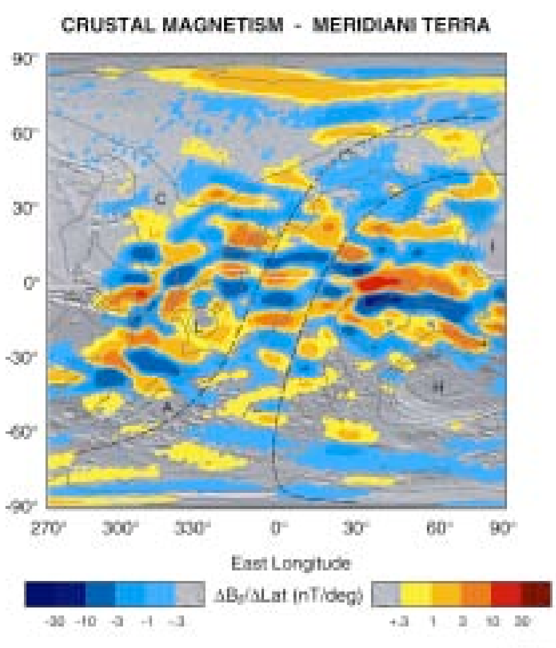
TECTONIC IMPLICATIONS OF MARS CRUSTAL MAGNETISM. J. E. P. Connerney[1], M. H. Acuna[1], G. Kleteschka[1], N. F. Ness[2], D. L. Mitchell[3] and R. P. Lin[3], [1]NASA Goddard Space Flight Center, Code 695, Greenbelt, MD 20771; Connerney@gsfc.nasa.gov, [2]University of Delaware, Newark, DE 19716, [3]Space Science Laboratory, University of California, Berkeley, CA, 94720.

Introduction: The Mars Global Surveyor spacecraft has completed three Mars years in nearly circular polar orbit at a nominal altitude of 400 km. The Mars crust is at least an order of magnitude more intensely magnetized than that of the Earth [1], and intriguing in both its global distribution and geometric properties [2,3,4,5]. We present here a new map of the magnetic field with an order of magnitude increased sensitivity to crustal magnetization. The map is assembled from > 2 full years of MGS night-side observations. The increased sensitivity and spatial resolution afforded by this new map invites geologic interpretation akin to that heretofor reserved for aeromagnetic and ship surveys on Earth.

Data Reduction: Vector observations obtained over the darkened hemisphere are used to minimize systematic errors due to external field variations. Time series data are averaged along-track and decimated to 1 sample every degree of latitude traversed by MGS. A simple 3-point non-recursive digital filter (differentiating Lanczos filter) is then applied to the time series to attenuate constant offsets and variations of larger spatial scale than those associated with variations of crustal magnetization. We take the median value of all points falling in each 1 by 1 degree bin in latitude and longitude to create a global image of the field. This map uses the filtered radial field component and has about an order of magnitude greater sensitivity to crustal magnetic fields compared to a map using unfiltered data. This map of the *change* in radial field with latitude (dBr/dTheta) is closely related to a map of the theta component of the field, with the advantage of superior removal of external fields.

Results: Crustal magnetization extends well beyond the older Noachian terrain. The smooth, flat northern lowlands are underlain by much older, now weakly magnetized crust. The east-west trending geometry evidenced in the intensely magnetized southern highlands appears north of the dichotomy boundary as well. A number of geologic features (volcanoes, Cerberus Rupes, Valles Marineris) now can be seen to have distinct magnetic signatures. A pronounced lack of magnetization appears in association with volcanic emplacements where the depth of burial exceeds a km or so. We suggest that the pattern of crustal magnetization may be understood in terms of a crust that was originally intensely magnetized (few km thickness). Areas now without significant magnetic fields were demagnetized by impact events and volcanic emplacements sufficient to elevate the crustal temperature (over few My) of the magnetic layer beneath.

In Meridiani (Fig) one sees a magnetic pattern that appears to shift across great faults (dashed lines). These are consistent with the properties of transform faults observed across mid-ocean ridges on Earth. These great faults lie on small circles about a common axis (marked with a cross NE of Hellas) and they are separated by about 1200 km (comparable to the great faults spanning the Pacific plate on Earth). The faults are flanked by similar magnetic field patterns that (apart from a scale factor) are consistent with each other and symmetry about an axis (white line).



Conclusions: The Mars crust retains in places the magnetic signature originally imprinted more than 4 billion years ago when it formed by crustal spreading in the presence of a reversing dynamo.

References:

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