\textbf{238U/235U VARIATIONS IN METEORITIC MATERIALS: EVIDENCE FOR CURIUM-247 IN THE EARLY SOLAR SYSTEM AND IMPLICATIONS FOR Pb-Pb DATING.}

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\textbf{Introduction:} The longstanding assumption that the 238U/235U ratio is invariable in meteoritic material (=137.88 \cite{1}) is a cornerstone of the high precision Pb-Pb chronometry that has defined the absolute ages of early Solar System materials. In this study, we present U isotope ratio measurements obtained from samples of the Allende and Murchison meteorites challenging this assumption. We additionally provide evidence that 238U/235U variations result from live 247Cm in the early Solar System.

\textbf{Samples and Methods:} Several calcium-aluminum-rich inclusions (CAIs), including both type-A and type-B inclusions, were separated from different sections of the CV3 Allende meteorite. Samples were crushed and dissolved in HNO\textsubscript{3}, HF, and HClO\textsubscript{4} acids, with approximately 5\% of each sample being reserved for trace element measurements. Uranium from the remaining sample solutions was separated from the matrix for measurement of the 238U/235U ratio, following a procedure outlined in Weyer et al., (2008) \cite{2}. Whole rock samples of Allende and Murchison (CM2) were processed using the same methods.

Measurement of the 238U/235U ratio was performed by MC-ICPMS on ThermoFinnigan Neptune instruments at both Arizona State University and the University of Frankfurt, utilizing a 236U/233U double spike to correct for instrumental mass bias. Multiple samples and standards were measured on both instruments independently to ensure the quality and reproducibility of the data. The U isotopic compositions of the samples are reported as 238U/235U ratios calculated relative to the U isotope standard SRM950a (238U/235U=137.88).

\textbf{Results, Discussion and Implications:} The whole rock 238U/235U ratios of Allende and Murchison meteorites are 137.816±0.012 and 137.866±0.017, respectively. 238U/235U ratios of Allende CAIs of this study range between 137.41±0.08 and 137.886±0.012. These values range from being within error to substantially lower than the value previously assumed for all Solar System materials (i.e., 137.88). This difference of up to -3.5\% implies that a correction of up to -5 Ma would be required if the Pb-Pb ages of these CAIs were obtained using the previously assumed uniform value. Our results demonstrate that the 238U/235U ratio of Solar System materials can be highly variable and that high precision Pb-Pb dating, in particular of CAIs, requires the additional measurement of the 238U/235U ratio in order to obtain the correct age.

\textbf{Evidence of 247Cm.} Because Th and Nd are chemically similar to Cm, they can be used as proxies for the extinct r-process only nuclide, 247Cm, which decays to 235U (t\textsubscript{1/2} ~15.6 Ma) \cite{3, 4}. The CAIs analyzed thus far in this study, with one exception, display a negative correlation of 238U/235U with Th/U or Nd/U. This evidence strongly suggests that 247Cm was present in the early Solar System, producing 235U excesses in some CAIs.