

Revisiting zircon Eu anomaly as a proxy for crustal thickness: a case study of the Sierra Nevada Batholith - *Shen-Su Sun Foundation Award Lecture*

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Quantifying the evolution of crustal thickness holds significant importance in unraveling the complex interplay among tectonism, magmatism, and climate in orogens. Here, we re-examine the reliability of zircon Eu anomaly as a proxy for tracking crustal thickness through a case study on the Sierra Nevada batholith in western North America. Our reconstruction shows two episodes of crustal thickening between 80-200 Ma in the Sierra Nevada region—one during the Jurassic (170–140 Ma) and the other in the Cretaceous (110–80 Ma). These findings are consistent with the results obtained using the whole-rock La/Yb proxy and observations on crustal deformation. Our results underscore the validity of zircon Eu/Eu* proxy for tracing the evolution of crustal thickness at the batholith or orogen scale, provided that a sufficient number of analyses are obtained. Recent petrologic models questioned the validity of the zircon Eu/Eu* proxy because of the complex interplay among various factors that may affect zircon Eu/Eu*. These models, however, overlooked the interconnections between these factors. In particular, magma redox condition and water content, which are known to significantly impact zircon Eu/Eu*, may also be controlled by differentiation pressure. Therefore, rather than complicating the interpretation, these factors could potentially enhance the pressure control on zircon Eu/Eu*.