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Structure and Heterogeneity of the Martian Crustal Magnetic Field

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Although the planet Mars no longer possesses an internal dynamo, its crustal rocks retain strong remanent magnetization thought to have been induced by an ancient core-sourced field. The strength and distribution of the observed crustal field is extremely heterogeneous. The strongest anomalies are found in the Terra Cimmeria region of the southern hemisphere, where large, correlated structures form several east-west trending lineations of alternating polarity [Connerney, 1999]. While several areas of the planet appear to have been demagnetized, including large impact basins and the Tharsis volcanic province, the distribution of the field is generally poorly correlated with surface geologic structures. Beyond the spatial pattern of crustal magnetization, the magnetic power spectrum can provide information about the distribution of the underlying sources. We use the spatiospectral localization technique of Wieczorek and Simons [2005], and Dahlen and Simons [2008] to isolate the magnetic power spectrum of specific areas of the martian surface. Localized spectral estimates, along with their calculated variances, allow us to examine the significance of observed variations between distinct regions of the planet, and to evaluate the validity of analyses which operate on the whole sphere. Approximate strengths and depths of the magnetic sources within the crust are calculated for tiled windows across the planet using idealized magnetic source models. We observe a wide range of estimated parameters, indicative of the spatial diversity of the martian field. We will present these results in the context of martian crustal formation and evolution.