

Structural and geological model of the Koyna-Warna reservoir area (Western India)

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The intensification of the technogenic influence, in particular, the large reservoirs building, can lead to a change in the geodynamic situation in tectonically active regions, being a trigger for the occurrence of induced seismicity. Of practical importance are the studies carried out in the area of the Koyna and Varna reservoirs, located in the western part of the Deccan highlands in the area of the Western Ghats, within which seismic events with magnitudes from 3 to 6.3 were recorded.

The study of the territory using remote sensing methods made it possible to draw up general schemes of tectonic faults. A detailed scheme of lineaments was formed in the basis of lidar survey. Based on the results of the performed geological and geophysical studies, refined structural and geological schemes of the area were proposed. The seismogenic disturbances were determined by comparing the recorded earthquake sources with these schemes.

Submeridional fault systems and NW-SE-trending faults, typical for Gondwana, are identified in the Precambrian basement. The NE-SW faults are active and are probably related to later plate tectonic movements. Younger Miocene sublatitudinal faults are traced in the trap sequence. The regional stress field is due to the movement of the Indo-Australian plate in the north-northeast direction, which is confirmed by GPS data. The local stress field is due to the response of deep faults in the study area to the regional stress field and to the technogenic impact, probably associated with the operation of reservoirs.

The use of the formalized LESSA (Lineament Extraction and Stripe Statistical Analysis) lineament analysis and the use of interactive interpretation of digital elevation models and satellite images of various resolutions makes it possible to more objectively identify fault systems, determine the zones of influence of disjunctives, detail their internal structure and establish a kinematic style.

According to the data of a formalized analysis, the submeridional seismogenic Koyna zone with a zone of dynamic influence up to 50 km wide was traced on the regional scheme of the structural lines. Probably, this regional structure is a zone of localization of deformations and represents a geomorphologically pronounced stepped transition zone from the Western Ghats to the foothill part of the Kankan plain. The axial zone of thickening of structural lines coincides with submeridional sections of the valleys of the Koyna and Varna rivers. Extended lineaments identified along the NW-SE direction mark the Chitradurga shear zone, which stretches through the southwestern part of the Hindustan peninsula.

The data of a comprehensive analysis of the results of processing space images and digital elevation models were used to build a structural-geological model of the area of the Koyna-Varna reservoirs. The scheme of spatial distribution of the total density of small lineaments is consistent with the previously proposed scheme for the development of the paleorift margin of the Indian continent according to the model (Tucker and Slingerland, 1994), which takes into account isostatic effects during denudation unloading of riftogenic continental margins.

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