San Joaquin Geological Society

Date: Tuesday, April 14th, 2015

Time: 6:00 PM Social Hour
7:00 PM Dinner
8:00 PM Lecture

Place: American Legion
2020 H St. Bakersfield, CA 93301

PSAAPG Members & Mesozoics
$25 w/ reservation
$30 without reservation

Non PSAAPG Members
$30 w/ reservation

Full-time Students with ID:
Free - Courtesy of Chevron & California Resources Corp.

*** RSVP ***
By: Friday, April 10th, 2015

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Some critical geological features along the eastern San Joaquin Basin--southern Sierra Nevada transition

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ABSTRACT

We present an overview of our critical findings along the eastern San Joaquin Basin-southern Sierra Nevada transition based on multi-decadal Sierran basement studies integrated with surface and sub-surface mapping along the eastern Basin margin. We recognize four distinct tectonic forcing regimes that have left clear imprints over mantle lithosphere to surface levels: 1) Late Cretaceous to Eocene subduction of multiple oceanic plateaus; 2) early and middle Miocene opening of the Pacific-Farallon slab window; 3) late Miocene initiation of the eastern Sierra escarpment system, and resulting westward tilting of the Sierra Nevada-Great Valley basement surface; and 4) Late Pliocene-Quaternary delamination of mantle lithosphere from beneath the southern Sierra and Great Valley region. Structural and thermal imprints left from each of these regimes profoundly influenced the structural and surface level responses to subsequent regimes. Most profound for our region of focus was the 95-85 Ma subduction of the Shatsky Rise conjugate beneath the southern California region, which resulted in a regional northdipping lateral ramp in the Farallon-North American subduction megathrust. This also resulted in the rapid removal of ~35 km of batholitic crust off the area of the Tehachapi-San Emigdio ranges, with diminishing exhumation northwards to ~12 km of upper crustal removal at ~35.7°N. This is more typical of the Late Cretaceous exhumation level along the western Sierra Nevada and axial Great Valley basement to as far north as ~40°N. Rapid exhumation in the southern Sierra-northwest Mojave region entailed trenchward transport of upper crustal rocks along large low-angle detachment faults linked to trenchward extrusion of subducted trench sediments, as driven by rapid slab rollback as the trailing edge of the Shatsky conjugate subducted beneath the region. This left much of the San Joaquin Basin-southern Sierra region stripped of its underlying mantle lithosphere, and with its residual crystalline basement severely deformed and weakened by extensional structures. The southern Sierra-San Joaquin Basin region is distinguished from regions to the north by a much more intense structural response to the underlying opening of the Pacific-Farallon slab window in the Neogene. At this time a complex system of highangle normal and related transfer faults that we call the southern Sierra fault system broke the region into a complex graben and horst system. Southern Sierra topography and the growth of eastern San Joaquin Basin accommodation spaces strongly reflect this Neogene normal fault system. This fault system was directly controlled by pre-existing, Late Cretaceous, extensional basement structures. We will present new findings on the middle Miocene Bealville Fanglomerate as a sample of structural-depositional features along the Basin margin that record very rapid early to middle Miocene structural relief generation along the fault system. Such normal faulting across the southern Sierra also produced a significant internal accommodation space that we call the Walker graben. This graben filled with ~2 km of Neogene sediments and volcanics prior to its exhumation, which was driven by regional uplift along the eastern Sierra escarpment system. A major late Miocene to early Pleistocene river system that we call the Caliente River redistributed most of the Walker graben fill into the eastern San Joaquin Basin as fluvial-deltaic units of the upper Bena, Chanac and Kern River formations, and marine units such as the Santa Margarita Formation, and most lobes of the Stevens submarine fan system. We will further present the results of numerical thermal-mechanical modeling for Neogene-Quaternary time that are closely interfaced with geologic constraints in order to pursue the more recent, yet subtle and complex, evolution of the region. In this model the residual mantle lithosphere that remained beneath the greater Sierra Nevada-Great Valley region following Shatsky conjugate subduction slowly necked off of adjacent North American lithosphere along the eastern edge of the Sierra Nevada batholith in response to thermal softening and buoyancy inversion by the northward opening slab window. Mantle lithosphere necking initiated the eastern Sierra escarpment system. Subsequent to necking the residual mantle lithosphere began to delaminate from east to west, further driving eastern Sierra uplift. As delamination progressed the southern truncated edge (Late Cretaceous megathrust lateral ramp) of the mantle lithosphere began delaminating from south to north beneath the southern Sierra-San Joaquin Basin. As a result the Kern arch rose out of the Basin margin over late Quaternary time driving up to ~1800 of exhumation across the arch and adjacent Sierran uplift. Detritus from this exhumation phase was re-distributed northwards into the Tulare sub-basin, southwards into the Maricopa sub-basin, and westwards into the residual southern axial Great Valley, thereby producing the modern Basin geometry.

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