Neogene Environments: Hints to the Future

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The Neogene time period (~2-24 million years ago (Ma)) is characterized by environmental conditions that may have been similar to those that would be expected to occur during warmer "greenhouse" conditions. To better understand this period – and its implication for future climate – ODP scientists have studied time-scales and magnitudes of Neogene environmental change, particularly those of sea-surface temperatures. The resulting information on methods, data, programs and models is available for other scientific initiatives and to the public on CD-ROM (Smolka and Volkheimer, 2000), which permits state-of-the-art modeling even in low–budget regions and as part of meteorological classroom exercises. Scientists using ODP information on Neogene oceans with a global atmospheric circulation model (including a land-surface model) are able to assess the non-reconstructable parameters during the Neogene such as the moisture distribution in the air.

It could be shown that the known present-day surface circulation existed, with modifications and changes of intensity of ocean currents, throughout the entire Neogene. Of special importance are the indirect effects of the closure of the Panama gateway during the Neogene (13 - 2.7 Ma, Fig. 2). A fundamental shift of temperatures is also recorded on a global scale at around 2.6 Ma, a time after which *widespread* glaciations can be observed. Of special importance, however, are regional temperature fluctuations at water-mass boundaries (for example between Australia and New Zealand and in the Eastern Equatorial Pacific), which imply that temperature fluctuations that occurred in the Neogene are of the same order of magnitude as those in the Quaternary. In other words: "warm" climates appear to be inherently as instable or stable as "cold" climates.

The coupling of the results with an atmospheric general circulation model (ccm3.6 from NCAR) showed moisture distributions that differ from present-day situations. Examples are the reduced moisture in Amazonia around 4-5Ma, the increased moisture over the central and southern Sahara and moderately arid conditions in NW Europe in the same time interval (Fig. 5). Some regions of the world had been affected by climate change towards warmer conditions while others remained fairly stable during Neogene times. Thus the study of past warm climates from the Neogene, based on ODP data, is one clue to future environmental conditions.

Ongoing work focuses on an enhanced data–coverage both in the high and very high latitudes. Knowledge about the ice–coverage in the Arctic Ocean during Neogene times is of prime importance for the understanding of the stability/instability of warmer climates.

References:
Smolka P.P. (2000): A new Paleotemperature Transfer Algorithm and its Application to the Reconstruction of Neogene Oceans. In: Smolka P.P. and Volkheimer W. (2000): Southern Hemisphere Paleo- and Neoclimates. Key Sites, Methods, Data and Models. Springer Science Publishers, pp 317–352 (with CD ROM).
Smolka P.P. and Volkheimer W. (2000): Southern Hemisphere Paleo- and Neoclimates. Key Sites, Methods, Data and Models. 381pp, CD ROM, Springer Science Publishers.

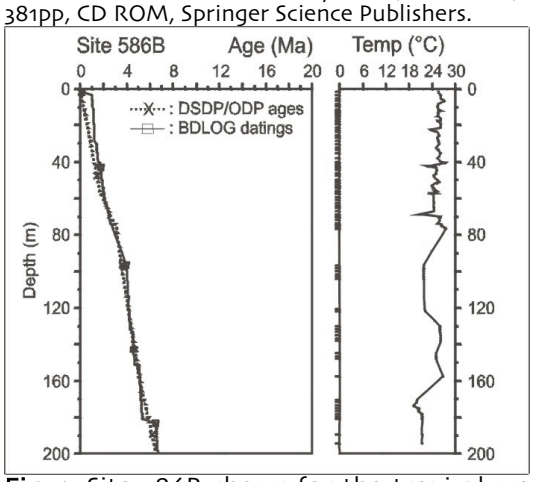


Fig. 1. Site 586B shows for the tropical west Pacific east of New Guinea from about 6–1 Ma temperatures around 26° C Especially between 2.6–0 Ma some short slightly colder intervals can be observed.

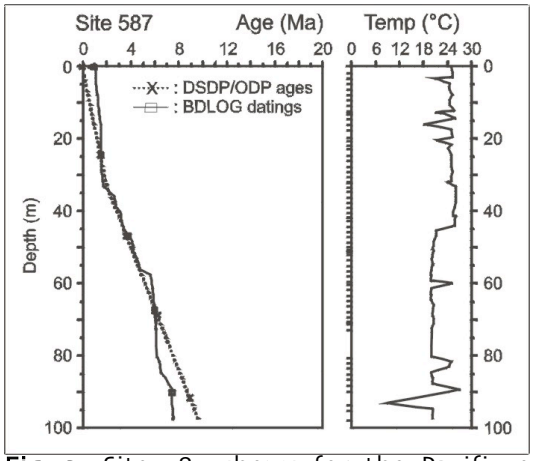
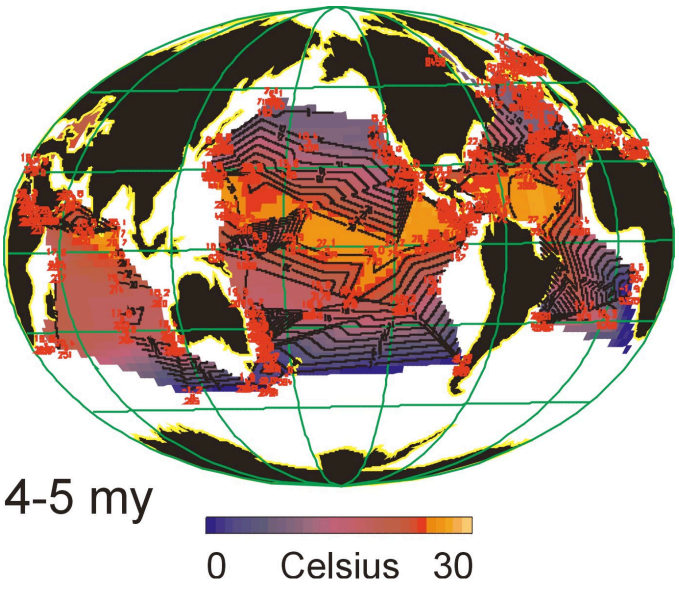
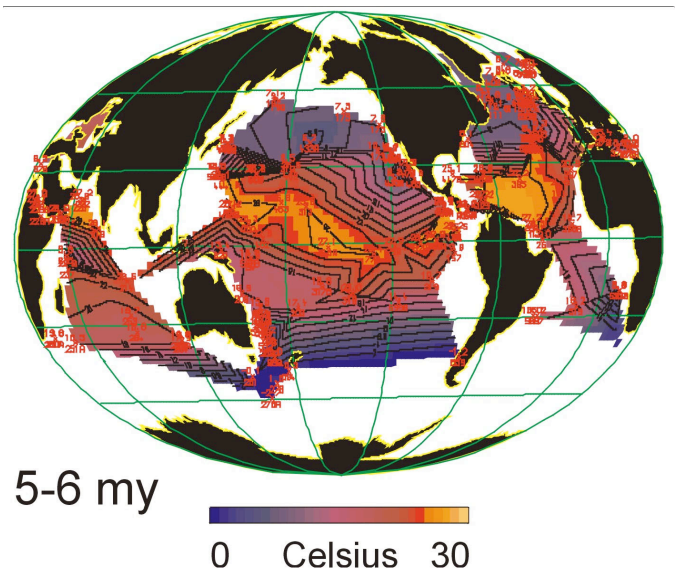
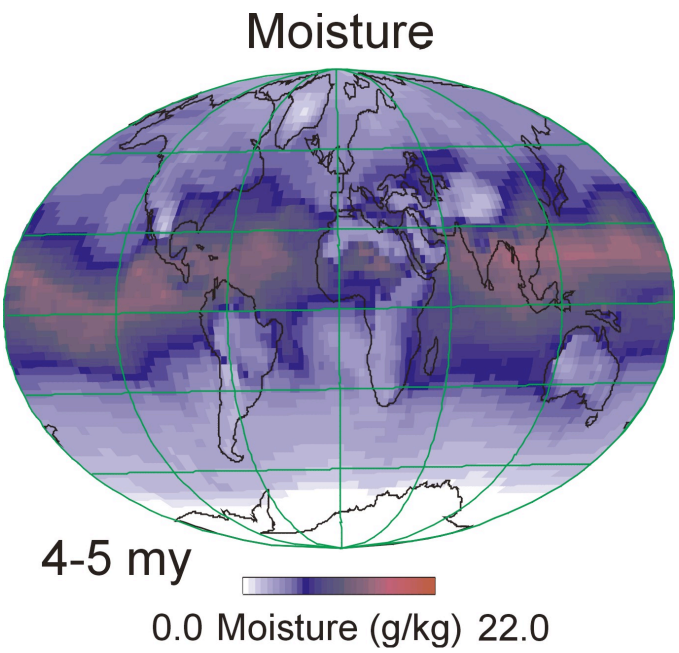


Fig. 2. Site 587 shows for the Pacific east of Australia generally warm conditions (summer temperatures) without pronounced fluctuations. Between 8 and 4 my temperatures around 20°C can be observed, while between 4 and 1 my higher values around 25°C can be found.

Fig. 3 (left) . Reconstructed sea surface temperature for 4–5 my (Northern Hemisphere Summer). **Fig. 4 (right)** Reconstructed sea surface temperature for 5–6 my (Northern Hemisphere Summer) Both maps show the primary data before interpretation (from Smolka 2000).







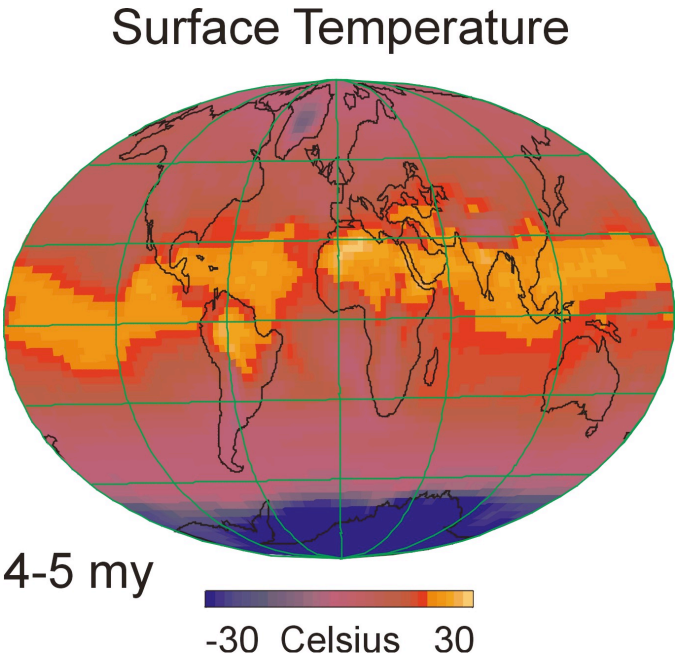


Fig. 5 (left) and Fig. 6 (right): See the moderatly low moisture over Amazonia and NW Europe. Note also the moderatly high moisture over parts of the Sahara .