SILICON ISOTOPIC COMPOSITION OF CV3 CHONDRULES AND ISOTOPIC FRACTIONATION IN THE SOLAR NEBULA.

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Introduction: Stable isotopic variations in chondrules can provide information on the physical processes involved with their formation. The origin of the stable isotopic variations observed in chondrules can have associated implications for isotopic heterogeneity in the solar nebula, and the interpretation of isotopic variations associated with solar system bulk materials. Here we report new Si isotopic data for eleven chondrules from Allende and four from Mokoia. In addition major element solution data were collected for ten of the Allende chondrules, which were also described petrographically.

Results: The δ^{30}Si compositions for the Allende chondrules range from −0.71‰ to −0.10‰, which is larger than the range currently observed for bulk meteorites (~0.3‰) [1]. However this is still a restricted range in comparison to recent CAI data [2-3]. The average Si isotopic composition of the Allende chondrules, δ^{30}Si =−0.47 ± 0.35 ($2\sigma_{SD}$), cannot be resolved from the average of seven aliquots of Allende (δ^{30}Si =−0.46 ± 0.07, $2\sigma_{SD}$)[1] and there is no hint of a systematic shift to heavier or lighter values. There is no consistent correlation between chondrule δ^{30}Si and petrological grouping, nor is there any strong inverse correlation with size or Si/refractory element ratio. The limited range in bulk chondrule Si data is consistent with other isotopic systems [4-5]

Discussion: The range observed in δ^{30}Si of these bulk chondrules makes formation from a previously differentiated body unlikely, as mafic portions of these bodies, including lunar pyroclastics, display a much narrower range (−0.56‰ to −0.30‰) [1,6] than chondrules. If the isotopic variation is the result of chondrules forming in a nebular setting, the Si isotopic range could either be the result of initial isotopic heterogeneity and closed system formation [7], or fractionation in an open system during formation. The limited range of chondrules relative to CAIs rules out simple evaporation into free space. If the variation is precursor heterogeneity, a multi-modal distribution might be expected, which is not observed, though the small sample size provides a caveat on completely ruling out this interpretation. However, what is a more likely interpretation is that varying degrees of evaporation and re-condensation [4], or open system exchange is responsible for the measured δ^{30}Si data.

References: [1] Armytage R. M. G. et al. (2011) *Geochimica et Cosmochimica Acta* 75, 3662-3676. [2] Hezel D.C. et al (2009) *Lunar and Planetary Science Conference XL,* Abstract #1772. [3] Shahar A. et al. (2009) *Earth and Planetary Science Letters* 257, 497-510. [4] Alexander C.M.O'D. et al. (2000) *Meteoritics & Planetary Science* 35, 859-868. [5] Zhu X. K. et al. (2001) *Nature* 412, 311-313. [6] Pringle et al. (2013) *Earth and Planetary Science Letters* 373, 75-82. [7] Grossman J.N. and Wasson J.T. (1982) *Geochimica et Cosmochimica Acta* 46, 1081-1099