Heterogeneous nucleosynthetic ^{84}Sr anomalies within and among CAIs

Y. DI* AND Y. AMELIN

Research School of Earth Sciences, Australian National University, Canberra 2601, Australia. (*correspondance: yankun.di@anu.edu.au, yuri.amelin@anu.edu.au)

Nucleosynthetic isotope anomalies of heavy elements in CAIs provide information about the stellar origin of elements in the Solar System, the material source of CAIs, and the dynamic evolution of the protoplanetary disk [1, 2]. Here we report measurement results (defined as $10^6[(^{84}Sr/^{86}Sr_{sample})/(^{84}Sr/^{86}Sr_{SRM987}) - 1]$) for CAIs from the Allende meteorite. Fifteen CAIs originally studied by [3] exhibit heterogenous $\mu^{84}Sr$ ranging from 48 to 226 ppm, consistent with the ranges previously reported by [4] and [5]. However, two fractions from the CAI USNM 3529–21 yielded negative $\mu^{84}Sr$ values of –80 ± 72 and –52 ± 18 ppm. Even when considering that the terrestrial $\mu^{84}Sr$ is –31 ± 8 ppm [6, 7], this CAI still shows an apparent ^{84}Sr deficit relative to the Earth. Such deficits were previously not found in 'normal' CAIs [1, 8], but larger ^{84}Sr deficits were reported for FUN CAIs [9, 10].

We also measured $\mu^{84}Sr$ in acid leachates and residues from the CAI USNM 3529–49 (unknown petrologic type, [11]) and the CAI SJ101 (forsterite-bearing type B, [12, 13]). All leachates and residues of SJ101 have identical $\mu^{84}Sr$ (56 ± 18 ppm) within uncertainty, suggesting complete isotope homogenization during melting. In contrast, the first leachates of CAI 3529–49 (L1 = cold 0.5M HNO_3, released >70% Sr) have significantly elevated $\mu^{84}Sr$ of 150 ± 11 ppm, while the later leachates and residues have lower and more uniform $\mu^{84}Sr$ of 71 ± 32 ppm. Heterogeneous $\mu^{84}Sr$ values within individual CAIs, previously reported by [4], indicate the existance of multiple isotope reservoirs for CAI-forming minerals. Our data further suggest that the *r*- or *p*-process isotope carrier phases with large ^{84}Sr excesses (≥150 ppm) in this CAI are easily soluble in the mild leaching step.

[1] Brennecka *et al.* (2013) *PNAS*, **110**, 17241-17246. [2] Dauphas & Schauble (2016) *Annu. Rev. Earth Planet. Sci.*, **44**, 709-783. [3] Mason & Taylor (1982) *Smithson. Contrib. Earth Sci.*, **25**, 1-30. [4] Myojo *et al.* (2018) *ApJ*, **853**, 48. [5] Charlier *et al.* (2019) *GCA*, **265**, 413-430. [6] Moynier *et al.* (2012) *ApJ*, **758**, 45. [7] Di *et al. in prep.* [8] Hans *et al.* (2013) *EPSL*, **374**, 204-214. [9] Papanastassiou & Wasserburg (1978) *GRL*, **5**, 595-598. [10] Amelin *et al.* (2015) *46th LPSC*, #2355. [11] Di & Amelin (2020) *51st LPSC*, #1132. [12] Amelin *et al.* (2010) *EPSL*, **300**, 343-350. [13] Petaev & Jacobsen (2009) *GCA*, **73**, 5100-5114.