Study of Subsurface of Lava Province on Mars using SHAllow RADar (SHARAD)

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At present, Mars is being probed using SHARAD (SHAllow RADar) onboard NASA's Mars Reconnaissance Orbiter (MRO), and MARSIS (Mars Advanced Radar for subsurface and ionosphere sounding) onboard ESA's Mars Express. These radars have shown evidence of subsurface ice, water, and lava flow. Particularly, SHARAD has improved the MARSIS based maps by providing more details about the layering structures.

The SHARAD uses linear frequency modulation (LFM) in the range of 15MHz to 25MHz. The radar transmits signals at a 700 Hz pulse repetition frequency (PRF) and collects reflections from both the surface and near subsurface of Mars. Vertical and horizontal resolutions are, respectively, 15 m (free-space) and 3–6 km (cross-track) by 0.3–1 km (along-track). The waves those transmitted into the subsurface may reflect from the dielectric interfaces and return to the instrument at greater time delay than the surface echo. The data represents surface reflections and intensity of the return signal from off-nadir or subsurface in the time domain. One of the major obstacles is in the identification of subsurface echo is due to surface returns that arrive at the sensor at the same time. For handling this issue, radar surface returns are simulated and compared with actual radargram (Ref. Fig.1).

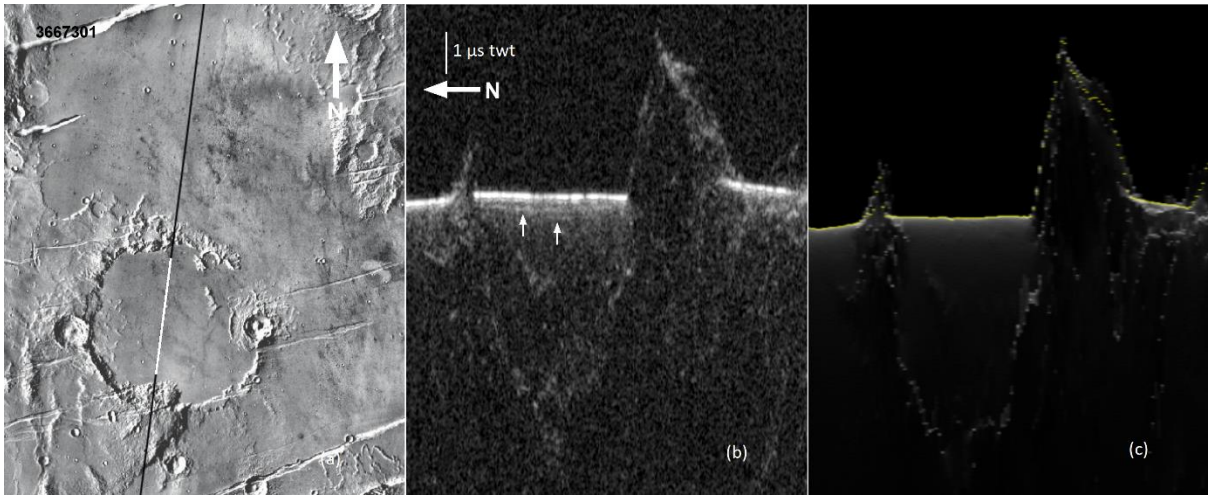

*Fig.*1: (*A*) *SHARAD ground track passing through unnamed Crater (B) SHARAD radargram with time delay and arrow indicate the subsurface reflection (C) Simulated radargram showing the off-nadir topographic clutter echoes*

The large area of Mars is covered with volcanic flows. The SHARAD investigation of these areas provides the dielectric properties of the subsurface material. SHARAD detects subsurface reflection in the northwest of the Tharsis region, West of Ascraeus Mons, south of Pavonis Mons. All these reflections indicate that the composition of subsurface material is moderate to dense basalt, and the dielectric range is between 6.2 to 17.3. While analyzing the SHARAD data of the subsurface reflection from an unnamed crater of South West of Arsia

Mons (14°35´/152° 36´ and 18°08´/148° 42´), a low loss tangent and dielectric permittivity material is detected within subsurface – this may refer to the presence of sedimentary rock layers beneath surface.

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