EXTENSIVE MELTING OF AMOEBOID-OLIVINE INCLUSIONS.

John T. Wasson, Alan E. Rubin and Josep M. Trigo-Rodriguez, University of California, Los Angeles, CA 90095-1567 USA.

In CO3.0 chondrites amoeboid olivine inclusions (AOIs) typically consist of ~50-80% olivine with the remainder anorthite and diopside; some AOIs contain spinel. $\Delta^{17}O$ values in CO3.0 AOIs are $\leq$-20‰, genetically linking them to refractory inclusions.

The classical view has been that AOIs consist of sintered aggregates of grains; sintering involves melt fractions <10% and porosity at grain boundaries. AOI textures, however, show continuous phase interfaces, more consistent with extensive melting. Fig. 1 shows an AOI from CO3.0 Acfer 094. The darkest phase is olivine, lighter gray is diopside and darker gray is anorthite. Small white grains are metal. In accord with the Fo-An-Di phase diagram, olivine crystallized first, followed by anorthite or diopside depending on the bulk Ca/Al ratio; olivine forms chains of 3-10 m crystals. There is appreciable (5-10%) porosity; pores are rounded and located in or at the edge of diopside or anorthite.

The igneous crystallization sequence requires that AOIs experienced extensive melting; the small grain size indicates a high cooling rate, similar to that recorded by the thin overgrowth layers found on relict grains in CO3.0 chondrules. If the AOIs formed igneously and the diopside-anorthite intergrowths represent crystallized mesostasis liquid, then the round pores may represent contraction during crystallization; vapor-filled pores were surrounded by melt that solidified to a glass. Higher resolution images and consideration of surface-tension effects are required to interpret the porosity properly.

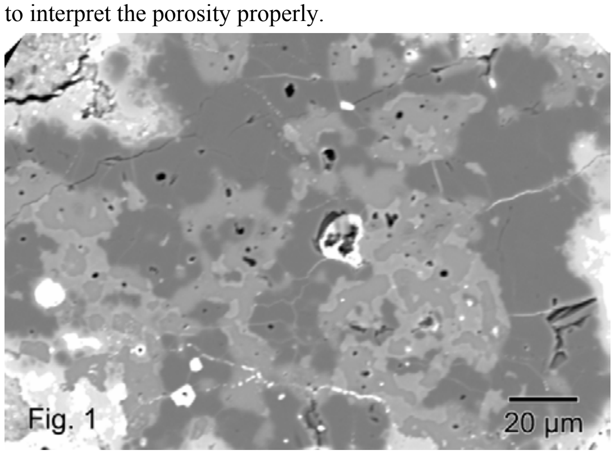

Fig. 1

Our igneous scenario for AOI formation is essentially the same as the consensus model for chondrule formation. Interestingly, the low-FeO type-I chondrules in CO3.0 chondrites show similar porosity textures in their mesostases. This similarity in inferred formation models for AOIs and chondrules raises the question of why there is no recognizable glass in AOIs. We suggest that anorthite-diopside mixes are poor glass formers; this is consistent with the observations that calcic glasses devitrify more readily than sodic glasses. A related question is why the minerals, especially olivine, do not show euhedral faces. We suggest that the cooling rate was too high. The interlocking phase arrangement in AOIs (e.g., Fig. 1) is typical of those found in rapidly cooled liquids that crystallize several phases. We have observed rather similar structures in the small clouds of crystals (we suggested the name caulifiorets) sometimes found in the mesostasis regions of chondrules.