

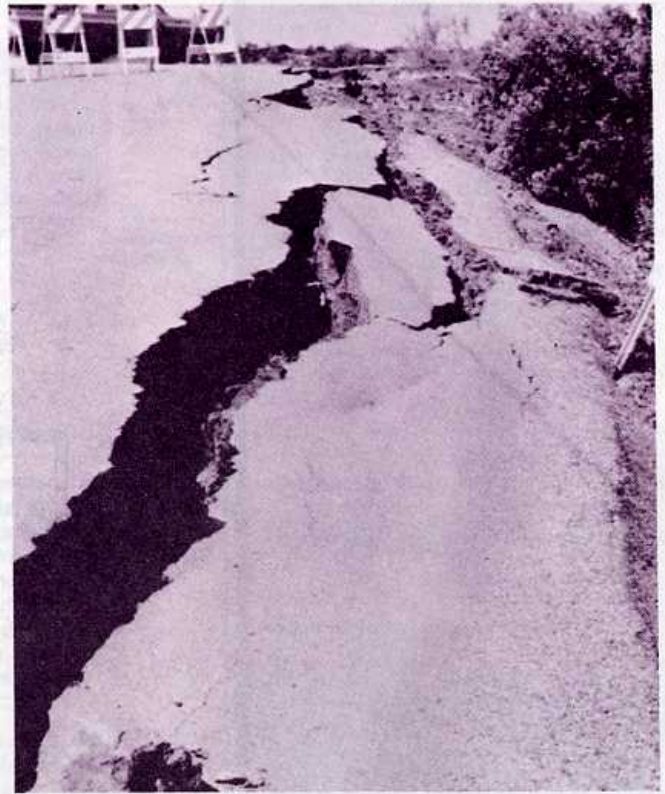
CALIFORNIA GEOLOGY

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MORGAN HILL EARTHQUAKE



Understanding California's Geology

- Our Resources -

- Our Hazards -

SPECIAL RENEWAL ISSUE

MORGAN HILL EARTHQUAKE OF APRIL 1984

Santa Clara County

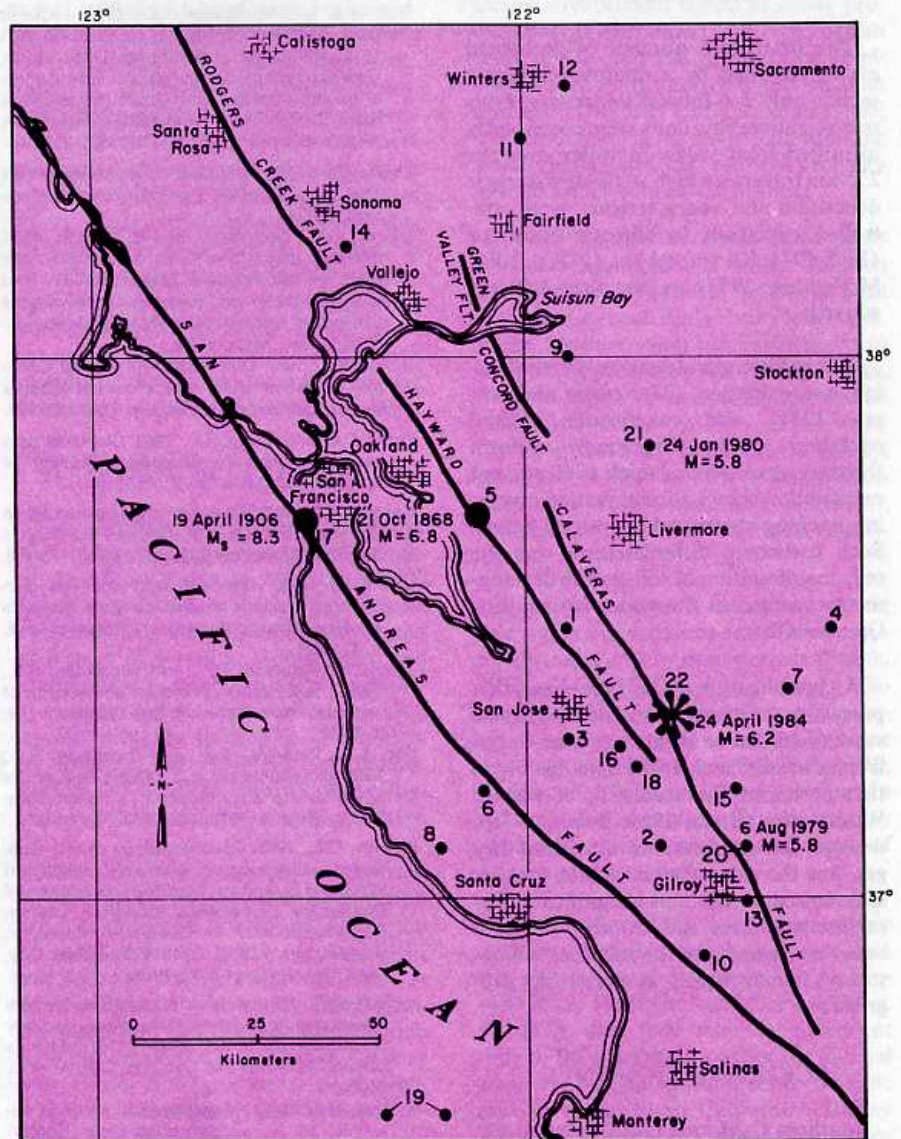
By
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A CDMG field team of seismologists, geologists, and strong-motion technicians were in Morgan Hill within hours of the earthquake of 24 April. Portable accelerographs were deployed to record strong motions from the aftershocks. Geologists searched the area for evidence of surface rupture. Seismologists inspected the damage to structures*editor.*

On Tuesday 24 April, at 1:15 p.m., an earthquake of Richter magnitude (M) 6.2 occurred near Mt. Hamilton, 16 km (10 miles) east of San Jose, Santa Clara County. This earthquake was felt strongly throughout the San Francisco Bay area, and as far away as Sacramento, 140 km (86 miles) to the north. Fortunately, the epicenter was located in the sparsely populated Coast Ranges. The reported damage was about \$7 million. This figure does not include the amount of damage to the high technology industry in the area.

The most dramatic effect was near Morgan Hill, where damage consisted of houses falling off unbraced cripple foundations and incaving of stream banks. Morgan Hill is located 20 km (12 miles) south of the epicenter of the main shock, but only 3 km (2 miles) west of the zone of aftershock epicenters. This is because the aftershock zone propagated some 25 km southeastward along the Calaveras fault from the main shock epicenter.

The southeastern end of the 1984 Morgan Hill aftershock zone coincided with the epicenter of the 1979 Coyote Lake earthquake. The aftershock zone of the 1979 earthquake also extended to the southeast of its main shock. During the 1979 and 1984 earthquake sequences, the Calaveras fault zone ruptured in the sub-surface along a total length of 45 km extending to the southeast from Mt. Hamilton. This rupture occurred mainly



Epicenters of $M \geq 5.8$ earthquakes in the San Francisco Bay area, 1850-1984. Approximate locations of pre-1900 epicenters were estimated from intensity data (Toppozada and others, 1981). See Table 1 for earthquake data. The largest events are represented by the 2 large circles; the star marks the epicenter of the 24 April 1984 Morgan Hill event. Adapted from Toppozada and Parke, 1982.

at earthquake depths of 1 to 10 km below the surface, according to focal depths determined by the U.S. Geological Survey.

Very little fault rupture propagated to the surface. The maximum observed surface displacement occurred during the 1984 earthquake, and was 20 cm (8 inches) of right-lateral strike slip on the fault zone opposite Morgan Hill. This was observed in a landslide area, and is considered probable surface faulting by CDMG geologists (Earl Hart, written communication). The more conspicuous open ground cracking was the result of ground failure from shaking and was not surface faulting.



Rockfall at Cockrane Bridge, Morgan Hill earthquake.

TABLE 1. EARTHQUAKES OF $M \geq 5.8$ WITHIN 100 KM OF HAYWARD, SAN FRANCISCO BAY, 1850-1984.

Map Number	Date (GMT)	Magnitude*	Region Damaged*
1	26 Nov 1858	6.1	San Jose (VIII) to San Francisco (VII)
2	26 Feb 1864	5.9	San Jose (VI) to Monterey (VI)
3	08 Oct 1865	6.3	New Almaden (IX) to San Jose (VIII)
4	15 Jul 1866	5.8	None reported, located between Stockton and San Jose
5	21 Oct 1868	6.8	Western Alameda County (IX)
6	17 Feb 1870	5.8	Los Gatos (VII) to Santa Cruz (VII)
7	10 Apr 1881	5.9	Hollister (VI) to Stockton (VI)
8	26 Mar 1884	5.9	Monterey (VI) to San Francisco (VI)
9	19 May 1889	6.0	Collinsville (VIII) to Martinez (VII)
10	24 Apr 1890	6.0	Sargents (VIII) to San Juan Bautista (VIII)
11	19 Apr 1892	6.4	Vacaville (VIII) to Winters (VIII)
12	21 Apr 1892	6.2	Vacaville (VIII) to Winters (VIII)
13	20 Jun 1897	6.2	Gilroy (VIII) to San Felipe (VIII)
14	31 Mar 1898	6.2	Mare Island (IX) to Port Costa (VIII)
15	06 Jul 1899	5.8	Watsonville (VII) to Pleasanton (VII)
16	03 Aug 1903	5.8	Evergreen (VIII) to San Francisco (VII)
17	19 Apr 1906	8.3	San Francisco Bay area (IX)
18	01 Jul 1911	6.6	Coyote (VIII) to San Jose (VII)
19	22 Oct 1926	6.1 & 6.1	Carmel (VII) to Santa Cruz (VII)
20	06 Aug 1979	5.8	Gilroy (VII) to Hollister (VII)
21	24 Jan 1980	5.8	Livermore Valley (VII)
22	24 Apr 1984	6.2	Morgan Hill (VII)

Since 1979, three earthquakes of Richter magnitude 5.8 or greater have occurred in the east San Francisco Bay area. The first of these was the August 1979 Coyote Lake earthquake, the second occurred in January 1980 some 16 km (10 miles) northwest of Livermore, and the third was the 1984 Morgan Hill earthquake. This is a marked increase over the rate of seismicity in this area since the great magnitude 8.3 San Francisco earthquake of 1906.

Since the 1849 gold rush when earthquake reporting became relatively complete, 23 earthquakes of $M \geq 5.8$ or greater have occurred within 100 km of San Francisco Bay. The largest earthquakes were the M 6.8 earthquake of 1868 that ruptured the Hayward fault over a length of 50 km (30 miles) centered near Hayward, and the M 8.3 San Francisco earthquake of 1906 that ruptured the San Andreas fault for some 400 km (250 miles) from near Monterey Bay to the Mendocino coast. No earthquakes of $M \geq 5.8$ occurred near San Francisco Bay between 1926 and 1979. The largest earthquake to occur in the area between 1926 and 1979 was the M 5.7 Santa Rosa earthquake of 1959. The seismicity was lower during this period than during the last century, reflecting the massive release of stress in the M 8.3 San Francisco earthquake of 1906.

*Magnitudes and regions damaged by pre-1900 earthquakes were estimated by Topozada, Real, and Parke (1981) from reported earthquake effects. Roman numerals are the Modified Mercalli Intensities at the locations indicated.

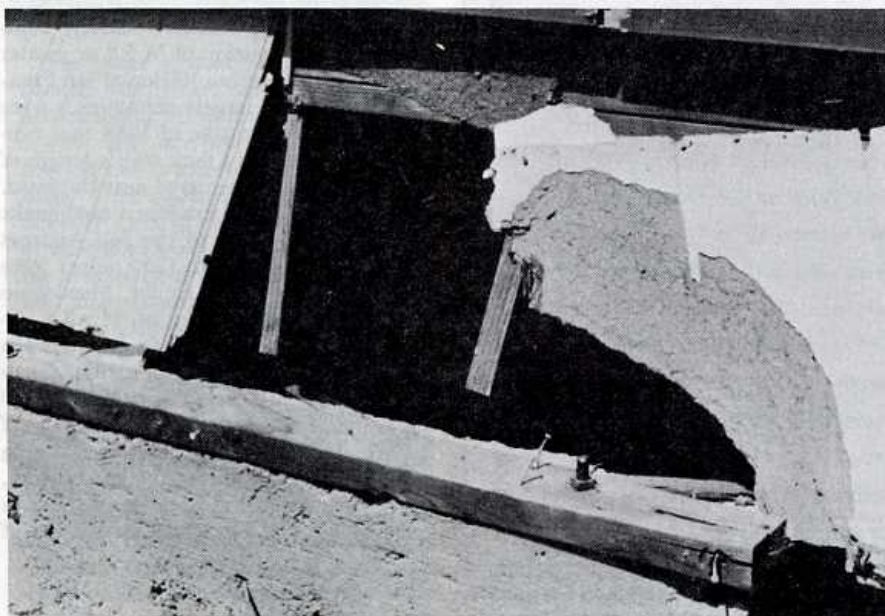


Structural damage, Morgan Hill.



Structural damage, Morgan Hill.

EARTHQUAKE !!



Structural damage, Morgan Hill.

The increase in seismicity since 1979 suggests a return to the higher seismic rates of the last century. This could be a sign that the crustal stresses are building up to the levels that preceded the 1906 and the 1868 earthquakes. If this is the case, earthquakes of magnitude about 6 will continue to occur near San Francisco Bay at intervals of less than five years, as was the case in the second half of the 19th century.

REFERENCES

- Topozada, T.R. and Parke, D.L., 1982. Area damaged by the 1868 Hayward earthquake and recurrence of damaging earthquakes near Hayward, in Hart, Earl W., Hirschfeld, Sue E., and Schulz, Sandra S., editors, Proceedings, Conference on Earthquake Hazards in the eastern San Francisco Bay area: California Division of Mines and Geology, Special Publication 62, p. 321-328.
- Topozada, T.R., Real, C.R., and Parke, D.L., 1981. Preparation of isoseismal maps and summaries of reported effects for pre-1900 California earthquakes: California Division of Mines and Geology, Open-File Report 81-11 SAC.