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METAL AND SULFIDE IN SEMARKONA CHONDRULES AND RIMS: EVIDENCE FOR REDUCTION, EVAPORATION, AND RECONDENSATION DURING CHON-DRULE FORMATION. S. Huang, P. H. Benoit, and D. W. G. Sears, Cosmochemistry Group, Department of Chemistry and Biochemistry, University of Arkansas, Fayetteville AR 72701, USA.

The fact that many chondrules in UOCs contain metal associated with sulfide has been attributed to either low-temperature formation (<680 K) and lack of subsequent heating sufficient to cause evaporation [1] or metamorphism after chondrule formation [2]. We have examined the metal and sulfide in group A and B chondrule interiors and rims in the most primitive ordinary chondrite, Semarkona, in order to further explore these options.

Most group A1 chondrules contain abundant metal (3–4 wt%), which occurs mainly as rounded grains of kamacite (<1–60 μm), usually situated in the mesostasis near the chondrule edge. For the 37 group A1 chondrules investigated, only five contain sulfide, and it was abundant only in one. The sulfides were usually found associated with metal near the chondrule surfaces and, in a few cases, the metal grains were enclosed in sulfides. The "dusty metal" [3] is common in group A1 chondrules, but is not found in group B chondrules, and the host olivine is often embayed by metal-free pyroxene, which has a lower Fe/Fe+Mg ratio than the coexisting olivine. In contrast, metal in group B1 chondrules is much less abundant (generally less than 1 wt%) and occurs as both kamacite and taenite. It is often associated with sulfide, with the sulfide being more abundant than metal.

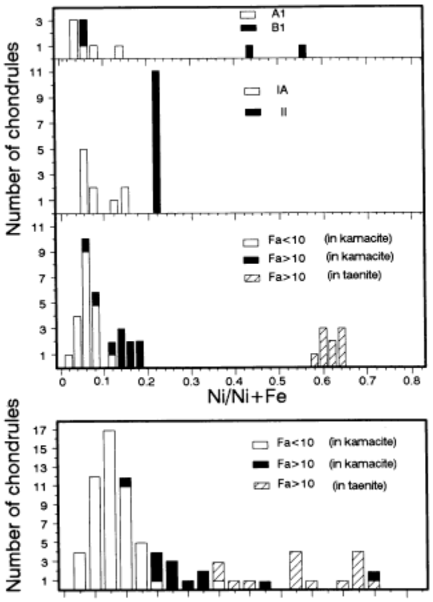

Fig. 1. Chondrule metal compositions (data from [4,6,8]).

Metal in group A1 chondrules is generally poorer in Ni than the metal in group B1 chondrules (Fig. 1). A similar observation was made for type IA and II chondrules [4,5], which are subsets of group A and B respectively. Additionally, metal in chondrules with Fe-poor olivine contains lower abundances of Ni and Co than metal in chondrules with Fe-rich olivine (Fig. 1) [6].

Group A1 chondrules are more frequently rimmed than group B1 chondrules (~70% by number, compared with ~30%) and seem to have higher ratios of rim thickness to chondrule diameter (Fig. 2). Most group A1 chondrule rims contain ultrafine-grained metal- and sulfide-rich materials, which are not observed in chondrites of higher petrographic grades. In contrast, group B1 chondrule rims, when present, contain fine-grained matrixlike materials with dispersed or massive sulfide and metal, which, in contrast to the ultrafine sulfides/metal-rich rims in group A chondrules, are also observed in higher petrographic types [7].

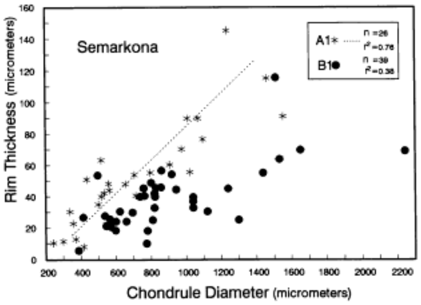

Fig. 2. Rim thickness vs. chondrule diameter with regression lines.

These results can best be explained by reduction of ferrous olivine and loss of FeS by evaporation during group A1 chondrule formation with the recondensation of FeS and/or reactions between recondensed metal and H_2S in the nebular gas at lower temperatures. Thermoluminescence, cathodoluminescence, and compositional zoning in several Semarkona group A1 chondrules has also been interpreted in terms of recondensation of major volatile elements like Na and Mn [8,9].

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