Geophysical Research Abstracts
Vol. 13, EGU2011-1286, 2011
EGU General Assembly 2011

Fluid Dynamics Model of the Formation of Giant Gas and Gas Condensate Deposits

Inna Balanyuk (2), Anatoly Dmitrievsky (1), Sergey Shapovalov (2), Olga Chaikina (2), and Tatiana Akivis2 (2)
(2) P.P. Shirshov Institute of Oceanology, Russian academy of Sciences, Moscow, Russian Federation (iebalanyuk@yandex.ru), (1) Institute of Oil and Gas Problems Russian Academy of Sciences, Gubkina 3, Moscow, Russian Federation

The specific fluid regime that led to formation of the giant gas condensate deposit in the Astrakhan carbonate massif is suggested to result from collision events of the Karpinsky dislocation belt. The Triassic version of the belt deformation related to collision events at the active margin of the Peritethys is supported by the authors.
Geomechanical models of the fluid dynamics with both one-phase and two-phase fluids in overthrusts and faults, more than 7 km deep, are proposed. Based on these models, we studied conditions and mechanisms of giant gas and gas condensate deposits formation in structures like the Astrakhan carbonate massif. The Astrakhan arch is characterized by an increase in reservoir capacity of carbonate rocks owing to generation of joint cavities during faulting related to Karpinsky belt formation.
It is suggested that the entire Caspian depression serves as a giant oil generating body, which is able to supply any trap with hydrocarbons within this region.
Caspian depression and Astrakhan arch in particular, represent a large zone of oil and gas accumulation. Structure of the region is complicated by major faults and nappes. One can expect that formation and development of hydrocarbon deposits within this area is related to fluid migration through the faults. Fluid regime is considered here as a consequence of rock mechanics. Any tectonic motion is forced by lateral stresses in the crust and lithosphere which, in turn, are generated by global geodynamic processes related to mantle convection. We believe that the character of fluid dynamics in deep faults depends on successive alternation of dilatancy and compaction. Competing regimes induced by such oscillations lead to formation of giant hydrocarbon deposits like the Astrakhan deposit.
According to geophysical data, the structure of Astrakhan arch is characterized by deep faults. Crustal blocks within the Karpinsky belt area are affected by tectonic forces which lead to dislocations in faults and to seismic events. Fluids appearing in the focus zone may serve as a trigger for earthquakes, i.e. may cause a trigger effect
Most filtration models for faults are based on the assumption about hydrocarbons and water filtration through an elastic (or elastic-fragile) skeleton, i.e. on the elastic consolidation model. These phenomena are described by parabolic equation of piezoconductivity. Observed characteristics of the cyclic process allow us to suggest that a variation cycle of seismotectonic regime in this region consists of rapid and slow phases. The fluidization phase in a fault is a slow phase of viscous consolidation during which fluids are pressed out from main fissures into smaller ones. The reverse process of fluid pumping into faults is described by the rapid dilatancy phase.
Formation and development of the giant Astrakhan deposit is related to fluid migration through faults associated with nappes of the Karpinsky belt. All movements are forced by lateral stresses in the crust and lithosphere which are created by global geodynamic processes responding the mantle convection.
The character of fluid dynamics in deep faults depends on successively alternating dilatancy and compaction. Calculations show that a shift in dilatance regime generates negative pressures within faults which result in a vigorous fluid suction effect.
The authors suggest that the powerful mechanism of competing self-oscillating regimes of fluid migration may lead to formation of many giant hydrocarbon deposits like the Astrakhan gas condensate deposit.