Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SEM036-P03 Room:Convention Hall Time:May 26 10:30-13:00

Magnetic behaviors of sediments including maghemitized magnetite in thermal demagnetizations of artificial remanences

Naoto Ishikawa[1*], Akira Hayashida[2], Yoshihiko Tanigawa[1], Keiji Takemura[3]

[1]Grad. EHS, Kyoto Univ., [2]Dept. Environ. Sys. Sci., Doshisha Univ., [3]Beppu. Geo. Res. Lab., Kyoto Univ.

Low-temperature oxidized magnetite (maghemitized magnetite: Magh-Mt) has been recognized as a common magnetic mineral in sediments and soils. It is important to identify the presence of Magh-Mt and to clarify its magnetic property for environmental-magnetic and paleomagnetic investigations on sediments and soils. We present results of thermal experiments performed on Magh-Mt bearing sediments, especially progressive thermal demagnetization (PTHD) experiments of artificial remanences. Analyzed samples were taken from a sediment core (BIW07-5) obtained by piston coring in Lake Biwa, central Japan. The core consisted of homogeneous lacustrine clay with 6 tephra layers. Freeze-dried clay samples were used for thermomagnetic experiments.

Low-temperature magnetometric results showed the presence of Magh-Mt in the clay samples. Warning curves from 5 to 300K of isothermal remanence (IRM) imparted at 5K in 1T after zero-field cooling showed a large decrease of IRM between 5 and 40K and suppressed Verway transition of magnetite between 90 and 120K. As S-ratios (maximum field of 2.5T and back filed of 0.3T) of the samples were higher than 0.965, Magh-Mt was regarded as a principal magnetic mineral.

PTHD experiments of artificial remanences in air and Ar were carried out for clarifying magnetic mineralogy. Samples were packed in small quartz cups. IRM was imparted along the cup axis in a DC field of 1.9T, and then anhysteretic remanence (ARM) was imparted perpendicular to the axis by a peak alternating-field of 100mT and a DC field of 0.1mT. PTHD up to 680 or 700^{o}C were performed using a noninductively wound electric furnace in a six-layer mu-metal magnetic shield; the internal stray field was less than 5 nT. The initial magnetic susceptibility (Xo) was measured using a KLY-3S susceptibility meter at each demagnetization step.

During the PTHD in air, decay curves of ARM and IRM components showed inflections at about 280 and 360^{o}C, respectively. The ARM components were unblocked at 620^{o}C. The IRM components were unblocked at 680^{o}C after small or no decrease at 620^{o}C. Xo decreased gradually up to 680-700^{o}C. During the PTHD in Ar, the ARM components increased at 280^{o}C, accompanied with increase of Xo, and were unblocked at 560^{o}C. The IRM components decreased at 560^{o}C and were unblocked at 640-680^{o}C. Xo increased from 280 to 680-700^{o}C. The ARM component is carried initially by Magh-Mt, and carriers of the IRM component are likely carried by Magh-Mt with higher coercivity and primary hematite. It is suggested that the conversion of Magh-Mt occur from 280^{o}C and that magnetite converted during heating in Ar may acquire remanence newly or inherit remanence from parent Magh-Mt.

Additionally, PTHD experiments above 500^{o}C in Ar were performed after demagnetizations in air at lower temperatures (200, 300, 400 and 480^{o}C). Decay curves of ARM and IRM components above 500^{o}C from samples demagnetized at 200^{o}C in air were quite similar to the curves during the PTHD in Ar at all steps, indicating the complete conversion of Magh-Mt to magnetite. Samples demagnetized at 300-480^{o}C in air provided the presence of remanence unblocked between 540 and 620^{o}C during the PTHD in Ar. The amount of the unblocked remanence increased with increasing the demagnetization temperature in air. It is implied that a converted product from Magh-Mt during heating in air is stable for heating and carries the remanence unblocked up to 620^{o}C.

A PTHD experiment of artificial remanences is a simple and useful method for identifying magnetic minerals. However, in the case of Magh-Mt bearing samples, it is inferred that decay curves of artificial remanences do not represent initial magnetic mineralogy because a converted product carries remanence during heating.

Keywords: maghemite, rock magnetism, magnetite