SO290: Bulk properties and biomarker composition of surface sediments from the Tasman Sea

Nicoletta Ruggieri[1], Frank Lamy[1], Niklas Kubik[1], Katharina Pahnke[2]

Background

The **Tasman Sea** plays a key role in the formation and northward transport of Antarctic Intermediate and Bottom Waters, influencing global ocean circulation and climate. During **SONNE cruise SO290**, surface sediments were collected **off New Zealand** (Fig. 1) to provide essential baseline data for refining regional proxy interpretations in paleoenvironmental reconstructions. This study focuses on **bulk sediment properties**, **alkenone- and GDGT-based sea surface temperature proxies**, and **plant-wax n-alkanes** as indicators of terrigenous input.

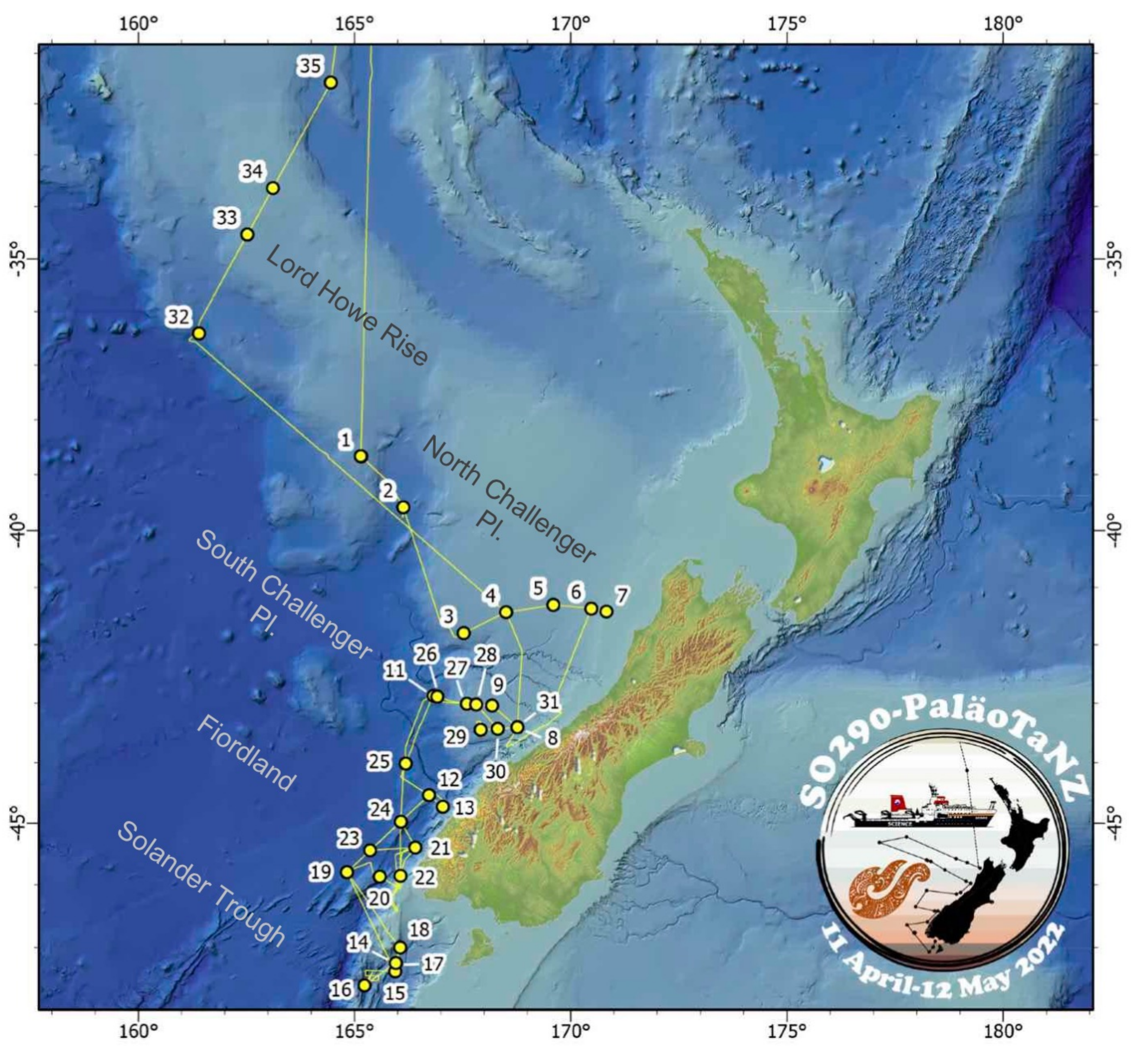

Figure 1. Working areas and sampling stations.

Bulk Sediment Parameters and n-Alkanes

Sediments off New Zealand are **dominated by terrigenous material and biogenic carbonate** (Fig. 2). Strong fluvial input off the South Island leads to **low $CaCO_3$** (~10–30%) and **high sedimentation rates**, indicating dilution by terrigenous material. **$CaCO_3$ increases northward**, exceeding 90% on the Lord Howe Rise, where terrigenous input is minimal and likely reflects **aeolian input from Australia**. **Opal** contents are generally **low** (<5%). The **n-Alkane distribution mirrors terrigenous input.** Consistent with previous work off New Zealand's east coast, **plant waxes** are **mainly delivered by fluvial transport** (Jaeschke et al., 2017), while offshore an **aeolian contribution from Australia** is likely.

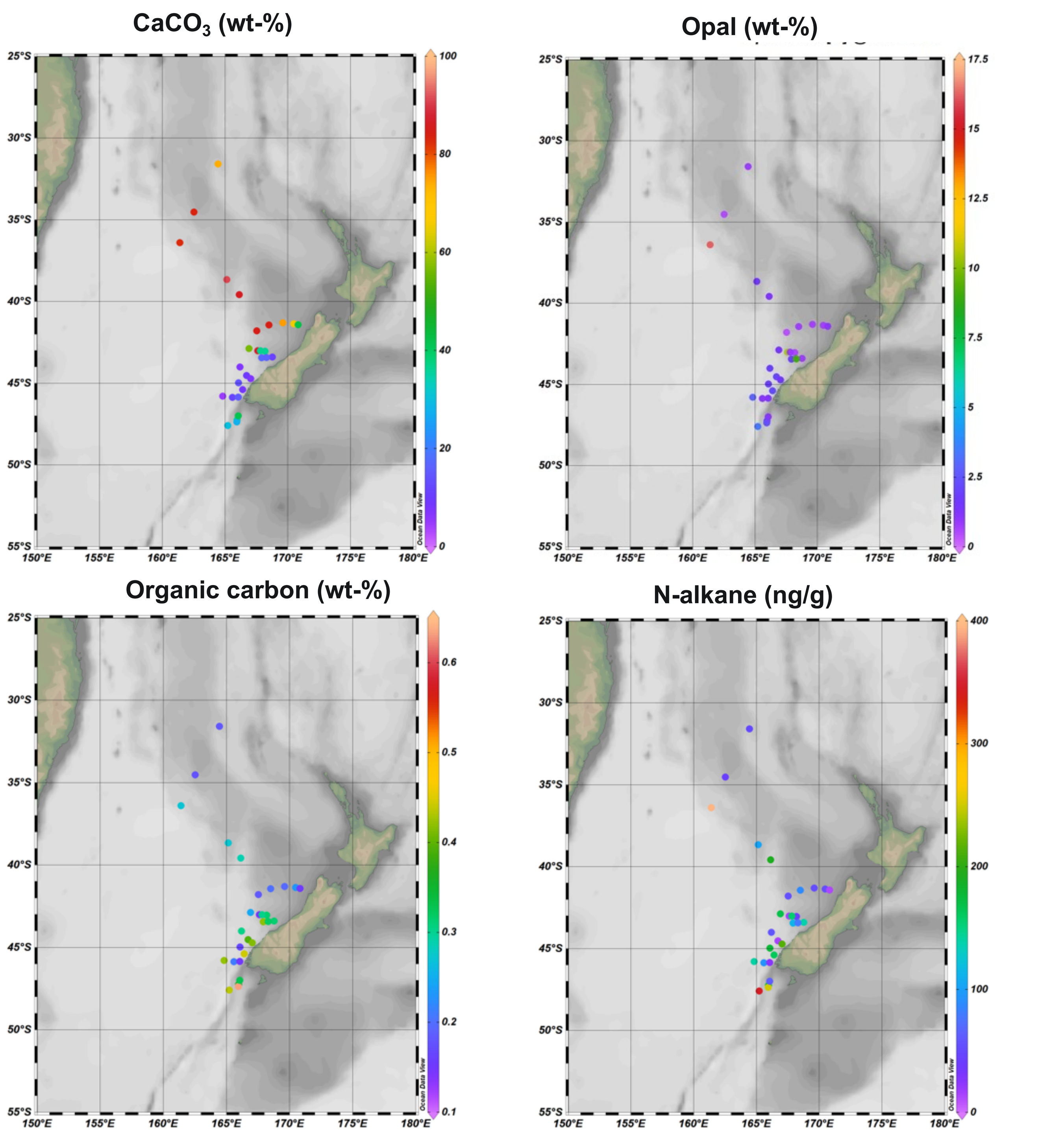

Figure 2. Bulk sediment parameters and n-alkane concentrations in surface sediments from SONNE cruise SO290.

Sea Surface Temperature

We analysed several biomarker proxies for **SST reconstructions** in our surface sediment dataset, with a primary focus on **alkenone-based UK'_{37} SST**. Figure 3 compares alkenone-derived SSTs, calculated using the surface-sediment calibration of Müller et al. (1998), with modern annual mean and seasonal instrumental SSTs. The results show that **alkenone-SSTs** are consistently higher than modern annual mean temperatures and **most closely match warm austral summer conditions**. This seasonal bias is in agreement with previous findings from the Subantarctic Southern Ocean (Jaeschke et al., 2017; Sikes et al., 1997).

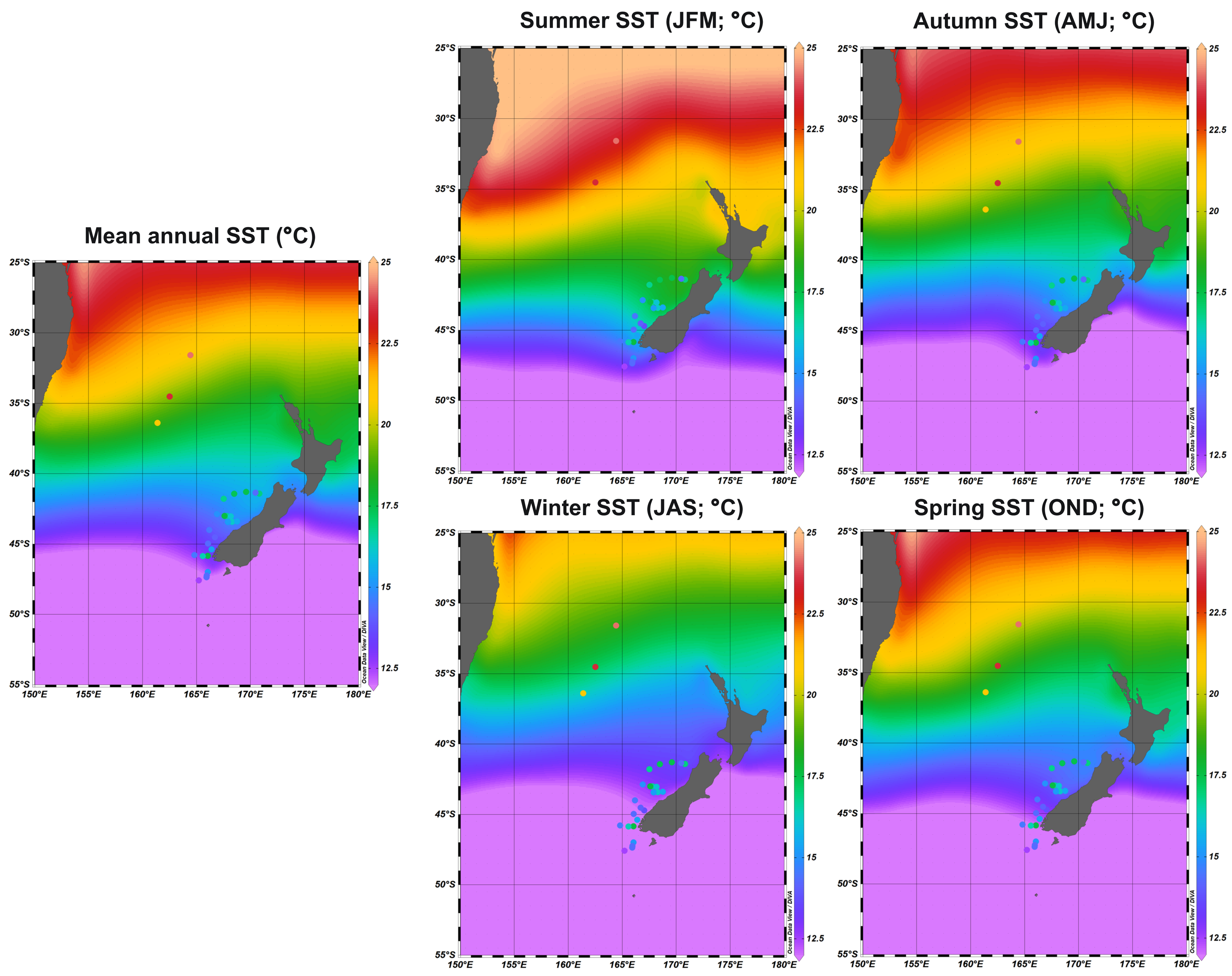

Figure 3. Alkenone-based SSTs from surface sediments (Müller et al., 1998) compared with annual mean and seasonal SSTs from WOA05 (Locarnini et al., 2006).

In addition to alkenone-based reconstructions, we tested **GDGT-based SST** proxies (Fig. 4). The **TEX^H_{86} index** consistently yields SSTs **substantially warmer than modern summer** values, a pattern reported from other regions (e.g., Kim et al., 2010; Ho et al., 2014), except at the northern stations on the Lord Howe Rise, where TEX^H_{86} SSTs agree with modern summer temperatures. In contrast, the **RI-OH index** (Lü et al., 2015) more **closely matches modern summer SSTs** across the Tasman Sea, although it appears to underestimate temperatures on the Lord Howe Rise.

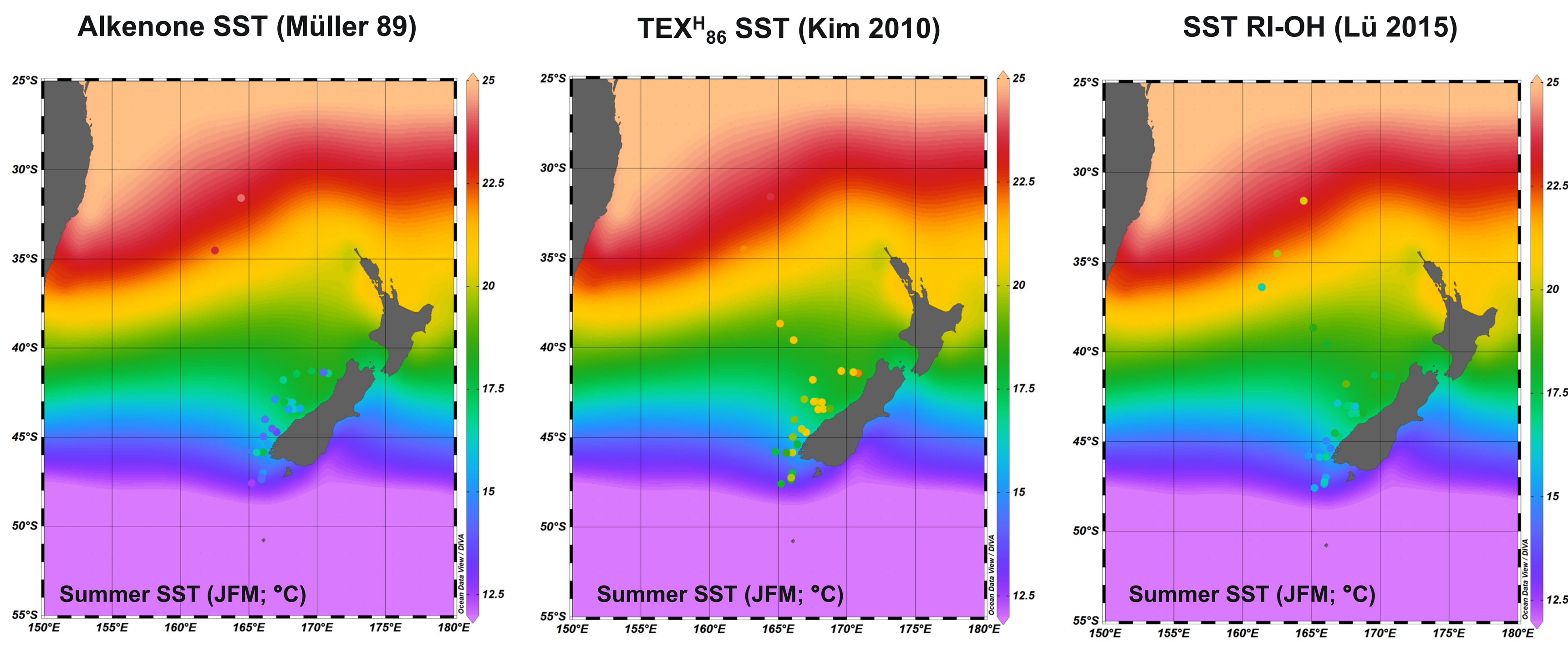

Figure 4. Comparison of SSTs reconstructed from different biomarker proxies: alkenone SST (Müller et al., 1998), TEX_{86} (Kim et al., 2010), and SST RI-OH (Lü et al., 2015).

Summary

This study presents a comprehensive surface-sediment reference for the Tasman Sea, establishing a framework for detailed paleo-environmental reconstructions.

The spatial distribution of bulk parameters and n-alkanes provides insight into provenance and transport pathways, with fluvial inputs dominating coastal regions and aeolian transport becoming more significant offshore.

The spatial variability in SST proxy performance highlights the need for regional calibration to improve paleo-SST reconstructions in the Tasman Sea.

References

Ho, S.L. et al. (2014) Appraisal of TEX86 and TEX86L thermometries in subpolar and polar regions. Geochim. Cosmochim. Acta, 131, 213–226.

Jaeschke, A. et al. (2017) A biomarker perspective on dust, productivity, and SST in the Pacific sector of the Southern Ocean. Geochim. Cosmochim. Acta, 204, 120–139.

Kim, J.H. et al. (2010) New indices and calibrations from crenarchaeal GDGT distributions: implications for SST reconstructions. Geochim. Cosmochim. Acta, 74(16), 4639–4654.

Locarnini, R.A. et al. (2006) World Ocean Atlas 2005, Volume 1: Temperature. NOAA Atlas NESDIS 61.Westerhold, 2020

Lü, X. et al. (2015) Hydroxylated GDGTs in Chinese coastal seas and potential as paleotemperature proxy. Org. Geochem., 89–90, 31–43.

Müller, P.J. et al. (1998) Calibration of $U_{37}^{k'}$ based on core-tops from the eastern South Atlantic and global ocean. Geochim. Cosmochim. Acta, 62(10), 1757–1772.

Sikes, E.L. et al. (1997) Alkenones and alkenes in the Southern Ocean: implications for paleotemperature estimation in polar regions. Geochim. Cosmochim. Acta, 61(7), 1495–1505.

Affiliations

1 Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Bremerhaven, Germany

2 Institute for Chemistry and Biology of the Marine Environment (ICBM), Carl von Ossietzky Universität Oldenburg, Oldenburg, Germany