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Developing Matrix-Matched Epidote Reference Material for LA-ICP-MS U-Pb Dating

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Epidote is common in porphyry, skarn, epithermal, and orogenic gold deposits, and in metamorphic rocks. Its age can directly constrain the timing of hydrothermal and metamorphic events. However, no epidote reference material (RM) currently exists for LA-ICP-MS U-Pb dating. Allanite samples have been used as RMs for epidote dating, but their effectiveness is limited by significantly different matrix from epidote (high vs low Th) despite they belong to the same group. Other known issues include high common Pb, excess ²⁰⁶Pb, Th/U fractionation, and chemical heterogeneity.

This study strives to find epidote samples as matrix-matched RMs. We have tested 20 epidote samples and found one potential RM, Antapata. The epidotes were tested using zircon 91500 and allanite Tara as primary RMs, and CAP and BONA as secondary RMs. Back-scattered electron imaging and LA-ICP-MS trace element mapping were used to find U-rich domains, which correspond to brighter BSE zones. NIST 610 and NIST 612 were used for trace element calibration, and electron probe micro-analysis (EPMA) was conducted to obtain major element compositions.

The Antapata epidote was dated three times. The U-Pb dates with 91500 as the primary RM range from 35.9 ± 1.2 to 37.3 ± 0.5 Ma, whereas Tara-calibrated dates are 33.8 ± 1.2 to 35.5 ± 0.7 Ma. Antapata has U contents of 10-285 ppm, low Pb contents of 0.1-0.9 ppm, and low Th contents of 0.2-0.6 ppm, with low common Pb of ~5% in high U zones. EPMA results indicate relatively homogenous major element composition, with 16.02 ± 0.42 wt.% Fe₂O₃. Uranium has a positive correlation with Fe ($R^2=0.82$). Antapata epidote features uniform dates, high U, low common Pb, low Th, and identifiable U-rich domains, which makes it a promising matrix-matched RM for epidote LA-ICP-MS U-Pb dating. TIMS dating is on-going to obtain the accurate and precise age of Antapata.