

14. Recent Activities of Volcano Usu (II).

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The writer carried out seismometric observations and tilt-observations on and around the new volcano at the eastern foot of Usu, during July—October, 1944. The outline of observations conducted during the above mentioned period is given in this paper.

Beside the continuous observations of tilt by means of spirit-levels set at Hukaba and Takinoue, and levellings covered the rising area, a set of four bench marks in a square form was established at 18 places on and around the upheaving area. Length of a side of these 18 squares is taken from 15 m to 40 m in proportion to the topography. Setting the Zeiss' level at the centre of the square where is the equal distance from the four bench marks, the heights of them were precisely observed by use of Zeiss' invar staff. During July 21, 1944—August 10, the observations were repeated 7 times and during October 3–12, they were carried out three times.

On the basis of variations of relative heights on the top of four bench marks, tiltings of the ground were made clear. As the result, it is remarked that two triangles separated by a diagonal line of the square show different tilts in their direction and magnitude, though their areas are very small as described above. On the other hand, the result of levellings on the same place shows the upheaval with almost constant rate in the same period. As an example, the daily velocities of tilt of two triangles of a square and those along four sides of the square are represented in Fig. 1 and Table I.

In order to know the topographical distribution of tilt at the eastern side of Volcano Usu, variations of inclinations at 18 spots in the period of July 21—October 10, 1944, are shown on the map in Fig. 2. In this map, tilts of a rectangular rombus at 18 places are represented by two vectors respectively, in which the one is tilt of a triangle formed by a diagonal line of the square and the other is that of the other triangle. At a glance of the geographical distribution of tilt, it will be seen that the marked deformation of the ground is limited in the narrow region and no remarkable crustal deformation took place at the north side of Usu. Consequently, the northern side of the new mountain has very steep, and the northern side of the new mountain

Table I. Daily velocities of tilt along four sides of the square at the spot No. 12.

	Date	N-E	W-S	S-E	W-N
1	July 23	+ 51''	+24''	- 8''	-32''
2	„ 25	+ 34	+15	- 4	-25
3	„ 27	+ 27	+17	-11	-21
4	„ 29	+ 28	+12	- 8	-24
5	Aug. 1	+ 21	+13	-20	-27
6	„ 4	- 3	+ 4	-23	-17
7	„ 8	- 46	-20	-41	-14
8	Sept. 7	-126	-43	-81	0.0
9	Oct. 4	-100	-65	-40	- 7
10	„ 8	- 97	-85	-37	-15

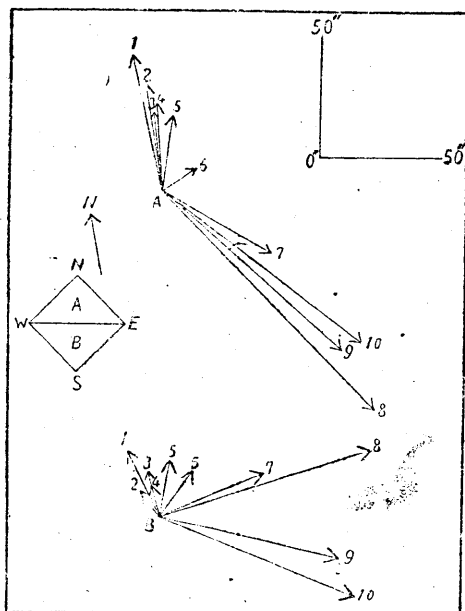


Fig. 1. Daily velocities of tilt of two triangular parts (A, B) at the station No. 12.

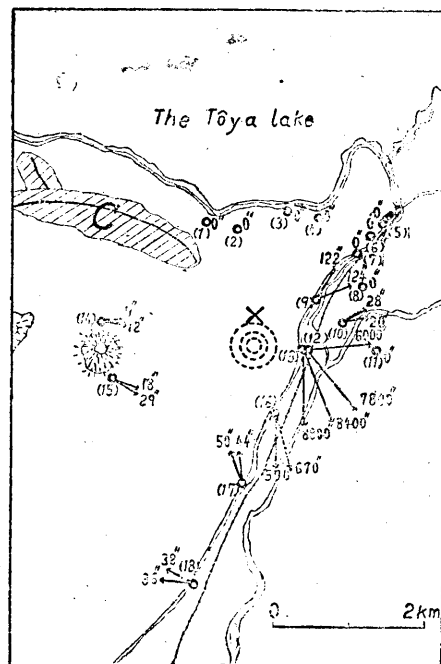


Fig. 2. Geographical distribution of tilt on and around the new mountain.

X; new mountain.

C; explosion craters in 1910.

where is only one km from the centre of the rising area, does not show tiltings of the earth's surface in the period. These characteristics of the topographical deformation harmonizes with the geological structures of the region in which the northern part of the new mountain is not the formation of the Usu ejecta, but is the older and more stable formation (Takinoue lava) than that of the southern part. As seen on the map of Fig. 2, the southern part of the new mountain which is located in greater distance than 4 km from the center of rise, is markedly disturbed by the present volcanic activities.

Table II. Tilts of two triangles (A, B) at 18 places on and around the new mountain during July 21,—October 10, 1944.

Places	A		B	
No. 1	0''		0''	
„ 2	0		0	
„ 3	0		0	
„ 4	0		0	
„ 5	0		0	
„ 6	0		0	
„ 7	0		0	
„ 8	0		0	
„ 9	122''	N 23° E	124''	N 66° E
„ 10	28''	N 59° E	20''	N 75° E
„ 11	0		0	
„ 12	6000''	N 84° E	7800''	N 141° E
„ 13	8400''	N 157° E	8800''	S
„ 14	9''	N 88° E	12''	N 99° E
„ 15	18''	N 120° E	29''	N 110° E
„ 16	670''	N 166° E	590''	N 179° E
„ 17	50''	N 20° W	44''	N 8° W
„ 18	38''	N 85° W	36''	N 60° W

During July to September 1944, a component of micro-seismographs was set at five temporary stations around the volcano, one of which was set at the station on the north-western foot, was operated during March, 1944 to July, 1945. On the basis of these seismograms at the five stations, positions of hypocentres of these earthquakes were studied in detail. The geographical distribution of hypocentres of the earth-

quakes occurred during July, 1944, is illustrated on the map in Fig. 3. In addition, in order to show the depth distribution of these hypocentres, they are projected on the vertical plane (ab in Fig. 3) as seen on the map (Fig. 3).

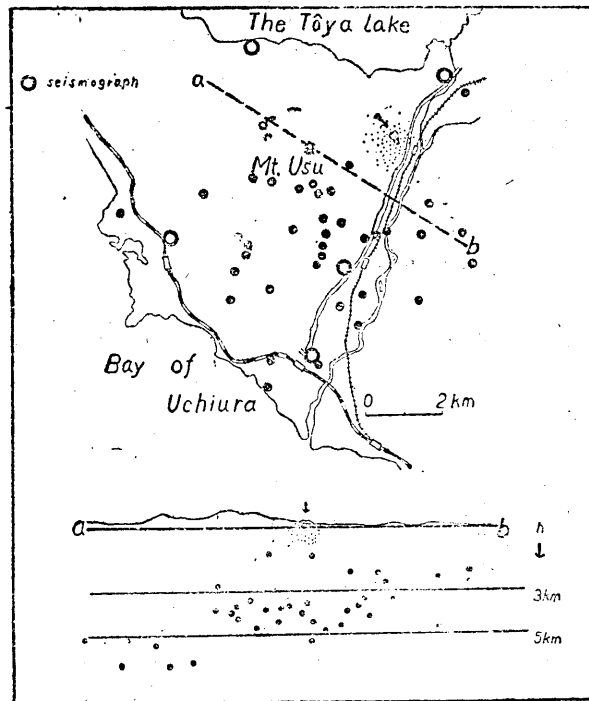
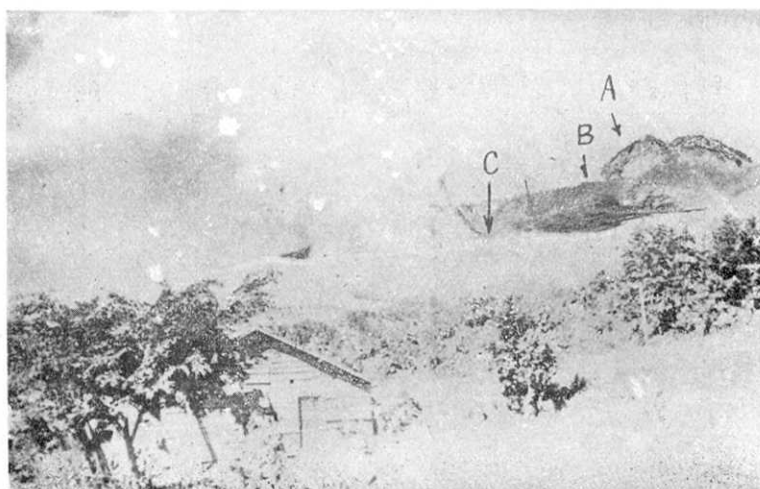


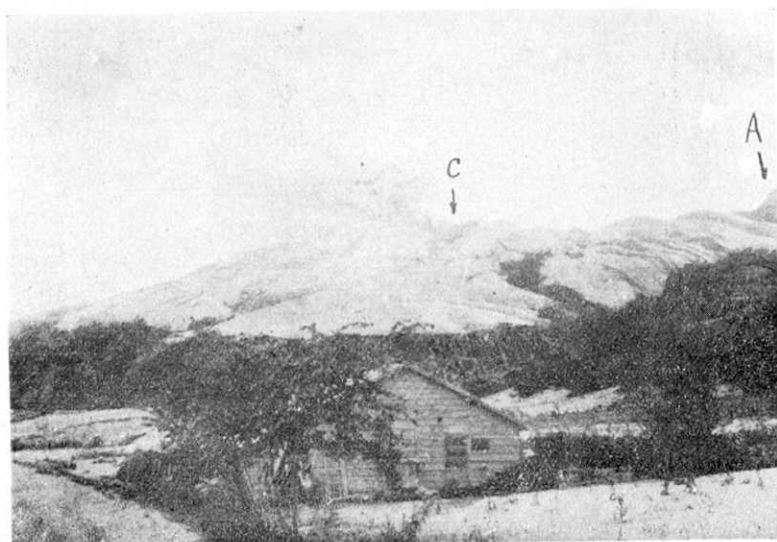
Fig. 3. Geographical distribution of hypocentres of the volcanic earthquakes during July, 1944.

As the map indicates clearly, no earthquake occurred at the northern foot of the volcano, where in 1910, many a number of craters newly opened. Moreover, it is remarked in Fig. 3, that these hypocentres in the western side of volcano Usu are deeper on the average than those in the eastern. As already described, severe earthquakes took place almost under the western side of the volcano at the beginning of the present activities. Though, it is impossible to show precisely on the map, a great number of the extremely shallow earthquakes less than 1.0 km in depth concentrated near the crater which is the center of the rising area.

On the basis of these seismometric and geodetic studies, and from various observations conducted on the present activity, it may be con-



(a)



(b)

Fig. 5. Four stages of growth of the new mountain.

A, Ōusu (top of Volcano Usu).

B; Somma.

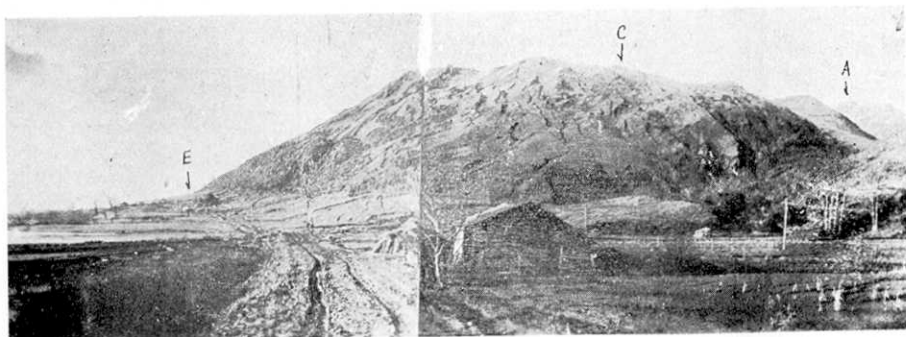
C; New mountain.

D; New lava-dome.

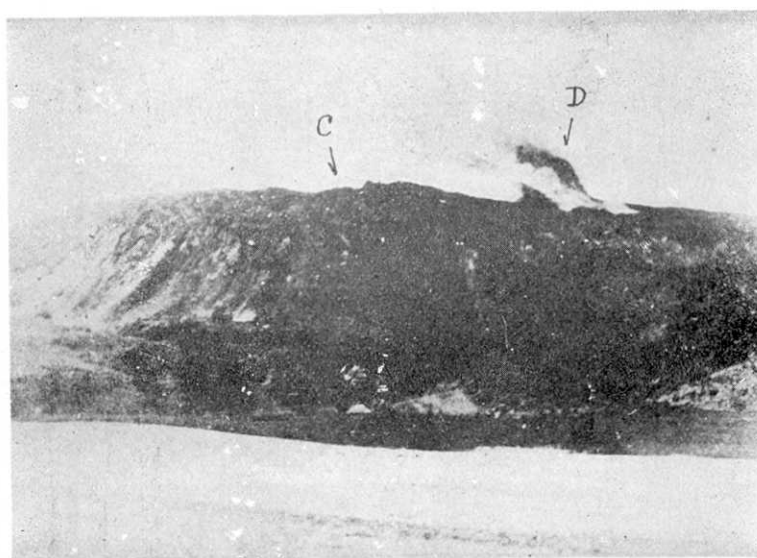
E; Hukaba (village).

(a) June 30, 1944,

(b) August 10, 1944.



(c)



(d)

Fig. 5. (c) October 5, 1944.

(d) July 10, 1945.

cluded that the present activity was caused by the intrusion and extrusion of the viscous lava: in other words, juvenile lava at the depth 1-3 km under the volcano, was intruded in the upper crust near the eastern foot of Usu and at last extruded on the earth's surface. Whereas, intrusion and extrusion of the lava which is such highly viscous as the one of the present Usu are possible only by the great pressure. Owing to such high pressure acting to the earth's ground on and around the volcano in the course of growth of the new lava-dome, numerous earthquakes and the large scale topographical deformations took place during this period. From the view-point above mentioned, it will be remarked that the rising area where is remarkable also in tilting of the earth's surface, harmonizes perfectly with the epicentral area.

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