



#### Supplementary Information: Temperature calibrations

Example of hypothetical calcification temperatures obtained when using empirical temperature calibrations for Mg/Ca (Surge and Lohmann, 2008), Mg/Li (Montagna et al., 2014) and Sr/Li (Füllenbach et al., 2015). Error bars show the extent of measurement error on the trace element results ( $2\sigma$ ). Thick lines show the result of bandpass filtering of diurnal cyclicity. Results show that Mg/Ca and Sr/Li proxies, while yielding reasonable sea surface temperatures, underestimate the (more reliable) temperatures reconstructed using stable oxygen isotopes. Mg/Li temperatures overestimate stable oxygen isotope reconstructions. Sub-daily variability in these trace element ratios is too large to be explained by changes in calcification temperature (see discussion in main text). Therefore we conclude that these variations reflect diurnal changes in light availability. Temperature fluctuations in long records are ascribed to temperature seasonality.