Paleoseismic studies along the Warm Springs Valley fault zone

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Background and Proposed Investigations

The Warm Springs Valley fault system is one of three prominent, northwest-striking fault systems that make up the northern Walker Lane. These systems appear to be the principal structures accommodating strike-slip deformation that is measured in the western Great Basin (Bennett and others, 1998, Thatcher and others, 1999). The right-lateral Warm Springs Valley fault system is a major earthquake source in western Nevada, and the southern portion of the fault crosses a valley that is undergoing relatively rapid urban development.

The goals of this study are to create a 1:24,000 scale map of the fault system, to explore the paleoseismic history of the southern half of the system, and to constrain the late Quaternary slip rate.

Results to Date

One of our first tasks on this project was to map the fault system at a scale of 1:24,000 and to annotate the map with tectonogeomorphic features related to the system. From this mapping additional potential trench sites were targeted and offset geomorphic features that may be used to estimate slip rates were identified.

The Warm Springs Valley fault system (WSVFS) is a major 60 km long fault that extends from Warm Springs Valley in the south through Winnemucca Valley, crosses the northernmost part of the Virginia Range, and continues into Honey Lake Valley to the northwest.

The southernmost surface expression of the WSVFS is a set of small rises of the floor of Warm Springs Valley that are bound on their northeast side by a discontinuous fault scarp that is between 20 and 60 cm high. This is known as the Flying Eagle Ranch site, for the development that is about to occur there. A gravity map of the Warm Springs Valley (Gimlett, 1967) indicates the system continues into the southern part of the valley,

where it likely steps to the right across a prominent gravity low to a poorly defined fault that bounds the west side of the valley. North and south of the Flying Eagle Ranch site the fault is buried by mid to late Holocene deposits.

The next surficial expression of the WSVFS to the north is a prominent set of linear hills aligned up the center of Winnemucca Valley, a small valley extending to the northwest of Warm Springs Valley. The main fault along this portion of the system usually bounds the east side of these hills, but overall is made up of a zone of subparallel and interconnected faults up to 1½ km wide. Geomorphic features along this portion of the system include fault scarps and scarplets, grabens, sidehill benches, right-laterally offset stream channel margins, shutter ridges, and linear troughs. Several trenching targets have been identified along this portion of the system including back-facing scarps where coarse footwall material is juxtaposed against the fine-grained distal fan deposits in the hanging wall. Several other places where there is a vertical component and fault scarps are also potential places to gain a paleoseismic history of the fault.

The central part of the fault system crosses the northern part of the Virginia Range before it enters Honey Lake Valley. This section of fault is also made up of a series of parallel fault traces up to about 1½ km wide, although the main fault trace bounds the sides of a small linear valley that appears to be a pull-apart basin with a playa in its central part. This trace appears to have the most recent event along it and strikes through the west side of the playa; this is one potential trench site. Geomorphic expression along this portion of the fault includes fault scarps, side-hill benches, hill-top notches, linear valleys and troughs, and tonal and vegetation lineaments.

Overall, the system is made up of several fault traces that commonly step to the right. Although this is not necessarily typical of right-lateral systems, the kinematics are consistent, with extension evident at the right steps in the fault. These right steps may be influenced by the overall transtensional environment of the western Great Basin, or by a preexisting structural pattern.

Ten trenching sites at five locations are identified as potential targets. Permission has been secured for four sites at two locations, and permission is being delayed pending county approval of some land use permits requested by the developer for the Flying Eagle Ranch location within Warm Springs Valley (two cross-fault, and two fault-parallel trench sites); we are optimistic that permission at the Flying Eagle Ranch site will be granted within the next few months. This site has a clear fault trace, low sedimentation rate, and low erosion rate. We hope to develop a paleoseismic history and slip rate from this location.

Non-Technical Summary

The right-lateral, strike-slip Warm Springs Valley fault system in northwestern Nevada is being studied to determine its earthquake potential, and how it accommodates deformation measured by geodesy in the western Great Basin. Mapping of the fault

system reveals several probable Quaternary fault traces that are subparallel along much of the fault, and several geomorphic features related to Late Quaternary fault activity. Ten potential trenching sites have been identified, and efforts are underway to secure permission for trenching at these sites.

Reports Published

None

References:

Bennett, R. A., Wernicke, B.P., and Davis, J.L., 1998, Continuous GPS measurements of contemporary deformation across the northern Basin and Range Province: Geophysical Research Letters, v. 25, p. 563-566.

Gimlett, James L., 1967, Gravity study of Warm Springs Valley, Washoe County, Nevada: Nevada Bureau of Mines and Geology, Report 15, 31 p.

Thatcher, W., Foulger, Julian, B.P., Svarc, J., Quilty, E., Bawden, G.W., 1999, Present day deformation across the Basin and Range Province, western United States: Science, v. 283, p. 1714- 1718.