

First Demonstration of In Situ Rb–Sr Dating Using LA-ICP-MS/MS Applied to Beryl and Amazonite

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Abstract: Beryl and amazonite are crucial minerals in the extraction of beryllium (Be) and rubidium (Rb) rare metals. Direct dating of these minerals provides a more accurate estimation of mineralization time for Be and Rb rare metals compared to indirect methods like U-Pb dating of other accessory minerals. This study demonstrates the feasibility of in situ Rb-Sr dating of beryl and amazonite using LA-ICP-MS/MS. The beryl samples from Inner Mongolia, China, contain Rb levels ranging from 20 to 200 $\mu\text{g}\cdot\text{g}^{-1}$, with relatively low Rb/Sr ratios. The amazonite samples, sourced from the United States, Norway, Japan, and China, show higher and more varied Rb contents, with Rb levels between 1,963 and 11,200 $\mu\text{g}\cdot\text{g}^{-1}$. The results confirm that in situ Rb-Sr dating of beryl and amazonite is a viable technique. Experiments conducted in northern Inner Mongolia revealed a beryl Rb-Sr age of 239.7 ± 2.5 Ma, consistent with the U-Pb age of niobium-tantalum ores, within the error margin. This significantly outperforms the Rb-Sr age of albite (383 ± 14 Ma) from the same location. The study also introduces a data reduction scheme (DRS) and a Visual Rb-Sr age plugin for Iolite software to process the Rb-Sr age data. Unlike previous research that used the magmatic U-Th-Pb system to determine the age of rare-metal-bearing granitic pegmatites, this in situ Rb-Sr geochronology of beryl and amazonite offers a new, independent method for determining the age of beryllium and rubidium rare-metal minerals. The development of beryl and amazonite geochronology marks a significant breakthrough in the study of Be and Rb-bearing rare-metal deposits.