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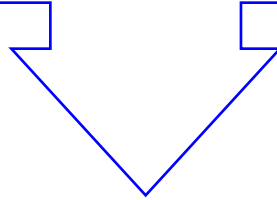
The nature of mineralising fluids involved in the Pedra-Alta (Sn-Li) and Vale Pião (W) systems

A. Guedes; A. Yakovenko; M. Rodrigues;
M. Gaspar; A. Mateus

Objectives



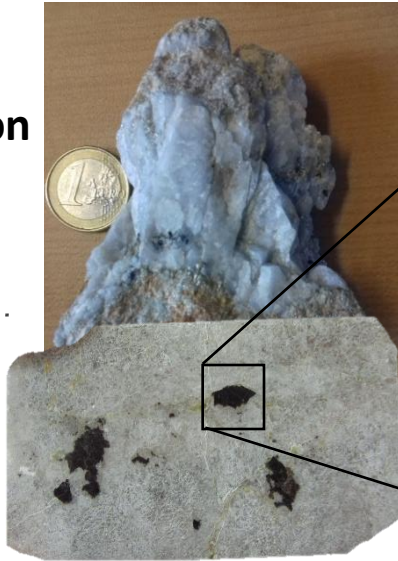
Identification and characterization of fluids, and the track of pathfinders in fluid inclusions chemistry, determining the composition of mineralizing fluids ...



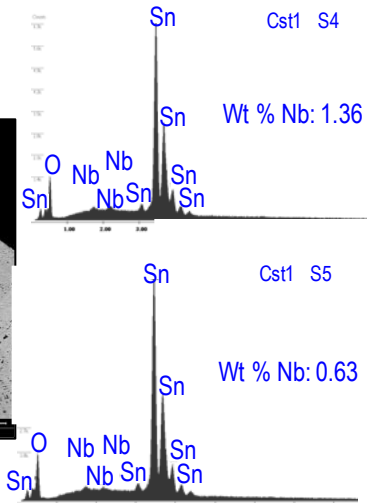
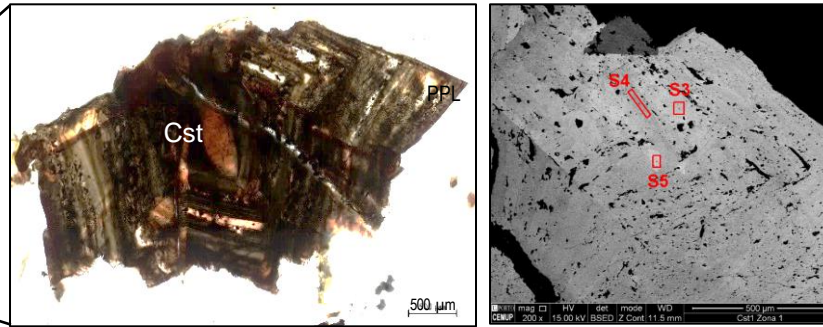
Interpretation of these results together with mineral chemistry will help the recognition of determinant factors for metal concentration/deposition at the ore system scale.

Materials and methods

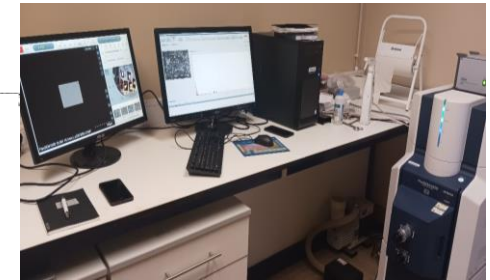
Sample preparation



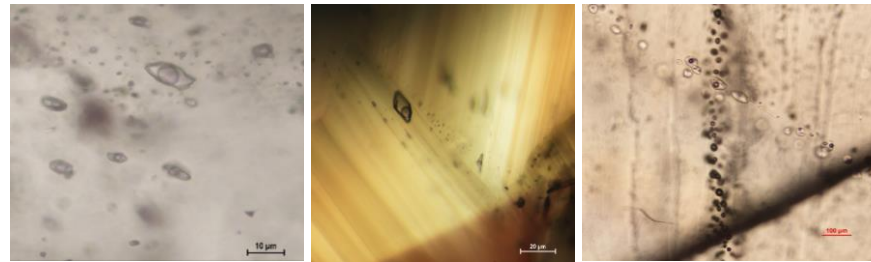
Petrography



SEM-EDS



Fluid inclusions study



Stable isotopic analyses

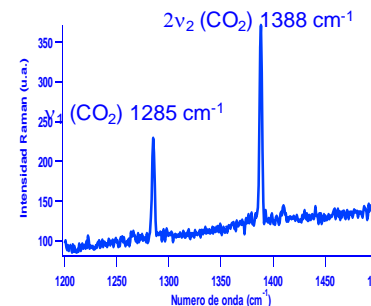
$\delta^{18}\text{O}$
 δD

Microthermometry

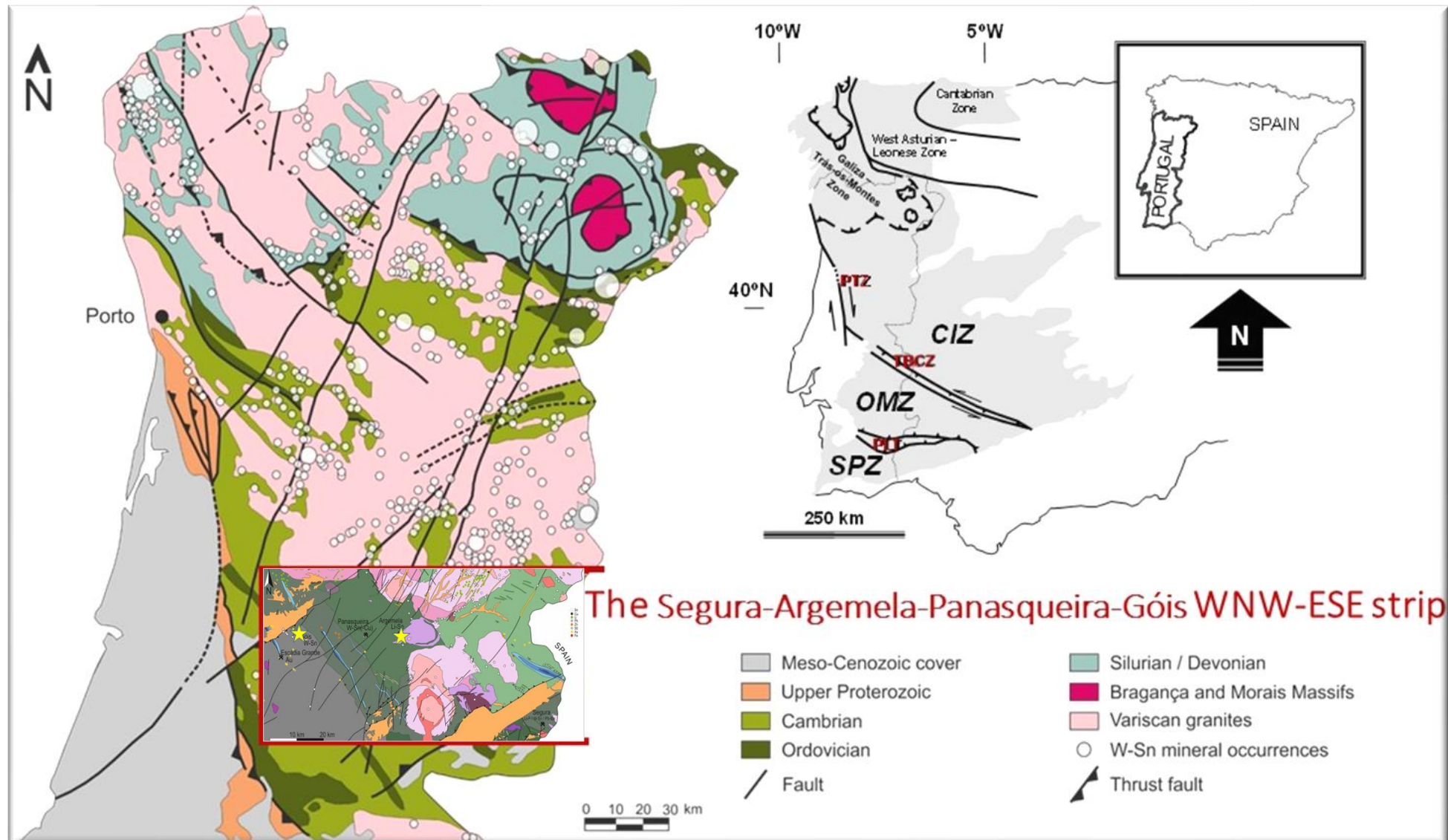


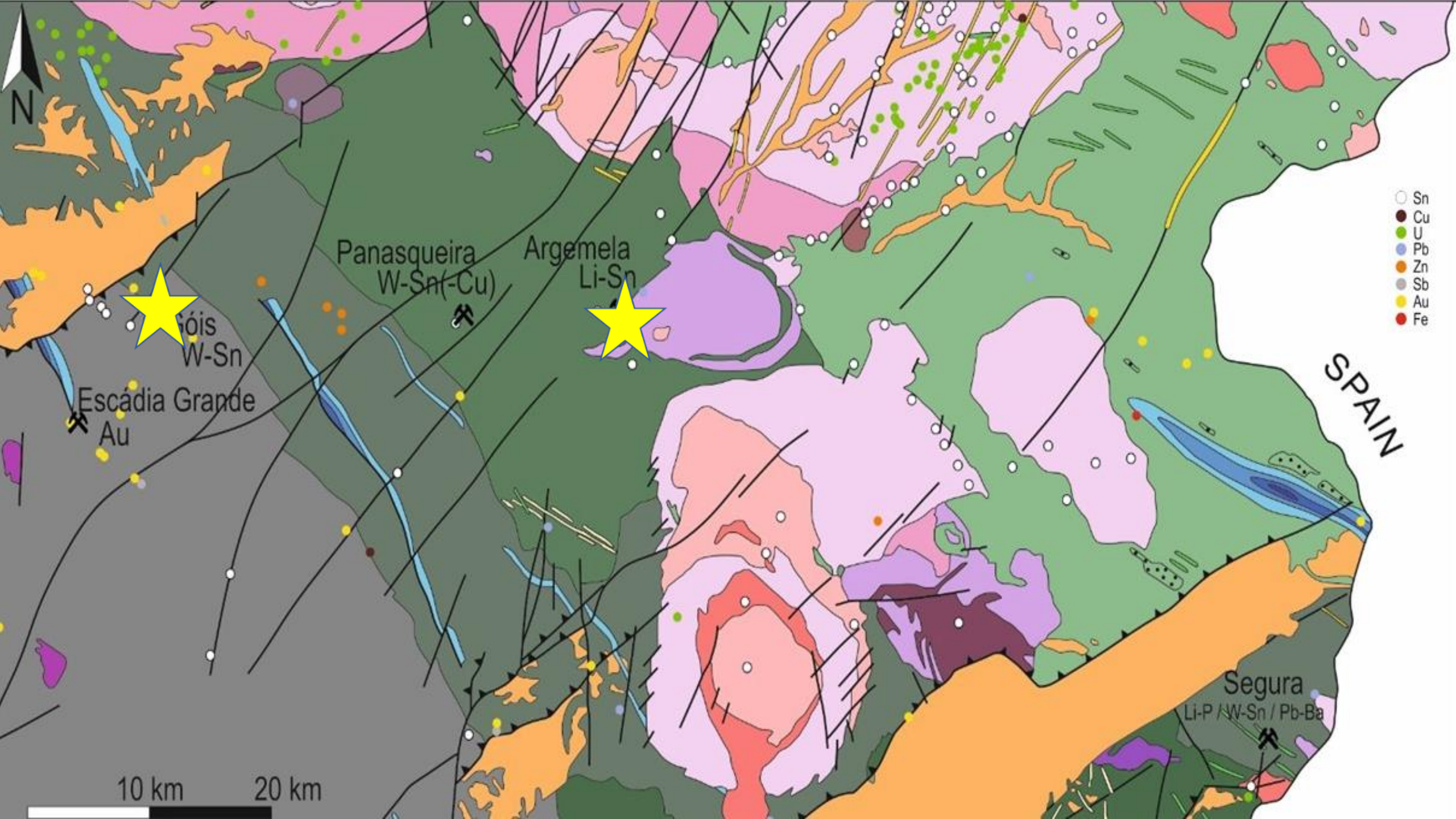
TmCO_2
 Tmice
 TmCl
 ThCO_2
 Th

Raman microspectrometry

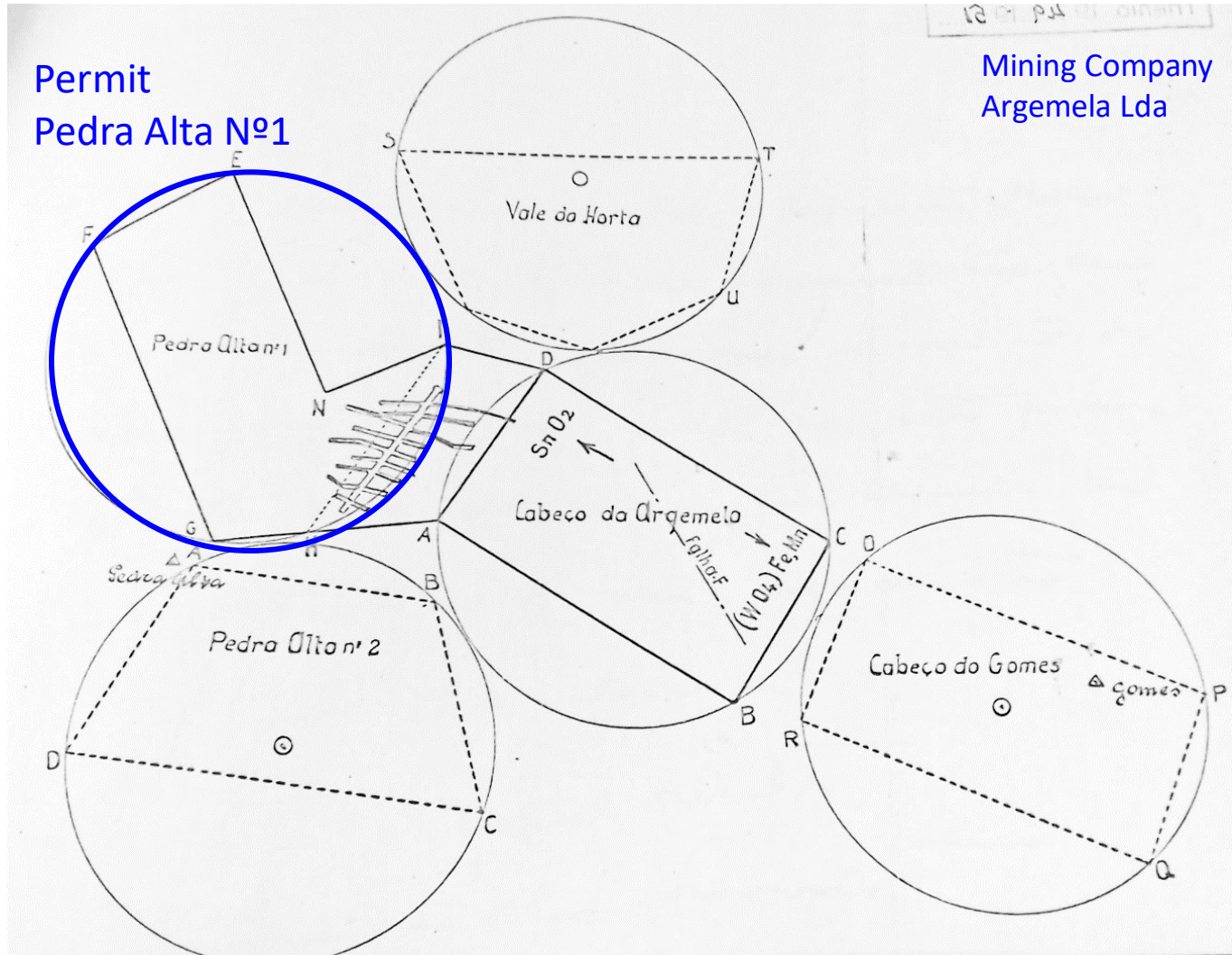


Pedra-Alta (Sn-Li) and Vale Pião (W) systems





Argemela tin mine - Pedra Alta



Mineralized quartz lodes collected on the old underground mine were studied.

Previous studies

Quartz lodes:

Inverno & Ribeiro (1980); Inverno et al. (2019); and Michaud & Pichavant (2020).

Fluid inclusions studies:

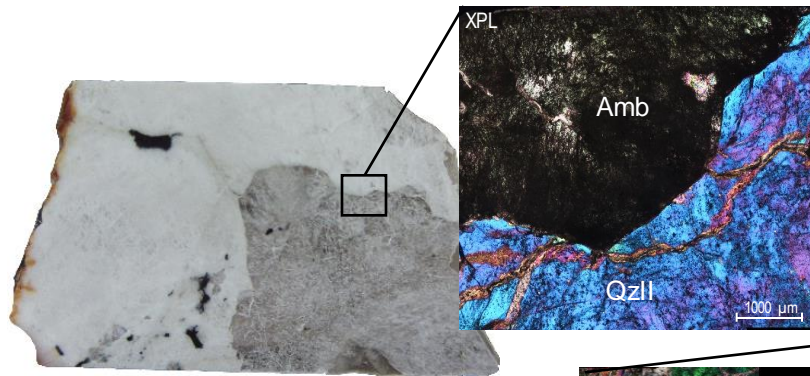
Lourenço (2002)- Cryometric studies on quartz and cassiterite – detected clathrates;

Inverno et al. (2019) -

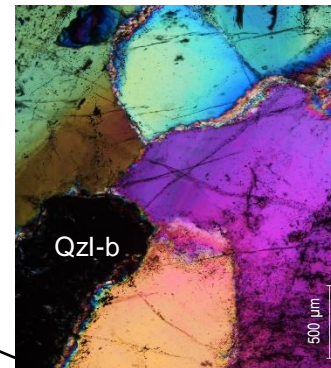
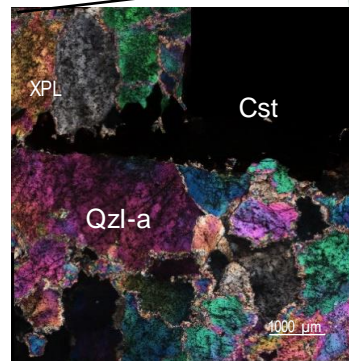
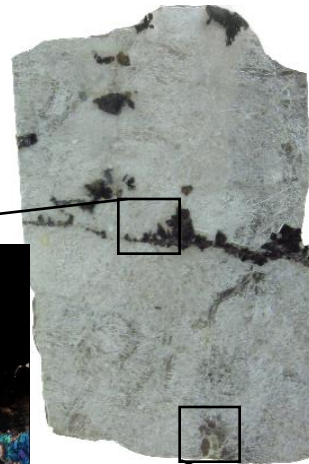
Microthermometric studies in quartz, cassiterite, apatite, ..; Raman microspectrometric analyses on quartz – no volatiles detected.

Mineralogy

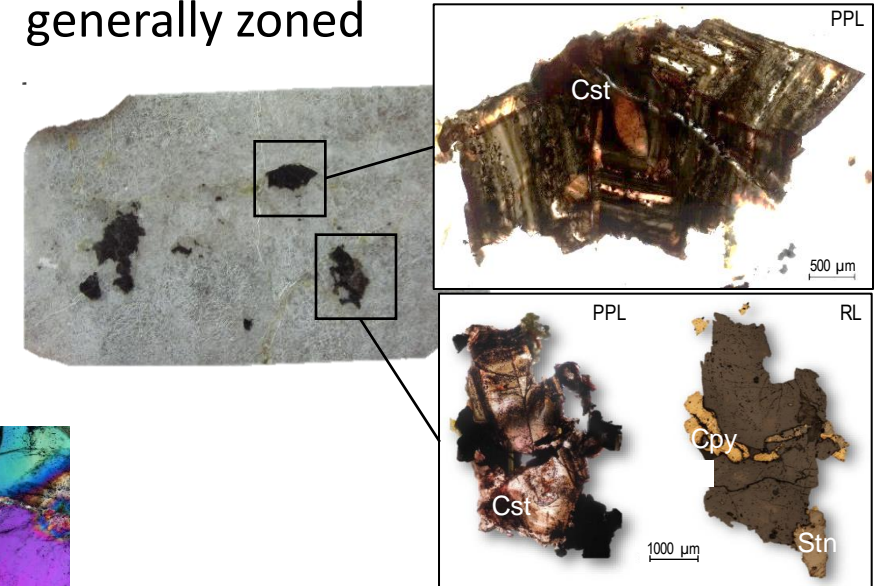
Massive **amblygonite**, white to greenish in colour, in well-developed crystals



Milky to hyaline **quartz**, heterogeneous in size, some with a comb texture and undulating extinction

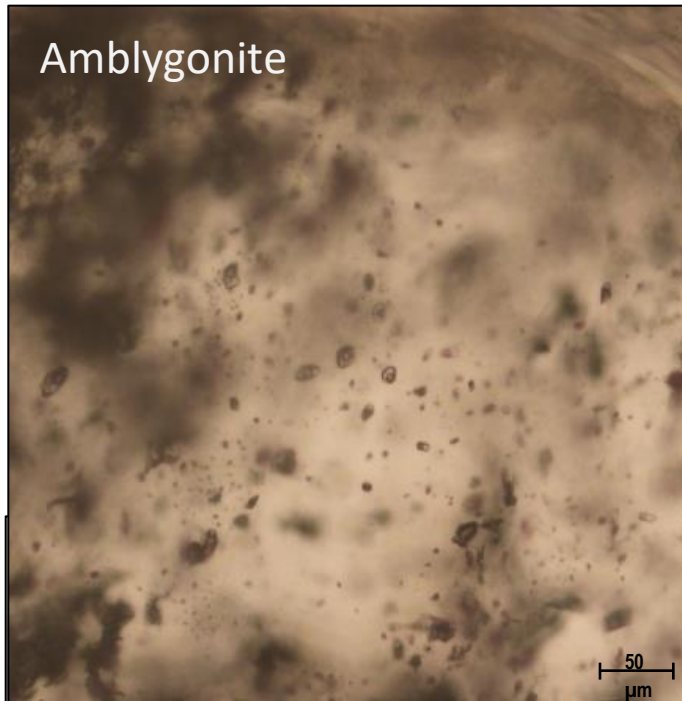


Anhedral to euhedral **cassiterite** generally zoned

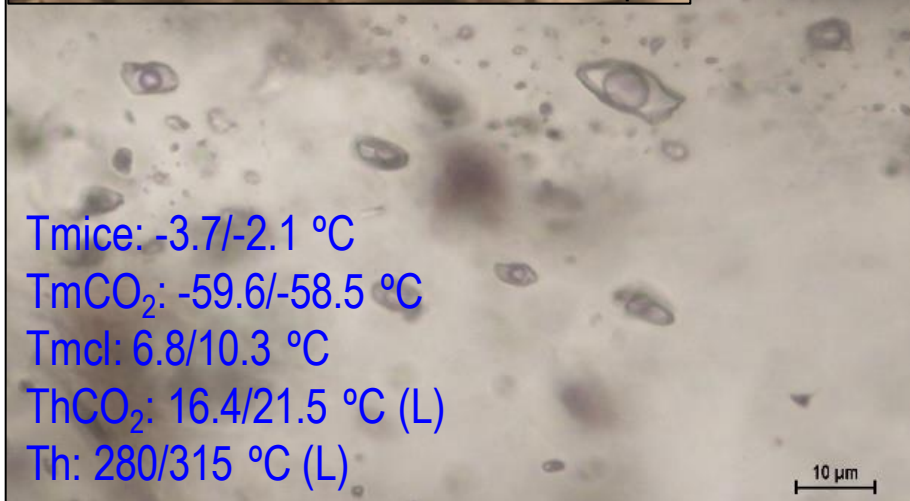
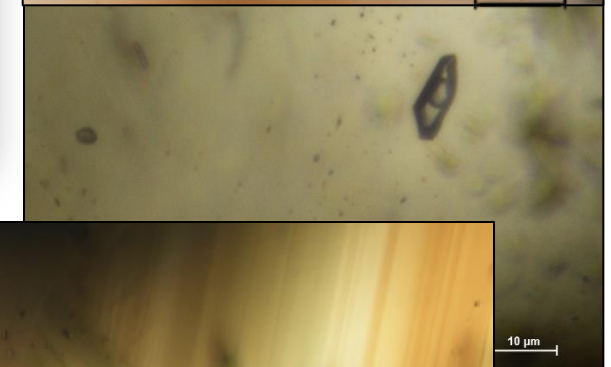
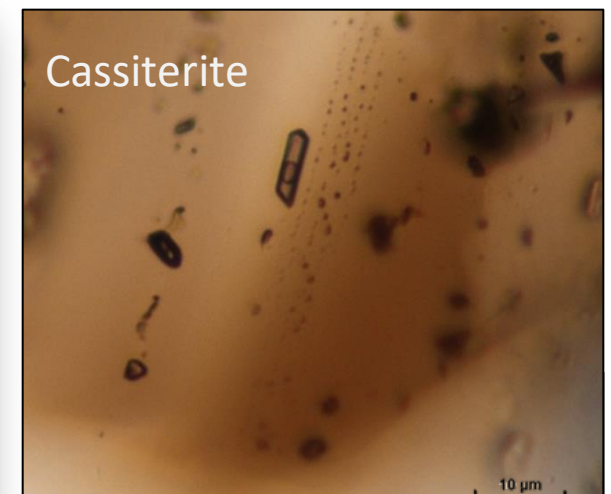
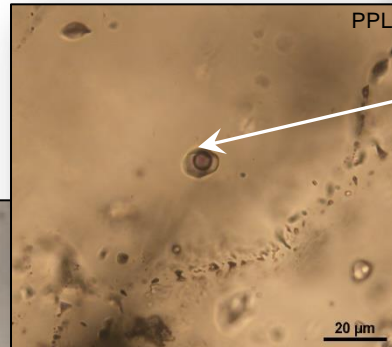
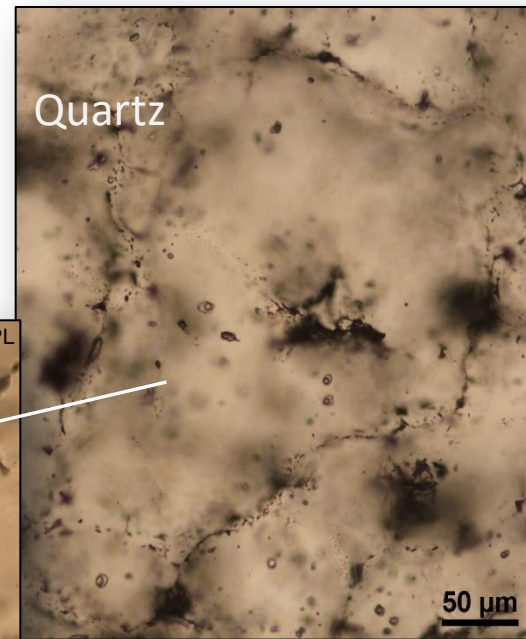


Lodes also contain sphalerite, stannite, chalcopyrite, columbo-tantalite, native bismuth, bismuthinite, ..

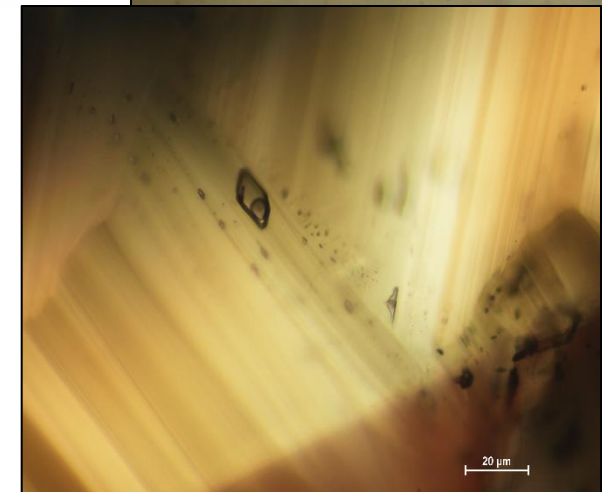
Fluid inclusions petrography and microthermometry



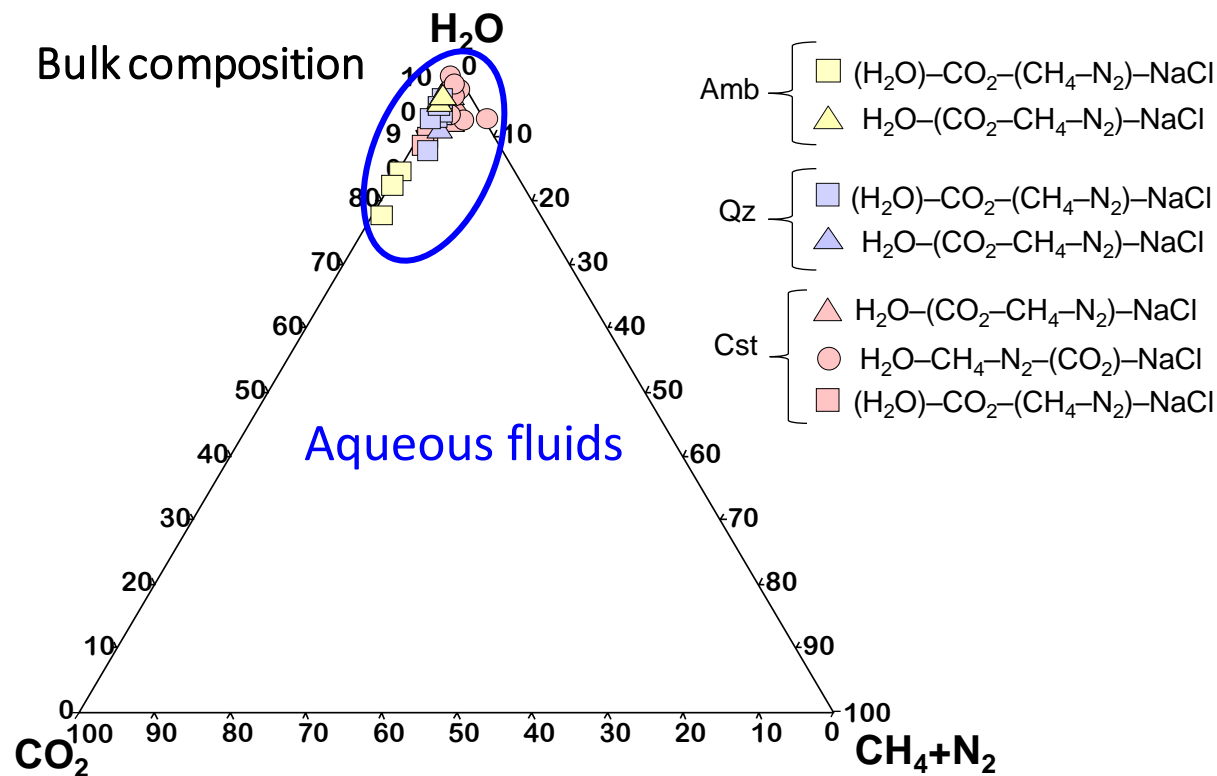
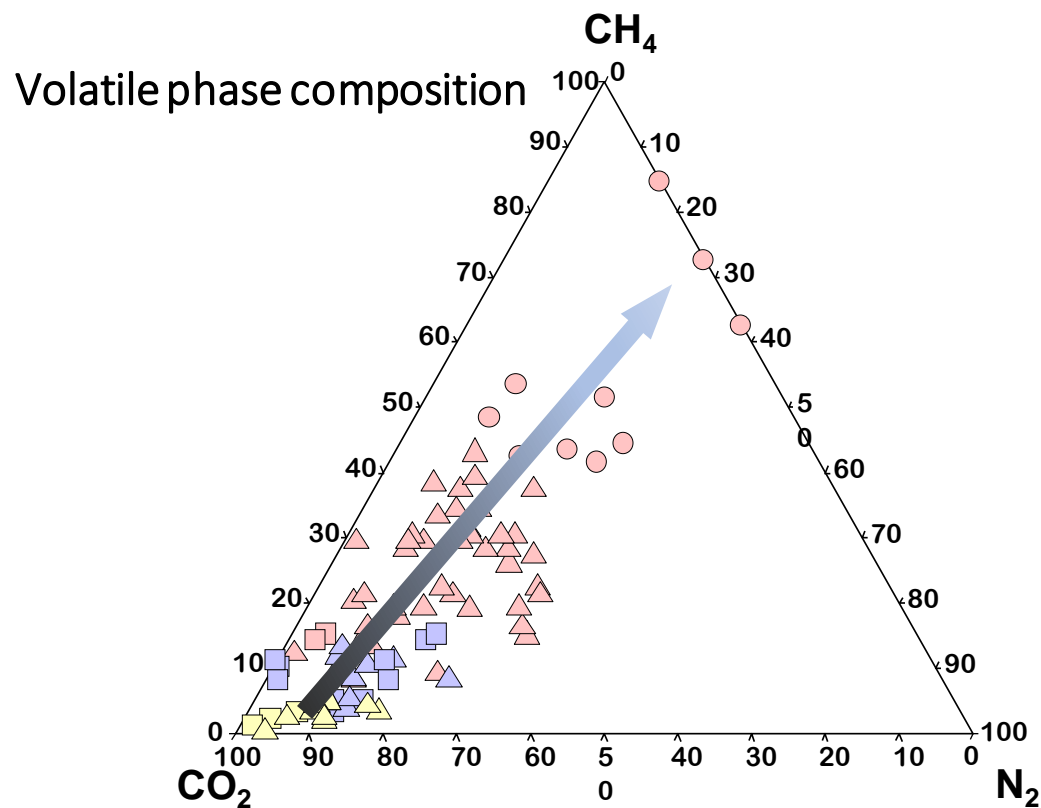
Tmice: -4.3/-0.5 °C
TmCO₂: -61.7/-60.2 °C
ThCO₂: -9.7/0.5 °C (V)
Tmcl: 9.4/14.2 °C
Th: 311/351 °C (L)



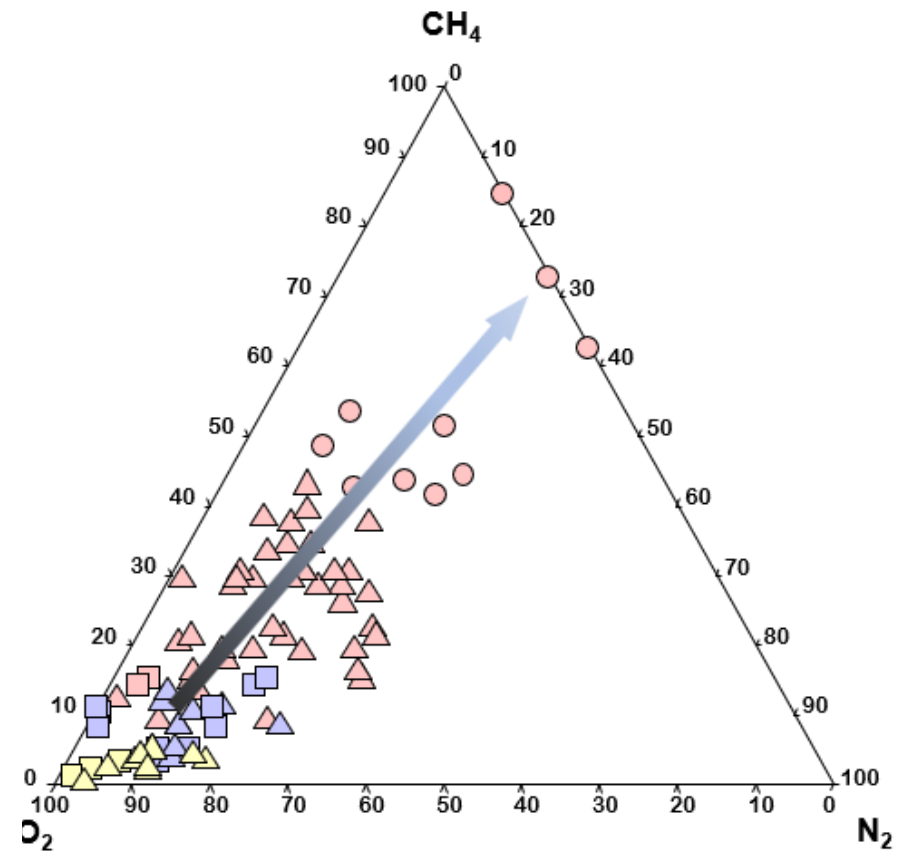
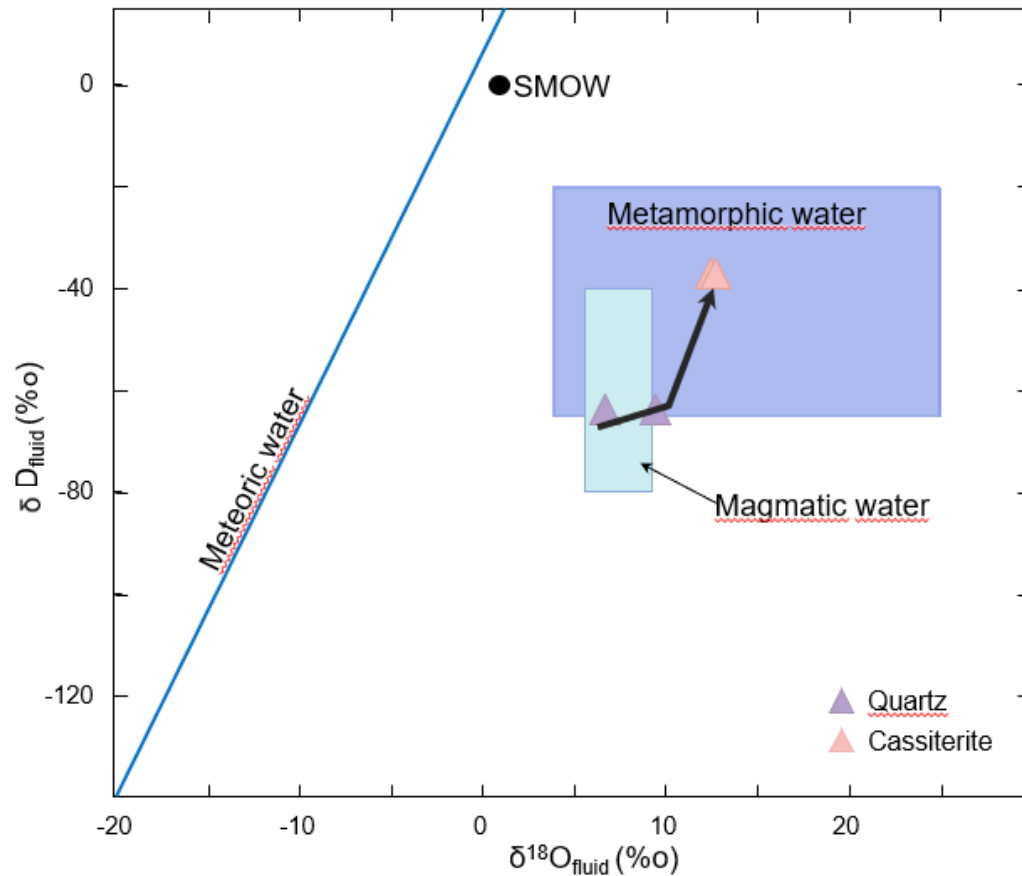
Tmice: -3.0/-0.8 °C
TmCO₂: -63.5/-62.9 °C
ThCO₂: 2.3/3.8 °C (C)
Tmcl: 4.1/16.8 °C
Th: 234/329 °C (L)



Composition of ore-forming fluids

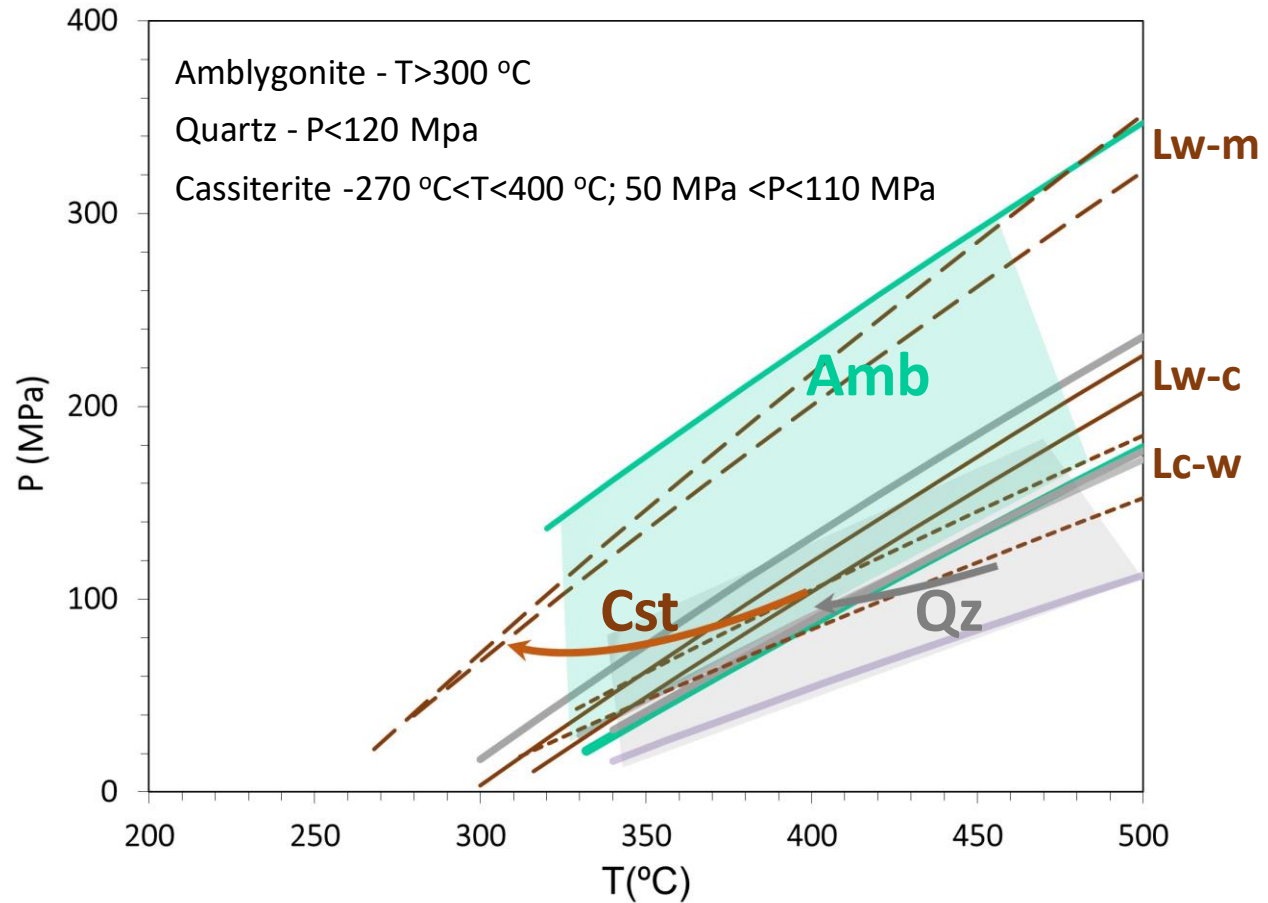


Isotopic composition of ore-forming fluids

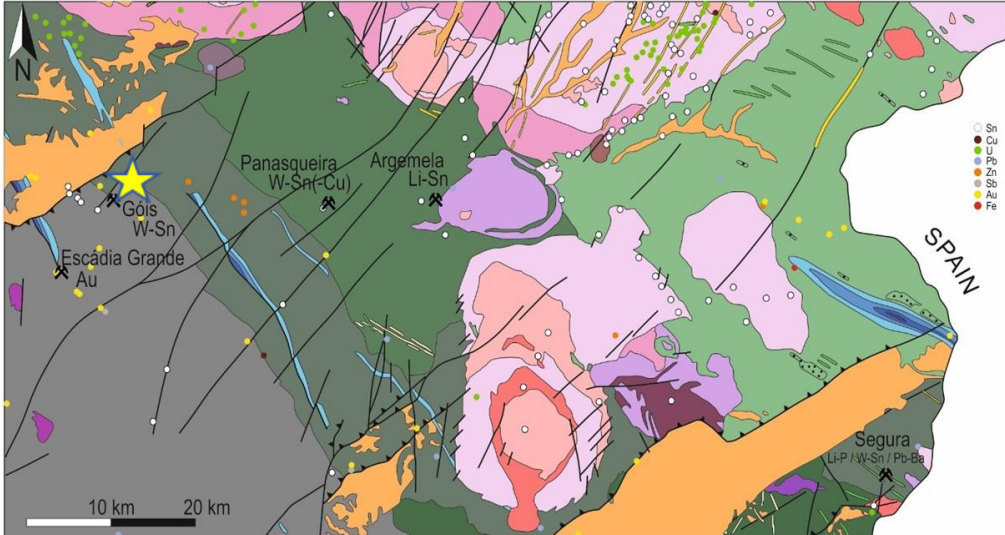


Isotopic composition of the fluids suggests the involvement of mixtures of components derived from “magmatic/hydrothermal waters” with a fluid isotopically equilibrated with the metamorphic host rocks. This fluid show variations from CO_2 -dominated to CH_4 -dominated and was responsible for cassiterite deposition.

Trapping conditions of ore-forming fluids

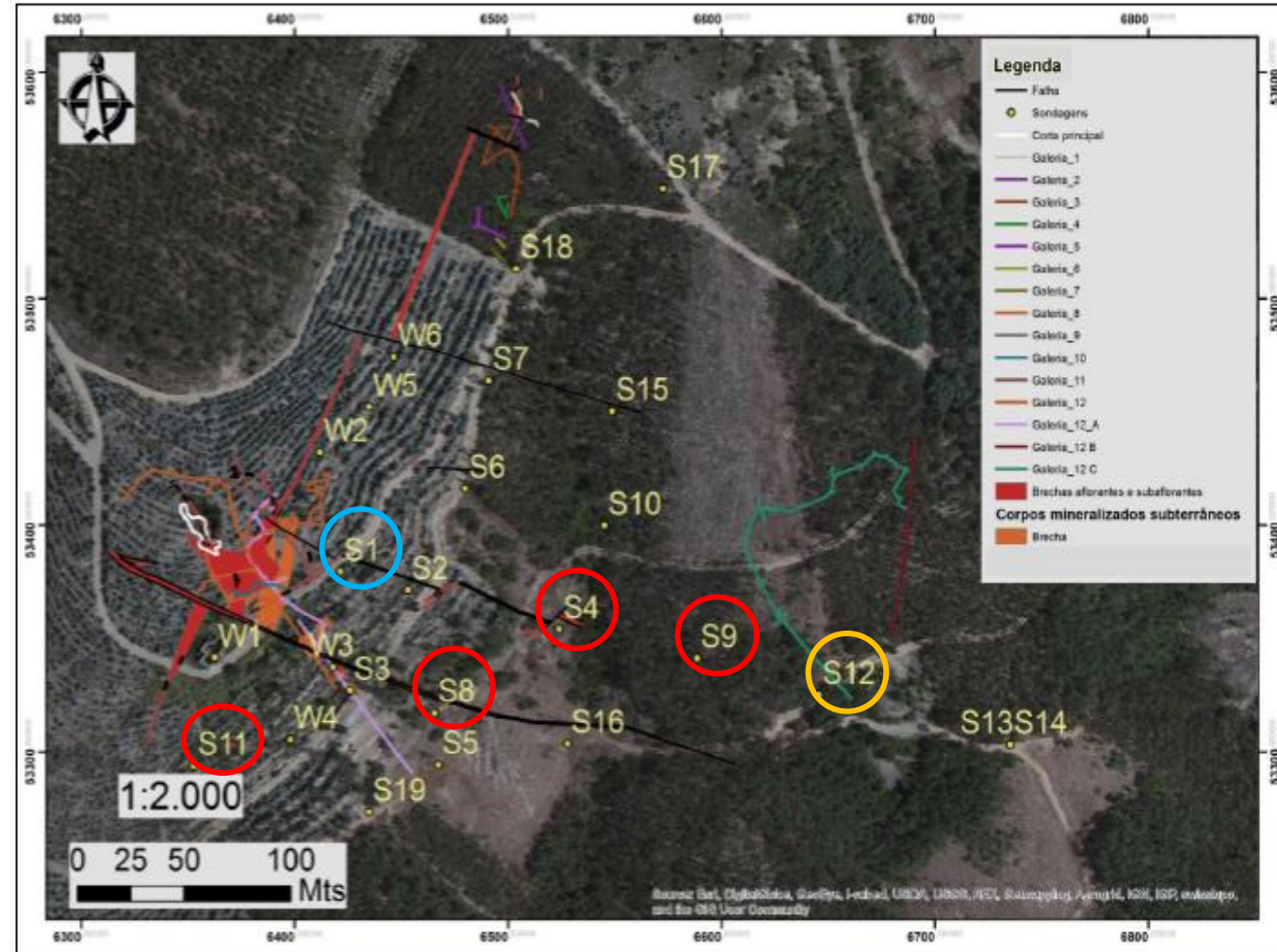


Vale Pião



According to the official, 1:500.000 Geological Map (LNEG). Mineralization occurrences as in SIORMINP (LNEG)

Drillholes location in the Vale Pião zone



Preparation of 27 doubly polished sections from quartz lodes and breccias with scheelite

Samples already studied by M. Gaspar and collaborators.

Drillhole (2)	Sample (8)
S1 Quartz lodes with scheelite	S1 65.20
	S1.76.75 L1
	S1 81.60
S12 Breccia with scheelite	S12 180.29 L1
	S12 180.74 L1
	S12 180.74 L3
	S12 182.39 L1
	S12 183.70 L2

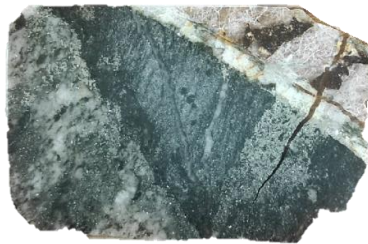
S1

Quartz lodes with scheelinite



65.20

Disseminated



76.75

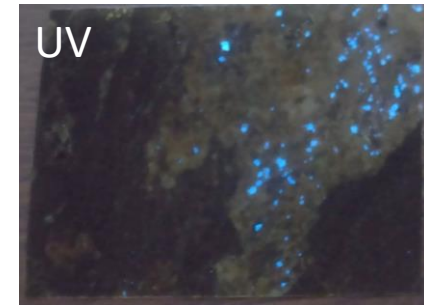
In veinlets



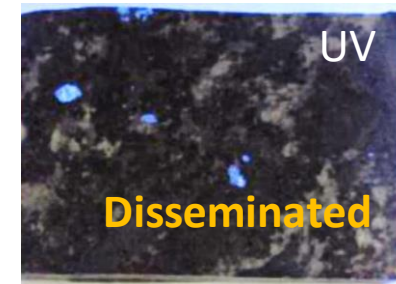
81.60

S12

Breccia with scheelinite

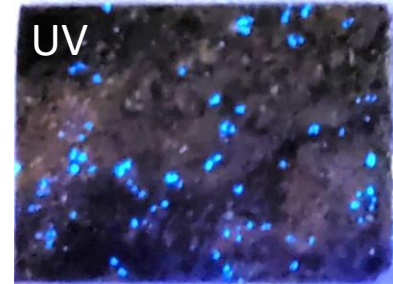


180.29 L1

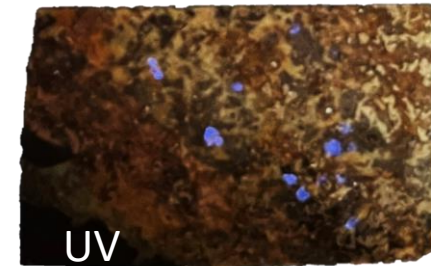


180.74
L1+L3

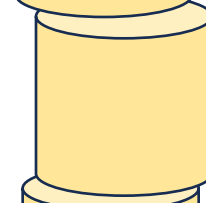
Disseminated



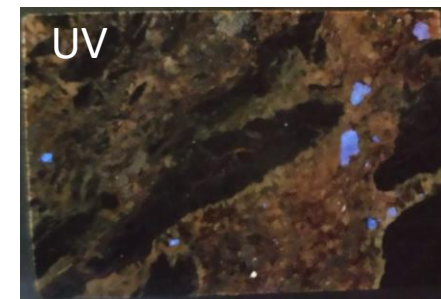
182.39 L1



UV



183.70 L2



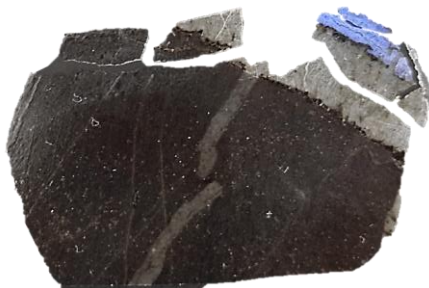
UV

Drillhole S1

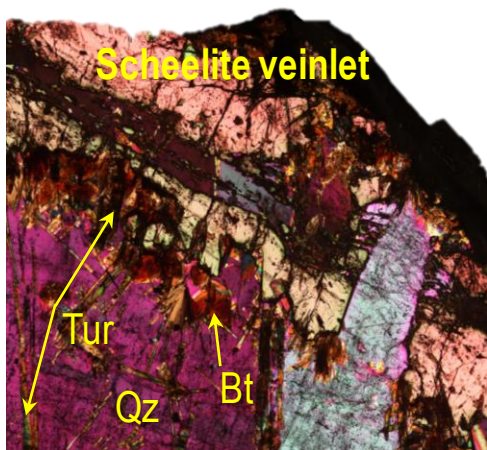
Quartz lodes with scheelite

Fluid inclusions petrography and microthermometry- **Scheelite**

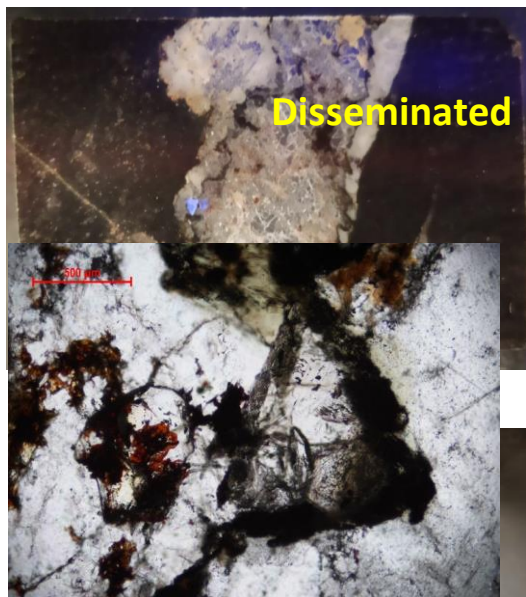
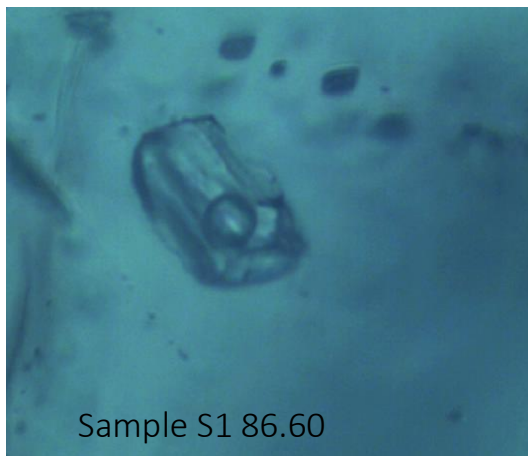
Tmice: -2.8/-1.8 °C and Th: 225/252 °C (L)



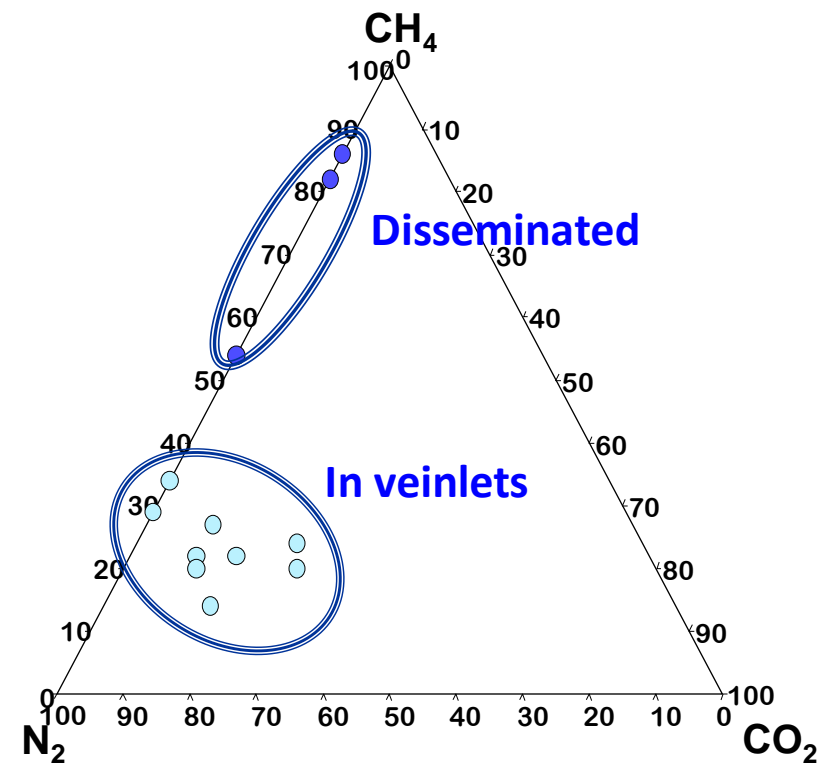
Tmcl: 2.3/16.2 °C
(81.60) in veinlets



Tmcl: 16.2/16.7 °C
(65.20) disseminated

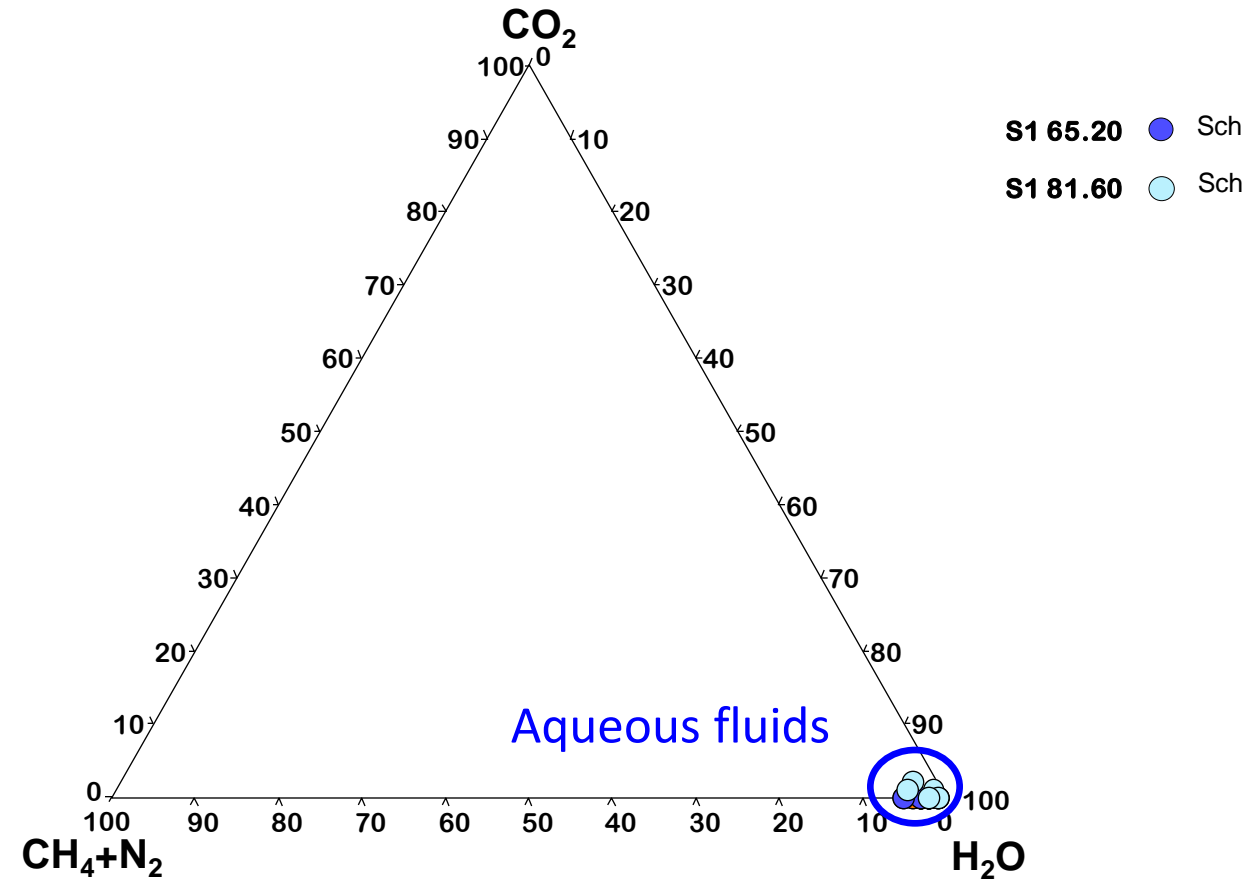


Volatile phase composition of ore-forming fluids



Quartz lodes with scheelite

Bulk fluid composition



Breccia with scheelite



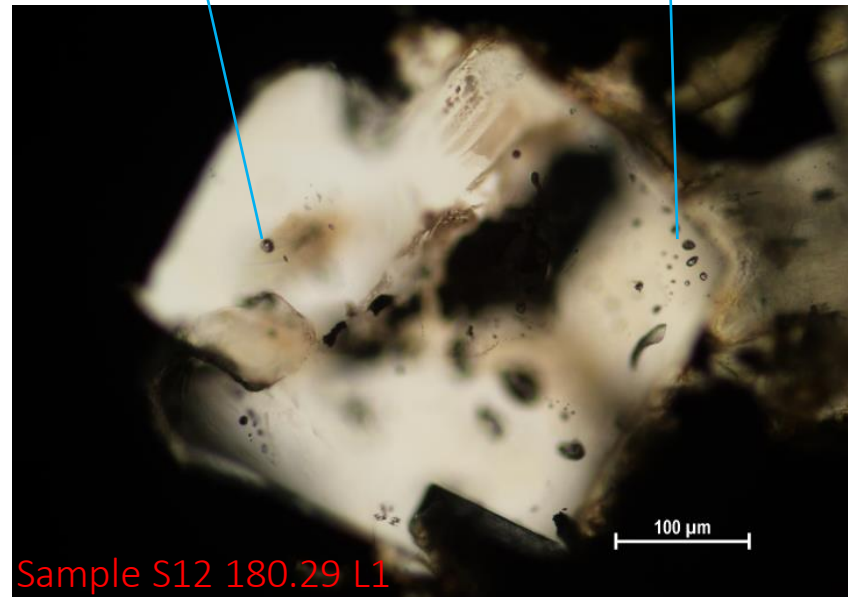
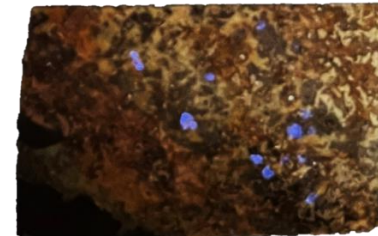
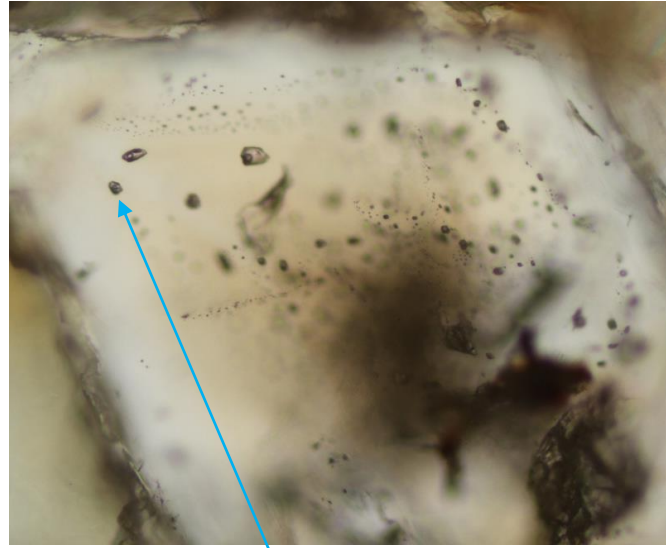
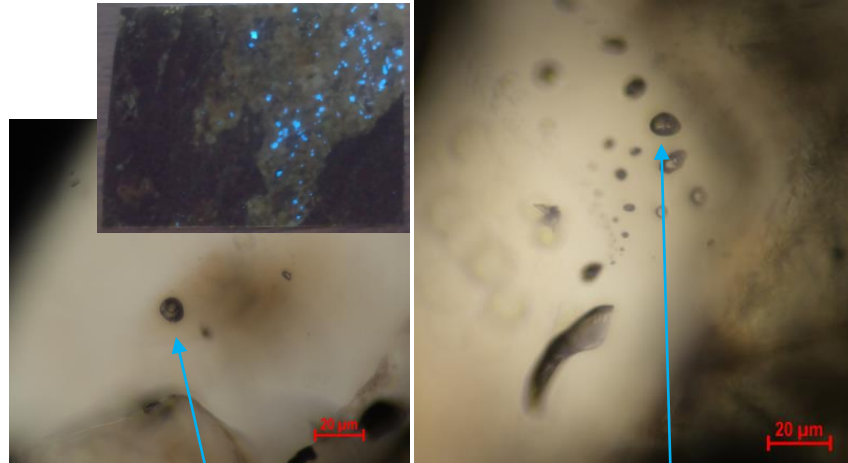
Fluid inclusions petrography and microthermometry- Scheelite

ThCH₄: -90.9/-88.2 °C

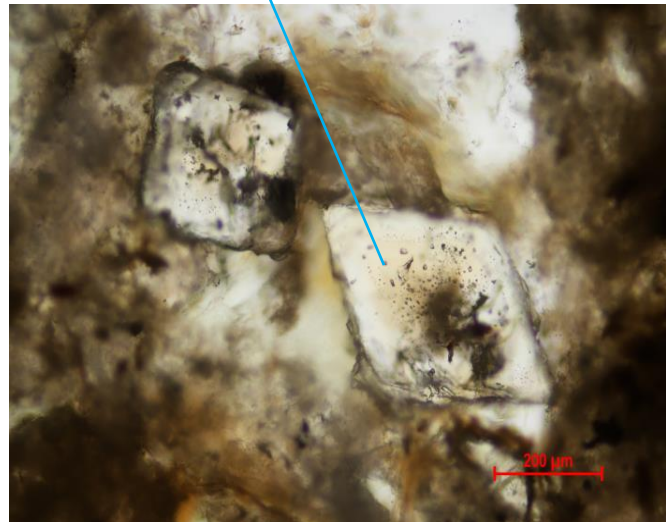
Tmice: -4.2/-1°C

Tmcl: 5.2/17.6

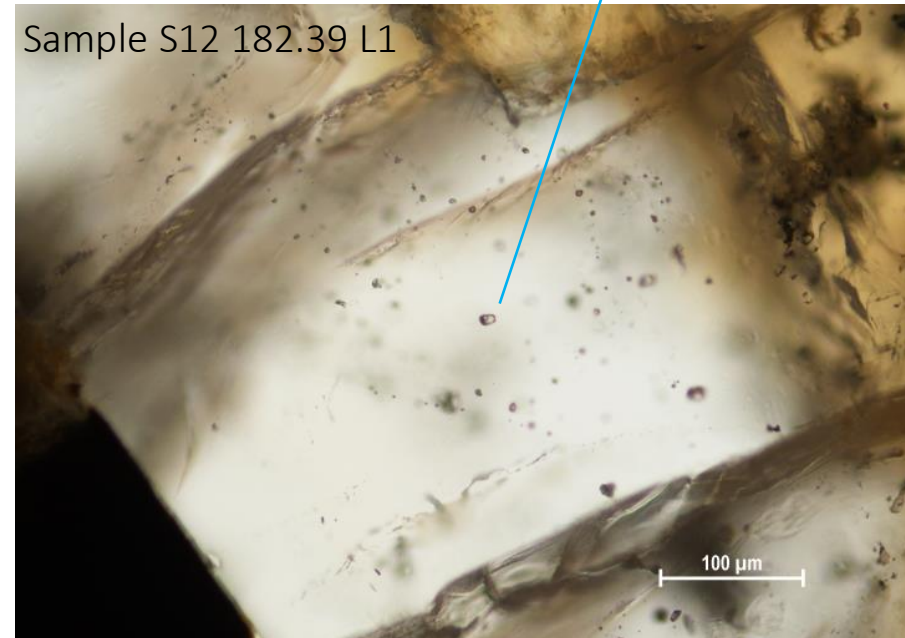
Th: 223/301°C (L)



Sample S12 180.29 L1



Sample S12 182.39 L1

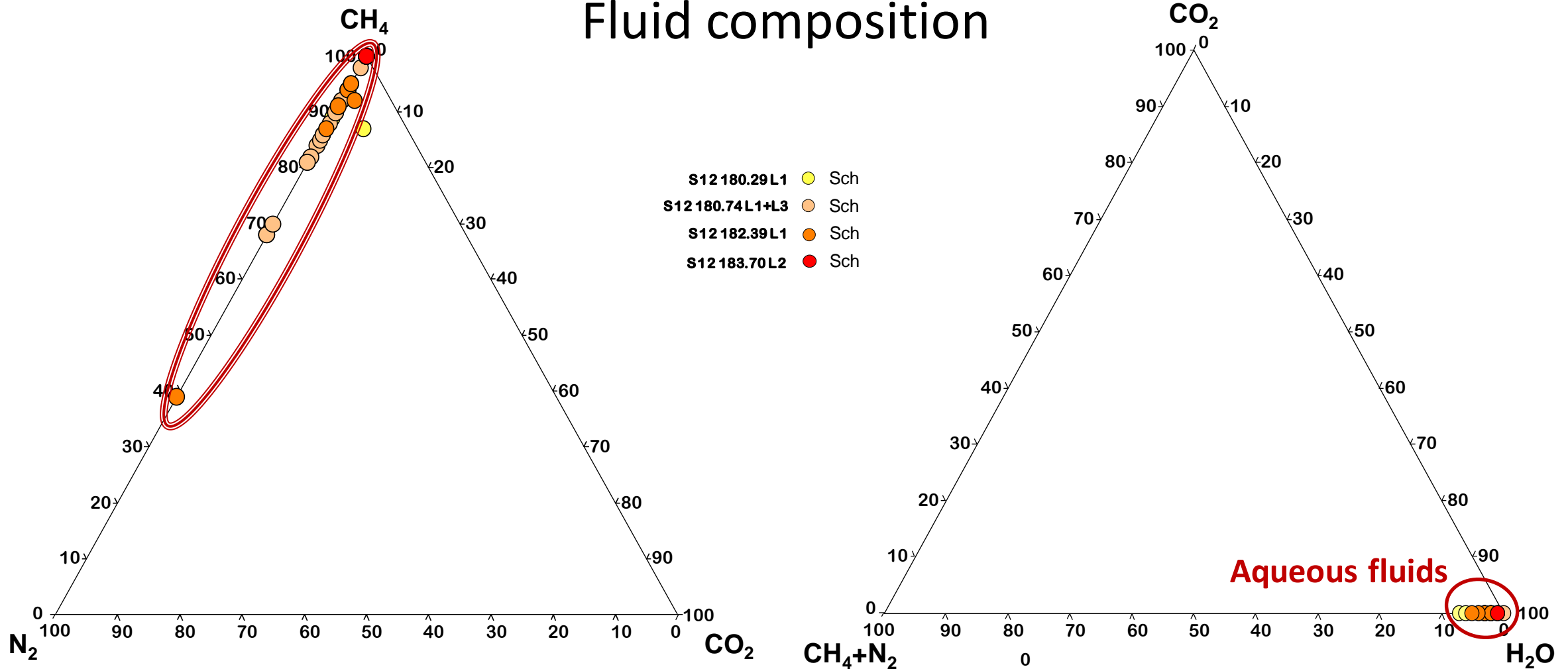


S12

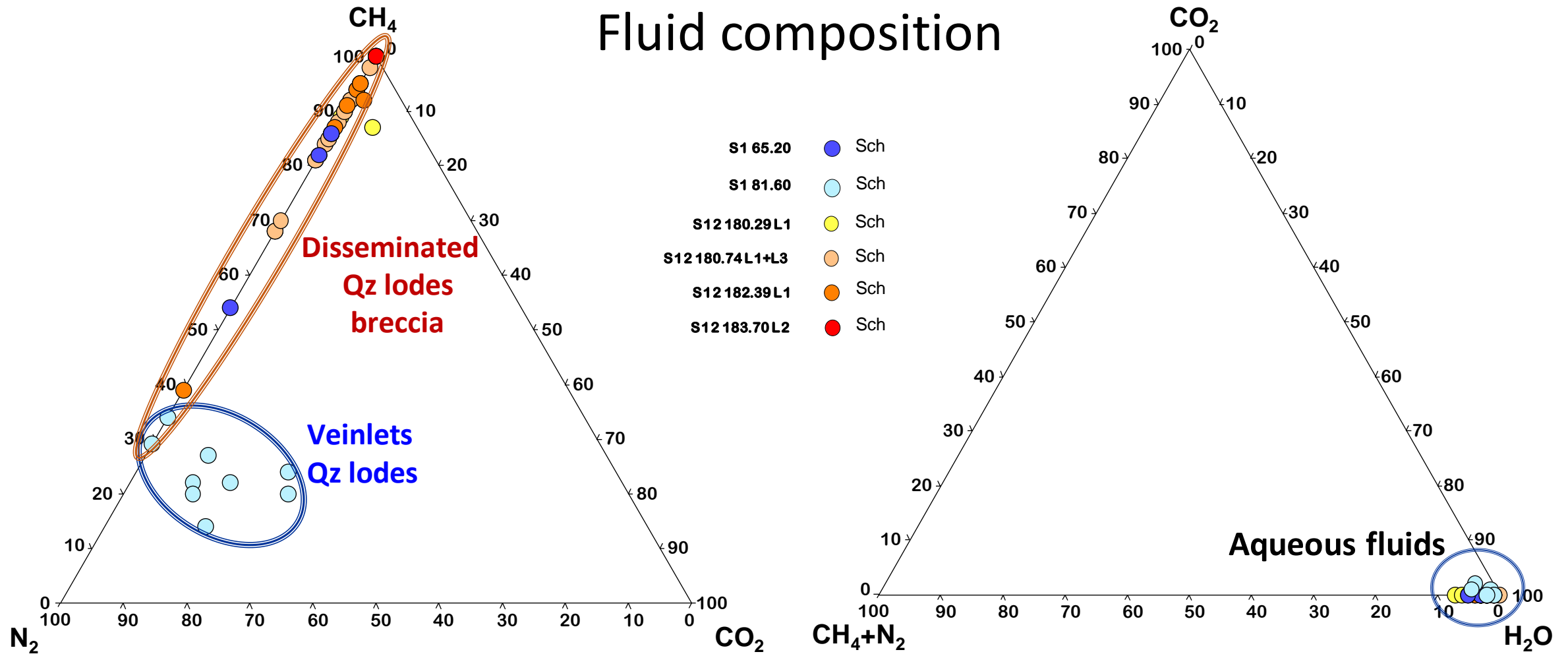


Breccia with scheelite

Fluid composition

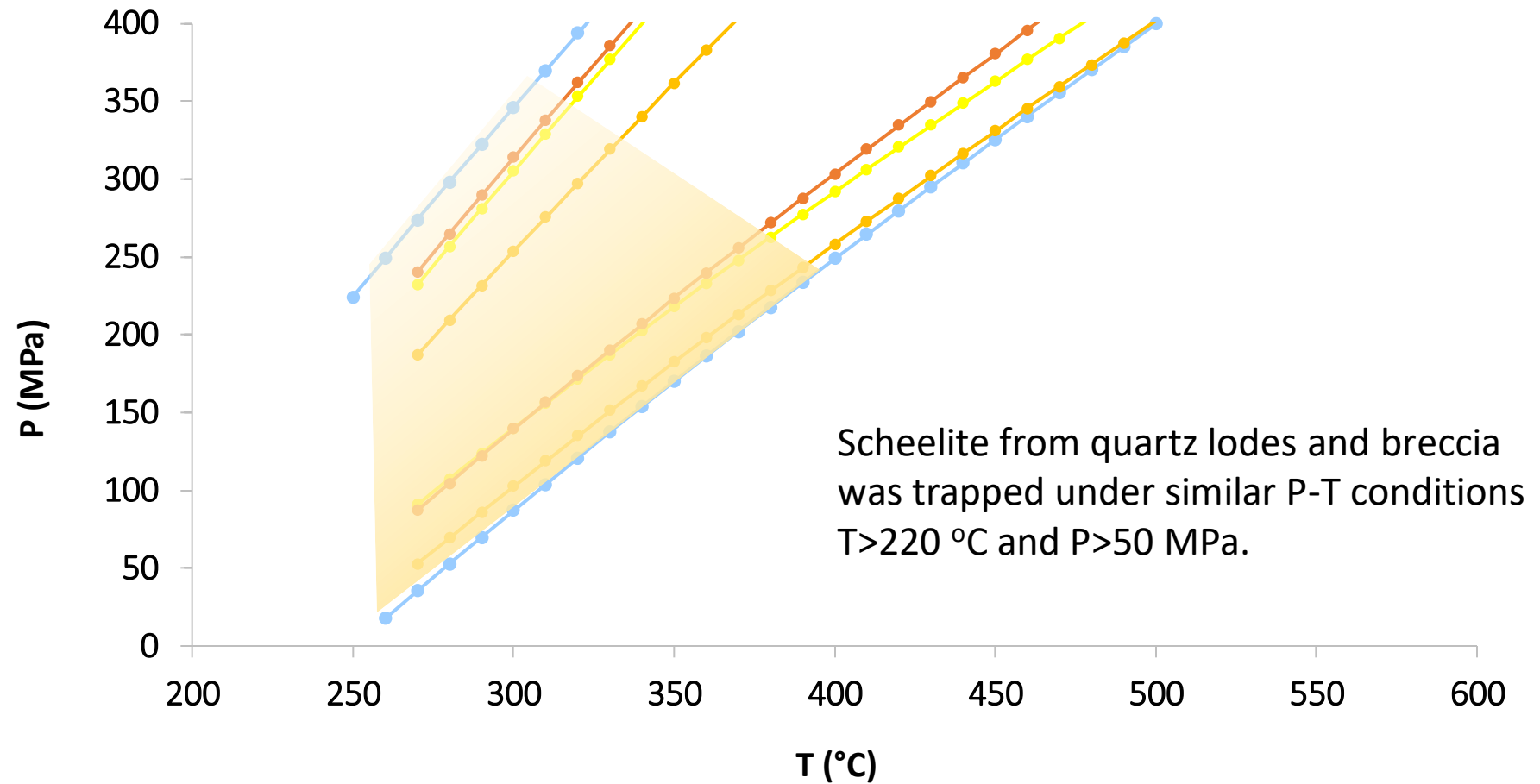


Quartz lodes and breccia with scheelite



Water is the main component an CO_2 , CH_4 , N_2 and salt components are minor;
 In disseminated scheelite, both in quartz lodes and breccias, volatile phase are enriched in CH_4 and N_2 ;
 In scheelite veinlets volatiles includes CO_2 , and the N_2 content is higher than CH_4 .

Trapping conditions of ore-forming fluids



Conclusions

- The ore-forming fluids involved in the Pedra-Alta (Sn-Li) and Vale Pião (W) systems are aqueous with low volatile content.
- The mineralizing fluids responsible for cassiterite mineralization at Pedra Alta and scheelite mineralization at Vale Pião show a volatile phase enriched in CH_4 and N_2 tracing an increasing participation of fluids equilibrated with metamorphic rocks hosting the mineralization.

Conclusions

- In Pedra Alta system fluids trapped in amblygonite and quartz show a volatile phase dominantly constituted by CO_2 , however fluids trapped in cassiterite show variations from CO_2 -dominated to CH_4 -dominated.

The isotopic composition of the fluids in equilibrium with quartz and cassiterite suggests the involvement of mixtures of components derived from magmatic /hydrothermal waters with others equilibrated with the metamorphic host rocks. The latter fluid components increase from quartz to cassiterite deposition, tracing an increasing participation of fluids compositionally buffered by the metasedimentary rocks hosting the mineralised veins throughout the ore-forming events at temperature and pressure around 400 °C and 110 MPa.

- In Vale Pião system fluids trapped on disseminated scheelite show volatiles enriched in CH_4 and N_2 , whereas the volatile phase composition of fluids in scheelite veinlets also includes CO_2 and the N_2 content is higher than CH_4 . Scheelite from quartz lodes and breccia were trapped under similar P-T conditions.



Thank you