Polar sea temperature and $\delta^{18}O_{sw}$ during the Toarcian Oceanic Anoxic Event.

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The Toarcian Oceanic Anoxic Event (TOAE) is considered as one of the most severe carbon cycle perturbation of the Phanerozoic eon. It is widely accepted that the TOAE was associated with a massive injection of ^{13}C depleted carbon into the oceanic and atmospheric reservoirs, triggering a cascade of environmental changes that included seawater warming, enhanced continental weathering, and widespread anoxia. Temperature records of the TOAE, however, are currently restricted to $\delta^{18}O$ data from low paleolatitudes (20-35°N) sites of the western Tethys. Temperature response of high latitudes remains unconstrained. Here, we present new mineralogical, clumped isotopes ($\Delta47$) and stable isotopes data from lower Toarcian bivalve shells of *Dacryomya inflata*, from the Polovinnaya River succession (Siberia), that was deposited near the Early Jurassic North Pole (>80°). Raman spectroscopy and SEM observation reveal that all investigated bivalve specimens retained their original aragonite mineralogy and pristine microstructural organization.

The bivalve shell $\delta^{13}C$ trends and absolute value (3.4 to 5.1‰ VPDB), together with published organic carbon $\delta^{13}C$ and biostratigraphic data, place our record within the rising limb of the TOAE positive carbon isotope excursion. The measured $\Delta47$ imply high polar temperatures (8 to 18.0 °C), in agreement with coeval Siberian paleobotanical data, and consistent with existing high-latitude paleotemperature proxy records of Cretaceous and Eocene warming events. The calculated seawater $\delta^{18}O$ values are relatively ^{18}O depleted (between -5 and -2‰ VSMOW), and fully agree with values predicted by previous Mesozoic ocean-atmosphere general circulation models. The reconstructed TOAE polar temperature, however, far exceed those been suggested by TOAE simulations and implied considerably more reduced latitudinal thermal gradients. Our results provide some of the oldest $\Delta47$-based polar temperature estimates of the Phanerozoic and bring challenging but crucial constraints for numerical simulations of past greenhouse climates.

Keywords: Toarcian OAE, Paleotemperature, Sea water $\delta^{18}O$, Clumped isotopes, Ice free world

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