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Comparing biosignatures from North Pond, Mid-Atlantic Ridge and the Louisville Seamount Chain, off New Zealand

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The subseafloor ocean represents Earth's largest aquifer and the flow of seawater fluxed through these flanks is > 1016 L/yr, rivaling the rate of river discharge into the oceans. When volcanic basalt glass is exposed to oxygen-rich seawater, rims of palagonite form at the expense of glass. Within subseafloor basalt glass, a range of putative microbial biosignatures have been interpreted as traces of life in these basaltic aquifers, and these have been studied as a potential analogue for early life on Earth or extraterrestrial habitats for several years. However, little is known about the relationship of the physical and chemical nature of the habitat and the prevalent types of biosignatures. We report and compare biosignatures from two distinctly different study sites that vary strongly. We analyzed rock samples microscopically for their putative textural biosignatures and their associated organic molecules via Fourier transform infrared spectrometry. The biosignatures found in basalts from the North Pond Region, at the western flank of the Mid-Atlantic Ridge 23°N, which is young well-oxygenated crust, are characterized by a small textural diversity. However, the organic molecules associated, show evidence for the occurrence of complex molecules like proteins. In contrast, the biosignatures from the Louisville Seamount Chain, which are much older (50 – 80 Ma), are more diverse in terms of textures, while the organic molecules are more degraded and suggest an Archaeal origin. We propose that microbial communities change significantly during crustal evolution and that microbes associated with older and severely altered crust may not be related to the textures commonly found within subseafloor basalt glass and often interpreted as trace fossils.