C and O stable isotope compositions of pedogenic carbonates

The plot at right shows the range of C and O stable isotope data from some pedogenic carbonates from a variety of settings. Things to note include the following:

1) Values of δ13C are typically negative, reflecting input of carbon from soil gas CO2 generated by plant root respiration and/or by decay of organic matter.

2) δ18O values are typically negative, because pedogenic carbonates are precipitated from meteoric water that has ultimately evaporated from the ocean (where δ18O = ~0). The meteoric water thus has δ18O < 0 relative to the SMOW scale, and CaCO3 precipitated from that water thus has values of δ18O < 0 relative to PDB, unless evaporation has increased the δ18O of the soil water.

3) Values of δ13C are typically greater in pedogenic carbonates from regions with C4, rather than C3, plants. This is clear in the two fields of data from Pakistan and likely to account for much of the difference between the two fields of data from Texas shown here.

4) Rain-out effects can lead to smaller values of δ18O in pedogenic carbonates. This probably accounts for the smaller values of δ18O in northwestern Texas compared to the Texas coast (because of distance from the Gulf of Mexico), and account for the relatively small δ18O in the data from the Spring Mountains of Nevada (because of elevation).

5) Values of δ13C and δ18O are commonly greater at the tops of soil profiles because of mixing with atmospheric CO2 to give greater δ13C and because of evaporation of soil water to give greater δ18O. Another SFMG page addresses this issue further.