EXPLORING BULK COMPOSITIONS OF LARGE EQUATORIAL BASINS FILLS ON MARS USING MARSIS AND SHARAD DATA. E. Heggy[1]; J. Boisson[2]; C. Grima[3]; S. M. Clifford[4]; Y. Gim[1]; A. Frigeri[5]; J. J. Plaut[1], [1] Jet Propulsion Laboratory, Pasadena, CA, United States (heggy@jpl.nasa.gov). [2]Institut de Physique du Globe de Paris, Saint Maur des Fosses, France. [3]Laboratoire de Planetologie de Grenoble, Grenoble, France. [4]Lunar and Planetary Institute, Houston, TX, United States. [5]Universita degli Studi di Perugia, Perugia, Italy.

Introduction. Assessing volatiles distribution in the Martian subsurface is a key element in understanding Mars hydrogelogical past and the current state of water presence [1]. To address this objective two low-frequency, nadir-looking, pulse-limited radar sounders, MARSIS (Mars Advanced Radar for Subsurface and Ionosphere Sounding) onboard the Mars Express spacecraft and SHARAD (SHAllow RADar instrument) onboard the Mars Reconnaissance Orbiter are currently performing a global probing of the electromagnetic properties of the upper crust in a search of dielectric contrasts that can be interpreted as the signature of subsurface water saturation. MARSIS operates at the frequency band from 1.3 to 5.5 MHz while SHARAD operates at a higher frequency range from 15 to 25 MHz [2, 3]. In this study our focus is on the analysis of the surface amplitude decay return arising from the dielectric interfaces at a shallow depth constrained by the first few wavelengths of the radar returned echo. We examine the first 10 μs of the MARSIS and SHARAD backscattered echoes in order to determine the signal loss rate (in dB/μs or in correspondant dB/m) in the near subsurface (first ~150 to 300 m). However, because both surface clutter and the ionospheric distortion can influence the near-pulse peak analysis, their relative impact on the signal loss rate must be carefully considered in order to accurately determine the subsurface dielectric contribution to the total observed losses. The detailed description of the method and its limitation can be found in Boisson et al., 2009 [4].

Study areas. Of particular interest are Isidis and Amazonis Planetias as both basins are hypothesized to be filled by either sediments derived from drainage leading into those lower topographic zones or by an older paleoocean [5]. It has been suggested that those large-scale sedimentary deposits may still be volatile-rich. The Gamma Ray Spectroscopy Observations onboard Mars Odyssey suggested a maximum inferred water abundance of 3 wt% in the top few meters in Isidis [6]. In order to constrain the origin and type of each of these basin fills, we created three-dimensional regional-normalized attenuation maps of the surface and shallow subsurface using the signal-decay method to provide insights into the three-dimensional variations of dielectric properties within these terrains. By comparing the dielectric values inferred from the analysis of the orbital radar data (cf. figure 1) with those of Mars analog soils measured in the lab, we can provide additional constraints on the composition of the subsurface [7]. Both Amazonis and Isidis, present very smooth surface at MARSIS and SHARAD wavelengths, allowing an appropriate correlation between the signal decay and the shallow subsurface dielectric properties. Furthermore, because our analysis is based largely on nighttime data obtained at 3- and 5-MHz, the potential effect of ionospheric distortion on the surface echo decay has been minimized.

Results. Our preliminary results suggest that the upper fill in the first few hundreds meters (~300m) in Amazonis and Isidis have different dielectrical properties, suggesting they are filled with different types of sediments. Moreover the differences in the slope of the loss-time function suggest differences in heterogeneity and layering between the two fills. Figure 2, shows slices of the attenuation maps generated using the MARSIS tracks (shown in Figure 1) over Amazonis and Isidis. We clearly observe that the surface signal decay rate is higher in Amazonis then for Isidis with both study areas having similar rougthnesses. On the other hand, the SHARAD data in Figure 3, suggests the detection of a shallow subsurface layer in Amazonis, but no measurable subsurface reflection/penetration in Isidis. These differences can be explained by a combination of variations in layer thickness and dielectric contrast within each basin. The MARSIS attenuation analysis suggests that the fill in Isidis basin may have a fairly homogenous composition, while Amazonis show a more complex fill type with a more complex dielectric geographical variation. Based on these findings, we discuss the potential origin of the sedimentary fill in Isidis and Amazonis and the implications for the paleo-ocean hypothesis.

References. [1] Clifford S.M. (1993) *JGR, 98, 10,973–11,016*. [2] Picardi G. et al, (2005) *Science, 310, 1925–1928*. [3] Philipps R. et al. (2008) *Science, 320, 1182-1186*. [4] Boisson J. et al. (2009) *JGR, 114, E08003*. [5] Dohm J.M. et al. (2009) *Planetary and Space Science,* 57, 664–684 [6] Helbert J. and Benkhoff J. (2006) *Planetary and Space Science,* 54, 331-336. [7] Heggy E. et al. (2003) *JGR, 108, 8030*.

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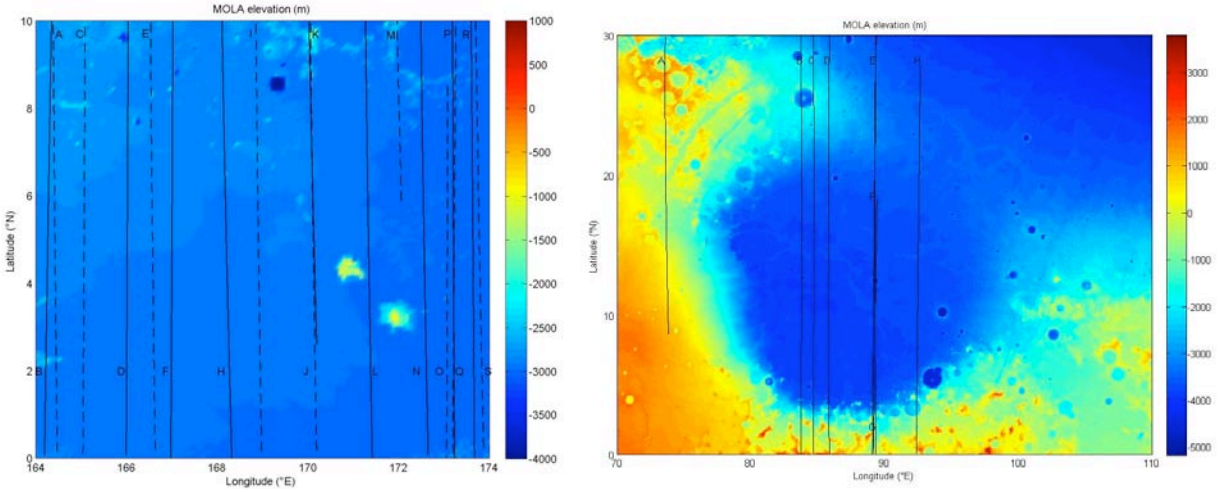

Figure 1. MARSIS tracks at over the smooth central parts of Amazonis (on the left) and Isidis (on the right). On Amazonis orbits A, E, I, L and S are centred at 3 MHz. Orbits H and N are centred 4 MHz. Orbits C, D, F and Q are centred at 5 MHz.

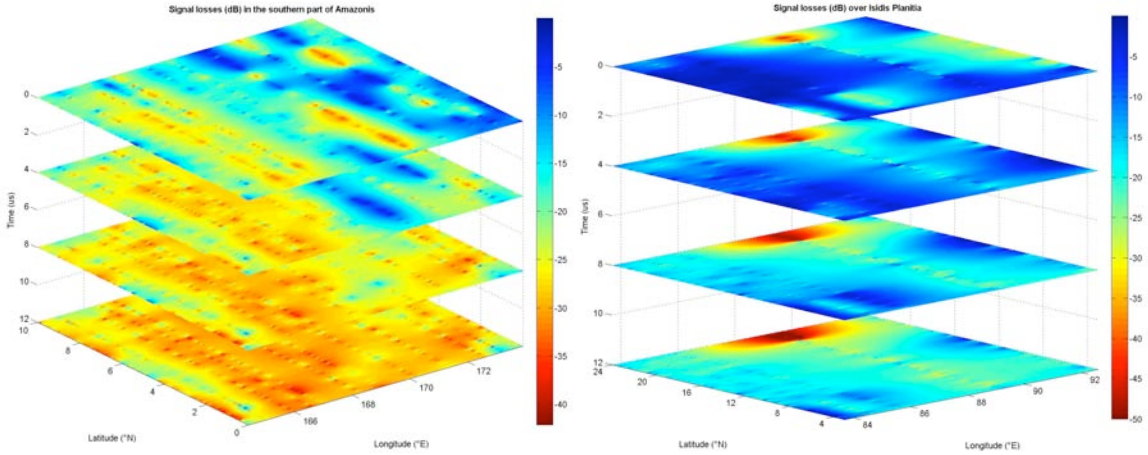

Figure 2. Time slices of the regional attenuation maps performed using the MARSIS tracks shown in Figure 1 over Amazonis (on the left hand) and Isidis (on the right hand). We note that the surface signal decay rate is higher in Amazonis then the one observed in Isidis

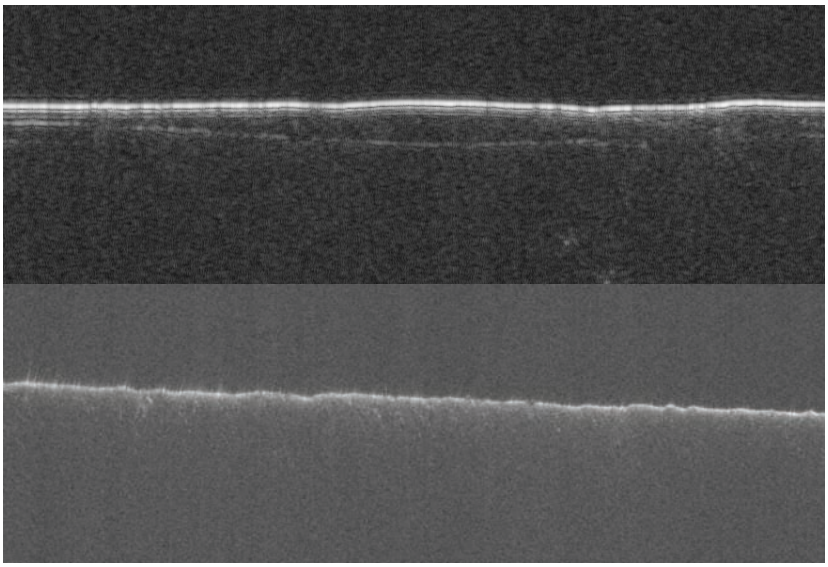

Figure 3. On the top, SHARAD radargram (FPA_566001000) over the central part the Amazonis basin. We can clearly identify a shallow subsurface layer dipping downword toward the center of the radargram. The estimated depth is less the 150m. On the bottom, SHARAD radargram (FPA_418601000) over the central part of Isidis with no evidence of detectable subsurface feature. The comparaison between both radargrams suggest that the fills inside both basins have different composition and stratigraphy.