Climate of the Past Discussions

Clim. Past Discuss., referee comment RC2
https://doi.org/10.5194/cp-2022-87-RC2, 2023

Comment on cp-2022-87

Wolfgang Ruebsam (Referee)

Referee comment on "Environmental changes during the onset of the Late Pliensbachian Event (Early Jurassic) in the Cardigan Bay Basin, Wales" by Teuntje P. Hollaar et al., Clim. Past Discuss., https://doi.org/10.5194/cp-2022-87-RC2, 2023

Review for Hollaar et al. - Environmental changes during the onset of the Late Pliensbachian Event (Early Jurassic) in the Mochras Borehole, Cardigan Bay Basin, NW Wales.

The work by Hollaar et al. presented detailed data on late Pliensbachian strata from the Mochras Core. Data provide detailed insights into environmental (oceanographic and continental weathering) during a period of major environmental change. The paper is well written and logically structures. Interpretation of the data are sound and proof and supported by the data. I basically agree with the interpretations by the authors.

However, I'd like to point out one issue that might require some attention. Much of the oceanographic changes reconstructed for late Pliensbachian times is linked to updoming in the North Sea area. Updoming can explain the regional development of a regressive facies and to major changes in current systems across the shallow shelf sea. According to my understanding and what have read in the works by Underhill and coauthors, North Sea dominig occurred in the late Toarcian to early Aalenian (e.g., Underhill and Partington, 1993; GSL – Petr.Geol. Conf. 4, 337-345). Korte et al. (2015) argued that dominig in the late Toarcian was one parameter controlling shelf currents and heat transport across the shallow shelf. Are you sure that the same model can be applied to the late Pliensbachian? To my best knowledge, the works quoted by Korte et al. (2015) provide no evidence for doming during the late Pliensbachian. Maybe the authors can discuss this issue more detailed.

Some specific comments below. Hope you consider the comments constructive and helpful.

Best regards,

Wolfgang Ruebsam

Lines 36-37: Fully agree that marked climate changes occurred throughout the Early Jurassic. However, the view of an overall warm and high pCO2 Early Jurassic word has been challenged by several works. It is more likely that Jurassic climate shifted between cold and warm phases, including icehouse periods (e.g., Dera et al., 2011; Korte and Hesselbo, 2011; Krencker et al., 2019; Ruebsam and Schwark, 2021). The work by McElwain et al. (2005) provides stomata-based pCO2 estimates for the early Toarcian only. This work provides no information on CO2 levels in the Pliensbachian. This work further attests to contrasting CO2 levels in the early Toarcian. Thus, quoting to McElwain et al. (2005) and saying that the Early Jurassic was an overall warm and high pCO2 world is not correct.

Lines 60-63: Updoming in the North Sea region will have impacted current systems at the northwestern West Tethys shelf. This area was a very sallow seaway (shelf area) and I'm not convinced that changes in water circulation at this shallow shelf will have impacted global ocean circulation. Changes in the thermohaline circulation may have occurred in relation to global-scale tectonic changes (continent configuration). The work by Bjerrum et al. (2001) further attests to the presence of southwards-directed current system throughout the Viking Corridor. Thus, there no proof that warm Tethyan current transported warm water massed towards polar latitudes via this narrow seaway. The current system indicated in figure 1 (red arrow) is speculative. On the contrary, there is robust evidence (e.g., 18O data; modeling) that a southwards-directed Arctic current system transported low-saline cooler water masses to the northwestern West Tethys shelf via the Viking Corridor (Bjerrum et al., 2001; Dera and Donnadieu, 2012).

Method part - lines136 and following: Detailed data on the Mochras Core geochemistry have been published previously: Ruhl et al., 2016 – XRF; Strom et al., 2020 – TOC, H, 13Corg; can the author please clarify if all data presented here (TOC, 13Corg, XRF) have been newly generated in this study? If data were taken from previous studies, those works must be quoted.

Figure 4: This figure nicely defines the late Pliensbachian +veCIE. I think most (or all?) of the data shown here have been generated in previous works and are not part of this study. Thus, this figure should be shown in the introduction part and not in the results. Showing the figure in the introduction may give the reader a good impression of the late Pliensbachian events, as recorded in the sediments of the Mochras Core.

Figure 3: Figure 3 should be shown after figure 4, as the Pliensbachian events are defined in the latter. Moreover, figure 3 shows a lot of data interpretation, which should not be part of the results section.

Lines 355-372: Here changes in the composition and nature of the sedimentary organic matter are described on the basis of palymnological data. These data could be compared with HI/OI data that were presented in Storm et al. (2020). Integration of Rock Eval (or HAWK) data may allow assessing changes in the preservation of marine organic matter.

Lines 355-372: Could changes in grain size (and Zr/Rb, Si/Al) also be affected by sea-level variations? 4thorder sea-level cycles have been related to long-eccentricity forcing. Could be interesting to explore this aspect.

Lines 448-449: Tmax values of 421-434°C indicate that the sediments (and the organic matter) may have reached the early oil window and experienced a burial temperature of at least 60°C. Thus, the thermal maturity/diagenesis should be classified as weak-moderate.

Line 492 and following: Korte et al (2015) explained that North Sea doming and uplift occurred in the late Toarcian (relevant works were quoted in Korte et al.). Is there any data that support an early updoming in the Pliensbachian?

The late Pliensbachian record a long-term sea-level lowstand (e.g., Haq, 2018). A low eustatic sea level will have narrowed small ocean gateways (such as the Viking Corridor) and thereby impacted current systems and faunal realm. This aspect should be added to the discussion. In lines 501 and following it is explained how a sea level highstand in the Bifrons Zone could have terminated anoxia in the European Basin System. This indicates that eustatic sea level changes strongly impacted oceanographic conditions at this shallow shelf sea.

Lines 494-495: As pointed out before, the current directions in at the northwestern Tethys shelf remains debated. There is strong evidence for a southwards directed Arctic current and (to my best knowledge) not strong evidence for a northward directed current through the Viking corridor (e.g., Bjerrum et al., 2001; Dera and Donnadieu, 2012).

Lines 510-512: Correct, but s is highly speculative if the Hispanic Corridor efficiently connected the Panthalassic and the Tethys Ocean and thereby impacted global ocean circulation pattern during the Pliensbachian-Toarcian.

Lines 540-541: As mentioned earlier, the late Pliensbachian records a global eustatic sea level lowstand. It is unlikely that the doming was the major factor causing the development of a regressive facies.