Results from the SHARAD Sounding Radar on the Mars Reconnaissance Orbiter

Roger J. Phillips*[(1)], Roberto Seu [(2)], and the SHARAD Team
(1) Southwest Research Institute, Boulder, CO 80302, roger@boulder.swri.edu
(2) University of Rome La Sapienza, INFOCOM Dept., 18-00184, Rome, Italy

SHARAD (SHAllow RADar) is a sounding radar provided by the Italian Space Agency as a Facility Instrument on the Mars Reconnaissance Orbiter mission. Its 20-MHz center frequency and 10-MHz bandwidth complement the lower frequency, relatively narrower bandwidth capability of the MARSIS sounding radar aboard the Mars Express Orbiter. SHARAD has been in operation since November, 2006, and has already acquired a large volume of data. A better understanding of the effect of the spacecraft structure (particularly the variable articulation of the solar panels) on the antenna pattern has led recently to strategies for improving the SNR of signals returned form the planet. The radar is particularly good at mapping the internal, fine-scale layering in the deposits at the North and South Poles of Mars. At the North Pole, SHARAD paints a three-dimensional picture of the stratigraphy mapped (by visible imaging) only in canyon exposures on the periphery of the cap. Differences in elevation across the cap are seen to be caused by a relatively constant thickness (~ 2 km) ice-rich layered unit resting on a more coarsely layered basal deposit that is of variable thickness and likely contains a sand component. Of particular interest are the mapped subsurface patterns of ice and dust layers, which are tied to the martian climate history over the last several million years and thus to variations in the planet's orbit and its spin axis obliquity and precession. In both the North and South Polar regions of layered deposits, SHARAD has mapped angular unconformities, possible faulting, and possible folding. Also detected are layered ice deposits on the periphery of the caps. Additionally, SHARAD has detected subsurface reflectors at mid- and low-latitudes on Mars. For example, in Amazonis Planitia, SHARAD has mapped an interface at 40-90 m depth along the margin of a high backscatter area as mapped by Earth-based 12.6-cm radar and interpreted to be a lava flow. The best explanation for subsurface reflections across Amazonis is that they arise from the interface between lava flows and underlying sediments. There is little support for a near-surface ice-rich sediment layer in Amazonis Planitia. Similarly, in the southern Elysium region of Mars, a vast area (~500,000 km^2) contains deposits that are transparent to SHARAD radar waves and have a thickness of ~70 meters as observed by SHARAD. Other observations, from visible images and spectrometers, indicate that these deposits are of volcanic origin. Further to the west, in the area considered by some workers as the "Frozen Sea" (~5°N, 150°E), SHARAD does not detect any evidence of ice. Elsewhere in the northern lowlands of Mars, subsurface reflectors have been detected and the analyses of these results are ongoing. Both SHARAD and its sister radar MARSIS are revolutionizing our understanding of the shallow subsurface of Mars.