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Palaeomagnetism on the Environs of Cape Kawajiri

by

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Asami (1954, 1956) reported that the bulk of Kawajiri-misaki (Cape Kawajiri) basalts is composed of a single lava flow which has in general the reversed natural remanent magnetization (A and C belts), although there exists the positional intermixing of the normal and the reversed polarities in the lava (B belt). In the inner part of Cape Kawajiri, however, rocks covering the reversely magnetized lava flow could not be sampled, because they are mostly covered with ordinary soils. Recently, it was geologically observed that some samples in rocks which were normally magnetized belong to a different lava flow which is placed over the lava with reversed or mixed polarities. In order to bring into

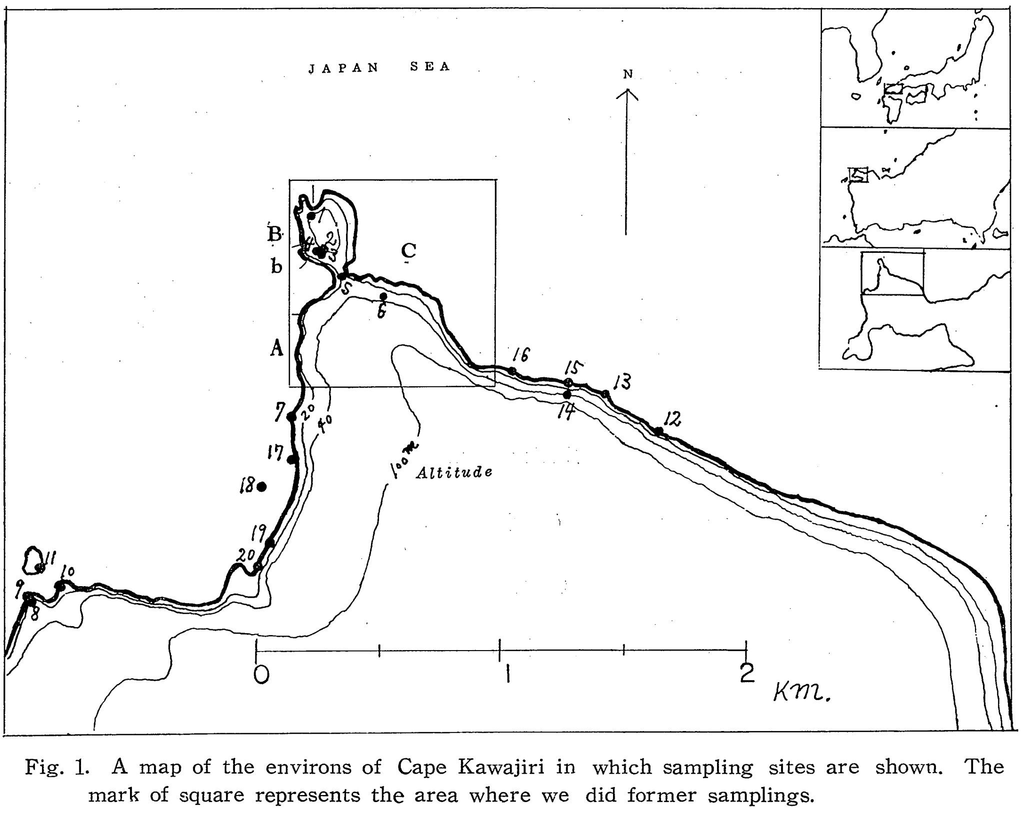


Fig. 1. A map of the environs of Cape Kawajiri in which sampling sites are shown. The mark of square represents the area where we did former samplings.

relief the contour of the positional intermixing zone of the normal and the reversed polarities, the present authors collected many samples from olivine basalts lying at other locations in Kawajiri District (Cape Kawajiri and its neighbouring area) than the spots where we did former samplings, and also from some different lava flows covering that at the cape with the reversed magnetization already reported (Fig. 1).

Kawajiri District consists mainly of olivine basaltic flows in which are sandwiched a few lapilli tuffs and they are considered to have undergone no conspicuous dynamical disturbances since their eruption, because they are nearly horizontal for the most part (Okamoto and Imamura, 1964). The lava flow with the reversed magnetization already reported, in which is found the positional intermixing of polarities, lies in the lowest part (less than 25 m from the sea level) of lava flows at the cape (Fig. 2). The lava flow is distinctly covered with the lapilli tuff of about 5 m in thickness, and alternating layers

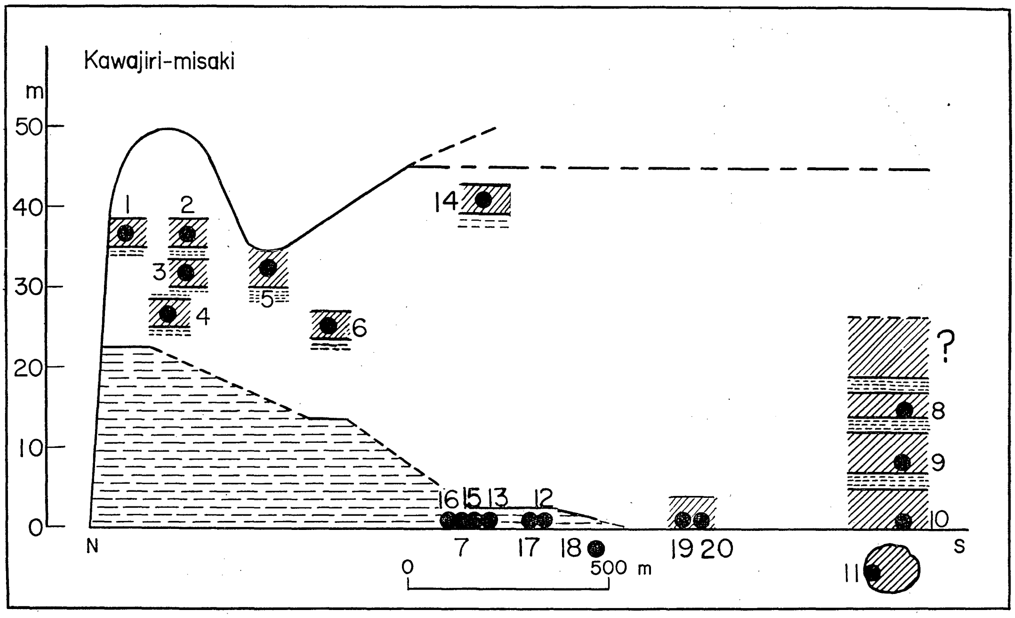


Fig. 2. Schematic section of the southwestern and southeastern coast cliffs in Kawajiri District. Horizontal broken line shows reversed lava flows and oblique line normal lava flows. Dotted line shows lapilli tuffs and unknown beds. Numbered dots are sampling sites.

of basaltic flow and lapilli tuffs are superimposed on them as shown in Fig. 2. Oriented samples were collected from the lava flows belonging to upper part (more than 25 m from the sea level) of the cape, and also from basaltic flows exposed on the coast cliffs or sunk in the sea along the southwestern and southeastern coasts of Kawajiri District in order to reveal the structure of horizontal and vertical distributions of the reversed magnetization and the positional intermixing of polarities. We further intended, if possible, to find out a transition zone, which will show a change of the geomagnetic field from the reversed to the normal polarities or vice versa.

Oriented hand samples were taken from extensive areas as much as practicable at each

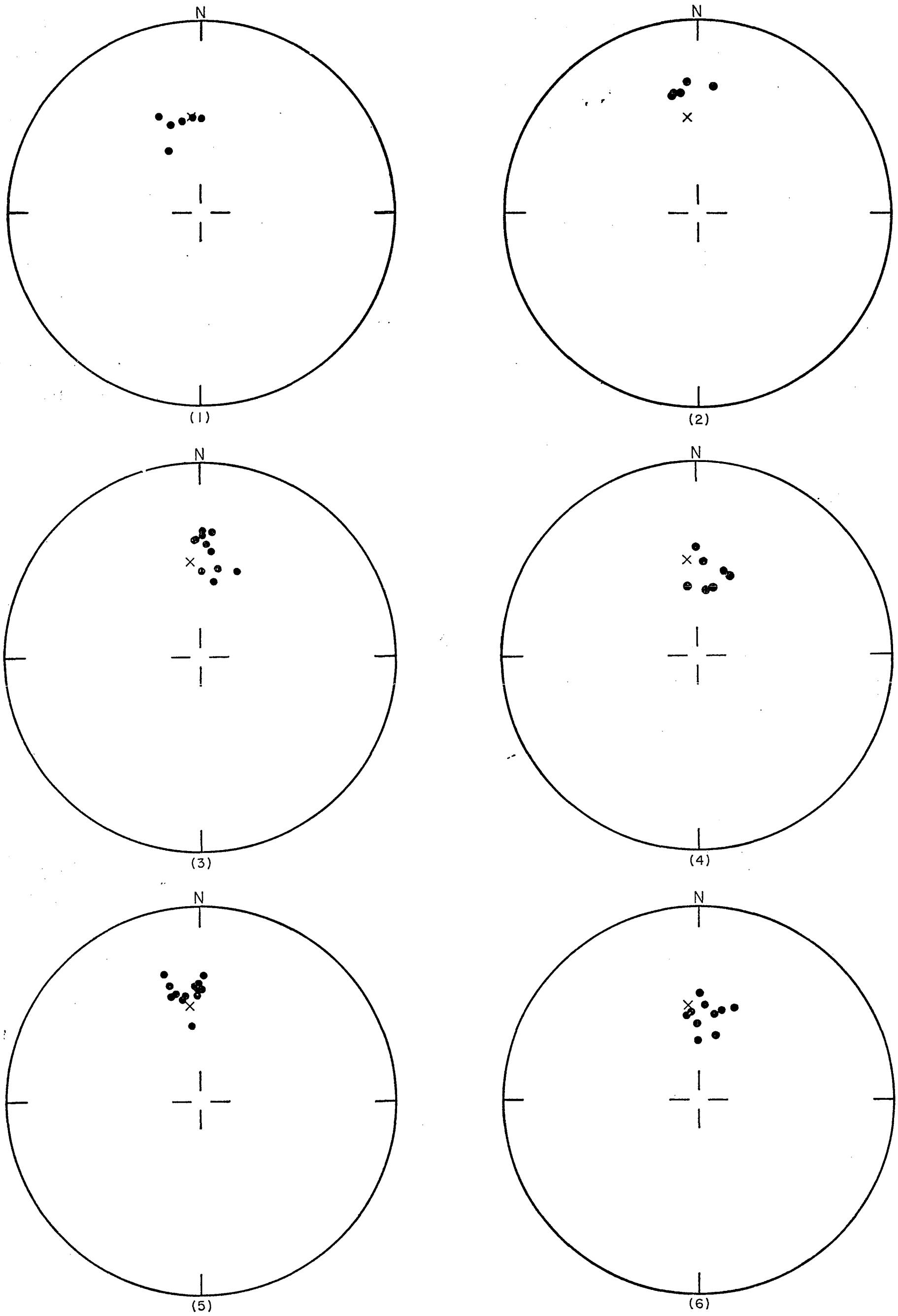
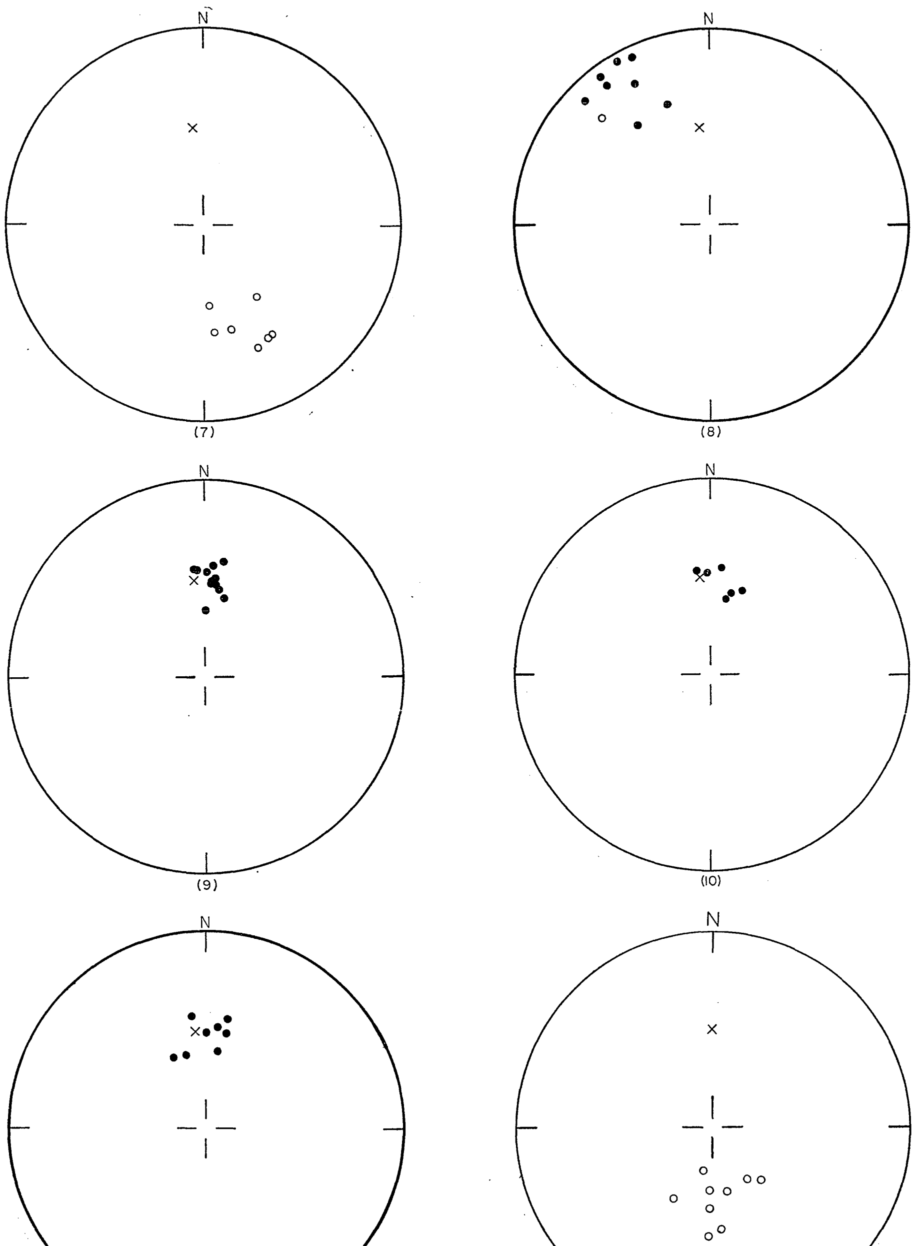


Fig. 3. Directions of natural remanent magnetization. Collecting sites are numbered as in Fig. 1 and Fig. 2. The Schmidt's equal net is used.
● : Lower hemisphere
○ : Upper hemisphere
× : Direction of the present geomagnetic field



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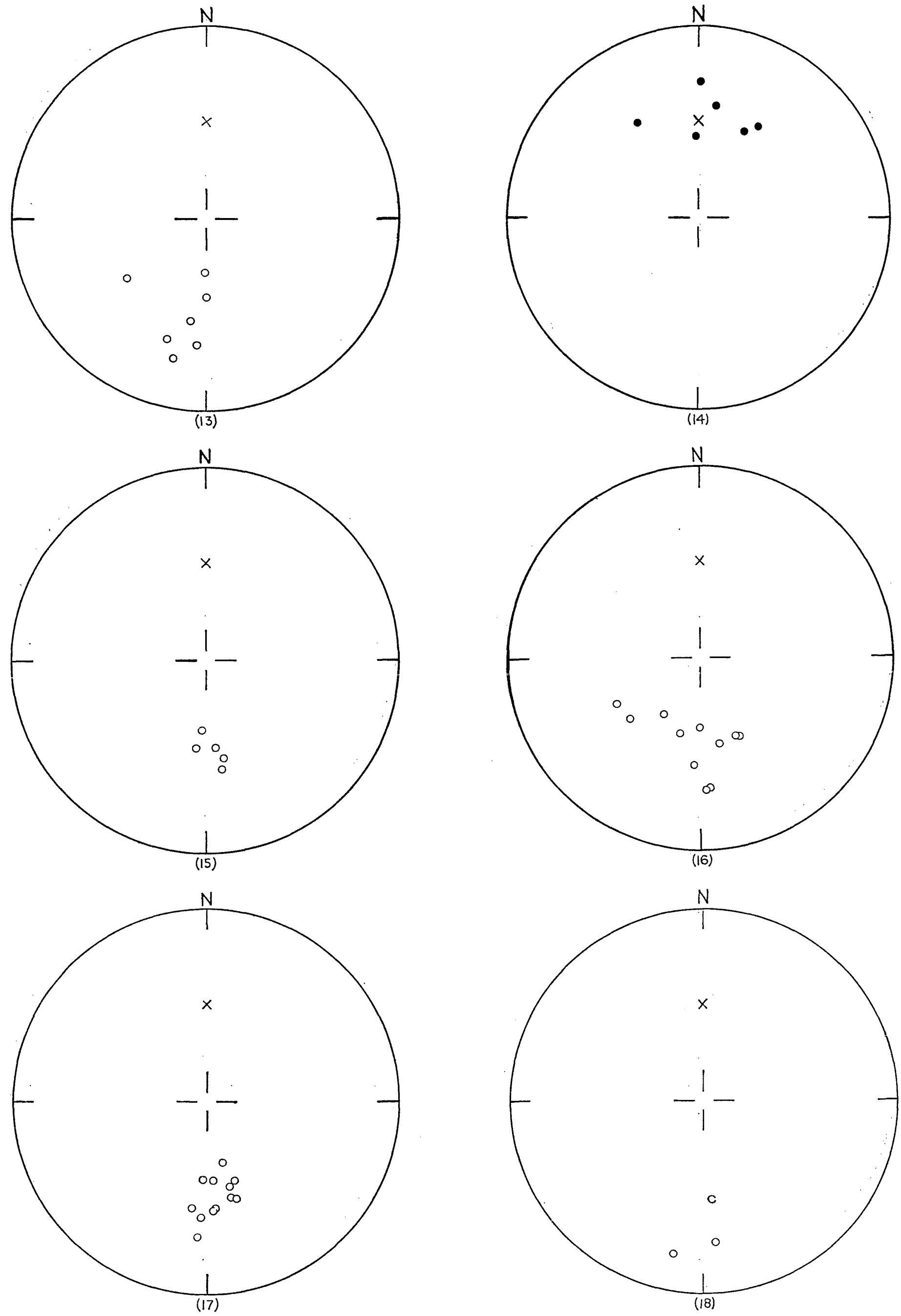

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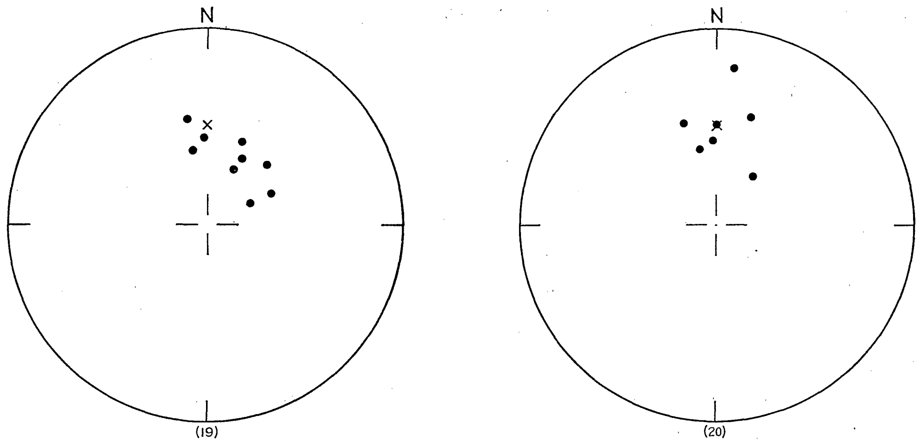

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outcrop in all lavas, because there may be the positional intermixing of polarities or the distinct boundary between the normal and the reverse magnetizations. The lava flows where we did samplings and the mean sampling sites are shown in Fig. 1 and Fig. 2. The directions of natural remanent magnetization are plotted on the Schmidt's equal net in Fig. 3. Intensity of magnetization of rocks with the normal magnetization is of the order 10^{-3} emu/g. On the contrary, it is worth while to note here that, as already reported, in the single lava flow with reversed or mixed polarities lying in the lowest part, the intensities of magnetization of both the normal and the reversed rocks are not uniform, ranging from 10^{-2} to 10^{-4} emu/g.

Stability test was carried out by laboratory heat treatment up to the maximum of 300°C for an hour in the air, samples being set approximately parallel and antiparallel to the earth's field. Consequently samples with unstable components are taken off from data in this paper.

According to the present palaeomagnetic observations, the lava flows in this region are clearly divided into two large groups by the directions of magnetization. All the samples from the lava flows in the upper part of the cape and also from the outcrops exposed on the coast cliffs situated more than 1.4 km to the southwest of the cape show the normal magnetization approximately parallel to the present geomagnetic field except those at the site (8). To the southeast of the cape, we could collect no sample farther than the site (12) as the outcrops are not exposed, and normal rocks were not observed. The single lava flow with the reversed magnetization already reported (Asami, 1954, 1956) lies in the lowest part of the cape and inclines slightly towards south, dipping below the sea level at about 1.35 km from the cape.

If we now assume that the lowest reversed lava represents a geomagnetic field reversal, contrary to our conclusion in the previous paper (Asami, 1956), the results described above may give the evidence that basaltic flows were poured out before and after the geomagnetic field had changed its direction from the reversed to the normal. The duration of transition of the geomagnetic field in this region seems to correspond to the layer of lapilli tuff sandwiched between rocks with the reversed and the normal magnetizations. The reason is that samples with the significant intermediate direction, which is to suggest a transient stage of a dipole field, were never found in every site of the lavas, although rocks with the ordinary directions of the reversed and the normal magnetizations are respectively obtained from the lowest and the upper lavas in Kawajiri District. The lava flows exposed at Ōshima Island (11) and its adjacent area were normally magnetized in all. Of these lavas, rock samples obtained at the site (8) had the directions of magnetization which deviated considerably from the north toward the west showing shallower dip than others. However, it is unknown whether the lava lying near Ōshima correspond exactly with the normally magnetized lavas of upper part of the cape. The age of extrusion of lavas in these regions is estimated to be the late Pliocene or the early Pleistocene from the stratigraphical sequence (Okamoto and Imamura, 1964). The present authors, in a previous paper (1965), reported examples of an apparently abrupt transition of polarity observed in Pleistocene lava flows in Mishima and Oki Islands.

The intermixing phenomenon of the normal and the reversed polarities was not observed in the upper lava flows which are normally magnetized. Hence, it seems that the positional intermixing in the single lava flow in question suggesting the self-reversal mechanism is a phenomenon of its own which occurred, under a certain circumstance, only in the lowest lava of the cape.

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