Clim. Past Discuss., 10, C1909–C1913, 2014
www.clim-past-discuss.net/10/C1909/2014/

Climate of the Past Discussions

Interactive comment on "The bivalve *Glycymeris planicostalis* as a high-resolution paleoclimate archive for Rupelian (Early Oligocene) of Central Europe" *by* E. O. Walliser et al.

Anonymous Referee #1

Received and published: 12 November 2014

The sclerochronology paper by Eric Otto Walliser and his co-authors deals with the use of fossil shells of *Glycymeris planicostalis*, a bivalve mollusk species that lived during the Oligocene, as archives of past seawater temperature in the Mainz Basin (Germany). They analysed several specimens collected in an outcrop formed 30 Ma ago for their age and stable isotope composition. They counted the number of growth increments in the hinge plate section of the shell in order to age all specimens, based on the (reasonable) assumption that these increments were formed annually (as on modern *Glycymeris* species). The three shells they worked on were 67 to 84 years old. After checking that shells were not diagenetically altered, they drilled carbonate samples in order to analyse their oxygen isotope composition. After conversion of this

value into paleo-temperatures (using a $\delta^{18}O_{water}$ value reconstructed from Oligocene sirenian tooth enamel collected in the same area as shells), they concluded that these shells lived in a marine setting with seawater temperature between 12.3 and 22.0°C, a range typical of current conditions prevailing in modern environments such as the northwestern Mediterranean.

This manuscript is well written and definitely suitable for the readership of an international journal such as *Climate of the Past*. It presents new data for an epoch (Early Oligocene) that has been under-investigated from a climatic prospect, although climate conditions during this period were roughly similar to predictions for the coming millenia. The abstract clearly reflects and summarises the content of the paper. The state-of-the-art methods used to achieve the main goals of the paper are well described and appropriate for this kind of studies. The discussion is of appropriate size given the amount of results presented in the manuscript. Subsection 5.3 within the discussion is particularly interesting and I appreciated that the authors tried to explain the discrepancies between their $\delta^{18}O_{bivalve}$ temperature reconstruction and the paleo-temperature data provided by other archives such as teeth, forams, etc.

Nevertheless, the discussion would have benefited from some hypotheses about what drives the fall growth stop. Given the annual temperature range reconstructed from $\delta^{18}O_{bivalve}$, i.e. temperature between 13.6 (winter average) and 17.3°C (summer average), it is quite unlikely that thermal stress (extreme temperatures) could explain this growth stop. I'd rather suggest that this growth stop could be formed during the main gametogenesis period of the year as this represents a high metabolic demand (energy can therefore not anymore be allocated to shell growth).

I am also wondering why the authors did not use the structural information archived in the shell in the form of growth increment width. Measurement of growth increment width in *G. planicostalis*, followed with ontogenetic detrending, would have been useful to confirm the hypothesis of a quasi-decadal oscillation in extreme temperatures. I understand that it is difficult to sample carbonate all along the outer shell cross-section,

from umbo to ventral margin, and that temperature cannot be reconstructed for the whole lifespan of the animal. But extreme temperatures can also lead to changes in growth increment width. The construction of SGI (standardized growth increments) chronologies, spanning the 67–84 years of growth of each specimen, could reveal oscillations related to quasi-decadal climatic oscillation. I think this is important information, easily available, that could definitely strengthen the hypothesis of quasi-decadal climatic oscillation in the late Rupelian.

The study by Walliser *et al.* is definitely an important contribution towards a better understanding of climate conditions prevailing during the Early Oligocene. The manuscript is worthy of publication, although some issues (listed below) require further consideration. I also strongly suggest the authors to add data about growth increment width (see my comment above). To conclude, I recommend publication of this work after minor-to-moderate revisions.

- Line 15, page 4097: the average $\delta^{18}O_{water}$ value calculated from sirenian tooth enamel is -0.9 ‰. A comparison with modern value would suggest that such water was typical of subpolar settings or the current Baltic Sea. But you state page 4090 (lines 24–29) that the Mainz Basin had an overall warm climate comparable to modern subtropical climate zones of the Mediterranean during the Oligocene. Today, these environments have a $\delta^{18}O_{water}$ value close to 1.5 ‰. How could you explain the difference between this value and the one you calculated from tooth enamel?
- Lines 12–13, page 4087: apart from the coasts of the Baltic Sea, I cannot see any other "densely populated coastal areas and ecosystems in Central Europe". I think the coasts of Western Europe must also be mentioned are they are much longer than the Baltic shoreline of Central Europe.
- Line 17, page 4088: although I am no specialist of *Glycymeris planicostalis*, I

hardly imagine a worldwide distribution for this species. All actual *Glycymeris* species are only restricted to relatively "narrow" geographic areas.

- Page 4089: I don't see any sound reason for excluding the section "study area" from the Material & Methods section.
- Lines 19–23, page 4089: It is relatively weird to me to read the main conclusion of the paper at the very end of the introduction. This should be deleted.
- Lines 19–22, page 4090: replace "nannoplankton" with "nanoplankton"
- Lines 4–5, pages 4091: precise what you mean with "surface waters" (upper first meter? upper 10 m?) and "bottom waters" (what depth?).
- Lines 19–20, page 4091: According to Figure 1, it actually seems that your fossils come from the paleo-coastline of the Upper Rhine Graben, and not from the southwestern shore of the Mainz Basin.
- Line 2, page 4092: delete "of" before *Glycymeris*.
- Lines 11–16, page 4093: where were the carbonate samples drilled in the shell? You sampled the equivalent of 10 to 16 years of growth whereas the specimens lived up to 84 years old. I guess you didn't sample the shell for oxygen isotope analyses close to the ventral margin, i.e. you didn't sample the last 10–16 years of shell growth. I would rather think that you sampled the ontogenetically youngest years of shell growth, i.e. the shell portions close to the umbo region. Please mention it.
- Lines 7–8, page 4094: you must provide the reader more information about the method you used to get this 0.3°C accuracy in your temperature reconstruction. Which statistical descriptor did you use?
- Line 17, page 4095: remove bracket before Coplen.

- Lines 20–23, page 4098: you should remove these sentences as your time-series is definitely too short to identify any decadal oscillation in your records. I think all discussion about this periodicity is purely speculative.
- Line 17, page 4105: salinity must be expressed without unit (PSU, ‰, g/L). It is a dimensionless number. Remove PSU.
- Figure 2: please add information on the different photographs about their orientation.