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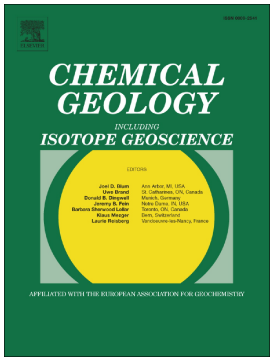

High Ni and low Mn/Fe in olivine phenocrysts of the Karoo meimechites do not reflect pyroxenitic mantle sources

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High Ni and low Mn/Fe in olivine phenocrysts of the Karoo meimechites do not reflect pyroxenitic mantle sources

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Abstract

Nickel contents and Mn/Fe in olivine phenocrysts have been suggested to reflect the mineral composition of the mantle source of the host magma. This hypothesis is tested here against a well-characterized suite of meimechitic (or Ti-rich komatiitic) dikes from the Antarctic extension of the Jurassic ~180 Ma Karoo large igneous province. The presented trace element data on $Fo_{82–92}$ olivines show relatively high Ni (2430–3570 ppm) and low 100*Mn/Fe (1.32–1.5; Mn = 890–1570 ppm), compatible with pyroxenite-rich sources (X_{px} = 37–75%). Many other mantle source indicators (parental melt MgO and whole-rock Zn/Fe, MgO/CaO, FC3MS, Zr/Y vs. Nb/Y, and radiogenic isotope compositions) suggest dominantly or solely peridotitic mantle sources, however. Therefore, the measured high Ni and low Mn/Fe are likely to reflect high temperatures and pressures of melting and possibly high water contents in the peridotite source of the studied rocks, rather than pyroxenite-rich source regions. We recommend considerable caution when using Ni and Mn contents of olivine as source indicators, as they may only serve for qualitative comparison of primitive volcanic rocks that originated under fairly similar mantle conditions.

Keywords: olivine; LA-ICP-MS; trace elements; nickel; manganese; mantle sources; pyroxenite; peridotite; recycled crust; large igneous provinces; Karoo

1. Introduction

Mantle pyroxenite may form by reactions between recycled crust (subducted eclogite) and mantle peridotite. Whether Mg-rich volcanic rocks, especially in various intraplate settings, originate dominantly from pyroxenitic or peridotitic mantle sources has been debated (e.g., Putirka, 1999; Sobolev et al., 2005, 2007; Niu et al., 2011; Putirka et al., 2011, Yang and Zhou, 2013).