Nucleosynthetic ^{84}Sr heterogeneity in the early solar system

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Nucleosynthetic anomalies in extraterrestrial materials hold the key to disentangling the development of the early solar system. Strontium isotopes (^{84}Sr, ^{86}Sr, ^{87}Sr and ^{88}Sr) are critical for discerning the various nucleosynthetic origins of early solar system building blocks and the timing of processes. Strontium isotopic differences between early solar system materials cannot be unequivocally evaluated because internal normalisation methods during analysis assume a single value of ^{86}Sr/^{88}Sr = 0.1194 to correct for instrumental mass fractionation. Double spike (DS) techniques in contrast recover the absolute abundances of the strontium isotopes, free from this assumption.

We show from DS measurements that Sr isotopes in Earth, Moon, eucrites, and some angrites share a common origin because they lie on a single mass-dependent fractionation trend in three-isotope space (δ^{88}Sr vs δ^{84}Sr). ^{84}Sr anomalies are revealed in bulk CI, CV3 and CM chondrites and some angrites. Sr anomalies reflect primary nucleosynthetic heterogeneity, and demonstrate the existence of two angrite parent bodies. Double-spike techniques provide unique insights and contrasting perspectives into the strontium isotopic composition of the early solar system, and demonstrate fundamental differences between materials forming the asteroids and terrestrial planets, versus chondritic materials and some angrites. We can unequivocally identify ^{84}Sr anomalies reflecting contributions of supernova origin.