Process of maghemization and pyritization in Labrador Sea sediments inferred from rockmagnetic study

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http://www7.ocn.ne.jp/~kiko29/kwmr.html

Magnetic properties of sediments are thought to be changed during the diagenesis. To understanding the diagenesis on magnetic minerals has been important topics concerning the interpretation of environmental magnetic records and reconstructing relative paleointensity, which become a good geologic time scale in the core sediments.The magnetic measurements are a clue to understand the processes and mechanisms of the magnetic mineral changing. The related chemical reactions occur between the minerals and pore fluids.The transformation of magnetite (Fe_2O_3) to maghemite (gamma Fe_2O_3) under oxic conditions is called maghemization, and that to pyrite (FeS_2) under the anoxic conditions is named pyritization. However both chemical and physical conditions of these reactions are not fully understood to date. In this study we aimed at elucidating the process of change in magnetic properties due to these reactions under the rapid deposition.

Cores were collected during the IODP Expedition 303 from the sites U1305A, U1306A and U1307A in Labrador Sea off Greenland. Core locations, water depth and length of cores are as follows: U1305A: 57 28.507'N, 48 31.842'W, 3463.0m, and 294.5 m; U1306A: 58 14.228'N, 45 38.588'W, 2270.5 m, 307.0 m; and U1307A: 58 30.347'N, 46 24.033'W, water depth; 2575.1 m, total length; 156.6 m. Of there, site U1305A is located farthest from Greenland and the water depth was the greatest. Magnetic hysteresis loop and thermal isothermal remnant magnetization (IRM) were measured on the whole length of cores, by 7 m intervals, using 10 to 30 mg samples of homogeneous silty clay, except for the Heirinch and the detrital carbonate layers.

The results are as follows: the magnetic minerals in the homogeneous silty clay are mainly magnetite at the shallow parts of 0 to 7 m below the sea floor surface (mbsf) at U1305A, 0 to 7 mbsf at U1306A and 0-14 mbsf at U1307A, whereas maghemite is dominant at the middle depth of 7 to 64 mbsf at U1305A, 7 to 180 mbsf at U1306A and 14 to 80 mbsf at U1307A. All these results are deduced on the basis of distribution on the Day-Plot that obtained from the hysteresis loop parameters and that of thermal changes of IRM data. It is thus inferred that the magnetite grains are transferred to maghemite at the depth of 7 to 14 mbsf, and to magnetite again at the depth of 64 to 180 mbsf. At the meddle depth, 7 to 14 mbsf, the maghemitization takes place by slow oxidation of magnetite grains. Maghemite skin comes to cover the surface of magnetite grains at this depth. Maghemitization at the U1305A should occur at the shallower depth than at U1306A and U1307A, and produced maghemite further changed to magnetite again at about 64 to 180 mbsf. Maghemite skin is presumably decomposed to magnetite at the lower part of the cores by the reduction, as is well known everywhere. The sites U1306A and U1307A are situated in the middle of NADW that are additionally identified by the oxygen maximum, thus the maghemitization should have been accelerated in the sediment. Decomposed magnetite and maghemite were recrystallized into pyrite under the reduction conditions. Magnetic susceptibility in high field (0.7 to 1.0 T) deduced from the hysteresis loop parameters is consistent with the occurrences of pyrite, and indicates the paramagnetic signals of pyrite, which tend to increase downwards with burial depth.

This is the induced process of maghemitization and pyritization in the surface layers of the sea bottom sediments.