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**Sedimentary processes, evolution, and paleoenvironmental
reconstruction of the southern margin of the Ediacaran Yangtze
platform (Doushantuo Formation, central China)**



Vorgelegt von
Elodie Vernhet
aus Sète (34-Frankreich)

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Erstgutachter: Prof. Dr. Christoph Heubeck
Freie Universität Berlin
Institut für Geologische Wissenschaften
Fachrichtung Geologie
Malteserstrasse 74-100, Haus B
D-12249 Berlin
Deutschland

Zweitgutachter: Prof. Dr. Maria Mutti
Universität Potsdam
Institut für Geowissenschaften
Postfach 60 15 53
D-14415 Potsdam
Deutschland

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„Non ! Les braves gens n'aiment pas que
l'on suive une autre route qu'eux!“

G. Brassens.

A Juliane...
A ses parents...
A mes parents...

Summary

The southern margin of the Ediacaran Yangtze platform is unusually important for the study of the Ediacaran/Cambrian transition because the platform combines good-quality outcrops and an exceptional fossil record. Nonetheless, progress in the understanding of the environmental conditions of the Precambrian/Cambrian bioradiation event has been limited by the lack of correlation between sections and biota found therein.

This dissertation, conducted in the frame of the multidisciplinary Sino-German project “From ‘Snowball Earth’ to the Cambrian bioradiation”, aimed to construct a detailed sedimentary and stratigraphic framework and to apply sequence-stratigraphic analysis.

I investigated more than 30 sections in three provinces during two field seasons in 2002 and 2003. Field data combined with existing data refined the previous paleoenvironmental reconstruction and highlight the irregular bathymetry of the Ediacaran Yangtze platform, inferred to reflect paleorelief inherited from rifting of Rodinia. Facies analysis of shelf sections shows that the Doushantuo Formation records two-and-a-half 2nd-order parasequences. The platform may have alternately evolved during Doushantuo time as a rimmed (epeiric) shallow-water platform and as a wave-dominated, shallow-water open shelf. In the basinward slope environment of the southern Ediacaran Yangtze platform, abundant gravity-related mass deposits disturb the eustatic signal. Regionally correlatable thick intervals of shallow-water limestone, interbedded with debrites and turbidites are interpreted as platform-margin-derived, large-scale slide sheets. Bedding within the slide sheets was only moderately deformed. A sedimentary analysis of allochthonous facies recognised the parasequences documented on the shelf. Sliding may have occurred during the regressive period at the end of parasequence II.

Zusammenfassung

Der südliche Rand der Ediacaran Yangtze-Plattform ist besonders wichtig für das Studium des Überganges vom Ediacarium zum Kambrium, da in der Plattform qualitativ gute Aufschlüsse und eine außergewöhnliche fossile Abfolge miteinander kombiniert sind. Dennoch sind Fortschritte im Verständnis der Umgebungsbedingungen der Präkambrium/Kambrium Bioradiation gering, begründet durch unzufriedenstellende Korrelationen zwischen stratigraphischen Sektionen und Biota in der Plattform.

Diese Dissertation, angefertigt im Rahmen des multidisziplinären sino-deutschen Projektes „From ‚Snowball Earth‘ to the Cambrian Bioradiation“, hat zum Ziel, einen auf Untersuchungen stratigraphischer Abfolgen basierenden Korrelationsrahmen zu konstruieren, welcher auf die gesamte Plattform angewandt werden kann.

Ich habe über 30 Sektionen in drei Provinzen während zweier Geländeaufenthalte in den Jahren 2002 und 2003 untersucht. Mit Hilfe der Geländedaten, zusammen mit vorhandenen Daten, wurde die existierende Konstruktion des Paleomilieus präzisiert und eine unregelmäßige Bathymetrie der Ediacara-Yangtze-Plattform verdeutlicht, bei welcher es sich um ein vom Rodinia-Rifting ererbtes Paleorelief handeln kann. Faziesanalysen von Schelfsedimenten zeigen, dass die Doushantuo Formation zweieinhalb Parasequenzen zweiter Ordnung aufweist. Die Plattform könnte sich während der Doushantuo Zeit abwechselnd als eine äußere (epirogene) Flachwasserplattform bzw. als wellendominierter offener Flachwasserschelf entwickelt haben. In der beckenwärtigen Hangumgebung der südlichen Ediacara-Yangtze-Plattform stören viele gravitationsbezogene Massenablagerungen das eustatische Signal. Regional korrelierbare mächtige Intervalle von Flachwasser-Kalksteinen, eingebettet zwischen Debriten und Turbiditen, werden als vom der Schelfkante abgeleitete Rutschschichten interpretiert. Die Lagerung der Rutschschichten ist nur mäßig deformiert. Eine sedimentäre Interpretation der allochthonen Fazies erkannte die für die Schelffazies dokumentierte Parasequenzen. Die Rutschungen könnten am Ende der regressiven Periode der Parasequenz II aufgetreten sein.

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Erklärung

Hiermit versichere ich, dass ich die vorliegende Arbeit selbständig verfasst und keine andere als die angegebenen Hilfsmittel benutzt habe. Die Stellen der Arbeit, die anderen Werken wörtlich und inhaltlich entnommen sind, wurden durch entsprechende Angaben der Quellen kenntlich gemacht.

Diese Arbeit hat in gleicher oder ähnlicher Form noch keiner Prüfungsbehörde vorgelegen.

Berlin, 03.08.2005

Foreword

This dissertation took place in the frame of the Sino-German program “From ‘Snowball Earth’ to the Cambrian bioradiation...”, co-funded by the Deutsche Forschungsgemeinschaft (DFG) and the National Science Foundation of China (NSFC). This program focused on the evolution of the Yangtze platform (central China) from the late Neoproterozoic, represented by the Marinoan glaciation (Nantuo diamictites), to the early Cambrian. The objective of the project was to understand the underlying processes of the Cambrian bioradiation by constraining paleoenvironmental conditions using a multidisciplinary (sedimentology, palaeontology, and geochemistry) approach. My research aimed to study the sedimentary evolution of the southern Yangtze platform margin during the Ediacaran Doushantuo Formation.

This dissertation is composed of six chapters. An introduction (Chapter 1) proposes an overview about the geological setting of the Ediacaran Yangtze platform, which clarifies the context in which this dissertation took place. Chapter 2 introduces the sedimentary evolution of the shelf and slope environments developed in Chapters 3 and 4, respectively. Chapter 5 documents the sedimentary history of the platform margin. Chapter 6 summarizes the sedimentary evolution of the Ediacaran Yangtze platform and introduces some perspectives for future studies.

Four articles in various stages of submission as independent manuscripts form the backbone of this work.

- **Chapter 2:** The first manuscript "Paleotopographic influence on the development of the Ediacaran Yangtze platform (Hubei, Hunan, and Guizhou provinces, China)" highlights the irregular bathymetry of the shelf and relates it to the passive-margin history of the Yangtze platform.

Author: E. Vernhet

The manuscript was submitted to *Sedimentary Geology*

- **Chapter 3:** The second manuscript "Sequence analysis and sedimentary evolution of the Ediacaran Yangtze platform shelf (Hubei and Hunan provinces, Central China) " provides an analysis of the platform facies and proposes a sequence-stratigraphic correlation between seven sections on the southern Yangtze platform in Hubei and Hunan provinces.

Authors: E. Vernhet

The manuscript was submitted to *Sedimentology*

- **Chapter 4:** The third manuscript "Large-scale slope instability at the southern margin of the Ediacaran Yangtze platform (Hunan province, central China)" documents the depositional processes on the slope and the presence of large-scale olistostromes.

Authors: E. Vernhet, C. Heubeck, M-Y. Zhu, J-M. Zhang

The manuscript was submitted to *Precambrian Research* and is currently in revision.

- **Chapter 5:** The fourth manuscript "Ediacaran stratigraphic reconstruction of Yangtze platform margin (Hunan province, China) from shelf-edge collapse products" proposes a facies analysis and paleoenvironmental reconstruction of the Ediacaran platform edge.

Authors: E. Vernhet, C. Heubeck, M-Y. Zhu, J-M. Zhang

The manuscript was submitted to *Palaeogeography, Palaeoclimatology, Palaeoecology*

The co-authors participated by contributing data, by scientific discussion, and providing useful comments to the redaction of these manuscripts. Prof. C. Heubeck corrected the English.

Literature references for each chapter form one list at the end of this thesis.
The appendices provide supporting field and analytical data.

Thin sections and hand samples related to this project are archived at the
Department of Geological Sciences
Freie Universität Berlin
Malteserstr. 74-100
12249 Berlin
Germany