Geophysical Research Abstracts
Vol. 19, EGU2017-2840-2, 2017
EGU General Assembly 2017

Coralline Algal Skeletal δ13C as a Multicentury Recorder of Carbon Dynamics in the Labrador Sea

Alicia Meng Xiao Hou (1), Jochen Halfar (1), Walter Adey (2), Ulrich Wortmann (3), Branwen Williams (4), and Phoebe Chan (1)

(1) Department of Chemical and Physical Sciences, University of Toronto, Mississauga, Canada (alicia.hou@utoronto.ca), (2) Smithsonian Institution, National Museum of of Natural History, Washington D.C., USA, (3) Department of Earth Sciences, University of Toronto, Toronto, Canada, (4) W.M. Keck Science Department, Claremont McKenna College, Pitzer College, Scripps College, Claremont, USA

Abstract. The introduction of isotopically light carbon due to the emission of fossil fuel derived CO_2 since the beginning of the industrial revolution has decreased δ13C in the atmosphere and oceans (termed the δ13C Suess effect). Approximately 48% of CO_2 emissions from fossil fuel combustion and cement manufacturing were taken up by the oceans during the period 1800 to 1994, decreasing the δ13C of the oceanic dissolved inorganic carbon reservoir (DIC). Rates of oceanic carbon uptake vary regionally in response to several factors including ocean circulation, productivity, and water temperature. Despite the enhanced CO_2-uptake ability of the North Atlantic Ocean, carbon fluxes of surface ocean waters in high latitude regions are relatively poorly understood compared to tropical oceans. Therefore, century-scale, high-resolution marine climate archives from high latitude regions are needed in order to better understand both preindustrial carbon isotope dynamics as well as carbon isotope changes in response to anthropogenic forcing. Here, we present a 193-year record of δ13C obtained from the annual growth bands of a long-lived calcified coralline alga collected off the coast of central Labrador, near Kingitok Island, Canada (55.3983° N, 59.8467° W) to observe regional changes in carbon isotopes beginning in the preindustrial period. The algal δ13C record demonstrates an overall decreasing trend of -0.006‰year from 1819 (1.15‰ to 2012 (-0.013‰, with the fastest rate of decrease (-0.032‰year) occurring from 1960 (1.63‰ to 2012 (-0.013‰. Comparisons of the coralline algal δ13C record to a bivalve δ13C record ($r = 0.30$, $p < 0.00007$) and an atmospheric CO_2 δ13C record from compiled ice core and direct measurement data ($r = 0.35$, $p < 0.00000051$) displays a good correspondence of century-scale δ13C trends. The coralline algal record is interpreted as representing a combination of changes in primary productivity, which dominates the signal during the preindustrial portion of the record (1819 to 1850), and the increasing atmospheric input of anthropogenically derived light carbon post 1850. The latter effect becomes increasingly important in the younger portion of the coralline algal record. In order to study changes in surface ocean productivity, we therefore mathematically removed the Suess effect from 1850 onwards using a previously established Suess Effect Correction Factor. The Suess corrected algal δ13C record now exhibits an overall increasing trend from 1850 to 2012. We interpret this as reflecting an ongoing increase in Labrador Sea primary productivity, which is supported by observed recent increases in ocean productivity associated with the decline in sea ice cover in the Arctic and Subarctic oceans. Considering the important economic value of enormous fisheries supported by the Arctic and sub-Arctic oceans and the role of this region as a significant CO_2 sink, it is necessary to quantify changes in primary productivity as well as the rate of oceanic uptake of anthropogenic CO_2, both of which are reflected in changes in the carbon isotope composition of oceanic DIC.