

**LETTERS TO PROGRESS IN PHYSICS****Bio-Precursors of Earthquakes and Their Possible Mechanism**

Takhir R. Akhmedov

333 S. Webster Ave, Suite 4, Norman, OK 73069. E-mail: TakhirAkhmedov@yandex.com

People observed anomalous behavior of animals prior to powerful earthquakes since ancient times. Only in mid-20th century scientific community got interested in understanding what makes some animals “sensitive” to approaching earthquakes. Questions were raised of whether we are truly observing anomalous behavior or just interpreting it as such after the earthquake. Do animals actually “feel” the earthquakes? What are the stimuli impacting animal behavior? Scientists looked at chemical composition of ground water, release of some gases, sound booms and even electromagnetic activity as potential stimuli. With no comprehensive and systematic study of animal behavior prior to, during and after powerful earthquakes no plausible hypotheses explaining the sensitivity exist at this point. In this article, we propose a possible mechanism based on gravitational receptor, which each and every animal possess.

Accurate prediction of powerful earthquakes is one of the important problems faced by modern geophysics.

Rikitake (1979) presented extensive research data used for predicting earthquakes and tried to provide theoretical explanation [1]. While existing instrumental and statistical methods of predicting earthquakes allow identification of some patterns of future earthquakes, they do not answer the most important questions — the magnitude of future earthquake and its precise time. Geller (1997) states that “extensive searches have failed to find reliable precursors” [2]. He further notes that “theoretical work suggests that faulting is a non-linear process which is highly sensitive to unmeasurably fine details of the state of the Earth in a large volume, not just in the immediate vicinity of the hypocentre” [2].

Usually powerful earthquakes are accompanied with rapid increase in speed of vertical shift of Earth’s crust in epicenter and adjacent areas. For example, after Ashkhabad, Turkmenistan, earthquake (October 5, 1948) as a result of leveling an increase in speed of vertical shift of Earth’s crust with a maximum near Ashkhabad was identified. Similar observation made during Tashkent, Uzbekistan, earthquake (April 26, 1966).

Therefore, we can assume, that prior to powerful earthquakes an increase in speed of vertical shift of Earth’s crust can be observed.

In recent years scientists got interested in the anomalous behavior of animals prior to powerful earthquakes. Even though anomalous behavior of animals is long known, scientific community only recently started researching this phenomenon. In late 1976, USA hosted the first conference on this subject.

The most important task facing scientists is identification of the physical nature of the processes, which lead to anomalous behavior of animals prior to powerful earthquakes.

Out of four types of forces (electromagnetic, gravitational, strong and weak) only electromagnetic and gravitational forces could be related to the mechanism of sensitivity of bio-precursors of earthquakes. Characteristics of Earth’s electromagnetic field experience significant variations, which may impact sensitivity of the mechanism. Therefore, we will not consider electromagnetic force as the main force, which impacts the mechanism of sensitivity of bio-precursors of earthquakes. Let’s consider gravitational force as the main force.

It is known that biological objects evolved within constant influence of gravitational field of the Earth. This lead to the creation of apparatus, gravitational receptor, allows biological objects to orient themselves in gravitational field [3]. Gravitational receptor basically consists of two main parts — “proof mass” with a mass  $m_p$ , which is capable of moving within the organ and around receptors that react to the changes of position of “proof mass”.

One essential peculiarity of gravitational field is its constant presence and our inability to shield against its impact, i.e. all-pervading nature of the field.

One of the main characteristics of the gravitational field is free-fall acceleration  $g$  (analogous to the electric field intensity  $E$ ). With changing characteristics of the field changes the force, which impacts the “proof mass” with the mass  $m_p$ . Such changes are possible prior to powerful earthquakes. However, there have not been successful measurements of such changes due to inadequate sensitivity of the instruments.

Biological objects, it seems, are able to react to the speed of changing free-fall acceleration parameter, which results from vertical shift of Earth’s crust. If we consider the value of sensitivity of biological objects to such changes as  $m_p/M$ , where  $M$  is mass of the Earth, then biological objects are able to sense relative changes of the free-fall acceleration resulting from a vertical shift of Earth’s crust, numerical value of

which exceeds  $m_p/M$ . Evaluations showed that speed of relative changes of free-fall acceleration, resulting from vertical shift of Earth's crust, exceeds maximum sensitivity of gravitational receptors of biological objects.

Thus, we conclude that biological objects, using signals from gravitational receptors, can react to the relative local changes of gravitational field prior to powerful earthquakes.

For experimental test of the proposed mechanism, we would suggest experiments with biological objects used as sensors of characteristics of gravitational field via continuous recording of bioelectric current from gravitational receptor during rapid increase in speed of vertical shift of Earth's crust in active seismic zones.

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## References

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