

Tracing variations in the Flux of Extraterrestrial Material in the late Devonian.

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The extraterrestrial flux to Earth varied over time, but consistent reconstructions are lacking due to biases in conventional proxies: iridium, osmium isotopes, ³He, and extraterrestrial spinels. These methods depend on large-scale stochastic events in sediments, yielding variable flux estimates [1-4]. Current estimates cover short accumulation windows (≤50 kyr – a few Myr) and a limited micrometeorite size range (200–400 μm) [5,6]. As most extraterrestrial material weathers easily, refractory micrometeorites and minerals record past flux variations but must be combined for an unbiased extraterrestrial flux record [7,8].

We collected 30 kg of Late Devonian carbonates from Chanxhe, Belgium, at high precision (13 intervals representing <2 Myr). We extracted micrometeorites using a novel methodology combining dissolution, magnetic, and optical separation, to recover fossil micrometeorites while minimizing extraction biases. Petrographic classification and primary chemical compositions were acquired using SEM-EDX, chemical compositions were measured by EMPA and oxygen-isotope compositions were determined using SIMS.

The study provides the first fossil micrometeorites collection from Devonian, representing one of the largest geochemical dataset of fossil micrometeorites. Their petrography and geochemical compositions allow us to assess the weathering conditions and could represent a way for assessing Earth's atmospheric oxidizing conditions during the Late-Devonian. We also identify potential variations in the extraterrestrial flux across the stratigraphic interval. Conventional proxies are planned (iridium concentrations, osmium isotope ratios, ³He content, and extraterrestrial spinels), to discuss the differences between various proxies, proposing a multiparameter method for extraterrestrial flux reconstructions. We compare the flux of micrometeorite extracted in Chanxhe, to a contemporary section in Royseux, to assess local environmental effects.

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