THE MARTIAN SUBSURFACE FROM THE ORBITING GPR MARSIS AND SHARAD: DETECTION AND ANALYSIS OF POSSIBLE FLOOD BASALTS. G. G. Ori[1] L. Marinangeli[1] S. Di Lorenzo[1], F. Ogliani[2], R. Seu[3] and D. Biccari[3] [1]Int'l Research School of Planetary Sci. (Viale Pindaro 42, 62127 Pescara, Italy, ggori@irsps.unich.it, luciam@irsps.unich.it), [2] Sclumberger Italiana (Strada 7, Palazzo T1, Rozzano, 20089, Milano Italy), [3]Dip. INFOCOM, Universita' La Sapienza (Via Eudossiana 18, 00184, Roma, Italy, rob-seu@incocom.uniroma1.it, d.biccari@infocom.uniroma1.it)

Introduction: Two radars with ground penetrating capabilities are scheduled to investigate the Martian subsurface in the next few years: MARSIS on board of Mars Express and SHARAD on board of Mars Reconnaissance Orbiter. The first radar is planned to have a high penetration capability and, consequently, low resolution; whereas the latter will have a higher resolution and smaller penetration. Both radars, however, can provide a wealth of data on the nature of the upper crust. Even if water is the major scientific subject of MARSIS, the internal crustal interface will be detected at depth greater than those reachable by SHARAD. The Agenzia Spaziale Italiana and IRSPS set a programme in order to understand the geological and geophysical capability of the two radars. One of the striking features recognised by the camera on board of MGS is the presence of stratified units forming the crust near Tharsis and around Valles Marineris [1,2]. The strata have been interpreted as flood basalt layers and have been found to be present across the entire section of the Valle Marineris walls. Other areas on Mars may show this kind of units and they may be relevant to the geological history of the planet [3]. The subsurface-investigating radar may provide some clues on their presence and on their geodynamic relevance. The radar will be useful to detect other possible flood basalts and flood basalt-like units on Mars providing hints on the nature of the upper crust and clues on the geological evolution of the planet

Characteristics of MARSIS and SHARAD: MARSIS is a nadir-looking pulse limited radar sounder and altimeter with ground penetration abilities. In standard operative mode it can transmit signal with 1 MHz bandwidth centered at 1.8 MHz, 2.8 MHz, 3.8 MHz and 4.8 MHz. The nominal vertical resolution will be 150m in vacuum and 50-100 m in the subsurface, depending on the e.m. wave propagation speed in the crust. Footprints will be of 5 km in the along track and 10 km in the cross track. Up to four echo profiles will be produced at intervals of around 1 s, with a sampling rate of around 5 km. On day side operations, it will operate only in the 3.8 MHz and 4.8 MHz frequencies due to ionospheric plasma frequency of Mars cutting off all frequencies lower than around 3 MHz, while all four nominal frequencies will be available for subsurface sounding on night side operation.

SHARAD (SHAllow RADar) is a nadir-looking pulse limited radar sounder and altimeter, which uses synthetic aperture techniques to isolate subsurface reflections. SHARAD can be effectively operated at any altitude reached by the MRO spacecraft, has a bandwidth of 10 MHz centered at 20 MHz that can be split in two bandwidths of 5 MHz able to penetrate the ionosphere to estimate the dielectric properties of the subsurface detected interfaces and for further reduction of the surface clutter. The along-track space resolution is 300 m and the cross-track footprint is around 5 km. The depth resolution is 10-25 m.

The radar model: In order to model the radar response to the possible presence of flood basalts we used a geological models consisting of: (i) a substratum made up of megaregolith, (ii) a thick (2 to 8 km) unit of basalt layers, (iii) a cover of volcanic basalt partially covering the flood basalt the layered unit. The surface of the putative Martian flood basalts shows crater ages younger than the Noachian cratered units. This probably means that they may overlay the megaregolith. In our model we gave to the megaregolith dielectric constant values ranging from 5 to 10 with a chaotic 2D pattern. The dielectric constant of the flood basalt unit ranges from 10 to 12. The layers are horizontal and 5 – 50 m in thickness [2]. The Tharsis volcanic edifice has been modeled with slightly inclined strata with a dielectric constant ranging from 5 to 12 and with variable thickness (1 to 10 m). Therefore, the modeled geological setting consists of a Noachian megaregolith overlain by a thick sequence of flood basalts partially covered by the younger volcanic complex of Tharsis. Early results show that the megaregolith cannot be detected, both by MARSIS and SHARAD, at depth below 2 – 4 km. The detection limit is strongly dependent on the attenuation that cannot be properly modeled at the present stage. Flood basalts layering are remarkably observable, mostly due to the remarkable bedding thickness. The contrast between the younger Tharsis stratification and the flood basalts is also clear in both the signal amplitude and the geometric downlap relations of the two units.

References: [1] Malin M.C. et al.. (1998) *Science, 279,* 1681–1685. [2] McEwan A.S.. et al. (1999) *Nature., 397,* 584-586. [3] Keszthelyi L. et al. (2000) *JGR., 105,* 15027-15049. [4] G.G. Ori and F. Ogliani, (1996) PSS, 44, 1303-1315.