Geophysical Research Abstracts
Vol. 16, EGU2014-7421, 2014
EGU General Assembly 2014

Carbonaceous matter and putative microfossils of the mid-Archean Kromberg type-section re-visited, Barberton Greenstone Belt, South Africa

Nicola McLoughlin and Eugene Grosch
University of Bergen, Dep. Earth Science, Centre for Geobiology, Bergen, Norway (nicola.mcloughlin@geo.uib.no)

Silicified seafloor sediments of the Kromberg Formation from the Onverwacht Group of the Barberton greenstone belt (BGB), South Africa, have been argued to contain some of the world's oldest preserved carbonaceous microfossils. Previous studies of these cherts have reported filamentous, spheroidal and ellipsoidal microfossils in thin-section (Walsh 1992); and bacteriomorph like structures in HF-etched samples (Westall et al. 2001). These microtextural studies however, lack supporting in-situ geochemical data, and are hampered to some degree by re-mobilisation of the carbonaceous matter (Van Zuilen et al. 2007). In light of these concerns, and ongoing debates surrounding carbonaceous remains in other Archean cherts (e.g., W Australia), further in-situ data from the Kromberg is required to positively identify carbonaceous matter of biogenic origin. New data will also help to address outstanding questions regarding the relative contribution of benthic versus planktonic microorganisms, and the putative microbial metabolisms involved.

This study focuses on surface samples and drill core from the Barberton Scientific Drilling Programme, (BSDP, Grosch et al. 2009) from the southeastern limb of the Onverwacht anticline of the BGB. We sampled the Footbridge chert and a second chert horizon in drill core KD1 of the BSDP in the upper Kromberg Fm; and surface outcrops of two black cherts from the lower Kromberg Fm. Sedimentological logging reveals horizons rich in volcaniclastics with interbedded finely laminated grey-black chert, also intrusive black cherts, and sulphide rich horizons. The TOC of the sampled cherts is 1.24 to 5.40 wt%. Preliminary bulk carbon isotope values range from δ^{13}C -21.1 to -35.3‰ values that are consistent with organic matter produced by anoxygenic photosynthesis. Microfabrics preserved in the Kromberg cherts include, primary wispy-laminated carbonaceous films suggesting compaction of early carbonaceous laminae. Also large composite carbonaceous grains $>$30 μm across recording wave-motion on the seafloor. Secondary fabrics include hydrothermal veins containing remobilized carbon and sometimes sulphides, also void-filling silica spherulites coated in carbonaceous matter.

A novel fabric discovered in the lower Kromberg chert is silicified carbonaceous fragments with plastic deformation that are morphologically comparable to microtextures reported from the 3.416 Ga Buck Reef Chert (Tice and Lowe 2004) interpreted to be deformed microbial mat fragments. These fabrics are currently being studied by raman spectroscopy to assess the effects of taphonomic processes and metamorphic alteration on this potential biosignature. In-situ sulphur isotope measurements by SIMS on sulphides associated with primary carbonaceous fabrics of the Footbridge chert found a narrow range in $\delta^{34}S_{CDT}$values of -6.00 to + 1.50 ‰ and positive Δ^{33}S values up to +2.50 ‰ suggesting the involvement of atmospheric sulphur aerosols, but do not strongly support either microbial sulphate reduction or disproportionation (Grosch and McLoughlin 2013). The geochemical evidence for microbial processes must therefore be further tested in the Kromberg cherts to build upon the bulk carbon isotope data that is consistent with, but alone not diagnostic of, microbial processes.

In summary, this new survey of carbonaceous cherts from the Kromberg type section has identified well-preserved candidate microbial microfabrics that will be the target of ongoing high resolution in-situ geochemical and ultrastructure analysis.