FORMATION OF SYMPLECTITE-LIKE INCLUSIONS BY DIRECT QUENCHING FROM IGNEOUS LIQUID IN LUNAR METEORITE NWA 773.

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Introduction: Symplectites are finely-intergrown minerals with curved surfaces which formed from rapid breakdown of a pre-existing phase. Fayalite+hedenbergite+silica symplectites have been observed in lunar and martian meteorites and in returned samples from the Moon, and are commonly attributed to breakdown of pyroxferroite [1-4]. Pyroxferroite is a pyroxenoid that forms metastably during rapid cooling of a liquid that has evolved to very low Mg/(Mg+Fe); subsequently the pyroxferroite breaks down to form fayalite+hedenbergite+silica symplectite (see [1-4]; but also see [5]). Key observations for the pyroxferroite breakdown petrogenesis are the uniform modal distribution and stoichiometry of fayalite, hedenbergite and silica, such that modal recombination of these phases yields a pyroxferroite composition [4].

Symplectite clasts have been identified in the breccia of lunar meteorite Northwest Africa 773 (NWA 773) and paired meteorites [6,7]. Many of the NWA 773 symplectites apparently formed by pyroxferroite breakdown as described above. However, deviations from silica stoichiometry in some silica-rich blebs associated with the symplectite suggest a different origin—namely, direct quenching from silicate liquid.

Analytical Methods: One polished thin section (on loan from M. Killgore of University of Arizona) was studied studied by petrographic microscope, back-scattered electron and elemental imaging, and quantitative elemental analyses. Imaging and analyses were collected using a JEOL JXA-8900 electron microprobe at Waseda University.

Results and Discussion: Several symplectite clasts with uniform distributions of hedenbergite, fayalite and silica are present in the NWA 773 breccia. One large clast has a texturally distinct core composed of a fayalite (Fa_{98}) crystal with abundant, blebby inclusions. Elemental mapping shows that the symplectite surrounding the fayalite core is essentially free of K and Al, whereas K and Al are concentrated in the blebby inclusions. The blebby inclusions do not have feldspar stoichiometry (~3.4 Si, 0.6 Al and 0.5 K atoms per 8 oxygen, respectively). Detailed mapping shows elongate SiO_2 crystals present within some inclusions. The lobate shape of the inclusions, deviations from stoichiometry and presence of silica microphenocrysts suggest an origin by direct quenching from liquid, without an intervening pyroxferroite stage.

Other lithic clasts with low Mg/(Mg+Fe) in the NWA 773 breccia are characterized by high-Ba K-feldspar [6]. This variety of evolved clasts reflects a diversity of processes during late-stage solidification of evolved lunar magma. The variety of clasts in NWA 773 may have resulted from more than one magmatic system, or from immiscibility of late-stage liquids, among other processes.

References: [1] Burnham C.W. 1971. *Proc. 2nd Lunar Sci. Conf.* p. 47-57. [2] Rubin A.E. et al. 2000. *Geology* 28:1011-1014. [3] Aramovich C.J. et al. 2002. *Amer. Mineral.* 87:1351-1359. [4] Warren P.H. et al. 2004. *Meteorit. Planet. Sci.* 39:137-156. [5] Xirouchakis D. et al. 2002. *Geochim. Cosmochim. Acta* 66:1867-1880. [6] Fagan T.J. et al. 2003. *Meteorit. Planet. Sci.* 38:529-554. [7] Zeigler R.A. et al. 2007. *Lunar Planet. Sci. Conf.* XXXVIII: Abstract #2109.