenance: Shahdad
Excavation no.: 319-50
Museum inventory no.: 9404 b
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 8.8 cm
Diameter: 0.2 cm
Weight: 1.9 gr
Type: R.24
Dating: 2200-1750 BCE
References: Hakemi & Sajjadi 1988, 146; Meier 2008, 50-55.

cat.no. 479
Provenance: Shahdad
Excavation no.: s.i.r.
Museum inventory no.:
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 7.4 cm
max. thickness: 0.1 cm
Weight: 1.8 gr
Type: R.24
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 480
Provenance: Shahdad
Excavation no.: 527-50 / s.i.r.
Museum inventory no.:
Object group: needle, pin, spatula (?)
Material: Cu/Br-alloy
Measurements:
max. length: 14.9 cm
max. width: 5.4 cm
max. thickness: 0.1 cm
Weight: 22.7 gr
Type: R.25
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 481
Provenance: Shahdad
Excavation no.: 253-55 / s.i.r.
Museum inventory no.:
Object group: needle, pin, spatula (?)
Material: Cu/Br-alloy
Measurements:
max. length: 17 cm
max. width: 4 cm
Weight: 28.8 gr
Type: R.25
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 482
Provenance: Shahdad
Excavation no.: 510-50
Museum inventory no.: 9458
Object group: needle, pin, skewer (?)
Material: Cu/Br-alloy
Measurements:
max. length: 72.4 cm
max. thickness: 0.5-1 cm
Weight: 396.7 gr
Type: R.26
Dating: 2200-1750 BCE
References: Hakemi 1972, 32, 265; Meier 2008, 50-55.

cat.no. 483
Provenance: Shahdad
Excavation no.: 519-50 / s.i.r.
Museum inventory no.:
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 6.7 cm
max. thickness: 0.5 cm
Weight: 12.9 gr
Type: R.27
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

Table 162

cat.no. 484
Provenance: Shahdad
Excavation no.: 520-1348-50 (?)/ s.i.r.
Museum inventory no.:
Object group: needle, pin, ghalam (?)
Material: Cu/Br-alloy
Measurements:
max. length: 7.8 cm
max. thickness: 0.5 cm
Weight: 13.2 gr
Type: R.27
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 485
Provenance: Shahdad
Excavation no.: 1348-50 / s.i.r.
Museum inventory no.:
Object group: needle, pin, ghalam (?)
Material: Cu/Br-alloy
Measurements:
max. length: 5.9 cm
max. thickness: 0.4-0.6 cm
Weight: 7.1 gr
Type: R.27
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 486
Provenance: Shahdad
Excavation no.: 230-55 / s.i.r.
Museum inventory no.:
Object group: needle, pin
Material: Cu/Br-alloy
Measurements:
max. length: 13.6 cm
max. thickness: 0.3 cm
Weight: 4.7 gr
Type: R.27
Dating: 2200-1750 BCE
References: Meier 2008, 50-55.

cat.no. 487
Provenance: Shahdad
Excavation no.: 395-50
Museum inventory no.: 9295
Object group: strainer, colander
Material: Cu/Br-alloy
Measurements:
max. height: 8 cm
Diameter: 12.8 cm (rim), 5 cm (base)
Weight: 124.9 gr
Type: S.01
Dating: 2200-1750 BCE
References: Hakemi 1972, 32, 280, pl.XIX C; Hakemi 1997, 641, Gr.1, 1897, Gr.169.

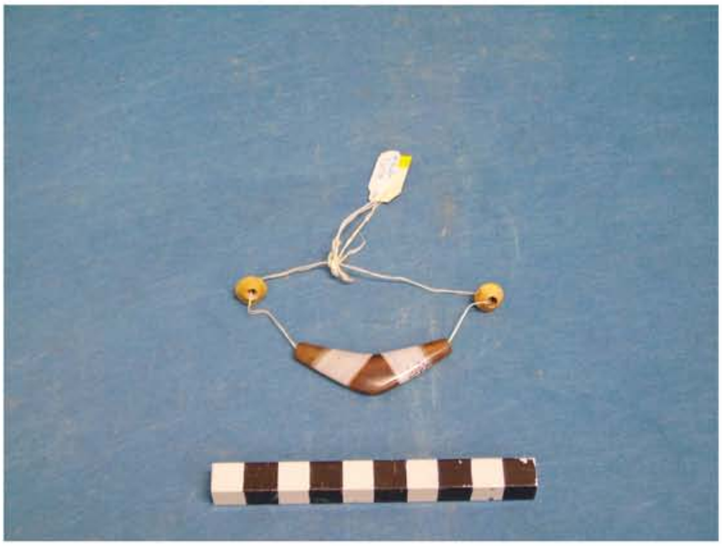
cat.no. 488
Provenance: Shahdad
Excavation no.: 539-50
Museum inventory no.: 9720
Object group: vessel with chain suspension
Material: Cu/Br-alloy
Measurements:
max. height: 18.5 cm
Diameter: 18 cm
Weight: 825 gr
Type: S.02
Dating: 2200-1750 BCE
References: Hakemi 1997, 642, Gr.2, 1068, Gr.115 (?); ebd., 643, Gr.3, 1168, Gr.120 (?).

cat.no. 489
Provenance: Shahdad
Excavation no.: 298-49
Museum inventory no.: 8923
Object group: vessel with chain suspension
Material: Cu/Br-alloy
Measurements:
max. height: 19.5 cm
Diameter: 12.5 cm (bowl)
Weight: 726 gr
Type: S.03
Dating: 2200-1750 BCE
References: Hakemi 1997, 627, Ga.2, 0809, Gr.083.

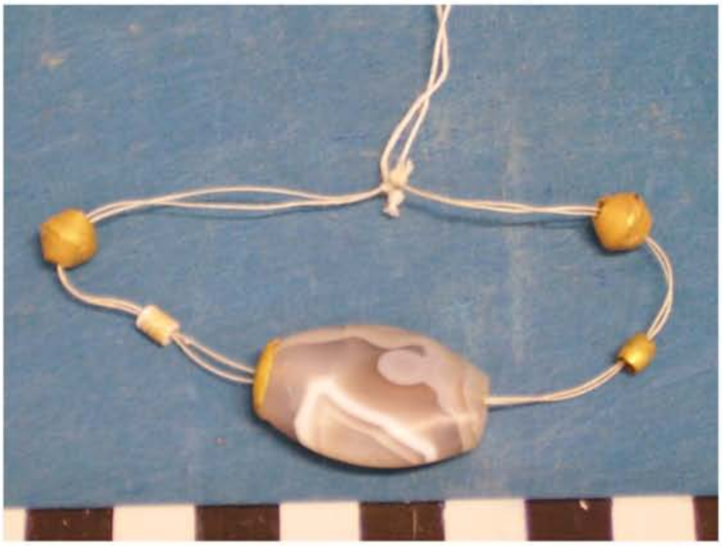
cat.no. 490
Provenance: Shahdad
Excavation no.: 299-49
Museum inventory no.: 8926
Object group: bottle
Material: Cu/Br-alloy
Measurements:
max. height: 23.3 cm
Diameter: 9 cm (rim), 7.6 cm (base)
Weight: 879 gr
Type: S.04
Dating: 2200-1750 BCE
References: Hakemi 1972, 30, 229, pl. XVIII A; Hakemi & Sajjadi 1988, 146; Hakemi 1997, 627, Ga.3, 0814, Gr.084; Bellelli 2002, 88.116, Taf.20.116.

cat.no. 491
Provenance: Shahdad
Excavation no.: 407-51
Museum inventory no.: 9729
Object group: necklace
Material: Au-alloy
Measurements:
Weight: 4.3 gr
Type: S.05
Dating: 2200-1750 BCE
References: Hakemi 1997, 658, Hd.1, 2714, Gr.221 (?).

cat.no. 492
Provenance: Shahdad
Excavation no.: 425-51
Museum inventory no.: 9731
Object group: jewellery beads
Material: Au-alloy
Measurements:
Diameter: 0.9 cm (bead)
Weight: 1.8 gr
Type: S.05
Dating: 2200-1750 BCE
References: Hakemi 1997, 384, 2653, Gr.217 (?).



cat.no. 493
Provenance: Shahdad
Excavation no.: 424-51
Museum inventory no.: 9730
Object group: jewellery beads
Material: Au-alloy
Measurements:
Diameter: 0.6 cm (beads)
Weight: 1 gr
Type: S.05
Dating: 2200-1750 BCE
References: Hakemi 1997, 388, 2702, Gr.220 (?).



cat.no. 494
Provenance: Shahdad
Excavation no.: 791-55
Museum inventory no.: 7665
Object group: stamp
Material: Cu/Br-alloy
Measurements:
max. length: 1.3 cm
Weight: 3.9 gr
Type: S.06
Dating: 2200-1750 BCE

cat.no. 495
Provenance: Shahdad
Excavation no.: 780-55
Museum inventory no.: 7524
Object group: stamp
Material: Cu/Br-alloy
Measurements:
max. length: 1.9 cm
Weight: 8.4 gr
Type: S.06
Dating: 2200-1750 BCE
References: Hakemi 1997, 708, 717, 4514, Xn (?).

Table 166

cat.no. 496
Provenance: Shahdad
Excavation no.: 296-50
Museum inventory no.: 13264
Object group: "Shahdad standard"
Material: Cu/Br-alloy
Measurements:
max. width: 24.4 cm
max. height: 23.4 cm
Weight: 230.6 gr
Type: S.07
Dating: 2200-1750 BCE
References: Masoumi 1971; Hakemi 1972, 33, 300; Vatandoust 1977, 94.16; Orthmann 1985, 380, Tf..XXXIII; Hakemi 1997, 649, Gt., 1049, Gr.114; Bochum 2004, 593, 73.

cat.no. 497
Provenance: Shahdad
Excavation no.: 296-50
Museum inventory no.: 13246
Object group: "Shahdad standard" (pole)
Material: Cu/Br-alloy
Measurements:
max. length: 119.2 cm
max. width: 12 cm (wingspan)
max. thickness: 0.4-0.9 cm
Weight: 547.4 gr
Type: S.07
Dating: 2200-1750 BCE
References: Masoumi 1971; Hakemi 1972, 33, 300; Vatandoust 1977, 94.16; Orthmann 1985, 380, Tf..XXXIII; Hakemi 1997, 649, Gt., 1049, Gr.114; Bochum 2004, 593, 73.

cat.no. 498
Provenance: Shahdad
Excavation no.: 300-49
Museum inventory no.:
Object group: "trumpet" (?)
Material: Cu/Br-alloy
Measurements:
max. length: cm
max. width: cm
max. thickness: cm
Weight: gr
Type: S.08
Dating: 2200-1750 BCE
References: Lamberg-Karlovsky & Hiebert 1992, 136f., fig.1; Hakemi 1997, 246, 635, 0787, Gn.2, Gr.81 (?).

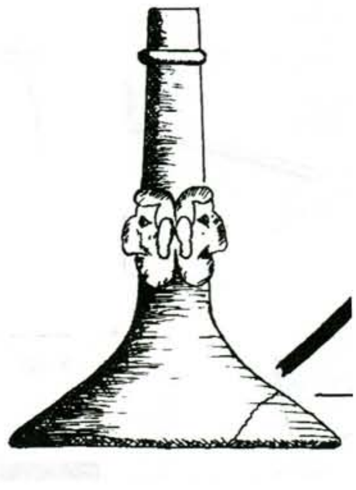


Table 167

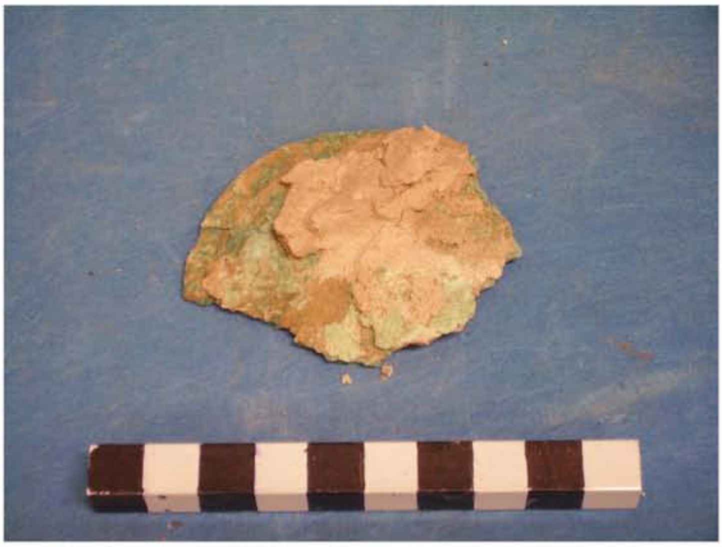
cat.no. 499
Provenance: Shahdad
Excavation no.: 1348-50 / s.i.r.
Museum inventory no.:
Object group: button, application (?)
Material: Cu/Br-alloy
Measurements:
Weight: 109.8 gr
Type: T.01
Dating: 2200-1750 BCE

cat.no. 500
Provenance: Shahdad
Excavation no.: 1348-50 / s.i.r.
Museum inventory no.:
Object group: needle, pin, blade
Material: Cu/Br-alloy
Measurements:
Weight: 73.3 gr
Type: T.01
Dating: 2200-1750 BCE

cat.no. 501
Provenance: Shahdad
Excavation no.: 534-50 / s.i.r.
Museum inventory no.:
Object group: sheet metal fragments
Material: Ag-alloy (?)
Measurements:
max. thickness: 0.05 cm
Weight: 7.9 gr
Type: T.01
Dating: 2200-1750 BCE

Table 168

cat.no. 502
Provenance: Shahdad
Excavation no.: 541-50 / s.i.r.
Museum inventory no.:
Object group: fragment
Material: Cu/Br-alloy
Measurements:
Weight: 22.7 gr
Type: T.01
Dating: 2200-1750 BCE



cat.no. 503
Provenance: Shahdad
Excavation no.: s.i.r.
Museum inventory no.:
Object group: slag fragments
Material: Cu/Br-alloy
Measurements:
Weight: 751.8 gr (l.), 845.2 gr (r.)
Type: T.01
Dating: 2200-1750 BCE
References: Bochum 2004, 590, 62.

cat.no. 504
Provenance: Shahdad
Excavation no.: 209-55 / s.i.r.
Museum inventory no.:
Object group: n.i. fragments
Material: Cu/Br-alloy
Measurements:
Weight: 286 gr
Type: T.01
Dating: 2200-1750 BCE

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