Precise reconstruction of two-component mixing lines - an alternative Rb-Sr dating concept

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Conventional Rb-Sr dating generally assumes isotopic homogenization of Sr. Many common geological processes, however, involve mixing of two components having different Sr isotopic compositions rather than isotopic homogenization, such as overprinting of sedimentary rocks by hydrothermal solutions during ore deposit formation.

These rocks then may contain newly-formed or overprinted detrital sheet silicates found in different grain sizes of the clay fraction. As Sr isotopic homogenization was not necessarily achieved, these fractions may alternatively form a straight two-component mixing line in a $^{87}Sr/^{86}Sr$-$1/^{86}Sr$ mixing diagram at the time of hydrothermal overprint. The $^{87}Sr/^{86}Sr$ ratios of the fractions will change with time due to decay of ^{87}Rb and the linearity will be destroyed. The original mixing line then can be reconstructed by iterative recalculation of the sample $^{87}Sr/^{86}Sr$ ratios for various ages according to their complemetary $^{87}Rb/^{86}Sr$ ratios until the line of best statistical fit is obtained.

This approach was applied to different clay fractions of intensely altered sedimentary rocks hosting vein-type fluorite mineralization in the Harz mountains, Germany. These fractions display no linear arrangement in a Rb-Sr isochron diagram. Using a Sr mixing plot, however, a well-defined two-component mixing line is obtained for an age of 209 ± 4 Ma (2σ, MSWD=1.6). It can be shown that the Sr isotope signature of fluorite constitutes one end member, representative for the overprinting hydrothermal solution, whereas the other component is defined by coarse-grained detrital sheet silicates of the original rock system.