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コンドライト隕石の Sr 同位体異常
Nucleosynthetic Strontium Isotope Anomalies in Carbonaceous Chondrites

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We present precise Sr isotopic compositions in samples from sequential acid leaching experiments for three carbonaceous chondrites, Allende, Murchison, and Tagish Lake, together with those in the bulk aliquots of these meteorites. The chondritic acid leachates and residues were characterized by Sr isotope anomalies with variable μ^{84}Sr values (10^6 relative deviation from a standard material) ranging from +120 to -4700 ppm, documenting multiple nucleosynthetic sources within a single meteorite. In addition, the μ^{84}Sr patterns across leaching samples for individual chondrites differed from one another. The highest μ^{84}Sr values were observed for leaching Step 3 ($HCl+H_2O$, 75 ℃) for Allende and Murchison likely because of the incorporation of calcium and aluminum-rich inclusions (CAIs). In contrast, extremely low μ^{84}Sr values were observed in the later fractions (Steps 6 and 7) for Murchison and Tagish Lake, suggesting the existence of s-process-enriched presolar SiC grains derived from AGB stars.

A μ^{84}Sr-ϵ^{54}Cr diagram was prepared with the CAIs and bulk aliquots of carbonaceous chondrites and other meteorites (non-carbonaceous) that were plotted separately; however, they still formed a global positive correlation. CAIs presented the highest μ^{84}Sr and ϵ^{54}Cr values, whereas carbonaceous chondrites and noncarbonaceous meteorites had intermediate and the lowest μ^{84}Sr and ϵ^{54}Cr values, respectively. The positive trend was interpreted as resulting from global thermal processing in which sublimation of high μ^{84}Sr and ϵ^{54}Cr carriers generated the excess μ^{84}Sr and ϵ^{54}Cr signatures in CAIs, while noncarbonaceous planetesimals accreted from materials that underwent significant thermal processing and thus had relatively low μ^{84}Sr and ϵ^{54}Cr values. Apart from the global trend, the carbonaceous chondrites and noncarbonaceous meteorites both exhibited intrinsic variations that highlight an isotopic dichotomy similar to that observed in other isotope combinations (e.g., ϵ^{54}Cr-ϵ^{50}Ti, ϵ^{54}Cr-$\triangle^{17}$O). A plausible scenario for creation of the intrinsic variations involves local thermal processing (e.g., flash heating for chondrule formation) caused by additional selective destruction of presolar grains different than that caused by global thermal processing. The existence of such a global positive trend and local variations for two meteorite groups suggests a complicated dynamic history for the dust grains with respect to thermal processing, material transportation, and mixing in the protoplanetary disk prior to planetesimal formation.

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