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Is magnetic susceptibility a reliable proxy for detrital supply? - A case study of the Upper Devonian carbonates from the Holy Cross Mountains

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Two Upper Devonian sections (Janczyce 1 borehole and Kowala Quarry), located in the Holy Cross Mountains were selected for detailed analyses of magnetic susceptibility (MS) signal and rock magnetic properties. In order to distinguish MS carriers several tests were performed, such as: isothermal and anhysteretic remanent magnetization (IRM, ARM), S-ratio, thermoanalysis, hysteresis measurements. In addition, natural gamma ray signal was tested as well as geochemical analyses were performed for selected samples.
Relatively long Frasnian and Famennian interval (about 450 meters) of the Janczyce 1 borehole was sampled. Clear, large-scale magnetic susceptibility (mean value $18.8*10^{-9}$ kg/m^3) changes are in agreement with a total gamma ray record. Geochemical analyses of Zr, Ti and Al content confirmed that MS signal is mostly of terrigenous origin, therefore can be indirectly correlated with postulated T-R cycles. It can be also traced in other local sections as well as in distant outcrops.

Uppermost Devonian (ranging from *annulata* through *Hangenberg* shales) and Lower Tournaisian interval (39 meters) of Kowala Quarry, comprises black bituminous shales, marly shales, sometimes with carbonate nodules, micritic and wavy nodular limestones. A mean MS value is 48 $*10^{-9}$ kg/m^3. Marls and marly shales are dominated by paramagnetic minerals, which contribute significantly to MS signal. High positive correlation (0.82) between MS and ARM, and the lack of MS-IRM correlation is clearly visible in black bituminous shales, what indicates that fine grained magnetite is the dominant magnetic mineral in this kind of rocks. Moderate positive correlation between MS and ARM is noted in wavy nodular limestone and micritic limestone (0.61 and 0.30, respectively). In this case also some admixtures of high coercivity minerals (hematite) influenced MS signal. The presence of hematite-rich horizons, positive S-ratio, with values close to 1, was also confirmed by more detailed studies of rock magnetic properties. Secondary hematite is related to Permo–Triassic remagnetization episode of Devonian carbonates postulated by some authors (see SZANIAWSKI et al., 2011).
The complex nature of magnetic susceptibility signal and of carbonate magnetic mineralogy makes it difficult to draw direct conclusions related to detrital input, basing only on small scale MS changes. More detailed analyses are important, because the presence of secondary minerals and their influence on MS signal should not be omitted.

References

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