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PETROLOGICAL AND ORGANIC GEOCHEMICAL STUDY OF THE HIGH RANK COAL FROM THE VRŠKA ČUKA BASIN (SERBIA)

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Lower Jurassic coal-bearing series from the Vrška Čuka Basin (Eastern Serbia) were studied for their organic petrological and geochemical characteristics. Channel coal samples from the Avramica underground mine show low to high vitrinite (17.7-76.8 vol %; av. 59.6 vol %), moderate to higher inertinite (11.6-41.7 vol %; av. 23.2 vol %), low liptinite (0.1-4.6 vol %; av. 1.1 vol %) and low to moderate mineral matter content (2.5-38.5 vol.%; av. 16.1 vol %). Collotelinite is the most abundant vitrinite maceral, while collodetrinite, vitrodetrinite and corpogelinite are less abundant. Telinite and gelinite are present in low amounts. Liptodetrinite is the most abundant liptinite maceral with low content of sporinite, resinite, cutinite and exsudatinite. Semifusinite and fusinite are the most abundant inertinite macerals with variable amount of inertodetrinite, macrinite, and micrinite content. Carbonate and pyrite are the most common minerals, while contents of clay, quartz and other minerals are low. Measured vitrinite reflectance ranges from form 2.27±0.05 % to 2.32±0.05 % (av. 2.29±0.05 %) and confirms high rank of studied coals.

Total organic carbon (TOC) content varies in wide range from 23.9 % to 86.8 %. Total sulphur is low (0.3 %) to high (6.0 %). Content of extractable organic matter (EOM) is low (0.7–1.5 mg/g TOC). EOM is dominated by polar compounds (41-55 %). Aliphatic fractions of studied coal samples consist of *n*-alkanes, diterpenoids, hopanoids, steroids and isoprenoids. The main constituents of aromatic fractions are polycyclic aromatic hydrocarbons (PAHs) and their methylated counterparts, diterpenoids, sulphur-containing PAHs, and benzohopanes.

The presence of pimarane, phyllocladane and aromatic diterpenoids with abietane skeleton (simonellite, retene) indicates contribution of conifer families to the precursor OM. Detection of pimarane and 16α(H)-phyllocladane in such mature samples suggests their good preservation, that can be attributed to absence or very low amount of clay minerals, which catalyze their aromatization and/or deposition of OM in reducing environment, as indicated by low pristane/phytane ratio (<0.54). Carbon isotope composition ($\delta^{13}C$) of individual diterpenoids ranges from –24.0 to –26.7 ‰, which is similar to those reported in low rank coals, implying that $\delta^{13}C$ signatures are preserved even at anthracite stage. Phenanthrene and methylphenanthrenes, which are the most abundant compounds in aromatic fractions, exhibit very similar $\delta^{13}C$ values with retene, confirming precursor-product relationship. Dibenzothiophene derivatives are enriched in ^{13}C in relation to phenanthrenes up to 1.5 ‰.

n-alkane distributions in all samples dominate by mid-chain (C_{21}-C_{25}) homologues. $\delta^{13}C$ values of *n*-alkanes (C_{18}-C_{29}), in range from –27.9 to –30.4 ‰, exhibit almost no variations or slight decrease with increase of carbon chain length. $\delta^{13}C$ of C_{27} and C_{29} *n*-alkanes imply a dominant carbon source from C_3 higher plants (O'Leary, 1981).

Distributions of regular C_{27}-C_{29} steranes are characterized by relatively high percents of C_{27} and C_{28} steranes (21.5-35.1 % and 21.0-30.6 %, respectively). Although maceral compositions do not indicate any impact of algae, occasional marine intrusion or post-depositional marine influence, is documented by occurrence of marine plant *Posidonia bronii,* Brachiopods and Cephalopods in the overlying sediments (Đurić, 2022), as well as by abundant sulphur-containing PAHs. Changes in depositional environment, probably caused by tectonic activity, and changes in the hydrological regime are reflected through significant variations in TOC and sulphur contents.

Maturity indices based on steranes and methylphenanthrenes do not show correlation with measured vitrinite reflectance. Conversely, the calculated vitrinite reflectance (% R_o) based on methyldibenzothiophene ratio in range 1.91-2.37 % is consistent with the measured one.

References:

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