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 (ellipitical) 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.

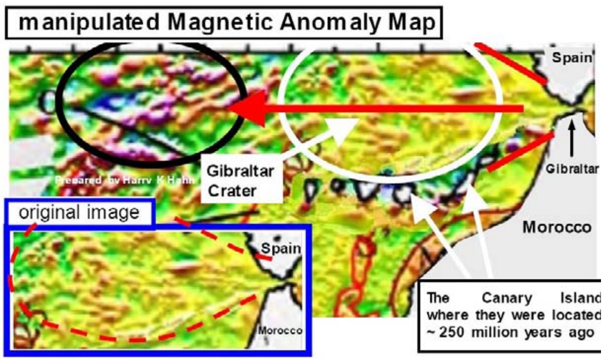
Some of the analysed feldspar-samples may show Raman-spectra which indicate (W) weakly-shocked or (M) moderately-shocked Alkali-Feldspar. But these Raman-spectra must be analysed by experts who have the experience to correctly assess such spectra. Unfortunately I don't have the required expertise.
The 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 basaltc shield of Tenerife.

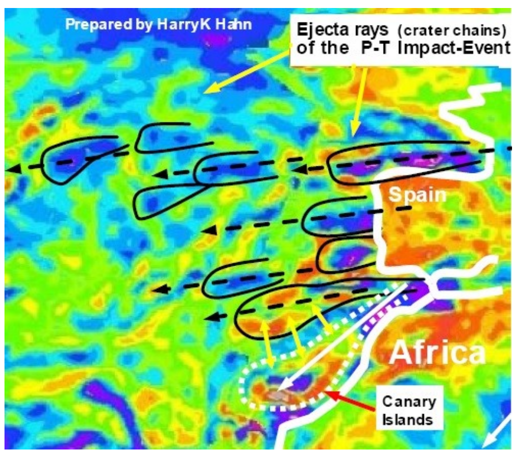
→ Images of the analysed rock samples and photos of the sample sites are in the Appendix at page **30**
→ A general summary to all analysed samples regarding my **PTI-hypothesis** (**P1**) → in **Part 6** (**P6**)
→ More images of all sample sites are available on www.permiantriassic.de or www.permiantriassic.at

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



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

Gravity Anomaly Map of the Canarian-Island-area

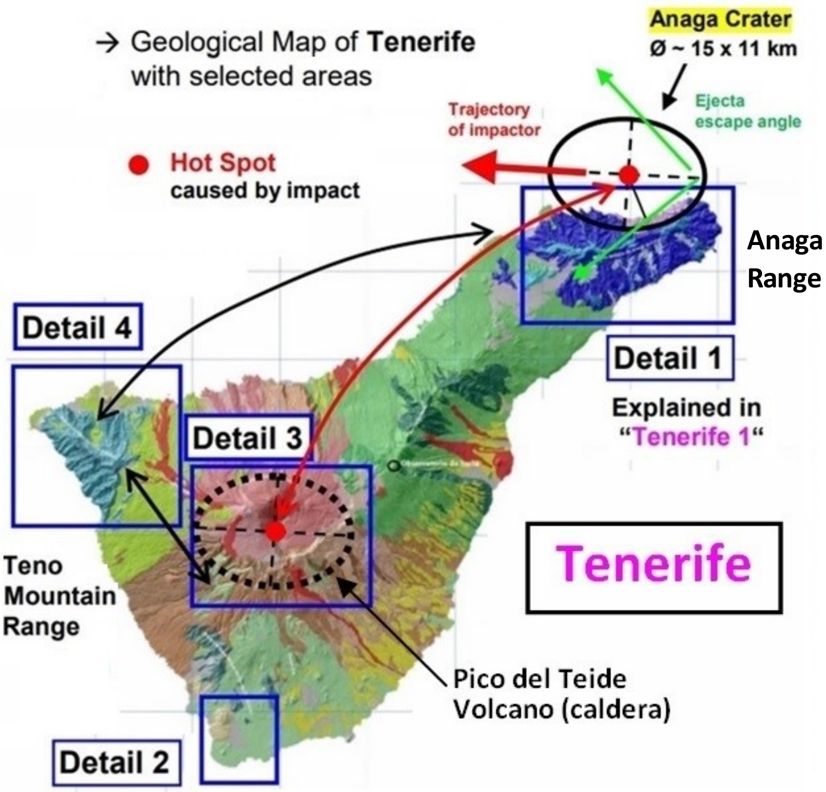


The Ø 15 x 11 km Anaga Crater has caused a hotspot

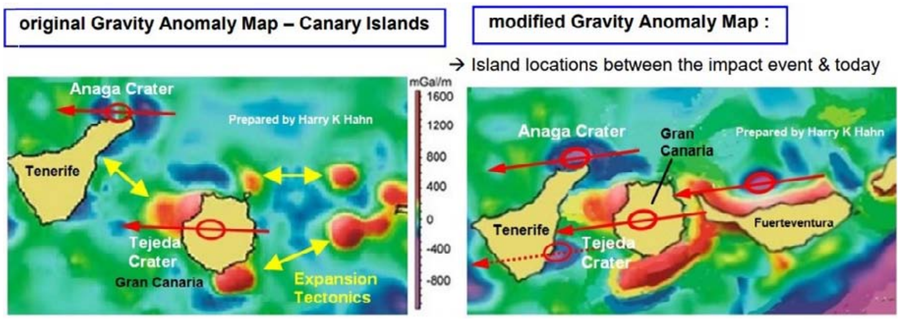
The Island Tenerife shows evidence of an Impact Event. This is the **Ø ~15 x 11 km** hypothetical **Anaga Crater** just north of the Anaga Range on Tenerife. This **"Anaga Crater"** in all probability was caused by an oblique Impact (a secondary impact) caused by the Permian-Triassic Impact Event (PT-I). 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.

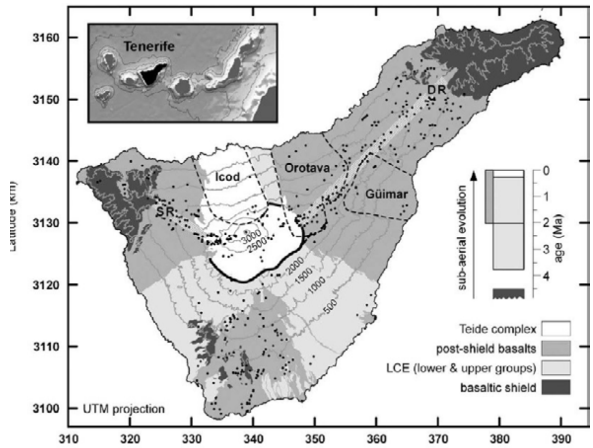
The old **"Teno Mountain Range"** probably was the western extension of the Anaga Range (Crater Wall) at the time of the PT-Impact (and was effected by the Anaga-Impact). Later it drifted away from the Anaga Range (see black arrow on the image) caused by an "expansion tectonics process" which was triggered 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 Ajuy Crater on Fuerteventura.**



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



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

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.

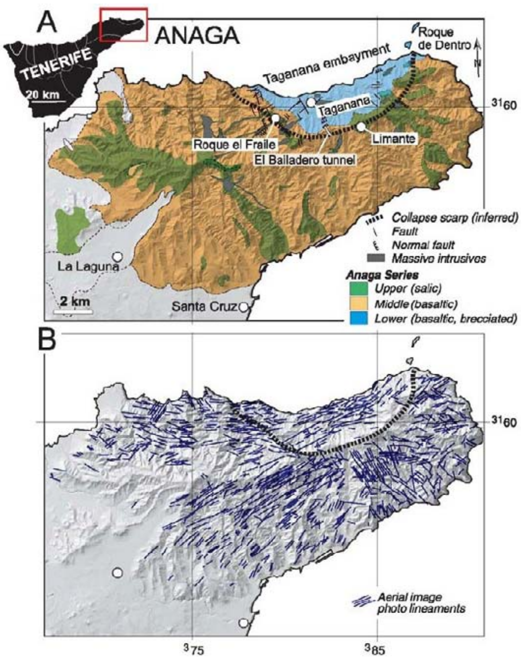


Fig. 2 Maps of Anaga area showing (**A**) a simplified geological map with the three major geological series, and (**B**) lineament distribution from aerial images on Anaga. *Dashed black line* marks the morphologically prominent horseshoe-shaped amphitheater and debrite outcrops. Note the numerous lineament 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-ENE. 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

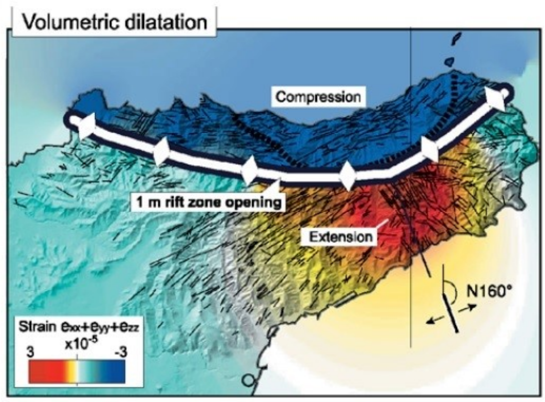
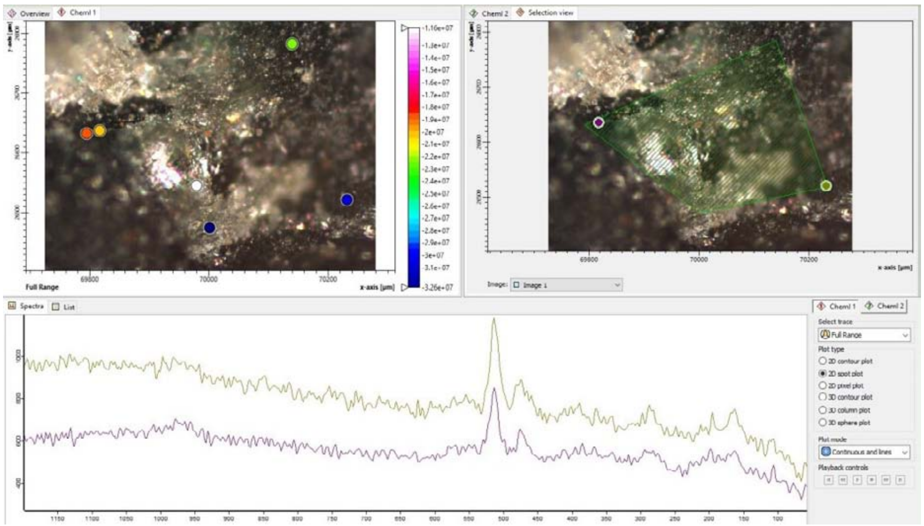


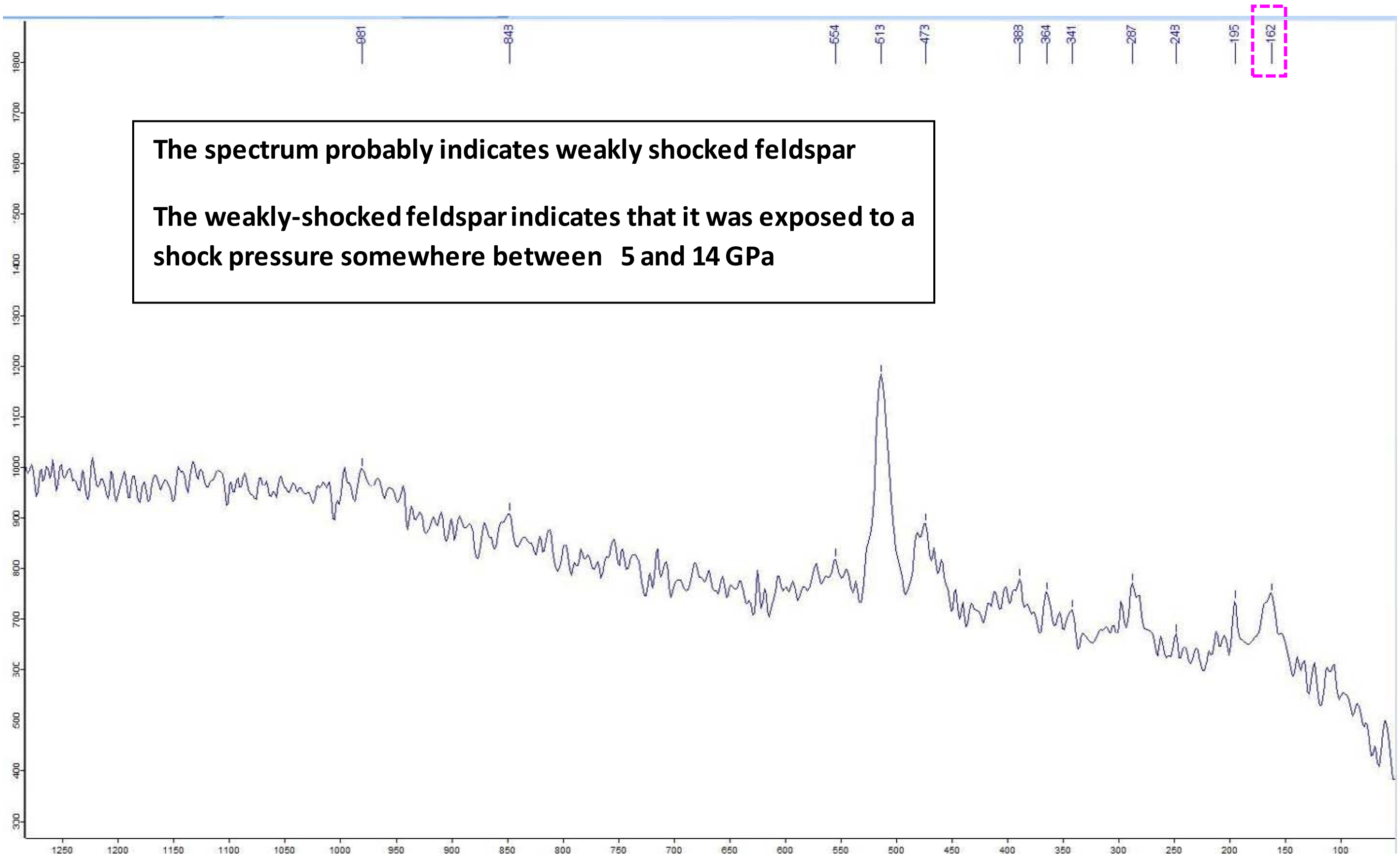
Fig. 7 Dislocation models calculated at a horizontal plane. A segmented rift zone was defined with an outline similar to the middle rift episode on Anaga. A curved tensile fault simulates the curved rift zone, uniform dislocation is 1 m. (**A**) Surface displacement vectors show that movement focused 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



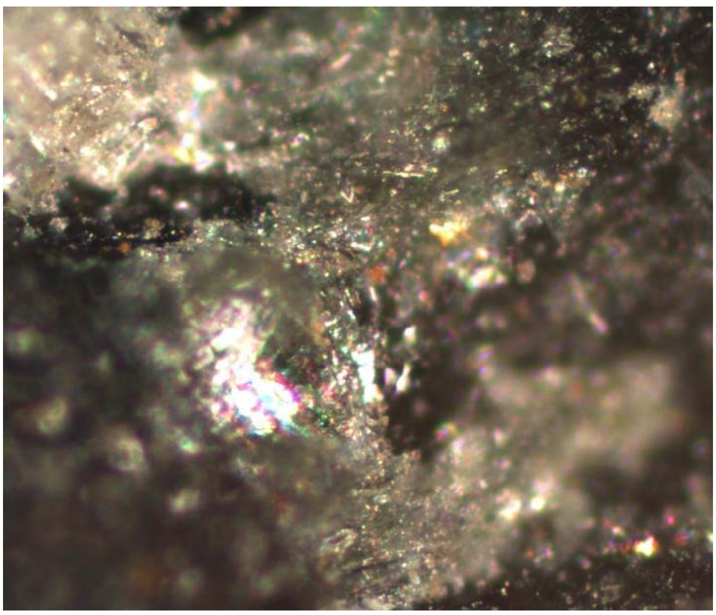
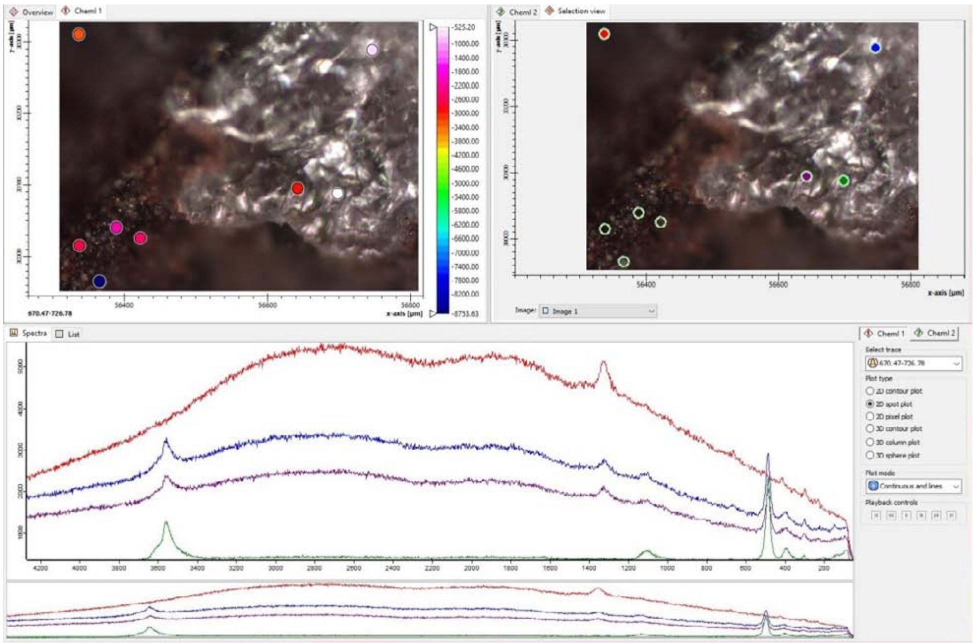


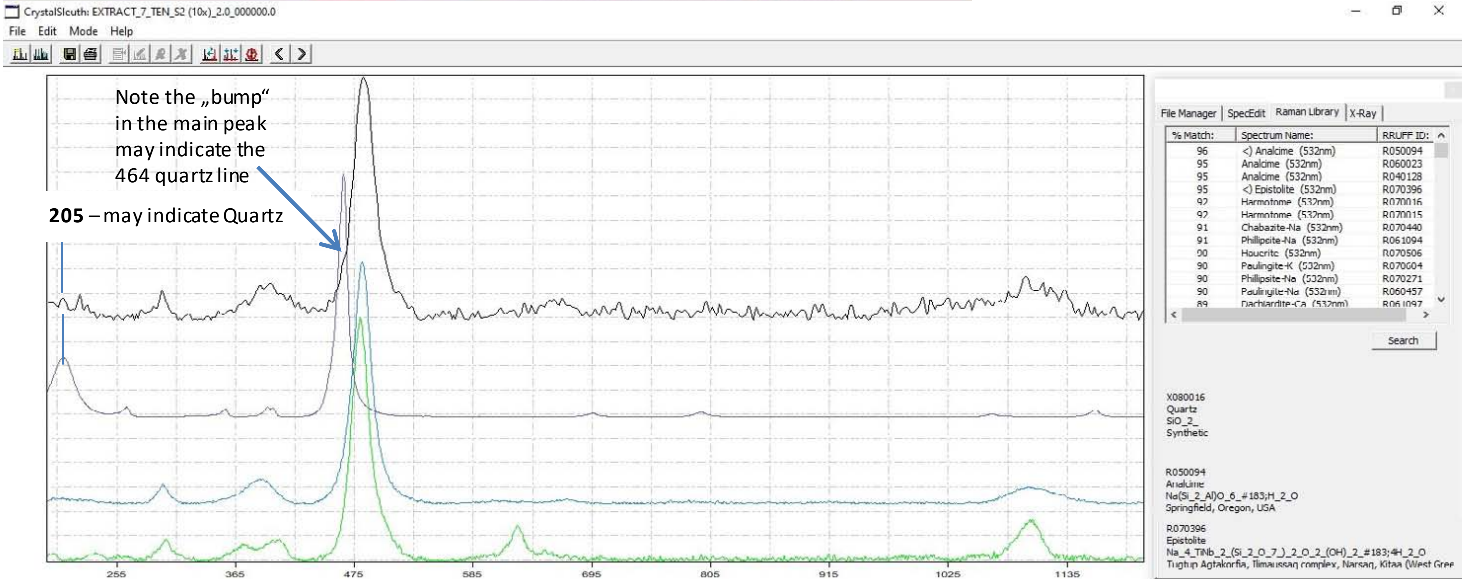
Image size ≈ 300 x 300 µm

Sample Site 7 : Stone 5_spectra 1- A indicates : Analcime_Epistolite and Quartz(?) (→ RRUFF_search result)

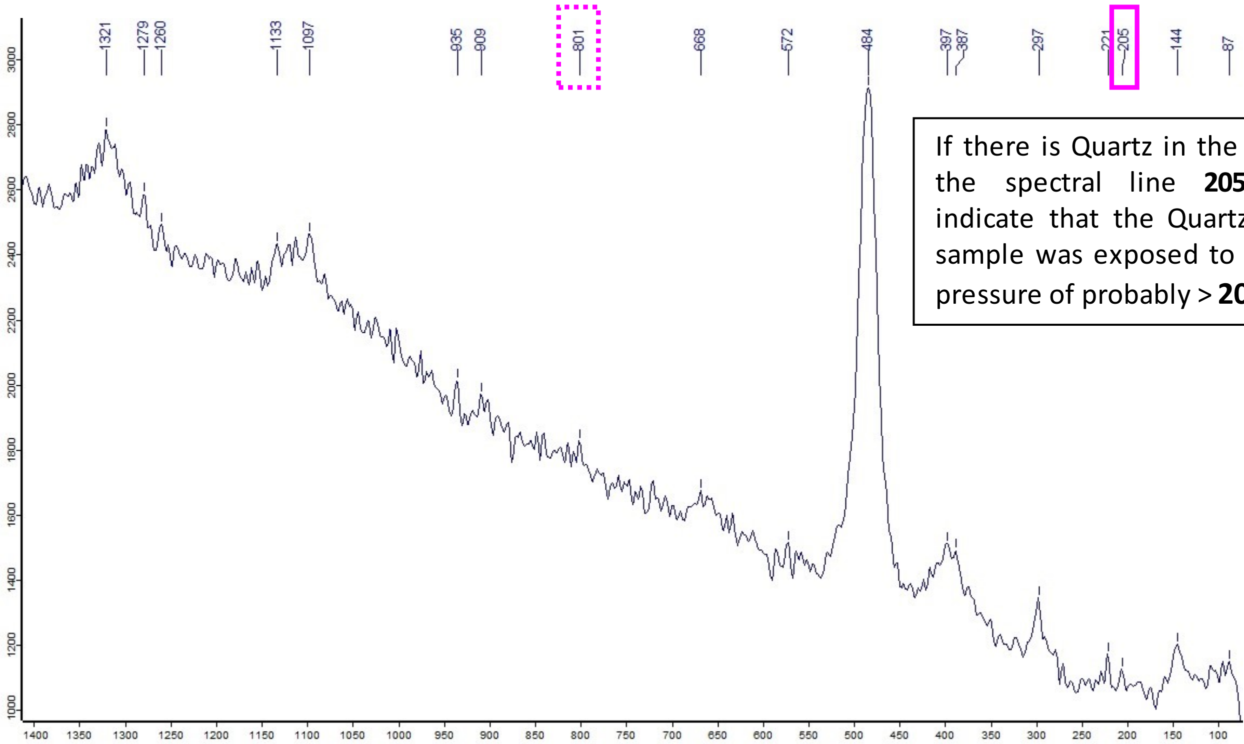


Note :
Spectral-lines of Quartz may be present in the spectra of the sample (32% match). This could indicate a small amount of quartz in the rock

Sample :

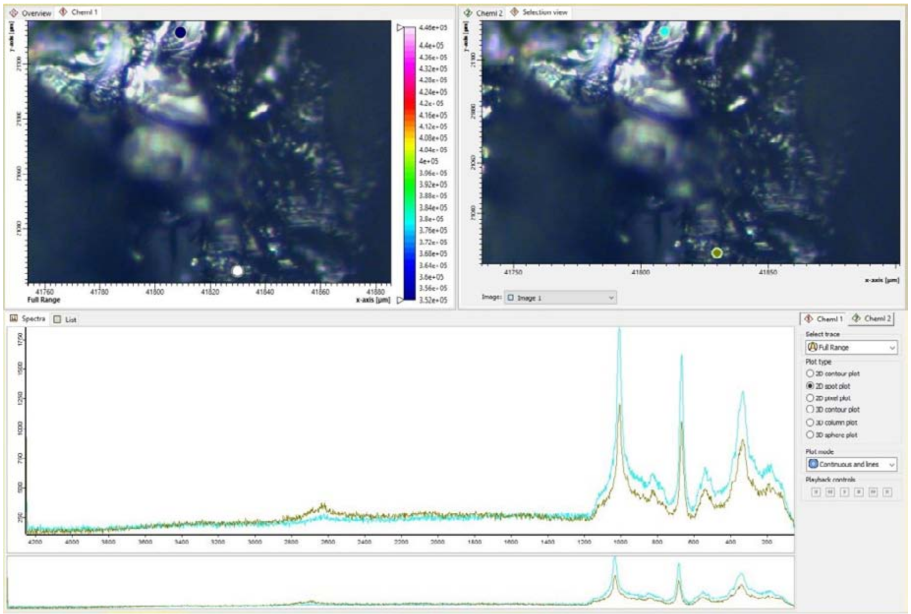


The spectral line 205 which probably comes from Quartz may indicate a shock event (→ peak shift from 206 to 205)

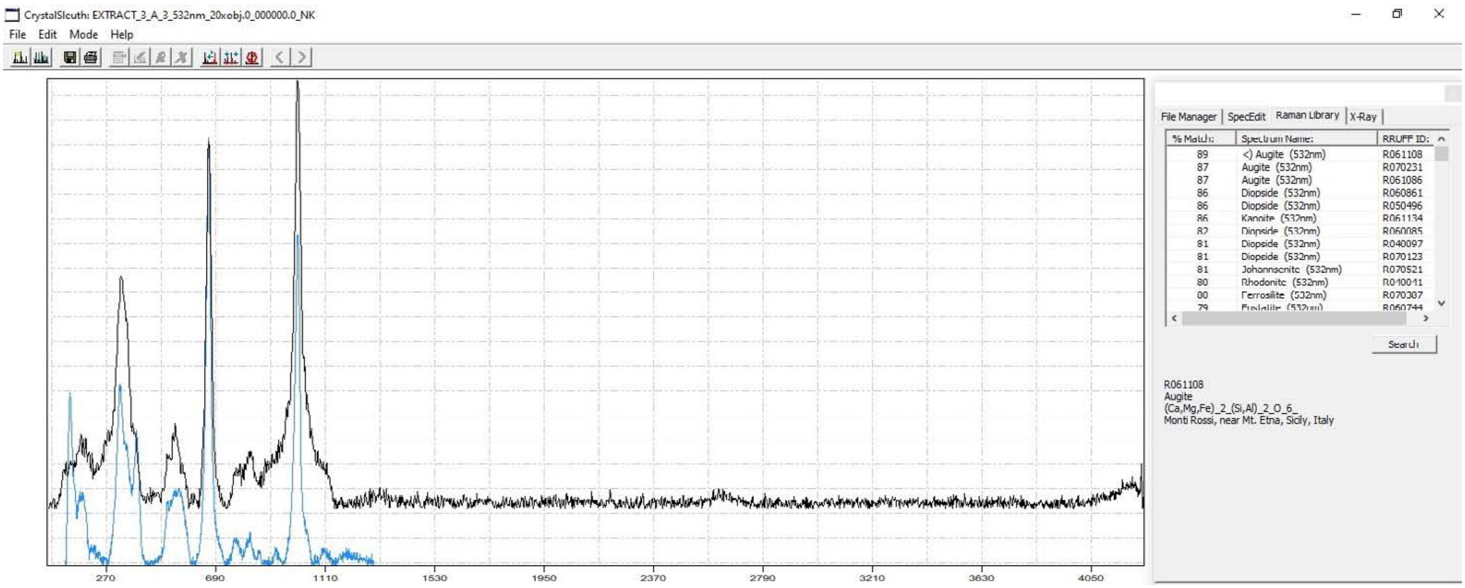


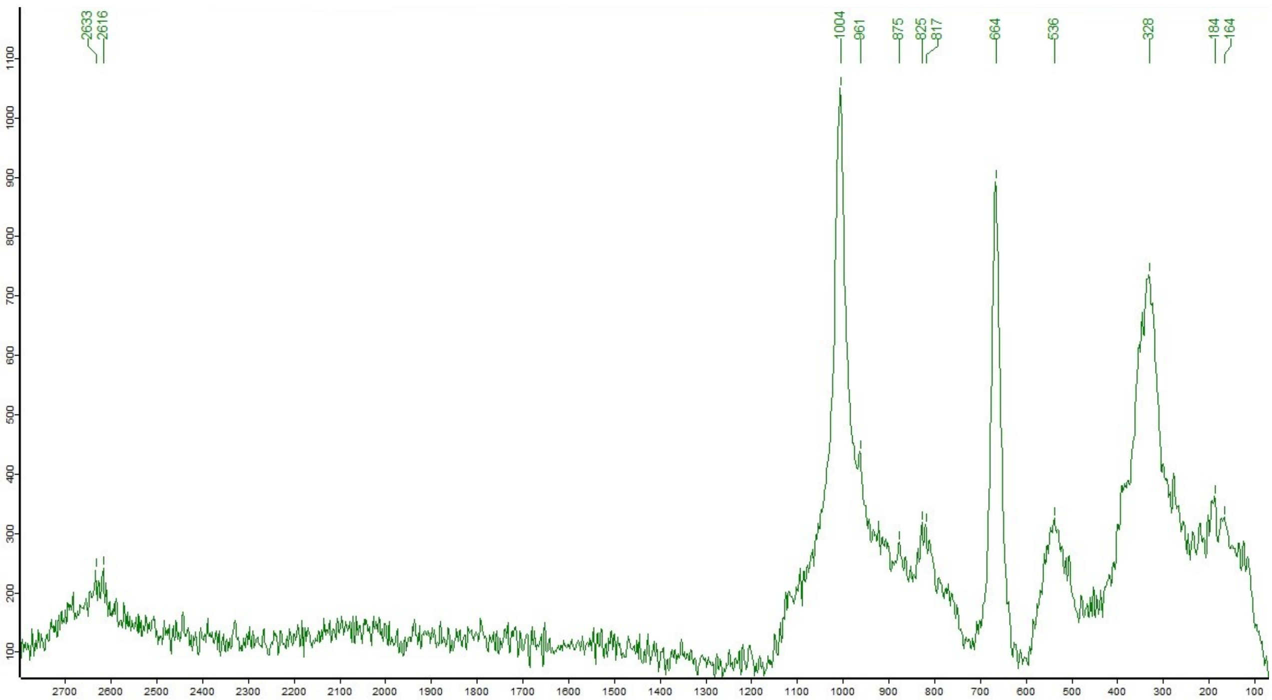
If there is Quartz in the sample the spectral line **205** could indicate that the Quartz in the sample was exposed to a shock pressure of probably > **20 GPa**

Sample Site 7 : Stone 1_spectra 3 (dark mineral) indicates : Augite (→ RRUFF_CS search result)

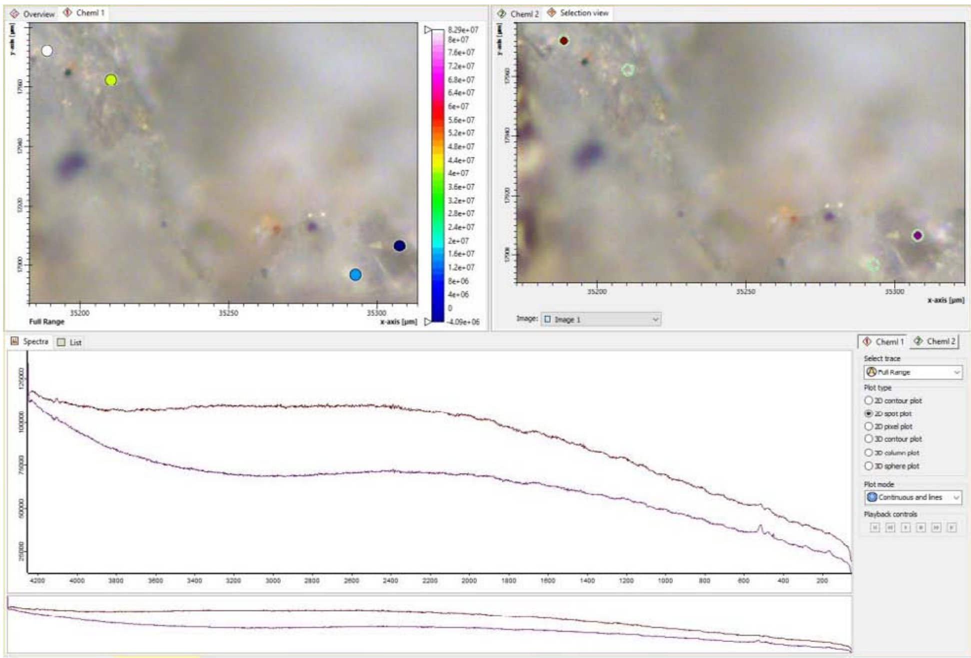


Sample :

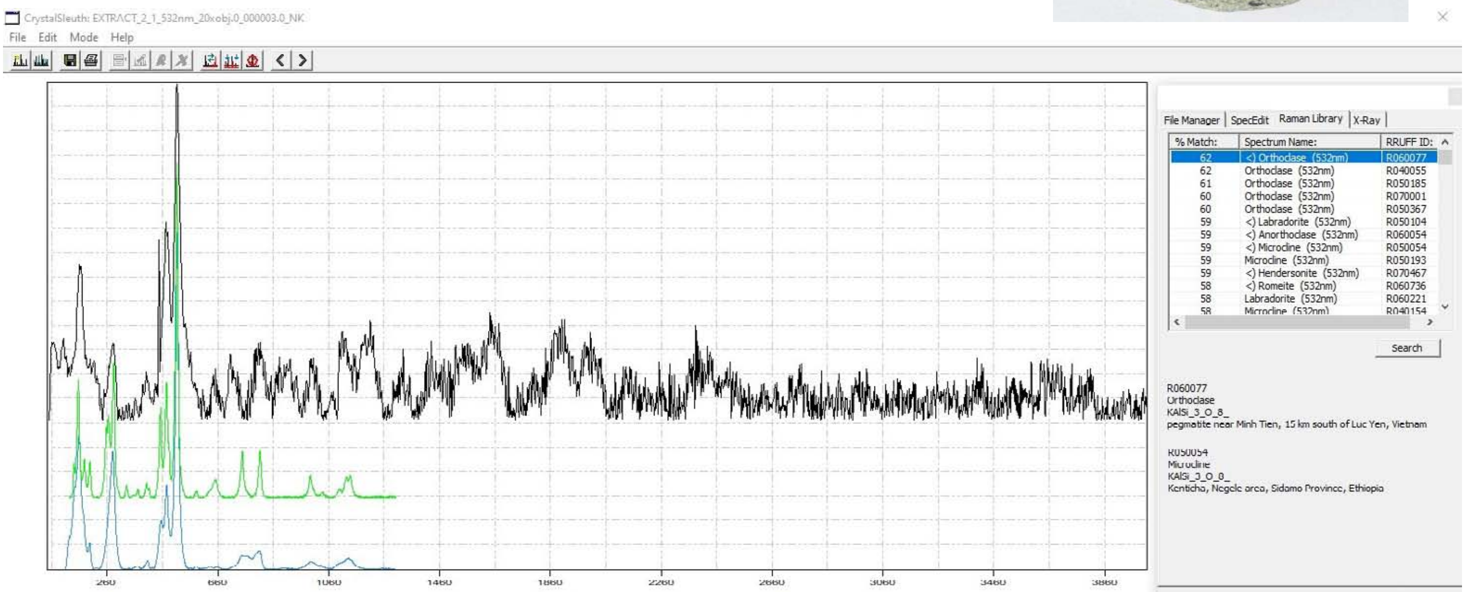




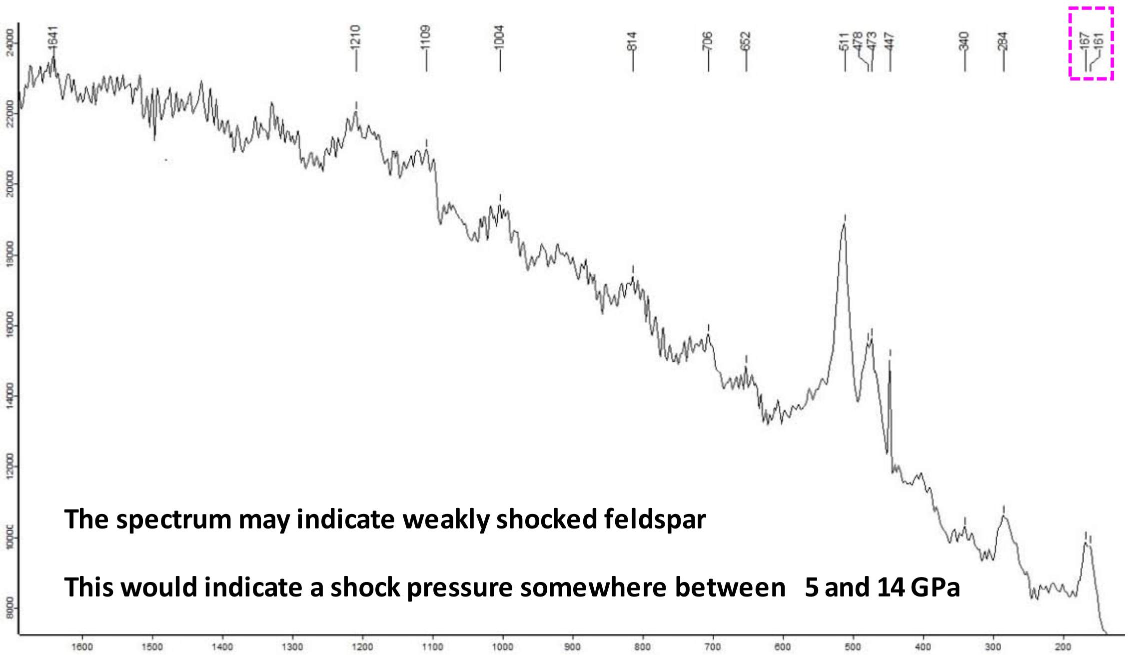
Sample Site 9 : Stone 1_spectra 1 (white minerals) indicates : Orthoclase , Microcline etc. (→ RRUFF_CS)



Sample :



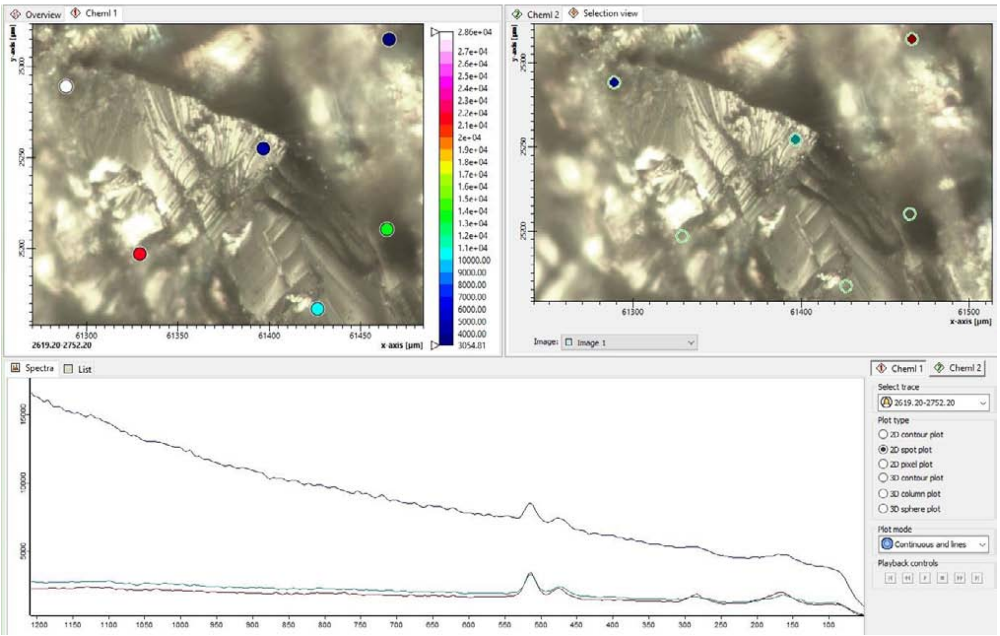
The spectrum probably indicates weakly shocked feldspar



The spectrum may indicate weakly shocked feldspar

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

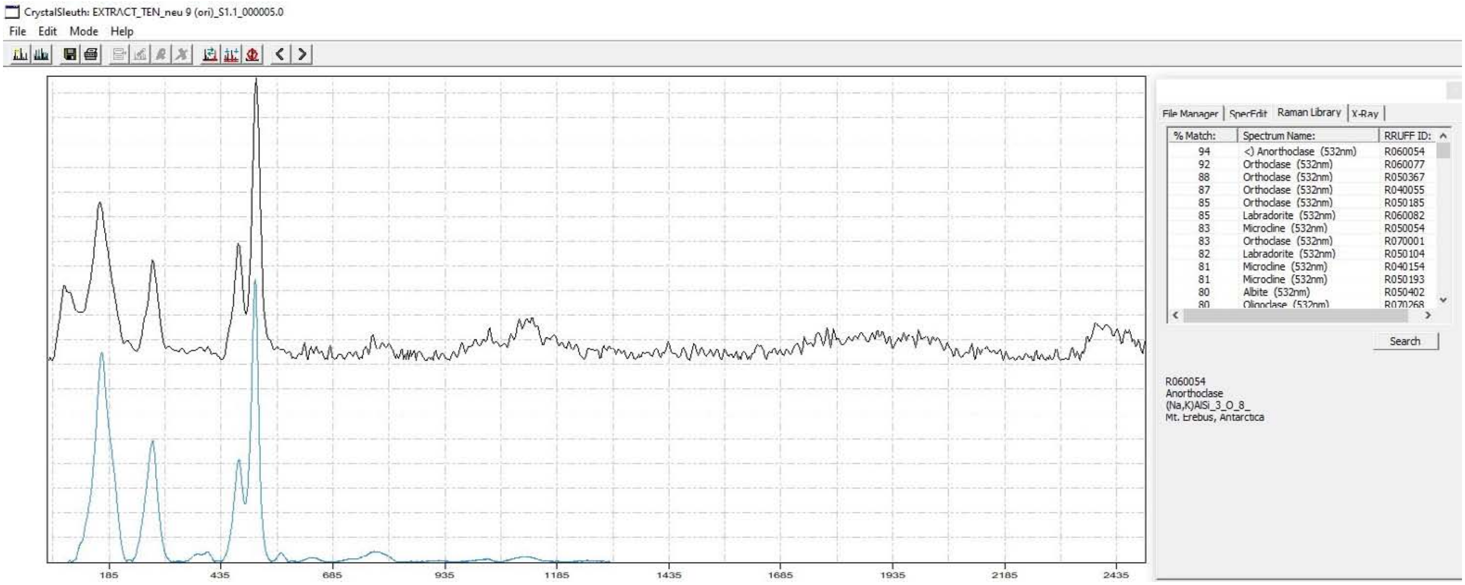
Sample Site 58 : Stone 1_spectra 1 (matrix of the stone) indicates : Anothoclase (→ RRUFF search result)



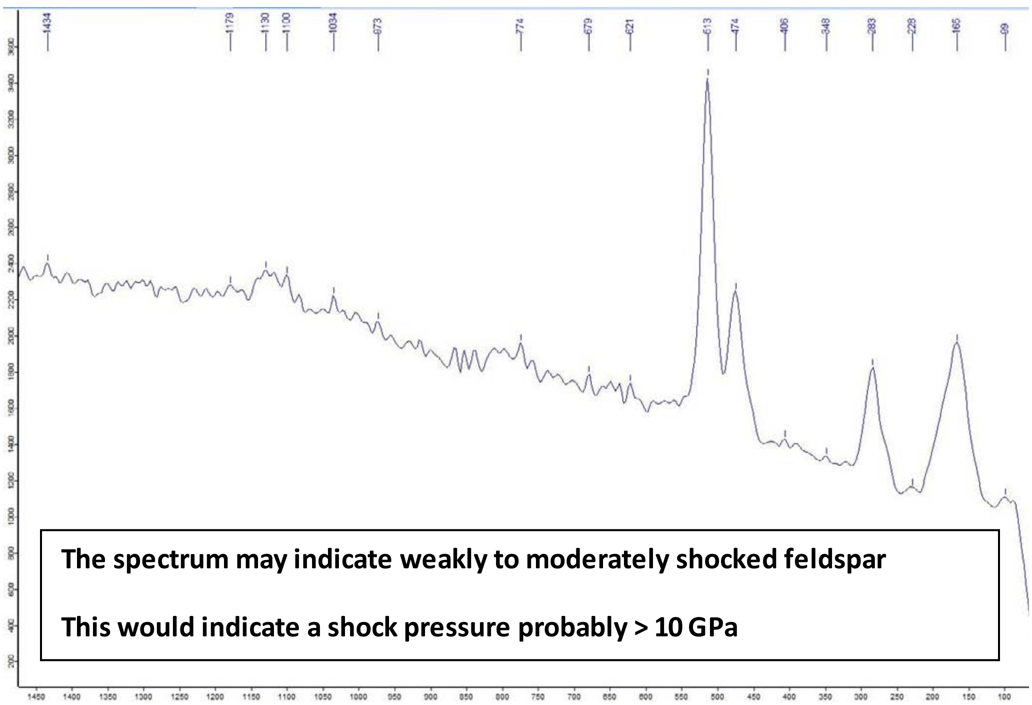
The sample is from an **old rock island** inside the Teide Volcano caldera.

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

Sample :



The spectrum probably indicates weakly to moderately shocked feldspar



The spectrum may indicate weakly to moderately shocked feldspar

This would indicate a shock pressure probably > 10 GPa

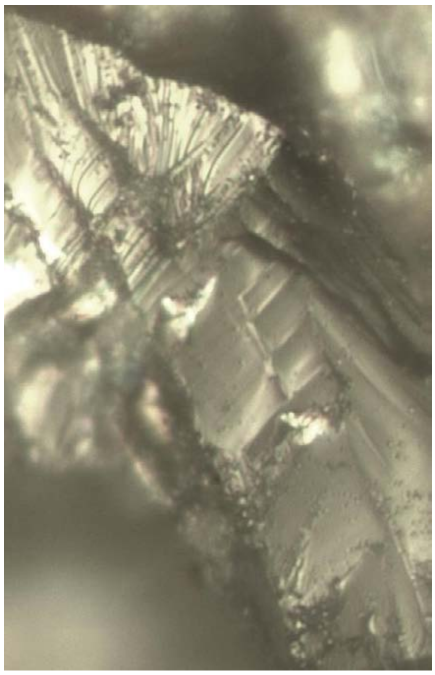
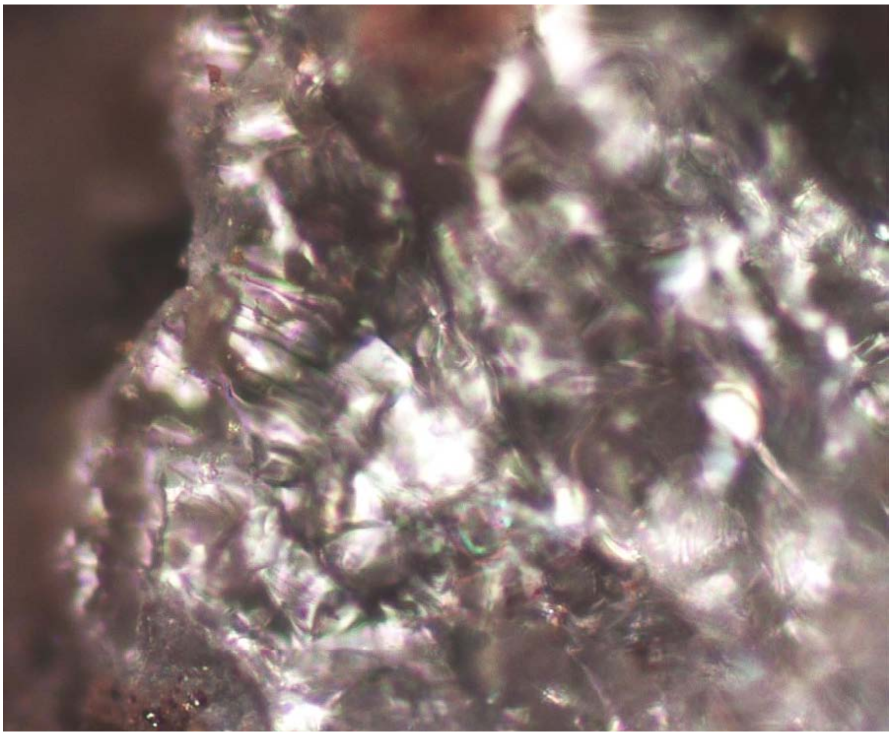


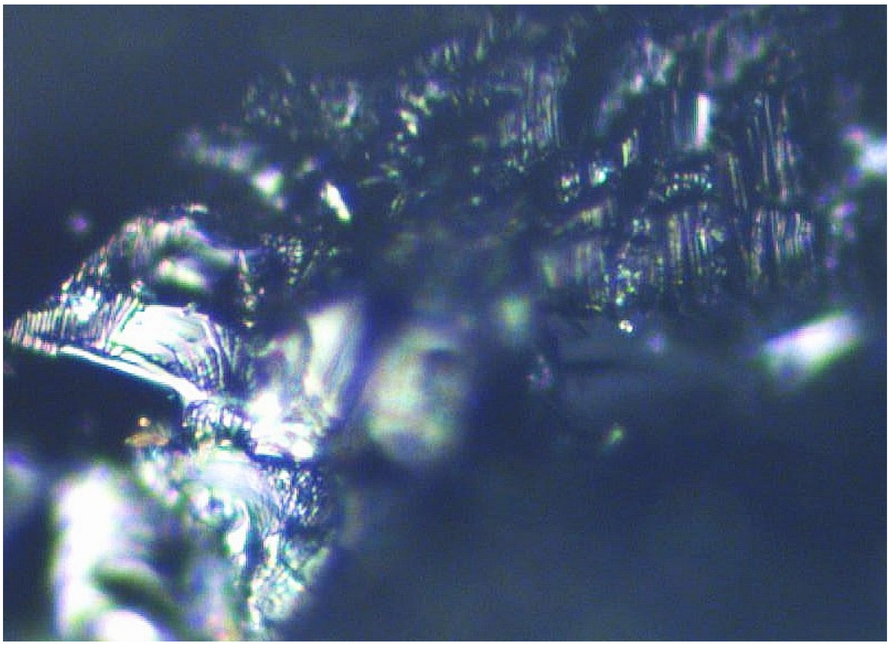
Image size : ≈ 150 x 250 µm

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



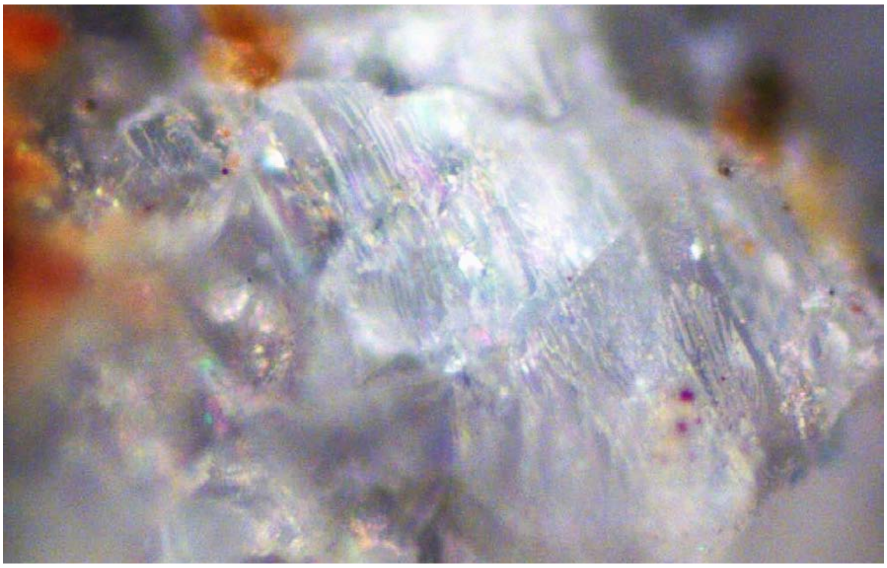
Sample Site 7 : Stone 1_spectra 3 (dark mineral) indicates : Augite - Image size : ~ 150 x 120 µm



Note the linear structures visible in the Augite mineral !

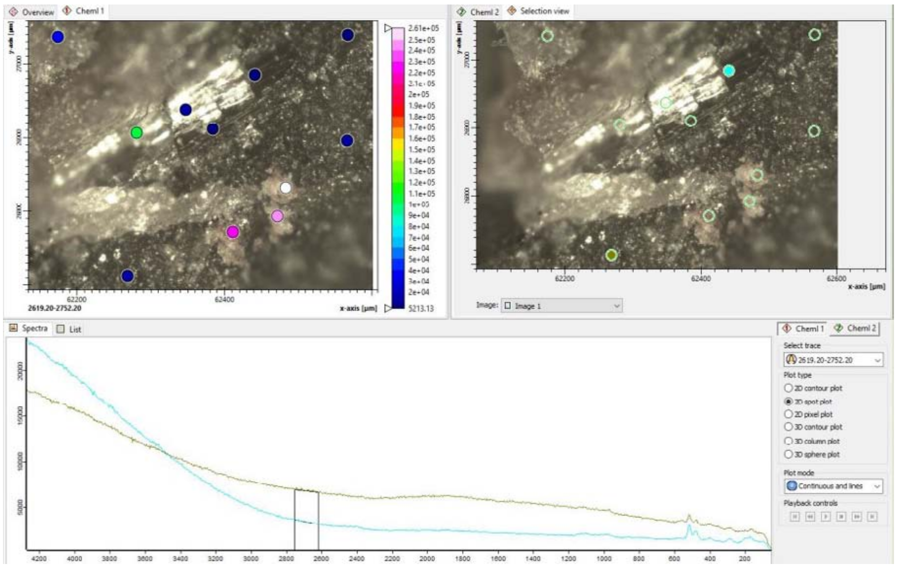
(→ top righthand side of image)

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)



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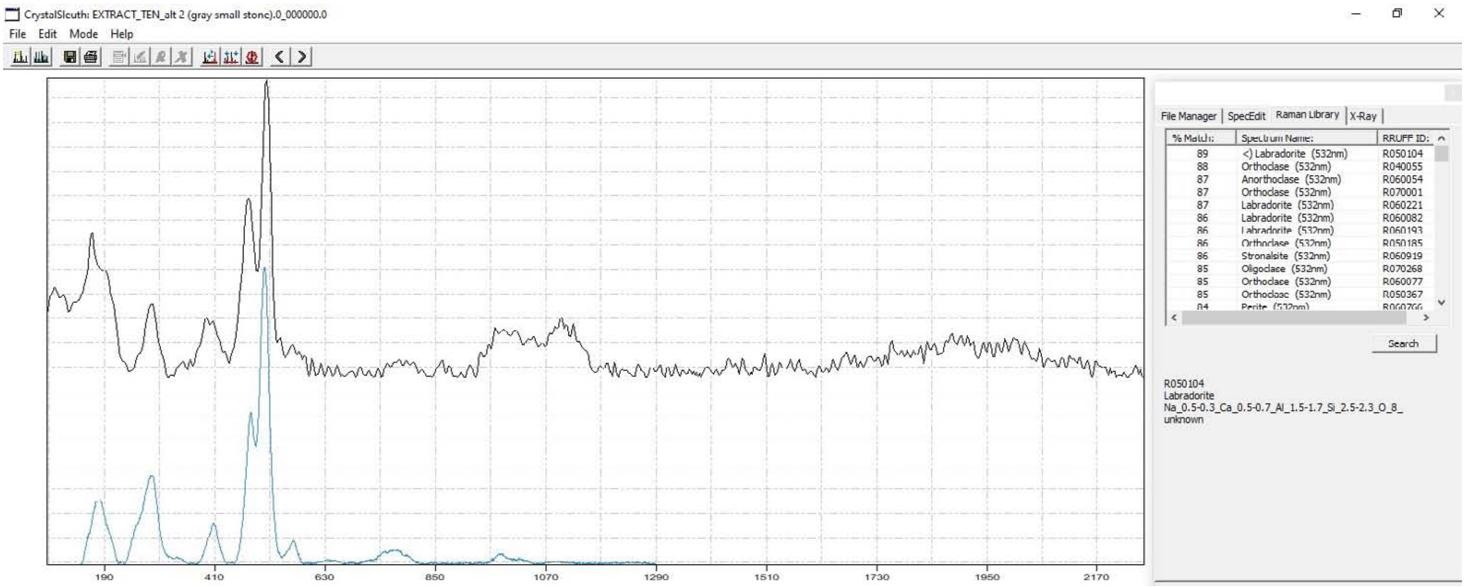


The spectrum probably indicates weakly shocked feldspar

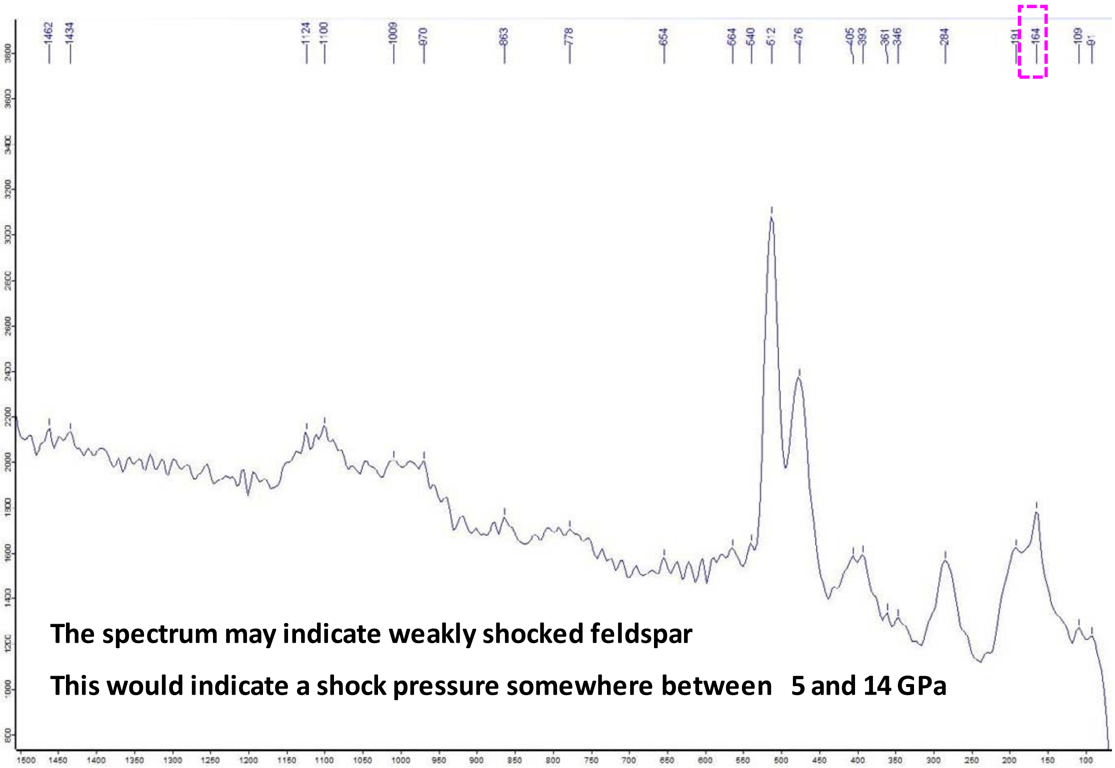
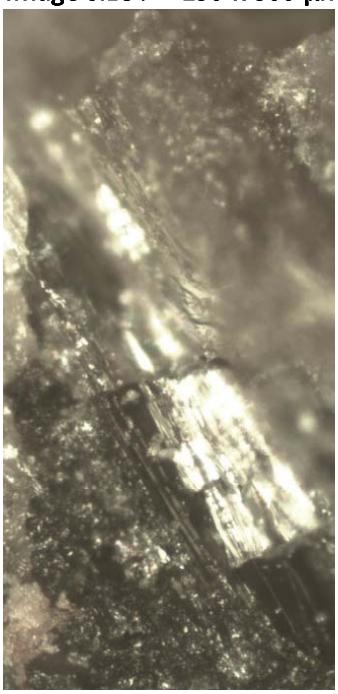
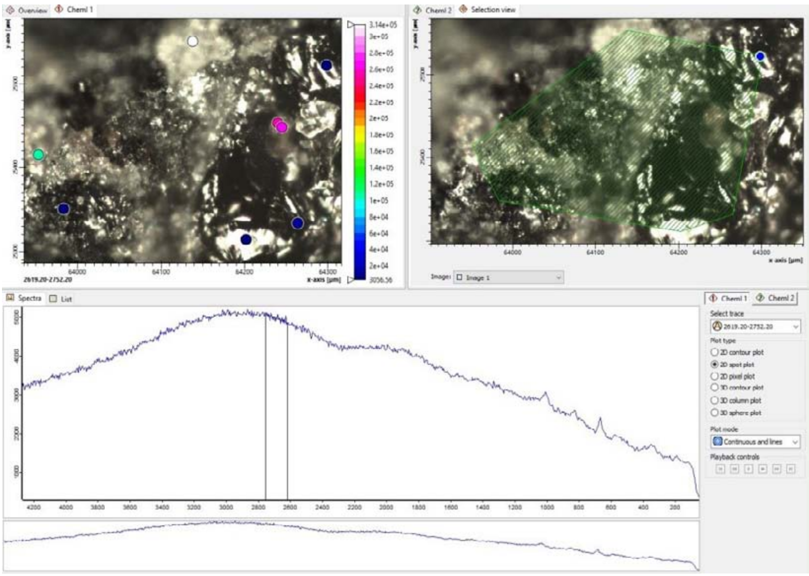


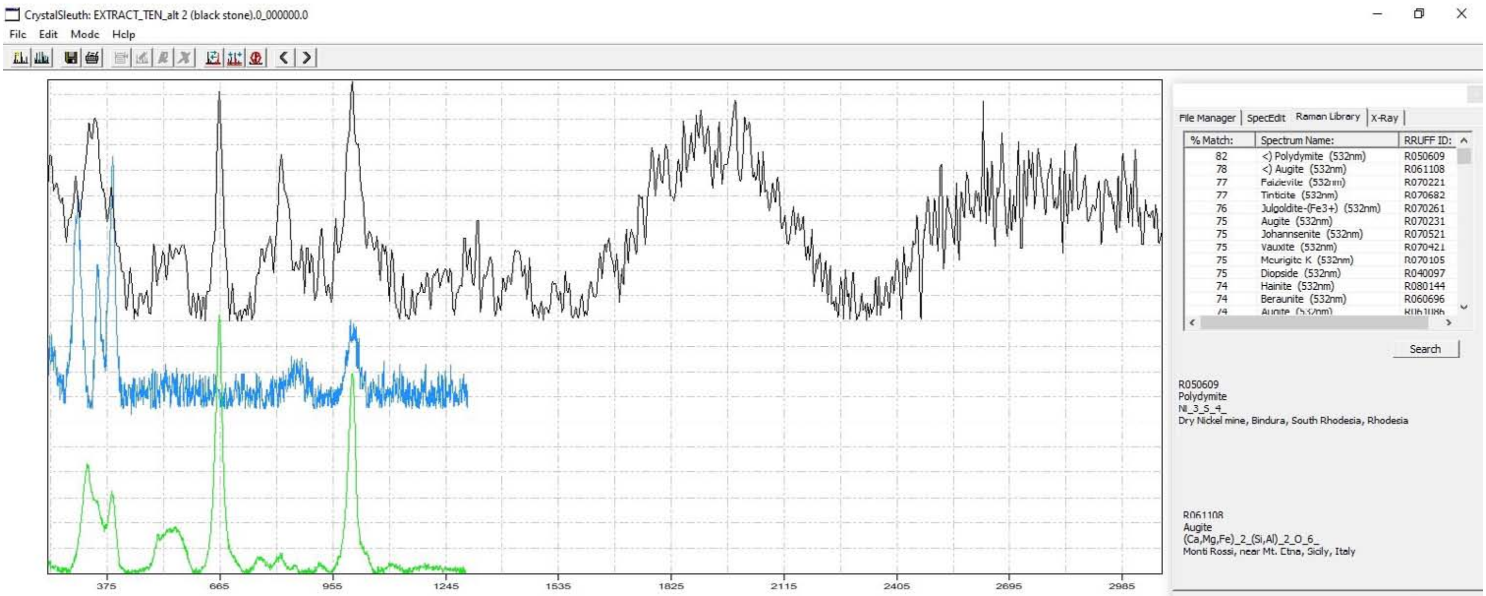
Image size : ≈ 150 x 300 µm

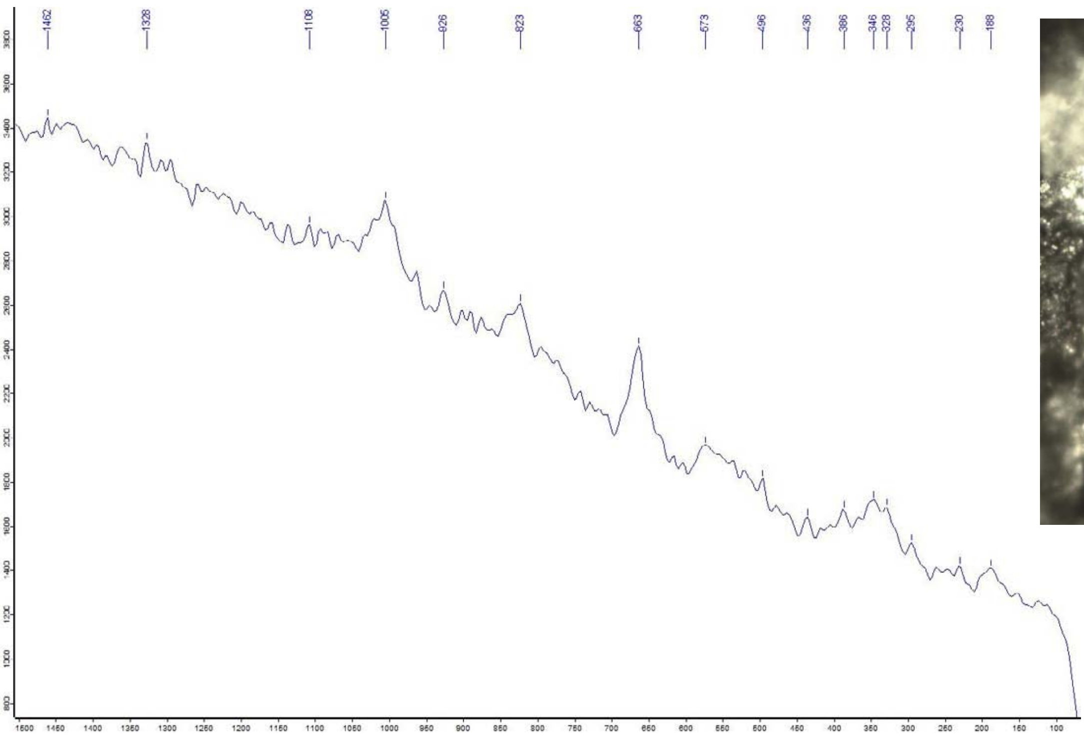


Sample Site 2 : Stone 1_spectra 1 (dark mineral) indicates : Polydymite, Augite. (→ RRUFF_CS)



Samp





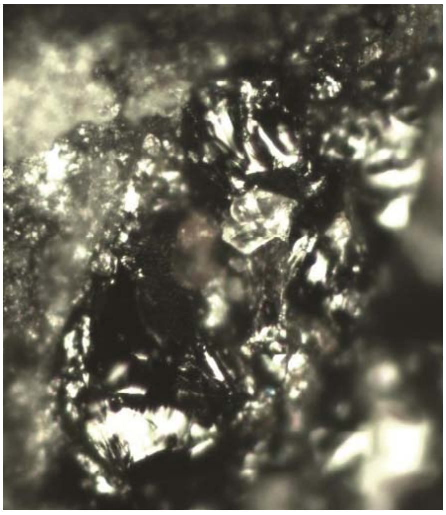
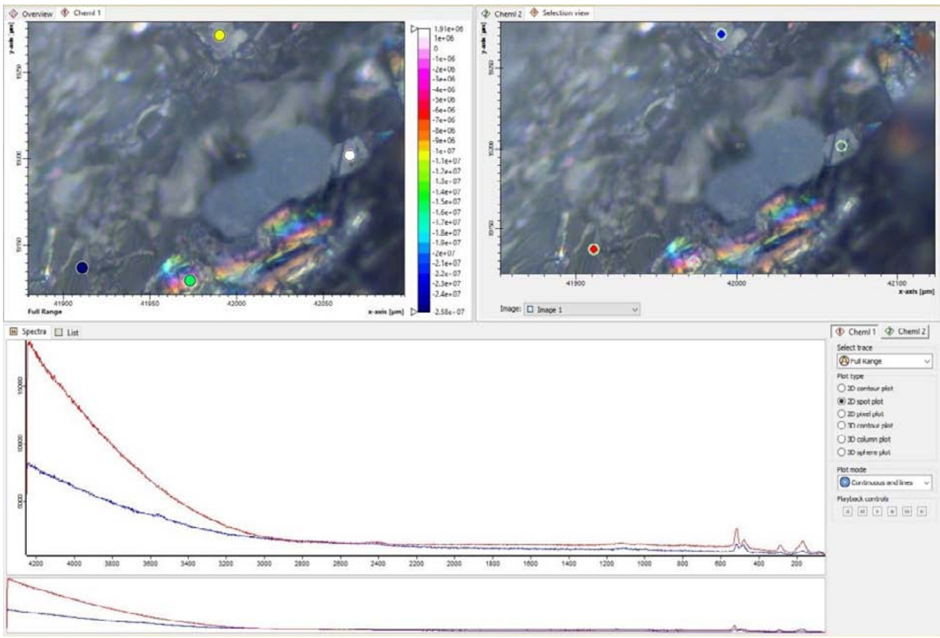
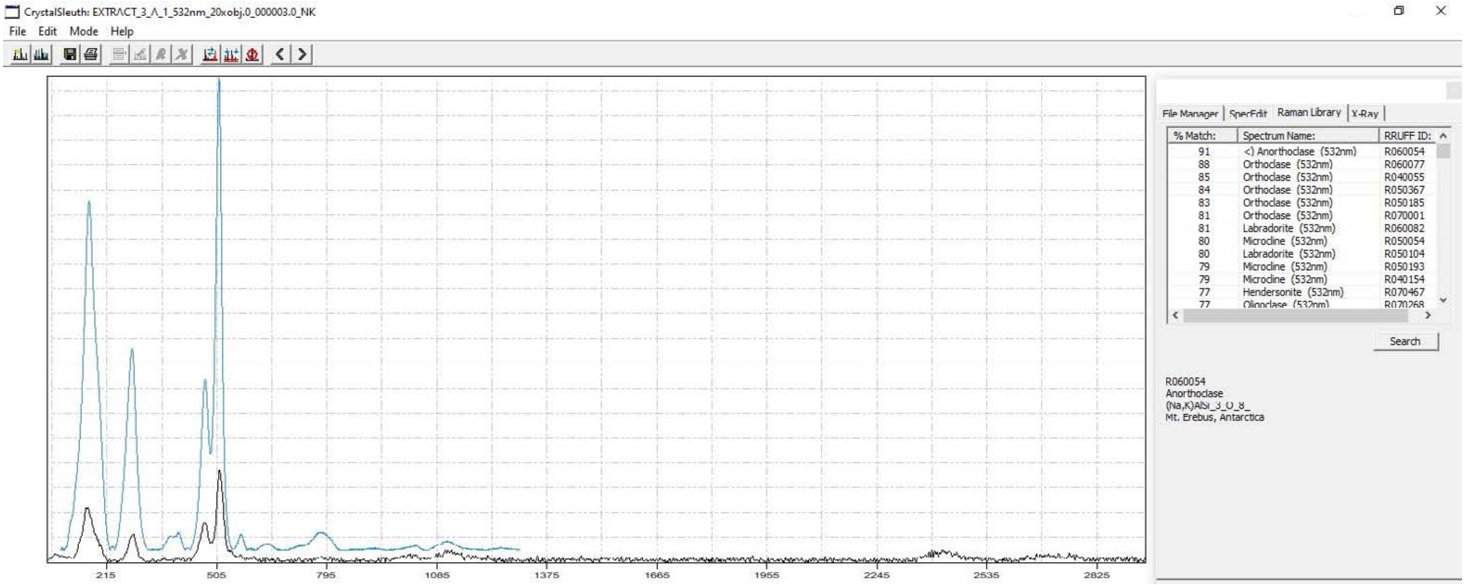


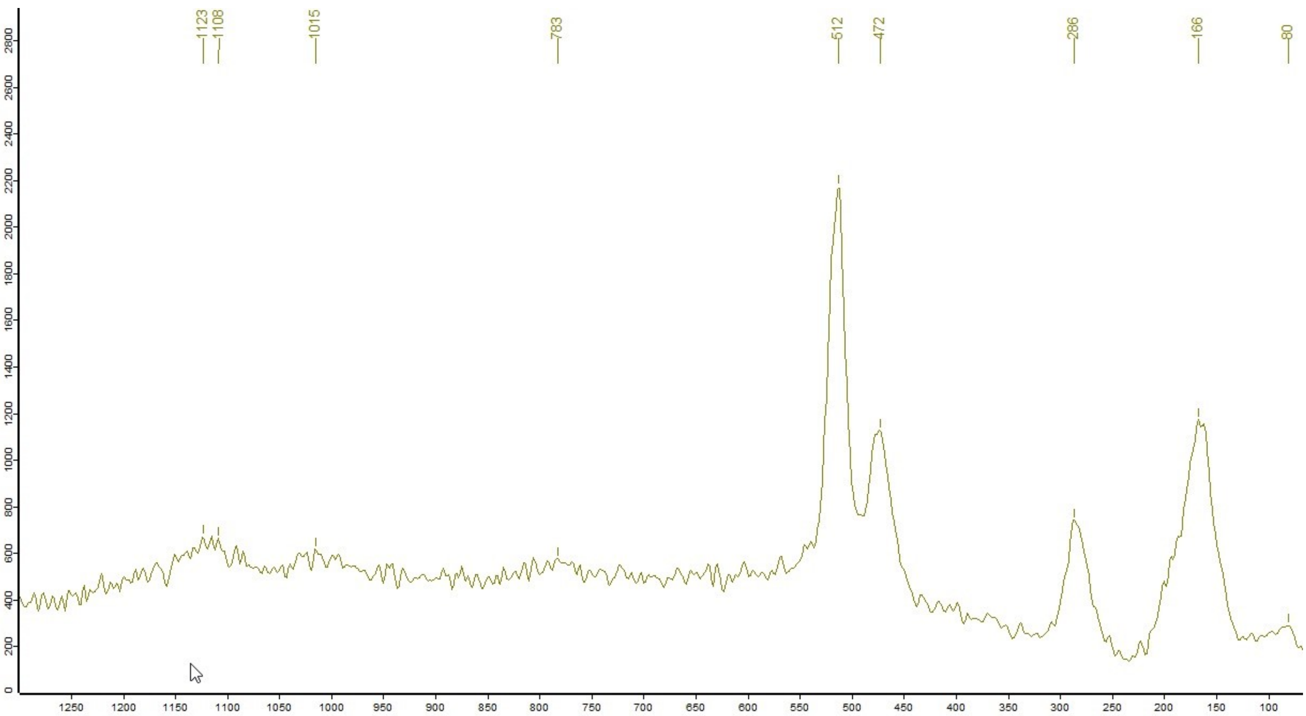
Image size ≈ 200 x 250 µm

Sample Site 7 : Stone 1_spectra 1+2 (white minerals) indicates : Anorthoclase (→ RRUFF_CS search result)



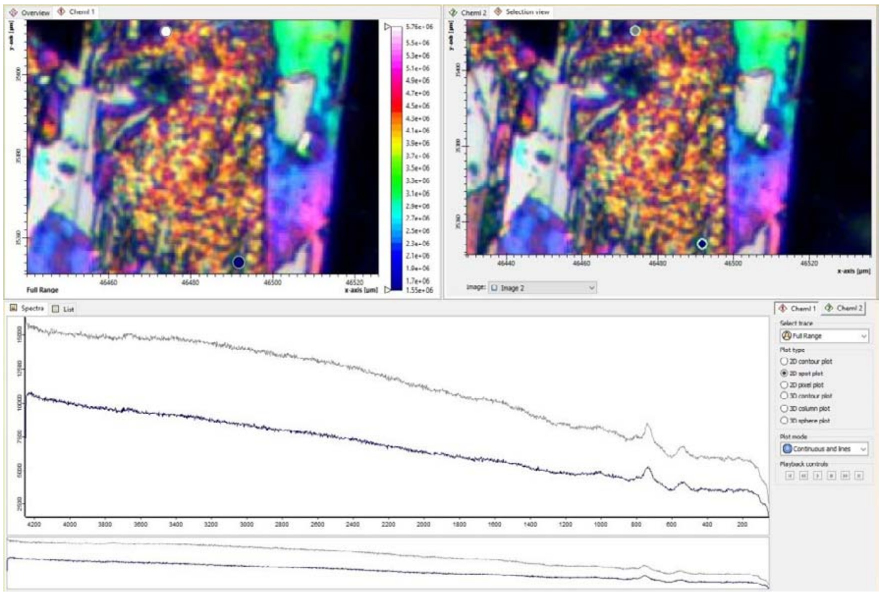
Sample :





Sample Site 7 : Stone 1_spectra 4 (dark minerals) indicates : Flourophlogopite, Annite, Tengerite (y)

(→ RRUFF_CS search result)



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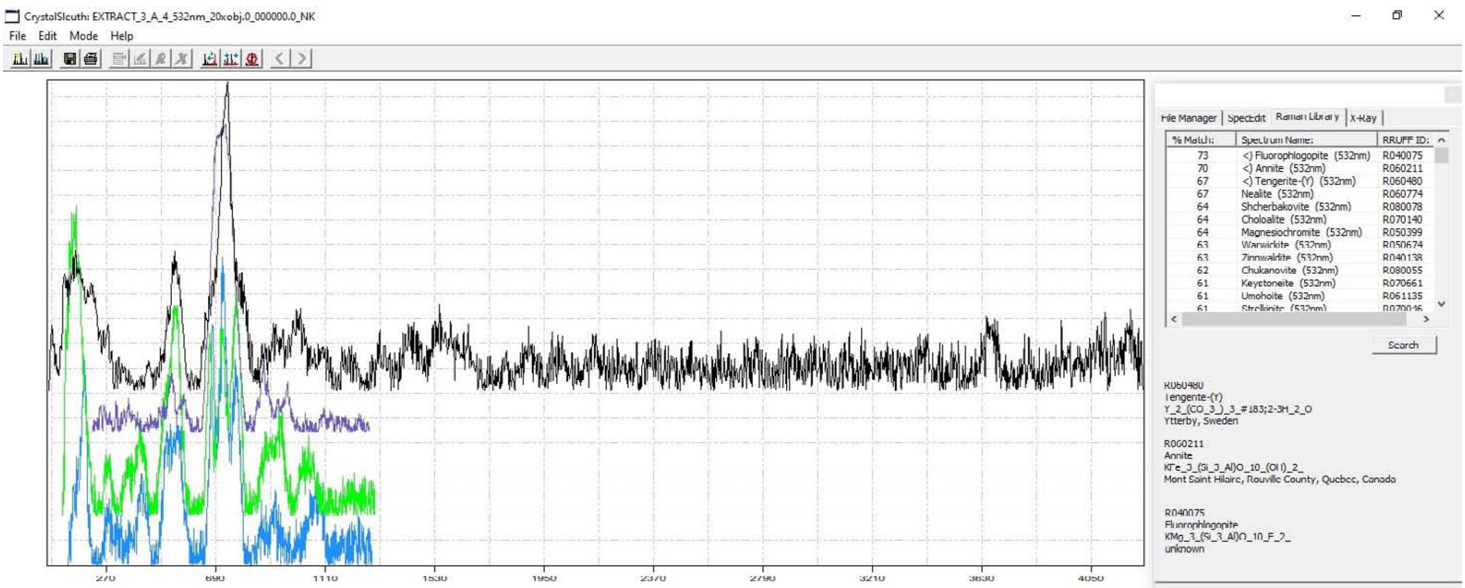
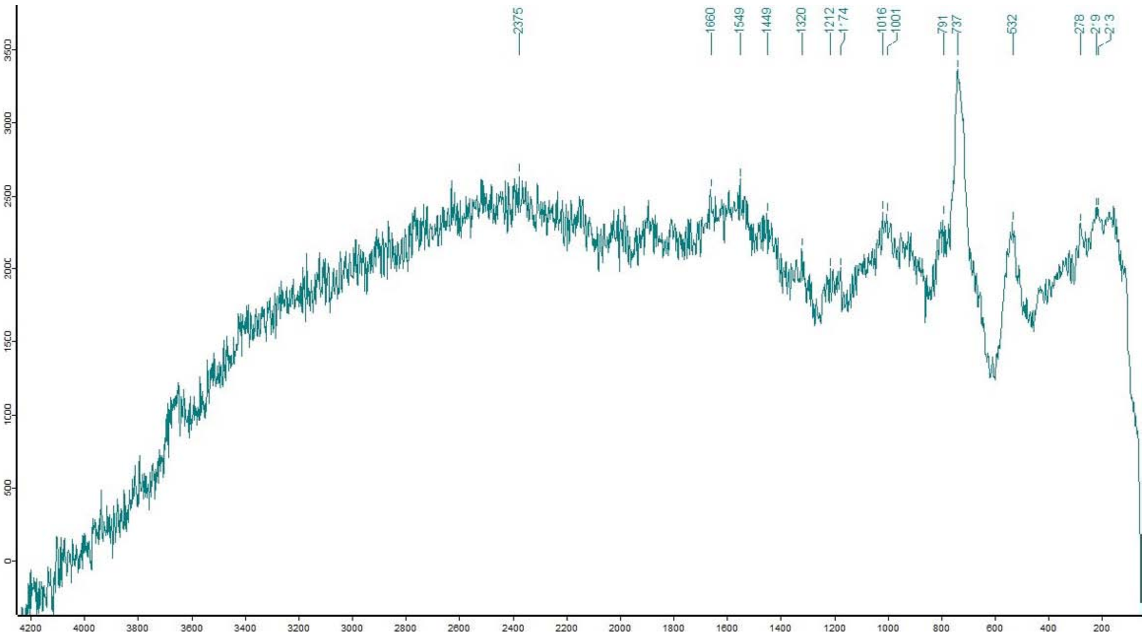
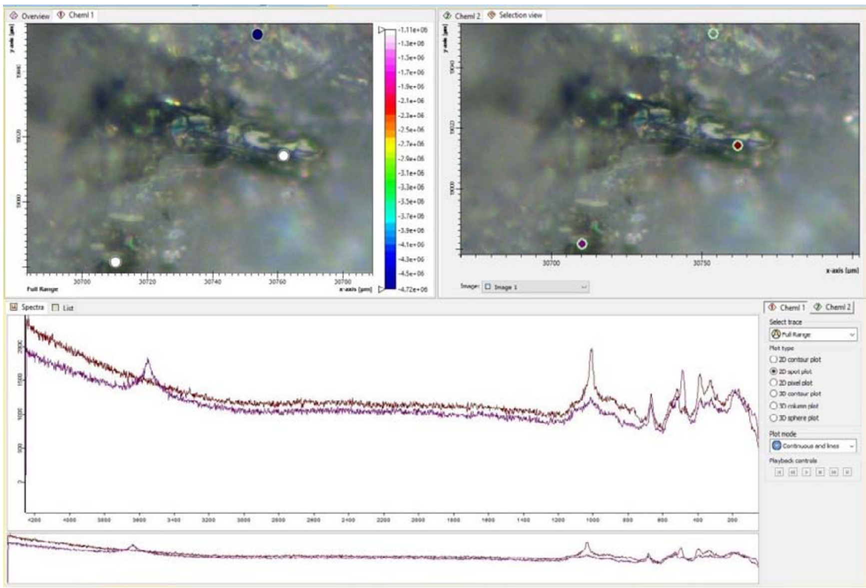




Sample Site 7 : Stone 1_spectra 5 (grey material) indicates : Augite, Johannsenite (→ RRUFF_CS)



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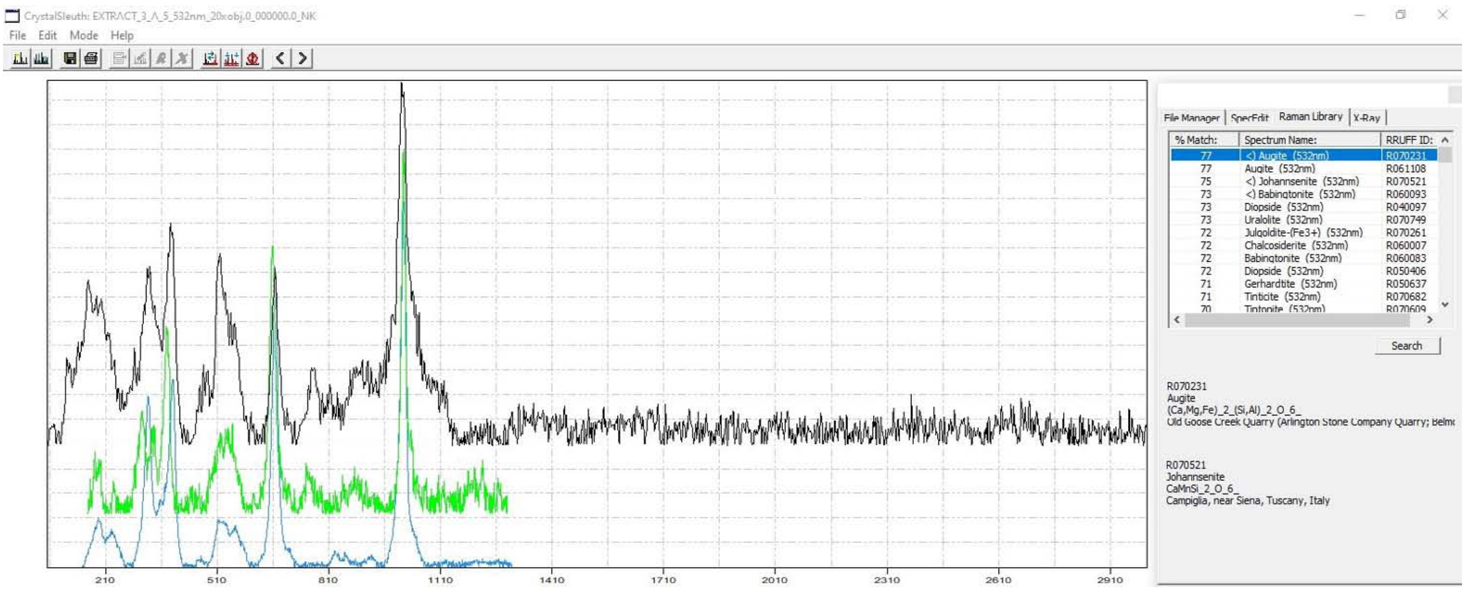
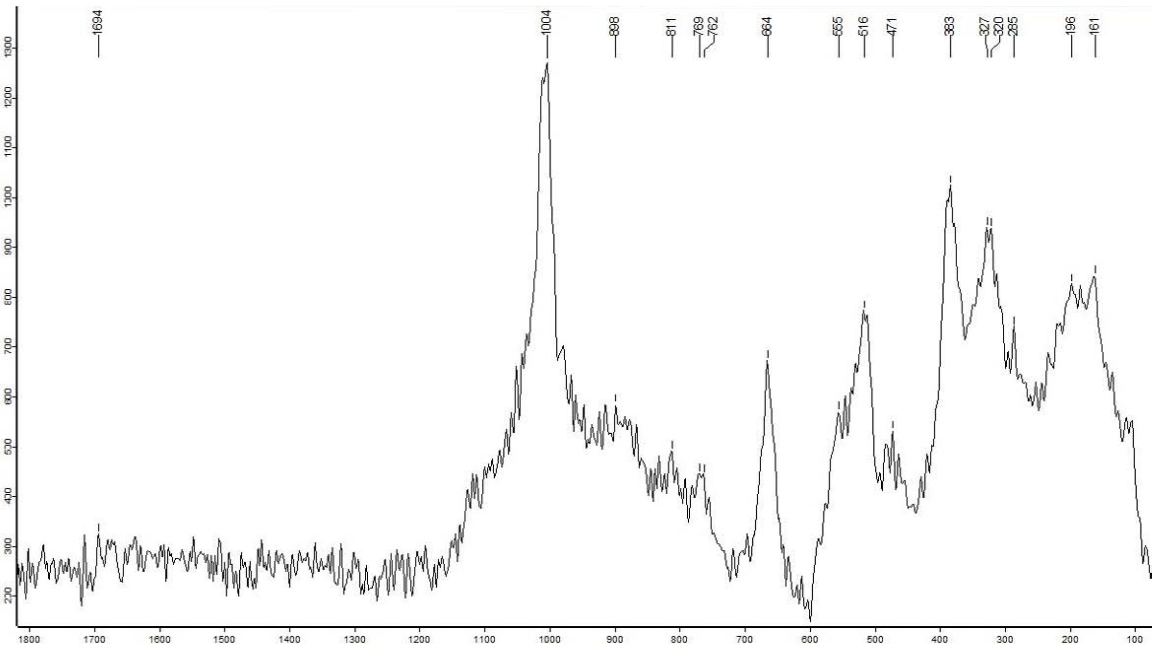
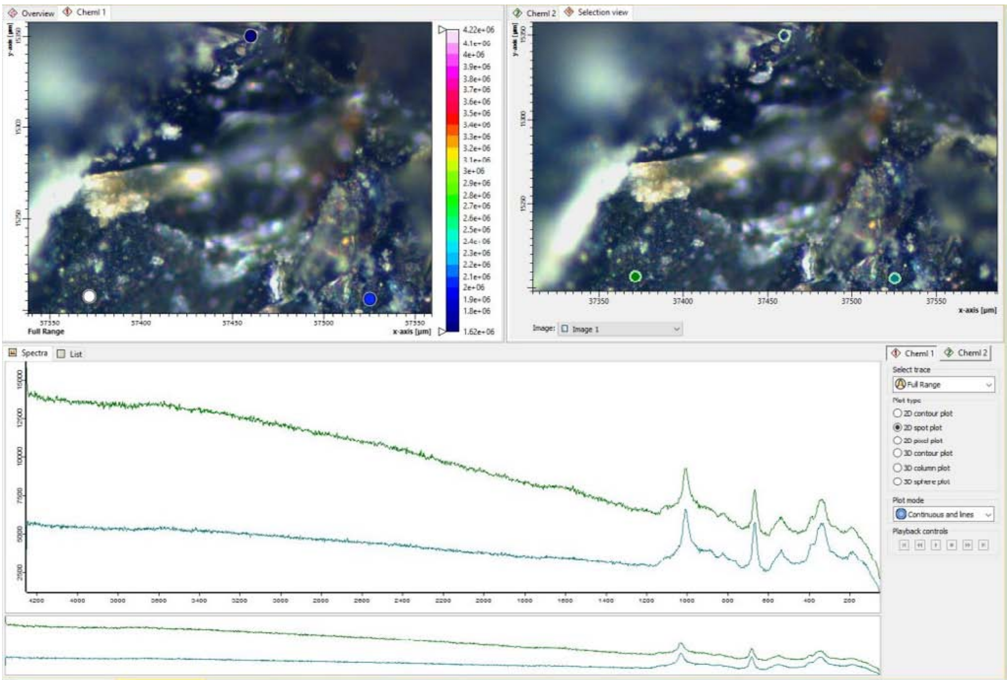




Sample Site 7 : Stone 2_spectra 1 (dark minerals) indicates : Augite, Diopside, Ferrosilite

(→ RRUFF_CS search result)



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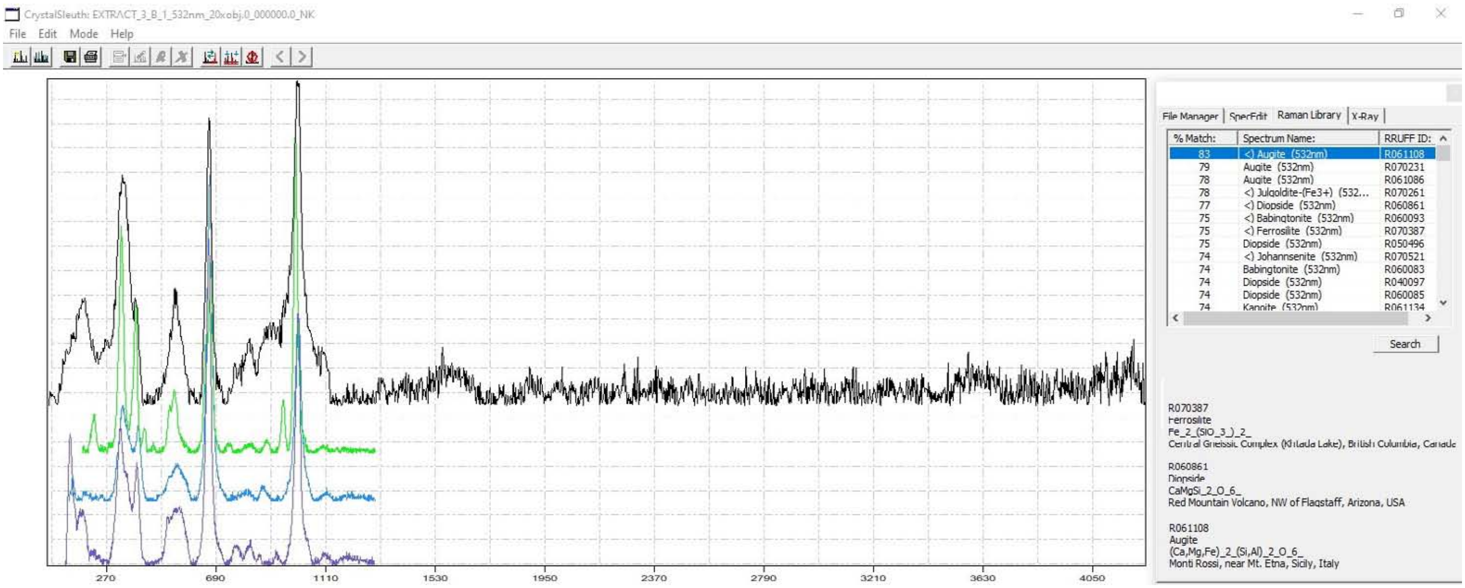
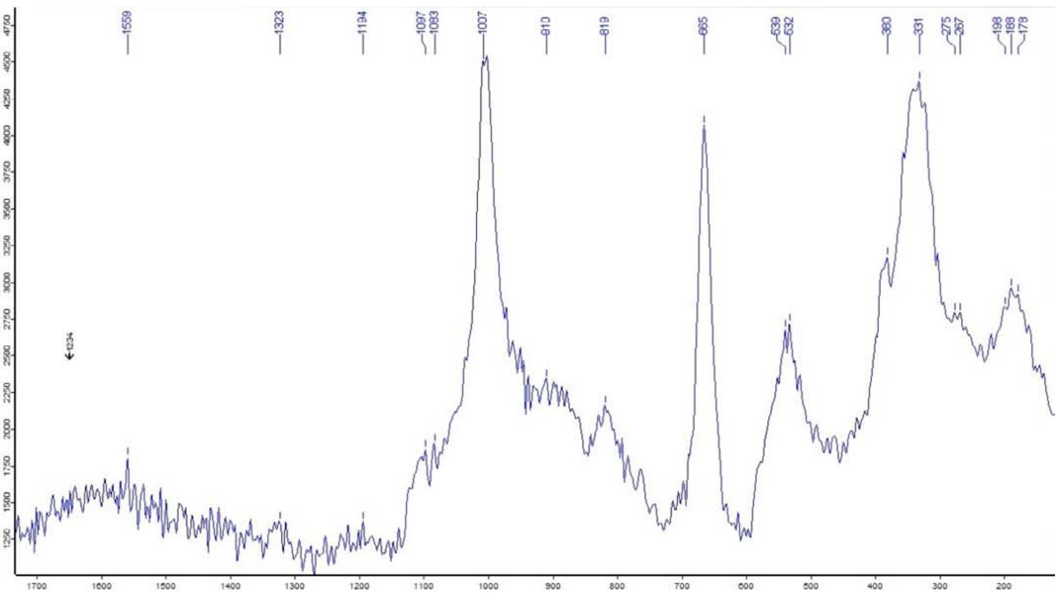
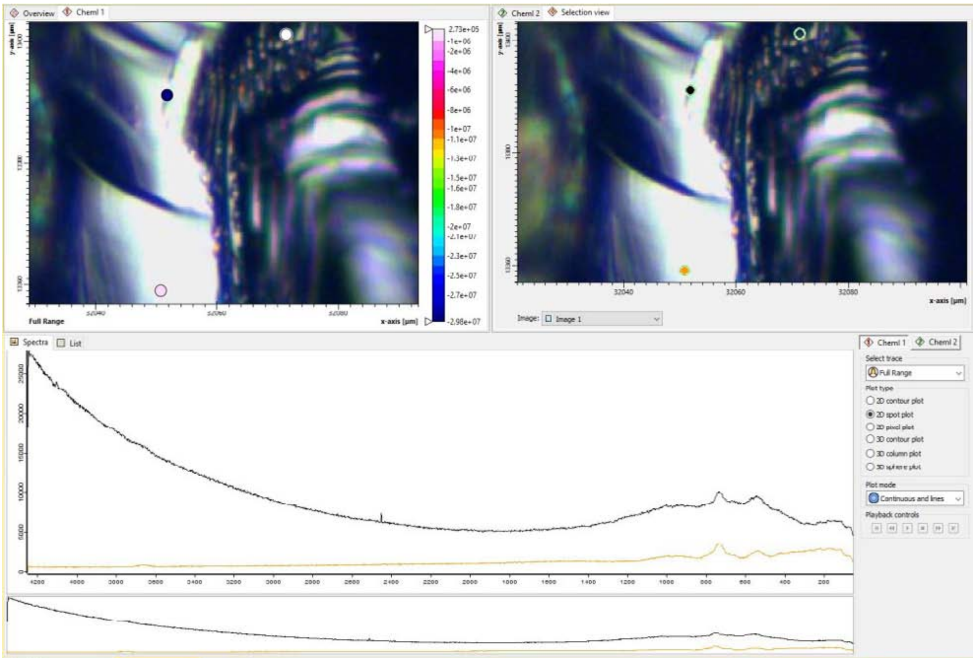


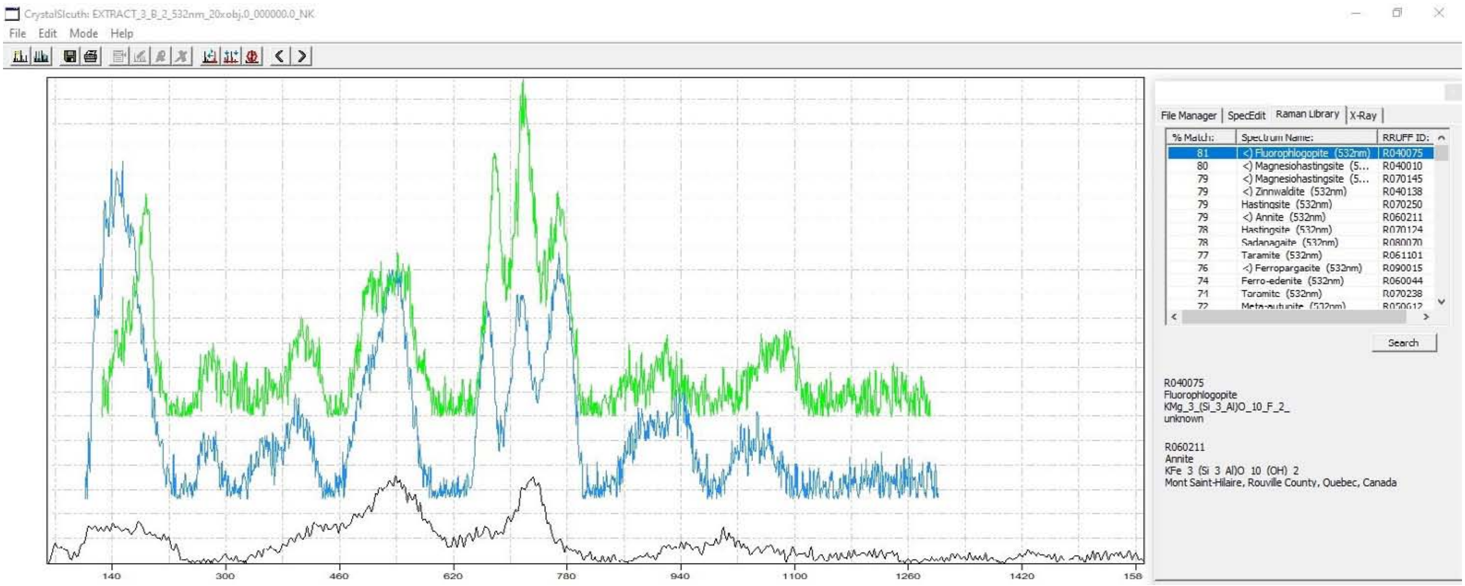


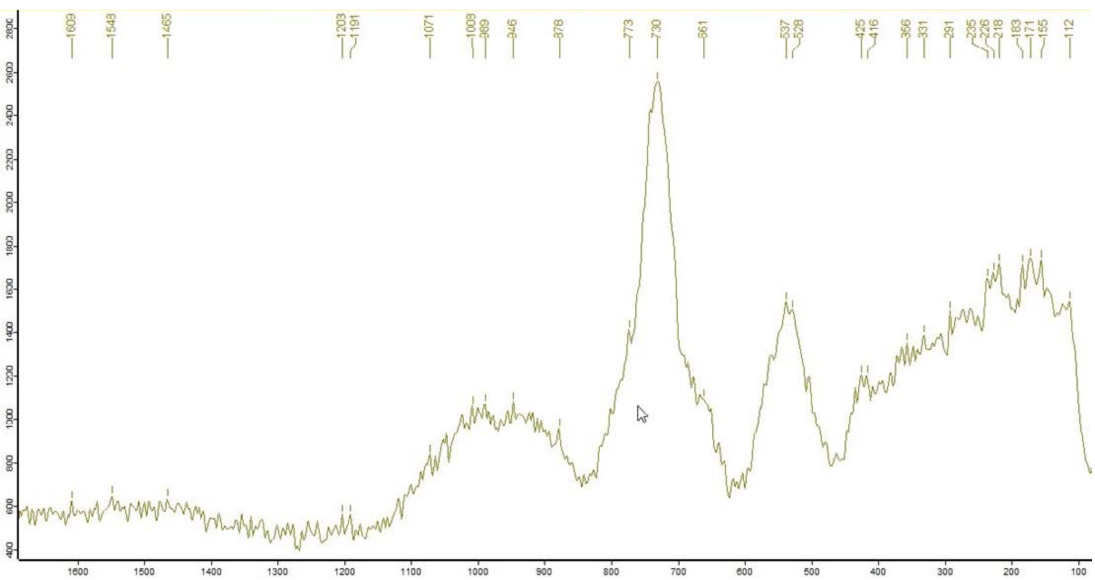
Sample Site 7 : Stone 2_spectra 2 (dark minerals) indicates : Flourophlogopite, Annite

(→ RRUFF_CS search result)



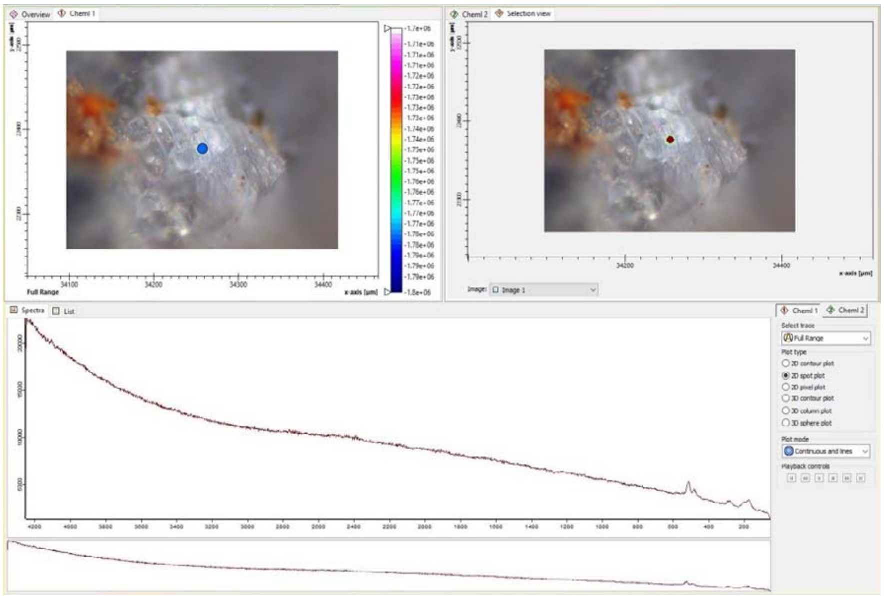
Sample :





Sample Site 7 : Stone 3_spectra 4 (white minerals) indicates : Anorthoclase, Labradorite

(→ RRUFF_CS search result)



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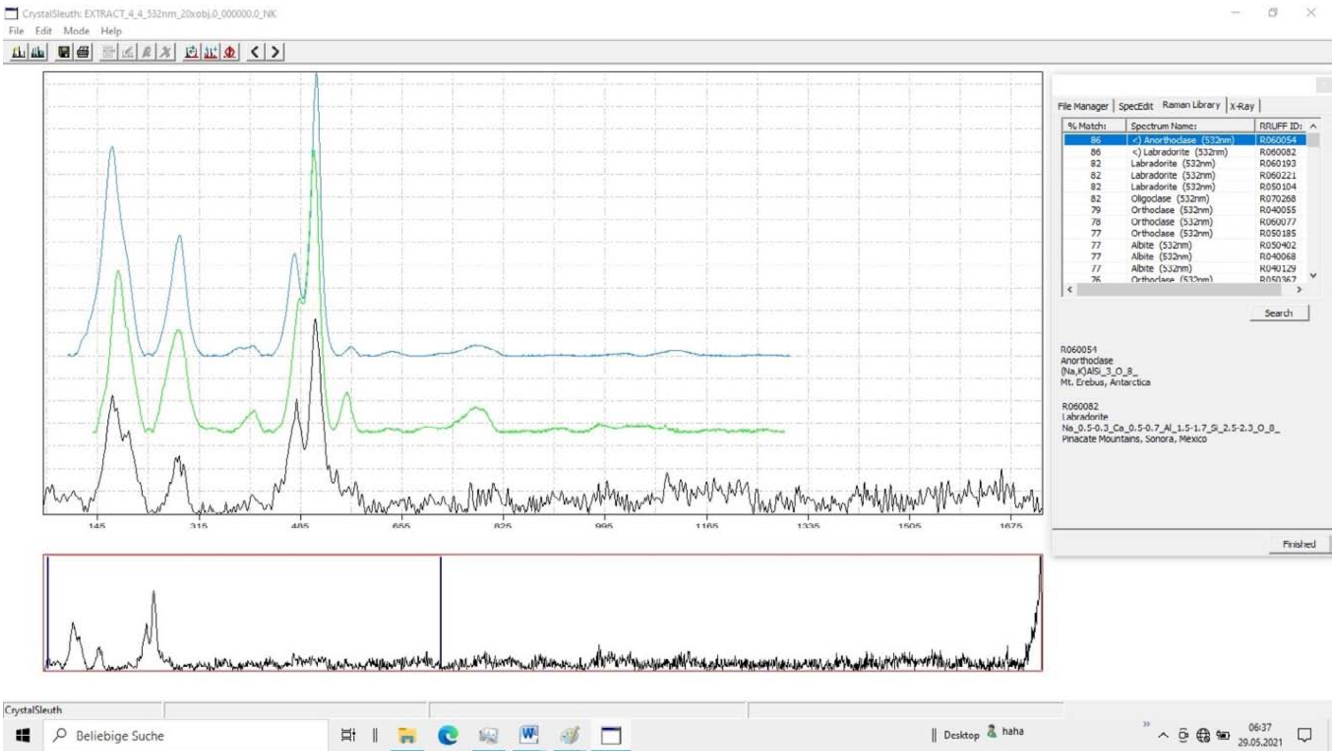
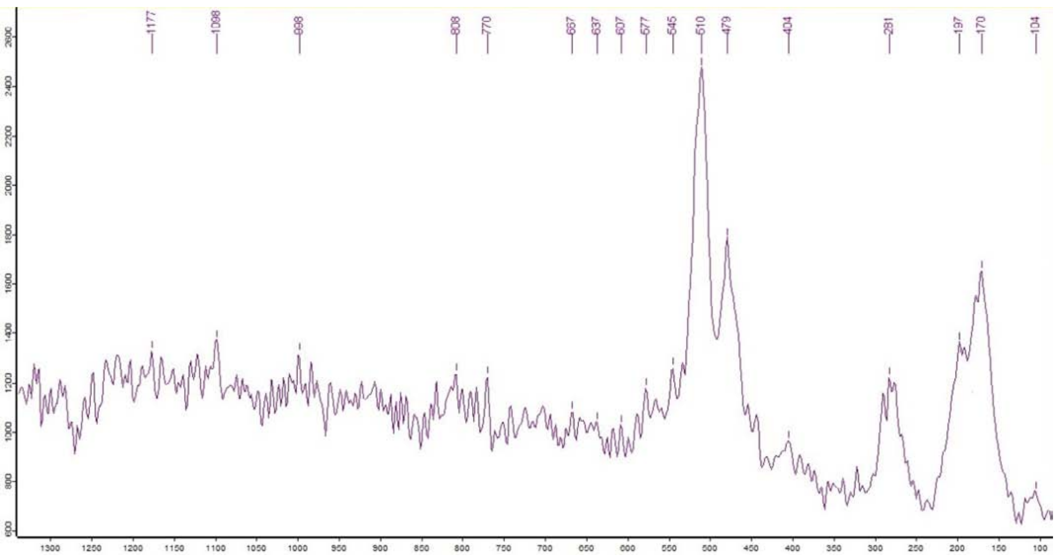
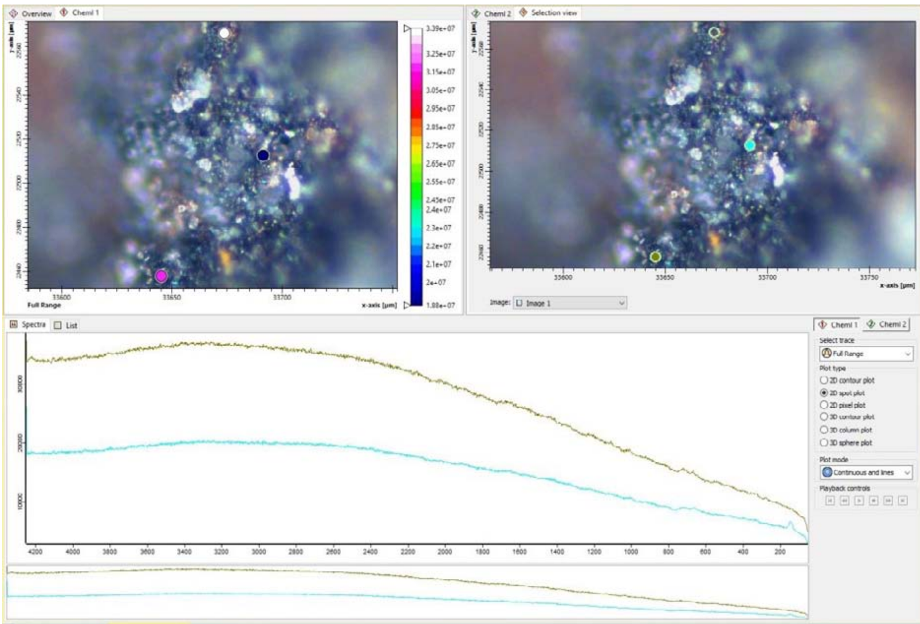




Sample Site 7 : Stone 3_spectra 2-1 (dark minerals) indicates : Annite , Bokite (→ RRUFF_CS search result)



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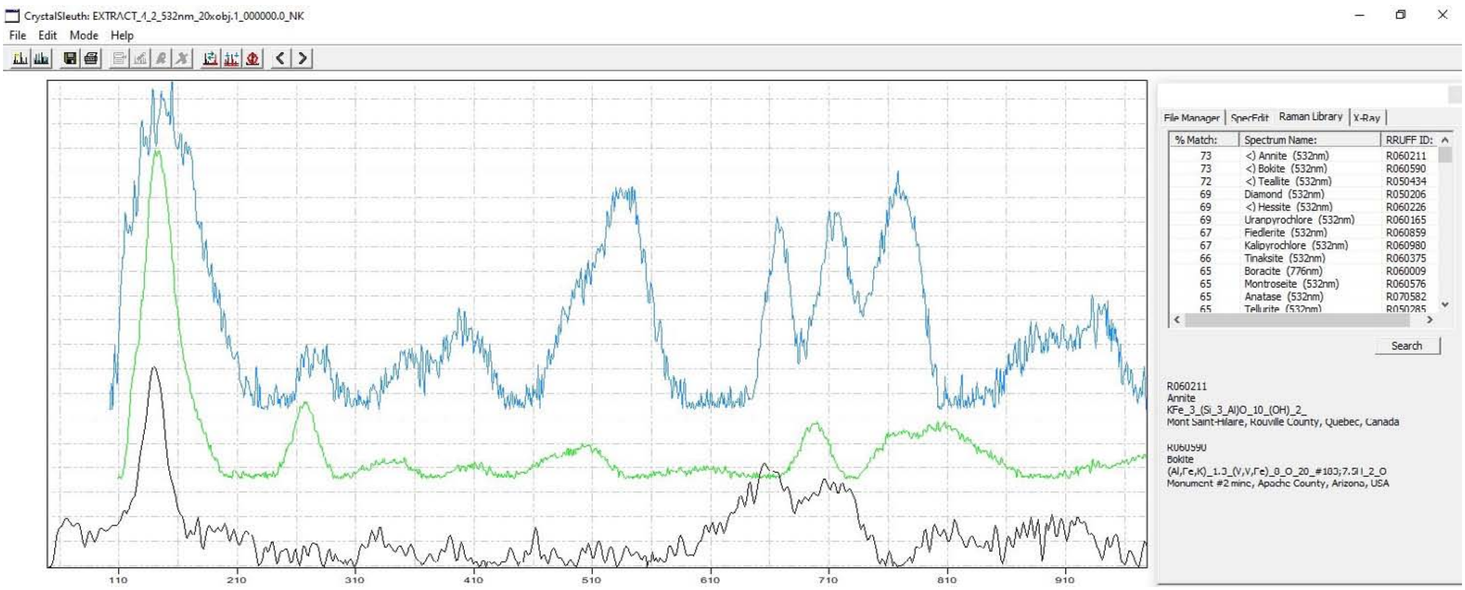
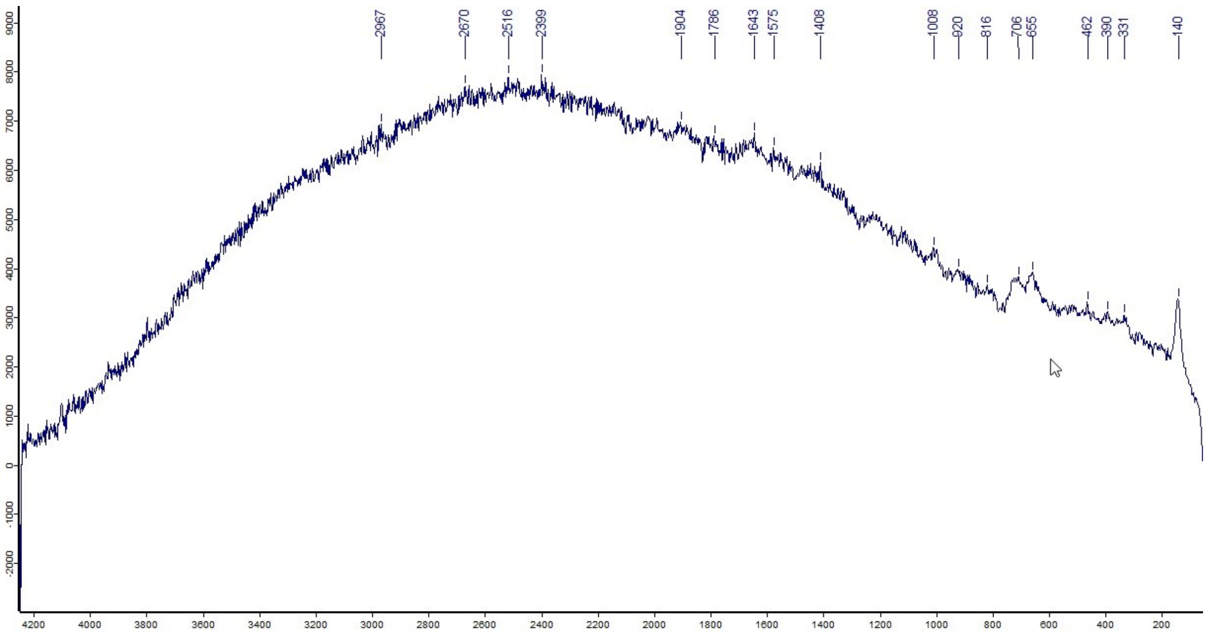
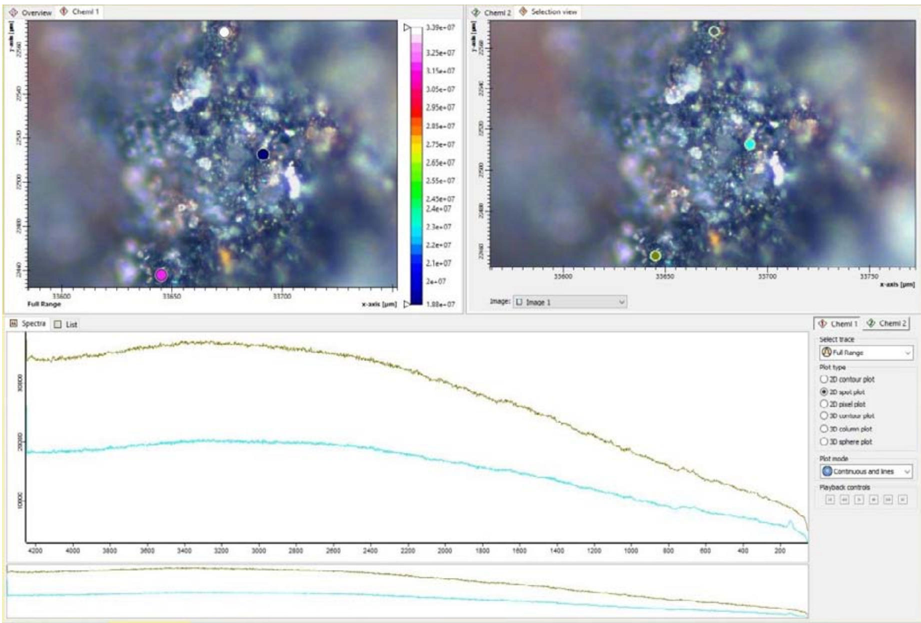


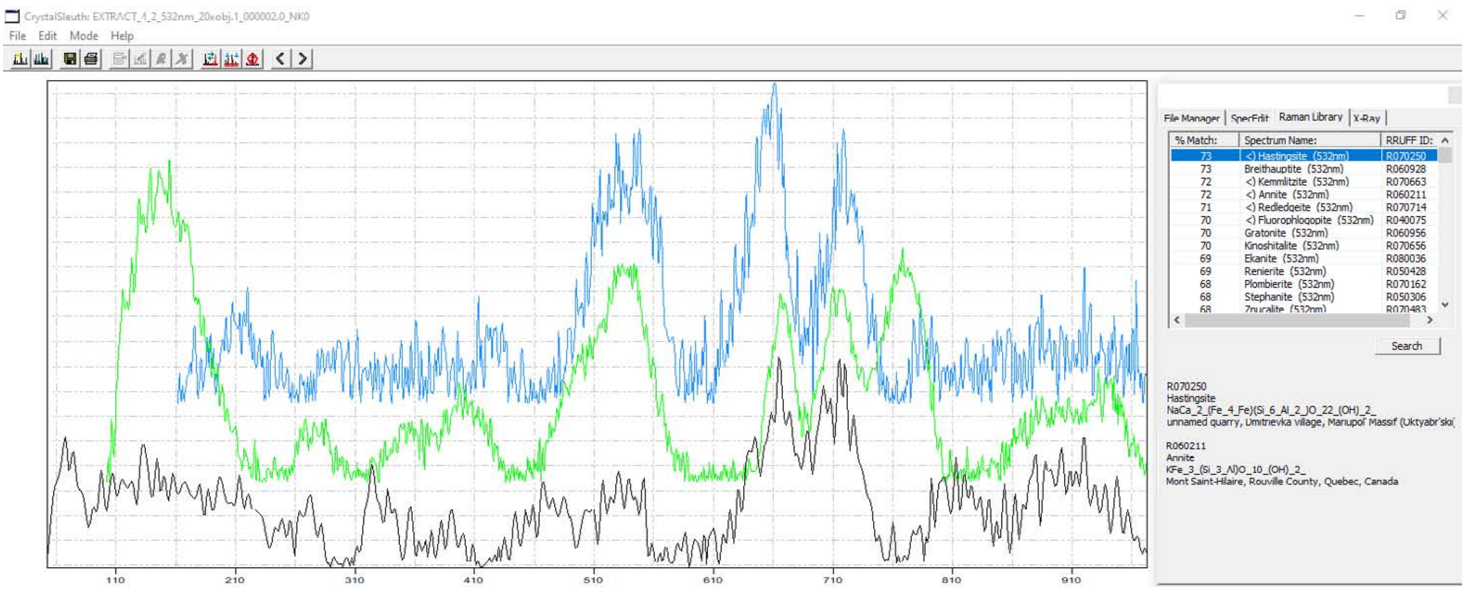


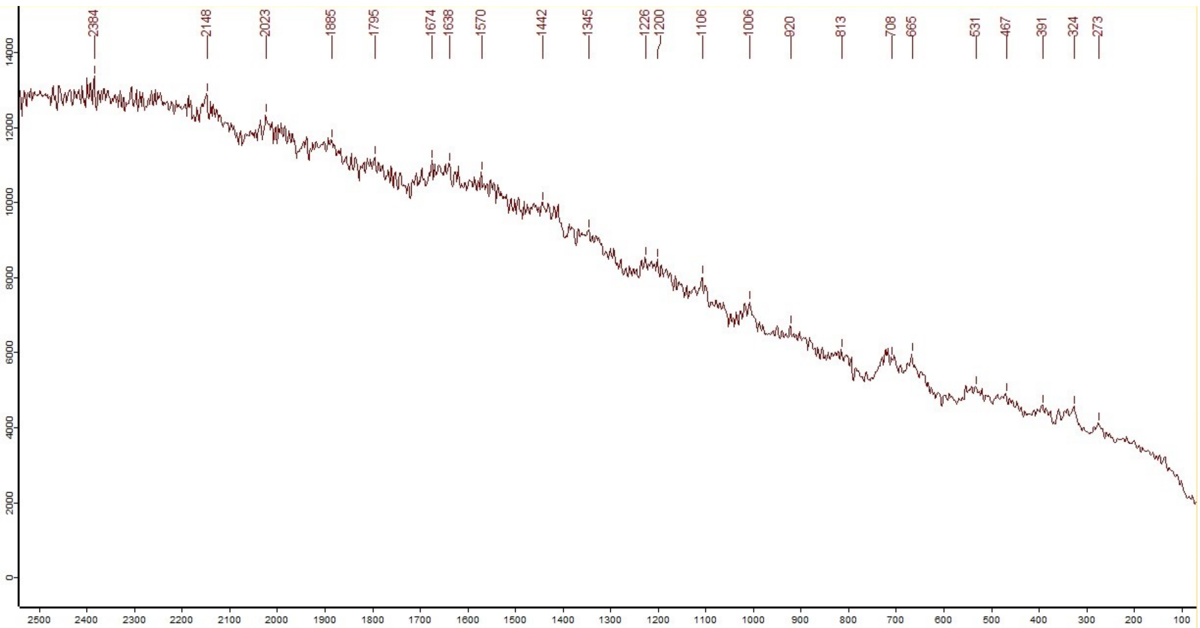
Sample Site 7 : Stone 3_spectra 2-2 (dark minerals) indicates : Hastingsite , Annite

(→ RRUFF_CS search result)

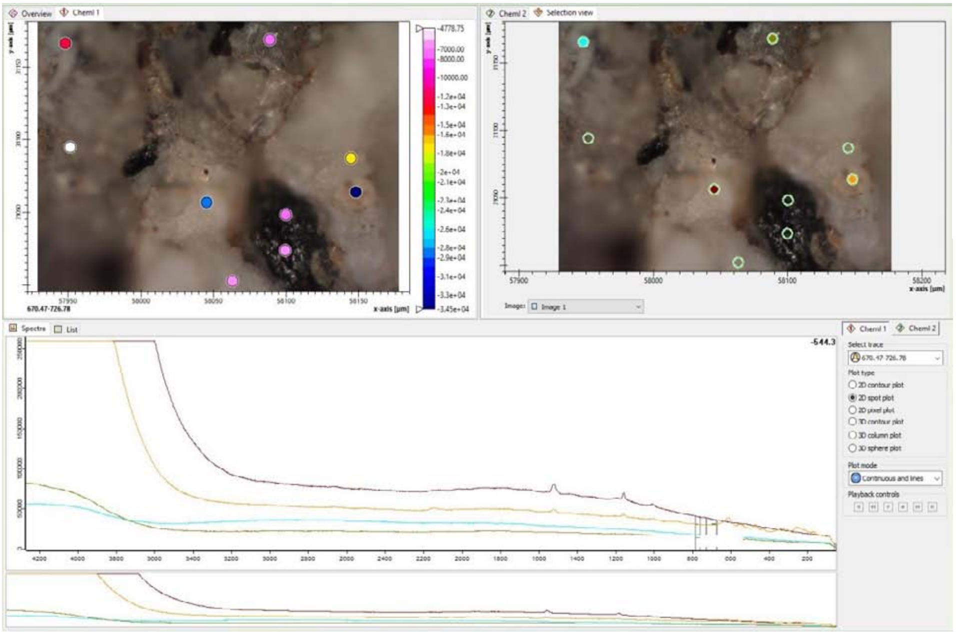


Sample :

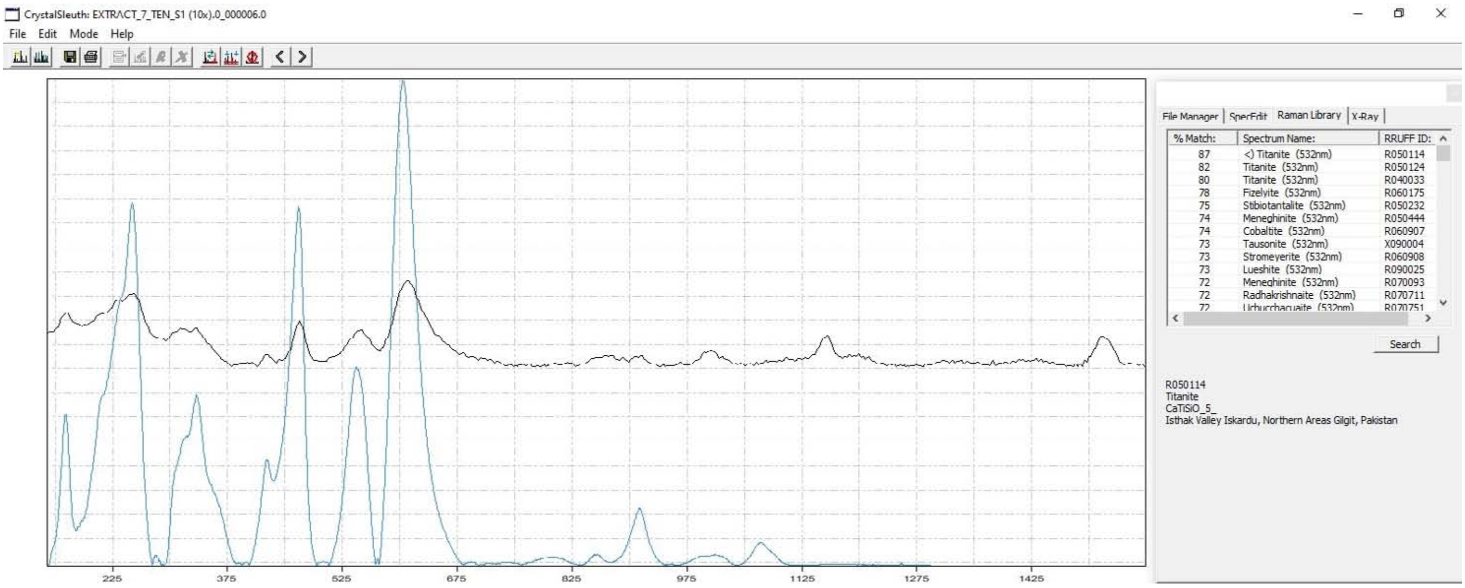


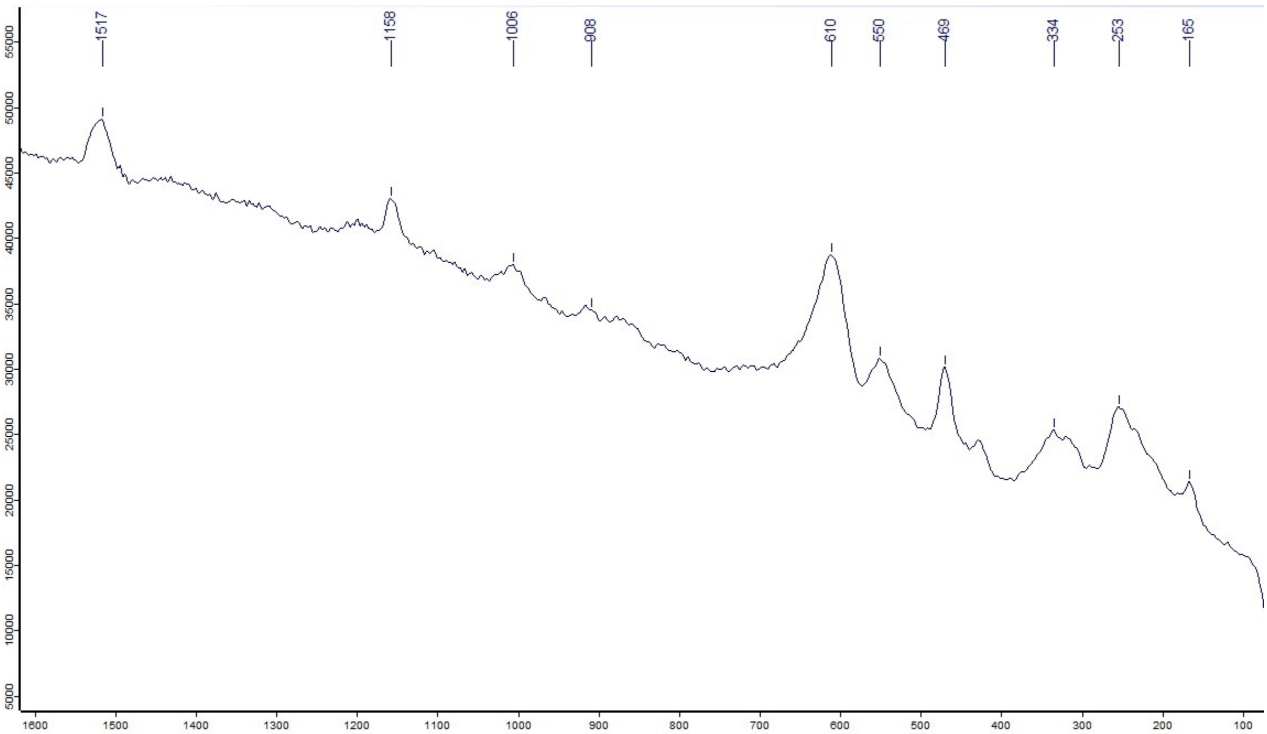


Sample Site 7 : Stone 4_spectra 1 indicates : Titanite (→ RRUFF_CS search result)

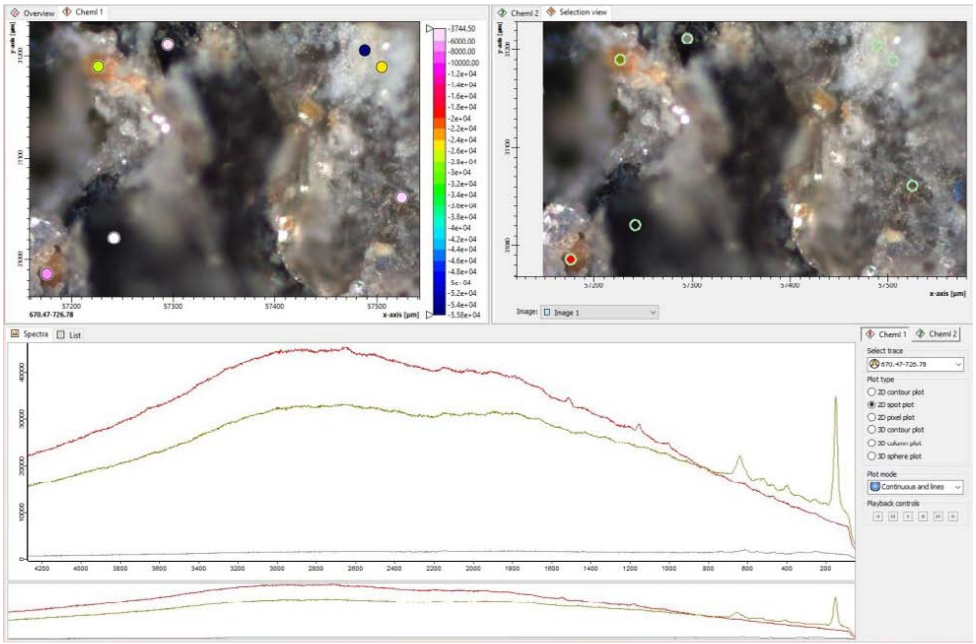


Sample :

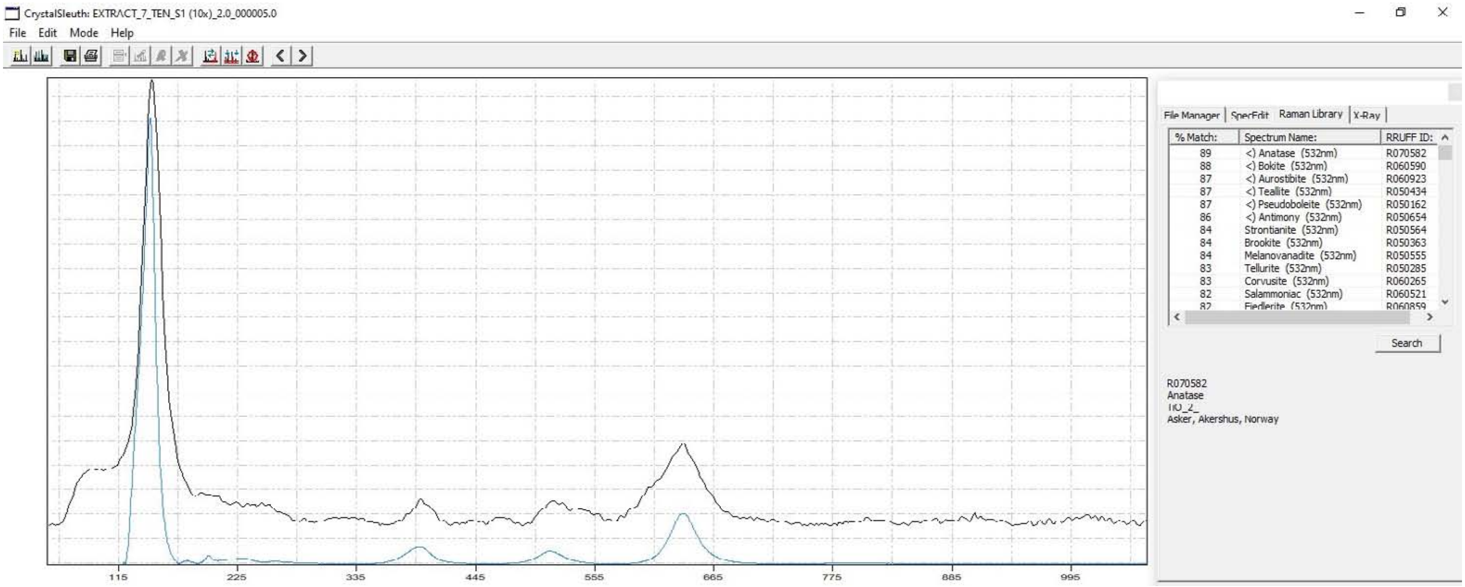


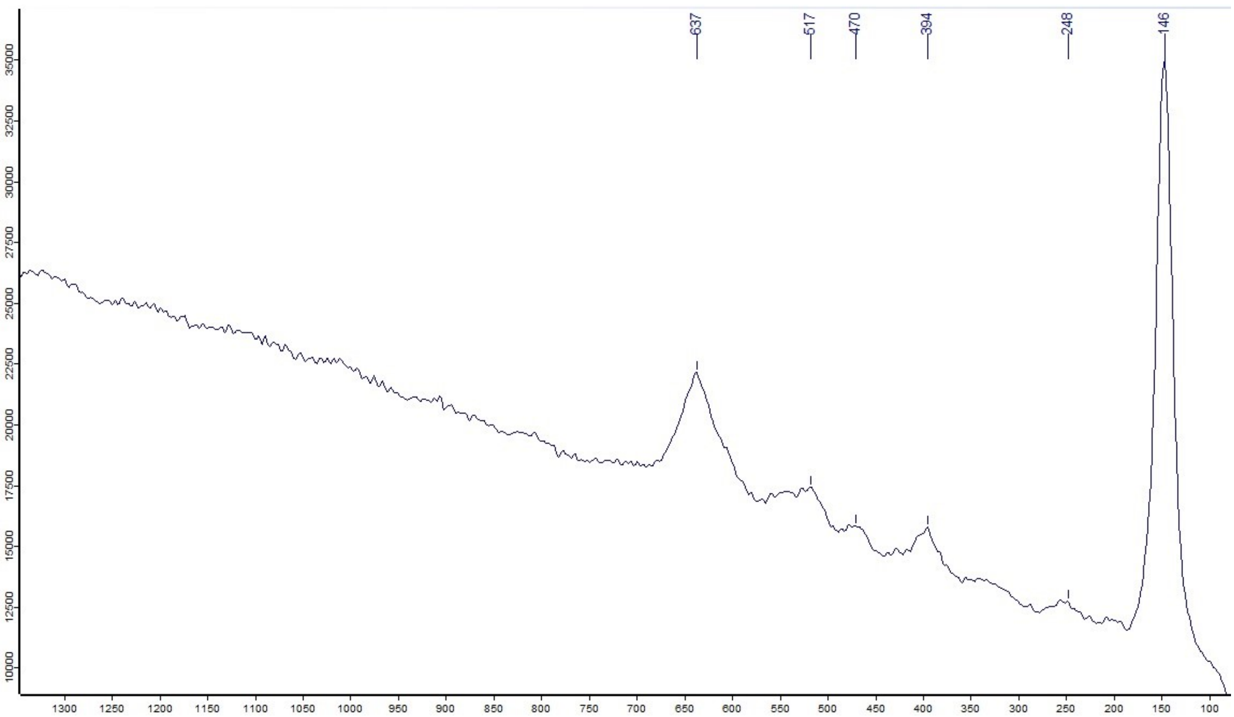


Sample Site 7 : Stone 4_spectra 3 indicates : Anatase (→ RRUFF_CS search result)

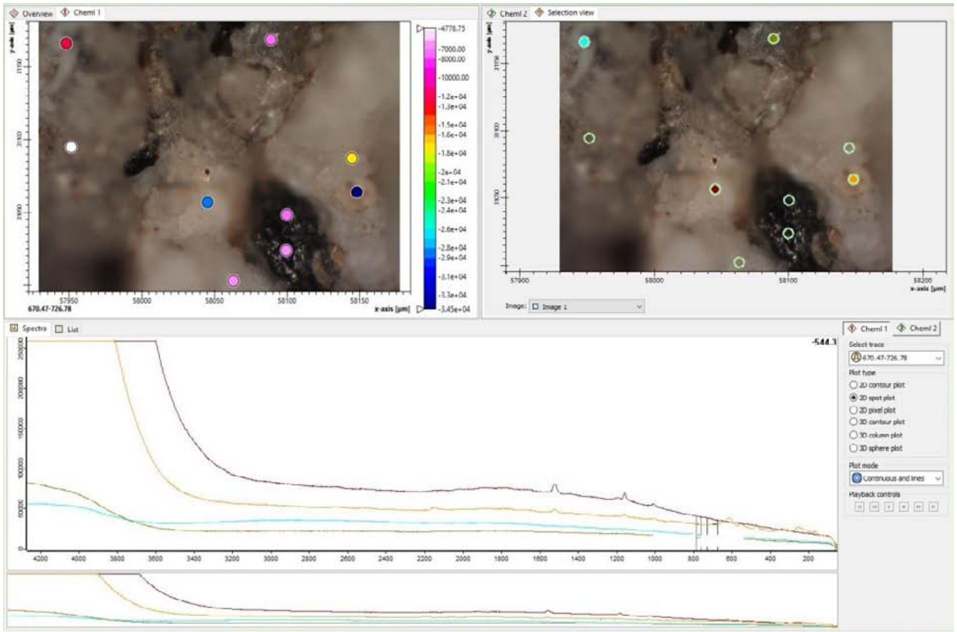


Sample :

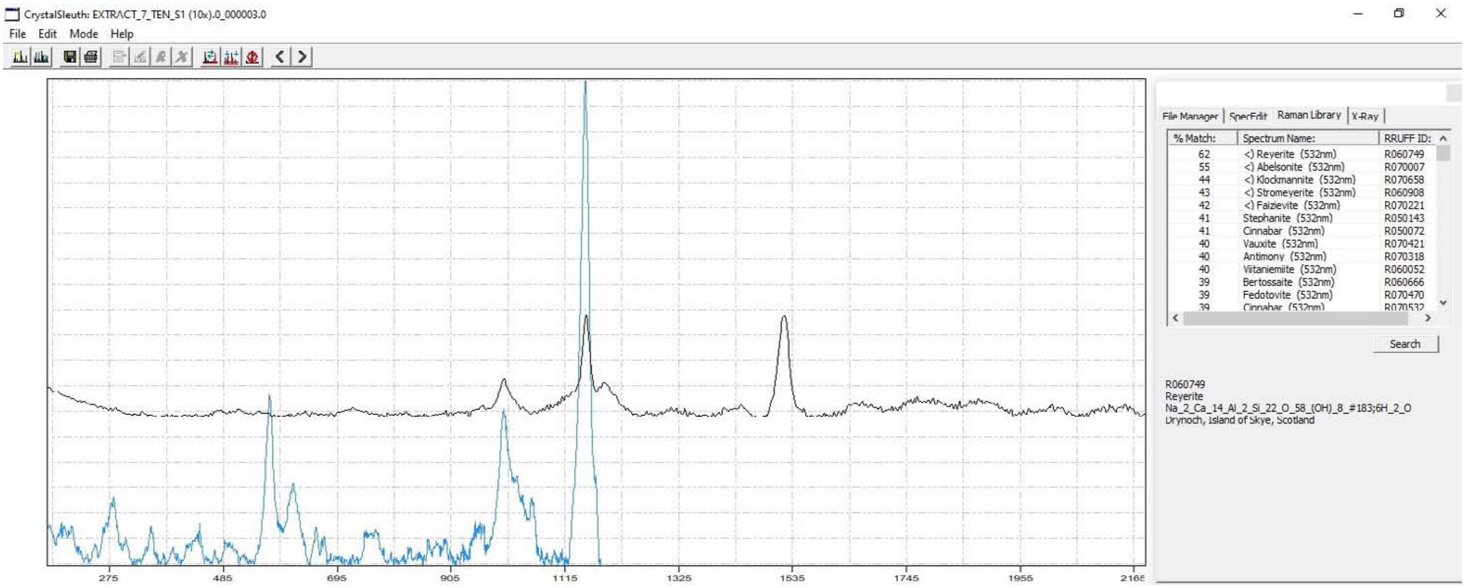


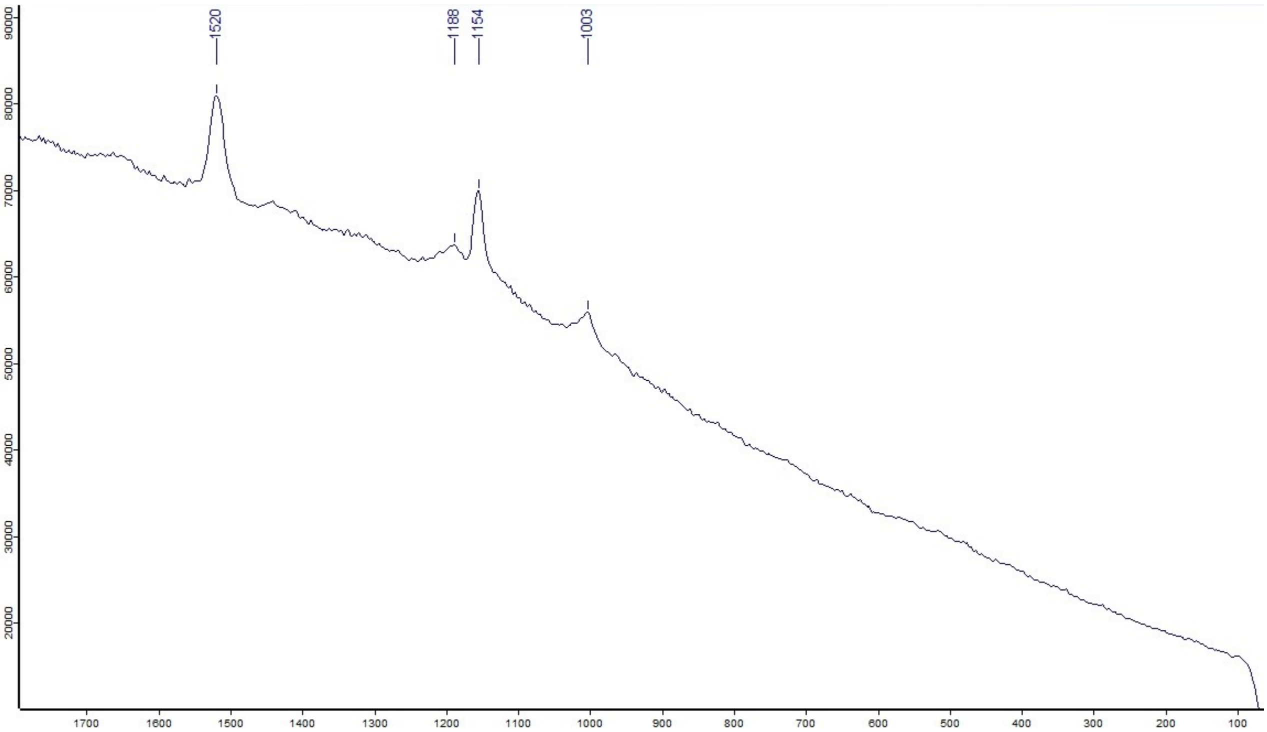


Sample Site 7 : Stone 4_spectra 2 indicates : Reyerite (→ RRUFF_CS search result)

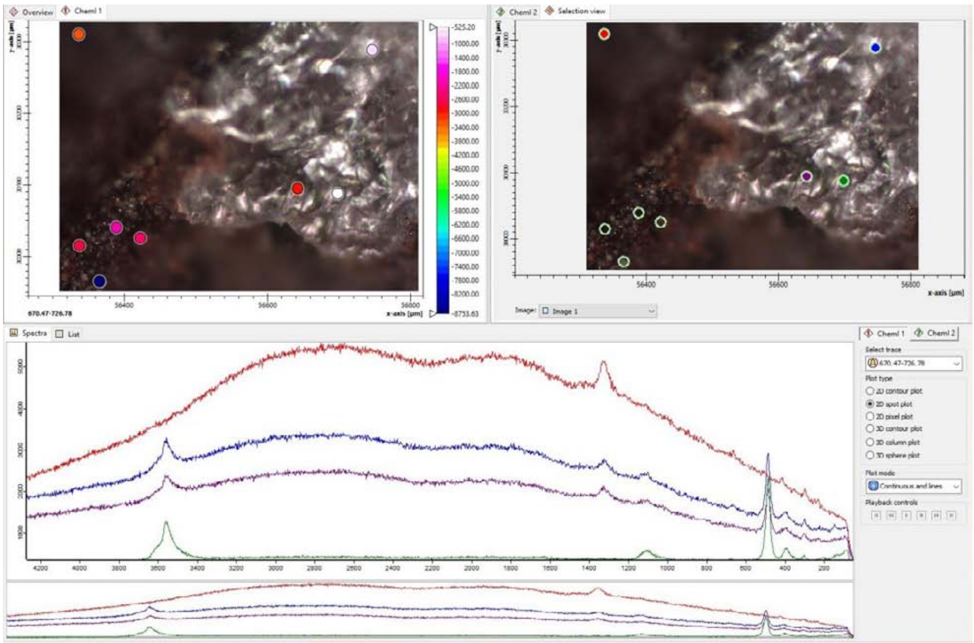


Sample :

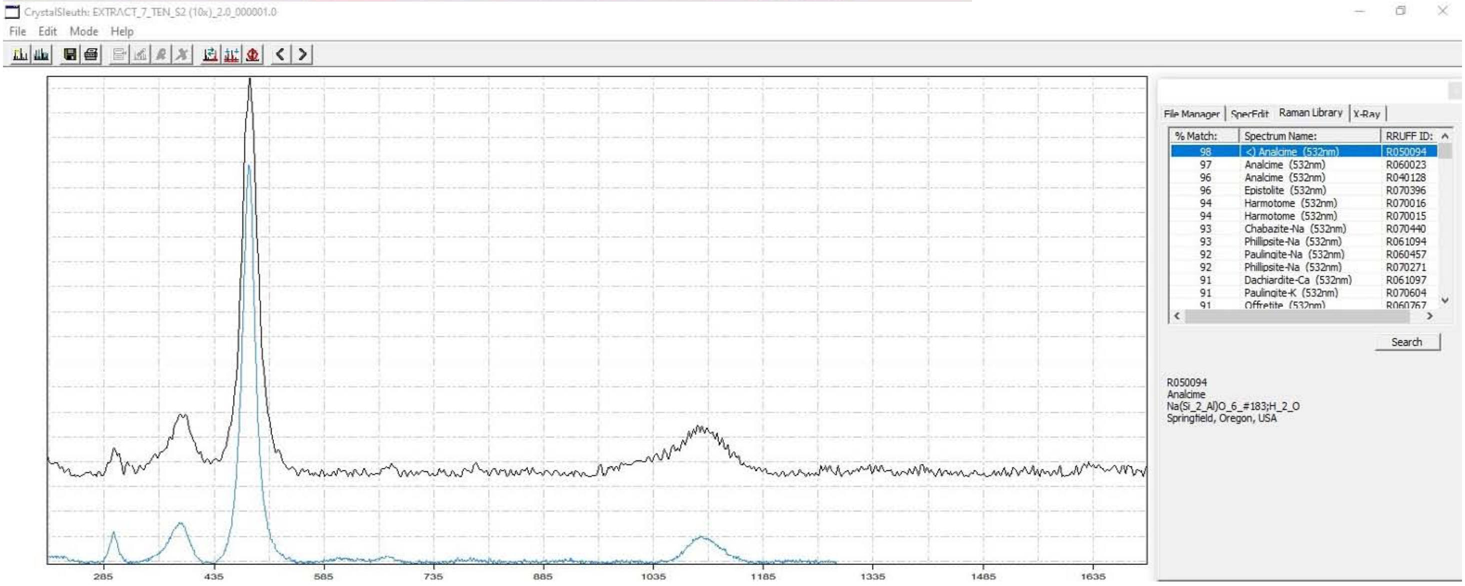


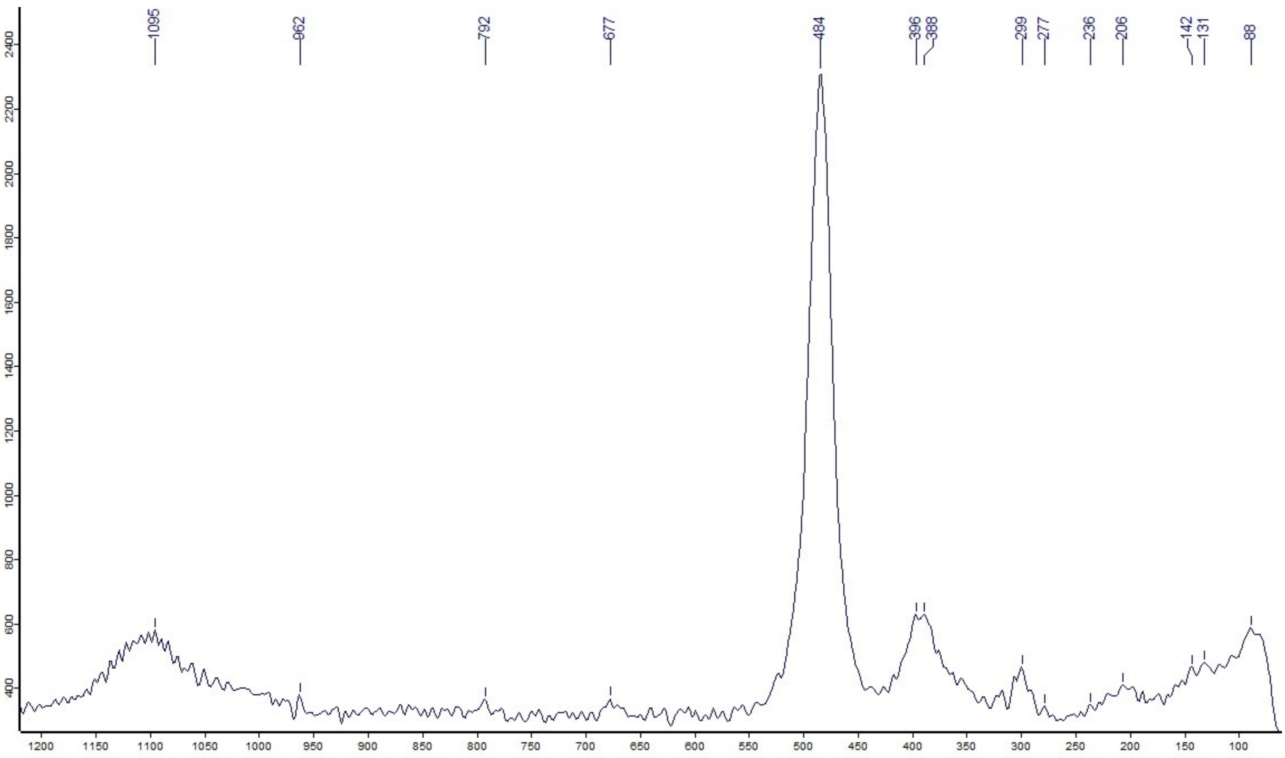


Sample Site 7 : Stone 5_spectra 1-B indicates : Analcime (→ RRUFF_CS search result)

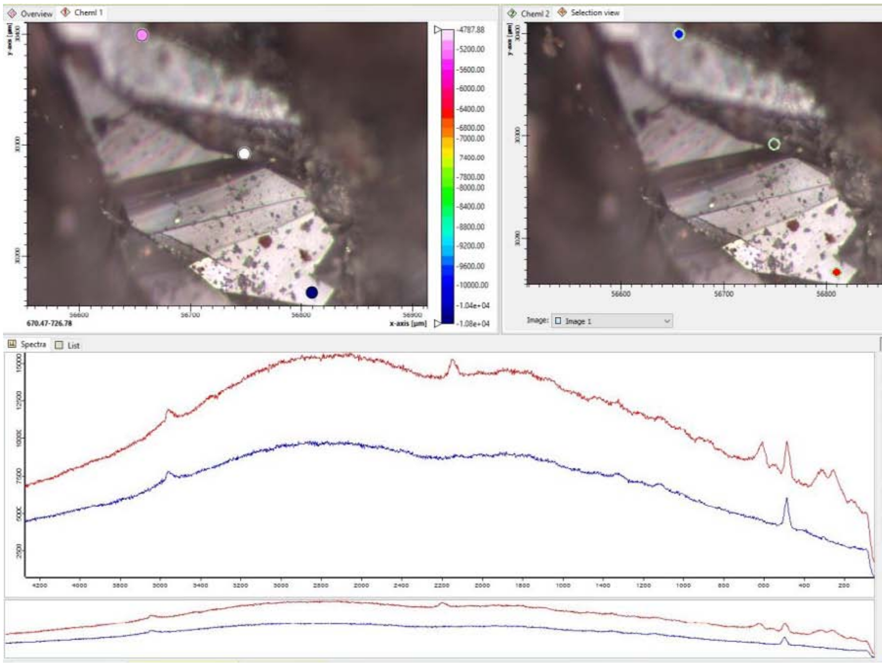


Sample :

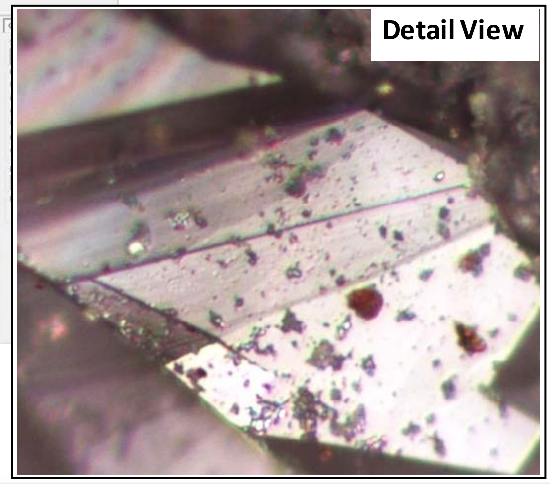


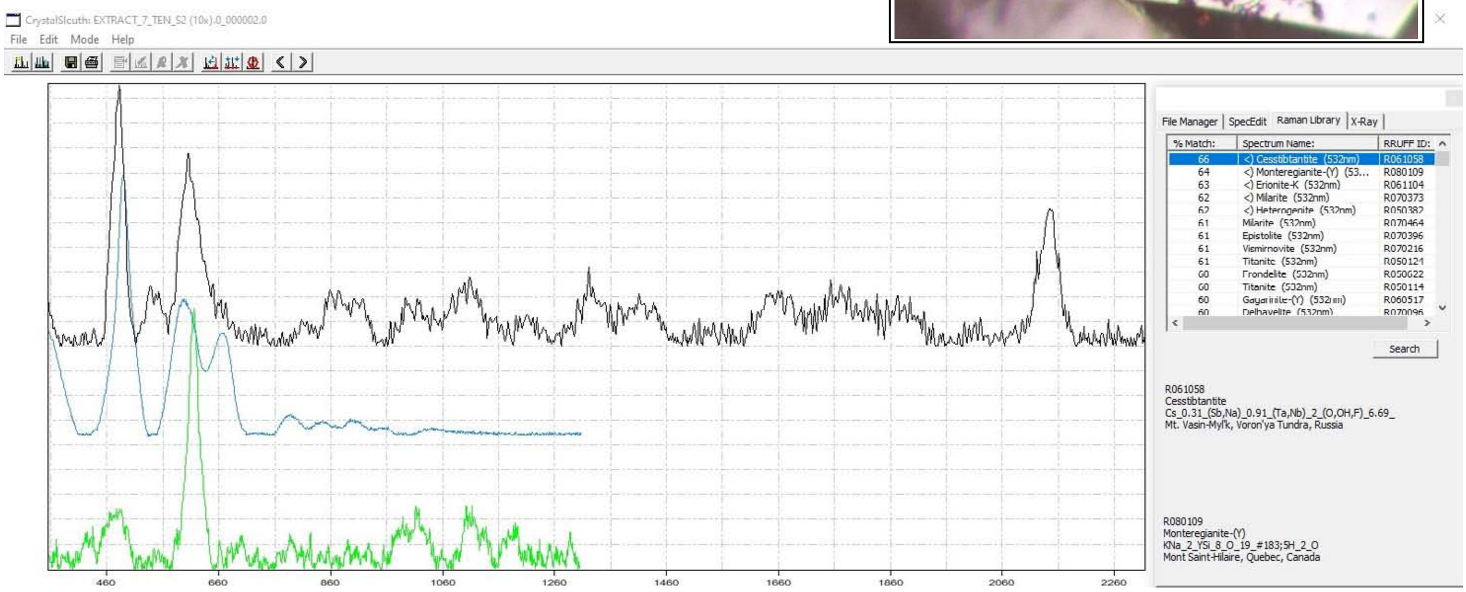


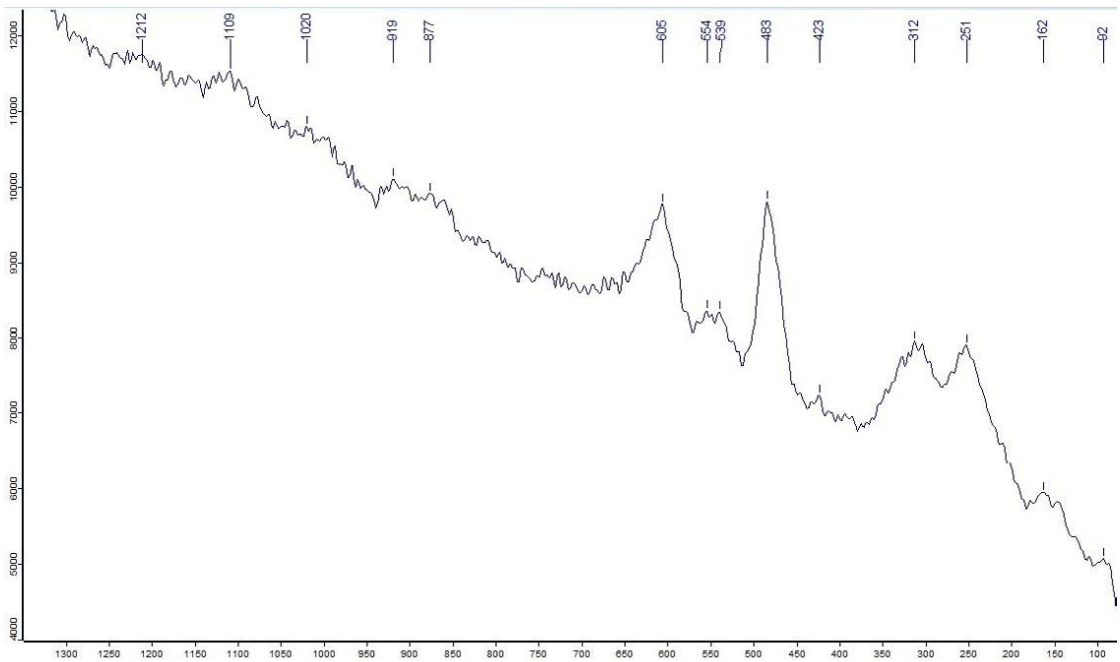
Sample Site 7 : Stone 5_spectra 2 indicates : Cesstibtantite_Monteregianite-(Y) (→ RRUFF_CS search result)



Sample :

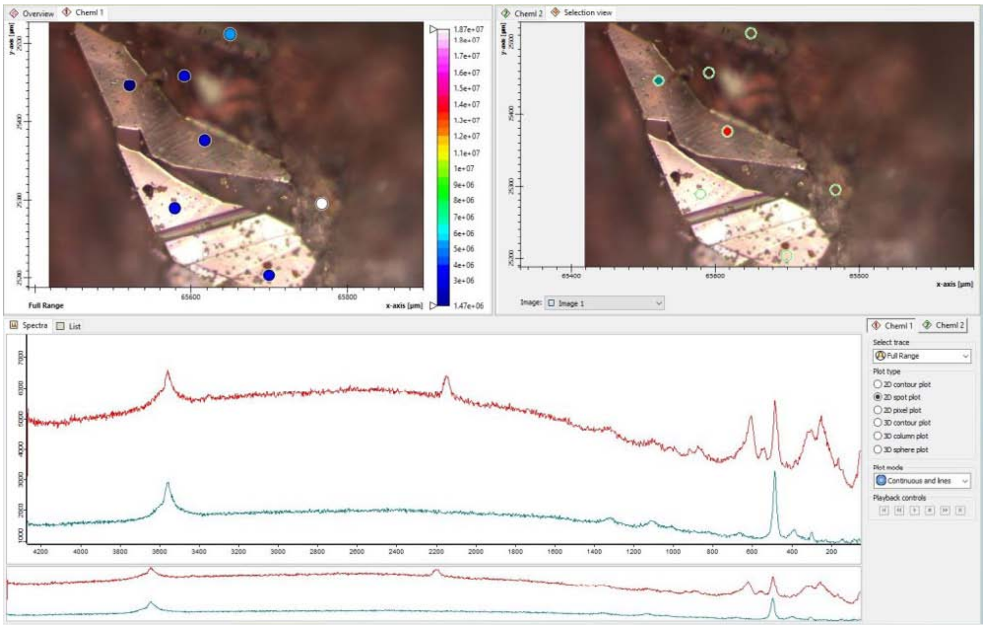




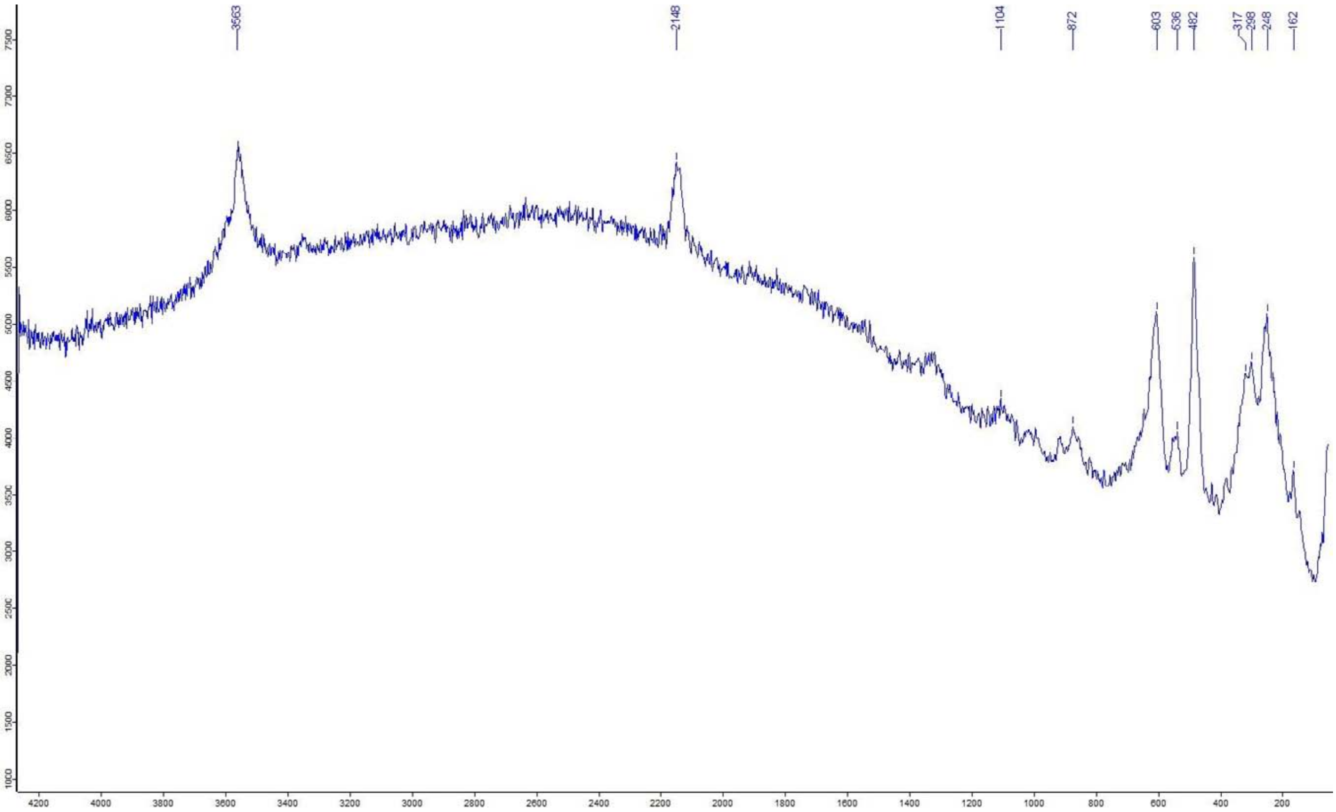


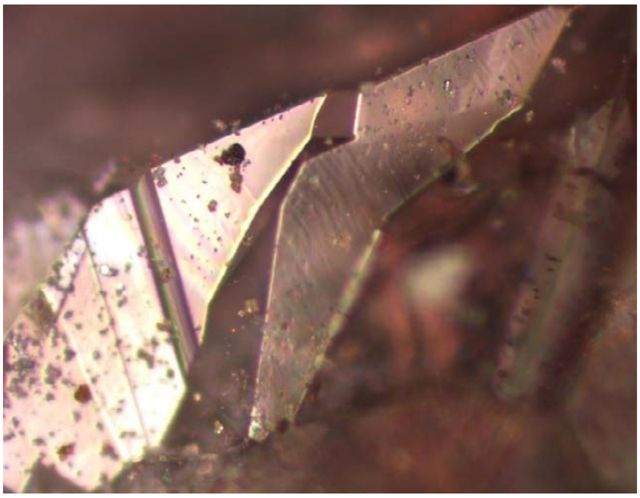
Sample Site 7 : Stone 5_spectra 3 → similar to spectra 2 (see previous page) – indicates :

Cesstibtantite and Monteregianite-(Y) (→ crystal in the brown matrix of the stone)

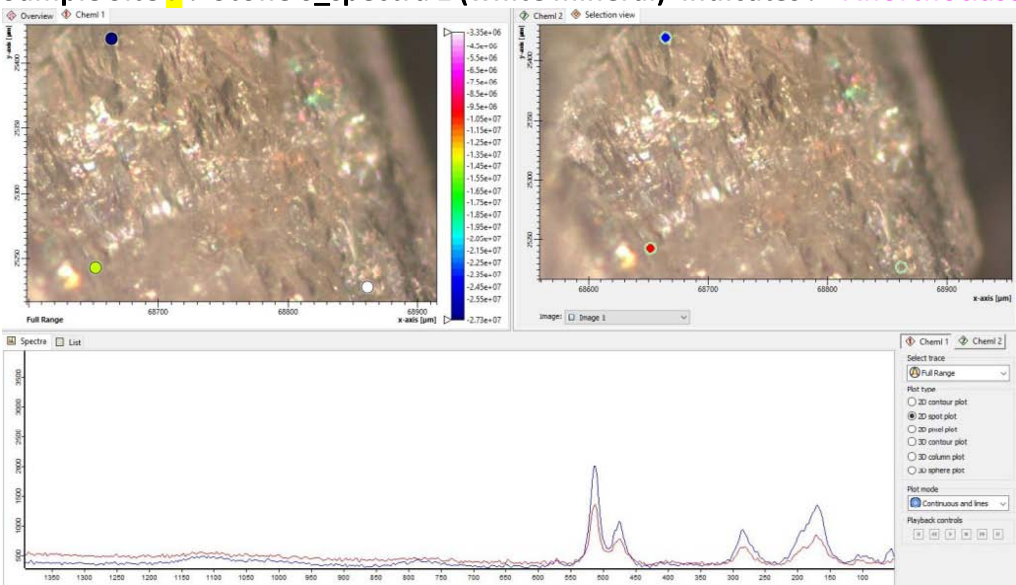


Sample :

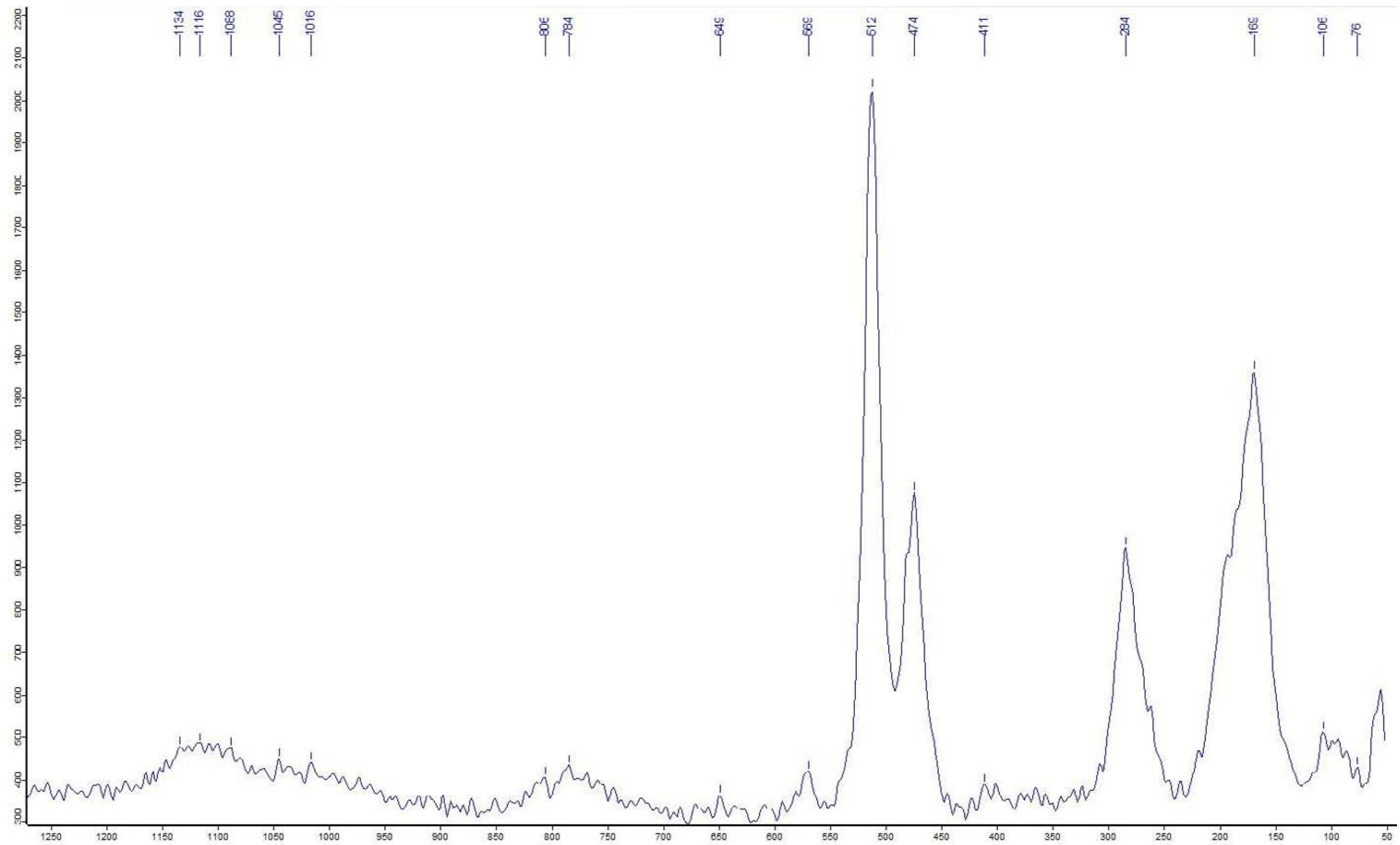


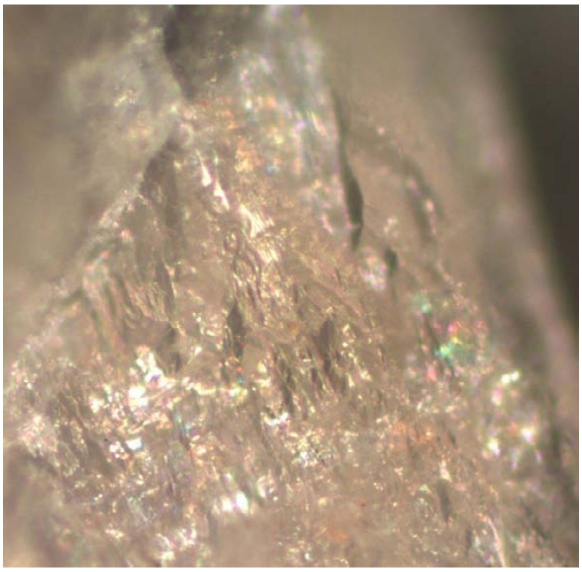


Sample Site 7 : Stone 6_spectra 1 (white mineral) indicates : Anorthoclase, Labradorite

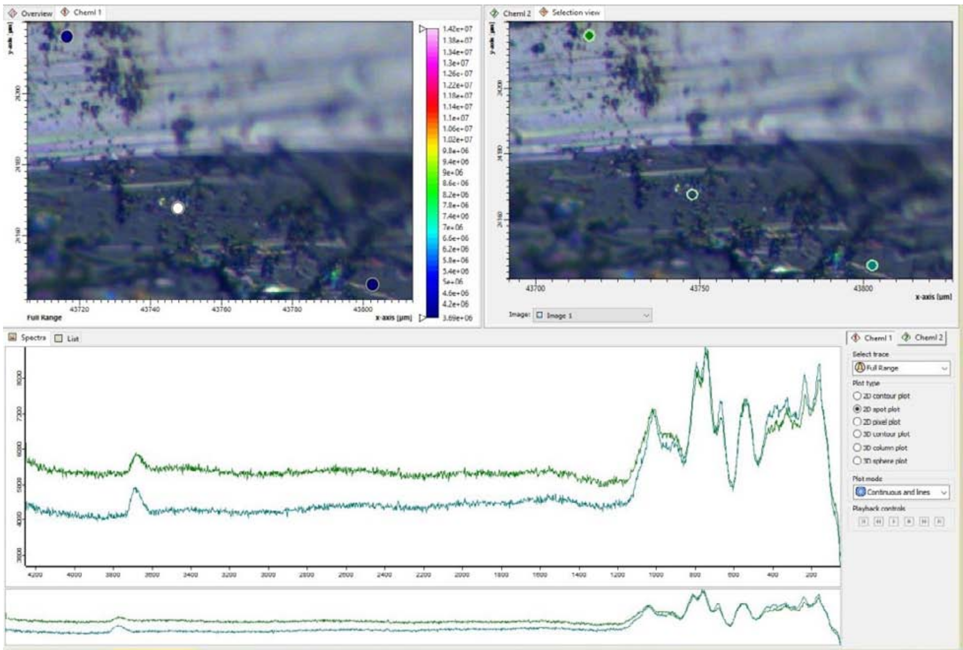


Sample :

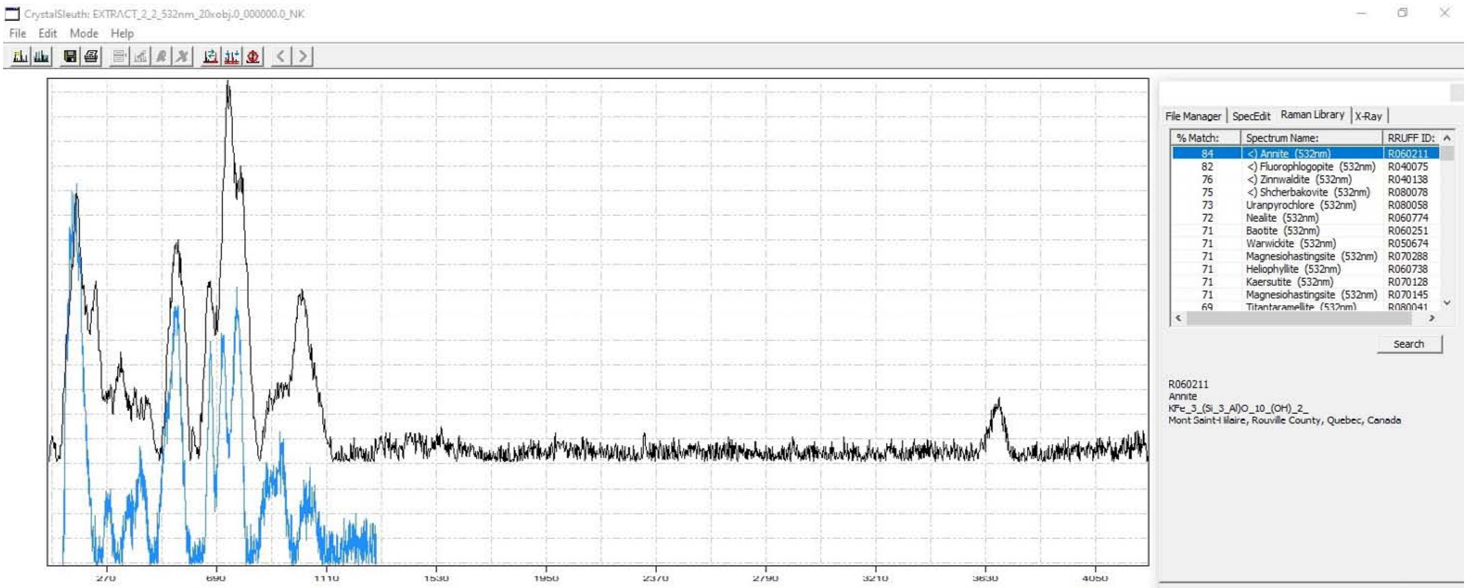


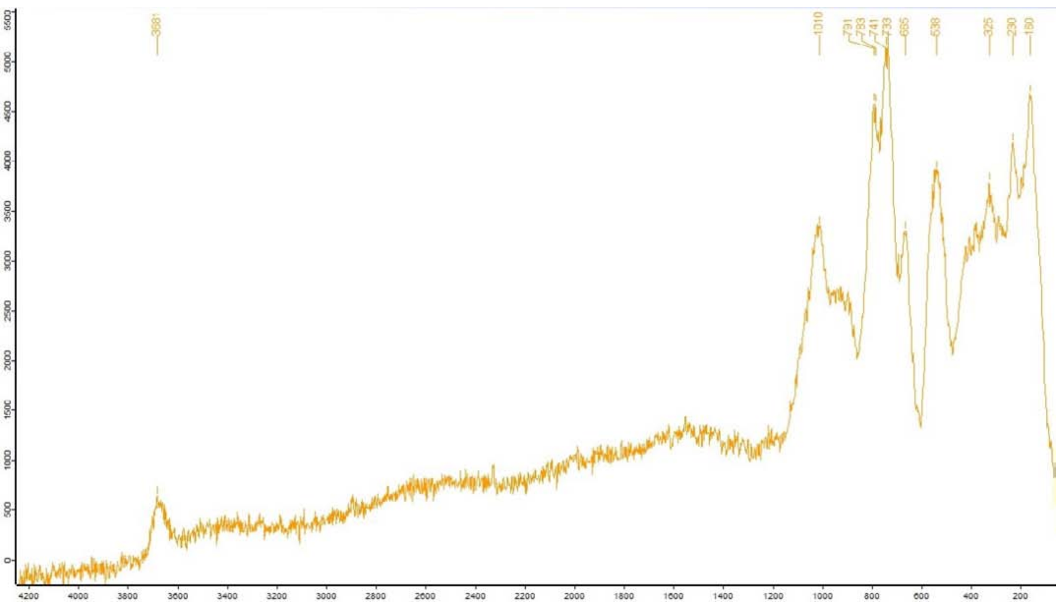


Sample Site 9 : Stone 1_spectra 2 (dark mineral) indicates : Annite (→ see RRUFF_CS search result)

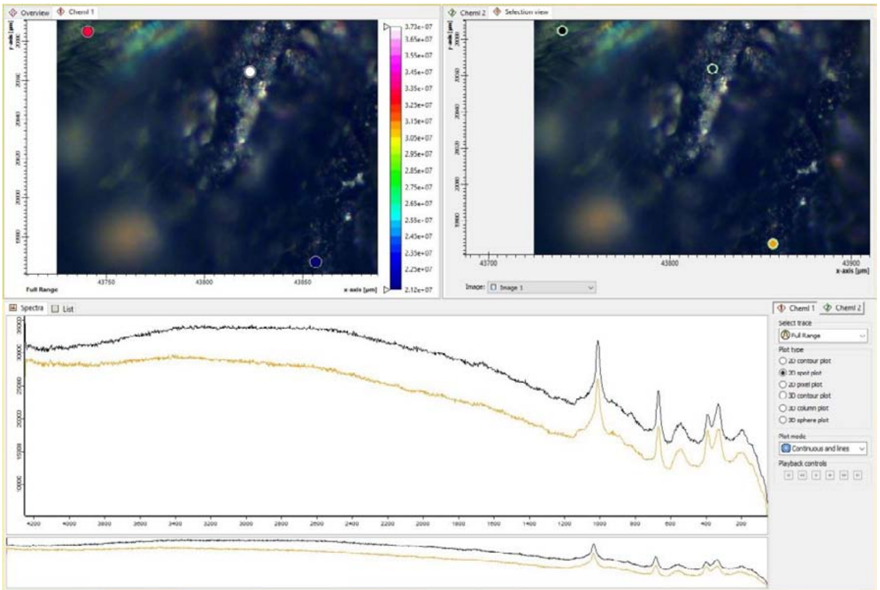


Sample :





Sample Site 9 : Stone 1_spectra 3 (dark minerals) indicates : Augite or similar (→ RRUFF_CS search result)



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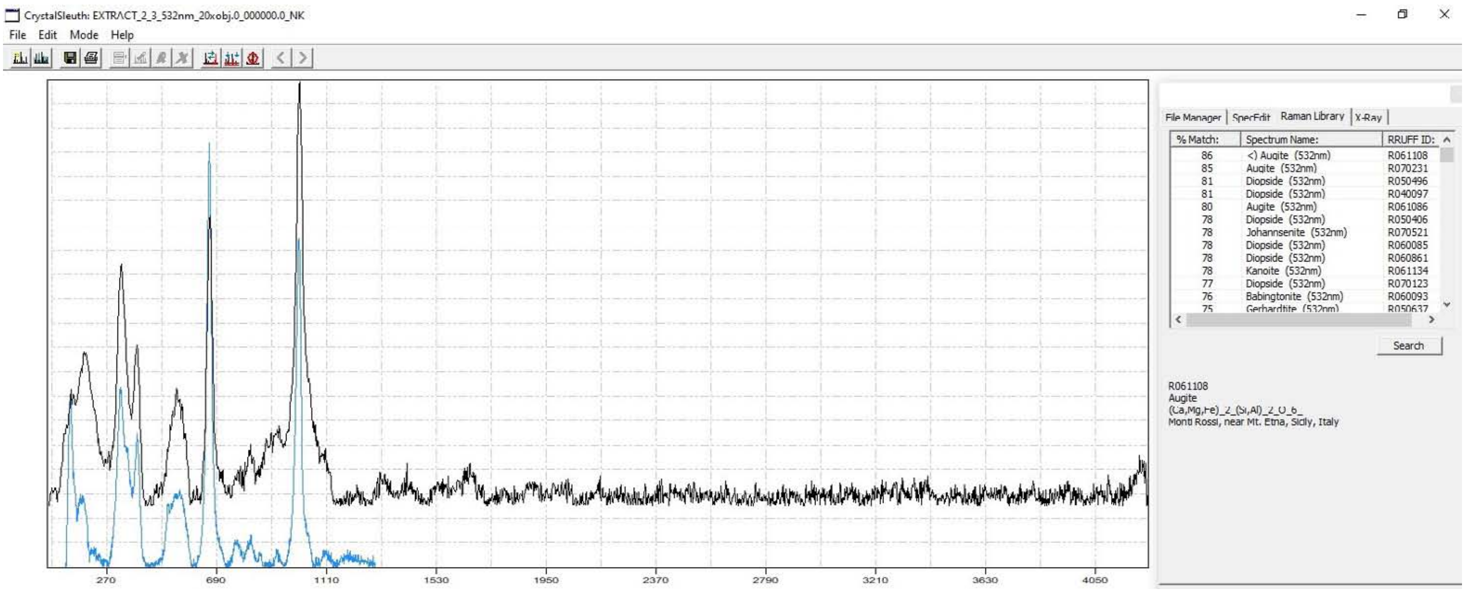
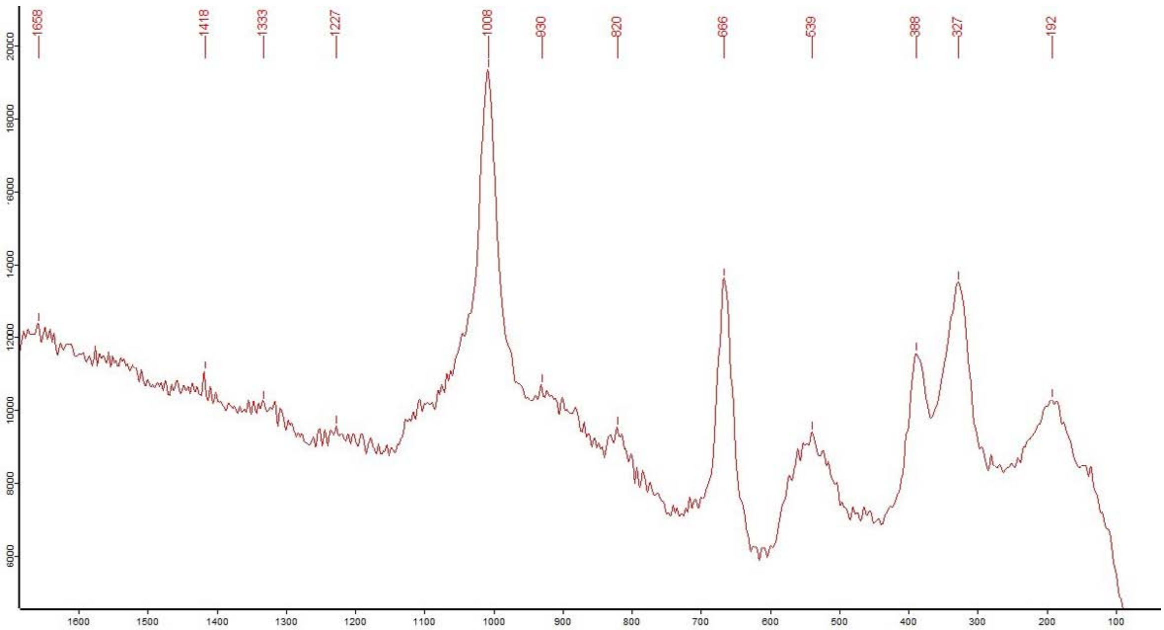
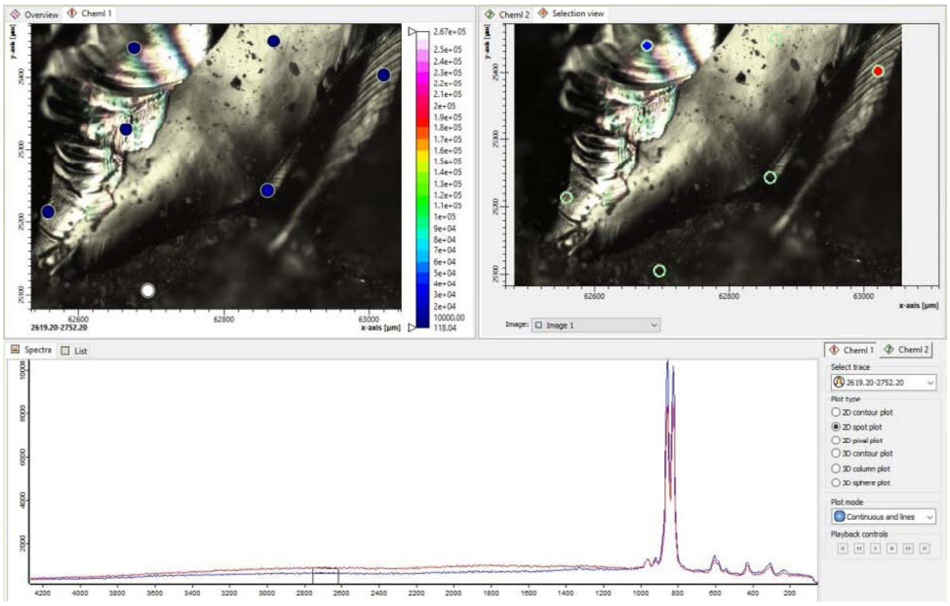
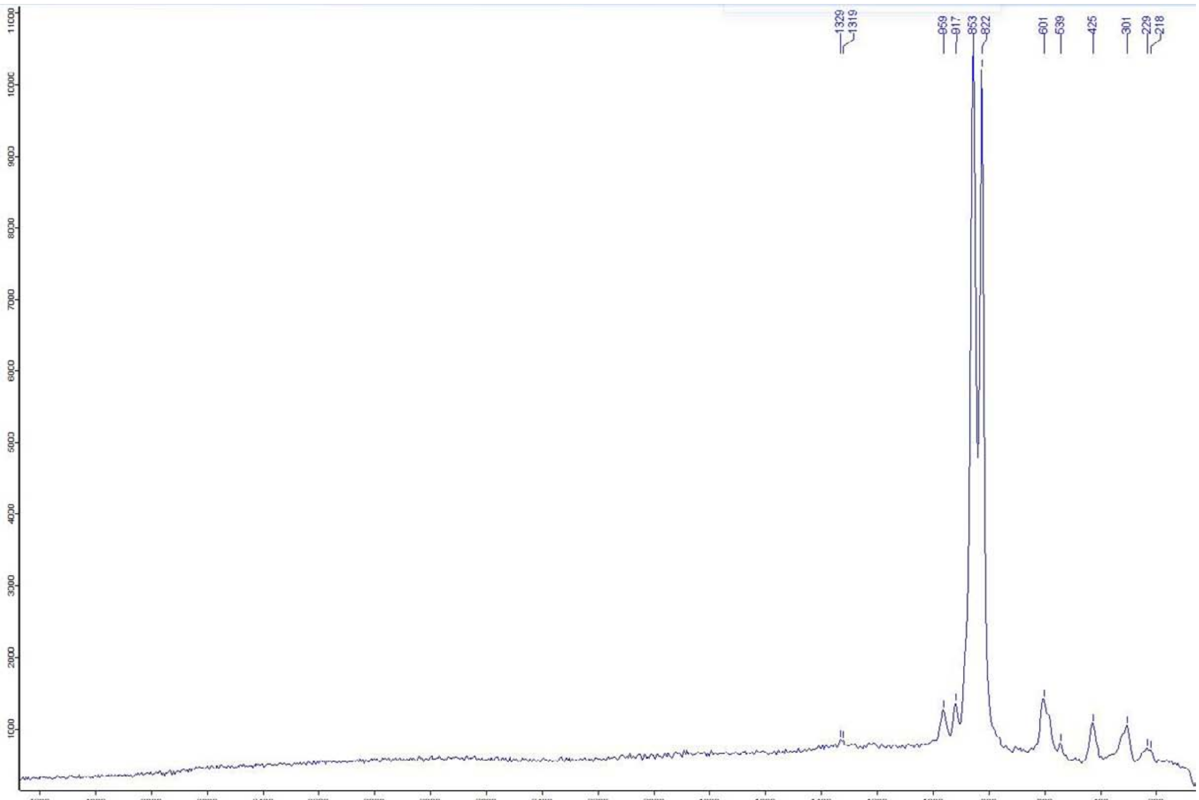


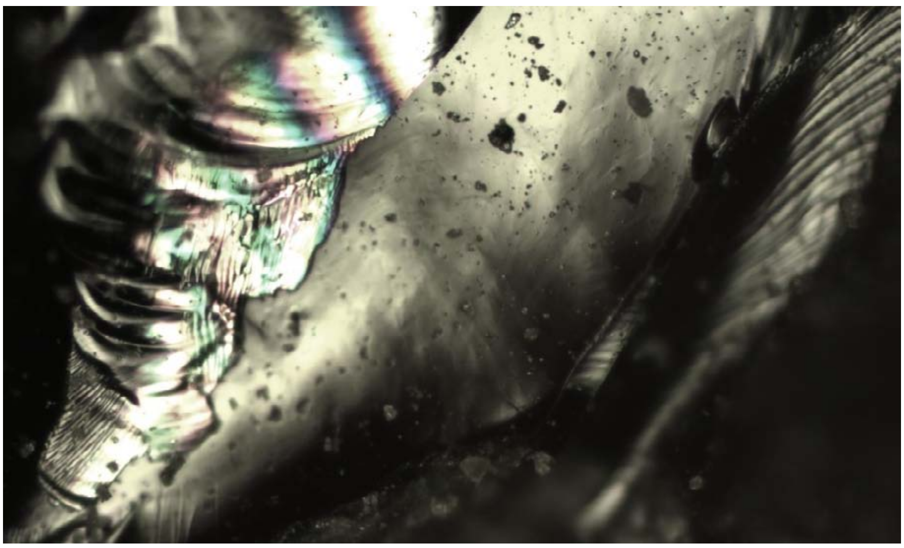


Sample Site 56 : Stone 1_spectra 1 (crystal in grey matrix of stone → see image) : no analysis done

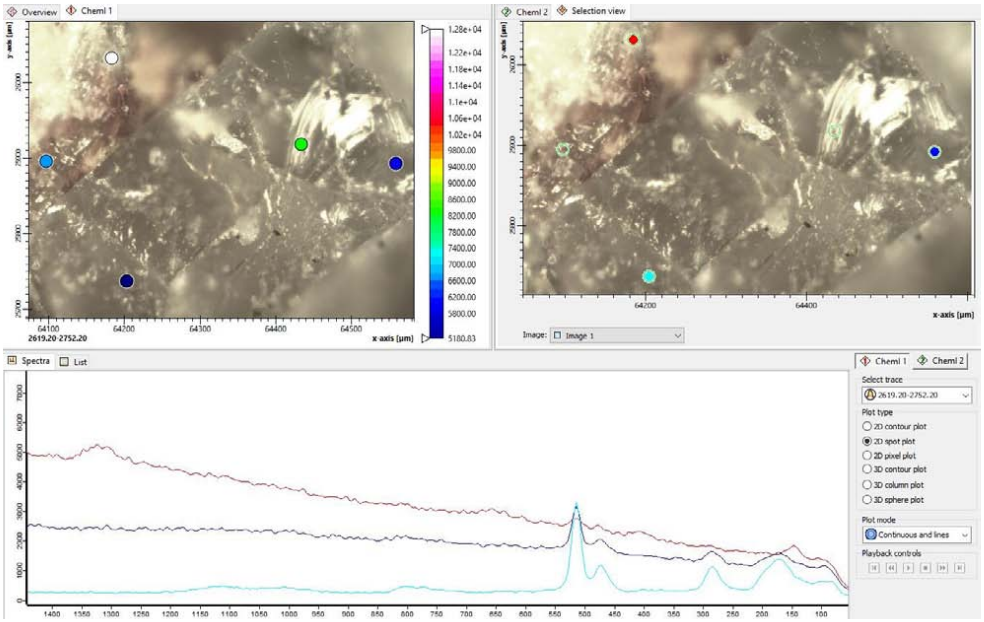


Sample :





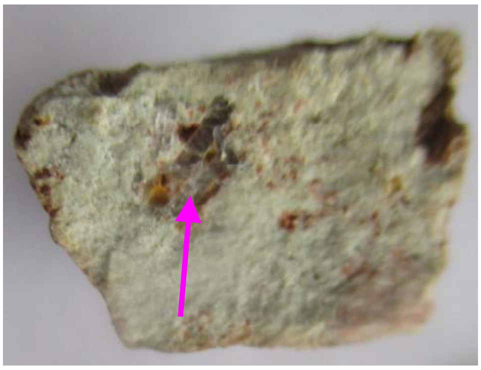
Sample Site 58 : Stone 1_spectra 2 (white crystal inclusion) indicates : Anorthoclase (→ RRUFF)

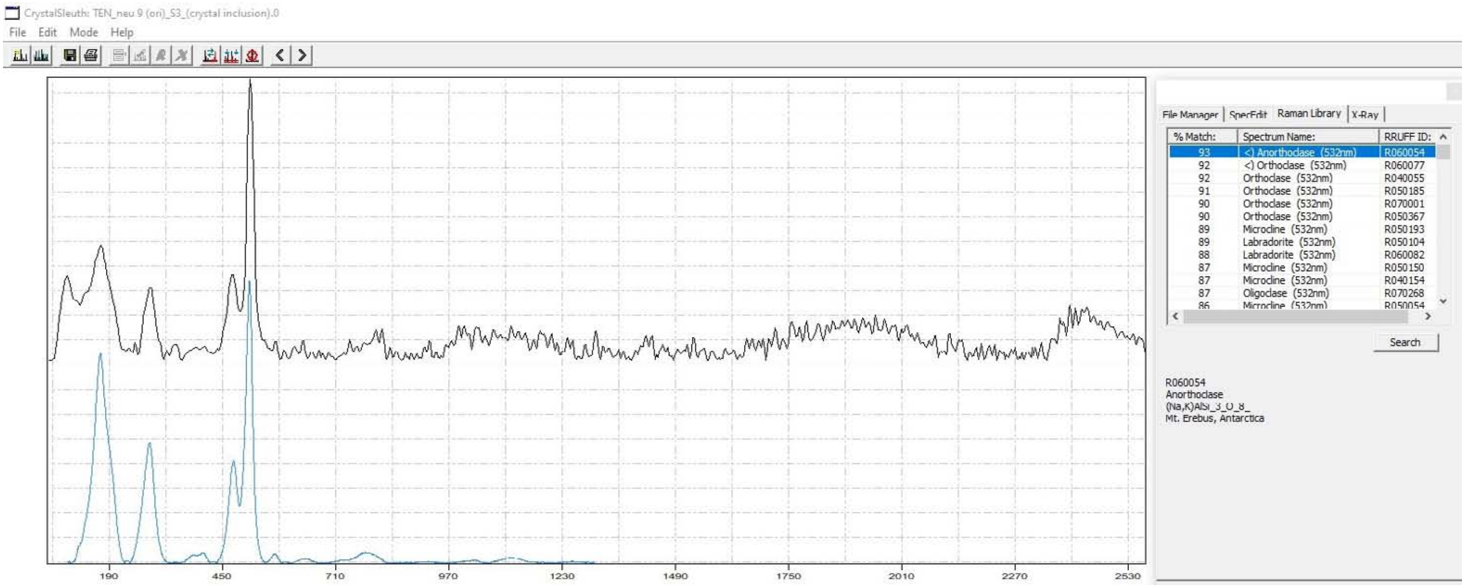


The sample is from an **old rock island** inside the Teide Volcano caldera.

Approx. 400m SW from the "Rocks de Garcia"

Sample :





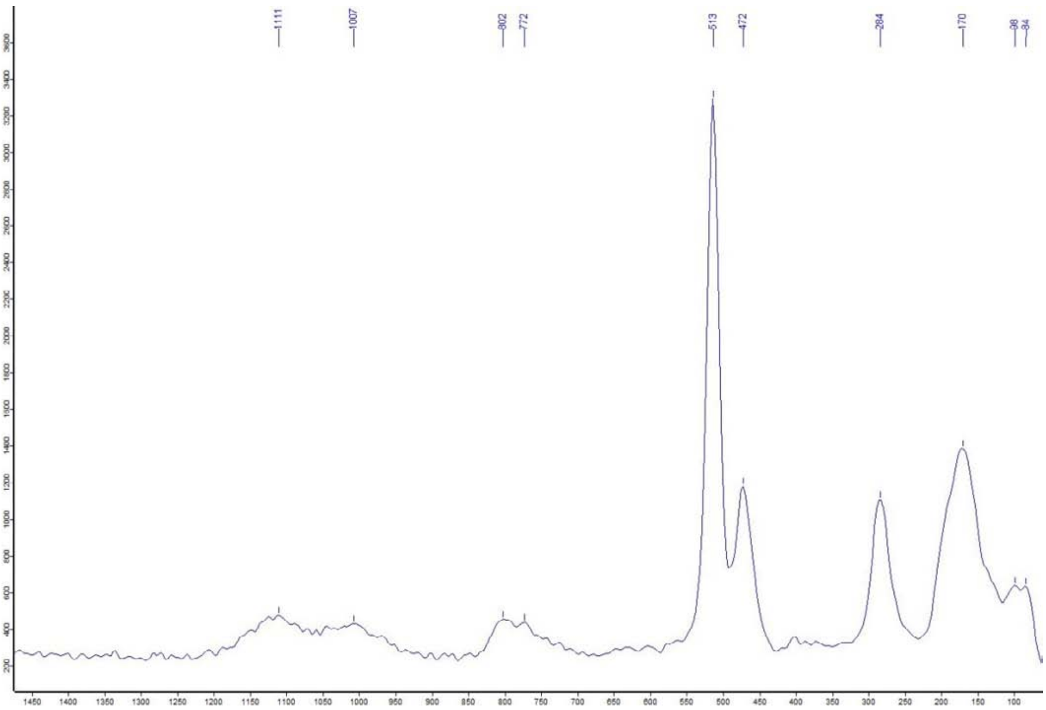
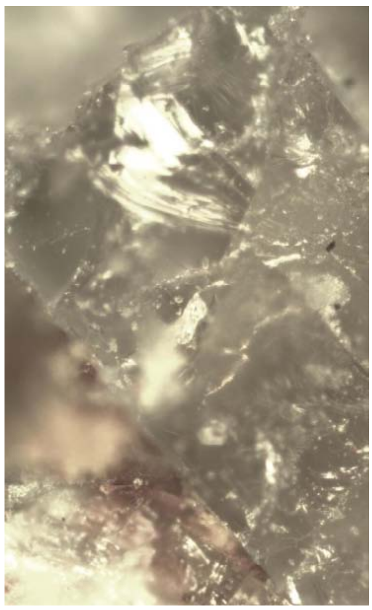


Image size : ≈ 200 x 350 µm



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

→ See next page

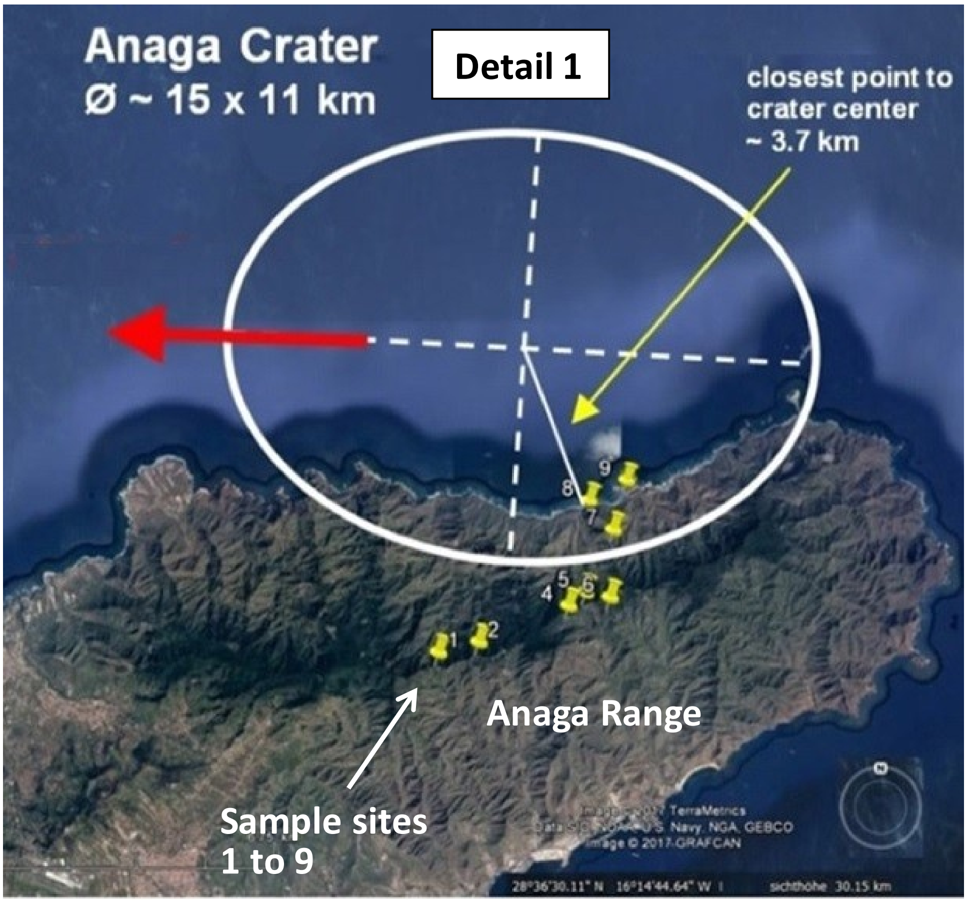
Note : Photos of the Samples Sites 2, 5, 7, 9 and 58 and other sample sites are available on my website. → weblink : Sample Sites "Anaga Crater" (or here) together with geological maps and a GPS-Data List of the sample sites.

Satellite Image with Sample sites No. 1 – 9 :

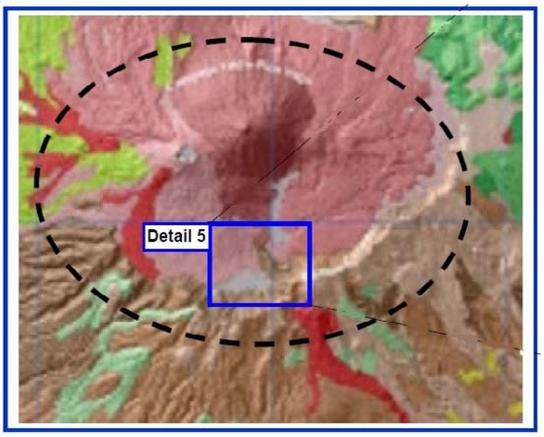
→ Weblink to the Digital Geological-Map (IGME) :

→ http://info.igme.es/visorweb/

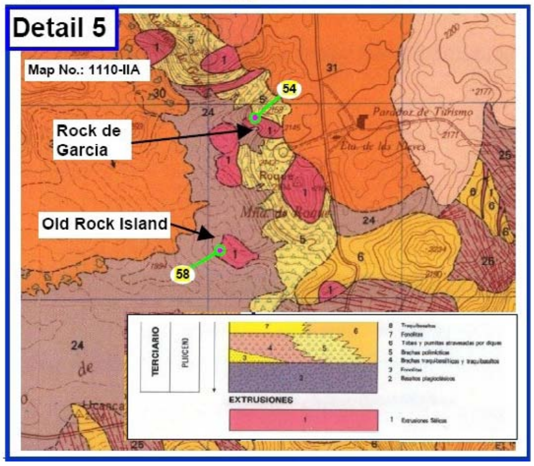
→ zoom-in to Tenerife

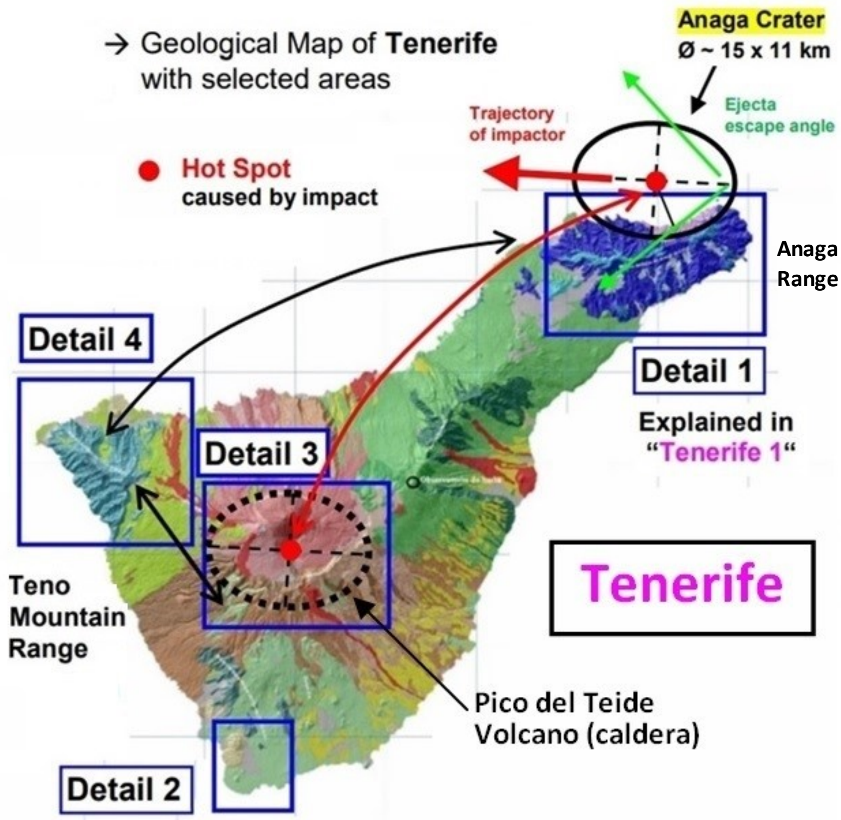


Detail 3 Pico del Teide - Volcano



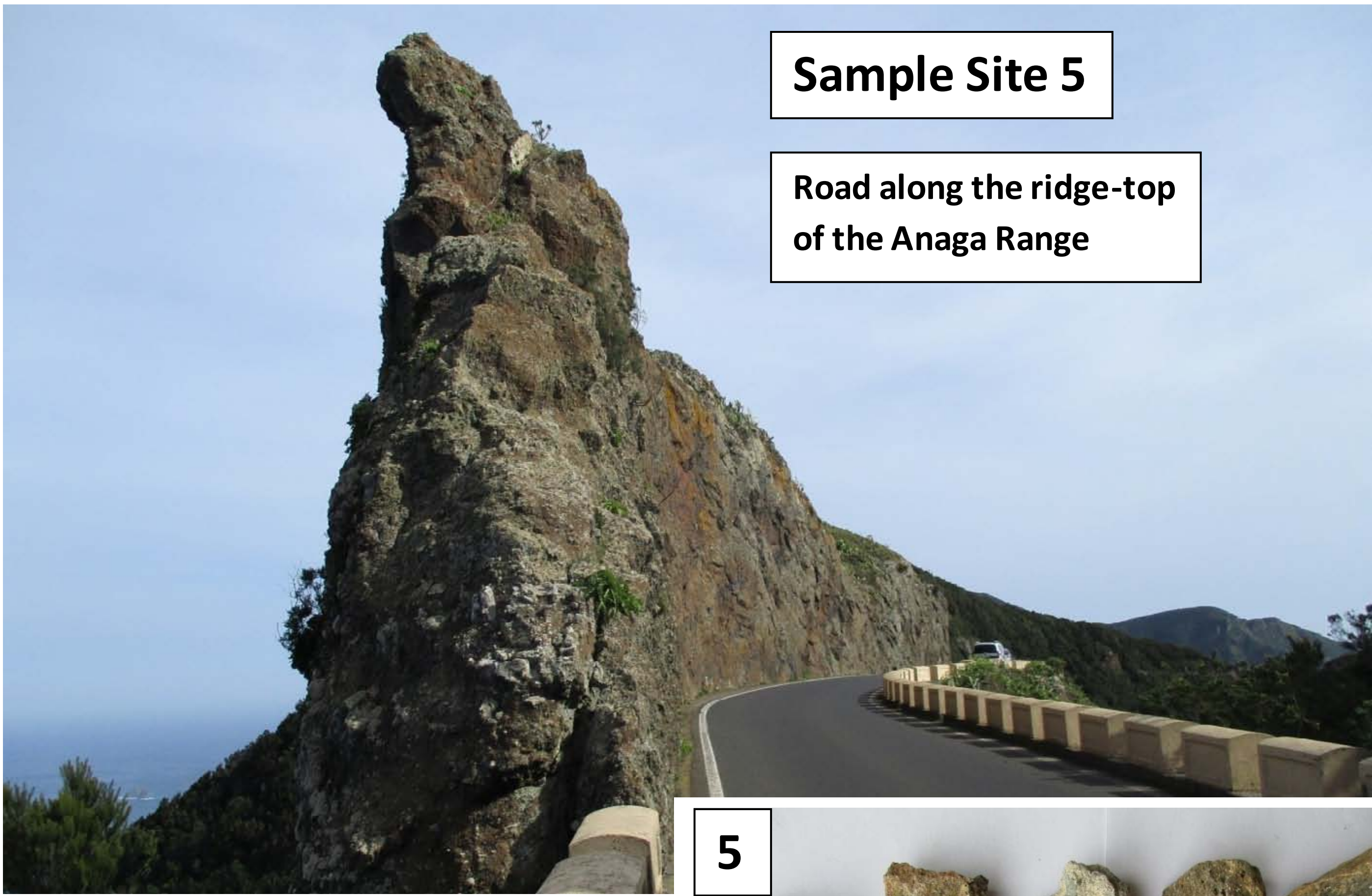
Geological Map → Weblink : MapasIGME: MAGNA 50 - scale 1:50.000

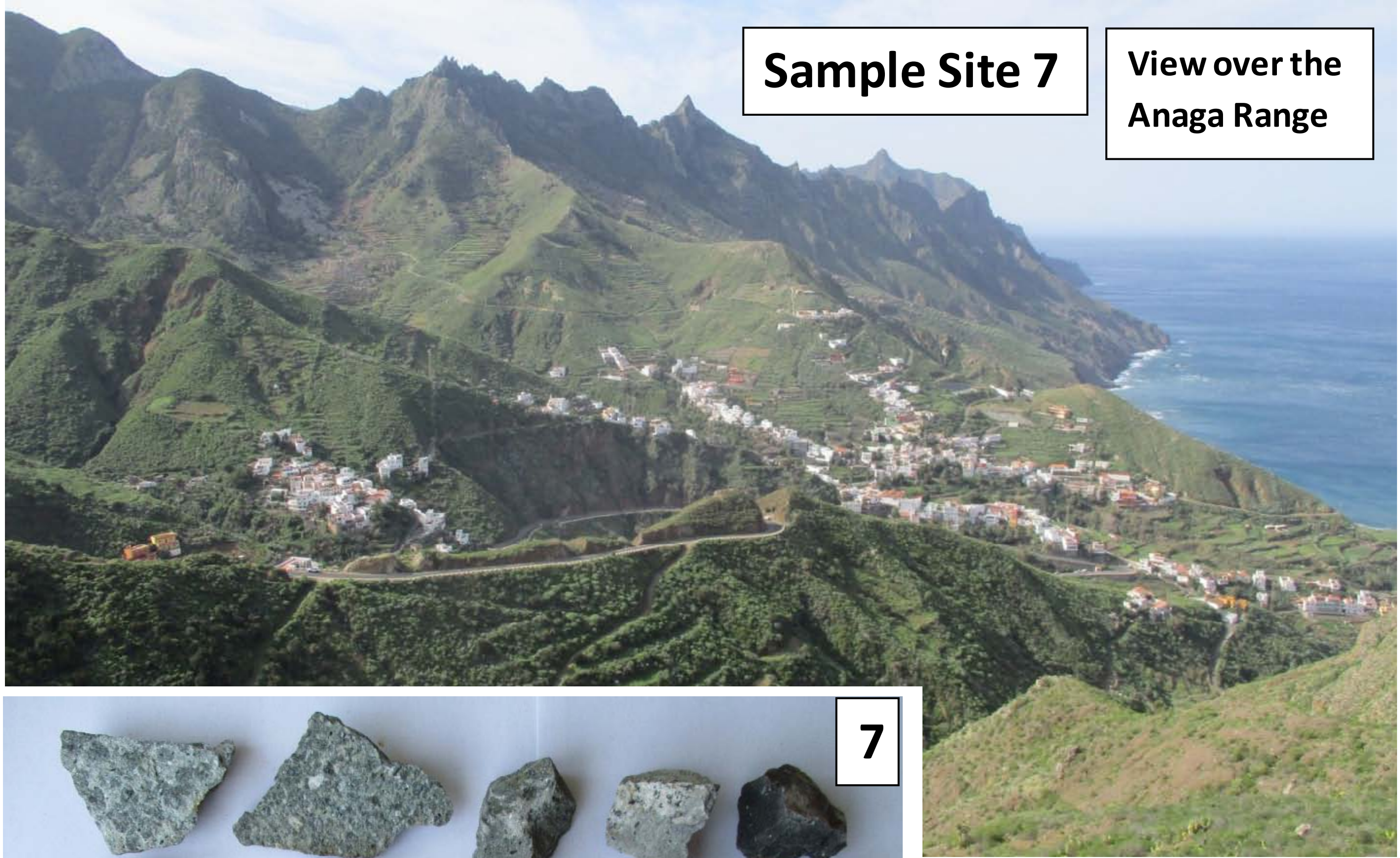




Sample Site 5

Road along the ridge-top of the Anaga Range

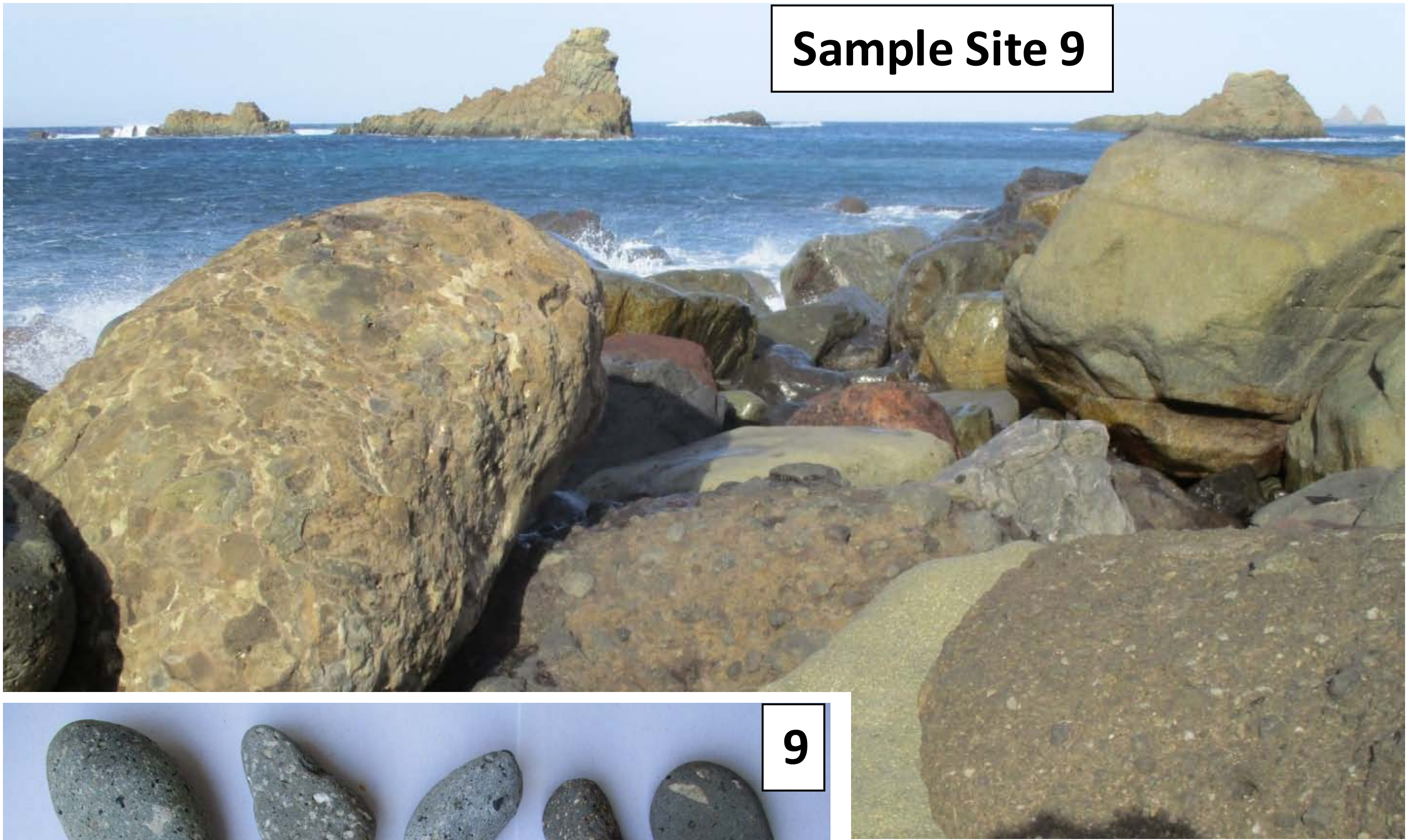



Sample Site 7
View over the
Anaga Range


7
7 28° 33,696 N 16° 12,386 W 8 m Spain - Canary Islands

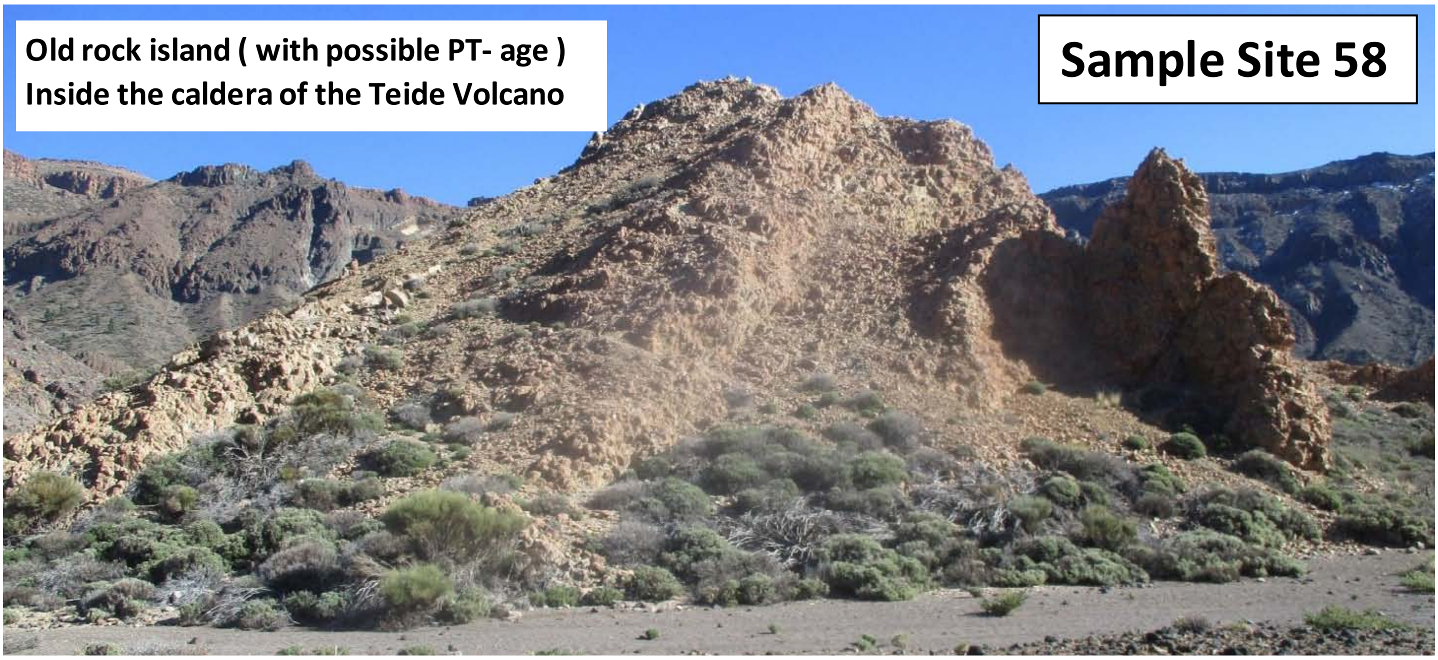

7
7 28° 33,696 N 16° 12,386 W 8 m Spain - Canary Islands

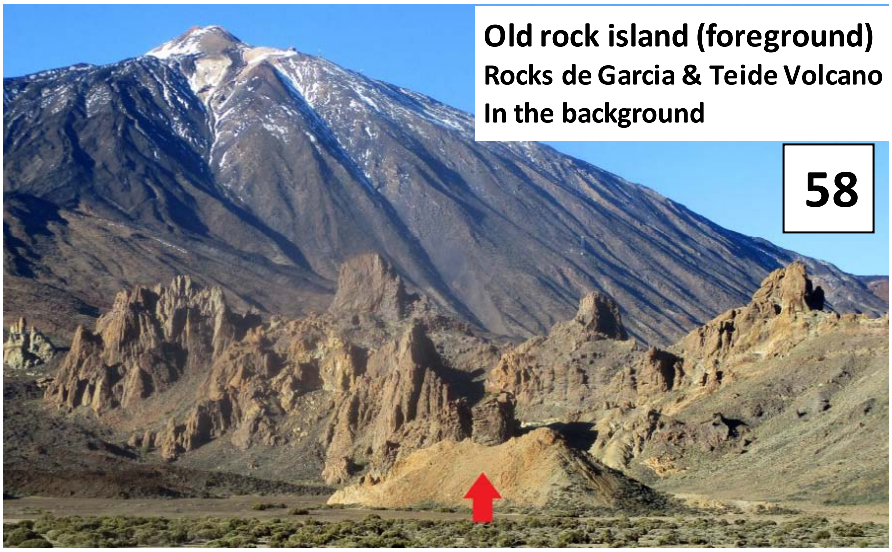
Sample Site 9



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
58 | 28° 13,160 N | 16° 38,083 W | 20m | Spain - Canary Islands


Sample Site 2
Road along the ridge-top of the Anaga Range


2
28° 32,242 N
16° 14,412 W
50 m
Spain - Canary Islands

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

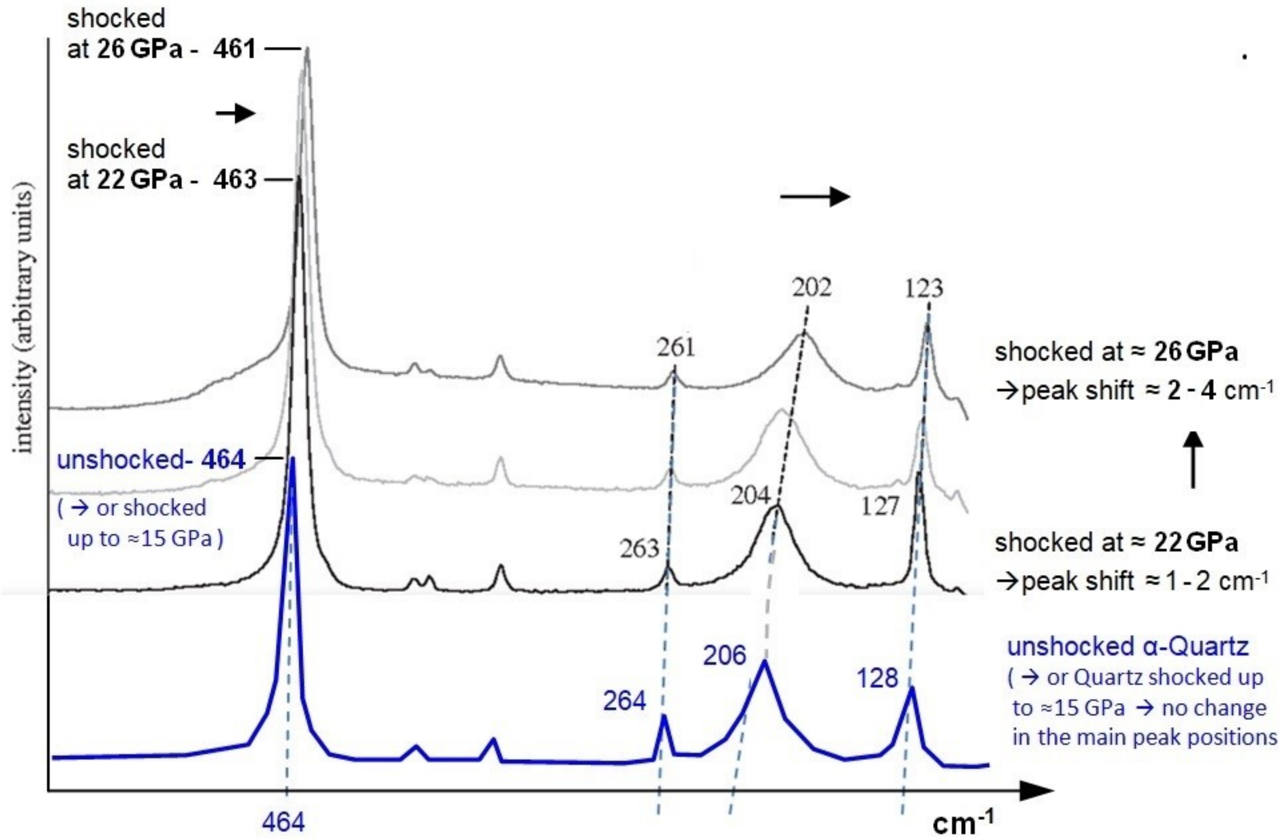
In order to verify a sample site as an impact site or impact structure, shock-metamorphic effects must be discovered in the rocks of the sample site. This can be done by different methods.

For example with the help of PDFs (planar deformation features) which are visible in the quartz with the help of a microscope. However this requires careful preparation of the samples and expertise.

Another, easier method, is the use of a RAMAN microscope. Micro-RAMAN Spectroscopy on quartz grains in the samples can provide the first evidence for a shock event, that was caused by an impact.

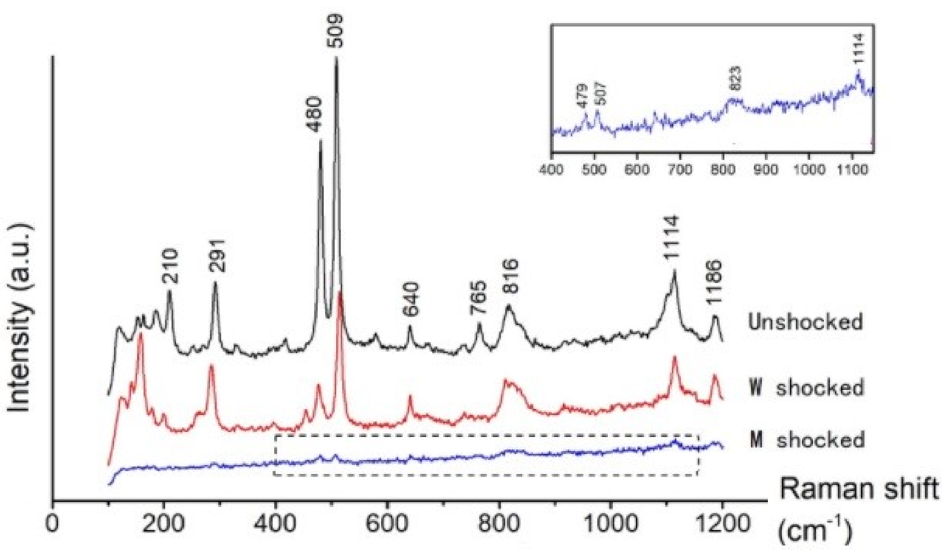
Mc Millan et al. (1992) and others have shown that the main RAMAN-peaks of Quartz shift towards lower frequencies if the Quartz was exposed the a shock-pressure > 15 GPa. → see diagram below

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



Quartz shocked with **22 GPa** and **26 GPA** shows shifts of the main RAMAN-peaks of 1 - 4 cm^{-1} to lower frequencies

Appendix 3 : Raman spectra of (W) weakly-shocked & (M) moderately-shocked Alkali-Feldspar



Weakly shocked alkali feldspar mainly developed irregular fractures and undulatory extinction. Note that the Raman-lines 210 and 765 are missing in the w-shocked feldspar, and an additional line at ≈ 150 appears.

The shock pressure for the w-shocked feldspar was estimated to be between 5 and 14 GPa

References :

Photos of all Sample Sites & Rock Samples are available on : 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.) Scientific Studies to **Tenerife & the Canarian Island's Geology** (→ links on page 2 !) - (→ or here)

2.) Scientific Studies 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**

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, ...
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