Geophysical Research Abstracts
Vol. 19, EGU2017-1414-1, 2017
EGU General Assembly 2017

Size Matters: FTIR Spectral Analysis of Apollo Regolith Samples Exhibits Grain Size Dependence.

Dayl Martin (1), Katherine Joy (1), John Pernet-Fisher (1), Roy Wogelius (1), Andreas Morlok (2), and Harald Hiesinger (2)

(1) School of Earth and Environmental Sciences, University of Manchester, Manchester, United Kingdom (dayl.martin@manchester.ac.uk), (2) Universität Münster, Wilhelm-Klemm Straße 10, 48149 Münster, Germany

The Mercury Thermal Infrared Spectrometer (MERTIS) on the upcoming BepiColombo mission is designed to analyse the surface of Mercury in thermal infrared wavelengths (7-14 μm) to investigate the physical properties of the surface materials [1]. Laboratory analyses of analogue materials are useful for investigating how various sample properties alter the resulting infrared spectrum.

Laboratory FTIR analysis of Apollo fine (<1mm) soil samples 14259,672, 15401,147, and 67481,96 have provided an insight into how grain size, composition, maturity (i.e., exposure to space weathering processes), and proportion of glassy material affect their average infrared spectra. Each of these samples was analysed as a bulk sample and five size fractions: <25, 25-63, 63-125, 125-250, and <250 μm.

Sample 14259,672 is a highly mature highlands regolith with a large proportion of agglutinates [2]. The high agglutinate content (>60%) causes a 'flattening' of the spectrum, with reduced reflectance in the Reststrahlen Band region (RB) as much as 30% in comparison to samples that are dominated by a high proportion of crystalline material.

Apollo 15401,147 is an immature regolith with a high proportion of volcanic glass pyroclastic beads [2]. The high mafic mineral content results in a systematic shift in the Christiansen Feature (CF – the point of lowest reflectance) to longer wavelength: 8.6 μm. The glass beads dominate the spectrum, displaying a broad peak around the main Si-O stretch band (at 10.8 μm). As such, individual mineral components of this sample cannot be resolved from the average spectrum alone.

Apollo 67481,96 is a sub-mature regolith composed dominantly of anorthite plagioclase [2]. The CF position of the average spectrum is shifted to shorter wavelengths (8.2 μm) due to the higher proportion of felsic minerals. Its average spectrum is dominated by anorthite reflectance bands at 8.7, 9.1, 9.8, and 10.8 μm. The average reflectance is greater than the other samples due to a lower proportion of glassy material.

In each soil, the smallest fractions (0-25 and 25-63 μm) have CF positions 0.1-0.4 μm higher than the larger grain sizes. Also, the bulk-sample spectra mostly closely resemble the 0-25 μm sieved size fraction spectrum, indicating that this size fraction of each sample dominates the bulk spectrum regardless of other physical properties. This has implications for surface analyses of other Solar System bodies where some mineral phases or components could be concentrated in a particular size fraction. For example, the anorthite grains in 67481,96 are dominantly >25 μm in size and therefore may not contribute proportionally to the bulk average spectrum (compared to the <25 μm fraction). The resulting bulk spectrum of 67481,96 has a CF position 0.2 μm higher than all size fractions >25 microns and therefore does not represent a true average composition of the sample.

Further investigation of how grain size and composition alters the average spectrum is required to fully understand infrared spectra of planetary surfaces.

[1] – Hiesinger H., Helbert J., and MERTIS Co-I Team. (2010). The Mercury Radiometer and Thermal Infrared Spectrometer (MERTIS) for the BepiColombo Mission. Planetary and Space Science. 58, 144-165.

[2] – NASA Lunar Sample Compendium. https://curator.jsc.nasa.gov/lunar/lsc/