

## Ferrocapholite from Colle Ciarbonet (Cottian Alps)

DURING a petrographical investigation of the uranium-bearing high-pressure metamorphic rocks of the Aceglio Zone, E. Zanettin (1960) cursorily described the first occurrence of carpholite in the Western Alps at Colle Ciarbonet. The mineral occurs in calcite-quartz knobs and lenses to be found in the sheared zones of a horizon of Permian muscovite-chlorite phyllitic schists that underwent metamorphism at high pressure resulting in the scattered formation of lawsonite. Carpholite forms strongly elongated, fibrous prisms, bright green in colour, macroscopically indistinguishable from an actinolitic amphibole. It was identified through the following optical properties: colourless in thin section, medium birefringent with negative optic sign,  $2V_{\alpha} 70^{\circ}$ ,  $\gamma : [001] 2^{\circ}$ , maximum index of refraction less than 1.635.

Carpholite s.s., the Mn-rich variety of the carpholite group of minerals ( $\text{Mn, Mg, Fe}^{\text{II}}$ )  $\text{Al}_2[(\text{OH})_4\text{Si}_2\text{O}_6]$ , has never been described in Italy whereas ferrocapholite appears to be common in Calabria, southern Italy, sometimes in occurrences similar to that of Colle Ciarbonet (de Roever *et al.*, 1967, 1971). In view of the possible significance of ferrocapholite as the alleged equivalent of the chloritoid + quartz + water assemblage at high pressure (de Roever and Kieft, 1971), as well as of the incompleteness of another alpine description (Goffé *et al.*, 1973), it seemed worth while to carry out a thorough investigation of the Colle Ciarbonet occurrence, so as to verify whether carpholite actually is present in the western Alps as well as to give new data on the distribution of a mineral the significance of which in metamorphism is far from being entirely understood.

The original sample having been misplaced (E. Zanettin Lorenzoni, personal communication), we studied two specimens collected in 1967 by one of us (G.S.) a few metres east of Colle Ciarbonet, south of Aceglio in the Maira valley, Piedmont ( $7^{\circ} 22' 05''$  E,  $44^{\circ} 27' 04''$  N). These specimens are now deposited in the City Museum of Natural History of Milan. They consist of a mass of white quartz with a few grains of milky calcite, embedding large (several cm) crystals of the greenish-grey carpholite, showing a strong elongation with fibrous parting along the *c* axis. Thin section examination showed, moreover, numberless tiny needles of carpholite crossing the quartz, as well as a few flakes of white mica and small opaque spots, possibly graphite.

Optical, powder diffraction, and microprobe investigations were carried out on the large crystals. The analytical work was done with a microprobe Microscan MK V, operated at a probe current of 30 mA and 20.0 keV acceleration energy. The specimens and the standards ( $\text{SiO}_2$ ,  $\text{Al}_2\text{O}_3$ , MgO, Fe, Mn) were diamond-polished and coated with carbon. The ZAF-corrections were done following the procedure outlined by Sweatman and Long (1969). The cell parameters were obtained from diffractometric powder patterns indexed by comparison with the data of Borg and Smith (1969).

Although the cell parameters and the optical properties of the two carpholites examined are very similar, their compositions are slightly different (Table I). Both are ferrocapholites with a substantial content of the Mg end-member, nearly equal to that of the Fe end-member, and with traces of the Mn end-member. Their dimensions are considerably smaller than those of carpholites s.s., and even smaller than those of the ferrocapholite from Tomata, Indonesia (de Roever, 1951) presumably owing to the substitution by the smaller  $Mg^{2+}$  ion.

TABLE I

	a	b	a'	b'		a	b
SiO <sub>2</sub>	36.9	37.0	2.01	2.02	<i>a</i>	13.730(7) Å	13.747(9)
TiO <sub>2</sub>	0.14	0.14	0.006	0.006	<i>b</i>	20.140(10) Å	20.123(11)
Al <sub>2</sub> O <sub>3</sub>	30.3	30.3	1.94	1.95	<i>c</i>	5.109(4) Å	5.110(4)
FeO	13.0	11.8	0.59	0.54	<i>V</i>	1412.8(2.5) Å <sup>3</sup>	1413.6(2.9)
MnO	0.33	0.31	0.015	0.015	$\alpha$	1.615	1.625
MgO	5.6	5.8	0.45	0.47	$\beta$	1.627	1.634
H <sub>2</sub> O+	n.d.	n.d.	—	—	$\gamma$	1.632	1.638
$\Sigma$	86.3	85.4			$2V_{\alpha}$	65 ± 5°	70 ± 4°
					$\gamma : [001]$	0 to 2°	0°

a. Ferrocapholite (specimen no. 4041), Colle Ciarbonet, Cottian Alps, Italy.

b. Ferrocapholite (specimen no. 4042), *ibid.*

a', b'. Atomic ratios to 8 oxygen (anhydrous).

The occurrence of ferrocapholite in the Acceglio Zone of the Penninic Belt of the Alps, where both lawsonite and the jadeite+quartz assemblage have been reported, could appear to be significant in relationship with the high-pressure-low-temperature eoalpine metamorphic phase occurring in the Alpine Range. However, the quartz knobs carrying large undeformed ferrocapholite crystals of Colle Ciarbonet appear to have formed during a late phase of metamorphic segregation, rather than during the earliest penetrative phase of the alpine metamorphism. If the latter were the case, they should be broken and possibly retrogressed, since they were involved in several crystallization and deformation episodes. Nevertheless, a more careful mineralogical investigation of the quartz knobs carrying minerals superficially similar to actinolite is thought to be opportune, in that it could give new indications of carpholite occurrences, thus allowing a better understanding of the areal extent and of the metamorphic significance of this mineral in the Alpine Belt.

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*S.I.M.P., Corso Venezia 55; 20121 Milano (Italy)*

*Istituto di Mineralogia dell'Università,*

*Piazza Porta S. Donato 1; 40127 Bologna (Italy)*

*Institut für Mineralogie der Ruhr-Universität;*

*463 Bochum-Querenburg (Germany)*

G. SCAINI

A. MOTTANA

K. ABRAHAM

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