

Two types of spinel from a peridotite associated with Bushveld Complex, South Africa: Tectonic implications

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Spinel is a common accessory mineral in ultramafic and mafic rocks, and because of its refractory nature, chemical composition of Cr-spinel is frequently used to infer the geotectonic environment of the rock which contains them. The tectonic setting of the largest layered ultramafic to mafic intrusion in the world, the Bushveld Complex, is still debated, with some studies suggesting a plume origin, while others arguing for a subduction setting. Few mineralogical studies have been carried out to address the possible tectonic setting. This study presents detailed petrographic and mineral chemical characterization of two types of spinels occurring within the Apiesdooringdraai peridotite, an extensive peridotite body that is spatially associated with the marginal sills and lower chill sequence, considered as parental to earliest magmas to the Bushveld Complex.

The peridotite body is composed mainly of olivine and orthopyroxene with minor amphibole, mica, spinel, apatite and sulphides. The first type of spinel is euhedral to subhedral and Cr-rich with Cr# ($=Cr/(Cr+Al)$) of 0.58 to 0.78 and Fe# ($=Fe/(Fe+Mg)$) of 0.60 to 0.75. With respect to the trivalent cations, the Cr-spinel grains do not show any within-sample variations. Mn and Ti are present in trace amounts. The second type of spinel is subhedral to anhedral and Al-rich with Cr# of 0.01 to 0.13 and Fe# of 0.25 to 0.34. Based on their petrographic and mineral chemical characteristics, the Cr-rich spinel is considered to represent the primary or near-primary spinel composition, while the Al-rich spinel is related to later fluid overprint contemporaneous with the formation of amphibole and mica in the rock. The later is further supported by the Ni and Zn contents in the Al-rich spinel, more than those in the Cr-spinel.

In comparison with a compilation of Cr-spinel composition from various tectonic settings, this study places constraints on the possible tectonic setting of the Bushveld Complex layered intrusion, forming part of the Bushveld large igneous province (Rajesh et al., 2013).

Reference

Rajesh, H.M., Chisonga, B.C., Shindo, K., Beukes, N.J., Armstrong, R.A. (2013) Petrographic, geochemical and SHRIMP U-Pb titanite age characterization of the Thabazimbi mafic sills: Extended time frame and a unifying petrogenetic model for the Bushveld Large Igneous Province. Precambrian Research (in press).

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