

SPECTRAL PROPERTIES OF SELECTED SOILS FROM THE DRY VALLEYS OF ANTARCTICA. David G. Agresti¹, Richard V. Morris², Jeffrey A. Newcomb¹, and Howard V. Lauer, Jr.³. ¹Dept. of Physics, University of Alabama at Birmingham, Birmingham, AL 35294, ²SN4, NASA-JSC, Houston, TX 77058, and ³LEMSCO, Houston, TX 77058.

Introduction. The Dry Valleys are an ice-free network of valleys located in southern Victoria Land, Antarctica. The cold, dry climate of these valleys is probably the best terrestrial approximation to the current environmental conditions on the surface of Mars [e.g.,1]. In the Dry Valleys, physical weathering dominates because the low temperatures and the scarcity of liquid water limit chemical weathering and also participation by biological activity. Chemical weathering does occur [e.g.,2], although at very slow rates. The purpose of our investigation is to determine the spectral manifestations of weathering in Dry Valley soils and to evaluate how similar weathering might act on Mars to modify the spectral properties of its surficial material.

Samples and Methods. The soils discussed in this paper were collected in Wright Valley in 1979 and kept in cold storage (approximately -35°C) since then. According to [1], the samples were collected at an air temperature of -6°C and are not known to have seen higher temperatures prior to or during cold storage. We studied soils collected from a soil pit on Prospect Mesa, a red-colored soil, and two soils collected in brine ponds. Portions of the samples were warmed to room temperature, washed with deionized water, and sieved to pass 1 mm. Spectral data for these processed samples were obtained at room temperature with a Cary 14 configured with an integrating sphere; Mossbauer spectra (Elscint spectrometer) were also obtained for a few of these samples. Spectral data for pristine samples (samples that have not been warmed) were obtained by transferring them while still frozen to a freezer ($-25\pm 5^{\circ}\text{C}$) for measurements with a Guided Wave spectrophotometer.

Results and Discussion. The spectral data for three processed soils from the soil pit are shown in Figure 1. Their spectra are very similar. The approximately 1.4 and 1.9 μm bands are due to bound H_2O . The minimum near 0.95 μm and the broad band at longer wavelengths are suggestive of pyroxene [e.g.,3] and probably correspond to the clinopyroxene observed petrographically in these soils [1]; this is consistent with their Mossbauer spectra which show mostly ferrous iron. The permanently-frozen zone was encountered at a depth of approximately 40 cm so that soils WV219 and WV218 were subjected to natural freeze-thaw cycles but WV214 was not. The spectral data show that if significant differential weathering actually occurs above and below the boundary of the permanently-frozen zone due to this process, it is not readily observable in the spectral data. Spectral data for pristine samples WV218 and WV219 at $-25\pm 5^{\circ}\text{C}$ are shown in Figure 2; visually, these samples did not appear wet. Comparison with Figure 1 reveals no apparent differences in the positions of the spectral features; even the magnitudes of the reflectivities are about the same. Therefore, for these two samples, the spectral consequences of washing (i.e., removal of the soluble salts present at approximately 5 wt % [1]) and recording the spectra at room temperature are minimal.

Only a few distinctly red soils were found during the 1979 expedition [4]. One of them (WV419) is coarse-grained, and the individual particles appear to be coated by a red pigment. Its spectrum is compared with one for a grey pit soil (WV214) in Figure 3. In keeping with the visual color difference, the absorption edge for WV419 is displaced significantly to longer wavelengths as

compared to WV214. The shift is probably due to the presence of ferric oxide or oxyhydroxide. The ferric coating, however, is sufficiently thin that the ferrous absorption near $0.97 \mu\text{m}$ is not masked.

Soils DJ202 and WV485 were collected from the centers of Don Juan Pond and an unnamed dry pond, respectively, and both are visually damp at -35°C , indicating a high salt content for the fluid. The spectra of the pristine soils are shown in Figure 4. The strong band near $1.47 \mu\text{m}$ and the much weaker one (most easily seen in DJ202) near $1.2 \mu\text{m}$ are H_2O absorptions [e.g., 5, 6]. The overall lower reflectivity for the brine soils is due to the fluid around the soil particles which reduces their scattering power. Other than these differences attributable to the presence of H_2O , the spectra of the brine soils are very similar to those in Figures 1 and 2 that are not visibly wet.

In summary, we found that soluble salts present on the Antarctic soils did not effect their spectral properties; presumably, iron-bearing salts are present at spectrally insignificant levels, and this could also be the case on Mars. For the soil pit samples we found no spectral evidence for differential weathering between the permanently and seasonally frozen soil. However, the ages of these soils and also the red soils are needed before the results can meaningfully be applied to Mars. And finally, if soils similar to the brine soils are present over a sufficiently large spatial region on Mars, they should be telescopically observable.

References. [1] Gibson et al., *PL3LSC*, A912, 1983; [2] Ugolini and Jackson, *Antarctic Geoscience*, 1101, 1982; [3] Adams, *JGR* 79, 4829, 1974; [4] Gibson, pers. comm., 1986; [5] Hunt and Salisbury, *Mod Geo* 1, 283, 1970; [6] Clark, *JGR* 86, 3074, 1981.

