REGULARITY OF PERIODS OF TECTONOMAGNETIC PRECURSORS

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Abstract.*The variability of the periods of earthquake precursors, which manifest themselves during the development of the source, has been studied. It was found that with the increase in the next number of the precursor, there is a natural increase in the period of the precursor, which can be used to determine the date of the earthquake.*

Key words: *earthquake, source, tectonomagnetic field, precursor periods.*

Using the formulas obtained in [1], it is always possible to determine the values of magnitude and hypocentral distance if we have the values of the parameters of the tectonomagnetic precursor of a given source being formed. But it is impossible to determine the date of an earthquake unless you have a history of the formation of the source.

The date can only be determined based on data from the harbingers of the outbreak, which appear from time to time. Since it is assumed that the duration of periods of precursors depends on the frequency of occurrence of precursors, there is a need to study the duration of periods from the first to the last precursor. This assumption is based on the following reasoning. With increasing deformation and elastic stresses inside the fault, a process of increasing density develops, with which the friction force increases, which complicates sliding between neighboring tectonic blocks. An interfering factor for free sliding is the hooking of rough near-vertical surfaces of tectonic plates. As a result, catch zones are formed – future earthquake hypocenters. Further increase in deformation and tectonic stress will lead to fragmentation within the fault. Earthquakes with small magnitudes occur. This process is repeated on larger protrusions located on the near-vertical surfaces of the blocks and continues until the moment of the main shock. The time it takes to overcome obstacles, of course, increases, as the areas of sliding surfaces increase. The response of this process should be observed on curves constructed from the values of the periods of tectonomagnetic precursors.

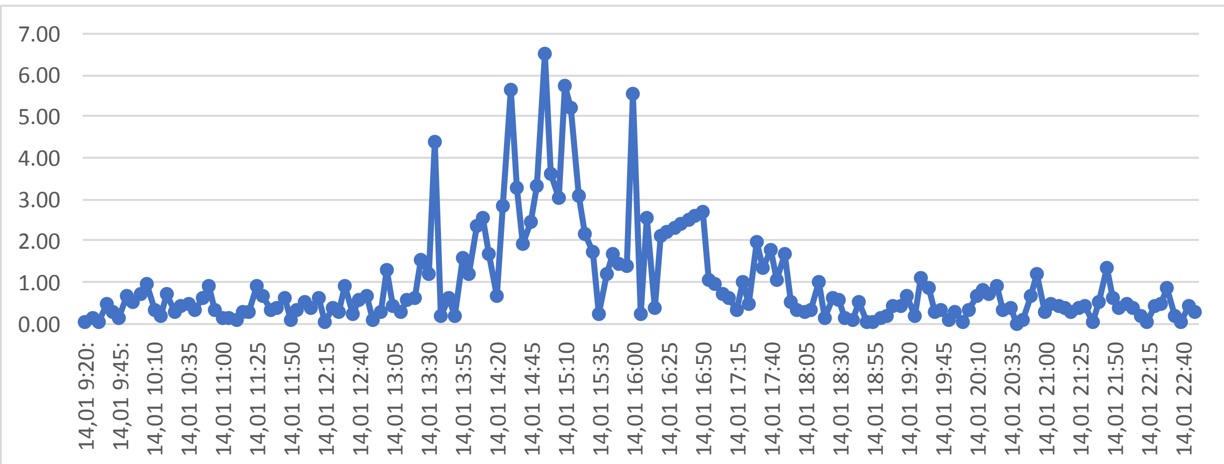

Fig. 1. A bunch of values of the rate of change of the tectonomagnetic field. For clarity purposes, the graph is plotted using modular speed values. (Geomagnetic station "Saragyugh").

To verify and confirm the above, the periods and durations of fluctuations of the precursors were studied, which repeat each other in composition and behavior of variability. Precursors of an earthquake with M=4.9, 02/13/2021. over the period of time 07/21/2019 – 02/12/2021 appeared 44 times, the response of which is observed in the form of separate beams with increased amplitudes of the rates of change. Against the background of speed variations, they differ not only in maximum values, but also in periods. (Fig. 1) shows the twenty-ninth precursor of the noted earthquake, discovered on January 14, 2021. This beam, or precursor, is observed in the time interval 1250-1850. Against the background of variations of ±0.5 nT, five amplitudes stand out with their increased values, namely (1300, 1430, 1455, 1510 and 1600). Statistics and experience allow us to make the statement that they are the tectonomagnetic effect of various emerging earthquake sources, which during the period (1250-1850) are in active dynamics.

It should also be noted that in Fig. 1 all the point values are the tectonomagnetic effect of a certain emerging source.

Studies have shown that the beam of one precursor includes many tectonomagnetic waves with different amplitudes, which arise and end during the entire period of existence of the tectonomagnetic precursor. To construct time graphs of tectonomagnetic waves, data from beams of all precursors (44 precursors) of the earthquake with M=4.9, 02/13/2021 were used (Fig. 2).

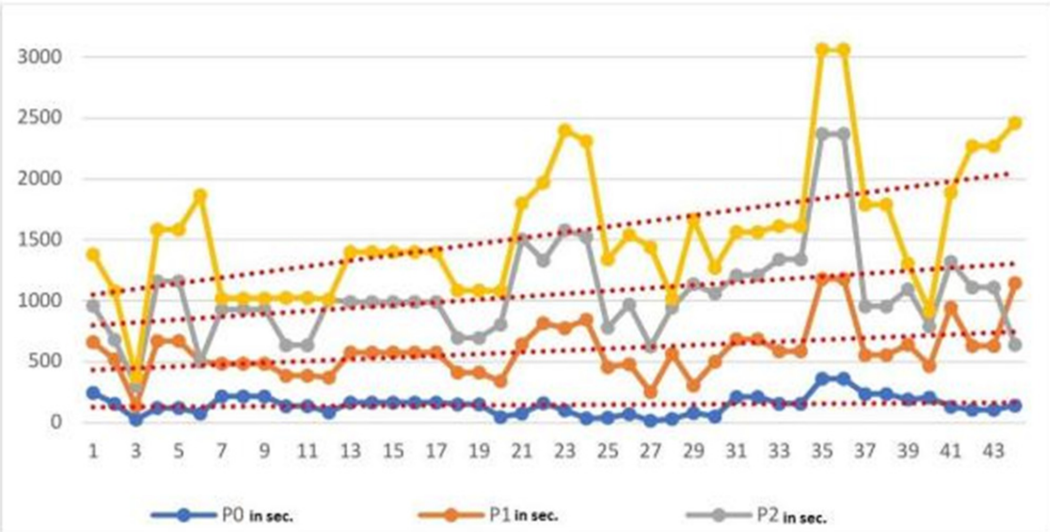

Fig. 2. Time graphs of tectonomagnetic waves in the compositions of earthquake precursors with M=4.9, 02/13/2021. The vertical axis is time in minutes, and the horizontal axis is the numbers of precursors. According to the Saragyugh geomagnetic station.

The curves are plotted based on the maximum VT values. The first curve (lower-Po) has a maximum value of VT=2nT; the second (P1) is 4nT, the third (P2) is 6nT and the fourth (P3) is 8nT.

As can be seen from Fig. 1, the values of the periods of different oscillations change proportionally, and a certain direct correlation is observed between the curves, which can be explained by a common source of influence. It is assumed that the common source for all vibrations is the regional stress-strain state. It can also be seen that as the number of the precursor increases, or as the date of the earthquake approaches, the values of the periods increase. The intensity in the form of increased amplitudes is increased at the initial stage, in the middle and at the end of the precursor. Linear correlation shows that there is a general increase, which increases with increasing period values. This is clearly expressed in the curves (P3), which are distinguished by high values of the periods included in the beam.

To estimate the parameters of the resulting earthquake sources, it is necessary to monitor the development of the source formation, during which certain parameters of the source can change within the acceptable error.

Thus, summarizing the presented material, we can say that:

1. The first step to detect the precursors of any emerging source is to find and isolate data bundles from the general background of variations in the data on changes in tectonomagnetic field velocities.
2. Estimation of amplitude values included in the beam.
3. Using the well-known formula M=2.7964*LnVT -1.2367 [1], calculate the magnitude of the resulting source of the expected earthquake. This calculation is carried out for all detected beams.
4. In the Po interval (for example, in Fig. 1 the interval 1250-1850 is taken) we determine the average value of VT, which is the local component of the tectonomagnetic field created by the source.
5. Using the formula Ro=33.4*M/TELav [1], the hypocentral distance from the observation point is calculated.
6. Time graphs are constructed following the example in Fig. 2.
7. After the appearance of the last minimum (in Fig. 2 this is the 40th point), it is necessary to monitor variations in the rates of change in the tectonomagnetic field, the values of which tend to zero. This is where you should expect an earthquake.

References

[1] Hovhannisyan S. R., Petrosyan K. K., Makaryan A. G., Gevorkyan A. A. Determination of the hypocentral distance of the earthquake source from the observation point. // “Dangerous natural and man-made processes in mountain regions.” Vladikavkaz 2022 Art. 219-223. Hovhannisjan S. R., Makarqn A. H., Geologikal and Geographical Sciences YSU, 2022., 155-160 pp.