# 3. *A Gravity Survey on Volcano Mihara, Ooshima Island by Means of a Worden Gravimeter.*

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## 1. Introduction

The Earthquake Research Institute has long been much interested in the geophysical and geological phenomena on Volcano Mihara, Ooshima Island, one of the most active volcanoes in Japan. Seismometrical, geomagnetic and geodetic observations have been repeatedly carried out in connection with the recent activities of the volcano.

As regards gravity measurements, T. Nagata[1] swung pendulums at three stations and also observed the second derivatives of the gravity potential at 18 stations on Ooshima Island in 1938. In 1950 and 1951, during which period the volcano displayed very active eruptions, K. Iida, M. Hayakawa and K. Katayose[2] made gravity surveys by a North American gravimeter with the chief intention of finding, if any, the relation between eventual changes in gravity with time and those in subsurface physical conditions associated with volcanic activities. Although the observations in that survey were made at numerous points with precisions high enough for the purpose, the points were unfortunately localized in too small area to obtain the general picture of gravity anomaly distribution around the volcano.

In order to find the distribution of gravity anomaly all over Ooshima Island and to get clues for figuring out the subterranean structure of the volcano together with other geomagnetic and geological information, the writers carried out a gravity survey by means of a Worden gravimeter in August, 1956.

## 2. Observations and reductions

The instrument used in the present survey was a Worden gravi-

1) T. NAGATA, *Bull. Earthq. Res. Inst.*, **17** (1939), 93.

2) K. IIDA, M. HAYAKAWA and K. KATAYOSE, *Geological Survey of Japan*, *Report* No. 152 (1952).

Table I. Observation points.

| | | |
|---|---|---|
| No. 1 | Dormitory of E.R.I. at Nomashi, M.S. No. 37 | 野増震研宿舎 |
| 3 | Yunohama T.P. | 湯の浜三角点 |
| 4 | Motomachi Primary School, M.S. No. 47 | 元町小学校 |
| 5 | Motomachi town office | 元町役場 |
| 6 | Old road to Okata | 元町から測候所の間 |
| 7 | Weather Station (seismo. room) | 測候所（地震計室） |
| 8 | 〃 〃 (wind tower) | 〃 （風向塔） |
| 9 | 〃 〃 (bench mark) | 〃 （水準点） |
| 10 | Crossing N.E. of Weather Station | 測候所の北東三叉路 |
| 11 | Bus stop at Kitanoyama | 北の山バス停留場 |
| 12 | Ogawa Farm, Zinooka | 地岡小川農園前 |
| 13 | Top of Mt. Atago, T.P. | 愛宕山頂三角点 |
| 14 | Atago shrine | 愛宕神社 |
| 17 | Habu wharf | 波浮港荷揚場 |
| 18 | Ryuoozaki lighthouse | 龍王岬灯台 |
| 20 | Beach of Otainohama | オタイの浜 |
| 21 | Uenoyama, Habu | 波浮上の山 |
| 25 | Habu Fisheries Station (bench mark) | 波浮水産試験場 |
| 26 | Kuddachi B.M. 0-7 | クダッチ水準点 |
| 27 | Sashikizi Primary School | 差木地小学校 |
| 28 | Foot of Mt. Takenohira | 岳平山麓 |
| 29 | Top of Mt. Takenohira, T.P. | 岳平山頂三角点 |
| 30 | Radio Beacon Station, Sashikizi, M.B. 0-6 | 差木地送信所前水準点 |
| 33 | Nomashi climbing path | 野増登山道中腹 |
| 35 | Outer somma, M.S. No. 39 | 御神火茶屋地磁気測点 |
| 37 | Gojinka-chaya B.M. 0-10 | 御神火茶屋水準点 |
| 36 | Anei-lava at atrio, B.M. 0-11 | 沙漠安永熔岩水準点 |
| 38 | Kakoo-chaya B.M. | 火口茶屋水準点 |
| 39 | Peak of Kengamine | 劒ケ峯 |
| 40 | Foot of Mt. Shiraishi | 木星号遭難地 |
| 41 | Outer somma, Suberidai | 滑り台上，鳥居 |
| 42 | Suberidai path | 滑り台登山道中腹 |
| 47 | Ooshima Park, B.M. 0-1 | 大島公園水準点 |
| 48 | 〃 〃 , magnetic station, M.S. No. 43 | 大島公園地磁気観測所 |
| 49 | Ooshima Park, path | 大島公園登山道中腹 |
| 50 | Eastern atrio, M.S. No. 44 | 裏沙漠 |
| 51 | Boundary between Senzu and Sashikizi | 泉津，差木地境界線 |
| 52 | Tsuruoka-game | 鶴岡ガメ |
| 53 | Crossing N. of Habu | 波浮北方三叉路 |
| 57 | Path N. of Radio Beacon Station | 送信所北方山道 |
| 58 | Beach of Mabushi, M.S. No. 26 | 間伏海岸 |

(to be continued.)

Table I.—(continued.)

| | | |
|---|---|---|
| No. 59 | Path N. of Mabushi | 間伏北方登山道 |
| 60 | Sembazaki, B.M. 0-5 | 千波崎水準点 |
| 63 | Naganehama, Motomachi T.P. | 長根浜三角点 |
| 65 | Motomachi Kindergarten, B.M. 0-4 | 元町保育園水準点 |
| 66 | Miharashi-chaya | 見望茶屋 |
| 67 | Utano-chaya | 歌の茶屋 |
| 68 | Motomachi climbing path | 六合目の上 |
| 70 | Observatory at outer somma | 山頂火山観測所 |
| 73 | Kagamihata T.P. | 鏡端三角点 |
| 74 | Crater-Okata path at atrio | 沙漠の火口，岡田道 |
| 75 | Odori-chaya, outer somma | おどり茶屋 |
| 76 | Yuba, B.M. 0-9 | 湯場水準点 |
| 77 | Hachinowo, M.S. No. 45 | 蜂の尾 |
| 78 | Senzu climbing path | 泉津登山道中腹 |
| 79 | Senzu | 泉津村入口 |
| 80 | Senzu Primary School | 泉津小学校 |
| 83 | Oomiya Park, Nomashi, M.S. No. 24 | 大宮公園 |
| 84 | Tatsunokuchi, Nomashi | 龍の口入口 |
| 85 | Cross road, W.S., B.M. 0-3 | 測候所下水準点 |
| 86 | Daimaru, B.M. 0-4 | 大丸水準点 |
| 87 | Kazahaya lighthouse | 風早灯台 |
| 90 | Cross road, Mitsumine | 三峯三叉路 |
| 92 | Okata, B.M. 0-2 | 岡田入口水準点 |
| 93 | Okata climbing path, M.S. No. 46 | 岡田登山道 |
| 94 | Ooshima High School, Motomachi | 大島高等学校昇降口 |

M.S.: magnetic station
T.P.: triangulation point
B.M.: bench mark of precise levels

meter No. 60. The methods of measurements are the same as those described by C. Tsuboi and his colleagues[3] in this Bulletin. The observed gravity value at the very site of a bench mark is relatively accurate within a few hundredths of a *milligal*. The readings of the gravimeter were corrected for the drift of the gravimeter spring and for the effect of the earth tides. All the gravity values have been deduced relative to the value at the Tokyo Fundamental Station which has been taken to be exactly 979.80100 relative to Potsdam. Thus, the results in this survey are comparable with those in the survey along the lines of precise levels throughout Japan by C. Tsuboi and his colleagues.

3) C. TSUBOI, A. JITSUKAWA, H. TAJIMA and A. OKADA, *Bull. Earthq. Res. Inst., Suppl. Vol.*, **4** (1953).

Our observations reached 66 in number, 15 of which are bench marks laid by the Institute and 4 are triangulation points. Observation points are listed in Table I and shown in Fig. 1.

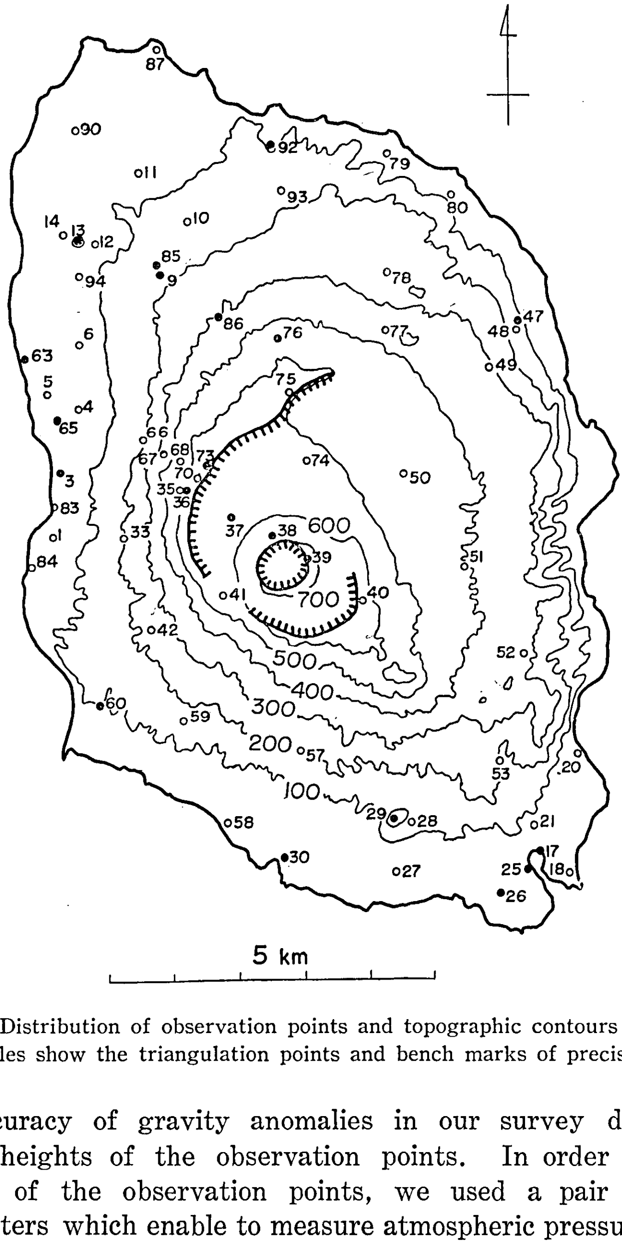


Fig. 1. Distribution of observation points and topographic contours in *meter* (full circles show the triangulation points and bench marks of precise levels)

The accuracy of gravity anomalies in our survey depends upon that of the heights of the observation points. In order to determine the heights of the observation points, we used a pair of Askania's microbarometers which enable to measure atmospheric pressure difference of 0.01 *mm Hg*. One of the pair was placed at the Ooshima Weather Station during the observation period and the other was carried along together with the gravimeter throughout the course of the survey. Calculation of the heights of the points was made by the Laplace's barometric formula and the accuracy of the results depends on atmospheric conditions in general. The height of the base-point at the Ooshima Weather Station which was deduced from barometric observations in relation to the points where the true heights had been already known by triangular and levelling surveys, is shown in Table II. The accuracy

Table II. Height of the base-point deduced from barometric observations (true height is 191.93 *m*).

| Date (1956) | Time | No. | Point | Deduced Height (*m*) | Remarks |
|---|---|---|---|---|---|
| Aug. 20 | 09*h*15*m* | 17 | Habu-ko B.M. | 190.65 | |
| 〃 | 14 15 | 26 | B.M. 0-7 | 191.78 | |
| 〃 | 16 25 | 29 | Takenohira T.P. | 190.41 | |
| 〃 | 17 25 | 30 | B.M. 0-6 | 192.08 | |
| 21 | 11 25 | 36 | B.M. 0-10 | 189.93 | Windy |
| 〃 | 13 25 | 37 | B.M. 0-11 | 192.41 | |
| 23 | 14 40 | 17 | Habu-ko B.M. | 192.73 | |
| 24 | 09 00 | 65 | B.M. 0-4 | 192.62 | |
| 〃 | 11 25 | 36 | B.M. 0-10 | 193.69 | Windy |
| 〃 | 12 05 | 73 | Kagamihata T.P. | 189.92 | |
| 〃 | 15 30 | 76 | B.M. 0-9 | 190.93 | |
| 25 | 10 25 | 86 | B.M. 0-8 | 191.80 | |
| 〃 | 14 00 | 92 | B.M. 0-2 | 193.19 | Disturbed by motors |
| 〃 | 18 10 | 60 | B.M. 0-5 | 190.98 | |

proved itself to be higher than 3 *meters* at the worst. Thus, the writers succeeded in obtaining the accuracy of determining of gravity anomaly within 1 *mgal*.

In calculating gravity anomalies, the free air reduction was first made by the formula

$$0.3086 \times h(m) \qquad \text{in } mgal$$

although the coefficient 0.3086 is known to vary according to gravity anomalies. The values of $\partial g/\partial z$ which were calculated from the gravity values observed at the bottoms and tops of high towers etc. at several places, are shown in Table III, without topographical corrections. In

Table III. Observed values of $\partial g/\partial z$.

| No. | Date (1956) | $\Delta g$ ($mgal$) | $\Delta z$ ($m$) | $\partial g/\partial z$ ($mgal/m$) |
|---|---|---|---|---|
| 5 | Aug. 19 | 3.35 | 10.45 | 0.321 |
| 8 | 〃 19 | 4.05 | 12.16 | 0.333 |
| 〃 | 〃 19 | 7.27 | 21.87 | 0.332 |
| 18 | 〃 20 | 2.81 | 7.68 | 0.366 |
| 25 | 〃 20 | 3.90 | 12.70 | 0.307 |
| 70 | 〃 24 | 2.37 | 6.40 | 0.370 |
| 87 | 〃 25 | 4.39 | 11.16 | 0.393 |

fact, the values vary notably from a place to another. Here, the writers take the vertical gradient to be 0.3086 $mgal/m$ throughout only for the sake of simplicity.

In order to calculate the Bouguer and topographical corrections, it is necessary to know the density of the mountain-mass which, strictly speaking, varies from place to place. In this respect, Iida and his colleagues minutely examined the density of ejecta from the volcano and obtained the result that the average density of volcanic ash and lava is 1.6 and 2.6 $gr./cc$ respectively. The volcano is actually a composite of such ejecta and its overall mean density will lie between the abovementioned values. On the other hand, we may deduce the effective density of the mountain-mass from the results of gravity survey as follows: Neglecting the topographical effects and assuming the uniform density, the gravity value at the height $h\,m$ is expressed as

$$g_h = g_0 - 0.3086\,h + 2\pi k^2 \rho h \text{ in } mgal,$$

where $\rho$ is the mean density. The relation between the observed gravity values and heights is beautifully linear as shown in Fig. 2. By the least square method, the density was found to be 2.08 $gr./cc$. In the follow-

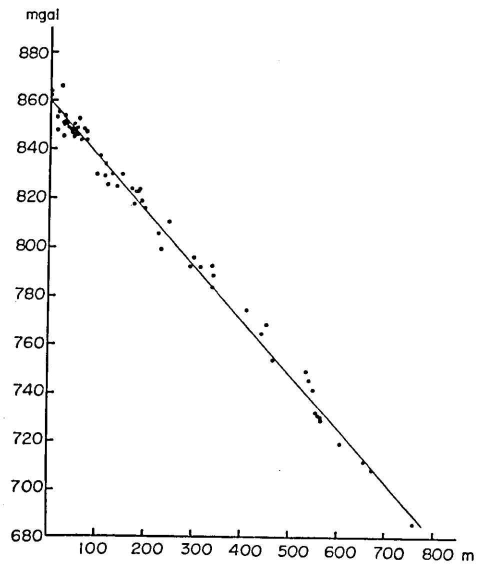


Fig. 2. Relation between observed gravity values and height

Table IV. Observed values, corrections and the Bouguer anomalies.

| No. | Height (*m*) | Normal value (*mgal*) | Observed value (*mgal*) | Free-air correction (*mgal*) | Bouguer correction (*mgal*) | | Topographical correction (*mgal*) | Bouguer anomaly (*mgal*) | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | $\rho$=2.1 | $\rho$=2.0 or 2.4 | | $\rho$=2.1 | $\rho$=2.0 or 2.4 |
| 1 | 45.6 | 722.6 | 848.5 | 14.1 | 4.0 | 3.8 | 3.4 | 139.4 | 139.6 |
| 3 | 51.0 | 723.3 | 847.0 | 15.7 | 4.5 | 4.3 | 3.6 | 138.6 | 138.7 |
| 4 | 58.0 | 724.0 | 847.5 | 17.9 | 5.1 | 4.9 | 3.5 | 139.8 | 140.0 |
| 5 | 30.2 | 724.1 | 852.4 | 9.3 | 2.7 | 2.5 | 3.2 | 138.2 | 138.3 |
| 6 | 47.7 | 725.0 | 848.2 | 14.7 | 4.2 | 4.0 | 3.9 | 137.6 | 137.8 |
| 7 | 191.9 | 725.6 | 822.4 | 59.2 | 16.9 | 16.1 | 5.5 | 144.6 | 145.4 |
| 8 | 191.4 | 725.6 | 822.0 | 59.1 | 16.8 | 16.0 | 5.5 | 144.1 | 145.0 |
| 9 | 190.5 | 725.6 | 822.4 | 58.8 | 16.8 | 16.0 | 5.5 | 144.3 | 145.1 |
| 10 | 149.7 | 726.1 | 834.6 | 46.2 | 13.2 | 12.5 | 4.6 | 146.1 | 146.8 |
| 11 | 76.5 | 726.7 | 848.2 | 23.6 | 6.7 | 6.4 | 3.5 | 141.9 | 142.2 |
| 12 | 65.1 | 726.0 | 847.0 | 20.1 | 5.7 | 5.4 | 3.4 | 138.8 | 139.1 |
| 13 | 119.5 | 726.0 | 829.4 | 36.9 | 10.5 | 10.0 | 4.7 | 134.5 | 135.0 |
| 14 | 38.7 | 726.1 | 852.6 | 11.9 | 3.4 | 3.2 | 3.5 | 138.5 | 138.7 |
| 17 | 1.2 | 718.9 | 860.2 | 0.4 | 0.1 | 0.1 | 4.3 | 145.9 | 145.9 |
| 18 | 57.6 | 718.7 | 844.6 | 17.8 | 5.1 | 4.8 | 3.7 | 142.3 | 142.6 |
| 20 | 48.4 | 720.1 | 863.5 | 14.9 | 4.3 | 4.9 | 7.1 | 161.2 | 160.5 |
| 21 | 60.2 | 719.2 | 849.3 | 18.6 | 5.3 | 5.0 | 3.6 | 147.0 | 147.3 |
| 25 | 2.8 | 718.8 | 858.2 | 0.9 | 0.2 | 0.2 | 4.3 | 144.3 | 144.4 |
| 26 | 29.7 | 718.4 | 849.4 | 9.2 | 2.6 | 2.5 | 3.2 | 140.8 | 140.9 |
| 27 | 44.1 | 718.7 | 842.6 | 13.6 | 3.9 | 3.7 | 3.1 | 136.7 | 136.9 |
| 28 | 128.0 | 719.2 | 826.6 | 39.5 | 11.3 | 10.7 | 3.7 | 139.3 | 139.9 |
| 29 | 231.9 | 719.2 | 796.2 | 71.6 | 20.4 | 19.4 | 3.5 | 131.7 | 132.7 |
| 30 | 26.0 | 718.8 | 841.4 | 8.0 | 2.3 | 2.2 | 3.1 | 131.4 | 131.5 |
| 33 | 226.3 | 722.5 | 806.1 | 69.8 | 19.9 | 19.0 | 7.3 | 140.8 | 141.7 |
| 35 | 553.3 | 723.0 | 732.8 | 170.8 | 48.7 | 46.3 | 11.3 | 143.2 | 145.6 |
| 36 | 558.5 | 723.0 | 731.4 | 172.4 | 49.1 | 46.8 | 11.3 | 142.9 | 145.3 |
| 37 | 539.1 | 722.9 | 746.5 | 166.4 | 47.4 | 54.2 | 10.1 | 152.6 | 145.9 |
| 38 | 672.6 | 722.7 | 709.4 | 207.6 | 59.2 | 56.4 | 11.6 | 146.7 | 149.5 |
| 39 | 755.8 | 722.3 | 686.4 | 233.2 | 66.5 | 63.3 | 14.3 | 145.1 | 148.3 |
| 40 | 653.8 | 721.8 | 711.4 | 201.8 | 57.5 | 54.8 | 11.7 | 145.5 | 148.3 |
| 41 | 562.2 | 721.9 | 728.4 | 173.5 | 49.5 | 47.1 | 11.5 | 142.0 | 144.4 |
| 42 | 291.7 | 721.5 | 791.8 | 90.0 | 25.7 | 24.4 | 7.0 | 141.6 | 142.9 |
| 47 | 103.9 | 725.0 | 840.3 | 32.1 | 9.1 | 8.7 | 9.1 | 147.3 | 147.8 |
| 48 | 113.4 | 725.0 | 836.4 | 35.0 | 10.0 | 9.5 | 9.1 | 145.5 | 146.0 |
| 49 | 313.9 | 724.4 | 794.4 | 96.9 | 27.6 | 26.3 | 8.4 | 147.6 | 149.0 |
| 50 | 450.8 | 723.3 | 769.4 | 139.1 | 39.7 | 45.3 | 8.5 | 154.0 | 148.4 |
| 51 | 410.3 | 722.2 | 774.5 | 126.6 | 36.1 | 41.2 | 8.6 | 151.4 | 146.3 |
| 52 | 337.2 | 721.2 | 791.7 | 104.1 | 29.7 | 33.9 | 8.1 | 153.0 | 148.8 |
| 53 | 179.6 | 719.9 | 820.3 | 55.4 | 15.8 | 18.1 | 5.3 | 145.3 | 143.0 |
| 57 | 174.9 | 720.1 | 815.4 | 54.0 | 15.4 | 14.6 | 6.7 | 140.0 | 141.4 |
| 58 | 13.5 | 719.2 | 844.2 | 4.2 | 1.2 | 1.1 | 3.1 | 131.1 | 131.2 |
| 59 | 136.5 | 720.5 | 822.6 | 42.1 | 12.0 | 11.4 | 3.7 | 135.9 | 136.5 |
| 60 | 111.9 | 720.6 | 827.3 | 34.5 | 9.8 | 9.4 | 3.6 | 135.0 | 135.4 |
| 63 | 13.8 | 724.6 | 855.3 | 4.3 | 1.2 | 1.2 | 3.2 | 136.9 | 137.0 |
| 65 | 32.8 | 723.9 | 851.8 | 10.1 | 2.9 | 2.8 | 3.3 | 138.4 | 138.5 |
| 66 | 196.7 | 723.7 | 817.2 | 60.7 | 17.3 | 16.5 | 6.1 | 143.0 | 143.8 |
| 67 | 338.7 | 723.4 | 784.7 | 104.5 | 29.8 | 28.4 | 8.3 | 144.3 | 145.7 |
| 68 | 463.6 | 723.4 | 755.0 | 143.1 | 40.8 | 38.8 | 8.9 | 142.8 | 144.8 |
| 70 | 565.4 | 723.2 | 730.6 | 174.5 | 49.7 | 47.4 | 11.3 | 143.4 | 145.8 |
| 73 | 604.0 | 723.3 | 720.4 | 186.4 | 53.1 | 50.6 | 12.6 | 142.9 | 145.5 |

(to be continued.)

Table IV.—(continued.)

| No. | Height ($m$) | Normal value ($mgal$) | Observed value ($mgal$) | Free-air correction ($mgal$) | Bouguer correction ($mgal$) | | Topographical correction ($mgal$) | Bouguer anomaly ($mgal$) | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | $\rho=2.1$ | $\rho=2.0$ or 2.4 | | $\rho=2.1$ | $\rho=2.0$ or 2.4 |
| 74 | 534.1 | 723.3 | 750.5 | 164.8 | 47.0 | 53.7 | 9.7 | 154.7 | 148.0 |
| 75 | 548.6 | 724.3 | 743.6 | 169.3 | 48.3 | 46.0 | 8.3 | 148.6 | 150.9 |
| 76 | 441.0 | 724.8 | 767.3 | 136.1 | 38.8 | 37.0 | 7.5 | 147.3 | 149.1 |
| 77 | 337.6 | 724.8 | 791.3 | 104.2 | 29.7 | 28.3 | 7.0 | 148.0 | 149.4 |
| 78 | 246.9 | 725.6 | 813.8 | 76.2 | 21.7 | 24.8 | 6.7 | 149.4 | 146.3 |
| 79 | 69.6 | 727.0 | 852.4 | 21.5 | 6.1 | 7.0 | 7.6 | 148.4 | 147.5 |
| 80 | 49.9 | 726.5 | 854.5 | 15.4 | 4.4 | 5.0 | 7.5 | 146.5 | 145.9 |
| 83 | 17.2 | 722.7 | 855.0 | 5.3 | 1.5 | 1.4 | 3.4 | 139.5 | 139.6 |
| 84 | 26.3 | 722.2 | 850.4 | 8.1 | 2.3 | 2.2 | 3.4 | 137.4 | 137.5 |
| 85 | 169.1 | 725.7 | 827.3 | 52.2 | 14.9 | 14.2 | 5.5 | 144.4 | 145.1 |
| 86 | 300.5 | 725.1 | 798.4 | 92.7 | 26.4 | 25.2 | 6.0 | 145.6 | 146.8 |
| 87 | 98.5 | 728.1 | 835.3 | 30.4 | 8.7 | 8.2 | 7.2 | 136.1 | 136.6 |
| 90 | 28.3 | 727.2 | 854.5 | 8.7 | 2.5 | 2.4 | 4.1 | 137.6 | 137.7 |
| 92 | 76.0 | 727.1 | 851.5 | 23.4 | 6.7 | 7.6 | 5.2 | 146.4 | 145.4 |
| 93 | 185.2 | 726.5 | 827.8 | 57.2 | 16.3 | 18.6 | 4.1 | 146.3 | 144.0 |
| 94 | 46.8 | 725.6 | 850.1 | 14.4 | 4.1 | 3.9 | 3.5 | 138.3 | 138.5 |

ing calculation, we take the effective density of the whole mountain-mass to be 2.10 *gr./cc.*

Topographical corrections were computed by using topographic maps on a scale of 1/5,000 up to 1.3 *km* and on a scale of 1/50,000 to 13 *km* and bathymetric charts on a scale of 1/100,000 to 33 *km*. Here, the densities of land and sea-water were taken to be 2.10 and 1.03 *gr./cc* respectively.

The normal gravity value was calculated according to

$$\gamma=978.04900(1+0.00528840\, sin^2\varphi-0.00000590\, sin^2 2\varphi)$$

where $\varphi$ is latitude of the gravity point determined by using topographic maps on a scale of 1/5,000. The Bouguer anomalies are listed in Table IV and are shown in Fig. 3.

In the above discussion, we assumed the uniform density of the mountain-mass as the first approximation and obtained the Bouguer anomalies shown in Fig. 3 where relatively high anomalies are seen in the eastern and northern parts of the island. If we adopt different values for density in each part of the island as the second approximation, we may get picture of more deep structure of the volcano. Tentatively, the writers have adopted modified values for density for the above two parts, namely, observation points Nos. 37, 50, 51, 52, 53; 78, 79, 80, 92 and 93. By the same method as beforementioned, the effective density was obtained as 2.32 and 2.44 *gr./cc* respectively while 2.00 *gr./cc* for the remainder. Adopting the value of 2.40 *gr./cc* for the high anomaly parts and 2.00 *gr./cc* for the rest, the Bouguer anomaly is

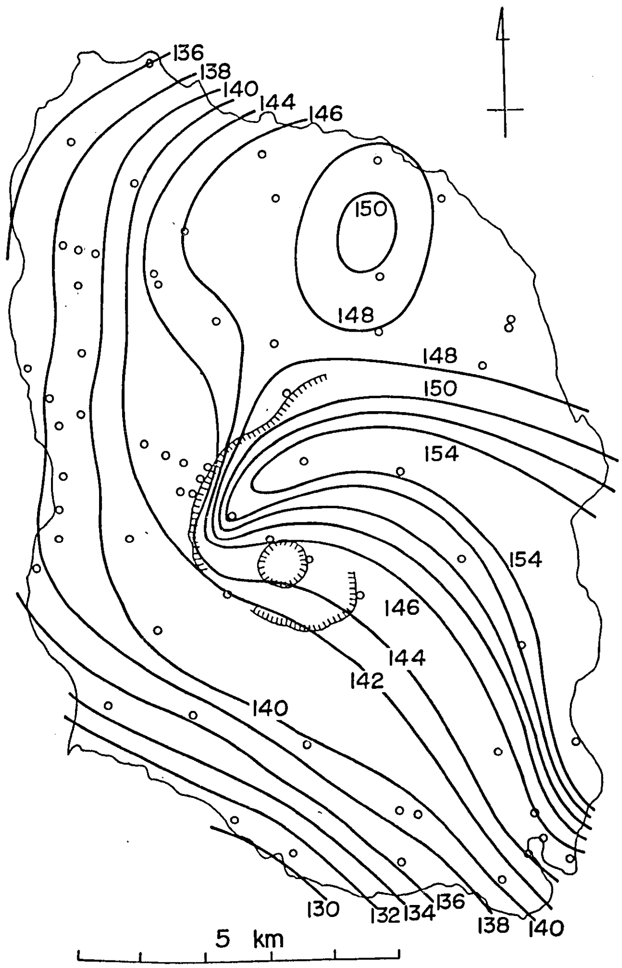


Fig. 3. Distribution of the Bouguer anomaly in *mgal*

obtained as shown in Table IV and Fig. 4 where the topographical corrections are left as before because the effect of density on them is rather small. The distribution of the Bouguer anomalies represented in the figure may be deemed to roughly suggest the density distribution under the sea level.

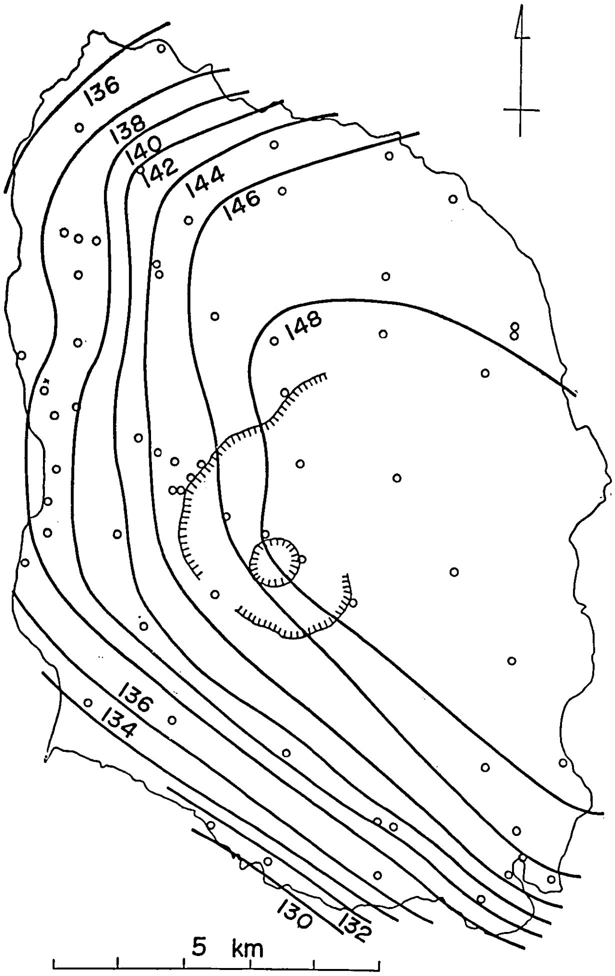


Fig. 4. Distribution of the Bouguer anomaly in *mgal* (adopting the modified Bouguer corrections)

## 3. Discussion and conclusions

Reserving the detailed and quantitative geophysical interpretations of the distribution of the Bouguer anomalies for future studies, the writers will mention the notable facts as seen in Figs. 3 and 4.

1) Generally speaking, the Bouguer anomaly contours are more or less similar to the shape of the island and this fact is not attributable to the coast effect of the Japan Trench which is situated about 200 *km*

distant eastward from Ooshima Island although we have not numerous observations on the sea in this area.

2) There are two areas of high gravity anomaly in the northern and eastern parts of the island as was stated before. The former gravity high corresponds to the positive anomaly of the vertical component in the geomagnetic field and may suggest the existence of a dense mass which is completely covered by the ejecta from the present central cone, Volcano Mihara. The latter may be taken as indicating the existence of a dense mass of which Hudeshima-Basalt at the eastern coast of the island may be an outcrop. It is interesting to note that Yuba fumarole is located near the saddle point between these two areas.

3) The outer somma is in defect in the eastern part of the caldera where the high anomaly prevails. This fact may indicate that the dense mass must have been existing before the caldera subsided.

4) The low gravity anomalies are found on the parasitic cones (No. 13 Mt. Atago and No. 29 Mt. Takenohira) as well as on the central cone. These low values are not due to errors in the topographical corrections but seem to indicate the existence of some coarse material around the volcanic vents whether this is the cause or effect of eruptions.

The above results of the present survey nicely agree with those of Nagata's and Iida and his colleagues' surveys.

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## 3. ウォルドン重力計による伊豆大島の重力測量

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伊豆大島三原火山の構造を解明する手掛りを得る目的で，ウォルドン重力計による重力測量を行つた．大島全体に普遍的に測点を設けるように努め，高さの決定には一対のアスカニヤ微気圧計を用いてその精度を最悪 3 *m* 以内に止めた．地形補正は 33 *km* の範囲まで計算した，山体の密度を二様に仮定して，それぞれに対するブーゲー異常を求めた，その結果は現在までの地質調査の結果を裏付けするものであり，又磁気測量の結果ともよく調和するものである．