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MOURA Martian magnetometer potential for high resolution magnetic mapping

Marina Díaz-Michelena (1) and Rolf Kilian (2)
(1) INTA, Madrid, Spain (diazma@inta.es), (2) University of Trier, Geology, Trier, Germany

Mars Global Surveyor (MGS) mission mapped the magnetic signature all along the Martian globe during its operation between 1996 and 2006. These data shows that Mars does not present an active global magnetic field as the Earth. However, the Martian crust has an overall magnetic signature stronger than the Earth which was inherited from the active magnetic field of the Martian core during its early cooling history.
The MGS survey shows plenty of magnetic anomalies located in particular within high lands of its Southern Hemisphere. Several magnetic models have been derived to explain the MGS data considering magnetic dipoles distribution in the Martian crust with moderate to high magnetic intensities and pronounced regional anomalies. However, the origin of major magnetic anomalies remains highly disputed [1].
From the magnetic investigation point of view it would be of major importance to perform near-surface magnetic measurements [2] to compare both surface and in orbit (between 100 and 440 km) data. This would help to comprehend not only the distribution of the magnetic dipoles but also to make progress in the identification of different rock types and understanding of their degree of alteration which could have modified superficial magnetic signatures.
In the frame of Finnish-Russian and Spanish MetNet mission, to perform meteorological studies on Martian surface, a miniaturized magnetometer and gradiometer named MOURA was developed with the objective to improve the interpretation of the magnetic anomalies and their origin. In order to test this magnetometer, comparative on Earth magnetic measurements were performed with MOURA and a reference absolute scalar magnetometer (Geometrics 853) in areas with a representative and large variation of magmatic rocks compositions. The final goal is to test the appropriateness of the developed magnetometer for the in situ measurements on Mars.
The active continental margin of the Patagonian Andes was used for this case study, since it provides a large variety of mafic to felsic intrusive and extrusive magmatic rocks, partly corresponding to rocks suggested for the Martian crust. As an example, areas with complex intermediate to felsic magmatic intrusions and basaltic dykes as well as their interaction with surrounding crustal sedimentary and metamorphic rocks have been exhaustively mapped. The objective was on the one hand to cover all the range from gabbroid to granitic intrusive rocks including subvolcanic rocks, and on the other hand effusive and explosive volcanic craters.
The comparative results of both the MOURA Martian magnetometer and reference scalar magnetometer show a good correlation of the magnetic intensities. MOURA magnetometer has been proven to have resolution enough to differentiate not only between different magmatic rock types but also depict different degree of alteration of primary magnetic minerals in these rocks. Mapping within an active basaltic volcanic field including a transect across a crater and its surroundings indicate that the Moura magnetometer is able to distinguish between effusive and explosive basaltic rocks and their degree of porosity.

1 - Planetary magnetic fields, Earth and Planetary Science Letters 208 (2003) 1-11
2 - Planetary and Space Science 48 (2000) 1231-1247