

Nevada Bureau of Mines and Geology Priority List for Fault Investigations

8 May 2009

The Nevada Bureau of Mines and Geology has established the following list of fault systems in the Reno-Sparks-Carson City-Lake Tahoe urban area for which we recommend that the U.S. Geological Survey support fault investigations. These are listed in order of priority, from 1 (highest) to 7 (still high in priority). In creating this list, we considered a combination of factors (what has already been accomplished with previous investigations of faults; how detailed the areas are geologically mapped; what is known about the likelihood of being able to find dateable materials in fault trenches, mapped stratigraphic units and geomorphic surfaces, or sedimentary basins accessible through drilling or deep excavations; and earthquake risk, based on a combination of nearness to population centers, loss-estimation modeling, and current knowledge of the likely range in earthquake frequency).

We recognize that there are significant earthquake risks in southern Nevada, including Las Vegas Valley, as well. However, considering the higher hazard identified in the U.S. Geological Survey's probabilistic seismic hazard analysis for the Reno-Carson City urban area than for the Las Vegas area, and the fact that the U.S. Geological Survey is focusing some of its internal efforts on obtaining better seismic, geodetic, and geologic information about earthquake hazards in the Reno-Carson City urban area, we currently consider fault studies in the Las Vegas urban area as lower priority. As studies in the Reno-Carson City urban area mature, we anticipate that the Las Vegas urban area will be elevated to highest priority.

At a workshop organized by the U.S. Geological Survey and the Nevada Bureau of Mines and Geology on 21-22 April 2009, to discuss how best to integrate geodetic and geologic information into the U.S. Geological Survey's probabilistic seismic hazard analysis, the participants identified some promising opportunities that would complement the specific investigations of fault systems listed by priority at the end of this document. The opportunities are bulleted below:

- Collect geologic, geodetic, and seismic data in a transect across the Mohawk Valley-Honey Lake-Warm Springs systems.
- Studies that look for shear deformation coming up through the Reno, Truckee Meadows area.
- Studies that refine slip rates (esp. longer term, i.e. late Pleistocene) on major faults in western Nevada.
- Studies that evaluate resolution, reliability and stability of strain maps and block models. These studies should include participation in an upcoming workshop that will address these issues.

- Collect geologic, geodetic, and seismic data in a transect at the latitude of Reno evaluating block rotations using geologic, geodetic, and seismic data.
- Obtain LiDAR data to support transects (both along and across faults).

An overarching theme of the workshop discussions was the need to understand the kinematics of strain release in the Reno-Carson City-Lake Tahoe area (northern Walker Lane). This involves the integration of geologic data (particularly the late Pleistocene record, that is, the last 130,000 years) with geodetic and seismic data. A significant question to be answered is how much of the geodetic strain has been released, at various locations within the region, by major earthquakes versus other mechanisms such as fault creep or rotation and slippage on short faults with only relatively small, less hazardous earthquakes.

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1. Carson Range fault system (generally east-dipping normal faults on the east side of the Carson Range, close to and dipping below the communities of Reno and Carson City). This includes the main north-striking frontal faults (Genoa, Washoe Valley, and Mount Rose faults), the three northeast-striking faults in the Carson City area (Indian Hill, Carson City, and Kings Canyon faults), and synthetic faults within the range (Little Valley fault and unnamed faults in the northern Carson Range). These faults form the main seismic hazard to western Nevada and are among the most studied faults in the area, but large uncertainties remain about the frequency and timing of events, and about segmentation behavior. Of particular concern is a better understanding of activity over a period on the order of 10^5 years, including better age constraints on late Pleistocene alluvial and glacial deposits.
2. Faults on the eastern side of the basins that are east of the Carson Range (generally, but not always, north-striking, west-dipping normal faults located close to the communities of Reno, Sparks, Carson City, Minden, and Gardnerville; also included are geologically and geophysically identified, west-dipping normal faults near the center of Reno that are responsible for at least some of the tilting of Miocene sedimentary and volcanic rocks). These include the Eastern Reno Basin fault zone, the North Virginia Range fault, faults on the east side of Washoe Valley, and the Eastern Carson Valley fault zone. These faults are generally believed to be less active than the frontal fault system, but they are poorly understood and their proximity to urban areas elevates their importance.
3. Left-lateral strike-slip fault systems (mostly affecting the communities of Fernley, Silver Springs, and Dayton, but also posing hazards for Sparks, Reno, and Carson

- City). These include the Spanish Springs Peak and Olinghouse faults and the Carson lineament.
4. Faults within urban areas, primarily west of downtown Reno. These include the Verdi fault and the right-lateral strike-slip fault that moved during the 2008 Mogul earthquake swarm and its possible extensions to the southeast. Many short faults are mapped or otherwise identified throughout the area and more faults likely exist, but their activity, extents, and structural relations are poorly understood. Better depiction of active fault strands and identification of sites suitable for paleoseismic study are a needed first step.
 5. Faults in the valleys north of Reno and Sparks. These include the Long Valley, Petersen Mountain, Peavine Peak, Freds Mountain, and Spanish Springs Valley faults. Much of the North Valleys area is undergoing rapid urban development, and a better understanding of how deformation is distributed across this area is needed.
 6. Right-lateral strike-slip systems. These include the Mohawk Valley, Honey Lake, Warm Springs Valley, and Pyramid Lake faults. These are key for resolving the apparent discrepancy between geodetic and geologic strain rates, but they are generally farther from the urban areas than the previously mentioned fault systems, and some have been relatively well studied already.
 7. Lake Tahoe area fault systems. These include the West Tahoe fault and its possible continuation to the north as the Dollar Point fault, the North Tahoe fault, and the Incline Village fault. Although more work needs to be done, including work to understand how these faults link kinematically with the Mohawk Valley fault, recent and ongoing studies have contributed nicely to understanding the seismic hazards of these faults.

The Nevada Bureau of Mines and Geology plans to update this list of priorities at least annually, before proposals are due for submission to the U.S. Geological Survey's external grants portion of the National Earthquake Hazards Reduction Program.

We welcome comments and suggestions. Please address these to Dr. Jonathan G. Price, State Geologist and Director, Nevada Bureau of Mines and Geology, jprice@unr.edu. Thank you.