

The occurrence and composition of chevkinite-(Ce) and perrierite-(Ce) in tholeiitic intrusive rocks and lunar mare basalt

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ABSTRACT

Chevkinite-(Ce) and perrierite-(Ce) are the most common members of the chevkinite group of minerals. They are dimorphs, and both have the general formula $A_4BC_2D_2Si_4O_{22}$, where A = REE, Y, Ca, Sr, Th; B = Fe²⁺, (Mn, Mg); C = Ti, Al, Fe³⁺, Fe²⁺, Cr, Mn, Mg, Zr, Hf, Nb; and D = Ti. Both have been reported from a wide range of igneous, metamorphic, and hydrothermal rocks types, but occurrences in mafic rocks are rare, with minimal chemical and crystallographic documentation. Chevkinite-(Ce) and/or perrierite-(Ce) occur with other Ti-, Zr-, and REE-bearing accessory phases in eight suites of tholeiitic dolerite from Western Australia, and in lunar mare basalt 10047. They are more abundant than has been recognized previously in mafic igneous rocks, and they are significant hosts of incompatible elements. Chevkinite-(Ce) and perrierite-(Ce) from mafic rocks have distinctive chemical compositions with higher Zr than recorded in examples from most other common rock types. Among mafic rocks, two groups are recognized based on total Fe contents in electron microprobe analyses: crystal structural analysis by electron diffraction indicates that the high-Fe group (>8 wt% FeO) is chevkinite-(Ce), while the low-Fe group (<8 wt% FeO) is consistent with perrierite-(Ce), and both minerals can occur within a single hand specimen. A previously proposed chemical discriminant is not applicable to chevkinite-group minerals from typical mafic igneous rocks and crystal structural information is required to unequivocally distinguish between the two dimorphs.

Keywords: Chevkinite, perrierite, tholeiitic dolerite, lunar mare basalt, chemical (mineral) analysis, electron diffraction