

Université de Liège
Faculté des Sciences
Département de Géologie
Laboratoire de Minéralogie



Occurrence of tellurides in the Stavelot Massif, Belgium

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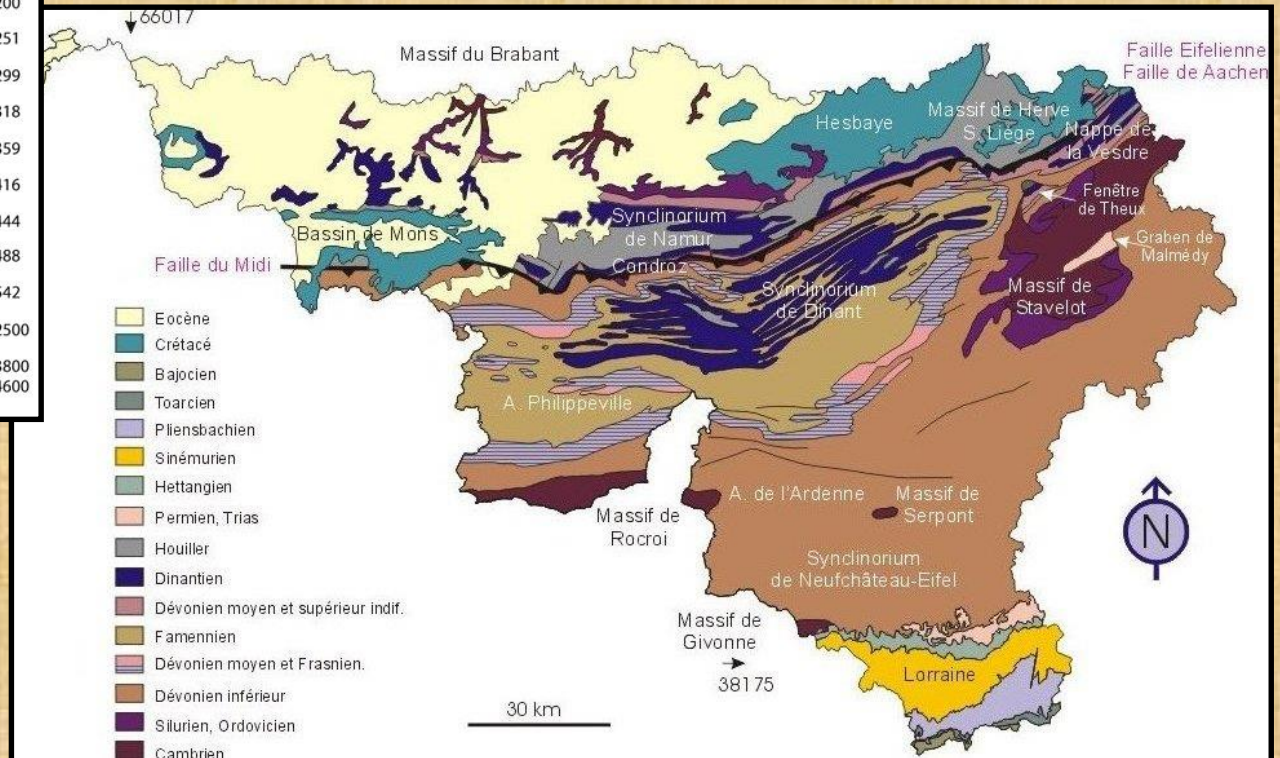
IMA2014, September 5th, 2014

Geology of Belgium

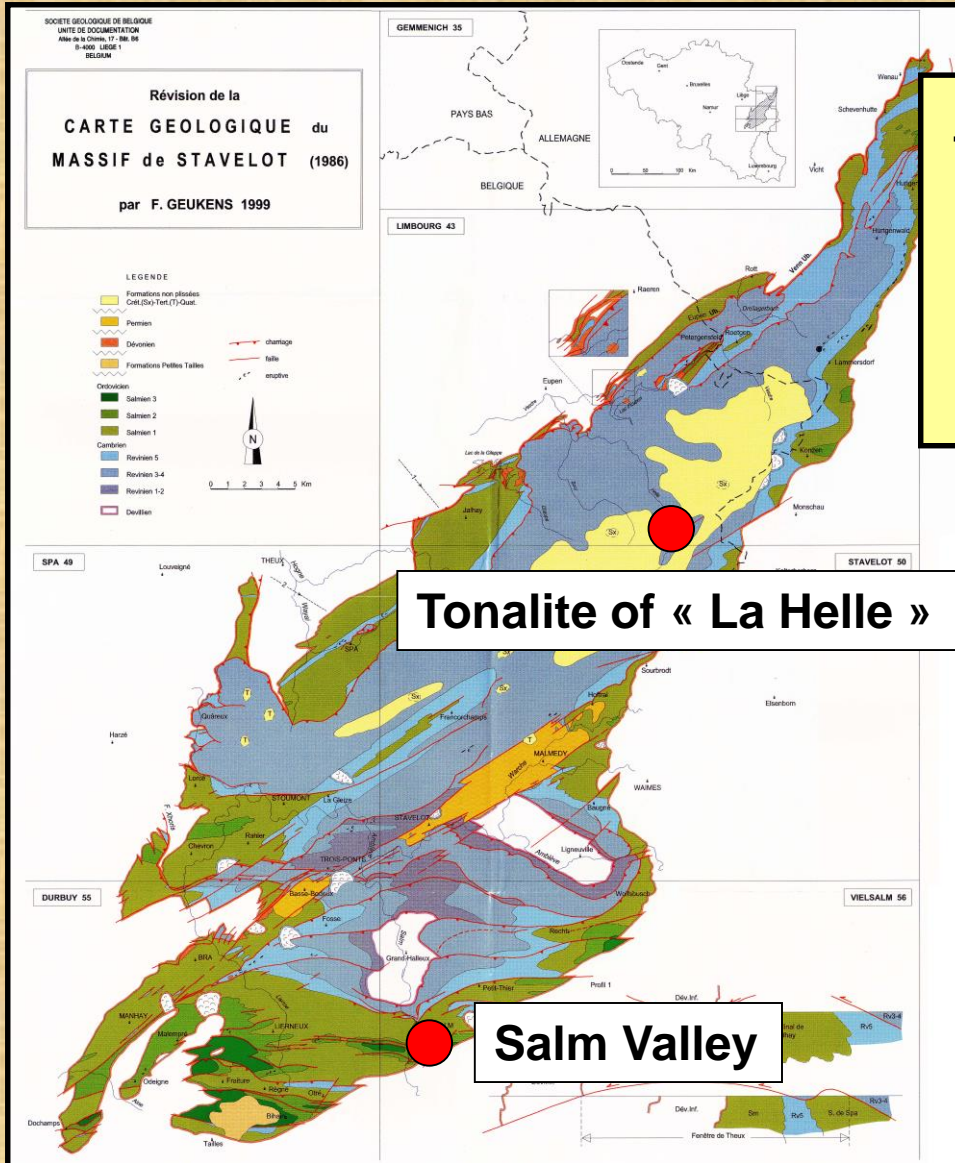
Cambro-Ordoviciens Massifs:

Stavelot, Rocroi, Serpont, Givonne

Éon	Ère	Période	Époque	Ma	
PHANÉROZOÏQUE	CÉNOZOÏQUE	QUATÉRNAIRE	HOLOCÈNE	0,01	
			PLÉISTOCÈNE	1,8	
		NÉOGÈNE	PLIOCÈNE	5	
			MIOCÈNE	23	
		PALÉOGÈNE	OLIGOCÈNE	34	
			ÉOCÈNE	56	
	MÉSOZOÏQUE	PALÉOZOÏQUE	CRÉTACÉ	146	
			JURASSIQUE	200	
			TRIASSIQUE	251	
			PERMIEN	299	
			CARBONIFÈRE	PENNSYLVANIEN	318
				MISSISSIPIEN	359
			DÉVONIEN	416	
			SILURIEN	444	
ORDOVICIEN	488				
CAMBRIEN	542				
PRÉCAMBRIEN	PROTÉROZOÏQUE	ARCHÉEN	2500		
		HADÉEN	3800		
			4600		

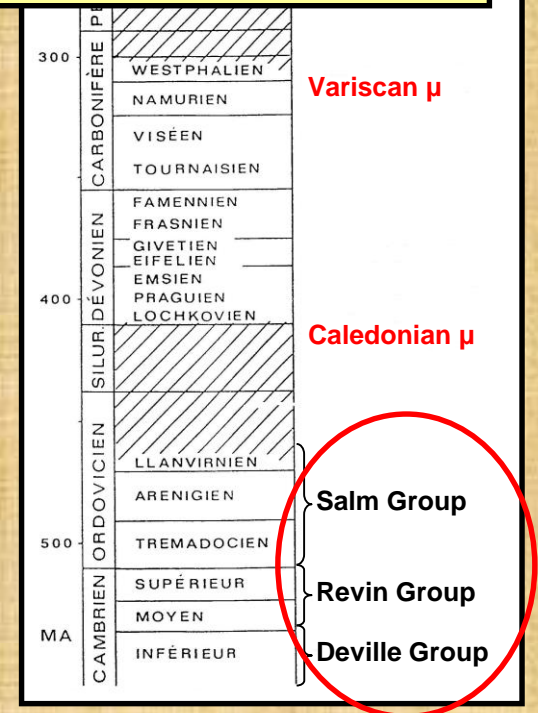


The Stavelot Massif

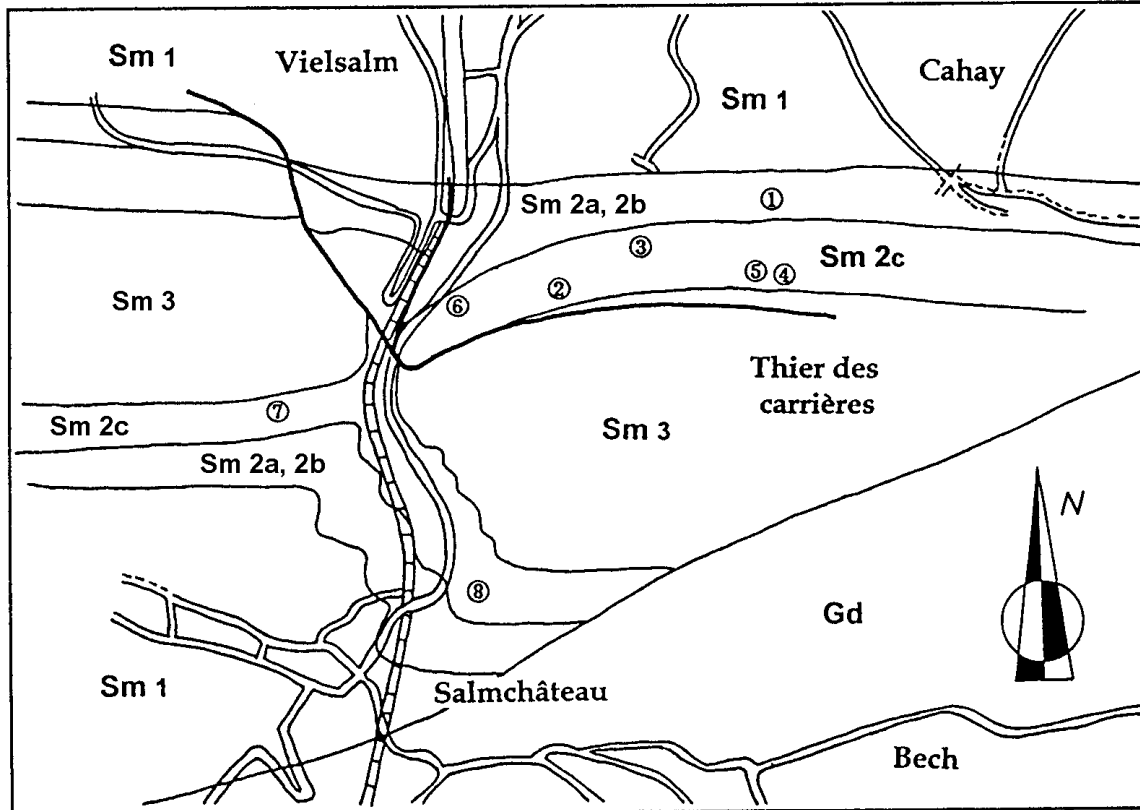


Caledonian Metamorphism:
300°C (Salm Valley)

Variscan Metamorphism:
420°C/2-3 kbar (Salm Valley)
380°C/2 kbar (Lienne Valley)



The Salm syncline



Salm Group

Sm3 = Bihain Fmt.
Sm2 = Otré Fmt.
Sm1 = Jalhay Fmt.

Disseminations:

1, 2, 7

Pseudocoticules:

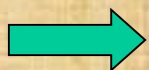
3, 7

Linear quartz veins:

2, 3, 6

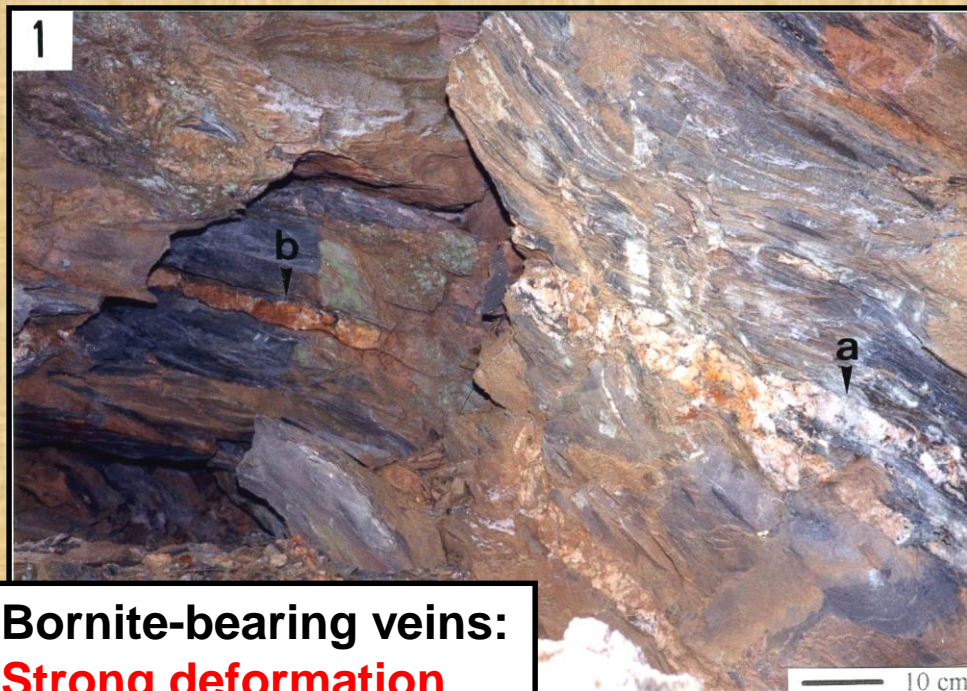
Deformed quartz vein:

4, 5, 6, 8

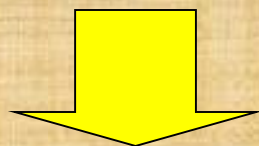


Copper sulfides mineralizations localized in the Colanhan Mbr. (Sm2c) schists

Sulfide-bearing quartz veins



Bornite-bearing veins:
Strong deformation



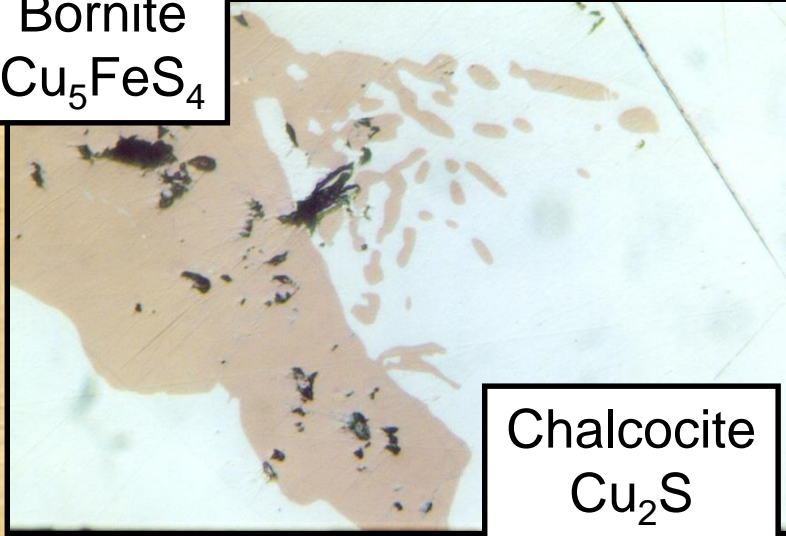
**Correlation between
deformation and mineralogy**



Chalcocite-bearing veins:
Weak deformation

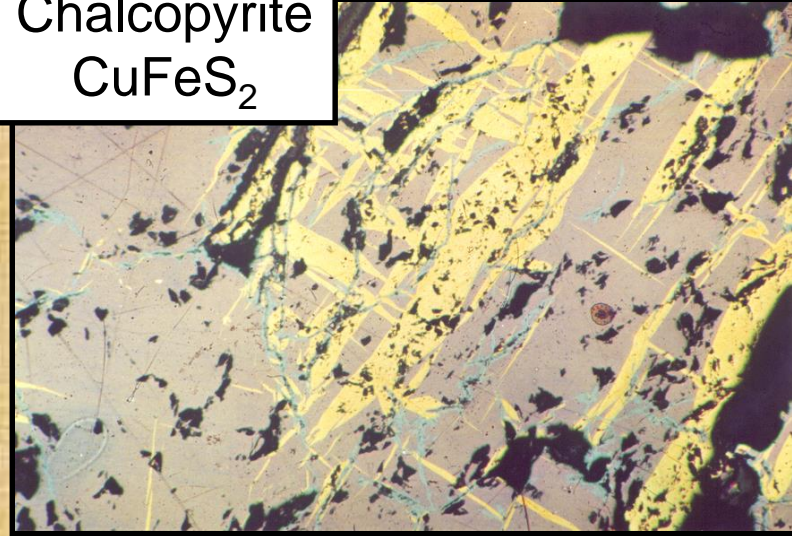
Copper sulfides from Vielsalm

Bornite
 Cu_5FeS_4

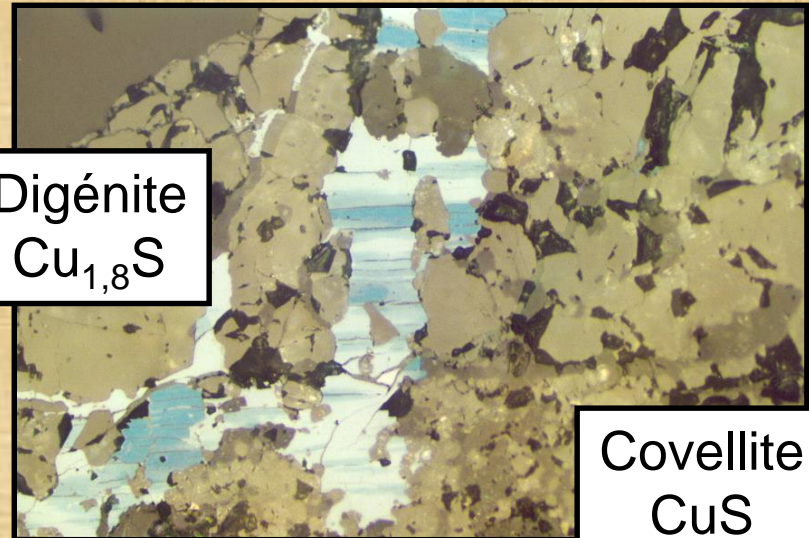


Chalcocite
 Cu_2S

Chalcopyrite
 CuFeS_2



Digénite
 $\text{Cu}_{1,8}\text{S}$



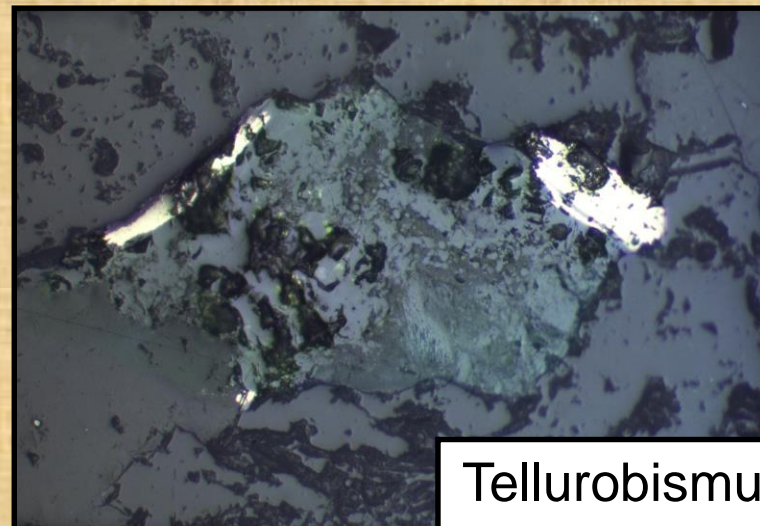
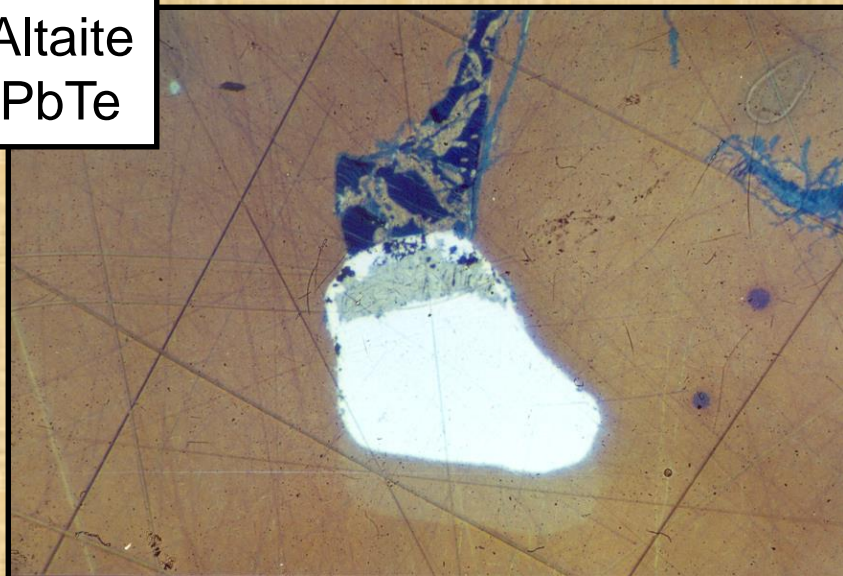
Covellite
 CuS

Idaïte
 Cu_3FeS_4

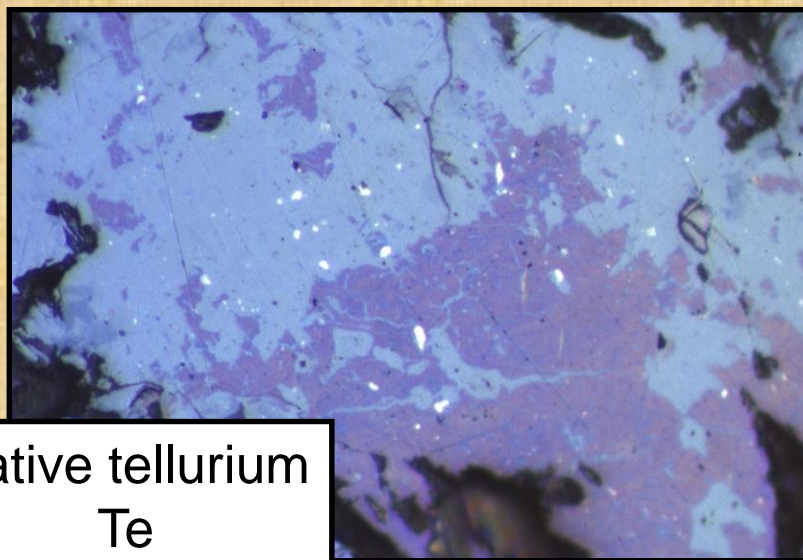


Tellurides from Vielsalm

Altaite
PbTe



Tellurobismuthite
 Bi_2Te_3



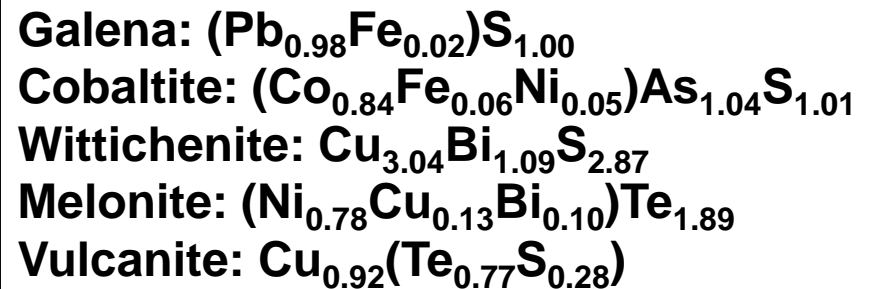
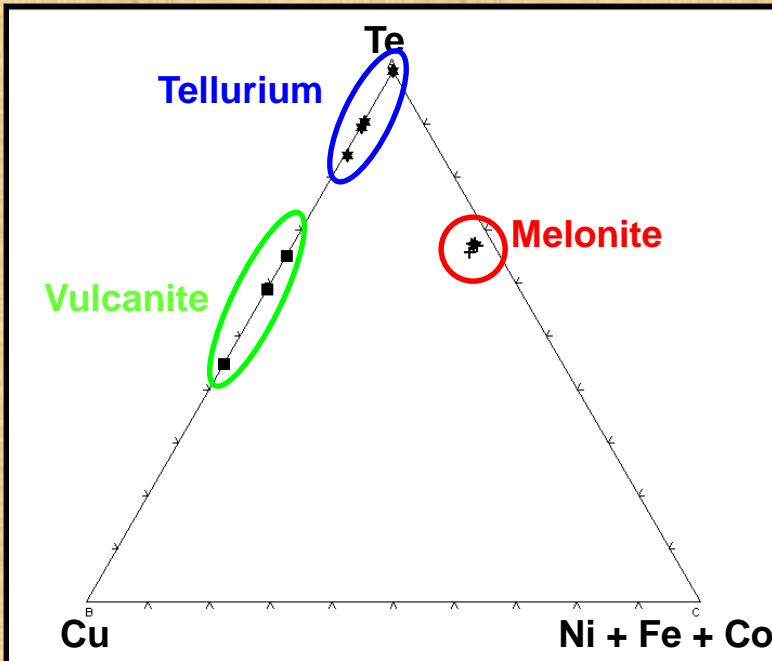
Native tellurium
Te

Altaite: $(\text{Pb}_{0.97}\text{Cu}_{0.03})\text{Te}_{0.99}$
 Tellurobismuthite: $\text{Bi}_{2.00}(\text{Te}_{2.96}\text{Se}_{0.02})$
 Native tellurium: $\text{Te}_{0.89}\text{Cu}_{0.10}$

Tellurides from Vielsalm

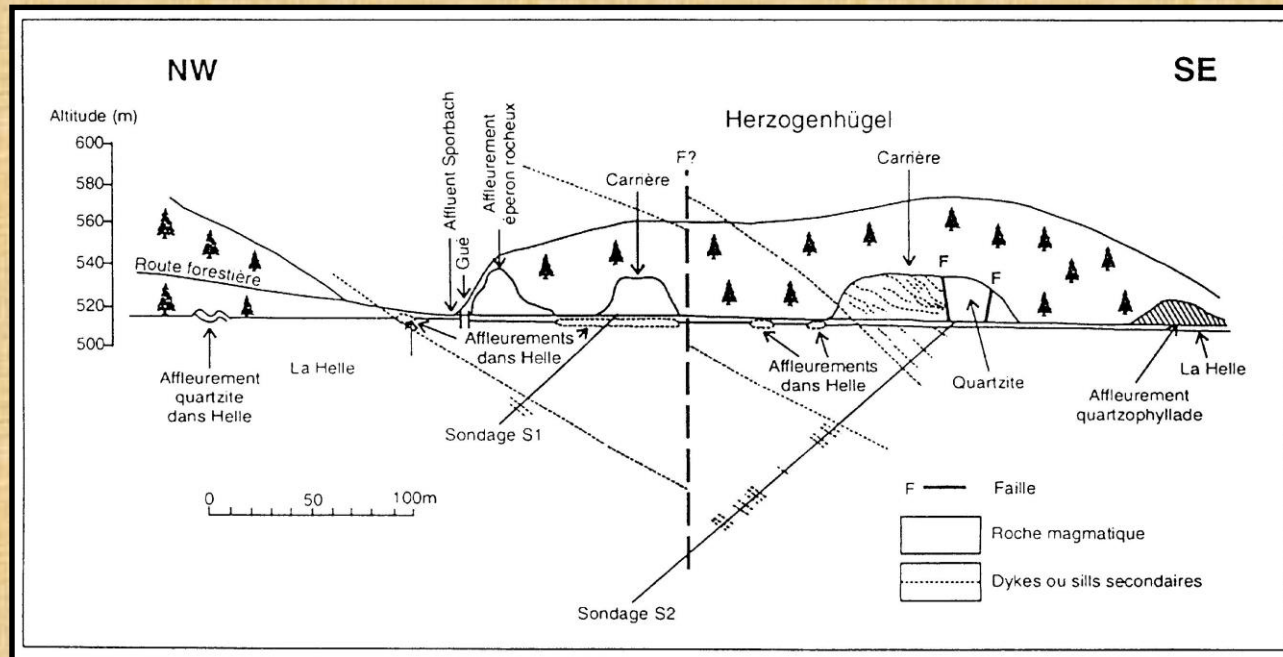


Galena
PbS



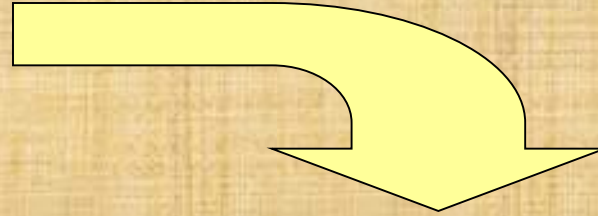
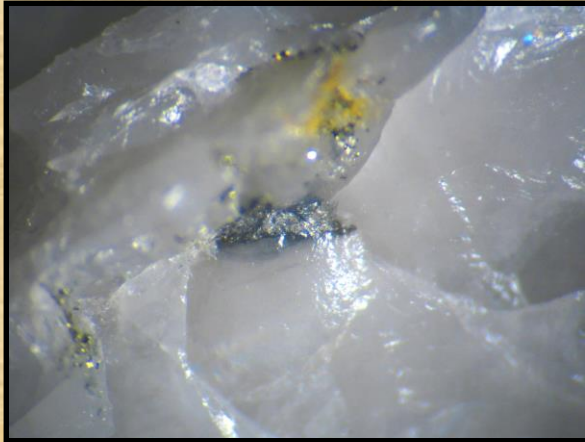
The tonalite of « La Helle »

- Granodiorite intrusion of ca. 100 m diameter.
- Located close to the river of « La Helle ».
- Intruded in quartzites of the Revin Group (Upper Cambrian).
- Porphyry-copper-type mineralization.
- Inclusions of pyrrhotite, chalcopyrite, and molybdenite.

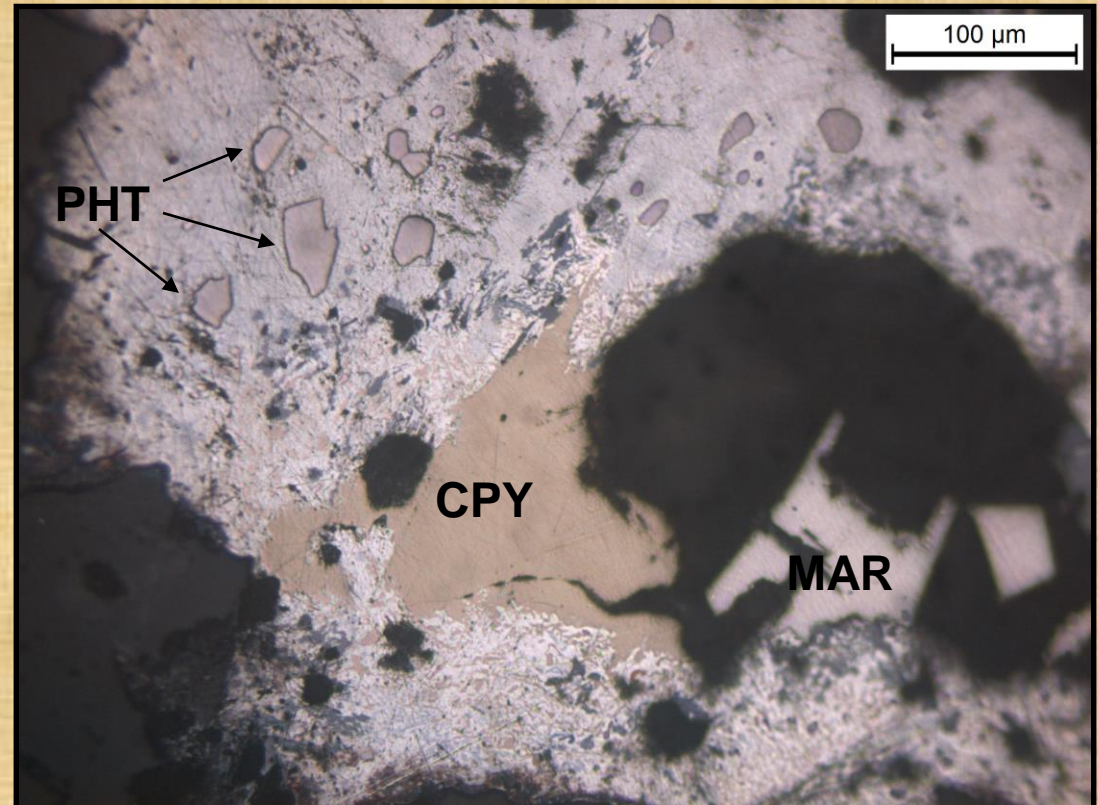


- Tellurides occur in quartz veins crosscutting the host rocks.

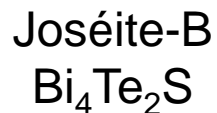
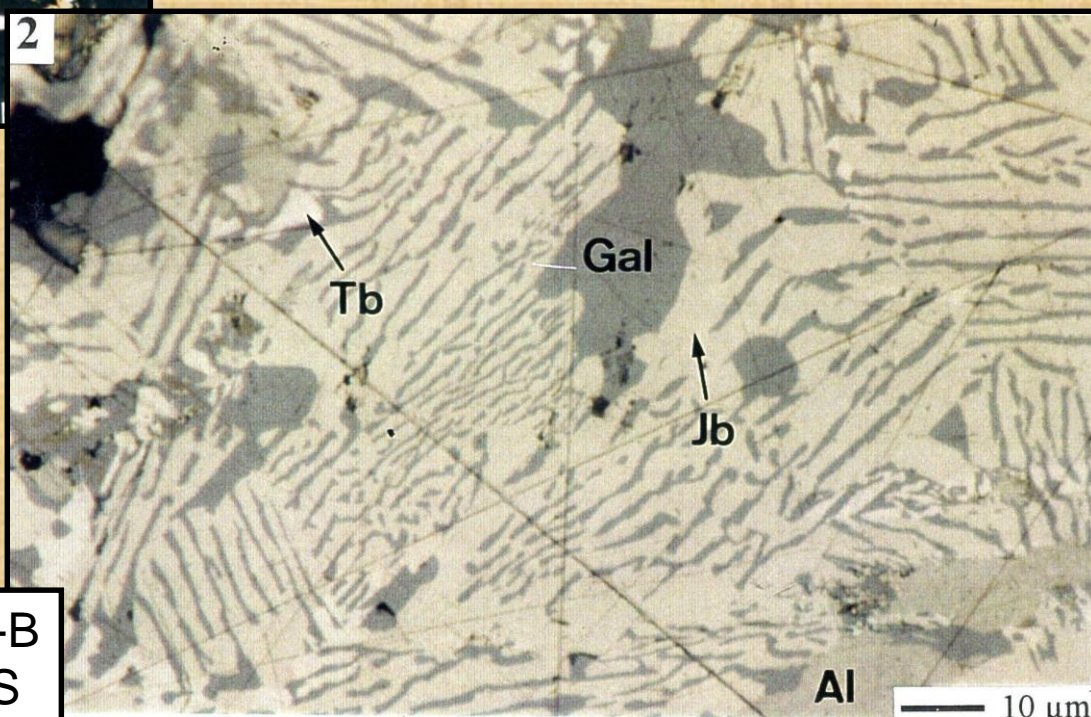
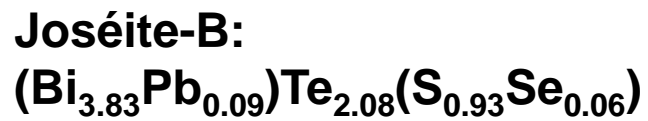
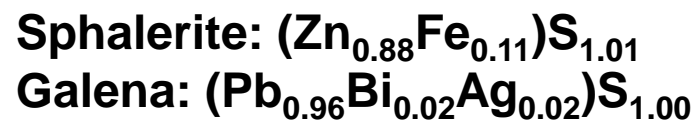
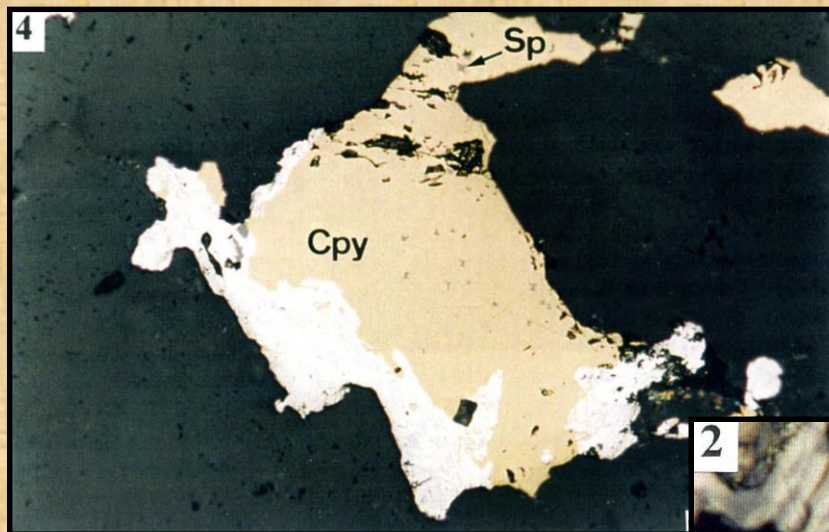
Tellurides from La Helle



Chalcopyrite: $\text{Cu}_{1.00}\text{Fe}_{0.99}\text{S}_{2.01}$
Marcasite: $\text{Fe}_{1.00}\text{S}_{2.00}$
Pyrrhotite: $\text{Fe}_{0.86}\text{S}_{1.00}$

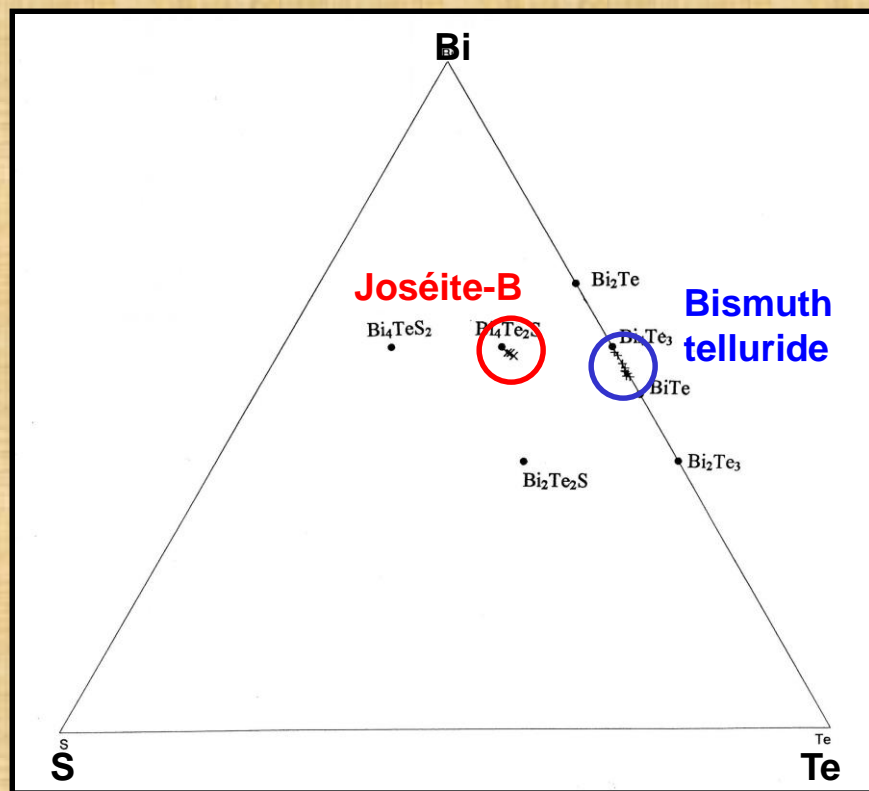


Tellurides from La Helle

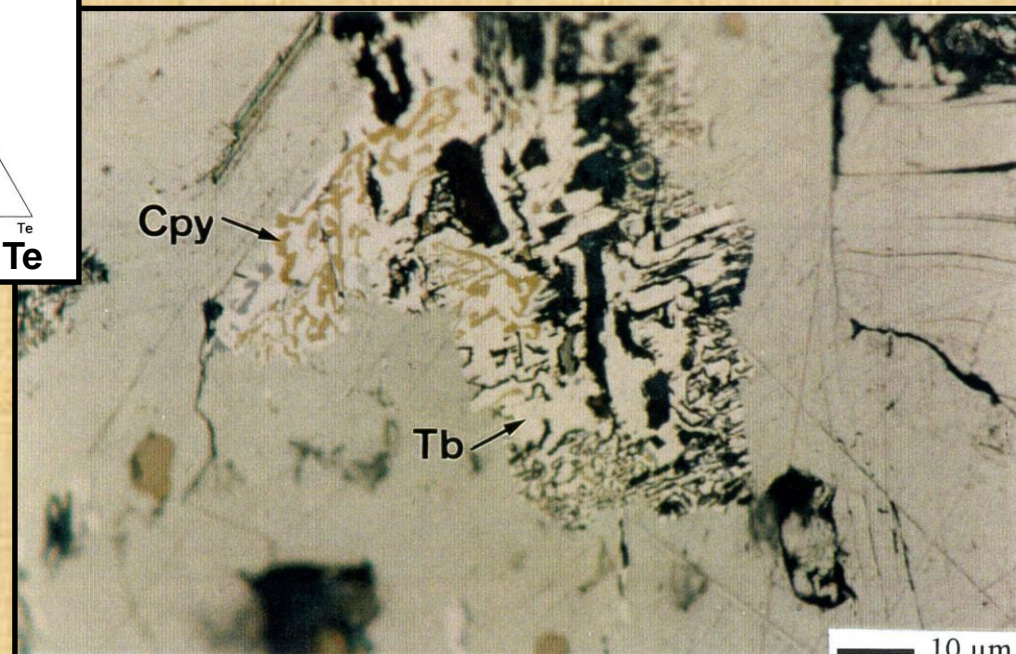


Al  10 μm

Tellurides from La Helle

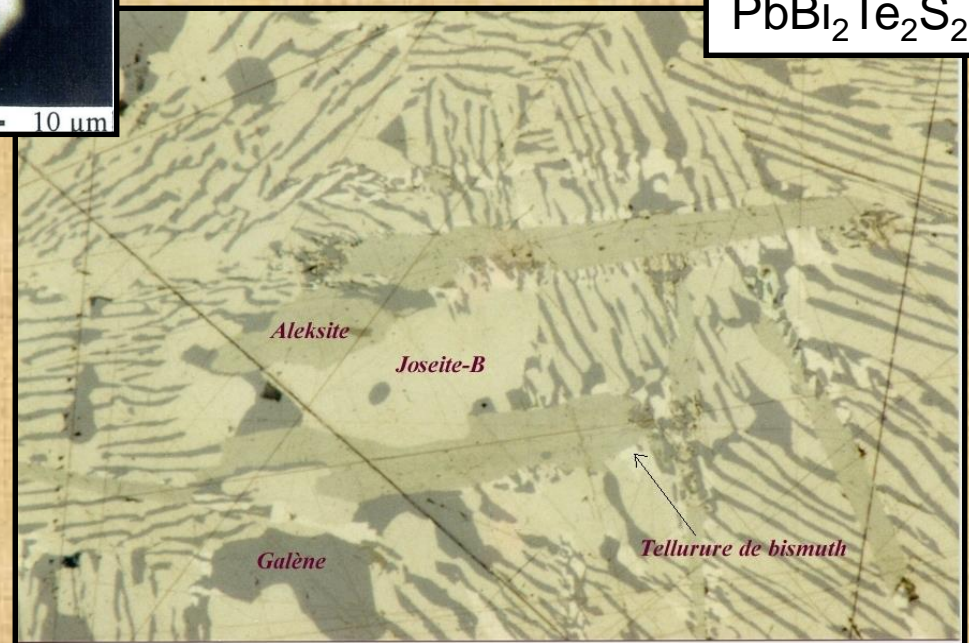
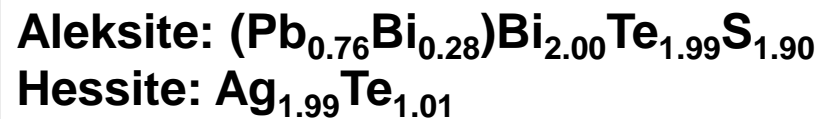
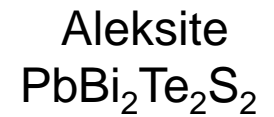
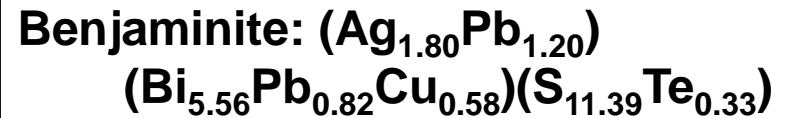
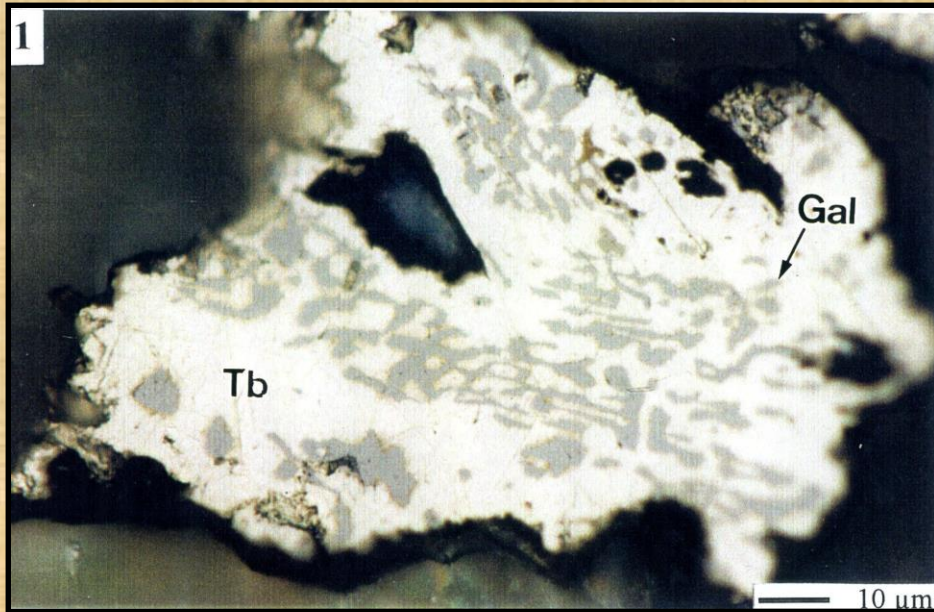


- Bismuth telluride, white compared to joséite-B.
- Chemical composition between tsumoite (BiTe) and pilsenite (Bi₄Te₃)



New mineral species?

Tellurides from La Helle



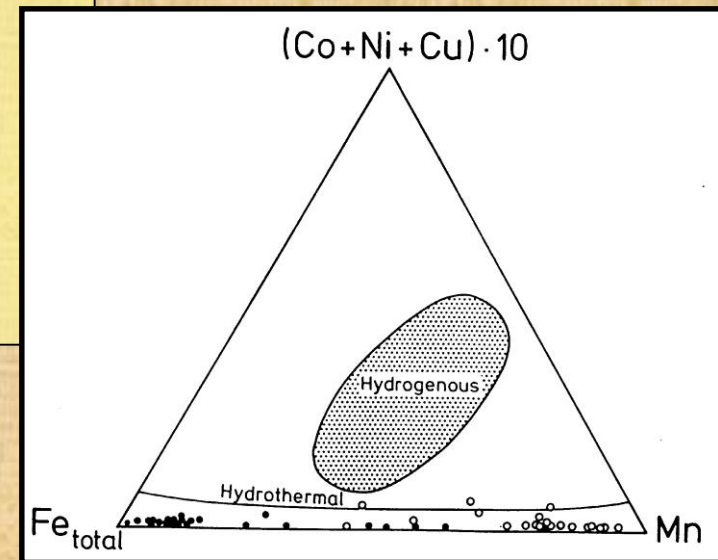
Genetical considerations

Tellurides from Vielsalm

- Tellurides located in copper-bearing quartz veins.
- Quartz veins crosscut schists of Ordovician age.
- Crystallisation during Variscan metamorphism, at temperatures lower than 420°C.
- Origin of tellurium: pseudocoticules (spessartine quartzites).
- Coticules and pseudocoticules related to magmatism; hydrothermal exhalations (Krosse & Schreyer, 1986).

Tonalite of « La Helle »

- Tellurides located in quartz veins from the granodiorite.
- Intrusion took place during Silurian period.
- Magmatic origin of tellurium.



Conclusions

- Tellurides occur in two localities of the Stavelot Massif, Belgium
- In Vielsalm, these minerals are associated with copper sulfides, in quartz veins crosscutting Ordovician schists. These veins are of metamorphic origin (max. 420°C), but tellurium was remobilized from pseudocoticules, which were produced by hydrothermal exhalation processes.
- In « La Helle », tellurides occur in quartz veins associated with a granodiorite; tellurium is clearly of magmatic origin.
- The economic value of these ores is extremely weak, since the outcrops are of very small size, and located in protected areas.