A lithogeochemical assessment of element mobility in Archaean cratons: implications for Nb-Ta anomalies and PGE mobility

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Archaean geodynamic regimes remain highly controversial, with age predictions for intiation of Phanerozoic-type plate tectonics ranging from the Palaeoarchaean to Neoproterozoic [1]. Negative Nb-Ta-(Zr-Hf-Ti) anomalies on normalised plots are widely attributed to subduction-related magmatism in the Phanerozoic [2], with this interpretation often extended into the Archaean [3]. However, owing to complex geologic and metamorphic histories, the components of Archaean cratons are highly susceptible to post-emplacement metasomatism. Therefore, geodynamic interpretations based on geochemistry must constrain the alteration component before identifying and interpreting the magmatic signature. By applying a lithogoechemical approach to ultramafic-mafic complexes in the Lewisian Complex, we assess element mobility and outline implications for Archaean geodynamics.

In the 5 km^2 Ben Strome complex, ultramafic rocks generally exhibit flat chondrite-normalised rare-earth element (REE) patterns (n=22; $[La/Gd]_N$=0.5-1.7) and flat mantle-normalised trace-element patterns. However, 15 samples show light-REE enrichment ($[La/Gd]_N$ =2.11–21.4) coupled with negative Nb-Ta-(Zr-Hf-Ti) anomalies. Such variability is not shown by chondrite-normalised platinum group-element (PGE) patterns, which are fractionated ($[PPGE/IPGE)]_N$=5.3-15.7).

As a result of light-REE mobility, negative Nb-Ta-(Zr-Hf-Ti) anomalies represent post-emplacement light-REE enrichment, rather than magmatic (subduction) signatures. Henceforth, immobile heavy-REE and PGE are the most prospective tools for ‘fingerprinting’ the provencance and geodynamic significance of ultramafic units in Archaean cratons.

References: [1] Beddard et al. **(**2013). *Precam. Res.* **229**. 20-48 **[2]** Foley et al. (2000). *Geochem. et Cosmo. Acta.* **64**. 933-938. **[3]** Guo et al. (2017) *J. Asian Earth Sci.* **135**. 347-369