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Research Article

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Oils and Organic Matter of Oligocene-Miocene Rocks of Talysh (Azerbaijan): Characteristics and Correlation

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Abstract First results are presented of isotopic-geochemical characteristics for surface oil seeps from Agdash and Gasanly localities and for organic matter of Oligocene-Miocene source rocks from outcrops in the Talysh region of Azerbaijan. Varying degrees of biodegradation were established leading to distinct chemical compositions. Similarities in carbon isotope signatures together with biomarker analyses permit a genetic affinity comparison. Correlation of oil source rocks revealed that the oil seepages are products of Miocene deposits.

Keywords Oil, Organic matter, Source rocks, İsotopic-geochemical characteristics, Correlation, Talysh, Azerbaijan

Introduction

Azerbaijan is represented geologically by the intermountain Kura-South-Caspian basin fringed to the north by the Greater Caucasus mountain chains and by the Lesser Caucasus and Talysh to the south (Fig.1).

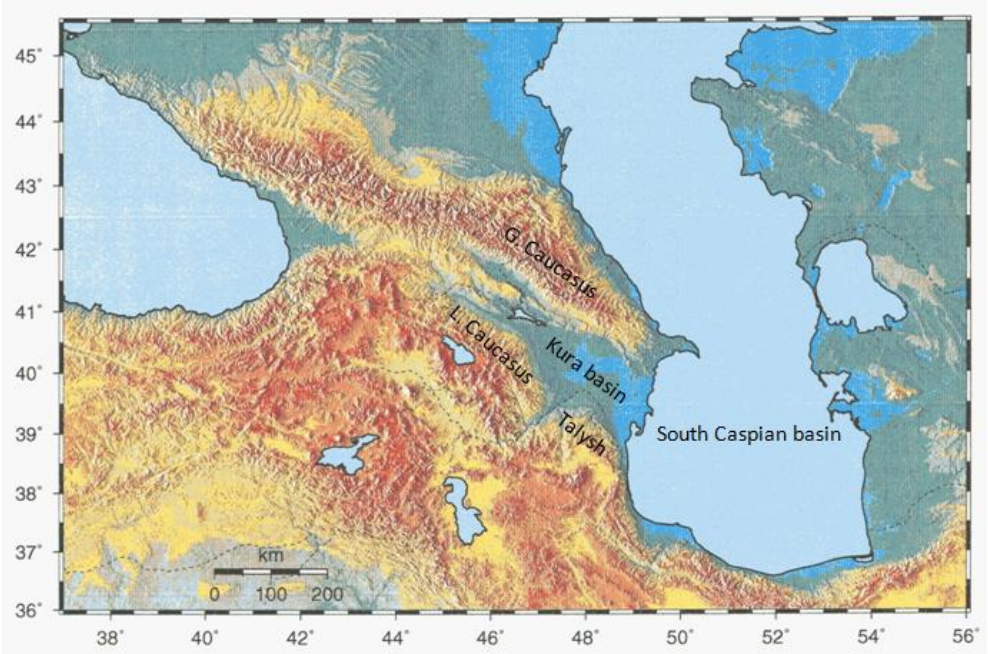

Figure 1: Locations of main geological structures in Azerbaijan

The geological structures together with the common aspectsof their development history produce some distinct geologic features. On the SE termination of the *G. Caucasus* mud volcanism is widely developed, while it is absent in the Talysh region. Geochemically characteristics of fluids in Talysh are diversified so that all types of natural gas manifestations have been encountered whereas in the SE termination region of the *G. Caucasus* only methane gas occurs [1]. In contrast to the *G. Caucasus* Talysh is distinguished by facies characteristics of Paleogene strata. While Eocene deposits on *G. Caucasus* are composed solely of sedimentary facies, in Talysh coeval sediments occur both in sedimentary and volcanogenic facies. Facies distinctions between the regions are present also within Oligocene-Miocene sediments [2-3].

In stratigraphic sections of the Kura-South Caspian basin Oligocene – Miocene deposits are recognized by more favourable hydrocarbon (HC) potential [4-5]. Geochemically these deposits are characterized based on outcrop studies at the south-east end of the Great Caucasus. Mountain outcrops within Talysh are represented mainly by Oligocene and Eocene deposits and very few by Miocene deposits. HC potential of the Eocene and Maykop Talysh deposits refers to rocks with low content of organic matter (OM) where a terrigenous constituent prevails. Due to Eocene volcanism the OM of Talysh Paleogene rocks is thermally more mature [2].

Oil seepages have been found on the northern–western slope of Talysh mountain [6]. However exploration wells did not reveal commercial hydrocarbon accumulations. The composition of oils in Talysh has not been studied to date and the oil source is still debatable.

In this connection results of studies of oil seep samples from the nearby villages Agdash and Gasanly (Talysh region) and prediction of their potential source is of great scientific and practical importance.

Study Methods

Oil and rocks extracts samples were studied by integrated gaschromatographic, mass spectrometric (biomarker) and isotopic methods. The stable isotopic composition of rock extracts and oils were analysed using VG 602C and CJS Sigma mass spectrometers.

To determinate type of source material optical examination of organic matter in rock samples was also used. Results of analyses were used for correlations of oil – oil and of oil – rock to define a potential stratigraphic confinement for the oil source(s).

Results and Discussions

Isotopic – geochemical characteristics of oils and rocks

Some main parameters of chromatographic and isotopic analyses of oils and rocks extracts are given in Table 1.

Table 1: Isotopic – geochemical parameters of oils and rock extracts from Talysh

Studied object	Density of oil (API)	Sulphur, (%)	Saturated HC, (%)	Aromatic HC, (%)	(NSO)(%)	Pr/Ph	Pr/n-C_{17}	Ph/n-C_{18}	δ^{13}Csat.	δ^{13}Carom.
Agdash (oil)	26.8	0.11	81.4	16.1	2.5	1.64	1.50	0.94	-26.5	-25.4
Gasanly (oil)	15.0	0.29	51.4	25.0	23.5	-	-	-	-26.3	-25.7
Yardymly (rock)			44.3	29.6	26.4	4.81	2.16	0.47	-26.45	-24.6
Dashkend (rock)			49.6	26.8	23.6	4.47	1.45	0.32		

Table 1 shows considerable biodegradation of Gasanly oil which is reflected in the high content of heteroelements (NSO) and correspondingly high gravity (see Table 1). This result can be seen more clearly by comparing the chromatograms of normal and iso-alkanes of Agdash and Gasanly oils (Fig. 2a).

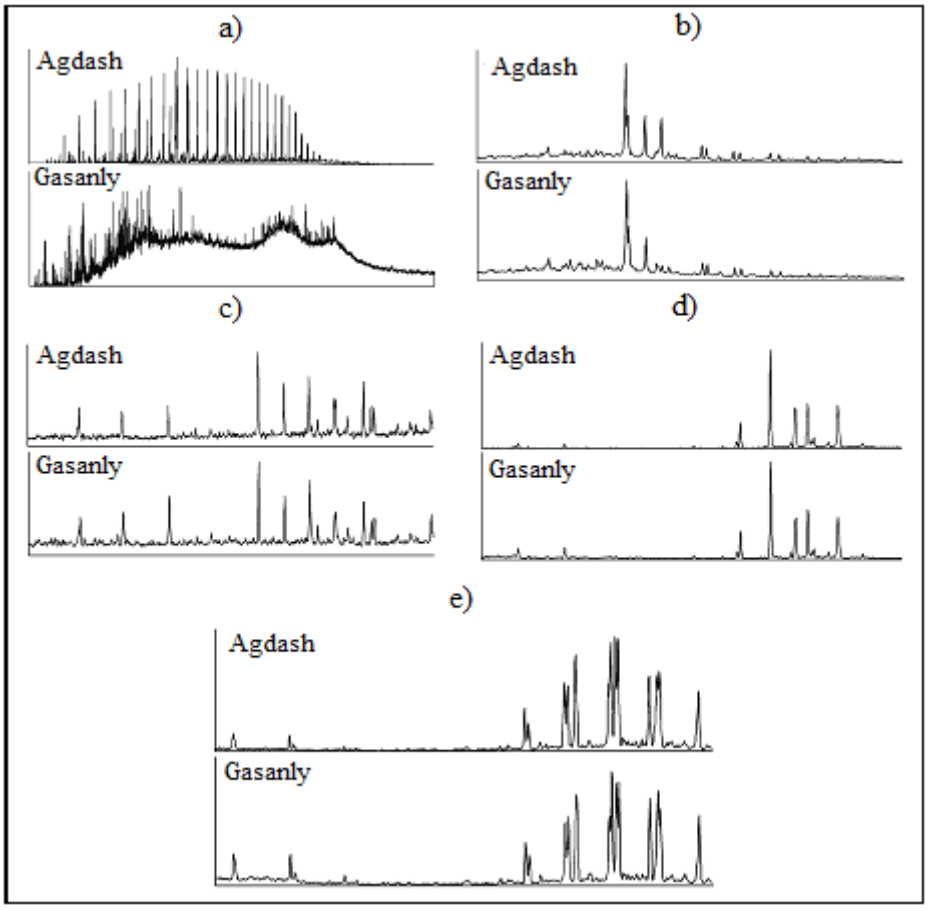

Figure 2: Distribution of HC compounds in Agdash and Gasanly oils: a) normal and iso-alkanes; b) dimethyl hopanes; c) tricyclic terpanes; d) triaromatic steranes; e) monoaromatic steranes.

The chromatograms show that Agdash oil is not subject to secondary biochemical changes while the typical naphthene "bulge" is well defined for the Gasanly oils.

Despite the fact that the studied oils samples differ considerably in their various degrees of preservation, the isotopic composition of carbon and high molecular biomarkers preserved the primary properties. Based on carbon isotopic composition (ICC) the studied oil samples are similar genetically and probably have a single source. This suggestion can be supported by results of biomarker analyses with different fragments of oils being very similar (Figure 2 b, c , d, e).

Oil –source rock correlation

Unfortunately data for oil – rock correlation are very restricted: there are only two analyses of oil seeps and two analyses of Oligocene – Lower Miocene rocks (analogue of Maykop series) from outcrops on Talysh mountain (nearby Yardymly city and Dashkend village).

Comparison of geochemical parameters for oils and rocks (see Table 1) shows that both OM of rocks and Gasanly oil are characterized by high concentrations of heterocomponents. This fact, and also very high values of the prystane – phytane ratio (Pr/Ph), allow one to conclude that accumulation of OM occured by prevailing oxidizing geochemical conditions and, therefore, only ICC of OM can be used as a reliable correlative parameter. Based on this indicator the genetic relationship is noted despite the influence of biodegration processes on the chemical composition of oils and rocks.

Correlation of the percentage distribution of normal HC (C_{14}-C_{35}) in Agdash oil, in extracts of Oligocene-Lower Miocene rocks of Talysh and also Miocene rock-ejecta from the Bozdag-Gyuzdek mud volcano (MV) indicates a definite correlative connection between oil (Agdash) and rock extract from Bozdag-Gyuzdek MV (Fig. 3).

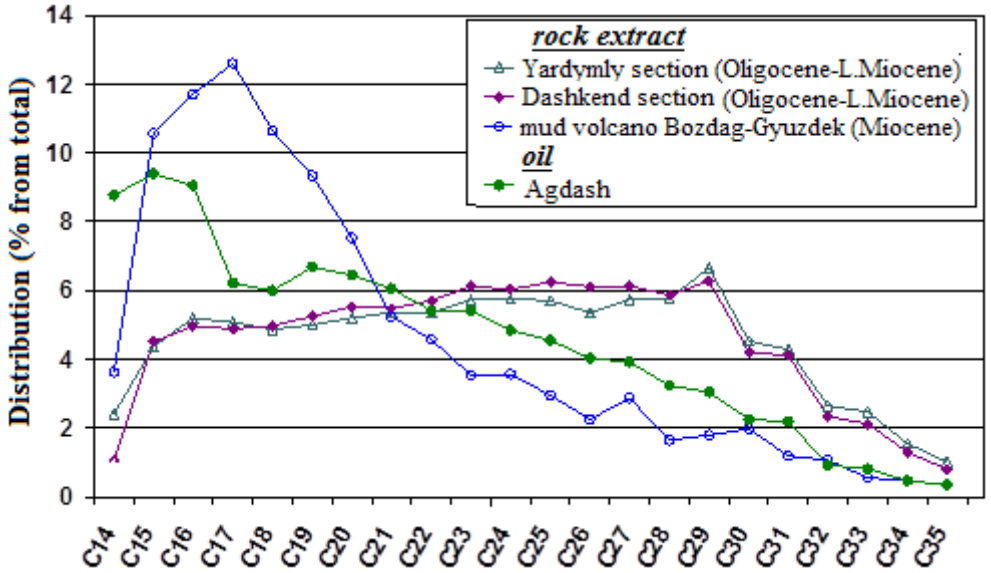

Figure 3: Distribution of normal HCs in oil (Agdash) and in extracts of Oligocene-Miocene rocks from Talysh and also erupted rock from the Bozdag- Gyuzdek mud volcano.

Predicting the potential stratigraphic source of Talysh oils was achieved using a diagram of saturated and aromatic fraction of oils and extracts of rocks from Shamakhy-Gobustan region and Baku archipelago as given in [1].

Positions of Talysh oil values (Fig. 4) allows one to conclude that these oils are not derived from an Oligocene source but rather from younger Miocene rocks (including the upper division of the Maykop Series).

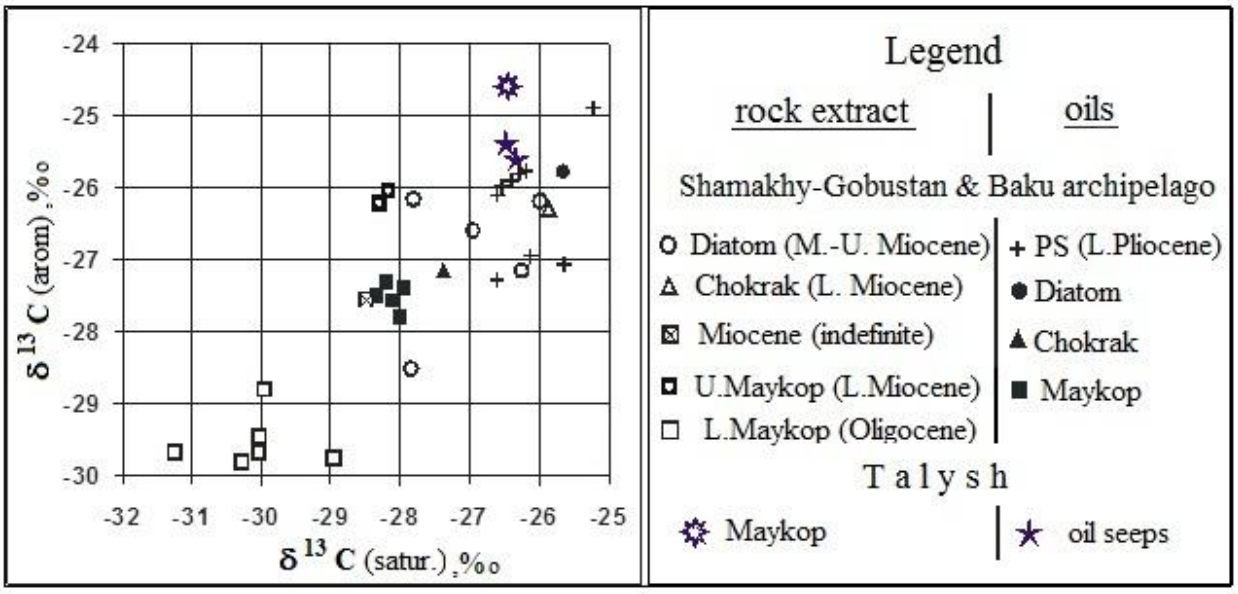

Figure 4: Correlation of carbon isotope composition for saturated and aromatic fractions of oils and extracts from rocks for the Shamakhy-Gobustan region (SE end of G. Caucasus), Baku Archipelago (offshore SCB) and Talysh

Results of optical studies of OM quality for both Miocene and Oligocene rocks of Talysh showed a mainly continental origin (up to 60-75 %) (Fig. 5).

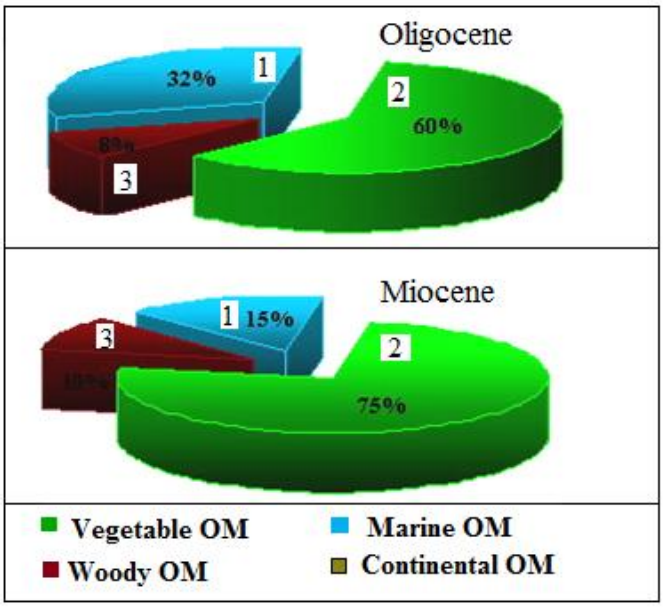

Figure 5: *Circular diagrams reflecting results of OM optical study of Oligocene and Miocene rocks from Talysh. Type of OM: 1 – marine; 2-4 – continental (2-vegetable; 3-woody; 4-vegetable/woody)*

Conclusions

Isotopic–geochemical characterization of oil seeps and OM of Oligocene-Miocene rocks from outcrops in the Talysh region of Azerbaijan and oil-oil, oil-rock correletaion were carried out from which one can conclude:

- organic matter from both Miocene and Oligocene rocks is essentially of continental origin;
- Miocne rocks have favorable potential for generation and accumulation of HCs (with predominance of gaseous HCs);
- Agdash and Gasanly oils differed by chemical composition caused by various degrees of biodegradation. However, the two oils have the same carbon isotope composition. This fact,together with results of biomarker analyses, allow one to to conclude the oils have a genetic relationship;
- results of rock–oil correlation permit one to identify the source of Talysh oil seeps being from Miocene deposits (including the upper division of Maykop series).

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