Late-stage fluids in gabbros from the Earth and Moon: Implications for the preservation of KREEP

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The paucity of H2O-rich minerals collected during the Apollo and Luna missions led to the interpretation that melting and crystallization on the Moon occurred in water-poor settings [1]. Subsequent to the Apollo era, however, SIMS analyses of lunar glasses and apatites have shown that at least some H2O was present during igneous processing on the Moon [e.g., 2,3]. In this study, we compare olivine cumulate gabbro (OC) from the NWA 773 clan of lunar meteorites [4] with similar gabbro from the Murotomisaki sill, Shikoku, Japan [5] in order to evaluate the role of water during late-stage and post-magmatic crystallization of igneous bodies from the Earth and Moon.

We identified late-stage magmatic pockets from elemental mapping of a thin section of NWA 2977, a member of the NWA 773 clan consisting entirely of OC [6]. Pockets in the OC are characterized by K-Ba-feldspar and the REE-bearing Ca-phosphates apatite and merrillite, indicating an incompatible KREEP-rich component characteristic of the Moon [1]. Some late-stage magmatic pockets in sample Muro-14 from the Murotomisaki sill also have apatite. However, all of the Muro-14 pockets (1) have H2O-rich minerals such as prehnite or chlorite, and (2) are bounded by albitized feldspar, indicating recrystallization and element mobility in the presence of a post-magmatic aqueous fluid. Shreds of biotite are mostly replaced by chlorite. No other K-rich minerals occur in the Muro-14 pockets.

The chlorite-after-biotite texture suggests that pockets in Muro-14, similar to those of the NWA 2977 OC, were enriched in K during magmatic crystallization. Subsequently, however, K was dissolved in aqueous fluid and transported away from the pockets, leaving the Muro-14 pockets enriched in REEP, but not in K. In contrast, K-feldspar persisted in the low P(H2O) post-magmatic environment of NWA 2977 OC. Therefore, preservation of the KREEP pattern within lunar mafic rocks may be connected to the limited activity of aqueous fluid on the Moon.

References: [1] Robinson K.L. and Taylor G.J. (2014) *Nature Geoscience* **7**, 401-408. [2] Saal A.E. et al (2008) *Nature* **454**, 192-195. [3] Tartese R. et al (2014) *MaPS* **49**, 2266-2289. [4] Fagan T.J. (2014) *GCA* **133**, 97-127. [5] Hoshide T. et al (2006) *Jour. Mineral. Petrol Sci.* **101**, 223-239. [6] Zhang A.-C. et al (2011) *MaPS* **45**, 1929-1947.