(1) ABSTRACT
Boron/Ca (B/Ca) ratios in planktonic foraminifera have been suggested as a potential proxy to reconstruct seawater pH (Yu et al. 2007) and, another parameter of the carbonate system, atmospheric carbon dioxide. However, in addition to pH the calcification temperature has a strong influence on the incorporation of boron into foraminiferal tests. To assess the various influences of these parameters we have measured B/Ca, as well as Mg/Ca and oxygen isotopes as independent temperature proxies, in Globigerinoids from the SEATS. These records will be used to estimate the relative contribution of temperature and pH. These results available from previously published down-core calibration studies and with new sediment trap data from South China Sea which were collected through the South East Asian Time-series Study (SEATS). All these studies combined indicate that temperature is the dominant control with pH being a secondary influence. Thus, we compare our data with results from previously published proxy of pH. The different proxies, in Globigerinoids and in the sedimentary record, are expected to complement each other in providing a more comprehensive understanding of the carbonate system variability.

(2) OBJECTIVES
- Test whether B/Ca can be used to record the decrease in pH observed from recent surface ocean acidification
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- Determine the effect of boron dissolution on the B/Ca ratio
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- Develop a seawater pH proxy using sediment trap time series
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(3) WHY A SEDIMENT TRAP BASED CALIBRATION?
- Well-preserved foraminiferal samples with high-resolution and contemporaneous hydrographic data that can be used to deconvolute the various influences on boron incorporation into foraminiferal tests.
- Large annual cycle in surface water pCO2 of ~80 kPa, which is predominantly driven by the seasonal change in SST. Surface water pH changes seasonally by ~0.1 with the lowest values during the warm, high pCO2 summer months (Bates 2007).

(4) BACKGROUND ON BORON/CALCIUM
- Boron in seawater exists predominantly as two species, borate \( \text{B(OH}_3\text{)}^+ \) and borate \( \text{B(OH}_4\text{)}^- \), and their relative abundance is dependent on pH.
- Evidence from boron isotopes in modern marine carbonates is within the isotopic range of borate suggesting it is the boron species incorporated into marine calcite (Hemming & Hanson 1992).

\[ \text{CaCO}_3 + \text{B(OH}_3\text{)}^+ + \text{HCO}_3^- \rightarrow \text{Ca[B(OH}_3\text{)}_2] + \text{CO}_3^{2-} \]

Based on (4), we can define the partition coefficient \( K_{\text{D}} \) in CaCO3

\[ K_{\text{D}} = \frac{\text{[B(OH}_3\text{)}_2]}{\text{[B(OH}_3\text{)}^+] \cdot \text{[HCO}_3^-]} \]

And the measured ratio in foraminiferal calcite is

\[ \text{B/Ca}_{\text{CaCO}_3} = \frac{\text{[Ca[B(OH}_3\text{)}_2]}{\text{[CaCO}_3]} \]

(5) RESULTS
- Seasonal Cycle 1993-1996 Gruber w
- Comparison with published studies
- SEATS site Gruber w 2004-2005
- SEATS site Gruber w 2004-2005
- Comparison with published studies

CONCLUSIONS:
- Both SEATS and OFP have seasonal variability of B/Ca that co-varies with calcification temperature.
- The \( K_{\text{D}} \) to temperature relationship is minimal at OFP suggesting that regional effects are influencing boron incorporation. A stronger influence of pH may be reducing the temperature effect.
- Both SEATS and previously published calibrations suggest that calcification temperature has a dominant influence on B/Ca ratios in Gruber w.
- Future work of developing B/Ca as a seawater proxy is to understand the effect of dissolution on boron so that accurate pH may be reconstructed.

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