# Deep microbial proliferation at the basalt interface in aged oceanic crust

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The upper oceanic crust is mainly composed of basaltic lava that constitutes one of the largest habitable zones on Earth. However, the nature of deep microbial life in oceanic crust remains poorly understood, especially where old cold basaltic rock interacts with seawater beneath sediment. It is shown that microbial cells are densely concentrated in Fe-rich smectite on fracture surfaces and veins in 33.5- and 104-million-year-old (Ma) subseafloor basaltic rock drilled during the IODP Expedition 329. The Fe-rich smectite is locally enriched in organic carbon. Nanoscale solid characterizations reveal the organic carbon to be microbial cells within the Fe-rich smectite, with cell densities locally exceeding $10^{10}$ cells/$cm^3$. Dominance of heterotrophic bacteria indicated by analyses of DNA sequences and lipids supports the importance of organic matter as carbon and energy sources in subseafloor basalt. Given the prominence of basaltic lava on Earth and Mars, microbial life could be habitable where subsurface basaltic rocks interact with liquid water.

 