Ni ISOTOPE ANORMALIES AND ^{60}Fe IN SULFIDES FROM UNEQUILIBRATED ENSTATITE CHONDRITES. Y. Guan[1], G. R. Huss[1, 2], L. A. Leshin[1, 2] and G. J. MacPherson[3], [1]Department of Geological Sciences and [2]Center for Meteorite Studies, Arizona State University, P.O. Box 871404, Tempe AZ 85287, USA, [3]Department of Mineral Sciences, National Museum of Natural History, Smithsonian Institution, Washington DC 20560-0119, USA. (e-mail: yunbin.guan@asu.edu)

Recent studies have demonstrated the existence of short-lived ^{60}Fe in unequilibrated ordinary chondrites [1-3]. In this report we investigate both the ^{60}Fe-^{60}Ni and the ^{53}Mn-^{53}Cr isotopic systematics in sulfides of enstatite chondrites. We identified thirty-seven sulfide grains or assemblages with apparent low Ni and Cr contents from four unequilibrated enstatite chondrites (UECs): Qingzhen (EH3), Sahara 97072 (EH3), EET 87746 (EH3), and MAC 88136 (EL3). Isotopic analyses were carried out using the Cameca ims-6f at Arizona State University. The minerals analyzed include alabandite, daubréelite, kamacite, niningerite, sphalerite, and troilite.

Most sulfides in the four UECs have Fe/Ni ratios too low to permit detection of the expected small anomalies in ^{60}Ni. However, a few sulfide grains do show resolved ^{60}Ni excesses. A troilite-kamacite-niningerite assemblage (QZ3-S4) in Qingzhen has Fe/Ni ratios up to 130,000 and gives an apparent isochron with an initial ^{60}Fe/^{56}Fe ratio [(^{60}Fe/^{56}Fe)$_o$] of $(3.4\pm2.1)\times10^{-7}$ (2σ error). The three troilite grains with the highest Fe/Ni ratios in MAC 88136 (M3641-T1, M3641-T11, and M3641-T14) also contain ^{60}Ni excesses, and the inferred (^{60}Fe/^{56}Fe)$_o$ values are $(\sim2.0\pm1.0)\times10^{-7}$. In general, the (^{60}Fe/^{56}Fe)$_o$ ratios in these two UECs are consistent with those observed in troilites from Krymka [1,2], but lower than that from Semarkona [3]. One object shows a very different result. Sphalerite in a sphalerite-alabandite-troilite assemblage (M3645-S5) from MAC 88136 gives large excesses at ^{60}Ni and ^{62}Ni (δ^{60}Ni=129±128‰; δ^{62}Ni=238±147‰; Fe/Ni=~350,000) with ^{61}Ni as the reference isotope. If we correct for mass fractionation using ^{62}Ni/^{61}Ni, the resulting ^{60}Ni excess yields (^{60}Fe/^{56}Fe)$_o$=$(8.2\pm4.1)\times10^{-7}$, similar to that inferred for Semarkona troilite [3]. If instead we use an external fractionation correction, the inferred (^{60}Fe/^{56}Fe)$_o$ ratio is $(2.8\pm2.7)\times10^{-7}$, close to that inferred for Krymka troilite [1,2]. However, the Ni isotope anomalies may not be due to live ^{60}Fe, but may instead be of nucleosynthetic origin, inherited from a presolar precursor. The isotope pattern for ^{60}Ni, ^{61}Ni, and ^{62}Ni is very similar to the pattern observed in several Allende inclusions by [4], although the magnitude of the M3645-S5 anomalies is much larger.

It would be ideal to use several short-lived radionuclides together to explore the evolution of the early solar system. Therefore, we also examined Mn-Cr isotopic systematics in some of the sulfides. Excesses of ^{53}Cr were detected in two sulfide assemblages from MAC 88136. The sulfide assemblage with large Ni isotope anomalies, M3645-S5**,** has ^{53}Cr excesses corresponding to an inferred initial (^{53}Mn/^{55}Mn)$_o$ ratio of $(1.7\pm0.5)\times10^{-7}$. A second troilite-sphalerite assemblage (M3645-S1) gives an isochron with (^{53}Mn/^{55}Mn)$_o$=$(5.7\pm0.8)\times10^{-7}$. The inferred (^{53}Mn/^{55}Mn)$_o$ values and their variability agree with previous data from MAC 88136 [5]. The spread in (^{53}Mn/^{55}Mn)$_o$ ratios probably reflects diffusional redistribution of Mn and Cr after the decay of ^{53}Mn. Therefore, chronological interpretations of these ^{53}Mn-^{53}Cr data are not warranted. Further work is clearly required before a comprehensive chronology based on multiple short-lived radionuclides can be developed.

References: [1] Tachibana S. and Huss G. R. (2003) *LPS XXXIV*, abstract 1737. [2] Tachibana S. and Huss G. R. (2003) *ApJ 588*, L41-L44. [3] Mostefaoui S. et al. (2003) *LPS XXXIV*, abstract 1585. [4] Birck J. L. and Lugmair G. W. (1988) *EPSL, 90,*131-143. [5] Wadhwa M. et al. (1997) *Meteorit. Planet. Sci. 32,* 281-292.