

Magnetic hysteresis parameters and Day plot analysis to characterize diagenetic alteration in gas hydrate-bearing sediments

Enkin R., Baker J., Nourgaliev D., Iassonov P., Hamilton T.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

The J meter coercivity spectrometer is a machine capable of rapid and simple measurement of magnetic hysteresis, isothermal remanence acquisition and magnetic viscosity of rocks and sediments. The J meter was used to study a suite of samples collected from strata in the gas hydrate-bearing JAPEx/JNOC/GSC Mallik 5L-38 well (69.5°N, 134.6°W) in the Mackenzie Delta of the northwestern Canadian Arctic. The Day plot of magnetic hysteresis ratios for these samples is exotic in that the points do not plot along a hyperbola as is usually observed. Rather, they plot as a scatter which is shown to contour into vertical slices using coercivity field (HC) or saturation magnetization (JS), and horizontal slices using the relative quantity of superparamagnetism (JSPM/JS). Optical microscopy reveals that the magnetic minerals are detrital magnetite and authigenic greigite. Greigite is dominant in sands which in situ had >70% gas hydrate saturation and in silts in which gas hydrate growth was blocked by insufficient porosity. We infer that the silts were the accumulation sites for solutes which had been excluded from the pore waters in neighboring coarser-grained sediments during the course of gas hydrate formation. Consequently, we conclude that magnetic properties are related to gas hydrate-related processes, and as such, may have potential as a method of remote sensing for gas hydrate deposits. Copyright 2007 by the American Geophysical Union.

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