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Influence by the C-H-O-N-S-Me Deep System on Hydrocarbons Formation of the Sedimentary Basins

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The authors describe the theory of deep C-H-O-N-S systems as a source of hydrocarbon fluids lying outside the sedimentary cover. This theory is primarily based on researches conducted in the late 1960s and early 1970s by E.B. Chekalyuk, that have shown that a wide range of organic substances can be stable under mantle conditions. Further studies by A.A. Kadik, V.K. Karzhavin, F.A. Letnikov and some other scientists determined the fields of stability for reducing fluids at varying P, T and fO2. In recent years, thermodynamic modeling has demonstrated that hydrocarbons can be synthesized in the deep lithosphere. It is natural to suppose that these fluids must leave their traces both in the crystalline basement and sedimentary cover when moving in an upward direction. Experimental materials from all major oil and gas provinces of the former USSR permitted the identification of such traces sealed in secondary microfractures. The vacuole composition study has revealed three types of hydrocarbon trace systems: bitumiol-hydrocarbon, bitumiol-hydrocarbon-water and pure-hydrocarbon represented by dry gas, mainly methane. The presence of vacuoles filled with saline water allowed the determination of the system's temperature for various oil and gas provinces. Its upward decrease from 320°C to 60°C obviously indicates an upward fluid migration. The saline water has been found to contain Ca2+, Mg2+, K+, Na+, Cl-, HCO- and SO42-. Bitumiol substances were enriched with a wide range of microelements including chalcophile, siderophile and lithophile groups, thus indicating that microelements were transferred together with organic ligands. When thermodynamic conditions of the migration changed, the sparingly soluble compounds were separated from the fluids to form bitumen. Microelement studies showed that bitumen had a high metal content, not characteristic of the transformation products

of oil or other hydrocarbon-containing substances synthesized by pneumolithic or hydrothermal processes. Highly carbonated compounds have a maximum concentration of microelements, which is lower in asphalt and oil, but is fully consistent with the thermodynamic state of the system. Hard bitumen contains lithophile elements (U, Th, REE), and the chalcophile and siderophile ones are mainly accumulated in oil. The analysis of six oil and gas provinces suggests a new, unconventional, scheme of oil genesis based on fluid thermodynamics and the microelement composition of disintegration products of the fluids.