

Raman spectroscopic characterization of a highly weathered basalt: Igneous mineralogy, alteration products, and a micro organism

Alian Wang, Bradley L. Jolliff, and Larry A. Haskin

Department of Earth and Planetary Sciences and McDonnell Center for the Space Sciences, Washington University, St. Louis, Missouri

Abstract. On-surface identification of minerals on Mars is likely to depend mainly on observations of rocks and soils as found, without access to fresh surfaces or other sample preparation. Both the original mineralogy of rocks and their alteration mineralogy will be important. To determine the capability of Raman spectroscopy to provide good mineralogical characterization of an altered igneous rock such as might be encountered on Mars, we have analyzed the heavily weathered, exterior surface of a cobble of Keweenaw basalt and compared the results with those from a roughly cut, unpolished interior surface, using a Raman point-counting method. Despite ubiquitous hematite, a strong Raman scatterer, and despite considerable alteration, original igneous plagioclase and pyroxene were identified and their approximate proportions determined from point-counting traverses on the original surface of the rock. Saponite, an alteration product, was easily identified on the freshly cut surface but could only occasionally be identified on the weathered surface, where saponite-rich areas were highly photoluminescent. Amygdular fill gave strong spectra of calcite and thomsonite (a zeolite). Tiny, sparse crustose lichen gave clear spectra of their waxy organic coating. On the basis of the surface Raman spectra alone, the rock could be identified as a mafic rock, probably basaltic, that was hydrothermally altered in an oxidizing environment at a temperature between ~250 and ~350°C.