Project Title:  Study of Modern Geodynamic Processes of Seismic Regions using Magnetotelluric Sounding Methods (by the example of Tien Shan)

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**Main Results of the Project in 2017**

The purpose of the project is to solve the fundamental problem of the Earth studies – the problem of studying modern geodynamic processes in a wide range of phenomena – from disastrous (earthquakes, landslides, karst formation etc.) to virtually unnoticeable changes of stressed and deformed state of geologic environment. These processes become apparent in different physical fields and physical parameters including electromagnetic fields and electromagnetic parameters of lithosphere. To create tools of electromagnetic monitoring of modern geodynamic processes, the Project involves the solution of a number of theoretical and practical tasks within the scope of development of new approach to processing of magnetotelluric sounding data (MTS) to single out endogenous electromagnetic fields.

On the basis of analytical solution found for the direct problem of MTS using continuation of a field, we suggested an approach according to which endogenous electromagnetic field enters into impedance relations by an additive way. Such linear relation allows distinguishing the electromagnetic field recorded at daylight surface by the position of sources. The main idea of algorithm is that using the known impedance of lower half-space we need to find the difference of tangent components of electromagnetic field recorded at daylight surface. For implementation of this algorithm, we developed the MTS data processing program to single out the sources of

endogenous electromagnetic field.

As a result of processing of historical MTS data received by the Research Station RAS in Tien Shan region, the components of endogenous electromagnetic field were singled out for a number of MT observation sites and their energy characteristics were calculated. In the received processing results we revealed a periodic component in behavior of the curves of energy characteristic of endogenous electromagnetic field with a period of 12 hours.

Such behavior of endogenous electromagnetic field energy characteristic called for their comparison with luni-solar tides. For the 3-day field recording of MTS observation site 901, we compared energy characteristics of the singled out endogenous electromagnetic field with parameters of luni-solar tides, and we found out that the reason of changes in energy characteristic of endogenous electromagnetic field are luni-solar tides. Thus, we can define a task of detecting the cause-effect relation between luni-solar tides and energy characteristic of endogenous electromagnetic field. Moreover, there is a time delay between luni-solar tides and changes in energy of endogenous electromagnetic field. Thus, for the MTS site 901, this delay period made up 2.2 hours. In other words, first we see changes in luni-solar tides, and then 2.2 hour later we see chances in the energy of endogenous electromagnetic field.

Further in the project we considered the idea about the relation between endogenous electromagnetic field energy and variations of electric resistance of geologic environment, which calls for its practical corroboration. Using the results of magnetotelluric monitoring at Kambarata site and their comparison to isolated components of endogenous electromagnetic field, we detected a stable relationship between anisotropy of electric resistance and energy characteristic of endogenous electromagnetic field. Therefore, modern geodynamic processes cause changes in structural and textural characteristics of rocks which are expressed both in reversible processes (closing and opening of cracks) and irreversible process related to crack formation processes. This single geodynamic process manifests itself in two related phenomena – changes of electric resistance of geological environment and generation of electromagnetic field sources.