ABSTRACT

The magnetic field produced by magnetization in Earth's crust and lithosphere can be distinguished from the field produced by electric currents in Earth's core because the spatial magnetic power spectrum of the crustal field differs from that of the core field. Theoretical forms for the spectrum of the crustal field are herein derived by treating each magnetic domain in the crust as the point source of a dipole field. The geologic null-hypothesis that such moments are uncorrelated is used to obtain the magnetic spectrum expected from a randomly magnetized, or unstructured, spherical crust of negligible thickness. This simplest spectral form is modified to allow for uniform crustal thickness, ellipsoidality, and the polarization of domains by an aperiodically reversing, geocentric axial dipole field from Earth's core. Such spectra are intended to describe the background crustal field. Magnetic anomalies due to correlated magnetization within coherent geologic structures may well be superimposed upon this background; yet representing each such anomaly with a single point dipole may lead to similar spectral forms. Results from attempts to fit these forms to observational spectra, determined via spherical harmonic analysis of MAGSAT data, are summarized in terms of amplitude, source depth, and misfit.

Each theoretical spectrum reduces to a source factor multiplied by the usual exponential function of spherical harmonic degree n due to geometric attenuation with altitude above the source layer. The source factors always vary with n and are approximately proportional to n^3 for degrees 12 through 120. The theoretical spectra are therefore not directly proportional to an exponential function of spherical harmonic degree n. There is no radius at which these spectra are flat, level, or otherwise independent of n.