THE ARISTARCHUS PLATEAU ON THE MOON: NATURE AND STRATIGRAPHY OF THE SUBSTRATUM.

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Introduction: The Aristarchus Plateau is one of the most complex regions on the Moon. It is an old rectangular elevated crustal block about 170x220 km, with its west and east borders approximately concentric to the Imbrium basin, surrounded by younger mare basalts of Oceanus Procellarum (e.g., [1]). The Plateau shows extensive dark mantling deposits (DMD) of volcanic pyroclastic origin (e.g., [2]). The Aristarchus crater (40 km in diameter), which formed at the edge of the Plateau, permits to document the nature and the stratigraphy of the crust in this region of the Moon.

Data and analysis: We present here results [3] from integrated UV-VISNIR (410-2000nm) Clementine spectral reflectance data (i.e. using both the UV-VIS and NIR cameras). Extreme spectral behaviours, characterizing specific lithologies, have been evidenced in the area of investigation (Fig. 1) from a statistical analysis (PCA: principal component analysis). Based on earlier developments [4,5,6,7,8, 9, 10], an Iterative Linear Mixture Modeling (ILMM) has been applied to the dataset, taking endmembers spectra among extreme spectral types determined from the PCA analysis. Units have been mapped showing the degree of mixing of the different types of lithologies at the subpixel scale (Fig. 2).

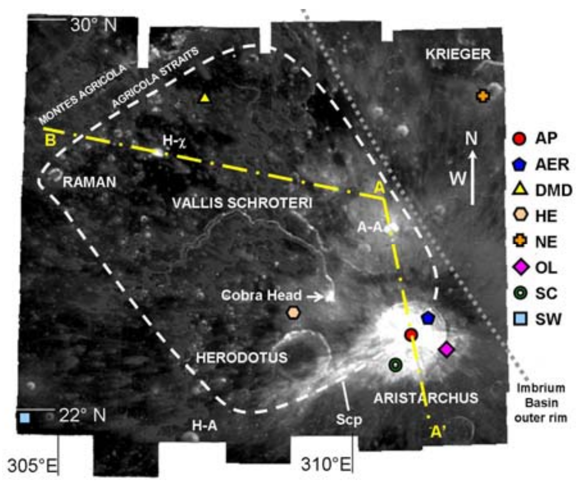

Figure 1. Area of study. Dashed contour delimits the Aristarchus Plateau. B-A and A-A' refers to cross sections in figure 3.

Results: Our anlysis shows that seven endmembers (noted AP, AER, DMD, NE, OL, SC and SW, see below), used in 3 mixing iterations, are requested to give a comprehensive description (82% of the image modeled) of the distribution and amount of surface mixing of the units present across the Plateau and its immediate surroundings [3].

The first iteration, involving DMD (pyroclastic glass-rich dark mantling materials), AER (anorthositic with clinopyroxene and orthopyroxene), NE (pyroxene-rich materials) and OL (olivine-rich materials), describes surface regional mixtures associated with the Plateau setting (substratum, pyroclastic deposits) (Fig. 2). The second iteration, involving AER, SC (anorthositic with pyroxene) and SW (mare basalt), describes mixtures of mare units lying outside the Plateau and ejecta materials from the Aristarchus crater. The third iteration, involving AP (anorthositic with pyroxene and olivine), AER and OL, describes the structure of the Plateau inferred from the stratigraphic sequence of the materials excavated by the Aristarchus crater.

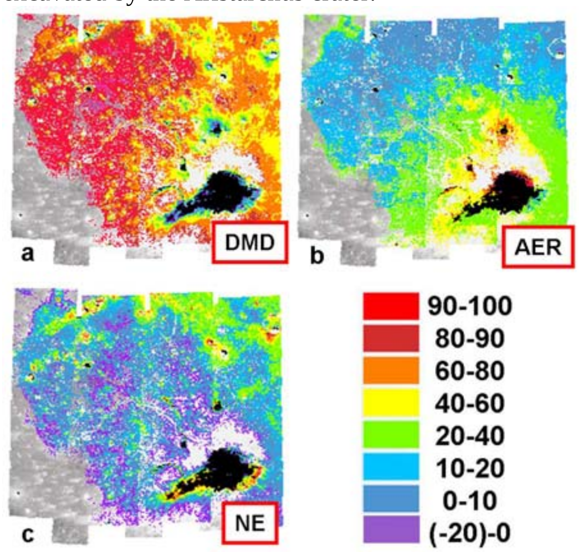

Figure 2. Fraction images for the fist iteration of the ILMM (image fraction of OL not shown since OL is detected in a small part of Aristarchus crater). For a given fraction image color scale gives abundances (%) of the endmember.

Units AP, AER, NE, OL and SC form the substratum of the Plateau. The crater Aristarchus, 3 km deep [11], formed on the elevated edge (2 km above the mare deposits) of the Plateau. Most of the excavated materials do not represent original crustal materials but more probably Imbrium ejecta materials deposited during the Imbrium basin formation and forming the Alpes Formation, less than 1 km thick in this region [1,12]. Thus the determination of clear relationships and origin of the different units forming the structure of the Plateau is not obvious, as most of the surface materials represent complex materials from the Imbrium impact event.

AER and NE have close spectral characteristics [3], i.e., representing feldspar-rich materials with ortho- and clinopyroxene as mafic components. The fact that AER is present on some heights on the Plateau (e.g,, crater Aristarchus A) (Fig. 2b) and that the NE endmember distribution delineates Agricola Montes for instance or reflects materials excavated by small impact craters through DMD deposits (Fig. 2c) show that both NE and AER represent near-surface materials of the Plateau substratum. High abundances (>40–60%) of AER and NE are observed in areas of the ejecta which are close to the rim of the Aristarchus crater, respectively to the northeast and the southeast (Fig. 2b, 2c). This indicates that both AER and NE are found at depth and thus correspond to a rather thick horizon within the substratum (at least in the southern part of the Plateau) and that they likely represent the bulk composition of the whole Plateau (Fig. 3). This horizon, formed by both the AER and NE units probably represents the Imbrium ejecta, i.e., the Alpes formation from [12]. It is hard to tell whether AER forms a rather thick horizon emplaced on an NE-rich unit (if so some residual topography should appear in the northern part of the Plateau; e.g., Montes Agricola) or AER and NE form a single thick horizon showing a gradational compositional change from AER to NE, from the south to the north of the Plateau. In either case, the Imbrium regional ejecta shows a norite and anorthosite rich composition (AER), with the presence of a clinopyroxene component in the uppermost layer (NE). Unit AP (feldspar-rich materials with clinopyroxene and olivine as mafic components) is uniquely detected at Aristarchus Peak and its surroundings. This unit represents the deepest horizon in the Plateau exposed by the Aristarchus crater (Fig. 3). Other relative deep crustal units, at the same horizon than AP or intermediate between AP and AER, and locally distributed in the Aristarchus crater and its vicinity (Aristarchus A crater, and the scarp forming the southern edge of the Plateau), are represented by pyroxene-bearing anorthosite (SC unit) and olivine-rich (OL unit) composition (Fig. 3). Although in low abundance, olivine-rich materials are found to be widespread in this region [3].

Volcanic pyroclastic deposits (DMD unit) are widely distributed on the Plateau, with high abundances and a fairly homogeneous composition (Fig. 2a and 3). Their emplacement could have possibly lasted up to the Eratosthenian, indicating a more important pyroclastic activity in time than previously thought and a rather voluminous and stable reservoir for their source [3].

References: [1] Zisk S. H. et al. (1977), *The Moon*, 59-99. [2] Weitz C. M. et al., (1998), *JGR, 103*, 22725-22759. [3] Chevrel S. D. et al., (2009), *Icarus, 199*, 9-24. [4] Martin et al., (1996), *Planet. Space. Sci., 44*, 859-888. [5] Tompkins et al., (1994), *Icarus, 110*, 261-274. [6] Chabrillat et al., (2000), *Int. J. Rem. Sensing, 21,* 2363-2388. [7] Pinet P. et al. (2000), *J. Geophys. Res., 105*, 9457-9475. [8] LeMouélic et al. (2000), *J. Geophys. Res., 105*, 9445-9455. [9] Pinet P. et al. (1999), *LPSC 30th*, #1555. [10] Chevrel S. D. et al. (2004), *LPSC 35th*, # 1559. [11] Guest J. E. (1973), *Geol. Soc. of Amer. Bull., 84*, 2873-2894. [12] Spudis P. D. (1987), *Proc. Lunar Planet. Sci. Conf. 18*, 155-168.

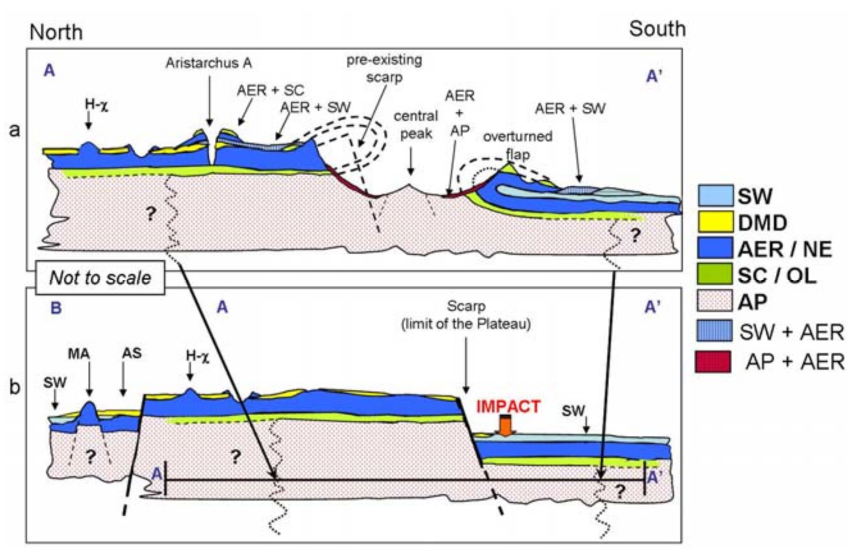

Figure 3. Cross section along lines B-A and A-A' (Fig.1) of the Aristachus Plateau post (a) and pre (b) impact of the Aristarchus crater.