SHARAD OBSERVATIONS OF LAVA FLOW FIELDS WEST OF ASCRAEUS MONS. L. M. Carter[1], B. A. Campbell[1], J. W. Holt[2], R. J. Phillips[3], N. E. Putzig[3], C. H. Okubo[4], R. Seu[5] and D. Biccari[5], [1]Center for Earth and Planetary Studies, Smithsonian Institution, PO Box 37012, Washington, DC 20013 (carterl@si.edu), [2]Institute for Geophysics, J. A. and K. A. Jackson School of Geosciences, U. Texas, Austin, TX 78713, [3]Southwest Research Institute, Boulder, CO 80302, [4]U.S. Geological Survey, 2255 N. Gemini Dr., Flagstaff, AZ 86001, USA, [5]INFOCOM Department, University of Rome "La Sapienza", 00184 Rome, Italy

Introduction: The plains west of Ascraeus Mons are the site of numerous lava flows, most of which eminate from an elevated rift zone linking Ascraeus Mons and and Pavonis Mons. These flows travel for hundreds of kilometers, and have been interpreted as late-stage flows from rift-zone fissures [1]. The flows have varying thicknesses, but are typically between 30 and 70 m thick. Physical models suggest that they may have been emplaced as individual thick flows traveling over flat, smooth surfaces [2].

The SHARAD sounding radar on Mars Reconnassaince Orbiter can potentially be used to measure the dielectric properties of lava flow material. If the radar wave travels through a lava flow and reflects from a flat subsurface interface, and if the height of the flow can be independently measured from MOLA topography, it is possible to measure the dielectric properties of the material. The large flow field north and west of Ascraeus Mons is one of the few areas on Mars where the SHARAD radar appears to penetrate through volcanic flows to reveal a basal interface.

Summary of SHARAD Data: The SHARAD radar operates at 20 MHz and has a free-space vertical resolution of 15 m [3], which corresponds to a 5-10 m vertical resolution in common geologic materials. The lateral resolution of SHARAD is 3 to 6 km, reducible to 300 to 1000 m in the along-track direction with synthetic aperture focusing [3,4]. For smooth surfaces, the cross-track resolution is ~750 m [4].

Northwest of Ascraeus Mons, SHARAD detects late time-delay echoes associated with the distal parts of smooth flows (Figure 1). SHARAD data are sensitive to wavelength-scale topographic features that contribute off-nadir surface clutter to the radargrams; however these echoes are not present in surface clutter simulations performed using MOLA topographic data. There are also no obvious sources of clutter in available imaging data of the region. We therefore interpret the late-time delay echoes as interfaces between the flows and the underlying terrain.

At present, only four SHARAD orbit tracks cover the central portions of the flow complex where the subsurface interfaces are located. Closely spaced tracks show identical features. Figure 2 shows one of the radargrams along with the ground-track topography.

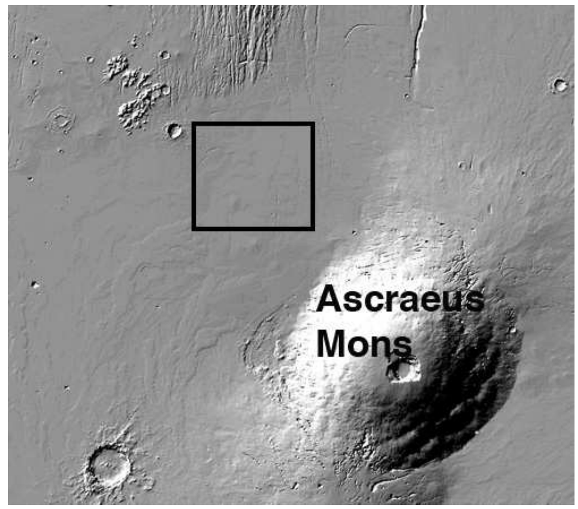

Figure 1: Shaded relief topography of Ascraeus Mons and flows to the west. A box surrounds the study area where subsurface interfaces are observed beneath flows.

Discussion: The area highlighted in Figure 1 consists of long lobate, channelized flows that primarily eminate from the rift zone south of Ascraeus Mons (Figure 3). Flows also come from the direction of Alba Patera to the north. The area is covered in numerous wind streaks that form behind small craters.

An estimate of the permittivity (i.e. real part of the dielectric constant) of the flows can be made by comparing the measured time-delay of the subsurface interface with altimetry measurements of the flow heights. The permittivity (ε') can be computed from:

$$\varepsilon' = \left(\frac{c\,\Delta t}{2h}\right)^2$$

where h is the height relative to the surrounding plains as measured from MOLA topography and Δt is the two-way time delay between the surface and subsurface echoes measured from the radargram. We assume that the flows lie on a flat continuation of neighboring smooth regions. Preliminary measurements yield high dielectric constants (~9). For dry materials, the real part of the permittivity is primarily influenced by density. Pumice, volcanic ash, and tuff have permittivity values between ~2.5 and 3.5, while most terrestrial

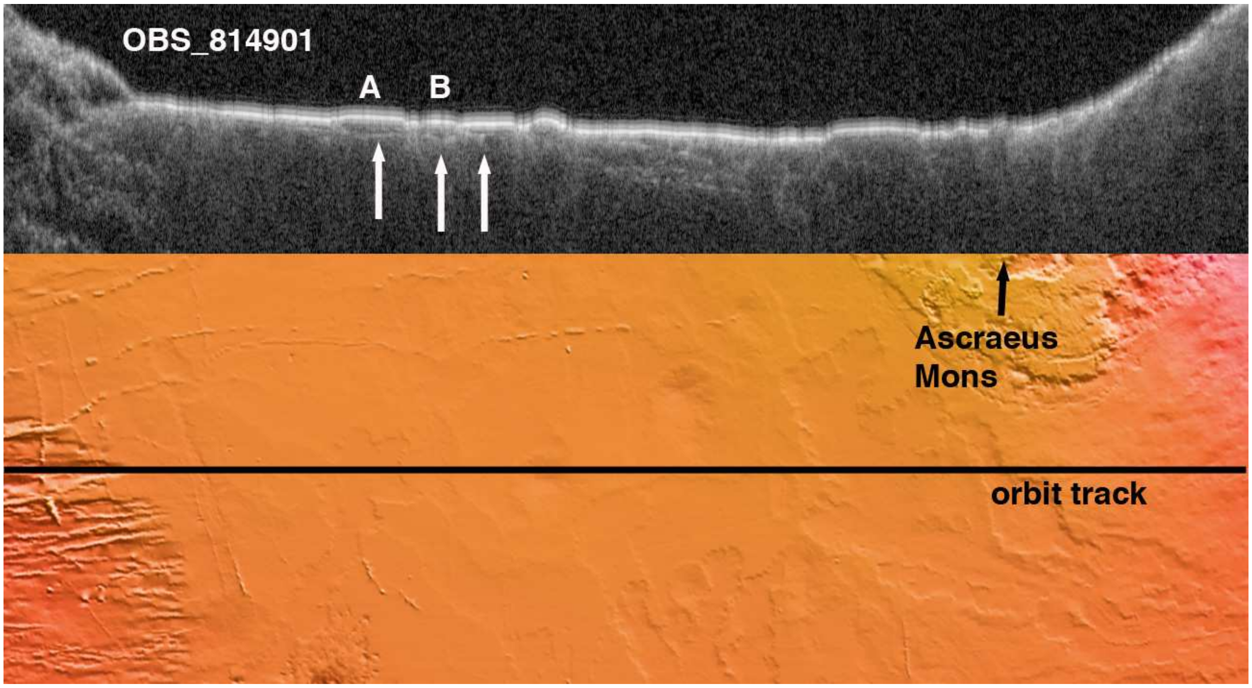

Figure 2: SHARAD radargram showing thin flows northwest of Ascraeus Mons. In the lower image, the orbit track is marked on MOLA topography. The track runs from 20° N (left) to 9.8°N (right), at a longitude of ~251° E.

basalts have ε′ values around 7 to 9 [5]. The permittivity of the flows northwest of Ascraeus Mons is clearly higher than what was measured in the case of the Medusae Fossae Formation and is consistent with basaltic lava [6].

To date, there have been few detections of subsurface interfaces in volcanic settings with SHARAD. Flat plains regions such as Amazonis Planitia show subsurface interfaces that result from packages of sediments covering lava flows [7], and SHARAD penetrates through the Medusae Fossae Formation material [6], but the Ascraeus Mons flows are so far the only example of interfaces associated with discrete surface flow units. Additional SHARAD data is currently being acquired to better understand the full extent of the flows and to allow an improved determination of the dielectric properties. These will include SHARAD observations where the spacecraft is rolled to produce higher signal-to-noise data that could possibly reveal deeper reflections. HIRISE images of selected areas will also be used to better understand the morphology and surface roughness of these flows.

References: [1] Scott et al. 1981, USGS Map Series, I-1268. [2] Baloga, S. M. et al. 1003, *JGR, 108*, 5066, doi:10.1029/ 2002JE001981 [3] Seu, R. et al. (2004) *Plan. Space Sci., 52*, 157. [4] Seu, R. et al. (2007), JGR, 112, doi:10.1029/2006JE002745, E05S05. [5] Campbell, M. and Ulrichs, J. (1969), *JGR, 74*, 5867. [6] Carter, L. M. et al. (2008) Icarus, doi:10.1016/j.icarus. 2008.10.007. [7] Campbell, B. A. et al. (2008) *JGR*, doi:10.1029/2008JE003177.

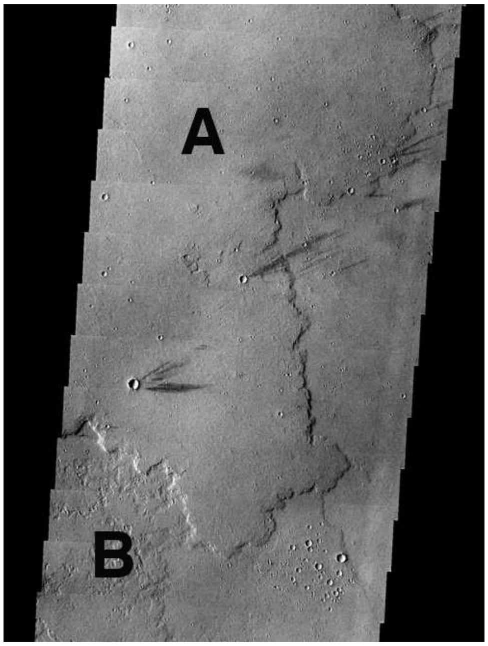

Figure 3: THEMIS VIS image (V27873009) of flows with observed subsurface interfaces. Labels A and B correspond to portions of the flow marked in Figure 2. The image is 25 km across and is centered at 17.1° N and 251.3° E.