Mineralogical- and Geological Evidence for the Permian-Triassic Impact Event

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

by Harry K. Hahn / Germany - **Update** from **22. July 2021** - **Note:** Document not allowed for commercial use !

Abstract :

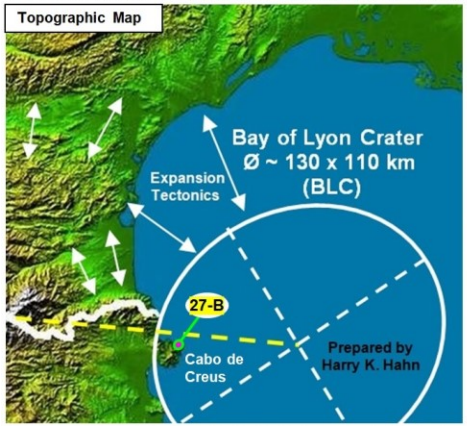
With this part of my study I want to present mineralogical evidence for my Permian Triassic Impact Hypothesis. I do this with the help of selected rock samples where I have found shock-metamorphic effects in the samples. I used **Micro-Raman Spectroscopy** on quartz grains in the samples, to provide first evidence for a shock event, that was caused by an Impact. In this Update I present spectra of samples from **five possible secondary impact craters of the Permian Triassic Impact Event (PTI)** in Europe & Australia where a clear shift of the main Raman-peaks of the analysed quartz-grains is visible towards lower frequencies. This shift of the Raman peaks indicates that the Quartz was shocked with a shock-pressure in the range of 20 – 22 GPa. One sample from the possible Ø130 x 110 km „Bay of Lyon" Crater even indicated a shock pressure of ≈ 24 GPa. I also present the analysis results of two more possible secondary impact craters (No. 4 & 6), one in Italy and one in Australia. where the spectroscopic evidence is a bit weaker.

First I will give a short description of each possible Secondary Impact Crater of the PTI with the help of geophysical information (topography, gravity- & magnetic-anomaly maps) Then I will show the spectra of the quartz-grains which provide evidence for an impact shock event. All spectra were made with a BRUKER Senterra-II Raman Microscope with a wavenumber precision < 0.1 cm^{-1}. Therefore the measured shifts of the quartz peaks in the range of 1 – 4 cm^{-1} towards lower frequencies can be considered to be precise and real A diagram in the Appendix (see last pages) shows how the shift of the quartz peaks depends on the shock pressure the quartz-grain was exposed to, during the impact event.

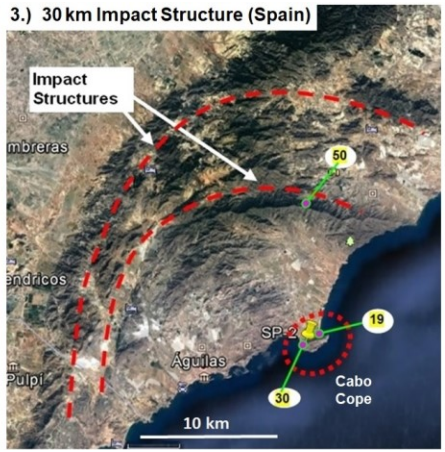
For some of the other impact structures described in my PTI-hypothesis I also want to present a few Raman spectra of selected samples. But it will be more difficult to present spectroscopic evidence for these possible impact structures. I will do this in an Update in the coming months. Please have a look from time to time. In any case I want to ask all scientists who read my study, to help to proof the Permian Triassic Impact Crater in the Arctic Sea. The best way to proof it would be a detailed analysis of drill core samples from the rim of the PTI-Crater. But first a proper analysis of samples from the possible PT-Secondary Craters No. 1 – 7, for PDFs (planar deformation features) should be done.

The **Micro-Raman spectroscopic analysis results** and images of all Rock Samples & Sample Sites are on my website : **www.permiantriassic.de** (or : **www.permiantriassic.at**)
The detailed description of the Permian Triassic (PT)-Impact Event, which formed the **Ø 1270 x 950 km PT-Impact Crater** in the Arctic Sea, can be found in **Part 1** to **4** of my study
Possible sample sites for the PT-Impact Crater, its Secondary Craters & other Craters - see here : Recommended sites to proof the PT-Crater & other (Secondary) Craters (or : L2)

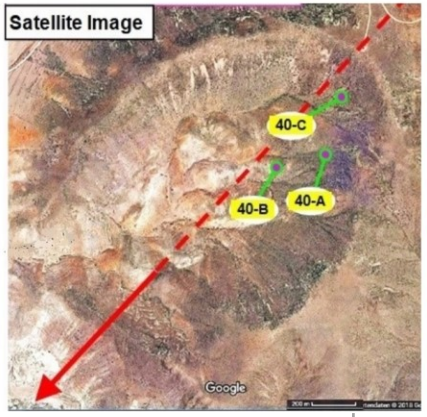
1.) Ø130 x 110 km Bay of Lyon Crater (Spain/France)



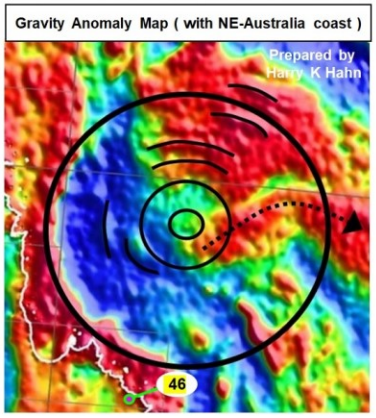
3.) 30 km Impact Structure (Spain)



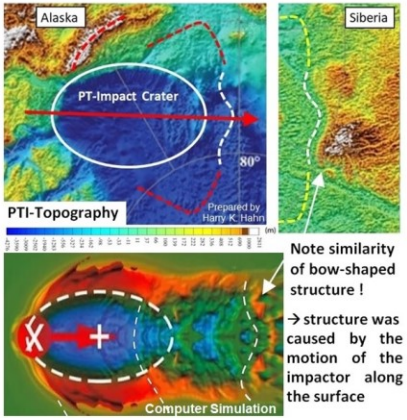
2.) Ø1.6 x 1.2 km elliptical Impact Crater (Spain)



5.) Ø 320 km Cape York Crater (Australia)



The Ø 1270 x 950 km Permian-Triassic Crater

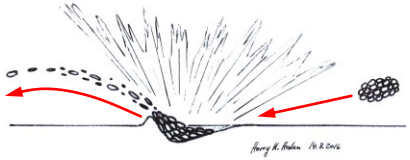


Contents :

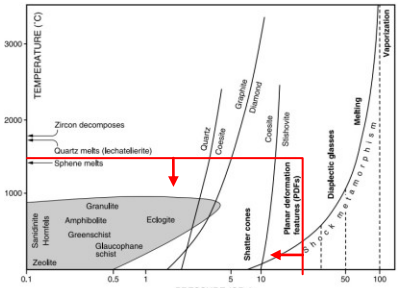
1	Summary of new evidence for the PT-Impact / Existing evidence for the PTI	**Page :**	**2 / 3**
2	The Ø 130 x 110 km "Bay of Lyon Crater" / Raman spectra of rock samples		**4**
3	The Ø 1.6 x 1.2 km elliptical Impact Crater / Raman spectra of rock samples		**7**
4	The Ø 30 km Impact Structure (Spain) / Raman spectra of rock samples		**10**
5	The Ø 160 km "Salerno Crater" (Italy) / Raman spectra of rock samples		**13**
6	The Ø 320 km Cape York Crater (Australia) / Raman spectra of rock samples		**16**
7	The Ø 30 km Mt Warning Crater & Ø1.5 km Crater (Australia) / Raman spectra		**19**
8	The Ø 40 x 33 km elliptical Pilbara Crater (NW-Australia) / Raman spectra		**22**
9	Other possible Impact Structures (e.g. the Ø 320 km SOC & the Canary Islands		**25**
10	Appendix 1 : Raman peaks of Quartz shocked with 22-26 GPa / **References**		**29/30**

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 impact researchers and geologists and the head office from the University Karlsruhe (KIT) about the discovered PT-Impact Crater. But the only answer and feedback, which I got so far (from the KIT) was : "My discoveries aren't explainable with the current state of geophysics"

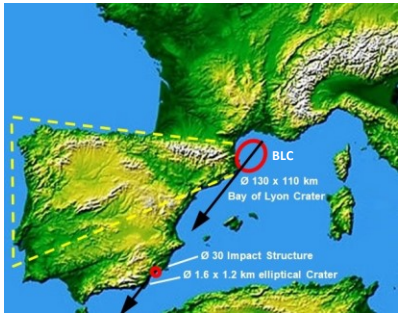
Summary of the mineralogical- and geophysical evidence for the PT-Impact Crater & -Impact Event



The PT-Impact Crater was formed by a very shallow impact with low shock pressures



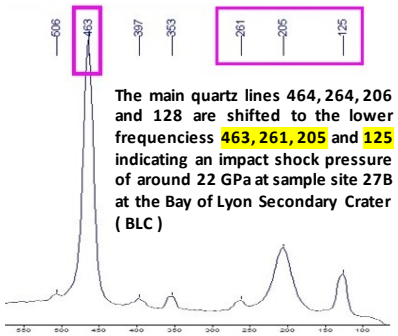
Shock metamorphic effects in PT-ejecta → red marked box (shock metamorphism diagram)



This map shows the three most interesting PT-Secondary Craters for further research in Europe, according to my analysis.

The Ø130x110 km "Bay of Lyon Crater", the Ø30 km and the Ø1.6x1.2km Impact Craters

The Raman Spectra of quartz grains from sample site 27B at the BLC shows a clear shift of main quartz peaks to lower frequencies



To proof an impact-crater or impact-structure shock-metamorphic effects must be discovered which provide clear evidence for each impact crater- or structure. In the case of the Ø 1270 x 950 km PT-Impact Crater described in my hypothesis (→**Part 1** to **4** of my study) this isn't an easy job !

Two main reasons why it's difficult to proof the PT-Crater :

1.) The PT-Crater is located on the ocean floor of the Arctic Ocean in > 2000 m depth, and it is filled with sediments.

2.) The PT-Crater was caused by an oblique impact. This means the impactor, an asteroid or comet with a Ø 60 to 200 km, impacted in a very shallow angle of less than 8° with an impact velocity of < 8 km/s (=orbital velocity of a small moonlet close to Earth). That's why **the impactor impacted and moved in a nearly horizontal direction** along Earth's surface, excavating big amounts of crust- & mantle-material.

Therefore the impact pressure caused during the impact was relatively low and **most of the ejecta material** that was ejected **from the PT-Crater was exposed to a shock pressure of probably less than 20 GPa**. Impact glass probably doesn't exist in this ejecta material. And shock-metamorped minerals like Coesite probably only exist in small amounts.

The same is true for all secondary structures caused by ejecta from the PT-Crater. The shock-pressure was mainly < 20 GPa

Exceptions seem to be real PT-Secondary Craters which can clearly be identified on topographiy-, magnetic- and gravity-anomaly maps as crater structures. Here shock-metamorphic effects can be found in rocks inside of the crater, in the crater-rim area or close to the Crater (e.g. Cape York Cater)

My analysis indicates that shock-pressures in the range of 22-24 GPa can be identified in / near such Secondary Craters

These impact shock-pressures can be identified with the help of **PDFs** or with **Micro-Raman Spectroscopy** on quartz grains

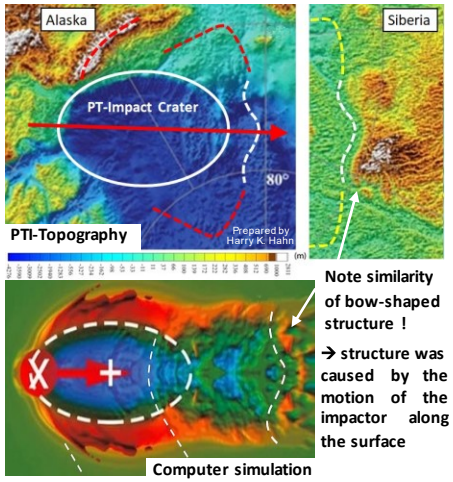
The Ø130x110km Bay-of-Lyon Crater and the Ø30km Impact Structure and the Ø1.6x1.2km Impact Crater in Spain are the most interesting PT-Secondary-Craters for further scientific research in Europe (→proof of PT-Impact Event !). And the Ø320km Cape York Crater and the Ø40x33km Pilbara Crater are the most interesting PT-Secondary Craters in Australia.

Detailed information about the material that was ejected by the PT-Crater can be found in studies about the **Siberian Traps**

The geophysical evidence for the Ø 1270 x 950 km PT-Impact Crater is provided by different map types.

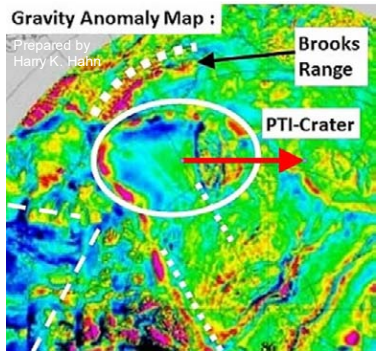
According to my hypothesis, the similarities of structures visible on a topographic map, to structures calculated by a computer simulation provide the most impressive indication (proof) for the PT-Crater !

Further indication for the enormous PT-Impact Crater described in my hypothesis comes from a gravity-anomaly- & magnetic anomaly map.



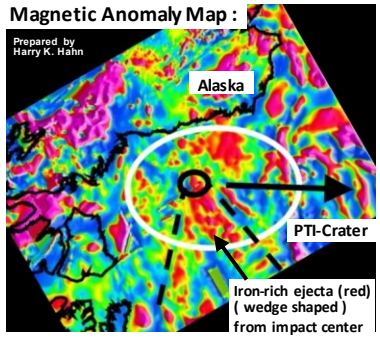
The gravity anomaly map is clearly indicating the elliptical PT-Crater and a section of the elliptical crater-rim that drifted away from the PT-Crater caused by forces of the escaping ejecta

This former section of the crater-rim is the Brooks Range in Alaska which indicates a formation age of ≈ 250 Ma ! Further there are linear structures noticable, caused by ejecta rays.



The magnetic anomaly map shows a distinct wedge-shaped structure with the apex of the structure being congruent with the PT-Crater center.

This indicates iron-rich ejecta that was ejected from the PT-Crater (red color)



Further evidence comes from the distribution pattern and outline of the Siberian Traps. The map on the right shows the PTI-Crater in reference to the Siberian Traps as it was located at the time of the Impact. The trajectory of the impactor fits perfectly to the "main flow-direction" of the Siberian Traps (red). **Note :** The PTI ejected ≈ 100.000.000 - 200.000.000 km^3 material

Indication and evidence for the Permian-Triassic (PT) Impact Event which is coming from existing studies :

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

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

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

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

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.

see Study :
End-Permian catastrophe by bolide impact: Evidence of a gigantic release of sulfur from the mantle
by Kunio Kaiho, Y.Kajiwara, Yasunori Miura

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. (→ These events were the result of the P/T-Impact Event !! → comment from Harry.K.Hahn)

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

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

→ Evidence of shock-metamorphic effects from five possible Secondary Craters of the PT - Impact Event

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1.) The ≈ Ø 130 x 110 km "Bay of Lyon Crater" in France :

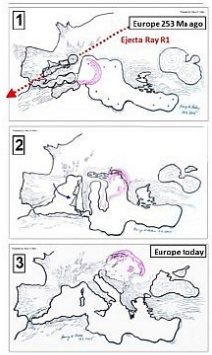
→ Shock-metamorphic effects of the Impact : Shocked quartz was found in rock samples from sample site 27-B

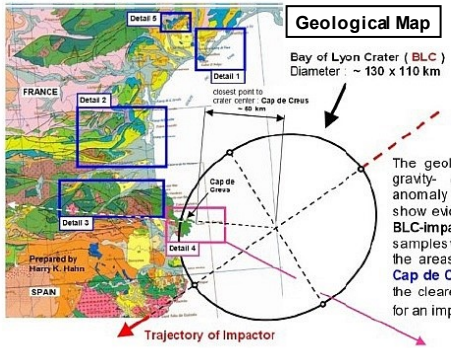
Photos of the Sample Sites & Rock Samples (No. 27-B3 (1-4)) are available here : ► Sample Sites "Bay of Lyon Crater"

The Ø 130 x 110 km Bay of Lyon Crater is the first member of a secondary impact crater chain which formed the coastline of Eastern-Spain and the western coastline of Italy. (→ see description in my PT-Impact hypothesis) It was the first and probably most powerful crater at the northern end of this secondary crater chain, and it represents approximatelly the pivet-point, around which the Italian mainland and the Yugoslavian Block, rotated after the PT-Impact Event (see image sequence 1-3 below). RAMAN spectra of quartz grains from sample site 27-B clearly indicate a shock-event caused by an Impact which has formed "Cabo de Creus" (site 27-B). **This is a first strong indication for the existence of the Ø 130x110km "Bay of Lyon" Crater**

The possible impact crater is noticeable on a gravity anomaly map and the crater-center has left a strong signature on the magnetic anomaly map too, which indicates that the impactor (a big ejecta fragment from the PT-Crater) probably consisted of a considerable amount of iron.

The closest point on land in reference to the assumed crater center of the "Bay of Lyon Crater" is **Cabo de Creus** in Spain. Here sample location **27-B** is located. The rock-type (46) marked in dark green on the geological map is ≈ 440-550 Ma old (Paleozoic Age) and therefore contains shock-metamorphic effects of the PTI-event, in this case from the "Bay of Lyon Crater". Sample site 27-B shows a large area which consists of rock that was partly melted and strongly deformed. In all probability all the rock on this site is partly melted ejecta from the Bay of Lyon Crater, and some of the rocks may be ejecta from the PT-Impact Crater as well. Cabo de Creus may represent a small remaining section of the original crater-wall of the "Bay of Lyon Crater"

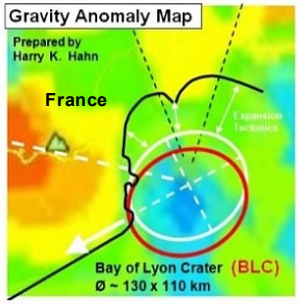


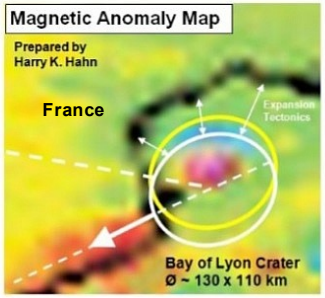


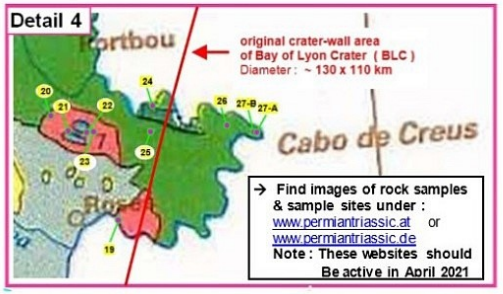
The geological map, gravity- & magnetic anomaly maps all show evidence for the **BLC-impact**. Rock samples were taken in the areas Detail 1-5. **Cap de Creus** shows the clearest evidence for an impact event.

→ Geological Map of Spain :

http://www.zonu.com/fullsize-en/2010-09-01-12020/Geological-map-of-Spain-1994.html







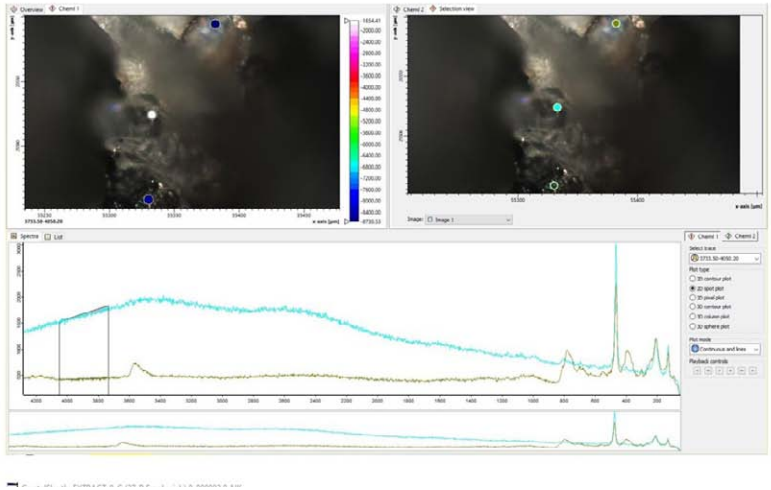
The above shown **Cap de Creus** is the closest point to the center of impact of the **Bay of Lyon Crater (BLC)**. Distance to the crater center **~ 50 km**

It seems that **Cap de Creus** is a remain of the original crater-wall of the Bay of Lyon Crater ! Therefore it should be a primary research area for the scientific analysis of this Impact Event.

RAMAN-Spectra of Rock Samples from Sample Site 27-B , provide first evidence for the Ø 130 x 110 km "Bay of Lyon" Crater (France)

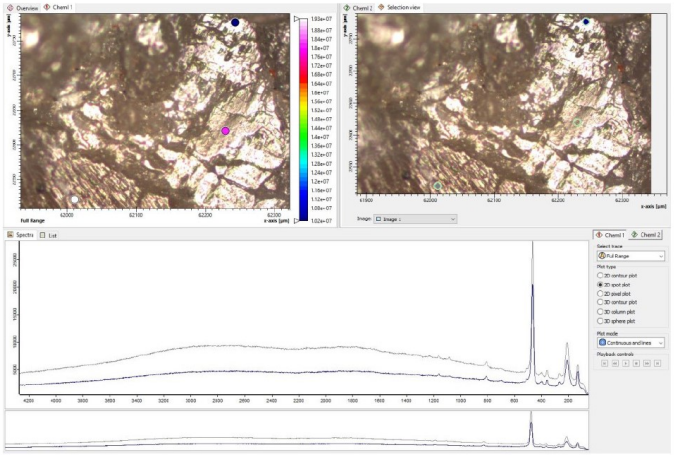
→ **All spectra and microscope-images taken from rock samples are available here : Raman spectra of rock samples from the Bay-of-Lyon Crater** (or **here**)

Sample Site 27-B : Stone 6_spectra 1 indicates :
Quartz, Dachiardite-Na, Sugilite, Amicite (RRUFF database)



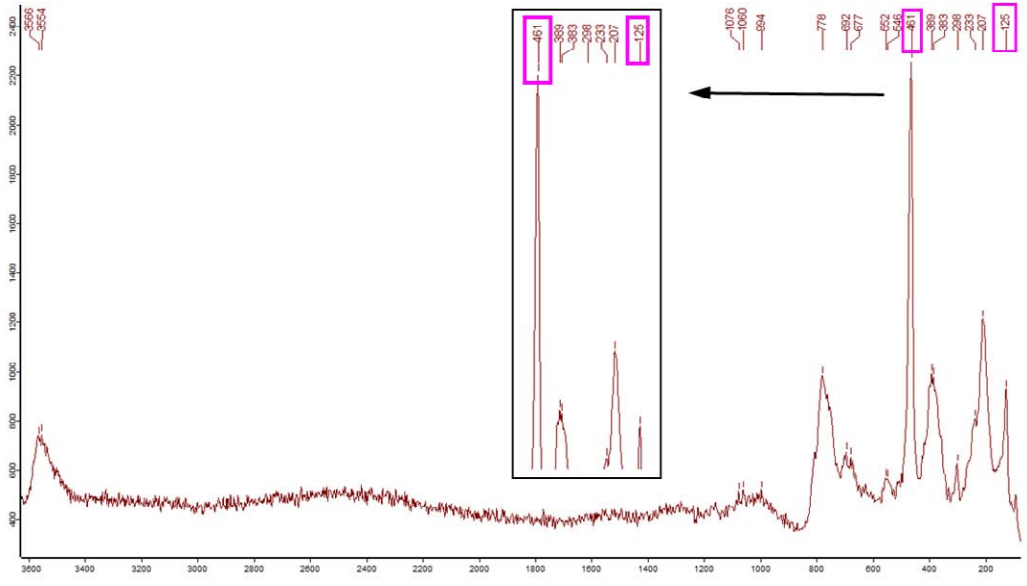
Sample :

Sample Site 27-B : Stone 3_spectra 1 indicates : Quartz
(→ see RRUFF database search result)

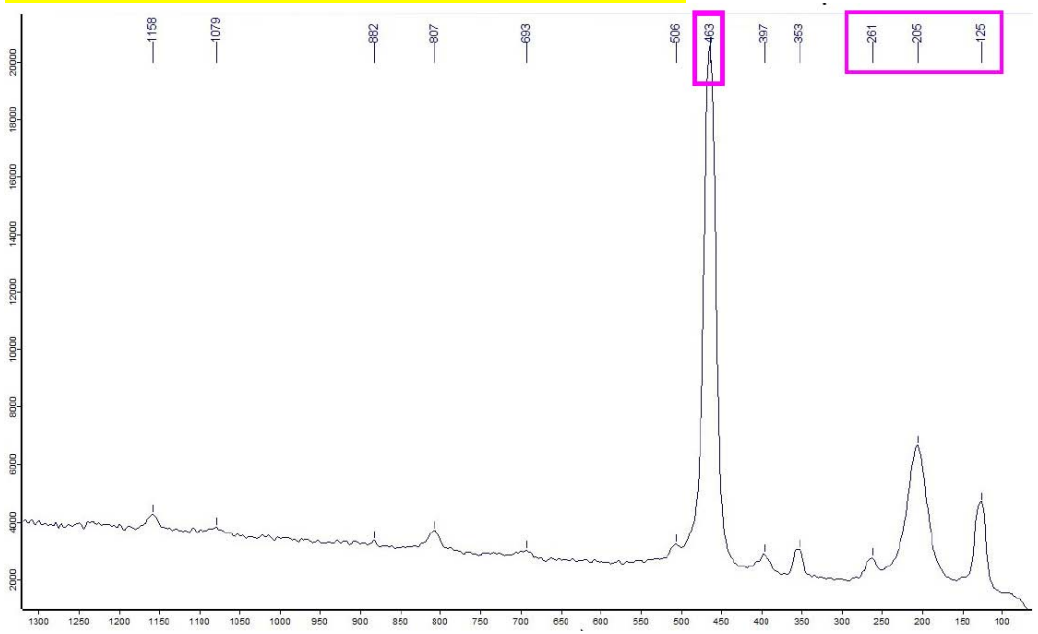


Sample :

The shift of the main spectral line of the Quartz towards 461 in the sample indicates a shock pressure of around 24 GPa

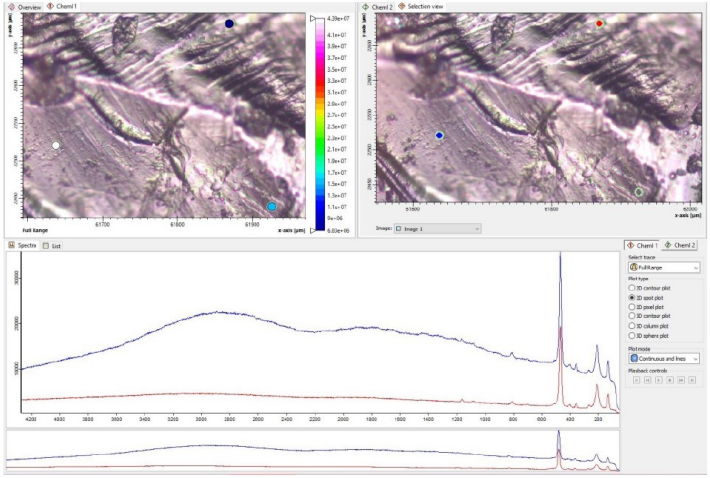


The shift of the main spectral line of the Quartz towards 463, 261, 205 and 125 in the sample indicates a shock pressure of around 22 GPa



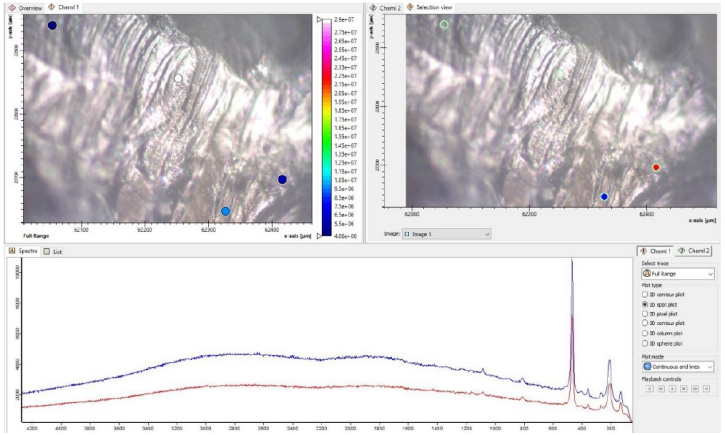
→ **All spectra and microscope-images taken from rock samples are available here : Raman spectra of rock samples from the Bay-of-Lyon Crater** (or **here**)

Sample Site 27-B : Stone 2_spectra 1 indicates : Quartz (→ RRUFF)



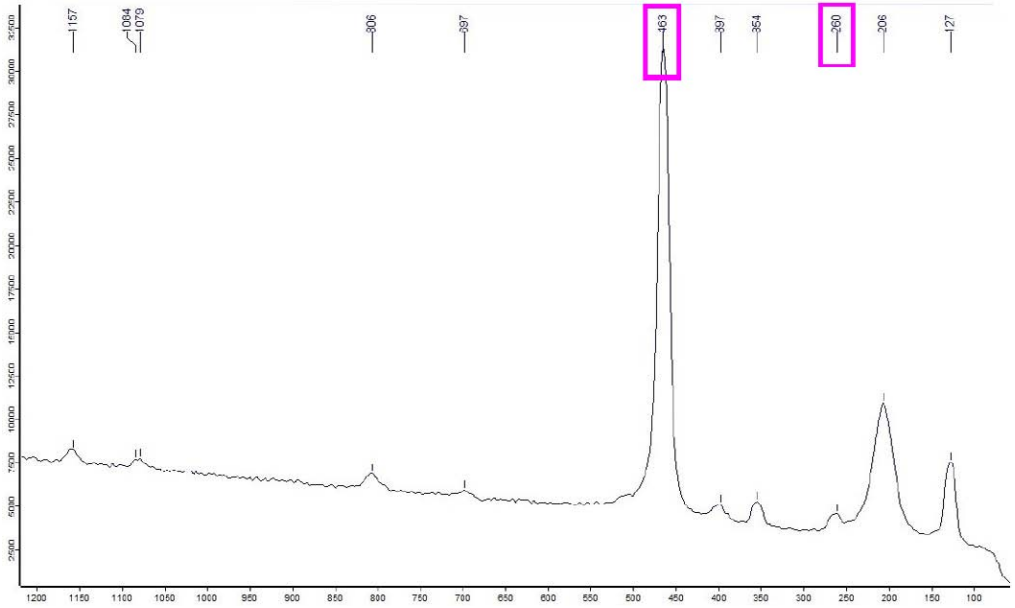
Sample :

Sample Site 27-B : Stone 5_spectra 1 indicates : Quartz (→ RRUFF database)

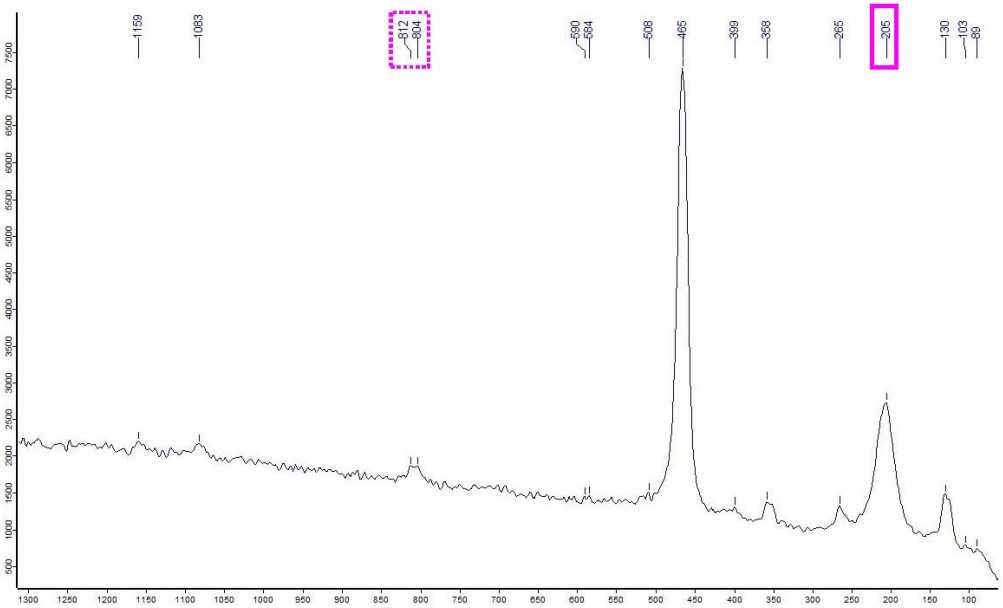


Sample :

The shift of the main spectral line of Quartz towards 463 in the sample indicates a shock pressure of around 22 GPa



Indication for a shock event is the shift of the marked Quartz spectral line towards 205



2.) The Ø 1.6 x 1.2 km elliptical Impact Crater in Southern-Spain (≈ 35 km East of Almeria) :

→ **Shock-metamorphic effects of the Impact : Shocked quartz was found in rock samples from Sample Site 40-B**

Photos of the Sample Sites & Rock Samples (No. 40-B and others) are available here : ► Sample Sites - Spain_3

At the center of this elliptical Impact Crater shock-metamorphed rock (Impact-Breccia) crops out of the ground. This certainly isn't a volcanic structure ! It is a perfect Ø 1.6 x 1.2 km "oblique impact crater", but unknown to the geological society ! **RAMAN spectra of quartz from sample site 40-B point towards a shock-event caused by an Impact.** The spectra indicate that the quartz was exposed to an **impact shock pressure of around 22 GPa.**

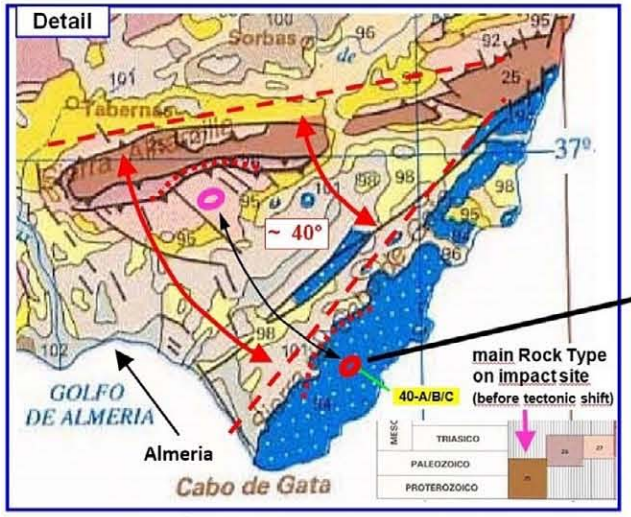
This elliptical Impact Crater is very interesting because it has the potential to proof the large-scale impact-scenario in Southern-Spain, which in all probability was caused by the PT-Impact Event. And it can proof the tectonic-shift and rotation of a large area consisting of Proterozoic Rock (> 250 Ma old) which in all probability was caused by the tectonic motion of the African Plate, that was triggered by impacting ejecta of the PT-Crater.

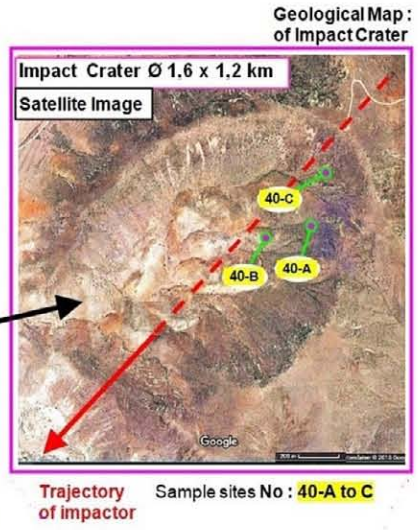
Please note that the crater originally impacted in the "brown-colored" rock-type 25, which is Proterozoic Rock ! (see Geological Map below !)

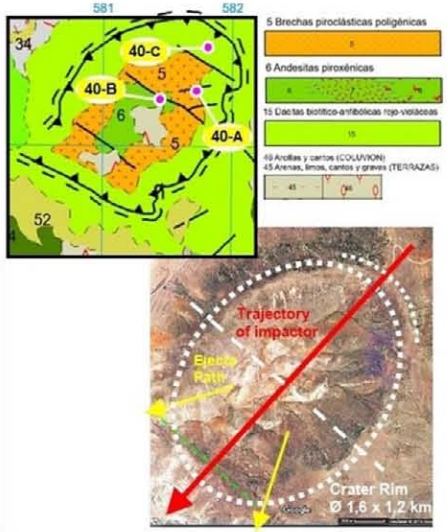
This is indicated by the curved cutout (or dent) visible in the brown rock-type (see map below), which represents a linear 300 - 400 m high mountain range. I have drawn-in a small pink-colored ellipse on the position where I believe the crater was originally located in reference to this mountain range.

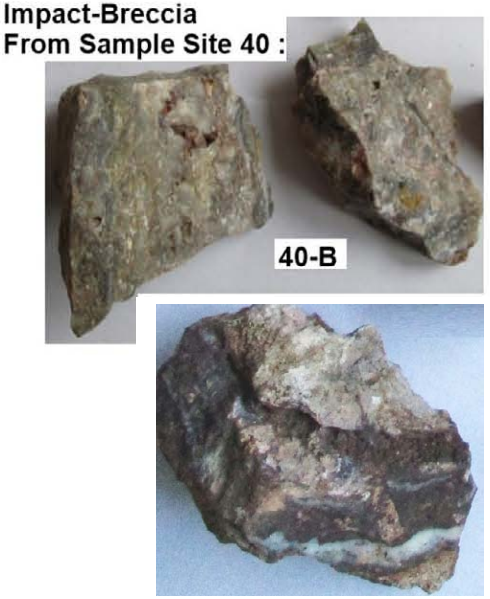
This mountain range consisting of rock-type 25 in all probability is the remaining section of an ejecta ray from the PT-Crater, and the small elliptical crater was caused by a larger fragment from the ejecta of the PT-Crater. The blue-colored rock type is much younger and was produced by the volcanic activity which was triggered by the large-scale impact event.

The orientation, ellipticity and shape of the impact crater, which is perfectly orientated in line with the mountain range, provide precise information about the trajectory, impact angle and velocity of the ejecta from the PT-Crater that impacted here. Therefore this secondary-crater of the PT-Impact Event should be an important study object in order to bring light in the large-scale impact scenario caused by the PTI which took place in Europe ≈ 253 Ma ago









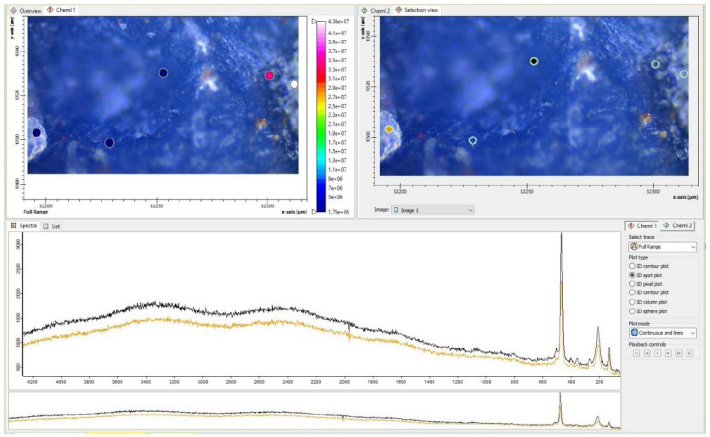
→ **Weblink to the Geological Map of Spain :**

http://www.zonu.com/fullsize-en/2010-09-01-12020/Geological-map-of-Spain-1994.html

RAMAN-Spectra of Rock Samples from Sample Site 40-B, provide first evidence for the Ø 1.6 x 1.2 km elliptical Crater (southern-Spain)

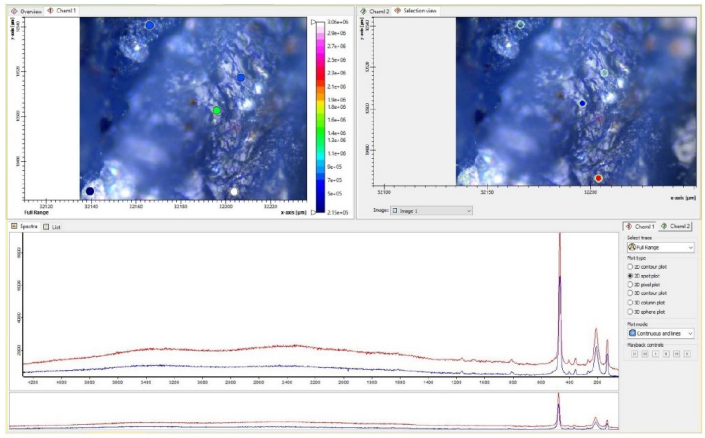
→ **All spectra & microscope-images taken from rock samples are available here : Raman spectra of samples from the 30 km & 1.6x1.2 km Craters** (or **here**)

Sample Site 40-B : Stone 1_spectra 1 indicates : Quartz (→ RRUFF_search results)



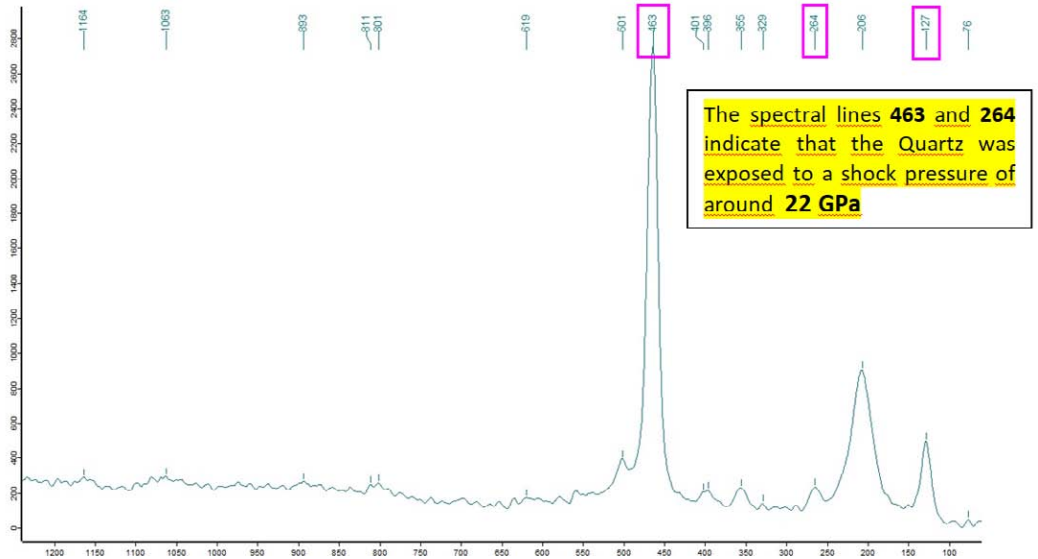
Sample :

Sample Site 40-B : Stone 1_spectra 2 indicates : Quartz (→ RRUFF_search results)

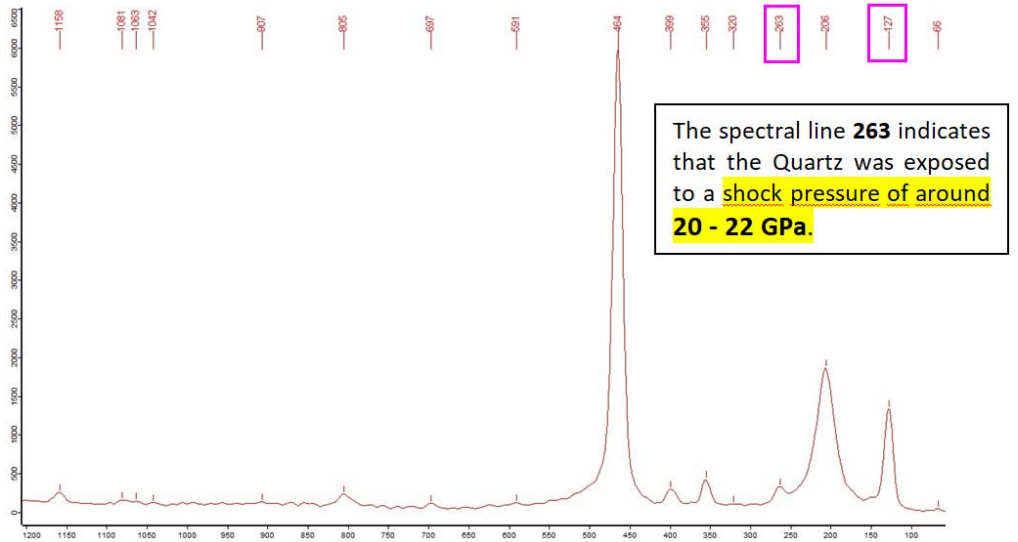


Sample :

Indication for a shock event are the shifts of the marked Quartz spectral lines towards 463 and 264

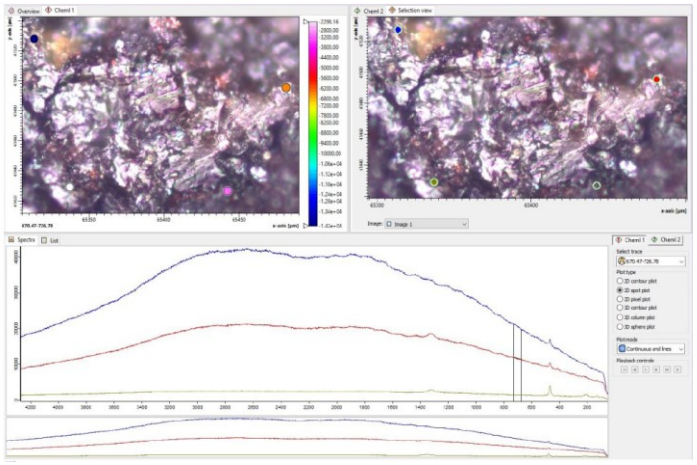


Indication for a shock event is the shift of the marked Quartz line towards 263



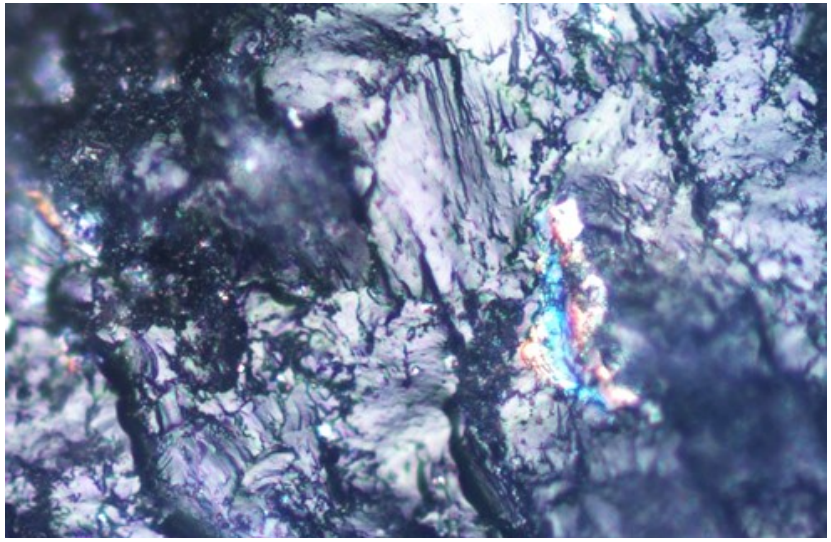
→ **All spectra and microscope-images from rock samples are available here : Raman spectra of samples from the 30 km & 1.6x1.2 km Craters** (or **here**)

Sample Site 40-B : Stone 2_spectra 1 (brown mineral) indicates : Quartz
(→ see RRUFF_search results)

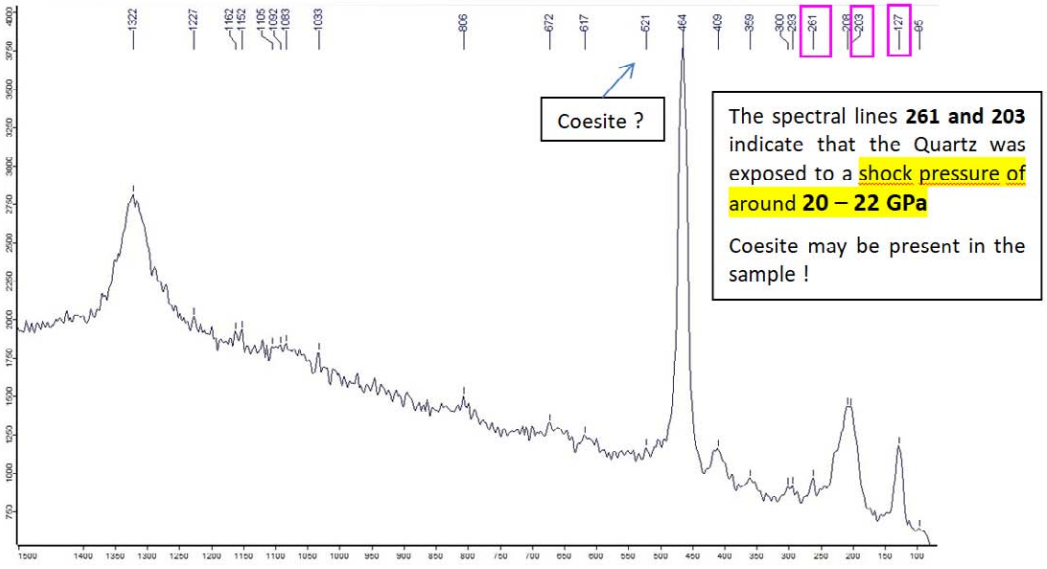


Sample :

Sample Site 40-B : Stone 1_spectra 2 : Quartz - Image size : ~ 400 x 300 µm



Indication for a shock event are the shifts of the marked Quartz spectral lines towards 261 and 203



Rock Samples from Sample Site 40-B :

3.) The ≈ Ø 30 km Impact Structure in Southern-Spain (near Puerto de Mazarron in Murcia in Andalucia) :

→ Shock-metamorphic effects of the Impact : Shocked quartz was found in rock samples from the Sample Sites 50 and 19-B & 30-B

Photos of these Sample Sites & Rock Samples (and others) are available here : ► Sample Sites - Spain_3 & Sample Sites -Spain_1 & 2

The ≈ Ø 30 km bow-shaped Structure which is visible on the satellite image (→ see image below) was caused by an Impact Event. **Shocked quartz** that was found on **sample site 50** clearly indicates that the quartz was exposed to a **shock pressure of around 22 GPa**. (→ see RAMAN spectra on the next pages)

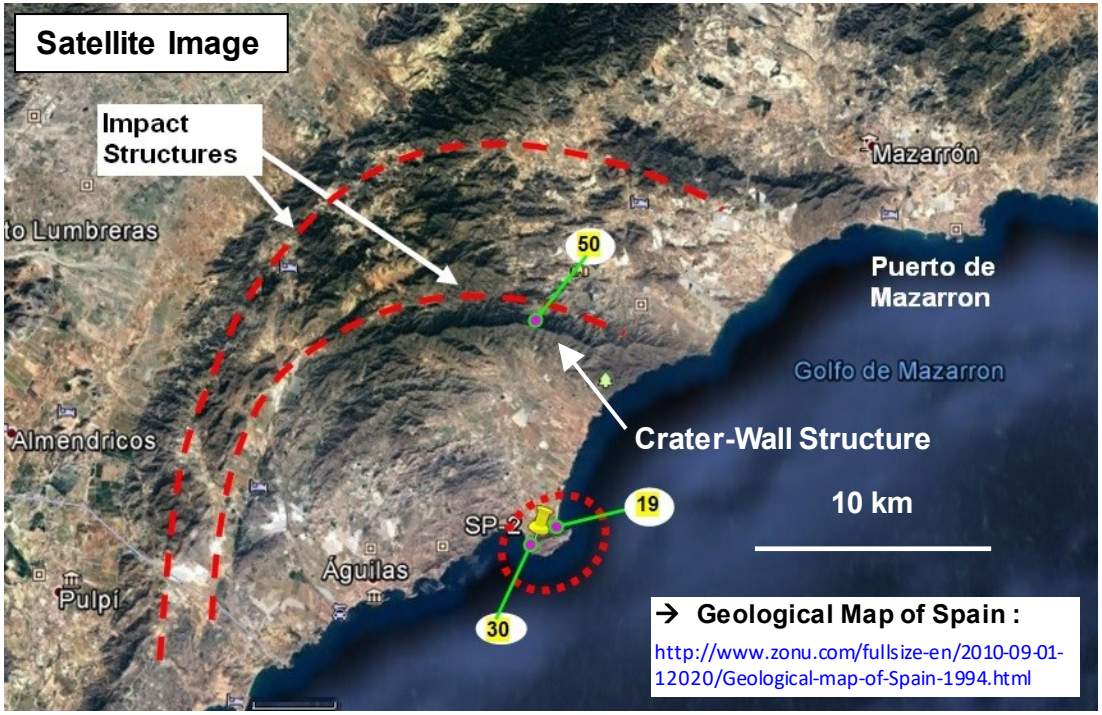
This large bow-shaped Impact Structure belongs to a large-scale impact event which according to my hypothesis was caused by ejecta material that was ejected from the Permian Triassic (PT) Crater in the Arctic Sea (see Parts 1 to 5 of my hypothesis).

The impact structure belongs to a large-scale Secondary Crater Chain that was caused by the PT-Impact Event. The "Bay-of-Lyon Crater" described under **1.)** and the Ø 1.6 x 1.2 km "oblique impact crater" described under **2.)** are impact craters which belong to the same Secondary Crater Chain (→ PT-Impact Event)

The Geological Map of Spain shows that the bow-shaped "Crater-Wall structure" consists of rock-type 25 (brown-colored on the geological map), which is Proterozoic Rock that probably is > 250 Ma (million years) old !

The age of the rock at sample site 50 also indicates that the impact structure can be a result of the PT-Impact Scenario described in my hypothesis.

Rock samples collected at the sample sites 19 and 30, at the center of the bow-shaped impact structure (Cabo Cope), also indicate a impact shock event.
Quartz in these rock samples shows similar (but slightly weaker) shifts of the main Raman peaks, as the shocked quartz collected on sample site 50.

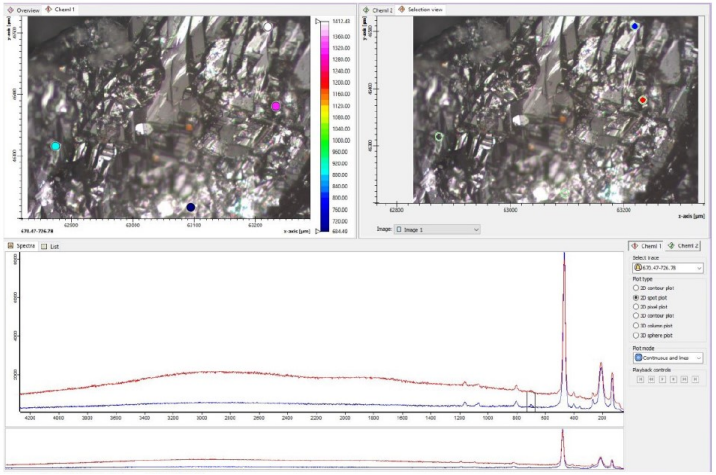


Sample Site 50 (at AP7 tunnel exit)

RAMAN-Spectra of Rock Samples from Sample Site 50 & 19, provide first evidence for the Ø30 km Impact Structure (in southern-Spain)

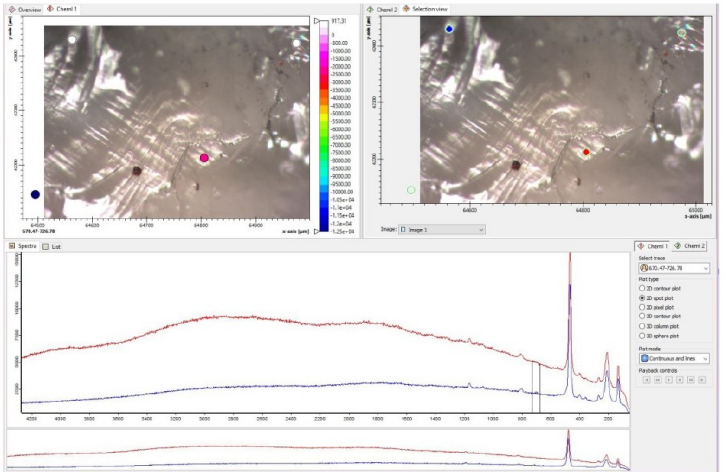
→ **All spectra and microscope-images taken from rock samples are available here : Raman spectra of samples from the 30 km & 1.6x1.2 km Craters** (or **here**)

Sample Site 50 : Stone 1_spectra 1 indicates : Quartz (→ RRUFF_search results)



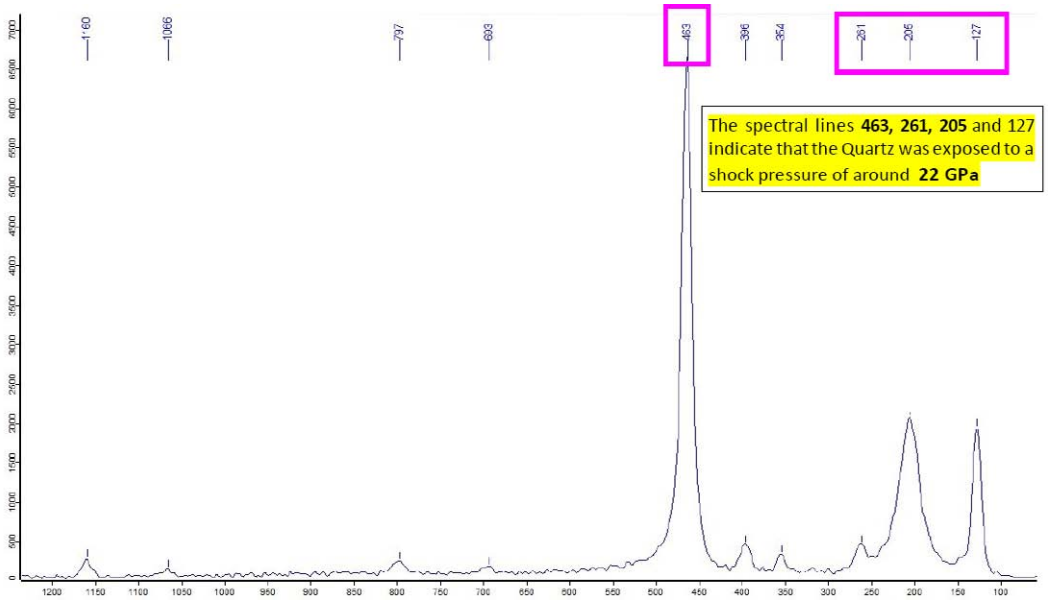
Sample :

Sample Site 19-B : Stone 3_spectra 1 indicates : Quartz (→ RRUFF_search results)

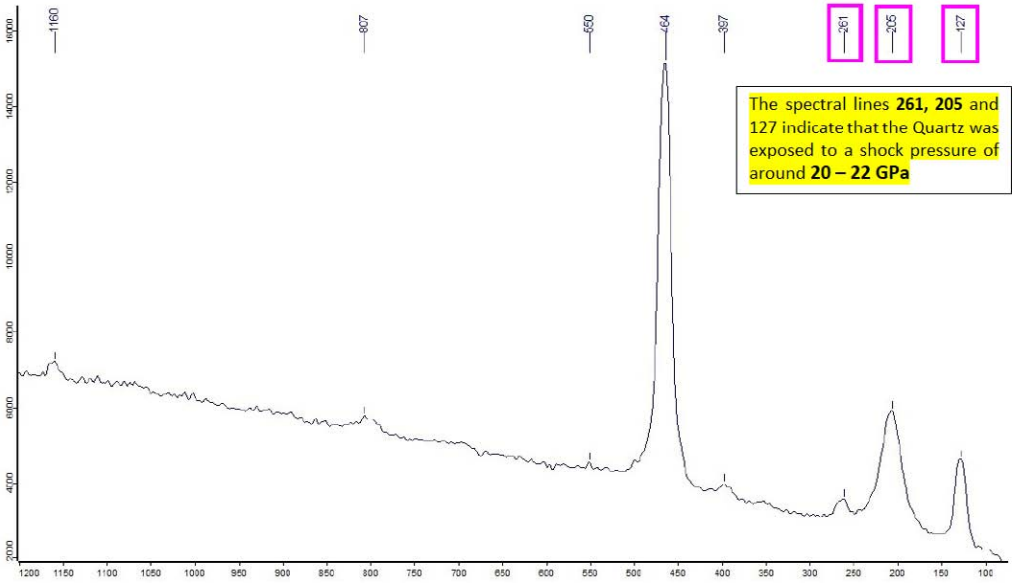


Sample :

Indication for a shock event are the shifts of the marked Quartz spectral lines towards 463, 261 and 205



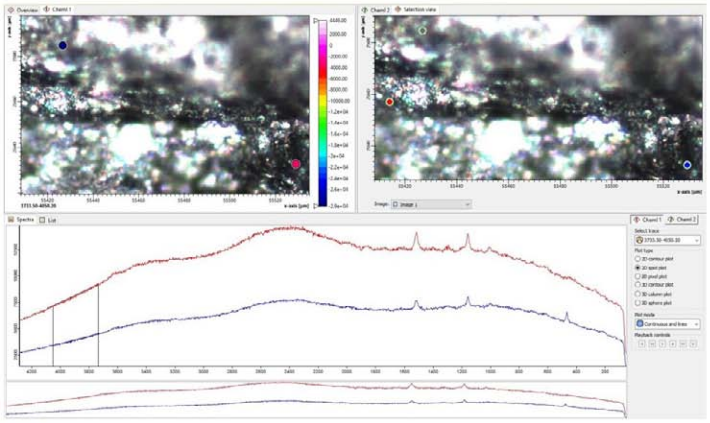
Indication for a shock event are the shifts of the marked Quartz spectral lines towards 261 and 205



→ **All spectra and microscope-images from rock samples are available here :** **Raman spectra of samples from the 30 km & 1.6x1.2 km Craters** (or **here**)

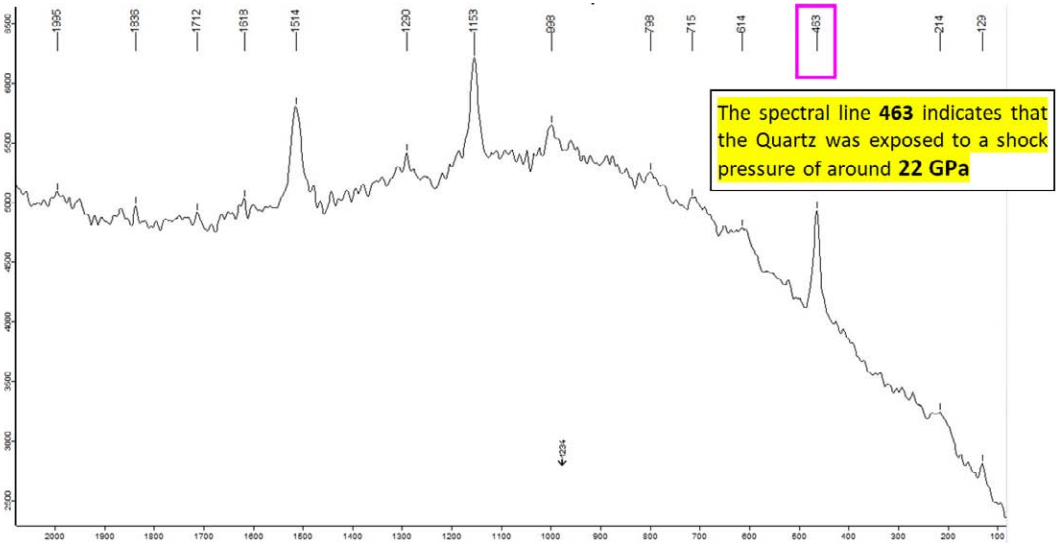
Sample Site 30-B : Stone 1_spectra 1 indicates : Quarz, Reyerite

(→ see RRUFF_search results)



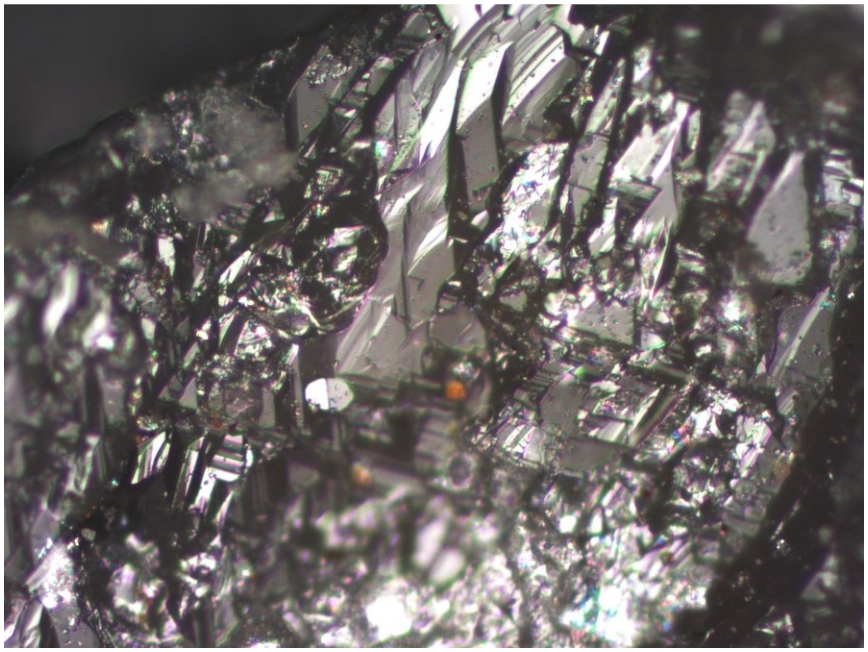
Sample :

Indication for a shock event is the shift of the marked Quartz spectral line to 463



Sample from Site 50 : Quartz - Image size : ~ 400 x 300 µm

Note the exceptional fracture pattern visible in the quartz sample !



Sample Site 50 : (a cut through the crater-wall), accessible over Highway AP7 , site is located near the tunnel exit of the highway AP7

4.) The ≈ Ø 160 km "Salerno Crater" in Italy :

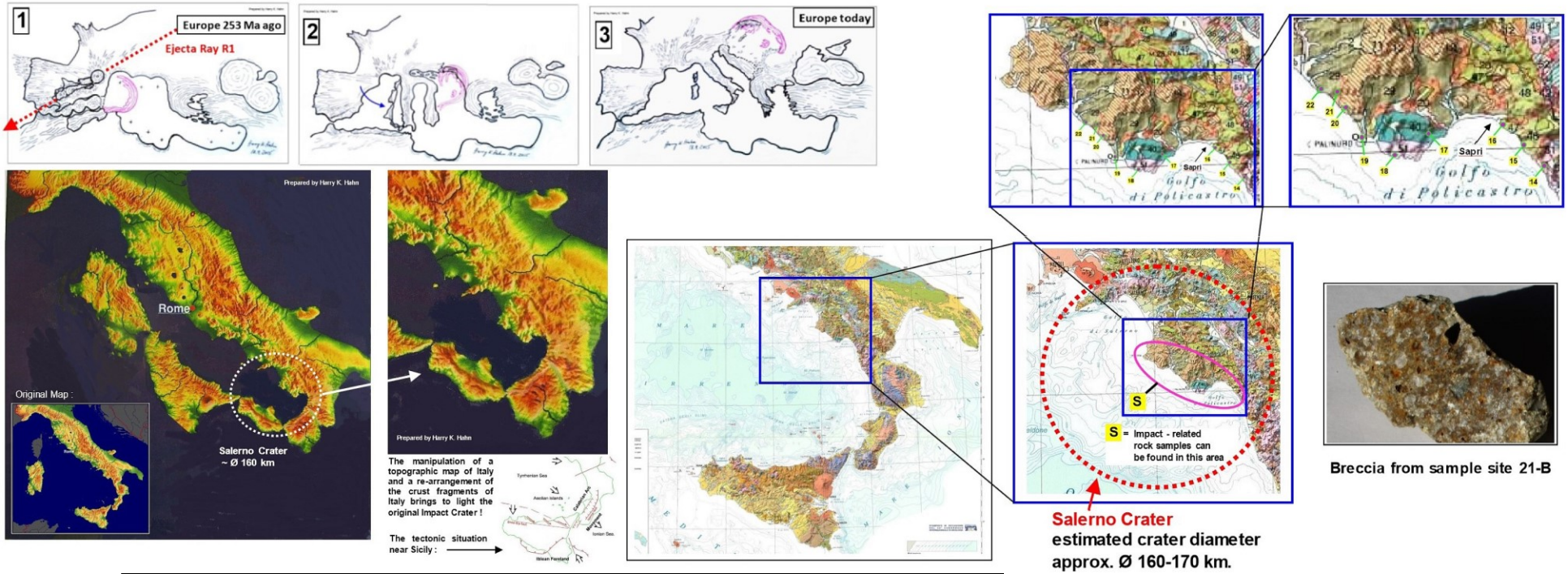
→ **Shock-metamorphic effects of the Impact : Indication for Shocked quartz was found in rock samples of Sample Sites 20 & 21**

Photos of these Sample Sites & Rock Samples (and other sample sites) are available here : ► Sample Sites "Salerno Crater"

The Ø 160 km "Salerno Crater is part of the same secondary crater chain as the "Bay of Lyon Crater" described under **1.)** , which in all probability was caused by ejecta that was ejected from the Permian Triassic Crater Ø 1270 x 950 km Permian Triassic Impact Crater (PTI) in the Arctic Sea near Alaska
This secondary crater chain probably consisted of at least four major secondary craters. (→ see image sequence **1** to **3** below)
The first crater of this crater chain is the "Bay of Lyon Crater" (→ probably the most powerful crater) and the last crater was the "Salerno Crater" which is still noticeable on the topography map of Italy, if the crust fragments which form Italy are arranged in their positions as they were approx. 200 Ma ago.

In the **Raman Spectra of quartz grains** from rock samples collected at the **sample sites 20 & 21** there are shifts of main Raman bands (peaks) to the lower frequencies noticeable in the spectra, which indicate that the quartz was exposed to a **shock pressure of ≈ 20 - 22 GPa.**
But these shifts of the main Raman peaks are less pronounced than the peak shifts in the samples of the "Bay of Lyon Crater" (BLC). This indicates that the impact pressure or shock pressure was less at the end of the described crater chain than at the start of the chain (at the BLC).

Microscope images of some of the analysed quartz grains in samples from the **sites 21 & 20** also seem to indicate an impact shock event.
In order to confirm the Salerno Crater as a secondary crater of the PT-Impact Event an analysis for PDFs (planar deformation features) should be done.

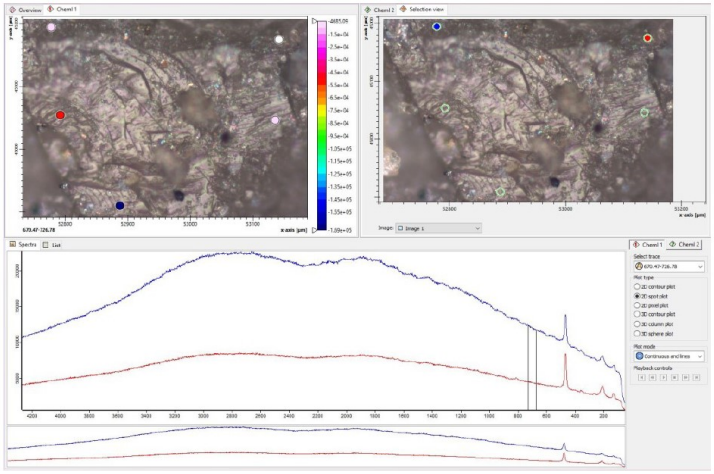


→ **Geological Map 1:250000** → other geological maps → raster selection 1:100000

RAMAN-Spectra of Rock Samples from Sample Site 21 & 20, provide first evidence for the Ø 160 km "Salerno Crater" (Italy)

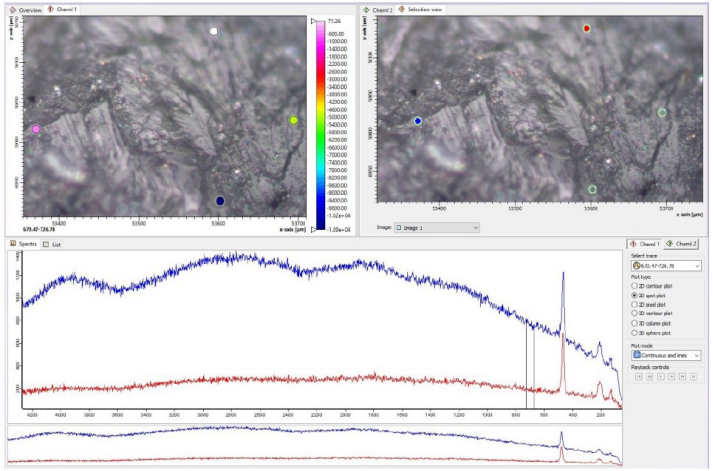
→ **All spectra and microscope-images taken from rock samples are available here : Raman spectra of rock samples from the Salerno Crater** (or **here**)

Sample Site 21 : Stone 1_spectra 1 indicates : Quartz (→RRUFF_CS results)



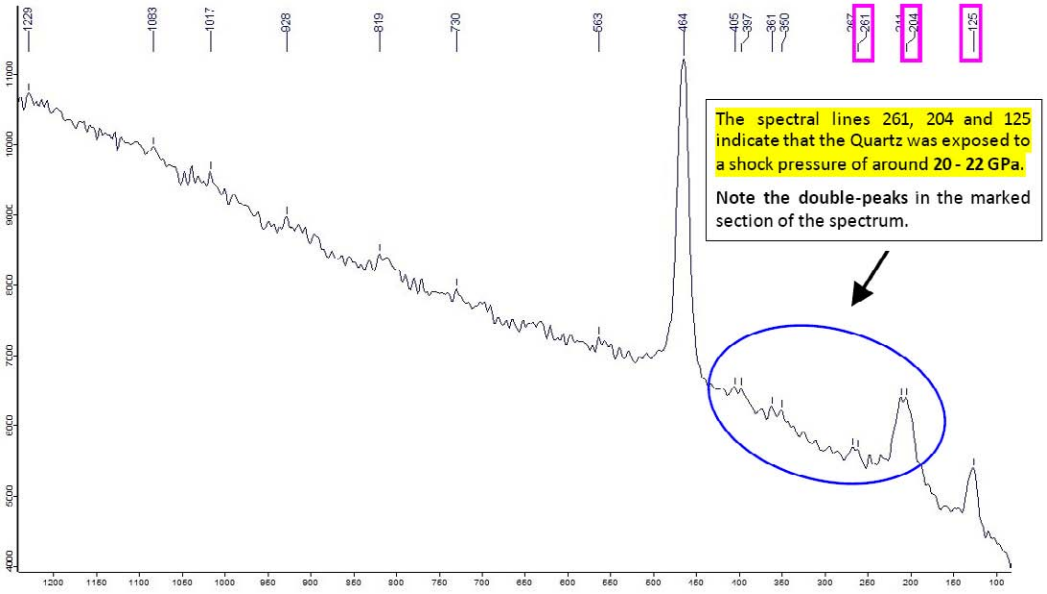
Sample :

Sample-Site 21 : Stone 2_spectra 1 indicates : Quartz (→ RRUFF_CS results)

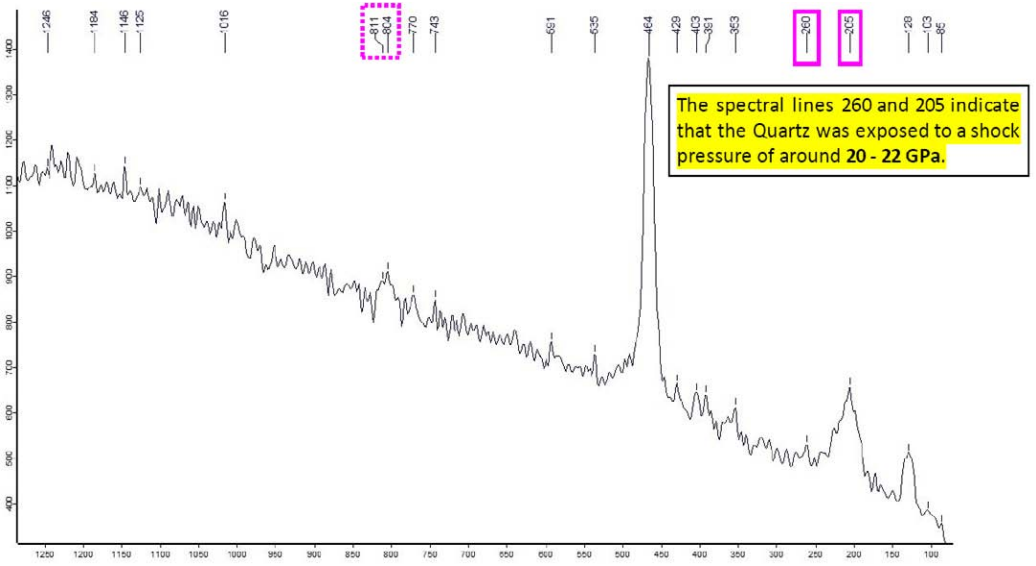


Sample :

Indication for a shock event are the shifts of the marked Quartz spectral lines towards 261, 204 and 125

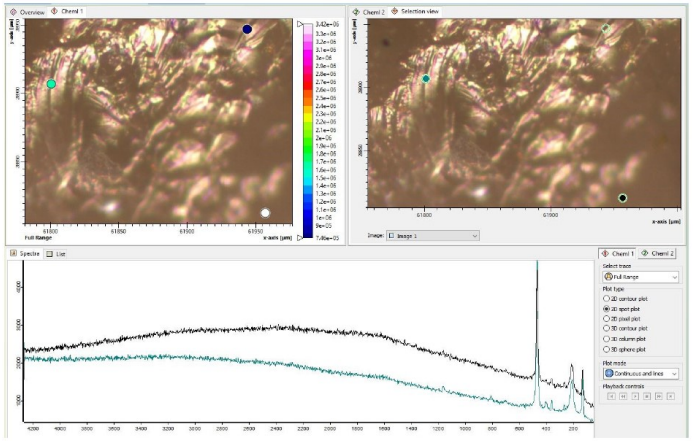


Indication for a shock event are the shifts of the marked Quartz spectral lines towards 260 and 205



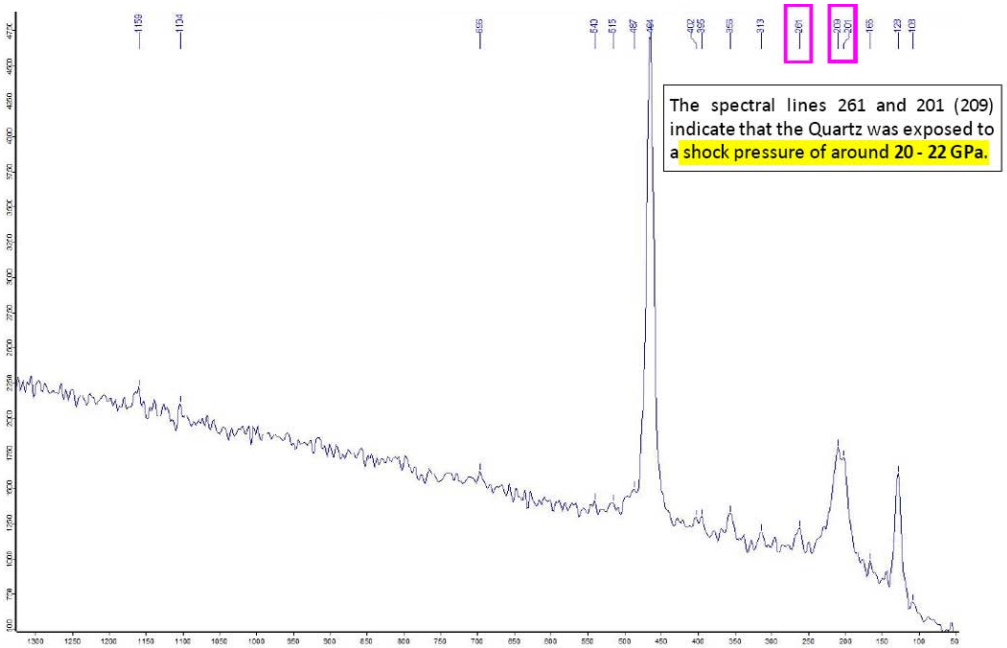
→ **All spectra and microscope-images taken from rock samples are available here :** **Raman spectra of rock samples from the Salerno Crater** (or **here**)

Sample-Site 21 : Stone 3_spectra 1 (crystal inclusion) indicates : Quartz
(→ see RRUFF_CS results)

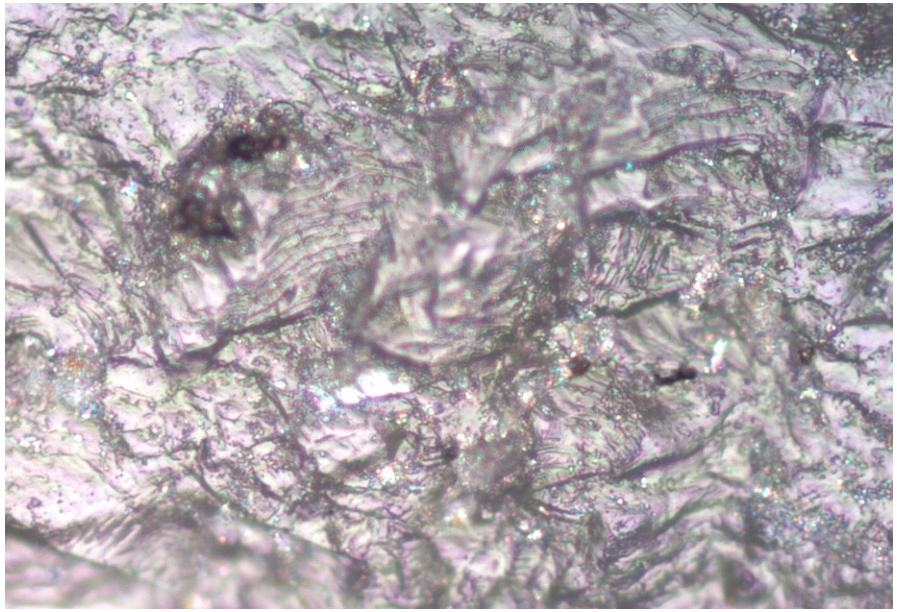


Sample :

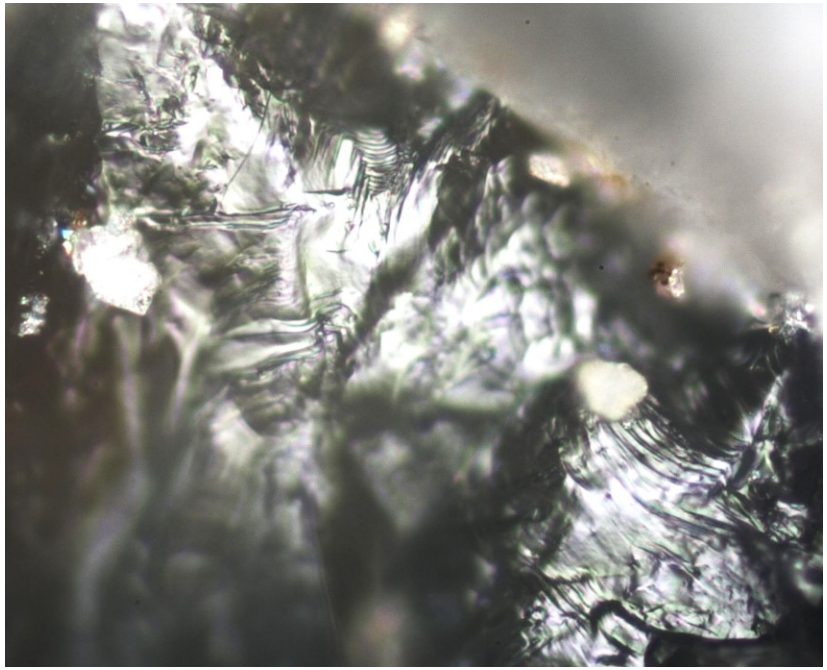
Indication for a shock event are the shifts of the marked Quartz spectral lines towards 261 and 201 (209)



Sample Site 21 : Stone 2 : Quartz - Image size : ~ 400 x 300 µm



Sample Site 21 : Stone 1 : Quartz - Image size : 250 x 200 µm



5.) The ≈ Ø 320 km "Cape York Crater" in North-East Australia :

→ Shock-metamorphic effects of the Impact : Shocked quartz was found in rock samples from the Sample Sites 46 & 50 (2.trip)
the sample site 49-C / 23 (1. & 2.trip) also indicates an impact event

Photos of Sample Sites & Rock Samples are available here : ► Sample Sites CY-Crater 2 (2.trip) **& Sample Sites CY-Crater 1** (1.trip)

The yet unknown giant Ø 320 km "Cape York Crater" (CYC) in NE-Australia is located on the ocean floor just east of the Cape York Peninsula.

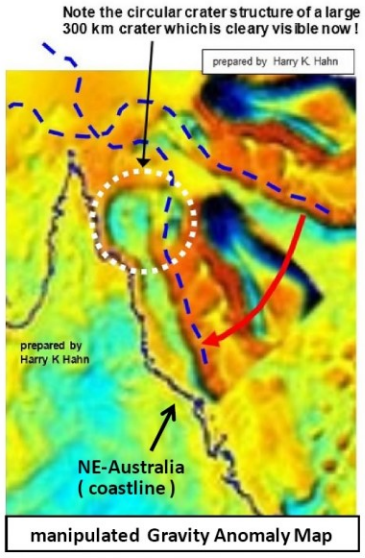
The possible impact crater is noticeable on different gravity anomaly maps and on topographic maps.
According to my PT-Impact Hypothesis the crater belongs to a Secondary Impact Crater Chain, which was caused by ejecta material that was ejected from the Ø 1270 x 950 km Permian Triassic Impact Crater (PTI), located in the Arctic Sea near Alaska. (→ see my **Study** about this Crater).

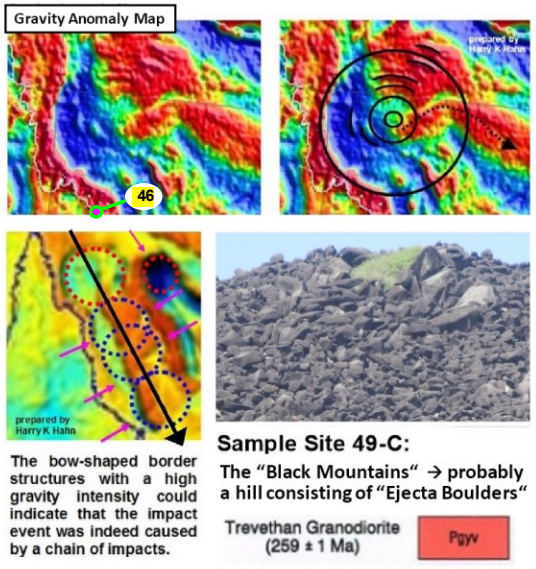
The closest point on land in relation to the crater center is **Cape Melville** which probably represents a small section of the original outer crater-wall and which is only reachable on a difficult 4W-track or with a boat (probably the best option !). The satellite image of Cape Melville shows hills of **large grey boulders of up to Ø 20 m**. These grey boulders consist of **Cape-Melville-Granite with an Early-Permian Age**. But I haven't been on this site yet !

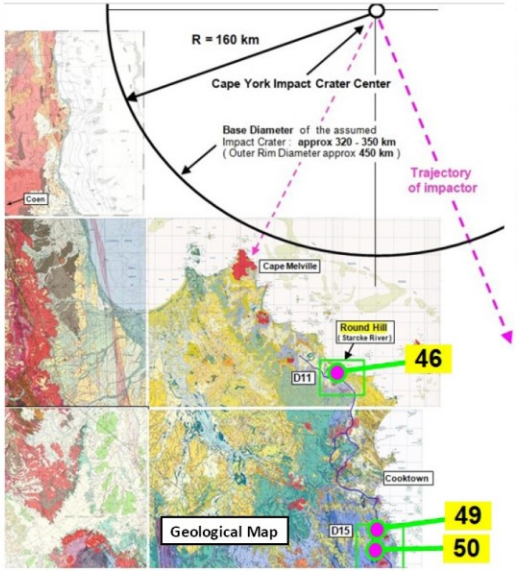
The closest site that I could reach on my 2.trip (Cape York 2), in reference to the Ø 320 km Crater, is **sample site 46** located approx. 75 km south of the crater-rim of the Ø 320 km "Cape York Crater" (→ see map). This sample site is a hill consisting of Silurian-/ Devonian-age rock, accessible per road

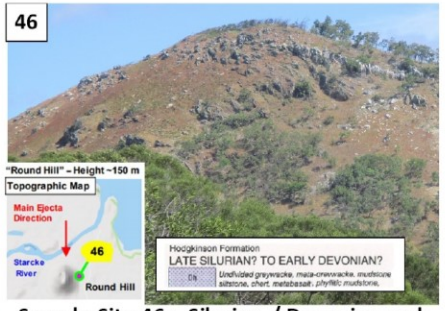
RAMAN spectra of quartz grains from sample site 46 clearly indicate a shock-event caused by an Impact. This is strong indication for the existence of the Ø 320 km "Cape York Crater". Further evidence comes from sample site 50. **The RAMAN spectra of quartz from sample site 50 also provides evidence for a large-scale impact event.** It shows similar shifts of the Raman peaks of the quartz to the lower frequencies, which indicates a **shock pressure of ≈ 20 - 22 GPa** that was caused by the large-scale "secondary impact event" (crater-chain) described in my hypothesis.
Sample Site 49-C is located at the "Black Mountains" 20 km south of Cooktown. These "Ejecta-Boulder-Hills" (Black Mountains) probably were formed during the large-scale Cape-York Impact. **The boulders** of the "Black Mountains" **consist of Trevethan Granodiorite with a given age of 259 +/- 1 Ma** which is very **close to the PT-boundary age of ≈253 Ma**. Cape Melville also seems to consist of these kind of Ejecta-Boulders from the PT-boundary
RAMAN spectra from quartz at site 49-C also indicate a shock event. However the shift of the RAMAN peaks is less and the evidence therefore weaker.

Weblinks : Gravity Anomaly Map 1 ; Gravity Anomaly Map 2 - **Geological Maps :** Cape Meville ; Cooktown area





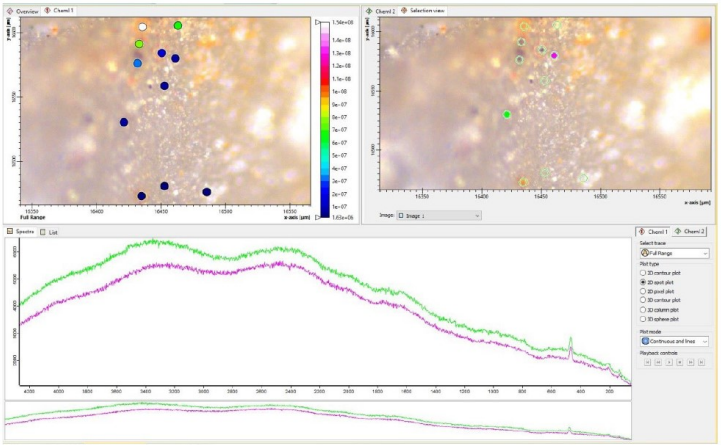




RAMAN-Spectra of Rock Samples from Sample Site 46, 50 & 49-C provide first evidence for the Ø 320 km Cape York Crater (NE-Australia)

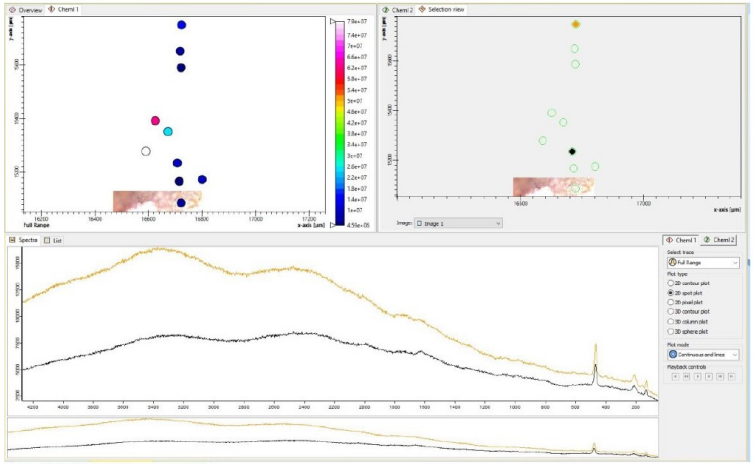
→ **All spectra and microscope-images taken from rock samples are available here : Raman spectra of rock samples from the Cape York Crater** (or **here**)

Sample Site 46-C (2.Trip) : Stone 2_spectra 1 indicates : Quartz (→ RRUFF_ results)



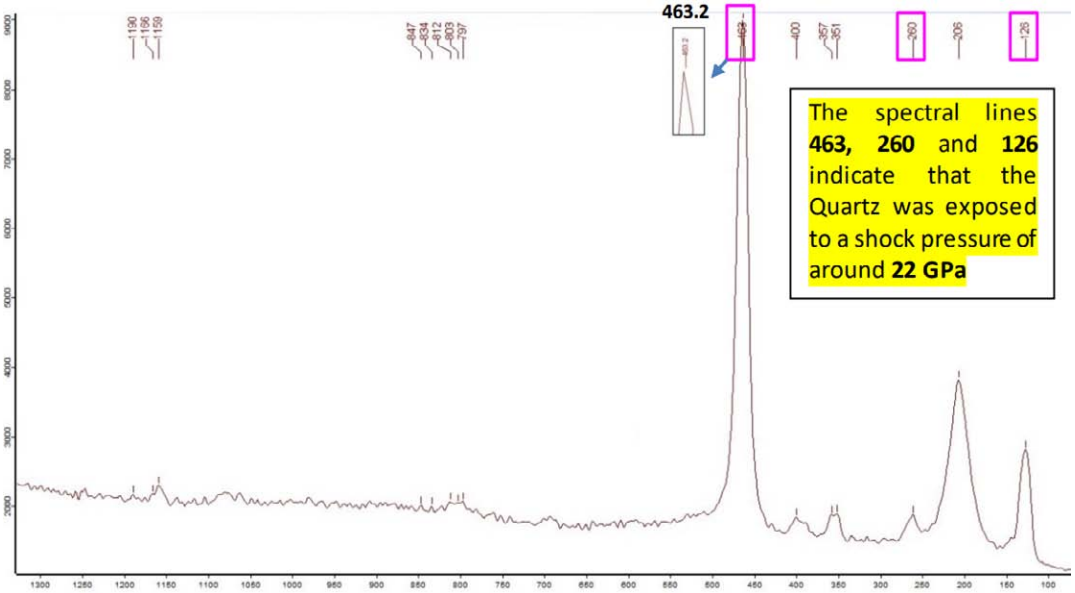
Sample :

Sample Site 46-C (2.Trip) : Stone 1_spectra 3 indicates : Quartz (→ RRUFF_ results)

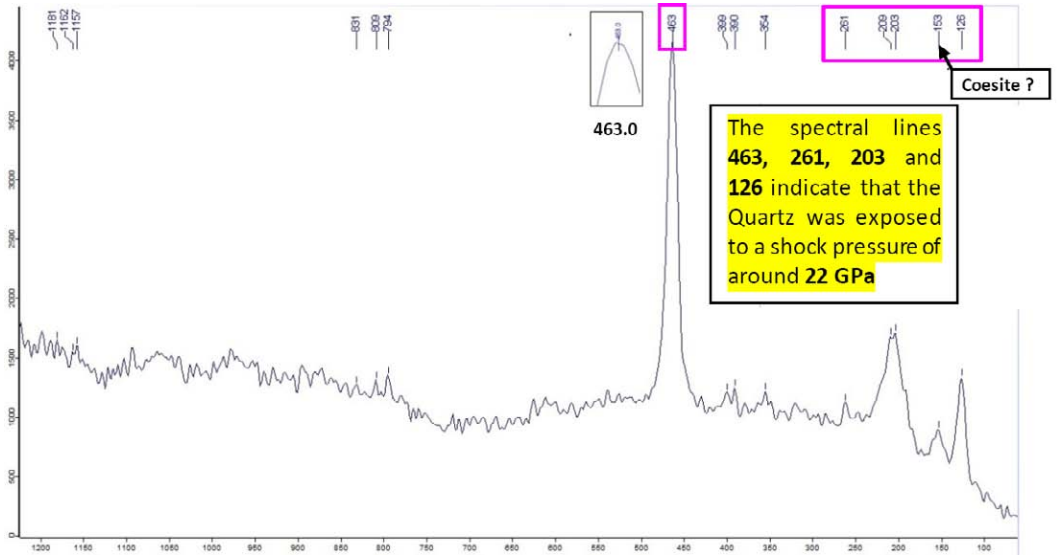


Sample :

Indication for a shock event are the shifts of the marked Quartz spectral lines towards 463, 260 and 126

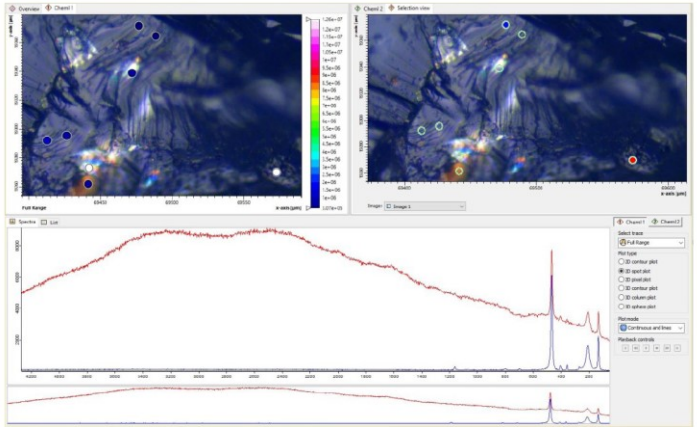


Indication for a shock event are the shifts of the marked Quartz spectral lines towards 463, 261, 203 and 126



→ **All spectra and microscope-images taken from rock samples are available here :** **Raman spectra of rock samples from the Cape York Crater** (or **here**)

Sample Site 50 (2.Trip) : Stone 1_spectra 1 indicates : **Quartz** (→ RRUFF)

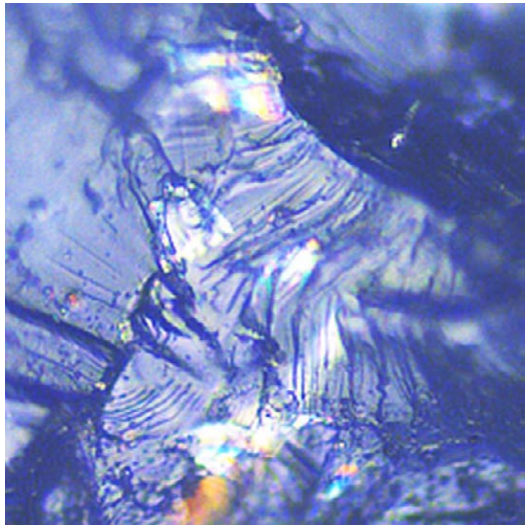


Note the fracture pattern on the microscopic image.

Sample :

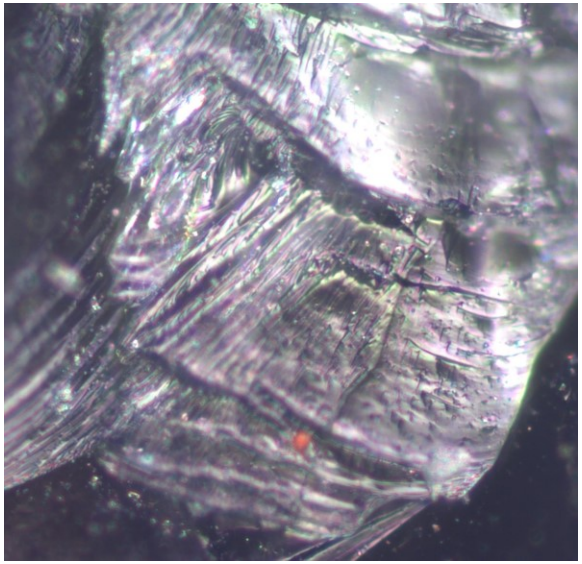
Sample Site 50 : Stone1 : Quartz

Image Size : ≈ 120x120 µm

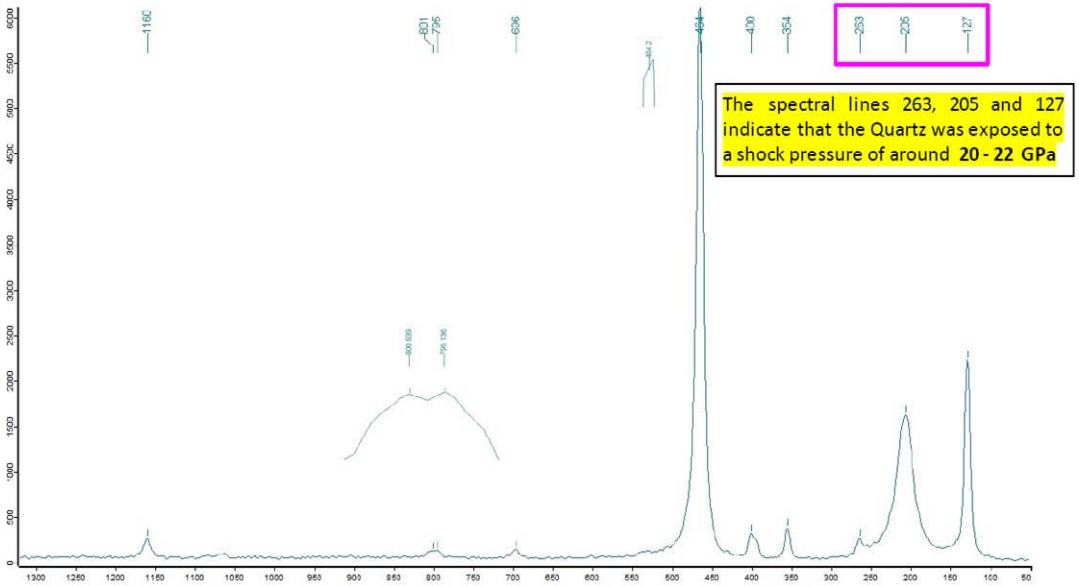


Sample Site 49-C / 23 Stone 2 : Quartz

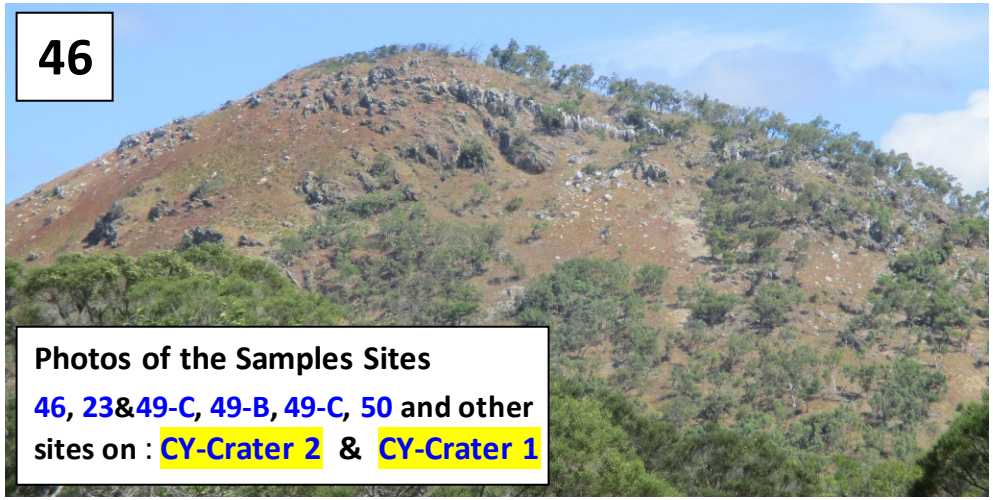
Image Size : ≈ 350x350 µm



Indication for a shock event are the shifts of the marked Quartz spectral lines towards 263 and 205



Sample Site 46 ("Round Hill") → This hill is consisting of **Silurian-/Devonian-age** rock material which is > 400 million years old and was effected by impact shock waves of the Cape York Crater (CYC) / Secondary Crater Chain impact event



6.) The Ø 30 km Mt Warning Impact Crater & 1.5 km Impact Crater (East Australia) :

→ Shock-metamorphic effects of the Impact : Shocked quartz was found in rock samples from the Sample Site 8-B2 /-B3

Photos of these Sample Sites & Rock Samples (and others) are available here : ► Sample Sites "Mt Warning Crater"

The Ø 30 km crater-shaped Mt Warning area and a smaller ≈ Ø 1.5 km crater structure, which is located directly near the crater-rim of the Mt Warning Crater, seem to belong to the large-scale impact event caused by the Ø 320 km Cape York Crater and by other large secondary craters of the PT-Impact Event.

(→ see Study : **The 320 km Cape York Crater** (link2))

Mount Warning seems to be the result of a large **secondary impact** caused by the Cape York Impact Event in NE-Australia. And it is not the rest of an erroded shield-volcano as currently believed ! Therefore the true age of the Mt Warning crater may be ~253 Ma (→ PT-boundary age).

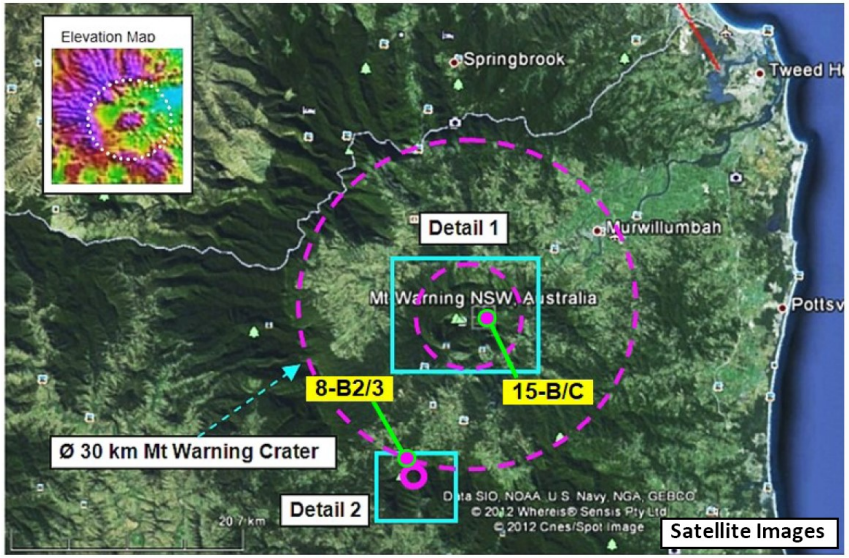
The chaotic looking central area of the Mt Warning crater-area (**Detail 1**) probably is the result of a shield volcano which grew on top of the Mt Warning impact crater after the Impact Event. When the volcanic activity ended, this shield volcano then heavily eroded and collapsed into the visible chaotic structure, which consists of magmatic material. Only the original Crater-wall of the Mt Warning crater is a remain of the original earlier impact event. (→ my hypothesis)

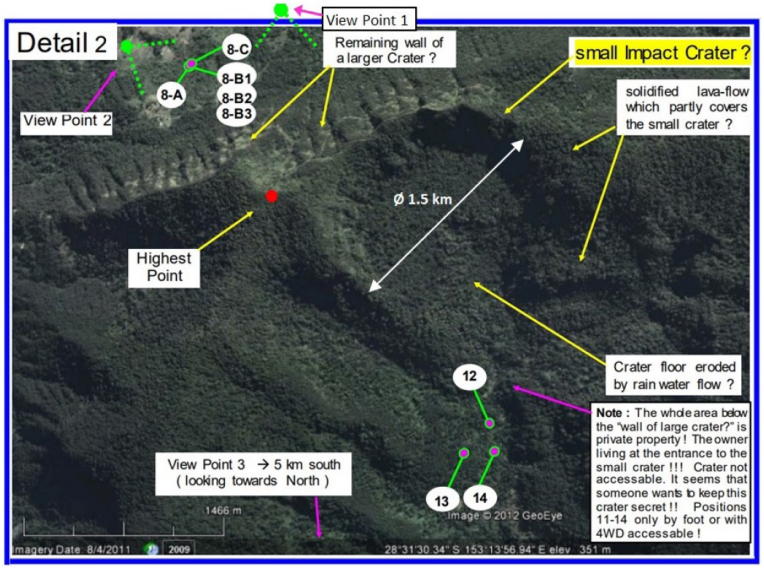
The samples 8-B2 /-B3 were collected on the foot of a possible remain of the original crater-wall of the Ø 30 km Mt Warning Impact Crater.

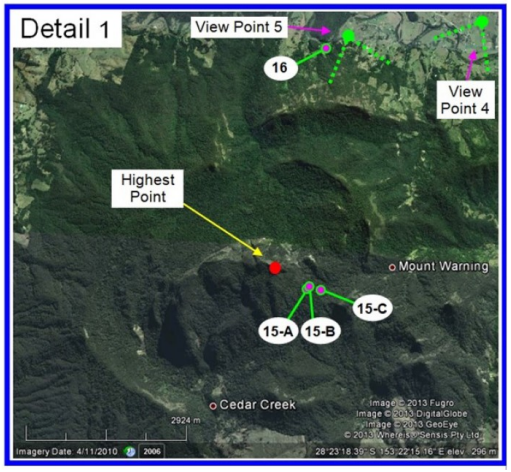
The **Raman spectra** of quartz from sample site **8-B2,** on the foot of the Mt Warning crater-wall, and on the outside of the smaller Ø 1.5 km circular crater visible in **Detail 2** provides **first indication for an impact event !** The shifts of the main Raman peaks of the analysed quartz grain to lower frequencies, which is visible in Raman-spectra, indicates that the quartz from this site in all probability was exposed to a **shock pressure of around 20 - 22 GPa**.

The spectra of the rock samples from site **15-B** and **15-C,** the central mountain in the Mt Warning Crater, all indicate magmatic material.

Geological Map : → **Moreton Geology :** go to : **Geology Maps** → type in : **WARWICK**



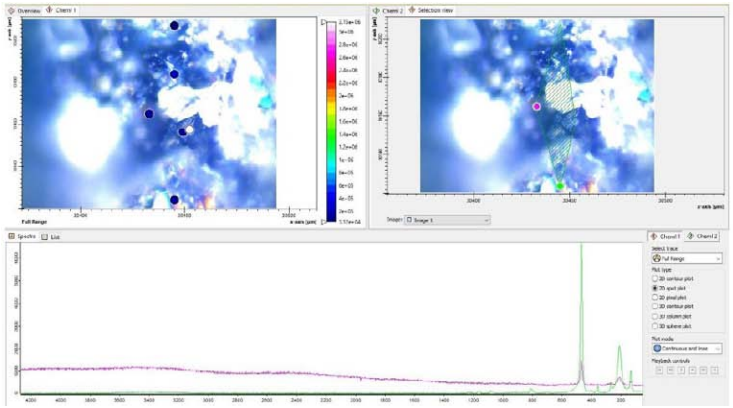




RAMAN-Spectra of Rock Samples from Sample Site 8-B2/B3 provide first indication for the Ø 30 km Mt Warning Crater (E-Australia)

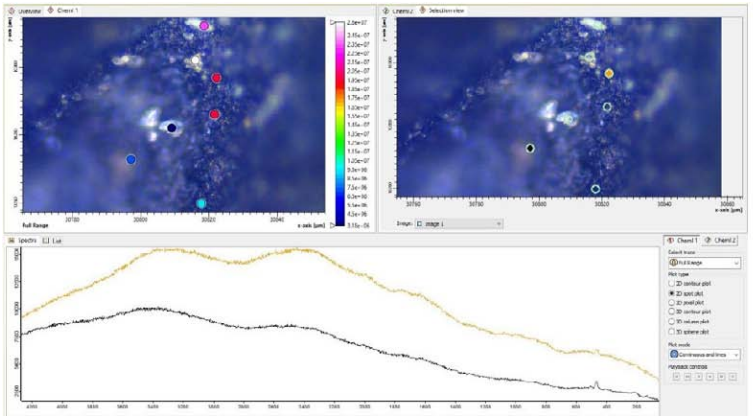
→ **All spectra and microscope-images taken from rock samples are available here : Raman spectra of samples from the 30 km Mt Warning Crater** (or **here**)

Sample Site 8-B2 : Stone 3_spectra 2 (Green inclusions) indicates : Quartz
(→ RRUFF_CS results)



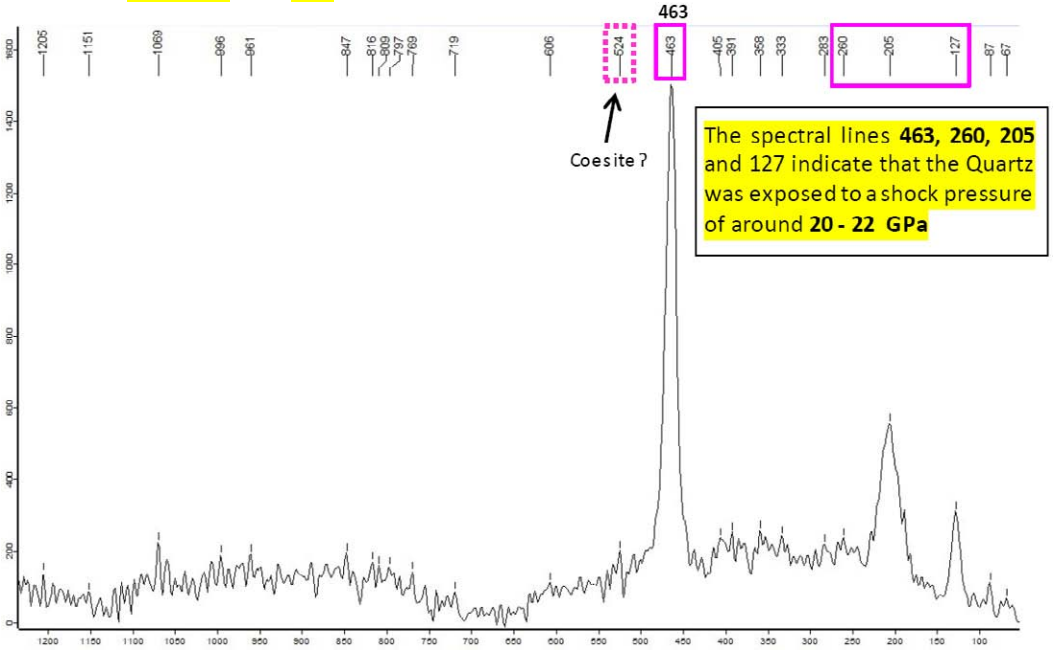
Sample :

Sample Site 8-B2 : Stone 2_spectra 1 indicates : Quartz (→RRUFF_CS results)

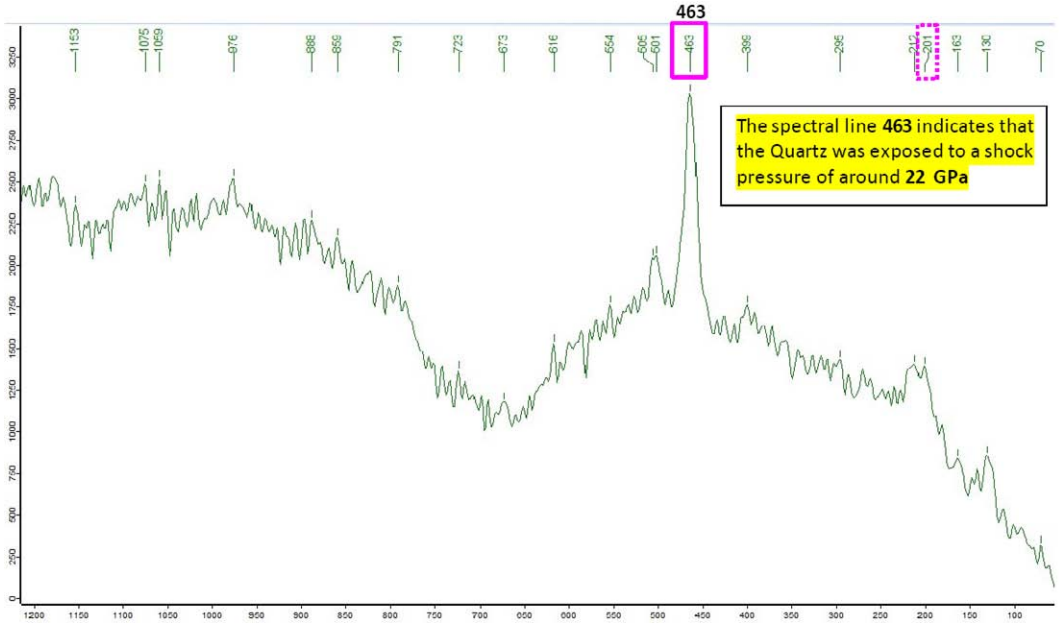


Sample :

Indication for a shock event are the shifts of the marked Quartz spectral lines towards 463, 260 and 205

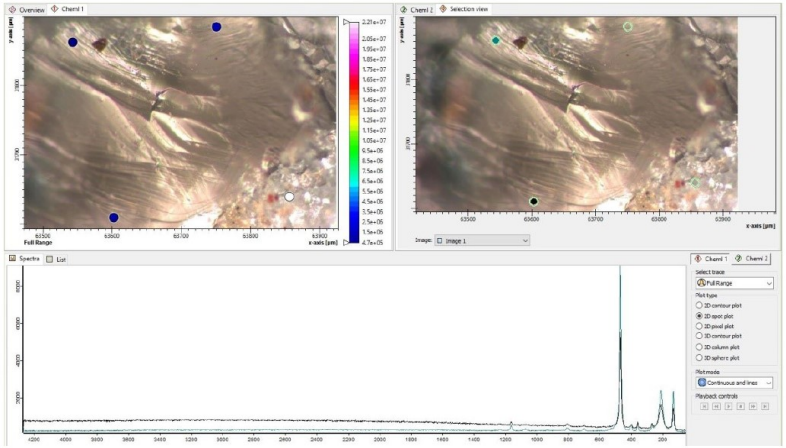


Indication for a shock event is the shift of the marked main Quartz spectral line towards 463



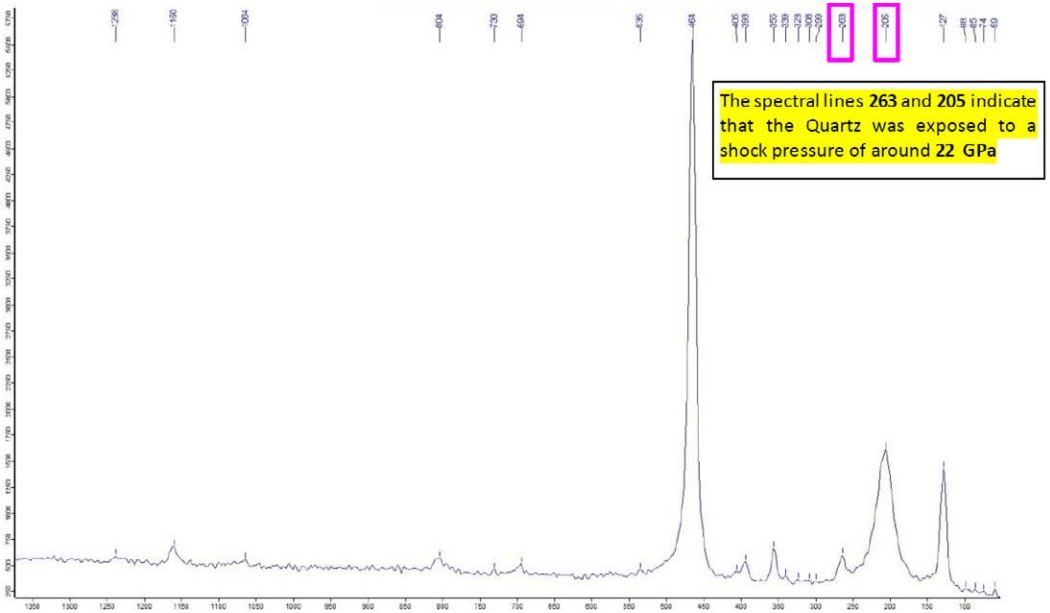
→ **All spectra and microscope-images taken from rock samples are available here :** **Raman spectra of samples from the 30 km Mt Warning Crater** (or **here**)

Sample Site 8-B3 : Stone 1_spectra 1 (white mineral inclusions) indicates : Quartz
(→ RRUFF_CS results)

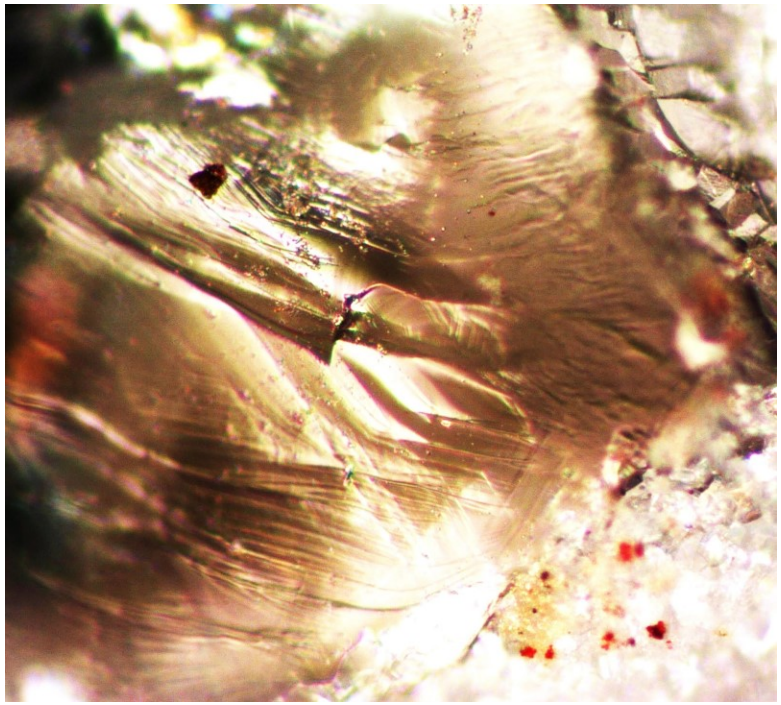


Sample :

Indication for a shock event are the shifts of the marked Quartz spectral lines towards 263 and 205

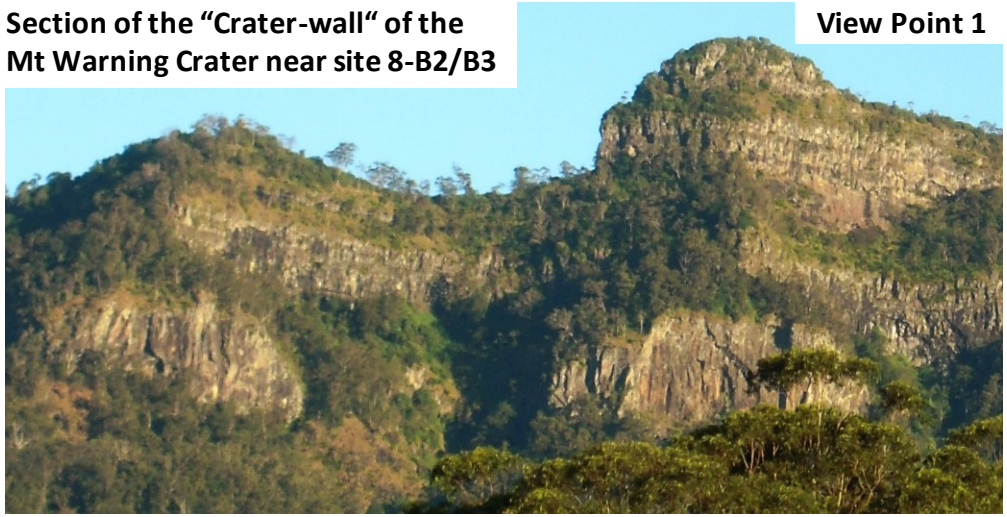


Sample Site 8-B3 : Stone 1 : Quartz
Image size : ~ 250 x 250 µm



Section of the "Crater-wall" of the Mt Warning Crater near site 8-B2/B3

View Point 1



7.) The Ø 40 x 33 km elliptical Pilbara Crater near Port Hedland (NW-Australia)

→ Shock-metamorphic effects of the Impact : Shocked quartz was found in rock samples from the Sample Sites 25, 10 and 11

Photos of these Sample Sites & Rock Samples (and other sample sites) are available here : ► Sample Sites Pilbara Crater 1

The Ø 40 x 33 km elliptical impact crater is located near the town Port Hedland in the North of Western Australia.

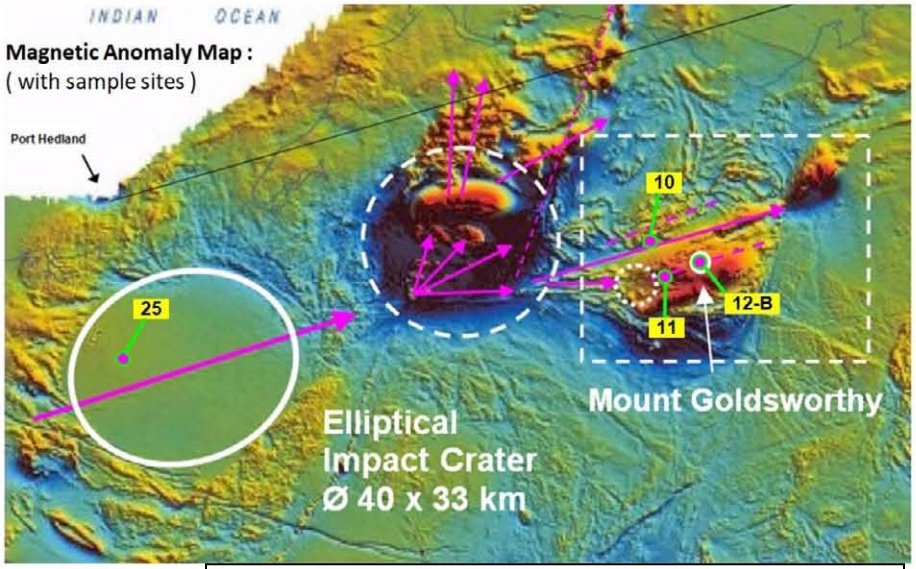
Because of the ellipical shape of the crater it is the result of an **oblique impact**. That means the impactor which formed the crater impacted in a very shallow angle of probably less then 10°. Because of this shallow impact angle, fragments of the impactor were ejected from the crater and caused complex secondary impact structures 40 km and 80 km further east of this elliptical crater. (sample sites 10 and 11 are located here)

One of the secondary impact structures is **Mount Goldsworthy**, which is a famous **Iron Ore Mine** that contained the world's richest deposits of ferrous (iron)-ore with a share of up to 68 % iron. These impact structures are all noticeable on a magnetic anomaly map (→ see map below)

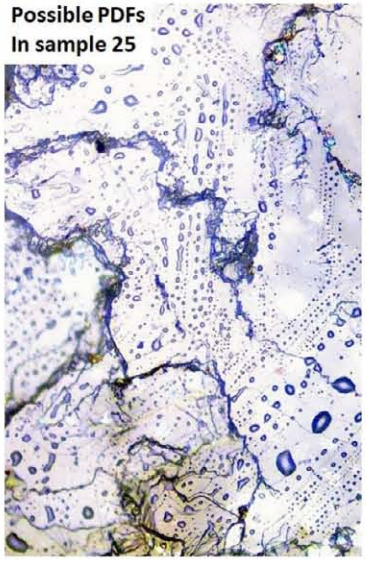
The Ø 40 x 33 km elliptical Impact Crater near Port Hedland probably was formed by ejecta material that was ejected by a larger crater near Onslow, a town on the NW-coast of Western Australia. This crater near Onslow in all probability was caused by the Permian-Triassic Impact Event 253 Ma ago.
The base-rock of the area were the Impact Structures are located is 2.9 Ga old. But the impact structures seem to be much younger ! (→ see iron-outcrops)

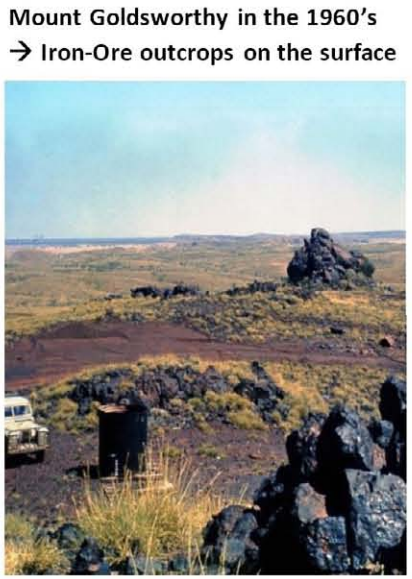
RAMAN spectra of quartz grains from the sample site 25 near the center of the elliptical crater **and from the sample sites 10 and 11** located in the secondary impact structures of this crater **clearly indicate a shock-event caused by an Impact.**
The shifts of the Raman peaks of the analysed quartz samples to lower frequencies indicates an **impact shock pressure of ≈ 20 - 22 GPa**

Further evidence comes from a **microscopic image of sample 25** which **indicates planar deformation features (PDFs).**



→ zoom-in to : Geological Map: Port Hedland-Bedout Island

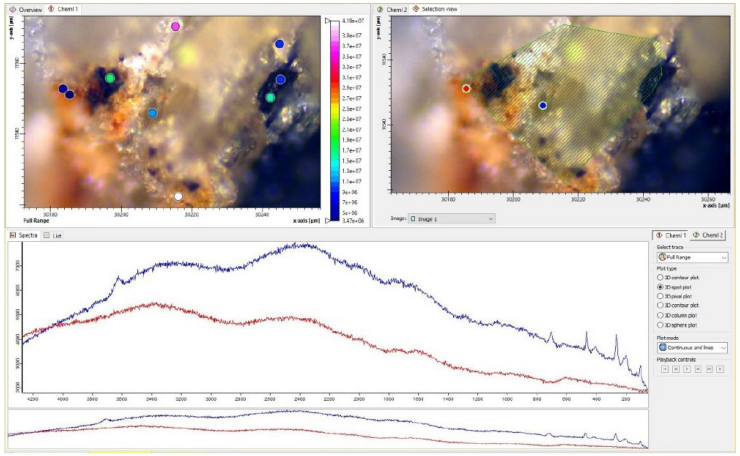




RAMAN-Spectra of Rock Samples from Sample Sites 25, 11 & 10 provide first evidence for the Ø40x33 km Pilbara Crater (NW-Australia)

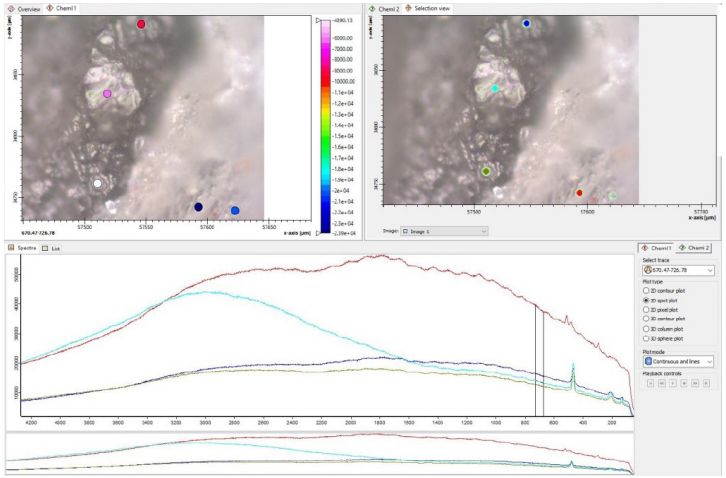
→ **All spectra and microscope-images taken from rock samples are available here : Raman spectra of samples from the 40x33 km Pilbara Crater** (or **here**)

Sample Site 25 : Stone 2_spectra 2 indicates :
Quartz & Trilithionite, Muscovite (→ see RRUFF_CS results)
The Spectrum indicates a mixture of Quartz and Trilithionite / Muscovite



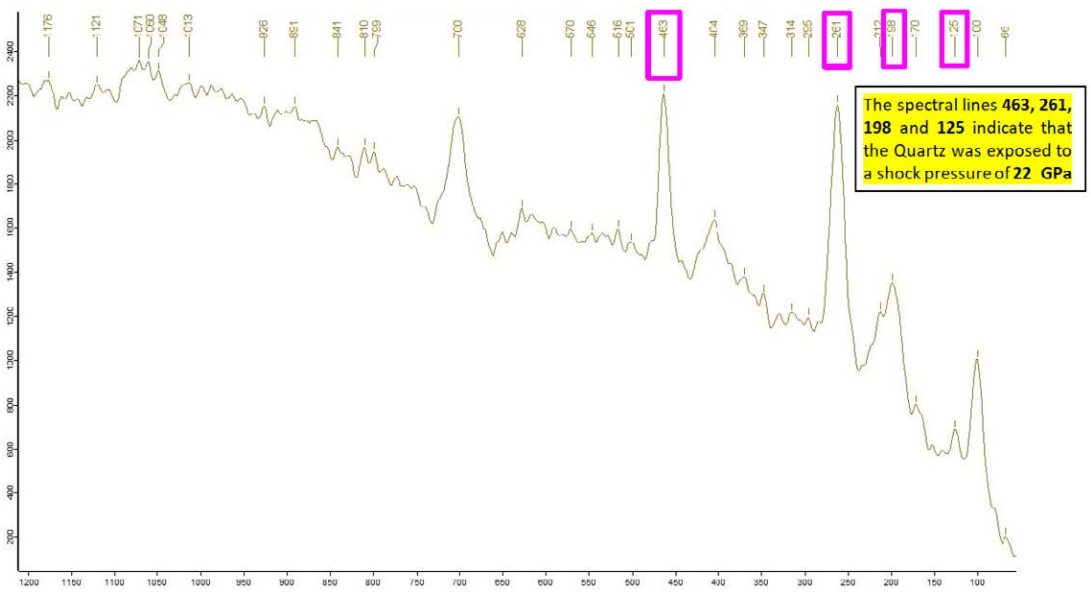
Sample :

Sample-Site 25 : Stone 2_spectra 3 indicates : Quartz (→ RRUFF_ results)

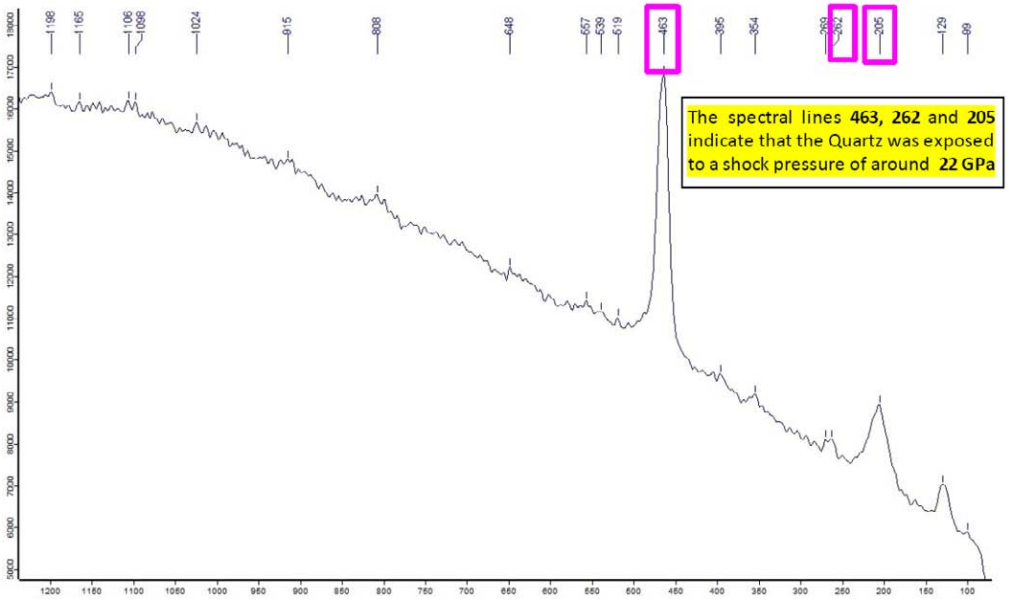


Sample :

Indication for a shock event are the shifts of the marked Quartz spectral lines towards 463, 261, 198 and 125

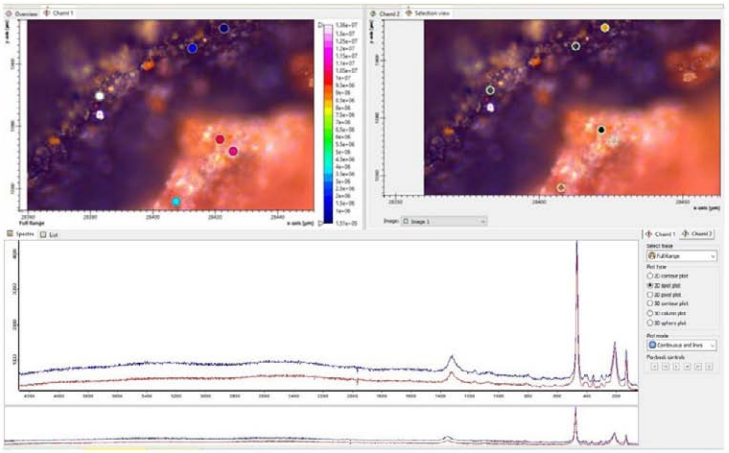


Indication for a shock event are the shifts of the marked Quartz spectral lines towards 463, 262 and 205



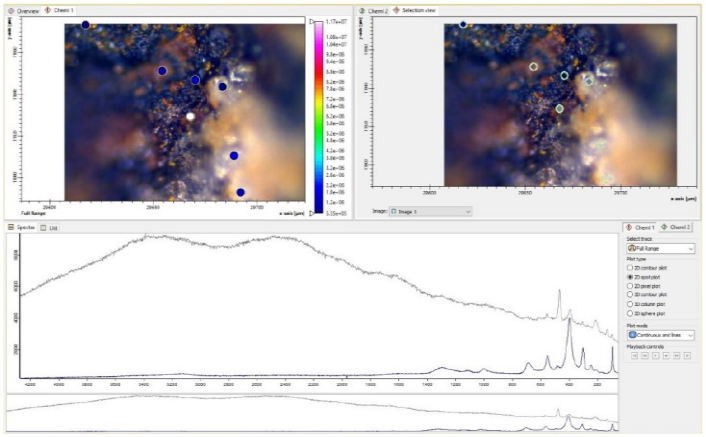
→ **All spectra and microscope-images taken from rock samples are available here : Raman spectra of samples from the 40x33 km Pilbara Crater** (or **here**)

Sample Site 11 : Stone 2_spectra 1 indicates : Quartz (→ RRUFF_CS results)



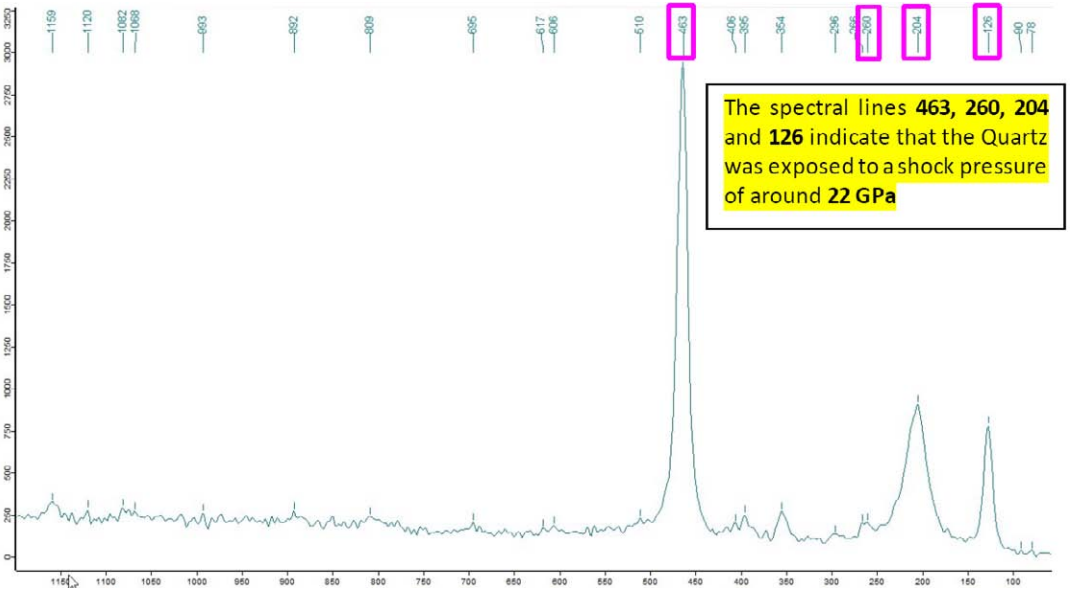
Sample :

Sample Site 10 : Stone 2_spectra 1 indicates : Quartz , Ericssonite (→ RRUFF)

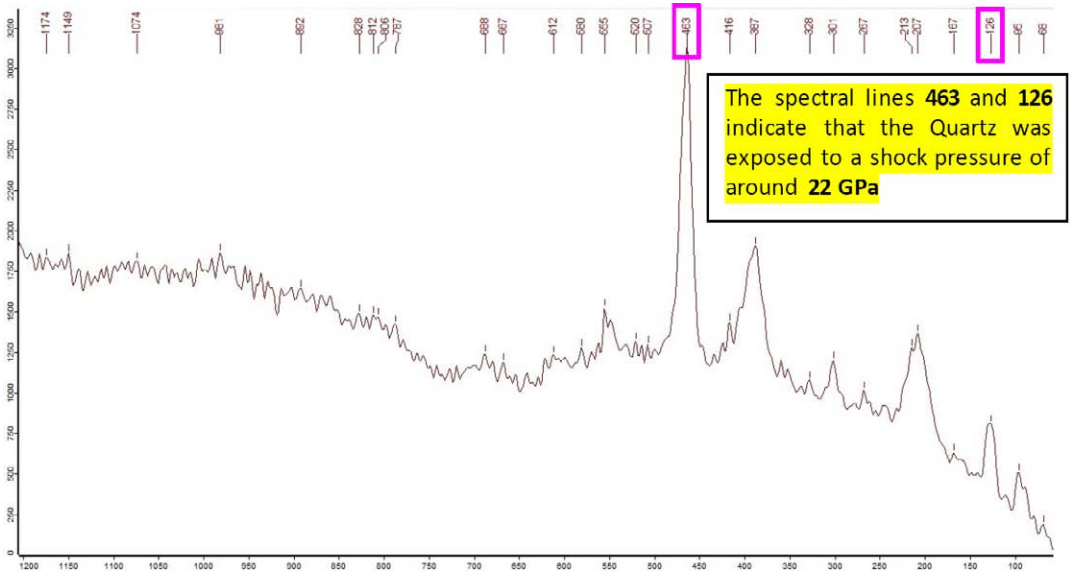


Sample :

Indication for a shock event are the shifts of the marked Quartz spectral lines towards 463, 260 and 204



Indication for a shock event are the shifts of the marked Quartz spectral lines towards 463 and 126



→ Other possible Secondary Impact Sites of the PT - Impact Event

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For the following possible Secondary Impact Sites of the PT -Impact Event ,
I will present RAMAN spectra of some rock samples soon !! (→ probably in September 2021)

8.) The Ejecta Ray from the ≈ Ø 420 km "Southern Ocean Crater (SOC)" in Western Australia

→ **Shock-metamorphic effects of the Impact structure : Shocked quartz was found in rock samples from the Sample Sites 50 and 52**

Other interesting sample sites are : **49** (shocked quartz may be present here too !) **;** **53** (ground is full of black glass-like stones → Micro-Tectites ?)
and **55** (ground consist of one mass of solidified ceramic-like material with linear flow-texture and low density like wood !)

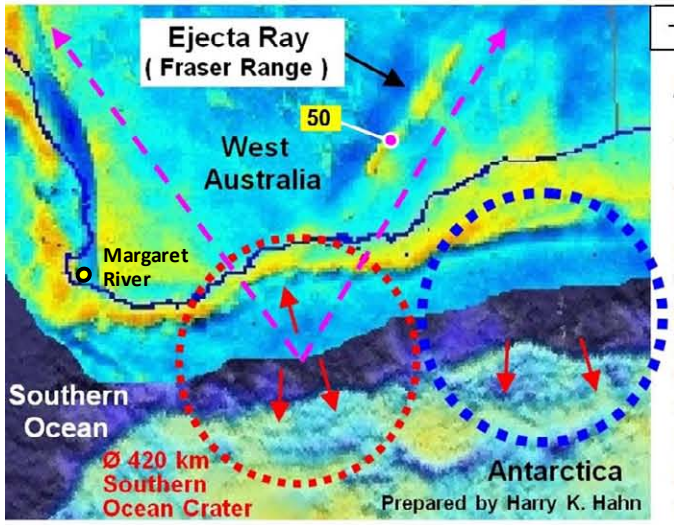
Photos of these Sample Sites & Rock Samples (& other sample sites) are available here : ► Sample Sites - Ejecta Ray of the 420 km SOC

Note : **Shock-metamorphic effects caused by ejecta from the Ø 420 km Southern Ocean Crater** may also be found in rocks of another area where I have collected samples : ► Sample Sites - Margaret River Area ; **interesting sample areas :** ► : 7-A & 7-B and 8-A & 8-B

The massive ejecta ray of the ≈ Ø 420 km "Southern Ocean Crater" (SOC) is noticable on a gravity anomaly map of Australia. A map combination of a gravity anomaly map of Australia and a topographic map of Antartica, arranged to each other so as they were ~200 Ma ago, shows the outline of the Ø 420 km SOC.

A magnetic anomaly map provides clear evidence of the circular structure of the crater. And a geological map of the area south of Kalgoorlie indicates the precise linear structure of the **Fraser Range** which represents the massive ejecta ray that was ejected from the crater. The age of the rock which forms the linear Fraser Range is given with ≈1.3 Ga. This is the age of the crust-material that was ejected by the SOC ! But the impact event itself was at the PT-boundary

Rock samples from the center line of this linear mountain range provide first evidence for an impact event. The **Raman spectra** of quartz from **sample site 50 & 52 provide first indication for an impact event !** The shifts of the main Raman peaks of the analysed quartz grain to lower frequencies, which is visible in Raman-spectra, indicate that the quartz from this sites was exposed to a **shock pressure of around 20 - 22 GPa**.



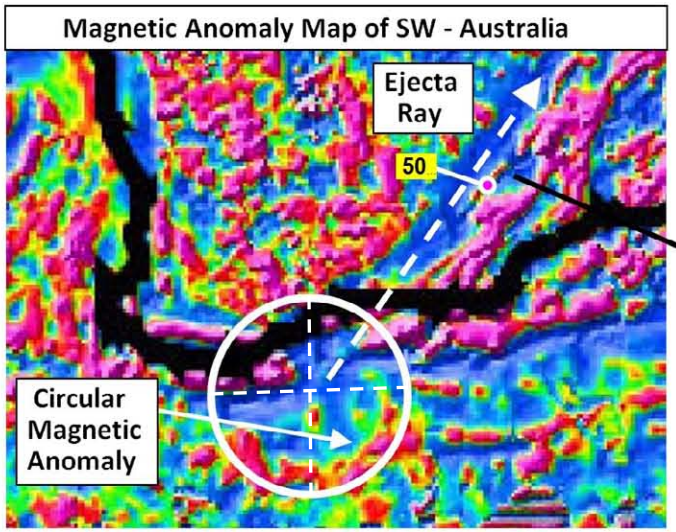
→ **Gravity Anomaly Map 1**

Explanation to this map :

A map combination of a gravity anomaly map of Australia and a topographic map of Antarctica, arranged to each other, so as they were ~ 200 Ma ago indicate a ≈ Ø 420 km Impact Crater.

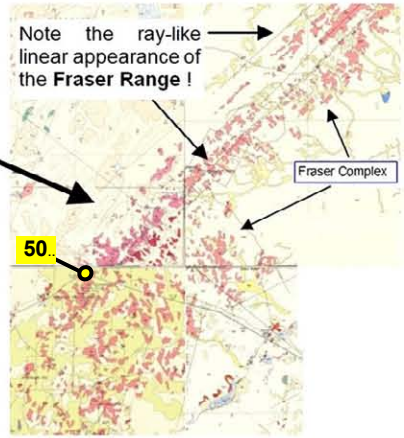
Note the ring structures, the strong ejecta ray and the triangular shaped gravity anomaly which has its apex in the center of the red marked impact crater.

And there may be another impact crater (blue marked).



Geological Maps
→ go to : "Geology" – 1:250K maps then select : Norseman / Balladonia

→ 4 Geological Maps joined together



9.) The Ø 8 x 7 km elliptical "Warwick Crater" in East-Australia

→ **Shock-metamorphic effects of the Impact structure : Shocked quartz was found in rock samples from the Sample Site 51**

Photos of these Sample Sites & Rock Samples (and other sample sites) are available here : ► Sample Sites – Ø 8 x 7 km Warwick Crater

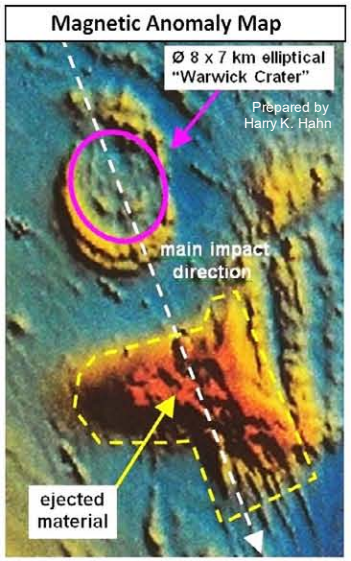
The Ø 8 x 7 km elliptical Warwick Crater is located ≈150 km south-west of Brisbane, near the Town Warwick (≈ 160 km west of the Mt. Warning area.).

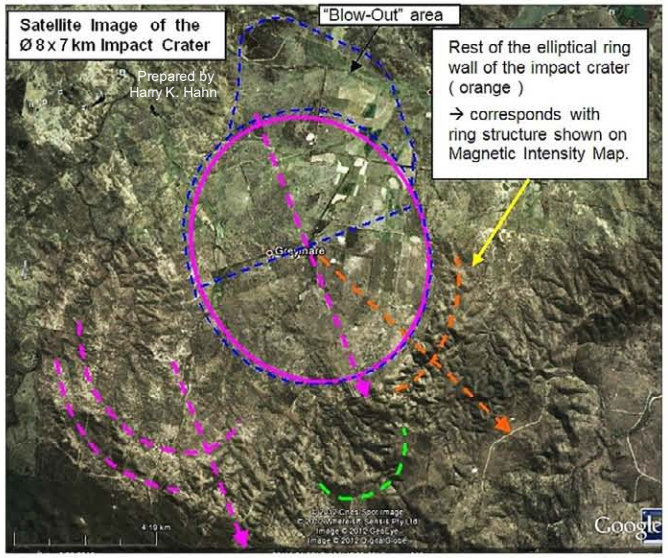
There is a precise **Elliptical crater structure** noticeable on the **Magnetic Intensity Map**. This **elliptical ring structure** is not completely closed, which is an indication that the impactor arrived in a shallow angle. The orientation of the elliptical ring structure corresponds to the orientation of the (assumed) ejecta blanket. (see marks (lines) on the geological map below) The age of the oblique impact in all probablility is ≈ **253 Ma**. (PT-boundary age)
(see explanation in Part 2 of my hypothesis about the PT-Impact Event)

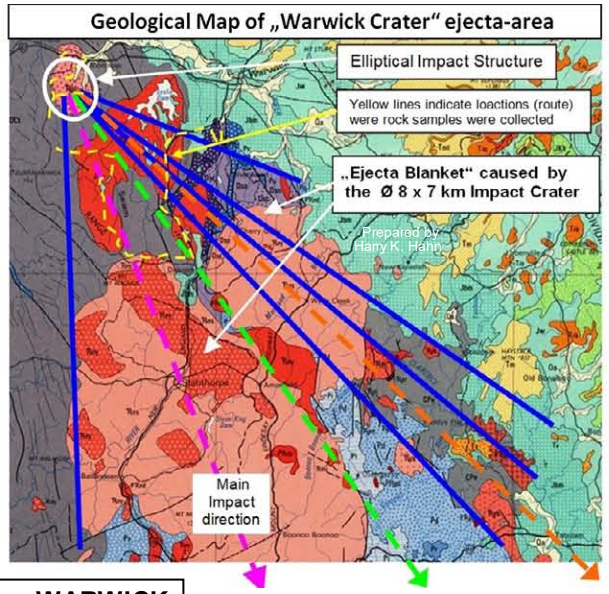
The geological map of the surrounding area shows a very striking distribution of certain rock types along sectors, which are limited by „rays“, which all seem to come from the same starting point. And it seems that all rays have their starting point within the elliptical impact structure ! Only the rays which limit the sector of the grey colored rock type seem to have their starting point shifted a bit towards the direction where the impactor came from. It seems that the pink & red colored rock types, and also the grey colored rock type, were scattered during the impact towards the south-east, in a cone-shaped pattern.

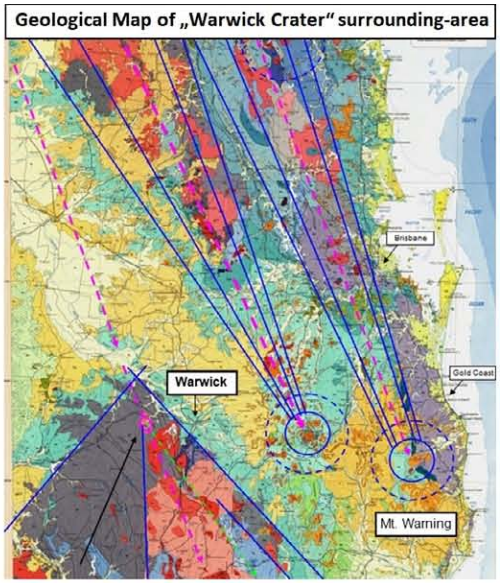
The main impact direction of this elliptical Impact Crater points towards the Cape York Crater (chain). Therefore in all probability the Ø 8 x 7 km “Warwick Crater” was caused by a large ejecta fragment of the Cape York Impact Event. But it is also possible that it was caused by a large ejecta fragment of the PT-Impact Crater.

Rock samples from the center of the possible impact crater provide first evidence for an impact event. The **Raman spectra** of quartz from **sample site 51 provide first indication for an impact event !** The shifts of the main Raman peaks of the analysed quartz grain to lower frequencies indicate that the quartz from this sample site was lightly shocked and exposed to a **shock pressure of around 20 - 22 GPa**.









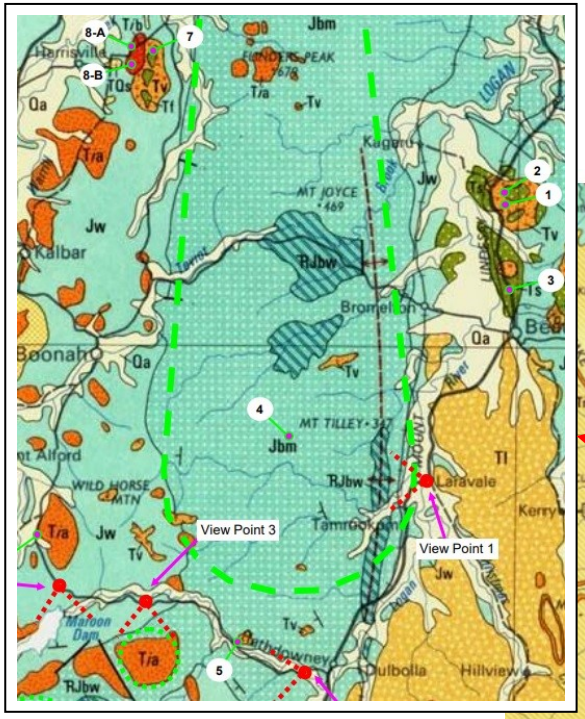
Geological Map : → **Moreton Geology :** go to : **Geology Maps** → type in : **WARWICK**

10.) The drop-shaped 60 x 15 km Secondary Impact Structure of the PTI, north-west of Mt. Warning (Australia)

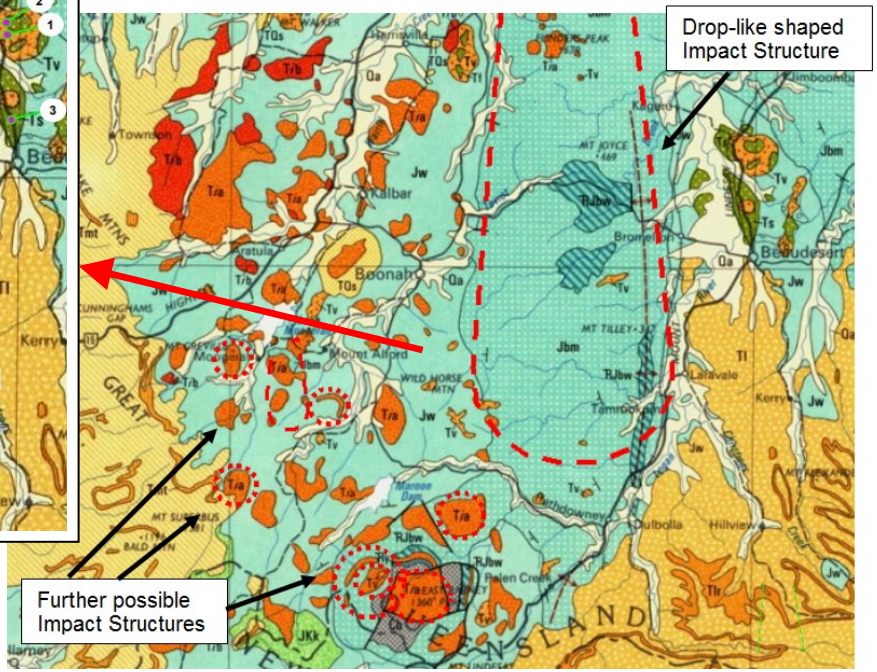
→ **Shock-metamorphic effects of the Impact structure : w-shocked feldspar was found in rock samples from the Sample Site 8-B**

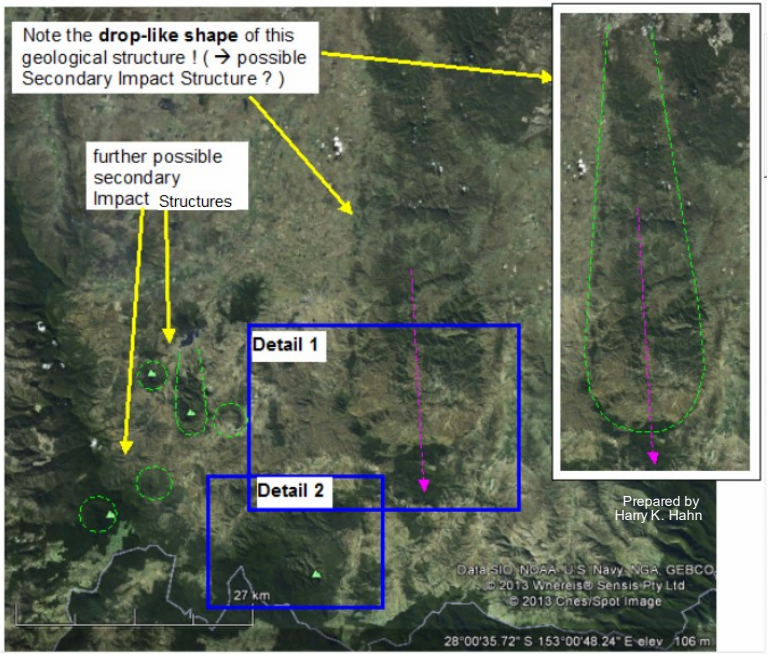
Photos of these Sample Sites & Rock Samples (and other sample sites) are available here : ► Sample Sites – NW of Mt Warning

The 60 x 15 km drop-shaped secondary impact-structure ≈ 60 km north-west of Mt. Warning is visible on a satellite map (see image below). In all probability it was caused by the Cape York (Crater Chain) impact event. There are other smaller circular, ring-shaped and drop-shaped structures located on the left side of the larger structure, which also seem to be secondary impact structures. Sample site **8-B** is located on one of these smaller structures just ≈ 3 km left of the larger structure. Raman spectra of feldspar from sample site 8-B indicate weakly-shocked feldspar. This points to a shock-event caused by an Impact.



Geological Map : → **Moreton Geology :** go to : **Geology Maps** → type in : **WARWICK**





11.) The Ø 15 x 11 km "Anaga Crater" on Tenerife (Canary Islands) :

→ Photos of Sample Sites & Rock Samples are available here : ► Sample Sites Anaga Crater → Interesting sample sites : 7 & 9 (Beach)

A **strong indication for an impact event** comes from the fracture pattern in the Anaga Range, which shows an area effected by compression stress and an area effected by tensile stress, separated by a curved rift zone. (→ blue weblink opens a PDF with references to geological studies of Tenerife ► see **page 2**)

I strongly believe that **the hot spots which gave birth to the Canary Islands originally were impact sites of large ejecta fragments which were ejected from the Permian Triassic Impact Crater** in the Arctic Sea. And I am sure that these impact sites (hot spots) were produced by the same large-scale secondary impact event caused by the PT-Impact, which also has formed the "Bay of Lyon Crater" and the impact structures in southern Spain. → **see 1.) - 3.)**

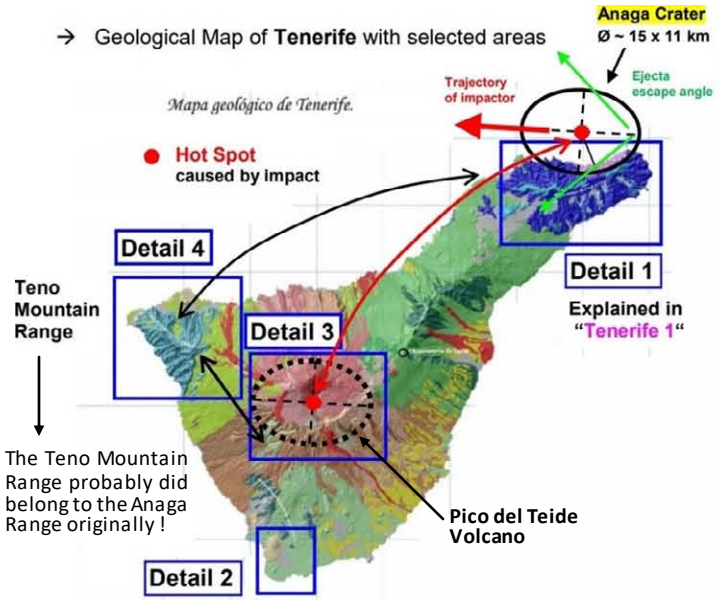
But it will be difficult to provide evidence for this hypothesis, because the evidence is buried under thick layers of lava and magmatic rocks. Maybe a drill core analysis of rock material from locations close to the assumed original impact sites (e.g. the center area of the "Anaga Impact Crater") may provide the evidence

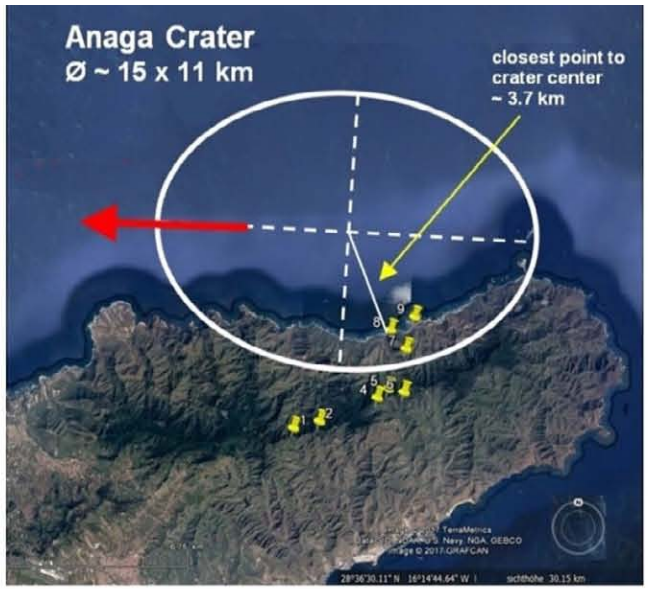
The **Anaga Range** on Tenerife belongs to the old basaltic shield of Tenerife, which is the oldest rock on Tenerife. The most rock on the Canary Islands is considered to be only a few million years old. But the base structure under the old basaltic shields seems to be much older. **The oceanic ground where the Canary Islands are located , definitely is > 150 Ma old.** Therefore the deep base rock under the Anaga Range may have a PT-boundary age of ≈ 250 Ma.

I believe the impact point of the Anaga Crater (a "**hot spot**") drifted away from the original Anaga Impact Crater later after the impact event (→ **see red arrow on map**), supported by an Expansion Tectonics process, and was responsible for the formation of the large Pico del Teide Volcano which is still active today.

On another canary island "Fuerteventura" old oceanic sediments with an age of ≈ 200 Ma can be found as fragments embedded in magmatic material near the village **Ajuy**, on the west-coast of Fuerteventura. (see documentation to the "Ajuy Crater" on Fuerteventura). It seems an impact has caused some of these fragments of old ocean sediments during the impact, and they were then mixed with ejecta material. A precise age analysis of these sediments is required !

On sample site 7 the geological map shows an area consisting of batholith material (intrusive igneous rock). And on the sample site 9 (beach) many different kinds of breccia (probably mostly out of feldspar minerals) can be found in the form of round pebbles, formed by the strong waves on this north-facing coast.





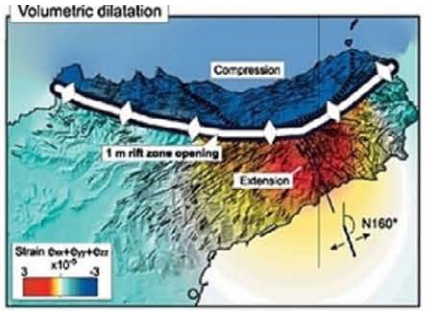


Fig. 7 Dislocation models calculated at a horizontal plane. A segmented rift zone was defined with an outline similar to the middle rift episode on Anaga. A curved tensile fault simulates the curved rift zone, uniform dislocation is 1 m. (A) Surface displacement vectors show that movement focused on the northern flank that is encircled by the rift zone. Dike intrusion along such a curved rift zone will thus promote flank creep. (B) Volumetric dilatation caused by 1-m horizontal widening of a curved rift zone. Dislocation models were calculated for a horizontal plane at 2 km depth, i.e. approximately at sea level. Positive strain (*red color*) matches the region where the third rift arm oriented NNW–SSE (160°) developed on Anaga. Negative volumetric dilatation is found elsewhere, strongest in the northern sector. Virtually complete absence of the NNW–SSE dike trend in the northern sector is due to the compressive field to the north of the curved rift

feldspar minerals

Appendix 1 : A short overview : The Raman bands (peaks) of Quartz shocked with 22-26 GPa

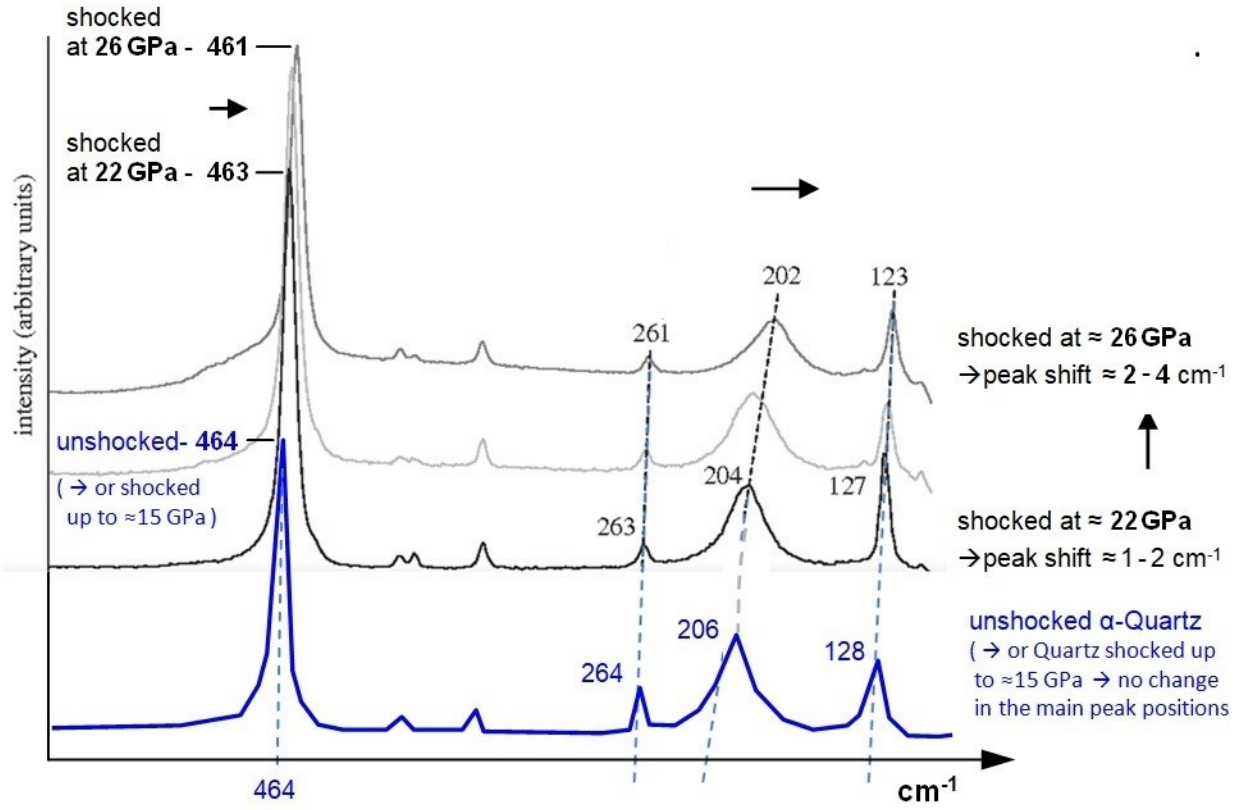
In order to verify a sample site as an impact site or impact structure, shock-metamorphic effects must be discovered in the rocks of the sample site. This can be done by different methods.

For example with the help of PDFs (planar deformation features) which are visible in the quartz with the help of a microscope.
However this requires careful preparation of the samples and expertise.

Another, easier method, is the use of a RAMAN microscope.
Micro-RAMAN Spectroscopy on quartz grains in the samples can provide the first evidence for a shock event, that was caused by an impact.

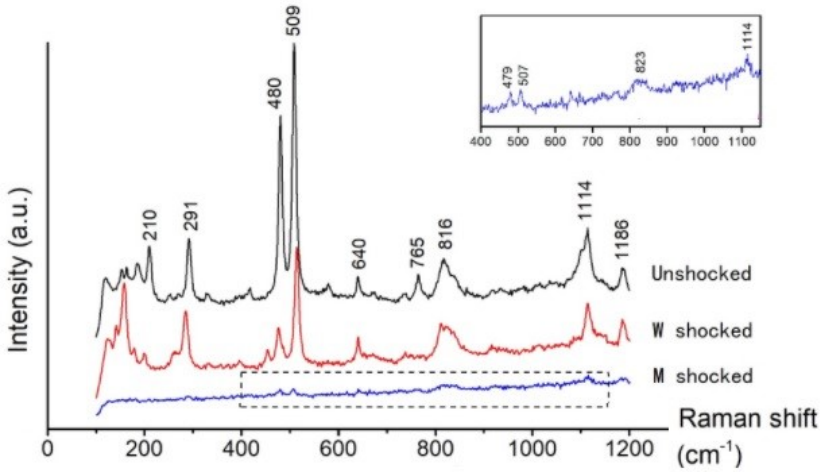
Mc Millan et al. (1992) and others have shown that the main RAMAN-peaks of Quartz shift towards lower frequencies if the Quartz was exposed the a shock-pressure > 15 GPa. → see diagram below

The shift of the main quartz RAMAN-peaks can be used to identify quartz that was shocked by an impact



Quartz shocked with 22 GPa and 26 GPA → shows shifts of the main RAMAN-peaks of 1 - 4 cm^{-1} towards lower frequencies , compared with unshocked Quartz

Appendix 2 : Raman spectra of (W) weakly-shocked & (M) moderately-shocked Alkali-Feldspar



Weakly shocked alkali feldspar mainly developed irregular fractures and undulatory extinction.

Note that the Raman-lines 210 and 765 are missing in the w-shocked feldspar, and an additional line at ≈ 150 appears.

The shock pressure for the w-shocked feldspar was estimated to be between 5 and 14 GPa

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Weblinks to my studies on → vixra.org :	**Weblinks to my studies on → archive.org**
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Part 2 : https://vixra.org/abs/2101.0052	Study-Part 2
Part 3 : https://vixra.org/abs/2101.0096	Study-Part 3
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