

# GEOMAGNETIC STUDY OF ASO VOLCANO

BY

Masaziro OTA

## Introduction

The Aso Volcanic Laboratory of Kyoto University was planning geomagnetic studies of Aso Volcano, and continued the observation of geomagnetic time-variation from 1932. But magnetization of Aso Volcano is not so predominate as other active volcanoes, judging from the fact that amount of lava is not so much at the time of severe eruptions occurred in 1953 and 1958. One paper for preliminary result of magnetic survey was published in 1939 by the author.

Recently, the author has begun to study magnetization of rocks sampled at Mt. Aso and preliminarily concluded that all of them are normally magnetized for the present Geomagnetic field. Magnetic survey was also done at 18 points in Aso in 1962. On this survey six points are selected at the same places as the previous surveys, so that secular variation at Aso District can be discussed.

Magnetic charts for every components are shown from the present data (1962) and the previous data (1934~40) reduced their secular variations. It can be said that large part of magnetization of Aso District is not affected by rocks of surface-structure, because the main axis of magnetization at Aso is about  $45^\circ$  east referred to the geomagnetic axis. The origin of this magnetization is not so clear, but it is supposed that this is affected by geological structure of lower layer or magnetization of the somma.

Further study will be done the origin of this magnetization in the near future.

## Magnetization of Rocks

To investigate the magnetic anomaly of Aso Volcano, magnetic properties of different kinds of rocks were measured. Fig. 1 shows map of Mt. Aso and points where rocks are collected, and Table 1 shows their results of remanent magnetism. At the same time, induced magnetism is also measured, but this is very small compared with remanent magnetism. By this Table, it can be seen that Nakadake-lava has large magnetization than the others, i.e.  $\chi \left( = \frac{k}{\rho} \right)$  is order of  $10^{-2}$ . Directions of their magnetization are also shown in Table 1, and it may be said that

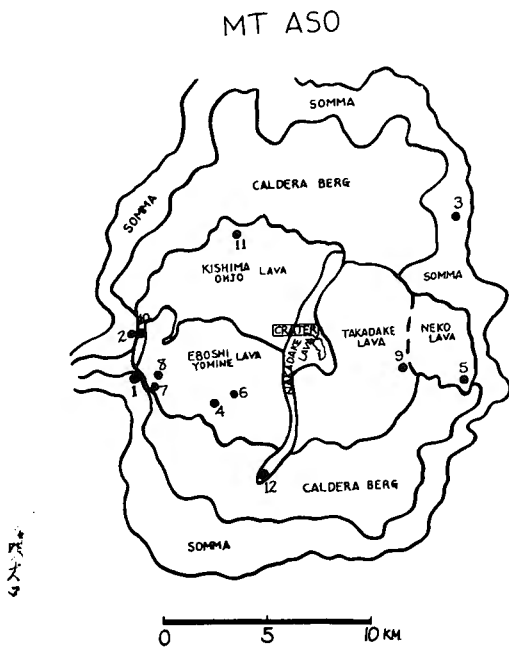


Fig. 1 Map of Mt. Aso and points where rocks are sampled (Nos. of points correspond to that in Table 1)

all of them are normally magnetized refer to the present geomagnetic-field. Precisely speaking, they show directions of the geomagnetic field respective to the geological ages. Numbers of points indicate the order of the age when those rocks were formed. This study will be published in a separate paper. As the first approximation, the author wishes to conclude that they are normally magnetized. Then, local anomaly of Aso Volcano must be shown as the remanent magnetism of these rocks, in general. But, the results of magnetic surveys are not so satisfactory on the above consideration, as shown in the following paragraph,

Geomagnetic charts

Preliminary surveys were done in 1934, 1935 and 1940. We expressed no

Table 1 Remanent magnetism of rocks at Mt. Aso

| No. | Location<br>Name         | Declination | Inclination | Intensity of<br>magnetization ( $\chi$ )<br>per unit mass |
|-----|--------------------------|-------------|-------------|-----------------------------------------------------------|
| 1   | Tawarayama (the somma)   | NE 14°      | 55° N       | $1.56 \times 10^{-3}$                                     |
| 2   | Sugaru (the somma)       | NE 10°      | 36° "       | 0.98 "                                                    |
| 3   | Sakanashi (the somma)    | NE 5°       | 66° "       | 2.29 "                                                    |
| 4   | Yomineyama (1-10)        | NE 14°      | 49° "       | 1.11 "                                                    |
| 5   | Nekodake (1-1-173)       | NE 10°      | 20° "       | 1.34 "                                                    |
| 6   | Eboshidake (11-17)       | NW 3°       | 44° "       | 0.39 "                                                    |
| 7   | Lower-Tochinoki (41-45)  | NE 5°       | 52° "       | 1.02 "                                                    |
| 8   | Upper-Tochinoki (21-24)  | NE 17°      | 34° "       | 0.77 "                                                    |
| 9   | Takadake (18-114)        | NE 12°      | 54° "       | 1.70 "                                                    |
| 10  | Kishimadake (11-102)     | NW 12°      | 37° "       | 0.99 "                                                    |
| 11  | Ohjōdake (11-10, 11-100) | NW 10°      | 46° "       | 4.13 "                                                    |
| 12  | Nakadake (101-116, 1-10) | —           | —           | 13.10 "                                                   |

conclusions about the results of these surveys, because the distribution of the selected 19 points was not sufficient to discuss the magnetization of the volcanic

region. It was suggested that large anomaly at Chôyô, south-west region of Mt. Aso, was seen.

To investigate the further study on geomagnetic anomaly, measurements of geomagnetic three components at 18 points at Aso were done in 1962. Five of them are the repeated points respective to the previous surveys. From these results, secular variations are examined, as shown in Table 2. It can be said that

Table 2 Secular variation at Aso Region

| Observing point |                                                            | Difference betw. values at 1962. 74 and at 1934. 89 |                      |          |
|-----------------|------------------------------------------------------------|-----------------------------------------------------|----------------------|----------|
| No.             | Name                                                       | Declination                                         | Horizontal intensity | Dip      |
| 1               | Aso. Mag. Obs.                                             | 63'.2 W                                             | 528 $\gamma$         | -24'.3 N |
| 56              | Imamachi                                                   | 4'.3 W                                              | (540)                | -27'.2 N |
| 61              | Asokôkô                                                    | 41'.2 W                                             | 556                  | -27'.2 N |
| 67              | Nishishimoda                                               | 86'.3 W                                             | 552                  | -28'.3 N |
| 65              | Tateno                                                     | 39'.5 W                                             |                      | -19'.6 N |
| 50              | Matoishi                                                   | 70'.3 E                                             |                      | -24'.1 N |
|                 | Average value used here                                    | 52'. W                                              | 540 $\gamma$         | -25'.0 N |
|                 | Results from the<br>Bulletin of the<br>Hydrographic Office | 40'. W                                              | 600 $\gamma$         | -14'.0 N |

average values of these four or six stations show the variations during 28 years for Aso Region. These values are somewhat different from the secular variation for the Japanese Region published in the Bulletin of the Hydrographic Office. This difference can be thought the local effect of Aso Region.

The data of the previous surveys can be reduced to the values of the present survey, if we assume that the secular changes at the every points of the previous surveys show the same values. With this permission, we get three components of the geomagnetic values for epoch of 1962.47 (0<sup>h</sup> G.M.T., Sep. 25, 1962) and can draw the magnetic charts of Aso region from the data of these 37 points. Figs. 2~5 are these results.

### Geomagnetic Anomalies in Aso Region

By Figs. 2, 3, 4 and 5, two kinds of geomagnetic anomalies are seen, one is the general anomaly for the whole Aso Region and the others are local anomalies. The latter depend chiefly on one mountain or lava-flow which is strongly magnetized. We can find five local anomalies, which are denoted in Fig. 6, i.e., Chôyô (Y), Bochû (B), Crater-zone (C), Neko (N) and Nakamatsu (M). Lava collected at Nakamatsu (No. 12 in Fig. 1) is strongly magnetized and this rock is nominated by Nakadake-lava which flew out from the present crater. The other anomalies

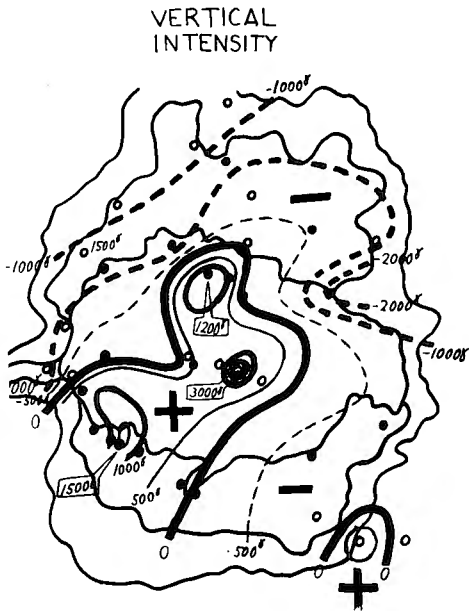


Fig. 2 Map of Equal Vertical Intensity  
circle : positions of the previous surveys  
(1934, 1935 and 1940)  
dot : positions of the present survey (1962)

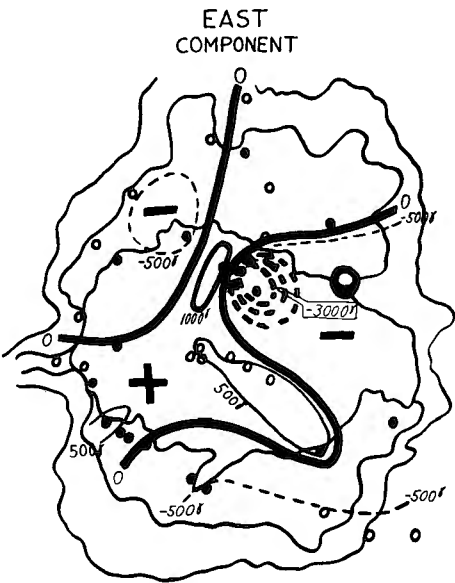
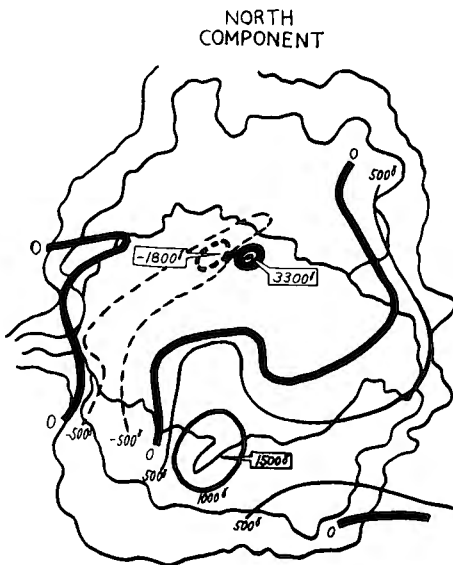


Fig. 3 Map of Equal East Component  
circle : positions of the previous surveys  
(1934, 1935 and 1940)  
dot : positions of the present survey (1962)



are not identify the definite origin, now. More difficult problems will be proposed to investigate the fine structure of these anomalies.

The author wishes to propose the new idea about the general anomaly, whose intensity is not so large and axis of magnetization is about  $45^\circ$  east to the present geomagnetic field.

#### Interpretation of the general anomaly in Aso

In this paragraph, the author wishes to consider the origin of the general anomaly, whose axis shows about  $45^\circ$  east of north. In this survey, the points are limited inside the somma. If central groups of volcanoes are strongly magnetized, we can discuss the cocorrelation between magnetization of volcano and that of rocks. Unfortunately, our first attempt for these discussion is unsuccessful, unless an incomplete speculation about subterranean structure are submitted. But this work will be continued, and will extend to the investigation of wide region outside the somma and more wide region where cover the whole Kyûshû District.

By the present results, the following interpretations are considered:— the general anomaly is due to magnetization of the somma or the constructure of deep lava.

#### Acknowledgement

The author wishes to express sincere thanks to Mr. H. Ito and Mr. M. Yasuhara for their kindness to assist this work and to Dr. N. Kawai to suggest various opinions, and also to Dr. A. Kubodera to give the convenience of the field-work.

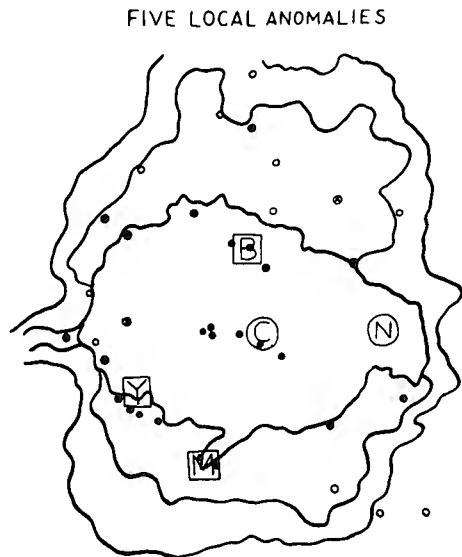


Fig. 6 Positions of Five Local Anomalies  
dot: points of large anomalies, included that of the present survey  
cross: points of the present survey (1962)