ORGANIC GEOCHEMISTRY AND PETROGRAPHY OF COAL CLASTS DEPOSITED IN PENNSYLVANIAN SANDSTONE (UPPER SILESIAN COAL BASIN, POLAND)

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Introduction

Instances of re-deposited organic matter are only rarely described in geochemical literature. This comes from its relatively low resistance to mechanical forces acting in sediment transport and to bacterial degradation. Both these factors, acting together, lead to rapid decay of organic matter and to its total mineralization. Special conditions are required for organic material to be re-deposited and included into younger sediments such as low temperature (e.g. polar climate), relatively short transportation distance, and very rapid sedimentation under a quickly growing overburden (Fabiańska et al., 2008).

The bituminous coal clasts occurring in the Upper Silesian Sandstone limnic series of Early Pennsylvanian were the object of geochemical and petrographic research. Eighteen semi-rounded coal fragments, 2-5 cm in diameter and comprising up to 5% of the total rock volume occur in the Golkowice IV core (depth 877-908 m) in the SW part of the USCB. The bright and banded coal clasts are perpendicular to sandstone cross-stratification and similarly to the coal seam that lies below. Clasts were separated manually from the surrounding rocks, powdered and extracted with dichloromethane. Fourteen clasts were processed for palynology. Polished blocks were prepared for microscopic examination that included identification of maceral groups, determination of their content and random reflectance (R_r) measurements. Composition of extracts was analysed with GC-MS using an Agilent gas chromatograph 7890A, a HP–5 column (60 m × 0.25 mm i.d., a 0.25 μm stationary phase) coupled with a mass spectrometer 5975C XL MDS (70 eV, 50 - 650 Da, full scan). The compounds were identified by using their mass spectra, comparison of peak retention times with those of standard compounds, interpretation of MS fragmentation patterns and literature data (MSD 2012). Ratio values were calculated using manually integrated peak areas.

Results

Five coal clasts are rich in miospores and upper plant tracheids content; the rest contained tracheids only. Miospores are well preserved, indicating the same palaeotemperature conditions (~7-8 in the SCI index). Stratigraphically they belong to the Lower Namurian age.

Organic matter is represented by all three maceral groups that total content is 0-65%. Macerals are mostly represented by vitrinite (mostly collotelinite and vitrodetrinite) group followed by inertinite (mostly fusinite, semifusinite, inertodetrinite) and liptinite (mainly sporinite and liptodetrinite). Random reflectance (R_r) is in the range 0.9-1.05%.

Despite re-deposition, organic geochemistry of coal clasts is well preserved. Their extracts contained a series of n-alkanes, acyclic isoprenoids, pentacyclic triterpenoids, alkyl aromatic hydrocarbons and 2-5 ring polycyclic aromatic hydrocarbons (PAHs). Steranes were absent in the extracts, as it is common in Upper Silesia bituminous coals (Fabiańska et al., 2013). n-Alkanes present in the range from n-C_{12}-n-C_{35} show a predominance odd-over-even carbon atom number in a molecule expressed by CPI values in the range from 1.15 to even 2.31. CPI
values slightly decreases with depth indicating that some maturation occurred after re-deposition. Two types of \( n \)-alkane distribution can be distinguished 1) that present in shallower samples (depth 877-884 m), dominated by long-chain \( n \)-alkanes with higher CPI values (1.80 on aver.) and 2) that found in deeper samples (887-908 m), strongly dominated by short chain \( n \)-alkanes with lower CPI values (1.30 on aver.). Only the first of them shows some influence of water washing during the transport, i.e. partial removal of lighter \( n \)-alkanes.

\( \text{Pr/Ph values (1.45-4.36) correspond to kerogen III and there are no significant differences between both parts of the core, the same as in the case of Pr/n-C}_{17} \) (0.05-0.58) and Ph/n-C\(_{18} \) values (0.02-0.26).

Pentacyclic triterpenes distribution is mature and ends at \( C_{32} \) or \( C_{33} \) \( \alpha \beta \) hopanes, as it is common in terrestrial organic matter (Peters et al., 2005). These compounds are present in very low concentrations in the upper part of the core, in particular. Values of \( C_{31}\alpha \beta \) \( 22S/(S+R) \) ratio are all close to 0.60 indicating the middle catagenesis at least whereas \( \text{Ts/(Ts+Tm)} \) is ca 0.50.

The extracts were rich in aromatic hydrocarbons. Alkyl aromatic hydrocarbons comprised \( C_{1}-C_{5} \) derivatives of naphthalene, \( C_{1}-C_{3} \) derivatives of phenanthrene, anthracene, pyrene, and chrysene. Distributions of better water-soluble methyl- and dimethyl naphthalenes do not show removal of these compounds during transportation.

**Conclusions**

Most of coal clasts were derived probably from an older coal or peat seam that eroded during the Namurian C whereas the coal itself is of the Namurian A or B. All features of primary coal are well preserved. No significant loss of water-soluble compounds, good preservation of miospores, and absence of oxidation signs in petrography suggest low influence of weathering at the surface, i.e. relatively short time from clasts erosion to their deposition within sand beds. This also means short transportation distance and rather rapid burial.

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**References**


