CHARACTERIZATION AND AGE ESTIMATION OF BASALTIC FLOWS ON THE APOLLO BASIN (MOON) BY GENERATING COMPOSITE IMAGES AND USING THE CRATER COUNTING METHOD.

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Introduction: The Apollo Basin in the South Pole-Aitken Basin of the Moon is a potential landing site for future lunar robotic exploration missions. It is thus essential to characterize the composition of its basaltic lava flows by using composite images, and estimate the age of the lava flows by using the crater counting method [1].

Generating composite images with the M³ instrument: The Moon Mineralogy Mapper (M³) is an imaging spectrometer launched in 2008 onboard Chandrayaan-I, India's first planetary mission. It was designed to obtain visible to near-infrared reflectance data (430nm to 3000nm). We used the "global" acquisition mode with a resolution of 140m/pixel to map the Apollo Basin. With this mode, we had a complete coverage of the Apollo Basin and the reflectance of each pixel was captured at 85 different wavelengths. The result of this acquisition is called a cube (Figure 1: M³ cube and derivated spectra).

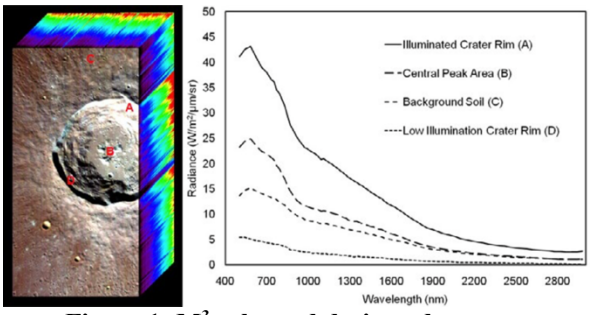

Figure 1: M³ cube and derivated spectra.

We wrote an open-source python code (available at https://github.com/ines-torres/M3-data-processing) in order to generate composite images, and analyze the composition and mineralogy of the Apollo basaltic lava flows [2] [3] (Figure 2: Apollo basin RGB coverage).

RGB images were generated in the following way:

- Red channel: derived Integrated-Band-Depth (IBD) at 1000nm. Oranges and yellows are indicative of high-Ca pyroxenes (basalts and gabbros).
- Green channel: IBD at 2000nm. Greens are suggestive of low-Ca bearing pyroxenes (noritic material).
- Blue channel is the reflectance at 1580nm. Blue colors represent anorthositic or low-FeO bearing materials.

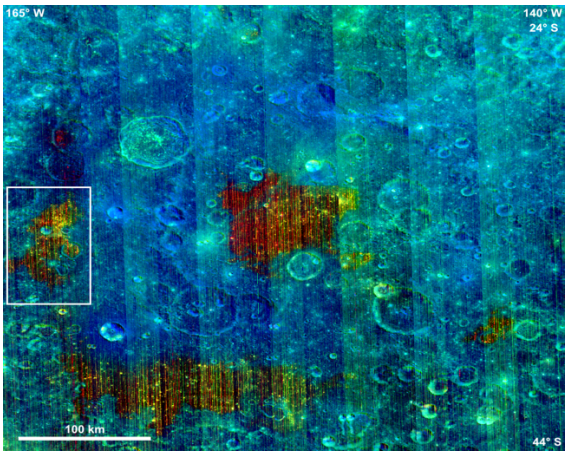

Figure 2: Apollo Basin RGB coverage.

Using the crater counting method to estimate the age of basaltic lava flows: Analyzing the density of impact craters on planetary surfaces is the most common technique for learning their ages remotely. We used the high-resolution Kaguya Terrain Camera (7m/pixel) and the composite M³ data to define a homogeneous counting area surface on the western basaltic flow of the Apollo Basin (see the white box in Fig 2). Once the area was defined, we counted all the craters from 360m to 9km diameter and, using crater size frequency distribution (CSFD) measurements, we obtained an absolute model age of 2.68 (+0.18 -0.20) Ga.

Conclusion: The open-source python code that we wrote in order to generate M³ composite rasters is a good alternative to the licensed ENVI software. The results we obtained for the Apollo Basin mineralogy and age estimation were consistent with previous studies of the same region of the Moon [1].

References:

[1] Pasckert et al. (2018) *Lunar farside volcanism in and around the South Pole–Aitken basin.*

[2] Besse et al. (2011) *Compositional variability of the Marius Hills volcanic complex from the Moon Mineralogy Mapper (M3).*

[3] Martinot et al. (2018) *Mineralogical Diversity and Geology of Humboldt Crater Derived Using Moon Mineralogy Mapper Data.*

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