

The Ø 160 km “Salerno Crater” (Italy)

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

Summary :

Raman spectra of quartz samples collected at sample site **21** near Ascea on the west-coast of Italy (near Sapri) provide first indication for the Ø 160 km Salerno Impact Crater described in my hypothesis. The yet unknown Ø 160 km “Salerno Crater” belongs to a larger Secondary Impact Crater Chain, which was caused by impacting ejecta material that was ejected by the Ø 1270 x 950 km Permian Triassic Impact Crater (PTI), located in the Arctic Sea near Alaska, according to my hypothesis.

(→ weblink to my Permian Triassic Impact Hypothesis : → [Part 1 \(P1\)](#), [Part 2 \(P2\)](#) of my hypothesis)

The samples which I collected to proof the “Salerno Crater” did not provide the same clear evidence for a secondary impact crater, as for example the samples from Cabo de Creus in Spain, which provided solid evidence for the **130 x 110 km „Bay-of-Lyon Impact Crater“** ([Link2](#)), that belongs to the same Secondary Impact Crater Chain as the “Salerno Crater”, caused by the PT Impact-Event.

But the Raman spectra of quartz from sample site **21** at least provide first indication for a shock event.

The shifts of the main Raman bands (peaks) to the lower frequencies **261, 204** and **125 cm⁻¹** (Stone 1) and to **260** and **205 cm⁻¹** (Stone 2) which are visible in the Raman Spectra of these quartz-samples from sample site **21** at least give a first indication that the quartz was exposed to a **shock pressure in the range of 20 - 22 GPa**. The shock pressure probably was just below the treshold of 22 GPa so that the main quartz line at 464 didn't shift to a lower frequency (→ see explanation in the Appendix at page **28**)

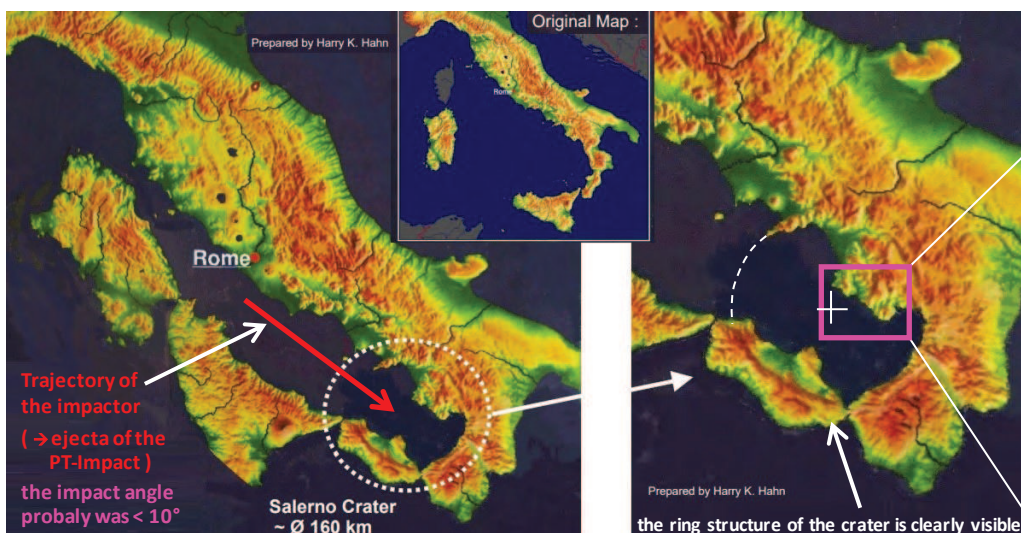
Quartz in the samples from the sample site **20** also show shifts in one or two of the main Raman bands (peaks) to the lower frequencies **263** and **205 cm⁻¹**. The microscopic images of some of the analysed quartz grains in samples from site **21** & **20** may provide further proof for a shock event caused by an impact (see [page 5 & 6](#)). The images show complex micro-fracture-patterns in the analysed quartz grains. The spectra were made with a **BRUKER Senterra-II Raman Microscope** (wavenumber precision <0.1cm⁻¹)



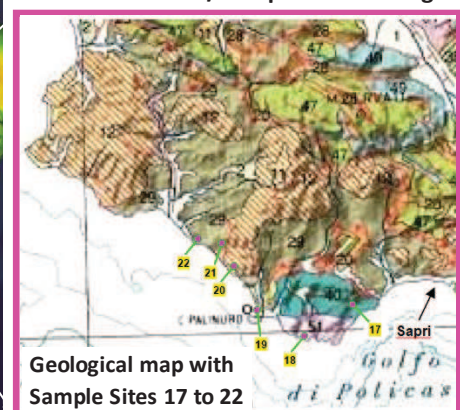
→ Images of the analysed rock samples and photos of the sample sites are in the Appendix at [page 24](#).

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

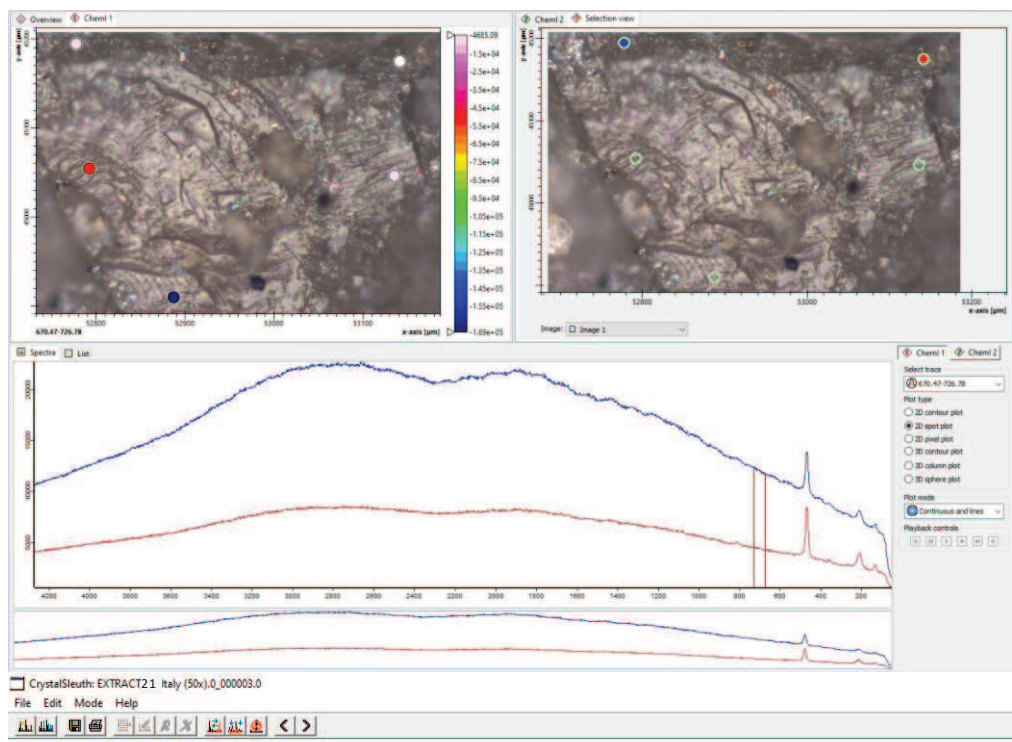
→ More images of all sample sites are available on www.permiantriassic.de or www.permiantriassic.at



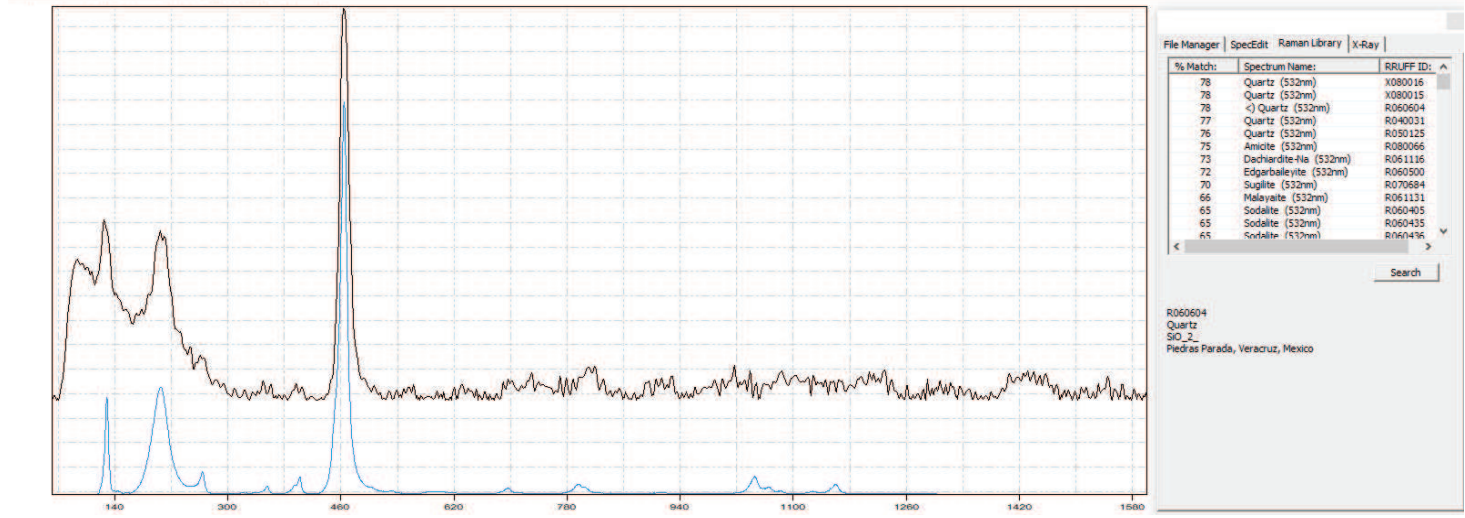
The manipulated topographic map on the left shows the probable position of the crust fragments which form Italy at the time of the P/T-Impact 253 Ma ago



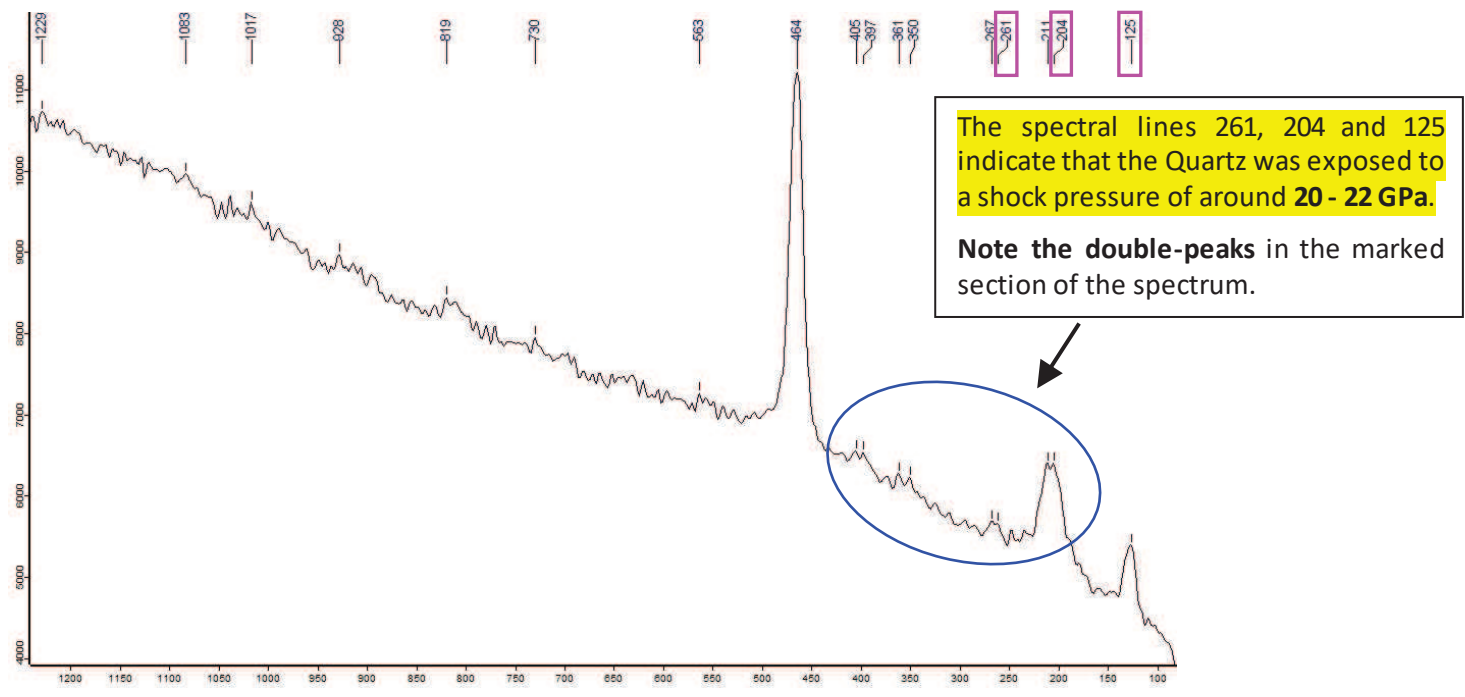
Sample Site **21** : Stone 1_spectra 1 indicates: **Quartz** (→ see RRUFF_CS results)



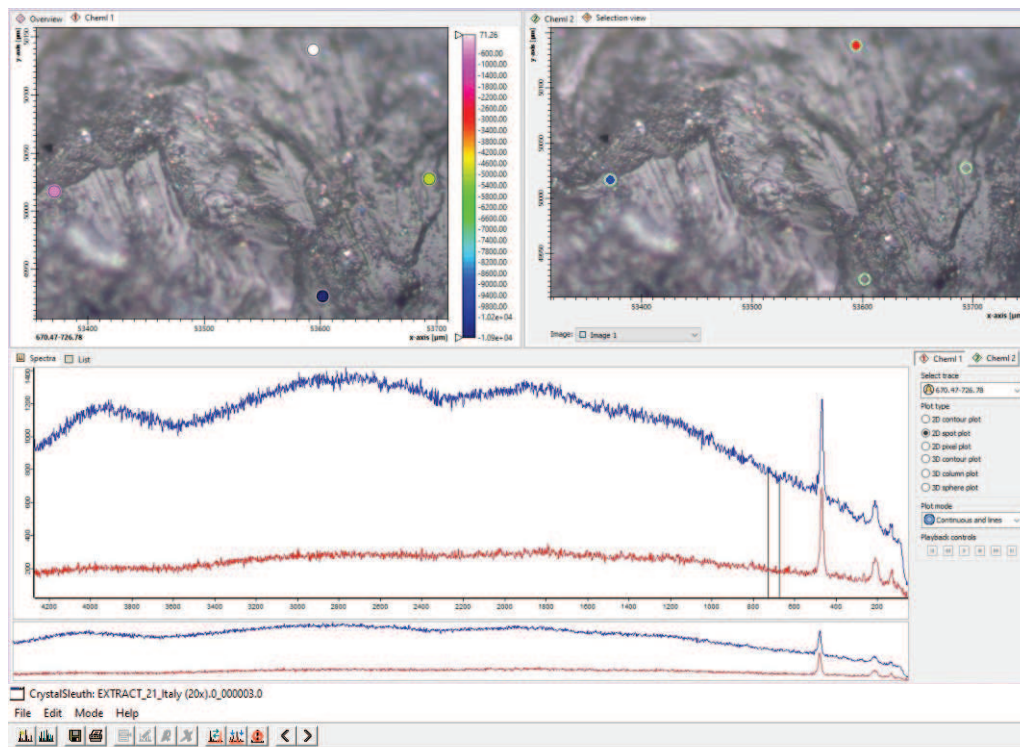
Sample :



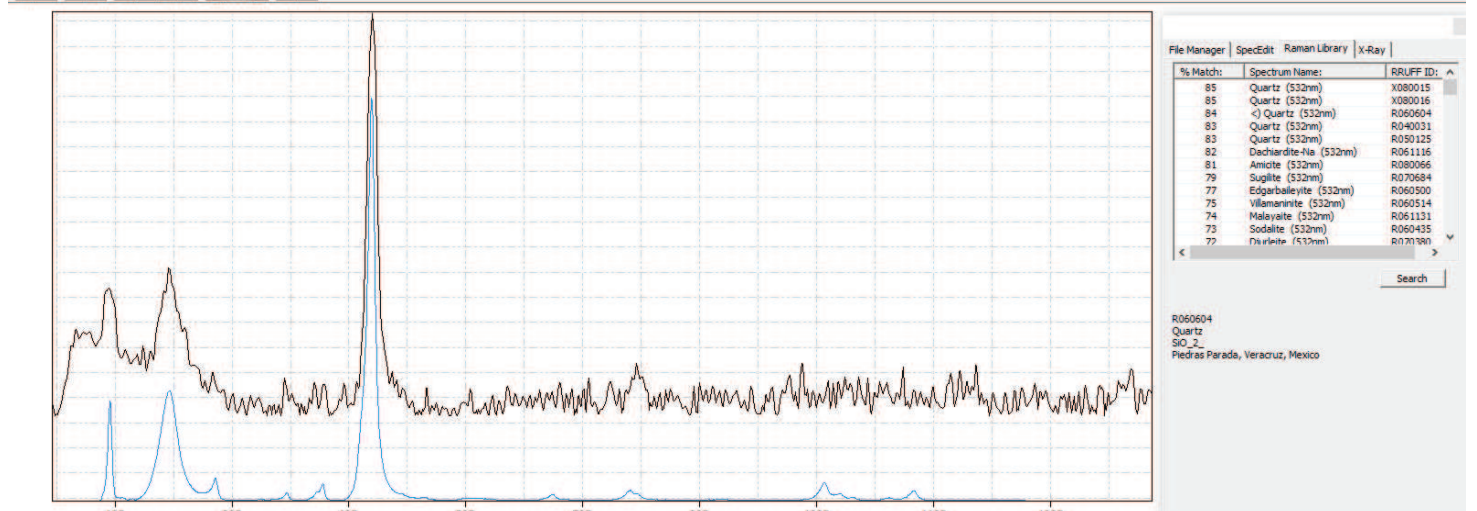
Indication for a shock event are the shifts of the marked Quartz spectral lines towards 261, 204 and 125



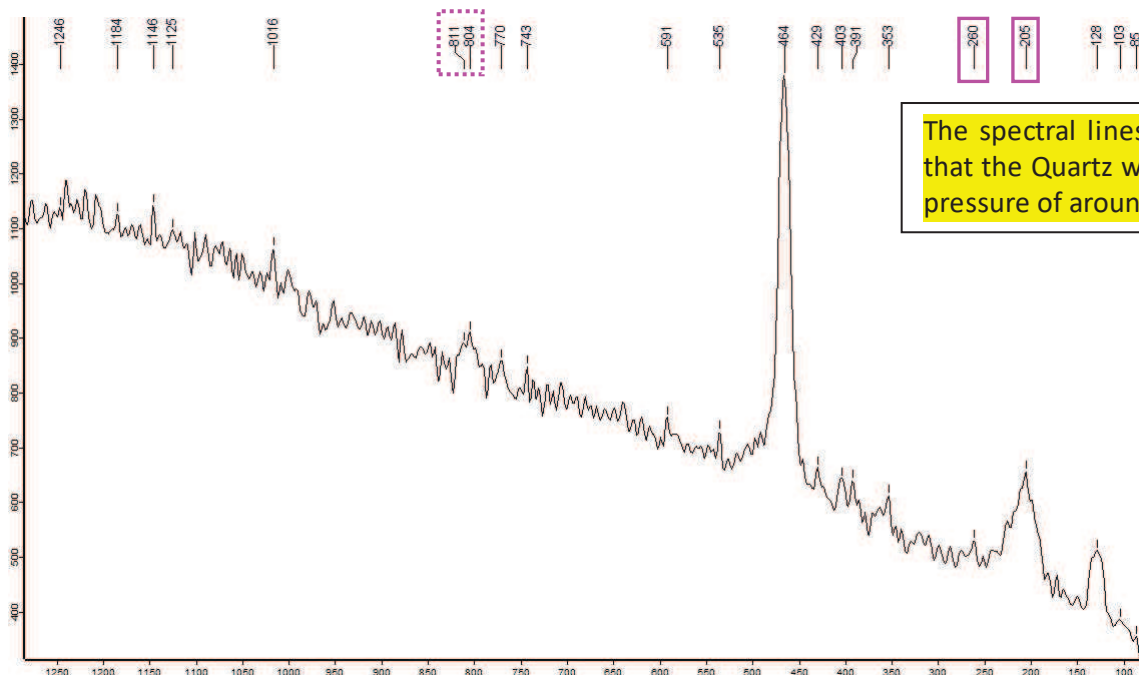
Sample-Site **21** : Stone 2_spectra 1 indicates : **Quartz** (→ see RRUFF_CS results)



Sample :

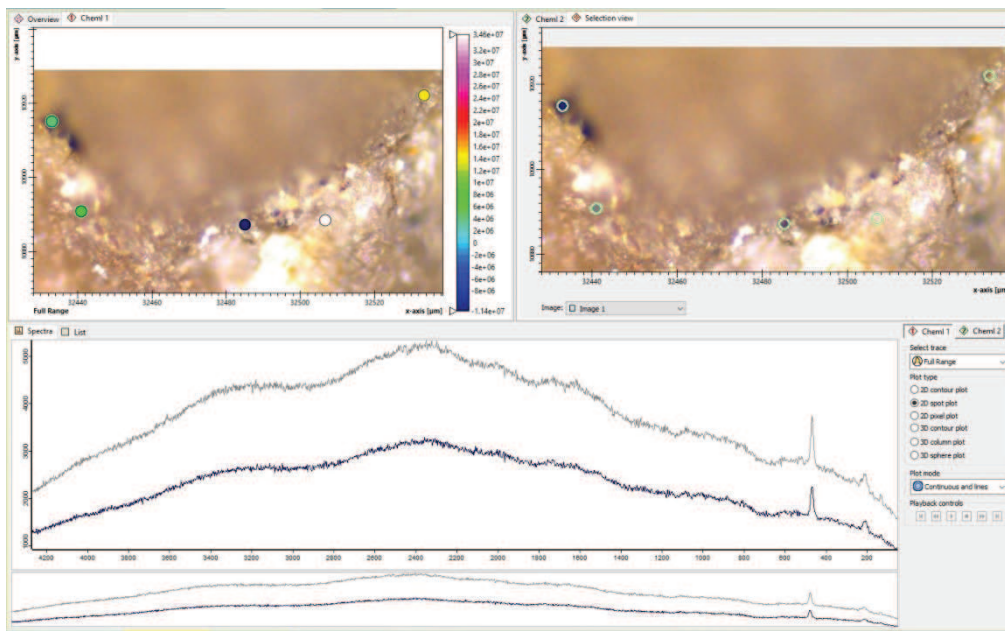


Indication for a shock event are the shifts of the marked Quartz spectral lines towards 260 and 205

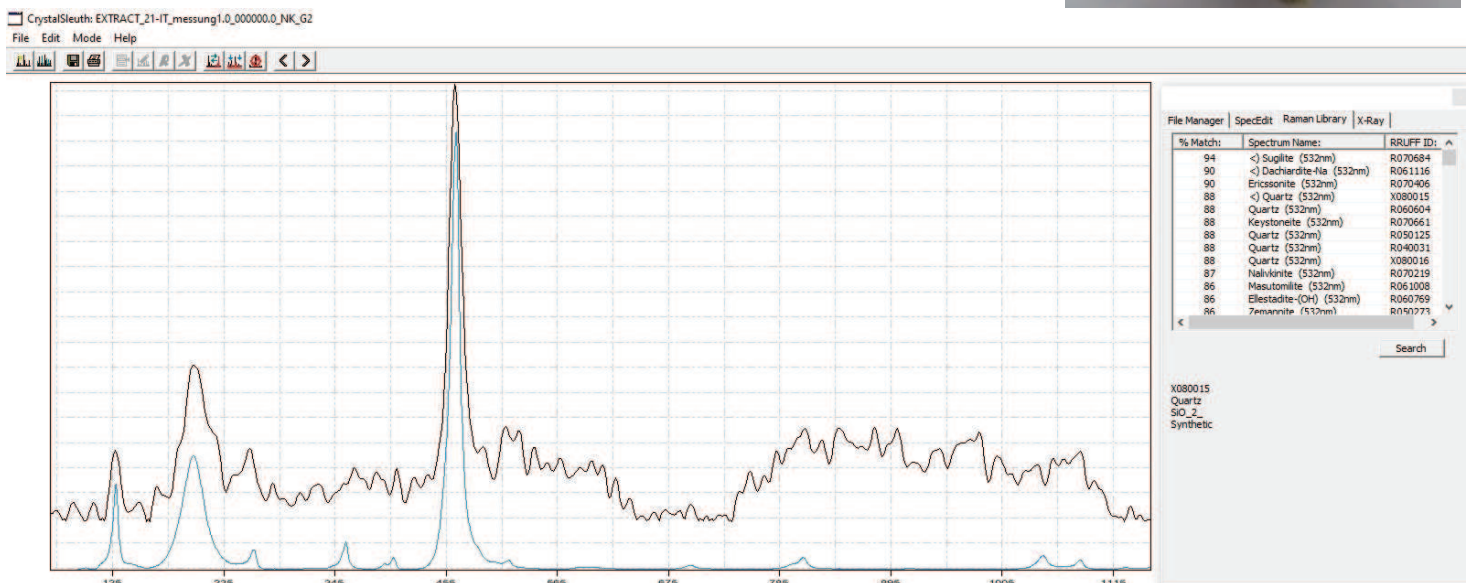


The spectral lines 260 and 205 indicate that the Quartz was exposed to a shock pressure of around 20 - 22 GPa.

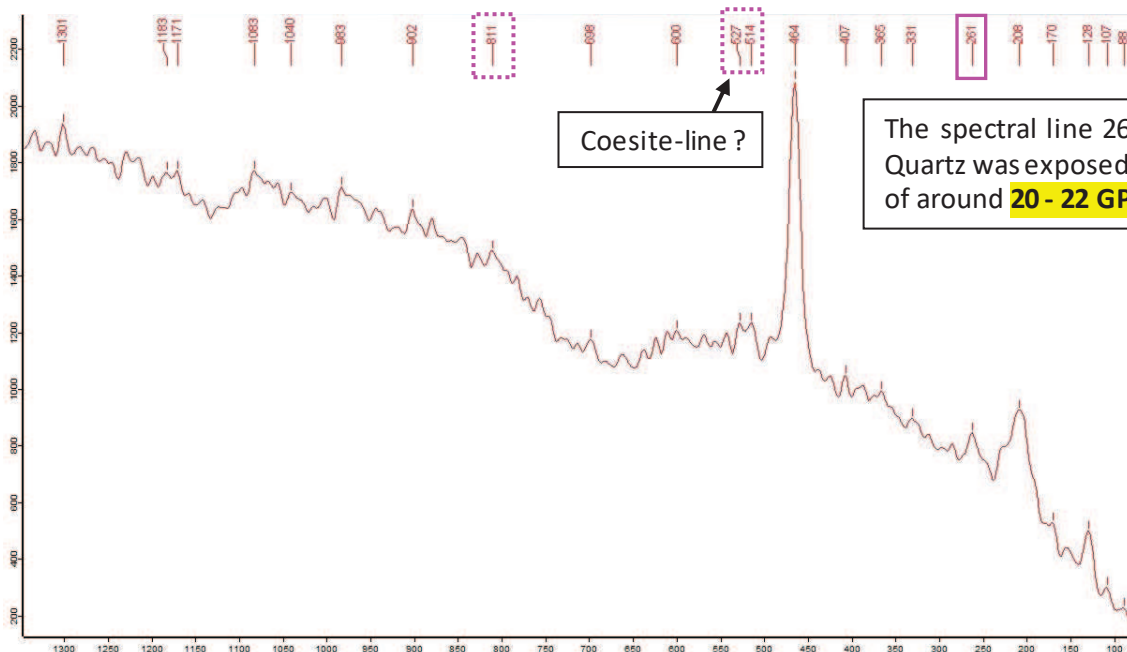
Sample Site **21**: Stone 2_spectra 2 indicates: **Quartz** (→ see RRUFF_CS results)



Sample:

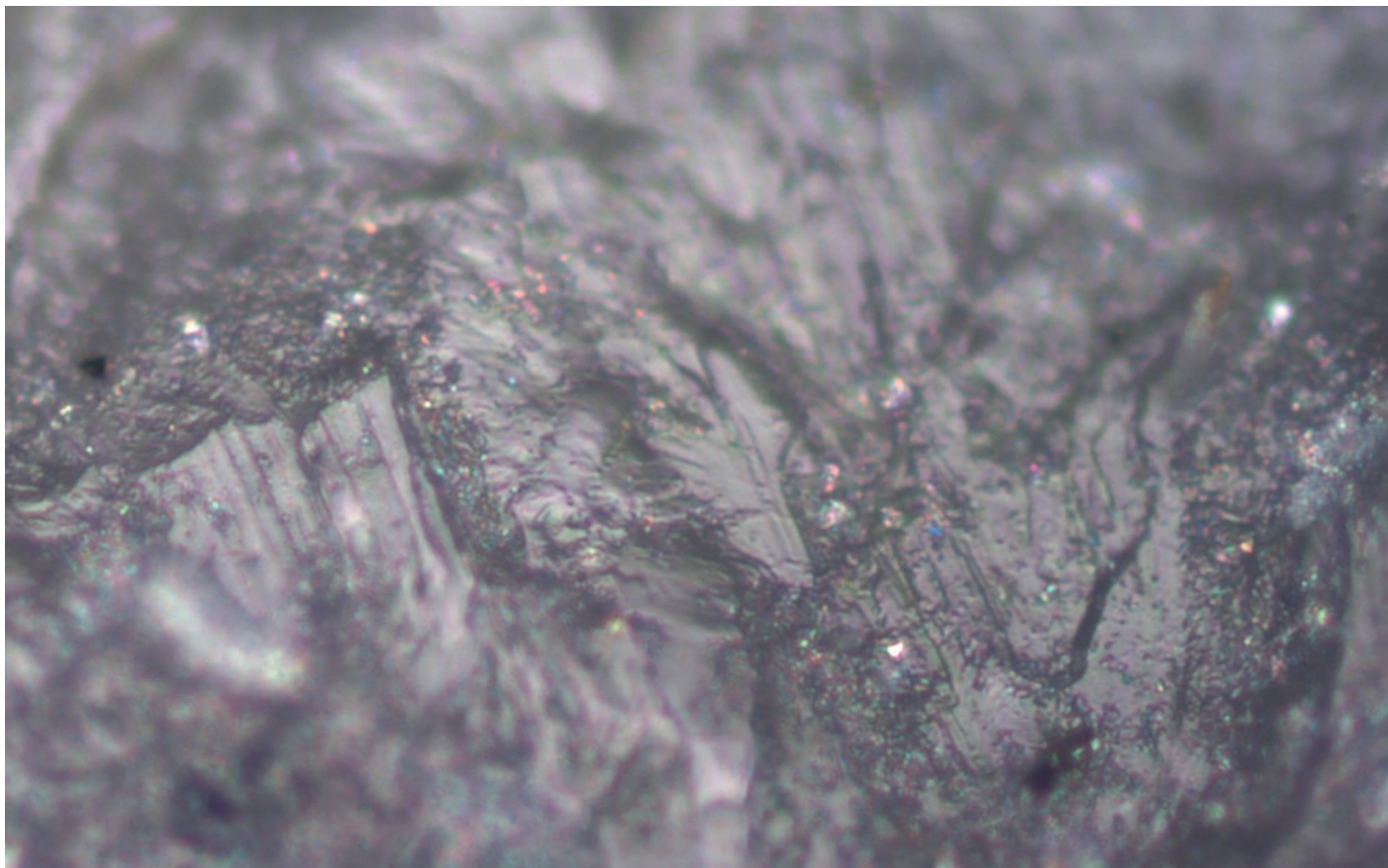


Indication for a shock event is the shift of the marked Quartz spectral line towards 261

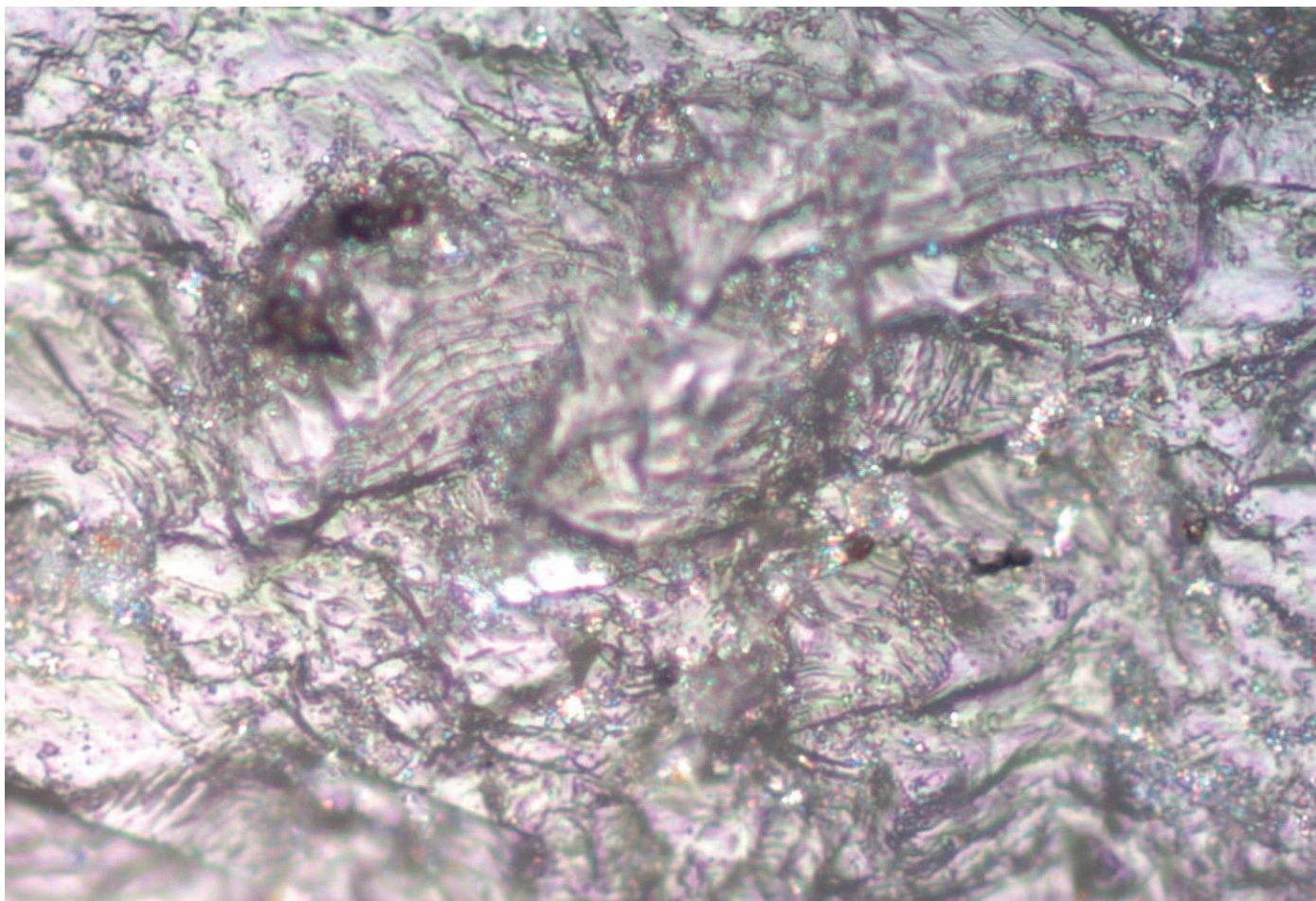


Microscopic Images : Sample from Site 21 → original state (no preparation for analysis)

Sample Site 21 : Stone 2_spectra 1 : Quartz - Image size : ~ 400 x 250 μm

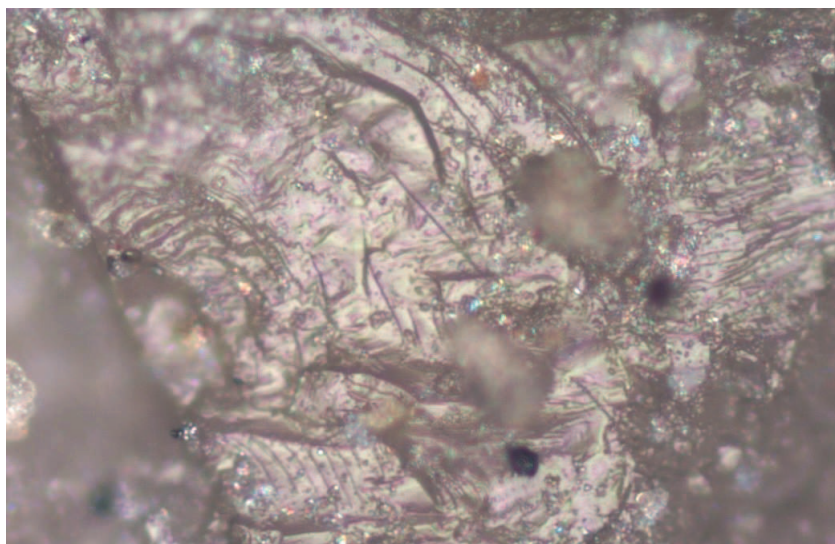


Sample Site 21 : Stone 2 : Quartz - Image size : ~ 400 x 300 μm

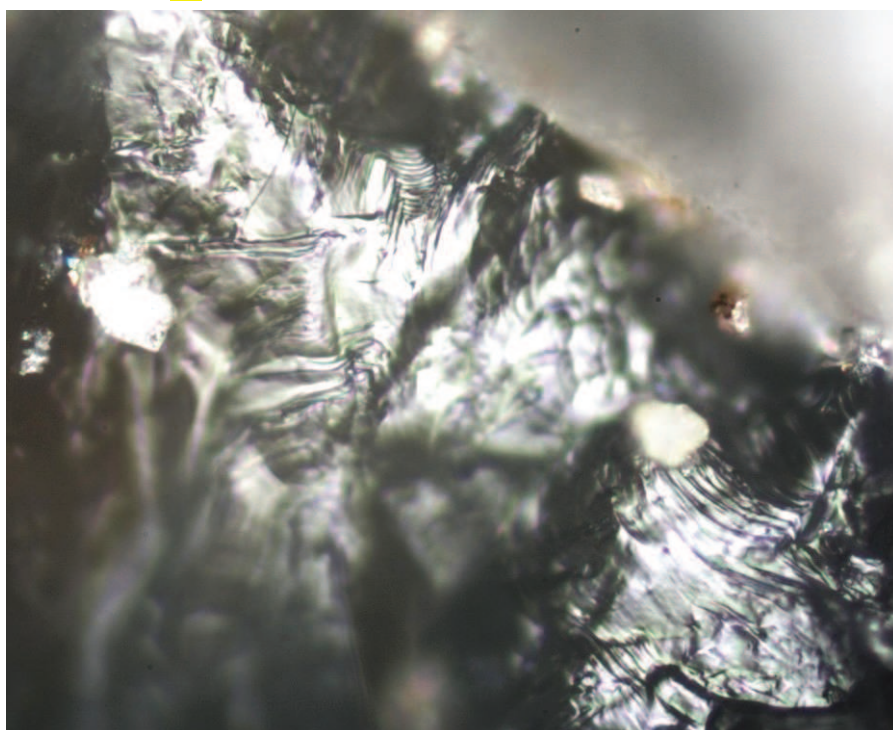


Microscopic Images : Sample from Site 21 → original state (no preparation for analysis)

Sample Site 21 : Stone 1_spectra 1 : Quartz - Image size : ~ 400 x 300 μm

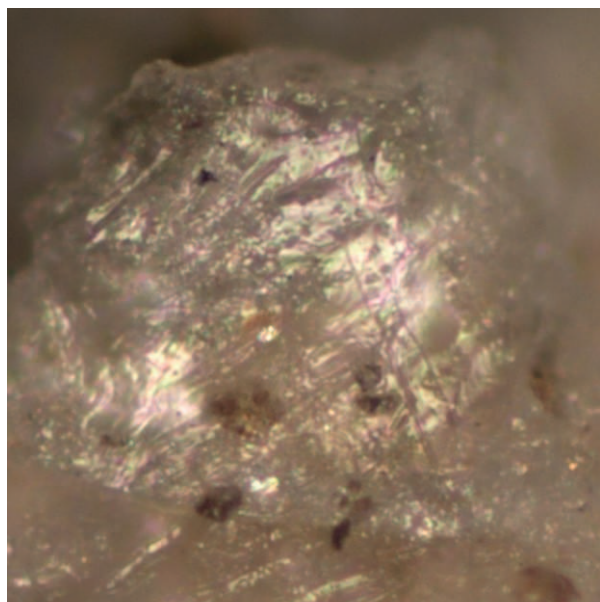


Sample Site 21 : Stone 1_spectra 2 : Quartz - Image size : ~ 250 x 200 μm



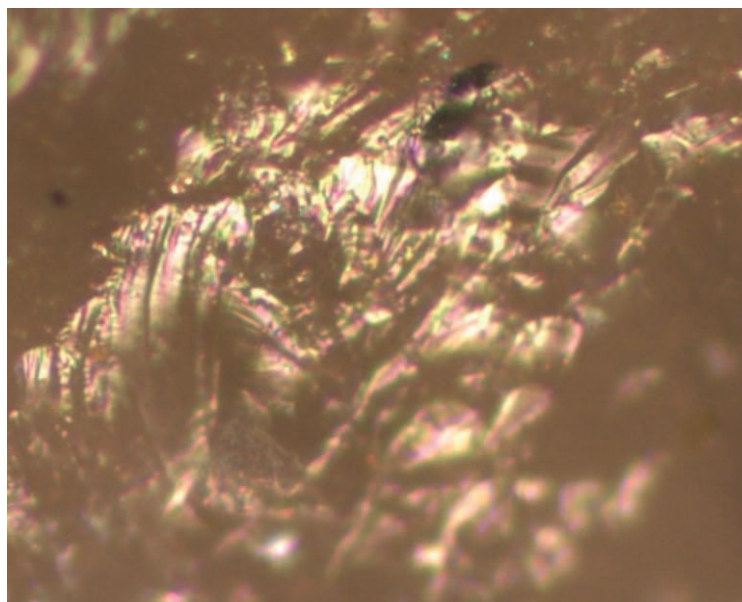
Sample Site 21 : Stone 1 : Quartz

Image size : ~ 200 x 180 μm

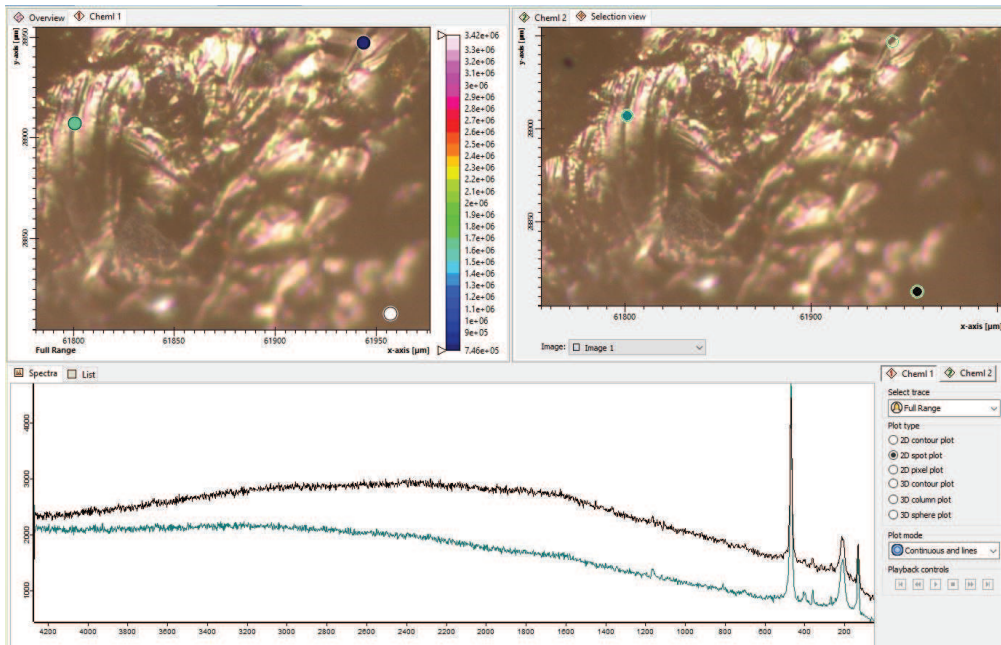


Sample Site 21 : Stone 3 : Quartz

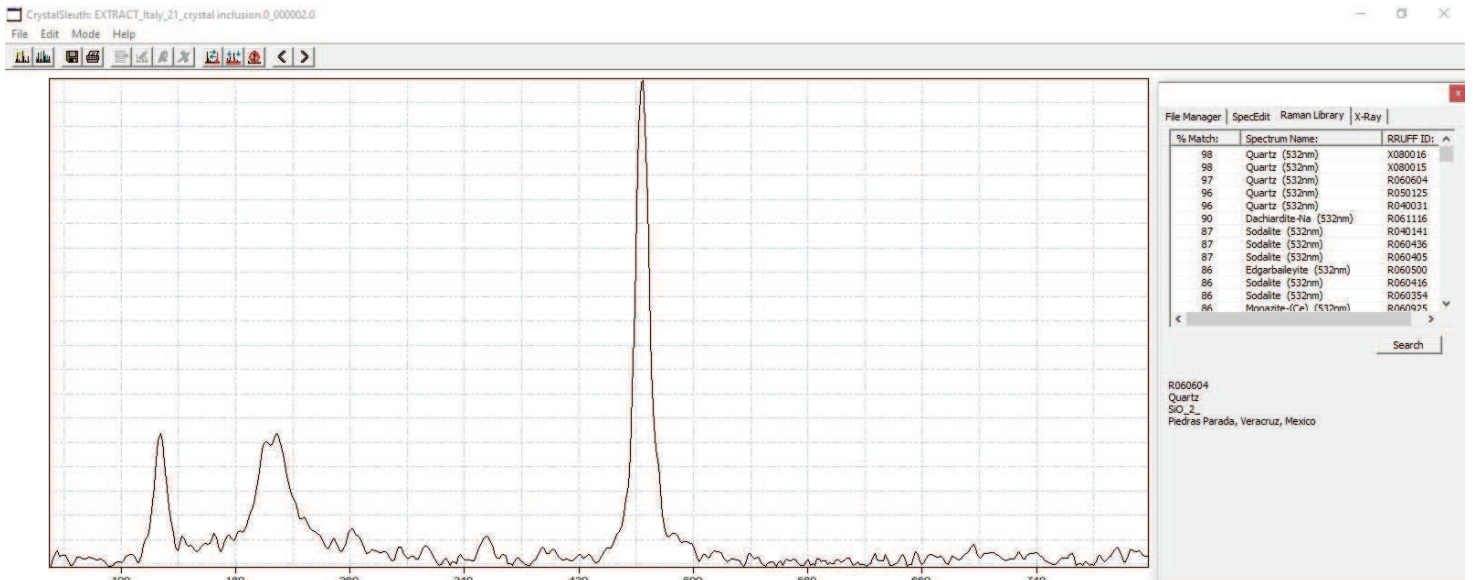
Image size : ~ 220 x 200 μm



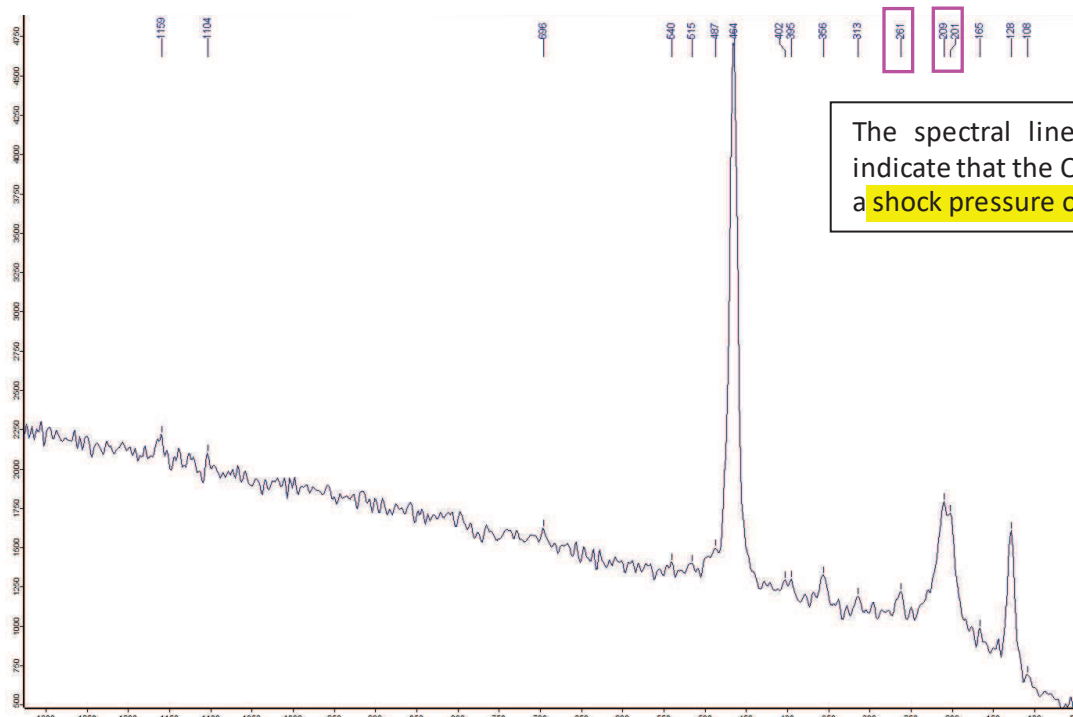
Sample-Site **21**: Stone 3_spectra 1 (crystal inclusion) indicates: **Quartz** (→ see RRUFF_CS results)



Sample :



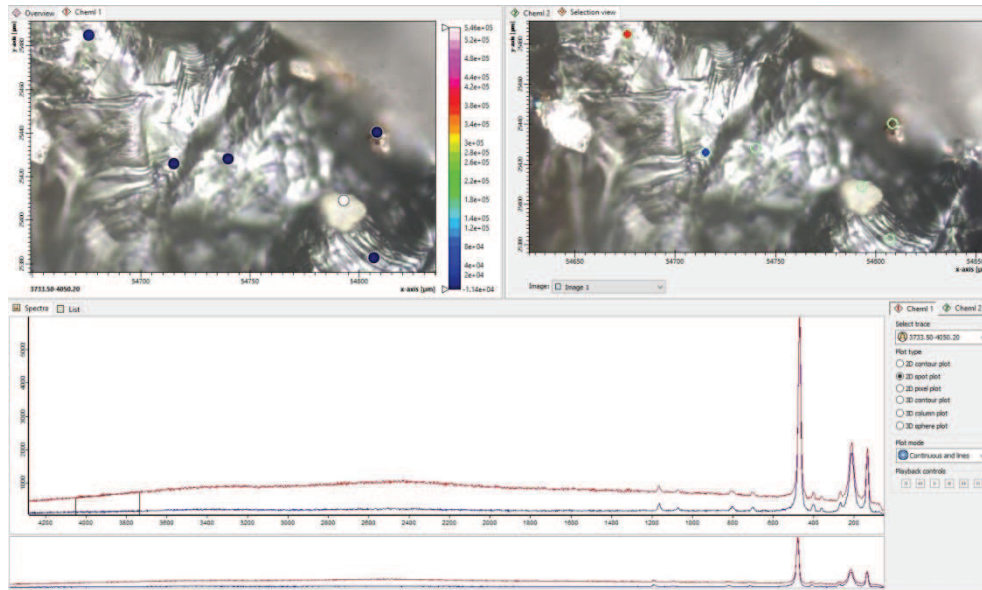
Indication for a shock event are the shifts of the marked Quartz spectral lines towards 261 and 201 (209)



The spectral lines 261 and 201 (209) indicate that the Quartz was exposed to a shock pressure of around 20 - 22 GPa.

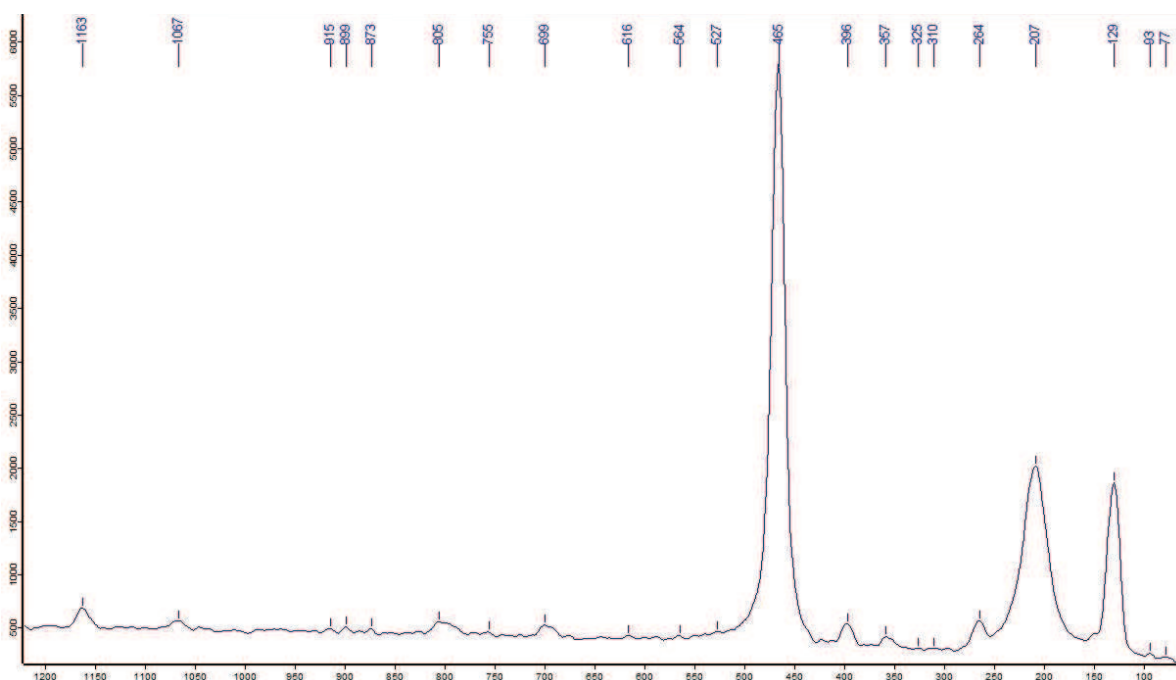
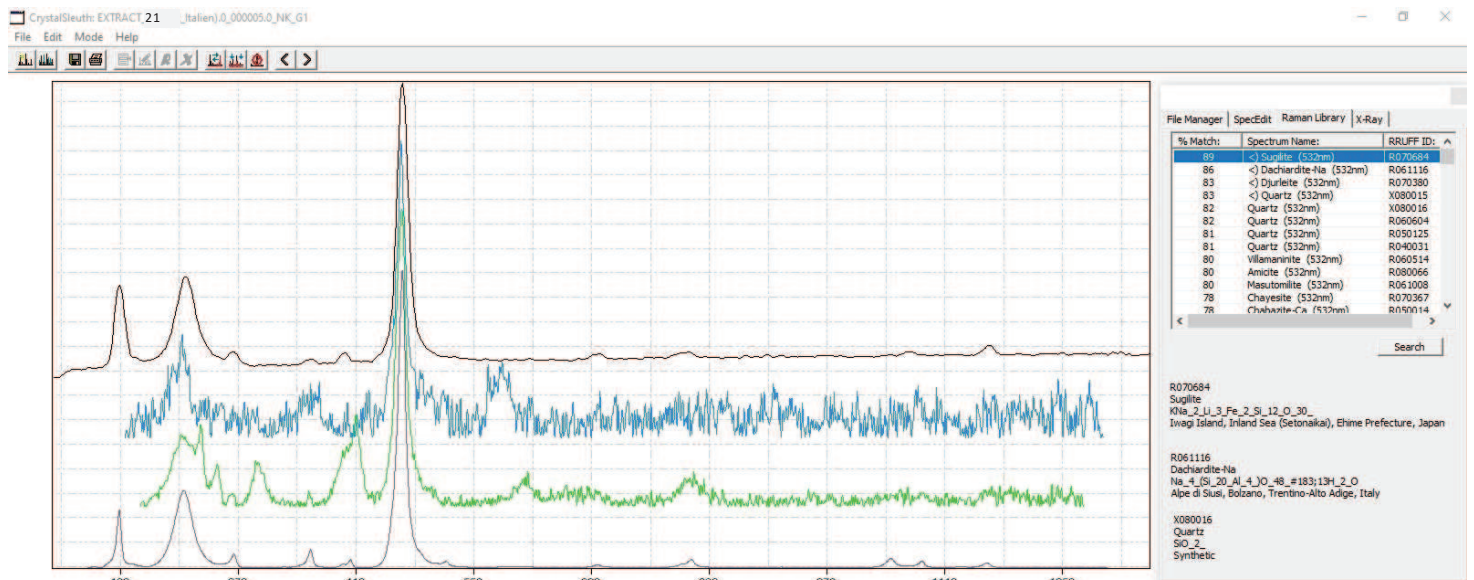
Sample Site **21**: Stone 1_spectra 2 indicates: **Quartz Sugilite, Dachardite-Na** (→ see RRUFF_CS results)

The spectral lines indicate that **Quartz** is the most probable mineral measured in this spectral analysis

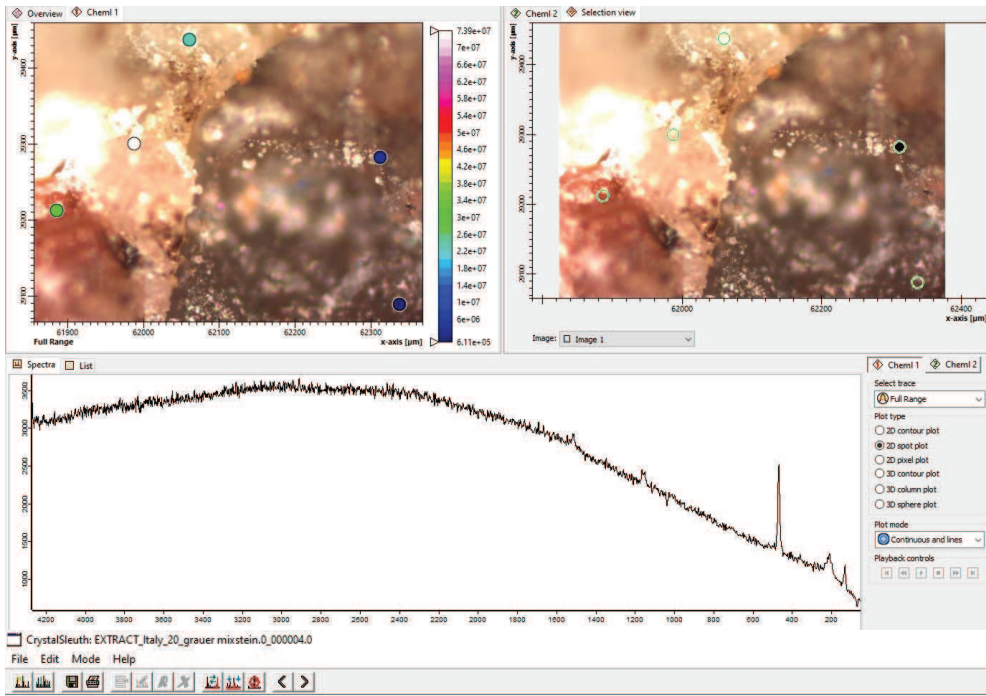


Note the fracture patterns on the microscopic image.

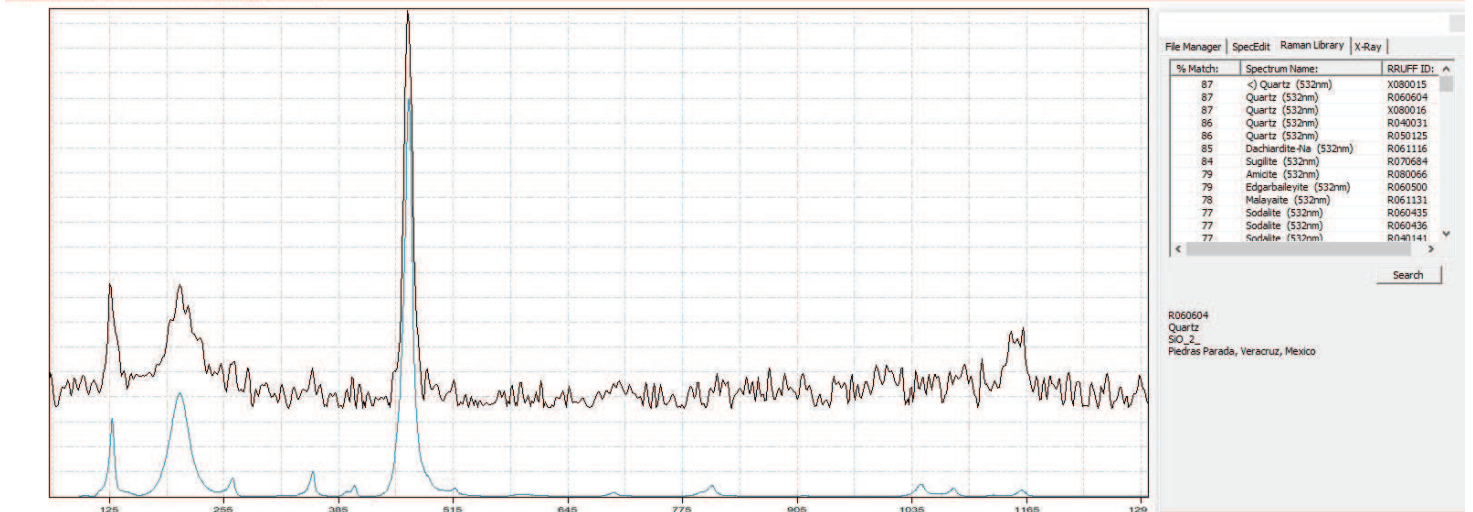
Sample :



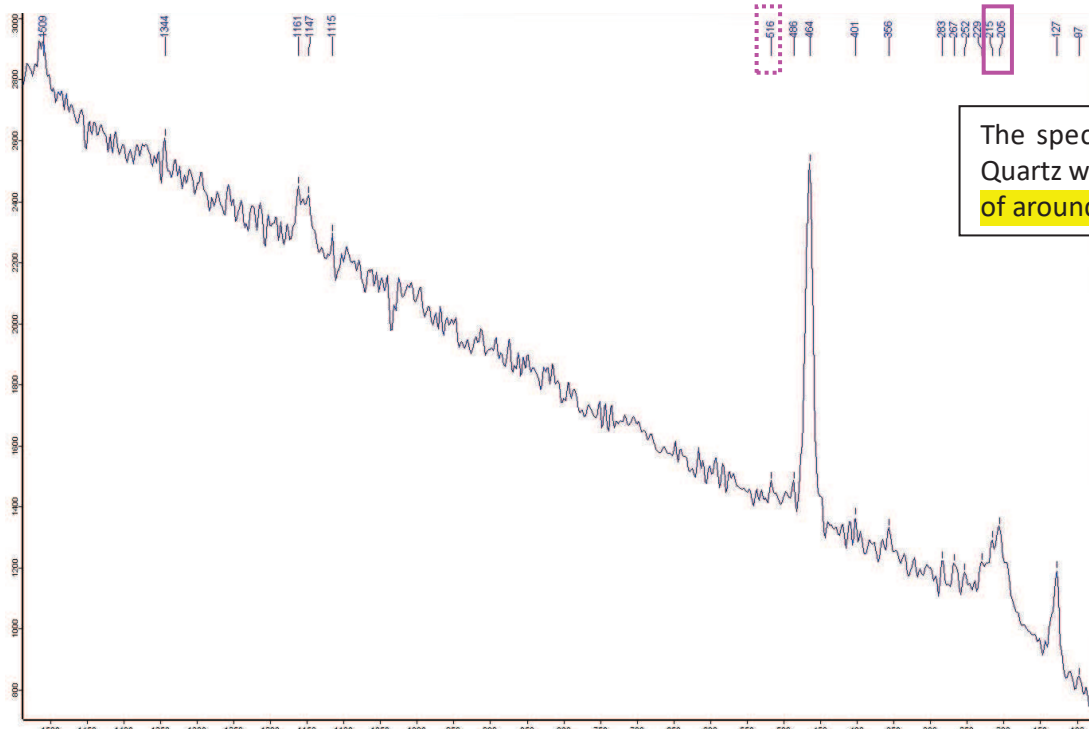
Sample Site **20**: Stone 4_spectra 1 indicates: **Quartz** (→ see RRUFF_CS results)



Sample :

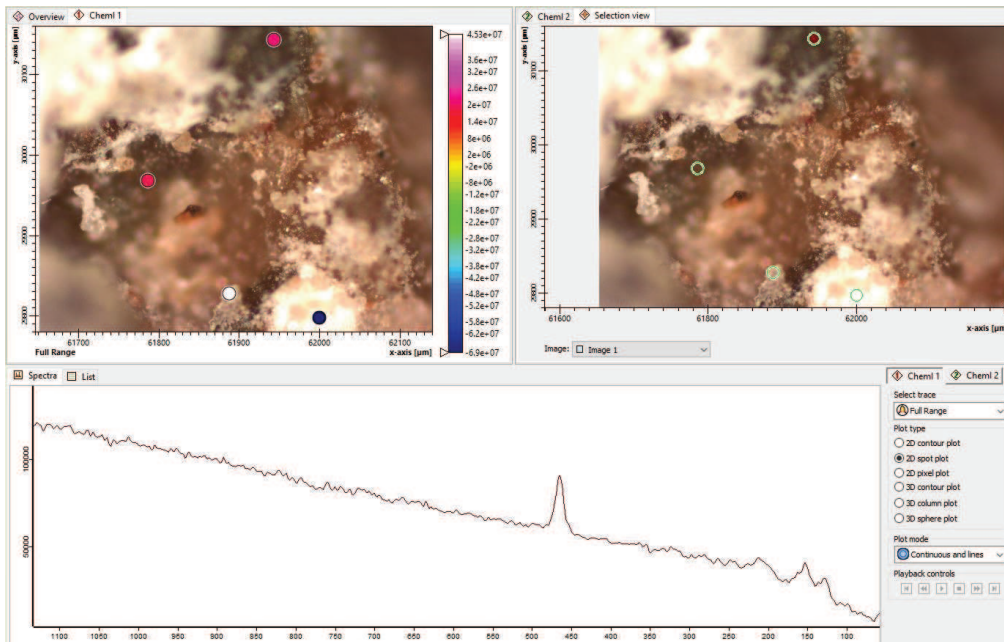


Indication for a shock event is the shift of the marked Quartz spectral lines towards 205

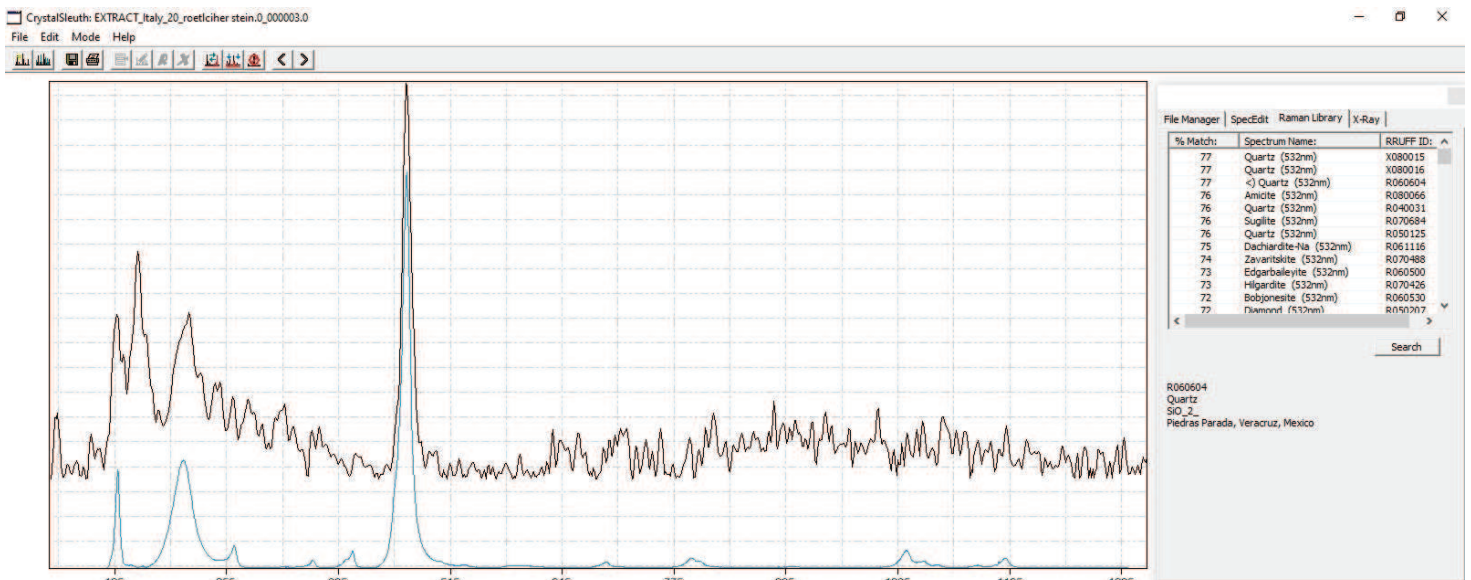


The spectral line 205 indicates that the Quartz was exposed to a **shock pressure of around 20 – 22 GPa.**

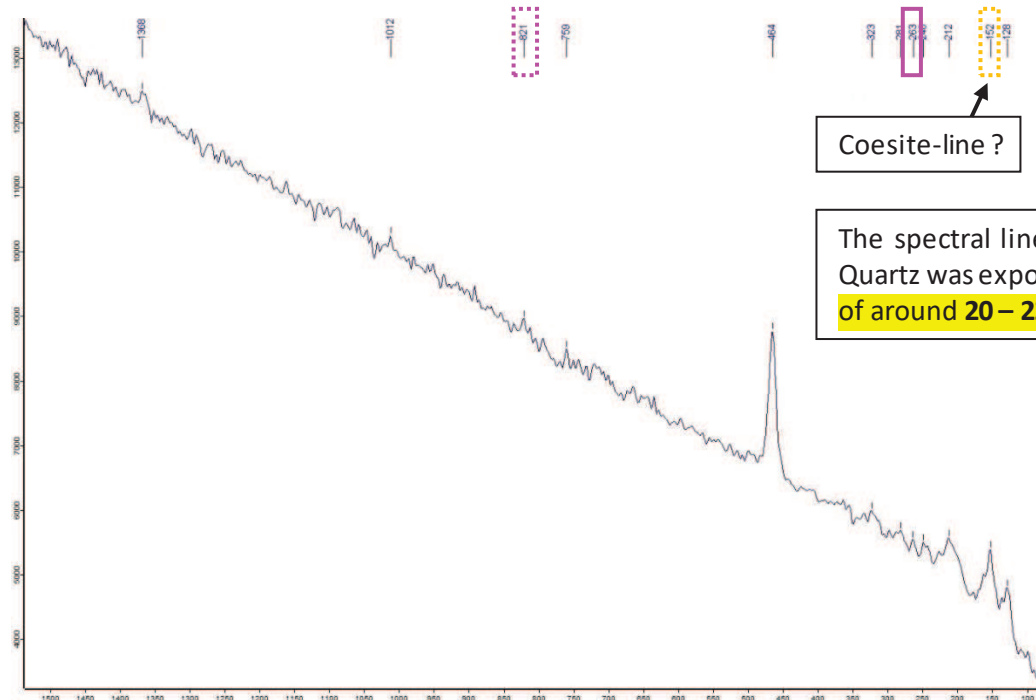
Sample Site **20**: Stone 5_spectra 1 indicates: **Quartz** (→ see RRUFF_CS results)



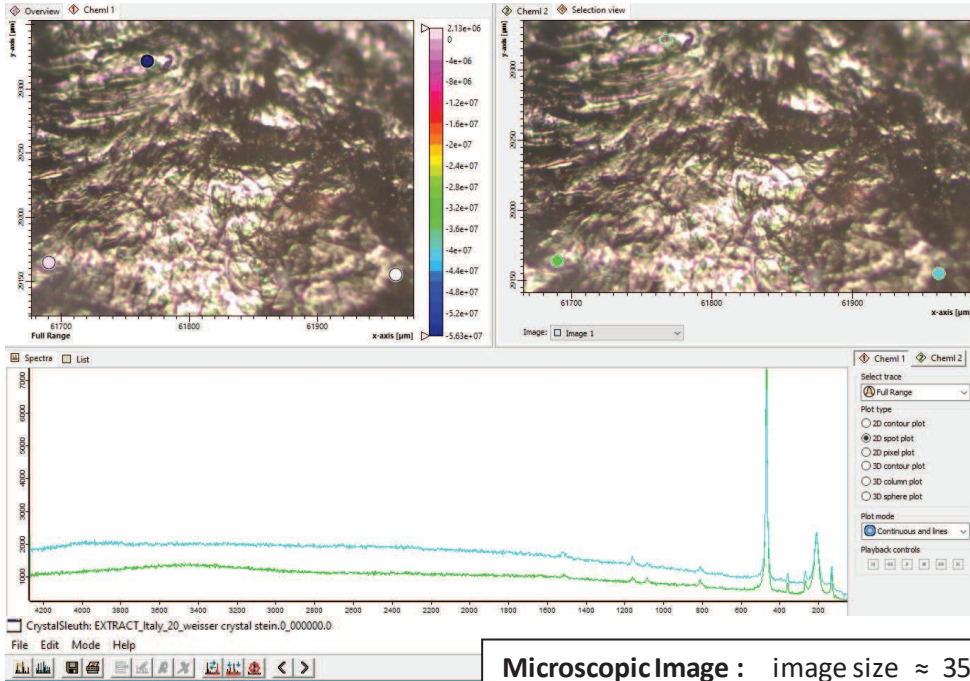
Sample :



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



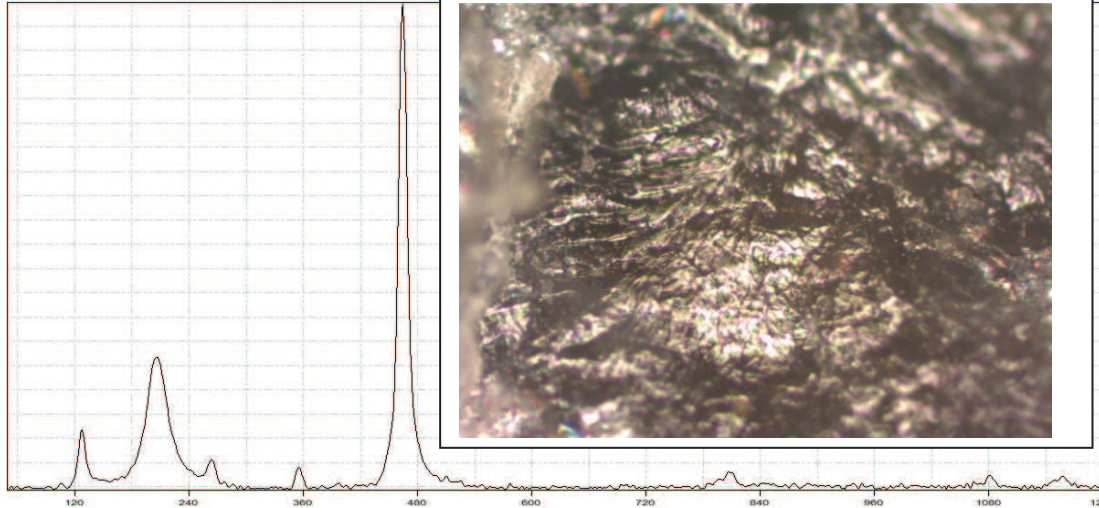
Sample Site **20**: Stone 6_spectra 1 indicates: **Quartz** (→ see RRUFF_CS results)



Sample :



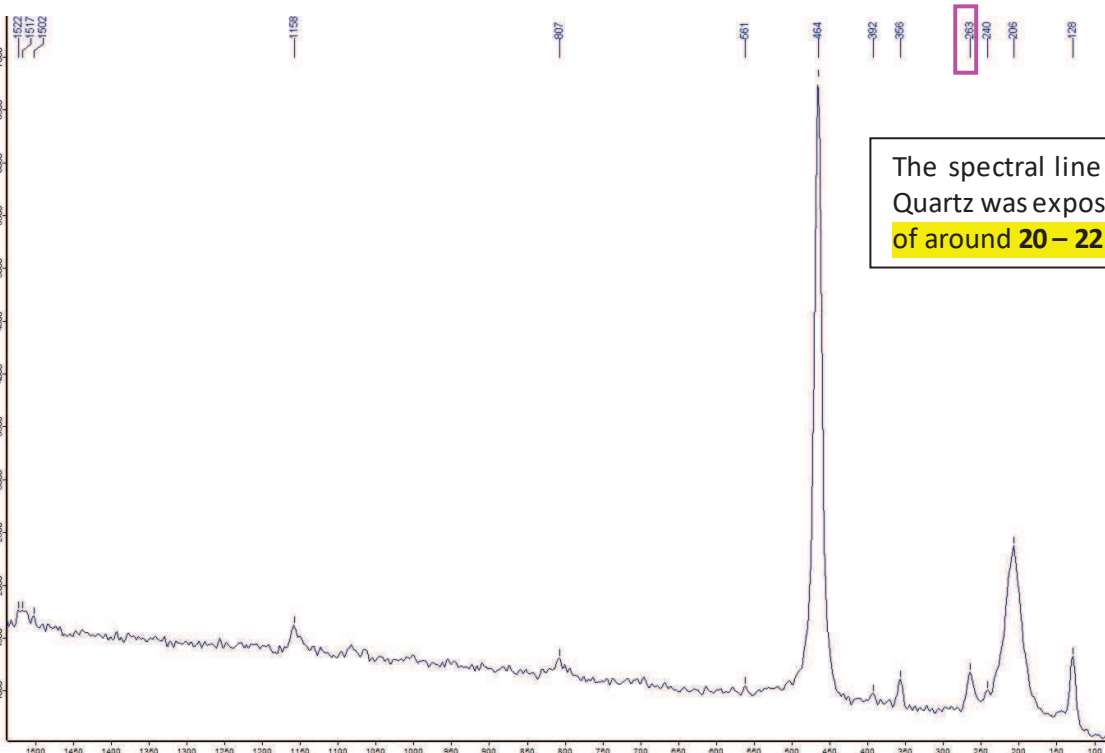
Microscopic Image : image size $\approx 350 \times 300 \mu\text{m}$



% Match	Spectrum Name	RRUFF ID
99	Quartz (S32nm)	X080015
99	Quartz (S32nm)	X080016
99	Quartz (S32nm)	R050125
98	Quartz (S32nm)	R060604
98	Quartz (S32nm)	R040031
90	Dachardite-Ha (S33nm)	R061116
86	Edgarbaileite (S32nm)	R060500
86	Sodalite (S32nm)	R060436
85	Sodalite (S32nm)	R040141
84	Sodalite (S32nm)	R060416
84	Sodalite (S32nm)	R060354
84	Amicite (S32nm)	R080066
84	Sodalite (S32nm)	R060415

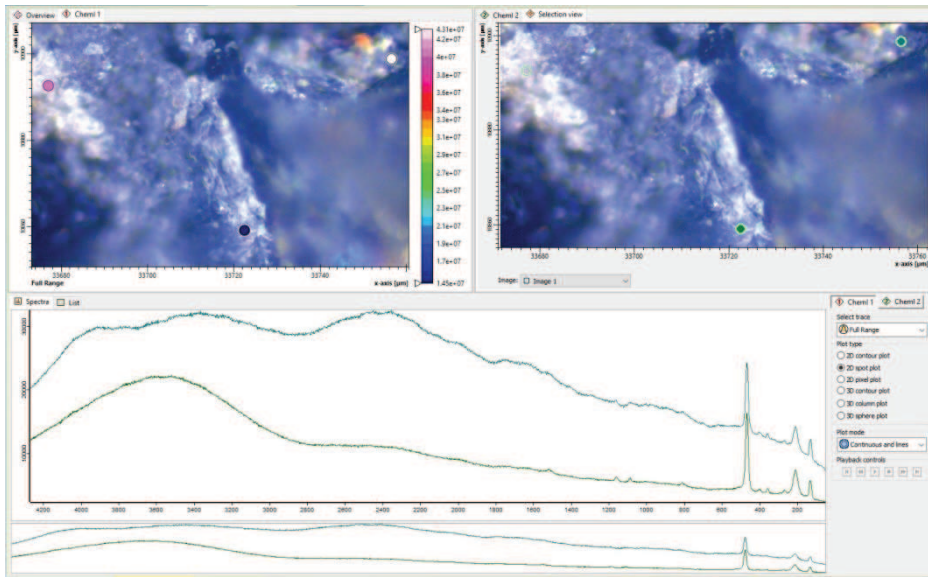
R050125
Quartz
SiO₂
Linópolis, Minas Gerais, Brazil

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

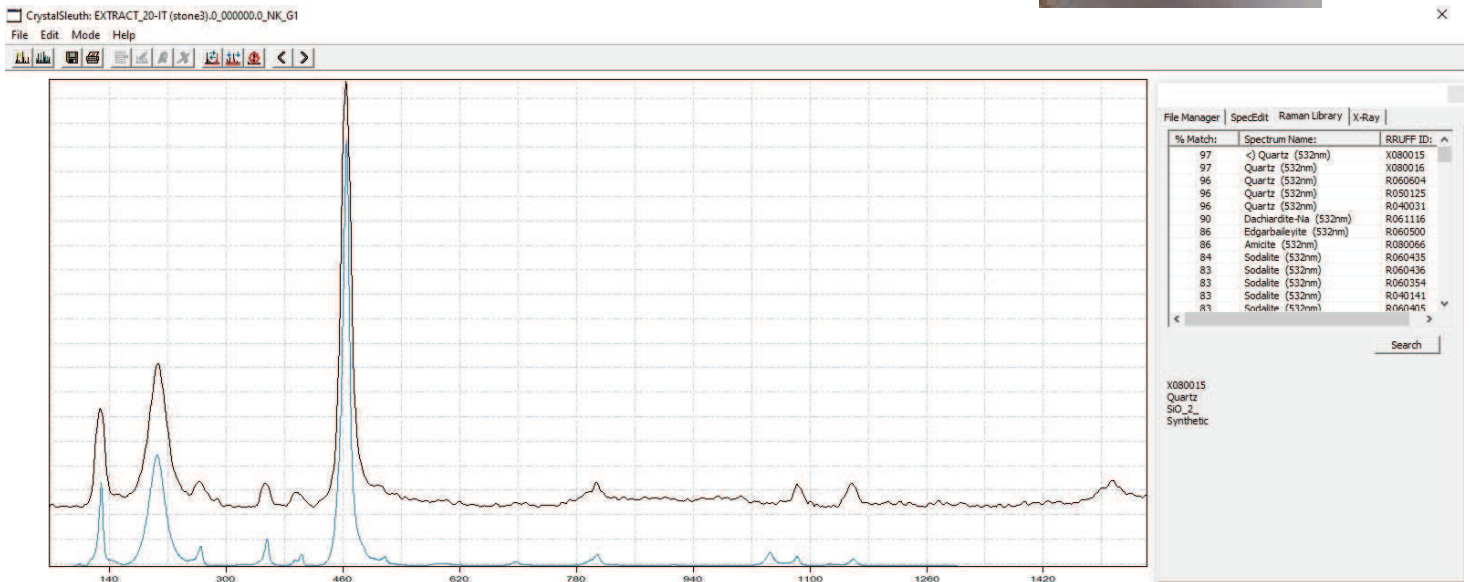
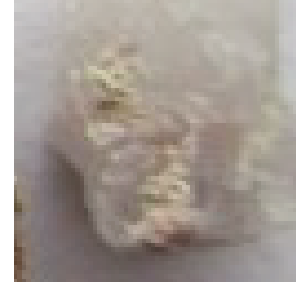


The spectral line 263 indicates that the Quartz was exposed to a **shock pressure of around 20 – 22 GPa.**

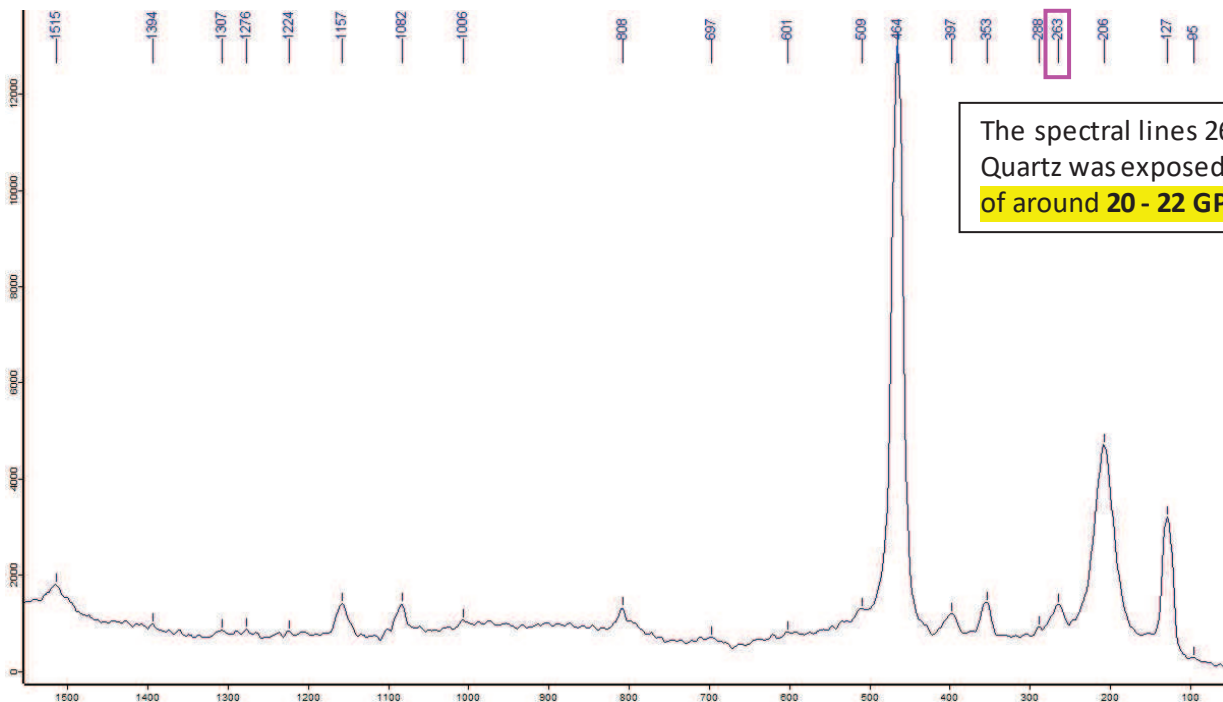
Sample Site **20**: Stone 3_spectra 1 indicates: **Quartz** (→ see RRUFF_CS results)



Sample :

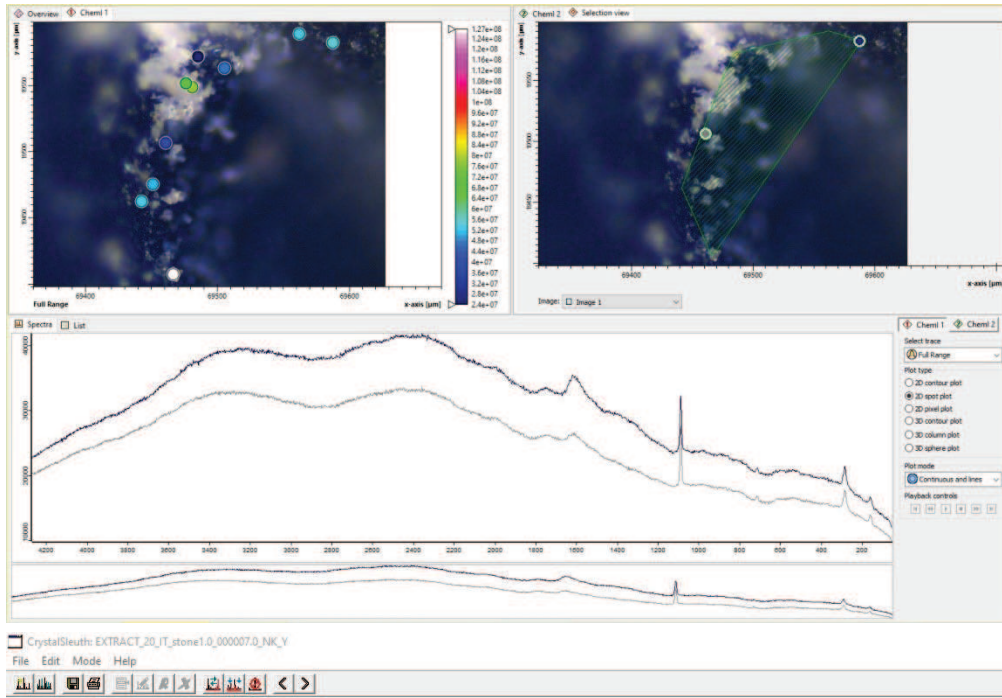


Indication for a shock event is the shift of the marked Quartz spectral lines towards 263

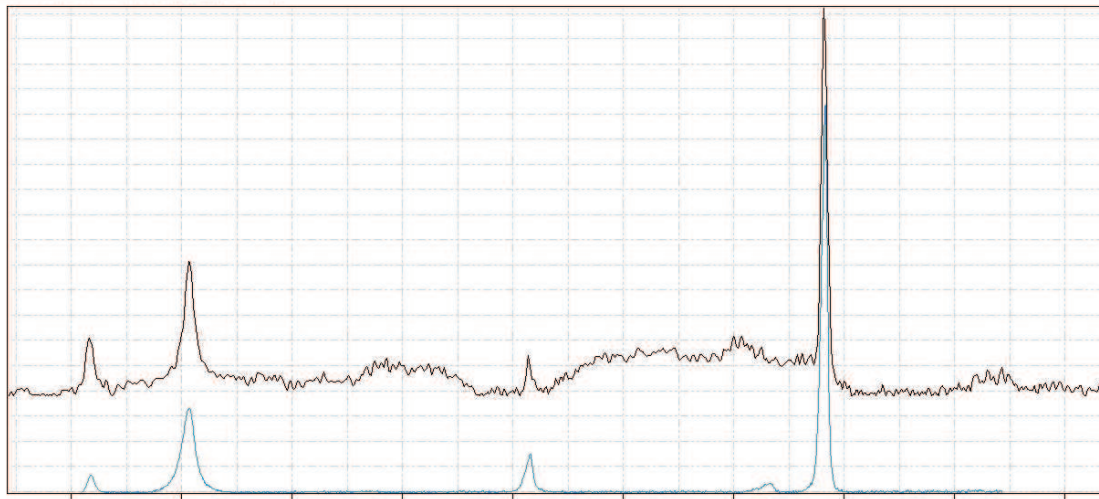


OTHER SPECTRA FROM THE SAMPLES No's.: 20, 18, 17 and 22, 23 on the following pages :

Sample Site **20**: Stone 1_spectra 1 indicates: **Calcite** (→ see RRUFF_CS results)

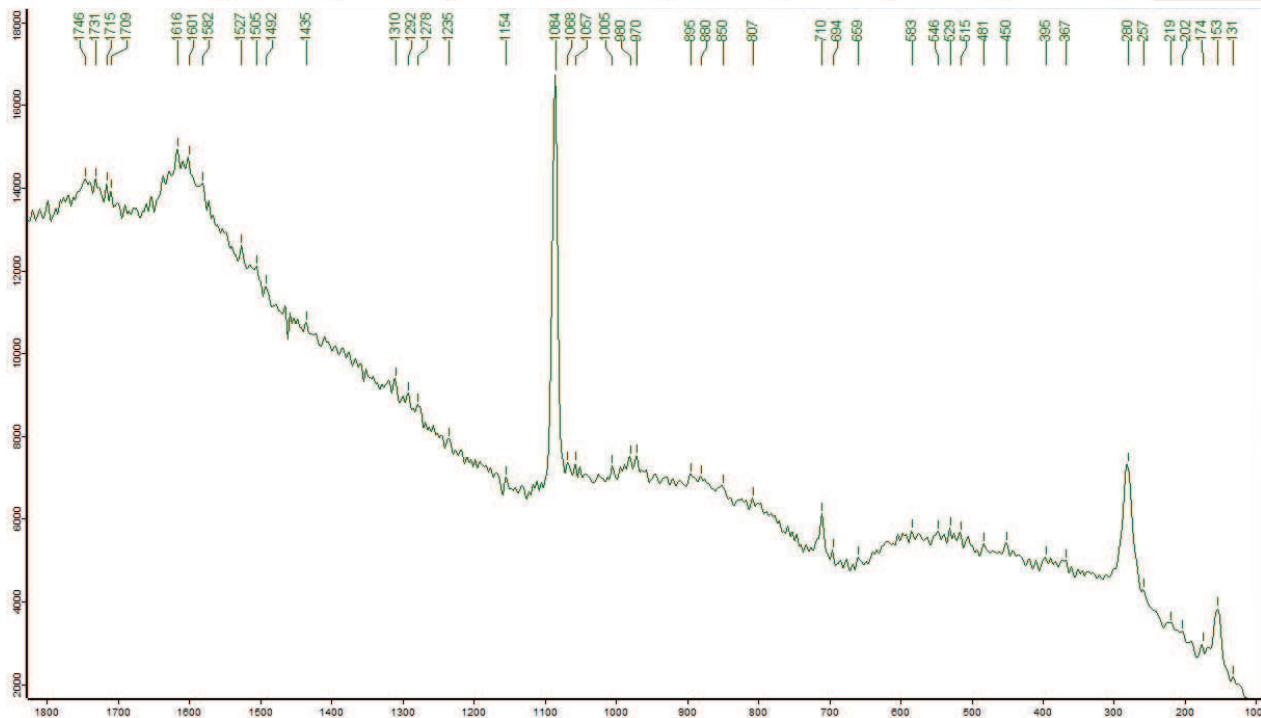


Sample :



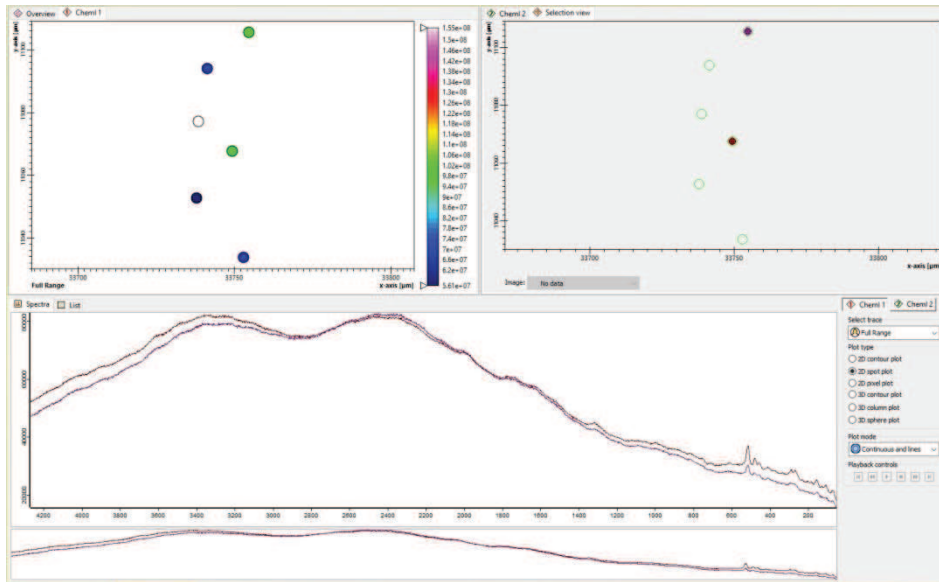
% Match	Spectrum Name	RRUFF ID
81	Calcite (532nm)	R040170
77	Kutnohorite (532nm)	R050473
76	Calcite (532nm)	R050048
76	Otaivite (787nm)	R050677
75	Siderite (532nm)	R050349
75	Rhodochrosite (532nm)	R040133
74	Calcite (Ca) (532nm)	R050248
74	Calcite (532nm)	R050009
74	Rhodochrosite (532nm)	R050116
74	Calcite (532nm)	R050307
73	Calcite (532nm)	R040070
73	Rhodochrosite (532nm)	R050019
71	Calcite rhodochrosite (532nm)	R070073

R040170
Calcite
CaCO₃
Peramea, Lerida Province, Catalonia, Spain



Sample Site 20 : Stone 2_spectra 1 indicates : **Orthoclase , Microcline**

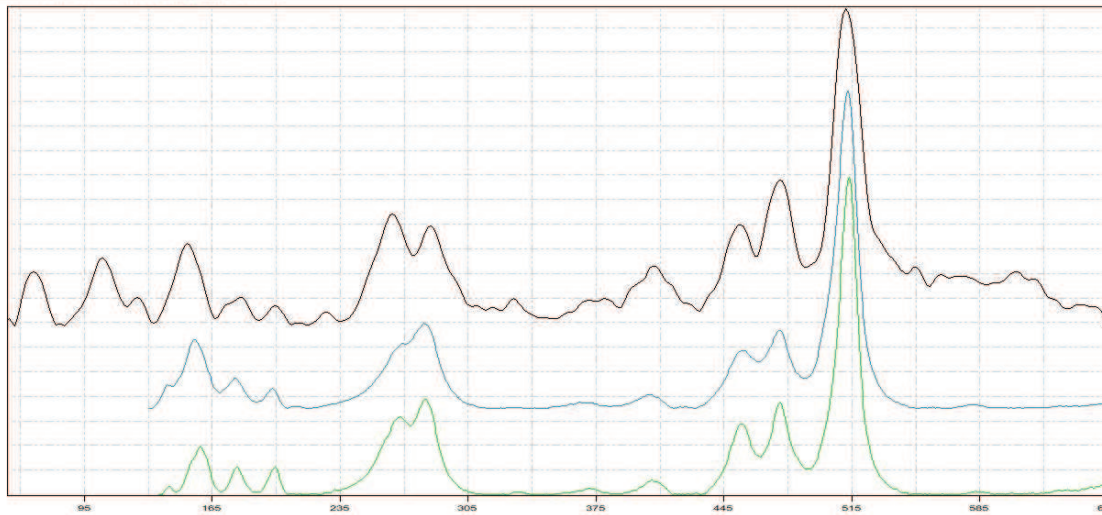
(→ see RRUFF_CS results)



Sample :



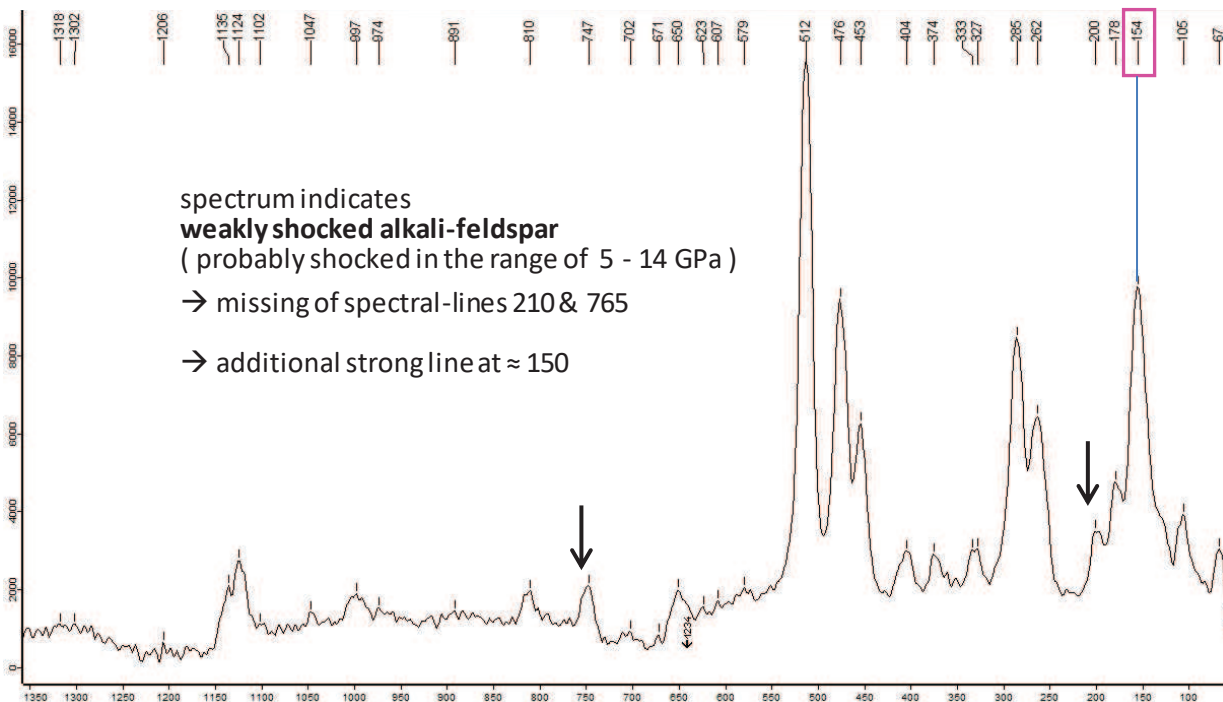
CrystalSleuth: EXTRACT_20-IT (stone2)_0_000000_0_NK_G2



% Match	Spectrum Name	RRUFF ID
89	Orthoclase (532nm)	R050193
89	Microcline (532nm)	R050193
89	Orthoclase (532nm)	R040055
89	Microcline (532nm)	R050150
88	Orthoclase (532nm)	R070001
88	Microcline (532nm)	R040154
88	Microcline (532nm)	R050054
88	Orthoclase (532nm)	R050367
85	Orthoclase (532nm)	R060077
85	Labradorite (532nm)	R050104
84	Bytownite (532nm)	R070598
83	Nickeliumite (532nm)	R060573
R1	Androsite (532nm)	R050546

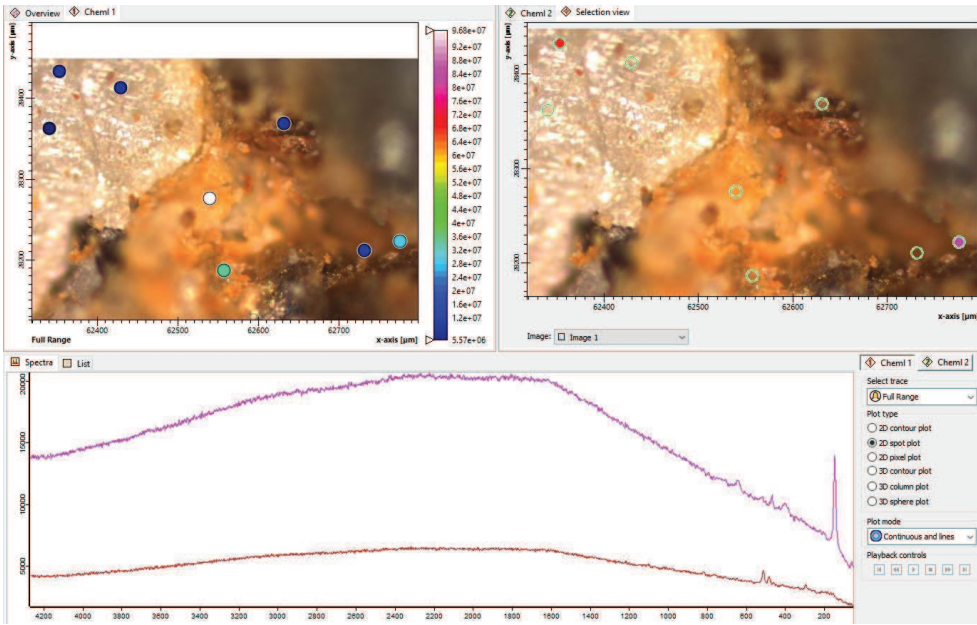
R050193
Orthoclase
KAS1_3_O_8
Silica Bell Property, west of Hope, British Columbia, Canada

R050193
Microcline
KAS1_3_O_8
Devil's Head, Douglas County, Colorado, USA



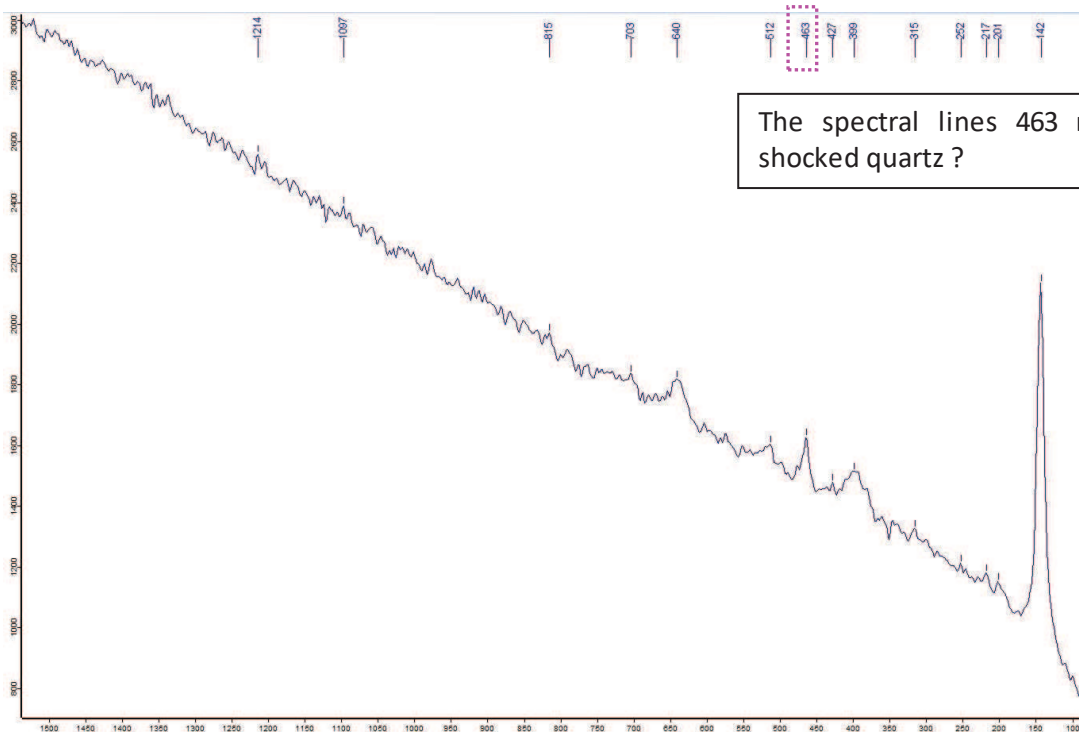
spectrum indicates
weakly shocked alkali-feldspar
 (probably shocked in the range of 5 - 14 GPa)
 → missing of spectral-lines 210 & 765
 → additional strong line at ~ 150

Sample Site 19: Stone 1_spectra 1 (white crystal inclusion) indicates : **Microcline , (Quartz ?)**



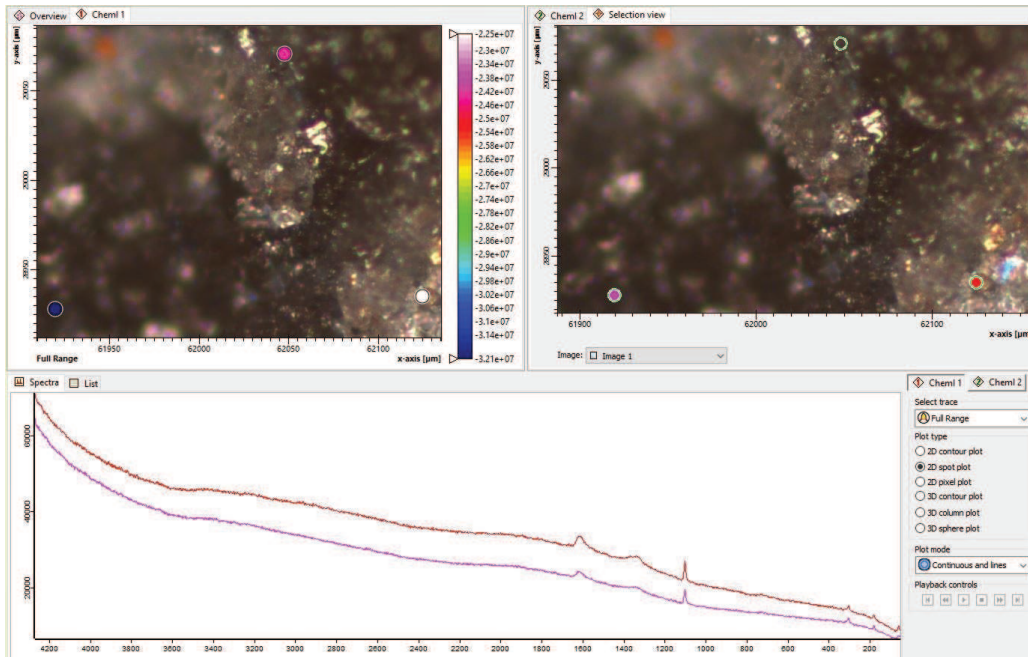
The spectrum may also indicate shocked quartz

Sample :

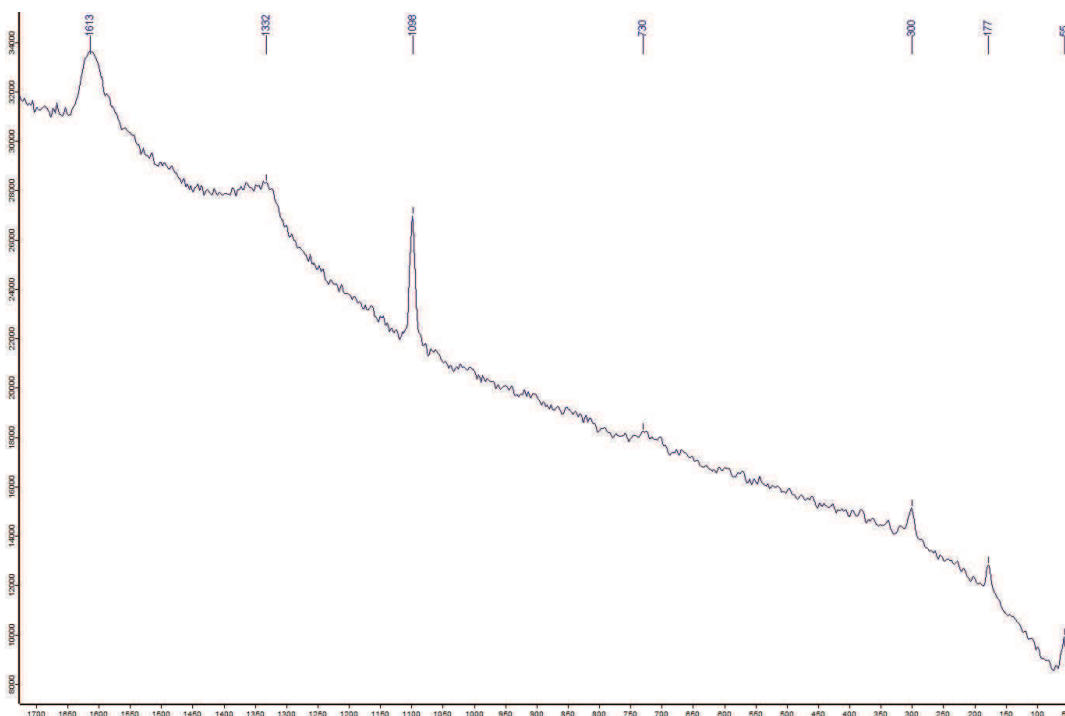
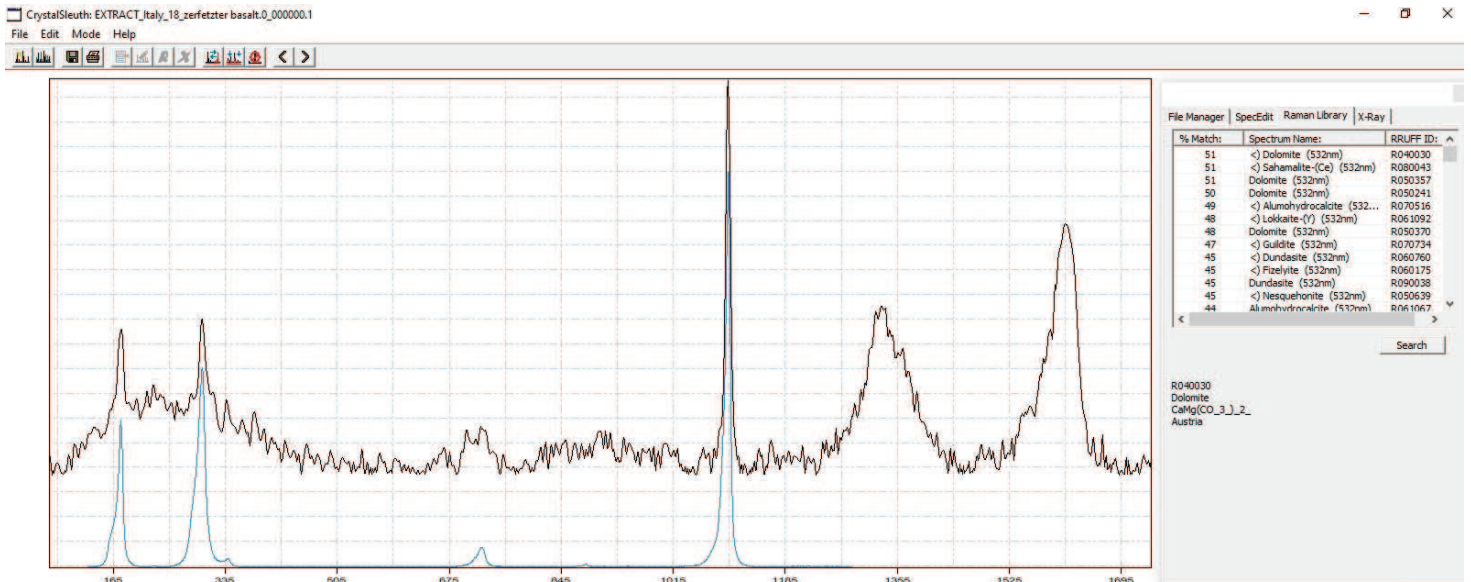


The spectral lines 463 may indicate shocked quartz ?

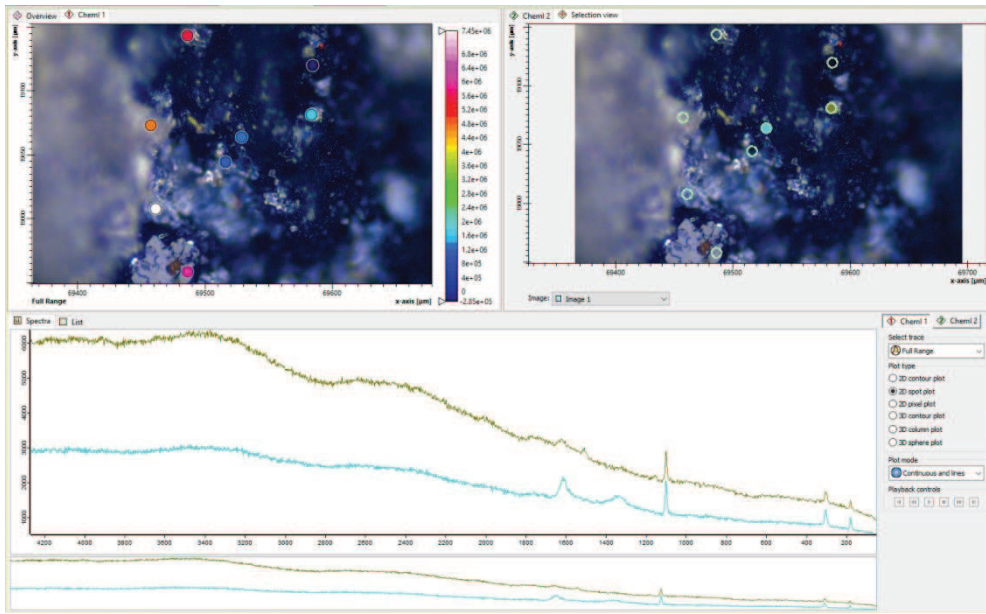
Sample Site 18: Stone 2_spectra 1 (dark mineral) indicates: Dolomite, Sahamalite-(Ce) (→ RRUFF_CS)



Sample :



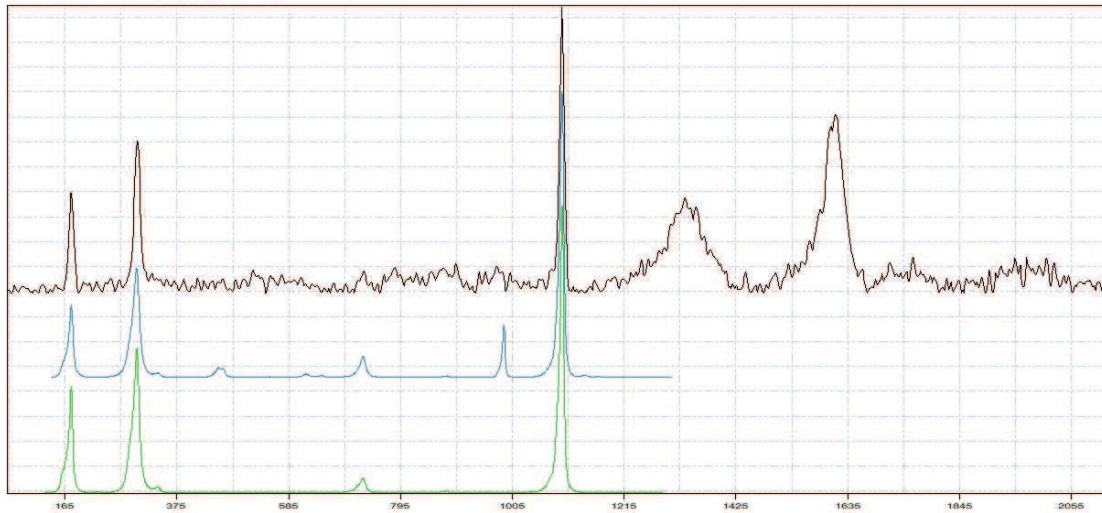
Sample Site 18: Stone 1_spectra 1 (dark mineral) indicates: Dolomite, Sahamalite-(Ce) (→ RRUFF_CS)



Sample :



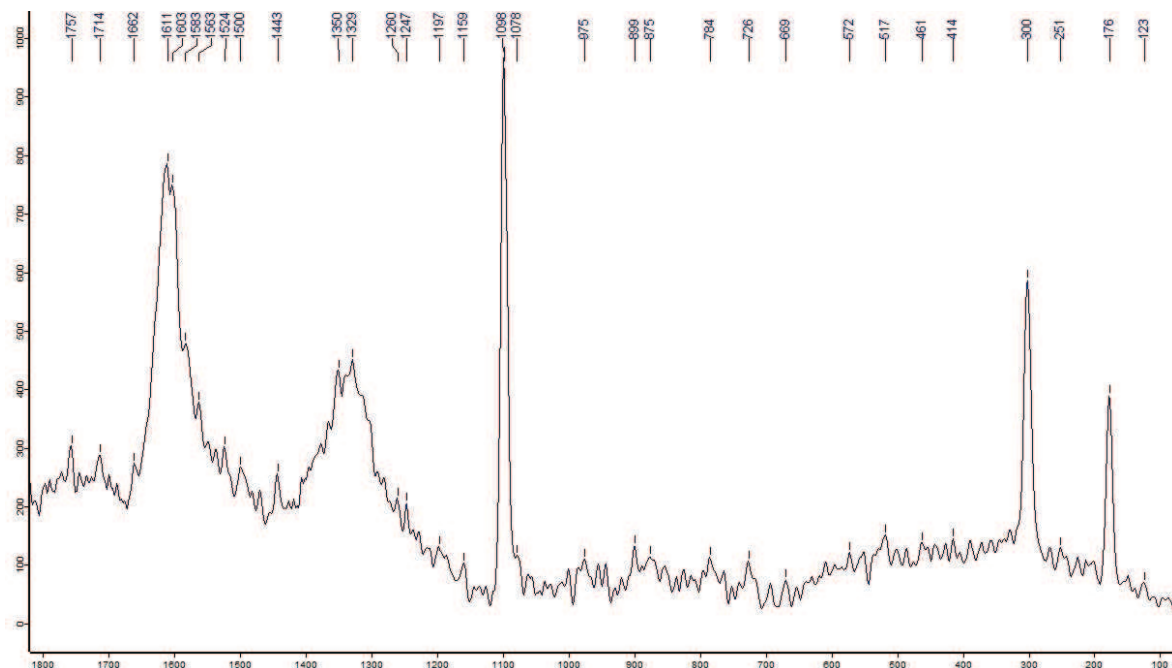
CrystalSleuth: EXTRACT_18-A-B(IT)_dunkel(black)_0_000000_0_NK_G1
File Edit Mode Help



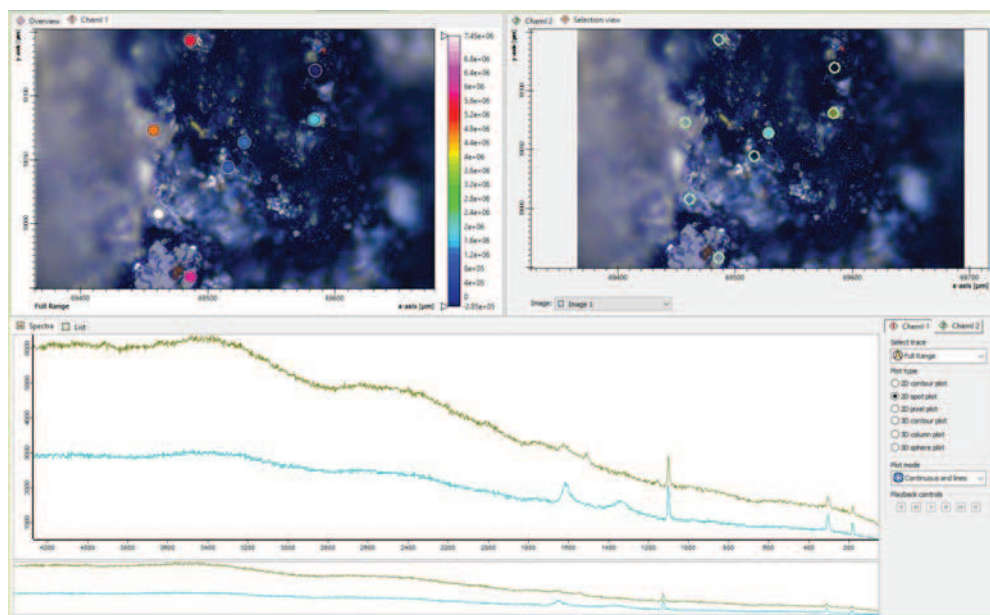
% Match	Spectrum Name	RRUFF ID
58	<v> Sahamalite-(Ce) (532nm)	R080043
57	<v> Dolomite (532nm)	R040030
57	Dolomite (532nm)	R050357
56	Dolomite (532nm)	R050241
53	Dolomite (532nm)	R050370
48	Nesquehonite (532nm)	R050539
48	Dolomite (532nm)	R050272
45	Rosasite (532nm)	R050294
44	Lokkaiite-(Y) (532nm)	R061092
44	Kimuraitite-(Y) (736nm)	R050586
44	Smithsonite (532nm)	R040035
44	Smithsonite (532nm)	R040051
43	Dolomite (532nm)	R050129

R080043
Sahamalite-(Ce)
Ce₂Mg(CO₃)₂
Mountain Pass Mine (Sulfide Queen mine; Bastnaesite deposit; Mo)

R040030
Dolomite
CaMg(CO₃)₂
Austria



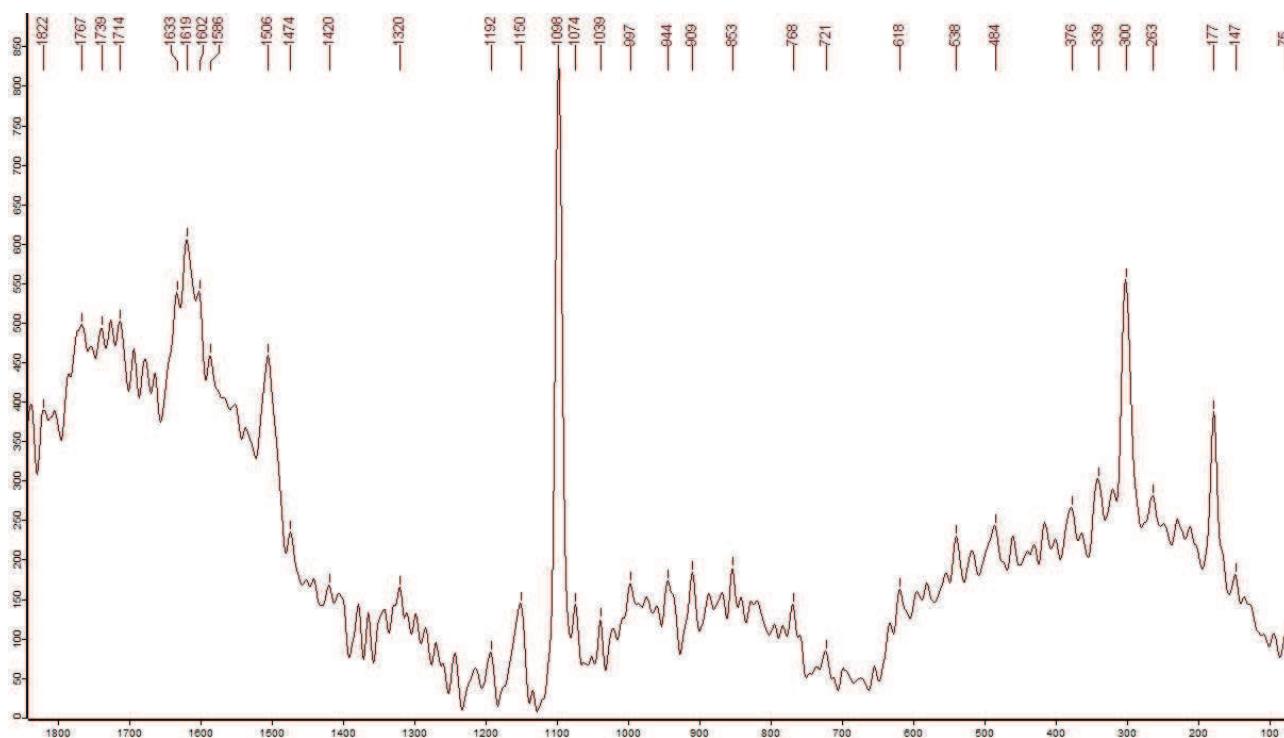
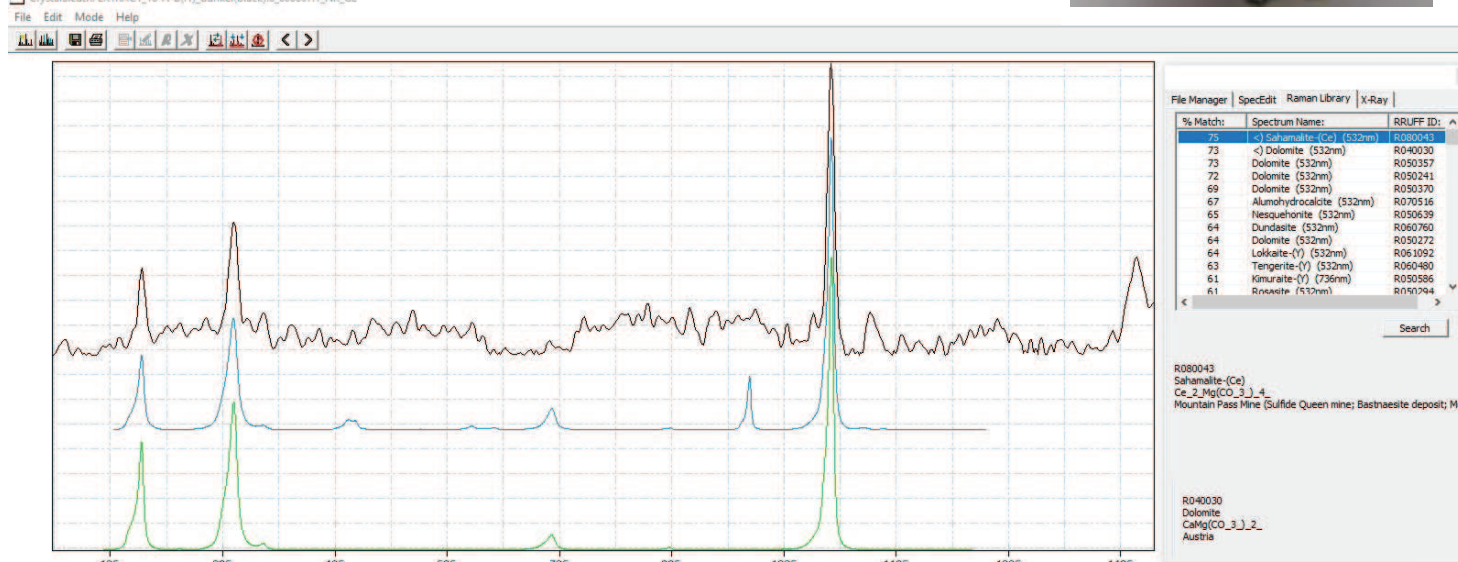
Sample Site 18: Stone 1_spectra 2 (dark mineral) indicates: Dolomite, Sahamalite-(Ce) (→ RRUFF_CS)



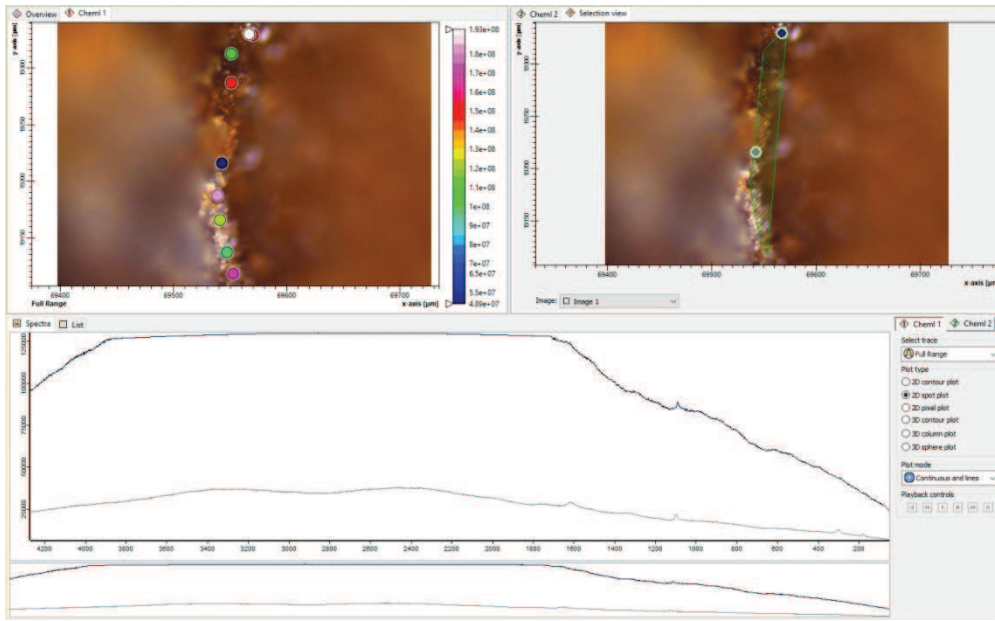
Sample :



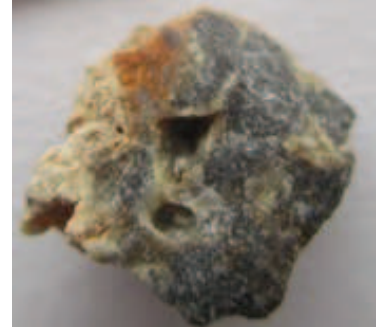
CrystalSleuth: EXTRACT_18-A-B(T)_dunkel(black)_0_000007_1_NK_G2



Sample Site 18: Stone 1_spectra 3 (red mineral) indicates: Dolomite, Sahamalite (→ see RRUFF_CS)

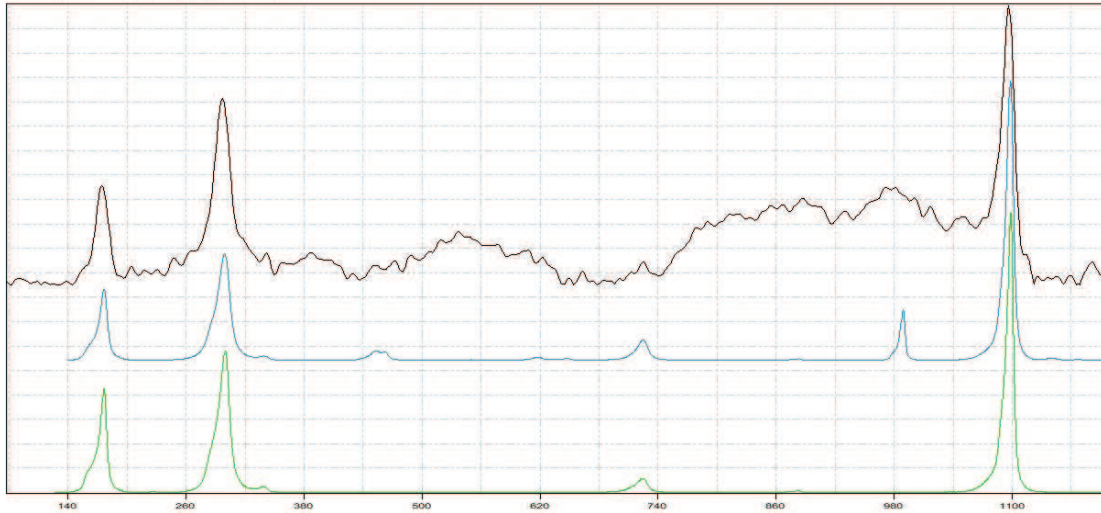


Sample :



CrystalSleuth: EXTRACT_18-A-8(T)_red.0_000000.0_NK_G2

File Edit Mode Help

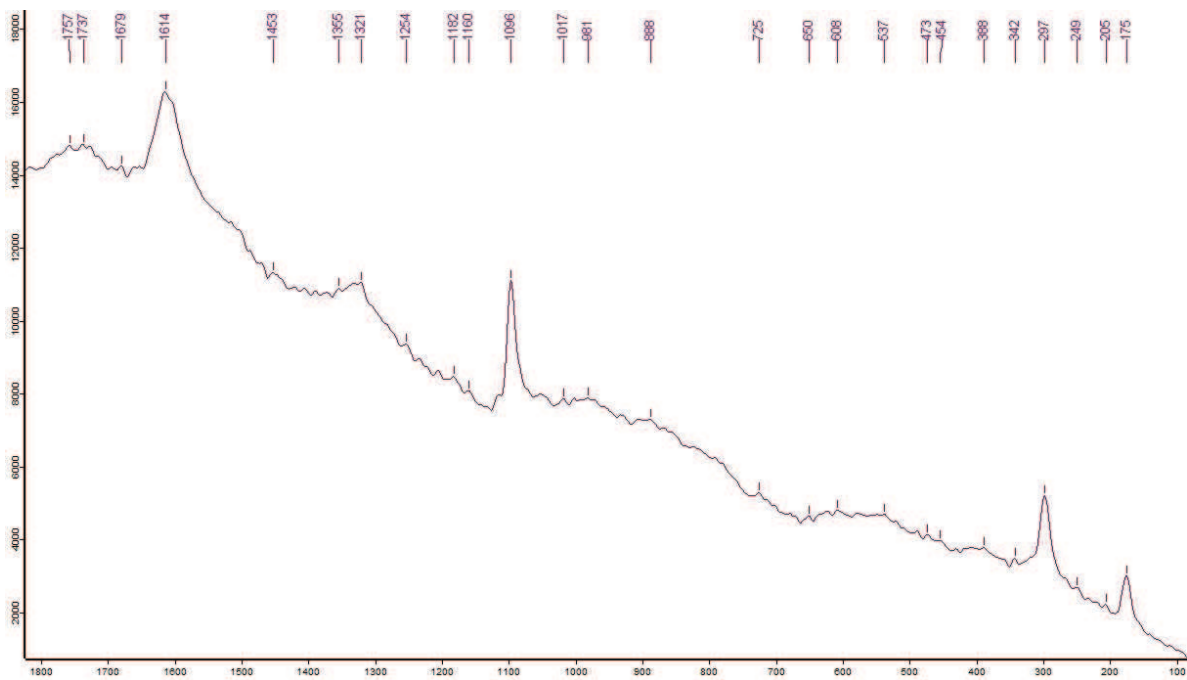


File Manager | SpecEdit | Raman Library | X-Ray

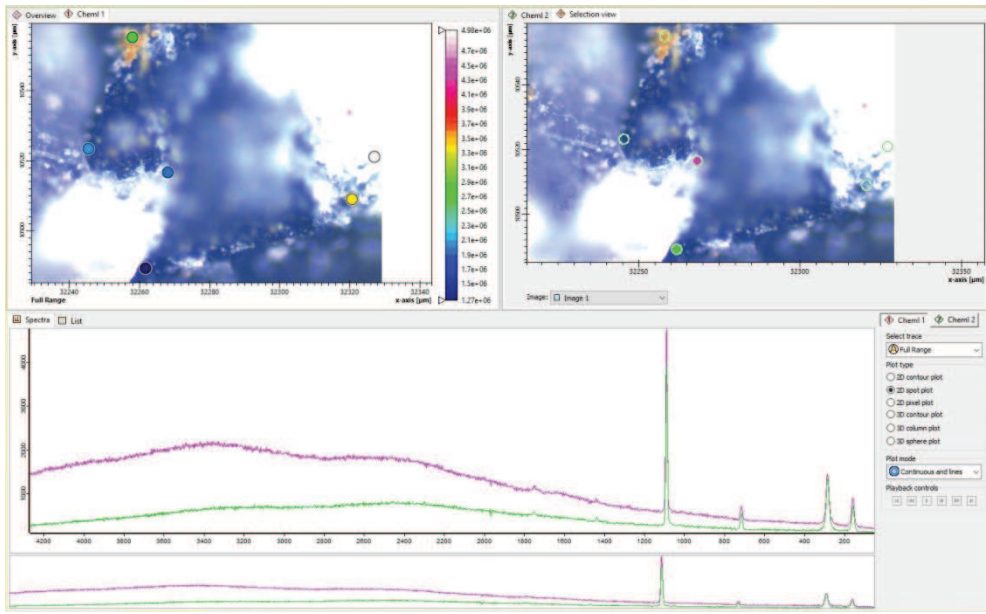
% Match	Spectrum Name	RRUFF ID
66	<-> Sahamalite-(Ce) (532nm)	R080043
66	Zhuocite (532nm)	R070483
65	Faizite (532nm)	R070221
65	<-> Dolomite (532nm)	R040030
65	Rinkite (532nm)	R050229
65	Gratonite (532nm)	R060956
65	Derbyite (532nm)	R070382
65	Isolite (532nm)	R070495
65	Sonolite (532nm)	R070752
65	Yulsporite (532nm)	R060818
65	Imiterite (532nm)	R080014
65	Tengerite-(T) (532nm)	R060480
64	Stilleite-(Ca) (532nm)	R060911

R080043
Sahamalite-(Ce)
Ce₂Mg(CO₃)₄
Mountain Pass Mine (Sulfide Queen mine; Bastnaesite deposit; Mo

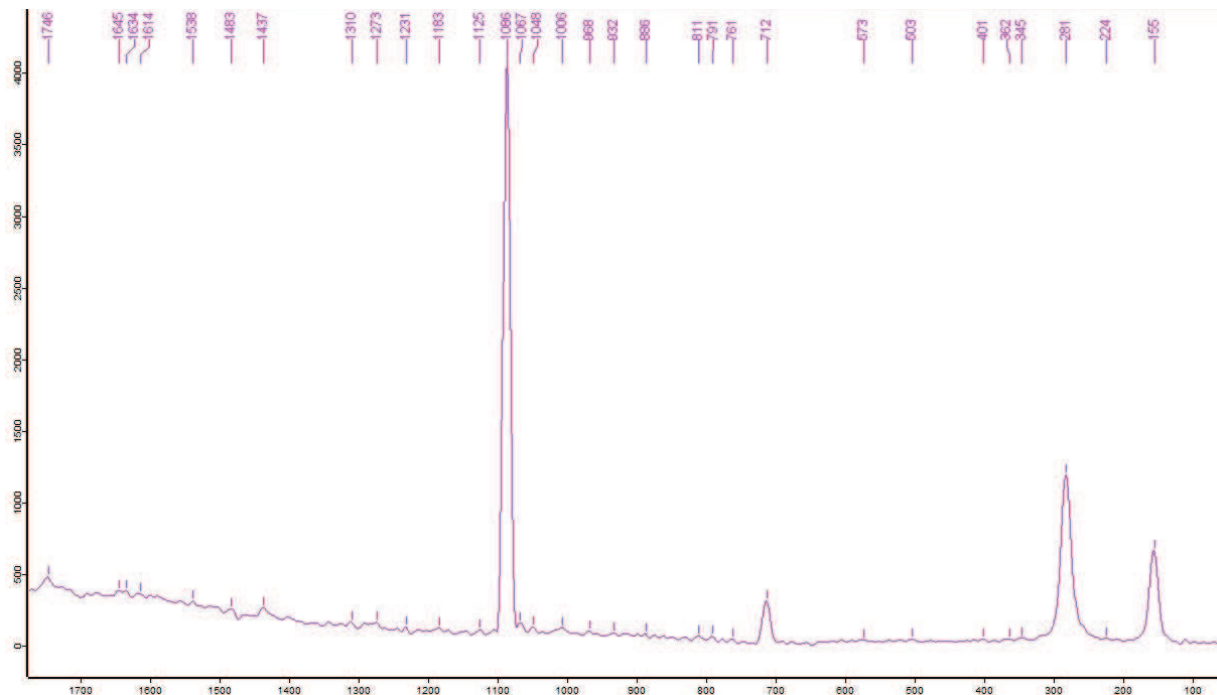
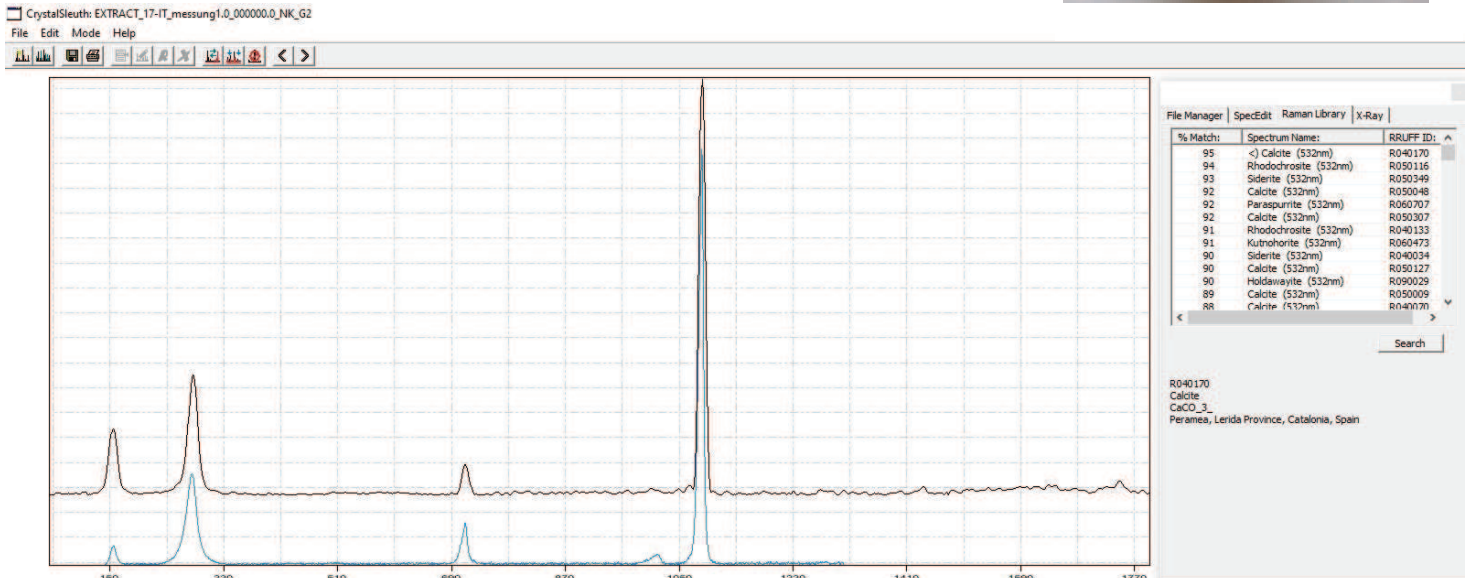
R040030
Dolomite
CaMg(CO₃)₂
Austria



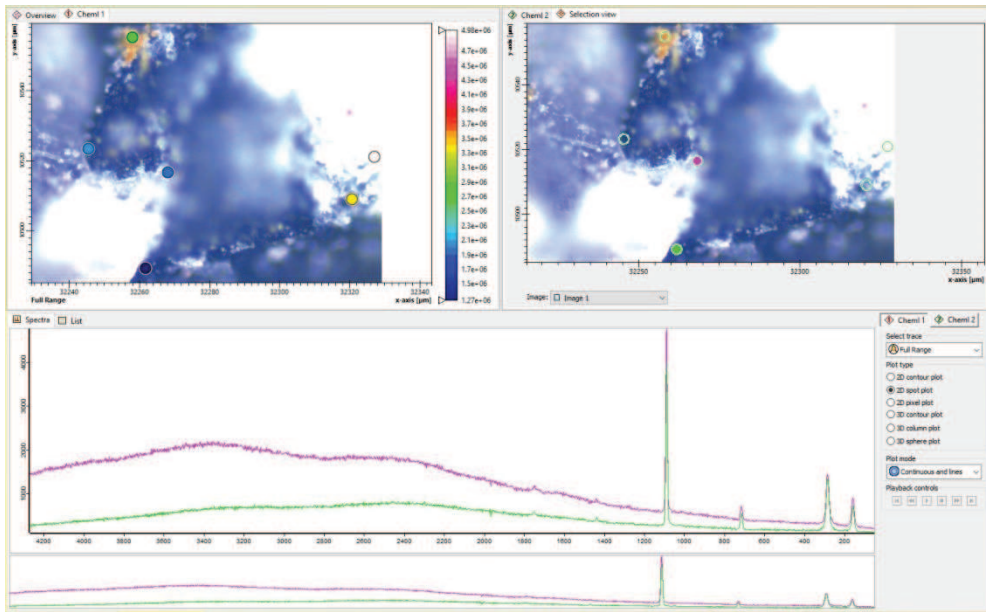
Sample Site 17: Stone 1_spectra 1 indicates: **Calcite** (→ see RRUFF_CS)



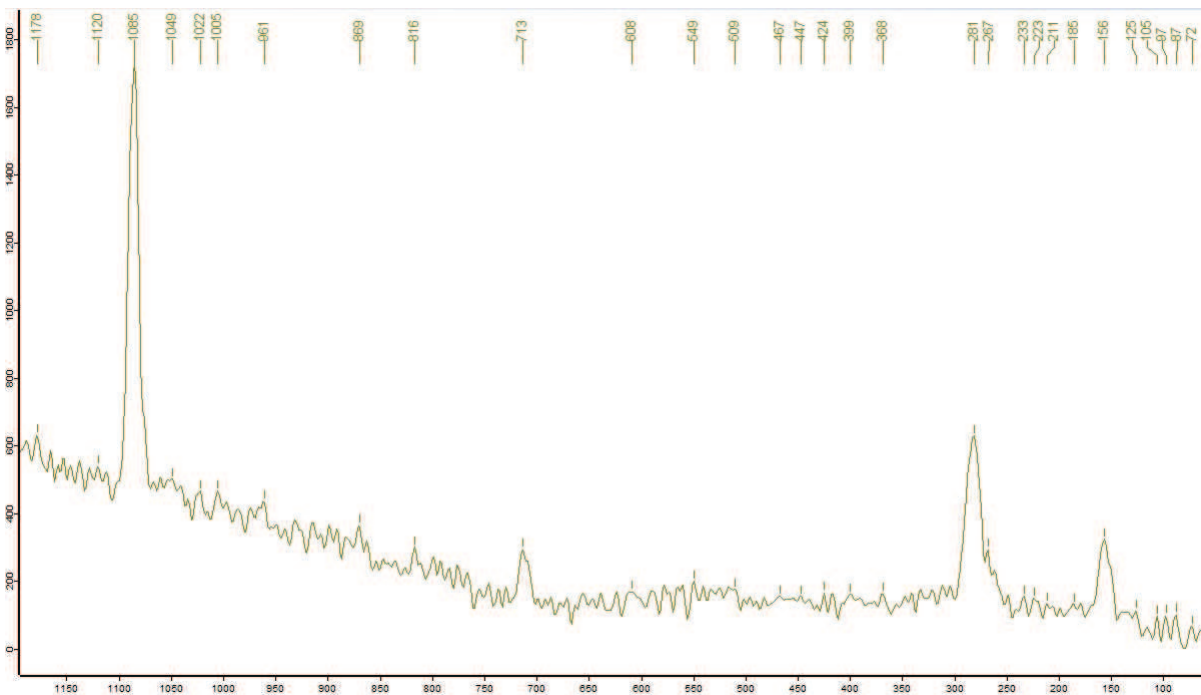
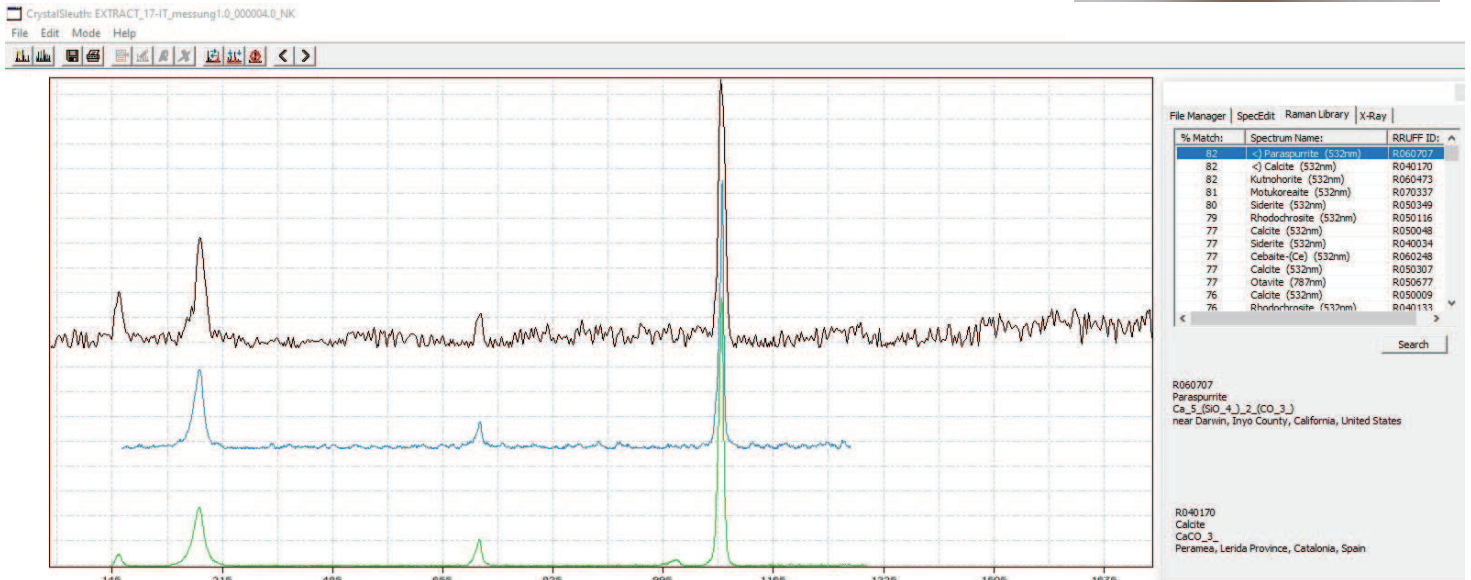
Sample:



Sample Site **17** : Stone 1_spectra 2 indicates : **Calcite , Paraspurrite** (→ see RRUFF_CS)

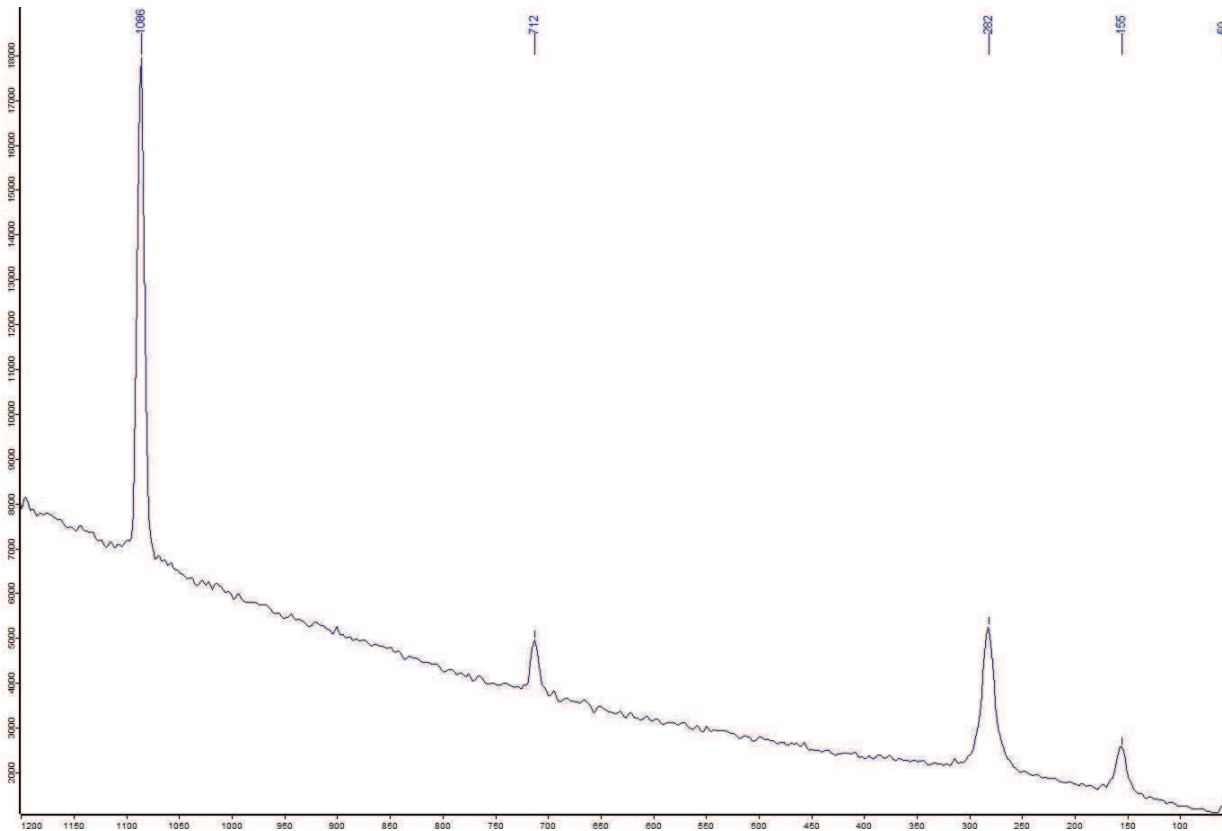
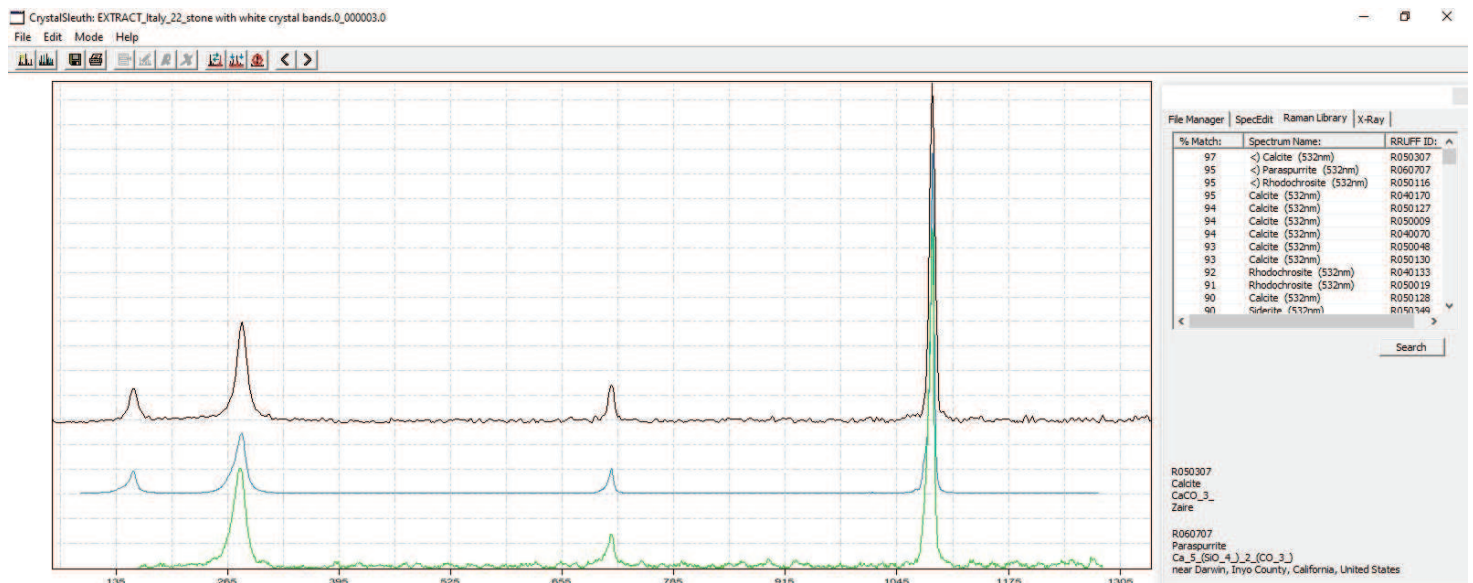


Sample :

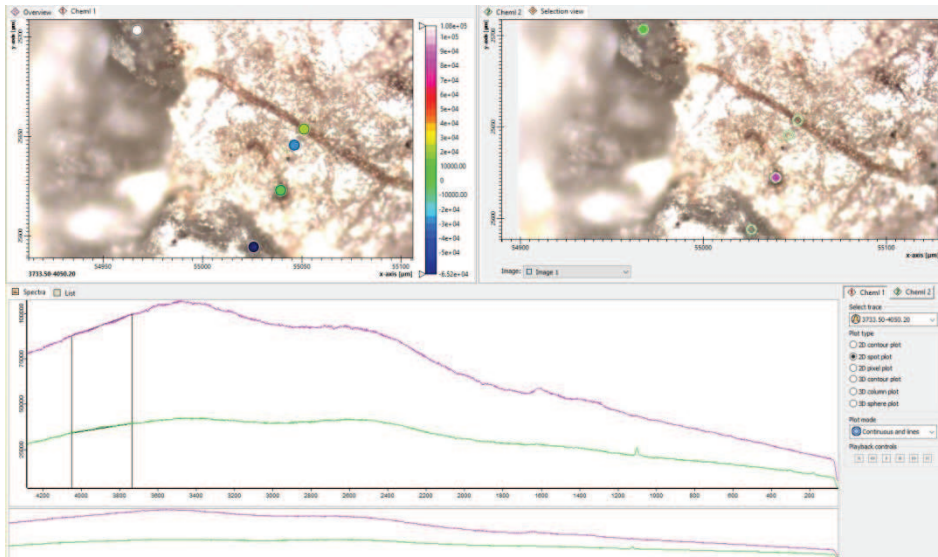


Sample Site **22** : Stone 1_spectra 1 indicates : **Calcite, Paraspurrite** (→ see RRUFF_CS)

Sample :



Sample Site **23-B** : Stone 1_spectra 1 indicates : **Bokite** etc. (→ see RRUFF_CS results)

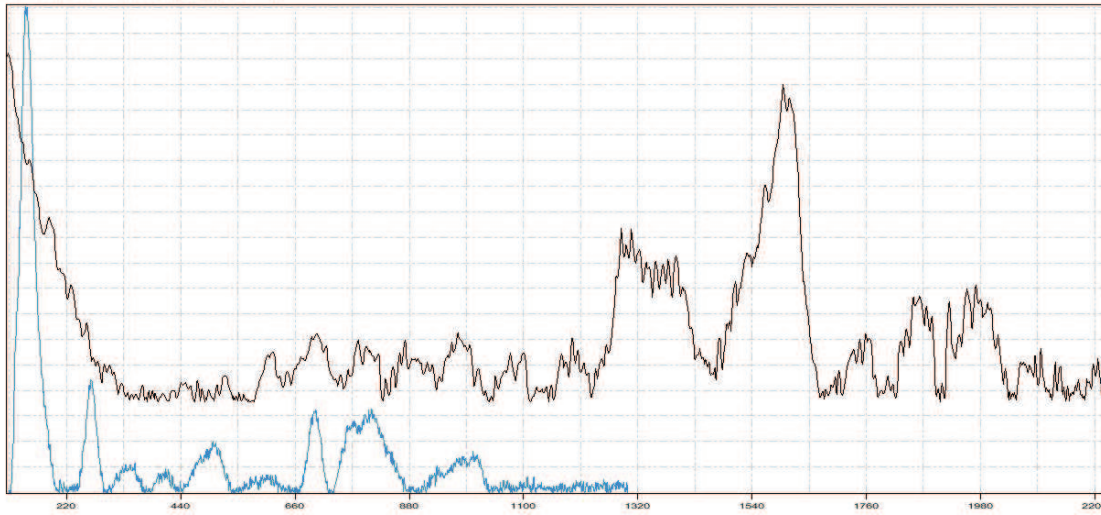


Sample :



CrystalSleuth: EXTRACT_5-B (23-B Italien)_0_000000_0_NK_G1

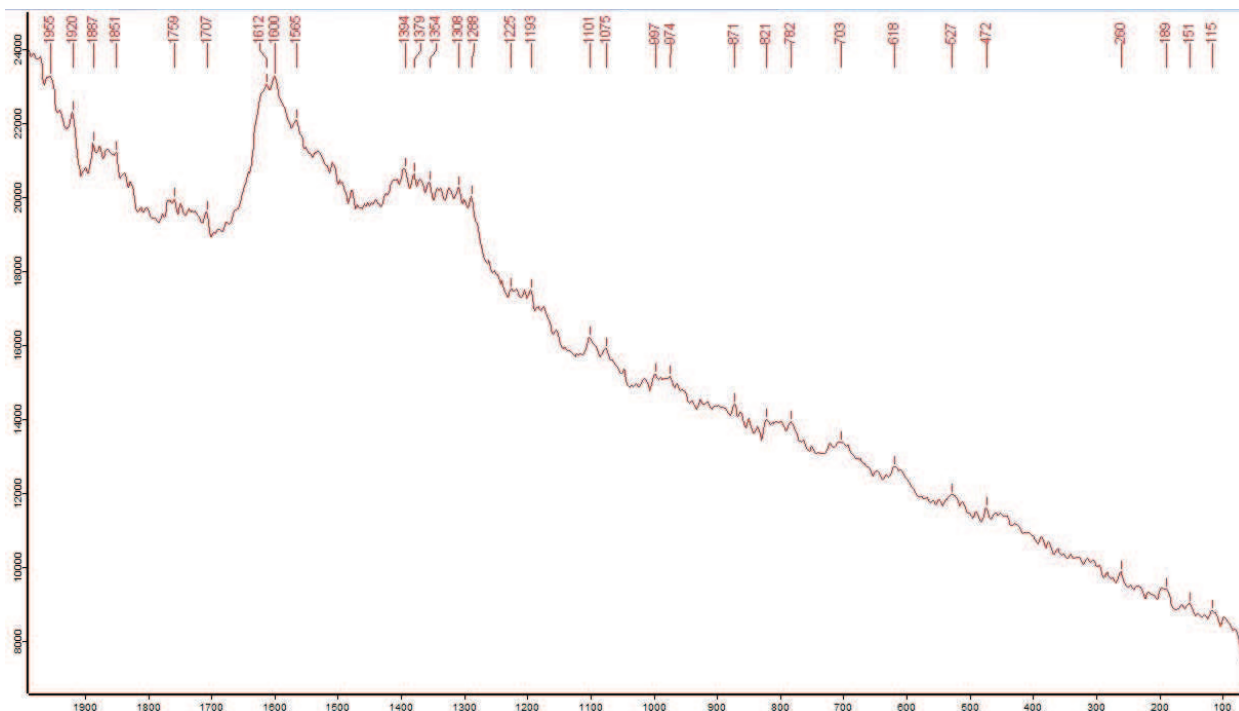
File Edit Mode Help



File Manager | SpecEdit | Raman Library | X-Ray |

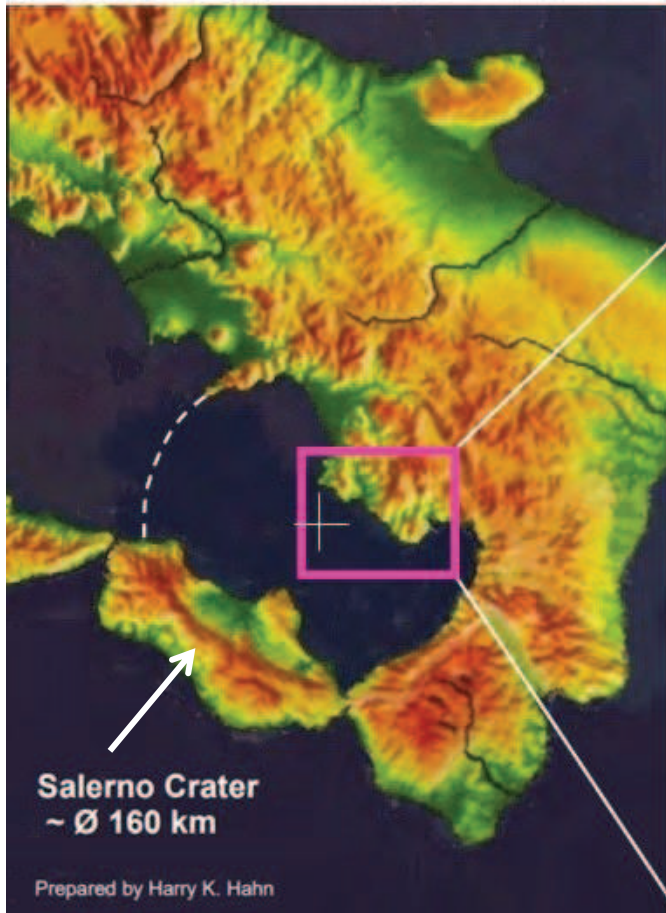
% Match	Spectrum Name	RRUFF ID
78	← Bokite (532nm)	R060590
78	Chalcopyrite (532nm)	R050222
78	Antimony (532nm)	R050554
78	Pyrrhotite (532nm)	R050290
78	Tschermakite (532nm)	R060887
78	Pavonite (532nm)	R070566
78	Aqualite (532nm)	R070413
78	Tauntonite (532nm)	R080089
78	Dravite (532nm)	R050059
78	Stibnite (532nm)	R050066
78	Calomel (532nm)	R070499
78	Mordenite (532nm)	R061118
78	Selenarot (532nm)	R061141

R060590
Bokite
(Al,Fe,K)₃-3(V,V,Fe)₈O₂₀ #183;7.5H₂O
Monument #2 mine, Apache County, Arizona, USA

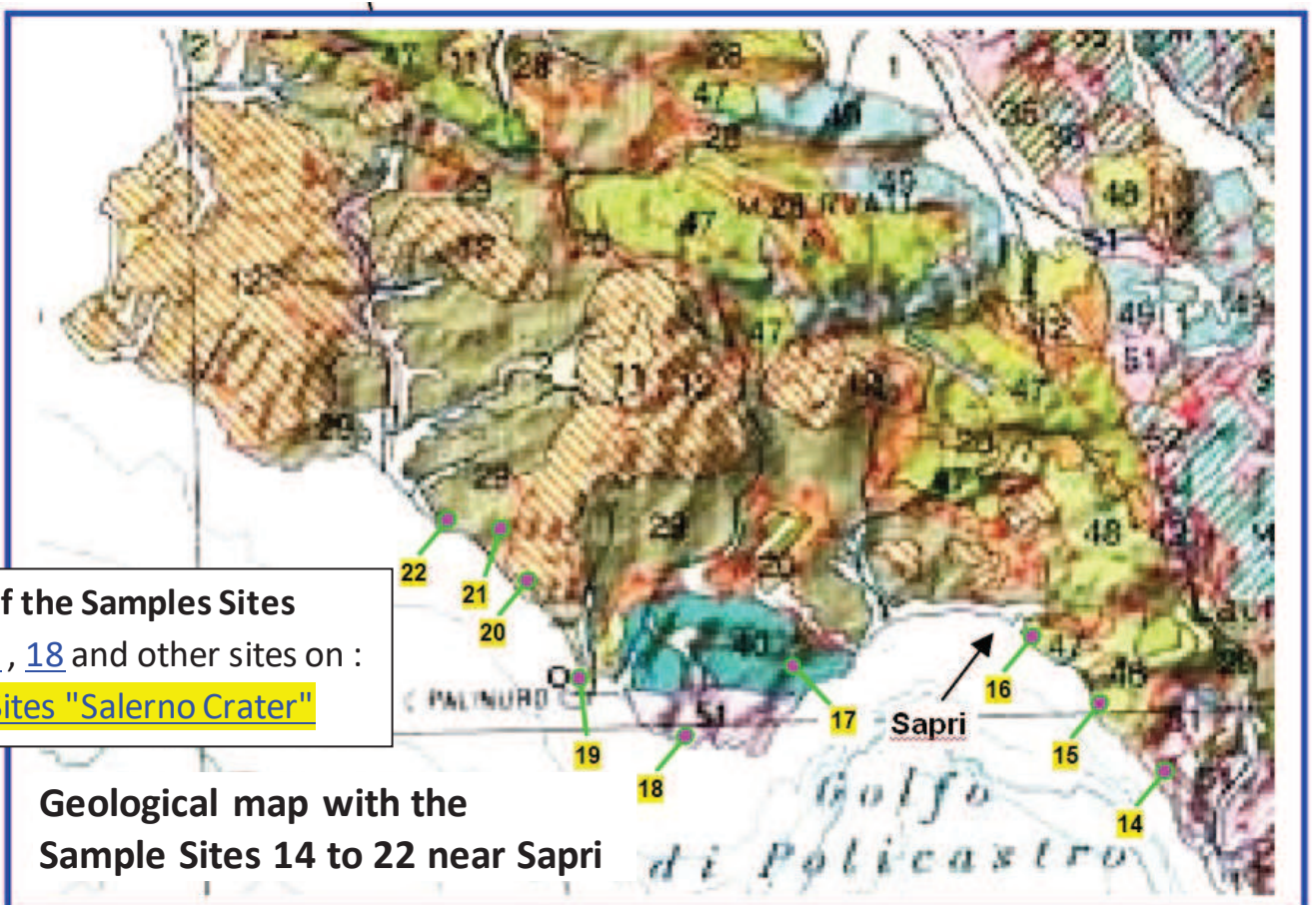
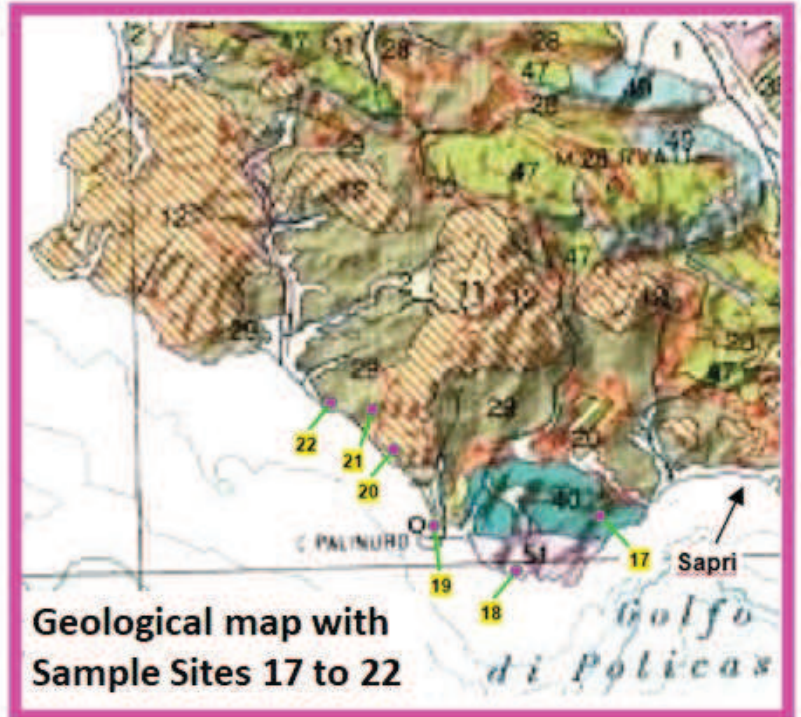


Appendix 1 : Photos of rock samples from sample sites 21-B and 18 to 23 → see next page !

Note : Photos of all Samples Sites [18](#), [19](#), [20](#), [21-B](#), [22](#) & [23-B](#) and other sample sites are available on my website. → see weblink: [Sample Sites "Salerno Crater"](#)

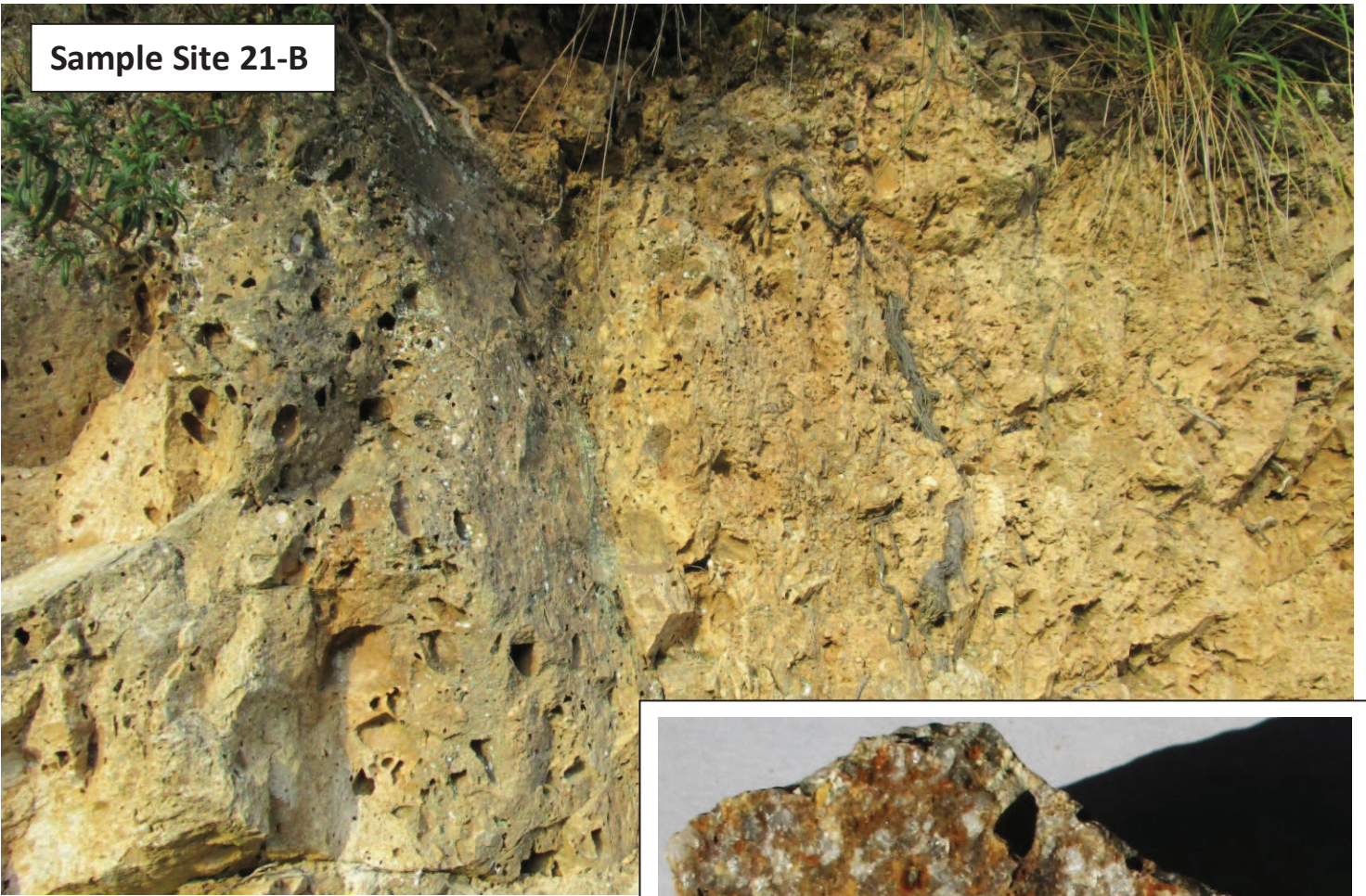


The manipulated topographic map on the left shows the probable position of the crust fragments which form Italy, at the time of the P/T-Impact ≈253 Ma ago



Photos of the Samples Sites [21-B](#), [20](#), [18](#) and other sites on : [Sample Sites "Salerno Crater"](#)

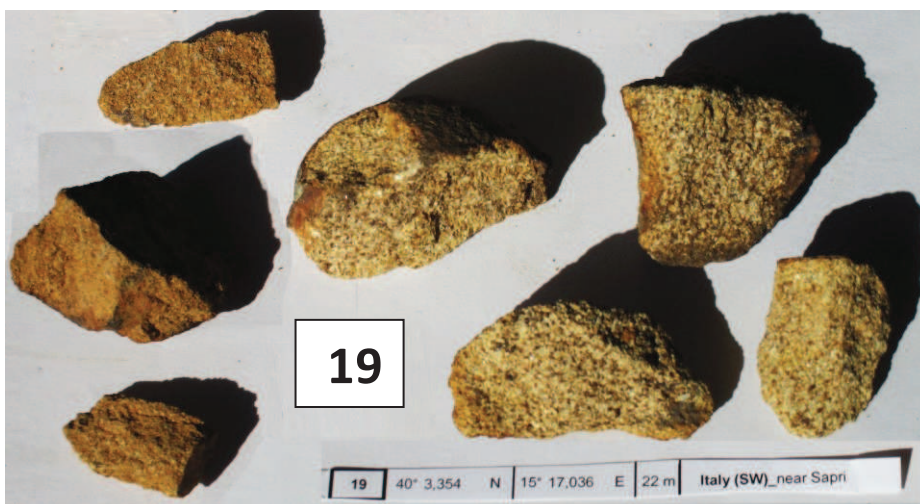
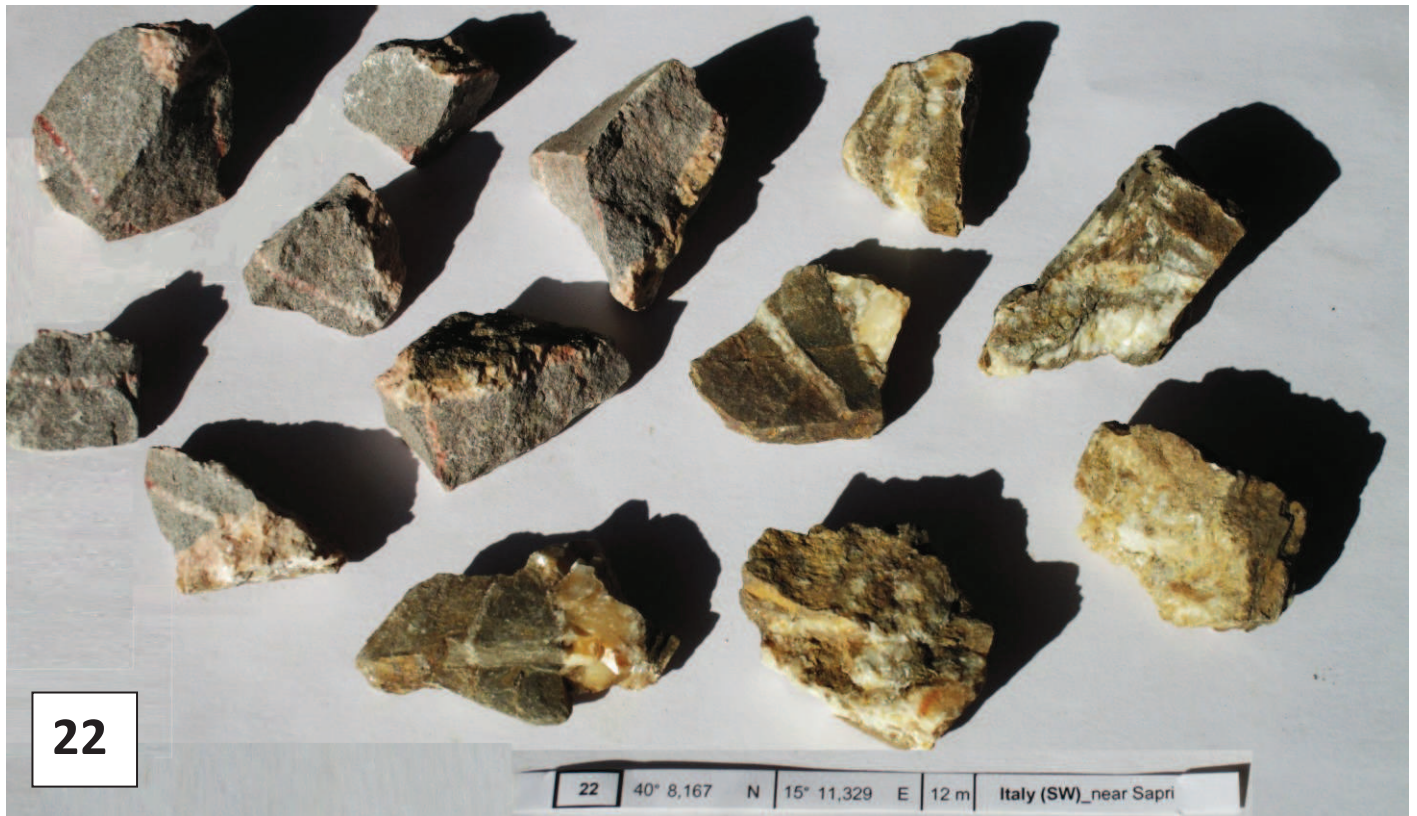
Sample Site 21-B



Note : All sample sites are relatively easy accessible over normal country roads.

21





Note : All sample sites are relatively easy accessible over normal country roads.

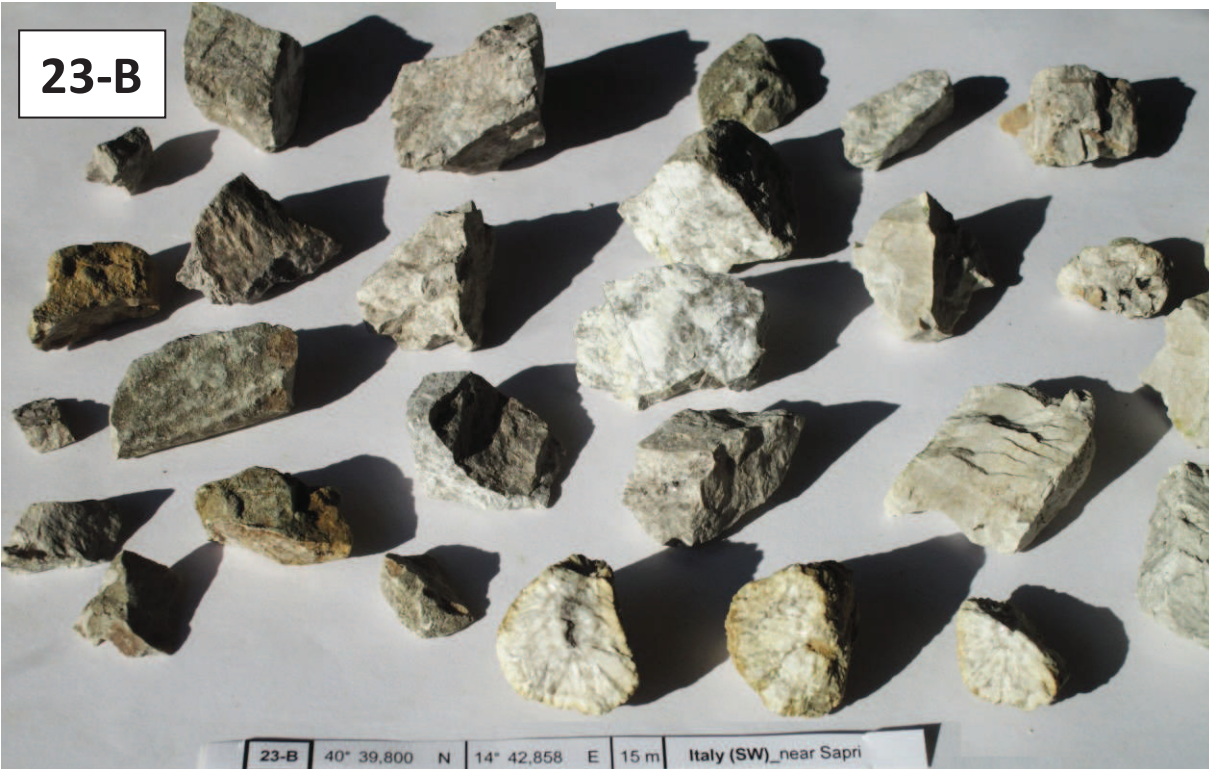
18-A



Sample site 18



23-B



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

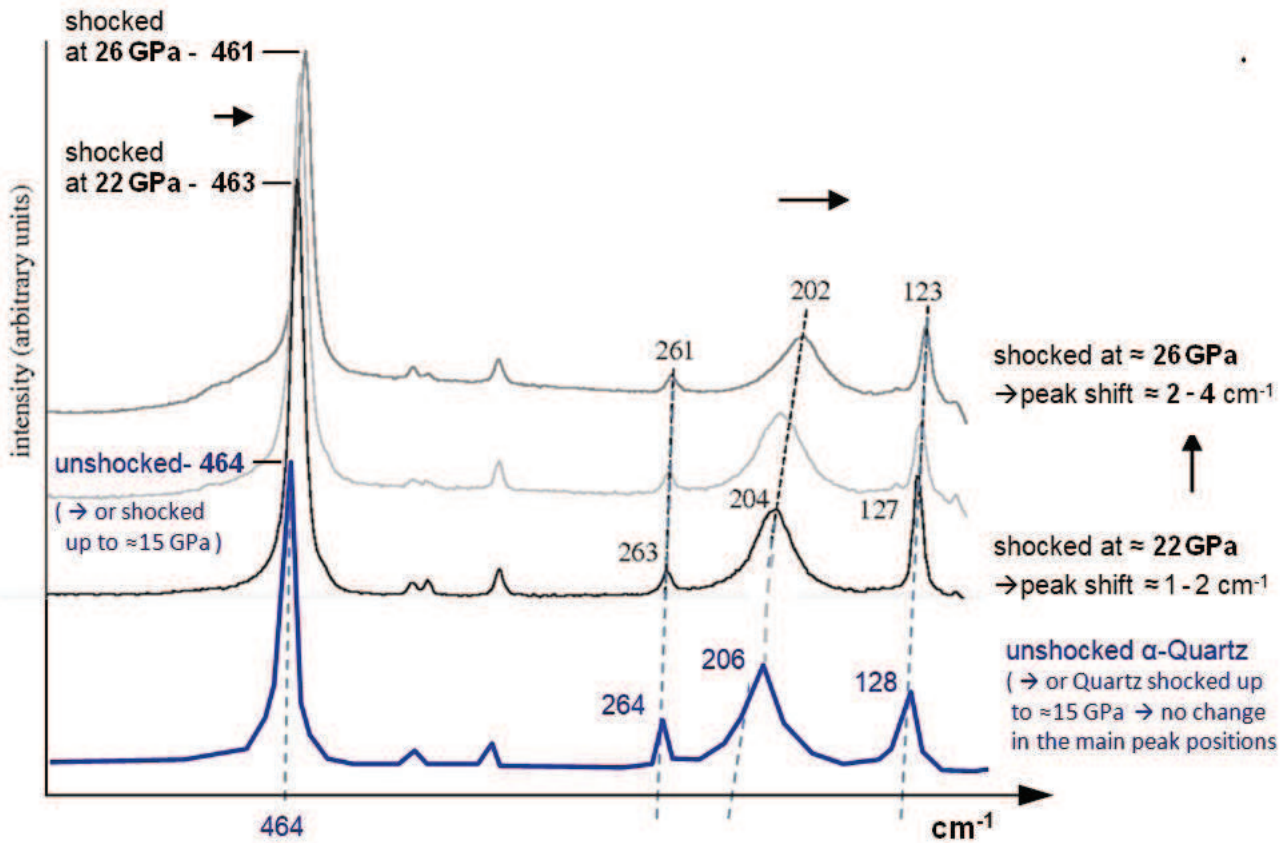
In order to verify a sample site as an impact site or impact structure, [shock-metamorphic effects](#) must be discovered in the rocks of the sample site. This can be done by different methods.

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.

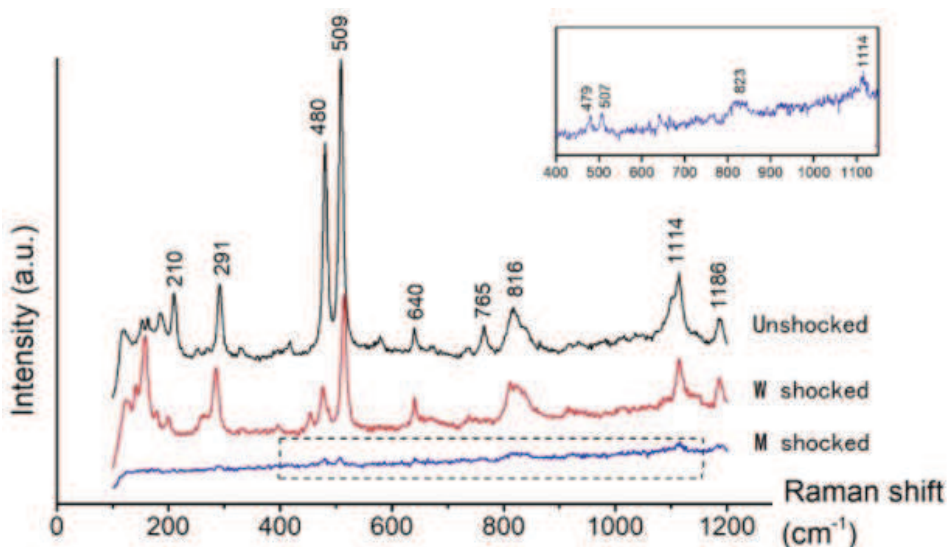
Mc Millan et al. (1992) and others have shown that the main RAMAN-peaks of Quartz shift towards lower frequencies if the Quartz was exposed to a shock-pressure > 15 GPa. → see diagram below

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

References :

Photos of all Sample Sites & Rock Samples are available on : [Sample Sites "Salerno Crater"](#) (or : [Samples "Salerno Crater"](#))

Raman spectra of quartz samples from the "Bay-of-Lyon Crater" : [Evidence for the Bay-of-Lyon Impact Crater](#) (or : [Link2](#))

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 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

Shock-metamorphic effects in rocks and minerals - <https://www.lpi.usra.edu/publications/books/CB-954/chapter4.pdf>

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

Stöffler - 2018 - Meteoritics & Planetary Science – Wiley: <https://onlinelibrary.wiley.com/doi/epdf/10.1111/maps.12912>

A Raman spectroscopic study of shocked single crystalline quartz - by P. McMillan, G. Wolf, Phillipe Lambert, 1992

<https://asu.pure.elsevier.com/en/publications/a-raman-spectroscopic-study-of-shocked-single-crystalline-quartz>

alternative : <https://www.semanticscholar.org/paper/A-Raman-spectroscopic-study-of-shocked-single-McMillan-Wolf/cfaaf6eb3e46fbd2912fb91c7acf40e88e721132>

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

alternative : <https://www.sciencedirect.com/science/article/pii/S1631071302017005>

Shock-induced irreversible transition from α -quartz to CaCl₂-like silica - Journal of Applied Physics: Vol 96, No 8

<https://aip.scitation.org/doi/10.1063/1.1783609>

Shock experiments on quartz targets pre-cooled to 77 K - J. Fritz, K. Wünnemann, 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_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_Shock-](https://www.researchgate.net/publication/339672303_A_Study_of_Shock-Metamorphic_Features_of_Feldspars_from_the_Xiuyan_Impact_Crater)

[Metamorphic_Features_of_Feldspars_from_the_Xiuyan_Impact_Crater](https://www.researchgate.net/publication/339672303_A_Study_of_Shock-Metamorphic_Features_of_Feldspars_from_the_Xiuyan_Impact_Crater)

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

<https://onlinelibrary.wiley.com/doi/pdf/10.1111/maps.12495>

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

https://www.researchgate.net/publication/348675414_ExoMars_Raman_Laser_Spectrometer_RLS_a_tool_for_the_potential_recognition_of_wet_target_craters_on_Mars