Questioning the global nature of the Toarcian carbon isotope excursions.

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Two new records of seawater sulfate-sulfur isotopes derived from carbonate associated sulfate suggest that other isotopic records found in sediments from the European epicontinental sea (EES) during the Toarcian may represent principally local scale rather than global changes. The first of these, from belemnites from the Yorkshire coast in the UK (within the EES), describe a rapid change from +16.5‰ to +22.2‰ $\delta^{34}S_{VCDT}$ between the *semicelatum* and *exaratum* ammonite subzones. Radiometric dating shows that the entire Toarcian represents around 5 myr and individual subzones (if equal in length) can be calculated to be around 400,000 years in duration. Hence, it is conservatively estimated that this ~6 ‰ isotopic change occurred in 1.5 myr or less. This is considerably shorter than the modern residence time of sulfate in the oceans (20 myr) and requires either; that the concentration of oceanic sulfate in the Toarcian was much lower than its modern value, or; that the European epicontinental sea became isolated from the worlds oceans at this time. A second record from southern Tibet from sediments deposited on the margin of Tethys, whilst having less exact dating and a degree of scatter, shows no such consistent change and records an average value of around +18‰ $\delta^{34}S_{VCDT}$. The Tibetan data therefore favours the hypothesis that the EES developed a chemistry significantly different from that of the worlds oceans during the Toarcian. If correct, this suggests that carbon (and other) isotope data from Toarcian sediments from the EES only records regional variation and calls into question previous models of extensive synchronous global carbon burial, as well as the need for large scale methane release at this time.