

LETTER

The oxidation state of vanadium in titanomagnetite from layered basic intrusions

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ABSTRACT

The redox conditions prevailing during the formation of vanadiferous titanomagnetites from three layered intrusions (Bushveld; Koillismaa; Skaergaard) have been estimated from the valence state of vanadium using synchrotron X-ray absorption near edge structure spectroscopy (XANES). Using a high energy-resolution X-ray emission spectrometer, we show that vanadium occurs mostly as V³⁺, with minor V⁴⁺. The most concentrated samples (up to 2.4 wt% V₂O₃) contain approximately 10% of vanadium as V⁴⁺. Both V³⁺ and V⁴⁺ occur in the octahedral site of the spinel structure. Considering the low magnetite/melt V⁴⁺ partition coefficients, this suggests that vanadium ores crystallized under specific oxidizing conditions.

Keywords: Trace elements, XAS (XANES), igneous petrology, new technique