UNPACKING THE VOLCANIC HISTORY OF THE ARISTARCHUS PLATEAU WITH MULTIWAVELENGTH RADAR

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Introduction: The Aristarchus Plateau on the lunar nearside is host to a diverse assemblage of volcanic features including extensive pyroclastic deposits, multiple rilles, such as the prominent Vallis Schröteri, in addition to examples of intrusive and extrusive silicic volcanism (Figure 1). The plateau is surrounded by the flood basalts of Oceanus Procellarum which, with the possible exception of the enigmatic IMPs [1], include the youngest volcanic flows identified on the Moon [2]. Collectively, the Plateau region preserves a full spectrum of eruptive styles that spans the history of lunar volcanic activity.

We will present the results of analysis of Mini-RF S- (12.6 cm) and X-band (4.2 cm) bistatic radar coverage of the Aristarchus Plateau and surrounding mare (Figure 1). Building off previous, earth-based radar studies [3–7] our new analysis provides unique insights into the volcanic history of the region.

Figure 1 (A) Mini-RF coverage of the Aristarchus Plateau. (B) S-band (12.6 cm wavelength) radar image mosaic (S1 radar data, equivalent to total backscattered power). The radar bright region delineated by the red line corresponds to lava flows below a locally thin region of the pyroclastic deposit. Red arrows highlight the terminal extent of the pyroclastic blanket to the SW and NE (see text for more details).

Mini-RF Data: The Mini-RF instrument aboard NASA Lunar Reconnaissance Orbiter (LRO) is a hybrid-polarized, dual-frequency synthetic aperture radar (SAR) that operates in cooperation with transmitting ground stations: Arecibo Observatory (at 12.6 cm wavelength/S-band); Goldstone DSS-13 antenna (at 4.2 cm wavelength/X/C-Band).

Pyroclastic/Mare Stratigraphy: Quantifying the scale of the explosive eruptions responsible for the Aristarchus pyroclastics and the volume of the associated resources - due to the high H₂O content - requires accurate knowledge of the spatial extent of the blanket. Such mapping efforts are also important as they enable the stratigraphy of the deposits relative to other units to be established, which in turn provides insights into the timing of the eruptions. We find that backscatter boundaries in the southwest and northeast (described below) may provide bookends on the timing of the formation of this pyroclastic deposit, offering constrains on eruptions to between 1 and 3 Ga.

Southwest: both wavelengths display a low backscatter signature which abruptly terminates along the boundary where the Procellarum mare flows embay the plateau flanks (Figure 1). This distinct contrast in radar backscatter was also noted by [7] and suggests these mare flows postdate the pyroclastics. The basaltic flows to the southwest constitute the youngest mare surfaces on the Moon, with an age ~ 1 Ga [2,8].

Northeast: The two radar datasets suggest the pyroclastics extend onto the surface of the mare flows that flooded the Agricola Straights. Figure 1 shows low backscatter values (relative to those returned from the mare as a whole) extend from the plateau and onto the eastern side of the mare within the Agricola straights, thus suggesting the pyroclastics in this region sit stratigraphically above the mare. It therefore appears that this region of the mare was emplaced prior to (at least) the final phase of pyroclastic eruptions. No age estimates have been presented within the literature for this region of the mare. If the Agricola Straights mare are associated with the adjacent P26 unit, then the associated 3Ga age [2] places constraints on the timing and duration of explosive eruptions on the plateau.

Plateau Center: In contrast to the relatively radar dark pyroclastics that blanket most of the Aristarchus Plateau, a small region within the center of the plateau exhibits relatively high backscatter (Figure 1). This region was also highlighted by [7] - due to the enhanced Earth-based S and P-band backscatter - and was interpreted to be due the presence of shallow mare below regions where the blanket was relatively thin. At both Mini-RF wavelengths, anonymously bright radar returns can be traced extending from the southern rim of Vallis Schröteri for ~ 20km in a southeastern direction.