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Reestimating the carbon sink due to authigenic carbonate formation in marine sediments with high sediment accumulation rates

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The removal of carbon from the surface of the planet is a critical component of the long-term carbon cycle; this removal is through the deposition and subsequent burial of carbon-minerals in the ocean. Sedimentary, post-depositional processes play a key role in the global carbon cycle because much of the organic carbon in sediments is microbially oxidized back to dissolved inorganic carbon some of which can precipitate as authigenic carbonate. Previous attempts to quantify the amount of precipitation of authigenic carbonate have been based upon the assumption of Fick's first law; the flux of calcium into the sediments due to diffusion under steady state can be used to calculate the total amount of sedimentary carbonate precipitation. We postulate that in areas where sediment burial is rapid the assumption of Fick's first law is no longer valid, and a sedimen-burial model becomes a more valid assumption.

We identify the areas where there are both high rates of sedimentation and a calcium concentration decrease in the sediment pore fluid using the global ODP/IODP database. The database can then be correlated with a range of physical and chemical properties of the sites including water depth, chlorophyll A and POC concentrations and the distance from the shore by using a neural network. The areas where there are the fastest decrease in calcium concentrations within sediments such as the eastern margin of ocean basins are also correlated with high rates of sediment burial, suggesting that the flux of authigenic carbonate was previously underestimated. This new approach shows how the sink of carbon due to the precipitation of authigenic carbonate should not be ignored in models of the global carbon cycle. Previous estimates of authigenic carbonate precipitation of 2-3% of total carbonate precipitation, are likely an underestimate by at least 50% when sediment advection and the neural network approach for the extrapolation of global fluxes are combined.