

Mapping of the Martian magnetic anomalies on the surface with the SVM method

Masao Yamaguchi[1]; Hideo Tsunakawa[2]; Futoshi Takahashi[3]

[1] Dept. of Earth & Planetary Sciences, Tokyo Tech; [2] Dept. Earth Planet. Sci., Tokyo TECH; [3] Kyushu Univ.

Strong magnetic anomalies of the crustal origin have been detected by the satellite observation, although Mars has no global magnetic field of the core dynamo origin at present (Acuna et al., 1998). Using Mars Global Surveyor (MGS) observations, the Martian magnetic anomalies mapped so far are normalized at high altitudes: vector mapping at 400 km altitude by magnetometer observations (e.g. Acuna et al., 2001; Connerney et al., 2005), and total intensity mapping at 185 km altitude by electron reflectometer observations (e.g. Lillis et al., 2008). The observed magnetic anomalies often show some systematic patterns such as magnetic stripes and demagnetization due to impact. Connerney et al. (2005) reported several lineated magnetic anomalies of about 25 degree wavelength in the Meridiani region. This pattern may imply possible existence of plate tectonics of the early Mars like the present Earth. Therefore the Martian magnetic anomalies could provide crustal constraint on thermal evolution of the Mars.

The magnetic field observation at 400 km altitude results in convolution of the neighboring crustal magnetic fields within ~800 km in diameter (~13 degrees on Mars). Thus, it may be difficult to detect fine structures of the crustal magnetic fields at high altitudes due to rapid attenuation of short wavelength components with respect to altitude. If the magnetic anomaly mapping has higher spatial resolution, more useful information would be obtained in comparison with surface features, that is, topography, geology and so on. In the present study, we have applied the Surface Vector Mapping (SVM) method to Martian magnetic anomalies, which is originally developed for the lunar magnetic anomaly mapping on the surface (Tsunakawa et al., 2014; 2015).

The regional SVM method has been applied to the Terra Sirenum region on the southern hemisphere. Mapping result of radial components on the surface shows elongated magnetic anomalies of about 3 degree width which is much shorter than that in the previous map (Connerney et al., 2005). Based on the SVM result, we calculated the magnetic fields at 200 km altitude to show good consistency with the magnetic fields at similar altitudes observed by MGS during aerobraking phase (1997-1999; e.g. Purucker et al., 2000). We also applied the regional SVM method to the Meridiani Planum near the equator, where plate tectonics was suggested (Connerney et al., 2005). Although a few elongated magnetic anomalies can be seen on the SVM map, the overall patterns of magnetic anomalies are complicated due to relatively short wave length components. We will discuss possible implications as well as effects of the data preprocessing and dependence of analyzed region in relation to the reliability of the Martian SVM analysis.