Title: Changes in coralline algal calcification as a paleoclimate indicator of sub-arctic ocean acidification

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Abstract: Ocean acidification can seriously impact calcifying marine plants and animals. In fact, it has recently been suggested that tropical corals and other marine calcifiers are already suffering from declining calcification rates. Greater oceanic CO_2 uptake at mid-to-high latitudes means calcium carbonate organisms in the subarctic are more susceptible to increasing ocean acidification than at lower latitudes. This is particularly true for the metabolically expensive high Mg-calcite skeletons of the shallow-water, habitat-forming coralline algae. Here we present the first century-scale record of skeletal densities in the coralline algae *Clathromorphum* sp. from the Bering Sea and the subarctic NW Atlantic. *Clathromorphum* forms annual growth increments in its massive calcitic skeleton and is known to have a lifespan of up to several centuries. Time series of skeletal density were generated at submonthly resolution using Micro Computer Tomography yielding a century-long time series of density variations in subarctic coralline algae from two ocean basins. Results indicate a decline in calcification since 1990 as well as positive departures from 1940-1990. These patterns give a first indication of the influence of rising atmospheric CO_2 on mid- and high-latitude shallow marine ecosystems. Furthermore, the similarity between the records from subarctic high-Mg coralline alga and the tropical corals is striking, and demonstrates not only the potential of coralline algae as archives of ocean acidification, but also the possible global-scale decline in calcification of some important marine biota.