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First high-resolution d13C-records across black shales of the Early Aptian Oceanic Anoxic Event 1a within the mid-latitudes of northwest Europe (Germany, Lower Saxony Basin)

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The late Early Aptian Fischschiefer, a laminated black shale horizon deposited under anoxic conditions in a shallow epicontinental sea in northwest Europe (Lower Saxony Basin), has been investigated in detail over the last decades. It has been suggested, that the Fischschiefer horizon corresponds to the Oceanic Anoxic Event 1a (OAE 1a). So far high resolution carbon isotope records across the Fischschiefer horizon are still missing. In the present study, two sediment cores of Aptian age (Hoheneggelsen KB 9 and 40) from the Brunswick area, north Germany, have been investigated in detail with respect to their lithostratigraphy, geochemistry ($CaCO_3$, TOC), biostratigraphy (coccoliths, nannoliths) and high resolution chemostratigraphy (d13Ccarb and d13Corg). The data allow to establish a detailed stratigraphy for the cores, suggesting an Early to early Late Aptian age. The d13Ccarb and d13Corg data enabled us to subdivide the deposits into isotope segments (C2-C7), which are commonly used as stratigraphic markers in coeval sediments around the world. Strong 13Ccarb depletion in some intervals of the core, including the Fischschiefer horizon, indicate an influence of early diagenesis (sulfate reduction and methanogenesis, accompanied by authigenic carbonate formation). d13Corg values of the same samples do not show significant signs for diagenetic alterations. Our data clearly prove, that the Fischschiefer horizon is the regional sedimentary expression of the OAE 1a.
The high-resolution stratigraphy sheds new light on previous publications of the Fischschiefer horizon. Independent evidence suggests, that anoxic and sulfidic conditions prevailed during the early phase of the OAE 1a (=C3 segment) in sediment and bottom waters of the Lower Saxony Basin. This was accompanied by high sulfate reduction and authigenic carbonate formation rates. The environmental conditions were probably triggered by a prominent global warming trend near the onset of the OAE 1a and associated processes (e.g. establishment of a freshwater cap, increased primary productivity/organic matter supply to the sediments and stable water stratification). Sulfate reduction and carbonate formation rates gradually decrease during the C4-6 segments, being associated with a reverse greenhouse effect/global cooling.