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Century-scale variability of Coralline Algal Calcification Rates in the North Pacific and North Atlantic

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Ocean acidification may inhibit calcification pathways of marine plants and animals. Recently, it has been suggested that aragonitic tropical corals and other marine calcifiers already exhibit declining calcification rates. Greater oceanic CO_2 uptake at mid-to-high latitudes may result in greater inhibition of calcium carbonate secretion in subarctic organisms than in those at lower latitudes. Such inhibition may be particularly evident in the metabolically expensive high Mg-calcite skeletons of the shallow-water, habitat-forming coralline algae. It has been shown that biogenic high Mg-calcites exceed the solubility of aragonite at approximately 12 mol% $MgCO_3$. Here we present the first century-scale records of calcification rates in the coralline alga Clathromorphum sp. from the North Pacific/Bering Sea region and the subarctic NW Atlantic. Clathromorphum forms annual growth increments in its massive skeleton and is known to have a lifespan of up to several centuries. The seasonal $MgCO_3$ range in Clathromorphum from our subarctic collection sites fluctuates between 10-15 mol%. Century-long time series of calcification rates - the product of skeletal density and linear extension - were generated at submonthly resolution using Micro Computer Tomography. Results indicate that coralline algal calcification rates display multidecadal cycles that covary with regional climate indices such as the Pacific Decadal Oscillation. Unlike studies of other marine calcifiers, this study has not detected a significant decline in calcification rates during the past decades. This is likely attributable to Clathromorphum calcification being metabolically driven, with the organism maintaining significant physiological control over both placement and dissolution of carbonate. Most carbonate in Clathromorphum cells is deposited along an inner wall embedded in an organic matrix of very small, radially-placed high magnesium calcite crystals.