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Archaeobotanical Investigations in the Trans-Urals (Siberia): The Vegetation History

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Archaeobotanical Investigations in the Trans-Urals (Siberia): The Vegetation History

Trans-Urals; palynology; climate; Bronze-Age; steppe.

1 Introduction

During the 2nd and 3rd millennia BC a series of innovations emerged in the Trans-Urals steppe (fortified settlements, metallurgy, chariots, the cultivation of grain is also under discussion), which apart from questions as to origin and genesis raises the question of possible triggers.[1] The assumption of climatic change has been put forward,[2] because especially in the steppe climatic alterations lead to substantial changes in living conditions and adaptations of economic structures.

The recent German-Russian research project "Environment, Culture and Society of the Karagaily-Ayat Micro-Region," supported by the German Research Foundation (DFG) and the Russian Foundation for Humanities and Social Sciences (RGNF), attempts to investigate the archaeology, settlement history, subsistence and environment of the Bronze Age Sintašhta and Petrovka cultures in the Trans-Urals region. In one of the settlement areas in the valley of Karagaily-Ayat (Oblast Cheliabinsk) three Bronze Age fortified settlements are being investigated.[3] Archives for palynological investigations are the numerous depressions along the riverside, partly filled with water or already completely silted up, containing organic sediments. These "water holes" provide the best conditions for research in a micro-region to record changes in vegetation and sedimentary depositions during the Holocene in order to answer important questions about economic activity and agriculture.[4]

2 Study Area

The Karagaily-Ayat valley is located in the south-eastern fringe of the Ural Mountains, in the so-called Trans-Urals region (Fig. 1). The annual mean temperature is about 3.7°C, with an annual rainfall of 340–430mm. It is a continental climate with seasonal temperature variations of > 30°C.

The landscape is characterized by a gently rolling steppe with small patches of woodland covered with feather grass of which not much is left today, due to extensive pasturing with horses, cattle and sheep. In the 1950s, 60s and 70s the "Virgin Lands Campaign" was initiated by Khrushev to transform the steppes into farmland. Today, only small-scale

1 e.g., Koryakova and Epimakhov 2007; Hanks and Doonan 2009.
2 Koryakova and Epimakhov 2007; Shishlina 2008; Anthony 2009.
3 For a summary see Krause et al. 2010.
4 Gayduchenko 2002; Frachetti et al. 2010.

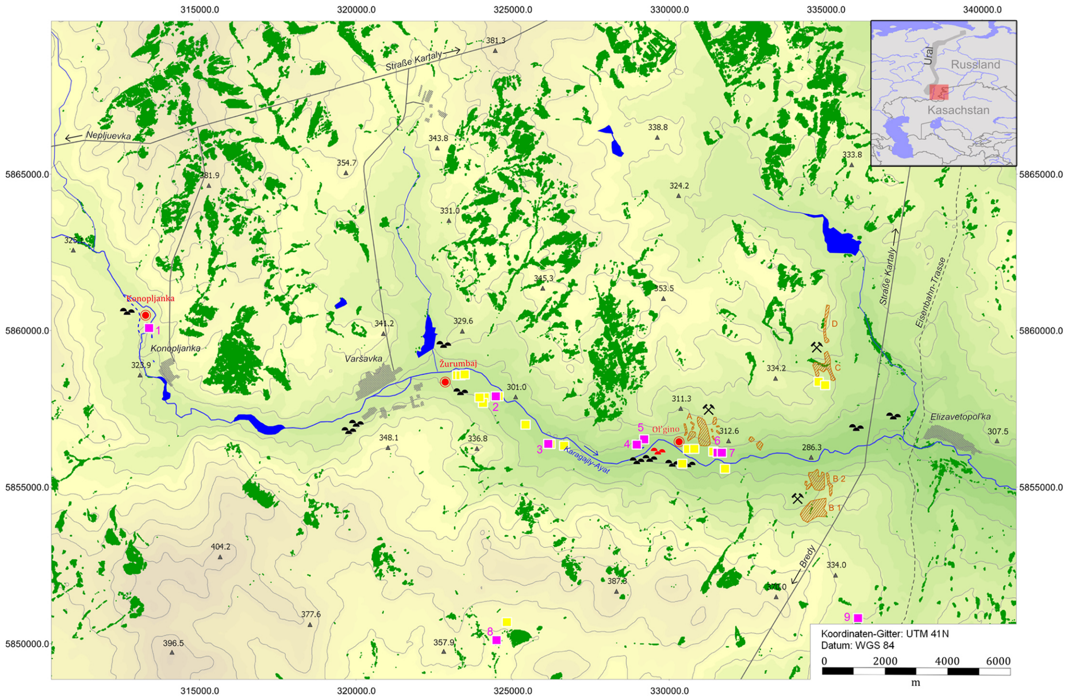

Fig. 1 | Map of the study area. The pink and yellow squares mark the coring sites (map D. Knoll).

cereal growing has survived and the steppe is actually regaining its former habitats, but in a degraded state. Natural birch woodland only occurs locally on soils with impeded drainage; pine woodland is present throughout the region.

The Urals and their foothills are of special interest in respect to rich mineral and ore deposits. Moreover, in the immediate surroundings of the excavation, traces of ore mining prevailed dating back to the Bronze Age.[5]

3 Methods

32 depressions have been drilled so far along the River Karagaily-Ayat (Fig. 1). The sediment cores were examined by means of pollen and radiocarbon dating.

Sample preparation for pollen and microfossil analyses followed a standard method.[6] *Lycopodium* tablets were added for the calculation of pollen concentrations.[7]

The age of the sediment sequences was determined by means of radiocarbon dating. The samples (terrestrial plant macrofossils) were analysed by AMS (Acceleration Mass Spectrometry) at the University of Cologne (Centre for Accelerator Mass Spectrometry), Beta-Analytic (London-Florida) and the Curt-Engelholm-Zentrum Archäometrie (Mannheim/Tübingen). The ^{14}C-results are calibrated via OxCal 4.17.[8]

4 Results

Sediments could be detected throughout the Holocene—except for the millennium between 7000–6000 cal. BP. Most of them date back to the last 500 years. So far we could not find a deposition without hiatus.

5 Krause et al. 2010.
6 Faegri and Iversen 1989.
7 Stockmaar 1971.
8 Reimer et al. 2009; Bronk Ramsey et al. 2010.

4.1 Vegetation Development

To date two cores have been analysed in detail. Profile "Weihe" was deposited between 600 cal. BC and cal. AD 500,[9] the FS-profile between 7200 cal. BC and the present day (Fig. 2). A number of gaps of several millennia lie between these periods.

The FS-profile starts at 7200 cal. BC (zone 1). The dominating vegetation in the area of investigation is composed of *Artemisia* and Poaceae with Chenopodiaceae playing a special role. The values for tree pollen (*Betula* and *Pinus*) reach only ca. 10%. From 6900 cal. BC onwards (zone 2), the values for tree pollen rise up to more than 20% and *Picea* is now regularly proven. For the first time pollen grains from *Ulmus, Alnus* and *Tilia* appear. The values for Poaceae reach more than 20%, while Chenopodiaceae decrease down to 10%. The *Artemisia* curve, in contrast, is still dominant with more than 40%. A steppe landscape prevailed in the area of investigation, but along the river and on the edaphically advantageous locations more trees were found than in the Early Holocene. This vegetation remained unchanged until at least 5500 cal. BC. It is not possible to draw any firm conclusions about the following 1700 years, because there is another hiatus.

About 3800 cal. BC (zone 3)—when sediments are again preserved—the tree pollen-values have not significantly changed, continuing with 20–25%. Now there is a stronger emergence of *Picea* and an increase of *Pinus*. Typical indicators of disturbances like *Polygonum* species appear more frequently. *Myriophyllum* decreases but the *Spirogyra* curve starts. Between 3700 cal. BC and 2000 cal. BC no sediments are preserved.

From 2000 cal. BC onwards (zone 4) deciduous trees rise and the *Pinus* curve declines slightly. The indicators of disturbances remain the same, but the diversity of species increases. The *Triglochin/Potamogeton*-type appears more frequently, while *Myriophyllum* almost disappears.

Between 900 cal. BC and cal. AD 1300 there is another hiatus in the FS-profile. But the period between 600 BC and AD 500 was deposited in the "Weihe"-profile.[10] The pollen diagram shows tree pollen values between 20 and 30% and a wormwood-rich grass steppe prevailed.

For the period from cal. AD 1300 until the present day (zone 5), tree pollen values between 20 and 30% could be shown in the FS-profile. The deciduous trees, *Artemisia* and Chenopdiaceae decrease, whereas the Poaceae increase. *Sparganium* is more frequent now.

5 Conclusion

The results of the investigations carried out so far in the Karagaily-Ayat valley of the Trans-Urals region point to a high degree of stability of the vegetation in regard to climate and human impact.

The values for tree pollen have remained the same since the 7th millennium cal. BC, but they have never exceeded the present values. The forest resources therefore seem to have stayed constant since the Boreal (there is a lack of evidence for the time span between 5500 and 3800 cal. BC and no statements regarding this aspect), so in contrast to other authors[11] the palynological analyses could not find strong evidence for shifts of vegetation belts caused by climate.

All depressions show a different filling pattern that indicates that it is difficult to make only climatic changes responsible, as postulated by Kremenetski et al.[12] Deposits, and thereby also existent or nonexistent time slices, are—apart from a few trends—

9 Krause et al. 2010; Kalis and Stobbe 2012.
10 Krause et al. 2010.
11 Levina and Orlova 1993; Lavrushin and Spiridonova 1999; Zakh, Ryabogina, and Chlachula 2010.
12 Kremenetski, Tarasov, and Cherkinsky 1997.

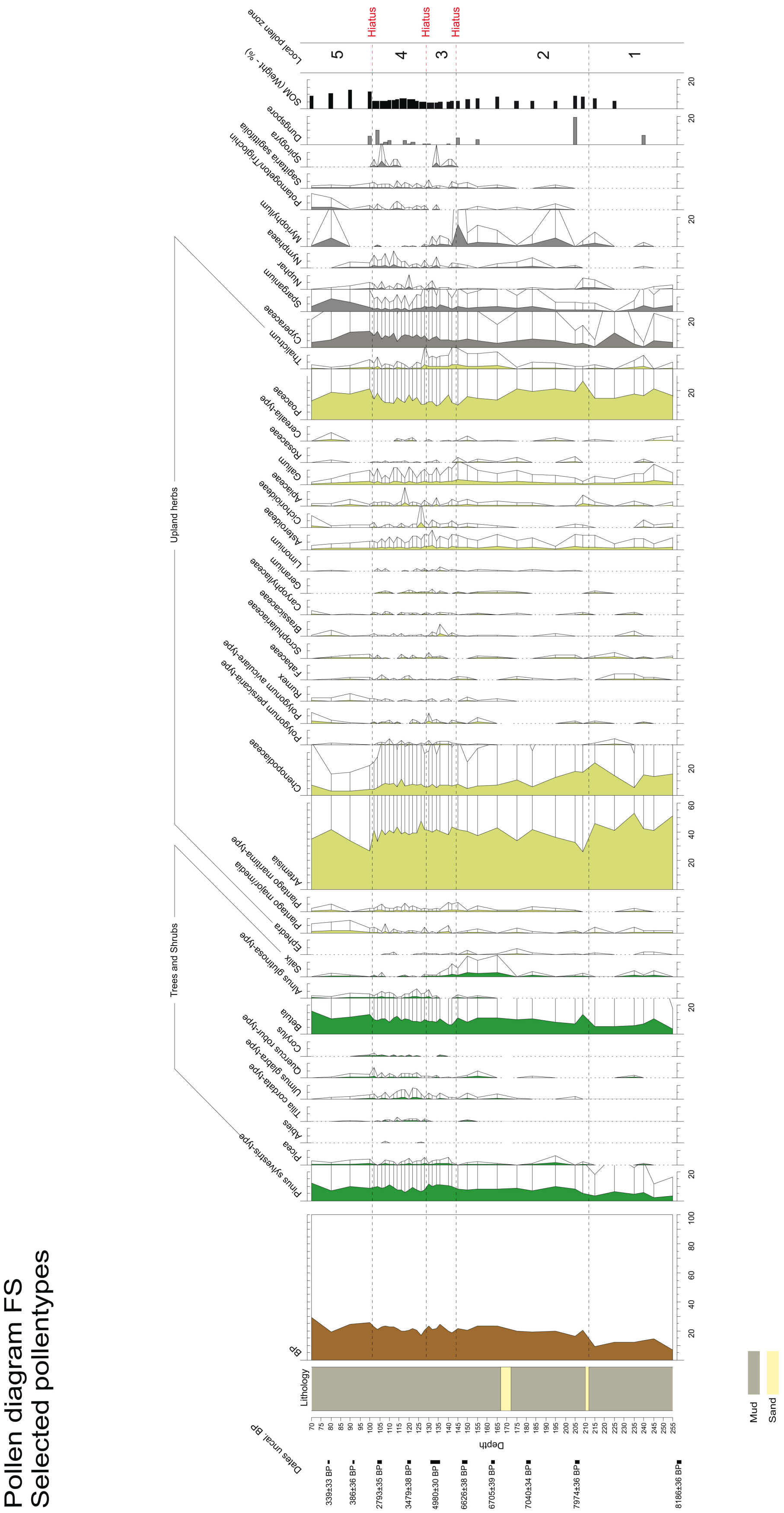

Fig. 2 | Pollen diagram from a depression in the Karagaily-Ayat valley (Trans-Urals).

very broadly scattered in time. Therefore other possible causes could also have been local geomorphology events, like consolidations of subsoils or meander cut-offs.

To date the pollen-analytical studies do not show a strong influence on the vegetation in the Bronze Age. The diversity of species rises, but the appearance of 'typical indicators of disturbances' in the pollen diagram started before the fortified settlements developed. So far, neither the charred macro-remains nor the pollen grains give any indications for agriculture. Surprisingly, since the Boreal pollen grains are in the pollen spectra that correspond in size, pore and annulus[13] to the cereal type. The vegetational surveys of the region carried out within the scope of the project show that at the bottom of the Kargaily-Ayat valley wild barley (*Hordeum brevisubulatum* subsp. *nevskianum*) is often dominant and that its pollen type corresponds to the cereal type. Thus the pollen grains of the cereal type that could be detected since the Boreal are presumably from wild barley.

13 Beug 1961.

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