A closer look at the hydrogen isotopic composition of alkenones as proxy for paleo sea surface salinity

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Culture studies of Emiliania huxleyi and Gephyrocapsa oceanica grown at different salinities and different temperatures and, as a consequence, different growth rates showed that there is a strong correlation between the fractionation factor Alpha(alkenones-growth water) and salinity for both E. huxleyi and G. oceanica (Schouten et al., 2006). The hydrogen isotope fractionation by these haptophyte algae predominantly depends on salinity, with less fractionation at higher salinities. Based on the results of Schouten et al., paleosalinities of the Black Sea and the Eastern Mediterranean have been reconstructed using the DeltaD of alkenones (vd Meer et al., 2007, 2008). Recently, however, there has been some debate about whether analyzing the C37 alkenones together is appropriate for reconstructing paleosalinity since there is a relatively large difference in the DeltaD of the C37:2 and C37:3 alkenones, respectively (D'Andrea et al., 2007; Schwab and Sachs 2008). To examine this potential problem we analyzed the C37:2 and C37:3 alkenones of the original Schouten et al. E. huxleyi samples separately and found an increasing difference in DeltaD between the C37:2 and C37:3 alkenone with decreasing temperature and, therefore, decreasing relative abundance of the C37:2 alkenone. This is likely caused by a form of Raleigh distillation as the C37:3 is formed from the initially synthesized C37:2 alkenone. These results suggested that for the purpose of reconstructing paleo SSS it might be better to analyze the C37 alkenones together rather than the separate isomers. Schouten et al 2006 showed that besides salinity, growth rate also had an effect on the hydrogen isotopic composition of C37 alkenones. To get better handle on growth rate as a controlling factor E. huxleyi was grown under different light intensities to vary growth rate but not salinity. This experiment showed that light intensity itself has a large effect on hydrogen isotope fractionation probably through the light dependent reduction of NADP to NADPH in photosystem I.