P32-MO

SOURCE ROCKS WITHIN THE SEDIMENTARY SEQUENCE OF EASTERN PART OF THE BLACK SEA REGION

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Eastern part of the Black Sea region (its largest part is situated within the marine part of the Black Sea) is weakly geochemically studied nowadays. At the same time its HC potential is undoubtedly high. This could be proved by multiple oil, gas and bitumen shows and small oil and gas fields determined within Mesozoic-Cenozoic rocks of the southern slope of the Great Caucasus (Russia and western part of Georgia). Gas (CH_4 and its homologues, CO_2) and oil seeps (oxidized without light fractions) are revealed in bottom shelf sediments and mud volcanic emissions. Multiple oil, gas and hydrate displays are observed on the Turkish shelf and continental slope.

Mesozoic-Cenozoic rocks from different outcrops of Western Caucasus, mud volcanic emissions on the Black sea marine part have been object of investigation. For comparison geochemical data on even-aged Azov-Kuban basin were also taken. Obtained results allowed distinguishing main source strata within the stratigraphic sequence: Lower-Middle Jurassic (undivided J_{1-2}) and Middle Jurassic (J_2), Lower Cretaceous, Upper Eocene and Oligocene-Miocene.

Jurassic deposits are represented by terrestrial dark-gray predominantly clayey sediments. Geochemical characteristics vary quite sharply: TOC=0,12-3,25% (mode–0,78%), β=1-10% (mode 2-3%), (S_1+S_2) = 0,4-1,8 $^{kg\ HC}/_{t\ rock}$, HI=60-275 $^{mg\ HC}/_{g\ TOC}$. J_2 deposits are characterized by higher values; n-alkane maximum lies on C_{16}-C_{18}, Ph is prevailing under Pr, sterane distribution C_{27}:C_{28}:C_{29} = 41:27:32 (J_{1-2}) and 31:37:32 (J_2) is characteristic for deposits of normally marine basin. Main bio-producer is phytoplankton, although input of terrestrial OM is evident: C_{29} is prevailing sometimes, C_{28}/C_{29}=0,5-1. Rarely met 28-trisnorhopane is present in bitumen. High density of clayey components (2,53-2,62 g/cm^3), Tmax (432-460^{o}C and higher), alkane (Pr/nC_{17}=0,1, Ph/nC_{18}=0,1), sterane (K^1=S/(S+R)=0,4-0,56, K^2=ββ/(αR+ββ)=0,6-0,8, K^3=ββ/[α(S+R)+ββ]=0,6-0,7, C_{29} [$^{dia}/_{reg}$]=0,2-0,9) maturity index testify that rocks mainly passed the “oil window” zone. Most mature are J_{1-2} deposits.

Aptian-Albian claystones are related to Lower Cretaceous source rocks: TOC=0,7-2,8%, (S_1+S_2)=0,4-1,9 $^{kg\ HC}/_{t\ rock}$; HI=36-206 $^{mg\ HC}/_{g\ TOC}$. Sharp prevailing of phytogenic initial OM is determined by high values of nC_{18}/nC_{28} – 4,8-5,3 and low Pr/Ph=0,6. Sterane distribution (C_{27}:C_{28}:C_{29}= 40:23:37, C_{27}/C_{28}=1,4-1,8, C_{28}/C_{29}=0,6) is typical for OM deposited in a marine basin with marine phytoplankton main bio-producer. Rocks reached the level of

"oil window": Tmax 437-452°C (mode - 440°C), sterane maturation indexes - K^1=0,45-0,5, K^3=0,7; $^{dia}/_{reg}$ C_{29}=0,2-0,3; hopane indexes vary in wider ranges and do not always correspond to the transformation level of the observed deposits (M_{30}/Γ_{30}=0,1-0,8, Ts/Tm=0,5-1,8).

Eocene sequence is characterized by presence of flysch predominantly carbonate-claystone Navagin suite with shale laminae. Shales are defined by TOC=7-9,8%, HI=396–790 $^{mg\ HC}/_{g\ TOC}$, (S_1+S_2)=37,4-56,2 $^{kg\ HC}/_{t\ rock}$, whereas background values in claystones are much lower: TOC=1,50-1,57%, (S_1+S_2)=3,8-3,9 $^{kg\ HC}/_{t\ rock}$; HI=235-239 $^{mg\ HC}/_{g\ TOC}$. Sterane composition C_{27}:C_{28}:C_{29}=(31-32):(19-31):(36-53), bi-modal n-alkane distribution point on continental input in initial OM. Maturity is not high: Ki=1-4,2, Tmax=429-432°C.

Oligocene – Lower Miocene dark-colored claystones-siltstones (Majkop series) are characterized by: TOC=0,38-1,87%, (S_1+S_2)=0,7-5,3 $^{kg\ HC}/_{t\ rock}$, HI=76-282 $^{mg\ HC}/_{g\ TOC}$. Low HI values are in contradiction with chemical, petrographic and facial characteristics of Majkop OM with planktonic marine algae initial material (dinoflagellates, cyanobacteria, green, diatomic algae). This could be connected with adsorption effect of montmorillonite and illite Majkop clays on low transformation stages (Tmax=431-437°C) that is lowering HI values. Pyrolysis of Majkop rocks and pure kerogens for Precaucasus proved this effect and showed that Majkop deposits possess high source rock potential OM (HI 650-750 $^{mg\ HC}/_{g\ TOC}$).

Composition, variations in distribution character of biomarkers of Majkop OM of Precaucasus region also testifies on marine predominantly algal composition of initial OM with different continental input. Deeper facies (central part of Azov-Kuban basin) are characterized by prevailing of uni-modal n-alkanes distribution with maximum on C_{17}-C_{19}, or bi-modal with maximum on C_{19}-C_{21} and C_{27}-C_{29}, Pr/Ph=0,7-3,7; sterane distribution C_{27}:C_{28}:C_{29}=46:21:33, hopane distribution (m/z=191) C_{27}:C_{29}:C_{30}:C_{31}=14:16:27:43 that is stipulated by extremely low OM maturation in the samples, although bitumen with prevailing of C_{30} hopane are met. All studied samples contain sterane C_{30} synthesized by marine algae *Chrysophyta* with low concentrations of oleananes and cheilantanes (tri-/penta- <0,01-0,07).

Except main source suites the sedimentary sequence possesses rocks with predominantly gas source potential – such as Upper Jurassic, Neokomian, Upper Cretaceous, Paleocene-Eocene rocks containing predominantly humic type of kerogene on different catagenetic transformation levels. Middle Miocene – Quaternary rocks are characterized by: onshore - TOC=0,35-1,11% (mode – 0,71%), III type of OM (HI=147 $^{mg\ HC}/_{g\ TOC}$), Tmax – 434°C, R^o 0,55-0,65 %; quality and transformation level of OM within marine part of the basin are increasing and the rocks can take part in oil generation.