The volcanic record of central Sierra Nevada Mesozoic arc flare-ups and secular evolution of the lithosphere

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Temporal and spatial variations in arc and orogenic activity, termed 'arc tempos', show no clear links between shifting subduction dynamics and magmatic volume addition rates, suggesting that upper plate processes, occurring in either the lithosphere or mantle wedge, drive arc tempos [1]. We present ~1500 ICPMS-LASS zircon U-Pb geochronology and trace element analyses coupled with ~900 subsequent zircon Lu-Hf isotope analyses from grains separated from 42 samples of central Sierra Nevada (California, USA) Mesozoic metavolcanics. This volcanic zircon record provides petrologic and tectonostratigraphic context missing from detrital zircon, plutonic, and whole-rock geochemical records, revealing multi-scale temporal trends in magmatic activity and lithospheric evolution.

Individual samples show zircon grain initial εHf values spanning up to 20 epsilon units, indicative of variably mixed evolved and juvenile end member melt sources. Zircon trace elements do not show trends with respect to zircon Ti and Hf concentrations or Hf isotopic composition. Complex mixing of melts and/or zircons may have occurred via diverse mechanisms spanning melt generation to volcanic eruption.

New volcanic U-Pb ages confirm the expression of previously documented [1] 10s Ma scale episodic magmatism in the volcanic record. Over each ~30 Ma flare-up, initially widely spread zircon initial εHf values decrease in range and become more primitive. Zircon trace elements show repeated patterns within each flare-up that are more prominent than differences across flare-ups. These temporal trends, equal in scale to spatial geochemical trends across the North American Cordillera attributed to varied deep lithospheric architecture [2], are consistent with progressively maturing transcrustal magmatic systems driven by high mantle input.

Zircon initial εHf values become progressively more primitive across each flare-up, indicative of the increasing modification of continental crust by addition of juvenile material over 150 Ma of arc activity.

[1] Kirsch *et al.* (2016) *Am. Mineralogist* **101**, 2133-2154.
[2] Chapman *et al.* (2018) *GSA Bulletin* **130**, 2031-2046.