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# Preliminary Results from the R. V. *Tansei-maru* Cruise KT99-14 in the Central and Northeastern Marginal Parts of the Japan Sea (Part III: Depositional Facies of P-11 Core from the Yamato Bank)

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**Abstract**

The core KT99-14 P-11 recovered from the eastern part of the Yamato Bank in the central part of the Japan Sea at a water depth of 888m is composed mainly of bioturbated mud with five intercalations of volcanic ash layer. No marked erosional surfaces were recognisable in the core. The uppermost ash layer at 110 to 115 cm below sea-floor can be correlated lithologically with Aira-Tn ash (AT ash).

**Key Words**: depositional facies, deep-sea core, Japan Sea, Yamato Bank, AT ash, R/V *Tansei-maru*

## Ⅰ. Introduction

Four piston cored sediments, KT99-14 P-8, -9, -10, and -11, were recovered from the flat top, the upper part of the eastern slope and the lower part of the southern slope of the East Bank of the Yamato Bank in the central Japan Sea (Fig. 1) during the R. V. *Tansei-maru* Cruise KT99-14 (Tsukawaki *et al*., 2001) from the 13th to 21st of September, 1999 and lithological facies of the core P-9 was already reported (Tsukawaki, 2003). This short article purposes to describe lithological facies and volume magnetic susceptibility of the core KT99-14 P-11 recovered from the southern slope of the bank (Latitude 39°26.9’N, Longitude 135°51.5’E, 888m deep) to provide its basic information for palaeoceanographic studies in the central part of the Japan Sea.

## Ⅱ. Topography of Sampling Site

The Yamato Bank, 230 km long and 55 km wide with an E-W trend, is situated in the southern part of the Yamato Rise which is the largest and most conspicuous topographic high in the Japan Sea. The shallowest part, 236 m deep, is situated in the central part of the bank (Iwabuchi, 1968). Several topographical highs with flat tops and depressions are recognised on the bank. The bank is divided into the West, Central and East Banks roughly by the longitudinal lines of 134°40’E and 135o35’E, respectively (Iwabuchi, 1968). The core KT99-14 P-11 was obtained from the upper part of a broad valley in the southern slope of the East Bank at a water depth of 888 m (Fig. 1).

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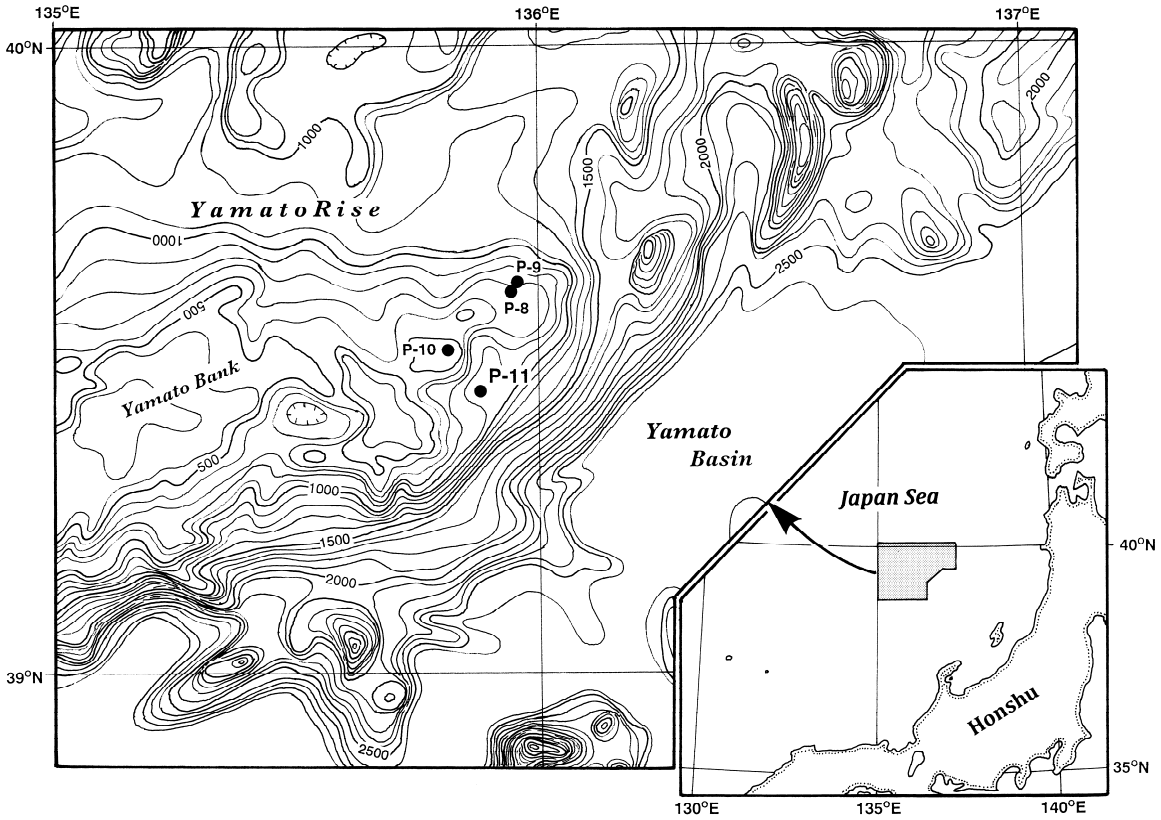


Fig. 1 Submarine topography and sampling site of the core KT99-14 P-11 and other cores in the Yamato Bank, central Japan Sea during R/V *Tansei-maru* cruise KT99-14 (Hydrographic Department, M. S. A., Japan, 1979).

## Ⅲ. Sampling Methods and Analytical Procedures

A six-metres-long stainless-steel pipe piston core sampler with a 600 kg weight and a 70-cm-long Nasu type pilot core sampler were utilised to obtain cored sediments. Volume magnetic susceptibility were measured first at 1 cm intervals by using a Barrington pass through type magnetic susceptibility system model MS-2. Then, each sediment that had been kept at about 4°C since its recovery was cut vertically into two halves by a nylon fishing line. One of these was processed for sedimentological investigations at a laboratory of the General Education Hall, Kanazawa University, and the other was processed for palaeoceanographic investigations in Tohoku University.

The cutting surface of the former was shaved first by a stainless-steel spatula, and then brushed well by spraying a water atomiser for detailed visual observations. After visual observations and core descriptions were made, an 8 mm thick, 7 cm wide and 20 cm long sliced sediment was cased in a plastic box from the cutting surface for soft X-ray radiograph observation through the core.

For X-raying, the boxed samples were placed on Fuji industrial X-ray film type IX-100. The source-to-sample distance on the X-ray unit, SOFTEX type M-60, was 70 cm. Voltage, amperage and exposure time were hold constant at 50 kVp, 4 mA and 60 - 90 seconds, respectively. The exposed X-ray films were immediately processed by the EK type D-19 film developer for 5 minutes. Microscopic observations using a number of smear slides for fine-grained sediments and thin sections for coarse-grained sediments conduced to the textural and compositional description of a certain number of horizons for cored sediments.

## Ⅳ. Depositional Facies of KT05-4 P-11 Core

Figure 2 shows the columnar diagram of the core KT99-14 P-11 based on visual observation under normal light. The core, 475 cm long, is composed mostly of bioturbated mud with various grades of biogenic disturbance. Five volcanic ash layers intercalated at 110 to 115 cm, 182 to 183 cm, 285 to 290 cm, 316 to 320 cm, and 454 to 454 cm below sea-floor. Selected soft X-ray radiographs are shown in Plates 1 and 2.

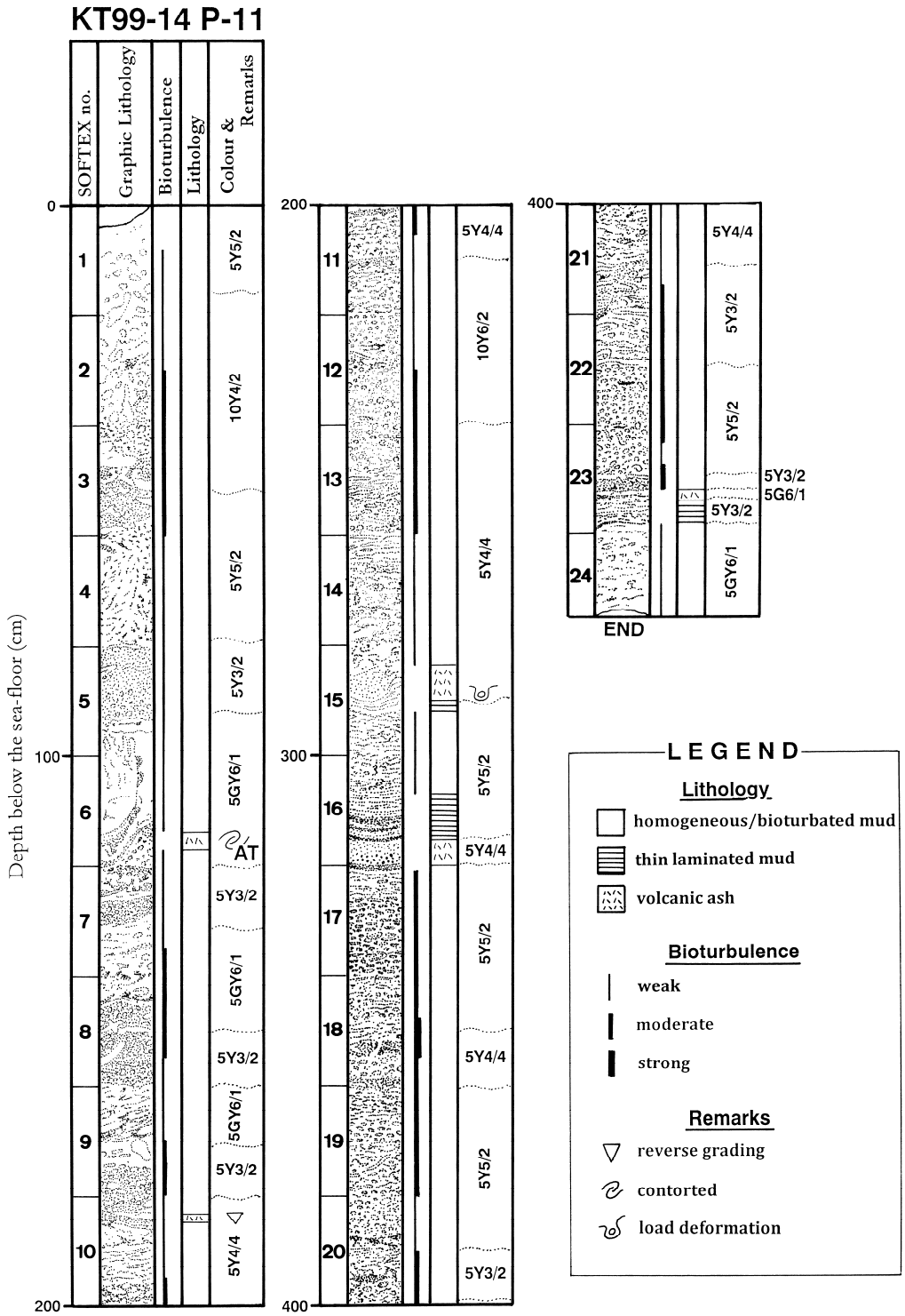


Fig. 2 Graphic descriptions of the core KT99-14 P-11.

The uppermost 15 cm of the core is composed of less bioturbated light olive grey soft mud. Planktonic foraminiferal tests are frequently recognisable in the mud. Below the soft mud, rather compact greyish olive mud, about 40 cm thick (about 15 to 55 cm below sea-floor), in which large pale burrows are frequently developed (Plate 1, fig. 1) overlies an about 25 cm thick light olive grey mud (55 to 80 cm ditto) in which tiny burrows are markedly developed, followed by an about 15 cm thick less bioturbated olive grey mud (80 to 95 cm ditto, Plate1, fig. 2), then an about 15 cm thick weakly bioturbated greenish grey compact mud (95 to 110 cm ditto). Each boundary between these muds is transitional.

An about five centimetres thick light greenish grey contorted fine- to medium-grained volcanic ash layer is intercalated at about 110 to 115 cm below sea-floor. An about 15 cm thick olive grey mud (115 to 130 cm ditto, Plate 1, fig. 3 upper) underlies the ash layer with a sharp but undulated boundary. Biogenic disturbance is weakly developed in the mud. Below the mud, an about 15 cm thick moderately bioturbated greenish grey compact mud (130 to 145 cm ditto, Plate 1, fig. 3 lower) overlies an about 15 cm thick olive grey bioturbated mud (145 to 160 cm ditto) in which small grey burrows are developed, followed by an about 8 cm thick less bioturbated greenish grey mud (160 to 168 cm ditto), then bioturbated olive grey mud, about 14 cm thick (168 to 182 cm ditto) in which planktonic foraminiferal tests are dominant. Each boundary between these mud layers is transitional.

A thin yellowish grey very fine-grained volcanic ash layer, about one centimetre thick (Plate 1, fig. 4 upper), is intercalated at 182 to 183 cm below sea-floor. A weak reverse grading is observed within the layer. An about 27 cm thick less bioturbated moderate olive brown mud (183 to 210 cm ditto, Plate1, fig. 4 lower) underlies the ash layer. Below the mud, an about 30 cm thick pale olive compact mud (210 to 240 cm ditto) in which tiny borrows are developed overlies an about 45 cm thick bioturbated mud (240 to 285 cm ditto). Strong biogenic disturbance is developed in the upper half of the mud (Plate 2, fig. 1)

An about five centimetres thick light olive grey fine-grained volcanic ash layer is intercalated at 285 to 290 cm below sea-floor. The boundary between the ash layer and the underlain thinly laminated light olive grey mud, about two centimetres thick, is sharp but warped downwards. An about 13 cm thick light olive grey compact less bioturbated mud (292 to 305 cm ditto) underlies the thinly laminated mud followed by an about 11 cm thick thinly laminated mud (305 to 316 cm ditto) in which no biogenic disturbance is recognisable.

A moderate olive brown volcanic ash layer, about four centimetres thick, composed mainly of medium- to coarse-grained grey pumice underlies the above-stated thin laminated mud layer with a transitional boundary, followed by an about 30 cm thick bioturbated light olive grey mud (320 to 350 cm ditto, Plate 2, fig. 2 upper), then an about 10 cm thick strongly bioturbated moderate olive brown mud (350 to 360 cm ditto, Plate 2, fig. 2 lower), light olive grey bioturbated mud, about 30 cm thick (360 to 390 cm ditto), olive grey strongly bioturbated mud, about 10 cm thick (390 to 400 cm ditto), less bioturbated moderate olive brown mud, about 10 cm thick (400 to 410 cm ditto, Plate 2, fig.3 upper), moderately bioturbated olive grey mud, about 20 cm thick (410 to 430 cm ditto, Plate2, fig. 3 lower), light olive grey bioturbated mud, about 20 cm thick (430 to 450 cm ditto, Plate 2, fig. 4 upper), and thin olive grey strongly bioturbated mud, about 4 cm thick (450 to 454 cm ditto, Plate 2, fig. 4 middle). Each boundary between these mud layers is transitional.

An about one centimetre thick greyish green volcanic ash layer composed of very fine-grained volcanic glass shards is recognised at about 454 to 455 cm below sea-floor (Plate 2, fig. 4 middle). Below the ash layer, thinly laminated olive grey mud (454 to 457 cm ditto), about three centimetres thick, overlies an about 15 cm thick less bioturbated greenish grey compact mud (457 to 475 cm ditto, Plate 2, fig. 4 lower).

## Ⅴ. Volume Magnetic Susceptibility

Figure 3 shows vertical fluctuations in volume magnetic susceptibility (VMS) through the core

KT99-14 P-11. The VMS of the upper 190 cm is rather low around 5 x 10-6 c.g.s. with a broad trough around 80 cm below sea-floor, and a sharp trough around 180 cm. A sharp peak, around 38 x $10^{-6}$ c.g.s., is recognised around 200 cm which corresponds to less the bioturbated moderate olive brown mud layer. The VMS of the lower part of the core is also low around 7 x $10^{-6}$ c.g.s. with broad peaks around 290 and 370 cm below sea-floor.

## Ⅵ. Discussion – Intercalated Volcanic Ash Layers

Five volcanic ash layers are recognised in the core KT99-14 P-11 at 110 to 115 cm, 182 to 183 cm, 285 to 290 cm, 316 to 320 cm and 454 to 455 cm below sea-floor.

The uppermost ash layer, about 5 cm thick, consists mainly of clear and colourless bubble wall type fine- to medium-grained volcanic glass shards without any phenocrysts. These lithological features and the depth of the ash layer below the sea-floor in the central Japan Sea suggest that this volcanic ash layer can be correlative with the Aira-Tn (AT) tephra (Machida and Arai, 1976) discovered in many cored sediments from the central to south Japan Sea (Machida and Arai, 1992).

On the other hand, the lowermost volcanic ash layer is composed of medium- to coarse-grained pumice with a certain amount of phenocrysts such as orthopyroxene and clinopyroxene, and other three volcanic ash layers consist mainly of fine-grained pumice type volcanic glass shards with a little amount of phenocrysts. Many volcanic ash layers having similar lithology are known from the central part of the Japan Sea (Machida and Arai, 1996). Since it is not attributable to distinguish them under the microscopic observations, the correlations of these volcanic ash layers should be left pending.

## Ⅶ. Concluding Remarks

The depositional facies of the core KT99-14 P-11 obtained from the southern slope of the Yamato Bank, central Japan Sea is summarised as follows:

1. The cored sediment, 475 cm long, is composed

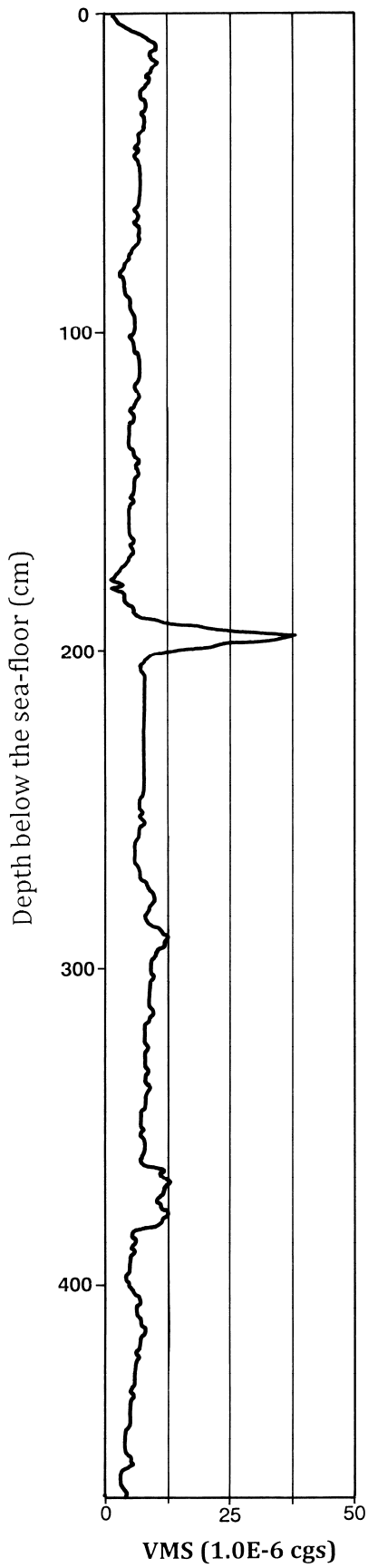


Fig. 3 Volume magnetic susceptibility of the core KT99-14 P-11.

mainly of bioturbated mud with several intercalations of thin laminated mud layers. No marked erosional surfaces are recognisable through the core.

2. Five volcanic ash layers are intercalated in the core. The uppermost ash layer, 110 to 115 cm below sea-floor, can be correlative with the Aira-Tn tephra but correlations of other four ash layers are left pending.

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## Explanation of Plate 1

Selected soft X-ray radiographs of the upper half of the core KT99-14 P-11.

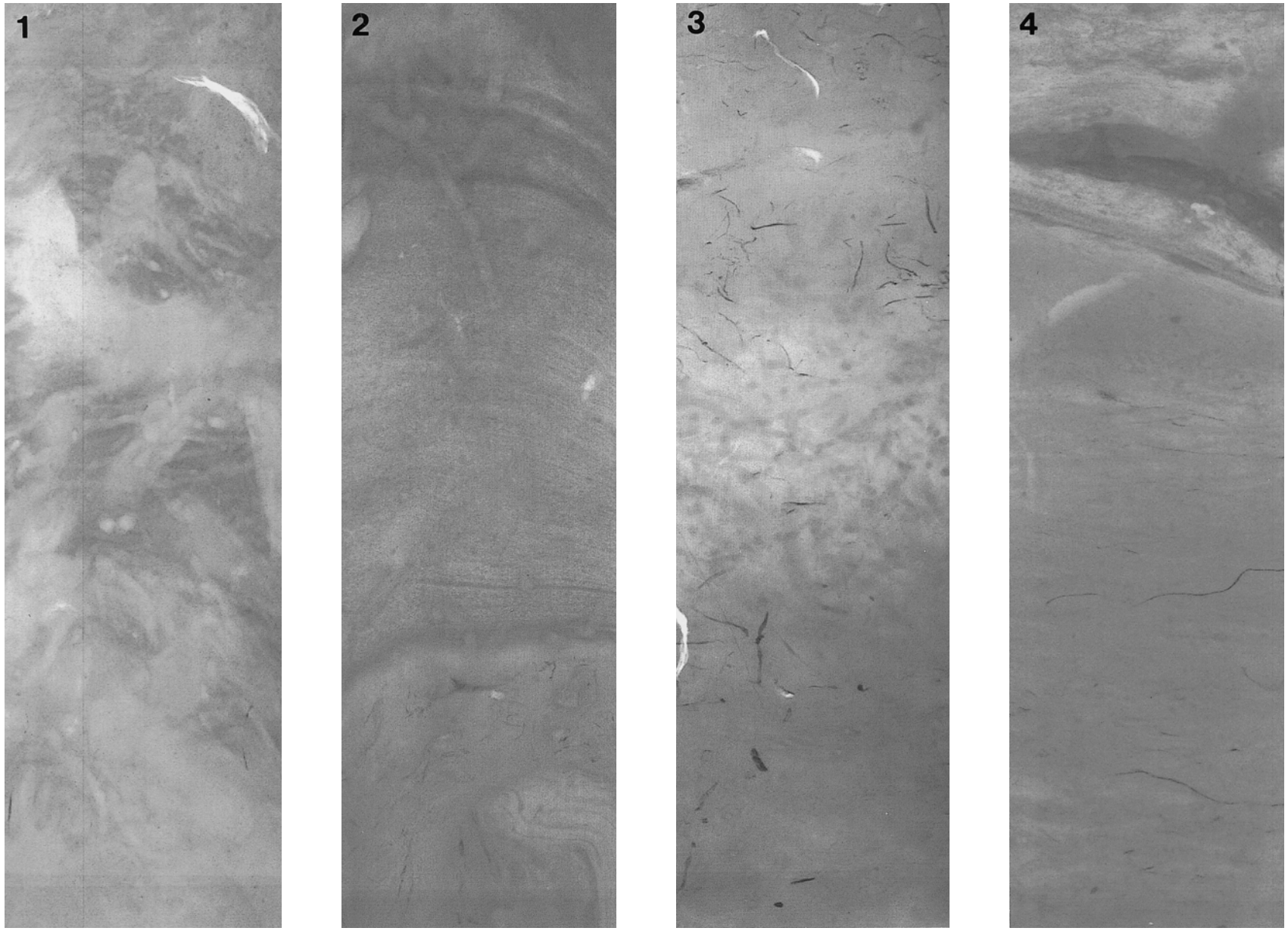
Fig. 1 Compact greyish olive mud with large pale burrows at 41 to 58 cm below sea-floor.

Fig. 2 Upper less bioturbated olive grey mud (12 cm thick) and lower weakly bioturbated greenish grey compact mud at 81 to 98 cm below sea-floor. Thin laminations are recognisable in the upper mud.

Fig. 3 Upper less bioturbated olive grey mud (12 cm thick) and lower moderately bioturbated greenish grey compact mud at 122 to 139 cm below sea-floor.

Fig. 4 Upper bioturbated olive grey mud (3 cm thick) and lower less bioturbated moderate olive brown mud at 181 to 199 cm below sea-floor. A thin yellowish grey very fine-grained volcanic ash layer, about one centimetre thick, is intercalated between them.

**Plate 1**



## Explanation of Plate 2

Selected soft X-ray radiographs of the lower half of the core KT99-14 P-11.

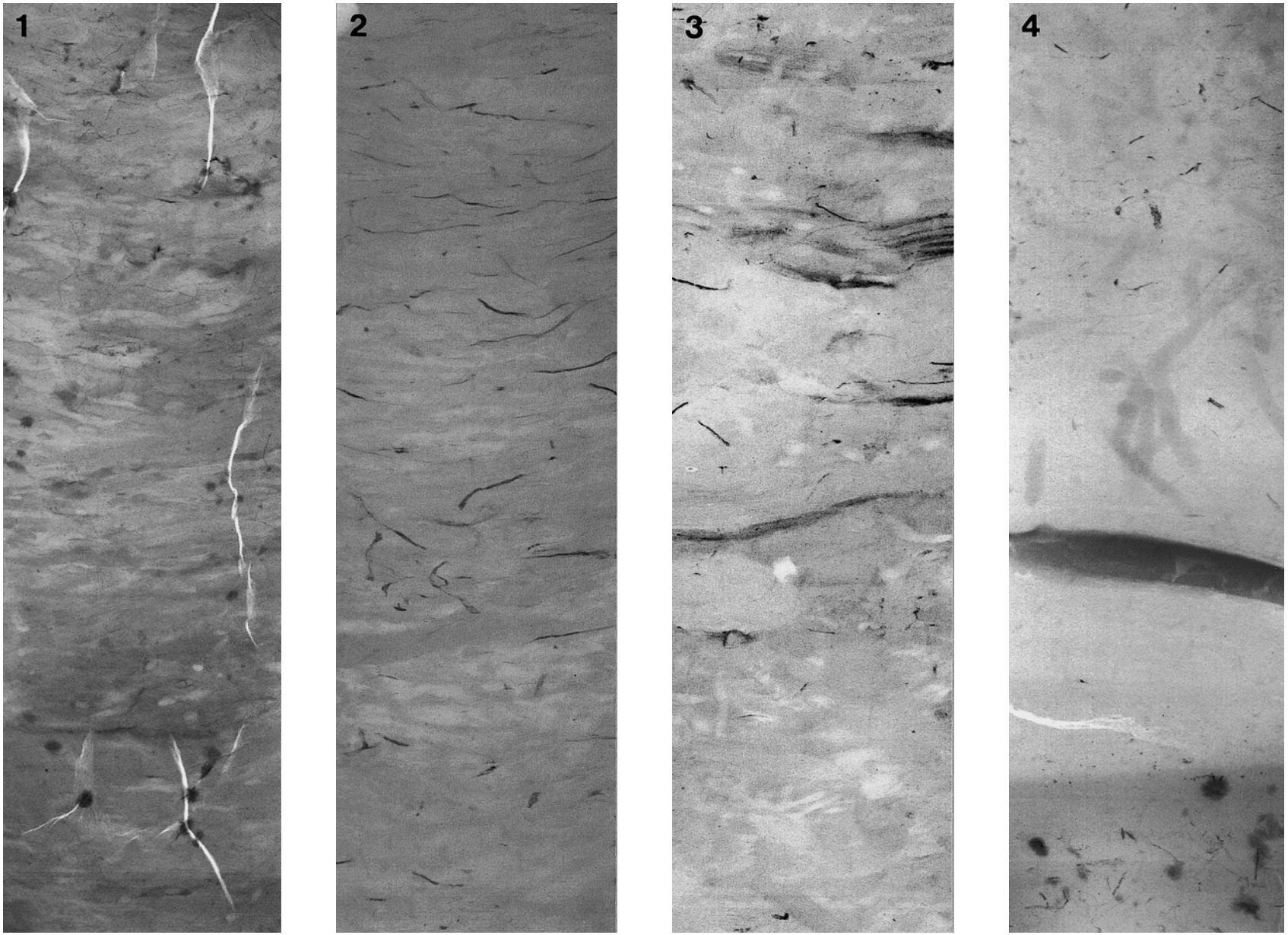
Fig. 1 Pale olive compact mud at 222 to 239 cm below sea-floor. Small borrows are developed in the mud.

Fig. 2 Upper less bioturbated light olive grey mud (10 cm thick ) and lower moderately bioturbated moderate olive brown mud at 342 to 359 cm below sea-floor.

Fig. 3 Upper less bioturbated moderate olive brown mud (10 cm thick) and lower moderately bioturbated olive grey mud at 400 to 418 cm below sea-floor.

Fig. 4 Upper light olive grey bioturbated mud (10 cm thick) and lower thinly laminated mud at 440 to 457 cm below sea-floor. A one centimetre thick greyish green volcanic ash layer is intercalated between them.

**Plate 2**



# 日本海中央部ならびに北東縁部における淡青丸KT99-14次航海の予察的成果（第３部：大和堆で採取されたP-11コアの堆積相）

塚脇真二[1]・堂満華子[2]・尾田太良[3]

**要　旨**

日本海中央部大和堆東部の水深888mの海底から採取されたKT99-14 P-11コア（全長475 cm）はほぼ全体をとおして生物擾乱が発達する緑灰色～暗灰色の泥から構成され，平行葉理が発達する泥ならびに5枚の火山灰層が挟在する。明瞭な浸食面はコアをとおして認められない。最上位となる火山灰層（海底下110-115 cm）はその岩相上の特徴にもとづき姶良-Tn（AT）火山灰に対比される。

**キーワード**：海底コア，堆積相，日本海，大和堆，姶良−Tn火山灰，淡青丸

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