

# On the Bread Crust Bomb from Shiro-yama, Kagoshima City, Japan.

Kenji YAMAGUCHI

## Introduction

Southern Kyushu including the district around the Bay of Kagoshima abounds not only in recent volcanoes of the Kirishima Chain, but also in volcanic relics older in geological ages, this being proved by the wide distribution of various kinds of volcanic rocks with abundant pyroclastic sediments over that area. Among them, some rocks as andesites, built up the isolated mountain masses, while the pyroclastic sediments, which are overlain either on the Tertiary Formation or on the volcanic lavas as basalt, plagioliparite and trachyandesite, formed the plateau in topography. The pyroclastic materials occupying the upper part of the plateau consist, for the most part, of volcanic sand with other volcanic detritus. These sandy materials are popularly called "Shirasu" in that region of Japan, by which name is meant "white sand". As this name is now commonly used, this formation will hereinafter be known as the "Shirasu Bed".

In the middle of April, 1952, the writer had a very fortunate opportunity to find a few samples of the bread crust bomb from the Shirasu Bed, at the base of the southern side of Shiro-yama, the small hill, in the City of Kagoshima. Although the pumiceous lapilli and block of various size may rather abundantly be seen in the volcanic sands composing the Shirasu Bed, no bread crust bomb, so far as the writer's knowledge goes, ever has been reported from the same bed. Therefore, the writer's discovery of these samples are the first in this connection, and may also be said to be a rare care. For this reason in the present paper, the writer will report the petrology of this interesting ejectamenta of the ancient volcanism with special reference to the Shirasu Bed in which the collections are included.

## General Properties of the Bread Crust Bomb

The bomb in question in most cases is roughly spheroidal in shape, but some exhibit a more or less irregular polyhedral outline bounded by the curved surfaces. The size of the bomb ranges from 8 cm to 15 cm in length. Its surface is traversed with polygonal cracks. The colour is gray both on the surface and in the interior. In structure it is very minutely porous, thus crumbling easily with the thumb nail.

The apparent specific gravity of the bomb measured is about 0.65 in average, and so that all the bombs float in water.

### Microscopic Examination of the Bomb

Under the microscope, it shows a porphyritic structure consisting chiefly of phenocrysts of plagioclase, quartz, hypersthene and magnetite, and of the glass as groundmass. The quantity of an each phenocryst is in the same order as just described. The quartz is sometimes subhedral in shape, but more commonly rounded by corrosion. The size of the crystal is about 1.5 mm in diameter.

The phenocryst of plagioclase is euhedral or subhedral in shape with a longer axis from about 0.5 mm to 1.5 mm in length. Each crystal is attached to another as the Carlsbad and Albite Types. Some of the plagioclase show the zonal structure.

The hypersthene is most inferior in quantity as phenocrysts. It occurs as a short prismatic crystal with the longer axis about 0.5 mm in length.

The groundmass of the bomb consists nearly entirely of the glass of porous structure. The glassy walls of the bubbles are originally colorless, but they seemed fairly dirty because of the inclusion of the numerous crystallites of dark colour. The pores as seen in the glass are numerous, with a diameter from about 0.03 mm to 1.0 or rarely 2.0 mm, being elongated in one direction.

The optical constants of the constituent minerals and of the glass of the bread crust bomb measured are given in the following table :

Table I

Quartz	+
Plagioclase	Ab <sub>56</sub> An <sub>44</sub>
Hypersthene	$n_1$ on (110) = 1.715
	$n_2$ on (110) = 1.726
	$2V(-) = 55^\circ$
Glass	$n = 1.502$

### Chemical Composition

The chemical compositions of the two samples of the bread crust bomb analysed by the writer are as follows : (Table II)

From the data based on the microscopical and chemical investigations given above it may be concluded that the bread crust bomb in the Shirasu Bed is the ejected product derived in the molten state from the magma that is equivalent petrologically to the plagiolarite.

Table I

	No.1	No.2
SiO <sub>2</sub>	73.46	72.22
Al <sub>2</sub> O <sub>3</sub>	12.41	13.23
Fe <sub>2</sub> O <sub>3</sub>	0.49	0.34
FeO	1.14	1.34
MgO	0.19	0.39
CaO	2.69	2.55
Na <sub>2</sub> O	3.74	3.64
K <sub>2</sub> O	2.67	2.59
H <sub>2</sub> O +	2.36	2.65
H <sub>2</sub> O -	0.48	0.34
TiO <sub>2</sub>	0.21	0.20
P <sub>2</sub> O <sub>5</sub>	0.17	0.10
MnO	0.04	0.04
Total	100.05	99.63

### Petrology of the Pumiceous Block in the Shirasu Bed

As already stated, the Shirasu Bed consists mainly of volcanic ash and sand with lapilli and blocks of pumice in variable amounts. Of these, the volcanic sand predominates in quantity, and is composed in turn of quartz, plagioclase, hypersthene, magnetite and fragments of glass. Among these component materials, the pumiceous block seems to possess the nature of the original magma, from which all the fragmental materials mentioned above are derived. For this reason, the writer had published in former times the results of his investigation on the pumice contained in the different strata in the district around the Bay of Kagoshima.<sup>(1)</sup>

In the following tables data related to the pumice in the Shirasu Bed will be reproduced briefly.

The optical constants measured on the samples of the three localities are given in Table III.

Table III

		No. 3	No. 4	No. 5
Quartz		+	+	+
Plagioclase		Ab <sub>63</sub> An <sub>37</sub>	Ab <sub>63</sub> An <sub>37</sub>	Ab <sub>54</sub> An <sub>46</sub>
Hypersthene	n <sub>1</sub>	1.719	1.717	1.715
	n <sub>2</sub>	1.732	1.728	1.723
	2V	n. d.	n. d.	50° (-)
Glass	n	1.499	1.499	1.502

## Localities :

No. 3, Plateau west of Tokiwa-cho, Kagoshima city.

No. 4, Iwasaki-dani, Shiro-yama, Kagoshima city.

No. 5, Meziri, Honjo-mura, Kagoshima-gun, Kagoshima prefecture.

The chemical compositions of these samples are as follows :

Table IV

	No. 3	No. 4	No. 5	Average
SiO <sub>2</sub>	73.76	73.03	73.01	73.26
Al <sub>2</sub> O <sub>3</sub>	13.16	12.47	12.84	12.82
Fe <sub>2</sub> O <sub>3</sub>	0.44	1.11	0.03	0.53
FeO	1.76	1.56	1.56	1.63
MgO	0.44	0.30	0.44	0.39
CaO	2.38	1.98	1.92	2.09
Na <sub>2</sub> O	3.01	3.93	3.80	3.58
K <sub>2</sub> O	2.49	2.99	3.17	2.88
H <sub>2</sub> O +	2.30	2.41	2.09	2.27
H <sub>2</sub> O -	0.31	0.41	0.56	0.43
TiO <sub>2</sub>	0.17	0.17	0.15	0.16
P <sub>2</sub> O <sub>5</sub>	0.10	0.20	0.24	0.18
MnO	0.03	0.08	0.08	0.06
Total	100.35	100.65	99.89	100.28

The localities of the samples are the same as that given in Table III.

Comparing the data of the optical and chemical investigations given in the four tables above, it may be inferred that the bread crust bomb and the pumiceous block in the Shirasu Bed are petrologically identical, being derived genetically from the same origin as the co-magmatic products.

## Petrology of the Plagioliparite

As stated in the preceding chapter, the bread crust bomb is considered to be identical genetically with the plagioliparite, with which the Shirasu Bed forms the plateau everywhere around the Bay of Kagoshima. To show the similarity of the petrologic character of these two rock species, the following chemical compositions of the plagioliparite will be cited from the paper published by the writer long years ago.<sup>(2)</sup>

Table V

	No. 6	No. 7	No. 8	No. 9	Average
SiO <sub>2</sub>	74.65	74.04	72.75	73.27	73.68
Al <sub>2</sub> O <sub>3</sub>	14.27	13.67	14.54	14.22	14.18
Fe <sub>2</sub> O <sub>3</sub>	0.53	0.40	0.64	0.15	0.43
FeO	1.75	1.92	1.43	1.73	1.71
MgO	0.61	0.67	0.67	0.58	0.63
CaO	2.67	2.77	2.66	2.40	2.63
Na <sub>2</sub> O	3.43	3.05	4.23	4.34	3.77
K <sub>2</sub> O	2.16	2.50	2.43	2.28	2.34
H <sub>2</sub> O +	0.47	0.28	0.24	0.61	0.40
H <sub>2</sub> O -	0.02	0.39	0.18	0.17	0.19
TiO <sub>2</sub>	0.15	0.13	0.17	0.18	0.16
P <sub>2</sub> O <sub>5</sub>	0.07	0.26	0.14	0.08	0.14
MnO	0.04	0.04	0.04	0.03	0.04
Total	100.82	100.12	100.12	100.07	100.30

## Localities :

- No. 6, Base of the cliff on the northern side of Hayasaki, Tarumizu-mura, Osumi province.
- No. 7, The cliff on the northern side of Hayasaki, Tarumizu-mura, Osumi province.
- No. 8, Western flank of Hayasaki, Tarumizu-mura, Osumi province.
- No. 9, Eno-shima on the sea of Kaigata, Tarumizu-mura, Osumi province.

## Summary

In this paper the writer reported the petrological study of the bread crust bomb, which was discovered for the first time by him from the Shirasu Bed, at Shiro-yama, Kagoshima city, with special references to the pumiceous block in the same bed, and of the plagioliparite, both of which formed the plateau in topography. Because a bomb is, in general, interpreted as the projected pieces of the lava torn in a molten state the bread crust bomb in question may be conceived to be the representative of the original magma, from which all the materials composing the Shirasu Bed are derived. According to the petrological data of these rocks previously given, it may be concluded that they are identical in genesis.

References

- (1) Yamaguchi, K. : Petrological Study of the Pumice around the Bay of Kagoshima (Part 3), (in Japanese), Jour. Geol. Soc. Japan, Vol. IXV, No. 542, pp. 782—783, 1938.
- (2) Yamaguchi, K. : Petrological Study of "Ash Stone" around the Bay of Kagoshima (Part 4), (in Japanese), Jour. Geol. Soc. Japan, Vol. IXV, No. 535, pp. 333—337, 1938.

(August 1954)

0.0	0.38	0.67	0.67	0.61	MgO
0.03	0.03	0.66	0.77	0.67	CaO
0.77	4.34	4.23	3.05	3.43	Na <sub>2</sub> O
0.34	0.28	0.43	0.50	0.16	K <sub>2</sub> O
0.40	0.61	0.24	0.28	0.47	H <sub>2</sub> O +
0.19	0.17	0.18	0.39	0.02	H <sub>2</sub> O -
0.16	0.18	0.17	0.13	0.15	TiO <sub>2</sub>
0.14	0.08	0.14	0.26	0.07	P <sub>2</sub> O <sub>5</sub>
0.04	0.03	0.04	0.04	0.04	MnO
100.30	100.07	100.12	100.12	100.82	Total

Localities :

- No. 6. Base of the cliff on the northern side of Hayasaki, Tatumizu-mura, Osumi province.
- No. 7. The cliff on the northern side of Hayasaki, Tatumizu-mura, Osumi province.
- No. 8. Western bank of Hayasaki, Tatumizu-mura, Osumi province.
- No. 9. Eroshima on the sea of Kaigata, Tatumizu-mura, Osumi province.

Summary

In this paper the writer reported the petrological study of the bread crust bomb which was discovered for the first time by him from the Shirasu Bed, at Shinoyama Kagoshima city, with special references to the pumiceous block in the same bed and of the pizigoliparite both of which formed the plateau in topography. Because a bomb is in general interpreted as the projected pieces of the lava torn in a molten state the bread crust bomb in question may be conceived to be the representative of the original magma from which all the materials composing the Shirasu Bed are derived. According to the petrological data of these rocks previously given, it may be concluded that they are identical in genesis.