Geophysical Research Abstracts,
Vol. 11, EGU2009-10977, 2009
EGU General Assembly 2009

Age, Distribution and Preservation of Microbial Alteration Textures in the Precambrian Sub-seafloor

N. McLoughlin (1), H. Furnes (1), D.J. Fliegel (1), A. Simonetti (2), N.R. Banerjee (3), H Staudigel (4), K. Muehlenbachs (5), M. de Wit (6), and M. Van Kranendonk (7)

(1) Dept. of Earth Science and Center for Geobiology, Allegaten 41, Bergen, Norway, N-5007, (2) Dept. Civil Engineering and Geological Sciences, University of Notre Dame, Notre Dame, IN 46556, USA; simonetti.3@nd.edu, (3) Dept. of Earth Sciences, University of Western Ontario, London, Ontario, Canada N6A 5B7; neil.banerjee@uwo.ca, (4) Scripps Institution of Oceanography, University of California, La Jolla, CA 92093-0225, USA; hstaudigel@ucsd.edu, (5) Dept of Earth Sciences, University of Alberta, T6G 2E3 AB, Edmonton, Canada; karlis.Muehlenbachs@ualberta.ca, (6) AEON and Dept of Geological Sciences, University of Cape Town, Rondebosch 7701, S-Africa; Maarten.DeWit@uct.ac.za, (7) Geological Survey of Western Australia, 100 Plain St. East Perth, Western Australia 6004, Australia; martin.vankranendonk@doir.wa.gov.au

The microbial alteration of basaltic glass in the sub-seafloor is a globally extensive process with a fossil record that extends to the early Archean [1]. Prokaryotic microorganisms create granular and tubular trace fossils [2] in glassy pillow lava rims and volcanic breccias that can be used to trace the origins and evolution of microbial life in the sub-seafloor.

We have examined meta-volcanic glass from several Precambrian pillow lava sequences including: the ~2.0 Ga Pechenga Greenstone Belt of the Kola Peninsula; the ~2.52 Ga Wutai Group of N China; the ~3.5 Ga Hooggenoeg Formation of the Barberton, S Africa; and the ~3.35 Ga Euro Basalt of Western Australia [3].

In these little deformed greenschist facies sequences, clusters of titanite mineralized filamentous textures typically <10µm across and up to ~150µm long are sporadically found. These are comparable in size and morphology to the traces of euendolithic microbes found in the modern sub-seafloor. The pillow lava rims that bear these trace fossils also contain disseminated carbonates that exhibit d13C values that are shifted relative to the pillow cores consistent with microbial activity. These C isotopic signatures are more widely preserved than the trace fossils indicating that a special taphonomic window is required to preserve the textural evidence.

In-situ U-Pb dating of titanite infilling the trace fossils by LA-MC-ICP-MS enables us to obtain minimum age estimates of formation for the trace fossils [4]. For example, in the case of the ~2.52 Ga Wutai sequence a titanite age of 1.81 ± 0.12 Ga (95.4% confidence, n=22, 206Pb/238U weighted average) was obtained. In all sequences investigated the titanite ages correspond to the timing of regional metamorphic events affecting the pillow lava sequence. The oldest titanite age yet found comes from the Barberton Greenstone belt at 3.15 ± 0.05 Ga (95.4% confidence, n=60, 206Pb/238U weighted average) suggesting that a sub-seafloor biosphere was established by at least 3.15 Ga [5].

This database of textural, geochemical and geochronological evidence allows us to present a preliminary model for the distribution of microbial life in the Precambrian sub-seafloor.

[1] Staudigel et al. (2008). 3.5 Billion years of glass bioalteration: Volcanic rocks as a basis for microbial life? Earth Science Reviews 89, 156-176. [2] McLoughlin et al. (2009). Ichnotaxonomy of Microbial Trace Fossils in Volcanic Glass. J. Geol. Soc. London 166, 159-170. [3] Furnes et al. (2008). Oceanic pillow lavas and hyaloclastites as habitats for microbial life through time – A review "In: Links between Geological Processes, Microbial Activities, and Evolution of Life " (Ed) Y. Dilek, H. Furnes and K. Muehlenbachs Springer Book Series, pp1-68. [4] Banerjee et al. (2007). Direct dating of Archean microbial ichnofossils. Geology 35, 487–490. [5] Fliegel et al. (2008) In situ dating of the oldest morphological traces of life on Earth. Eos Trans. AGU 89 (53) Fall

Meeting Suppl. abstract P51A-1395