CONSTRAINING THE EARLY SOLAR SYSTEM Cm/U RATIO.

J. M. Friedrich and U. Ott. Max-Planck-Institut für Chemie, Department of Cosmochemistry, Joh.-J.-Becher-Weg 27, D-55128 Mainz, Germany. E-mail: fried@mpch-mainz.mpg.de.

Introduction: The relative abundances of r-process nuclides within early solar system material reflect the complexity of the r-process. For example, derived solar r-process residuals [1] show ^{182}Hf abundance is consistent with continuous r-process nucleosynthesis up to ~20 Ma before incorporation into the early solar system. However, using the same residuals, ^{129}I abundance would require a decay time of ~80 Ma. To accommodate this discrepancy, [2] suggested two types of r-processes that operate with different frequencies at different nuclidic mass ranges, each being main sources for either ^{129}I or ^{182}Hf. However, [3] favor co-production of these nuclides in a single process: they note the current ^{247}Cm/^{235}U limit of <4 10^{-3} [4] is incompatible with measured ^{182}Hf abundance because all recognized theories demand co-production of actinides with Hf-mass range nuclides. We have been performing measurements to improve estimates of the early solar system ^{247}Cm/^{235}U abundance ratio to address if a distinct nucleosynthetic process is necessary to account for the (high) early solar system ^{182}Hf abundance.

Table 1: Comparison of time between steady state and early solar system abundance ratios for selected short-lived radionuclides.

	^{129}I	^{182}Hf	^{244}Pu	^{247}Cm
$T_{½}$ (Ma)	16	9	81	15.6
Ref. Nuclide	^{127}I	^{180}Hf	^{238}U	^{235}U
Prod. Ratio [1,5,6]	1.4	1.4	0.7	0.53
Steady State ISM Ratio†	0.0032	0.0018	0.013	0.012
Early Solar System Abundance Ratio [4,5]	1 10^{-4}	1 10^{-4}	7 10^{-3}	< 4 10^{-3}
$\Delta T_{\text{Steady State – ESS Abundance}}$	80 Ma	24 Ma	80 Ma	> 25 Ma

† Calculated using methods of [5] and references therein.

Methods: ^{247}Cm decays to ^{235}U through four nuclides with a half live of about 15.6 Ma. Deviations in ^{238}U/^{235}U ratios would likely be due to the former presence of ^{247}Cm. We have used high-precision mass spectrometric methods to investigate the U isotopic composition of a wide variety of early solar system components and sequential acid digestions of them [7]. For this work, in addition to new isotopic results, we quantified REE in isotopically analyzed sample aliquots to estimate the degree of actinide fractionation possible within each sample.

Results and Discussion: Aside from a refractory Allende residue showing an enticing +4‰ anomaly – which needs to be analytically verified – we have found no statistically significant deviations (> ±1.8‰) from the ^{238}U/^{235}U solar system value of 137.88 in any of the 22 CAI, chondrite, or eucrite samples investigated. Currently, we are pursuing additional measurements of separated early solar system components to investigate possible trends emerging between LREE/U ratios and δ^{235}U. With our measurements, we will be able to shed new experimental light on nucleosynthetic theories.

References: [1] Arlandini C. et al. 1999 *Astrophys. J.* 525: 886-900. [2] Qian Y.-Z. et al. 1998 *Astrophys. J.* 494: 285-296. [3] Pfeiffer B. et al. 2001 *Nuc. Phys. A* 688: 575c-577c. [4] Chen J. H. and Wasserburg G. J. 1981 *Earth Planet Sci. Lett. 52*: 1-15. [5] Meyer B. S. and Clayton D. D. 2000 *Space Sci. Rev.* 92: 133-152 [6] Lingenfelter R. E. et al. 2003 *Astrophys. J.,* 591: 228-237. [7] Friedrich J. M. et al. 2004 Abstract #1575, 35th LPSC.