Petrographic and spectral study of hydrothermal mineralization in drill core from Hawaii: A potential analog to alteration in the martian subsurface

Wendy M. Calvin[1,*,†], Nicole Lautze[2], Joe Moore[3], Donald Thomas[2], Eric Haskins[2], and Brandon P. Rasmussen[1]

[1]Department of Geological Sciences, University of Nevada, Reno, Nevada 89577, U.S.A.
[2]Hawaii Institute of Geophysics and Planetology, University of Hawaii, Honolulu, Hawaii 96822, U.S.A.
[3]Energy and Geoscience Institute, University of Utah, Salt Lake City, Utah, 84108, U.S.A.

Abstract

Continuous rock core was collected for 1764 m (5786′) on the Pohakuloa Army Training base near the center of the big island of Hawaii. The core traverses basaltic lava flows from the volcano's shield-building phase, and perched aquifers and higher temperature groundwaters were encountered. The collected samples record water-rock interactions of basaltic materials in a setting that may be a model for groundwater interactions on Mars. We collected visible and infrared point spectra of materials in the lowest portion of the core, where alteration was noted to become more prominent. We identified three types of phyllosilicate spectral signatures and three types of zeolites. The phyllosilicates show similarity to those identified on Mars using data from the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM). Based on the field survey, 25 depths were selected for sampling and petrographic analysis of thin sections. The spectral data and thin section work have a strong agreement in the types of materials identified by the two different techniques. Both the spectral and petrographic data indicate low to moderate temperature geothermal alteration occurred in the lower half of the core. The field spectra are a useful reconnaissance tool for selecting mineralogic diversity for subsequent higher resolution and more time-consuming laboratory analysis.

Keywords: IR spectroscopy, aqueous alteration, Hawaii drill core, geothermal; Earth Analogs for martian Geological Materials and Processes