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Manifestation of the earthquake of January 23, 2024 (Northern China) in the components of the electromagnetic field (Northern Tien Shan)

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Modern geodynamic processes, as a rule, are reflected in variations of the Earth's electromagnetic (EM) field. The study of ones is of significant interest for understanding their internal mechanisms, since variations contain important information that is in demand when developing models of interactions and transformation of geophysical fields [1-4].

In order to determine the relationship between variations in the electrical conductivity of the Earth's crust and geodynamic processes, the Research Station of the Russian Academy of Sciences in Bishkek carried out EM soundings during the Kambarata explosion [5]. To process the sounding results, a technique for azimuthal magnetotelluric monitoring was proposed [5, 6], which makes it possible to identify not only anomalous changes in the modulus and phase of the apparent electrical resistivity (ρ_{app}), but also to determine the directions corresponding to their maximum increase and decrease (compression and tension axes). Based on the analysis of field data, experimental confirmation of the relationship between the stress-strain state of the medium and changes in ρ_{app}, due to the idea of redistribution of mineralized fluids between systems of cracks, was obtained [7-10].

As an example of the existing relationship between variations in geophysical fields and seismicity, in this work we considered 5 components of the Earth's EM field obtained at the Ak-Suu station, located in the Chu region during the earthquake 23.01.2024 (Tien Shan). This earthquake with a magnitude of M=7.0-7.27 occurred at 18:09:05 UT at a depth of ~13 km. The source of the earthquake was located in China, city of Aikol in the Xinjiang Uygur Autonomous Region (41.23° N, 78.59° E).

The data obtained indicate pronounced variations during the earthquake for 5 time series - two horizontal telluric components (E_x, E_y) and two horizontal (H_x, H_y) and vertical (H_z) components of the geomagnetic field. The maximum amplitude of variations is observed in mV for E_x = 0.45, E_y = 0.34, H_x = 450, H_y = 150, H_z = 530; the duration of the variations manifested themselves to a greater extent in the horizontal components of the magnetic field. As for the nature of the observed variations, they can be associated with mechanoelectric processes that arise at the extreme stage of preparation of the earthquake source and during the implementation of the seismic event.

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