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Investigation of sources of variability inherent in the MBT-CBT paleotemperature proxy from a field study of the Eastern Cordillera of Colombia

Veronica J. Anderson[1], Timothy M. Shanahan[1], Joel E. Saylor[2], Brian K. Horton[1]
v.anderson@utexas.edu
1. Jackson School of Geosciences, The University of Texas at Austin, Austin, TX
2. School of Earth Sciences and Environmental Sustainability, Northern Arizona University, Flagstaff, AZ

Recently, the distribution of branched GDGT's (glycerol dialkyl glycerol tetraethers) has been proposed as a proxy for temperature and pH in soils via the MBT/CBT index, and has been used to reconstruct past temperature variations in a number of settings ranging from marine sediments to loess deposits and paleosols. However, empirical calibrations of the MBT/CBT index against temperature show significant scatter, leading to uncertainties as large as ±2 degrees C . In this study we seek to add to and improve upon the existing soil calibration using a new set of samples spanning a large elevation (and temperature) gradient in the Eastern Cordillera of Colombia. At each site we buried temperature loggers to constrain the diurnal and seasonal temperature experienced by each soil sample. Located only 5 degrees north of the equator, our sites experience a very small seasonal temperature variation – most sites display an annual range of less than 4 degrees C. In addition, the pH of all of the soils is almost invariant across the transect, with the vast majority of samples having pH's between 4 and 5. This dataset represents a "best-case" scenario – small variations in seasonal temperature, pH, and well-constrained instrumental data – which allow us to examine the brGDGT-temperature relationship in the absence of major confounding factors such as seasonality and soil chemistry. Interestingly, the relationship between temperature and the MBT/CBT index is not substantially improved using this dataset, suggesting that there remains substantial uncertainty in MBT-CBT-derived temperature estimates that cannot be explained by soil pH variations or poorly constrained soil temperatures. However, the reduction in scatter that we observe in our dataset when compared to the global dataset seems to be related to the absence of a seasonal signal in our field area, suggesting that further investigation is needed on the effect of seasonal variability on GDGT growth.

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