Astronomical and Astrophysical Transactions (*AApTr*), 2016, Vol. 29, Issue 3, pp. 377–388,
ISSN 1055-6796, Photocopying permitted by license only, ©Cambridge Scientific Publishers

The forced relative displacements of shells of planets and satellites as the main mechanism for variation of their natural processes

Yu.V. Barkin†

Lomonosov Moscow State University, Sternberg Astronomical Institute, Moscow 119991, Russia

Received 15 September, 2015

The key issue of the theory of natural planetary processes on the Earth and other celestial bodies at all times in the history of the earth sciences posed a question about the source of energy that provides unprecedented activity of the planet and many other celestial bodies. We offer a solution to this difficult question about the sources of endogenous activity and about the primary mechanism of excitation energy of the planets, satellites, the Sun based on the mechanism of excitation of their shells by external celestial bodies. The main geodynamic substance of the developed concept is that the planets, moons and sun are a defined systems of shells (of the core, mantle, and others) and commit the relative translational and rotational motion and deformations due to the gravitational mutual influence of the surrounding celestial bodies. We have developed the foundations of the geodynamic models and described the main types of motions of these shells. In particular, the tides have been studied in a viscous elastic mantle of the planet which are generated by the gravitational interaction with the movable core. These tides lead to dissipation of mechanical energy in the material of the planet (in its mantle), which is converted into heat and the temperature field inside the planet is generated. As a result, the heat flow is defined as integral (global) and heat flows in the northern and southern hemispheres.

From positions of geodynamic model of the forced gravitational swing, wobble and relative displacements of shells of a planet are studied and some fundamental problems of geodynamics, geology, geophysics, planetary sciences are solved etc. We discuss the mechanism of cyclic variations of activity of natural processes in various time scales; the power of endogenous activity of planetary natural processes on planets and satellites; the phenomenon of polar inversion of natural processes on planets and satellites; step-by-step and catastrophic changes of activity of natural processes; the phenomenon of twisting of hemispheres (latitude zones or belts) of celestial bodies; formation of the pear-shaped form of celestial bodies and the mechanism of its change; the ordered planetary structures of geological formations; the phenomena of bipolarity of celestial bodies and antipodality of geology formations and others. To some of these phenomena on the Earth and other solar system bodies we give illustrative explanation. Based on

†Deceased

the proposed mechanism the foundations of the theory of natural processes are developed and explained.

1 Introduction

The key issue of the theory of natural planetary processes on the Earth and other celestial bodies is the question of the sources of energy of endogenous activity of underlying mechanism of energetic cyclic excitation of celestial bodies. We offer a solution to this age-old problem, based on the excitation mechanism of shells of given celestial body by external celestial bodies. The main provision of developed geodynamic concept is that the planets, satellites and the Sun are systems of shells (core, mantle, and others) that commit to each other the small translational – rotational motions and deformation and other changes under the gravitational influence of all the surrounding celestial bodies [1, 2].

We have developed the basics of the geodynamic model and described the main types of these relative motions of shells. Tides have been studied in a viscous-elastic mantle of the planet, which are generated by the gravitational forces of interaction with a moveable core. Their change in time leads to the scattering of mechanical energy in the material of planet (in its mantle), which is converted into heat and generates a temperature field inside the planet. We have shown that this energy problem is solved by the gravitational geodynamic mechanism of the forced relative oscillations of the core and mantle of a celestial body [2]. These displacements lead to a shift of the core center of mass of the Earth relative to the mantle, which is currently available for the study of space geodetic techniques (satellite methods). Currently, a wide range of oscillations of the center of mass of the Earth is revealed and its secular trend in a northerly direction is discovered (in the area of the Taimyr Peninsula) [3, 4] (Fig. 3). On the other hand in the displacements of the center of mass of the Earth [5] we can restore the style and features of the relative displacements of the core and mantle of the planet, to study geodynamic consequences of these shifts, such as deformation of the layers of the mantle, the variations of its elastic energy, power dissipation and heat flux of the planet, and other physical fields, redistribution of the masses of fluid, etc.

As a result of solving the problem of the theory of elasticity the strain rate tensor of the planet was determined and the averaged temperature field inside the planet was studied. An integral heat flux of the Earth was estimated and these studies actually solve the energy issue in the life of planets and satellites. In particular, the power dissipation of the elastic energy of the Earth's mantle for the observed motions and oscillations of the center of mass (or core) according to our estimates may be 1,000–10,000 terawatt (TW) [6, 7]. This gigantic power value explains all of the endogenous activity and energy balance for all geodynamic and geophysical processes of the Earth. In fact, energy is drawn from the translational-rotational motion of celestial bodies. The regarded geodynamic model of synchronous relative displacements of shells of the solar system bodies (oscillation core and mantle) explains the basic properties of planetary processes on the Earth and other planets, satellites and Sun: cyclicity, unity, synchronicity, inversion, polar activity jump process, sawtooth, orderliness, twisting layers of the mantle, pear shaped form of celestial bodies, universality. The reported

phenomena and properties of endogenous activity of celestial bodies in the report are illustrated by natural processes on the bodies of the solar system. In particular we have established and interpreted synchronicity abrupt changes of natural processes on the Earth, the Sun, the Moon and Mars.

The key issue of the theory of natural planetary processes on the Earth and other celestial bodies, is the question about the sources of endogenous activity and the underlying mechanism of energetic excitation of celestial bodies. We offer a solution to this difficult question on the basis of the mechanism of excitation of the shells of a celestial body by gravitational attraction of the external celestial bodies. The main provision of the developed geodynamic concept lies in the fact that the planets, moons and the Sun are a defined system of shells (of the core, the mantle, and others), which make to each other translational-rotational motion and deformation changes under the influence of other external celestial bodies. The main exciting factors of systems of shells of the celestial body (planets, satellites, stars, pulsars, etc.) are their non-sphericity and the eccentricity of their mutual positions [1, 7].

We have developed the fundamentals of this geodynamic model of the forced and free oscillations of the shells. In particular, the tides in the viscous-elastic mantle of the planet, which are generated by the gravitational forces of interaction with the movable core. They change over time and this leads to the dissipation of the mechanical energy in the material of planet, which is transformed into heat and generates the temperature field inside the planet. As a model of the non-deformed planet we consider viscous elastic homogeneous sphere, the material behavior is described by the Kelvin–Voigt model. It is determined by the strain rate tensor of deformations of rotating planet and the average temperature field inside the planet. The integral heat flow is global so are determined in the northern and southern hemispheres of the Earth. The most important question, of course, at all times in the history of geosciences was the question about the source of energy, which provides unprecedented activity of the Earth, and many other celestial bodies. The known energy mechanisms such as radiogenic heat, tidal friction and others cannot explain either by a total energy or cyclical processes, not to mention the above fine planetary phenomena of inversion, step-by-step phenomena, the activity of the polar regions and others [2]. The current research clearly shows that tidal friction gives only a small contribution to the total observed heat flow of the Earth ($\sim$0.4 TW) across the surface of the Earth, which is currently estimated at 46$\pm$3 TW, i.e. order of one percent. The dissipation of tidal energy on Enceladus can explain only 1 part of 27 of the observed heat flow. The dissipation of tidal energy in the satellite Io explains only a small part of the observed heat flow and the endogenous activity of the satellite. All these problems are solved with the help of the geodynamic mechanism of the forced relative oscillation of the core and mantle of the Earth [2]. These displacements of the core lead to a shift of the center of mass of the Earth relative to the mantle, which is currently available for the study of space geodetic techniques (satellite methods). Currently, a wide range of oscillations of the center of mass of the Earth is revealed [4, 5] and the secular trend towards the north discovered (the area of the Taimyr Peninsula) [4, 7].

On the other hand, the displacements of the center of mass of the Earth can restore the style and features of the relative displacements of the core and mantle of the Earth; the study of geodynamic consequences of these shifts, such as physical fields, the redistribution fluid masses and other studies carried out effectively solve the

energy issue in the life of deformation of the mantle, the variations of its elastic energy, power dissipation and heat flux of the planet, the other the planets and satellites [6–9].

2 Geodynamic and geophysical properties of planetary processes due to oscillations in the shells of celestial bodies

The proposed mechanism of excitation of the shells of a celestial body (planets, satellites, sun) under the gravitational influence of the bodies of the solar system is a determining factor in the organization of natural processes and the changes in their activity. It is possible to explain many of geodynamic and geophysical phenomena on the Earth and other bodies of the solar system. On the basis of the mechanism under discussion the phenomenal properties of the observed natural processes on the Earth, the other bodies of the solar system, and the bodies of exoplanet systems were explained [2]: power of natural processes; cyclical nature of natural processes; steps in the activity of natural processes spasmodic; sawtoothed activity of natural processes; unity and synchrony variations of planetary processes; increased activity of natural processes in the polar regions of the planets and satellites; inversion of natural processes in opposite hemispheres of celestial bodies (in particular the northern and southern hemispheres); twisting phenomenon hemispheric bodies in the solar system; the phenomenon of ordering geological, tectonic and other structures [7–9].

Now it is important to emphasize that these properties of natural processes should be observed in a variety of time scales from hours to galactic time scales (hundreds of millions of years). These properties are universal and apply to all bodies of planetary and solar systems of the universe. All these properties are geodynamic and geophysical consequences of relative displacements and vibrations of shells of celestial bodies under the influence of the gravitational pull of the surrounding celestial bodies. It is not possible to give a detailed description of the observed properties of the Earth and other planets, satellites of the solar system, the Sun. Therefore, in the next Section, we briefly look at some simple illustrations of these properties of natural processes. The basic principles and development properties of the mechanism of forced oscillations and motions of the shells were first studied and presented by the author in 1999–2002 [1, 2].

In particular the power of dissipation of the elastic energy of the mantle for the observed oscillations of the core and according to our estimates may be 1000–10,000 terawatt (TW) [6–11]. This is a huge value of power with a vengeance explains all the endogenous activity of the Earth. The regarded geodynamic model of the relative displacements and oscillations of the core and mantle explains all the fundamental properties of planetary processes on Earth and other planets, satellites and Sun: cyclicality, unity, synchronicity, inversion, polar activity, step-by-step phenomena (Fig. 2), saw-toothed, orderliness, twisting of layers of the mantle, the pear-shaped form of celestial bodies, versatility.

After 15–20 years of our studies the above mentioned phenomena and properties of endogenous activity of the celestial bodies have become more widely developed in geosciences and planet science. Some of them are illustrated in the report on the examples of natural processes on the Earth, the Sun, the Moon, Enceladus, Titan, Mars, etc. [7].

3 The mechanism of endogenous activity of the Earth and climate change

The main publication on mechanism of endogenous activity of celestial bodies and discussed properties of natural processes (Fig 1: left); schematic illustration of the gravitational excitation of the Earth's shell system (Fig 1: right). The proposed mechanism of excitation of the endogenous activity planets, moons and the sun is a highly effective and highly energetic. It allowed us to explain (sometimes to predict the existence of) many of the observed processes and changes in the Earth's geodynamics, geophysics, geodesy, planetary science, the nature of the solar–terrestrial relations, etc. The proposed geodynamic model of displaced relative oscillations and rotations of celestial bodies shell opens and offers wide opportunities for research and solutions to old and existing problems in science and new problems are constantly arising in modern studies of the Earth and all bodies in the solar system and other planetary systems.

In accordance with the basic provisions of the developed geomodel the forced relative oscillations of the core and mantle lead to visco-elastic deformations of all layers of the mantle, to the cyclic release of heat and the formation of the heat flow, affecting the activity of oceanic, atmospheric, and of all the synoptic processes [2, 7, 9]). Ultimately the core is deeply involved in the formation and change of climate of the planet, both global and in its the northern and southern hemispheres. However, oscillations and displacements of the core are controlled by the Moon, Sun and planets. This reflects the relationship and unity and interrelation of all bodies in the solar system, unity of styles and synchronity of variations of their natural processes. Systems of shells of the Sun and planets are also experiencing excitement and synchronously. It is one and the most important features of solar–terrestrial and solar–planetary relations. This is confirmed, for example, by the fact that the jumps in variations of natural processes on the Sun, Moon, Earth, Mars, and other bodies of the solar system in 1997–1998 occurred synchronously [13]. Cores of mentioned bodies have excited and excited synchronously (due to particularities of the orbital

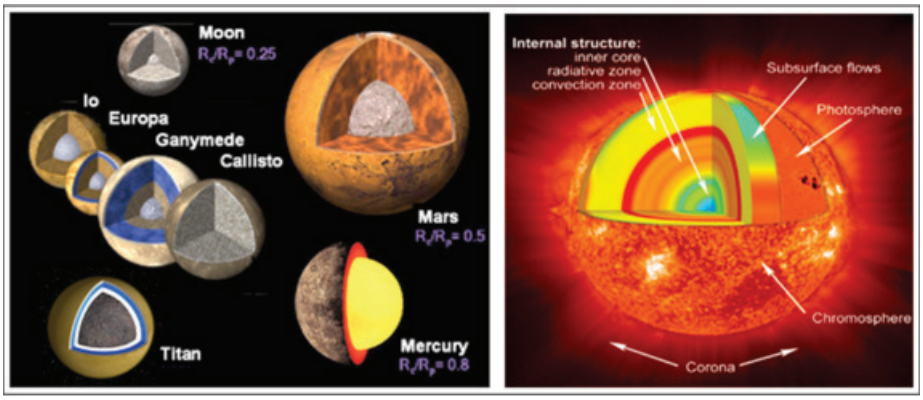


Figure 1 The fundamental feature of the structure of the planet and satellites (left) and the Sun (right) is their inner shell structure.

and rotational motions of bodies in the solar system and the motion of its barycenter) and had a gravitational effect on all of their shells and natural processes. Relative displacements, rotations and deformations of shells draw energy from a huge "pot" of energy of translational and rotational motion of all bodies in the solar system.

The report discusses the mechanism of planetary climate change in different time scales. On the basis of the mechanism of forced gravity swing of the core and mantle, and visco-elastic deformation of the mantle the interpretation of the phenomena of warming and cooling, the inversion of climate change on Earth in the northern and southern hemispheres, their contemporary manifestations have been studied. This mechanism controls the integral heat flux of the Earth and its redistribution between the hemispheres of the Earth. Similar effects have been observed on other bodies of the solar system (including the Sun), and the inversion phenomenon of activity of natural processes (alternating activity between the hemispheres) is the surest sign of the active mechanism of excitation of the shells of celestial bodies [2]. An explanation and justification is given for these difficult-to-understand phenomena such as activation of natural processes, geologic and tectonic activity in the polar regions of the planets and satellites.

The phenomenon of "climate swings" was predicted – contrasting successive changes of climatic environments in the northern and southern hemispheres, which was later fully confirmed by the data of modern research and observation [9]. The proposed geodynamic model naturally explains the energetics and high energy dissipation of natural processes on the Earth and explains other complex planetary phenomena: cyclicity, energy, unity processes, inversion, polar activity, jumps, etc.). Here there are, of course, all natural processes, as well as the physical fields of the Earth.

4 The dynamics of shells of planets and satellites as the main mechanism for variation of their natural processes.

Figure 2 shows the spectrum of the center of mass of the polar oscillations of the Earth obtained from satellite observations.

Figure 3 illustrates these abrupt changes in the Earth's center of mass coordinates obtained from satellite observations of DORIS [4].

5 The total power of dissipation of the elastic energy of the mantle, under consideration of polar oscillations of the core

The full expected power of dissipation in the Earth mantle is $D = 0.427 \cdot 10^{13}$ Wt. The full expected power of dissipation of the Earth is $D = 0.427 \cdot 10^{13}$ Wt. The main mechanism is the forced core–mantle oscillations [1, 2, 7, 13]. In these papers the values of warm energy generated in the mantle by separate oscillations of the core of the Earth (for 15 harmonics) have been obtained (estimated on amplitudes). We also presented there the periods of oscillations of the core in days. We omit here the full tables of powers of dissipation for all considered oscillations. But we want to note that a total value of summary power of dissipation in the mantle for the observed

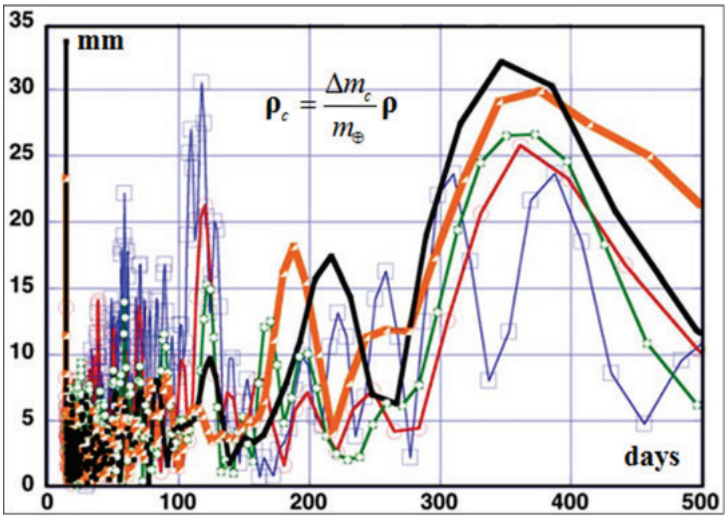


Figure 2 Oscillations of the center of mass of the Earth according to various satellite systems observations. Y-axis: values of the amplitudes in millimeters, abscissa: periods in days [5].

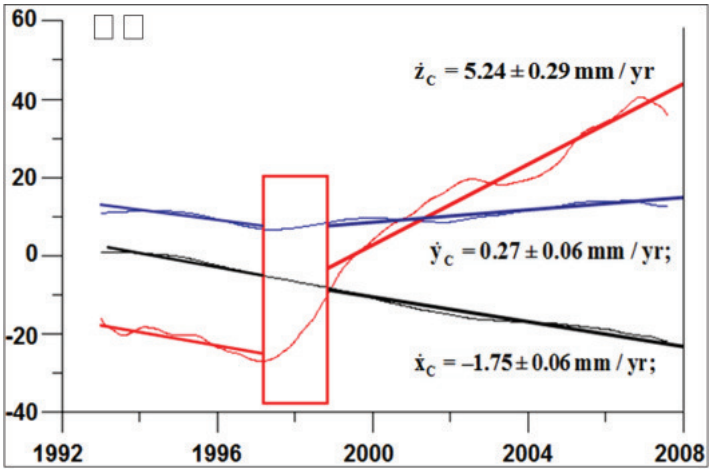


Figure 3 The trend coordinates of the center of mass of the Earth in the period 1993–2007 and jumps in the values of its Cartesian Greenwich coordinates in the period of 1997–1998 [4].

15 harmonics is up to $D = 0.427 \cdot 10^{13}$ Wt. And it is only some part of the power. For simplicity we consider here only polar oscillations of the center of mass of the Earth (and core). It can be said that we discovered here a more effective source of endogenous activity of the Earth. The energy and power of dissipation sufficient for all natural processes on the Earth is taken from the forced oscillation of the core–mantle

system. Ultimately the endogenous activity is taken from the orbital and rotational motions of the Earth, Moon, Sun and other bodies of the solar system.

This is a solution of the centuries-old search for energy sources of geoevolution and the Earth's natural processes. We have estimated the power dissipation of energy in the Earth's mantle for each of the 15 known planetary oscillations of the core (based on the data of geocenter motions) and the resulting total power of dissipation. The full estimated power of the dissipation of energy in the viscous-elastic mantle has a phenomenal value of more than 10^{15} Wt.

Here we give a comparison of the obtained value of the power of dissipation with similar contributions of other observed natural processes of the Earth. The obtained estimation of power of dissipation of energy allows us to explain the geodynamical life and evolution of the Earth.

6 Explanation of the energy and dissipation of the Earth's natural processes

Here are some known estimates of power dissipation of thermal energy for the basic natural processes of the Earth [8]:

1. Power of the seismic activity $3 \cdot 10^{10}$ Wt;
2. Power of the volcanic activity 10^{10} Wt;
3. Power of the warm convection 10^{13} Wt;
4. The warm flow 4.4–$4.8 \cdot 10^{13}$ Wt;
5. Power of the tidal deformation $4 \cdot 10^{11}$ Wt.

The full value of power of the mechanism of forced oscillations of the core–mantle system is about $D = 10^{14}$–10^{15} Wt.

7 The mechanism of excitation of shells of celestial bodies. Introduction to the theory of natural processes

The main geodynamic consequences of the mechanism of forced oscillations of the relative core and mantle are surveying changes in redistribution of Oceanic and Atmospheric masses; geodynamic changes in the Earth's rotation; geophysical change in all sorts of planetary processes. Similar changes are taking place in many bodies of the solar system. There is a strict correspondence between the style of the displacement with respect to the core of a viscoelastic mantle and style variations and changes in natural processes.

In the series of our work we have found and studied the secular trend of the core relatively to the mantle at a rate of about 2.6 cm/yr, and a sharp jump in the core in a northerly direction at 10.9 cm in 1997–1998. The trends of coordinates of the center of mass of the Earth during 1993–2007 and jumps in the values of its Cartesian coordinates of Greenwich during 1997–1998 (see Fig. 3) are determined in [4]. All displacements and oscillations of the core are correlated with the respective secular and cyclical variations of natural processes.

7.1 The movable core as "the organizer and conductor" of the planetary processes

From the results of our work there should be stronger statements about the decisive role and impact on virtually of all planetary terrestrial processes. The following important properties of planetary natural processes are:

1. The secular trend of the Earth's core relatively to the mantle is a determining factor in the secular variations of the natural planetary processes;
2. Cyclic oscillations in the Earth's core motion is a determining factor in the corresponding cyclic variations of natural planetary processes;
3. Abrupt displacement of Earth's core is a determining factor abrupt changes in the activity of the natural planetary processes;
4. Sawtooth variation caused by natural processes changing modes of the core motion with respect to the mantle (they are connected with the reciprocating motion of the core and is accompanied by regular and abrupt changes of velocity of drift of the core).

According to the satellite system DORIS (for the period of 1993–2007), the components of the drift of the center of mass of the Earth with respect to the Greenwich coordinate system are [4]:

$$\dot{X}_c = -1.75 \pm 0.06 \text{ mm/yr}, \dot{Y}_c = 0.27 \pm 0.06 \text{ mm/yr}, \dot{Z}_c = 5.24 \pm 0.29 \text{ mm/yr}.$$

Figure 3 shows the steps in the coordinates of the center of mass of the Earth in 1997–1998. Similar steps of activity and a variety of natural processes and their synchronization are observed in other bodies of the solar system.

7.2 Inversion and asymmetry of cyclic and secular variations of natural processes

The essence of these widely distributed phenomena is, that the activity of natural processes varies in an antiphase in opposite hemispheres of the Earth (first of all in northern and southern hemispheres)and concerns all geodynamic and geophysical processes, variations of physical fields, tectonic and geodetic reorganizations of layers of the Earth, redistributions of atmospheric, oceanic and other fluid masses of the Earth. The certain asymmetry of the displays of processes in northern and southern hemispheres on the other hand is marked. So secular trends of some processes are in contrast in northern and southern hemispheres, i.e. velocities of secular changes are essentially different. All the described phenomena are caused first of all by cyclic oscillations and secular drift of the core to the north (in the present epoch). In longer time scales similar phenomena of inversion, dissymmetry also have a place and determine a nature and style of displacements of continents and lithospheric plates, planetary magmatic activity and plume tectonics as a whole;formation of mountains, elevations and depressions, systems of lineaments and cracks, regressions and transgressions of sea levels etc. [1].

8 Some explanation of the phenomenon and the fundamental problems of celestial mechanics, geophysics and geodynamics

The proposed mechanism of the geodynamic relative displacements and vibrations of the main shells of planets and satellites [1, 2] allowed us to bring clarity to the understanding of the many problems of the Earth and planets. In particular, on the basis of this mechanism, there is an explanation and interpretation of these ancient and modern indigenous fundamental problems of geodynamics and celestial mechanics.

1. Secular drift (and steps) of the center of mass of the Earth.
2. The secular variations (and steps) of gravity.
3. Variations of geopotential coefficients (second, third and fourth harmonics) and their steps.
4. Secular drift (steps) of the axis of rotation of the Earth's pole.
5. Non-tidal acceleration of the Earth's axial rotation (angular velocity steps in the axial rotation of the Earth).
6. The secular change in the average sea level and mean sea level in the northern and southern hemispheres (the step in 1997).
7. Steps in changing the mean sea levels and differences of the mean sea levels in the northern and southern hemispheres (jumps in 1997) [14].
8. 8. Secular change and a step in value of the period of nutation of the Earth's liquid core and many other problems of the Earth's and planet's sciences.

Abrupt changes in these phenomena and processes were explained for the first time.

Conclusion

Variations of natural processes on the planets, moons and sun, their spatial and temporal properties are largely determined by the mechanism of action of forced fluctuations and relative swing and shells of these heavenly bodies. The basic properties of planetary processes on Earth and other planets, moons and sun: the cyclical and high energy, unity and synchrony, polar activity, polarity inversion, pear shaped form of celestial bodies and twisting hemispheres and latitudinal belts, spasmodic, sawtooth, regularity and universality.

The geodynamic model of the relative displacements and forced oscillations of the Earth's core and mantle by the gravitational attraction of the surrounding celestial bodies have obtained efficient applications in various geosciences [1, 2]. From the results obtained on the basis of this geomodel, in particular, an important conclusion about the redistribution of fluids in the modern era from the southern hemisphere to the northern hemisphere follows. As a result of this process it should occur planetary increase fluid volumes (including oil and gas) in the northern hemisphere and their redistribution to higher latitudes (in the modern epoch). Northern oceanic tide in the modern era is one of these processes [14]. This is a slow process, but in the modern age it has a positive tendency to stabilize and increase capacity of oil and other natural formations (gas, etc.). This slow process is superimposed on annual, decadal

and other cyclical variations of fluid mass redistribution. They are all dictated and directed by mechanisms of the gravitational action on the upper shells and fluids by the moving core of the planet and this impacts on all planetary terrestrial processes.

At the same time the following important properties of planetary natural processes must be emphasized: I. Secular trend in the Earth's core is a determining factor of the secular variations of all planetary natural processes; II. Cyclical oscillations of the Earth's core is a determining factor of corresponding cyclic variations of activity of planetary natural processes; III. Abrupt (step-by-step) displacements of the Earth's core is a determining factor of abrupt changes in the activity of all natural planetary processes (at different timescales). Therefore there should be a important property of synchronicity of natural processes in all spheres (shells) of the Earth, including the biosphere, the noosphere, social sphere and all societal processes in their deep relationships and complete dependence on geodynamic processes. All of these phenomena and their properties have already obtained numerous confirmations in geosciences and planetary sciences. Cyclic variations of natural processes and their steps (juddering) changes are direct instructions to activate and change social processes. Steps in the activity of natural processes correspond to catastrophies in nature and revolutionary changes in society and are dictated by displacements of the Earth's core.

Of course a wide range of observed phenomena – the consequences of action and active manifestations of oscillations and forced relative displacements of shells of celestial bodies can be applied to processes on the Earth and in the interpretation of planetary processes on other planets and moons.

References

[1] Barkin Yu.V. (2002) Tectonic activity of the planets and satellites: mechanism and nature of cyclicity. In: Earth-like planets and moons. Proceedings of the 36th ESLAB Symposium, 3–8 June 2002, ESTEC, Noordwijk, The Netherlands. Eds.: B. Foing, B. Battrick. ESA SP-514, Noordwijk: ESA Publications Division, ISBN 92-9092-824-7, 2002, pp. 201–207.

[2] Barkin Yu.V. (2002) Explanation of endogenous activity of planets and satellites and its cyclicity. Proceedings of the Section of Earth Sciences of the Russian Academy of Natural Sciences. VINITI. 2002. Issue 9, p. 45–97. In Russian.

[3] Barkin Yu.V. (1995) Motion of the Earth's center of mass induced by global changes in its dynamic structure and by tidal deformations. Mosc. Univ. Phys. Bull., Vol. 50, No 5, pp. 92–94. English translation of Vestni. Mosk. Univ. 3, Fiz., Astron. (Russia). 1995. Vol. 50. No 5, pp. 99–101.

[4] Zotov L.V., Barkin Yu.V., Lubushin A.A. (2009) Geocenter motion and its geodynamical contenst. "Space Geodynamics and Modeling of the Global Geodynamic Processes", Novosibirsk, Russian Federation, 22–26 September, 2008; Russian Academy of Sciences, Trofimuk Inst. Of Petrol. Geol. And Geophys., SB RAS. – Novosibirsk: Academic Publishing House "Geo". 2009. pp. 98–101.

[5] Gobinddass M.L., P. Willis P., O. de Viron, A. Sibthorpe, N. P. Zelensky, J. C. Ries, R. Ferland, Y. Bar-Sever , M. Diament (2009) Systematic biases in DORIS-derived geocenter time series related to solar radiation pressure mis-modeling. J Geod (2009) 83:849?858. DOI 10.1007/s00190-009-0303-8.

[6] Barkin Yu.V. (2012) Explanation of energy and cyclicity of the endogenous activity of the Earth, inversion of climate change. Collection of scientific papers. Physical problems of ecology (environmental physics). 2012. v. 19. pp. 54–69. Physical department. Moscow State University. In Russian.

[7] Barkin Yu.V. (2014) Geophysical consequences of the relative displacements and oscillations of the core and the mantle. Report of the sixth meeting of the All-Moscow tectonophysical workshop at hand. Prof. Yu.L Rebetskiy (September 16, 2014, the Institute of Physics of the Earth. Schmidt RAS). Presentation of report on the website DL: http://www.ifz.ru/lab_204/omts/2014-god/zasedanie-omts-1609/
Video of report in youtube: http://www.youtube.com/watch?v=yLfHYBNya5E&feature=youtu.be http://www.ifz.ru/uploads/media/ZAJAVKA_BARKIN_16_SENTJABRJA_2014.pdf

[8] Barkin Yu.V. (2012) Cyclic inversion of climate change in the northern and southern hemispheres: bipolar "climate swings" and their mechanisms, manifestations of his actions in the modern era and the importance of climate in Russia. In the monograph "The scientific aspects of environmental problems in Russia", Under the general editorship. Yu.A. Izrael and N.G. Rybalsky. - M .: NIA-Priroda, 2012, pp. 46–51 (349 p.).

[9] Barkin Yu.V., Klige R.K. (2012) Gravity heliocosmic impact factors on the endogenous activity of the Earth. In the monograph: Modern global changes of natural environment. V. 3. The factors of global change. M. The scientific world. pp. 46–61.

[10] Barkin Yu.V., Shatina A.V. (2005) Deformation of the Earth's mantle due to core displacements. AApTr, 24(3): 195–213. doi: 10.1080/10556790500496339. http://images.astronet.ru/pubd/2008/09/28/0001230856/195-213.pdf.

[11] Barkin Yu.V. (2004) Dynamics of the Earth shells and variations of paleoclimate. Proc. Milutin Milankovitch Anniversary Symposium "Paleoclimate and the Earth climate system" (Belgrade, Serbia, 30 August – 2 September, 2004). Belgrade, Serbian Academy of Sciences and Art. pp. 161–164.

[12] Barkin Yu.V. (1995) Motion of the Earth?s center of mass induced by global changes in its dynamic structure and by tidal deformations. Mosc. Univ. Phys. Bull., Vol.50, N 5, pp. 92–94. English translation of Vestn. Mosk. Univ. 3, Fiz., Astron. (Russia). 1995. Vol. 50. No 5, pp. 99–101.

[13] Barkin Yu.V. (2013) Synchronous jumps in the processes and phenomena on the Earth, Moon and Sun in 1997–1998 and a unified mechanism. Geology of seas and oceans: Proc. XX Int. Scientific Conference (School) in marine geology. Vol. 5. M.: GEOS. pp. 21–25. In Russian.

[14] Barkin Yu.V. (2011) Explanation of secular changes in global mean sea level and average levels of the ocean in the northern and southern hemispheres of the Earth. Vestnik MGU. Series 3: Fiz. Astron. No 4, pp. 1–15. In Russian.