Rare Earth Element partition coefficients during high-grade metamorphism: Experiments, realities and large datasets

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For 15 years rare earth element (REE) partitioning between zircon and garnet has facilitated the coupling of U–Pb ages to metamorphism, particularly in the granulite facies. The combination of in situ analysis and rapid data acquisition, particularly through combined techniques such as laser ablation split stream (LASS), means that complex terranes can be interrogated with increasing detail. However this detail provided by large datasets must also be combined with an understanding of the processes involved, for example the relative mobility of the REE, Ti, U and Pb within zircon grains that have withstood intense P–T conditions to varying degrees. Care must also be taken in identifying open system conditions, for example the presence or passage of partial melts that result in non-equilibrium, or very localised equilibrium, between the phases of interest.

Visualisation of REE partition coefficients (D_{REE}) becomes more complex with large datasets particularly when dealing with variably recrystallised zircon grains or multiple generations of garnet. Simple methods of visualising the important partitioning parameters enable direct links to be made between experimental and empirical datasets, and can possibly be used as thermometers for zircon growth and for the identification of thermal peaks.

Investigation of D_{REE} values in both long-lived high grade terranes (e.g. S. India), and complex polymetamorphic terranes (e.g. Enderby Land, E. Antarctica) provides an insight into how partitioning information can be interrogated consistently even when dealing with issues such as variably recrystallised zircon and melt migration.