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Diagenetic alteration of magnetic signals in Labrador Sea sediments

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Stability of iron oxides and sulfides in marine sedimentary environments are susceptible to changing redox conditions in interstitial waters with burial depth. Therefore, the original magnetic signals recorded in the sediments are subject to post-depositional diagenetic alteration that could complicate paleomagnetic and paleoenvironmental interpretations.

In order to test the possible effects of early diagensis on magnetic signals in the sediments, we qualitatively identified magnetic mineral species by measuring magnetic properties in the lower Pliocene hemipelagic sediment samples from IODP Sites U1305, U1306, and U1307 on Eirik Drift in the Labrador Sea. All of the samples analyzed are unlithified silty clay sediments recovered by piston corer from the depths down to 285 mcd. Analytical techniques we employed in this study include magnetic susceptibility (m^3/kg), natural remanent magnetization, saturation remananence, coercive force, remanent coercivity, high-low temperature magnetometry, and energy dispersive spectrometer. We then compared our results to shipboard interstitial sulfate, iron, manganese, and methane concentration data to assess the mineral assemblage stability in association with downhole redox conditions. The deep-sea sites we selected are characterized by the sulfate-methanogenesis interface (SMI) at 70-90 mcd.

Our preliminary results indicate general downward (1) decreasing trends in natural remanent magnetization and saturation remanence, (2) increase in mean grain size of magnetic minerals, and (3) changes in magnetic mineral compositions. Magnetite (Fe_3O_4) is recognized at all depths analyzed, whereas maghemite (Fe_2O_3) is found only above the iron reduction depth zone. Furthermore, greigite (Fe_3S_4) appears to occur below the SMI. We assume that anaerobic methane oxidation and associated change in interstitial redox condition induce preferential dissolution of relatively small sized magnetic grains of maghemite and magnetite, and authigenic precipitation of greigite.