Determining cave air CO$_2$ sources in Pisani rov using carbon isotopes

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WHY?!

• Lot of „unknowns“ regarding karst and caves in spite of its local and global prevalence
• Environmental concern (atmospheric CO$_2$ concentrations, carbon fluxes)
• Caves can affect soil CO$_2$ flux
• DIC leaching
• Paleoclimate studies
CO$_2$ degased from dripwater

External atmosphere CO$_2$

Deep CO$_2$ sources

Cave air CO$_2$

Soil and epikarst CO$_2$
CO₂ soil (similar to SOC)
C from parent rock \( \delta^{13}C_{\text{rock}} = 1.6\% \)
Open or closed system
Rayleigh distillation & calcite precipitation

\[ \text{C from parent rock} \]
\[ \delta^{13}C_{\text{rock}} = 1.6\% \]

Above cave
\( \delta^{13}C_{\text{atm}} = -9 \% \)
510\( \mu \text{mol/mol} \)

Degassing from the upper mantle
Thermos-methamorphism of carbonate rock
\( \delta^{13}C \) in the range from -6 to 0\%
Organic carbon from sedimentary rocks:
\( \delta^{13}C \) typically lower than -20\%
RADIOCARBON \( \Delta^{14}C \) around -1000 \%
Mixing lines with isotopically light CO\textsubscript{2}.

-30 ‰
-25 ‰
-27 ‰
-30 ‰

$\delta^{13}$C

CO\textsubscript{2} from carbonate weathering by contemporary plant CO\textsubscript{2}.

Atmospheric CO\textsubscript{2}

Contemporary C3 plants

Carbonate rocks
Soil and epikarst CO₂ → CO₂ degased from dripwater → Cave air CO₂ → External atmosphere CO₂
Soil and epikarst CO$_2$ → CO$_2$ degased from dripwater → Cave air CO$_2$ → External atmosphere CO$_2$