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 $\delta^{13}C$ are typically negative, reflecting input of carbon from soil gas CO_2 generated by plant root respiration and/or by decay of organic matter.

2) $\delta^{18}O$ values are typically negative, because pedogenic carbonates are precipitated from meteoric water that has ultimately evaporated from the ocean (where $\delta^{18}O = \sim 0$). The meteoric water thus has $\delta^{18}O < 0$ relative to the SMOW scale, and $CaCO_3$ precipitated from that water thus has values of $\delta^{18}O < 0$ relative to PDB, unless evaporation has increased the $\delta^{18}O$ of the soil water.

3) Values of $\delta^{13}C$ 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 $\delta^{18}O$ in pedogenic carbonates. This probably accounts for the smaller values of $\delta^{18}O$ in northwestern Texas compared to the Texas coast (because of distance from the Gulf of Mexico), and account for the relatively small $\delta^{18}O$ in the data from the Spring Mountains of Nevada (because of elevation).

5) Values of $\delta^{13}C$ and $\delta^{18}O$ are commonly greater at the tops of soil profiles because of mixing with atmospheric CO_2 to give greater $\delta^{13}C$ and because of evaporation of soil water to give greater $\delta^{18}O$. Another *SFMG* page addresses this issue further.