Global Impact Events are the cause for Plate Tectonics and the formation of Continents and Oceans (Part 5)

This is Part 5 of my study. Please also see: Parts 1 to 4 & 6 → These parts describe the Permian-Triassic Impact and its effects on Earth in more detail.

by Harry K. Hahn / Germany - 8. July 2017 - Note: Study isn’t allowed for commercial use ! Study Documentation on: www.permiantriassic.de or here (18.1.2022 → added page 16) (→ higher resolution version of study is available here: www.archive.org > see Part 5_hr)

Abstract:
The 1270 × 950 km Permian-Triassic (PT)-Impact Crater on the ocean floor of the Arctic Sea will confirm the hypothesis that Global Impact Events are the cause for plate tectonics or more precisely the cause for a combination of plate tectonics and expansion tectonics! The PT-Impact Crater in all probability was caused by a big comet or asteroid with a diameter of 60 to 200 km, and it probably collided with our planet at a very shallow angle of less than 8° near the North Pole, with an estimated low impact velocity of ≈ 8 km/s.

A global fracture pattern on Earth’s crust was caused by this powerful impact and the ejecta of the impact, which mainly impacted in the form of powerful ejecta-rays and caused secondary-crater-chains with craters in the range of Ø 100-300 km visible on different continents! The most impressive are the Ejecta-Rays 1 to 4 in Africa (see Part 2 of my study).

The sudden decompression of Earth’s mantle, caused by the PT-Impact, triggered an expansion process in the mantle, which was caused by volatiles like H₂O, CO₂ and SO₂ in the mantle material. Earth’s mantle probably consisted of a partially differentiated mixture of rock and ice (e.g. Ice-V to -XI) at the time of the PT-Impact, similar to the mantle of Jupiter’s moon Callisto. The large amounts of ejected (and molten) material, caused by the PT-Impact, partly descended in Earth’s mantle and caused the African- and Pacific-LLSV (ULVZ) and in this way the volcanism on Earth for the last ≈250 Ma! The PT-Impact also started a plate tectonics process on the expanding Earth-mantle, which is still going on today. In the same way an Expansion-Tectonics-and Plate-Tectonics-process was triggered on Earth, it was initiated by an impact on other planets and moons of our Solar System as well! There is evidence for other powerful Global Impact Events which occurred on the planets Venus, Mars and Pluto, and on Jupiter & Neptune, and on Jupiter’s moon Ganymede, on Saturn’s moons Enceladus & Iapetus, and on Pluto’s moon Charon, and on our Moon too! → see description of the traces of these global impact events in this Part 5!

There is evidence that these global impact events, which occurred on the other planets and moons of our solar system, probably all took place within the last 300 million years! The root cause of these powerful impact events, caused by large Impactors (asteroids & comets) in the diameter range 20-200 km, are probably large amounts of debris located mainly close to the galactic plane of our galaxy. Tidal debris streams, probably in the range of 10 to 100 x 10³ sun-masses, caused by dozens of galaxy-collisions over the lifetime of our galaxy, seem to be the source of the debris (asteroids & comets) distributed along the galactic plane. This dark debris-material may represent the invisible “Dark Matter”!

There is a distinct 62 Million year (Ma) Bio-Diversity-Cycle (or Extinction-cycle !) visible in the geological record of Earth. This extinction-cycle corresponds well to the 66 +/- 6 Ma period for the vertical oscillation of our Solar System about the galactic plane of our galaxy! Therefore there is an increased risk for powerful impact events all ≈33 Ma when our solar-system is crossing the galactic plane, which seems to be a kind of debris disk (similar to Saturn’s Ring) consisting of a layer of large asteroid & comets ( “Dark Matter”!!).

Contents:
1 Introduction – The PT-Impact Event and its fundamental causes and effects
2 Debris streams (→ “Dark Matter”) = Asteroids & Comets in the galactic plane
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Mid of 2012 I informed ≈ 10 geologists and impact researchers (e.g. Prof. C. Koeberl, Prof. T. Kenkmann and Prof. U. Reimold) about the discovered 300 km diameter Cape-York Crater and other possible impact structures on Australia’s East coast. In 2015 & 2017 I informed the above mentioned, +geologists & the head office of the UNI Karlsruhe (KIT) about the discovered PT-Impact Crater. I even went to the 16th Symposium for “Tectonics” TSK2016 in Bonn in March 2016 and distributed copies of my study about the PT-Impact. But the only answer I got so far (KIT) was: My discoveries aren’t explainable with the current state of geophysics.
The real cause of Earth’s Plate Tectonics for the last 250 million years!:

1.) Not mantle plumes are the primary cause of Plate Tectonics!

   Global impact events, caused by powerful asteroid- or comet-impacts, are the primary driver of Plate Tectonics!

   → The **hard evidence** will be the confirmation of the Permian-Triassic (PT) Impact Crater!

2.) The Geo-Scientists don’t know yet, that the Permian-Triassic-boundary was caused by a large asteroid- or comet impact!

   Some Geologists & Impact Researchers already speculate that a large impact Crater may have caused the P/T-boundary. But nobody has found the crater yet!

   Yes there is a large impact crater which has caused the P/T-boundary!

   It is so large, that probably everyone has just overlooked it, because of its immense size of Ø 1270 x 950 km!! It’s an elliptical crater.

   You need to move up high above planet Earth to see it!

   In my study I will give a detailed description of the P/T-Impact Crater!

3.) The distribution of metal-ores and energy resources like crude-oil or natural gas, isn’t just a coincidence! And some mining companies probably know that!

   The distribution of many mineral- & energy-resources (e.g. metal-ores, crude-oil- and natural gas) is mainly caused by big impact events!

   That’s why a precise knowledge of all impact structures on Earth is crucial!

   And the knowledge of the P/T-Impact Event and other large Impact Events will make a big difference in future explorations, in order to find the resources which are needed for the further peaceful & prosperous development of mankind!

Weblink: “Numerical modelling of basin-scale impact crater formation”

   ( if the weblink doesn’t work: then just type-in the shown web-address in the browser )

   These two large circular gravity anomaly signatures probably indicate the two impact craters which are responsible for the big oil- & gas-fields in Saudi Arabia and in the Persian Gulf.

   ( Eigen-GL04C free-air gravity anomaly map )
Mineralogical Evidence (shock-metamorphic effects in rocks) for the Permian-Triassic (PT) Impact Event which I have found:

Please read Part 6 of my study: Mineralogical and Geological Evidence for the Permian-Triassic Impact Event (or alternatively here: Part 6) or on my website: www.permiantriassic.de or: www.permiantriassic.at

Indication and evidence for the PT- Impact Event, which is coming from existing studies:

A number of scientists specialized in impact research already proposed, that the Siberian Traps, the largest eruption of continental flood lavas on Earth, may be better explained by a large Impact than by a conventional mantle plume. Unfortunately the scientists haven't found the impact crater yet!

With my hypothesis (Parts 1 to 6) I want to proof that Global Impact Events* are the primary cause for Plate-Tectonics (and Expansion-Tectonics) on Earth and on other planets and moons of our solar system, and that such a Global Impact Event caused the formation of Continents and Oceans on Earth!

The hard evidence for the correctness of my hypothesis, will be the confirmation of the Permian-Triassic (PT) Impact Crater described in my study.

In the following I want to show now some extracts from a book written by the well-known impact researcher Prof. Dr. Christian Koeberl. These extracts from the book show the existing indication and evidence for a Permian-Triassic (PT) Impact Crater. But no information is given for its location.


Here the extracts from the book:

Page 29: Siderophile element anomalies (e.g. enhanced Ir contents) were found at some P-Tr boundary locations (e.g., Holser et al. 1989). And recent research succeeded in demonstrating the P-Tr boundary event was a much shorter event than thought. At Meishan, China, a negative excursion in the carbon isotopic composition had a duration of less than about 160,000 years and suggested that it could be the result of the impact of an icy carbon-rich comet.

Page 29: Kaiho et al. (2001) reported sulfur isotope and chemical data for samples from the Meishan (China) Permian-Triassic (P-Tr) boundary section. They interpreted S-isotope data, as well as the occurrence of Fe- and Ni-rich particles, as evidence for a large-scale impact event that penetrated the Earth's mantle and formed a crater approximately 1000 km in diameter.

A number of scientists pointed out that the Siberian Traps cannot be the result of a mantle plume (e.g., Czamanske et al. 1998, Sharma 1997, Elkins-Tanton and Hager 2000).

Page 109: An impact event is also supported by evidence from extraterrestrial noble gases in fullerenes found in P-Tr boundary beds in China, Japan, Hungary.

Page 109: Because there is a similar duality of signals between likely volcanic and impact sources at the P-Tr boundary, similar to the K-T boundary, the hypothesis of Impact Researchers should be tested, which claims that the Siberian Traps could have been caused by decompression melting at the impact site. And that impact volcanism can uniquely explain the dual signals in the geological record.

Page 110: An indicative model of Impact Researchers shows that it is possible for the volume of decompressed mantle beneath a large ~ 200 km sized crater to greatly exceed the excavated volume of the impact crater itself, primarily due to reduction of lithostatic load. Under suitable conditions of geothermal gradient, this would lead to near instantaneous melting with volumes of the order of 10^6 km^3, similar to the characteristic volumes of LIPs.

Page 110: And the induced large-scale vertical and horizontal thermal gradients are expected to have a long-term effect on secondary mantle flow.

Page 111: Decompression melting may contribute more melt than conventional shock melting.

Page 111: We propose that the Siberian Traps, which are accessible and currently under considerable scrutiny, may be better explained by a large impact than by a conventional mantle plume. The closure of a former ocean between Siberia and Mongolia, as well as amalgamation with north and south China blocks may also have been occurring during Permian-Triassic times. (These events were the result of the P/T-Impact Event!! comment from Harry.K.Hahn)

Page 97: Decompression melting must be seriously considered whenever an impact is sufficiently large to cause the transient crater depth to excavate a substantial fraction of the local crustal thickness, and thereby cause a sudden drop in lithostatic pressure beneath the crater.

Another study which indicates a Permian-Triassic Impact Event in Australia: Raining lead around 250 mya: A smoking gun for an Australian impact origin of the Permian Extinction; by Jim Standard & C. Austen Angell, Department of Chemistry and Biochemistry, Arizona State University, Tempe, AZ 85287.
Introduction - The Permian Triassic Impact

There is evidence for an elliptical impact crater with the enormous dimensions of 1270 x 950 km on the ocean floor of the Beaufort Sea near the north-coast of Alaska. This impact crater seems to be responsible for the Permian-Triassic Boundary, which has caused the most severe mass extinction in Earth's history, ~253 million years ago. This Permian-Triassic (PT) Impact Crater was formed by an oblique impact. That means that the impactor (an asteroid or comet) collided with our planet at a very shallow angle of probably less than 8°.

The impactor, an asteroid or a carbon-rich comet with a diameter of 60 to 200 km, impacted in the Beaufort Sea close to the north-pole and caused a gigantic butter-fly shaped ejecta blanket with two large ejecta wings which covered the majority of the northern hemisphere. Within the boundaries of this ejecta blanket many large secondary impact craters were formed by the ejecta, with crater diameters of up to 450 km. In Europe (in the Mediterranean area) at least 8, but probably up to 20 such large secondary craters were formed by the impacting ejecta, which was thrown out of the PT-impact crater. These impact craters and the resulting large-scale magma (lithospheric) flow is responsible for the tectonic development of Europe during the last ~253 Ma. Two of these secondary craters (Ø160 & Ø220 km), which formed the Tyrrenian Sea north of Sicily (Italy) and which are still noticeable on topographic- & geological maps (see below), should provide the evidence to confirm the described impact scenario.

The main impulse of the PT-impact, together with the impulses and secondary craters, produced by the ejecta material, caused a global fracture pattern on Earth's crust, which was the trigger for the break-up of Pangea and for a global expansion tectonic process. This expansion tectonic process caused the dichotomy on Earth → the formation of continents and ocean basins. And it is responsible for the transport of big amounts of volatiles (mostly H₂O) from Earth's mantle to Earth's surface.

Earth's diameter increased from an estimated diameter of 6500-7500 km ~250 million years ago to a diameter of 12756 km today, with an average expansion rate of ~20mm/year.

The expansion of Earth's mantle probably was caused by ≥two effects: By abrupt decompression of Earth’s mantle, which led to the large-scale expansion of volatiles, especially H₂O (ice/water), in Earth’s mantle. And by phase changes (transformation) of minerals and high-pressure ice e.g. Ice XI & X caused by the thermal energy (heat) that was induced in Earth’s mantle by the molten PTI-ejecta which descended in Earth’s mantle and formed the African-LLSV and the Pacific-LLSVP:

The ocean basins, which represent new surface area of our planet and which formed between the old crust fragments (the continents), continuously filled up with water (H₂O) over the last ~250 Ma. This water was, and still is, transported from Earth’s mantle to Earth’s surface through fractures caused by the PT-impact, and through the Mid-Ocean Ridges were new surface areas of planet Earth (→ the ocean floors) are continuously created.

In the same way as the water was transported to the surface of our planet Earth, and in the same way the expansion tectonic process was initiated on Earth it happened on other planets and moons of our Solar System. There is evidence for other powerful global impact events which occurred on the planets Venus, Mars and Pluto, on Jupiter’s moon Ganymede, on Saturn’s moons Enceladus & Iapetus, on Pluto’s moon Charon and on our moon. The Moon’s Mare are probably the result of a global impact less the 300 million years ago (see: L1, L2, L3, L4) similar as on other planets & moons. These global impact events in all probability took place in the last 300 million years!

But back to the Permian-Triassic (PT)-Impact!:

The main impulse of the Permian-Triassic (PT)-impact on Earth initially caused a break-off of the Angara Craton from the Russian Craton and it caused a strong acceleration of the Angara Craton towards South, were China and Australia were located at that time. The following powerful southward movement of the Angara Craton then caused
the HP- and UHP-orogens in China, through the extreme compression which it produced in the crust fragments caught between the North China Craton & the Angara Craton. This dynamic process led to the formation of the Altaid-magmatic-fronts.

In the NE & NW of Australia, off the coast, two exceptional large craters with ~ 350-400 km diameter can be identified, which both seem to be secondary craters caused by ejecta from the PT-impact event. Here especially the Cape York impact crater located off the NE-coast of Australia must be mentioned, because it strongly influenced the tectonic development of the Pacific Plate through a number of gigantic magma eruptions.

The stratigraphic record of the NE-coast of Australia (e.g. “Moreton Geology”) indicates the probable connection of the Cape York crater, and its secondary impact structures, with the PT-impact event. At least eight (8) gigantic magma eruptions can be assigned to the Cape York Crater, which took place within the last ~200 million years. The fifth eruption of this series of magma eruptions, which was very powerful, not only left clear visible traces on the Pacific Plate. The magma front of this eruption also moved a small cratic block (the Colorado Plateau) deep into the north-american continent. This has caused the formation of the Rocky Mountains and the Basin & Range Province. Further, a second magma front resulting from this eruption strongly influenced the geology of Antarctica, and it separated Antarctica from Australia & South-America.

This eruption No.5 may have been triggered by extreme earthquakes, of magnitude >12 (on the Richter Scale), maybe caused by the Chicxulub Impact Event ~65 Ma ago, and could therefore be partly responsible for the extinction of the dinosaurs. The magma eruption No.6 of the Cape York crater left further distinct traces on the Pacific plate and it strongly influenced the geology of Mexico and of the Gulf of Mexico, when the magma front crossed this area. This magma front was also responsible for the formation of the Appalachians, which were created by a crust-fragment that was relocated (bended) towards the East by the magma front.

A key map for the further analysis of these magma eruptions is the NOAA ocean floor map, which shows the topography of the Pacific Plate in fine detail. This map shows all the fine traces which will lead to the confirmation of these magma eruptions, and it will help to understand the dynamic geological processes caused by these magma eruptions, e.g. the separation of New Guinea & New Zealand from Australia, and the separation of Japan from New Guinea, the formation of Indonesia, French Polynesia etc.

Another key map is a global ocean-floor-age map which shows the 1200-1600 km wide ocean-floor stripes (between 60°N & 30°S latitude) where the magma fronts moved along from west to east.

→ see detailed description in Part 1 of my study!

Along the NE coast of Australia there are many other secondary impact structures noticeable, which all were caused by the Cape York impact. Other possible secondary impact craters, caused by the PT-impact event, were found in India, in Arabia and in South-America. Here the 450 x 380 km elliptical crater identified in India, which formed the Bay of Bengal, seems to be related (identical) to the large secondary crater off the NW-coast of Australia with the estimated dimension of 400 x 350 km, that is responsible for the ejection of large amounts of ejecta, rich in Platinum Group elements in a ray-like pattern on the Yilgarn Craton.

A large elliptical crater with the dimensions of 840 x 630 km, found in South-America, which can be identified on topographic maps and on satellite images, may also be related to the PT-impact event. (maybe caused by ejecta ray R2)

Another largescale impact event in Africa, which also must be mentioned here, are the four chains of impact craters R1 – R4 (with probably >10 craters per chain), formed by secondary-craters in the Ø100 to Ø300 km range, caused by PTI-ejecta rays which crossed the whole continent in slightly different angle directions! These impact craters were caused by ejecta material which was excavated in the PT-Crater during the PT-Impact.

A gravity anomaly map of Africa provides evidence for the very powerful ejecta rays caused by the PT-Impact Event in Siberia. The traces of the Ejecta Rays R1-R4, which caused long secondary-crater chains, are clearly visible in the form of linear negative (blue) anomalies on the Map of Africa. Craters with Ø100-300 km caused these crater chains!

(→ Find a more detailed description of the Ejecta Rays and crater chains caused by the PT-Impact Event in the Parts 1 to 3 of my study)
My investigation points towards the strong Ejecta-Ray No. 4 along the east-coast of Africa, and the strong ejecta ray along the north-east-coast-line of Australia, which produced a number of ~Ø 300 km secondary impact craters (e.g. the Cape-York Crater), as the probable location (→ the two cracks in Earth’s crust) where a big part of the PT-ejecta material descended in Earth’s mantle and caused the African- & the Pacific-LLSV & ULVZ (Large Low-Shear- and Ultra-Low- Velocity Provinces)!

I believe that Earth’s mantle probably consisted of a partially differentiated mixture of Rock and Ice (e.g. Ice-X or -XI) ≈ 250 million years ago, similar as the mantle of the big Jupiter moon Ganymed or Callisto. However the molten ejecta material which descended into Earth’s Mantle after the impact probably caused a phase-change in the Ice towards an Ice-type with lower density and it probably produced big amounts of volatiles, which led to a constant expansion of Earth’s mantle until today!

I now want to mention an interesting discovery on Mercury. The image on the right shows the Ø 80 km Basho Crater on Mercury. The low-reflectance material (black) which is surrounding the crater is a form of carbon called graphite. Scientists believe it was excavated by the impact from the planet’s original, ancient crust which lies deeper.

It is thought that Mercury was once covered by a crust composed of graphite, when much of the planet Mercury was still molten. An alternative explanation would be that the carbon was brought-in by the impactor itself, for example if the impactor was a carbon-rich comet. This would be my first guess when I look at this image. However an origin from within Mercury (from Mercury’s mantle) is also possible.

I mention this discovery for the following reasons:

1.) In all probability the PT-impactor was a carbon-rich comet with a diameter of 60 - 200 km.
2.) Lengai Volcano located in Tanzania within the strong ejecta ray R4 is erupting Carbonatite Lava. Carbonatites are formed essentially of carbonate. It is possible that the carbonate which formed the carbonatite lava was caused by the PT-impact, because the distribution of carbonate rocks in Europe seems to be closely related to the PT-impact event in Europe, caused by PTI-ejecta. In all probability the carbonatite was caused by carbon-rich rock material from the Carboniferous period which was excavated during the PT-Impact, and then transformed in carbonatite after the carbon-rich ejecta material impacted on Earth’s surface.

The other possibility is that the carbonatite was caused by carbon material from the impactor itself.

3.) The 12 km “Kola super-deep borehole” showed that at a depth > 7 km the rock in Earth’s crust is saturated with Hydrogen (H₂) and H₂O which originates from deeper sources in the mantle! It’s possible that big amounts of the hydrocarbon deposits found close to impact structures may be a direct result of the thermochemical processes which are going on during & after an impact event! (→ e.g. deposits consisting of CH₄, C₂H₆ etc.)

First indication for six PT-Secondary Craters!:

I have found indication for shock-metamorphic effects in the rock-samples of six possible Secondary Craters of the PT-Impact Event. This provides the first scientific evidence for real impact structures caused by the PTI-event!

I used Micro-Raman Spectroscopy on quartz-grains to provide the evidence for a shock event, that in all probability was caused by the PT-Impact. Shifts of the Raman peaks in quartz-samples of these six possible PT-secondary-craters indicate that the quartz-grains were shocked with a shock-pressure in the range of 20-22 GPa in some cases. This is clear indication for an impact shock event! The most interesting PT-Secondary-Craters for further scientific research in Europe, to proof the PT-Impact Event, are the Ø 130 x 110 km „Bay of Lyon Crater“ and the Ø 30 km Impact Structure near Puerto de Mazarron and the Ø 1.6 x 1.2 km elliptical Impact Crater near Rodalquilar, both in southern Spain. In Australia the most interesting PT-Secondary Craters are the Ø 320 km Cape York Crater, the Ø 40 x 33 km elliptical Pilbara Crater the Ø 8 x 7 km elliptical Warwick Crater, and the possible Ø 30 km Mt Warning Crater. All these PT-Secondary Craters are unknown yet!

A detailed analysis in Part6(P6) of my hypothesis.

References:
- My hypothesis involves the study of impact structures on Earth and Mercury, focusing on the role of carbon-rich materials in the formation of impact craters.

- The discovery of carbonatite lava in Tanzania is linked to the PT-Impact event, indicating the presence of carbon-rich rock material originating from deeper sources in the mantle.

- The Kola super-deep borehole provided evidence for the presence of hydrogen and water in Earth’s crust at depths greater than 7 km, which supports the idea of shock-metamorphic effects caused by impact events.

- Micro-Raman spectroscopy was used to analyze quartz-grains from potential PT-Secondary Craters in Europe and Australia, providing strong evidence for shock events that caused the formation of these structures.

- The most interesting PT-Secondary Craters include the Bay of Lyon Crater in Spain, the Pilbara Crater in Australia, and potential craters in Europe and Africa, which are yet to be discovered.
Introduction – Evidence for a fundamental cause of Global Impact Events and “Super-Continent Break-Ups”

There is strong indication that the Sagittarius Dwarf Galaxy (Sgr-DG), a companion of our own galaxy (Milky Way), is responsible for “periods of global impact events” in our solar system, and in million other solar systems as well! This means that around each pericenter event of the Sgr-DG with our own Galaxy (pericenter event = closest approach between the mass centers (or the collision) of both galaxies), millions of planets in our galaxy were hit by large impactors (large debris) caused by the collision of the two galaxies.

During Earth’s history there were at least three (maybe even 4 or 5) of the mentioned pericenter events. The image sequence on the left shows the last three pericenter events in quick-motion (images 1 to 7 & 1 to 4). The images are extracted from a super-computer simulation of the dynamic behaviour of the two galaxies over the last 2.65 Gyrs (1 Gyr=1 billion years). The key events are the three pericenter (P)-events (collisions, or closest approaches of the two galaxies). They took place at: P1=1.9 Gyr, P2=0.9 Gyr and P3= 0 Gyr (now )

Here the weblink of the movie which shows the Dynamical Analysis of the galaxy collisions:

→ Movie Dynamic Analysis

The dynamical analysis of the three collisions (pericenters 1 to 3) of the Sagittarius Dwarf Galaxy with our own galaxy shows, that gravitational disturbances, which are caused on our galaxy disk at each collision, shear into trailing arms, which are then enhanced, strengthening the transients spiral modes of our galaxy. In other words means that collisions of this Dwarf Galaxy with our own galaxy cause & intensify the spiral arms and spiral structure of our own galaxy. As everyone can imagine this has consequences for all solar systems located in the new created spiral arms caused (or later intensified) by these collisions!

The spiral arms created by the collisions are actually vortices in which billions of solar-systems rotate around the bow-shaped center-lines of these spiral arms. And on each rotation around the center-lines of the spiral-arms the solar-systems cross the center-plane of the galaxy disk two times. (up-& down oscillation through disk)

The diagrams on the left show that there is a distinct correlation between the U/Pb Zircon age peaks in orogenic granitoids & detrital zircons) on Earth and the ages / times when the Sagittarius Dwarf Galaxy (S-DG) impacted on our own galaxy (→ pericenter events P1 & P2 ). And because there is also a correlation between the Zircon age peaks and the break-up & formation of super-continents, it can be concluded that each pericenter event with the Sagittarius Dwarf Galaxy resulted in a super-continents “break-up” & “formation” cycle (or in a shattered crust) on Earth! These “supercontinent cycles” must be the result of strong variation of “debris-flow” in our own Galaxy, caused by the collisions (pericenters) with the S-DG, which led to times with many global impact events on the planets of our solar system, when the debris flow was high, or they led to quiet periods with low debris flow → which then allowed planets to heat fractures in their crust caused by the global impact events. In the last 600 Ma (P3) more global impact events occurred, because there was a constant debris flow of stellar material from S-DG through our Galaxy.

The S-DG debris stream : a comparison of the real and simulated debris stream

<table>
<thead>
<tr>
<th>Our Galaxy's Milky Way data</th>
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<tbody>
<tr>
<td>disk (galaxy) diameter :</td>
</tr>
<tr>
<td>disk height :</td>
</tr>
<tr>
<td>number of stars : 100 - 300 billion</td>
</tr>
<tr>
<td>orbit period of our solar system around the galaxy center : 230 My</td>
</tr>
<tr>
<td>age of our galaxy : 13.8 Ga</td>
</tr>
</tbody>
</table>

Sagittarius Dwarf Galaxy data : disk (galaxy) diameter : 30000 - 160000 LY |
number of stars around 1 billion age of galaxy : approx 13 Ga
Diameter of stars approx 10 - 170 LY

The diagrams on the left show that there is a distinct correlation between the U/Pb Zircon age peaks in orogenic granitoids & detrital zircons) on Earth and the ages / times when the Sagittarius Dwarf Galaxy (S-DG) impacted on our own galaxy (→ pericenter events P1 & P2 ). And because there is also a correlation between the Zircon age peaks and the break-up & formation of super-continents, it can be concluded that each pericenter event with the Sagittarius Dwarf Galaxy resulted in a super-continents “break-up” & “formation” cycle (or in a shattered crust) on Earth! These “supercontinent cycles” must be the result of strong variation of “debris-flow” in our own Galaxy, caused by the collisions (pericenters) with the S-DG, which led to times with many global impact events on the planets of our solar system, when the debris flow was high, or they led to quiet periods with low debris flow → which then allowed planets to heat fractures in their crust caused by the global impact events. In the last 600 Ma (P3) more global impact events occurred, because there was a constant debris flow of stellar material from S-DG through our Galaxy.
Introduction - Evidence for a 62 +/- 3 Ma Cycle in Bio-Diversity on Earth, caused by big Impact Events

There is strong analytical evidence for a 62 +/- 3 Ma cycle in Fossil Diversity (or Bio-Diversity). Sharp cuts in the bio-diversity of Earth clearly occur within approx. 20 Ma (Myr) long extinction periods. These sharp cuts all happen within the declining phases of the 62-Ma (Myr) cycle (→ see sin-wave diagram 1c).

Currently we live at the end of such an extinction period, within the declining phase of the 62-Ma cycle which is still going on for another 3 to 5 million years!! But it is obvious that there wasn’t a similar sharp cut yet, in the current cycle, if compared with the past 8 cycles!!

Note that in 6 of the past 8 cycles at least 70% of all marine species became extinct!!! (diagram 3). And in all 8 cycles the minimum percentage of extinct species was 40%. However the current cycle doesn’t show any cut in Bio-Diversity worth mentioning!! Have we just been very lucky?, or is the cause of the sharp cuts in bio-diversity just a bit late in the current cycle which is still going on?? Note: In cycles 5 and 8 a sharp cut occurred right at the end of each cycle! (corresponds to eruptions & craters in Diagram 2).

There are indicators in diagram 2 & 3 that the sharp cuts in bio-diversity may be caused by periods of large impact events. Note in Diagram 2 the 5 large eruption events (which could have been caused by big impacts), which occurred within or very close to cycles 1 & 5-8, and the two large impact events in cycle 5 & 8! → also see Diagram 3!

It would be important to produce a more extensive and precise diagram to the age and size of large impact events & large eruption events with information to age tolerances!

The most plausible cause for the 62 +/- 3 Ma period "Big impact cycles" is the periodic crossing of the galactic plane by our Solar System. The galactic plane may be full of debris (asteroids & comets) similar to the debris in Saturn’s Ring-plane. The 62 +/- 3 Ma Bio-Diversity cycle is in good agreement with the 66 +/- 6 Ma period for the vertical oscillation of our Solar System about the plane of our galaxy! Note that it seems that the last crossing of the galactic plane occurred ≤ 3 Ma ago 1, which is approx. 5 to 7 Ma after mid of the calculated extinction cycle!! → see weblinks:

- 1.) Weblink Studie 1
- 2.) Weblink Studie 2

Diagram 1:
- Shows the Fourier Spectrum of the short-term variations of the bio-diversity on Earth.
The Fourier Spectrum is dominated by a strong spectral peak with period 62 +/- 3 Ma!

The sin wave corresponding to this cycle is shown in Fig. 1c where it accounts for 35% of variance.

Diagram 1e also shows a second spectral peak with period 140 +/- 15 Ma.

The 62-Ma cycle is very significant. By contrast the 140 Myr cycle can plausibly result from random processes.

Although no explanation exists, the 62-Ma cycle is not a subtle signal. It is evident even in the raw data (Fig. 1a), dominant in the short-lived genera (Fig. 2) and strongly confirmed by statistical analysis. It implies that an unknown periodic process has been having a significant impact on Earth’s environment throughout the Phanerzoic. The author considers the following physical processes: periodic comet showers triggered by a companion star or a planet X or by the oscillations of our solar system-up and down the galactic plane every 52-74 Myr or by periodic crossings of spiral arms, or periodic mantle plume cycles & volcanism cycles, or long-term solar cycles.

Diagram 2:
- Strong 62 million year cycle in the number of extinct marine genera!
- In cycles 5 and 8 a sharp cut occurred just a bit late.

Diagram 3:
- Large well dated Impact Craters
- Diagnostic evidence of Impact documented Iridium Spikes
- Percentage of Extinct Marine Species

Prepared by: Harry K. Hahn, 29-9-2013
A new hypothesis to Dark Matter: Interstellar -Asteroids and -Comets caused by Galaxy-Collisions are the invisible matter!

Dark Matter is exactly what its definition says !: It is dark matter with a low albedo ! I am talking about Asteroids and Comets which are nearly invisible when they are far away from the sun. There is indication coming from different directions which shows us that we are totally underestimating the amount of asteroids- and comet-like objects which move through interstellar space! In 2017 the first Interstellar Asteroid “Oumuamua” was discovered. In 2019 the first Interstellar Comet 2I/Borisov was discovered. These small dark objects are very hard to detect !, because they move very fast. Old elliptical galaxies don’t seem to have dark matter (see: Study). All younger spiral galaxies seem to be the result of collisions and fusions of two or more galaxies, which have produced gigantic tidal debris streams that were distributed along the spiral arms, and in the longterm along the galactic planes. Collision simulations show that the spiral structures are caused by collisions ! (see Study2) And there is indication that all bipolar planetary nebulas are the result of direct star-collisions (Study3, Study4).

The curve on the left shows the Measured Rotation Curve (white) and the Calculated Rotation Curve (red) of stars in a typical spiral galaxy. It shows the rotation velocity of the stars around the galaxy center in relation to their distance to the center. In regards to the visible (luminous) matter which we can see, the rotation speed of stars further away from the center should drop rapidly (red curve). But it doesn’t!! That’s why astro-pheutics developed the idea of dark (invisible) matter that must be distributed between the stars further away from the center (in the so-called galaxy corona) in order to explain the much to high measured rotation speed of stars here.

In my opinion this “Dark Matter” can simply be explained by dark matter that consists of “dark debris (asteroids & comets)” caused by galaxy collision. Spiral-Galaxies are the result of collisions & fusions of two or more galaxies! Old Elliptical- (not collided) Galaxies don’t seem to contain dark matter! → see Study: https://arxiv.org/abs/1303.6896

Old Elliptical Galaxies are not the result of many collisions like spiral galaxies! A simulation of collisions of our own Galaxy with the Sagittarius Dwarf Galaxy (Sgr-DG) shows that gigantic tidal debris streams move through the areas, during collisions, where dark matter is expected. If we consider this tidal debris masses streams to be mainly asteroid- & comet-streams caused by billions of star-collisions then we can explain the mysterious dark matter (see images below left). A proof for this hypothesis may be bi-polar planetary nebulas located in the galactic plane of our galaxy which are aligned with the same ‘collision vector’

**Stellar Nebulae are caused by collisions:**
The Blue Ring Nebula is a cloud in space composed of debris & gas from two stars that collided and merged into one star. → see images (see: Study) This Nebula represents the bi-polar planetary nebula type! Another study to bi-polar planetary nebulae in our galaxy’s central bulge showed that they have their long axes mostly aligned along the disk-plane of our galaxy!! This is a first proof for my hypothesis that bi-polar Planetary Nebulae are the result of star-collisions!! Because stars mainly move parallel to the galactic-plane their collision-vectors will have a similar direction!

**Star-Collision (-Impact):** This image sequence shows what happens when two stars collide. It shows a section view of the collision event along the resulting collision vector (long nebula axis) It is an estimated event! But I am sure a computer simulation will show a similar result! I have considered two stars with slightly different size. The smaller star is marked in yellow color. The result of the collision is a bi-polar nebula and a fused star as shown below!

The images below show some bi-polar Nebulas
Introduction - Oblique Impact Craters & Impact Structures formed by several Impactors

To understand what happens when an asteroid or comet impacts on a planetary body, here a few examples of oblique impact craters and impact structures formed by several impactors (→ impactors which broke apart):

Here we don’t consider the case where the impact angle is 90° and a simple circular impact crater is formed.

The following images show what happens if an impactor (asteroid or comet) impacts on the surface of a planet or moon in a shallow angle, and what impact structures are formed by impactors which break apart just before impact.

The following facts of such “oblique impacts” with a shallow impact angle should be kept in mind:

1.) An elliptical impact crater is formed during impact.
2.) Oblique impacts (2) produce a butterfly-shaped ejecta blanket with two mostly forward directed wings.
3.) The ejecta blanket is formed by multiple ejecta lobes.
4.) The smaller the impact angle the more ejecta is thrown out without being melted → see below.
5.) There is often a blow-out rim on the rear end of the crater visible. (the crater has a flat end.)
6.) At multiple impact craters “ejecta strings” along the borders between the separate shock fronts are caused (accumulation of ejecta along lines).

The apparent distribution of the ejecta goes beyond, that this crater was formed by an oblique impact, by a stream of material, which is formed by multiple fragments of a burst comet, asteroid, or moon. There is often a blow-out rim on the rear end of the crater visible. (the crater has a flat end.)

At multiple impact craters “ejecta strings” along the borders between the separate shock fronts are caused (accumulation of ejecta along lines).

Prepared by Harry K. Hahn
Introduction: The cause of global Expansion Tectonics: A global impact event and a mantle that contains volatiles, in particular water/ice

High concentrations of volatiles in the mantle of certain planets & moons may be the driving force for their rapid expansion, after a global impact event has caused extensive fractures in their crust. The global impact event and the fractures in the crust are the trigger, which initiate the expansion of the planet or moon through abrupt decompression of the mantle. Then the volatiles in their mantle e.g. CO₂, H₂, SO₂, H₂S... but especially H₂O (ice) cause the rapid expansion of the mantle, and the formation of ice-crusts, oceans & atmospheres on the surface. As seen on Earth, Mars, Ganymede, Enceladus & Pluto etc. (see this study!). The H₂O may be present in different shells of high-pressure-ice (e.g. Ice-X & -XI) or present as water in the mantle, and it may go through a phase-transition, e.g. towards an Ice-type with a lower density, after the impact event!

Jupiter's moon Ganymede is definitely one of the most obvious examples of global expansion tectonics. It is easy noticeable that the (old) brown colored areas represent fragments of a sphere which drifted away from each other! The fragments of these shattered (older & smaller) sphere seem to get pulled apart from each other by an expanding sphere (the expanding mantle) underneath. The cause of the fractures in the old (brown-colored) crust and the trigger of the expansion tectonics was a global impact event!(see page 20 in this study!) And the substance which is driving the obvious expansion of the moon must be H₂O! Because the mantle of Ganymede mostly consists of Water & Ice in the state of different high pressure-Ice-types (I - XI)!(see diagram & P.20)

The expansion only slightly increases the moon's moment of inertia

![Ganymede - Global Geologic Map](Image)

Important indicators which support the Expansion Tectonics Hypothesis (see description below):

1) Earth's mantle contains 0.5 – 2 wt% H₂O. But because the mass of water (H₂O) in the mantle is poorly constant, the real value could be much higher!

2) A comparison of Earth's mantle with the mantle of other planetary bodies with high concentrations of H₂O on their surfaces (see diagram), indicates that the wt% of H₂O in Earth's mantle may be considerably underestimated!

3) Different analyses indicate that Earth's radius is expanding with 4 to 15 mm/y. This means Earth's diameter increased by 2000-7500 km in the last 250 Ma!

Hypothesis: A scenario for the expansion of a mantle, which is causing Global Expansion Tectonics:

1.) First we consider a crust of a planet or moon which is stable (undamaged by big impacts) for a long time period (200 Ma). Underneath this stable crust, which is acting like the wall of a pressure vessel, volatiles accumulate within the mantle material over a long time. These volatiles may be produced by different processes inside the mantle. At the beginning the mantle material of the planet or moon contains these volatile components in a dissolved state. How ever pressure and temperature in the mantle increase over time, because more and more volatiles accumulate within the mantle material, and because radioactive decay is constantly adding heat. The solubilities of the volatiles depend on pressure, temperature and the composition of the mantle material. When solubility decreases below volatile concentration, the volatiles will start to exsolve and start to expand the material.

2.) At this point the mantle material is super-saturated with these volatiles. And with further increasing pressure within the mantle material, finally the point will be reached where the pressure in the mantle exceeds the pressure caused by the lithostatic load (weight) of the crust. This is the point when tensile stress will start to build up inside the crust material of the planet or moon, which allows the pressure within the mantle to increase even further! (> 2km/h in a pressure vessel). This build-up of stress in the crust can go so far that the crust is close to fracturing through tensile stress! In this state the crust will be very vulnerable to impact events. The extremely fractured rock found at depths >7 km may be proof of this! (Note that Earth's mantle contains at least 0.5 - 2% H₂O!)

3.) If one or more large impacts are hitting the crust of the planet or moon in this state, the fracturing of the crust will be particularly extensive because it was already close to fracturing through increasing tensile stress. And as soon as the crust is fractured by the impact(s) the mantle material will start to expand rapidly. Because volatile solubility in the mantle material (magmas) decreases through the rapid pressure drop in the mantle, caused by the fracturing of the crust, more and more gas will exsolve!! And the mantle expands faster and faster because of the expanding mantle material. Heat from the impact event is contributing to this process!

4.) A self-accelerating process is initiated which only stops when a new equilibrium is reached between the decreased pressure in the mantle and the pressure produced by the new (thinner) overlying crust, which is caused mainly by gravity and not by the constraint of a closed spherical shell (a pressure vessel wall) anymore. Because of the expansion the mantle-density dropped considerably

![Inner structure of Ganymede, Pluto & Callisto](Image)

Other interesting information:

- Study 1, Study 2, Study 3, Study 4, Study 5, Study 6, Study 7, Study 8, Study 9
- The number of atoms increases during radioactive decay!!

Expansion Tectonic Earth models:

From James Maxlow & other geologists and geo-physicists who support this Theory:

Web-Links: L1, L2+L3, L4, L5, L6, L7+L8, L9, L10
The Permian-Triassic Impact Event: A Comet or Asteroid collided with Earth and caused a 1270 x 950 km elliptical Crater

The asteroid or comet had a diameter in the range of ≥ 60 to 200 km, and it caused the most severe impact event and mass extinction known in Earth history 253 Ma ago. This event caused the Permian-Triassic boundary, associated with the most extensive mass extinction of marine species and terrestrial vertebrates and plants. And it caused the largest eruption of “continental” flood lavas, the Siberian Traps.

The following images and explanations describe the impact event and its effects on our planet Earth during the ~ 253 million years from this event. As everyone can imagine, this powerful impact event completely reshaped our Earth’s appearance!

The two images on the left show the remains of the impact site as it appears today. The main impact site is located in the Beaufort Sea close to the coast of Alaska. Another part of the impact crater which moved away from the impact site through the impulse of the impacting asteroid is located in Siberia. By moving the two locations together the impact scene becomes evident.

The flood lavas caused by the impact: The Siberian Traps

Note the bow-shape of the northern edge of the flood-lava formation similar to bow-waves produced by ships!

The flood lavas directly caused after impact

Flood lavas caused later, a certain time after impact

Note the blow-out rim on rear end of crater

Material which streamed back from the Angara Craton into the Crater

Satellite image:

Here 3 informative movies about the P/T Event: PT_Movie 1; PT_Movie 2; PT_Movie 3

Note the trajectory of the asteroid or comet

Southern area of impact site today moved away from impact site through the impulse of the impact

Impact Site

Flood lavas

Southern area of impact site today

Prepared by Harry K. Hahn

Permian/Triassic Impact Crater

Alaska

Beaufort Sea

Angara Craton

Position of Angara Craton and southern area of impact site today

Main Impact Site location today

Source: Google Earth
To the crater formation of the Ø1270 x 950 km Permian-Triassic (PT) - Impact Crater

There is close correlation between the topography of the real P/T-impact crater and the topography of a simulated elliptical impact crater with similar properties (ellipticity, impact angle, impact velocity, target surface etc.). The PT-impactor probably had an impact velocity of around 8 km/sec. And the impact angle probably was in the range of around 5 to 7 degrees. Therefore the PT-impact was a "low-velocity impact" of a large asteroid or comet in the diameter range of 60 to 200 km, at a very shallow angle. During the impact the lower part of the impactor was decelerated by shearing along the surface, while the fragmented upper part of the impactor continued its motion nearly unaffected. The fragmented upper part of the impactor, together with a very large volume of partly molten excavated rock material was ejected in a very large butterfly-shaped ejecta blanket. This ejecta blanket which included many large secondary impactors (fragments of the P/T-impactor + ejecta), produced a number of secondary crater chains with crater diameters of 100-250 km, and a number of very large secondary craters with diameters of >300 km (e.g. Bengal Bay Crater, Cape York Crater, Pantanal Crater, etc.). There is strong indication that these impact crater chains are responsible for the major fractures in Earth's crust, which led to the break-up of Pangea. (e.g. the crater chains R1 to R4 - see Part 2 of Study)

The real structure of the Permian Triassic Impact crater area

\[ \text{Satellite Image (contrast enhanced):} \]

\[ \text{Impaction Site near Alaska} \]

\[ 1270 \times 950 \text{ km Impact Site today located in the Beaufort Sea} \]

\[ \text{PT-Impact Crater} \]

\[ \alpha = 10^\circ \quad \alpha = 5^\circ \]

\[ \text{Structure generated by projectile sliding along the surface} \]

\[ \text{Simulated Impact Structure of a 5° oblique Impact} \]

\[ \text{The secondary structures at the front-end of the crater are the result of the projectile motion along the target surface (friction)} \]

\[ \text{The diagrams below show that the maximum shock pressure is drastically reduced in a oblique impact at 15° impact angle compared to the vertical impact case. The reduction in volume of melt is 90% for a 15° impact! (This estimate does not include possible melting due to shear heating). That means the PT-Impact has ejected large volumes of unmelted rock!} \]

\[ \text{See Weblink to study: Study 1} \]

\[ \text{Model Setup} \]

\[ [5] \text{To investigate crater formation for shallow-impact angles, we have carried out a series of 3-D simulations with the hydrocode ISALE-3D [Elbeshausen and Wünnenmann, 2011; Elbeshausen et al., 2009]. This code uses finite difference and finite volume techniques on a Cartesian staggered mesh. It follows an Implicit Continuous-Fluid Eulerian and Arbitrary Lagrangian-Eulerian (ICF-1DE) approach, as described in Harlow and Amsden [1971] and Hirt et al. [1974], to solve the Navier-Stokes equations in a compressible manner. Hence, the kinematic description of motion can be either Lagrangian (where the mesh deforms according to the nodal velocities) or Eulerian (where mesh is fixed in space) or a mixture of both. Due to large deformations and shearing of matter that occur in particular during oblique impacts, the Eulerian approach is more appropriate for the given study [e.g., Collins et al., 2013]. The Eulerian kinematic description requires the reconstruction of interfaces between matter and the free surface (or different types of materials which was not considered in this study as target and projectile were assumed to consist of the same material) to enable a precise calculation of material flows. For the interface reconstruction, it is beneficial to use an adaptive approach coupled with a volume-of-fluid technique [Benson, 2002; Hirt and Nichols, 1981; Guesnier et al., 1999] as described in Elbeshausen and Wünnenmann [2011]. The code has been successfully validated against laboratory experiments and benchmarked against other numerical impact models [e.g., Davison et al., 2011; Pierazzo et al., 2003].} \]

\[ [6] \text{In all simulations, we assume terrestrial gravity conditions (g=9.81 m/s)}^2\text{and resolve the projectile by 16-24 cells per projectile radius. We varied the impact angle }\alpha\text{ in a range between 90° (vertical impact) and }5°. \text{The primary focus of this study was on low impact angles (}\alpha<30°\text{), since we expected the transition from circular to elliptical craters in this range. We used impact velocities of }U=8 \text{ km/s, 12 km/s.} \]

\[ \text{See Weblink to study: Study 2} \]
Large-scale structures caused by the PT – Impact, visible on different Maps

Gravity Anomaly- and Geoid Maps also indicate the PT-Impact

Note the indicated linear structures on the maps, probably caused by large Ejecta-rays & -blankets

There is an interesting example of an elliptical Crater on Mars with the dimensions of $10 \times 7.5$ km, which in all probability was caused by a small Mars-orbiting moonlet whose orbit tidally decayed, because it came close to the marsian atmosphere. It probably impacted in a very shallow angle $\leq 5^\circ$ (see trajectory-d at the image below) with a relative slow velocity of less than 5 km/s.

The impactor which caused the PT-Impact Crater on Earth probably also was a small moonlet, which was caught be Earth’s gravity and was orbiting around Earth, before its orbit tidally decayed in Earth’s atmosphere, and it finally impacted at a shallow angle of $\leq 8^\circ$ with an impact velocity of probably less than 8 km/s. This would explain the elliptical Crater, the visible ejecta-ray structures the Siberian Traps and the triggered Expansion Tectonics.

On the origin of a double, oblique impact on Mars
J.E. Chappelow\textsuperscript{a,b,*}, R.R. Herrick\textsuperscript{b}

A double, oblique impact feature north of Olympus Mons provides a unique opportunity to investigate the event that formed it. The sizes of the craters, their ellipticity, shapes of ejecta blankets, separation from each other, and positions relative to each other, all give us information about the event. Coupling this information with an existing model of micrometeoritic flight through an atmosphere allows us to test several possible scenarios for the event (object type and origin, pre-entry trajectory, atmospheric trajectory, prevailing atmospheric density). We find it highly improbable that the impactor was simply an extramartian asteroid or comet. We also find that it is unlikely to have been a double-asteroid or a tidally fractured one, but is more likely to have been a Mars-orbiting moonlet whose orbit tidally decayed, and that denser atmospheric conditions than today's may have prevailed when it impacted.

The trajectory (d) of the asteroid that caused the elliptical impact on Mars and the trajectory of the impactor that caused the PT-Impact were similar!

Fig. 1. A large ($7.5 \times 100$ km) elliptical crater with a smaller elliptical crater ($2.0 \times 3.0$ km) lying 12.5 km directly uprange (to the left). "Butterfly"-pattern ejecta occur around both craters. (Mosaic of THEMIS daytime IR images.) North is up.

Fig. 2. Atmospheric flight trajectories for asteroids (top) and a moonlet (bottom) in the martian atmosphere, as discussed in the text. Both are radially exaggerated.

by courtesy of NASA/JPL

\textsuperscript{a}Study: Weblink1, Weblink2

Gravity Anomaly- and Geoid Maps also indicate the PT-Impact

Front-end of PTI-crater (current location)
To the evolution of the PT – Impact Event, and the effects of the impact on Earth’s crust

The PT-Impact was an oblique impact. This means the impactor, a large asteroid or a comet, with ~ 60 to 200 km diameter, impacted on our planet in a very shallow angle. The impact angle was probably < 8°. Therefore the impact, which took place close to the north-pole, produced a large butterfly-shaped ejecta blanket, originating at the impact site and spreading over the majority of Earth’s surface area.

→ The butterfly-shaped outline of the ejecta blanket (marked in red) is shown on the map in FIG. 1

The tectonic map on the left (FIG 3), a polar projection shows the present situation. The two maps on the right side show the situation directly at the time of the PT-Impact, and at ~ 150 Ma after the PT-Impact.

Because of the immense size of the impactor, the ejecta blanket which resulted from the impact, covered nearly Earth’s complete surface, and it produced very large secondary impacts. Most of these secondary impacts were distributed within this butterfly-shaped ejecta pattern, and many secondary impact craters formed along distinct ejecta rays (e.g. ejecta rays R1 to R4), which have their starting point at the PT-Impact Crater.

Fig 1 : A Polar-Projection centred on the PT-Impact Crater. Earth diameter : ~6500-7500 km

Fig 2 : A Polar-Projection of the North-Pole area down to approx. 30° northern latitude, showing the scene at a time between the PT-Impact and today. All following considerations in this study are based on a smaller Earth before the impact and on strong Expansion Tectonics after the impact, because all maps used for the analysis indicate Expansion Tectonics!!

Fig 3 : Present Situation

The Impact drives the Angara Craton in a southern direction towards China

Strong Compression on the southern side of the Angara Craton, causing the Altaid magmatic fronts & the HP & UHP orogens in China

From the book : "The Tectonic Evolution of Asia", from An Yin & Mark Harrison

Prepared by Harry K. Hahn

Angara Craton

PT-Impact

Solidified Magma Vortex

NORTH CHINA DRAMON

Prepared by Harry K. Hahn

Figure 21.6. Paleotectonic map of Asia showing the primary orogenic-collision components mentioned in the text. Precambrian consolidated

Solidified Magma Vortex

Canada

Siberia

Europe

North America

Antarctica

Australia

Farallon Plate

North America

Angara Craton

Russian Craton

Europe

South America

Africa

PT-Impact

China

Figure 1: Polar-Projection of Earth’s complete surface area at the time of impact centreed on the PT-Impact Crater. Earth diameter : ~6500-7500 km

Fig 2 : Polar-Projection down to 30° N ~100 Ma ago, Ø Earth : ~ 10000 km
A re-constructed Tectonic Map of the Ø 1270 x 950 km Permian-Triassic Crater-area a certain time after the Impact Event

I have re-arranged some key-areas of the Tectonic- (Topographic-) Map of the PTI-Crater-area to provide a clearer picture of the deformations which the PT-Impact caused on Earth’s crust. This will make it a bit easier for Tectono-physicists (Geo-physicists) to confirm and accept the existence of the PT-Crater and the Expansion Tectonis process that obviously was triggered by this Impact Event!

The manipulated tectonic-(topographic-) map on the left shows the PT-Impact area as it probably looked a certain time after the Impact. The Hudson Bay (CA) and the Kolyma Range in Siberia were caused by ejecta-lobes of the PTI, which show the same ejecta triangle structure as an impact on planet Pluto and as two other secondary impacts caused by the PTI (see below).

The Gulf of Carpentaria in NE-Australia was formed by a similar ejecta-impact-structure (Ejecta-Triangle) as visible on planet Pluto. This “Ejecta Triangle” provides evidence for another ~300 km Crater which is hidden on the ocean floor. 

See also page 13 in Part 2 (or: Part-2)

Other shallow Impacts which caused “Ejecta-Triangles“:

A Ø 50 km Crater on planet Pluto caused a large „Triangular Ejecta Impact Structure“

A big ≈ Ø 250 km Crater in Ejecta Ray R3 shows an „Ejecta Triangle“

A shallow (oblique) Impact Event on Pluto, less than 100 million years ago, formed Hillary Montes at the border line of Sputnik Planum.

An ejecta-lobe (wing) from the impact-crater produced an Ejecta-Impact-Structure with a precise triangular shape! (→ red lines)

(→ see: Pluto Images)
The tectonic evolution after the PT – Impact Event

As already mentioned on the previous page, all the following considerations are based on a smaller Earth with ~Ø 6500-7500 km before the impact, and on strong Expansion Tectonics after the impact. Because all maps used for the analysis indicate that the PT-Impact triggered strong Expansion tectonics on Earth which is probably still going on today. (†There is certainly much more expansion than subduction going on today!)

An important key-map for the analysis:

On the lefthand side a composite of continental thicknesses scaled from vertical-S-wave upper-mantle travel-time-anomalies combined with an age-dependent model of ocean basins is shown. The map shows that there was originally a complete Eurasian Craton. However this large Eurasian Craton was hit by the asteroid ~253 Ma ago and broke apart through the immense shear- & bending stress which was induced into the Craton by the Impact Impulse.

The physical description of the impact event:

The PT-Impact event can roughly be divided into three phases which I will describe in the following:

**Phase 1:** The impact produced three main impulses which were induced into the surrounding Lithosphere. The impulse \( P_{IM} \) from the Impactor itself and the two Ejecta-Impulses \( P_{E1} \) and \( P_{E2} \) which all accelerated different areas of Earth's crust (lithosphere). The following formula can be applied:

\[
P_{Total} = P_{IM} + P_{E1} + P_{E2}
\]

**Phase 2:** The accelerated sections of Earth's Crust (e.g. the Angara & Russian Cratons, which rotated around a common pivot point) then later produced immense compression stress further away, where they collided with other thick crust areas.

**Phase 3:** The further tectonics is more complex, because of complex interaction between different areas of Earth's crust. The begin of phase 3 is roughly described in the image on the right-hand side.
The Pacific - LLSVP, which is responsible for the magma eruptions, and the African - LLSVP were caused by the PT-I:
There is strong indication that the Permian-Triassic Impact (PT-I) and the ejecta rays which were caused by this enormous impact are responsible for the formation of the two main LLSVPs (Large low-shear-mantle provinces) inside Earth’s mantle. These two large structures, which are characterized by slow (seismic) shear wave velocities and which consist of much hotter material (~4000°C) than the surrounding mantle material (~2000°C), extend laterally and vertically for thousands of kilometers from the core-mantle boundary. In all probability the remains of large secondary impactors and the powerful ejecta of the leading edges of the two ejecta-wings of the PT-I descended deep into Earth’s Mantle and caused the LLSVP’s as a result.

The diagram on the left shows the shallow (oblique) impact of the PT-I-magmatism which probably had a diameter of around ~60 to 200 km. It also shows a side view of the Victoria Lake Impact crater which was caused by a large secondary impactor ejected from the PT-I crater. Part of the ejecta from the VLC was as ejected forw and in impact direction where it formed another secondary crater, the BCC. The rest (the majority) of the VLC-ejecta was again ejected in a butterfly-ejecta-pattern. Traces of ‘forw-ard-ejecta’, which always seems to be dense & ductile metal-bearing material, are also visible near the CYC- and PHC (BC)-craters. The majority of the ejecta from the PT-I crater was ejected in the form of a gigantic butterfly-shaped ejecta blanket. Where the leading edges of the two ejecta wings of this butterfly-ejecta blanket impacted on Earth’s crust ( in the yellow marked areas ) extensive fractures (new continent borders) were formed. The north-polar-projection of Earth, shown on the left shows Earth at PT boundary time (~250 Ma). We can conclude that the Pacific LLSVP is due for an eruption soon! The solid upward pointing column at the top of the diagram shows the path of the source (outflow channel of next eruption), which is responsible for the magma eruption, and the African Rift Valley which seems to be one of the possible future eruption areas.

Note : All volcanos of the Pacific Fire Ring and other volcanos on Earth can be explained by the Permian-Triassic Impact! They are all located in the (fractured) crust areas which were directly caused by the ejecta of the PT-I!! The magma (molten mantle material) which causes these volcanos, in all probability is exclusively, a result of the impact of ejecta & secondary impactors from the PT-I!! Therefore a revised model for Earth’s mantle is required, which must consider a much higher share of volatiles, e.g. H$_2$O and CO$_2$, within the mantle material.

Warning : There is a high probability that another such volcanic eruption will occur in the near future!! This indicates that the next magmatism (magma eruption) will take place near the Fiji-islands! In an image on the right we see the path of the source (outflow channel positions = yellow dots) of the magmatism eruptions. It seems the Pacific LLSVP is due for an eruption soon! The solid upw ard pointing column at the top- end of the LLSVP, near the Fiji’s may indicate the coming eruption (mass extinction?). The vertical expansion rate of this column must be measured!!

Path of the magma eruption source (yellow dots), A2, A1882, C1-C3 represent drift-off-copies & remains of the first magma-eruption-zone A1

An alternative model for Earth’s mantle is required!! Earth’s mantle in all probability contains much more volatiles, especially H$_2$0, than currently believed!! Similar to Ganymede’s mantle, Earth’s mantle may contain a high share of high-pressure minerals, such as Ringwoodite, mixed with volatile material like Callisto’s mantle and other materials. H$_2$O may also be stored in minerals like Ringwoodite etc.
Earth at the time of the PT-Impact Event

The following maps show how our planet Earth probably looked at the time of the Permian-Triassic (PT)-Impact. On these maps, the arrangement of Earth’s continents at PT-time is based on impact structures which in all probability were caused by the PT-Impact Event (especially the CYC, the BBC/PHC and the VLC-Impact Event & the Ejecta Rays (crater chains) R1-R4 were used as a reference). And an Expansion Tectonics model for Earth was used as base for these maps. The PT-Impact Event caused the shown fracture pattern, which triggered an expansion tectonics process on Earth. ➔ Earth’s Ø at the time of the PT-Impact : ~ 6500-7500 km
Ganymede will help us to understand the Expansion Tectonics Process on Earth caused by the PT-Impact Event

Similar to Earth’s Jupiter’s moon Ganymede shows Expansion Tectonics over its whole surface area. Looking on Ganymede’s geological map then it is very obvious that the brown colored areas represent fragments of a sphere which are slowly drifting away from each other. It is undeniable that the moon’s mantle has expanded!

A new sharp image of Jupiter’s moon Ganymede was made by NASA’s Juno spacecraft during its June 7, 2021, flyby, from a distance of only 1038 km. The image shows clearly distinct dark and bright terrain, and long structural features possibly linked to tectonic faults. Ganymede’s surface is composed of two types of terrain:

1. Dark old regions, saturated with impact craters and currently dated to four billion years ago, cover about one third of it. These dark regions contain clays and organic materials that could indicate the composition of the impactors from which Jupiter moons accreted. (→ on the geological map the old regions are indicated in brown color).

2. Brighter and younger regions, crosscut by extensive grooves and ridges, cover the other two thirds of the moon’s surface. The cause of the light terrain’s disrupted geology was likely the result of tectonic activity.

Water ice seems to be present everywhere on Ganymede’s surface, with a mass fraction of 50–90%:

The bright grooved regions (areas) have a more icy composition than the dark regions. The modern view is that these bright grooved regions are mainly tectonic in nature. Cryovolcanism is thought to have played only a minor role. Scientists believe that in the past Ganymede may have passed through one or more Laplace-like resonances (episodes of eccentricity excitations of its orbit), and that this probably caused significant tidal heating of the interior of Ganymede. The formation of the grooved terrain may be a result of one or more such tidal heating episodes. The scientists think that this tidal heating episodes may have caused the expansion of Ganymede’s mantle caused by thermal expansion and phase transitions in the high-pressure ice which forms Ganymede’s mantle. But there is also the possibility that the Gilgamesh Impact and other Impacts have caused the mantle expansion (Harry K. Hahn)

Internal Structure

Jupiter’s largest moon Ganymede (Ø 5150 km) is composed of approximately equal amounts of silicate rock and water. It appears to be fully differentiated, with an internal structure consisting of an iron-sulfide–iron core, a silicate mantle and outer layers of water ice and liquid water, which may contain more water than all of Earth’s oceans combined. The precise thicknesses of the different layers in the interior of Ganymede depend on the assumed composition of silicates (fraction of olivine and pyroxene) and the amount of sulfur in the core.

The average density of Ganymede, 1.936 g/cm³, suggests a composition of about equal parts rocky material and mostly water ices (→ see info to: Water-Ice-types). Beside water ice there are various non-water materials on Ganymede’s surface present: carbon dioxide, sulfur dioxide and, possibly, cyanogen, hydrogen sulfate and various organic compounds. The Galileo space probe has also found magnesium sulfate (MgSO₄) and, possibly, sodium sulfate (Na₂SO₄) on Ganymede’s surface. These salts may originate from the subsurface ocean. Ganymede has a thin oxygen atmosphere that includes O, O₂, and possibly O₃ (ozone). Atomic hydrogen is a minor atmospheric constituent. The oxygen is thought to be produced when water ice on Ganymede’s surface is split into hydrogen and oxygen by radiation, with hydrogen then being more rapidly lost due to its low atomic mass. Thermolysis of water (→ water molecules split into hydrogen & oxygen at T > 2200°C), where the required heat is provided by impacts, could be another possibility! (comment by Harry K. Hahn).

Ganymede is the only moon known to have a magnetic field. This causes auroras to glow around the moon’s north and south poles.
The surface of Jupiter's moon Ganymede seems to be the result of Expansion Tectonics caused by a Global Impact Event.

Jupiter moon Ganymede (Ø 5150 km) shows indication for a global Expansion Tectonics process. Looking at Ganymede's geological map then it seems to be obvious that the brown colored (old crust-) areas represent fragments of a sphere which are slowly drifting away from each other. It’s obvious that an expansion process was started at a certain point of time and the fragments of the old smaller spherical shell (brown) got slowly pulled apart by an expanding mantle underneath! Having a close look at the pattern of the “expanding cracks” between the old brown-colored crust fragments, than it seems that one global impact event was the initial trigger for the break-up of Ganymede's old spherical shell (> the brown-colored surface area)!

This global impact event not only provided the impact energy and the required shock-waves to shatter Ganymede’s crust in one single event. It also provided the energy & conditions which started the massive mantle-expansion of Ganymede. My new analysis indicates that the Ø600 km Gilgamesh Impact Basin (pages 23-26, 78, 163, 214 in this PDF) and the impact energy and fracture pattern caused by this global impact event in all probability triggered the obvious expansion tectonics process on Jupiter’s moon Ganymede! Because there are strong similarities to the PT-Impact Event on Earth: e.g. crater (impact basin) size ≈ 1/10 to 1/5 of the planet’s (moon’s) Ø, the impact angle was ≤ 15°, a massive expansion tectonics was triggered (started) by the giant impact, and a surface & mantle which seems to have a similar structure (→ high water (ice) content) Ganymede will help to understand the similar expansion tectonics on Earth!

According to the Geological Map these curved furrows (fractures) were caused by large impact(s) into a relatively thin brittle lithosphere during the Nicholsonian period.

Near-infrared & UV-spectral analysis
Water ice exists everywhere on the surface of Ganymede with a mass fraction of 50–90%. Strong water-ice absorption bands are present.

Interesting Weblinks: Ganymede Geology
Rotating Geological Map: GEO Animation
Link 2: Rotation Animation 2

Image 1: I have moved the old (brown) crust-fragments back to the original position where they were located shortly after the Global Impact Event which caused the Ø 600 km "Gilgamesh" Impact Basin.

This manipulated Geological Map of Ganymede clearly shows that the old (brown-colored) crust fragments formed the original spherical shell of the moon Ganymede, which had a considerable smaller diameter at the time of the impact of ≈ Ø 3000 km.

Image 2: Global geologic map of Ganymede published by the U. S. Geological Survey
→ Weblink: Overview of map - PDF: Map

Global Geological Map of Ganymede by courtesy of USGS

Different structural features indicate the Impactor’s trajectory (→ see next page!)

“A shattered & expanding Sphere” by courtesy of NASA/JPL
The Gilgamesh Impact, a large shallow Impact, fractured Ganymed’s crust and caused Expansion Tectonics in the mantle.

There is strong indication that the Ø600 km elliptical Gilgamesh Impact Basin is responsible for the global fracture pattern that shattered the old and smaller spherical shell (dark regions) of Jupiter’s moon Ganymede, and that this giant Impact started an Expansion Tectonics process in Ganymede’s mantle, which slowly pulled apart the old crust fragments by an expanding mantle underneath. Similar as on Earth (→ the PT-Impact Crater) this giant oblique (shallow) Impact obviously caused the “tectonic plates” (the fragments of the old crust) and the Expansion Tectonics process on Ganymede. Beside the extreme seismic shock waves and the secondary impact structures (crater chains & big secondary craters) caused during the impact, also the powerful tangential impulse induced into Ganymede’s crust and mantle by the giant shallow impact, together with the induced impact heat, must have been the decisive factors for the global fracture pattern. Secondary Crater-chains and large Secondary Craters caused by the Gilgamesh Impact clearly indicate that the Gilgamesh Crater slowly drifted away from the original impact site into the direction of the original impact impulse (= trajectory of the impactor). Further indication comes from expansion tectonics structures on the rear-end of the impact basin. (→ see left image!) The real drift of the crater may exceed >1000 km!

Ganymede’s Isis Crater and an old Crater on Earth caused tectonic plates

Another interesting crater on Ganymede, the Ø75 km Isis Crater, also seems to have caused “plate tectonics” in a smaller scale on Ganymede. The image and the geological map of Ganymede’s Isis Crater and its surrounding area indicate that a small tectonic plate on Ganymede (→ brown-colored on the geological map) obviously was fractured by the Isis Impact (Crater) and the fragments of this old plate then drifted apart after the impact. A very similar impact crater which fractured Earth’s crust ≈ 3 Ga ago also exists on Earth!

On the Pilbara Craton in NW-Australia there is a similar, yet unknown!, impact scenario visible where an impact crater obviously has fractured Earth’s young crust and caused tectonic plates! Weblinks to my study: Link 1; Link 2. Study also available on: www.permiantriassic.de / www.permiantriassic.at
There is strong indication for a global impact event on Mars that probably happened less than 250 Ma ago. This global impact event produced at least four large impact craters of up to 600 km diameter which fractured the crust of Mars and triggered global expansion tectonics. The former oceans and ocean basins of Mars are a result of this event. The dichotomy on Mars, extreme volcanism and the ancient oceans & water erosion on Mars are a direct result of the impact event. The water which filled the developing ocean-basins on Mars was brought to the surface in the process of global expansion tectonics started by the impact, and that was going on for millions of years. The impactors which produced the impact craters probably had a diameter in the range of 20 to 50 km each.

The impact was an oblique impact which means that the impactors arrived in a shallow impact angle probably < 30° in regards to the surface. This is indicated by the ejecta pattern of the impact. The following images give a first explanation of the impact event:

This image shows a classical butterfly-shaped ejecta pattern on the righthand side of the impactor chain. From the shape of the ejecta pattern the trajectory of the impactors becomes obvious, because a butterfly-ejecta pattern is always wider in the direction in which the impactor(s) travelled before impact → see introduction

Regarding the accumulation of the ejecta material the following must be said: Because of the nearly simultaneous impact of the three main impactors there were three spherical shock waves developing around the three craters. And along the nearly plane meeting zones of the shock waves the ejecta was forced to accumulate along straight lines. → see Examples of double & triple impact in the Introduction!
The dichotomy on Mars → the clear difference in the topography between the northern and southern hemisphere of Mars, and the formation of the large ocean basins Utopia Planitia & Arcadia Planitia is a direct result of this global impact event!

Because there was strong expansion tectonics going on, which was triggered by the global impact event, the area which is marked in blue on the map (→ deepest area !) is mainly new (additional) surface area of the planet!! Please compare this global impact event on Mars with the one on the Jupiter moon Ganymede (see study!) and with the PT-Impact Event. These impact events are very similar!

The left side of the butterfly-shaped ejecta pattern (→ the left wing) caused straight fractures in the crust of Mars, similar as it happened on the right side, caused by the right wing of the ejecta, were the impact impulse of the ejecta and secondary craters fractured the crust in a straight line and caused the gigantic Valles Marineris Canyon, which stretches over a distance of 2400 km!

But on the left side the crust completely broke apart and strong Expansion Tectonics quickly began to form the new ocean basins.

It is also easy visible that large amounts of water came from the Valles Marineris Region! Which means that the water came from the interior of the planet! It was water which was contained in the magma, probably in a super-saturated state. And when the planetary crust fractured it was released because of the rapid drop of pressure in the uncovered (fractured) mantle regions.

The maximum filling of the ocean basins probably happened when the expansion tectonics was in full swing.

Compare the biggest flood channels on Mars Kasei Valles & Ayres with the largest flood channels on Earth !!!

MARS GEOLOGY:
Rotating Globe Geology: see → weblink

Note the extensive River-Systems which had their origin in the fractured Valles Marineris Region.

Part of the forward ejecta material caused by the three main impacts

by courtesy of NASA/JPL/(USGS)

Valles Marineris

That’s where the edges of the left butterfly wing impacted on Mars’ crust. Note the linear edges!
The strong concentration of the ejecta mass along the wing edges of the butterfly-ejecta pattern cut the complete crust of Mars along the edges of the ejecta blanket and formed the ocean basins **Utopia Planitia & Arcadia**. This ocean basins began to fill with water, coming out of Mars’ mantle, shortly after the impact and the start of expansion tectonics.

The maps on the righthand side show the full extension of the butterfly- and forward-ejecta blankets. Because there was expansion tectonics going on in the last 100-200 Ma, the forward ejecta area was probably much smaller at the time of impact. **Elysium Mons** was caused by the impact of the fourth Impactor from the Impactor-group (on the same orbit)!

The topographic map on the bottom shows the dichotomy border-line on Mars’ crust along which the crust was cracked & cut open by the ejecta.

And the geological map nicely illustrates the massive geological changes on Mars’ surface, caused by this global impact event.
Mars’ large shield volcanos are not the result of hotspots, they are the result of large impacts!

The large shield volcanos of the Tharsis Montes region are the result of an impact event of global scale, caused by the nearly simultaneous impact of at least three large impactors! They are not the product of so called hotspots. The three Tharsis Montes shield volcanos, and probably Elysium Mons as well, where caused by the fragments of a large asteroid or comet which probably broke apart just before impact!

The two images below show how volcanic domes grow above large impact craters. This happens when the fractures under the crater, which result from the impact, are so extensive and deep that magma from the mantle can rise.

Then the conditions are given that shield volcanos like the large shield volcanos of the Tharsis Montes region on Mars, Ascraeus Mons, Pavonis Mons, Arsia Mons and Elysium Mons can form. Olympus Mons the largest shield volcano is probably also the direct result of an impactor or it is the result of impacting ejecta from the Tharsis Montes impacts.

As these two examples of craters with dome structures, formed by magma outflow, clearly demonstrate, big impacts can cause large shield volcanos.

The shield volcano Olympus Moons is 23 km high and 600 km in diameter, and it is bordered by an escarpment up to 10 km high, at the foot, from a series of lobate deposits (ejecta lobes ?) extend for hundreds of kilometers.

These three shield volcanos represent three major impact craters (impact sides) caused by the global impact event on Mars.
Mars moon Phobos provides further evidence for the described global impact event on Mars

Mars moon Phobos is covered with parallel grooves which can only be created by a very large impact event on Mars. These grooves which were formed by parallel chains of secondary impactors are very dense on Phobos leading apex but completely missing on its trailing apex. This is strong evidence that a global impact event occurred on Mars.

Note that the distance between Mars and Phobos is around 9400 km!

To give an impression of the distance which the ejecta from Mars travelled to produce the grooves : Phobos orbits Mars in an average distance of 9380 km !!
Remnant massifs of the highland - lowland (dichotomy) boundary, probably are the result of a global Impact Event

The obtained absolute ages for the most recent resurfacing periods of these massifs (→ the covering of these massifs by large amounts of volcanic material) indicate that the global impact event may have happened in the range of 50 to 200 Ma ago. It also seems that the volcanic material (the volcanic ash) which periodically covered these massifs contained large amounts of volatiles (probably mostly water), which evaporated within a certain time and caused big landslides etc., because of “volatile-activity.”


Note the fluid-like appearance of the cover material of the massif!
**Venus**

Conventional interpretations assign Venus a volcanotectonic surface packed only by ~1000 small impact craters. But this is incorrect! Much of venusian plains are full of 100-600 km circular structures. And there are dozens of circular basins reaching up to 2500 km in diameter. All these circular structures are impact structures! And the larger ones with > 1000 km diameter are responsible for triggering extensive expansion tectonics on Venus. The hard evidence for this statement will be Artemis Chasma, which was caused by the oblique impact of a large impactor > ø 20 km with an orbit inclination > 45° (→ probably a comet or asteroid.).


Prepared by Harry K. Hahn, 24.09.2015

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**Earth’s Moon**

The gravity anomaly maps of Earth’s Moon indicates at least one global impact event which triggered Expansion Tectonics on the Moon. This impact event caused the Mare areas on the near-side of the Moon. Another big impact event caused a circular area of Ø1500 km on Moon’s far-side which comprises a handfull 200 km craters. (Leibnitiz- & Apollo-crater etc)

**The global impact event**

The global impact event on Moon’s near-side was caused by at least 5 large impactors, probably fragments of an asteroid, with Ø 10 - 60 km each! These impactors caused the base craters No. 1 - 7 with the diameters: 600, 550, 420, 530, 320, 330 and 220 km, which then produced most of Moon’s flood-lava filled Mare.

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Topographic Map of Venus with coronae marked (→ black dots)

**Artemis Chasma** is not a structure (coronae) which was caused by a mantle plume (current theory) Artemis Chasma definitely was caused by an impact!! There are a number of clear visible trendlines which mark the outline of the butterfly ejecta-blanket of this oblique impact!! And it is clear that the impact and the ejecta-impulse triggered global Expansion Tectonics on Venus, which is noticeable as a belt-like global fracture pattern (white) on the radar image below.

**Coronae and Pancake Domes** are definitely all impact structures! Here coronae are probably the result of a powerful atmospheric shockwave which causes a dent in the crust which then leads to the circular fracture pattern. And Pancake domes result from spherical shockwaves raising from under the ground.

Note the nearly linear border line between coronae 2 & 3!! Both coronae grew nearly simultaneously!! These are impact structures!!

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**The Mare formed by the impact craters No. 1 - 7:**

Mare 1 – 7: Imbrium, Serenitatis, Crisium, Smythei, Humorum, Nectaris, Asperrimus → the last two Mare are secondary craters! Linear fracture pattern is caused by the impact event of the crater No. 1. Expansion Tectonics Area

**Expansion Tectonics on the Moon:**

The nearly simultaneous impact of the mentioned 5 impactors caused an extensive fracture pattern on Moon’s near-side. Similar as on Earth, volatiles in the mantle must then have been the driving force for the following expansion of Moon’s mantle. These volatiles must have been in a super-saturated state at the same time after the impact when Expansion Tectonics begin. Because of their size the impactors may have been a result of the P1 impact or of the 1. or 2. Sgr-DG pericenter event.

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**Expansion Tectonics Area**

**Expansion Tectonics Area**

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**Impact Crater with Ø ~ 400 x 300 km in Artemis Chasma**

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**Moon’s ancient Rift Valleys (dark blue)**

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*Note the similarity to Earth’s North Pacific Area!*

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**Prepared by Harry K. Hahn**

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**Prepared by Harri K. Hahn**

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**Prepared by Harri K. Hahn**

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**Prepared by Harry K. Hahn**

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**Prepared by NASA/JPL**

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**Prepared by NASA/JPL**

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The Great Red Spot (GRS) on Jupiter and the big Dark Spots on Neptune are Impact-Sites of large Asteroid- or Comet Impacts!

A photograph from 1879 clearly shows how large the Great Red Spot of Jupiter was 140 years ago. It had a longish shape with a length of 40,000 km! Today it is only 15,000 km long. Since 1880 the GRS constantly shrank from a long elliptical shape of 40,000 km length to a short ellipse of 15,000 km length. It's illusory to believe that a 40,000 km long storm can exist without a gigantic heat source on the 18,000 km deeper mantle surface. In all probability the assumed heat source responsible for the GRS was caused by an impact from a number of impactors, asteroid or comet fragments, on the same latitude of Jupiter, similar as it happened in 1994 when fragments of Comet Shoemaker-Levy-9 impacted on Jupiter! But the impact that caused the GRS was probably >1000 times more powerful and was caused by impactors in the Ø10–30 km range. A similar impact occurred on Neptune just before 1989.

**Length of GRS in the past**

<table>
<thead>
<tr>
<th>Year</th>
<th>Length (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1880</td>
<td>40,000</td>
</tr>
<tr>
<td>2003 Feb</td>
<td>18,420</td>
</tr>
<tr>
<td>2005 Apr</td>
<td>18,000</td>
</tr>
<tr>
<td>2010 Sep</td>
<td>17,624</td>
</tr>
<tr>
<td>2013 Jan</td>
<td>16,954</td>
</tr>
<tr>
<td>2013 Sep</td>
<td>15,894</td>
</tr>
<tr>
<td>2013 Dec</td>
<td>15,302</td>
</tr>
<tr>
<td>2020</td>
<td>13,000</td>
</tr>
</tbody>
</table>

**Cassini's observation in 1665–1677** probably show a different spot caused by a different impact. All observations after 1880 when the gigantic spot was observed first, show a shrinking spot! This is strong indication for a heat source (impact site) in the deeper mantle which is constantly shrinking! A photo from 1879 shows the gigantic longish GRS shortly after the impact event!

**The Great Dark Spot (GDS) on Neptune** is an Impact Site of a large Asteroid- or Comet Impact! The GDS that was observed by spaceprobe Voyager 2 in 1989 had a size of 13,000 x 6,600 km. The scientists believed that this spot (GDS-89) was just a hole in the methane cover of Neptune. But a close look at the spot shows that there were two rotating cloud systems side by side! Only a physical reason like two strong heat sources on the deeper mantle surface caused by a double impact could cause such an impossible weather system. 2020 the Hubble Telescope observed two spots, which probably were also caused by a double impact Event.

**Fragments of Comet Shoemaker-Levy 9** impacted on Jupiter in July 1994, 21 distinct impacts of comet fragments were observed. The largest G-Fragment Ø1–2 km caused a giant dark spot Ø12,000 km and released an energy equivalent to 6,000,000 MT TNT (600 times the world's complete nuclear arsenal!)! 

- See weblink: Shoemaker-Levy-9 and some movies: movie 01, movie 02, movie 03, movie 04

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1880: Photograph by courtesy of NASA/JPL; Drawing from E. Trouvelt 1880; A photo from 1879 of Jupiter from Anne Clerk's Book ⇒ see: Weblink

1879: Photograph by courtesy of NASA/JPL; 2014: Photograph by courtesy of NASA/JPL

1989: Two transiting moons with shadows; Photograph by courtesy of NASA/JPL

1994: Photograph by courtesy of NASA/JPL; G Impact Site 1994: Green Methane
Enceladus, a moon of Saturn, shows evidence of a Global Impact Event, which probably happened < 200 Ma ago

**Enceladus** was hit by a large impactor, with a diameter in the range of 10 to 40 km on its leading hemisphere. This caused an impact crater (a circular impact structure) with an outer diameter of approx. 350 km and an inner diameter of approx. 200 km. This happened in the geological recent past, probably less than 200 Ma ago.

The current believe is that the so called **Tiger Stripes** in the southern pole area are caused by tidal pull from Saturn's gravity. But this is incorrect! The tiger strips are the result of largescale global deformation on the small Saturn Moon Enceladus caused by the yet unknown global impact event.

This impact event not only caused a global fracture pattern. It also caused expansion tectonics on the moon and largescale cryo-volcanism in the southern hemisphere, which is still going on today. The jets coming out of the cryo-volcanos mainly contain water out of the upper mantle of the moon.

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**Enceladus's orbit (marked in red)** from above Saturn's north pole

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**Chaos Region**
Prepared by Harry K. Hahn

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**Old surface area** with many craters only within this belt-shaped area (see yellow lines).
The belt with old surface area is terminating on the borders of the Tiger Strips Area.

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**Outer & Inner Impact Area**
Assumed Center of Impact

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**Detail view of the inner impact area**

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**Note the circular structures!**

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**Detail view of the chaos region near the center of the Trailing Hemisphere.**
This is where the peak of the shockwave, which travelled through the deep mantle, hit the trailing hemisphere from the inside. The two kidney-shaped "tectonic-plates" on the trailing hemisphere indicate that the shockwave travelled around a solid core before focusing in a peak area on the trailing side.
The “Tiger Strips” on Enceladus are the result of the described Global Impact Event

Researchers modeled eruptions on Saturn’s moon Enceladus as uniform curtains, along prominent fractures that stretch across the icy moon’s south pole. The fractures in Enceladus’ surface are more wavy than perfectly straight. The researchers think this optical illusion is responsible for most -- but not all -- of what appear to be individual jets. Some discrete jets are still required to explain Cassini’s observations.

The Tiger Stripes on Enceladus southpole-area are the result of the largescale impact event and the following global deformation of the moon. The global deformation of Enceladus was caused by the shockwave which was triggered by the impact. This shockwave travelled through the interior of the moon and caused large scale fracture patterns on the leading- and trailing hemisphere. However a belt between the leading- and trailing hemisphere survived mostly without damage, with exception of the Tiger Stripes area. But because there is strong indication of Expansion Tectonics in this Tiger Strips area, it can be concluded that the whole moon expanded considerably after the impact! And it seems that the expansion of the moon is still going on. The wide crack areas and the ongoing cryovolcanism are indicators for this! The expansion of the moon must be driven by the mantle-volatiles ejected by the jets.

Jets of water and ice shooting up from “the Tiger Stripes” on Enceladus. The volcanoes along the fractures are known as cryovolcanos, meaning “volcanoes of ice”. The jets are mostly water, they also contain ammonia, methane, carbon dioxide, nitrogen, and trace amounts of hydrocarbons as well as solid material including sodium chloride crystals and ice particles.

The jets (or plumes) at Enceladus seem similar in chemical makeup to comets (according to NASA scientists). There is evidence for a large south polar subsurface ocean of liquid water within Enceladus with a thickness of around 10 km.

Researchers on Earth compared the Mid-Ocean Ridges to the Tiger Stripes on Enceladus.

The fractures are much warmer than surrounding area

The fractures are much warmer than surrounding area
The icy surface on Saturn Moon Iapetus originates from a large cryo-volcano which is the result of a Global Impact

The analysis of NASA, that Iapetus had originally a complete icy surface which was covered with dark material, is incorrect!

It is the opposite way! Iapetus had originally a rocky surface which was covered by ice from a very large cryo-volcano, resulting from a global impact. This impact formed the Ø 580 km Turgis Impact Basin. And the equatorial ridge may be the result of the water-loss of the mantle region of Iapetus caused by the cryo-volcanism.

The following explanation will provide the hard evidences for this statement!!

Note the appearance of the craters from the selected areas in the northern- and in the southern hemisphere!!

It is easy noticable that the dark areas in the craters must be caused by melting (sublimation) of the ice which covers a dark rocky surface!!

It is always the area of the craters which faces towards the sun, where there is no ice-cover! This can only mean, we are talking about a thin ice cover on a rocky surface!! And this thin ice cover (< 100 m ?) has sublimated away from the sun-facing rocky surface areas of Iapetus!!

The ice-cover on Iapetus with high probability came from a large cryo-volcano in the Center of the Turgis Crater, which means that the Turgis Crater is responsible for the ice cover on Iapetus. Trend-lines in the ice formations around the crater indicate that the ice came from the marked cryo-volcano area. And the equatorial ridge therefore may be the result, of either the impact shockwave, the water-loss in the mantle & tidal forces or a result of a combination of them.
On Pluto the “heart-shaped” region & Sputnik Planum were formed by a complex global impact event

There are different geological formations around Sputnik Planum, which indicate an impact origin. Sputnik Planum itself seems to be the result of several big impacts which caused a large fracture and led to expansion tectonics and volatiles rising from the mantle to Pluto’s surface in this area.

The mountain areas around Sputnik Planum, e.g. Hillary Montes and Norgay Montes, are the result of a multiple Impact event. With high probability the fragments of a burst comet or asteroid formed these mountains, when they impacted on Pluto.

The image on the lefthand side shows clear trend-lines in the Hillary Montes region which all originate in an approx. 28 mile (45 km) wide crater, which is infilled with ice now. Hillary Montes at the border line of Sputnik Planum probably formed less than 100 million years ago as a result of this impact event. (see also: Pluto images from NASA)

“This is one of the youngest surfaces we’ve ever seen in the solar system,” said Jeff Moore (from the Geology, Geophysics and Imaging Team (GGI) / NASA)

“Because Pluto cannot be heated by gravitational interactions with a larger planetary body, some other process must be generating the mountainous landscape” said the GGI deputy team leader John Spencer.

And he is right! The mountains were formed by a complex multiple impact event!

The small 28 mile wide crater is only part of a much larger impact event!

From the slightly elliptical shape of this crater the trajectory of the impactor can be determined. The trajectory of the impactor and the arrangement and position of the butterfly-ejecta of this oblique impact crater give indication about the possible position of further impact craters and ejecta areas which all belong to this complex impact event.

The area “Detail 1” (marked in blue on the lefthand side) seems to contain remains of ejecta from a similar impact as the one described above (shown on the two images on the lefthand side).

However most of the ejecta of this impact is not visible anymore, either because it is located under the “sea level” of the “Sputnik Planum Ocean” now, or because it may have melted in the aftermath of the impact.

But it seems that there are more traces of this “impact crater” are visible on the other side of the “frozen Sputnik Planum Ocean”!!

→ See next page
A chain of impacts seems to have caused a large fracture in Pluto’s crust, which then led to expansion tectonics. Along the linear sides in the East and West of Sputnik Planum there are structures visible which indicate the impact of several impactors. (the two linear sides are marked with blue boxes). On the west side (marked with L) the already mentioned small elliptical impact is visible. And on the east side (marked with R) structures are noticeable which indicate **4 to 5 large impact craters with diameters in the range of \( \varnothing 70 \) to \( \varnothing 100 \) km.**

These impact craters are all flooded and filled with ice and only indirectly visible through circular structures in the ice (→ e.g. see Detail 3). It seems that these impact craters led to **expansion tectonics** which formed Sputnik Planum and led to the outflow of \( \text{H}_2\text{O}, \text{N}_2 \) and other volatiles from the mantle.

At the time of the impact the areas of detail 2 and detail 3 (or L & R) were one and the same area, before expansion tectonics set in and slowly moved the two sides (yellow lines) away from each other (see below!). Remains of the crater structure are only visible in detail 3. The slightly later formed small elliptical impact on the west site probably overprinted the remains of the larger crater indicated in detail 2 & 3.
The fracture belts on Charon are caused by Comet Impacts, which formed craters in the diameter range \( \Phi 60-110 \) km. A number of large impact craters, probably caused by high velocity comets, are responsible for the fracturing of Pluto Moon Charon's crust. The cracks which resulted from these impacts not only caused the extensive canyon systems on Charon, they also triggered global expansion tectonics on Charon. There is a "three-level dichotomy" visible on Charon which probably was caused by two global impact events, which happened at different times.

The Impact Craters visible in Details 1 & 2 were probably caused by comet fragments. These impacts are responsible for the fractures and the crustal deformation shown in the Details 1 & 2, which triggered global expansion tectonics and led to the "first dichotomy level". The dark surface markings in the north polar region are probably also the result of a big (carbon-rich) comet impact. See marks & description in Detail 4.
The “three-level-dichotomy” on Charon is a result of expansion tectonics, triggered by impact-induced fractures. The “first dichotomy level” noticeable on Charon was caused by at least two simultaneous impact events which occurred 350 km apart from each other. Each of these two impact events not only produced two distinctive crater areas, which again were formed by several (> 10) comet fragments. It also caused extensive fractures and deformations in Charon’s crust, which triggered global expansion tectonics and led to this “first dichotomy event”.

The two sections of the twin ejecta ray (yellow boxes), belonging together, were separated by crustal deformation.

The “second dichotomy level” noticeable on Charon was also caused by at least one (or more) large impact event(s) which led to another intensive episode of global expansion tectonics, which formed the young “Vulcan Planum” area on Charon. Crater C3, which is probably also the result of a (burst) comet impact, is responsible for the majority of the fractures shown in Detail 3! This can be read from the fracture pattern and the trajectory of the comet which produced the impact crater (“Alice Crater”). The smooth Vulcan Planum is the result of expansion tectonics triggered by the fractures, which brought large amounts of H₂O- & NH₃-rich material to the surface.

Detail 6 shows landslides probably caused by water-rich material, which probably was deposited by cryovolcanism. A result of expansion tectonics!
Epilogue:

At first a few words to some other planets and moons which need to be analysed under consideration of the new acquired knowledge about global impact events.

There are many structures noticeable on other planets and moons which seem to be traces of global impact events, but they are not recognized as such yet! That’s why planetary scientists must continue the work which I started with this study!!

For example on Uranus moon *Miranda* there is an impact structure visible, which obviously was caused by a powerful “gazing shot”!

A large impactor seems to have “scratched” along Miranda’s surface and has “turned-over” a certain area of Miranda’s crust in slow motion (→ like a skin-lobe is cut and turned over by a sharp knife). This caused the triangular-shaped feature on Miranda’s surface, which actually shows the deeper layers of Miranda’s crust, and it also caused the 5 km deep “Verona Rupes” fault-scarp. Because of the forceful stretching of Miranda’s crust in the triangular shaped area, contraction was caused in perpendicular direction to the impactor trajectory right and left of the stretched area. This caused the bow-shaped “rift-valleys” (cracks) right and left of the “triangular gash” which also show deeper layers of Miranda’s crust.

Or Saturn’s moon *Tethys* with the dominant feature, the 8-kilometer-deep and 440-kilometer-wide Odysseus impact basin. This moon can help to better understand global impact events.

For example the visible 2-3 km high (equatorial) ridge (yellow) may be a tectonic (shock) feature related to the impact event or it may be a deposit formed when the ejecta blasted out of Odysseus, and fell back onto the surface at high velocity. Between the ridge and Odysseus, the surface is scoured & pockmarked, and there are clear visible secondary crater chains in this area. At bottom right can be seen the globe-circling trench Ithaca Chasma, formed as part of Tethys stretched apart.

There are still many other large-scale impact structures on Earth which need to be properly analysed, in order to figure out the correct tectonic model for Earth before & after the PT-Impact Event → e.g. the East- & West-Warburton Impact Basins.

However this work must be carried out by experienced planetary scientists & geologists now, together with the analysis of all planets and moons.

Because we need to know the root causes of all global impact events which took place in our Solar System and we need to find all impact structures!!

After reading this study about global impact events

**What practical measures should be taken ??**

1.) The first and most important measure must be the continuation of the research work, regarding global impact events and their causes & effects, which was started with this study here!

Scientists from many different disciplines must take on the challenge to find further evidence for the global impact structures described in this study

2.) Rock samples from all new impact craters and impact structures described in this study (Part 1-4) should be collected and analyzed.
3.) After the confirmation of the P/T-impact crater and related secondary impact structures a new analysis & simulation of the tectonic processes in Earth's past, in the last 253 Ma, must be done!

4.) Then the cause of the expansion tectonic process, which obviously was triggered by the P/T-impact, must be found. And because there are other planets & moons in our solar system where expansion tectonic processes were triggered by a global impact event, a teamwork of scientists from different areas is required. To find the driving physical / chemical process for the mantle expansion visible on different planets and moons, a close collaboration of planetary scientists, geophysicists, geologists, chemists and physicists (especially with expertise in fission research and high-pressure / high-temperature material research) is required.

5.) A more precise and more detailed computer analysis of the collisions (pericenter events) of the Sagittarius Dwarf Galaxy with our galaxy must be done. In all probability debris- (mass) streams resulting from these collisions are the cause of periods of violent global impact events in our solar system! That’s why it is important to find out the exact composition, extension & the effects of the debris streams, caused by these collisions, on our solar system!!! The starting point of this analysis should be the study from Mr. Chris Purcell

**Important!**: Especially the effects and the position of the leading tidal tail of the Sgr-DG in the past (-300Ma) & in the future must be studied!!

6.) Because the distribution of metal-ores and energy resources, like crude oil or natural gas in Earth’s crust, is mainly caused and defined by large (global) impact events, knowledge of the precise location and size of all impact craters on Earth is crucial for future explorations of ore deposits, and especially for the exploration and discovery of new large oil- and gas-deposits!!

Good knowledge of all large impact structures on Earth will make a big difference in future explorations, in order to find these important energy- and ore-deposits for mankind!!

Especially the correlation of big impact craters with the formation and the development of large oil-fields & gas-fields must be precisely analysed!! It seems that in particular the impact-related tectonic motion of crust fragments and magma streams, which were created during large impact events, are an important condition for the development of large oil- and gas deposits!!

This correlation must be studied & analysed!

Having seen and analyzed the Permian-Triassic Impact and the global destruction which it caused:

The following warning must be given:

**We must consider different worst case scenarios in regards to one or more impactors (asteroids or comets) which are on a collision course with our planet Earth!!!** And we must find solutions, and build & install suitable defense technology in space, in order to deflect the impactors of all assumed worst case scenarios away from Earth!!!

**Possible worst case scenarios to consider!!**:

1.) Accumulations of Asteroids and/or Comets with a density like in the Asteroid Belt are approaching from deep space and they are on a collision course with Earth, having velocities up to 100 km/s!!

2.) Up to 10 Asteroids in the diameter range of Ø 10-40 km with velocities of 20-100 km/s are on a collision course with Earth and all are arriving at the same time!! Pre-Warning time < 18 months!!

3.) A large Asteroid with Ø 200 km and a velocity of 100 km/s is approaching from deep space (from outside the solar system!!) and is on a collision course with Earth. Pre-Warning time < 2 years!!

As long as we don't exactly know what astrophysical processes have caused the global impact events within the last 300 million years, described in this study, we must take sufficient precautions!! in this violent and merciless universe!! Because if we don't do so!!, Mankind and most other species on Earth could go extinct within a very short time!!, just like the Dinosaurs!!

There are already some ideas and plans for the realization of technology to deflect small asteroids. But every idea or plan which I have seen so far regarding the deflection of an asteroid or comet is far away from being able to cope with one of the described worst case scenarios!!

If we are very lucky we could survive Worst Case Scenario 1!! But only if all asteroids or comets > Ø 10 – 20 km would miss our planet Earth!! Because we are not able to deflect such large impactors yet!!! We just don't have the required defense capability and technology to do that!! I have made an own assessment, and I found a few suitable defense strategies which are able to cope with large impactors, up to Ø 200 km!!

However these strategies only work if the required technology is installed in space (in defined locations in our solar system) and if we are ready (well trained!!) to use this technology. And it would only be possible to cope with high-velocity Asteroids or Comets (with velocities >30-40 km/s) if the technology is installed with maximum rocket performance which is possible and if it would be installed on many locations in our solar system!!

It would probably take at least 20 years to design, build and install such a defense system and it would probably cost ≥ US$ 100 billion!! However if all members of the UNO cooperate in the effort to build such a defense system for our planet Earth, then it shouldn't be a problem to finance it!! And it should be a problem to
An action plan for Terra-Forming on Mars:
In order to create an additional “Second Earth” for Mankind we should perform Terraforming on Mars as quick as possible before the settlement starts!!
With a controlled impact series of probably 3 to 4 asteroids in the Ø 10-20 km range a large crack in the crust of Mars could easily be produced.
Alternatively a few 50 MT Fusion-Bombs located in 10km deep drill-holes can be used to achieve this.
In order to achieve the crack with the smallest possible impactor diameter & energy expense, the optimum area for the intended crack would be the thinnest crust area of Mars. This is in the center area of the northern lowland (⇒ the former ocean floor on Mars ) Here the crust is only 40 km thick! A large crack in this area should cause large amounts of volatiles ( e.g. H₂O ) to rise up to the surface, similar as it happened in Valles Marineris. This would quickly produce a small ocean near the crack and a thicker atmosphere, which would improve the living-conditions on Mars considerably!
Such a Terra-Forming project should first be tested on another planet or moon which is located further away from Earth, and which is not a primary target for human settlements. It could be tested for example on Jupiter’s moon Ganymede.

From this crack large amounts of salt-water from Mars’ mantle can fill up the old ocean basin!! Ø 10-20 km impactors produce a crater chain which causes a crack

A few words to the dangerous Pacific-LLSVP:
An essential new discovery in comparison to the first edition of my study is the fact that the Pacific Plate and the expansion tectonics process which has formed it, is the result of ≥ 8 gigantic magma eruptions in the west pacific region over the last 200 Ma. These magma eruptions were caused by the Pacific-LLSVP-(ULVZ), which in all probability is a direct result of impacting ejecta of the PTI!

Further new discoveries were the Victoria Lake Impact event, the Canary Islands Impact event, the localization of the “Bay of Lyon” Crater, the correct position & orientation of the Indian Plate, Madagascar and South-America at the time of the PTI-event and some other new interdependencies.

Regarding the described magma eruptions in the West Pacific the following Warning must be given:
With high probability another magma eruption will take place in the west pacific region! In all probability it will occur in proximity to the Fiji Islands. When it will happen is difficult to say! Therefore the mantle area below the Fiji region must be examined with seismic tomography in more detail, e.g. the vertical velocity of the magma flow under the Fiji region must be measured! see Part 1

Note that a new mass extinction, caused by another gigantic magma eruption of the Pacific-LLSVP, can begin at any time! Within a short time period such a largescale magma eruption could kill up to 60% of all
species on Earth! Like the other eruptions in the past it will cause an oceanic anoxic event (like the OAE-1a & OAE-2 and PETM (Paleocene-Eocene Thermal Maximum), which will release vast amounts of CO₂, H₂S etc. into the oceans and will kill up to 60% of all marine species. Large scale explosive volcanism with vast amounts of CO₂ released will be a result too (e.g. see Ajupa Island).

It could begin in a few years, or it may not happen in the next million years. But in all probability it will happen sometime within the next ~5 million years! A solid column at the top end of the Pacific LLSVP near Fiji, which is located close to the surface, may be an indication of the next due magma eruption!

And there seems to be a connection between these magma eruption events in the west pacific region and the 62 Ma biodiversity cycle on Earth (→ Extinction-cycle with two half periods of ≈31 Ma).

In all probability some of these violent magma eruptions were triggered by extreme earthquakes, e.g. caused by impact events, like the Chickxulub-Impact in Mexico. Like a punch which triggers an eruption of the contents of a heated Coke-bottle, the shock waves of an extreme earthquake may finally trigger a magma eruption from the Pacific-LLSVP (→ caused by a sudden pressure spike)!

But to make it clear: We are looking at two different periodic cycles here!

The periodic magma eruptions of the Pacific-LLSVP are caused by thermochemical processes which are going on inside the LLSVP & ULVZ. There seem to be long term thermochemical processes at work with cycle lengths of 10 - 30 Ma (million years).

(→ the cycle length seems to decrease over time)

And the final stage of this cycle, the magma eruption, can be triggered by an outer shock event (The 62 Myr Bio-Diversity Cycle (or 62 Ma Extinction-cycle!) is caused by a precise periodic astronomical event going on for at least 500 Ma! In all probability it is caused by the periodic crossing of the galactic plane by our solar system every 31 Ma. Every second crossing of the galactic plane seems to be particularly dangerous, because it has produced a worldwide mass extinction every time for the last 6 (62 Ma)-cycles! 6 of this 8 crossings caused a mass extinction each time, killing ≥ 70% of all marine species on Earth!

Because our solar system moves along a spiral path around the galactic center, at every second crossing our solar system crosses the same ring area of the galactic plane, which in all probability is densely packed with debris resulting from collisions of our Galaxy with the Sagittarius Dwarf Galaxy (Sgr-DG).

And to point this out: Our solar-system is currently crossing the galactic plane in this obviously dangerous ring-area! We know that the last worldwide extinction took place 65 Ma ago!

Therefore the next worldwide extinction event seems to be overdue and can happen at any time! Maybe we just haven't passed the dense debris-layer yet!

By the way: This assumed debris-ring (or debris accumulation) may be the cause of the Oort Cloud (→ the source area of comets!) around our solar system, and the densely packed debris ring(s) in the galactic plane (similar to Saturn's rings) may offer an alternative to explain the Dark Matter problem!!

Looking at the other global impact events which I have discovered on the planets Venus, Mars & Pluto, and on the moons Ganymede & Charon, which all indicate orbit inclinations ≥ 40° for the original orbit of the impactors (comets or asteroids), then it certainly must be taken into consideration that the impactors came from outside our solar system! → either from the Oort Cloud, or from the assumed debris ring (layer) in the galactic plane!

Because these global impact events probably all occurred within the last ~250 Ma, we must expect large impactors which are coming with high velocity from deep space!

As long as we don't exactly know the physical process which has caused the global impact events within the last 300 million years, described in this study, we must take sufficient precautions!!

Because we are not able to deflect such large impactors yet! We just don't have the required defense capability and technology to do that!

Therefore an asteroid- & comet deflection system must be built which protects our planet!

I have made an own assessment, and I found a few suitable defense strategies which are able to cope with large impactors, up to Ø 200 km!!

How such a defense system for our planet Earth could look like is described in my following study:

See: → “To the deflection of asteroids in the diameter range of 5 to 200 Km”

It will probably take at least 20 years to design, build and install such a defense system and it would probably cost ≥ US$ 100 billion! But it is our responsibility to build such a system!

It is also our task & responsibility to settle on our neighbour planet Mars as soon as possible, and to establish an independent civilization on Mars, which doesn't need support from Earth to survive!

This is the only way to make sure that our advanced technological civilization will survive in the case of a global impact event on Earth, caused by a large impactor coming from deep space, or in the case of another gigantic magma eruption caused by the Pacific LLSVP!

We may be able to build a defense system against a large impact on Earth. However it's not possible to build a defense system against a gigantic magma eruption coming from Earth's mantle!!
That’s why the development of nuclear drives for spaceships must be accelerated. We need much more payload capacity! Instead of just being able to lift 10 tons into orbit, we need payload capacities of thousands of tons to really make progress in establishing settlements on Mars and on other planets and moons. If we shift our focus to the development of nuclear driven spacecraft we can achieve this within a few decades!

Please note that 10 kg enriched Uranium contain as much energy as thousands of tons of rocket fuel! We already have enough fuel (enriched uranium) to build hundreds of spaceships with payload capacities ≥ 1000 tons! The weapons industry worldwide must be redirected to build such large spaceships, and the space-technology which we need for the colonization of Mars, instead of ever-increasing the weapons-piles on Earth! We must shift our focus!

At last a few words to our political leaders:

The G20 & UNO must set a new framework, so that “resource wars” can’t happen anymore!

Therefore I suggest an action plan and a number of global regulations with the following goals:

1.) To secure and explore the required resources for mankind far in advance before they are needed

2.) To define which resources should be extracted first and which ones should be put on hold, in order to minimize the environmental impact of the mining industry, in particular regarding very sensitive natural environments.

3.) Altogether there should be a longterm planning for a secure and environmental friendly resource exploitation worldwide.

Speculation on commodity markets must be restricted by setting bandwidths for trading.

Commodity prices must be forced into defined bandwidths to provide stability for world’s economy.

A worldwide analysis of all available mineral- and energy- resources and -reserves must be carried out under control of the UNO and G20.

A precise projection of the resource needs for the next 30 years must be done, and a 30 Year plan for food-, water-, energy- and mineral resources supply for mankind must be set up.

Because the next 30 years will be the most challenging time in human history, with maximum resource consumption!

→ see Part 4 of my study for further information

4.) Mining industries which are critical for the resource supply for mankind should be under observation and protection of the UNO & UNSC. (for example the crude oil exploration industry)

5.) More food and energy reserves (oil & gas) must be kept in stock during the coming very low sun-spot-cycle minima, in which cold Winters and shortened harvest seasons must be expected!!

see following links: link_1, link_2, link_3, link_4

6.) The population growth in the fastest growing countries must be reduced as quickly as possible with the financial help from the G20 & UNO.

And much more irrigated farmland is required!!

A Top-Down Approach is required to reduce resource consumption! First it must be defined how much resources can be used over the next 30 years. Then all key-industries must get limits for the use of resources, which they shouldn’t exceed!

We need to refocus! We must start many international projects where all members of the UNO & G20 work together to achieve a better and saver life for all people, a healthy environment and in general a good and positive vision for mankind!

One of these positive visions must be the realization of a constant settlement of mankind on Mars, realized by the G8, G20 and the UNO!

Other important visions for mankind must be:

That we really must get serious now about the Protection of the remaining Rainforests on Earth otherwise they will be gone in 10 years and with it millions of species! The rich countries must pay for achieving this goal!

The rainforests are the lungs and filters of our atmosphere, and they reduce climate change!!!

And we must get serious about removing the plastic waste from the rivers and oceans!

The source of plastic waste which ends up in the world’s oceans is plastic-waste which gets dumped in rivers and flood-areas.

This happens especially in highly populated asian countries and in India. The ten biggest rivers in this area transport ≈ 70-80% of the plastic waste into the world’s oceans!

Especially the monsoon-rain and the following floods transport all plastic waste from the once-a-year flooded areas into the worlds oceans!

To prevent this pollution the authorities in these countries must define dumping-sites for waste on higher flood-safe areas, and there must be high penalties for dumping waste elsewhere.

Cleaning up the oceans with specialized machines won’t work. The task is just to big!!

The root-cause must be eliminated, which is the dumping of waste in rivers and flood-areas!!

It’s high time to get serious on all this tasks!

The Author: Harry K. Hahn - 8.7.2017
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Interesting Online Documents & Websites:

Note: If weblinks don't work, then type-in or copy the shown web-address directly in your internet browser, or search with titel & author !

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    ➔ http://www.isale-code.de/redmine/projects/isale/wiki/Media
    (Especially watch the 3. animation!! clic on the thirth image!!)

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**Documentation of my Permian-Triassic Impact Hypothesis:**

**Weblinks to my PT-Impact Hypothesis:**

<table>
<thead>
<tr>
<th>Here the weblinks to the Parts 1 to 6 of my hypothesis</th>
<th>They are available on vixra.org and on archive.org</th>
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<td>Part 4: <a href="https://vixra.org/abs/2101.0067">https://vixra.org/abs/2101.0067</a></td>
<td>Study-Part 4</td>
</tr>
<tr>
<td>Part 5: <a href="https://vixra.org/abs/2101.0127">https://vixra.org/abs/2101.0127</a></td>
<td>Study-Part 5</td>
</tr>
<tr>
<td>Part 6: <a href="https://vixra.org/abs/2104.0099">https://vixra.org/abs/2104.0099</a> ➔ see also: Part 6b</td>
<td>Study-Part 6 and: Study-Part 6b</td>
</tr>
</tbody>
</table>

You can also find all parts of my hypothesis on my website: [www.permiantriassic.de](http://www.permiantriassic.de) or alternatively here: [www.permiantriassic.at](http://www.permiantriassic.at)

➔ See links on the main-page or under “Documents for Download”

**Note:** The weblinks to Raman spectroscopy analyses of rock samples which I have collected at, or near, secondary impact-craters & structures of the PT-Impact, which indicate shock-metamorphic effects (in particular) in quartz grains, can all be found in Part 6 of my hypothesis:

➔ See Part 6: [https://vixra.org/abs/2104.0099](https://vixra.org/abs/2104.0099) or Study-Part 6 (➔ or find this document alternatively on my website)

or go on my website to: ➔ “Mineralogical Evidence”

➔ On my website you can also find photos of all samples sites and all rock samples which I have collected