Atti Soc. tosc. Sci. nat., Mem., Serie A, 103 (1996)
pagg. 193-195, figg. 2, tabb. 2

E. BONACCORSI (*), P. ORLANDI (*)

SECOND OCCURRENCE OF PITIGLIANOITE, A MINERAL OF THE CANCRINITE-GROUP

Abstract - Pitiglianoite is a rare feldspathoid belonging to the cancrinite-group, originally found at Pitigliano, Southern Tuscany, Italy. The second occurrence of this minerals from another locality (Monte Cavalluccio, locality of Campagnano, province of Rome) is described. The cell parameters of the mineral are a = 22.230(1), c = 5.2679(5) Å, space group $P6_3$; its chemical composition is $Na_5K_3Si_6Al_6O_{24}(SO_4)\cdot 2H_2O$.

Key words - Pitiglianoite, cancrinite-group, feldspathoids.

Riassunto - *Secondo ritrovamento della pitiglianoite, un minerale del gruppo della cancrinite.* La pitiglianoite e' un raro feldspatoide appartenente al gruppo della cancrinite. E' stata trovata per la prima volta a Pitigliano, Toscana meridionale, Italia. Viene qui descritto il secondo ritrovamento di questo minerale, all'interno di un proietto vulcanico raccolto sul Monte Cavalluccio, in località Campagnano, provincia di Roma. I parametri di cella, ottenuti al diffrattometro automatico a quattro cerchi, sono a = 22.230(1), c = 5.2679(5) Å, gruppo spaziale $P6_3$; la composizione chimica del minerale è $Na_5K_3Si_6Al_6O_{24}(SO_4)\cdot 2H_2O$.

Parole chiave - Pitiglianoite, gruppo della cancrinite, feldspatoidi.

INTRODUZIONE

Pitiglianoite was firstly found within ejected metasomatic blocks in a pumice quarry, near Pitigliano, southern Tuscany, Italy (Leoni *et al.*, 1979). Originally, it was named «microsommite from Pitigliano», because its cell parameters closely resemble those of microsommite, a feldspathoid from Vesuvius (Bariand *et al.*, 1968); however, recent chemical and structural data (Merlino *et al.*, 1991) showed that pitiglianoite is a distinct mineralogical species. The genesis of this mineral is related to the interaction of a trachitic magma with the sulphate rocks of the volcanic vent.

In this paper we describe the second occurrence of pitiglianoite, which was found within a sanidine-rich volcanic ejectum near Monte Cavalluccio, Campagnano, province of Rome, Italy. Here, pitiglianoite occurs as prismatic, elongated [0001], vitreous transparent crystals, about 1 mm long and 0.2 mm in diameter (Fig. 1). Associated minerals are sanidine, aegirine-augite, titanite, zircon, magnetite, nepheline and a hellandite-group mineral. In the same hand specimen, the new mineral peprossiite-

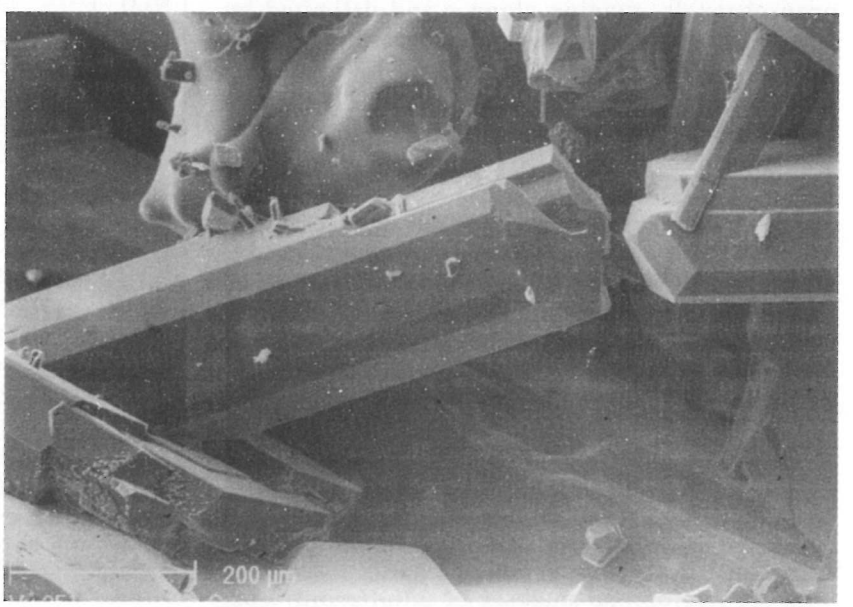

Fig. 1 - SEM microphoto of a pitiglianoite crystal in the sample from Campagnano.

(*) Dipartimento di Scienze della Terra, Università degli Studi di Pisa, Via S. Maria 53, 56126 Pisa.

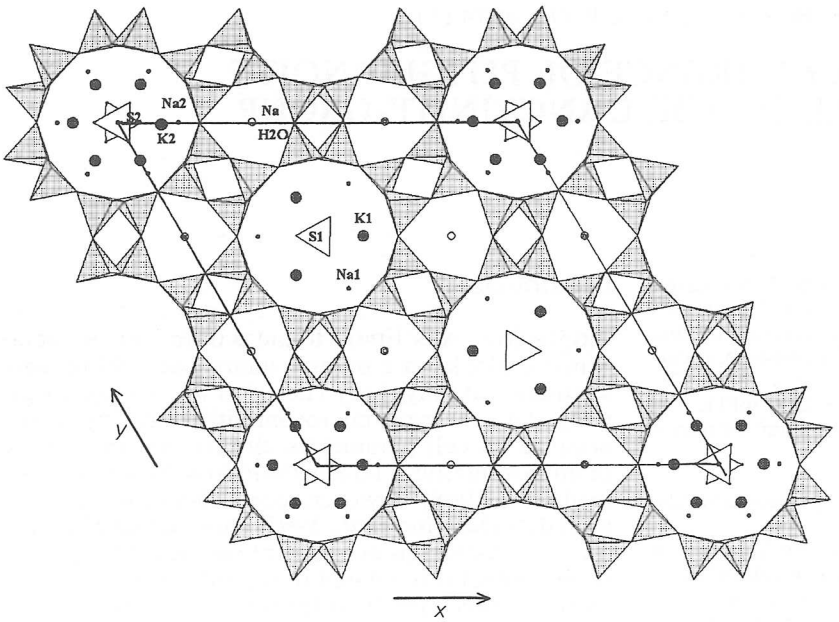

Fig. 2 - Schematic drawing of the structure of pitiglianoite as seen along [001]. A disordered distribution of the alkali cations and sulphate groups occurs in the channels at (0, 0, *z*) whereas the channels at (1/3, 2/3, *z*) and (2/3, 1/3, *z*) are ordered.

Ce (Della Ventura *et al.*, 1993) was identified for the first time.

General features

Both microsommite and pitiglianoite belong to the cancrinite-group of minerals, which are characterized by the ABAB ... stacking along *c* of six-membered rings of $[SiO_4]$ and $[AlO_4]$ tetrahedra. This stacking sequence gives rise to the development of open channels, running along *c* and delimited by columns of undecahedral cages (Fig. 2). If we consider the type of atoms and molecules that occupy the undecahedral cages, we can classify these minerals in two subgroups: *cancrinite-type minerals*, with Na and H_2O (cancrinite, vishnevite, pitiglianoite), and *davyne-type minerals*, with Ca and Cl (davyne, microsommite, quadridavyne). The large channels may contain several kinds of anions (CO_3^{2-}, SO_4^{2-}, Cl^-, OH), cations (Na^+, K^+, Ca^{2+}) and H_2O molecules. In pitiglianoite, as well as in microsommite, an ordered distribution of sodium and potassium cations, and sulphate groups occurs, giving rise to a three-fold supercell with respect to those of cancrinite and davyne, respectively, with $A = \sqrt{3}\ a$ and $C = c$, where *a* and *c* are the cell parameters of cancrinite and davyne.

Chemical data

The chemical analysis of the sample of pitiglianoite is reported in the first column of Table 1, together with the microprobe analyses of pitiglianoite from the type locality (Merlino *et al.* 1991) and of microsommite from Vesuvius. The chemical data were obtained with an EDS device attached to a Philips

Tab. 1 - Chemical analyses.

	(1) **pitiglianoite** (this work)	(2) **pitiglianoite** (Merlino et al., 1991)	(3) **microsommite** (Bonaccorsi et al., in prep.)
SiO_2	35.25	34.99	31.44
Al_2O_3	28.48	29.05	26.37
CaO	0.48	0.07	10.24
Na_2O	13.93	17.10	11.37
K_2O	12.13	9.41	6.98
SO_3	6.20	7.58	6.41
Cl	0.09	0.01	6.92
H_2O	3.44*	3.46**	-
Σ'	100.00	101.67	99.73
O = Cl			1.56
Σ			98.17
Si	6.15	6.07	6.03
Al	5.85	5.93	5.97
Ca	0.09	0.01	2.11
Na	4.71	5.75	4.23
K	2.70	2.08	1.71
S	0.81	0.99	0.92
Cl	0.03	0.003	2.25
H_2O	2.00*	2.00**	-

(1) SEM/EDS analysis, average of five points. (*)The H_2O wt.% is calculated on the basis of two H_2O molecules *p.f.u.* and the sum of oxides is normalized to 100.
(2) Microprobe analysis, average of seven points. (**)The H_2O wt.% is calculated on the basis of two H_2O molecules *p.f.u.*
(3) Microprobe analysis, average of seven points.

scanning electron microscope, working at 20 kV, 2500 cps, counting time of 100 s, spot size 200÷500 nm. The raw data were corrected by ZAF procedure. The H_2O weight % was calculated on the basis of two water molecules *p.f.u.*, as obtained from structural refinement (Merlino *et al.* 1991).
The resulting chemical formula, on the basis of 12 (Si+Al), is:
$Na_{4.7}K_{2.7}Ca_{0.1}Si_{6.1}Al_{5.9}O_{24}(SO_4)_{0.8}\cdot 2H_2O$
showing a content in potassium cations slighly higher than pitiglianoite from the type locality.
An idealized formula for our sample is:
$[Na_3K_3(SO_4)][Na_2(H_2O)_2][Si_6Al_6O_{24}]$
where the chemical composition of the three distinct structural modules - large channels, undecahedral cages and framework, respectively - is shown.

X-RAY STUDY

A single crystal was selected for X-ray characterization. By means of the oscillating-crystal and Weissenberg techniques, we obtained $c \sim 5.2$ and $a \sim 22.2$ Å, Laue symmetry $6/m$. In particular, $(hk0)$ Weissenberg photographs clearly indicated the presence of a superstructure, by showing strong reflections with $h - k = 3n$, and weaker reflections with $h - k \neq 3n$ which pointed to a supercell parameter $a \sim 22.2$ A.
The cell parameters were derived through least-square fit of the 2θ values of 30 reflections ($25° < 2\theta < 50°$) measured on a Siemens P4 automatic four-circle diffractometer, by using a graphite monocromatized MoKα radiation. The cell parameters are $a = 22.230(1)$, $c = 5.2679(5)$ Å; they are larger than those of pitiglianoite from the type locality, in accordance with the higher content in potassium cation of our crystals. In Table 2 the cell parameters are compared with those of similar phases.

Tab.2 - Cell parameters.

	pitiglianoite (this work)	**pitiglianoite** (Merlino *et al.*,1991)	**microsommite** (Bonaccorsi *et al.*, in prep.)
a (Å)	22.230 (1)	22.121 (3)	22.160 (2)
c (Å)	5.2679 (5)	5.221 (1)	5.346 (1)
V (Å^3)	2254.4 (3)	2212.8 (6)	2273.5 (5)
space group	$P6_3$ (or $P6_3/m$)	$P6_3$	$P6_3$

(ms. pres. il 5 maggio 1997; ult. bozze il 17 settembre 1997)

ACKNOWLEDGMENTS

We wish to thank the mineral collector G. Pierini for having provided us with the sample from Campagnano. Acknowledgments are due to S. Merlino, who revised the manuscript.

REFERENCES

Bariand, P., Cesbron, F. e Giraud, R., 1968. Une nouvelle espèce minérale: l'afghanite de Sar-e-Sang, Badakhshan, Afghanistan. Comparaison avec les minéraux du groupe de la cancrinite. Bull. Soc. franç. Minéral. Cristallogr., 91: 34-42.

Della Ventura G., Parodi G.C., Mottana A. e Chaussidon M., 1993. Peprossiite-(Ce), a new mineral from Campagnano (Italy): the first anydrous rare-earths-element borate. Europ. J. Mineral. 5: 53-58.

Leoni L., Mellini M., Merlino S. e Orlandi P., 1979. Cancrinite-like minerals: new data and crystal chemical considerations. Rend. Soc. ital. Mineral. Petrol., 35: 713-719.

Merlino S., Mellini M., Bonaccorsi E., Pasero M., Leoni L. e Orlandi P., 1991. Pitiglianoite, a new feldspathoid from southern Tuscany, Italy: chemical composition and crystal structure. Amer. Mineralogist 76: 2003-2008.