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Spectral gamma-ray correlations controlled by other stratigraphic methods – case studies from a Silurian carbonate platform and periplatform settings, East European Craton (Poland, Ukraine)

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The Silurian sedimentary rocks covering the south-western margin of the East European Craton represent a low-latitude, carbonate platform to periplatform setting (KALJO & JURGENSON, 1977). Recently, the basin is a subject of interest of oil industry, due to its high shale-gas potential. The Silurian succession is well dated by graptolites and conodonts, however the biostratigraphical data are often incomplete or insufficient in drillcore sections. One of the methods that can potentially be used for improvement of stratigraphical resolution in the basin is spectral gamma-ray. However, prior to its implementation in drillcore sections, the method needs to be tested in well dated and easily correlable outcrop sections. Here presented are two case studies, revealing different applicability potential of the method in inshore and offshore settings.

In the first case, an attempt has been made, to correlate the inner carbonate platform sections of Konovka to Sokol formations (early Ludlovian), exposed in the Dnister river escarpment, between Woronowica and Konovka vilages, in Podolia (Ukraine). The studied interval, which both, vertically and horizontally, contain various facies, records a regressive event with distinct palaeobathymetric changes; however without significant emersion in the studied profiles. Laterally continuous outcrops of horizontally lying strata enables to track beds and horizons laterally across different facies, which allows to construct a stratigraphic framework independent from the gamma-ray record. The radiometrically measured element contents (eK, eTh, eU), and their ratios, do not reveal any reliable isochronous levels at longer distances (>several hundreds metres) and are strictly dependent on lateral or vertical facial changes. The local concentrations of potassium and thorium seem to be controlled by various admixtures of clay minerals, whereas uranium content is elevated in organic matter bearing rocks.

In the second case, a long distance (~150 km) correlation between the mid-Ludfordian sections of the Mielnik IG1 and Goldap IG 1 boreholes (North-eastern Poland) is presented. The correlation is controlled biostratigraphically and independently by the mid-Ludfordian Carbon Isotope Excursion and by the rocks magnetic susceptibility. In this offshore example, the eK and eTh generally mirrors the eU content. The horizons with low eK and eTh contents, and with high eU content, show coincidence with the appearances of highly diversified graptolite assemblages and probably mark flooding surfaces, which allows the correlation of parasequences framework between the sections. This correlation is possible however only due to wide facies unification in the offshore setting and thanks to synchronous facies changes controlled by sea-level fluctuations.

The basic conclusion emerging from the comparison of the two cases is that the spectral-gamma ray studies may be used mainly to describe and to identify spectral-gamma (chemo-) facies. As any other facies, the vertically observed changes in the spectral gamma-ray record are often diachronous in proximal shelf setting and isochronous in offshore areas.

References

KALJO, D. & JURGENSON, E. (1977): Sedimentary facies of the East Baltic Silurian. 122-148. In: KALJO, D. (ed.), *Facies and fauna of the Baltic Silurian*, Institute of Geology, Academy of Sciences of the Estonian SSR, Tallinn.