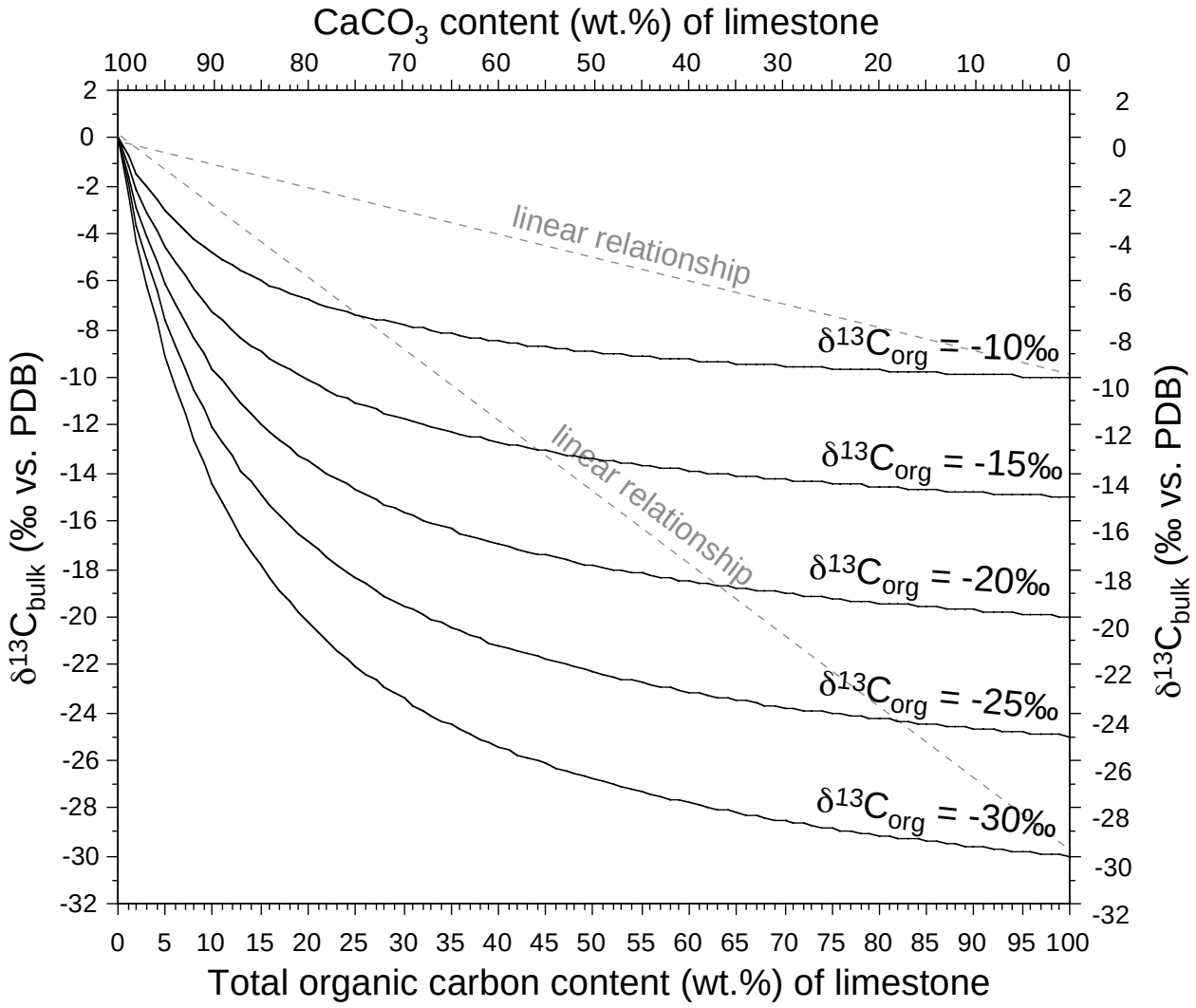
Isotopic Mixing Curves

The isotopic composition of a mixture of two components commonly does not vary linearly with the proportions of those two components. This non-linearity happens because the two components have different concentrations of the element in question.

For example, consider a mixture of organic carbon (which is 100%C) and $CaCO_3$ (which is 12% C). If we have a 50-50 (by weight) mixture of C_{org} and $CaCO_3$, the mixture has much more (8.33x) light organic carbon than heavy carbonate carbon. Thus the isotopic composition of the mixture is dominiated by the C_{org}. In any such system, the isotopic composition of an element in a mixture is pulled (here, downward) toward the isotopic composition of the component with the greater concentration of that element.

Other examples:

- Any element (e.g., C, S) other than H or O in estuarine mixing of river water and seawater.
- Any element (e.g., C, S, Sr) other than H or O in subsurface mixing of groundwater and seawater.
- N in mixing of clean (nitrate-poor) and skanky (nitrate-rich) groundwater.
- O in mixtures of quartz and calcite (or any two O-bearing minerals).
- S in mixtures of pyrite and gypsum.



$$\delta^{13}C_{bulk} = \frac{\delta^{13}C_{CO3}\,\frac{12}{100}\,Wt\%CaCO_3 + \delta^{13}C_{org}\,\frac{1}{1}\,Wt\%C_{0rg}}{\frac{12}{100}\,Wt\%CaCO_3 + \frac{1}{1}\,Wt\%C_{0rg}}$$

(Weight-ratio of C)