May 2014

Carbonate chemistry covariation with temperature and oxygen in the Salish Sea and California Current Ecosystems: implications for the design of ocean acidification experiments

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Reum, Jonathan; Alin, Simone; Bednarsek, Nina; Evans, Wiley; Feely, Richard; Hales, Burke; Mathis, Jeremy; McElhany, Paul; Jan Newton, Dr.; and Sabine, Christopher, "Carbonate chemistry covariation with temperature and oxygen in the Salish Sea and California Current Ecosystems: implications for the design of ocean acidification experiments" (2014). *Salish Sea Ecosystem Conference*. 41.


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Carbonate chemistry covariation with temperature and oxygen in the Salish Sea: implications for the design of ocean acidification experiments

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Ocean acidification experiments

Scenario IS92a

$\rho$CO$_2$ (µatm)

Year

Preind.

Today

2100

2000

1900

1800

1800

Today

Preind.
Ocean acidification experiments

body growth

280 PreInd
400 Today
800 Future

?
$\rho$CO$_2$ (µatm)

Temperature (°C)

OA treatment

control

?
How does pCO$_2$ change with temperature and oxygen?

What does covariation mean for OA experimental design and interpretation?
Reum et al. 2014. PLOS ONE
Vertical distribution

Depth (m)

Winter

Summer

Temperature (°C)
Vertical distribution

Depth (m)

- Nighttime
- Daytime
- Winter
- Summer

Temperature (°C)

8 10 12 14 16
Mooring
Puget Sound discrete
West coast discrete
Surface underway
Reum et al. In Review
pCO2 data
OA experiments

Reum et al. In Review
$pCO_2$ (\(\mu\)atm)

Temperature (°C)

- Negative response
- Positive response
- Non-significant
- Control

Reum et al. In Review
The diagram illustrates the relationship between temperature and $pCO_2$ (μatm) for both OA treatment and control groups.

- **OA treatment** shows a significant variation in both temperature and $pCO_2$ levels.
- **Control** maintains relatively stable conditions across the range of temperatures and $pCO_2$ values.

The diagram highlights the potential impacts of OA treatment on environmental conditions compared to the control group.
Equilibration with air CO₂ at formation

\[ \text{DIC}_{\text{Air}} - 800 \mu\text{atm} - \text{DIC}_{\text{formation}} = \Delta\text{DIC} \]

\[ \Delta\text{DIC} + \text{DIC}_{\text{Respiration + formation}} \]

Puget Sound

Upwelling
$\Delta$DIC = 90 $\text{umol kg}^{-1}$
Direct Effects

$\uparrow \text{CO}_2$

Upwelled/deep
- Low Oxygen
- Low Temp
- High pCO$_2$

Oceanic/shallow
- High Oxygen
- High Temp
- Low pCO$_2$

Carbonate chemistry niche
Acknowledgements

**Funding sources:**
- National Research Council Fellowship
- NOAA Ocean Acidification Program and NOAA Pacific
- Marine Environmental Laboratory
- University of Washington, including the PRISM program
Washington State Department of Ecology

**Field and laboratory support:**
The officers and crew of the R/V Thomas G. Thompson, Cynthia Peacock, Geoff Lebon, Cathy Cosca, Corinne Bassin, Jill Coyle, Dana Greeley, Julia Bos, Kathy Krogslund, Amanda Gray, Megan Black, Sylvia Musielewicz, and Jennifer Nomura for their shipboard, laboratory, and graphics support of this research effort.