



Intra-crystalline element and ion re-distribution in UHT zircon: consequences for U-Pb age determination.

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We propose an alternative mechanism for intra-granular elemental migration to that of simple volume-diffusion in zircon. A solid-state coupled dissolution-reprecipitation of zircon is a potentially viable mechanism by which compatible elements can be recycled and incorporated into 'new' zircon lattice, devoid of damage or misorientations. This case study will have important implications for interpreting complex age distributions from ancient zircon, especially those lacking intra-granular textural context (e.g. detrital grains with no equivocal core-rim relationships). Distinguishing between real or apparent ages in such grains is key to our interpretation of early Earth processes. By invoking coupled dissolution-reprecipitation, we also indirectly advocate the existence of Pb^{4+} as a compatible ion of Pb in zircon.

We present zircons from the Lewisian Gneiss Complex (LGC) with $^{207}\text{Pb}/^{206}\text{Pb}$ ages (98-102% concordant) that are irreconcilable with core-rim textures observed under cathodoluminescence (CL). The rim, in textural terms the *youngest* part of the grain, records an age much *older* than most of the core. This anomalous distribution of apparent ages is frequently explained in terms of an intra-crystalline migration of radiogenic Pb, but may also signify a redistribution of U.

Embayed regions of cores suggest partial resorption has occurred. We suggest that the dissolution of the core domain, coupled with its simultaneous reprecipitation as rim material could potentially explain the observed elemental redistribution within these grains, without necessarily having to invoke volume diffusion. The apparent age difference between the surviving core and the newly reprecipitated zircon might be explained in terms of a preferential uptake of Pb(VI)^{4+} into the rim over that of less compatible U. Furthermore, this would provide indirect evidence that radiogenic Pb(VI)^{4+} can readily substitute into the zircon lattice when suitable conditions are met.