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The SHARAD radar images the subsurface of Mars resulting in 2D radargram profiles. The Geological Survey of the Netherlands has years of experience in interpreting seismic data. A similar approach has been developed to interpret SHARAD data.

A 3D visualization and interpretation methodology for SHARAD radargram data from Mars

Introduction

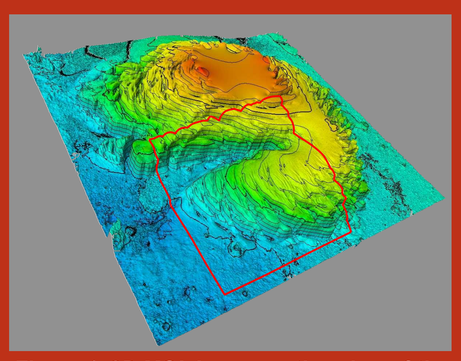

Figure 1. 3D MOLA perspective view of the North Polar ice cap on Mars and the extent of the Region of Interest (red)

Since December 2006, the Shallow Radar (SHARAD) of Agenzia Spaziale Italiana (ASI) on board of the NASA Mars Reconnaissance Orbiter (MRO) is active in orbit around Mars. The radar penetrates the subsurface of Mars up to 2 kms deep, and is capable of detecting multiple reflections in the ice caps of Mars (Seu et al. 2007).
In this poster we present the methodology which can be used for the 3D interpretation of SHARAD data. We selected the Titania Lobe region (Holt et. al. 2007) of the North Polar ice cap because of the abundance of available radar data and the complexity of the ice lobe (Figure 1).

Methodology

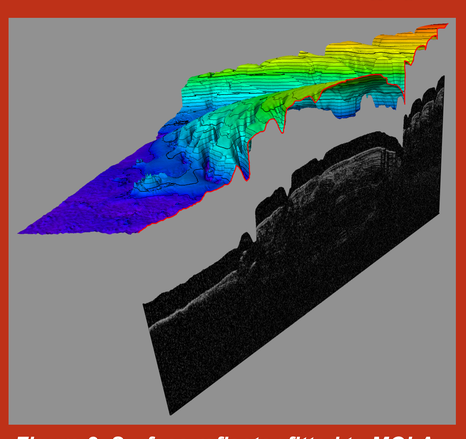

Figure 2. Surface reflector fitted to MOLA data

We extracted the radargram data plus coordinates and converted it into seismic files to be interpreted by the reservoir engineering software package Petrel of Schlumberger. The vertical reference information for each radargram didn't allow the radargrams to be aligned. Therefore a different approach was chosen. The highest point of the first reflector of each radargram is matched with Mars Orbiter Laser Altimeter (MOLA) data. By assuming a constant time to depth ratio, the radargrams match eachother quite accurately (Figure 2).

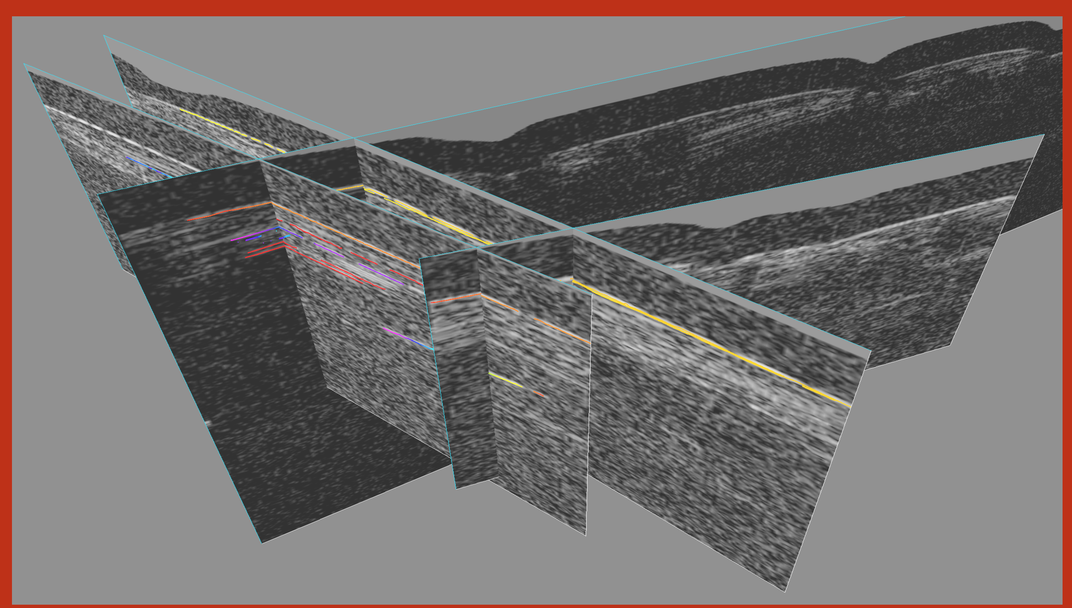

Figure 3. Interpreting radar reflections (colored lines) by following the reflections from one radargram to another.

Petrel has methods of interpreting seismic data in 3D. Reflectors of the surface or subsurface can be automatically traced. Furthermore, the crossing of these interpretations with other radargrams are visualized as well (Figure 3). Therefore it is easy to jump from one radargram to another to verify the interpretation.

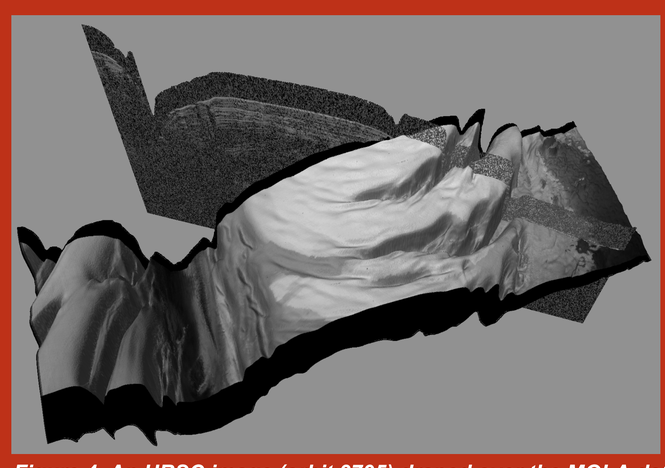

Figure 4. An HRSC image (orbit 3795) draped over the MOLA data in Petrel.

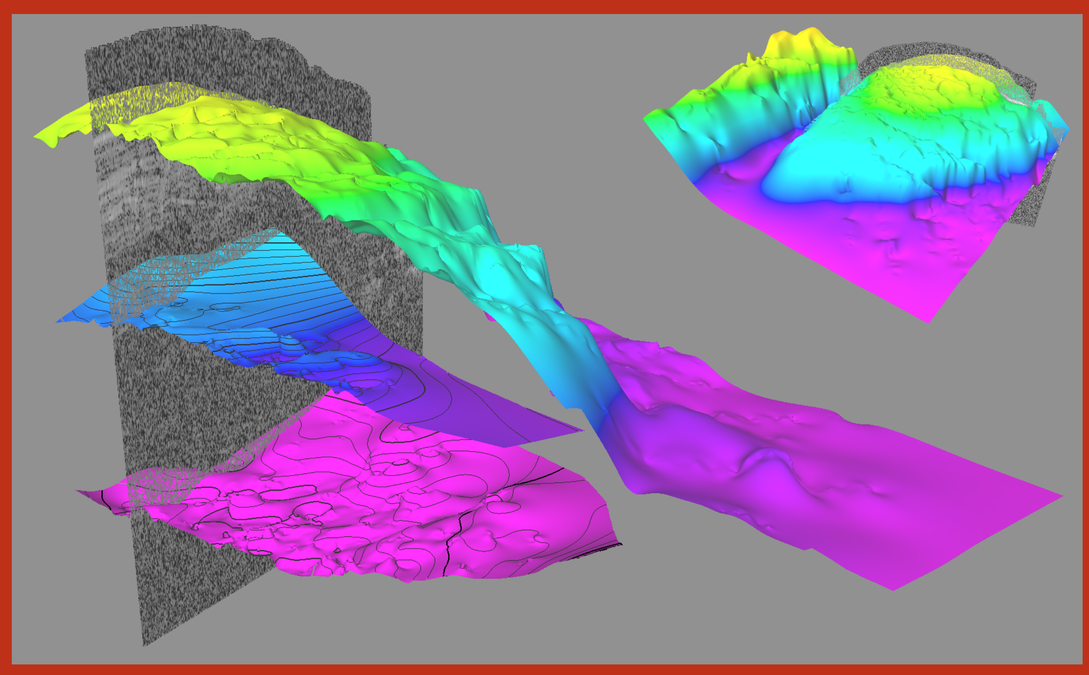

Figure 5. 3D surface interpolation maps created from interpreted SHARAD reflections

Within Petrel high resolution satellite images such as ESA High Resolution Stereo Camera (HRSC) images can be draped over elevation data (Figure 4), aiding the interpretation of SHARAD data.
Finished interpretations can be gridded to a surface (Figure 5) after which a time to depth conversion can be performed within Petrel. The visualization of these surfaces will offer a new look on the build up of the Polar Layered Deposits.

Outlook

1. Together with Tanja Zegers from Utrecht University we plan to perform a geological mapping of the Titania Lobe or another suitable region using available SHARAD lines, MOLA elevation and satellite images (such as HRSC data).
2. We are working on muting migration effects with the aid of seismic processing software.
3. The resulting interpreted subsurface layers will be visualized using Google Earth. As a first step we worked together with Roderik Koenders from PlanetaryGIS.org to visualize the SHARAD radargram images available on the NASA Planetary Data System in Google Earth (Figure 6)

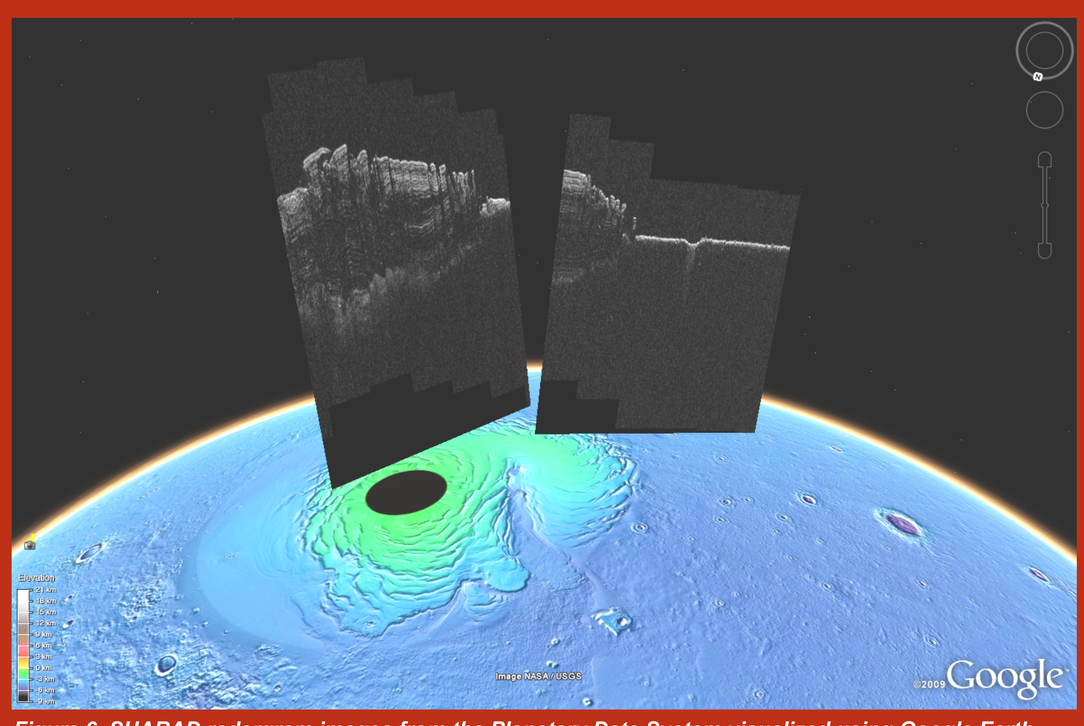

Figure 6. SHARAD radargram images from the Planetary Data System visualized using Google Earth.

References

Holt, J. W., et al. (2007), Seventh International Conference on Mars, Abstract 3372.
Seu, R., et al. (2007), Journal of Geophysical Research Planets, 112, E05S05.

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