

Geikielite exsolution in spinel

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ABSTRACT

Euhedral crystals of purple spinel are associated with calcite and forsterite in the central zone of composite metasomatic veins of the Adamello contact aureole (Northern Italy). In thin section, spinel is generally colorless, but exhibits concentric zones of dark brown color. These zones are aligned parallel to prominent crystal faces and contain abundant anisotropic, lath-shaped inclusions with their long axis oriented in the six $\langle 110 \rangle$ directions of spinel. This orientation results from the alignment of $\{001\}_{\text{Geik}}$ and the $\{111\}_{\text{Sp}}$ crystallographic planes. The small (up to approximately $20 \times 1 \mu\text{m}$) inclusions were identified as geikielite by means of element distribution maps, micro-Raman spectroscopy, and transmission electron microscopy.

Electron microprobe data revealed that spinel consists mainly of MgAl_2O_4 , with only minor amounts of other components. The overall chemical variation within individual crystals is characterized by a continuous increase in FeO_{tot} and ZnO from center to rim (0.6–2.1 wt% and <0.1 –1.0 wt%, respectively). Whereas V_2O_5 is relatively constant (0.15 wt%), the bulk TiO_2 concentration (analysis spot: $20 \mu\text{m}$ diameter) increases in general from center (0.12 wt%) to rim (1.2 wt%). This variation, however, is marked by several discontinuities that correspond to the zones containing geikielite inclusions. Where geikielite occurs, the spinel matrix is depleted in Ti relative to the inclusion-free zones. Geikielite was analyzed by analytical electron microscopy and has the formula $\text{Mg}_{0.83}\text{Fe}_{0.15}\text{Mn}_{0.02}(\text{Ti}_{0.99}\text{Fe}_{0.01})\text{O}_3$.

The textural relationships between geikielite inclusions and spinel matrix, combined with the analytical data, suggest that geikielite laths represent exsolution features, thus, a miscibility gap exists between Mg-Al-spinel and geikielite. The purple color results from scattering of light by the geikielite inclusions. Spinel with similar features was also observed in metasomatic veins of the Bergell contact aureole (Italy) and in granulite-facies marbles of Southern India.