^{60}FE-^{60}NI STUDIES OF FE-RICH CHONDRULES FROM EET90161 UNEQUILIBRATED ORDINARY CHONDRITE

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Introduction: ^{60}Ni excesses due to the decay of ^{60}Fe in various meteorites and their components provides constraints on the formation time scales, nearby late-nucleosynthesis injection events, and the evolution of the Early Solar System [e.g., 1-6]. Recently we have reported the ^{60}Fe-^{60}Ni systematics in Fe-rich olivines and enstatites in Semarokona LL3.0 unequilibrated ordinary chondrite (UOC), and found ^{60}Ni excesses corresponding to an inferred $(^{60}Fe/^{56}Fe)_0$ ratio of $(6.8 \pm 1.9)\times10^{-7}$ [2]. Previous determinations of the initial ^{60}Fe/^{56}Fe ratio from studies of Semarkona chondrules were $(2.2\text{-}3.7)\times10^{-7}$ [3], whereas chondrules from other UOCs ranged from 0.9 to 5.1×10^{-7} [4-6]. The initial ^{60}Fe/^{56}Fe ratio is not well constrained yet. Here we report new results of Fe-Ni systematics in Fe-rich chondrules (olivines and enstatites) from the EET90161 (EET) UOC.

Experimental: EET90161 is composed of close-packed aggregates of chondrules and their fragments and black matrix [7]. It is of low petrographic grade (L3.0-3.1) and is estimated to have experienced low temperature (~190°C) parent body thermal metamorphism [8]. We studied this meteorite to avoid potential overprints of thermal disturbance on the Fe-Ni systematics.

Fe-Ni isotopic measurements were carried out using the JSC NanoSIMS 50L as described in [4]. In brief, a focused O^- ion beam was rastered over ~15×15 µm. $^{57}Fe^+$, $^{60}Ni^+$, $^{61}Ni^+$, and $^{62}Ni^+$ were measured in multidetection with four electron multipliers at a mass resolving power of ~8000 to separate all relevant isobaric interferences as described in [9]. The instrumental mass fractionation and Fe/Ni sensitivity factors were calibrated by a San Carlos olivine.

Results & Discussion: About 80 enstatite and olivine chondrules and chondrule-fragments were identified in the EET thin section. We selected Type II enstatite and olivine chondrules (10-20 wt% FeO) for Fe and Ni isotopic measurements.

Olivines and enstatites from EET chondrules show excesses of ^{60}Ni corresponding to ^{56}Fe/^{61}Ni ratios (up to 5×10^6) with ^{61}Ni as the reference isotope. The best fit to ^{60}Ni excesses in EET chondrules yields $(^{60}Fe/^{56}Fe)_0 = 3.3\ (\pm 0.4, 2\sigma)\times10^{-7}$ and δ^{60}Ni intercept = -0.2 (± 2.1, 2σ) ‰. This ratio is about factor of two smaller than that of Semarkona chondrules in our previous study [4]. In terms of chronological interpretation, these observed variations in chondrules from Semarkona and EET UOCs imply that chondrule formation persisted for a few Ma, assuming a homogeneous distributions of ^{60}Fe in the Early Solar System. This timescale is consistent with Al-Mg studies of CAIs and chondrules [10].

We are now investigating whether Fe-Ni systematics in enstatite and olivine chondrules are homogeneous, to better constrain the duration of chondrule formation and/or the effects of subsequent thermal metamorphism during parent body process.

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