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Towards an organic palaeosalinity proxy: the effect of salinity, growth rate and growth phase on the hydrogen isotopic composition of alkenones produced by haptophyte algae

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Palaeosalinity is one of the most important oceanographic parameters which currently cannot be quantified with reasonable accuracy from sedimentary records. Schouten *et al.*[1] established that the fractionation of hydrogen isotopes between growth water and alkenones produced by the haptophyte algae *Emiliania huxleyi* and *Gephyrocapsa oceanica* is salinity dependent. As such, the δD values of alkenones recovered from sediment cores can be used to reconstruct variations in palaeo- sea surface salinity.[2] However, to accurately determine absolute palaeosalinity requires a better constraining of the relationship between this hydrogen fractionation, salinity and other parameters such as growth rate and growth phase.

Here, we present results from our ongoing work to constrain the relationship between the fractionation factor $\alpha_{alkenone-water}$, salinity, growth rate and growth phase for the major alkenone-producing haptophytes.

In batch cultures of different strains of the open-ocean haptophyte *E. huxleyi* sampled during the exponential growth phase, $\alpha_{C37alkenone-growthwater}$ increases by between 0.0022 and 0.0033 per unit increase in salinity. A similar relationship is observed in batch cultures of the coastal haptophyte *Isochrysis galbana*, where α increases with each unit of salinity by 0.0019 — slightly less than for *E. huxleyi*. However, absolute $\alpha_{C37alkenone-growthwater}$ values vary strongly between species suggesting that species composition has a strong impact on the δD value of alkenones.

The fractionation factor for alkenones produced by batch cultures of *I. galbana* is affected by growth phase: the rate of change of $\alpha_{C37alkenone-growthwater}$ with each unit of salinity decreases from 0.0019 in the exponential phase to 0.0010 during the stationary phase. We also show the effect of varying growth rate over the range 0.2–0.8 day^{-1} on the fractionation factor for alkenones produced by *E. huxleyi* grown in continuous culture.

These data show that alkenone δD can be used to reconstruct relative shifts in palaeosalinity in coastal as well as open ocean environments; however, for absolute salinity reconstructions changes in species composition, growth rate and growth phase effects will have to be constrained.

References

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