ORIGIN OF OILS AND SOURCE ROCKS CHARACTERIZATION OF THE TURIJA-SEVER OIL FIELD (SE PANNONIAN BASIN, SERBIA)

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The Banat Depression is the most prolific production area of the southeastern part of the Pannonian Basin, located in Serbia. Previous investigations were mostly related to local depressions: Banatsko Aranđelovo, Srpska Crnja and Zrenjanin (Mrkić at al., 2011). However, recent drilling discovery of new wells in the Turija-Sever oil field (Srbobran local depression) draws more attention to this area, which has not been studied in detail so far. Therefore, in this study, oils from the Turija-Sever oil field were investigated in order to understand their genetic relationships, and to define the depositional environment, thermal maturity and geologic age of the corresponding source rocks, which are still unknown. After precipitation of asphaltenes, oils were separated into saturated, aromatic and polar fractions. Saturated and aromatic fractions were analyzed by gas chromatography-mass spectrometry.

n-Alkanes are predominant compounds in the total ion chromatograms of saturated fractions of all samples, showing that Turija-Sever oils are not biodegraded. Equivalent abundances of long- and short-chain *n*-alkanes, suggest a mixed aquatic-terrestrial origin. The uniform distributions of regular C_{27}-C_{29} αα(R) steranes and similar values of oleanane (OI = oleanane x 10/(oleanane + C_{30} αβ-hopane)) and gammacerane indexes (GI = gammacerane x 10/(gammacerane + C_{30} αβ-hopane)) support the previous assumption. Carbon Preference Index is ≈ 1 in all samples. However, slight differences in distributions of *n*-alkanes are observed. Oils from the north part of the field are characterized by Low vs. High Carbon Preference Index (LHCPI) values higher than 1, whereas other oils have LHCPI < 1. This result can be attributed to a difference in maturity and/or to aquatic organic matter (OM) input. Since maturity ratios do not show substantial difference in maturity (see later), slight differences in contribution of terrestrial and aquatic OM can be concluded. Marine C_{30} steranes (4-desmethylsteranes) are present in low concentrations. This indicates OM deposition under restricted saline lagoonal conditions or brackish environment, which is supported by values of C_{26}/C_{25} tricyclic terpane ratio close to or lower than 1. The presence of oleanane in all samples implies a contribution of angiosperm plants to the precursor OM.

According to the values of pristane to phytane (Pr/Ph) and C_{35}αβ(S)/C_{34}αβ(S)-homohopane ratios, as well as the ratio of phytanylbenzene to sum of *n*-alkylbenzenes, two groups of oils can be distinguished. Precursor OM of the first group was deposited under reducing conditions, whereas OM of the second group was deposited in transitional to dysoxic environment. The presence of isorenieratane and its catagenetic products unambiguously indicates the photic zone of anoxia (Koopmans et al., 1996). The stratification of water column is also supported by relatively high values of GI > 1 and the presence of alkylated 2-methyl-2-(4,8,12-trimethyltridecyl)chromans (MTTCs), which were detected in all samples. A predominance of 5,7,8-trimethyl-MTTC over 5,8-dimethyl-MTTC, 7,8-dimethyl-MTTC and 8-methyl-MTTC, associated with the values of MTTC ratio (MTTC = 5,7,8-trimethyl-MTTC/ΣMTTCs) in 0.50 to 0.60 range, indicates deposition of OM in a restricted saline or brackish environment, consistent with low concentration of C_{30} 4-desmethylsteranes. Factually, oils from the first group originate from a reducing environment, have LHCPI < 1, sterane/hopane ratio > 1, higher amounts of isorenieratane and its derivatives, and are characterized by the presence of long-chain *n*-alkylnaphthalenes, which imply slightly greater contribution of algal OM and its better preservation under the higher water level.

Based on the values of OI, C_{28}/C_{29} regular steranes ratio and C_{30} moretane to C_{30} hopane ratio, Tertiary age of Turija-Sever oils is obvious.

Hopane maturity ratios C_{30}moretane/C_{30}hopane and $C_{31}\alpha\beta(S)/C_{31}\alpha\beta(S+R)$, sterane maturity ratios $C_{29}\alpha\alpha(S)/(\alpha\alpha(S)+\alpha\alpha(R))$ and $C_{29}\beta\beta(R)/(\beta\beta(R)+\alpha\alpha(R))$ and maturity parameters calculated from distributions of dimethylnaphthalenes, trimethylnaphthalenes and methylphenanthrenes indicate uniform maturity and generation of Turija-Sever oils in an early stage of oil window. Calculated vitrinite reflectance (Rc) ranges from 0.60 % to 0.65 %.

Assuming that oil, in the investigated part of the Pannonian Basin, was generated at a maturation level corresponding to present day burial depths (Marović et al., 2002), source rocks depths were estimated using a diagram that relates depth, vitrinite reflectance and regional geothermal gradient. Based on Rc calculated in this study, an annual mean surface temperature of 11 °C and an average geothermal gradient of 51 °C/km in the region, plotted in the diagram of Suggate (1998), a source rocks depth interval of 2300 m to 2500 m and a temperature interval of hydrocarbons generation of 128.3 °C to 138.5 °C were estimated. On the other hand, using the equation proposed by Kostić (2010; T = ln(Rr/0.2096)/0.085) and the Rc values observed in this study, the temperature interval of oil generation was estimated to be in the 123.7 ºC to 133.1 ºC range.

In the conclusion, the oils from the Turija-Sever oil field are generally similar and probably belong to the same genetic type. They originate from source rocks deposited in reducing to dysoxic redox conditions, with OM originating from mixed marine/terrestrial sources. Slight differences among oils are reflected through certain lower contribution of algal OM to oils from the northern part of the field and/or its faster degradation under dysoxic conditions. Oils were generated from source rocks in an early stage of oil window, corresponding to vitrinite reflectance between 0.60 and 0.65 %. Source rocks are of Tertiary age. Estimated source rocks depth interval and temperature interval of oil generation correspond to 2300 m – 2500 m and 124 °C – 138 °C, respectively.

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