Recent geodynamics of faults induced by operation of oil and gas objects

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Numerous studies of recent geodynamic processes at hydrocarbon fields under development and underground gas storage facilities have shown that the main forms of deformation processes are the subsidence of the earth's surface and the activation of fault zones.

The main kinematic type of movements of the earth's surface in the fault zones turned out to be local, quasisymmetric subsidence (local bends). The width of these anomalies varies in the range from 0.1 km to 1 km. The amplitudes of the earth's surface displacements vary from 5 mm to 50 mm. The morphological features of anomalous deformations of the earth's surface in fault zones are revealed. On the territory of underground gas storages, subsidence in fault zones alternates with upward bends. These alternating deformations of faults correspond to cyclic (2 times a year) gas injection and gas extraction. Within the limits of oil and gas deposits, periodic local downward bends are observed.

Geomechanical analysis showed that local deformations of the order of 10–50 ppm are induced by small man-made loads. Anomalous deformations of the earth's surface in fault zones located within underground gas storage facilities organized in aquifers are caused by pressure variations in the range of 0.3 - 1.5 MPa.

A mechanism is proposed for the formation of induced deformations of fault zones based on ideas about the activation of tensile fluid-saturated faults. To confirm this mechanism, the data of repeated gravimetric observations are used, which make it possible to record the dynamics of gas-water fluid.

Data are presented that demonstrate the connection of anomalous deformations with emergency situations of infrastructure facilities and formulated principles for organizing a system of integrated geodynamic monitoring of zones of dangerous faults.