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The Early Toarcian Oceanic Anoxic Event and its sedimentary record in Switzerland

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In the Jurassic period, the Early Toarcian Oceanic Anoxic Event (T-OAE), about 183 Ma ago, was a global perturbation of paleoclimatic and paleoenvironmental conditions. This episode was associated with a crisis in marine carbonate accumulation, climate warming, an increase in sea level, ocean acidification, enhanced continental weathering, whereas organic-rich sediments are noticeable for example in the Atlantic and in the Tethys. This episode is associated with a negative carbon excursion, which is recorded both in marine and terrestrial environments. The cause(s) of this environmental crisis remain(s) still controversial. Nevertheless, the development of negative δ13C excursions is commonly interpreted as due to the injection of isotopically-light carbon associated with gas hydrate dissociation, the thermal metamorphism of carbon-rich sediments and input of thermogenic and volcanogenic carbon related to the formation of the Karoo-Ferrar basaltic province in southern Gondwana (Hesselbo et al., 2000, 2007; Beerling et al., 2002; Cohen et al., 2004, 2007; McElwain et al., 2005, Beerling and Brentnall, 2007; Svensen et al., 2007; Hermoso et al., 2009, 2012; Mazzini et al., 2010).

Several studies of the T-OAE have been conducted on sediments in central and northwest Europe, but only few data are available concerning the Swiss sedimentary records. Therefore, we focused on two sections in the Jura Plateau (canton Aargau): the Rietheim section (Montero-Serrano et al., submitted) and the Gipf section (current study). A multidisciplinary approach has been chosen and the tools to be used are based on sedimentological observations (sedimentary condensation, etc.), biostratigraphy, mineralogy (bulk-rock composition), facies and microfacies analysis (presence or absence of benthos), clay-mineralogy composition (climatic conditions), major and trace-element analyses (productivity, redox conditions, etc.), phosphorus (trophic levels, anoxia), carbon isotopes and organic-matter content (source of organic matter and preservation). The Posidonia Shales in northern Switzerland accumulated in a relatively slowly subsiding transition zone between the southwestern part of the Swabian basin and the eastern part of the Paris basin under fully marine conditions (Reisdorf et al., 2011). The negative carbon isotopic excursion characteristic of the Early Toarcian is well developed in the Gipf section although the bituminous sequence is considerably reduced in thickness relative to the Rietheim section. Indeed, the Plienbachian-Toarcian transition in the Gipf section probably lacks most of the tenuicostatum Zone and the Gipf Bed, which is a peculiar limestone bed showing an erosive base, correlates with the erosion horizons of the Variabilis Zone, Late Toarcian (Rieber, 1973; Reisdorf, 2011). The Gipf Bed is overlain by an alternation of condensed, fossil-rich marl and nodular limestone. The analysis of Swiss sections will assist us in the identification of the mechanisms implied in the condensation and/or erosion of parts of the Lower Toarcian Posidonia Shale. Therefore, it will improve our understanding of the general paleoceanographic conditions leading to the development of widespread oceanic anoxia during the early Toarcian.