CRUSTAL MAGNETIC FIELDS AT MARS: IMPROVED INTERPRETATION THROUGH HIGHER RESOLUTION. J. R. Espley[1], J. E. P. Connerney[1], [1]Solar System Exploration Division, Code 695.0, Goddard Space Flight Center, Greenbelt, MD 20771 (Jared.Espley@.nasa.gov)

Introduction: Mars Global Surveyor's (MGS) magnetometer/electron reflectometer (MAG/ER) instrument observed regions of strongly magnetized crust on Mars [1]. Geological features identified from maps of these crustal fields have included transform and/or basement faults, demagnetized impact basins, volcanic demagnetization and partial demagnetization, and linear features suggestive of tectonic plate activity [2,3]. However, these interpretations have been constrained by the alitude of observation (the 400 km nominal mapping orbit for MGS). We report here on a promising new technique to enhance these observations and significantly increase the spatial resolution of the crustal field maps.

MGS dataset: The most accurate map of these crustal fields comes from data acquired during the approximately 400 km altitude MGS mapping orbit. This is because the large number number of observations (over 6 years worth) yielded excellent statistics and allowed Connerney et al. [3] to create a map using only nightside data in which the influence of the solar wind induced magnetic fields is small. However, data acquired during the premapping mission phases are also of great interest since it was acquired from much lower altitudes (between 80 and 200 km) and hence has much better spatial resolution of the source fields. Unfortunately this data is much sparser and was usually acquired during daytime illumination and hence contains large, time-varying induced fields due to the solar wind. Hence, for many purposes it would be useful to have data with the accuracy of the mapping orbit data and spatial resolution as good as the premapping orbit data. We use a technique called iterative downward continuation to achieve just such a goal.

Downward Continuation: Continuing field measurements (gravity, magnetic, etc.) made at one distance from the sources to another distance either closer or farther has been used in numerous applications [4]. Essentially one finds the distribution in Fourier space of the sources as observed at one's observing altitude, and multiplies this distribution by an continuation function to either upward or downward continue the distribution. Upward continuation is a smoothing function and maps, at higher altitudes, the contribution of the most extended sources. Downward continuation is subject to any noise in the original data since it strongly amplifies the smallest variations in the signal. Thus, downward continued signals must filter the size of the distribution of sources allowed to contribute to the continued field.

Case example: We have downward continued the mapping orbit data over a number of interesting regions of Mars. We note one of these regions as an example the type of interpretation we anticipate.

Terra Meridiani: The top panel shows the original 400 km dataset while the second panel shows the results when we iteratively downward continue that dataset to 100 km; note that the color scales differ by an order of magnitude. Throughout the mapped region, more lineated bands appear in the mapped data, with smaller scale size than their counterparts at altitude. The approximate locations of the two putative transform faults, indicated by the black arrows in the top panel, are clearly more easily identified in the data remapped to 100 km altitude using this method. There is a more distinct separation of features on either side of the putative faults and there are more geometrically lineated, smaller scale magnetic contours throughout. to further emphasize the utility of the improved map, we note several additional features amenable to geophysical interpretation that are not easily discernable in the original dataset. These are marked with broken gray arrows.

References: [1] Acuña M.H. et al. (1999), Science, 284, 790-793. [2] Connerney, J.E.P, et al. (1999), Science, 284, 794-798. [3] Connerney, J. E. P. et al. (2005), PNAS, 102, doi / 10.1073 / pnas.0507469102. [4] Blakely, R. J. (1995), Potential Theory in Gravity & Magnetic Applications, Cambridge University Press.

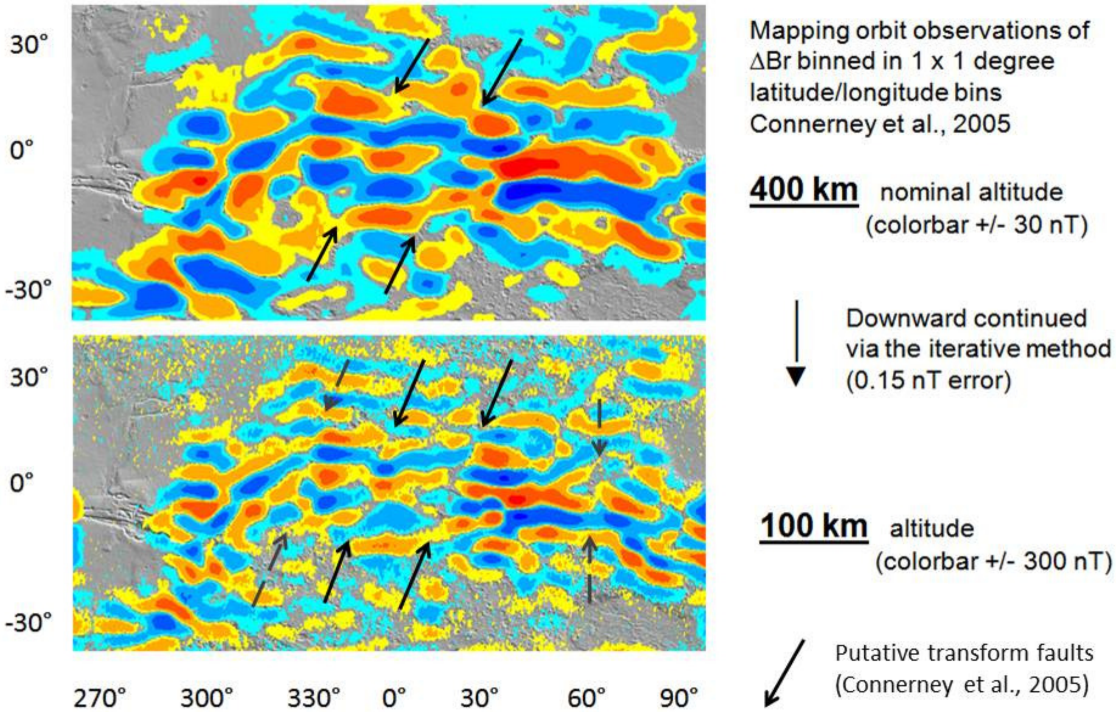

Figure 1 Example of iterative downward continuation using real MGS MAG data above Terra Meridiani. Top panel shows data as observed near 400 km. Bottom panel shows the same data having been iteratively downward continued (average error of 0.15 nT). Background image is MOLA shaded topography. Color bars differ by an order of magnitude between the two panels. The arrows in the top panel indicate the positions of Connerney et al.'s [3] putative transform faults; broken arrows indicate additional potentially interesting features in the downward continued (remapped) observations.