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FIBROUS FOITITE FROM SAN PIERO IN CAMPO, ELBA, ITALY

FREDERICO PEZZOTTA

Dipartimento di Scienze della Terra, Sezione di Mineralogia
Via Botticelli 23, Università degli Studi di Milano, 20133 Milano, Italy

FRANK C. HAWTHORNE, MARK A. COOPER AND DAVID K. TEERTSTRA

Department of Geological Sciences, University of Manitoba, Winnipeg, Manitoba R3T 2N2

ABSTRACT

A second occurrence of the *X*-site-vacant tourmaline foitite has been found in a complex pegmatite dike at San Piero in Campo, Elba. Foitite occurs as acicular and hairlike fibrous crystals associated with quartz and feldspars in miarolitic cavities in the medium-grained part of a complex tourmaline-bearing pegmatite. The fibers are unzoned and have the composition $\square_{0.63}Na_{0.36}Ca_{0.01}(Fe_{1.52}Mn_{0.19}Mg_{0.08}Al_{0.86}Ti_{0.01}Li_{0.33})Al_6Si_6O_{18}(BO_3)_3(OH)_4$, virtually identical to that recorded for foitite from southern California by MacDonald *et al.* (1993).

Keywords: foitite, tourmaline, fibrous mineral, pegmatite, Elba.

SOMMAIRE

Nous avons découvert le deuxième exemple de foitite, tourmaline ayant la position *X* vide, sur l'île d'Elbe, dans un filon de pegmatite granitique complexe à San Piero in Campo. La foitite s'y trouve en cristaux aciculaires et fibreux, semblables à des cheveux, avec des microcristaux de quartz et feldspath, dans des cavités miarolitiques de la partie à granulométrie moyenne d'un massif pegmatitique à tourmaline. Les fibres sont homogènes, et ont une composition $\square_{0.63}Na_{0.36}Ca_{0.01}(Fe_{1.52}Mn_{0.19}Mg_{0.08}Al_{0.86}Ti_{0.01}Li_{0.33})Al_6Si_6O_{18}(BO_3)_3(OH)_4$, presque la même que dans le cas de la foitite découverte en Californie du sud par MacDonald *et al.* (1993).

(Traduit par la Rédaction)

Mots-clés: foitite, tourmaline, minéral fibreux, pegmatite granitique, Elbe.

INTRODUCTION

MacDonald *et al.* (1993) recently described a new tourmaline of ideal composition $\square[Fe^{2+}_2(Al,Fe^{3+})]Al_6Si_6O_{18}(BO_3)_3(OH)_4$ from an unknown locality in southern California (possibly the White Queen mine, San Diego County). During a field trip to the tourmaline locality at Filone della Speranza, Elba, Italy, a second occurrence of foitite was found, this time "in place"; its description is presented here.

OCCURRENCE

The Monte Capanne monzogranitic pluton outcrops at the western end of the island of Elba, in the Tyrrhenian Sea, Italy. There are numerous aplite–pegmatite dikes along its eastern margin (Marinelli 1959), and these dikes contain miarolitic cavities lined with euhedral crystals of several minerals (Orlandi & Scortecci 1985). Fifty meters southwest of the locality La Speranza, there is an aplite–pegmatite dike 1.5–2.0 m wide, discovered by mineral collectors in 1991 and named Filone Rosina. This dike shows complex asymmetric zoning, with an aplitic Na-rich footwall and a coarse-grained K-rich hanging-wall. There are many large pockets rich in accessory minerals, including schorl, elbaite, spessartine, blue and pink beryl, petalite, pollucite and (Nb,Ta)-oxide minerals. In the upper part of the aplitic zone of the dike, there is a medium-grained phase rich in small (~1 cm) miarolitic cavities lined with small crystals of quartz and feldspars. Projecting into these cavities are acicular and hairlike crystals shown by electron-microprobe analysis to be foitite. Figure 1a shows a

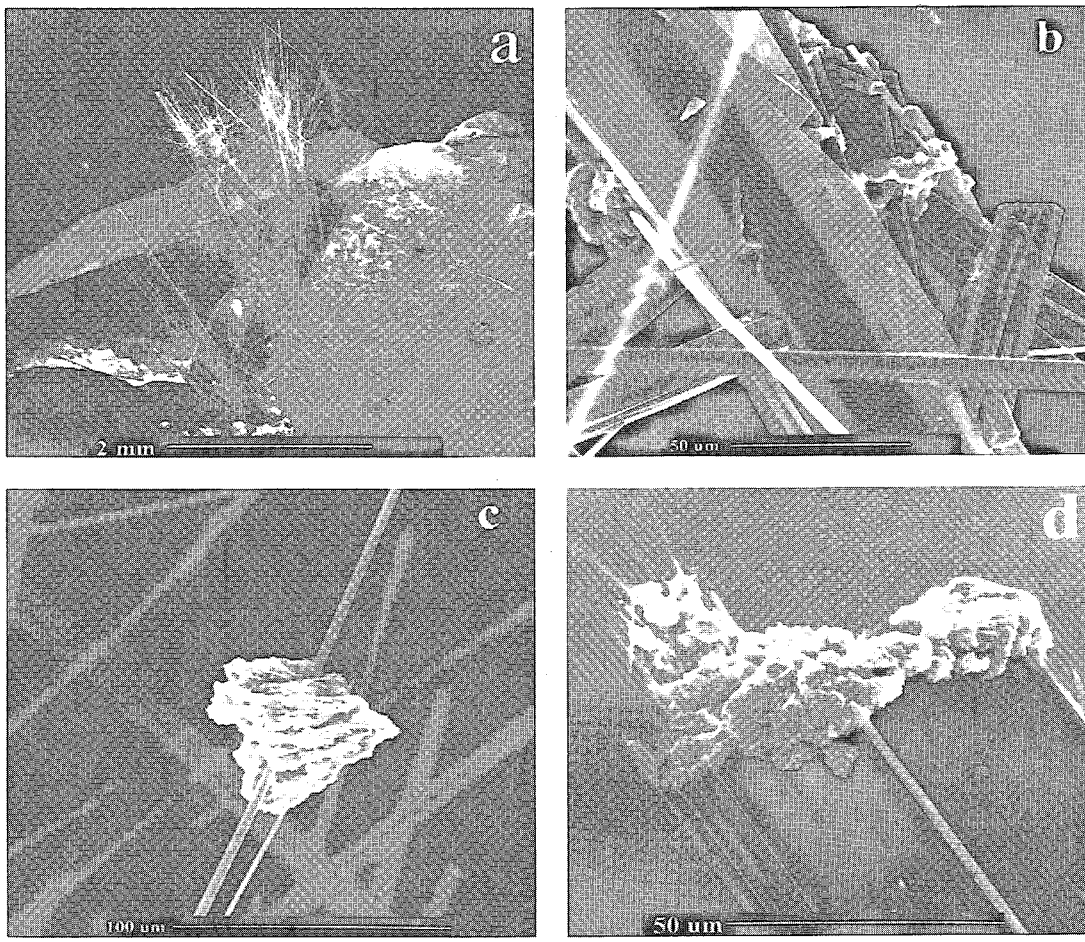

FIG. 1. Scanning electron micrographs of foitite from Filone della Speranza, Elba. (a) Low-magnification image of a miarolitic cavity showing feldspar (right foreground), quartz (background), and acicular and fibrous foitite (center foreground). (b) High-magnification image of foitite needles and fibers. (c) A single fiber of foitite overgrown by an aggregate of platy material (biotite). (d) A needle of foitite with the termination overgrown by platy material.

low-magnification SEM (scanning electron microscopy) image of part of one of the miarolitic cavities; in the foreground are acicular and hairlike crystals of foitite. Thicker crystals of foitite, together with many of the hairlike crystals, presumably grew into the cavity from between the microcrystals of quartz and feldspar; however, the hairlike crystals also occur in a tangled network (Fig. 1a) not in contact with the edges of the surrounding cavity. Higher-magnification images of this network (Fig. 1b) show that the larger acicular crystals seem pierced by the hairlike crystals, and the occurrence of microcrystals attached to larger crystals suggests that the tangled association of crystals is a primary growth-related feature.

Associated with the needles and hairs of foitite (Fig. 1c) is an aggregate of platy material; qualitative analysis by energy-dispersion spectrometry in the SEM indicates that it is biotite. From its physical relations with foitite, it seems to have crystallized essentially contemporaneously with foitite, in some cases obviously postdating the crystallization of foitite (Fig. 1d) and in other cases, postdating the coarser material but predating the more hairlike crystals of foitite. Other minerals associated with foitite in these cavities are colorless and blue beryl, cassiterite, manganocolumbite, euxenite, ilmenite, zircon and zeolites (mordenite and altered laumontite).

In some of the cavities, the foitite needles can be observed growing directly on and in crystallographic continuity with coarsely crystalline tourmaline. Large terminated crystals of tourmaline also project into the cavities, and both habits of tourmaline can be present in

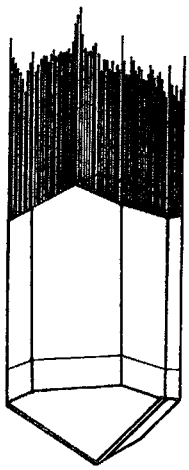

FIG. 2. Sketch of the crystallographic relations of fibrous and coarsely crystalline tourmaline.

the same cavity. A sketch of the crystallographic relations is shown in Figure 2, which emphasizes the effect of structural orientation on the composition and habit of the tourmaline crystals. Fibrous foitite only develops as an overgrowth on the analogous end of the crystals, and the antilogous end consists of coarsely crystalline schorl–elbaite. It is of great interest to see if such a relationship is of general applicability to fibrous tourmaline of all compositions (work in progress).

CHEMICAL COMPOSITION

Crystals of foitite were attached to a slide with their length parallel to the surface of the slide, and then very gently ground and polished to produce a flat surface for analysis. Analysis was done using a Cameca SX–50 electron-microprobe according to the procedure described by MacDonald *et al.* (1993), with Li_2O, B_2O_3 and H_2O calculated according to stoichiometric constraints. The chemical composition was surprisingly constant along the length of the fibers. Table 1 shows the average, minimum-Fe and maximum-Fe compositions, together with the unit formulae calculated on the basis of 31 anions assuming OH + F = 4 *apfu* (atoms per formula unit), B = 3 *apfu* and calculating Li as Li = 3 – ^{Y}Al – Ti – Fe – Mn – Mg.

TABLE 1. CHEMICAL COMPOSITION (wt %) AND UNIT FORMULA (*apfu*) OF FOITITE FROM FILONE DELLA SPERANZA, ELBA

	Mean	Min. Fe	Max Fe	**California
SiO_2	36.09	36.14	36.10	35.90
Al_2O_3	34.91	34.76	34.72	34.90
TiO_2	0.09	0.14	0.12	0.00
FeO	10.93	10.55	11.40	11.45
MnO	1.36	1.38	1.37	1.71
MgO	0.33	0.36	0.31	0.21
CaO	0.03	0.04	0.02	0.03
Na_2O	1.11	1.05	1.14	0.75
Li_2O	(0.49)†	(0.56)	(0.46)	(0.31)
B_2O_3	(10.42)	(10.40)	(10.43)	(10.37)
H_2O	(3.60)	(3.59)	(3.60)	(3.56)
Total*	99.36	98.96	99.66	99.19
Si	6.02	6.04	6.02	6.01
^{Z}Al	6.00	6.00	6.00	6.00
Al	0.86	0.85	0.82	0.89
Ti	0.01	0.02	0.01	0.00
Fe	1.52	1.47	1.59	1.60
Mn	0.19	0.20	0.19	0.24
Mg	0.08	0.09	0.08	0.05
Li	0.33	0.38	0.31	0.22
ΣY	2.99	3.01	3.00	3.00
Na	0.36	0.34	0.37	0.25
Ca	0.01	0.01	0.00	0.01
ΣX	0.37	0.35	0.37	0.26

* P, Cr, V, K, F not detected;
** from MacDonald *et al.* (1993);
† calculated according to the stoichiometric constraints described in the text.

DISCUSSION

Foitite from southern California (MacDonald *et al.* 1993) occurs as coarse crystals ~4 mm in diameter and at least 2 cm long, whereas foitite from Elba occurs as extremely fragile acicular and hairlike crystals. Despite this gross difference in physical appearance, they are of almost identical chemical composition (Table 1), the only significant differences being ~0.1 *apfu* in their Li and Na contents. The foitite of MacDonald *et al.* (1993) was not found *in situ* and was not associated with any matrix material; its pegmatitic association was assumed from the cited locality, southern California. Thus foitite from Elba provides us with the first paragenetic information on this species. The association with feldspar and quartz in miarolitic cavities suggests a fairly low-temperature origin, the foitite postdating the crystallization of both quartz and feldspar in these cavities. Ruggeri & Latanzi (1992) gave an upper pressure of formation of the Elba pegmatites as approximately 2 kbar.

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