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Interactive Comment

Interactive comment on "Middle Jurassic-Early Cretaceous high-latitude sea-surface temperatures from the Southern Ocean" *by* H. C. Jenkyns et al.

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In any DSDP/ODP sequence one can sample at progressively higher resolution, if not precluded by core recovery. But you have to start somewhere. What this report does is extend the use of the TEX86 proxy back to the Jurassic for the very first time. Clearly there is a springboard here for further research: that is a positive, not a negative factor. It has not escaped us that a logical next step would be to sample what appear to be cooler (but not glacial) intervals at higher levels of stratigraphic resolution. But that would be another paper.

Referring to extrapolation of Cretaceous TEX86 values from the Arctic Ocean as 'Geophantasy' is not a scientific counter-argument.

As is clear from detailed reviews of the available biostratigraphy, the high-latitude situation of the Falkland Plateau Site makes for some difficulties in assigning exact ages and there are disagreements as to where stage boundaries are placed. Accessing the available Sr-isotope stratigraphy compounds these problems to some extent. However, some parts of the section are biostratigraphically well constrained and this is illustrated in the figures. It is manifestly not the purpose of this article to discuss competing claims on the positions of stage boundaries – but to offer a 'best fit' to all the currently available bio- and chemostratigraphic data. The reconstructed stratigraphy is more than sufficient to enable useful discussion of the results.

The pros and cons of the TEX86 proxy have been discussed in many papers, so it is neither necessary nor particularly helpful to repeat them here. The BIT indices for the sediments at both sites are less than 0.1%, indicating that the TEX86 proxy is not biased by the presence of terrestrial organic matter. Alternative calibrations do not change the TEX86 sea-surface results to any great degree. The core-top calibration of Kim et al. (2010) is the most comprehensive at the present time, given that it is based on the most extensive data base: that is why it was chosen. The point here is that the reconstructed Jurassic–Early Cretaceous temperatures are warm and remarkably uniform over a long period of geological time.

In terms of the reconstruction of the thermocline, the most remarkable result is how constant is the temperature difference between the belemnite and TEX86 palaeotempeature data. This relationship is clear, despite the caveats applied to belemnites that the anonymous reviewer lists. Below the thermocline, the water temperature will not change that much, so any migration of these molluscs within the lower part of the watermass is immaterial. How realistic is a 14 degree difference between sea-surface temperatures and sub-thermocline temperatures? Such figures are entirely compatible with what one would expect in seas and oceans of a greenhouse world where high latitudes experienced sub-tropical conditions. The fact that near-polar regions in the Jurassic and Cretaceous may (or may not) have been sources of deep water is irrelevant.

The position of the early Aptian OAE is based firstly on the recognition of the critical interval from published nannofossil data. If the reviewer wishes to challenge this attribution, based perhaps on a revision of the nannofossil data from Site 511, (s)he must provide chapter and verse. Mere opinion is not sufficient. TOC values are at their highest where the OAE is indicated in Figure 4 and – significantly – this is where δ13C values are at a minimum. Above this level, average TOCs drop dramatically (it is simply not correct to state that they are at the same level throughout the Cretaceous) and the carbon-isotope values rise into a positive excursion: these are characteristic features of the early Aptian OAE, as has been well documented from many European sections. The Aptian carbon-isotope signature of the Bédoule section in France (Kuhnt et al., 2011), albeit based on carbonate rather than organic matter, is comparable with that illustrated from the Falkland Plateau and similarly extends stratigraphically over a few tens of metres. Perhaps the reviewer has been misled by comparison with Alpine sections that are stratigraphically condensed and illustrate more abrupt negative carbon-isotope excursions

Cold snaps: examination of Fig. 4 shows that the lowest temperatures in the profile from the Falkland Plateau all correlate with periods that have been proposed as relatively cool. Is this coincidence? We think not.

One could – as obviously the anonymous reviewer would prefer – squeeze short-period icehouse intervals into fortuitously unsampled Jurassic–Cretaceous intervals. However, given that TEX86 data from other Early Cretaceous high-latitude DSDP/ODP sites (249, 692, 766) show closely comparable values to those illustrated here (Littler et al., 2011), it is clear that there is no direct evidence whatsoever for near-freezing temperatures at sea level in this region of the southern hemisphere.

If the reviewer wishes to argue that Jurassic and Cretaceous sea-level changes require polar ice, (s)he is on very shaky ground. As stated in the article, if such ice did exist, it must have been situated on high-altitude sites.

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