OCEANIC ACIDIFICATION AND DEOXYFICATION AND THE REAL EFFECTS OF RAPID CO_2 EMISSIONS AND CLIMATE CHANGE ON THE GLOBAL BIOGEOCHEMICAL CYCLES. A MULTI-PROXY PERSPECTIVE FROM THE ANCIENT WORLD.

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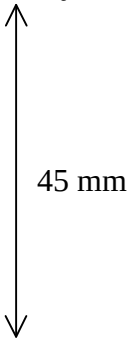
ABSTRACT

Investigating the possible effects of anthropogenic (industrial) CO_2 emissions on global climate and oceanic biogeochemical cycles has become a priority to the international community[1]. In recent years, particular attention has been given to possible ocean acidification resulting from anthropogenic CO_2 emissions and its potentially severe affects on marine biological activity and geochemical cycles[1-7]. Although the oceans are the major sinks for atmospheric carbon over geological timescales, they only absorb about 30% of the annual anthropogenic CO_2 released to the atmosphere[1-2] due to the rapidity of carbon release.

INTRODUCTION

The transfer of great amounts of atmospheric CO_2 into the oceans results in increased concentrations of dissolved inorganic carbon species. Such an increase affects the distribution of the different carbon species in the global oceans and results in an increase in the concentration of hydrogen ions, which lowers the oceanic pH. The decreased oceanic pH reduces the saturation of carbonate ions in the oceans. This process, known as ocean acidification, promotes the dissolution of marine calcium carbonate[2-3]. As carbonate is the main mineral component of modern mineralizing organisms, the increased anthropogenic CO_2 emissions to the atmosphere and the resulting oceanic acidification are expected to have devastating effects on the main biological activity of shell building (calcifying) organisms and on the ecology of the future oceans[5-7].

Although evidences of the devastating effects of oceanic acidification in the marine biota are provided by the decreased rate of coral skeleton production and the reduced ability of algae and free-swimming zooplankton to maintain protective shells, among others[5-7]; predicting the long-term effects of oceanic acidification on the future oceans has remained rather difficult. Attempts to investigate past episodes of acidification and their effects on the marine biogeochemical cycles have required non-traditional stable isotope techniques (e.g., B and Ca isotopes)[8-9].



Here we present a critical evaluation of the use of Ca-isotopes as a reliable geochemical proxy of acidification during periods of extremely high atmospheric pCO_2 (the Neoproterozoic postglacial intervals and the Permian-Triassic transition). As important perturbations (decrease) on oceanic oxygen levels seem to have paralleled these periods, an evaluation of the role of high atmospheric pCO_2 on the control of oceanic oxygenation would be done by comparing the Ca-isotope records with additional available geochemical proxies (i.e. Mo isotopes). This work aims on helping constraining and understanding the possible future effects of modern anthropogenic CO_2 emission, oceanic acidification, oceanic deoxyfication and climete extremes on the future oceans by highlighting the use of Ca isotopes to investigate the long-term response of the global marine biogeochemical cycles to rapid CO_2 release in the geological past.

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