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加热环境对人工合成磁赤铁矿热磁行为的影响

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Effects of heating environments on thermomagnetic behaviors of synthetic maghemite

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摘要

热磁测量,包括高温磁化率和高温磁化强度测量,是根据热磁曲线转折点的温度(居里点、尼尔点或相变点)鉴定样品中磁性矿物种类的有效方法.本文选取两个人工合成磁赤铁矿样品,利用四种热磁测量仪器分析不同的条件下测得的热磁曲线.依据样品与空气接触程度,将测量环境设为开放、封闭、封闭(通入氩气或氮气)三类.结果表明:热磁测量环境的开放程度对居里点和曲线可逆程度产生极大的影响.封闭环境下测得的居里点较开放环境下的低,分别对应磁铁矿和磁赤铁矿;开放系统的热磁曲线不可逆程度高于封闭系统.造成这些差异的原因是氧化还原条件的不同.本文的磁赤铁矿样品在封闭的条件下,加热至250 ℃左右开始转化为磁铁矿,因此无法通过居里点被正确识别;在开放的氧化环境下,加热的最终产物为赤铁矿,能够测得正确的居里点.本实验结果启发人们:在不同的加热环境下,磁性矿物可能表现出不同的热磁行为,根据单一的热磁曲线,很容易对样品中磁性矿物的种类造成误判.全面对比不同条件下的测量结果,才能够得出更为准确的结果.

关键词 磁赤铁矿, 热磁测量, 居里点, 氧化还原, 矿物变化

Abstract:

Thermomagnetic measurements including high temperature magnetic susceptibility and high temperature magnetization, are the crucial way to distinguish magnetic minerals by determining the turning points (e.g. Curie point, Neel point or other transforming points) on thermomagnetic curves. In this study, two synthetic maghemite samples are subjected to different thermal environments (open, close, close with Ar or N_2, which defined by the air exposure degree) with 4 instruments for thermomagnetic measurements. The results turn out that Curie point and curve reversibility between heating and cooling are significantly affected by the heating environments. The Curie point corresponding to magnetite is lower in closed environment than that of maghemite in open environment. And the degree of curve irreversibility in open environment is much higher than that in closed environment. Redox environments account for the differences above. Because the maghemite in closed environment transforms into magnetite when heated up to 250 ℃, it is impossible to be distinguished by its curie point; the final mineral in open environment (oxidizing environment) is hematite which can be determined by the Curie point. The results suggest that maghemite likely displays very differently in different heating environments. Therefore single thermomagnetic curve tends to misleading in determining magnetic minerals. Combination of measurements in different conditions is essential to obtain more accurate estimation.

Keywords Maghemite, Thermomagnetic measurements, Curie point, Redox environment, Mineral transformation

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