An Investigation of the Earth-current on the Volcano Aso

Part II. Distributions of the Earth-current in the Old Atrio of Aso

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Abstract

In January 1936 the writer measured the distributions of the potential gradients of the earth-current in the old atrio of Aso. By study of the measurements the writer came to the following conclusions:—

1). There are some anomalous distributions of the earth-current in the neighbourhood of the volcanic tectonic lines.
2). Under the NW part of the atrio, a magma reservoir seems to exist.
3). The barranco of Taténo may be an erosional valley and not a graben.
4). The writer can say nothing about the problem of the Aso volcanic sink because no measurements of the somma are available.

I. Introduction

The writer measured the distributions of the potential gradients of the earth-current in the old atrio of Aso in January 1936. Prof. T. Nomitsu has recently entered upon a study of the volcanic tectonic lines from the standpoint of hydrophysics[1]. Dr. F. Homma and M. Mukae wrote "Preliminary Reports of the Geologic Structure of Aso Central Cones."[2] They are going far toward the study of the structure of this atrio. The writer studied the results of the above measurements so far as they referred to his own problems.

II. The Measurements

The method of measurement of the potential gradient of the earth-current is the same as that described in my last report[3]. This time

1. Prof. Dr. T. Nomitsu:—Aso-Volcano viewed from the geophysical standpoint. 日本學術協會報告, No. 14, 1938.

2. F. Homma and M. Mukae:—Preliminary Reports of the Geologic Structure of Aso Central Cones. 火山, Dec. 1938.

3. M. Namba:—An Investigation of Earth Currents on the Volcano Aso. Part I. The Potential Difference of the Upward Earth-current flowing toward the top of a volcano. These Memoirs, Vol. XXI, No. 6, 1938.

we adopted 200 meters as the distance of the electrodes. The azimuth was determined referring to the topographic object. We assumed the resultant of the two components (which cross each other at right angles) as the potential gradient of the earth-current at that point. We tried hard to measure in a short period as much as we could for fear that meteorological condition upon the wide atrio might not remain uniform.

At each observation point there must be similar topographic conditions and a space 200 meters wide for the elctrodes. Therefore it was so labourious to select such uniform points in the atrio that we succeeded in selecting only 15 observation points in the atrio and a point (No. 13) on the somma.

The results are tabulated, and the direction and magnitude of the potential gradient are denoted by the full arrow in the figure. The equipotential surface at each point is also added.

Table of the Distributions of the Earth-current in the Aso old atrio.

1936 Jan.	Observation Point	Potential Gradient in M.V./100^{m}	Resistance ohms/200^{m}
28th	No. 1	18.6	4.9×10^{3}
„	2	8.4	2.0
„	3	**233.0**	**5.7**
„	4	9.9	3.8
„	5	*6.4*	*1.1*
„	6	13.8	5.3
27th	7	*23.1*	3.4
„	8	19.6	5.7
30th	9	*21.3*	1.9
29th	10	141.0	1.6
„	11	6.8	1.8
„	*12*	*20.0*	1.4
„	13	37.2	6.1
„	14	24.0	1.9
„	15	19.0	2.2
30th	No. 16	29.0	3.1×10^{3}
Mean.		33.2	3.2×10^{3}

Max. resistance is 5.7×10^3 ohms (No. 3), min. resistance is 1.1×10^3 ohms (No. 5), and the mean value of the resistances is 3.2×10^3 ohms per 200 meters.

Max. potential gradient is 233.0 milli-volts per 100 meters (No. 3), min. potential gradient is 6.4 milli-volts per 100 meters (No. 5), and the mean value is 33.2 milli-volts per 100 meters.

III. Consideration of the Results Obtained

It is of course impossible to study the structure of the atrio perfectly on the basis of only 16 measurements and the author's conclusions can be only tentative. But it will mark some degree of progress if we analyze some of the features of the atrio even with these data and even though there is also possibility that some of the recorded distributions of the earth-current may not be continuously reliable. First let us consider the results taking as a starting point Prof. Ono's thesis that earth-currents are distributed irregularly in the neighbourhood of an underground fault[1]. We find the following tectonic weak lines :—

(1). The range of Neko-daké, Taka-daké and Naka-daké. This range is the same as the EW tectonic weak line which the geologists declare.

(2). The range of Narao-daké, Wasiga-miné and Maru-yama. This range is declared weak by Dr. Homma[2].

(3). The range of the active craters of Naka-daké, Maru-yama, and its elongation toward the SE direction.

(4). The range of Ôjôdaké, Kisima-daké, Senri-hama crater, Okamado-yama and its elongation toward an S direction. This is the elongation of the convex NS tectonic weak line reported by Dr. F. Homma[3].

(5). The range of Naka-daké, Kisima-daké, Ôjô-daké, Uwa-kométsuka, Kométsuka, Jano-o-yama, hot-spring of Kurumagaéri and Hutaétôgé.

(6). The NE line which passes through Hontsuka.

(7). The WE line between Tômigahana and the hot-spring of Yunoyama.

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1. Prof. Dr. S. Ono :—On the Anomalous Distributions of the Earth-current and the Underground Fault etc., 日本學術協會報告, No. 14, 1938.
2. Dr. F. Homma :—ditto.
3. Dr. F. Homma :—ditto.

These last (6) and (7) ranges rather seem to me together to make up one which passes through Hontsuka and the hot-spring of Yunoyama, corresponding to the outermost radial line proposed by Prof. Nomitsu.

The above ranges are denoted roughly by dotted lines in the figure. These weak lines are the same ones which the geologists will declare. But among the geologists' tectonic lines there is an exceptional one—the so-called Grosser-line—on which the earth-current makes no suggestion of the underground irregularity. The Grosser-line is the EW range of Ebosi-daké and the barranco of Taténo. Geologists have not settled the question whether the barranco is an erosional valley or a graben as Prof. Grosser[1] said.

There are two lower parts in the somma of the old crater, one of which is the crest of Hutaénotôgé and the other is the barranco of Taténo. The crest of Hutaénotôgé was declared to be an EW graben by Prof. T. Matsumoto[2] and his view seems to me supported by our observations at this time. The barranco of Taténo was declared to be a graben by Prof. Grosser, but after our study of the earth-current, we are obliged to suppose the barranco to be an erosional valley. About the problem of the Aso volcanic sink, the writer can say nothing at this time though there may be some anomalies between No. 12 and No. 13.

IV. Another Consideration of the Results Obtained

Now it seems safe to say on the whole that there is a tendency to a general arrangement of the potential gradient as indicated by the hollow arrows in the figure. If such distributions of the potential gradients as have been noted are observed on level ground with uniform topographic conditions, we must at once recognize the existence of a conductive mass under the ground. In our case, it is still hard to give the reason of such a distribution of the potential gradient without the existence of an underground conductive mass though it is not so simple a case as the previous one. And it may most reliably be said that the magma reservoir is situated under the NW part of the old atrio. Such a theory will account for the following facts :—

(1). The existence of the active craters of Naka-daké.

1. 震災豫防調査報告, No. 33, 1901.
2. T. Matsumoto, 大阿蘇之新研究, 1932.

(2). The existence of the hot-springs of Jigoku, Tarutama, Iwasita, Suzumé-Jigoku, Yunotani, Hontsuka, Uchinomaki, Yunoyama, Orito, Kurumagaéri and Totinoki.

(3). There is nowhere found any land slip on such a large scale as that in the inner wall of the somma which runs from Matoisi to Kabutoiwa (NW wall of the somma).

(4). The existence of the graben of Hutaénotôgé and the barranco of Taténo. These are the lowest parts of the somma.

(5). The volcanic cones which belong to the Kisima-Ôjô-system are said to be the newest ones among the Aso central cones.

V. Summary

Some of the peculiarities of the old atrio of Aso may fortunately be explained by the above considerations though they are daringly based upon so few observations in some of which even, some errors may be included. From this fact, it may be said that even so few observations of the distributions of the earth-current may not be an useless task. From the standpoint of the earth-current the writer may say that the barranco of Taténo may be an erosional valley. But he cannot say anything about the problem of the Aso volcanic sink because of lack of observations on the somma.

Finally, the writer may safely say that there are some anomalous distributions of the earth-current in the neighbourhood of the volcanic tectonic lines.

In conclusion the author wishes to express his best thanks to Prof. T. Nomitsu for the interest he has taken in the research.

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