

Negative Ni isotopic compositions of Chang'e-6 basalts, a result of SPA impact event?

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A marked compositional asymmetry exists between the farside and nearside of the Moon, which may be linked with the South Pole-Aitken (SPA) impact event. However, the nature of the impactor and its contribution to the evolution of SPA basin remain poorly constrained. The lunar samples returned by the Chang'e-6 (CE6) mission provide a valuable opportunity to investigate the effects of the SPA impact on the composition of the local lunar mantle. Siderophile elements, such as Ni, could be indicative in understanding the contributions of the impactor.

We conducted the Ni isotopic composition analyses of the CE6 regolith and clasts. Our results reveal that the Ni isotopic compositions of CE6 samples exhibit a remarkable variation (from -0.95‰ to 1.25‰) compared to other lunar samples. Most brecciated clasts exhibit elevated $\delta^{60}\text{Ni}$ along with Ni/Co, indicating the modification of micrometeorite bombardment during space weathering. In contrast, two low-Ti basalts show a low Ni content and Ni/Co, which suggests that they come from fresh local mare basalts. Notably, these two basalts are characterized by extremely negative Ni isotopic composition ($\delta^{60}\text{Ni} = -0.95\text{‰}$ and -0.48‰), in contrast to the almost constant positive values (0~0.32‰) observed for Apollo and CE5 basalts. Modelling calculations show that this characteristic cannot be generated either by magma crystallization or by diffusion of Ni from country rocks during magma ascending. Instead, this feature may be inherited from the relic of the SPA impactor.