^{60}FE-^{60}NI SYSTEMATICS OF SOME ACHONDRITES

N.Sugiura[1] and Q. -Z Yin[2]. [1]Univ. of Tokyo. E-mail Sugiura@eps.s.u-tokyo.ac.jp. [2]Univ. of California at Davis.

Introduction: ^{60}Fe is mainly produced by supernovae and not produced efficiently in AGB or by cosmic rays. Therefore, this is a crucial isotope to decipher the origin of extinct nuclides. Detection of significant excesses in ^{60}Ni has been reported for several meteoritic samples [1,2,3], whereas significant excesses in ^{60}Ni were not detected in other materials [4,5]. The upper limit to the initial ^{60}Fe/^{56}Fe of [5] is in conflict with some of the reported initial ^{60}Fe/^{56}Fe ratios [e.g. 3]. Here we report inferred initial ^{60}Fe/^{56}Fe ratios for old achondrites that contain minerals with high Fe/Ni ratios and hence can provide precise age data.

Ion probe measurements Iron-rich minerals in eucrites (Stannern and Asuka 881394: St and A88 for short) and angrites (Sahara 99555, D'Orbigny, Northwest Africa 1670 and Angra dos Reis: S99, D'O, NWA16 and ADOR for short) were measured with a Cameca-6f ion microprobe. Fe/Ni ratios of minerals in ADOR were not high enough for chronological purposes and its data are not included in the following results.

Of the 3 Ni isotopes (^{60}Ni, ^{61}Ni and ^{62}Ni) usually measured for Fe-Ni chronology, the abundance of ^{61}Ni is the smallest and cannot be measured precisely. Hence we measured only ^{60}Ni and ^{62}Ni for this study. The error due to changes in the instrumental mass fractionation was estimated from repeated measurements of ^{60}Ni/^{62}Ni for a running standard sample. Other measurement procedures are similar to those described in [4]. Corrections were made for tails of adjacent ^{44}CaO and ^{46}TiO peaks. A relative sensitivity factor of (Ni^+/Fe^+)/(Ni/Fe) ~0.75 was used for both Fe-rich olivine and pyroxene. This is similar to those used in [3, 4].

Results: Our preliminary results showed that all the ^{60}Ni/^{62}Ni ratios were normal within 2 sigma error. The inferred initial ^{60}Fe/^{56}Fe and 2 sigma error for St, A88, S99, D'O and NWA16 were (0.4±1.8) E-8, (-1.7±2.8) E-8, (-0.5±1.7) E-8, (3.0±3.5) E-8 and (3.2±3.5) E-8, respectively. S99, D'O and NWA16 have identical Mn-Cr ages and are about 5.1 Ma younger than CAIs. If data for these 3 angrites are combined, the initial ratio and the error are (0.6±1.4) E-8. According to Al-Mg systematics, A88 is about 3.9 Ma younger than CAIs. Using the age information, solar system initial ^{60}Fe/^{56}Fe ratios (at the time of CAI formation) were calculated to be (0.7±1.5) E-7 from combined angrites and (-1.0±1.7) E-7 from A88. St's data did not yield useful limits to the initial ratio for the solar system.

Discussion: The small (upper limit) initial ^{60}Fe/^{56}Fe ratios found in the present study are consistent with those reported earlier for eucrites [e.g. 1]. But, the variation of the initial ratios within a eucrite [1] suggested that it may be disturbed after the solidification. In contrast, A88 and angrites studied here are pristine samples not affected by impacts. Their ages have been well determined by Al-Mg and/or Mn-Cr systematics. Therefore, the present results place strict limits to the solar system initial ratio of ^{60}Fe/^{56}Fe <2.2 E-7. This is smaller than the previous upper limit of [5] and in conflict with reported initial ratios of >5 E-7.

References: [1] Shukolyukov A. and Lugmair G.W. 1993. Sci. 259:1138-1142. [2] Tachibana S. and Huss G.R. 2003. Astrophys. J. 588:L41-L44. [3] Tachibana et al., 2005. Abs #1529. 34th Lunar Planet. Sci. Conf. [4] Kita N.T. et al., 1998. Antarc. Met. Res. 11:103-121. [5] Kita N.T. et al., 2000. Geochim. Cosmochim. Acta 54: 3913-3922.