MARTIAN SOIL ANALOGS FROM ANTARCTIC DRY VALLEYS: ELEMENTAL ABUNDANCES AND MINERALOGY SIGNAL WEATHERING PROCESSES

P. Englert[1], J. L. Bishop[2,3], L. D. Hunkins[2,3,4] and C. Koeberl[5,6]. [1]University of Hawaii, Mānoa, HI, penglert@hawaii.edu. [2]SETI Institute, Mountain View, CA. [3]NASA Ames Research Center, Moffet Field, CA. [4]University of South Florida, FL. [5]Natural History Museum, Vienna, Austria. [6]Department of Lithospheric Research, University of Vienna, Vienna, Austria.

Introduction: The only Martian samples returned to date are meteorites. They provide important clues about the mineralogy of Mars; however they are not consistent with most of the planet's composition. Studies of soil and sediment alteration in cold and dry environments on Earth can contribute to understanding Martian surface properties. Antarctic Dry Valley soils exhibit complex chemical weathering in a low temperature and dry environment [1,2]. We present here analyses of elemental abundances and mineralogy of sediments from this area in order to contribute towards our understanding of Mars. Our study focuses on elemental abundances and visible/near-infrared (VNIR) reflectance spectroscopy for comparison with data collected by orbiters and rovers on Mars [e.g. 3-6]. Coordinated evaluation of chemistry and mineralogy of meteorites and Antarctic Dry Valley soils will provide insights into the weathering processes that occurred on Mars.

Samples: We characterized 24 samples, collected directly adjacent to Lakes Fryxell, Vanda, and Brownsworth by geochemical analysis and VNIR spectroscopy. This analysis complements results obtained previously for Lake Hoare sediment cores [2,7].

Chemistry: The soils from each of the lakes show distinct major and minor elemental abundance patterns and C concentrations indicating that each lake environment may represent moderately different soil formation and weathering conditions. The majority of the samples have a Chemical Index of Alteration of 55, indicating predominantly physical weathering.

K/Th ratios for the majority of large Martian domains range from about 4000 to 7000. K/Th ratios in the sample suite range from 522 to 5077, and are below 3000 for all but 3 samples, with Lake Vanda soils clearly distinguished by ratios systematically below 2000. The low spread of K/Th ratios for both Mars and the soil samples for this study indicate little loss of K through aqueous processes. More detailed analyses may provide model insight into the observation that Martian K/Th ratios do not seem to support aqueous alteration contrary to evidence of significant water/rock interaction [8].

Spectra: VNIR spectral analyses indicate orthopyroxene/clinopyroxene ratios of ~40/60 for most samples with higher pyroxene abundances near Vanda and Brownsworth. Weak clay bands are observed for most samples with differences observed among the 3 sites. The Fryxell samples exhibit CH and carbonate bands, consistent with their presence in the chemical analyses. Mid-IR spectra show the presence of quartz and feldspar.

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