Was the Archean subseafloor of the Barberton greenstone belt a habitat for early life?

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Evidence for the earliest traces of subseafloor micobial life have been reported from the Paleoarchean Barberton greenstone belt (BGB) of South Afica in the form of early titanite microtextures in metabasaltic pillow lavas [1]. If microbial bioalteration did occur on early Earth it would have catalyzed a number of processes marking the onset of Earth-life co-evolution. But how robust is the evidence for early microbial life in subseafloor basaltic glass? Current models are based mainly on titanite morphological arguments that compare metamorphic titanite microfilaments in altered 3.47 Ga pillow lavas to partially mineralized microtunnels from recent subseafloor basaltic glass argued to be of microbial origin [1].

In this study we present a wide range of high-resolution petrological data on titanite microstructures in c. 3.47 Ga metabasaltic pillow lavas of the BGB and question their biogenicity. A full spectrum of BGB titanite microstructures from fresh drill core are presented arguing that they do not compare in size or morphology to recent microtunnels. In-situ U-Pb titanite ages indicate that the microstrucures are ca. 1.6 billion years younger than the eruptive age of the pillow lava, rejecting the syngenecity of the titanite to a 3.47 Ga subseafloor bioalteration model. New microscale metamorphic temperature and micro-XANES Fe^{3+} speciation maps in chlorite surrounding the microstructures indicate that the titanite records low-temperature retrograde mineral growth related to contact metamorphism at ca. 2.9 Ga. Collectively, the new data strongly questions the biogenicity and antiquity of the titanite microstructures and we propose that other lines of evidence for early life (e.g. sulphur isotopes) in the early Archean subseafloor need to be explored.

[1] Staudigel, Furnes & DeWit (2015). *PNAS*, **112**, 6892-6897. [2] Grosch & McLoughlin (2014). *PNAS*, **111**, 8380-8385. [3] Grosch, Muñoz, Mathon & McLoughlin (2016). *Geol. Soc. Lon. Sp Pubs*, **448**.