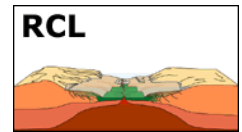


(U-Th)/He dating of the age and onset of rapid detachment-related cooling, Salton Trough, CA

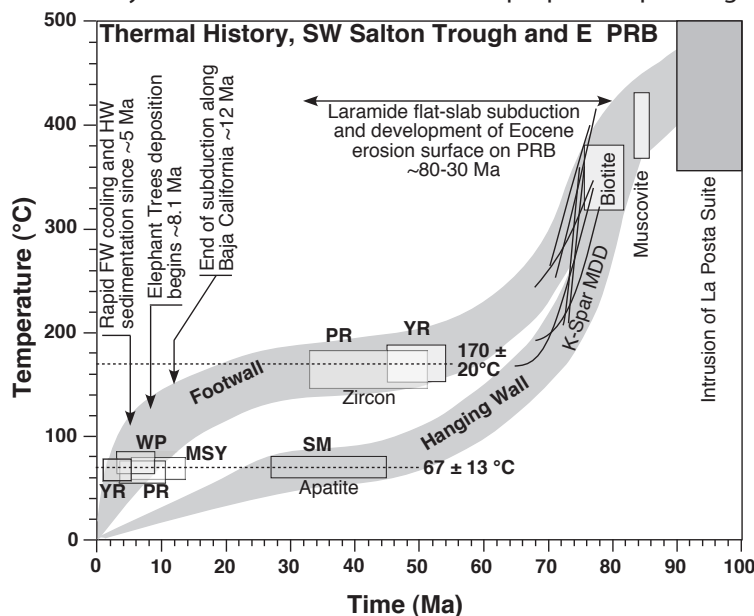


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This MARGINS-related research project (originally submitted to MARGINS, ultimately funded by Tectonics) was collaborative among Rebecca Dorsey (U. OR), Susanne Janecke (UT State), Bernie Housen (Western Washington), and Gary Axen (UCLA; now at New Mexico Tech). The project included detailed structural and stratigraphic mapping of the west Salton detachment system, the western rift-bounding structure at this latitude, along with magnetostratigraphy of syndetachment sediments and (U-Th)/He dating of rapid footwall cooling. This report focuses on the (U-Th)/He dating results, which were collected by UCLA M.S. student Catherine Shirvell at the University of Kansas (U-Th)/He laboratory of Dr. Daniel Stockli. The results form the core of an article submitted to Tectonics and currently accepted pending final revision (Shirvell et al., in review). The age of onset of extension and detachment faulting in the Salton Trough, where the southern San Andreas fault system enters the northern Gulf of California rift, is directly relevant to the evolution of strain partitioning in this strongly oblique rift, one of the key scientific points for which the Gulf was chosen as a MARGINS focus site. Our sedimentologic and magnetostratigraphic work (see Dorsey et al., 2007, *Geology*), along with those of previous workers, defined a period of rapid upper-plate sedimentation in the Fish Creek-Vallecitos basin that began at ~5 Ma. This is a minimum age for onset of detachment faulting but may record acceleration of detachment slip at that time, roughly contemporaneous with initiation of San Andreas slip in the trough. However, older (~8 Ma) syntectonic sediments in the Fish Creek basin were shed from a steep normal fault that may be unrelated to the detachment, or that can be interpreted as a hanging-wall structure or as an early breakaway (rift-margin). Regardless, those sediments record extension well before the San Andreas was a discrete structure in the trough (distributed wrench deformation may have already begun), but after the onset of extension in much of the Gulf. We dated apatite and zircon from the detachment footwall using the (U-Th)/He method. Apatite has a He closure temperature of ~45-70°C, depending upon cooling rate. The apatite results (very high lateral and vertical age gradients) confirm rapid footwall cooling from ~5 to ~2 Ma, consistent with the rapid upper-plate sedimentation record. Apatite also shows rather steep lateral and vertical age gradients as far back in time as ~12 Ma--probably too steep for the partial retention zone. These (presently enigmatic) results further suggest that footwall cooling and, by implication, detachment slip may have begun well before ~5 Ma, consistent with an ~12 Ma onset of extension in many Gulf localities and consistent with detachment slip interpreted to be that old immediately across the border in Mexico. A proposal is pending to follow-up on this possibility and to better date the onset



of extensional cooling and exhumation on both flanks of the Salton Trough (Axen, Stockli, and Kelley, submitted to MARGINS). The results (if funded) will be directly relevant to interpretation of the joint MARGINS-EarthScope seismic project underway in the Salton Trough.

Figure: Summary temperature-time plot for rocks above and below the west Salton detachment fault. Boxes with initials are (U-Th)/He apatite and zircon sample localities. In Eocene time the footwall and hanging wall were separated by ~100°C (~3-4 km). Most apatite (U-Th)/He footwall ages are 2-8 Ma, with high age-elevation or age-distance gradients (not shown here) that record rapid detachment-related cooling from at least 5 to 2 Ma. The Mount San Ysidro (MSY) footwall transect displays a high age-elevation gradient from ~12 to ~5 Ma, suggesting that detachment-related exhumation may have begun well before the San Andreas entered the Salton Trough (at ~5 Ma). From Shirvell et al. (in final review, *Tectonics*).

Shirvell, C.R., Stockli, D.F., Axen, G.J., and Grove, M., Miocene-Pliocene Exhumation along the West Salton detachment fault (WSDF), Southern California, from (U-Th)/He thermochronometry of apatite and zircon: *Tectonics*. Accepted pending final revision.

Dorsey, R.J., Fluette, A., McDougall, K.A., Housen, B.A., Janecke, S.U., Axen, G.J., and Shirvell, C.R., 2007 Chronology of Miocene-Pliocene deposits at Split Mountain Gorge, southern California: A record of regional tectonics and Colorado River evolution; *Geology*, v. 35, no. 1, 57-60, doi: 10.1130/G23139A.1.

