Annual Project Summary

Collaborative Research with University of Nevada and USGS: Seismic Hazard and Fault Mechanics in the Ruby Mountains

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The Great Basin physiographic province of the western United States is characterized by basin and range style deformation and encompasses an area reaching 800 km in width between the Sierra Nevada to the west and the Wasatch Mountains to the east (**Figure 1**). The western edge of the province is formed by the Walker Lane, a zone consisting primarily of northwest striking right-lateral faults. To the east, the basins and ranges are typically bounded by north- and northeasterly-striking active normal faults. Together, the strike-slip and extensional fault systems accommodate 15% to 25% of the 48 mm/yr of relative right-lateral motion between the Pacific and North American plates that is not taken up by displacements on the San Andreas fault system proper. The Ruby-East Humboldt Range sits approximately midway between the Sierra Nevada and Wasatch Mountains. The fault is an active element in the accommodation of extension across the Great Basin and, in turn, relative plate motion between the Pacific and North American plates. We have been examining neotectonic aspects of the rangefront bearing on the fault geometry and the recency, recurrence, and amount of offsets along the fault during the late Pleistocene. Initial results of the ongoing study are reported here.

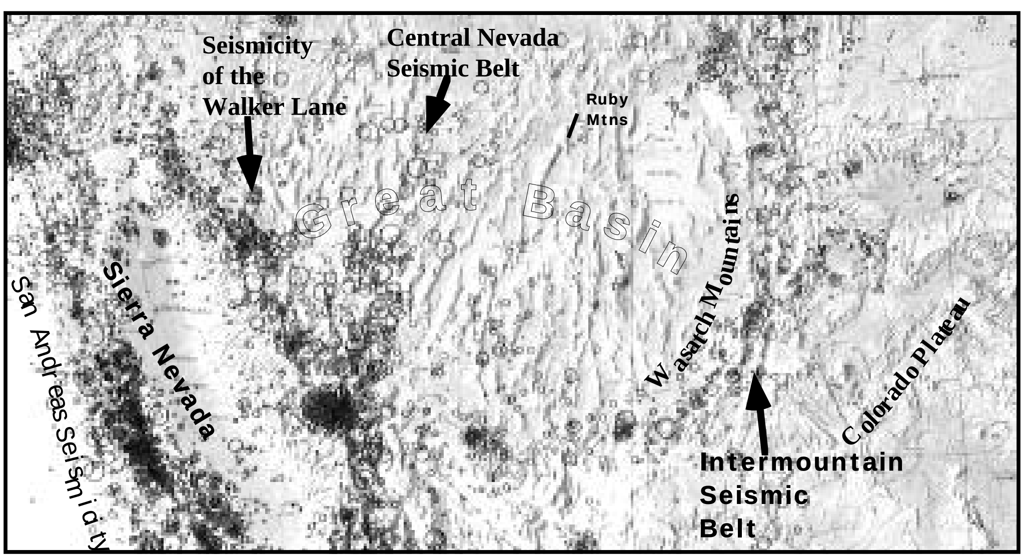

Figure 1. Seismicity and physiography of Great Basin and adjacent areas. The Great Basin is characterized by basin and range structure and extends between the Sierra Nevada on the west and the Wasatch in the east.

The northwestern flank of the Ruby Mountains is bounded by an active fault that cuts late Quaternary alluvial and glacial outwash deposits (**Figures 2** and **3**). The Ruby Mountain fault trace is composed of three distinct segments, each separated by a left step of 3 to 5 km, and totaling about 73 km in length. Glacial moraines are cut by the fault at Seitz and adjacent canyons (**Figures 3**). A profile along the crest of the offset Lamoille-age (Stage 6 correlative) moraine at Seitz canyon (**Figure 4**) indicates 16 ± 5 m of vertical separation. Dividing the range of offset by the age of Stage 6 glaciation (161 ± 33 kyr) yields a vertical uplift rate of 0.11 ± 0.05 mm/yr

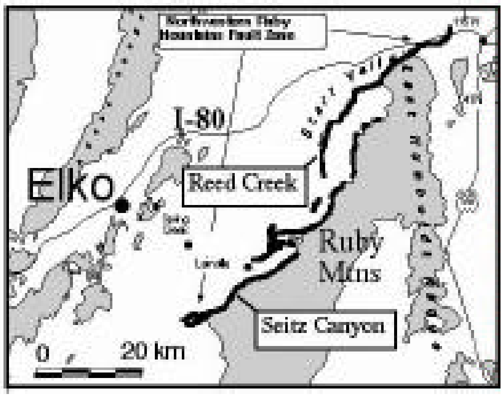

Figure 2. Mapping and trenching along the Ruby Mountain range front at Seitz Canyon and Reed Creek illustrate the methods and potential to extract information bearing on the paleoearthquake histories of faults across the proposed transect.

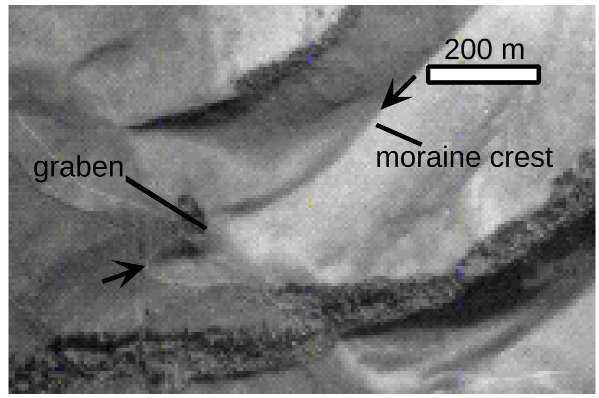

Figure 3. Vertical low sun angle photo shows offset and associated fault graben within lateral moraine crest at Seitz Canyon. Arrows show orientation of profile taken down moraine crest shown in Figure 4.

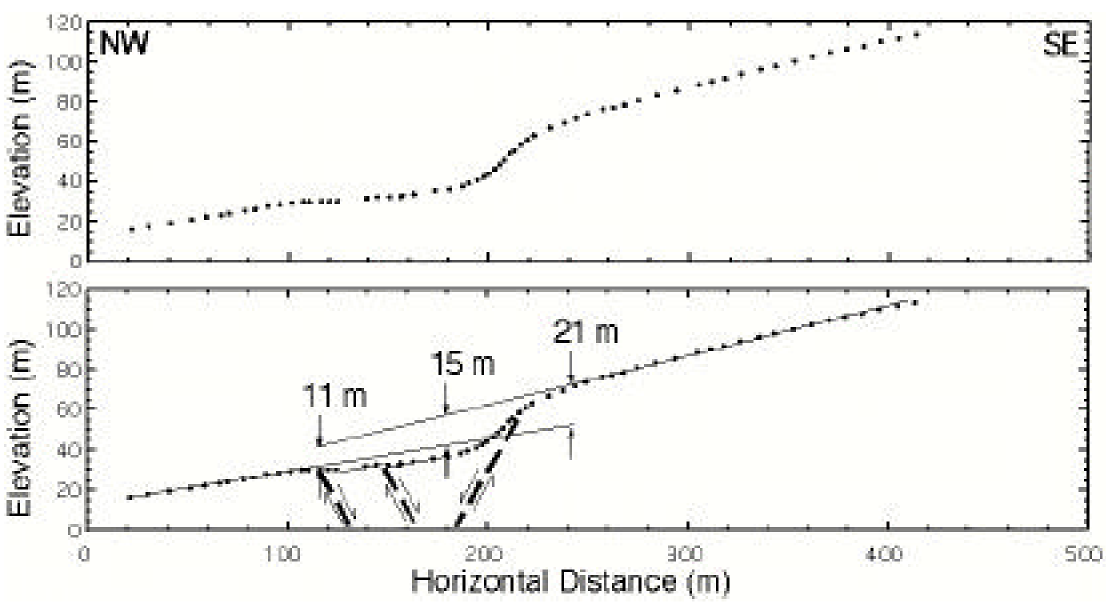

Figure 4. Profile along the crest of offset lateral moraine at Seitz Canyon that is shown in Figure 3.

Trenches have also been excavated on the northern and southern segments of the rangefront fault. The two trenches indicate a similar earthquake history. One of the trenches is located where the fault cuts fan sediments at the mouth of Reed Creek (**Figure 2 and 5**).. The most recent offset of the fault at Reed Creek has resulted in a scarp height of about 3 meters. The base of unit 4 shows the same vertical offset as the ground surface. Degradation of the scarp has since produced the colluvial wedge (unit 6). Unit 4 is composed of poorly sorted pebble and cobble gravels of fluvial origin and was the ground surface at the time of the most recent earthquake. On the footwall, unit 4 is currently capped by a well-developed soil profile that extends greater than 1 meter in depth and contains a Bt horizon of >20 cm thickness which, in turn, is underlain by a stage 2+ carbonate horizon of a half-meter thickness. On the hanging wall, unit 4 is now buried and preserved beneath the colluvial wedge unit (6) of the fault, and exhibits the same soil profile as observed on the footwall. The depth and structural grade of soil horizonation are most similar to those documented by Wayne (1984) and Chadwick et al. (1995) on the nearby glacial moraine and outwash deposits interpreted to be correlative to stage 6 glacial. The ground surface records only one event during this period of time. A radiocarbon date on a squirrel bone recovered at the base of the colluvial wedge indicates that the most recent displacement occurred at least 4370 ± 40 ypb. A radiocarbon date on organics recovered from the soil horizon (sample RCT-BS4-SGW) buried immediately beneath the colluvial wedge unit 6 is 6600 ± 40 radiocarbon years b.p.. In sum, these observations indicate the last displacement occurred between about 4370 and 6600 radiocarbon years b.p. and that the offset surface of unit 4 experienced no tectonic activity for many tens to perhaps even 100,000 years prior to the occurrence of the most recent offset.

Reconstruction of the trench log to remove the offset due to the most recent event juxtaposes unit 3 next to unit 5. The mismatch of units across the fault is evidence of prior faulting event(s). Unit 3 consists of thin to medium beds of laminated and cross-bedded fine and medium sands. Unit 5, in contrast, is generally massive silty very fine sands. A paleosol, manifest by slight increases in the clay content and weak blocky structure, is observed locally immediately beneath the eroded upper contact of unit 3 and relatively continuously beneath the upper contact of unit 5. Sufficient time thus passed subsequent to the juxtaposition of units 3 and 5 for the removal of any fault scarp, development of soil horizonation, and later emplacement of unit 4. These latter observations are also consistent with a period of time many tens of thousands of years or greater passing between the occurrence of the most recent and penultimate earthquakes.

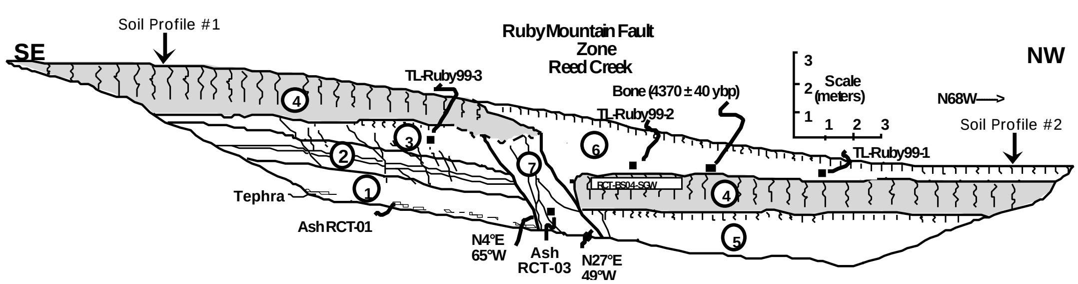

Figure 5. Trench log at Reed Creek elucidates earthquake history along west flank of the Ruby mountains. Depth of soil horizonation indicated by wiggly subvertical lines.