Supplemental File S1. Analytical Methods and Compilation Description

This supplementary file details sample preparation and analytical methods and should be cited as the paper it accompanies:

Attia, S., Paterson, S.R., Jiang, D., and Miller, R.B., 2022, Spatiotemporally heterogeneous deformation, indirect tectonomagmatic links, and lithospheric evolution during orogenic activity coeval with an arc flare-up: Geosphere, v. 18, no. X, <https://doi.org/10.1130/GES02478.1>.

**LASER ABLATION INDUCTIVELY COUPLED MASS SPECTROMETRY (LA-ICPMS) U-PB GEOCHRONOLOGY ANALYSES**

Zircon U-Pb isotopic age analyses were measured by LA-ICPMS at the University of Arizona LaserChron Center (ALC). Complete analytical data from this study are available on the EarthChem Library at https://doi.org/10.26022/IEDA/111714. To guide zircon analysis laser spot selection and placement, zircons on polished epoxy mounts were imaged by Cathodoluminescence Imaging (CL) at the University of Arizona. Images are made with a Hitachi 3400N SEM and a Gatan CL2 detector system (www.geoarizonasem.org). LA-ICPMS U-Pb age analyses were conducted on the ALC Nu HR ICPMS following the methods of Gehrels et al. (2008). Laser ablations spot locations were selected with reference to CL imagery to avoid inclusions or analyses across internal zonation domains. Up to 5 grains per sample with distinct core and rim zonation apparent in CL were selected for core-rim analyses. Below, we include a summary of the methodology used that is taken from documentation on the ALC webpage.

Analyses involve ablation of zircon with a Photon Machines Analyte G2 Excimer laser using a spot diameter of 30 microns. The ablated material is carried in helium into the plasma source of a Nu HR ICPMS, which is equipped with a flight tube of sufficient width that U, Th, and Pb isotopes are measured simultaneously. All measurements are made in static mode, using Faraday detectors with 3x1011 ohm resistors for 238U, 232Th, 208Pb-206Pb, and discrete dynode ion counters for 204Pb and 202Hg. Ion yields are ~0.8 mv per ppm. Each analysis consists of one 15-second integration on peaks with the laser off (for backgrounds), 15 one-second integrations with the laser firing, and a 30 second delay to purge the previous sample and prepare for the next analysis. The ablation pit is ~15 microns in depth.

For each analysis, the errors in determining 206Pb/238U and 206Pb/204Pb result in a measurement error of ~1-2% (at 2-sigma level) in the 206Pb/238U age. The errors in measurement of 206Pb/207Pb and 206Pb/204Pb also result in ~1-2% (at 2-sigma level) uncertainty in age for grains that are >1.0 Ga but are substantially larger for younger grains due to low intensity of the 207Pb signal. For most analyses, the cross-over in precision of 206Pb/238U and 206Pb/207Pb ages occurs at ~1.0 Ga. 204Hg interference with 204Pb is accounted for measurement of 202Hg during laser ablation and subtraction of 204Hg according to the natural 202Hg/204Hg of 4.35. This Hg is correction is not significant for most analyses because our Hg backgrounds are low (generally ~150 cps at mass 204). Common Pb correction is accomplished by using the Hg-corrected 204Pb and assuming an initial Pb composition from Stacey and Kramers (1975). Uncertainties of 1.5 for 206Pb/204Pb and 0.3 for 207Pb/204Pb are applied to these compositional values based on the variation in Pb isotopic composition in modern crystal rocks. Inter-element fractionation of Pb/U is generally ~5%, whereas apparent fractionation of Pb isotopes is generally <0.2%. In-run analysis of fragments of a large zircon crystal (generally every fifth measurement) with known age of 563.5 ± 3.2 Ma (2-sigma error) is used to correct for this fractionation. The uncertainty resulting from the calibration correction is generally 1-2% (2-sigma) for both 206Pb/207Pb and 206Pb/238U ages. Concentrations of U and Th are calibrated relative to Sri Lanka zircon, which contains ~518 ppm of U and 68 ppm Th.

CENTRAL SIERRA NEVADA ROCK AGE COMPILATION

We compiled new and published zircon U-Pb geochronology data from across the central Sierra Nevada within an area spanning ~37-38.25 degrees north. This compilation includes zircon U-Pb rock ages from 251 samples of Mesozoic plutons, 10 samples of Mesozoic hypabyssal intrusions, and 105 samples of Permo-Triassic to Cretaceous metavolcanic rocks as well as maximum depositional ages based on detrital zircon U-Pb age analyses of 31 samples of Neoproterozoic-Paleozoic metasedimentary strata and 50 samples of Permo-Triassic to Cretaceous metasedimentary strata.

Compiled ages from hypabyssal intrusions include two Triassic and eight mid-Cretaceous samples from the eastern CSN (Tobisch et al., 2000; Ardill et al., 2020; Attia et al., 2020; this study).

Compiled Triassic pluton ages are restricted to 15 samples from the Late Triassic Scheelite intrusive suite in the easternmost CSN (Stern et al., 1981; Barth et al., 2011; Cao et al., 2015; Cao, 2016; this study).

Samples from Jurassic plutonic rocks include: five samples from earliest Jurassic plutons associated with the Penon Blanco assemblage in the Western Metamorphic Belt (Stern et al., 1981; Saleeby, 1982), ten samples from various Late Jurassic plutons in the Western Metamorphic Belt (Stern et al., 1981; Saleeby et al., 1989), ten samples from the Late Jurassic Guadalupe intrusive complex in the Western Metamorphic Belt (Saleeby et al., 1989; Ernst et al., 2009; Ratschbacher et al., 2018), and eight samples from various Middle to Late Jurassic plutons in the eastern CSN (Stern et al., 1981; Frost, 1987; Tobisch et al., 2000; Noomade et al., 2003; Davis et al., 2012; Cao et al., 2015; Cao, 2016; this study).

Samples from Cretaceous plutons include: 52 samples from the Early Cretaceous Fine Gold intrusive suite in the western to axial CSN (Stern et al., 1981; Dodge and Calk, 1986; Lackey et al., 2012), two samples from Early Cretaceous plutons in the Western Metamorphic Belt (Saleeby et al., 1989), 22 samples from various Early and Late Cretaceous plutons unassigned to a particular intrusive suite from the axial to easternmost CSN (Stern et al., 1981; Tobsich et al., 1995; Mundil et al., 2004; Thompson et al., 2007; Cao et al., 2015; Cao, 2016; Leopold, 2016; Tomek et al., 2016; Ardill et al., 2018, 2020; Memeti et al., in press; this study), seven samples from the Early Cretaceous Shaver intrusive suite in the axial CSN (Stern et al., 1981; Tobisch et al., 1993; Lackey et al., 2012; Ardill et al., 2018), 18 samples from the Early Cretaceous Yosemite Valley intrusive suite in the axial CSN (Stern et al., 1981; Ratajeski et al., 2001; Taylor, 2004; Putnam et al., 2015; Ardill et al., 2018), seven samples from the Early Cretaceous Buena Vista Crest intrusive suite in the axial CSN (Stern et al., 1981; Tobisch et al., 1995; Putnam et al., 2015; Ardill et al., 2018), five samples from the Late Cretaceous Merced Peak intrusive suite in the axial to eastern CSN (Stern et al., 1981; McNulty et al., 1996), three samples from the Late Cretaceous Washburn Lake intrusive suite (Stern et al., 1981; Tobisch et al., 1995; this study), one sample from the Late Cretaceous Yosemite Creek pluton (Burgess et al., 2009), eight samples from the Late Cretaceous Jack Main Canyon intrusive suite in the axial CSN (Ardill et al., 2018; Scheland et al., 2018, 2019), 18 samples from the Late Cretaceous Mount Givens pluton in the axial to eastern CSN (Stern et al., 1981; Tobisch et al., 1993, 1995; Frazer et al., 2014; this study), two samples from the Late Cretaceous Sentinel pluton in the axial CSN (Coleman and Glazner, 1997; Burgess et al., 2009), two samples from the Late Cretaceous Sonora Pass intrusive suite in the eastern CSN (Leopold, 2016), 19 samples from the Late Cretaceous John Muir intrusive suite in the eastern CSN (Stern et al., 1981; Frost and Mattinson, 1988; Tobisch and Cruden, 1995; Davis et al., 2012), and 37 samples from the Late Cretaceous Tuolumne intrusive complex in the axial to eastern CSN (Stern et al., 1981; Coleman and Glazner, 1997; Coleman et al., 2004; Burgess and Miller, 2008; Memeti et al., 2010a, in press; Chambers et al., 2020).

We compiled zircon U-Pb age data from 105 samples of metavolcanic rocks from across the CSN (Figs. 2, 7) including: one Permo-Triassic and seven Late Jurassic samples from the Western Metamorphic Belt as well as a one Early Cretaceous sample from the Oakhurst pendant (Attia et al., 2020; this study), three Jurassic and one mid-Early Cretaceous samples from the Iron Mountain pendant (Ardill, 2020; Attia et al., 2020), two mid-Cretaceous samples from pendants associated with the Jackass Lake pluton (Stern et al., 1981; Memeti et al., 2010b), three late Early Cretaceous samples from the Cinko Lake pendant (Memeti et al., 2010b), one Triassic sample from the Mount Morrison pendant (Barth et al., 2018), and 86 Triassic to mid-Cretaceous samples from the Ritter Range and Saddlebag Lake pendants (Tobisch et al., 2000; Barth et al., 2011, 2018; Cao et al., 2015; Cao, 2016; Ardill et al., 2020; Attia et al., 2020; this study).

Maximum depositional ages based on detrital zircon U-Pb age analyses of CSN metasedimentary strata (Figs. 2, 7) include 31 Neoproterozoic-Paleozoic and 50 Mesozoic samples compiled by Attia et al. (2018, 2021) from references therein (Saleeby, 1982; Grasse et al., 2001; Snow and Ernst, 2008; Memeti et al., 2010b; Cao et al., 2015; Cao, 2016; Ardill et al., 2020).

Three plutonic and seven metavolcanic samples have no reliable rock age estimates and are excluded from Figures 2A and 7. Twelve additional plutonic samples with no available location coordinates and two metasedimentary samples with no reliable maximum depositional age estimates are also excluded from Figure 7.

REFERENCES CITED ONLY IN THIS DATA REPOSITORY ITEM

Stacey, J.S., and Kramers, J.D., 1975, Approximation of terrestrial lead isotope evolution by a two stage model: Earth and Planetary Science Letters, v. 26, p. 207-221.