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CHARACTERISATION OF SUBLITHOTYPES OF XYLITE-RICH COAL – IMPLICATIONS FROM PETROGRAPHIC AND BIOMARKER ANALYSIS

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Composition and characteristics of lignite, which directly influence its applicability, depend on the sources of organic matter (OM) and the degree of transformation during peat genesis and diagenesis. To provide evidences about the precursors of lignite OM and its digenetic alteration, petrographic (maceral) analysis and biomarker composition are commonly used. Although numerous petrographic and biomarker studies have been performed on whole lignite samples (e.g. Bechtel et. al., 2007), to the best of our knowledge detailed investigation of lignite sublithotypes has not been accomplished. Therefore in this study maceral compositions and biomarker distributions in sublithotypes of xylite-rich coal (pale yellow, dark yellow, brown and black) originating from the most important Serbian lignite basins, Kolubara and Kostolac were investigated in detail. Moreover, based on petrographic properties, the influence of sublithotypes of xylite-rich coal (SXCs) on rational utilization of lignite was also considered.

Lignites were manually separated into SXCs under the stereo microscope. The maceral analysis was performed in monochromatic and UV light illumination on 500 points. Elemental analysis was carried out to determine the contents of total organic carbon (TOC), sulphur, and nitrogen. Quantitative biomarker composition was obtained by gas chromatography-mass spectrometry.

Content of TOC was generally uniform (55-60 %) in all SXCs. Sulphur content does not show any relationship with the xylite sublithotype. It is low in Kolubara samples (< 0.9 %), while Kostolac samples have higher sulphur content (1.09-2.30 %), suggesting slightly reducing and/or more alkaline environment during peatification in Kostolac than in Kolubara Basin. The yield of extractable OM (bitumen) ranged from 15.31 to 273.24 mg/g TOC and decreased in the following order pale yellow SXC > dark yellow SXC > brown SXC > black SXC in both basins.

All samples are dominated by diterpenoids, followed by non-hopanoid triterpenoids and *n*-alkanes. Other hydrocarbon constituents of extractable OM are hopanoids, sesquiterpenoids, steroids and isoprenoids. Proportion of diterpenoids decreased in order: pale yellow SXC > dark yellow SXC > brown SXC > black SXC, whereas proportions of all other biomarkers increased in opposite trend, with exception of sesquiterpenoids which showed slightly higher proportion in brown SXC than in black SXC from both basins. Conifers had significant impact to the precursor OM of all samples, predominating over angiosperms. Contribution of gymnosperm vs. angiosperm vegetation decreased in order: pale yellow SXC > dark yellow SXC > brown SXC > black SXC, which resulted in reduce of tissue preservation. From the identified sesqui- and diterpenoids (eudesmane, cuparene, 16α(H)-phyllocladane, pimarane, totarane and hibaene) a predominant role of the conifer families Cupressaceae, Taxodiaceae and Pinacea are concluded in all sublithotypes of xylite-rich coal (Otto and Wilde, 2001). Abundance of non-hopanoid triterpenoids with lupane skeleton indicates that impact of Betulacea family decreased from yellow to brown and black SXC (Regnery et al., 2013).

Although all SXCs showed similar distributions of *n*-alkanes, characterized by the predominance of odd long-chain homologues (C_{27}-C_{31}), certain differences in *n*-alkane patterns were observed. The ratio of short-chain (C_{14}-C_{20}) to long-chain (C_{26}-C_{33}) *n*-alkanes decreased in order: pale yellow SXC > dark yellow SXC > brown SXC > black SXC. In addition, pale yellow SXC from both basins showed the lowest Carbon Preference Index (CPI) values. This result could be attributed to the lower input of fatty acids from epicuticular waxes. Namely, these acids predominantly contain even numbers of carbon atoms in a molecule and by decarboxylation they produce odd-carbon-atom *n*-alkanes. The lower contribution of epicuticular waxes to pale yellow SXC is consistent with the lowest content of liptinite macerals and total *n*-alkanes to this sublithotype.

Regarding to hopanoid distribution pale yellow SXC differs mostly from other SXCs having the lowest proportion of C_{31} 17α(H)21β(H)22(R)-hopane and elevated proportions of C_{27} hop-17(21)-ene, C_{27} 17β(H)-22,29,30-trisnorhopane and C_{30} hop-17(21)-ene. This result suggests that pale yellow XT mostly distinguishes according to microbial populations taking part during peatification.

The observed differences in precursor OM and diagenetic transformations are also reflected in petrographic characteristics and utilization properties. The content of total huminite macerals increased in order black SXC < brown SXC < dark yellow SXC < pale yellow SXC, whereas contents of total liptinite and inertinite macerals showed opposite trend. The predominant huminite macerals in all SXCs are textinite or ulminite. SXCs differ according to the textinite/ulminite ratio which notably decreased in order: pale yellow SXC > dark yellow SXC > brown SXC > black SXC. Regarding to composition of liptinite macerals SXCs mostly differ according to resinite/liptodetrinite and resinite/suberinite ratios, which are higher in yellow than in brown and black SXC. Tissue Preservation Index (TPI) and Vegetation Index (VI) increased from black and brown to dark and pale yellow SXC, whereas Gelification Index (GI) and Groundwater Index (GWI) showed opposite trend. The obtained result confirms that contribution of arboreal vegetation vs. impact of herbaceous peat-forming plants played an important role in differentiating of investigated SXCs.

Maceral compositions indicate that brown and black SXC have better grinding properties than dark and particularly pale yellow SXC. Brown and black SXC have poor properties for coal briquetting, whereas dark and especially pale yellow SXC positively influences this process. Suitability for gasification (Bielowicz, 2013) decreased in the following order: pale SXC pale yellow SXC > dark yellow SXC > brown SXC > black SXC.

References

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