Insights from titanites into the petrology of Archaean metabasalts from the Pilbara Craton

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Several geochemical studies of volcanic successions in Archaean terranes (e.g. Isua, Superior, Kapvaal, Pilbara) have previously addressed the bimodal bulk chemistry observed in early Archaean metabasalts. Most rocks show an affinitiy to undepleted mantle, while some have island arc- or cont. crust-like trace elment signatures with highly enriched Th, U, LREE and significant HFSE (Ti, Nb, Ta) depletion, despite being isotopially (Hf, Nd, Pb) homogeneous. This has been interpreted either as contamination by a crustal precursor of comparable age [1], or the origin from an enriched mantle source [2]. So far the role of accessory mineral phases in these rocks (which can hold a significant portion of the total trace element budget) has not been explored much.

Titanite has several advantages over other mineral geo-chronometers such as zircon or monazite: (i) strong textural and compositional links to the p/T history of the host rock, (ii) the potential to record post-emplacement metamorphic events and (iii) a higher modal abundance in mafic volcanic rocks. Therefore, titanite is a suitable canditate for *in situ* mineral microanalysis on early Archaean greenstones, which are linked to the formation and evolution of the Early Earth's crust.

Titanite crystals (~50–120 μm) from circa 3.45 Ga old metabasaltic rocks of the Warrawoona Group, sampled from several greenstone belts within the eastern Pilbara Craton in Western Australia, were analysed for major (EPMA), and trace element (LA-ICPMS) compositions. Bulk rock major element chemistry is partially reflected in titanites (Si, Ca, Na, not Ti), but corresponding LREE-enrichments are not found in titanites, which show overall flat to LREE-depleted REE patterns and 10–80x whole rock abundances. Most titanites appear to be of metamorphic origin with Al/Fe (apfu) between 2 and 5, low Th/U (<1) and low Zr (<100 μg/g). However, one sample shows distinctly magmatic affinities (Th/U 2–8, Zr >400 μg/g). Additional U-Pb dating will help to further constrain the titanite origin.

[1] Green et al., (2000), *Tectonophysics*, **322**, 69-88.
[2] Jenner et al., (2013), *Geology*, **41**, 327-330.