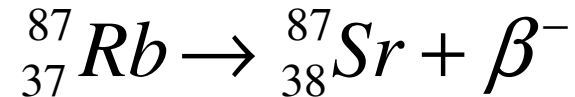


The Rb-Sr method

Based on the decay reaction:



with a half-life

$$T_{1/2} = 48.8 \text{ Ga}$$

We write the geochronometry equation in terms of the ratio ${}^{87}\text{Sr}/{}^{86}\text{Sr}$ because ratios are more accurately determined by mass spectrometry

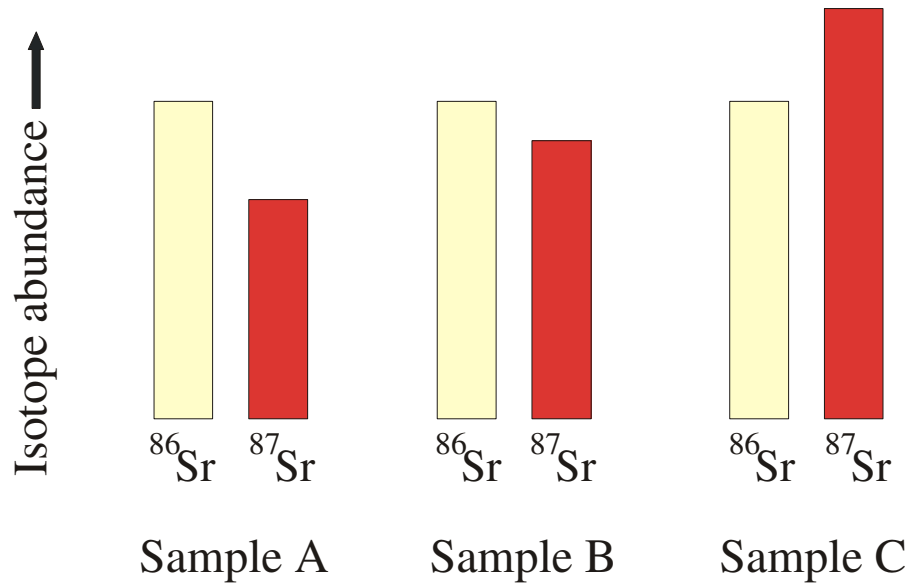
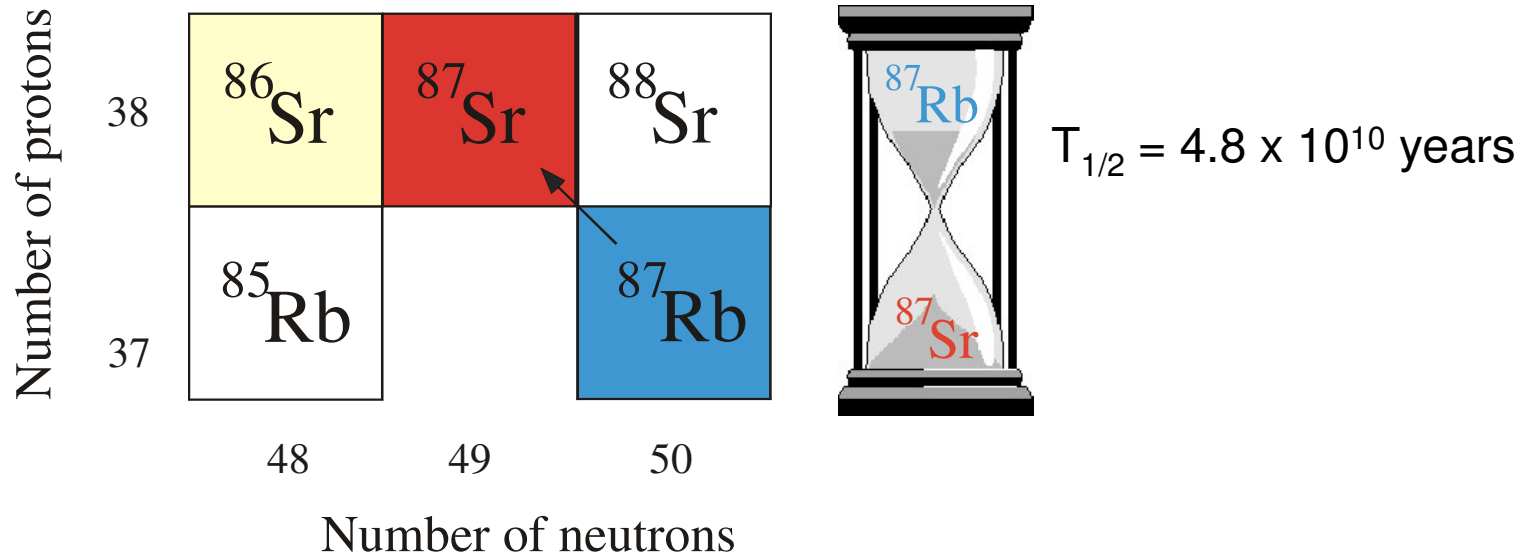
$$\frac{{}^{87}\text{Sr}}{{}^{86}\text{Sr}} = \left(\frac{{}^{87}\text{Sr}}{{}^{86}\text{Sr}} \right)_0 + \frac{{}^{87}\text{Rb}}{{}^{86}\text{Sr}} (e^{\lambda t} - 1)$$

The Rb-Sr method

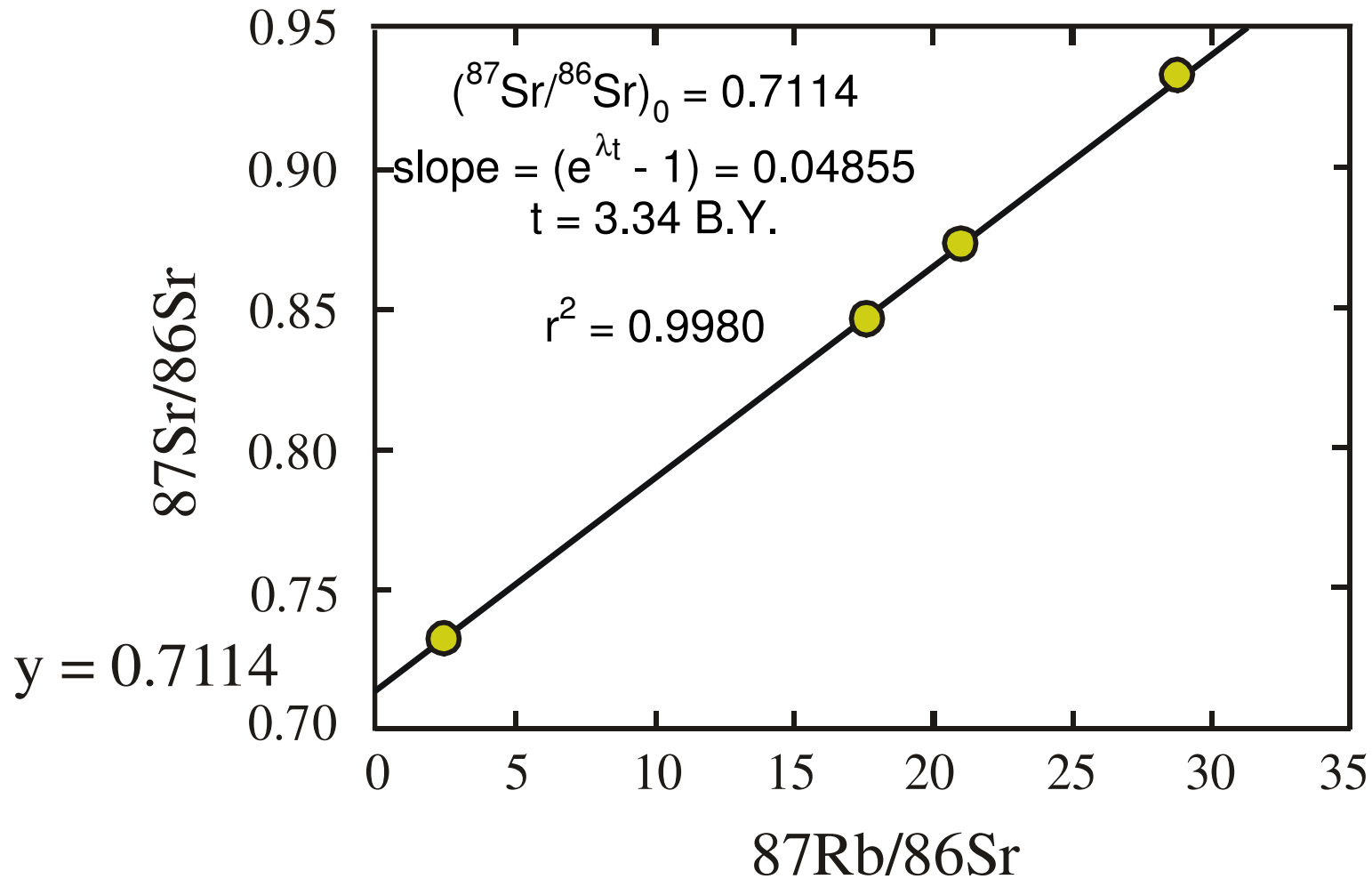
The Rb-Sr method is commonly used to date Rb-rich minerals such as muscovite, biotite and K-feldspar; these same minerals usually do not incorporate much Sr at the time of their formation (Goldschmidt's rules)

We usually use the **isochron method** to determine the age and initial $^{87}\text{Sr}/^{86}\text{Sr}$ ratio of a suite of rocks

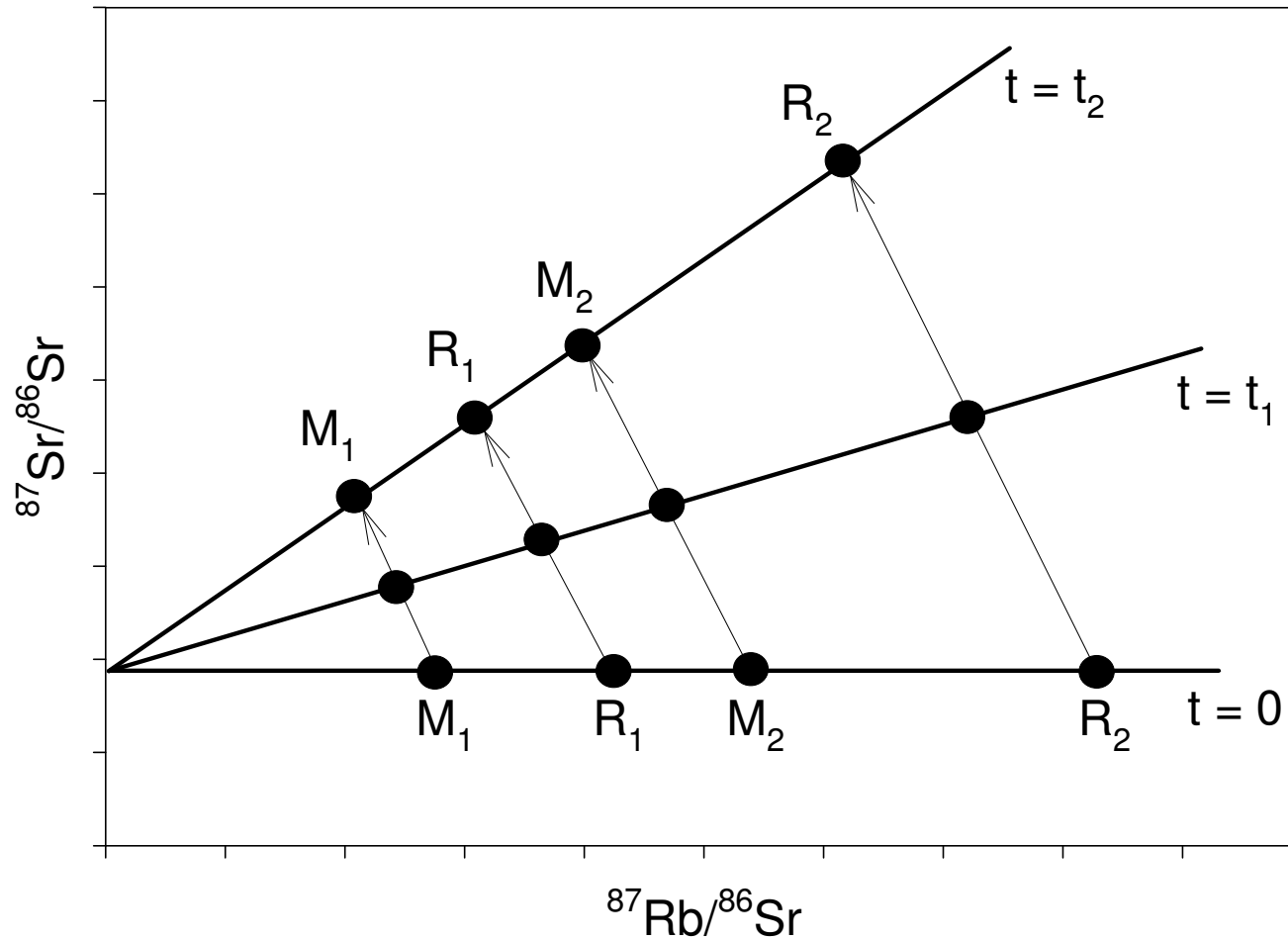
Rb-Sr System



Rb-Sr isochron diagram for a series of rock samples formed at the same time

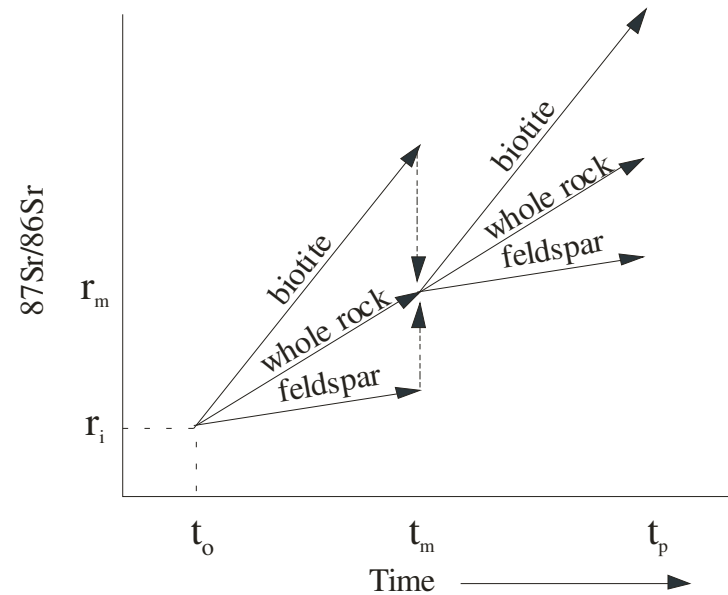
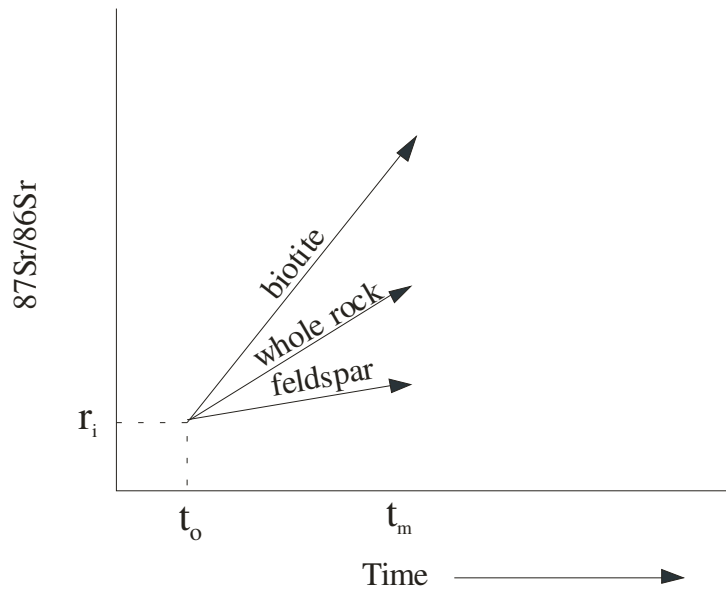
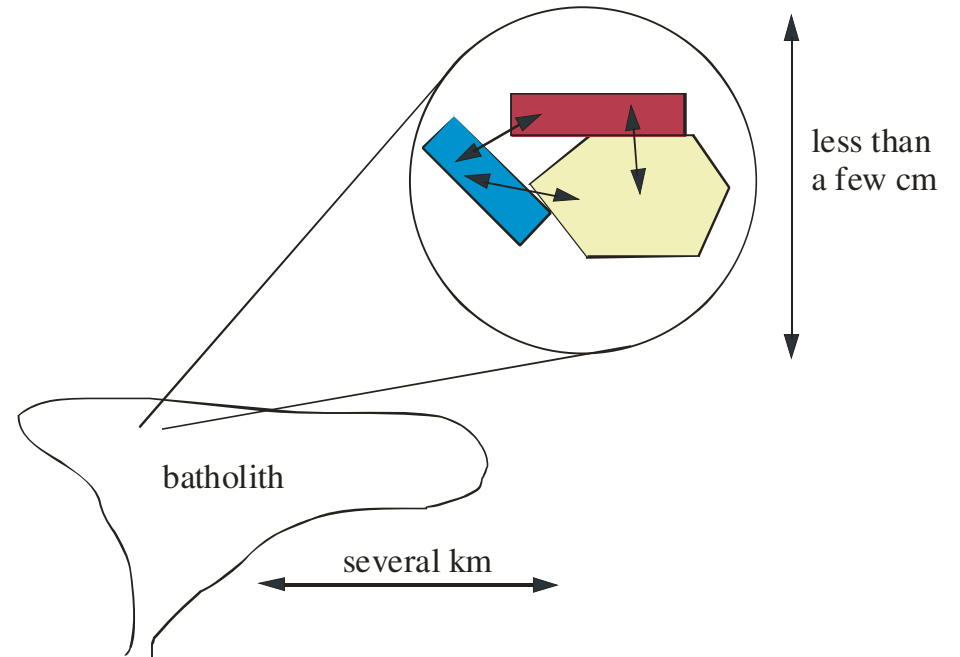


Rb-Sr isochron diagram illustrating how the isochron evolves as a function of time. M_1 and M_2 are cogenetic minerals and R_1 and R_2 are cogenetic rocks, all with different initial Rb/Sr ratios

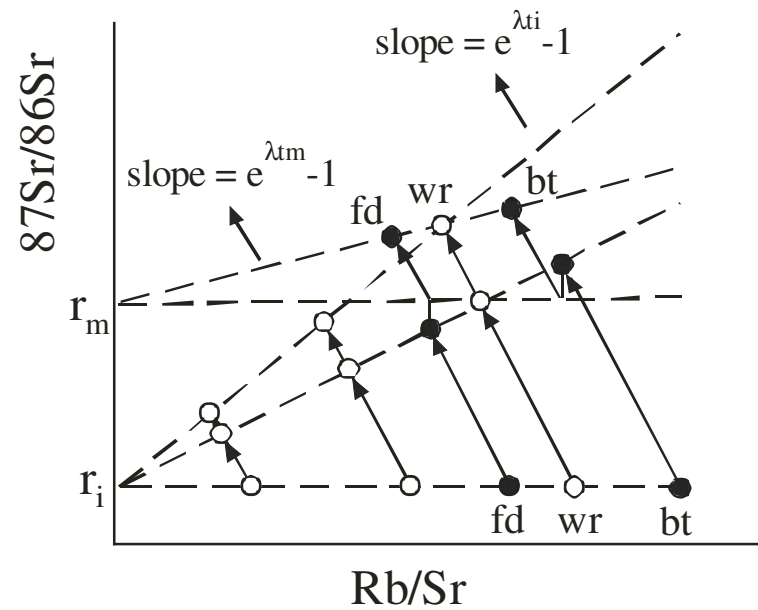
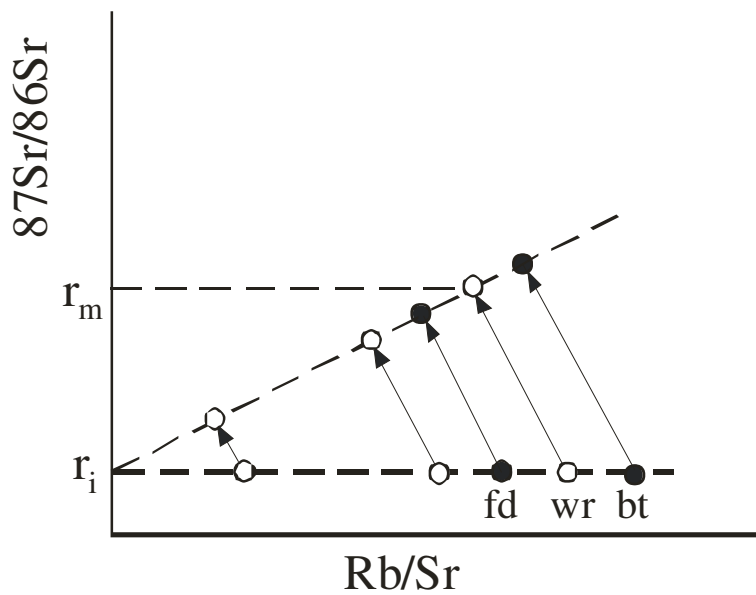
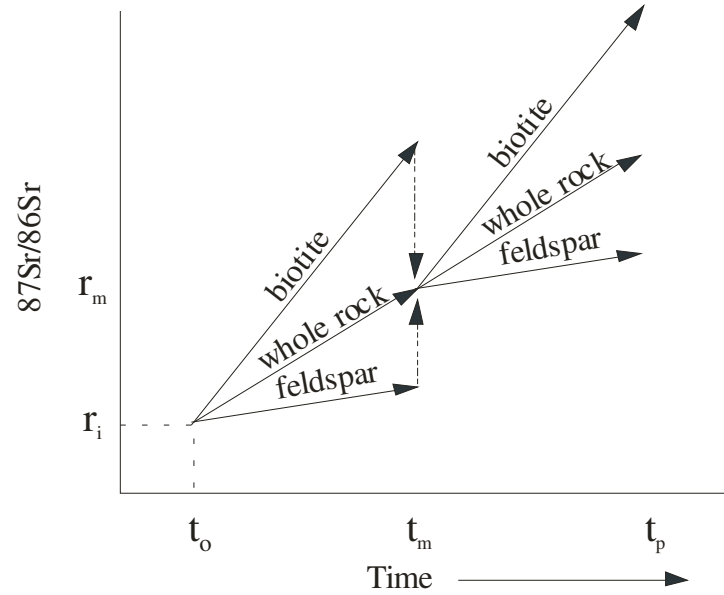
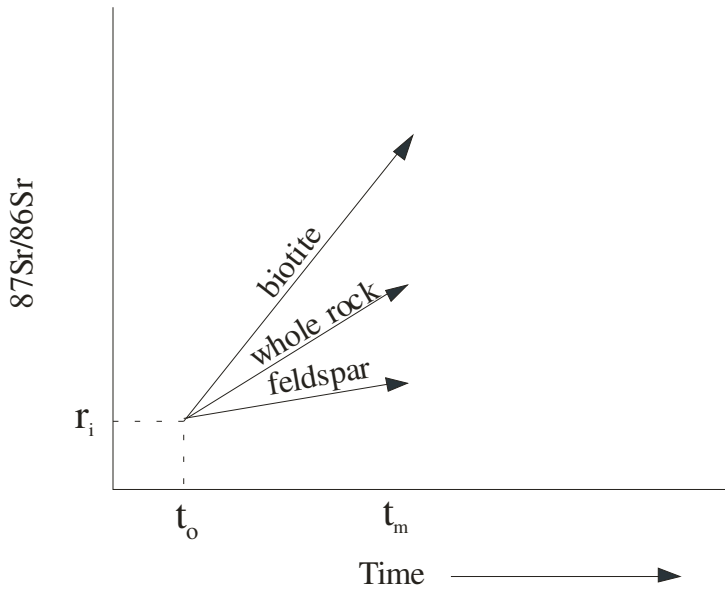


Rechts: Stoffdiffusion durch das Kristallgitter und entlang von Korngrenzen während der Metamorphose

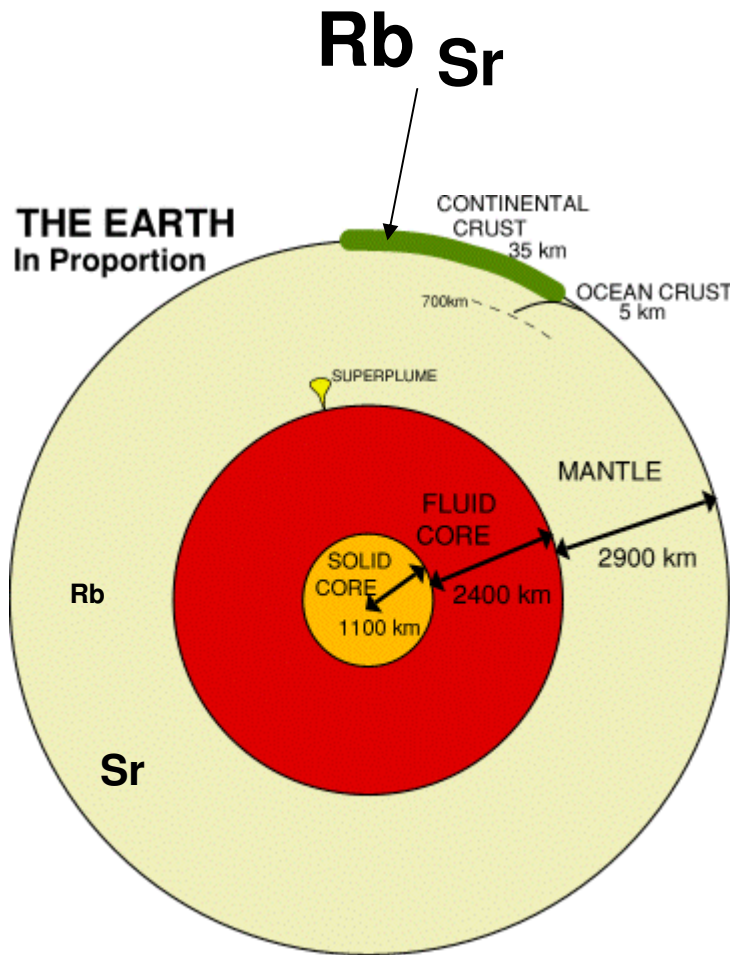
Unten: Verhalten des Rb/Sr-Systems während der Metamorphose



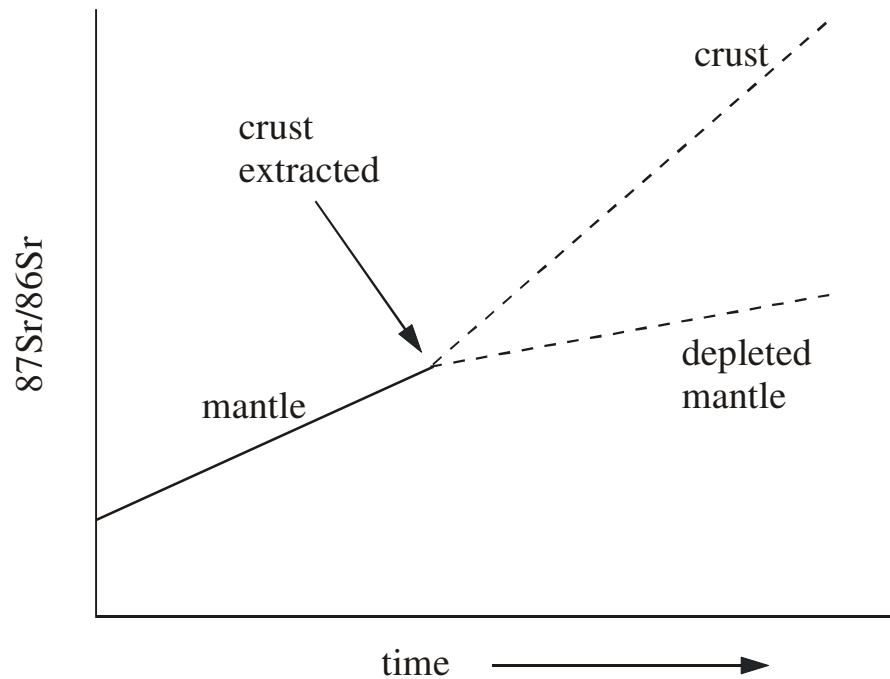
Verhalten des Rb/Sr-Systems während der Metamorphose



Sr isotopic evolution of the Earth

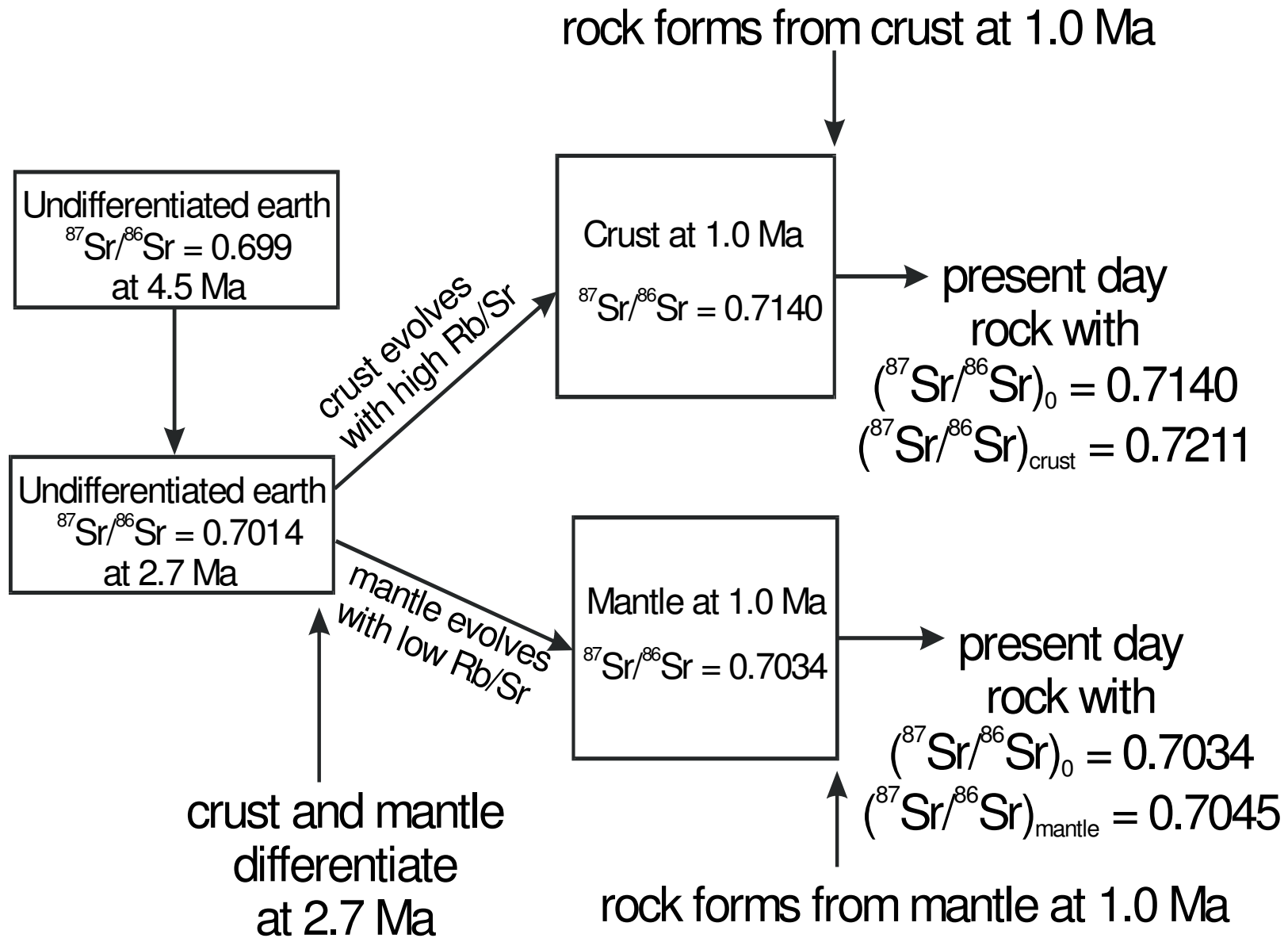


$^{87}\text{Sr}/^{86}\text{Sr}$ ratio of the crust is higher than that of the mantle due to the preferential partitioning of Rb into the crust relative to Sr.



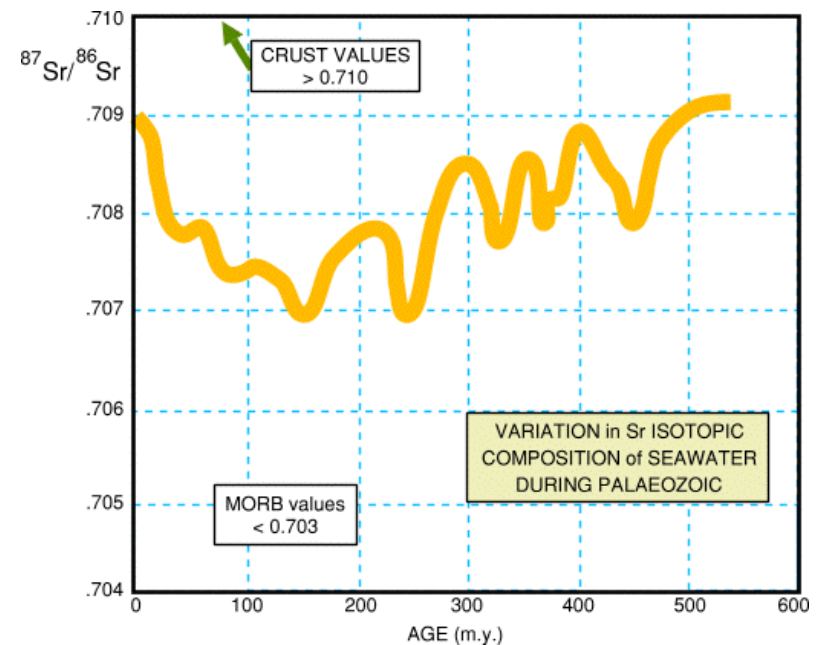
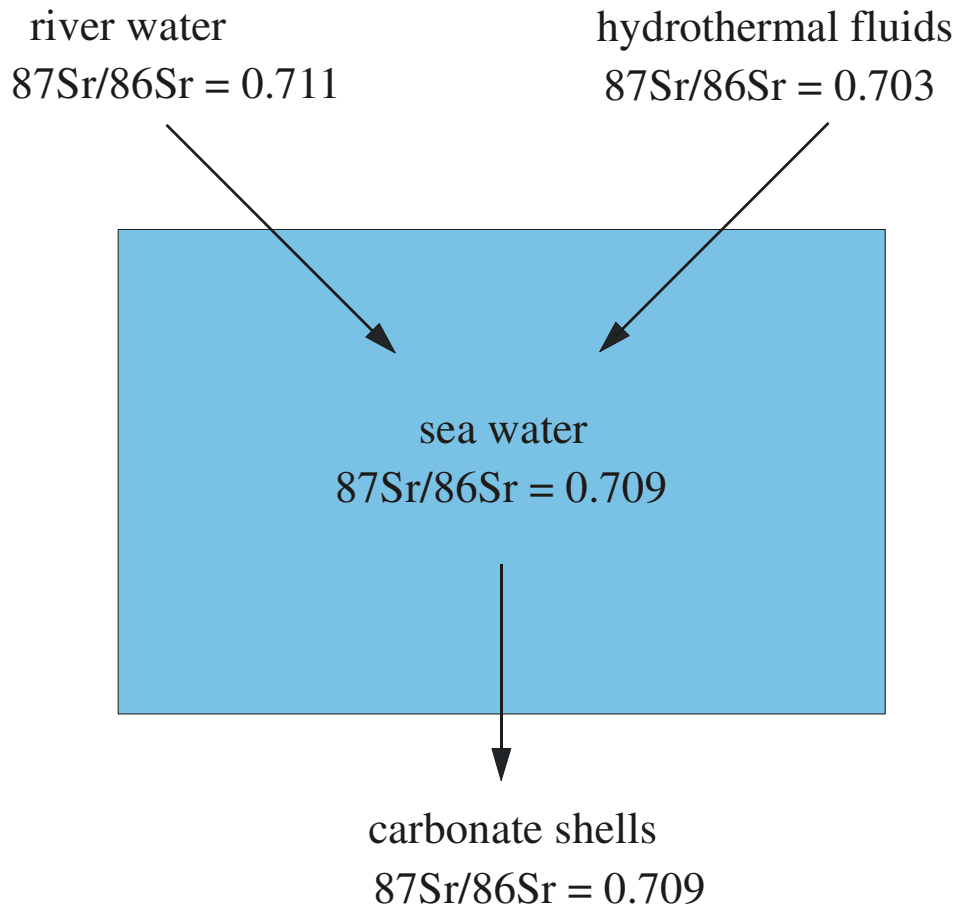
Continental crust: 32-78 ppm Rb, 260-333 ppm Sr
Depleted Mantle: 0.6 ppm Rb, 19.9 ppm Sr

Sr isotopes as tracer of rock origin



Sr in the oceans

Sr isotope composition of the oceans is determined by the relative contributions of Sr from river waters and hydrothermal sources



The evolution of $^{87}\text{Sr}/^{86}\text{Sr}$ with time in the continental crust and mantle

$(^{87}\text{Sr}/^{86}\text{Sr})_0$ ratios can be used as a tracer to determine if a magma evolved from the mantle or if crust was involved

For mantle-derived rocks:
 $(^{87}\text{Sr}/^{86}\text{Sr})_0 \approx 0.700\text{-}0.706$

For crustal involvement:
 $(^{87}\text{Sr}/^{86}\text{Sr})_0 \approx 0.705\text{-}0.740$

