EXPLORING OXYGEN ISOTOPE EXCHANGE IN THE SOLAR NEBULA WITH UV LASER-FLUORINATION.

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Introduction: Oxygen isotopic ratios from CAIs have been used to unravel the complex history of the solar nebula. Combining these data with the thermal and temporal histories deduced from several isotopic systems in these objects has the potential to shed light on the origins and evolution of CAIs.

Magnesium isotopic data from E44, a type B CAI from Efremovka, illustrate that this object has undergone several evaporative episodes, consistent with multiple passages through shock waves [1]. A complimentary oxygen isotopic data set would serve to further constrain or contravene the proposed thermal history for this object.

Results: Oxygen data were obtained on Efremovka matrix, E44, and a nearby chondrule using the UV-laser ablation fluorination line constructed at UCLA. Fassaite yields $\delta^{18}O = -37.7$ ‰ and $\delta^{17}O$ of −40.09 ‰, anorthite $\delta^{18}O$ and $\delta^{17}O$ values range from −32.5 to −35.5 ‰ and −35.14 to −37.96 ‰, respectively, and melilite $\delta^{18}O$ and $\delta^{17}O$ values range from−1.2 to 7.4 ‰ and −6.82 to 1.66 ‰. Matrix points plot from 4.13 to 8.55 ‰ in $\delta^{18}O$ with $\Delta^{17}O$ of −1.61 to −3.98 ‰. All CAI and matrix points lie on a line with a slope of 0.92. The difference between this line and the CCAM line is resolvable with the precision of laser-fluorination data. Measurements on a terrestrial standard indicate a precision of 0.2 to 0.3 ‰ in both in $\delta^{18}O$ and $\delta^{17}O$.

Using the solid-gas oxygen isotope exchange model discussed in [2], we explored the implications for E44's thermal history based upon the fluorination data.

Discussion: The oxygen isotope exchange recorded by anorthite and melilite indicates that high-temperature (T>1200K) solid-gas exchange is a plausible explanation for E44's isotopic history. This is consistent with the magnesium data obtained on this object [1]. Furthermore, the co-linear relationship between E44 and Efremovka matrix suggests that they share a common exchange medium.

Future work should be directed towards amassing a larger set of CAI and matrix oxygen data, as well as towards understanding the implications of water vapor as the exchanging gas phase (as opposed to CO) [3,4].

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