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Early Jurassic shale chemostratigraphy and U-Pb ages from the Neuquén Basin (Argentina): implications for the Toarcian Oceanic Anoxic Event

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New data from a Lower Jurassic shale section in the Neuquén Basin, Argentina, are presented in order to better constrain the triggering mechanism for the Toarcian Oceanic Anoxic Event (TOAE) and the associated negative carbon isotope excursion. Chemostratigraphy from a 65 m thick shale-dominated marine section of Late Pliensbachian to Early Toarcian age, shows the presence of a 19.5 m thick interval of organic-rich black shale where the bulk rock organic carbon content reaches almost 4 wt%. The [U+F064]13C of the bulk organic matter changes from -22.3 %■ in the lower parts of the profile to -29.8 %■ VPDB in the black shale interval, documenting a -8 %■ excursion over five stratigraphic meters. Twelve interbedded tuff layers, representing fallouts from paleo-Andean arc magmatism, were discovered in the section. Dating by ID-TIMS of zircons from two tuff beds located within the carbon isotope excursion interval gave ages of 181.42±0.24 Ma and 180.59±0.43 Ma. Assuming linear sedimentation rates within the black shale interval, the initiation of the anoxic event occurred at 182.16±0.6 Ma, lasting until 180.16±0.66 Ma. Thus the total duration is between 0.74 and 3.26 Ma, taking into account the propagation of dating uncertainties. The U/Pb age of the initiation of the observed carbon isotope excursion overlaps the U/Pb emplacement ages of mafic sill intrusions in the Karoo Basin in South Africa, and support the hypothesis that thermogenic methane released during contact metamorphism within the Karoo Basin was the main trigger of the anoxic event. Our findings show that the Toarcian carbon isotope excursion is present also in the southern hemisphere and that the TOAE was a global phenomenon likely triggered by a massive greenhouse gas release.