# Controls on lithium concentration in zircon

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Application of thermal annealing and chemical abrasion procedures to natural igneous zircons prior to laser ablation ICP-MS analysis leads to significantly higher concentrations of lithium in the zircon lattice, which is positively correlated with trivalent yttrium and rare earth elements. Prior to such treatments, zircons contain lithium below detection limits, unless correlated with lanthanum, aluminum and other melt/mineral inclusion-related elements (implying a contaminated signal). This suggests that lithium in zircon is primarily sequestered within inclusions, and is able to permeate the crystal lattice to charge-compensate trivalent cations during the thermal annealing procedure at rates that are 2-3 orders of magnitude faster than diffusion experiments have previously suggested. Because lithium is incompatible in zircon, charge compensation of rare earth elements in *natural settings* is likely accomplished by the much more abundant hydrogen under water-saturated conditions. However, thermal annealing places zircons (and their fluid-saturated melt inclusions) in strong disequilibrium with dry atmosphere, resulting in a tendency to lose hydrogen and lithium. This induced chemical potential is typically not taken into account in lithium-in-zircon diffusion experiments and may explain the perceived discrepancy in diffusion rates. We propose that these thermal annealing conditions in the laboratory may be analogous to pre- and syn-eruptive degassing, and accelerate the diffusion of lithium away from melt inclusions. These results may therefore be of importance in interpreting lithium-in-zircon diffusion data.