R004-18
D 会場 ： 11/26　PM2（14:50-16:20）
15:50〜16:05:00

水熱加熱レス試料の岩石磁気―実験後乾燥保管試料の長期磁気変化

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Rockmagnetism of hydrothermally heated loess samples; long-term magnetic changes during storage of samples dried after experiment

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Hydrothermal (HT) experiments using loess samples from the Chinese Loess Plateau and Paks, Hungary were conducted to clarify the mechanism of formation of pedogenic magnetic minerals. We have already shown that post-experiment changes in remanent magnetizations were observed during storage of hydrothermally heated samples that were cooled and dried after HT experiments. Here, we report that magnetic susceptibility also changes during storage of the samples. The samples were heated at 200 degrees C for 1 to 17 hours, followed by cooling down to the room temperature. Samples subjected to HT experiments were dried until the original dryness (natural dry sample), some of which were dried heavily at two levels; super dry 1 (SD1), relatively high dryness, and SD2, very high dryness. Both natural and super dry samples have no pore water, but have inter layer water of phyllosilicates of clay minerals. Most of samples after HT experiments were stored at room temperature, ca. 20 degrees C. Some were stored at 4 degrees C.

Magnetic susceptibility of natural dry samples stored at room temperature increased monotonically for the first 1 month, followed by gradual decrease with small fluctuations. Magnetic susceptibility of natural dry samples stored at 4 degrees C represent similar patterns, but the peaks were delayed by a few months, having subsequent smooth cooling curves. Magnetic susceptibility of super dry samples, all stored at room temperature, first increased for a couple of months, followed by keeping almost constant values or a slight monotonic decrease curve. In consideration of the magnetic hysteresis and IRM acquisition experiment data, the results of magnetic susceptibility changes indicate that superparamagnetic magnetite and hematite particles have been formed even after the HT experiment under room temperature and dry conditions. The newly formed fine magnetic particles contribute to growing in size by condensation, causing decreases in the number of fine particles. Lower temperature storages suppress these processes. The post-experiment formation of fine magnetic particles and condensation of them would occur in interlayer water of phyllosilicates.

レスの土壌性磁性鉱物生成の解明をめざし、レス試料を用いた水熱加熱実験を行った。これまでに、加熱温度・時間に依存した実験直後の帯磁率増加と、その後乾燥試料で数 10〜100 日の時間スケールで起こる残留磁化の増減変動を確認している。本発表では、保管中に帯磁率も長期変化することを報告する。実験には中国黄土高原とハンガリーのパクシュで採取済の強く土壌化した温暖湿潤期のレス試料を用いた。温度 200 ℃、加熱時間 1〜17 時間の水熱加熱実験を行った。実験終了後、試料を 70 ℃の乾燥器に入れ実験前の質量に戻るまで乾燥させた（自然乾燥試料）。一部の試料は乾燥時間を大幅に延ばして、元の質量から 2〜4 %減の 2 種類の超乾燥試料を作成した（乾燥度がやや緩い Super dry 1（SD 1）試料と非常に強い SD2 試料）。これら乾燥試料は砕屑粒子間の間隙水を全く含まず、層状珪酸塩鉱物の層間水は残している。磁気測定後、ほとんどの試料を室温（平均約 20 ℃）で、一部の試料は 4 ℃で保管した。

室温保管した自然乾燥試料の帯磁率は最初の約 1 か月間は単調に増加し、ピーク（実験直後の値＋ 1〜2 %）をとった後は緩やかに、小さく振動しながら減少する。4 ℃保管の自然乾燥試料も同様の帯磁率変化を示すが、約 2 〜 3 か月遅れてピークをとり、その後の減少はなめらかであった。室温保管した超乾燥試料の帯磁率は最初の 1 − 2 か月間は増加するが、その後はほぼ一定値をとるか（SD2 試料）、極めて緩やかな単調減少を示した（SD1 試料）。これらの帯磁率変化は、磁気ヒステリシス測定、IRM 獲得実験結果と合わせると、水熱加熱実験後も、磁鉄鉱と赤鉄鉱の超常磁性サイズ粒子の新規生成と、それらの凝結による粒径の成長がしばらく続くことを示唆する。低温保管はこれらの反応を減速させる。また、細粒磁性粒子の生成と成長は層状珪酸塩鉱物である粘土鉱物の層間水中で起こっていると思われる。