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Application of the method of seismic entropy to solve technological problems in the oil and shale gas industry

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The method of seismic entropy is currently used to solve dynamic problems of preparation, monitoring and forecast of earthquakes. Based on the law of seismic entropy production it allows to identify the hierarchy of seismically active volumes of the geological environment – seismic systems (SS), responsible for major earthquakes, for the formation of ruptures in the medium of different energy levels. Currently, more than 300 SS and subsystems with sizes from 20 to 3000 km with threshold magnitudes from 5.0 to 8.5 have been identified. The development of the method from large SS to small and the reduction of the threshold magnitudes of earthquakes to microscopic, allows the use of the seismic entropy method for solving technological problems in the oil and gas industry. In this report we describe the possibility of using this method for the control of microearthquakes (both natural and man-made) origin for the development of the control system over technogenic deformations, fractures, displacements associated with oil and gas developments. The method can be used to solve technological problems controlling the dynamics of hydraulic fracturing for hydrocarbon deposits. Hydraulic fracturing of formations is one of the most popular methods of well stimulation in oil and gas fields, and micro seismic monitoring is applied to control fracs. The method of seismic entropy was successfully tested for hydrocarbon deposits of 2x2 km and a well depth of 2.5 km. Comparison of the cumulative energy of micro seismicity using the seismic entropy method with traditional parameters recorded by seismological networks of observations allows us to identify the fluid and technogenic component in earthquake preparation. Thus, the influence of oil and gas developments on the Sakhalin shelf on the preparation of strong earthquakes (Neftegorsk 1995, Uglegorsk 2000) was revealed. The problems of environmental control and improve the efficiency of shale gas developments are can be solved based on the method. The effect of induced seismicity with magnitudes M = 4.5–5.3 to prepare devastating earthquakes in areas of hydrocarbon development in the Central US is negligible. However, the appearance of the induced seismicity in the local areas of shale gas development can cause great financial and economic damage. Induced seismicity can be monitored and technologically prevent in the small SS, based on the registration of micro seismicity (M < 3.0). Investigates the impact on the flow of natural seismic processes of technogenic factors in the development of Daqing oil and gas deposits and shale gas in the NE China (Songliao and Bohai Bay Basins). Considered spatially temporary impact on the dynamics of preparation of strong earthquakes and induced seismicity in a hydrocarbon field development in the NE China. The application of a method of entropy seismology for the retrospective analysis of preparation of powerful earthquakes (1966 - 1976) and identification of the manmade component is described. It is shown that a sharp increase in shale gas production since 2013 in the area of the Bohai Bay basin could cause seismicity in the NE of China and in Korea.