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Origin and Evolution of the White Wolf Fault and the Maricopa Basin

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ABSTRACT

The White Wolf fault is widely recognized as an important seismically active sinistral reverse fault that separates the Tehachapi-San Emigdio emergent block to the south from the Maricopa basin to the north. We posit that the White Wolf fault is in fact a polyphase structural zone (WWsz) whose inception in the Late Cretaceous was of fundamental importance in shaping southern California crustal structure, and that this structural zone has since imposed a strong control on subsequent Neogene and Quaternary deformation and basin evolution. The WWsz originated during a major orogenic episode in the Late Cretaceous that represents the plate edge expression of the Laramide orogeny. Integration of recent findings on the Pacific-Farallon spreading ridge and its coincident large igneous provinces (LIPs), regional upper mantle structure imaged by volcanic hosted xenolith studies and seismic tomography, basement geology, and geodynamic modeling indicates that at ca. 90 Ma the conjugate LIP massif to the Shatsky Rise collided and was subducted beneath the southern California region. Subduction flattened to a shallow trajectory as a result of LIP relative buoyancy, thereby shearing off the mantle wedge that sat beneath the Mojave-Salinia (restored) segment of the SW Cordilleran batholithic belt. The mantle wedge remained intact beneath the Sierra Nevada segment of the batholithic belt (SNB), resulting in huge lateral ramp in the subduction megathrust that dipped to the north beneath the southern SNB-Great Valley forearc. Following ~10-15 m.y. of Shatsky conjugate subduction normal abyssal Farallon lithosphere began entering the subduction zone again, and due to its relative negative buoyancy a rapid slab rollback phase resulted. Slab rollback imparted a strong suction force that pulled shallowly underplated subduction accretion assemblages back towards the trench in a massive return flow channel. Trenchward flow in the subduction channel viscously coupled extensional deformation into the upper batholithic plate(s). At this time the southernmost Sierra Nevada rotated westwards, and the then adjacent Salinia massif breached westwards across its former forearc-trench region. Basement rocks of the Tehachapi-San Emigdio's for the most part represent SNB lower crust that was pulled out from beneath the axial southern SNB. The proto-WWsz originated at this time in continuity with the Kern Canyon fault as a regional dextral transfer zone between highly extended basement of the Piute-Tehachapi-San Emigdio's, and more modestly extended basement of the proto-Maricopa basin. The proto-Maricopa originated as a supra-detachment basin at this time, with its westward displaced upper plate now locally exposed as the Eagle Rest Peak basement inlier of the western San Emigdios.

The WWsz was remobilized in the Neogene as a transfer structure that partitioned differential extension of lower magnitude between the Maricopa basin and a graben-horst system that formed between the Tejon Embayment area and Isabella basin. The Walker graben of this system, in which the 21-16 Ma Cache Peak volcanic center was nested, filled with at least 2 km of sediment in the Miocene. Late Pliocene-Quaternary uplift of the southern Sierra has resulted in the redistribution of the Walker graben sediment fill into the Maricopa basin, primarily through a channel system that was broken through the Kern Canyon-White Wolf transfer zone by the Edison graben. Sinistral and reverse components of active seismic deformation along the WWsz appear to be decoupled. Sinistral events occur at the eastern end of the zone and appear kinematically linked to west-side-up normal faulting along the Kern Canyon-Breckenridge zone, and oblique east-side-up normal faulting along the Kern gorge-Pond Poso zone. Active thrusting is related to a series of north-directed thrust faults that root southwards beneath the Tehachapi-San Emigdio's, and which ramp up across the basement trace of the original WWsz.

BIOGRAPHY

Born: October 24, 1948

EDUCATION AND EXPERIENCE:

- *1972 - Bachelor of Science(Geology) summa cum laude, California State University at Northridge*
- *1975 - Doctor of Philosophy(Geology), University of California at Santa Barbara*
- *1972 - Instructor, Geoscience Department, California State University at Northridge*
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TEACHING ACTIVITIES: Introductory and advanced geological field mapping, structural geology, physical geology, Cordilleran regional geology and tectonics, global mountain building and plate tectonics, application of petrogenetic and geochemical studies to regional and global tectonics. Volunteer educational outreach includes classroom and field instruction of middle and high school level Environmental Sciences and Arts, and Director of Island Outpost, a public charity designed toward environmental education field excursions and the disseminating of scientific information to the general public.

RESEARCH INTERESTS: Regional field, petrologic, radiogenic isotopic and geochronologic studies applied to the interactions of oceanic and continental plates, tectonic and magmatic accretion of continental crust, dynamics of continent edge batholithic belts and the paleogeographic development of western North America; petrogenesis and geodynamics of the upper mantle beneath the southwest United States region based on studies of Cenozoic volcanic hosted xenoliths integrated with regional geophysical studies integrated with geomorpohology and basin analysis; tectonic and petrogenetic development of the Greater Caucasus Mountain Range, southern U.S.S.R. , and the Dinaric Alps, Croatia, and their relationships with the paleogeographic evolution of the northern Tethys ocean basin.

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MS degree in Geology and Paleontology from University of Zagreb, Croatia (established in 1669, one of the oldest universities in Europe, and home university of "MOHO" seismologist – Andrija Mohorovicic

MS degree in geology from Indiana University in Bloomigton >BR>Both in Croatia and Indiana, research focused on carbonate sedimentology and petrology

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1990-1997 Senior geological engineer Shell Oil Company Bakersfield, Ca

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