Optimal techniques and parameters of electromagnetic monitoring in seismically active areas

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Electromagnetic methods with a controlled source are widely used for monitoring of electrophysical characteristics of the geological massif of rocks, which are subject to the impact of natural or man-made geodynamic processes. Earthquakes, collapses, landslides, rock bumps, karst processes in the areas of inhabited and industrial infrastructure, in the areas of mining of mineral deposits can attributed to the dangerous phenomena that need to monitor. It is known that electromagnetic methods are numerous, classified according to a number of characteristics, differ in the ways of excitation and registration of the field. Each of the methods has its advantages and disadvantages, different depth of research. For successful monitoring, it is important to choose a specific method. For regular observations, modifications of non-stationary electromagnetic sounding (TEM) and methods of resistance, such as vertical electrical sounding (VES), electrotomography (ERT), are mainly attracted. Considering features of methods, the choice should focus on the required depth of research. In addition, based on the existing experience of monitoring in the epicentral zone of the Chuya earthquake of 2003 in the Gorny Altai, measurements with a complex of methods can recommended. An example is monitoring in the Chuy Depression, where, according to several modifications of TEM and resistance methods, variations in two electromagnetic parameters — electrical resistivity and electrical anisotropy (λ) — observed, which certainly expands the informativeness of the study. As a result of the interpretation of the data of the TEM with grounded installations (AB-MN), regular variations in the anisotropy coefficient, associated with changes in the seismic regime, are obtained. Variations of resistivity according to coaxial installations also reflect changes in seismicity, but they are significantly smaller in amplitude compared to λ. The electrical anisotropy parameter in the conditions of Gorny Altai is more sensitive than the resistivity to the seismic regime of the territory. It is possible to give the result obtained in another seismically active region. The VES data of long-term monitoring in the Selenga depression of the Baikal rift zone allowed revealing the optimal parameter for this region - the integrated conductivity of the section, the variations of which increased with depth and correlated well with the seismic events. Thus, the choice of the parameter depends on the geoelectric conditions of the study sites. To analyze the data of regular observations, information about the structure of the site and the existing fault zones, their extent, width, inclination of the displacer is essential, therefore, field work is carried out in parallel with monitoring aimed at refining the geoelectric structure. Monitoring performed in the zone of influence of the fault makes it possible to assess the degree of its activity. In particular, the results of observations in the Chui depression showed that after the devastating earthquake of 2003, a number of internal faulting structures activated and the most significant variations of electrophysical parameters obtained in the zone of influence of faults. All field data obtained in Gorny Altai were interpreted using modeling and inversion software systems.