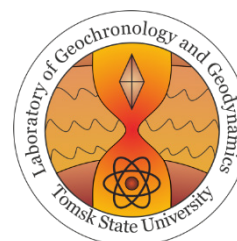


МИНИСТЕРСТВО НАУКИ И ВЫСШЕГО ОБРАЗОВАНИЯ РОССИЙСКОЙ ФЕДЕРАЦИИ
НАЦИОНАЛЬНЫЙ ИССЛЕДОВАТЕЛЬСКИЙ
ТОМСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ



Attraction of the leading scientists to Russian institutions of higher learning, research organizations of the governmental academies of sciences, and governmental research centers of the Russian Federation



**LARGE IGNEOUS PROVINCES THROUGH EARTH HISTORY:
MANTLE PLUMES, SUPERCONTINENTS, CLIMATE CHANGE,
METALLOGENY AND OIL-GAS, PLANETARY ANALOGUES
(LIP – 2019)**

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**КРУПНЫЕ ИЗВЕРЖЕННЫЕ ПРОВИНЦИИ В ИСТОРИИ ЗЕМЛИ:
МАНТИЙНЫЕ ПЛЮМЫ, СУПЕРКОНТИНЕНТЫ, КЛИМАТИЧЕСКИЕ
ИЗМЕНЕНИЯ, МЕТАЛЛОГЕНИЯ, ФОРМИРОВАНИЕ НЕФТИ И ГАЗА,
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FEATURES OF COMPOSITION AND PLASTICITY OF TWO ASTENOSPHERES OF PLANET EARTH

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Since ancient times, facts are known about the rapid movement of rock blocks and changes in their properties. The great thinker and politician B. Franklin wrote in 1782 "In my opinion, such changes in the near-surface parts of the Earth could not have happened if the Earth was solid inside. There may be a fluid, denser and heavier than any solid body we know, which could therefore float inside or on top of that fluid. Then the surface of the Earth should be something like a shell, which can be pierced and broken by powerful movements of the fluid on which this shell rests."

O. Fisher in 1889 in his work "Physics of the Earth's Crust" led the first scientifically based mobilistic ideas in the form of the concept of compression and stretching of the crust. The actual material was the discovery of two global active zones. One of them is the young mountain systems with their corresponding deep-sea depressions and island arcs that surround the Pacific Ocean and stretch across the Himalayas to the Alps and the Mediterranean. The other is the system of mid-ocean ridges (MOR) over land in East Africa, Iceland and in the West of North America. In the first system, the forces of compression and contraction of the cortex predominate, in the second, signs of its stretching and expansion. Both systems have not only global scale, but also cyclic activity and, probably, positive feedback between each other.

The first fairly reasonable ideas about the continental drift are associated with the names of A. Snyder, (1858) and A. Wegener (1912), whose views were developed (G. Baker, J. Darwin, F.B. Taylor, etc.). In 1925, an extended mountain range was discovered in the middle of the Atlantic Ocean. In 1953, physicists M. Ewing and B. Chizen discovered that along the submarine ridges the troughs extend - deep faults in the earth's crust. Somewhat later, G. Hess suggested that the MOR system is an area where a new oceanic crust is constantly being born.

So formed the main manifestation of plate tectonics. The methods were improved, a lot of hypotheses accumulated (about the age of the ocean floor, drift velocity, plate motion parameters, types of boundaries between the plates, on ore deposits above the subsurface zones, etc.), but the mechanism controlling the generation of the Earth's internal heat and plate drift one remained - convection-plume currents in the "subcrustal substrate".

In Russia, for a number of reasons, in the 60-70 s the "continental" thinking continued, therefore a new theory was born here "in spite of". The direction "Underground Thunderstorm" under the direction of physicist A.A. Vorobyov. It was born on the ideas of the Frenchman Georges Dari, expressed in 1885, and academicians V.A. Obrucheva and M.A. Usov (1936-1940). This direction was developed in the works of Professor TPU V.N. Salnikov. We have worked together for many years, obtained new experimental data on the geometry of constructive interference, the effect of which is similar to the effect of proton or impurity or defective superlattices. From a position of quantum-mechanical principles, A.A.

Friedman pointed out the possible proton-like structure of the Universe.

Since the end of the 70-s, E.A. Kozlovsky, A.V. Peive, S.A. Ushakov, V.E. Khain, O.G. Sorokhtin, L.P. Zonenshain, E.G. Mirlin, M.I. Kuzmin, V.M. Moralev, N.L. Dobretsov, L.M. Natapov and others publish results on global tectonics and its connection with mineral resources, mineralogical and petrogenesis. Concerning the reasons for convection, it appeared that it was thermal, according to the principle of V.J. Pfan, or caused by radioactivity. O.G. Sorokhtin and his colleagues developed a mechanism for the chemical- density gravitational differentiation of terrestrial matter in the framework of the first law of thermodynamics.

For more than half a century of the space age, man learned about the structure of the Earth much more than in the entire previous history. A need and opportunity has emerged to develop on a modern scientific basis a conceptual theory of the geodynamics of the Earth. In recent years, progress has been made in the synthesis of Euclidean and non-Euclidean representations of space. We are engaged in the theory of geodynamics of the Earth since the early 70-s of the twentieth century based on the concepts of spatially closed dynamic structures (CDS), which are a function of the autointerference of wave perturbations of space. The space is structured by areas of constructive and destructive interference. Areas of constructive interference exhibit signs of matter. By themselves, areas of constructive interference are coherent, but differing in phase and field sources. This "secondary" field creates its own interference grid both within the system and in its immediate environment, identical to those that arise in the fractal theory. The interaction of areas of constructive interference ultimately generates the interference structuring of the following hierarchical levels of space and defines a single mechanism for the formation of real dynamic systems of any scale. In this sense, the most striking manifestations are visible in the periodic structures of metals. But the internal structure of the planet, its relief and the location of planets and even galaxies are the result of resonating interference patterns of various hierarchical levels.

So, the geoid of the Earth and the surrounding air sphere (ionosphere) is a giant spherical resonator. The first to discover the low and ultra-low electromagnetic pulsations of the Earth's atmosphere, Nikola Tesla, then the physicist V.O. Schumann and doctor G. Koenig. They proved that in the Earth's atmosphere there are standing electromagnetic waves called "Schumann waves". These waves are the natural electromagnetic frequencies of the Earth. One of them, the main one, is on average 7.8 Hz. And yet, with these resonances in a new way, we need to approach the concept of "self-organization" and the knowledge of the limits of self-organization.

The principles of CDS have found application in crystallography of real crystals, in technical mineralogy and materials science in the management of material properties.

When applied to a geoid, firstly, the system under study

is complicated; it includes, in addition to the lithosphere and the mantle, all internal and external geospheres. Secondly, all CDS are the functions of the autointerference of the wave disturbances of space. The condition for the occurrence of autointerference is the Poynting vector closure. The most adequate mathematical apparatus for describing closed dynamic structures is the torus geometry, which interprets the Clifford surface. Thirdly, the transfer of matter in the torus space occurs along closed trajectories, when the torus rotates the inversion from the outside to the inside and from the inside to the outside. This transfer causes the birth and growth of all internal coordinated closed spaces (geospheres) and allows (taking into account the change in the size of the geoid) to simulate the dynamics of continental drift.

Modern resonant field theory of geodynamics. Near the center of the torus, the speeds of motion of the substance are maximum, and to the periphery they fall to a minimum, like the structure of a tornado. Therefore, intensive movement here under the action of both longitudinal and transverse vibrations unambiguously leads to the formation of gaps and the dismemberment of the shells. The wave (holographic) nature of tectonic activity, geodynamics is reflected in the structuring of the earth's crust and other geospheres. With the addition of vibrations, the method is used by A. A. Lissajous.

Based on the behavior of the geoid's own long-period oscillations, a rheological model of the Earth was created, in which two asthenospheric intervals were identified:

1) at depths of 10 – 225 km (belt B”);

2) 2700 - 2885 km - boundary layer D “between the lower mantle and the outer core, which should be reflected in the fundamental features of geodynamics, starting with the mechanisms for generating the internal heat of the planet.

Basalts are presumably in the molten state in the upper mosaic-discontinuous asthenosphere B”, since their melting points are lower than those of peridotites, which are here in the solid state. Basaltic magma smelting takes place in the process of partial melting of typical mantle rocks, harzburgites, verulites, etc. The smelting composition is determined by the chemical and mineral composition of the protolith by physical and chemical melting conditions, the degree of melting and the melting mechanism. According to experimental data, the melting points of silicates in the presence of water have a minimum in the pressure range of 500–1000 MPa.

In the lower asthenosphere belt D”, the melt is represented

by iron in low spin states (at temperatures below 2200 K) in a silicate matrix of ferripericlase (Mg, Fe) O and (Mg, Fe) SiO₃ with a perovskite structure. The asthenosphere behaves as an overheated and extremely viscous fluid, where an increase in electrical conductivity and a decrease in the velocity of seismic waves, indicating the manifestation of its plasticity.

For a long time (before Maxwell's theory), the plasticity of the asthenosphere was largely hypothetically explained by the fact that the substance is either in an amorphous state or in a semi-molten state. In geological sections, the manifestation of the plastic properties of rocks, starting with the micro level in the form of flow patterns in olivine crystals and up to various folds, diapirs is a confirmation of this. The theory of electromagnetism of Maxwell received full experimental confirmation and became the generally accepted classical basis of modern physics and should be used by geodynamics. The role of this theory was vividly characterized by A. Einstein: “... there was a great turning point, which is forever associated with the names of Faraday, Maxwell, Hertz. The lion's share in this revolution belongs to Maxwell. After Maxwell, physical reality was conceived in the form of continuous fields that could not be mechanically explained ... This change in the concept of reality is the most profound and fruitful of those that physics has experienced since Newton.” Therefore, from the position of the Maxwell relaxation time τ (reaching equilibrium of the system), the effect of plasticity becomes possible under the condition that the time of action of forces t exceeds many times τ :

$$t \gg \tau.$$

With dynamic compression over a geological time in excess of about 30,000 years, under the effect of all-round pressure at depths where the pressure is weaker than temperature (close to the liquidus), any hard part of the lithosphere is able to experience a flow like a viscous fluid.

Potential mechanisms for the generation of internal heat on the new model. The proposed theory allows the problem of energy sources to be solved at the modern level due to a whole range of new mechanisms instead of convection and plumes: 1) Subastospheric hot spots; 2) Electron-gas; 3) Comet-asteroid; 4) Friction heat of liquid in the outer core during the rotation of the Earth; 5) The heat of gravitons and nucleons based on analogies between electromagnetic and gravitational fields, generating proton purge.

TRIGGER EFFECTS OF GEODYNAMICS AND GLOBAL TOXICATION OF THE ATMOSPHERE

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The concepts of trigger effects developed in studies of the formation and development of the geodynamics of the lithosphere encompass a wide range of phenomena considered by tectonophysics, geomechanics, geodynamics, planetology, petrology, geochemistry and other sciences. But such approaches are not yet properly implemented. The empirical connections of magmatism and mineralization in most cases have exhausted their capabilities and do not help to isolate metallogenic taxa of various ranks, therefore, under the influence of mobilistic hypotheses, models of magmatic and ore

formation are actively developed in connection with plume tectonics. The lack of ideas is due to the fact that the place and mechanism of energy generation for plumes has not changed for a long time. These were convection-plume foci in the “subcrustal substrate”. For more than half a century of the space age, man learned about the structure of the Earth much more than in the entire previous history. A need and opportunity has emerged to develop on a modern scientific basis a conceptual theory of the geodynamics of the Earth, an alternative to convection-plume.