

Proclus crater: what a fresh, small crater can tell about the composition of lunar Highlands

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Proclus crater is a Copernican age (Apollo 15 PSR), simple and fresh crater, with a diameter of 28 km. It is located on the northwest rim of Crisium basin and east of Palus Somni (16.1° N, 47.0° E). Here, we have analyzed a M3 (onboard Chandrayaan-1 mission) image (m3g20090202t024131 image) to study the composition of Proclus crater. We first classified the crater in different spectral regions applying the Spectral Angle Mapper (Kruse et al., 1993) method and using image-driven end-members; subsequently, the spectra representative of each region have been deconvolved applying the Modified Gaussian Model (Sunshine et al., 1990) algorithm and compared to spectral libraries consisting of well characterized terrestrial analogues, both mafic (olivine, OL, and pyroxenes, PX) and plagioclase (PL)-bearing.

We recognized 5 spectral units into the crater:

- 1) spectral unit A, characterized by an absorption band at 1250 nm, is interpreted as dominated by PL;
- 2) spectral unit B, with three absorption bands at ca. 900, 1250 and 1800 nm, where the band depth ratio between the 900 and 1250 nm bands decreases from spectral sub-unit B5 to B1, can be compared with mixtures composed with high PL content (>90%) and PX;
- 3) spectral unit C, characterized by two absorption bands at 900 and 1800 nm, can be interpreted as PX affected from space weathering (the band depth is less deep than band depth in PX analyzed in the laboratory) or as a mixture of 90% PL and 10% PX;
- 4) spectral unit D shows a broad absorption centered at 1050 nm with a shoulder at ca. 1600 nm and can be compared with OL affected from space weathering or with a mixture of 90% PL and 10% OL;
- 5) spectral unit E, characterized by a broad absorption with a shoulder at shorter wavelengths than in the previous unit, can be compared to the spectrum of a mixture composed of PL, OL, PX and Mg-spinel (from Gross et al., 2104).

Moreover, spectral unit F has been recognized widespread into the crater; this unit shows flat, red spectra with a shallow absorption at ca. 2000 nm, but will not be discussed here.

Concluding, Proclus crater evidenced a PL-rich mineralogy comparable with what expected for lunar Highland materials. Anorthositic regions, with very high abundance of PL, have been discovered on N-NW crater walls, whereas outcrops enriched with mafic mineralogy, PX (associated with PL), have been observed on the east side walls and in a delimited, west region. Few outcrops of OL-bearing material are present on wall and floor. A unit with mafic mineralogy and spinel-like phase was also detected in a S-E area on the crater floor. Proclus could therefore evidence the presence of a PL-rich crust crystallized during the Magma Ocean, with the possible formation of pockets with more mafic composition entrapped into the PL floating material.