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PALEOMAGNETIC PROPERTIES ON THE ALKALINE DOLERITE  
COMPLEX IN THE NEMURO PENINSULA,  
HOKKAIDO, NORTHEAST JAPAN

*by*

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(with 3 figures)

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*Abstract*

A paleomagnetic study was made on 237 specimens from 32 sites on Late Cretaceous alkaline rocks forming single intrusive body in the Nemuro Peninsula, Hokkaido, Northeast Japan. The results suggest that the transitional geomagnetic polarity change did occur during cooling of these rocks.

Introduction

Alkaline rock complexes which occur in various stratigraphic horizons in the Upper Cretaceous deposits developed in the Nemuro Peninsula, Hokkaido, Northeast Japan were the subject of many petrographic works (Suzuki 1938, 1954, Yagi 1948, 1949, 1958, 1959, 1968). Geology and stratigraphy of the Nemuro Peninsula were also described by many authors (Sasa 1934, Mitani et al. 1958, Hasegawa and Mitani 1959, Fujiwara and Mitani 1959).

The igneous activities of these alkaline rocks may be divided at least into two stages from observable occurrence of these rocks. K-A age on these rocks proved the presence of two different igneous activities: 88 and 84 m.y. respectively (Ueda and Aoki 1968). We once reported the results of paleomagnetic analysis which also supported these conclusions in relation to the ages of these rocks, because of presence of rocks showing both normal and reversed polarities (Fujiwara and Nagase 1965, Fujiwara and Ohtake 1975). However, as described in our former paper (Fujiwara and Ohtake 1975), the intrusions of some alkaline rock complexes are also subdivided into two phases in terms of the presence of two different polarities in the alkaline rock complexes.

In this note, a result of additional paleomagnetic analysis of some alkaline rock complexes in the Nemuro Peninsula will be presented and newly found transitional geomagnetic polarity change within single rock body will be also

briefly discussed.

### Geologic setting of sampled rocks

The Late Cretaceous deposits in the Nemuro Peninsula have been called the Nemuro Group and subdivided into five formations. They are the Notsukamappu, Nemuro, Choboshi, Ochiishi and Ururi Formations in ascending order (Sasa 1934). The Notsukamappu Formation, among them, the lowermost member in this peninsula, is mainly composed of volcanic breccias with intercalation of volcanic conglomerate and thin tuffaceous shales. The age of this formation is generally believed to range from Coniacian to Campanian from fossil evidences. The Nemuro Formation which is mainly consisting in sandstone and mudstone in alternation and conformably covers the Notsukamappu Formation. Both Notsukamappu and Nemuro Formation include various types of alkaline rock intrusives as sheets, sills, dykes and sometimes lava flows in different stratigraphic horizons.

The alkaline rocks now in concern, can be classified into following three types from their petrographic nature and occurrence: (1) differentiated monzonite or piclitic dolerite complex, (2) undifferentiated trachy-dolerite and (3) trachy-dolerite with pillow structure. Three thick complexes of differentiated monzonite or piclitic dolerite are outcropping around the Cape Nosappu and Nemuro City. Among them, the first mentioned complex is actually developed as independent three rock units, and they were named Nosappu complex, Honioi complex and Poromoshiri complex respectively at each locality (Fujiwara and Ohtake 1975). For the present paleomagnetic analysis specimens were thoroughly sampled from the Nosappu complex (intrusive body) above mentioned. 237 samples were collected in all from 32 sites, covering from basal part to the topmost part of the body, with desiring to represent nearly entire part of this single intrusive body.

### Paleomagnetic properties of the Nosappu complex

At Nosappu Cape, a thick sill of differentiated monzonite-piclitic dolerite complex intrudes concordantly into the Nemuro Formation, gently dipping (about 20°) to southeast.

Direction of NRMs are plotted on Fig. 1. Site numbers are correspond to those of our former paper (Fujiwara and Ohtake 1975). Samples of sites 26–28 were collected from the part of porphyritic dolerite, the marginal facies of the Nosappu complex, while samples of sites 47–57 were collected from monzonite part, namely, the inner facies of this dolerite complex. Samples of

sites 29–46 were collected from the part representing piclitic dolerites facies which situate intermediate part between porphyritic dolerite and monzonite. Therefore, in terms of cooling history of this intrusive body, porphyritic dolerite may have been first magnetized, then, piclitic dolerite may have followed it and monzonite became finally magnetized.

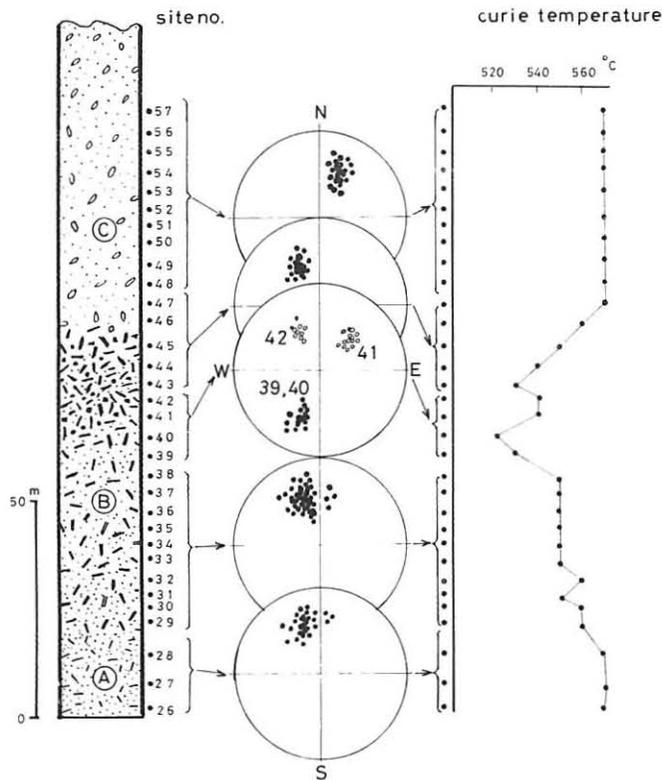


Fig. 1 Paleomagnetic directions and thermomagnetic properties of the Nosappu complex. Numbers on the right side of columnar section indicate the sampling sites. A: porphyritic dolerite, B: piclitic dolerite, C: monzonite

NRMs of sites 26–47 have positive inclinations with NW declinations except for sites 39, 40, 41 and 42. While sites 48–57 have also positive inclinations, however, their declinations differ about  $15^\circ$  toward east in comparison with those of sites 26–47. Inclinations of sites 39 and 40 are also positive but their declinations widely differ in reaching about  $180^\circ$  from another sites. Both inclinations of sites 41 and 42 are negative. This results suggest the presence of two different polarities in the same and single rock complex.

The presence of two different paleomagnetic polarities in this rock complex may be only plausibly explainable under the assumption that the geomagnetic field had been normal when the rock complex first intruded, and then the field should have been reversed during the time when the interior of the intrusive body became magnetized in accordance to extension of cooling part. Supposed pole position path is shown in Fig. 2 as inferred from the present paleomagnetic results of the Nosappu complex.

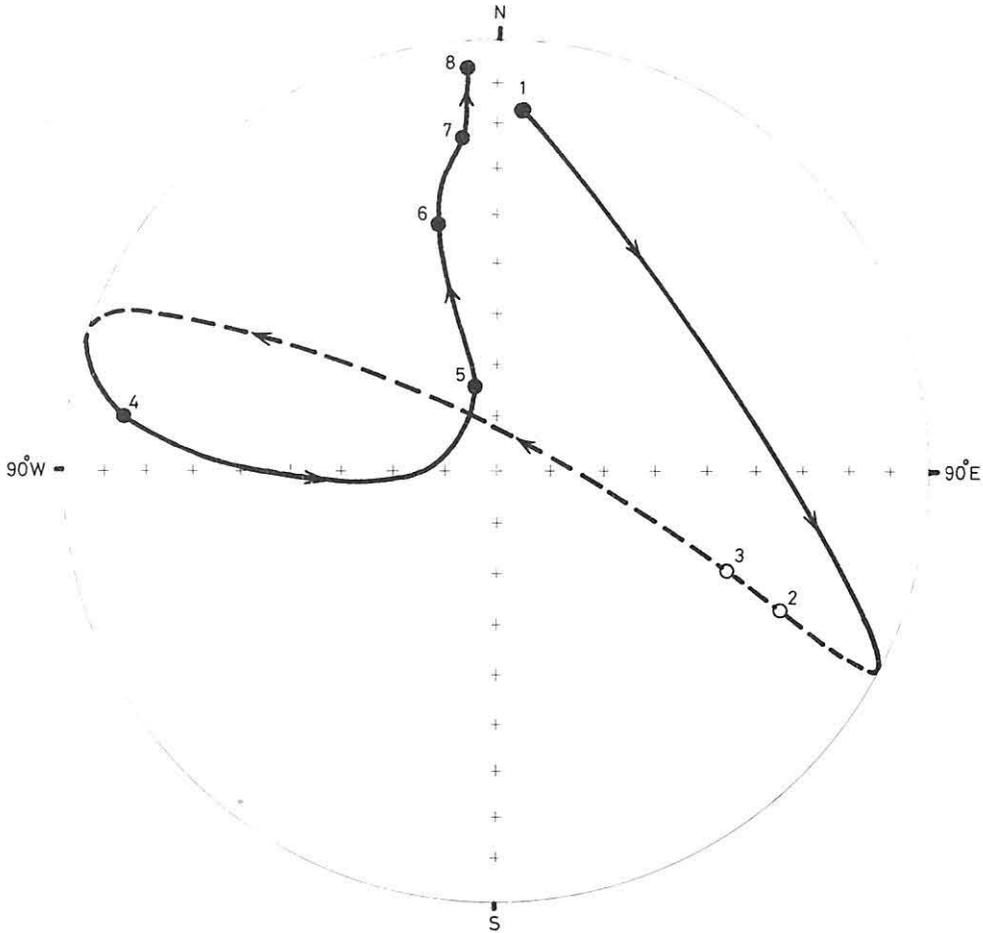


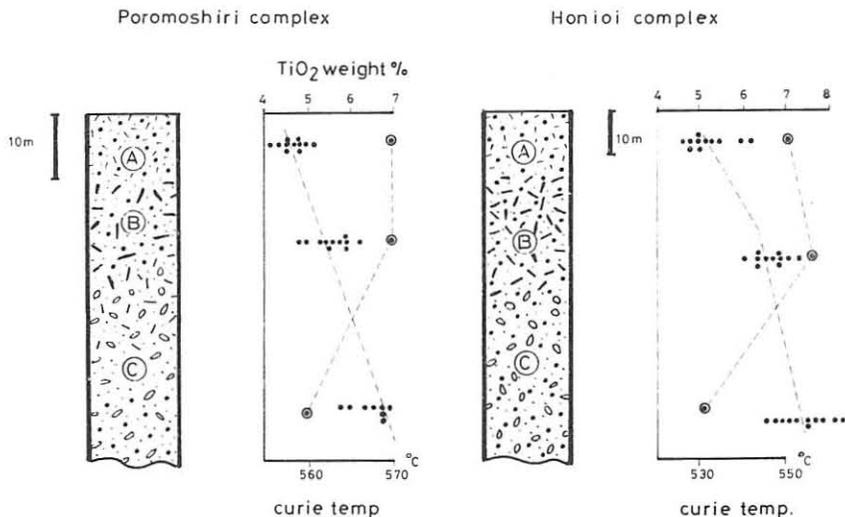
Fig. 2 Supposed pole position path as inferred from paleomagnetic analysis of the Nosappu complex. 1: pole position calculated from mean direction of sites 26 – 38, 2: site 39, 3: site 40, 4: site 41, 5: site 42, 6: site 44, 7: site 45, 8: mean from sites 46 – 57.

#### Thermomagnetic properties of the Nosappu complex

Thermomagnetic analysis was done on each specimen collected from each

site to ascertain the Curie temperature of ferromagnetic minerals by thermomagnetic balance. The results are also plotted in Fig. 1. The Curie temperature falls between  $520^{\circ}$  and  $570^{\circ}\text{C}$ . These are unexpectedly high values for such basic rocks ( $\text{SiO}_2$  46–52% after Yagi, 1968). As shown in Fig. 1, the Curie temperature takes the lowest value at the piclitic dolerite part which is recognized as the most cumulated zone of olivine and augite crystals.

The Curie temperature of Fe-Ti-oxide minerals is initially controlled by their Ti portions (Akimoto et al. 1961). The present results may suggest that the Ti-contents of the ferromagnetic minerals gradually increase toward the inside of the intrusive body and take maximum at the most basic part, then gradually decrease toward the monzonitic part. Ti-contents analysis of ferromagnetic minerals by X-ray microprobe analyzer of another two rock complexes, the Poromoshiri and Honioi complex, also shows the same tendency that Ti-contents of ferromagnetic minerals gradually increase toward the inside of the rock body (Fig. 3, Ohtake, unpublished data).



**Fig. 3** Variation of Ti-contents and Curie temperatures of the Poromoshiri complex and the Honioi complex. Solid points indicate Ti-contents and double circles mean Curie temperatures.

A: porphyritic dolerite, B: trachy dolerite, C: monzonite.

### Conclusions

1) Presence of two different polarities in the Nosappu complex may suggest that the geomagnetic field had reversed during cooling. K-A age determination suggests the age of this normal to reverse transition might be about 84 m.y.

2) The Curie temperatures of intrusive rock complexes in the Nemuro Peninsula fall between 520° and 570°C. These are unexpectedly high values for such basic intrusives.

3) Variations of Ti-contents of ferromagnetic minerals suggested by thermomagnetic analysis and also by XMA analysis show well agreements with orders of differentiation of intrusive body.

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