Geophysical Research Abstracts
Vol. 17, EGU2015-6645, 2015
EGU General Assembly 2015

High-resolution geology, petrology and age of a tectonically accreted section of Paleoarchean oceanic crust, Barberton greenstone belt, South Africa

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The ca. 3.53 to 3.29 Ga Onverwacht Group of the Barberton greenstone belt (BGB), South Africa records a rare sequence of exceptionally well-preserved volcanic, intrusive and volcani-clastic Paleaoarchean rocks. Numerous conflicting models exist for the geologic evolution and stratigraphy of this early Archean greenstone belt, ranging from plume-type dynamics to modern-style plate tectonics. Although much work has focussed on the komatiites of the ca. 3.48 Ga Komati Formation since their discovery in 1969, far less petrological attention has been given to the younger oceanic rock sequences of the Kromberg type-section in the mid-Onverwacht Group. In this study, we present new field observations from a detailed re-mapping of the Kromberg type-section, and combine this with high-resolution lithological observations from continuous drill core of the Barberton Scientific Drilling Project [1]. The new mapping and field observations are compared to a recent preliminary study of the Kromberg type-section [2]. A U-Pb detrital provenance study was conducted on a reworked, volcani-clastic unit in the upper Kromberg type-section for the first time. This included U-Pb age determination of 110 detrital zircons by secondary ion microprobe analyses (SIMS), providing constraints on maximum depositional age, provenance of the ocean-floor detritus, and timing for the onset of Kromberg ocean basin formation. These new zircon age data are compared to a previous U-Pb detrital zircon study conducted on the structurally underlying sediments of the ca. 3.43 Ga Noisy formation [3]. A multi-pronged petrological approach has been applied to various rock units across the Kromberg, including thermodynamic modelling techniques applied to metabasalts and metapyroxenites for PT-estimates, bulk- and in-situ isotope geochemistry providing constraints on protolith geochemistry and metamorphic history. Consequently, it is shown that this previously poorly studied Kromberg oceanic rock sequence of the mid-Onverwacht, is a key area in resolving stratigraphy models and understanding the geologic evolution of the BGB. The combined field and petrological data provide new insight into mid-Paleoarchean ocean basin formation and subsequent tectonic destruction.

[1]. Grosch et al., (2009b). EOS 90, 350-351. [2] Furnes et al., (2011) Precam. Research 186, 28-50. [3] Grosch et al. (2011) Precam. Research 191, 85-99.