Organic geochemistry of potential source rocks for shale gas from selected sections of Silurian from Northern Poland

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Potential source rocks for shale gas in Poland, from boreholes Darżlubie IG-1, Prabuty IG-1 (Baltic Basin) and Tłuszcz IG-1 (Podlasie Depression) were examined to identify biomarkers and molecular parameters of maturity. The analysed black, quartz–mica (muscovite, chlorite) shale of Wenlock–Ludlow age contain small amounts of organic matter (<1% TOC). Samples from Llandovery, containing 1.6–14.0% TOC, seam to be a good source rocks.

Detailed analysis of the organic matter was performed, including the extraction of bitumen, the extracts separation into fractions and molecular analysis. *n*-Alkanes, acyclic isoprenoids: *nor*-pristane, pristane and phytane, alkylnaphthalenes, phenanthrene and alkilophenanthrenes, chrysene and alkilochrysenes, fluoren-9-one and alkilofluoren-9-ones were identified. The only identified biomarkers, *nor*-pristane, pristane and phytane, indicate that organic matter origin from phototrophic organisms. The distribution of short-chain *n*-alkanes and rapid decrease of the higher homologues (Fig. 1.), suggest high maturity of the organic matter, alterating the initial distribution of *n*-alkanes by diagenetic/catagenetic processes, however, such distribution can also be a signal from microbial-algae bioprecursor.

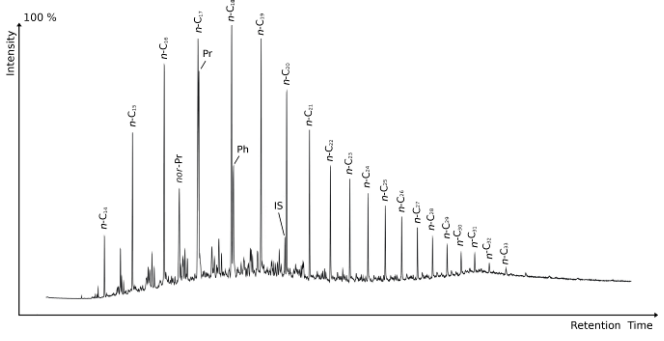

Fig.1.: The total ion current (TIC) chromatogram for sample DAR_1Ap (column HP-5MS); IS – Internal Standard: eikoz-1-en, *nor*-Pr – *nor*-pristane, Pr – pristane, Ph – phytane.

Distribution of dimethylphenanthrenes is consistent with the marine origin of the organic matter, also indicated by the presence of conodonts. A bimodal distribution of *n*-alkanes in one of the samples, with a second maximum for long-chain molecules, may indicate the existence in Silurian other than higher plant precursor of long chain *n*-alkanes, or bitumen mixing with hydrocarbons from younger rocks containing a component of higher plants. The rocks of Llandovery and middle Ludlow ages show high trimethylphenanthrene content, specific for some Paleozoic rocks, which can be used for age correlation in a wider area.

The absence of common biomarkers, except the most thermally resistant pristane and phytane, suggests maturity of organic matter above R_r=1.1%. It is consistent with the maturity estimated from the recalculation of the molecular maturity parameters values (CPI, MPI-1, DMPR, MPR, MCHR, 2-MChy/1MChy) into calculated vitrinite reflectance (R_c 0.66–1.19%), corresponding to oil window (R_r 0.5–1.2%). This suggests that in the analysed rocks primary thermogenic gas could be generated in small amount but generation of secondary thermogenic gas is unlikely.

However the resulted R_c values may be misleading, due to the fact that the relationships between molecular maturity parameters and calculated vitrinite reflectance (e.g., Radke & Welte, 1983; Cassani *et al*., 1988; Li *et al*., 2012) were developed for kerogen Type III, while the studied samples contain Type II kerogen. Degree of maturity of the samples containing Type II kerogen must be therefore confirmed by other studies, e. g., by measuring the Conodont Alteration Index.

Cassani, F., Gallango, O., Talukdar, S., Vallejos, C., Ehrmann, U. (1988): Org Chem, 13: 73-80.
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Radke, M., Welte, D. (1983): Adv Org Geochem 1981: 504-512.