

The Ø 12 x 9 km Tinajo Crater on Lanzarote (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 12 x 9 km "Tinajo Impact Crater" on Lanzarote, and on other interesting sites on the Island.

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 Lanzarote, Fuerteventura and Teneriffa, 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. I am sure that these impact sites (hot spots) were produced by the same large-scale secondary impact event (caused by the PTI), that also has 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 have caused the hotspots of the Canarian Islands.

A feldspar-sample collected on the sample site 65, that is close to the center of the hypothetical impact crater, may show a Raman-spectra which indicates (W) weakly-shocked feldspar.

(an explanation to Raman spectra of shocked Alkali-Feldspar : → see at page 17 in the Appendix 3)

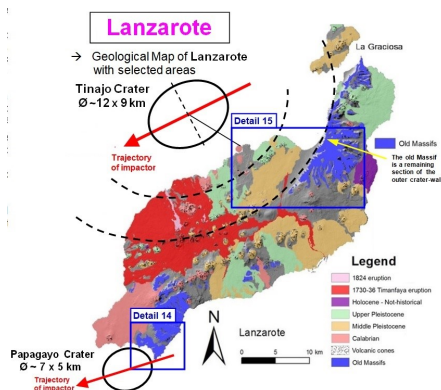
Minerals found in the analyses : Labradorite, Apatite-(Ca-F), Nepheline or Dachiardite-Ca, Forsterite, Reyerite, Dolomite or Rosasite, Kutnohorite or Calcite, Reynersonite (?)

→ Images of the analysed rock samples and photos of the sample sites are in the Appendix at page 12

→ 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 Lanzarote with the possible Tinajo Crater and Papagayo Crater marked on the map



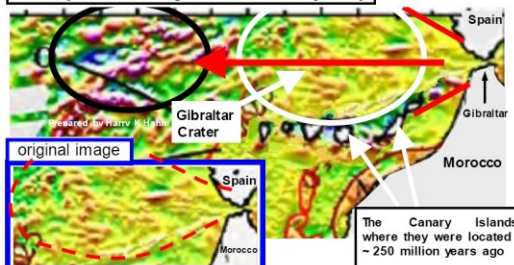
Gravity Anomaly Map of Lanzarote :

with the possible two impact Craters marked on the map. (indicated by blue color)

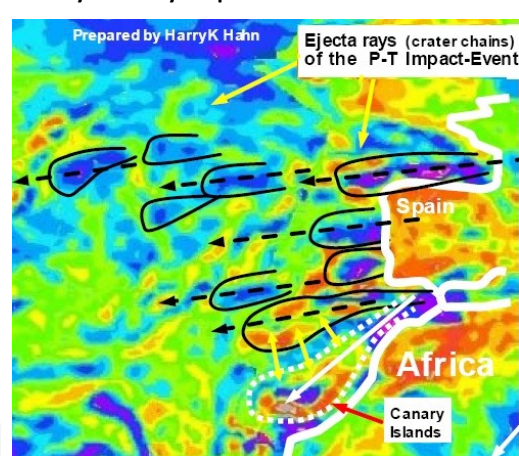
→ negative anomalies



manipulated Magnetic Anomaly Map



Gravity Anomaly Map of the Canarian-Island-area



The Ø 12 x 9 km Tinajo Crater offshore of Lanzarote

The gravity anomaly map of the Island Lanzarote indicates an Impact Event. This is the hypothetical Ø 12 x 9 km Tinajo Crater and the Ø 7 x 5 km Papagayo Crater just north-east and south (offshore) of Lanzarote's coast.

The elliptical "Tinajo Crater" and "Papagayo Crater" in all probability were caused by oblique Impacts (secondary impacts) caused by the Permian-Triassic Impact Event (PTI)

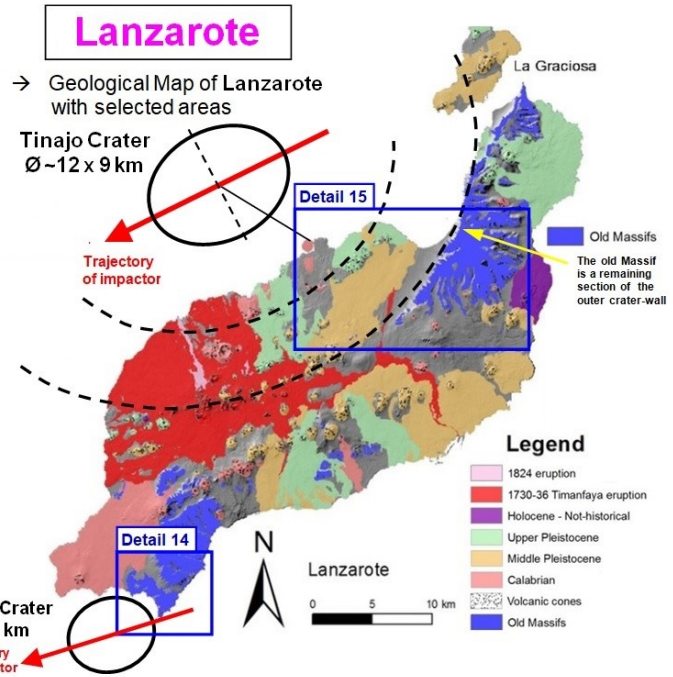
This secondary impact event probably caused hotspots in the area which are responsible for the volcanism on this island.

On **sample site 61** there are pyroclastic basaltic rocks visible with a streamline-shaped (blast-like) structure orientated in a nearly horizontal direction.

This could be an indication for the Ejecta that was ejected by the Ø 7 x 5 km Papagayo Crater

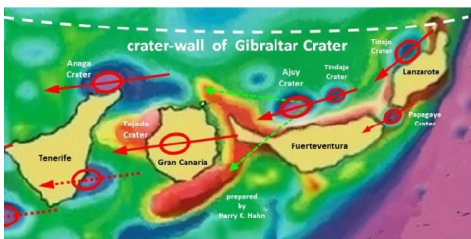
On **sample site 67** there is a massive crater-wall-shaped range which could be either the result of the hypothetical Ø 12 x 9 km Tinajo Crater itself, or it could be the result of a large shield volcano that grew on top of the impact crater after the impact event.

Shock-metamorphosed minerals to confirm the hypothetical impact event may only be accesible with the help of drill-core sample staken from the center-areas of the negative gravity anomalies.

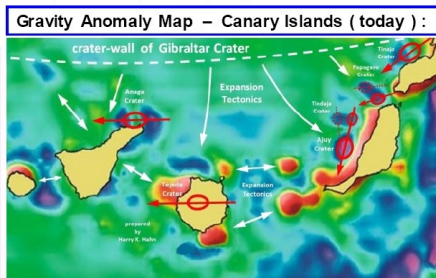


The old Massif on the **site 65** :

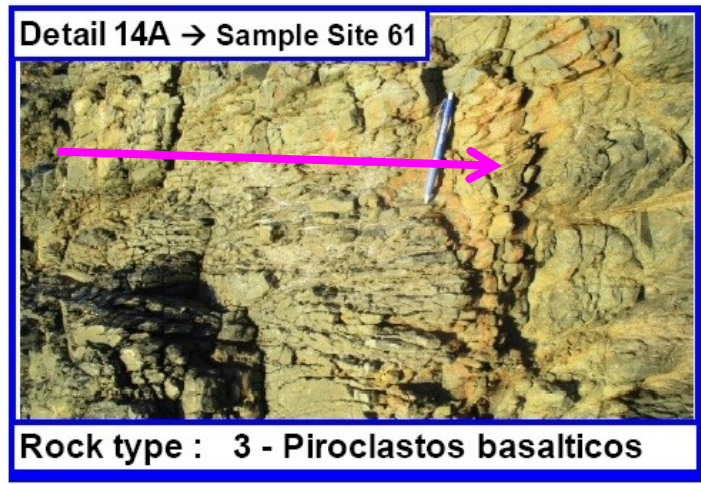
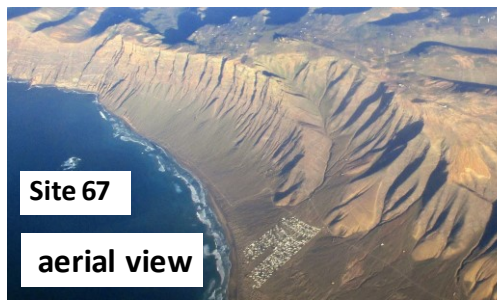
→ Islands locations shortly after the PTI - impact event : **manipulated Gravity Anomaly Map :**



→ original Gravity Anomaly Map :



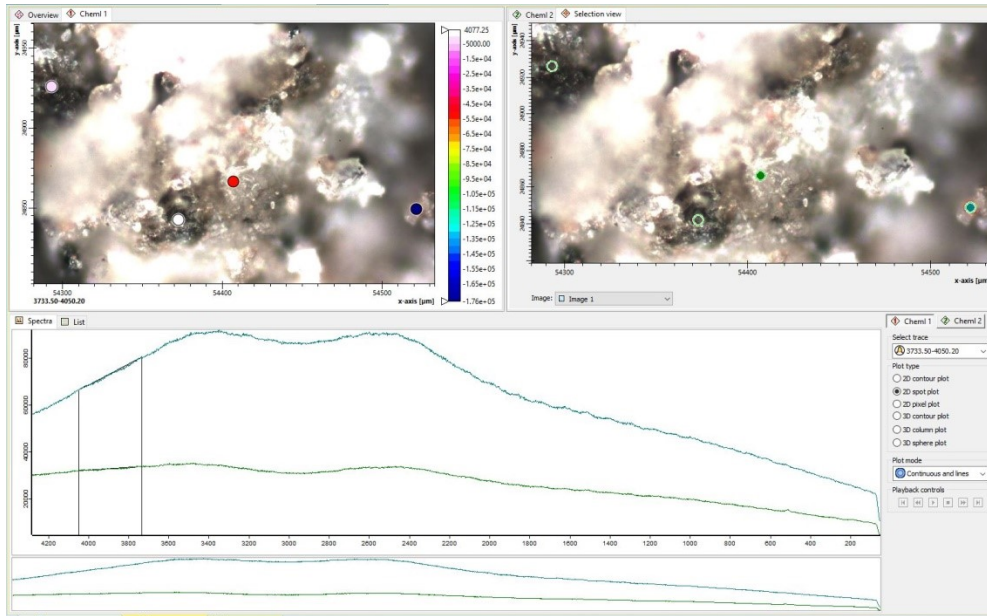
Note the structure of this range on **site 67** : (craterwall-like structure)



Pyroclastic basaltic rocks on **site 61**
Note the nearly horizontal orientated structure of these pyroclastic basaltic rocks



Sample Site 68: Stone 2_spectra 1 indicates: **Labradorite** (→ see RRUFF_CS results)

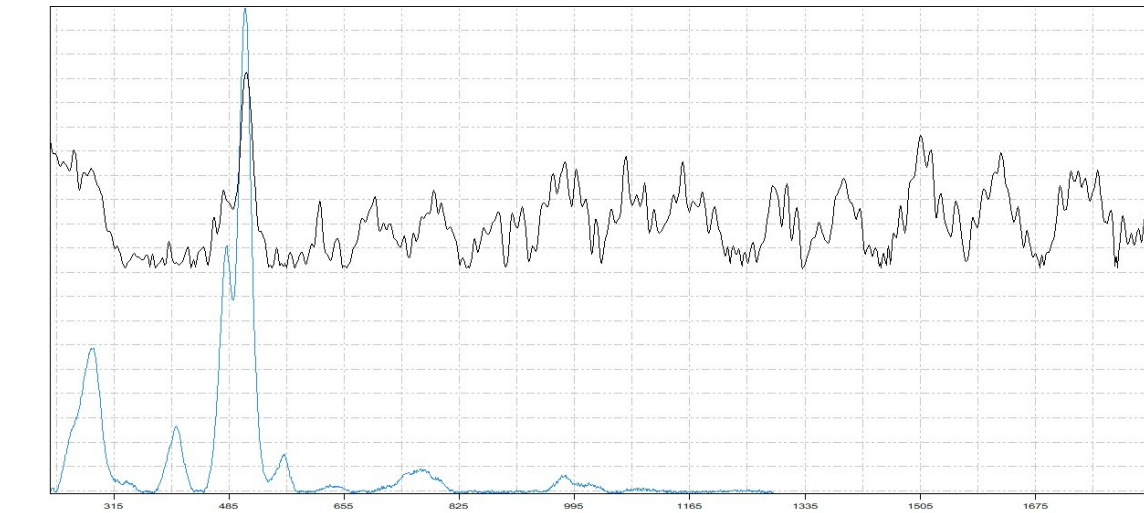


Sample :



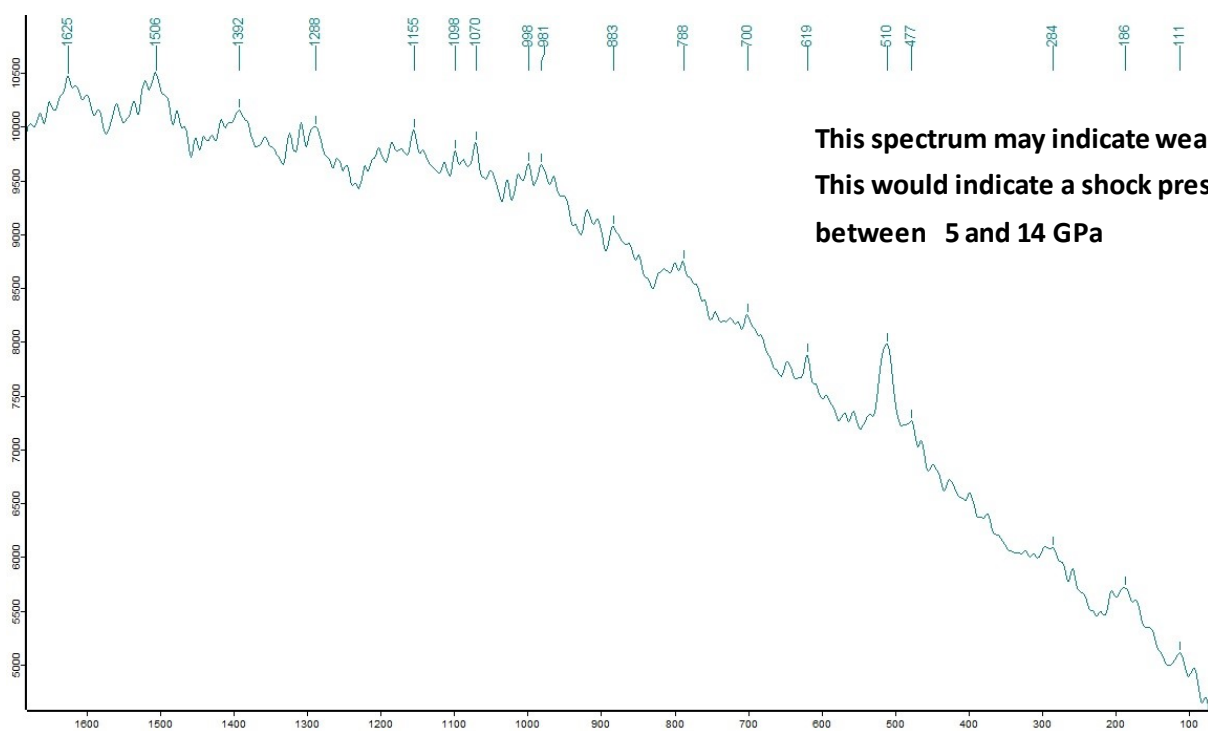
CrystalSleuth: EXTRACT_68-LANZ (Sp)_Z3_stein 2.0_000000.0_NK_Y_G2

File Edit Mode Help



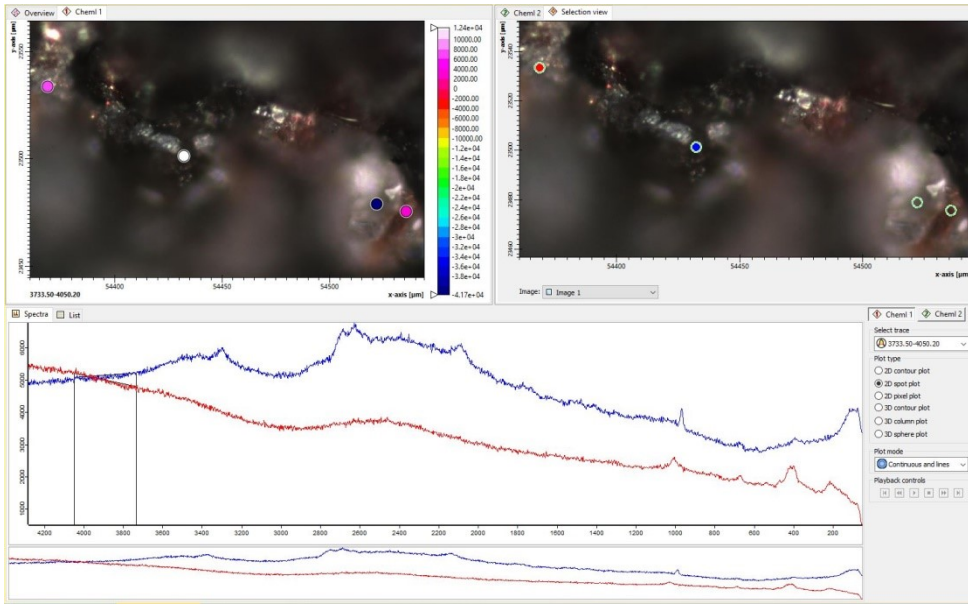
% Match	Spectrum Name	RRUFF ID
95	Mushstonite (532nm)	R060153
95	Anorthoclase (532nm)	R060054
95	Massicot (532nm)	R060454
94	-) Labradorite (532nm)	R050104
93	Langbanite (532nm)	R050664
93	Bindheimite (532nm)	R050546
93	Orthoclase (532nm)	R050367
93	Walpurgite (532nm)	R050573
93	Orthoclase (532nm)	R040055
93	Bytownite (532nm)	R070598
92	Labradorite (532nm)	R060082
92	Wheewellite (532nm)	R050240
92	Wheewellite (532nm)	R070655

R050104
Labradorite
Na_{0.5}-0.3Ca_{0.5}-0.7Al_{1.5}-1.7Si_{2.5}-2.3O₈
unknown



**This spectrum may indicate weakly shocked feldspar
This would indicate a shock pressure
between 5 and 14 GPa**

Sample Site **65**: Stone 1_spectra 1 indicates: **Apatite-(CaF)** (→ see RRUFF_CS results)

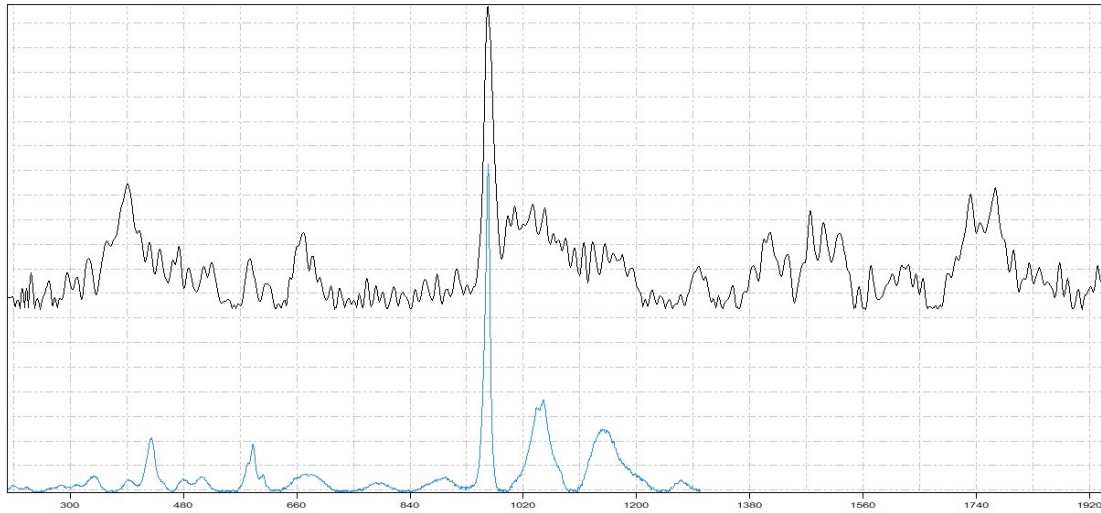


Sample :



CrystalSleuth: EXTRACT_65-LANZ (Sp)_Z3_stein 1.0_000000.0_NK_G2

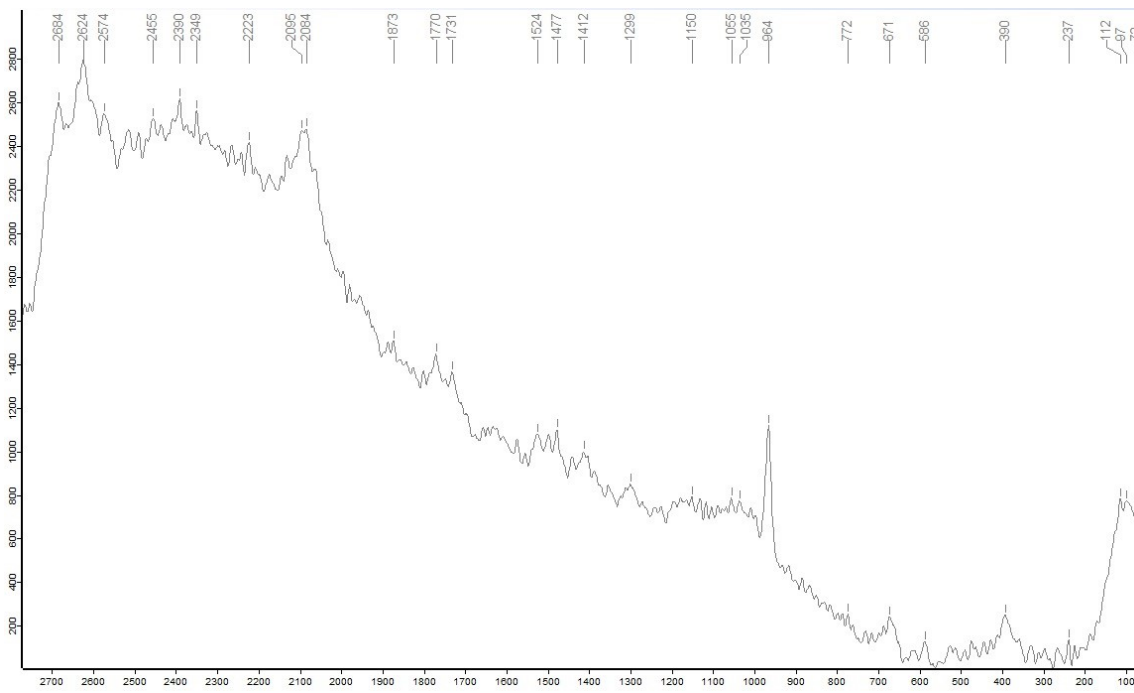
File Edit Mode Help



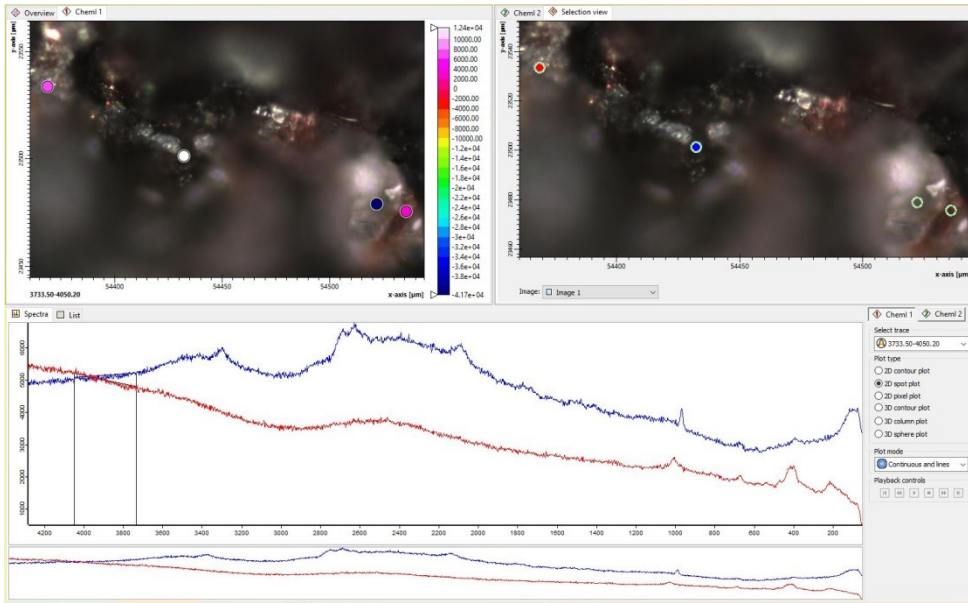
File Manager SpecEdit Raman Library X-Ray

% Match	Spectrum Name	RRUFF ID
72	< Apatite-(CaF) (532nm)	R060184
72	< Monelite (532nm)	R070259
70	< Varulite (532nm)	R060740
70	< Graftonite (532nm)	R070153
69	Owyheeite (532nm)	R070543
69	Cosalite (532nm)	R060625
69	Riomarinite (532nm)	R070112
69	Apatite-(CaF) (532nm)	R060070
68	Eosphorite (532nm)	R061055
67	Monazite-(Ce) (532nm)	R040106
67	Zincolibethenite (532nm)	R060763
67	Eosphorite (532nm)	R050557
67	Arsenite-(CaF) (532nm)	R050104

R060184
Apatite-(CaF)
Ca₅(PO₄)₃F
Yates mine, Otter Lake, Quebec, Canada



Sample Site 65 : Stone 1_spectra 2 indicates: **Nepheline, Dachardite-Ca** (→ see RRUFF_CS results)

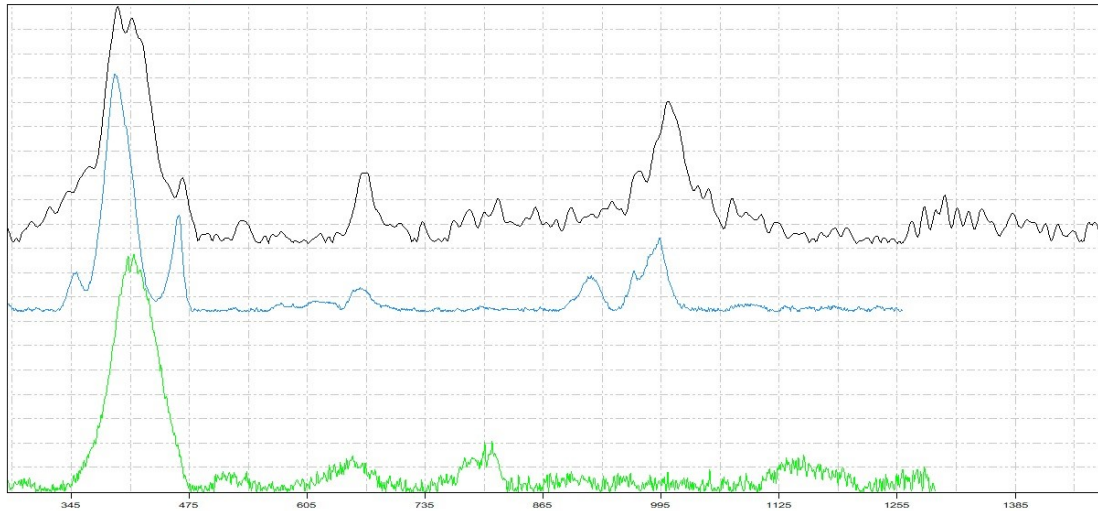


Sample :



CrystalSleuth: EXTRACT_65-LANZ (Sp)_Z3_stein 1.0_000003.0_NK_Y_G2

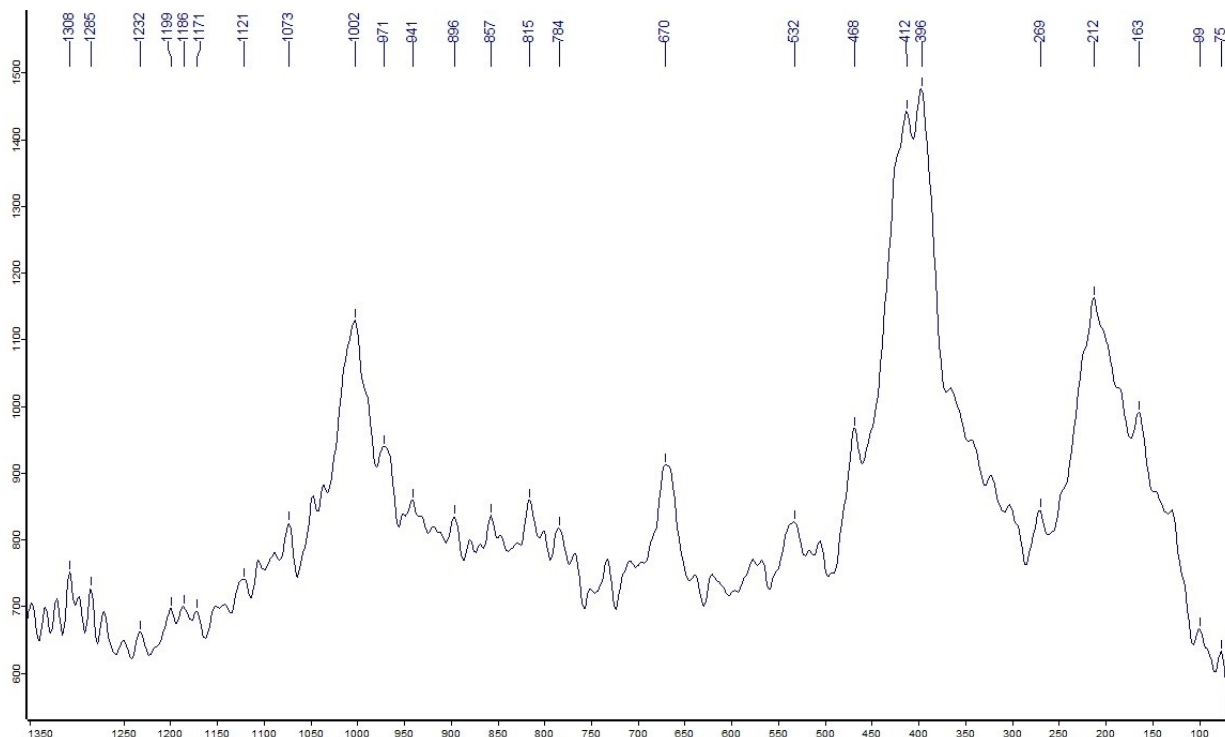
File Edit Mode Help



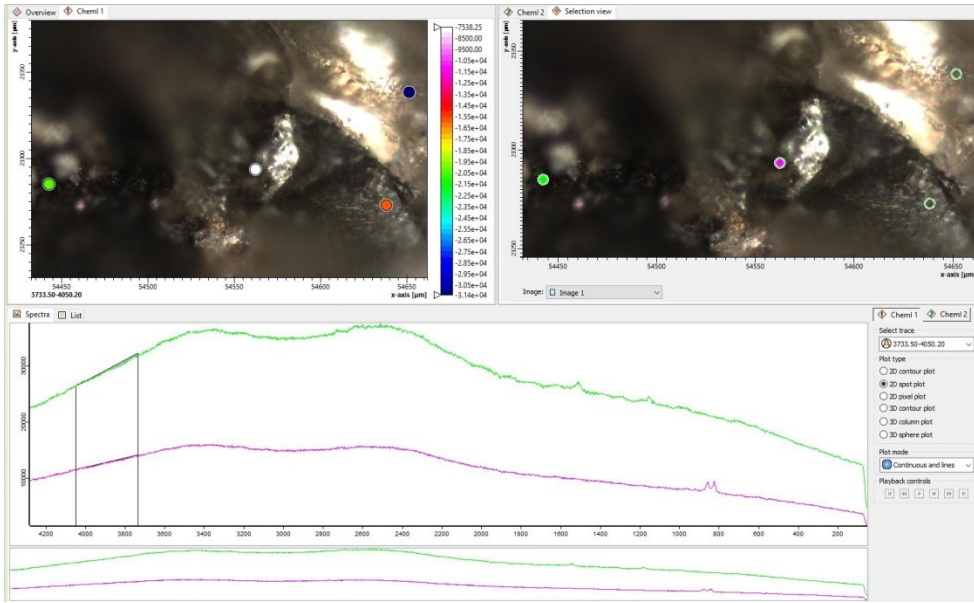
% Match	Spectrum Name	RRUFF ID
84	< > Dachardite-Ca (532nm)	R061125
83	< > Nepheline (532nm)	R060581
81	Nepheline (532nm)	R040025
81	Tridymite (532nm)	R040143
79	Kamphaugite-(Y) (532nm)	R080095
78	Sphalerite (532nm)	R060636
78	Epistilbite (532nm)	R061105
78	Erdite (532nm)	R070139
77	Opal (532nm)	R070627
76	Wavellite (532nm)	R050219
76	Jamesonite (532nm)	R050432
75	Sphalerite (532nm)	R050140
75	Chromite (532nm)	R050410

R060581
 Nepheline
 NaAlSi₃O₈
 Capo di Bova, Via Appia Antica, Rome, Italy

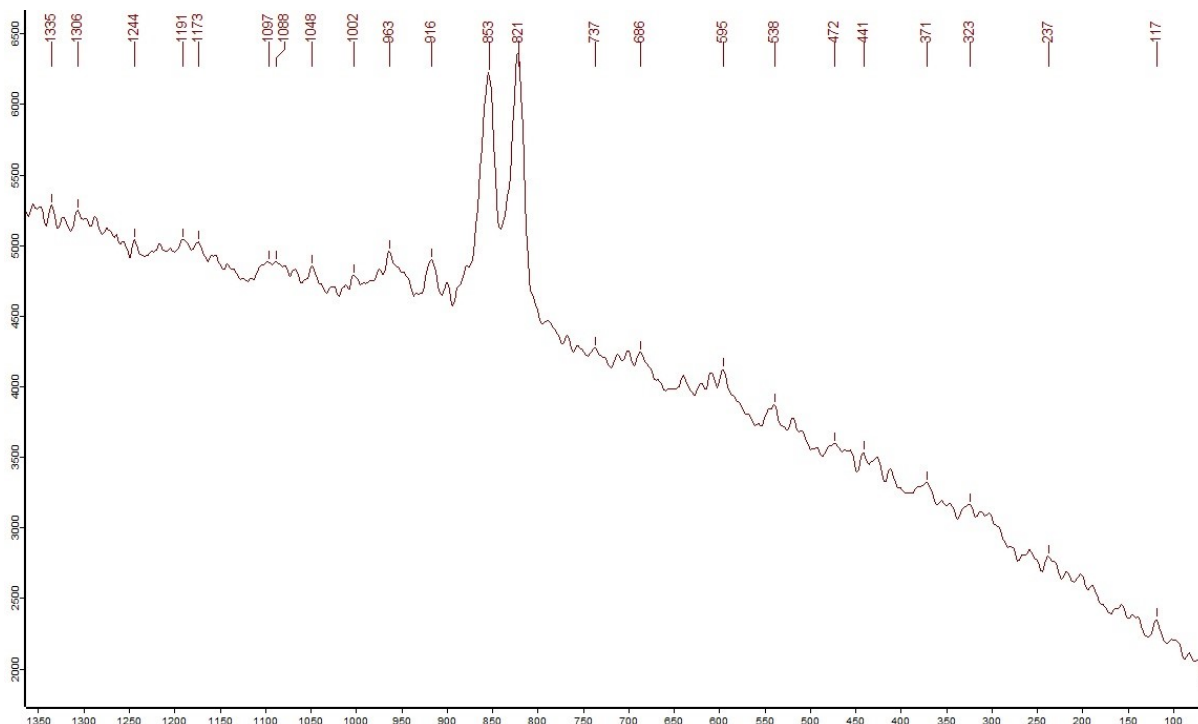
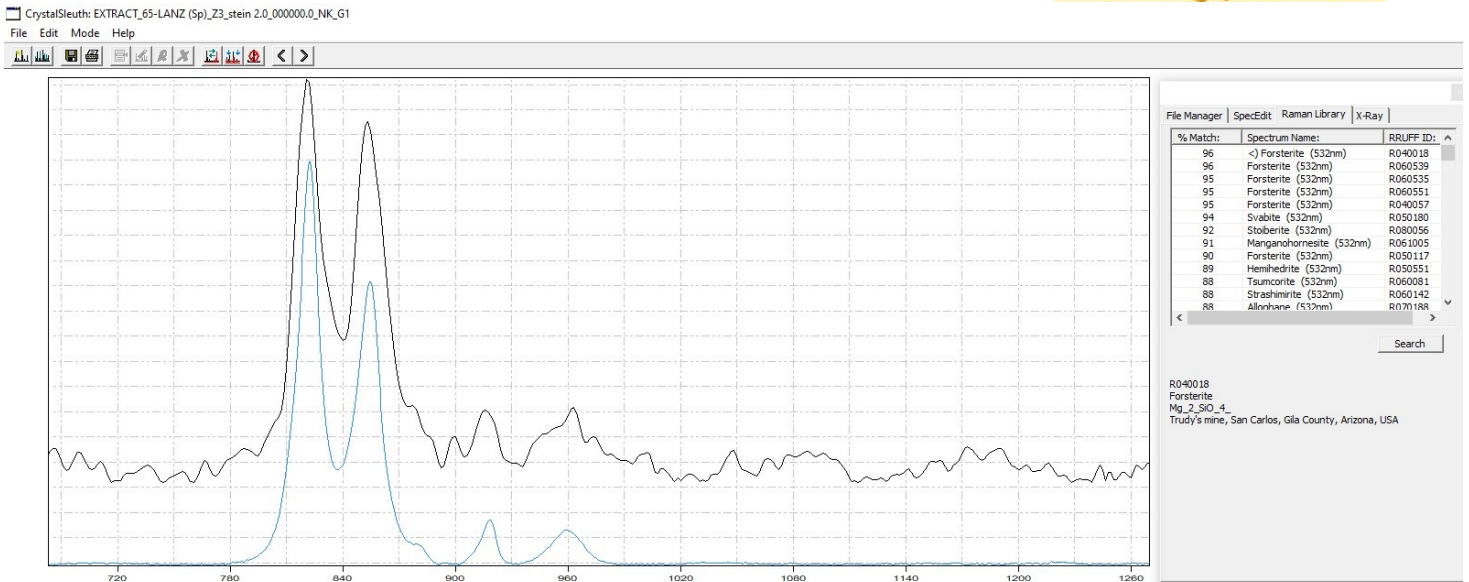
R061125
 Dachardite-Ca
 Ca₂(Si₂₀Al₄O₄₈)#183;13H₂O
 San Piero in Campo, Isle of Elba, Livorno, Toscana, Italy



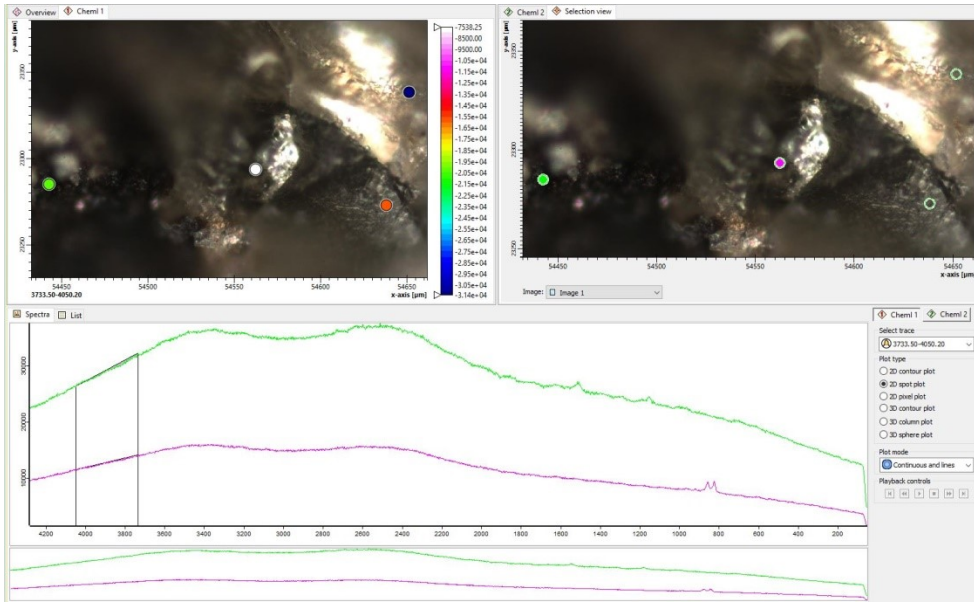
Sample Site 65 : Stone 2_spectra 1 indicates: **Forsterite** (→ see RRUFF_CS results)



Sample :



Sample Site 65 : Stone 2_spectra 2 indicates: **Reyerite** (→ see RRUFF_CS results)



Sample :



CrystalSleuth: EXTRACT_65-LANZ (Sp)_Z3_stein 2.0_000003_0_NK_Y_G1

File Edit Mode Help



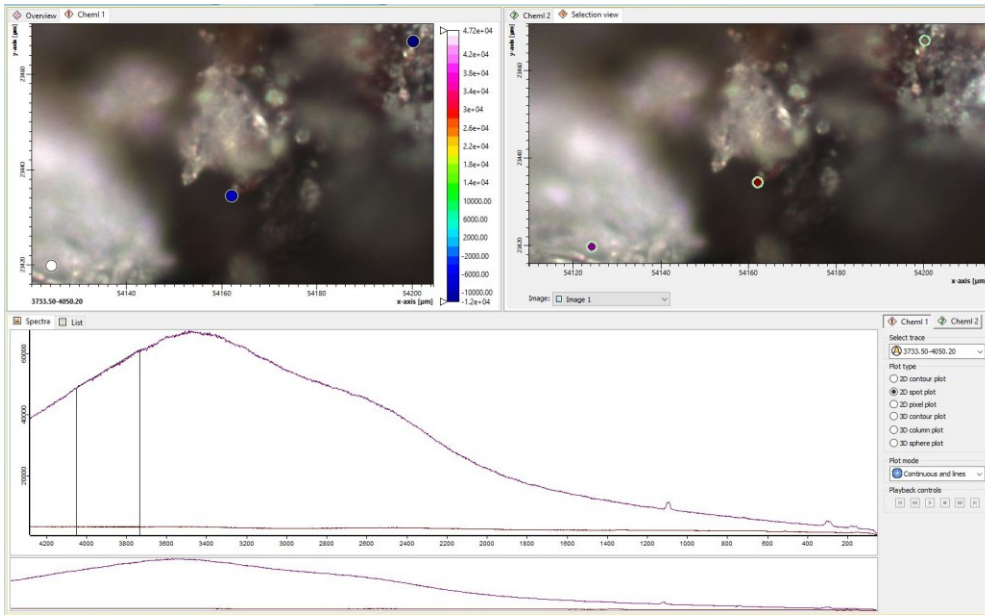
File Manager | SpecEdit | Raman Library | X-Ray

% Match	Spectrum Name	RRUFF ID
49	<-> Reyerite (532nm)	R060749
49	<-> Magnesiochlorite (532nm)	R070218
48	<-> Faizievite (532nm)	R070221
47	<-> Troilite (532nm)	R070242
47	<-> Stromeyerite (532nm)	R060908
46	Monette (532nm)	R070259
46	Lirangophane (532nm)	R070038
46	Antimony (532nm)	R070318
46	Digenite (532nm)	R060840
45	Abelsonite (532nm)	R070007
45	Breithauptite (532nm)	R060928
45	Khadamirite (532nm)	R070658
45	Ferroselite (532nm)	R071461

R060749
Reyerite
Na₂Ca₁₄Al₂Si₂₂O₃₈(OH)₈·#183;6H₂O
Drynoch, Island of Skye, Scotland



Sample Site 61 : Stone 1_spectra 1 indicates : **Dolomite, Rosasite** (→ see RRUFF_CS results)

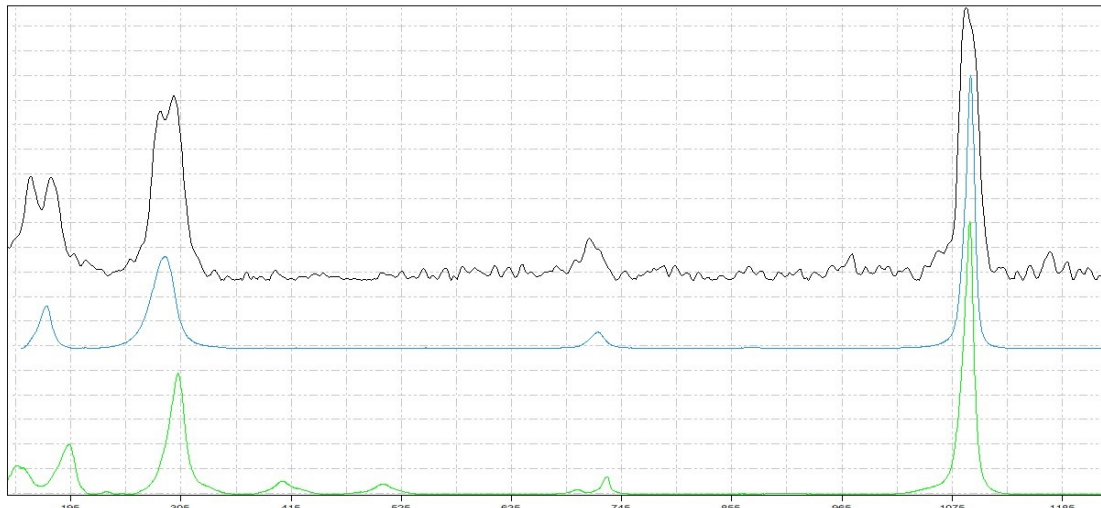


Sample :



CrystalSeuth: EXTRACT_61-LANZ (Sp)_Z3_stein 1.0_000002.0_NK_G1

File Edit Mode Help

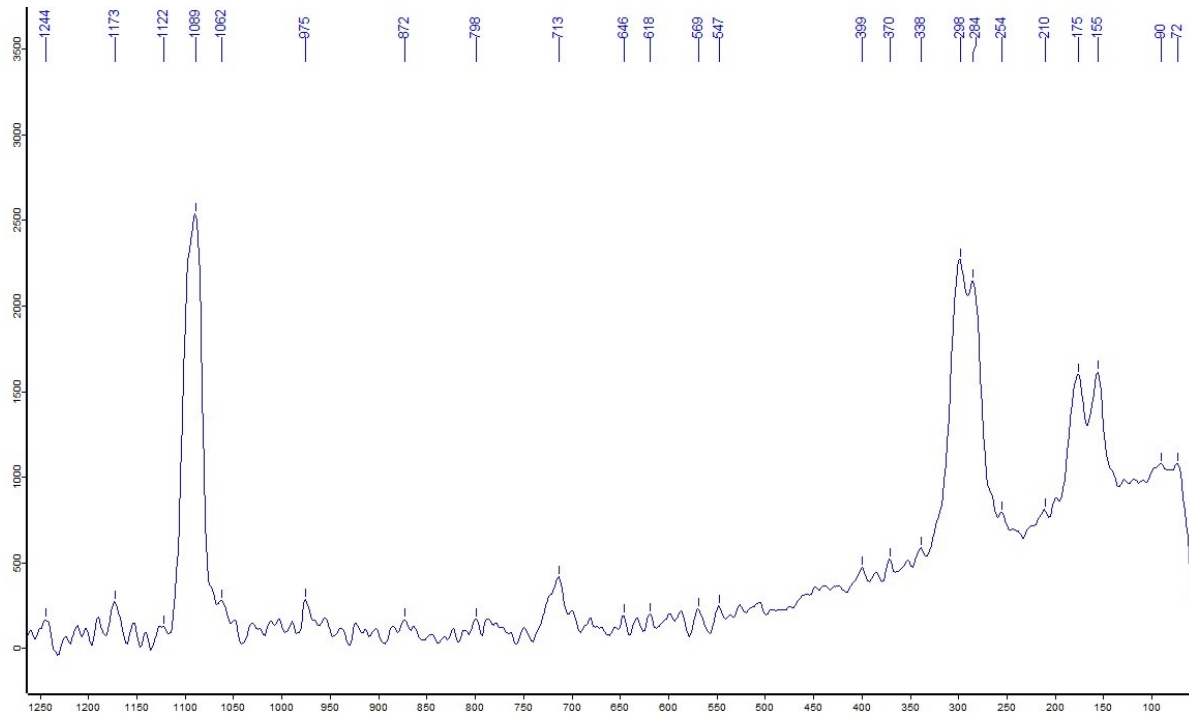


File Manager | SpecEdit | Raman Library | X-Ray

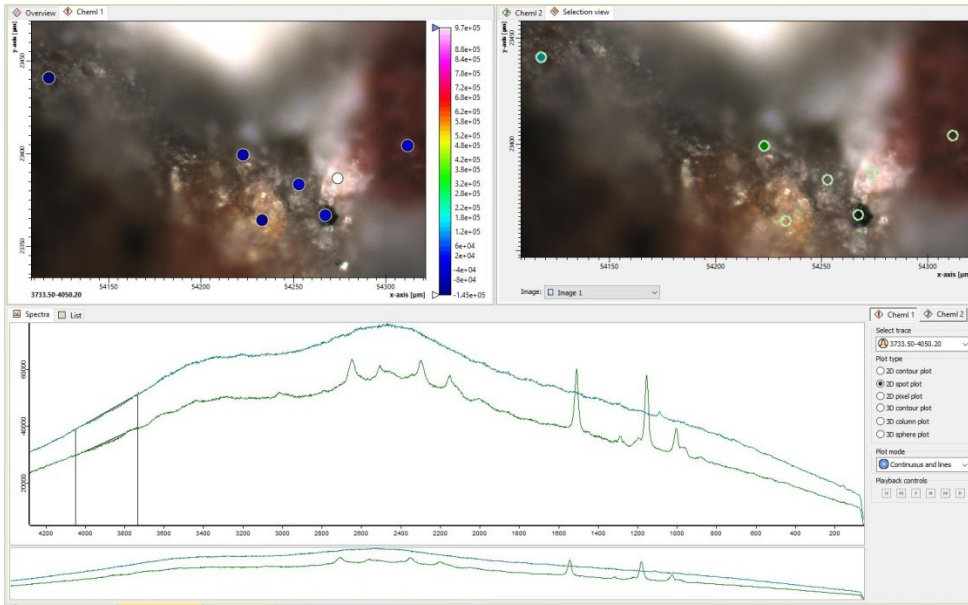
% Match	Spectrum Name	RRUFF ID
87	<-> Dolomite (532nm)	R050129
87	<-> Rosasite (532nm)	R050294
84	<-> Smithsonite (532nm)	R040035
83	Dolomite (532nm)	R050272
82	Siderite (532nm)	R050262
82	Dolomite (532nm)	R040030
81	Dolomite (532nm)	R050370
81	Siderite (532nm)	R040034
80	Dundasite (532nm)	R090038
80	Sphaerocobaltite (532nm)	R060497
80	Salmalite-(Ca) (532nm)	R080043
80	Kutnohorite (532nm)	R060473
79	Smithsonite (532nm)	R040051

R050129
Dolomite
CaMg(CO₃)₂
Black Cloud mine, Leadville, Lake County, Colorado, USA

R050294
Rosasite
(Cu,Zn)₂CO₃(OH)₂
79 mine, 4th level, Hayden, Gila County, Arizona, USA



Sample Site **61**: Stone 2_spectra 1 indicates: **Reyerite** (→ see RRUFF_CS results)

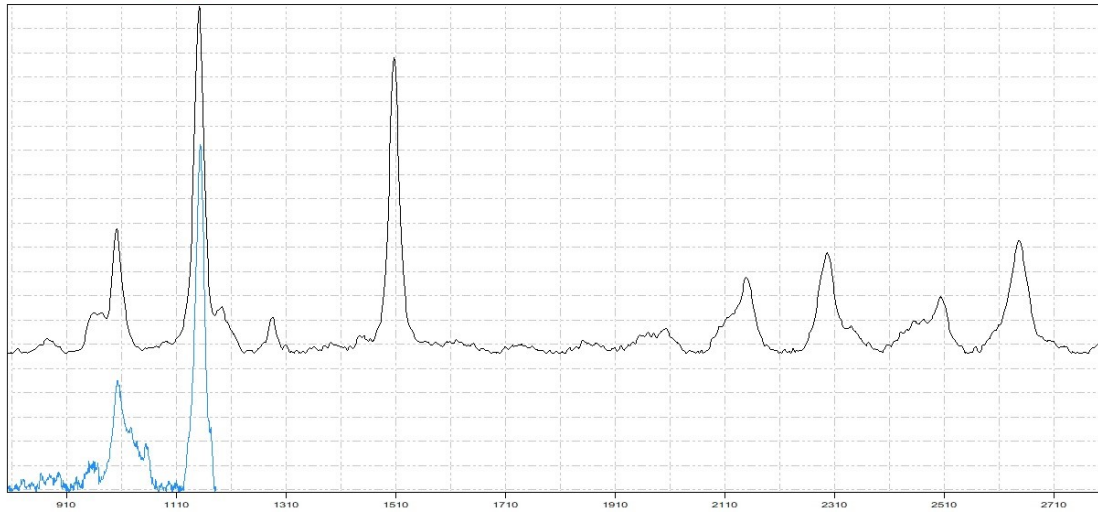


Sample:



CrystalSleuth: EXTRACT_61-LANZ (Sp)_Z3_stein 2.0_000000.0_NK_G1

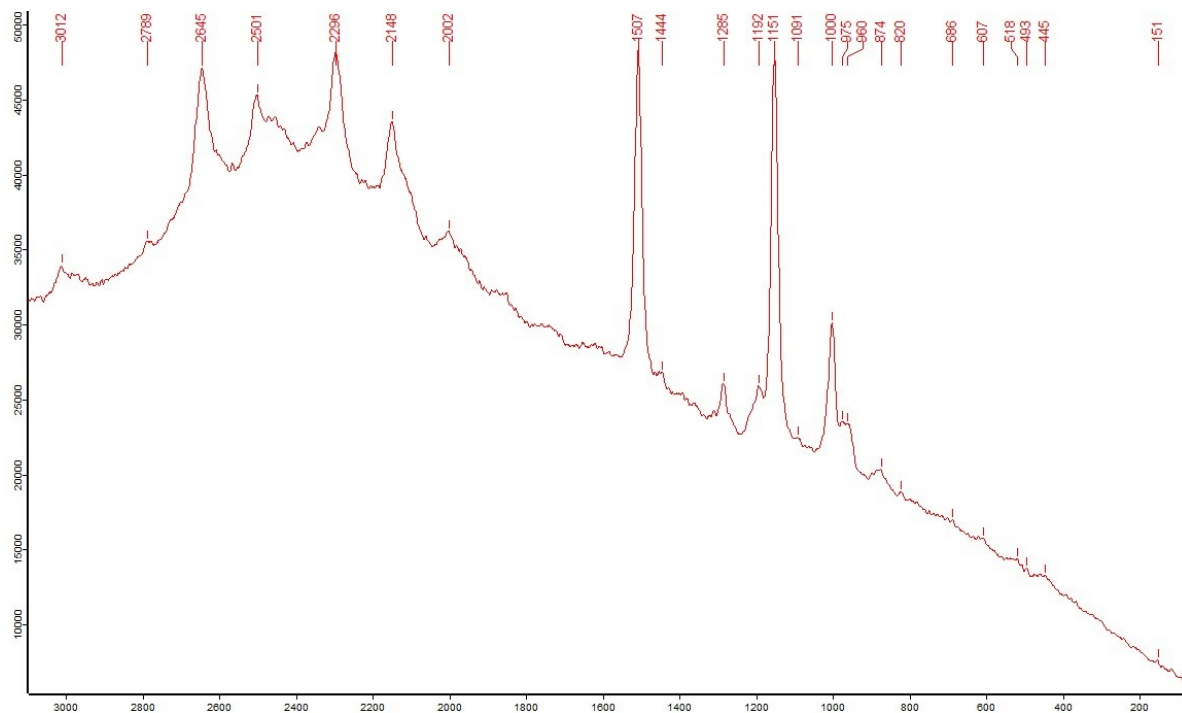
File Edit Mode Help



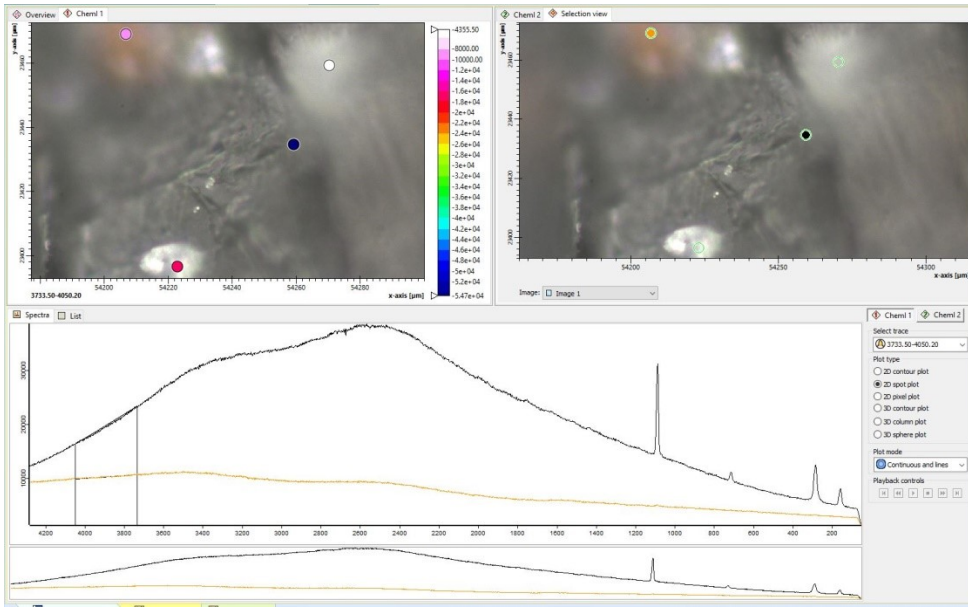
File Manager SpecEdit Raman Library X-Ray

% Match	Spectrum Name	RRUFF ID
67	<-> Reyerte (532nm)	R060749
54	<-> Abelsonite (532nm)	R070007
54	<-> Thonantite (532nm)	R060849
53	<-> Zincite (532nm)	R060027
52	<-> Reedmergnerite (532nm)	R060096
50	<-> Clinoptilolite-Ca (532nm)	R061098
50	<-> Dachardite-Ca (532nm)	R061097
50	Heulandite-Sr (532nm)	R070372
49	Stellerite (532nm)	R060483
48	Stellerite (532nm)	R070535
48	Heulandite-Ca (532nm)	R050017
48	Hausmannite (532nm)	R040090
47	Forsterite (532nm)	R050116

R060749
Reyerite
Na_2_Ca_14_Al_2_Si_22_O_58_(OH)_8_#183;6H_2_O
Drynoch, Island of Skye, Scotland



Sample Site 61 : Stone 3_spectra 1 indicates: **Kutnohorite, Calcite** (→ see RRUFF_CS results)

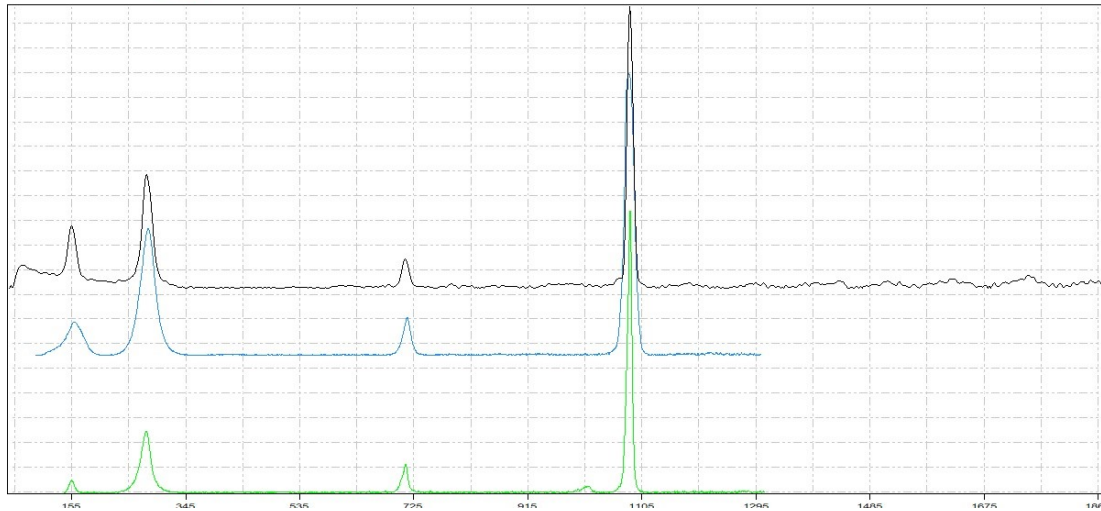


Sample :



CrystalSleuth: EXTRACT_61-LANZ (Sp)_Z3_stein 3.0_000000.0_NK_G1

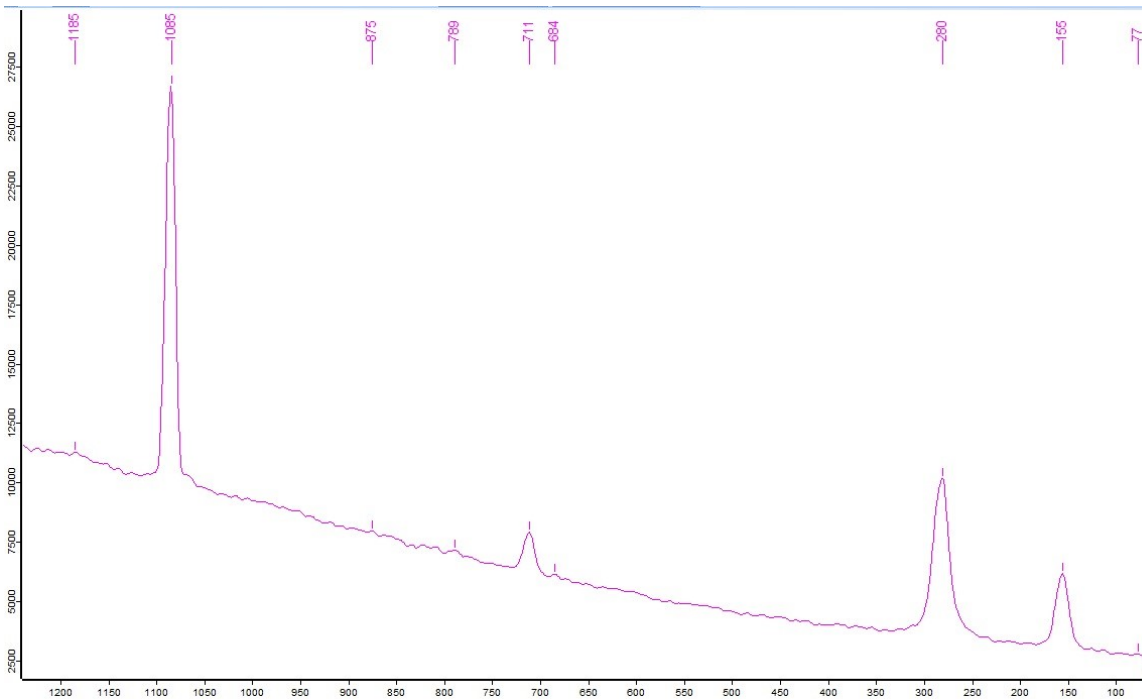
File Edit Mode Help



% Match	Spectrum Name	RRUFF ID
93	<-> Kutnohorite (532nm)	R060473
93	<-> Calcite (532nm)	R040170
92	Paraspurrite (532nm)	R060707
90	Siderite (532nm)	R050349
89	Rhodochrosite (532nm)	R050116
89	Calcite (532nm)	R050048
87	Calcite (532nm)	R050307
87	Rhodochrosite (532nm)	R040133
87	Siderite (532nm)	R040034
86	Calcite (532nm)	R050009
86	Ottavite (787nm)	R050677
86	Calcite (532nm)	R040070
85	Calcite (787nm)	R060748

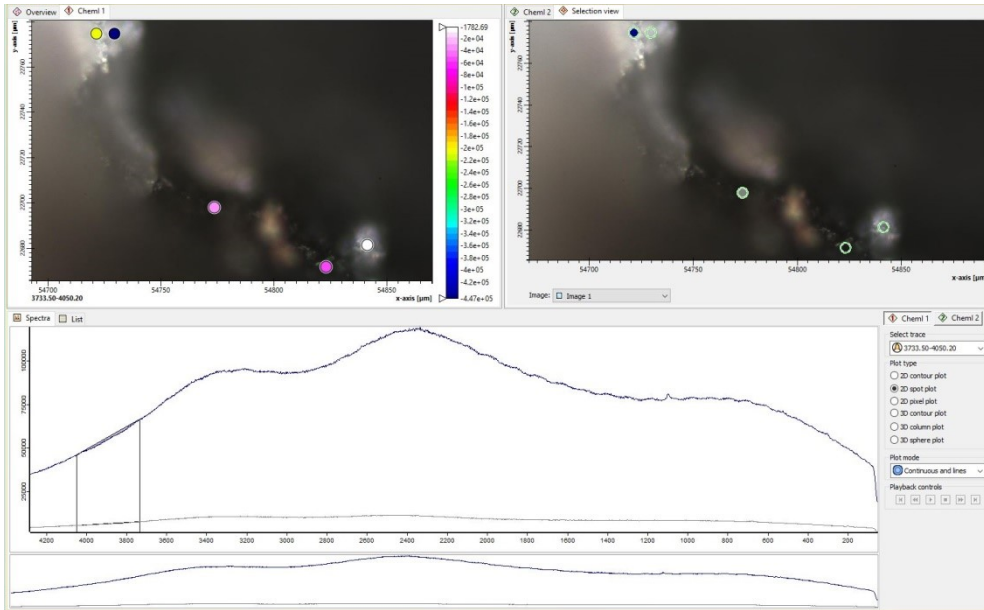
R060473
Kutnohorite
CaMn(CO₃)₂
N'Chwaning II mine, Kalahari Manganese Field, northern Cape Proc

R040170
Calcite
CaCO₃
Peramea, Lerida Province, Catalonia, Spain

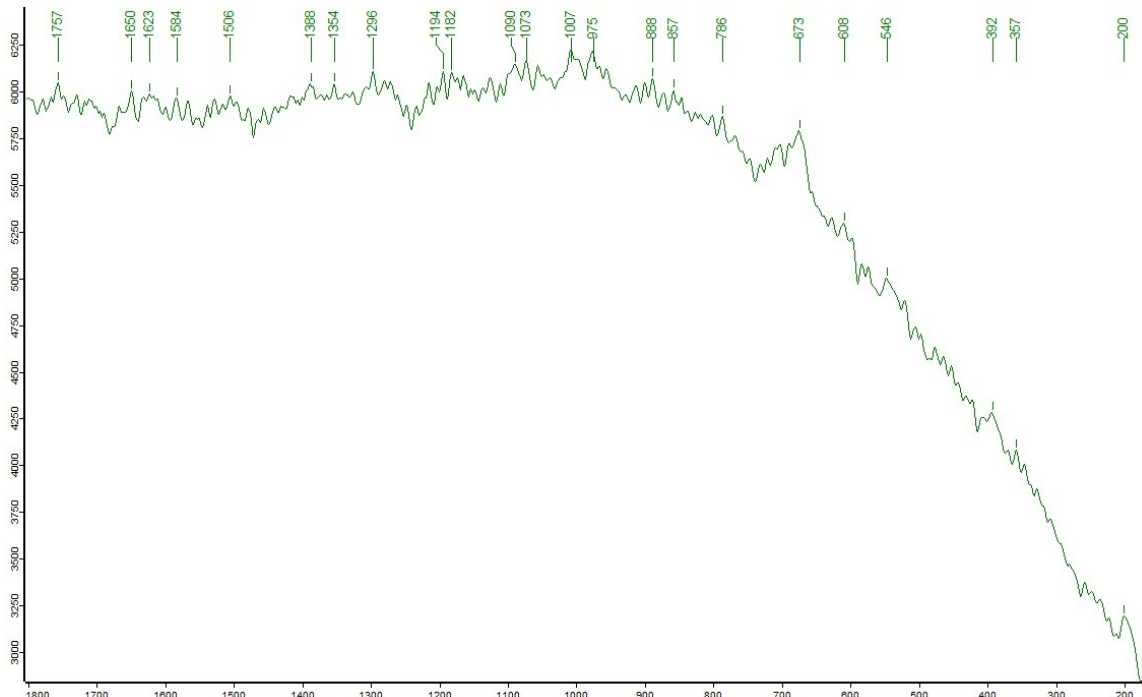
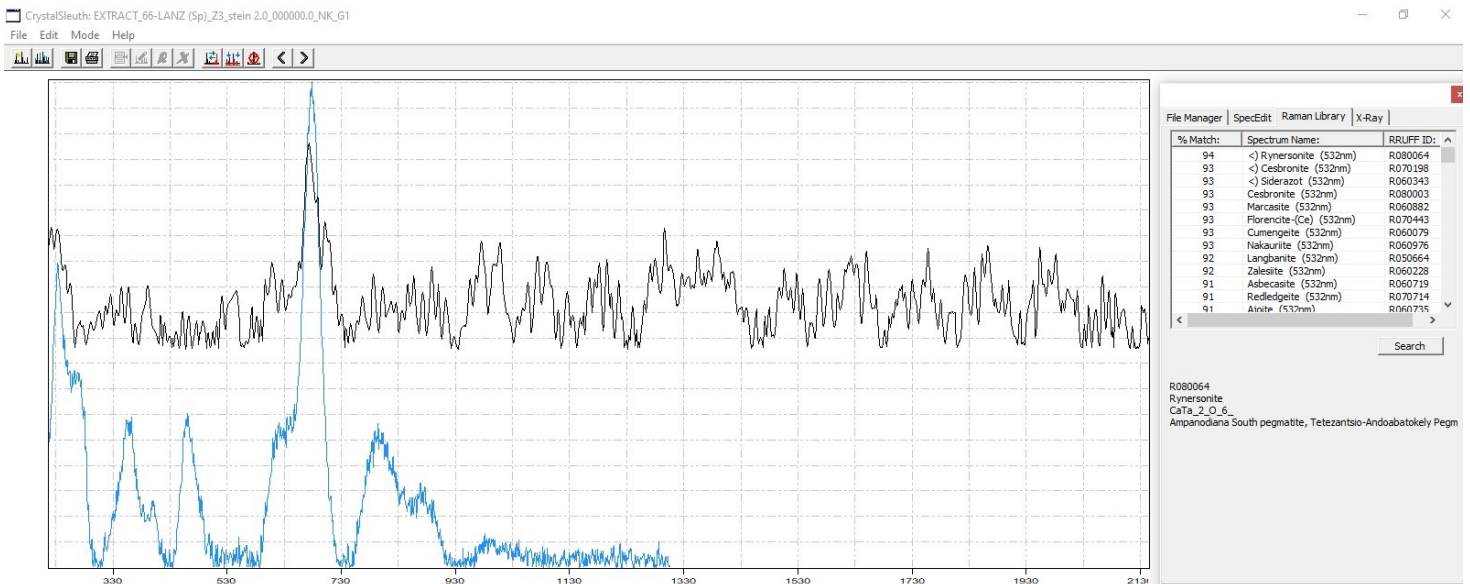


Sample Site **66**: Stone 2_spectra 1 indicates: (**Rynersonite**) (→ see RRUFF_CS results)

This result is guesswork because the spectra contains less information !



Sample :



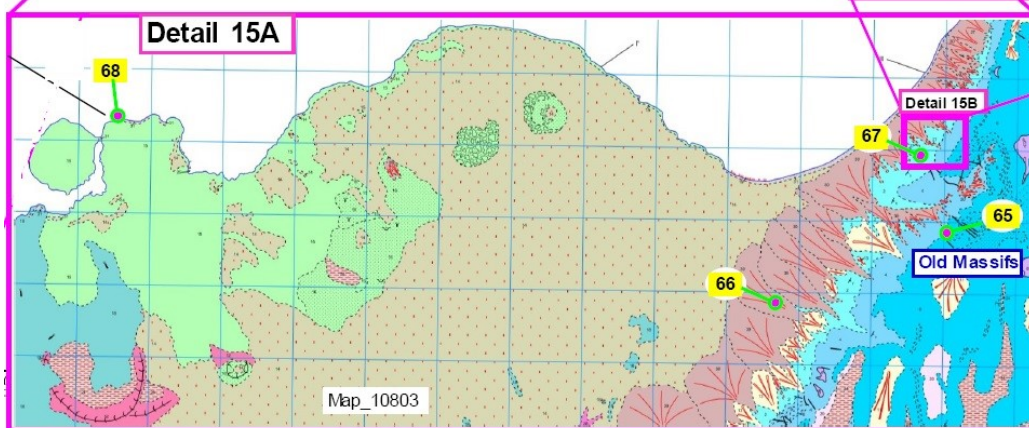
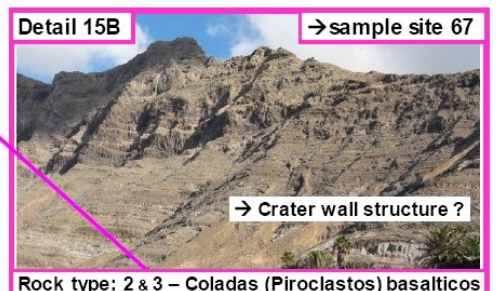
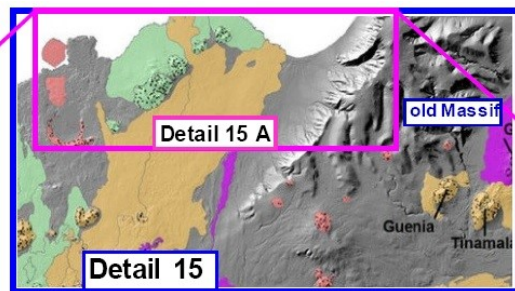
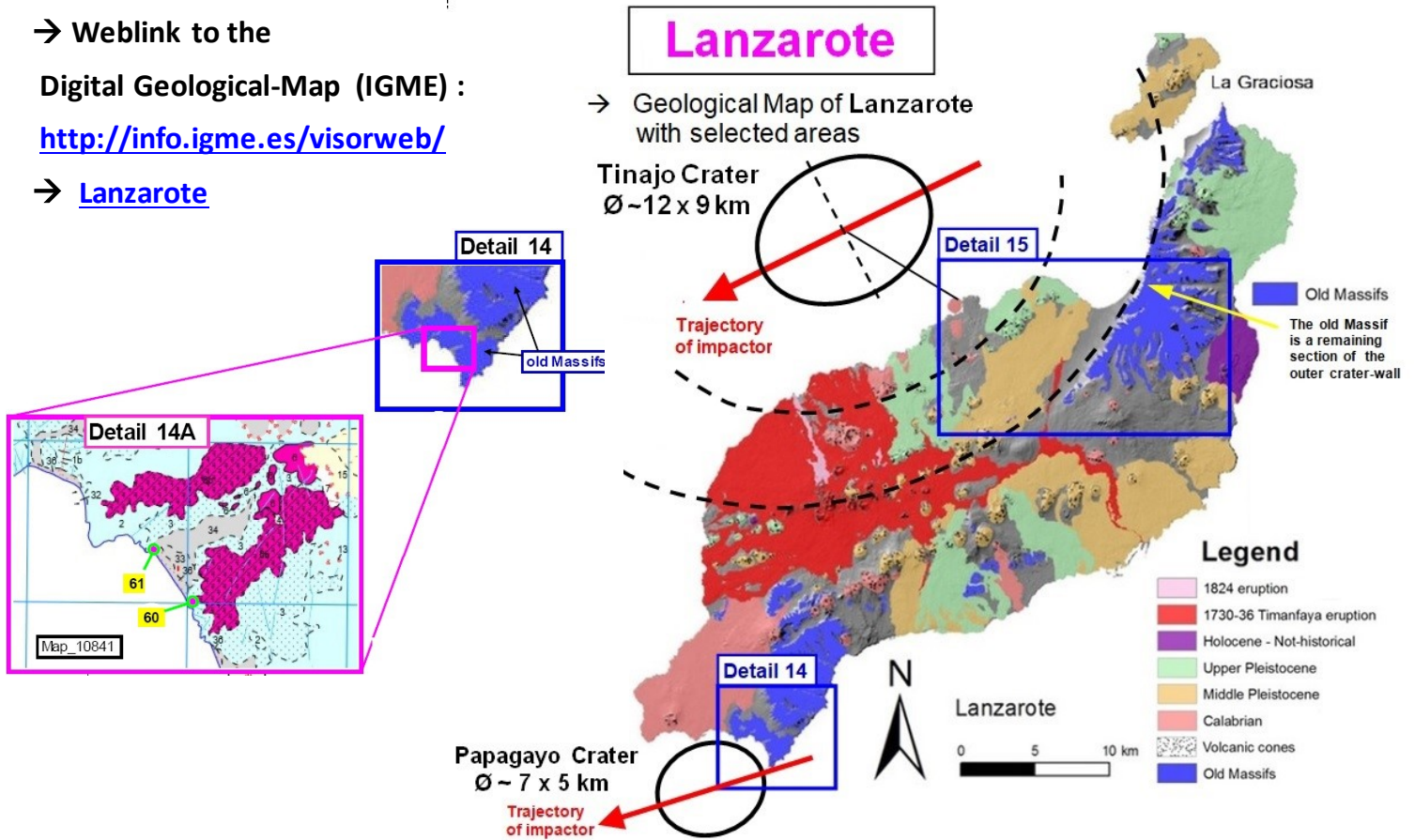
Appendix 1 : Photos of the rock samples from the sites : 61, 65, 67 and 68

→ See next page

Note : Photos of the Sites 61, 65, 67 and 68 and other sample sites are available on my website. → : **Sample Sites "Tinajo Crater"** (or here) together with geological maps and a GPS-Data List of the sample sites.

Geological maps of selected sample areas :

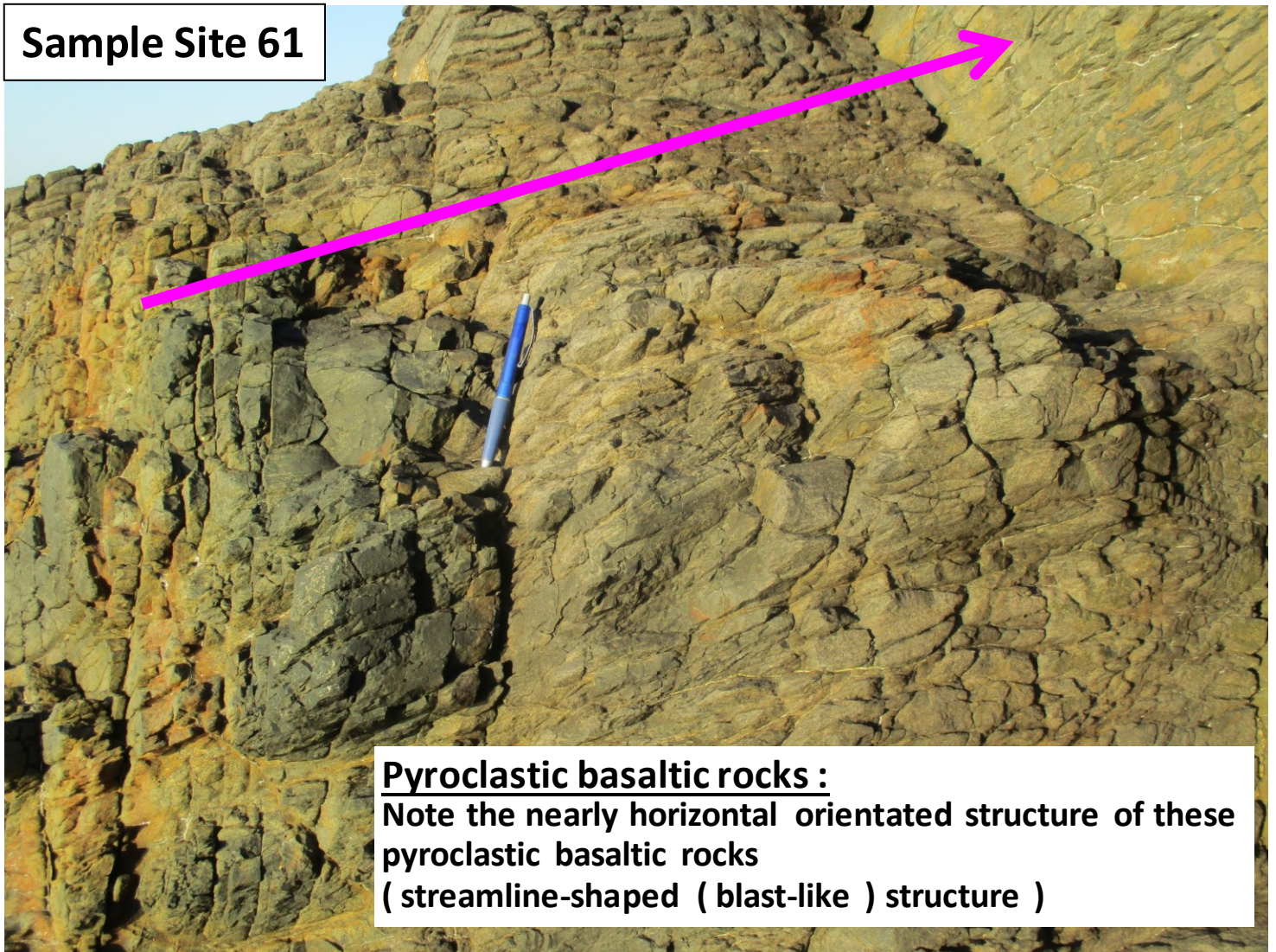
→ Weblink to the Digital Geological-Map (IGME) : <http://info.igme.es/visorweb/>
→ [Lanzarote](#)



Weblink Digital Geology-Map :

- 15 Coladas basálticas. Alineación volcánica de Soo
- 10 Piroclastos basálticos (lapillis, escorias y bombas)
- 9 Coladas basálticas
- 8 Intrusivos básicos (Tramo Superior)
- 7 Piroclastos basálticos (lapillis, escorias, bombas y proclastos de dispersión (Tramo Superior)
- 6a Delgados recubrimientos de lapillis sobre coladas basálticas en el Edificio Famara
- 6 Coladas basálticas (Tramo Superior)
- 5 Piroclastos basálticos (lapillis, escorias y bombas) (Tramo Medio)
- 4 Coladas basálticas (Tramo Medio)
- 3 Piroclastos basálticos (lapillis, escorias y bombas) (Tramo Inferior)
- 2 Coladas basálticas (Tramo Inferior)

Sample Site 61

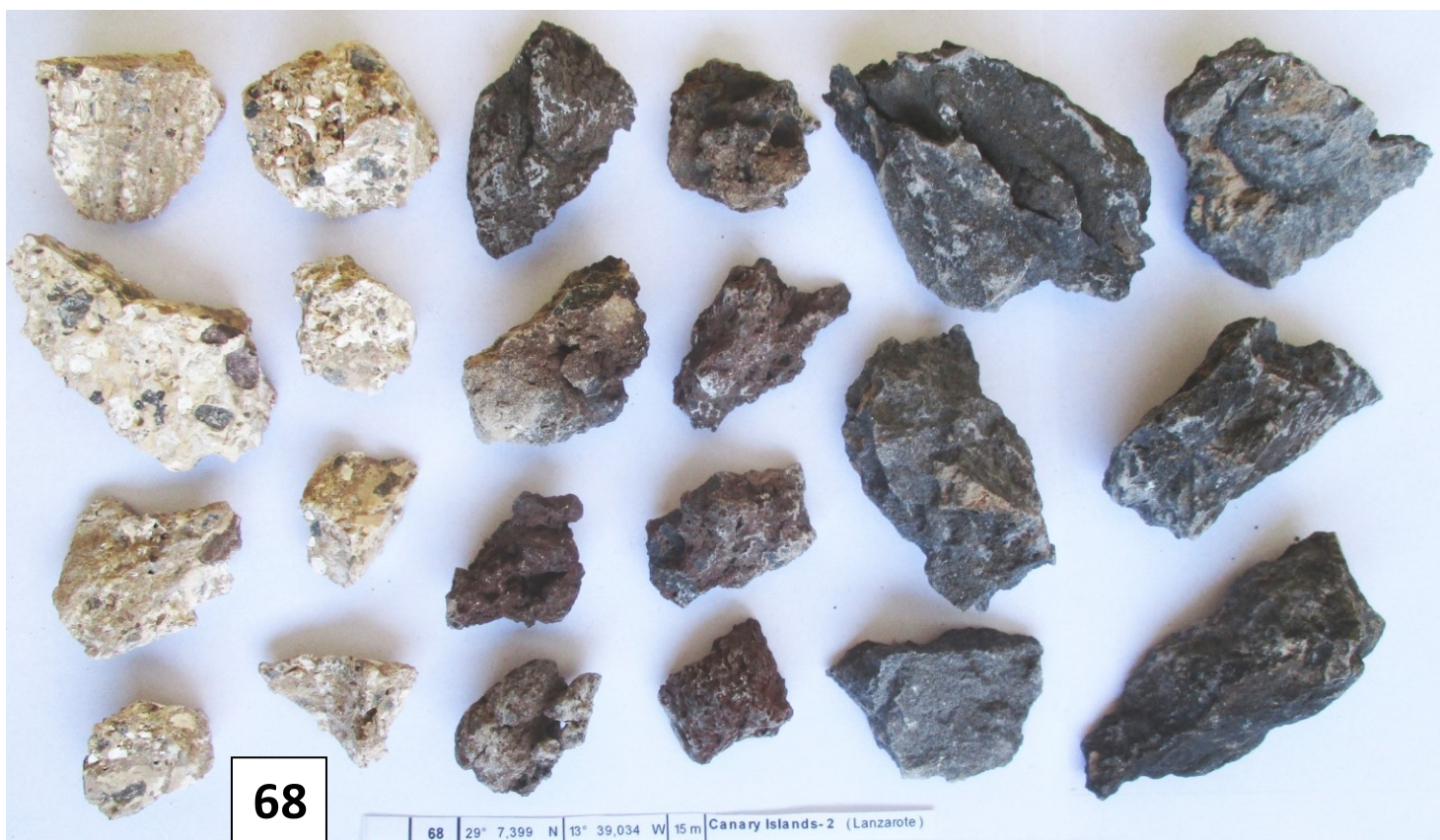
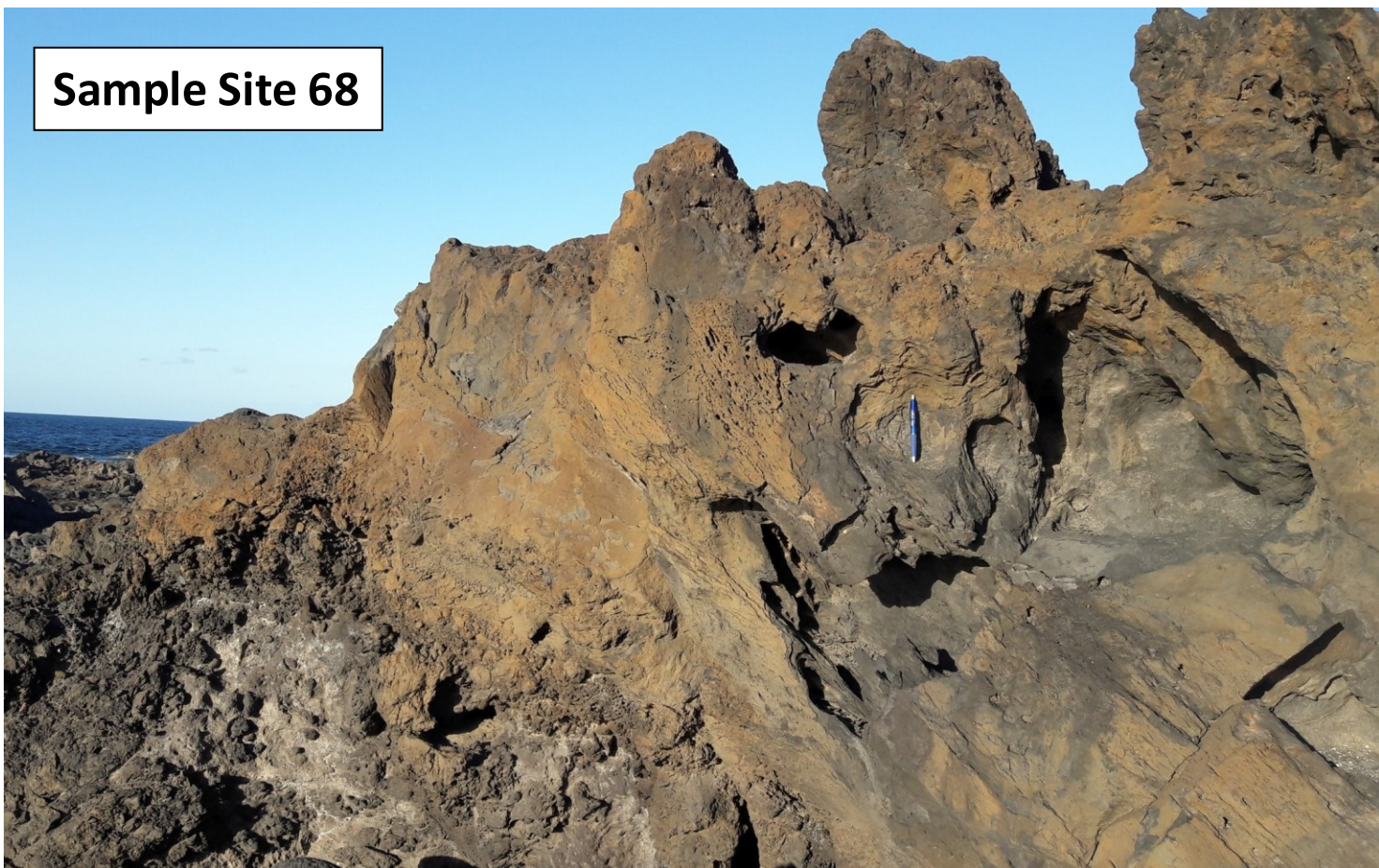


Pyroclastic basaltic rocks :
Note the nearly horizontal orientated structure of these pyroclastic basaltic rocks
(streamline-shaped (blast-like) structure)

61



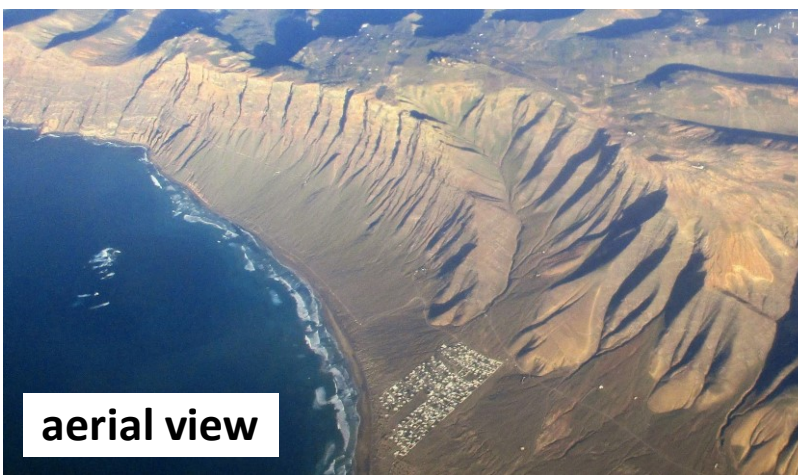
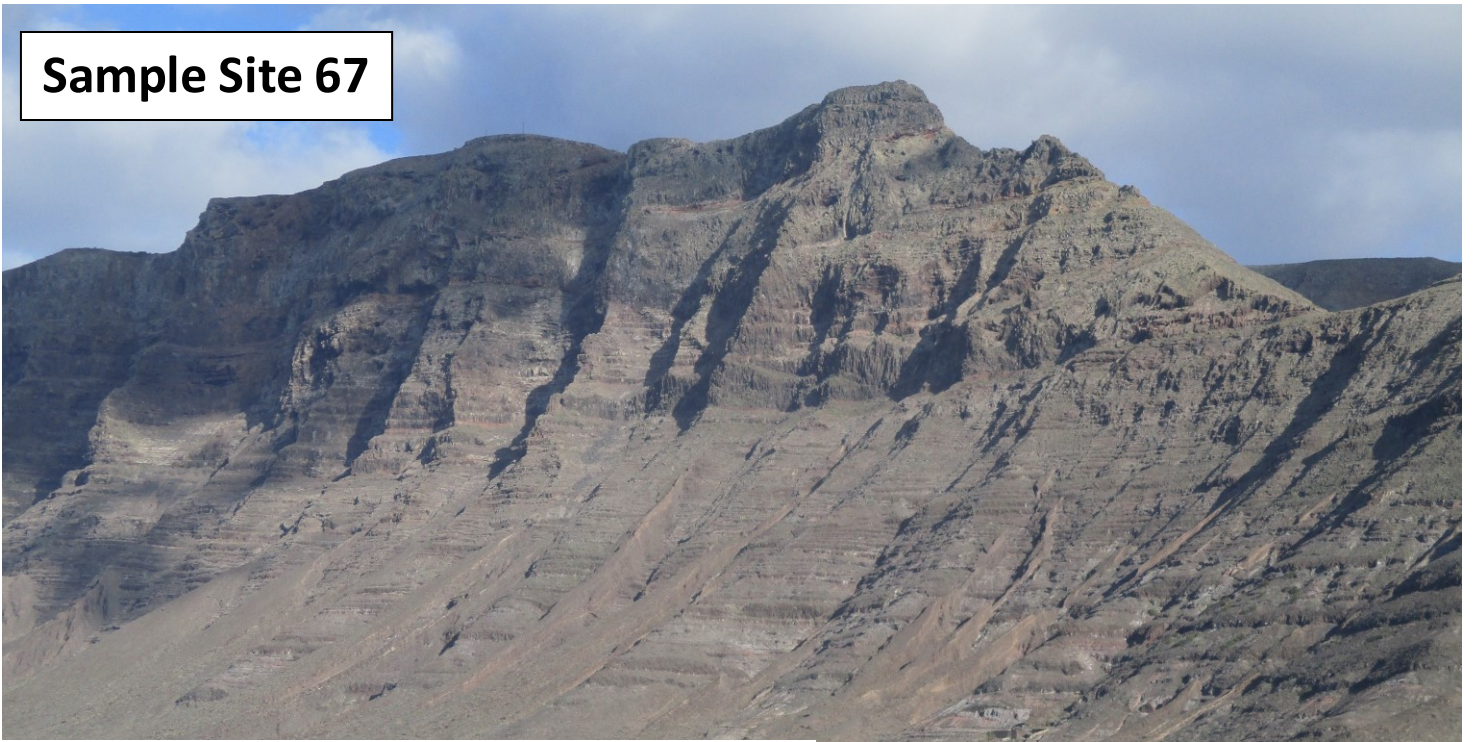
Sample Site 68



68

68 29° 7,399 N 13° 39,034 W 15 m Canary Islands-2 (Lanzarote)

Sample Site 67



aerial view

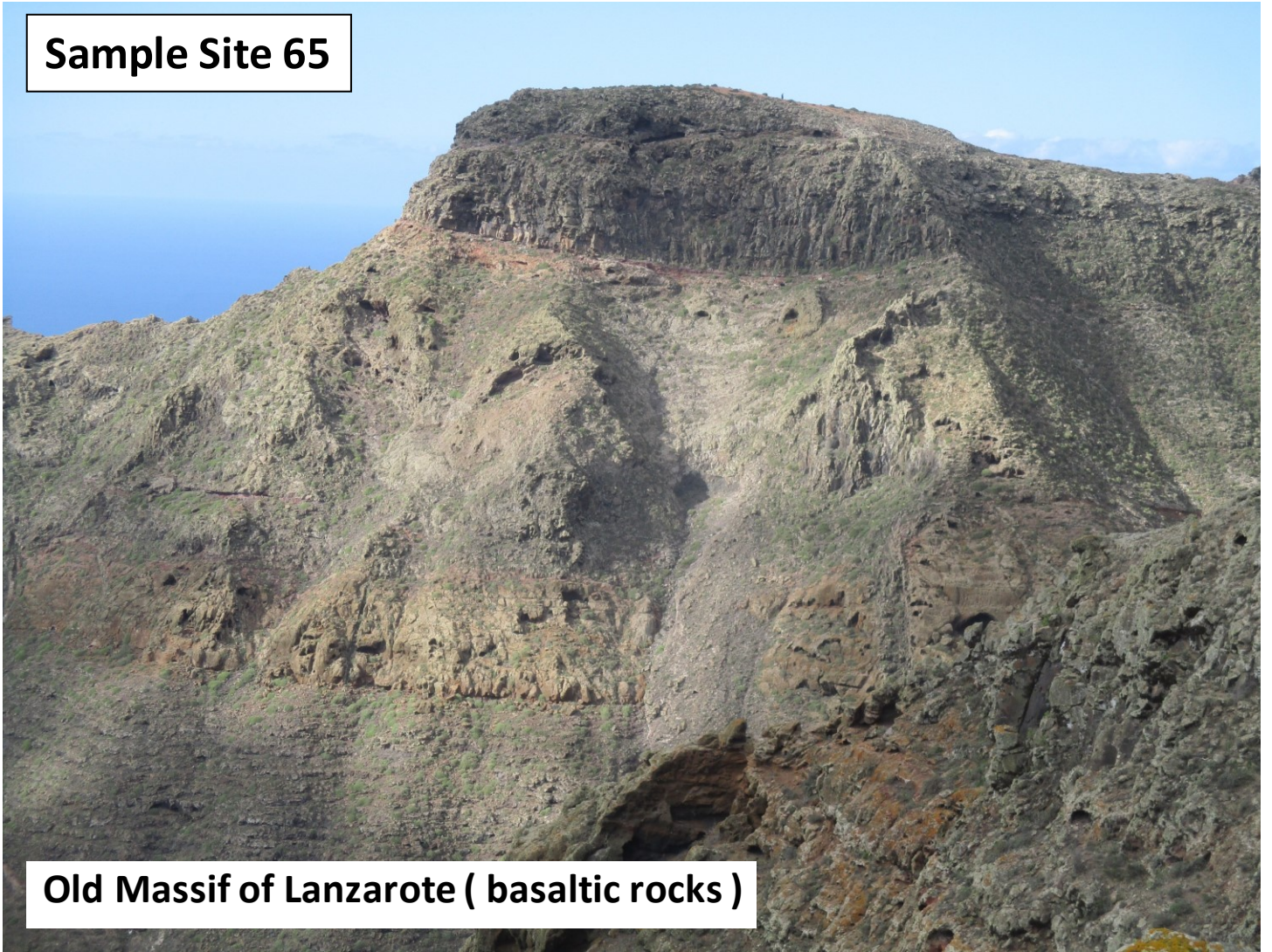


Note the structure of this wall (**craterwall-like structure**)

No analysis made of these rocks



Sample Site 65



Old Massif of Lanzarote (basaltic rocks)



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

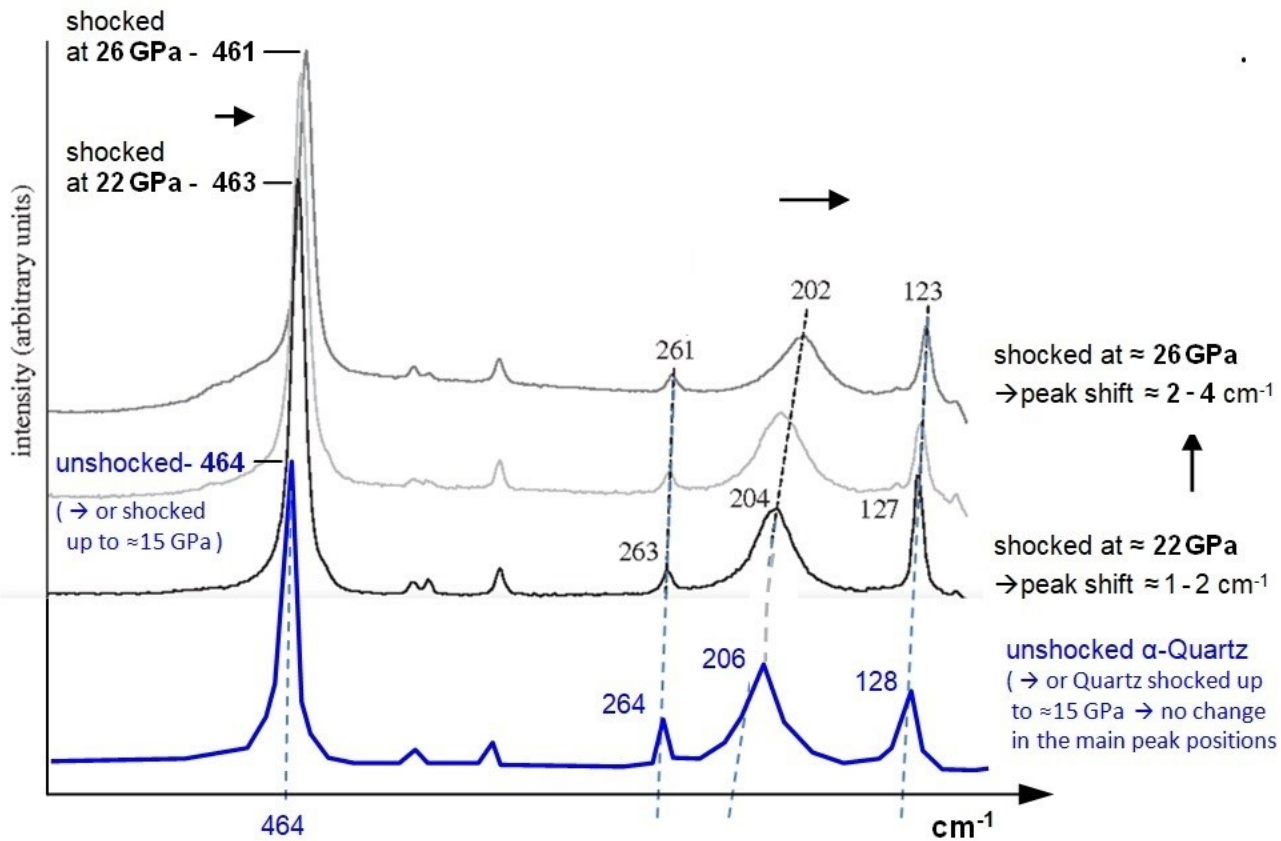
In order to verify a sample site as an impact site or impact structure, [shock-metamorphic effects](#) must be discovered in the rocks of the sample site. This can be done by different methods.

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.

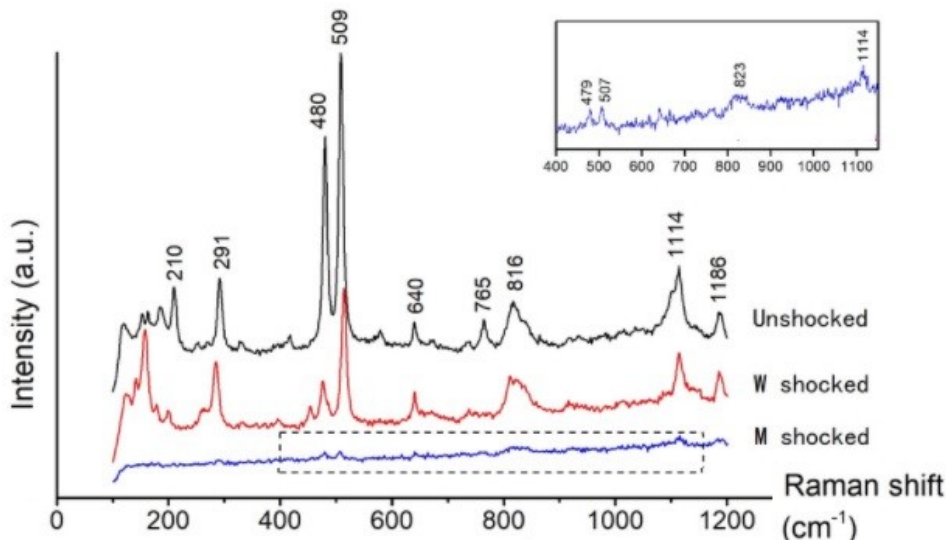
Mc Millan et al. (1992) and others have shown that the main RAMAN-peaks of Quartz shift towards lower frequencies if the Quartz was exposed the a shock-pressure > 15 GPa. → see diagram below

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 “Tinajo Crater \(Lanzarote\)”](#) (or 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)

Weblinks to : [Scientific Studies to the Geology of Fuerteventura & the Canary Islands](#) (→ 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>

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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

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Shock-Related Deformation of Feldspars from the Tenoumer Impact Crater, Mauritania - by Steven J. Jaret

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