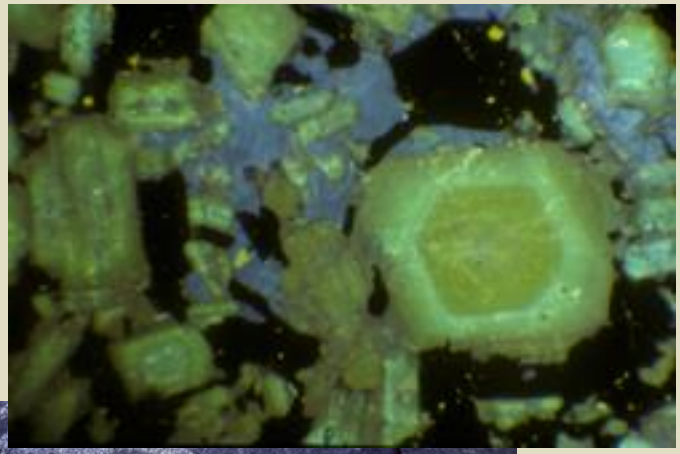
Mixing exercises

21.2: Major-elements based mixing test

In the CBPC, Amp and Cpx-bearing monzonites and monzogabbros are associated with the Kozárovice granodiorite (Janoušek et al. 2000). In addition, the granodiorite contains small net-veined bodies and enclaves of Bt–Amp quartz monzonite.



	1: granodiorite	M: quartz monzonite	2: monzogabbro
SiO_2	64.60	59.58	49.21
TiO_2	0.57	0.72	1.02
Al_2O_3	14.99	14.8	13.69
Fe_2O_3	1.27	1.69	2.47
FeO	2.79	4.08	6.96
MnO	0.08	0.14	0.15
MgO	2.37	4.11	8.53
CaO	3.44	5.33	9.74
Na_2O	3.12	2.84	1.89
K_2O	4.34	4.19	3.61

 `kozamix.data`

- Test whether the quartz monzonite (M) could correspond to a hybrid between granodiorite (1) and monzogabbro (2).
- Determine the proportion of granodiorite in the mixture.

21.2: Major-elements based mixing test

From mixing equation [6.23]:

$$C_M = f_1 C_1 + (1 - f_1) C_2$$

$$(C_M - C_2) = f_1 (C_1 - C_2) \quad \text{Eq. [21.13]}$$

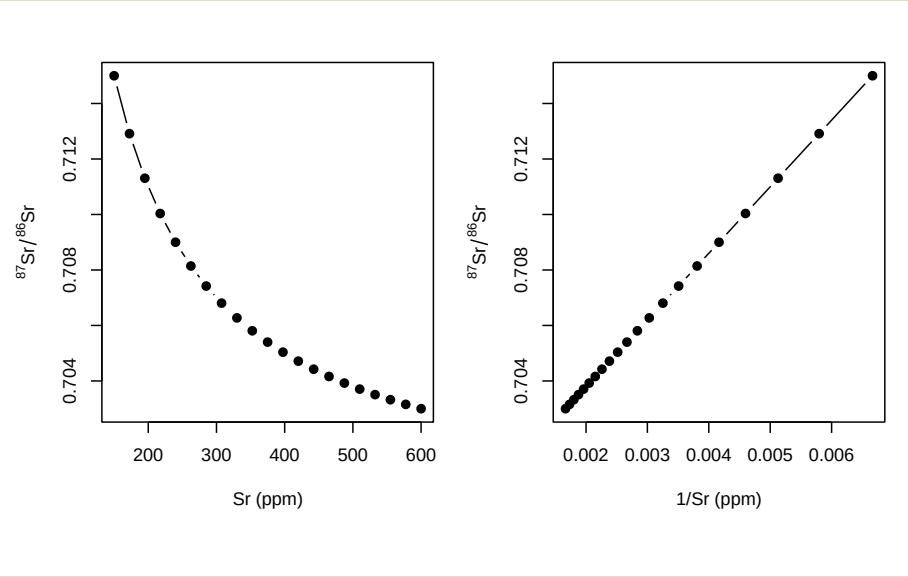
In R, the least-squares method is implemented by the function `lsfit` setting `intercept = FALSE`, so that the model passes through the origin.

18.1: Single isotopic ratio (direct mixing)

During its ascent, a basaltic magma is contaminated by a host-rock schist.

	A: schist	B: basalt
Sr	150 ppm	600 ppm
$^{87}Sr/^{86}Sr$	0.715	0.703

- Plot a theoretical mixing hyperbola between basalt and schist in the Sr–$^{87}Sr/^{86}Sr$ and 1/Sr–$^{87}Sr/^{86}Sr$ diagrams for 5% mixing increments.
- Calculate the $^{87}Sr/^{86}Sr$ ratio in a mixture containing 20 % of the schist.
- Determine the proportion of schist in the mixture that has $^{87}Sr/^{86}Sr$ = 0.710.



18.1: Single isotopic ratio (direct mixing)

$$C_M = f_1 C_1 + (1 - f_1) C_2$$ Eq. [16.2]

$$I_M = I_1 \left(\frac{C_1}{C_M} \right) f_1 + I_2 \left(\frac{C_2}{C_M} \right) (1 - f_1)$$ Eq. [16.1]

$$I_M = \frac{I_1 C_1 f_1 + I_2 C_2 (1 - f_1)}{C_1 f_1 + C_2 (1 - f_1)}$$ Eq. [16.3]

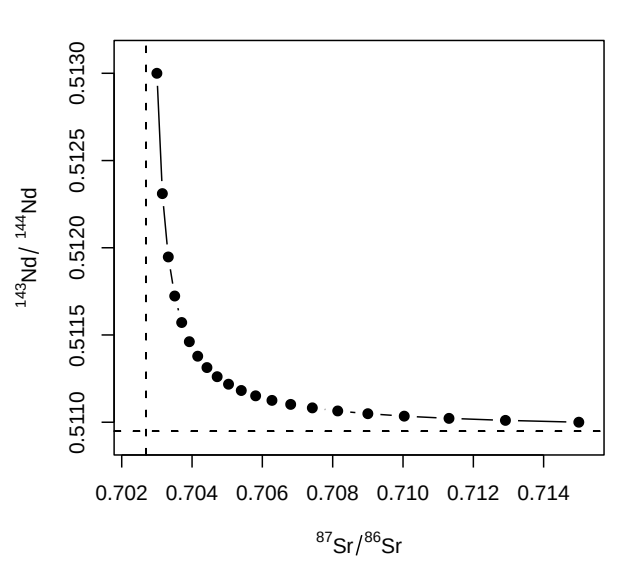
$$f_1 = \frac{C_2 \left(I_2 - I_M \right)}{I_M (C_1 - C_2) - I_1 C_1 + I_2 C_2}$$ Eq. [16.5]

18.2: Pair of isotopic ratios (direct mixing)

A basaltic magma is contaminated by a host-rock schist. However, here, both Sr and Nd isotopic data are available.

	A: schist	B: basalt
Sr	150 ppm	600 ppm
$^{87}Sr/^{86}Sr$	0.715	0.703
Nd	20 ppm	2 ppm
$^{143}Nd/^{144}Nd$	0.511	0.513

- Calculate the Sr (ppm), $^{87}Sr/^{86}Sr$, Nd (ppm) and $^{143}Nd/^{144}Nd$ of mixtures containing 0, 5, 10, … 100 % of the schist; print the result in a table.
- Plot a theoretical mixing hyperbola in the $^{87}Sr/^{86}Sr$ – $^{143}Nd/^{144}Nd$ space.
- Calculate and plot the asymptotes.



18.2: Pair of isotopic ratios (direct mixing)

$$C_M = f_1 C_1 + (1 - f_1) C_2$$ Eq. [16.2]

$$I_M = I_1 \left(\frac{C_1}{C_M} \right) f_1 + I_2 \left(\frac{C_2}{C_M} \right) (1 - f_1)$$ Eq. [16.1]

$$\alpha = \frac{(Sr / Nd)_2}{(Sr / Nd)_1}$$ Eq. [16.8]

Asymptotes:

$$x_0 = \frac{\left(\frac{^{87}Sr}{^{86}Sr} \right)_1 - \alpha \left(\frac{^{87}Sr}{^{86}Sr} \right)_2}{1 - \alpha}$$

$$y_0 = \frac{\left(\frac{^{143}Nd}{^{144}Nd} \right)_2 - \alpha \left(\frac{^{143}Nd}{^{144}Nd} \right)_1}{1 - \alpha}$$ Eq. [16.14]