Zircon below the micron scale: on the trail of errant elements

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Microbeam analysis of zircon requires an understanding of heterogeneities that might compromise U-Pb isotope systematics on the micro- and nano-scale. Heterogeneous Pb distribution has been identified using secondary ion mass spectrometry (SIMS) [1,2,3], transmission electron microscopy (TEM); [4,5,6] and atom probe tomography (APT) [7,8,9,10]. SIMS and APT studies have revealed clustering of radiogenic Pb atoms in zircon, whereas nano-inclusions of metallic Pb have been observed by TEM. Those identified by APT are in too low a concentration to affect U-Pb geochronology, whereas Pb nano-inclusions can affect U-Pb systematics. The formation of both types of inhomogeneity is likely produced through lattice recovery during annealing of radiation-damaged zircon, with the clustering possibly being a precursor to nano-inclusion formation. To ensure that analytical accuracy is not compromised, geochronological results need to be linked with micro- to nano-scale structural investigations, especially in cases where metamorphism has affected the minerals.

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