

# Discovery of Molluscan Fossils and a Tephra Layer from the Late Pleistocene Kiyama Formation in West of Fukui Prefecture, Central Japan

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## 福井県西部の後期更新世気山層からの貝化石及びテフラの発見

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**要旨** 福井県西部の美浜町気山の後期更新世気山層から海棲貝化石と火山灰層（美浜テフラ）が発見された。化石は内湾の砂泥底に棲む3種からなり、本層が内湾の潮間帯付近の浅い環境下で堆積したことを示唆する。美浜テフラは、北陸地方にも広く分布する三瓶木次テフラよりやや下位の大山火山に由来するものと推定される。

### Introduction

In Mikata and Mihama-cho, west of Fukui Prefecture, the Early to Late Pleistocene sediments distribute narrowly along the foot of mountains, and they make topographically hilly lands and three table-planes; the high, middle and low one. Stratigraphical researches of their sediments are quite rare; Miura and Wakasa Quaternary Research Group (1969).

According to Miura and WQRG (1969), the Pleistocene sediments are subdivided into four units; Notono, Mikata, Kiyama and terrace gravel formations in ascending order, and supposed to be deposited in lake or river excepting the Kiyama Formation. The Kiyama Formation forming the middle table-plane which is correlated with Hira-doko phase of Noto Peninsula, Ishikawa Prefecture (Late Pleistocene) is subdivided into two members; the lower mud and the upper gravel, and is supposed to be marine sediments. However, any paleontological evidence of marine was not offered from there. As some marine molluscan fossils and a tephra layer (Mihama tephra) were

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recently discovered from the Kiyama Formation at Mihama-cho, their outlines are described here.

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### Fossil locality and geologic outline

Some molluscan fossils with a cone of *Pinus* sp. are firstly discovered at Kiyama, Mihama-cho near the border of Mikata-cho, Mikata-gun, Fukui Prefecture, from a massive and gray silt bearing fossil burrows of a upper part of the middle mud Member of the Kiyama Formation (Fig.1). The exposure of beds in this area is generally very rare, but some out-crops are exposed around the location of fossils. The stratigraphic horizon of beds yielding fossils can be indicated as Fig.2. In the lowest, the Mikata gravel Formation graded normally is inclined slightly to the northeast part at Loc.2 at Kiyama (Fig.3).

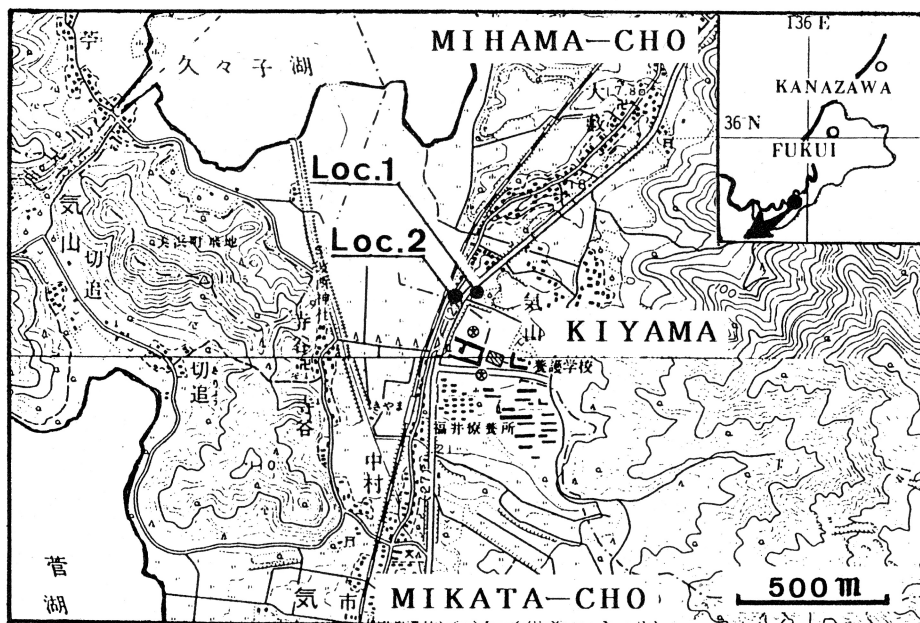


Fig.1 Location of molluscan fossils and the Mihama tephra.  
Topographic map "Hayase" and "Mikata" 1:25,000 in scale from the Geographical Survey Institute.  
Loc.1 : molluscan fossils      Loc.2 : Mihama tephra.

The observed Mikata gravel Formation, a thickness of about 5 m, is composed of granule to boulder gravel of granite, sandstone, shale, hornfelse and chert, and they are mostly subangular to subrounded ones in shape. The lower mud Member of the Kiyama Formation having the bottom plane rising to the southeast has a thickness of about 5~6 m and overlies unconformably the Mikata gravel Formation. Thin laminations are developed in the lower horizon of the Lower mud Member, and a tephra layer lies in the bottom.

### Molluscan fossils and sedimentary environment

As a part of the silt yielding fossils are very soft in keeping water and easily deformed and teared, it has difficulty in collecting complete specimens. Fossils without all shells are very rare and could be classified into three species;

*Theora* sp.

*Macoma* sp.

*Barnea* (*Umitakea*) *dilatata* (Souleyet)

Among them, *B.(U.) dilatata*, one of the boring molluscus, is most dominant and about six specimens, but the former two species are respectively only one and small size.

According to Habe (1977) and Okada *et al.*, (1965), these species live generally in muddy or sandy bottom of shallow marine such as intertidal zone to 20~90 m in depth from South Hokkaido to South East Asia.

*B.(U.) dilatata* is especially common in shallow Ariake bay and Seto inland sea. The facts of the distribution of molluscas and the stratigraphic sequence around the fossil locality settle clearly that the Lower mud Member was deposited in very shallow sea; perhaps in intertidal to subtidal zone at comparatively deep part of Paleo-Kiyama bay. From the plant fossils the paleoclimate of the Kiyama Formation are assumed to be in temperate during the Riss-Würm Inter-glacial time (Miura *et al.*, 1969; Hokuriku Quaternary Research Group, 1969).

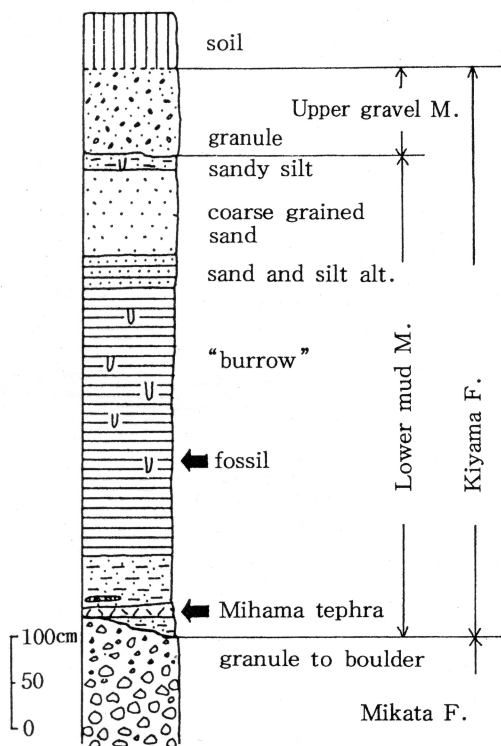


Fig. 2 Schematic columnar section bearing fossils and the Mihama tephra.

### Outline of the Mihama tephra

A tephra layer (Mihama tephra) with partially normal grading was firstly found near the bottom of the Kiyama Formation, and lies crossing unconformably on the Mikata Formation (Fig.3). It has maximum thickness of 20 cm and shows yellow or yellowish brown color. According to Dr.F.Arai (letter), the Mihama tephra without volcanic glass consists in composition of poor quartz crystals and less heavy minerals; abundant green hornblende crystals with refractive index of  $n_2=1.668\sim1.675$  more than magnetite.

In the Hokuriku district, Sambe Kisugi tephra having a age between 80 and 90 Ka in tephrochronological identification is only described as a marker tephra from the Pleistocene formations which are correlated with the Kiyama Formation (Toyokura *et al.*, 1991). They (1991) decided the Hamaji volcanic ash having  $0.12\pm0.02$  Ma by fission-track age in Fukui Prefecture (Nakajima and Miura, 1983) as the same of Sambe Kisugi tephra. The Mihama tephra is unfortunately distinguished from the Sambe Kisugi tephra in mineral composition, and possibly a older tephra than the Sambe Kisugi tephra from the Daisen volcano in the San-in district.

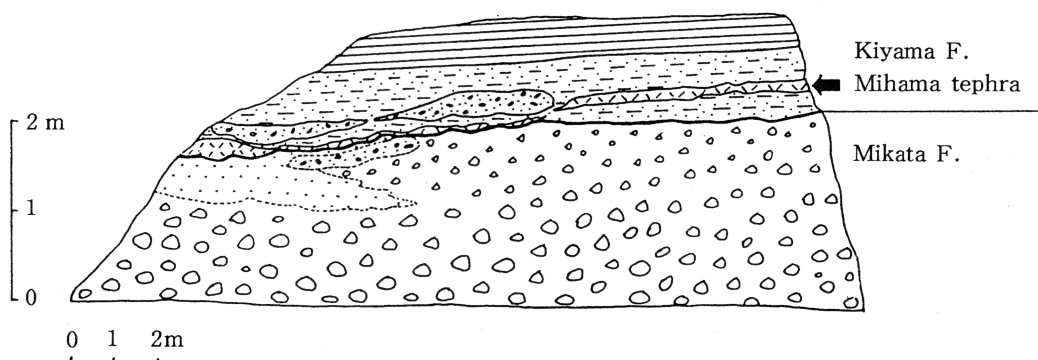


Fig.3 Stratigraphic section of exposure of beds at Loc.2.  
Legends are same as Fig.1.

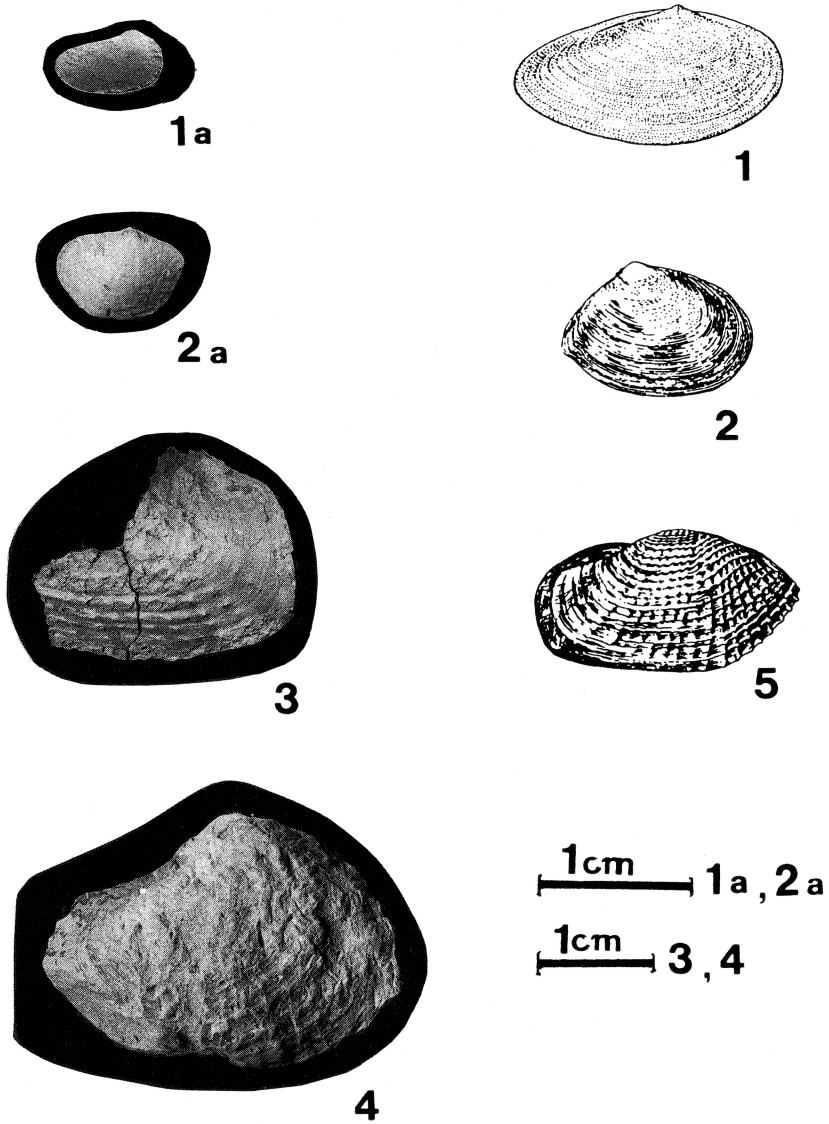


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\* in Japanese      \*\* in Japanese with English abstract

Plate 1



Fossils from the Late Pleistocene Kiyama Formation.

1 a : *Theora* sp. coll. no. K89802

1 b : Recent *Theora lata* (Hinds)

2 a : *Macoma* sp. coll. no. K89804

2 b : Recent *Macoma incongrua* (V. Martens)

3-4 : *Barnea (Unitakea) dilatata* (Souleyet)

3 : coll. no. K90603

4 : coll. no. K89801

5 : Recent *B. (U.) dilatata* (Souleyet)

1a, 2a and 5 are cited for comparison from Okada *et al.* (1965).