

Crystal chemistry of trioctahedral micas in alkaline and subalkaline volcanic rocks: A case study from Mt. Sassetto (Tolfa district, Latium, central Italy)

ANGELA LAURORA,¹ MARIA FRANCA BRIGATTI,^{1,*} ANNIBALE MOTTANA,² DANIELE MALFERRARI,¹
AND ENRICO CAPRILLI²

¹Dipartimento di Scienze della Terra, Università di Modena e Reggio Emilia, Modena, Italy

²Dipartimento di Scienze Geologiche, Università degli Studi Roma Tre, Roma, Italy

ABSTRACT

This work provides a crystal-chemical description of trioctahedral micas from volcanic rocks (lavas, tuffs, ignimbrites, and xenoliths) outcropping at Mt. Sassetto (Tolfa district, Tuscan Province, central Italy). Mica crystals vary in composition from ferroan phlogopite to magnesian annite. Heterovalent octahedral substitutions are mainly related to Al^{3+} , Ti^{4+} , and, only in a few samples, to Fe^{3+} . The two main mechanisms regulating Ti inlet into the mica structure are the Ti-oxy [$^{\text{VI}}\text{Ti}^{4+\text{VI}}(\text{Mg,Fe})_2(\text{OH})_2\text{O}_2^-$] and Ti-vacancy [$^{\text{VI}}\text{Ti}^{4+\text{VI}}\square^{\text{VI}}(\text{Mg,Fe})_2$] substitutions. In these micas, Ti content is the predominant crystal-chemical parameter and significantly affects octahedral and interlayer topology as well. Micas with the highest Ti contents deviate from the expected fractional crystallization trend in the Ti vs. $\text{Mg}/(\text{Mg} + \text{Fe}_{\text{tot}})$ diagram, possibly as a consequence of a variation in intensive parameters (T , P , f_{H_2} , f_{O_2} , $f_{\text{H}_2\text{O}}$) during crystallization in the magmatic chamber.

In micas with significant Fe^{3+} contents, the layer charge balance is accomplished by the following mechanisms: $^{\text{VI}}\text{Fe}_{-3}^{2+\text{VI}}\text{Fe}_3^{3+\text{VI}}\square$, $^{\text{VI}}\text{Fe}_{-1}^{2+\text{VI}}\text{Fe}^{3+}(\text{OH})_1\text{O}_2^-$, and $^{\text{VI}}\text{Fe}_{-1}^{2+\text{VI}}\text{Fe}^{3+\text{IV}}\text{Si}_{-1}^{4+\text{IV}}\text{Al}^{3+}$. These micas show mean electron counts greater for the octahedral M2 site than for M1, and unit-cell parameters significantly smaller than usual for other micas. Atmospheric weathering is unlikely to produce the observed Fe oxidation. The Fe^{3+} -vacancy and Fe-oxy substitutions could represent secondary, re-equilibration effects related to post-eruptive water-rock hydrothermal processes (acid-sulfate alteration).

Keywords: Volcanic micas, central Italy, mica oxidation, hydrothermalism, crystal chemistry, Ti-substitutions, hydrothermalism