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Large amplitude carbon isotope excursion during the Late Silurian Lau Event

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High magnitude excursions in the stable carbon isotope record reveal that the Silurian greenhouse world (443.7-416.0 Ma) represents a period of globally unstable environmental conditions. Fundamental changes in the global carbon cycle were more frequent and had a larger impact during the Silurian compared to any other period of the Phanerozoic [1]. The late Silurian "Lau event" is the largest of four major positive d13Ccarb excursions. The carbon isotope excursion associated with the "Lau event" is recognized globally and reaches values ranging from +6%■ from the Eastern Baltic, +8.5%■ on Gotland, 11%■ from southern Sweden and even up to 12%■ in Australia, Queensland. This makes the "Lau event" the strongest d13C excursion of the entire Phanerozoic, comparable in amplitude to Precambrian events. However, the mechanism underlying the Silurian stable isotope excursions is ill understood. Scenarios proposed include enhanced carbon burial due to anoxic conditions [2] and/or enhanced productivity [3]. Alternative hypotheses range from alternating wet and humid periods influencing global ocean circulation [4], weathering of carbonates [5] to changes in the primary producer community [6]. Evaluating these different scenarios critically relies on establishing the true magnitude of the isotopic excursions and rates of change. Existing stable carbon isotope studies of the Lau event were based on analyses of bulk carbonates or bulk organic matter. Both signal carriers are subject to admixing of organic matter or carbonates from various sources. Moreover, preferential preservation of some organic moieties, e.g. lipids, over other potentially offsets isotopic records, since the carbon isotopic signatures between these moieties substantially differ. A stable organic geochemical composition over the isotope events is thus crucial to ensure capturing the true amplitude of the excursion. Here we therefore investigate, using Curie point pyrolysis GC-MS, the composition of the organic matter of the Lau event. Establishing the true magnitude of the Lau event would, ultimately, rely on compound specific stable isotope analyses. Records suitable for such an approach are, however, difficult to find due to the high maturity of the organic matter. We, therefore, made an inventory of the biomarker potential of the Late Silurian Lau event from sections across the world.

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