

# Induced seismicity from oil and gas production - overview

---

**Rodkin M.V. (1, 4, 5), Ngo T.L. (2, 3), Rukavishnikova T.A. (4), Phung Thi T.H. (2, 3)**

(1) Institute of Oil and Gas Problems of the Russian Academy of Sciences, Moscow, Russia

(2) Geophysical Institute, Vietnam Academy of Science and Technology, Hanoi, Vietnam

(3) Graduate University of Science and Technology, Vietnam Academy of Science and Technology, Hanoi, Vietnam

(4) Institute of Earthquake Prediction Theory and Mathematical Geophysics of the Russian Academy of Sciences, Moscow, Russia

(5) Institute of Marine Geology and Geophysics, Far East Branch, Russian Academy of Sciences, Yuzhno-Sakhalinsk, Russia

e-mail: rodkin@mitp.ru

Currently, about 10% of the world oil production is accounted for by the United States. Of these, more than half is shale oil, whose production is growing particularly rapidly. The cost of shale oil now exceeds the cost of oil in the Persian Gulf countries by several times and is significantly higher than the average cost of oil in Russia. However, the technology of shale oil production allows the possibility of rapid cessation and recovery of production, which allows you to adjust the level of production to current oil prices. All this gives reason to talk about a fundamental change in the situation on the hydrocarbon market and the beginning of the era of shale oil. Such a development may, however, be hampered by an increase in seismicity caused by the extraction of shale oil. The article discusses two aspects of this problem: purely seismological - data on the induced seismicity, and the problem of practical measures and rules taken in different countries to prevent the increase in the induced seismicity.

Within the framework of the first aspect of the problem, examples of the possible relationship between seismicity and oil production are discussed. Now, the presence of the effect of the oil production regime on local seismicity can be considered as established. The extent of this impact and the magnitude of possible induced earthquakes, however, remain unclear. Concrete examples based on the experience in different countries and for different seismotectonic situations are examined. In addition to a review of data for the United States and Canada, examples of uprising and of absence of the induced seismicity for the northeastern Sakhalin and the giant White Tiger field on the Vietnam shelf are considered. Examples indicate the possibility of a rather weak spatial-temporal correlation of seismicity with the mode of impact in oil and gas production, while, however, the technogenic nature of seismicity seems very likely.

In terms of discussing measures to reduce the risk of losses due to the induced seismicity, the experience of a number of countries is considered: the Netherlands, Great Britain, and the USA. It seems expected that if the link between seismicity and oil production will be proved, and earthquakes will be hazardous, the payments of fines and various restrictions can make the production of shale oil unprofitable. Even without significant insurance payments, shale oil production may be significantly blocked by different kinds of restrictions related to the fears of the development of seismicity. In different countries, very strict and sharply differing requirements are imposed on monitoring seismicity and stopping the impact on the subsoil already in development of weak or even very weak earthquakes. It can be concluded that the factors that determine the development of the induced seismicity remain unclear, and the requirements on controlling the induced seismicity are not sufficiently scientifically substantiated.