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Reconstructing the oxygen isotope composition of the upper atmosphere using cosmic spherules

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The isotopic composition of the troposphere is well known, but sampling the thermo-/mesosphere (~80-115 km) is challenging. Molten iron-rich micrometeorites (I-type cosmic spherules) provide a new approach to sample the atmosphere at high altitudes. The molten spherules adopt the isotopic fingerprint of the atmospheric oxygen reservoir by oxidation during the atmospheric transit. We analysed the iron and oxygen isotope composition of 18 I-type cosmic spherules from Antarctica, in order to reconstruct the oxygen isotope composition of the upper atmosphere [1].

The reconstructed $\Delta'^{17}O$ of the upper atmosphere ranges from -0.47 ‰ to -0.39 ‰ with an average uncertainty of ~0.05 ‰. This result indicates that the $\Delta'^{17}O$ of atmospheric oxygen is homogenous up to the thermosphere and demonstrates that fossil I-type cosmic spherules can be used as proxy for atmospheric carbon dioxide mixing ratios throughout the geological record [2].

[1] Pack, A. et al. (2016) Nat. Commun. 8, 15702. [2] Young E.D. et al. (2014) Geochim. Cosmochim. Acta 135, 102–125.

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