

Assessing open-system behaviour in baddeleyite
(ZrO₂): A combined SIMS δ¹⁸O and TIMS U-Pb study

MIMMI K.M. NILSSON*, RICHARD A. STERN, LARRY M.
HEAMAN

Dept. Earth and Atmospheric Sciences, University of
Alberta, Edmonton, AB, Canada. T6G 2E3.

(*correspondence: mimmi@ualberta.ca)

Baddeleyite (ZrO₂) is a common accessory phase in silica-undersaturated rocks. Baddeleyite excludes Pb during crystallization, but incorporates uranium (up to 5000 ppm), making it an ideal mineral for U-Pb geochronology. Due to improved methods for extraction of micro-baddeleyite (<100 μm), as well as refined in-situ and dissolution analytical techniques, baddeleyite is now a common mineral used to date mafic rocks. However, certain aspects of baddeleyite U-Pb systematics have been largely overlooked. It is clear from co-crystallizing zircon (ZrSiO₄) and baddeleyite that the mechanism of lead-loss in baddeleyite differs from that of zircon, baddeleyite commonly yielding less discordant U-Pb ages. To better understand post-crystallisation open-system behaviour of baddeleyite, we report results from a combined SIMS δ¹⁸O and TIMS U-Pb study. Oxygen isotopic compositions of baddeleyite grains from an undeformed and unmetamorphosed Cenozoic syenite were analysed by SIMS, and subsequently extracted from the mount for TIMS U-Pb on individual grains. The baddeleyite δ¹⁸O_{VSMOW} values are heterogeneous and vary between +2.5 to -5.1 per mil, reflecting interaction with meteoric waters. The open-system behaviour is corroborated by discordant U-Pb TIMS ages. It is possible that an unusually high U content in baddeleyite facilitates open-system behaviour by higher degrees of alpha recoil damage.