The Permian-Triassic Impact Event and its Importance for the World Economy and for the Exploration- & Mining-Industry

Part 4 of my study: "**Global Impact Events are the cause for Plate Tectonics and the formation of Continents and Oceans**" - see also: **Part 1 to 3**, and **Part 5 & 6**

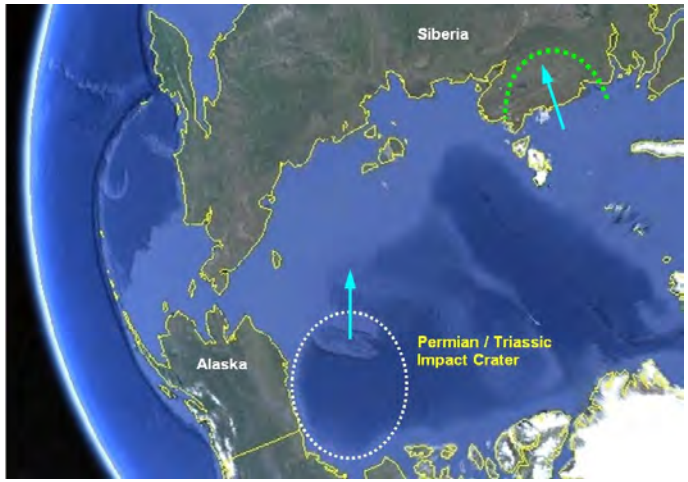
by Harry K. Hahn / Germany - **8. July 2017** - (→ see Documentation here : www.permiantriassic.de → will be active in March 2021)

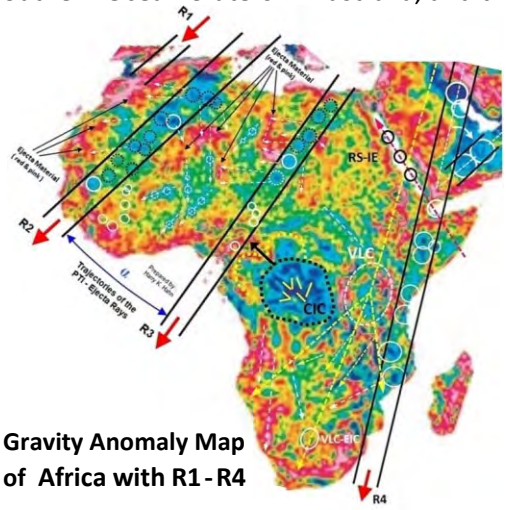
Abstract :

The Permian Triassic (PT) Impact Event 253 million years ago produced most mineral- & energy-resources worldwide ! The hard evidence for the correctness of this statement will be the confirmation of the 1270 x 950 km Permian-Triassic (PT)-Impact Crater on the ocean floor of the Arctic Sea, as described in my study. The impactor which caused the PT-Impact Crater, was a comet or asteroid with a diameter of 60 to 200 km, that contained a high share of precious metals (platinum group elements) and many other elements The asteroid or comet collided with our planet at a very shallow angle. Because of this very shallow impact angle of probably less than 8°, and an estimated low impact velocity of around 8 km/s, large amounts of un-melted material was excavated from Earth's crust during the impact. This excavated crust material, together with large fragments of the impactor in the 10 – 50 km diameter-range, rich in precious metals and iron, is the ejecta-material that caused many large secondary-craters and impact structures on Earth.

First I give an overview of the PT-Impact Event, before I describe some selected secondary-craters and impact-structures caused by the PT-Impact, which produced many mineral- & energy-resources worldwide. The section which describes the most interesting secondary craters caused by the PT-Impact, starts then at page 17.

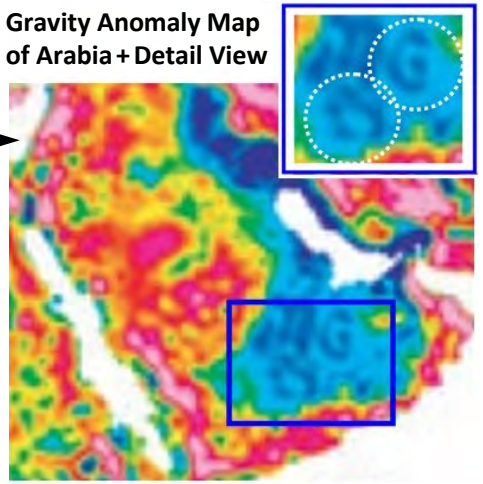
There are at least 10 secondary-impact craters with diameters ≥ 250 km and around 60 secondary craters with diameters in the 100 – 150 km range visible on gravity- and magnetic-anomaly maps, and on topographic- and satellite-maps. Regarding un-explored mineral resources the most interesting secondary craters are certainly located within the massive tracks of the PT-ejecta rays R1 to R4, which are clearly visible on gravity anomaly maps of Northern-Africa. Especially the craters located within ejecta ray R4 should be very interesting for the oil-exploration industry ! Here new discoveries similar to the Ghawar oil-field in Saudi Arabia should be possible, which is also located within ejecta ray R4 and was caused by a >300 km crater ! Other interesting craters for exploration are the > 350 km Bengal Bay Crater (India), the Victoria Lake Crater & EIC and the Congo Crater in Africa, the Port Headland Crater and the Southern Ocean Craters in Australia, and the large Pantanal Crater in South-America (→ see other parts of my study !)

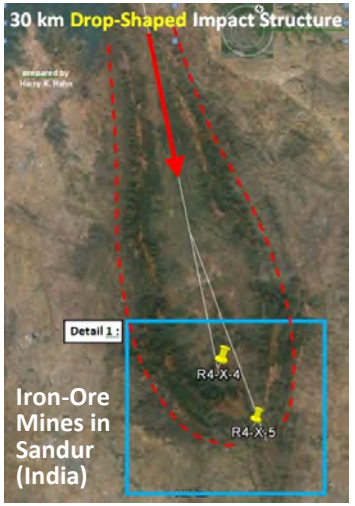




Gravity Anomaly Map of Africa with R1 - R4

Gravity Anomaly Map of Arabia + Detail View





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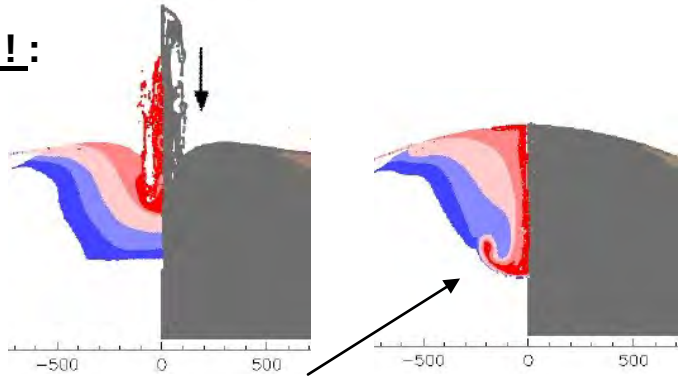
Mid of 2012 I informed ~ 10 geologists and impact researchers (e.g. Prof. C. Koeberl, Prof. T. Kenkmann and Prof. U. Reimold) about the discovered 300 km diameter Cape-York Crater and other possible impact structures on Australia's East coast. In 2015 & 2017 I informed the above mentioned + geologists & 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

To the real cause of Earth's Plate Tectonic during 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 driver of Plate Tectonics !

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



This is a big mantle plume !! But it was caused by the impact of a 100km asteroid and didn't just develop out of the blue !
These images show a simulation of such an impact on the moon

Weblink: **"Numerical modelling of basin-scale impact crater formation"**
→ http://www.lpi.usra.edu/lpi/potter/publications/RossThesis.pdf
(if the weblink doesn' work: then type in shown web-address in the browser)

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

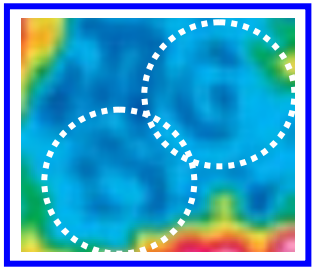
Some Geologists & Impact Researchers already speculated that a large impact Crater may have caused the P/T-boundary. But nobody has found the crater yet !

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

And it is so large, that probably everyone has just overlooked it, because of its immense size of 1270 x 950 km !!

You need to move high above the Earth to see it !

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



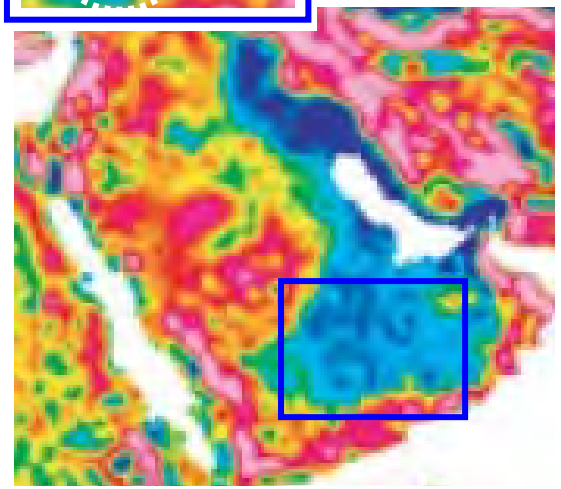
These two large circular gravity anomaly signatures probably indicate the two impact craters which are responsible for the big oil- & gas-fields in Saudi Arabia and in the Persian Gulf.

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

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



(Eigen-GL04C free-air gravity anomaly map)

Geological evidence for the Permian-Triassic (PT) - Impact Crater :

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 study 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.

I have collected many Rock samples in order to proof my hypothesis : **Images of this rock samples can be found on the following websites :**

www.permiantriassic.de (or www.permiantriassic.at) → **This website should be active in March 2021** (please try it in the next months from time to time)

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 will provide further indication and evidence for the Permian-Triassic (PT) Impact Crater and its effects, which I describe in my study !

The title of the book : **"Impact Markers in the Stratigraphic Record" – Authors : C. Koeberl & F. Martinez-Ruiz** (ISBN : 3-540-00630-3)

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 succeded 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 Sibirian 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 LIP's.

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 occuring during Permian-Triassic times (→ and may be the result of a large impact event ! → comment from H.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.

- Preface -

Before I start with the interesting part of my study, a few important words in advance : → Geology is currently based on a world model which is incorrect !

Not mantle plumes are the primary cause of Plate Tectonics and the break-up of Super-Continents !

Global Impact Events are the primary cause of Plate Tectonics, and the cause for the break-up of Super-Continents like Pangea !

Or more general : → Global Impacts are the cause for the complete fracturing of a planet's crust and the following development of Continents & Oceans.

In principle oceans are caused by volatiles which escape from a planet's- or moon's- mantle, a direct result of the sudden large-scale decompression of the mantle, resulting from the immense fracturing of the moon's- or planet's- crust, caused by a global impact event.

Further I want to mention that there are probably geo-strategical reasons and business-interests of mining companies of course, for the behaviour to keep certain scientific knowledge about impact events on our planet Earth secret ! But that's no wonder ! Asteroids are loaded with gigantic treasures when they impact on Earth ! Beside Iron, Nickel and Cobalt etc. they can contain considerable amounts of Platinum-Group-Elements (e.g. Gold, Platinum, Iridium, Palladium, Osmium etc.) and many other valuable resources. And the fracturing & brecciation of the bedrock under every craters, which results in very effective porosity & permeability of the bedrock, and the deposition of extensive post-impact shales, produces large valuable Oil- and Gas-fields in impact crater areas !

That's why having precise knowledge about a large-scale impact structure is equivalent to having a treasure map to a billion dollar treasure !

I am sure that the "yet unknown" big impact-craters described in my study will lead to resource-deposits with a value in the US$ 100 trillion range !!

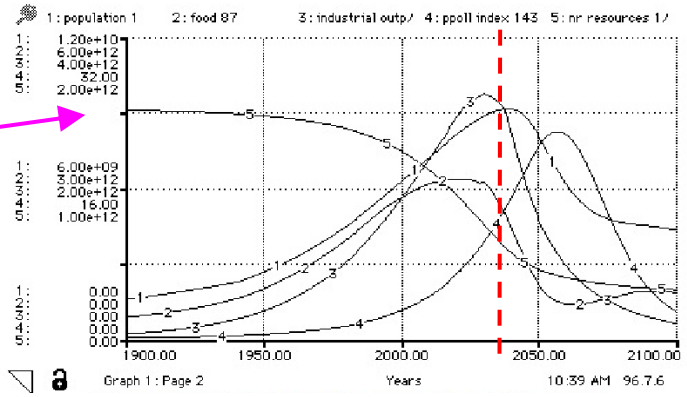
And it is easy to understand why mining companies would never publish such a study ! I am sure that important impact-related discoveries are kept secret, in order to protect business interests and / or geo-strategical interests too ! That may be a main reason why our knowledge in this field is so extremely limited !

And that's why an ordinary person like me had to publish this study ! I am not interested in geo-strategical superiority thinking or in billion dollar mining business. My interests are more far-sighted ! They are focussed on the survival capability of mankind, in regards to resources-(security) and in regards to active protection of our planet Earth against global impact events ! How much worth is all the smart geo-strategical thinking and the trillion dollar mining industry if a km-size interstellar asteroid like "Oumuamua" comes along with nearly 100 km/s without warning and impacts on Earth and destroys our Civilization ?

And exactly this may happen, because we are absolutely not prepared for such a situation, and therefore we may go extinct in the same way as the primitive dinosaurs ! The dinosaurs at least had the excuse that they just haven't had the brainpower and the technology to do anything against an approaching asteroid ! But we don't have this excuse ! We are simply not prepared because of geo-strategical superiority thinking, business-interests and therefore underestimating the impact risk ! Unfortunately the danger for a global impact event probably is much higher than anyone has calculated it ! This is the clear result of my study ! And there are also important economical reasons why Geology & the Exploration Industry must confirm the PT-Impact Crater and correct the Tectonics-Theory !

See Diagram : This diagram describes our fate ! (→graph No. 5)

We are running out of resources with increasing speed !



This diagram is the result of an extensive computer simulation of the whole world economy.

→ see World3 model

It is clear that we need very large amounts of resources in the next 30 to 50 years !!

→ And the World-Economy may soon start to collapse if we can't find enough resources for our Industries ! This collapse may happen around 2030.

But to find the required resources :

→ **We urgently need a correct Tectonics Theory!!**

Here are three short web-movies which explain you the serious consequences of exponential growth :

1.) **Limits to Growth_Is the prediction going to happen ? Please also see → Part 2 !!**

2.) **7 Billion : How did we get so Big so Fast ?**

3.) **Exponential Growth**

→ But now to the interesting part of my study !! Satellite Images, maps & diagrams will help to understand the real cause of Earth's plate tectonics !

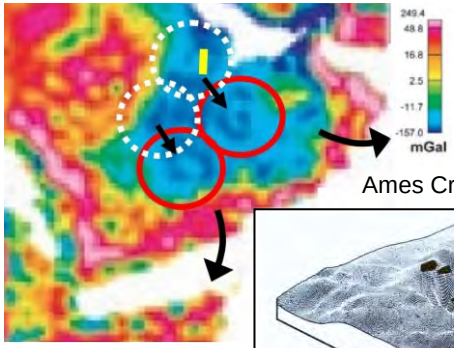
Executive Summary

Additional to my summary, which gives an over-view of the Permian-Triassic Impact Event (PTI) and its causes & effects, I now want to add an executive summary with information about new discoveries, information about a first scientific evidence, which confirms a secondary crater of the PT-Impact Event, and an action plan, in particular to find & secure important energy resources (oil & gas) & minerals, for the growing world population..

I consider crude-oil as the most critical energy resource over the next few decades (→ worldwide transport of goods & people depends to > 90 % on crude-oil !), see: **Study1**, **Study2** That's why I want to start with a request directed to the G20 & UNO

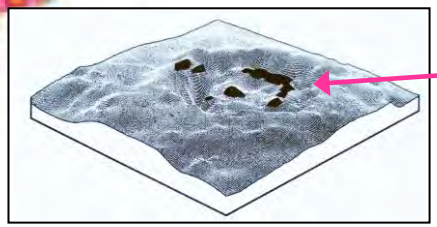
An international oil-exploration program must be started to explore, analyse and assess the expected large oil-fields located in the crater areas described in my study, which are still unknown to the oil-exploration-industry ! The following map shows crater areas with potential for large oil fields

Because there is a close link between impact craters and potential large oil-fields, as the **Ames Crater** (⌀ 14 km) in Oklahoma / USA clearly shows, it is only logical to carry out exploration drills in the new discovered impact crater areas too !



The largest oil-field of the world Ghawar (→ yellow line) is a result of a ≥ Ø300 km Impact crater (→PTI)

Ames Crater / Oklahoma USA



The largest oil-field in the world, the **Ghawar Oil-field** in Saudi Arabia, is a result of a ≥ Ø 300 km crater caused by the PT impact event ~250 Ma ago. This is indicated by the circular structure (blue) visible on the gravity anomaly map of Arabia.

After the impact event the upper layers of the two visible 300 km craters (red) slowly drifted away from the original impact sites (marked in white). The Ghawar Oil-field is located close to the center of the original impact site of the northern crater ! (→ Ghawar Oil-field marked by a yellow line).

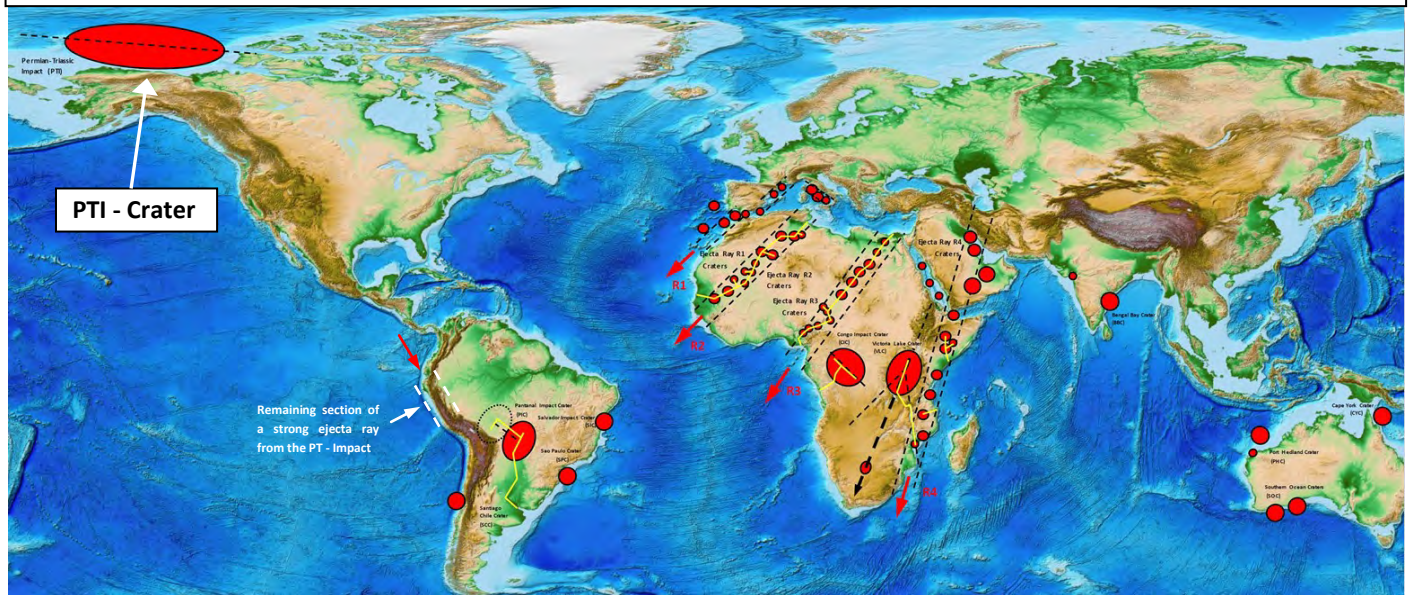
A scientific analysis of the **Ames impact crater** in Oklahoma showed, that the impact not only produced the required structural traps (by impact induced fracturing and brecciation of the granite under the crater, which resulted in very effective porosity & permeability), but also the palaeo-environment for the deposition of post-impact shales that provided the oil & gas (**black**), upon subsequent burial and maturation. The Ames Impact crater, which has a central uplift, is buried under 3 km of Ordovician Oil Creek shale and more Recent sediments. Approximately 100 wells have been drilled at Ames with a success rate of 50%. The reserves at Ames will exceed 50 million barrels of oil and 15-20 billion cubic feet of gas.

Another example is the worldclass Cantarell Oil-field which is located near the ⌀ 180 Chicxulub Crater in Mexico. The main hydrocarbon-bearing breccias of this oil-field resulted from the collapse of an offshore carbonate platform caused by seismic waves from the Chicxulub impact
The Canterall Oil-field has produced 7 billion barrels of oil and 3 trillion cubic feet of gas. The primary reserves may range as high as 30 billion barrels of oil and 15 trillion cubic feet of gas.

In North-America approximately 50% of the impact structures in hydrocarbon-bearing sedimentary basins have commercial oil- and/or gas-fields.

If we use the Ames Crater as a reference, then a ⌀ 150 km crater, which covers an area which is around 115 times larger than the Ames Crater could easily contain 3 to 6 billion barrels of oil and 2 trillion cubic feet of gas ! (→ the reserves at Ames Crater multiplied by a factor of 115)

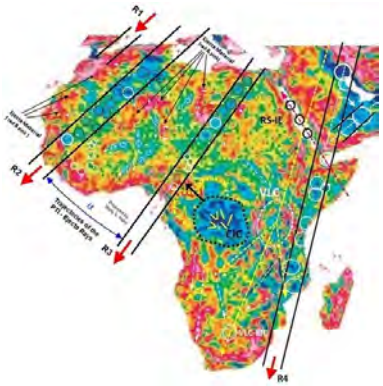
Topographic map showing the PTI-Crater and probable secondary craters and crater chains caused by the PTI :



This corresponds roughly to the oil- & gas-reserves found near the ø 180 km Chicxulub crater so far !

Therefore we use the above calculated reserve-values as a first reference for a ø 150 km crater.

All the new impact craters discovered during this study should lead to new oil- & gas-fields with more than 600 billion barrels of oil-reserves, and with more than 300 trillion cubic feet of gas-reserves ! (→ at a ~50 % success rate)



Especially the crater chains R1 to R4 and the CIC which are located on or near the African Continent, will contain a large share of these impact related oil- & gas-reserves. Because at least 50 ≥ ø150km craters are located within the crater-chains R1-4 & the CIC

The expected reserves in this areas alone should exceed 400 billion barrel oil & 200 trillion ft^3 of gas.

Additionally large reserves of metal-ores should be located in the ejecta areas of these impact craters.

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. The 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.

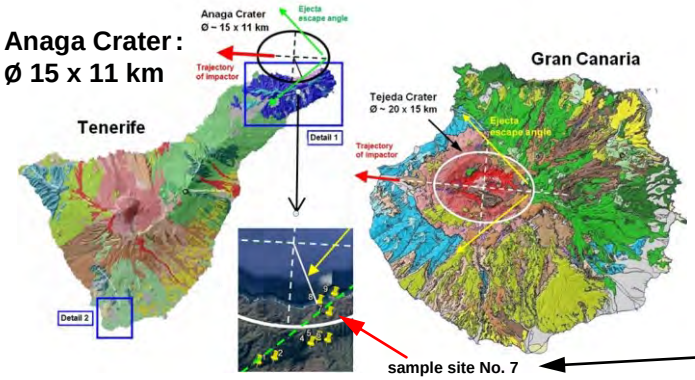
An alternative explanation would be that the carbon was brought-in by the impactor itself, for example if the impactor was a carbon-rich comet. This would be my first guess when I look at this image. However an origin from within Mercury (from Mercury's mantle) is also possible.

I mention this discovery for the following reasons :

1.) In all probability the PT-impactor was a carbon-rich comet with a diameter of ≥ 50km.

2.) Lengai Volcano located in Tanzania within the strong ejecta ray R4 is erupting Carbonatite Lava, Carbonatites are formed essentially of carbonate. Because the distribution of carbonate rocks in Europe seems to be closely related to the impact event in Europe, caused by PTI-ejecta, it must be considered that the carbonate which formed the carbonatite lava originates from the PT-impact.

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 (H_2) and H_2O which originates from deeper sources in the mantle ! Therefore we must take into consideration the possibility that certain amounts of the hydrocarbon reserves found close to impact structures could be a result of the thermochemical processes which are going on during & after the impact event ! (→ especially the gas reserves (CH_4, C_2H_6 etc.))



Anaga Crater :
Ø 15 x 11 km

The first diagram below is from the following study : "Infrared, Raman, and cathodoluminescence studies of impact glasses" from Arnold Gucsik, Prof. Koeberl & others. It shows Raman-Spectra of three types of known impact glass samples.

The Raman spectrum of the sample **No. 7** which I collected in the Anaga Range on Tenerife Island shows very similar spectra like two of the known impact (diaplectic) glass samples (see diagrams). This provides the **first scientific evidence** that the oblique impact crater Ø 15 x 11 km, which I assume on Tenerife (→ see image below) is a fact !

This impact crater, together with a nearly identical crater on Gran Canary (→ same orientation and similar size !) provides the first scientific proof for secondary craters, caused by the described global impact event at the Permian-Triassic boundary !!

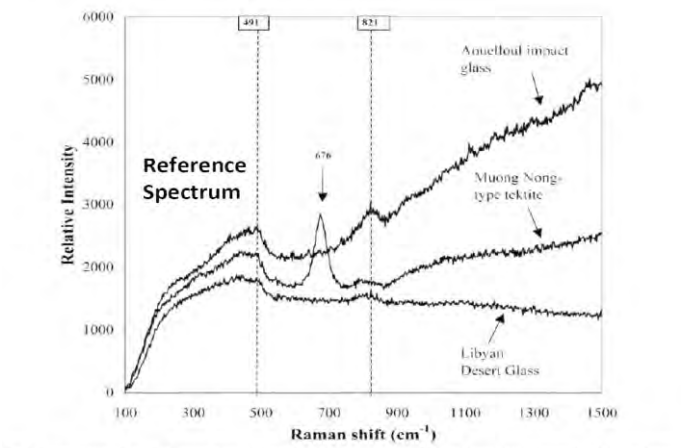
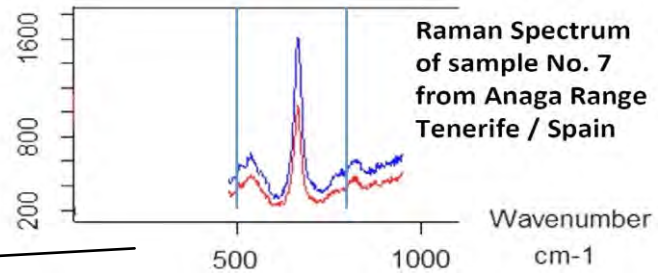


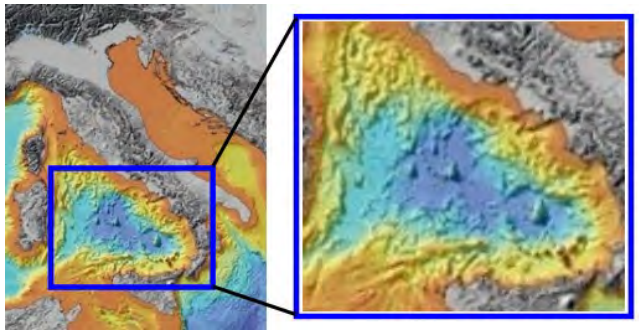
Fig. 8. Raman spectra of Aouelloul impact glass (a), Muong Nong-type tektite (b), and Libyan desert glass (c) generally exhibit two broad bands at 491 and 821 cm^{-1} and relatively high background fluorescence, which indicate a high degree of amorphization. These broad bands might be due to diaplectic glass. The numbers denote peak positions in cm^{-1}.



Summary regarding the PT-Impact Event

There is evidence for an elliptical impact crater with the enormous dimensions of **1270 x 950 km** in 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 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 150 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 (∅160 & ∅220 km), which formed the Tyrrhenian 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



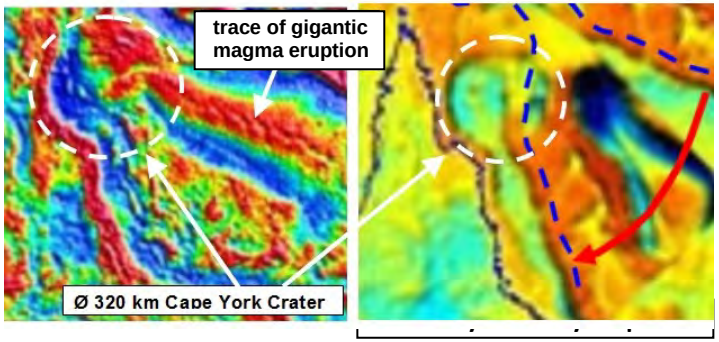
The main impulse of the PT-impact, together with the impulses and secondary craters, produced by the ejecta material, caused a global fracture pattern on Earth's crust, which was the trigger for the break-up of Pangea and a global expansion tectonic process. This expansion tectonic process caused the dichotomy on Earth → the formation of continents and ocean basins. And it is responsible for the transport of large amounts of volatiles from Earth's mantle to Earth's surface. Earth's diameter increased from an estimated diameter of 6500-7500 km ~253 million years ago to a diameter of 12756 km today, with an average expansion rate of ~ 20mm/year. The expansion of Earth was caused by abrupt decompression of Earth's mantle, which led to the large-scale expansion of volatiles, especially H_2O (water), in Earth's mantle. Through the sudden decompression of Earth's mantle, caused by the extensive fracturing of Earth's crust, the solubility of H_2O and other volatiles in the mantle material decreased below the volatile concentration. That's why Earth's mantle became super-saturated with H_2O and other volatiles (e.g. CO_2 & SO_2), which then started to exsolve and form gas-bubbles in the mantle material. These gas-bubbles continued to grow, and they were responsible for the transport of magma and volatiles (especially H_2O) to Earth's surface, through the overpressure which they caused in the mantle material. 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 (H_2O) over the last 253 Ma. This (hot) water was, and still is, transported from Earth's mantle to Earth's surface through the fractures caused by the PT-impact, mainly the Mid-Ocean Ridges, were the new surface areas of our 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 These global impact events, which are described in more detail in another part of this study probably all took place within the last 300 million years !

But back to the Perm-Triassic (PT)-Impact ! :
The main impulse of the Perm-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 south-ward 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 cratonic 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), which were 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.

The 7th magma eruption of the Cape York Crater again left clear traces on the Pacific Plate. It strongly influenced the geology of Middle America when its magma front impacted there.
The magma eruptions No.6 & 7 may have been triggered by strong impact-related earthquakes too (→ probably caused by the 62 Ma Impact-Cycle).
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 (e.g. from Google). This map clearly shows the 1200-1600 km wide ocean-floor stripes (between 60°N and 30°S latitude) along which the magma fronts moved mainly from west to east. In the eastern half of the Pacific Plate these stripes are clearly visible because of the strong east-ward shift of their ocean-floor ages on the map, which was caused by an eastward acceleration of these stripes, resulting from the massive eastward directed magma outflows. The distinct bend in the Hawaiian-Emperor-Chain (starting at 43 Ma) is, at least partly, a result of the faster east-ward motion of 2 or 3 of these ocean-floor stripes over the Hawaiian hotspot, because these ocean-floor stripes were accelerated (& stretched) in eastward direction by the magma eruptions (-outflows).

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 over the Yilgarn Craton.

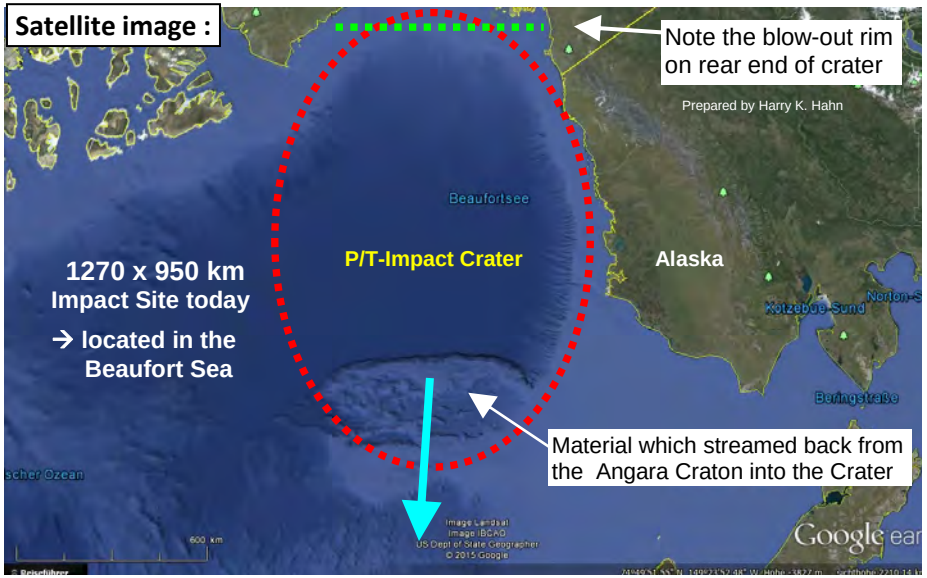
A large elliptical crater with the dimensions of 840 x 630 km , found in South-America, which can be identified on topographic maps and on satellite images, may also be related to the PT-impact event.

Another largescale impact event in Africa, which must be mentioned here, are four chains of impact craters (probably > 10 craters per chain), with craters in the Ø150 to Ø250 km range, which represent ejecta rays which cross the whole continent in different angle direction !
These impact craters are also secondary craters, which were caused by ejecta originating in the PT-Impact Crater !

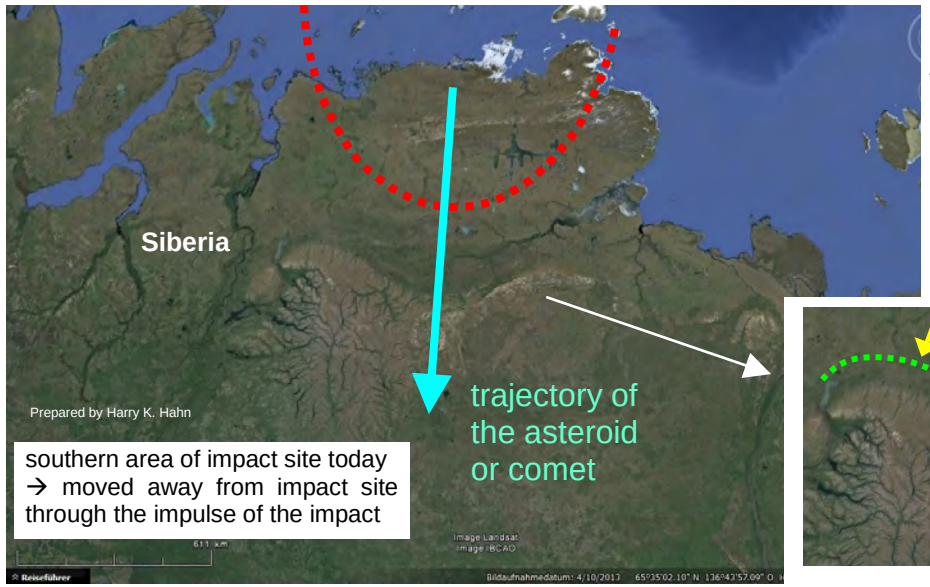
253 Million years ago a big Asteroid or Comet collided with Earth and caused a 1270 x 950 km elliptical Impact Crater

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. →This caused the Permian-Triassic boundary[1], which is associated with the most extensive mass extinction of marine species and terrestrial vertebrates & plants. And it caused the largest eruption of "continental" flood lavas, the Siberian Traps.

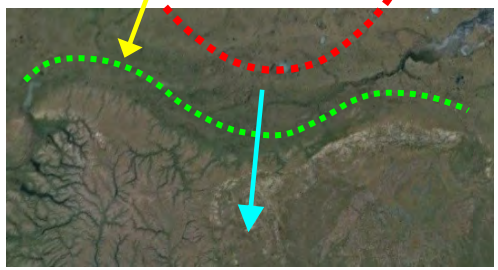
The following images and explanations describe the impact event and its effects on our planet Earth during the ~ 253 million years from this event. As everyone can imagine, this powerful impact event completely reshaped our Earth's appearance !

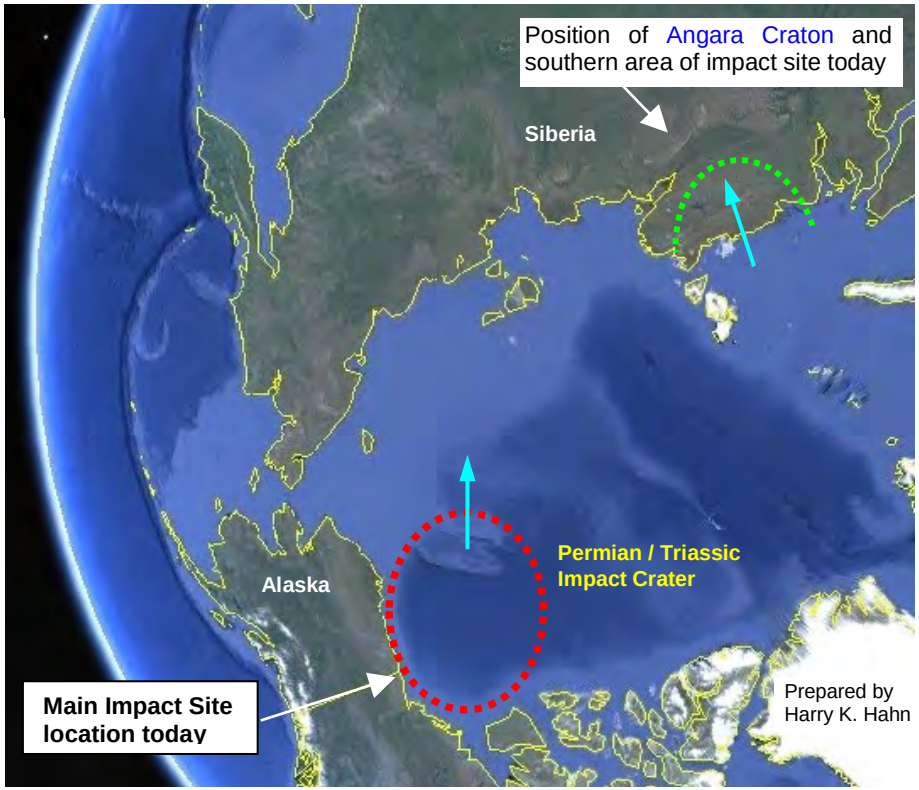


The two images on the left show the remains of the impact site as it appears today.
The main impact site is located in the Beaufort Sea close to the coast of Alaska. Another part of the impact crater which moved away from the impact site through the impulse of the impacting asteroid is located in Siberia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



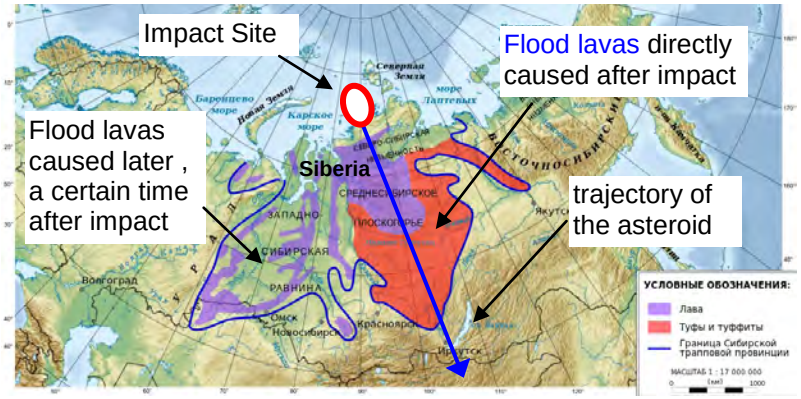
Note the bow-shape of the northern edge of the flood-lava formation
→ similar to bow-waves produced by ships !





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

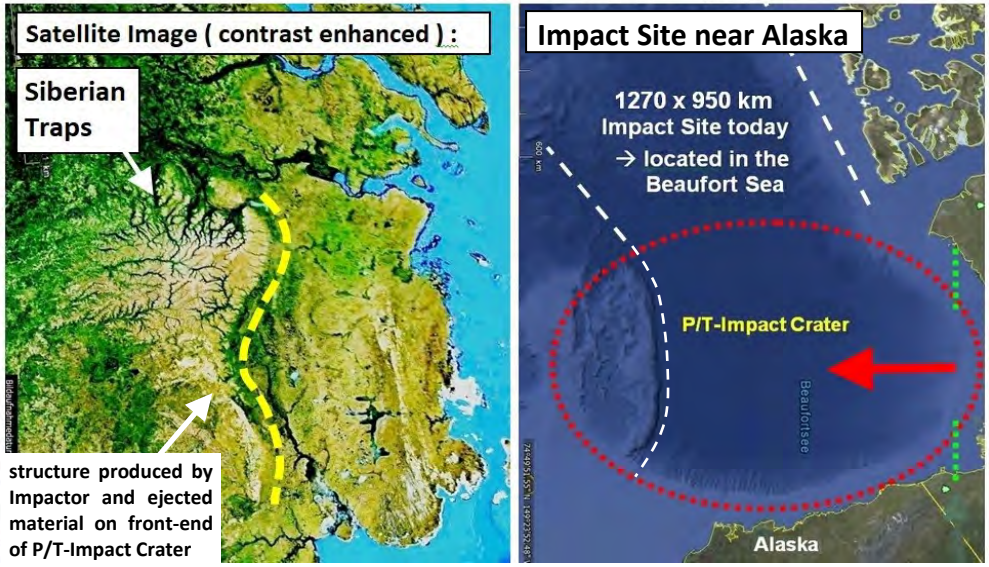
The flood lavas caused by the impact : The Siberian Traps



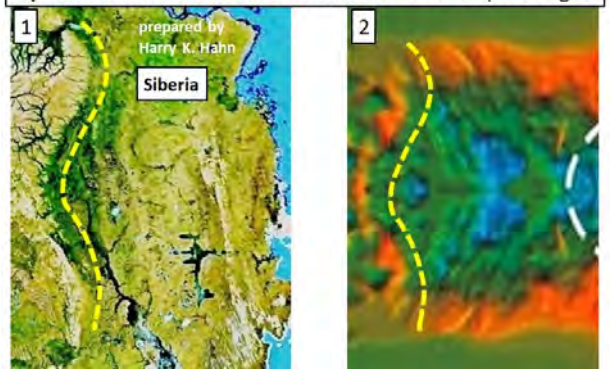
To the crater formation of the Ø 1270 x 950 km P/T-Impact Crater

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 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

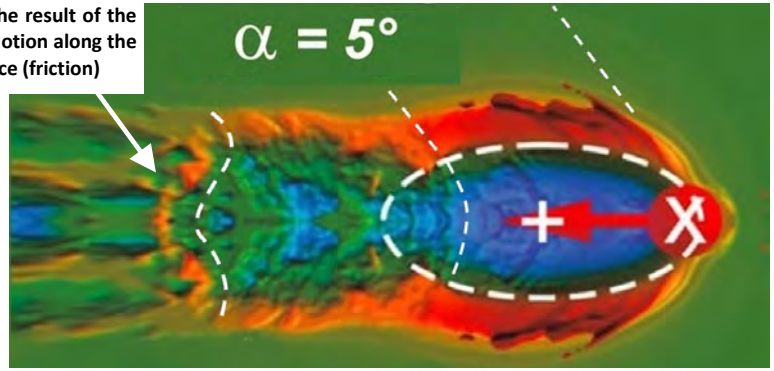


Compare → impact structures on front-end of crater :
1.) Reality : Satellite image **Siberia** (contrast enhanced)
2.) Simulation : front-end structure at ~ 5 - 7° impact angle



The secondary structures at the front-end of the crater are the result of the projectile motion along the target surface (friction)

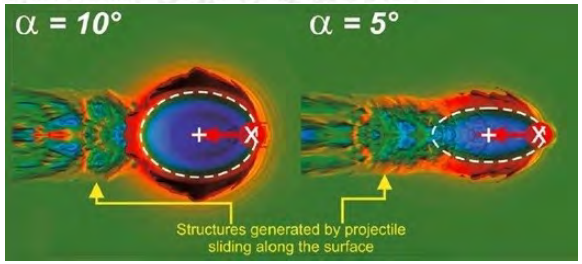
Simulated Impact Structure of a 5° oblique Impact :



Early reflections of shock and rarefaction waves in the projectile prevent plastic deformation in the upper part of the body. The strong pressure gradient in the projectile suggests fragmentation of the projectile would likely occur.

In this case, the lower part of the projectile is decelerated by shearing along the surface while the upper part continues its motion nearly unaffected.

Figure 2. Influence of the impact angle on crater shape. Impact of a 5 km sized projectile at 8 km/s and low impact angles α (friction coefficient $f = 0.3$; no cohesion). The dashed white line marks the inner boundary of the crater cavity just before the onset of crater modification (measured at the preimpact surface). The cross (X) indicates the contact point of the projectile with the target, the "+" marks the geometric center of the crater. The secondary structures close to the left crater rim are the result of the projectile motion along the target surface (friction) and indicate a very oblique impact angle. The color contours denote the elevation where green represents the initial level of the target, blue represents topography below, and red above the target level.



The transition from circular to elliptical impact craters

Dirk Elbeshausen,[1] Kai Wünnemann,[1] and Gareth S. Collins[2]

2. Model Setup

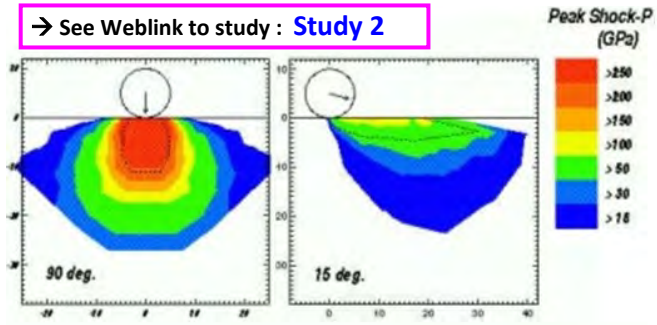
→ **Weblink to Study : Study 1**

[5] To investigate crater formation for shallow-angle impacts, we have carried out a series of 3-D simulations with the hydrocode iSALE-3D [*Elbeshausen and Wünnemann*, 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 (ICE'd ALE) 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; *Gueyffier et al.*, 1999] as described in *Elbeshausen and Wünnemann* [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.*, 2008].

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

The diagrams below show that the maximum shock pressure is drastically reduced in an 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 !**

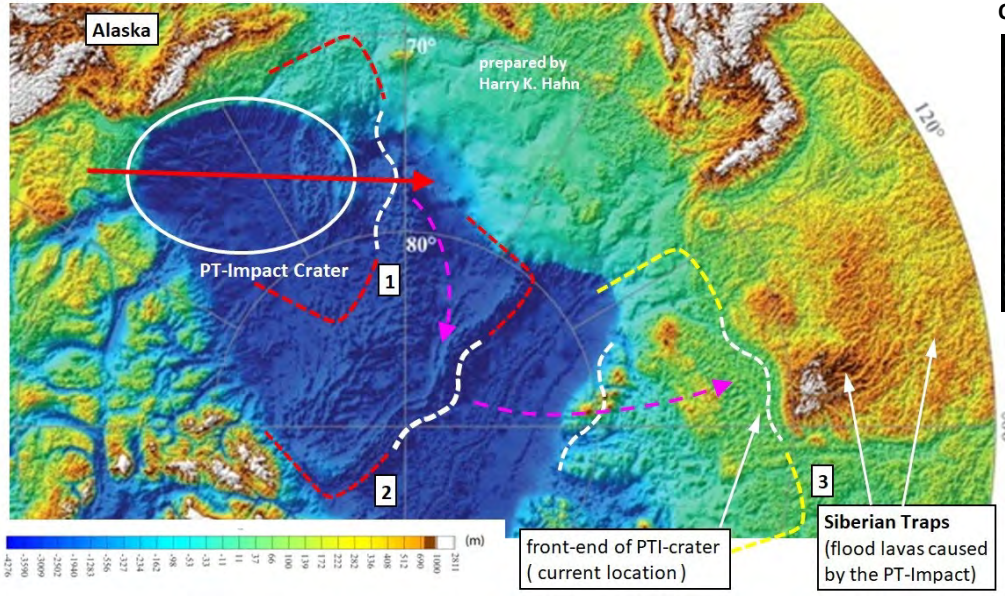
→ **See Weblink to study : Study 2**



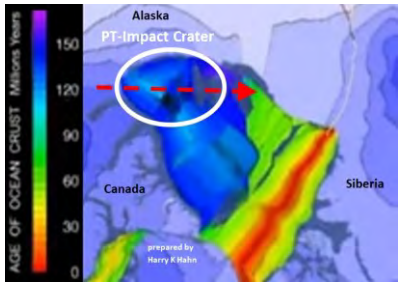
Large-scale structures caused by the PT – Impact , visible on different Maps

Polar-Projection of PT-Impact Area – Topographic Map

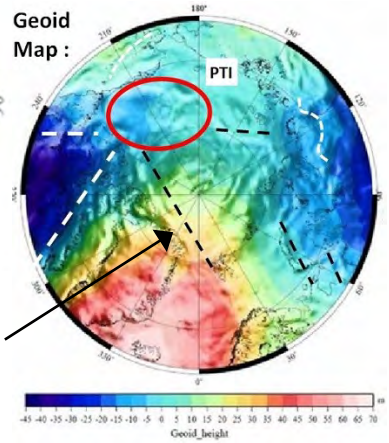
→ the motion of the front-end of the PTI-crater over time is indicated



Ocean-Floor Age Map of PT-Impact Area

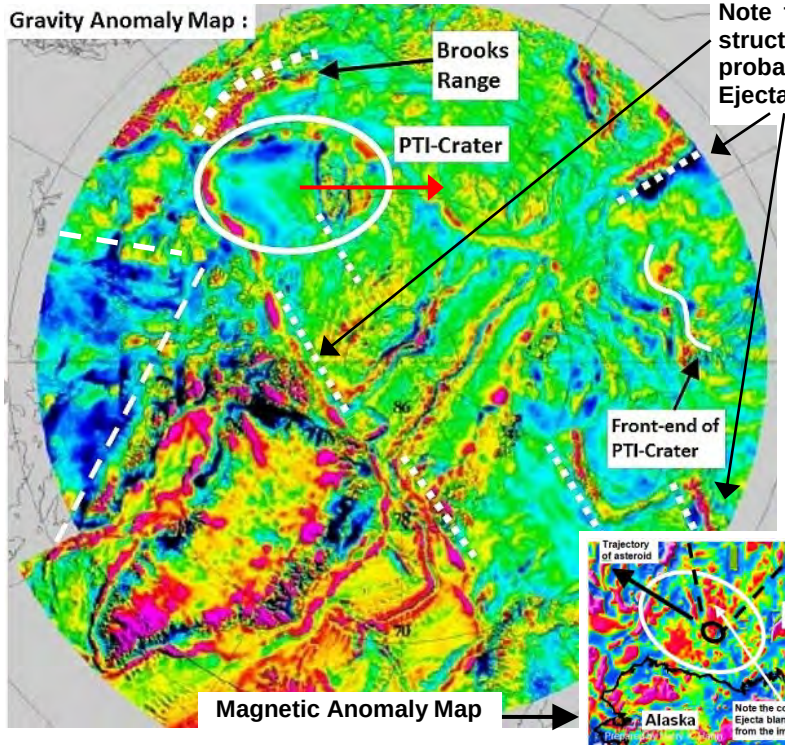


Geoid Map :



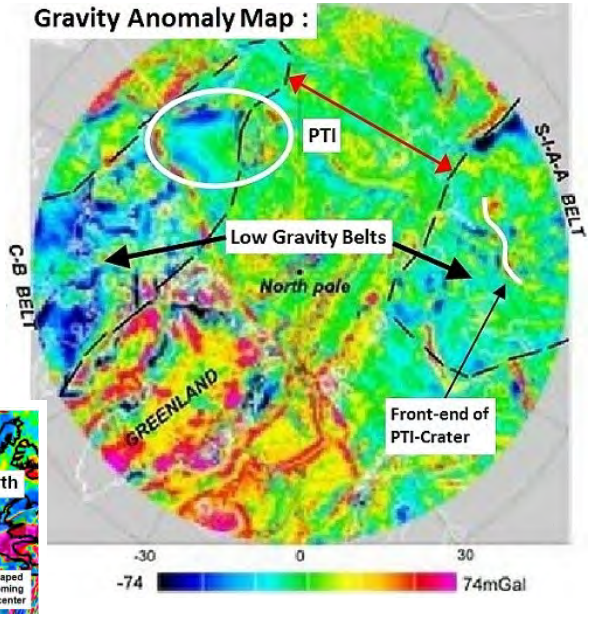
Gravity Anomaly- and Geoid Maps also indicate the PT- Impact

Gravity Anomaly Map :



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

Gravity Anomaly Map :



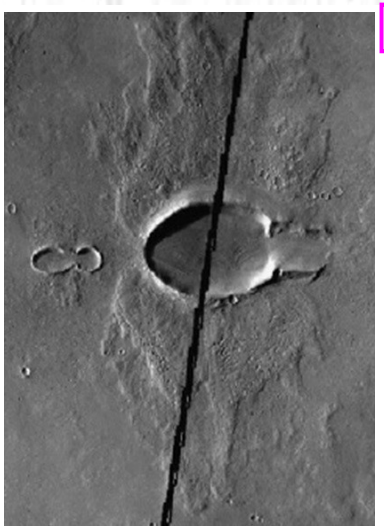
There is an interesting example of an elliptical Crater on Mars with the dimensions of 10 x 7.5 km, which in all probability was caused by a small Mars-orbiting moonlet whose orbit tidally decayed, because it came to close to the marsian atmosphere. It probably impacted in a very shallow angle ≤ 5° (see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

The impactor which caused the P/T-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 ≤ 7° 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.

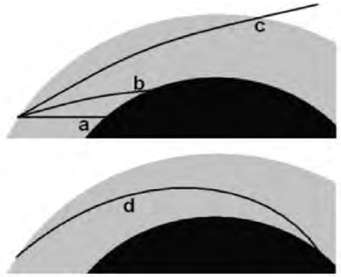
On the origin of a double, oblique impact on Mars

J.E. Chappelow [a,b,*], R.R. Herrick [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 meteoritic 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 extra-martian 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.



→ **Study : Weblink1, Weblink2**



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 × 10.0 km) elliptical crater with a smaller elliptical crater (2.0 × 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.

To the evolution of the PT – Impact Event, and the effects of the impact on Earth's crust

The PT_3-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.

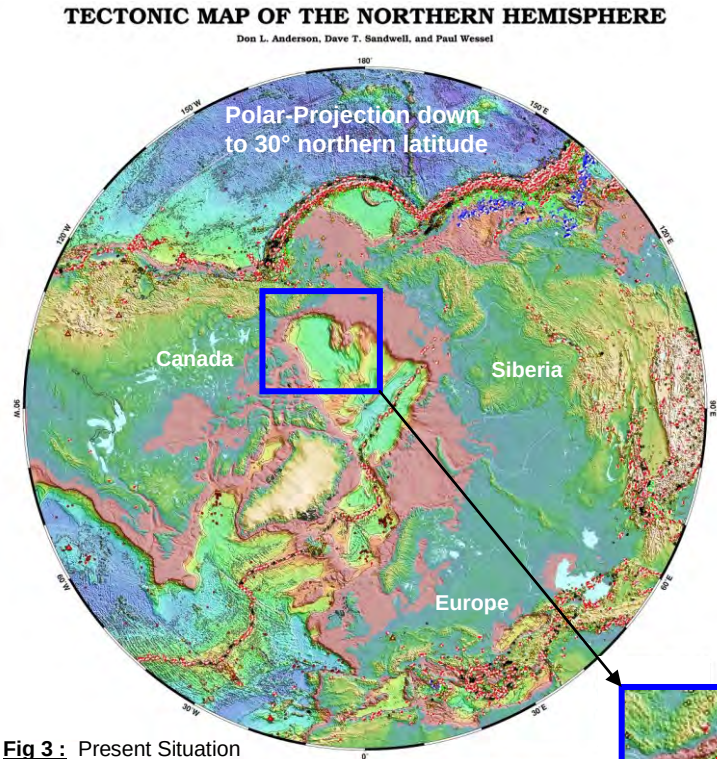
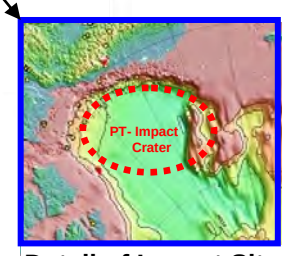
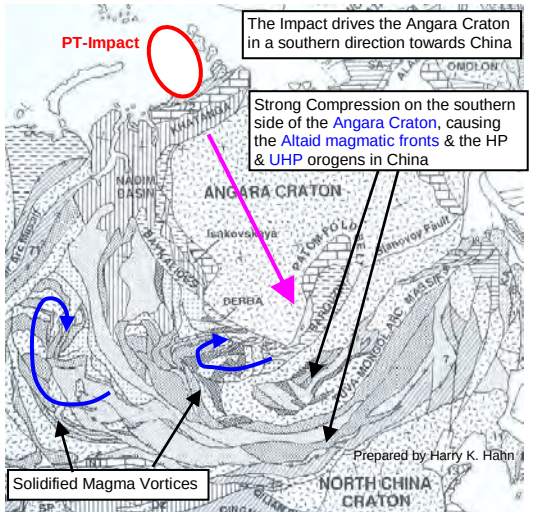


Fig 3 : Present Situation



Detail of Impact Site



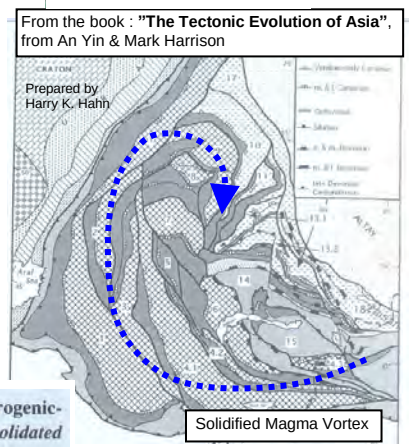


Figure 21.6. Paleotectonic map of Asia showing the primary orogenic-collage components mentioned in the text. *Precambrian consolidated*

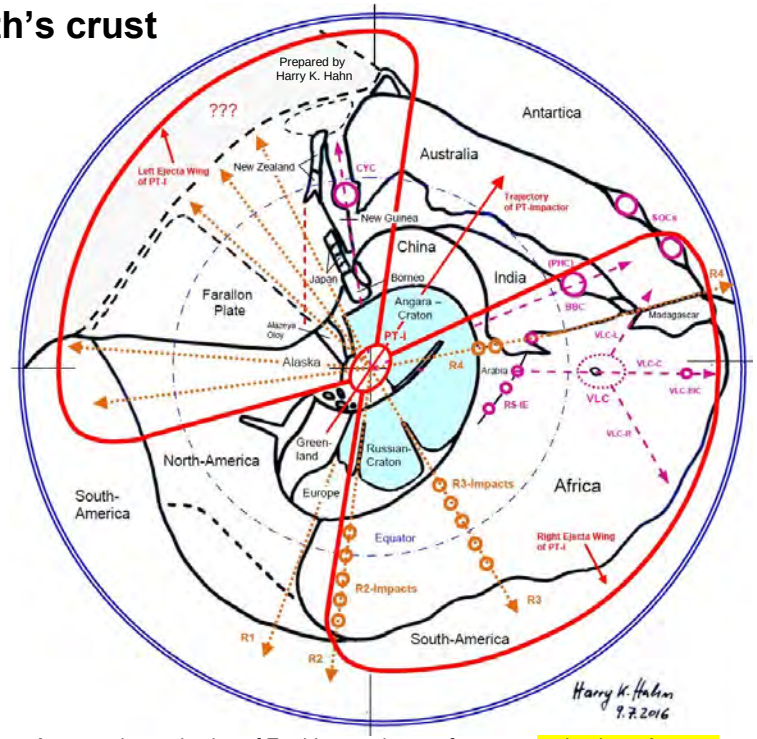


Fig 1 : Polar-Projection of Earth's complete surface area at the time of Impact centred on the PT-Impact Crater. **Earth diameter : ~6500-7500 km**

Fig 1 : A Polar-Projection centred on the PT-Impact Site (→ center point corresponds approx. to the North-Pole too). The map shows Earth's complete surface area and the positions of Earth's continents as they probably were located at the time of impact. The area which was most effected by the PT-Impact is located within the butterfly-shaped ejecta blanket (red) Most secondary impacts (marked in pink & orange) and ejecta rays are also located within this area.

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 !!

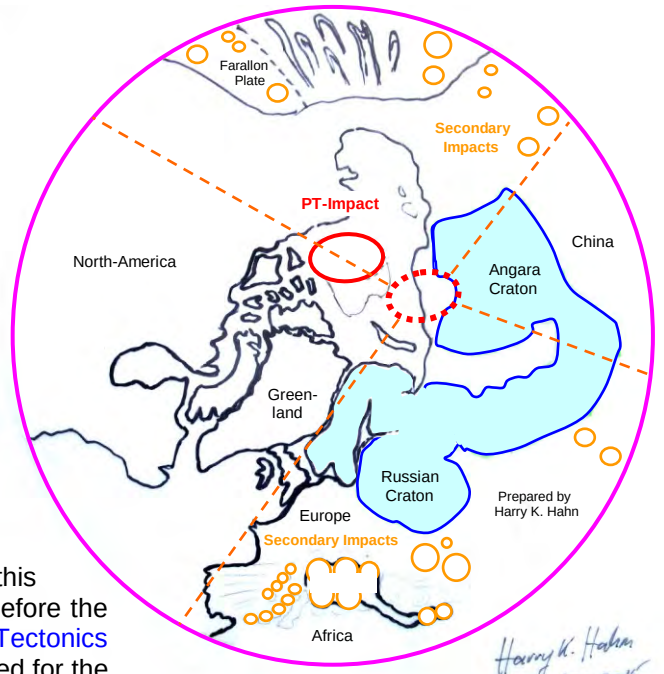
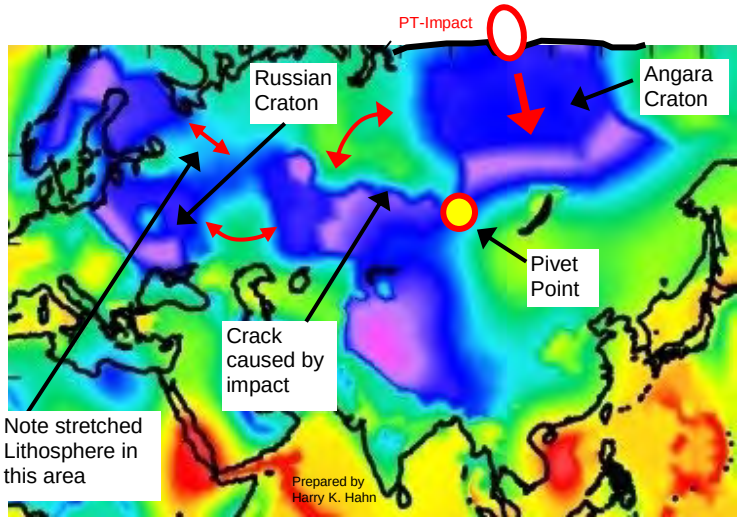


Fig 2 : Polar-Projection down to 30° N ~100 Ma ago, Ø **Earth : ~ 10000 km**

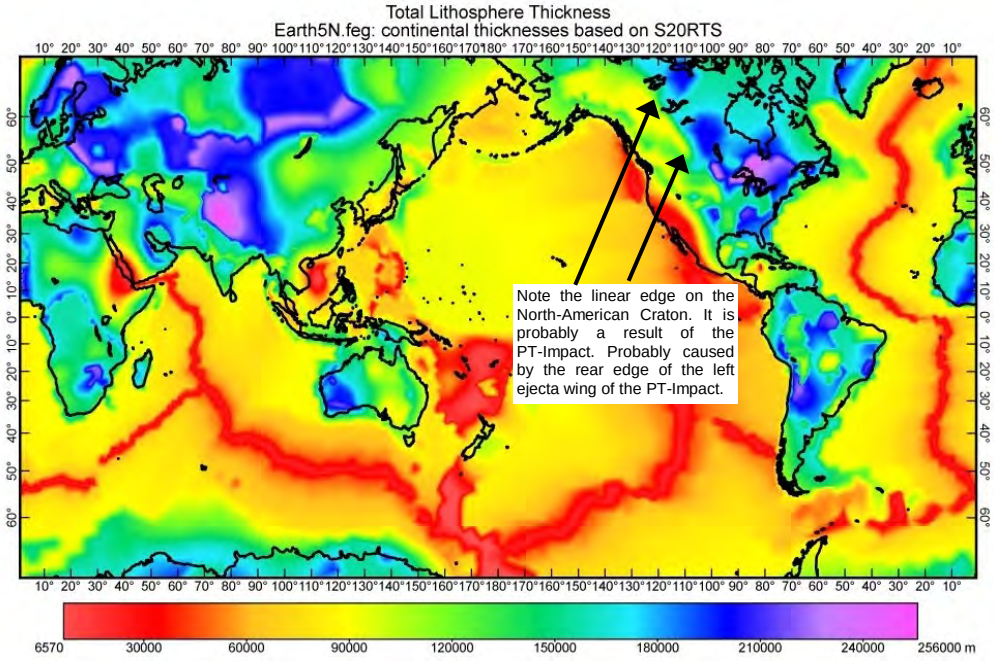
The tectonic evolution after the PT – Impact Event

Prepared by Harry K. Hahn

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_2-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 !)



Model of total lithosphere thickness. A composite of continental thicknesses scaled from vertical-S-wave upper-mantle travel-time-anomalies and an age-dependent model in the ocean basins.
See following Weblink : http://peterbird.name/publications/2008_torque_balances/012_total_lithosphere-Earth5N.jpg



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 :

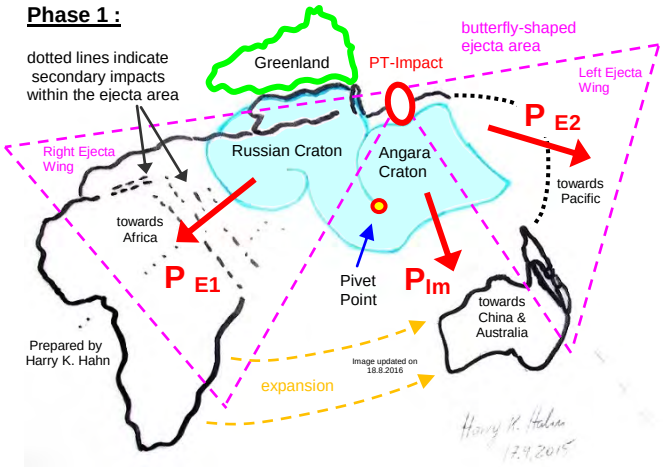
The PT_3-Impact event can roughly be divided into three phases which I will describe in the following :

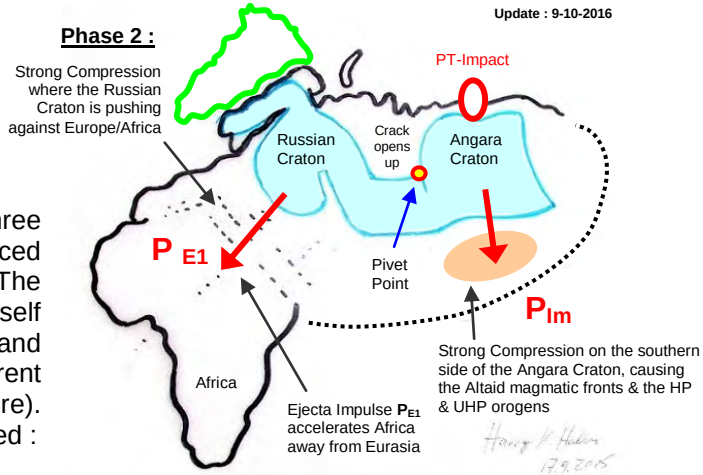
Phase 1 : The impact produced three main impulses which were induced into the surrounding Lithosphere. The impulse P_{IM} from the Impactor itself and the two Ejecta-Impulses P_{E1} and P_{E2} which all accelerated different areas of Eart's crust (lithosphere). The following formula can be applied :

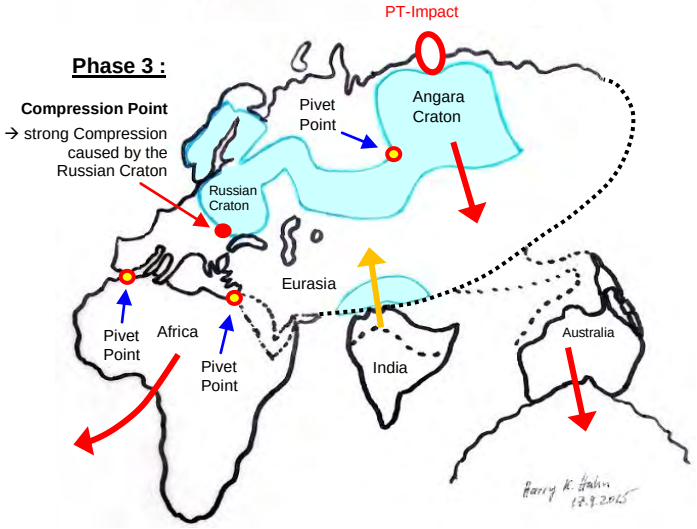
$$P_{Total} = P_{IM} + P_{E1} + P_{E2}$$

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.







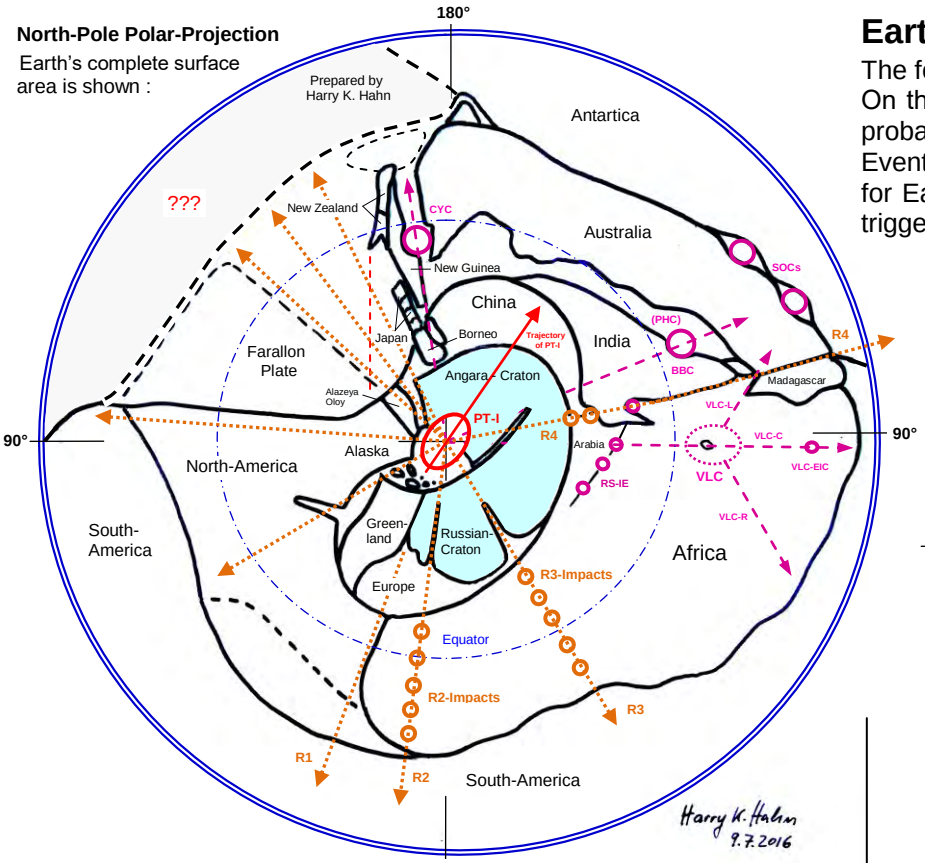
Earth at the time of the PT-Impact Event

Prepared by Harry K. Hahn

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 PTI-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**

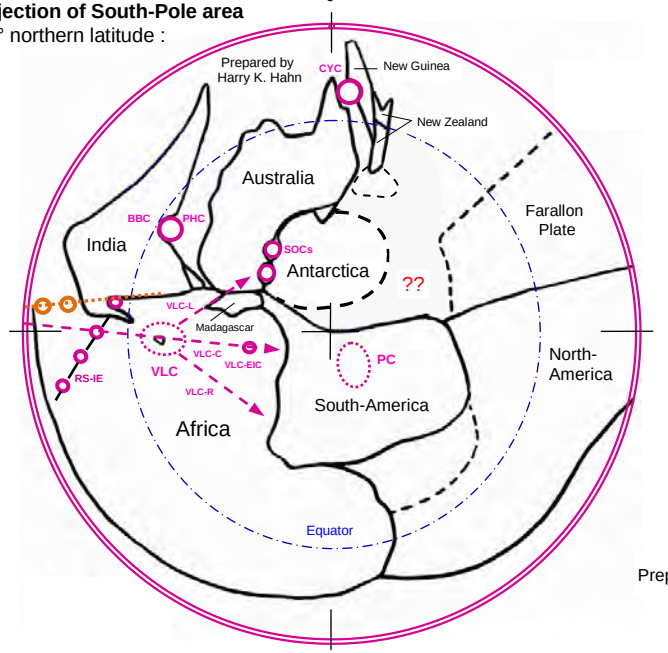
North-Pole Polar-Projection

Earth's complete surface area is shown :



Polar-Projection of South-Pole area

up to ~ 45° northern latitude :

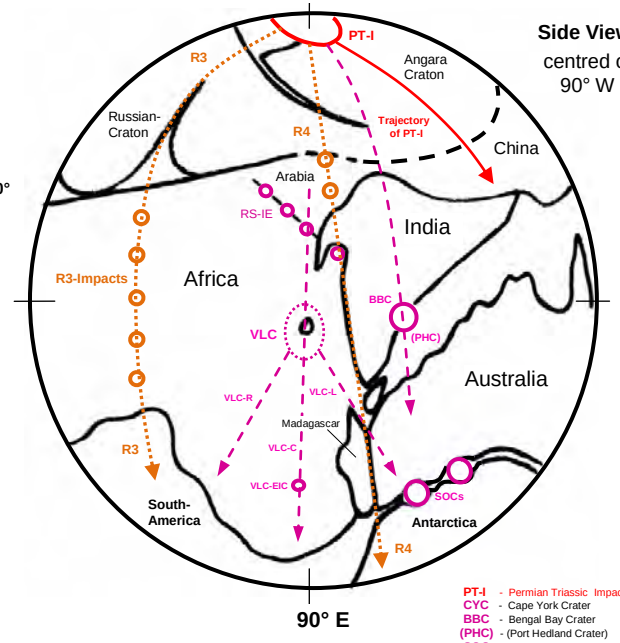


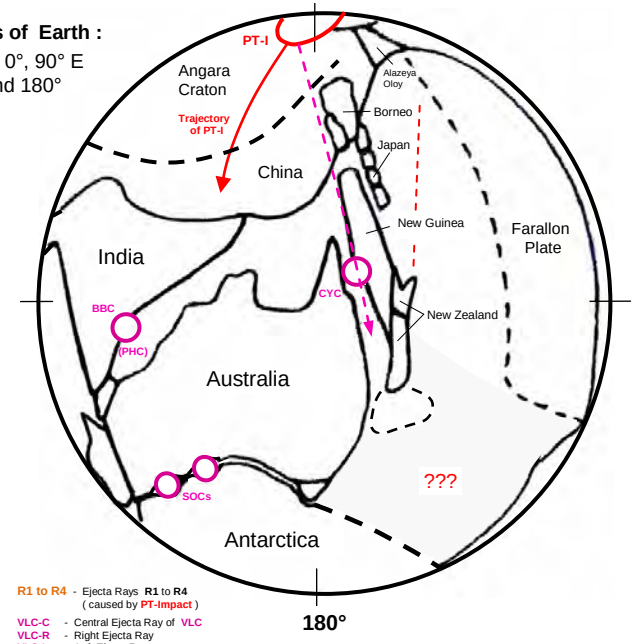
Prepared by Harry K. Hahn

Update : 9-10-2016

Side Views of Earth :

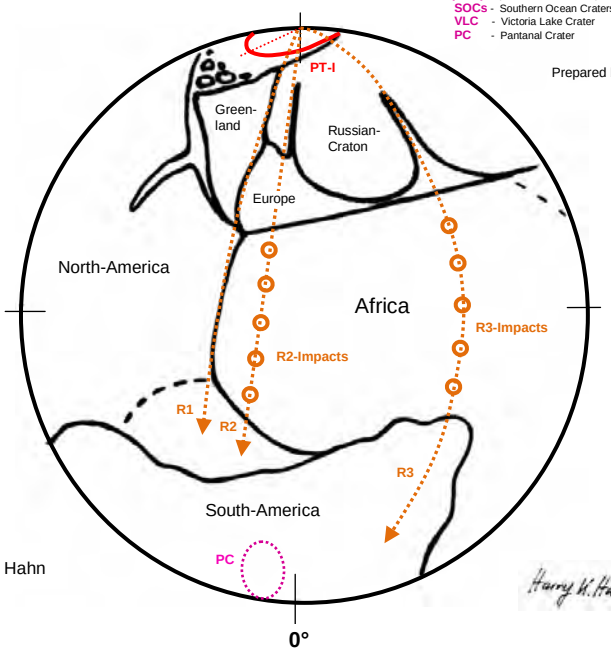
centred on 0°, 90° E 90° W and 180°

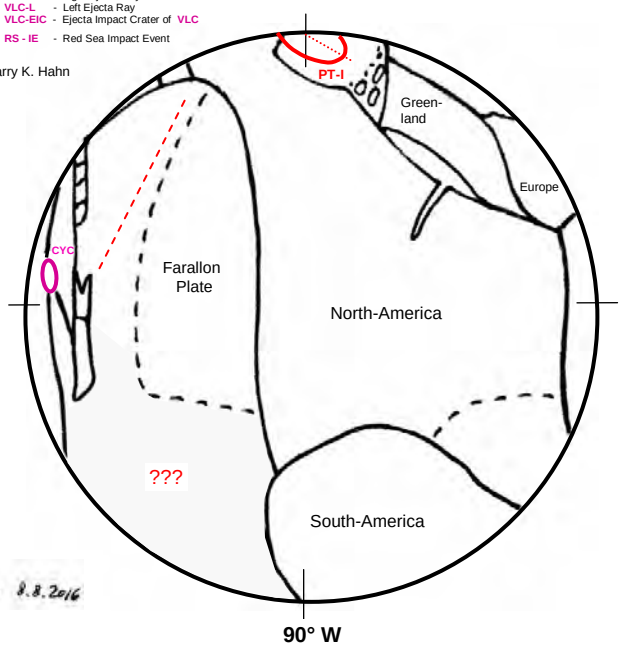




PT-I	- Permian Triassic Impact	**R1 to R4**	- Ejecta Rays **R1** to **R4** (caused by **PT-Impact**)
CYC	- Cape York Crater	**VLC-C**	- Central Ejecta Ray of **VLC**
BBC	- Bengal Bay Crater	**VLC-R**	- Right Ejecta Ray
(PHC)	- (Port Hedland Crater)	**VLC-L**	- Left Ejecta Ray
SOCs	- Southern Ocean Craters	**VLC-EIC**	- Ejecta Impact Crater of **VLC**
VLC	- Victoria Lake Crater	**RS - IE**	- Red Sea Impact Event
PC	- Pantanal Crater		

Prepared by Harry K. Hahn





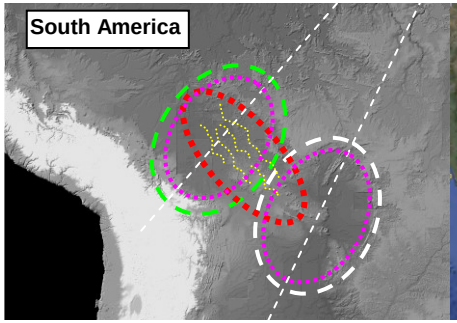
Harry K. Hahn 9.8.2016

There are > 60 large impact craters on Earth where big Oil- & Gas-fields and extensive metal-ore deposits should exist !

The world's largest Oil-Field Ghawar in Saudi Arabia **developed close to the center of an impact crater with ~ Ø 400 km !** (see map) There are more than a dozen similar-size impact craters on Earth, which must have produced similar large oil-fields as Ghawar ! The maps below indicate the areas were such large Oil-fields (& Gas-fields) could be find (marked with red & pink ellipses → highly fractured impact areas). **Note :** The impact craters are marked with white lines.
In Africa ejecta of the crater chains may have produced large metal ore deposits too. Areas were hydrothermal activity occured (post-impact shales) → marked in pink

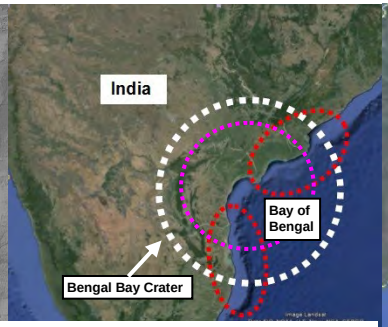
South-America / Pantanal Crater :

The ∅ 840 x 630 km elliptical crater caused a large shift of the NE-part of the continent and must have produced large oil- & gas deposits !



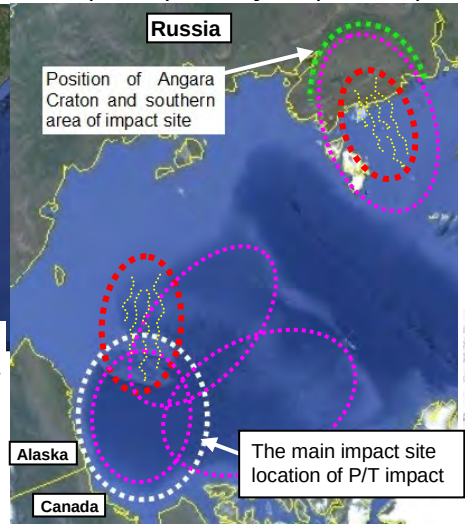
India / Bengal Bay Crater :

The ∅450 x 380km crater has caused the breakaway of India from Pangea. It has produced potential areas along the coast



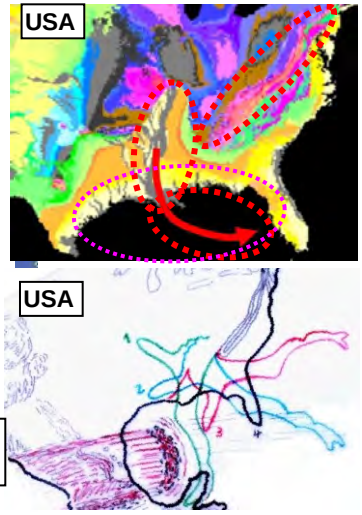
Permian / Triassic Impact Crater :

The gigantic ∅1330 x 880km crater has produced large areas with high potential for oil- & gas-deposits. But the deposits probably lie quite deep !



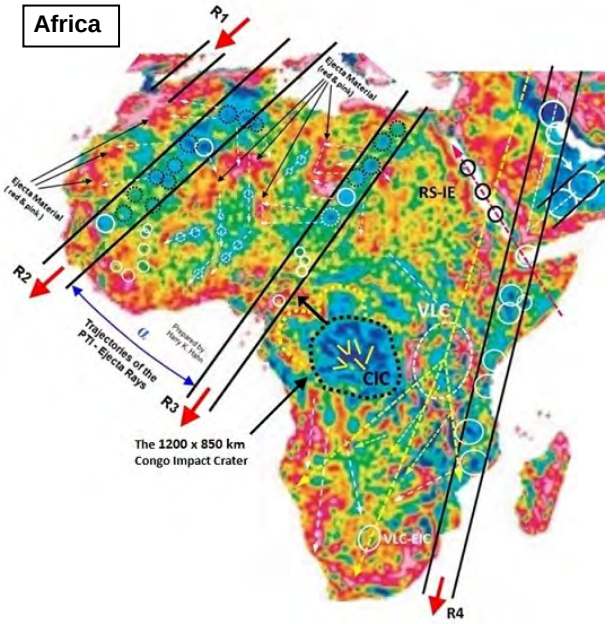
USA / Appalachian Fragment :

The forced movement of the Appalachian fragment caused large oil-, gas- & coal deposits along the path of the fragment



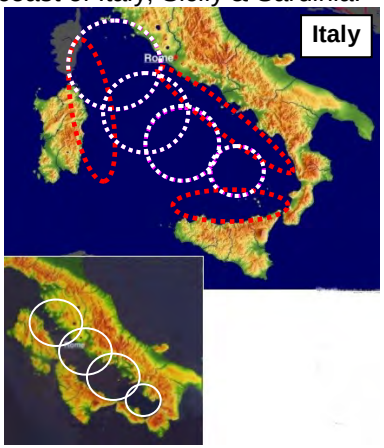
Africa with Crater Chains R1 to R4 and the Congo Impact Crater

Especially the crater chains R1 to R4 and the Congo Impact Crater (CIC) which are located on or near the African Continent contain a big share of impact related oil- & gas-reserves and metal-ore on Earth. Because **at least 50 ≥ Ø150km craters** are located in the crater-chains R1-4 & within the CIC that was caused by a dozen impactors



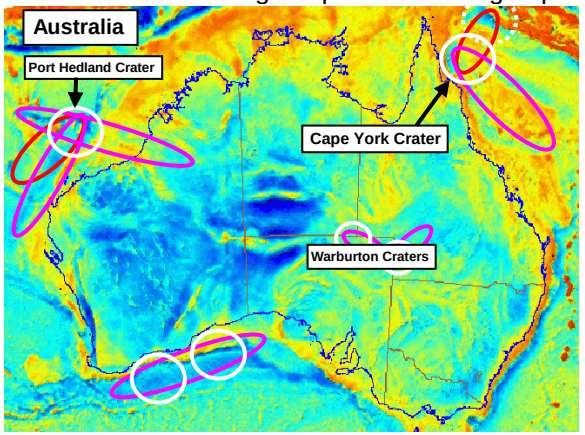
Italy / Secondary Crater chain:

The crater chain with ∅160-220km craters in the Tyrrhenian sea produced potential oil- & gas deposit areas along the coast of Italy, Sicily & Sardinia.



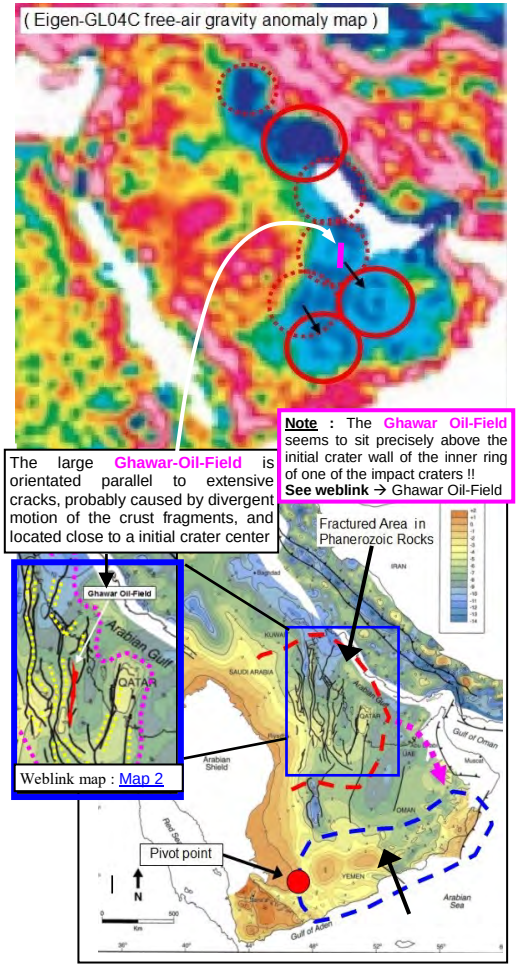
Australia / Impact Craters :

The ∅ 320 km CY-crater and the ⌀ 400x350 km PH-crater in the North produced areas with high potential for large oil- & gas-deposits because of the extensive movement of crust fragments. The two SO-craters also have good potential for big deposits



Arabia / (PT) - Secondary Crater Chain :

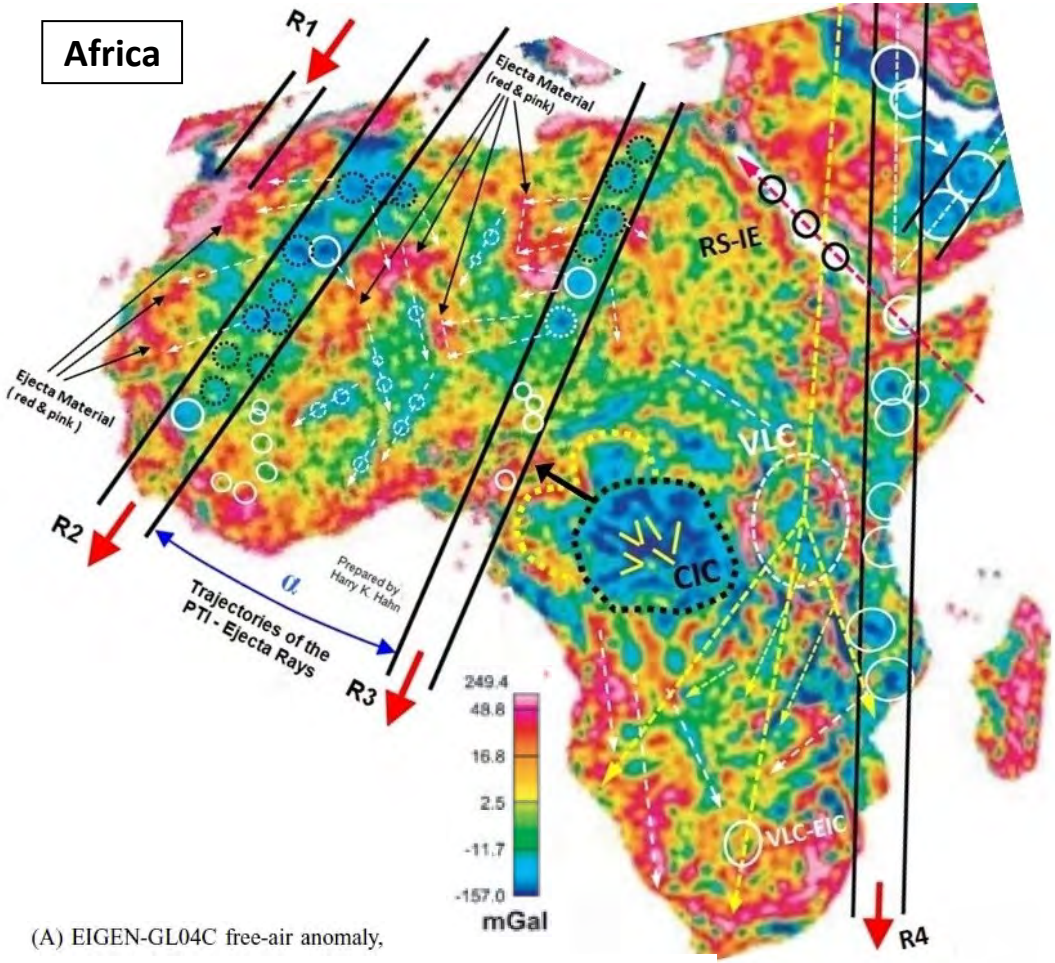
For comparison a gravity anomaly map of Arabia is shown. This map indicates a chain of impact craters (red) with ∅300km (probably secondary craters caused by the P/T-impact), which have split Arabia into 3 crust fragments, and which have caused a divergent motion of these fragments. The impacts have also caused extensive cracks in the Phanerozoic rock underneath Along these cracks large oil-fields formed !



Powerful Ejecta Rays of the PT- Impact indicated by negative gravity anomalies, produced Oil- & Gas-fields (post-impact shales)

Gravity Anomaly Map of Africa showing the PT-Ejecta Rays R1-R4 :

- ➔ Ejecta Rays **R1** to **R4** of the Permian Triassic impact (PTI) are marked on the map. (→ smaller crater chains are also indicated)
- ➔ Impact Craters appear as negative anomalies (blue or green areas)
- ➔ The **1200x850 km** Congo Impact Crater (**CIC**) is also shown on the map



(A) EIGEN-GL04C free-air anomaly,

A crustal thickness map of Africa derived from a global gravity field model using Euler deconvolution

Getachew E. Tedla,[1,2] M. van der Meijde,[1] A. A. Nyblade[2,3] and F. D. van der Meer[1]

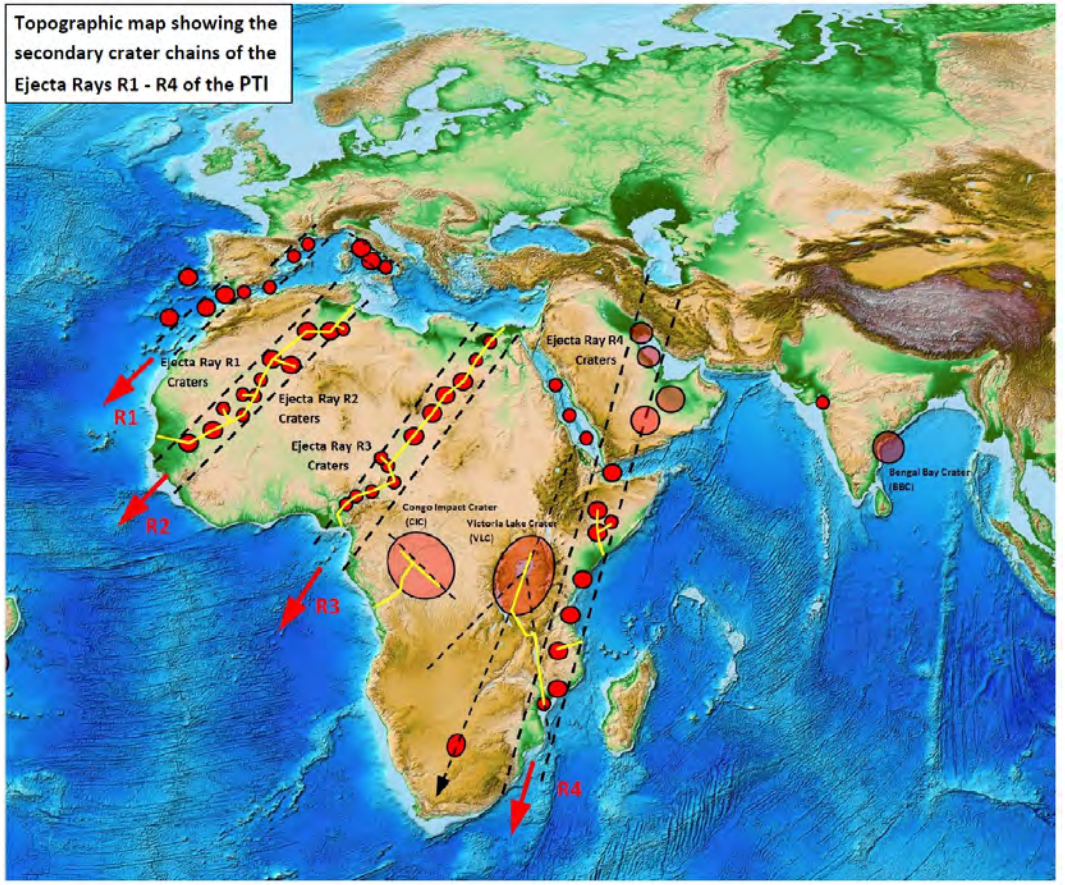
[1]*University of Twente, Faculty of Geo-Information Sciences and Earth Observation (ITC), Enschede, The Netherlands. E-mail: tedla@itc.nl, get11@psu.edu*
[2]*Department of Geosciences, Pennsylvania State University, University Park, PA 16802, USA*
[3]*School of Geosciences, The University of the Witwatersrand, Johannesburg, South Africa*

3 METHODOLOGY

As our main interest is the depth of the crust–mantle boundary, the gravity data are first subjected to a high-pass filter using a 1000-km cut-off wavelength to remove deep mantle sources (Obenson 1974; Block *et al.* 2009, Fig. 1B). Undesired tapering effects are minimized by expanding the gird up to 20 per cent of the total grid area. We then calculate the X, Y, Z derivatives of the filtered gravity anomaly on a 0.25° grid (Figs 1C, D and E) and use them as input to the 3-D Euler equation.

Topographic Map of Africa indicating the crater chains R1 to R4 :

- ➔ **The Chains of impact craters (R1 to R4)** shown on the topographic map (→ marked in red) in all probability **represent oil- & gas-rich areas**.
- ➔ These Impact Crater areas could easily be connected by major oil-piplines (Piplines marked in yellow)
- ➔ The Congo Impact Crater (**CIC**) and the Victoria Lake Impact Crater (**VLC**) probably also represent oil- & gas-rich areas.

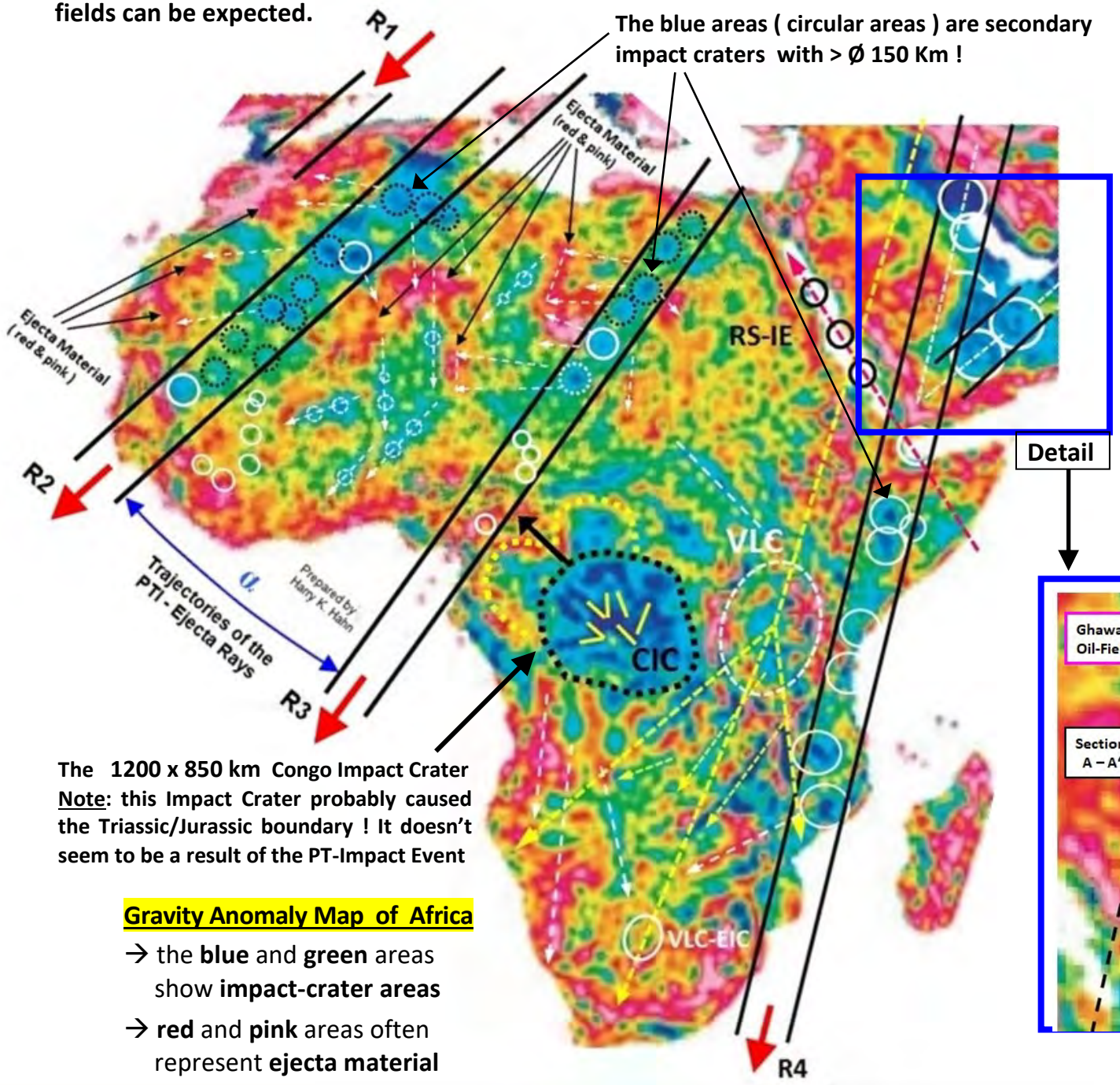


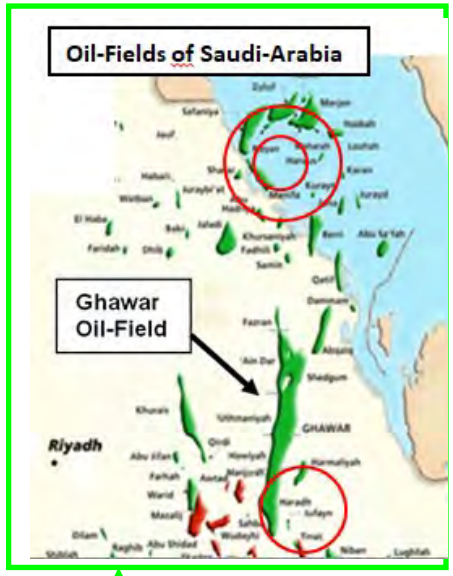
In the oil-exploration industry it is common knowledge that large oil-fields can be expected in an area effected by a big impact crater. Because a large impact not only produces the required structural traps (by impact induced fracturing and brecciation of the rock under the crater, which results in very effective porosity & permeability of the fractured rock), but also the palaeo-environment for the deposition of post-impact shales that provides the oil & gas.

There are geological examples available, like the Ames Crater (Ø 14 km) in Oklahoma / USA, or the worldclass Cantarell Oil-field, which is located near the Ø 180 km Chicxulub Crater in Mexico, which clearly indicate the close connection of impact craters & oil- & gas-fields

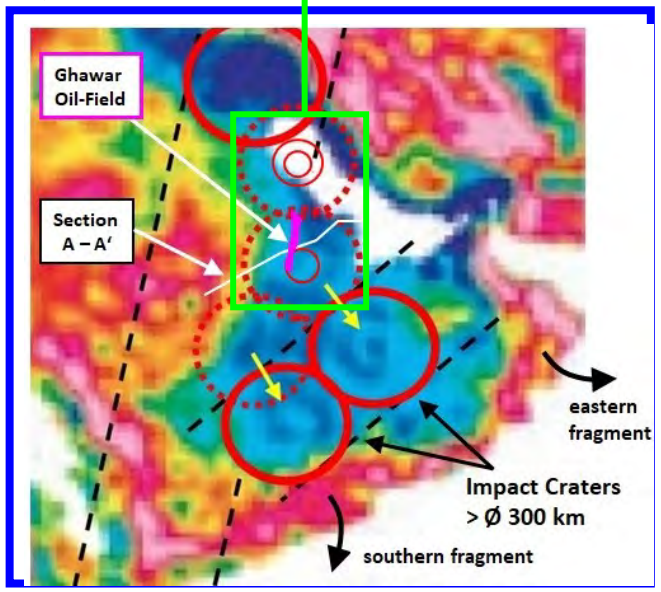
Note : **There is indication that the large Oil-fields in Saudi-Arabia are the result of 3 to 4 large PT- secondary impact craters within the strong Ejecta Ray R4. There are many more secondary impact craters visible on Africa's gravity anomaly map, where Oil- and Gas-fields can be expected.**

NOTE : Ghawar is the world's largest oil-field ! And it is located in the former center area of a ≥ 300 km Crater





Detail → Saudi Arabia



The 1200 x 850 km Congo Impact Crater
Note: this Impact Crater probably caused the Triassic/Jurassic boundary ! It doesn't seem to be a result of the PT-Impact Event

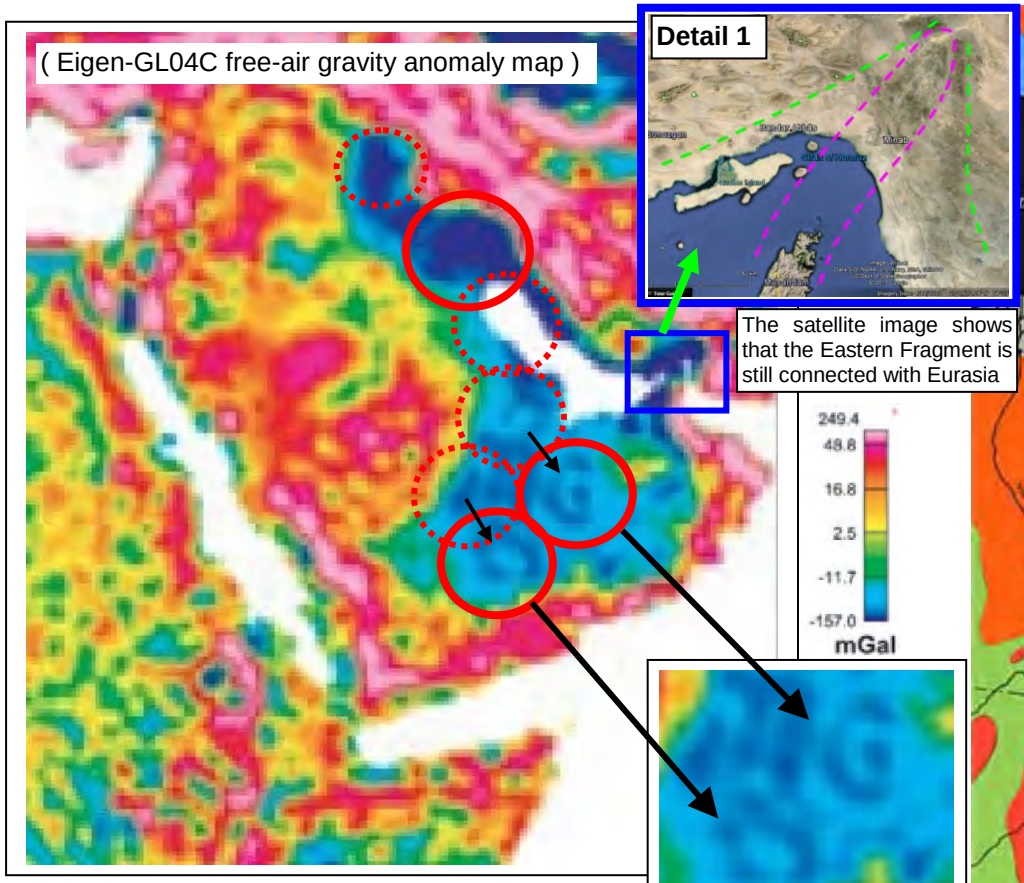
Gravity Anomaly Map of Africa

→ the **blue** and **green** areas show **impact-crater areas**

→ **red** and **pink** areas often represent **ejecta material**

Arabia's outline was formed by several impact craters (∅ 300-400 km) probably caused by ejecta from the PT-Impact Event

The gravity anomaly map of Arabia indicates at least three circular structures, probably secondary craters from the PT-Impact 253 Ma ago, which caused extensive fractures and led to expansion tectonics in the south-east of Arabia. The impact impulse resulting from this impact event caused a divergent motion of three crust fragments, which eventually formed the Arabian Peninsula and with it the rich Oil- and Gas-Fields in the area of Saudi Arabia.



The satellite image shows that the Eastern Fragment is still connected with Eurasia

Detail View of two distinct gravity anomaly signatures indicating two impact craters >∅ 300km

3 METHODOLOGY

As our main interest is the depth of the crust–mantle boundary, the gravity data are first subjected to a high-pass filter using a 1000-km cut-off wavelength to remove deep mantle sources (Obenson 1974; Block *et al.* 2009, Fig. 1B). Undesired tapering effects are minimized by expanding the grid up to 20 per cent of the total grid area. We then calculate the *X*, *Y*, *Z* derivatives of the filtered gravity anomaly on a 0.25° grid (Figs 1C, D and E) and use them as input to the 3-D Euler equation.

A crustal thickness map of Africa derived from a global gravity field model using Euler deconvolution

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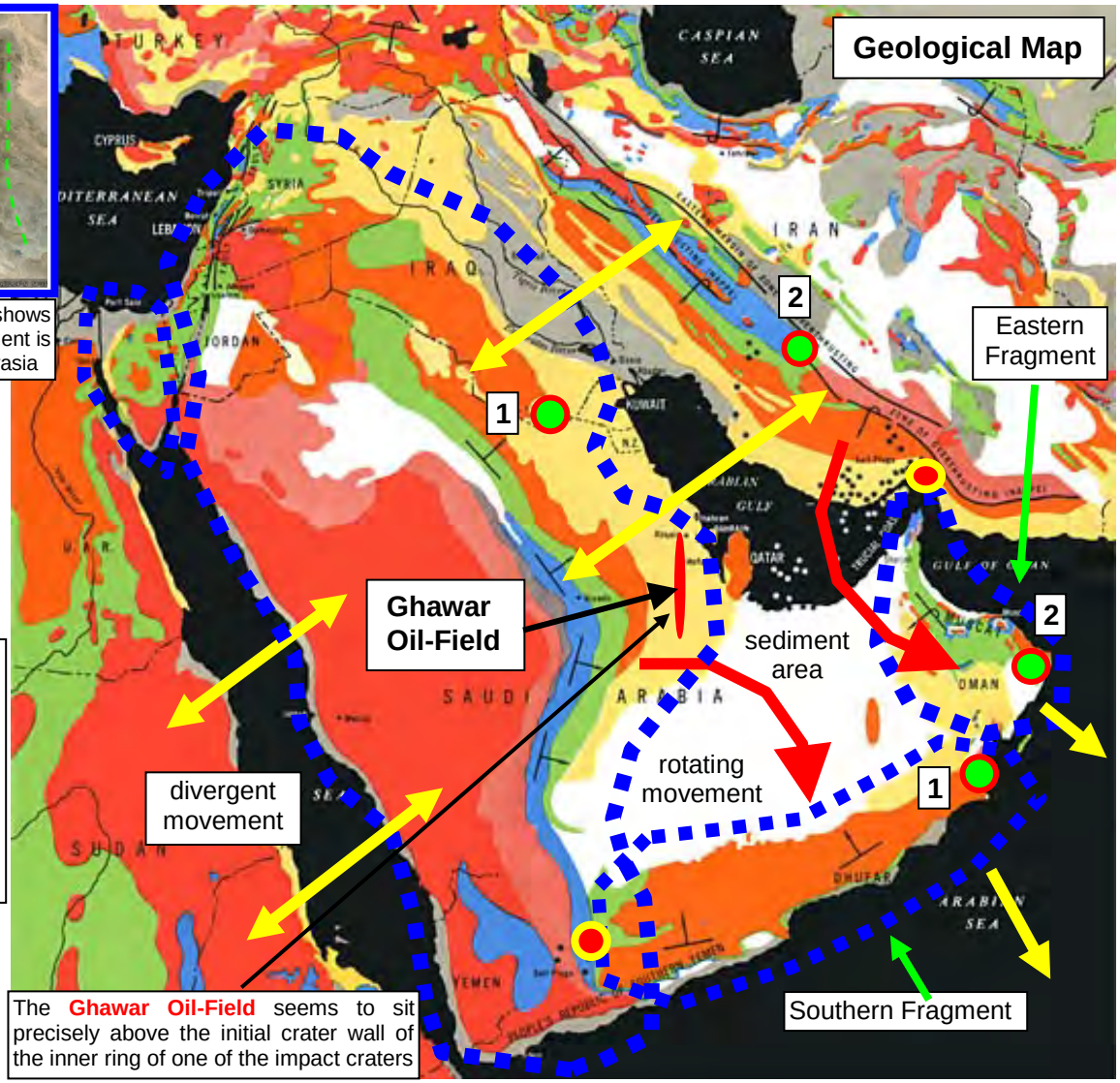
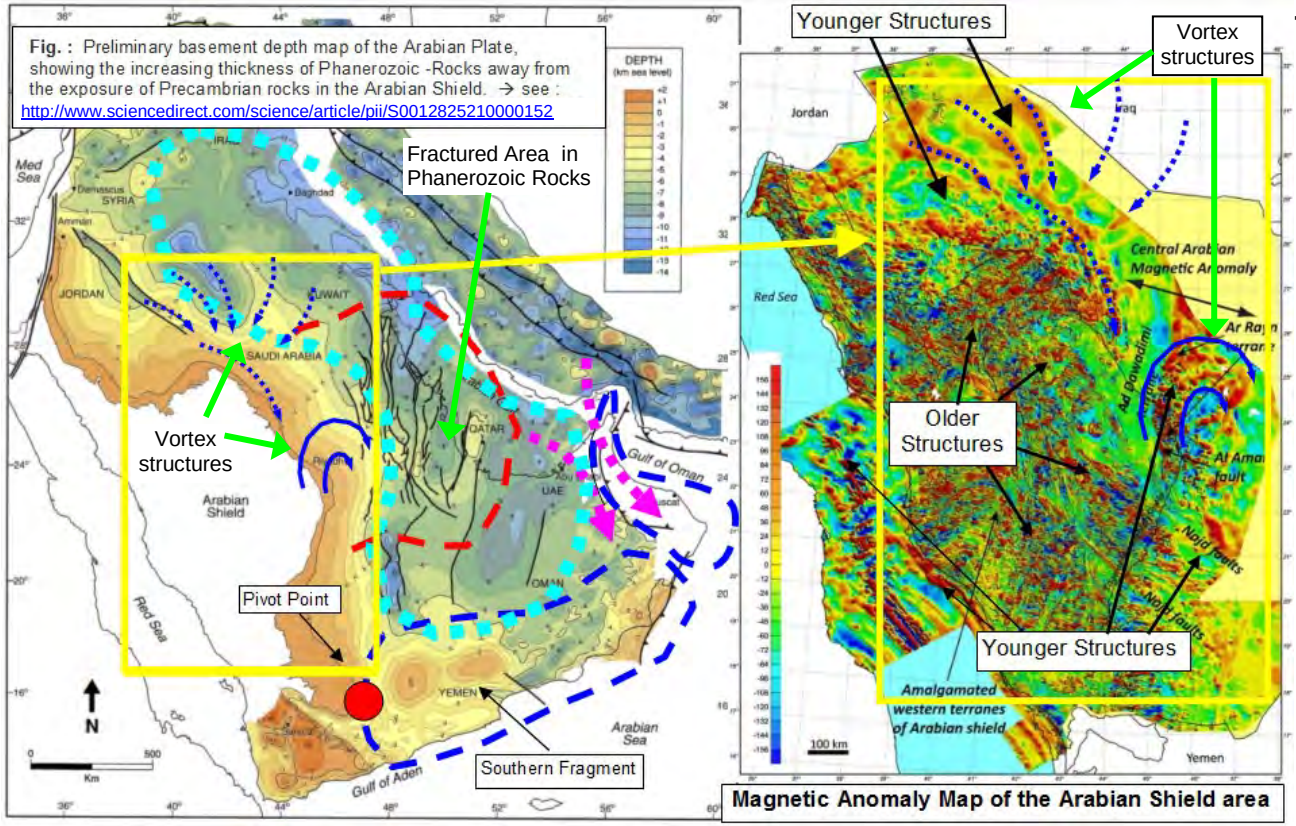


The **Ghawar Oil-Field** seems to sit precisely above the initial crater wall of the inner ring of one of the impact craters

Pivot Point of crust fragment

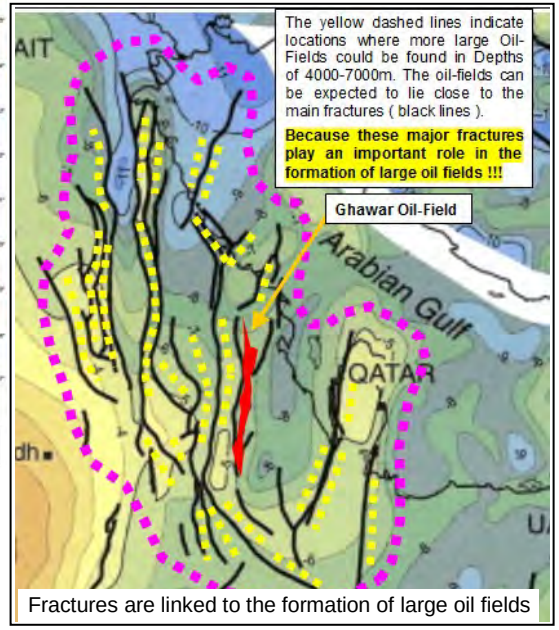
Original connection point of crust fragment

The Arabian Plate is a composition of at least three crustal fragments (blue marked areas) which moved to their present positions through the magmatic (lithospheric) streams which probably were caused by the divergent motion between Africa and Eurasia after the PTI. The area between the fragments first formed an inland-sea and later filled-up with sediments



To the motion of the crust fragments that formed Arabia

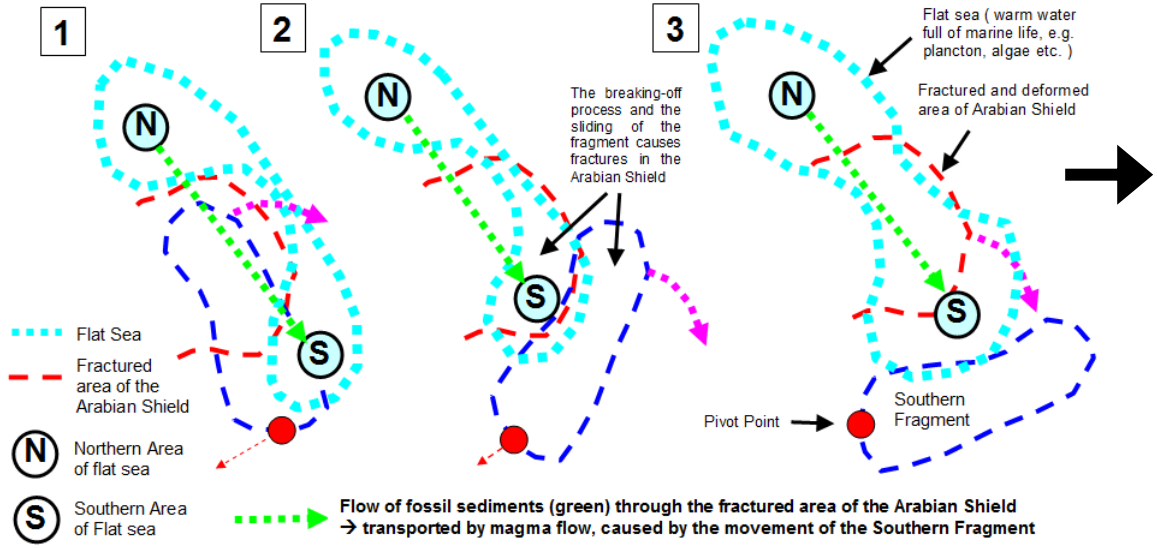
On the Magnetic Anomaly Map of the Arabian Shield there are different shaped structures noticeable. Here the fine structures represent older geological structures of the Arabian Shield, and the "younger – rough structures" probably indicate the final movement of younger magma streams before they solidified (probably < 150 Ma years ago). There are stream-like structures visible. Even "vortex-like structures" are noticeable (full blue arrows) ! The marked young stream-like structures (blue dashed arrows) indicate that there was a general movement towards a SE-direction of the magma streams. An analysis of a detailed magnetic anomaly map east & north of yellow marked area should confirm this this !



Fractures are linked to the formation of large oil fields

On the east side of the Arabian Shield there are extensive cracks visible, which probably were caused by the divergent movement of the crust fragments. The large **Ghawar Oil-Field** is orientated parallel to this cracks and formed in the initial center of a crater

Chronology of the movement of the Southern Fragment and the development of the Inland Sea → and their effect on the fractured and deformed area on the Arabian Shield



Stage 1 : The situation some time after the PT-Impact has caused compression & secondary impacts between Eurasia and Africa. In this stage Africa and the Arabian Shield were already moving away from Eurasia. In Stage 1 the Southern Fragment (blue) starts to rotate around the pivot point (red), caused by the impact impulse & magma streams acting on the Southern Fragment. An Inland sea starts to form

Stage 2 : shows the stage of maximum rotary velocity of the Southern Fragment → This is also the time of the maximum flow of magma and max. production of fossil sediments which accumulated in cracks of the fractured area of the Arabian Shield. Bio-mass was mainly produced close to the initial crater centers → This process created the big oil fields

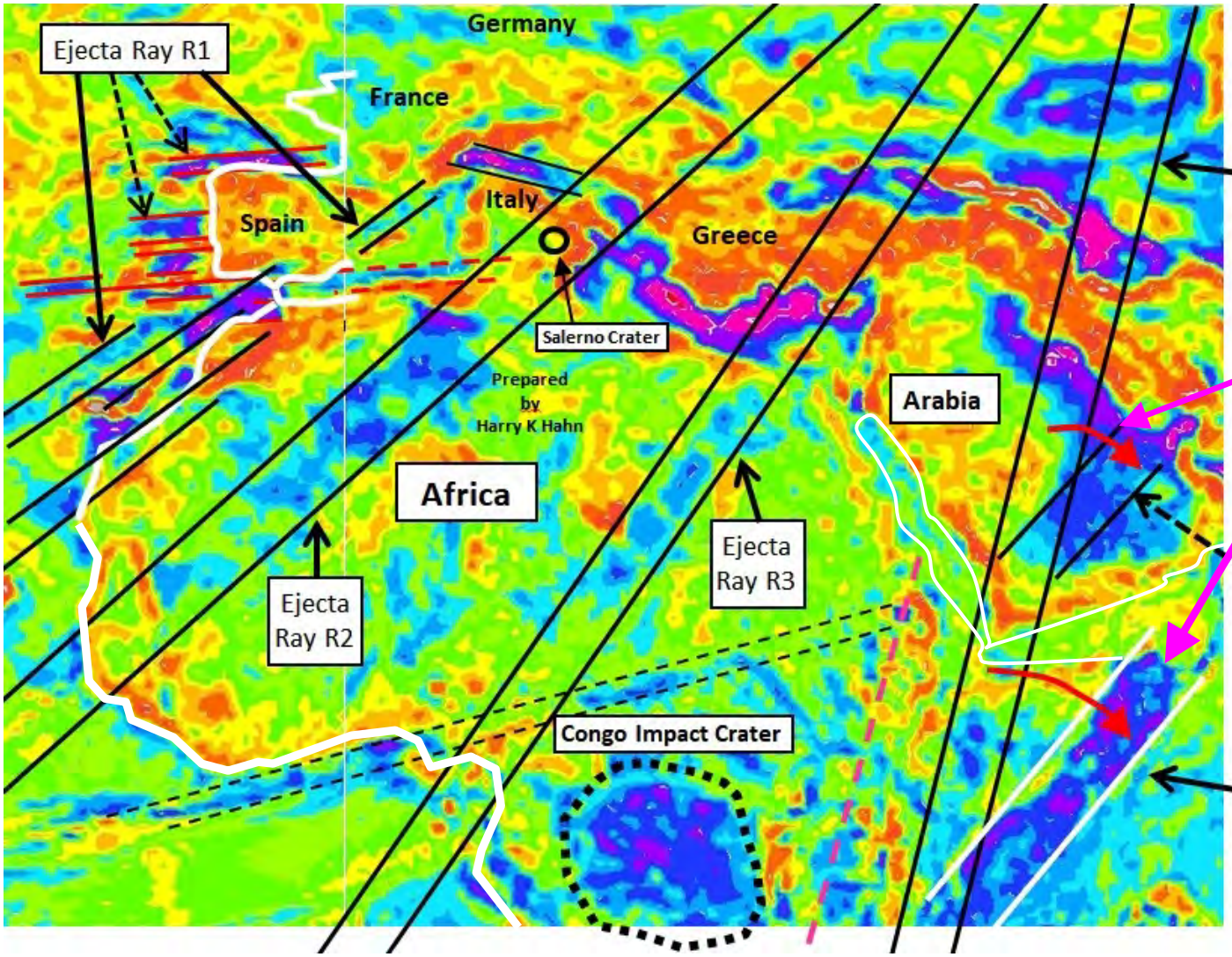
Stage 3 : End state → Southern Fragment in final position → Magma streams stop → Inland Sea, maximum extent → Sedimentation starts

The Ejecta-Ray tracks R2 to R4 and the Congo Crater are highly potential Onshore-exploration areas for Oil and Gas

→ The powerful Ejecta Rays of the PT- Impact shown on another Gravity Anomaly Map which also covers the ocean floor areas

This gravity anomaly map clearly indicates the very powerful **Ejecta Ray 4** which formed the east coast of Africa. The "Horn of Africa" represents an area that moved away from the original track of Ejecta Ray 4 as the black- and white lines and the red arrow on the map indicate. This probably was caused by the divergent motion between Africa and Eurasia after the PT-Impact Event. The deep blue linear section of **R4** (negative anomaly), which now represents the coast-area of Somalia should have a high potential for Oil- and Gas-Fields, comparable with oil- and gasfields found in the Persian Gulf !

Gravity Anomaly Map of Europe & Africa showing the tracks of the PT – Ejecta Rays R1 to R4



Ejecta-Ray R4

Somalia's Coastline probably represents a highly potential exploration area for Oil- and Gas-fields ! Similar to Arabia & the Persian Gulf area

Similar to the **Persian Gulf** region !

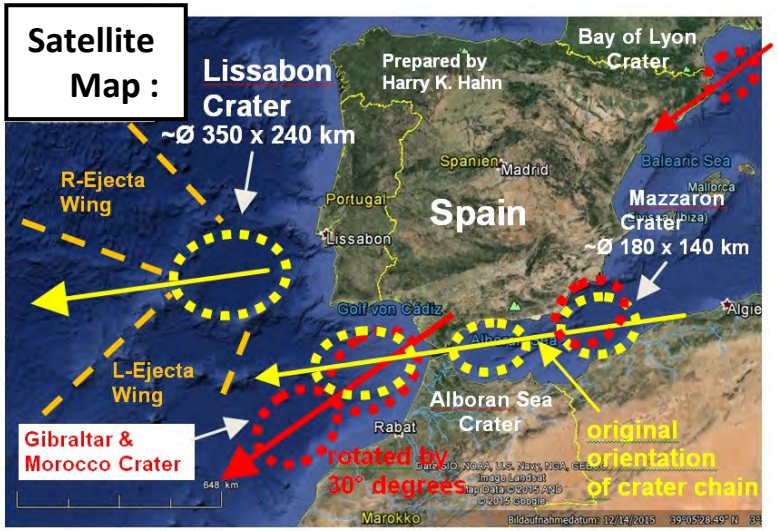
Tectonic Shift of Ejecta Ray R4 track here in this area, eastward, after PT-Event !

The area of Ejecta-Ray 1 contains potential exploration areas formed by large secondary craters of the PT-Event

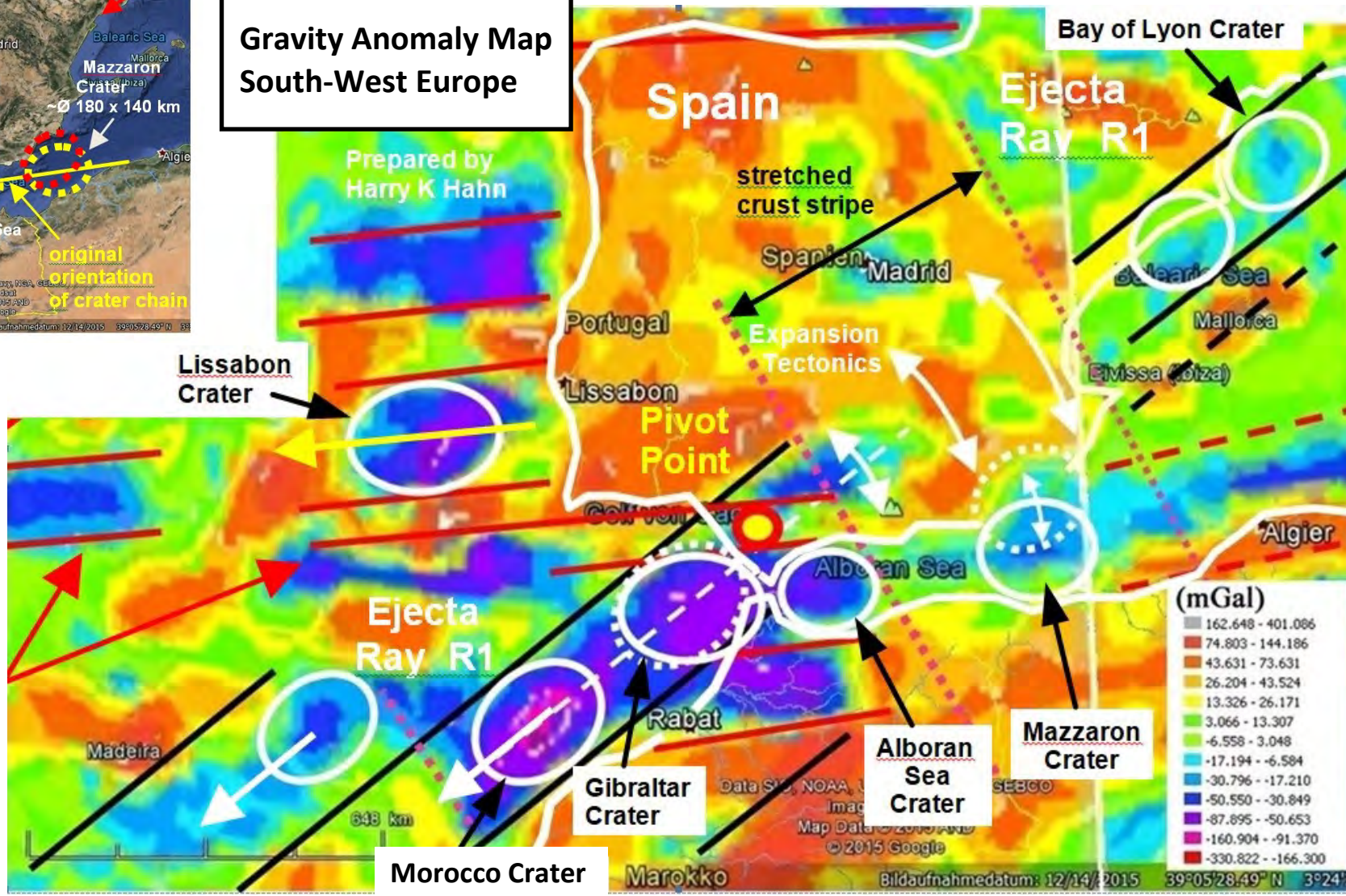
Potential "Offshore deep-water exploration areas" are located within the original track of **Ejecta Ray R1** indicated by negative gravity anomaly areas (→blue & pink). This should be exploration areas with high potential for large Oil- and Gas-fields. Especially the assumed Lissabon-, Gibraltar-, Morocco- and Alboran-Sea Craters should be mentioned here.

But because the expected oil- and gas-fields are probably located deep under the ocean floor, it may be a good idea to start with exploration in smaller craters first, for example in the Bay of Lyon Crater area.

Satellite Map :



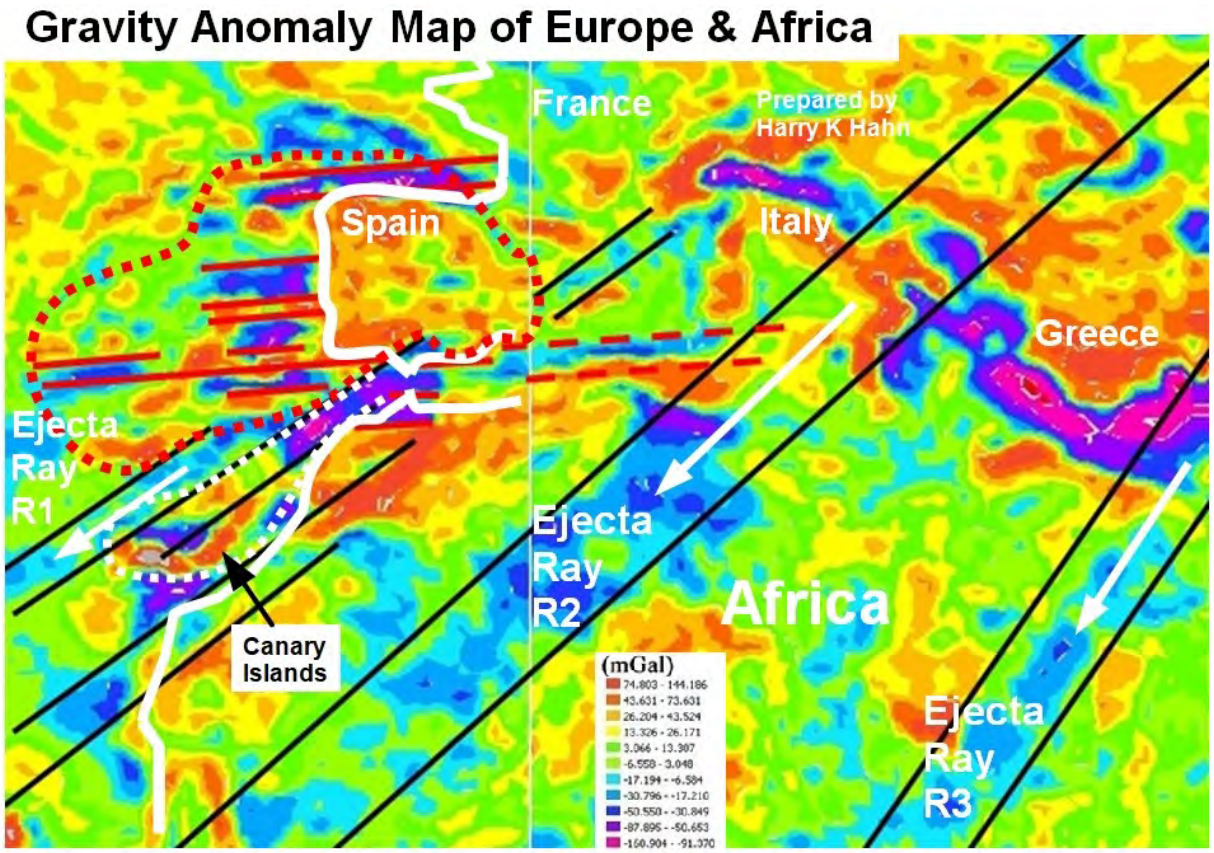
Gravity Anomaly Map South-West Europe



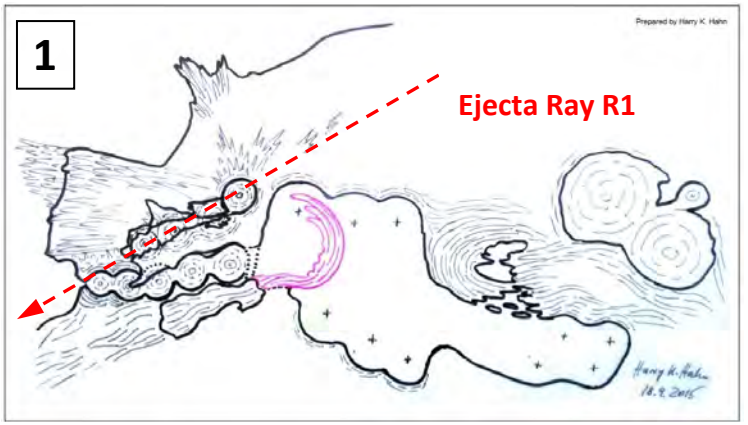
The ocean-floor area of the Mediterranean Sea formed by PT- Ejecta-Rays also contains potential exploration areas

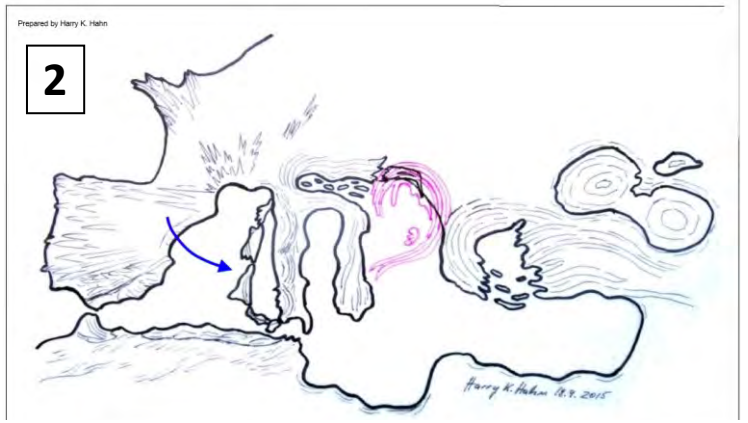
Potential "Offshore exploration areas" should still be located in the whole Mediterranean Sea area, which originally was formed by Ejecta of the PT- Impact Event that impacted here and formed the ocean basins of the Mediterranean Sea.

All negative gravity anomaly areas (→ blue & pink) in the Mediterranean Sea should be potential exploration areas for Oil- and Gas-fields.



Tectonic evolution of Europe after the impact of the P/T-Ejecta Ray R1



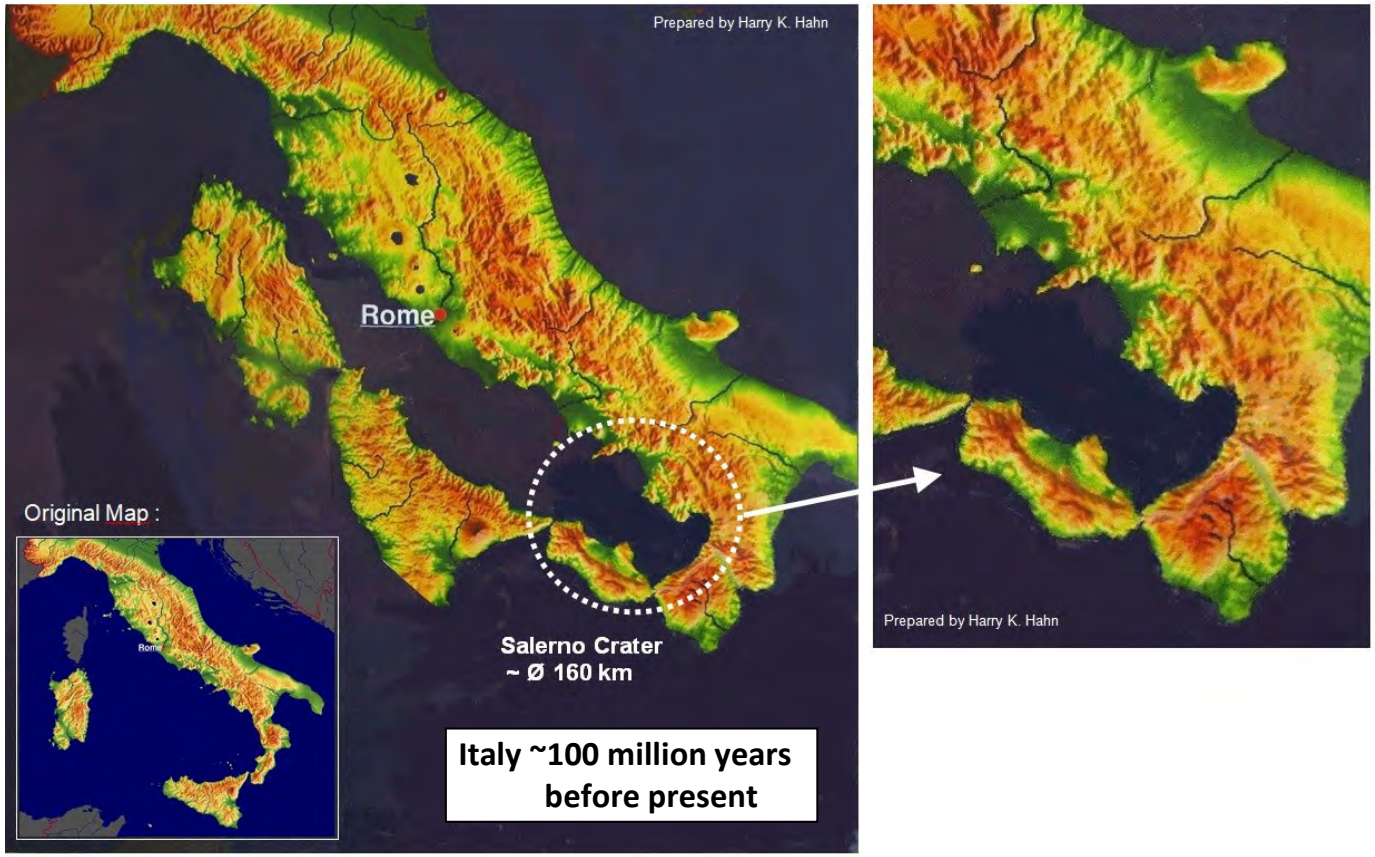


The drawings No. 1 to 3 on the right show were ejecta material (thrown out of the P/T Impact Crater) impacted in Europe ~253 million years ago. This ejecta material (impactors with Ø10 - 20 km) formed chains of secondary craters with Ø150 - 200 km. These craters formed the original ocean basins of the Mediterranean Sea.

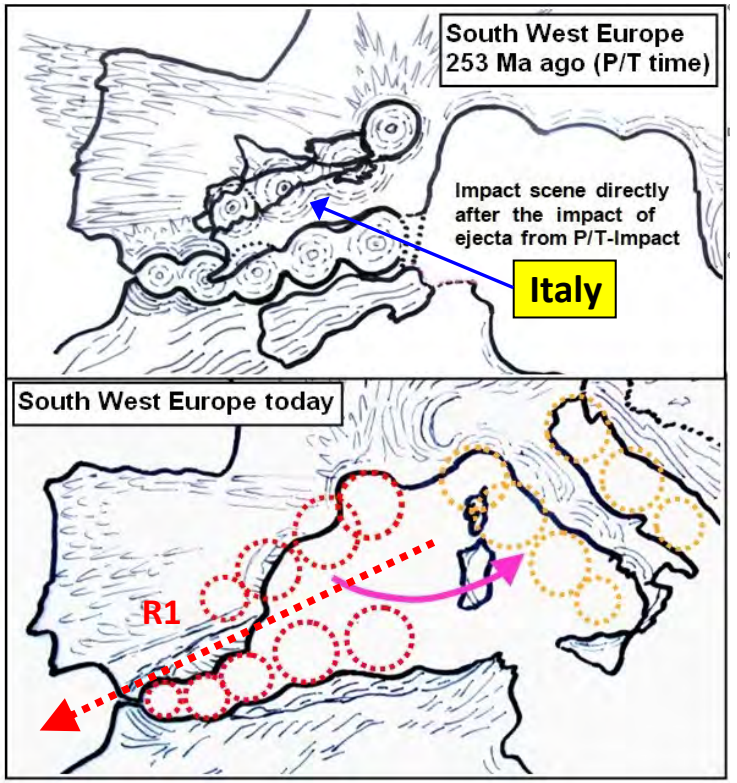
The cost-line of Italy, formed by the PT-Event, may still contains highly potential exploration areas for Oil- and Gasfields

This topographic map shows how Italy looked around 100 million years ago. Some parts of Italy were re-arranged in their position to show Italys original outline.

→ The Ø 160 km impact crater near Salerno becomes clearly visible on the Topographic Map !



There is strong indication that the topography of Italy was formed by Secondary Impact Craters (crater chains) caused by the PT-Impact Event !



These drawings show the probable position of Italy directly after the PT- impact Event and 253 Ma later (today). The original impact positions of large secondary craters, cause by the PTI, and the trajectory of Ejecta Ray R1 are marked in red on the map. The orange circles represent crater-floor areas which may still be attached tot he Italian mainland.
The motion of Italy probably was caused by the divergent motion of Africa & Europe after PTI

Europe's largest Onshore-Oil-Fields are located within the Ø 160 km Salerno Crater in Italy

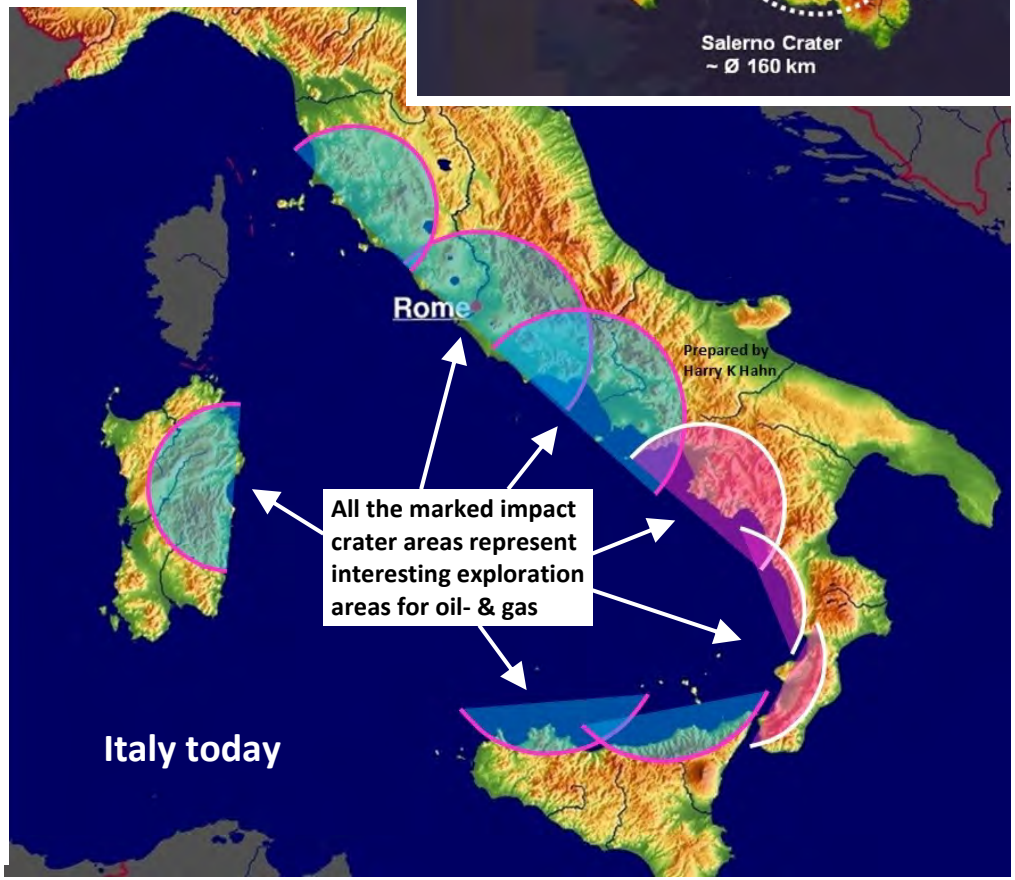
The largest "onshore" oil-fields of Europe are located within the Ø 160 km Salerno Crater (Italy). And there are more fields !

The Val D'Agri fields Tempa Rossa, Monte Alpi, Monte Enoc, Cerro Falcone, and Costa Molina (Fig. 4) rank as some of the largest in Europe. The total proved recoverable reserves for the four fields are estimated at 1.02 billion BOE.3

For comparison : The map on the right shows the original location of the Salerno Crater (white) and of further 3 Ejecta Craters (pink) which originally have formed an extensive Secondary Crater Chain.

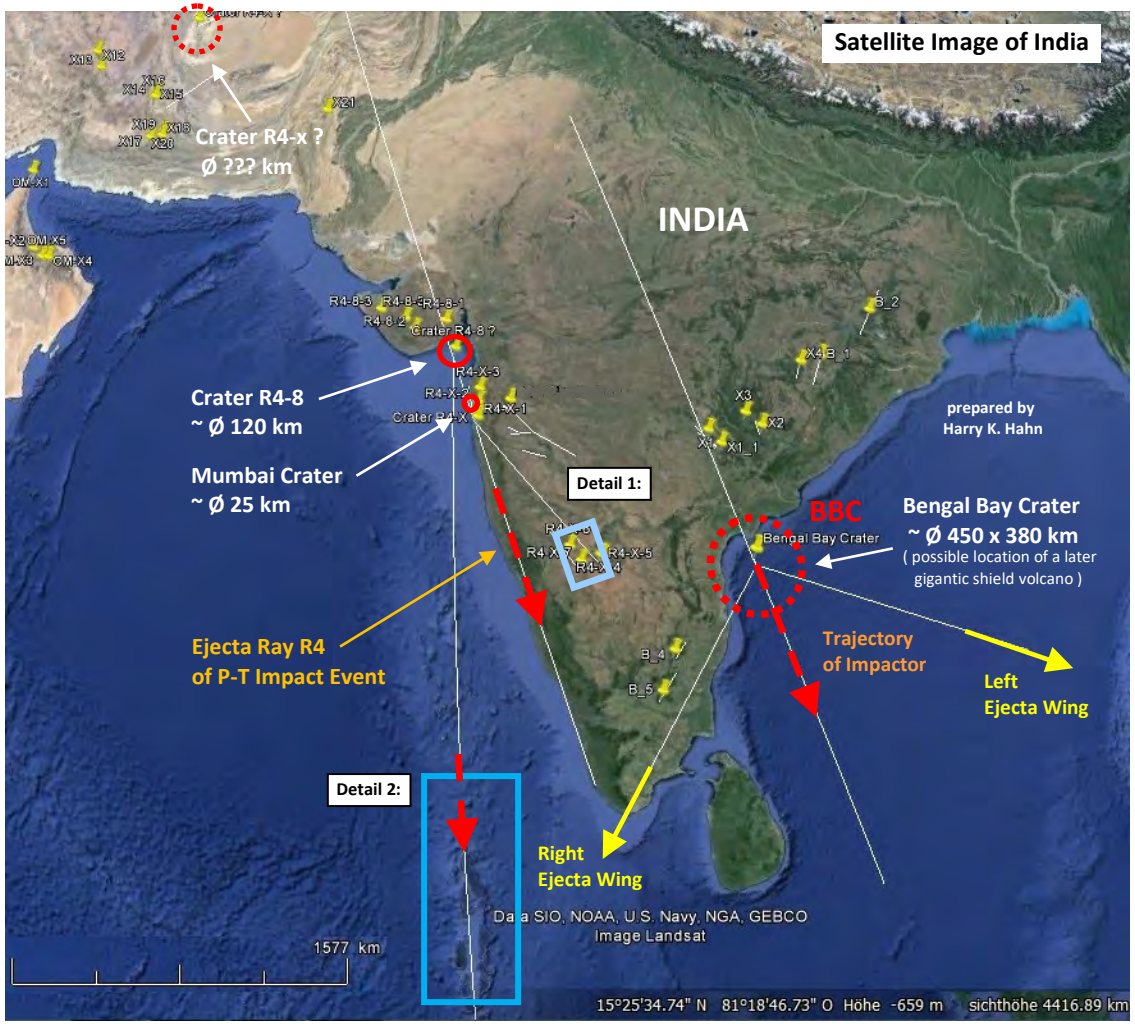
Topographic map of Italy :

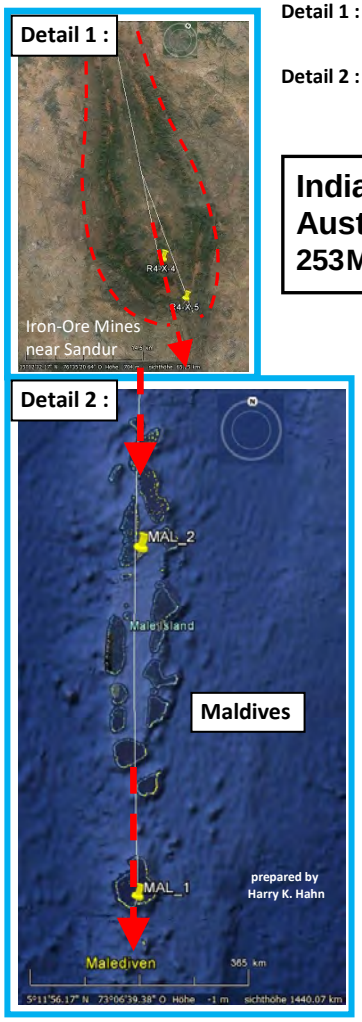
The white circle sections represent the Salerno Crater-area today. The Ø 160 km Salerno Crater is clearly visible on the topographic map.



A large >350 km crater in India's Bengal Bay and Craters on India's west-coast, related to the PTI, brought mineral resources to India

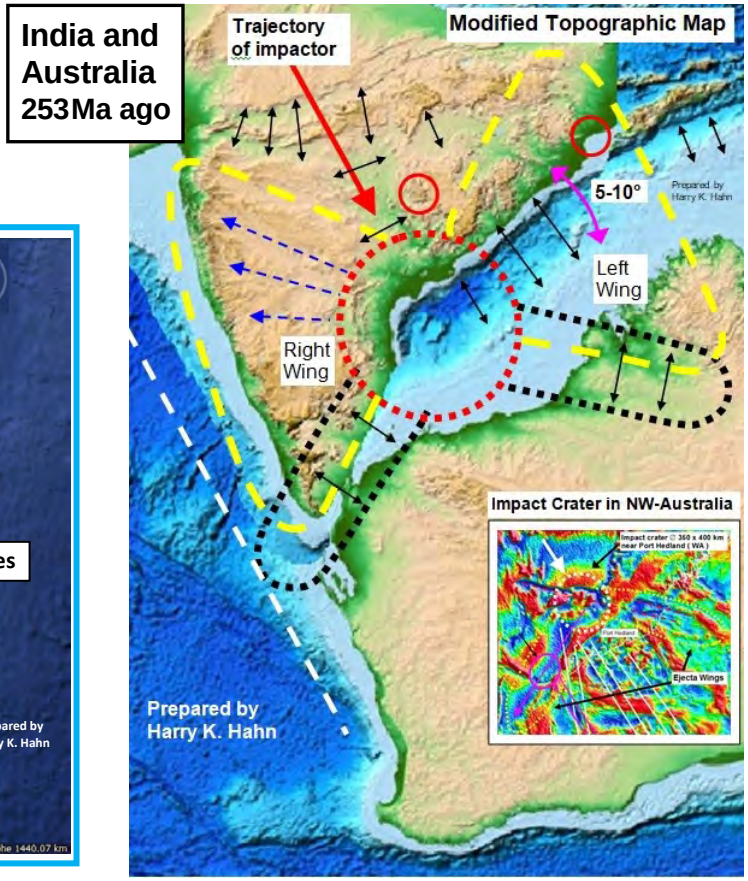
There is a large elliptical crater located at the center of India's east coast in the Bengal Bay. The assumed trajectory of the ≈Ø 20 to 40 km impactor which produced this large Crater indicates that this crater may be a large secondary crater of the PT-Impact Event 253 Ma ago. If we consider a rotation of India of 5-10° after the impact, and an arrangement of India to Australia, before the impact, as shown below, then this impact in India maybe the same impact as the one in NW-Australia ! This would mean that India & Australia were slightly different positioned to each other 235 Ma ago, as generally believed ! (→ see image below on the right !)
The western border of the Indian Plate was formed by Ejecta Ray R4 of the PT-Impact Event. Secondary Impact Structures along this western border of the Indian Plate indicate the location of two craters which lie on the track of Ejecta Ray R4. The first crater (R4-8) with Ø ~120 km is located on the northern end of the linear western border of the Indian Plate. And the second crater with Ø ~25 km ("Mumbai Crater") is located around 240 km south of crater R4-8 , directly on the west-coast of India near Mumbai. There is strong indication that the Iron-Ore Deposits around Sandur are ejecta material which is originating in the Mumbai Impact Crater. This is indicated by the orientation and the drop-shape of this Iron-Ore Deposits (Range). → see detailed images of this and other secondary impact structures on the following pages of this document. The Maldives Maldives, a linear island-chain was formed by either ejecta from Crater R4-8 or by Ejecta Ray R4 itself.
The Deccan Traps probably were caused by a much later violent magma eruption coming from the crack area caused by the BBC. Maybe these flood basalts came from a gigantic shield volcano which formed on top of the BBC and which collapsed because of earthquakes (>12 RS) triggered by the Chicxulub Impact , 65 Ma ago



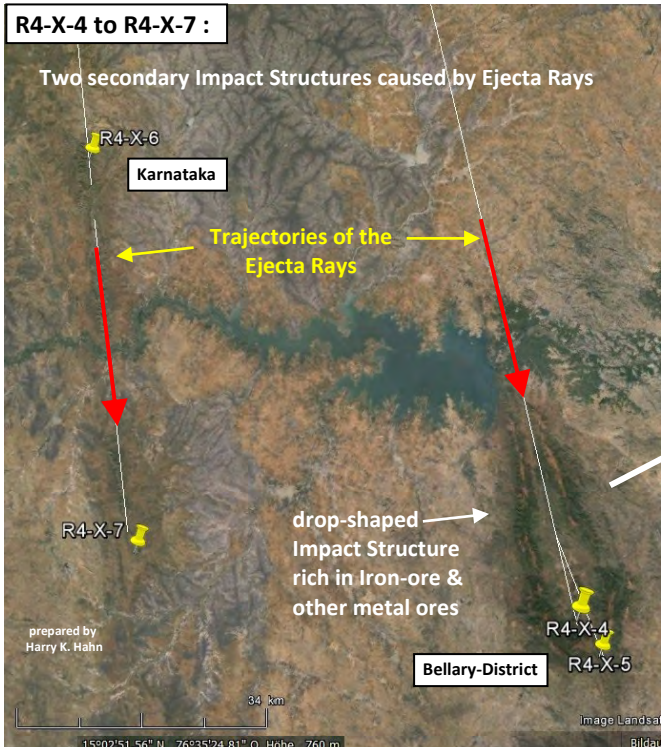


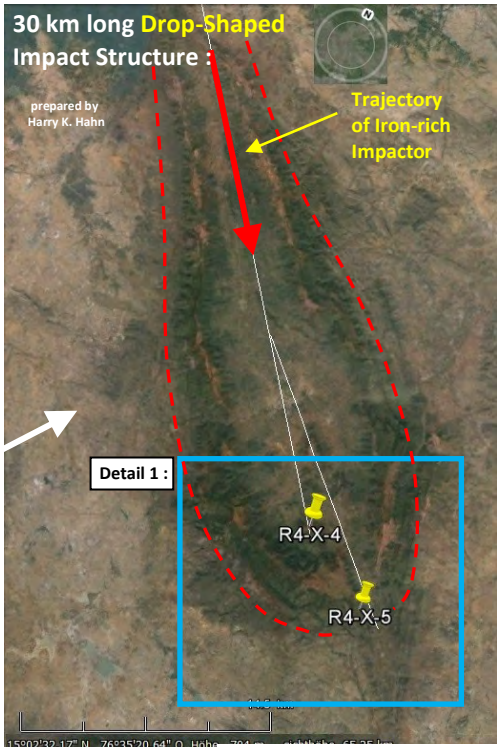
Detail 1 : The Iron-Ore Deposits around Sandur in the Ballari District are ejecta material which is originating in the Mumbai Impact Crater

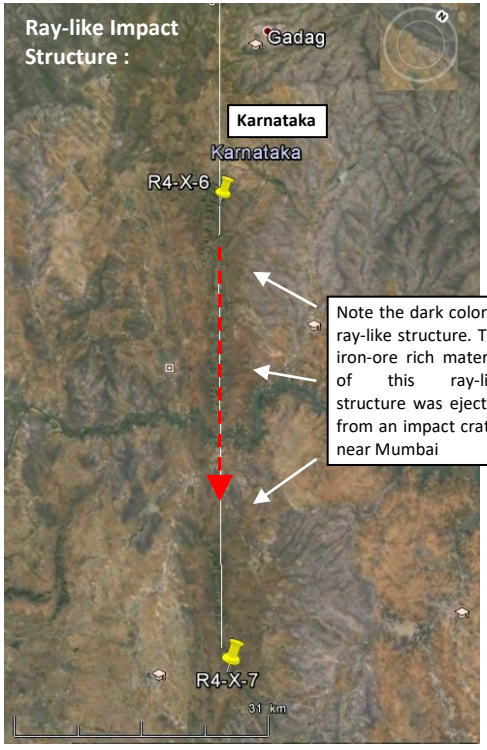
Detail 2 : The Maldives are the result of a strong ejecta ray from Crater R4-8 or a result of Ejecta Ray R4 itself. This ejecta material may also be rich in Iron-ore & other Metal-Ore. (magnetic anomalies on Maldives)



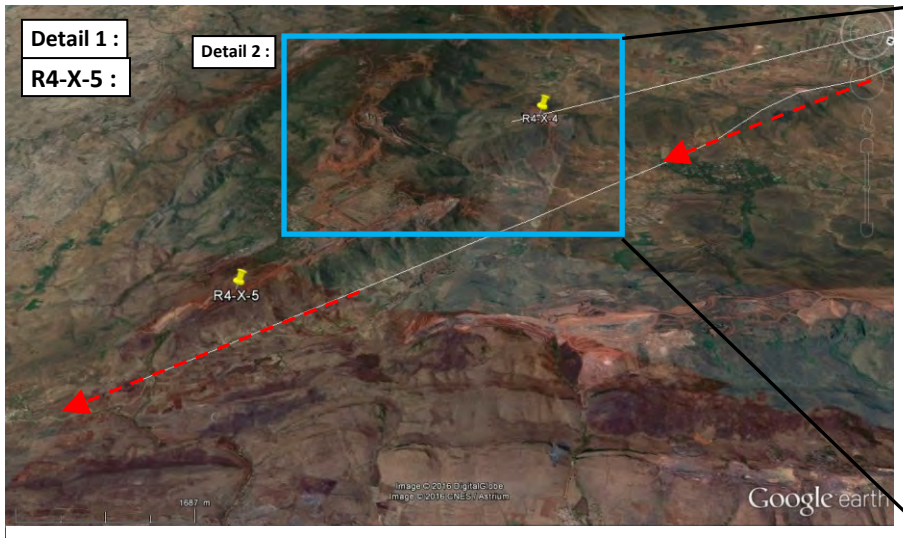
India's Iron-Ore-Reserves are the result of Secondary Impacts caused by ejecta from the Mumbai Crater and BBC & PT- Impact Crater in general







There is clear indication that the Iron-Ore Deposits near Sandur in the Ballari District are ejecta material which is originating in the Mumbai Impact



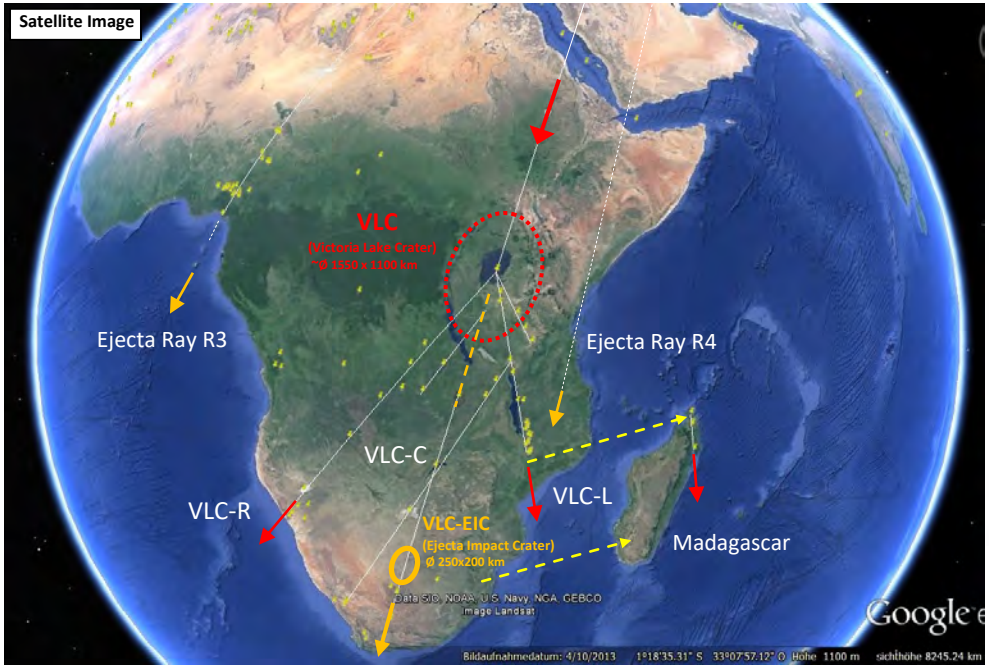
The drop-shape of the mountain range around Sandur (→ iron-ore deposits) its exact orientation and the visible ejecta ray near Gadag lead to the bay near Mumbai

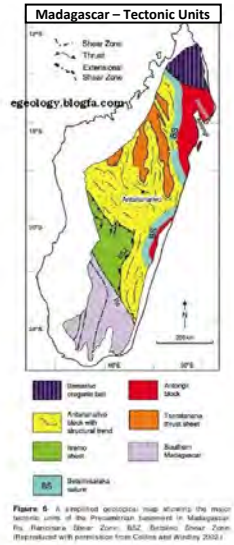
This leads to the logical conclusion that the bay of Mumbai must be caused by an Impact Crater, which was formed by an iron-rich impactor probably originating from the PT-Impact Event.
(this can be concluded from the probable trajectory of the Impactor which caused the Mumbai Impact Crater)

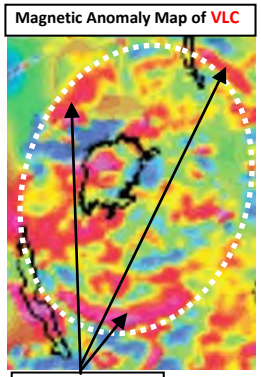
Ballari District is rich in mineral resources. It contains 25% of India's Iron ore reserves. It has both metallic and non-metallic minerals. The metallic minerals include iron ore, manganese ore, redoxide, gold, copper and lead. The non-metallic minerals include andalusite, asbestos, corundum, clay, dolomite, limestone, limekankan, moulding sand, quartz, soap stone, granite and red ochre.

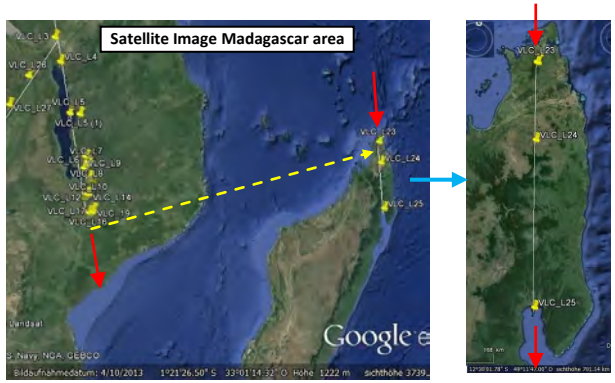
A powerful secondary impactor from the PT-Impact caused the Victoria-Lake Impact and brought rich resources to South-Africa

The separation of Madagascar from the African Plate was initiated by secondary impact events which were caused by the Permian-Triassic (PT) Impact ~253 Ma ago. Especially the secondary impact which caused the **"Victoria Lake Crater" (VLC)** contributed to this separation of Madagascar from Africa. This powerful Impact Event, which was an oblique impact, and which occurred in the Victoria Lake area, produced two strong "ejecta wings" or ejecta rays (VLC-R & VLC-L) and a "Central Ejecta Ray" (VLC-C) which caused the Iron-Ore Deposits in South-Africa (→EIC). From the location and shape of the secondary impact structures caused by the Victoria Lake Impact (→ yellow pins on satellite map → see following pages !), the orientation of the two ejecta wings and the trajectory of the main impactor can be reconstructed. This provides strong evidence that the VLC was caused by the PT-Impact. (→ similar to the Bengal Bay Crater). In all probability the impact impulse of ejecta ray VLC-L (L=left), which runs from the VLC over Malawi Lake (→ a result of the impact of VLC-L) towards the original position of Madagascar, caused fractures (→ on the western border of the Madagascar-Fragment) which are responsible for the break-off of Madagascar from the African Plate. This happened at the same time when Ejecta Ray R4 caused a major fracture between Africa and Australia/India (→ see modified map below) Gravity Anomaly- & Topographic- structures provide further evidence for this scenario. And Gravity Anomaly- & Magnetic-Anomaly Structures also confirm the VLC-Impact Scenario.



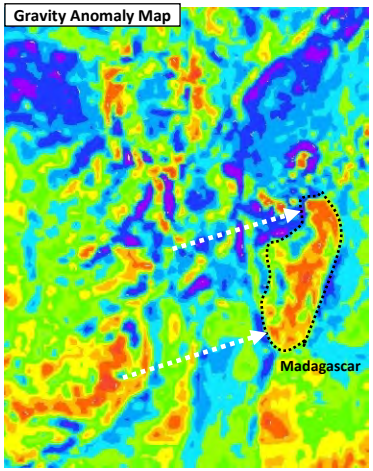




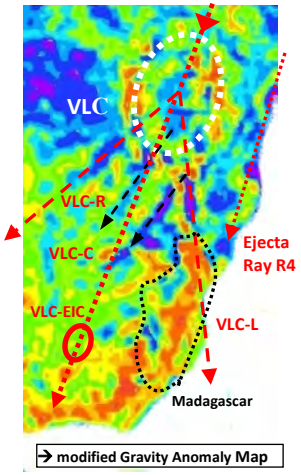


The modified Topograhic Map on the righthand side shows how Africa, India and Australia were positioned to each other, and how this land area of Pangea broke apart, caused by the powerful Ejecta Rays and Secondary Impactors from the PT-Impact Event.

Madagascar – Position Today

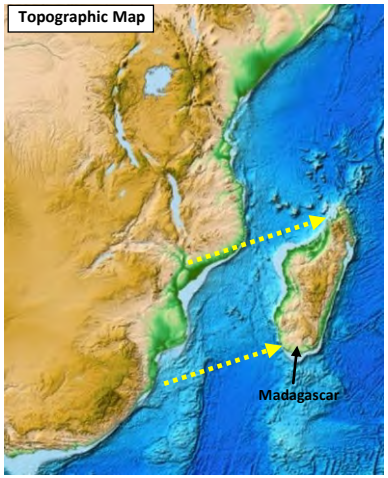


Madagascar – Original Position

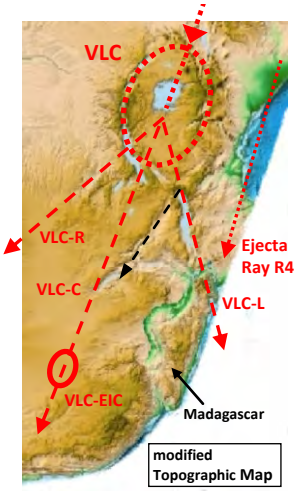


→ modified Gravity Anomaly Map

Madagascar – Position Today



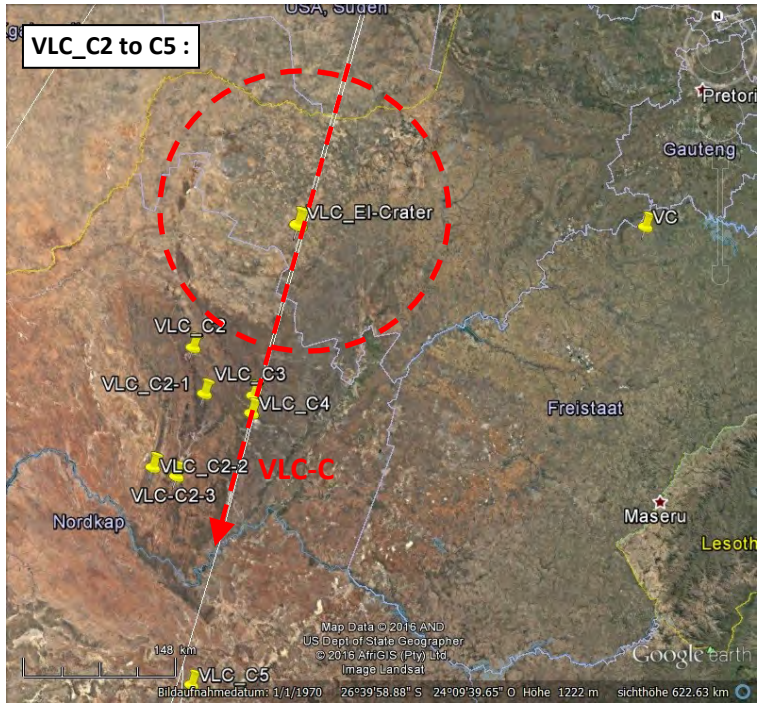
Madagascar – Original Position

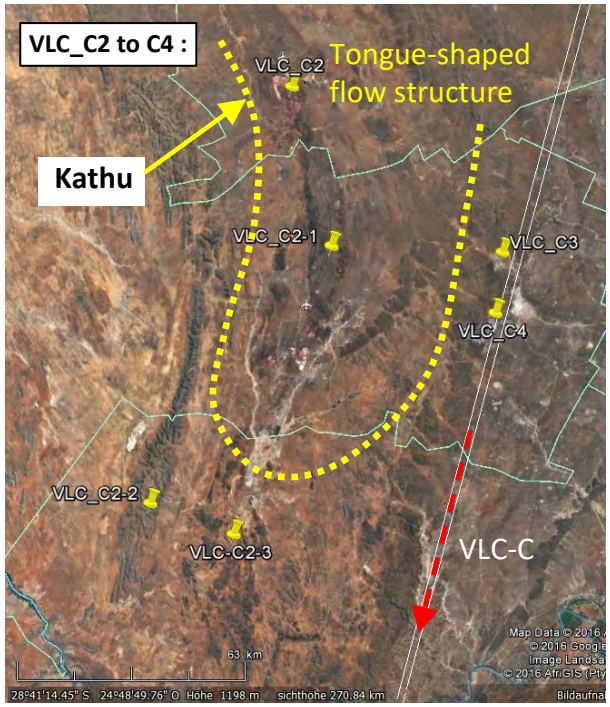


modified Topographic Map

Magnetic Anomaly Map of the VLC-Ejecta Impact Crater (→ Iron-Ore Deposits) ~ Ø 250 x 200 km

The Ejecta Impact Crater (EIC) Ø~ 250x200 km, located on the VLC-C (Central) Ejecta Ray of the VLC caused Iron-Ore Deposits in South Africa





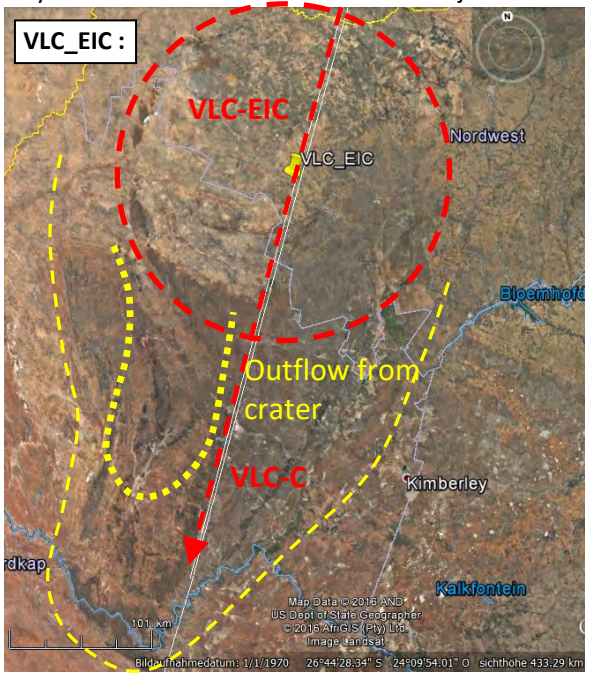
Satellite Image - Ejecta Impact Crater (EIC) Ø 250x200km

→ red arrow indicates the trajectory of the impactor
yellow lines indicate flow direction of Ejecta

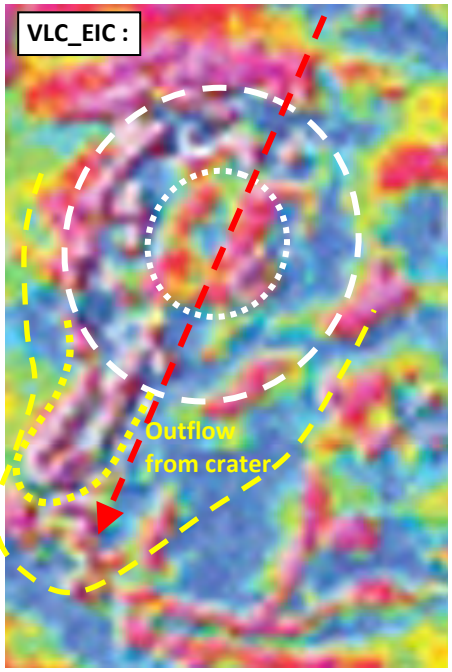
VLC-C2 : Kathu : → Iron-Ore Mines :

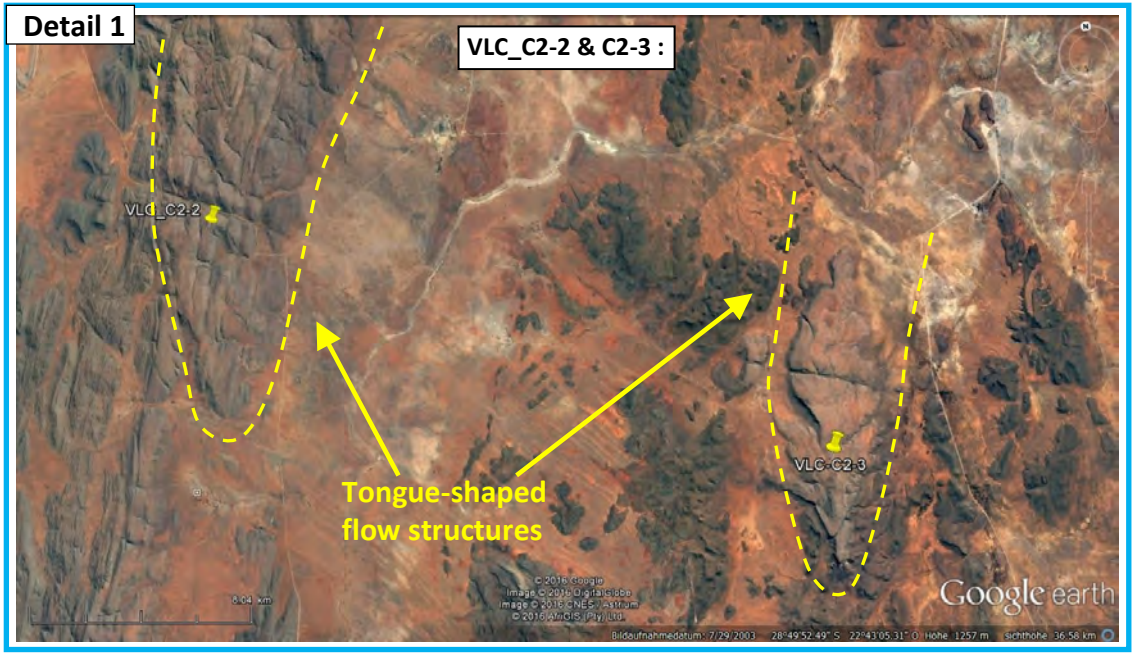
e.g. Sishen Mine 30km from Kathu is one of the largest Iron-Ore Mines in the world. Lump ore is extracted from a large Hematite ore body hosted by a Lake Superior-type banded iron formation (BIF) called Kuruman Formation (see also → manganese field). The lump to fine ratio of the Sishen ore is 60:40. The ore body measures approximately 14km long, 3.2km wide and 400m deep.

VLC-C2-1 : Postmasburg : → Iron-Ore (Hematite), Manganese Ore, Diamonds, Asbestos

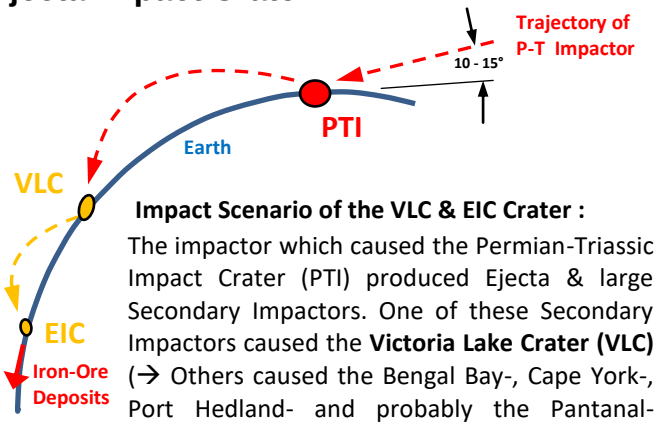


Magnetic Anomaly Map of EIC





Impact Scenario of Victoria Lake Crater & Ejecta Impact Crater :

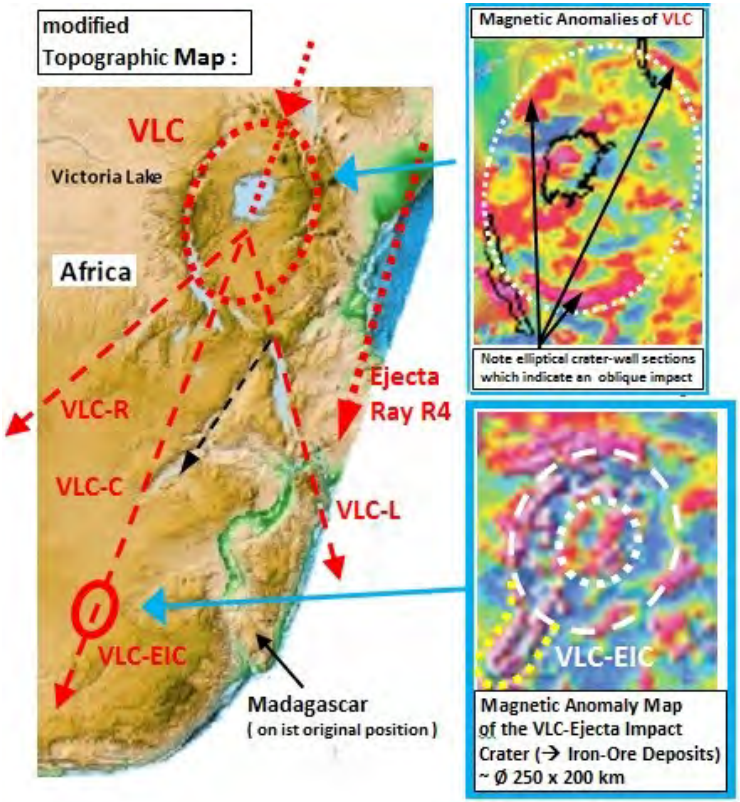


Impact Scenario of the VLC & EIC Crater :

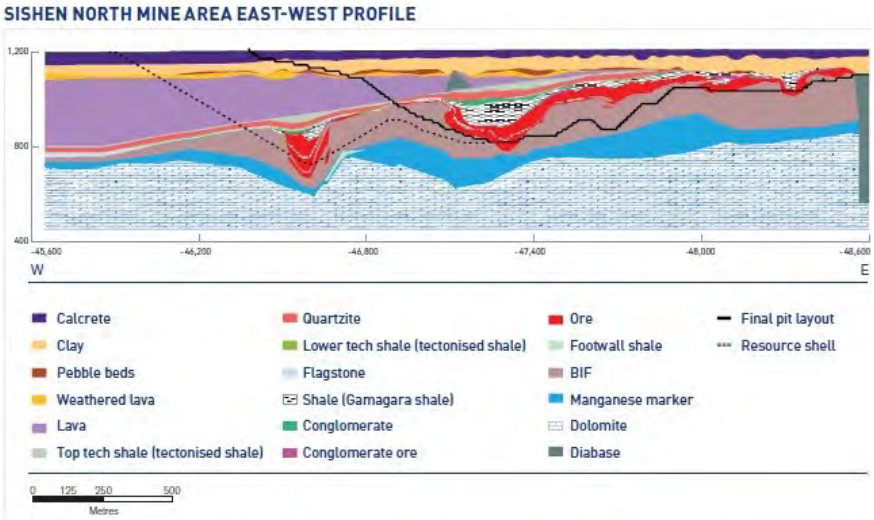
The impactor which caused the Permian-Triassic Impact Crater (PTI) produced Ejecta & large Secondary Impactors. One of these Secondary Impactors caused the **Victoria Lake Crater (VLC)** (→ Others caused the Bengal Bay-, Cape York-, Port Hedland- and probably the Pantanal- & Southern Ocean Craters)

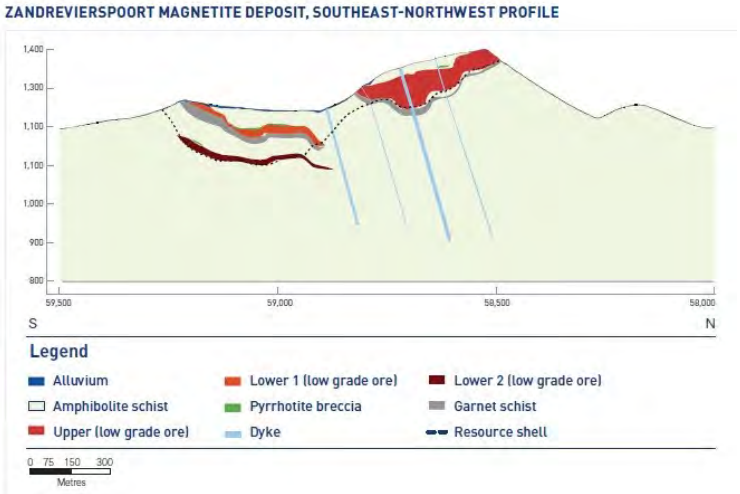
Then part of the VLC impactor was ejected from VLC and caused the Ø 250x200 km **Ejecta Impact Crater (EIC)** plus outflow from this crater, which caused the Iron-Ore Deposits in South-Africa

Detail view of the Victoria Lake Impact Event :



Geological Information to some Iron-Ore Deposits in South-Africa :





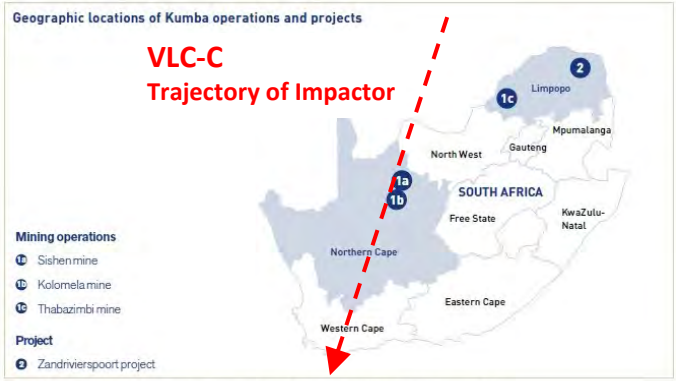


Figure 1: Geographic locations of Kumba operations and projects for which Ore Reserves and Mineral Resources have been declared.

At the Sishen mine deposit, the upper parts of the Asbestos Hills Subgroup have been ferruginised to ore grade. These stratiform, laminated and massive ores constitute the bulk of the resource. The laminated and massive ores are commonly folded and faulted into basinal and pseudo-graben structures.

Deep palaeo-sinkholes, filled with brecciated ore and Gamagara sedimentary rocks, are found on the southern parts of the Sishen properties. The sinkholes are restricted to antiformal structures close to the Maremane Dome on the southern portions of the mine. They are an important mechanism for preserving collapse breccia ore.

They are unconformably overlain by a thick package of sedimentary rocks (conglomerates, shales, flagstone and quartzite) termed the Gamagara Subgroup (S.A.C.S., 1995). Many researchers including Beukes and Smit (1987) and Moore (pers. comm.) have correlated this unit with the Mapedi Formation, which constitutes the lowermost unit of the Olifantshoek Supergroup. The Olifantshoek Supergroup is the oldest recognised red-bed sequence in the region. It is some 400 Ma younger than the Transvaal Supergroup.

Conglomerates of ore-grade with well-rounded clasts and fine-grained, well-sorted, gritty ores are common at Sishen mine. Partly ferruginised shales, interbedded with ore conglomerates and thick flagstones are also a feature of the Gamagara Subgroup.

Along the western margin of Sishen mine, diamictite of the Makganyene Formation and lavas of the Ongeluk Formation have been thrust over the sedimentary rocks of the Gamagara Subgroup. The diamictite and lava have been eroded by later events. Tillite of the Dwyka Group and pebble beds, clay and calcrete of the Kalahari Group, have been deposited on these erosional unconformities.

A few thin, diabase dykes with north-south and northeast-southwest orientations, have intruded the stratigraphic sequence. They form impervious barriers and compartmentalise the groundwater.

Haematite ore bodies:

- **Operation:** Kolomela mine (252.9Mt @ 64.3% Fe), year-on-year increase of 59%
- **Operation:** Sishen mine (563.8Mt @ 59.5% Fe), year-on-year increase of 4%
- **Operation:** Thabazimbi mine (17.1Mt @ 62.1% Fe), year-on-year increase of 5%

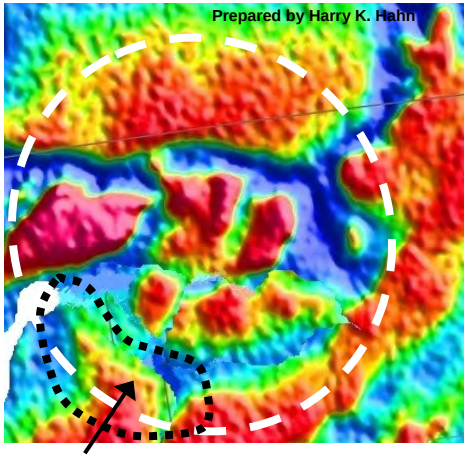
Magnetite ore bodies:

- **Project:** Zandrivierspoort (476.1Mt @ 34.5% Fe and 40.8% Magnetite)

A large Impact Crater with ∅400 x 350 km in the NW of Western Australia brought valuable resources to West Australia

The gravity anomaly map of West-Australia shows evidence for another large impact crater near **Port Hedland** which has an elliptical shape. The impactor probably had a diameter of approx. 20 to 50 km, and it probably was a fragment of the main PT-impactor, rich in Platinum-Group elements and rare-earth elements.
On the gravity anomaly map there are thin ejecta rays visible (red), which are related to mining sites of these elements.
This impact crater may be identical to the Bengal Bay Crater (BBC) in India and it may represent the SE-section of the BBC !

Elliptical Impact Crater ∅400x350 km



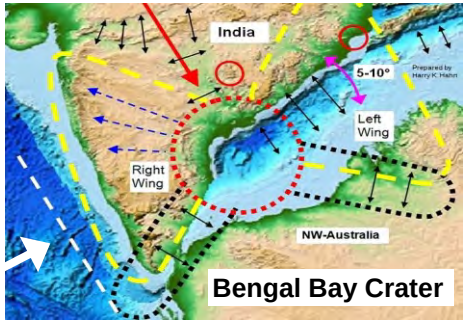
Note the precise crater-wall shape on the marked fragment !!

Because it was an oblique impact it produced a butterfly ejecta blanket. I have marked the two wings of the ejecta blanket with yellow dotted lines on the maps. Along the center lines of these ejecta wings big cracks in Earth's crust opened up. Here a majority of the ejecta mass impacted on the surface. But there were also some thin forward ejecta rays thrown out of this Crater. They are marked with white lines..
Some of the main mining sites for Platinum Group Elements (e.g.Kalgoorlie) are located where some of these Ejecta Rays impacted on the Yilgarn Craton

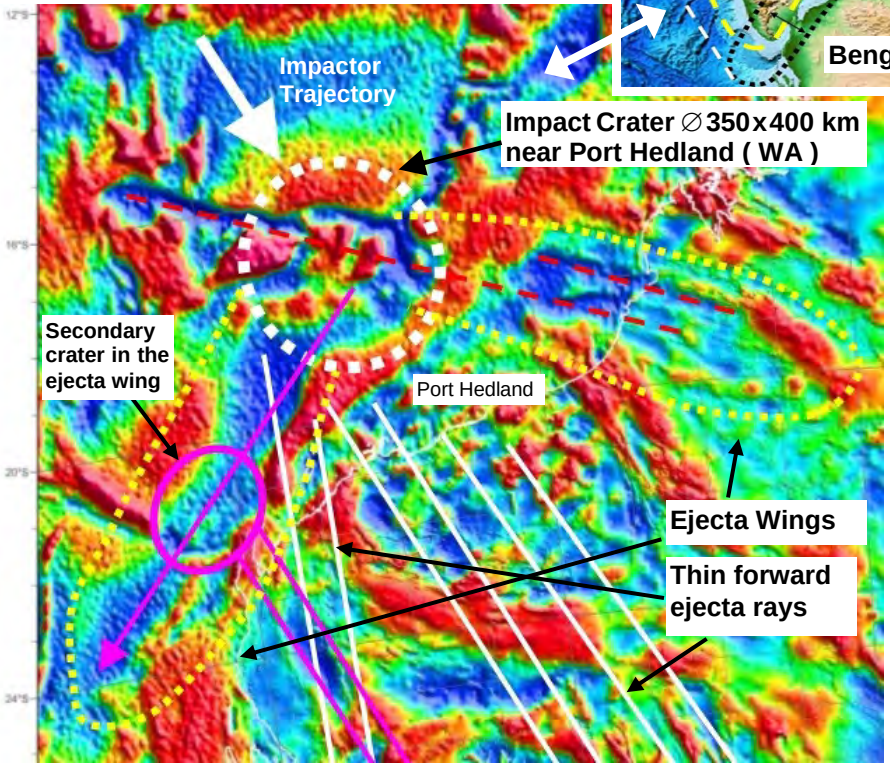
A few stronger ejecta rays of the Port Headland Crater (pink) seem to have cut-off Australia from Pangea. (→ east-coast of Africa)

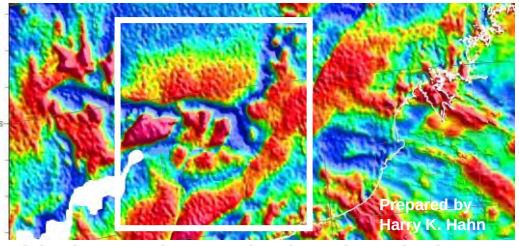
Please compare !

The **BBC** & the **Port-Headland Crater**

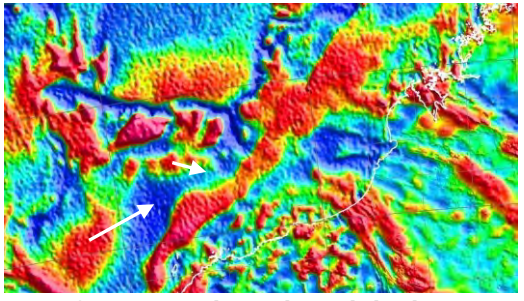


Bengal Bay Crater





This image is manipulated and shows the crater roughly in it's original state



Here for comparison the original map

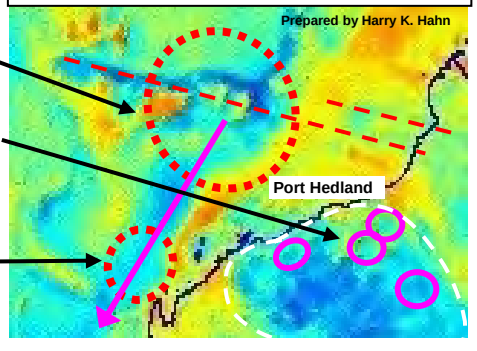
GRAVITY ANOMALY MAP OF THE AUSTRALIAN REGION 3RD EDITION, 2008

Elliptical Impact crater with central uplift visible

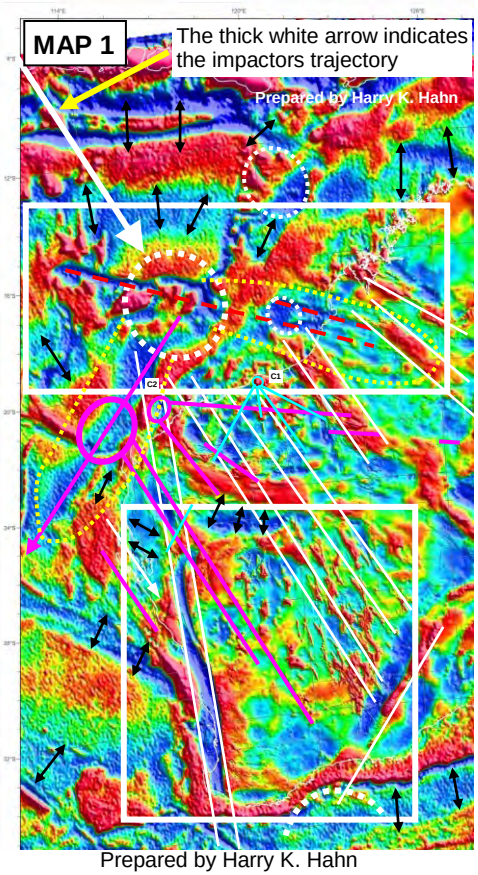
Note that there are many smaller impact craters are visible on the Pilbara Craton. But these are other mostly very old impact craters ! (> 3 Ga !)

Secondary Impact within the right ejecta wing

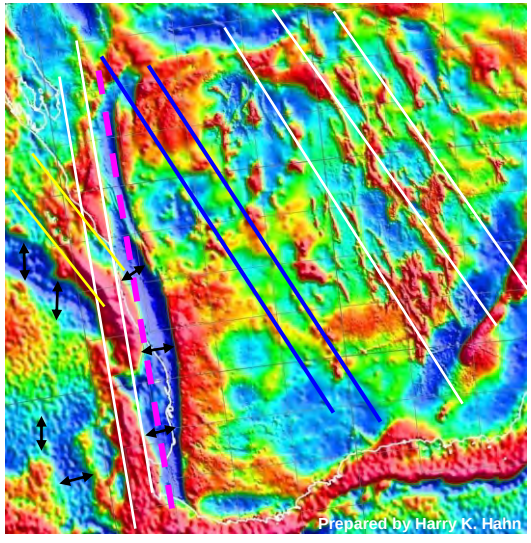
Other gravity anomaly map :



The left image shows that there is a smaller secondary elliptical structure within the right ejecta wing, from which further ejecta rays originate. The right image shows on the left side the strong ejecta rays which cut-off the Yilgarn Craton from Super-Continent Pangea.

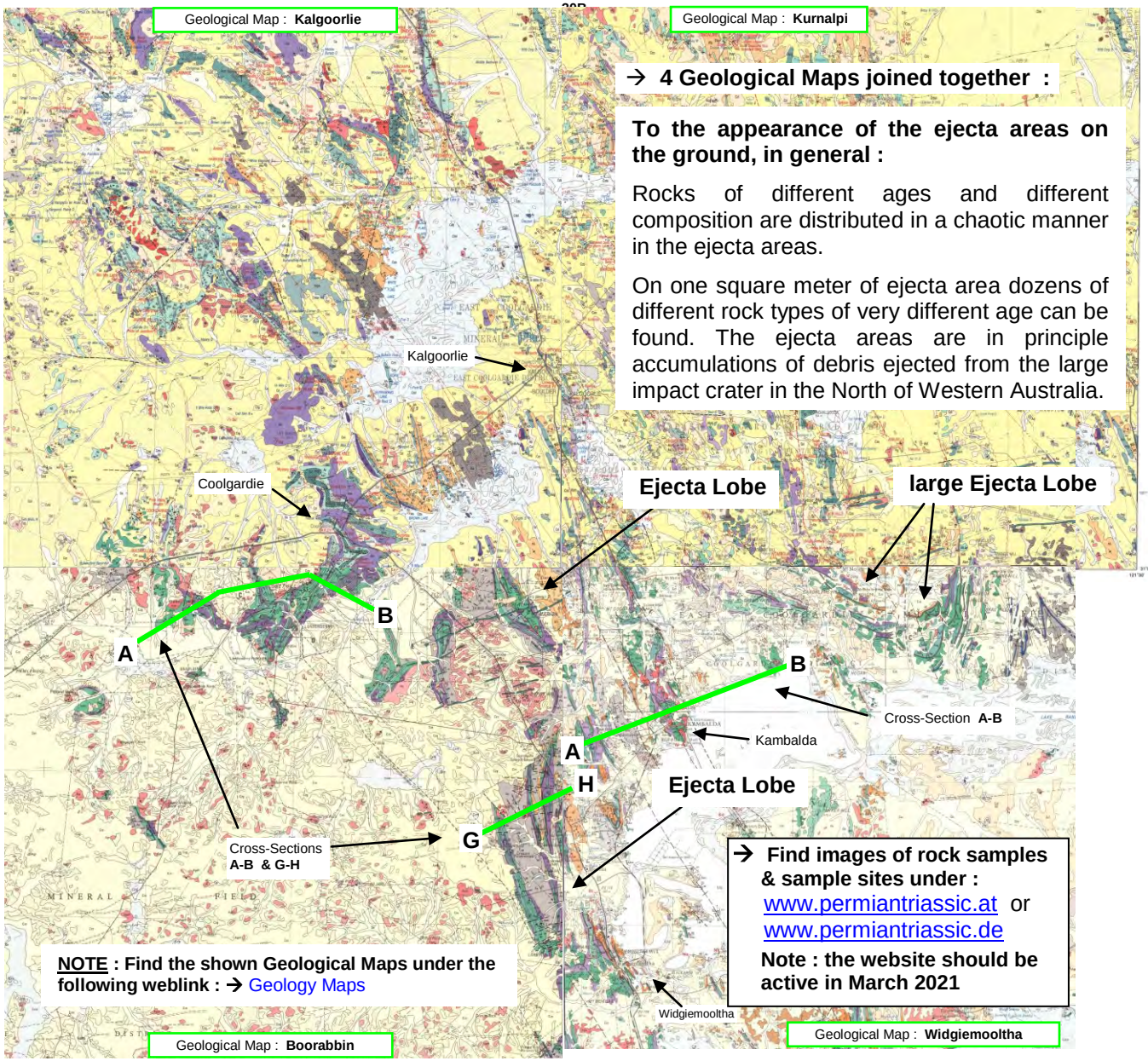


Prepared by Harry K. Hahn



To the appearance of Ejecta Rays rich in mineral resources, from the Port Headland Crater, on the geological maps :

The following image shows the area around Kalgoorlie, where a considerable share of the forward ejecta material impacted on the Yilgarn Craton. The geological map indicates that that the stripe-shaped (linear) formations and the lobe-shaped formations with high probability are ejecta lobes and ejecta rays which originate from the large impact crater in the NW of Western Australia. And it is no coincidence that many Mines for Platinum Group Elements are located in close proximity to these ray-shaped and lobe-shaped geological formations.. One of the biggest Gold Mines of the world is located in Kalgoorlie, close to one of this ejecta rays.



→ **4 Geological Maps joined together :**

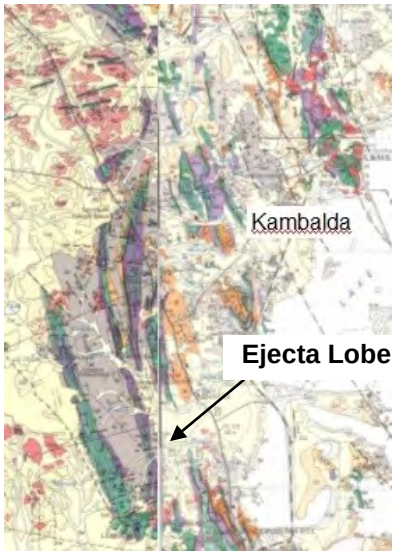
To the appearance of the ejecta areas on the ground, in general :

Rocks of different ages and different composition are distributed in a chaotic manner in the ejecta areas.

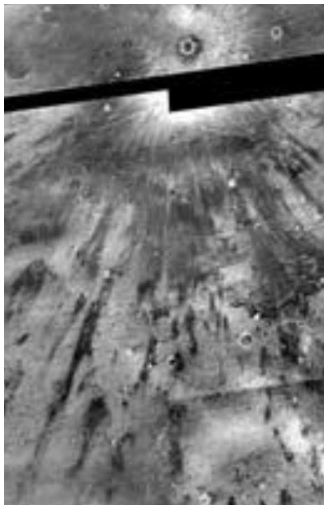
On one square meter of ejecta area dozens of different rock types of very different age can be found. The ejecta areas are in principle accumulations of debris ejected from the large impact crater in the North of Western Australia.

NOTE : Find the shown Geological Maps under the following weblink : → Geology Maps

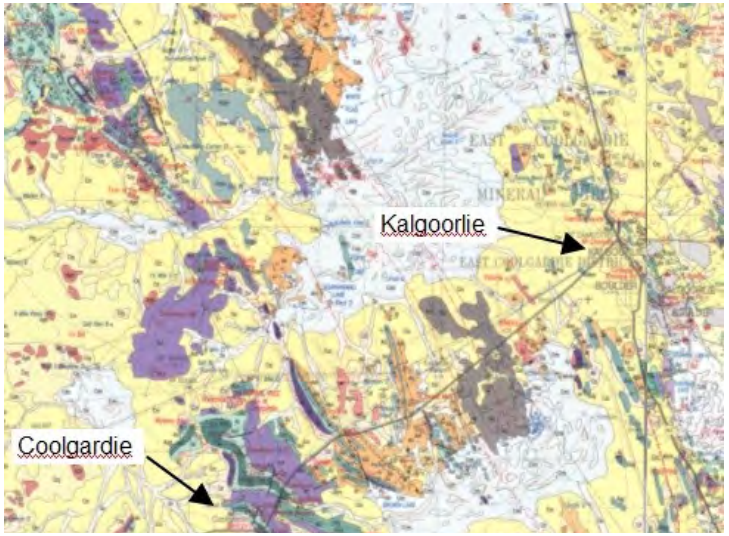
→ **Find images of rock samples & sample sites under :**
www.permiantriassic.at or
www.permiantriassic.de
Note : the website should be active in March 2021



Ejecta lobes near Kambalda



Graterri Crater on Mars : Compare the shape of the Ejecta-Lobes and -Rays !!

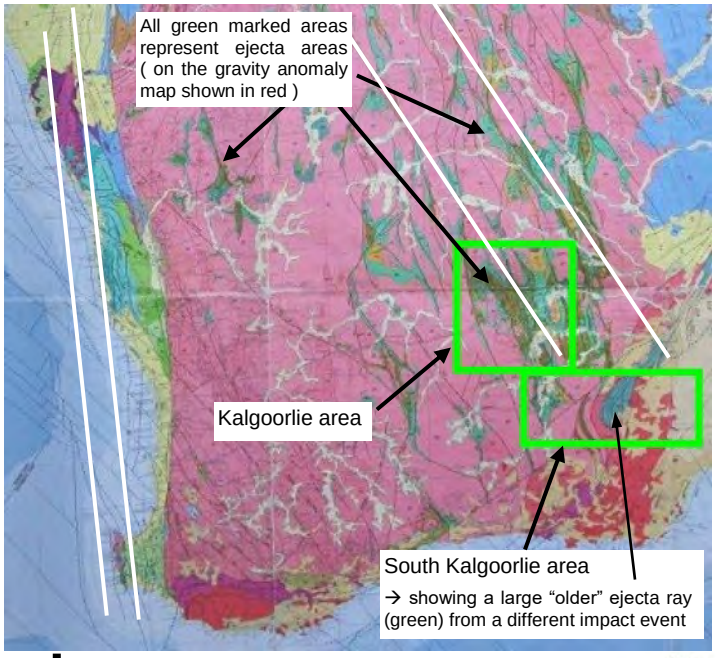


Ejecta lobes & rays near Kalgoorlie & Coolgardie

How the massive Ejecta rays, originating from the large impact crater in the NW, appear in geological cross-sections

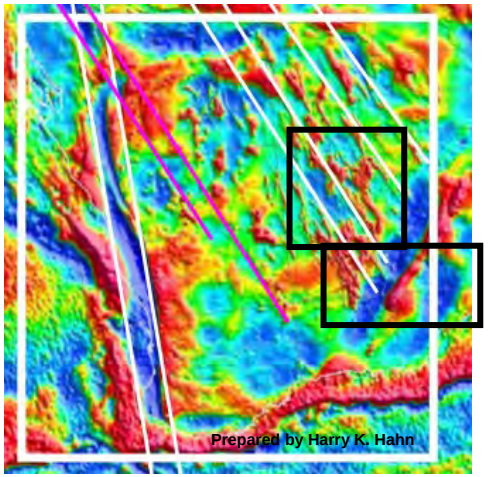
The ejecta rays visible on the gravity anomaly map of Australia, which were ejected from of the large crater north of the North-West Coast of Western Australia, were examined in many geological surveys. Here they show up in the geological cross sections on the maps, as parabola-shaped rock formations (intrusions) in the base rock of the Yilgarn Craton. These ejecta rays cut into the rock around **5 to 15 km deep**.
A strong ray along the west coast even cut-off the Yilgarn Craton.

Prepared by Harry K. Hahn



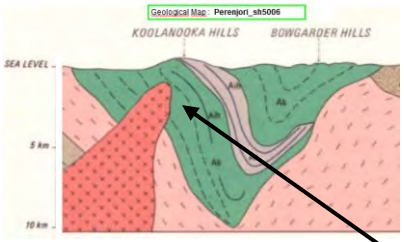
Geological Map of Western Australia

Compare with Gravity Anomaly Map :

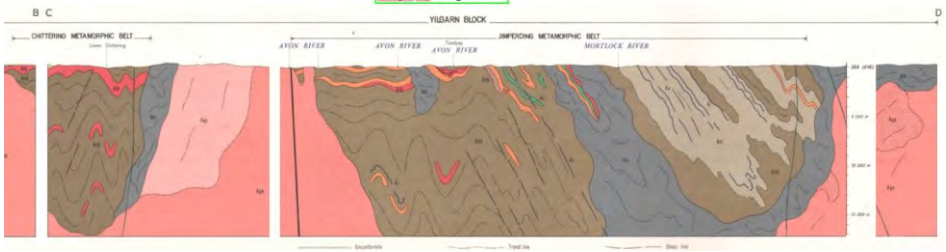


Geraldton area :

Cross-Section B-C — Geological Map : Perenjori_sh5006



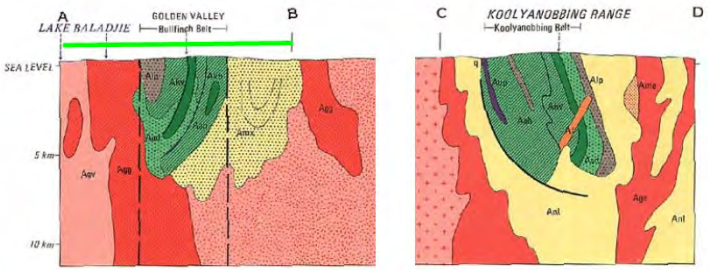
Cross-Section C-D — Geological Map : Perth_sh5014



Note how this ejecta ray (green layers) got deformed by the red marked rock formation

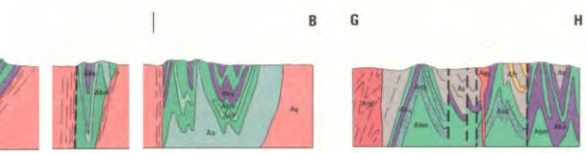
Southern Cross area :

Cross-Section A-D — Geological Map : Jackson_sh5012

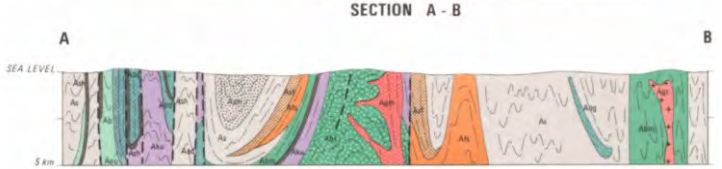


Cross-Section A-C — Geological Map : Southern Cross_sh5016

Cross-Sections from : Geological Map : Boorabbin_sh5113



Cross-Section from : Geological Map : Widgiemooltha_sh5114

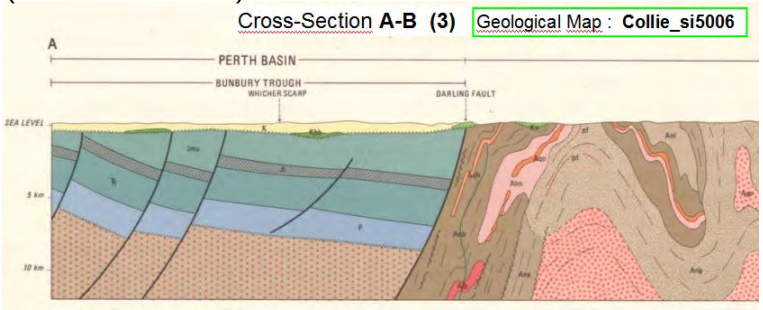


Kalgoorlie area :

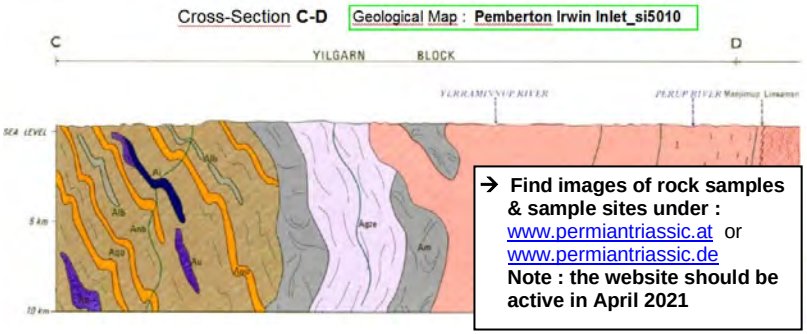
Margaret River area :
(SW corner of WA)

NOTE : Find the shown Geological Maps under the following weblink : → Geology Maps

Cross-Section A-B (3) — Geological Map : Collie_si5006



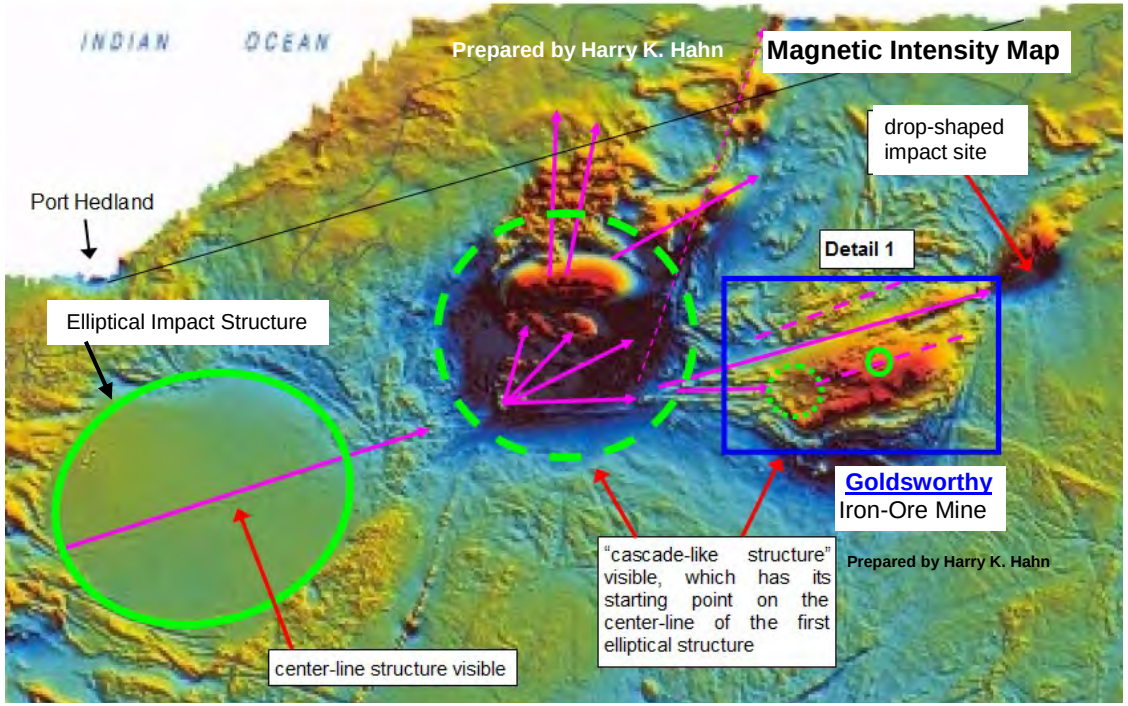
Cross-Section C-D — Geological Map : Pemberton Irwin Inlet_si5010

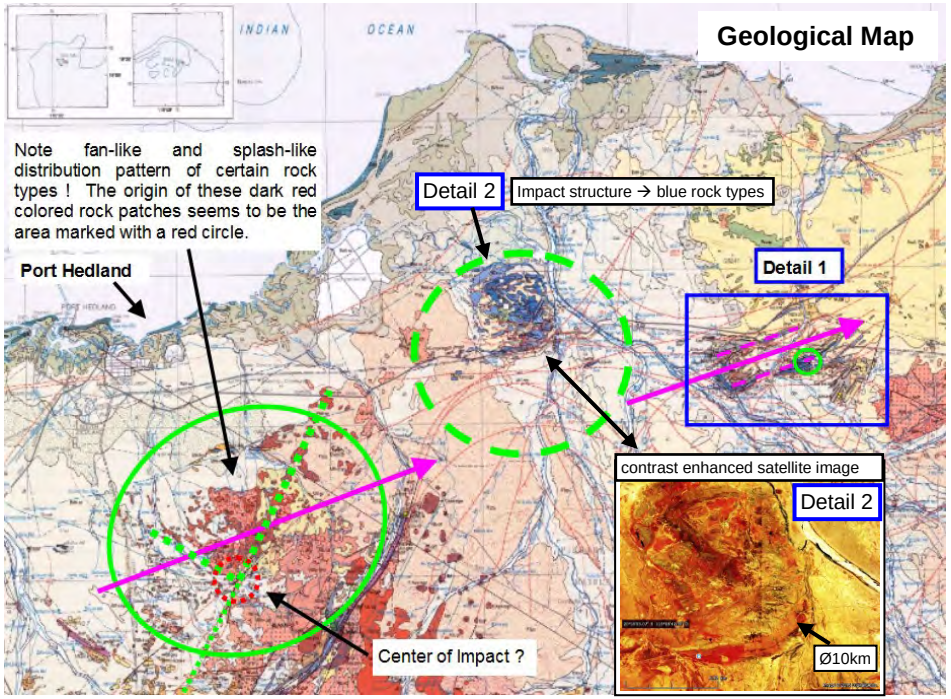


→ **Find images of rock samples & sample sites under :**
www.permiantriassic.at or
www.permiantriassic.de
Note : the website should be active in April 2021

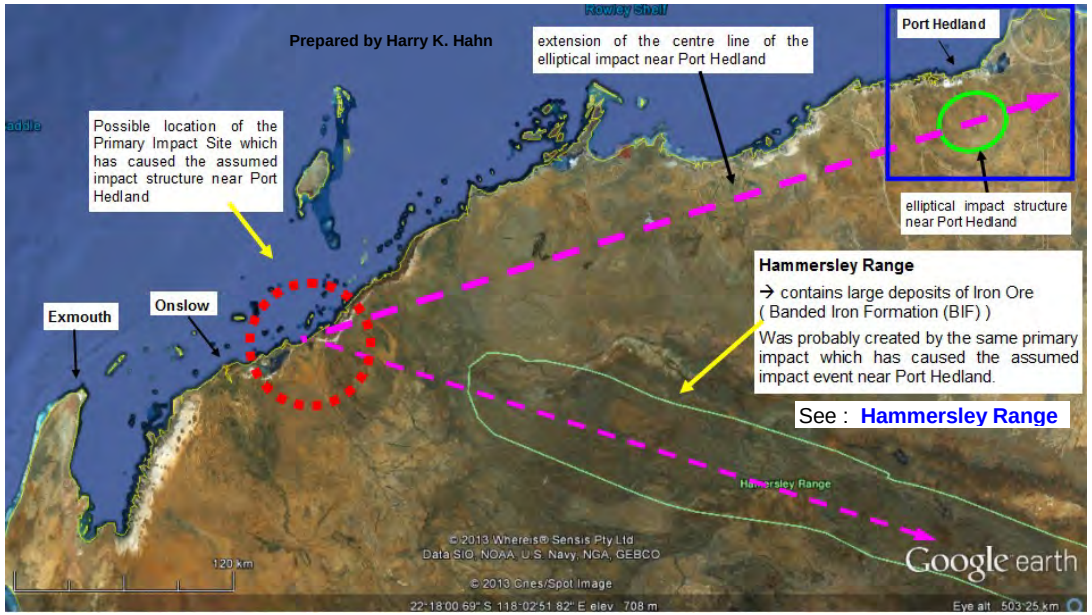
A “Tertiary Impact-Crater and –structures” (>∅ 30 km Crater) in the Pilbara Region (NW of West-Australia), probably caused by the Port Headland-/Bengal Bay Impact and the “Onslow-Crater” produced the Goldsworthy-Mine with the world’s richest Iron-Ore !

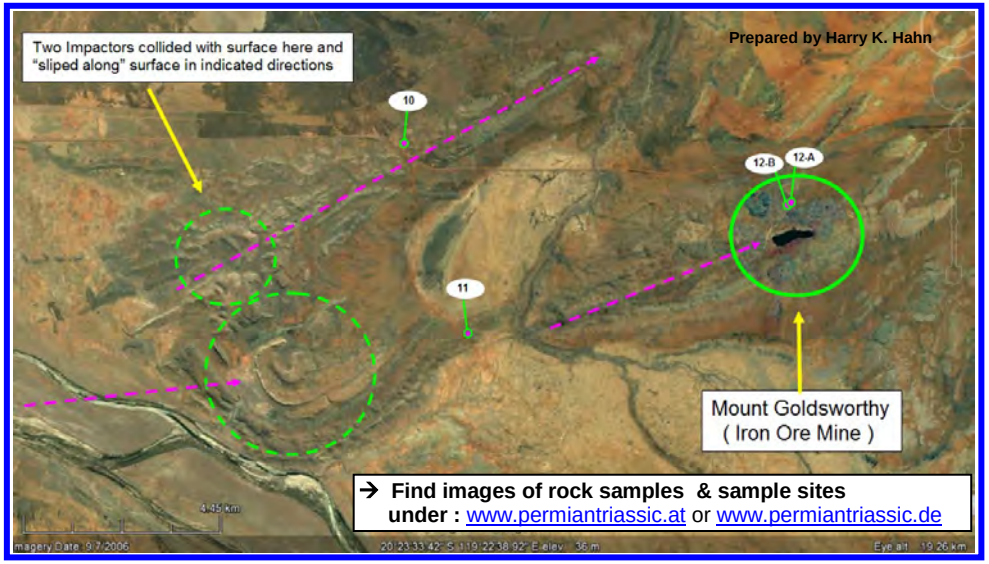
The satellite image, the magnetic intensity map and the geological map indicate a complex impact structure near **Port Headland** (in West-Australia), which probably was formed by ejecta that was coming from a secondary Crater of the PT–Impact Event that probably impacted near the town “Onslow”. Ejecta from this crater probably also caused the Iron-ore-rich Hammersley Range. The Goldsworthy Mine was produced by iron-rich ejecta material, maybe from the original PT-Impactor !?





Detail 1 : Satellite View with marked position of impactor sites & Iron Ore Mine
→The **Goldsworthy Mine** was caused by Ejecta that was sliding over the surface





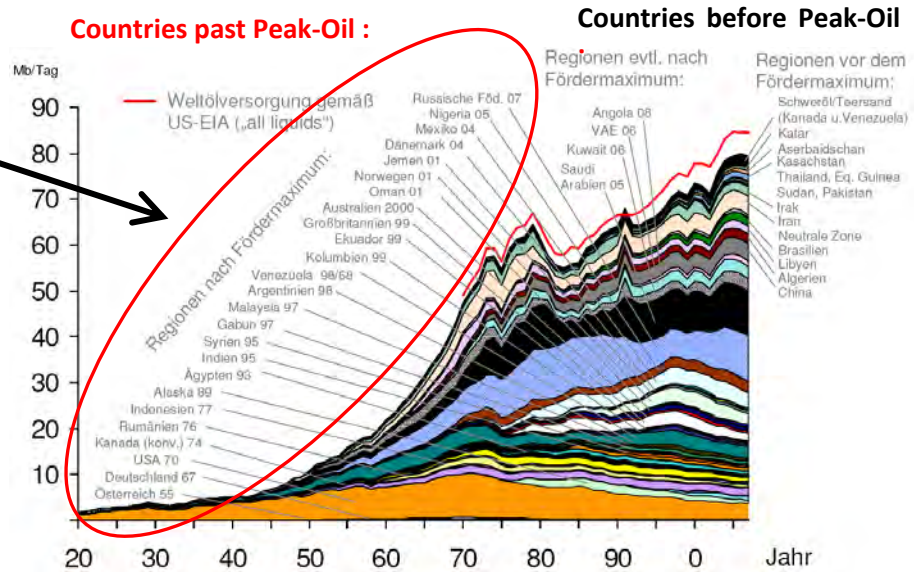
At last I give a Warning to all CEO's who read my study : We urgently must increase investments in Oil- exploration !

(→ for conventional oil)

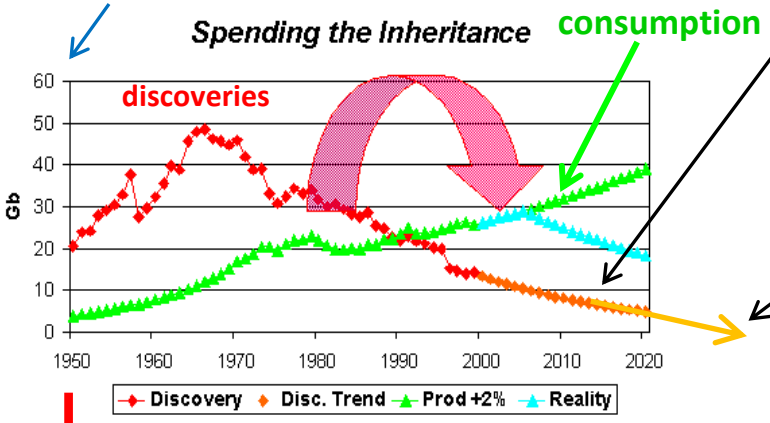
These countries have already passed "Peak-Oil" → crude-oil production is declining since that time !

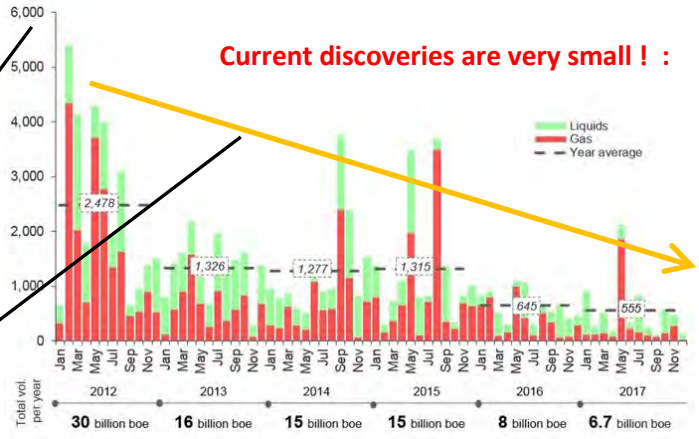
World consumption is still rising ! New discoveries are declining since 1965 !

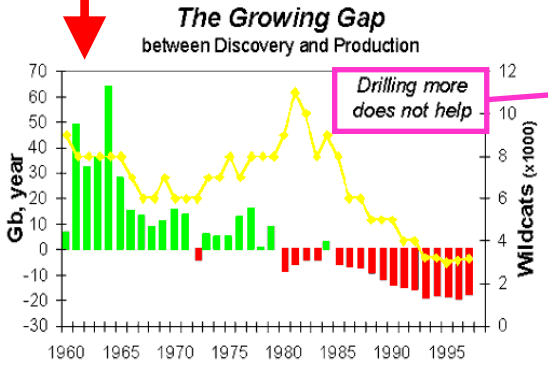
This is a serious problem !!



Giga Barrel !







Because they don't know where to drill !!!

→ My study will help to fix that problem !

WARNING !!! :

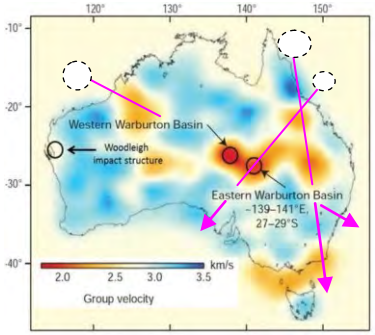
The last time Oil- and Gas companies added to their reserves by as much as they were producing was in 2006, when the so-called reserve replacement ratio reached 100%. It was down to 50% in 2012 , and 11% in 2017.

If oil discoveries continue trending down, We have to talk seriously about oil shortages in about a decade from now !!! Sonia Mladá Passos, a senior analyst at Rystad, estimates.

But shale oil cannot make up the shortfall in the conventional oil development: Conventional Oil-sources account for 69 million barrels a day of the current global output of 85 million barrels a day ! Shale oil resources are also declining much faster than concentional resources !!

Epilogue :

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.



→ see image on the left !

There are two craters which formed the East- & West Warburton Basins approx. 300-360 Ma ago (estimated diameter Ø 100-200km each)

Weblinks :

News Article 1 , News Article 2

East-Warburton Basin

Eromanga Basin

(Woodleigh Crater)

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 diciplines 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 and install suitable defence 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 astro-physical 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 also should't be a problem to convince the UNO members to invest in such a defense system for our planet Earth !!

Because this is really the only possible insurance against a global impact event and the extinction of mankind and the total destruction of our world !!

And we shouldn't wait until the devil comes around the corner ! Fast and smart action is required !

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

→ see Weblink : "**To the deflection of asteroids in the diameter range of 5 to 200 Km**"

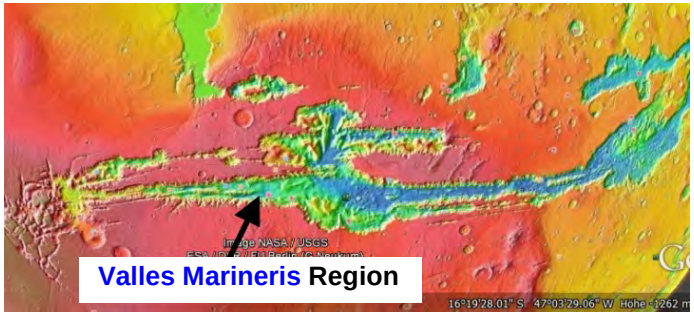
(This study will also be available at **www.vixra.org** soon. Just type-in my author-name in the search field and press enter. Then you will find the study.)

The interested readers should also have a look at the following Wikipedia page :

→ Asteroid Impact Avoidance Strategies

The strategies and the technology described in my above mentioned study : **"To the deflection of asteroids in the diameter range of 5 to 200 Km"** can also be used for doing Terra-Forming on Mars and on other planets & moons

With the described asteroid deflection strategies it would be possible to carry out controlled impacts of asteroids in the 10-20 km diameter range on Mars and on other planets & moons !!



The Valles Marineris is a deep 2400 km long Canyon on Mars probably caused by a crack in the crust of Mars.
Note : Mars' ocean water came out of the mantle here !

An action plan for Terra-Forming on Mars :

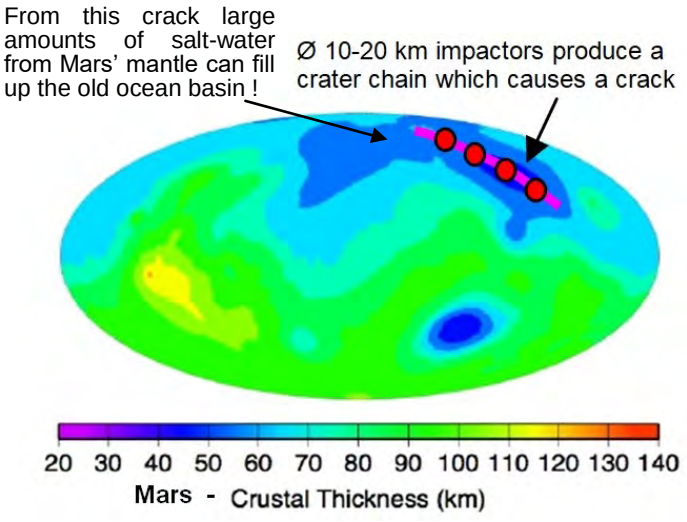
In order to create an additional "Second Earth" for Mankind we should perform Terraforming on Mars as quick as possible before the settlement starts !!

With a controlled impact series of probably 3 to 4 impactors in the Ø 10-20 km range a large crack in the crust of Mars could easily be produced.

In order to achieve this 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 !

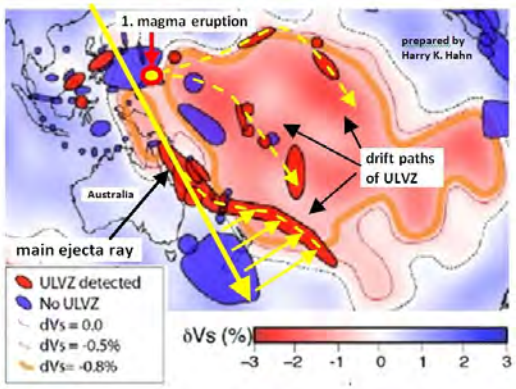
A large crack in this area should cause large amounts of volatiles (e.g. H_2O) to rise up to the surface, similar as it happened in Valles Marineris. This would quickly produce a small ocean near the crack and a thicker atmosphere, which would improve the living-conditions on Mars considerably!

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.



To the new discoveries :

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 are 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.
(See new pages, changes & additions in my study)

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 !
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 etc.) which will release vast amounts of CO_2, H_2S etc. into the oceans and will kill up to 60% of all marine species. Largescale explosive volcanism with vast amounts of CO_2 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 bio-diversity cycle on Earth (→ Extinction-cycle with two half periods of 31 Ma)

→ **See Part 5 of my Study !**

In all probability some of these violent magma eruptions were triggered by extreme earthquakes, e.g. caused by impact events, like the Chicxulub-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 longterm thermochemical processes at work with cycle lengths of 10 - 30 Ma (million years).
(→ the cycle length seems to decrease over time)

Please note : It may also be the case that a large amount of superheated mantle-water streams out of the Mid-Ocean-Range-crevices before a magma eruption starts, causing in this way climate change and sea-level rise !! see weblink to : → **News Article**

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 8 (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 world-wide 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 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 Saturns ring) 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 defence 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 defence strategies which are able to cope with large impactors, up to Ø 200 km !!

How such a defence 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 defence 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 civilisation on Mars, which doesn't need support from Earth to survive !

This is the only way to make sure that our advanced technological civilisation 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 defence system against a large impact on Earth. However it's not possible to build a defence system against a gigantic magma eruption coming from Earth's mantle !!

That's why the development of nuclear drives for spacecrafts 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 !!!

The G20 & UNO must now set a new framework, so that "resource wars" can't happen anymore !!

Therefore I suggest an **action plan** & a number of global regulations which have 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.

And a worldwide analysis of all available resources & reserves must be carried out under control of the UNO & 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 !

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 !!

Top-Down Approach is required to reduce resource consumption worldwide ! 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 a constant settlement of mankind on Mars, realized by the G20 and the UNO !

And we must protect the remaining Rainforests and clean up our World's Rivers from plastics !!

The Author : Harry K. Hahn - 8.7.2017

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