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(b) On a larger scale, chondrule forming regions differed in oxygen fugacity (giving rise to silicates differing in Fe/(Fe+Mg) ratio, olivine/pyroxene ratio of the silicates produced, and the typical maximum temperatures reached.

(c) Material was frequently transported between regions differing in one or more of these parameters. Thus, olivines and pyroxenes formed under different fO_2, and therefore differing in Fe/(Fe+Mg) ratio, or spinels, which formed at a high temperature location, were incorporated into molten chondrules as relict grains.

(d) Similarly, material which escaped heating collided with molten chondrules (matrix lumps inside chondrules: Rubin *et al.*, 1982), or accreted onto them (dust rims). In these cases either the dust or the molten chondrule may have been transported across the boundary of a chondrule forming region.

(e) Metal sulfide spherules may have formed as immiscible liquids during chondrule formation, and would therefore have been abundant in chondrule-forming regions of low fO_2. Nevertheless, compound objects consisting of chodrules and metal spherules appear to be rare, perhaps because they do not normally stick to each other.

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PRECHONDRITIC FRACTIONATION OF CHAINPUR CONSTITUENTS: EVIDENCE FOR STRONGLY REDUCING CONDITIONS IN THE EARLY SOLAR SYSTEM

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A suite of 20 chondrules and 10 chondrule-sized fragments from the Chainpur LL3 chondrite has been studied by INAA and electron microprobe analysis. The following observations have been made:

a) The K content of the silicate fraction of most chondrules varies from 0.4 × CI to 3 × CI, while Na is relatively constant (1.1-1.4 × CI). Preliminary data show similar variations of chondrule-sized lithic fragments. This could indicate that these fragments represent the chondrule parent rocks, which were composed of a fractionated K-poor and a K-rich component. Rb, Cs, and to a certain degree also Mn are correlated with K. Since conventional geochemical and cosmochemical fractionation models cannot account for the observed Na-K fractionation, we propose a new type of cosmochemical fractionation via sulfides (Kurat *et al.*, 1982, 1983). This implies strongly reducing conditions prevailing during the formation of prechondritic rocks. Under these conditions K and Na will separate in entering different sulfide phases such as djerfisherite and caswellsilverite respectively. By mobilizing and redepositing the K sulfide the observed Na-K fractionation can be explained in Chainpur and other chondrites (Wlotzka *et al.*, 1983).

Our model is strongly supported by chemical data on chondrules from the Indarch (E4) chondrite (Smith *et al.*, 1983) which show strong depletions of chondrules in K such as can be observed in K-poor chondrules and lithic fragments in Chainpur (LL3) (Kurat *et al.*, 1982, 1983). Observations on Qingzhen (E3) (El Goresy *et al.*, 1983) also support our model.

Sodium-K fractionation in chondrules and lithic fragments of chondrites is very common [e.g. Kurat (1967)]. Apparently, sulfide fractionation was a common process in the early Solar System. At that stage the Solar System matter must have been highly reduced and redox conditions had to change dramatically in order to account for the oxidation state of ordinary chondrites.

b) The most refractory chondrules (about 30% of our suite) are strongly depleted in Na, K, and Mn by factors down to 0.2, 0.1, and 0.5 × CI, respectively. These depletions apparently are due to vapor fractionation during chondrule formation.

c) In the metal fraction of chondrules, Ni, Cu, and Ir are negatively correlated with Co, similar to the results obtained on metals from L-chondrites (Rambaldi, 1976). This suggests that variable mixtures of taenite and kamacite have been sampled in the chondrule-forming process.

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