Study of the Dynamics of Deformation of Water-Saturated Reservoirs Under Seismic Impact

Petukhova S.M.
Sadovsky Institute of Geosphere Dynamics of the Russian Academy of Sciences, Moscow, Russia
e-mail: sofiya.petukhova@gmail.com

The paper presents the results of a comprehensive analysis of precision measurements of the deformation dynamics of water-saturated reservoirs in observation wells. The research objects are located in natural conditions on the territory of the geophysical observatory of the IDG RAS "Mikhnevo" (Moscow region) and natural-technogenic - in the zone of influence of the developed iron ore deposit of the Kursk magnetic anomaly (Gubkin, Belgorod region). Observation points are equipped with instrumental-measurement complexes. Hydrostatic pressure sensors are installed in the wells, seismometers and barometers are located at wellhead sites. Synchronization of registration at points is carried out using GPS modules.

Long-term hydrogeological data series are used to evaluate the barometric efficiency and tidal sensitivity of the reservoir-well systems under consideration. Filtration parameters - water conductivity and permeability are calculated on the basis of tidal analysis by phase shift between tidal components, identified in ground displacement and level, under quasi-stationary conditions. The intervals of values obtained under the conditions of seasonal and technogenic variations in the groundwater level at a rate of more than 5 cm/day are excluded.

Particular attention is paid to the study of the response of water-saturated reservoirs to the passage of seismic waves from distant earthquakes. Ground displacement velocities are recalculated from ZNE to ZRT coordinate system. Based on the poroelastic model [1], the pore pressure is determined from seismic data, taking into account separately the volumetric and shear components of the deformation of a water-saturated reservoir. The obtained values are compared with the recorded hydrogeological responses [2]. A similar scientific and methodological approach is planned to be used in the future for predictive assessment of the relative deformation of water-saturated reservoirs with different physical and mechanical characteristics.

The work was carried out within the framework of state order No. 122032900172-5 of the Ministry of Science and Higher Education of the Russian Federation and with the financial support of the Russian Foundation for Basic Research within the framework of the scientific project 20-35-90016.