



## **Forced relative displacements of the core and mantle as the basic mechanism of secular changes of the Earth shape and lithosphere plates tectonics**

Yury Barkin

Sternberg Astronomical Institute, celestial mechanics and gravimetry, Moscow, Russian Federation (barkin@inbox.ru, 07-495-9328841)

**The summary.** In the work planetary changes of a figure of the Earth and geoid in present epoch are discussed. Contrast and asymmetric geodetic changes of northern and southern hemispheres are revealed. The phenomenon of lengthening of latitude circles of a southern hemisphere and shortening of lengths of latitude circles of northern hemisphere, the phenomenon of expansion of a southern hemisphere and, accordingly, compression of northern hemisphere in relation to the center of mass of the Earth have been predicted. The reasons of the planetary tendency of displacement (drift) of plates in northern direction are studied. The geodynamic model is developed, on which the basic moving force in tectonics of plates is a gravitational influence of a moveable core of the Earth on all layers of the mantle, and also on blocks of the crust and lithosphere plates. In a base of all tectonic and geological reorganizations the mechanism of the forced relative oscillations and swings of the core and the mantle of the Earth in various time scales, including geological timescale lays.

**1 Mechanism of formation and changes of the pear-shaped form of the Earth.** According to developed geodynamic model a pear-shaped form of planets is not their given property for all time (as believed before scientists), and is the dynamic response to the slow forced relative displacements of the core and mantle [1]. Than more a relative displacement of the core and mantle (eccentricity of the core in some geology epoch), is especially clearly expressed pear-shaped form. The planet Mars possesses a big pear-shaped form and by our estimations the core of this planet is displaced in northern direction (to latitude in approximately  $60^{\circ} N$ ) on **20-25 km** [2]. An eccentricity of the Earth core is less (estimations give displacement about **3-4 km** in direction to Brazil [3]) and its pear-shaped form is much less.

**2 The phenomenon of asymmetric lengthening of latitude circles of southern and northern hemispheres of the Earth.** The phenomenon of inversion lengthenings of latitude circles of the Earth has been established theoretically. Subsequently the phenomenon of contrast and asymmetric lengthening of latitude circles in northern and southern hemispheres of the Earth has been confirmed by data of GPS observations [4]. A dependence of velocity of increase in lengths of latitude circles from latitude has been revealed.

**3 A phenomenon of asymmetric change of mean radiuses of northern and southern hemispheres of the Earth.** It is necessary to note, that changes of a figure of the Earth in geocentric system of coordinates (with the origin in the center of mass) are represented with set of two processes. First of them is a dynamic and represents the response to deformations of elastic layers of the mantle and crust. The second represents a geometrical effect and is caused by a displacement of the center of mass with respect to which the northern and southern hemispheres of the Earth are determined. For the explanatory we shall specify, for example, that even if the surface of the Earth would not vary, and its center of mass drifts to the north with a velocity in **5.54 mm/yr** [5], satellite observations (GPS) would reveal planetary inversion changes of the Earth surface w.r.t. a geocentric system of coordinates. Namely in northern hemisphere - lowering of a surface with a mean velocity **-2.77 mm/year**, and in a southern hemisphere on the contrary - rise of a surface with a mean velocity of **2.77 mm/years**. If the specified effect to subtract from the given satellite observations of change of heights of GPS stations as a result we shall obtain directly a deformation changes of a surface. In the given work the preliminary and simplified estimations of mean velocities of deformation of hemispheres of the Earth in present epoch are given. The first determination of velocities of change of mean radiuses of northern and southern hemispheres, executed on the base of GPS observations, gives a

value of **0.1 mm/yr** and **1.37 mm/yr**, accordingly [6]. Hence, to these values there correspond deformation changes of mean radiuses of northern and southern hemispheres with velocity: **+2.9 mm/yr** and **-1.4 mm/yr**, accordingly.

**4 Phenomenon of displacement of continental weights of a bark to the north.** On the basis of geodynamic model of the forced oscillations of core-mantle system of the Earth the observable secular variations of a gravity on a lot of base gravimetric stations (Ny-Alesund, Syowa, Churchill, Medicina etc. have been obtained an explanation [7]. They are caused by drift of the center of mass of the Earth and by deformations of its surface. Besides it has been shown, that at displacement of the core to the north not only a gravity (a radial component of force of a gravitational attraction of the Earth) varies, but also its tangential northern component also. Both in southern and in northern hemispheres of the Earth (at polar drift of the core to the north with the velocity specified above) in present epoch the northern component of gravitational force of the Earth attraction increases with a velocity about **0.5-1.0  $\mu$ Gal/yr**. The action of the specified latitudinal component of force on a long (geological) intervals of time in planetary scale forces superficial masses and in general masses of the crust and lithosphere (their blocks and plates) to be displaced to the north. It finds clear confirmations in observable tectonic reorganizations of geological structures of the crust and a bottom of ocean [8]. Really, in their congestion the continents or more precisely to tell their centers (or their centers of mass) during a modern geological epoch find out the tendency of the directed moving to the northern hemisphere [9]. The mechanical essence of tectonics of lithosphere plates is connected with this phenomenon - by one of the basic forces moving plates is a gravitational attraction of superfluous mass of moveable core. Owing to this influence a redistribution and displacements of plates, first of all continental plates, between hemispheres in a geological time scale is carried out. Thus oscillations and displacements of the core control and organize a plume tectonics activity, and also a spreading activity without which motions of plates to the north would be impossible. This mechanism allows to give a logic explanation to observable tectonic processes and polar changes of geodynamic states of supercontinents observable at formation during geoevolution [10]. According to table 3 of the work [9] the horizontal latitudinal components (in a direction the south-north) of linear velocities of conditional epicentres of lithosphere plates (they correspond to calculated modelling positions of their centers of mass) are equal: **3.47 mm/yr** for the Euroasian plate; **2.54 mm/yr** for the African plate; **50.3 mm/yr** for the Pacific plate; **83.8 mm/yr** for the Australian plate; **48.3 mm/yr** for the Indian plate; **26.8 mm/yr** for the Arabian plate; **35.3 mm/yr** for Philippine plate; **54.6 mm/yr** for a plate the Cocos; **11.1 mm/yr** for Juan de Fuca. For all specified 9 plates mentioned velocities speeds are positive and significant on values. Negative latitudinal components of velocities have the American continents: **-12.0 mm/yr** (the Northern-American plate) and **-9.8 mm/yr** (the Southern-American plate). Also negative latitudinal components have velocities of the centers of mass of the small plates: **-0.64 mm/yr** (the Antarctic plate) and **-1.2 mm/yr** (Nasca). In another words the clearly expressed tendency of displacement of epicentres of the centers of mass of plates to the north exists in reality [9]. The specified displacements are observed with respect to geocentric reference system of coordinates **HS2-NUVEL1** connected with hotspots. The obtained conclusion has a modelling character and does not consider some changes in positions of the conditional centers of plates because of the phenomena of spreading and subduction (i.e. here the conditional centers fastened to plates are considered).

**5 Phenomenon of global displacement of system of GPS stations to the north.** This phenomenon is easily established on known data about velocities of displacements of GPS stations of satellite observations in system of coordinates ITRF 2005 ([www.iers.org](http://www.iers.org)). The basic stations are displaced together with plates to the north. One from reason of this phenomenon can be the secular drift of the center of mass of the Earth to the North. This phenomenon has exclusively-great value for understanding of the mechanism of tectonics of plates and fundamental mechanisms spreading and subduction. The specified tendency of displacements of layers of a crust and lithosphere (their blocks) to the north is direct consequence of gravitational influence on them of the core of the Earth drifting to the north. To tendency of displacement of masses of oceanic plates continents interfere and the spaces borrowed already by them in northern hemisphere. As a result for a discharge of intensity they are forced to organize subduction zones and "to dive" under a continental lithosphere. On the other hand the material for construction of moving oceanic lithosphere plates acts along rifting zones, mainly located in a southern hemisphere. Therefore the geodynamical fact, that subduction zones and rifting zones are situated mainly in opposite hemispheres of the Earth is confirmed [1]. We reveal correlations of radial deformations of a surface on concrete gravimetric stations with the form of geoid (in dependence from latitude).

## References

[1] Barkin Yu.V. (2002) An explanation of endogenous activity of planets and satellites and its cyclisity. *Isvestia*

sekcii nauk o Zemle Rossiiskoi akademii estestvennykh nauk. Vyp. 9, M., VINITI, pp. 45-97. In Russian.

[2] Barkin Yu.V. (2009) About possible polar drifts of centers of mass of the Earth and Mars. Abstract Book (CD) of European Planetary Science Congress (Potsdam, Germany, 13 – 18 September 2009), Vol.4, EPSC 2009-118.

[3] Barkin Yu.V. (2000) Eccentricity of the Earth core. XXV General Assembly of EGS (Nice, France 25-29 April 2000) News Letter European Geophysical Society, N74, March 2000. Scientific Programme, p. 65.

[4] Barkin Yu.V. and Jin Shuanggen (2006) Kinematics and dynamics of the Earth hemispheres. EGU General Assembly (Vienna, Austria, 2-7 April 2006). Geophysical Research Abstracts, Volume 8, abstract # EGU06-A-01680 © European Geosciences Union 2006.

[5] Barkin Yu.V. (2008) Secular polar drift of the core in present epoch: geodynamical and geophysical consequences and confirmations. General and regional problems of tectonics and geodynamics. Materials of XLI Tectonic Conference. V. 1. - M.:GEOS. p. 55-59. In Russian.

[6] Barkin Yu.V. and Jin Shuanggen (2007) On variations of the mean radius of the Northern and Southern Hemispheres of the Earth. EGU General Assembly (Vienna, Austria, 15-20 April 2007). Geoph. Res. Abs., Vol. 9, 2007, abstract # EGU07-A-08183.

[7] Barkin Yu.V. (2009) An explanation of secular variations of a gravity at stations Ny-Alesund, Medicine, Churchill and Syowa. Materials of the International Conference: « Yu.P. Bulashevich's fifth scientific readings. A deep structure. Geodynamics. A thermal field of the Earth. Interpretation of geophysical fields» (Ekaterinburg, 6 – 10 July, 2009). pp. 27-31. In Russian.

[8] Raznitsyn Yu.N., Barkin Yu.V. (2009) Submeridional compression of Atlantic lithosphere and a polar drift of the core of the Earth. «Geology of the seas and oceans: Materials of XVII International scientific conference (school) on sea geology». vol.V. - M.: GEOS. p. 246-250. In Russian.

[9] Barkin, Yu.V. (2000) Kinematical regularities in plate motion. Astronomical and Astrophysical Transactions, Vol. 18, Issue 6, pp. 763-778.

[10] Bozhko N.A., Barkin Yu.V. (2009) A dissymmetry of tectonic processes during supercontinental cyclicality as dynamic consequence of relative polar displacements of the core and mantle of the Earth. Geology of polar areas of the Earth. Materials of XLII Tectonic meeting. Vol. 1.-M.: GEOS. P. 66-70. In Russian.