Nanoscale analysis of zircon standards by atom probe microscopy

D.W. SAXEY [1,2]*, S.M. REDDY[3], W.D.A. RICKARD[1,2], D. FOUGEROUSE[3], A. VAN RIESSEN[1,2]

[1] Geoscience Atom Probe, Advanced Resource Characterisation Facility, John de Laeter Centre, Curtin University, Perth, Australia (*correspondence: david.saxey@curtin.edu.au)

[2] Department of Physics and Astronomy, Curtin University, Perth, Australia

[3] Department of Applied Geology, Curtin University, Perth, Australia

Atom Probe Microscopy (APM) has recently been applied to the analysis of zircon[1,2.]. This 3-dimensional nanoscale analysis technique allows geochemists to peer beyond the spatial resolution limit imposed by more conventional ion-probe analysis techniques – particularly in investigating U, Th, Pb, and trace element distributions. These recent studies aim to elucidate the mechanisms underpinning trace element mobilisation in these minerals, and thereby improve the interpretation of geochronology and geochemical data sets. Insights gained from these high-resolution studies may also enable new methods – for example, dating of metamorphism, and deformation[3].

Laser-assisted Atom Probe Microscopy is based on the field-evaporation of atoms from a needle-shaped specimen, employing time-of-flight mass spectrometry to identify isotopic species[4]. In this 'laser-mode' the field-evaporation is triggered by a thermal pulse initiated by a laser focussed at the specimen apex. The acquisition process is highly dependent on the conditions in this region of the specimen, and the quality of the data (as determined by such metrics as background noise, mass resolving power, and the presence of molecular and complex ion mass interferences) may be highly dependent on the analysis parameters: laser pulse energy, evaporation rate, temperature, and specimen geometry among others. These acquisition parameters must therefore be optimised for each material system.

This work reports on foundational systematic studies in the APM analysis of zircon reference material 91500. Various optimisations are presented, aimed at providing general methods for maximising the extraction of geochemical information from zircon samples via APM. Comparisons are made with results from other correlative techniques.

[1] Valley *et al.* (2015) Am. Mineral. **100**, 1355–1377. [2] Piazolo *et al.* (2016) Nat. Commun. **7**, 10490. [3] Cavosie *et al.* (2015) Geology **43**, 99-102. [4] Kelly *et al.* (2012) Annu. Rev. Mater. Res. **42**, 1-31.