

Answer to comment bgd-12-C6417-2015 by referee Romain Amiot

The authors thank the referee Romain Amiot for his comments. Since no point-by-point comment was provided, we present the comments of the referee in blue and our response in black.

“One major point, however, needs to be properly discussed before this manuscript could be recommended for publication in BGD: the assessment of original isotopic preservation. This is really the key parameter that may allow to confidently interpret anomalous values in terms of original ecologies or environment, and should constitute a first paragraph in the discussion. In particular, comparison between enamel and dentin should be more discussed and maybe presented in a graph, and comparison between expected ecologies of each fish groups with measured values may hint to preservation or not of primary isotope compositions.” We hope that the details added following the revision of Fischer provide enough precision. See response to comment on Page 8, lines 21-25.

“It would be also more convenient for the reader if, in the data table, enamel and dentin samples of the same individuals are grouped.” We agree and changed the table.

“The second point that intrigues me is the value range for pycnodontiformes, somewhat larger than that of *Asteracanthus* samples. If we consider that *Asteracanthus* migrated to brackish or freshwater environments, it would explain indeed the low values in some samples as well as the large range in $\delta^{18}O_p$ values. Then what is the meaning of such a large range in Pycnodontiformes? Could it be related to peculiar ecologies? Could it be related to more fluctuating climatic or environmental conditions during the deposition of the considered sedimentary layer?”

About the lowest value of Pycnodontiformes, we wrote in section 5.1 “For the lowest Pycnodontiformes values however, an influence of reduced salinity cannot be excluded since some of those bony fish are known to be euryhaline (Kocsis et al., 2009; Poyato-Ariza, 2005).” As visible in the Figure 5, the value range for Pycnodontiformes is broad in deposits from both, the Lower and Upper Kimmeridgian, and in the different stratigraphic intervals (see details in table 1), which could point to salinity fluctuations and a tolerance to those for this taxa. In general, Pycnodontiformes values indicate a higher salinity than *Asteracanthus* values. Since we wrote in 5.2. that “Lateral salinity changes are readily caused by rainy winters coupled with an irregular morphology of the platform, creating marked depth differences and lagoons (Waite et al., 2013) where the proportion of meteoric water could have been important.”, semiconfined lagoon could also have created pools of higher salinity when subjected to evaporation in the dry season. There, some Pycnodontiformes could have recorded a higher isotopic composition. For the highest values that point out a relatively low water temperature, a deeper, colder environment (*i.e.* away from the platform) can be considered. In the manuscript, we already mentioned the possibility of the presence of salinity fluctuation in the study area. We propose to enhance this part.

Changes in the text:

Section 5.1.

When used in the eq. (1), the Pycnodontiformes $\delta^{18}\text{O}_p$ values result in a mean temperature range that is consistent considering the paleogeographical settings of the study site (23.9 ± 4.4 °C, $n=13$). **Still, the value range is quite wide (see Fig. 4) and can be interpreted as a tolerance to salinity fluctuations for this taxon, since some of those bony fish are known to be euryhaline and are probably bad environmental indicators (Kocsis et al., 2009; Poyato-Ariza, 2005). Semi-confined lagoons induced by local depth differences on the platform and subjected to higher evaporation rates during the dry season would have been characterised by a higher salinity and thus higher isotopic composition, potentially recorded by Pycnodontiformes. For the lowest value (18.2‰), an influence of a slightly reduced salinity cannot be excluded. The highest values are interpreted as reflecting a deeper, cooler environment around the platform.** The good state of preservation of Pycnodontiformes remains and the presence of several mandibles and tooth palates suggest that the material was not transported over long distances.

Section 5.2.

The location of this environment with reduced salinity remains open, especially since some sharks are known to migrate across very long distances, *e.g.* the blacktip shark (Castro, 1996). **Regarding the fish faunal composition of Porrentruy, salinity fluctuations within the study area cannot be excluded. Two of the most abundant bony fish taxa recorded – Pycnodontiformes and “*Lepidotes*” – are known to tolerate salinity fluctuations (Amiot et al. 2010; Kocsis et al., 2009; Poyato-Ariza, 2005). Additionally, several chondrichthyan taxa recorded are potential indicators of reduced salinity: the chimaeroid genus *Ischyodus* was reported in Jurassic freshwater deposits of Russia (Popov and Shapovalov, 2007) and can therefore not be considered as strictly marine. The modern shark *Palaeoscyllium*, relatively scarce but present in our fossil assemblage, is the oldest modern shark known to tolerate freshwater, so far only in the Cretaceous though (Sweetman and Underwood, 2006). Finally, and as mentioned above, hybodonts and rays are in some cases also linked to reduced salinity conditions (Duffin and Thies, 1997; Thies, 1995). Salinity fluctuations (from pliohaline to brachyhaline) are supported by different ostracods assemblages in the study site (Schudack et al., 2013), yet they overwhelmingly indicate brachyhaline conditions in our sample sections.**

Figure 4. – caption

Figure 4. Graphic representation of the $\delta^{18}\text{O}_p$ values (average, standard deviation, end members) measured for Porrentruy in this study and their corresponding water temperature using the eq. (1). Comparable water temperatures for all taxa require different $\delta^{18}\text{O}_w$ values, which relate to salinity. Bulk and dentine values might have suffered diagenesis. Note the strong difference between $\delta^{18}\text{O}_w$ of Pycnodontiformes and *Asteracanthus* enameloid values (*i.e.* distinct palaeoenvironments) when similar ecological T is assumed. The wide value range of Pycnodontiformes indicates a tolerance to salinity fluctuations occurring within the platform, and possibly a living area broader than the shallow-marine platform. No attempt to define the final $\delta^{18}\text{O}_w$ values or water temperatures is made here.

“Related to this point, Figure 4 shows that Pycnodontiformes of Porrentruy and Solothurn are not synchronous with *Asteracanthus* values of the same locality. Values should be put on the same level or it must be notified in the caption that for an easier reading, values have been slightly shifted.”

Author's response:

When the referee writes about Figure 4, we assume that he wanted to say Figure 5. In that figure, we shifted a bit the values that would otherwise superpose and make the graph unreadable. We agree that we can group better the data points of each study site. For more precision about the Porrentruy and Solothurn samples relative positions, please refer to the ammonite zones in the supplementary material. As for the stratigraphical position of the data points from other studies, the precision is sometimes limited (“Early-Middle Bathonian” for example).

Changes in the text:

Figure 5. Comparison of $\delta^{18}\text{O}_p$ values (average, standard deviation, end members) of Pycnodontiformes and *Asteracanthus* enameloid samples from Porrentruy, Solothurn and other European localities through time. **The stratigraphical position is approximate and corresponds to Early, Middle, Late divisions of each stage.** The approximate geographical positions of previously studied localities (Dromart et al., 2003, Lécuyer et al., 2003, Billon-Bruyat et al., 2005) is shown in Fig. 1. Detailed localities **and stratigraphic positions** are available in the supplementary material.

Changes in the figure :

