

The trace metal cycling in the water column of the South China Sea

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Introduction

Our previous study found that the trace metal composition in the phytoplankton collected in an offshore time series station of the South China Sea (SEATS) was mainly dominated by extracellular portion [1]. The trace metals were mostly anthropogenic, most likely originally derived from the aerosols emitted from fossil fuel burning which contained highly soluble trace metals [1]. Here, we studied the elemental composition and fluxes of the elements in the water column of the South China Sea, including Al, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, and Cd) through the sinking particles collected at the SEATS site. The sinking particles were collected by floating traps at 30, 100, and 160 m at four occasions in 2007, and were also collected by moored sediment traps deployed at the depths of 200, 600, and 3500 m for one year to examine their composition features and to study the roles of the biotic and abiotic particles on their vertical cycling processes.

Results and Discussions

Overall, strong vertical and seasonal elemental fluxes were observed. Most of the metal fluxes increased with increasing depths, indicating that lateral lithogenic particle input was the dominant particulate metal source in the deep water. However, the metal composition in the surface water was consistent with the previous finding on phytoplankton [1], proving that the trace metals were mainly anthropogenic. The East Asia has been the largest consumer of coal in the world. With the sharp increase of coals consumed in the East Asia during the past several decades, it is expected that the metals introduced to the marginal seas and the western Pacific due to fossil fuel burning may leave significant signatures spatially and temporally in the environment, which should be able to be quantitatively traced by their elemental and isotopic composition recorded in environmental recorders such as corals and sediments.

[1] Ho *et al.* (2007) *Limnol. Oceanogr.* **52**, 1776.

A study of sulfate mineral stability in marine sediments using the whole ODP/IODP porewater composition data base

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The whole ODP and IODP porewater data base (14416 samples from 95 Legs) was used to investigate the stability of celestite, barite, and gypsum in marine sediments, through the calculation of the mineral saturation indices at the *in situ* sediment temperatures and pressures using a model for the Na-K-Ca-Mg-Sr-Ba-Cl-SO₄-H₂O system [1]. The *in situ* temperatures were calculated from a compilation of the geothermal gradient for all the boreholes while pressure is simply calculated from depth. Molarities have been converted to molalities through the calculation of the porewater densities [2]. We also calculated the calcite and aragonite saturation indices using a seawater model for the carbonate system, in an attempt to provide some insight into the relationship between carbonate and sulfate minerals in marine sediments.

Although rarely reported, celestite saturation is reached in 83 boreholes drilled at 60 different sites during 22 ODP/IODP Legs. This is due either to the Sr increase linked to the dissolution of Sr-rich aragonite and precipitation of Sr-poor calcite, or to a salinity increase due to presence of brines that may increase all porewater concentrations, including Sr²⁺ and SO₄²⁻. Porewater at equilibrium with gypsum (22 sites from 12 Legs) have a Ca content at least 5 times higher than the seawater value, in relation with CaCO₃ undersaturation. Barium concentration profiles are more erratic and often lead to large barite supersaturation.

Our results show that equilibrium with sulfate minerals as celestite or gypsum can be easily reached during early burial diagenesis. We also illustrate cases where precipitation of a mineral destabilizes another one sharing a common ion (e.g. gypsum and celestite, or gypsum and aragonite or calcite).

[1] Monnin (1999) *Chem. Geol.* **153**, 187-209. [2] Monnin (1994) *Comput. Geosci.* **20**, 1435-1445.