The endogenous renewed source of fresh water in rifting geodynamic conditions

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The fresh water problem is very actual today both in planetary scale and in many regions of Russia. Pribaikalye in this respect possesses unique fresh ground and surface hydrosphere including its central link - object of the World heritage - Lake Baikal. The structural-tectonic analysis of this region attached to continental Baikal rift zone leads to expediency of consideration of high fresh water potential formation from positions of fluid geodynamics and lythospheric plate tectonics. Riftogenic geodynamic condition of the Baikal region development predetermines primarily its modern structural plan which is a basis of hydro-geological conditions forming. Conformably to the basic geostructural elements there are three types of the hydrogeological structures which different essentially in conditions of ground water distribution and forming: rift trough - hydrogeological basin; rift «shoulders» (a mountain range) - hydrogeological massif; riftogenic tectonic breaks - water-encroached fault (Didenkov, 1989).

The distribution analysis of ground waters in hydrogeological structures of region testifies to their largest accumulations is contained in basin and water-encroached fault. Generally cold fresh ground waters are localized in surface shatter zones; ground waters of deep fault have a high temperature, specific microelement and gas composition, and low mineralization.

In the course of researches the structural-hydrogeological analysis of hydrosphere forming is accompanied by physical and chemical modeling. Despite successes of domestic and foreign researchers and the doubtless progress reached in this area recently, the construction of quantitative theory of the endogenous fluid systems is still far from the full decision. Imitating modeling is of great importance in realization and development of this direction.

Imitating modeling is unique suitable means for research of hydrogen system characteristics along with qualitative geological-geochemical constructions, analytical and numerical decisions of heat and mass transport problems. A new approach was used in studying of hydrogen processes by imitating modeling with the help of a program complex Selector (Carpov, 2002).

The imitating model of hydrogen system includes: the magma chamber, as a deep source of heat and an unidirectional volatile flow with the pressure close to litostatic; the unconsolidated host rock, in which ascending and descending flows of infiltration water and deep waters under hydrostatic pressure; fluid canals, connecting magma chamber with a surface, which represent as various form of fault zones. In present researches the thermodynamic multi-reservoir model of fluid system conformably to structural-hydrogeological conditions of Baikal rift is created. We have defined reservoirs as zones differing by parameters of a changing ascending fluid.

The Physical-chemical model of an ascending fluid includes a water solution (10), a gas phase (128), graphite and diamond; total 140 components. The necessary thermodynamic information is taken from thermodynamic data bases which have been embedded in program complex Selector-W. The following scheme of calculations is accepted. In accordance with the present-day geochemical and experimental data about mantle fluid it is set three compositions: mainly carbon - H:C 1,8, corresponding to heavy degassed oil composition; hydro carbonic H:C 2,1, corresponding to gas-liquid inclusion compositions in mantle rock and minerals, and mainly methane H:C 4,5, corresponding to methane-hydrogen fluid flow composition. Transformation of each composition was studied according to following relations C to O 1:0.1, 1:0.5, 1:1. *PT*-conditions of thermodynamic equilibrium agree with geobarotherm values. The process of fluid ascent was modeled in two stages. The first stage - calculation of thermodynamic equilibrium in a system «fluid - condensed phases» at temperatures above 375□C. The second stage - calculation of thermodynamic equilibrium in system «a water solution - gas - condensed phases» in the range of temperatures 25□C - 375□C. The stages separation is the method which allows investigating H_2O behavior both in those conditions when water, gas and condensed phases can exist simultaneously, and when there is only a fluid and solid phase.

At present time localized flows of endogenous hydrocarbon fluids as decontamination products are discovered both in oceanic, and in continental rift zones. In Baikal rift zone hydrocarbons distributes in exclusively high seismic activity areas, where contrasting modern tectonic movements and thermal spring exist. The basic products of transformation of ascending endogenous oxygen-containing hydrocarbon fluids in spreading geodynamic conditions (Baikal rift zone) are given in the accompanying figure.

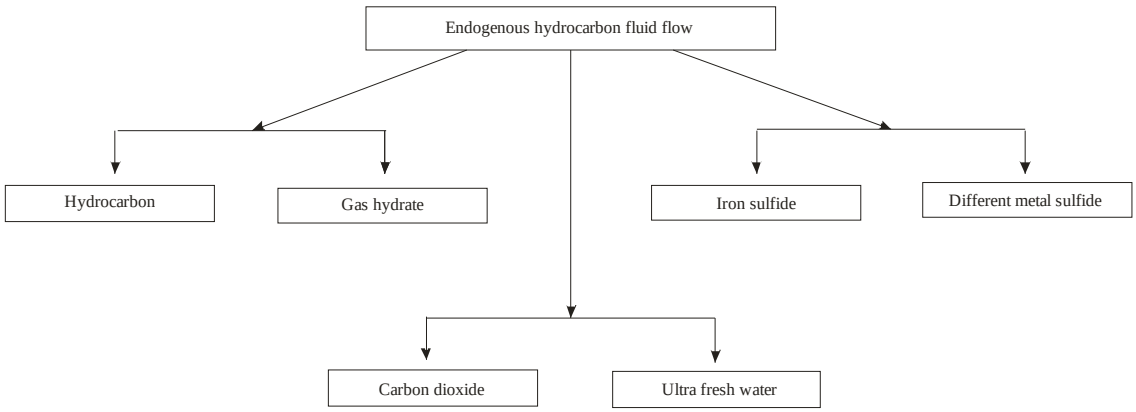

Fig. The basic products of fluid transformation

Structural-hydrogeological researches and imitating thermodynamic modeling indicate the modern Earth degassing in the rift zones and causes localized oxygen-containing hydrocarbon fluid flows. It leads to existence of deep fresh water source under the circumstances. The basic dissolved components in juvenile waters generating in the evolution of ascending fluids are methane and carbon dioxide. In our conception it is mechanisms that provides stable fresh hydrosphere of the Baikal region and along with biological processes preserve unique and stable composition of Baikal water. Gas hydrate forming in Baikal bottom sediment on the interface of ground and surface waters isolate Baikal water and regulate its desalination by gas hydrate waters. Desalination is possible in a rupture zone of the continuity of the gas hydrate frontier, where deep high-temperature hydrocarbon fluid rise. Thus fluid is a source of gas hydrate and desalinated gas hydrate waters; but first of all it is a renewed source of fresh waters.