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New Occurrence of Deerite in the Western Alps

By *G. V. Dal Piaz*)* and *G. Molin**)*

Abstract

Deerite has been found in the Cu-Fe sulfide deposit of Viafiorcia, Western Alps, associated with the Piemonte ophiolite nappe. This hydrous, ferrous, ferric silicate occurs together with Na-amphibole, stilpnomelane ± white mica, albite and carbonate, and with pyrite, chalcopyrite, bornite, pyrrothite, magnetite ± sphalerite, mackinawite, linneite, tennantite, chalcocite, digenite and covellite within a post-Triassic silica-rich deposit above a flattened lens of metagabbro and minor serpentinite which is interbedded in the calcschist sequence. This Cu-Fe-Si deposit is believed to have formed by precipitation from a hydrothermal system occurring in the extensional Piemonte margin.

Electron microprobe analyses (three points) of deerite yield the following structural formula:

$$(Mg_{0.87}Fe^{++}_{11.23}Mn_{0.15})_{12.25}(Fe^{+++}_{5.95}Al_{0.18})_{6.13}Si_{11.72}O_{39.78}(OH)_{10.22}$$

INTRODUCTION

Deerite is a hydrous, ferrous, ferric silicate which was first discovered together with howieite and zussmanite in a riebeckite-stilpnomelane-bearing rock associated with the metasediments from the Franciscan Formation, California (AGRELL et al., 1965, 1967; other data in ERNST et al., 1970). The crystal structure of deerite from Panoche, California, has been determined by FLEET (1977).

Deerite has also been found recently in New Caledonia (BLACK, 1973) and in the Western Alps in the Pennine continental crust (Ambin massif: AGRELL and GAY, 1970; Vanoise zone: BOCQUET, 1971), and in the blueschist Piemonte ophiolite nappe in the Cottian Alps, where it is associated with the Cu-Fe sulfide deposits of Beth-Ghinivert (BOCQUÉT and FORETTE, 1973; BOCQUET, 1974), Viafiorcia and Salbertrand (GRUPPO OFIOLITI, 1977; DAL PIAZ et al., 1978).

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DEERITE FROM THE CU-FE SULFIDE DEPOSIT OF VIAFIORCIA

Geologic setting

The Cu-Fe sulfide deposit of Viafiorcia crops out in the Vallone delle Miniere, upper Germanasca Valley, Italian Cottian Alps, and has been described by GRILL (1926) and by DAL PIAZ et al. (1978). It appears in syngenetic relationship with a silica-rich horizon above a flattened lens of metagabbro and minor serpentinite, interbedded within a thick sequence of Mesozoic calcschists. The occurrence of both a silica-rich layer and related ore mineralization is interpreted as the chemical deposit of a hydrothermal system which leached metals from the Jurassic ocean crust of the Piemonte basin and directly discharged sulfide phases onto the sea floor or into a muds (DAL PIAZ et al., 1978); see also the model postulated by SPOONER and FYFE (1973).

The Cu-Fe ore deposit of Viafiorcia and the surrounding lithologies record Alpine-age blueschist facies metamorphism, followed by weak greenschist facies reequilibration.

The main ore associations are: chalcopyrite, pyrrothite, pyrite, bornite, magnetite with minor sphalerite, mackinawite, linneite, tennantite, chalcocite, digenite and covellite. Relics of pre-metamorphic pyrite, displaying strongly deformed, zoned colloform textures, have been found (NATALE, 1969; DAL PIAZ et al., 1978), indicating a precipitation of sulfide phases from a hydrothermal system. The associated silicates, together with prevalent quartz, are: Na-amphibole, stilpnomelane, deerite ± white mica, albite, carbonate, barroisite and actinolite.

Deerite mainly occurs together with chalcopyrite-magnetite-rich ore mineralization and closely associated with a quartzitic matrix in which aboundant stilpnomelane (sometimes up to 20 per cent in volume) occurs (Fig. 1). Deerite appears as swarms of small, oriented prickles within the quartz matrix (Fig. 1) and is pseudo-opaque and dark brown in coulour.

Analytical data

Deerite from the Viafiorcia ore deposit was analyzed with an Etec Autoscan Autospec electron microprobe; a counting time of 30 seconds and an accelerating voltage of 15 KV for Mg, Al and Si, and 20 KV for Ca, Mn and Fe were used. Detection limits of the oxides (weight percent) were: 0.05 for Fe, Mn, and 0.1 for Mg, Al, Si. The spot size was about 1μ. The analysis reported in Table 1 (a) is the average among three points from the same crystal. The program (modified) "Computer program for calculating corrections in quantitative X-ray

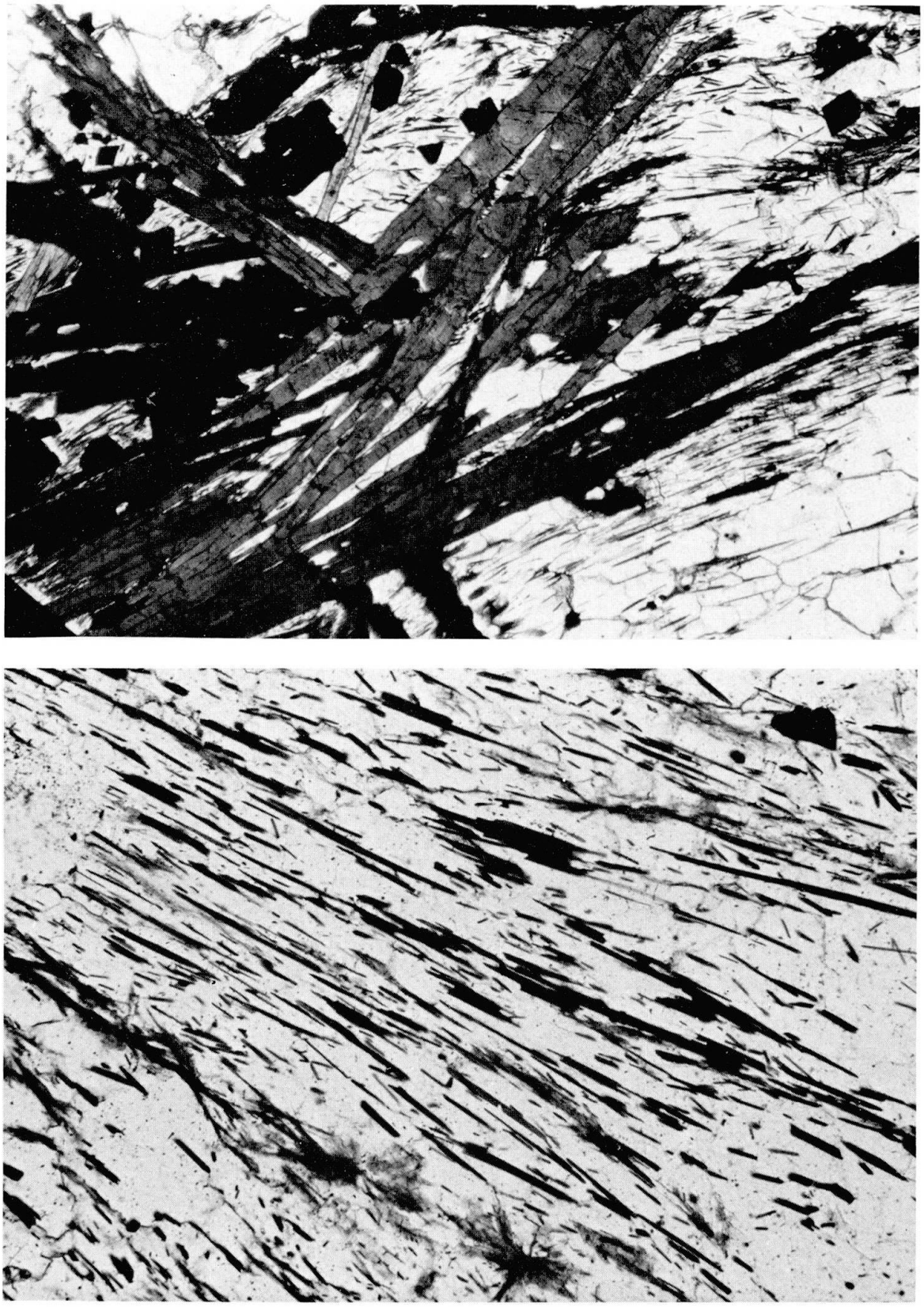

Fig. 1. *Top:* Large crystals of randomly oriented stilpnomelane and opaque grains of magnetite and trace chalcopyrite in matrix of prevalent quartz and very fine deerite (50×).
Bottom: detail of a swarm of deerite (150×).

microanalysis" by MASON et al. (1969) has been used to convert the counts to weight percent oxides, and the results are shown in Table 1 (a).

Table 1: *Deerite from Viafiorcia and other areas (weight percent oxide)*

	(a)	(a_1)	(b)	(c)	(d)	(e)
SiO_2	33.00	33.00	33.6	33.27	33.67	33.44
Al_2O_3	0.43	0.43	0.8	0.41	0.27	0.92
$FeO_{tot.}$	57.90					
FeO		37.84	38.7	35.64	35.80	36.67
Fe_2O_3		22.26	23.3	21.41	21.51	22.09
MnO	0.51	0.51	0.2	0.74	3.91	2.86
MgO	1.64	1.64	0.3	0.64	0.13	0.15
H_2O		4.32	4.25	4.25	4.25	4.25
Tot.	93.48	100.00	100.15	96.36	99.54	100.48
Si^{IV}		11.72		12.14	12.05	11.85
Al^{VI}		0.18		0.18	0.11	0.38
Fe^{+++VI}		5.95		5.88	5.79	5.89
Fe^{++VI}		11.23		10.88	10.71	10.87
Mn^{VI}		0.15		0.23	1.18	0.92
Mg^{VI}		0.87		0.35	0.06	0.08
OH^-		10.22		10.34	10.14	10.04
O		39.78		39.66	38.86	39.96

Samples: a) Viafiorcia; b) Beth-Ghinivert (BOCQUET and FORETTE, 1973); c) Ambin massif, Briançonnais zone (AGRELL and GAY, 1970); d and e) California (AGRELL et al., 1965). The last (e) is a wet chemical analysis, all the others were determined with the electron microprobe.

On the basis of the analytical data, the structural formula of deerite has been estimated by making two assumptions:

(1) The order of partioning between ion position M^{2+} and M^{3+} is two to one, according to the structural data of FLEET (1977) who proposed the following ideal formula for deerite:

$$Fe_6^{++}\,Fe_3^{+++}\,O_3\,(Si_6\,O_{17})\,(OH)_5$$

The Fe^{++}/Fe^{+++} partioning is made by saturation of the M_2 site with Fe^{++} (after Mg and Mn); the remaining Fe is Fe^{+++} and placed in the M_3 position, thus assuring charge balance.

(2) The amount of H_2O results as the difference between the total percent of oxides (after recalculating FeO and Fe_2O_3) and one hundred percent. The analytical data thus calculated are shown in Table 1 (a_1). The amount of Ca is less than the instrument sensitivity.

The analyzed crystal appears on elemental X-ray images (electron beam scans) as a moderately inclined section on the C axis (elongation axis), with di-

mensions of 8×18 microns. The scanning pictures and the three analyzed points indicate that the deerite grain is homogeneous in Si, Fe, Mg, and Mn.

CONCLUSION

Deerite from the Pennine continental crust (Ambin massif) and from the Piemonte ophiolite nappe of the Western Alps is closely associated with ironstones and appears to be connected with blueschist facies metamorphism as does deerite from California. Therefore, it appears to be a diagnostic mineral for these metamorphic conditions, as suggested by BOCQUET and FORETTE (1973). Moreover, deerite does not seem to occur within similar Cu-Fe sulfide deposits associated with the Piemonte ophiolite nappe showing a different metamorphic evolution which is indicated by either eclogite or greenschist facies mineral assemblages (DAL PIAZ, 1971; BRIGO et al., 1976). The absence of deerite may thus mean that it is not stable under the physical conditions of eclogite or greenschist metamorphism and not be due to bulk rock composition which appears appreciably unchanged in all ore deposits of the Piemonte ophiolite nappe.

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References

AGRELL, S. O., BROWN, M. G. and MCKIE, D. (1965): Deerite, howieite and zussmanite, three new minerals from the Franciscan of the Laytonville district, Mendocino Co., California. Am. Mineral., *50*, 278; idem in Mineral. Abstracts, *18* (1967), 207.

AGRELL, S. O. and GAY, M. (1970): De la deerite dans les Alpes franco-italiennes. Bull. Soc. fr. Minéral. Cristallogr., *93*, 263–264.

BLACK, Ph. M. (1973): Mineralogy of New Caledonian metamorphic rocks. Contr. Mineral. Petrol., *38*, 221–235, and *39*, 55–64.

BOCQUET, J. (1971): Cartes de répartition de quelques minéraux du métamorphisme alpin dans les Alpes franco-italiennes. Eclogae Geol. Helv., *64*, 71–103.

BOCQUET, J. (1974): Etudes minéralogiques et pétrologiques sur les métamorphismes d'âge alpin dans les alpes françaises. Thèse Grenoble, 489 p.

BOCQUET, J. and FORETTE, M. Cl. (1973): Sur la deerite de l'ensemble des calcschistes piémontais, à Troncea (Italie). Bull. Soc. fr. Minéral. Cristallogr., *96*, 314–316.

BRIGO, L., DAL PIAZ, G. V. and FERRARIO, A. (1976): Le mineralizzazioni cuprifere legate ai termini effusivi di alcuni complessi ofiolitici nell'area mediterranea. Boll. Ass. Mineraria Subalpina, *13*, 305–316.

DAL PIAZ, G. V. (1971): Alcune considerazioni sulla genesi delle ofioliti piemontesi e dei giacimenti ad esse associati. Boll. Ass. Mineraria Subalpina, *8*, 365–388.

DAL PIAZ, G. V., NATALE, P., NERVO, R., OMENETTO, P. and POLINO, R. (1978): La mineralizzazione a Cu-Fe di Viafiorcia (Alpi Cozie). Mem. Sc. Geol., *32*, 16 p.

ERNST, W. G., SEKI, Y., ONUKI, H. and GILBERT, M. C. (1970): Comparative study of low-grade metamorphism in the California Coast Ranges and the outer metamorphic bel of Japan. Geol. Soc. Amer. Mem., *124*, 276 p.

FLEET, M. E. (1977): The crystal structure of deerite. Amer. Mineral., *62*, 990–998.

GRILL, E. (1926): Contributo alla conoscenza dei giacimenti di pirite del Pinerolese. Nota II. Atti Soc. Toscana Sc. Nat., *37*, 273–290.

GRUPPO OFIOLITI (1977): Escursione ad alcuni giacimenti a Cu-Fe e Mn della falda piemontese, Alpi occidentali: 10–13 ottobre 1977. Ofioliti, *2*, 241–264.

MASON, P., FROST, M. and REED, S. (1969): B.M.-I.C.-N.P.L. Computer programs for calculating corrections in quantitative X-ray microanalysis. IMS, Report 2.

NATALE, P. (1969): Recrystallization and remobilization in some pyrite deposits of the Western Alps. Convegno rimobilizzazione min. metallici Cagliari, 23 p.

SPOONER, E. T. C. and FYFE, W. S. (1973): Sub-sea-floor metamorphism, heat and mass transfer. Contrib. Mineral. Petrol., *42*, 169–173.

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