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TECTONIC EVOLUTION OF THE CENTRAL CALIFORNIA MARGIN AS REFLECTED BY DETRITAL ZIRCON COMPOSITION IN THE MOUNT DIABLO REGION

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Supplementary Materials

Summary of Contents

Appendix S1: Geologic Map Data Sources

The geologic map of the Mount Diablo region in Figure 1B was assembled by stitching and digitizing 23 maps at 1:24,000 scale (Dibblee and Minch; 2005a–m, 2006a–i). Additionally, the 1:75,000 scale map of Graymer et al. (1994) was used to crosscheck map units and complete missing areas. References are found below.

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Appendix S2: Sample Preparation and Analytical Methods

Mineral Separation for Detrital Zircon Analysis (Stanford University Earth Materials Lab)

Rock samples were crushed and disaggregated using a Bico-Braun chipmunk jaw crusher and Bico-Braun disk grinder. Disaggregated samples were individually hydrodynamically processed on a Gemini table to concentrate heavy sand fractions. Heavy sand fractions were rinsed in acetone to prevent grains from rusting and then were oven-dried. Less magnetic minerals were concentrated using a sloped Frantz magnetic separator set at a 10° incline and 100 volts at 0.4 angstroms (Å), 0.8 Å, and 1.2 Å. Separates were then run through methylene iodide (MEI) heavy liquid (ρ=3.32 g/cm^3) to collect the final nonmagnetic heavy fraction. Sample separates were sent to the University of Arizona LaserChron center to be mounted individually in a 2.54 cm (1 inch) epoxy mount with fragments of primary (FC–Z5, 1099 Ma; Paces and Miller, 1993), Sri Lanka (SL-Mix and SL-F; 563.5 Ma; Gehrels et al., 2008) and secondary (R33, 419 Ma; Black et al., 2004) standard zircons. Mounts were polished to half of mean grain thickness (~20 μm) for imaging with a back-scattered electron (BSE) detector, using a Hitachi 3400N scanning electron microscope (SEM). The mounts were then polished to expose the zircon grain cores (1500 grit wet/dry sandpaper, followed by 6 μm, then 1 μm diamond powder slurries) on a Struers LabPol5 rotary polisher, and coated with roughly 10 nm high-purity gold in a Denton sputter coater before analysis.

U-Pb Geochronology Analysis by LA-ICP-MS (University of Arizona LaserChron Center)

U-Pb geochronology of zircons was conducted by laser ablation multicollector inductively coupled plasma mass spectrometry (LA-MC-ICPMS) at the Arizona LaserChron Center (Gehrels et al., 2006, 2008). The 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 ^{238}U, ^{232}Th, ^{208}Pb-^{206}Pb, 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 $^{206}Pb/^{238}U$ and $^{206}Pb/^{204}Pb$ result in a measurement error of ~1-2% (at 2-sigma level) in the $^{206}Pb/^{238}U$ age. The errors in measurement of $^{206}Pb/^{207}Pb$ and $^{206}Pb/^{204}Pb$ 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 ^{207}Pb signal. For most analyses, the cross-over in precision of $^{206}Pb/^{238}U$ and $^{206}Pb/^{207}Pb$ ages occurs at ~1.0 Ga. Instrument setup, tuning, run parameters, standard-unknown bracketing, and data reduction followed that of Gehrels and Pecha (2014).

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 $^{206}Pb/^{204}Pb$ and 0.3 for $^{207}Pb/^{204}Pb$ are applied to these compositional values based on the variation in Pb isotopic composition in modern crystal rocks. For each sample, the uncertainty in determining $^{206}Pb/^{207}Pb$ and $^{206}Pb/^{238}U$ ages result in generally 1-2% (2-sigma) for both. Concentrations of U and Th are calibrated relative to our Sri Lanka zircon, which contains ~518 ppm of U and 68 ppm Th.

U-Pb Geochronology Data Reduction (University of Arizona LaserChron Center)

U-Pb geochronology analyses by LA-ICP-MS were reduced at the University of Arizona LaserChron Center following standard methods (after Gehrels et al., 2006, 2008; https://sites.google.com/a/laserchron.org/laserchron/). Only grains with <20% discordance and <5% reverse discordance are included in interpretations. Final ages are based on $^{206}Pb/^{238}U$ if younger than 900 Ma, and $^{207}Pb/^{206}Pb$ for ages >900 Ma. Data reduction was performed with an in-house Python decoding routine and a Microsoft *Excel* spreadsheet (*NUagecalc*). Analytical data is available in (Table S1).

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