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The "orbital" hypothesis of cosmogenic impact on the relief and geodynamics of the Earth

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Abstract. On many territories of the Earth, the unnaturally flat extended surface areas are observed that are geomorphologically expressed relative to the adjacent areas and resembling a pattern of a planed-down tree in satellite images. A new hypothesis is proposed, explaining the formation of such a pattern due to the Earth capturing a massive satellite with a diameter exceeding 500 km, which in the process of rotation around the Earth along the downward trajectory at a high speed destructively affects the planet surface.

Keywords: Astroblems, orbital motion, deep-focus earthquakes, impact catalog.

1. Introduction

The classical physical model of an impact crater is described in [1–4]. The authors have brought forward the idea of the collision of the Earth with cosmic bodies (asteroids or comets) as a frontal or an oblique impact with the formation of a crater. At present, many researchers also support such a viewpoint [5, 6]. The general idealized picture [1–3] of the impact crater includes such visual elements as a negative form of relief, the base bank, and for complex craters — the central raising in the form of a ring or of an impact cone and the mound bank. However, observing a wide prevalence of other morphological signs of the external influence on the Earth's relief, we can assume a different model of cosmogenic effects.

According to this model, the Earth, by virtue of its size and mass, can attract cosmic objects, whose trajectory and speed are close to the direction and speed of its own motion. Getting into the gravitational field of the Earth, such a body becomes its satellite, gradually, approaching the Earth. While moving in the orbit, the body collapses because of both the atmospheric friction and the tangential collision with the surface of the planet. Moreover, if the size of the captured cosmic object is large enough, then the influence of the atmosphere as a decelerating and destructive factor is insignificant (according to [4], the destruction of the cosmic body in the atmosphere is more characterized for small objects that can leave a crater on the Earth with $D \leq 80$ km).

If the size of a cosmic body (CB) is tens or hundreds of kilometers, and this object moves at the first space speed (up to 7.2 km/s) along the Earth's orbit at 300–400 km altitude, its trajectory will be similar to the flight path of the ISS (International Space Station)[1], but with a gradual decrease in height along a very "gentle" trajectory and leveling effect on the relief by accompanying air-gas flow or multiple touching of its own edge.

2. Observation results

As a result of the study of the terrain of the Earth, the flat areas at hundreds of kilometers wide were discovered, which look absolutely smooth (polished), like a track from a bulldozer with of 400–800 km knife width. These are territories in Iran (south of the Caspian Sea in Figure 1b), West Africa, Mauritania, Morocco, South Africa, Western Australia, South America, and many others (see Figure 1). The first example (Figures 1a, d) is the Iranian mountains. On an area of 100–400 km, the terrain has a perfectly smooth surface with a "veneer-like" pattern. A similar picture can be seen in satellite images on the relief of Morocco (Figure 1e). A next example is the Australia's West (Figure 1f). The mountainous relief layer seems to be "cut down" to a level rich in iron and aluminum, making the soil colored rusty (an alternative view point is that the carbonate-free red soil was formed as a result of weathering of the rocks in hot and humid tropical conditions). Let us note that the west of Australia is also rich in gold in various forms. There are dozens of such examples.

Can such a characteristic pattern be formed due to the solidification of a smooth, weakly viscous flow of hot lava ("lava well")? Such an explanation seems to be implausible for squares hundreds of kilometers in size. Rather, the pattern looks as if a powerful smoothing process has taken place across the mountain range: dark brown spots mark the cut cores of the mountains, and the rings around them — the cut the multilayer structure of the mountains, gradually stackable by erupting magmas of different colors. It should be noted that such a model could explain the formation of a well-known and contradictory Rishat multiring structure [8], which has the shape of a truncated (cut to the base) tectonic dome.

According to the Geodynamic Map [7], the above-listed areas are marked by: Early Cenozoic folding and marginal deflections that were laid in the Early and continue their development in the Late Cenozoic (the Caspian part of Iran) or the pre-Late Cenozoic and Late Cenozoic sedimentary cover (West Africa, Australia) with rare outlets of pre-phanerozoic basement. This indicates to the Late Cenozoic age of the alleged event that has created the characteristic pattern.

[1]URL: spacegid.com/media/iss_tracker.

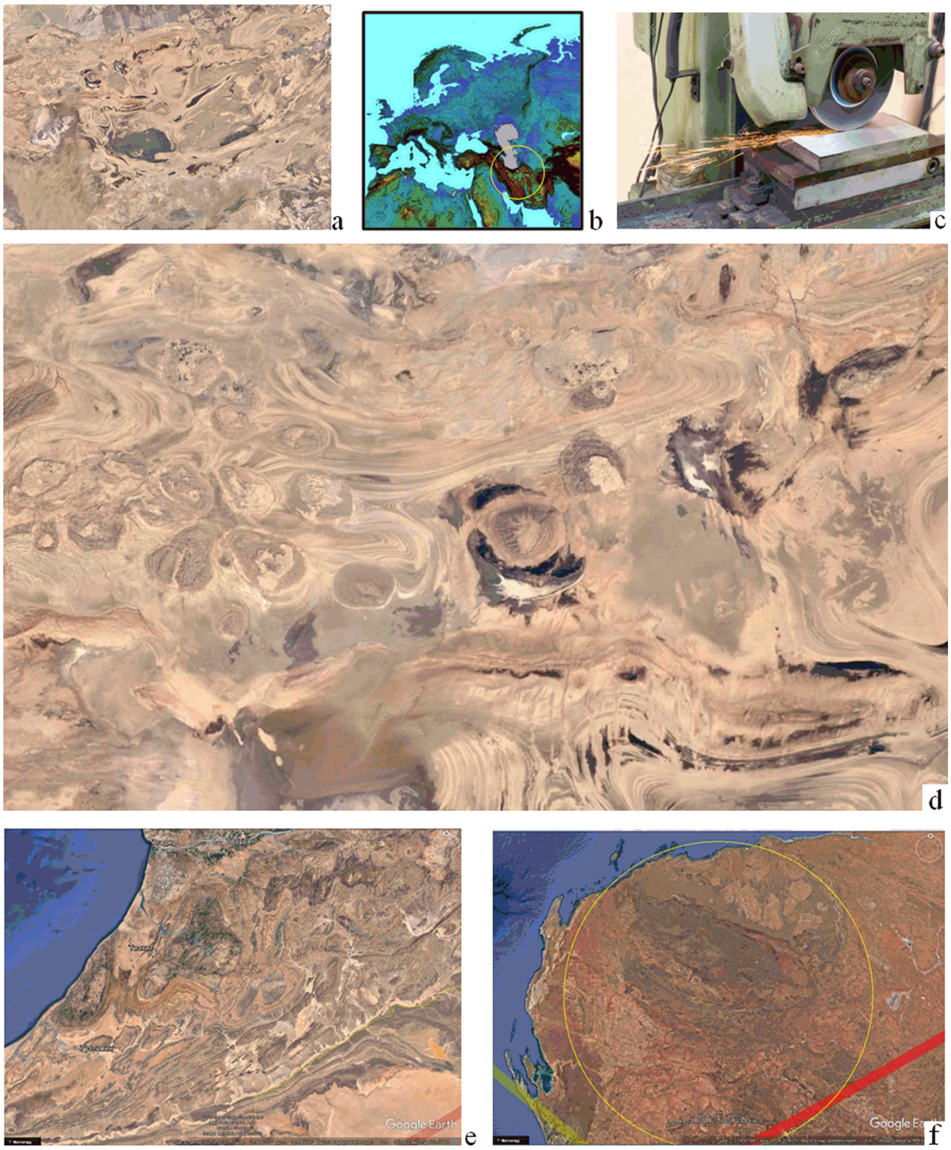

Figure 1. Smooth plains with the "veneer-like" pattern: a) and d) on the territory of Iran indicated by the circle in Figure b; e) on the territory of Morocco; f) in Western Australia (the circle diameter of 800 km); c) grinding machine

The authors found other manifestations of a possible tangential effect [8]. These are giant impact structures with diameter 800 km:

- the "LABMPG-OFA-Antofagasta" (−22.69°S; −69.69°W), resembling a giant inverted stratum of rocks, rich in minerals (the largest ore deposits of Chile: copper, silver, molybdenum, gold, lithium, iron, iodine) [8];
- the "Gates of Siberia" (57.24°N; 59.22°E) [8] with a center in the lowest part of the Ural Mountains (Figure 2d) with a variety of minerals (iron, copper, gold, etc.) and precious stones (the Gem band of the Ural: amethyst, topaz, emerald, beryl, diamonds, rubies, rhinestone, malachite, etc.);
- the "Gate of Africa" (18.3465°N; 20.0799°E) [8];
- the "Gate South" (−60.28°S; −62.75°W) on the interval between South America and Antarctica [8].

There are revealed the numerous flat structures (for example, "Gerat", "Abakanskaya", "Syria-African", "Krasnoturansky", "Ferganian Big" [8]), the chains of ringed plains (for example, "Obskoy 1–4", "Gruzinsky 1-5", "Iran 1–2" [8]), the elongated furrows 20–100 km wide (for example, the structures "Vlamingh", "King's Trough", "Kurdamir" [8] well expressed in the gravitational field), as well as grids of rectilinear furrows (for example, in Western Sahara on the territory of the "Zouerath" giabelema [8]). It is interesting that the formation of rectilinear furrows that are similar to the latter (width of tens to hundreds meters and first tens meters in depth) on the Mars Phobos satellite is explained by the tangential effect of large boulders in the process of their round-the-world movement at a speed of ≤ 6 m/s [9].

3. A cosmogenic hypothesis of forming the observed anomalies

The authors assume that the observed ground areas can be formed as a result of the "shaving" flight of a massive CB around the Earth. Suppose that a cosmic object of diameter 550–700 km can be pulled by the Earth into its circular orbit, at 300–400 km altitude.

The current concepts allow for the sustainable existence of natural satellites of planets at a distance not closer than the Roche limit (for example, for the strength level of a solid Moon is ~ 2.8 Earth's radius [10]). There are also other difficulties of mechanical models of the satellite capture, described in the literature as one of the hypotheses of the formation of the Moon [10,11]. These difficulties can be overcome if we take into account a short time of the existence of the orbit of an unknown satellite and choose more acceptable parameters of the model of its gravitational capture (as compared to the capture of the Moon), such as: 5 times less diameter (i.e., 125 times less mass), a higher level of adhesion of the constituent rocks, special conditions for the convergence of bodies for the implementation of capture. Theoretical calculations [12, 13] and observed irregular shapes of some natural irregular satellites (for example, the satellites Phobos and Deimos that are probably the asteroids captured by the Mars [11]) show that such captures are really possible.

An object of size exceeding $D = 550$ km could appear from the asteroid belt (the diameter of the largest asteroid Ceres is here 950 km). Having received from the excess of the orbital energy of the Jupiter, the asteroid could go to an elongated orbit and into the interior of the solar system, and then into the Earth's gravitational field.

If a close approach to the Earth had occurred in the region of its equator, then there would be traces of an impact on its surface along the sublatitudinal orbit. However, since the Main Belt asteroids are located in the region of $\pm 4^\circ$ from the ecliptic, such an approach could occur at other latitudes. For example, if a CB is captured in the region of one of the Earth's poles, it would lead to forming an orbit in a submeridional direction.

In the model proposed the CB attracted by the Earth flies around it over a path similar to the ISS, gradually decreasing by the value of 10 meters per 7,200 meters of the flight. Initially, the interaction with the surface of the Earth (occurring due to gravitational fluctuations and the non-ideal spherical shape of the Earth/satellite) is negligible for CB, since the center of its mass is at 300–400 km altitude, but after several orbits of CB, it abrades and collapses ever more rapidly as a result of repeated touching and the growing influence of the atmosphere.

Perhaps precisely such is the process of formatting the Asian smooth plains, suitable for agriculture and the construction of cities. For example, along Track 4 (Figure 2a) on the territory of Asia there are such cities as Ashkhabad, Kzyl-Orda, Dzhezkazgan, Astana, Temirtau, Novosibirsk, Tomsk, Yeniseisk, Mirny, Yakutsk.

As a result of the destruction of hundreds of meters of the sedimentary cover of the Earth's crust, it has become possible to discover deposits[2] of endogenous minerals (Figure 2c): Muruntau (gold), Temirtau (iron), Bakchar-Tomsk region (iron), Mirny (diamonds), oil and gas all over Track 4.

The rivers beds and desert chains (Karakum, Kyzylkum, Muyunkum) are confined to this line. The chain of deserts and plains on the right is contoured by the Intra-Asian (IA) seismic-lineament of the Earth's Great Circle, which was identified by means of the GIS-ENDDB program on the largest earthquakes localizations in the Asian region [15]. This lineament is

[2]URL: gold-deposit.ru/.

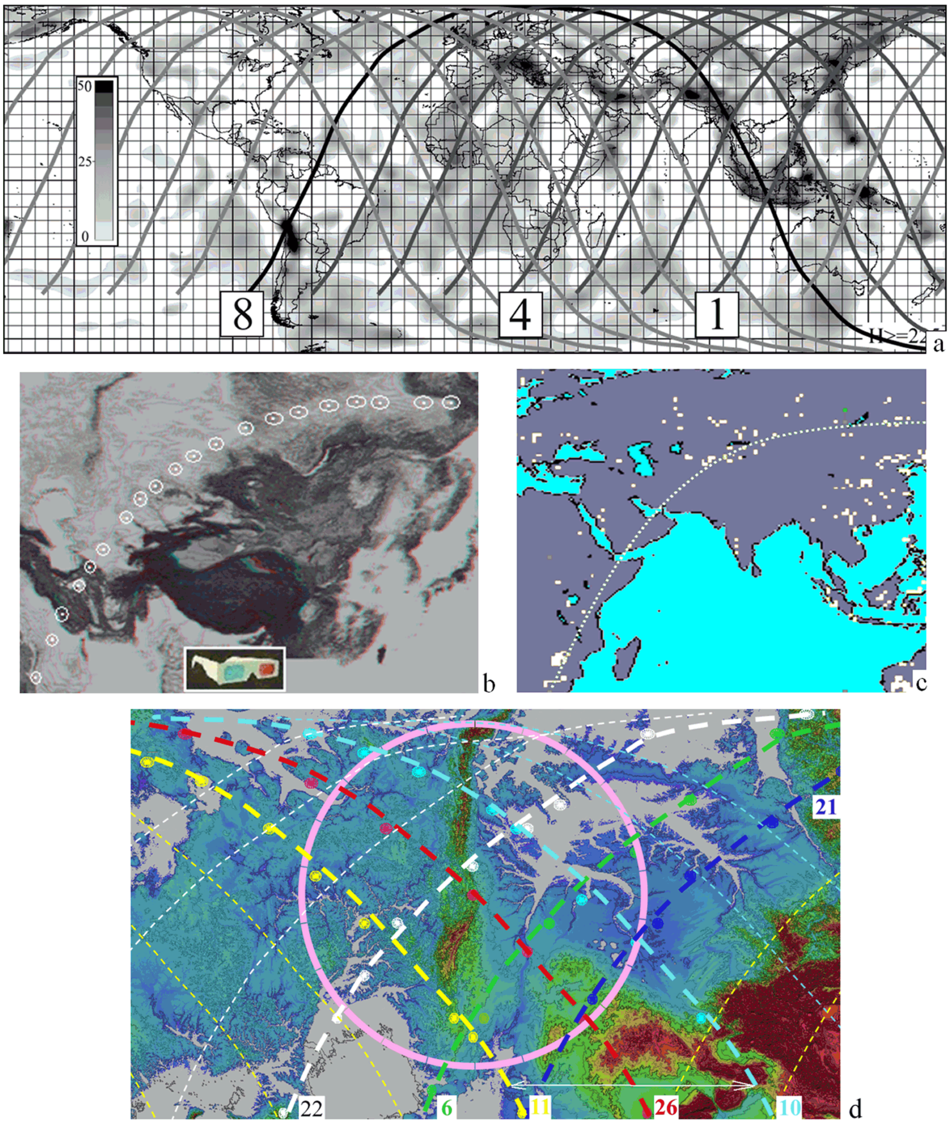

Figure 2. The projection of the possible trajectory of the CB along the Earth's orbit: a) several turns of the first day of the flight parallel to the ISS movement at the altitude of 300–400 km—black color shows Track 8 crossing the Indochina center of Ω-shaped geophysical megastructure and the local anomaly at the center of the Pacific coast of South America marked by a maximum of the summarized S_V-field [14] of all tomographic layers below the lithosphere base: $225 \leq H \leq 700$ km; b) Track 4 from (a) looks like abroad rut on the relief (stereo-relief was obtained in the Radio Mobile program); c) matching gold deposits (white dots) to Track 4; d) the "Gates of Siberia" astrobleme and the corresponding CB-tracks with their numbers

confined to the mountain belt of the same name (including the Hindu Kush, Pamir, Altai-Sayan and Tien-Shan mountain systems). The IA-lineament Great Circle to the south passes through the East African Plateau (including Kilimanjaro) and the South African Drakensberg Mountains; to the northeast it is through the Stanovoy and Aldan highlands, then crossing the Kamchatka Isthmus.

These facts may indicate to the energy influence of CB (in the course of the orbital flight) on the seismotectonic processes of the Earth. So, along with the impact component of the model proposed (which describes the continuous grinding effect on the planet by a gradually collapsing satellite over many revolutions), it is also necessary to consider the energy and contact components of the cosmogenic effect. Here the shock of large CB fragments splitting off in the process of rotation, and the final collision of the CB with the surface of the planet are called the "contact" effect.

3.1. Hypothetical impact effect. It is assumed that the tracks depicted in Figure 2a relate to a single event. Each next turn shifts 23°15′ to the west. Observed in the relief of the Earth furrows from CB follow by the same pattern. By taking Track 1 as the starting point (see Figure 2a), we have managed to create rather an entire picture of the complete flight path of the CB (Figure 3).

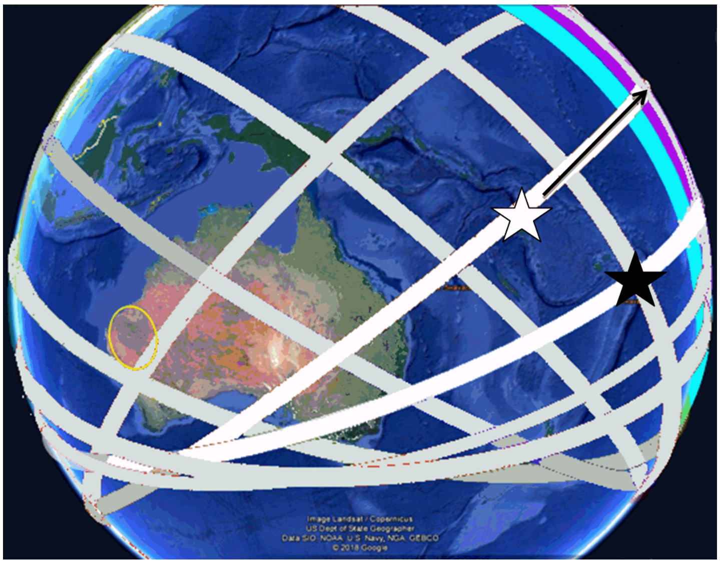

Figure 3. Large circles of the hypothetical CB flight around the Earth obtained by means of the Google Earth program. The width of the strips is 800 km. Asterisks indicate to geodynamically active areas: the white star is the Vanuatu, the black star is the Fiji

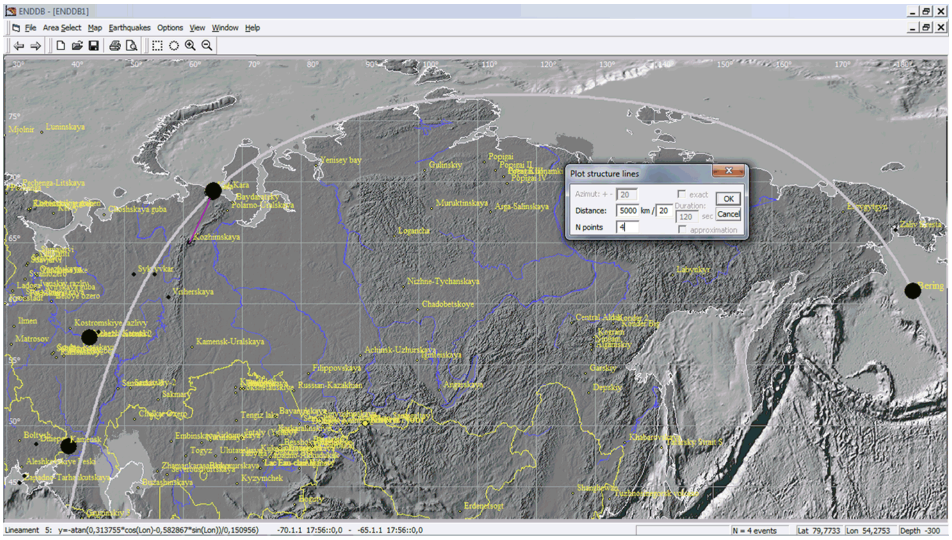

Figure 4. The Great Circle of the Earth built by means of the GIS-ENDDB program along the potential chain of the structures "Kamensk"–"Kara"–"Bering Sea"

In favor of the proposed "orbital" model of cosmogenic impact, the occurrence of its signs in the proven impact structures can evidence, i.e. the presence of chains of reliable structures that characterize the CB trail along the Great Circle of the Earth. Indeed, in paper [16], the proven impact structures "Kamensk", "Gusev", "Kara", "Ust-Kara" and the potential cosmogenic structure "Bering Sea" constitute a chain exceeding 7,000 km. The 300-kilometer strip of the Great Circle connecting the "Kara" and "Bering Sea" structures (Figure 4) also includes the proven craters "Karla", "Puchezh-Katunki", "Svetloyar" and many others [8].

3.2. Hypothetical energy effect (gravitational-tidal and thermal). It can be assumed that the passage of a giant CB at such a close distance from the surface of the Earth has a strong energy of influence: gravitational-tidal, thermal or shock (in the course of cleaving CB fragments) on the processes, occurring in the lithosphere and the asthenosphere. This may explain the coincidence of the trajectory in Figure 2a with the largest volcanoes on the planet. For example, one of the tracks passes through the volcanoes of Vanuatu-Hawaii-Yellowstone (the arrow in Figure 3). At the same time, the area of the island of Vanuatu is characterized not only by volcanism, but also by the increased seismicity, including the deep one. The region of localization of deep seismicity adjacent to it (the Fiji Islands region) is intersected by the previous route (laid by CB ~1.5 hours ago). The Pamir-Hindu Kush seismic focal zone is also intersected by Track 9 (see Figure 2a). A similar pattern is observed at other unique geodynamic points of the Earth: Track 3 (see Figure 2a) runs along Lake Baikal (in the direction of Madagascar-Baikal), and Track 7 crosses Lake Baikal again in the direction from NW to SE. A similar point of intersection of tracks is located near Great Lakes.

In the field of plate interaction, geological processes of pushing and sinking the edge parts of lithospheric plates could be activated at the points of the CB fly-over (many of these points are active even nowadays, representing highly localized seismic focal zones). The formation of an "echelon of arcs" — shaped deep anomaly along the edge of the Eurasian continent (see Figure 2a), identified by tomographic data (and representing a chain of deep "channels" with the diameter of the narrowest part $D = 400$–100 km [14]), may also be associated with such energy influence.

3.3. Hypothetical contact effect. Starting from a certain flight point of the CB (or of its fragments), the speed slows down so strongly that the speed of the Earth's surface (0.465 km/s) due to the daily rotation becomes greater than its speed. As a result, at the final stage of the flight of each fragment, the fragment may deviate from the orbital trajectory to the west (Figure 5a). Thus, the collision with the surface occurs at much lower speeds and at large angles, and the result of this impact may slightly differ from the classical impact (rather than explosive) crater. The most massive fragments of CB, which broke off along the flight path or reached the surface at the final stage of the flight, could, with their weight, bend the lithospheric plate (or tilt its edge) and plunge into the asthenosphere. The signs of such bending and plunging the lithosphere manifest themselves according to tomography, for example, in the area of the "Zaisan" channel (Figure 5b).

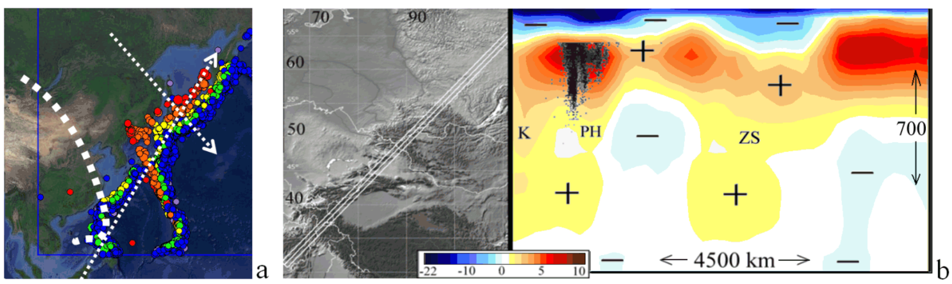

Figure 5. Hypothetical CB flight paths and deep geodynamic activity: a) the estimated shape of the trajectory of a CB fragment at the final stage of the flight (the bold dotted line), b) plunging the lithospheric masses (positive anomalies) in the vertical tomographic cross-section along the profile co-directed to the "Intra-Asian" seismic lineament: PH is "Pamir-Hindukush" channel, ZS is "Zaisan" channel

Conclusion

The observed signs of an unnaturally smooth alignment on many territories of the Earth, geomorphologically expressed relative to the adjacent areas, suggest the possibility of the large-scale external influence due to the capture of a large cosmic body as a satellite by the Earth's gravitational field. In the process of destruction and approach to the planet, the CB makes several turns around the planet, repeatedly interacting with its surface. In its route, not only traces of surface grinding (grooves and smooth plains), but also the lineaments of modern seismic activity are passing, and the mineral deposits located in the Earth's interior or associated with the introduction of a meteoritic material are opened at the points of the inferred touch. According to the tomography data, the following is revealed: in places of spalling of the most massive fragments — the signs of subsidence of the lithosphere and its absorption by the Earth's interior; in the areas of the intersection of the trajectory with the edges of the subducting plates — the "channels" of more active immersion of the edges of the lithospheric plates into the asthenosphere.

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