

Hadean-Eoarchean microfossils in hydrothermal vent-related sediments

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Jasper-carbonate rocks interpreted as hydrothermal vent-related sediments from the Nuvvuagittuq supracrustal belt (NSB) in northern Québec (Canada) are reported here to preserve early diagenetic features and the remains of microorganisms at least ca. 3770 Myr old[1] and possibly 4280 Myr old[2]. Our data show that microbes inhabited siliceous-ferruginous hydrothermal vent environments and are spatially associated with a range of diagenetic features, including carbonate rosettes and granules with identical structure and mineralogy to those in younger analogues, such as jasper in the Ordovician Løkken district (Norway) and in the late Paleoproterozoic Frere (Western Australia) and Biwabik (USA) formations. NSB jasper-carbonate rocks preserve isotopically light carbonate and carbonaceous material (CM)[3], as well as syngenetic graphitic carbon inclusions within diagenetic carbonate rosettes intergrown with apatite laths. Along with CM in magnetite-hematite granules, these observations point to diagenetically oxidised biomass. Additionally, hematite tubes and filaments in the NSB jaspers preserve morphologies and mineralogies identical to those of microfossils documented in hydrothermal vent sediments throughout the geological record. These independent observations collectively provide evidence for biological activity in hydrothermal environments within the first two to seven hundred million years of Earth history.

[1] Augland, L. E. & David, J. *EPSL* **428**, 162-171 (2015). [2] O'Neil, J., Carlson, R. W., Francis, D. & Stevenson, R. K. *Science* **321**, 1828-1831 (2008). [3] Papineau, D. *et al. Nature Geosci* **4**, 376-379 (2011).