The Ø 8 x 7 km elliptical Warwick Impact Crater (East-Australia)

- Raman Spectra of selected Rock Samples - by Harry K. Hahn, 30.6.2021 -

Summary :

The Ø 8 x 7 km elliptical Warwick Crater is located in East-Australia ≈150 km south-west of Brisbane, near the town Warwick. The crater is visible on the Magnetic Intensity Map as a precise elliptical structure

This elliptical ring structure indicates an oblique impact crater. This means the impactor arrived in a very shallow angle of probably < 10°. The orientation of the elliptical ring structure corresponds to the orientation of the assumed ejecta blanket (see lines on the geological map which mark the ejecta blanket) The age of the oblique impact in all probablility is ≈ 252 Ma. (→ PT-boundary age). The red- and pink colored rock types on the geological map, which present ejecta of the crater, formed ≈ 230-250 Ma ago !

The impact direction of the elliptical Warwick Crater points towards the Cape York Crater (-chain). Therefore the Ø 8 x 7 km "Warwick Crater" probably was caused by a large ejecta fragment of the Cape York Impact Event. But it is also possible that it was caused by an ejecta fragment of the PT-Impact Crater.

(→ weblink to my Permian Triassic Impact Hypothesis : see **Part 1** (**P1**) & **Part 2** (**P2**) of my hypothesis)

(Please also read my study : → The 320 km Cape York Crater (or alternative : weblink 2)

I have analysed some rock samples which I have collected inside the Ø 8x7 km elliptical Warwick Crater.

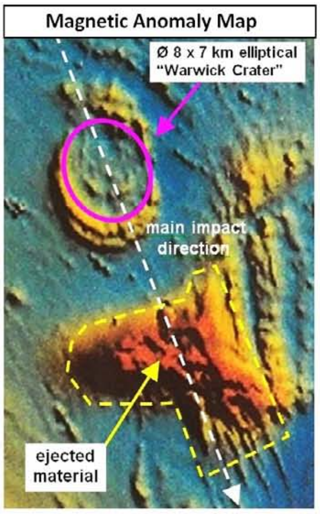
The Raman spectrum of quartz from sample site 43 provides first evidence for an impact shock event as the probable cause of the elliptical ring structure of the Warwick Crater. **The shifts of the main Raman peaks, of the analysed quartz, to the lower frequencies 463 and 204 cm^{-1}, provide indication for an impact shock event that caused a shock pressure of around 22 GPa.**

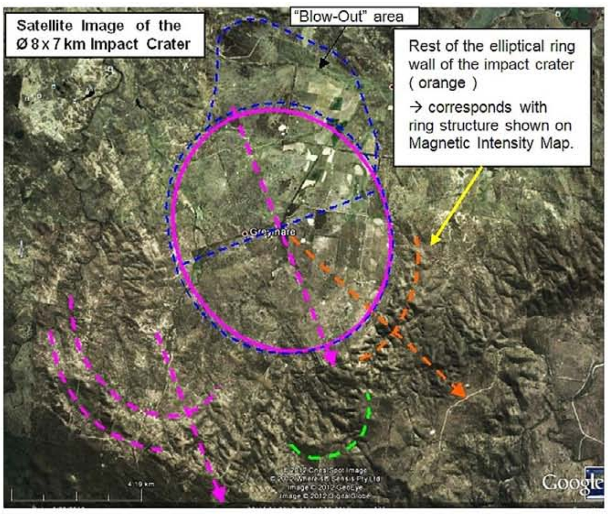
Further indication comes from the Raman spectra of quartz grains from **sample site 53** which show shifts of the main Raman peaks to the lower frequencies **263** and **205** (**204**) **cm^{-1}** , and from Raman spectra of **sample site 51 and 54**, which show shifts of the main Raman peaks of the analysed quartz grains to the lower frequencies **263** and **205 cm^{-1}** , to **260** and **126 cm^{-1}** and to **262** (265) and **204** (207) **cm^{-1}**.

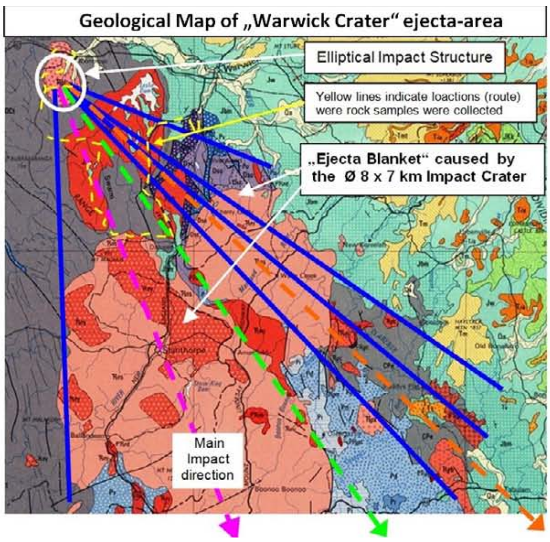
Microscopic images of some of the analysed quartz grains may provide further proof for a shock event. (see images on the **pages : 7, 11, 12** and **22)**.
All spectra were made with a **BRUKER Senterra-II Raman Microscope** (wavenumber precision <0.1cm^{-1})

→ Images of the analysed rock samples and photos of the sample sites are in the Appendix at **page 23**.
→ More images of all sample sites are available on www.permiantriassic.de or www.permiantriassic.at
→ **General Summary** of my Analysis : see **Part 6** (**P6**) of my **PTI-hypothesis** (P1) / References : **page 29**

Note : A shock pressure of 20 GPa exceeds every pressure caused by normal terrestrial metamorphism. The indicated shock pressure of ≈20 GPa is lower than the shock pressure that occured in other large impact craters on Earth. This indicates that the "**Warwick Crater**" was caused by an oblique impact and that the impactor (→ ejecta of the Cape York Crater or PT-Crater) impacted with low velocity <8 km/s.



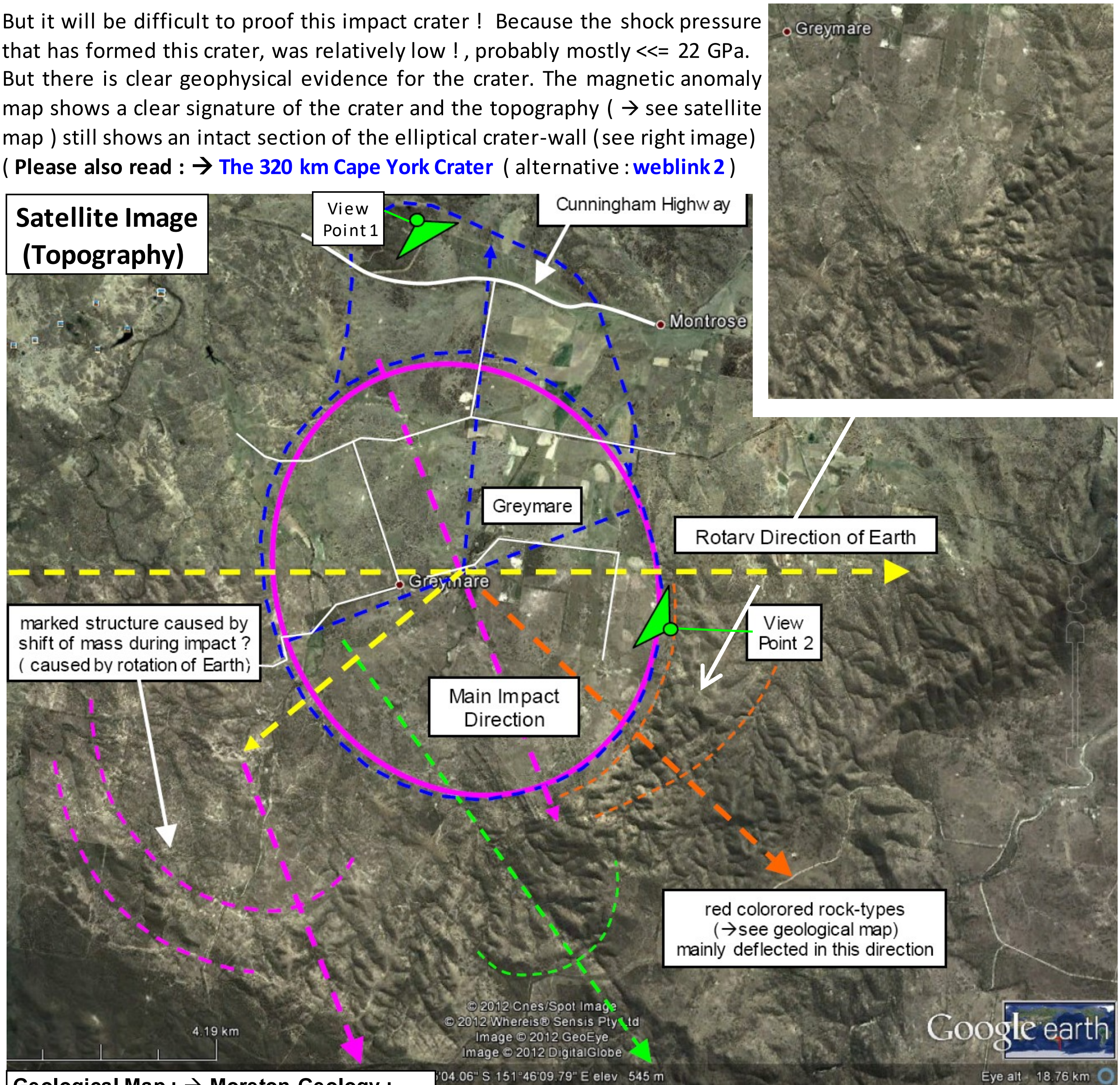




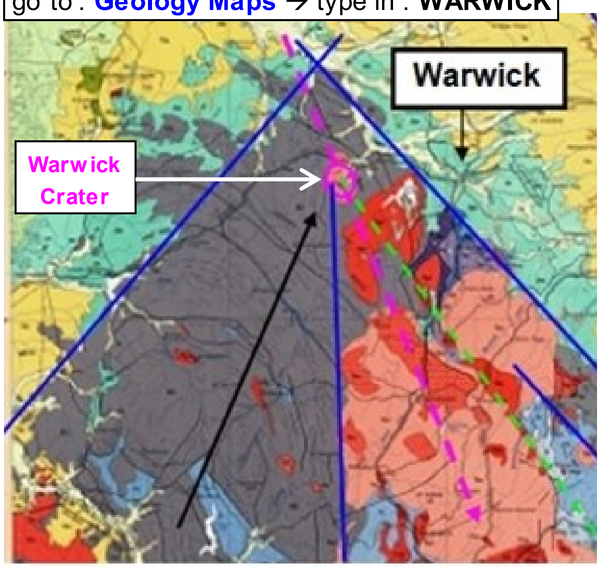
The Ø 8 x 7 km elliptical Warwick Impact Crater

In all probability this crater is a secondary-crater of the Cape York Impact, which was a large-scale secondary impact event in NE-Australia caused by the Permian-Triassic (PT) Impact Event, according to my PTI-hypothesis.

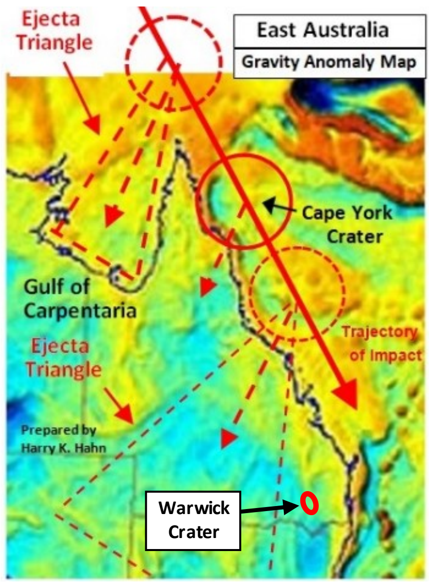
But it will be difficult to proof this impact crater ! Because the shock pressure that has formed this crater, was relatively low ! , probably mostly <<= 22 GPa. But there is clear geophysical evidence for the crater. The magnetic anomaly map shows a clear signature of the crater and the topography (→ see satellite map) still shows an intact section of the elliptical crater-wall (see right image) (**Please also read : → The 320 km Cape York Crater** (alternative : **weblink 2**)



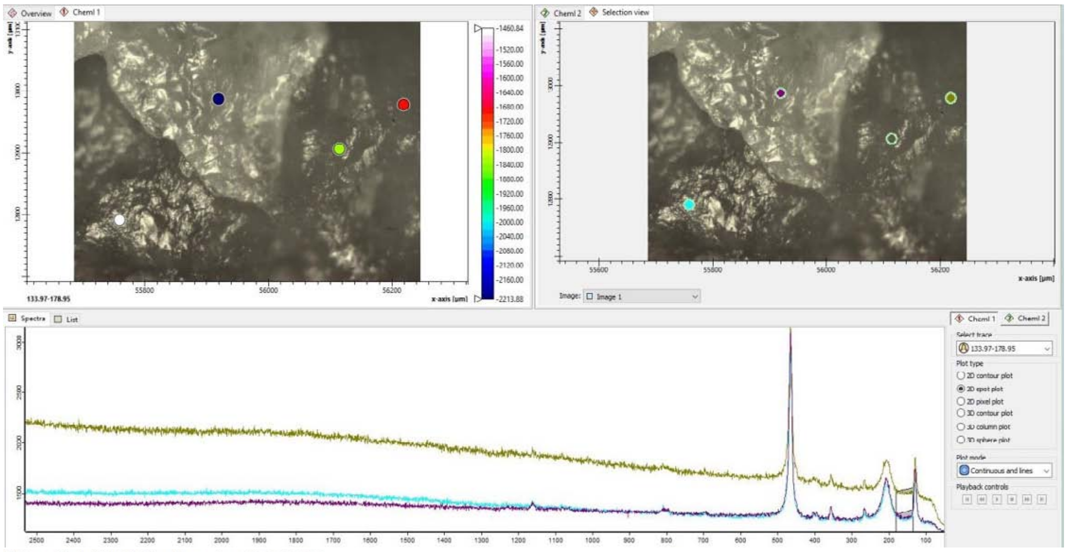
Geological Map : → **Moreton Geology :**
go to : **Geology Maps** → type in : **WARWICK**



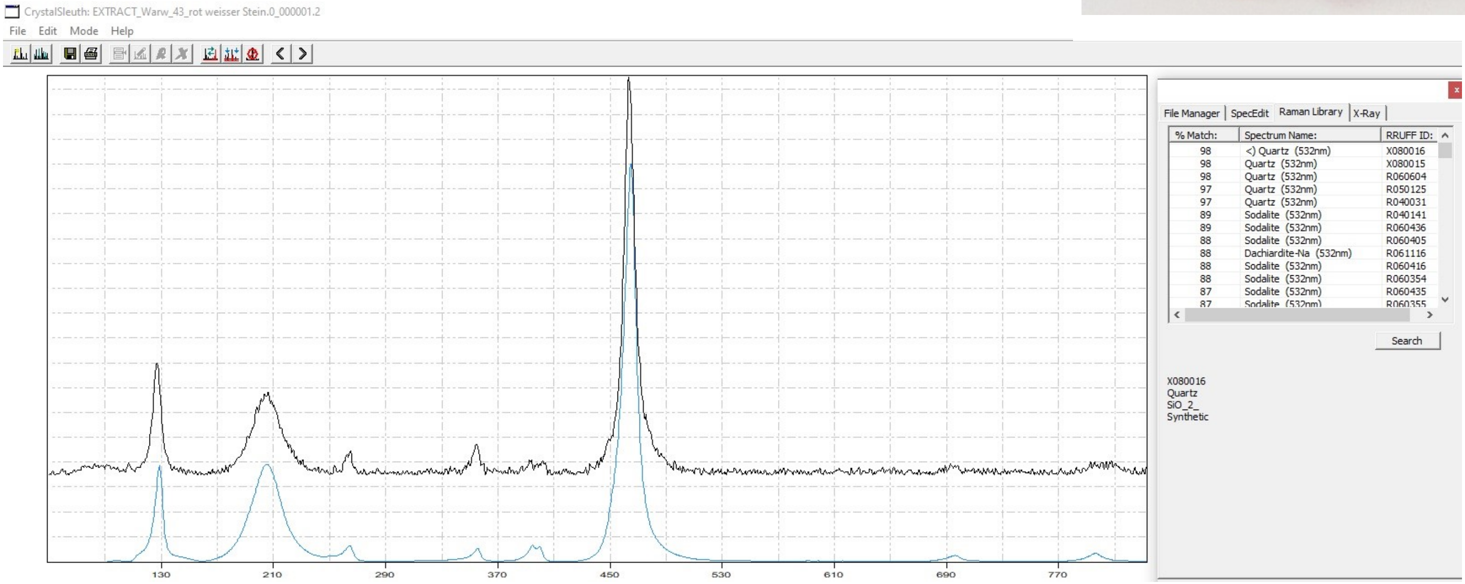
Note : The red and pink marked rock types on the geological map have a measured age of 230-240 Ma (in all probability **PT-boundary age** !!) And the surrounding grey rock-type has an age of 330-370 Ma. The markings on the geological map (left) indicate that the grey- and red-colored rock-types seem to be the result of Ejecta, probably from the assumed Ø 320 km Cape York Crater (right image) that was scattered over the Warwick area ! The red and pink rock-types may come from a large ejecta fragment !



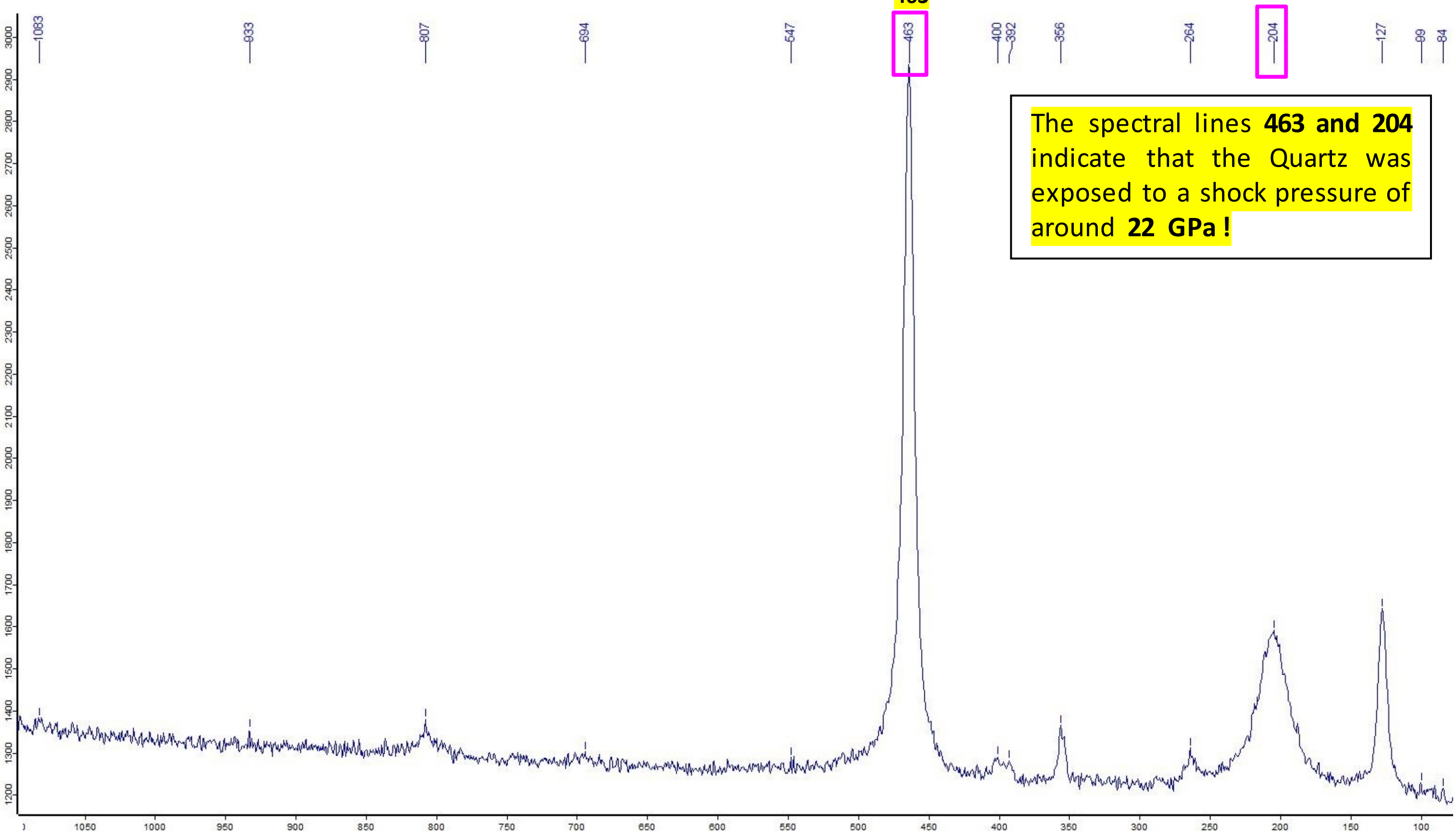
ample Site 43 : Stone 1_spectra 1 indicates : Quartz (→ see RRUFF_CS results)



Sample :

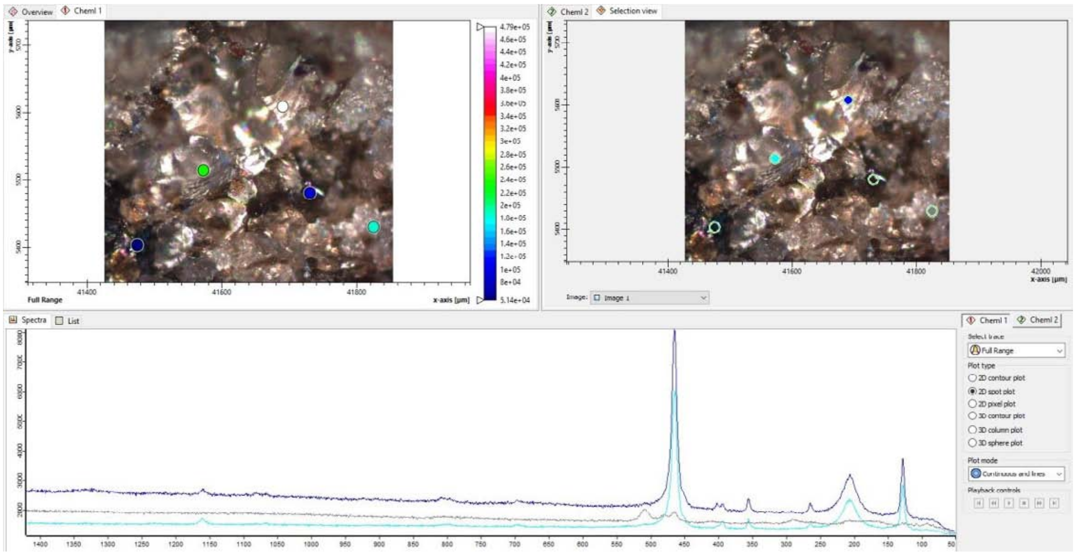


Indication for a shock event are the shifts of the marked Quartz spectral lines towards 463, 204 and 127



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

Sample Site 53 : Stone 1_spectra 1 (grey mineral) indicates : Quartz (→ see RRUFF_CS results)



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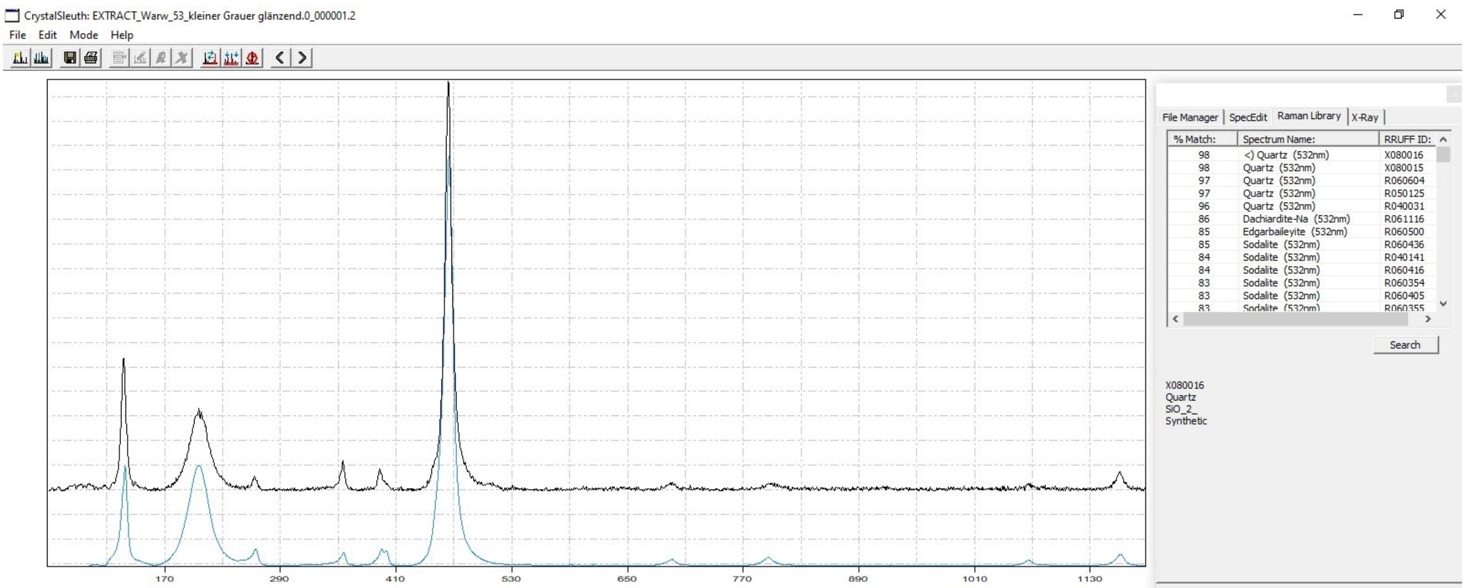
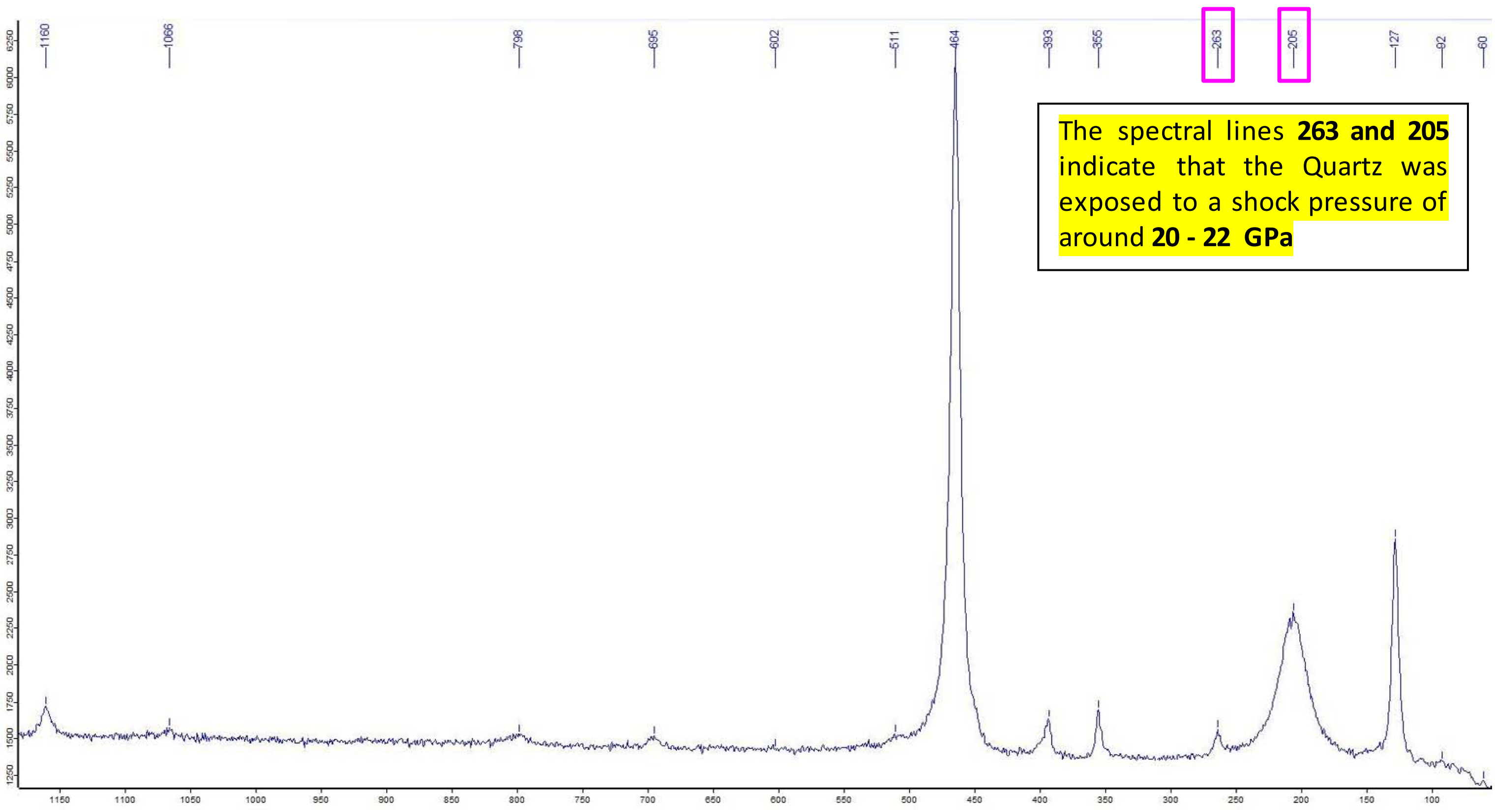
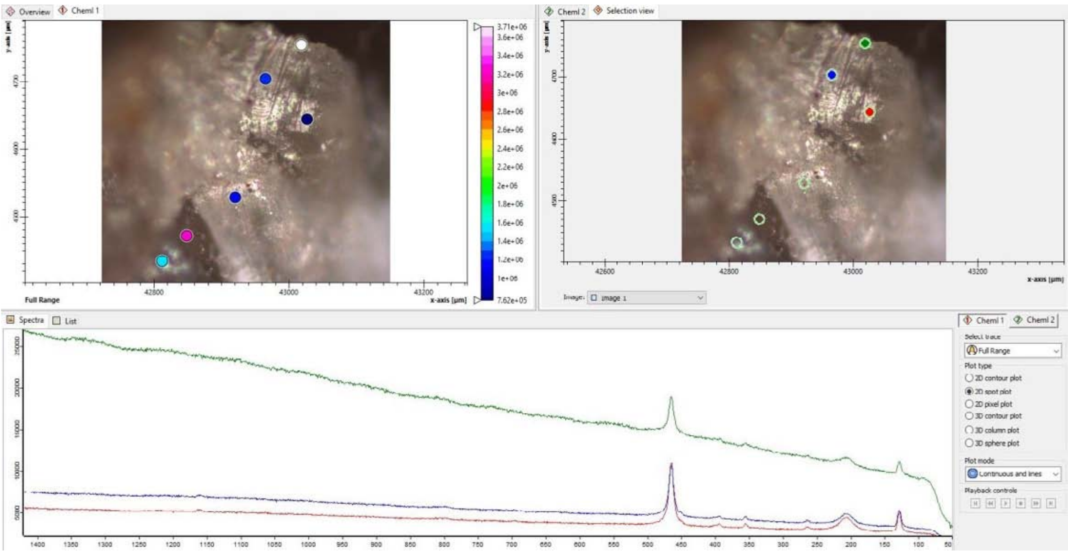


Indication for a shock event are the shifts of the marked Quartz spectral lines towards 263 and 205



Sample Site 53 : Stone 2_spectra 1 (white mineral) indicates : Quartz (→ see RRUFF_CS results)



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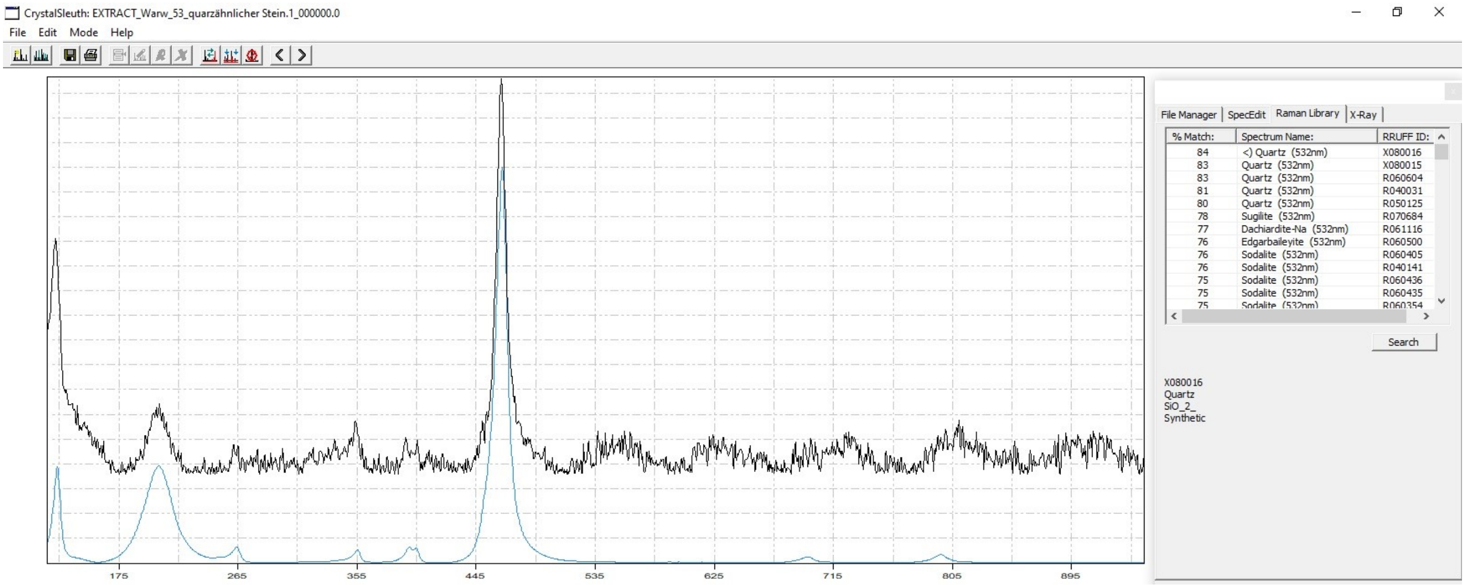
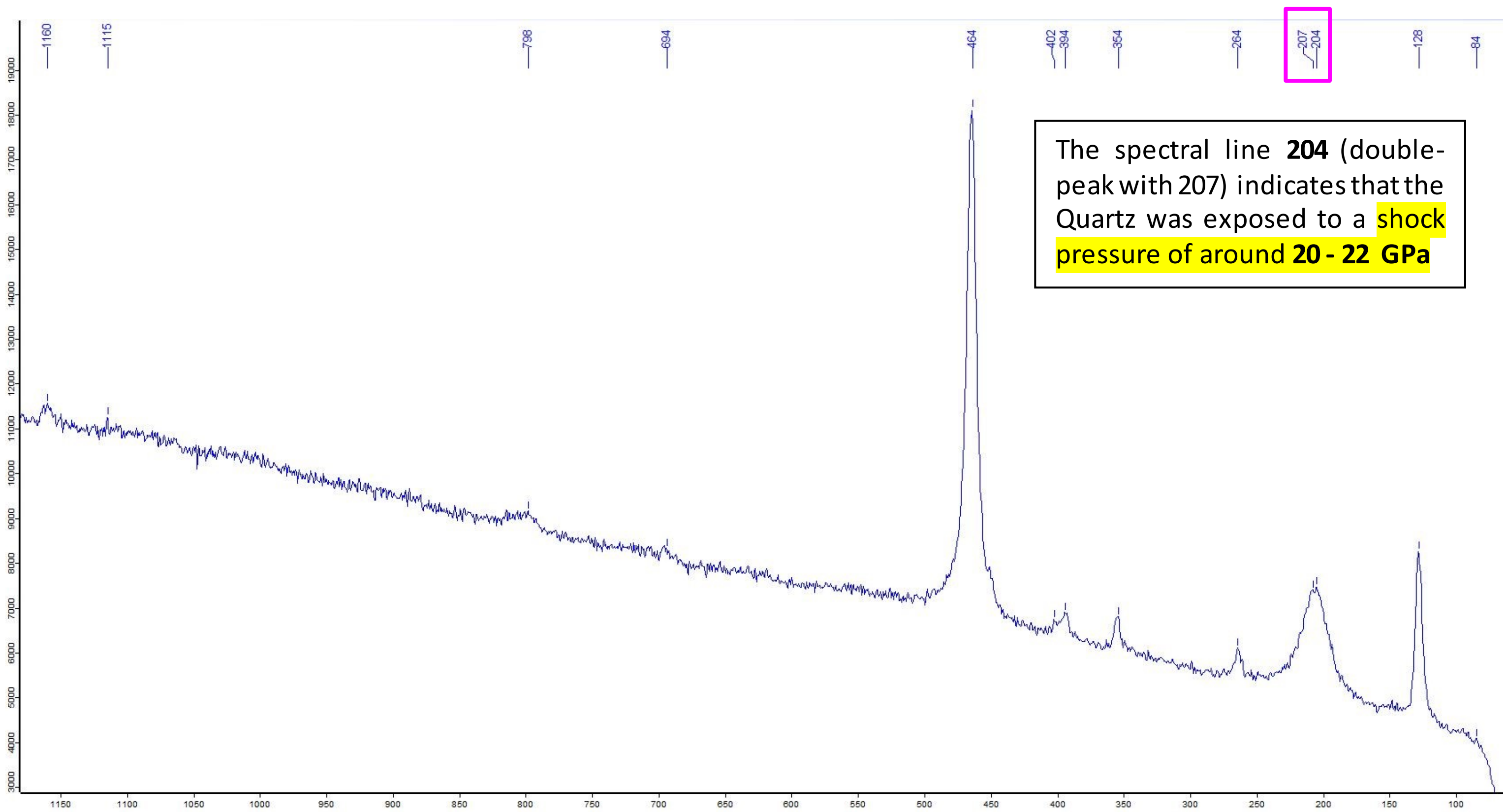
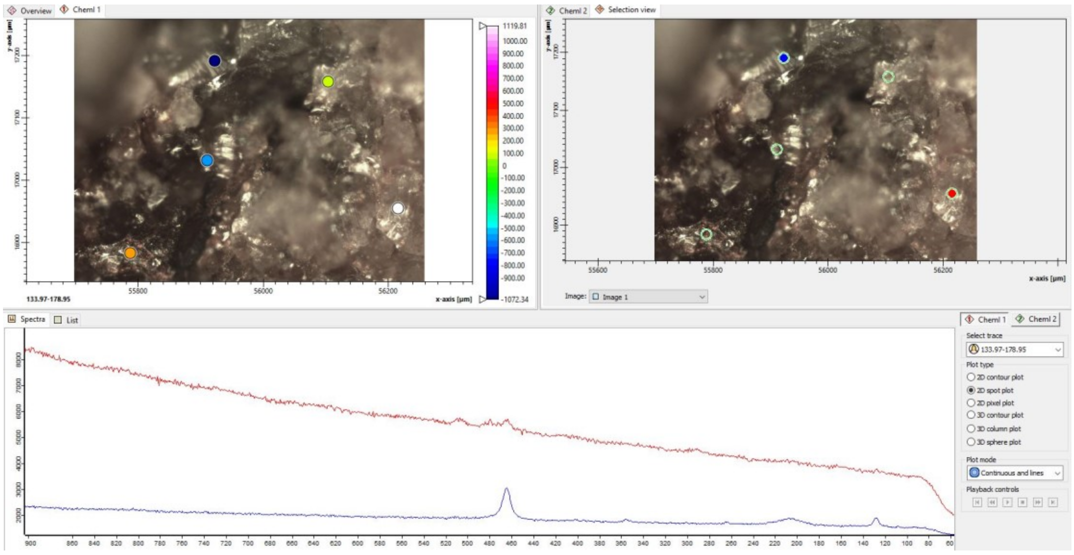


Indication for a shock event is the shift of the marked Quartz spectral line towards 204 (207)



Sample Site 54 : Stone 1_spectra 1 indicates : Quartz (→ see RRUFF_CS results)



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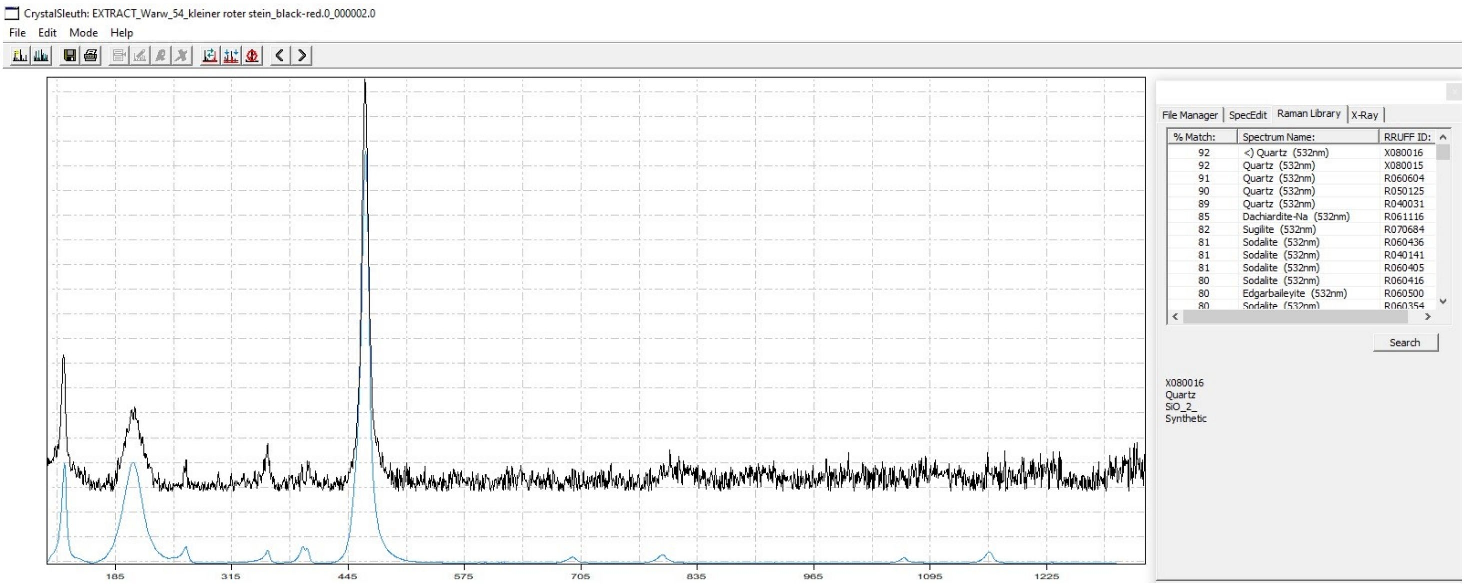
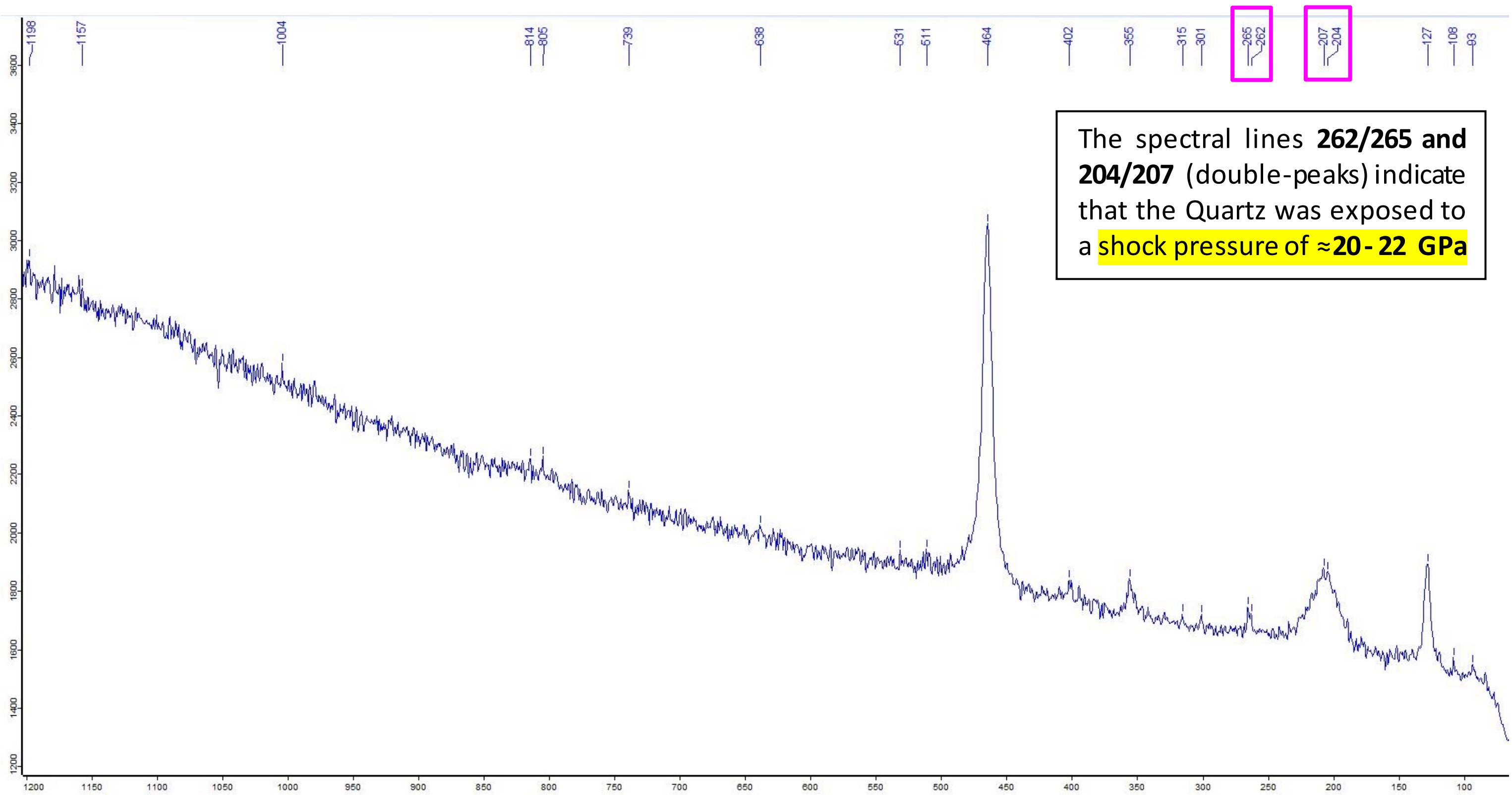
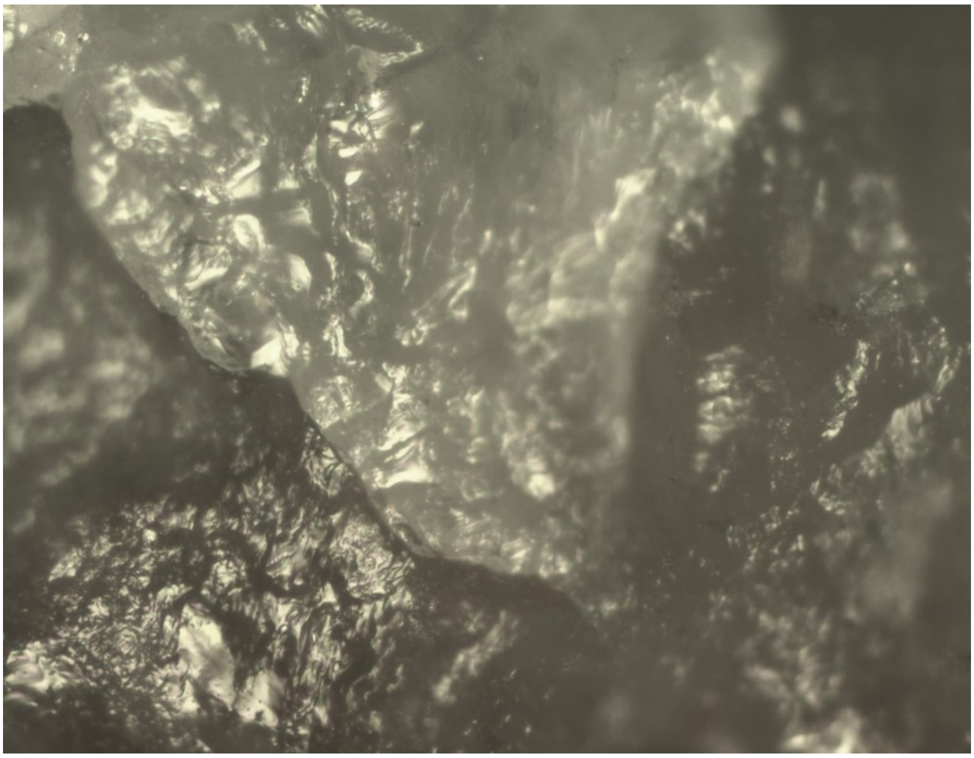


Indication for a shock event are the shifts of the marked Quartz spectral lines towards 262 and 204 (double-peaks)

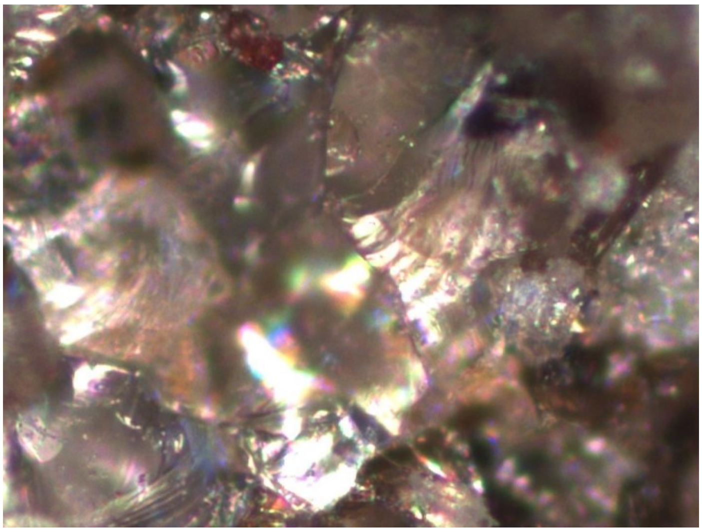


Microscopic Images : Sample from Sites 43, 53 & 54 → original state (no preparation for analysis)

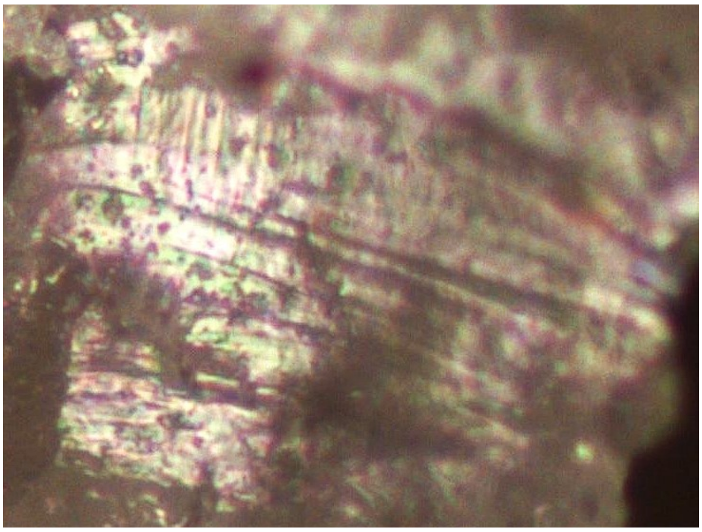
Sample Site 43 : Stone 1_spectra 1 indicates : Quartz - Image size : ~ 400 x 300 µm



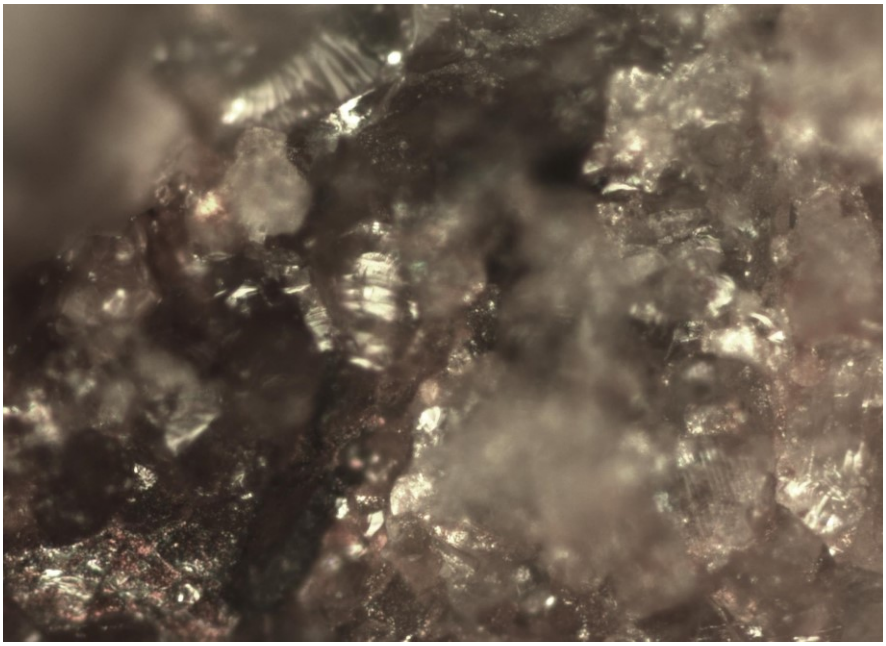
Sample Site 53 : Stone 1_sp. 1 : Quartz ~ 200 x 200 µm



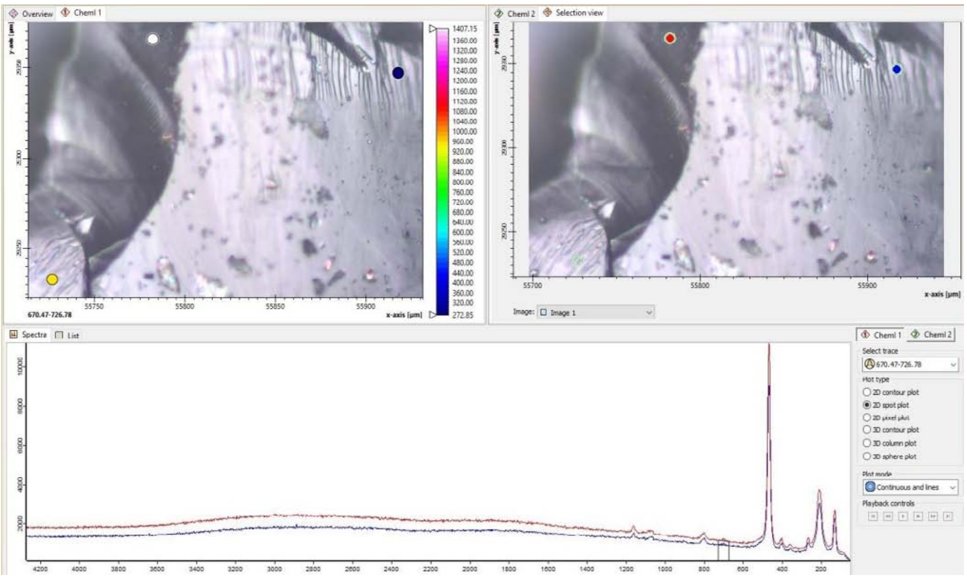
Sample Site 53 : Stone 2_sp. 1 : Quartz ~ 150 x 100 µm



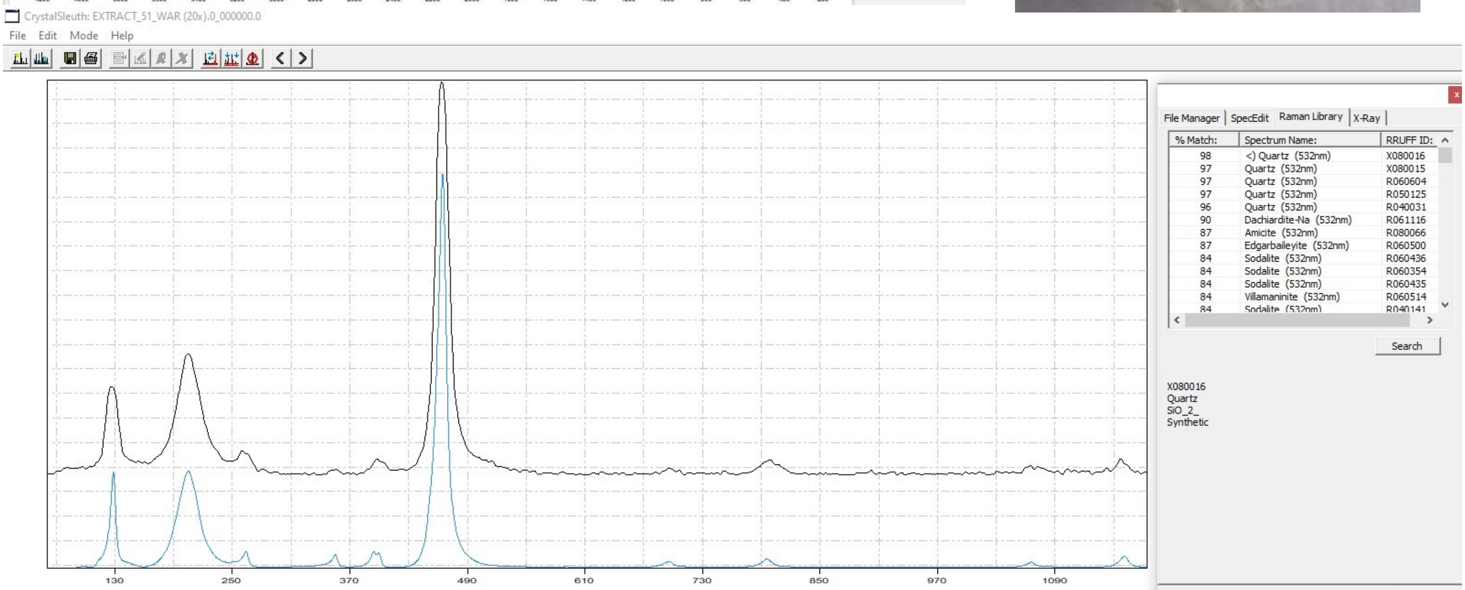
Sample Site 54 : Stone 1_spectra 1 (white mineral) indicates : Quartz - Image size : ~ 400 x 300 µm



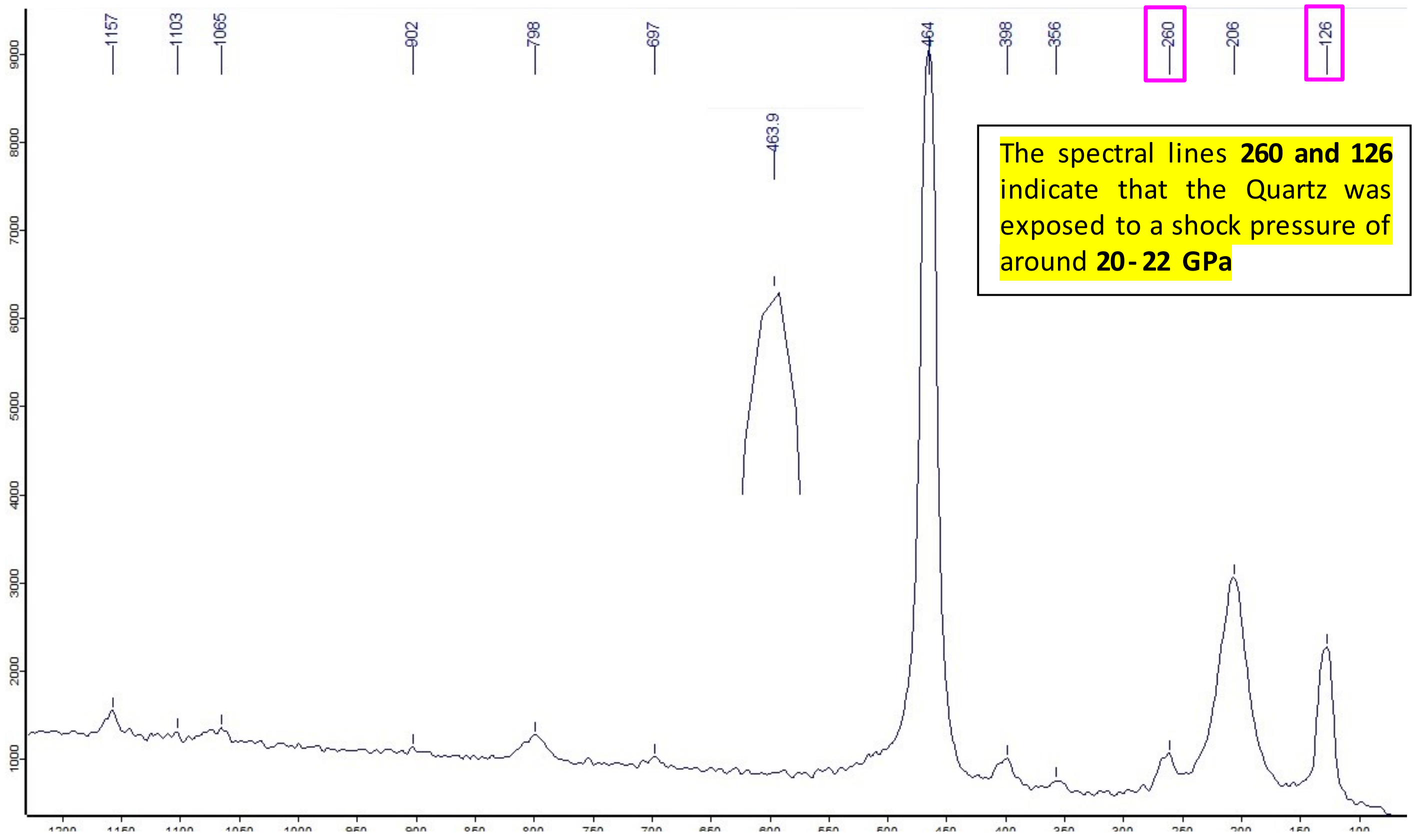
Sample Site 51 : Stone 1_spectra 1 indicates : Quartz (→ see RRUFF_CS results)



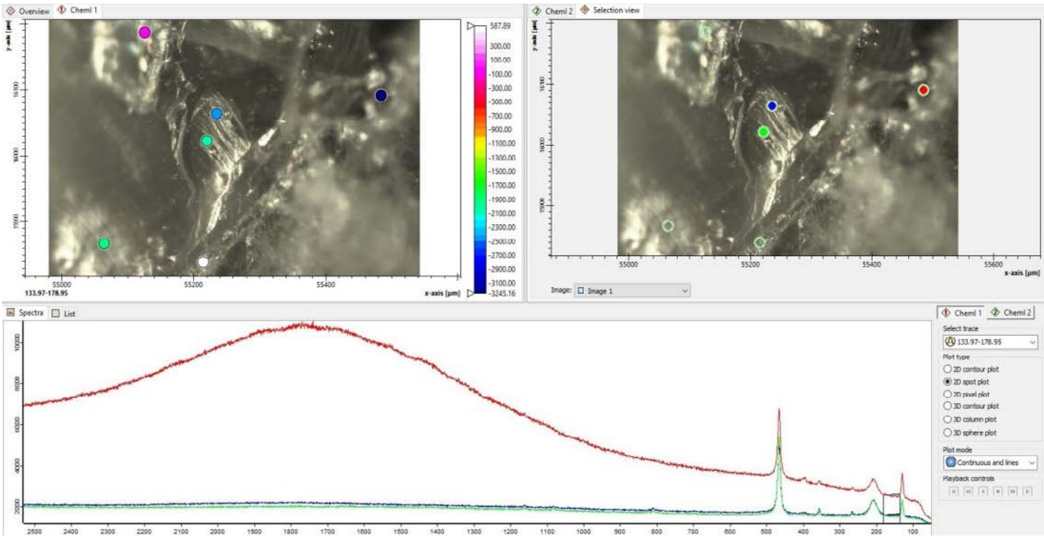
Sample :



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



Sample Site 51 : Stone 2_spectra 1 indicates : Quartz (→ see RRUFF_CS results)



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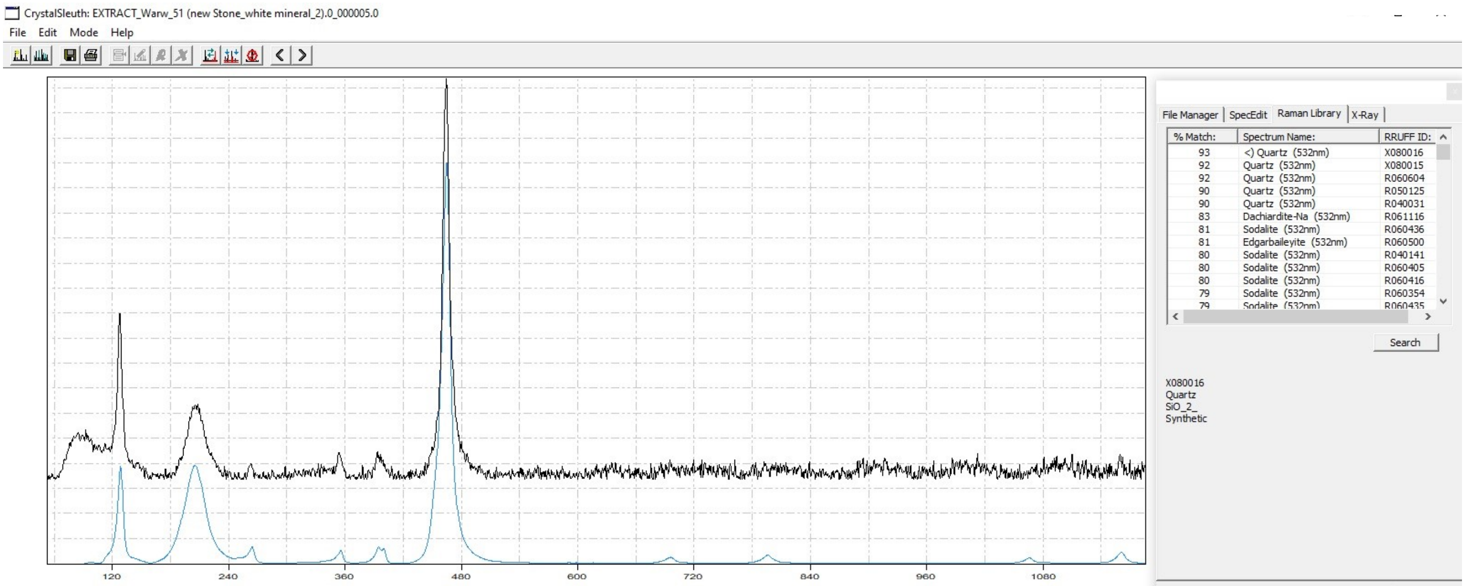
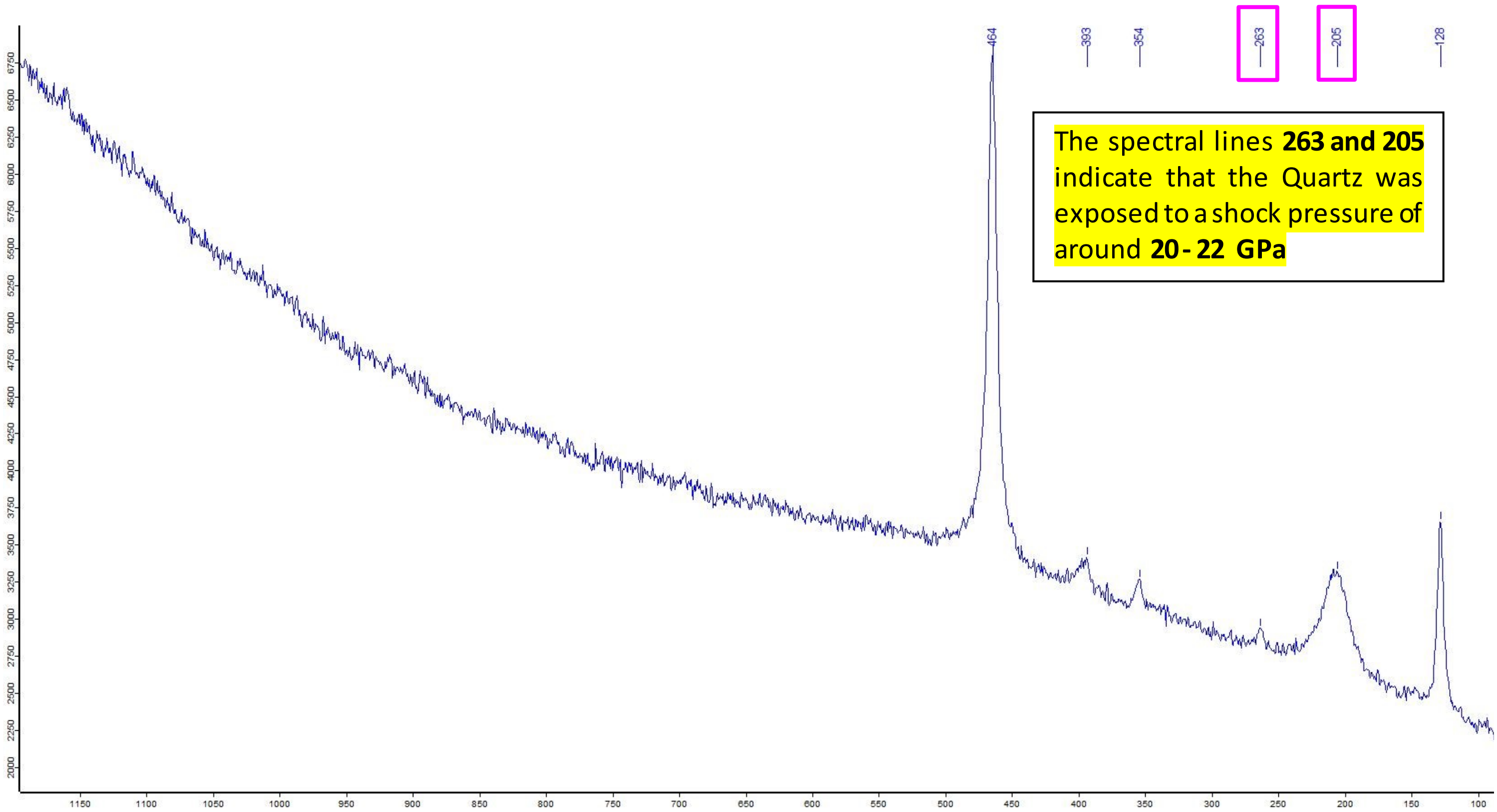
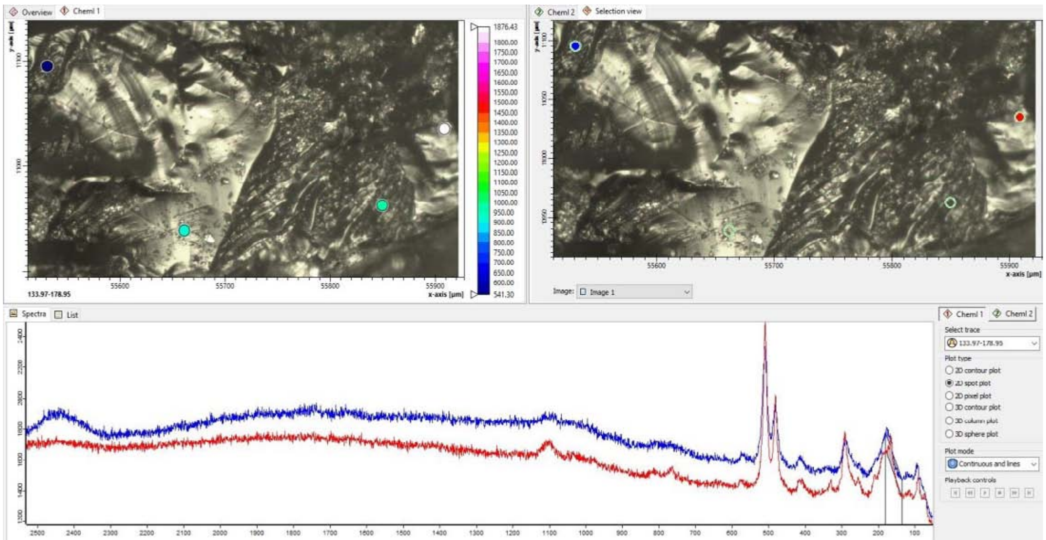


Indication for a shock event are the shifts of the marked Quartz spectral lines towards 263 and 205



Sample Site 51 : Stone 2_spectra 2 indicates : Albite (→ see RRUFF_CS results)



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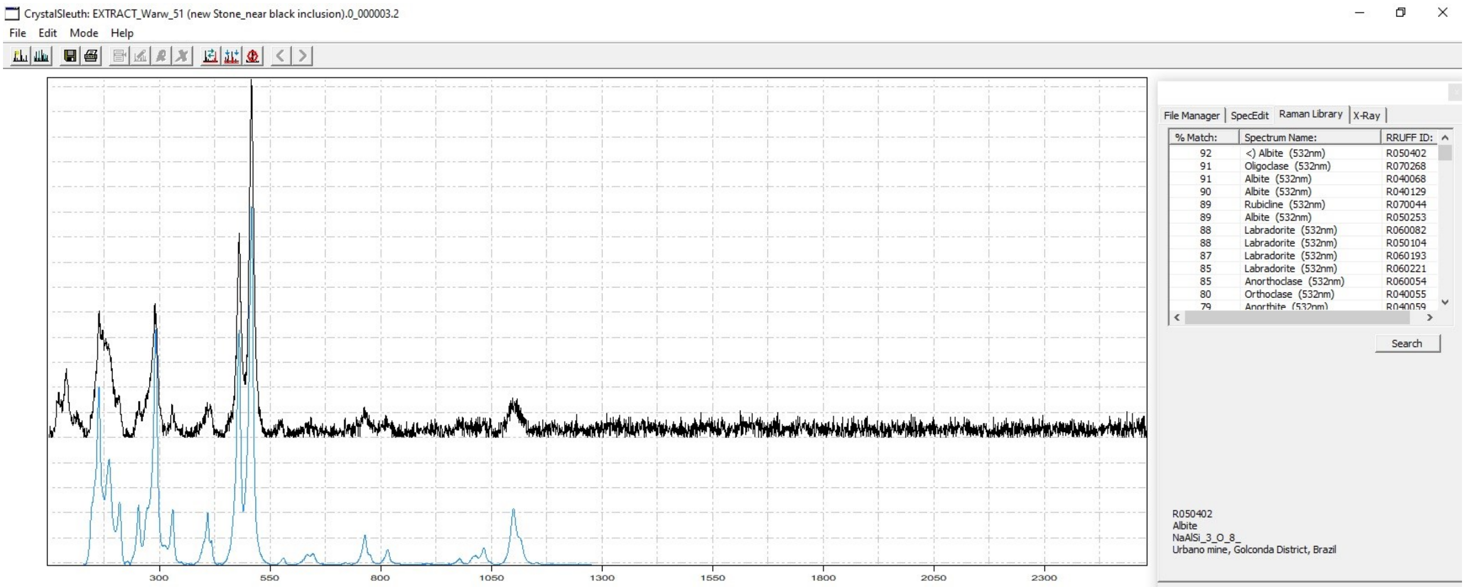
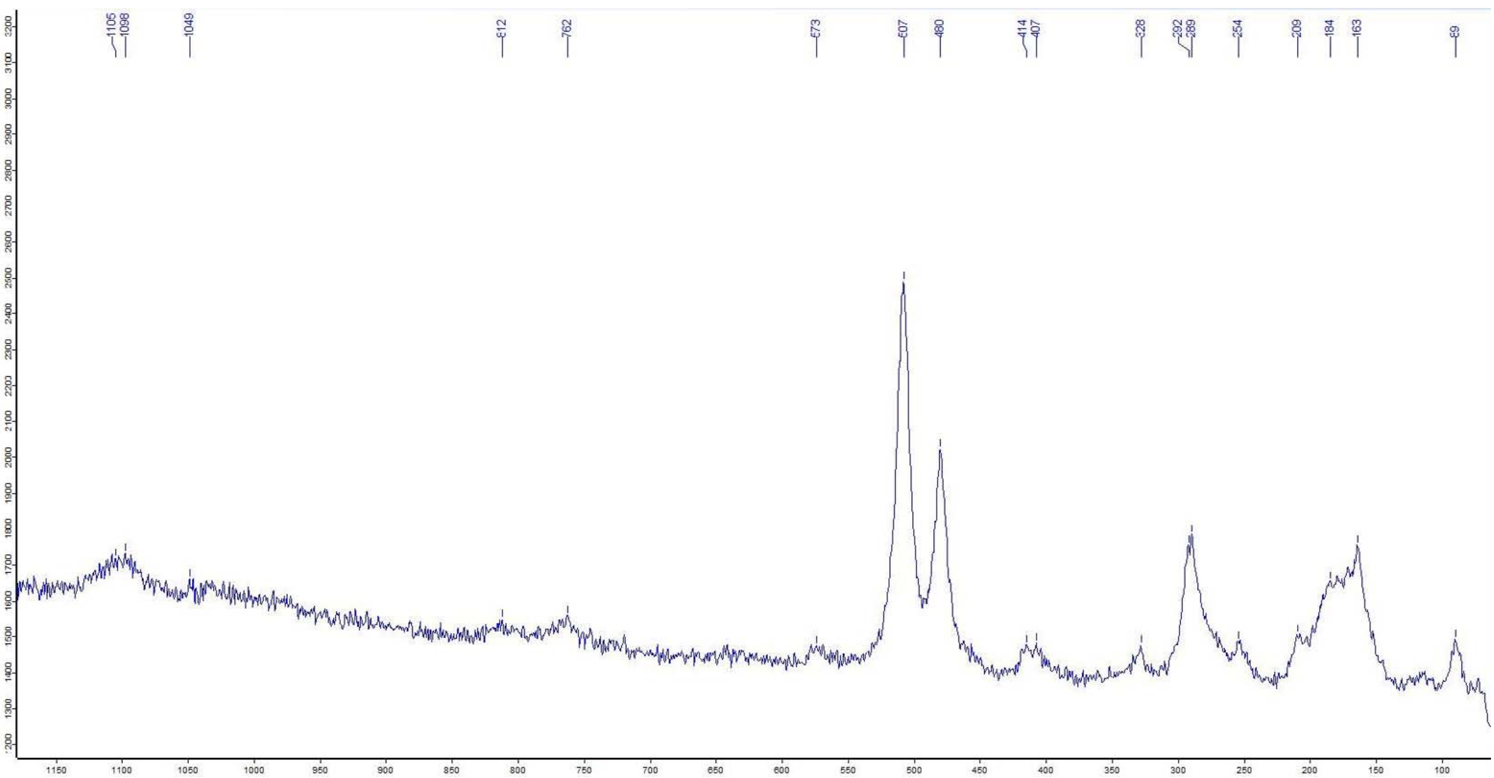
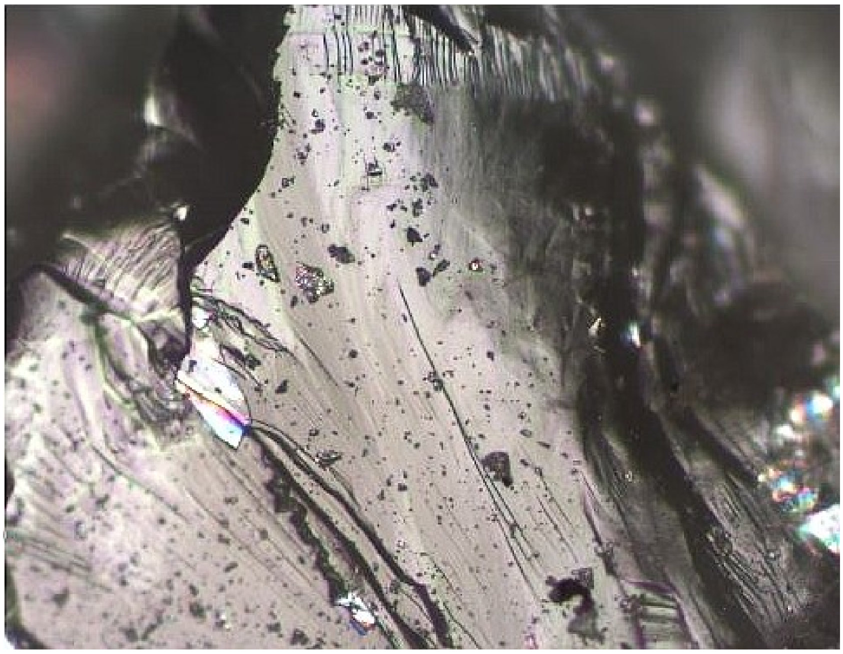


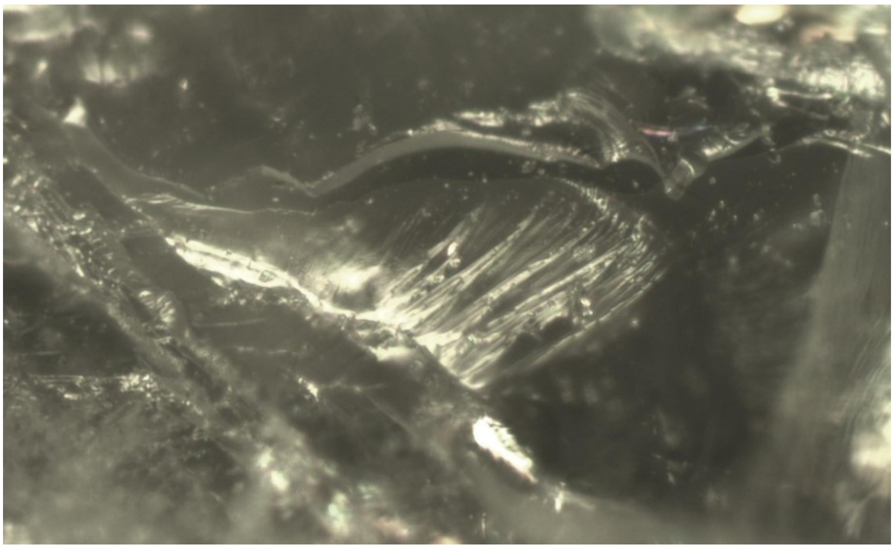


Microscopic Images : Sample from Site 51 → original state (no preparation for analysis)

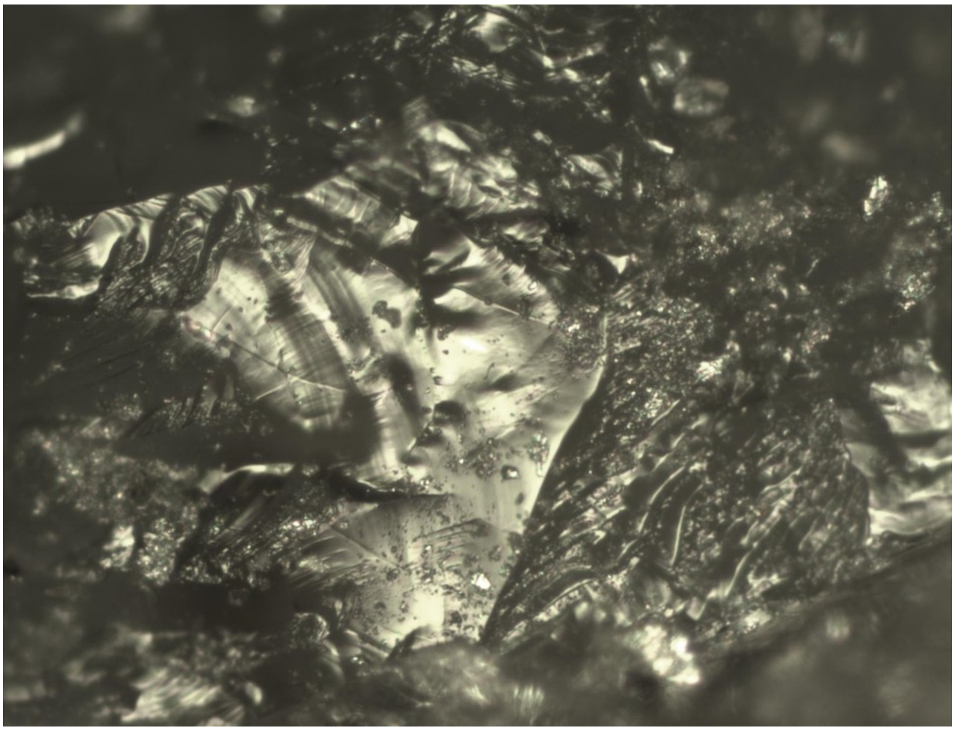
Sample Site 51 : Stone 1_spectra 1 indicates : Quartz - Image size : ~ 400 x 350 µm



Sample Site 51 : Stone 2_spectra 1 indicates : Quartz - Image size : ~ 300 x 200 µm

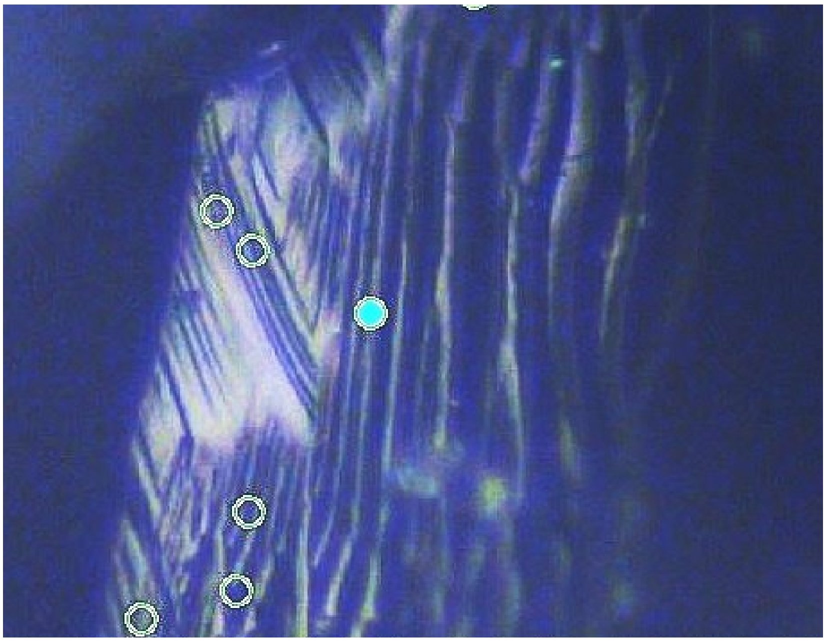


Sample Site 51 : Stone 2_spectra 2 (black mineral) indicates : Albite - Image size : ~ 400 x 300 µm

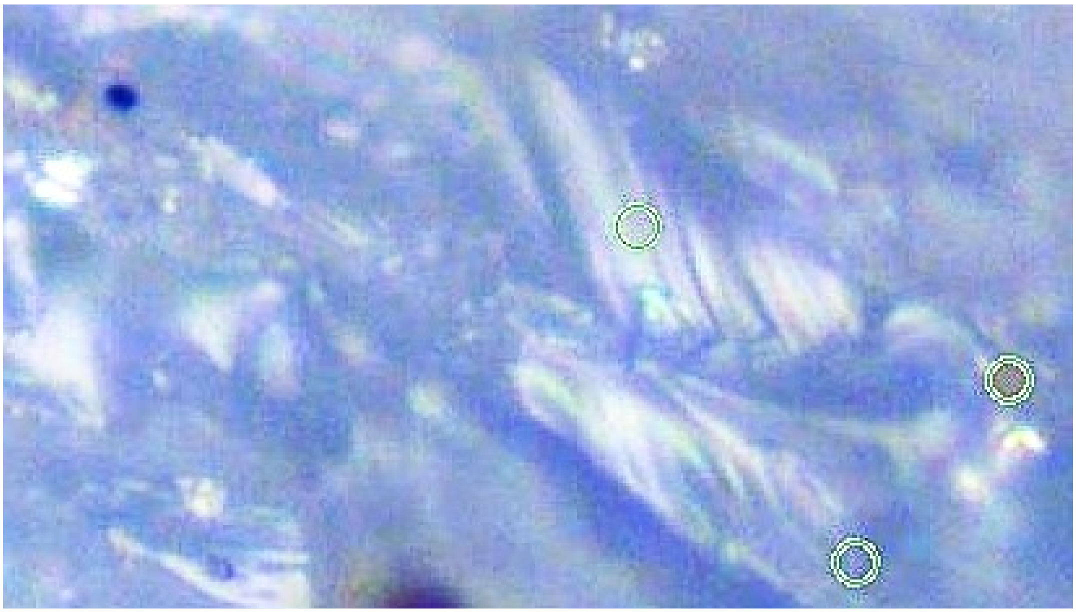


Microscopic Images : Sample from Site 51 → original state (no preparation for analysis)

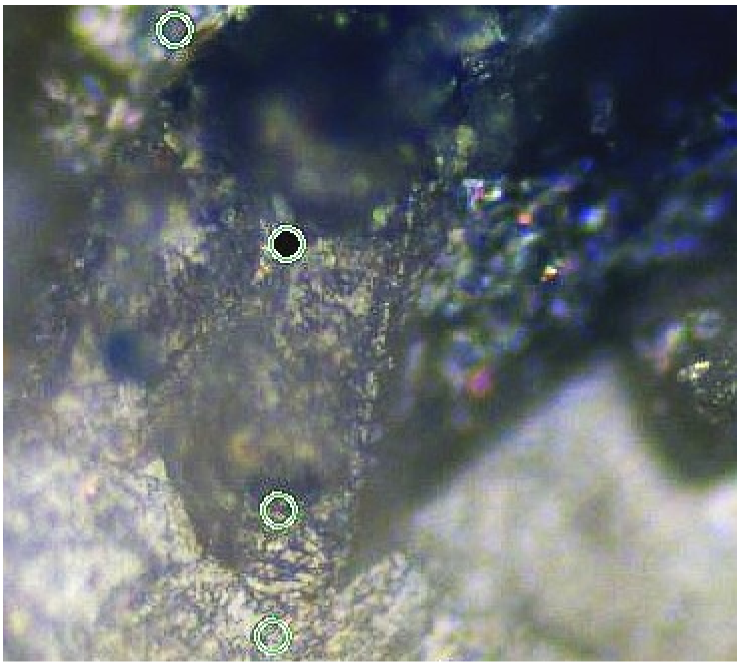
Sample Site 51 : Stone 1_spectra 2 indicates : Orthoclase - Image size : ~ 200 x 200 µm



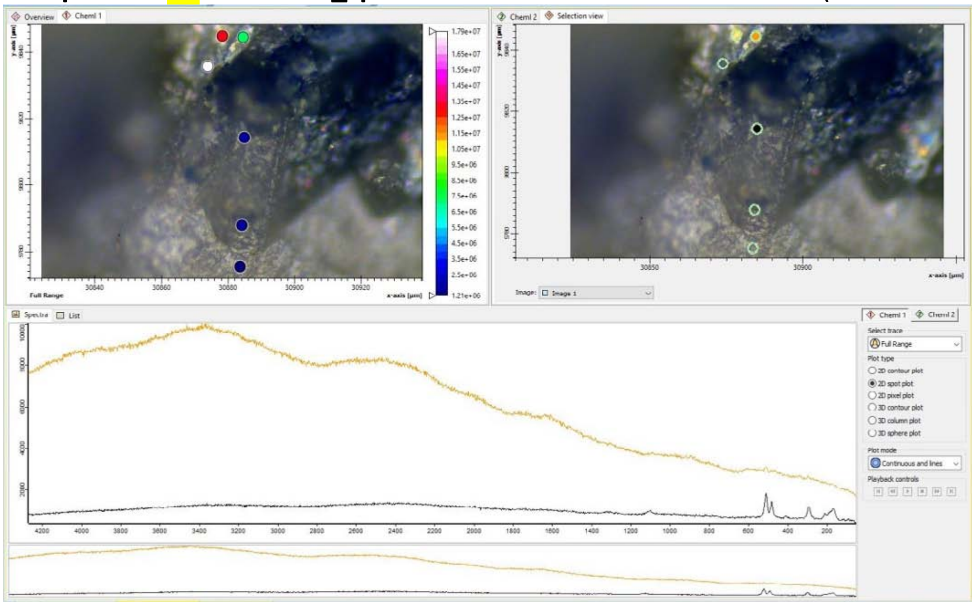
Sample Site 51 : Stone 1_spectra 3 indicates : Labradorite - Image size : ~ 150 x 100 µm



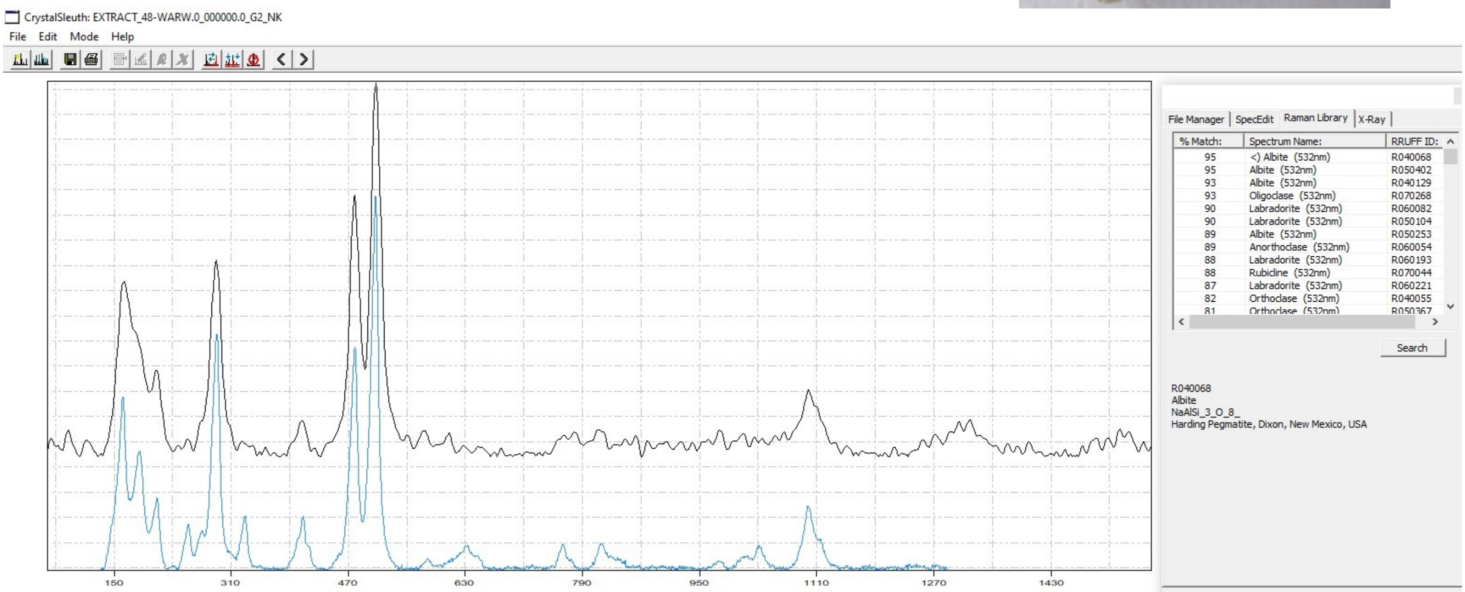
Sample Site 48 : Stone 1_spectra 1 indicates : Albite - Image size : ~ 200 x 200 µm

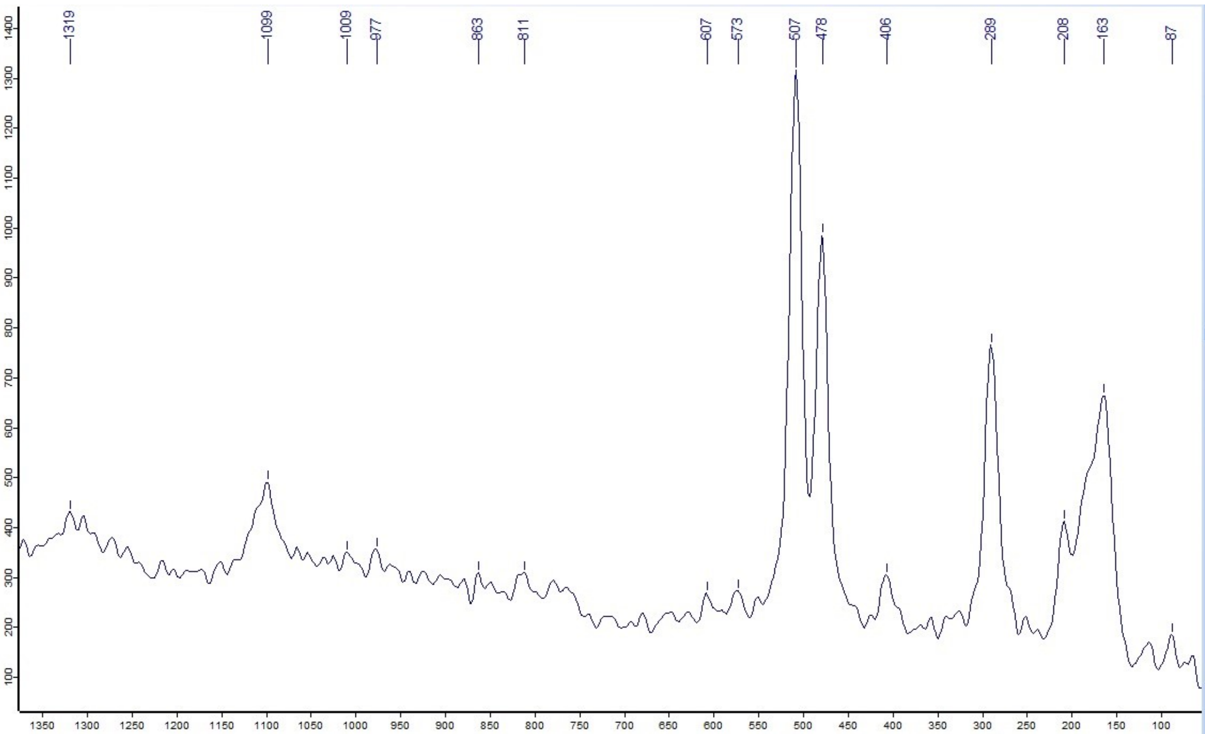


Sample Site 48 : Stone 1_spectra 1 indicates : Albite (→ see RRUFF_CS results)



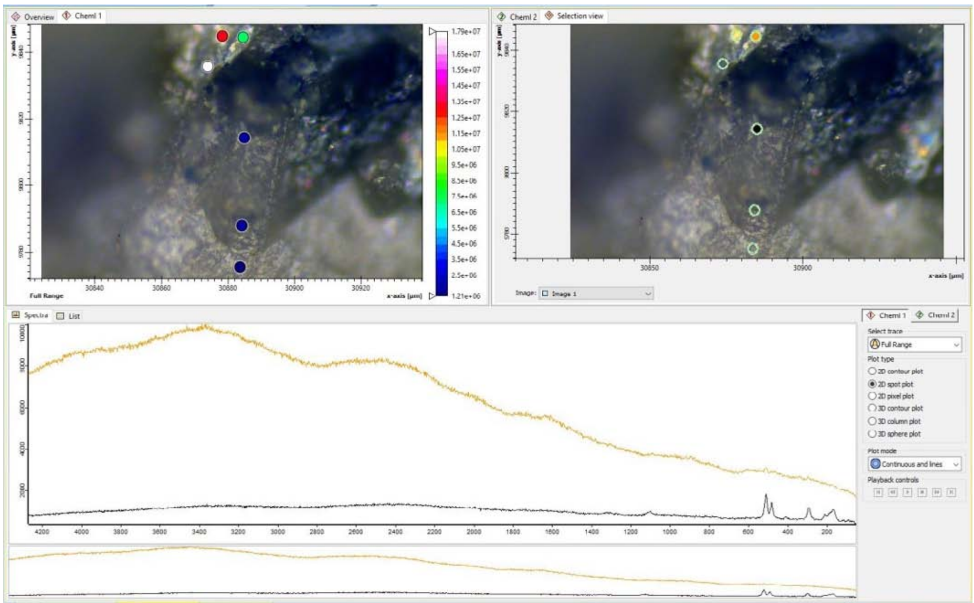
Sample :



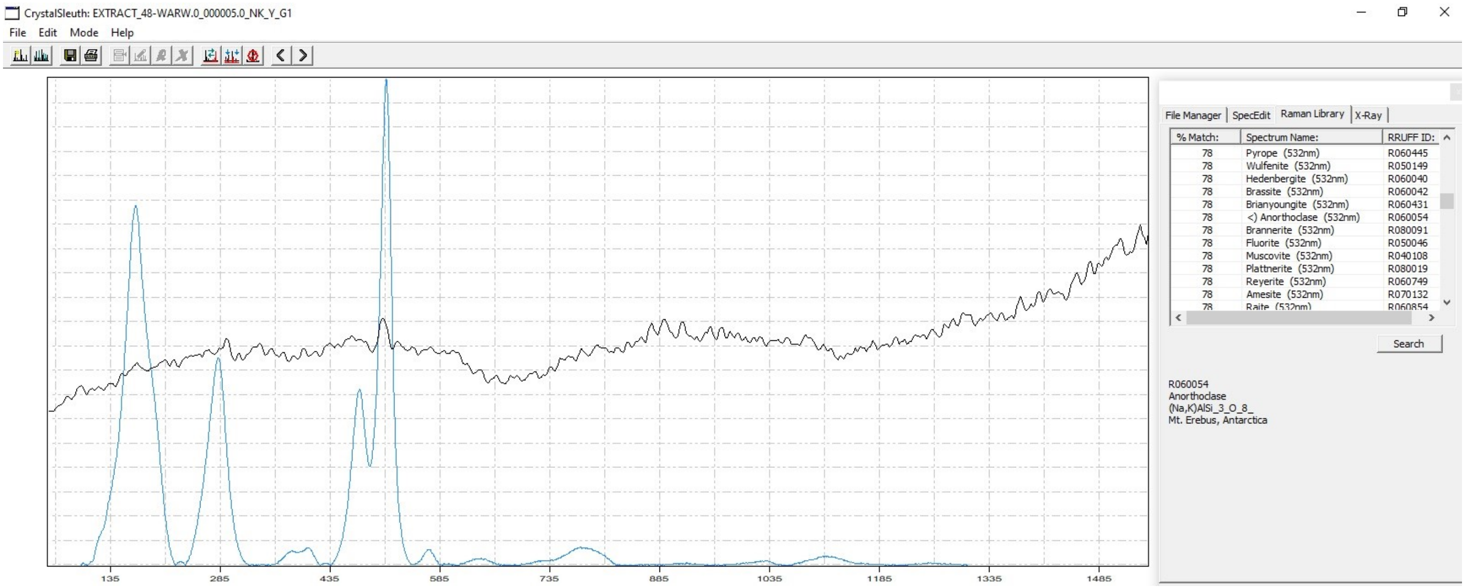


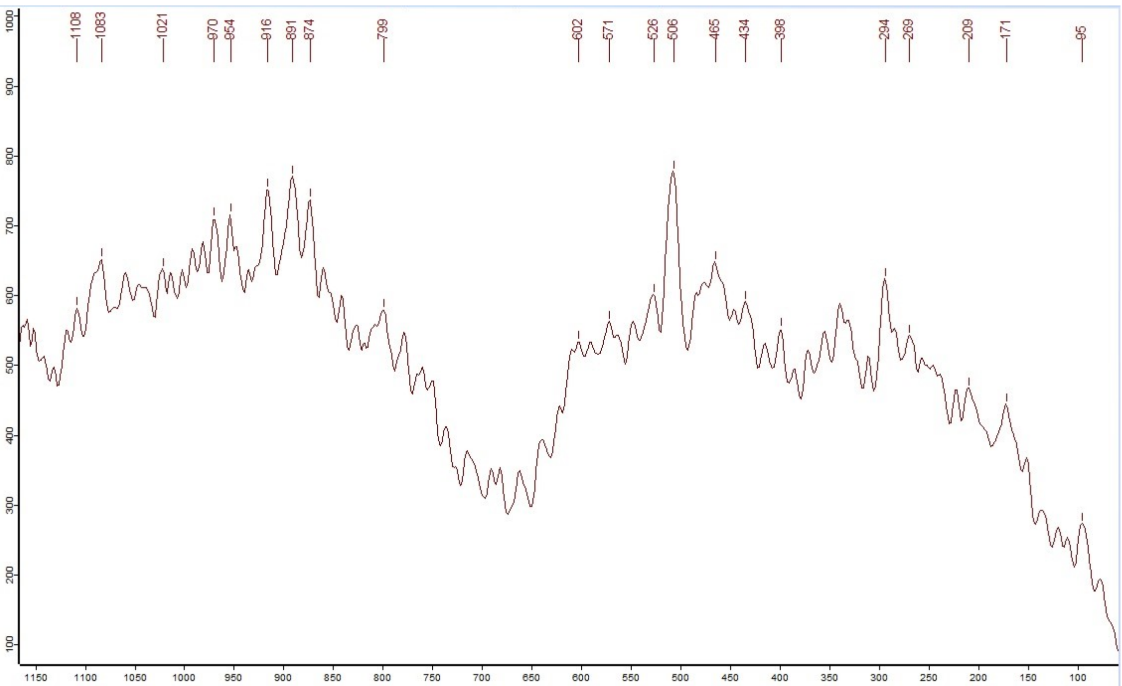
Sample Site 48 : Stone 1_spectra 2 indicates : Anorthoclase (or Albite) (→ see RRUFF_CS results)

→ This result is guesswork because the spectra contains less information !

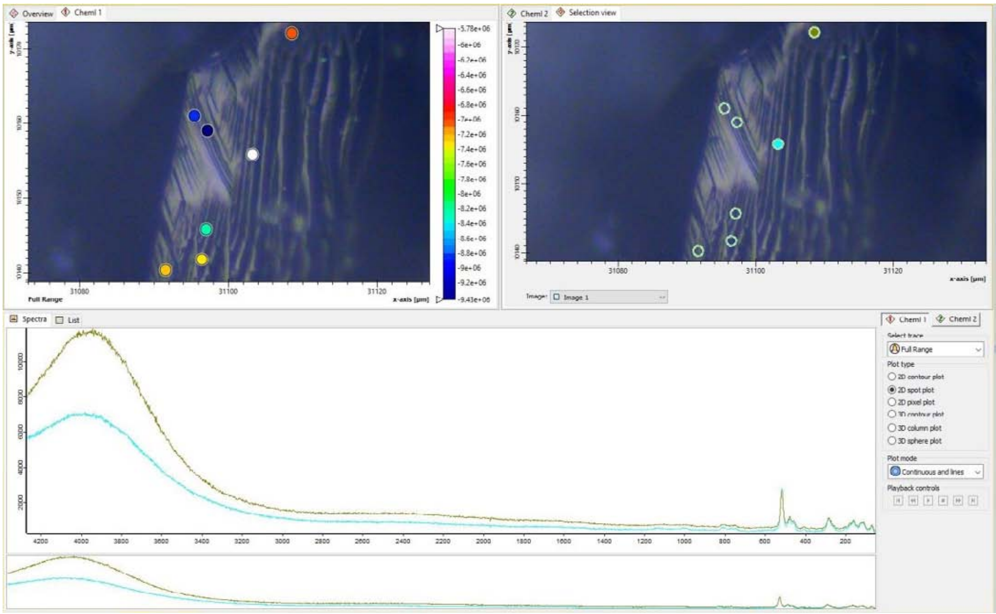


Sample :

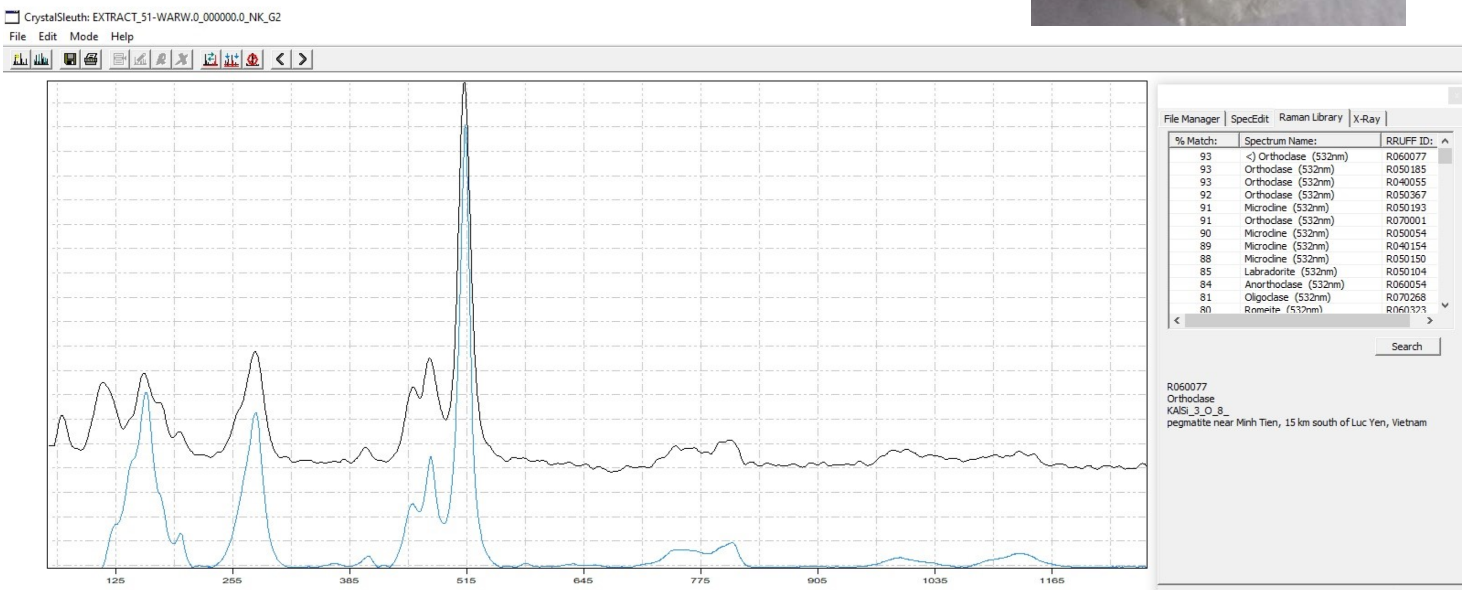


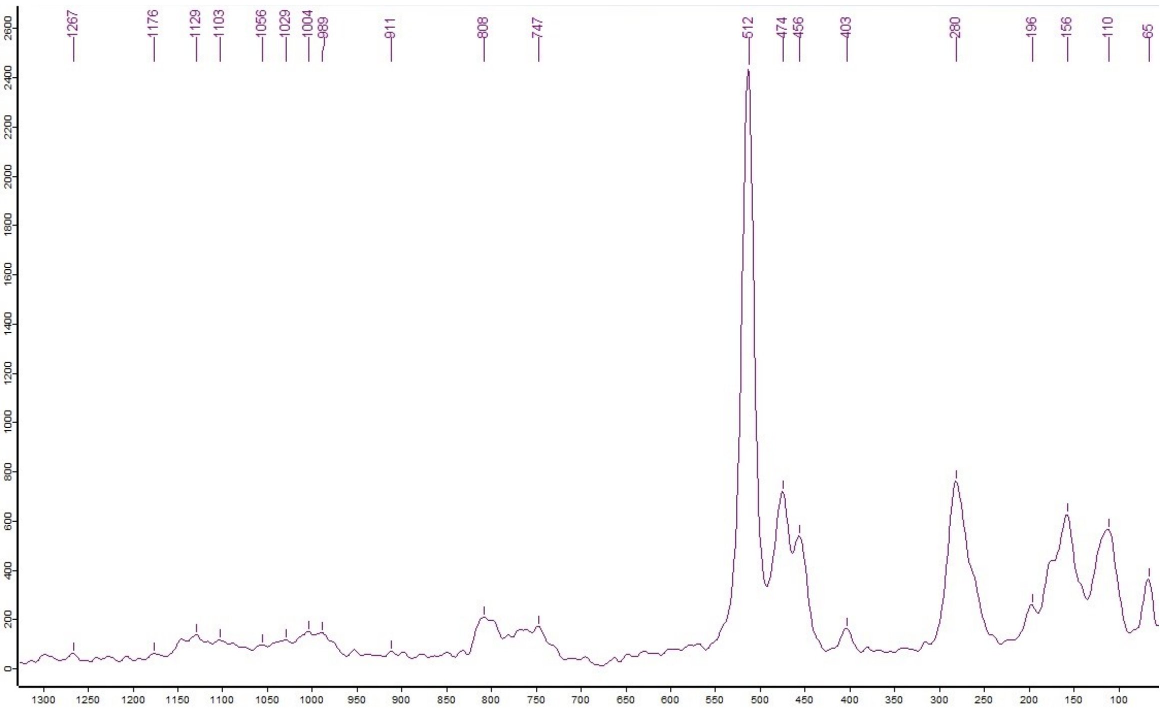


Sample Site 51 : Stone 1_spectra 2 (dark mineral) indicates : Orthoclase (→ see RRUFF_CS results)

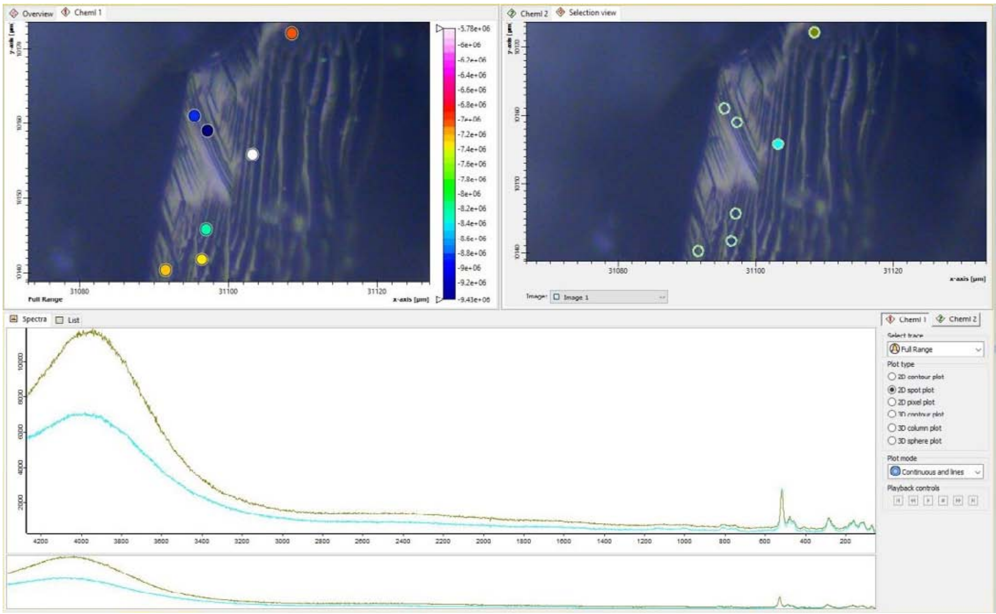


Sample :





Sample Site 51 : Stone 1_spectra 2 (dark mineral) indicates : Orthoclase (→ see RRUFF_CS results)



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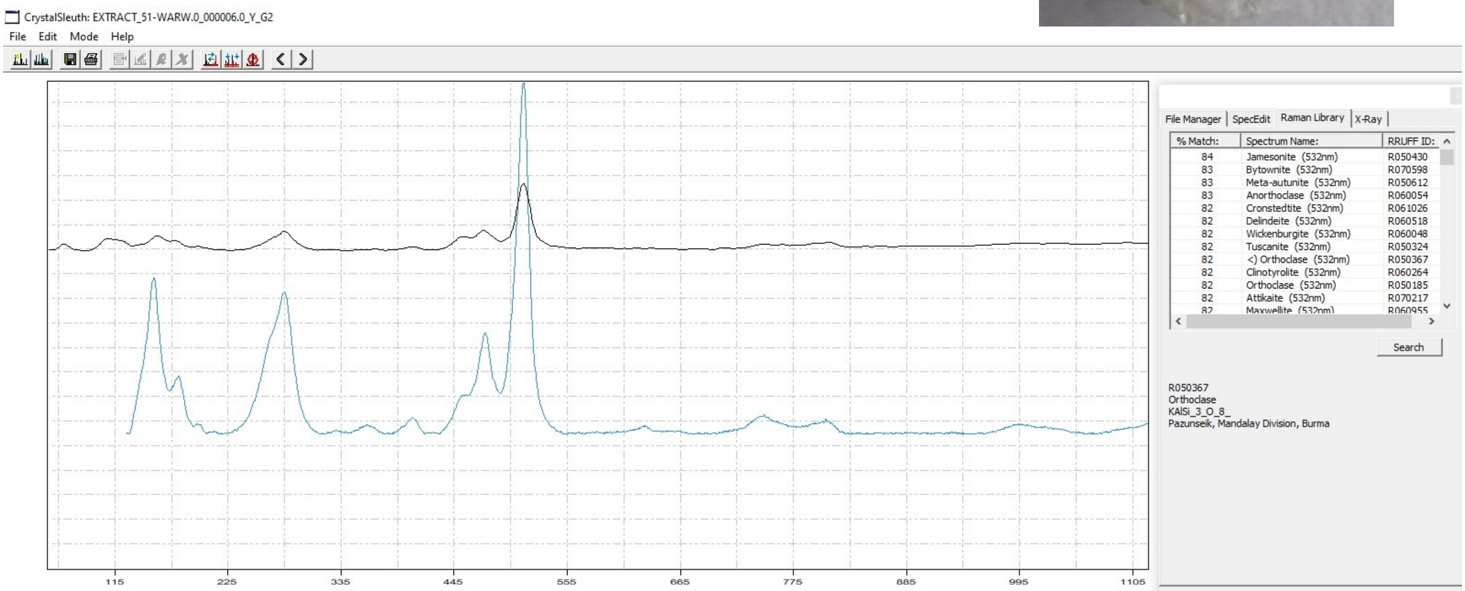
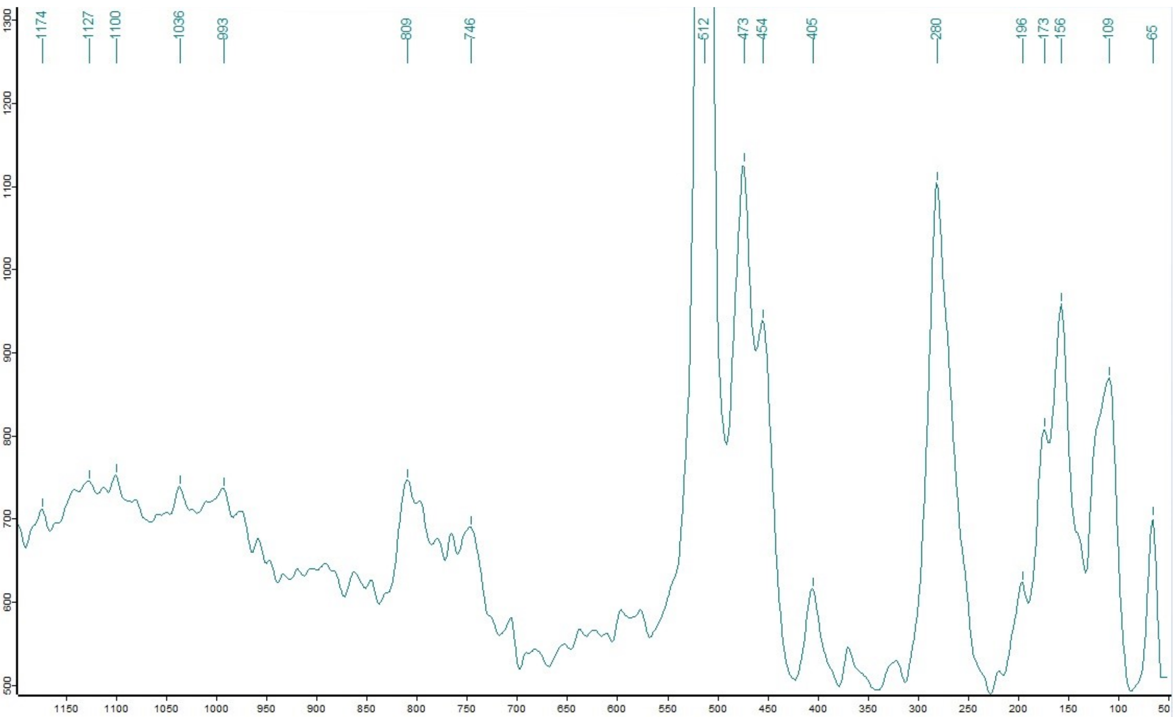
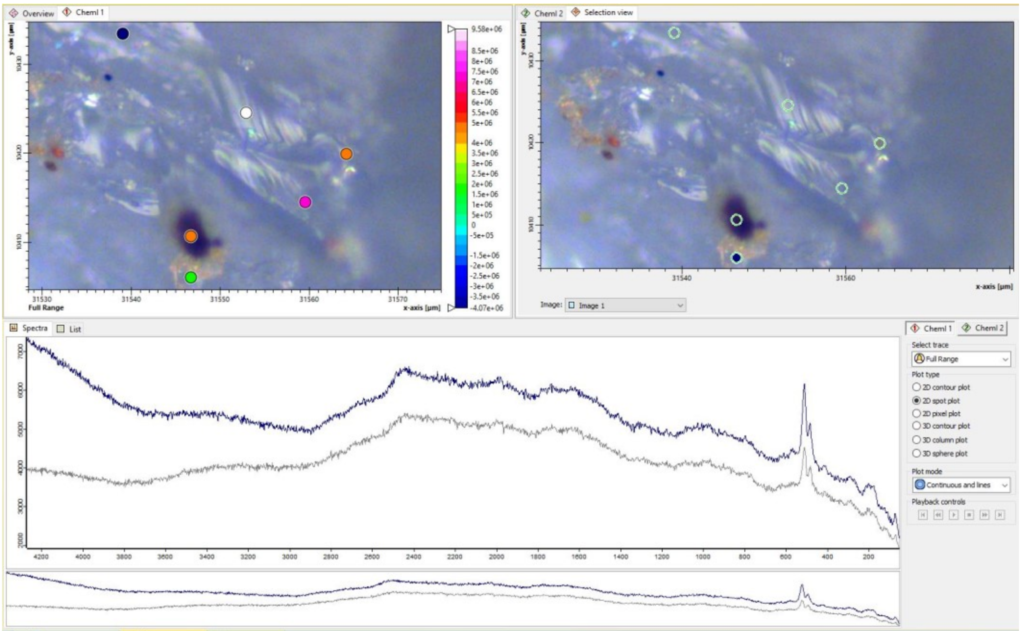
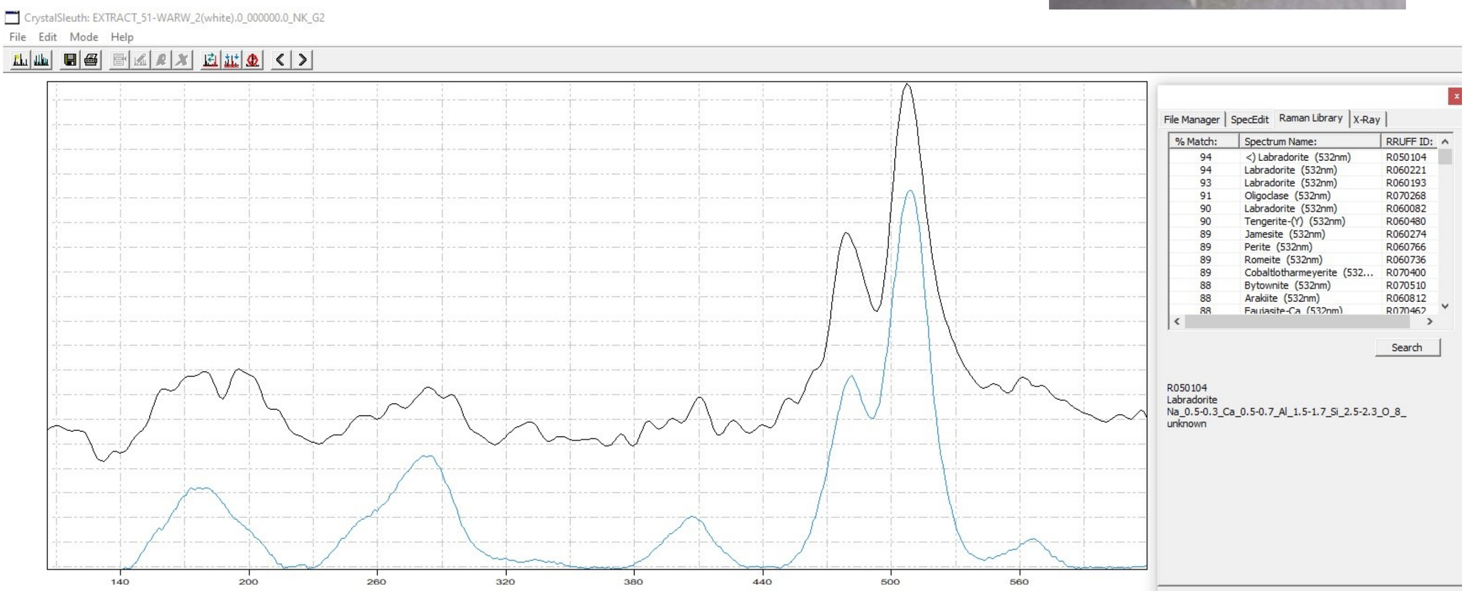


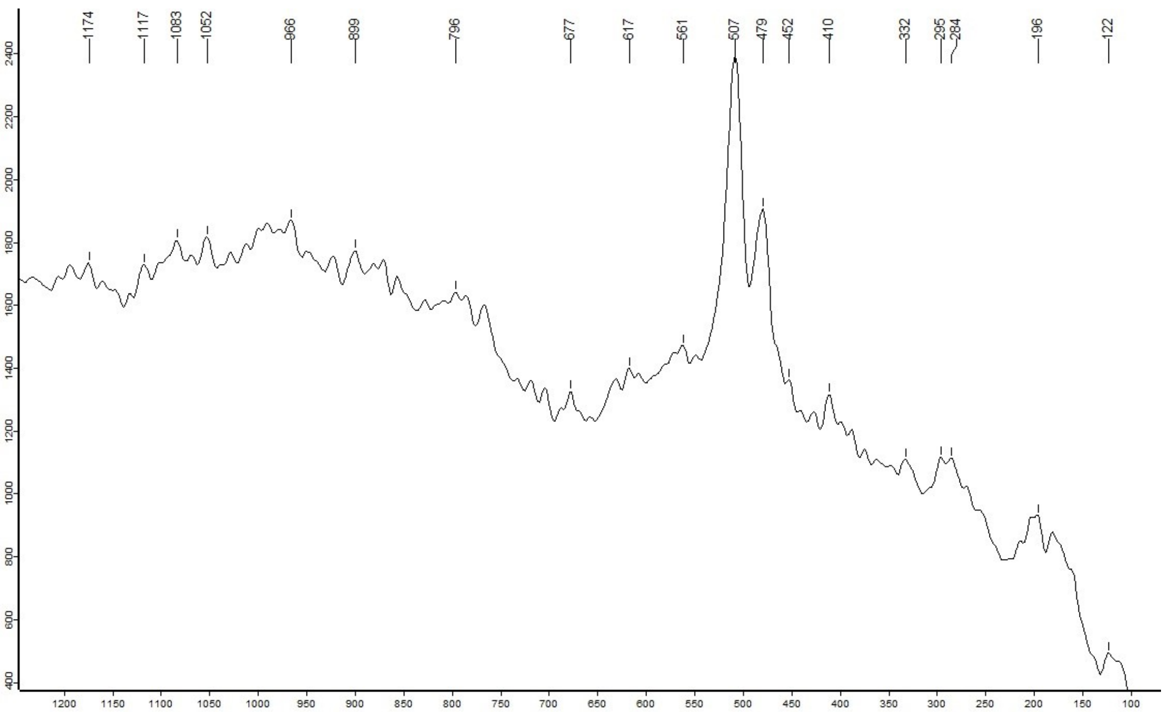


Sample Site 51 : Stone 1_spectra 3 (white mineral) indicates : Labradorite (→ see RRUFF_CS results)

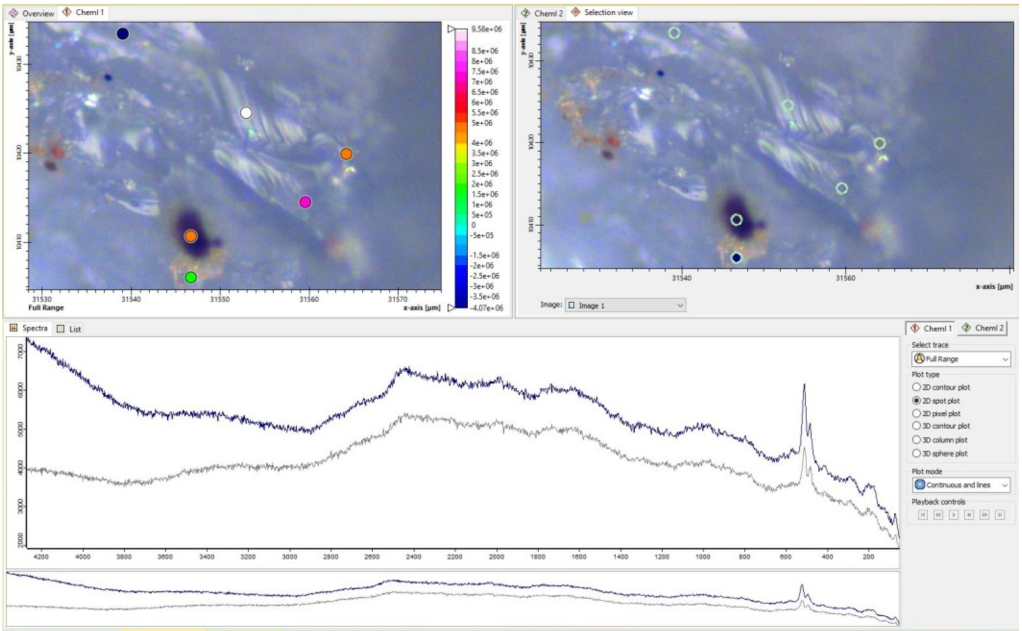


Sample :

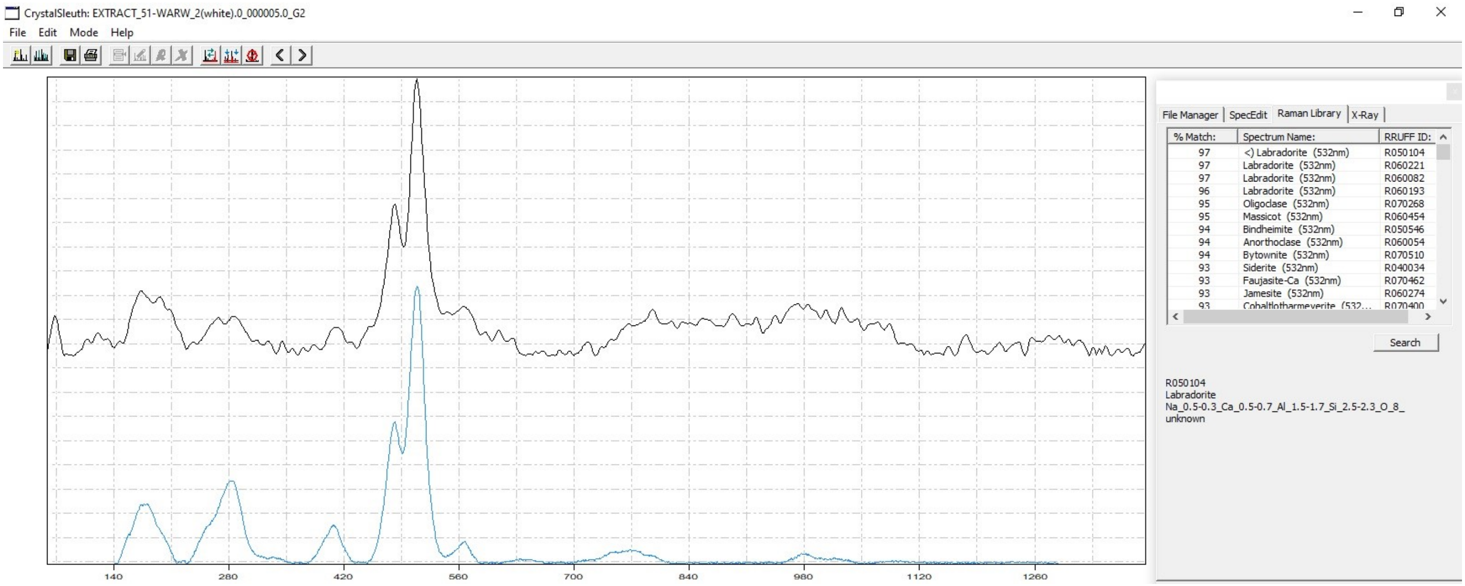


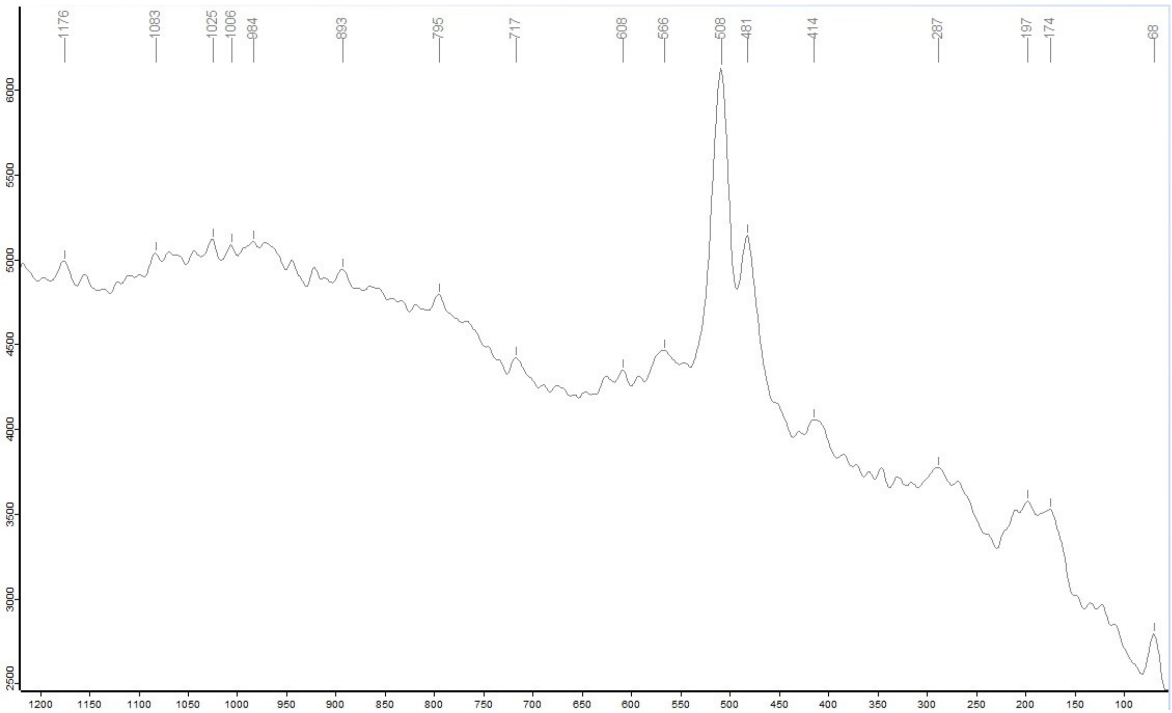


Sample Site 51 : Stone 1_spectra 3 (white mineral) indicates : Labradorite (→ see RRUFF_CS results)

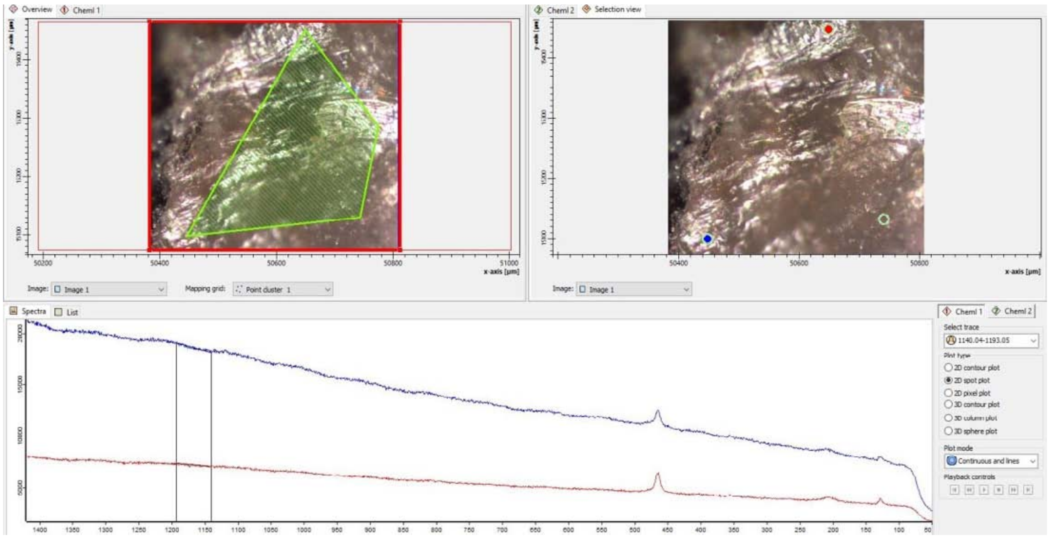


Sample :

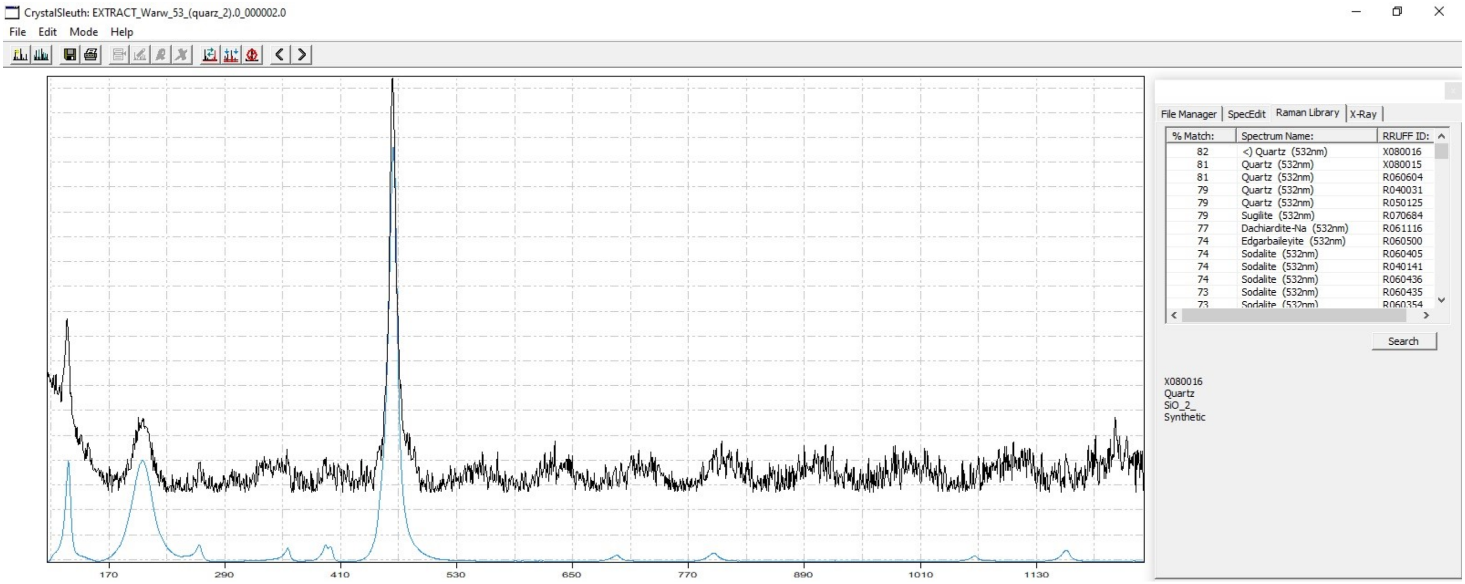


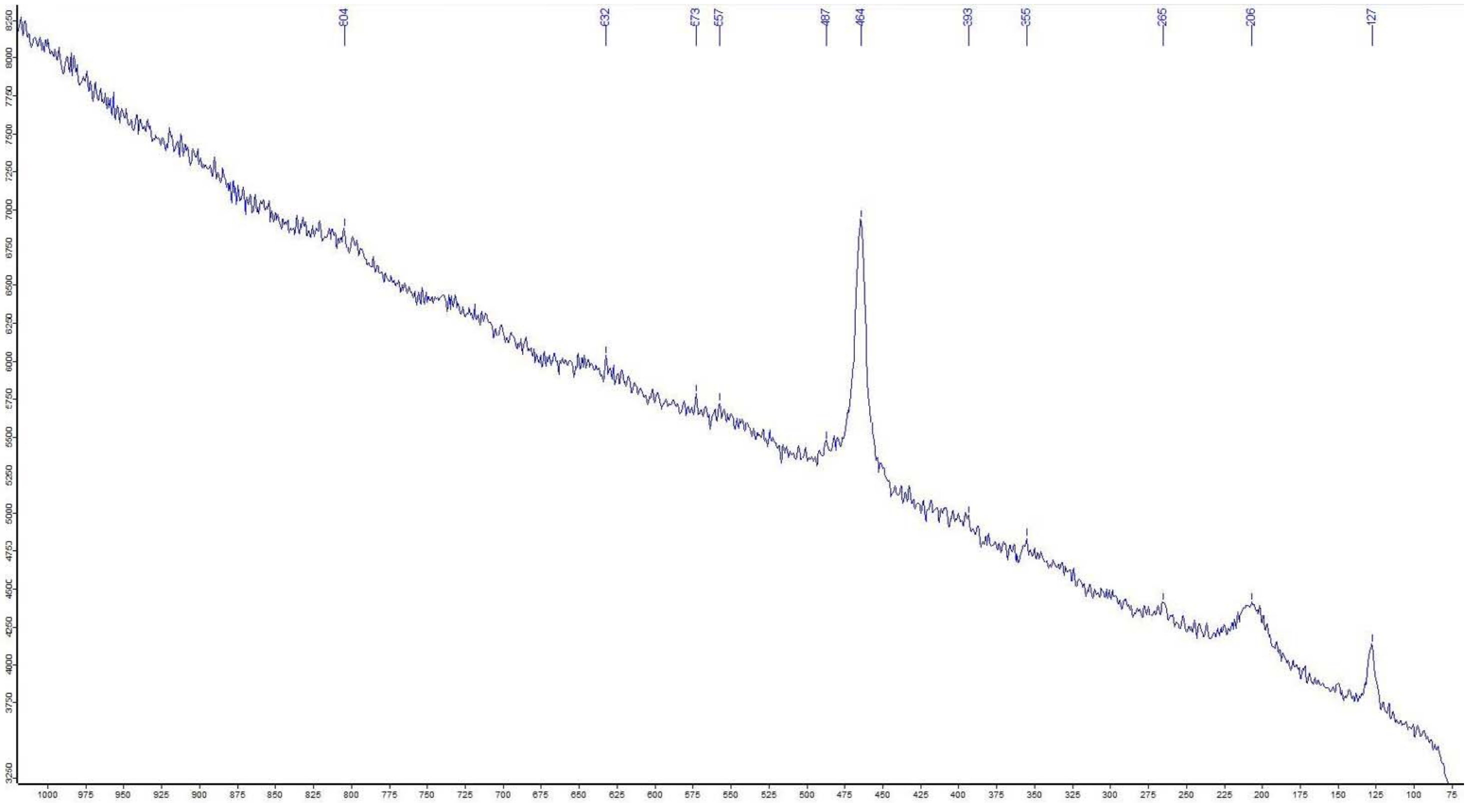


Sample Site 53 : Stone 2_spectra 2 indicates : Quartz (→ see RRUFF_CS results)

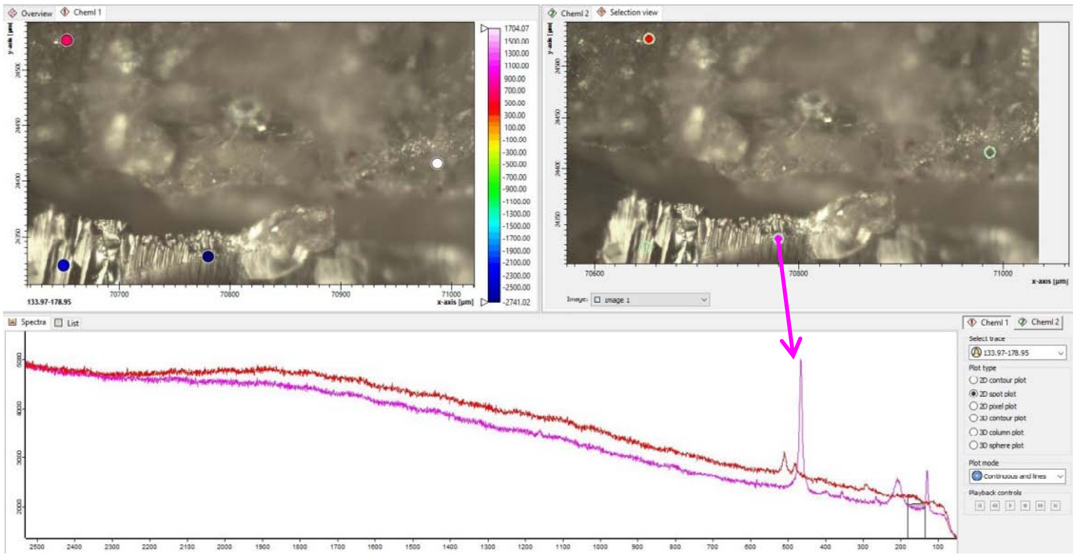


Sample :

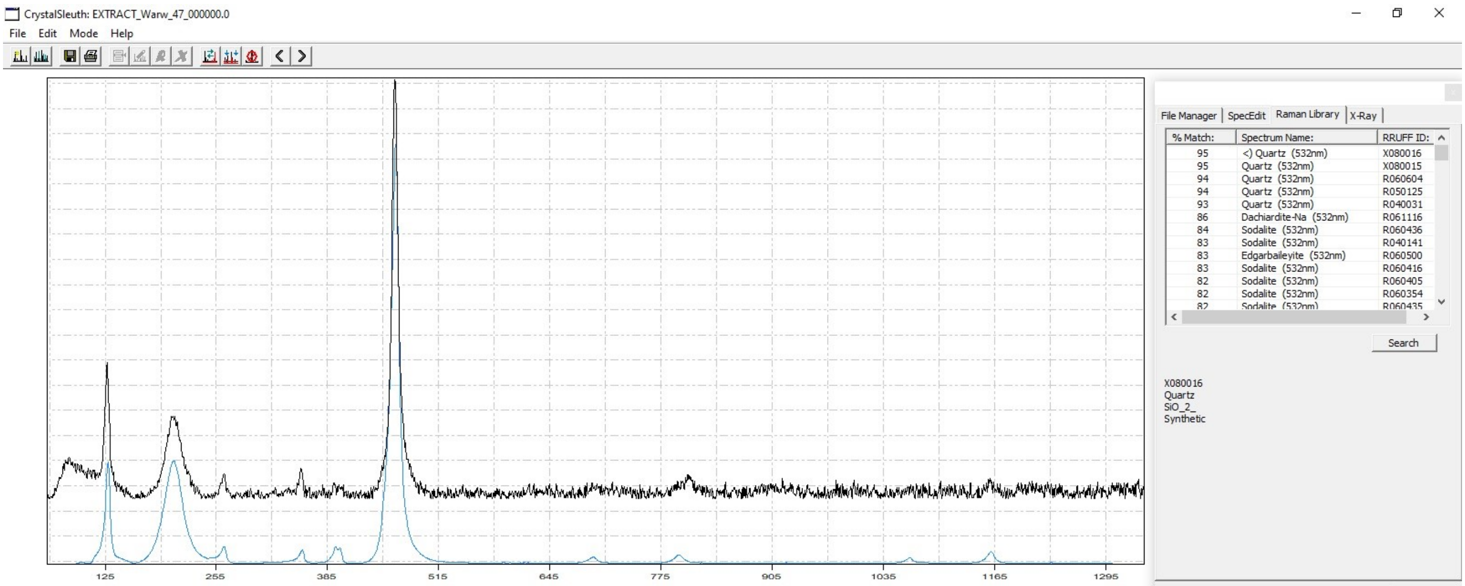




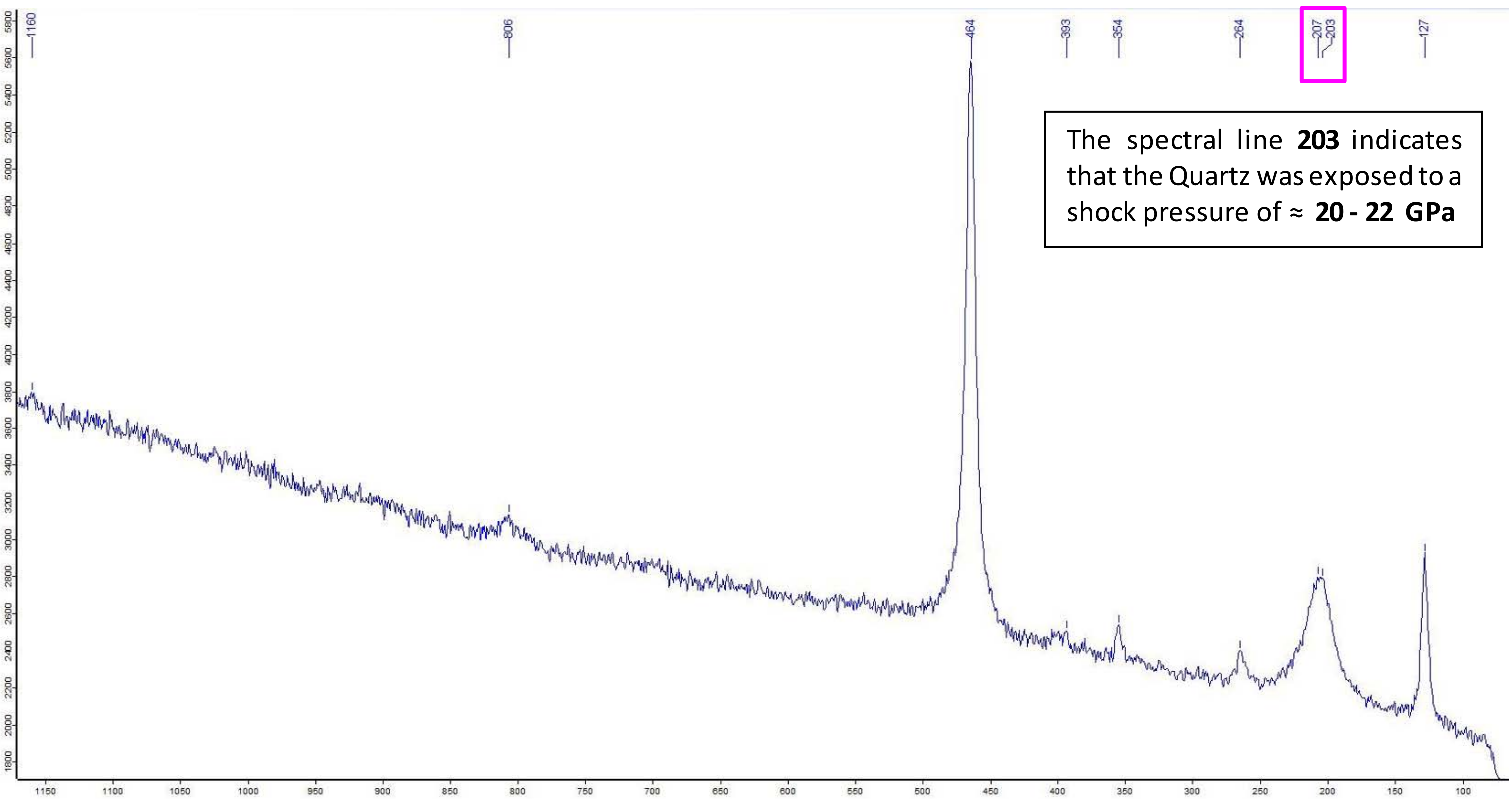
Sample Site 47 : Stone 1_spectra 1 indicates : Quartz (→ see RRUFF_CS results)



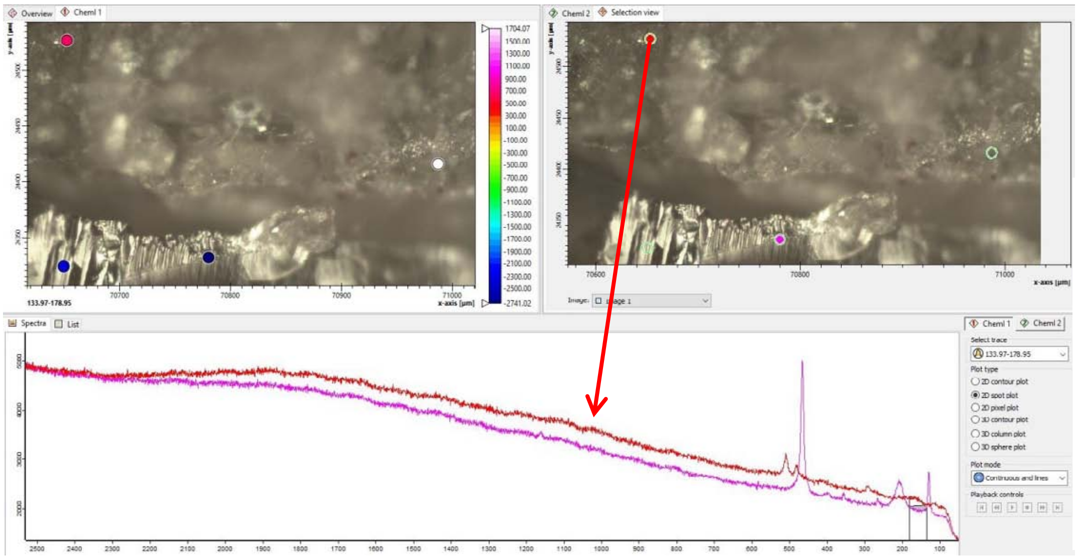
Sample :



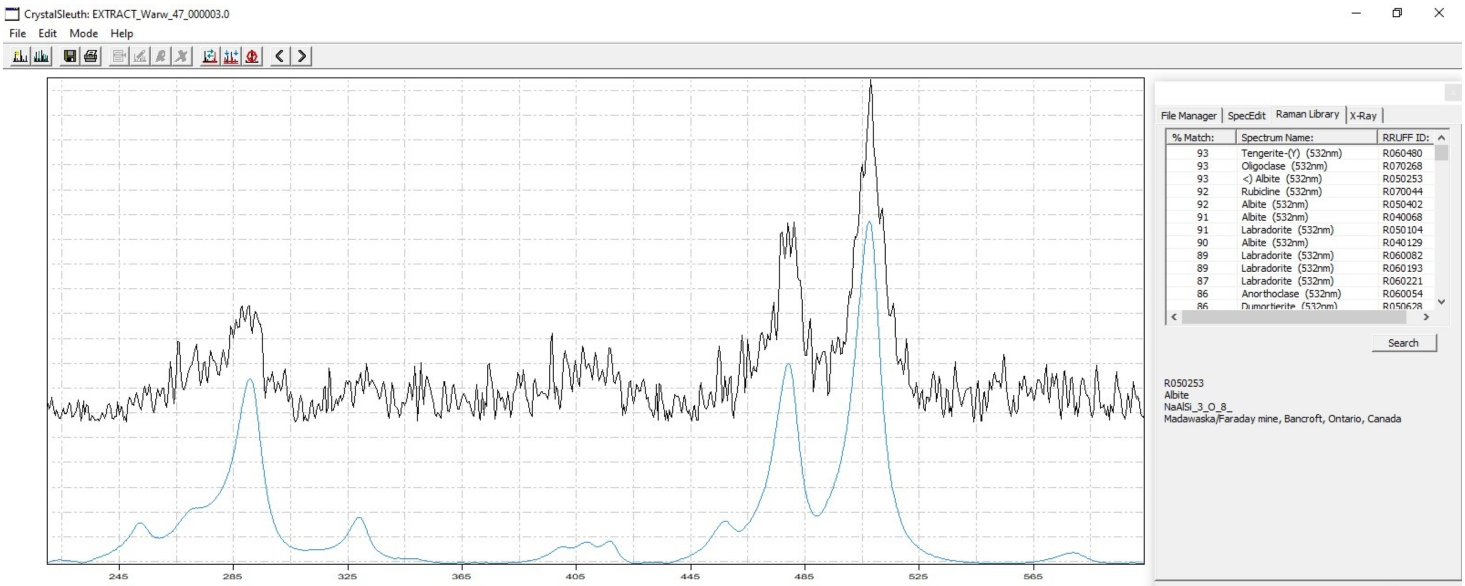
Indication for a shock event is the shift of the marked Quartz spectral lines towards 203 (double-peak)



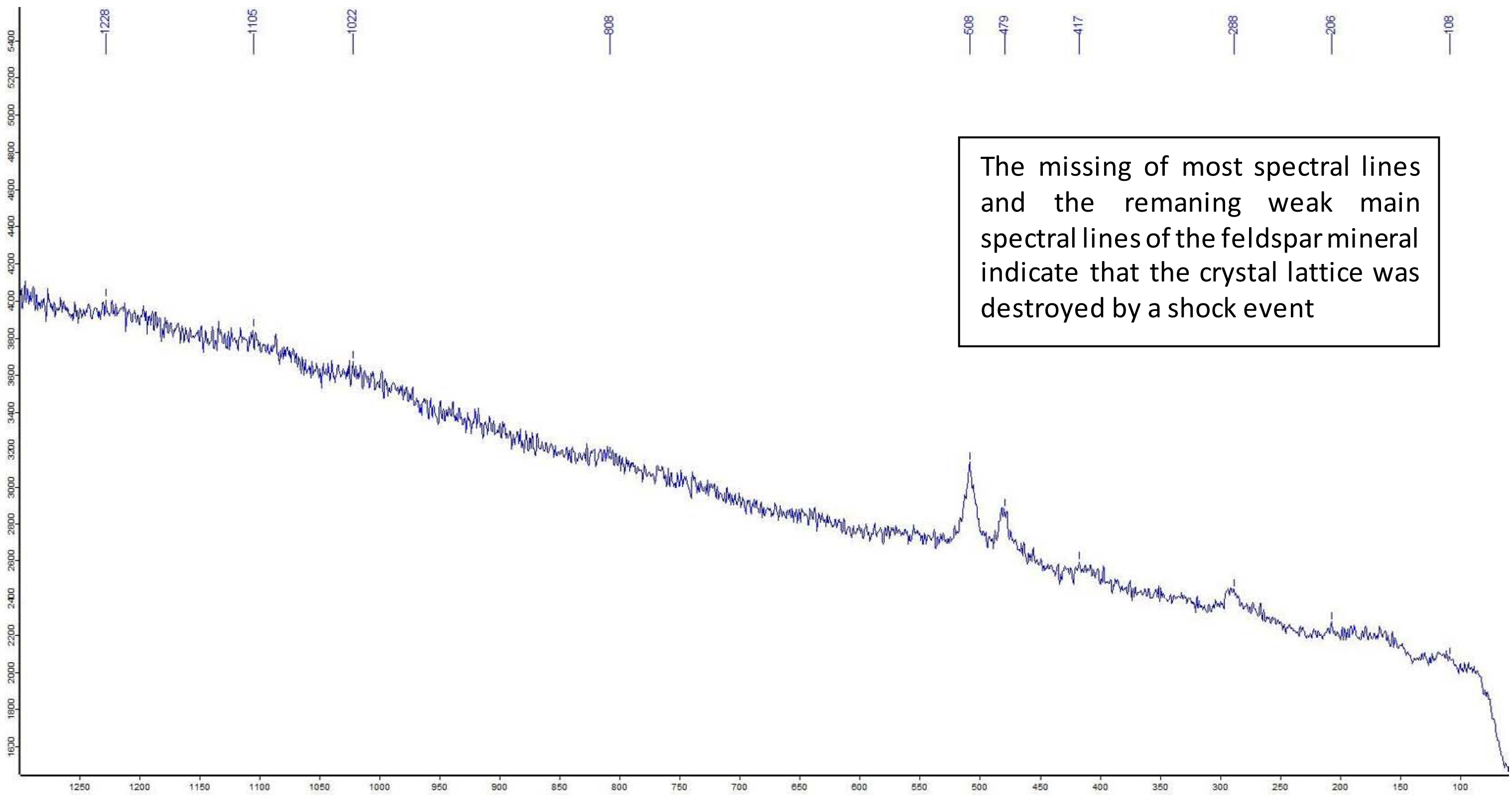
Sample Site 47 : Stone 1_spectra 2 indicates : Albite (→ see RRUFF_CS results)



Sample :



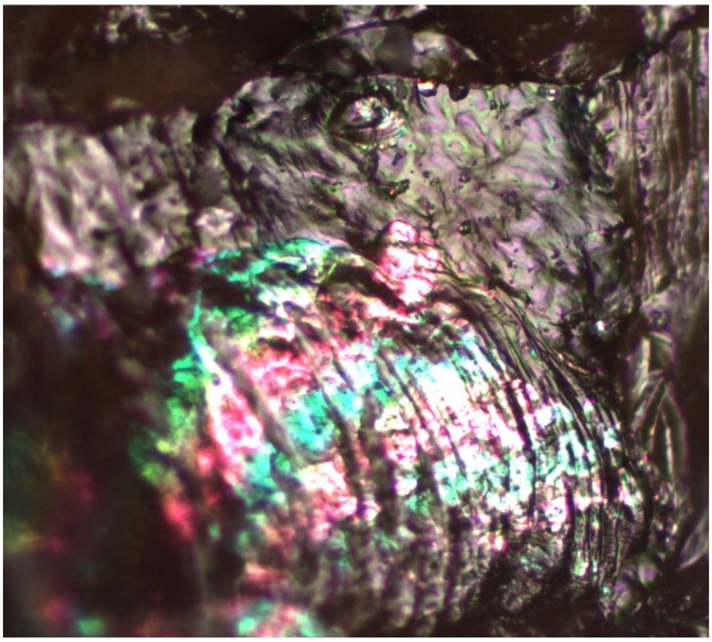
The Raman spectra indicates a weakly-shocked to moderately-shocked Feldspar mineral



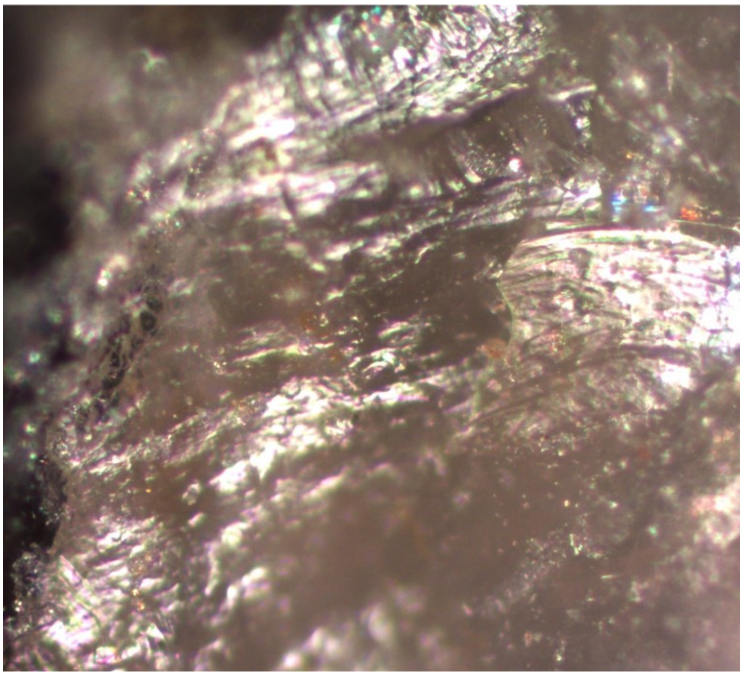
The missing of most spectral lines and the remaning weak main spectral lines of the feldspar mineral indicate that the crystal lattice was destroyed by a shock event

Microscopic Images : Samples from Sites 53 and 47 → original state (no preparation for analysis)

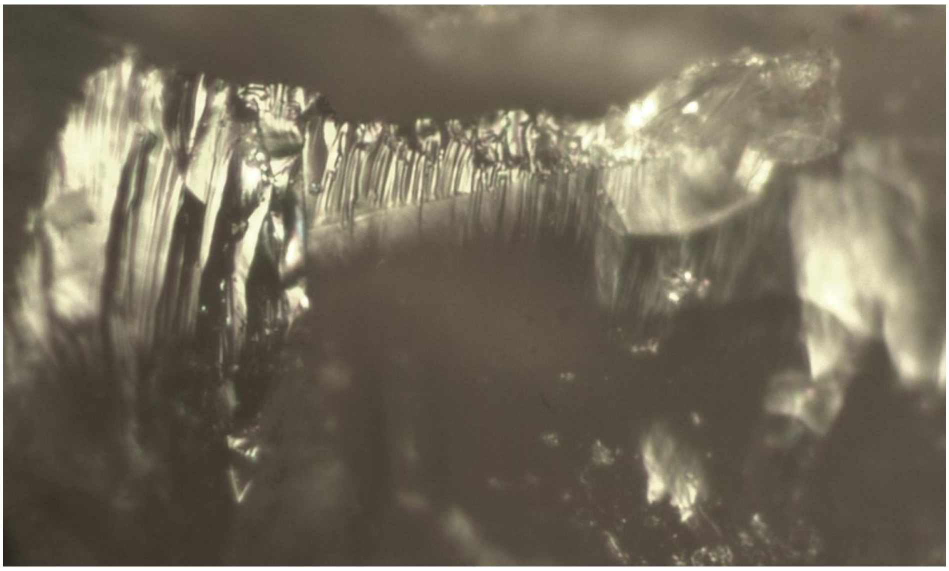
Sample Site 53 : Stone 2_spectra 2 indicates : Quartz - Image size : ~ 400 x 400 µm



Sample Site 53 : Stone 2_spectra 2 indicates : Quartz - Image size : ~ 400 x 400 µm

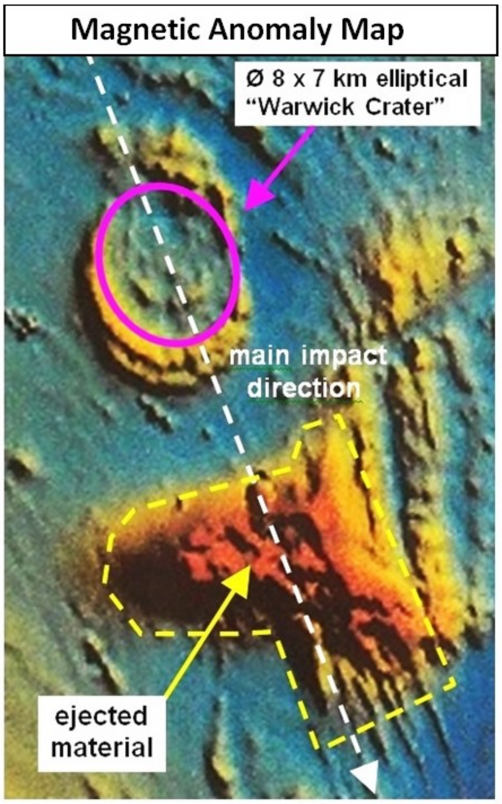


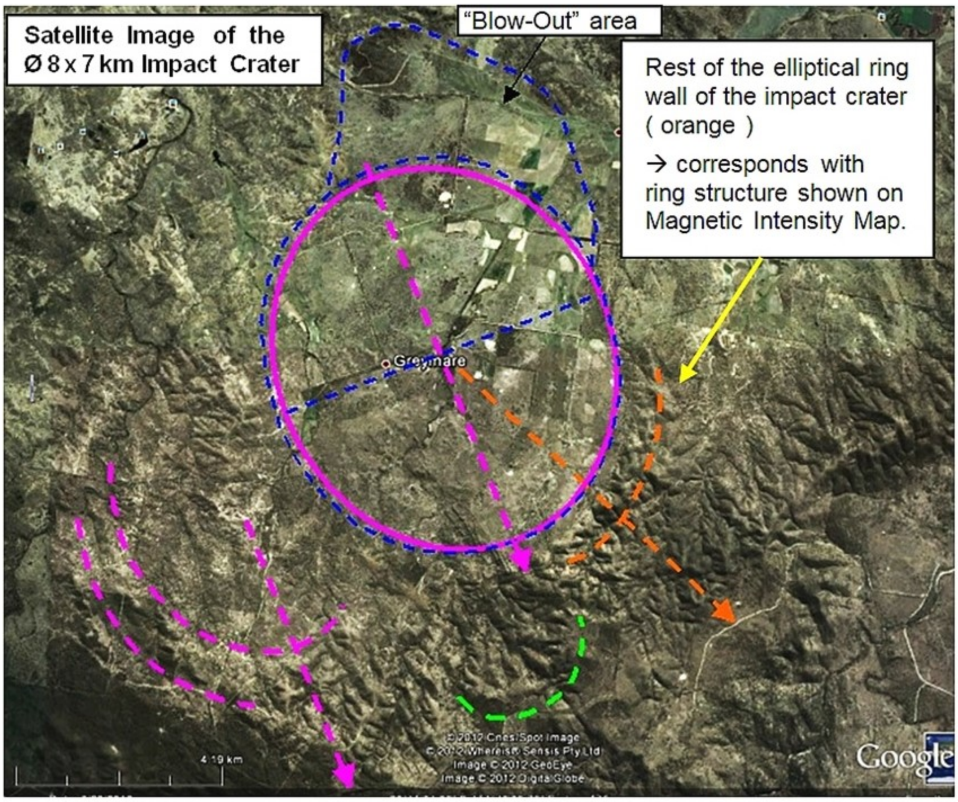
Sample Site 47 : Stone 1_spectra 1 indicates : Quartz - Image size : ~ 250 x 150 µm



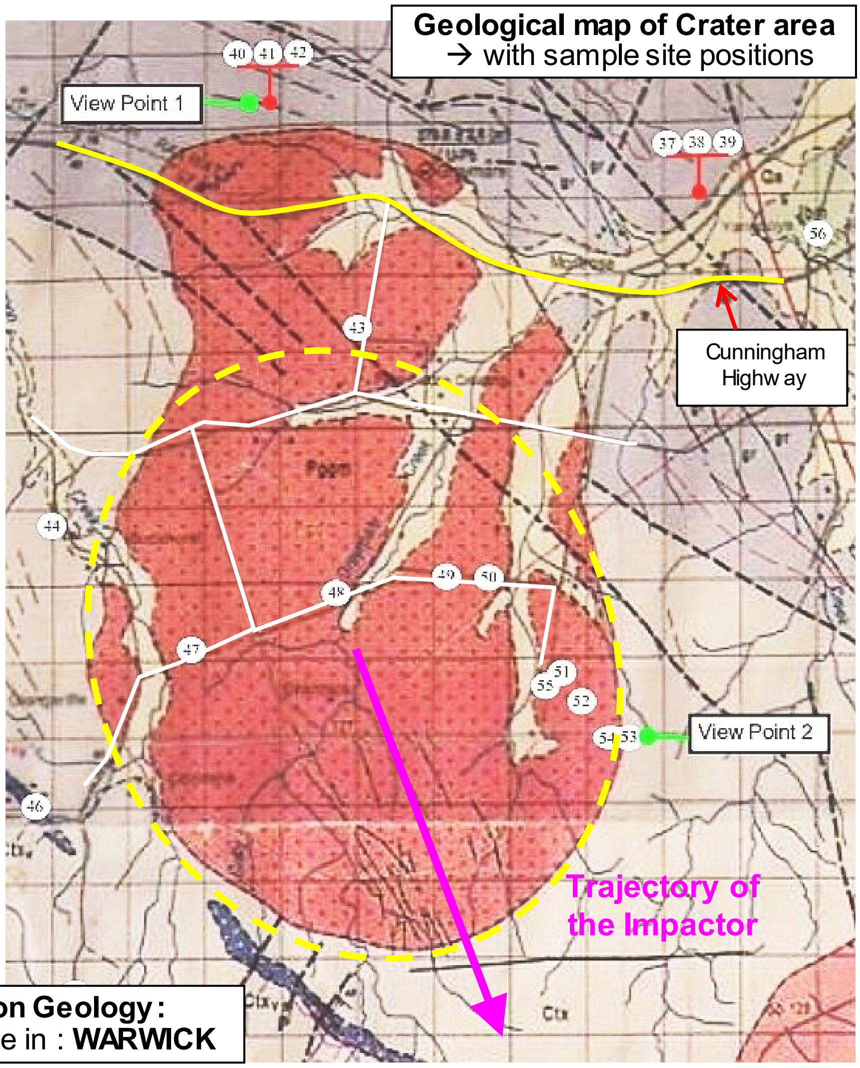
Appendix 1 : **Photos of the rock samples from sample sites : 43, 47, 48, 51, 53 and 54**
→ **See next page !**

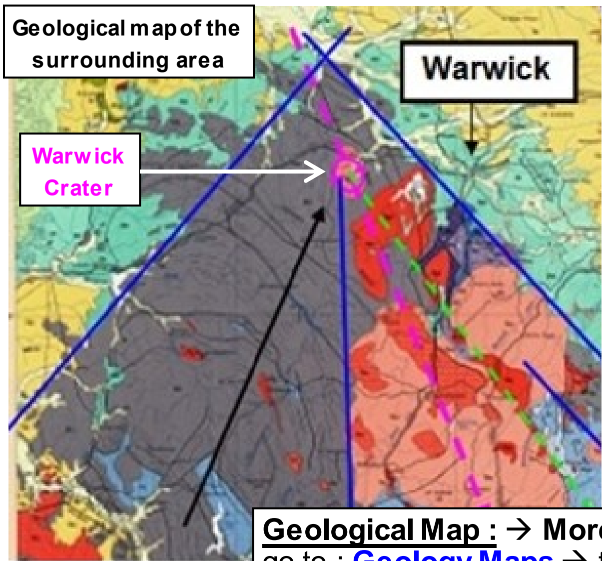
Please note : **Photos of Sample Sites and other sample sites are also available here → weblink : Sample Sites – Ø 8 x 7 km Warwick Crater**





The Warwick Crater area is accessible over an unsealed road, through a gate, from the Cunningham Highway near Montrose (sign : Greymare). It lies on private pasture land. But the marked roads are accessible. The red marked rock type on the geological map has a measured age of 230-240 Ma (probably **PT-boundary age** !) And the surrounding grey rock-type has an age of 330-370 Ma. The markings on the geological map below indicate that the grey- and red-colored rock-types seem to be the result of ejecta, probably from the 320 km Cape York Crater, that was scattered over this area !

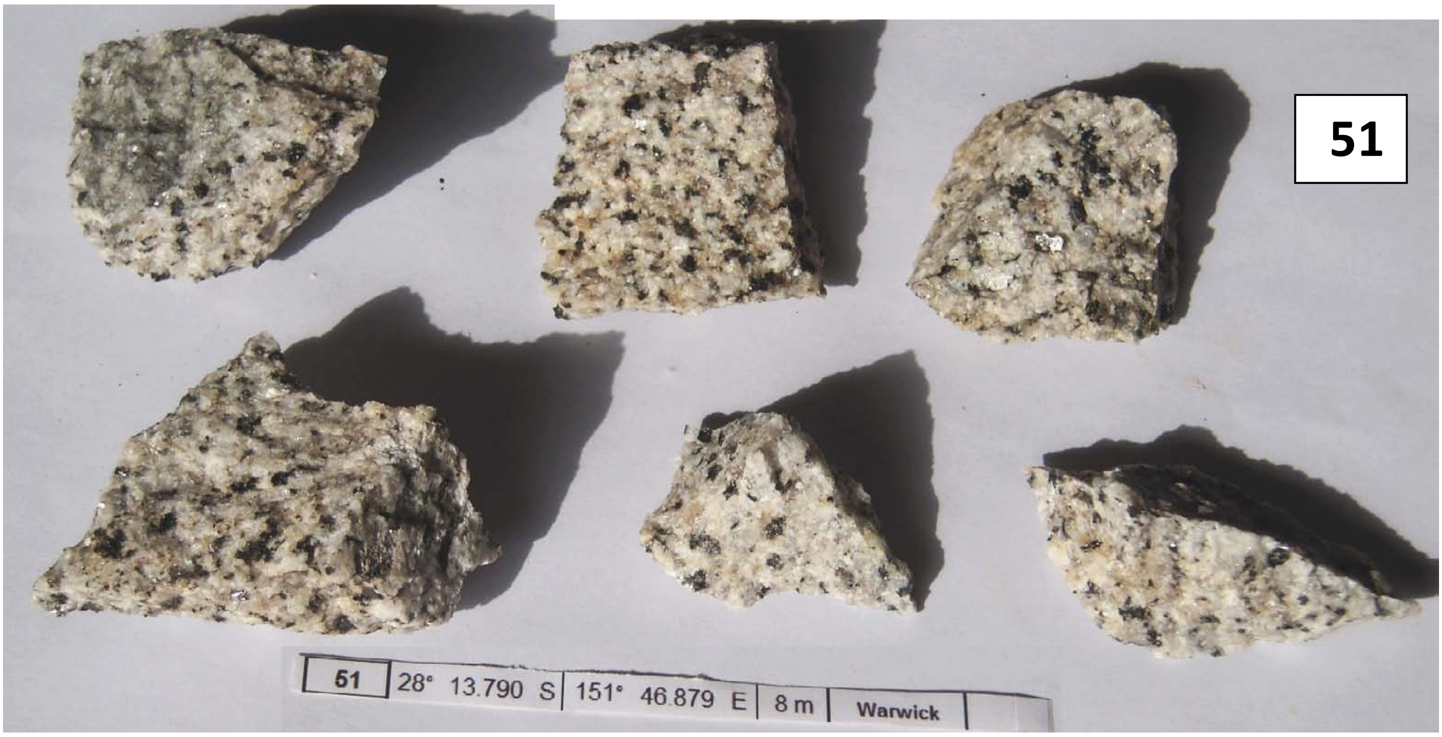




Geological Map : → Moreton Geology :
go to : **Geology Maps** → type in : **WARWICK**

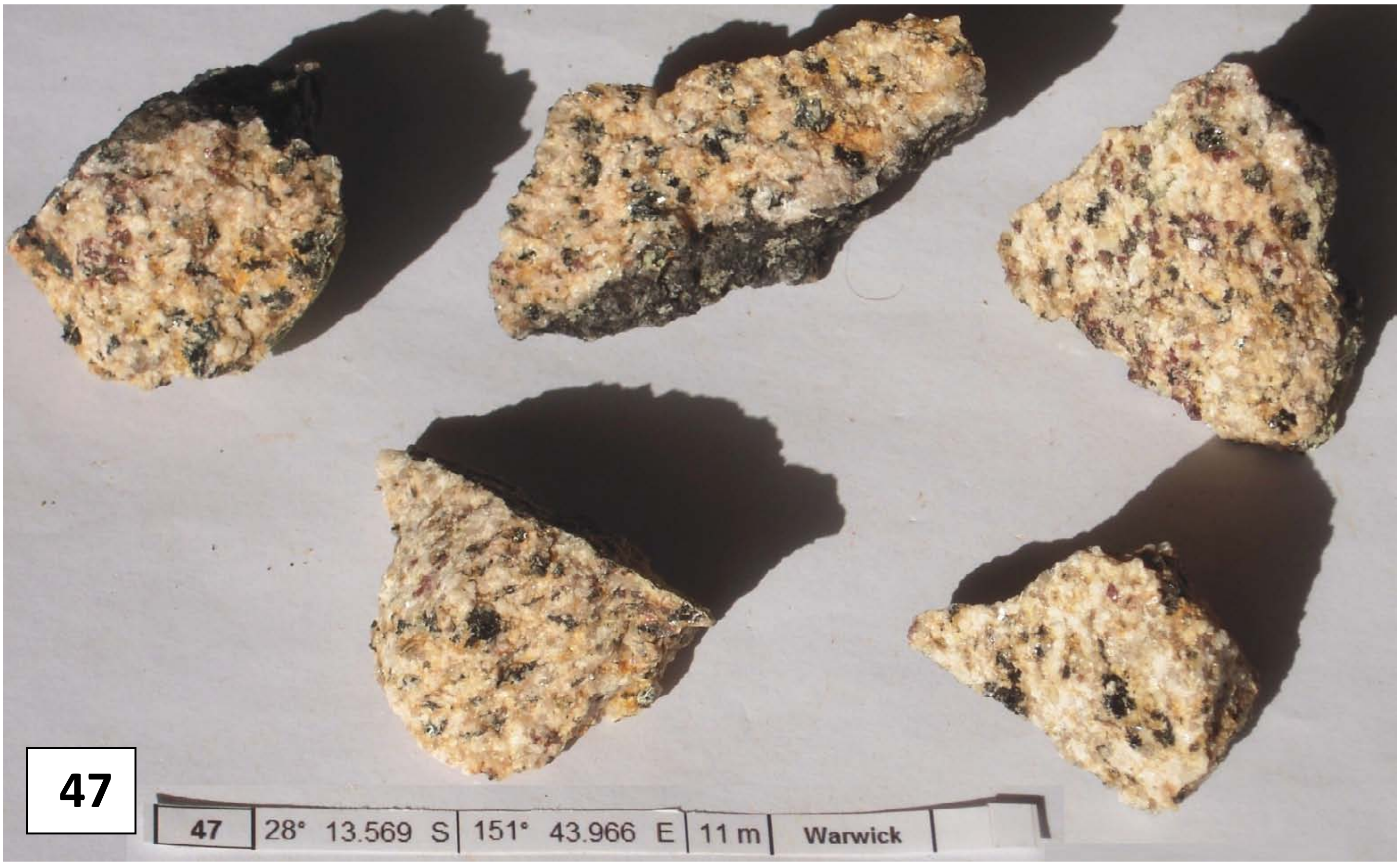
The rock samples are from the boulders visible in the image

Photos of the rock samples from the sample sites : 43, 47, 48, 51, 53 and 54 and from other sites are also available here : Sample Sites- Ø 8 x 7 km Warwick Crater

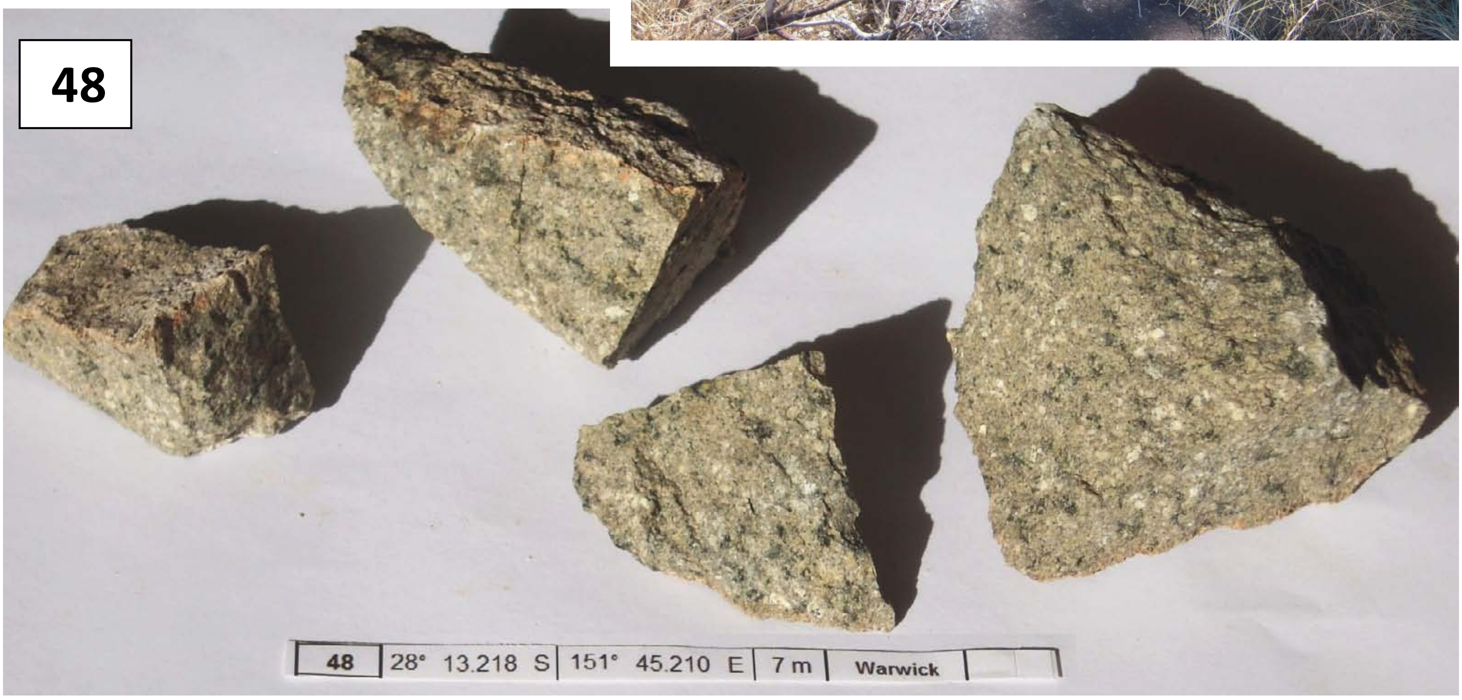


Sample site 53 is located on a section of the original elliptical crater-wall of the Ø 8 x 7 km Warwick Crater

The rock samples are from the boulders visible in the image



The rock samples are from the boulders visible in the image



Appendix 2 : A short overview : The Raman bands (peaks) of Quartz shocked with 22-26 GPa

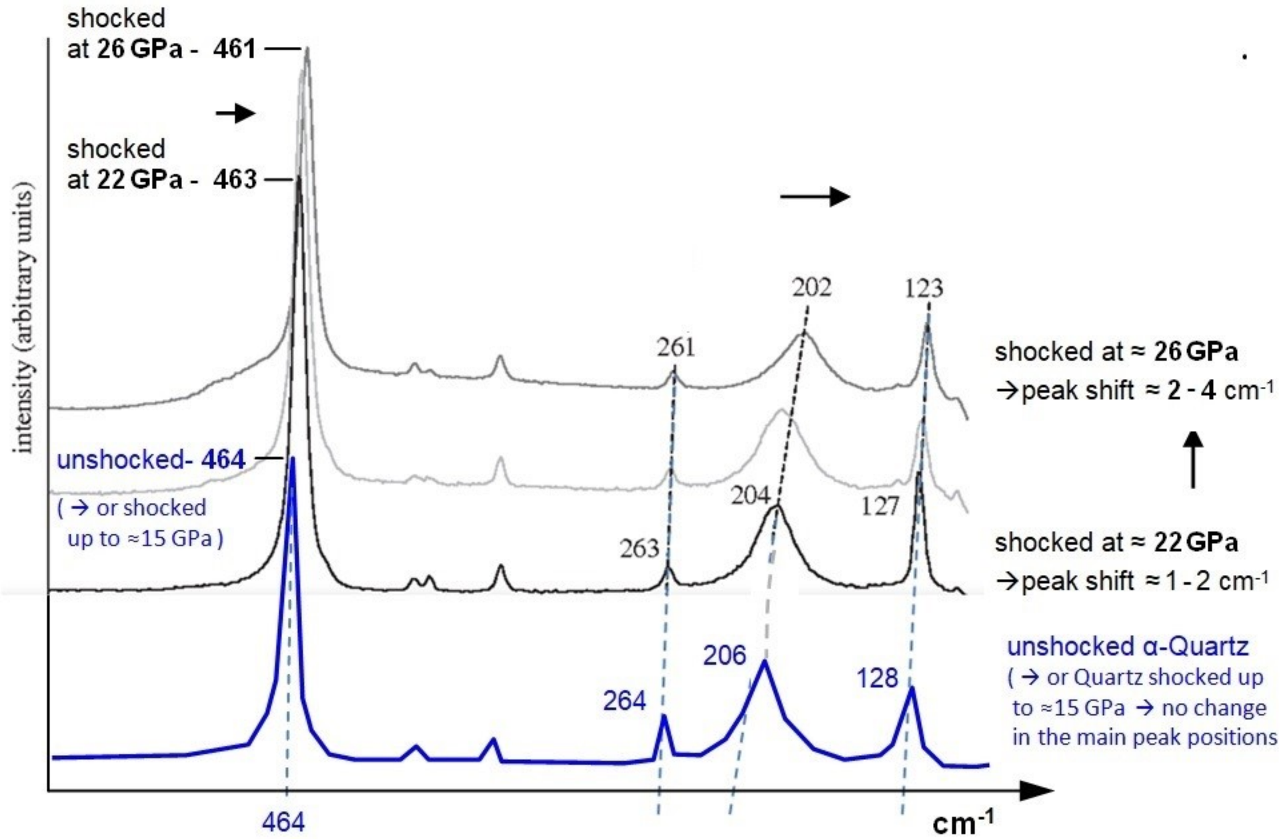
In order to verify a sample site as an impact site or impact structure, shock-metamorphic effects must be discovered in the rocks of the sample site. This can be done by different methods.

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.

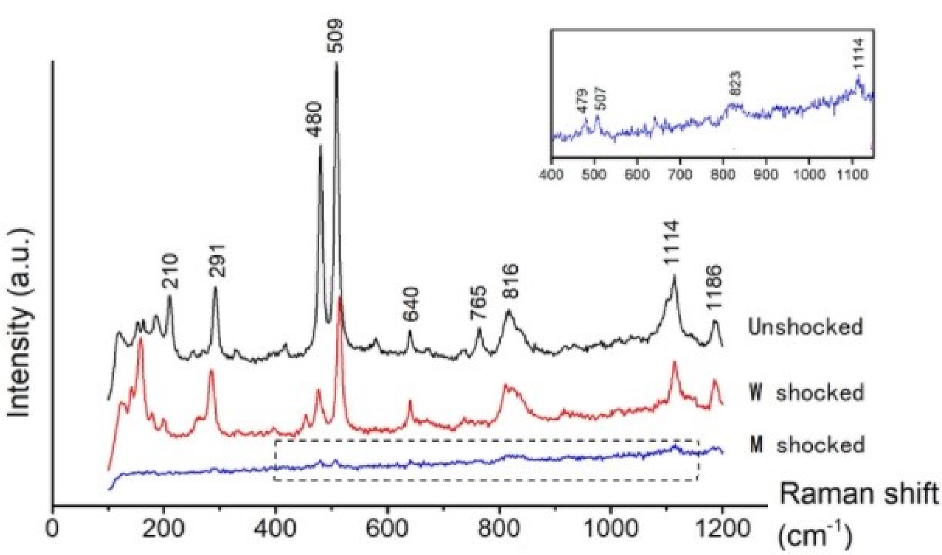
Mc Millan et al. (1992) and others have shown that the main RAMAN-peaks of Quartz shift towards lower frequencies if the Quartz was exposed the a shock-pressure > 15 GPa. → see diagram below

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



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

References :

Photos of all Sample Sites & Rock Samples are available on : Samples Ø 8 x 7 km Warwick Crater (or : Warwick Crater)

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Part 2 : The Permian-Triassic Impact Event caused Secondary-Craters and Impact Structures in Europe, Africa & Australia
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)
Part 6 : Mineralogical- and Geological Evidence for the Permian-Triassic Impact Event
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

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