Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.29275

Chromium and strontium isotopic evidence for the Al-depleted parental magma in Chang'e 5 basalts

YINGNAN ZHANG[1], ZIWEI WANG[1], JI SHEN[1], YIYANG HU[1], XIAOQING HE[2], XI YU[1], KECHENG LIU[1], JIAHUAI SUN[1], BING YANG[1], RICHARD W. CARLSON[3] AND LIPING QIN[1,4]

[1]University of Science and Technology of China
[2]Anhui University of Science and Technology
[3]Carnegie Institution for Science
[4]Deep Space Exploration Laboratory

The Chang'e-5 (CE-5) mission returned ~2.0 Ga mare basalts from Oceanus Procellarum, underscoring the significance of Eratosthenian volcanic activity. However, the mantle source and melting mechanisms of the parent magma remain debated. Stable isotopic fractionation is sensitive to mineral crystallization, with Cr isotopes influenced by pyroxene and spinel and Sr isotopes by plagioclase. Thus, Cr and Sr isotopic compositions, along with other isotopic systems, can help constrain magma crystallization sequences and provide insights into the source of the parental magma.

We conducted high-precision Cr and Sr isotopic analyses on three CE-5 basalt clasts and a regolith sample. The CE-5 basalts exhibit systematically lighter Cr isotopic compositions and homogeneous Sr isotopic composition compared to Apollo low-Ti basalts. The Cr isotopic composition decreases with decreasing Mg# in these samples. The lightest Cr isotopic composition was observed in a clast with Mg# of 14.5 (δ^{53}Cr= –0.58 ± 0.04‰), suggesting extensive mafic mineral crystallization (>50%). The muted Sr isotopic signals suggest minimal plagioclase crystallization (<3%). AlphaMELTS2 modeling for the fractional crystallization indicates that this limited plagioclase crystallization resulted from an Al-depleted parental magma, distinct from Apollo low-Ti basalts. This unique source of parental magma may offer new insights into the prolonged volcanic activity in the Procellarum KREEP Terrane (PKT) region.