Spatial variation of total alkalinity and total inorganic dissolved carbon along the Brazilian continental shelf-break and slope

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CO₂ net fluxes along south and southeast Brazilian continental shelf and slope

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Background

• Rapid increase of CO₂ in the atmosphere is affecting the global climate (absorption of CO₂ by the ocean).
• Continental margins play an important role in biogeochemical cycles.
• Lack of long-term measurements of carbonate system parameters along Brazilian continental shelf and slope.

Methods

• Early spring 2014.
• Seawater samples in entire water column (Figure 1).
• CO₂ molar fraction (xCO₂) continuous measurements (GO-8050 / LiCOR LI-7000).

Figure 1: Study region. Position of hydrographic stations developed during EstARte-Sul cruise. Bathymetry in colour scale.

- Temperature and Salinity – CTD SBE 9plus.
- Total alkalinity (Aₜ) and total dissolved inorganic carbon (Cₜ) – potentiometric titration in a closed cell (Dickson, 2007).
- CO₂ partial pressure (pCO₂) was calculated using continuous xCO₂, T and S.
- CO₂ net fluxes were determined using wind speed from ECMWF reanalysis project – based on Takahashi et al. (2009) transfer coefficient (FT09).

References

• Bollmann et al., 2010. World Ocean Review 2010- Living With the Oceans.
• Dickson et al. (2007). Guide to best practices for ocean acidification research and data reporting.
• Takahashi et al., 2009. Climatological mean and decadal change in surface ocean pCO₂, and net sea-air CO₂ flux over the global oceans. Deep Sea Research.

Findings

It was possible to identify six water masses in the water column (Figure 2). Aₜ values ranged between 2248 and 2470 µmol kg⁻¹ (Figure 2a). Cₜ values ranged between 1980 and 2444 µmol kg⁻¹ (Figure 2b).

Figure 2: (a) S/S-Aₜ and (b) S/S-Cₜ diagrams. Water masses are indicated by coloured polygons and their acronyms are: Plata Plume Water, Subtropical Shelf Water, Tropical Water, South Atlantic Central Water, Antarctic Intermediate Water, and North Atlantic Deep Water.

FCO₂ average value was -87.9 ± 41.8 µmol m⁻² d⁻¹. A senescent bloom of Trichodesmium spp was observed, resulting in high pCO₂,sw values achieving 873 µatm (ΔCO₂, of 476 µatm), being one of the three regions along the slope where CO₂ was released to the atmosphere (Figure 3).

Figure 3: Surface results. (a) ΔpCO₂ (µatm) cruise data. Colour indicates atmospheric pCO₂ (µatm). (b) FT09 (µmol m⁻² d⁻¹). Colour indicates temperature (°C). (c) FT09 (µmol m⁻² d⁻¹) along cruise, without considering two peaks of emission.

Conclusion

A qualitative comparison with available database shows higher values of Aₜ and Cₜ for these data, reinforcing the need for more sampling efforts.

Furthermore, in the spring of 2014, the continental shelf was shown as a CO₂ sink, and biological effect was considered the main factor to characterize this behaviour.