NOTES ON THE JANUARY 1983 MAMMOTH LAKES, CALIFORNIA, EARTHQUAKE SWARM

Alan Ryall
Seismological Laboratory
University of Nevada
Reno, NV 89557

Starting at 0027Z on January 7, 1983, an earthquake sequence occurred near Mammoth Lakes, California, where a major earthquake swarm has been in progress since October, 1978. This sequence was well-recorded by stations of the University of Nevada seismic telemetry network, and the latter was supplemented by an array of portable stations operated for two weeks by Woodward-Clyde Consultants, Sandia National Laboratories and the University of California, Santa Cruz. Data from the portable instruments and the permanent network are currently being integrated for a detailed study of this important sequence.

The largest shocks of this sequence, at 0138Z and 0324Z on 7 January had ML 5.2 and 5.4, respectively. As shown by Figure 1(a), 99 events analyzed so far for the month of January were concentrated in a WNW-ESE cluster located just inside the southern ring fracture system of Long Valley caldera. Most of the events within this 10 km long zone were in the depth range 2-9 km, although a few were located outside this range. The fault-plane solution for one of the larger events was consistent with right-oblique slip on a fault striking WNW and dipping steeply to the north. The largest events were preceded by foreshocks over a period of about one hour.

For comparison, Figure 1(b) shows almost a thousand events located in the Mammoth Lakes area during 1982. In general, earthquakes of this sequence since 1978 have not correlated well with mapped surface faults, but instead have occurred within an irregular-shaped zone extending more than 30 km in a NW-SE direction and 25 km from north to south. While most of the activity has been located south of the caldera, some of it -- particularly since the occurrence of four shocks with ML 6+ on May 25 and 27, 1980 -- has taken place

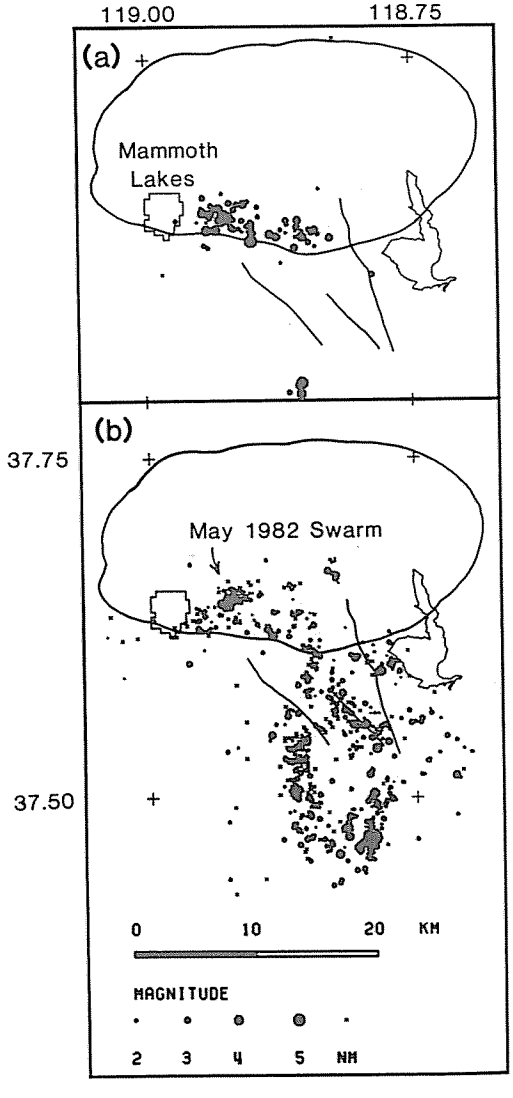

Figure 1.

inside the southern caldera boundary. In this regard, the January 1983 swarm represents the most significant activity since May 1980; in terms of numbers and size of events, it is the largest burst of activity in the area since a swarm occurred in September and October 1981 in a north-south zone that was mostly outside the caldera. Fluctuations in activity in the Mammoth Lakes area since 1977 are shown by Figure 2, a plot of the monthly count of events with ML 3.0 or greater. Both the January 1983 swarm and the sequence in September and October 1981 had 47 such earthquakes in a 30-day period, but the 1981 series was spread over two calendar months and does not appear as prominent on the figure.

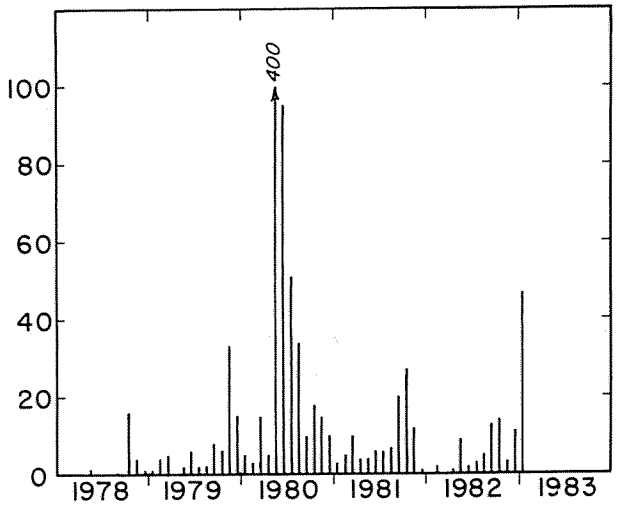

Figure 2.

In at least eight instances, intensive microearthquake swarms with the appearance of spasmodic tremor have been observed in the southwest part of the caldera. This activity, characterized by hundreds of small events occurring over a period of 1-2 hours, has been observed only since the strong earthquakes in 1980, and only in a small area just east of the town of Mammoth Lakes. The occurrence of such a burst during a scientific meeting at Mammoth Lakes in May 1982 (Figure 1b) figured prominently in the issuance by the U. S. Geological Survey of a Notice of Potential Volcanic Hazard for the southern Sierra Nevada. In volcanic regions, spasmodic tremor is considered to represent intensive cracking within the volcanic system, due either to injection of a tongue of magma or to gas released under high pressure from the magma chamber. A search for evidence of spasmodic tremor associated with the January 1983 swarm has been inconclusive, since continuous aftershock activity following the strong shocks on January 7 would have masked a small volcanic sequence. No spasmodic tremor has been seen between January 7 and the time of this writing (February 13).

It is interesting to note that the Mammoth Lakes sequence and associated magmatic activity are part of a broader increase in tectonic activity in and around the region that Robert Wallace calls the "White Mountains seismic gap" -- the area between the north end of the 1872 Owens Valley rupture zone and the south end of faulting associated with the 1932 Cedar Mountains earthquake. While more than 110 shocks with ML 4.0-6.3 have occurred in the Mammoth Lakes area since 1978, another 50+ events with ML 4.0-5.4 have been recorded in zones northeast of Mono Lakes, east of the White Mountains, and around Bishop. Even if the Mammoth Lakes sequence is excluded, this represents a six-fold increase in the level of seismicity for the region compared with the previous decade and perhaps longer. Comparison of various characteristics of this activity with that preceding large historic earthquakes in the California-Nevada region suggests that the potential for a major earthquake in the White Mountains gap has significantly increased since 1978.