Highlights and Breakthroughs

Merrillite and apatite as recorders of planetary magmatic processes

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Abstract: Merrillite, $Ca_{18}(Ca,\square)Mg_2(PO_4)_{14}$–$Ca_{18}Na_2Mg_2(PO_4)_{14}$–$Ca_{16}REE_2(Mg,Fe)_2(PO_4)_{14}$ as a primary phosphate along with apatite, in lunar and martian rocks, and in meteorites. It is nominally anhydrous, but attempts to directly measure H in this mineral have not previously been reported. Because of the occurrence on Earth of whitlockite, $Ca_{18}(Mg,Fe^{2+})_2(PO_4)_{12}[HPO_4]_2$, and the apparent incorporation in whitlockite of a merrillite component, the lack of a whitlockite component in extraterrestrial merrillite could be taken as an indicator of low hydrogen fugacity, and this implication has been applied to lunar merrillite. On the other hand, for martian rocks, where magmatic OH or H_2O contents were likely higher, apatite accordingly contains higher OH contents, yet coexists with anhydrous, Na-rich merrillite. With direct measurements by SIMS, McCubbin et al. (2014), which is in the July issue of *American Mineralogist* (p. 1347–1354), show that Shergotty merrillite is anhydrous and infer that the high T of crystallization of Shergotty precluded incorporation of a whitlockite component. The mineral pair apatite-merrillite in extraterrestrial rocks constitutes a powerful pair for recording magmatic conditions; however, as McCubbin et al. show, the implications of these minerals and their compositions must be interpreted in light of careful and complete analyses and crystal chemical constraints. **Keywords:** Merrillite, apatite, shergotty, planetary materials