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Distinction between natural greigite components by high-temperature magnetic remanence measurements using a Magnetic Properties Measurement System (MPMS)

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The ferrimagnetic sulphide mineral greigite (Fe_3S_4) has been subject of geomagnetic studies in the past, but only recently clear evidence has shown the presence of differing greigite phases in geological records.

We present a new thermomagnetic technique applying magnetic remanence measurements in an oxygen-free environment in the range from room tempetature to 530˚C using a highly sensitive *Quantum Design MPMS* (at the University of Bremen). These measurements are suitable to detect the exact starting temperature of the thermomagnetic decay of greigite-containing natural samples. Heating is performed in an ideal helium/near vacuum atmosphere. Therefore oxidation effects of sulphides can be neglected. These new experiments are compared with more classical methods by linking their thermomagnetic results to those of standard Curie balance measurements.

Dekkers et al. (2000) performed Curie balance heating experiments on synthetic greigite in air and in argon flushed atmosphere. Their results show lower decay temperatures for heating in air compared to heating in argon. This temperature shift is associated with oxidation effects during heating which can be minimized using the argon gas flushing technique. Nevertheless, only if actually no free oxygen is present during the heating experiment, oxidation effects can be distinghuished from true magnetic decay behavior. This is provided by the completely closed and oxygen free sample chamber of the MPMS.

The temperature dependence of magnetic remanence and magnetization of natural greigite-rich samples of a recent (Gulf of Mexico; Fu et al., subm.) as well as a paleo high-sedimentation regime (Caparthian Fordeep; Vasiliev et al., 2007) were examined to test the sensitivity of our method. It is shown that in these specific samples, two distinct temperature ranges for the magnetic decay of greigite can be discriminated. We attribute those features to the presence of two different greigite populations: a very fine biogenic SD and a coarser chemogenic SD phase, for which Vasiliev et al. (in rev.) provided clear evidence in their samples using transmission electron microscopy.

The presented high-temperature MPMS method constitutes a well-defined and highly sensitive magnetic tool to unambigously detect and distinguish between those two magnetically similar SD greigite components of different origin.

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