

Hydrogen deficiency in mantle-derived phlogopites

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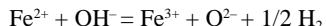
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ABSTRACT

The substitution mechanisms of Fe and Ti have been determined in phlogopite megacrysts from an ultramafic lamprophyre dyke from the Okenyena igneous complex, northwestern Namibia. Mica separates were heat-treated from 800 to 900 °C, 1 atm to 10 kbar, and f_{H_2} from that of the IQF solid-state buffer to that of air. Iron oxidation states and H₂O contents of the run products were determined using ⁵⁷Fe Mössbauer spectroscopy and a vacuum fusion, U-furnace manometry system, respectively.

The least-squares fit between the univalent anion content (OH + F) and molar Fe³⁺ atoms per formula unit (apfu) has a negative slope with a high correlation coefficient and, at the 95% confidence level, is consistent with the Fe-oxy reaction,



By adding O²⁻ to the univalent anion content in 2:1 molar proportions to the Ti, the total anion content in the OH site of the natural phlogopite is, at the 95% confidence level, close to the theoretical value of 4.0 (O = 24 apfu) for the mica structure. It is proposed that the total H deficiency in the natural phlogopite can be explained by both Fe- and Ti-oxy substitution mechanisms. Principal Components Analysis carried out on exchange components for the experimentally treated phlogopite confirms the operation of the oxy-substitution mechanisms.

Both oxy-substitutions dominate in the compositions of natural igneous micas from a variety of tectonic environments. The dehydrogenation of Fe oxy-components in micas from silicic lavas may be a source of water that can be liberated into crustal melts and play an important role in the mechanism for initiating volcanic eruptions.