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SUPPLEMENTARY INFORMATION
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Significant contribution of authigenic carbonate to marine carbon burial

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Supplementary material

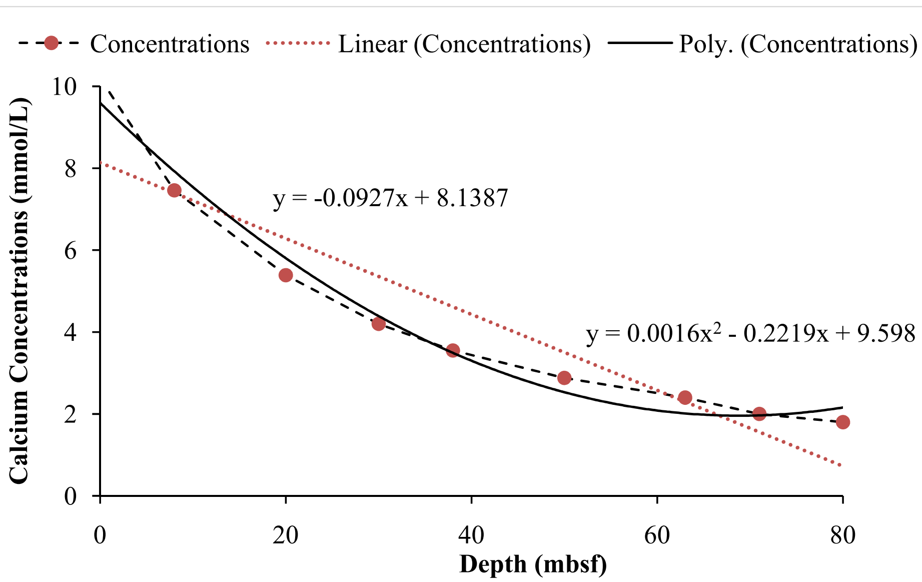
Error evaluation for linear approximation used by Fick's law on concentration profiles

The Fick's law is defined as

$$F = -\varphi \times D_{Ca} \times \left(\frac{dC}{dz}\right)$$

where C is the calcium concentration and z is depth. For a specific site, porosity (φ) and diffusion coefficient (D_{Ca}) are constant, thus the error associating with the overall flux (F) is mainly due to estimating $\frac{dC}{dz}$.

Here, we evaluate three curve-fits that could be used to estimate the flux based on a hypothetical profile of measured calcium concentrations: 1) linear regression, 2) simple polyline, and 3) concave fit based on a 2nd order polynomial line.



Supplementary Figure 1 Three methods used to estimate the flux from a hypothetical change in calcium concentrations in pore fluids.

If we assume φ= 0.65 and D_{Ca} = 0.0075 m^2/yr:

- Method 1

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$\frac{dC}{dz}$ is directly estimated as the slope of the linear regression line, i.e., $\frac{dC}{dz} = -0.0927$.

F=0.45 mmol/m^2/yr

- Method 2

The 9 data points are connected by straight lines. The slope of each line is derived as $\frac{C_{i+1}-C_i}{z_{i+1}-z_i}$, where i is from 1 to 9. In order to estimate the $\frac{dC}{dz}$ for the whole depth each slope is assigned a weight (%) as $\frac{z_{i+1}-z_i}{z_9}$. In the end, the $\frac{dC}{dz}$ for the whole depth is estimated as $\frac{dC}{dz} = \sum \frac{C_{i+1}-C_i}{z_{i+1}-z_i} \times \frac{z_{i+1}-z_i}{z_9} = \sum \frac{C_{i+1}-C_i}{z_9} = -0.1050$.

F=0.51 mmol/m^2/yr

- Method 3

A 2nd order polynomial line is fitted to the 9 data points, then the polynomial line is split into 8 parts. For each part a tangent line is fitted at the middle point, and the slope of the tangent line is considered as the concentration gradient for that part of the polynomial line. For each part a same weight is assigned like in method 2. In the end the estimated $\frac{dC}{dz} = -0.0939$.

F=0.46 mmol/m^2/yr

In summary, $\frac{dC}{dz}$ derived from all three methods show no significant difference, and the uncertainty associated with F is < 10% based on using the linear regression in the pore fluid database.