ON THE NATURE OF FLUIDS IN TEVRIZ GAS CONDENSATE FIELD, WESTERN SIBERIA

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We collected, analyzed and interpreted a large number of natural gas samples from petroleum accumulations in Western Siberia during many years of research. Based on the carbon isotopic composition of C_1-C_5, the investigated gases can be divided into three quite distinctive groups that also correspond to three main genetic types of oils (Goncharov et al. 2003, 2005, 2012).

The Tevriz gas-condensate field is located in the southern part the West Siberian basin. Carbon isotopic composition of C_1-C_3 components in the Tevriz field is very different from other gases in Western Siberia. Specifically, C_1-C_3 gases are significantly enriched in light isotope ^{12}C relative to the other studied gases from the basin (Fig. 1). On the other hand, methane has isotopic composition ($\delta^{13}C$ = -64.1‰, δD = -222 ‰) typical for gases located in shallow cool Cenomanian pools in the northern part of Western Siberia and formed, at least partially, from biodegraded oils (Milkov, 2010; Nemchenko, 2002). In contrast, Tevriz gas condensate field has pay zones in the Neocomian Achimov formation located at the depth of 2,200-2,300 m and temperatures 75-77°C. In addition, biodegraded and secondary microbial gases are usually relatively dry (C_1/C_{2+} > 100), but gas in the Tevriz field has 5-6% of C_{2+} gases.

According to Chung et al. (1988), C_1-C_5 hydrocarbons originated from one source must form a straight line in coordinates $\delta^{13}C$ versus 1/n (where n is the number of carbon atoms in the molecule). However, Figure 1 clearly shows that gases from the Tevriz field do not form a straight line on Chung's plot and therefore they have a mixed nature. Such mixing can explain the isotopic composition of methane. However, it is still unclear what caused the relative enrichment of ethane and propane in light isotope ^{12}C.

Ethane and propane abnormally enriched in light isotope ^{12}C were reported from a primary microbial gas field in the Gulf of Mexico (Milkov et al., 2007). However, microbial gas accumulations typically do not contain such high concentration of C_{2+} components as found in the Tevriz field.

Based on the molecular and isotopic composition of gases, we suggest that gas in the Tevriz field was generated mostly from organic matter at relatively low levels of thermal maturity. Mixing of this early mature gas with some more mature gas perhaps leaking from deeper reservoirs may explain the enrichment of methane in heavy isotope ^{13}C relative to the methane modeled based on the straight line extrapolation (Chung et al., 1998) (Fig. 1).

Molecular composition of C_{7+} hydrocarbons in condensates provide further information about the nature of petroleum accumulation in the Tevriz field. There are no signs of biodegradation. The ratio of pristane to phytane is 2.7. The ratio of methylcyclohexane to n-C_7 is 5.2, which is exceptionally high relative to other oils and condensates in the Western

Siberia (Fig. 2). Parameters Ki (1.7) and 4MDBT / 1MDBT (0.87) also indicate that the condensate has low maturity. Distribution of steranes suggests that the condensate was generated from marine organic matter and has low maturity (S / (S + R) Steranes (C29) = 0.24; ββ / (αα + ββ) Steranes (C29) = 0.31).

Condensate in the Tevriz field is significantly enriched in light isotope ^{12}C ($\delta^{13}C$ = -34.9 ‰). No such ^{12}C-enriched condensates have been found in the southern and south-eastern parts of Western Siberia before. Most condensates in this area have $\delta^{13}C$ more positive than -32 ‰.

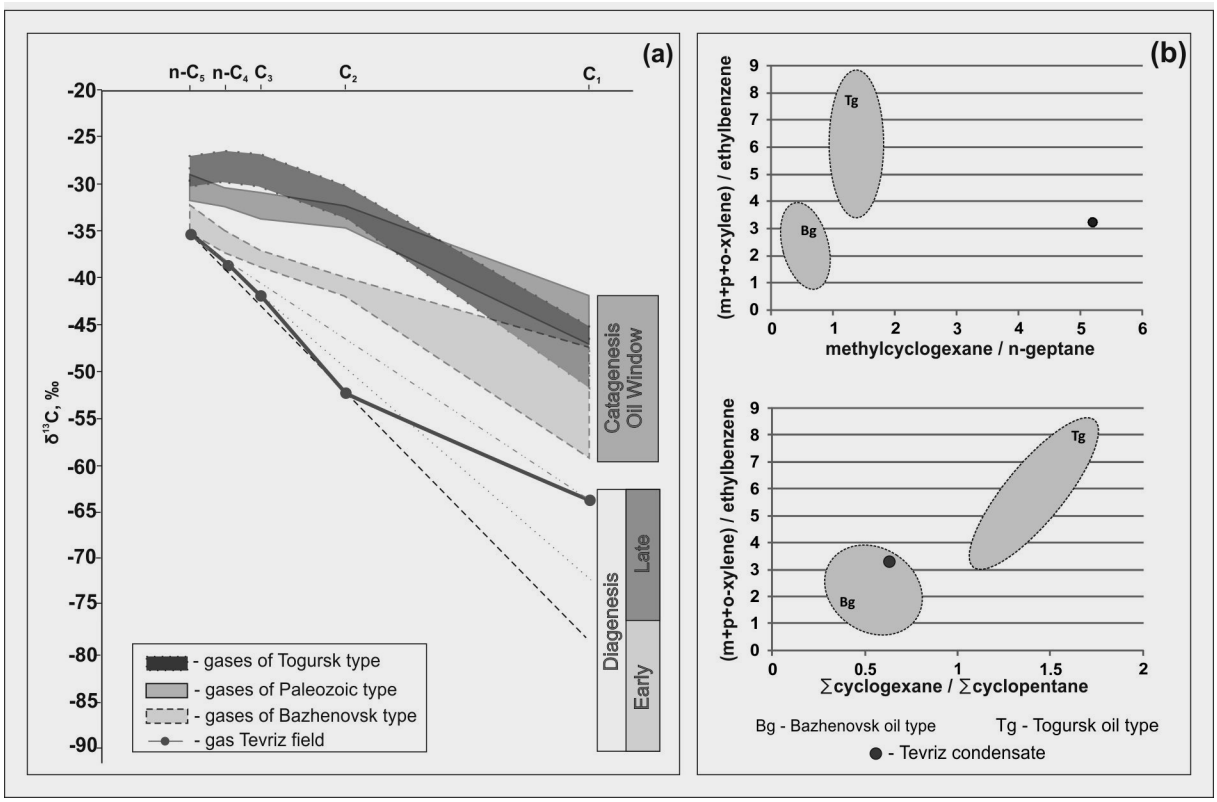

Figure 1. (a) Carbon isotopic composition ($\delta^{13}C$) of gas from the Tevriz field relative to other gases from south-eastern part of Western Siberia (Goncharov et al., 2012, with additions). (b) Molecular ratios for condensate from the Tevriz field relative to other oils and condensate in the south-eastern part of Western Siberia sourced from Bazhenov and Togur source rocks.

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