IRON ISOTOPE HETEROGENEITY IN COMPONENTS OF MESOSIDERITE METEORITES.

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Introduction: Mesosiderites are a brecciated mixture of FeNi-metal and silicates [e.g. 1,2], and likely formed by impact-mixing of silicates with molten metal [e.g. 2,3]. We measured the Fe-isotope composition of bulk, silicate and metal phases to establish the degree of heterogeneity within these samples.

Methods & Samples: Samples were characterized using a Cameca SX-50 EMP. Dissolution followed a two step HF-$HClO_4$-HCl method and iron was separated using anion exchange chromatography [4]. ^{56}Fe and ^{57}Fe were measured on a fixed resolution (m/ m = 500) MC-ICP-MS (IsoProbe) and are bracketed with IRMM-014 [5]. Errors are ±0.05‰ (2) for ^{56}Fe and ±0.09‰ (2) for ^{57}Fe. Six bulk basaltic-rich type A mesosiderites (Clover Springs, Estherville, Mount Padbury, Pinnaroo, and Vaca Muerta) were analyzed. In addition, silicate and metal digests were separated for Estherville and Vaca Muerta.

Results: Fe-isotope signatures are tightly grouped and fall on the mass fractionation line already described for chondrules [5], other solar system samples [6], and HED meteorites 7]. Mesosiderite Fe-fractionation falls within the range of the HEDs [7]. Thus, these components, from different parent bodies [8], cannot be distinguished. Bulk analyses range from 0.01-0.20‰ for ^{56}Fe and 0.04-0.23‰ for ^{57}Fe. Mount Padbury and Pinnaroo are the isotopically heaviest bulk samples. Silicate (^{56}Fe = 0.01 to 0.02‰) and metal (^{56}Fe = 0.03 to 0.05‰) components from Estherville and Vaca Muerta are indistinguishable from each other, and from the bulk composition, within error.

Discussion: Although metal, silicate and bulk from Estherville and Vaca Muerta are not very different from each other or from the bulk Clover Springs analysis, the isotopically heavier signatures of Mount Padbury and Pinnaroo indicate that there is a reservoir of isotopically heavy iron. Further work is necessary to determine if this source is from the metal or silicate phases or perhaps both. The similar Fe-isotopic composition of Clover Springs, Vaca Muerta and Estherville may be due to homogenization during the impact-mixing event that formed the mesosiderites. It is possible that components from Mount Padbury and Pinnaroo were less homogenized during the impact event. As all the samples analyzed to date are compositional type A, the effect of differing silicate composition cannot be assessed. No systematic variation is seen between Fe-isotope composition and extent of regolithic/metamorphic processing (types 1 to 4 [9,10]).

References: [1] Floran R.J. (1978) LPSC IX, 1053. [2] Hewins R.H. (1983) LPSC XIV, JGR 89, C289. [3] Hassanzadeh J. et al. (1990) GCA 54, 3197. [4] Mullane et al. (2003) In: Holland & Tanner (Eds.) Plasma Source Mass Spec., Royal Soc. Chem. 351. [5] Mullane et al. (2003) LPS XXXIV, Abs. #1027. [6] Zhu et al. (2001) Nature 412: 311. [7] Mullane et al. (2004) LPSC XXXV, Abs. #1015. [8] Bogard D.D. (1995) Meteoritics 30: 244. [9] Floran RJ et al. (1978) LPSC 9; 1083. [10] Powell (1971) GCA 35, 5.