TYPE II CHONDRULE ORIGIN IN O AND C CHONDRITES.

R. H. Hewins[1,2] and B. Zanda[1,2]. [1]MNHN & CNRS, 75005 France; [2]Dept. of Earth and Planet. Sci., Rutgers Univ., Piscataway, NJ, USA. hewins@rci.rutgers.edu.

Relict grains are widespread in chondrules: many Type I chondrules contain olivine not crystallized from their associated Al-rich melts [1], including grains with very low $\Delta^{17}O$ [2,3] and GOA with several specific O isotope compositions closer to TFL than solar [4]. This suggests chondrule formation with various dust/gas ratios and relatively inefficient recycling. Addition of SiO to the rims of many chondrules changes them from IA to IAB to IB, perhaps in regions of higher dust/gas ratio generating high P_{SiO} during chondrule heating, with higher $\Delta^{17}O$ [5]. The Nancy open-system chondrule model [1,3,4,5] has recently been extended to Type II chondrules formed from Type I material by adding Fe and O from the gas [6]. We use our recent extensive EMP data [7] for Type II chondrules in Paris and other CM chondrites to develop the Nancy Type II chondrule model.

Type II chondrules contain abundant Na, FeO and S, consistent with formation in large dusty clumps yielding high P_{Na}, etc. The common survival of relict forsterite of Type I composition in Type II chondrules in both CC and OC strongly supports a Type I precursor. Oxidation of Fe from metal in Type I chondrules [6] would explain the jump in FeO from Type IA olivine composition to the most magnesian Type IIA chondrule olivines. However, Type II chondrules in both CC and OC have positively correlated FeO and MnO, consistent with condensation rather than oxidation [7]. Olivine in Type II chondrules in Paris and other CMs extends up to Fa_{70}, more ferroan than in OC. The OC chondrules experienced less condensation of FeO, possibly because of lower P_{H2O}, and we find f_{O2} from QFI about ½ log unit lower.

Type II chondrule olivine in CMs has an Fe/Mn ratio like that in CO [8], micrometeorites and Wild 2 [9], but distinct from that in OC [7] and therefore comes from a different reservoir. The occurrence of IIA-IIB chondrules in both Paris and Semarkona indicates Fe- and Si-enrichment paths in both reservoirs. CR chondrites, on the other hand, contain Type IIs with intermediate Fe/Mn and O isotope characteristics split between CM-CO and OC reservoirs [8,10], and thus indicate changing redox conditions related to variations in dust/gas ratios and/or ice contents.

OC contain clusters of chondrules, both Type I and Type II, with similar $\Delta^{17}O$, consistent with recycling side by side. This suggests turbulent mixing on a local scale before and during transient heating events. In CC, Type II chondrules are much less abundant and formed at higher f_{O2} than in OC while Type I chondrules have $\Delta^{17}O$ mostly closer to solar than those in OC. Thus Type IIs were moved to a domain containing abundant dust, including Type Is, themselves formed in several oxygen isotopic reservoirs. This assemblage was not recycled before accretion.

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