

## **NATURAL AND INDUCED SEISMICITY OF THE ROMASHKINSKOYE OIL FIELD, REPUBLIC OF TATARSTAN, RUSSIA**

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Exploitation of hydrocarbon reserves can cause tectonic movements, earthquakes and changes in geophysical fields as it breaks the strain equilibrium of the earth's crust.

The Republic of Tatarstan, including the Romashkinskoye oil field, is located in the central part of the East European Platform with low natural seismicity. Nevertheless, earthquakes force 6 to 7 (MSK-64 scale) took place here in the past. Since 1982, i.e. after forty-year exploitation of the Romashkinskoye oil field, 50 shocks (mostly weak to middle) have been observed, 2 of them reaching force 6.

A network consisting of 9 seismic stations with 60-km aperture, and 6 polygon profiles for high-precision geodesic measurements have been set to study induced seismicity. Since 1982, over 700 earthquakes of  $M \geq 0.5$  have been recorded here at 0 to 5km depths most of which coincided in time with intensive water injection when pressure exceeded natural pressure at 1.5 to 1.7km depths.

Seismicity has been correlated with the amount of injected water and pumped-out oil, and their unbalance for the Berezovskaya, Minnibaevskaya, Almetyevskaya and Sever-Almetyevskaya oil production areas. Highest correlation values (0.5-0.8) were recorded for areas with greater injected water amounts and 'injected water/pumped-out oil' unbalance. 9 geodesic observation cycles have been conducted that resulted in recording vertical fault-related movements of the earth's surface of up to 20cm associated with the oil production activity.