Lunar Exploration: Need of Experimental Imaging Spectrophotometric Measurements for Preparing and Interpreting High Spatial Resolution Orbital Spectral Imaging Data

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Earthbased and Clementine multispectral observations in the UV-VIS-NIR domain, with spatial resolutions in the range of 100m - 1km largely contributed to the spectral characterization of lunar surface units. As a result, a first global description of the lateral compositional heterogeneity of the lunar surface with the detection of the main geological units and boundaries has been established. It certainly greatly improves our understanding of the lunar crust structure and nature, and of the emplacement of the maria and cryptomaria. It reveals that the importance of early lunar volcanism, predating 3.8 Gyr, and of impact melt contribution may have been widely underestimated in the previous descriptions of the crustal layering and structure. However, in this current investigation the optical heterogeneities related to the physical properties of the surface (texture, surface roughness, maturity, degree of cristallinity) at the subpixel scale have been overlooked until now.

With the dramatic improvement of the spatial resolution of the soon-to-come observations, it can be addressed by high resolution stereo-imaging, generating local digital elevation models (DEM) and by the production of spectral datasets, under various geometry conditions, giving access to photometric properties of the surface. Both geomorphologic studies will benefit of these data and geologic interpretation of the spectral/spectroscopic information will be significantly improved. These new data are within the reach of the upcoming missions LUNAR-A, Smart-1 and Selene. A particular effort is however needed in the field of experimental imaging spectrophotometric studies to produce extensive databases documenting the various physical and mineralogical/ compositional mixing processes integrated in a remote sensing observation, made at a macroscopic scale. Some examples will be used to illustrate this point.