

# The Ø 15 x 11 km Anaga Crater on Tenerife ( Canary Islands )

## - RAMAN Spectra of selected Rock Samples -

by Harry K. Hahn / Germany - 16.3.2022

### Summary :

Here a summary of the Raman-spectroscopic analysis a of rock-samples which I have collected near the Ø 15 x 11 km "Anaga Impact Crater" on Tenerife, and on other interesting sample sites on Tenerife.

The Gravity Anomaly Map of the Canarian Islands indicates a large scale Impact Event. This impact event probably was the result of Ejecta from the PTI ( Permian Triassic Impact ) which formed a large secondary crater, the hypothetical Ø 430 x 290 km Gibraltar Crater (GIC). ( see gravity anomaly map on the next page ). The smaller oblique (elliptical) impact craters indicated on this Gravity Anomaly map, offshore of the Islands Teneriffa, Fuerteventura and Lanzarote, belong to this impact event and are located along the hypothetical crater-wall (-rim) of the GIC. A magnetic anomaly map of the Atlantic Ocean-floor south-west of Spain provides indication for this Ø 430 x 290 km Gibraltar Crater.

(→ see the explanation on pages 28 & 29 of my PT Impact Hypothesis: Part 2 (or alternative here: P2))

The hot spots which caused the Canary Islands originally were impact sites of large ejecta fragments, which were ejected from the Permian Triassic Impact Crater in the Arctic Sea. And I am sure that these impact sites ( hot spots ) were produced by the same large-scale secondary impact event ( caused by the PTI), which also formed the Bay of Lyon Crater (or BLC) and other impact structures in Spain (or L2)

In all collected rock samples no quartz was found. This makes it difficult to provide evidence for the secondary impacts of the PTI which probably caused the hotspots of the Canarian Islands. One sample from sample sites 7 probably shows some spectral lines coming from small traces of quartz in the rock.

Some of the analysed feldspar-samples may show Raman-spectra which indicate (W) weakly-shocked or (M) moderately-shocked Alkali-Feldspar. But these Raman-spectra must be analysed by experts who have the experience to correctly assess such spectra. Unfortunately I don't have the required expertise. The Raman-spectra of feldspar-samples from sites No.: 2, 5, 7, 9 & 58 may indicate shocked minerals.

( an explanation to Raman spectra of shocked Alkali-Feldspar : see at page 36 in the Appendix 3 )

Minerals that were indicated by the Raman-spectroscopic analyses : Labradorite (2) ; Orthoclase (5) ; Augite, Titanite, Reyerite, Analcime (7) ; Annite, Augite (9) ; Anorthoclase (58) → samples site No. in ( )

Beside possible shocked minerals or minerals which may indicate an impact event, there definitely is one site on Tenerife that should be examined in more detail, in regards to the described impact event.

This is sample site 58, an old rock-island inside the large caldera of the Pico del Teide Volcano. This old rock probably was lifted by the impact or by the later volcano from the original ancient ocean floor.

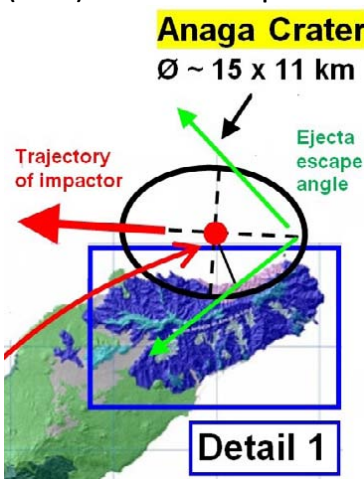
Other interesting sites are located on the road along the ridge-top of the Anaga Range, in the Teno Mountain Range and site 10 which also belongs to the old basaltic shield of Tenerife.

→ Images of the analysed rock samples and photos of the sample sites are in the Appendix at page 30

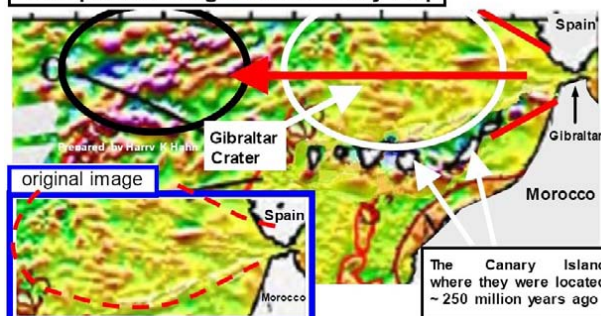
→ A general summary to all analysed samples regarding my PTI-hypothesis (P1) → in Part 6 (or: P6)

→ More images of all sample sites are available on [www.permiantriassic.de](http://www.permiantriassic.de) or [www.permiantriassic.at](http://www.permiantriassic.at)

Geological Map of the Anaga Range (→ blue) with indicated Impact Crater



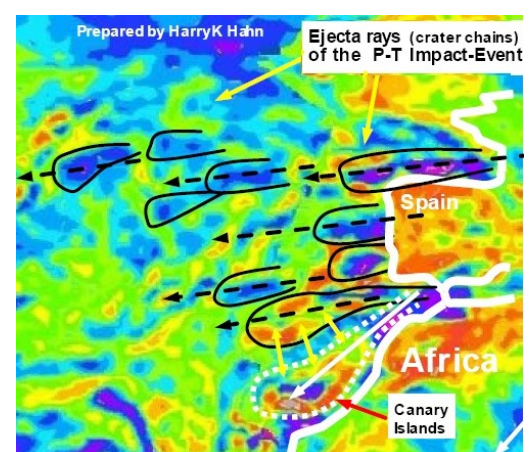
manipulated Magnetic Anomaly Map



Old Rock-island (PT-age ?) inside the Pico del Teide caldera



Gravity Anomaly Map of the Canarian-Island-area



## The Ø 15 x 11 km Anaga Crater has caused a hotspot

The Island Tenerife shows evidence of an Impact Event. This is the Ø ~15 x 11 km hypothetical **Anaga Crater** just north of the Anaga Range on Tenerife. This “Anaga Crater” in all probability was caused by an oblique Impact ( a secondary impact ) caused by the Permian-Triassic Impact Event (PT-I). The impact point of the Anaga Crater in deeper crust layers ( a “hot spot” ) later drifted away from the Anaga Crater ( see red arrow ), caused by an expansion tectonics process, and it was responsible for the formation of the large Pico del Teide Volcano which is still active today. The deep impact point which probably caused a puncture (hole) in Earth’s crust was responsible for the massive volcanism ( Pico del Teide volcano ) on Tenerife.

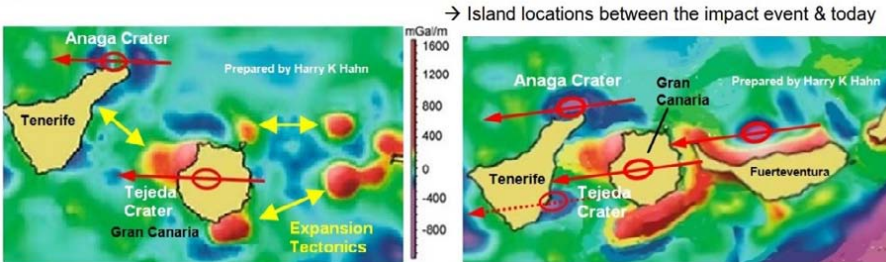
An interesting site is an „Old rock Island“ inside the caldera which may provide proof of the Anaga Crater impact event. This old rock could have a P/T-age of ~252 Ma. The old rock probably was lifted by the impact or by the growing volcano from the original ancient ocean floor.

The old “Teno Mountain Range” probably was the western extension of the Anaga Range (Crater Wall) at the time of the PT-Impact ( and was effected by the Anaga-Impact ). Later it drifted away from the Anaga Range ( see black arrow on the image ) caused by an “expansion tectonics process” which was triggered by the PT-Impact Event. The hot spot is still slowly drifting away from the Anaga Crater in south-western direction as the red arrow on the geological map indicates.

Please also read about [the 13,5 x 10 km Ajú Crater on Fuerteventura](#).

original Gravity Anomaly Map – Canary Islands

modified Gravity Anomaly Map :



## The Gravity Anomaly Map of the Canarian Islands indicates a large scale Impact Event

A strong indication for an impact event on Tenerife comes from the fracture pattern in the Anaga Range, which shows an area effected by compression stress and an area effected by tensile stress, separated by a curved rift zone.

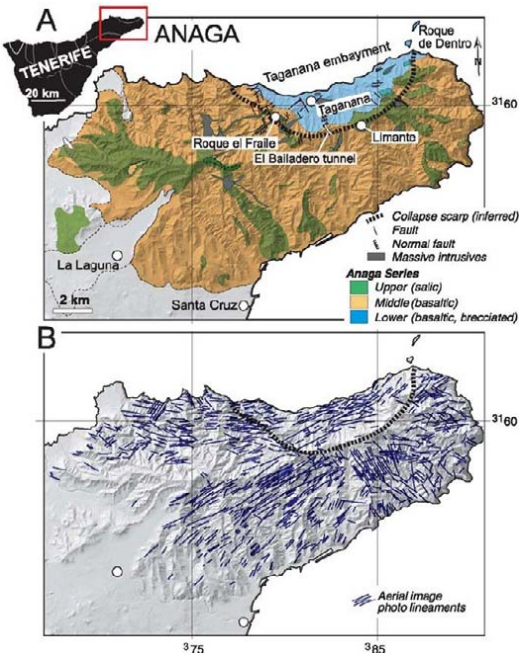
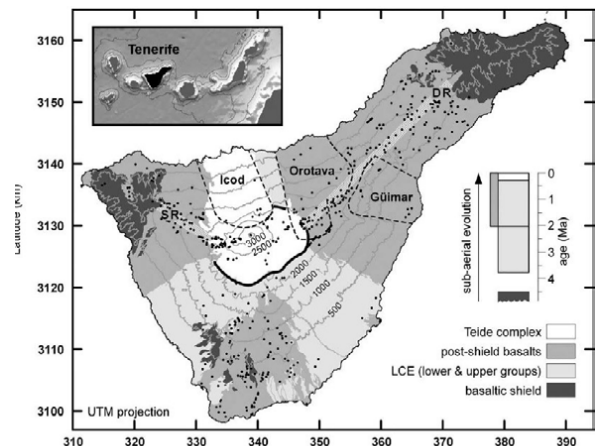
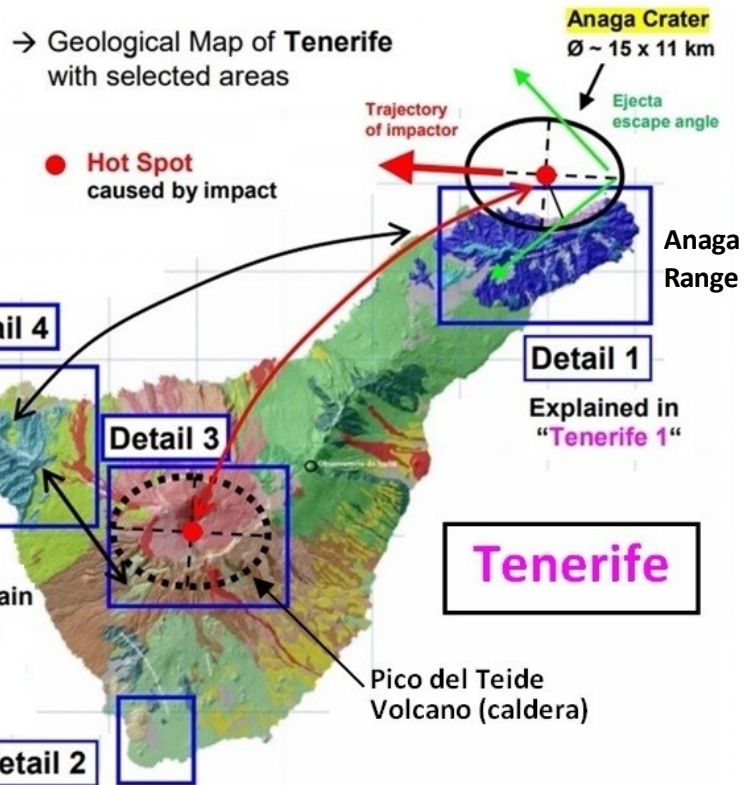


Fig. 2 Maps of Anaga area showing (A) a simplified geological map with the three major geological series, and (B) lineament distribution from aerial images on Anaga. Dashed black line marks the morphologically prominent horseshoe-shaped amphitheater and debris outcrops. Note the numerous lineament paths that outline this amphitheater. In central Anaga, a NE-SW swarm of lineaments is pronounced. This trend becomes more diffuse towards the northeastern coast of Anaga. To the southeast, lineament traces are oriented NNW-SSE (160°) and thus perpendicularly to the topographic ridge WSW-ESE. This trend is not favored by topography and is not found within the northern sector, i.e. it appears to be confined to the south of the amphitheater



This map shows the old basaltic shield (black) → the fragments of the original Anaga Range at PTI-time

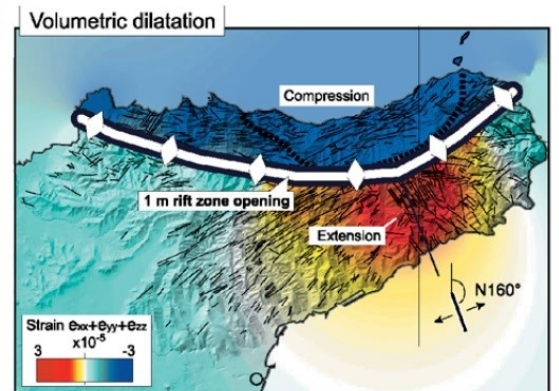
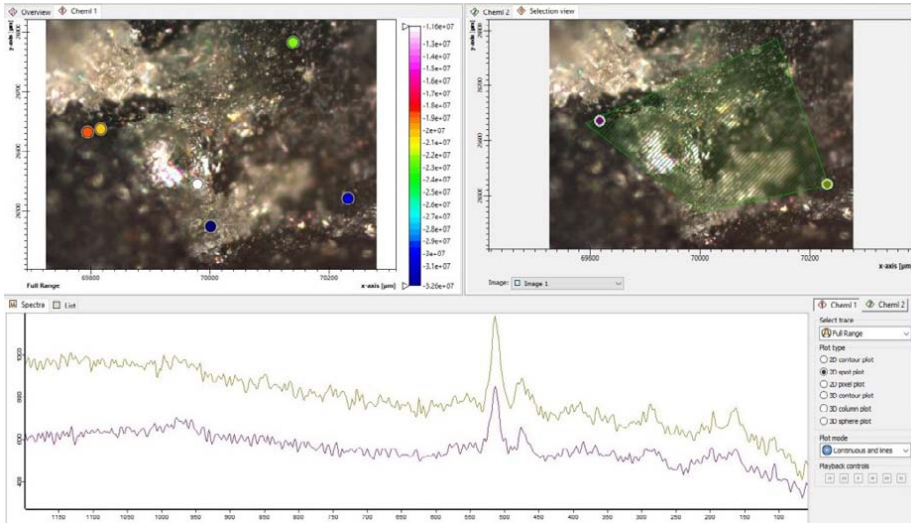


Fig. 7 Dislocation models calculated at a horizontal plane. A segmented rift zone was defined with an outline similar to the middle rift episode on Anaga. A curved tensile fault simulates the curved rift zone, uniform dislocation is 1 m. (A) Surface displacement vectors show that movement focused on the northern flank that is encircled by the rift zone. Dike intrusion along such a curved rift zone will thus promote flank creep. (B) Volumetric dilatation caused by 1-m horizontal widening of a curved rift zone. Dislocation models were calculated for a horizontal plane at 2 km depth, i.e. approximately at sea level. Positive strain (red color) matches the region where the third rift arm oriented NNW-SSE (160°) developed on Anaga. Negative volumetric dilatation is found elsewhere, strongest in the northern sector. Virtually complete absence of the NNW-SSE dike trend in the northern sector is due to the compressive field to the north of the curved rift

Sample Site 5: Stone 1\_spectra 1 ( dark mineral ) indicates : probably Orthoclase or Anorthoclase



Sample :



The spectrum probably indicates weakly shocked Orthoclase or Anorthoclase

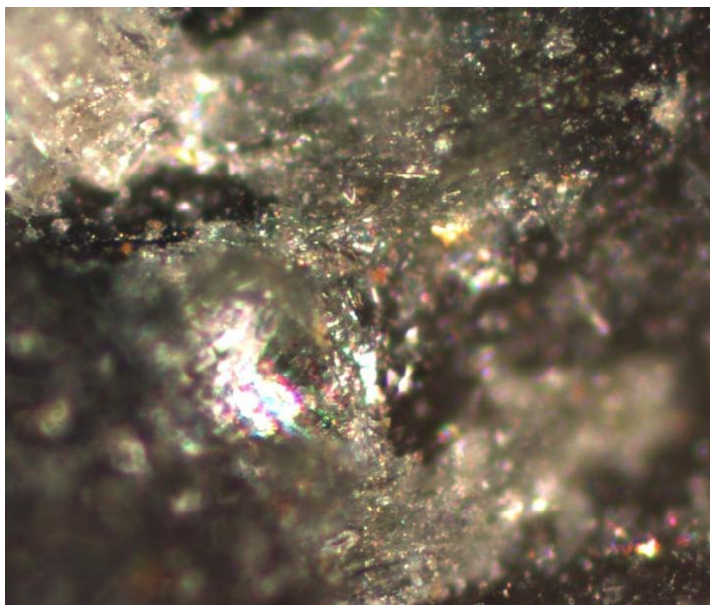
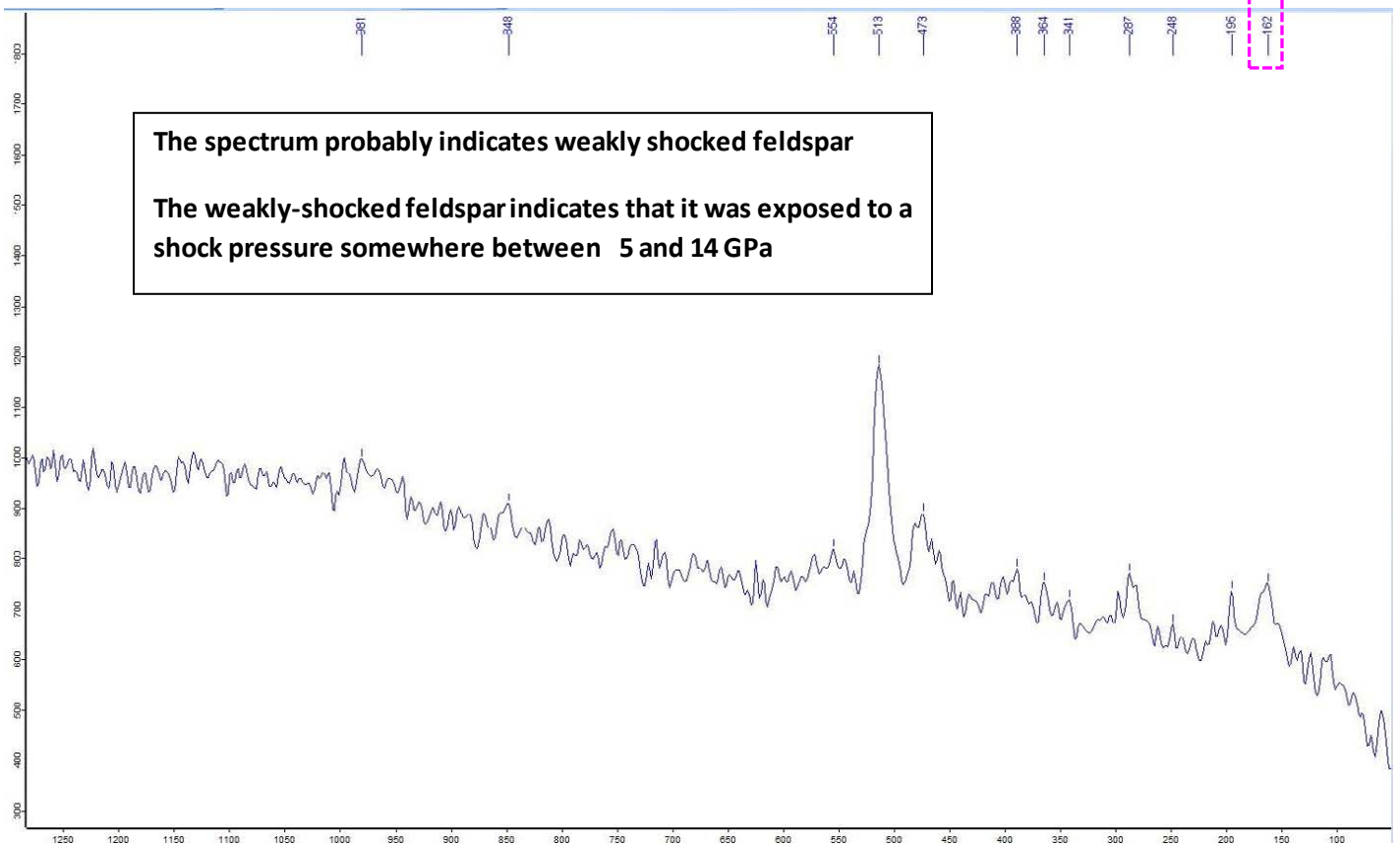
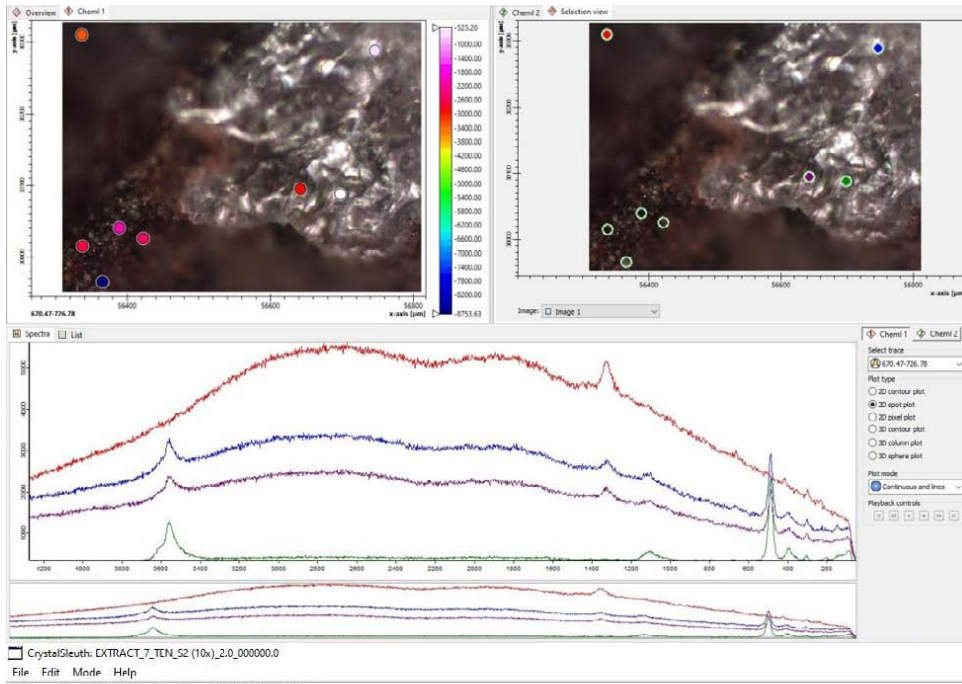


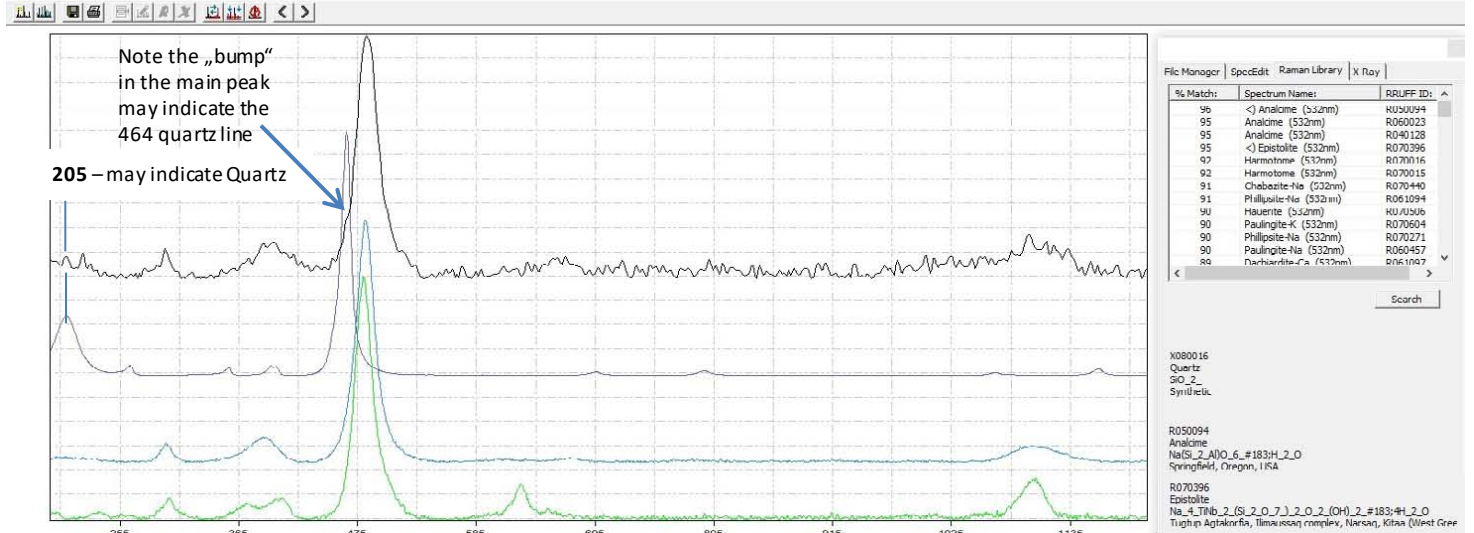
Image size  $\approx 300 \times 300 \mu\text{m}$

**Sample Site 7: Stone 5\_spectra 1- A indicates: Analcime\_Epistolite and Quartz(?) (→ RRUFF\_search result)**

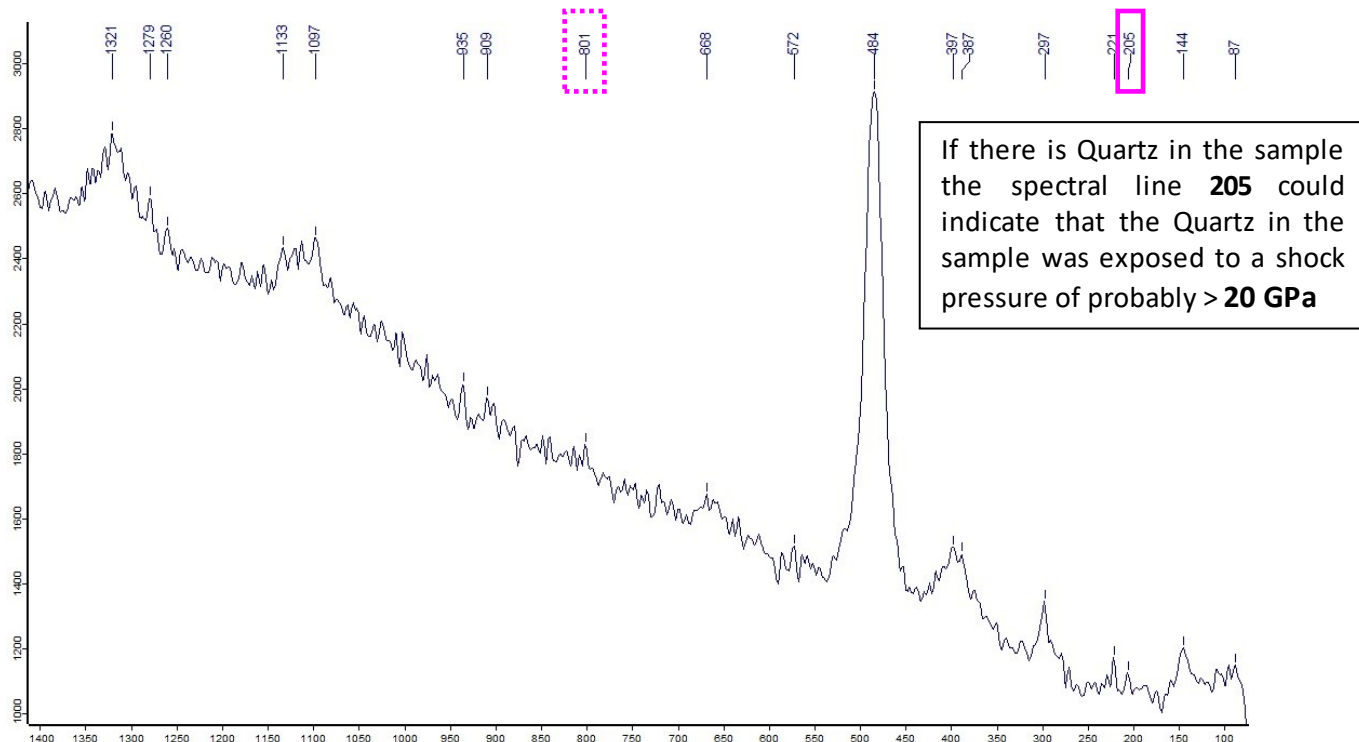


**Note :**  
Spectral-lines of Quartz may be present in the spectra of the sample ( 32% match ). This could indicate a small amount of quartz in the rock

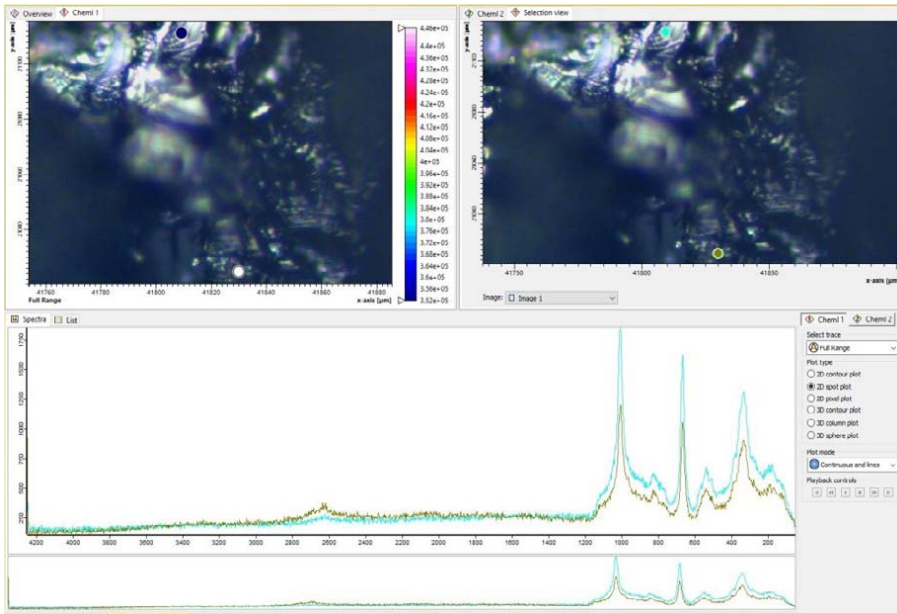
**Sample :**



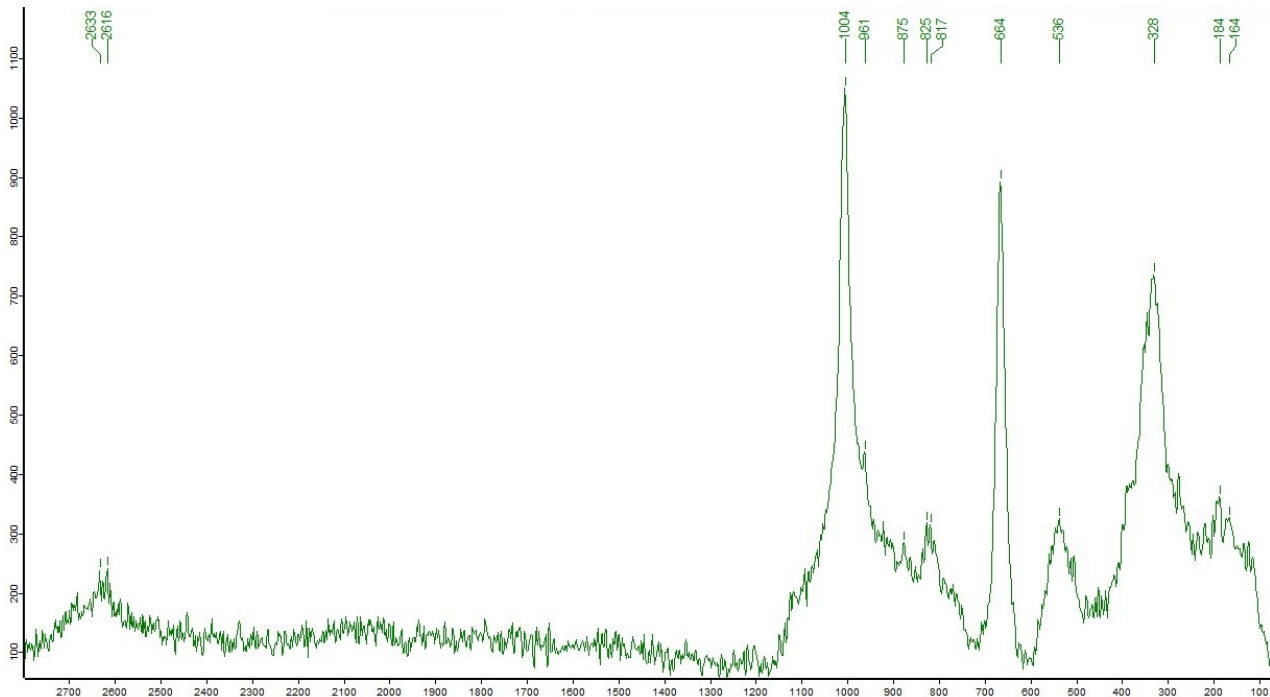
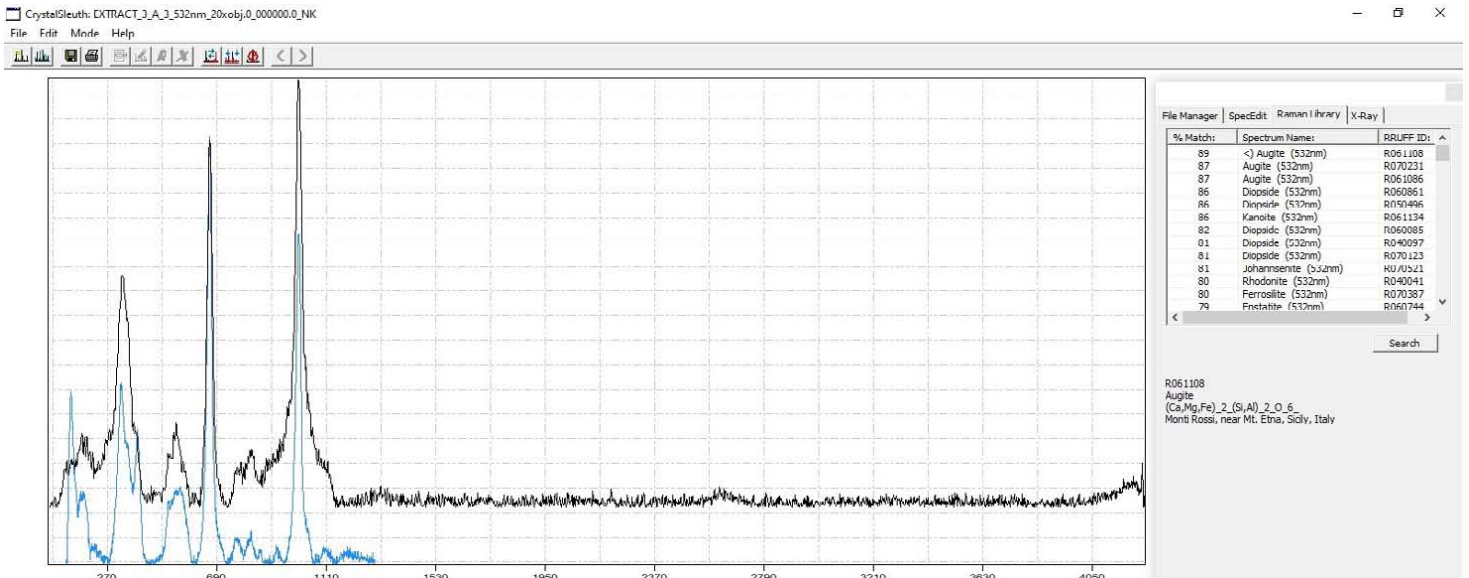
**The spectral line 205 which probably comes from Quartz may indicate a shock event ( → peak shift from 206 to 205 )**



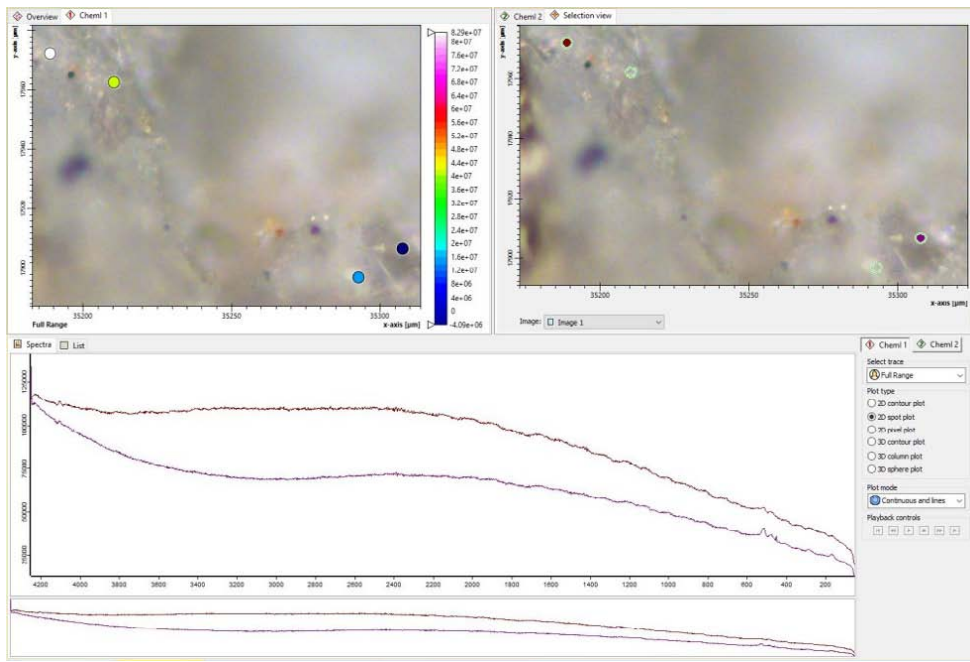
Sample Site 7: Stone 1\_spectra 3 ( dark mineral ) indicates : **Augite** ( → RRUFF\_CS search result )



Sample :



Sample Site 9: Stone 1\_spectra 1 ( white minerals ) indicates : Orthoclase , Microcline etc. ( → RRUFF\_CS )

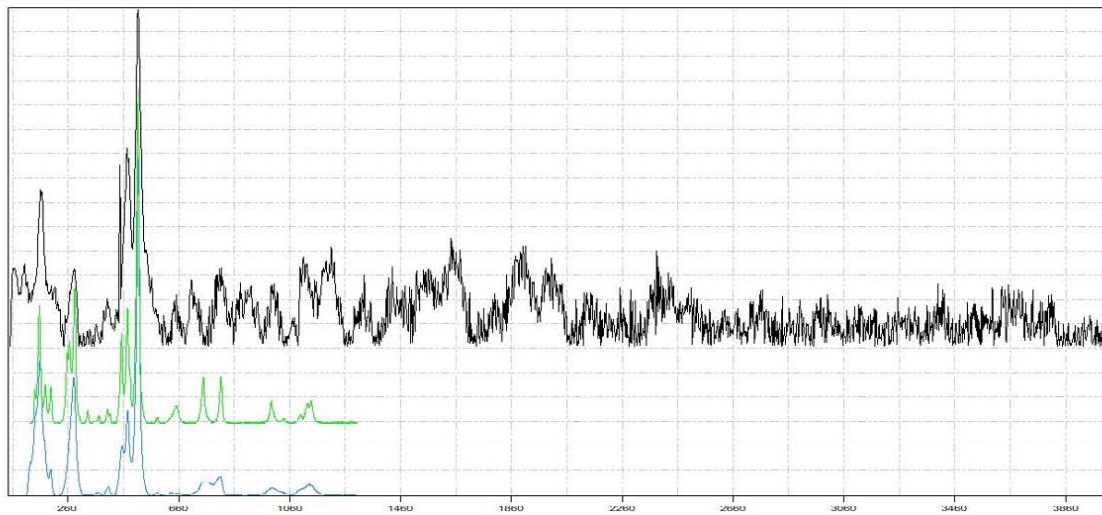


Sample :



CrystalSculpt: EXTRACT\_2\_1\_532nm\_20xobj\_0\_000003\_0\_NK

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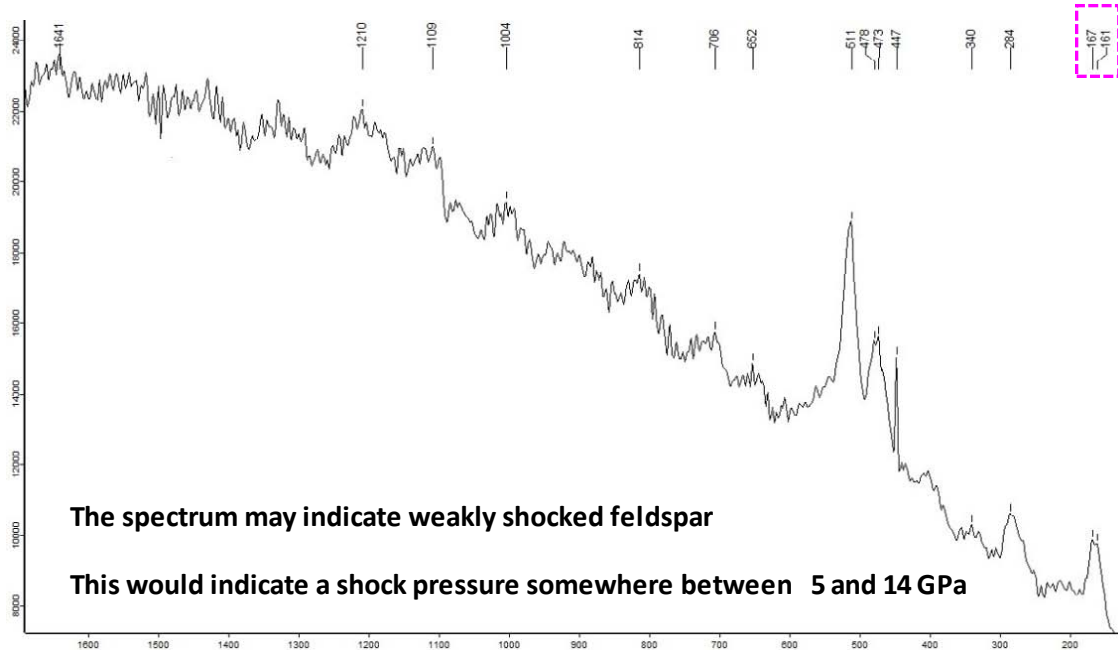


% Mat(L):	Spectrum Name:	RRUFF ID:
62	<  Orthoclase (532nm)	R060077
62	Orthoclase (532nm)	R040055
61	Orthoclase (532nm)	R050185
60	Orthoclase (532nm)	R070001
60	Orthoclase (532nm)	R050367
59	<  Labradorite (532nm)	R050104
59	<  Anorthoclase (532nm)	R060054
59	<  Microcline (532nm)	R050054
59	Microcline (532nm)	R050163
59	<  Hendersenite (532nm)	R070467
58	<  Romeite (532nm)	R060736
58	Labradorite (532nm)	R060221
58	Microcline (532nm)	R040164

Search

R050054  
Microcline  
KAISI\_3\_0\_8  
Kentcha, Negele area, Sidamo Province, Ethiopia

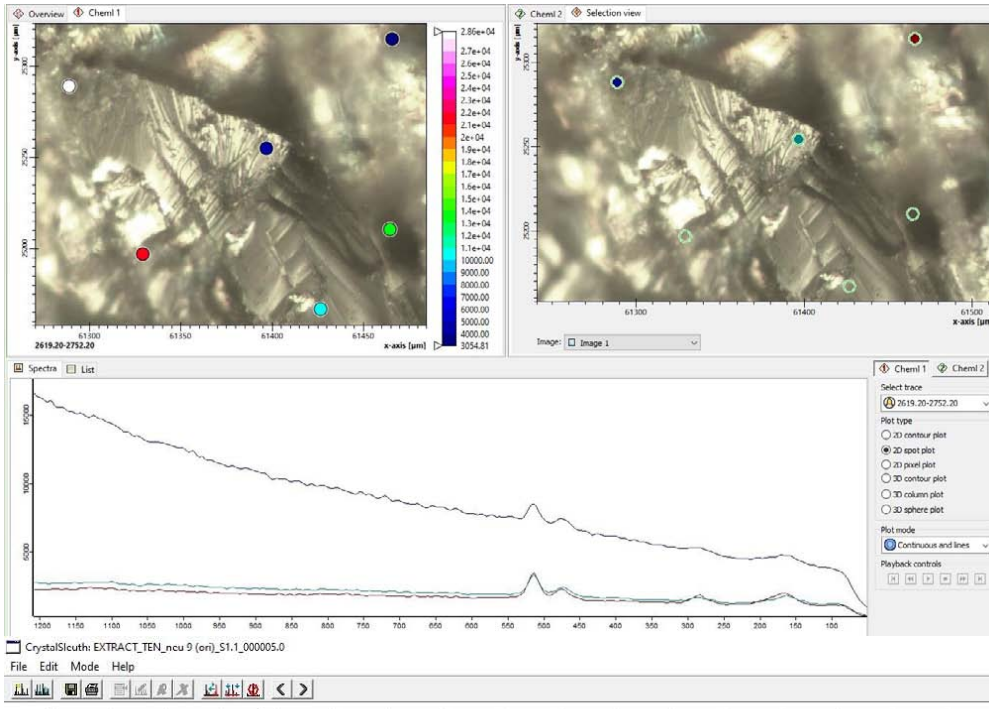
The spectrum probably indicates weakly shocked feldspar



The spectrum may indicate weakly shocked feldspar

This would indicate a shock pressure somewhere between 5 and 14 GPa

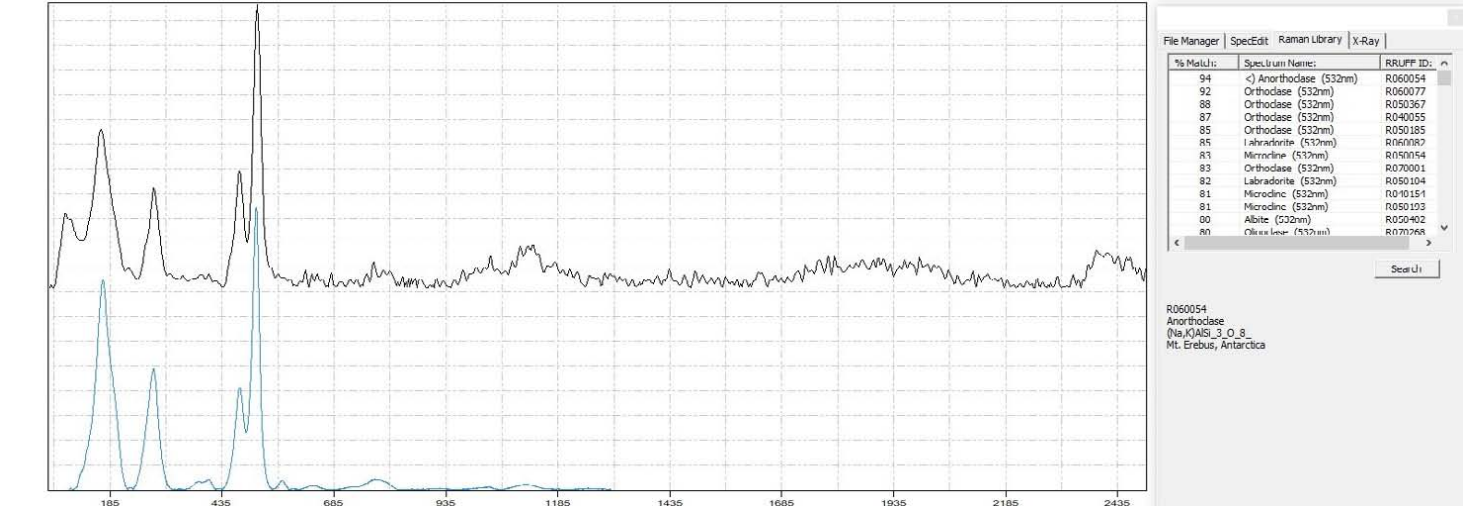
Sample Site 58: Stone 1\_spectra 1 ( matrix of the stone ) indicates : Anorthoclase ( → RRUFF search result )



The sample is from an **old rock island** inside the Teide Volcano caldera.

→ approx. 400m SW from the "Rocks de Garcia"

Sample :



The spectrum probably indicates weakly to moderately shocked feldspar

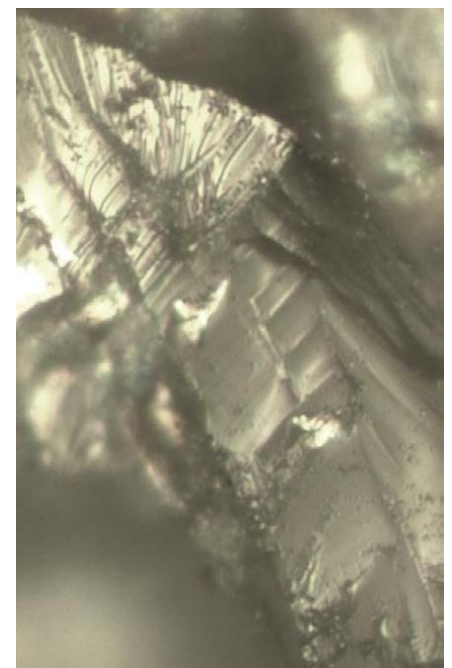
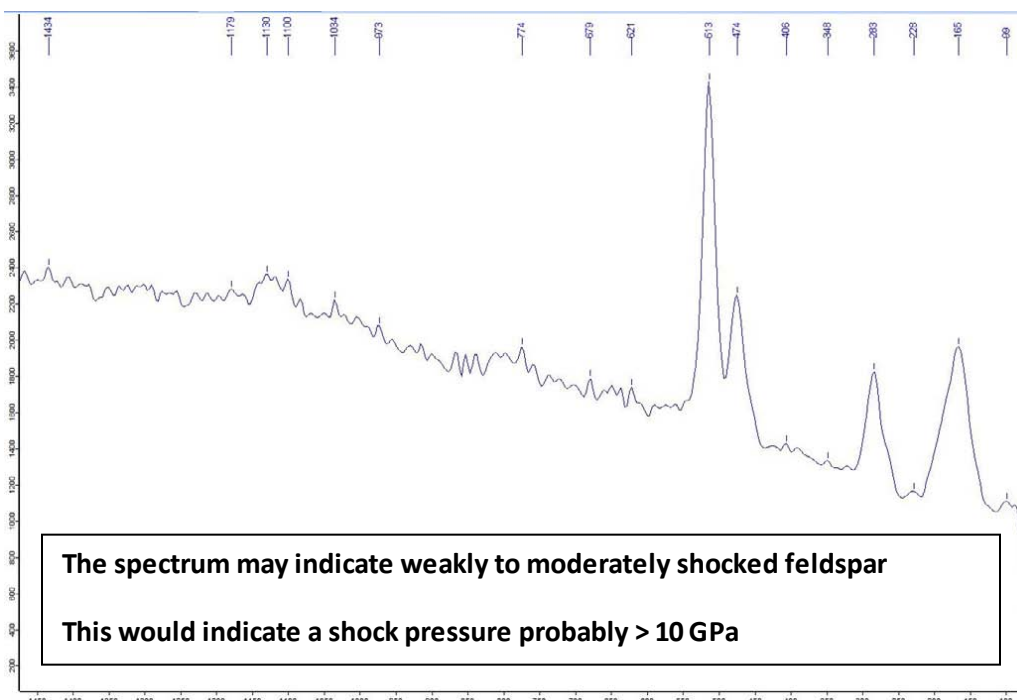
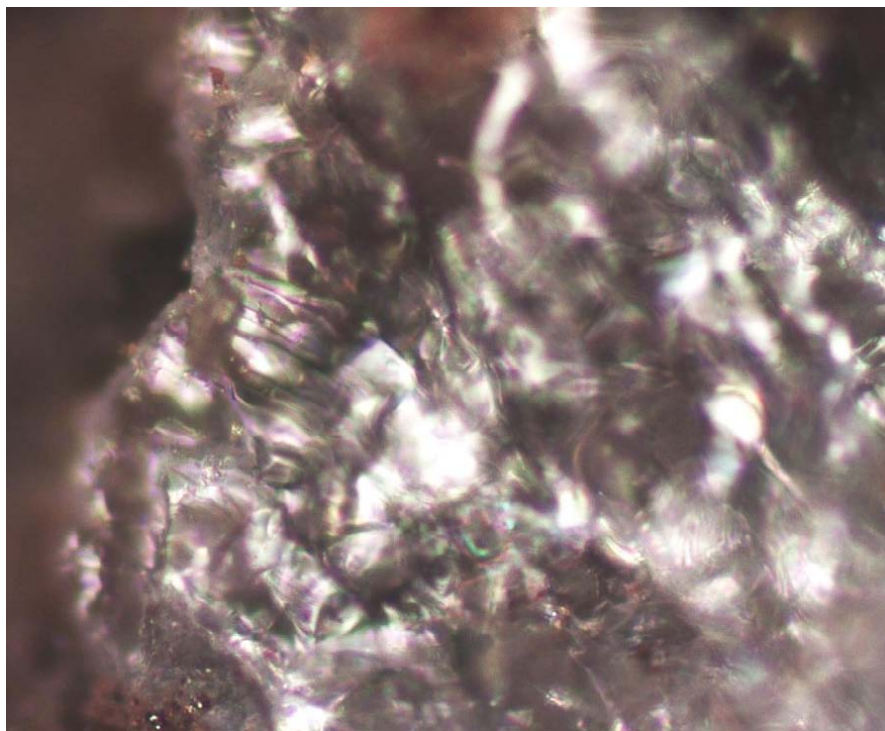


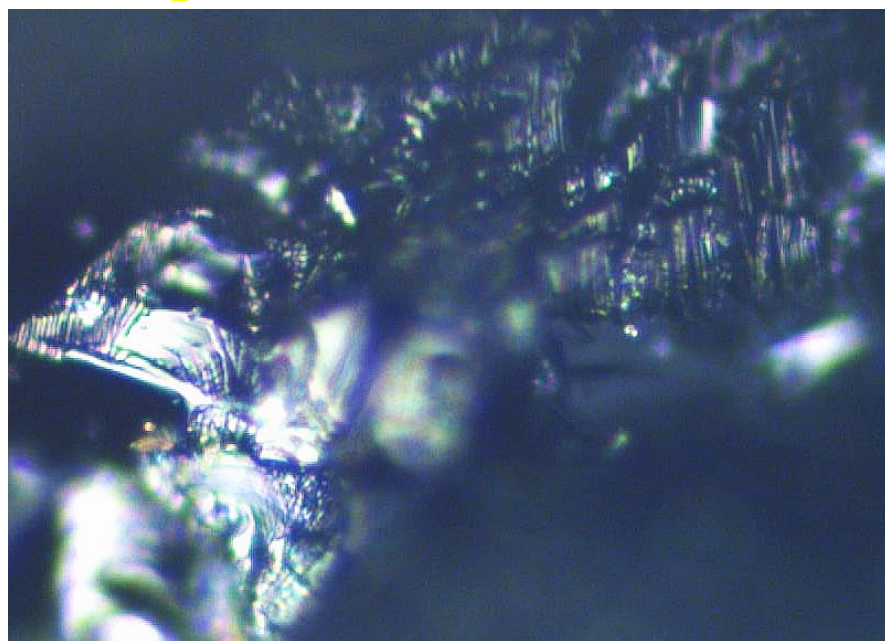
Image size : ≈ 150 x 250 μm

Microscopic Images : Sample from Site 7 → original state ( no preparation )

Sample Site 7 : Stone 5\_spectra 1 : **Analcime\_Epistolite\_& (Quartz)** - Image size : ~ 300 x 250 μm



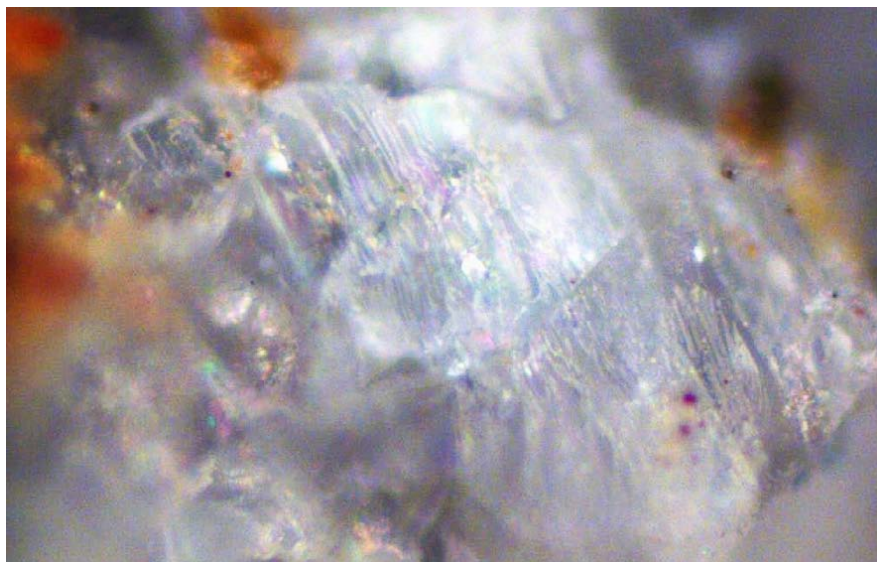
Sample Site 7 : Stone 1\_spectra 3 ( dark mineral ) indicates : **Augite** - Image size : ~ 150 x 120 μm



Note the linear structures visible in the Augite mineral !

( → top righthand side of image )

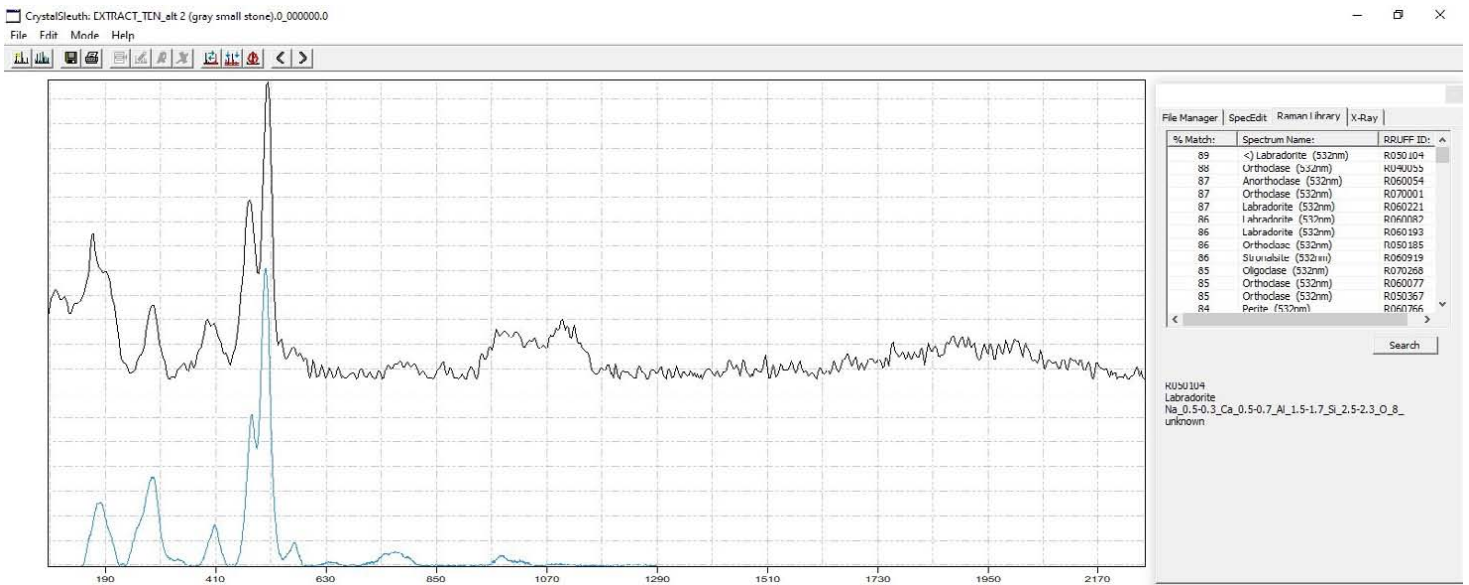
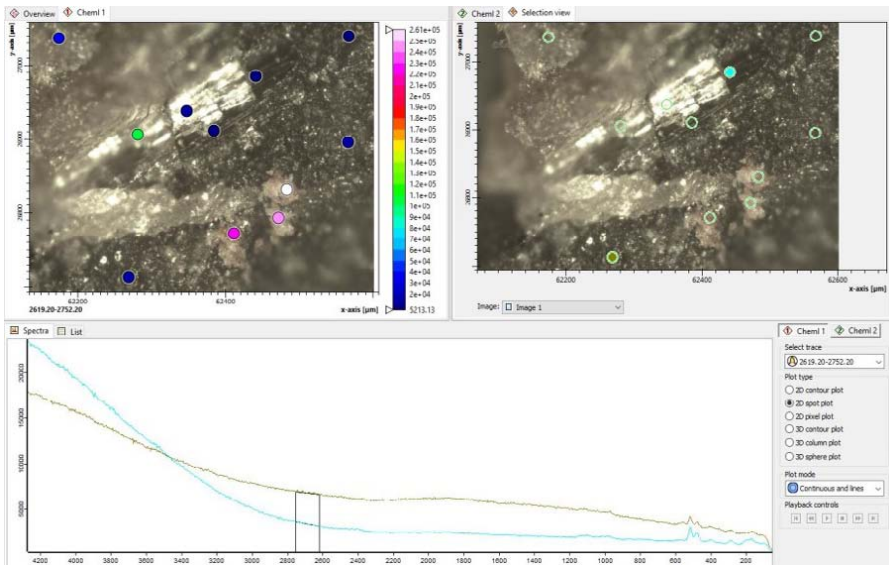
Sample Site 7 : Stone 3\_spectra 4 ( white mineral ) : **Anorthoclase, Labradorite** : ~ 200 x 140 μm



Note the linear structures visible in the sample !



Sample Site 2: Stone 2\_spectra 1 (grey mineral) indicates: **Labradorite**. ( → RRUFF\_CS )



The spectrum probably indicates weakly shocked feldspar

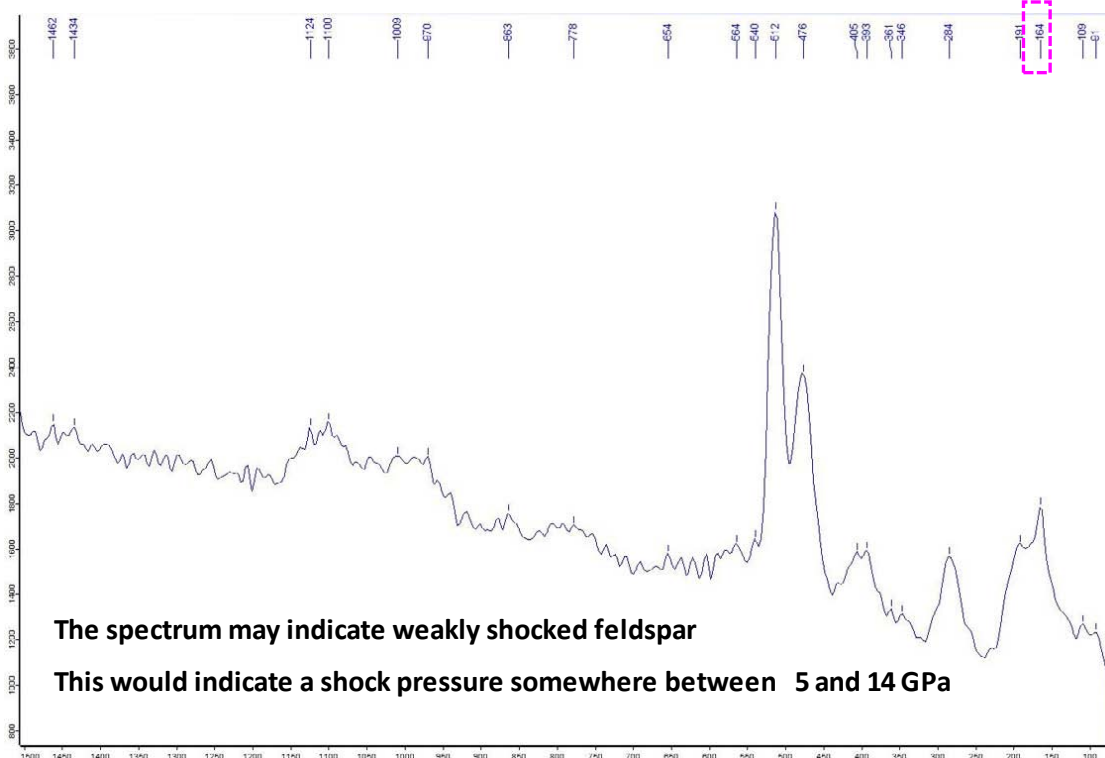
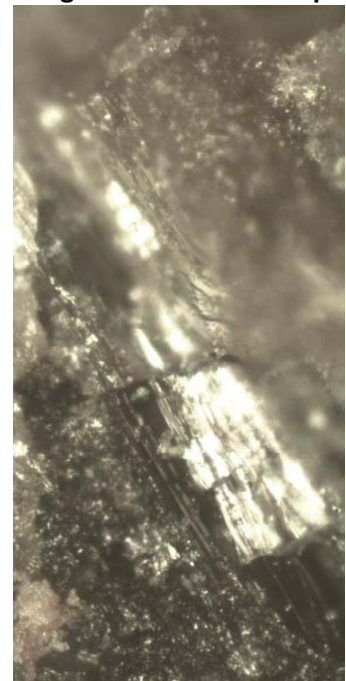


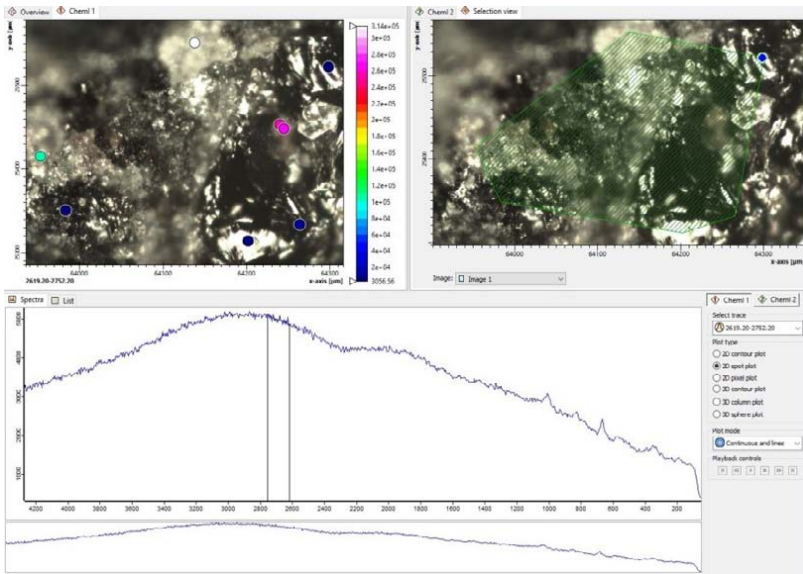
Image size : ≈ 150 x 300 μm



The spectrum may indicate weakly shocked feldspar

This would indicate a shock pressure somewhere between 5 and 14 GPa

Sample Site 2: Stone 1\_spectra 1 ( dark mineral ) indicates : **Polydymite, Augite.** ( → RRUFF\_CS )



Sample

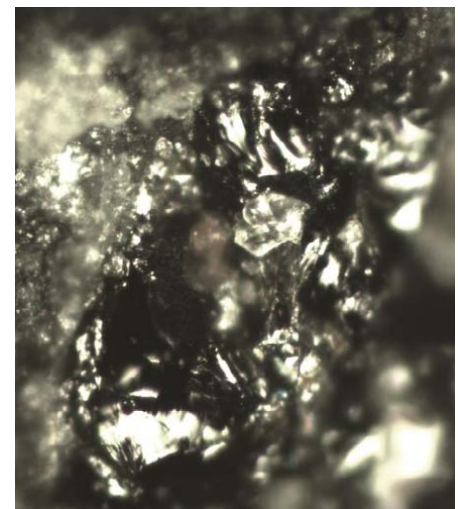
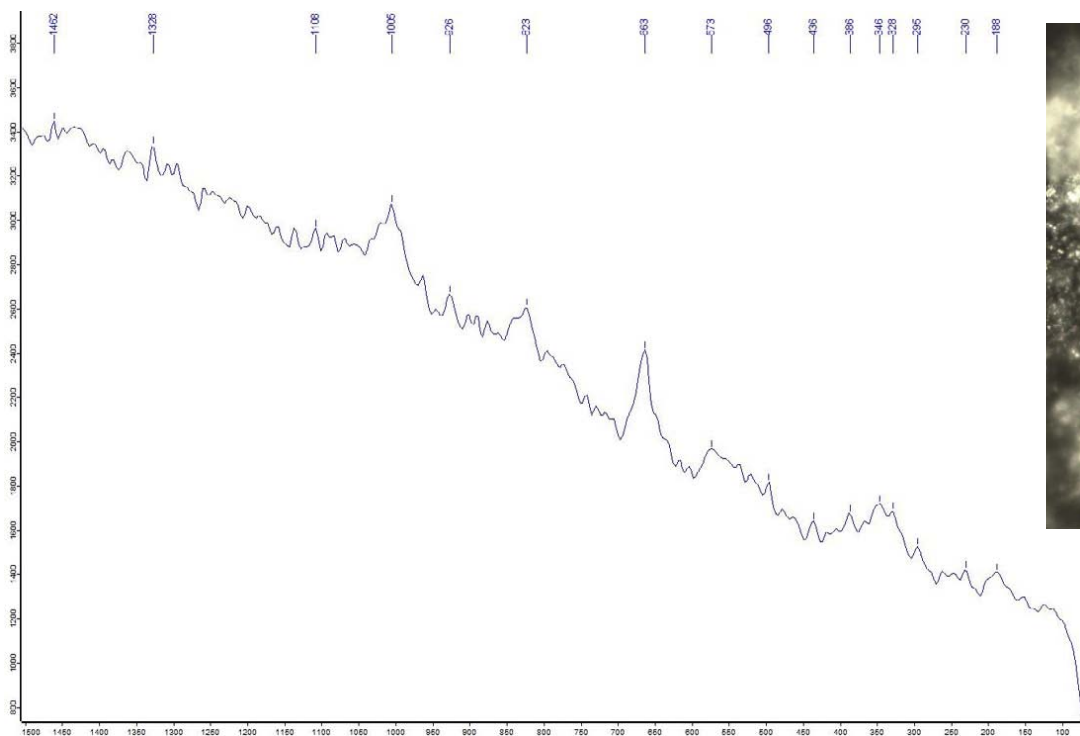
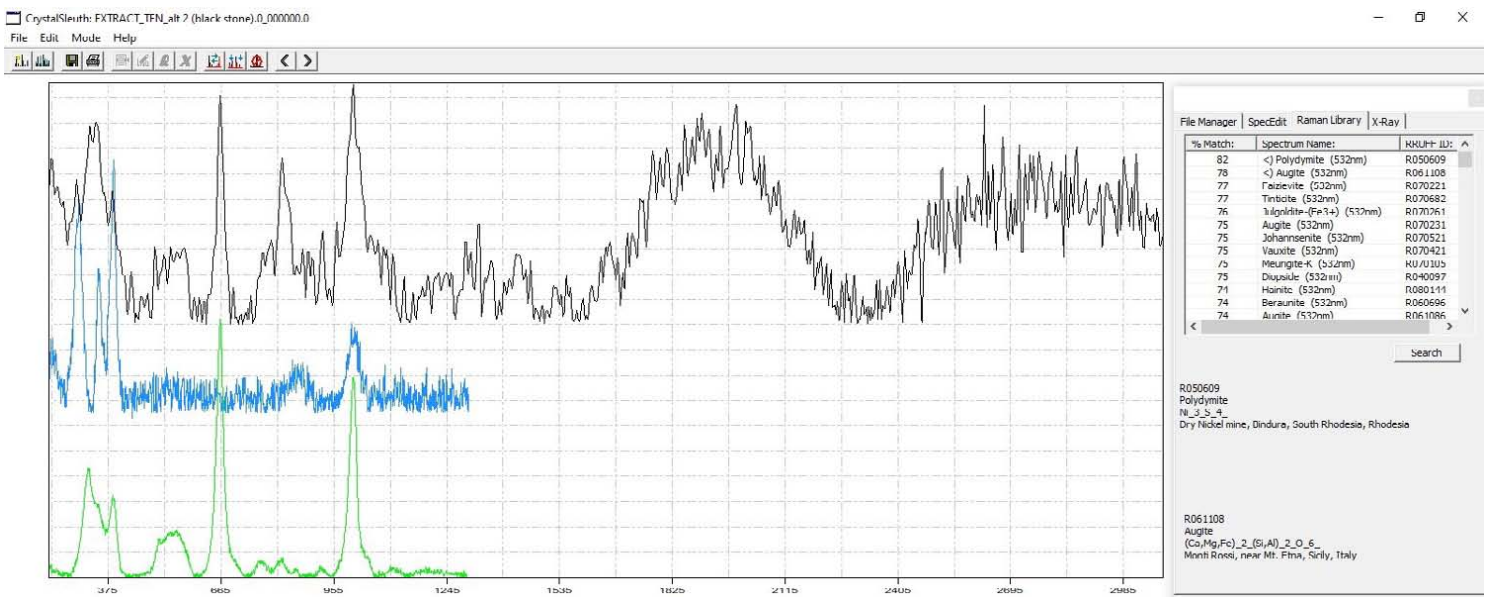
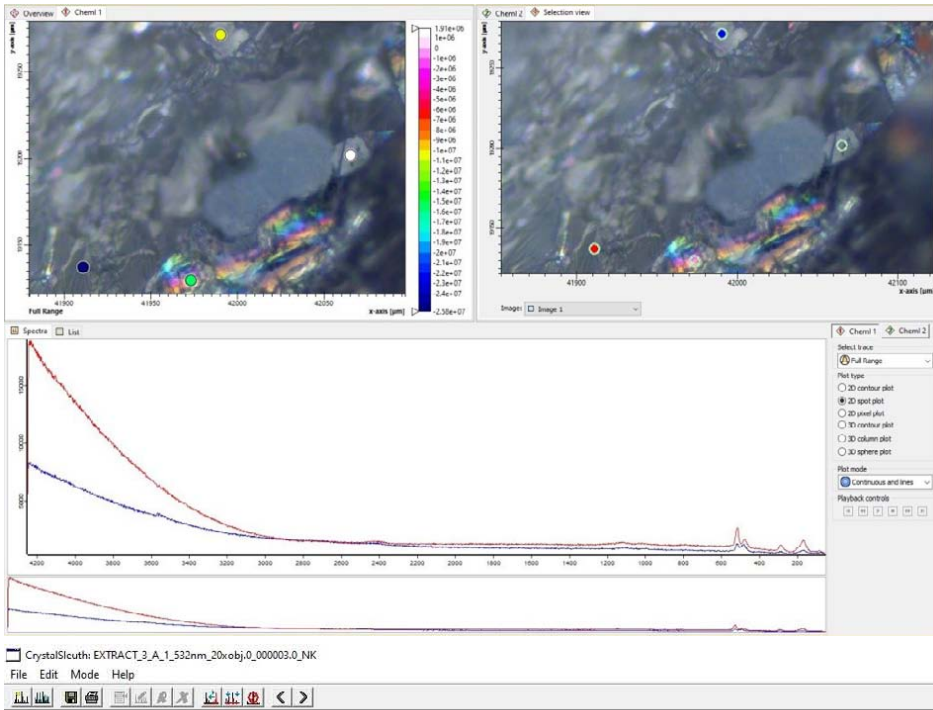
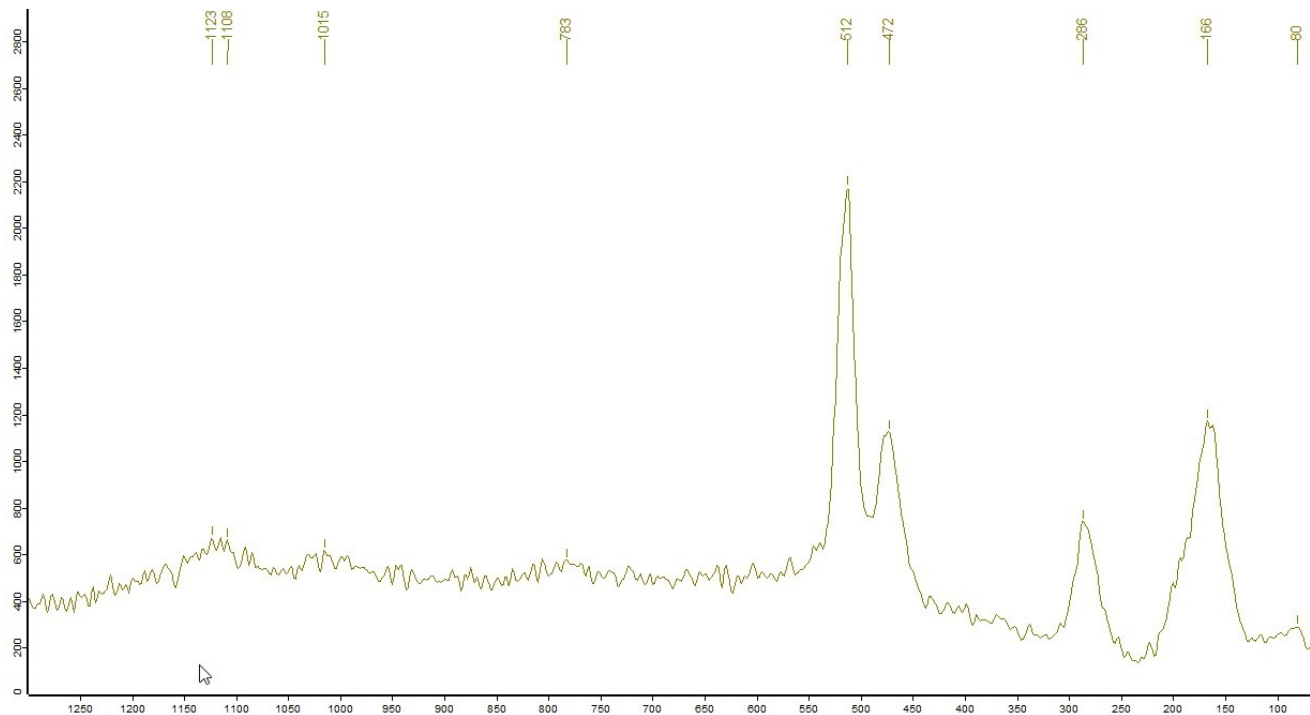
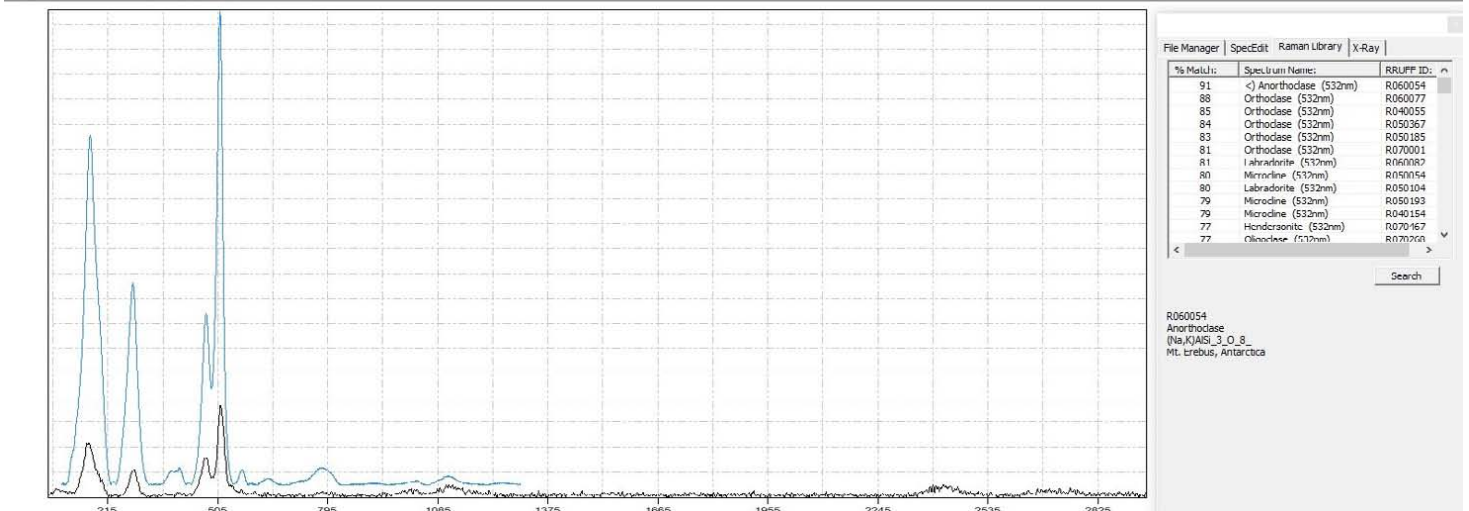


Image size ≈ 200 x 250 μm

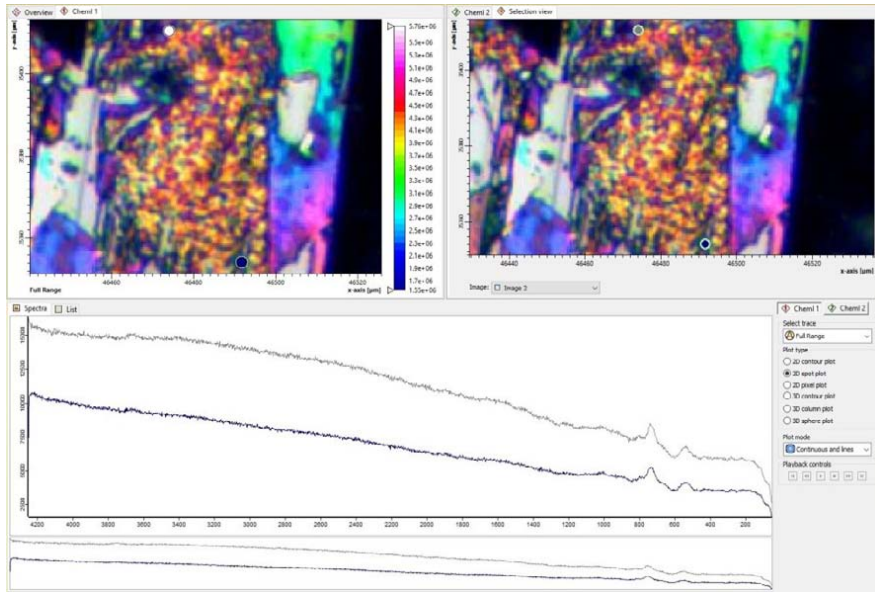
Sample Site 7: Stone 1\_spectra 1+2 ( white minerals ) indicates: **Anorthoclase** ( → RRUFF\_CS search result )



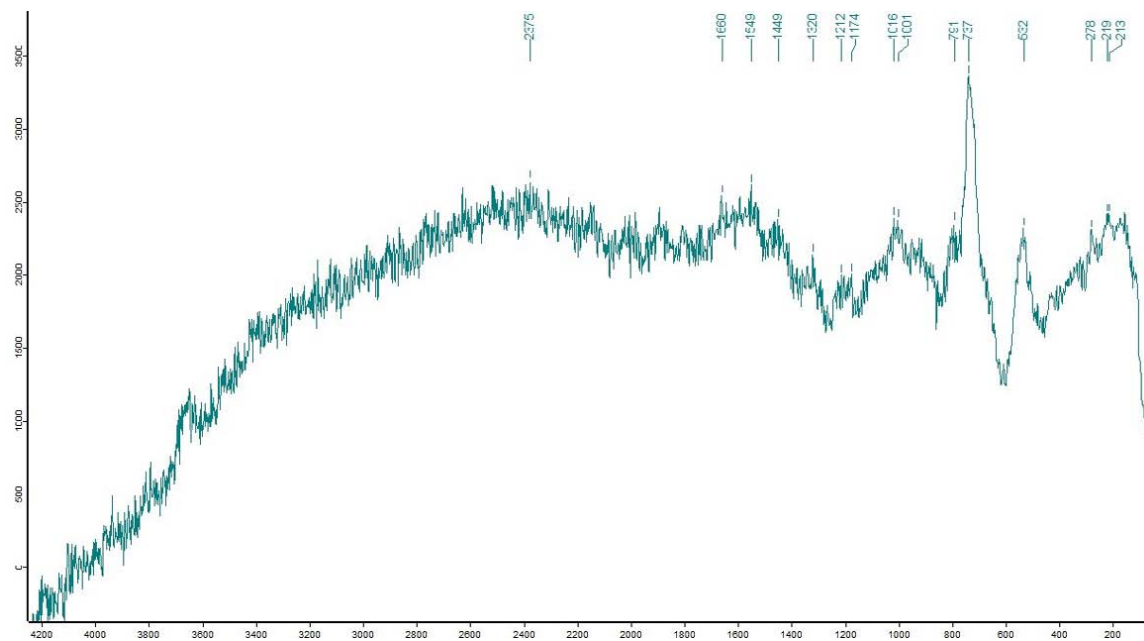
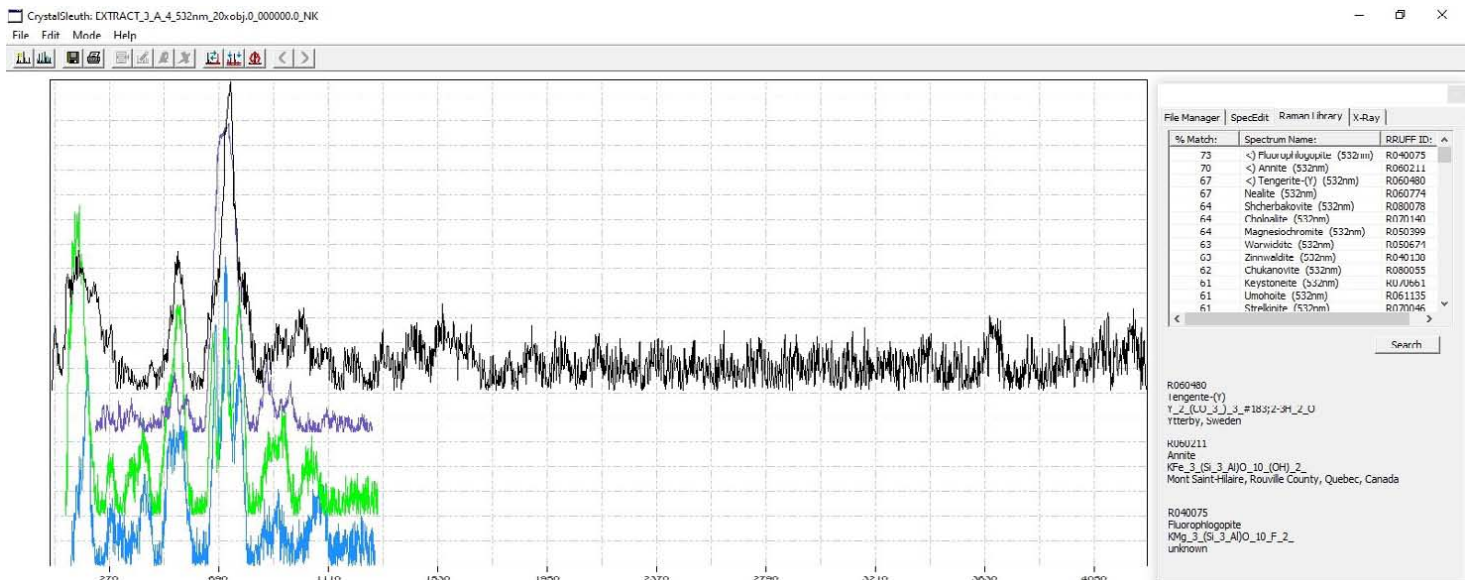
Sample :



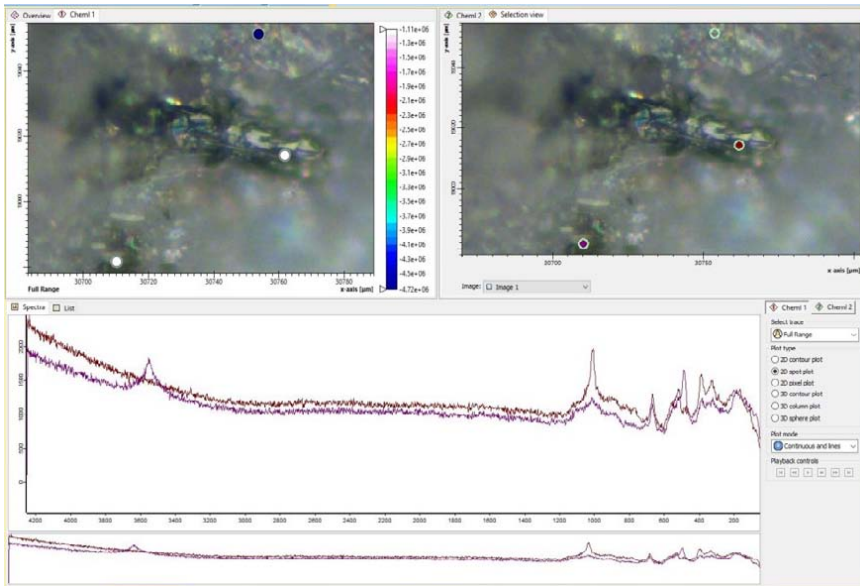
Sample Site 7: Stone 1\_spectra 4 ( dark minerals ) indicates : **Fluorophlogopite, Annite, Tengerite (y)**  
 ( → RRUFF\_CS search result )



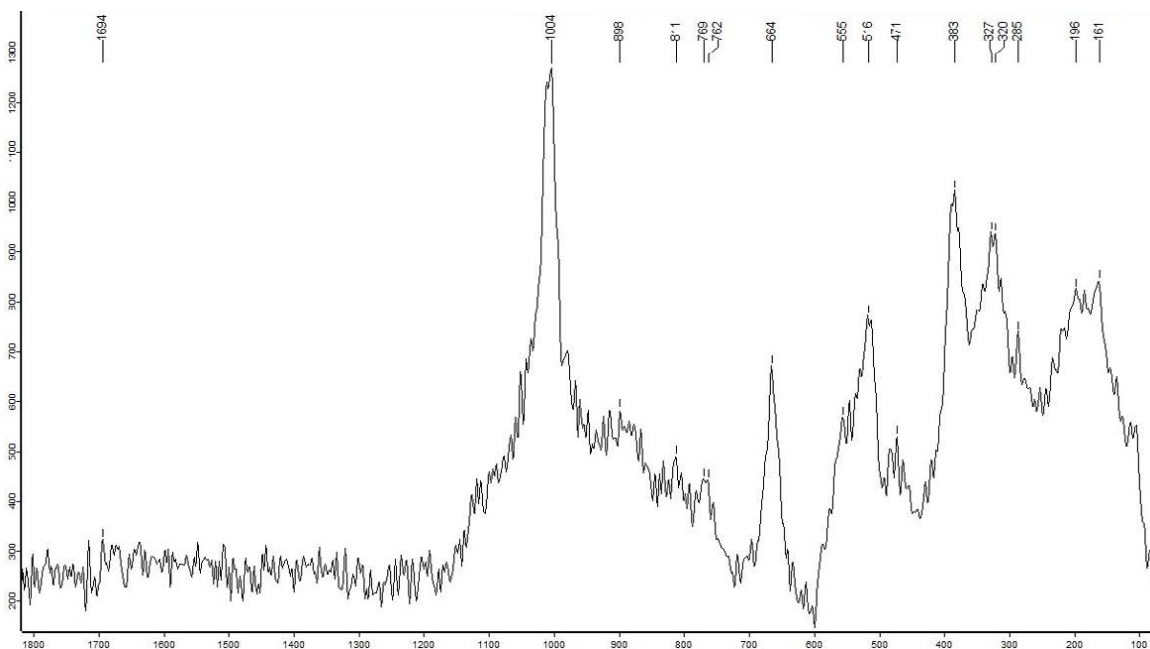
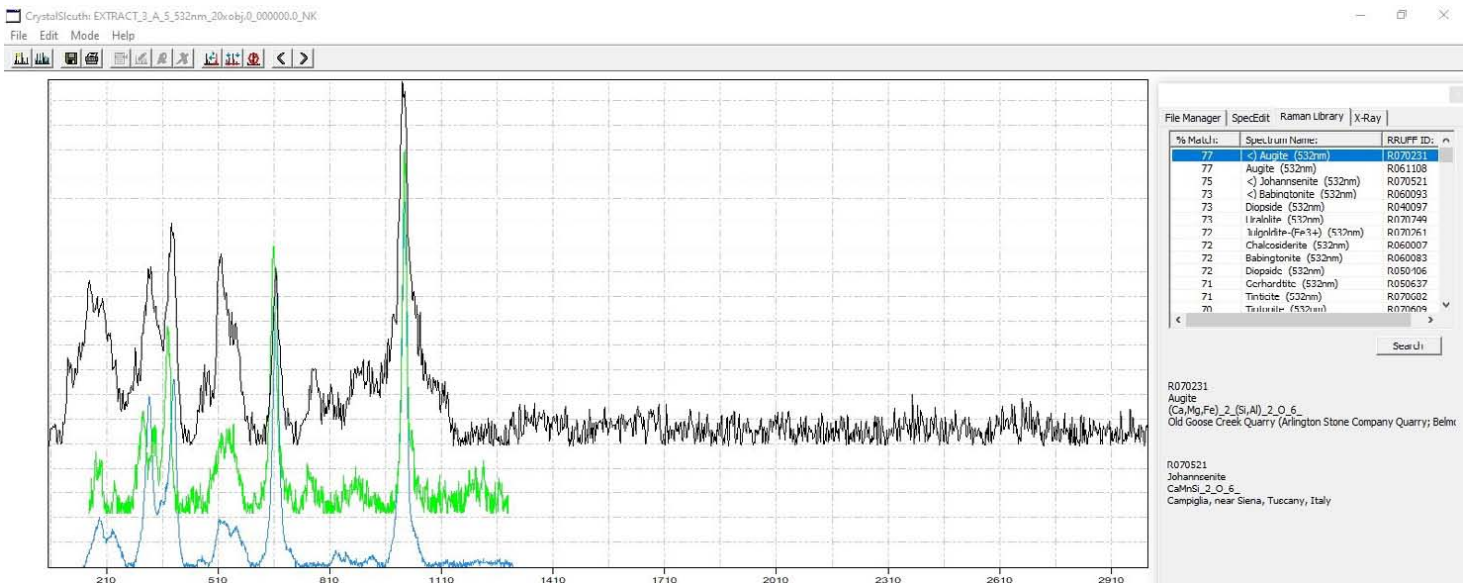
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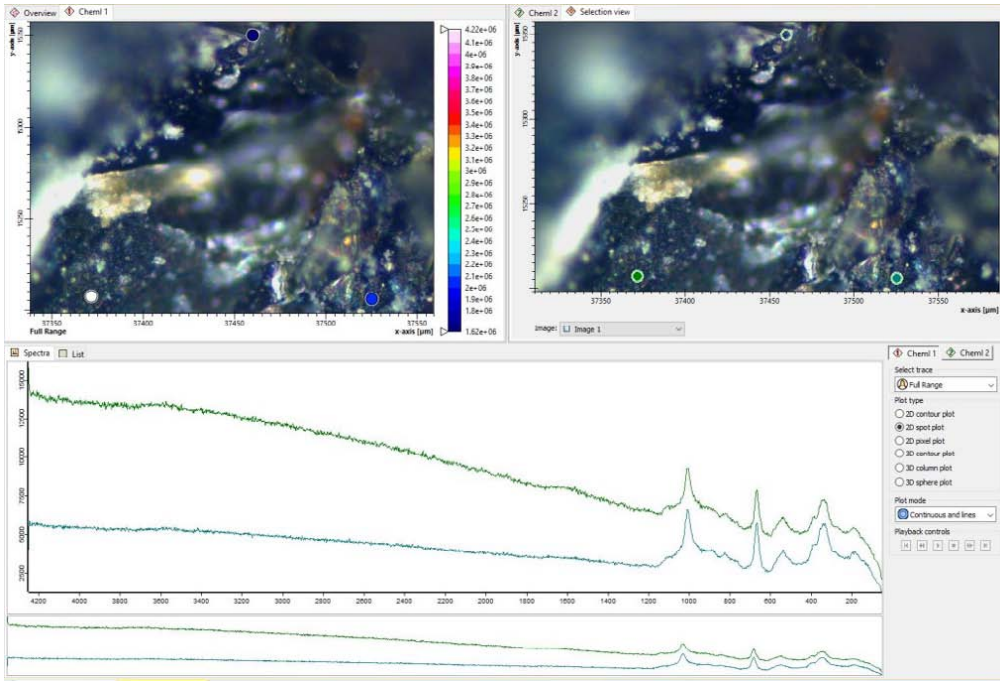
Sample Site 7: Stone 1\_spectra 5 (grey material) indicates: **Augite, Johannsenite** (→ RRUFF\_CS)



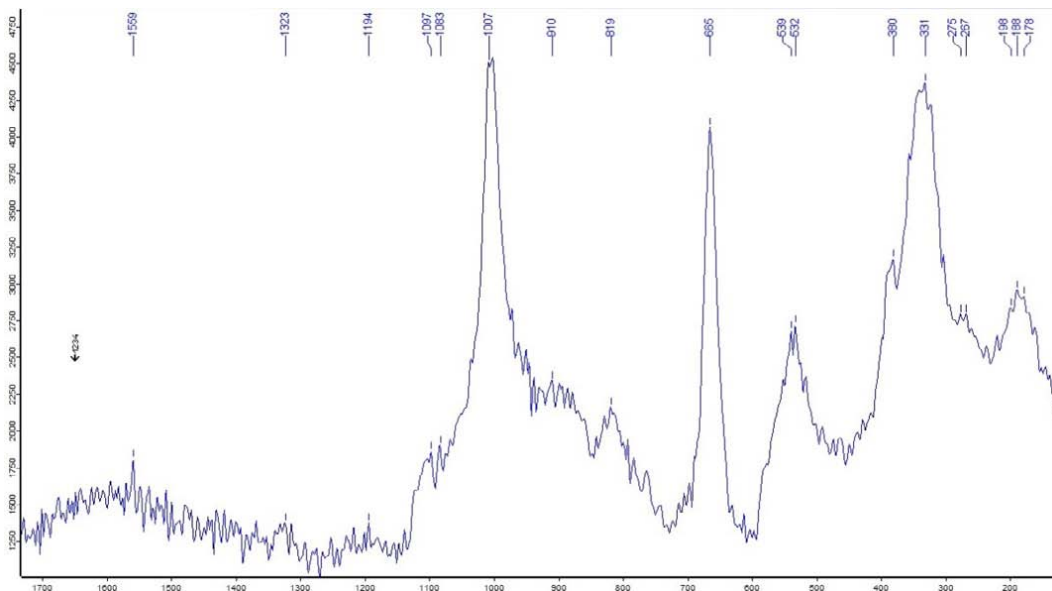
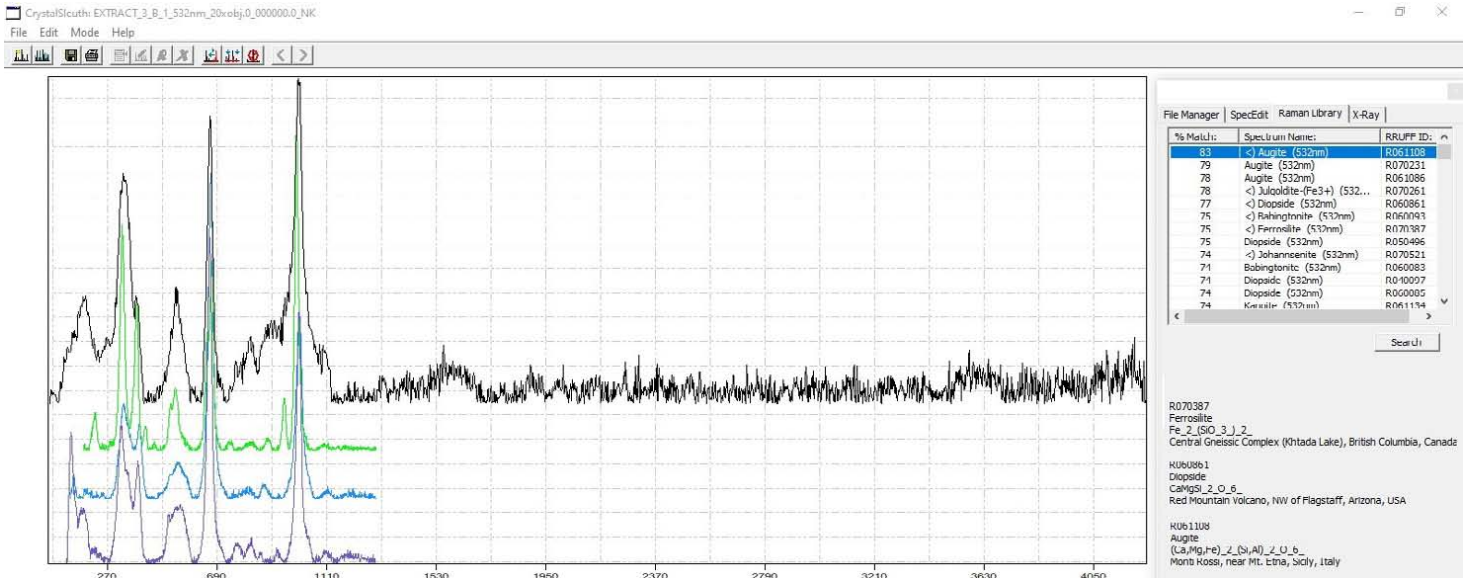
Sample:



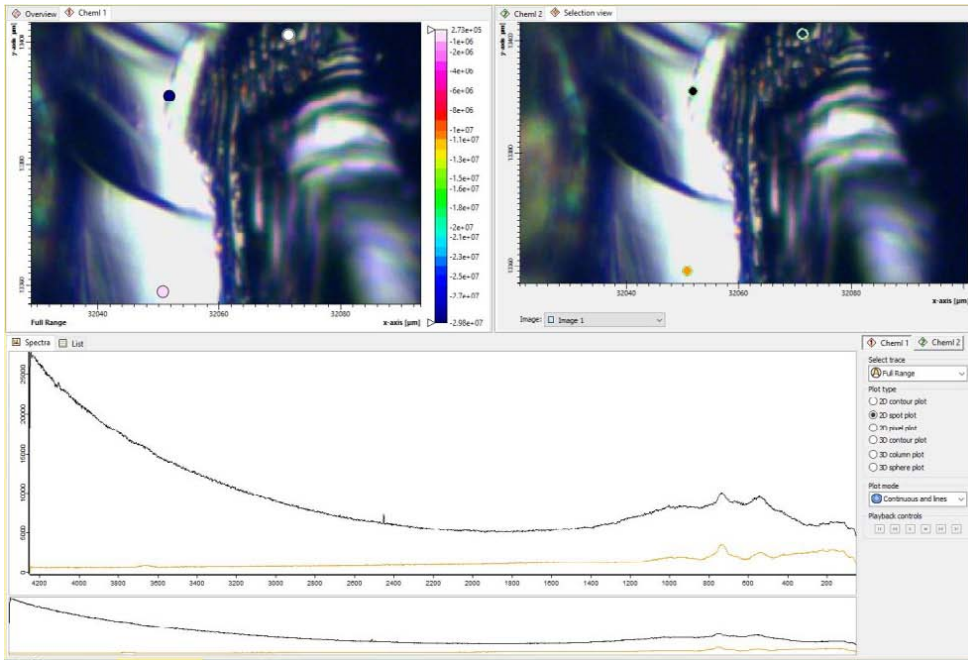
Sample Site 7: Stone 2\_spectra 1 ( dark minerals ) indicates: **Augite, Diopside, Ferrosilite**  
 ( → RRUFF\_CS search result )



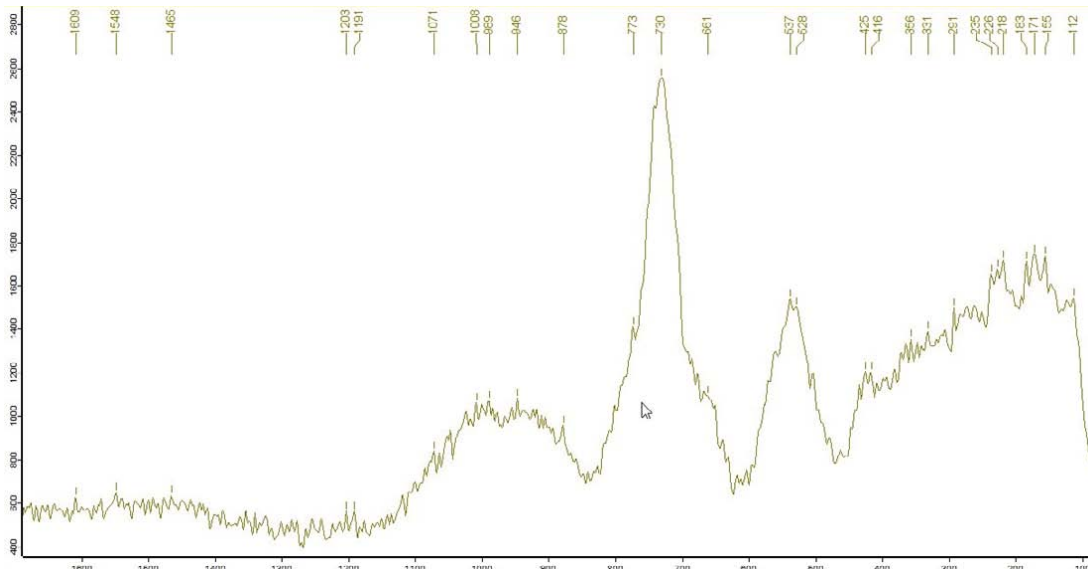
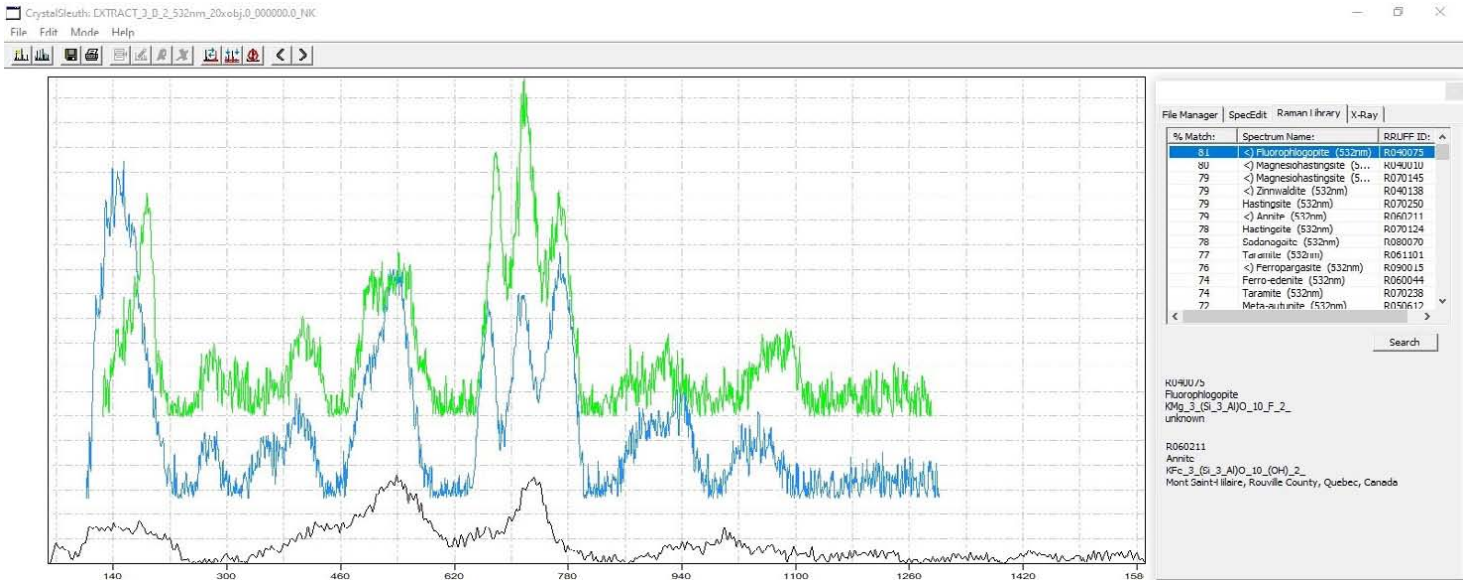
Sample :



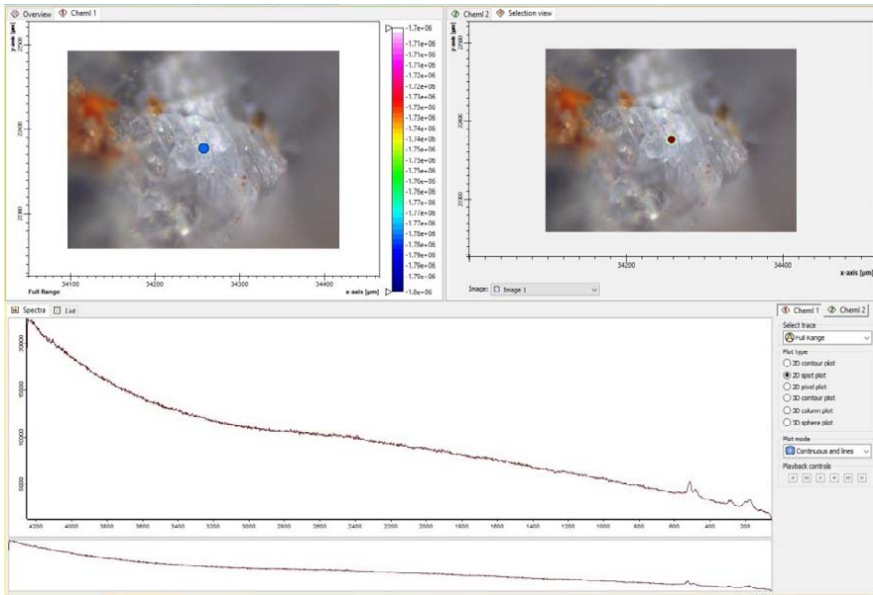
Sample Site 7: Stone 2\_spectra 2 ( dark minerals ) indicates: **Flourophlogopite, Annite**  
 ( → RRUFF\_CS search result )



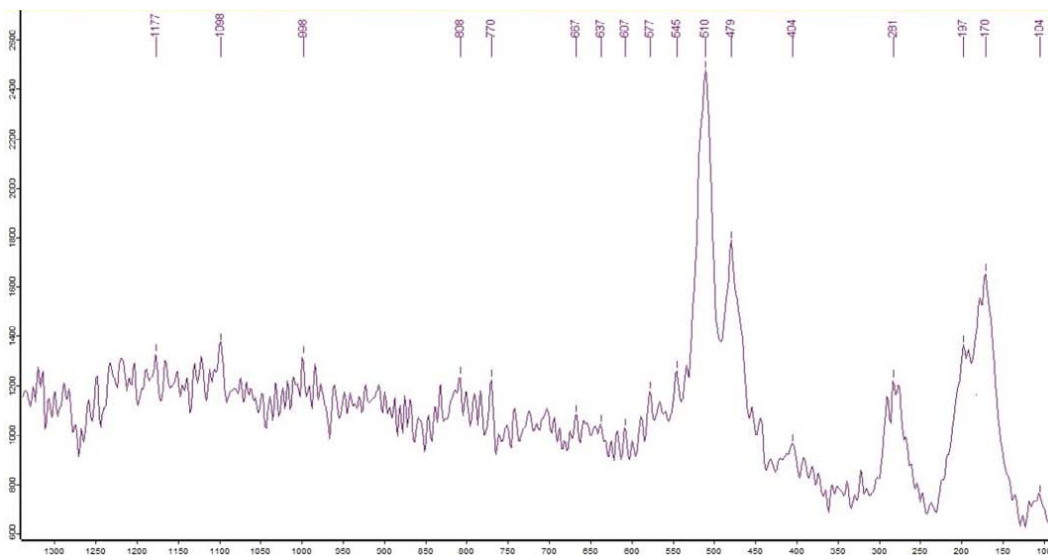
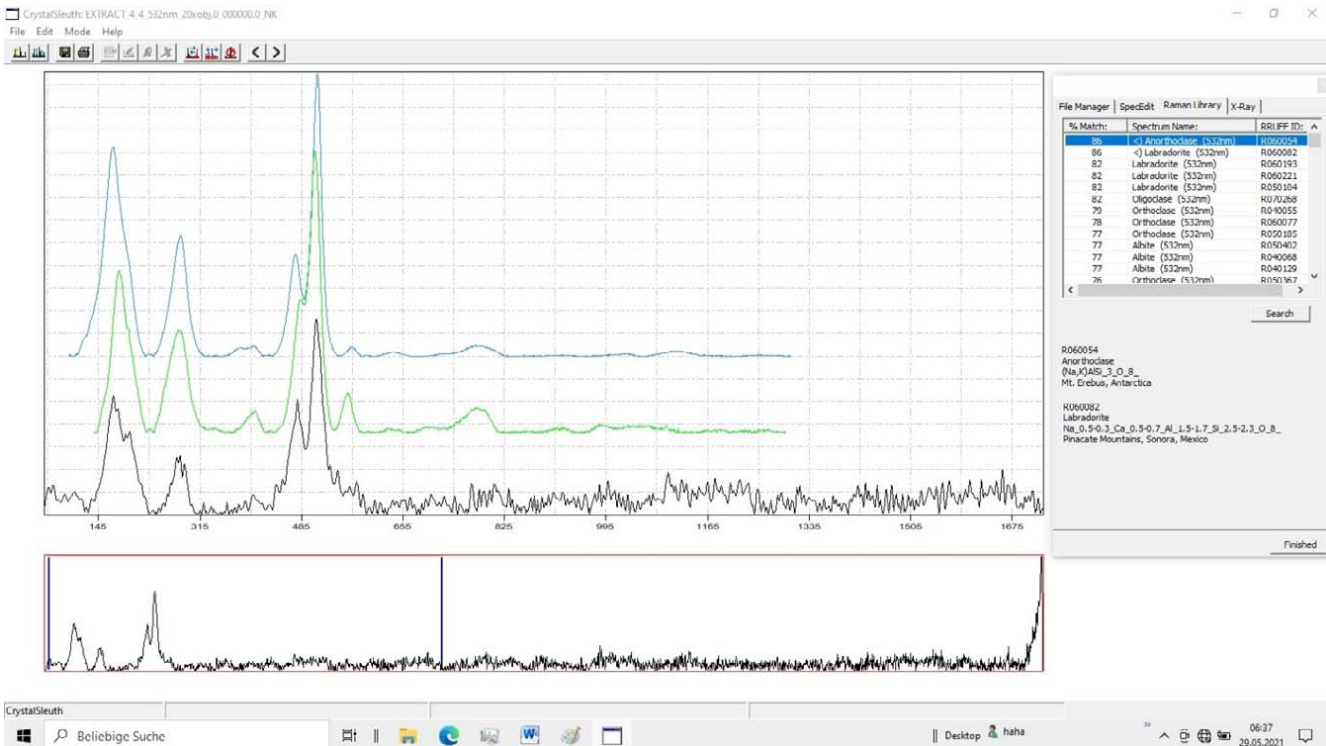
Sample:



Sample Site 7: Stone 3\_spectra 4 ( white minerals ) indicates : **Anorthoclase, Labradorite**  
 ( → RRUFF\_CS search result )

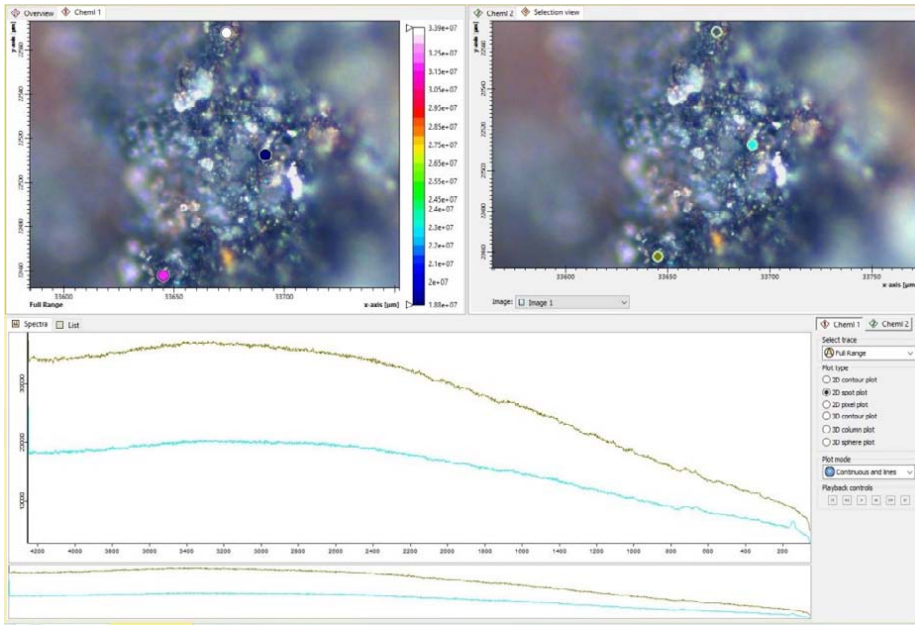


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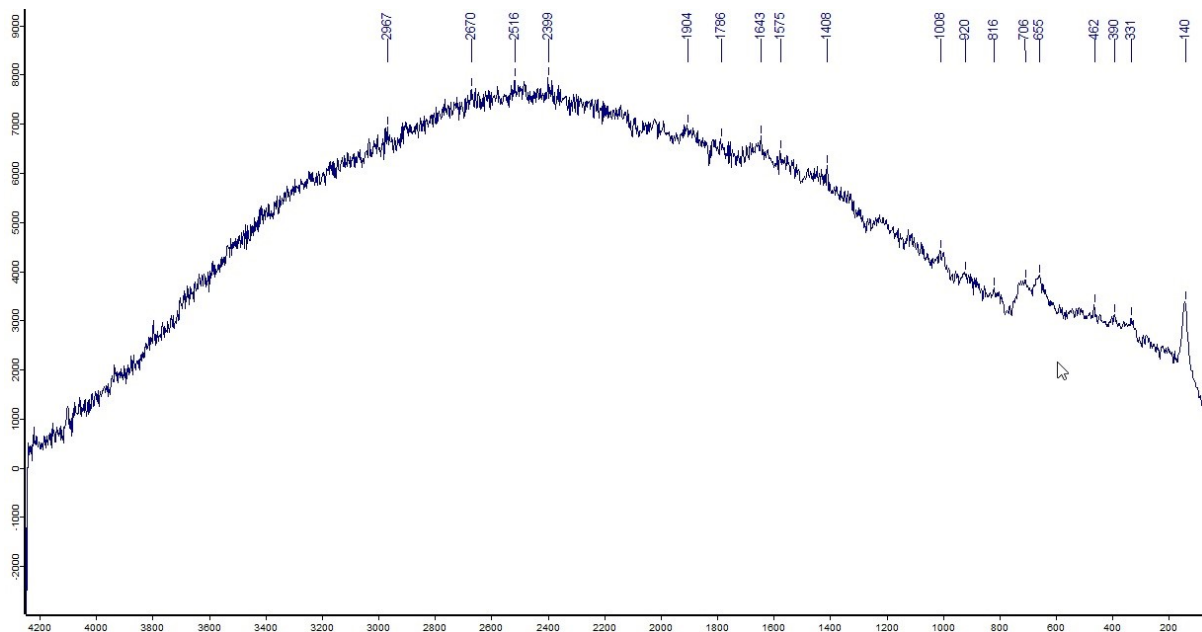
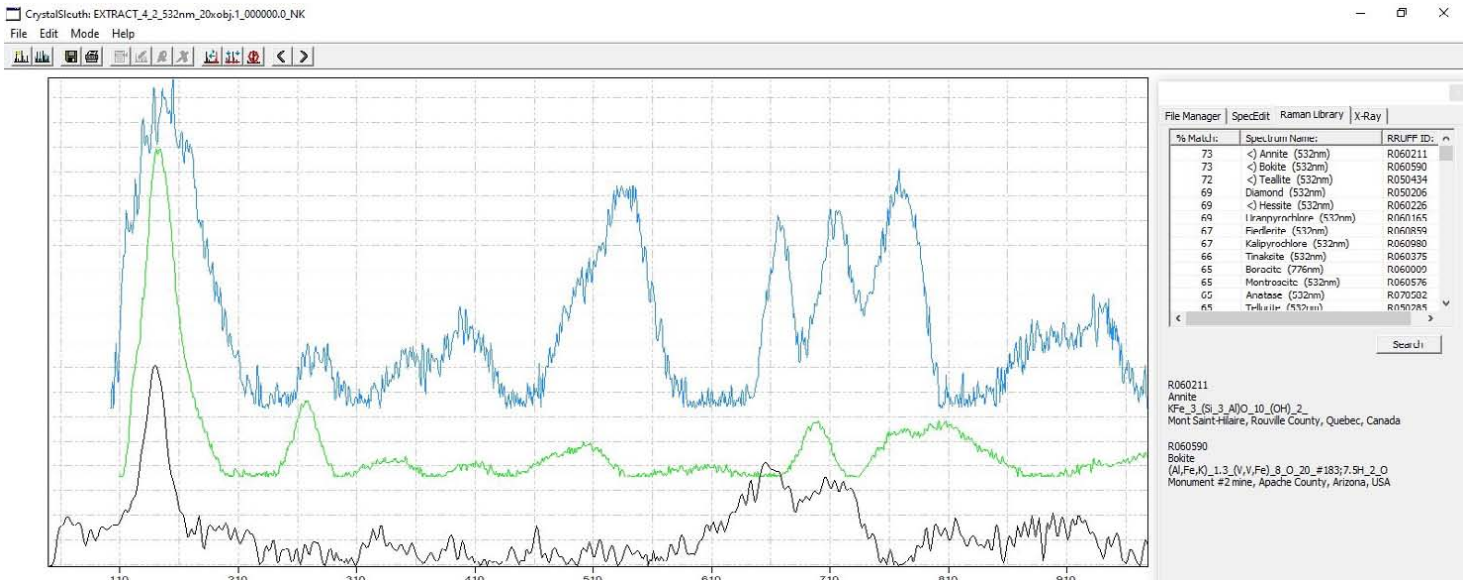




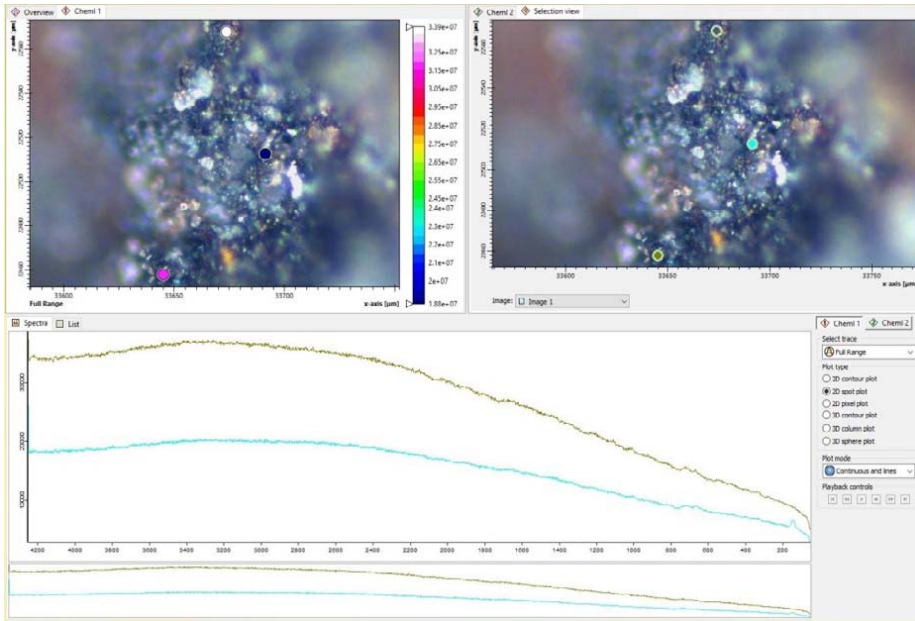
Sample Site 7: Stone 3\_spectra 2-1 ( dark minerals ) indicates : **Annite, Bokite** ( → RRUFF\_CS search result )



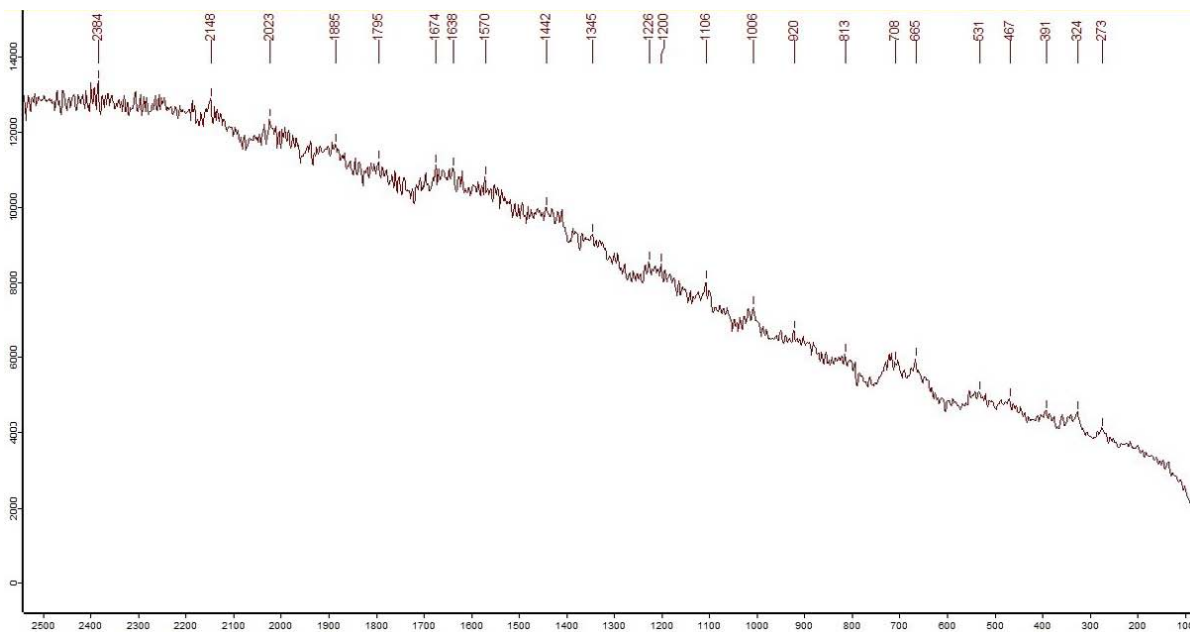
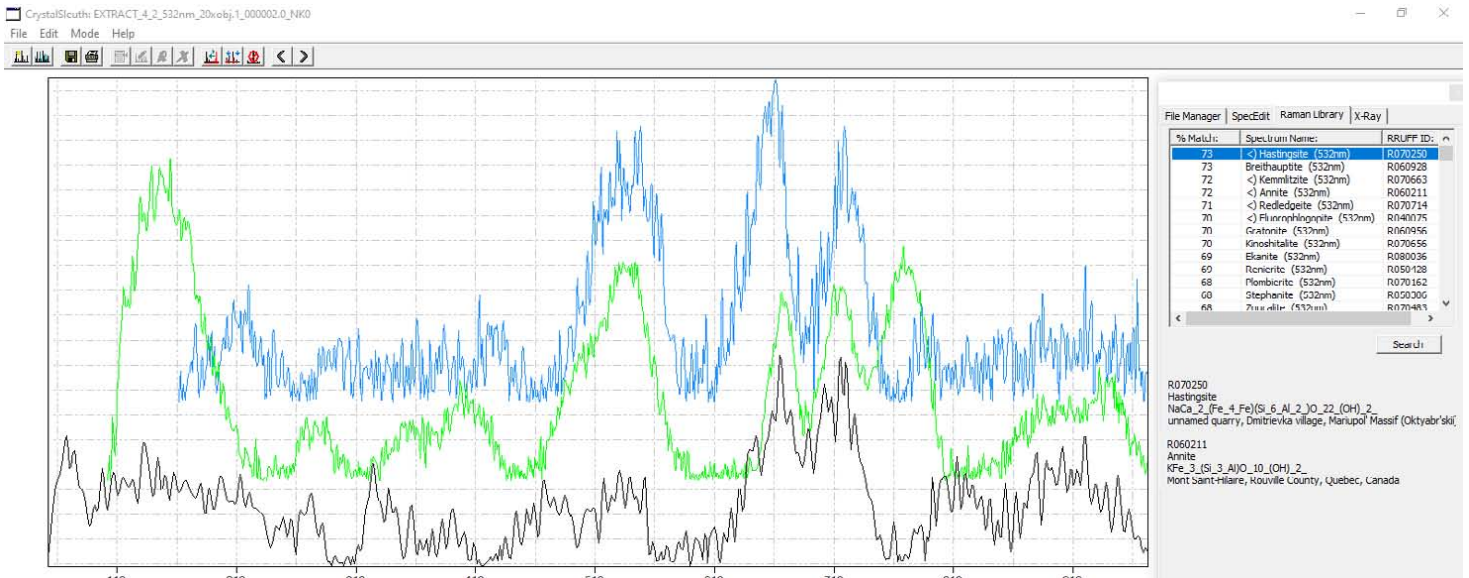
Sample :



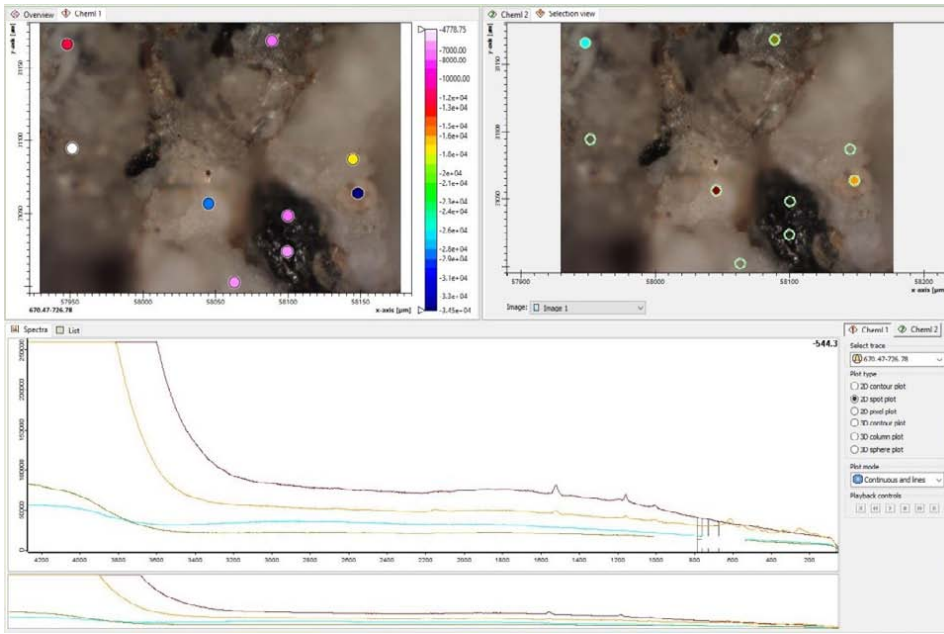
Sample Site 7: Stone 3\_spectra 2-2 ( dark minerals ) indicates : **Hastingsite , Annite**  
 ( → RRUFF\_CS search result )



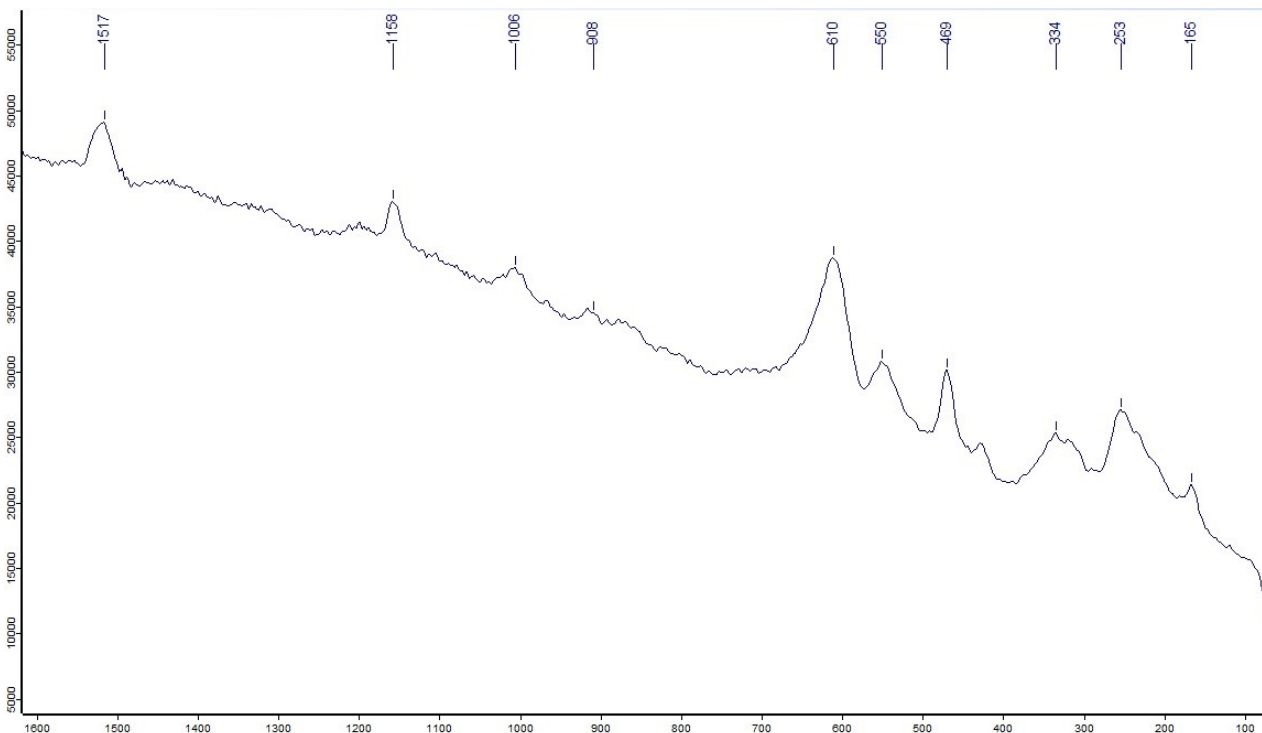
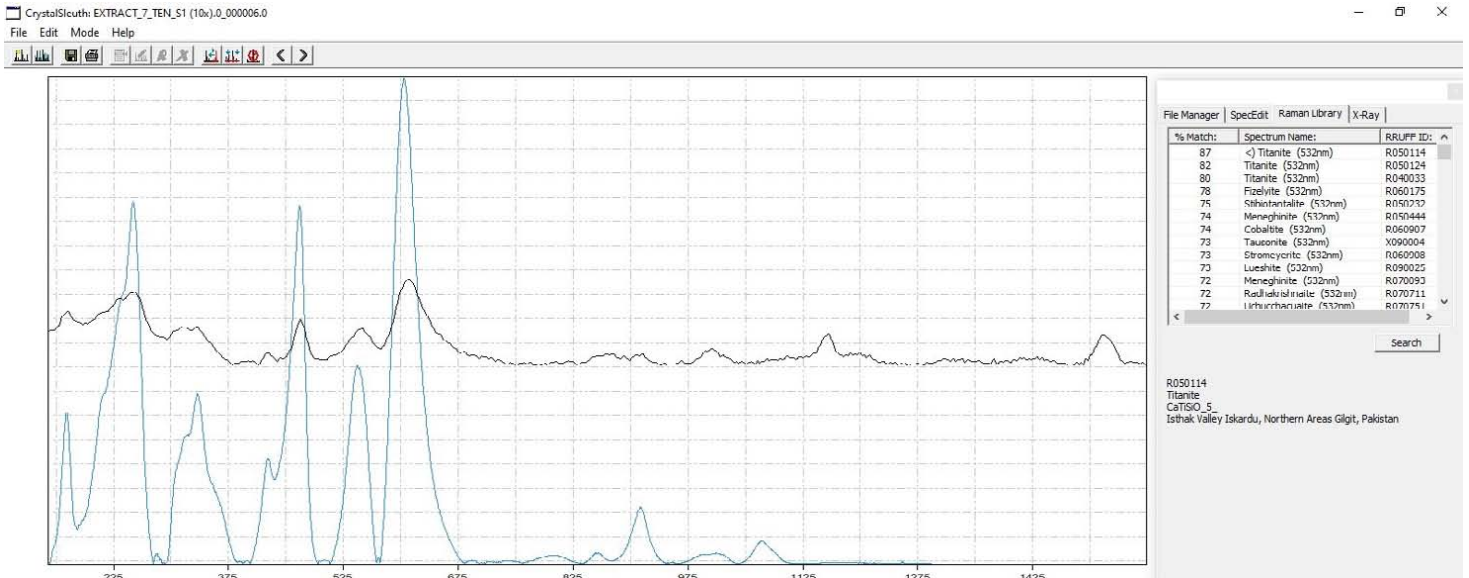
Sample :



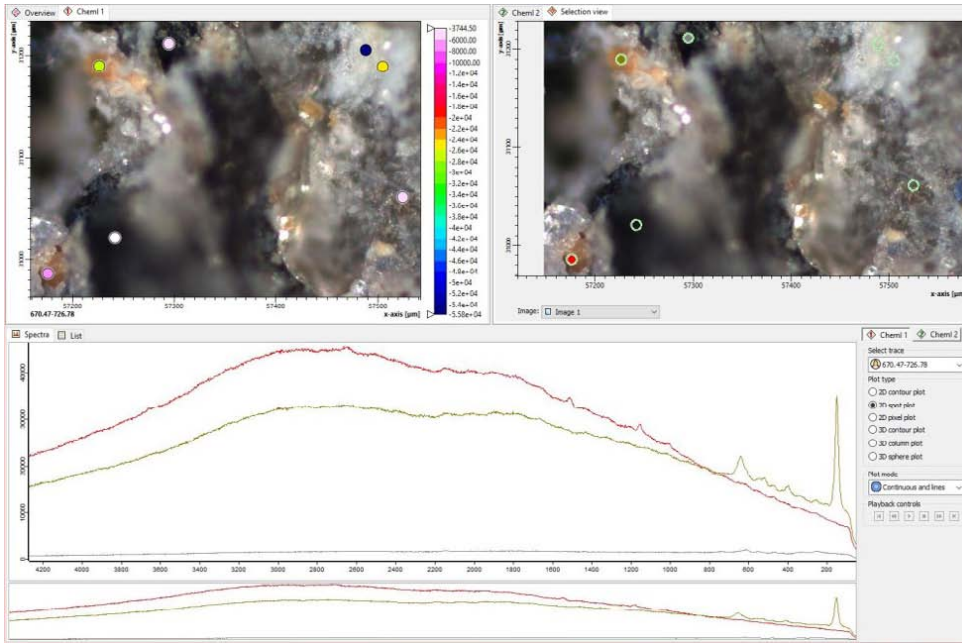
Sample Site 7: Stone 4\_spectra 1 indicates: **Titanite** (→ RRUFF\_CS search result)



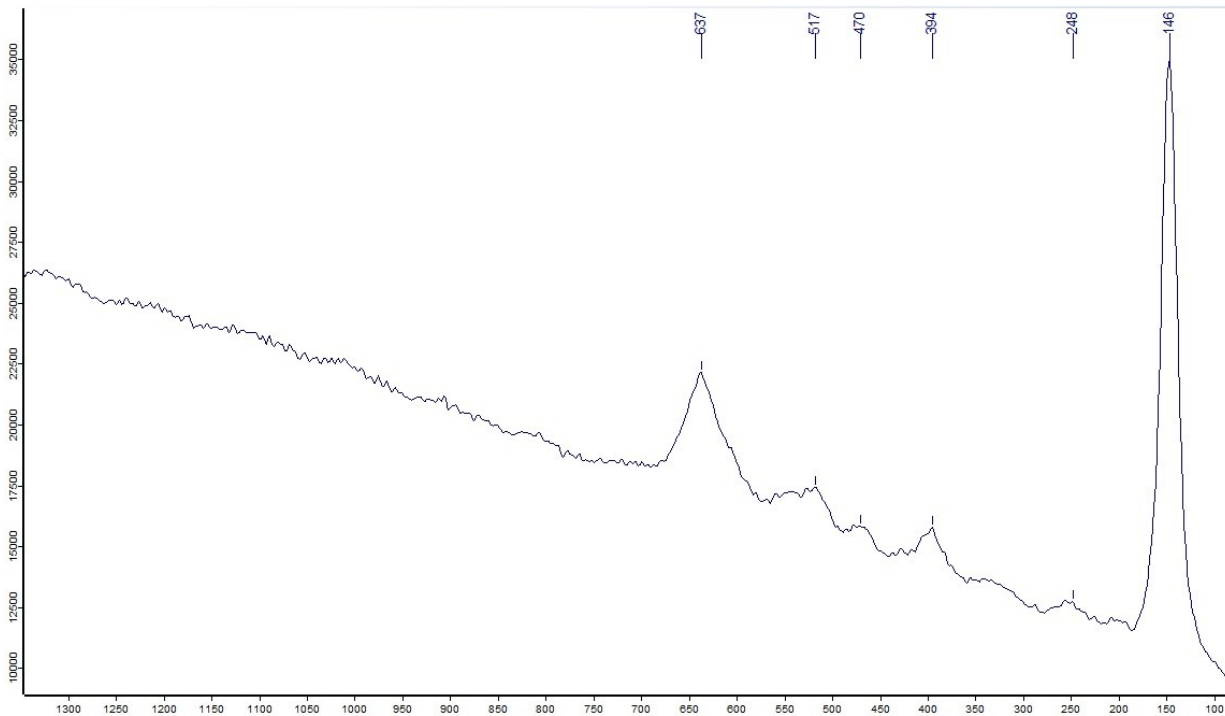
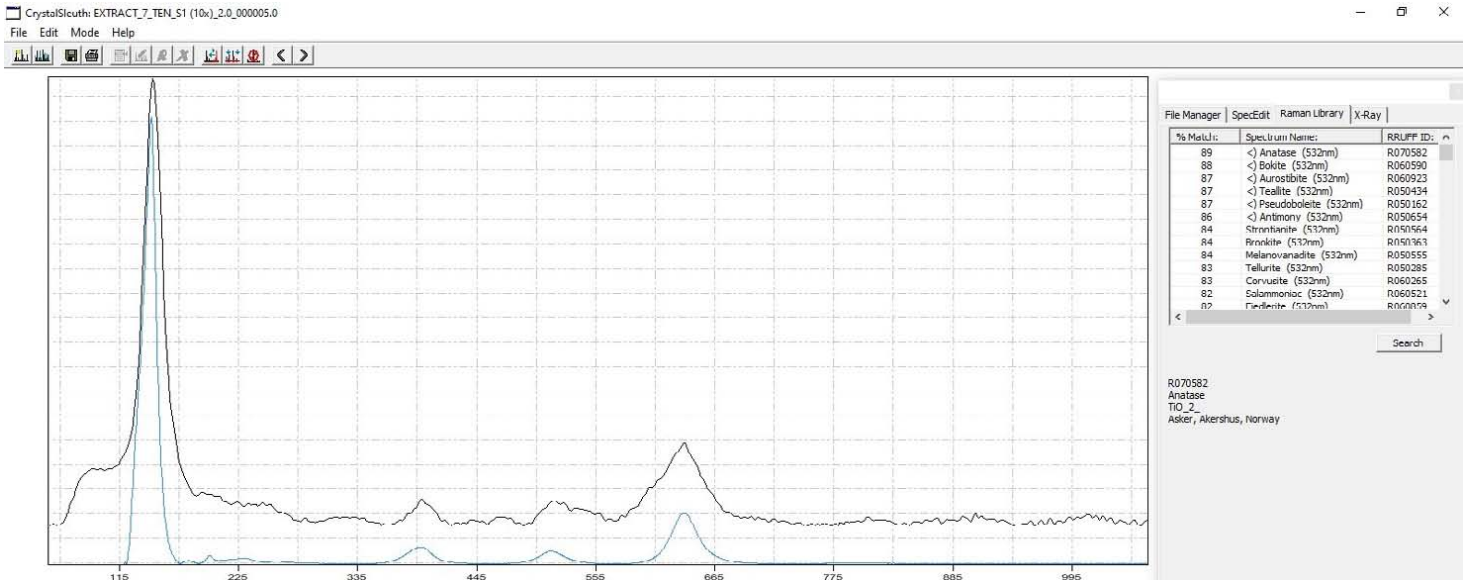
Sample :



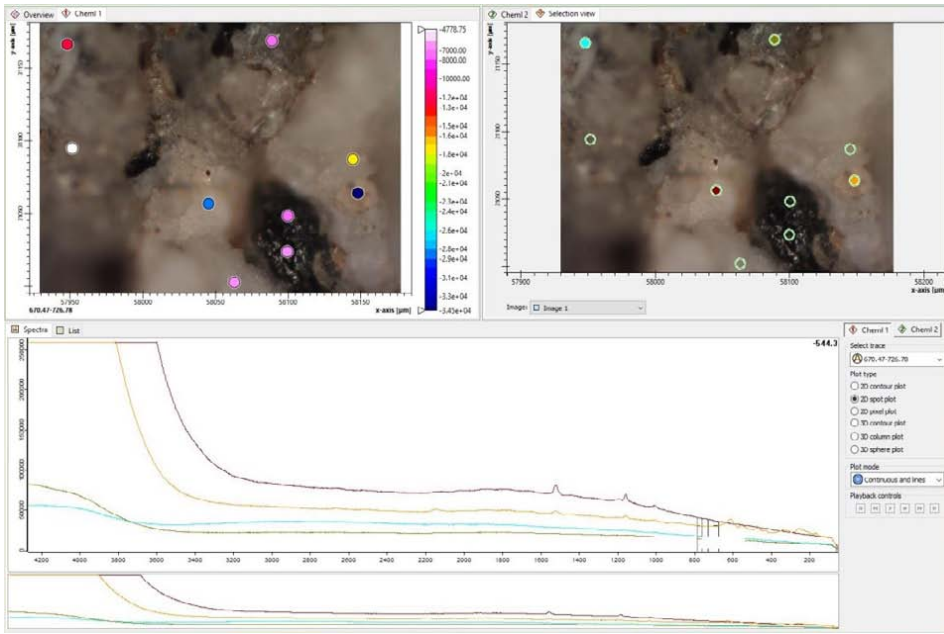
Sample Site 7: Stone 4\_spectra 3 indicates: **Anatase** ( → RRUFF\_CS search result )



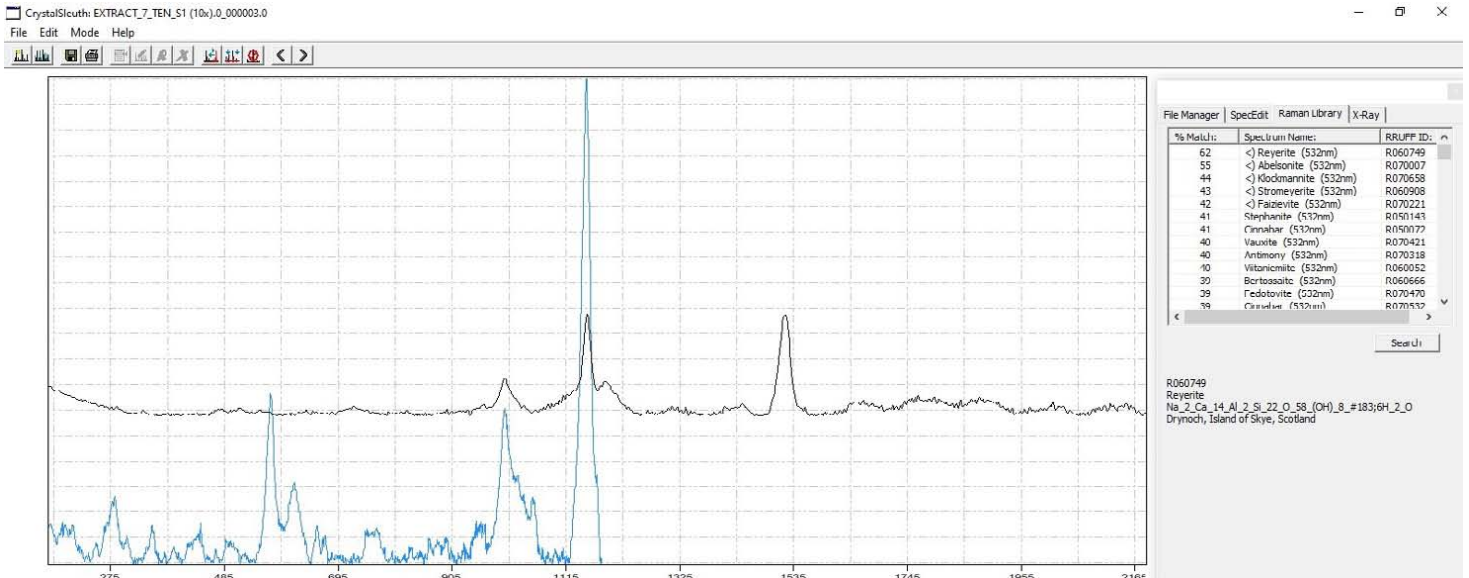
Sample :



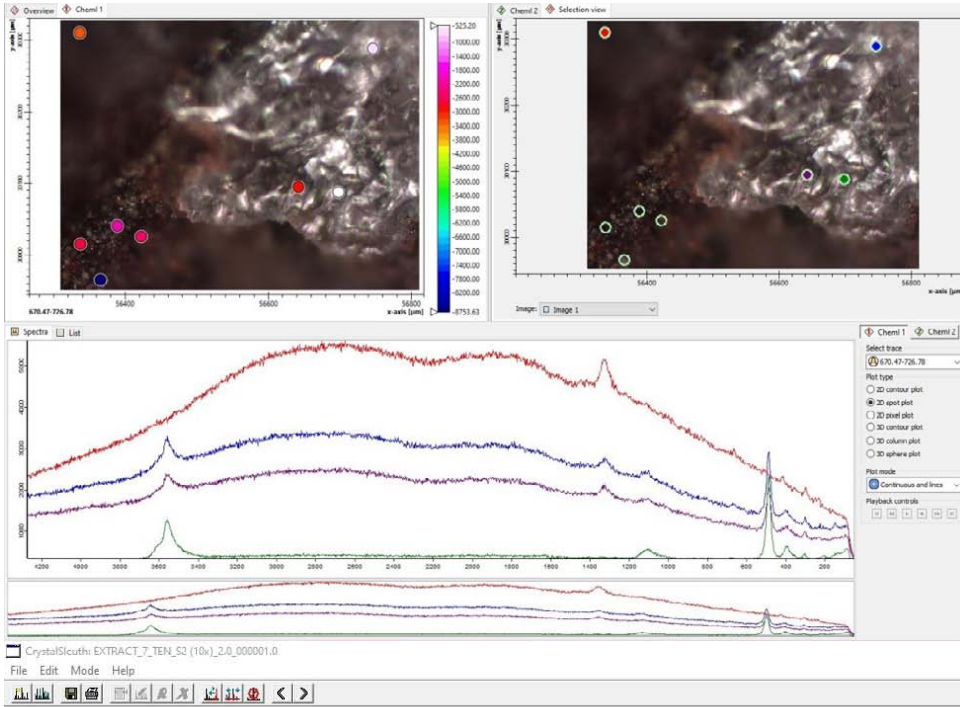
Sample Site 7: Stone 4\_spectra 2 indicates: **Reyerite** ( → RRUFF\_CS search result )



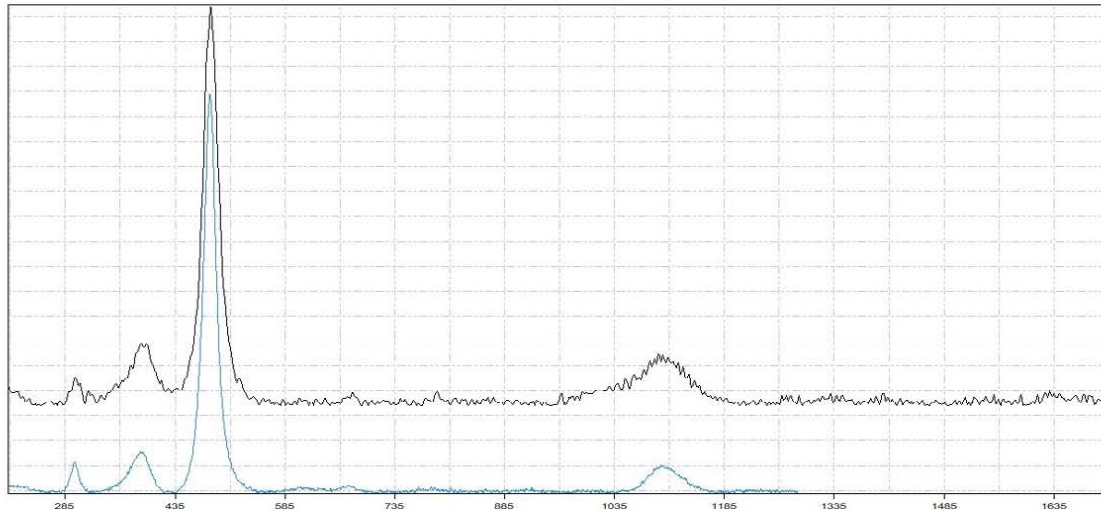
Sample :



Sample Site 7: Stone 5\_spectra 1-B indicates: **Analcime** (→ RRUFF\_CS search result)

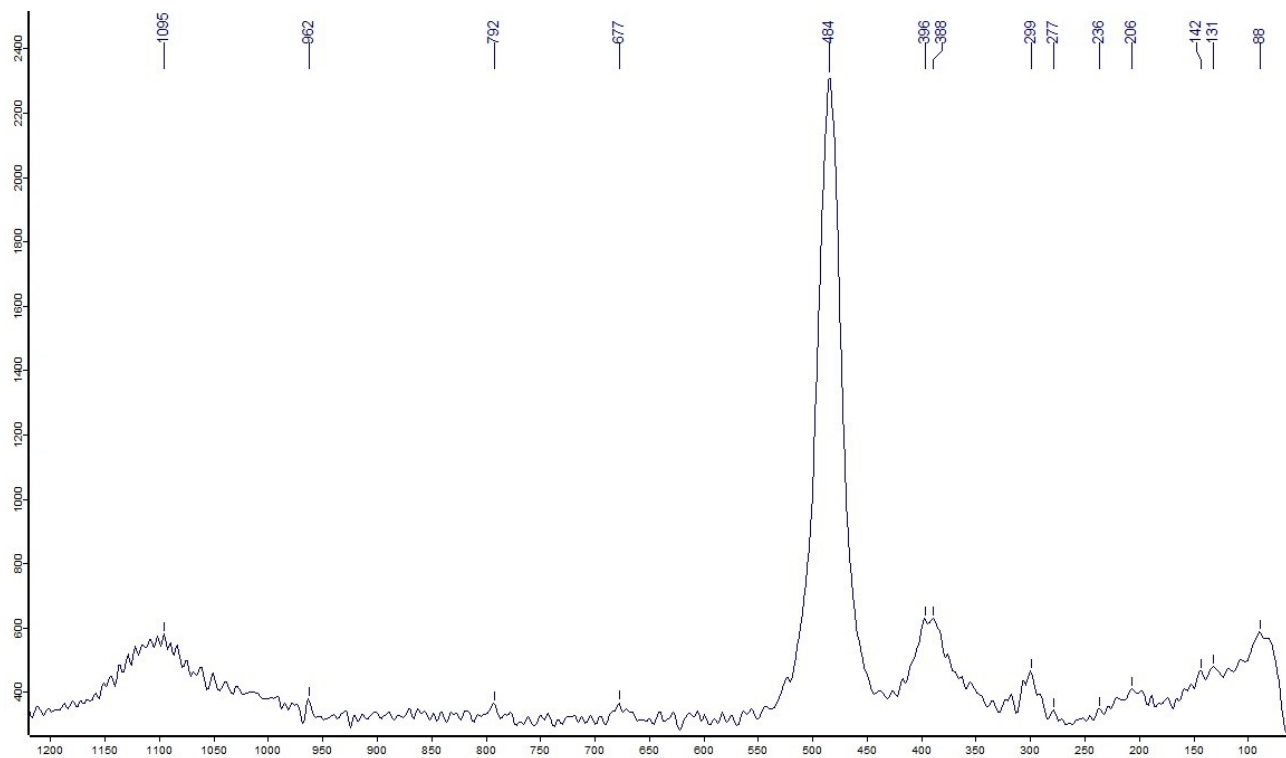


Sample:

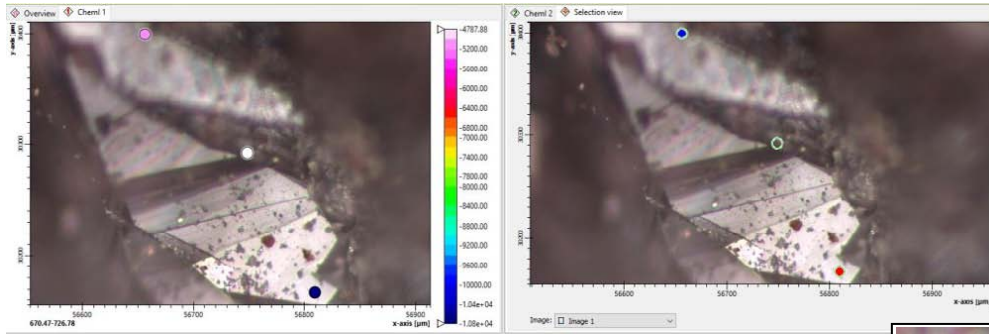


% Match	Spectrum Name	RRUFF ID
98	Analcime (532nm)	R050094
97	Analcime (532nm)	R060023
96	Analcime (532nm)	R040128
96	Epistilite (532nm)	R070396
94	Harmotome (532nm)	R070016
94	Harmotome (532nm)	R070015
93	Chabasite-Na (532nm)	R070440
93	Phillipsite-Na (532nm)	R061094
92	Faujasite-Na (532nm)	R060157
92	Phillipsite-Na (532nm)	R070271
91	Dachardite-Ca (532nm)	R061097
91	Faujasite-Na (532nm)	R070694
91	Cyffrinite (532nm)	R060767

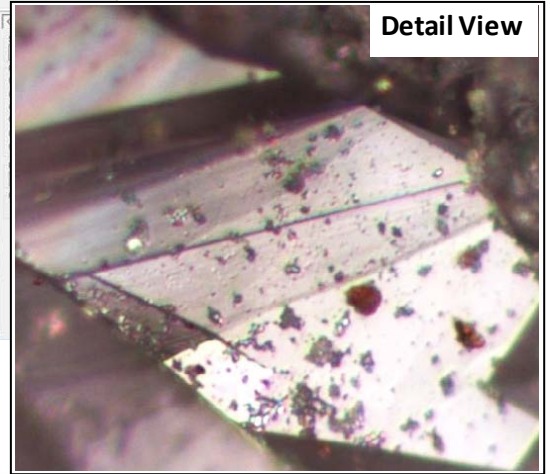
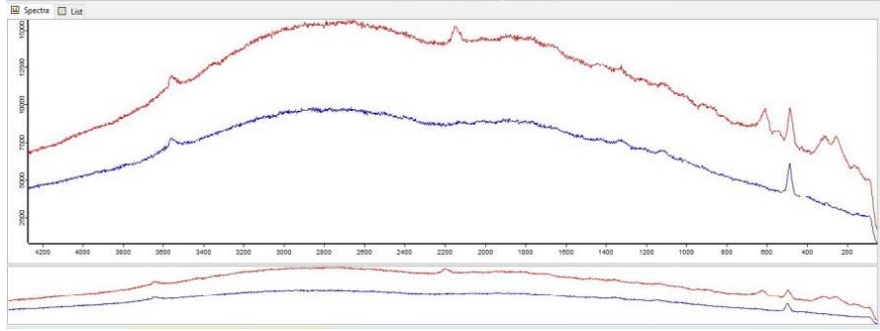
R050094  
Analcime  
Na(Si<sub>2</sub>AlO<sub>6</sub>·nH<sub>2</sub>O)  
Springfield, Oregon, USA



Sample Site 7: Stone 5\_spectra 2 indicates: **Cestibtantite\_Monteregianite-(Y)** ( → RRUFF\_CS search result )

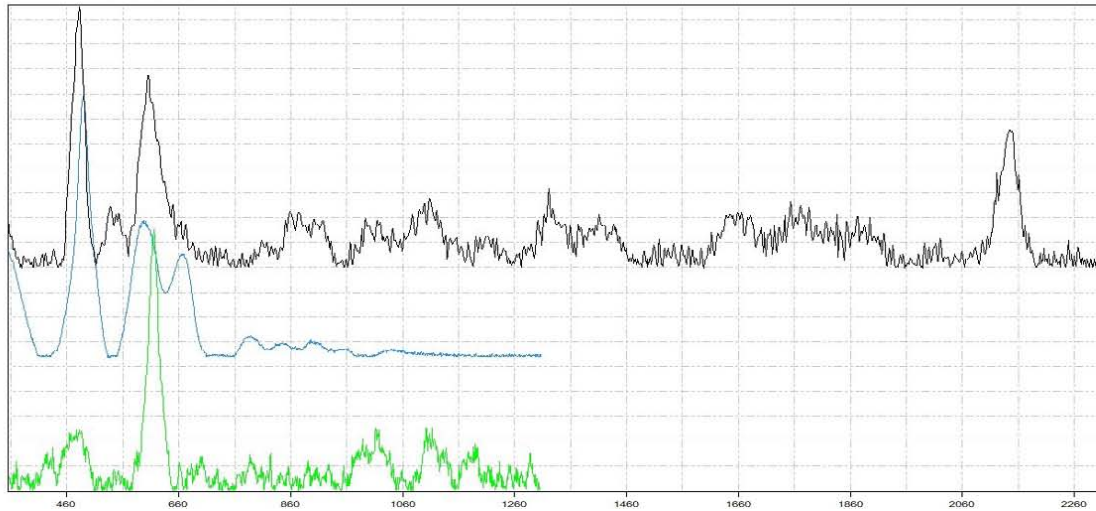


Sample :



CrystalSearch: EXTRACT\_7\_TEN\_S2 (10x) 0.000002.0

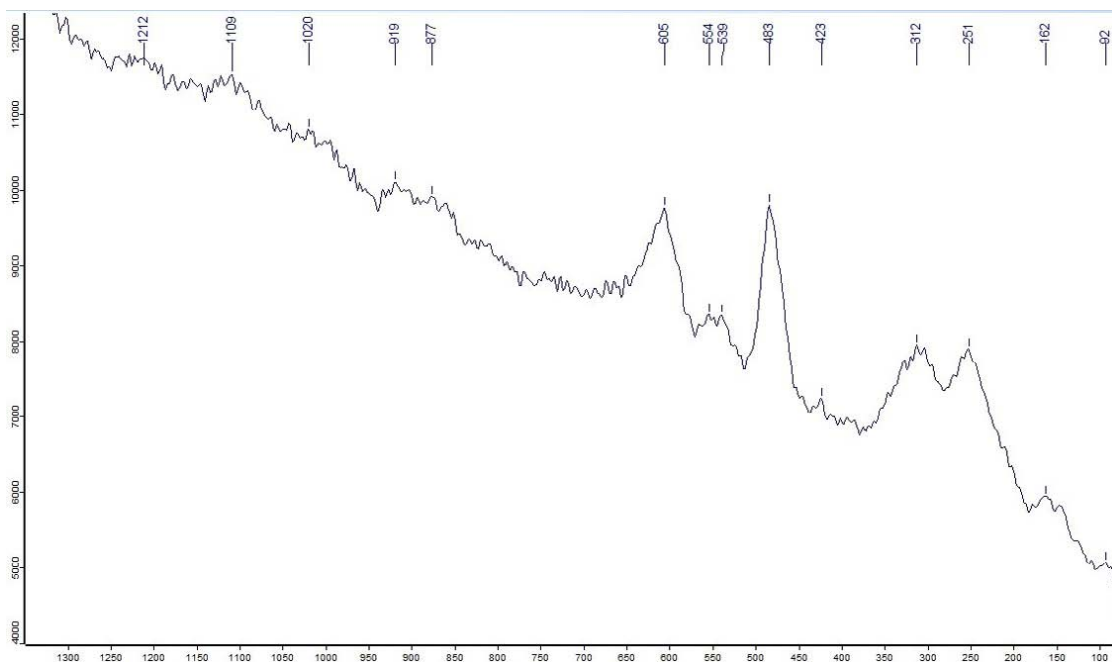
File Edit Mode Help



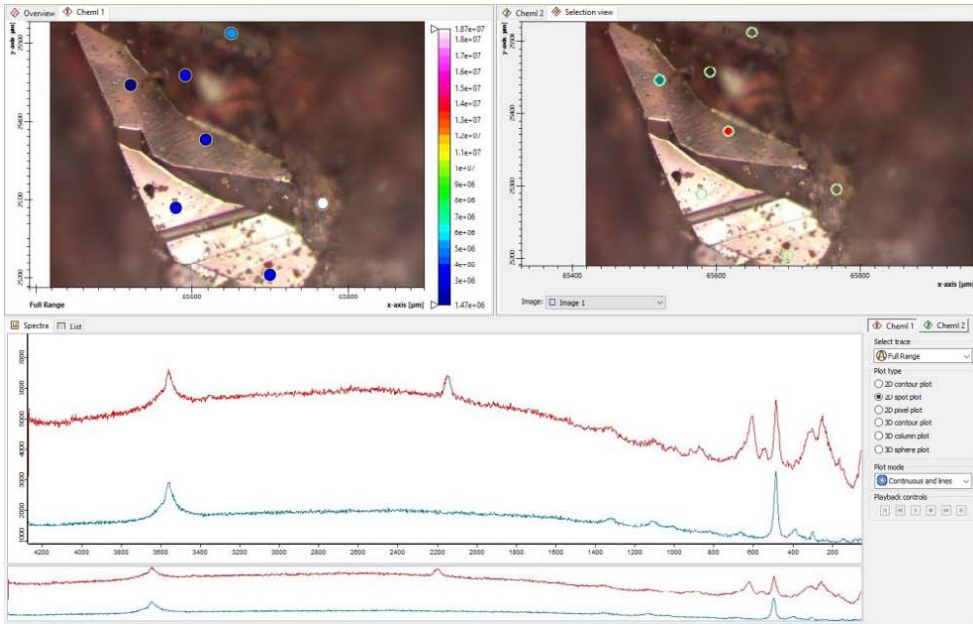
% Match	Spectrum Name	RRUFF ID
65	<1> Cestibtantite (532nm)	R061038
64	<1> Monteregianite-(Y) (532nm)	R080109
63	<1> Enionite-K (532nm)	R061104
62	<1> Milarite (532nm)	R070373
62	<1> Helmergenite (532nm)	R015387
61	Milarite (532nm)	R070464
61	Epistilite (532nm)	R070396
61	Vasikuvite (532nm)	R070216
61	Itanite (532nm)	R050124
60	Frondeite (532nm)	R050622
60	Titanite (532nm)	R050114
60	Gagarinite-(Y) (532nm)	R060517
60	Dahavite (532nm)	R070106

R061038  
Cestibtantite  
Cs<sub>0.31</sub>(Sb,Na)<sub>0.91</sub>(Ta,Nb)<sub>2</sub>(O,OH,F)<sub>6.69</sub>  
Mt. Vasin-Myk, Voron'ya Tundra, Russia

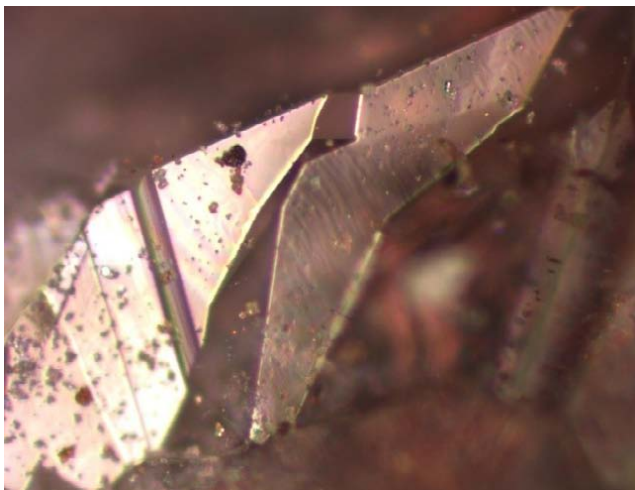
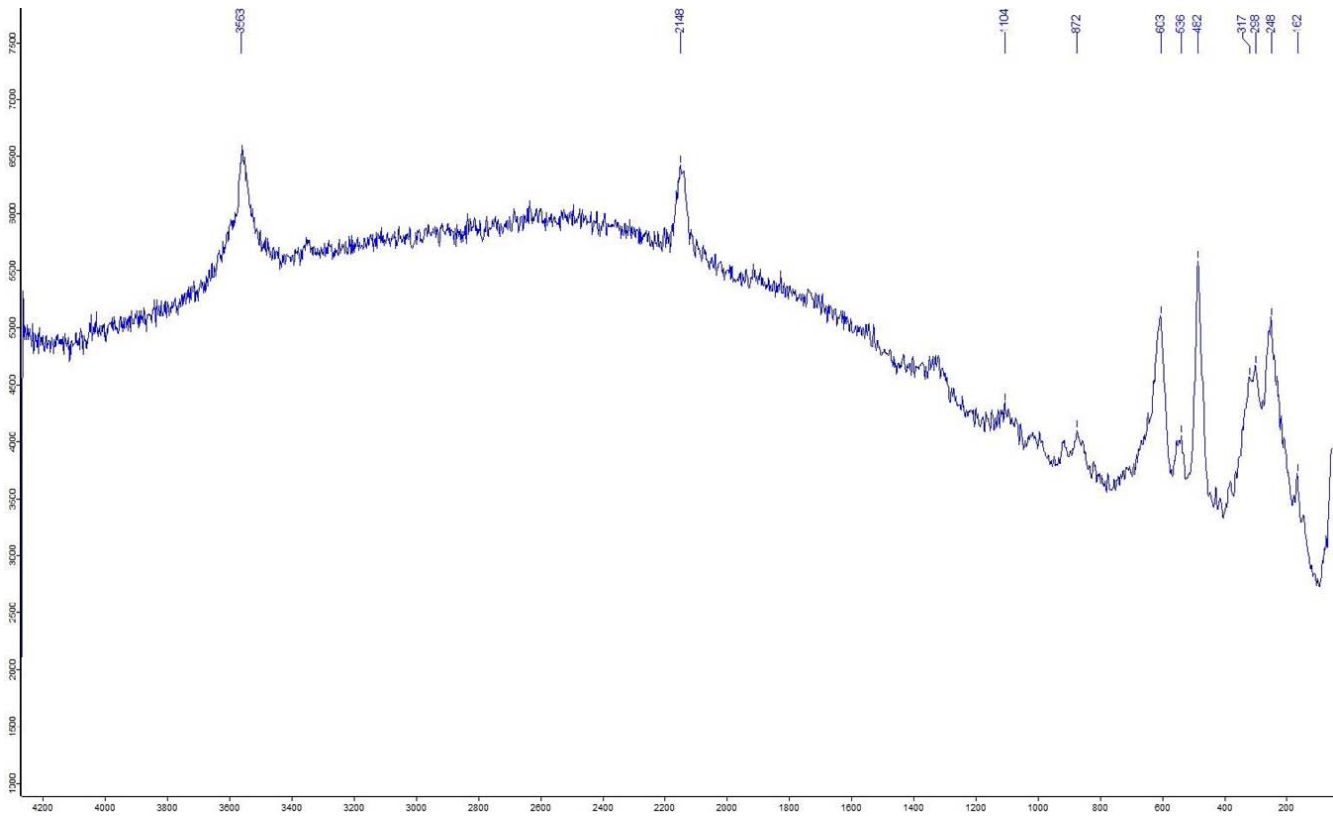
R080109  
Monteregianite-(Y)  
KNa<sub>2</sub>Al<sub>2</sub>Si<sub>2</sub>O<sub>10</sub>(OH)<sub>2</sub>F<sub>2</sub>  
Mont Saint-Hilaire, Quebec, Canada



Sample Site 7: Stone 5\_spectra 3 → similar to spectra 2 ( see previous page ) – indicates : **Cestibtantite and Monteregianite-(Y)** ( → crystal in the brown matrix of the stone )

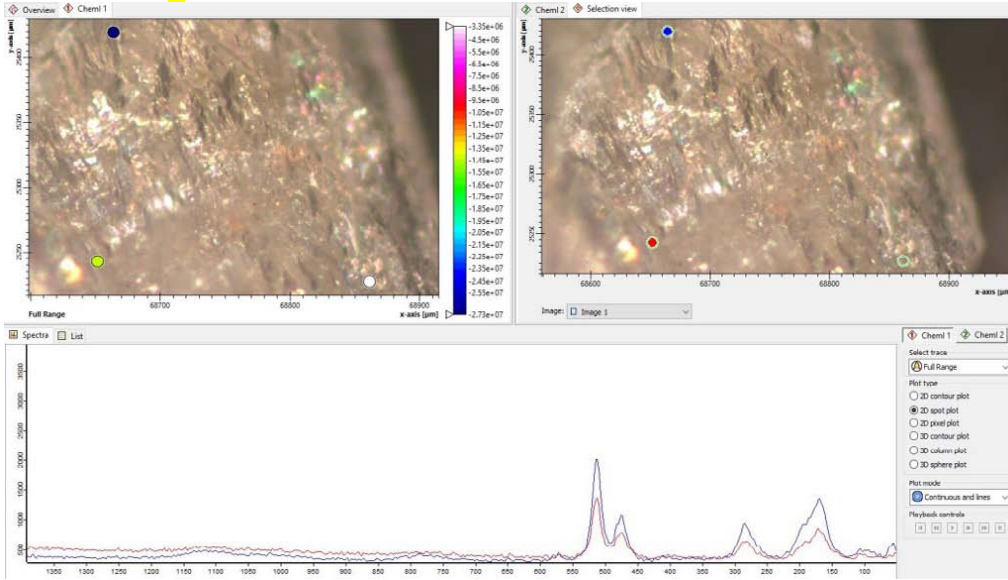


Sample :

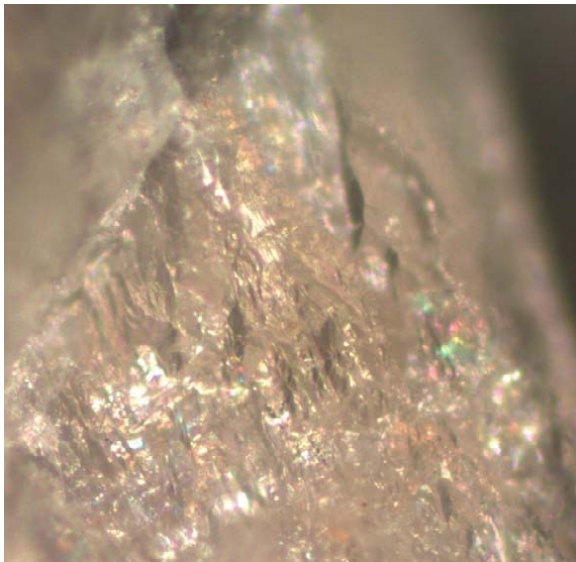
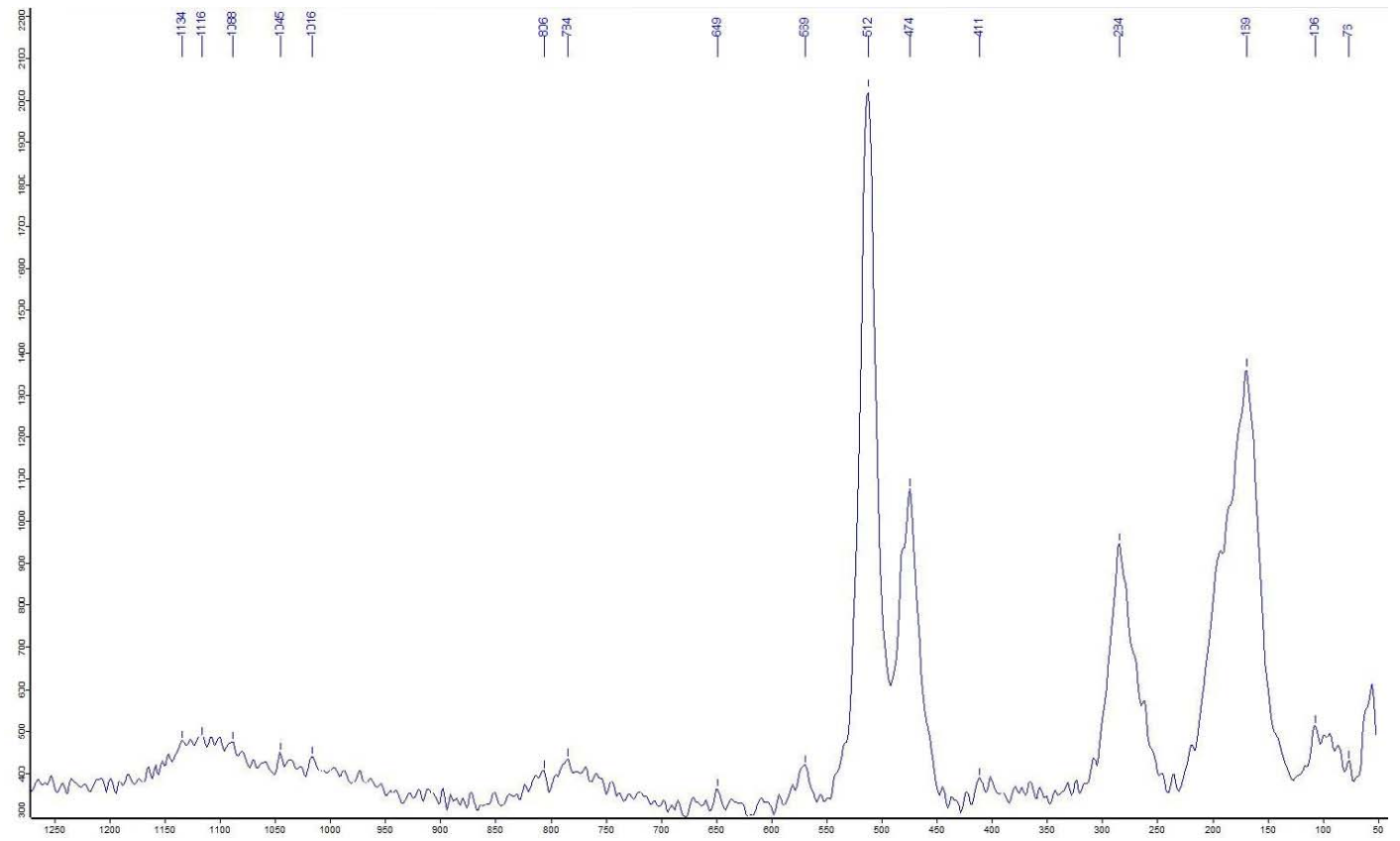




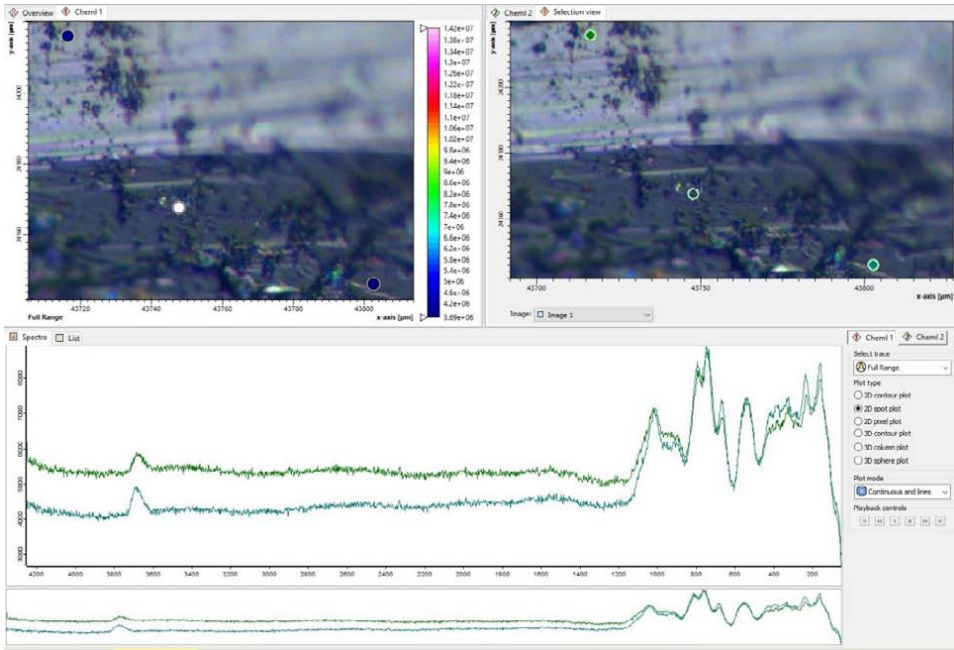
Sample Site 7: Stone 6\_spectra 1 (white mineral) indicates: Anorthoclase, Labradorite



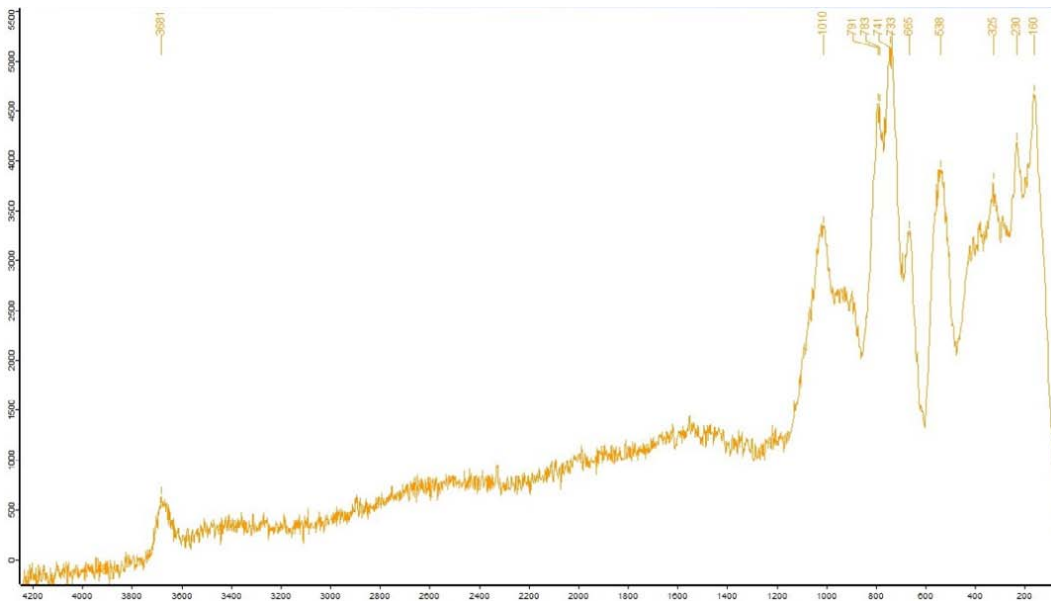
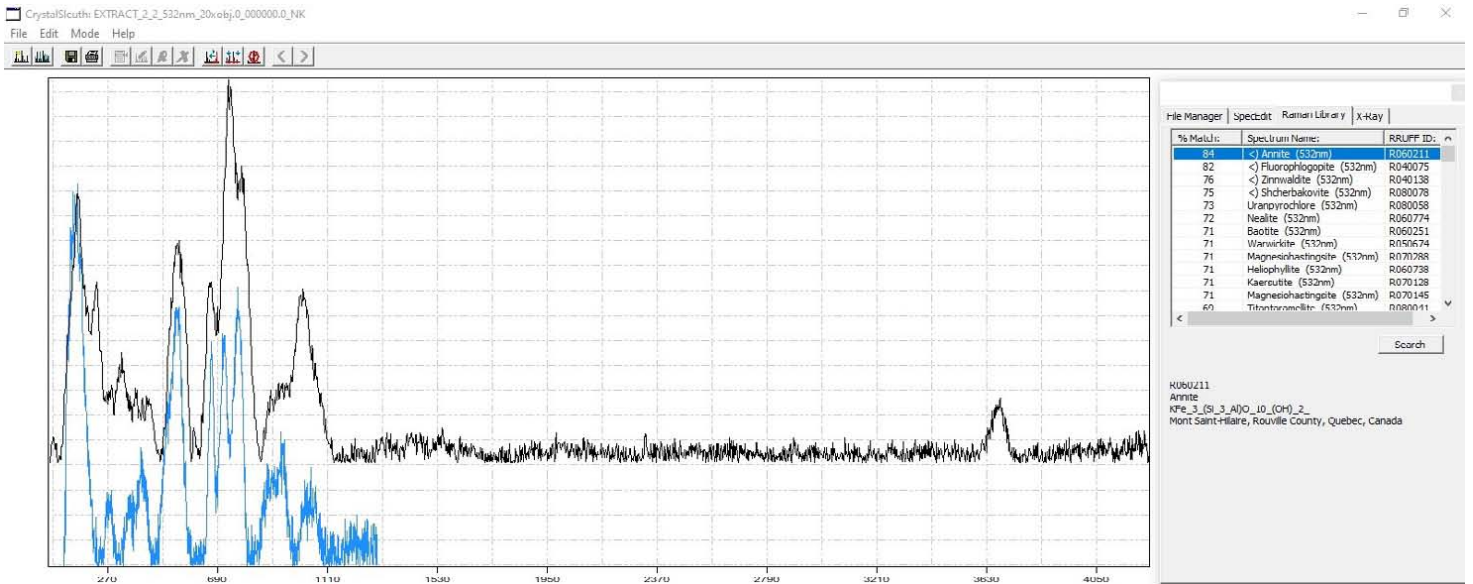
Sample :



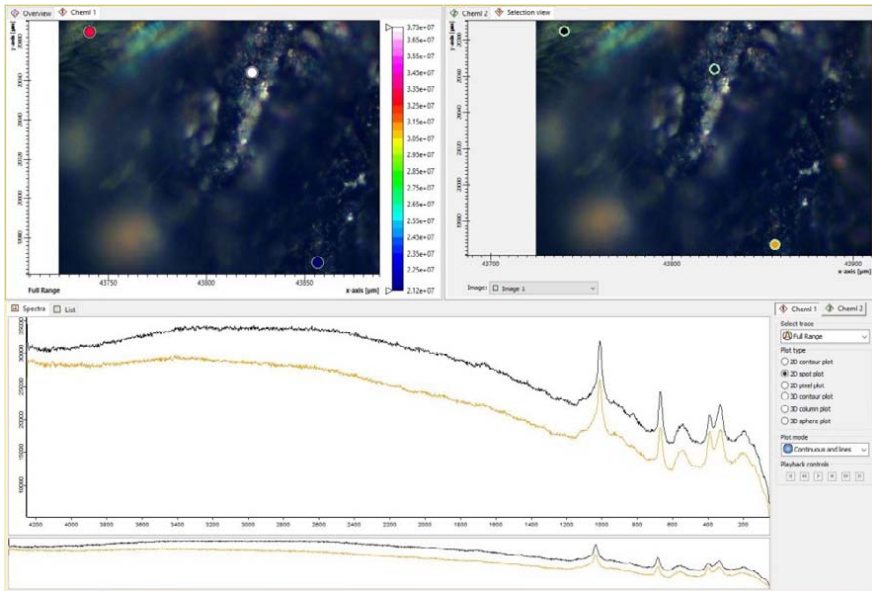
Sample Site 9: Stone 1\_spectra 2 ( dark mineral ) indicates: **Annite** ( → see RRUFF\_CS search result )



Sample :



Sample Site 9: Stone 1\_spectra 3 ( dark minerals ) indicates : **Augite** or similar ( → RRUFF\_CS search result )

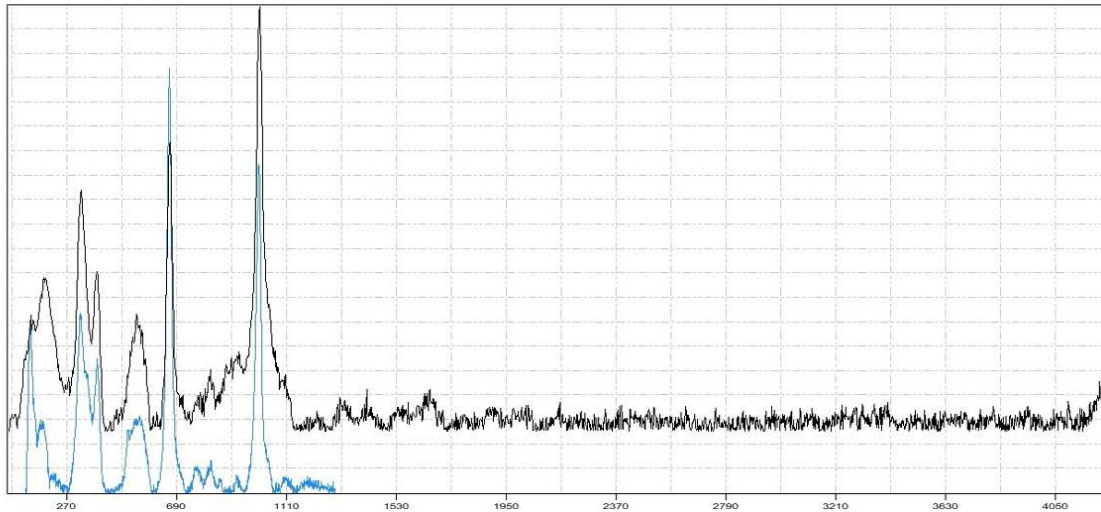


Sample :



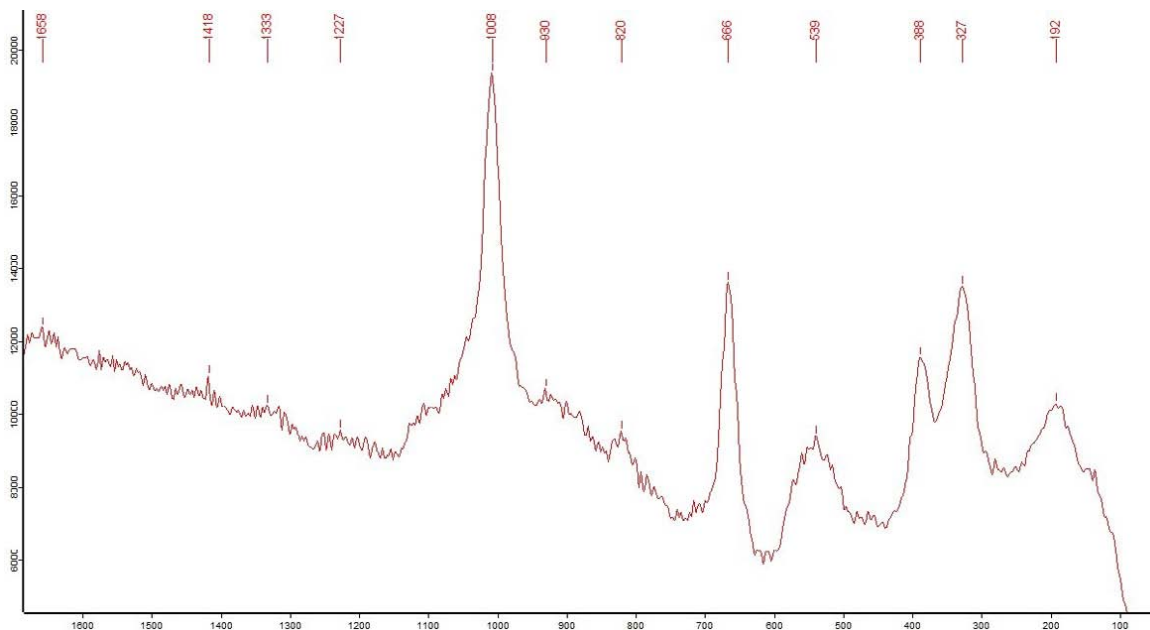
CrystalScout: EXTRACT\_2\_3\_532nm\_20xobj\_0\_000000\_0\_NK

File Edit Mode Help

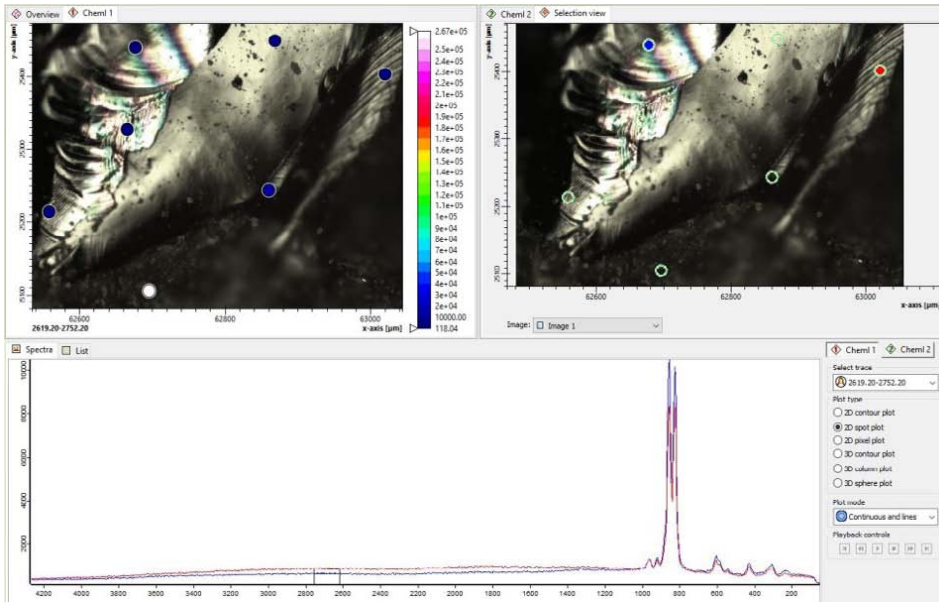


% Mol/Lic	Spectrum Name:	RRUFF ID:
86	<) Augite (532nm)	R061108
85	Augite (532nm)	R070231
81	Diopside (532nm)	R050496
81	Diopside (532nm)	R040097
80	Augite (532nm)	R061086
78	Diopside (532nm)	R050406
78	Inhannsenite (532nm)	R070521
78	Diopside (532nm)	R060085
78	Diopside (532nm)	R060061
78	Kanoite (532nm)	R061134
77	Diopside (532nm)	R070123
76	Bobingtonite (532nm)	R060003
75	Geherite (532nm)	R070117

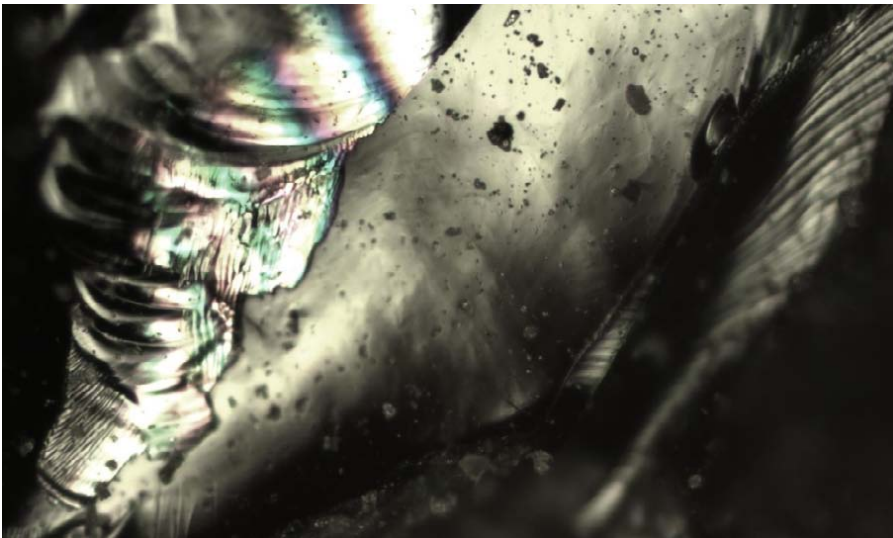
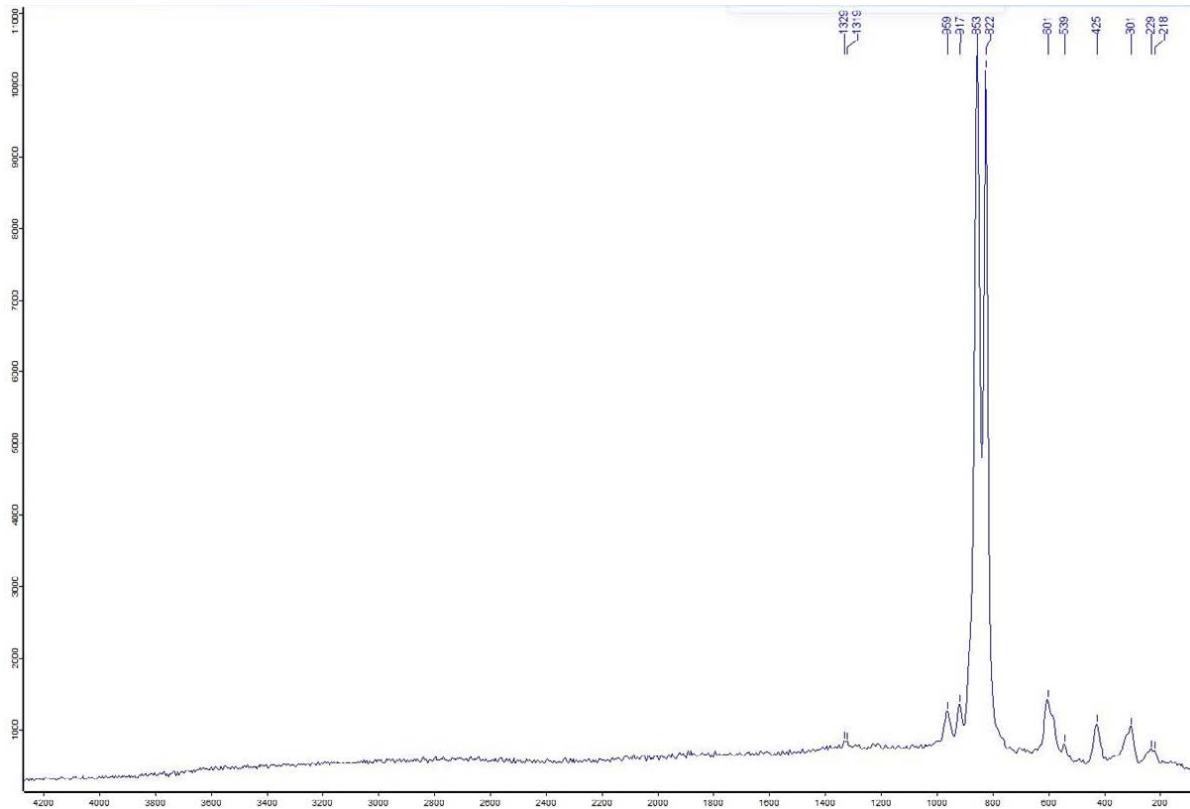
R061108  
Augite  
(Ca,Mg,Fe)<sub>2</sub>(Si,Al)<sub>2</sub>O<sub>6</sub>  
Mont Rossi, near Mt. Etna, Sicily, Italy



Sample Site 56: Stone 1\_spectra 1 ( crystal in grey matrix of stone → see image ) : no analysis done



Sample :



Sample Site 58: Stone 1\_spectra 2 ( white crystal inclusion ) indicates : Anorthoclase ( → RRUFF )

The sample is from an **old rock island** inside the Teide Volcano caldera.

Approx. 400m SW from the “Rocks de Garcia”

Sample :

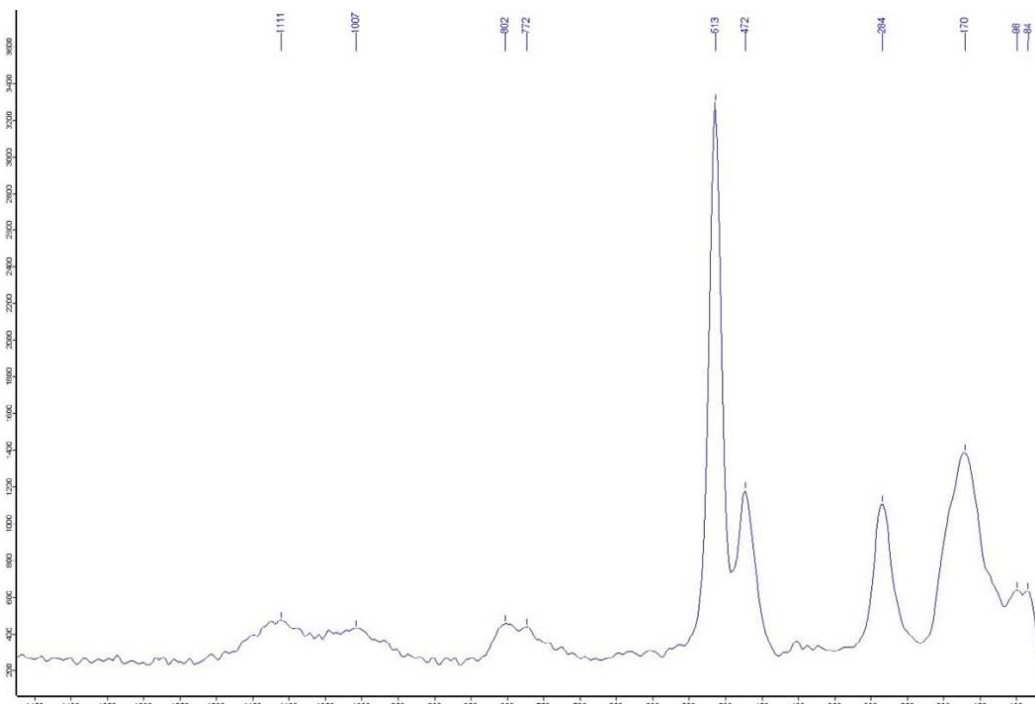
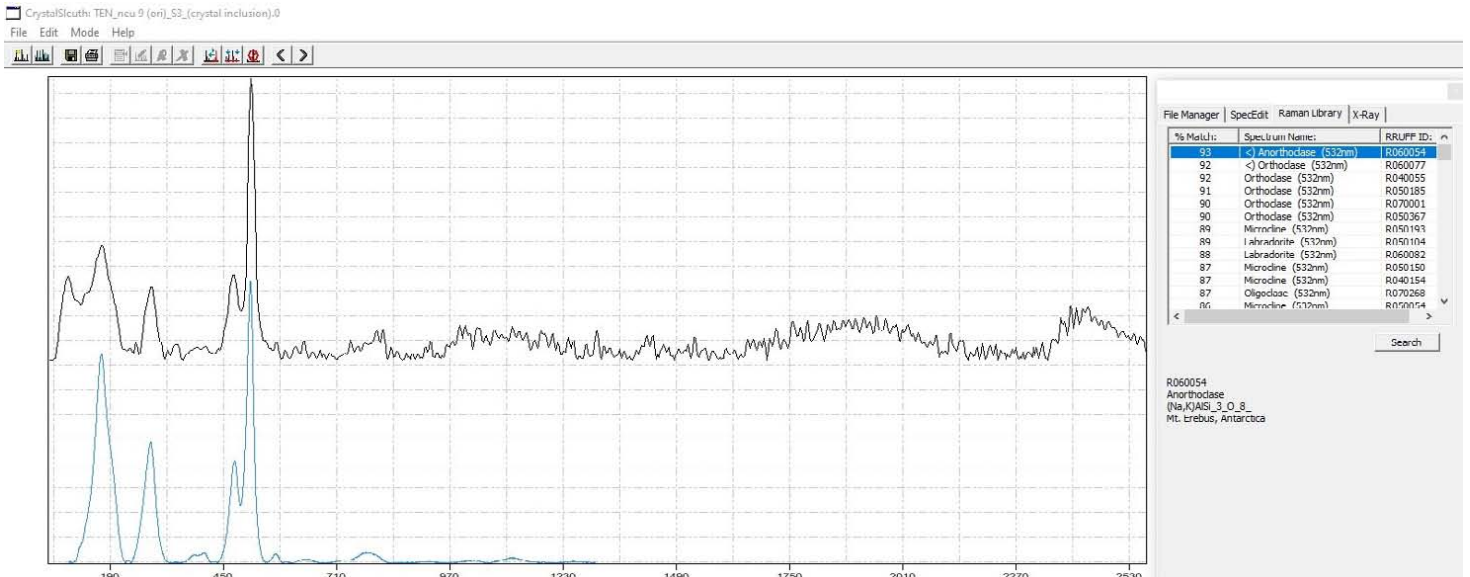
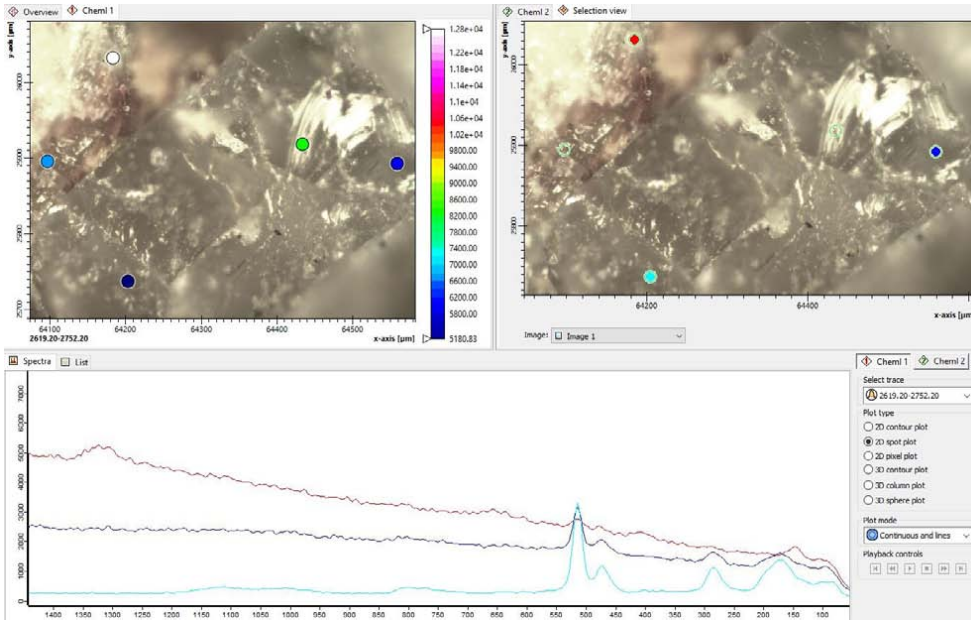


Image size : ≈ 200 x 350 μm



**Appendix 1 : Photos of the rock samples from sample sites : 2, 5, 7, 9 and 58**

→ See next page

**Note :** Photos of the Samples Sites 2, 5, 7, 9 and 58 and other sample sites are available on my website. → weblink : [Sample Sites "Anaga Crater"](#) ( or [here](#) ) together with geological maps and a GPS-Data List of the sample sites.

Satellite Image with Sample sites No. 1 – 9 :

→ Weblink to the Magna 50 ( 1:50000 )

Digital Geological-Map :

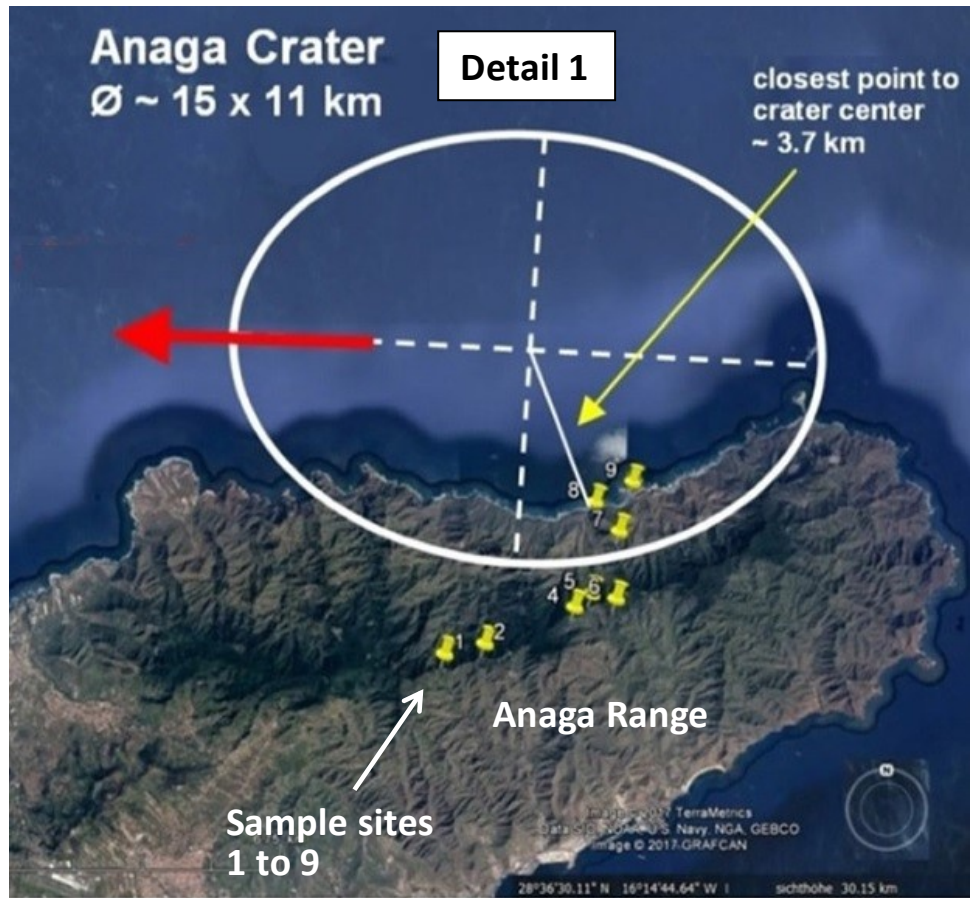
→ Tenerife (Hoja 1104)

or

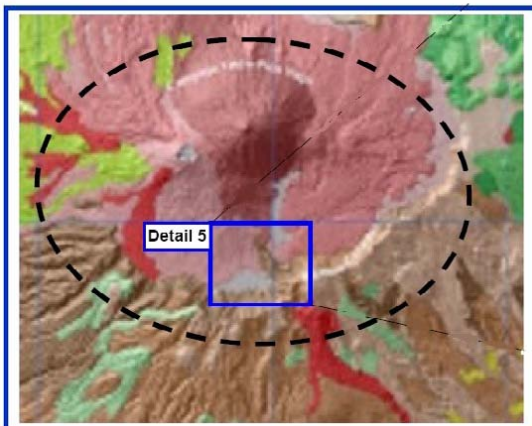
general entry to the maps :

→ Magna 50 - GEO-Maps

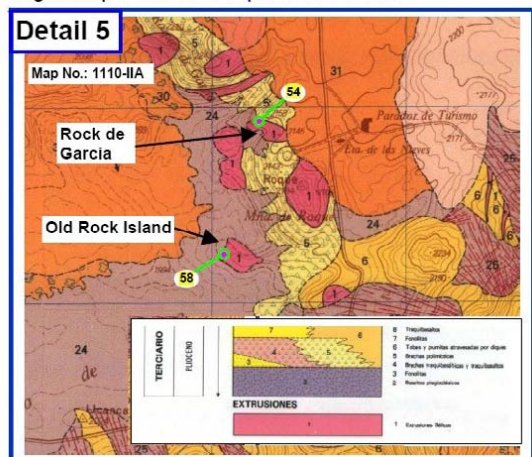
→ zoom-in to Tenerife



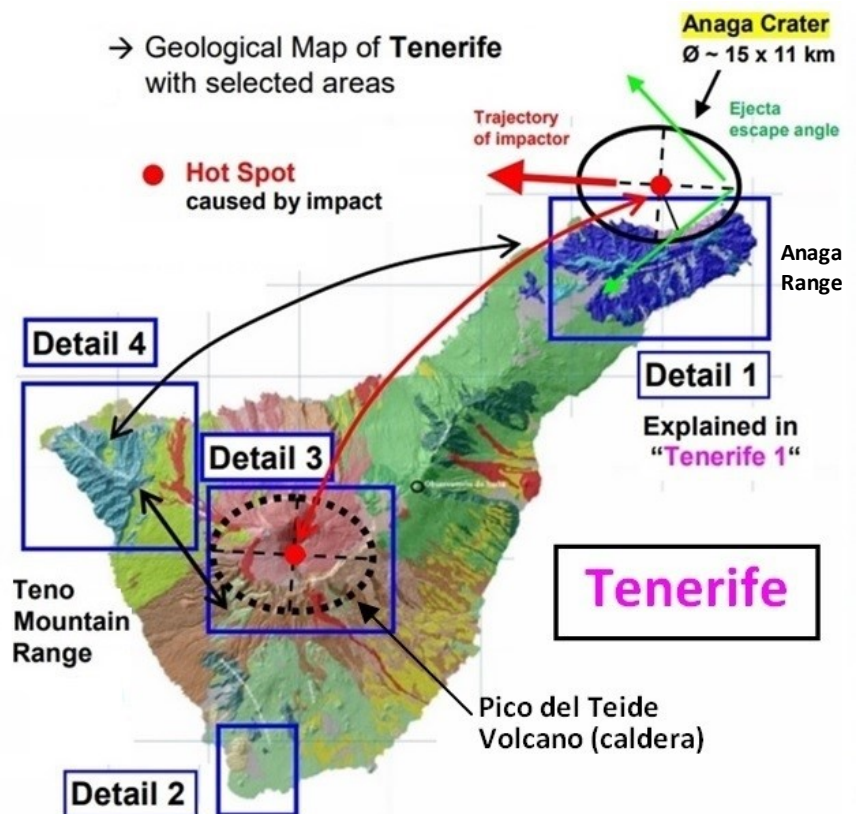
Detail 3 Pico del Teide - Volcano



Geological Map → Weblink : MapasIGME: MAGNA 50 - scale 1:50.000

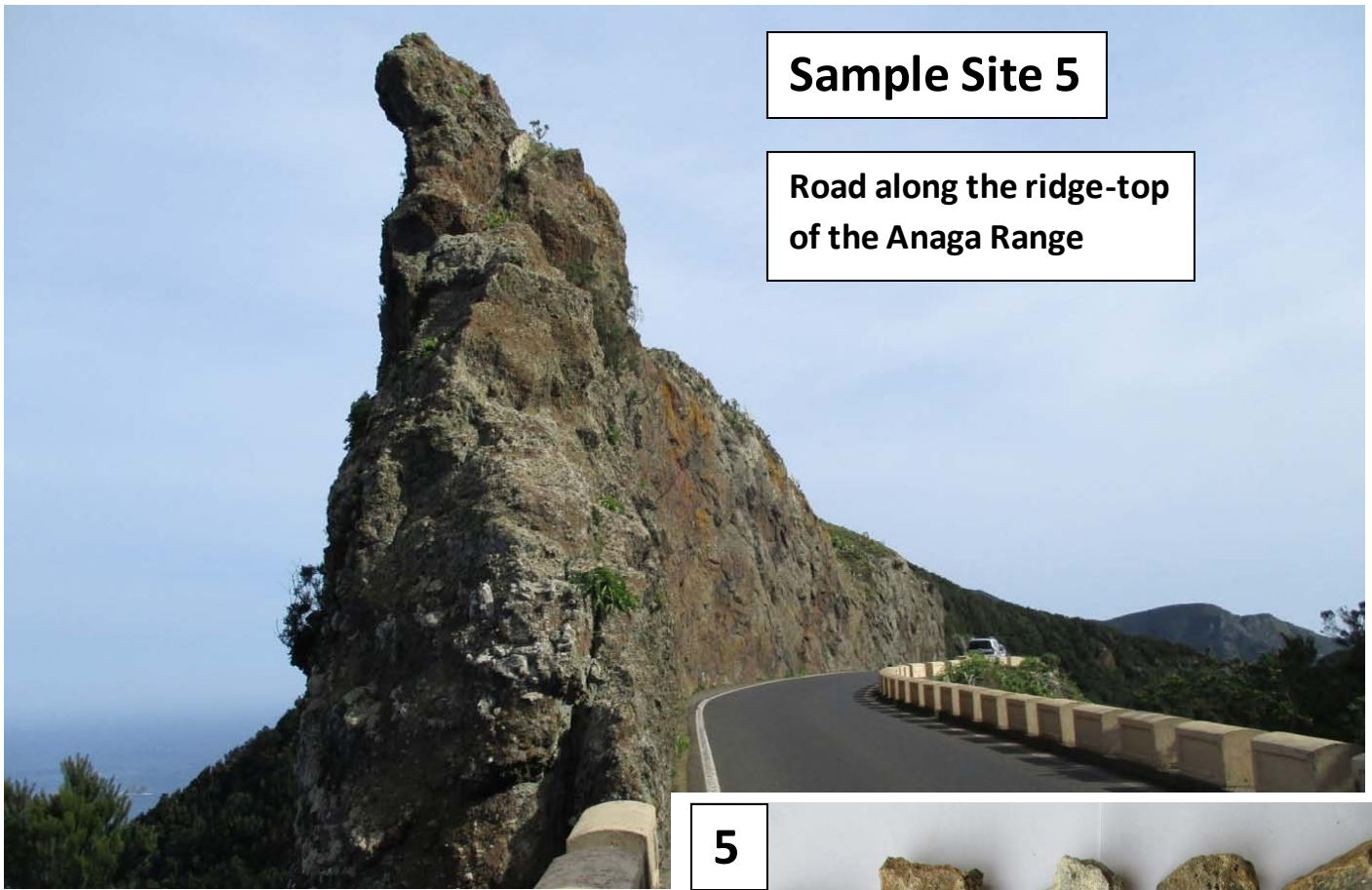


→ Geological Map of Tenerife with selected areas



# Sample Site 5

Road along the ridge-top of the Anaga Range



5



5 28° 32.884 N 16° 12.770 W 25 m Spain - Canary Islands



5

5 28° 32.884 N 16° 12.770 W 25 m Spain - Canary Islands

# Sample Site 7

View over the Anaga Range





# Sample Site 9



Beach is full of small and large pebble-stones which consist of many different Breccia types ( mainly feldspar-minerals )



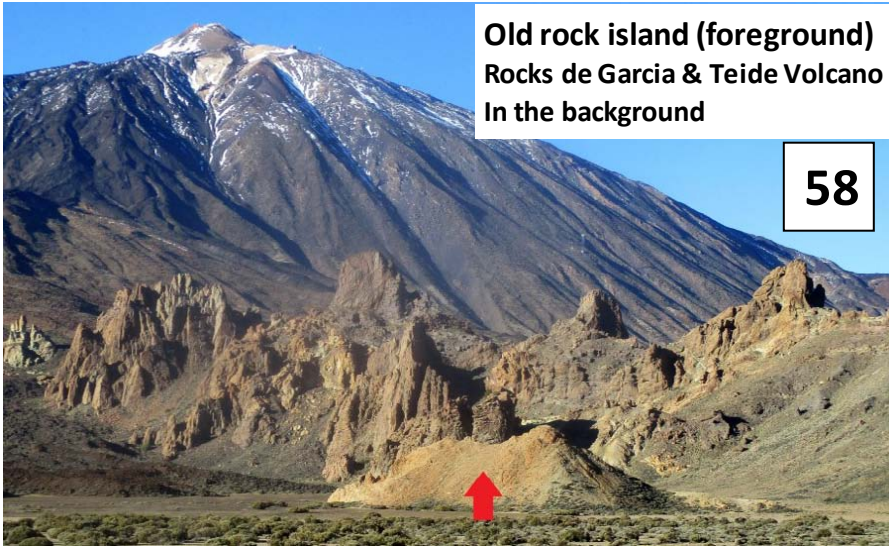
Old rock island ( with possible PT- age )  
Inside the caldera of the Teide Volcano

Sample Site 58



Old rock island (foreground)  
Rocks de Garcia & Teide Volcano  
In the background

58



Detail



58



# Sample Site 2

# Road along the ridge-top of the Anaga Range



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

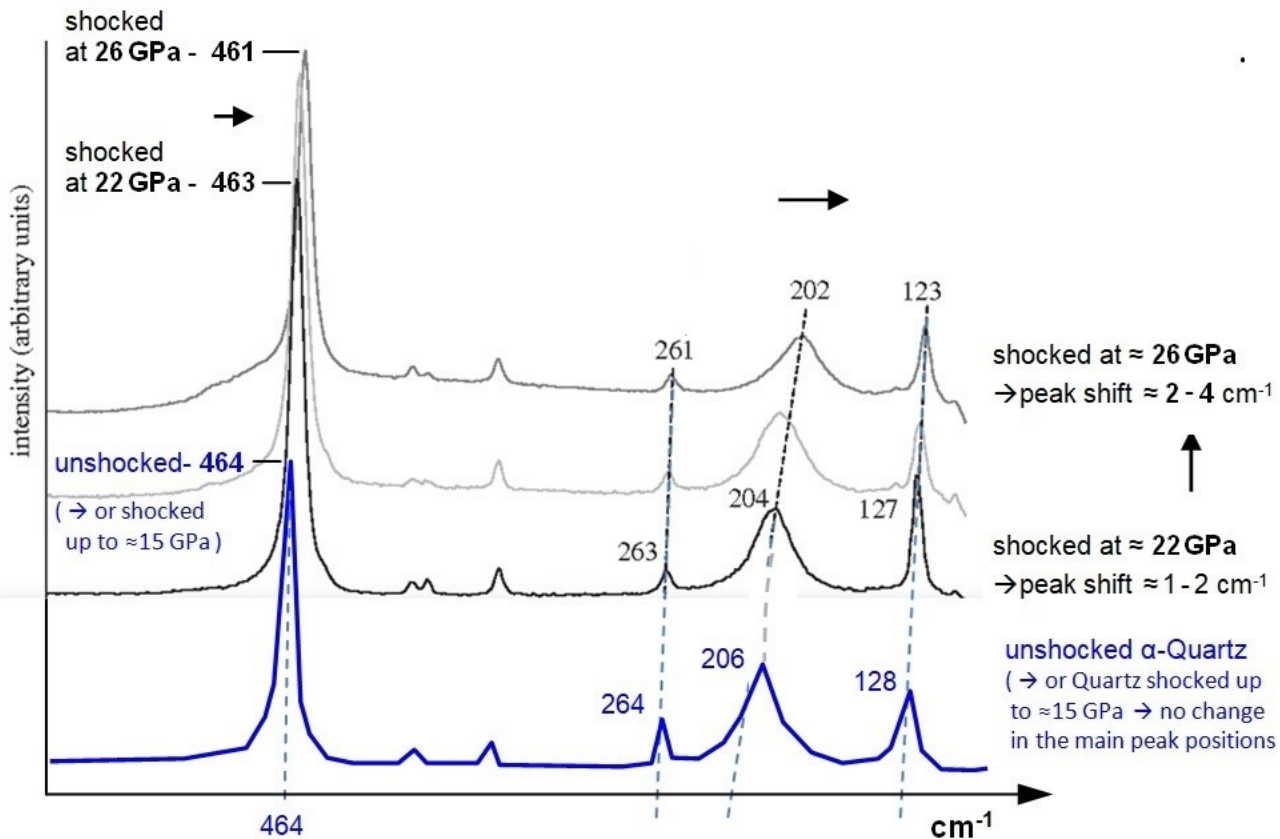
In order to verify a sample site as an impact site or impact structure, [shock-metamorphic effects](#) must be discovered in the rocks of the sample site. This can be done by different methods.

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.

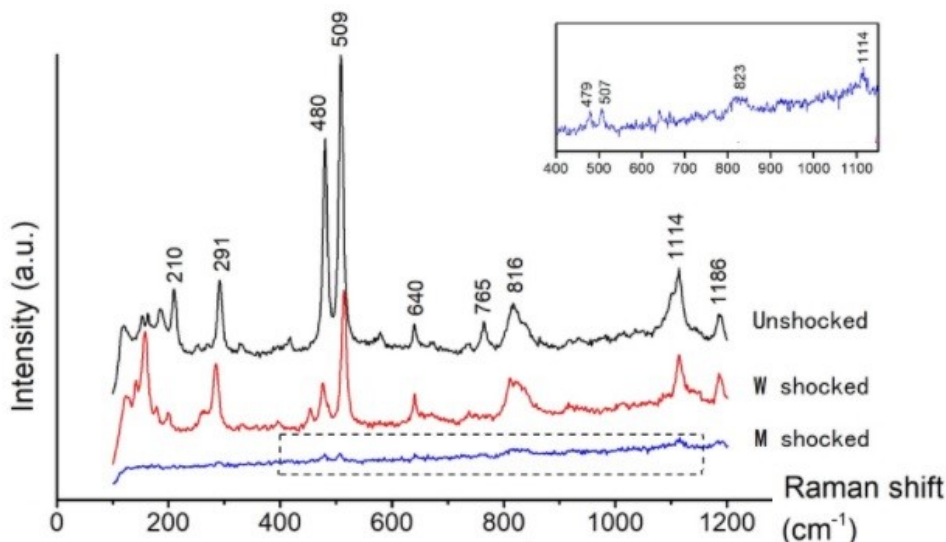
Mc Millan et al. (1992) and others have shown that the main RAMAN-peaks of Quartz shift towards lower frequencies if the Quartz was exposed the a shock-pressure > 15 GPa. → see diagram below

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<sup>-1</sup> 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 "Anaga Crater"](#) ( or alternatively : [here](#) )

The following Impact-Craters & -structures belong to the same large-scale secondary impact event caused by the PTI :

[The 130 x 110 km Bay-of-Lyon Impact Crater \(France\)\\_Raman spectra of selected Rock Samples](#) ( or here )

[A 30 km Impact Structure and a 1.6 x 1.2 km Elliptical Crater in Southern Spain\\_Raman Spectra of Rock Samples](#) ( or here )

[Impact Craters on Fuerteventura & Gran Canaria](#) : Raman-anlaysis of rock-samples : → [soon](#) on [vixra.org](#) & [archive.org](#)

Please also read : 1.) ScientificStudies to [Tenerife & the Canarian Island's Geology](#) (→ links on page 2 ! ) - (→ or [here](#) )

2.) ScientificStudies to [Fuerteventura & Canarian Island's Geology](#) (→ links on page 2 ! ) - (→ or [here](#) )

[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](#)

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[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, Phillippe 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](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  \$\alpha\$ -quartz to CaCl<sub>2</sub>-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](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](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](#)

[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](https://www.researchgate.net/publication/348675414_ExoMars_Raman_Laser_Spectrometer_RLS_a_tool_for_the_potential_recognition_of_wet_target_craters_on_Mars)