Ground-Penetrating Radar Investigations of Terrestrial Analogs to the Martian Crust for a 2011 Mars Scout Mission

Project:	20.R9470
Sponsor:	SwRI® Advisory Committee for Research
Principal Investigator:	Cynthia L. Dinwiddie
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Low-frequency Ground-Penetrating Radar

Vertical Electrical Soundings

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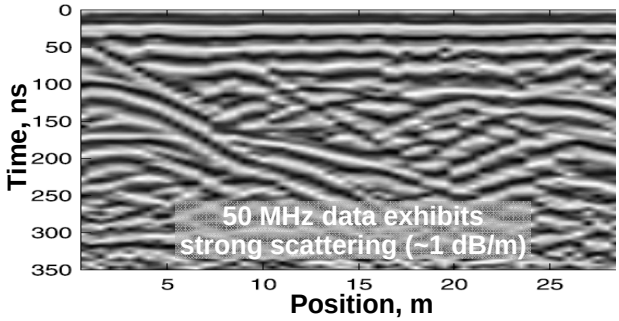
Program Brief

Statement of Problem: The Mars Advanced Radar for Subsurface and Ionospheric Sounding (MARSIS) onboard the European Space Agency's (ESA) Mars Express spacecraft began acquiring low frequency radar data (1.8–5.0 MHz central frequencies with 1 MHz bandwidth) in June 2005. Because no MARSIS prototype was field tested and only limited ground-penetrating radar investigations of the Earth have been made within its low frequency range, interpretation of MARSIS data is uncertain. The SHAllow RADar (SHARAD) sounder (20 MHz central frequency with 10 MHz bandwidth) onboard NASA's Mars Reconnaissance Orbiter began acquiring somewhat higher frequency radar data in September 2006. Prior to the deployment of these two sounding radars, our team obtained low-frequency radar data and complementary geoelectrical data from terrestrial analogs to Mars to support future interpretation of radar data from Mars.

Approach and Accomplishments: Our team conducted transient electromagnetic soundings, vertical electrical soundings, and ground-penetrating radar soundings of moderately to poorly welded tuff at the Volcanic Tableland, Bishop, California, at frequencies similar to those intended for use at Mars. Geoelectrical data obtained from complementary geoelectrical methods enables study of basic radar physics and later application of findings to Mars. For example, we derived the overall attenuation rates in the Bishop Tuff at 12.5–50 MHz and used geoelectrical soundings to subtract the direct current loss. The residual was well fit by a scattering model.



Client Benefits: This project generated important basic data on the attenuation and scattering characteristics of Mars-analog geologic units. The project also demonstrated the value of data collected using complementary geoelectrical methods in reducing ambiguities inherent in use of individual methods alone.

Publications: [1] Grimm, R.E., E. Heggy, S. Clifford, C. Dinwiddie, R. McGinnis, and D. Farrell (2006), Absorption and scattering in ground-penetrating radar: Analysis of the Bishop Tuff, *J. Geophys. Res., 111*, E06S02, doi:10.1029/2005JE002619. [2] Heggy, E., S.M. Clifford, T.G. Farr, C.L. Dinwiddie, and R.E. Grimm (2006), Radar investigations of planetary and terrestrial environments, J. *Geophys. Res., 111*, E06S01, doi:10.1029/2006JE002759. [3] Heggy, E., S.M. Clifford, R.E. Grimm, C.L. Dinwiddie, D.Y. Wyrick, and B.E. Hill (2006), Ground-penetrating radar sounding in mafic lava flows: Assessing attenuation and scattering losses in Mars-analog volcanic terrains, *J. Geophys. Res., 111*, E06S04, doi:10.1029/2005JE002589.