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Dixie Valley fault zone, Stillwater seismic gap section (Class A) No. 1687a

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Synopsis	**General:** The Dixie Valley fault is a range-front structure that bounds the east side of the Stillwater Range. The Stillwater Range has been uplifted several kilometers relative to the bounding basins since basin-and-range faulting began (<13 Ma), and the southern part of range was tilted 40° to 90° east during early Miocene extensional faulting. This long, continuous, well-defined to spectacularly expressed fault zone is divided into two sections. The southern section ruptured in the 1954 earthquake, and the northern one did not. The 1954 Dixie Valley earthquake produced spectacular surface ruptures (up to 2.8 m high) along the southern part of the fault zone. The northern part of the fault zone has been referred to as the "Stillwater seismic gap" because it is located between coseismic surface ruptures of the 1915 Pleasant Valley earthquake to the north and 1954 Disie Valley earthquake to the south. In addition to geophysical studies, including seismic

	refraction, aeromagnetics and gravity surveys, and reconnaissance and detailed photogeologic mapping of the fault zone, detailed mapping and measurement of the 1954 ruptures, scarp morphology, and 5 trench at 4 sites are the sources of data. **Sections:** This fault has 2 sections. The pattern of 1954 surface faulting and general movement history provide a basis for subdividing the Dixie Valley fault zone into a southern section (1954 section), which ruptured in the 1954 earthquake and a northern section (Stillwater seismic gap section) that did not rupture. The Stillwater seismic gap section, which overlaps north end of 1954 scarps, extends along and near front of Stillwater Range from about Hare Canyon northward to mouth of White Rock Canyon, and discontinuously northeast to the area east of McKinney Pass.
Name comments	**General:** Refers to faults mapped by Slemmons (1968, unpublished Reno 1:250,000-scale map), Willden and Speed (1974 #3645), Bell (1984 #105), Wallace and Whitney (1984 #167), Bell and Katzer (1987 #205), Greene and others (1991 #3487), Caskey (1996 #2437), Caskey and others (1996 #2439), Dohrenwend and Moring, (1991 #282), and Dohrenwend and others (1992 #283). The fault extends along east side of Stillwater Range and in western Dixie Valley from La Plata Canyon, in northern part of Fairview Valley, northward to The Bend and continues northeastward across mouth of White Rock Canyon, to about 2 km north of the mouth of Man Canyon where one trace bends sharply east and separates into echelon northeast-striking traces and another steps west, where it forms discontinuous northeast-striking fault scarps that continue north to the area east of McKinney Pass (the topographic divide between the Stillwater and East Ranges). Slemmons (1957 #154) is an early reference to the Dixie Valley fault zone name. **Section:** Refers to faults mapped by Slemmons (1968, unpublished Reno 1:250,000-scale map), Willden and Speed (1974 #3645), Bell (1984 #105), Wallace and Whitney (1984 #167), Greene and others (1991 #3487), Caskey (1996 #2437), Caskey and others (1996 #2439), Dohrenwend and Moring (1991 #282), and Dohrenwend and others (1992 #283) along east side of Stillwater Range and in western Dixie Valley from south of Mississippi Canyon northward to mouth of White Rock Canyon, and northeast to the area east of McKinney Pass. Wallace and Whitney (1984 #167) informally referred to this section of the fault zone as the "Stillwater seismic gap". As compiled here, the

	section overlaps and is west of the rupture zone of the 1915 Pleasant Valley earthquake along the Sou Hills section of the Pleasant Valley fault [1629d]. **Fault ID:** Refers to fault number R29 (Dixie Valley fault zone) of dePolo (1998 #2845).
County(s) and State(s)	CHURCHILL COUNTY, NEVADA PERSHING COUNTY, NEVADA
Physiographic province(s)	BASIN AND RANGE
Reliability of location	Good Compiled at 1:100,000 scale. *Comments:* Fault locations west of long -118° are generally based on 1:48,000-scale map of Caskey (1996 #2437, reproduced in Caskey and others, 1996 #2439). Mapping by Caskey (1996 #2437) was based on detailed photogeologic analysis of 1:10,000- to 1:12,000-scale, vertical, low-sun-angle aerial photography, transferred by inspection to 1:24,000-scale mylar orthophotos and directly to 1:24,000-scale topographic maps, that were then reduced to 1:48,000-scale. Some of this mapping was also based on detailed field mapping and hundreds of measurements of fault offsets along fault zone. Selected fault locations in this region are also based on 1:250,000-scale map of Bell (1981 #2875; 1984 #105); which is mapping from photogeologic analysis of 1:40,000-scale low sun-angle aerial photography, supplemented with 1:12,000-scale aerial photography of selected areas, several low-altitude aerial reconnaissance flights, and field reconnaissance of major structural and stratigraphic relationships. Fault locations east of long -118° were taken from 1:250,000-scale maps of Dohrenwend and Moring (1991 #284) and Dohrenwend and others (1992 #283), which were produced by 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	This long, continuous, well-defined to spectacularly expressed fault zone has: (1) range-front faults bounding east front of Stillwater Range from near Elevenmile Canyon north to The Bend, east for several kilometers along northern margin of The Bend, and continues nearly continuously from about Hare Canyon northeastward to mouth of White Rock Canyon; (2) subparallel

	piedmont faults are widely distributed in western Dixie Valley, particularly in The Bend as much as 5 to 6 km east of range front, on piedmont slope between East Lee Canyon and about Cain Spring Canyon, on alluvial fan of Elevenmile Wash, and bounding and in uplifted pediment on Quaternary-Tertiary alluvium at westward step in range front at about La Plata Canyon; and (3) short intermontane faults on range-front escarpment between about Rough Creek Canyon north to James Canyon (Slemmons, 1968, unpublished Reno 11:48,000-scale map of Caskey (1996 #243t; Bell, 1984 #105; Bell and Katzer, 1987 #205; Greene and others, 1991 #3487; Caskey, 1996 #2437; Caskey and others, 1996 #2439). Dixie Valley is an asymmetric graben-in-graben bounded on west by the range-front fault zone and traversed in its western part by the piedmont fault zone, each have as much as 1500 to 1800 m of late Cenozoic (approximately 15 Ma) vertical offset (Burke, 1967 #2432; Herring, 1967 #3711; Meister, 1967 #3715; Thompson and Burke, 1973 #164; Bell, 1981 #2875; Anderson and others, 1983 #2852; Schaefer, 1983 #3716). The Stillwater Range has been uplifted several kilometers relative to the basin beneath Dixie Valley and Carson Sink since basin-and-range faulting began (<13 Ma), and southern part of range was tilted 40° to 90° east during early Miocene extensional faulting (John, 1995 #3713). In its north-most part, one splay of the fault zone steps left and continues discontinuously along the Stillwater Range to its north end and a second splay bends sharply east and separates into echelon northeast-striking traces, forming the boundary between Dixie Valley and the Sou Hills. The 1954 Dixie Valley earthquake produced spectacular surface ruptures along fault zone from east of La Plata Canyon to east of Mississippi Canyon (Bell, 1984 #105; Caskey, 1996 #2437; Caskey and others, 1996 #2439). The rupture pattern of the 1954 Fairview Peak-Dixie Valley earthquakes suggests that this fault zone may be related to the Louderback Mountains fault [1689], Gold King fault [1691], West Gate fault [1692], and Fairview Peak fault zone [1690]; the general pattern of young faulting suggests fault zone is also related to the Sand Springs Range fault [1685] to the south (Bell and Ramelli, 1999 #4330).
Length (km)	This section is 53 km of a total fault length of 105 km.
Average strike	N31°E (for section) versus N21°E (for whole fault)
Sense of movement	Normal *Comments:* (Slemmons, 1968, unpublished Reno 1:250,000;

	Wallace and Whitney, 1984 #167; Greene and others, 1991 #3487; Caskey, 1996 #2437).
Dip Direction	SE
Paleoseismology studies	
Geomorphic expression	Southeast-facing prehistoric fault scarps are found along a narrow sinuous zone of the Stillwater seismic gap section for about 40 km (Wallace and Whitney, 1984 #167). They strike about N. 35° E. and are 4-6 m high, lack beveled portions or inflections in their cross profiles, and are thus considered to be single-event features (Zhang and others, 1991 #188). They displace mid Holocene soils about the same amount as late-Holocene soils, suggesting only one prehistoric surface-faulting event during the mid and late Holocene. Range-front faults are marked by sinuous abrupt eastern front of Stillwater Range and as young, prominent scarps of mid and late Holocene age (Wallace and Whitney, 1984 #167; Pearthree and Wallace, 1988 #2562; Bell and Katzer, 1990 #111; Pearthree and others, 1996 #2153). The Stillwater Range front is steep, rises abruptly from the piedmont, and exhibits wineglass canyons (Wallace, 1987 #240) and up to 146-m-high basal fault facets (dePolo and Anderson, 2000 #4471). North of the Churchill/Pershing County line, the front rises precipitously more than 1000 m at overall angle approaching 30° (Wallace and Whitney, 1984 #167). Piedmont faults are primarily marked by paleoliquefaction-related scarps on deposits that contain Mazama ash (6845±50 yr) (Caskey, 1996 #2437; Caskey and others, 1996 #2439). Near Mississippi Canyon scarps are up to 4.5–6 m high and have slope angles up to 28° on Holocene deposits.
Age of faulted surficial deposits	Holocene. There is general agreement that faults in this section displace Holocene piedmont-slope deposits, although in many places these are liquefaction-related features, rather than primary surface-faulting features (*e.g.*, Bell, 1981 #2875; 1984 #105; Hecker, 1985 #212; Caskey, 1996 #2437); some faulted deposits along and near range front may be as young as late Holocene (Wallace and Whitney, 1984 #167). In the Winnemucca 1:250,000-scale map, lineaments and east-facing scarps west of the Sou Hills and southeast-facing scarps bounding Dixie Valley against the Sou Hills are on late Pleistocene (10-130 ka) or latest Pleistocene and (or) Holocene (0-30 ka) deposits or erosion surfaces (Dohrenwend and Moring, 1991 #282). Only southeast of Fencemaker Pass do those authors recognize the fault on

	Holocene deposits or surfaces.
Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* Although timing of most recent paleoevent is not well constrained, a Holocene to late Holocene time is suggested based on mapping of Bell (1981 #2875; 1984 #105), Wallace and Whitney (1984 #167), Hecker (1985 #212), Caskey (1996 #2437), Caskey and others (1996 #2439), and Dohrenwend and others (1996 #2846). Pearthree and others (1986 #2564) implied that the most recent event on this section occurred between 2 and 6 ka and that it also ruptured the adjacent section to the south [1687b].
Recurrence interval	*Comments:* Not studied in detail; Wallace and Whitney (1984 #167) considered the long-term slip rate (<13 Ma) and that, if the fault zone ruptured during 1- to 2-m-displacement events, then the average recurrence interval is a few thousands of years; interval assumes constant slip rate in past 13 Ma. Pearthree and others (1986 #2564) reported an event between 2 and 6 ka and an early Holocene event, apparently supporting this poorly constrained recurrence interval.
Slip-rate category	Between 0.2 and 1.0 mm/yr *Comments:* Wallace and Whitney (1984 #167) estimated a late Cenozoic vertical slip rate on the Dixie Valley fault zone (this section ?) of 0.26–0.35 mm/yr based on apparent offset a 10.4–12.9 Ma volcanic unit at an elevation of 2200 m in Stillwater Range and a correlative unit about 1280 m below sea level near center of Dixie Valley based on seismic-reflection data. dePolo (1998 #2845) and dePolo and Anderson (2000 #4471) calculated a preferred vertical slip rate of 0.14 mm/yr (0.07–0.23 mm/yr) for the Dixie Valley fault zone, based on up to 31 m offset of a deposit estimated to be 200–500 ka by Bell and Katzer (1990 #111). Assigned slip-rate category based on the higher value presented here and the presumption that the slip rate for this section is not significantly different from the published rated for the southern section.
Date and Compiler(s)	1999 Thomas L. Sawyer, Piedmont Geosciences, Inc.

	R. Ernest Anderson, U.S. Geological Survey, Emeritus
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