An open-ocean assessment of alkenone δD as a paleo-salinity proxy

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Sea surface salinity (SSS) is arguably the least constrained major variable of the past (paleo) ocean, which is unfortunate because it is a fundamental variable controlling density of seawater and thus large-scale ocean circulation. The hydrogen isotopic composition (δD) of non-exchangeable hydrogen of biomarkers, specifically alkenones, has been proposed as a proxy for paleo SSS. Thus, the δD of surface seawater is correlated with SSS, and, in turn, laboratory culture studies have shown the δD of algal growth water to be reflected in the δD of alkenone molecules under certain circumstances. However, a large-scale field study testing the validity of this proxy is lacking. Here we present the δD of open-ocean Atlantic and Pacific surface waters and coincident δD of alkenone molecules sampled by underway filtration. Two transects of approximately 100° latitude in the Atlantic Ocean and more than 50° latitude in the Western Pacific sample much of the range of open ocean salinities and δD, and thus allow probing of the relationship between δD in seawater and in alkenones. Overall, the open ocean δD alkenone data correlate significantly with SSS, and also agree remarkably well with δD water vs. δD alkenone regressions developed from culture studies. Subtle deviations from these regressions are discussed vis-à-vis physiological factors as recorded in the carbon isotopic composition of alkenones. Overall, the data presented here suggest that SSS variations as low as 1.2 can be reliably reconstructed from δD alkenone measurements (SSS = (δD_{K37} + 343±37)/4.32±1.0, n = 63, p-value < 0.001*)*.