3-D Imaging of Mars' Polar Ice Caps using Orbital Radar Data

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Abstract\textsuperscript{5}

Since their arrival in early 2006, instruments aboard NASA’s Mars Reconnaissance Orbiter (MRO) have been collecting a variety of scientific and engineering data from orbit around Mars. Among these is the SHAllow RADar (SHARAD) instrument, supplied by Agenzia Spaziale Italiana (ASI) and designed for subsurface sounding in the 15-25 MHz frequency band. As of this writing, MRO over 48,000 polar orbits of Mars, 30\% of which have included active SHARAD sounding. After acquisition, along-track synthetic-aperture radar (SAR) processing is performed on the SHARAD data, resulting in focused radar profiles (“radargrams”) imaging Mars’ surface and subsurface. While a substantial body of science and research has been—and continues to be—produced using these inherently 2-D radargrams, their collective use in producing 3-D images has only recently become possible. By 2009, a sufficient density of SHARAD coverage had been acquired over Mars’ polar regions to support 3-D data imaging and analysis. Using tools and techniques commonly employed in terrestrial seismic exploration, we have taken subsets of the total SHARAD radargram collection covering the north and south polar regions and processed them into SHARAD 3-D volumes imaging the interiors of the north and south polar ice caps (known, respectively, as Planum Boreum and Planum Australe). We discuss and present results of this work, including some 3-D images of the interiors of the ice caps and some scientific findings made using these images.

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\textsuperscript{5} A modified version of this abstract is to appear in the January 2017 Special Section on Remote Sensing of The Leading Edge. Copyright restrictions apply.
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Dr. Nathaniel E. Putzig (Than) is a Senior Scientist at Planetary Science Institute and has been studying the geology and climate of Mars with orbital radar and thermal data since 2001. He serves as the U.S. Deputy Team Leader for the Shallow Radar (SHARAD) Team on NASA’s Mars Reconnaissance Orbiter Mission. In 2009, Than initiated the effort to use SHARAD data for 3-D imaging of Mars’ north polar ice cap, a project that subsequently expanded to Mars’ south polar ice cap. He has played a central role in SHARAD extended mission planning and science operations, leading and participating in many SHARAD-based scientific investigations of polar ices, volcanic terrains, and landing sites. He also has a background in terrestrial oil & gas exploration, with 14 years experience in seismic data processing and analysis. Than holds a degree in Geophysical Engineering from Colorado School of Mines, and advanced degrees in Geophysics from Rice University and Geophysics from University of Colorado.