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Supporting Online Material for

Radar Sounding Evidence for Buried Glaciers in the Southern Mid-Latitudes of Mars

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This PDF file includes:

SOM Text

Fig. S1

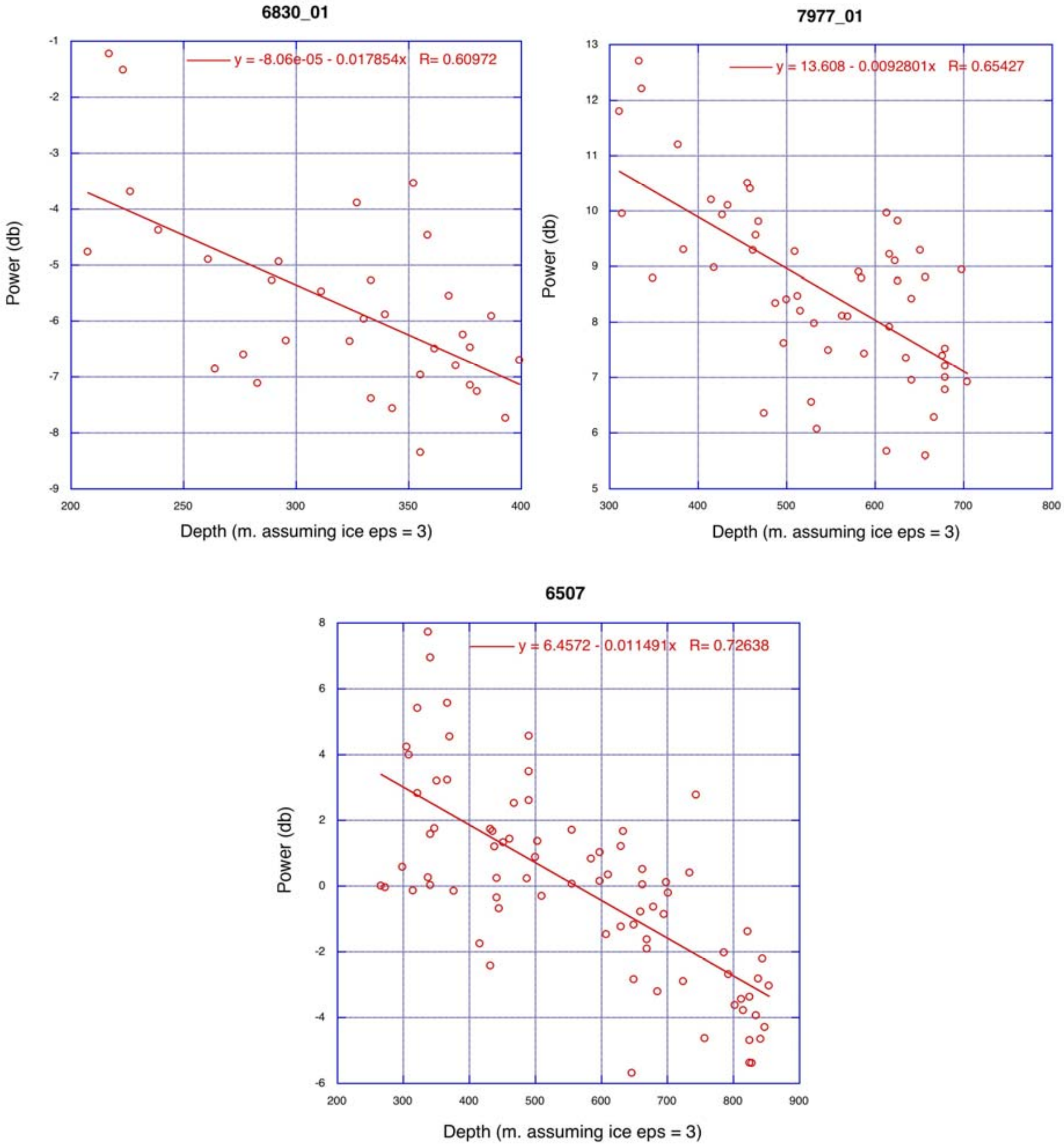
References

Supporting Text

SHARAD description. The Shallow Radar (SHARAD) (*S1*) on the Mars Reconnaissance Orbiter spacecraft has a 20 MHz center frequency (15 m free-space wavelength, or ~ 9 m in water ice) and chirp bandwidth of 10 MHz yielding a one-way range resolution of 15 m divided by the square root of the real part of the permittivity of the propagation medium. The radar transmits a 10-W, 85-msec chirped (linear FM) pulse from a 10-m dipole antenna at a pulse repetition frequency of 700 Hz. MRO's altitude ranges from ~250 km to ~315 km. The first Fresnel zone for a smooth, flat surface is ~3 km in diameter. Data shown here were processed with a focused synthetic aperture radar (SAR) technique to obtain an along-track resolution of ~300 meters. Depth conversions assume a permittivity (real part) of 3.2, a value consistent with a composition of water ice at typical Mars temperatures (*S2*).

Clutter Simulation. Surface echoes were simulated using a facet-based, geometrical optics model (*S3*). Inputs consist of the Mars Orbiting Laser Altimeter (MOLA) 1/128 degree-per-pixel gridded radius data (*S4*) and the spacecraft ephemeris data interpolated to the timing of individual radar records. Rectangular facets were constructed from the MOLA data by resampling the gridded data along azimuths perpendicular to the spacecraft track at each position, extending 45 km across track left and right. Facet size was approximately 100 x 62.5 meters along- and across-track, respectively, and were constructed using a double cosine interpolation for each vertex. Diffuse and specular components were computed and summed incoherently into 4096 range bins, equivalent to the radar sampling. This incoherent surface clutter prediction is conservative, predicting more echoes than appear in the coherently summed radar data. Left- and right-side-only simulations were examined separately to further check correlations and identify clutter sources, but are not shown here.

Supporting Figures



Supporting Figure 1. Radar attenuation measurements. Relative bed echo strength is plotted against the depth of the bed reflector below the surface reflector. Depth is calculated using a real dielectric constant of 3, equivalent to water ice. The slope of the best-fit line represents the two-way loss rate in dB/m, so the one-way loss rate is half of this slope. (top left) Orbit 6830 over LDA-2B, showing an estimated one-way attenuation rate of 9 dB/km. (top right) Orbit 7977 over LDA-2C, showing an estimated one-way attenuation rate of 4.7 dB/km. This is a repeat track of orbit 3672. (bottom) Orbit 6507 over LDA-2C, adjacent to 3672/7977, showing an estimated one-way attenuation rate of 5.5 dB/km. Our results indicate that in all cases the LDA material attenuates the radar waves at a rate less then 10 db/km. An estimate of the lower limit would be unreliable due to the unknown variability of subsurface roughness.

References for Supplementary Material

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