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Comparison of magnetic properties of topmost sediments at the first and second depressions in North Basin of Lake Biwa

Tomoko Asami[1*], Naoto Ishikawa[1], Kanako Ishikawa[2]

[1]Graduate School of Human and Environment, [2]Lake Biwa Environmental Research Institu

Rock-magnetic investigations are performing on topmost sediments in Lake Biwa for clarifying the effect of early diagenesis on magnetic properties of sediments and analyzing environmental changes mainly based on variations in magnetic properties of the sediments. In this time, we present results from rock-magnetic analyses of sediments cored at the second depression off Ohmimaiko (Ie-1, water depth 71m) in North Basin of Lake Biwa and comparison with previously reported magnetic properties of sediments at the deepest area of the first depression in North Basin off Imazu (N4, water depth 91m).

In North Basin, the lake water is stratified from summer to autumn associated with the thermocline formation, and is circulated in a whole in winter. This change causes variations in environmental conditions at the bottom water. At Ie-1 and N4, the amount of dissolved oxygen (DO) shows a seasonal variation: relative high values of DO are observed in February to April at both sites, while low DO values below 1 mg/L at N4 and about 4mg/L at Ie-1 in October and November.

At Ie-1, sediments cores of 13-30cm long were taken in October 2008, and March and June 2009 by a HR-type gravity corer. The cored sediments consisted of homogeneous claly silt of black to dark greenish gray color, similar to those at N4. Analyzed samples were taken from the cores continuously at 1 or 2 cm intervals and freeze-dried.

Results from high and low temperature magnetic analyses suggested that magnetic minerals in the sediments of Ie-1, as well as N4, are dominantly maghemitized magnetite. Based on downcore variations of magnetic parameters, the sediment cores were divided into the following three units: Unit-A (0-12cm in depth), B (12-20cm in depth), and C (20-30cm in depth). Unit-A was characterized by a downward decrease of coercivity. In Unit-B and C, concentration and magnetic-granulometric proxies for magnetic minerals decreased downward. These magnetic variations at Ie-1 were similar to those at N4, but the depth of the unit boundaries were about 2cm deeper than N4.

Among concentration parameters of magnetic mineral, initial magnetic susceptibility (x), ARM susceptibility (x-ARM), saturation remanence (Mrs) and saturation magnetization (Ms), the parameters but x-ARM were lower at Ie-1 than N4 in the whole units. The difference in x was remarkable, and x-ARM showed no difference. High-field susceptibility values were same at both sites. It is inferred that the amount of magnetic mineral is smaller at Ie-1, and/or that the contribution of super-paramagnetic grains is larger at N4.

Among magnetic granulometric proxies (ARM/Mrs, x-ARM/x and Mrs/x), ARM/Mrs and x-ARM/x were slightly larger at Ie-1 than N4. It is possibly implied that magnetic grain size is relatively smaller at Ie-1.

Among magnetic coercivity proxies, coercivity (Hc), coercivity of remanence (Hcr) and S-ratio (S-0.1T), Hcr and S-0.1T were smaller in Unit-A at Ie-1 than N4, while Hc values were same at both sites. The lower coercivity at Ie-1 may imply the smaller grain size of magnetic minerals, which is inconsistent with the above-mentioned implication based on the magnetic granulometric proxies. The difference in coercivity is also caused by the difference in the maghemitization degree of magnetite. However, based on low-temperature magnetic behaviors of isothermal remanence (IRM), there was little difference in the maghemitization degree between Ie-1 and N4 samples except for samples at both sites in Oct. 2008 when the minimum values of DO in the bottom water were observed.

In Unit-A, a seasonal change of magnetic coercivity was observed at N4, while Ie-1 samples provided no seasonal change. Although the low temperature behaviors of IRM indicated the presence of a magnetic mineral with a distinctive decrease of IRM at 29K in N4 samples of Unit-A and B, the Ie-1 samples did not provide any magnetic behaviors indicating the existence of such a magnetic mineral.