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CONTROL ID: 1502412

TITLE: Using Apollo sites and soils to compositionally ground truth Diviner Lunar Radiometer observations

ABSTRACT BODY: Apollo landing sites and returned soils afford us a unique opportunity to “ground truth” Diviner Lunar Radiometer compositional observations, which are the first global, high resolution, thermal infrared measurements of an airless body. The Moon is the most accessible member of the most abundant class of solar system objects, which includes Mercury, asteroids, and icy satellites. And the Apollo samples returned from the Moon are the only extraterrestrial samples with known spatial context. Here we compare Diviner observations of Apollo landing sites and compositional and spectral laboratory measurements of returned Apollo soils.

Diviner, onboard NASA’s Lunar Reconnaissance Orbiter, has three spectral channels near 8 µm that were designed to characterize the mid-infrared emissivity maximum known as the Christiansen feature (CF), a well-studied indicator of silicate mineralogy. It has been observed that thermal infrared spectra measured in simulated lunar environment (SLE) are significantly altered from spectra measured under terrestrial or martian conditions, with enhanced CF contrast and shifted CF position relative to other spectral features. Therefore only thermal emission experiments conducted in SLE are directly comparable to Diviner data.

With known compositions, Apollo landing sites and soils are important calibration points for the Diviner dataset, which includes all six Apollo sites at approximately 200 m spatial resolution. Differences in measured CFs caused by composition and space weathering are apparent in Diviner data. Analyses of Diviner observations and SLE measurements for a range of Apollo soils show good agreement, while comparisons to thermal reflectance measurements under ambient conditions do not agree well, which underscores the need for SLE measurements and validates our measurement technique.

Diviner observations of Apollo landing sites are also correlated with geochemical measurements of Apollo soils from the Lunar Sample Compendium. In particular, the correlations between CF and FeO and Al2O3 are very strong, owing to the dependence on the feldspar-mafic ratio. Our analyses suggest that Diviner data may offer an independent measure of soil iron content from the existing optical and gamma-ray spectrometer datasets.

CURRENT SECTION/FOCUS GROUP: Planetary Sciences

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Decades of Samples and Surface Data

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