C and O stable isotope compositions of speleothems

The plot at right shows the range of C and O stable isotope data from speleothems (mostly stalagmites) from a variety of settings. Things to note include the following:

1) Within individual sets of data, as well across the entire plot, the range of $\delta^{13}C$ values is greater than the range of $\delta^{18}O$ values.

2) $\delta^{18}O$ values are almost invariably negative, because speleothems are precipitated from meteoric water that has 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.

3) Rain-out effects dictate that $\delta^{18}O$ of speleothems from high altitude and high latitude have exceptionally small values of $\delta^{18}O$. The data from the Austrian Alps provide a striking example of the effect of altitude.

4) The greatest values of $\delta^{18}O$ are from desert regions, probably as the result of evaporation.

5) Values of $\delta^{13}C$ are generally negative, reflecting the input of soil CO_2 influenced by plant root respiration and decay of organic matter.

6) Values of $\delta^{13}C$ range from very small in regions of lush vegetation (e.g. Indonesia) to positive values in regions of little vegetation (as shown by southern African deserts here).

7) Sets of data spanning multiple types of speleothems and/or long times commonly have greater ranges of $\delta^{13}C$ and $\delta^{18}O$. The data shown from Israel and SE France are good examples.

8) In the example from northern Spain in gray, lesser vegetation in the cold glacial period than in the warmer period of deglaciation presumably caused the greater values of $\delta^{13}C$ in the former. Greater $\delta^{18}O_w$ of the ocean and colder temperatures in the glacial period than in the period of deglaciation probably caused the greater values of $\delta^{18}O_c$ in the former.