

CHANGES IN THE GEOMAGNETIC FIELD OF THE TASHKENT REGION

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Annotation. Anomalous variations of a regional nature are manifested in sinusoidal, bay-like and trend forms lasting from 1 to 7 years. For the trend type, the gradient is 0.5–2.0 nT/year. Anomalous variations of the local type are observed, as a rule, in sinusoidal and bay-like forms. The bay-shaped anomaly has a positive and negative sign, as well as a reversible nature of the change. The intensity of the anomalies is from 2 to 25 nT, the duration is from 10–15 days to 3 years or more. Local anomalous variations are neither predictive nor technogenic. This type of anomalies has been detected for the first time in large numbers in the territories of the geodynamic polygons of Uzbekistan. An analysis of scientific data over the past 40–50 years showed the absence of any information on this type of anomalous variations. They cannot be explained by the accepted mechanisms of the formation of the secular course of the geomagnetic field, the lithological composition of rocks, tectonics, hydrogeological conditions, and geophysical fields of the studied territories. One of the features of the manifestation of local anomalous variations of this type is that they can change in time, in shape, in size of area, intensity, in sign. The published data related to the anomalies of the secular variation of the geomagnetic field have been studied. However, these materials, unfortunately, do not provide practically any information about the nature of those local anomalous variations that are discussed in our work.

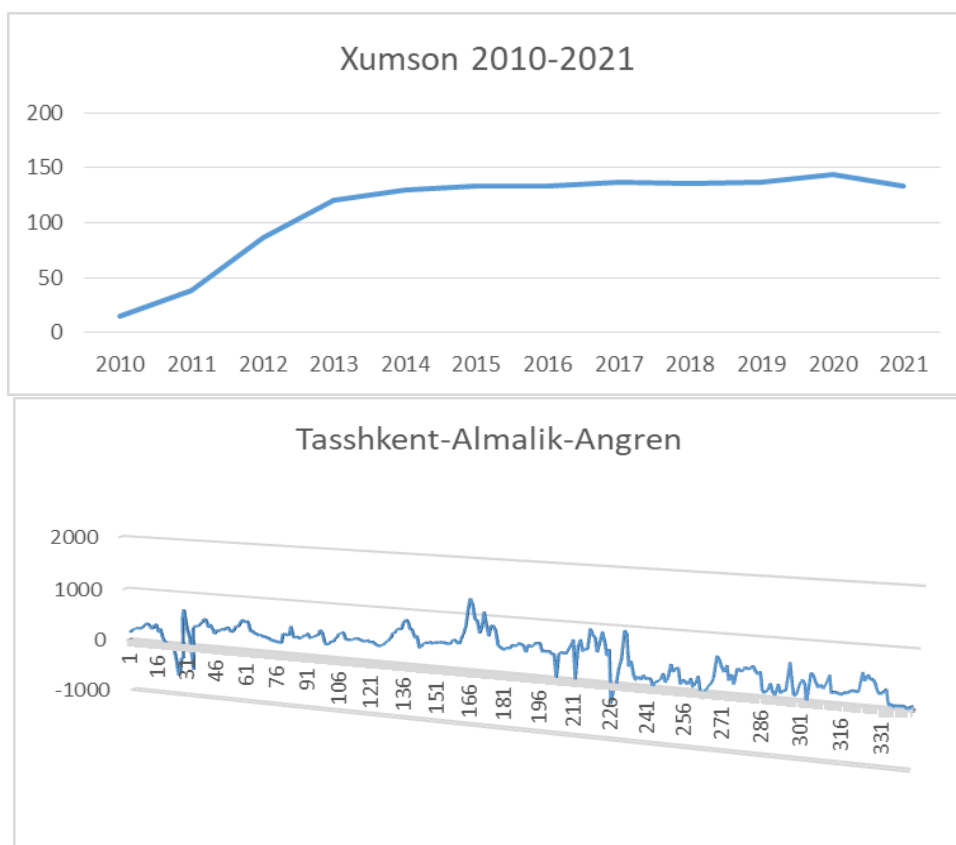
Keywords: Earth's crust, magnetic field, local and regional anomalous variation, amplitude, duration, geodynamic polygon.

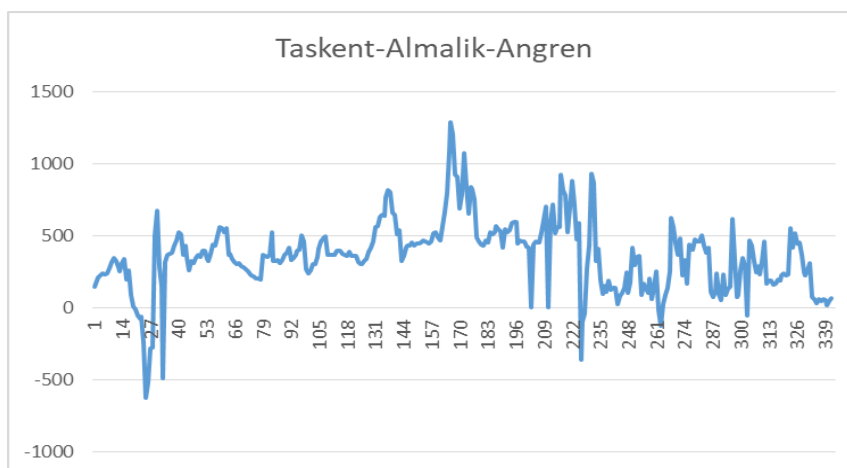
Introduction. Work on the search for geomagnetic precursors of earthquakes on the territory of Uzbekistan has been carried out since 1968 at specially organized geodynamic sites and in the epicentral zones of strong earthquakes. Geomagnetic studies were also carried out on the territories of man-made objects - natural underground gas storages, large reservoirs and exploited oil and gas fields by the methods of repeated route, areal and stationary regime measurements. Absolute proton magnetometers were used. For more than 50 years of geomagnetic research, more than 1100 points have been laid with a total length of route areal surveys of about 7750 km. About 25 stationary magnetic stations were involved. As a result, a wide amplitude-time spectrum of local variations of various nature was revealed, associated with: 1) the processes of preparation and occurrence of strong ($M \geq 5$) earthquakes; 2) with the activity of man-made objects -

underground natural gas storage facilities, large reservoirs and operated oil and gas fields

Methodology. Geomagnetic studies were carried out by the methods of repeated route, areal surveys in combination with stationary regime measurements of the magnetic field. Absolute proton magnetometers were used. The types of proton magnetometers used and the magnitude of errors in the selection of local changes for the corresponding period of research at the test sites of Uzbekistan are given (Fig. 2,3). The total value of the error in identifying anomalous variations in the geomagnetic field was regularly estimated. A value exceeding two times the value of the total error was taken as a reliable value of the anomaly. This process was carried out regularly at the Yangibazar magnetic observatory for research on the territory of the Tashkent geodynamic test site (TGP). Regime magnetic stations were also involved in the territory of the Fergana geodynamic test site (FGP). All anomalous changes in the geomagnetic field on the territory of the TGP are considered relative to the Yangibazar magnetic observatory (Fig. 2). On the territory of the Tashkent region, the Khumson station (Fig. 1), located 18 km from the Charvak reservoir, was taken as the reference station.

Results of research. Local variations of the geomagnetic field caused by earthquakes and the activity of technogenic objects are covered in detail and repeatedly in our publications [Abdullabekov, Maksudov, 1975; Electric..., 1983; Abdullabekov et al., 1994; 2016; Abdullabekov, Shapiro, 1978; Abdullabekov, Tuychiev, 2016; Abdullabekov, 1991; Tuychiev, 2007; Muminov





So, local anomalous variations appear on the territory with linear dimensions from the first units to 100 km and more. Forms of manifestation of local anomalies in most cases are bay-shaped, sinusoidal, trend. The bay and trend forms have both positive and negative signs. Their intensity can range from 2–3 to 25 nT or more. In the case of manifestation in the form of a trend, the change gradient ranges from 0.5–1.0 to 3 nT/yr and more.

As the results of long-term observations on the territory of the TGP, in particular in the area of the Charvak reservoir, show, the form of manifestation, the size of the area, and the intensity of the anomalies are not constant. All of them change over time. In this regard, it is not possible to associate them with the geological-tectonic, geophysical features of the studied territories. As for the nature of these anomalous variations, the above review of literature data on nature does not say anything [Zolotov, 1970], or it is noted that they can be associated with the effect of piezomagnetism, currents of an electrokinetic nature, telluric currents, thermo-EMF [Shapiro, 1986; Mukhamadeeva et al., 2014].

Recently, a new direction in geophysics has appeared and began to develop - near-surface geophysics. As objects of research, she considers phenomena and processes occurring in the near-surface part of the earth's crust to depths of about 10 km and in the near-surface layer of the atmosphere, also with a thickness of about 10 km. The choice of such an interval of the depth of the earth's crust and atmosphere is due to the fact that it is in this interval that the most dangerous phenomena of natural and man-made origin are concentrated [Adushkin, Spivak, 2019]. Here the Earth with all geospheres and geophysical fields is a single dynamic system, where they interact with each other and exchange mass and energy. Geophysical fields can participate in the interaction: gravitational, thermal, electric and magnetic fields of the Earth, fields of emanations of underground fluids, seismic and acoustic vibrations, etc. [Itogi..., 1966]. Some of the results obtained by us in the territories of the geodynamic polygons of Uzbekistan, apparently, should be considered as an object of near-surface geophysics. Let us assume that the revealed variations of the geomagnetic field of a regional nature (Fig. 8, Fig. 9) are due to processes in the deep part of the Earth's crust and upper mantle and, possibly, have a current nature. Another group is anomalous variations of the geomagnetic field of a local nature (Fig. 1, Fig. 2, Fig. 5, Fig. 6, Fig. 7, Fig.

11), possibly due to changes in the physical and mechanical properties of the medium and the dynamics of its fluid flows, causing current systems near the earth's surface. In this case, to confirm both noted or other mechanisms for the formation of anomalous variations in the geomagnetic field, it is necessary to conduct special detailed geomagnetic studies. So, their implementation requires a long time and can be 8-10 years or more. These studies will need to be organized through stationary continuous measurements at several points and frequent repeated areal surveys of the geomagnetic field. To determine the mechanism of manifestation of local anomalous variations of the geomagnetic field, one should also organize or involve data on the study of seismodynamics, electrodynamics, hydrodynamics and other physical fields of the Earth.

Conclusions. For more than 50 years, high-precision geomagnetic studies have been carried out on the territories of the geodynamic polygons of Uzbekistan using the methods of repeated route areal surveys in combination with stationary regime measurements of the geomagnetic field. As a result, local anomalous variations in the geomagnetic field were revealed, which are caused by processes at different depths in the Earth's crust and upper mantle. They have a wide spatio-temporal and amplitude spectrum. Their form of manifestation is also varied. A detailed analysis showed that they are not associated with specific strong earthquakes, the seismic regime of the studied territories, as well as with the activity of underground natural gas storage facilities, large reservoirs and exploited oil and gas fields. Their dynamics in time and space is observed, sometimes - the imposition of short-period anomalies on longer-period ones. To determine the nature of these local anomalous variations, it is necessary to organize, apparently, special long-term geophysical (magnetic, electromagnetic), geotectonic, hydrogeological and other studies on the territories of seismically active regions, geodynamic polygons. The need to organize and conduct these studies is dictated by the importance of determining the nature of the manifestation of the noted local anomalous variations in the geomagnetic field.

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