Magnetic properties of sedimentary smythite (Fe9S11)

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Smythite (Fe₉S₁₁) is an occasionally reported magnetic iron sulphide mineral that occurs in varied geological settings and co-occurs commonly with other magnetic iron sulphide minerals. Determining the magnetic properties of smythite is important to understand its geological distribution and paleomagnetic and environmental magnetic significance. We have identified sedimentary smythite from three locations in Taiwan (one terrestrial and two marine), which suggest that smythite forms in methanic diagenetic environments into which sulfide has been reintroduced. We report the magnetic properties of our purest smythite sample and compare them with those of other magnetic iron sulfide minerals. The magnetization of smythite is controlled by multi-axial anisotropy, with magnetic easy axes that lie within the crystallographic basal plane. Smythite has stable magnetic properties with no low-temperature magnetic transition. The magnetic properties of smythite at elevated temperatures are dominated by thermal alteration, which precludes Curie temperature determination. Hysteresis and coercivity properties of stable single domain smythite are similar to those of greigite at, and below, room temperature. In contrast to greigite, and similar to pyrrhotite polytypes, smythite crystals occur as hexagonal plates. This morphological contrast facilitates discrimination of smythite from greigite in electron microscope observations, but it does not assist discrimination from pyrrhotite. Similar magnetic and morphological properties between smythite and other magnetic iron sulfides means that diagnostic mineralogical analyses (e.g., X-ray diffraction) are needed to identify these minerals. Further work is needed to obtain pure samples to develop a comprehensive domain state dependent magnetic property framework for smythite.