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SPECIMENS 1-6/CAPOOSE LAKE/1977

Six specimens from Capoose Lake sulphide deposit(British Columbia, Canada) have been studied microscopically and grouped as follows: 1, 2, 3-5 and 6/Capoose Lake. Specimen 1/Capoose Lake was given by Mr. M Muzylowski 25.11.1977 in SMS meeting in Helsinki. Other specimens were delived by Mr. R Matikainen (Dr. E Peltola, 30.11.1977).

1/Capoose Lake (thin section L13942, polished section P9572) Quartz-porphyry (of volcanic or subvolcanic origin) with poor sulfide dissemination.

Major minerals: plagioclase ($\sim An_{20}$), quartz, muscovite
Accessory minerals: potash feldspar, sulfides, garnet, rutile, zircon.
Major sulfides: sphalerite, pyrite
Accessory sulfides: covellite, marcasite, chalcopyrite, pyrrhotite, galena.
Porphyritic quartz crystals (diameter $\leq$ 0.8 mm) are anhedral and corroded (reacted with the melt).
Sphalerite and pyrite form aggregates (diameter $\leq$ 1 mm) frequently surrounded by muscovite (immiscible fraction of sulfide melt?). Covellite occurs as films ($\leq 20\,\mu m$ thick) on the surfaces of sphalerite. Chalcopyrite, pyrrhotite and galena occur as inclusions (diameter $\leq$ $10\,\mu m$) in pyrite. Matrix between porphyritic crystals and sulfide aggregates is fine-grained ($\leq$50 µm). No Ag-minerals were observed in the specimen.

2/ Capoose Lake (thin section L13943, polished section P9573). Garnet rock containig sphalerite-rich sulfide mineralization (Fig. 1).
Major minerals: garnet, sulfides, quartz
Accessory minerals: ilmenite, chlorite, epidote, carbonate, apatite, sphene.
Major sulfides: sphalerite, arsenopyrite, chalcopyrite
Accessory sulfides: pyrite 1, pyrite 2, pyrrhotite, galena, argentian tetrahedrite, bornite, pyrargyrite and (Ag, Au)-alloy (electrum). (Pyrite 1 is considered as "primary crystallization" and pyrite 2 as secondary oxidation product of pyrrhotite).
Garnet shows low, abnormal anisotropy (0.002-0.003).
The space between garnet crystals is filled by sulfides (Fig 1). Sulfides have closely intergrown with each other and contain numerous inclusions:

sphalerite:	inclusions of arsenopyrite, ilmenite and chalcopyrite, exolutions of chalcopyrite
arsenopyrite:	inclusions of sphalerite, chalcopyrite pyrrhotite, galena, argentian tetrahedrite and pyrargyrite
chalcopyrite:	inclusions of arsenopyrite and pyrrhotite

pyrite: inclusions of sphalerite, arsenopyrite, argentian tetrahedrite and galena.

Argentian tetrahedrite is relatively common and occurs as inclusions in pyrite (Fig. 2) and in arsenopyrite. Diameter of argentian tetrahedrite crystals is less than 80 μm. Electron microprobe analysis of argentian tetrahedrite is given in Table 1. Pyrargyrite is rare and occurs as crystals less than 40 μm in diamete mostly together with arsenopyrite and chalcopyrite.

3-5/Capoose Lake (thin section L13944, polished sections P9574, P9575, P9576).
Sphalerite-rich sulfide ore containing fragments of acid volcanic rock and quartz aggregates.
Major minerals: sulfides, quartz, garnet, plagioclase
Accessory minerals: biotite, monoclinic amphibole (colorless), muscovite, chlorite.
Major sulfides: sphalerite, galena, arsenopyrite, chalcopyrite
Accessory sulfides: pyrite 2 (= secondary oxidation product of pyrrhotite), pyrite 1 ("primary pyrite"), argentian tetrahedrite, pyrrhotite, cubanite, pyrargyrite, cubanite, mackinawite, (Ag, Au)-alloy (electrum).
Sulfides are closely mixed together (Fig. 3) and contain numerous inclusions (see description of specimen 2/Capoose Lake). Argentian tetrahedrite is common especially as inclusions in galena (Figs. 4 and 5). Diameter of argentian tetrahedrite crystals is less than 150 μm. Electron microprobe analysis of argentian tetrahedrite in specimen 3/Capoose Lake is given in Table 2. Pyrargyrite is rare and was observed as tiny inclusions in galena and sphalerite. (Ag, Au)-alloy was observed as inclusions (diameter ≤20 μm) in galena and arsenopyrite. Semiquantitative analysis by electron probe gave the approximate composition $Ag_{0.83}Au_{0.17}$.

6/Capoose Lake (thin section L13945, polished section P9577). Granite. Major minerals are potassium feldspar (orthoclase?), quartz and plagioclase ($\sim An_{10}$).
Opaques, biotite, chlorite and rutile occur as accessor constituents.
Granite has cracks filled by pyrite, molybdenite, chalcopyrite and quartz. Accessory ore minerals in veinlets are pyrrhotite, cubanite, ilmenite and goethite.
Between the fresh granite and a sulfide veinlet there is a few millimeters thick zone of leaching (leached granite) which contains andalusite (?, mostly hydrated to muscovite), less alkali-feldspars (especially plagioclase) and more muscovite than the granite.

Discussion concerning specimens 2-5/Capoose Lake. Because of intimate mixing of sulfides (inclusions, etc their separation by flotation to obtain good quality concentrates with good recovery is going to face difficulties. Possibilities for the satisfactory separation of sphalerite are quite reasonable, but not so good in the case of chalcopyrite and galena. The most important Ag-bearing mineral argentian tetrahedrite was observed as inclusions most frequently in galena, arsenopyrite and pyrite and is expected to follow them in the flotation. The major problem in the processing of the ore (concentrates) will be arsenopyrite.

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Tabel 1. Specimen 2/Capoose Lake. Electron micro.probe analysis of argentian tetrahedrite.

	Crystal 1	Crystal 2	Mean
Ag	32.38	32.59	32.49
Cu	15.42	13.06	14.24
Zn	0.82	0.80	0.81
Fe	6.31	6.57	6.44
Sb	27.45	27.07	27.26
As	0.61	0.14	0.38
S	20.60	20.61	20.61
Σ	103.59	100.84	102.23

Formula: $(Cu_{4.53}Ag_{6.09})_{10.62}(Fe_{2.33}Zn_{0.24})_{2.57}(Sb_{4.53}As_{0.10})_{4.63}S_{13.00}$

Tabel 2. Specimen 3/Capoose Lake. Electron microprobe analysis of argentian tetrahedrite.

	Crystal 1	Crystal 2	Crystal 3	Mean
Ag	34.88	33.74	31.93	33.52
Cu	15.75	14.54	15.49	15.26
Zn	0.88	0.63	1.47	0.99
Fe	5.26	4.97	5.38	5.20
Sb	24.81	24.89	27.09	25.60
As	1.18	1.10	0.78	1.02
S	20.32	20.34	20.63	20.43
Σ	103.08	100.21	102.77	102.02

Formula: $(Cu_{4.90}Ag_{6.35})_{11.25}(Fe_{1.90}Zn_{0.31})_{2.21}(Sb_{4.29}As_{0.29})_{4.58}S_{13.00}$

Analysing conditions of electron microprobe are given in Appendix 1.

In specimen 2/Capoose Lake argentian tetrahedrite was checked with respect to the elements: Pb, Bi, Co, Ni, Mn, Sn, Au, Te and Se, which were not detected in measurable quantities.

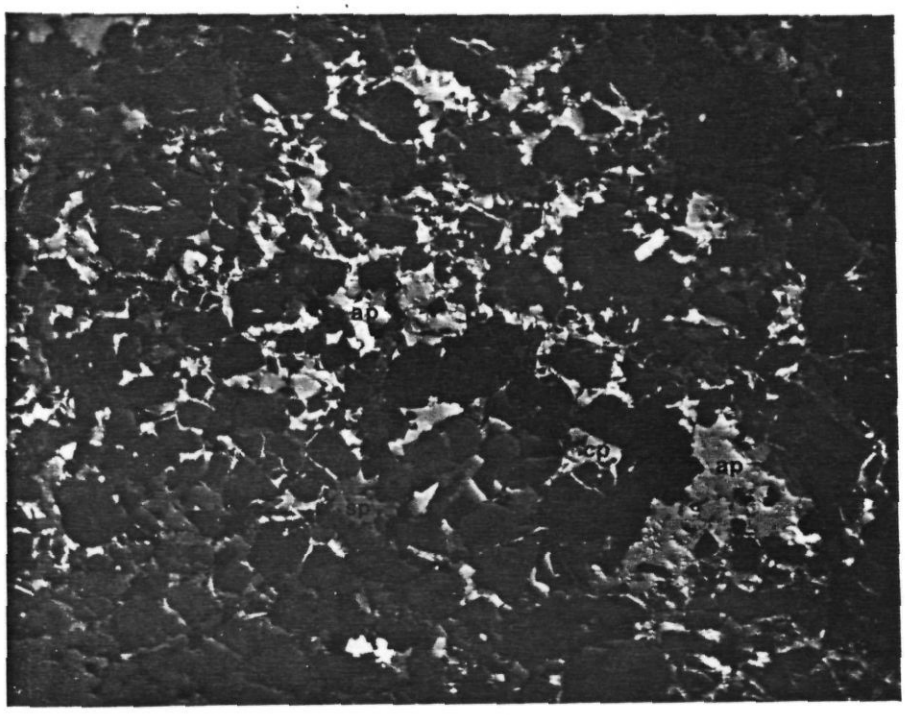

Fig. 1. Specimen 2/Capoose Lake. Garnet rock. The space between garnet crystals is filled by sphalerite (sp), chalcopyrite (cp) and arsenopyrite (ap). Interference optics. Magnification 63 x.

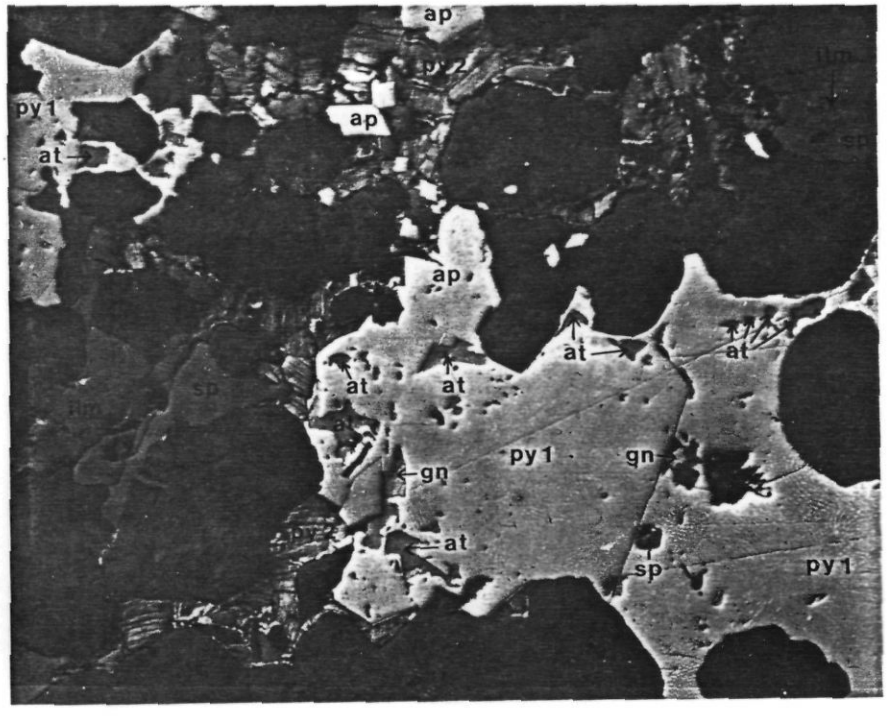

Fig. 2. Specimen 2/Capoose Lake. Argentian tetrahedrite (at) inclusions in pyrite 1 (py 1). Ilmenite (ilm) inclusions in sphalerite (sp). Arsenopyrite (ap), galena (gn) and pyrite 2 (py 2). Dark areas are garnet crystals. Interference optics. Magnification 180 x.

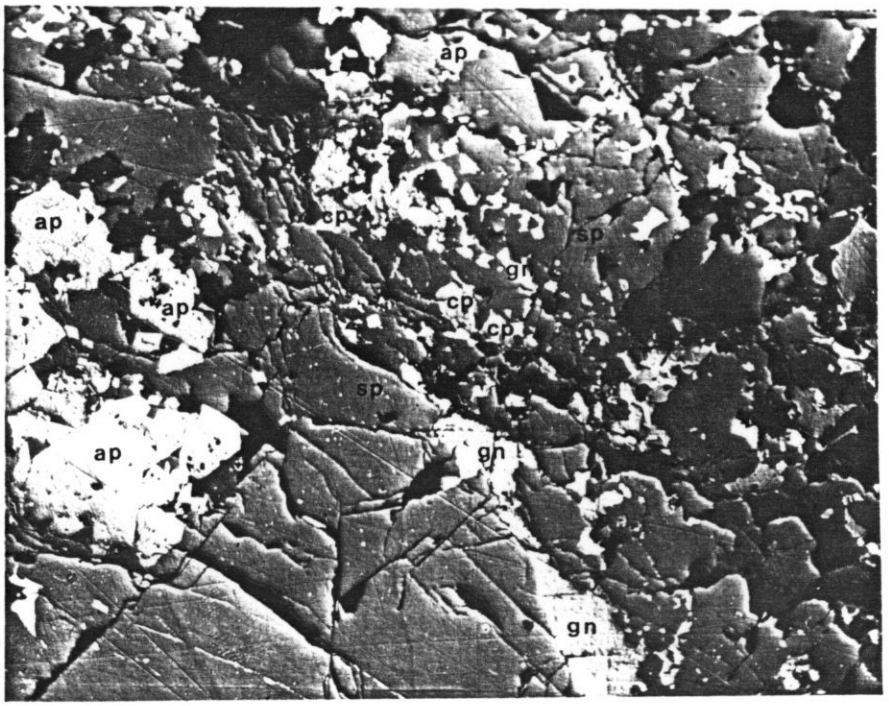

Fig. 3. Specimen 4/Capoose Lake. Sphalerite (sp)-chalcopyrite (cp)- galena (gn)- arsenopyrite (ap)-ore. Interference optics. Magnification 63 x.

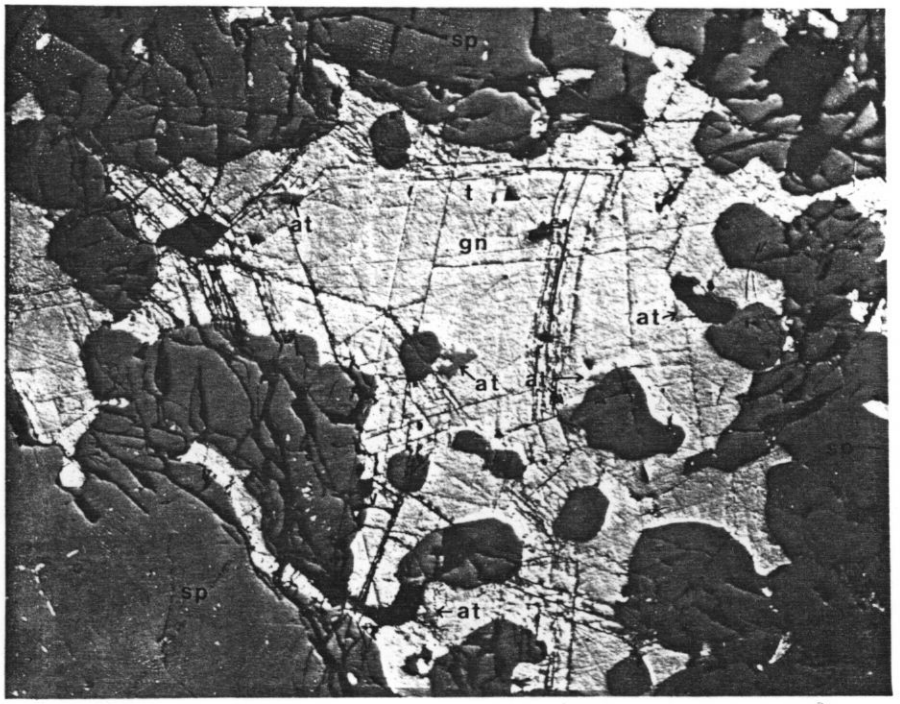

Fig 4. Specimen 3/Capoose Lake. Sphalerite (sp)-galena (gn)-ore. Argentian tetrahedrite (at) inclusions in galena. Interference optics. Magnification 63 x.

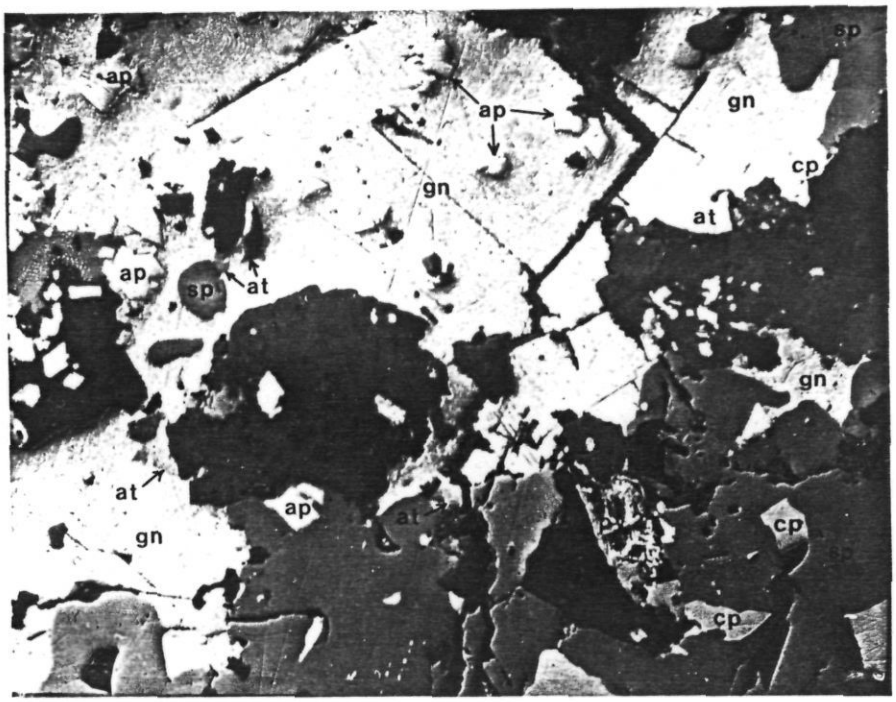

Fig. 5. Specimen 4/Capoose Lake. Sphalerite (sp)-galena (gn)-arsenopyrite (ap)-chalcopyrite (cp)-ore. Argentian tetrahedrite (at) inclusions in galena. py 2 = pyrite 2. Interference optics. Magnification 125 x.

Appendix 1. Analysing conditions of argentian tetrahedrites by the elctron microprobe (model Mark II, Cambridge Instruments). Specimens 2 and 3/Capoose Lake.

Voltage 20 kV.
Counting time 10 sec.
Analysing crystals: LiF: Cu, Fe, Zn, As
Quartz: Ag, Sb, S

Standards:			
AgLα	: metallic Ag,	Ag = 99.99 %	
CuKα	: metallic Cu,	Cu = 99.99 %	
ZnKα	: metallic Zn,	Zn = 99.99 %	
SbLα	: metallic Sb,	Sb = 99.99 %	
AsKα	: arsenopyrite,	As = 46.01 %	
		Fe = 34.30 %,	S = 19.69%
FeKα, SKα	: pyrrhotite,	Fe = 62.54 %,	Ni = 0.99%
		S = 36.46%	

Corrections of the probe data are processed by the computer program EMPADR VII (Rucklidge & Gasparrini, 1969).