Eur. J. Mineral.
2005, **17**, 475-481

# Crystal structure and chemistry of trilithionite-2$M_2$ and polylithionite-2$M_2$

MARIA FRANCA BRIGATTI[1,*], ENRICO CAPRILLI[1], DANIELE MALFERRARI[1], LUCA MEDICI[2] and LUCIANO POPPI[1]

[1]Dipartimento di Scienze della Terra dell'Università di Modena e Reggio Emilia,
Via S. Eufemia 19, I-41100 Modena, Italy
[2]CNR – Istituto di Metodologie per l'Analisi Ambientale, C.da S. Loja, I-85050 - Tito Scalo (PZ), Italy

**Abstract:** The crystal chemistry of three Li-bearing mica-2$M_2$ crystals from pegmatites has been studied by chemical analyses and single crystal X-ray diffraction; their belonging to the trilithionite-polylithionite join is highlighted by the following compositional ranges in atoms per formula unit [based on $O_{12-(x+y)}(OH)_xF_y$] : $3.198 \le Si \le 3.538$, $0.462 \le {}^{[IV]}Al \le 0.811$, $1.195 \le {}^{[VI]}Al \le 1.390$, $0.031 \le (Fe+Mn) \le 0.072$, $1.522 \le Li \le 1.757$, $0.872 \le K \le 0.906$, $0.030 \le Na \le 0.073$, $0.000 \le (Cs+Rb) \le 0.099$, $1.541 \le F \le 1.722$. The correlation between F and Li content is confirmed, as observed in Li-rich micas.

Crystal structure refinements were carried out in space group *C*2/*c* (*R* values vary between 0.030 and 0.031). The crystal chemistry is mostly influenced by tetrahedral chemical composition. Increasing ${}^{[IV]}Al$ content, $\alpha$ and $\psi_{M1}$ parameters increase; Si content involves a lowering of the interlayer separation and tetrahedral thickness. Li content affects octahedral thickness. The stability of 2$M_2$ polytype seems to be induced by a relative increase of $\Delta z$ tetrahedral parameter, which reduces the repulsion between basal tetrahedral oxygen atoms. Unlike Li-bearing muscovite, trioctahedral Li-bearing mica crystals show an octahedral occupancy not related to octahedral charge.

**Key-words:** mica, trilithionite, polylithionite, lithium, 2$M_2$ polytype.

## Introduction

The crystal structure, composition and polytypism of the micas were recently reviewed (Brigatti & Guggenheim, 2002; Ferraris & Ivaldi, 2002; Nespolo & Ďurovič, 2002). These contributions evidence the significant advancement in describing the crystal chemistry of true micas belonging to 1*M* polytype, mostly showing trioctahedral occupancy, and 2$M_1$ polytype, mostly dioctahedral. More limited results are available for 2$M_2$, 3*T* and 2*O* sequences both true and brittle micas.

2$M_2$ polytype was detected for a limited set of samples, mostly Li-containing trioctahedral micas (Takeda *et al.*, 1971; Sartori *et al.*, 1973; Guggenheim, 1981) or dioctahedral micas with uncommon interlayer composition (Zhoukhlistov *et al.*, 1973; Ni & Hughes, 1996). Trioctahedral micas-2$M_2$ in the system K-Li-Fe-Al-Si [Takeda *et al.*, 1971; Sartori *et al.*, 1973 and Guggenheim, 1981 ("lepidolite-2$M_2$" from Radkovice, Czech Republic)] as well as the dioctahedral nanpingite-2$M_2$ (Ni & Hughes, 1996) were refined in the space group *C*2/*c* and indicate the presence of a large *trans*-site and two equivalent *cis*-sites, whereas ordering of tetrahedral cations is unusual. Unlike 1*M* polytype, no octahedral ordering between octahedral *cis*-sites was indicated for 2$M_2$ polytypic arrangement in Li-bearing micas.

At present, there are relatively few published studies on crystals belonging to the 2$M_2$ polytype in the K-Li-Fe-Al-Si trioctahedral mica system. Accordingly, this paper attempts to: (1) introduce three new crystal structure refinements of trioctahedral mica-2$M_2$ crystals with unusual composition between trilithionite and polylithionite; (2) identify the ordering pattern of the octahedral and tetrahedral sites along the trilithionite-polylithionite join; (3) compare the 2$M_1$ and 2$M_2$ long-range ordering for crystals along the $Al^{3+}$ -$Li^{+}$ join.

## Samples

Samples under examination come from Varuträsk (Västerbotten, Sweden) and from Chèdeville (France). The sample from Varuträsk (label: SBT) is from the Varuträsk pegmatite. It is mostly made from mica species, pink in colour, with maximum crystal dimensions of 9 mm. Mica is also associated to albite and stibiotantalite, an uncommon Sb, Ta, and Nb oxide. The outcrop from Varuträsk, genetically related to the Revsunb granite (Quensel, 1955), is a complex granitic LCT pegmatite, according to the Černý nomenclature (Černý, 1992).

Samples from Chèdeville (labels: Lch 59a and Lch 132) were also selected from LCT aplitic pegmatites

*E-mail: brigatti@unimore.it

DOI: 10.1127/0935-1221/2005/0017-0475
0935-1221/05/0017-0475 $ 3.15