Agglomeratic olivine (AO) objects: melting of dust to create Type II chondrules

A.M. Ruzicka and M. Hutson, Cascadia Meteorite Laboratory, Department of Geology, Portland State University, 17 Cramer Hall, 1721 SW Broadway, Portland OR 97207, USA

SUMMARY

AO objects in ordinary chondrites are composed primarily of fine-grained (≤5-10 µm-diameter) ferrous (Fa12-35) olivine, and troilite that is often concentrated towards the peripheries of objects. These objects also contain pyroxene, feldspathic material, relict magnesian olivine and pyroxene grains, relict chondrules and rare micro-CAs. They are present as both chondrule-sized inclusions and as rims around other objects (chondrules, isolated grains). AO objects compose ~2% of ordinary chondrites overall [1] and may be chondrule precursors [1, 2, 3].

We studied AO objects and possibly related chondrules in three LL chondrites (NWA 4910-- LL3.1; NWA 3127-- LL3.1; Sahara 98175-- LL3.5) using OLM, SEM, EMPA and SIMS methods to evaluate the origin of AO objects, their relationship to chondrules, and implications for the origin of chondrules.

We conclude that:
1) AO objects and Type II chondrules form a transitional sequence in texture and chemistry resulting from various degrees of thermal and chemical processing;
2) AO objects represent dust aggregates, which have quasi-chondritic composition on average, which were melted to produce Type II chondrules;
3) Both AO objects and Type II chondrules probably formed in similar locations within dense nebular dust clumps, in oxidizing environments generated by dust vaporization;
4) Both AO objects and chondrules formed as part of a recycling process that involved dust accretion, heating, evaporative melting, grain growth, mechanical disruption, and additional chemical processes including condensation, vaporization and reduction.

MODEL: DUST PROCESSING AND CHONDRULE FORMATION

Dust accretion, includes chondrule debris

Incipient melting of dust aggregates, form AO objects

Evaporative melting drives S into gas; some S condenses into AO objects

Mechanical disruption of chondrules, both Type I & II