

CRYSTAL CHEMISTRY OF REE-PHOSPHATES: A LINK BETWEEN GROWTH CONDITIONS AND GROWTH AGES

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The partitioning of REE, Th, and U between the REE-phosphates monazite and xenotime depends strongly on temperature and slightly on pressure and is thus appropriate for use as a geothermometer. Temperatures calculated with this thermometer can be compared with temperatures obtained from various phase equilibria of coexisting silicates. Equilibrium and disequilibrium partitioning of REE are easily recognized. In the case of equilibrium distributions, U-Pb chronometry of single monazite or xenotime grains provides a direct link to their growth conditions and information on pressure-temperature-time paths. Progradly zoned monazites could reveal prograde branches of P-T-t paths provided that the spatial resolution and the resolution of the time-scale of the age determination method is precise enough. Partitioning of REE between both phosphates is also strongly dependent on ionic radii of the REE. This results in significantly different Sm/Nd-ratios at different temperatures even in the case of equilibrium. Sm-Nd chronometry provides reasonable two-mineral isochrons for such monazite-xenotime pairs. Xenotime acts much more effective than garnet as a refractory phase for HREE during anatexis and its role in melting processes is probably underestimated by far. In coexisting REE-phosphate pairs, U is strongly partitioned into xenotime via $(U,Th)+Si = REE+P$, whereas Th fractionates preferentially into monazite via $(Th,U)+Ca = 2REE$. U/Th ratios in coexisting phases depend on temperature and may differ by several orders of magnitude. Different behaviour of monazite and xenotime during anatexis dramatically alters U/Th-ratios of melt and residue. This effect is probably also important during fractional crystallization of granitic melts.