



Fine-particle magnetic granulometry in an ash-flow tuff

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The Tiva Canyon Tuff at Yucca Mountain in the southwestern U.S. is a welded ashflow deposit containing nanoscale Fe-oxide grains that approximate ideal assemblages of narrowly sized non-interacting magnetic particles. The low-impurity magnetite microcrystals exsolved from volcanic glass in the basal 5 m section of the tuff and display a continuous variation in grain size with stratigraphic height due to differential cooling rates in the unit. These rocks can potentially serve as useful reference material for determining fine magnetic particle grain size from size-sensitive magnetic properties in environmental and rock magnetic studies. A detailed magnetic characterization of this section revealed a distinctive magnetic signature at each stratigraphic level in the section corresponding to different grain-size distributions, with salient transitions in room temperature magnetic susceptibility and remanence that denote the spatial limits of stable single domain behavior. The progression in magnetic grain size and domain state from superparamagnetic grains near the base to pseudo-single domain grains near the top of the section, inferred from fundamental magnetic properties, are also indicated by thermal fluctuation tomography as well as previous electron microscope observations. These rocks constitute a unique natural example of weakly interacting fine magnetic particle assemblages that display clear grain-size-dependent magnetic properties over a broad range of grain sizes.