Geophysical Research Abstracts
Vol. 15, EGU2013-11280, 2013
EGU General Assembly 2013

Investigation of an alpine ice cave in Austria with the EXOMARS WISDOM GPR

Valerie Ciarletti (1), Stephen Clifford (2), Dirk Plettemeier (3), Sophie Dorizon (1), Christoph Statz (3), Benjamin Lustrement (1), Olivier Humeau (1), Rafik Hassen-Khodja (1), Alexandre Galic (1), and Philippe Cais (4)

(1) LATMOS-IPSL;UVSQ;CNRS/INSU, Guyancourt, France (valerie.ciarletti@latmos.ipsl.fr), (2) LPI/USRA, Houston, Texas, USA, (3) Technische Universität Dresden, Germany. , (4) OAB, Bordeaux, France

The WISDOM (Water Ice Subsurface Deposit Observations on Mars) Ground Penetrating Radar (GPR) is among the instruments selected as part of ESA's 2018 ExoMars Rover mission, whose scientific objectives are to search for signs of past and present life and to investigate the planet's subsurface. Combined with the rover, the GPR will provide high resolution observations of the structure of the shallow subsurface and assist in the identification and location of sedimentary layers or massive ice deposits, where organic molecules are the most likely to be found and well-preserved. The resulting data sets will also be a valuable tool for determining the nature, location and extent of potential targets for drilling.

WISDOM prototypes, representative of the final flight model, are currently being field tested in various Mars analogue and cold-climate environments. In April 2012, members of the WISDOM team brought two development prototypes to an Alpine ice cave in Dachstein, Austria, to field test the instrument and participate in the Mars Simulation organized by the Austrian Space Forum.
The GPRs were tested on 3 different platforms including the radio-controlled "Magma White" Rover from ABM Space Education in Poland. Radar investigations were conducted in four different cave environments, measuring ice thickness, stratigraphy, fracture geometry, and basal topography.
Data sets processed and analyzed prove to be in agreement with the shallow environment characteristics determined by direct observation and previously obtained with commercial GPRs.
From a geoelectrical point of view, massive ice containing a small amount of impurities can be approximate as a rather homogeneous medium. A massive ice unit will appear on a radargram as an area with no noticeable signal return, due to the little backscattered signal. Ice is also a low conductivity medium which leads to a deep penetration of the electromagnetic waves. The radargrams obtained from WISDOM data are consistent with those features. Deep and strong reflections can be observed from single scattered embedded in the ice or from interfaces below the ice unit. The wave velocity and thus the depth and the real permittivity values can be retrieved using individual reflectors' signature (hyperbolic shape) or the estimated reflection coefficient in case of a flat and smooth interface between a known material (air for example) and ice.
Because of variations in fracture width, density and orientation, determining fracture geometry is the most challenging task among the retrieval of the other characteristics. The radar-derived 2- and 3-D reconstructions of the internal characteristics of the ice deposits and cave floor seem yet to be consistent with the observations.

Additional field investigations, conducted in a wide variety of simulated and natural cold environments, are planned to build a database of well-characterized ice-rich terrestrial environments and improve our ability to characterize them. A more detailed discussion of these field results is currently in preparation.