

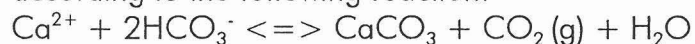
CHARACTERIZATION OF SURFACE LAYERS ON INDIVIDUAL MARINE CaCO₃ PARTICLES, USING "VARIABLE ENERGY" ELECTRON PROBE MICROANALYSIS

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The ocean constitutes a large sink for anthropogenic CO₂, and thus plays a significant role in the global biogeochemical cycle of carbon and its perturbations. There remain, however, large uncertainties concerning the uptake of anthropogenic carbon by the ocean, mainly due to insufficient knowledge of processes controlling the pCO₂ in surface waters. Most of the previous research efforts have been concentrated on the study of CO₂ exchange at the air-sea interface due to temperature effects related to the general circulation of water masses or to the biological activity in terms of new production of organic matter and export to deep waters. The effect of precipitation of calcium carbonate by calcifying organisms in the euphotic zone and the redissolution of their skeletons has not been fully taken into account yet. This precipitation-dissolution process affects both the concentration of dissolved inorganic carbon (DIC) and alkalinity and plays thus a significant role in the buffering capacity of seawater and its potential to act as a sink or a source of CO₂ for the atmosphere. Quantification of the processes affecting the inorganic carbon cycle is fundamental, not only for the understanding of the present day situation, but also for the predictive studies in the context of global warming.

The anthropogenic CO₂ can be transferred into or out of the ocean via air-sea exchange as a result of various processes. They include dissolution of CO₂ (g) in seawater, photosynthesis and respiration, and precipitation of carbonate particles. During photosynthesis, CaCO₃ is precipitated and this carbonate sinks out of the surface layer along with the exported organic carbon. The calcification process modifies the dissolved inorganic carbonate system according to the following reaction:



The production of CaCO₃ will thus consume alkalinity, increase pCO₂ and reduce total DIC in the surface layer of the ocean, driving CO₂ from the ocean to the atmosphere.

We aim to study the processes associated with the oceanic production and dissolution of CaCO₃ in order to quantify the role of calcifying phytoplanktonic organisms in sequestering CO₂.

Electron probe microanalysis (EPMA) was used for characterization of individual particles for their composition, morphology and dissolution features. Most attention is paid to the concentration of Mg and Sr in CaCO₃ particles, because of their effect on the solubility of carbonates and because of the fact that they are characteristic for their origin.

In June 2001, a mesocosm experiment: "Biological responses to CO₂ - related changes in seawater carbonate chemistry during a bloom of *Emiliana huxleyi*" was set up at the Large Scale Facility for Marine Pelagic Food Chain Research, University of Bergen, Bergen, Norway. Three different pCO₂'s (200 ppm, 380 ppm, 700 ppm) were generated in different mesocosms where cultures were grown. Organisms from each of these cultures were analysed using optimised low-Z EPMA technology to examine the difference in calcification. "Variable-energy" EPMA was applied for the characterization of surface layers of the CaCO₃-scales of *Emiliana huxleyi*.