THE TIDE-GENERATING FORCES AND THE STRONG EARTHQUAKES OF CALIFORNIA

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We will consider the strong earthquakes in California during 1903-1956 with their instrumental magnitudes following the list given by Ch. F. Richter (1958). During these 54, years 87 earthquakes with the magnitude of $M \geqslant 6$ have been registered. 75 out of them had a magnitude of M = 6-6.9, 11 earthquakes had a magnitude of M = 7-7.7 and one (the Californian, of the April 18, 1906) had a magnitude of $M' = 8.3$. This last earthquake is considered as the strongest earthquake of the world and to its share falls 60% of the whole seismic energy of California during 1903-1956. All the rest of the earthquakes taken together represnt only 40% of the released energy. In order not to overwhelm the features of the distribution of seismic energy of all the earthquakes of California, this earthquake (M = 8.3) is excluded from the statistical calculations given below, although its placement usually is marked in the corresponding diagrams.

The distribution of all the earthquakes of California is shown in fig. 1. The group of the strong earthquakes tends toward the concentration and to the dispersion into separate belts. These belts are drawn out (in the figure) parallel to the direction from the left lower angle to the right upper angle. In the odd belts, in comparison with the even ones, the number and the energy of the earthquakes (M = 6-7.7 as a whole was 2.5 times greater (fig. 2). The strongest earthquake with M = 8.3, falls into the third belt. Taking into consideration this earthquake (that really occured too), then in the odd belts, the release of the seismic energy represented 95.5% in comparison with the even belts. In general, the increase of the earthquake's number in the odd belts compartively with the even ones, takes place not due to some exceptionally strong earthquake but

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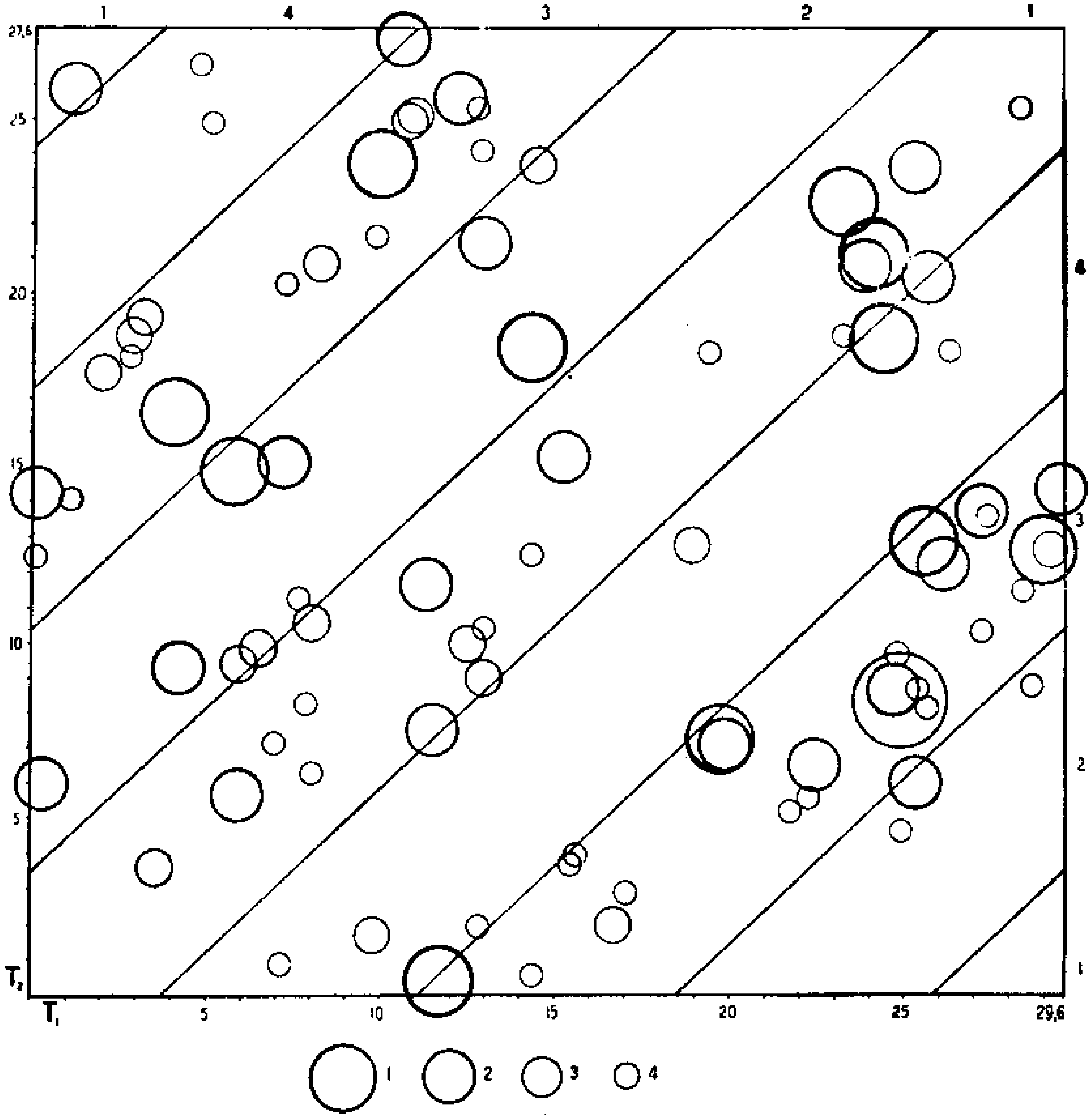

Fig. 1. The distribution of strong (M ⩾ 6) earthquakers of California during 1903-1956 depending on the average synodic and the reduced anomalistic age of them. Dates of the average synodic month (T_1) are on the horizontal line the dates of the reduced anomalistic month (T_2) are on the vertical line. Magnitudes of earthquakes: 1-7-7.7; 2-6.5-6.9; 3-6.25-6.4; 4-6-6.2.

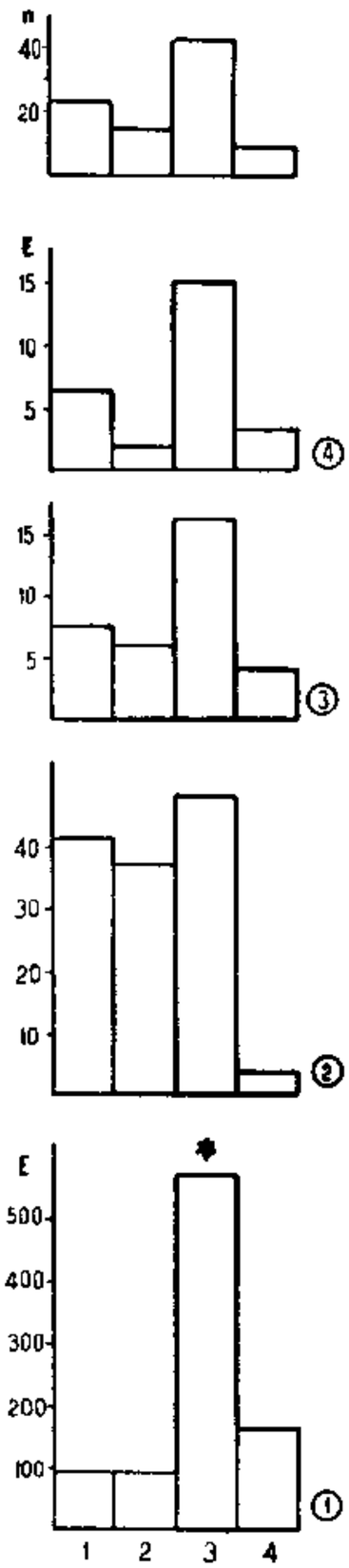

Fig. 2. Distribution of the energy of strong earthquakes of California by belts of seismic activity (1903-1956).

n — number of earthquakes, 1, 2, 3 and 4 — numbers of belts. E — **energy of earthquakes** (in 10^{21}erg); magnitudes: 1-7-7.7; 2-6.5-6.9; 3-6.25-6.4; 4-6-6.2; **the** earthquake of the magnitude M = 8.3 is asterisked.

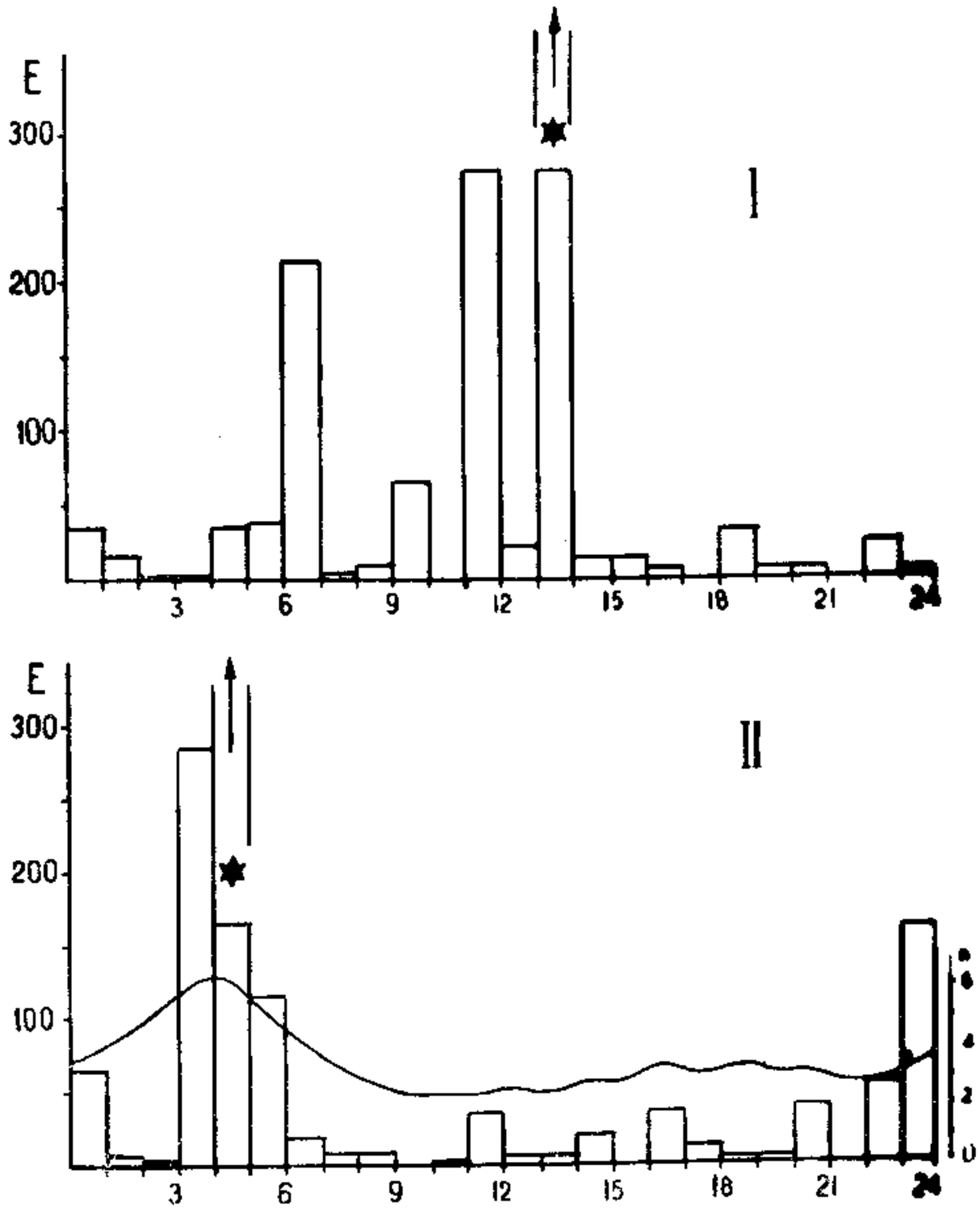

Fig. 3. The intra-diurnal distribution of the energy of strong ($M \geqslant 6$) earthquakes of California (1903-1956).

I — by civil (Greenwich) time, II — by local (close to the standard Pacific time), n — number of earthquakes by three-hours period (the curved line).

has a systematical character which shows in all the groups under consideration of the magnitude (from M = 6-6.2 up to M = 7-7.7); table 1.

The influence of the tide-generating forces upon the earthquakes is found, for example, in the diurnal motion of the seismoactivity.

Thus, in fig. 3 (II) it is seen that the number of earthquakes was above average after midnight from 0 to 7 o'clock and decreased during the rest of the day.

On the whole, the seismoactivity of California increases after midnight, reaching the maximum between 3 and 4 o'clock after passage of the sun through the local meridian. To this corresponds also the quantity of the released energy which turns out to be gratest between 3 and 6 o'clock after midnight (within these 3 hours 52% of all the energy of the earthquake with the magnitude M = 6 7.7 was released; taking into account the earthquake with M = 8.3 it made up 82% of "the average daily allowance" of the seismoenergy of California). The seismoenergy release increases every passage of the sun through the local meridian (between 22 and 24 o'clock local time, 20% of the seismoenergy was released). On the whole between 22 and 6 o'clock local time i.e. during 8 hours, nearly 80%, and, if account is taken of the earthquake with M = 8.3, then 92% of all the seismic energy of California was released; during the other 2/3 of the day time, from 6 to 22 o'clock this area is the least seismoactive.

TABLE I

Distribution of the energy of strong earthquakes ($M \geqslant 6$) of California during 1903-1956 in separate belts of seismic activity of different magnitudes.

Magnitude	Number of the earth-quakes	Energy of the earthquakes by belts of seismoactivity (in 10^{21}erg)							Energy of the earth-quakes of the odd belts relative to the even belts (in%)
		Belts							
		1	2	3	4	2+4	1+3	Total	
7-7.7	II	84.4	84.4	570.9	158.5	242.9	655.3	898.2	270
6.5-6.9	23	41.2	37.1	47.6	3.6	40.7	88.8	129.5	218
6.25-6.4	17	7.6	5.8	15.9	4.0	9.8	23.5	33.3	239
6.0-6.2	35	6.3	1.9	14.8	3.1	5.0	21.1	26.1	422
whole	86	139.5	129.2	649.2	169.2	298.4	788.7	1087.1	264

In conclusion the frequency and the quantity of the seismic energy of California during 54 years (1903-1956) were depending on the cosmic conditions. In the nocturnal third of the day (107-340) $x10^{21}$erg per hour were released whereas within the rest 2/3 of the day about $14x10^{21}$ erg per hour were released, i.e. 7-24 times less. By this, from 3 to 6 o'clock a.m. the quantity of the released seismic energy increased up to (188-879) $x10^{21}$erg per hour and so the seismoactivity at this time period exceeded 13-64 times the seismopassive part of the day.

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