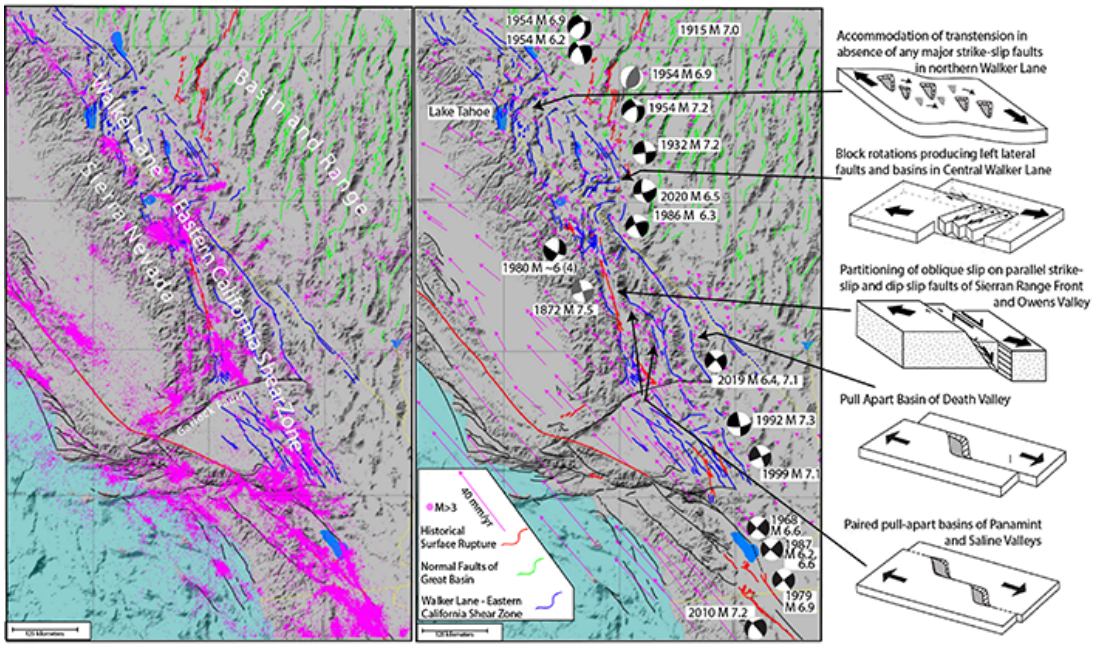
SCEC became the **Statewide** California Earthquake Center in 2024. This is the archived website of the Southern California Earthquake Center with information about the Center through 2023. Visit www.scec.org for more information about the Center's new statewide activities.

The Walker Lane: A Potential Target for SCEC Studies?



Seismicity, faults, and geodetic vectors along the Walker Lane - Eastern California Shear Zone with sketches illustrating how Pacific-North America motion is accommodated along its length. Data from: USGS, 2020a; USGS, 2020b; and Zeng and Shen, 2016.

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By Steven Wesnousky

Studies outside Southern California proper can further our understanding of aspects of the earthquake process that are the grist for development of seismic hazard maps in Southern California. It is therefore natural that the Southern California Earthquake Center (SCEC) is considering expanding its geographic scope. The Walker Lane extending northward from the Eastern California Shear Zone (ECSZ) in the Mojave is part of the discussion. The newsletter is a fitting place to introduce aspects of the Walker Lane fault system to the unacquainted. The Walker Lane and ECSZ are characterized by numerous active faults, abundant seismicity, a history of large surface rupture earthquakes, and the potential to host more.

Maybe best to start with a little history. A M7.2 earthquake occurred along the western edge of the Basin and Range in 1932: the M7.5 Cedar Mountain earthquake. The event produced right-lateral offsets along a fault zone oriented subparallel to the San Andreas. A couple of UNR geologists recognized the orientation and sense of offset to be similar to that reported for the great Owens Valley earthquake of 1872 (Gianella and Callaghan, 1934). They correctly concluded the underlying causes of displacement along the western edge of the Basin and Range were likely related to those in California and the moniker Walker Lane was shortly thereafter attributed to the system of faults striking along the east flank of the Sierra Nevada (Locke et al., 1940). Some 40 years later, large right-lateral offsets were documented along a similarly oriented system of faults in the Mojave and defined collectively as the Eastern California Shear Zone (Dokka and Travis, 1990). Observations now show the Walker Lane and Eastern California Shear Zone are

names accorded to an integrated system of faults that serve to accommodate Pacific-North American plate motion. A look at the literature shows studies of active faults within the Mojave are generally assigned to the Eastern California Shear Zone, similar studies up further north (near Reno) to be in the Walker Lane, and both the Walker Lane or Eastern California Shear Zone are used at latitudes in between, with the latter generally being a function of from where the individual investigator heralds.

The modes of fault deformation within the Eastern California Shear Zone – Walker Lane (ECSZ-WL) are diverse and well manifested in the regional topography, particularly as one moves northward from the Garlock Fault. Whereas the San Andreas Fault System is characterized by a relatively continuous set of interconnected or anastomosing faults dominated by the continuous San Andreas, the ECSZ-WL is a broad disjointed set of northwest striking right-lateral and normal faults interrupted by east striking left-lateral faults, such that none are continuous along the entire length of the system. The contrast with the San Andreas system to the west is the result of the lower amount of accumulated strike-slip and transtensional nature of motions that here drive fault displacement, distinct from the transpressional nature of deformation that characterizes most of the San Andreas north of the Salton Sea (e.g., Wesnousky, 2005ab). The pull-apart genesis of the Death Valley, Panamint Valley, and Saline Valley basins and range fronts has long been attributed to bends along the strike-slip faults that host them (Burchfiel et al., 1987; Burchfiel and Stewart, 1966). The Sierran Range front fault striking subparallel to the great 1872 Owens Valley earthquake is analogous to the partitioning manifest along the San Andreas during the 1980 Coalinga earthquake in California (Wesnousky and Jones, 1994). To the north, the creation of large basins resulting from rotation of crustal blocks is well displayed as is the creation of large en-echelon arranged basins in response to right-lateral displacement. Add to this the abundant seismicity and the Walker Lane is a natural laboratory for SCEC to consider issues of seismicity and fault mechanics that are important to understanding the seismic hazard in Southern California.

About the Author

Steve Wesnousky is a Professor of Geology and Seismology at the University of Nevada, Reno. His research ranges from efforts to understand how characteristics of earthquakes and seismicity are related to the geometrical evolution of fault systems over geologic time to the paleoseismology of great Himalayan earthquakes. He has been an active member of the SCEC community since its founding year.

References

- Burchfiel, B.C., Hodges, K.V., Royden, L.H., 1987. Geology of Panamint Valley - Saline Valley pull-apart system, California - palinspastic evidence for low-angle geometry of a Neogene range-bounding fault. Journal of Geophysical Research-Solid Earth and Planets 92, 10422-10426.
- Burchfiel, B.C., Stewart, J.H., 1966. Pull-apart origin of central segment of Death Valley California. Geological Society of America Bulletin 77, 439-+.
- Dokka, R.K., Travis, C.J., 1990. Role of the eastern california shear zone in accommodating Pacific-North-American plate motion. Geophysical Research Letters 17, 1323-1326.
- Gianella, V.P., Callaghan, E., 1934. The earthquake of December 20, 1932, at Cedar Mountain, Nevada and its bearing on the genesis of Basin and Range structure. Journal of Geology 47, 1-22.
- Locke, A., Billingsley, P., Mayo, E.B., 1940. Sierra Nevada tectonic patterns. Geological Society of America Bulletin 51, 513-540.
- USGS, 2020a. United States Geological Survey Advanced National Seismic System (ANSS) Comprehensive Earthquake Catalog Event and Products (ComCat). https://earthquake.usgs.gov/data/comcat/ accessed July 7, 2020.
- USGS, 2020b. United States Geological Survey Quaternary fault and fold database. https://earthquakes.usgs.gov/hazards/qfaults.
- Wesnousky, S.G., 2005a. Active faulting in the Walker Lane. Tectonics 24.
- Wesnousky, S.G., 2005b. The San Andreas and Walker Lane fault systems, western North America: transpression, transtension, cumulative slip and the structural evolution of a major transform plate boundary. Journal of Structural Geology 27, 1505-1512.
- Wesnousky, S.G., Jones, C.H., 1994. Oblique slip, slip partitioning, spatial and temporal changes in the regional stress-field, and the relative strength of active faults in the Basin and Range, Western United-States. Geology 22, 1031-1034.
- Zeng, Y.H., Shen, Z.K., 2016. A Fault-Based Model for Crustal Deformation, Fault Slip Rates, and Off-Fault Strain Rate in California. Bull. Seismol. Soc. Amer. 106, 766-784.

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