

## Evidence for repeated and global palaeoenvironmental perturbations during the Aalenian

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The Jurassic was punctuated by several episodes of abrupt environmental changes associated with climatic instabilities, severe biotic crisis, and perturbations of the global carbon cycle. Over the last decades, the Toarcian Oceanic Anoxic Event and the early Bajocian Event have attracted much attention because they represent such episodes of global and severe environmental changes. Bracketed in between the Toarcian and the Bajocian, the Aalenian stage (Middle Jurassic, ~174-170 Ma) has been overlooked, although there is evidence from Tethyan and Boreal sites that it was a time of environmental changes marked by carbon cycle perturbations associated with marine biotic turnovers. Hence, there is certainly important knowledge to gain from the Aalenian in order to better understand the wider context of the Toarcian and Bajocian events.

In this study, we provide high-resolution, biostratigraphically well-defined carbon isotope records ( $\delta^{13}\text{C}_{\text{org}}$  and  $\delta^{13}\text{C}_{\text{carb}}$ ) combined to Rock-Eval data for the upper Toarcian–lower Bajocian interval of two expanded marl/limestone alternation successions from France (French Subalpine Basin) and Chile (Andean Basin). The comparison with available records from the Tethyan and Boreal domains highlights that medium-term  $\delta^{13}\text{C}$  fluctuations are reproducible across different palaeoceanographic settings from both hemispheres and between different carbon substrates. This study provides one of the most expanded high-resolution chemostratigraphic records for the entire Aalenian stage, and shows compelling evidence from both hemispheres that it was a time marked by recurrent medium-term global carbon cycle perturbations. Combined with a review of geological events, climate modes, abundance and diversity of major fossil groups, and trophic conditions inferred from the calcareous nannofossil record, our study shows that the middle–late Aalenian was a time of major palaeoenvironmental changes, biotic reorganization and carbon cycle perturbation. Indeed, this time interval records a prominent positive carbon isotope shift, the demise of platform carbonate factories associated to an increase in eutrophic calcareous nannofossils, which likely indicate an increase in seawater fertility. This middle–late Aalenian Event certainly represents a precursor episode of the early Bajocian carbonate crisis, and might have been triggered by major tectonic rearrangement and volcanic activity.

**Mots-Clés :** carbon isotope stratigraphy, recurrent carbon cycle perturbations, biotic events, Middle Jurassic