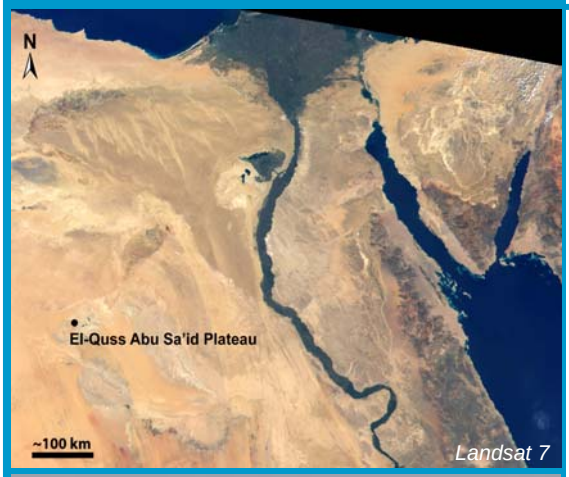
Geophysical Investigation of Hyper-Arid Desert Terrain: The Western Desert of Egypt

Project: 20.11807

Sponsor: Lunar and Planetary Institute – Universities Space Research Association / NASA

Principal Investigator: Cynthia L. Dinwiddie

Inclusive Dates: 9/2005 to 6/2006



Transient Electromagnetic Method

DC Electrical Resistivity

For more information contact:
Cynthia L. Dinwiddie, Ph.D.
cdinwiddie@swri.org
(210) 522-6085

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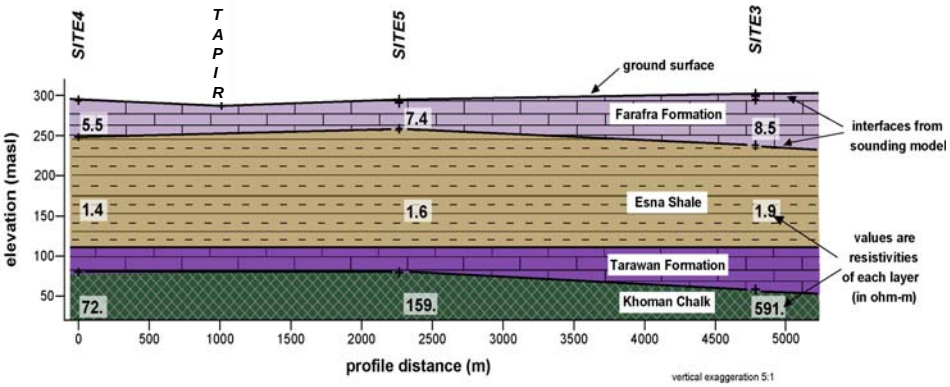
Program Brief

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 few ground-penetrating radar investigations of the Earth have been made within its low frequency range, interpretation of MARSIS data is uncertain. Somewhat higher frequency radar data began being acquired by the SHAllow RADar (SHARAD) sounder (20 MHz central frequency with 10 MHz bandwidth) onboard NASA's Mars Reconnaissance Orbiter in September 2006. To support future interpretation of radar data from Mars, our client sought low-frequency radar data from the western desert of Egypt and we supported their effort by obtaining complementary geoelectrical data.

Approach and Accomplishments: Our team conducted transient electromagnetic (TEM) soundings and vertical electrical soundings (VES) at Sites 3, 4, and 5 on the El-Quss Abu Sa'id Plateau (figure below), which is capped by the lower Eocene-age Farafra Formation (composed of 30- to 50-m-thick white and yellow fossiliferous limestone). The plateau-capping unit is underlain by Paleocene-age rocks of the Esna Shale (composed of 150-m-thick greenish-grey shale with interbeds of limestone and clay high in the section), Tarawan Formation (composed of 50-m-thick whitish chalk and limestone), and the Khoman Chalk (composed of white, richly microfossiliferous chalk). Co-located TEM and VES data were inverted simultaneously to generate a 1D discrete layered earth model. Joint data inversion improves resolution of layer parameters and reduces model non-uniqueness.



Client Benefits: This project generated unambiguous subsurface geoelectrical information that accurately indicated radar attenuation would be problematic because of the high electrical conductivity of marine units at this location.