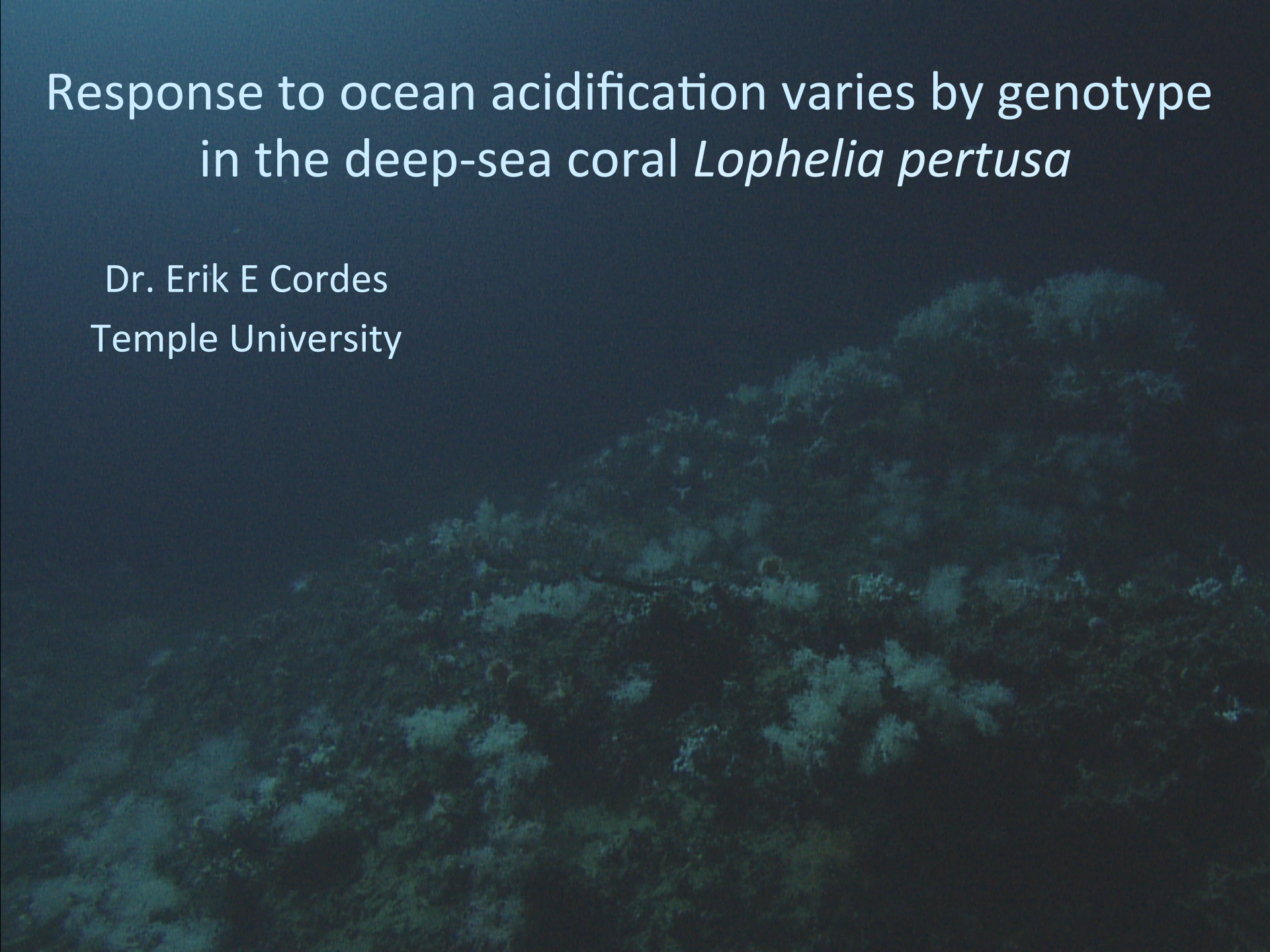
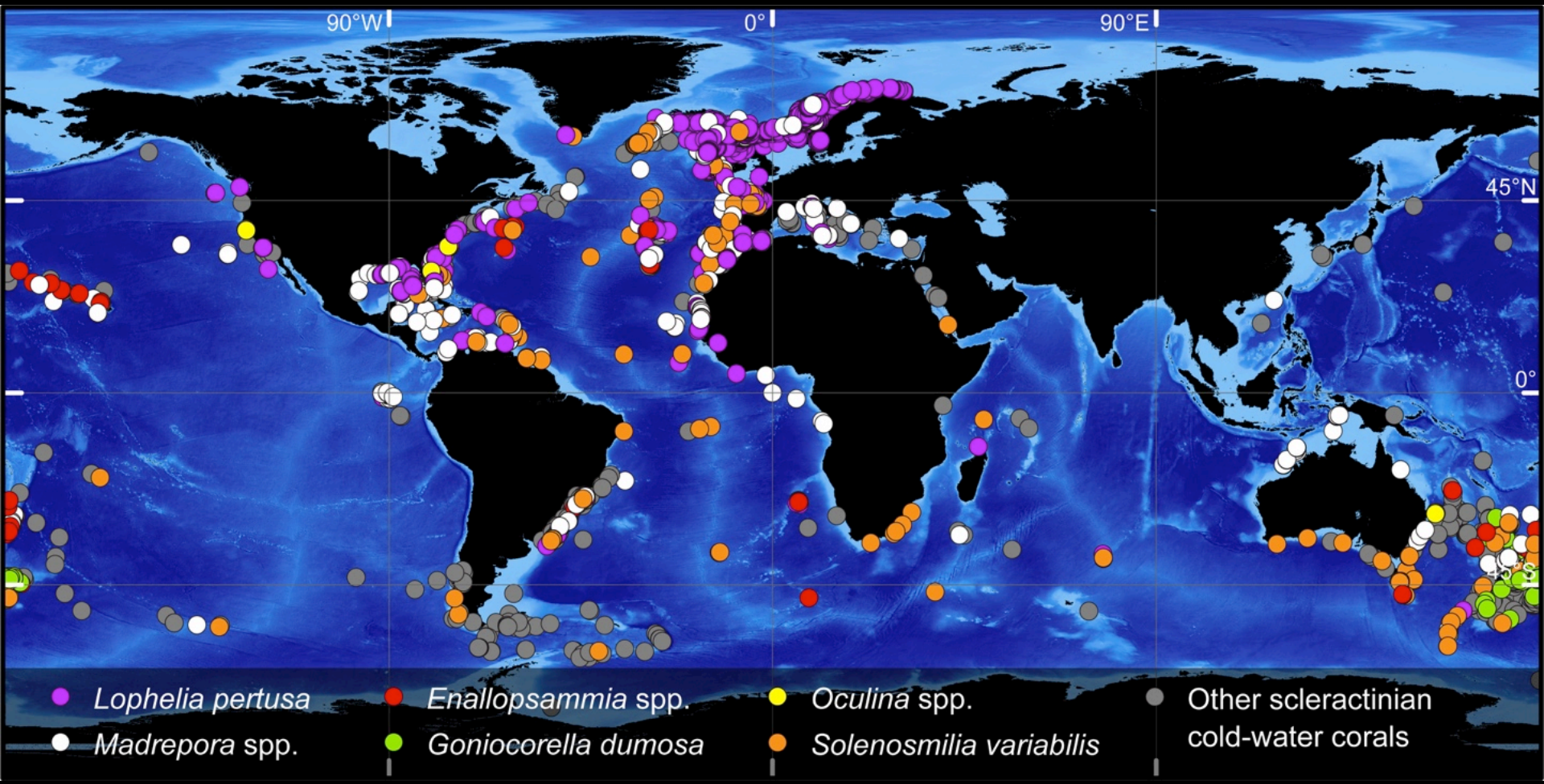
Response to ocean acidification varies by genotype in the deep-sea coral *Lophelia pertusa*

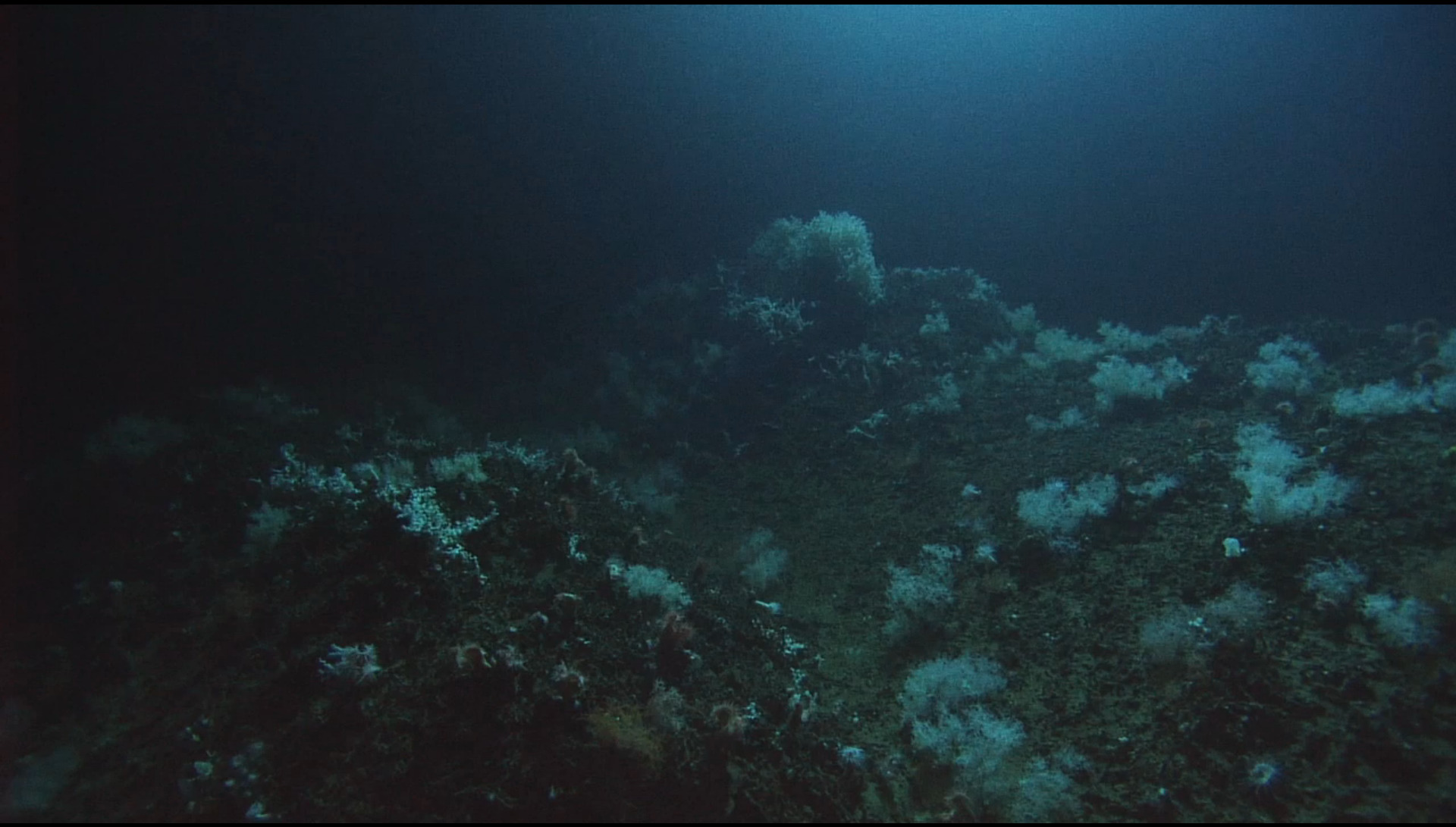
Dr. Erik E Cordes

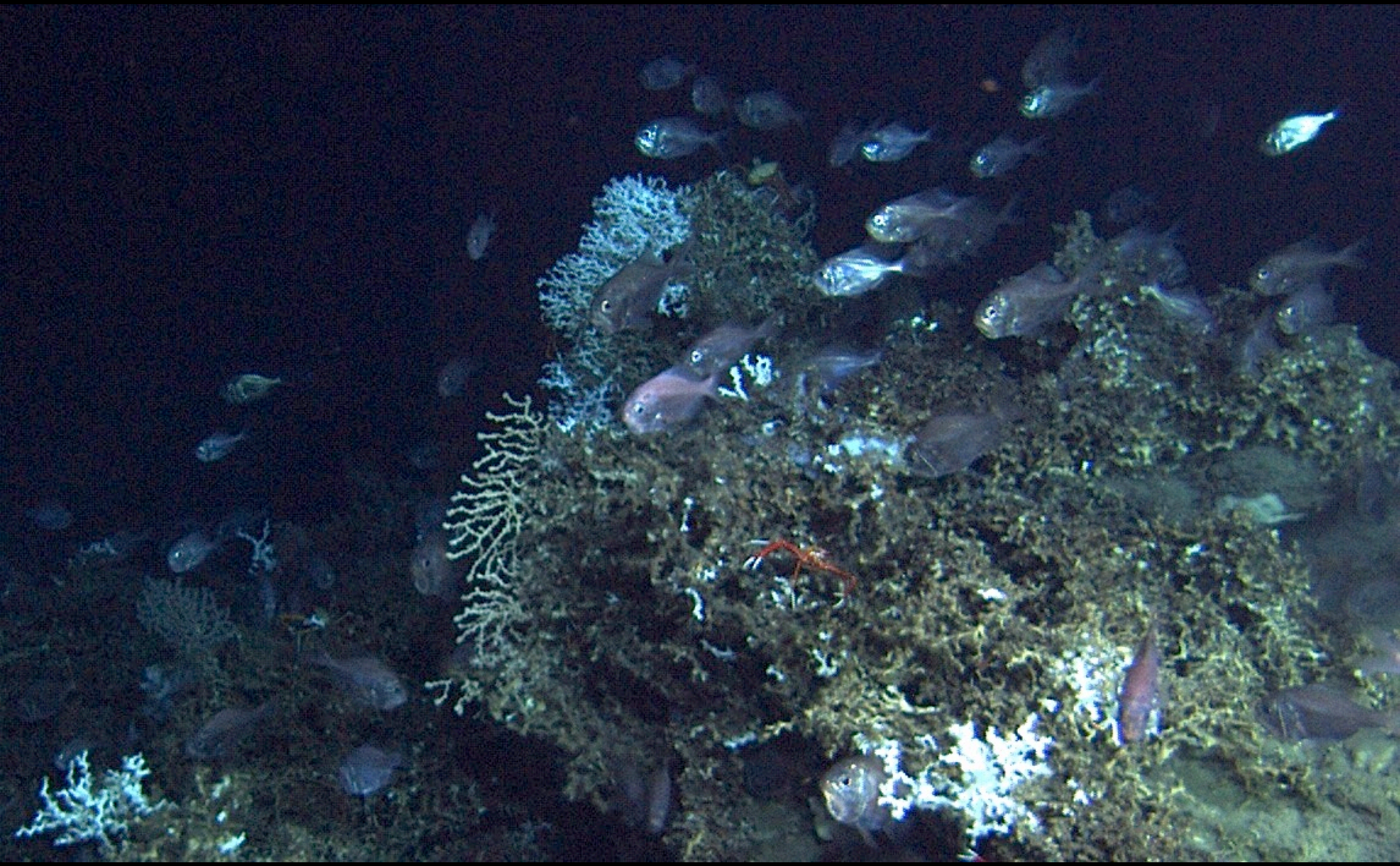
Temple University





Cordes et al. in press, UNWOA (updated from Freiwald et al. 2005, UNEP)

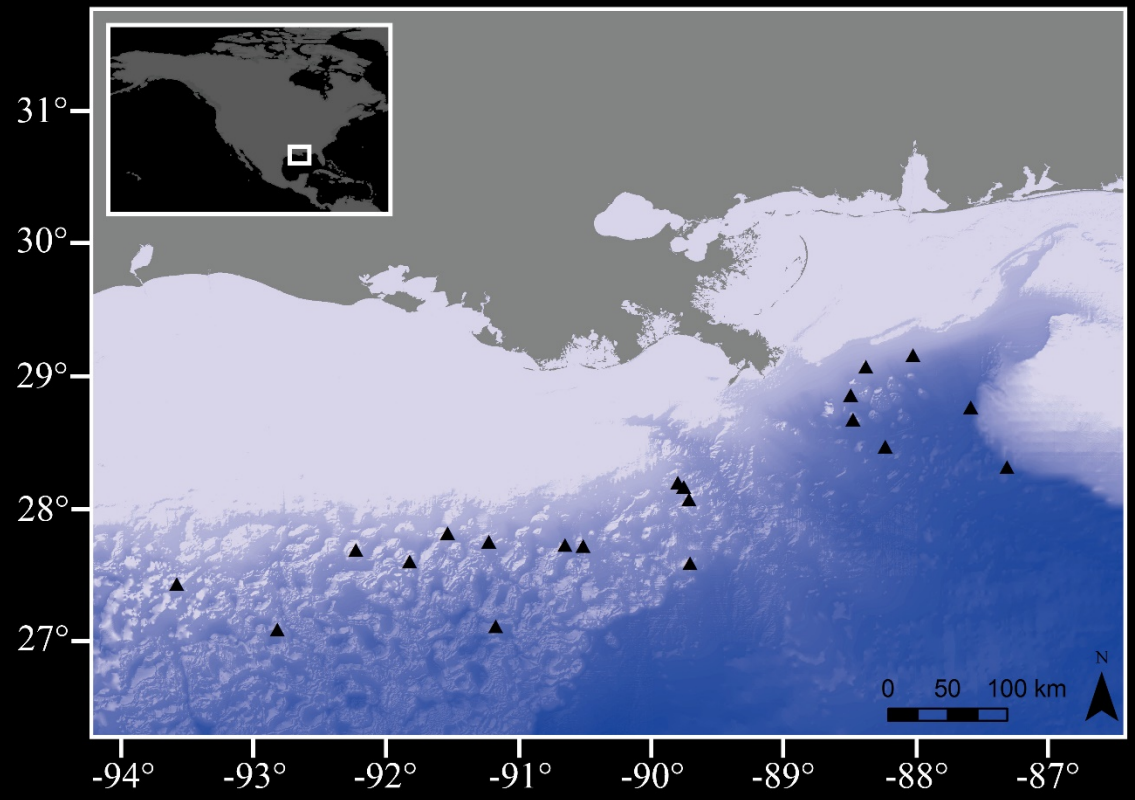


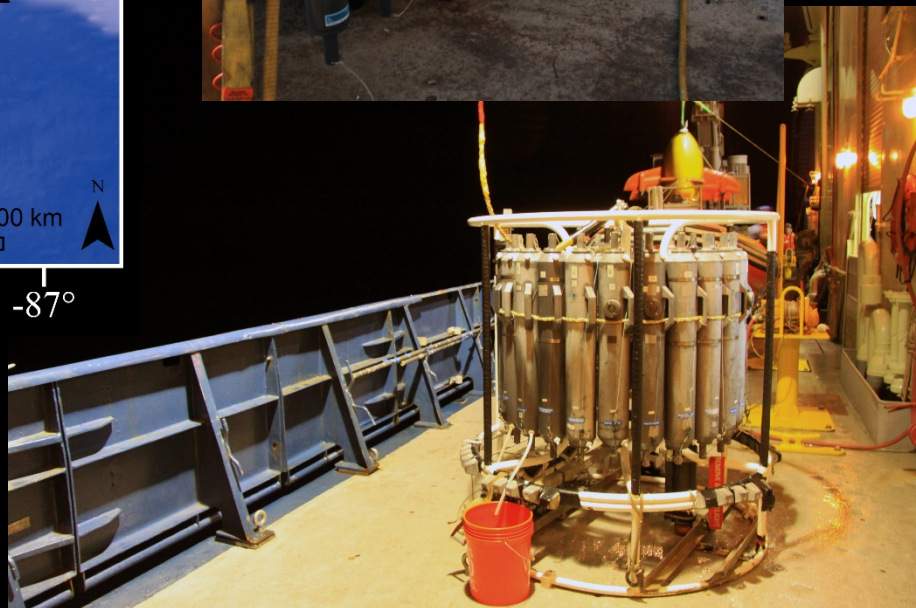


22 sampling stations

Depth range: 2–2500 m

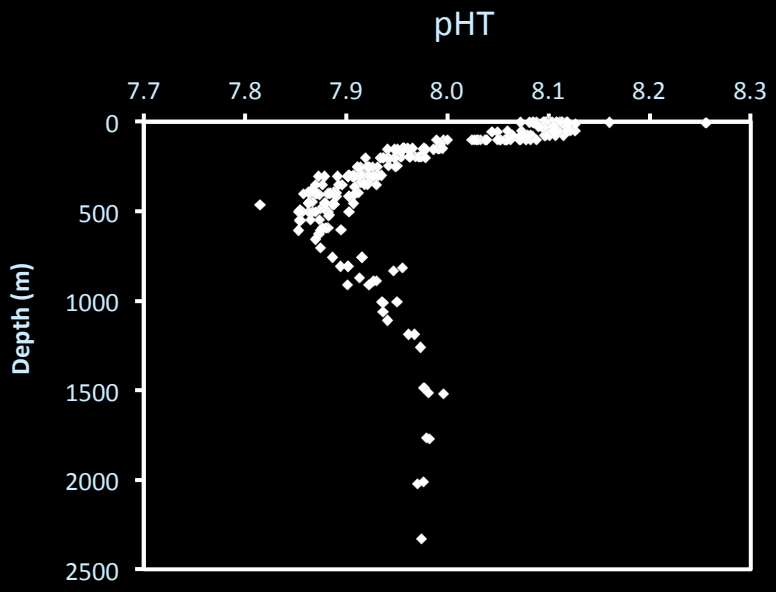
2010–2014 (Spring – Fall)

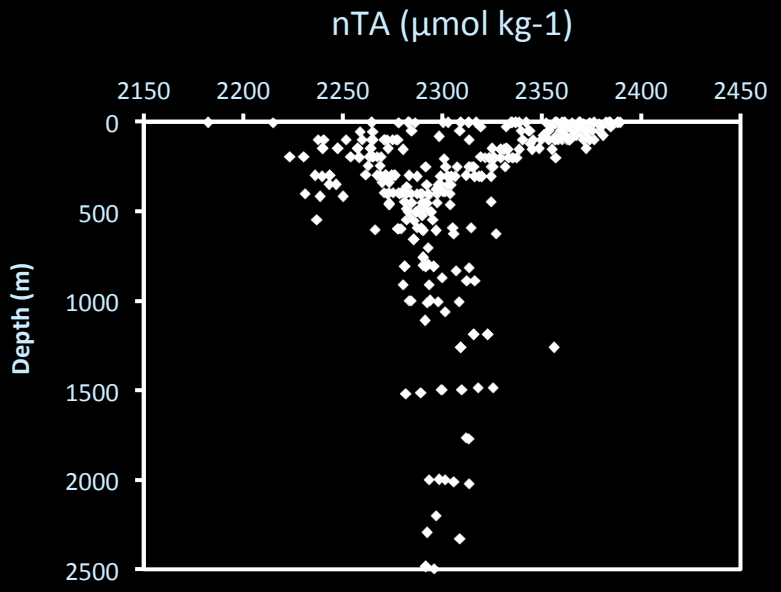


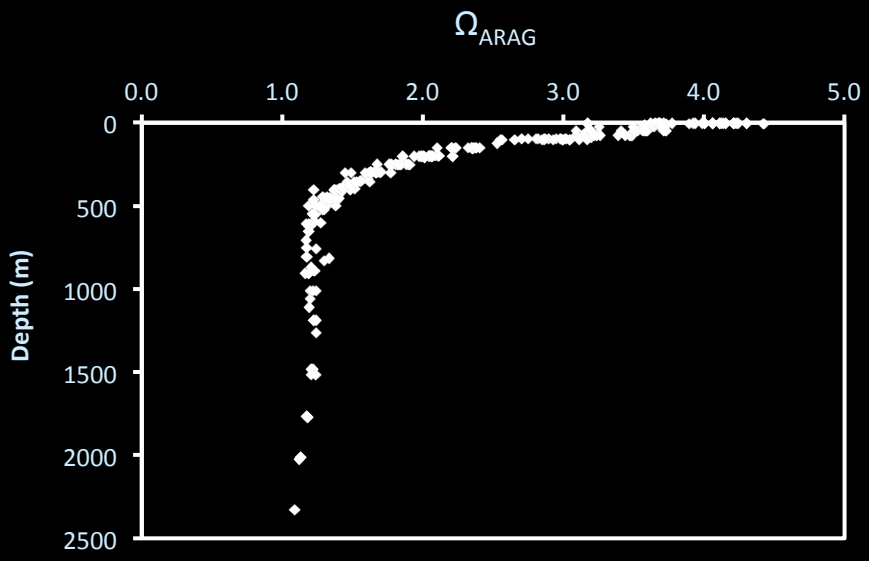


Lunden et al. 2013, L&O; Georgian et al., in prep

CTD data providing the first estimates of Ω_{ar} at depth in the Gulf of Mexico

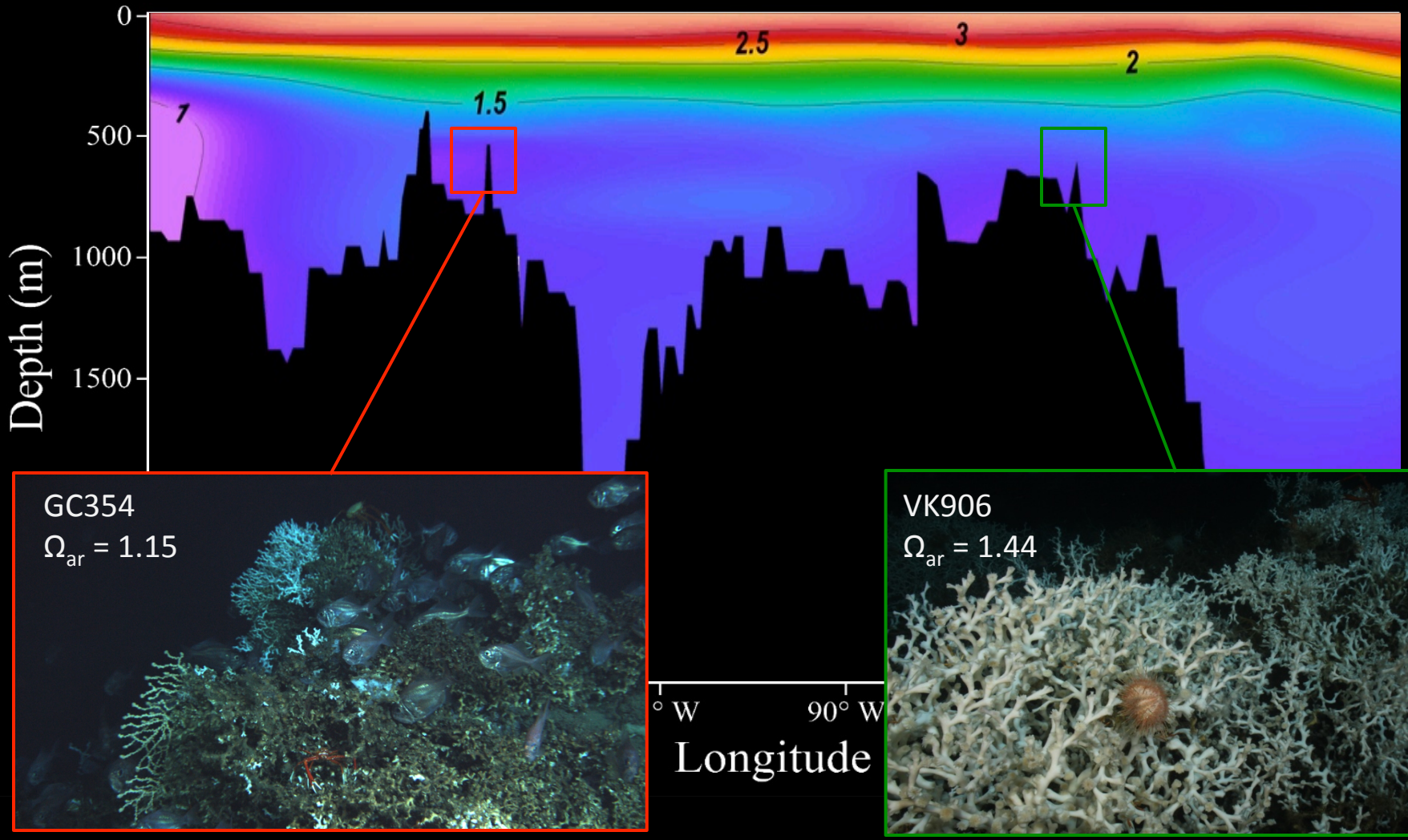






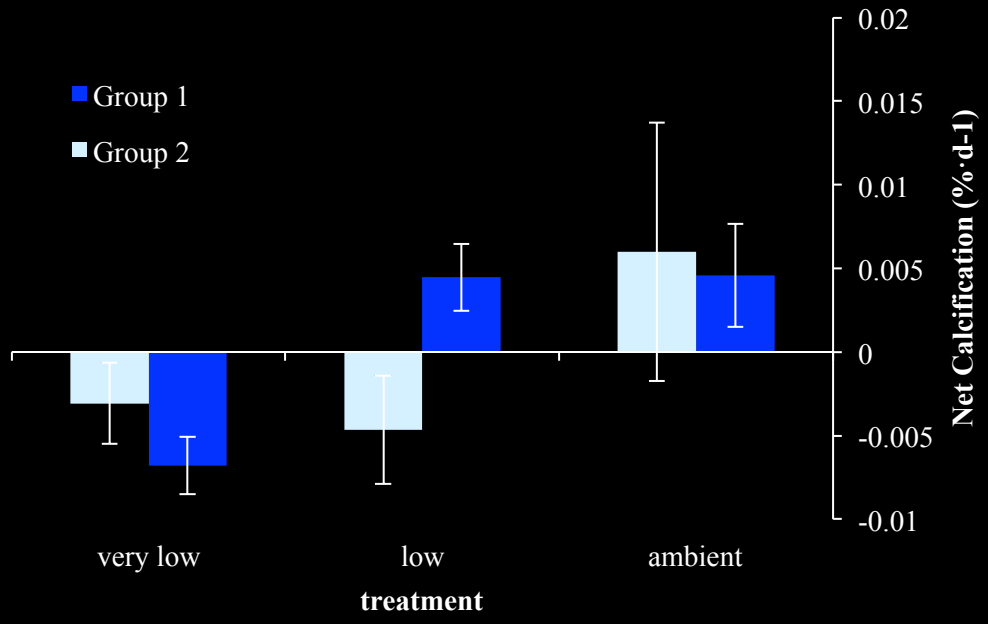
Lunden et al. 2013, L&O; Georgian et al., in prep

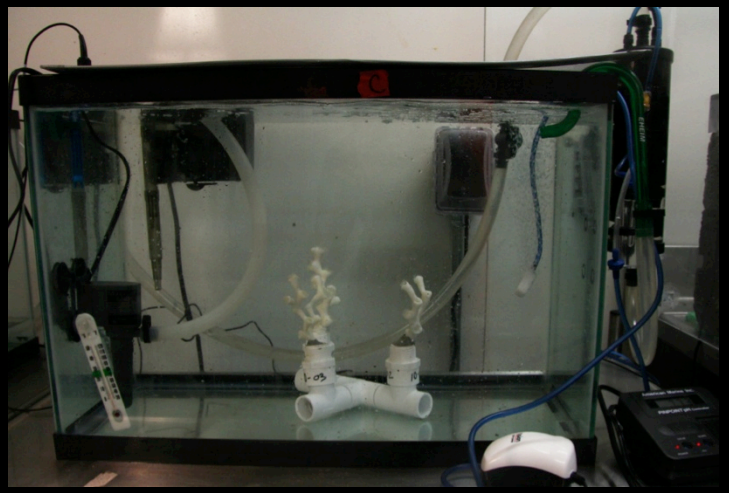
Low Ω_{ar} at deep-water reefs

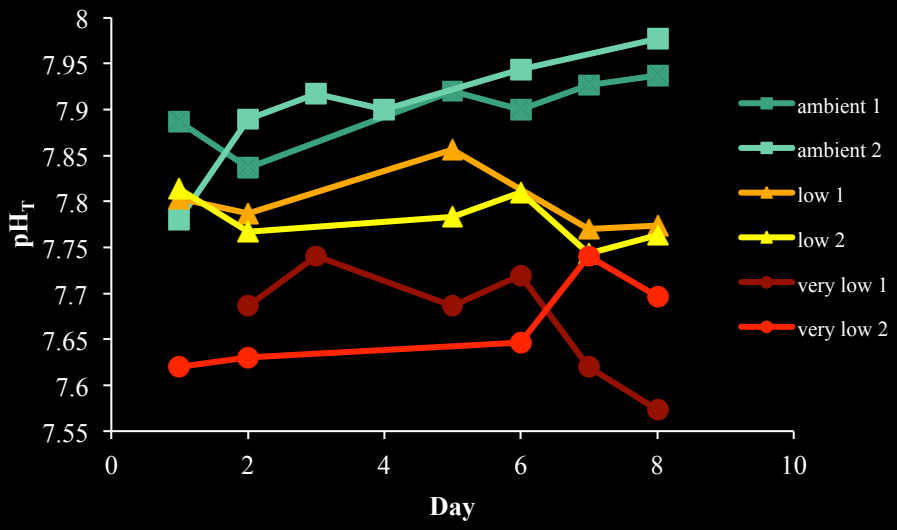


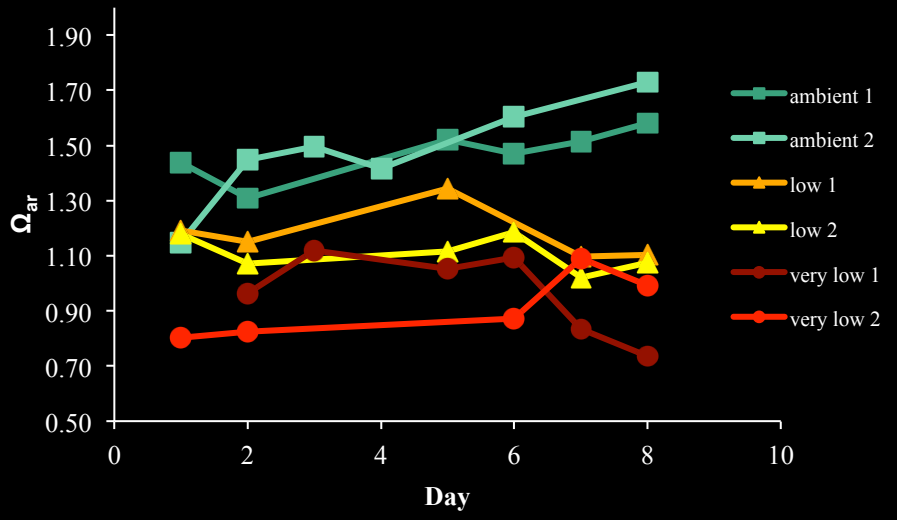
Lunden et al. 2013, L&O; Georgian et al., in prep

Short-term decline in growth in response to low pH and Ω_{ar} treatments





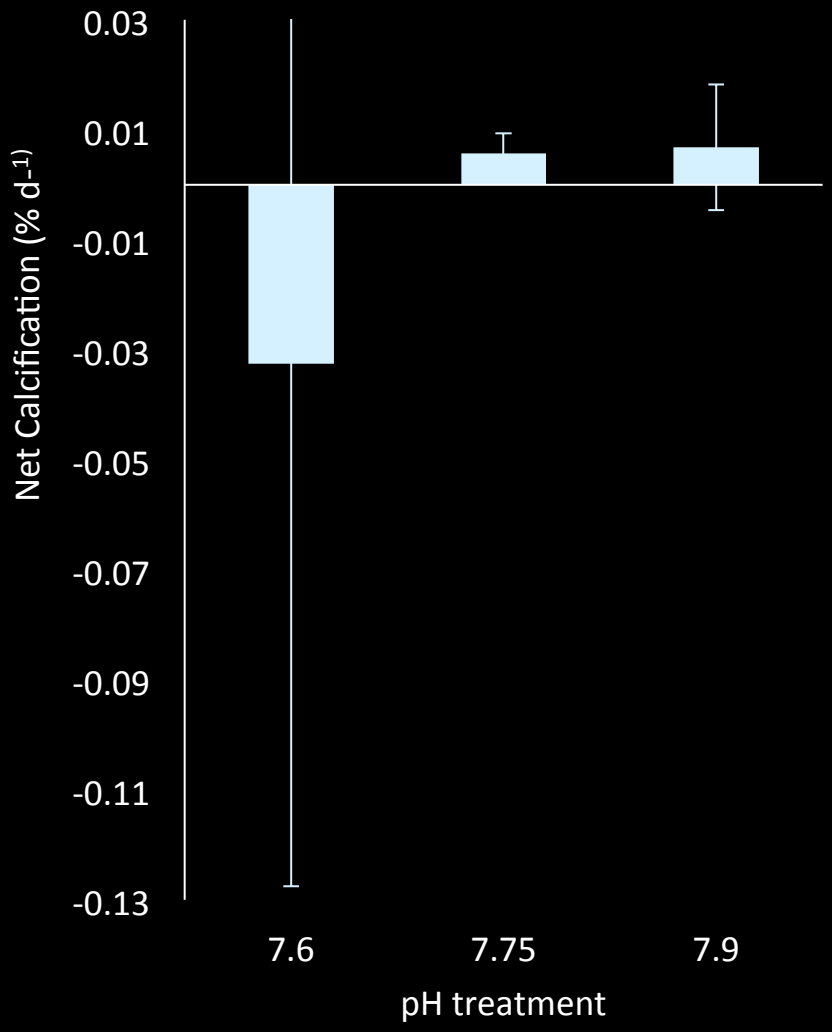




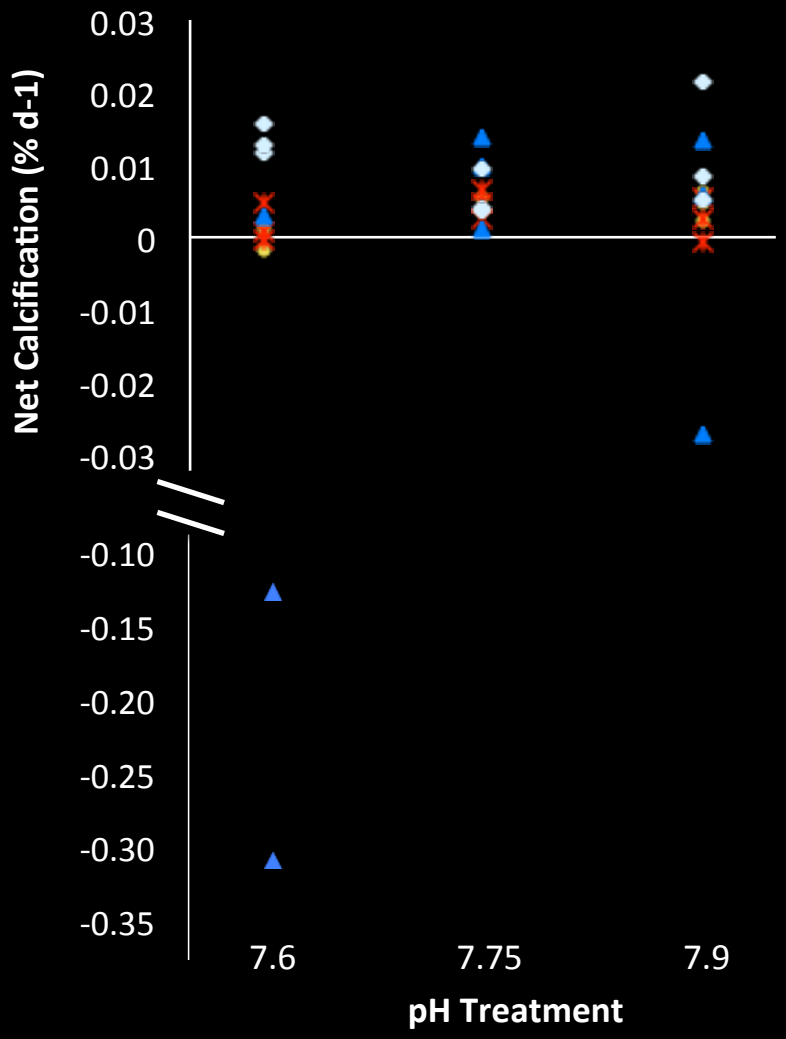
Lunden et al. 2014, Frontiers Mar Sci

Variable response by genotype in short term experiments

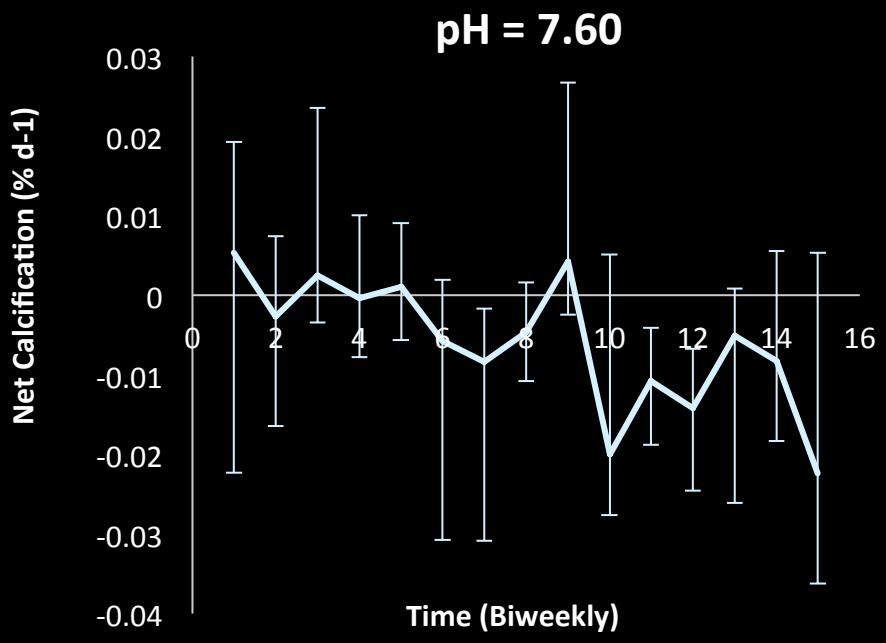
Average response to pH

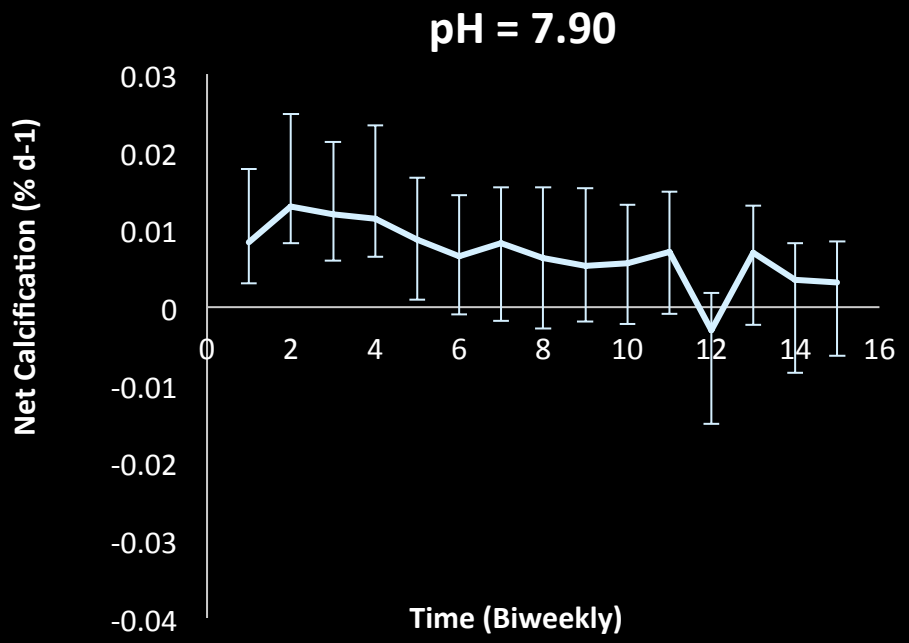


Genotype-specific response to pH

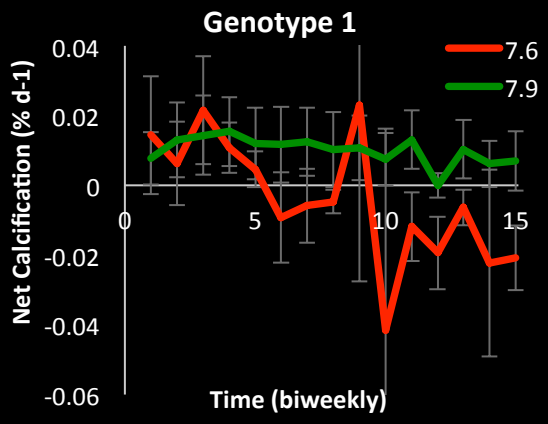


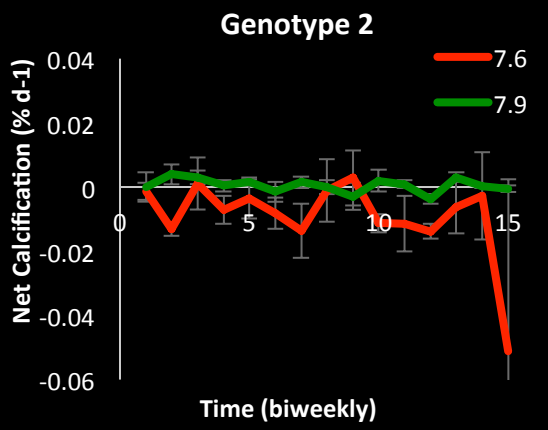
Long-term decline in growth in response to low pH and Ω_{ar} treatments

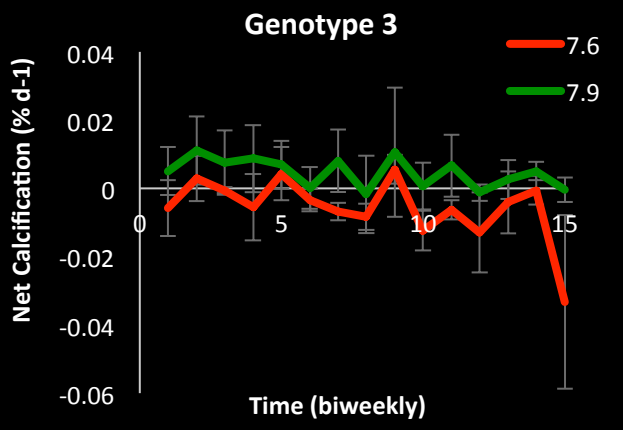


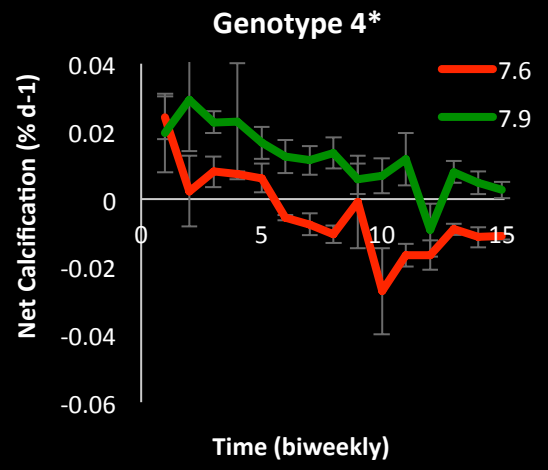


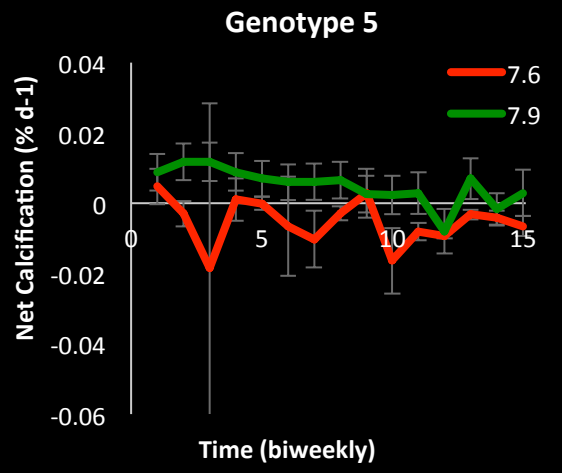
Variable response by genotype in long term experiments

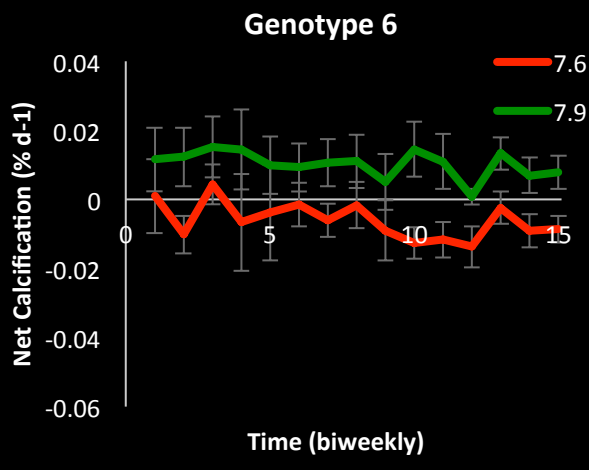




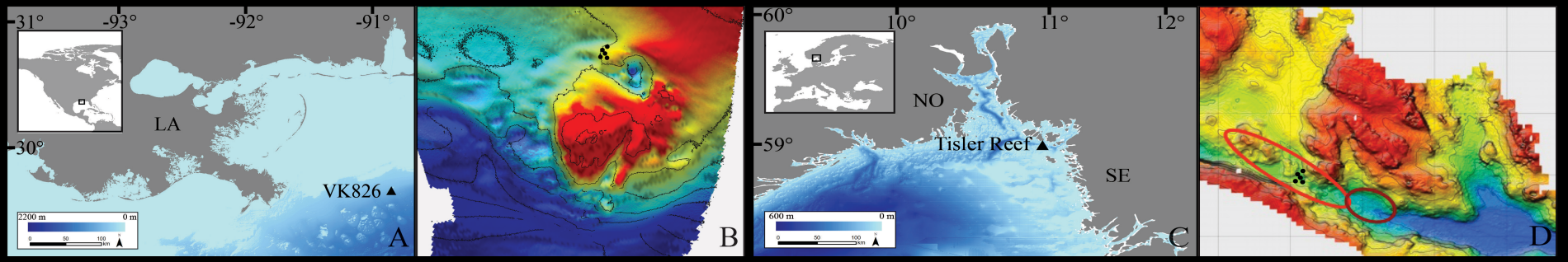


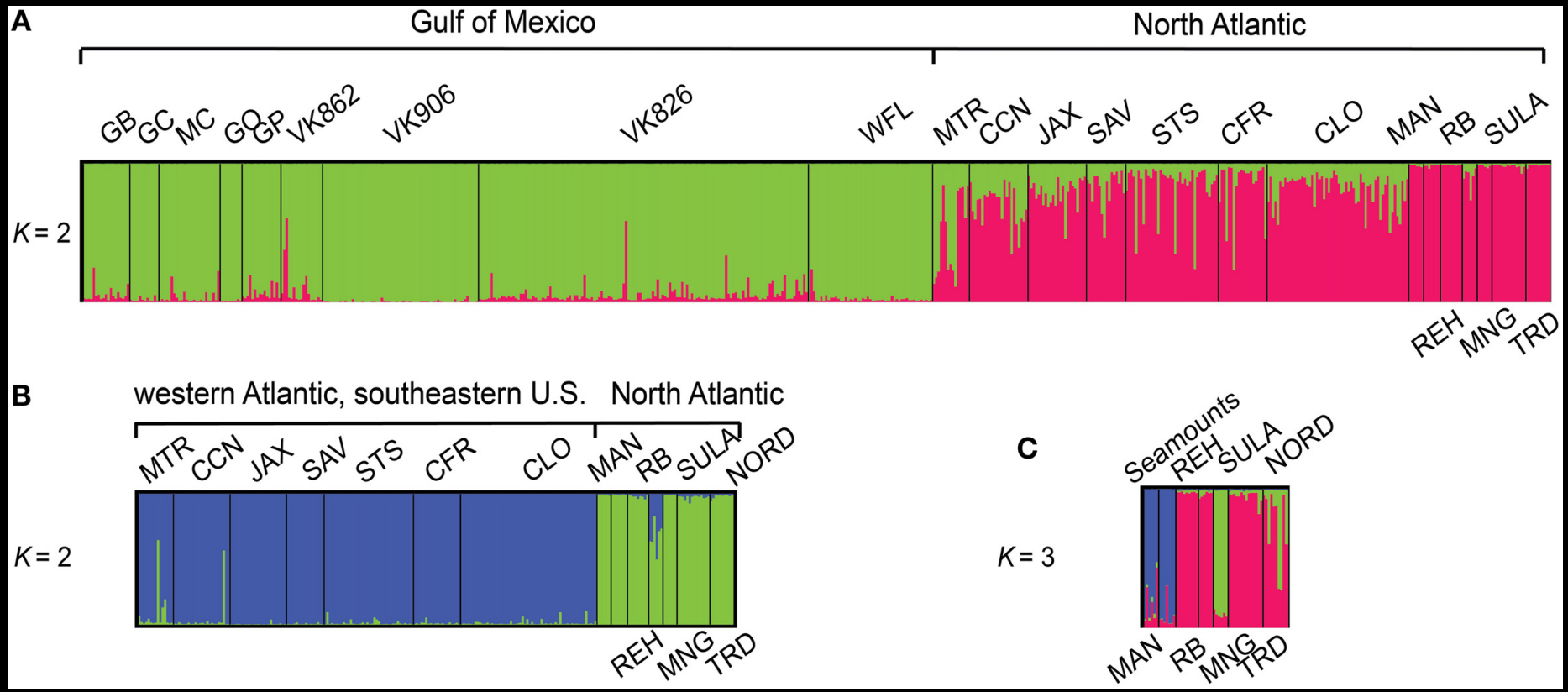






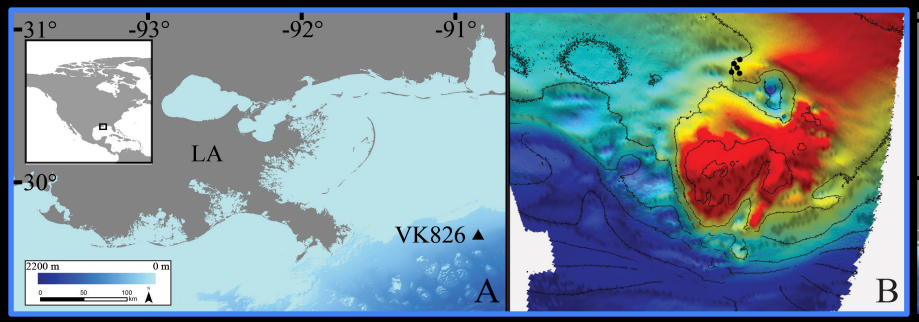
Variable response by population: genetic isolation

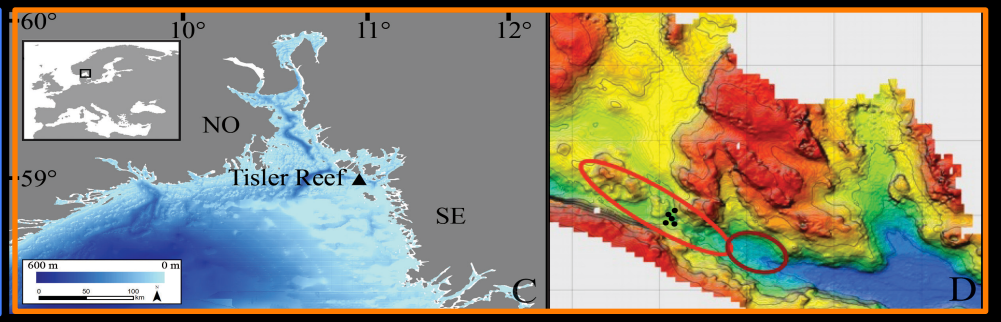


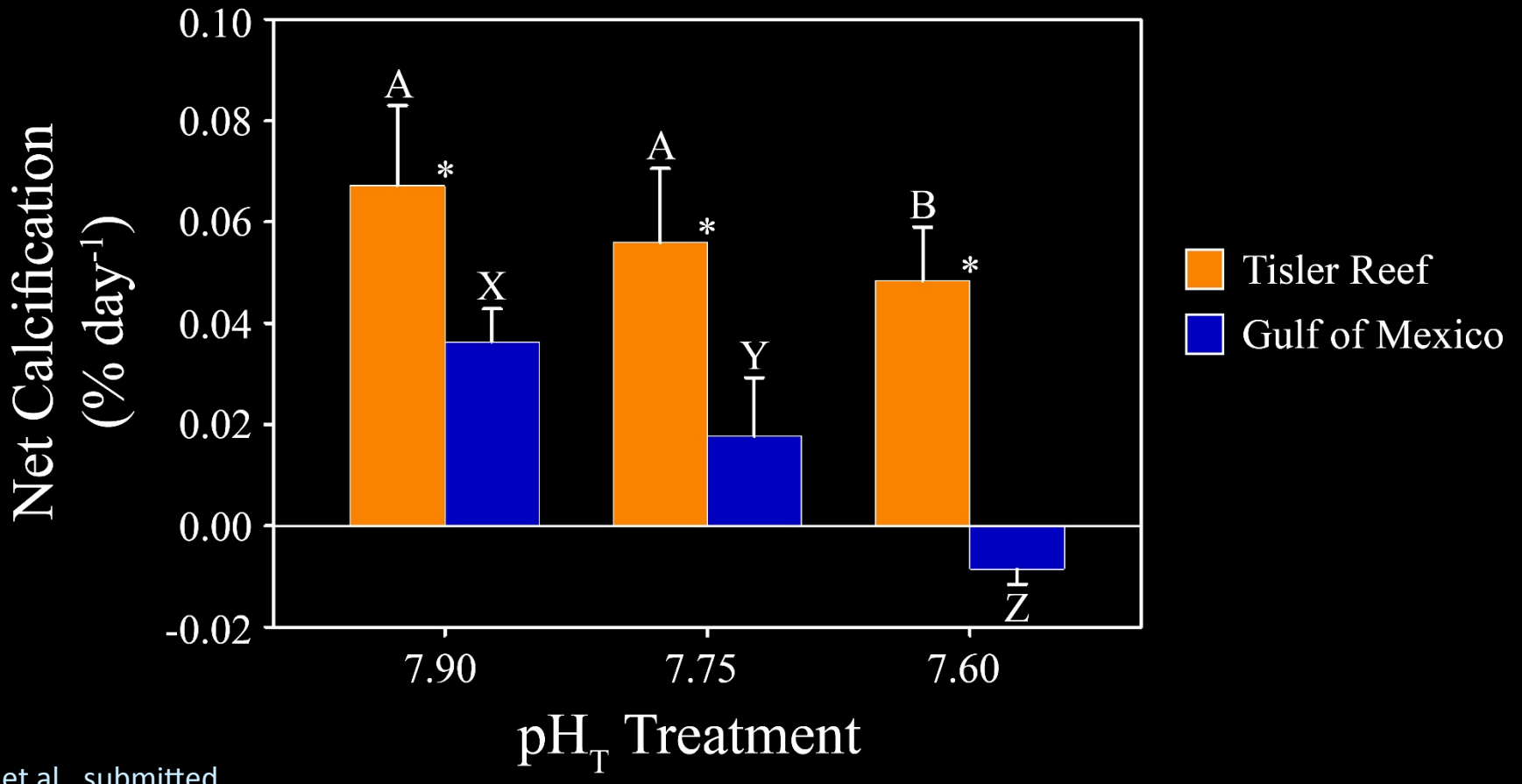


Lunden et al. 2014, Frontiers Mar Sci

Variable response by population: growth rate

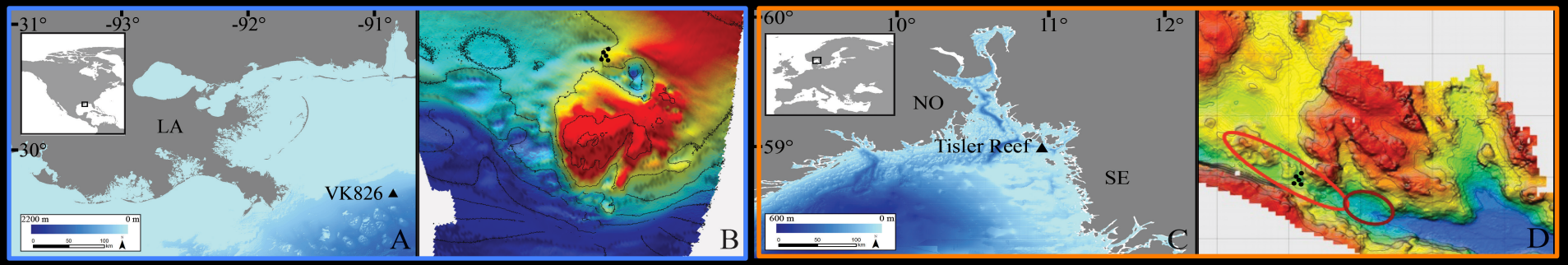


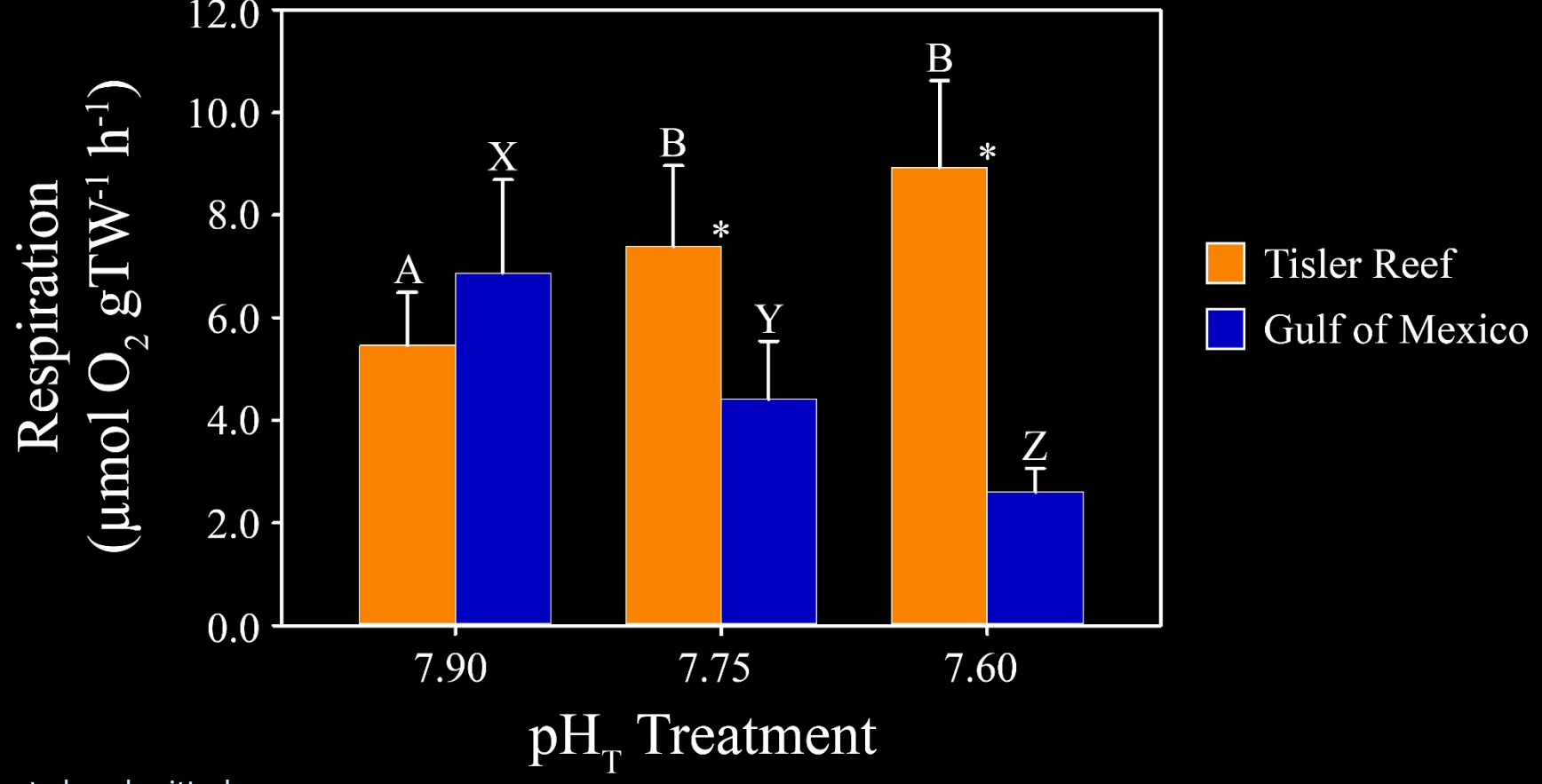




Georgian et al., submitted

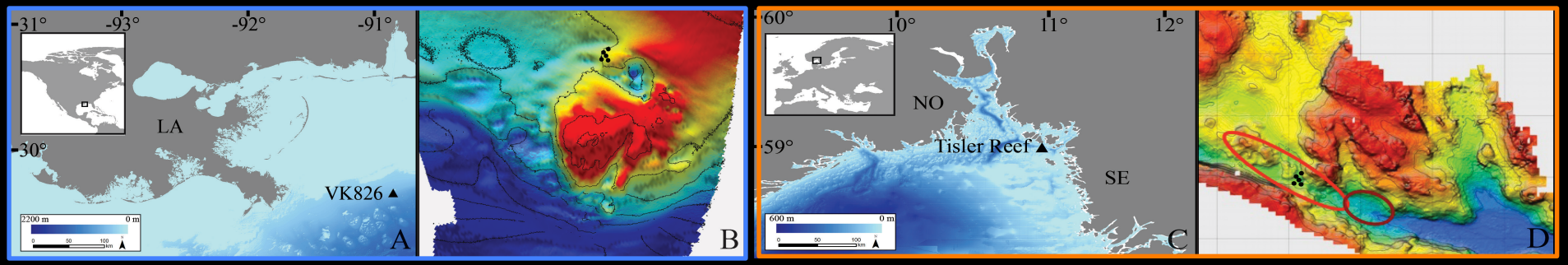
Variable response by population: respiration rate

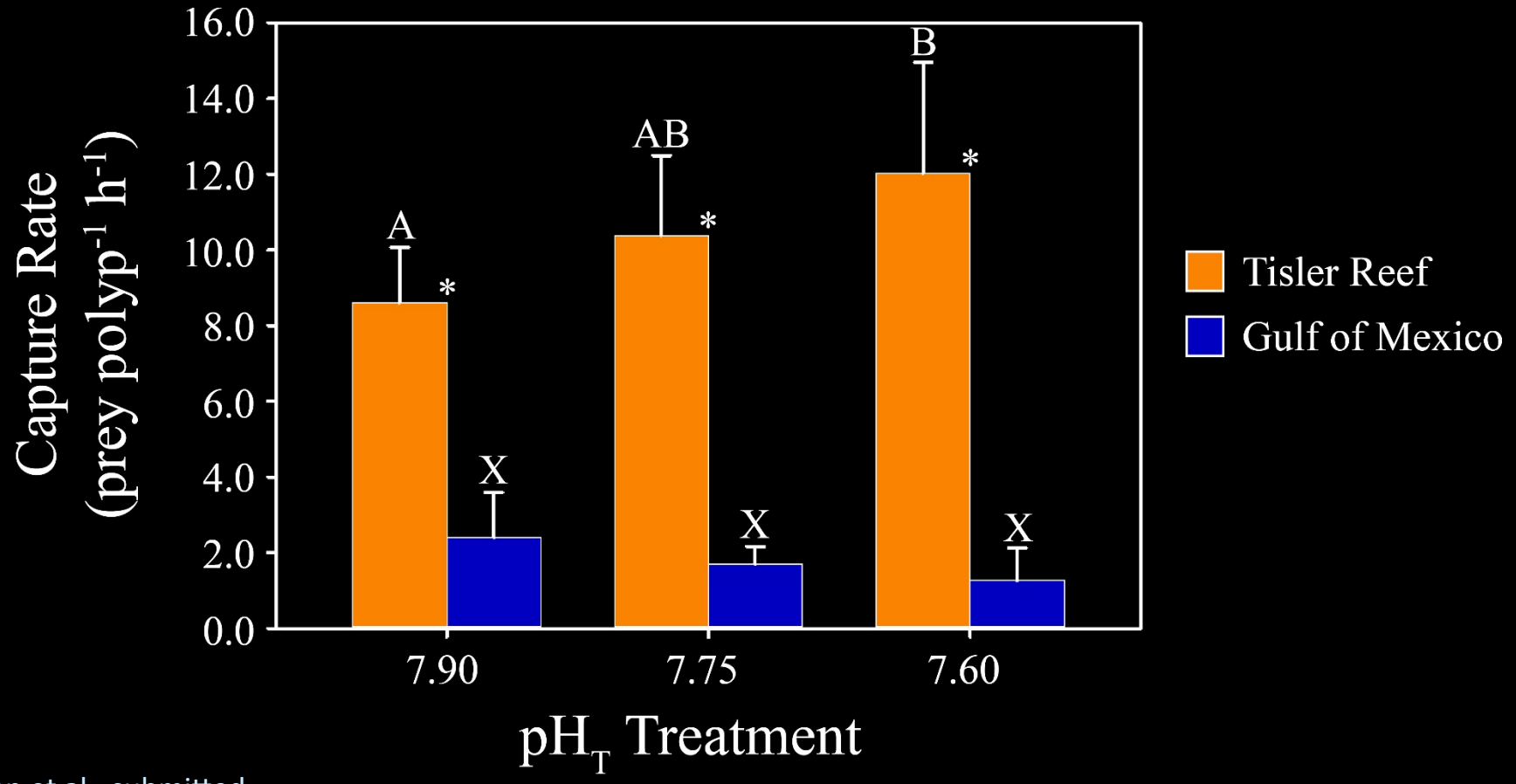




Georgian et al., submitted

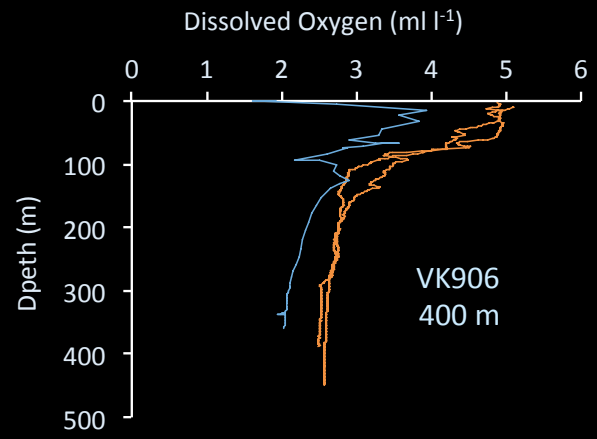
Variable response by population: feeding rate

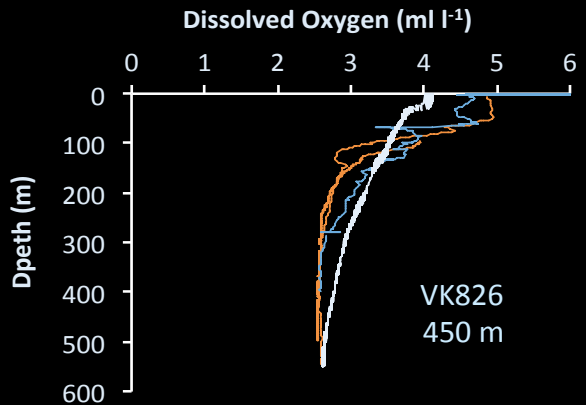


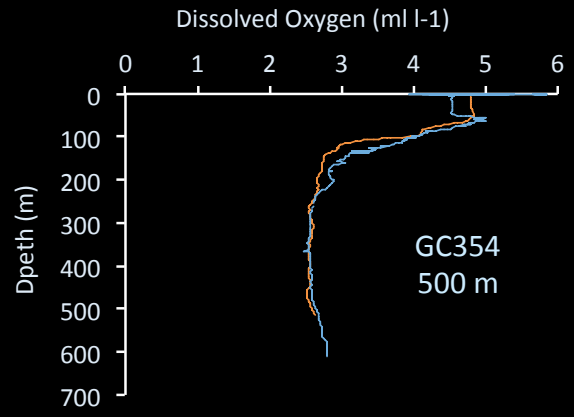


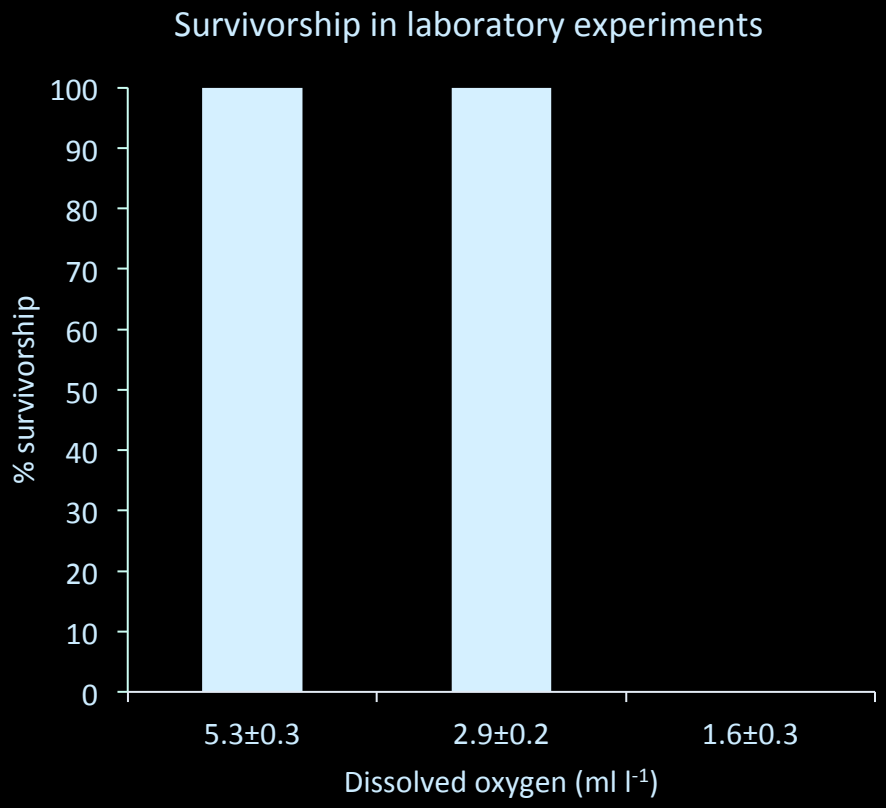
Georgian et al., submitted

Gulf of Mexico *Lophelia* occurs close to lower bounds of dissolved oxygen tolerance

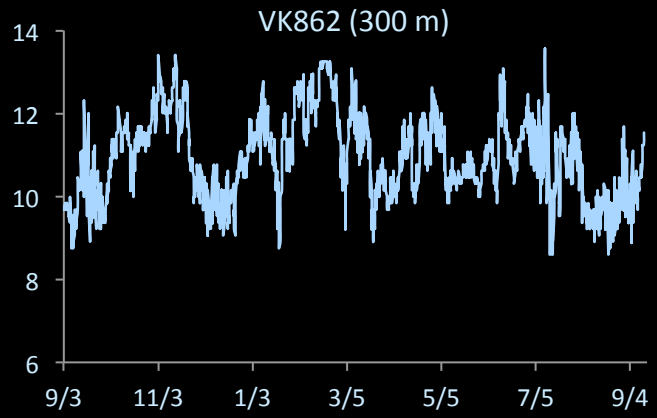


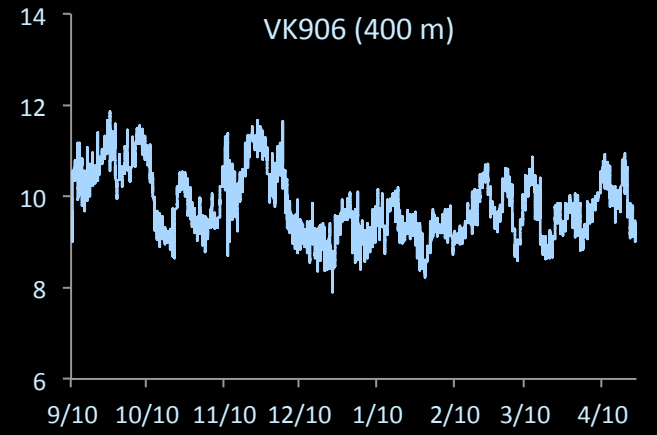


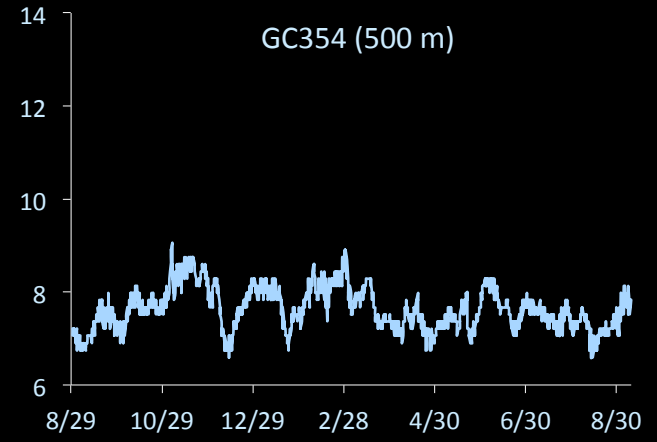




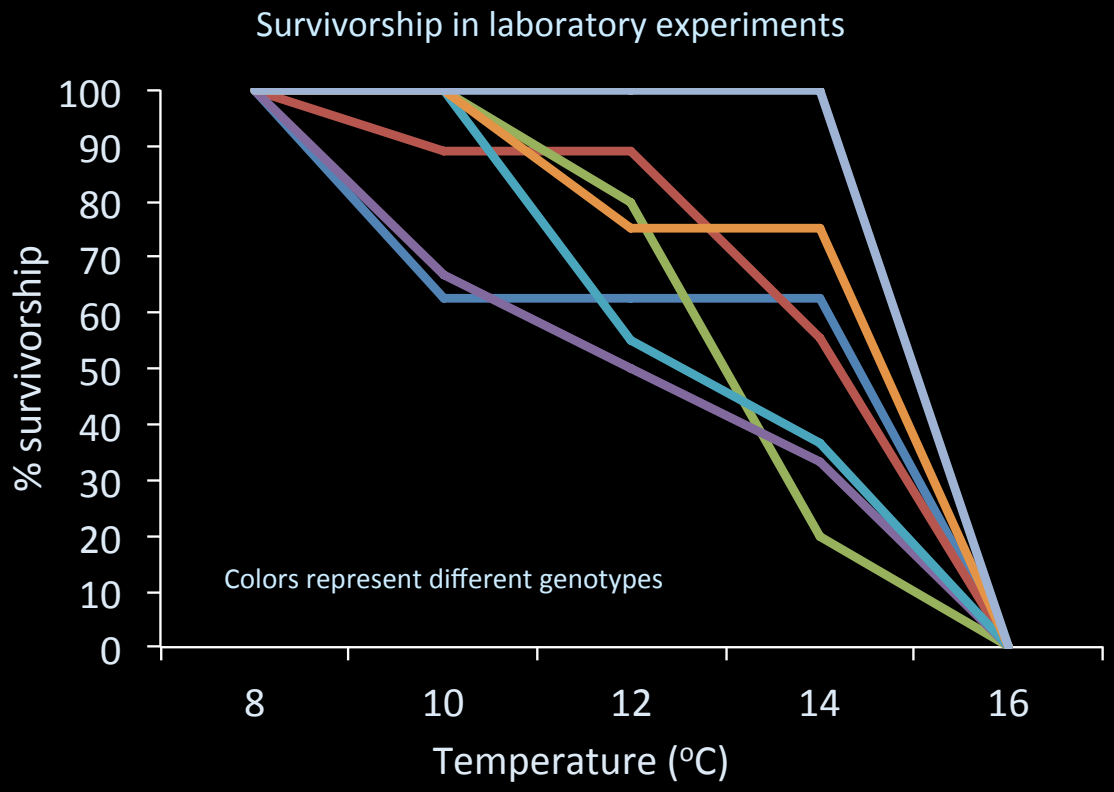
Lunden et al. 2014, Frontiers Mar Sci







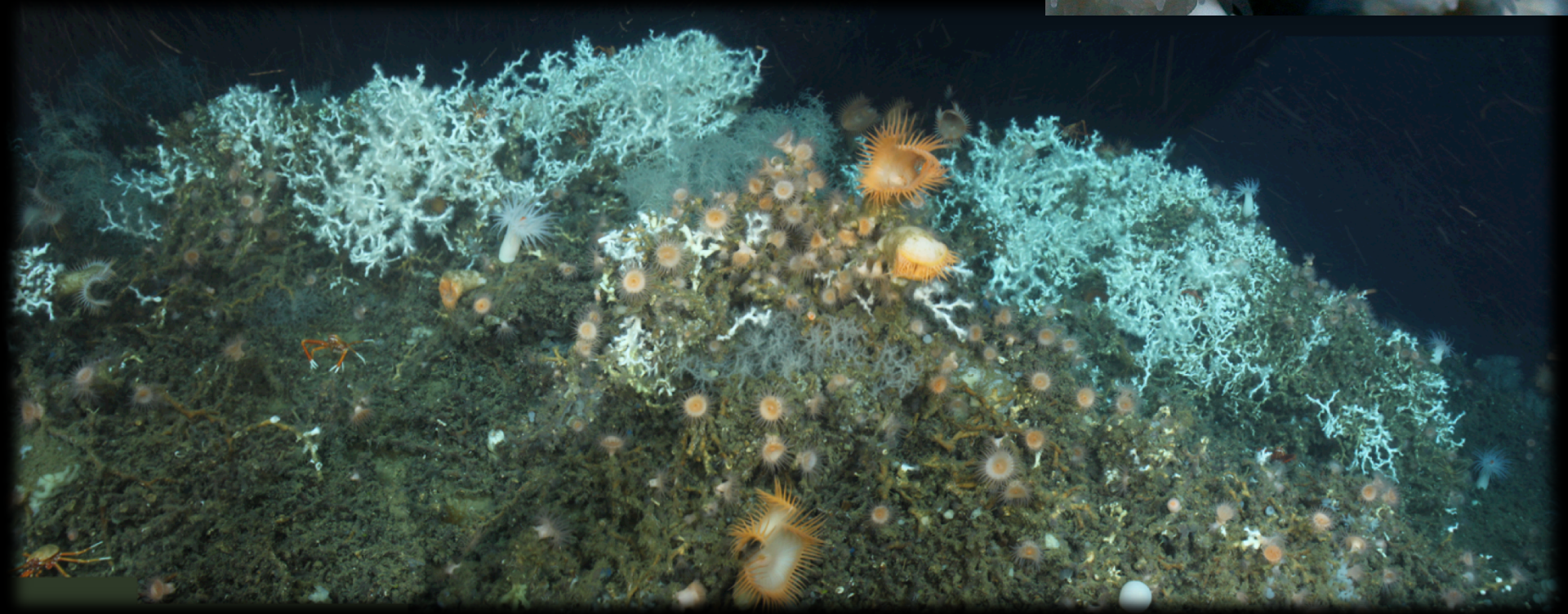
Gulf of Mexico *Lophelia* occurs close to upper bounds of temperature tolerance



Lunden et al. 2014, Frontiers Mar Sci

The complex response of *Lophelia* to ocean change

- Low saturation states near deep reefs
- Growth occurs above $\Omega_{ar} = 1$ in lab experiments
- Variability in response
  - some genotypes can calcify at $\Omega_{ar} < 1$
  - different physiological strategies in populations
- Gulf of Mexico populations may be more sensitive due to
  - multiple stressors in natural environment



Thanks to my lab for the data: Sam Georgian, Carlos Gomez, Melissa Kurman, Jay Lunden, Conall McNicholl, Chris Sears, Jeff Turner
Thanks for sampling gear: Ian MacDonald, Reuben Mills, Bruce Strickrott
The rest of the scientists, crew, and pilots on the cruises with the
Atlantis / Alvin and Sentry
Falkor / Global Explorer
Nautilus / Hercules and Argus
Ron Brown / Jason II

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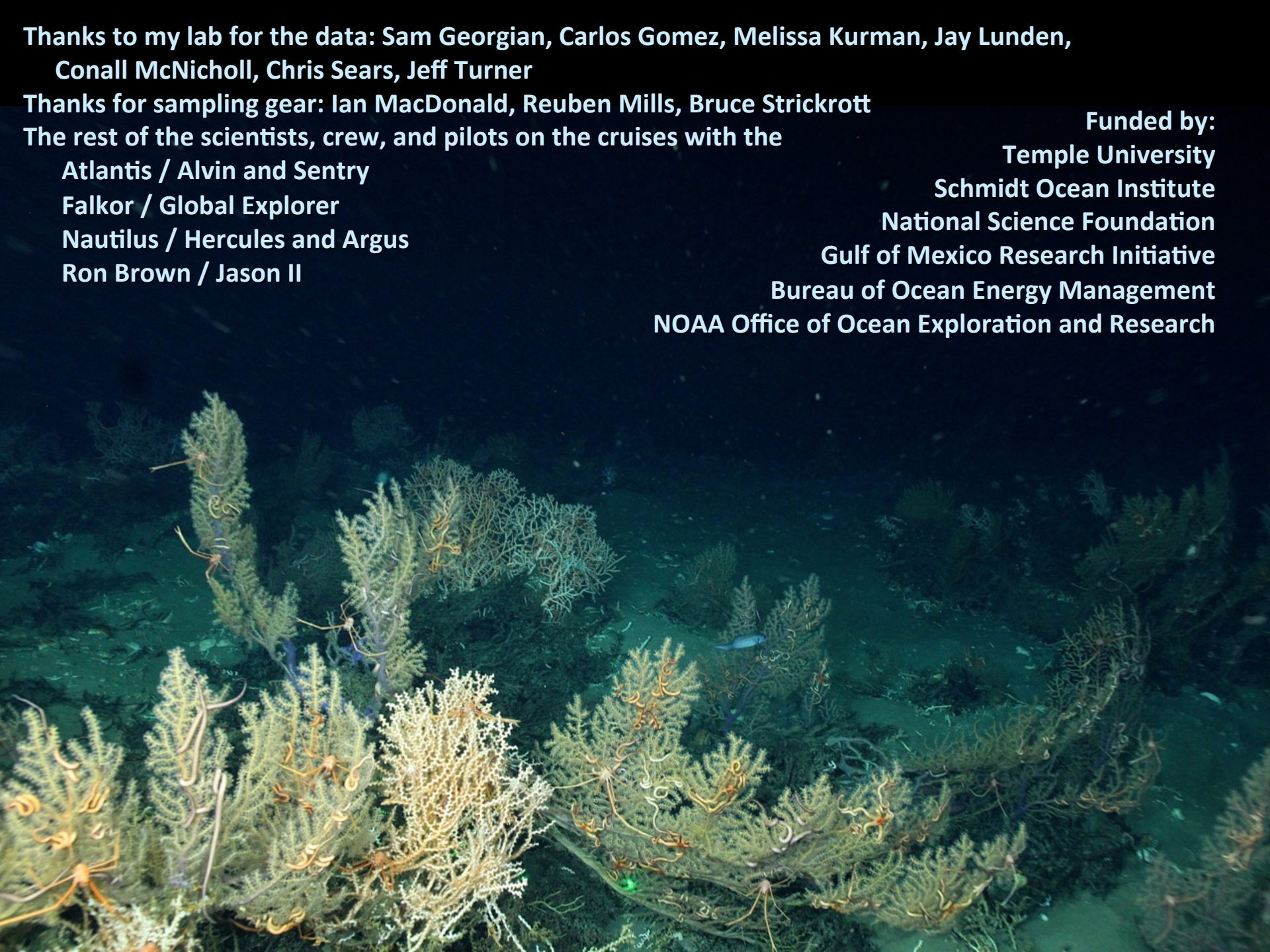
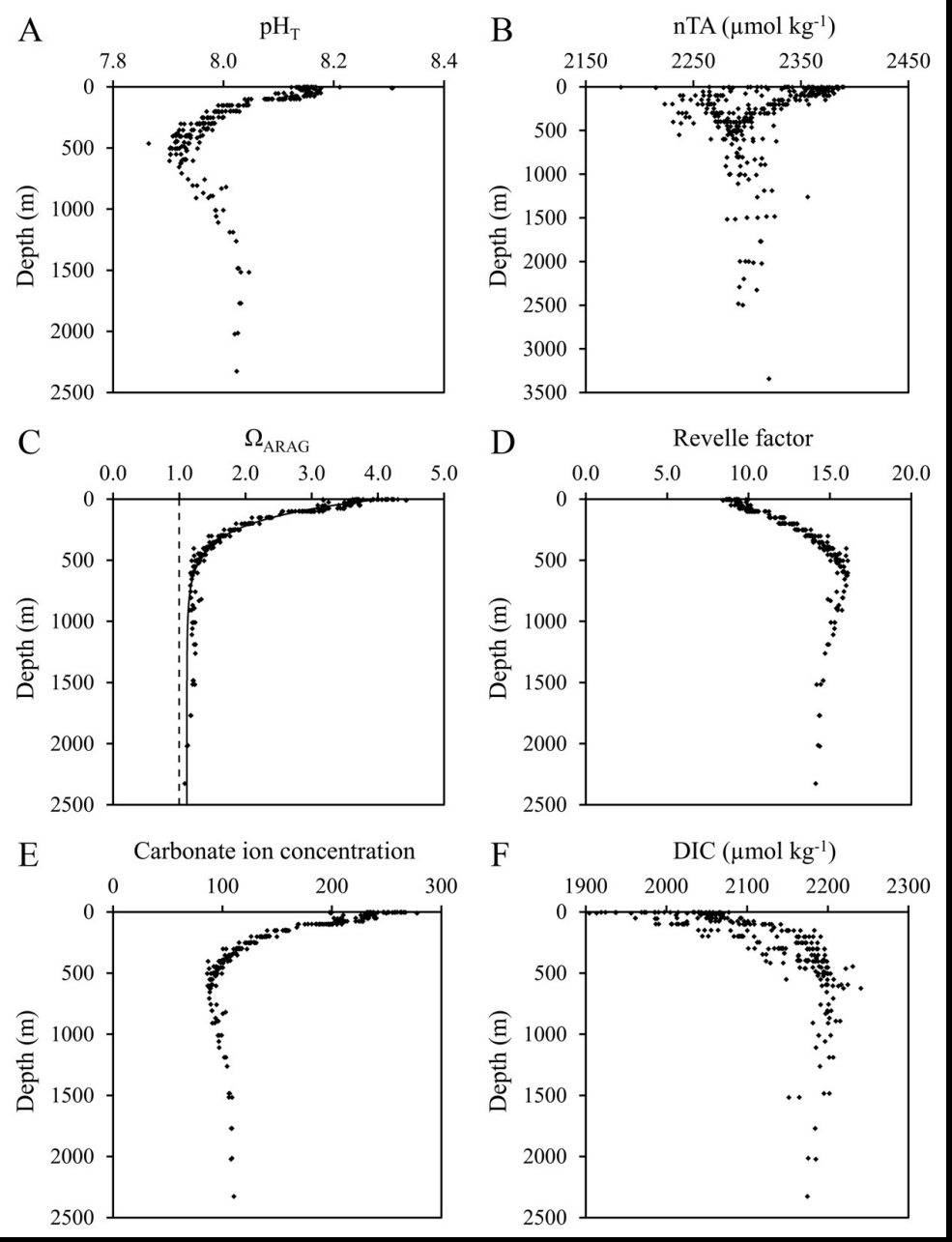
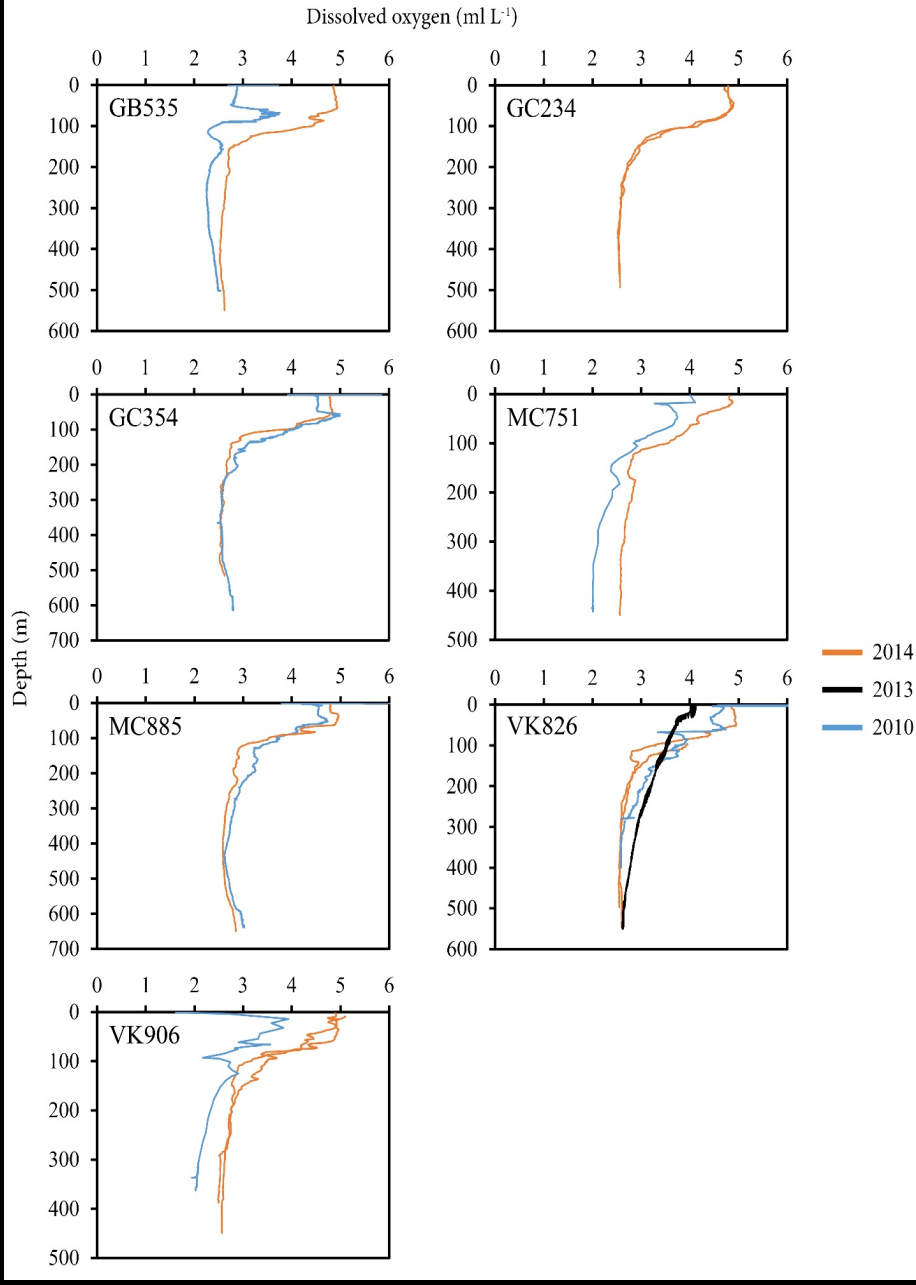
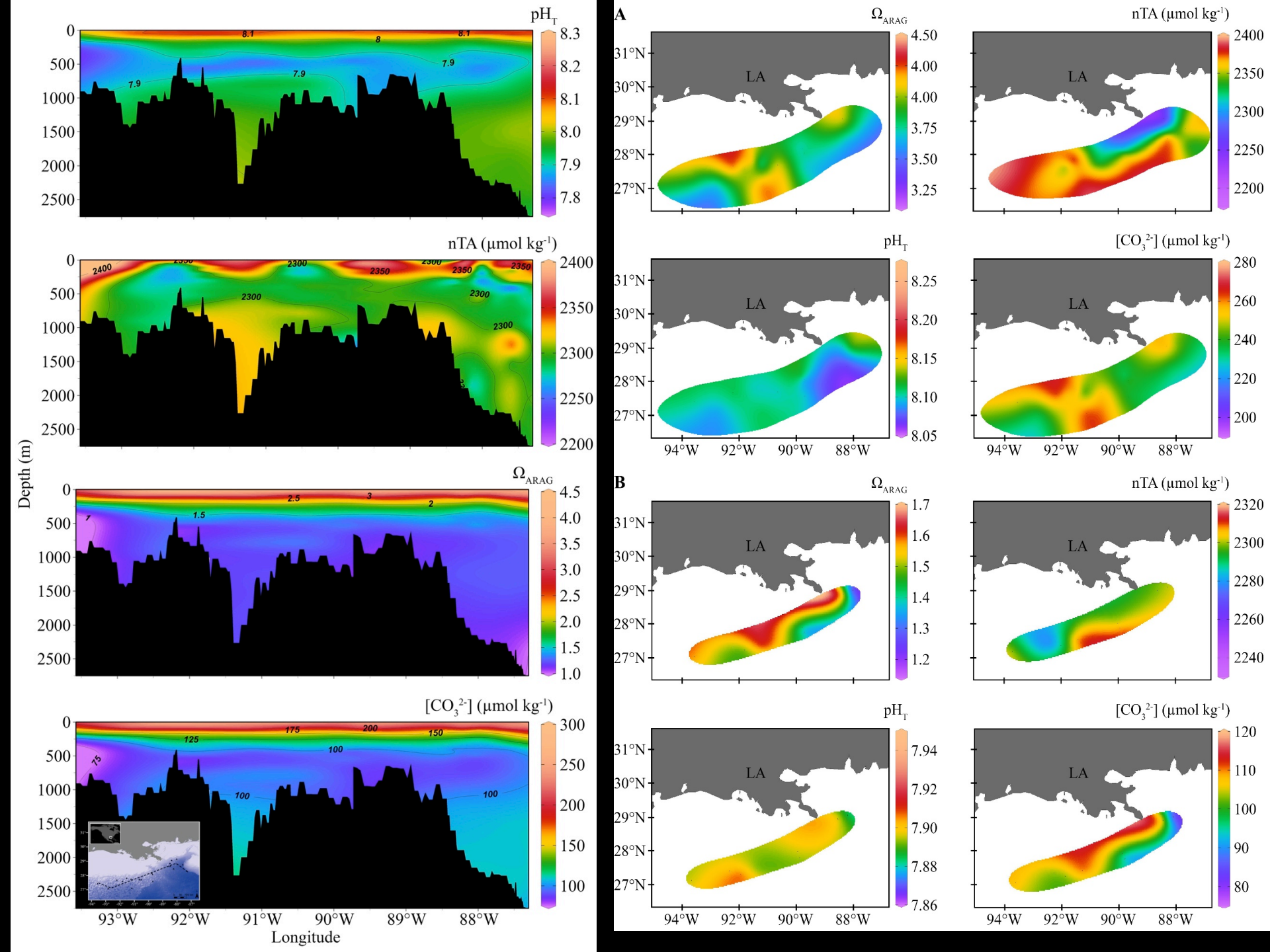
Temple University
Schmidt Ocean Institute
National Science Foundation
Gulf of Mexico Research Initiative
Bureau of Ocean Energy Management
NOAA Office of Ocean Exploration and Research




A
pH$_T$
7.8
8.0
8.2
8.4
Depth (m)
0
500
1000
1500
2000
2500
B
nTA (μmol kg^{-1})
2150
2250
2350
2450
3500
C
Ω_{ARAG}
0.0
1.0
2.0
3.0
4.0
5.0
D
Revelle factor
0.0
5.0
10.0
15.0
20.0
E
Carbonate ion concentration
0
100
200
300
F
DIC (μmol kg^{-1})
1900
2000
2100
2200
2300


Dissolved oxygen (ml L^{-1})
Depth (m)
GB535
GC234
GC354
MC751
MC885
VK826
VK906
2014
2013
2010


pH$_T$
nTA (μmol kg^{-1})
Ω_{ARAG}
[CO_3^{2-}] (μmol kg^{-1})
Depth (m)
Longitude
93°W
92°W
91°W
90°W
89°W
88°W
A
B
LA
31°N
30°N
29°N
28°N
27°N
94°W
92°W
90°W
88°W