^{60}Fe-^{60}Ni ISOTOPE SYSTEMATICS OF BULK UREILITES.

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Introduction: Ureilites are ultramafic achondrites whose petrogenesis is not well understood, although they are generally believed to be products of partial melting in an asteroidal mantle [1]. They have highly heterogeneous oxygen isotope compositions that do not define a single mass-dependent fractionation line [2]. These data are interpreted as evidence that the chemistry of ureilites is strongly influenced by nebular processes, and that the ureilite parent body (UPB) may have formed very early in the history of the Solar System [2]. While ureilite chronology is not well constrained, there have been several recent studies of the ^{26}Al-^{26}Mg, ^{53}Mn-^{53}Cr and ^{182}Hf-^{182}W extinct radionuclide chronometers in these meteorites that suggest ancient formation ages [3-6]. It has been suggested that the ureilites represent the early stages of metallic melt migration and core formation on their parent asteroid and bulk samples have a relatively wide range of Fe/Ni ratios [7]. The early formation ages and range of Fe/Ni ratios of ureilites make them a promising target to better constrain the abundance of ^{60}Fe in the early Solar System [8]. Previous attempts to search for evidence of live ^{60}Fe in ureilites have yielded variable and inconclusive results [9-11]. Here we present ^{60}Fe-^{60}Ni isotope systematics of bulk samples of four ureilites.

Methods: Bulk samples of the ureilites Kenna, Haverö, Dhofar 1519 and a coarse-grained ureilite lithology of the Almahatta Sitta meteorite (each weighing ~50 mg) were obtained from the collection at the Center for Meteorite Studies at Arizona State University (ASU). After digestion, Ni for isotopic measurements was extracted from the samples using procedures modified from [12-13]; ~10% of each sample was left unprocessed for determination of Fe/Ni ratios. Nickel isotopes and Fe/Ni ratios were measured using the Neptune MC-ICPMS at ASU. The external reproducibility on the mass-bias corrected ^{60}Ni/^{58}Ni ratio (normalized to the ^{62}Ni/^{58}Ni ratio) is ±0.13ε (2SD), determined on repeat measurements of an in-house pure Ni standard solution.

Results and Discussion: The urelites investigated here span a range of ^{56}Fe/^{58}Ni (~60-250). Despite the variable Fe/Ni ratios, all ureilite samples analyzed here have normal Ni isotope compositions (i.e., ε^{60}Ni = 0) within analytical uncertainty. These data are in contrast to the report of uniform deficits in ε^{60}Ni of ~0.3ε in ureilites by [11]. The lack of excess ^{60}Ni in these ureilites suggests they either formed after the decay of ^{60}Fe or experienced later disturbances that equilibrated the Ni isotopes with non-radiogenic Ni. These ureilites therefore cannot provide an estimate of the ^{60}Fe abundance at the time of their formation.

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