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**Organic Geochemical Society - Treibs Medal Lecture****Isotope organic geochemistry**

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Alfred Treibs was first to discover porphyrin in oil and identified it as a fragment of a chlorophyll molecule. This discovery was the starting point of developing of organic geochemistry. Presence porphyrins and isoprenoids and some other biomarkers in oil were believed to be strong indicator of its biological source. However some geologists based on geological evidence suggested that oil might have endogenous ("inorganic") origin. They argued that hydrocarbons form in the mantle and then come upward and fill sedimentary reservoirs. And on their way across the sedimentary shell the hydrocarbons extracted biogenic fossils from the ambient rock. In other words the biomarkers are alien structures in oil, having nothing to do with the main amount of the oil hydrocarbons. But we found that hydrocarbons and biomarkers (porphyrins and isoprenoids) show isotope distribution pattern indicating their common origin in any particular oil (Bogacheva, Galimov, 1979; Galimov, 1986). Thus isotope organic geochemistry provided the decisive prove of the "organic" origin of oil.

Moreover a method was developed to identify oil-source rock by comparison of the isotope distribution patterns characterizing certain fractions of the oil and the same fractions of the organic matter from the presumptive source rocks (Galimov, Frik, 1985). This was not just a fingerprint identification. In many cases from the specific features of the isotope distribution pattern information can be obtained on the initial facies, thermal and redox history of the oil (Galimov, 1986).

In the gas geochemistry long-standing paradigm existed that natural gases (including catagenic methane) formed at the relatively late stage of geochemical maturation of organic matter, just after the stage of oil formation. In accordance with this paradigm huge gas accumulation in the West Siberia (30% of the world resources), occurred in the relatively shallow Cenomanian deposits, formed by extensive migration of the gas from the depth. However the isotope investigation showed that supergiant gas pools of the West Siberia are more likely formed from terrestrial organic matter of low degree maturation and at moderate depths (Galimov, 1988). This conclusion was drawn from the theoretical model suggesting that there exists a different type of distribution of activation energy of methane production for sapropelic and humic type of organic matter.

Isotope approach in organic geochemistry is especially important and fruitful for identification of biogenous/

abiogenous origin of organic compounds. As example, in sedimentary gas deposits methane, ethane, propane, butane show growing  $^{13}\text{C}$  content with increasing molecular weight. This is due to kinetic isotope effect during degradation of organic matter. The opposite isotope effect takes place when hydrocarbons are synthesized from a simpler precursor. In natural conditions inverse distribution starting from isotopically heavy methane (about  $-3\text{‰}$ ) to the isotopically lighter ethane and propane was first to be discovered in gas-liquid inclusions in minerals of magmatic rock (Galimov, Petersilye, 1967). The same pattern of isotope distribution is proved to be a characteristic of  $\text{C}_1\text{-C}_3$  hydrocarbons synthesized experimentally in spark discharge (Des Marais et al. (1981).

As known organisms discriminate against the heavy carbon isotope. The biological isotope effect, including isotope effect of photosynthesis, was thoroughly studied by P. Abelson, S. Epstein, E. Degens, J. Lerman, M. O'Leary, W. Meinschein, J. Hayes, J. Farquhar and many others. Our contribution is consisted of the first study of some individual biological compounds, intramolecular isotope study, and discovery of a "strange" correlation between the measured isotopic composition of a biological compound and the value ( $\beta$ -factor) characterizing its isotope behavior in an equilibrium system. This was preceded by theoretical study of isotope fractionation in complex organic systems and elaboration of the method of isotopic bond numbers that allowed evaluation of thermodynamic carbon isotopic factors ( $\beta^{13}\text{C}$ -factor) for complex organic compounds (Galimov, 1985). The consistent pattern of isotope distribution in biological substances creates a basis for interpretation of isotope effects during fossilization of organic matter. Also, because the ordered distribution of carbon isotopes, including intramolecular site-specific isotope fractionation, is a property of living systems, new criterion emerges for recognizing biogenic and abiogenic compounds.

At present, search for life in extraterrestrial environment (Mars, Europa, Titan) becomes actual. Therefore organic geochemistry should embrace the objectives of astrobiology. The experience of organic geochemistry can be used to determine fundamental geochemical consequences of presence of life and provide a tool for identification of vestiges of life. To get these goals one needs better understanding of the essence of prebiotic and early biotic evolution.