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Dear Dr. Feakins,

We are pleased to submit our manuscript (2025GL115237), titled *"A nutrient effect on the TEX_{86} paleotemperature proxy,"* for consideration in *Geophysical Research Letters* as a *Research Letter*. Our study provides compelling evidence that nutrient stress significantly alters the distribution of archaeal membrane lipids (GDGTs) in marine sediments, leading to elevated TEX_{86} values independent of temperature.

Using an expanded global core-top database, we demonstrate that once the temperature influence is removed from sedimentary TEX_{86} distributions, there is a significant negative relationship between the residuals and surface ocean nitrate concentrations, which we use as a proxy for ammonia oxidation rates. While laboratory studies have shown that nutrient availability influences GDGT cyclization, our study is the first to systematically reveal that this nutrient effect is preserved in marine sediments. Beyond the global core-top analysis, we compare TEX_{86} records with $U_{37}^{K'}$—an independent organic paleotemperature proxy—over glacial-interglacial cycles. Our results suggest that nutrient stress likely explains periods when TEX_{86}-based temperature estimates exceed $U_{37}^{K'}$-based SSTs. These findings underscore the need to account for nutrient effects in TEX_{86} paleothermometry and offer a pathway to reconcile long-standing discrepancies among paleotemperature proxies. We believe our study presents novel insights that will enhance the accuracy of TEX_{86} as a paleotemperature proxy.

Enclosed are the main text (3,510 words and 4 figures) and supplementary materials (supplementary texts, 7 datasets, 2 code notebooks, 9 figures, and 3 tables) in PDF format. In compliance with AGU's open research guidelines, all data and code necessary to reproduce our results are archived in Zenodo and GitHub repositories with DOI links. Should the manuscript be accepted for publication, we will ensure these repositories are publicly accessible.

This manuscript is original, has not been published elsewhere, and is not under consideration by any other journal. We appreciate your time and consideration.

Sincerely,

Dr. Ronnakrit Rattanasriampaipong
NOAA Climate & Global Change Postdoctoral Fellow
Department of Geosciences, The University of Arizona

On behalf of co-authors, Dr. Jessica E. Tierney, Dr. Jordan T. Abell, and Lauren Gilmore