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The Analysis of Observations of Ionospheric and Geomagnetic Time Series for Detection of Precursors of Earthquakes

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Abstract

The displays of earthquake preparation of Shorzha (Armenia, 29.05.2022, M=3.5) and Vardenis (Armenia, 29.04.2008г, M=3.6) in time-series have been studied using the geomagnetic and ionosphere tools and aiming at earthquake precursors apportionment.
There were received some results, which are allowing to make out the difference of seismogenic anomalies of ionosphere between the longer anomalies. They are connected to magnetic activity of ionosphere by the method of vertical reconnaissance of ionosphere. For a research of assessment of the current seismic hazard were studied observation geomagnetic fields and vertical sounding of ionospheric time series. Results of the analysis observation have confirmed communication between earthquakes magnitude $M \geq 3.5$ and absorption of a radio-emission of discrete radiation sources radio atmospheric observations and also dependence between and geomagnetic parameters. Lebed - A and Cassiopeia - A (ionospheric station of observation Saravand), geomagnetic station observation of Garni have been used.

Keywords: Earthquake, precursors, ionosphere, time-series, geomagnetic

Introduction

It is known, that the geophysical environment, including seismically active zones, are made up of solid, liquid and gaseous phases. In that zone of two phases separation is forming a Zone of Separated Changes (ZSC), or as they are called in physical chemistry, double ionic (electric) layers. Depending on their structure, each of the ZSC of geophysical environment is characterized by capacity, inductivity and resistance [Balassanian., 1990].

Seismic hazard assessment is carried out by continuous recording of various (electromagnetic, geomagnetic, ionospheric, etc.) symptoms in the hazard zone. Figure 1 shows observations of the daily variations of the geomagnetic field series (Garni station). For considering the geomagnetic field, the high accuracy proton magnetometers, which are measuring the T inductivity of geomagnetic field each 5 minutes, are used for measuring the geomagnetic field [Badalyan. et al., 2001]. There have been used the time – series for Saravand ionospheric and Garni geomagnetic stations.

The results obtained earlier allow to make out the difference between activity of ionosphere, by the method of vertical reconnaissance of ionosphere.
Radio astronomical monitoring method makes possible, along with immediate detection of electromagnetic emission from the Earth's depth in the selected frequency band, to observe other types of lithospheric impact on the atmosphere, such as aerosol, electrostatic, acoustical/gravitational, etc. Those sources ultimately create anomalies at different altitudes of the atmosphere, high affect the propagating radio astronomical signal [Martirosyan. R., 2006].

The method and technique of research

A new Methodology has been elaborated that provides possibility to estimate the current Seismic hazard (its intensity, location and time) with a sufficiently big probability. The elaborated methodology was used for analysis of data received in the process of perpendicular ionosphere from "Swan- A" and "Cassiopeia - A" point radio sources by radio astronomy methods. The time – series of geomagnetic field tension of T full vector.

Table 1

Year	*Month*	*Day*	*Lat*	*Lon*	*H*	*M*	*Region*
2022	*5*	*29*	*40.48*	*45.27*	*10*	*3.5*	*Armenia (Shorzha)*

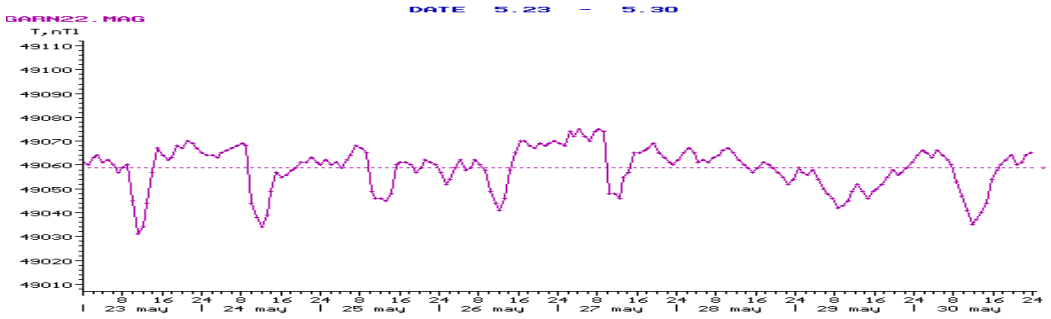

Fig 1. It can be seen that after the violation of the diurnal cycle, there were earthquakes with a magnitude m=3.5.

Swan –A Cassiopea-A

29.04.2008

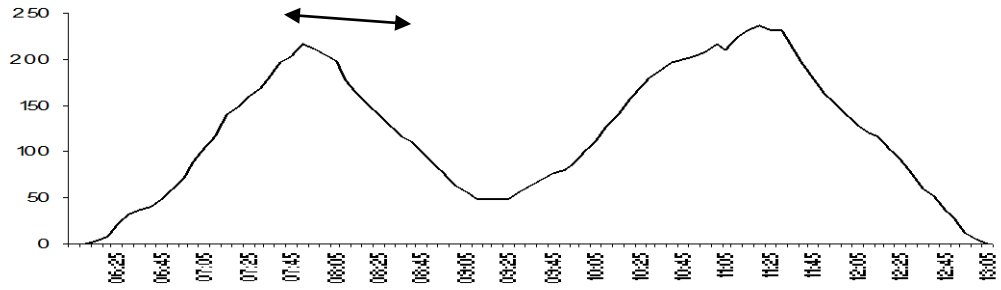

Fig 2. Radio astronomical observation of the radio emission of discrete radio sources Swan-A and Cassiopea-A before the Vardenis (Armenia, 29.04.2008, M=3.6) earthquake.

One can see a decrease in the power value of the discrete radio source Swan – a, which may be associated with seismic activity.

Conclusion

1. The above methods provide anomaly detection approximately 1-4 days before the earthquake.
2. The obtained anomalies are characterized by local dynamic changes, which are preceded by a significant and strong earthquake.

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