



PGE-Re concentrations in carbonaceous siltstones from the Barberton Drilling Project: Sources and processes

Philipp Rammensee and Sonja Aulbach

Goethe University, Institut für Geowissenschaften, Fachinheit Mineralogie, Frankfurt am Main, Germany
(s.aulbach@em.uni-frankfurt.de)

The emergence, diversification and disappearance of Earth's life forms are closely tied to the redox state of the oceans, and the sources and sinks of metabolically cycled metals. It is generally accepted that the early terrestrial atmosphere contained extremely low levels of free oxygen [1]. While a significant change to atmospheric oxygen levels has been constrained to ca. 2.45 Ga ago, the details of the complex prior redox evolution of the oceans and atmosphere, and their influence on continental weathering, are still blurry [1]. Among the trace metals that have been applied to this problem, Re and the platinum-group elements (PGE) have variable redox chemistry that has been successfully exploited to identify detrital vs. hydrogenous sources and the presence of oxic vs. suboxic or euxinic conditions both in young and ancient sediments, including predominantly outcrop samples from the Barberton Greenstone Belt (BGB) [2,3]. As ^{187}Re decays to ^{187}Os , the Re-Os isotope system can additionally be used to date the deposition of carbonaceous shales through construction of isochrons and obtain the initial Os isotope composition, which is a tracer for continental input of radiogenic Os [4].

The sampling approach here was to choose 8+ samples from narrow intervals (≤ 1 m, to avoid initial Os isotope heterogeneity) from the Barberton Drilling Project (two depths in core BARB5/Fig Tree Group and one interval in core BARB3/Buck Reef Chert. We are currently finalising institution of the sample preparation and analytical techniques, involving (1) high-pressure asher digestion and (2) low-temperature leaching of presumably hydrogenous, acid-soluble components of spiked samples, followed by solvent extraction of Os and cation exchange column chromatography to isolate PGE-Re from the residue, further purification with BPHA and measurement of Ru-Pd-Ir-Pt by ICPMS and of Re-Os by MC-ICPMS. Preliminary tests with the SDO-1 standard have revealed that concentrations of Ir and Pt in low-T dissolutions are indistinguishable from those in high-T dissolutions within the uncertainty, implying that these elements are contained fully in the hydrogenous component. In contrast, Re concentrations in the low-T digest are significantly lower (by 8%), indicating some control by the detrital component in a Phanerozoic shale. Prior work [3] has shown that PGE-Re abundance patterns of BGB sediments resemble those of komatiites, indicating an ultramafic, detrital source. Given the age of the BGB (3.5 – 3.2 Ga) and the absence of oxidative weathering, we expect to see low concentrations and no resolvable difference between the two digestion approaches that would be attributable to the variable redox behavior of Re and PGE. We aim to present results showing whether any short-scale changes occur in the sources and processes of PGE-Re incorporation into the sediment, and to eventually obtain robust Re-Os isotope constraints.

[1] Canfield (2005) *Annu. Rev. Earth Planet. Sci.* 33:1–36; [2] Lee et al. (2003) *Geochim. Cosmochim. Acta* 67: 655–670; [3] Siebert et al. (2005) *Geochim. Cosmochim. Acta* 69: 1787–1801; [4] Kendall et al. (2009) *Geol. Soc. London Spec. Publ.* 326: 85-107