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Quaternary Fault and Fold Database of the United States

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Ruby Mountains fault zone (Class A) No. 1573

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Synopsis	The Ruby Mountains fault zone consists of three, generally northeast-striking, left-stepping faults, each of which are 25–35 km long that bound the northwest side of the northern Ruby Mountains and the East Humboldt Range. The faults generally follow the range-front however, locally they extend onto the piedmont. Within this zone, faults juxtapose Quaternary alluvium against bedrock and form scarps and lineaments on Quaternary alluvium adjacent to the range front and on piedmont slopes. The East Humboldt Range and Ruby Mountains form a prominent west-tilted horst block and is the highest range between the Sierra Nevada and the Wasatch Mountains. In general, reconnaissance and detailed geologic study and photogeologic mapping of fault related features are the main sources of data. A brief descriptions of one trench site is currently available. Late and latest Pleistocene deposits are offset suggesting strong evidence for

	young movement as well as recurrent movement in the past 200 k.y.
Name comments	This fault is variously named in the modern literature. As used herein, the Ruby Mountains fault zone as defined by Wesnousky (1995 #4420), which refers to the north-east-striking range-front and piedmont faults that bound the northernmost East Humboldt Range and places it against the basin of Starr Valley and the northeast-striking range-front and piedmont faults that bound the northern Ruby Mountains and place them against the basin of Lamoille Valley. Wesnousky and others (2000 #5811) also refer to this fault as the Ruby Mountain (sic) East Humboldt fault. dePolo (1998 #2845) used the name Ruby Mountains fault system for an alignment of faults considerably longer than those included here. We describe separately as Northern Snake Mountains fault [1726] (his fault number EK5A), the Northern Huntington Valley fault zone [1714] (his EK5D), and the Southern Huntington Valley fault zone [1715] (his EK5E). Previously, Willoughby (1998 #2658) used the name Northern Ruby Mountains fault zone. Barnhard (1985 #428) mapped three groups of scarps on alluvium and called them the Starr Valley, Northern Lamoille Valley, and Southern Lamoille Valley scarps. Refers to faults mapped by Sharp (1939 #2864), Slemmons (1967 #156), Garside (1968 #2863), Coats (1987 #2861), Dohrenwend and others (1991 #290; 1991 #286). The fault, as defined here, bounds the northern and western fronts of the East Humboldt Range and the northwest front of the Ruby Mountains a set of left-stepping faults from about 1 km north of Interstate 80 west of Wells, southwest to Chimney Creek, about 15 km southwest of Lamoille and 5 km north of the South Fork of the Humboldt River. **Fault ID:** Refers to EK5B and EK5C of dePolo (1998 #2845).
County(s) and State(s)	ELKO COUNTY, NEVADA
Physiographic province(s)	BASIN AND RANGE
Reliability of location	Good Compiled at 1:100,000 scale. *Comments:* Location based on 1:48,000-scale map of Willoughby (1998 #2658); mapping by photogeologic analysis of low-sun angle, black and white, 1:20,000-nominal-scale photographs

	transferred to 1:24,000-scale topographic maps and reduced to a 1:48,000-scale strip map. Additional faults were compiled from the 1:250,000-scale map of Dohrenwend and others (1991 #290); mapping by photogeologic analysis of 1:58,000-nominal-scale color-infrared photography transferred directly to 1:100,000-scale topographic quadrangle maps enlarged to scale of the photographs.
Geologic setting	The Ruby Mountains fault zone consists of three generally northeast-striking left-stepping faults, each of which are 25–35 km long. The faults have range front and piedmont traces. The range front traces bound northern East Humboldt Range and western side of the northern Ruby Mountains. The East Humboldt Range and Ruby Mountains are a westward tilted horst block (Stewart, 1978 #2866). Sharp (1939 #2864) estimated a minimum of 610 m of vertical displacement across the fault at Boulder Creek. In the Elko quadrangle, the fault zone is on the western side of an area of complexly faulted east-tilted Tertiary volcanic and sedimentary strata (Coats, 1987 #2861). These faulted strata appear to be the surface expression of a listric-faulted terrane (Anderson, 1983 #2852) or detachment block.
Length (km)	76 km.
Average strike	N43°E
Sense of movement	Normal *Comments:* Normal sense of movement from Dohrenwend and others (1991 #290); normal-oblique-sinistral movement inferred from northwest pitch of oblique striations on a fault at the mouth of Secret Pass (Sharp, 1939 #2864) and the formation of grabens at left steps and left bends (i.e., releasing bends?) in the fault trace (Willoughby, 1998 #2658).
Dip	50° W *Comments:* Sharp (1939 #2864) reported a 50? west-dipping fault exposed in the south bank of Secret Creek (east edge of sec 2, T34N, R59E) that juxtaposes Quaternary alluvium against Miocene deposits. Smith (1984 #2865) calculated a dip on the fault of 20? using seismic reflection lines; Willoughby (1998 #2658) projected the 20? fault dip of Smith (1984 #2865) to surface faults along the base of laid back range-front facets,

	which he considered to be consistent with a low-angle dip for this fault. dePolo (1998 #2845) assumed 40? dipping fault plane for calculations of slip rate.
Paleoseismology studies	
Geomorphic expression	Most of the fault is expressed by multiple-event scarps on late Pleistocene and single event scarps on Holocene alluvium adjacent to the range front and on upper piedmont-slope surfaces (Sharp, 1939 #2864; Dohrenwend and others, 1991 #286; 1991 #290; Willoughby and Wesnousky, 1997 #2657; Willoughby, 1998 #2658). Grabens 50-200 m wide with small vertical separations are common along the range front. Where faults extends out onto the piedmont, the range front is more sinuous and has less developed facets (Willoughby and Wesnousky, 1996 #4324; 1997 #2657; Willoughby, 1998 #2658). dePolo (1998 #2845) reported spectacular main-fault facets with indistinct basal facets. He reported a preferred maximum basal facet height of 98? 24 m. In the Elko quadrangle, Barnhard (1985 #428) reported that "scarps are present along only 2.5 km of the 7-km length" of the fault zone, and that the "scarps on Tertiary strata form an aligned array of truncated spurs and interstream divides along the trace of the fault." First examined in the field by Barnhard (1985 #428), who measured alluvial scarp heights of as much as 8 m and scarp-slope angles of as much as 20?. More extensive scarp-height and vertical-separation data were determined from alluvial scarps along the fault trace as mapped by Willoughby (1998 #2658). Single-event scarps are 1-2 m high along the southernmost echelon trace and 2-3 m high along the northern two echelon traces (Willoughby and Wesnousky, 1997 #2657). the morphology of theses scarps is more subdued than would be expected based on the timing of the most recent event. The local climate may be responsible for the higher degradation rates.
Age of faulted surficial deposits	Latest Pleistocene and/or Holocene, late Pleistocene, early to late Pleistocene, early to middle Pleistocene, and Miocene. Faults in this section displace virtually all surficial deposit of early, middle, late Pleistocene and latest Pleistocene and/or Holocene age (Sharp, 1939 #2864; Dohrenwend and others, 1991 #286; 1991 #290; Willoughby and Wesnousky, 1996 #4324; 1997 #2657; Willoughby, 1998 #2658), as well as Miocene bedrock (Sharp, 1939 #2864). Lamoille (early Wisconsin or possibly late Illinoian) and Angle Lake (late Wisconsin) glacial moraines and outwash

	deposits are displaced at the mouth of Lamoille, Seitz and Hennen Canyons (Willoughby and Wesnousky, 1996 #4324; 1997 #2657; Willoughby, 1998 #2658). Willoughby (1998 #2658) reported the youngest faulted deposits to be 15,000-23,000 years old (latest Pleistocene). In the Elko quadrangle, Barnhard (1985 #428) noted that Tertiary volcanic and sedimentary rocks and Quaternary deposits are offset. Dohrenwend and others (1991 #286; 1991 #290) interpreted that the faults cut early to middle and late Pleistocene and Holocene sediment.
Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* Although timing of the most recent event is not well constrained, detailed mapping by Willoughby and Wesnousky (1996 #4324; 1997 #2657) and Willoughby (1998 #2658), reconnaissance photogeologic mapping by Slemmons (1967 #156), and unpublished trenching data by Steve Wesnousky concur and suggest a latest Quaternary time. Willoughby and Wesnousky (1996 #4324; 1997 #2657) reported that the most recent event occurred during the past 13 to 20 k.y., based on his interpretation of the age of glacial outwash surfaces. In the Elko quadrangle, Barnhard (1985 #428) measured 5 scarp profiles but this was an insufficient number for a regression analysis to determine the age. Nonetheless, he noted that four of the five data points lie above the regression-equation line for the Lake Bonneville shoreline (14.5 radiocarbon years), and he suggested that the latest faulting event was younger than that age. dePolo (1998 #2845) reported late Pleistocene and Holocene activity, but does not substantiate the Holocene age.
Recurrence interval	2.4-17.7 ka (<23 ka) *Comments:* Willoughby reported a return time of 2,400-17,700 years with a preferred value of 10,000 years. The return time is from single event offsets divided by a calculated late Quaternary slip rate. Wesnousky (1995 #4420) used similar reasoning, and calculated his recurrence interval based on dip-slip offset and the slip rate that he calculated by inferring that the fault dips 60?. His calculated recurrence interval is slightly longer at 12,777?8,313 yr.
Slip-rate	Less than 0.2 mm/yr

category	*Comments:* Slip-rate estimates are highly sensitive to dip of the fault and several investigators have attempted to to define this fault's slip rate along the plane of the fault. Dip estimates for this fault range from 60? to 20?, which can result in very different values. We will report here only vertical slip rates that have been derived; the published rates are based on the offset moraine crest at Seitz Canyon that has a preferred vertical separation of 15 m (11-21 m). Willoughby (1998 #2658) notes that the site has a prominent graben and his reported vertical separation accounts for its presence. The uncertainty in the age of the moraine at Seitz Canyon is the greatest problem. Initial correlation of this deposit to oxygen-isotope stage 4 yield rates greater than 0.2 mm/yr. dePolo (1998 #2845) and dePolo and Anderson (2000 #4471) used a value of 20.8 m of preferred vertical offset the late Pleistocene (60-120 ka) glacial moraine to arrive at 0.28 mm/yr preferred vertical slip rate. But if one considers the Lamoille glacial deposits to correlate to oxygen-isotope stage 6, the vertical slip rate is 0.10 mm/yr (Willoughby, 1997 #2658), and even the extremes (0.06-0.16 mm/yr) are less than 0.2 mm/yr (Willoughby, 1997 #2658; Wesnousky and Willoughby, 2000 #5811). The assigned slip-rate category is based on those found in Willoughby (1997 #2658) and Wesnousky and Willoughby (2000 #5811).
Date and Compiler(s)	1998 Thomas L. Sawyer, Piedmont Geosciences, Inc. John A. Oswald, Piedmont Geosciences, Inc. Peter C. Rowley, U.S. Geological Survey, Retired R. Ernest Anderson, U.S. Geological Survey, Emeritus
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