Geophysical Research Abstracts
Vol. 14, EGU2012-9318-3, 2012
EGU General Assembly 2012

Diagenesis, weathering and paleoenvironmental conditions from postglacial diamictite/cap carbonate transition layers of the Otavi Group (NW-Namibia)

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Introduction
The so-called “Snowball Earth hypothesis” states that the “Sturtian” (710 Ma) and “Marinoan” glaciations (635 Ma) were of global extent and may have lasted for several million years. Our samples were collected from conspicuous transition layers on top of the glaciogenic Chuos (Sturtian) (10 samples) and Ghaub (Marinoan) formations (63 samples) of the Neoproterozoic Otavi Group in NW-Namibia. The goal of this study is to obtain information concerning the provenance and geochemical composition of postglacial diamictite/cap carbonate transition layers and to estimate the paleoenvironmental conditions with respect to glacio-marine sea water composition and attendant sediment accumulation in mineralogical-geochemical aspects.
Methods
The mineralogical composition of our samples was studied using the petrographic microscope, X-ray powder diffraction, cathodoluminescence microscopy, and micro-Raman spectrometry. Instrumental neutron activation and X-ray fluorescence analyses, as well as analytical electron microscopy, were used for the geochemical study.
Results
Detrital components derived from crystalline and/or dolomite platform source areas are enclosed within a diagenetically recrystallized matrix of carbonate and quartz minerals.
Clay samples from both, Marinoan and some Sturtian postglacial layers are characterized by high Ni/Co, Cr/V, and low Th/Sc, La/Sc, V/Ni and Cr/Ni ratios compared to PAAS (Postarchean Australian shale, [1]), which could indicate mafic-ultramafic source material[1]. According to SEM-EDX measurements, only hematite, quartz, and feldspar make up the detrital composition, thus the Cr-Ni enrichment does not seem to be associated with any specific mineral phases.
Specific results for the Sturtian postglacial transition layers:
An U/Th ratio >0.75, and Mo-enrichment in the topmost iron-rich Sturtian diamictites (Chuos Fm.) and their superposed postglacial boundary layers (Rasthof Fm) indicates reducing conditions in the sea water [2,3]. The detritus of the basal cap carbonates is rich in kaolinite and montmorillonite and has low K/Cs values, indicating a high weathering rate.
Specific results for the Marinoan postglacial transition layers:
The Marinoan diamictites (Ghaub Fm.) and their superposed postglacial transition layers (basal Maieberg Fm) are characterized in a few cases by very high Th/Co, Th/Sc and LREE/HREE ratios, which indicate some influence of a felsic source area. The detrital/recrystallized components of these iron-poor diamictites are rich in pyrite and quartz and display a REE enrichment compared to PAAS, which indicates a hydrothermal component during their accumulation [3].
Conlusions
1) Sturtian layers: possibly different source areas supplied the sedimentary basins
2) Marinoan layers : sediments were influenced by hydrothermal fluids and diagenetic alteration
3) Reducing conditions existed in the marine environment during both of the “Snowball Earth” glaciation periods each followed by oxidative conditions reflected in the geochemical composition of related postglacial cap carbonates.
Acknowledgement
Our work is funded by the Austrian Academy of Sciences (IGCP 512) (to CK).

References

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