Impact-area of an Ejecta-Ray from the Port Hedland Crater, located near Southern-Cross (Western Australia)

- Raman Spectra of selected Rock Samples - by Harry K. Hahn, 30.12.2021

Summary:
The visited area is located near the small town Southern-Cross in Western Australia. The Gravity Anomaly Map indicates that Ejecta-material from the assumed Ø 400 x 350 km Port Hedland Crater (Impact) in all probability impacted here and formed these linear structures. The Port Hedland Crater is located north of the town Port Hedland on the sea-floor of the Indian Ocean. The Port Hedland Crater, which is unknown yet, in all probability is a large secondary crater caused by the Permian-Triassic Impact Event. Another possible source of the linear ejecta rays could be the Victoria Lake Impact (see map on next page).

For a detailed description of the Permian-Triassic Impact (PTI) Hypothesis please read Part 1 (P1) of my hypothesis. And for more information to the Ø 400 x 350 km Port Hedland Crater (PHC) please read pages 14-16, 20-21 and 24-27 of Part 3 (P3) and page 33 of Part 2 (P2) of my hypothesis.

The geological map identifies the nearly linear structures as structures (low mountain ranges) which consist of different rock types than the surrounding plains of the Yilgarn Craton. These linear structures seem to penetrate the Yilgarn Craton down to a depth of around 6 km (see geologic cross-section A-B).

I have collected some rock-samples from these nearly linear structures in the Southern-Cross area and have analysed these samples, mostly quartz, with Micro-Raman-Spectroscopy, to find out if they were exposed to a shock pressure which may indicate an Impact Event. And indeed that seems to be the case!

The Raman-spectra of quartz from the Sample Sites 1, 9, 16 and 18 provide first evidence for an impact event as the probable cause of the linear ray-structure in the Southern-Cross area.

The clear shifts of the main Raman peaks, of the analysed quartz samples, to the lower frequencies 463, 261, 204 and 126 cm⁻¹ (Site 1), to 463, 261 and 205 cm⁻¹ (Site 9 & 16) and to 463, 261, 204 and 125 cm⁻¹ (Site 18) provide first proof for an Impact Event as the cause of the linear ray-structure!

(⇒ see explanation in Appendix 1 at page 25: Overview: The Raman bands (peaks) of shocked Quartz)

Microscopic images of some analysed quartz grains seem to provide further proof for a shock event. PDFs (planar deformation features) seem to be present in some samples (⇒ images on pages 4 to 11).

All spectra were made with a BRUKER Senterra-II Raman Microscope (wavenumber precision <0.1 cm⁻¹)

⇒ Images of the analysed rock samples and photos of the sample sites are in the Appendix at page 18.

⇒ More images of all sample sites are available on www.permiantriassic.de or www.permiantriassic.at

⇒ References: see page 26 / and pages 14-16, 20-21 and 24-27 of Part 3 (P3) of my hypothesis.

Note: A shock pressure of 20 GPa exceeds every pressure caused by normal terrestrial metamorphism. The indicated shock pressures of ≈20-22 GPa therefore in general point to an impact shock event.

Gravity Anomaly Map of Southern-Cross area

Port Hedland Crater (= Bengal Bay Crater) + surrounding area (Gravity Anomaly Map)
The thin ejecta-ray-structures visible on the gravity anomaly map of Western Australia as linear red (positive) anomalies, were caused either by the $\phi 400 \times 350 \text{km}$ Port Hedland Crater (=Bengal Bay Crater) or by the Victoria Lake Impact Crater. According to my Permian-Trassic Impact (PTI) hypothesis the Port Hedland Crater (PHC) is a big secondary-crater caused by the PT-Impact Event, which is also responsible for the formation of the Bengal Bay (= Bengal Bay Crater). The topographic map below shows the original situation at the time of the PT-Impact Event. The gravity anomaly map indicates a number of linear ejecta-ray-structures (red) on the Yilgarn Craton which are (nearly) parallel.
Sample Site 1: Stone 1_spectra 1 indicates: Quartz

The spectral lines 463, 261, 204 and 126 indicate that the Quartz was exposed to a shock pressure of around 22 GPa!
Sample Site 1: Stone 2_spectra 1 indicates: Quartz

The spectral lines 463 and 263, indicate that the Quartz was exposed to a shock pressure of around 22 GPa!
Sample Site 9: Stone 1_spectra 1 indicates: Quartz

The spectral lines 463, 261 and 205 indicate that the Quartz was exposed to a shock pressure of around 22 GPa!
Microscopic Images: Sample from Site 1 and 9 → original state (no preparation for analysis)

Sample Site 1: Stone 1: Quartz (Image ~ 300 x 250 μm)

Sample Site 1: Stone 2: Quartz (Image ~ 500 x 400 μm)

Sample Site 9: Stone 1: Quartz (Image: ~ 500 x 400 μm)

Detail: Image size: ~ 250 x 200 μm
Sample Site 16: Stone 1_spectra 1 indicates: Quartz

The spectral lines 463, 261 and 205 indicate that the Quartz was exposed to a shock pressure of around 22 GPa!
Sample Site 18: Stone 1_spectra 1 indicates: Quartz

The spectral lines 463, 261, 204 and 125 indicate that the Quartz was exposed to a shock pressure of around 22 GPa!

Sample Site 18: Stone 1: Quartz
Detail of Microscopic Image
Image size: ~ 250 x 200 µm
Sample Site 2: Stone 1_spectra 1 indicates: Quartz
Sample Site 16: Stone 1: Quartz (Image ~ 500 x 400 µm)

Sample Site 18: Stone 2: Quartz (Image ~ 500 x 400 µm)

Sample Site 2: Stone 1: Quartz (Image: ~ 500 x 400 µm)

Detail: Image size: ~ 250 x 200 µm
Sample Site 16: Stone 2_spectra 1 indicates: **Quartz**

**Sample:**

**Detail:** Image size: ~ 200 x 150 µm

**Image size:** ~ 400 x 300 µm
Sample Site 11: Stone 1 spectra 1 indicates: Amicite_Quartz_Dachiardite-Na (see RRUFF_CS results)
Sample Site 11: Stone 1_spectra 2 indicates: Quartz_ (⇒ see RRUFF_CS results)

Note the black- and white laminated structure of the Quartz

Sample:

Detail of microscopic image
Sample Site 11: Stone 2_spectra 1 indicates: Quartz_ (see RRUFF_CS results)

Note the red- and black laminated structure of the Quartz

The spectrum was measured in the red-colored quartz

Sample:

Detail of microscopic image:
(size ≈ 100 x 90 µm)

Note the black glass-like spots on the red-colored quartz mineral!

Sample very similar to sample No: 12 from the Geralton-area!!
Sample Site 12: Stone 1_spectra 1 indicates: Erdite_Cechite_Florecite-(Ce)_Geothite (→ see RRUFF_CS)

Note the laminated structure of the mineral

→ Iron-bearing mineral!

Sample:
Sample Site 12: Stone 3_spectra 1 indicates: Heulandite-Sr_Mordenite_Dachiardite-Na_Amicite (→ RRUFF)

Sample:

Detail of microscopic image:
Sample Site 17: Stone 1_spectra 1 indicates: Oligoclase, Labradorite

(see RRUFF_CS results)
Appendix 1: Photos of the rock samples from the analysed sample sites: 
→ See next page!

Please note: Photos of all Sample Sites & Rock Samples are available on my website: 
→ Samples from Southern Cross Area or here: Southern Cross Area

Geological Map of SW-Australia
Location where samples were collected:

Cross-Section A - B
The sections of an ejecta-ray of the Port Hedland Crater (or VLC) → the nearly linear green-colored structures seem have penetrated the Yilgarn Craton down to a depth of around 6 km.

→ Geological Maps can be downloaded here:

Then go to “Geology” – 1:250K Geological Maps and search for the required map.
Sample site 9
Sample site 11
Sample site 12
Sample site 16
Sample site 18
Appendix 2: 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 to 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 to lower frequencies

Appendix 3: 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.
Photos of Sample Sites & Rock Samples are available on: Samples from Southern Cross Area (or: Southern Cross Area)

Find more information to the linear Ejecta-Ray structures in W-Australia in Parts 2 & 3 of my hypothesis - by Harry K. Hahn
Please read pages 14-16, 20-21 & 24-27 of Part 3 (P3) & page 33 of Part 2 (P2) of my hypothesis (→ weblinks below!)

Please also read my Raman-analyses to rock samples from the Kalgoorlie area; Geralton-area & Margaret-River area!! → You can find these analyses either on www.vixra.org or on www.archive.org → under my author name: Harry K. Hahn

The Permian-Triassic (PT) Impact hypothesis - by Harry K. Hahn - 8. July 2017:
Part 1: The 1270 X 950 km Permian-Triassic Impact Crater caused Earth’s Plate Tectonics of the Last 250 Ma
Part 3: The PT-Impact Event caused Secondary-Craters and Impact Structures in India, South-America & Australia
Part 4: The PT-Impact Event and its Importance for the World Economy and for the Exploration- and Mining-Industry
Part 5: Global Impact Events are the cause for Plate Tectonics and the formation of Continents and Oceans (Part 5)

Alternative weblinks for my Study Parts 1 - 6 with slightly higher resolution: Part 1, Part 2, Part 3, Part 4, Part 5, Part 6
Parts 1 – 6 of my PTI-hypothesis are also available on my website: www.permiantriassic.de or www.permiantriassic.at


Shock metamorphism of planetary silicate rocks and sediments: Proposal for an updated classification system

A Raman spectroscopic study of shocked single crystalline quartz - by P. McMillan, G. Wolf, Phillipe Lambert, 1992
alternative: https://www.semanticscholar.org/paper/A-Raman-spectroscopic-study-of-shocked-single-McMillan-Wolf/cfaaf6eb3e46fb2d912fb91c7acf40e88e721132

Raman spectroscopy of natural silica in Chicxulub impactite, Mexico - by M. Ostroumov, E. Faulques, E. Lounejeva
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Shock-induced irreversible transition from α-quartz to CaCl2-like silica - Journal of Applied Physics: Vol 96, No 8

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https://www.researchgate.net/publication/234026075_Shock_experiments_on_quartz_targets_pre-cooled_to_77_K

A Raman spectroscopic study of a fulgurite – by E. A. Carter, M.D. Hargreaves, ...
https://www.researchgate.net/publication/44655699_Raman_Spectroscopic_Study_of_a_Fulgurite
alternative: https://royalsocietypublishing.org/doi/abs/10.1098/rsta.2010.0022

Shock-Related Deformation of Feldspars from the Tenoumer Impact Crater, Mauritania - by Steven J. Jaret
https://trace.tennessee.edu/cgi/viewcontent.cgi?article=1002&context=pursuit

A Study of Shock-Metamorphic Features of Feldspars from the Xiuyan Impact Crater - by Feng Yin, Dequi Dai
https://www.researchgate.net/publication/339672303_A_Study_of_Skock-Metamorphic_Features_of_Feldspars_from_the_Xiuyan_Impact_Crater

Shock effects in plagioclase feldspar from the Mistatin Lake impact structure, Canada – A. E. Pickersgill—2015

Shock Effects in feldspar: an overview - by A. E. Pickersgill

ExoMars Raman Laser Spectrometer RLS, a tool for the potential recognition of wet target craters on Mars