

Unmixed spinel in chromitite from the Iwanai-dake peridotite complex, Hokkaido, Japan: A reaction between peridotite and highly oxidized magma in the mantle wedge

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ABSTRACT

Spinel [(Mg, Fe²⁺)(Cr, Al, Fe³⁺)₂O₄] with an inhomogeneous texture was observed in a chromitite section from the Iwanai-dake complex, Hokkaido, Japan, which mainly consists of highly depleted Alpine-type peridotite. The inhomogeneous spinel identified under reflected-light microscopy has speckled and symplectic textures in the chromitite layer adjacent to dunite. On the other hand, spinel in the surrounding dunite and harzburgite is homogeneous. The inhomogeneous spinel comprises two different phases: an MgAl-rich spinel and an Fe-rich spinel with wide variation of Cr content. The compositional relationships of contiguous phases correspond to the solvus at 600 °C, which suggest that the inhomogeneous spinel was formed by an unmixing process due to the miscibility gap between Al-rich and Fe³⁺-rich phases. The original spinel composition in the chromitite layer, estimated from bulk spinel composition, is intermediate between magnesioferrite (MgFe³⁺O₄) and magnetite (Fe²⁺Fe³⁺O₄). Such an Fe³⁺-rich spinel composition indicates that the chromitite was formed under highly oxidized conditions at magmatic temperatures. A highly oxidized hydrous silicate melt, such as minette or absarokite, generated by melting of hydrous mantle, possibly reacted with peridotite in the mantle wedge and crystallized the Fe³⁺-rich spinel.