Abstract

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The air-sea fluxes of CO_2, hydrography and distribution of carbonate system parameters have been studied in two major upwelling foci off central (30°S) and northern Chile (23°S) during 1996 and 1997. The upwelling of cold and CO_2-rich subsurface waters maintains a higher fugacity of CO_2 (fCO_2) in the surface water than in the atmosphere, leading a strong CO_2 outgassing (**Papers I-IV**). Coastal CO_2 supersaturation can exceed 200% when deep, cold and salty water reaches the surface during wind-forced upwelling (**Papers I and III**). Wind-driven upwelling events occur on weather-related time scales (days), and lead to periods of intense upwelling and strong CO_2 outgassing, which can be followed by a relaxation in which the CO_2 outgassing is weak or even reversed to an uptake flux (**Paper I**). Upwelling events and the associated CO_2 outgassing have been observed during both winter and summer at 30°S (**Paper IV**), and even during warm El Niño periods (**Paper II**). However during austral summer, the surface water can be strongly stratified and undersaturated in CO_2, since the CO_2 uptake by phytoplankton exceeds the supply of CO_2 from deeper waters (**Papers III and V**). Off northern Chile between 29° and 24°S during austral summer 1997, biological uptake of CO_2 sequestering follows complex patters associated with filaments of cold and phytoplankton rich surface waters, which contrast with the surrounding oligotrophic and CO_2-supersaturated open ocean subtropical waters (**Paper V**). The intensity of CO_2 outgassing caused by upwelling increases towards the south along north-central Chilean coast, following latitudinal gradients in the wind forcing of upwelling (**Paper III**).

Keywords: Carbon dioxide, coastal upwelling, air-sea exchange, Pacific Ocean, Chile, El Niño

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