IMPLICATIONS OF STRONG NATURAL REMANENT MAGNETIZATION REGIONS ON THE EARTH FOR THE INTERPRETATIONS OF STRONG AND REGIONALLY EXTENSIVE MAGNETIC ANOMALIES ON MARS

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Magnetization of the observed anomaly features on Mars is not likely to be homogeneous. To explain strong isolated magnetic features observed on Mars, it may be necessary to consider large sources similar to either the strongest magnetic sources observed on Earth (e.g., SD magnetite, titanohematite and MD hematite mineralogies having 500-1000 A/m, McEnroe et al. and/or Kletetschka et al.) or even more strongly magnetic exotic sources. On Earth, geologic formations containing the strong magnetic mineralogies are spatially limited and lead to rapid attenuation with altitude of these strong (10,000s of nT) near-surface magnetic anomalies (not observable even in the lowest altitude satellite magnetic data from Earth). Most Earth-based satellite altitude magnetic anomaly features are coalescence effects of anomalies from discrete geologic units having a combination of induced magnetization and different NRMs. The presence of coalescence effect on Mars can be inferred from observed scatter of paleopoles from some 30 largest magnetic anomaly features modeled by Arkani-Hamed and Hood et al. (over about 60° in latitude and 110° in longitude centered around 30°N, 240°E. If one further considers modeling of features of >4 A/m by Phillips, a mean paleopole of about 50°N, 195°E results with the scatter of ±50°. Modeling of all large features by Langlais et al. and Whaler and Purucker leads to paleopoles nearly everywhere on the planet. Since the core-field on Mars was relatively short-lived, this would imply that different magnetic terranes on Mars have moved erratically. In general, the more the number of features considered, the more the scatter of paleopoles. An alternative explanation for the observed scatter of the inferred paleopoles is that the isolated appearing magnetic features observed on Mars must have been caused by coalescence effects of anomalies from smaller sources with different magnetic directions, the resultant direction dependent on the specific geologic situation. Moreover, if the paleopole determinations were correct, then the long-linear anomaly features in Southern Highlands of Mars must result from fortuitous agglomeration of discrete magnetization features and non-continuous zones of magnetization (and at the minimum there are two such features). This further adds support to the idea that the magnetic anomaly features are indeed coalescence effects. Discretization of these individual anomaly zones of isolated magnetic features with different magnetic directions requires us to think of very strong crustal-scale magnetizations, at the high end of possible NRMs observed on Earth and perhaps even higher.

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