On the development of a seismic-geological approach to the medium-term earthquake forecast in the Baikal rift zone

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The development of a methodological approach to identifying earthquake sources that are preparing in the Baikal rift zone has been carried out at the Institute of Earthquakes of the Siberian Branch of the Russian Academy of Sciences since 2001 within the time frame of the medium-term earthquake forecast (1-11 years). The main emphasis is on elucidation of the multifactorial conditions of earthquake preparation in the field study of geological and geophysical conditions that affect the preparation of earthquake sources in exhumed deep fault segments, with the involvement of field experiments in ice and geological environments. The analysis of the earthquake catalog presented by the Baikal branch of the Unified Geophysical Survey of the Russian Academy of Sciences in Irkutsk is also underway.

With the use of the developed GIS "Prediction incoming information about the modes of seismic activity is constantly analyzed, with an emphasis on studying the conditions for preparing a shock event. Interpretation of long-term observations of the parameters of the preparatory seismic regime showed that within the BRZ, the sources of strong earthquakes with K≥13 (M≥5.0) occurred mainly in the border areas of seismic gaps in zones of high-ranking active faults or fault nodes [Ruzhych, 1997]. Later, when conducting physical modeling on fault areas, the mechanism of the formation of seismic pulse emission sources in areas of active displacements of faults with irregularities was elucidated (Ostapchuk al., 2019). From the analysis of the information obtained on the modern structure of the BRZ seismic field, the features of seismic regimes in the fault zones for several years or decades before the moments of strong and strong earthquakes with M≥5.0 were revealed. This seismological information contains information about the approach of a shock event in the form of two stages: increasing pre-shock seismic activation on the periphery of the calm area and the stage of seismic calm. Taking into account the results of field experiments on real geological objects and physical modeling, it was found that such a regime indicates the approaching moment of coseismic rupture of strength barriers or the destruction of large irregularities in some segments of the main faults. By determining the energy parameters of pre-shock activation and the duration of a seismic lull, it becomes possible, based on calculations using GIS, to estimate the energies of preparing shock events (E) - and the remaining time of their preparation until the moment of implementation (T). These conclusions are supported by the analysis of the accumulated information on the events that have occurred in the BRZ within the framework of the developed seismic-geological method of medium-term forecasting.

According to the analysis, over a time interval of 1.5 years (09/18/2019 - 01/20/2021), 82% of the epicenters of the occurred earthquakes with class K≥13 (M≥5.0), including very strong aftershocks of the Khubsgul earthquake (2021, M=6.8), fell into the expected places. This result can be considered satisfactory at the considered stage of research.