Evolution of the carbon cycle and seawater temperature from the Triassic-Jurassic boundary to the Early Toarcian based on brachiopod geochemistry (preliminary results)

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Introduction

The ecological crisis and mass extinction at the end of the Triassic (ETE) coincides with several environmental perturbations such as global temperature rise, ocean acidification and carbon isotope anomalies, with a large observed negative carbon isotope excursion (CIE) in the Late Rhaetian as well. Followed by the ETE, the Early Jurassic was characterized by marked fluctuations of the global seawater temperature and carbon cycle. Carbon isotope records are showing positive and remarkable negative excursions. A particular example of these phenomena is connected to the Toarcian Oceanic Anoxic Event (TOAE). Beside the TOAE there are many other, smaller scale carbon isotope anomalies and environmental perturbations are reported. For example at the Sinemurian-Pliensbachian transition and at the Pliensbachian-Toarcian boundary.

The goal of our study is to provide new brachiopod δ13C, δ18O, and Mg/Ca data from the time interval starting in the Late Rhaetian till the end of the Early Toarcian. Considering the strong resistance of brachiopod shells against diagenesis, our aim is to reconstruct seawater temperature, seawater Mg/Ca, and carbon cycle evolution based on a reliable geochemical proxy database of the studied time interval. The samples have been collected from various localities across Europe achieving a good, at least ammonite zone scale resolution for the Rhaetian stage and for the Lower Jurassic. Now in this presentation only our Rheatian and Sinemurian-Pliensbachian brachiopod data are shown.

The studied sections

Hybe, Rhaetian: located in Slovakia in the Lower Tatra Mountains (Fig.1). The section mostly composed of micritic limestones and bioclastic packstones-wackestones with the intercalations of blackish organic rich and laminated marly intervals (Fig.2 C,D).

Priborzhavske, Sinemurian-Pliensbachian: located in the Ukranian Klippen belt (Fig.1). Build up by spotted limestones, marly limestones and calcareous marl intercalations (Fig.2 A,B).

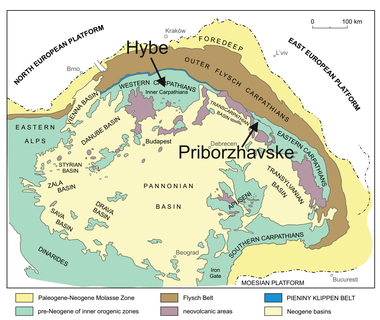


Fig. 1. Location of the studied sections and tectonic sketch map (modified after Wierzbowski et al. 2012; source: Kováč et al. 1998; Plašienka et al. 2000)

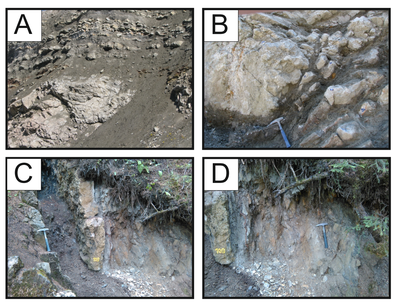
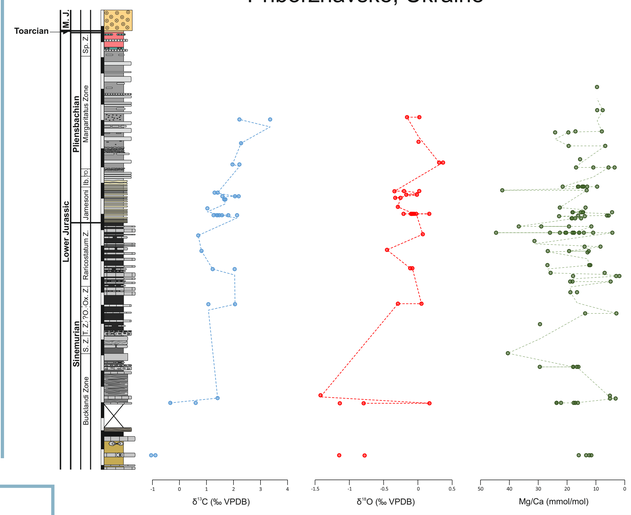
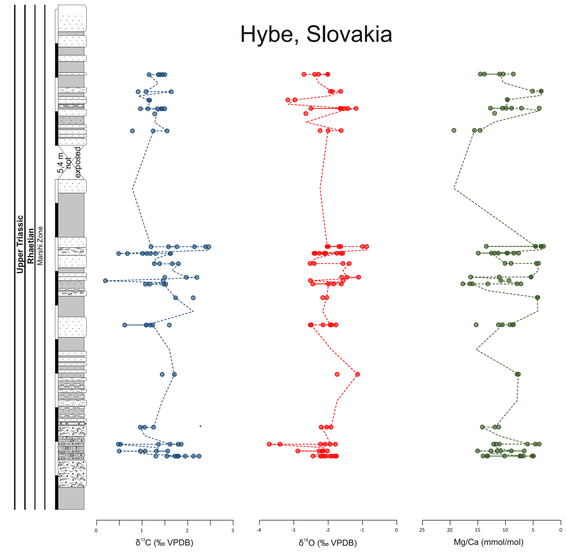


Fig. 2. Outcrop conditions of the studied sections. A,B: Priborzhavske, Unkraine. C,D: Hybe, Slovakia

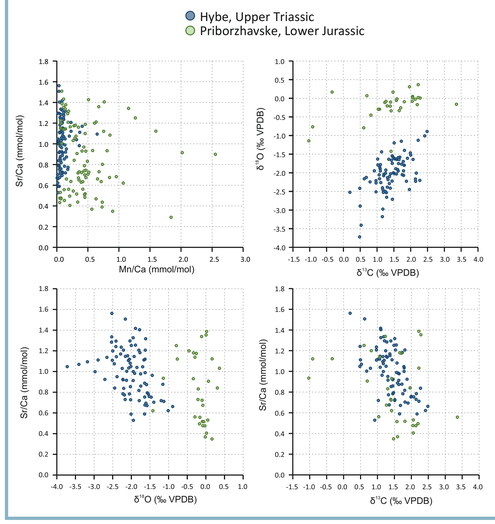
Brachiopod geochemistry results

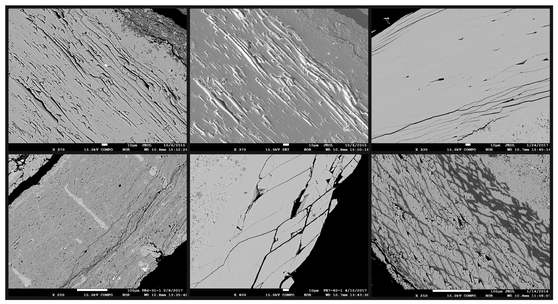


S. Z. - Semicostatum Zone
T. Z. - Turneri Zone
?O - ?Obtusum Zone
Ox. Z. - Oxynotum Zone
Ib. - Ibex Zone
?D - ?Davoei Zone
Sp. Z. - Spinatum Zone
M. J. - Middle Jurassic



Preservation and diagenesis





Examples of shell structure preservation on BSE and SEM images. Small scale alternations and issues of diagenesis.

Future plans

- Increasing the resolution of our data set:
  - acheaving a good ammonite zone or even subzone resolution
  - looking for other potential sections (especially Hettangian and Toarcian)
- Investigation the effect of species specific variations
- Using other tools for paleotemperature estimations (clumped isotopes)
- Modelling the seawater temperature changes and carbon cycle of the studied time interval