

Appendix A4

Mixing equations

When mixing two endmember gases (A, B), where we mix a fraction ϕ_A of gas A into gas B, the hybrid isotopic compositions will be:

$$\left(\delta^{13}\text{C}\right)_{\text{hybrid}} = \frac{C_A^{\text{CO}_2} \phi_A (\delta^{13}\text{C})_A + C_B^{\text{CO}_2} (1 - \phi_A) (\delta^{13}\text{C})_B}{C_A^{\text{CO}_2} \phi_A + C_B^{\text{CO}_2} (1 - \phi_A)} \quad \text{and} \quad (1)$$

$$\left(\frac{{}^{222}\text{Rn}}{\text{CO}_2}\right)_{\text{hybrid}} = \frac{C_A^{\text{CO}_2} \phi_A \left(\frac{{}^{222}\text{Rn}}{\text{CO}_2}\right)_A + C_B^{\text{CO}_2} (1 - \phi_A) \left(\frac{{}^{222}\text{Rn}}{\text{CO}_2}\right)_B}{C_A^{\text{CO}_2} \phi_A + C_B^{\text{CO}_2} (1 - \phi_A)} \quad (2)$$

Where:

$C_X^{\text{CO}_2}$ = concentration of carbon dioxide in ppm in gas X

$(\delta^{13}\text{C})_X$ = isotopic composition of carbon in units of per mil in gas X

$\left(\frac{{}^{222}\text{Rn}}{\text{CO}_2}\right)_X$ = radon to carbon dioxide ratio in Bq kg^{-1} in gas X