

Zach Ioannou¹, Daniel Moraetis² & Kosmas Pavlopoulos³

¹ Department of Physics, College of Science, Sultan Qaboos University, Al-Khoudh 123, Muscat, Oman

² Department of Applied Physics and Astronomy, University of Sharjah, Sharjah 27272, UAE

³ Department of Geography and Planning, Sorbonne University, Abu Dhabi, UAE

Hyperspectral mapping of crust and mantle rocks in the UAE Al-Hajar mountains: Locating raw materials for Martian regolith simulants.

The objective of the present study is to identify rock lithologies which can be used to produce Mars regolith simulants. It is well known from Curiosity Rover data, that mafic and ultramafic components are the main constituents of the Martian surface regolith (Blake et al. 2013). We have acquired 9 rock samples taken from different locations and rock outcrops located in the Fujairah, Sharjah and Dubai emirates of the UAE and used to obtain crustal (mafic) and mantle (ultramafic) rock spectral signatures (Philips et al. 2006, Thomas et al. 2006). The samples are analyzed using X-ray fluorescence and X-ray diffraction techniques. Based on their mineralogical composition and characteristics we distinguished two main categories of rocks, close to the Hatta and Kahir areas. The analysis showed a range of SiO₂ compatible with ultramafic to mafic rocks (43-46% ±1%) in the Hatta area and some samples with extreme high (73%±1%) or low (21%±1%) values of SiO₂. The aforementioned extreme concentrations are possibly correlated to sedimentary or metasedimentary rocks. The mineralogy in the Hatta area comprised mainly of pyroxene and plagioclase and some amorphous material while the metasedimentary rocks are mainly rich in calcite and quartz. The Kahir area samples are showing a SiO₂ content between ultramafic to mafic rocks (39-49% ±1%). The mineralogy in the Kahir samples comprised of pyroxene and plagioclase and in several samples the ultramafic rocks are exhibiting strong serpentinization (serpentine mineral). In addition to ground investigations, we have also mapped the extended regions that surround the areas of our rock samples using hyperspectral imagery obtained in 2009 and 2011 by the Hyperion instrument on the Earth Observation-1 (EO-1) satellite. Feature extraction and hyperspectral classification such as the supervised Spectral Angle Mapper (SAM) and Spectral Feature Fitting (SFF) methods are carried out to map the different lithologies in the extended regions of interest. We combine the ground truth spectral classification of our samples with the hyperspectral classification of the wider area to improve the accuracy of the mineral map around the Hatta and Kahir regions.

References:

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