Pore water alkalinity in the Bay of Cádiz (North East Atlantic)

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Introduction

Total alkalinity (TA), along with other parameters, like pH and dissolved inorganic carbon (DIC), is used to estimate the partial pressure of carbon dioxide (pCO_2) in ocean water. In open ocean waters, TA consists mainly of bicarbonate, carbonate and borate ions.
TA is typically higher in pore water than the overlying water, as the proportion of non-carbonate species can have a considerable contribution to TA [1].

$$TA = [HCO_3^-] + 2[CO_3^{2-}] + [B(OH)_4^-] + [OH^-] + [HPO_4^{2-}] + 2[PO_4^{3-}] + [NH_3] + [HS^-] + [SiO(OH)_3^-] - [H^+] - [HSO_4^-] - [H_3PO_4]\text{-[HF]}$$

Recent studies suggest that coastal sediments are a source of alkalinity to the overlying water, favoring the role of the coastal ocean as a potential sink for atmospheric CO_2 [2, 3].

The aim of this work was to a) compare concentration of **TA** and **non-carbonate inorganic bases (N-CIBs)**, b) determine the **proportion of N-CIBs** in pore water and c) estimate **TA fluxes** in the **Bay of Cádiz**.

Area of study

The two coastal ecosystems studied are: the **Sancti Petri** channel (18 km length; depth 2 – 7 m) connecting the Bay of Cádiz to the North East Atlantic, and the **Rio San Pedro** creek (length 12 km; depth 3 – 5 m) flowing across an area of salt marshes within the **Bay of Cádiz** (36° 29' N, 6°13' W).

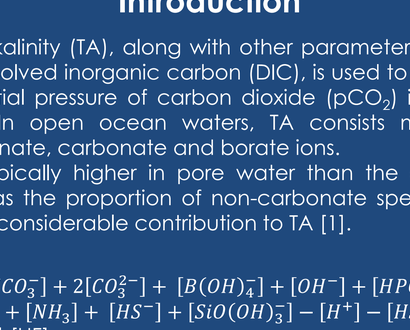

Fig. 1. Map of the Bay of Cádiz and sampling locations

Methods

Pore water and bottom water properties:

- Potentiometric - Alkalinity and pH;
- Spectrophotometric - Ammonium, Phosphate, Silicate;
- Ion chromatography – Sulphate, Chloride, Calcium;
- CO2sys - pH, HCO_3^-, CO_3^-, CO_3^{2-} at in situ conditions (T, S);

Results

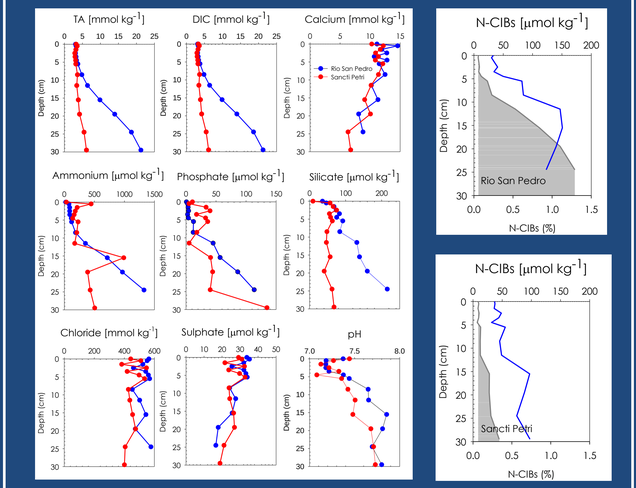

Fig. 2. Pore water profiles of carbonate and non-carbonate species

- TA: 3.2 – 21.2 mmol kg-1
- N-CIBs: 7.1 – 172 µmol kg-1 (only 0.2 -1% TA)
- TA, nutrients increase with depth
- Sulfphate and calcium decrease wiht depth
- Ca and Ar Saturation increases with depth

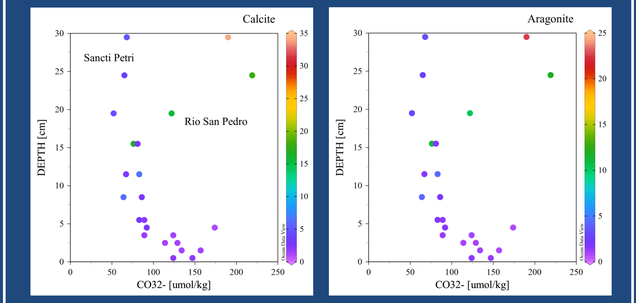

Fig. 3. Pore water profiles of carbonate and non-carbonate species

Main findings

- Carbonate alkalinity contribution > 90%
- Non-carbonate alkalinity contrib<ution low < 1%
- TA flux: 80 – 1140 µmol m^{-2} d^{-1}
- High spatial variability
- Ongoing measurements at spatial and seasonal resolution

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References

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