Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.18564

Synchronous co-located S and Cl isotope ratio measurements in lunar meteorite and Apollo apatites

RITA ECONOMOS[1], KATELYN LEHMAN FRANCO[1], CAROLYN A. CROW[2], TIMMONS ERICKSON[3], ELIZABETH BELL[4] AND ERIN SUMMERLIN-DONOFRIO[1]

[1]Southern Methodist University
[2]University of Colorado Boulder
[3]Jacobs - JETS, Astromaterials Research and Exploration Science Division, NASA Johnson Space Center
[4]Dept. of Earth, Planetary, and Space Sciences, UCLA

Presenting Author: reconomos@smu.edu

Lunar apatites have long interested platetary scientists due to the large positive Cl isotopic fractionations in some samples, up to +81‰[1,2,3]. Lunar apatites are typically low in sulfur, which is predicted by apatite's strong partitioning preference for sulfate over sulfide and the low oxygen fugacity of the moon. Synchronous S and Cl isotope ratio measurements via CAMECA1300 secondary ionization mass spectrometer at UCLA allow for high-sensitivity monitoring of sulfur concentrations in lunar apatites during Cl isotope analysis. Through this method, we have collected S+Cl counts per second data for 10 meteoritic and 20 Apollo 14 apatites, which allows us to calculate S concentrations via an RSF using terrestrial standard apatites[4]. Six lunar meteorite apatites and 1 Apollo apatite contained enough S to yield accurate $^{32}S/^{34}S$ isotopic ratios, including multiple grains large enough for replicate analyses.

All meteorite apatites were analyzed from thick sections of NWA12593, a clast-rich fragmental breccia known for its abundance of accessory phases. Six apatite grains were located within a fe-olivine-dominated symplectite clast. $\delta^{37}Cl$ of these apatites cluster between +15-+19‰. $\delta^{34}S$ isotope ratios of these spots range between -2.5 to 6‰. Two other matrix grains (outside of the symplectite clast) yield: $\delta^{37}Cl$ = 26.7‰, $\delta^{34}S$ = 10.65‰ and $\delta^{37}Cl$ = 16‰, $\delta^{34}S$ = -0.3 – 3.7‰. One Apollo apatite yielded a $\delta^{34}S$ of 8.2‰ but did not have enough Cl for an isotopic measurement. However, this grain should not be subject to potential terrestrial contamination observed in meteorites[5], thus it assists in the assessment of the fidelity of the meteorite record.

These data represent the first strongly positive S isotopic fractionations identified in lunar samples and the first not directly attributable to syn-eruption degassing[6].

[1]Sharp et al., 2010, *Nature,* [2]Boyce et al., 2015*, Sci Adv,* [3]Wang et al., 2019, *Sci Reports,* [4]Economos et al., 2022, *Goldschmidt,* [5]Brounce et al., 2020*LPSC,* [6]Saal and Hauri, 2021, *Sci Adv.*