



Spectral analysis of Apollo Basins on the Moon through spectral units identification

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The spectral analysis of a planetary surface is fundamental for a deeper understanding of the mineralogy and composition. In particular, the determination of spectral units is a reliable method to infer the physical and compositional properties of a surface by processing several spectral parameters simultaneously, instead of the more traditional approach of interpreting each single parameter separately. To define the spectral units, we first compute the most relevant spectral parameters, based on a preliminary detailed analysis of the spectral properties of a surface. This method could be used for different bodies and is described in [1].

For this work, we selected the Apollo Basin area within South Polar Aitken [2,3], the largest and deepest impact basin on the Moon. We analyzed the M³/Chandrayaan-1 data [4] after performing the most up-to-date calibration, thermal removal and photometric correction [5,6]. Lunar spectra are characterized by two strong pyroxenes absorption bands at 1 and 2 μm . In this regard, we decided to define the Apollo Basin spectral units by using the two pyroxenes band depths, the reflectance at 540 nm (standard visible wavelength), and the spectral slope of the 1 μm (see [7]). In Apollo Basin, we found 12 different spectral units. Among these units, the most peculiar is the one linked to the basaltic smooth plains within the floor of the crater. This unit is characterized by low reflectance, deep band depths and a strongly positive spectral slopes (more red surfaces). Subsequently, an analysis of absorption band center at 1 and 2 μm and a comparison with RELAB synthetic pyroxenes [8] revealed a composition compatible with material dominated by strong pyroxene absorptions, e.g. clinopyroxenes, such as pigeonite or augite, with Low Ca and Mg, and relatively high Fe (Fs: 34-75; En: 6-23; Wo: 10-27). The rest of the units show a similar mineralogy to the orthopyroxenes, with intermediate amount of Fe and Mg.

This work allows for a detailed understanding of the mineralogy of Apollo Basin, but also lays the groundwork to search for a link between spectral, and morpho-stratigraphic units [9] to reach out

highly informative geological maps of the Moon. This innovative approach is one of the main goals of the H2020 no. 776276-PLANMAP project [10].

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References: [1] Zambon et al., 2020 LPSC. [2] Ohtake, M. et al., 2014, GRL. [3] Moriarty, D.P. et al., 2018, JGR. [4] Pieters et al., 2009, Current Science. [5] PLANMAP D4.3- Spectral Indices and RGB maps. [6] Besse, S. et al., 2012, Icarus. [7] PLANMAP D4.3- Spectral Indices and RGB maps. [8] http://planetary.brown.edu/relabdocs/synth_pyx/pyroxenes.html. [9] Ivanov, M.A., 2018, JGR. [10] <https://www.planmap.eu/>.