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Phobos spectral clustering: first results on the MRO-CRISM 0.4-2.5 micron dataset

Whether Phobos is a captured asteroid or it formed in situ around Mars, is still an open and debated question within the scientific community. If confirmed, the Mars Moon eXploration (MMX) sample return mission proposed by JAXA will have the main aim to solve this conundrum, reaching Phobos in early 2020s and returning Phobos samples to Earth few years later. Nonetheless, before being provided with scooped samples here on Earth, there is still an important spectral dataset that can be mined in order to constrain Phobos' surface properties and returning possible implications on its origin: the MRO-CRISM multispectral datacube.

After correcting the MRO-CRISM visible and infrared cube (0.4-2.5 micron) for illumination conditions and observing geometries, i.e. taking into account the incidence and emission angles of the observation, we apply a technique that identifies different clusters based on a proximity measure through a K-means partitioning algorithm. By selecting specific wavelength ranges, located on Phobos reflectance spectrum absorption bands, we are able i) to identify the possible mineralogical compounds leading to such spectral behavior, ii) the relative abundances of the mineralogical constituents, and iii) the spatial distribution of such compounds on the surface of the target.

This work paves the way to a deeper analysis of the available dataset regarding this target, suggesting possible regions of interest on the surface of Phobos that can be taken into account as sampling area by the MXX mission.

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