A solution to a long-standing Miocene mystery? New temperature records to resolve enigmatic pCO_2 reconstructions

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Reconstructing accurate and precise records of atmospheric CO_2 is an essential objective of environmental research, allowing for improved understanding of the response of the Earth system to the high-CO_2 conditions expected by the end of the century. The middle Miocene (11.6-16.0 million years ago) is a possible partial analogue for future climate, with global temperatures ~4-5 °C warmer than today that are assumed to be driven primarily by higher CO_2 levels. However, the precise level and evolution of atmospheric CO_2 during the Miocene is to date uncertain. In particular, a paucity of data combined with enigmatic CO_2 records have hindered our understanding of Miocene climate evolution and thus, of the Earth System.

One particularly problematic dataset is that of Pagani et al., (1999) which infers both low and invariant atmospheric CO_2 during the growth of the East Antarctic icesheet. Whereas more recent CO_2 reconstructions hint at much larger changes in atmospheric CO_2 consistent with our understanding of the climate system (Badger et al., (2013), Foster, Lear and Rae (2012)), these data remain sparse and thus, the evolution of middle Miocene CO_2 remains enigmatic.

One possible solution to this controversy, long suspected but never tested (see discussion in SOM of Pagani et al. (2010)), is that the temperature records underlying the Pagani et al., (1999) CO_2 estimates are fatally flawed – they are based on recrystallized planktic foraminifera with compromised oxygen isotope signatures on which the temperature estimates are based. Here we present new, likely more robust temperature records for idential or directly adjacent samples (using the Mg/Ca ratio of planktic foraminifera and GDGT-based TEX_{86}) for one of the key Pagani et al., (1999) CO_2 records.