Seasonal variation of b-value for trigger seismicity of Koyna-Varna

Smirnov V.B. (1, 2), Potanina M.G. (1, 2), Ponomarev A.V. (1), Mikhailov V.O. (1, 2), Patonin A.V. (3), Chadha R. (4), Bondarenko N.B. (1, 2), Kartseva T.I. (1, 2)

(1) Schmidt Institute of Physics of the Earth of the Russian Acsdemy of Sciences, Moscow, Russia

(2) Lomonosov Moscow state university, Faculty of Physics, Moscow, Russia

(3) Geophysical observatory «Borok» - the branch of Schmidt Institute of Physics of the Earth of the Russian Acsdemy of Sciences, Borok, Yaroslavski district, Russia

(4) National Geophysical Research Institute - CSIR, Hyderabad, India

e-mail: avp46@mail.ru

Annual variations in the water level in reservoirs allow us to investigate the seasonal excitation and relaxation of the seismic regime. Using the example of the classical field of such studies of Koyna-Warna in Western India, it is shown that the seasonal maxima of the excited seismicity fall both on the interval of maximum water levels in reservoirs, and approximately in the middle of the interval of decreasing depths of reservoirs. This result confirms the well-known conclusions about the presence of at least two mechanisms of seasonal activation - immediate and delayed. Both of them are associated with an increase in pore pressure, in the first case due to compression of the skeleton of rocks and, accordingly, a decrease in the volume of the pore space, in the second - due to diffusion of fluid or its pore pressure into the depth and to the side of the reservoir along permeable fault zones. The difference in localization of immediate and delayed activations in space in the Koyna-Varna region is explained by the difference in size and localization of areas of increased stress created by the weight of the reservoir in the first case and reduced strength due to an increase in pore pressure in the high-permeable fault zones in the second case.

According to the regional catalog of earthquakes in the area of the Koyna and Warna reservoirs, characteristic changes in the parameters of the seasonal seismicity regime were revealed. On the activation interval, both immediate (autumn) and delayed (spring) components, the b-value decreases, and on the interval of decrease in activity in these components - increases. During the period of activation of the winter (December) component, this arose after the attenuation of the autumn and spring components, the b-value increases with the increase in activity.

The results show that the seasonal activation of the seismic regime is accompanied by a redistribution of the destruction process over its scale. The revealed decrease of b-value at the stage of activating seasonal seismicity corresponds to the scenario of the fusion and crack growth process (crack avalanche instability model), and an increase in this parameter during a decline in activity corresponds to the aftershock relaxation scenario. Such changes, found in the seasonal transitional regimes and characteristic of the preparation and aftereffects of tectonic earthquakes, testify, in our opinion, to the triggering nature of the initiation of seasonal components of induced seismicity, whose dynamics obey the same laws as the dynamics of tectonic seismicity.