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Abstract

Radar Observations of the Polar Layered Deposits of Mars

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The northern and southern polar layered deposits of Mars (NPLD and SPLD, respectively) consist of layers of water ice mixed with small amounts of dust and are thought to contain a record of recent climate variations. Two sounding radar instruments – MARSIS, onboard Mars Express (operating at 2-5 MHz) and SHARAD, onboard Mars Reconnaissance Orbiter (operating at 20 MHz) – are currently collecting information about the interior of these deposits, providing new insights into their composition and the first look at their internal structure. MARSIS penetrates to the base of both the NPLD and the SPLD, while SHARAD only does in certain regions. Both instruments detect internal reflections from portions of the deposits. Beneath the NPLD, both detect a diffusely reflective zone that likely corresponds to a basal unit previously identified in images. From these observations, it is possible to map the topography of the NPLD-basal unit interface in the north, and the contact with the underlying material at both poles. Both radar instruments detect subsurface reflections at multiple depths within the SPLD in several locations, most notably in the Promethei Lingula region (90°-140°E) of the SPLD. MARSIS observes up to three strong internal reflections, plus a strong basal reflection at approximately 1.2–1.5 km depth (assuming pure water ice, consistent with the strength of the basal reflection). In the same region, SHARAD detects many tens of reflections, with several packets of multiple reflections separated by non-reflective regions, alternating with depth; the deepest reflection is observed intermittently at approximately 1 km depth. Comparisons of neighboring and crossing orbits indicate that MARSIS reflections correlate to the boundaries of packets of reflections in the SHARAD data; whatever change in composition that causes the SHARAD reflections to occur in packets may also be the source of the MARSIS reflections. Comparisons of radar reflections and visual images indicate that major reflectors in this region are likely to be related to distinctive groups of layers as seen in Mars Odyssey THEMIS visible (17 m/pxl) images rather than to individual layers.