Biogeosciences Discuss., 10, C2731–C2734, 2013
www.biogeosciences-discuss.net/10/C2731/2013/

Biogeosciences
Discussions
Open Access

Interactive comment on "Repercussions of differential settling on sediment assemblages and multi-proxy palaeo-reconstructions" *by* A. G. M. Caromel et al.

Anonymous Referee #2

Received and published: 14 June 2013

This study deals with an interesting and rarely considered issue of the degree to which microfossil assemblages deposited at the sea floor are autochthonous in the sense of consisting exclusively of individuals that inhabited the overlying water column. In theory, during transit from the surface layer, these fossils can be displaced by currents. This phenomenon is known as expatriation. The degree of expatriation is a function of residence time in the water column, which in turn is a function of settling velocity. At sub-millimeter scales, the latter becomes a complex function of size and shape and because different microfossils differ by size and shape, they are likely to experience differential expatriation. This issue has been recognized many years ago by workers like Berger (1970), Berger and Piper (1972) and thoroughly conceptualized by Weyl

(1978). It is a pity that the authors do not seem to be aware of that study, because it might have guided them in a different direction in their research.

This brings me to the main problem I have with the paper. In my opinion, the approach is inappropriate because it only considers transport during settling. Yet, by far the most important component of transport occurs during life. Microplankton organisms have no means of propulsion to counteract passive transport by currents. Since during their life they inhabit the most dynamic surface layer and because their life span can range from weeks to months, the distance they travel during life will inevitably be many times longer than the amount of lateral displacement during settling. I am afraid the authors have focused on the wrong aspect of expatriation and their conclusions and calculations are really only useful for a case where one would attempt to compare microfossil assemblages intercepted by a series of vertically arranged sediment traps. I note that the authors use the example of the Agulhas leakage as a process expatriating microfossils into an entirely different ecological context (Peeters et al. (2004), noting that Agulhas leakage transports life assemblages of plankton, but then this issue is not developed any further.

Thus, although I appreciate that the research is tackling a relevant and interesting issue, I feel the paper does not do justice to the topic and that the authors could do better to bring their assessment closer to reality. In addition to the major issue outlined above, I have identified several minor points, which I feel should be addressed as well.

1) The authors apparently carried out settling experiments to determine terminal settling velocities of foraminifera of various sizes and shapes. I wonder a) why and b) how. There are numerous earlier studies, based on various approaches that have determined in detailed settling velocities of foraminifera and their relationship to size and shape. A good example is the study by Fok-Pun and Komar (1983). A cursory look at their results reveal identical range of values as that reported here in Table 1. Why was the new experimental determination of the velocities necessary? More importantly, how were the experiments carried out? It does not seem appropriate to me to refer to

unpublished work in this context.

2) I am worried about the calculations being based on empty specimens with no cytoplasm inside and without spines. This does not reflect the typical state of foraminifera after death. Also, the work is based on the assumption that most foraminifera sink individually. This remains to be established.

3) The effect of turbulence in the surface layer, which is not considered here, may be larger than the authors expect, making the displacement estimates presented here far too conservative (Sciascia et al., 2013).

4) The discussion where the authors consider the effects of lateral displacement of microfossils and other particles on proxy calibration is correct in principle but it misses the point that the effect of lateral transport is already contained in the existing calibrations. These are based on relating sediment parameters to surface water properties at the same location, thus assigning environmental values to assemblages irrespective of the degree of lateral transport.

References

Berger, W.H., 1970b. Planktonic foraminifera: differential production and expatriation off Baja California. Limnology and Oceanography 15, 183–204. Berger, W.H., Piper, D.J.W., 1972. Planktic foraminifera: differential settling, dissolution, and redeposition. Limnol. Oceanogr. 17, 275–287. Fok-Pun, L., Komar, P.D., 1983. Settling velocities of planktonic foraminifera: density variations and shape effects. J. Foram. Res. 13, 60–68. Peeters, F.J.C., Acheson, R., Brummer, G.-J.A., de Ruijter, W.P.M., Schneider, R.R., Ganssen, G.M., Ufkes, E., Kroon, D., 2004. Vigorous exchange between the Indian and Atlantic ocean at the end of the past five glacial periods. Nature 430, 661–665. Sciascia, R., De Monte, S., Provenzale, A., 2013. Physics of sinking and selection of plankton cell size. Physics Letters A 377, 467–472 Weyl, P.K., 1978. Micropaleontology and ocean surface climate. Science 202, 475–481.

Interactive comment on Biogeosciences Discuss., 10, 6763, 2013.