Impacts of ocean acidification and iron enrichment on photosynthetic ability of diatoms in the Bering Sea as estimated from their *rbcL* gene expressions

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Rising atmospheric CO_2 concentration is leading to greater CO_2 uptake by the oceans, resulting in a concomitant decrease in seawater pH (i.e. ocean acidification). Although CO_2 is the primary substrate for algal photosynthesis, it is largely unknown whether or not ocean acidification can promote photosynthetic carbon fixation by marine phytoplankton in situ. In addition, climate change might increase iron supply to surface water from dust deposition (Woodward et al., 2005). To clarify the physiological responses of marine phytoplankton to CO_2 and iron enrichment, an on-deck CO_2-manipulated bottle incubation experiment was carried out in the Bering Sea during summer of 2009. Partial pressures of CO_2 in the air injected into the incubation bottles were set at 180, 380, 600, and 1000 μatm. Because the study area is known to be one of the HNLC (high nutrient, low chlorophyll-*a*), iron-added (5nM) and non-iron-added bottles were also prepared. HPLC pigment based estimates of biomass (CHEMTAX) indicated diatoms were predominant phytoplankton group in all CO_2 and iron treatments throughout the experiment. We examined changes over time in the transcript levels of *rbcL* gene, which encodes the large subunit of RubisCO, in diatoms with different CO_2 levels. As a result, *rbcL* gene transcription in diatoms decreased in response to CO_2 increment in the non-iron-added bottles on Day 3. In the iron-added bottles, a similar trend was also observed on Day 2, while the opposite pattern was found on Day 4. The *rbcL* gene transcript levels of diatoms were clearly regulated by iron availability. Previous studies (Corredor et al., 2004; John et al., 2007) showed that the transcript levels of diatoms *rbcL* gene correlated with maximum photosynthetic rates (P_{max}). Our results suggest that progression of ocean acidification and/or iron enrichment possibly regulate the *rbcL* gene transcript levels of diatoms, and those can affect the ability of CO_2 absorption in the study area.

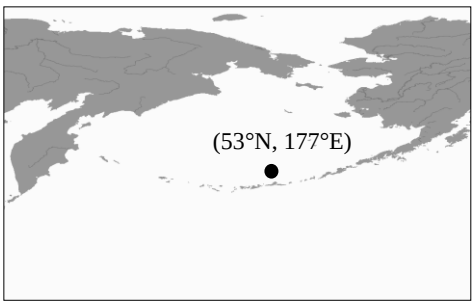

Figure 1. Sampling site of seawater for our incubation experiment.

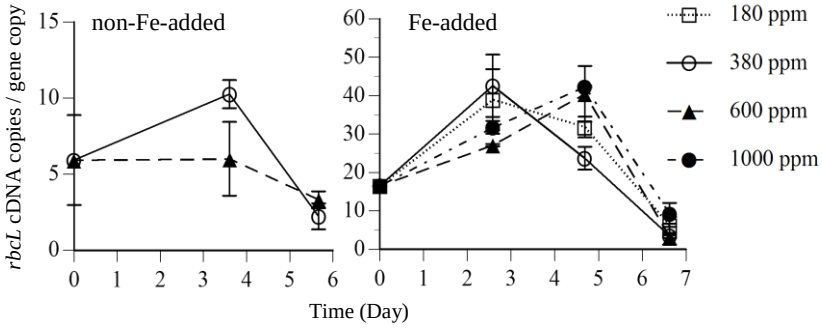

Figure 2. Time-course of *rbcL* transcription rates in non-Fe-added and Fe-added bottles with different CO_2. Error bars denote ± 1 SD (n = 3).

References

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