Carbonate system parameters monitoring in coastal waters of Chile

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Abstract

The spatial variability of surface water ΔpCO₂ of the greater part of the South American west coast (Fig.1), suggest two contrasting systems: (1) Coastal upwelling ecosystem (2) Coastal fjord ecosystems. The first is characterized by strong CO₂ outgassing, and the other one by strong CO₂ uptake during warm periods (Fig.1). These two systems, also show differences in the frequency of the periods of high surface seawater pCO₂. While an open shore (fully exposed to the SW winds) upwelling area (1) is characterized by intra-seasonal variability, the Patagonian Archipelago (2) shows a marked seasonal variability in surface water pCO₂.

Experimental work aimed at estimating the effect of increasing levels of atmospheric pCO₂ on west coast South American biota has been largely based on perturbation experiments using constant pCO₂ levels. However, coastal surface water pCO₂ in this region varies at different time scales (seasonal or intra-seasonal periodicities). Our goal is to understand the periodic fluctuations of high pCO₂ that is most relevant for OA on marine biota?

Methods

Surface seawater samples were collected directly at the intertidal zone of three locations at 30°S, 40°S and 42°S. Sampling frequency was approximately 2-3 days per week, with the exception of the 42°S location which is a compilation of various sampling expeditions of about 1-2 weeks in which samples were collected 1-2 times per day. pH, TA, temperature and salinity were measured immediately in seawater samples soon after collection.

Findings

While year around events of very low pH characterized the exposed coast of an upwelling area (40°S, 2), the Northern Patagonia inner water (42°S, 3) is characterized by a sustained seasonal drop in pH during winter time. An intermediate situation occurs in coastal upwelling inner waters (Herradura Bay at 30°S, 1) in which a stronger seasonal signal is evident, probably related to summer stratification and longer residence time.

Conclusions

Different patterns of coastal water CO₂ variability along Chile, highlight the importance of including this variable (periodic fluctuations) in the design of perturbation experiments, in order to have a more realistic assessment of the effect of OA on marine biota along the South America west coast.

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Herradura Bay (30°S), inner waters at the upwelling area, Scallop farm.

Calfuco (40°S), wind exposed coast upwelling area.

Fig 1. The air-surface water CO2 gradient (ApCO₂) off the Chilean coast. (Torres et al., 2011)

Metri (42°S), North Patagonia Inner waters, Blue mussel farm. (also see poster 43)

Spring - Summer - Fall - Winter

Seasonal average of omega aragonite in surface coastal water at 30°, 40° and 42°S

Omega Aragonite