**Unusual Radar Backscatter Properties Along the Northern Rim of Imbrium Basin.** T. W. Thompson[1], Bruce A. Campbell[2], [1]Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, Pasadena, California, USA 91109-8099, twthompson@jpl.nasa.gov, [2] National Air and Space Museum, Smithsonian Institution, MRC 315, P.O. Box 37012, Washington, DC 20013, campbellb@nasm.si.edu

**Introduction:** In general, radar backscatter from the lunar terrae is 2-4 times that of the maria. One exception to this is the terra terrain along the northern rim of Imbrium Basin. The highlands that surround Sinus Iridum and crater Plato have long-wavelength (70-cm) radar backscatter that is comparable to or lower than that from the adjacent maria. We are studying new 70-cm radar images and earlier multi-spectral data to better constrain the regional geology.

**Radar Data.** We collected opposite-sense (OC) circular-polarized radar echoes from the northern rim of Imbrium in 2000, using the Arecibo radio telescope. These new data have a spatial resolution of 300-600 m per pixel, depending upon the radar incidence angle and the distance of a target point from the apparent lunar spin axis (Fig. 1). These data clearly show the low radar echoes from the terrae, but also reveal radar-bright proximal ejecta deposits of Plato less visible in 3.8-cm radar images (Fig. 2). These ejecta deposits are evidently buried by at most 10 m of mantling material.

The northern rim of Imbrium is viewed at relatively high incidence angles, where radar echoes are dominated by diffuse scattering. At 70-cm wavelength, diffuse scattering is controlled by the number of meter-sized blocks/rocks that the radar "sees" on the surface or in the upper ~10 m of the subsurface. At 3.8-cm wavelength, the scattering blocks are ~5 cm or larger, and lie within perhaps 1 m of the surface. In general, mare-terrae differences in radar backscatter seen elsewhere on the Moon are attributed to lower electrical losses in the terrae material, which permit more reflections from the subsurface blocks/rocks. The lunar subsurface along northern Imbrium, to depths of perhaps 100's of m, is dominated by the ejecta from cratering events that created Plato and Sinus Iridum.

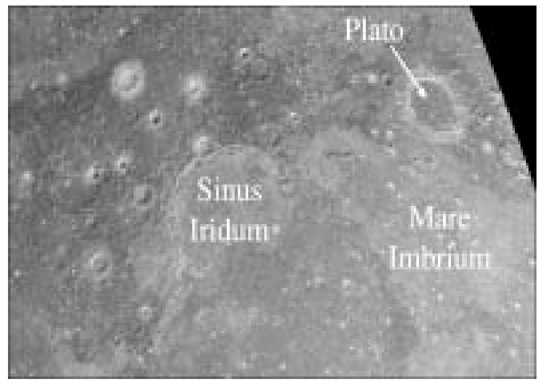


**Fig. 1.** 70-cm opposite-sense circular polarization radar image of the northern rim of Imbrium basin, showing Sinus Iridum and crater Plato. Image resolution 400-600 m per pixel. Note the radar-bright signature of proximal ejecta of Plato, and the overall low return from terrae north and northwest of Mare Imbrium.

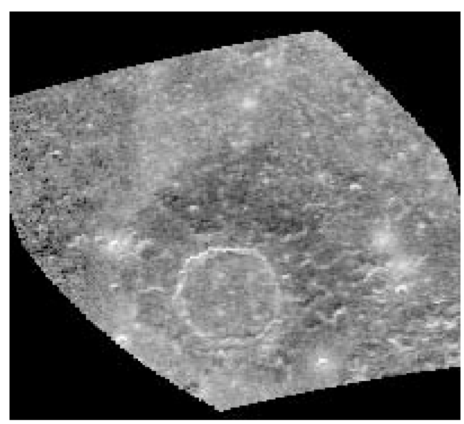

**Fig. 2**. 3.8-cm same-sense circular radar image (~2 km resolution) of crater Plato (90-km diameter) [Zisk et al., 1974]. Low radar return observed at 70-cm is visible, but backscatter from the proximal ejecta is subdued.

**Interpretations:** Possible explanations for the low radar echoes from the northern rim of Imbrium include some combination of:

a) There are fewer m-sized rocks/blocks on the surface or in the first few meters of the subsurface,
b) These areas have a higher electrical loss, which decreases the penetration of the radar waves.

Possibility (a), fewer surface and sub-surface rocks, is consistent with the observation that Sinus Iridum and Plato are the largest craters on the Imbrium rim. These radar dark areas could result from the deposition of relatively block-poor ejecta from the Sinus Iridum and Plato impacts. Radar-dark "haloes" are noted for many Eratosthenian and Copernican craters, but these haloes disappear with increasing age [Ghent et al., 2005]. Sinus Iridum and Plato are considerably older than the oldest observed dark-halo craters, so very large areas of extant block-poor deposits seem unlikely. In addition, the low-return crater haloes are typically not well defined at 3.8-cm wavelength, whereas the terrae N and NW of Imbrium are marked by low 3.8-cm echoes (Fig. 2).

Higher electrical losses in the subsurface could explain how the low 3.8-cm and 70-cm echoes might arise if (1) the target sites for the Sinus Iridium and Plato impacts contained some component of more "lossy" material, or (2) the area was subsequently contaminated by lossy, rock-poor material such as a pyroclastic deposit. The lossy component of the target material might arise from highlands terrain with distinct mineralogic properties, or from pre-Imbrium mare deposits. The former is not supported by the electrical properties of Apollo highland samples; the latter should be evident as an FeO and/or $TiO_2$ enrichment within the Imbrium rim materials. Terrain NW of Mare Humorum also has low radar echoes, and these areas have been correlated with mafic contamination of the basin ejecta [e.g., Hawke et al., 1993].

Pyroclastic deposits elsewhere on the Moon have low radar backscatter [Zisk et al., 1977], and a mantle of such debris has been suggested as the explanation for the region surrounding Plato [Gaddis et al., 1985]. Clearly, such a deposit in this region must post-date the Imbrium impact and the formation of Plato and Iridum, but must be older than the "visible" flow units south of the basin rim and within Plato. While there are numerous volcanic rilles in this region, we are investigating whether pyroclastics can explain the properties of the entire northern Imbrium rim.

**Summary and Future Work.** The low radar echoes from the northern rim of Imbrium basin represent an anomalous behavior relative to typical lunar highlands. We are investigating several possible mechanisms for these properties, with mare contamination from pre-Imbrium flows or a post-Imbrium surficial pyroclastic layer most favored. Clementine multi-spectral data will be used to identify possible mare or pyroclastic signatures within the terrae. We are also planning to collect dual-polarization 70-cm radar data for this region in 2005, which will permit a more detailed analysis of surface and subsurface scattering contributions.

**References**.

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