Mass Balance for the Bulk Moon K Budget and Isotopic Composition

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The elemental budgets and isotopic compositions of the Moon are key tools with which to evaluate the robustness of different Moon formation models. Notably, the Moon and the Earth are isotopically indistinguishable for elements with nucleosynthetic anomalies (*e.g.*, $\Delta^{17}O$). Of particular interests are the volatile depletion patterns and elevated isotopic compositions in some moderately volatile systems of the Moon relative to Earth. The potassium (K) isotope system is a key candidate for providing new information relevant to the origin of the Moon and the mechanism of its volatile depletion. Hence, a comprehensive evaluation of the bulk Moon K elemental and isotopic budget is needed.

In this study, we analyzed eighteen samples with diverse geochemical and petrological contexts (all relative to NIST SRM 3141a) [1]. We propose that the lunar basalt average $\delta^{41}K$ of –0.07 ± 0.09‰ (2SD) is the best current estimate for the lunar mantle. Moreover, the indistinguishable $\delta^{41}K$ between low-Ti and high-Ti basalts suggests an isotopically homogeneous mantle reservoir for K. The crust and the ultramafic mantle are the two major K reserviors in the Moon. The lunar crust is characterized as exhibiting "terranes" that have undergone distinct geologic histories and that exhibit broad lithochemical variations. [2]. By coupling our measured K isotopic compositions with assumptions for the lunar upper/lower mantle and crustal thicknesses, thicknesses of different geological terranes, core size, mare basalt partial melting parameters, density and [K] for different regions in the lunar interior, and exposed surface area for crustal terranes, we have developed a *Monte Carlo* simulation for the bulk Moon K concentration and corresponding K isotopic composition. The results are going to be reported on the conference. The revised bulk Moon $\delta^{41}K$ is expected to be heavier than the lunar mantle owing to the elevated $\delta^{41}K$ of the Procellarum KREEP Terrane (PKT).

Reference: [1] Tian et al. (2018) *Goldschmidt 2018*, 2537. [2] Jolliff et al. (2000) *JGR* **105**, 4197-4216.