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High-resolution Mg/Ca ratios in crustose coralline red algae from the subarctic North Pacific – a record of past climate variability

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A long-lived crustose coralline red alga (*Clathromorphum nereostratum*) was collected in 1969 alive at Amchitka Island in the western Bering Sea/Aleutian Island region. Annual growth increment widths were determined by using state-of-the-art imaging techniques (reflected light microscope attached to an automated sampling stage/imaging system). Counting of annual growth increments revealed a total age of the specimen of 154 years (1969-1815), with individual growth increments reaching 300 μm average growth per year (ranging between 150 and 490 μm/year).

The specimen was sampled using electron microprobe analysis (EPMA) technique in order to reveal elemental (Mg/Ca) composition of the skeleton with high spatial resolution. We present here the first continuous high-resolution record of Mg/Ca variations within a *C. nereostratum* coralline red algae. The sampling transect spans 63 growth years (1969-1906) in high temporal resolution (15 measurements/year, electron beam spot size 3μm). Results show that Mg/Ca ratios in the high-Mg calcite skeleton display well-pronounced annual cycles (ranging between 0.084 and 0.215; 0.131 on average) and are highly correlated to local sea surface temperature (SST) on annual to decadal time scales (r = 0.41; annually averaged algal Mg/Ca values and

ERSSTs$_{Jun-Nov}$ (Extended Reconstructed Sea Surface Temperature); r = 0.81 for 5-year means), as well as to regional SST variability in the subarctic North Pacific, a region of high oceanographic importance. In addition, high spatial correlation of algal Mg/Ca to large-scale SST variations is observed, with the most prominent correlation pattern located near the coast of western Canada and Alaska, and along the Aleutian Island chain generally following the direction of the Alaska Current and the Alaskan Stream. This signature suggests that algal Mg/Ca ratios are useful for tracking major oceanographic features in this region. Thus, crustose coralline red algae represent a valuable tool that can be used to gain new insights into past climate variability of a region which presently is lacking long-term marine proxy archives.