

Elemental remobilization in marine sediments: Growth and destruction of authigenic mineral fronts above gas hydrate systems

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Microbial oxidation of dissolved methane in marine sediments often leads to depletion of dissolved sulfate and an abrupt change in alkalinity. We present data from Blake Ridge (ODP Leg 164), the Peru Slope (ODP Leg 201), and the Japan Sea (Cruise UTO4) where long-term oxidation of methane has produced pronounced authigenic fronts within the sediment column as a result of this process. These fronts are produced as a result of supersaturation with respect to the carbonate minerals and barite. Without exception, major fronts are closely associated with the present zone of sulfate-methane transition (SMT), indicating that they are part of an ongoing dynamic process and do not represent relicts of previous depositional events. The depth profiles of pore fluids also indicate a corresponding response to microbial sulfate reduction as the predominant oxidative process in shallow sediments. The depth of the SMT in the three study areas ranges from as little as 2m in the Japan Sea study area to as great as 20m in the Blake Ridge.

In order for the authigenic fronts to persist as discrete intervals within the SMT, precipitation at the top of the fronts must be countered by dissolution of the lower portions as they are buried. Over time, the diffusive return of solutes to zones of saturation leads to the growth of these fronts. Based on present flux of dissolved calcium, barium and strontium, the accumulation of barite and carbonate fronts spans over tens of thousands of years. Similarities between data from distinct localities support the hypothesis that the upward diffusion of methane on continental margins is both regionally ubiquitous and temporally nonephemeral.

Impacts of Fe-rich sediment input upon chemical diagenesis of shallow marine tropical carbonates: Discovery Bay, Jamaica

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The chemical dissolution of skeletal carbonate grains has been identified as a significant diagenetic process in shallow water, tropical carbonate sediments. Such dissolution is associated with acidity produced through the oxidation of sulfide generated during bacterial sulphate reduction. It is to be expected, however, that the presence of Fe, introduced through terrigenous input, will significantly modify chemical diagenesis. High Fe levels should promote bacterial Fe(II) reduction, minimising sulfide production and subsequent oxidation. In order to test the effects of Fe-rich sediment input we have examined sites in Discovery Bay, Jamaica, a carbonate-dominated embayment in which some areas have been subject to the input of Fe-rich bauxite dust since 1965.

Cores from non-impacted ('clean') areas of the bay show evidence for active sulphate reduction in the upper 10cm of the sediment column. Associated petrographic and SEM observations of carbonate grains (specifically *Halimeda* and *Amphiroa*) show clear morphologic evidence of chemical dissolution. In contrast, cores from sites subject to significant bauxite sediment inputs (up to 7500 ppm Fe) show evidence of active iron reduction in the top 10cm of the sediment column, with no evidence of active sulphate reduction. Carbonate grains from these same sites show little evidence for active dissolution and are characterised by often pristine surface morphologies. The implications of such shifts in chemical diagenesis as a result of Fe-rich sediment input are far-reaching. Inhibition of grain dissolution will result in better grain assemblage preservation, and greater preservation of primary isotopic and chemical compositions.