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MAGNETIZATION OF ASO VOLCANO

By

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Abstract

To investigate the status of the magnetization of Aso Volcano, Geomagnetic surveys at Aso volcanic region have been done for many years. From these results we found the two kinds of geomagnetic anomalies, i. e., one is the general magnetization of Aso Caldera and the other is the local anomaly which is classified into the several limitted places. In this paper the scale and the orientation of the rock-body which causes this general magnetization of Aso Caldera will be discussed, and it is concluded that this seems to be situated just underside the ground-level of Aso Caldera. Under an assumption that a shape of this rock-body is a rotational ellipsoid, the observational results have been compared with the calculated values.

1. Introduction

In the previous paper (OTA M, 1963), one of the authors reported the results of the observations and showed the tendency of the general magnetization of Aso Caldera. He also pointed out the five places where the very large anomalies were seen. Recently, geomagnetic surveys have been done at the several new places, and these results serve to identify the previous configuration about geomagnetic anomalies. From these results, it may be said that the origin of the general magnetization of Aso Caldera is a rock-body just underside the ground-level. For mathematical convenience this rock-body is replaced by a block-mass of an uniformly magnetized ellipsoid. In this case the magnetic properties of the block-mass are assumed to be the same as those of the rocks collected at the ground-level by sampling. Comparing observational results with calculated values, a good agreement between them is confirmed. It is concluded that the present method is acceptable for geomagnetic study on volcanoes.

2. Geomagnetic Survey

Survey-points are fifty-two in all, as shown in Figure 1, but the times of the observations are different, covering thirty years or more. To reduce respective values to the same time, geomagnetic records and values of

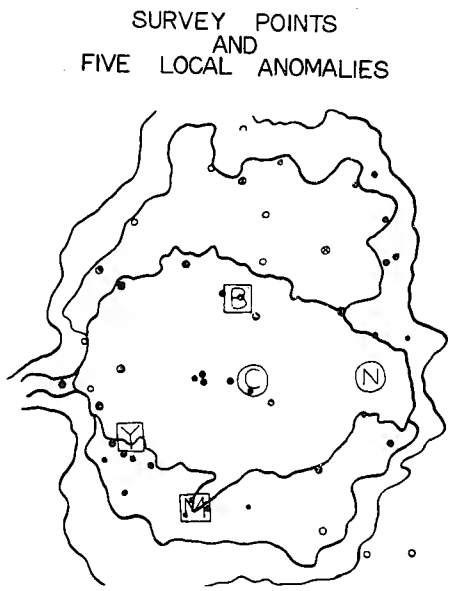


Fig. 1. Distribution of the Survey-point and Positions of Five Local Anomalies.

absolute measurements at Aso Volcanic Laboratory of Kyoto University are used. This consideration means that geomagnetic change is just the same over the whole region where we observe geomagnetic elements. About the secular change the following posturation is considered; by the results at the five repeated survey-points as shown in Table 1, it may be said that secular

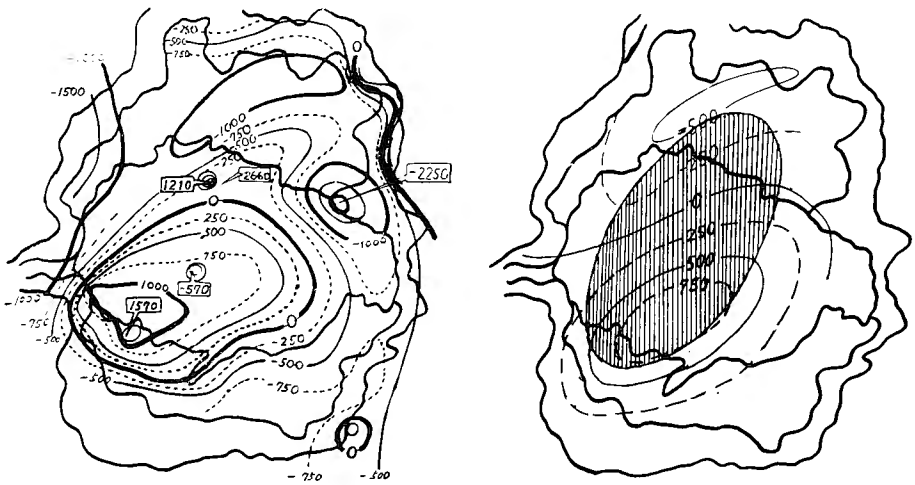
Table 1. Secular variation at Aso Region

Observing point		Difference betw. values at 1962. 74 and at 1934. 89		
No.	Name	Declination	Horizontal intensity	Dip
1	Aso. Vol. Lab.	63′.2W	528γ	−24′.3N
56	Imamachi	4 .3W	(540)	−27 .2N
61	Asokôkô	41 .2W	556	−27 .2N
67	Nishishimoda	86 .3W	552	−28 .3N
65	Tateno	39 .5W		−19 .6N
50	Matoishi	70 .3E		−24 .1N
Average value used here		52 . W	540	−25 .0N

changes at Aso region take approximately the same values, and the average value of the above-mentioned values are regarded as the secular variation at Aso region.

Figs. 2a-5a are the results at the time of 1962.47 (Oh G.M.T. Sep. 25, 1962) thus obtained. In these figures latitudinal and longitudinal corrections about

VERTICAL COMPONENT



a b

Fig. 2. a, (left) Map showing Vertical Intensity by survey (expressed in gamma).
b, (right) Map showing Vertical Intensity by calculation (expressed in gamma).

NORTH COMPONENT

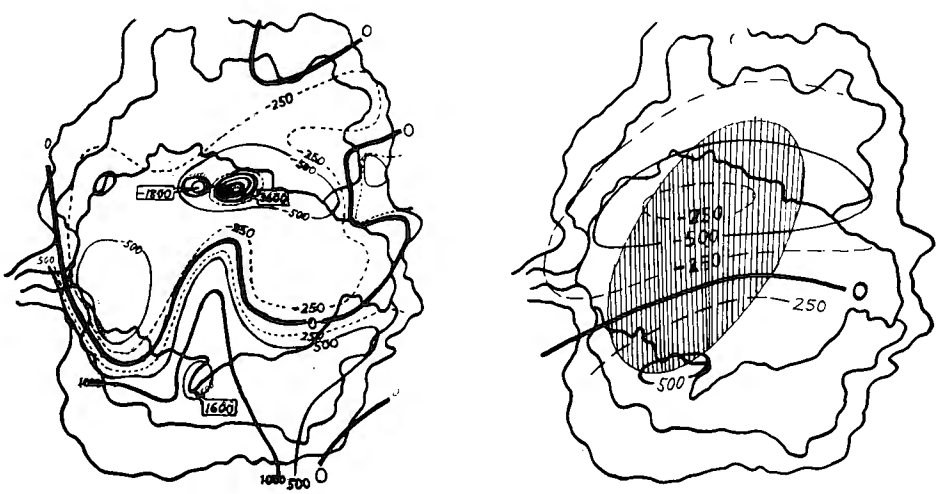


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Fig. 3. a, (left) Map showing North Component of Horizontal Intensity by survey (expressed in gamma).
b, (right) Map showing North Component of Horizontal Intensity by calculation (expressed in gamma).

EAST COMPONENT

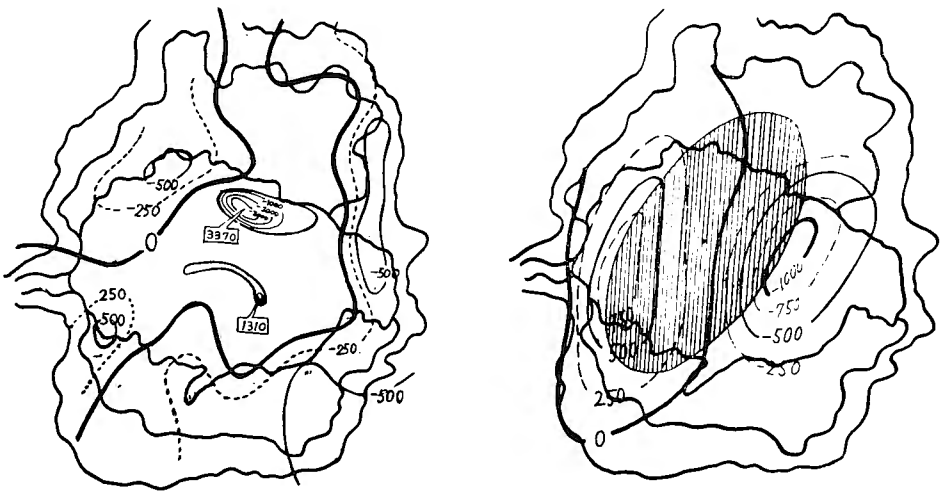

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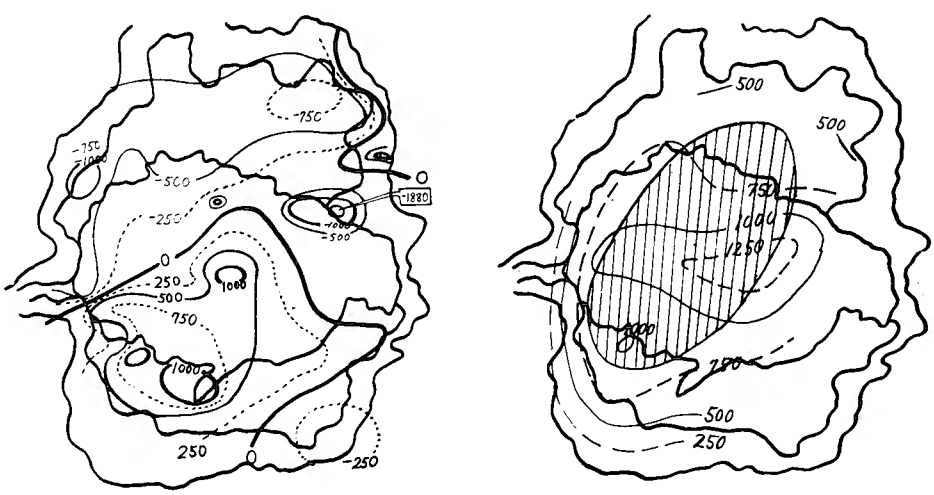
Fig. 4 a, (left) Map showing East Component of Horizontal Intensity by survey (expressed in gamma).
b, (right) Map showing East Component of Horizontal Intensity by calculation (expressed in gamma).

TOTAL INTENSITY



a b

Fig. 5. a, (left) Map showing Total Intensity by survey (expressed in gamma).
b. (right) Map showing Total Intensity by calculation (expressed in gamma).

geomagnetic values are not in consideration, because these values are small compared with the geomagnetic anomalies now discussed. (the lower limit in consideration is 100 gamma).

3. Magnetic properties of Rocks sampled at Aso volcanic region

Fig. 6 shows the distribution of different rocks at Aso region (after Homma) and also shows the places where rocks are sampled. The magnetic properties of these rock-samples are measured and their results are shown in Table 2. By these results it may be said that rocks of Aso Caldera are normally magnetized and have NRM of order 10^{-3} except Nakadake-lava.

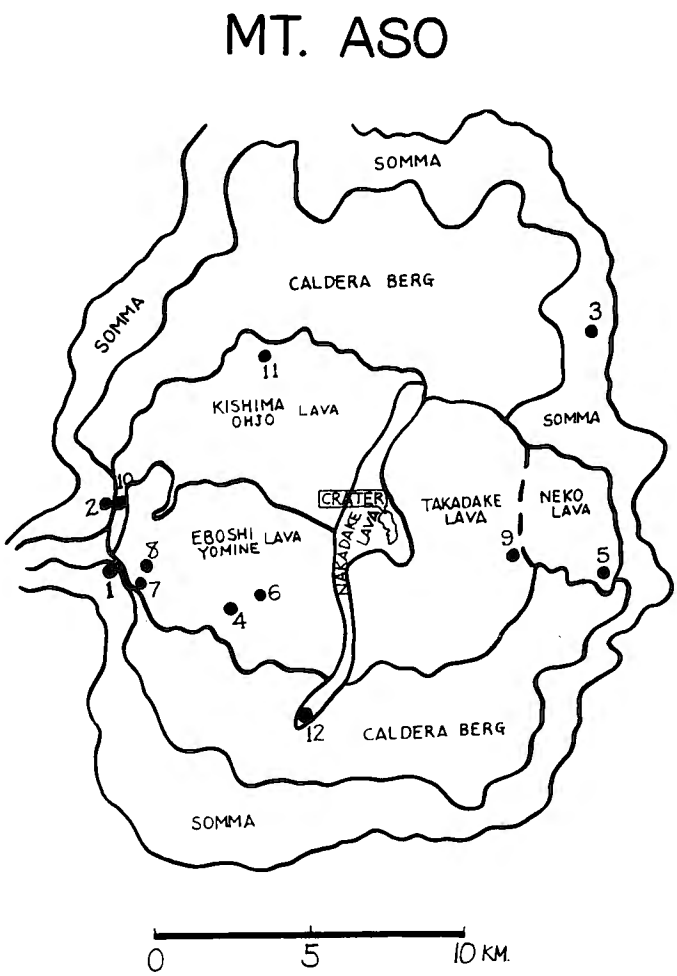


Fig. 6. Map showing ontline of geological structure and points where rocks are sampled.
(Nos. of points correspond to those in Table 2).

Table 2. Remanent magnetism of rocks at Mt. Aso.

Location No.	Name	Declination	Inclination	Intensity of magnetization per unit mass
1	Tawarayama (the somma)	NE 14°	55°N	1.56×10^{-3}
2	Sugaru (the somma)	NE 10°	36°	0.98
3	Sakanashi (the somma)	NE 5°	66°	2.29
4	Yomineyama	NE 14°	49°	1.11
5	Nekodake	NE 10°	20°	1.34
6	Eboshidake	NW 3°	44°	0.39
7	Lower-Tochinoki	NE 5°	52°	1.02
8	Upper-Tochinoki	NE 17°	34°	0.77
9	Takadake	NE 12°	54°	1.70
10	Kishimadake	NW 12°	37°	0.99
11	Ôjôdake	NW 10°	46°	4.13
12	Nakadake	—	—	13.10

4. General Magnetization and Subterranean Structure

Considering the results of geomagnetic survey at Aso volcanic region, intensity of magnetization of Aso Volcano is not so large as other volcanoes. But, judging from Figs. 2a-5a, there exists general magnetization and its axis is about 30° east of north. If the effect of the somma is left out of accout, this phenomenon is to be the effect of Aso Caldera. As the survey-area is limitted within Aso Caldera and rocks of the somma are not precisely investigated, we wish to discuss the effect of the somma in the future problem as the secondary effect.

Now, the two facts are confirmed ; i. e., the first, rocks of caldera are normally magnetized, the second, an axis of general magnetization is not magnetic north, but about 30° east of north. For mathematical convenience, the rock-body, which causes the general magnetization of Aso Volcano, is considered as an uniformly magnetized ellisoid. Its major axis is 30° east of north in direction and 14 km in length, and minor axis is 7 km in depth as well as breadth. The situation of this rock-body is shown in hatched area in Figs. 2b-5b. Numerical figures and contour lines show the results of the calculation which is derived from the potential theory. In this calculation numerical values of susceptibility and NRM of the rocks are taken from the average values of the results of rock sampling. Comparing the calculated results (Figs. 2b-5b) with observational results (Figs. 2a-5a), the general feature is pretty similar, but the numerical value is not so good. About the latter we wish to say that numerical value of NRM can be changed as twice as the adopted values.

5. Local anomalies

By the local anomaly in this paragraph is meant that amount of anomaly is large (greater than 1000 gamma) and anomalous region is very limitted (only several hundred meters apart between maximum and minimum). From the results of geomagnetic survey in Aso, there are five regions of this kind of anomaly. In the previous paper (1963) the author has already pointed out this fact, as shown in Fig 1. But it may be considered that subterranean origin of these anomalies would be different among them. These discussions need the further observations which will be done in the near future.

6. Conclusion

This paper shows the first approximation of magnetization on Aso Volcano, and also set a proposal about the subterranean structure of Aso Caldera. The principle of this work deals with the relation between the results of the survey and the magnetic properties of rocks sampled at the same places. The effect of Aso somma is not considered here. This, which is caused by some different origin, shall not be referred to the present discussion.

Reference

Ota M., Geomagnetic study of Aso Volcano, PP. 409-413, Geophysical Papers dedicated to Professor Kenzo Sassa, 1963.