

Environmental and physiological influences on the TEX₈₆ proxy

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The TEX₈₆ sea surface temperature (SST) proxy is a widely employed tool, yielding climate records from a diverse range of geographic locations over the past ~100 million years of Earth history [1] [2]. TEX₈₆ is an empirically calibrated proxy based on the membrane lipids of planktonic archaea, glycerol dibiphytanyl glycerol tetraethers (GDGTs). While the TEX₈₆ temperatures determined from marine sediments correlate with overlying SSTs, GDGTs produced throughout the upper water column do not reflect *in situ* temperatures at the depth of growth. This suggests that additional physiological factors, such as the need for cellular energy conservation, also affect the TEX₈₆ ratio. The ecology and growth conditions of marine archaea potentially play important roles in establishing the TEX₈₆-temperature correlation.

We investigated the mechanistic underpinning of the TEX₈₆ proxy using a combination of experimental and modeling approaches. We used isothermal culture studies of the ammonia-oxidizing thaumarchaeon *Nitrosopumilus maritimus* and modeled oceanographic parameters to explore the relationship between TEX₈₆ and growth conditions. Evidence suggests that growth rate and electron donor supply are important controls on GDGT ratios. Constraining the physiological basis of the TEX₈₆ proxy and the mechanism by which this signal is preserved in the sedimentary record is crucial in the proxy's application to ancient environments.

[1] S. Schouten, E.C. Hopmans, E. Schefuß, J.S. Sinninghe Damsté, *EPSL* **204** (2002) 265. [2] H.C. Jenkyns, A. Forster, S. Schouten, J.S. Sinninghe Damsté, *Nature* **432** (2004) 888.