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Intricate Textures at Glass-Clay Boundaries in Oceanic Basalts

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A wide variety of intricate textures occur at the interface of glass and hydrous alteration products of glass in oceanic basalts. These textures are found where there is free circulation of water within the basalt and where temperatures are less than 100˚C. These textures occur in basalt glass exposed to bottom seawater and to subsurface, suboxic water. The intricate textures occur at the outside surface of basalts and along fractures in the interior of basalt. There is considerable speculation that the textures are the result of microbial activity in the rocks but no such textures have been produced in laboratory experiments, nor have such textures been produced by abiotic means. Common characteristics of the textures are: (1) they extend into glass from a surface exposed to water; (2) they are localized along surfaces and fractures; (3) they exhibit a wide variety of texture types, but a small number of texture types within a single sample, (4) where tunnels are formed, they have uniform diameters along their lengths; and (5) dark minerals often have precipitated at the margin of glass where the textures are present. We have characterized numerous types of textures based on size, branching, roughness, distribution, and shape. The hypothesis examined in this study is that the texture type is dependent on the ambient conditions in the basalt. These conditions either affect the style of chemical alteration or promote the growth of specific microbes, which in turn produce the intricate textures. To test this hypothesis we examined glass from basalts with different ages, compositions, ambient temperatures, from oxic and suboxic environments, from below different thicknesses and types of sediment, and from basalts exposed to bottom seawater and to water circulating in the subseafloor. Over 130 basalts cored from beneath the sea floor by the Deep Sea Drilling Project, the Ocean Drilling Program, and the Integrated Ocean Drilling Pro-

gram, over 50 basalts collected by dredging and submersible dives on oceanic rifts and seamounts, and basalts from the Hawaii Scientific Drilling Program have been investigated. Polished petrographic thin sections were prepared from these basalts and examined with an optical microscope in plane-polarized light at 400x magnification. Basalt glass from the surface of seamounts appears to have a type of intricate texture that is different from textures in basalt cored from beneath the sea floor and Hawaii. We speculate that some textures form by abiotic action of water on basalt glass, but that textures are the consequence of microbial action that is promoted by the organic matter and nutrients in the water, or by nutrients in the volcanic glass.