

Application of broad-band frequency spectrum of AC magnetic susceptibility: Grain-size distribution of SP particles

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Low-field alternating current magnetic susceptibility is among the most commonly used magnetic property, not only in rock and mineral magnetism but also in environmental magnetism studies. Particularly, frequency dependent susceptibility, defined as the change in susceptibility per decade frequency, has also been widely used for detecting the presence of fine-grained magnetic particles around SP to SD threshold. However, this conventional method is not sufficient to fully characterize SP-SD particles. This study proposes a new rock magnetic method for characterizing SP-size magnetic particles by measuring low-field alternating current magnetic susceptibility at a number of frequency steps spanning four orders of magnitude from 125 Hz to 512 kHz. Measurements were made for a set of natural samples, with various grain size distributions (GSDs), including loess and paleosol (Luochuan, Central Loess Plateau in China), and tuff (Yucca Mountain, Nevada). The resulting frequency spectrum of magnetic susceptibility (FSM) generally decrease with increasing frequency, but their rates of decrease were different. Quantitative estimates of GSD proposed in this study allowed reconstructing characteristic GSD patterns, demonstrating the difference in the GSD of SP particles in more contrasting and clearer fashion.

Keywords: rock magnetism, AC susceptibility, grain size distribution, superparamagnetism