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Maacama fault zone, northern section (Class A) No. 30a

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Compiled in cooperation with the California Geological Survey

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Synopsis	**General:** This is a major dextral fault that extends from near Laytonville in Mendocino County nearly to Mark West Creek in Sonoma County. It has been interpreted as a right-stepping northern extension of the Rogers Creek fault [32] and is defined mainly by geomorphic features mapped by Herd and others (1977 #4858), U.S. Army Corps of Engineers (1978 #4867), Huffman and Armstrong (1980 #4862), Pampeyan and others (1981 #1250), Smith (1981 #4863; 1981 #4864; 1981 #4865; 1982 #4866), Bryant (1982 #4851) and Upp (1982 #4868; 1989 #4869). Based on Holocene surface traces, the California Division

	of Mines and Geology established it as a regulatory Earthquake Fault Zone under the Alquist-Priolo Act (Hart and others, 1983 #4857). McLaughlin (1981 #4859) inferred about 20 km of dextral offset during the Quaternary. Fault creep measured near Ukiah and Willits shows about 5.6 mm/yr, and 7.6 mm/yr, respectively, of dextral slip (Galehouse, 1995 #4853). The fault is fairly well defined by seismicity (Goter and others, 1994 #4855). A paleoseismic study indicates that the most recent event is prehistoric and occurred between 1520 A.D. and 1650 A.D. (Sickler and others, 1999 #4861) whereas other trench investigations indicate Holocene rupture in several places near Ukiah and Willits. Sickler and others (1999 #4861) estimated a preliminary maximum dextral slip rate of 11-14 mm/yr, based on a dextrally offset terrace riser of middle to early Holocene age **Sections:** This fault has 2 sections. Jennings (1994 #2878) identifies two Maacama fault sections—a northern and central one (his number 114) and a southern one (his number 141). His twofold sectioning (which is adopted herein) is largely based on surface traces of Holocene faults and is similar that zoned under the Alquist-Priolo Act by the California Division of Mines and Geology (Hart and others, 1983 #4857; 1997 #4856). The two sections vary in strike by about 15 degrees. Working Group on California Earthquake Probabilities (1996 #1216) divided the fault into three sections—north, central and south (their H6, H5, and H4 faults). Petersen and others (1996 #4860) adopted the Working Group on California Earthquake Probabilities sectioning scheme. The northern endpoint of the fault used by Working Group on California Earthquake Probabilities and Petersen extends much farther north than that of Jennings (1994 #2878) or Hart and others (1983 #4857) and appears to be somewhat arbitrary and not based on geomorphic expression. Upp (1989 #4869) recognized 4 "sub zones" for the northern and central sections of others and describes 10 named discontinuous faults. The basis for sectioning and the selection of endpoints used by Working Group on California Earthquake Probabilities, Petersen and others, and Upp is partly unclear.
Name comments	**General:** Apparently first named by Gealey (1951 #4854) who showed the fault as a zone of subparallel traces that crossed Maacama Creek in the Healdsburg 15-minute quadrangle. Fault mapped as extending to the southeast and northwest by Herd and others (1977 #4858), U.S. Army Corps of Engineers (1978 #4867), Huffman and Armstrong (1980 #4862), Pampeyan and others (1981 #1250), Smith (1981 #4863; 1981 #4864; 1981

	#4865; 1982 #4866), Bryant (1982 #4851), and Upp (1982 #4868; 1989 #4869). Different fault strands have at times been given different names, none of which are prominent in the literature. **Section:** The north section approximately corresponds with the northern and central parts of the Maacama fault of Jennings (1994 #2878). This section was designated as the Talmadge fault by Harding-Lawson Associates in App. CE-1 of U.S. Army Corps of Engineers (1978 #4867). However, the term "Talmadge" was later restricted to a very short fault trace near Talmadge by Upp (1989 #4869) and most subsequent workers have instead applied the name Maacama. This section possibly could be further subdivided into two shorter sections at a point between Ukiah and Willits, where the fault makes a broad left step of about 1.5 km, but such a division seems unjustified on the basis of current data. **Fault ID:** Refers to number 114 (Maacama fault, northern and central parts) of Jennings (1994 #2878), and number H5 (Maacama central) and H6 (Maacama north) of Working Group on California Earthquake Potential (1996 #1216).
County(s) and State(s)	MENDOCINO COUNTY, CALIFORNIA
Physiographic province(s)	PACIFIC BORDER
Reliability of location	Good Compiled at 1:24,000 scale. *Comments:* Location based on digital revisions to Jennings (1994 #2878) using original mapping by Upp (1982 #4868), Pampeyan and others (1981 #1250), and Smith (1981 #4863; 1981 #4864; 1981 #4865; 1982 #4866) at 1:24,000 scale.
Geologic setting	Major dextral component of the San Andreas fault system. Connects via a 6 km right step with the Rodgers Creek fault [32] to the south. Extension to the north of Laytonville is not well documented, but suggested by seismicity (Goter and others, 1994 #4855) or it may connect structurally with late Quaternary Brush Mountain shear zone [154] to the northwest (Jennings, 1994 #2878). The fault offsets Pliocene-Pleistocene sediment of the Glen Ellen Formation and all older units (Wagner and Bortugno, 1982 #4870). Locally offsets late Quaternary alluvium near Maacama Creek (Huffman and Armstrong, 1980 #4862), Ukiah

	(Smith, 1981 #4863), and Willits (Upp, 1989 #4869). McLaughlin (1981 #4859) estimated about 20 km of dextral slip has occurred during the Quaternary based on inferred offset of the Pliocene Sonoma Volcanics.
Length (km)	This section is 107 km of a total fault length of 160 km.
Average strike	N24°W (for section) versus N28°W (for whole fault)
Sense of movement	Right lateral *Comments:* Dextral slip is indicated by systematically right-deflected drainages (U.S. Army Corps of Engineers, 1978 #4867; Pampeyan and others, 1981 #1250; Smith, 1981 #4863; 1981 #4864; 1981 #4865; and Upp, 1982 #4868; 1989 #4869). Deflected curbs and other cultural features show a historic dextral sense of movement in Willits and near Ukiah (Pampeyan and others, 1981 #1250; Smith, 1981 #4863; Galehouse, 1995 #4853). Surveying of alignment arrays also documents dextral fault creep (Galehouse, 1995 #4853). Castillo and others (1993) suggested that the fault may have a reverse component of movement on the basis of observations of east-dipping planar alignment of seismicity and oblique-slip focal mechanisms. However, trench observations reported by Sickler and others (1999 #4861) indicate slickensides that plunge only 2.5° N., indicating nearly pure horizontal slip. Linearity of fault traces also indicates a dominant dextral strike-slip offset.
Dip Direction	V *Comments:* Assumed to be 90°, or nearly so, based on linearity of fault traces.
Paleoseismology studies	The fault has been investigated in detail at five sites. The Upp Creek site (30-1) consists of three trenches dug just north of Willits (Upp, 1982 #4868; 1989 #4869). These trenches exposed a thick sequence of older colluvium and soils juxtaposed against Franciscan sandstone and shale by a vertical fault. The fault appears to vertically offset the base of the youngest colluvial/soil unit about 30 cm and to truncate a stoneline at its base. Although the colluvial unit was judged by the investigator to postdate the scarp, an alternative explanation is possible wherein trench log 3B (Upp, 1982 #4868; 1989 #4869) suggests multiple displacements. The Laughlin Range site (30-2) 6 km south of Willits (Upp, 1982

	#4868; 1989 #4869) consists of two trenches dug across sags. The trenches exposed faulted colluvial and lacustrine deposits that were radiocarbon dated. The investigator concluded that the Maacama fault had at least two rupture events in the past 16,200 yrs (i.e., is latest Pleistocene or Holocene), but that there was no movement in the past 1,140 yrs. Site 30-3 is the location of a paleoseismic study by the U.S. Geological Survey near Talmadge, east of Ukiah. Evidence of a folding event (but no brittle rupture) after about 1500 A.D. was revealed in this study by Galehouse and others (1992 #4852). Site 30-4 consists of a trench excavated at Howell Creek in an effort to define an upper boundary for the timing of the event observed at site 30-3. Bogar and others' (1996 #4850) results are somewhat ambiguous because of problems with reworked carbon, but there is clear evidence for at least two rupture events, the younger of which is late Holocene. Site 30-5 consists of 2 fault-normal trenches and 1 fault-parallel trench (Sickler and others, 1999 #4861). These trenches exposed faulted buried strath terrace deposits that are incised into Pleistocene sediment of the Ukiah Formation. Radiocarbon dates from faulted and unfaulted alluvium indicate that the most recent event occurred between 1520 A.D. and 1650 A.D. In Willits and just east of Ukiah, active fault creep has been measured by Galehouse (1995 #4853) at rates of 7.6±0.5 mm/yr and 5.6±1 mm/yr, respectively. Additional fault-creep localities were identified by Smith (1981 #4863), Pampeyan and others (1981 #1250), and Upp (1982 #4868; 1989 #4869).
Geomorphic expression	Linear troughs, scarps and sidehill benches, closed depressions, and dextrally deflected drainages define discontinuous, recently active surface traces of the fault and are especially well-developed near Ukiah and Willits (U.S. Army Corps of Engineers, 1978 #4867; Pampeyan and others, 1981 #1250; Smith, 1981 #4863; 1981 #4864; 1981 #4865; 1982 #4866; Upp, 1982 #4868; 1989 #4869).
Age of faulted surficial deposits	Fault mostly offsets Franciscan melange of Tertiary and Cretaceous age, but locally offsets late Quaternary alluvium. Offset Holocene alluvium was observed in several places in trenches near Willits and Ukiah (Upp, 1982 #4868; 1989 #4869;

	Galehouse and others, 1992 #4852; Sickler and others, 1999 #4861) and unpublished reports AP-2804 and AP-3092 (on file at California Division of Mines and Geology in San Francisco).
Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* At least two events have been documented for the past 16.2 k.y. south of Willits based on trenching and radiocarbon dating (Upp, 1982 #4868; 1989 #4869). Coseismic folding of alluvium in the past 500 years was determined east of Ukiah (Galehouse and others, 1992 #4852; Goter and others, 1994 #4855). Sickler and others (1999 #4861) reported that the most recent event occurred between 1520 A.D. and 1650 A.D., based on radiocarbon-dated faulted and unfaulted alluvium.
Recurrence interval	*Comments:* Most recent event identified by Sickler and others (1999 #4861) suggests a minimum recurrence interval of at least 370 years to 500 years (incomplete recurrence interval since most recent event).
Slip-rate category	Greater than 5.0 mm/yr *Comments:* Based on creep rates determined at Ukiah and Willits (Galehouse, 1995 #4853), and an assumed fault slip rate of 9 mm/yr for similar faults, such as the Hayward and Rodgers Creek (Working Group on California Earthquake Probabilities, 1996 #1216; Petersen and others, 1996 #4860). Sickler and others (1999 #4861) estimated a preliminary maximum dextral displacement rate of 11–14 mm/yr on the basis on 70 m dextral offset of a terrace riser that has a radiocarbon age between 4.9 ka and 6.2 ka.
Date and Compiler(s)	2001 Earl W. Hart, California Geological Survey William A. Bryant, California Geological Survey
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