*Supplementary Information*

**GDGT and alkenone flux in the northern Gulf of Mexico: Implications for the TEX86 and U**$\genfrac{}{}{0pt}{}{K'}{37}$ **paleothermometers**

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**Age Model**

In this study we present data from the upper 5 cm of three different sub-cores of a multicore cast (GMT14-MC3K, GMT14-MC4R and GMT14-MC4S). An age-model based on 210Pb profile of a fourth sub-core (GMT14-MC3J) was applied to the three sub-cores used for down core biomarker analyses. The resulting age model indicates a sediment accumulation rate of 0.58mm/yr. Data are shown in Table S.1.

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**Figure S1.** Excess210Pb activity plotted against cumulative mass depth (left) and modelled calendar age (Year C.E.) plotted against depth interval (right) for multi-core GMT14-MC3J.Depth-Age model was constructed using constant rate of supply (CRS) model.

Table S.1.

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**Table S.1.** 210Pb data for sub-core GMT14-MC3J used to construct age model

**Comparison of LGM-to-Holocene SST in the Gulf of Mexico: Mg/Ca vs. U**$\genfrac{}{}{0pt}{}{K'}{37}$

There are two foraminiferal Mg/Ca-based SST reconstructions from the northern Gulf of Mexico that span the glacial-interglacial transition. The Orca Basin record (Williams et al., 2010) is based on paired Mg/Ca-18Ocalcite in *Globigerinoides ruber* (white), and covers the deglaciation at multi-decadal resolution. The DeSoto Canyon record (Nürnberg et al., 2008) is also based on paired Mg/Ca-18Ocalcite in *G. ruber* (white), and covers the LGM through late Holocene and multi-centennial resolution. The Pigmy Basin record (Jasper and Gagosian, 1989) is a U$\genfrac{}{}{0pt}{}{K'}{37}$ -based SST record that spans the LGM-to-late Holocene at millennial resolution. We plot the records here to compare the results of using the Sonzogni et al. (1997) U$\genfrac{}{}{0pt}{}{K'}{37}$-SST equation versus the Prahl (1988) U$\genfrac{}{}{0pt}{}{K'}{37}$-SST equation in the context of foramiferal Mg/Ca-based SST. Notwithstanding large discrepancies in the pattern of warming between the Mg/Ca and U$\genfrac{}{}{0pt}{}{K'}{37}$-based SST reconstructions, the use of the Sonzogni (1997) equation overestimates the LGM-to-late Holocene warming in the GoM, and the Prahl (1988) equation yields comparable results to Mg/Ca. The Prahl (1988) equation therefore, is most appropriate to use in the GoM on glacial-interglacial timescales, when most of the SST range is below 25ºC. During the late Holocene, when mean annual SSTs likely varied between 24ºC and 27ºC in the GoM, the non-linearity of the U$\genfrac{}{}{0pt}{}{K'}{37}$-SST relationship at high temperatures must be accounted for, and we recommend the Sonzogni (1997) equation.

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**Figure S.2.** Down core comparison of Mg/Ca-SST and U$\genfrac{}{}{0pt}{}{K'}{37}$-SST from the Gulf of Mexico. The DeSoto Canyon Mg/Ca-SST (black circles) originally published in Nürnberg et al. (2008), and the Orca Basin (black triangles) originally published in Williams et al. (2010) are recalibrated to SST here using the Mg/Ca-SST-S equation from Tierney et al. (2016). The U$\genfrac{}{}{0pt}{}{K'}{37}$-SST the Pigmy Basin was originally published in Jasper and Gagosian (1989), and is shown here calibrated to SST using the Prahl (1988) equation (teal), and the Sonzogni (1997) equation (red) BAYSPAR equation (red).

**Comparison of last Millennium SST in the Gulf of Mexico: Mg/Ca v. TEX86**

Mg/Ca and TEX86-based SST reconstructions from co-occurring sediments in the Pigmy Basin over the last millennium provide an opportunity to compare different TEX86 calibrations. The Kim et al. (2010) TEX$\genfrac{}{}{0pt}{}{H}{86}$-SST calibration yields an SST reconstruction that is 2ºC warmer than the Mg/Ca-SST record, on average. Given the slight winter-weighting, and likelihood that TEX86 represents an integrated surface-subsurface (0-200 meter) signal, we conclude that this equation is not appropriate to use. The BAYSPAR (Tierney and Tingley, 2015) SST calibration produces a core-top SST that is within uncertainty of the core-top Mg/Ca-SST estimate, and an overall amplitude that matches Mg/Ca-SST. However, the sediment trap data suggest that TEX86 represents a sub-surface signal in the GoM, so it is most appropriate to use the sub-T BAYSPAR calibration of (Tierney and Tingley, 2015).

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**Figure S.3.** Down core comparison of Mg/Ca-SST and TEX86-SST from the Pigmy Basin, GoM. The black curve is the Pigmy Basin Mg/Ca-SST, originally published in Richey et al. (2007), and recalibrated to SST here using the Mg/Ca-S.3.ST-S equation from Tierney et al. (2016). The TEX86 from a different sub-core in the Pigmy Basin was originally published in Richey et al. (2011), and is shown here calibrated to SST using the Kim et al. (2010) equation (teal), the BAYSPAR equation (red) (Tierney and Tingley, 2015), and BAYSPAR sub-T equation (pink) from Tierney and Tingley (2015). The horizontal dashed line indicates the modern mean annual SST (ºC) for the nGoM.