Formation of complex hydrocarbon systems from methane at upper mantle thermobaric conditions

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Methane as the simplest member of the saturated hydrocarbons has always been of the great scientific interest. It is widely spread on the Earth and in the Universe. Methane is presented in the Earth's atmosphere, crust, and mantle. It was experimentally proved that methane could be formed from inorganic donors of carbon and hydrogen at high pressure and temperature, corresponding to upper mantle pT conditions[1]. Moreover, the formation of heavier saturated[2] (ethane, propane and n-butane) and unsaturated hydrocarbons with double and triple bond[3] from methane was observed during high pT experiments in DAC with the *in situ* analysis by means of Raman spectroscopy.

We carried out experiments on methane transfornations at pT conditions, corresponding to the upper mantle conditions, using Toroid-type high-pressure equipment. The gas products of reactions were analysed by means of gas chromatography. Our experiments demonstrated the formation of the complex hydrocarbon systems up to C7 from methane at 860 K and 2.5 GPa, corresponding to the depth of 80-90 km. The hydrocarbon mixture consisted of normal and iso-paraffins, naphtenes and aromatic hydrocarbons with trace amounts of unsaturated hydrocarbons with double and triple bond. At 1000 K and 2.5 GPa the mixture consisted of ethane, propane, normal and iso-butane with trace amounts of pentane isomers and light unsaturated hydrocarbons.

We suggest, that the complex hydrocarbon system can be formed from methane in cold zones of upper mantle and stay stable. In warmer mantle zones light saturated hydrocarbons predominate. The results obtained provide contribution to the knowledge about methane transformations in upper mantle and chemical pathways of abyssal hydrocarbons formation.

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