THE CARBON ISOTOPE COMPOSITION OF THE SUN

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Introduction: The NASA *Genesis* mission succeeded in measuring O and N isotope ratios in returned solar wind samples [1], [2], but has not yet reported a C isotope ratio. Here we reanalyze solar photosphere spectral data to determine the C isotope ratio of the sun.

Spectroscopy of the photosphere: CO rovibrational transitions dominate the 2-5 micron spectral window of the photosphere. Shuttle-borne ATMOS FTS data contains thousands of CO fundamental and first-overtone lines, recorded at high signal-to-noise ratio and at high spectral resolution [3], [4]. We used the latest CO dipole moment functions [5] to reduce line strength uncertainties.

Results: Our ^{18}O abundance for the temperature-enhanced photosphere is $\delta^{18}O_{SMOW} = -50 \pm 11$‰, which is the same within errors as the inferred ratio from *Genesis* [1]. Our ^{17}O value is $\delta^{17}O_{SMOW} = -65 \pm 33$‰, which cannot distinguish between the *Genesis* photosphere value and a terrestrial value at the 2-σ level. We find the photosphere has $\delta^{13}C_{PDB} = -48 \pm 7$‰. Earth mantle carbon is believed to have a mean $\delta^{13}C = -5$ ‰ [6], implying that bulk terrestrial C is enriched in ^{13}C relative to the Sun by nearly as much as bulk terrestrial O is enriched in ^{18}O. Our results confirm measurements of solar wind in lunar regolith grains [7], and disagree with TiC data from CAIs in the Isheyevo meteorite which have $\delta^{13}C \sim 0$ ‰ [8].

Implications: Our results demonstrate that bulk Earth, Mars, and asteroids, are enriched in ^{13}C relative to the starting material that formed the solar system. Possible enrichment scenarios, including CO self-shielding in the nebula [9], and inheritance of ^{13}C-rich grains, will be discussed.

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