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Petrochronology of detrital titanite reveals both local and arc-scale processes across Sierra Nevada arc

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This study explores the utility of detrital titanite petrochonology as a tool to investigate arc processes that operate on local- and regional scales using titanite derived from the Sierra Nevada Cretaceous batholith. To characterize the full range of titanite ages and trace-element compositions across the Cretaceous batholith, we collected six samples of modern sands (n = 850) from stream catchments dominated by exposures of the western Fine Gold Intrusive Suite (FGIS; ca. 120–110 Ma), the axial Yosemite Valley Intrusive Suite (YVIS; ca. 105-100 Ma), and the eastern Tuolumne Intrusive Suite (TIS; ca. 96–88 Ma).

Trace-element plots yield several interesting trends: 1) a bimodal distribution of Th/U. Older samples tend to have low Th/U, with some high values, whereas younger samples tend to have high Th/U, with a moderate amount of low values. Grains with low Th/U also have low Zr, La, and Sr. We interpret this to reflect the difference between two types of titanite crystallization (local scale): i) sub-solidus crystallization, either at the expense of ilmenite or through hydrothermal alteration and ii) primary igneous growth. The change from one dominant style of crystallization to another signifies changes in a more regional scale, possibly in the source, thermal history, etc. 2) Eu anomaly variability decreases over time. Buffering of Eu in the older grains is indicated by a negative correlation between Sm and Eu^*. This monotonic decrease in Eu^* variability is likely caused by changes in the source over time. 3) Transition metals (Cr, V) decrease monotonically from ca. 120–100 Ma, and then again from ca. 96–88; variability also decreases over time. These trends likely show shifts in the source between the YVIS and TIS, and changes in the source during continued emplacement over shorter time periods. Taken together age+TE data in titanite can provide insight into a number of processes occurring over a variety of scales.