# Cosmic impact

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### *1 - Introduction*

We will discuss in this article a fairly common phenomenon in the history of a planet, namely its collisions with other non-planetary astronomical bodies (AB)[1] such as comets or asteroids. Such a non-planetary AB has a variable trajectory depending on how it was generated inside the planetary system (PS), being able at some point to intersect the trajectory of a planet when it is present on the direction of motion of said AB. In these circumstances there is a collision between the two ABs, with energy levels depending on the mass and velocity of the incident body (the asteroid or comet nucleus). A moving AB is equivalent to a displacement flux, so on impact with the real separation surface (RSS) of the hit (actuated) AB, this flux considered as an incident flux will decompose into the two components[2]: reflected flux and transmitted flux, each with two other components - normal and tangential. But the impact also generates a set of fluxes, this time propagation, normal flux and tangential flux. One last remark: according to the classification of the types of fluxes in the objectual philosophy, the incident flux is also formed by the two fundamental components of the material fluxes - the structural flux (SF, the matter contained in the incident AB with its volume and density) and the energetic flux (EF, the kinetic energy of an AB as a whole plus its internal energy).

[1] Non-planetary AB means a large astronomical body (from a few km to a few hundred km), but much smaller than the planet it collides with.

[2] See Chap. 7 of [10].

***2 - Objectual analysis of the impact and its effects***

Starting from the empirical observation according to which the thickness of the transition zone[3] has the same order of magnitude as the incident object (the transition zone being the RSS volume at the place of impact), in case of impact of an AB with Earth, if this AB has a diameter of about 1 km, then the thickness of the transition zone, of the impact phenomena, has the same order of magnitude (between 1 and 9 km), depending on the density of the incident energy flux, i.e. the velocity and mass of the agent AB. When a AB collides on the surface of the planet[4] the following types of fluxes occur:

– Incident flux, represented by the agent object (asteroid or comet nucleus fragment) with mass $m_a$ and velocity $v_i$ (on average, approx. 20 km/s), which strikes the surface of the planet under the angle of incidence $\theta$ relative to the tangent at the point of impact;

– Reflected flux, formed by the matter ejected to the outside following the impact. The displacement velocity of this flux is comparable to that of the incident flux, as a result part of this flux will be ejected into interplanetary space, exceeding the first cosmic velocity (11.2 km/s in the case of Earth), and another part will be thrown (ballistically) at a great distance from the place of impact;

– The normal component on the RSS of the transmitted flux, directed radially towards the interior of the planet, a displacement flux to the depth of penetration $h$ and a propagation flux (radial shock wave), whose FDV[5] are $\overline{f}_{nd}$ , and $\overline{f}_{np}$ respectively);

– The tangential component on RSS of the transmitted flux, a tangential displacement flux with FDV $\overline{f}_{td}$ and a tangential compression wave with FDV $\overline{f}_{tp}$ . These fluxes have collinear FDV with tangent from the point of impact;

– Transverse surface wave, caused by the normal displacement flux in the liquid mass of the magma on which the continental blocks float. This wave has the initial amplitude proportional to the depth of penetration $h$, a propagation velocity $v_s$ and a wavelength $\lambda_s = v_s \cdot T$ , where $T$ is the period of the surface wave.

Let's look at each of these components:

– Normal incident flux of displacement with FDV $\overline{f}_{nd}$ , a flux that exists as long as $\overline{v}_{in}$ exists (the normal component of the incident flux velocity), i.e. until the kinetic energy stock of the agent AB expires (until its penetration depth $h$ is reached in the earth's crust);

– Normal propagation flux with FDV $\overline{f}_{np}$, radial shock wave, which propagates inside the planet at the velocity of compression waves and will travel back and forth for several cycles until complete damping;

– Tangential displacement flux[6] with FDV $\overline{f}_{td}$ , a flux that exists as long as $\overline{v}_{it}$ exists (the tangential component of the transmitted flux velocity), a flux with the effective area equal to the tangential projection of the impact crater. This flux will generate (according to the

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[3] We remind the reader that an RSS of a material system is between two theoretical surfaces $S_e$ (external) and $S_i$ (internal) located at distance $h$, between which is the transition volume (zone) of the RSS, a volume in which the transition from the parameters of the external environment (atmosphere) to the parameters of the internal environment (terrestrial crust) takes place. See [10].

[4] We limit ourselves to analysing the impact with our planet because the consequences of such a phenomenon are extremely important for the future of the Earth's biosphere.

[5] FDV is the flux density vector introduced in Chap. 5 of [10].

[6] If the angle of impact with respect to the unit vector of the tangent to the earth's surface $\overline{\tau}$ of the incident flux is $\theta$ and FDV of the incident flux is $\overline{f}_{id}$ we will have $\overline{f}_{td} = f_{id} \cos\theta \cdot \overline{\tau}$ . So, only at a perfectly normal collision $(\theta = \pi/2)$ the tangential flux will be zero.

known laws of momentum conservation) the tangential displacement of the hit continental block and, with it, of the blocks as a whole;

– Tangential propagation flux with FDV $\overline{f}_{tp}$, tangential shock wave of collinear compression with the tangent from the point of impact;

– Surface wave similar to the waves generated by the impact of a stone on the surface of the water (let's not forget that the blocks in which the earth's crust is divided float like floes, on a huge planetary ocean of fluid lava), a wave that will also propagate concentrically relative to the point of impact. This transverse surface wave (the motion of the blocks is perpendicular to the direction of propagation), will travel several times the surface of the planet at a much slower velocity than the compression wave, but also with a much longer lifespan until its damping.

Strange as it may seem, this very last component, rather neglected by classical theories of such catastrophes, has some of the most disastrous effects on the Earth's biosphere. The surface wave in the liquid magma causes the reciprocal motion of the tectonic plates in the vertical plane, generating both devastating earthquakes and especially a long-lasting planetary-scale volcanism, through the periodic modulation of the interstices between the plates. Global and long-term volcanism, by opacifying the atmosphere and the toxic gases emitted, can lead to the temporary disappearance of all sun and air quality-dependent biosystems (plants) and with them, of the entire food chain that relied on them.

Another consequence, this time of the tangential flux of displacement is the appearance of a global continental drift (of the earth's crust as a whole) in the direction $\overline{f}_{td}$, in addition to drift due to internal causes (caused by convection currents in the liquid mantle). Such a drift causes the position of the continental blocks to have other geographical coordinates (other latitude and longitude) with respect to the internal reference system of the planet (axis of rotation and the equatorial plane of the planetary matter not disturbed by impact[7]). This global drift could be a more logical explanation for rock paleomagnetism anomalies than the current theory with magnetic pole reversal, or of climatic anomalies in certain parts of the crust (so-called ice ages, or the existence of green areas in parts of today's desert).

Comment 2.1: The direction of magnetization stored at the solidification in the liquid phase of a rock is given by the position of the emerging magma relative to the direction of the Earth's magnetic field at the time of solidification. As this position is variable depending on cosmic events (drift produced by extraterrestrial AB impacts), it results that the direction of magnetization will be variable (with the statistical frequency identical to the statistical frequency of major impacts, able to induce a global drift). The possibility of an abnormal drift of the Earth's crust was also analysed by Charles Hapgood [14], but without mentioning an external (extraterrestrial) origin of this phenomenon, the alleged cause being an imbalance of ice mass covering the poles of the planet.

As it is known, the earth's crust is an assembly (a union) of solid blocks[8], floating on an ocean of molten lava - the earth's mantle. The thickness of these blocks is estimated to be between 8 km in the ocean floor and 150 km in the mainland. We would thus have an average thickness of about 80 km of solid rock (a blanket of solid rocks, like adjacent floes, on a continuous, spherical ocean of molten lava). This solid blanket can have motions with respect to its liquid support, in the event that it (the solid blanket) receives from the outside a

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[7] We must take into account the proportion between the mass of the earth's crust, consisting of the so-called tectonic plates and the rest of the planet's mass. The Earth's crust represents only a few percent of the planet's total mass, with the remaining of over 90% of the planet's mass retaining its axis and speed of rotation before the impact.

[8] An interesting analogy can be made between the Earth's crust floating on an ocean of molten lava and the layer of slag floating on the molten metal volume in a furnace. If we could know the composition of the slag according to the composition of the furnace melt, we could know the composition of the magma under the crust (currently unknown) depending on the composition of the crust. It is the composition of the deep layer of the crust, the one in contact with the liquid magma, not the upper layers formed by sedimentary or metamorphic rocks.

sufficiently strong pulse to set it in motion. Such a pulse can be provided by the collision with a sufficiently large AB (asteroid or comet nucleus).

Fig. 2.1 reproduces an image taken from an article[9] published in a Soviet magazine in 1982, an article in which the author advocates the theory of magnetic pole reversal, starting from the idea that such a motion of the magnetic poles illustrated in the figure is inconceivable.

The irony of fate is that such a trajectory is possible due to the motion of the earth's crust caused by some impacts with sufficiently large extra-terrestrial AB, a motion not of the magnetic poles but of the rocks in the composition of the crust relative to the magnetic poles remaining stationary.

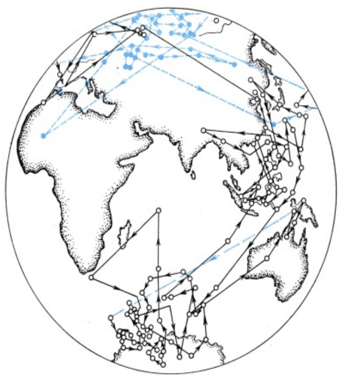

*Fig. 2.1 - Migration of terrestrial magnetic poles that would justify the change of the magnetic polarity of rocks. The blue lines are the trajectories on the opposite side of the globe.*

The planetary magnetic field[10] is given by the differentiated rotation of the charge carriers from the strongly ionized medium (and electrical conductor) of the incandescent part of the planet (mantle and nucleus), much larger in volume and mass than the volume and mass of the crust. This incandescent medium remains impassive (in terms of axis and speed of rotation) to any impact of an AB much smaller in size than it is, but large enough to move the crust. In other words, according to the objectual philosophy, the Earth's magnetic field remains invariant (within the precession of the magnetic pole axis), the position of the Earth's crust relative to the magnetic pole axis being randomly variable, a variation caused by random collisions with cosmic objects of different sizes and random collision parameters.

Comment 2.2: Regarding the Earth's magnetic field, the hypothesis of the objectual philosophy is the following: The rotational motion of an AB, both around its own axis (spin rotation) and the orbital revolution, is induced (not remaining from formation) by the rotor field due to the motion of material systems through (and relative to) MFP (ether)[11]. At the same intensity of the rotor field (the one that determines the rotation of the planet around its axis) the particles of different mass will respond differently, those with lower mass will have a higher speed. In this way, in the mass of molten lava, electrons with much higher mobility than positive ions will move faster generating a global current, the source of the Earth's magnetic field. According to this hypothesis, the magnetic field of an AB is directly proportional to the spin speed and to the volume and mass of molten (ionized) matter inside it.

### *3 - Other effects of the impact*

The effects of the incidence of a large body with the surface of a planet are different both in terms of the type of medium which the incident AB (the agent object) is formed of, as well as in terms of the type of medium that is in the impact area of the hit AB (actuated object).

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[9] **П е т р о в а Г. Н.** - *Инверсии магнитного попя Земпи*, Земля и Вселенная 1982.05

[10] The model of the objectual philosophy for the magnetic field of an AC is different from the current official model.

[11] The hypothesis of the universal rotor field belongs to the Romanian engineer Ioan N. Popescu, published in his paper **Gravitația („Gravity")** – *Editura Ştiinţifică şi Enciclopedică,* Bucharest 1982. In the objectual philosophy this hypothesis is nuanced, limiting itself only to the media formed by electric particles (EP), being justified by the specific way of approaching the structure of EP and the way of their motion/propagation through ether.

We now know that in our planetary system (PS) these agent bodies can belong to two classes - asteroids and comet nuclei. The first are made of solid rock, often with metal inclusions, a sign that they originally belonged to planets destroyed by a cataclysm (see [11]).

The second class - comet nuclei - is formed at the periphery of the PS, in the area of impact between the fluxes emitted by the central star (emerging fluxes) and the interstellar matter fluxes attracted to or intersected by PS in its motion in our galaxy. From the huge multitude of these bodies existing in the peripheral area of the PS (called the Oort cloud), some of them penetrate inside the PS and appear periodically in the form of known comets. Unlike meteorites (asteroids), comet nuclei are made up of solidified gases, mixed with cosmic dust. Gases come either directly from the Sun (components of the solar wind such as hydrogen and helium), or from the entrainment by the solar wind of gases from the upper layers of the planet atmospheres. Part of the dust in the composition of comets could also come from here. If we take into account the fact that the predominant element in the known universe is hydrogen (over 90%), and that much of the composition of the solar wind is made up of hydrogen nuclei (protons), we can say that much of the mass of comet nuclei is in turn consisting of solidified hydrogen.

Comment 3.1: The fact that much of the composition of the comet nucleus could be made up of hydrogen is very important when we talk about the impact with a planet the atmosphere of which contains a large amount of oxygen, as is the case with Earth. We know that when entering the atmosphere at cosmic speeds, a large amount of heat is produced which leads to the incandescence of the incident body. But the mixture of comet hydrogen plus terrestrial oxygen is known to be an explosive mixture. When we talk about at least a few thousand tons of hydrogen, about how much a fragment of a comet nucleus can contain (like the one that could have caused the explosion in Tunguska, or more recently in Chelyabinsk), we can realize another effect - the chemical one - in addition to the impact ones, which a collision with a comet can cause on Earth. It should be noted that in this case, the explosion occurs before contact with the crust and there will be no impact remains on the planet's surface.

We have therefore seen that the agent object in the event of a collision with a planet can be a meteorite or a comet nucleus. We also saw that the effects of the collision are either mechanical (those analysed above) or chemical (in the case of comets). We can also break down the effects according to the type of medium found in the impact area, in the Earth's case if the respective zone is on the continental or oceanic (or maritime) area.

If the impact zone is aquatic, the reflected flux will also be mainly composed of water, most of it ejected with cosmic speed, water reaching the cold from outer space in the form of ice blocks that will go to interplanetary space[12].

Comment 3.2: It is time to make a very important observation, namely that the flux of terrestrial matter ejected into space by a cosmic impact will contain the specific footprint of the Earth compared to other planets in the solar system - the existence of life. Even if biosystems ejected with water or soil will not withstand the conditions of the extraterrestrial environment, there will still be organic matter that can withstand these conditions (organic molecules, maybe even DNA fragments, viruses, spores, etc.). Another remark, given the current knowledge about our planetary system - water in large quantities is found only on Earth - so if we find amounts of water on the surface of other nearby ABs, then we can assume that this water comes from Earth following an impact with an extraterrestrial AB that hit the planet ocean.

Another part of the flux reflected in the case of water impact - the surface wave - will turn into the first wave of surface impact, with about the same order of magnitude as the incident body. This wave (similar to a tsunami caused by an earthquake, but much larger), will traverse the entire surface of the planet, brushing everything away.

Comment 3.3: In [14] the discovery in the frozen soil of northern Russia of large animals (mammoths) that had in their stomachs remains of flowering plants growing hundreds of miles further south is also being analysed. Trees that could not grow in the polar climate were buried in the same frozen soil, so they had been transported with the animals. Those who saw the aftermath of the tsunami in Japan[13] in 2011 will be able to understand that such a phenomenon, but on a much larger scale can lead to such consequences.

[12] With everything that water contains, i.e. the biosystems in it and the dissolved substances. These ice blocks can reach after who knows how long the surface of some ABs lacking atmosphere (such as the Moon or Mercury), forming water deposits observed by astronomers lately.

[13] On March 11, 2011, a 9.0 magnitude earthquake - one of the worst to hit Japan - killed more than 20,000 people and caused a tsunami of up to 40.5 meters that hit the Fukushima Daiichi nuclear power plant, triggering the melting of the reactor core. The wave produced was up to 39 meters high in the city of Miyako and penetrated about 10 km into Sendai. The wave flooded about 561 square kilometres in Japan.

If the agent object is a comet nucleus, in addition to the mechanical effects, there are also chemical ones (explosion).

All these estimates are valid in the hypothesis that the depth of penetration of the agent body is limited to the depth of the ocean. If the impact is deeper, the tectonic effects discussed at the beginning are added to the chemical ones (in the case of comets).

### *4 - Deposits of natural economic resources in impact structures*

The location and origin of natural economic resource deposits in impact structures [8] are controlled by several factors related to the impact process and the nature of the target. The types of deposits are classified according to their formation time relative to the moment of impact in: progenetic, syngenetic and epigenetic.

The progenetic economic deposits are those the origin of which predates the impact event, through the mechanism of pure terrestrial concentration. The impact event causes the spatial redistribution of resources and in some cases, pushes them to the surface or near the surface from where they can be more easily exploited. Progenetic deposits include iron, uranium, gold and others.

Syngenetic deposits are those that come from the period of impact or immediately afterwards as a direct result of impact processes. They originate in the storage of impact energy in the local environment by melting and changing its phase. Hydrothermal deposits whose heat was produced directly by the impact process are also considered syngeneic.

Epigenetic deposits result from the formation of a delimited topographic basin, with limited sedimentation or a long-lasting flux of fluids forced to circulate on routes imposed by the impact structure.

Two case studies:

1. The Vredefort Crater in South Africa is the oldest and largest crater recognized as an impact crater. Scientists believe that this largely eroded crater complex formed more than 2 billion years ago when a meteorite more than 10 km in diameter hit the area. The crater estimated to be 140 by 300 km has long been considered to have a volcanic origin. It completely surrounds the area now known as the Witwatersrand Basin. Located near the centre of the impact structure is a circle of hills called Vredefort Dome. Measuring 70 km in diameter, the circle is the remnant of the peak (uplift) created by the ebb of the rock below the place of impact of the meteorite. The Witwatersrand Basin is the largest gold field in the world, supplying about 40% of the gold ever mined worldwide.[14]. Grieve & Masaitis [8] state that uranium and gold remobilization in Witwatersrand Basin took place due to Vredefort impact event.
2. The Apuseni Mountains, a quasi-circular mountain massif (see Fig. 4.1) with a diameter of about 60 km, isolated from the Carpathian chain. This massif houses the so-called Gold-Quadrilateral (GQ see [1]) with an estimated density of 0.69 t gold/km$^2$, which has produced over 2000 tons of gold and other metals over the past 2000 years of exploitation by various empires that owned the area, starting with the Dacian Empire, the Roman Empire, the Habsburg Empire and ending with the Soviet.

Comment 4.1: In the years before World War II, German geologists discovered a uranium deposit in the Apuseni Mountains that they could no longer exploit after the loss of the war. Instead, the Soviet victors took care to exploit it to the point of exhaustion in the following years, under the pretext that they were extracting ... lead.

The rocks of which these mountains are composed (according to [1]) are predominantly volcanic and date from the Tertiary Period, although there are no volcanoes or other types of tectonic phenomena in the area that could explain the lava. The possible conclusion is that

[14] In the 100 years since its discovery, it has produced 47,000 tons of gold, and the remaining reserve is estimated at about 20,000 tons.

through an unknown process this lava together with the metals contained in it was pushed to the surface of the Earth's crust.

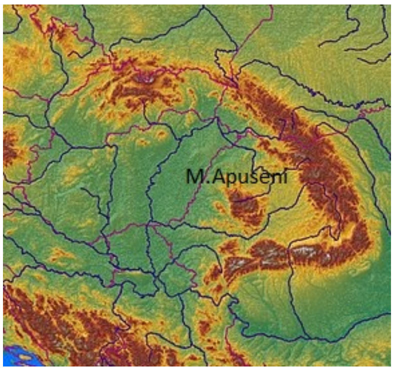


*Fig. 4.1 Overview of the Carpathian Mountains*

But we have seen before that there is such a process, manifested in the case of Vredefort, namely the impact in that area with a large asteroid, which resulted in a reflux (uplift) of molten magma to the surface of the Earth's crust. Although it seems hard to believe, however the shape of the mountain massif, its isolation from the Carpathian chain, the presence of large amounts of gold and uranium (similar to the case of Vredefort) are just a few arguments to support the hypothesis that this massif is the strongly eroded remnant of the central dome of an impact crater. It is possible that the Carpathian chain is also a deformed fragment of this crater (Transylvanian crater), deformation due to tectonic motions that followed the impact.

**4.1 - Quantitative estimation of an impact crater**

In Fig. 4.1.1 (Internet source) we see a section through an impact crater, assumed to be circular (shape valid only for collisions perpendicular to the crust):

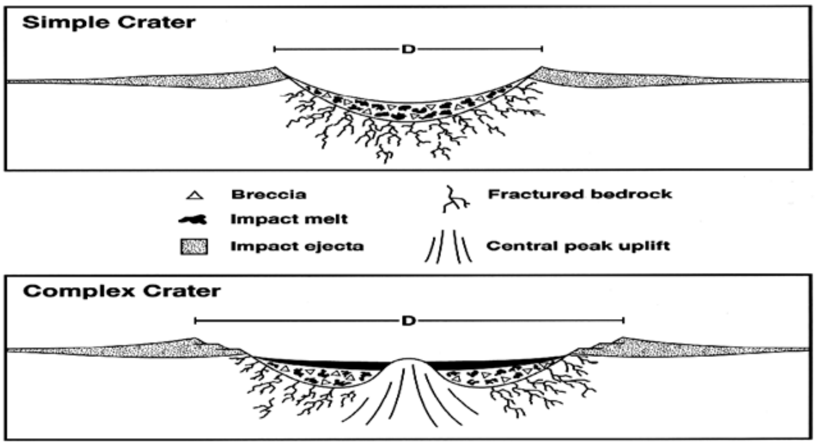


*Fig. 4.1.1 The structure of an impact crater*

The case considered for the Transylvanian crater is the Crater Complex in Fig. 4.1.1, in which the Impact Ejecta area is a section through the Carpathian Mountains, and the Central Uplift (Apuseni Mountains) is what is left of the Central Peak Uplift (similar to the Central Dome in the case of Vredefort).

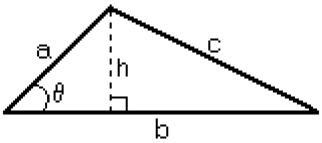


*Fig. 4.1.2 Model of the section through the mountain chain (Impact Ejecta from Fig. 4.1.1)*

Let a mountain chain with a triangular section (similar to the ejecta in Fig. 4.1.1), with $b \cong 50\,km$, $h \cong 1\,km$ and with length $L = 2\pi r$, where $r \cong 150$ km. Transverse area $S = \frac{1}{2} b \cdot h$ whence it results S$\cong$25 km$^2$. The rock volume V=$2\pi \cdot 150 \cdot 10^3 \cdot 25 \cdot 10^6 = 2.356 \cdot 10^{13}$ m$^3$. At an average density of the terrestrial rock-asteroid rock mixture of 4500 kg/m$^3$ a mass of approx.

$1.06 \cdot 10^{17}$ kg would result, a mass that the impact projects (reflected flux) after a ballistic trajectory at the final distance R (see Fig. 4.1.3).

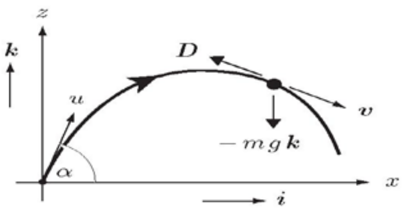


*Fig.4.1.3 Ballistic trajectory*

In Fig. 4.1.3 (according to [13]) we have a ballistic trajectory in which:

- *u* is the initial velocity with the angle $\alpha$ with respect to the horizontal (axis *x*);
- D it is the resistance of the medium;
- *m* is the mass of the projectile (of ejected matter);
- $g=9.81$ $ms^{-2}$ gravitational acceleration.

The maximum distance the projectile reaches:

$$R = u^2 \sin 2\alpha / g \tag{4.1.1}$$

To throw the mass $1.06 \cdot 10^{17}$ kg at distance R of 150 km (see equation 4.1.1) a launch speed[15] $u=1213$ m/s is required, to which an energy of $6.43 \cdot 10^{19}\,J$ would correspond. Since most of the trajectory in the case of impact remnants is outside the atmosphere we will neglect D. The kinetic energy of a spherical meteorite with a radius of 5 km, the density[16] $\rho \cong 3500\,kg/m^3$ and the impact velocity of 20 km/s is $3.66 \cdot 10^{23}\,J$, much higher[17] than the energy required to transport a mass of $1.06 \cdot 10^{17}$ kg (the approximate mass of the initial circular Carpathian chain) at a distance of about 150 km, so an asteroid even smaller than 10 km in diameter was needed to create this impact mountain chain.

A fundamental question arises from the fact that in the impact areas the distribution of mineral resources (especially heavy metals such as gold or uranium) is very different from the same distribution in the adjacent areas not subject to impact processes. What could be the explanation for this discrepancy? At first glance we might assume that the excess gold (for example) comes from the asteroid material (syngenetic process), which is hard to believe because in the case of Vredefort that 10 km diameter body should have contained at least 50,000 tons of gold as the amount of precious metal in the Witwatersrand Basin is estimated. Not to mention the uranium estimated at about 625,000 tons [3] from which about 150,000 tons were extracted. As this hypothesis is difficult to accept, only the remobilization of the resources in the earth's crust by the impact processes (progenetic process), i.e. the pushing to the surface of the mineral resources at great depth, remains in question. But this hypothesis brings with it another question: Is there such a high concentration of heavy metals in the layer just below the earth's crust? Almost uniform concentration at the surface of the entire globe, because a similar event, but at a great distance (in the centre of the European continent) produced the same mobilization of heavy metal content in the impact area.

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[15] The launch angle is the optimal of $\pi / 4$ .

[16] Average density of bodies in the asteroid belt.

[17] Even if the energy contained in the reflected flux is only a part of the energy of the incident flux.