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Quaternary Fault and Fold Database of the United States

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Grand Valley fault, Star Valley section (Class A) No. 726d

Last Review Date: 2011-02-03

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Synopsis	**General:** This long fault extends from eastern Idaho into western Wyoming along the western base of the Snake and Salt River Ranges. **Sections:** This fault has 4 sections. Detailed mapping and limited trenching suggest that the fault is composed of four segments and has an additional poorly characterized part. These different parts of the fault suggest that it has different rates of Quaternary displacement and apparently different paleoseismic histories. Those segments are herein considered as informally named sections in accordance with this compilation. From north to south they are: the Swan Valley section [726a], the Grand Valley section [726b], the Prater Mountain section [726c], and the Star Valley

	section [726d]. The southernmost section is the youngest and most active part of the fault. The northern part of the fault is outside the Intermountain Seismic Belt and surface ruptures are less frequent than on those parts to the south.
Name comments	**General:** Name of fault and its sections are modified from Piety and others (1992 #538). Earlier workers in the area restricted the use of "Grand Valley fault" to that part of the structure in Idaho; the southern extension in Wyoming was known as the "Star Valley fault." The use of a single name as utilized by Piety and others (1992 #538) is followed here. The Grand Valley fault extends from about 26 km southeast of Pocatello, Idaho, south to about 22 km south of Afton, Wyoming. **Section:** The section was defined by Piety and others (1992 #538) as extending from Prater Canyon on the south to 1 km north of the Salt River (as shown by Warren, 1992 #837). This part of the fault bounds two distinct structural and physiographic basins of approximately equal size (Piety and others, 1986 #55). Furthermore, the topographic high separating these two basins near "The Narrows" is coincident with a 4-km-wide right step in the trace of the fault. The Star Valley section includes both parts of the Star Valley fault of Witkind (1975 #819) in Wyoming. Piety and others (1986 #55) suggested that the southern 27 km of the Grand Valley fault has similar faulting histories on either side of the echelon step. **Fault ID:** Refers to number 22 (Grand Valley fault, Idaho) of Witkind (1975 #320) and numbers 20 and 21 (Star Valley fault, Wyoming) of Witkind (1975 #819).
County(s) and State(s)	LINCOLN COUNTY, WYOMING
Physiographic province(s)	MIDDLE ROCKY MOUNTAINS
Reliability of location	Good Compiled at 1:24,000 scale. *Comments:* Fault location is from 1:24,000-scale maps of Warren (1992 #837) and 1:275,000-scale map of Piety and others (1992 #538); the fault's location is further constrained by satellite imagery and topography at scale of 1:24,000. Reference satellite imagery is ESRI_Imagery_World_2D with a minimum viewing distance of 1 km (1000 m).

Geologic setting	Down-to-the-west range-front normal fault that extends from near the Snake River Plain southward along the western base of the Snake and Salt River Ranges. Basin fill is estimated to be 2- to 3-km thick based on seismic reflection data (Royse and others, 1975 #4391; Dixon, 1982 #4382).
Length (km)	This section is 52 km of a total fault length of 136 km.
Average strike	N8°W (for section) versus N22°W (for whole fault)
Sense of movement	Normal *Comments:* (Piety and others, 1986 #55; Piety and others, 1992 #538)
Dip	10–70° W. *Comments:* According to cross-section 1 of Webel (1987 #815), the fault dips 70° near the surface, but progressively flattens and merges with the Absaroka thrust fault (dip 10°W.) at a depth of about 12 km.
Paleoseismology studies	Site 726-1. Warren (1992 #837) trenched an 11-m-high scarp at a site 0.8 km south of Swift Creek (the Afton trench site). The exposed stratigraphy suggests that three latest Quaternary surface-rupturing earthquakes occurred at about 5,540±70 14C yr BP (3 m of vertical displacement), 8,090±80 14C yr BP (4 m of vertical displacement), and about 12–15 ka (4 m vertical displacement). McCalpin (1993 #796) reported that the earliest (third) event at the site occurred between 14 and 15.5 ka.
Geomorphic expression	Discontinuous fault scarps are present on late Quaternary alluvial fans at the mouths of major valleys (Piety and others, 1992 #538). These scarps tend to fall into to one of two size classes: 5–6 m high and 11–15 m high suggesting multiple episodes of movement. Elsewhere, the fault is at the abrupt contact between alluvium and bedrock, and few scarps are present in the interfluves between the mouths of the narrow valleys.
Age of faulted surficial deposits	Holocene and late Pleistocene alluvial fans along the eastern margin of Star Valley.
Historic	

earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* Warren (1992 #837) dated the most recent paleoearthquake as mid-Holocene in age at about 5540±70 14C yr BP; these data also are reported by McCalpin (1993 #796).
Recurrence interval	>5.5 k.y. (<5.5 ka); 2.4–2.7 k.y. (5.5–8 ka); 4–7 k.y. (8 to 14.5–15 ka) *Comments:* Warren (1992 #837) documented two recurrence intervals from his three dated events. The most recent recurrence interval was 2,400–2,700 14C yr, preceded by a less well-constrained interval of about 4–7 k.y. However, since most recent event occurred at about 5,540±70 14C yr BP, the present interval of quiescent suggests that recurrence intervals can be longer than 5.5 k.y., which appears to be the criteria used by Mason (1992 #463) to suggest that the repeat time between earthquakes on this section is 5–2.4 k.y. based on data presented by Piety and others (1986 #55).
Slip-rate category	Between 0.2 and 1.0 mm/yr *Comments:* Warren (1992 #837) reported a late Quaternary vertical displacement rate of 0.73–0.91 mm/yr. This rate must be derived from the cumulative vertical displacement of the two most recent events (7 m) and the time interval between about 5.5 ka and 12–15 ka. Earlier, Piety and others (1986 #55; 1992 #538) and then Anders and others (1990 #409) suggested that the latest Quaternary (<15 ka) vertical displacement rate for the Star Valley section is 0.6–1.1 mm/yr based on 8.3–11.6 m high scarps on 11–15 ka deposits. Interestingly the vertical displacement rate on this part of the fault is comparable to that on the Swan Valley section during the interval from 2.0–4.4 Ma. Wong and others (2000 #4484) reported fault rates ranging from 0.026 to 2.3 mm/yr, with maximum weighting of 60 percent on a value of 1.1 mm/yr. These reported rates are based on a combination of data from Anders and others (1990 #409), Piety and others (1986 #55; 1992 #538), and McCalpin (1993 #796). The late Quaternary characteristics of this fault (overall geomorphic expression, continuity of scarps, age of faulted deposits, etc.) suggest the vertical displacement rate during this period is probably less than the 1.1 mm/yr that Wong and others (2000 #4484) favored. Because most of the reported rates are less than 1 mm/yr (especially the younger ones), we

	assign the 0.2–1 mm/yr slip-rate category to this section of the Grand Valley fault.
Date and Compiler(s)	2011 James P. McCalpin, GEO-HAZ Consulting, Inc. Michael N. Machette, U.S. Geological Survey, Retired Kathleen M. Haller, U.S. Geological Survey
References	#409 Anders, M.H., Rodgers, D.W., McCalpin, J.P., and Haller, K.M., 1990, Late Tertiary and Quaternary faulting north and south of the eastern Snake River Plain, *in* Roberts, S., ed., Geologic field tours of western Wyoming: Geological Survey of Wyoming Public Information Circular 29, p. 1-38. #4382 Dixon, J.S., 1982, Regional structural synthesis, Wyoming salient of Western Overthrust belt: American Association of Petroleum Geologists Bulletin, v. 66, p. 1560-1580. #463 Mason, D.B., 1992, Earthquake magnitude potential of active faults in the Intermountain seismic belt from surface parameter scaling: Salt Lake City, University of Utah, unpublished M.S. thesis, 110 p. #796 McCalpin, J.P., 1993, Neotectonics of the northeastern Basin and Range margin, western USA: Zeitschrift fuer Geomorphologie N. Folge, v. 94, p. 137-157. #538 Piety, L.A., Sullivan, J.T., and Anders, M.H., 1992, Segmentation and paleoseismicity of the Grand Valley fault, southeastern Idaho and western Wyoming, *in* Link, P.K., Kuntz, M.A., and Platt, L.B., eds., Regional geology of eastern Idaho and western Wyoming: Geological Society of America Memoir 179, p. 155-182. #55 Piety, L.A., Wood, C.K., Gilbert, J.D., Sullivan, J.T., and Anders, M.H., 1986, Seismotectonic study for Palisades Dam and Reservoir, Palisades Project: Bureau of Reclamation Seismotectonic Report 86-3, 198 p., 2 pls. #4391 Royse, F.J., Warner, M.A., and Reese, D.L., 1975, Thrust belt structural geometry and related stratigraphic problems Wyoming-Idaho-northern Utah, *in* Bolyard, D.W., ed., Deep drilling frontiers of the central Rocky Mountains: Denver, Colorado, Rocky Mountain Association of Geologists—1975 Symposium, p. 41-54.

#837 Warren, G.A., 1992, Quaternary geology and neotectonics of southern Star Valley and the southwest flank of the Salt River Range, western Wyoming: Logan, Utah State University, unpublished M.S. thesis, 96 p., 3 pls., scale 1:24,000.

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#320 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in Idaho: U.S. Geological Survey Open-File Report 75-278, 71 p. pamphlet, 1 sheet, scale 1:500,000.

#819 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in Wyoming: U.S. Geological Survey Open-File Report 75-279, 35 p. pamphlet, 1 sheet, scale 1:500,000.

#4484 Wong, I., Olig, S., and Dober, M., 2000, Preliminary probabilistic seismic hazard analyses—Island Park, Grassy Lake, Jackson Lake, Palisades, and Ririe Dams: U.S. Department of the Interior, Bureau of Reclamation Technical Memorandum D8330-2000-17.