An Impact Structure Ø 30 km and Impact Crater Ø 1,6 x 1,2 km in Southern Spain - RAMAN Spectra of selected Rock Samples - by Harry K. Hahn, 30.6.2021 -

Summary:

Raman spectra of samples taken from the sample sites 50, 30 and 19 provide evidence that the large bow-shaped structure visible on the satellite image (see image below) was caused by an impact event. This bow-shaped structure ≈ Ø 30 km belongs to a large-scale impact event which according to my hypothesis was caused by (impacting) ejecta material from the Permian Triassic Crater in the Arctic Sea (→ weblink to my Permian Triassic Impact Hypothesis: see Part 1 (P1) and Part 2 (P2) of my study).

The bow-shaped impact structure is located near Puerto de Mazarron in the state of Murcia in Andalucia. This impact structure belongs to large Secondary Crater Chain of the PT-Impact Event.

Further evidence for the large-scale impact event in Southern Spain (Andalucia & Murcia) comes from rock-samples collected in a small elliptical Crater with Ø 1,6 x 1,2 km near the town of Rodalquilar. This elliptical crater in the remote East of Andalucia, which belongs to the assumed large-scale impact event in Southern Spain, has the potential to provide precise evidence for my hypothesis, because it provides the precise trajectory and impact angle of the impactor (→ ejecta from the P/T-Crater)!

The Raman spectra of quartz from sample site 50 on the outside of the crater-wall of the bow-shaped impact structure (near the tunnel exit of the AP7) provides clear evidence for an impact event!

The shift of the main Raman bands (peaks) to the lower frequencies 463, 261, 205 and 127 cm⁻¹ which is visible in the Raman Spectra of the quartz-sample, clearly indicates that the quartz was exposed to a shock pressure of around 22 GPa. (see explanation in the Appendix at page 24). Similar shifts of the Raman bands are visible in the spectra of samples 19 & 30 from the center of the structure.

The spectra of the quartz sample 40-B from the center of the Ø 1,6 x 1,2 km elliptical Crater shows similar shifts of the Raman bands, e.g. the measured bands at 463, 261/263, 203 and 127 cm⁻¹, which also indicate a shock pressure of ≈ 22 GPa that can only be the result of an impact event!

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

A shock pressure of 22 GPa far exceeds every pressure caused by normal terrestrial metamorphism. Therefore the quartz was clearly shocked by an impact event. The indicated shock pressure of 22 GPa is lower than the shock pressure that occurred in other large impact craters on Earth, which can reach 100 GPa. This indicates that the bow-shaped structure was caused by an oblique impact. That means the impactor which formed the struture (→ ejecta of the PT-Crater) impacted in a very shallow angle. The same is true for the yet unknown Ø 1,6 x 1,2 km elliptical Impact Crater near Rodalquilar.

Images of the analysed rock samples and photos of the sample sites are in the Appendix at page 19.

A general summary to all analysed sample sites is provided by Part 6 (P6) of my PTI-hypothesis (P1)

More images of all sample sites are available on www.permiantriassic.de or www.permiantriassic.at
Sample Site 50: Stone 1_spectra 1 indicates: **Quartz**

(→ see RRUFF_search results)

Indication for a shock event are the shifts of the marked Quartz spectral lines towards 463, 261, 205 and 127.

The spectral lines 463, 261, 205 and 127 indicate that the Quartz was exposed to a shock pressure of around **22 GPa**.
Sample Site 50: Stone 1_spectra 1 indicates: Quartz - Image size: ~ 300 x 200 µm

Note the exceptional fracture pattern visible in the quartz sample!
Sample Site 30-B: Stone 1_spectra 1 indicates: Quartz, Reyerite (→ see RRUFF_search results)

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

The spectral line 463 indicates that the Quartz was exposed to a shock pressure of around 22 GPa.
Sample Site 19-B: Stone 3_spectra 1 indicates: Quartz (see RRUFF_search results)

Indication for a shock event are the shifts of the marked Quartz spectral lines towards 261, 205 and 127.

The spectral lines 261, 205 and 127 indicate that the Quartz was exposed to a shock pressure of around 20 – 22 GPa.
Sample Site 40-B: Stone 1_spectra 1 indicates: Quartz
(→ see RRUFF_search results)

Indication for a shock event are the shifts of the marked Quartz spectral lines towards 463, 264 and 127

The spectral lines 463, 264 and 127 indicate that the Quartz was exposed to a shock pressure of around 22 GPa
Sample Site 40-B: Stone 1_spectra 2 indicates: Quartz

(→ see RRUFF_search results)

Indication for a shock event are the shifts of the marked Quartz spectral lines towards 263 and 127.

The spectral lines 263 and 127 indicate that the Quartz was exposed to a shock pressure of around 20 - 22 GPa.
Sample Site 40-B: Stone 2_spectra 1 (brown mineral) indicates: Quartz  (➔ see RRUFF_search results)

Indication for a shock event are the shifts of the marked Quartz spectral lines towards 261, 203 and 127.

The spectral lines 261, 203 and 127 indicate that the Quartz was exposed to a shock pressure of around 20 – 22 GPa.
Sample Site 40-C: Stone 2_spectra 1 (brown mineral) indicates: Quartz, Dachiardite-Na (→RRUFF)

Indication for a shock event are the shifts of the marked Quartz spectral line towards 263.

The spectral line 263 indicates that the Quartz was exposed to a shock pressure of around 20 – 22 GPa.
Microscopic Images: Sample from Sites 19-B, 40-B and 40-C → original state (no preparation)

Sample Site 19-B: Stone 3_spectra 1: Quartz - Image size: ~ 400 x 300 µm

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

Sample Site 40-C: Stone 2: Quartz, ~ 300 x 200 µm
Sample Site 40-C: Stone 3_spectra 1 indicates: Quartz (see RRUFF_search results)

Indication for a shock event are the shifts of the marked Quartz spectral lines towards 261
Sample Site 40-C: Stone 3_spectra 2 indicates: **Dachiardite-Na, Versiliaite**  
(⇒ see RRUFF_search results)

Sample:
Sample Site 50: Stone 3_spectra 1 indicates: **Graphite** (less probable: Stillwellite, Ixiolite) (→ RRUFF)

The Spectral Lines 264 and 129 indicate that also Quartz is present in the sample.
Sample Site 50: Stone 2_spectra 1 indicates: Dolomite (→ see RRUFF_search results)
Sample Site 19-B: Stone 1_spectra 1 indicates: Reyerite (→ see RRUFF_search results)
Sample Site 19-B: Stone 2_spectra 1 indicates: Reyerite. (→ see RRUFF_search results)

Sample:
Sample Site 19-B: Stone 3_spectra 2 indicates: Sahamalite, Dolomite

( see RRUFF_search results )
Sample Site 19-B: Stone 4: no usable search result

Sample:
Appendix 1: Photos of the rock samples from sample sites: 50, 30-B, 19-B, 40-B/C

Please note: Photos of the Sample-Sites 50, 30-B, 19-B, 40-B/C and other sample sites are available here → weblink: Sample Sites: Spain Craters-2 & Spain Craters-1

Impact Structure near Puerto de Mazarron & Aguilas (Spain) with sample sites

Site is accessible over the Highway AP7 (but a long stop on the side-stripe of the highway isn’t recommended!)

Photos of the Samples Sites (weblinks 2) 50, 40-B, 30-B, 19-B and other sites on: Spain Craters-2 & Spain Craters-1
Please note: The rock samples 40-B were collected close to the center of an elliptical Crater Ø 1.6 x 1.2 km that is completely unknown to impact research yet!

All photos of the samples site here 40-B (or alternatively available here: 40-B) (→Spain Craters-2 or Spain Craters-2)
Site 50:
( the crater-wall ) is accessible over the Highway AP7
( but a long stop on the side-stripe of the highway isn’t really recommended! )
The site is located near the exit of the highway tunnel just outside of the crater-wall.

Site 19-B:
The site is very easy accessible by road.
From a little parking area on the coast it’s a 300 m walk to the Impact-effected rocks.
The image shows the rocks in the foreground.
Looking towards the parking area, in the background of the image the Crater-wall ( the Site 50 ) of this Secondary Impact-Structure of the Permian Triassic (PT) Impact Event is visible.

Site 40-B:
The image shows the center of the small Ø 1.6 x 1.2 km elliptical Impact Crater near the village Rodalquilar.
In the background of the image a section of the inner crater-wall is visible. In the foreground an outcrop of impact breccia is visible.
The crater is accessible over an unsealed road. But there is a radar station on the crater rim. Permission may be required for an expedition.

The Ø 1.6 x 1.2 km elliptical Impact Crater
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 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.

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.
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/cfaaf6eb3e46fbd2912fb91c7ac40e88e721132

Raman spectroscopy of natural silica in Chicxulub impactite, Mexico - by M. Ostroumov, E. Faulques, E. Lounejeva
https://www.academia.edu/8003100/Raman_spectroscopy_of_natural_silica_in_Chicxulub_impactite_Mexico
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Shock-induced irreversible transition from α-quartz to CaCl2-like silica - Journal of Applied Physics: Vol 96, No 8

Shock experiments on quartz targets pre-cooled to 77 K - J. Fritz, K. Wünemann, W. U. Reimold, C. Meyer
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_Scudy_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

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

Shock Effects in feldspar: an overview - by A. E. Pickersgill
https://www.hou.usra.edu/meetings/Lmi2019/pdf/5086.pdf

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

References:

Photos of all Sample Sites & Rock Samples are available on: Spain Craters-2 & Spain Craters-1 (or: Spain-2 & Spain-1)