New Insights into the Internal Structure of the Martian Polar Plateaus from MARSIS 3D Mapping

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The polar regions of Mars have been the focus of attention for decades due to the substantial vestige-rich deposits that likely contain records of variations in the Martian climate on timescales of years to 106 of millions of years. In this poster, we discuss the interpretation of new 3D radar sounding image compilations of MARSIS (Mars Advanced Radar for Subsurface and Ionospheric Sounding) data for both polar regions.

MARSIS has been collecting subsurface sounding data since 2005. It operates simultaneously at 2 of 4 frequency bands (1.8, 3.0, 4.0, 5.0 MHz) with a 1 MHz bandwidth. The polar data sets consist of about 3000 entries at each pole, taken in the 3 highest frequency bands. Details of the compilation of the 3D radar imaging “volumes” are provided in the accompanying poster by Gim et al. Key features are: voxel (volume pixel) dimensions 1.5 km x 1.5 km (horizontal) x 50 m (depth); depth correction is applied in the subsurface using a wave speed in pure water ice; overlapping echo frames from different orbits are averaged; empty voxels are filled with horizontally applied nearest neighbor interpolation; volumes are constructed for bands at 3, 4, and 5 MHz separately, and as combined products; slices are extracted for all vertical and horizontal planes in each volume for individual study and animations.

![Horizontal slice through the MARSIS 3D radargram volume.](image1.png)

Vertical slice (top), similar to an original radargram, through part of the 3D volume containing some of the thickest SPLD deposits. Lower panels show location of the slice on a horizontal slice at an intermediate depth in the SPLD. While airways show strong basal reflections, up to 3.5 km deep, Red arrow points to internal SPLD layers that display strong frequency dependence; we infer that resonances that depend on the wavelength emphasize certain layer packets over others in the various frequency bands. Green arrows indicate detections of the basin of Dorsa Argentea materials: left, a mound within the crater Schmidt, and right, on the floor of the Prometheus Basin: the contact extends beneath the SPLD >50 km.

![Vertical slice showing returns from apparent depressions with floors >1 km below the normal basal interface.](image2.png)

An original single-frequency band MARSIS radargram of Planum Boreum with features highlighted. Over 2000 of these original radargrams were combined into the 3D volumes for each of the polar regions. Features identified in the lower-resolution 3D volumes can be studied in detail in the original data.

![Top: Radargram slice showing extensive thick deposits of Dorsa Argentea Formation (arrows). Bottom: Horizontal slice of the area (rotated 90 deg, from the usual orientation). Occurrence on the left is within a large degraded impact crater. Occurrence on the right is associated with ungraded plateaus above Cav Angustii pitted terrain. Thicknesses up to 1.5 km are implied, assuming a refractive index (dielectric constant) of ice. Estimated thickness would be less if refractive index is higher, e.g., in ice-poor sediments.](image3.png)

Ask the author to show you the videos!

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