

## THE ORGANIC GEOCHEMICAL, PETROGRAPHICAL AND PALYNOLOGICAL COMPOSITION OF COAL FROM THE KOVIN DEPOSIT (SERBIA)

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The organic geochemical, petrological and palynological study was performed on lignite coal samples from the Kovin mine, Kovin deposit, Serbia. The Kovin coal deposit is located around 50 km east from Belgrade and is divided in two fields: western – field "A", and eastern - field "B". It is a part of the "Banat-Morava" depression, which consists of clastic sediments of Sarmatian (Middle Miocene), Pannonian and Pontian (Upper Miocene) age. These sediments transgressively and disconformly overlie metamorphic complex of the Serbo-Macedonian mass. Coal-bearing Pontian sediments are made up of loosely bounded sand with three coal seams (upper, I-Ib; middle, II; lower III). Mean random huminite reflectance of coal from Kovin basin is  $0.30 \pm 0.03$ .

The nineteen coal and one carbonaceous clay core samples were collected from different parts of the I-Ib coal seam in the near-shore parts of the "A" field. For the organic geochemical analyses, the pulverized coal samples were Dionex ASE extracted using dichloromethane as a solvent. The asphaltenes were precipitated and the remainder was separated into three fractions using liquid chromatography over silica gel. The saturated hydrocarbons were then analyzed by GC-FID and GC-HRMS (MAT95S). Maceral analysis was performed on a LEITZ DMLP microscope, at normal and ultraviolet reflected light, using the oil immersion. Palynological analyses were performed on thin sections.

The *n*-alkane fraction comprises saturated hydrocarbons in the C<sub>15</sub>-C<sub>31</sub> range, with an odd-over-even predominance. Distributions of the *n*-alkanes from the Kovin lignites revealed that long-chain (*n*-C<sub>25-33</sub>) compounds dominate the alkanes – with varying degrees of average chain length. Acyclic isoprenoid hydrocarbons are minor constituents in the aliphatic fraction. The major biomarkers in all samples from Kovin deposit are diterpenoids. They were identified as fichtelite, norpimarane, isophyllocladane, sandaracopimarane, isopimarane, phyllocladane, abietane and dehydroabietane. 16 $\alpha$ (H)-phyllocladane is the major compound

in all samples. Some demethylated diterpanes of pimarane class (e.g. norpimarane) and isopimarane also occur in higher amounts. Isophyllocladane, sandaracopimarane and fichtelite are found in small amounts, while abietane and dehydroabietane are present in very small amounts. Coal from the Kovin deposit is characterized by occurrence of  $\beta\beta$ - and  $\alpha\beta$ - hopanes. The predominant hopanoid in most samples is the hop-17(21)-ene.

Vertical variations of petrographic composition and palinospectres indicate four distinct zones: I. Intermediate swamp zone, with high amounts of atrinite and partially densinite, telohuminitite, rezinitite and suberinite (pollen grain *Myrica*); II. The presence of fern and swamp forests (*Taxodiaceae*, *Cupresaceae*, *Sequoia*, *Nyssa* et al.), indicate the well-developed wet forest swamp environment. High amount of textinite and partly ulminite prevail in the coal from this zone; III. The reed marsh zone is related to drier parts of the moor, and is represented by ferns (*Polypodiaceae* and *Myrica*). Textinite, together with high amounts of atrinite and densinite, prevail in coal from this zone; 4. Forests around the moor zone consist of: *Carya*, *Salix*, *Platanus*, *Betula*, *Fagus*, and *Luquidambar*. Coal from this zone is rich in textinite, accompanied by inertinite and densinite. Relatively rare coniferous pollen assemblages (*Abies*, *Pinus*, etc.), indicate the presence of hilly region in the vicinity of moor.

The results of organic geochemical, petrological and palynological investigation suggest that coal-forming plants in the Kovin deposit were mostly gymnosperms (conifers). High amount of phyllocladane-type diterpenoids (16 $\alpha$ (H)-phyllocladane) indicates that coal forming plant were conifer families Taxodiaceae, Podocarpaceae, Cupressaceae, Araucariaceae, Sciadopityaceae, Phyllocladaceae (Otto and Wilde, 2001), while higher amounts of isopimarane and norpimarane suggest Pinaceae, Taxodiaceae, and Cupressaceae (Sukh Dev., 1989; Otto and Simoneit, 2001).

## REFERENCES

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