Comparing biosignatures in aged basalt glass from North Pond, Mid-Atlantic Ridge and the Louisville Seamount Trail, off New Zealand

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Microbial life can leave various traces (or biosignatures) in rocks, including biotic alteration textures, biominerals, enrichments of certain elements, organic molecules, or remnants of DNA. In basalt glass from the ocean floor, microbial alteration textures as well as chemical and isotopic biosignatures have been used to trace microbial activity. However, little is known about the relationship between the physical and chemical nature of the habitat and the prevalent types of biosignatures. Here, we report and compare strongly variable biosignatures from two different oceanic study sites. We analyzed rock samples for their textural biosignatures and associated organic molecules. The biosignatures from the 8 Ma North Pond Region, which represents young, well-oxygenated, and hydrologically active crust, are characterized by little textural diversity. The organic matter associated with those textures shows evidence for the occurrence of remnants of complex biomolecules like proteins. Comparably the biosignatures from the older Louisville Seamount Trail (~70 Ma) are more texturally diverse, but associated with organic molecules that are more degraded. The Louisville Seamount has less fresh glass left and decreased permeability, which metabolic pathways may dominate that only leave molecular biosignatures without textural evidence of glass alteration. We propose that diverse biosignatures in oceanic crust may form during different stages of crustal evolution.