

Structural and chemical characterization of baddeleyite with implications for U-Pb geochronology

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Baddeleyite (ZrO_2) is a trace phase found in mafic rocks that can be used for U-Pb geochronology since it incorporates U into its crystal structure whilst rejecting Pb, similar to zircon. U-Pb ages determined from baddeleyite are typically concordant or close to concordant, whereas non-chemically abraded zircon from the same samples with similar U concentrations often record large and variable degrees of discordance. The difference between baddeleyite and zircon suggests that these minerals respond differently to radiation damage created by Uranium decay.

Here we attempt to investigate how baddeleyite responds to radiation damage using structural, chemical and geochronological information from a suite of baddeleyite crystals from gabbroic sills, dolerite dykes, carbonatites and metamorphosed limestones with an age range of 2 Ga. We use TEM, Raman spectroscopy, elemental analysis, electron imaging and U-Pb geochronology to investigate how baddeleyite responds to radiation damage. We relate these findings to open system behaviour in baddeleyite with the aim of determining how Pb is lost from baddeleyite crystals.

Based on our exhaustive analysis of different baddeleyite crystals, we determine the most likely causes of open system behaviour.