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Hydrocarbon Fluids in Subduction Zones

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In the zones of collision of continental lithospheric plates, the subducting plates drive down great amounts of sediments formed at the former passive margins. This sedimentary layer, enclosed between two plates, contains significant quantities of hydrocarbons and occurs under the effect of strong shear deformations and special thermodynamic conditions. As the mass of the sediments passing through this zone is rather great, there are favorable conditions for occurrence of numerous hydrocarbon fields of industrial importance, including fields–giants.

At a conceptual level, the process of formation of hydrocarbons beneath the island arcs in the zones of collision of continental plates is described in detail in our works. In this relation, mathematical modeling of geodynamic and fluidodynamic processes in these zones seems very promising. Combined consideration of geodynamic and fluidodynamic aspects in a model of lithospheric plates collision enables to understand the influence of P–T conditions and shear deformations on the mechanism of hydrocarbon generation and to look after their migration in the lithosphere up to the formation of deposits. Such model would allow one not only to describe and to explain these processes, but also to predict some features essential for the search and exploration of hydrocarbon fields in these regions and their classification.

The authors propose a set of fluidodynamic models of hydrocarbon formation in subduction zones. In terms of compaction models, multiphase filtration in a piezoconduction mode and crustal waveguide (regimes of compaction and dilatance) models major stages of fluid evolution under the conditions of developing passive margins and in the zones of collision of plates are described. In particular, compaction models of one of the stages of fluid mode evolution within a sedimentary basin and fluid migration from the convergence zones toward the upper layers are considered. In the final part of work,

computation of fluid transfer of hydrocarbons in a pulse mode described by the equation of piezoconductivity is presented for a mature oil-bearing sedimentary basin over individual sections for short periods of a few hundreds of years. These calculations were executed on the basis of a new mathematical method *TEKON* and computer programs for quantitative analysis of fluid migration and formation of hydrocarbon deposits with account taken for actual geometrical and lithological properties of the layers. On the basis of the specified numerical calculations the scales, form, and routes of fluid movement were disclosed, as well as the formation of zones of anomalously high rock pressure and non-traditional hydrocarbon deposits.

Calculations with this model were simultaneously carried out for the sedimentary basins of Timan–Pechora region, Barents Sea, Volga–Ural area, etc.

The suggested geodynamic and fluidodynamic models can further serve as an effective tool for integration of the geological and geophysical data. They may help the studies of a sedimentary basin as a historically evolving system to disclose its structure, origin, and stages of development. These models can form the basis for perfection and creation of new effective techniques of the accelerated search and exploration of oil and gas deposits.