Record of Early Cretaceous Oceanic Anoxic Events in Adriatic Platform, Croatia

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Abstract

The long (700 m) Hauterivian to Albian Adriatic Platform section mainly from Mljet Island, Croatia underwent little post-Mesozoic burial or little later diagenesis. Consequently its smoothed $\delta^{13}C$ and $\delta^{18}O$ record from calcite lime mudstone matrix provides one of the most continuous stable-isotope curves from an Early Cretaceous platform. This record captures the carbon isotope excursions (CIEs) and oceanic anoxic events (OAE1a, b, c) evident in published hemipelagic sections, with the added advantage of providing information on the shallow platform response to the OAEs. The platform facies appear to have been little affected by the OAEs, except for OAE1a when deposition of organic-rich laminated limestones occurred in local downwarps.

Keywords

Oceanic anoxic event • Carbon isotope excursion • Carbonate diagenesis • Early cretaceous • Adriatic platform

1 Introduction

Mesozoic carbon-isotope excursions were mainly documented from deep water facies and used to document major periods of oceanic anoxic events or OAEs as well as long- and short-term changes in carbon cycling [1–4]. In contrast, Mesozoic shallow carbonate platforms also may preserve a record of $\delta^{13}C$ excursions (albeit somewhat noisier), with the potential advantage that the history of relative sea-level changes on the platform are preserved in the facies successions and the platform response to the OAE can be ascertained [5–8]. We described a long duration, 30 m.y. Early Cretaceous, Hauterivian through Albian $\delta^{13}C$ and $\delta^{18}O$ record from the Adriatic Platform, southern Croatia, which underwent little post-Mesozoic burial or later diagenesis.

2 Methods

The $\delta^{13}C$ (and $\delta^{18}O$) stratigraphy is based on lime mudstone matrix generally sampled at 1 m intervals on Mljet Island, southern Croatia (Fig. 1). Dolomites and diagenetic cement-bearing packstones and grainstones were excluded [9, 10].

3 Results

The Adriatic Platform $\delta^{13}C$ curve captures the isotope excursions evident in the hemipelagic sections. The Faraoni OAE is evident as the negative excursion just below the top of the Barremmian. The OAE1a is well defined on the Adriatic Platform, as the major negative excursion followed by more positive $\delta^{13}C$ values. The major negative excursion of Niveau Fallot in the basin is subdued but present on the Adriatic platform. This is followed by the major negative excursion of the OAE1b set straddling the Aptian–Albian boundary. OAE1c is well developed on the Adriatic Platform as a major negative followed by a positive excursion. The oxygen isotope data proved unreliable as it was reset. Fischer plots were used to examine long-term accommodation and sea-level change but they proved to be of limited value due to common poorly cyclic subtidal intervals.

4 Discussion

Some diagenetic resetting of the platform lime mudstones is indicated by their $\delta^{13}C$ and $\delta^{18}O$ values which are only slightly lower (by ~2‰) than Early Cretaceous pelagic values [10, 11]. Although negative shifts in $\delta^{13}C$ and $\delta^{18}O$

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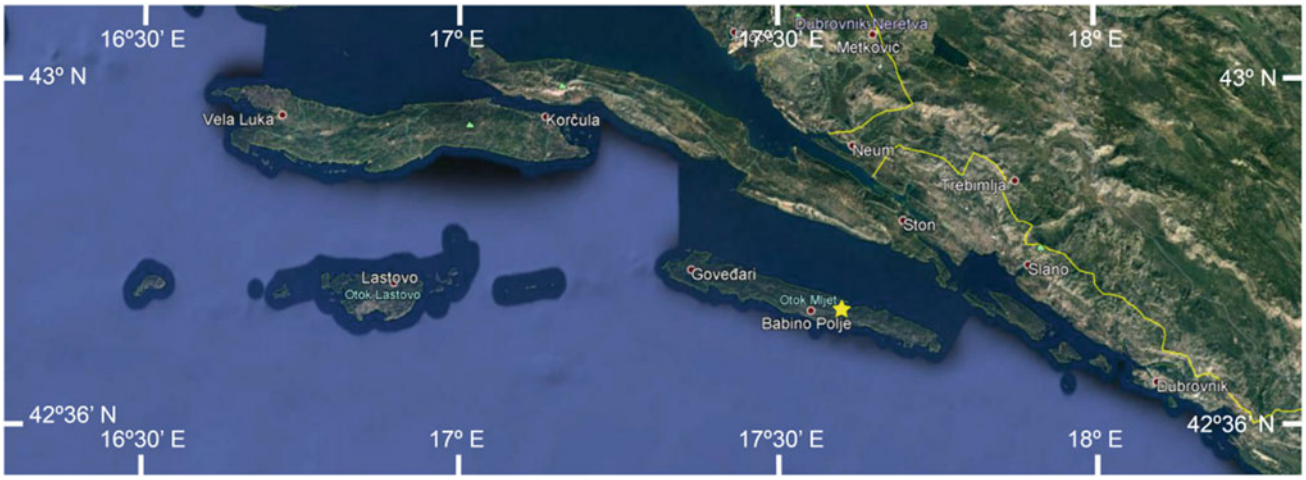

Fig. 1 Satellite image (© 2018 Google) of southern Croatia. Yellow star indicates location of the Mljet Island section

beneath unconformities are commonly observed, they only occur in sequence boundary zones, and affect very little of the stratigraphic succession [5, 6].

The negative excursions in $\delta^{13}C$ associated with the OAEs and CIEs have been attributed to input of ^{13}C into the oceans which caused warming, increasingly humid conditions. The positive CIEs resulted from the sequestration of C_{org}, resultant drawdown of atmospheric CO_2, and cooling [12–14]. We do not have usable oxygen data.

5 Conclusion

The Hauterivian to Albian Adriatic Platform section (Mljet and Korčula Islands), which for most intervals had predominantly calcite precursor mineralogies, underwent little post-Mesozoic burial or attendant diagenesis. It thus provides one of the most continuous Early Cretaceous platform $\delta^{13}C$ and $\delta^{18}O$ curves, including OAE1a, b and c. Although somewhat noisier than the hemipelagic/pelagic record, the Adriatic Platform recorded the major relative changes in $\delta^{13}C$ and $\delta^{18}O$ of platform waters over 30 m.y. at several time scales, in spite of periodic emergence, and thus provides an important repository of carbon cycling and relative sea-level changes.

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