The Ø 1270 x 950 km Permian Triassic Impact Crater → Supplement 1 to the geophysical evidence (Part 6b)

Please also read : **Part 1** to **Part 6** of my PT-Impact Hypothesis - more infos at : www.permiantriassic.de (or : www.permiantriassic.at)

by Harry K. Hahn / Germany - **30.12.2022** (update from 20.3.2023 / new pages: 2,7,9,13,15) - **Note :** This document is not allowed for commercial use !

Abstract :

This is a supplement document to my Summary of geophysical evidence for the Ø 1270x950 km Permian Triassic (PT)-Impact Crater (→ **see Part 6b** of my hypothesis)
The purpose of this document is to point-out the main geo-physical features visible on our planet Earth, which were directly caused by the Permian-Triassic Impact Event (PTI).
A precise comparison of the real PT-Crater topography with a computer-simulated topography indicates a Probability > 99,9999725 % for the real existence of the PT-Crater !
With this additional proof I support my hypothesis and provide a stronger case for further scientific research regarding the discovered Ø 1270x950 km PT–Crater. (see page3-8)
The expansion of Earth's mantle after the PTI probably was caused by phase-transitions of minerals in Earth's mantle, caused by the Pacific- & African-LLSVPs, a result of the PTI.

Further I want to inform the interested reader about two other possible impact-structures on Earth, **which I believe are a result of the global PT-Impact Event too.**

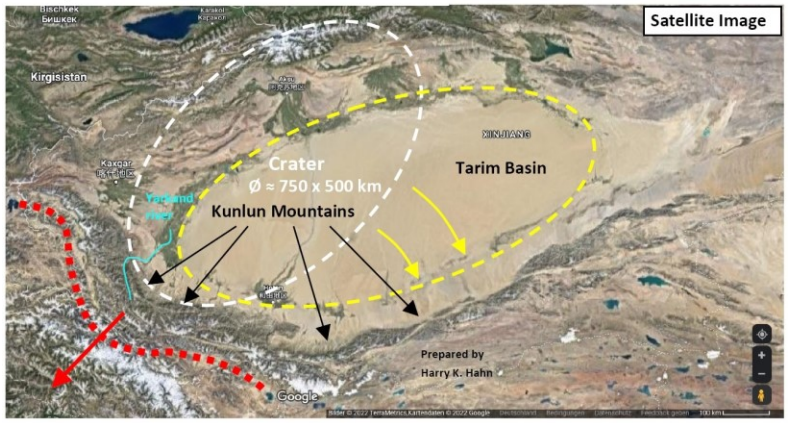
The first structure seems to be a "smaller twin" of the PT-Impact Crater. It **is the Tarim-Basin in North-West China.** The Kunlun Mountains around it indicate an age of 250 Ma !
The Tarim Basin has an approximate elliptical shape with the dimensions of ≈ 900 x 400 km (see page 7 & 8). This basin probably was formed by a second impactor that impacted in-line with the main-impactor which has caused the PT-Impact crater. Or in other words, the impactor which has caused the Tarim Basin in all probability was on the same orbit (trajectory) as the PT-Impactor, during the PT-Impact Event, either a bit ahead or behind of the main-impactor.
The 900 x 400 km elliptical Tarim Basin probably had a shorter elliptical outline of around 750 x 500 km shortly after the PT-Impact, but was then deformed (squeezed) later.

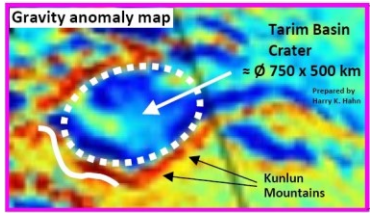
If we use the double-oblique elliptical impact crater-twin on Mars as a reference (see explanation in this study), then the Tarim-Basin Impact was caused by a similar effect as the smaller oblique impact crater of the Mars-Impact, which is located in-line with the bigger oblique impact crater but a bit uprange (ahead) of the main impact crater.
In the NASA-study about this double-oblique impact on Mars, as reason for this double-impact, the probable collapse (break-up into pieces) of the impactor shortly before the impact was mentioned. This collapse (break-up into two pieces) of the impactor just before the impact in all probability was caused by atmospheric effects (e.g. by the atmospheric impact-shock-wave which hit the impactor, and atmospheric drag etc.). Initial cracks inside the impactor probably already occurred when the impactor reached the "Roche-limit" of Mars (the point where gravitational forces start to rip the impactor apart). In the case of the PT-impactor the situation probably was very similar !

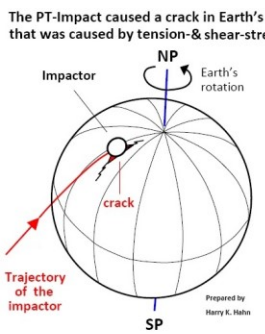
The other possible impact-structure which I want to describe **is the 41 x 32 km elliptical shaped F'derik Zouerate district Iron-ore mine in Mauretania** (NW-Africa). → page 12
It is located in a dark colored area which contains Fe-rich minerals. This iron-rich area has an outline which can be fit precisely into an ellipse ! That's why I believe that this iron-rich area is the result of a secondary- or tertiary-impact in the PT-Ejecta Ray R1, which was caused by the PT-Impact Event and which runs along the NW-coast of Africa.

All parts of my PT-Impact Hypothesis + images of Rock Samples & Sample Sites are available on my website : www.permiantriassic.de (or : www.permiantriassic.at)

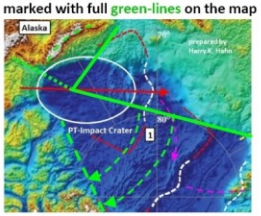
The Tarim Basin and the Kunlun Mountains in NW-China seem to represent an impact crater similar to the PT-Crater !



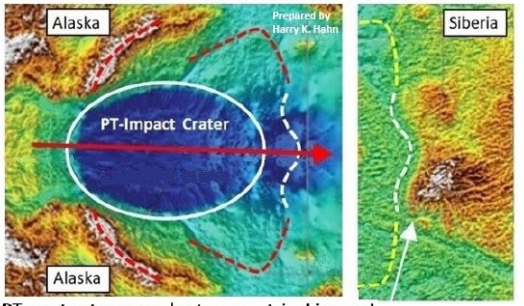




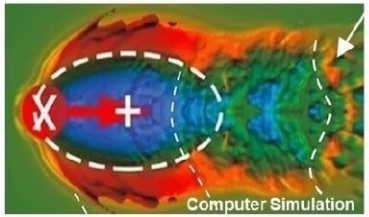
The initial cracks in Earth's crust are marked with full green-lines on the map



The Ø 1270 x 950 km Permian-Triassic Crater



PT- crater topography (symmetrical image)



Note similarity of bow-shaped structure !

→ structure was caused by the motion of the impactor along the surface

Summary to the additional proof for the PT-Impact Crater :

The Ø 1270 x 950 km Permian Triassic Impact Crater on the ocean-floor of the Arctic Sea is real, there is no doubt !
The evidence for the Impact Crater is very strong. **Especially the comparison of the real topography** of the left-side (the west-side) of the Crater **with a Computer-Simulation** of an oblique (shallow) Impact-Crater that was caused by an impact-angle of ≈ 5° to 8° **provides strong evidence for the existence of the PT-Impact Crater.** (→ see right image)

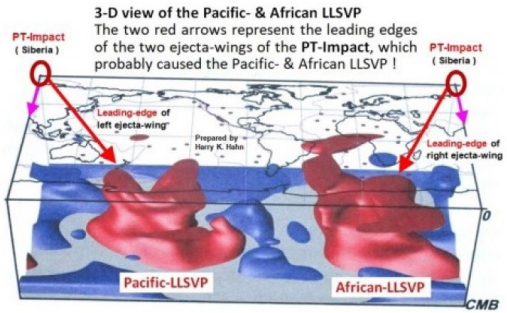
I have marked 10 Topographic Features on the real PTI-topography that are nearly identical to 10 features of the computer simulated oblique impact (→ 1 - 10 on the map). Because the 10 topographic features are nearly identical and because they appear in the same sequence from left to right the probability for the existence of the PT-Crater is very high! A simplified probability consideration by using 10! , the factorial of 10, indicates that **the Probability is > 99,999975 % for the real existence of the PT-Crater !** (see also page 5). If other properties of the topographic features would be considered, for example if it is a positive- or negative-anomaly, or if the position of the features in reference to the middle axis of the crater is the same etc. , then the probability for the existence of the PT-Impact Crater is even higher !
Beside the topographic features there is even more proof coming from gravitational-anomaly- & magnetic-anomaly maps.

If we now realize that the PT-Impact Crater really exists, and that the "Plate-Tectonics" which was taking place on Earth during the last ≈ 252 million years obviously was caused by this powerful impact event, then **we have to answer the next question : What process has caused the obvious expansion of Earth's mantle that was caused by the PTI ?**

Because, if we look at the **Arctic-area** where the PT-Impact Event took place then **we clearly see strong expansion of Earth's crust in this area !** All crust-fragments caused by the PTI clearly moved away from each other ! And that's not all ! We can see global expansion tectonics which was triggered by the PTI ! **In Part 1 of my PTI-hypothesis I have described how the whole Pacific-Plate obviously was caused by an expansion tectonics-process** that was triggered by a powerful impact-crater chain in NE-Australia. Massive amounts of Ejecta-material from the PT-Impact impacted in the NE of Australia and caused the **Ø 320 km Cape-York Crater** and other similar large secondary-craters along a large **crater-chain**.

I believe that **the massive ejecta-material of the PTI** that impacted in NE-Australia descented into Earth's mantle and **caused the Pacific-LLSVP**. The **LLSVP** is a large volume of hot material in Earth's mantle **near the CMB** (core mantle boundary). **The Pacific-LLSVP was caused by the left ejecta-wing** (ejecta-blanket) **of the PTI.** And **the African-LLSVP**, the other large volume of hot material in Earth's mantle, **was caused by the right-ejecta wing of the PTI**. (see image below !)

PTI-ejecta which decended in Earth's mantle and formed the African-LLSVP and the Pacific-LLSVP :

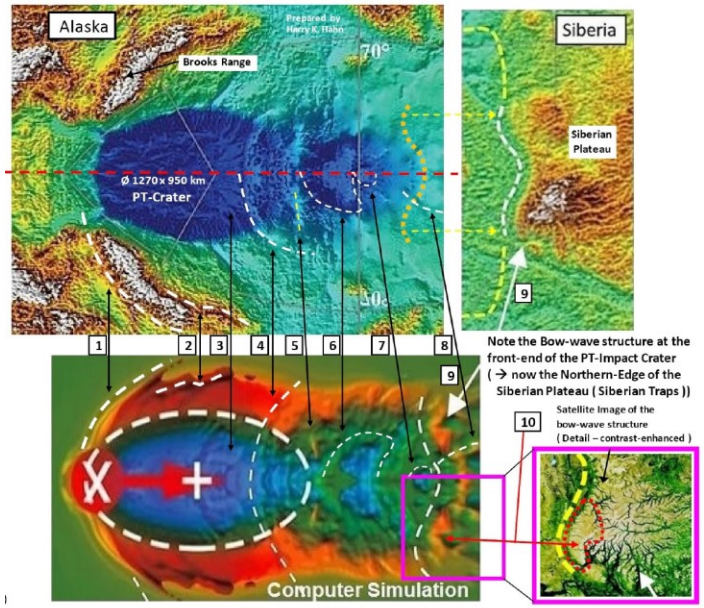


For a long time scientists already suggested that the two big LLSVP-areas in Earth's mantle were caused by a giant impact event. The PT-Impact Event can now explain the two large LLSVPs in a very logical way by the two gigantic ejecta-wings that were caused by the oblique PT-Impact Event.

This hot material in Earth's mantle (→ red marked in the left image) has obviously caused the strong expansion of Earth's mantle in the last 252 Ma

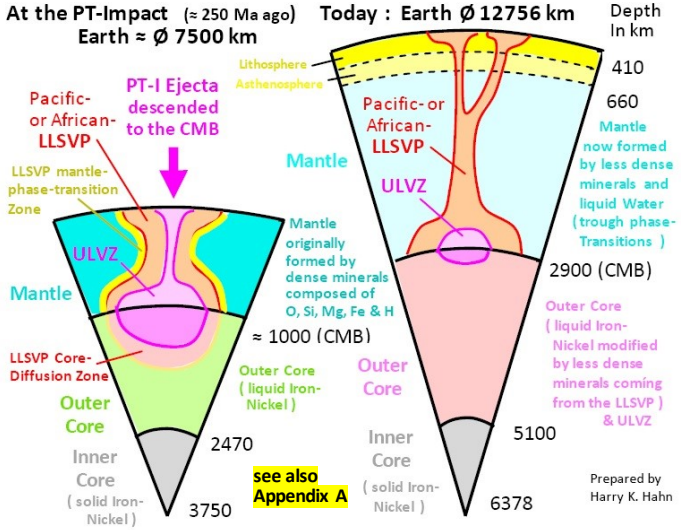
How the strong expansion of Earth's mantle was caused by the two major LLSVPs, which are the result of the PTI, needs to be analysed now !
To explain the strong expansion of Earth's mantle **the volume of Earth's mantle must have expanded by a factor in the range of ≈ 7 to 12 !**
Water in the mantle probably played an important role here ! (see page 9)

It is possible that Earth's mantle originally was formed mainly by **Enstatite** ($MgSiO_3$), **a major component of Enstatite-meteorites , and Water** (H_2O), **which then formed more-dense- & more-compact-hydrous-minerals, over time under higher pressure** , which were stable inside Earth's mantle over a long time. **Then after the PT-Impact** which caused a global fracture-pattern and a decompression of Earth's mantle and the hot LLSVP-areas in the mantle, **these compact hydrous minerals disintegrated and/or passed through phase-transitions and caused a many times less dense mantle !**



Comparison of the **real Topography of the Ø 1270 x 950 km** elliptical **Permian Triassic Impact Crater with a Computer-Simulation** of an oblique (shallow) Impact-Crater that was caused by an **impact-angle of ≈ 5° to 8°**
The 10 different features (1-10) in the same sequence indicate a **Probability >99,9999 % for the real Crater** !
Note : for the comparison only the left Crater-Topography of the real PT-Crater was used ! In the top left image this is the area above the red dashed line. This side was mirrored to achieve a complete Crater-image (→ because the right-side of the PT-Crater was deformed to much by expansion-tectonics after the impact)
Used topographic-map : ETOPO 1 ; Amante & Eakins 2008, Topography of the Circum-Arctic Region
Computer Simulation was made by D.Elbeshausen & K. Wünnemann etc. at MfN at the Humboldt Uni Berlin

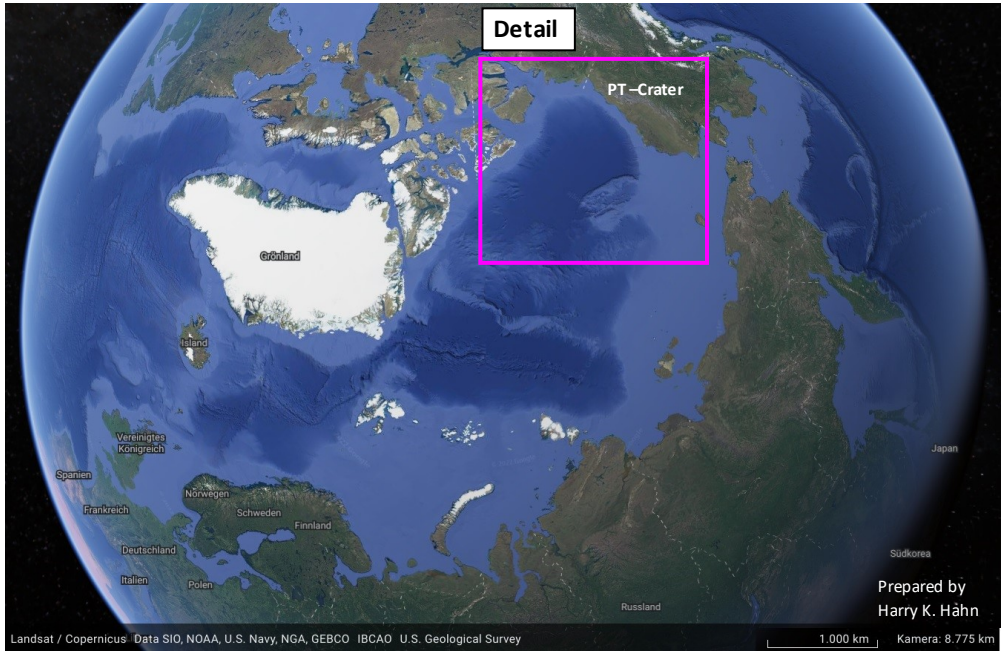
Concept for the expansion of Earth's mantle after the PT-Impact :

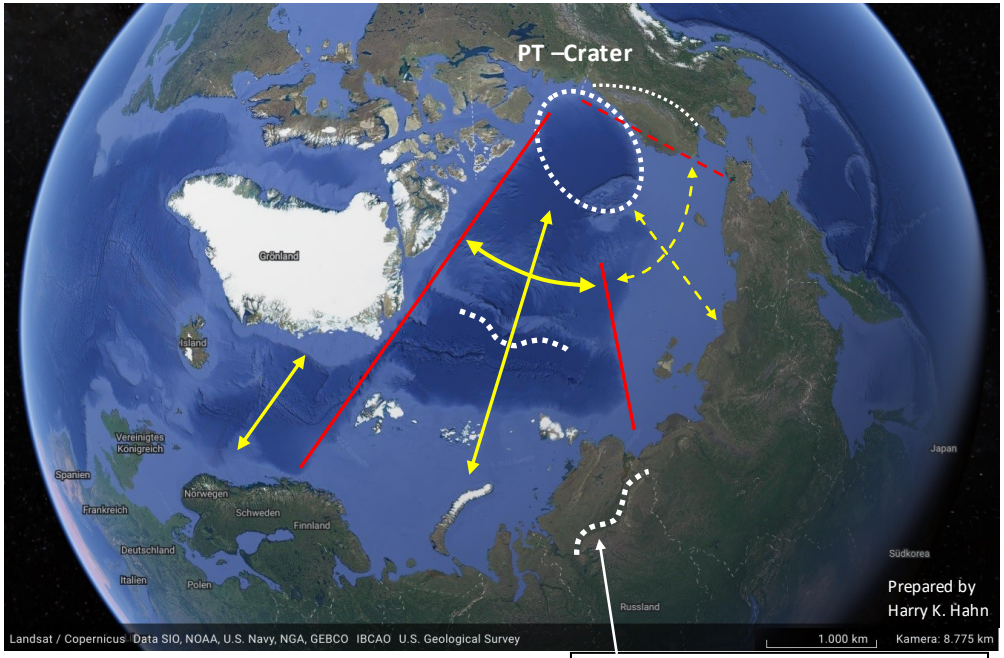


Earth's interior ≈ 250 Ma ago :
Before the PT-Impact **Earth's mantle was formed by much denser minerals** which were mainly **composed of the elements O, Si, Mg, Fe & H** and which (partly) have been dense **hydrous minerals that contained 3- 14 wt% Water.** Further **Ice X** may have formed a share of Earth's mantle. The minerals probably came from **Enstatite-Chondrites**

Earth's interior today :
After the PT-Impact the combined effect of Earth's fractured crust → **the decompression of Earth's mantle, and the Ejecta of the PTI that descended into the mantle and formed the LLSVPs & ULVZs,** have together **caused phase-transitions of minerals and Ice X in the mantle towards much less dense minerals and Water**

Global view of the PT – Impact Crater area : → important topographic features & trendlines are marked on the images



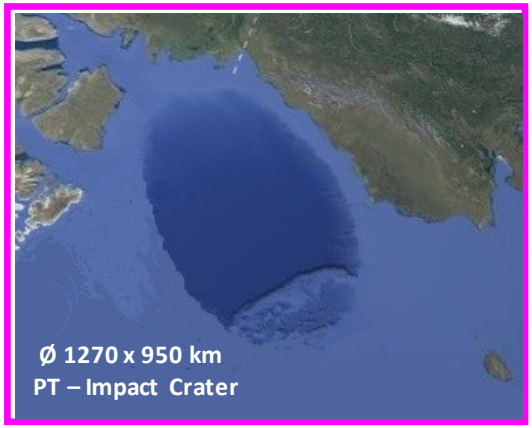


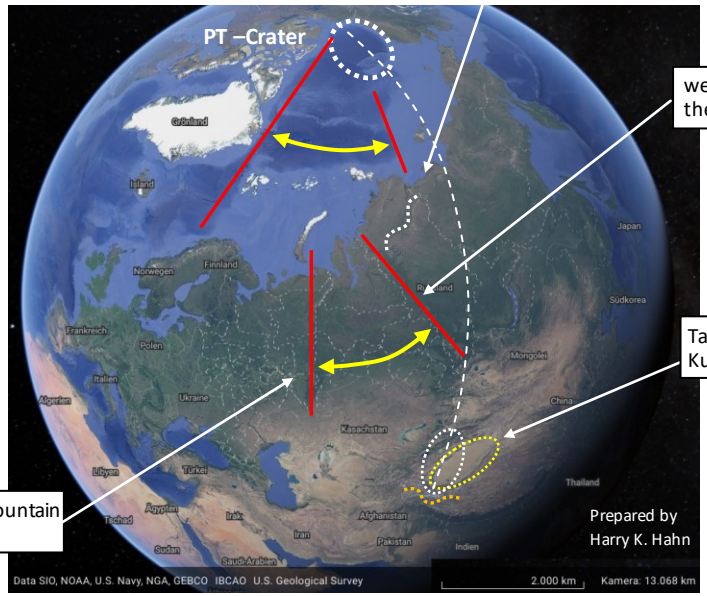
Front-End of the PT-Crater
(→ northern edge of the Siberian Traps)

Crater area shown without the angle sector of Earth's crust that openend-up caused by a Crack & Expansion Tectonics

Detail :

Manipulated Topographic map





western Edge of the Angara Craton

Tarim Basin & Kulun Mountains

Ural Mountain Range

Note the strong similarity of the structures visible on a topographic map of the PT-crater-area, to structures calculated by a computer simulation of a big oblique impact :

The Ø 1270 x 950 km Permian-Triassic Crater

The real PT-Crater topography →

The "Brooks Range" was caused by the PT-Impact

The reason why the elliptical crater-rim on the right-side of the crater is missing, was a crack in Earth's crust that opened up and expanded after the impact event !

A bow-shaped feature similar to the "Brooks Range" also existed on the right-side of the PTI-Crater. But because of the mentioned crack and because of expansion tectonics this bow-shaped feature broke-apart into fragments. These fragments in all probability are the following canadian islands today : **Ellesmere Isand, Axel Heiberg Island** and **Devon Island** in North-Canada

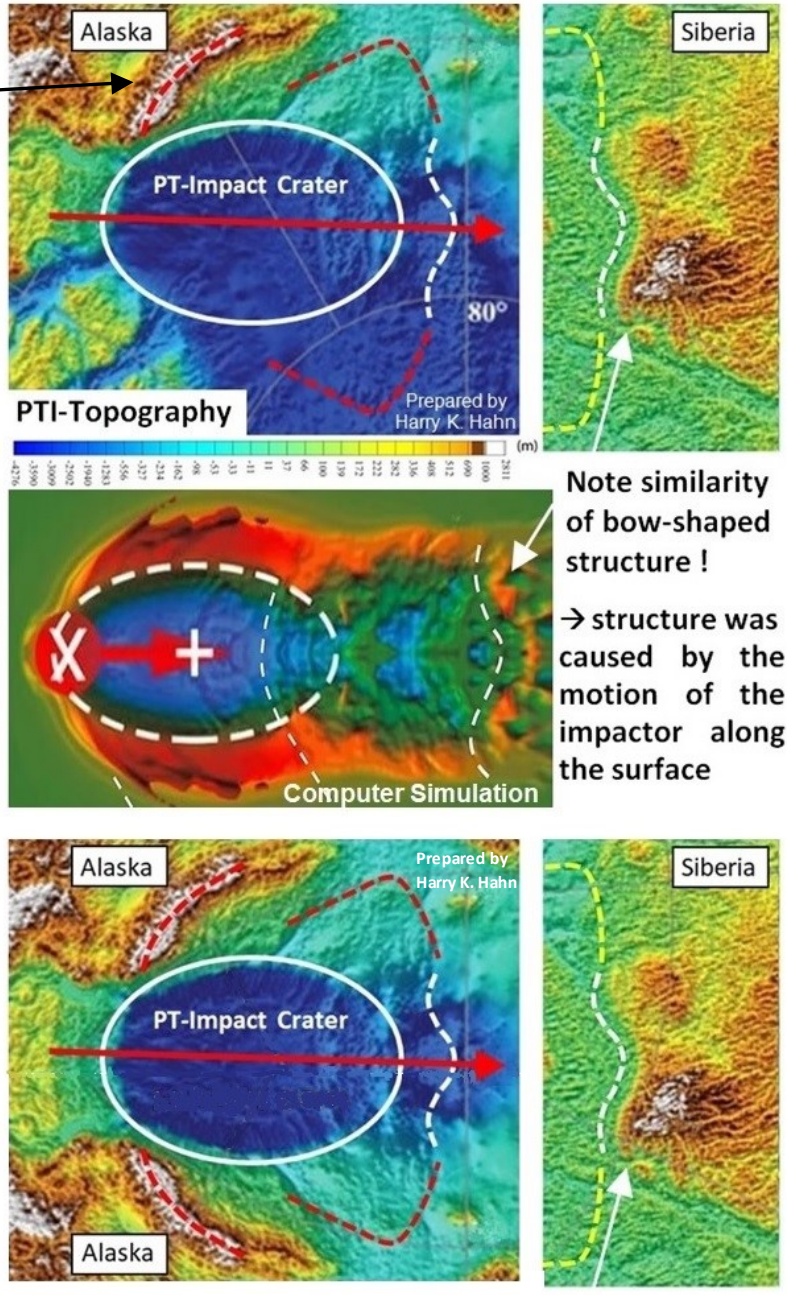
Computer Simulation of a 5° to 7° (degree) oblique impact →

Manipulated PTI - topographic map →

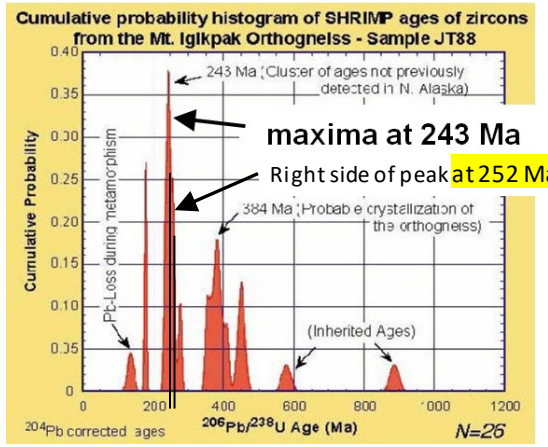
This map illustrates the strong similarity of the real PT-topography to the structure calculated by the computer simulation !

In this image I have mirrored the left-side of the real PT-topography to the right-side of the crater to create a symmetrical image

➔ **Weblink to the topographic map**



An age-analysis of the "Brooks Range" indicates a formation-age of ≈ 252 Ma



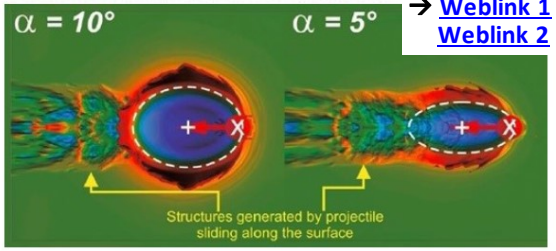
➔ **Weblink to this analysis**

The transition from circular to elliptical impact craters

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

[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],

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.



→ Weblink 1
Weblink 2

Comparison of the real Permian-Triassic Crater-Topography with a simulated topography & Probability Considerations

The left side (east-side) of the real topography of the PT-Impact Crater was mirrored to achieve a symmetrical image of the original PTI-Crater as it looked like shortly after the Impact. (→ Because the right-side of the Crater was strongly deformed after the impact caused by expansion tectonics)
The real PTI-Crater topography then was compared with a computer simulation and a first assessment of the probability of the real existence of the PT-Impact Crater was made :

I marked **10 Topographic Features on the real PTI-topography** that are **nearly identical to 10 features of a computer simulation** of a 5° - 7° oblique Impact Event of a big impactor.

Because the shown 10 different features are arranged in the same linear sequence !, the probability that the PTI is real is very high

The probability of the PTI is > 99,9999725% !

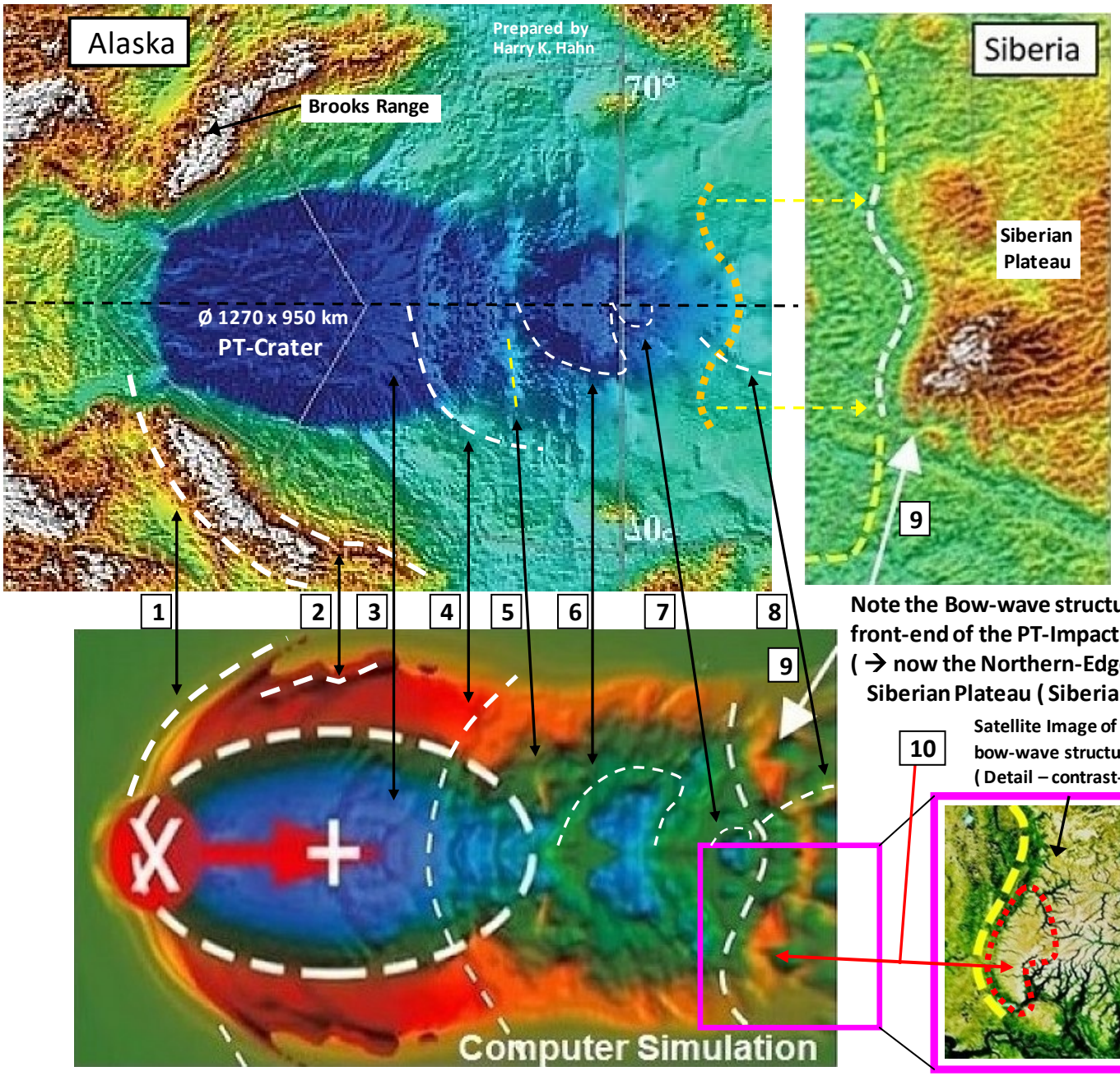
The chance that this is only a coincidence (happened by chance) is only 1 : 3 628 800 !!

Note : In mathematics the **factorial** of a non-negative integer, denoted by **n!** , is the product of all positive integers. **Factorials** are used in probability theory and in combinatorics, e.g. to obtain results concerning finite structures (e.g. to assess probabilities).
(e.g. : **10! =** 1x2x3x4x5x6x7x8x9x10 = **3 628 800**)

10 different Topographic Features of the PTI :

1 - Bow-structure 1 (Brooks Range) (positive)
2 - zigzag Ridge-structure 1 (positive)
3 - nearly Elliptical-Crater-structure (negative)
4 - Bow-structure 2
5 - Linear-Structure 1 (positive above crater)
6 - big Bell-shaped structure 1 (negative)
7 - small Bell-shaped structure 2 (negative)
8 - Bow-structure 3
9 - Bow-wave structure (positive)
10 - Hook-shaped structure (positive)

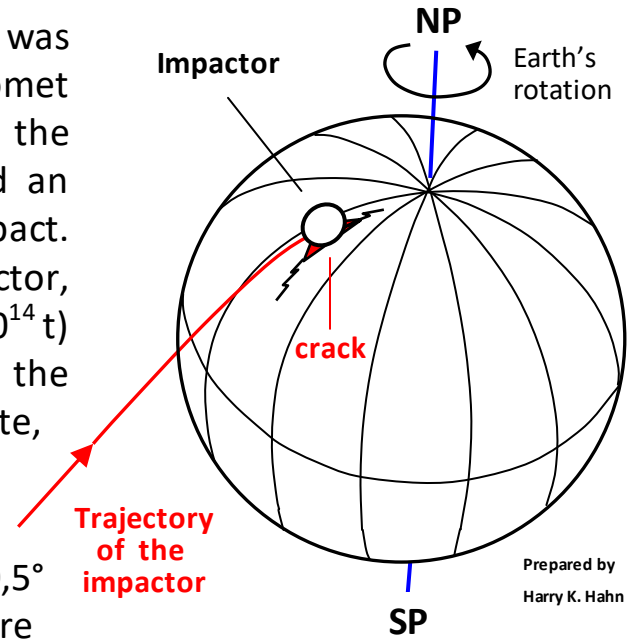
Topography : negative (blue) / **positive** (orange/brown)



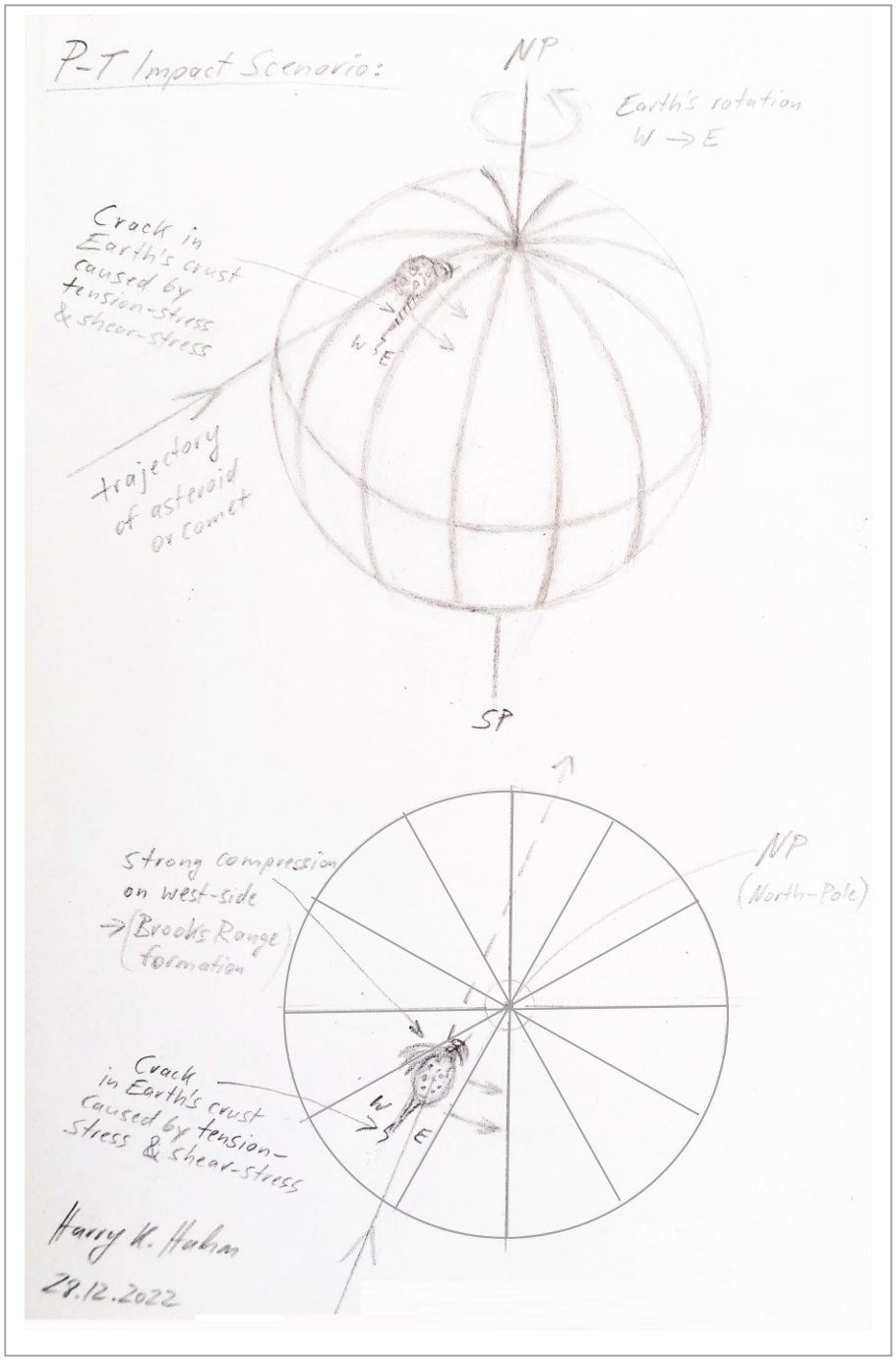
Note the Bow-wave structure at the front-end of the PT-Impact Crater (→ now the Northern-Edge of the Siberian Plateau (Siberian Traps))

The PT-Impact caused a crack in Earth's crust , that was caused by tension- & shear-stress

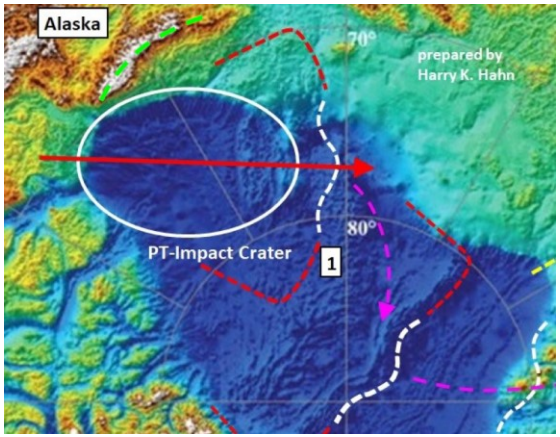
Because the **PT-Impact Crater** was caused by a large asteroid or comet in the **Ø 50 – 200 km** range the inertia of the impactor played an important role during the impact. The immense mass of the impactor, probably ≥ 500 trillon tons ($5x10^{14}$ t) deccelarated Earth's crust on the left side (west) of the impact site, during the crater formation which took around 120 sec.



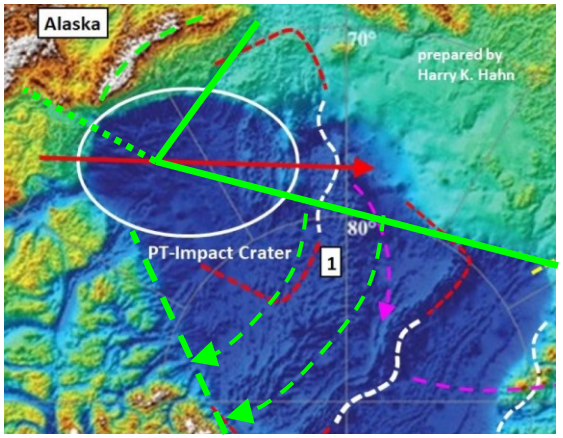
Because Earth rotated around 0,5° during the crater formation there was tension- & shear-stress building-up on the right side (east) of the impact site. This has lead to a large initial crack in Earth's crust in particular on the right side of the impact crater. This crack in Earth's crust quickly opened-up during the later Expansion Tectonics process. The formation of the crack(s) was supported by very strong ejecta rays



PT-Crater topography



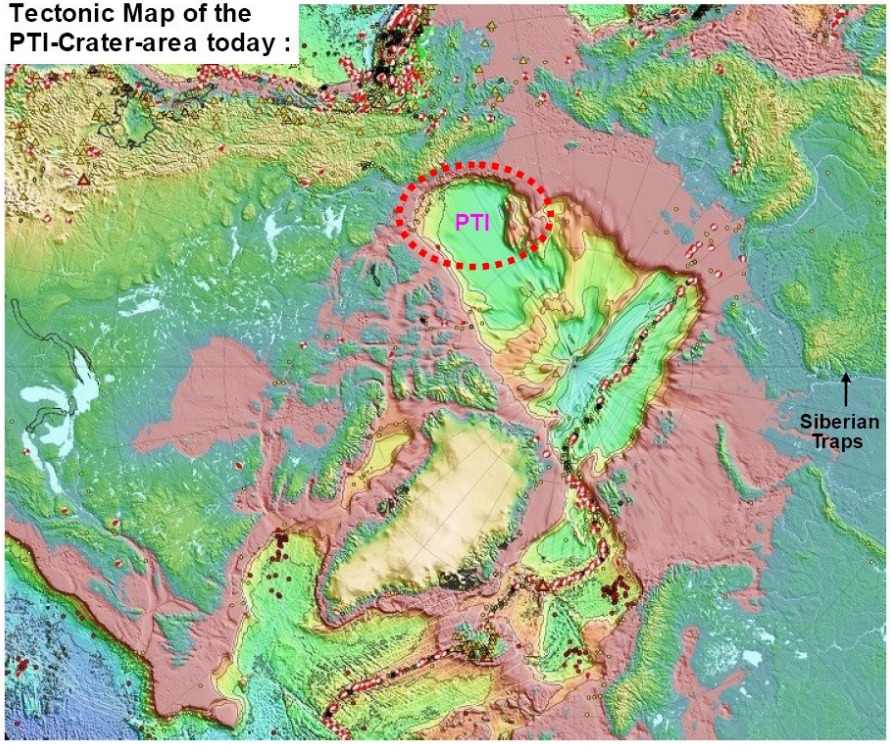
The initial cracks in Earth's crust are marked with full green-lines on the map



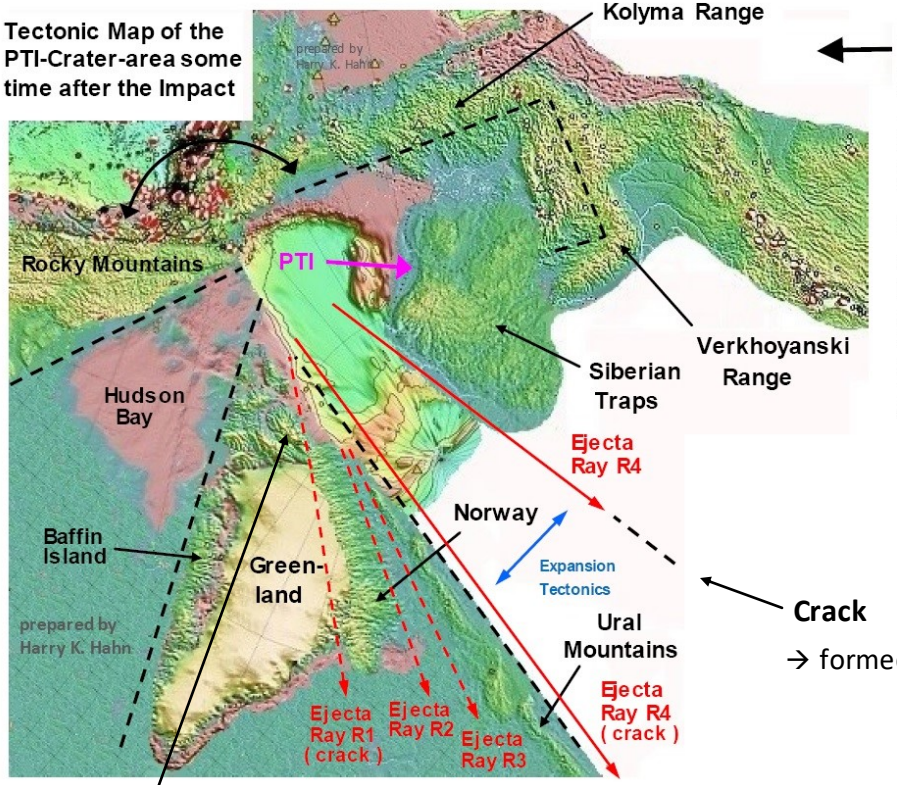
A re-constructed Tectonic Map of the Ø 1270 x 950 km Permian-Triassic Crater-area a certain time after the Impact Event

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

Tectonic Map of the PTI-Crater-area today :



Tectonic Map of the PTI-Crater-area some time after the Impact



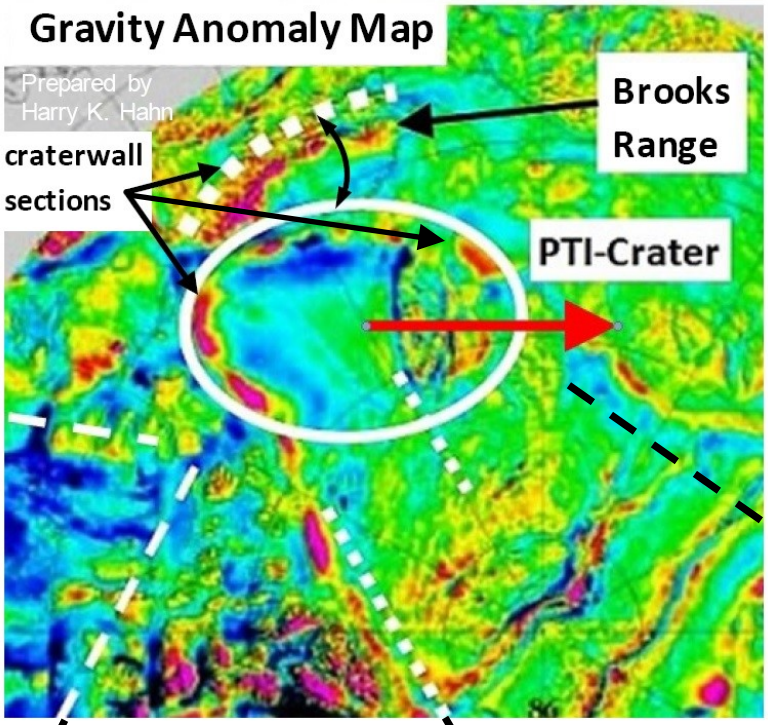
The manipulated tectonic-(topographic-) map on the left shows the PT-Impact area as it probably looked a certain time after the Impact The Hudson Bay (CA) and the Kolyma Range in Siberia were caused by ejecta-lobes of the PTI, which show the same ejecta triangle structure as an impact on planet Pluto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

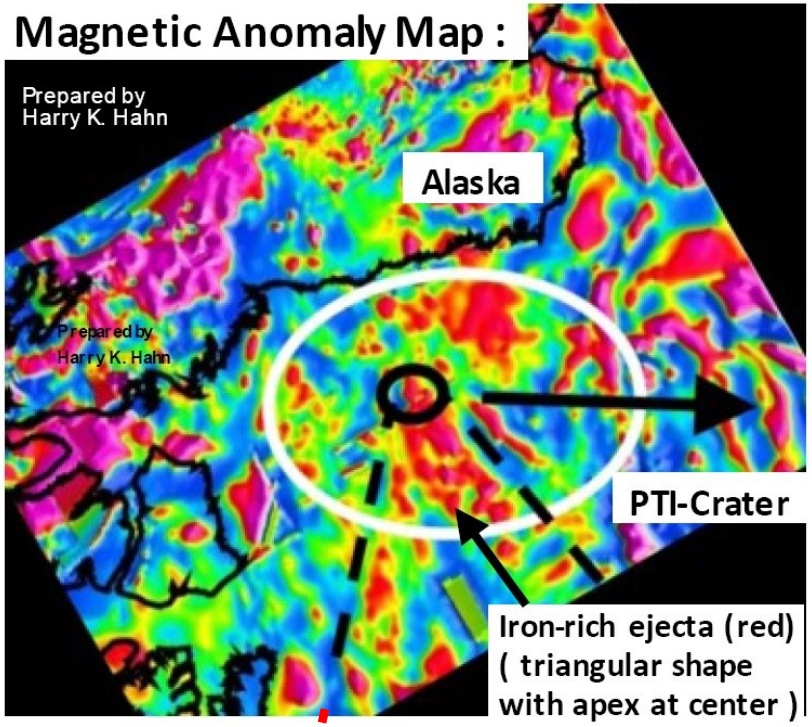
Ellesmere Isand, Axel Heiberg Island and **Devon Island** in North-Canada

→ These islands in all probability represent fragments of a „bow-shaped" feature similar to the „Brooks-Range" that existed on the right-side of the PT-Crater directly after the impact event. (→ this bow-shaped feature broke-apart in an expansion tectonics process after the impact event)

The reason why the elliptical crater-rim on the right-side of the crater is missing, was a crack in Earth's crust that opened up and expanded after the impact event ! (see map above)

The gravity anomaly map & magnetic anomaly map provide clear indication for the PT-Crater





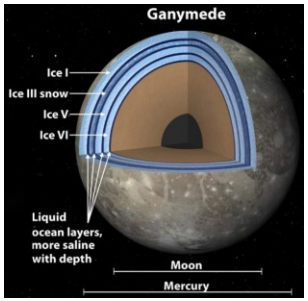
→ Weblink 1
Weblink 2
to the map

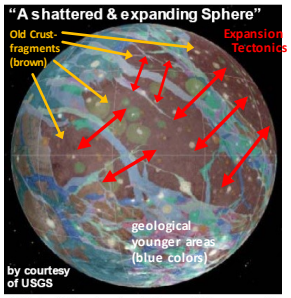
→ Weblink 3
to the map

Angle Sector of Earth's crust that openend-up because of a Crack & Expansion Tectonics (→ Crack probably was caused by tension- & shear stress and by a strong Ejecta Ray)

large amounts of iron-rich ejecta probably supported the formation of a crack in Earth's crust on the right-side of the PT-Impact Crater

Water in Earth's mantle caused World's Oceans and it supported the expansion tectonics process after the PT-Impact





Global Geological Map of Ganymede

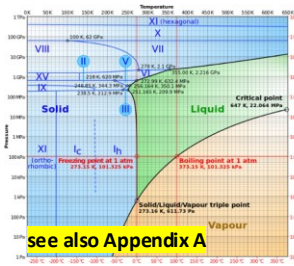
In order to explain the **expansion tectonics-processs** which obviously was **started by the PT-Impact** on Earth, we have to identify the **thermochemical process** and the substance(s) **inside Earth's mantle**, which are responsible for the considerable increase of the volume of Earth's mantle since the P/T-boundary (~253 Ma ago). **The heat-sources** responsible for the expansion of Earth's mantle **are the Pacific-LLSVP & African-LLSVP** which **probably were caused by** big amounts of **molten Ejecta-material from the PT-Impact which descended into Earth's mantle**

I believe that **beside minerals made of Mg, O & Si Water (H_2O) plays a major role in the expansion of the mantle** !

There is indication coming from different sides for this assumption : **Water vapour** is consistently the **most abundant volcanic gas**, normally comprising **≥ 60%** of total emissions. **Water is constantly released** into the world's oceans **along the 65000 km long mid-ocean-ridge-system** either as hot water >60°C or **as a supercritical fluid with up to 464°C**. (→In my opinion the most logical process that created and still is filling Earth's oceans !)

The 12 km "Kola super-deep Borehole" showed that **at depths>7 km** the **rock is extremely fractured** and that it is **saturated with H_2O & Hydrogen from deeper sources**, which means **this water is coming from Earth's mantle !**

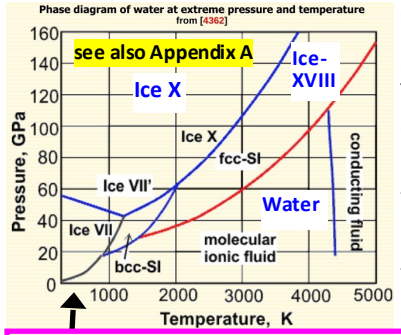
Different studies indicate that **Comet-Impacts are not the source of the world's ocean water !** (see: **Study1**, **Study2**)
A new study showed that **EC-meterorites** may have **brought to Earth > 3-times the mass of Water in it's oceans**
Jupiter's moon Ganymede, which also indicates **global expansion tectonics**, may provide some answers !



The phase-diagram of Water (H_2O)

Structural data on the ice polymorphs

Ice polymorph	Density, g × cm⁻³ [a]		Crystal [h]	Notes
VII, Ice-seven	1.50	1.591	Cubic [e]	two interpenetrating ice Ic frameworks
VIII, Ice-eight	1.46	1.885	Tetragonal [f]	low-temperature form of ice VII
IX, Ice-nine	1.16	1.160	Tetragonal	low-temperature form of ice III, metastable in ice II space
X, Ice-ten	2.51	2.785	Cubic [e]	symmetric proton form of ice VII
XI, Ice-eleven	0.92	0.930	Orthorhombic	ordered form of ice Ih phase (needs OH⁻)
XI, Ice-eleven [k]	>2.51		Orthorhombic [e]	Superionic



Ganymede's mantle probably **consists of different layers of high pressure water-ice and liquid water.** (→ see images above)

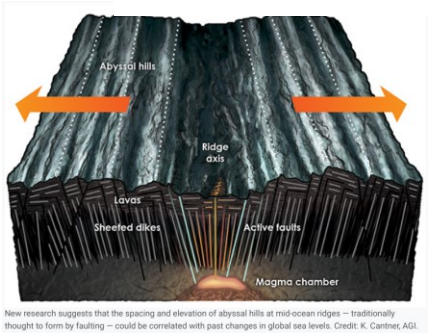
Similar to Earth the surface of **Ganymede consists partly of old regions (3 - 3.5 Ga old)**, which are **similar to the continents on Earth**. The **rest of the surface** (the bright areas between the "continents") **consists of considerably younger surface area**. And **the obvious expansion-tectonics** that took place on Ganymed **in all probability was also caused by a global Impact Event**, similar in results as the PT-Impact Event on Earth. My analysis indicates that **the ø153 km Gilgamesh-Impact probably caused a global fracture pattern and the following global expansion tectonics process**. (→ please see **pages 20 & 21** in **Part 5** (or here: **Part 5_hr**) of my PT-Impact hypothesis)

NASA-scientists think that tidal-heating-episodes **caused expansion in Ganymede's mantle by phase-transitions in the high pressure-ice** that forms Ganymede's mantle. → I believe that the **Gilgamesh Impact** caused this expansion & phase-transition !
Similar to the PT-Impact on Earth, hot ejecta descending in the mantle + decompression-melting was the cause !

The **phase diagram of water (Ice) at very high pressures** & **high temperatures** shows **a phase-change of Ice X to Ice-XVIII and then to Ionic-Water** (**Ionic-Fluid**) **at pressures of** around ≈ **40 GPa to 130 GPa** if the temperature increases by around **1000° K. Caused by the two hot LLSVP-areas, Ice X in Earth's mantle may have transformed through pase-changes into Ionic Water.**
This could explain a big density-drop and a volume-increase of 50 – 100% for the water in Earth's mantle. In a similar way compact hydrous-minerals consisting of the elements Mg, O & Si may have increased the Earth-mantle-volume by a factor 7-12 by going through phase-transitions / and by disintegrating into less dense minerals, caused by the thermochemical processes started by the LLSVPs.


(EC) = Enstatite Chondrite →
May have caused World's Oceans
→ See : Study

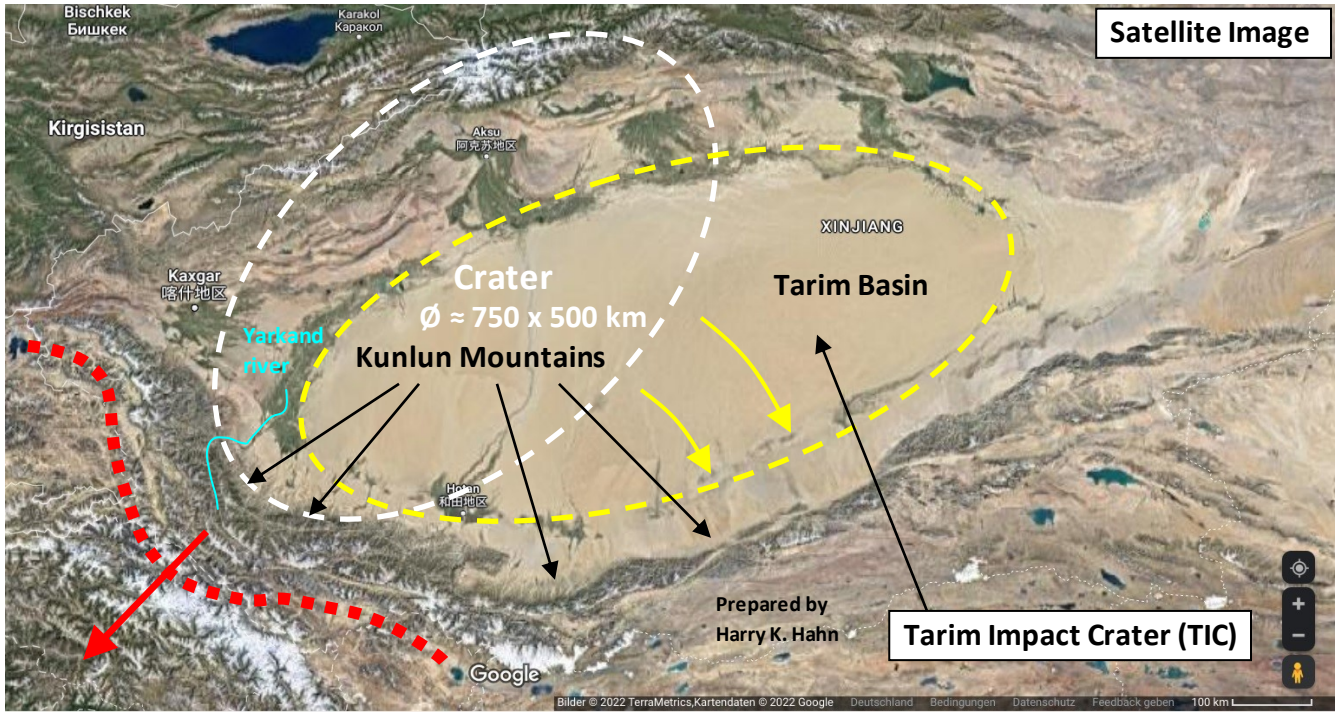
The **mid-ocean-ridges**, the spreading-centers of the seafloor of the world's oceans, have recently become the focus of an investigation into possible links between the deep Earth (Earth's mantle) and the short-time-changes on its surface. Namely, whether **mid-ocean-ridge-volcanos** either respond to variations in sea-level, or **variation in the activity** of the **mid-ocean-ridge-volcanism may cause sea-level changes**, and whether those **mid-ocean-ridge-volcanism may influence the climate changes** on Earth. (→ **see news-article : Reading the Ridges..**) →
→ Because scientists made an interesting discovery about the abyssal hills (the ridges) parallel to the central troughs of the mid-ocean-ridges



New research suggests that the spacing and elevation of abyssal hills at mid-ocean ridges -- traditionally thought to form by faulting -- could be correlated with past changes in global sea levels. Credit: K. Cantner, AGI.

Note : The spacing & elevation of the ridges + valleys (abyssal hills) that ripple away from the mid-ocean-ridges seem to correlate with past changes in global sea-level and with past changes of Earth's climate !! The scientists believe that ice-age oscillations are the cause for that. But I believe that periodic changes in the activity of the LLSVP (e.g. the Pacific-LLSVP) in Earth's mantle cause "pressure pulses" & expansion-areas in Earth's mantle which then lead to new parallel ridges along the mid-ocean-ridges and increased out-flow of water from the mantle

The Tarim Basin and the Kunlun Mountains in NW-China seem to represent an impact crater similar to the PT-Crater !



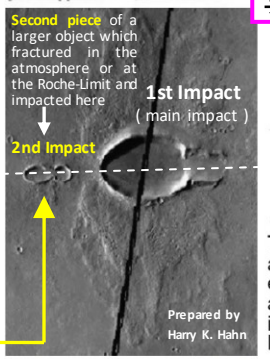
The bow-shaped **Kunlun mountain-range** on the west-side of the **Tarim Basin** in northwest China has the same "bow-wave shape" as the northern edge of the Siberian Plateau (Siberian Traps). The Britannica Encyclopaedia shows that the folded structures and the granitic rocks of the **Kunlun Mountains** date to about **250 million years** ago ! Therefore I assume that this bow-shaped range and the Tarim Basin were formed by the same global P/T-Impact Event !

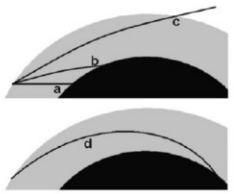
Like the elliptical impact on Mars, the **Tarim Basin** may represent a **second impact** that impacted **in-line with the PTI**.

On the origin of a double, oblique impact on Mars

J.E. Chappelow [a,b,*], R.R. Herrick [b]

→ : Weblink1, Weblink2



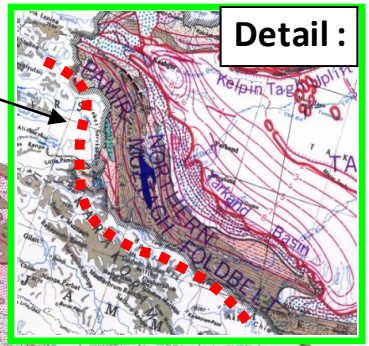


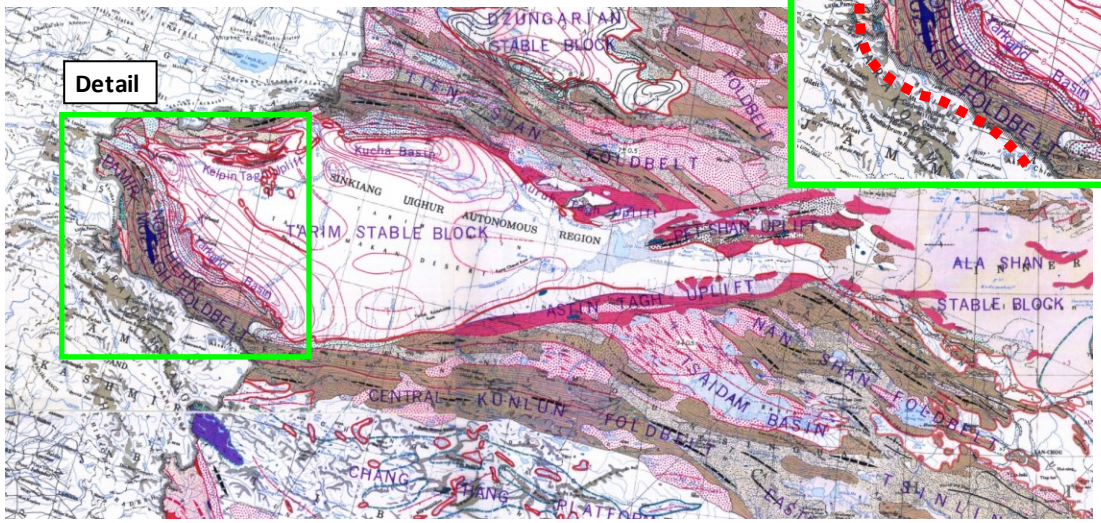
The trajectory (**d**) of the asteroid that caused the elliptical impact on Mars and the trajectory of the impactor that caused the PT-Impact were similar !

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.

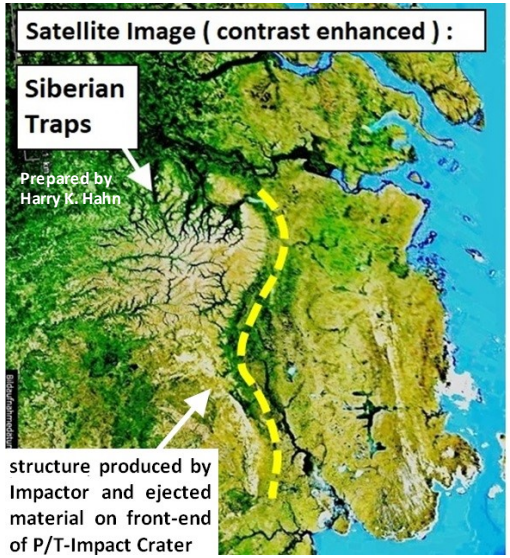
Fig. 2. Atmospheric flight trajectories for asteroids (top) and a moonlet (bottom) in the martian atmosphere, as discussed in the text. Both are radially exaggerated.

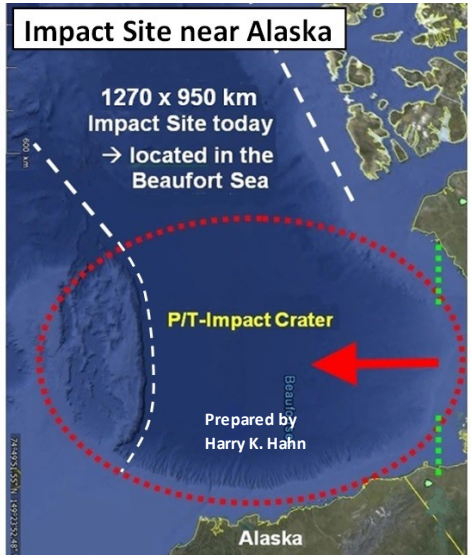
The bow-shaped "Northern Pamir Muztagh Foldbelt" may represent the front-end of another oblique PT-Crater





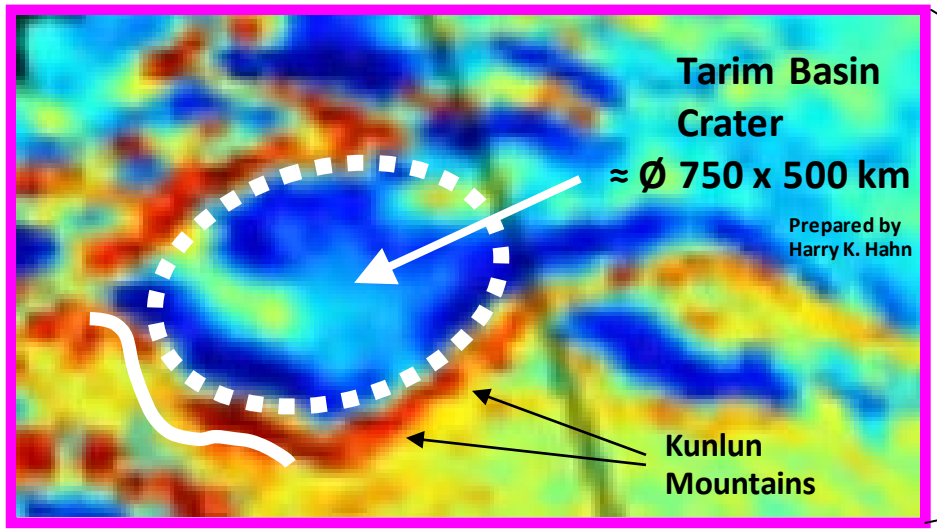
For comparison : front-end of the PT-Impact Crater



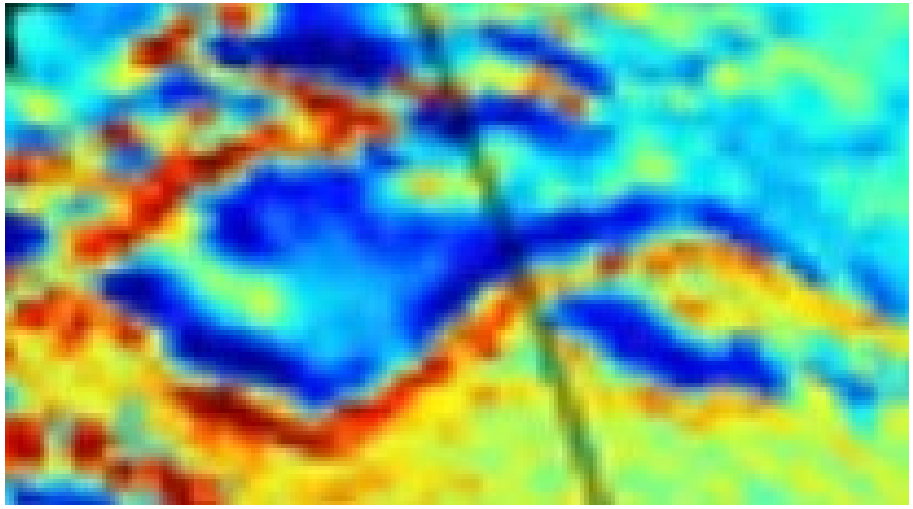


The gravity anomaly map of the Tarim Basin shows a strong negative anomaly (blue)

This indicates that the Tarim Basin and the surrounding Kulun-Mountains (positive anomaly) were caused during the global Permian Triassic Impact Event (see explanation on previous page)

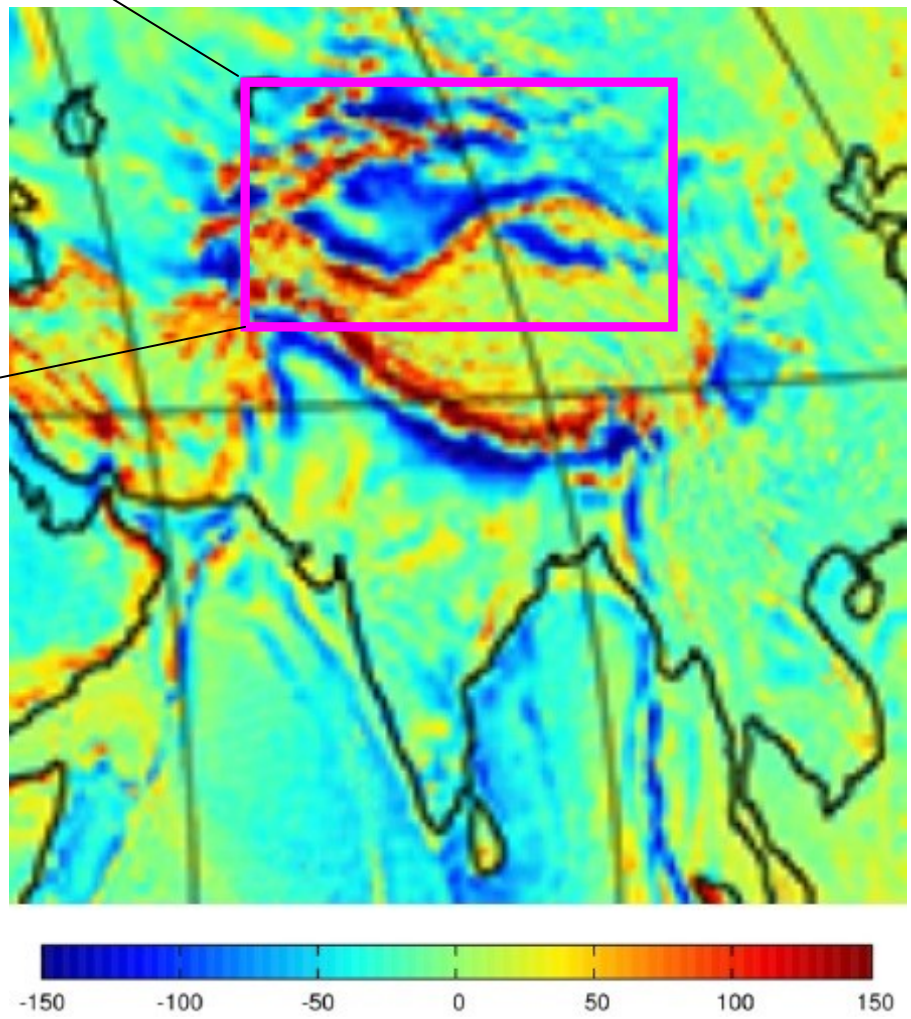


Gravity anomaly map of the Tarim Basin



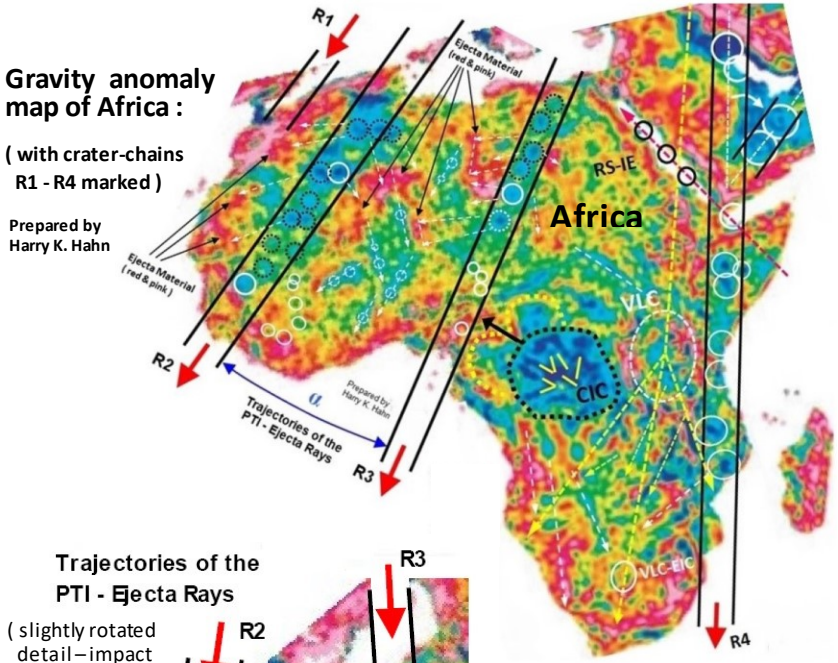
Gravity anomaly map of the India-Himalaya region

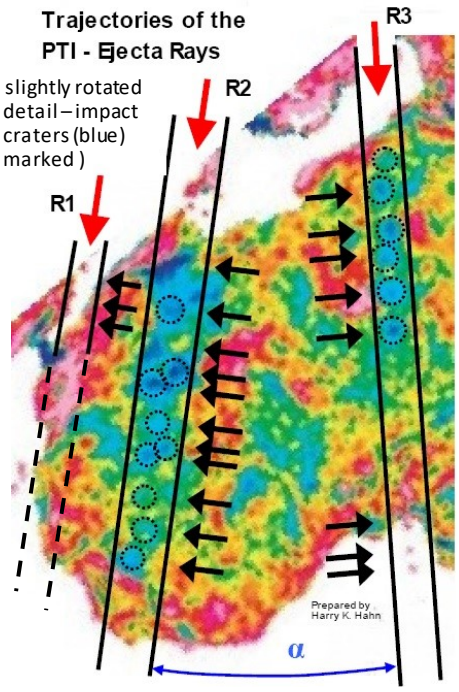
See weblink : Weblink 1, Weblink 2



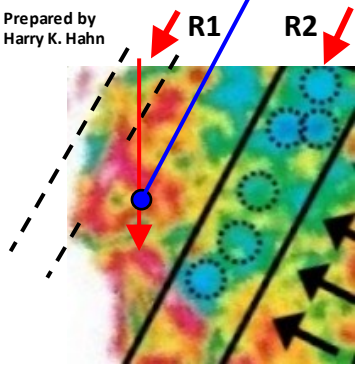
The F'derik Zouerate iron-ore mine in Mauretania may have been caused by iron-rich ejecta from Secondary-Craters within the R1-Ejecta Ray of the Permian Triassic (PT) Impact Event

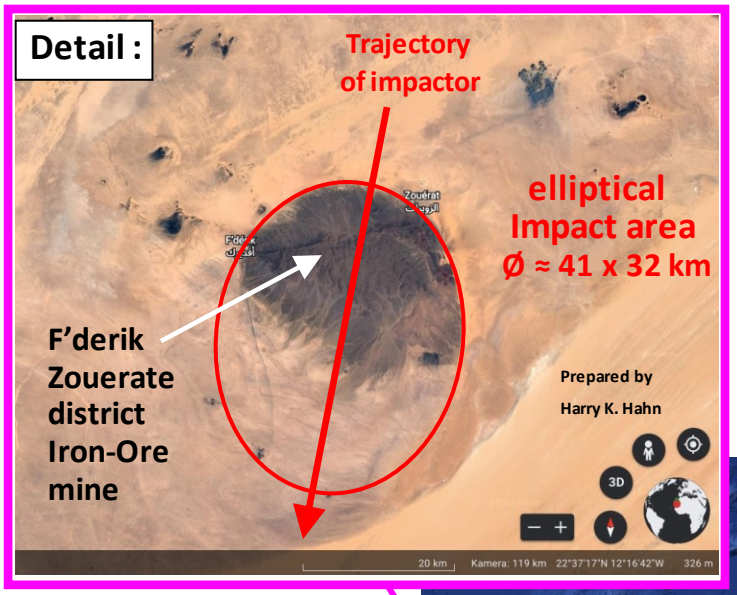
There are four (secondary) impact crater chains **R1 to R4** visible on the gravity anomaly map of Africa, which probably were caused by ejecta from the PT-Impact. The ejecta rays which caused R1 to R4 originate in the center of the PTI-Crater ! The **F'derik Zouerate iron-ore deposits** probably were caused by **R1** ! (see also **Part 2** of my study)





The gravity anomaly map indicates that the **F'derik Zouerate iron-ore** (**mine**) was caused by ejecta (red) from craters within the **R1-Ejecta Ray** of the Permian Triassic (PT) Impact event



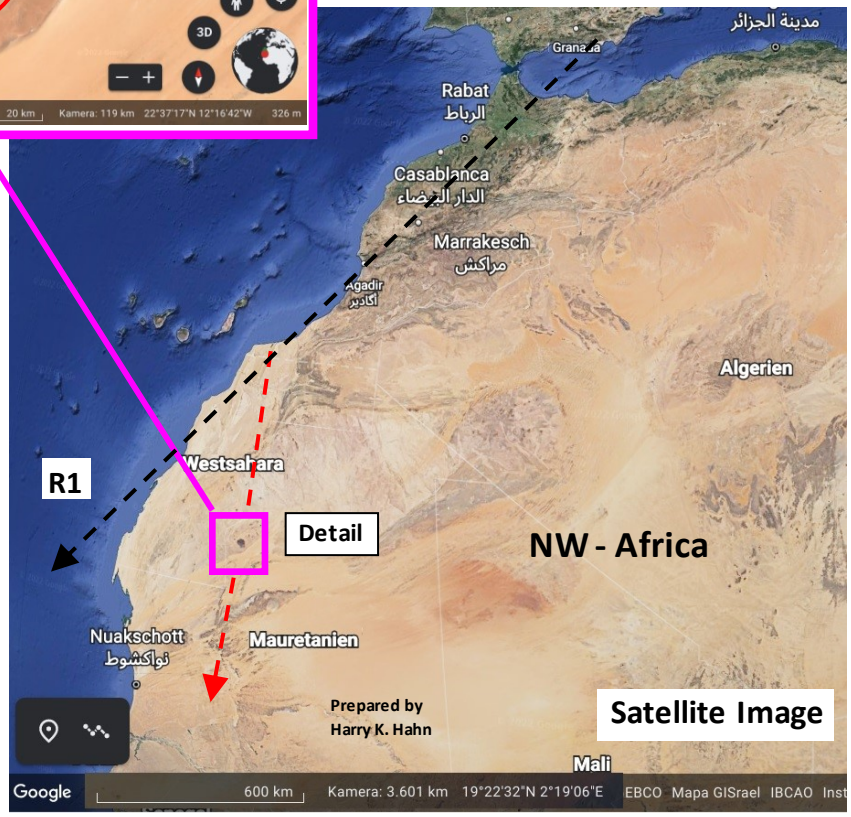


The high-grade iron-ore that was mined in the **F'derik Zouerate district iron-ore mine** in Mauretania since 1952 reached **60-65 wt% Fe** !

Today the magnetite iron-ore comes from Algoma-type banded iron formations (BIF). The main host is magnetite quarzite layers within Mesoarchean **granulite** facies

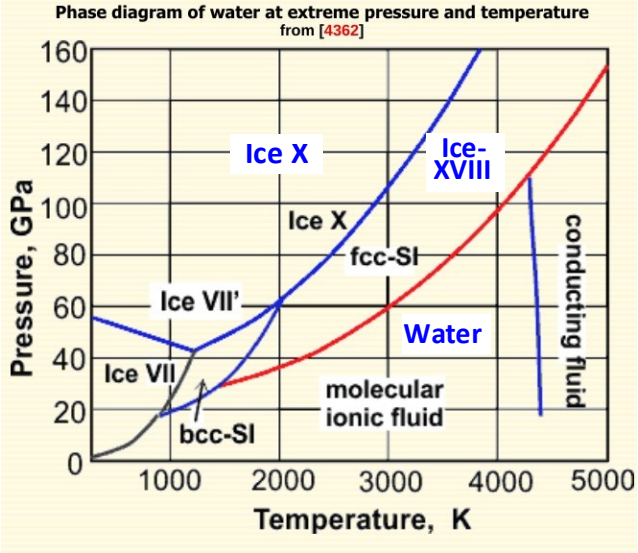
Granulite Facies are highly metamorphed rocks which were transformed under a pressure of around 1Gpa and temperatures of ≈ 700-900°C

The **F'derik Zouerate district iron-ore mine** in Mauretania is located in a dark colored area which contains Fe-rich minerals (high-grade iron-ore minerals). **This iron-rich area has an outline (shape) which can be fit precisely into an ellipse !** → see image on the left ! (even if the southern section isn't visible) Therefore I believe that the iron-rich area is the result of a secondary- or tertiary-impact caused by the PT-Impact Event. And the iron in the metamorphed rock was coming from iron-rich PTI-ejecta !



Appendix A : Phase-Transition Diagrams of Water / Ice and other minerals in Earth's mantle at high pressures and high temperatures

The phase diagram of water (Ice) at very high pressures & high temperatures shows the phase-change of Ice X to Ice-XVIII and then to Ionic-Water (Ionic-Fluid) if the temperature increases or if the pressure drops



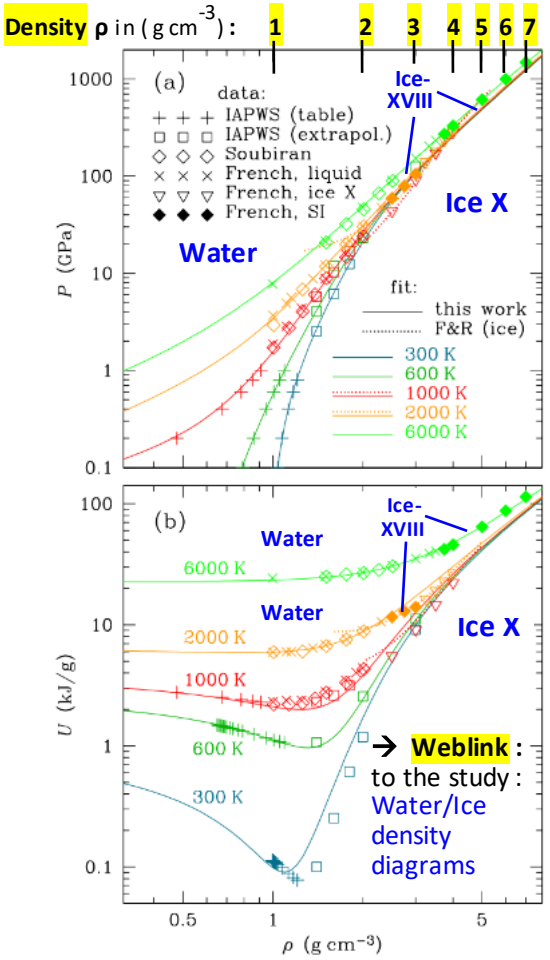
→ **Weblink** : to this Phase diagram of water_Info

A phase diagram of water at extreme pressures (up to 160GPa) and temperatures (up to 5000 K) is available, see right, ([4362] also compares prior work). The stability regions for the two superionic phases, face-centered cubic oxygen atoms, fcc-SI, and body-centered cubic oxygen atoms, bcc-SI, are indicated. The data was obtained using synchrotron X-ray diffraction and optical spectroscopy measurements of water in a laser-heated diamond anvil cell. The densities of

Many properties of cold liquid water change above about 200 MPa (for example, viscosity, self-diffusion, compressibility, Raman spectra, and molecular separation), which may be explained by the presence of a high-density liquid phase containing interpenetrating hydrogen bonds. The chemical properties of water are also greatly changed at high temperatures and pressures due to the changes in dissociation, solubility, diffusivity, and reactivity due to decreasing hydrogen-bonding [1116].

Diagram (a) : Comparison between input data and analytical fitted **isotherms** for Ice X , Ice-XVIII (superionic water) and liquid-Water **in reference to Density** & **Pressure** (in GPa)

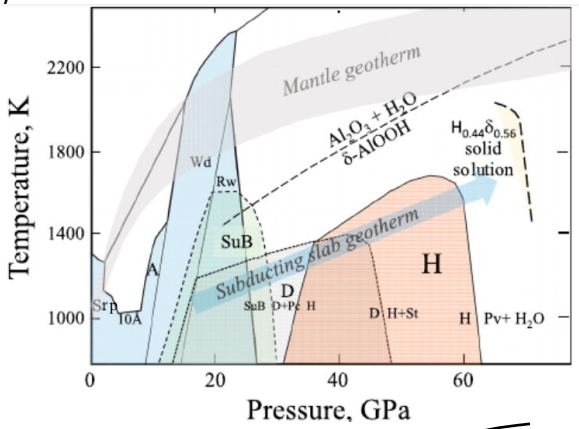
Diagram (b) : and for the internal energy (U)



→ **Weblink** : to the study : Water/Ice density diagrams

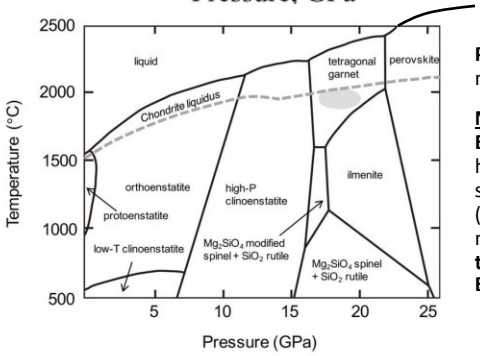
Fig. 3. Comparison between the input data and the analytical fitted isotherms for the pressure P (*panel a*) and for the internal energy U (*panel b*) at relatively low densities. Symbols show the data: the IAPWS (Wagner & Pruß 2002) published table for $P < 1$ GPa (straight crosses) and extension to $P > 1$ GPa according to the IAPWS free-energy model (squares); results of ab initio calculations by Soubiran & Militzer (2015; empty diamonds) and by French et al. (2009; oblique crosses for liquid, inverted triangles for ice X, filled diamonds for the superionic [SI] phase). Solid lines represent the present fit; dotted lines represent the fit of French & Redmer (2015) for ice X.

Here are some **phase-diagrams** of minerals which are believed to form most of the volume of Earth's mantle. (Earths mantle is composed of the elements **O** (43.7%), **Si** (22.5%), **Mg** (18.8%) and **Fe** (9.88%)). However it seems that **Hydrogen** (**H**) also seems to be present in a considerable share in the mantle-minerals, which then forms e.g. **Ice X** and **Water** during phase-transitions



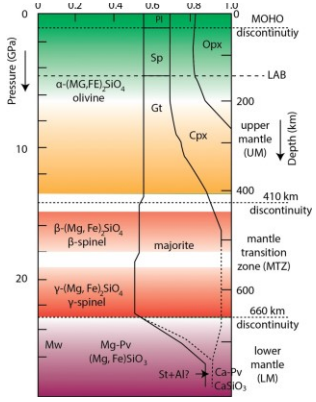
Phase-Diagram of different **hydrous minerals** under lower mantle conditions and conditions up to the transition-zone. The stability fields of the hydrous minerals **Srp**_Serpentinite, 10A-phase, phase-A , and the hydrous **Wd**_Wadsleyite and hydrous **Rw**_Ringwoodite, and the super-hydrous phases B & D are based on Ohtani (2004/05) Further the stability fields of hydrous mineral (MgSi)OOH) → phase H, and δ (AlOOH) estimated by Ohira (2014) is shown as dashed line.

→ **see Study**



Phase-diagram of **Enstatite** ($MgSiO_3$) modified from Pyroxene

Note : **The Perovskite-structure** in **Earth's lower mantle** is adopted at high pressure by **Bridgmantite**, a silicate with the chemical formula **(Mg,Fe)SiO_3** , (the magnesium end-member), which is **believed to be the most common mineral in Earth's mantle**



Phase-diagram showing the phase transformations of the minerals in the upper mantle, transition zone (MTZ) and in the upper part of the lower mantle. (down to ≈ 800 km depth) in reference to depth (in km) and pressure (in GPa).
The horizontal axis shows the share of these minerals.
(1.0 = 100%)

At 410 km and 660 km depth major phase-changes take place

References :

Hypothesis about the Permian Triassic Impact Event (PTI) → weblinks to the Parts 1 to 6 of my hypothesis : → available on **vixra.org** and on **archive.org**

Weblinks to my studies on → vixra.org :	**Weblinks to my studies on → archive.org**
Part 1 : https://vixra.org/abs/2012.0210	Study-Part 1
Part 2 : https://vixra.org/abs/2101.0052	Study-Part 2
Part 3 : https://vixra.org/abs/2101.0096	Study-Part 3
Part 4 : https://vixra.org/abs/2101.0067	Study-Part 4
Part 5 : https://vixra.org/abs/2101.0127	Study-Part 5
Part 6 : https://vixra.org/abs/2104.0099	Study-Part 6
Part 6b : https://vixra.org/abs/2110.0042	Study-Part 6b

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2. Jim Standard & C. Austen Angell **:** Raining lead around 250 mya : A smoking gun for an Australian impact origin of the Permian Extinction Department of Chemistry and Biochemistry, Arizona State University - A study which indicates a Permian-Triassic Impact Event in Australia :
3. C. Koeberl, F. Martinez-Ruiz : **Impact Markers in the Stratigraphic Record** 2003 ; Springer Verlag ; ISBN : 3-540-00630-3

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1. Dirk Elbeshausen, Kai Wünnemann, Gareth S Collins : **The transition from circular to elliptical impact craters** → or alternative : weblink 2
2. Dirk Elbeshausen, Kai Wünnemann : **The Effect of Target Topography and Impact Angle on Crater Formation** -- Insight from 3D Numerical Modelling
3. Michael H. Poelchau : **The subsurface structure of oblique impact craters**
4. Dr. Ludovic Ferriere : Introduction : **Impact Metamorphism** → weblink : http://www.meteorimpactonearth.com/impactmeta.html
5. W.U. Reimold, R.L. Gibson : **Meteorite Impact** ; Council for Geoscience, Germany 2009, Springer Verlag
6. R.L. Gibson, W.U. Reimold : **Large Meteorite Impacts and Planetary Evolution IV** The Geological Society of America, Special Paper 465 Boulder Colorado 2010 ; ISBN: 978-0-8137-2465-2
7. C. Koeberl, F. Martinez-Ruiz : **Impact Markers in the Stratigraphic Record** 2003 ; Springer Verlag ; ISBN : 3-540-00630-3
8. R.W.K. Potter : **Numerical modelling of basin-scale impact crater formation** → http://www.lpi.usra.edu/lpi/potter/publications/RossThesis.pdf, **see also**: Orientale impact
9. **Crater Formation on the Moon** → Animations to explain the Crater Formation on the Moon

References to studies & infos about the origin of Earth's water, and possible hydrous-minerals & Water/Ice in Earth's mantle & phase diagrams

Where did Earths water come from ? - Conel Alexander, Carnegie Science – Earth & Planetary Lab.
https://epl.carnegiescience.edu/news/where-did-earths-water-come

Origin of water on Earth - Havard University
https://courses.seas.harvard.edu/climate/eli/Courses/EPS281r/Sources/Origin-of-oceans/1-Wikipedia-Origin-of-water-on-Earth.pdf

Reading the ridges: Are climate and the seafloor connected ? - Julia Rosen
https://www.earthmagazine.org/article/reading-ridges-are-climate-and-seafloor-connected

CM Chondrites & Enstatite Chondites
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Ab initio based equation of state of dense water for planetary and exoplanetary modeling - S. Mazevet, A. Licari
https://www.aanda.org/articles/aa/abs/2019/01/aa33963-18/aa33963-18.html

Water Phase Diagram at very high pressures & temperatures
https://water.lsbu.ac.uk/water/water_phase_diagram.html

Open questions on the structures of crystalline water ices - Thomas Loerting, Violeta Fuentes-Landete & others
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