MARS INTERNAL STRUCTURE DERIVED FROM MGS MAGNETIC DATA. F. Civet and P. Tarits, IUEM/UEB, UMR6538 (place Nicolas Copernic, 29280, PLOUZANE, francois.civet@univ-brest.fr).

Introduction: We developed a new method to infer planetary internal electrical conductivity using global electromagnetic induction theory from satellite magnetic data. The method was tested on synthetic data calculated for the ESA SWARM mission, then successfully validated on the magnetic data from the Danish ØRSTED mission [1]. . We analyzed 8 years of magnetic data during mapping phase of Mars Global Surveyor (MGS). In contrast with Earth exospheric field, Mars has a heterogeneous external source field both in space and time. Furthermore MGS magnetic time series are not continuous which makes any standard spectral method used on Earth fail. Hence we developed a new method including a source field proxy to complete the gapped data. Two proxies of different origins, representatives of the external source time variations were calculated. The first one is derived from the MGS data. The second is obtained from Advanced Composition Explorer (ACE) data which measured magnetic characteristics of the solar wind close to the Earth during the mission period of MGS. We applied a time shift along the arm of a pseudo Parker's spiral passing through ACE position to Mars position.

Data analysis and results: We used the Martian crustal anomaly field calculated from [2] to subtract the static field. The proxy of the external variability was introduced to complete the time series to compute its spectra. We binned the data onto a grid to expand the field in spherical harmonics (SHE). This operation resulted into a time series, for which we computed the spectra in a period range from 1 day to some tens of days. The SHE was carried out on the field spectra. For each SH degree and order we separated the field into its internal and external parts and we obtained the corresponding magnetic potential. The ratio of these potentials (internal/external) is a direct function of the in-depth conductivity.

The SHE external field shows a dominant coefficient of degree 2 and order 0 which could be due to a ionic precipitation at high latitude [3]. Moreover, the energy of the internal SH coefficients appeared distributed homogeneously over the 3 degree of the SH expansion. This results is controversial because the signal is barely above the noise level. If confirmed, it could reveal a lateral heterogeneity of the mantle electrical conductivity distribution

We used a 1-D inversion algorithm that could combine the external potentials, all periods and all time windows of the MGS time series to derive 1-D electrical conductivity models. We obtained 1-D models (Fig.1) for several length of MGS time windows, from 125 days up to 210 days using both MGS and ACE proxies. All the models showed an increase of electrical conductivity from depth from about 200-1000 km, with a rapid increase between 1100 and 1300 km in depth. A sensitivity analysis on the conductivity values showed that data constrained the models up to 0.3 log unit between 0 and 1400 km depth. Below that depth, the values are not constrained by the data. The comparison of our models to mineral physics predictions for different mantle composition and temperature profiles [4], [5] suggests that the mineralogical model from [5] is a possible model for the Martian mantle mineralogy and adiabat.

Below 200 km, we observed a conductive layer in models obtain using the MGS proxy only. More test are necessary to determine whether or not this feature is an artifact or real. This result could have important implication on the composition of the crust.

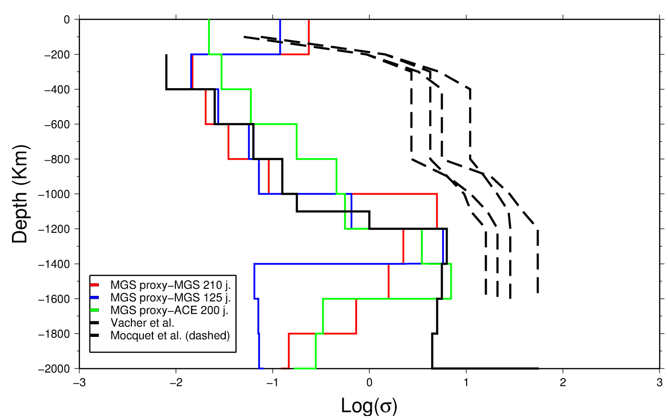

Figure 1: Electrical conductivity models (in Log scale in function of the depth) obtained for the 2 proxys: proxy-ACE (green) for a time windows of 200 days, proxy-MGS for time windows of 210 (red) and 125 (blue) days. Models from [4] (black line) and [6] (black dashed) are also shown.

References:

[1]Civet F. and Tarits P., (2012) *Submitted to Planet. & Space Sci.* [2]Langlais B., Purucker M. and Mandéa M., 2004, *JGR,* 109 [3]Stenberg G. et al., *EPSC-DPS Joint meeting,* 2011, p. 1117, Nantes [4]Vacher P. and Verhoeven O., 2007, *Planet. & Space Sci.*, 55(4), p. 455-466 [5]Bertka C., and Fei Y., 1997, JGR, 102 (B3), p. 5251-5264 [6]Mocquet A. and Menvielle M., Planet. & Space Sci., 2000, 48 : 1249-1260