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***Review Article***

# MANIFESTATION OF EARTHQUAKE PRECURSORS WITH DISTANCE AND DIMENSION OF GEOTECTONIC BLOCKS

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**ABSTRACT**
The article studies the relationship between the spatial dimensions of the earthquake precursors with differently ranked seismotectonic processes and magnitude of earthquakes. The results have been discussed thoroughly.

***Keywords:*** *Earthquake Precursors, Seismotectonic Processes, Magnitude, Dependence of the Manifestation of Precursors on Magnitude*

## INTRODUCTION

The solution of main problems of earthquake forecasting, such as the development of models of preparation processes, theories and methods of forecasting is associated primarily with an estimation of spatiotemporal parameters of earthquake precursors. So far, the predominant number of domestic and foreign researches is devoted to the study of temporal parameters: the classification of precursors by time, as well as searching for relationships between medium and long-term precursors with the magnitude. Little attention is paid to the study of the features of the manifestation of precursors in relation to the distance. Therefore, the analysis of the manifestation of precursors with the distance and the establishment of their relations with the size of geological bodies depending on earthquake's magnitude is an extremely important and essential problem.

The aim of this work is to do comparative analysis of the relationships between the spatial dimensions of the manifestation of the precursors with different-ranked seismotectonic processes and magnitude of earthquakes.

Tectonic processes occur in all geological bodies. Geological bodies by dimension are clearly divided into hierarchical units. However, the separation is hierarchically clearly regular and phased. Each geological body has its own shapes and sizes. Tectonic processes in geological bodies also have their own parameters (size, age, different physical and chemical bases). In previous works (Abdullabekov, 2006; Abdullabekov and Yusupov, 2014), based on the analysis and generalization of data from various authors (Hain, 1973; Golovkov *et al.*, 1990), geological bodies were hierarchically divided into the following 5 types (by size):

1) The Earth. The linear size at the equator is 40,000 km. The average depth (radius) is 6371 km.
2) The average linear size is 12738km. Depth 2000-2100 km. They correspond to tectonic plates - Pacific, African, Indo-Australian, Eurasian etc. On the borders of these lithospheric plates, earthquakes with a magnitude of M=8.25–9 are possible (Chilean, 1960, M=8.8; Alaska, 1964, M=8.8; Sumatra, December 26, 2004, M=9; Japanese, March 11, 2011. M=9.0, etc.).
3) Includes regions with large lithospheric plates. Linear dimension is about 4000 km, average depth H=650 km. In the Asian region, the seismic belt passes through the territory of Iran, Afghanistan and further in the southeast direction. The width of the zone is 3000-4000 km. Strong earthquakes with magnitudes M=7.25-8.2 are possible here (Chilean, 1889, M=8.2; Kashgar, 1902, M=8.2; Karatag, 1907, M=7.5; Kebin, 1911, M=8.2; Haiti, 1949, M=7.5; Gazli, 1976 and 1984, M=7.0, 7.2 and 7.3; Sichuan, 2005, M=7.5; Nepal, April 25, 2015, M=7.9).
4) This type combines a system of several mountain ranges. Morphometrically correspond to parts of mountainous countries. For example, Northern Tien-Shan, Southern Tien Shan, Northern Pamir,

Southern Pamir, etc. The average linear size ($L_{av}$) -1292 km. Depth 206km. Strong earthquakes with magnitude M=6.0-7.0 are possible here.

5) The average linear size ($L_{av}$) is 411.5 km. They correspond to mountain ranges, seismogenic zones, etc. For example, Chatkal, Kuram, Ferghana, Zerafshan, Gissar, etc. Strong earthquakes with a magnitude of M=5.0-6.0 are prevail here.

6) The average linear size ($L_{av}$) is 131km. Earthquakes with magnitude M=5 and below are possible here.

Consider the relationship of the spatial distribution of precursors according to the types (by size) of tectonic units. For this, the dependence of the spatial manifestation of the precursors on the magnitude of earthquakes was investigated. Columns 2-6 in the Table 1 show the dependences of the epicenter distances of the manifestation of the precursors on the magnitude of earthquakes according to Dobrovolsky [1991], Sadovsky et al [1979], Ulomov [1977] and Abdullabekov and Tuychiev [2014]. Column 7 represents their average values, column 8 shows linear sizes of various ranks of tectonic structures (Abdullabekov, 2006; Abdullabekov and Yusupov, 2014; and Hain, 1973) in column 9 - sizes of seismically active regions according to ranking of Golovkov *et al.* [1990] and in column 10 - sizes of blocks of the earth's crust and continental plates according to Sadovsky [1979].

As can be seen from the table, the average values of the radius of manifestation of the precursors (column 7) and the linear sizes of geotectonic units (column 8: plates, continents, oceans, mountain structures, etc.) for the same magnitudes are close to each other.

**Table 1: Comparison table of epicentral distances of manifestation of precursors with the sizes of tectonic units (plates, structures, blocks) and seismically active areas with earthquake magnitude**

| M | $e^M$ km [5] | 20P [7] | 0.204M+1 [8] | 0.35M+0.04 [6] | 0.46M+0.08 [9] | $R_{av}$ | L.km [1-3] | $R_{av}$ [4] | L.km [10] |
|---|---|---|---|---|---|---|---|---|---|
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
| 4 | 53.9 | 26 | 65.5 | 27.5 | 70.5 | 48.68 | 41.7 | | |
| 5 | 146.2 | 88 | 104.7 | 61.6 | 173 | 114.7 | 131 | 30-40 | 100 |
| 6 | 396.1 | 300 | 167.5 | 138 | 691.8 | 338.68 | 411.5 | 150-250 | |
| 7 | 1073.5 | 1000 | 267.9 | 303 | 1995 | 927.88 | 1292 | 800-1000 | |
| 8 | 2909.1 | 4200 | 428.5 | 691 | 5754 | 2796.54 | 4000 | 2000-4000 | 5000 |
| 9 | 7883.6 | 12000 | 685.6 | 1549 | 16600 | 7743.64 | 12739 | 40000 | |

The distances of manifestation of the precursors are also compared with the sizes of seismically active regions identified by Golovkov and others [Golovkov, *et al.*, 1990] and with the sizes of blocks of the earth's crust and continental plates according to Sadovsky [1979]. The convergence of the sizes of seismically active regions [Hain, 1973] with the scale of precursors and continental plates [Sadovsky, 1979] with the scale of precursors is close to each other. Especially close convergence is observed for precursors of earthquakes with magnitudes M=7 and M=8.

The figure shows graphs of changes in the average values of the radius of precursors ($R_{av}$) and the sizes of geotectonic blocks (L) depending on the magnitude. The average radius of manifestation of the precursors

is expressed by the formula $R_{av}$=3184Lg(M)-1497, and the linear dimensions of geotectonic blocks are expressed by the formula L=5094Lg(M)-2484. These dependences are reliable starting from M=4 and higher. The close convergence between the average distances of the precursors and the linear dimensions of geotectonic units is clearly seen from the figure.

The close convergence of the graphs of changes in the scale of precursors with the size of geotectonic blocks depending on the magnitude is not random, they are interconnected. The scale of precursors strictly obeys the hierarchy of sizes of geotectonic structures. Large scope of precursors is inherent in large geological structures. In other words, large earthquakes cannot occur in small geotectonic blocks.

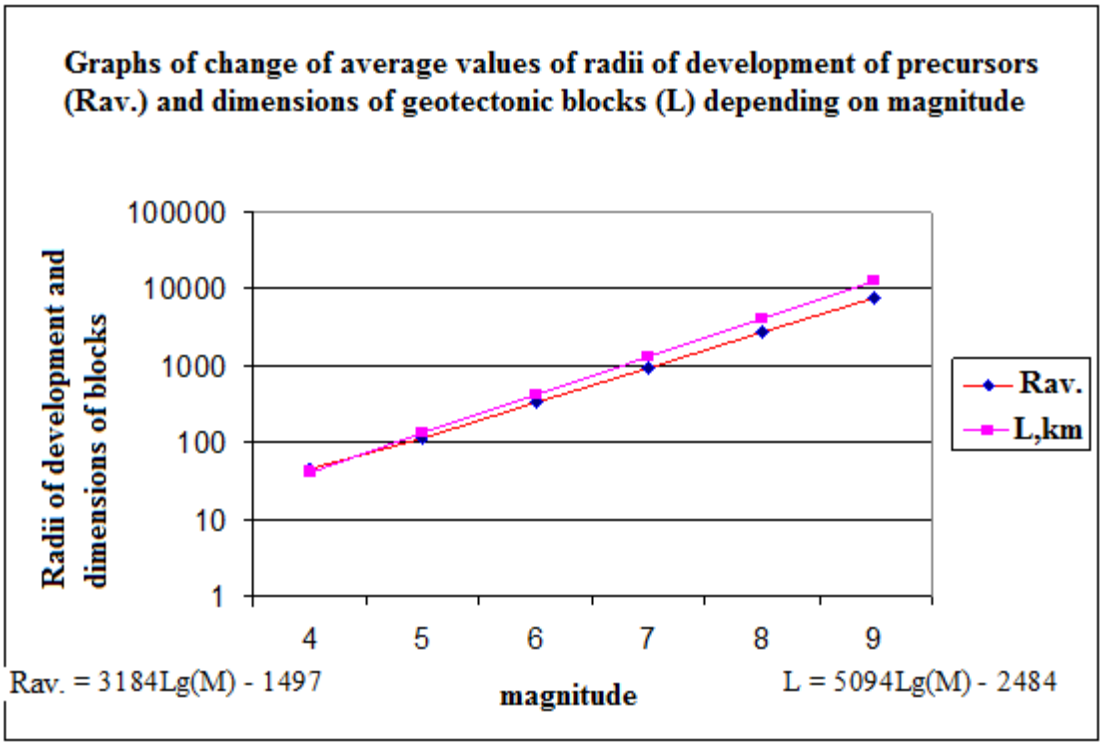


**Figure 1. Graphs of changes in the scale of manifestation of precursors (a) and sizes of geotectonic blocks (b) depending on the magnitude**

## CONCLUSION

Earthquakes are the product of processes occurring at various depths of the Earth, ranging from the core-mantle to the earth's crust. It seems that earthquake precursors should be called up with seismotectonic processes of different depths and physical phenomena. Based on this position, the presence of a close relationship between the spatiotemporal dimensions of the precursors of earthquakes and different types (by size) seismotectonic processes, as well as geological bodies, is natural. Despite the evidence of these facts over many decades, little attention has been paid to the relationship of the spatial dimensions of the manifestation of precursors with the sizes of geological–tectonic units and the various processes occurring in them. Often in scientific researches that are concerned to earthquake source models, forecasting theory and the physical foundations of precursors, various theoretical calculations were performed for homogeneous media. Different calculations of the expected anomalous manifestations with the distance and time were constructed for homogeneous isotropic media. The results of summarizing the data of many years of research on the features of the spatiotemporal manifestation of precursors in Uzbekistan

and other countries show that the spatiotemporal features of the precursor manifestation primarily depend on the size of the geological bodies and the seismotectonic processes occurring in them.
Thus, the scale of manifestation of the precursors obeys the hierarchical distribution of the types (by size) of geotectonic units, the larger the area of distribution of the precursors, the larger sizes of the geotectonic units and the magnitude of the earthquakes will occur.

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