Tin ores and fluids in the Segura district: from magmatic to hydrothermal stages

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https://mostmeg.rd.ciencias.ulisboa.pt/

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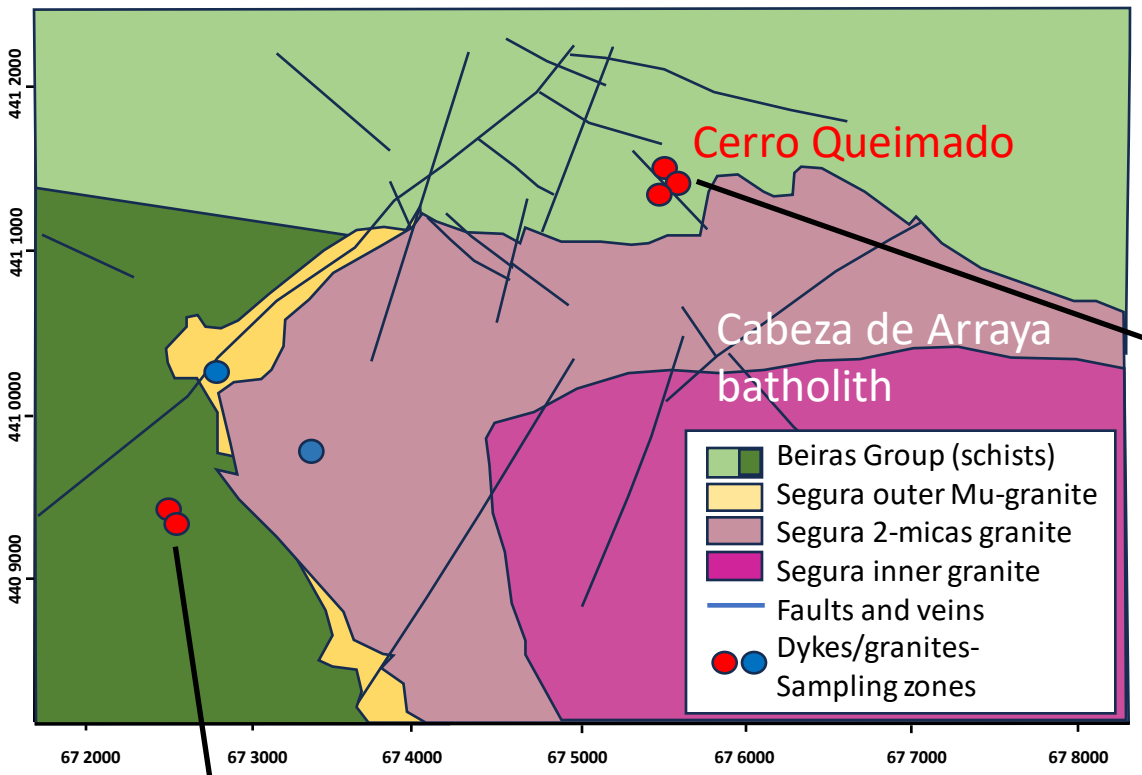
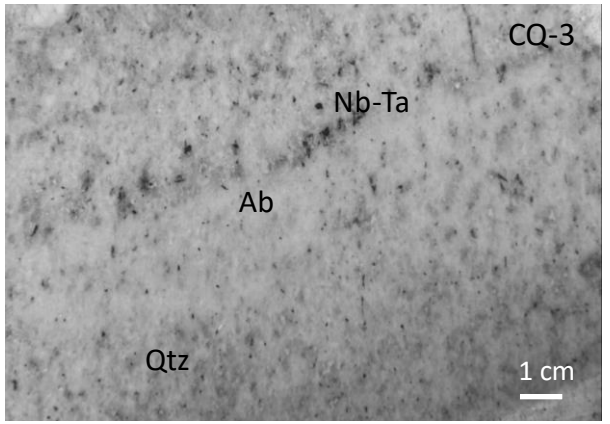
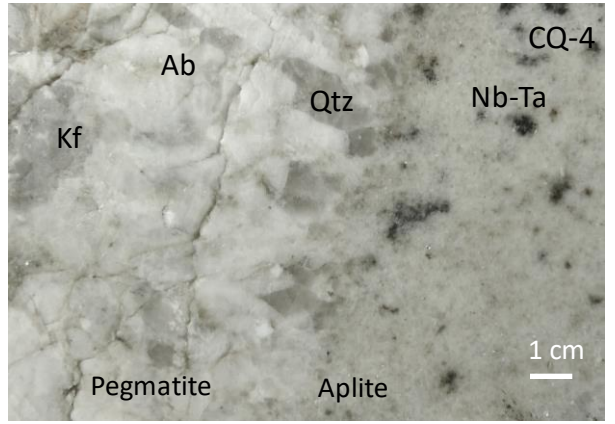
Sn ores in Segura dykes



Cassiterite disseminated in hyper-differentiated dykes (aplites and pegmatites)
Hyperfluid magmas enriched in Li, F, P (Sn, Nb-Ta)

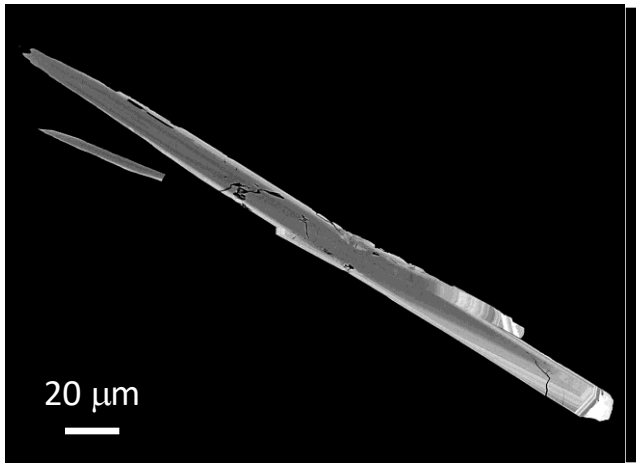
Meter thick dykes croscutting the sub -vertical schist foliation

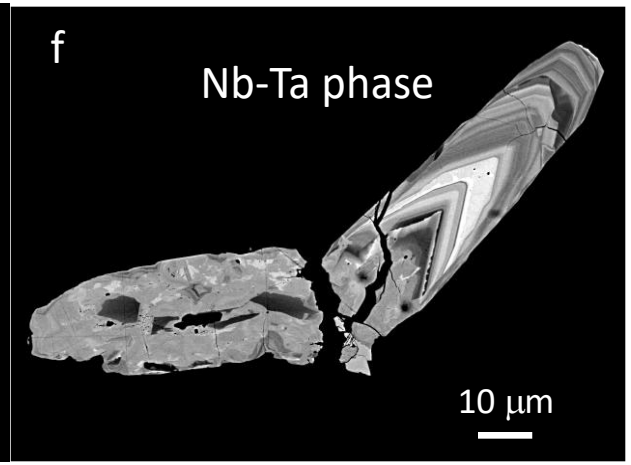




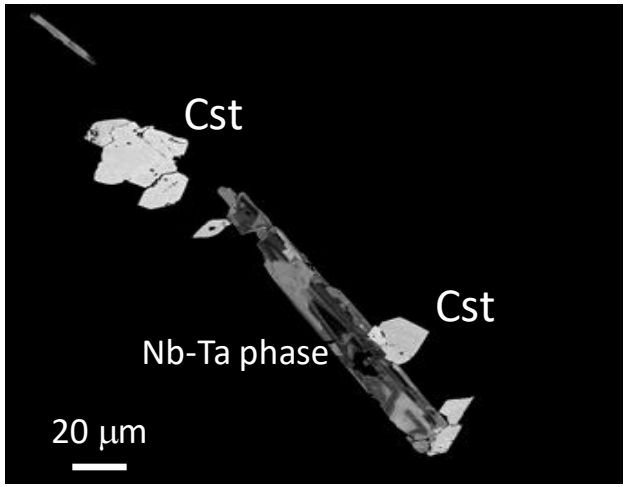
Leucocratic Albite-Quartz-Kfeldspar association with Nb-Ta-(Sn) oxides

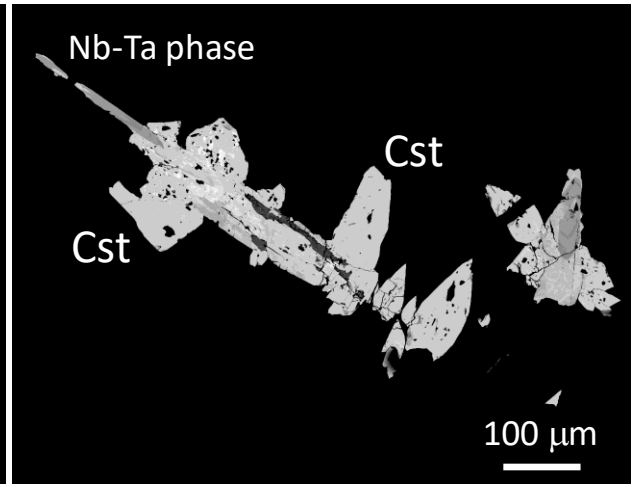
Sn - Nb –Ta oxides in the dykes

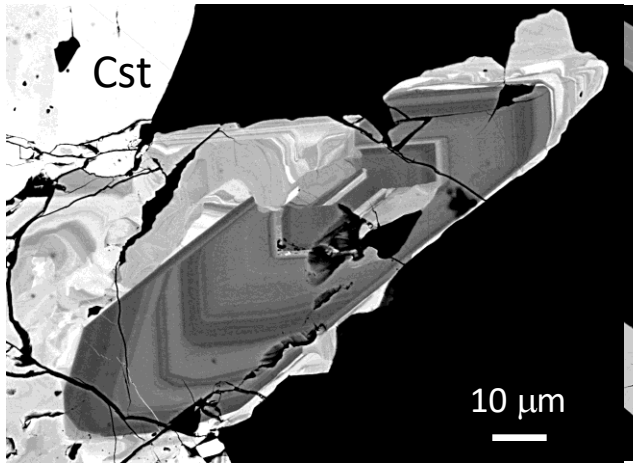


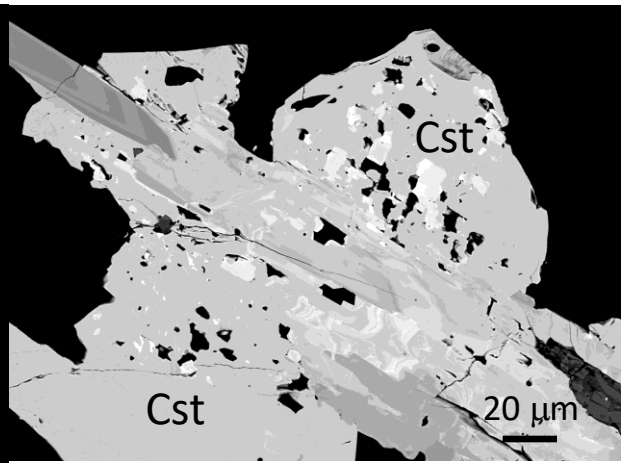


Nb-Ta oxides crystallize first
They serve of nucleus for euhedral cassiterites





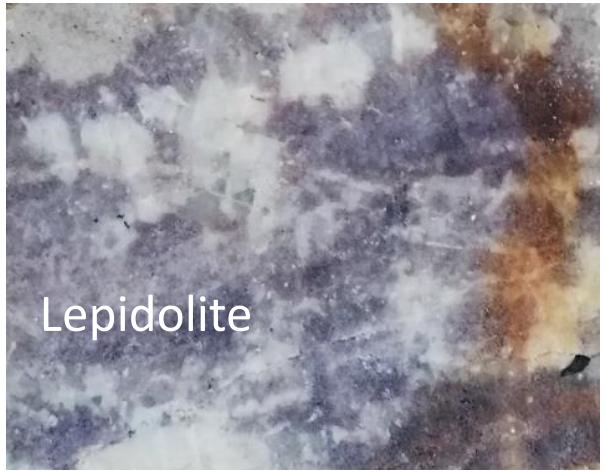


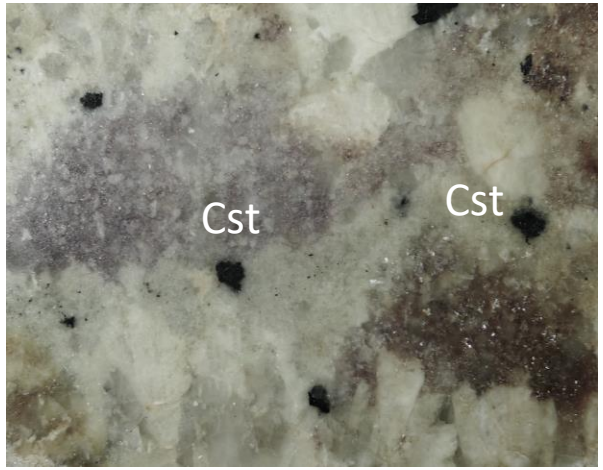


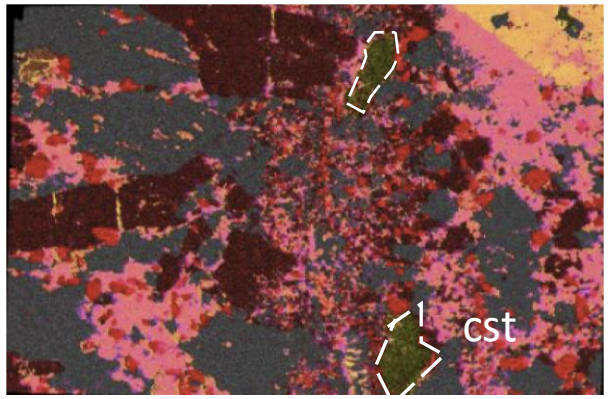
Cassiterite - second stage in the dykes

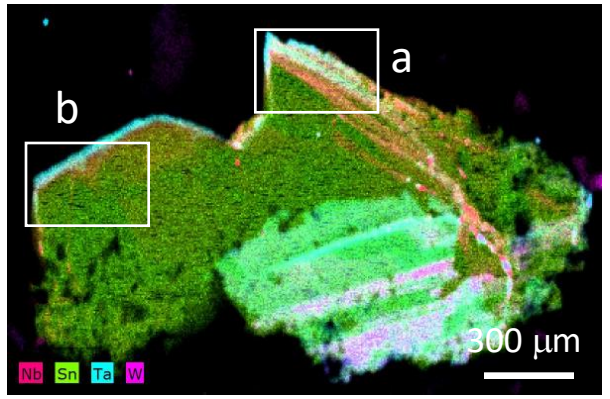
Second stage of cassiterite formation :
large euhedral crystals in lepidolite-rich altered dykes

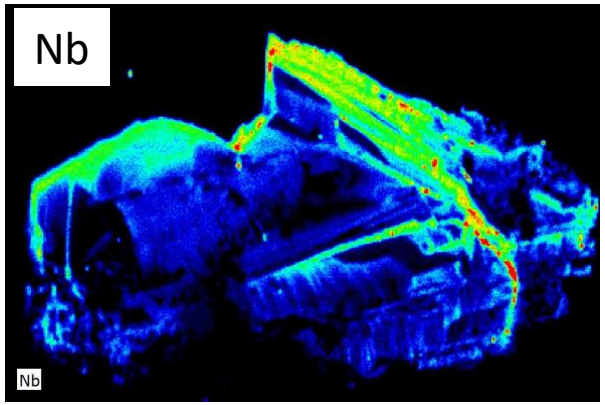
Cerro Queimado

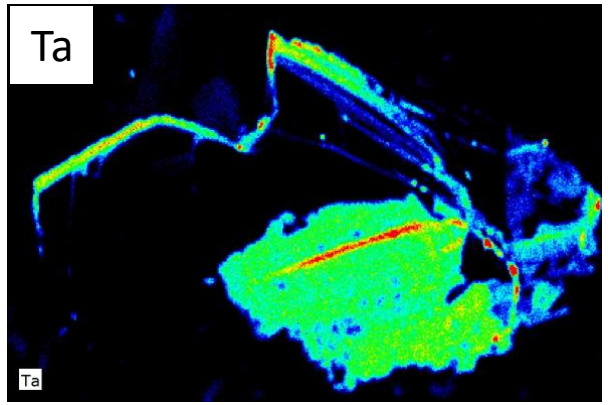


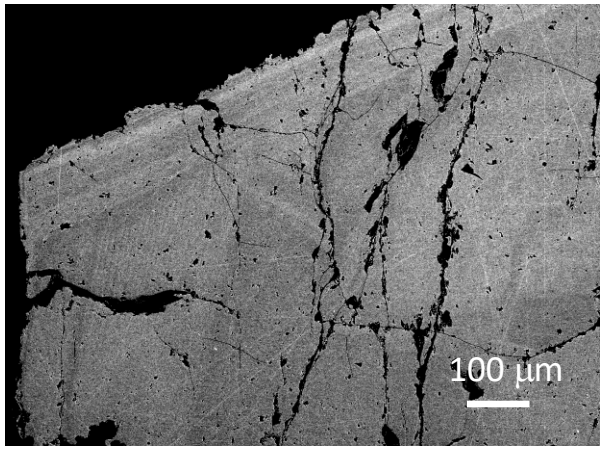


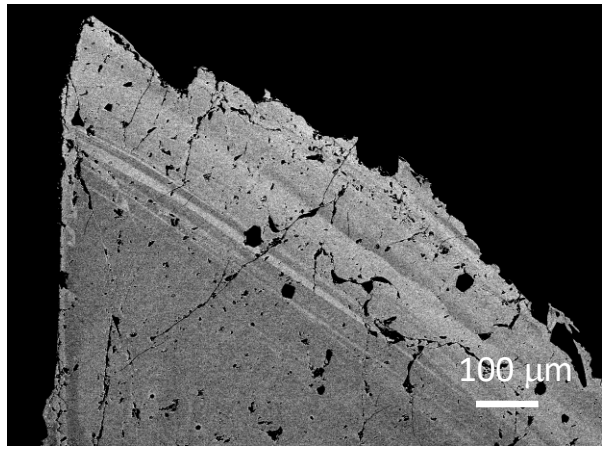








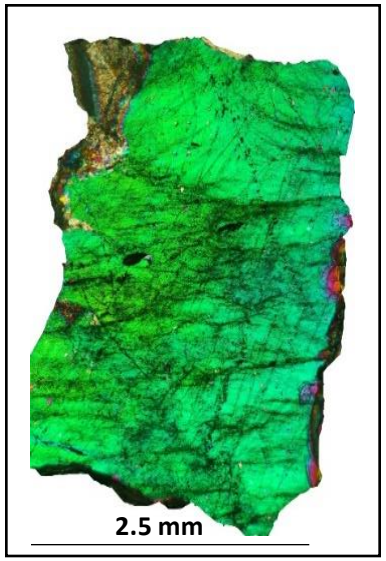




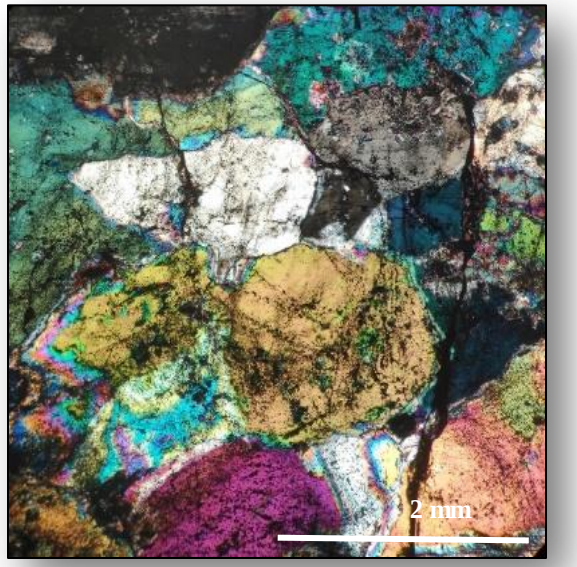
Quartz types (southern zone)

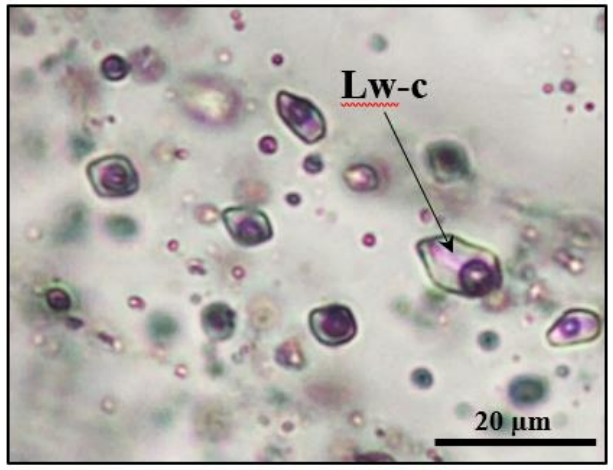
Q1A – Large crystals of a clear quartz with fractures
Q1B – Subhedral clear mosaic quartz slightly recristallized in the borders

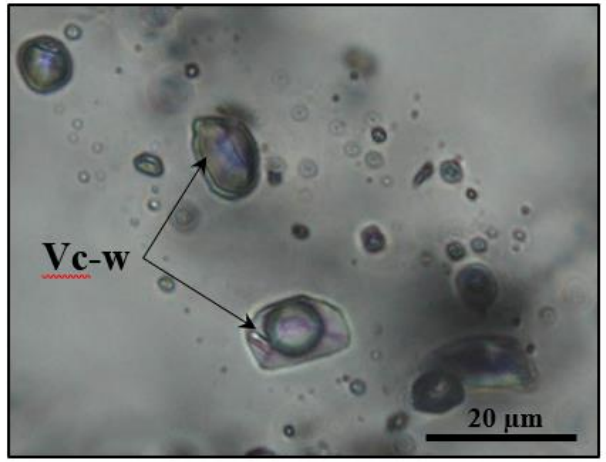
Q1A

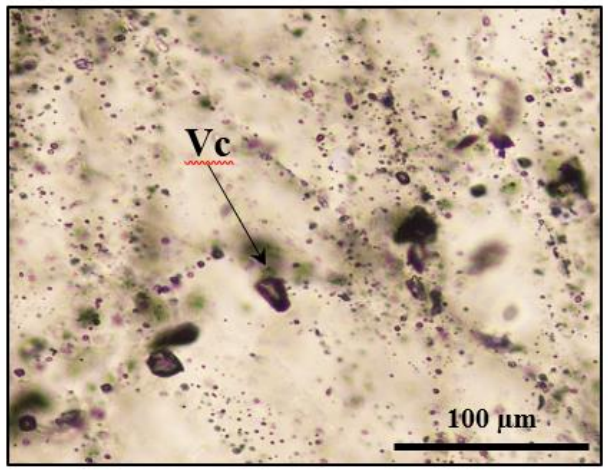


Q1B





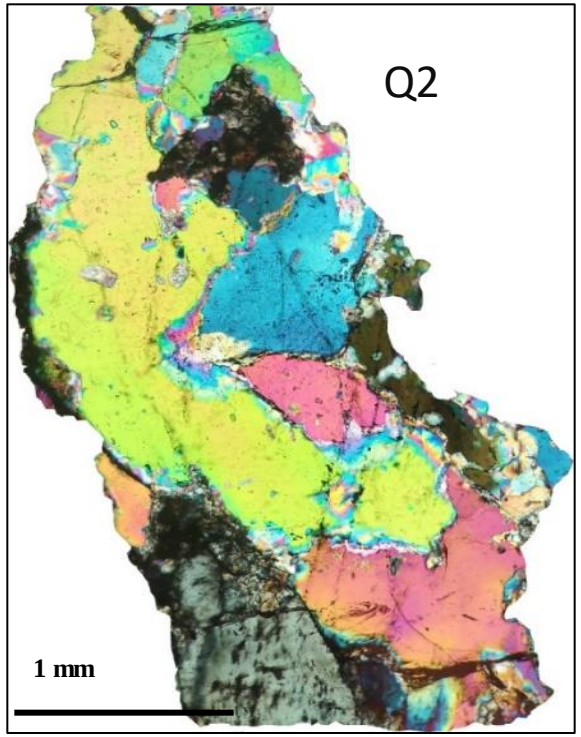


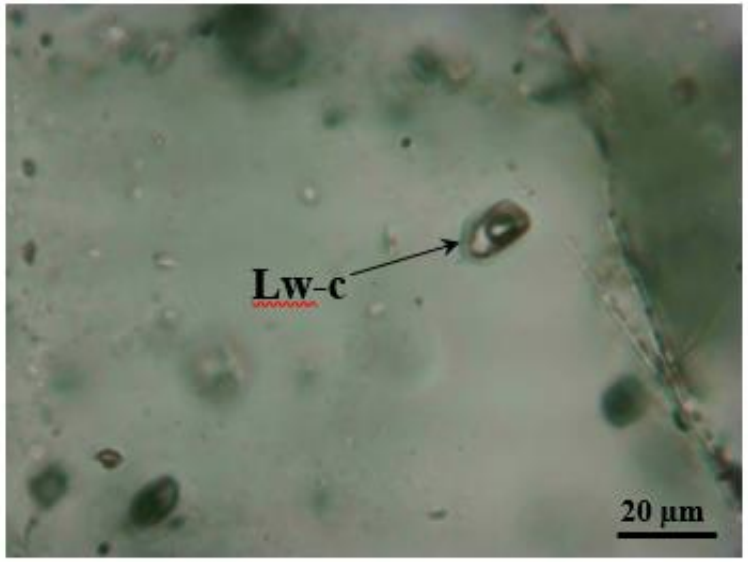


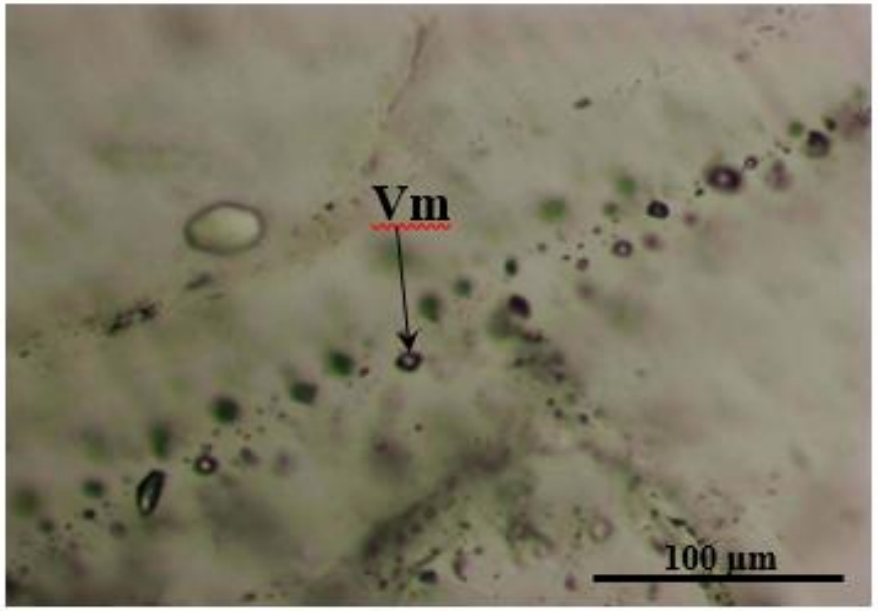
Cerro Queimado

Quartz type : Q2 (northern zone)

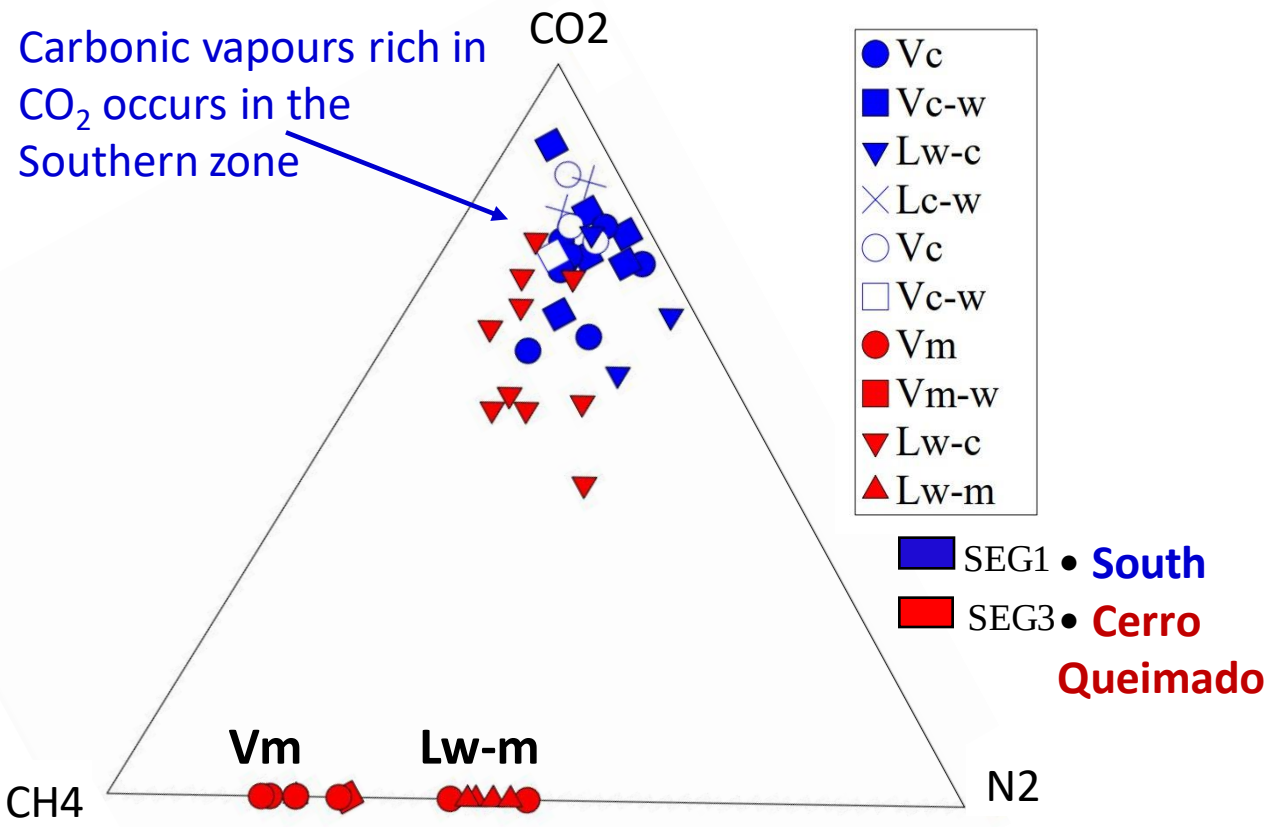
Q2 – anhedral clear quartz with some recrystallization



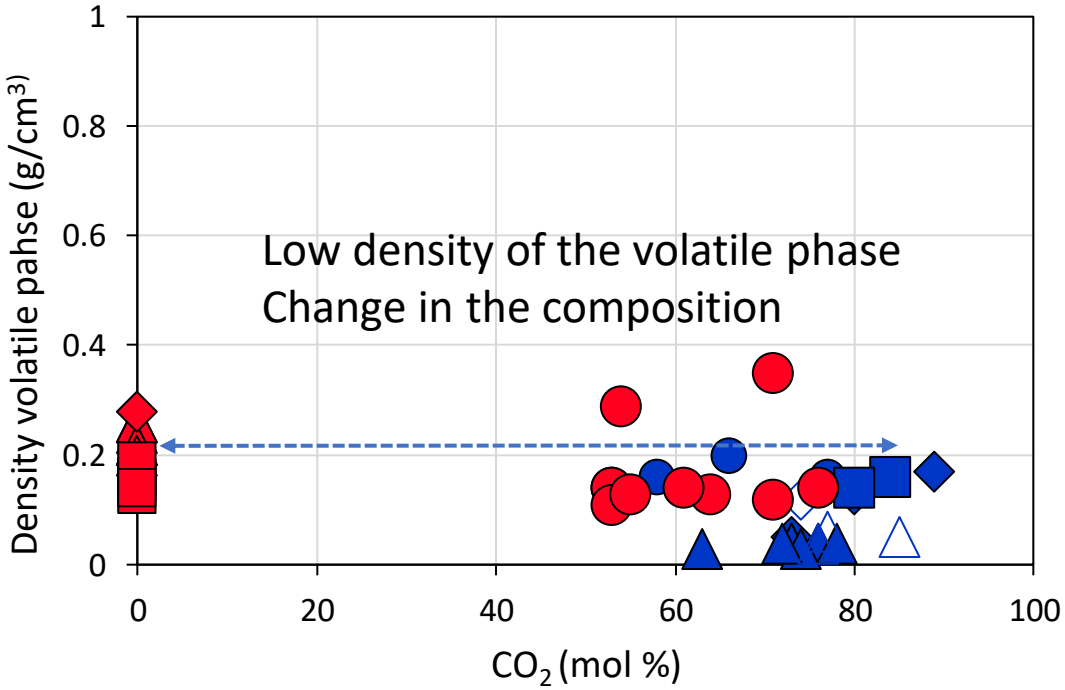




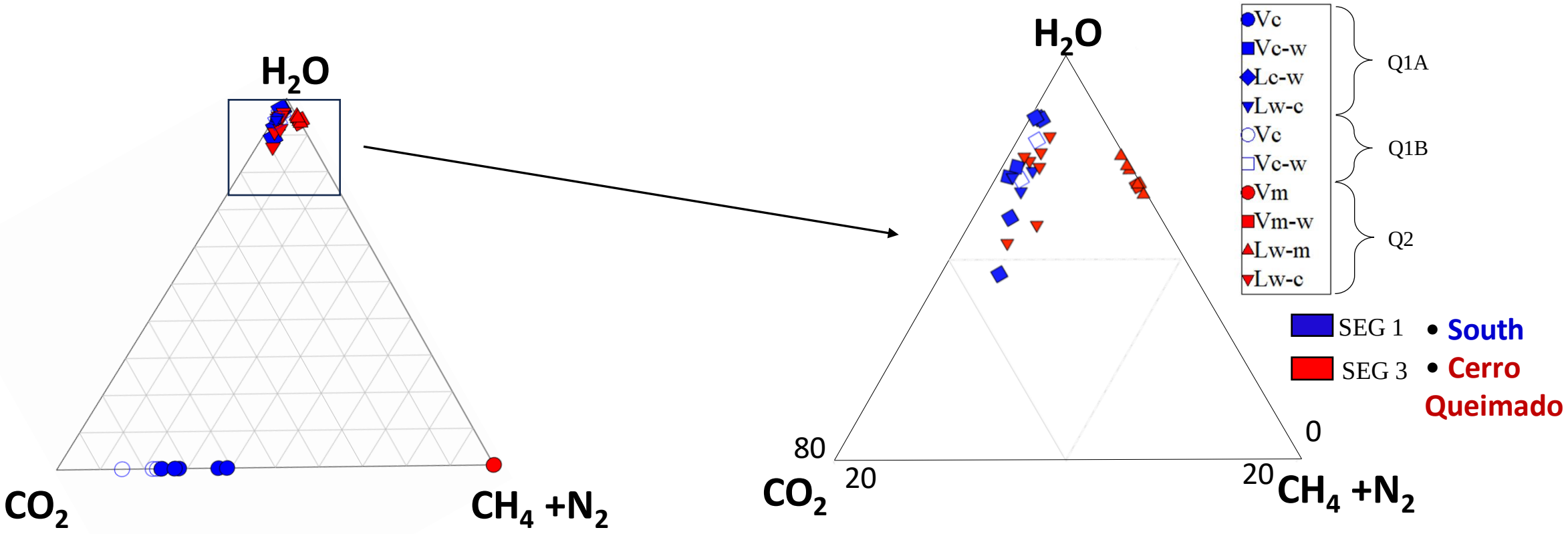
Composition of the volatile phase



The abundant fluid inclusions dominated by methane occurs only in the northern zone (Cerro Queimado)



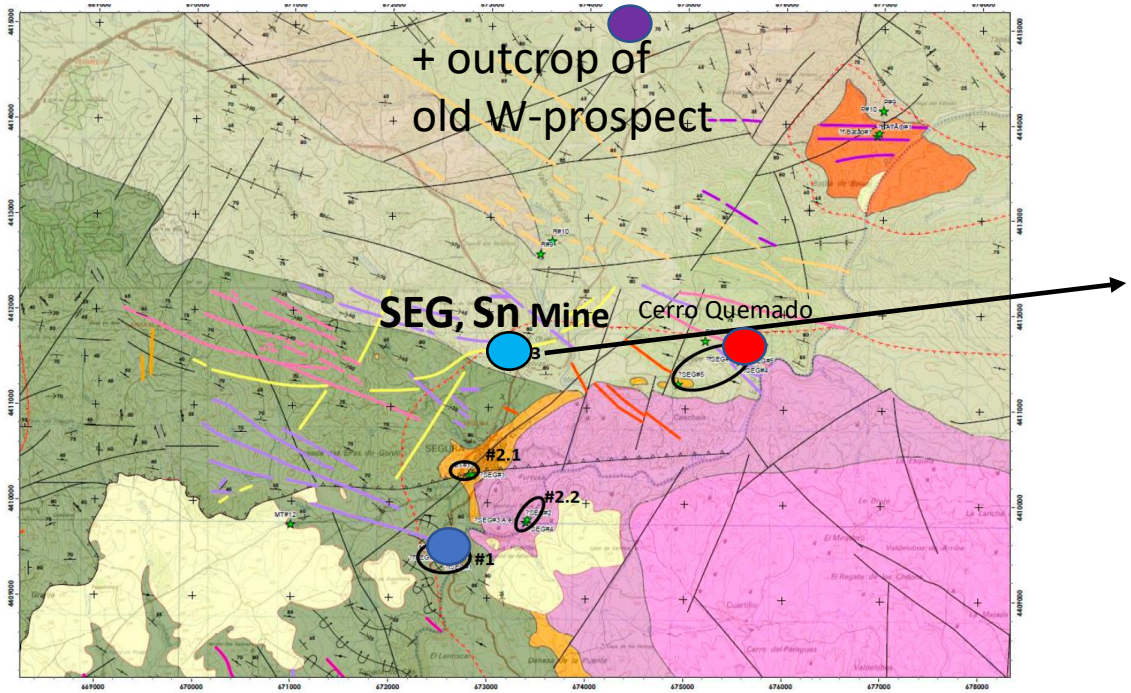
Bulk composition of fluids



2 constrasted fluid compositions :

- aqueous fluids with minor volatiles
- volatile rich vapours : with two sub-types, one rich in methane, and the other rich in CO_2

SEGURA - Sn veins in micaschists : Old Mine Sn and W-prospects

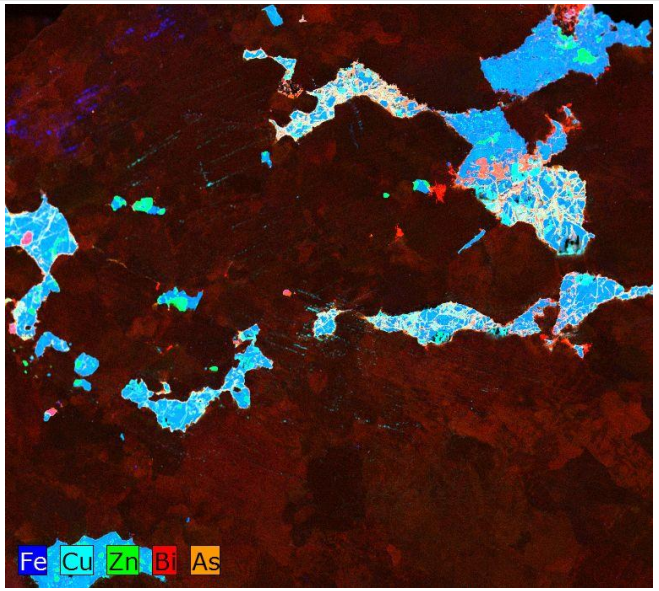


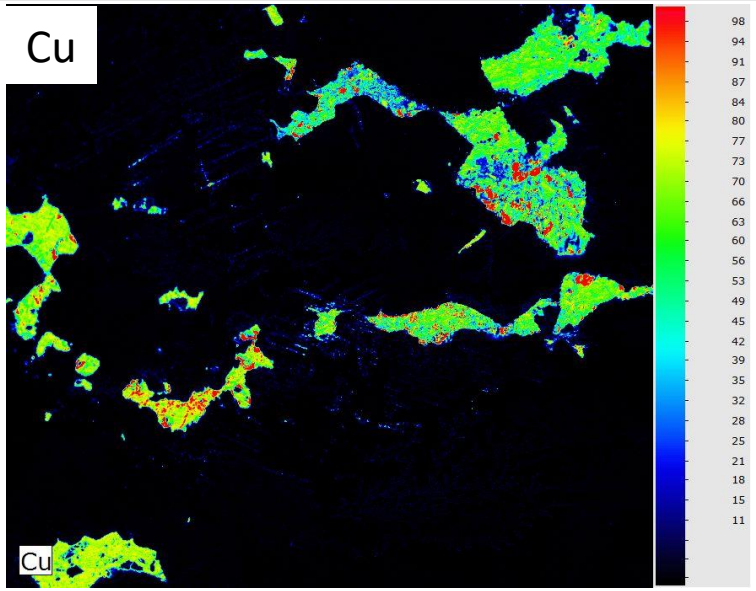
Milky quartz with minor arsenopyrite

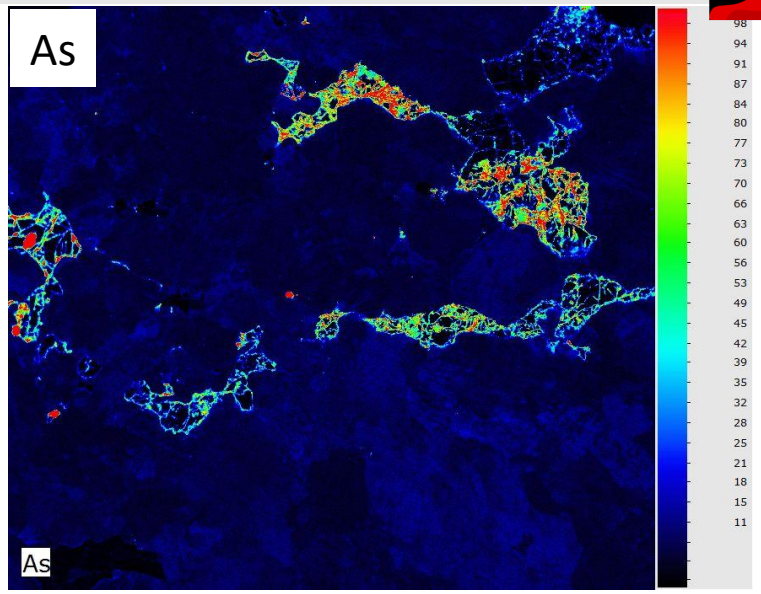
The tin mine of Segura

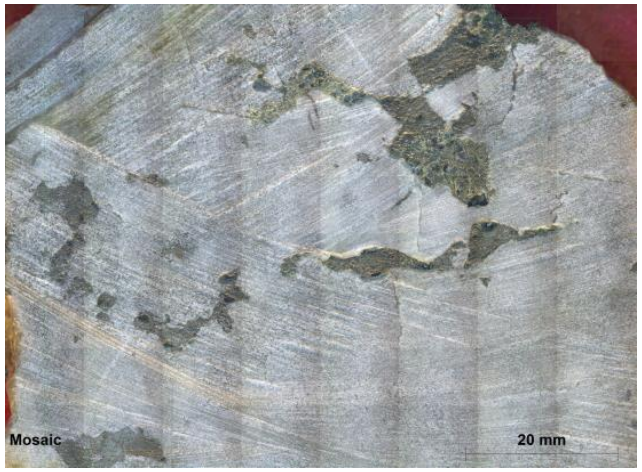
Sub-horizontal quartz veins, with abundant microfractures
Crosscutting subvertical schist foliation

SEGURA - the Sn mineralisation



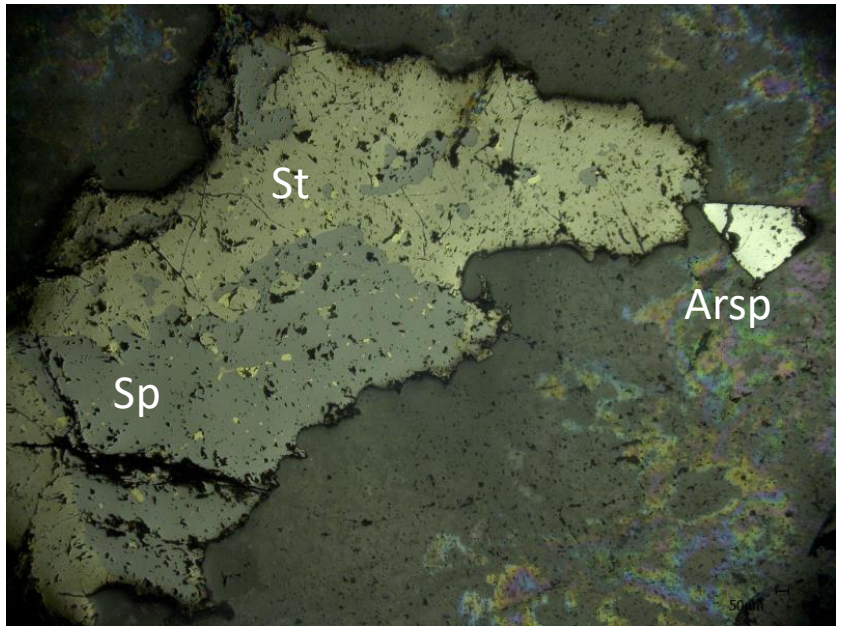




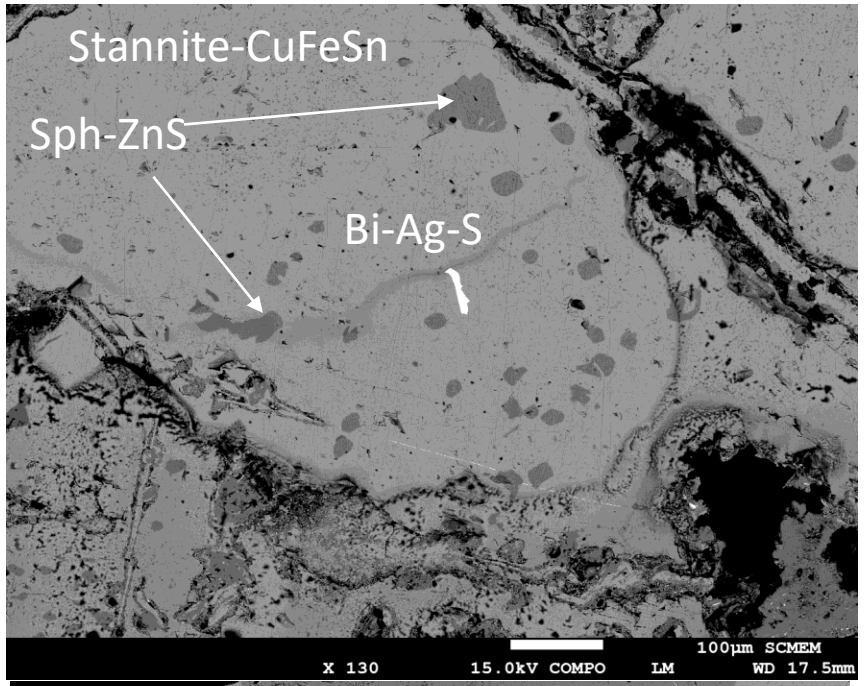


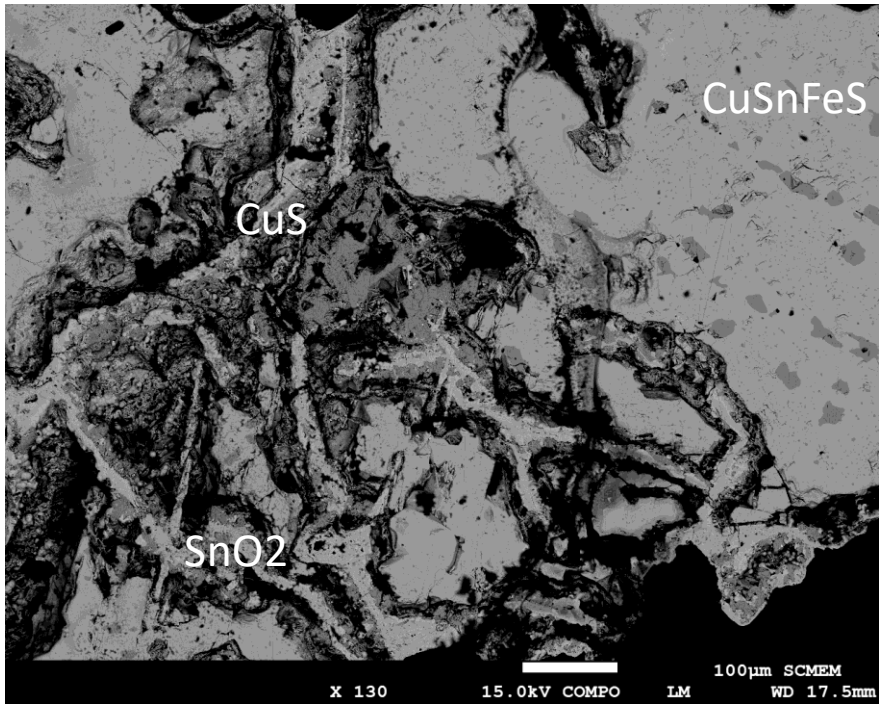
Quartz-Stannite

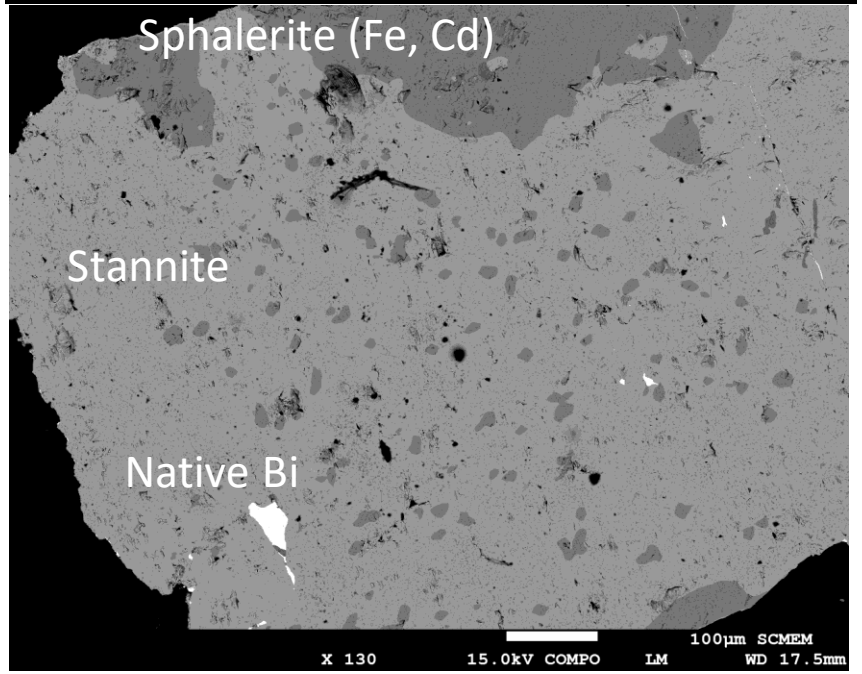
Cu_2FeSnS_4



Quartz vein with stannite, sphalerite, arsenopyrite, native Bi, Ag-Bi-sulphide and minor covellite and SnO_2 as alteration products.







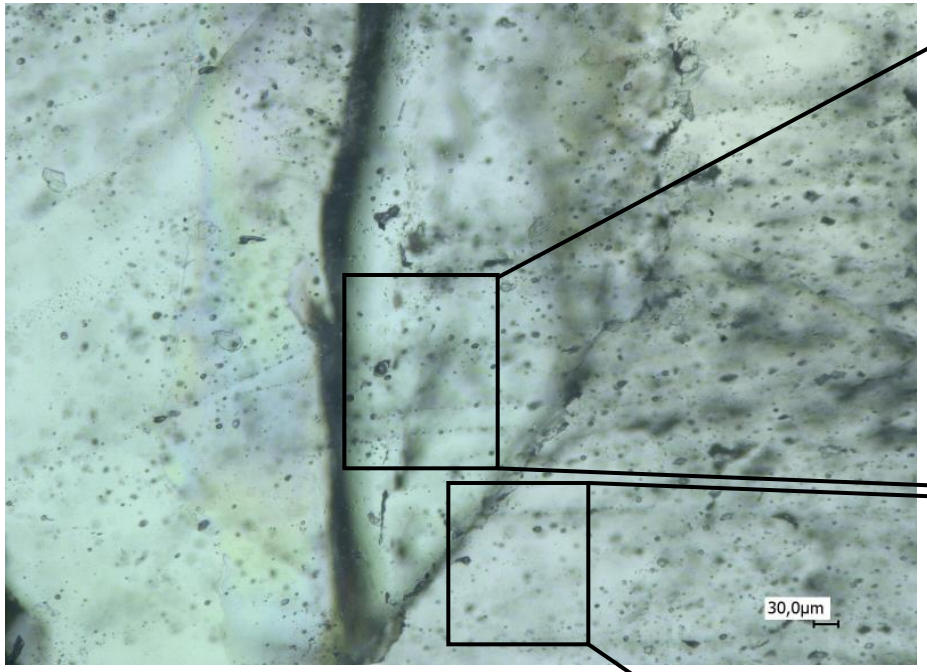
Stannite close to stoechiometry : $Cu_2Fe(Zn)SnS_4$

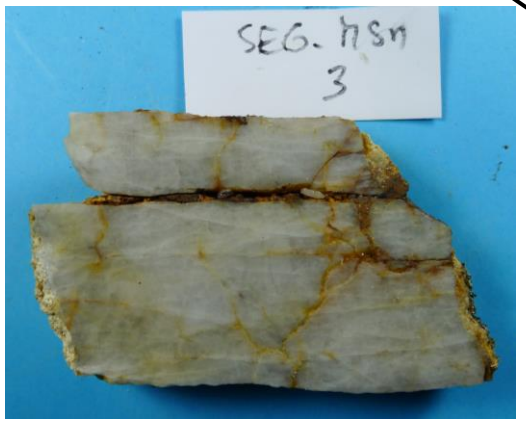
Iron	13 %	Fe	11.2	11.2	11.2
Copper	29.5 %	Cu	28.6	29.2	28.5
Zinc			4.3	2	2.1
Tin	27.6 %	Sn	26.1	27.1	26.8
Sulfur	29.8 %	S	29.5	29.4	29. 1

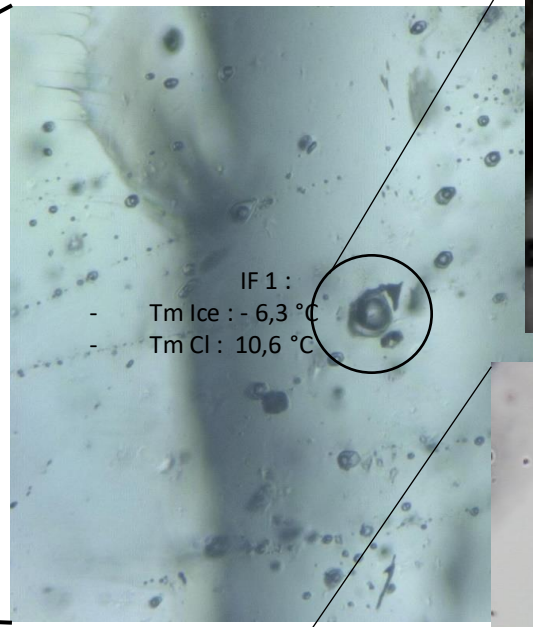
Old Mine - sample SEG-M-Sn

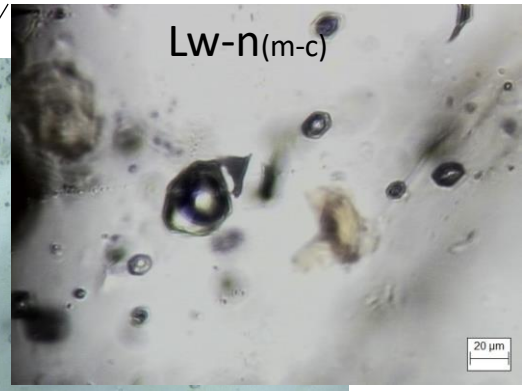
Aqueous – carbonic inclusions

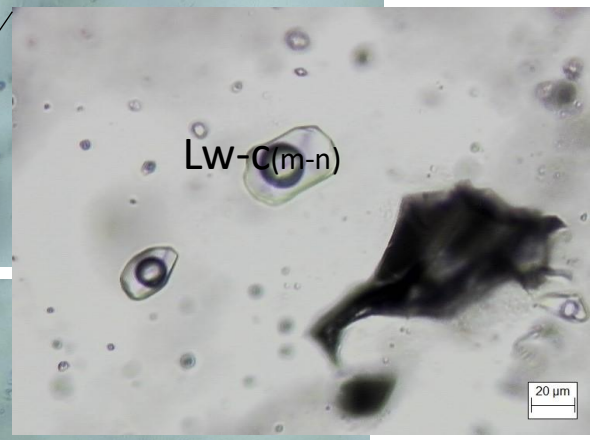
Lw-c (m-n) and Lw-n (m-c)

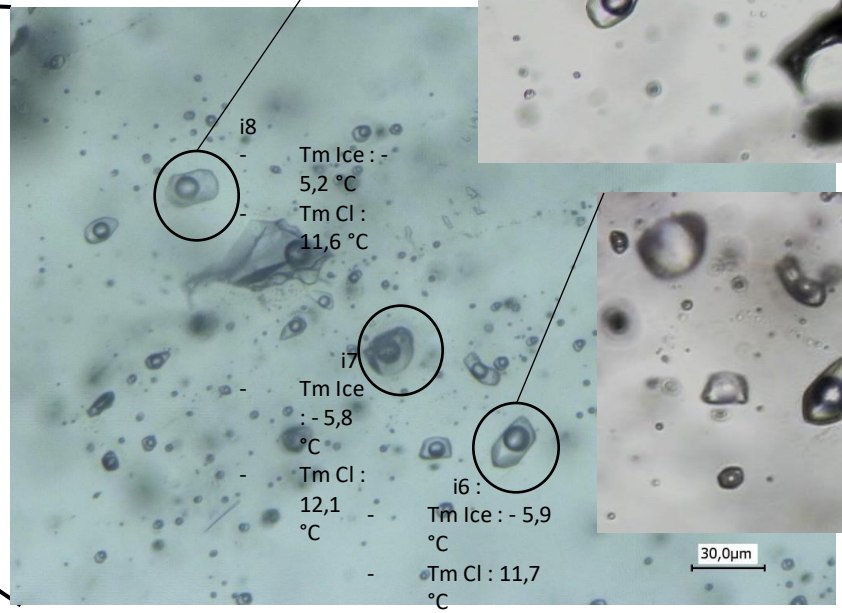




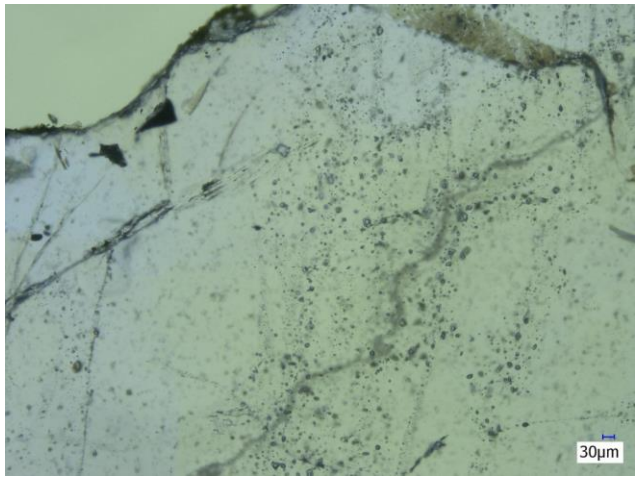


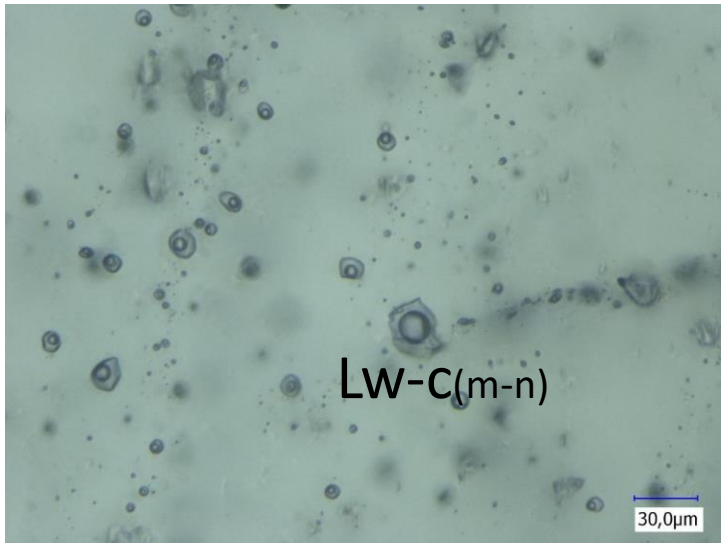


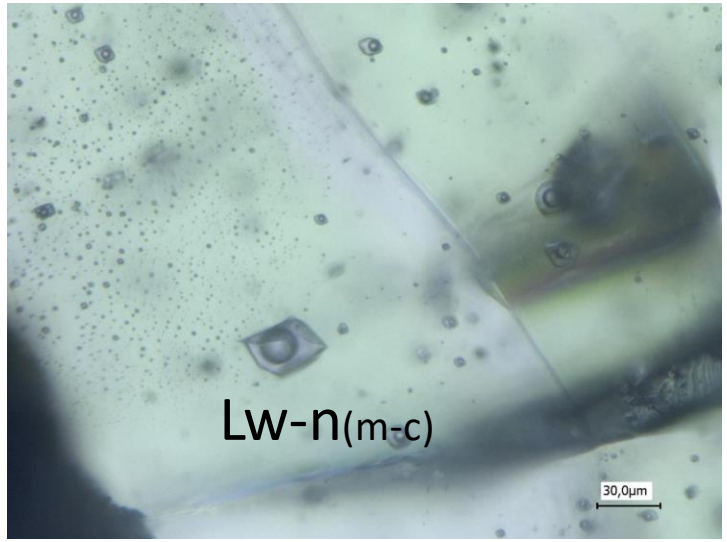




SEGURA- sample SEG-7X - close to stannite

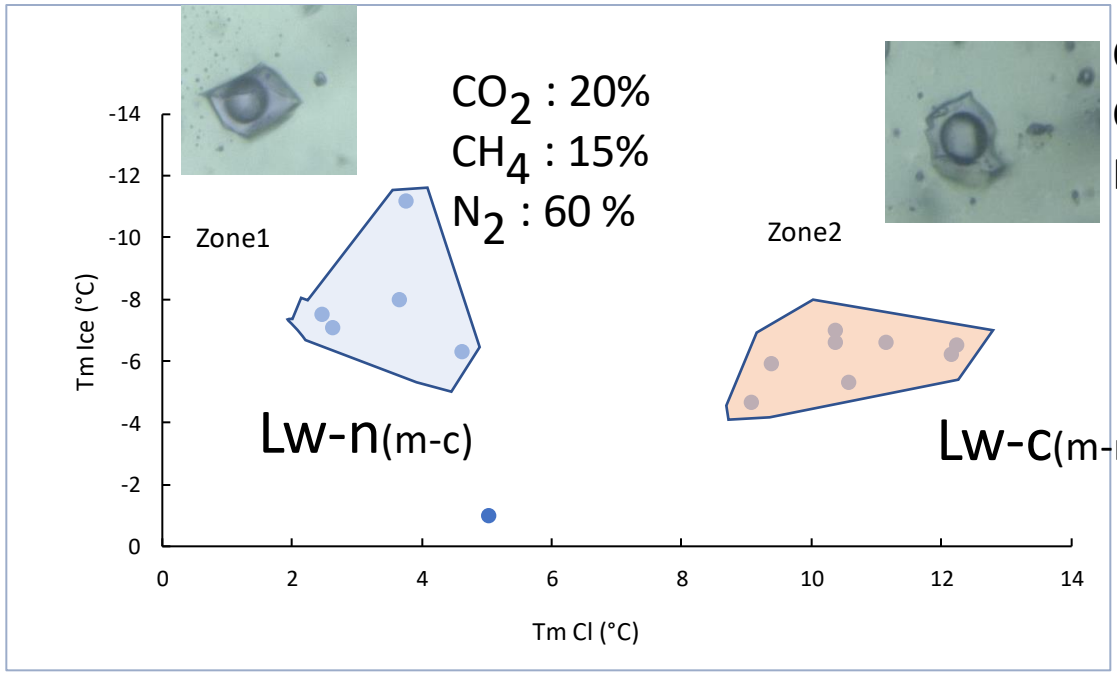






Aqueous – carbonic inclusions

Lw-c (m-n) and Lw-n (m-c)

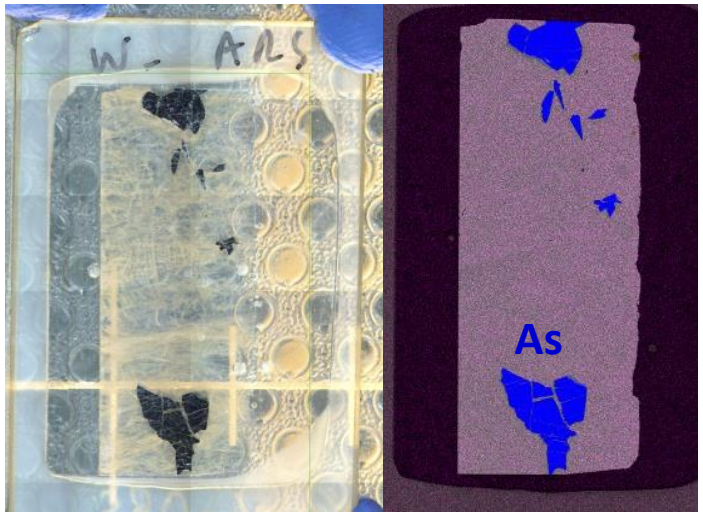


CO_2 : 60-70%

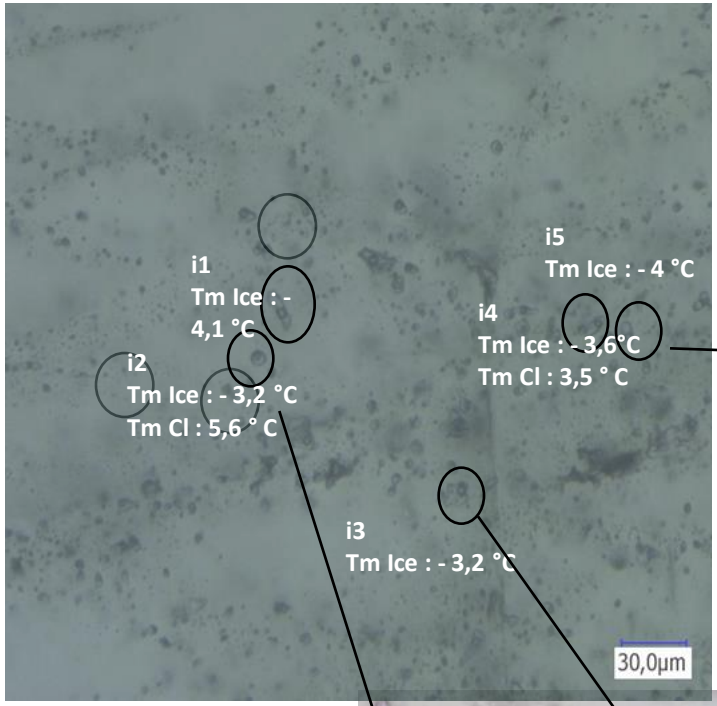
CH_4 : 15-20%

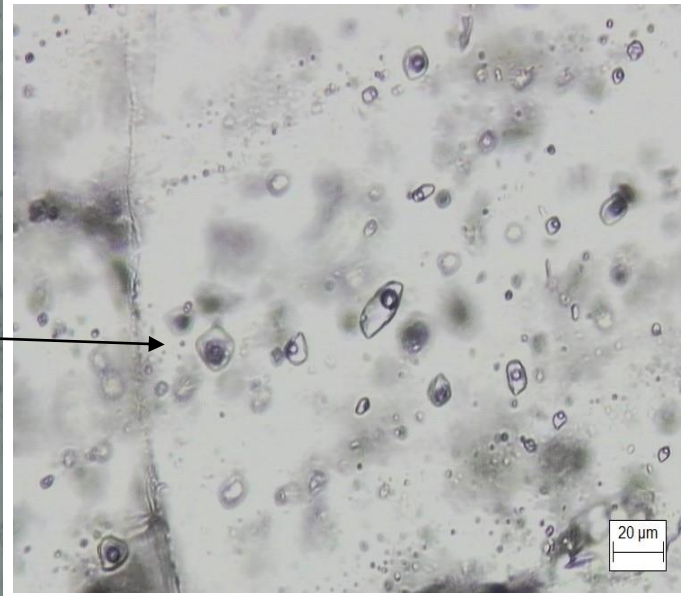
N_2 : 15%

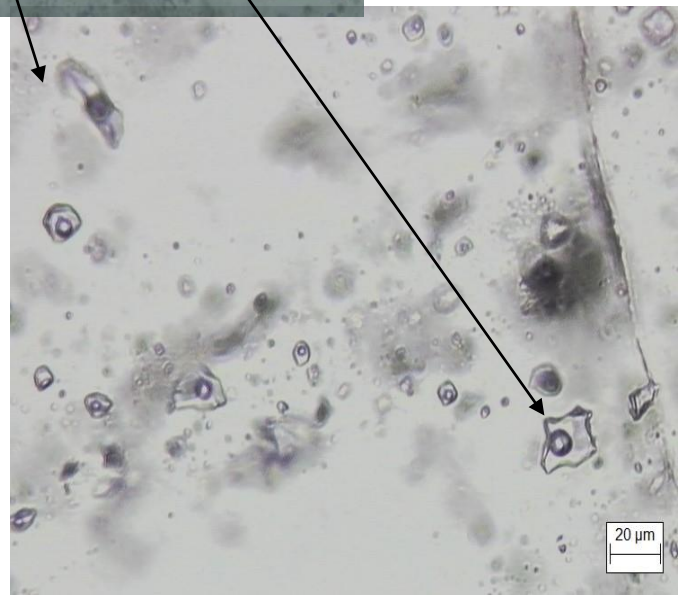
Old W prospect



W Ars (arsenopyrite-quartz)







Dominant aqueous Inclusions

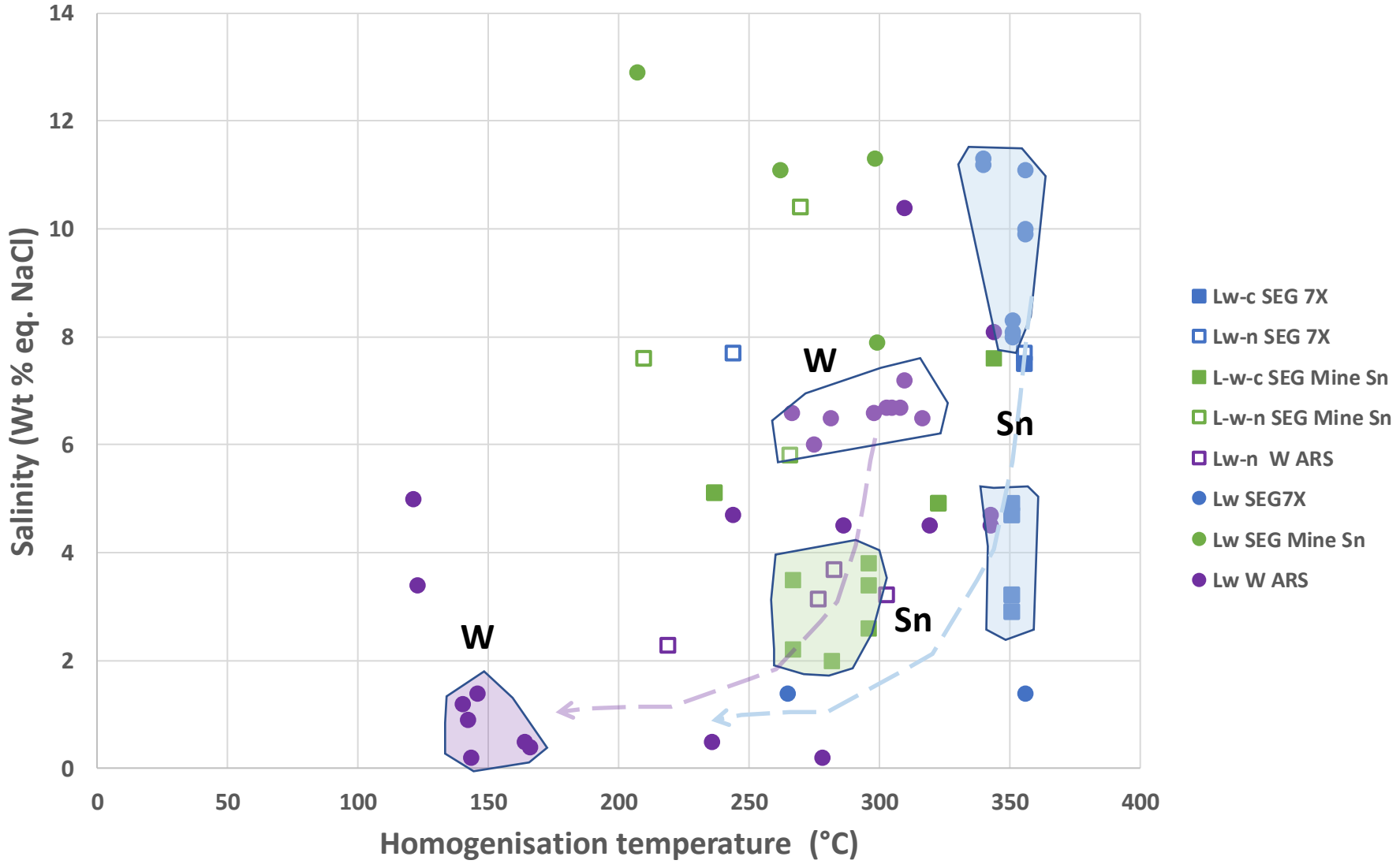
Some inclusions with the presence of gas

N_2 80mol.% and CH_4 20 mol.%

No CO_2

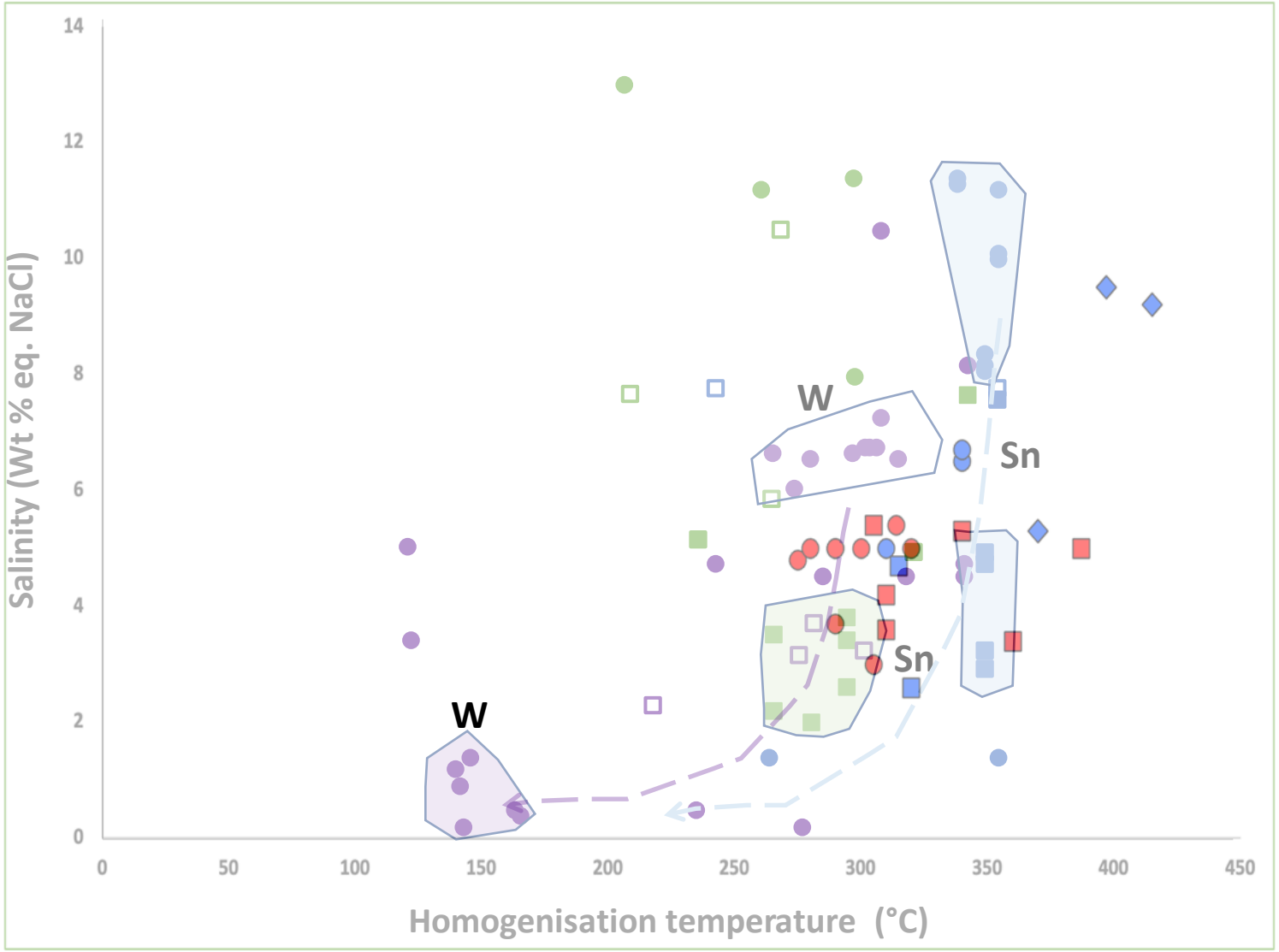
Moderate to low salinity fluids

SEGURA- Sn and W prospection or mining zones



Decreasing salinity and decreasing minimal trapping temperature

SEGURA - all data



Sn and W mining zones

- Lw-c SEG 7X
- Lw-n SEG 7X
- L-w-c SEG Mine Sn
- L-w-n SEG Mine Sn
- Lw-n W ARS
- Lw SEG7X
- Lw SEG Mine Sn
- Lw W ARS

Segura dykes

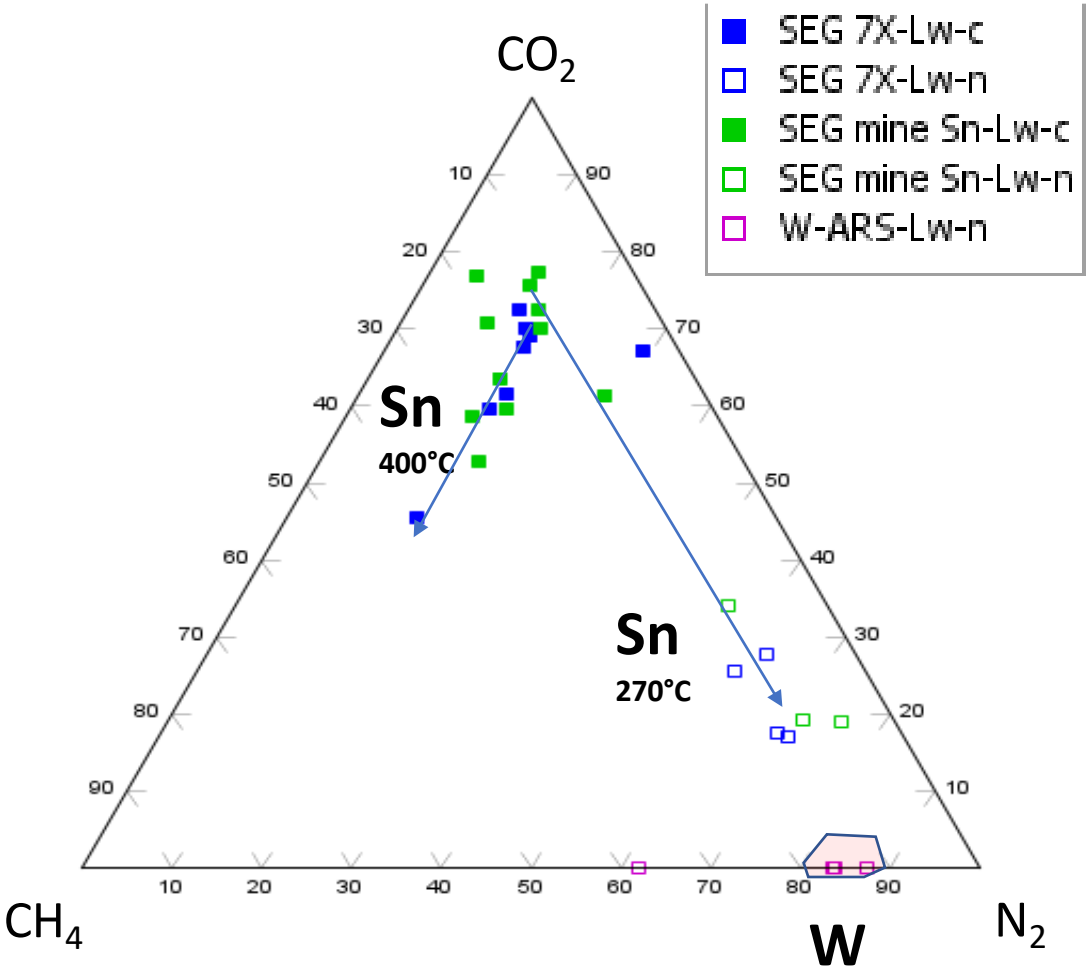
South

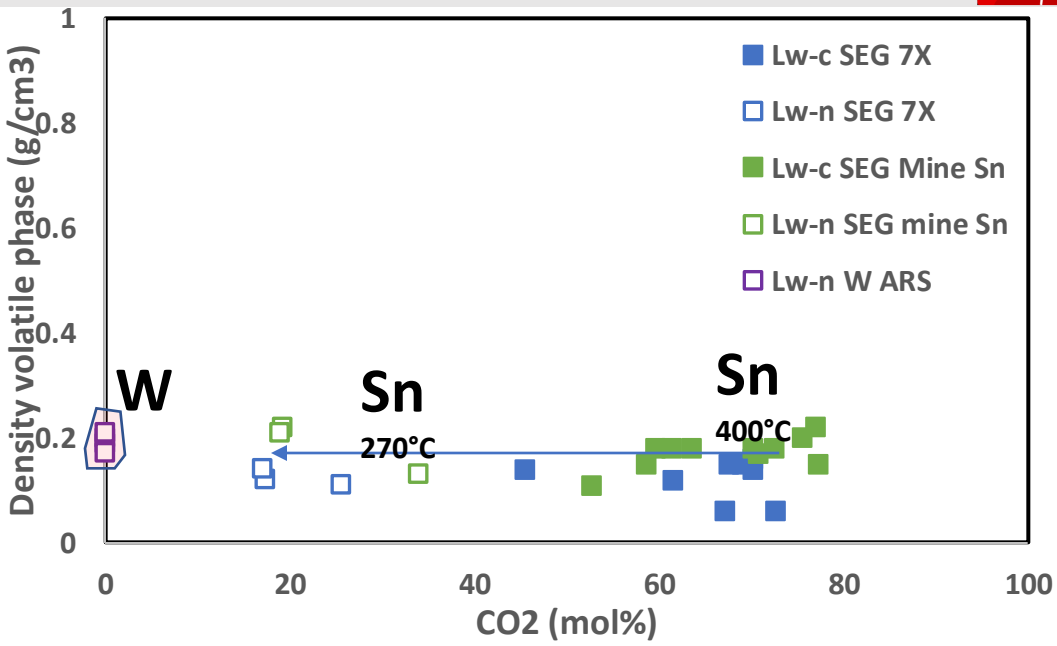
Q1A
- Lw-c
- Lc-w
- Vc-w

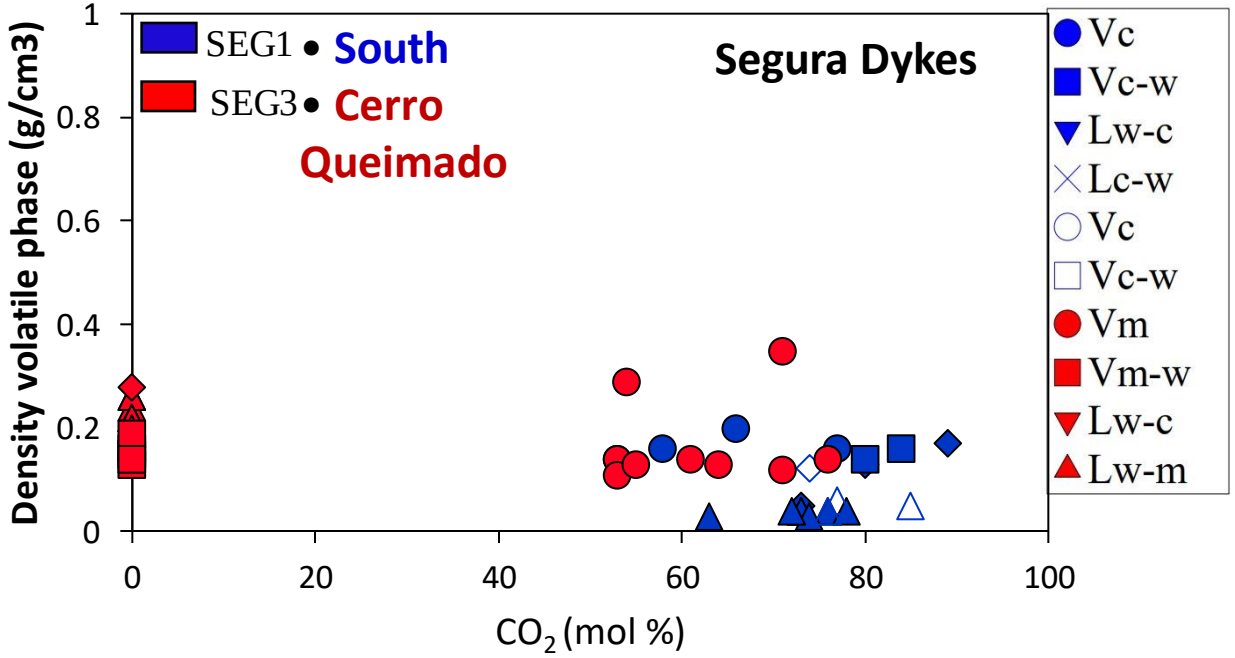
Cerro Queimado

Q2A
- Lw-c
- Lw-m
- Vm-w

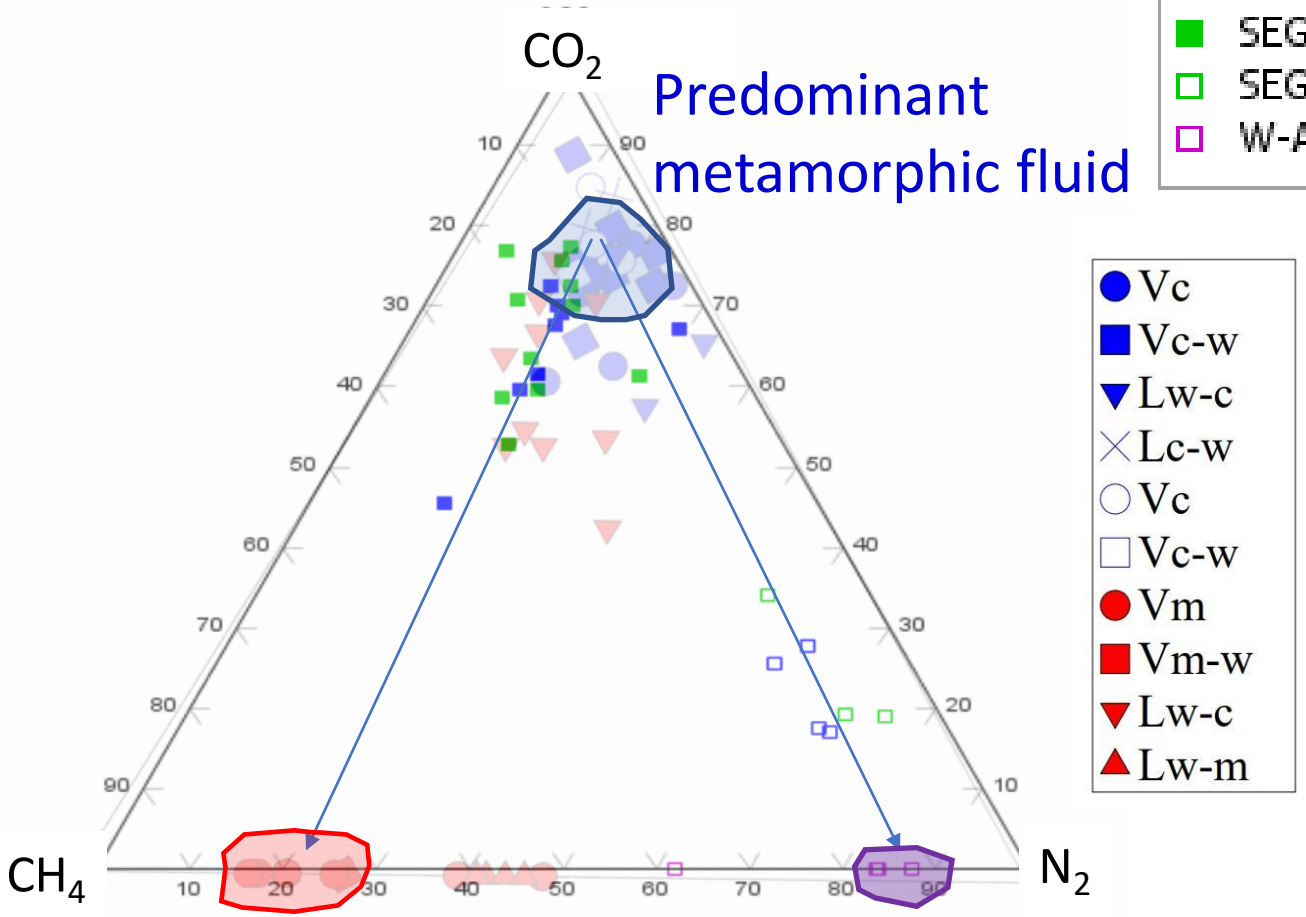
Composition of the volatile phase







Composition of the volatile phase- SEGURA area - all data



SEG 7X-Lw-c
SEG 7X-Lw-n
SEG mine Sn-Lw-c
SEG mine Sn-Lw-n
W-ARS-Lw-n

Vc
Vc-w
Lw-c
Lc-w
Vc
Vc-w
Vm
Vm-w
Lw-c
Lw-m

Predominant metamorphic fluid

Methane rich Vapours

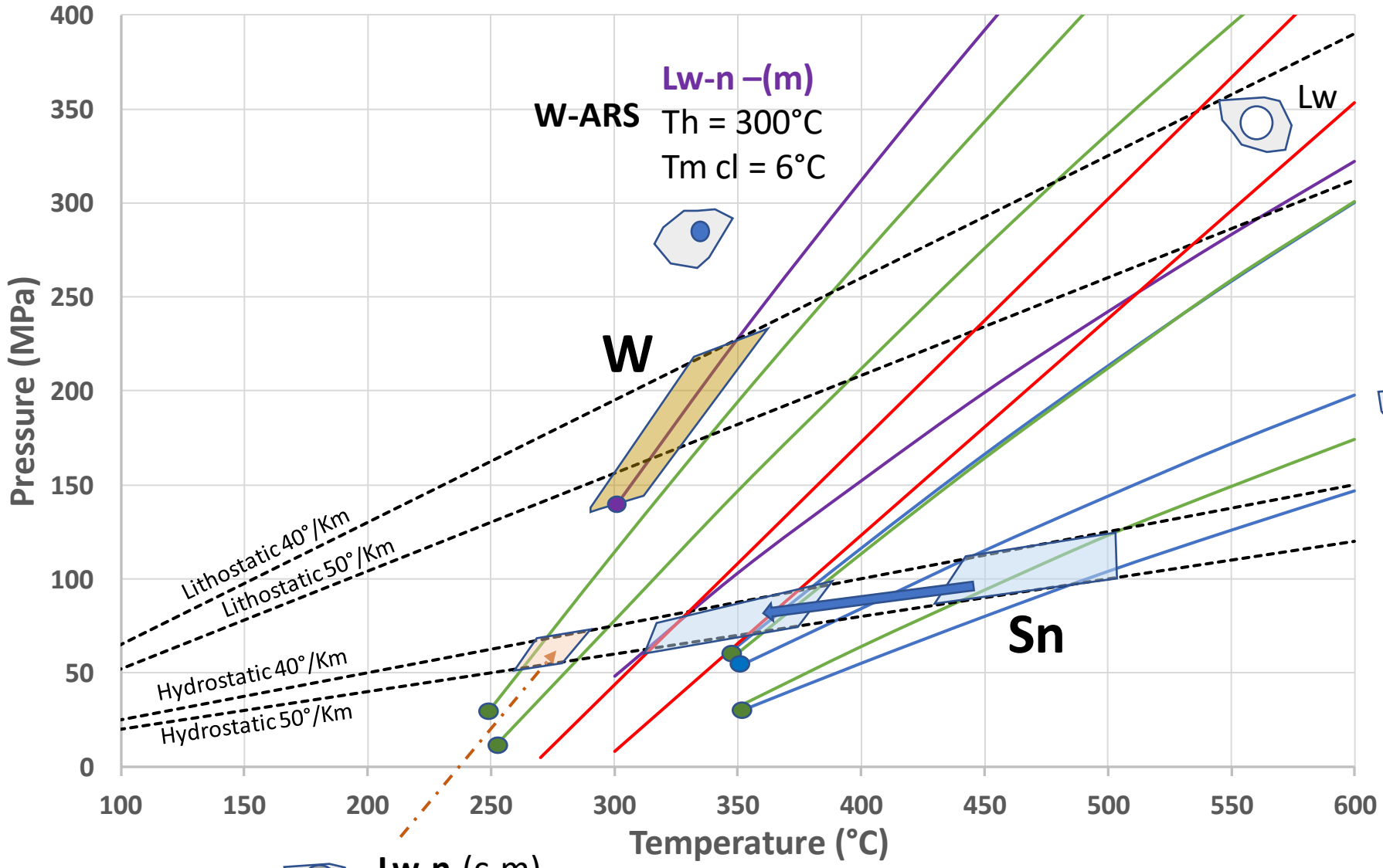
Nitrogen bearing aqueous fluid inclusions

No evidence of magmatic fluids as in many other Sn-W prospects, even in dykes

- Lack due to quartz recrystallization ?

Or quasi-absence ?

SEGURA- Sn and W prospection or mining zones



Sn mines

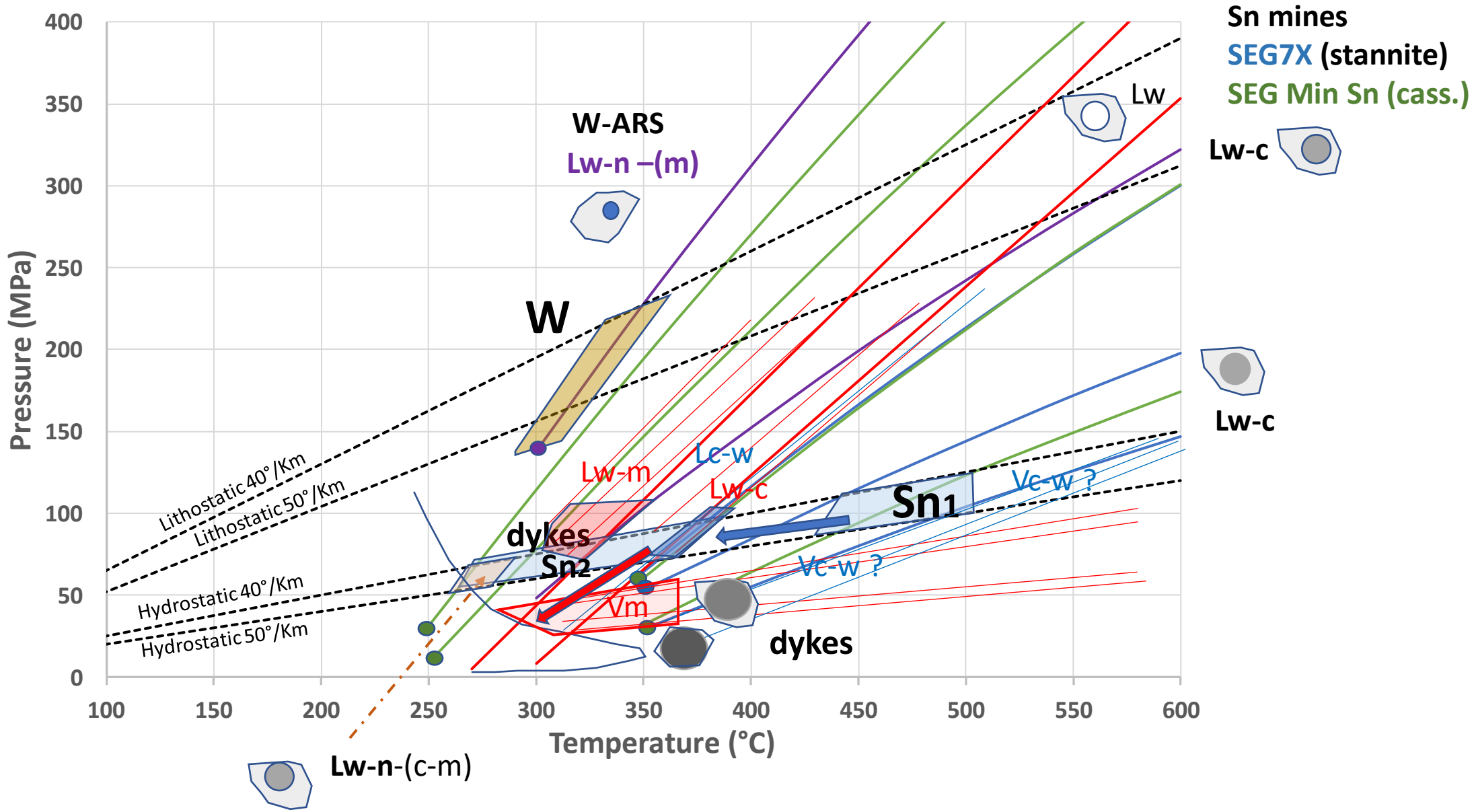
SEG7X (stannite)

SEG Min Sn (cass.)

Lw-c
Th = 250°C
Tm cl = 10-12°C
Some Tm CO_2

Lw-c
Th = 350°C
Tm cl = 10-11°C
Tm CO_2 = -62°C

SEGURA area - all data



Main conclusions

Sn ores in Segura dykes : Two stages of Sn mineralisation

- Cassiterite disseminated in hyper-differentiated dykes, Sn - Nb –Ta oxides in the dykes
- Large euhedral crystals of cassiterite in lepidolite-rich altered dykes

Sn ore in micaschists : Old Mine Sn and W-prospects

- Quartz vein with stannite, sphalerite, arsenopyrite, native Bi, Ag-Bi-sulphide

Composition and origin of the fluids

Sn- ores

- Predominant metamorphic fluids (H_2O-CO_2 rich fluids, low density of the volatile phase) associated to Sn ores
- Methane-rich vapor in the dyke from Cerro Queimado
- Change in the composition of the volatile phase: increase of the CH_4 and N_2 content,
  Temperature decreases from 400 to 270°C, sub-constant pressure around 50 MPa

W- ores

H_2O-N_2 (CH_4) rich fluids (No CO_2) 150-200 MPa and 300-350°C

No evidence of magmatic fluids as in other Sn-W prospects, even in dykes