Mechanisms of Radiogenic Isotope Redistribution in Minerals: Evidence from the Nanoscale

STEVEN M. REDDY*[1,2], DAVID W. SAXEY[1], WILLIAM D.A. RICKARD[1], DENIS FOUGEROUSE[1,2], RICK VERBERNE[1,2], CHRIS KIRKLAND[2] & EMILY PETERMAN[3]

[1]Geoscience Atom Probe, Advanced Resource Characterization Facility, John de Laeter Centre, Curtin University, GPO Box U1987, Perth, WA 6845, Australia.

[2]School of Earth and Planetary Sciences, Curtin University, GPO Box U1987, Perth, WA 6845, Australia.

[3]Earth and Oceanographic Science; Bowdoin College; Brunswick, Maine, USA.

(*correspondence: s.reddy@curtin.edu.au)

The application of thermochronology to rocks and minerals is underpinned by an assumption that isotope mobility is governed by volume diffusion. Such an assumption allows age variations to be systematically modelled and T-t paths to be constructed. However, an increasing number of nanoscale studies are showing that the growth and subsequent modification of mineral elemental and isotopic compositions are governed by a complex range of processes that take place at the atomic scale. Investigating such processes requires a comprehensive analytical workflow that integrates structural and compositional data at a range of scales. This talk will focus on recent advances in our ability to characterize nanoscale isotopic heterogeneities in Pb within minerals. These new approaches highlight the important role of mineral defects (e.g. dislocations, interfaces) in controlling Pb distribution and the evolution of isotopically-distinct nanoscale Pb reservoirs in minerals. This increasingly complex picture of Pb behavior may compromise the traditional approach to thermochronological investigations that rely on volume diffusion. However, such knowledge will ultimately lead to new advances in the reconstruction of T-t histories from minerals and their host rocks.