Magnetic Susceptibility Variations in lower Paleozoic Shales of the Baltic Basin (Poland) – A Helpful Tool for Regional Correlations and Decoding of Paleoenvironment Changes

D. K. NIEZABITOWSKA[1]*, J. ROSZKOWSKA-REMIN[2] AND R. SZANIAWSKI[1]

[1] Institute of Geophysics Polish Academy of Sciences
[2] Polish Geological Institute National Research Institute

Magnetic susceptibility (MS) is commonly used logging method for investigating stratigraphic changes in marine sediments or petrophysical parameters. A new application of MS core logging as a tool identifying paleoenvironment and potential high organic matter content is presented. The aim of the study was to define the relationship between magnetic methods, RockEval data, and the results of natural gamma ray wireline logging. The study was performed on six drill cores from exploration wells in lower Paleozoic shales from the Baltic Basin, Poland. In each drill core an interval of approximately 200 meters was examined. We analyzed intervals of rocks with variable amounts of organic matter. The aim was to define the potential of the magnetic methods by identifying MS variation origin and then verifying its correlations to geochemical data. Further, these dependences have led to determine the variations of lower Paleozoic shales and an attempt of intra-basin correlation.

Our results indicate that MS general trend variations in the analyzed rocks are strongly combined with the percentage amount of chlorite and correlate positively with Oxygen and Bioturbation Indexes, while negatively with Total Organic Carbon (TOC). This relationship suggests that MS values were determined by oxygen condition on sea bed on a very early stage of diagenesis. We found that MS value is mainly controlled by ferroan chlorite amount. Thus, to understand the origin of MS variations, it is crucial to define the genesis of this mineral. When considering the thermal history of studied rocks (buried above 80°C), the diagenetic origin of chlorite is the most likely. However, in context of MS variation origin important is to define also the source of Fe-rich clays, which became precursors for further diagenetically modified chlorite. We found that Fe-chlorite content is defined by syn-sedimentary input of ferroan clays, then modified to chlorite by burial. Summarizing, combined MS variations, RockEval analysis and gamma ray logs allowed to better understand deposition and burial evolution of gas-bearing shales.