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Alkenone unsaturation ratios in the Chesapeake Bay Estuary, eastern USA

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Alkenone unsaturation ratios are widely used as a geochemical proxy for sea surface temperature, and the %$C_{37:4}$ relative to $C_{37:3}$ and $C_{37:2}$ has driven increasing interest in its potential use as indicator of water salinity. Here, we present alkenone distributions in surface sediments and suspended particles from the Chesapeake Bay estuary (CB), eastern USA, at the end of May 2006. CB is characterized by a typical estuarine circulation with an outflow of freshwater in the upper layers and an inflow of seawater at depth resulting in a gradual increase of salinity from the head (0 PSU) to the mouth (30.8 PSU) and the establishment of a strong vertical salinity gradient.

Alkenones were observed in a wide range of concentrations in particles and sediments at salinities of 3.7 to 30.8 PSU (sum of C_{37} and C_{38}). In suspended particles alkenone concentrations were *ca*. 0.1 μgL^{-1} in the upper Bay, *ca*. 0.8 μgL^{-1}in the middle Bay and *ca*. 0.3 μgL^{-1} in the lower Bay with highest values usually found near 5 m water depth. Converted to weight of freeze-dried suspended matter alkenone concentrations were 0.5 to 271 μg g^{-1}. Highest values occurred in the middle Bay with values close to those encountered in a $E.$ *huxleyi* bloom in the northwestern North Pacific (Blanz et al., 2005). In surface sediments highest alkenone concentrations were also observed in the middle Bay with values up to 20 μg g^{-1} dry weight of sediment. Sedimentary alkenone concentrations decreased to 6 μg g^{-1} in the upper Bay and to 2 μg g^{-1} in the lower Bay.

The distribution of alkenones was similar in all samples with a dominance of methyl C_{37} over ethyl C_{38} alkenones, the absence of methyl C_{38} alkenones and a higher

abundance of tri-unsaturated relative to di-unsaturated analogs. Measured sea surface temperatures in the Bay were between 14.0 and 19.7˚C, while alkenone unsaturation ratios in suspended particles imply alkenone production at 3.9 to 6.8˚C, and those from surface sediment imply production at 4.2 to 9.7˚C.

In coastal environments, the absence of a relationship between alkenone unsaturation ratios and SST and an increase in the $\%C_{37:4}$ (relative contribution of $C_{37:4}$ to the sum of $C_{37:4}$, $C_{37:3}$ and $C_{37:2}$) with decreasing salinity have been attributed to non-marine haptophyte production of alkenones and a change in alkenone biosynthesis associated with salt stress (e.g., Rosell-Melé, 1998; Blanz et al., 2005). In suspended particles the $\%C_{37:4}$ was between 3.5% and 7% and was positively correlated with salinity ($R^2 = 0.74$, n = 44), suggesting a salinity influence on alkenone unsaturation ratios in the Chesapeake Bay. However the observed relationship is opposite to that previously reported in several studies in the coastal and open ocean in which the $\%C_{37:4}$ was *inversely* correlated with salinity (e.g., Rosell-Melé, 1998; Blanz et al., 2005). These data further indicate that the factors controlling alkenone production in the coastal environment remain poorly understood.

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Rosell-Melé, A., 1998. Interhemispheric appraisal of the value of alkenone indices as temperature and salinity proxies in high-latitude locations. Paleoceanography 13, 694-703.