A low abundance of ^{135}Cs in the early Solar System: Barium isotopic signatures of volatile-depleted meteorites

G.A. Brennecka[1*], T. Kleine[1]

[1]Institut für Planetologie, University of Münster, Münster, Germany (*correspondence: brennecka@gmail.com)

Precise knowledge of the abundances of short-lived radionuclides at the start of the Solar System leads to fundamental information about the stellar environment of Solar System formation. Previous investigations of the short-lived $^{135}Cs \rightarrow ^{135}Ba$ system ($t_{1/2}$ = 2.3 Ma) have resulted in a range of calculated initial amounts of ^{135}Cs, with most estimates elevated to a level that requires extraneous input of material to the protoplanetary disk [1-4]. Such an array of proposed $^{135}Cs/^{133}Cs$ initial Solar System values has severely restricted the system's use as both a possible chronometer and as an informant about supernovae input. However, if ^{135}Cs was as abundant in the early Solar System as previously proposed, the resulting deficits in its daughter product ^{135}Ba would be easily detectable in parent bodies from the very early Solar System with sub-chondritic Cs/Ba.

In this work, we investigate the Ba isotopic signatures of volatile-depleted samples from the very early Solar System, such as angrites and eucrites. For angrites in particular, it is known from Rb-Sr systematics that the volatile-depletion event occurred within ~1 million years of the start of the Solar System [5], making angrites the ideal sample set to quantify initial $^{135}Cs/^{133}Cs$ from Ba isotope signatures.

The measured average $^{135}Ba/^{136}Ba$ of angrites and eucrites is indistinguishable from that of terrestrial standards with a $\varepsilon^{135}Ba = 0.04 \pm 0.06$ (2SD, N=9). From this, and a known volatile-depletion age of ~1 Ma for angrites [5], we calculate an upper limit for the Solar System initial $^{135}Cs/^{133}Cs$ of 2.8×10^{-6}, well below previous estimates. This significantly lower initial $^{135}Cs/^{133}Cs$ ratio now suggests that all of the ^{135}Cs present in the early Solar System was inherited simply from galactic chemical evolution and no longer requires an addition from an external stellar source such as an asymptotic giant branch star or type II supernova, corroborating evidence from several other short-lived radionuclides [6].

References: [1] Hidaka et al. (2001) *EPSL* **193**, 459. [2] Nichols et al. (2002) LPSC Abstract #1929. [3] Srinivasan et al. (2011) LPSC Abstract #1953. [4] Hidaka & Yoneda (2013) *NatSR* **3**, 1330. [5] Hans et al. (2013) *EPSL* **374**, 204. [6] Young (2014) *EPSL* **392**, 16.