[Journal of the Faculty of Science, Hokkaidô University, Japan, Ser. VII, Vol. II, No. 2, 1964]

Preliminary Report on a Gravimetric Survey on Toya Caldera, Hokkaido, Japan

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(Received Nov. 10, 1964)

Toya Caldera in the south-western part of Hokkaido contains a circular caldera lake measuring about 10 km in diameter. At the centre of the lake there is an island, Nakano-sima, composed of 11 lava domes which were formed by the post-caldera activities. The caldera was formed in Pleistocene and post-caldera volcano Usu erupted in Holocene on the southern part of the caldera rim. At the foot of Usu, new volcanoes measuring about 240 meters and 407 meters in height above sea-level were formed in 1910 and 1944 respectively. The latter is named Syowa Sinzan.

On and near Syowa Sinzan, T. Nemoto *et al.*[1] of the Geological Survey of Japan carried out a local but very detailed gravity survey in 1952~53. The writer made a gravity survey on this caldera as a series of gravimetric studies on the calderas in Japan. In this paper, the gravity values and gravity anomalies observed at each station and the distribution of the Bouguer anomalies are reported as preliminary. Detailed studies on the subterranean structure of the caldera and comparative discussions with other calderas will be postponed to the future papers.

The writer made surveys on this caldera twice, in 1961 and 1963. The former survey was made in co-operation with the Geographical Survey Institute by means of a North American Gravimeter while the latter by means of a LaCoste & Romberg Gravimeter of the Hokkaido University. Reading accuracies of a single observation by these gravimeters are almost the same, about 0.04 mgal. Both surveys were standardized by the gravity value (g=980.4901 gal) at the pendulum station at the Low Temperature Science Research Institute of the Hokkaido University. As for the observation points, many bench marks for precise levels were occupied and also temporary stations were set along the shore-line of Lake Toya. Heights of the remaining stations were determined by means of a precise microbarometer of the American Paulin System within an accuracy of about 3 meters at worst. The number of the observation points reached about 50. Fig. 1 shows the distribu-

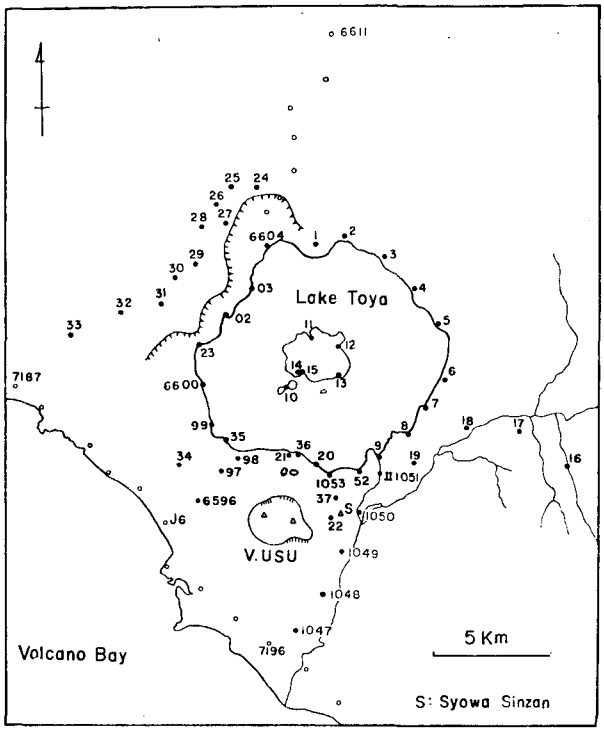

Fig. 1. Distribution of the gravity stations on and around Toya Caldera. Solid circles denote the stations of the present survey.

tion of the gravity points.

To obtain the gravity anomalies, the author takes the density of the earth-crust as 2.67 gr./cc and the vertical gradient of gravity as 0.3086 mgal/meter and neglects the topographic corrections. The results thus obtained are listed in Table I where "Observed value" is the gravity value at the hieght given in column under the designation "Height" and the distribution of the Bouguer anomalies is shown in Fig. 2. Concerning the gravity field at the periphery of Toya district, the Geographical Survey Institute[2] has made gravity measurements at the bench marks of precise levels along the main roads.

A part of the expenses necessary for the present survey was defrayed from the funds for scientific research of the Ministry of Education, for which the author here expresses his gratitude.

Table I. Gravity values and anomalies observed on and around Toya Caldera.

Station	φ 42°N	λ 140°E	Height (*m*)	Normal value (*mgal*) 980,	Observed value (*mgal*) 980,	Free-air anomaly (*mgal*)	Bouguer anomaly (*mgal*)
T 1 独 標	38.5	51.2	93	416.78	452.25	64.2	53.8
2 川 東	38.6	52.1	86.3	416.93	457.70	67.4	57.8
3 独 標	38.2	53.3	90	416.34	456.46	67.9	57.8
4 〃	37.5	54.9	87.5	415.29	456.58	68.3	58.5
5 〃	36.7	55.0	91	414.09	455.66	69.6	59.5
6 〃	35.4	55.2	88	412.14	456.34	71.4	61.5
7 〃	34.8	54.6	87.2	411.24	451.37	67.0	57.3
8 〃	34.2	54.0	91.9	410.34	448.81	66.8	56.6
9 滝の上桟橋	33.6	53.1	85.9	409.44	450.83	67.9	58.3
10 観音島	35.2	50.3	85.6	411.84	448.30	62.9	53.3
11 水島湾	36.5	51.0	85.2	413.79	443.64	56.1	46.6
12 大 湾	36.1	51.9	85.2	413.19	443.26	56.4	46.8
13 湖 岸	35.4	51.8	85.0	412.14	442.45	56.5	47.0
14 中島桟橋	35.5	50.6	85.2	412.29	446.48	60.5	51.0
15 森林博物館前	35.5	50.7	85.5	412.29	446.34	60.4	50.9
BM I 6598	33.7	48.9	91.75	409.6	450.06	68.8	58.5
〃 I 7198	28.1	51.9	5.39	401.2	448.82	49.3	48.7
〃 II 1047	29.8	50.6	10.5	403.74	448.56	48.1	46.9
〃 II 1048	30.6	51.3	22.1	404.94	449.88	51.8	49.3
〃 II 1051	33.3	53.3	52.4	408.99	455.22	62.4	56.6
〃 II 1052	33.3	52.6	86.2	408.99	449.98	67.6	58.0
〃 II 1053	33.2	51.5	86.4	408.84	450.31 (surveyed in 1961)	68.1	58.5
T16 弁景温泉橋	33.4	59.2	217	409.14	425.47	83.3	59.1
17 久保内中学校	34.4	57.6	135	410.64	449.08	80.1	65.0
18 下久保内バス停	34.2	55.7	99	410.34	451.19	71.4	60.4
19 阿波国踏切	33.5	54.1	75	409.29	448.26	62.1	53.7
20 湖 岸	33.7	50.7	84	409.59	448.65	65.0	55.6
21 グランドホテル前	33.8	49.9	88	409.74	447.12	64.5	54.8
22 徳永氏宅	32.3	51.8	183	407.49	420.82	69.8	49.4
23 実験所前	36.4	47.6	84	413.64	458.78	71.1	61.7
24 大 原	39.8	49.3	276	418.73	410.02	76.5	45.6
25 香 川	39.6	48.7	268	418.43	412.74	77.0	47.0
26 〃	39.3	48.2	260	417.98	415.08	77.3	48.2
27 独 標	39.0	48.5	258.3	417.53	413.08	75.3	46.4
28 〃	39.0	47.7	260.4	417.53	415.86	78.7	49.6
29 成香独標	38.0	47.5	270.1	416.04	409.21	76.5	46.3
30 〃	37.6	46.7	283.8	415.44	410.13	82.3	50.5
31 花和独標	37.0	46.1	298.5	414.54	408.60	86.2	52.8
32 〃	36.8	45.1	258.0	414.24	414.68	80.1	51.2
33 桜三叉路	36.5	43.7	240	413.79	423.27	83.5	56.6
34 虻田鉱山	33.5	46.8	121	409.29	446.18	74.2	60.7
35 湖 岸	34.1	48.4	87.5	410.19	455.26	59.7	61.6
36 〃	33.9	50.2	84	409.89	448.55	64.6	55.2
37 昭和新山道	32.8	51.7	145	408.24	433.81	70.3	54.1
BM II 1048	30.7	51.3	21.9	405.09	449.75	51.4	49.0
〃 II 1049	31.5	52.0	43.3	406.29	448.68	55.8	50.9
〃 II 1050	32.3	52.7	38.3	407.49	451.48 (surveyed in 1963)	55.8	51.5

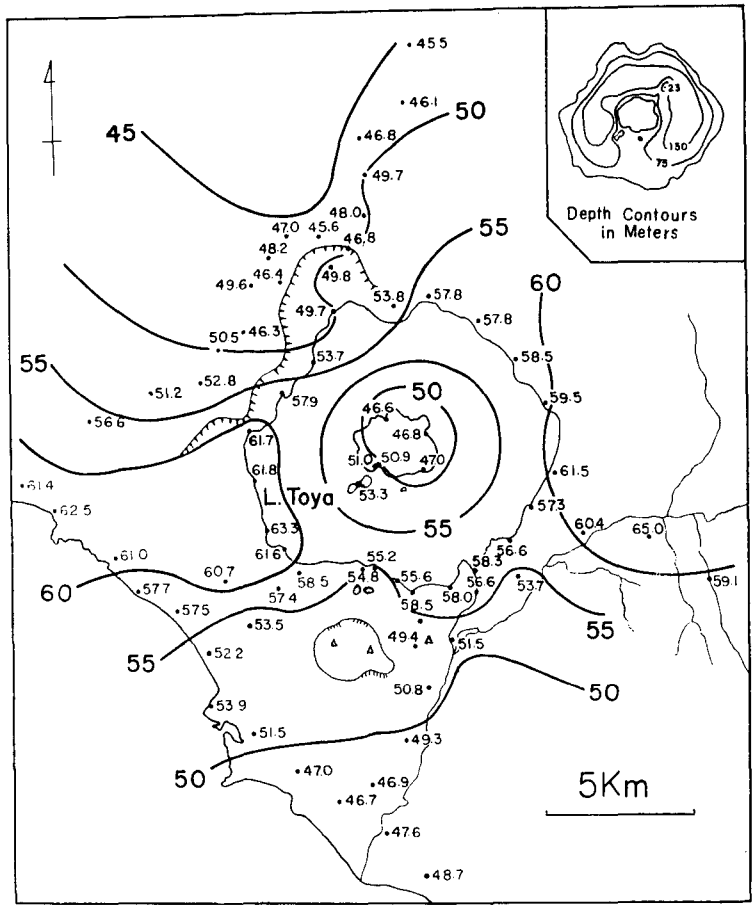

Fig. 2. Distribution of the Bouguer anomalies in *mgal* on and around Toya Caldera (not corrected for topography).

References

1) NEMOTO, T., HAYAKAWA, M., TAKAHASHI, K. and OANA, S.: Report on the Geological, Geophysical and Geochemical Studies of Usu Volcano (Showa-Shinzan), Report No. 170, Geological Survey of Japan (1957).

2) Geographical Survey Institute: Gravity Survey in Japan (1), I. Gravity Survey in Hokkaido District, Bull. G.S.I., IV (1955), 23-99.