

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 threshold 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)

In order to really verify the sample sites **20** and **21** as sites which were effected by an impact event and which are part of the described “Salerno Crater” clear shock-metamorphic effects must be discovered in the rocks of these sample sites. This can be done with the help of PDFs (planar deformation features). However this requires careful preparation of the samples and experience in PDF-analysis.

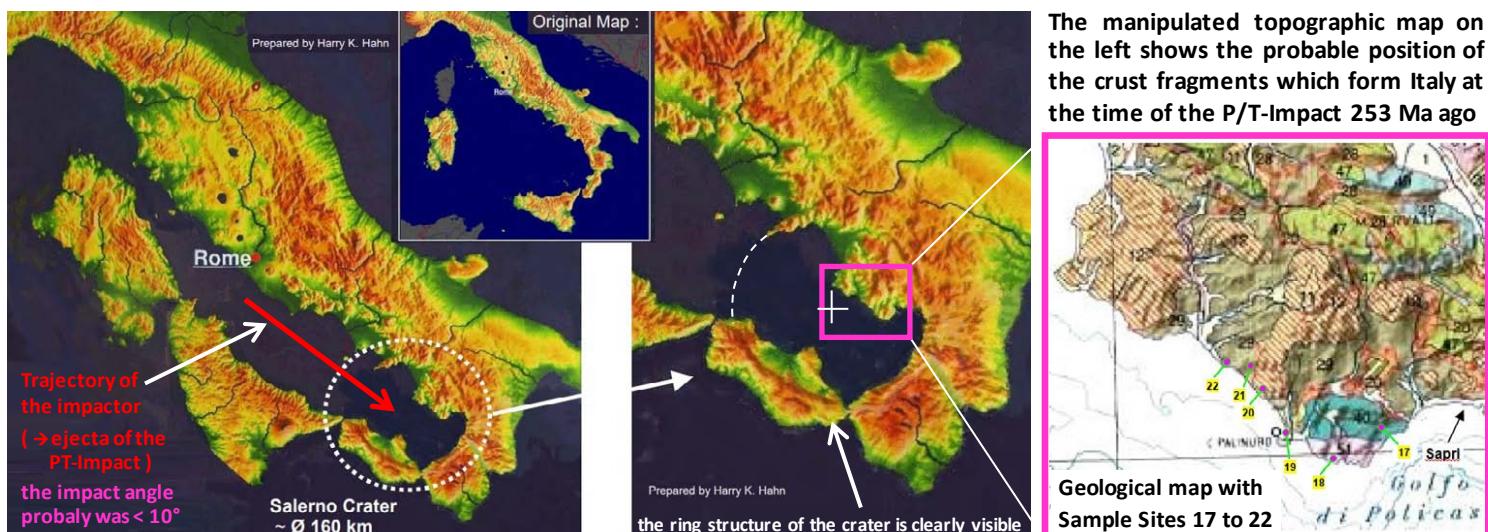
Therefore I want to ask scientists who read my studies to organize a professional analysis of samples from the center-area of the “Salerno Crater” in order to proof it as a secondary crater of the Permian Triassic Impact Event as described in my hypothesis.

A shock pressure of 20 GPa far exceeds every pressure caused by normal terrestrial metamorphism. The indicated shock pressure of ≈20 GPa is lower than the shock pressure that occurred in other large impact craters on Earth. This indicates that the “Salerno Crater” was caused by an oblique impact, and that the impactor which formed the crater (→ ejecta of the PT-Crater) impacted with low velocity <8 km/s

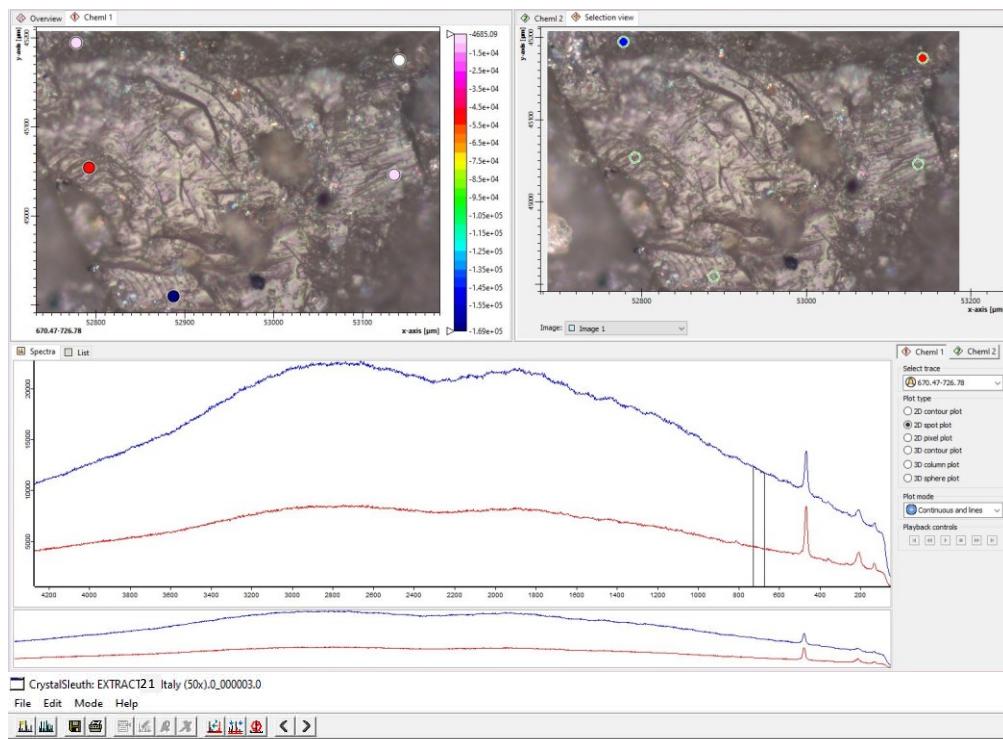
→ Images of the analysed rock samples and photos of the sample sites are in the Appendix at [page 24](#).

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

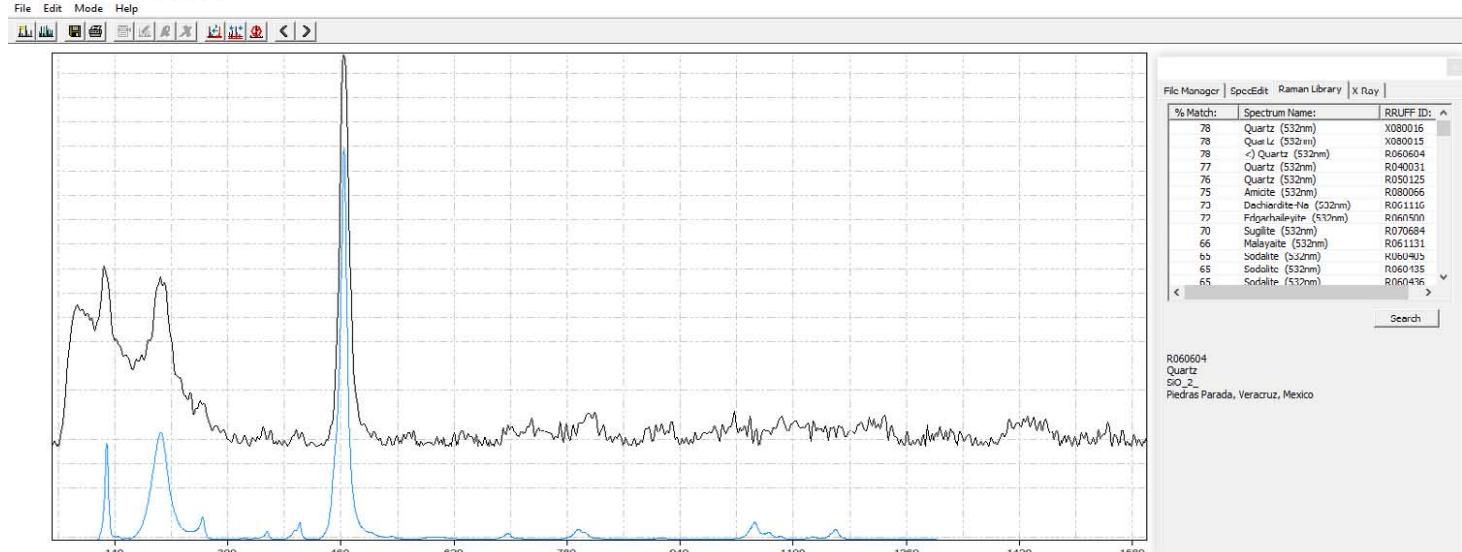
→ More images of all sample sites are available on www.permiantriassic.de or www.permiantriassic.at



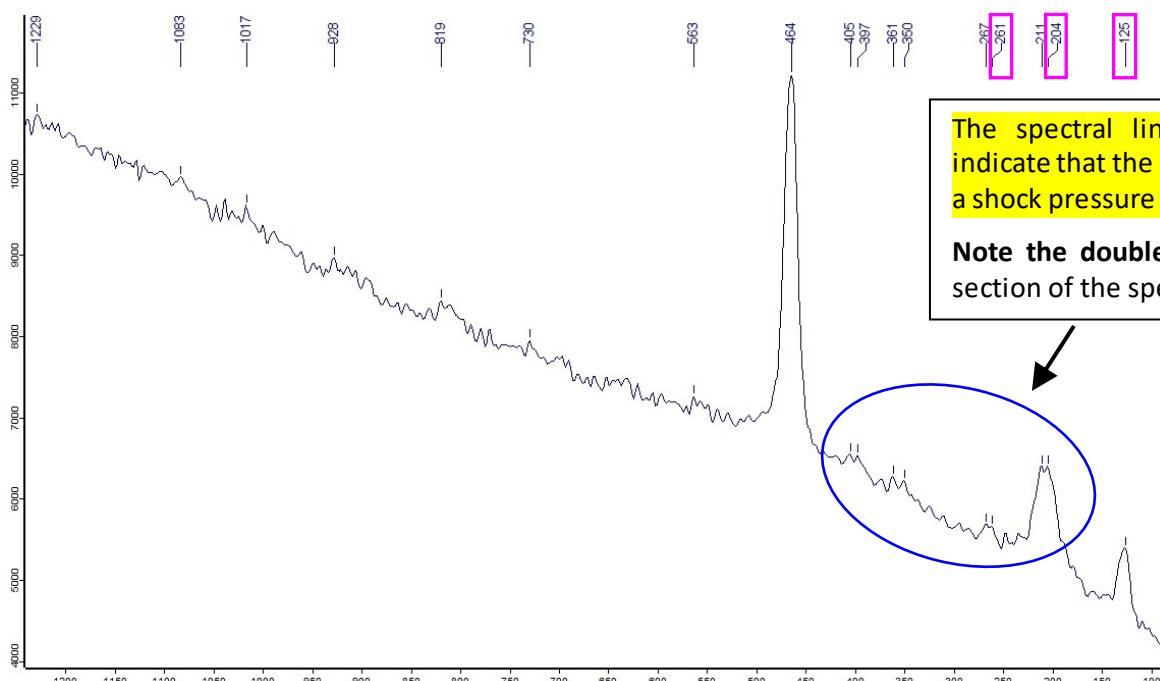
Sample Site 21 : Stone 1_spectra 1 indicates : Quartz (→ see RRUFF_CS results)



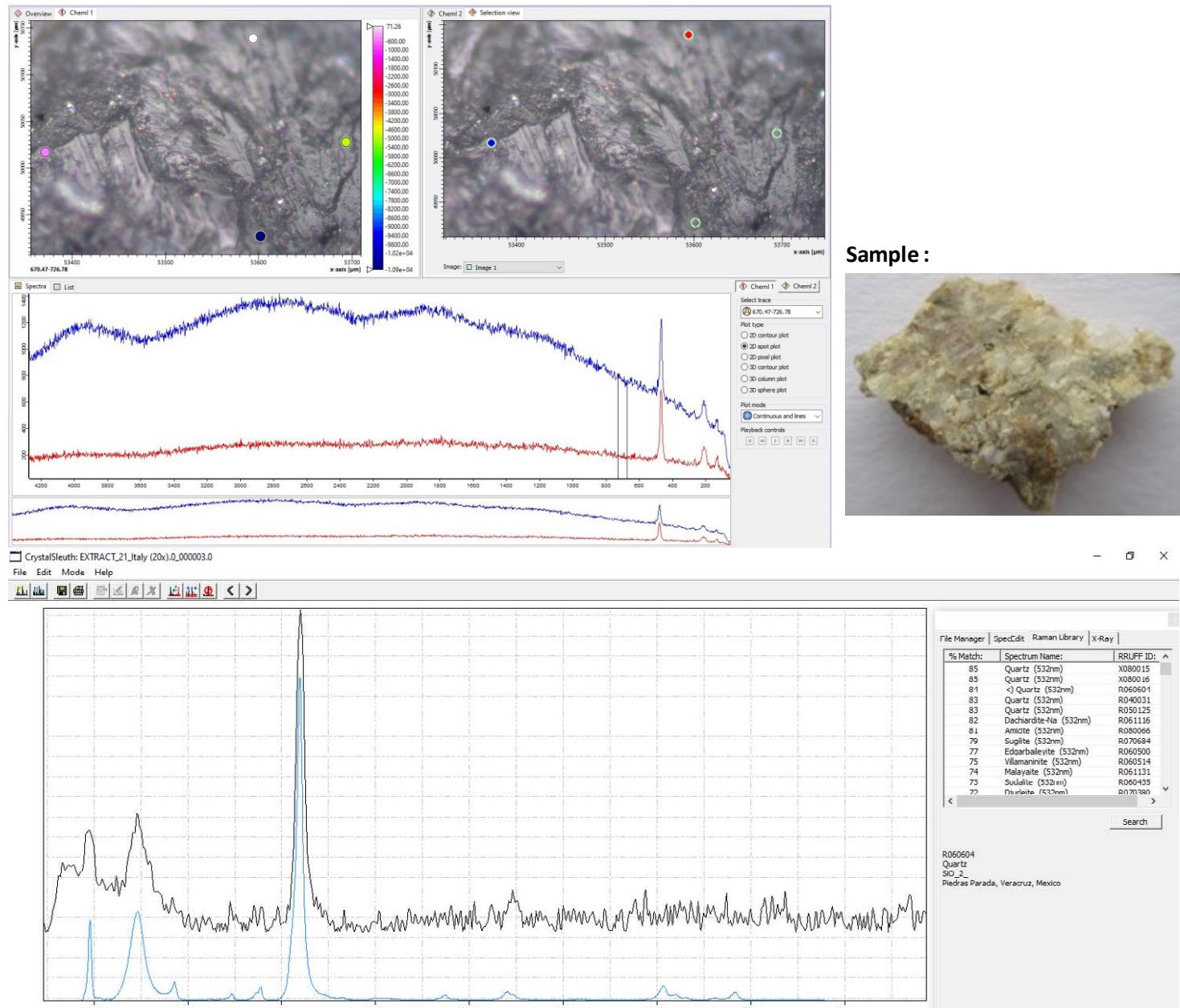
Sample :



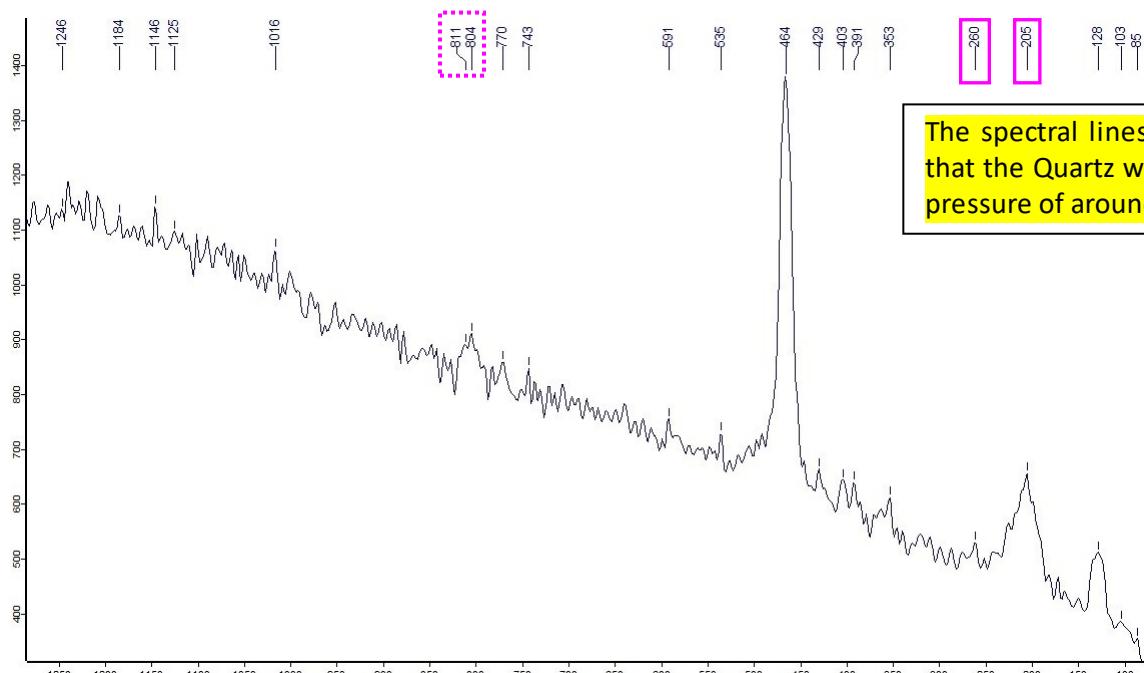
Indication for a shock event are the shifts of the marked Quartz spectral lines towards 261, 204 and 125



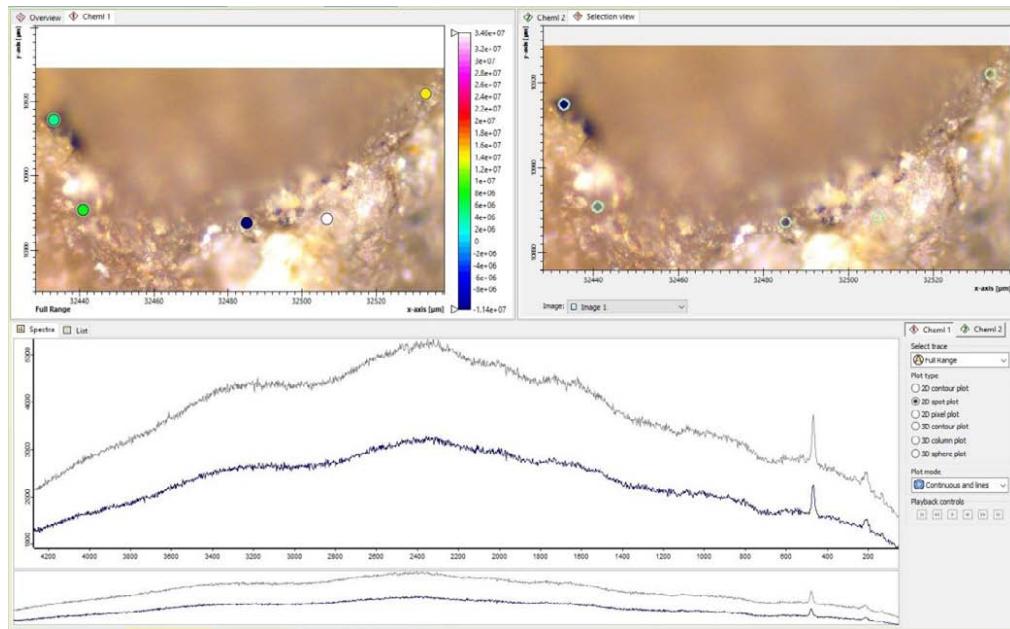
Sample-Site 21 : Stone 2_spectra 1 indicates: Quartz (\rightarrow see RRUFF_CS results)



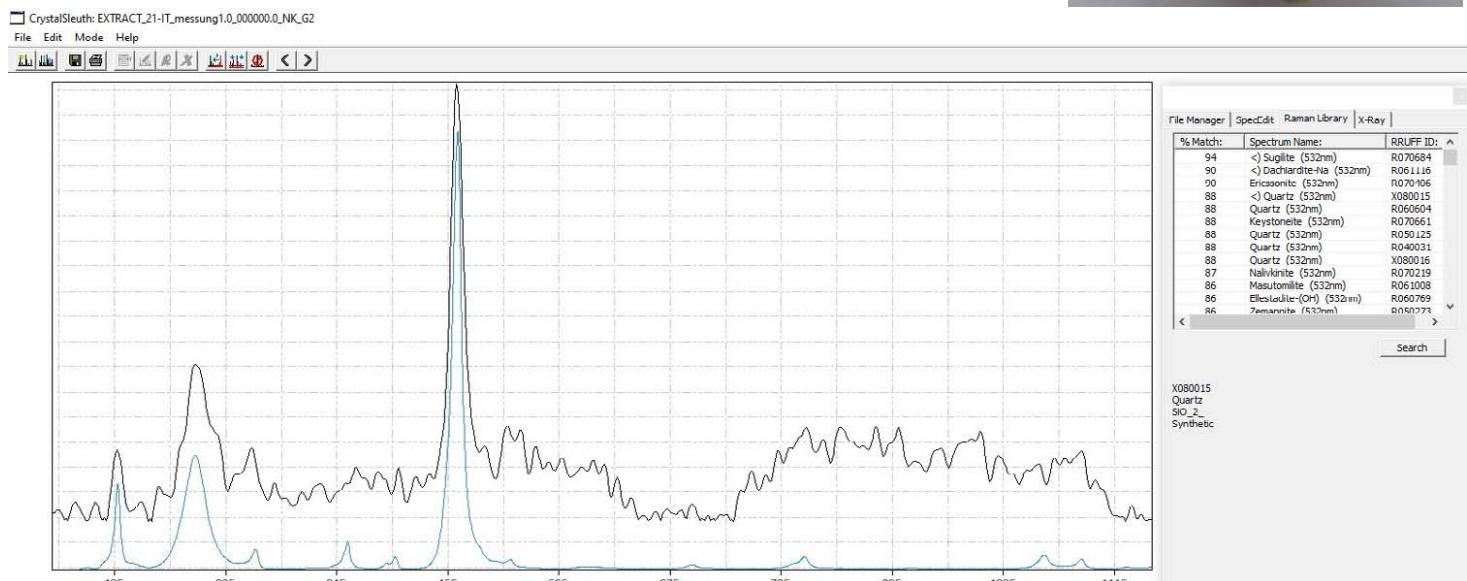
Indication for a shock event are the shifts of the marked Quartz spectral lines towards 260 and 205



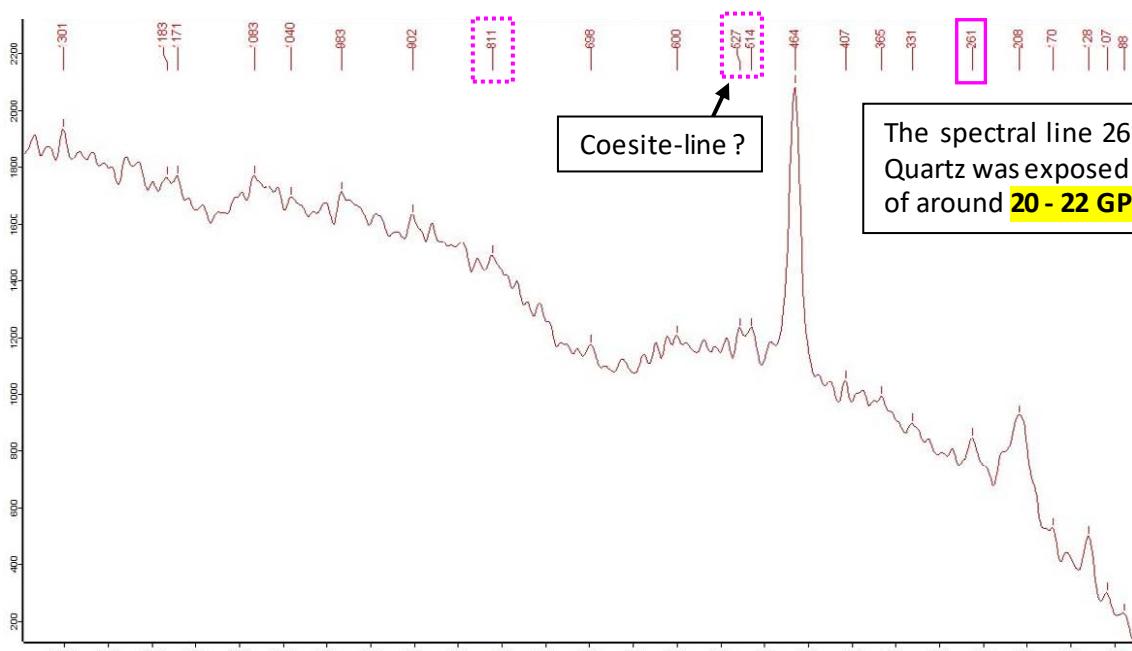
Sample Site 21 : Stone 2_spectra 2 indicates : Quartz (→ see RRUFF_CS results)



Sample :

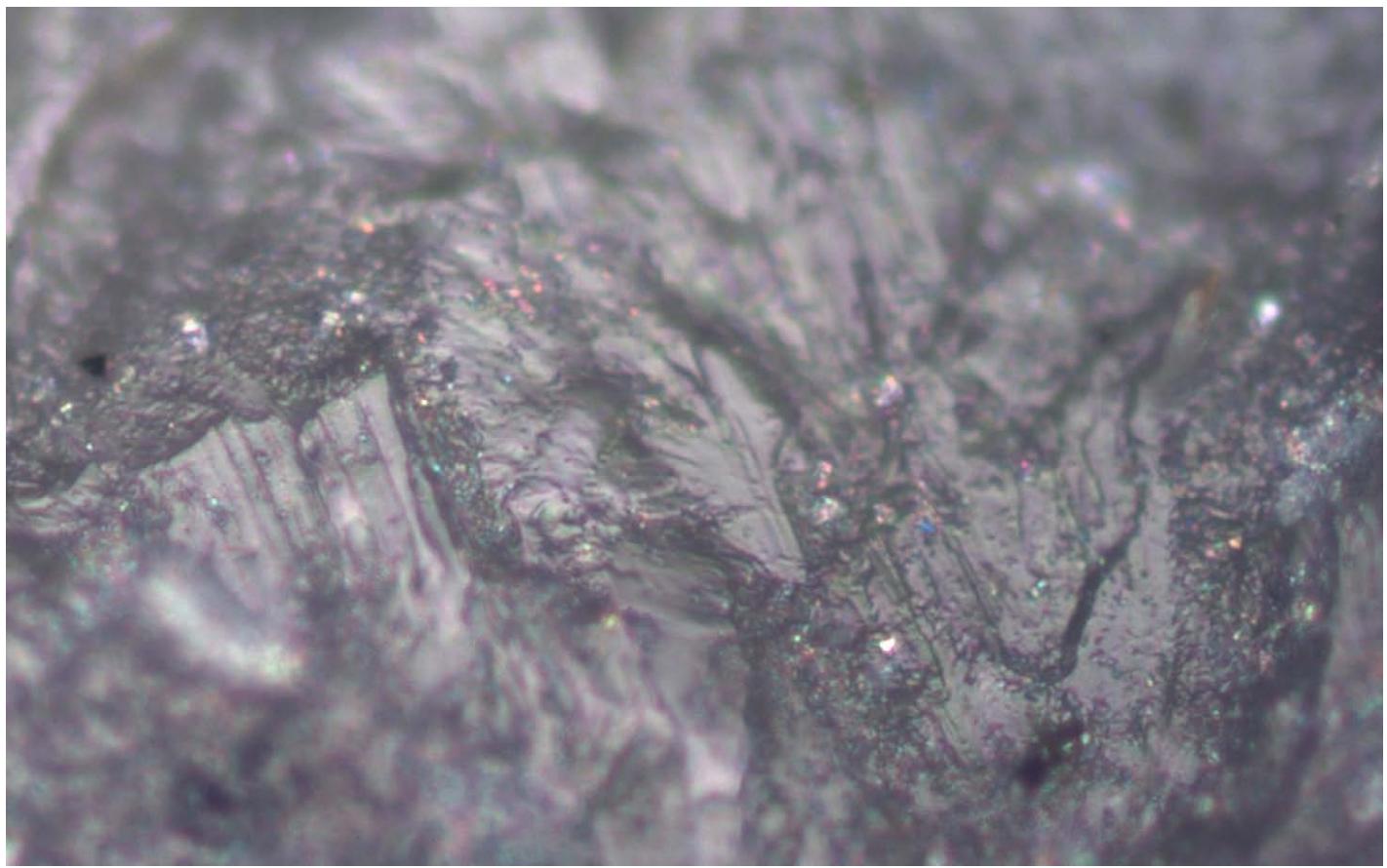


Indication for a shock event is the shift of the marked Quartz spectral line towards 261

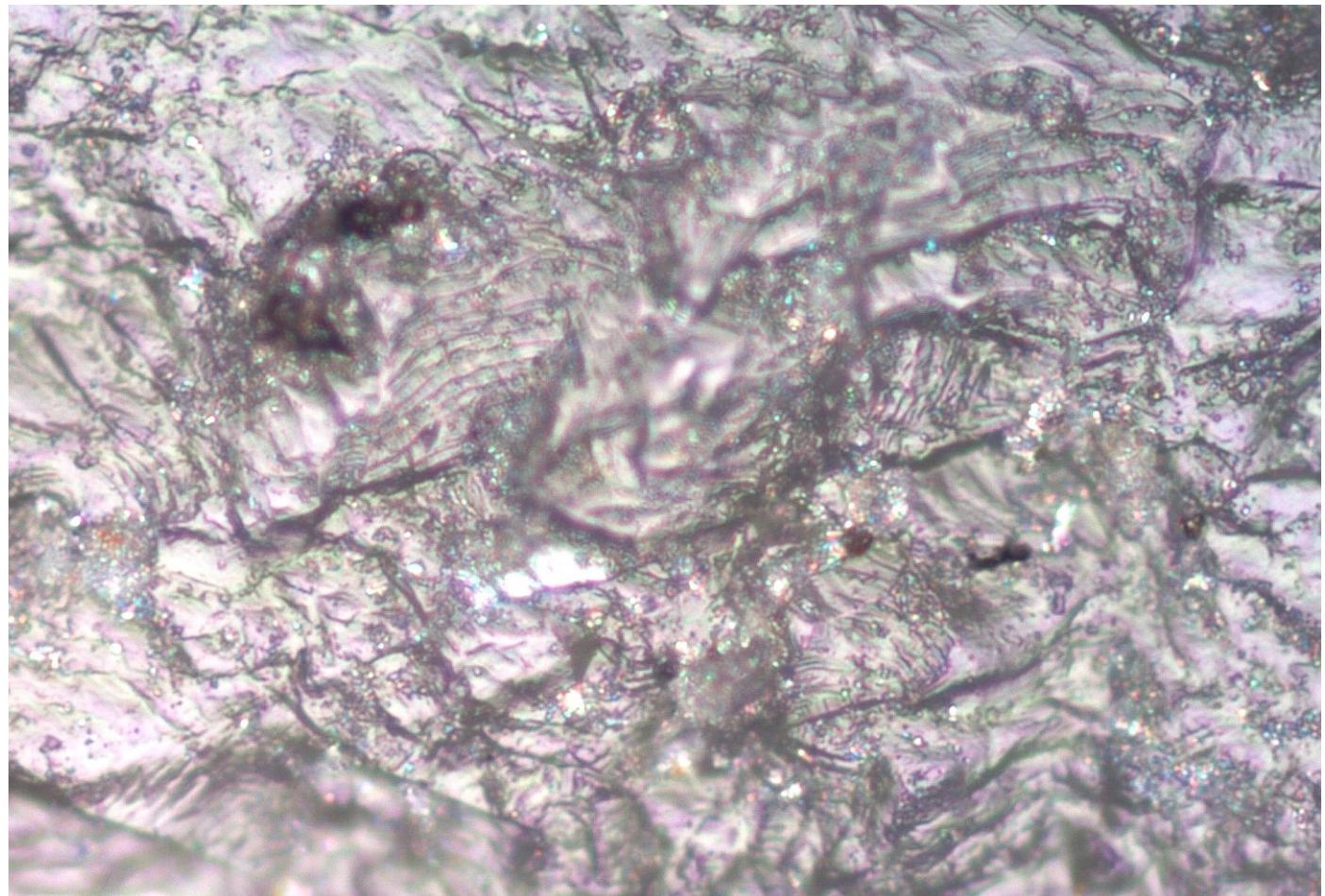


Microscopic Images : Sample from Site 21 → original state (no preparation for analysis)

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

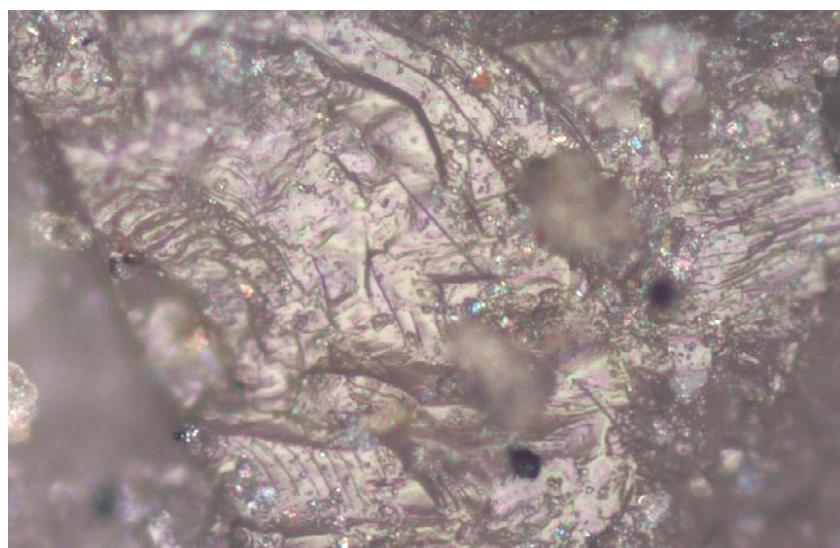


Sample Site 21 : Stone 2 : Quartz - Image size : ~ 400 x 300 µm

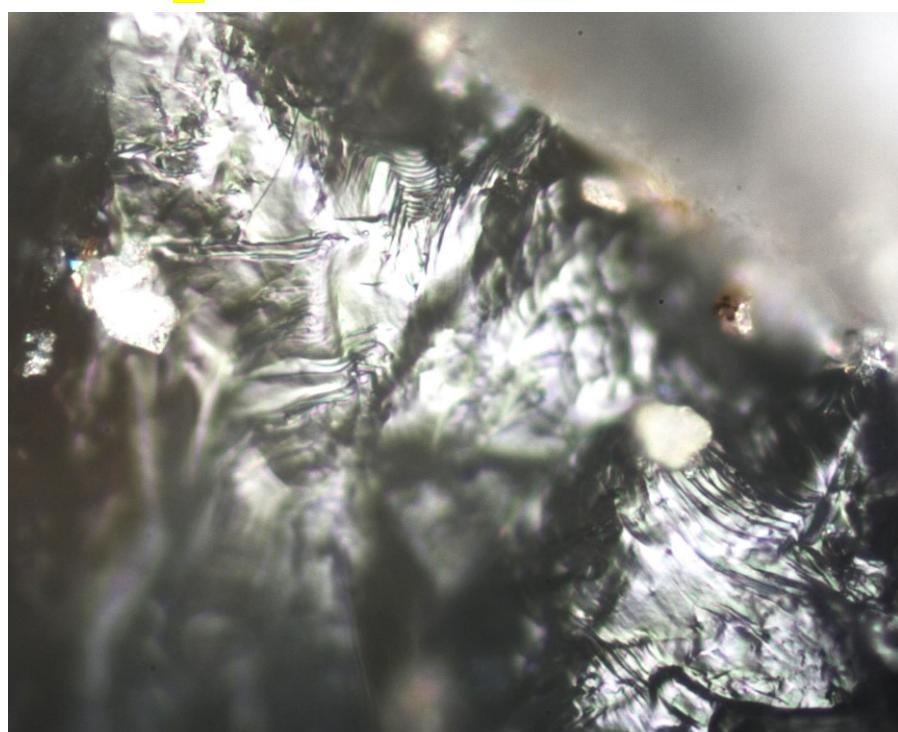


Microscopic Images : Sample from Site 21 → original state (no preparation for analysis)

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

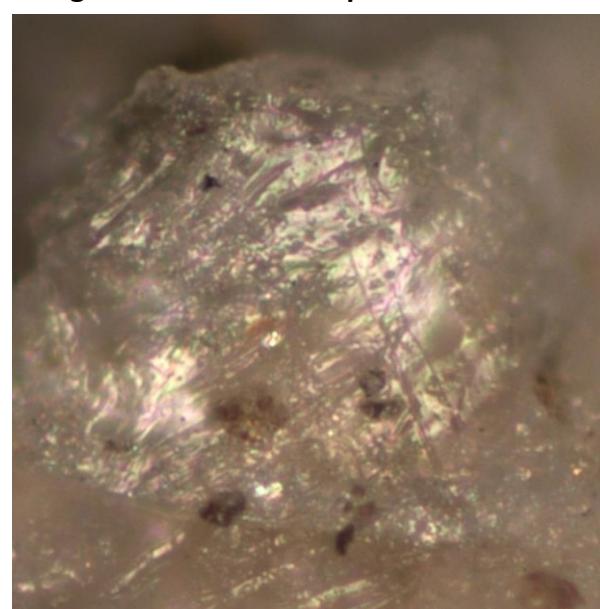


Sample Site 21 : Stone 1_spectra 2 : Quartz - Image size : ~ 250 x 200 µm



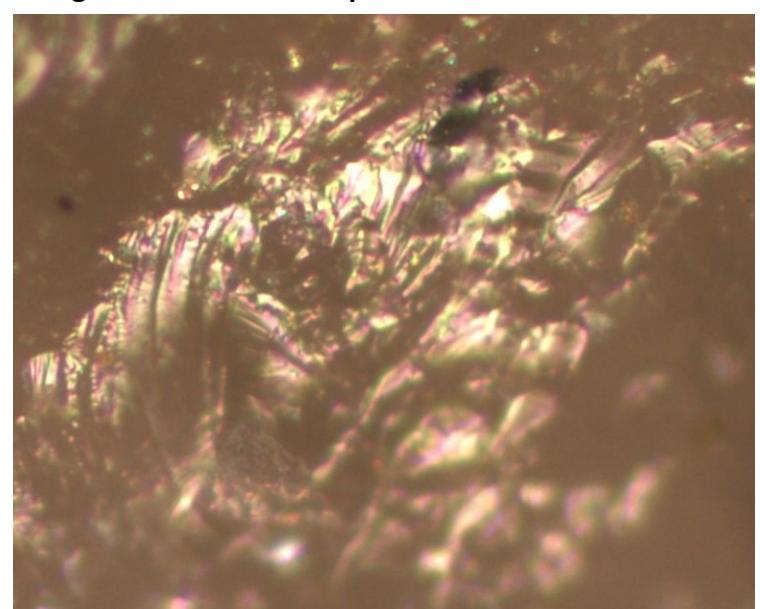
Sample Site 21 : Stone 1 : Quartz

Image size : ~ 200 x 180 µm

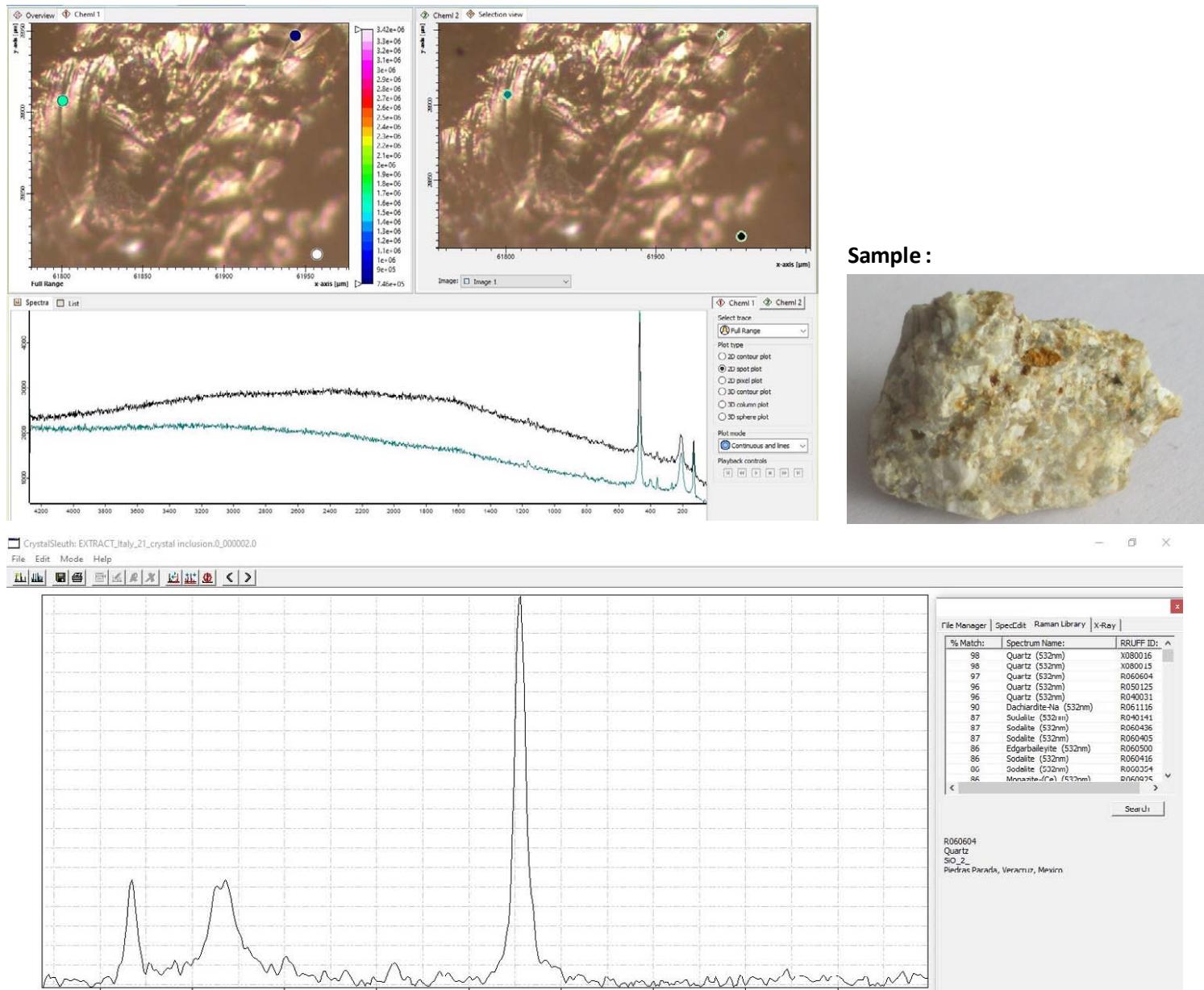


Sample Site 21 : Stone 3 : Quartz

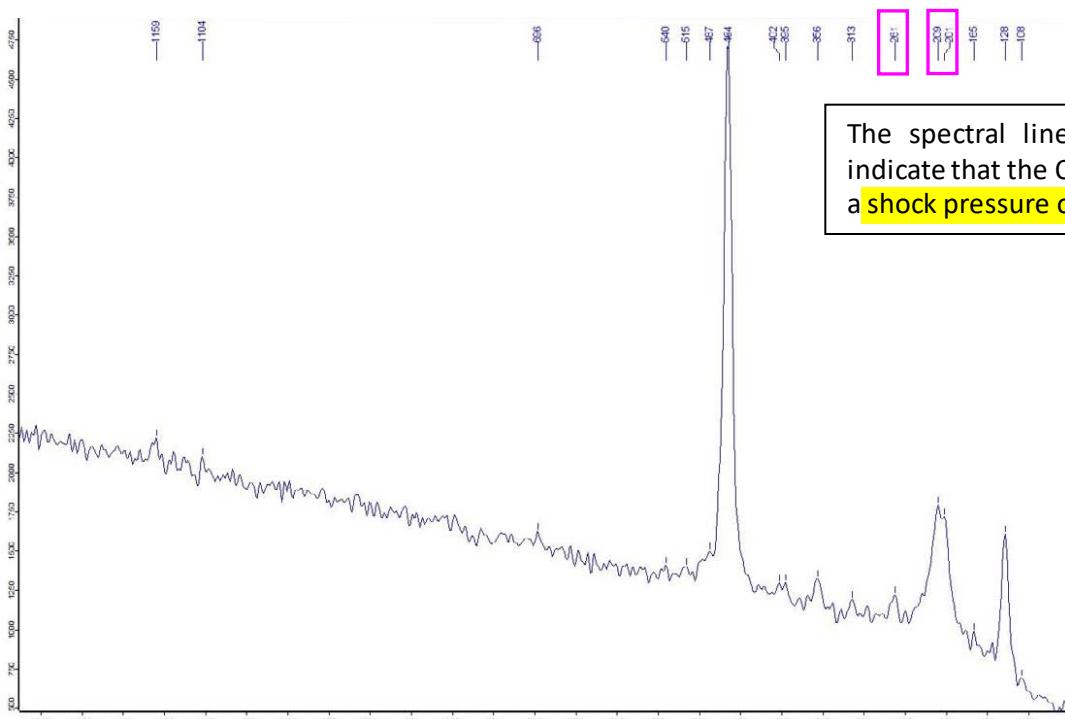
Image size : ~ 220 x 200 µm



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



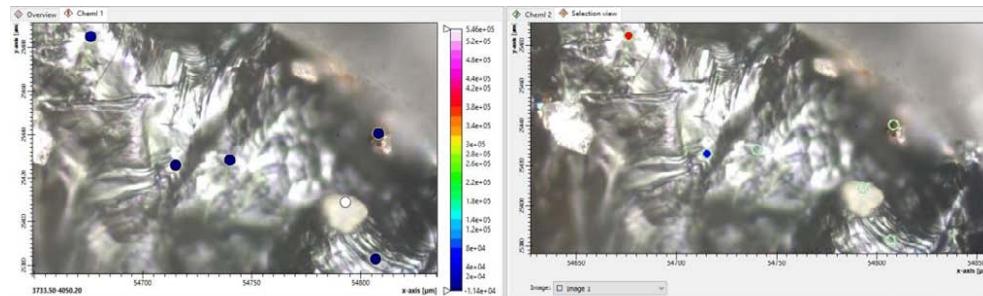
Indication for a shock event are the shifts of the marked Quartz spectral lines towards 261 and 201 (209)



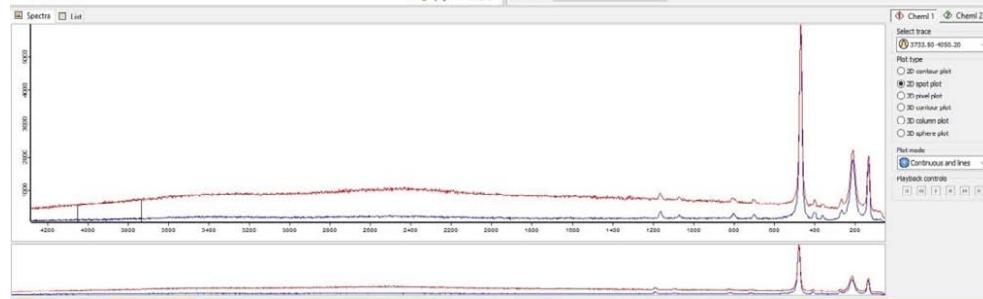
The spectral lines 261 and 201 (209) indicate that the Quartz was exposed to a shock pressure of around 20 - 22 GPa.

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

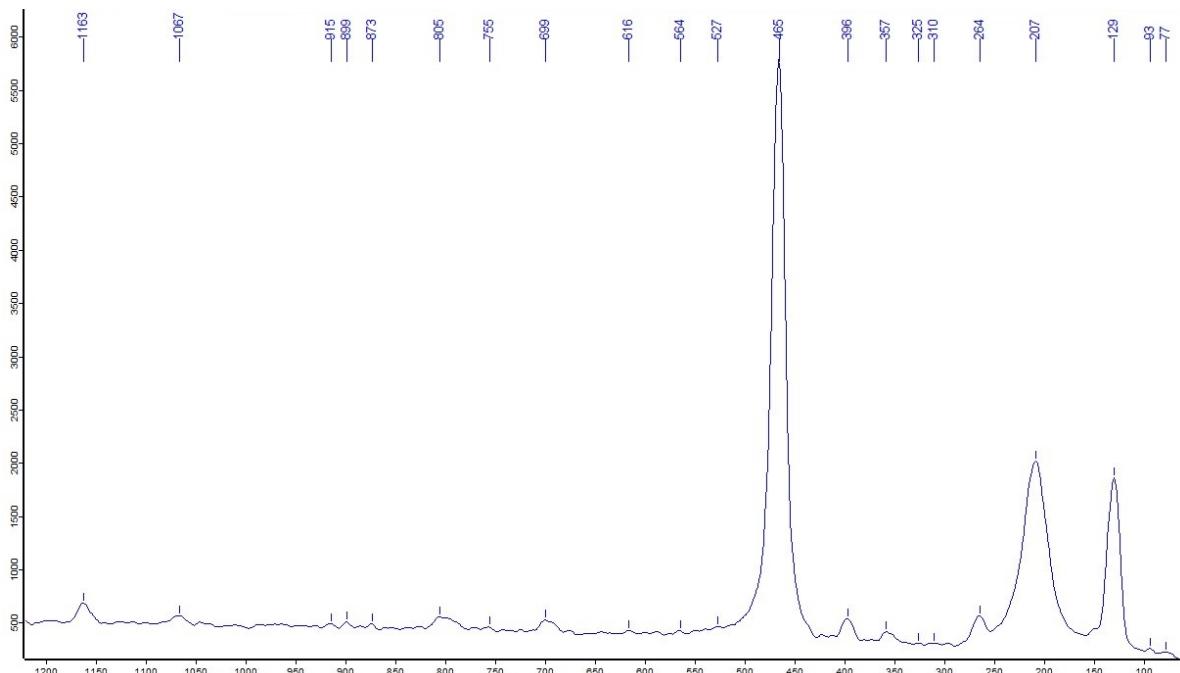
The spectral lines indicate that Quartz is the most probable mineral measured in this spectral analysis



Note the fracture patterns on the microscopic image.



Sample :



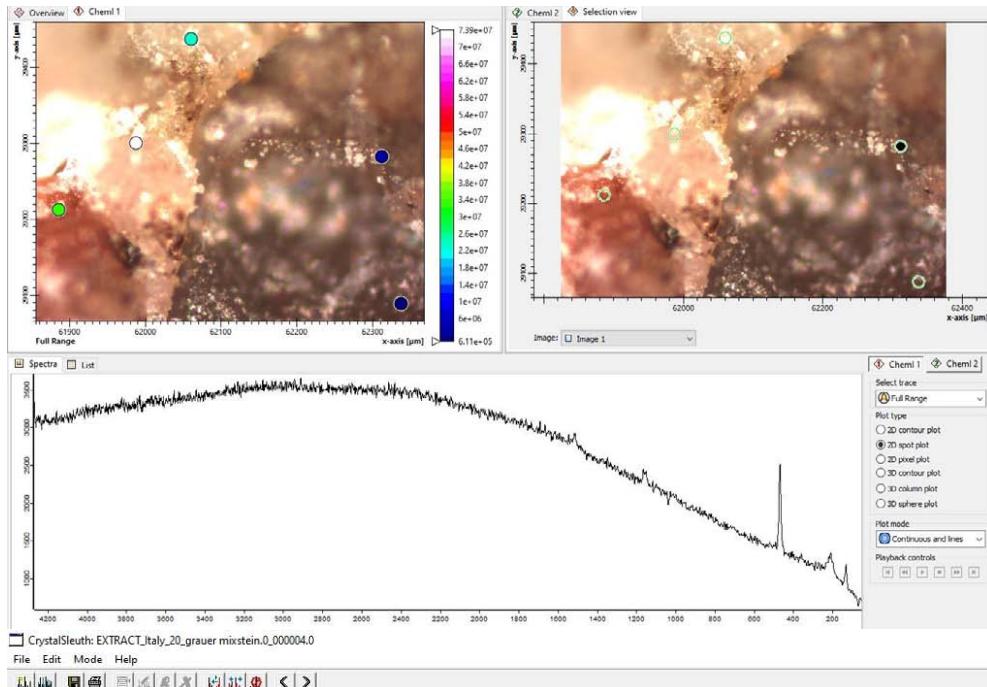
File Manager	Spectrum Name:	RRUFF ID:
89	<1> Sugilite (532nm)	R070684
86	<1> Dachiardite-Na (532nm)	R061116
83	<1> Quartz (532nm)	R071190
82	Quartz (532nm)	X080015
82	Quartz (532nm)	X080016
81	Quartz (532nm)	R060504
81	Quartz (532nm)	R040031
80	Villanaminite (532nm)	R060514
80	Anorthite (532nm)	R061064
80	Moldavite (532nm)	R021000
78	Chalybite (532nm)	R070367
78	Chalybite-Cu (532nm)	R050014

R070684
Sugilite
Kio₂Li₃Fe₂Si₁₂O₃₀
Iwagi Island, Inland Sea (Setonaikai), Ehime Prefecture, Japan

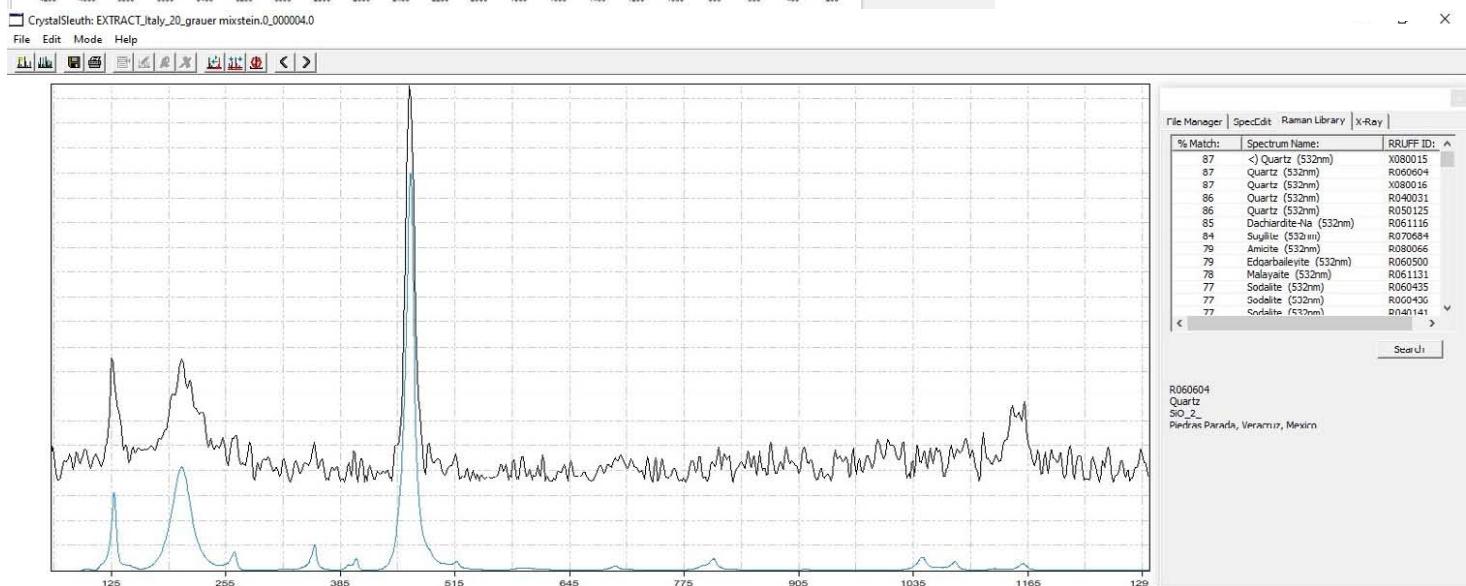
R061116
Dachiardite-Na
Na₄-(Ca₂₀Al₄)O₈·18H₂O
Alpe di Suisi, Bolzano, Trentino-Alto Adige, Italy

X080015
Quartz
SiO₂
Synthetic

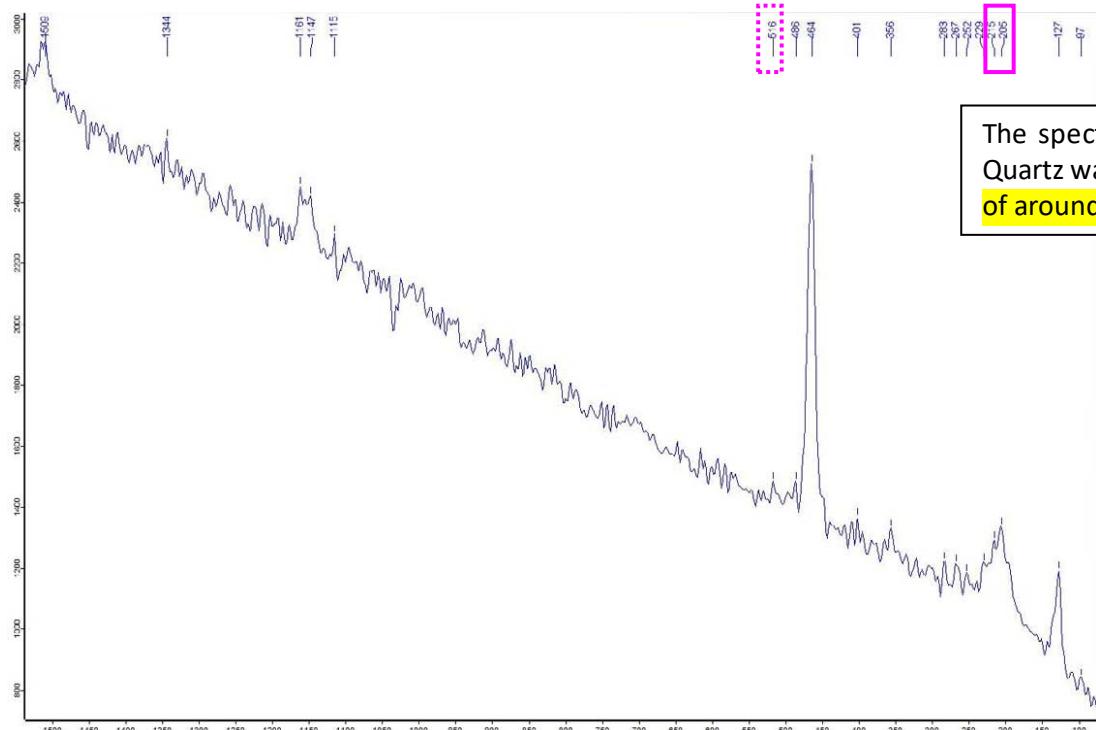
Sample Site 20 : Stone 4_spectra 1 indicates : Quartz → see RRUFF_CS results)



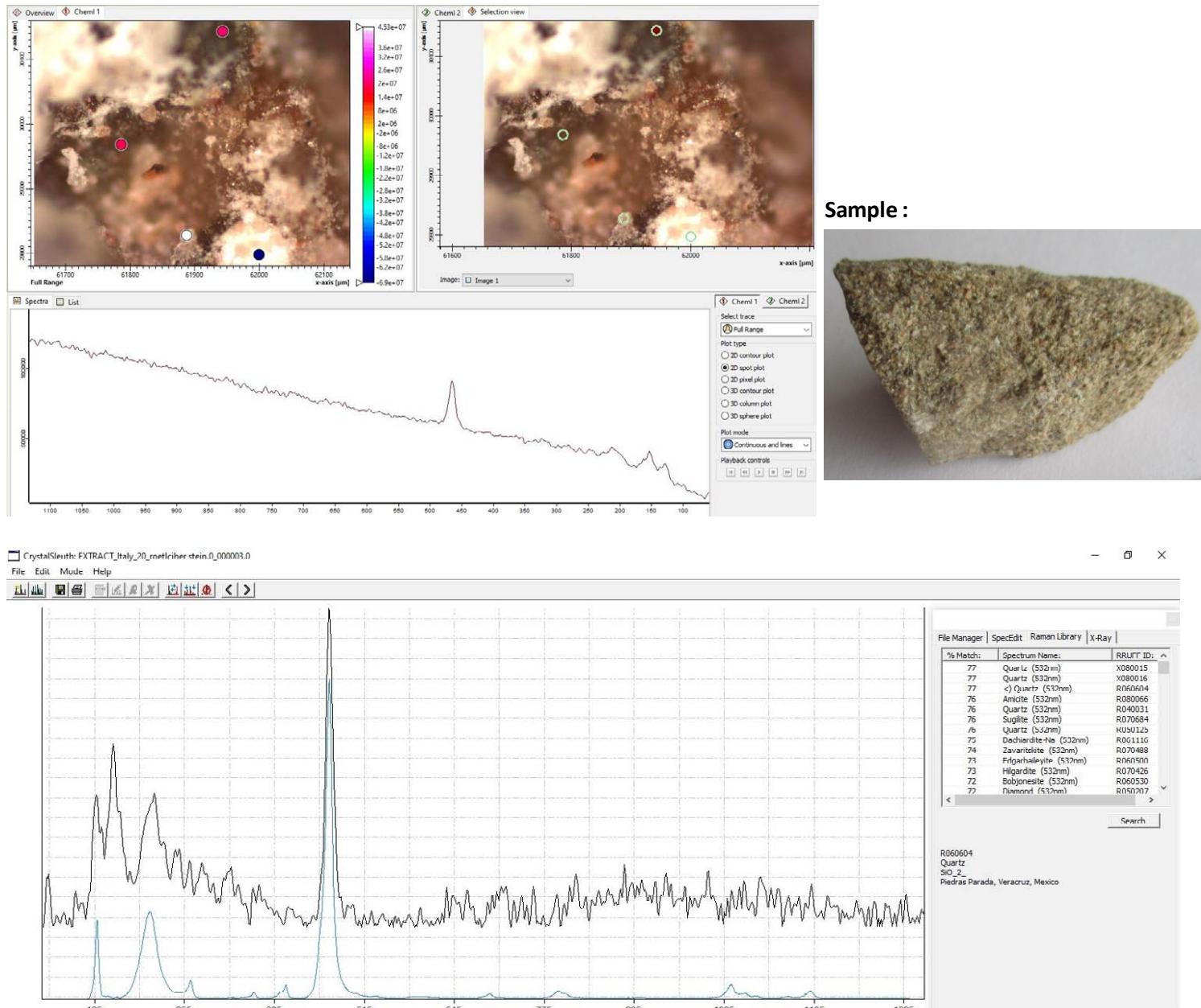
Sample :



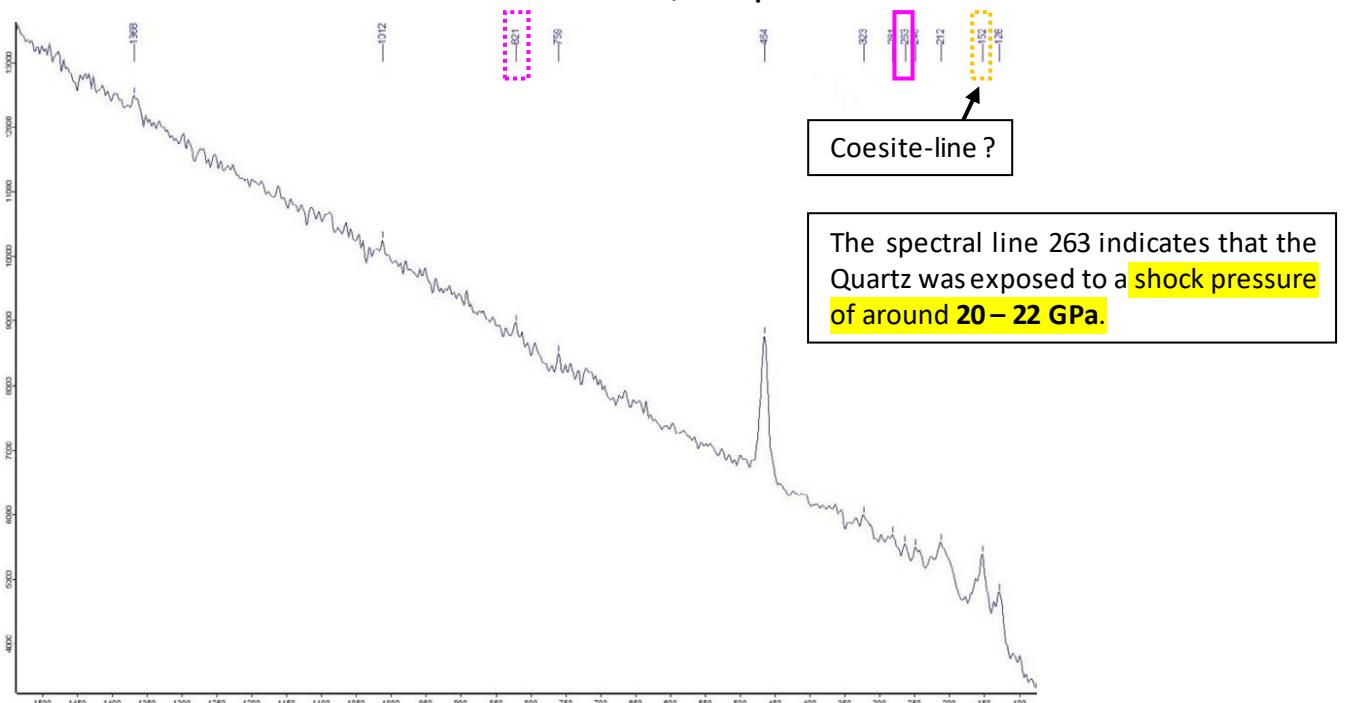
Indication for a shock event is the shift of the marked Quartz spectral lines towards 205



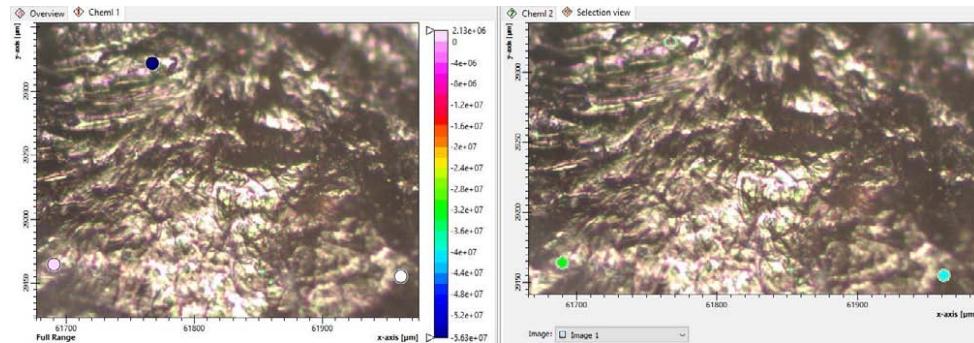
Sample Site 20 : Stone 5_spectra 1 indicates : Quartz (→ see RRUFF_CS results)



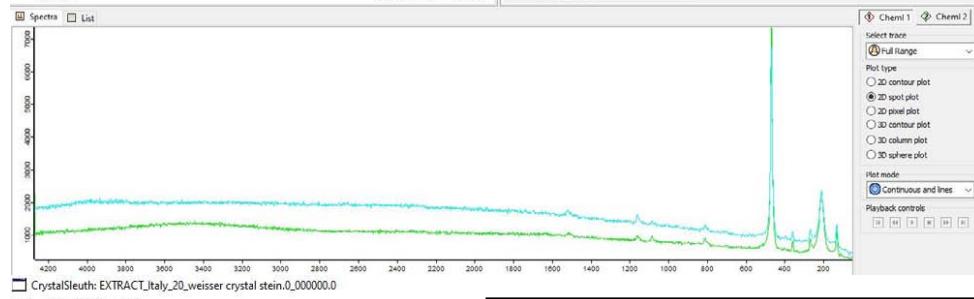
Indication for a shock event is the shift of the marked Quartz spectral lines towards 263



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

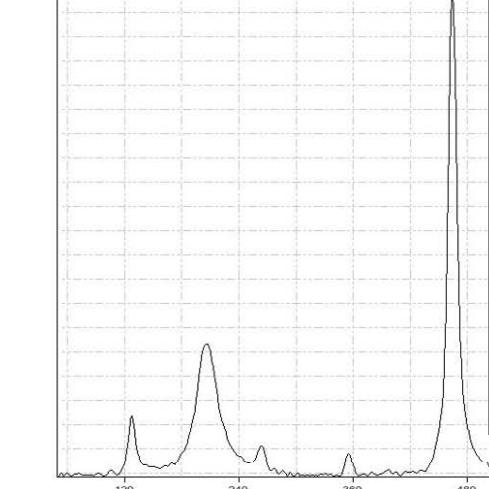


Sample :

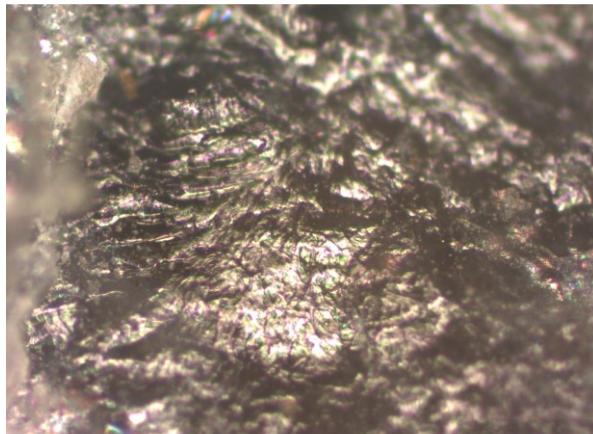


CrystalSleuth: EXTRACT_Italy_20_weisser crystal stein.0_000000.0

File Edit Mode Help



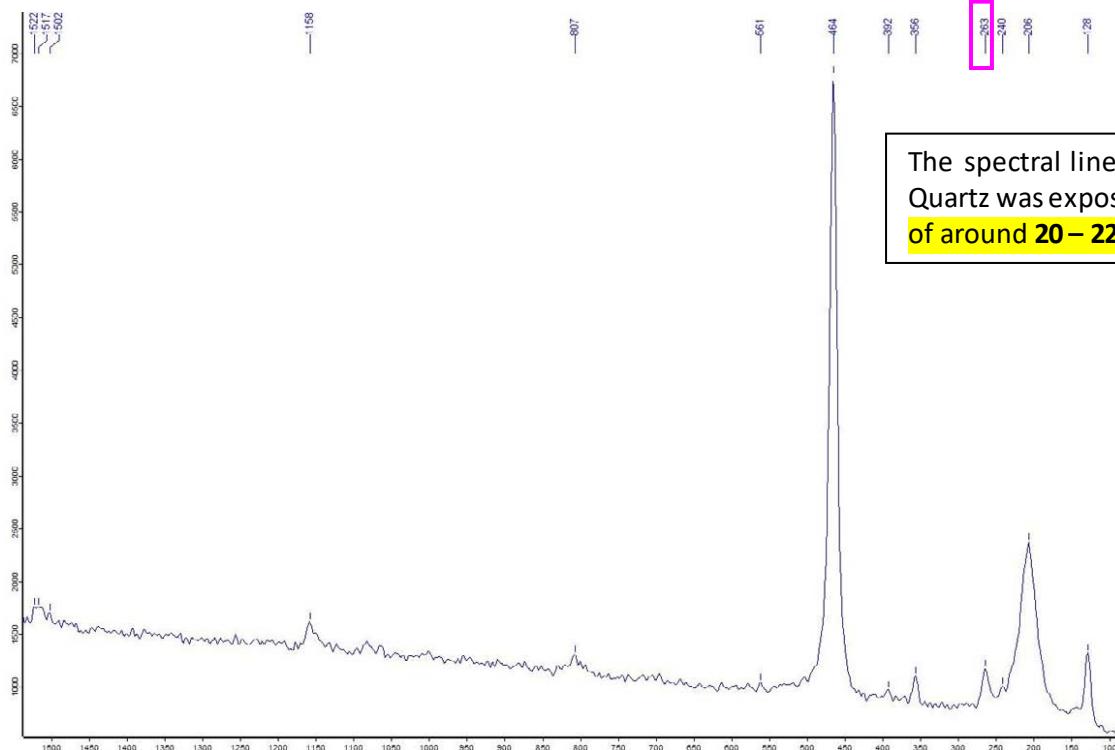
Microscopic Image : image size ≈ 350 x 300 µm



% Match:	Spectrum Name:	RRUFF ID:
99	Quartz (532nm)	X080015
99	Quartz (532nm)	X08016
99	Quartz (532nm)	R050125
98	Quartz (532nm)	R060604
98	Quartz (532nm)	R040031
90	Dachardrite-Na (532nm)	R061116
86	Edgarballyte (532nm)	R060500
86	Sodalite (532nm)	R060436
85	Sodalite (532nm)	R040141
84	Sodalite (532nm)	R060316
84	Sodalite (532nm)	R060354
84	Analcite (532 nm)	R080066
94	Sodalite (532nm)	R060405

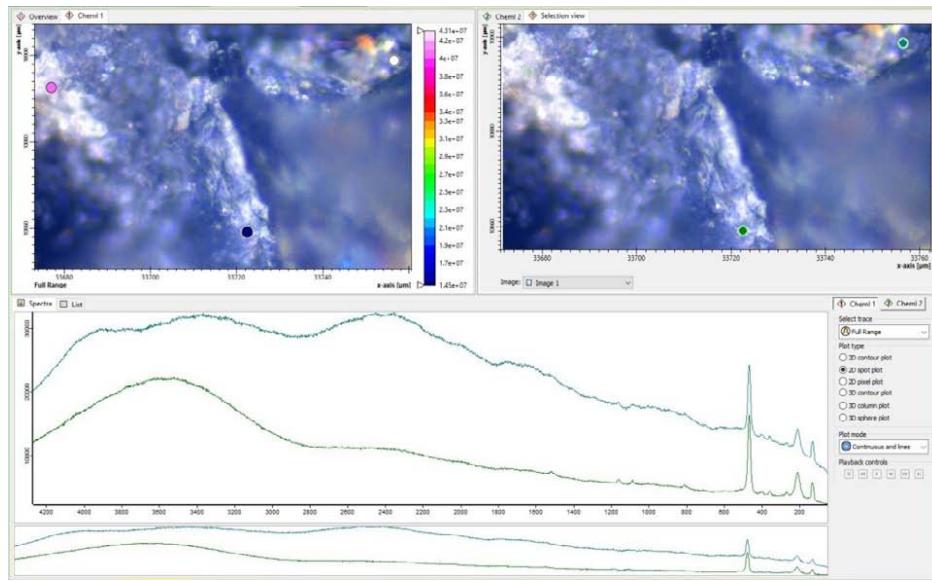
R050125
Quartz
SiO₂
Lindópolis, Minas Gerais, Brazil

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

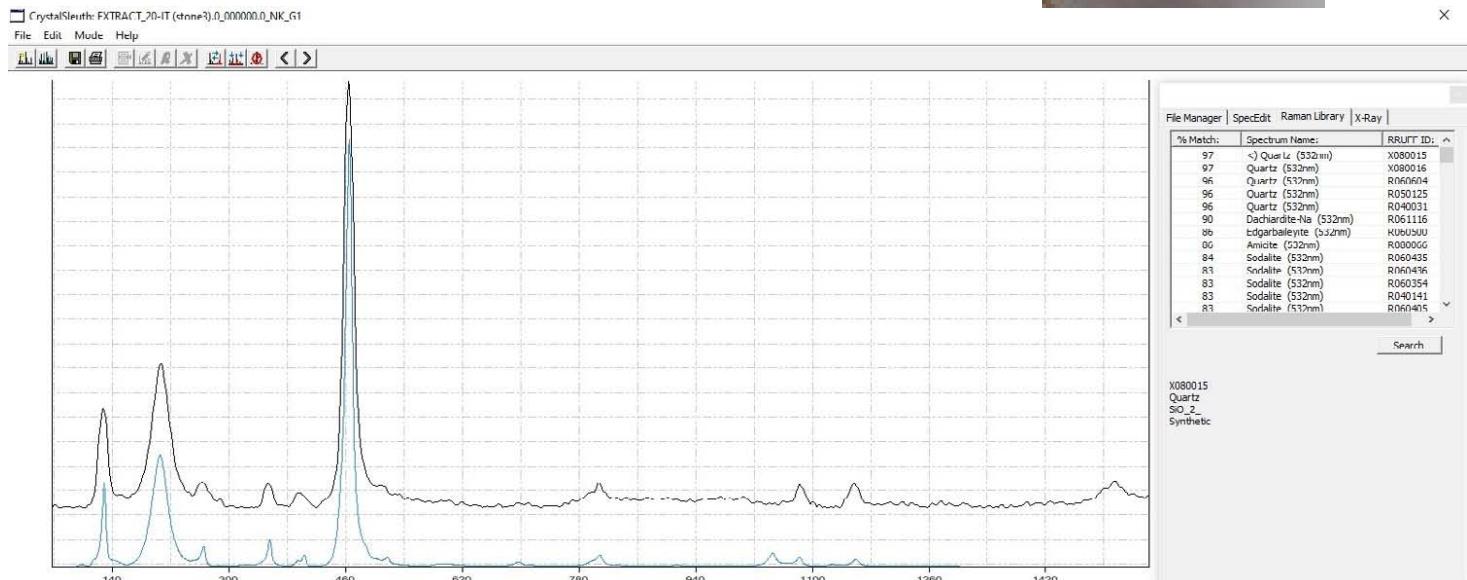


The spectral line 263 indicates that the Quartz was exposed to a shock pressure of around 20 – 22 GPa.

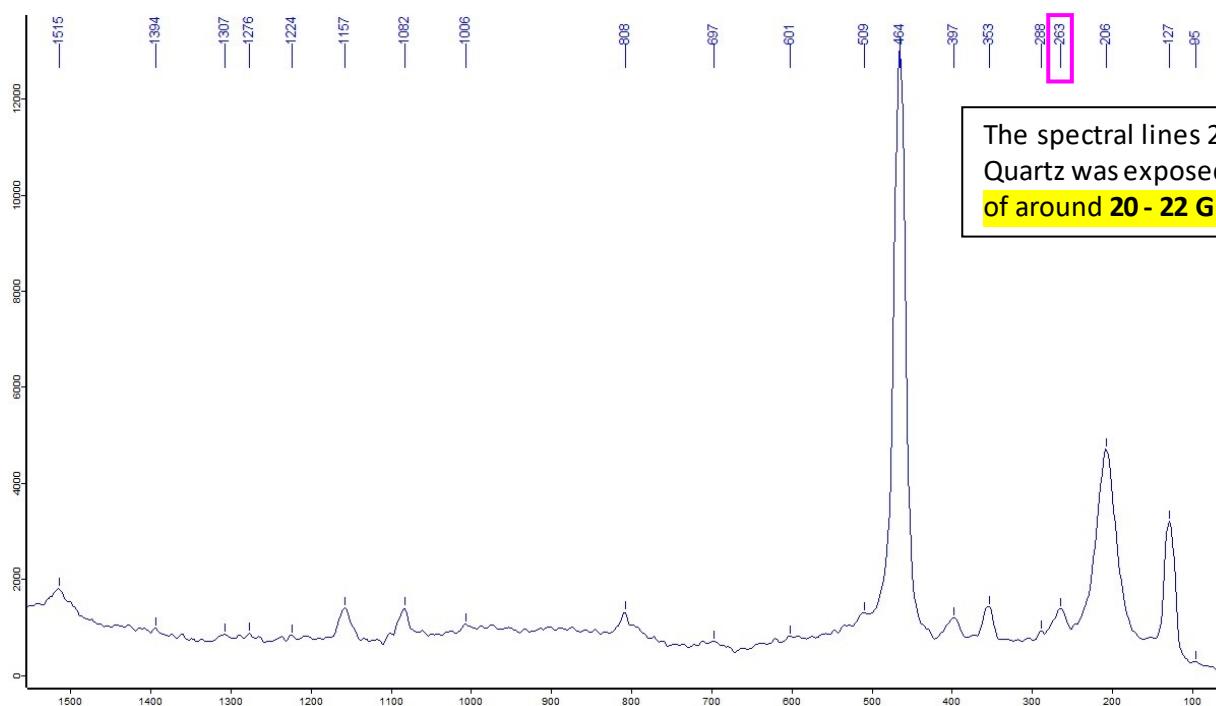
Sample Site 20 : Stone 3_spectra 1 indicates : Quartz (→ see RRUFF_CS results)



Sample :



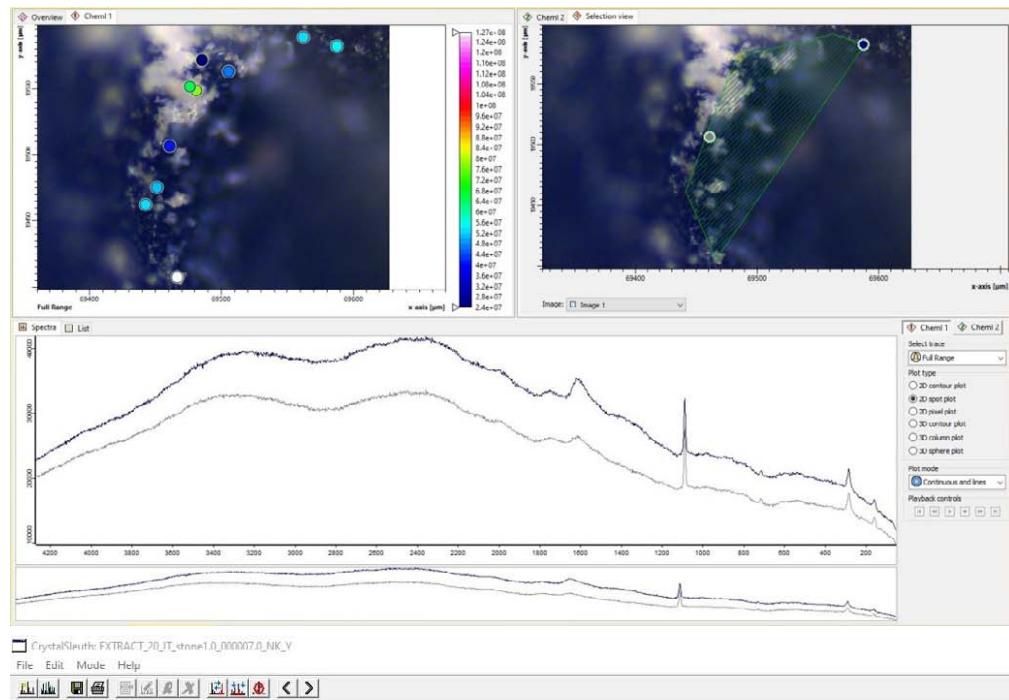
Indication for a shock event is the shift of the marked Quartz spectral lines towards 263



The spectral lines 263 indicates that the Quartz was exposed to a shock pressure of around 20 - 22 GPa.

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

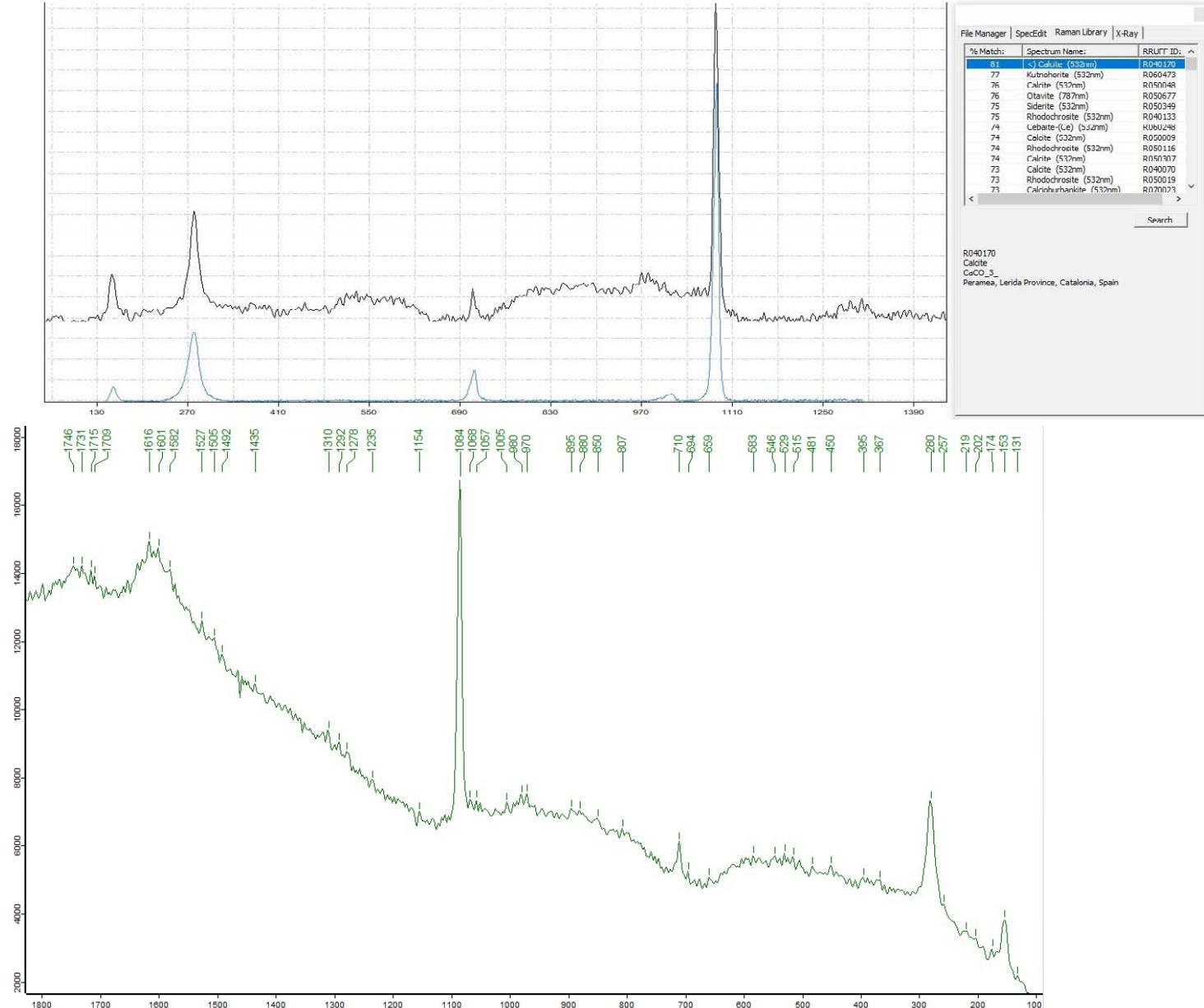
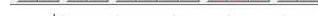
Sample Site 20 : Stone 1_spectra 1 indicates : Calcite (→ see RRUFF_CS results)



Sample :

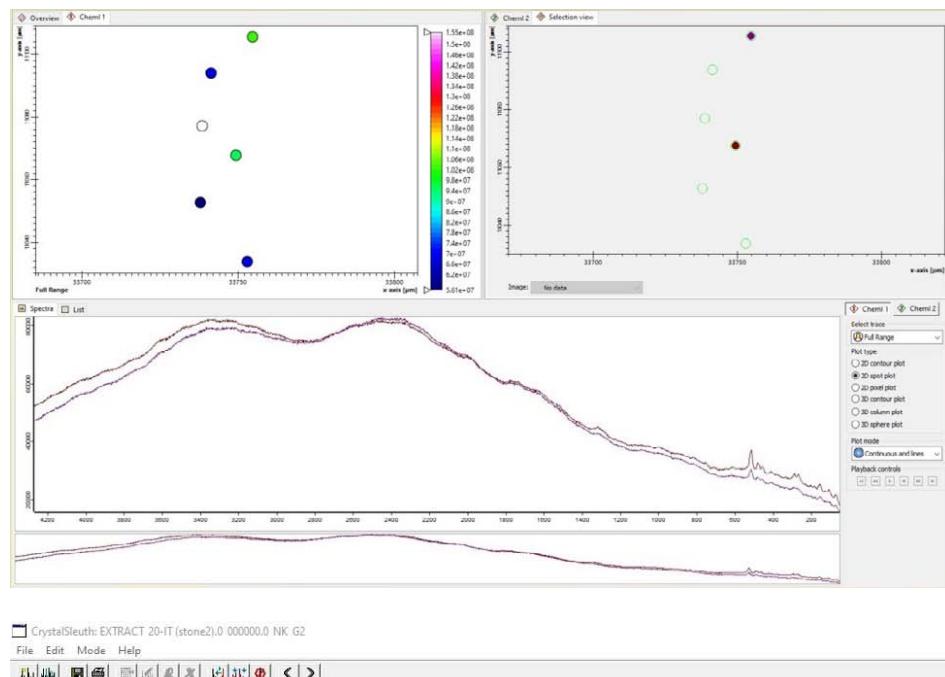


CrystalSleuth: EXTRACT_20_IT_stone1_0_0000070_NK_V
File Edit Mode Help

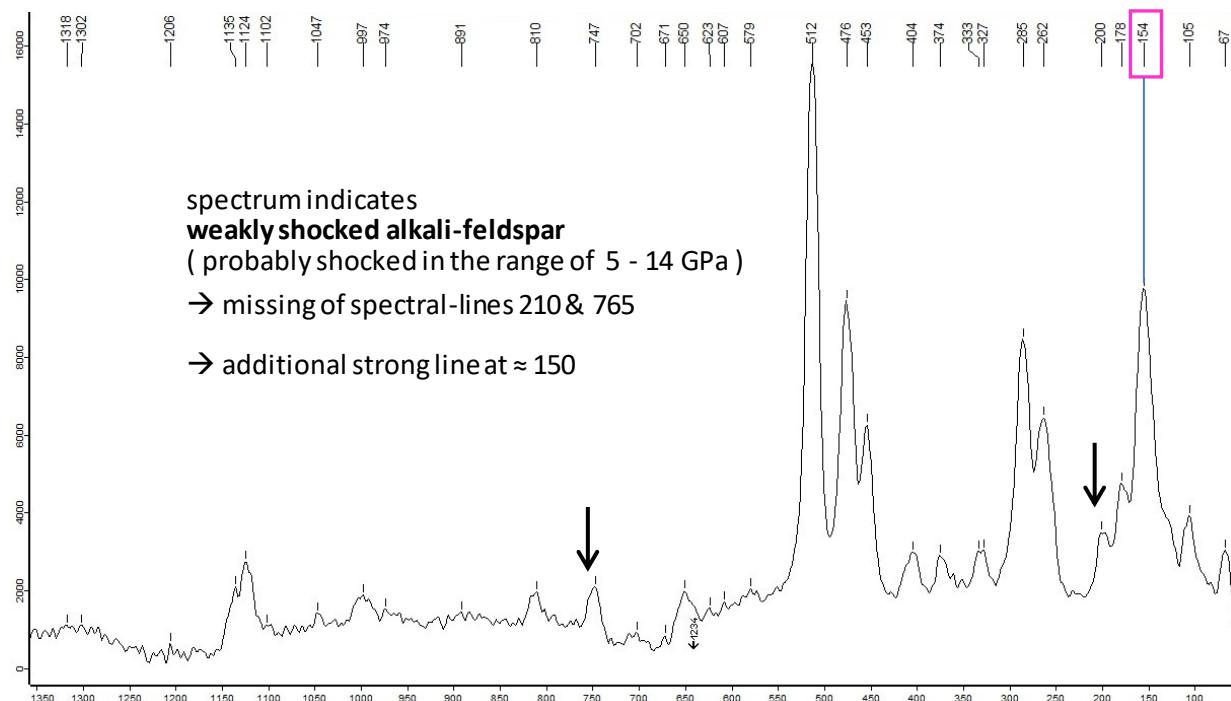
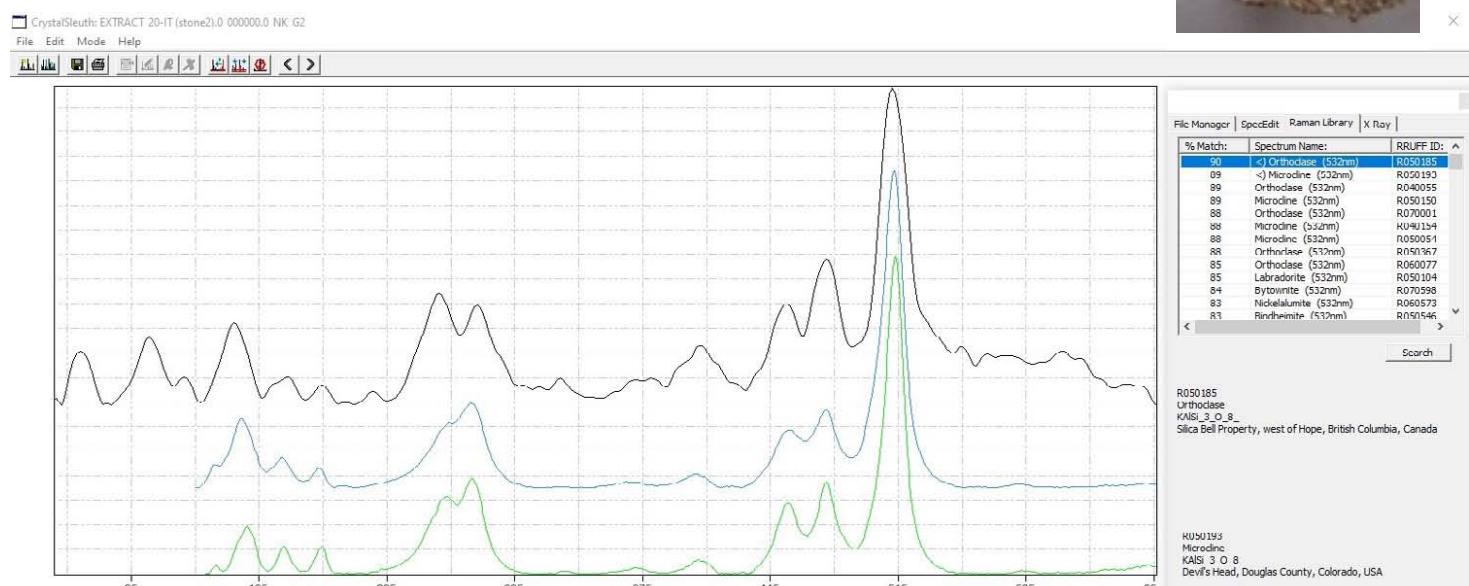


Sample Site 20 : Stone 2_spectra 1 indicates : Orthoclase , Microcline

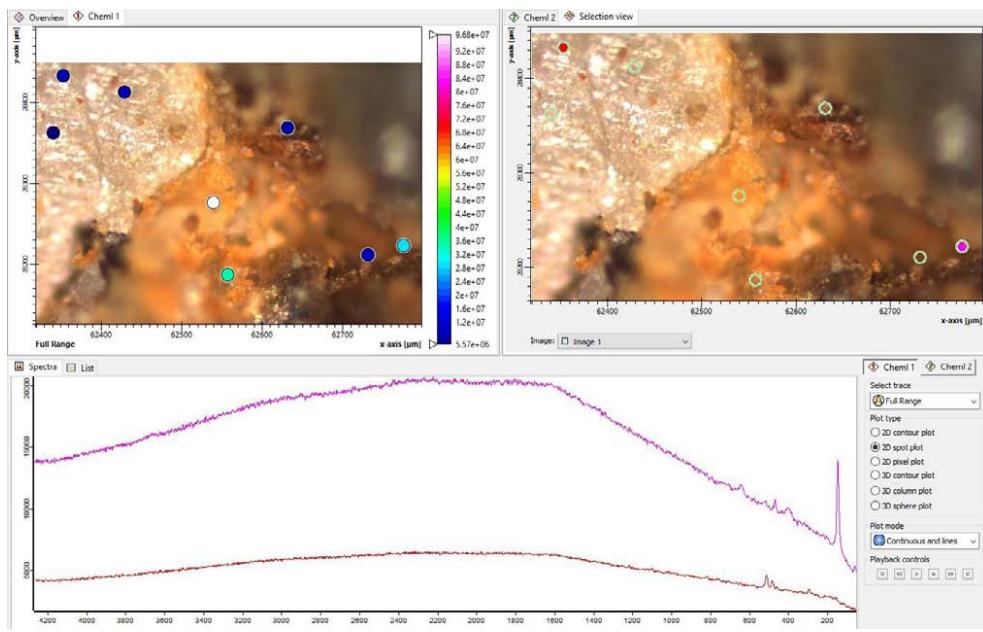
(→ see RRUFF_CS results)



Sample :

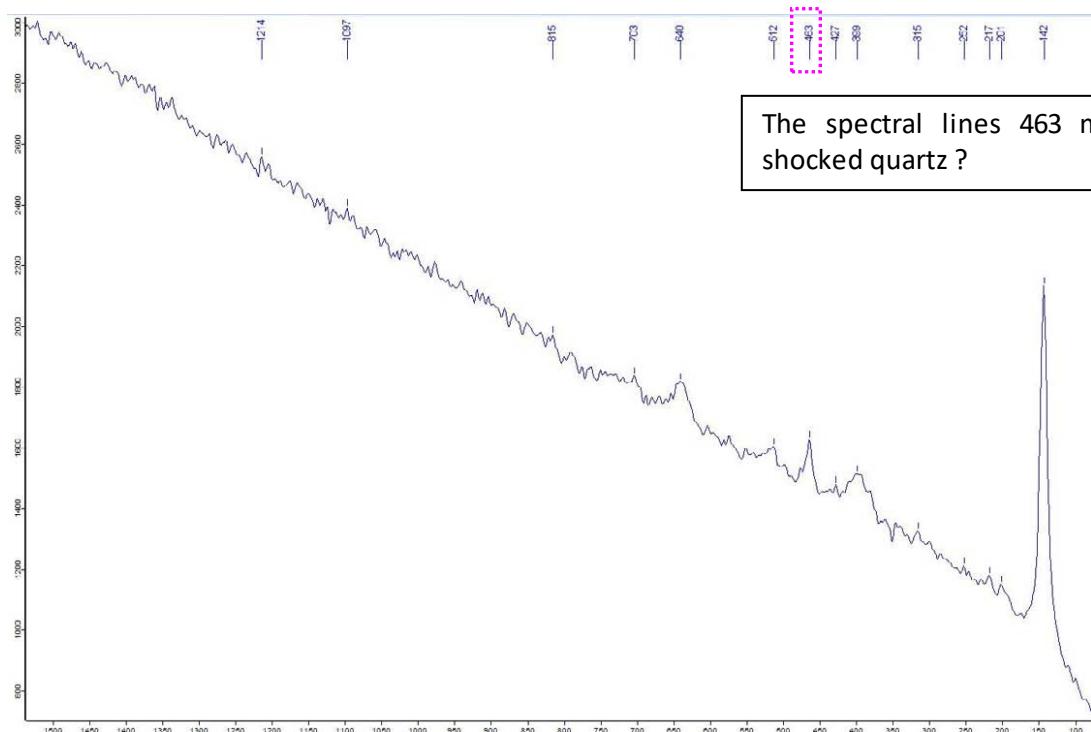


Sample Site 19 : Stone 1_spectra 1 (white crystal inclusion) indicates : Microcline , (Quartz ?)

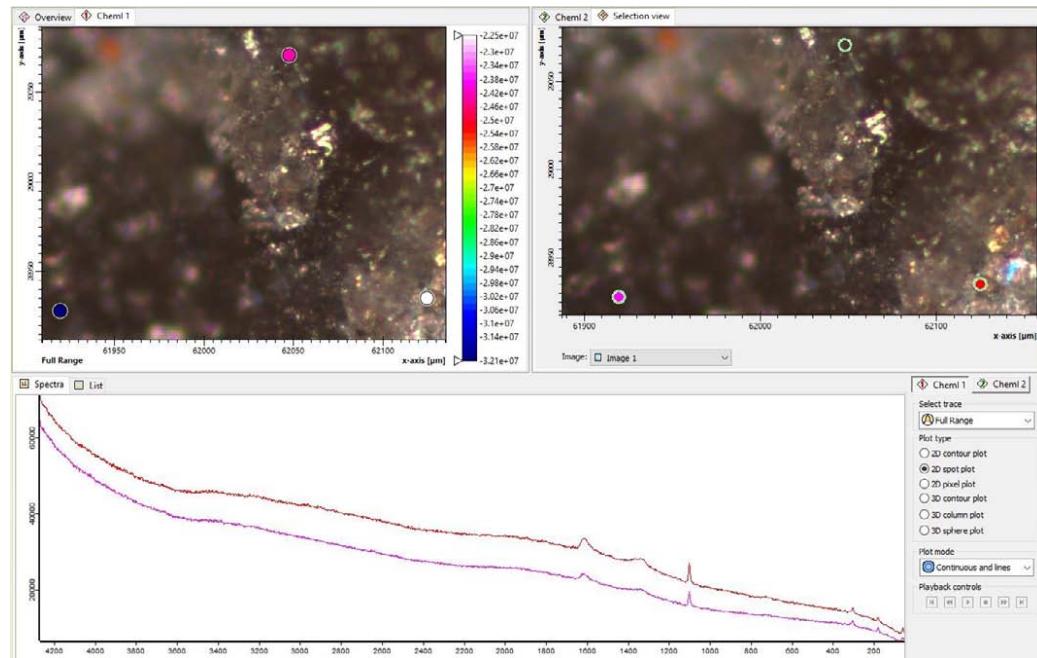


The spectrum may also indicate shocked quartz

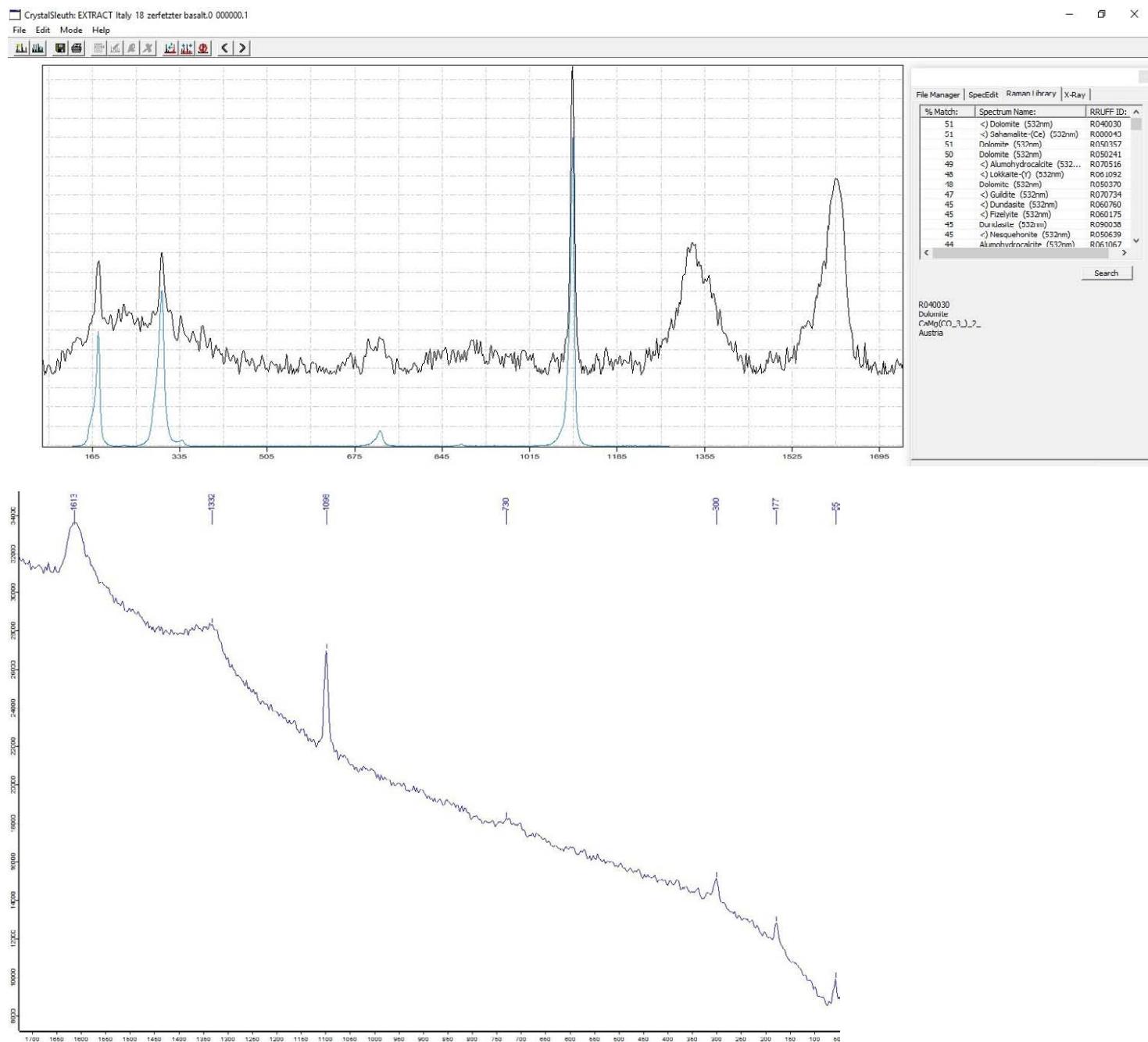
Sample :



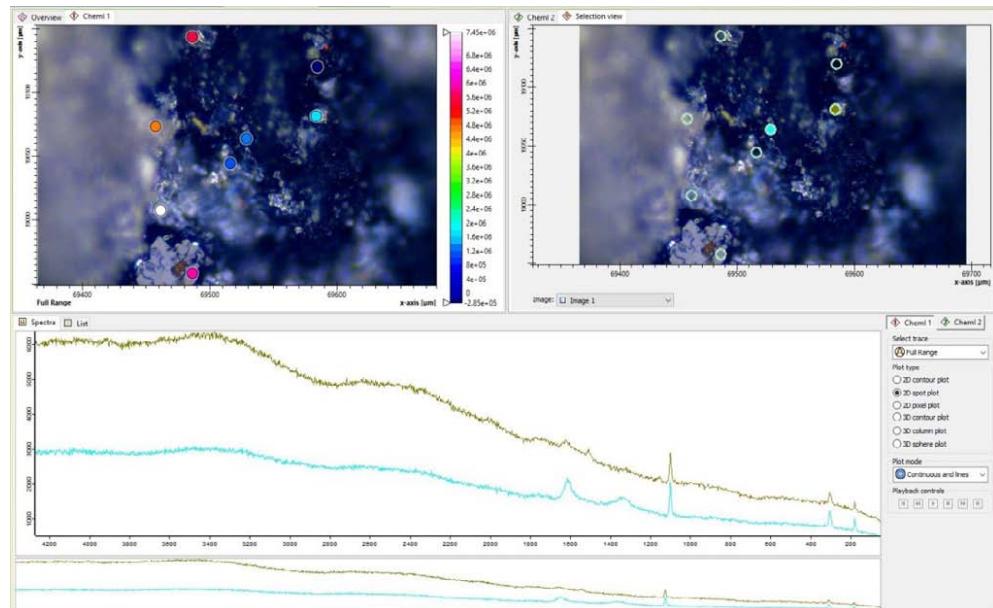
Sample Site 18 : Stone 2_spectra 1 (dark mineral) indicates: Dolomite , Sahamalite-(Ce) (→ RRUFF_CS)



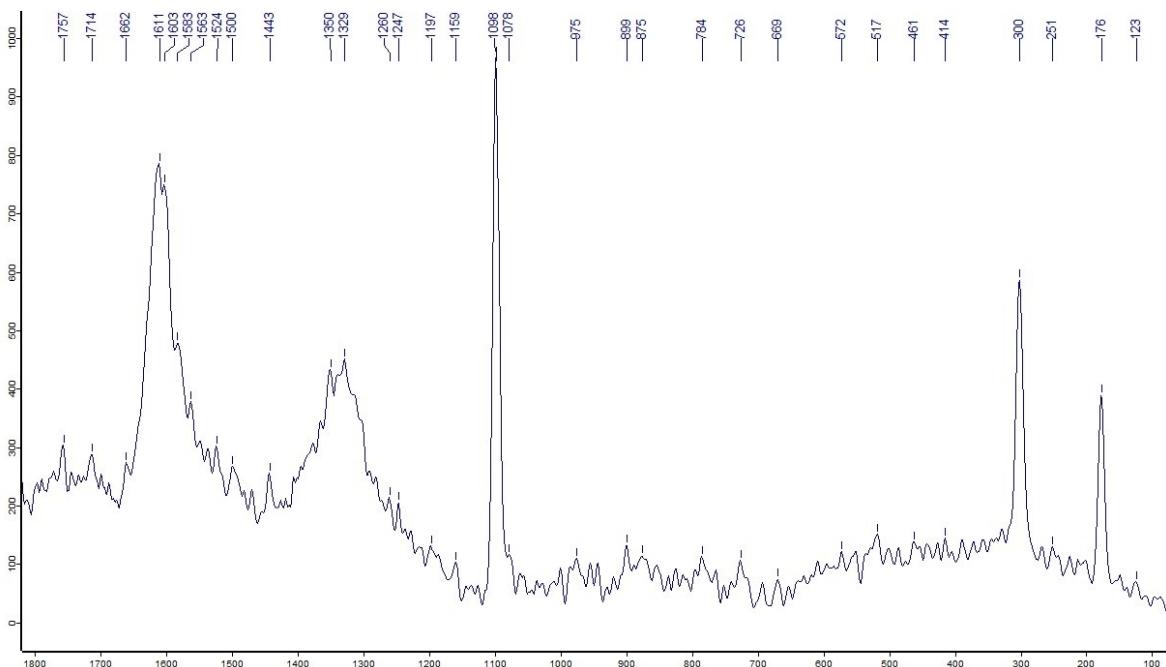
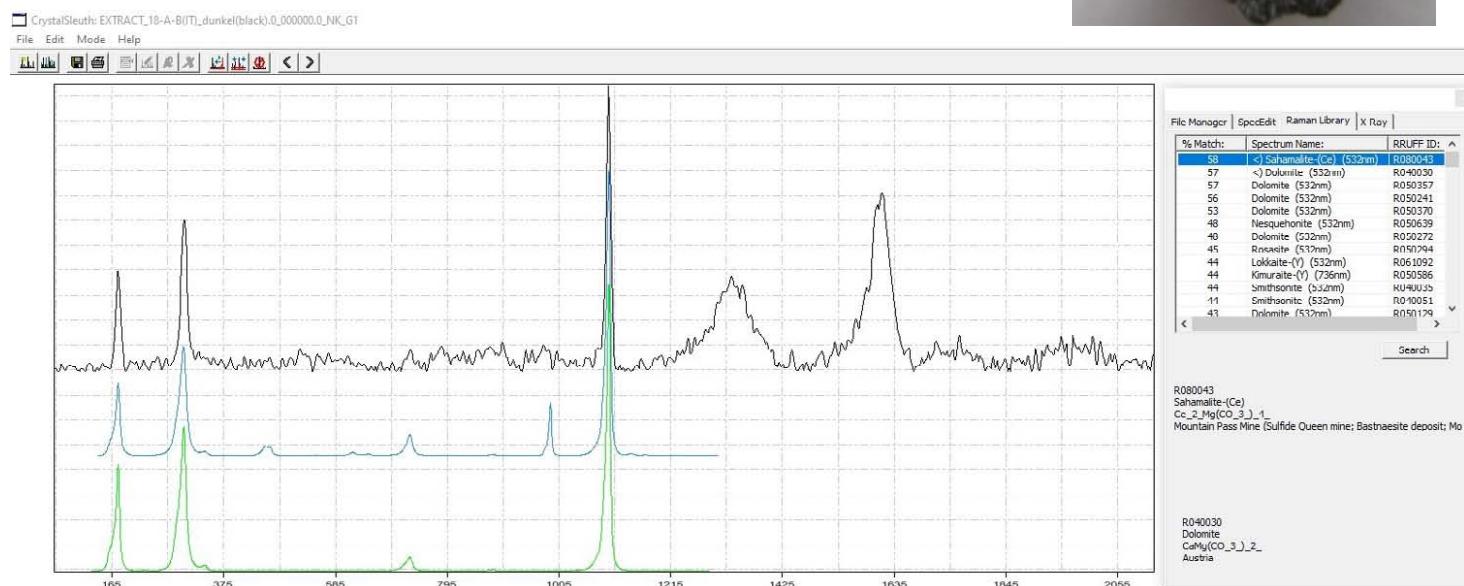
Sample:



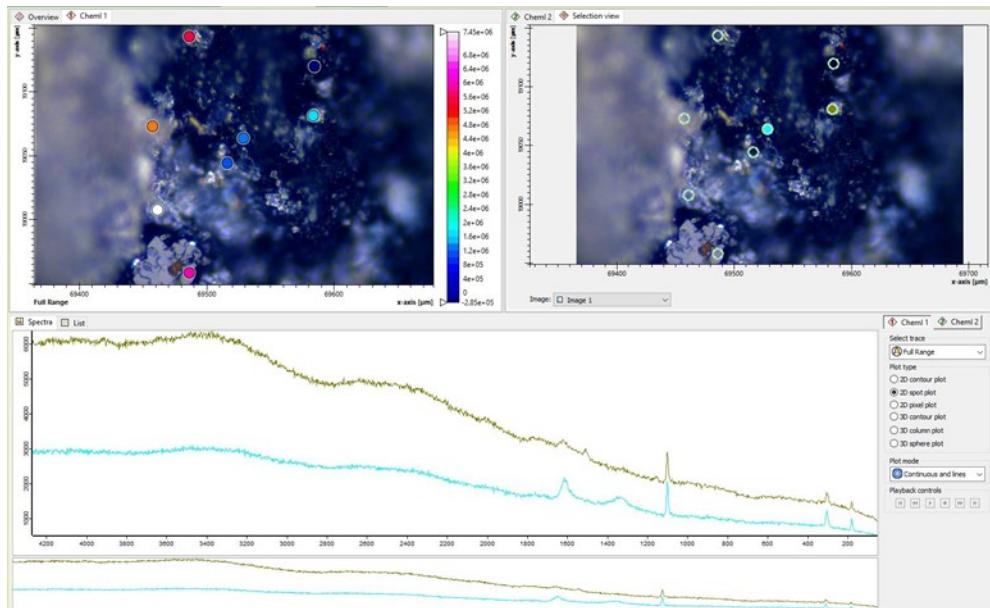
Sample Site 18 : Stone 1_spectra 1 (dark mineral) indicates : Dolomite , Sahamalite-(Ce) → RRUFF_CS)



Sample :

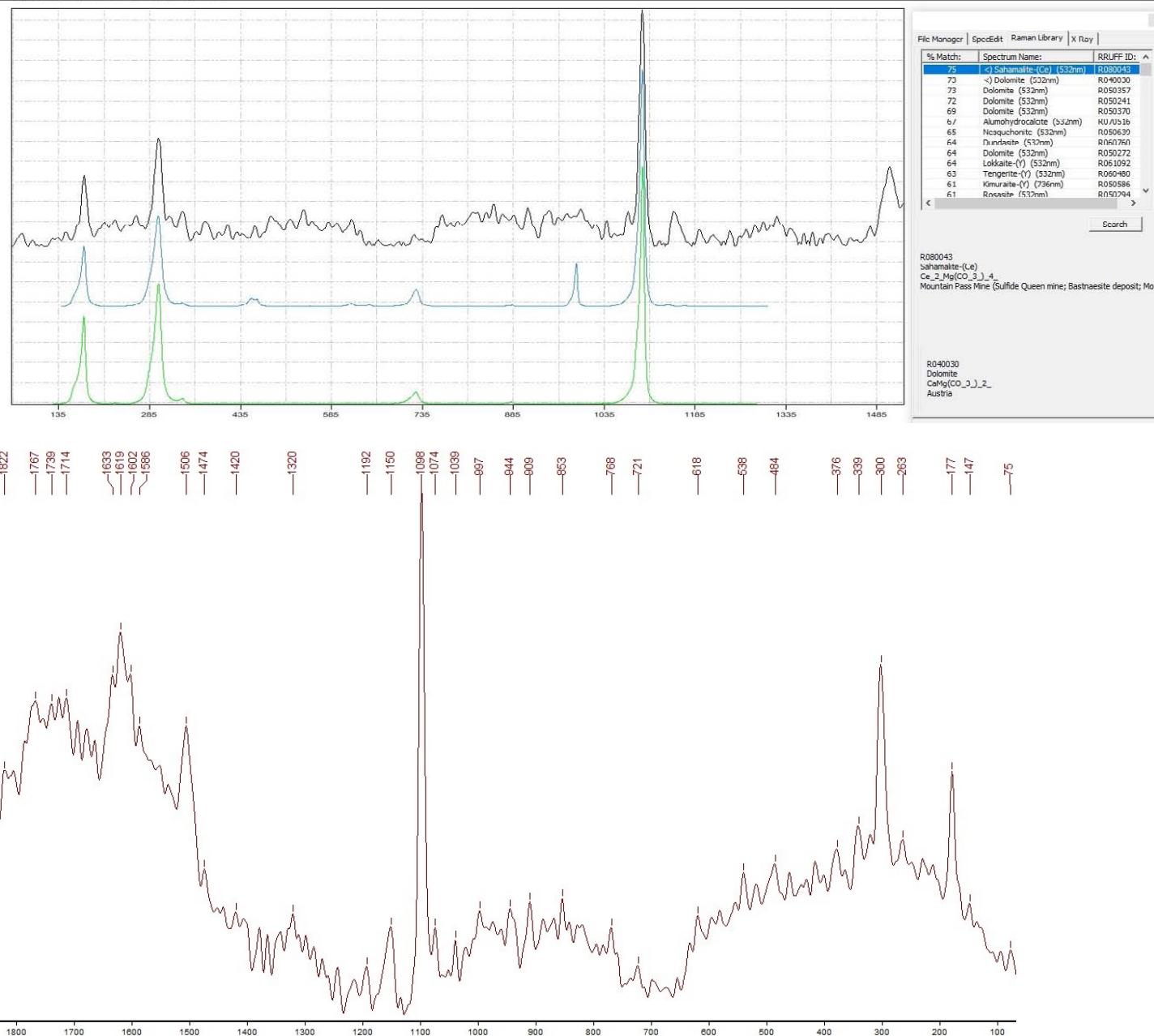


Sample Site 18 : Stone 1_spectra 2 (dark mineral) indicates : Dolomite , Sahamalite-(Ce) (→ RRUFF_CS)

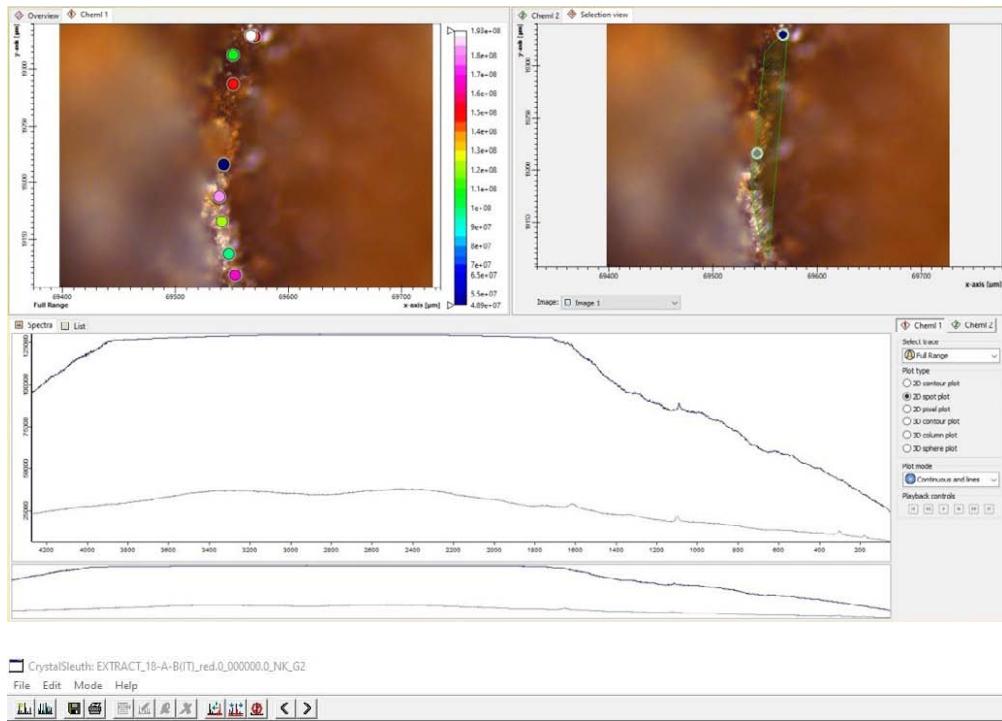


CrystalSleuth: EXTRACT 18-A-B(1T) dunkel(black).0 000007.1 NK G2

File Edit Mode Help



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



Sample :



CrystalSleuth: EXTRACT_18-A-B(1T)_red.0_000000_0_NK_G2

File Edit Mode Help

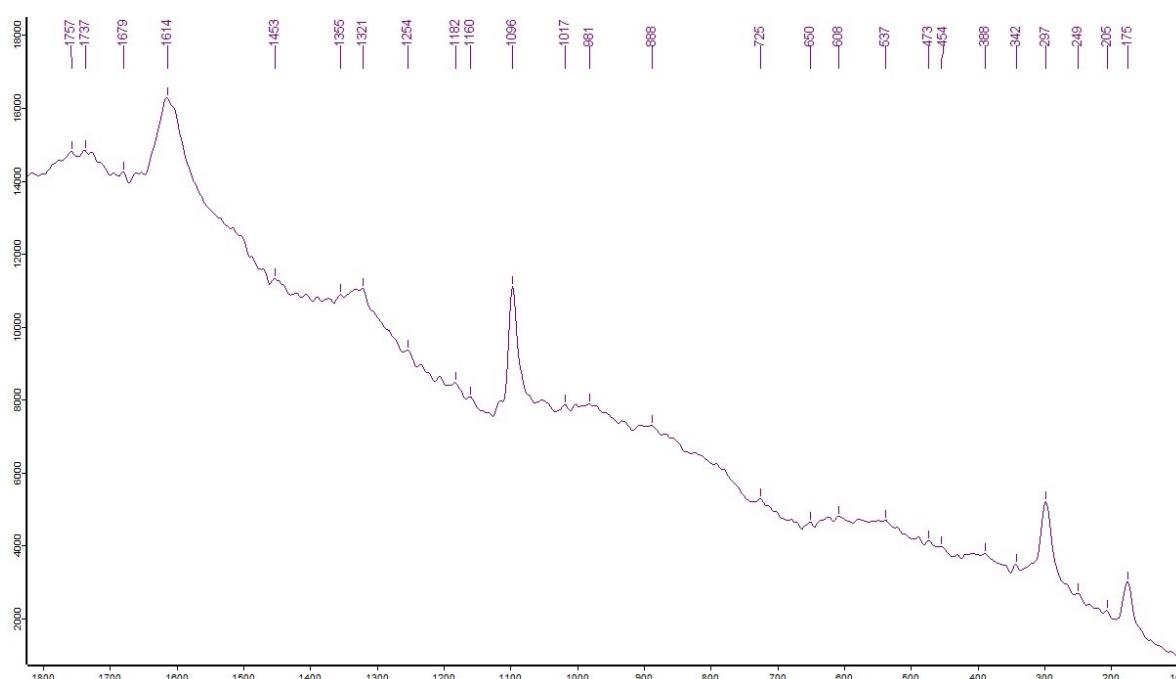
File Monogram SpcEdit Raman Library X-Ray

% Match:	Spectrum Name:	RRUFF ID:
66	< > Sahamalite-(Ce) (532nm)	R080043
65	Zirkulite (532nm)	R070483
65	Faieelite (532nm)	R070221
65	< > Dolomite (532nm)	R040030
65	Rinkite (532nm)	R050229
65	Gratomite (532nm)	R060956
65	Derbylite (532nm)	R070302
65	Tixnitite (532nm)	R070495
65	Sonolite (532nm)	R070752
65	Yuksporite (532nm)	R060518
65	Ulmite (532nm)	R080044
65	Tengrite (Y) (532nm)	R060180
64	Shilovitite-(Ce) (532nm)	R060911

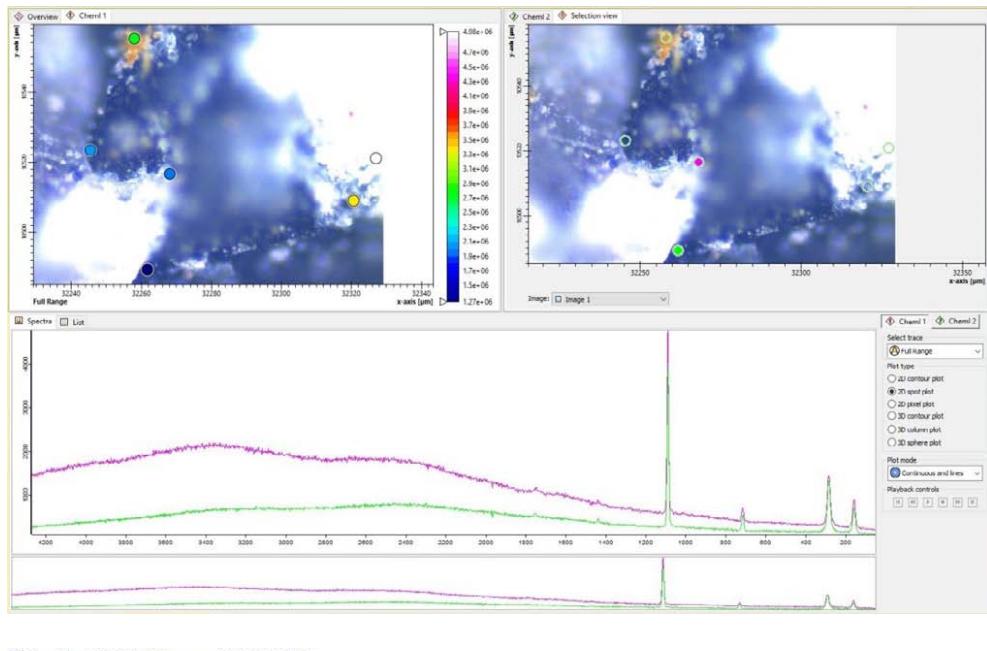
Search

R080043
Sahamalite-(Ce)
 $\text{Ca}_2\text{Mg}(\text{CO}_3)_2$
Mountain Pass Mine (Sulfide Queen mine); Bastnaesite deposit; Mo

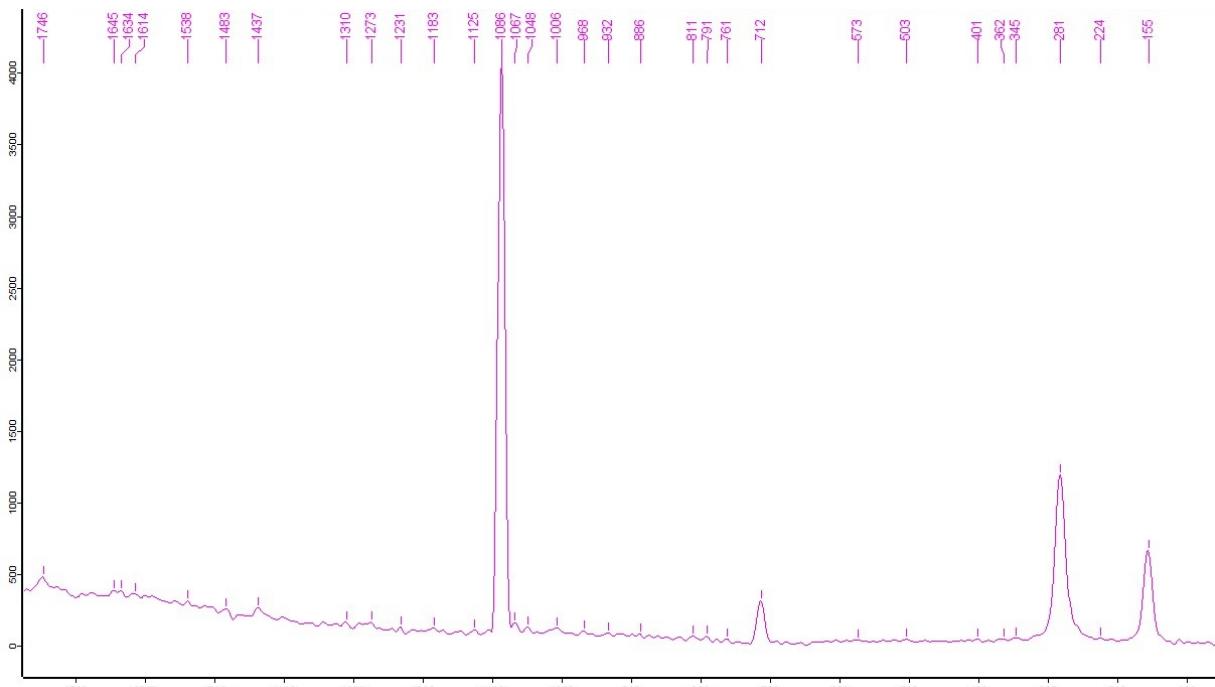
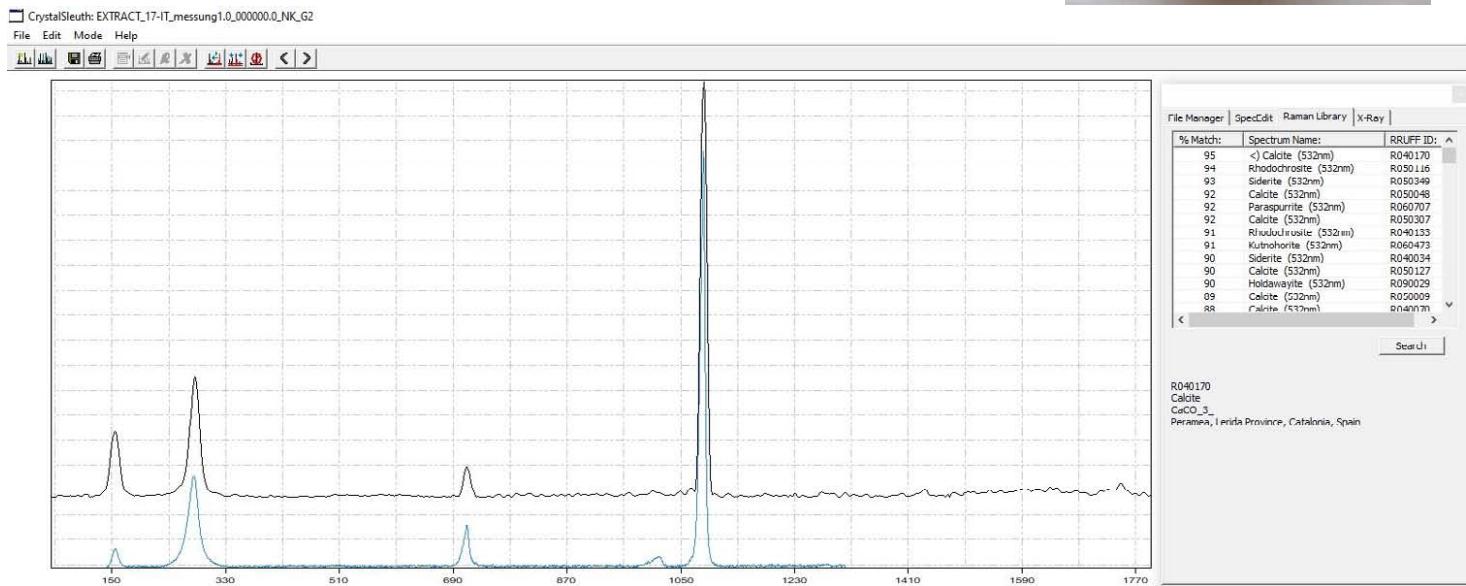
R040030
Dolomite
 $\text{CaMg}(\text{CO}_3)_2$
Austria



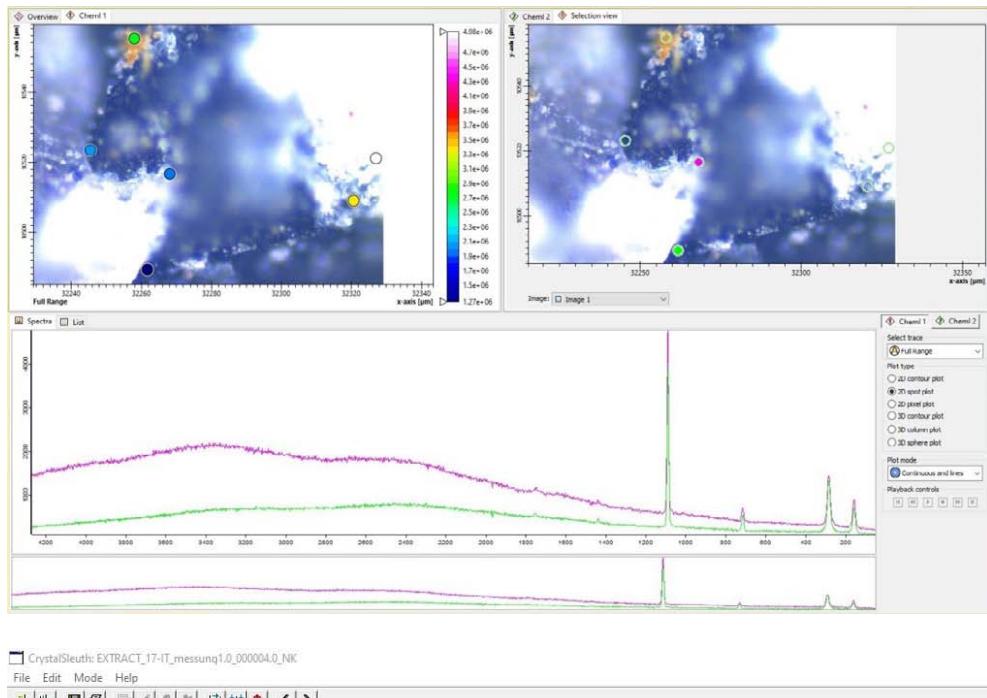
Sample Site 17 : Stone 1_spectra 1 indicates : Calcite (\rightarrow see RRUFF_CS)



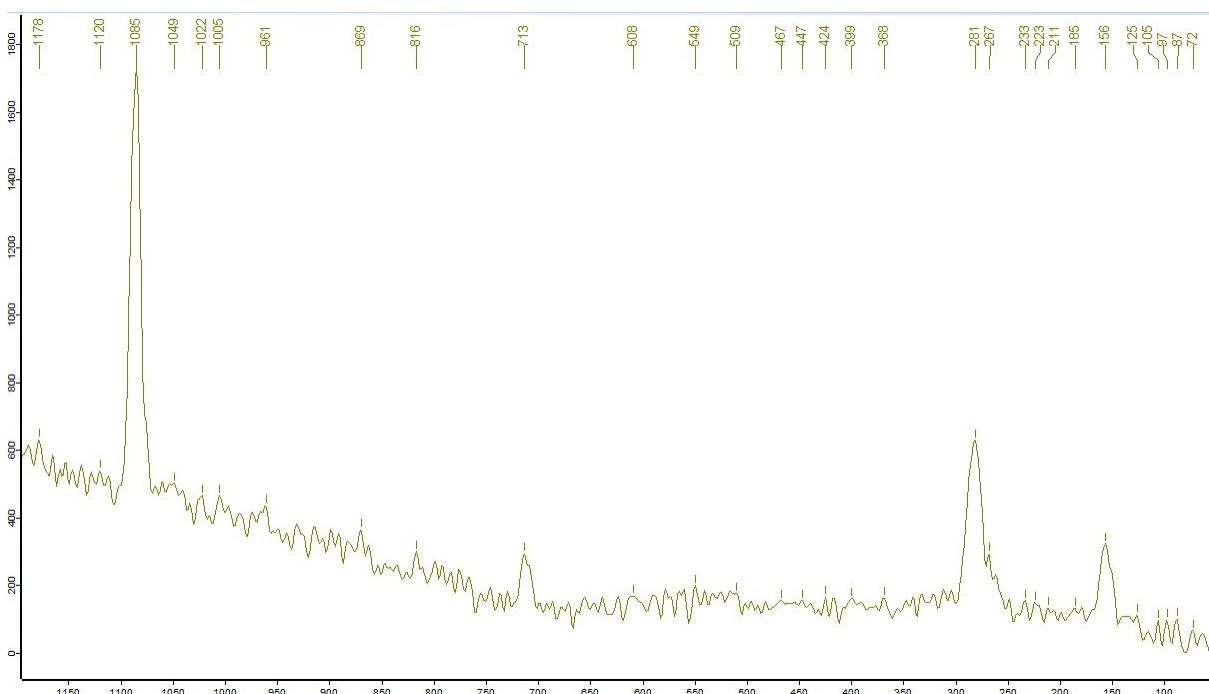
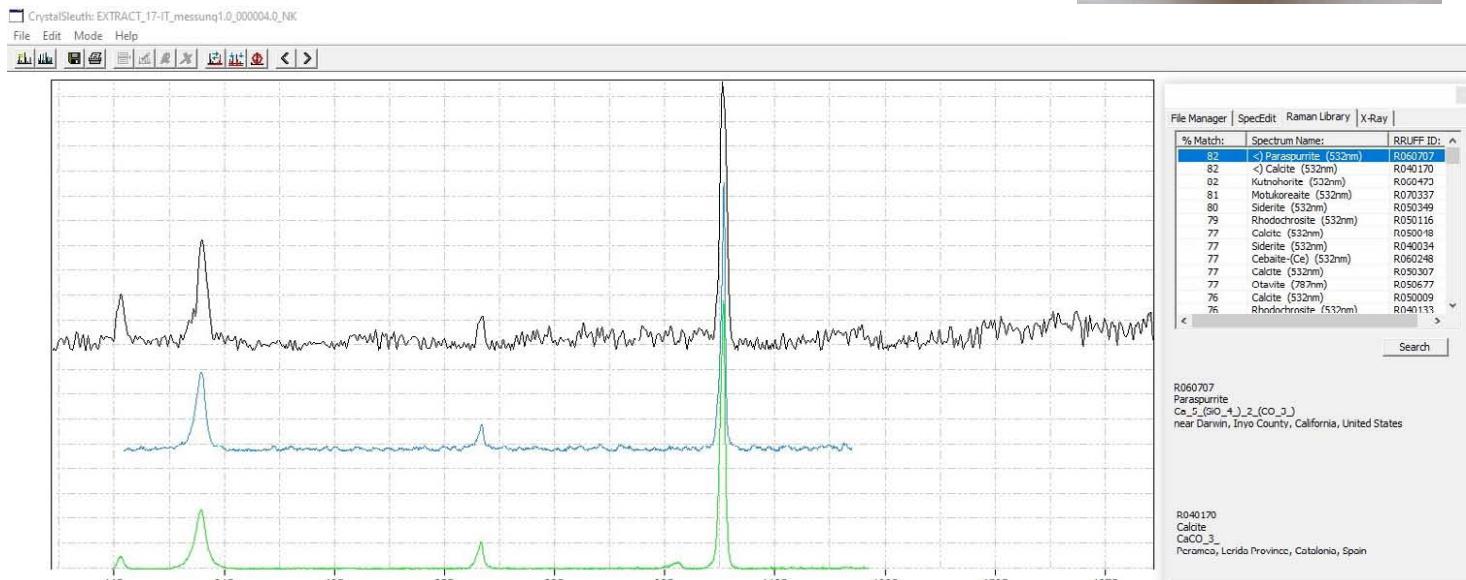
Sample :



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)

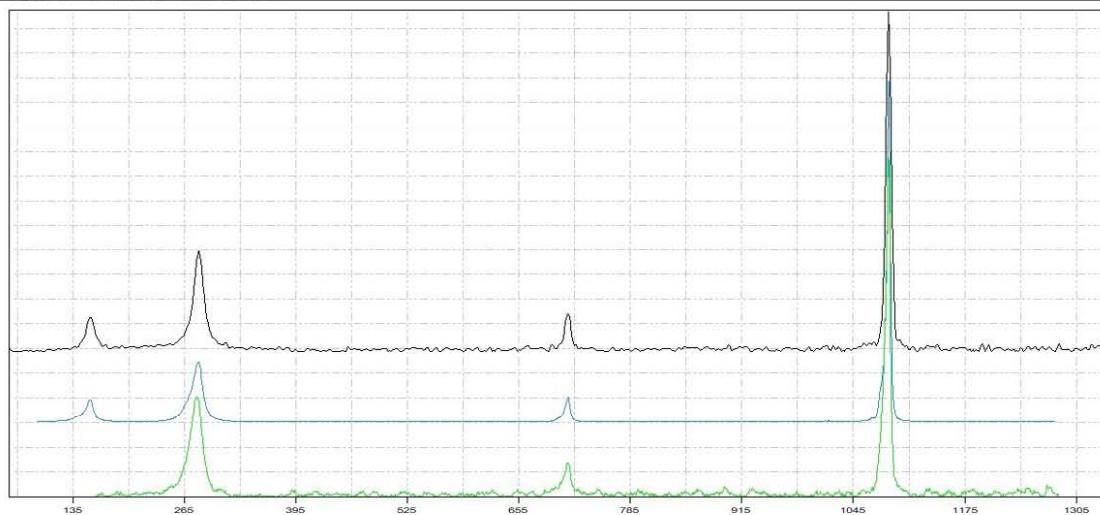
Sample :



CrystalSleuth: EXTRACT_Italy_22_stone with white crystal bands.0_000003.0

File Edit Mode Help

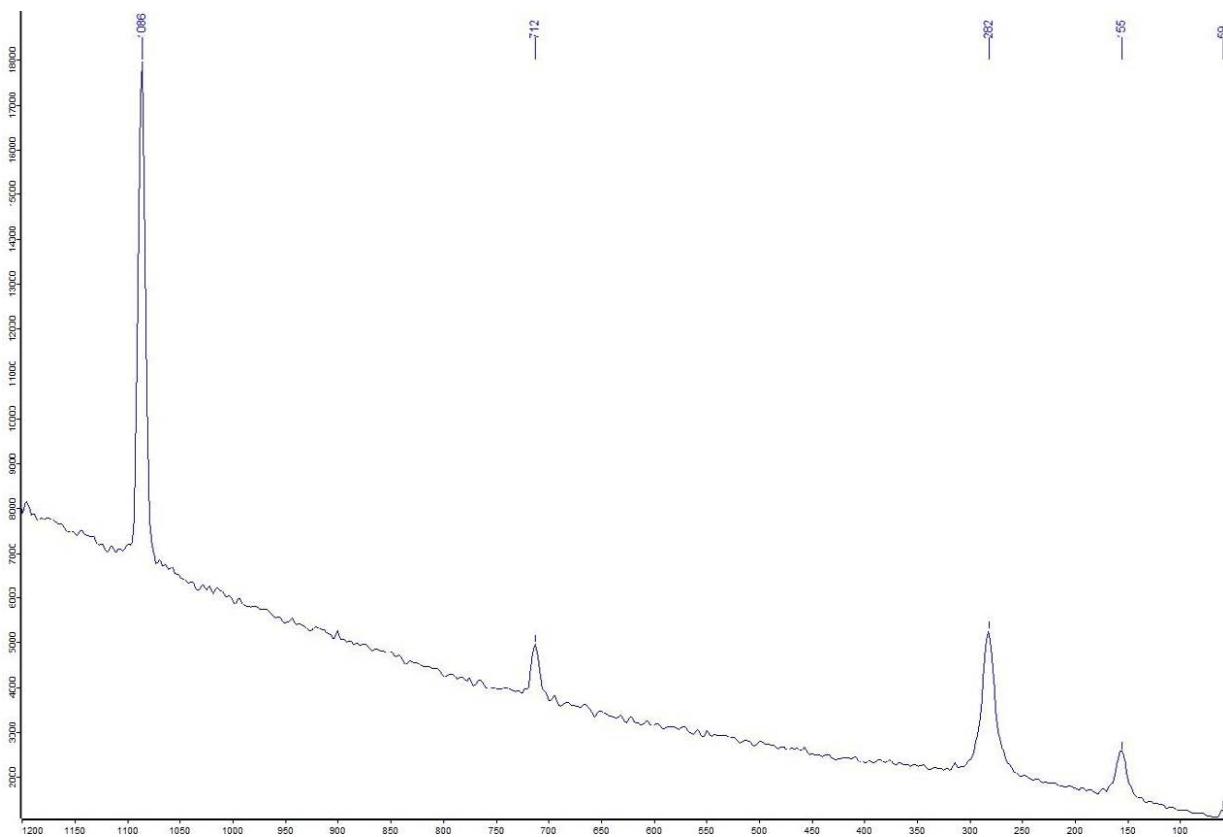
[File] [New] [Open] [Save] [Print] [X] [Help] [Exit]



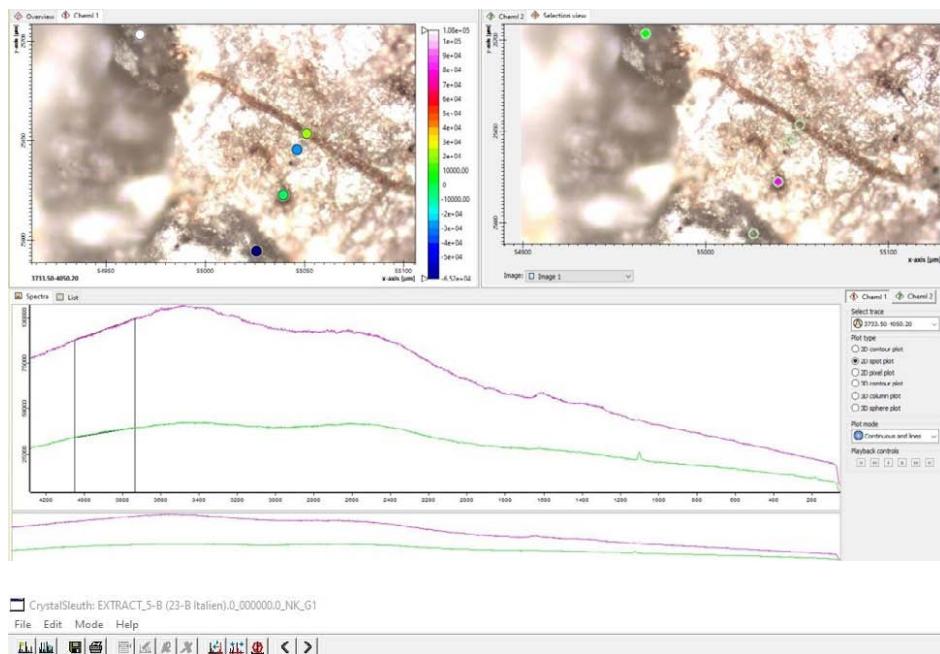
% Match:	Spectrum Name:	RRUFF ID:
97	< Calcite (532nm)	R050307
95	< Paraspurrite (>522nm)	KU6010/
95	< Rhodochrosite (532nm)	R050116
95	< Calcite (532nm)	R050107
94	< Calcite (532nm)	R050127
94	< Calcite (532nm)	R050009
94	< Calcite (532nm)	R040070
93	< Calcite (532nm)	R050048
93	< Calcite (532nm)	R050130
92	< Rhodochrosite (532nm)	R040133
91	< Rhodochrosite (532nm)	R050019
90	< Calcite (532nm)	R050128
90	< Siderite (532nm)	NN50199

R050307
Calcite
 CaCO_3
Zaire

R060707
Paraspurrite
 $\text{Ca}_3(\text{SO}_4)_2(\text{CO}_3)_3$
near Darwill, Inyo County, California, United States



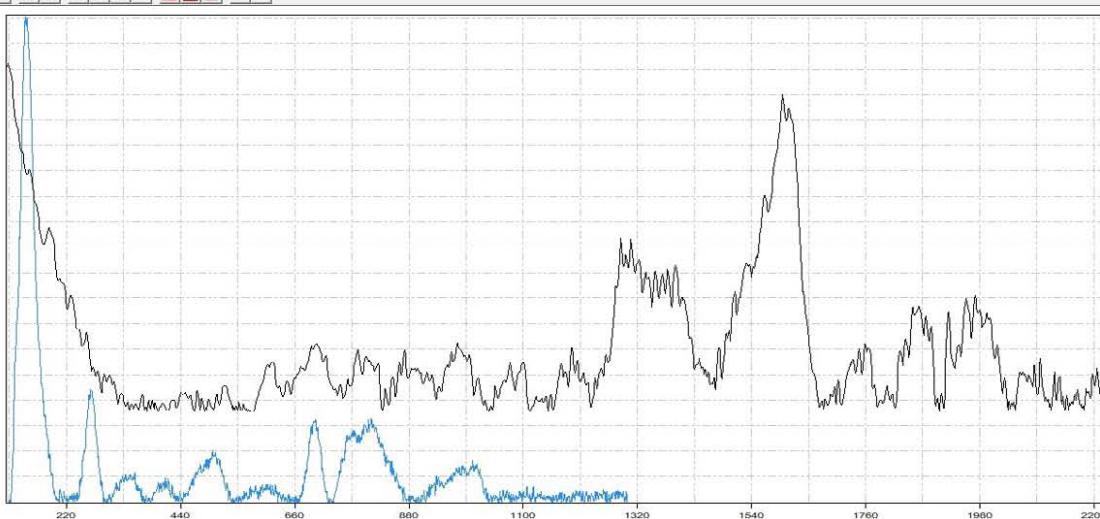
Sample Site 23-B : Stone 1_spectra 1 indicates : Bokite etc. (→ see RRUFF_CS results)



Sample :



CrystalSleuth: EXTRACT_5-B (23-B Italien).0_0000000_NK_G1
File Edit Mode Help



% Match:	Spectrum Name:	RRUFF ID:
78	↔ Bokite (532nm)	R060590
78	Cleakopyrite (532nm)	R059222
78	Antimony (532nm)	R059354
78	Pyrrhotite (532nm)	R059390
78	Tochilinite (532nm)	R060887
78	Pavonite (532nm)	R070566
70	Aquellite (532nm)	R070413
78	Tennantite (532nm)	R080089
78	Dravite (532nm)	R050059
78	Stibnite (532nm)	R050066
78	Calomel (532nm)	KU/U499
78	Mordovite (532nm)	R061118
78	Siderazot (532nm)	R061141

Search

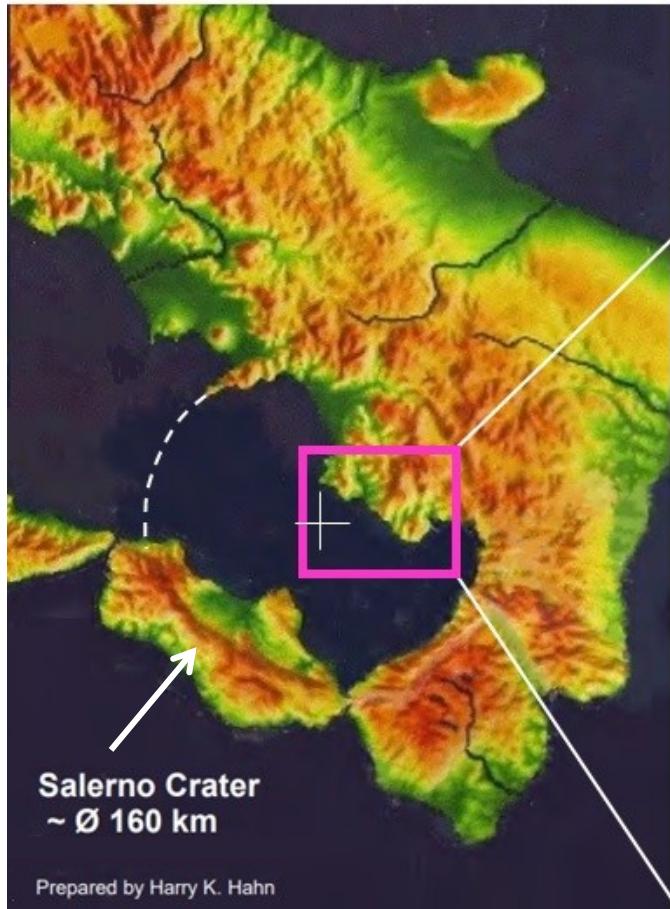
R060590
Bokite
(Al,Fc,Io)-1-3-(V,V,Fc)-8-O-20-#183;7.5H-2-O
Monument #2 mine, Apache County, Arizona, USA



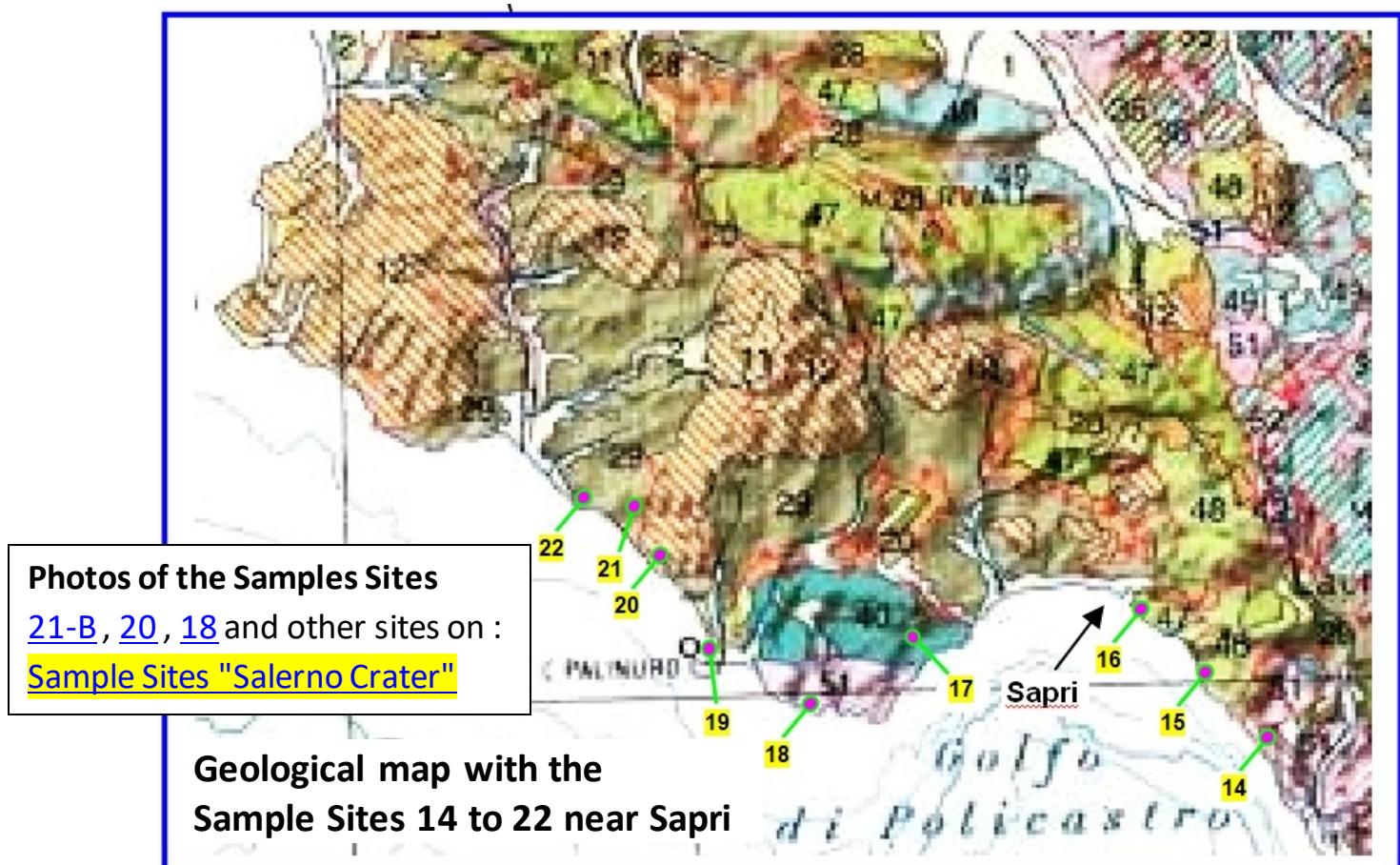
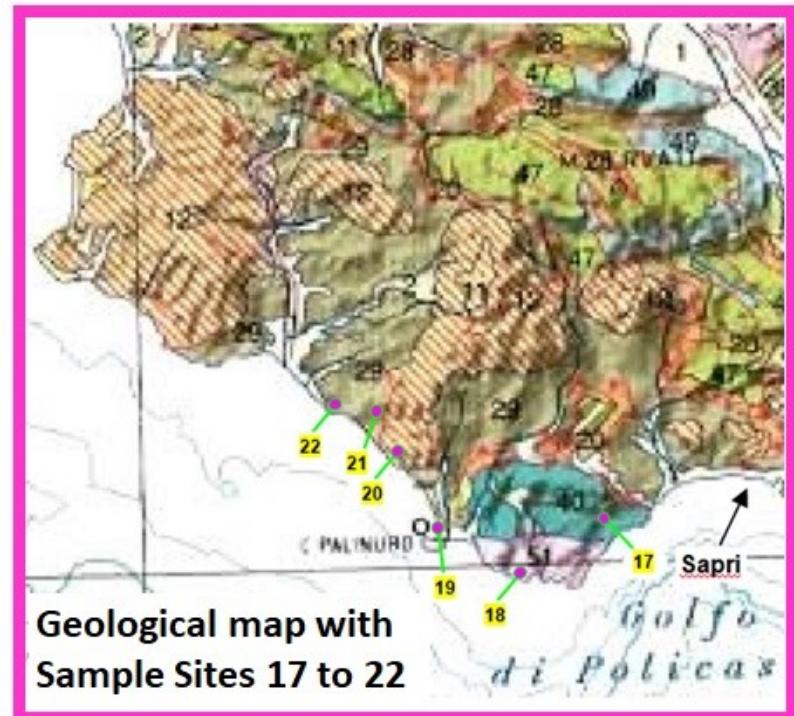
Appendix 1 : Photos of rock samples from sample sites 21-B and 18 to 23 → see next page !

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



Sample Site 21-B



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



21



21

40° 7,670

N

15° 14,621

E

5 m

Italy (SW)_near Sapri

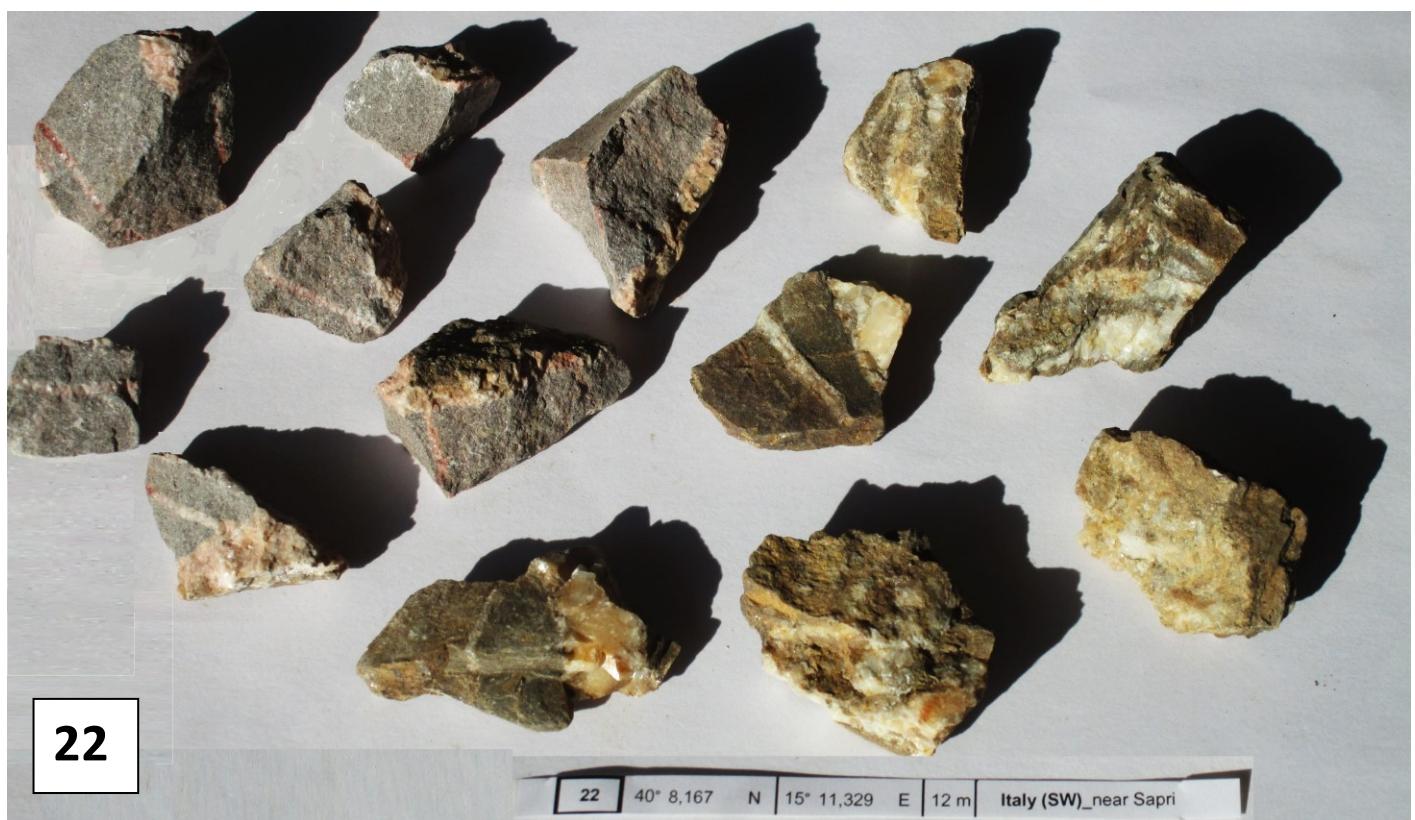
20

20 | 40° 5,616 N | 15° 14,914 E | 24 m | Italy (SW)_near Sapri



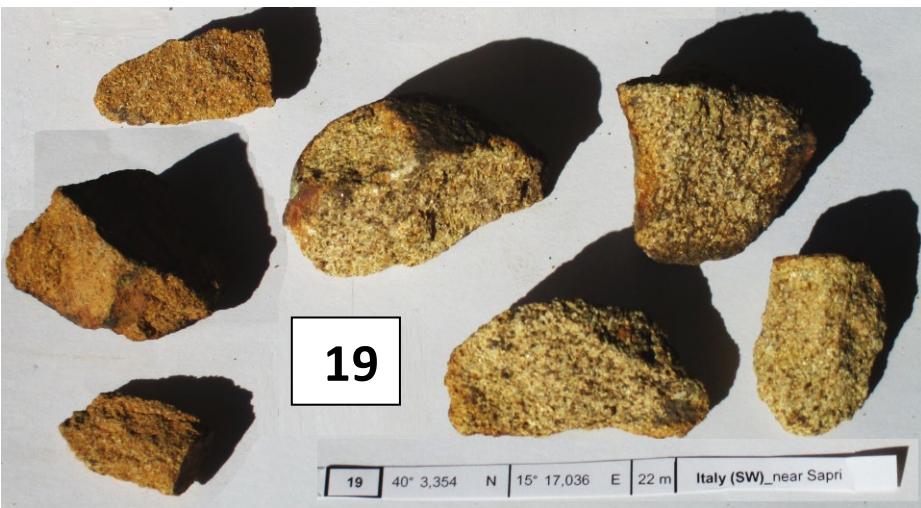
22

22 | 40° 8,167 N | 15° 11,329 E | 12 m | Italy (SW)_near Sapri



19

19 | 40° 3,354 N | 15° 17,036 E | 22 m | Italy (SW)_near Sapri



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

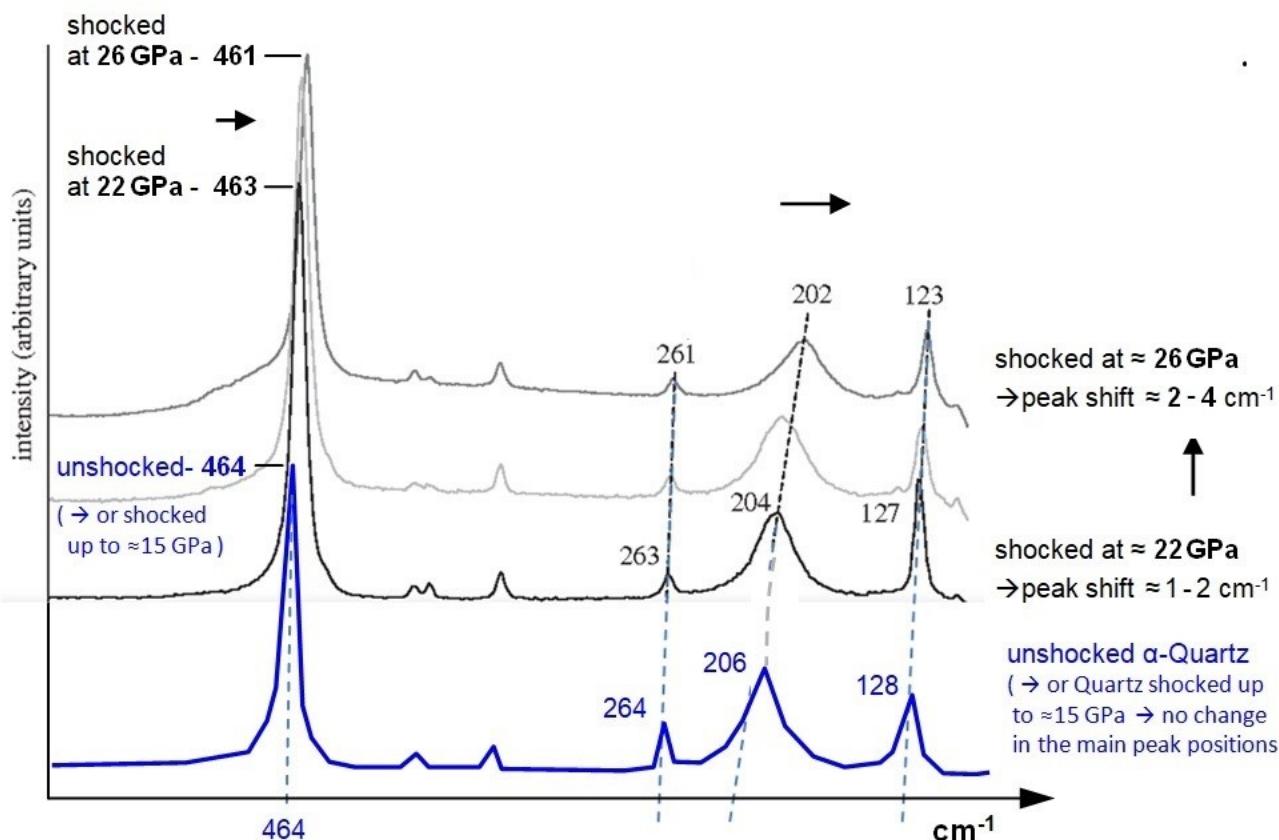
In order to verify a sample site as an impact site or impact structure, [shock-metamorphic effects](#) must be discovered in the rocks of the sample site. This can be done by different methods.

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.

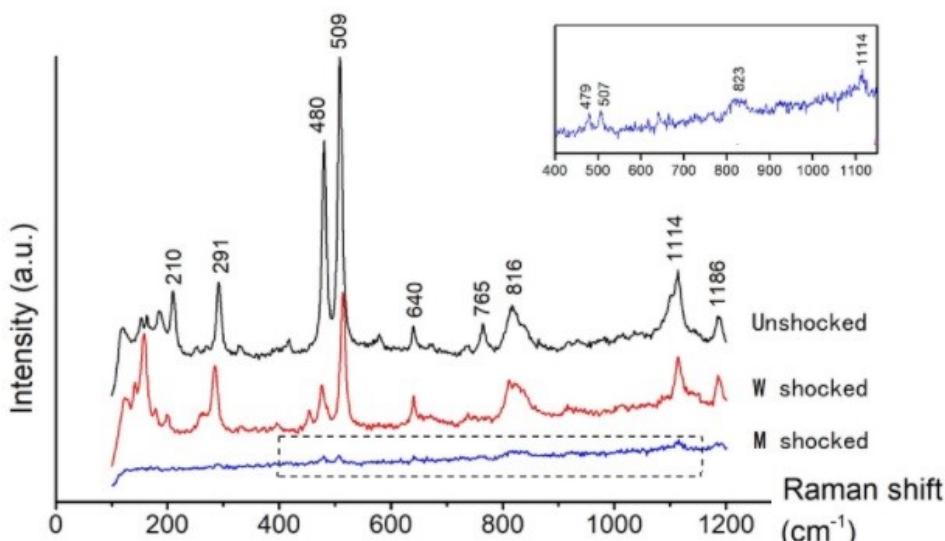
Mc Millan et al. (1992) and others have shown that the main RAMAN-peaks of Quartz shift towards lower frequencies if the Quartz was exposed to a shock-pressure > 15 GPa. → see diagram below

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 $1 - 4 \text{ cm}^{-1}$ 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, Phillip 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/cfaaf6eb3e46fb2912fb91c7acf40e88e721132>

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-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>

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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