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A combined trace- and body-fossil approach reveals high-resolution record of oxygen fluctuations in Devonian seas

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ABSTRACT

Black shales deposited in epeiric seas preserve dynamic, bottom-water oxygen conditions as inferred from high-resolution trace- and body-fossil data. Nearly all paleoproxies are imperfect; however, this study utilizes the strength of paleobiological proxies to capture variability in bottom-water oxygen levels through aerobic and anaerobic, as well as dysaerobic (reduced but non-zero oxygen) conditions. Trace- and body-fossil data were collected at high resolution from twelve localities through central and western New York State, United States, exposing Devonian black shales. The combination of relative amount of bioturbation, estimated as ichnofabric index (ii), maximum burrow diameter measurements, and body-fossil species diversity allows relative bottom-water oxygen levels to be interpreted on a millimeter scale. Overall, trace-fossil size and diversity through the dysaerobic zone are much reduced compared with those described from younger strata. The decreased depth of bioturbation compared with younger strata, and resulting reduced overprinting of the sedimentological record by deep burrowing infauna, provide the opportunity for records of high frequency fluctuations in relative oxygen levels to be preserved. The biological signal preserved in these units reveals that bottom-water oxygen levels fluctuated considerably within a narrow stratigraphic range (on a centimeter scale) and that the dysaerobic zone is not temporally stable.