

Crystal chemistry of tourmalines from Mozambican pegmatites

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Introduction

- Tourmalines were found in Mozambique at the dawn of the 21st century.
- Main occurrences in granitic pegmatites and secondary deposits (paleoplacers).
- In 2004, Cu-bearing elbaites with Paraíba-type colors were discovered in the Mavuco secondary deposit, Alto Ligonha pegmatitic district.
- Supergroup of complex trigonal borosilicates with a R3m space group.
- General formula : $XY_3Z_6[T_6O_{18}](BO_3)_3V_3W_2$

Occurrences of tourmalines in Mozambique

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Unit-cell parameters





Muano : elbaite-schorl serie – Zn enriched (ZnO 1.24 wt%)

 $(Na_{0.83} \square_{0.14} Ca_{0.02} K_{0.01})_{1.00} (Al_{1.07} Li_{0.92} Fe_{0.75} Zn_{0.15} Mn_{0.11})_{3.00} Al_{6} (BO_{3})_{3} Si_{6} O_{18} (OH)_{3} (F, OH)$

Nahipa : elbaite-schorl serie – Mn enriched (MnO 1.23 wt%)

 $(Na_{0,83}\Box_{0.13}Ca_{0.03}K_{0.01})_{1.00}(Al_{1.06}Li_{0.97}Fe_{0.75}Mn_{0.17}Zn_{0.05})_{3.00}Al_{6}(BO_{3})_{3}Si_{6}O_{18}(OH)_{3}(F,OH)$

Single crystal X-ray diffraction



R¹⁺: Na¹⁺>>K¹⁺ R2+: Ca2+ R^{2+} : Fe²⁺ ~ Mg²⁺ > Mn²⁺ >>> Zn²⁺, Ni²⁺, Co²⁺, Cu²⁺ R^{3+} : Al³⁺ >> Fe³⁺ > Cr³⁺ >> V³⁺ R1+: Li1+ R4+: Ti4+ R^{3+} : Al³⁺ >> Fe³⁺ > Cr³⁺ > V³⁺ R²⁺: Mg²⁺ > Fe²⁺ R4+: Si4+ R^{3+} : $Al^{3+} > B^{3+}$ R³⁺: **B**³⁺ S1-: OH1-S2-: O2-S1-: OH1-~F1 S2-: O2-X-site coordination Inverse correlation

between distortions of

the Y and Z sites

Common cations and anions at each site

Mavuco : liddicoatite

 $(Ca_{0,51}Na_{0.32}\Box_{0.15}Pb_{0.02})_{1.00}(Li_{1.70}Al_{1.13}Fe_{0.06}Mn_{0.06}Ti_{0.05})_{3.00}Al_{6}(BO_{3})_{3}Si_{6}O_{18}(OH)_{3}(F,OH)$

Minor and trace elements



4. Bettencourt Dias, M. & Wilson, W.E., 2000. The Alto Ligonha pegmatites, Mozambique.

The Mineralogical Record, 31, 459–497.

- Main substitutions take place on the Y crystallographic site between the major elements (Al+Li) (elbaite) and Fe (schorl).
- Optical and compositional zonations reflect the evolving set-up conditions of granitic pegmatites.
- Atypical compositions have been identified in the Mavuco Pegmatite samples : liddicoatite
- The Fluor-liddicoatite component may be linked to an REE enrichment

An inverse correlation has been highlighted between the distortions of Y and Z sites. Highest distortions values are observed for schorlrich compositions

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