

Spinels and Mg Ilmenites from the Noril'sk 1 and Talnakh Intrusions and Other Mafic Rocks of the Siberian Flood Basalt Province

STEPHEN J. BARNES†

Magmatic Ore Deposits Group, CSIRO Exploration and Mining, Floreat Park, Western Australia 6014, Australia

AND V. Y. KUNILOV

Noril'sk Mining and Metallurgical Kombinat, Noril'sk 663300, Russia

Abstract

Spinels from the mineralized Noril'sk 1 and Talnakh intrusions show a broad and distinctive compositional spectrum, from normal chromite to Ti-enriched aluminous magnetite. In the Talnakh intrusion, in particular, the range of spinel compositions extends across a compositional space where spinels are rare in other layered intrusions. Spinel compositions vary widely on a scale of individual thin sections and are influenced by the nature of the enclosing silicate phase. Spinels enclosed in olivines are less Ti enriched than those outside olivine grains.

Compositional variance in the spinels is attributed to variable but generally advanced reaction between cumulus chromite grains and solidifying trapped intercumulus liquid. The advanced nature of the process is attributed to the open nature of the intrusions. Continuous, prolonged flow-through of hot magma enabled cumulates within the intrusions to remain above their solidus temperature for longer than would be normal for sills of comparable thickness.

The barren Chibacheka River intrusion shows some of the same features but differs from Talnakh in that spinel-olivine pairs record equilibration temperatures higher than those at Talnakh. Temperatures recorded by spinel-olivine pairs at Talnakh are anomalously low for such a small intrusion, again indicating prolonged slow cooling consistent with a flow-through model for the sill.

Spinel compositions support a hypothesized comagmatic relationship between the Chibacheka River intrusion and the Ti-, Cr-rich Gudchichinsky picritic basalts. Spinels in the Noril'sk and Talnakh intrusions imply a parent magma with a lower Cr/Al ratio than the Gudchichinsky picritic basalts.

Spinels from the Siberian intrusions show a similar range in compositions to the feeder intrusions of the Karoo flood basalt province. Jinchuan spinels share the features of high Ti contents and anomalously low equilibration temperatures with the Noril'sk-Talnakh spinels.

Mg ilmenites are a feature of the Siberian and Jinchuan intrusions. They are attributed to crystallization of ilmenite from evolved trapped intercumulus liquid buffered by surrounding Mg-rich cumulus phases. Their existence implies moderately but not unusually Ti-rich parent magmas, consistent with compositions of the Siberian Traps lavas.