

## Evaluation of the Stillwater Complex Anorthosite (ANII) as an Archean U-Pb Geochronology Standard

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Reference materials are essential for precise and accurate U-Pb zircon geochronology. For a natural reference material, there must be a well-established method to first determine the true value. In the case of U-Pb geochronology, chemical abrasion isotope dilution thermal ionization mass spectrometry (CA-ID-TIMS) is the “gold standard” for U-Pb dating. The growing use of *in-situ* techniques, especially U-Pb zircon dating by laser ablation ICP-MS, requires the development of natural reference materials for matrix-matched age calibration, age normalization, and quality control. Although there are a number of zircon standards available for U-Pb LA-ICP-MS (e.g., Plesovice, 91500, Temora, FC-1), there are as yet no widely available Archean zircon standards. This lack of an adequate standard becomes important when assessing downhole U-Pb fractionation during LA-ICP-MS analyses and when applying a correction for Archean zircon grains of unknown age. Zircon is relatively abundant in a sample of anorthosite (ANII, Middle Banded Zone) in the Stillwater Complex, a Neoarchean mafic-ultramafic layered intrusion in Montana (USA). We present new U-Pb isotopic results for ANII zircon and propose that it is a candidate as a reference material for U-Pb LA-ICP-MS dating of Archean zircon.

Zircon grains were inspected by both backscattered electron (BSE) and cathodoluminescence (CL) imagery. Zoning patterns, when present, are simple igneous sector zoning and there is no evidence for inheritance. The chemically abraded grains (n=9) were slightly pink, crack-free, inclusion-free, and ~250 microns in the longest dimension. All nine analyses yielded equivalent U-Pb and Pb-Pb dates (<0.1% discordance), clustering near the concordia curve. The weighted mean  $^{207}\text{Pb}/^{206}\text{Pb}$  age of  $2710.44 \pm 0.32/0.32/2.35$  Ma (analytical/+tracer/+decay constant errors, MSWD = 0.12) is indistinguishable from the concordia age of  $2710.0 \pm 2.4$  Ma (MSWD = 0.02, decay constant errors included). All zircon grains analysed by LA-ICP-MS were large (>300 microns), clear, colourless to light pink, and inclusion/crack-free to avoid possible Pb-loss zones. Of the 65 laser spots, 58 yielded U-Pb dates that are concordant with a weighted  $^{207}\text{Pb}/^{206}\text{Pb}$  age of  $2713 \pm 11$  Ma (MSWD = 0.27) and a concordia age of  $2710.3 \pm 5.0$  Ma (MSWD = 0.10, decay constant errors included). Despite the lower precision of the laser ablation-ICP-MS dates compared to those by ID-TIMS, these results demonstrate age homogeneity on the scale of tens of microns both for individual grains and for a multi-grain sub-sample. The lack of any significant Pb-loss can be attributed to the consistently moderate U concentrations (~300 ppm on average) resulting in only minor crystal lattice damage since crystallization.