COMPATIBLE VECTOR COMPONENTS OF THE MAGNETIC FIELD OF THE MARTIAN CRUST. J. Arkani-Hamed, (Department of Earth and Planetary Sciences, McGill University, Montreal, Canada, jafar@eps.mcgill.ca)

Introduction: A highly repeatable and reliable magnetic anomaly map of Mars is essential for the investigation of the relationship between the tectonic features and the magnetization of the Martian crust. After the first phase of the analysis of the magnetic anomalies of Mars that provided the major characteristics of the magnetic field, it is now the time to resume the second phase by correlating the anomalies with tectonic features on a relatively smaller scale. I use the immense amount of the magnetic data acquired during the mapping phase of the Mars Global Surveyor to derive a high-resolution spherical harmonic model of the radial component of the magnetic field specified by spherical harmonics of degree up to 80. The radial component is least contaminates by non-crustal sources and the resulting model is highly repeatable. This makes it possible to determine the tangential components of the model field and assess the quasi-static external field contribution to the measured data. The minimum noise level also allows safely downward continue the model field to the surface and delineate detailed features of small-scale anomalies, and their correlation with tectonic formations of the planet.

A Compatible magnetic Field Model: The science-phase and aerobreaking-phase of the Mars Global Survey (MGS) provided low-altitude data acquired within 100-200 km elevations that delineated the major characteristics of the Martian magnetic field [1,2,3,4]. Despite the along-track high resolution of the data, they are not useful for the investigation of small-scale weak magnetic anomalies. This is partly because of the wide gaps in the data that severely reduces the across-track resolution of the maps derived from the data. There are only a few original tracks over a given small anomaly, which provide no significant constraint on the exact shape of the anomalies. It is also partly because the data are acquired in daytime and have contributions from the external field. Although, the non-crustal part has minor effects on the strong magnetic anomalies over the southern hemisphere, it has an appreciable contribution to the weak anomalies. The MGS has provided a huge amount of magnetic data acquired within 360-420 km altitudes since it has been put in the mapping phase orbit. The magnetic field models derived from the data acquired in the early stages of the mapping-phase [5,6,7] used data from all three components of the magnetic measurements. However, the west-east component and to a lesser extent the north-south component of the measured magnetic field are contaminated by non-crustal external magnetic field, because of the proximity of the satellite orbits to the Martian ionosphere [8]. This makes it difficult to relate the weak curstal magnetic anomalies to their source bodies.

Although the high altitude of the spacecraft limits the resolution of the mapping-phase data [9,5] the immense amount of the data provides an opportunity to derive a highly repeatable and accurate magnetic anomaly map at that altitude. For this purpose I use the least-contaminated radial component of the nighttime mapping-phase magnetic field data available at present in order to minimize the effects of the external magnetic field. The final model is obtained by using the most common features selected on the basis of covariance analysis.

Using the linear relationship between the spherical harmonic coefficients of the radial component of the magnetic field and those of the magnetic potential I calculate the magnetic potential model corresponding to the radial component model, and subsequently the west-east and north-south components of the model. The resulting models of the three orthogonal components of the magnetic field are totally compatible. Their noise level is likely minimum, controlled by the noise level of the radial magnetic data which are least contaminated. The tangential components of the model field are compared with the observed tangential components to determine the contribution of the non-crustal sources to the observed data. A time-varying external field with a period of is translated to a special variation of wavelength = v, where v is the MGS orbital velocity, and contaminates the crustal field of the same wavelength. Both the time-varying and possibly the quasi-steady part of the external field have appreciable contribution to the tangential component of the magnetic measurements.

The minimum contamination of the model field by the non-crustal noise allows retain crustal magnetic features much smaller that those included in the previous magnetic field models. The final spherical harmonic model of the field contains harmonics of degree up to 80 with ~85% repeatability. It is also possible to downward continue the model field to the surface of Mars and better delineate the source bodies. Many small and weak new anomalies are detected in the northern lowlands as well as in the periphery of the strong magnetic anomalies of the southern hemisphere. Some of these anomalies are related to tectonic features of the planet. Their geophysical interpretations are presented.

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