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CBD方法对天然样品磁性矿物影响

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Effects of CBD treatment on magnetic minerals of natural samples

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摘要

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摘要 本研究选择川西高原、天山和西伯利亚Kurtak剖面的黄土古土壤样品及亚热带非风成样品进行CBD处理,系统测量并对比处理前后的磁学参数,包括低频磁化率、频率磁化率、非磁滞剩磁、饱和等温剩磁、剩磁矫顽力和热磁曲线($J-T$ 曲线),分析处理前后磁性矿物种类、含量和磁畴的变化。结果表明,CBD方法对于磁性矿物的溶解并无明显的选择性,在温度与反应时间一定的条件下,磁性矿物的溶出量主要受控于其粒径分布。CBD方法可以非常有效地去除具有更大比表面积的细粒($< 1 \mu\text{m}$)磁性矿物,同时溶解粗粒($> 1 \mu\text{m}$)磁性矿物外缘,使其粒径变细。CBD处理后磁化率变化存在多种可能,对于成土作用较强的古土壤,CBD方法可以较为准确地提取成土成因的磁性信息;而干旱和过度湿润条件下的风积黄土,不宜使用CBD方法区分原生与次生磁性矿物。

关键词 CBD技术, 黄土古土壤, 磁性矿物, 磁学特征, 环境磁学

Abstract: Loess-paleosol sequences are good archives in paleoclimate research over the last 2.5 million years and even earlier. Magnetic susceptibility of loess-paleosol sequences has been used extensively as a proxy for paleoclimate interpretations. Magnetic minerals in loess/paleosols are of lithogenic (allochthonous) origin or pedogenic (authigenic) origin. It is of great significance in loess magnetism study to separate magnetic signals and investigate whether it is magnetite or maghemite that mainly contributes to magnetic susceptibility enhancement in paleosol. Though the combination of CBD(Citrate-Bicarbonate-Dithionite)procedure with loess magnetism shed light on these questions, the CBD method is still in debate and its mechanism unclear. To better understand the effects of CBD method on magnetic minerals, in this paper, loess/paleosol samples from Western Sichuan plateau, Tianshan mountains and Kurtak, Siberia and non-aeolian samples from Subtropics were undergone CBD treatment. Magnetic parameters, including low-field magnetic susceptibility, frequency dependent magnetic susceptibility, anhysteretic remanent magnetization, saturation isothermal remanent magnetization and thermomagnetic curves ($J-T$ curves), were measured before and after CBD treatment. Changes in magnetic mineralogy, magnetic concentration and magnetic domain were analyzed. The results suggest that CBD method is not apparently selective in dissolving various magnetic minerals, the dissolving quantity is controlled by grain size distribution if the temperature and duration are given. CBD method can efficiently remove fine grains which have higher ratio between surface and volume, and dissolve a rim from the outside of the coarse grains resulting in finer grain size. There are multiple possibilities of changes in magnetic susceptibility after CBD treatment. CBD method can be used to obtain magnetic signal of pedogenic original. It is not advisable to use the method to separate lithogenic and pedogenic magnetic minerals in loess from arid or over-wet area.

Keywords CBD technique, Loess/paleosol, Magnetic minerals, Magnetic properties, Environmental magnetism

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