

# The age and source of Be and U mineralization from the Baiyanghe Deposit

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Critical elements (e.g., Li, Be, U) are essential for energy, technology, and national defense applications. Therefore, it is important to develop effective exploration strategies, understand how critical element deposits form and develop genetic models for these deposits. The Baiyanghe deposit, China, is the largest Be-U deposit in Asia. Despite several recent studies, the age and sources of Be and U remain controversial. Here we use the Sm-Nd and Sr isotopic composition of ore-bearing and barren fluorite and the U-Pb isotopic composition of uranophane beta to precisely date the Be and U mineralization, and the O isotopic composition of calcite and quartz to determine the source of the fluids. Our results indicate that there are two stages of Be mineralization that occurred at  $310 \pm 12$  and  $261 \pm 3$  Ma. The Sr and Nd isotope data suggests that fluorite formed from mantle-derived fluids that interacted with the Yangzhuang rhyolite (YR) and the Tarbagatay Group, which are the sources of Be and U. The O stable isotope data indicate mineralization is associated with two fluids with different  $\delta^{18}\text{O}$  values that mixed with meteoric or basinal fluids. Recent meteoric fluid events remobilized U from uraninite and precipitated uranophane at  $14.1 \pm 3.6$  Ma and  $4.1 \pm 2.0$  Ma along fractures throughout the YR. Therefore, the Baiyanghe Be-U deposit is a hydrothermal deposit hosted in volcanics where recent meteoric fluids remobilized U leaving the Be mineralization relatively intact.