PRF# 56245-UR8

Testing models for the formation of the Great Valley Basin using detrital zircon U/Pb dates: An Early Cretaceous forearc basin or a mid-Jurassic pull-apart basin?

Dr. Diane Clemens-Knott, Department of Geological Sciences, California State University, Fullerton

This ACS-PRF grant supports a field- and laboratory-based project focused on identifying the protoliths of metavolcanosedimentary pendants in the western Sierra Nevada batholith, and reconstructing their post-depositional tectonic histories. Specific goals of the study are to use detrital zircon "bar codes" to locate boundaries between metavolcanosedimentary pendants having unrelated protoliths, and to work towards reconstruction of Mesozoic depositional environments. The overarching goal of the study is to assess whether any of these boundaries may represent structures that participated in the formation of the latest Jurassic to earliest Cretaceous forearc basin, in which California's oil-rich Great Valley Group was deposited.

During the first two years, my students and I worked hard to move the field and lab-components forward; this third year focused on mopping up field sampling, completing analyses, and presenting initial results:

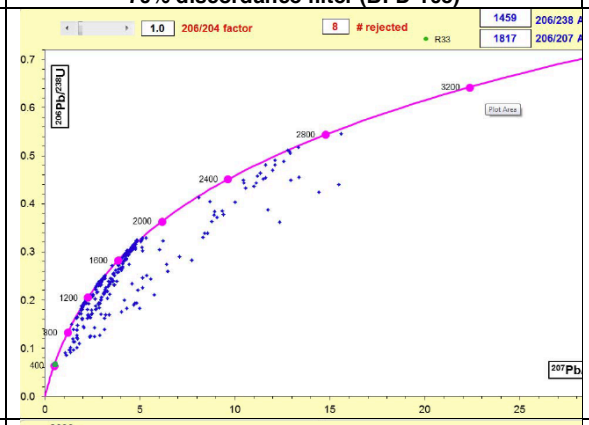
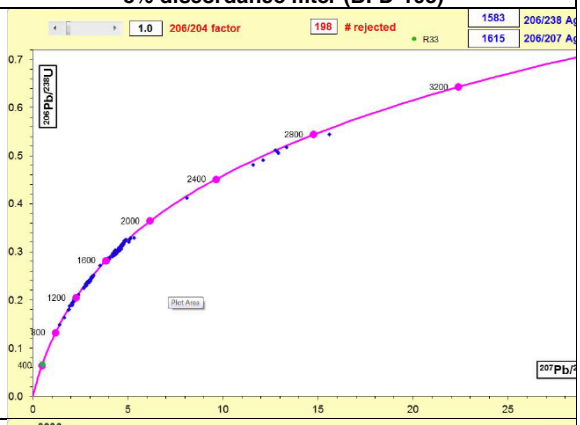
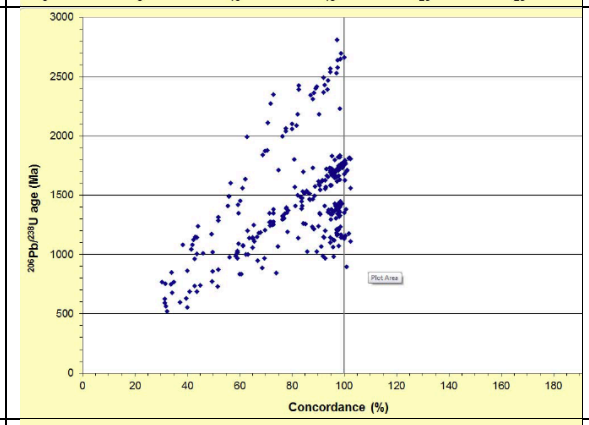
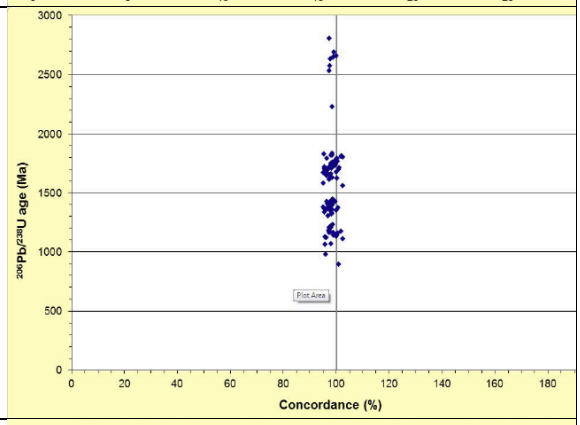
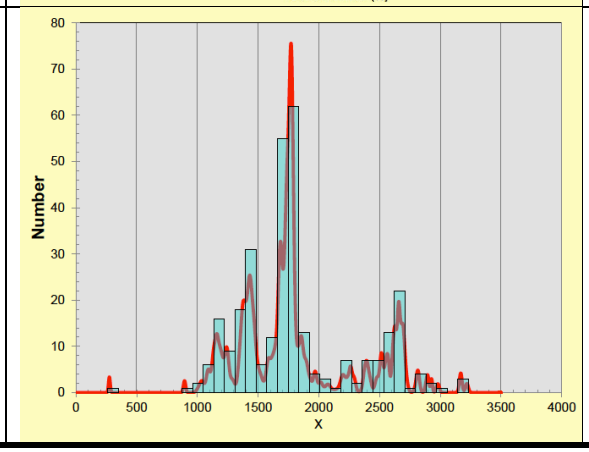
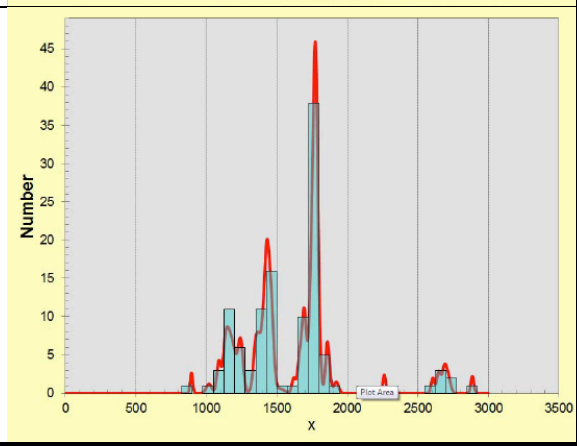
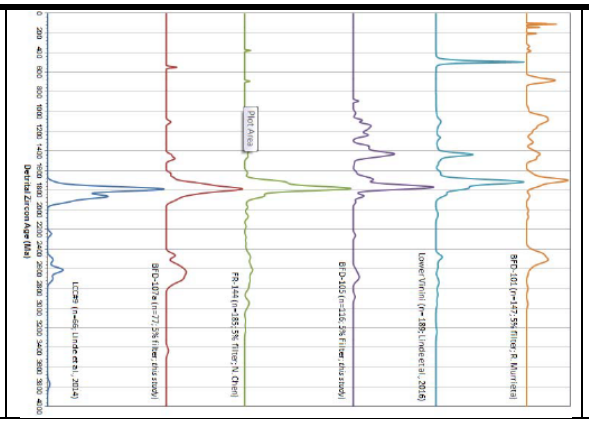
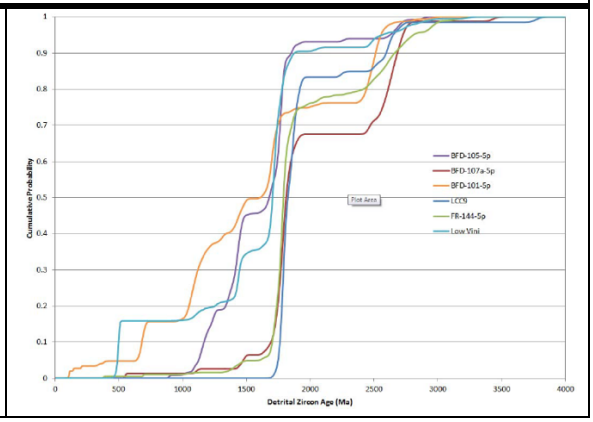
- In October 2018, two weekend sampling trips targeted three remaining pendants, one of which involved my graduate petrology class. Undergraduate lab assistant, Erin Boeshart, and I later entered the Mountain Home Experimental Forest, to collect three more samples. Arranging a sampling visit behind the locked gates of this CAL-FIRE reserve took more than a year to arrange, but success allowed us to access these unstudied rocks.
- In January 2019, three CSU undergraduate students joined me and CSUF alumna Dr. Michelle Gevedon (then a UT Austin post-doctoral fellow) for a four-day visit to the Arizona LaserChron Center to analyze the U-Pb-Hf isotopes of zircon, which we'd separated from more than 20 samples at CSUF during fall 2018.
- My last two undergraduate research students (Rodrigo Avila, Christian Concha) finished writing their required research theses; additionally, lab assistant Boeshart successfully completed her B.S. All three students are now employed as geoscientists in the environmental and engineering geology fields. Their PRF-funded research provided them with invaluable experience in the field and lab, as well as experience with statistical analysis.
- In April 2019 I presented initial research results at the Cordilleran section meeting of the Geological Society of America (Portland, OR). Earlier that month, Dr. Gevedon and I submitted a manuscript to *GEOLOGY*, and a revised manuscript was submitted in August.
- In August 2019, I finally secured permission to sample on a remote BLM wilderness. These samples will be processed by an undergraduate during Fall 2019.

To date, this grant has supported the required undergraduate research of four undergraduate (Aviles, Concha, Magumcia, Murrieta) and two graduate students (Chen, Duccini). Four more students (Titular, Kohler, Boeshart, Langer) have gained valuable laboratory experience while being gainfully employed as laboratory assistants. All ten of these students are members of groups that are underrepresented (seven by gender; six by ethnicity) in the Earth sciences. ACS-PRF support has provided these students with rich field and laboratory research experiences, opportunities to work in labs at R1 universities, and the means to present at professional scientific conferences. I will take a student crew to Arizona Laserchron Center in January 2020 to complete data collection. Final data analysis and manuscript preparation/submission will follow.

<u>Ex: Identifying the protoliths of intensely deformed and altered metasedimentary pendants</u>

During the summer of 2016, undergraduate Christian Concha and I collected samples from two adjacent metamorphic pendants in the little-known Greenhorn Mountain range of the southwestern Sierra Nevada Mountains. The only published rock descriptions suggested that a possible difference in original rock type (protolith) existed between these intensely deformed and recrystallized rocks. After painstaking lab work, Christian was able to separate zircon. Initial U-Pb results were difficult to interpret, as the rocks had experienced significant lead-loss during the Late Jurassic hydrothermal alteration of the southern Sierra Nevada volcanic arc. Christian and I experimented with various strategies of data correction, finally devising a strategy that enabled us to confidently cull out the isotopically disturbed and geologically misleading zircon grains, leaving us with an isotopic "bar code" that could be statistically compared to samples from inland regions (e.g., Nevada, Utah) which had not suffered Jurassic hydrothermal disturbance. In brief, we applied a generous 70% discordance filter, in order to better see the linear lead-loss trajectories (Table 1: AB) and identify the original age ("upper intercept") of the disturbed populations. We then removed most of the disturbed grains by applying a strict 5% discordance filter (Table 1: DE). Comparison of probability function plots in C (70% filter) and F (5% filter) shows how most effects of Jurassic hydrothermal alteration were removed, producing much sharper peaks in the isotopic "bar code". Finally, statistical comparison of the filtered data to unaltered sediments (Table 1: GH) enabled us to correlate metamorphic pendant BFD-105 to the Ordovician lower Vinini Formation, deposited on the western rift margin of the Pangaean supercontinent, and pendant BFD-107 to the exotic Harmony B Formation (LCC9), thrust onto the Laurentian continent during the Devonian Period (Linde et al., 2016, 2017).

TABLE 1: STATISTICAL ANALYSIS OF U-PB DATA FROM DETRITAL ZIRCON (aka "zircon sand grains")

	70% discordance filter (BFD-105)		5% discordance filter (BFD-105)	
A				D
B				E
C				F
G				H