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Geochemical perspectives on the sensitivity of coralline algae to environmental change

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Coralline algae are marine calcifiers and critical foundational species in the photic zone of higher latitude coastal regions, but also significantly contribute to carbonate production in coral reef structures. From a geochemical perspective they are significantly understudied compared to corals. Here we present some highlights of $\delta^{11}B$, trace element, organic C and N stable isotope data collected from a series of experiments on both articulate and encrusting species and species complexes from New Zealand. One experiment explores the influence of changing light levels on the geochemistry of four coralline algae complexes, finding no overall change in $\delta^{11}B$ but other geochemical results reflected significant differences in the carbon utilization between articulate and encrusting complexes. In a second experiment we performed a comparative analysis of the sensitivity to elevated pCO_2 in seven different species – finding a wide variation in $\delta^{11}B$ from 20-28‰ and complexes that showed no change with external acidification and those that showed high sensitivity. Some but not all these complexes also showed signs of compromised photophysiology and calcification under acidification. In a third experiment, we tested the individual and interactive effects of elevated pCO_2 and a combined low-light/high-temperature regime across four species. All species exhibited pronounced vulnerability, particularly in terms of calcification, although responses diverged with respect to driver dominance and interaction type. These differences appear to reflect species-specific capacities to balance increased energetic demands under constrained resource acquisition (i.e., low light) and to effectively allocate energy among competing processes, including carbon acquisition and regulation of carbonate chemistry at the site of calcification. Therefore, we find evidence for physiological diversity in coralline response to changing ocean pH and carbonate chemistry, as well as significant differences in geochemical proxy sensitivity between species and morphological groups of species.