

Combined Halogen (Cl, Br, I) and noble gas mantle geochemistry

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Not yet two decades ago the community view of the mantle structure had converged on a mantle geochemically layered at 670km depth. This model has passed on, is no more, ceased to be, expired and is now history. Killed, by geophysical observation. Although the layered mantle is now an ex-model the geochemical observations used to support it remain; the formation, location and evolution of a volatile rich mantle reservoir capable of fluxing the mantle beneath mid ocean ridges with accretionary volatiles, such as ³He, still attracts significant attention.

High precision multi-collector noble gas mass spectrometry is providing us with new detail of the mantle system. MORB basalts and mantle-derived CO₂ natural gas fields show a MORB-source mantle with light and heavy noble gases, and therefore associated volatiles, that originate as a trapped component in accreting meteorites [1]. New data from Iceland nevertheless, shows that the Iceland OIB source region is incompatible with this source simply providing the noble gases now in the upper mantle [2]. An additional volatile input into the mantle is today through recycling noble gases with a seawater signature [3], while dry subduction may have operated on the Early Earth to introduce accretionary volatiles into the mantle [4].

Heavy halogens (Cl, Br, I), in combination with noble gases, are a powerful tool to understand the subduction of volatiles and highly incompatible elements in detail [5]. Due to low Br and I concentrations, new techniques only now allow us to determine: accretionary material characteristics; partitioning data; and investigate the different terrestrial reservoir halogen mass balance. We present an overview of progress in this new field and discuss how the combined halogen/noble gas data might be used to reconcile the apparent need for a volatile-rich reservoir that fluxes the shallow mantle with the new Icelandic data [2].

[1] Holland *et al.*, *Science* (2009); [2] Mukhopadhyay, *Nature* (2012) [3] Holland and Ballentine, *Nature* (2005); [4] Tolstikhin and Hofman *PEPI* (2005); [5] Sumino *et al.*, *EPSL* (2010)

Reconstructing the Rheic: Geochemical analysis of ocean lithosphere from the Variscides

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Although the Rheic Ocean dominates palaeo-geographic reconstructions of central Europe during the Palaeozoic, many factors regarding its general evolution & internal tectonic configuration are inadequately constrained [1]. A major component in aiding a better understanding of these factors is the accurate assessment of suture zones & associated metabasite suites within the internal Variscides. As such this study focuses on the geochemistry of the Lizard- Cornwall, Sudetes-Poland, Acatlan-Mexico & Ossa-Morena, Careon, Morais-Iberian ophiolite complexes. Sampling within these complexes focused on the least deformed mafic members in order to fully assess the geo-tectonic setting of basalt genesis. Major, trace and rare earth element data (XRF & ICP-MS) has been examined and shows general LREE depletion & a lack of significant Ta, Nb or crustal derived element anomalies for all complexes. The new geochemical data enables an accurate discrimination of the geo-tectonic setting for each complex and aids in constraining future palaeo-geographic reconstructions of the enigmatic Rheic basin. The lack of crustal contamination & origins within the upper mantle, facilitates use of some samples for a future Hf-Nd isotope study aimed at fingerprinting the Devonian upper mantle and furthering our understanding of the origin & evolution of the Dupal anomaly [2]. Additionally, we will use the isotope data to investigate models to explain the apparent depleted nature of the source of Rheic Ocean basalts [3].

[1] Kroner & Romer (2013) *Gond Res.* In press. [2] Dupre & Allegre (1984) *EPSL* **71**, 71–84. [3] Murphy *et al.* (2010) *Lithos* **123**, 165–175.