

5. MIDDLE MIOCENE TO UPPER QUATERNARY DIATOM BIOSTRATIGRAPHY OF THE IZU-BONIN/MARIANA REGION, EAST PACIFIC OCEAN¹

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ABSTRACT

Diatoms are present in lower middle Miocene through Holocene sediments recovered during Leg 125 in the Izu-Bonin region of the east Pacific Ocean, whereas diatoms are rare and without age-diagnostic species in the Mariana region. The diatom assemblage in the Izu-Bonin region is dominated by species characteristic of a low-latitude pelagic environment, but middle to high latitude species also were encountered. Age-diagnostic species occur sporadically and can be assigned only to several separated zones that range in age from middle Miocene to Holocene.

INTRODUCTION

During Leg 125, 15 holes were drilled at nine sites (Fig. 1) between the deep ocean trenches and island-arc volcanoes of the Mariana (Sites 778 through 781) and Izu-Bonin (Sites 782 through 786) regions south of Japan (Fryer, Pearce, Stokking, et al., 1990).

Diatom biostratigraphy of the Mariana region was investigated by DSDP scientists previously during Legs 59 and 60 and near the Izu-Bonin region by DSDP scientists during Leg 31 (Sites 296 through 298). Both investigations report only rare occurrences of diatoms, with the exception of mass occurrences of *Ethmodiscus rex* in the Mariana region.

The diatom zonation proposed by Barron (1985a, 1985b) for the equatorial Pacific was generally used during Leg 125. In addition, the middle- to high-latitude zonations of Barron (1985b) and Akiba (1986) were consulted.

METHODS

Shipboard and subsequent shore-based sample preparation followed standard procedures. In a 250-mL beaker, 10% HCl was added to 1 cm³ of sediment until the carbonate reaction ceased, then it was heated in 10% H₂O₂ and washed repeatedly in distilled water. Strewn slides of cleaned material were prepared using a Hyrax mounting medium, and the diatom valves were then identified at magnifications of 1000×

RESULTS

Sites 778 through 781, Mariana Region

In the Mariana region, upper Quaternary to upper Pliocene sediments were recovered. Diatoms, with the exception of *Ethmodiscus rex* fragments, are generally rare. No age-diagnostic species were observed. *E. rex* fragments were common in Cores 125-779A-1R and 125-779B-1R and abundant in Cores 125-781A-1R and -15R.

Site 782

Site 782 (30°51.60'N, 141°18.60'E; water depth, 2958 m) is located on the eastern margin of the Izu-Bonin forearc basin, about

halfway between the active volcanic arc and the trench (Fig. 1). Hole 782A penetrated to 476.8 mbsf.

The absence of age-diagnostic species in many samples resulted in large unzonated intervals. However, one may date the sedimentary interval in Hole 782A as ranging from the Quaternary to the middle Miocene.

Sample 125-782A-1H-CC was assigned to the *Pseudoenotia doliolus* Zone (Fig. 2) by the presence of *P. doliolus* and absence of *Nitzschia reinholdii*. Sample 125-782A-2H-CC was placed in the *N. reinholdii* Zone by the co-occurrence of *N. reinholdii* and *P. doliolus*.

Samples 125-782A-6H-CC to -8H-CC were assigned to the late Pliocene *Rhizosolenia praebergonii* Zone, based on the occurrence of *R. praebergonii*. Samples 125-782A-9H-CC through 125-782A-14X-CC contain *Nitzschia jouseae* and belong to the (lower *R. praebergonii*-) *N. jouseae* Zone. *Rosiella tatsunokuchiensis* without *N. jouseae* occur in Sample 125-782A-21X-CC, which was assigned to the *Thalassiosira convexa* Zone.

Nitzschia miocenica without *N. reinholdii* appears in Sample 125-782A-22X-CC; this sample was placed in the late Miocene *N. miocenica* Zone. The occurrence of *Actinocyclus moronensis*, *Crucidentacula punctata* (*Denticulopsis punctata* f. *hustedti*), and *Coscinodiscus plicatus* without *Hemidiscus cuneiformis* in Sample 125-782A-27X-CC and the occurrence of *Thalassiosira* (*Coscinodiscus*) *yabei*, *C. lewisianus*, *Craspedodiscus coscinodiscus*, and *Crucidentacula* (*Denticulopsis*) *nicobarica* in Sample 125-782A-32X-CC, places this interval in the middle Miocene *Coscinodiscus gigas* var. *diorama* Zone.

Site 783

Site 783 (30°57.86'N, 141°47.27'E; water depth, 4646.8 m) is located on the northern, mid-flank portion of a seamount that forms part of a ridge, more than 500 km long, that runs along the lowermost, inner wall of the Izu-Bonin Trench (Fig. 1). The seamount at this site has a thin sedimentary cover, perhaps in part because it lies at the distal end of a prominent submarine canyon system. Hole 783A reached a depth of 168.2 mbsf. Only three samples from the hole contained age-diagnostic species.

Sample 125-783A-1R-1, 1 cm, contains *Nitzschia reinholdii*, and Sample 125-783A-1R-CC is characterized by *Pseudoenotia doliolus* and *N. reinholdii*. The whole of this core was assigned to the *N. reinholdii* Zone (Fig. 2).

Sample 125-783A-5R-CC can be dated to the late Pliocene *Rhizosolenia praebergonii* Zone by the presence of *R. praebergonii* and the absence of *P. doliolus*. *Nitzschia jouseae* is present in Sample 125-783A-10R-CC. This sample was assigned to the (lower *R. praebergonii*-) *N. jouseae* Zone.

¹ Fryer, P., Pearce, J. A., Stokking, L. B., et al., 1992. *Proc. ODP, Sci. Results*, 125: College Station, TX (Ocean Drilling Program).

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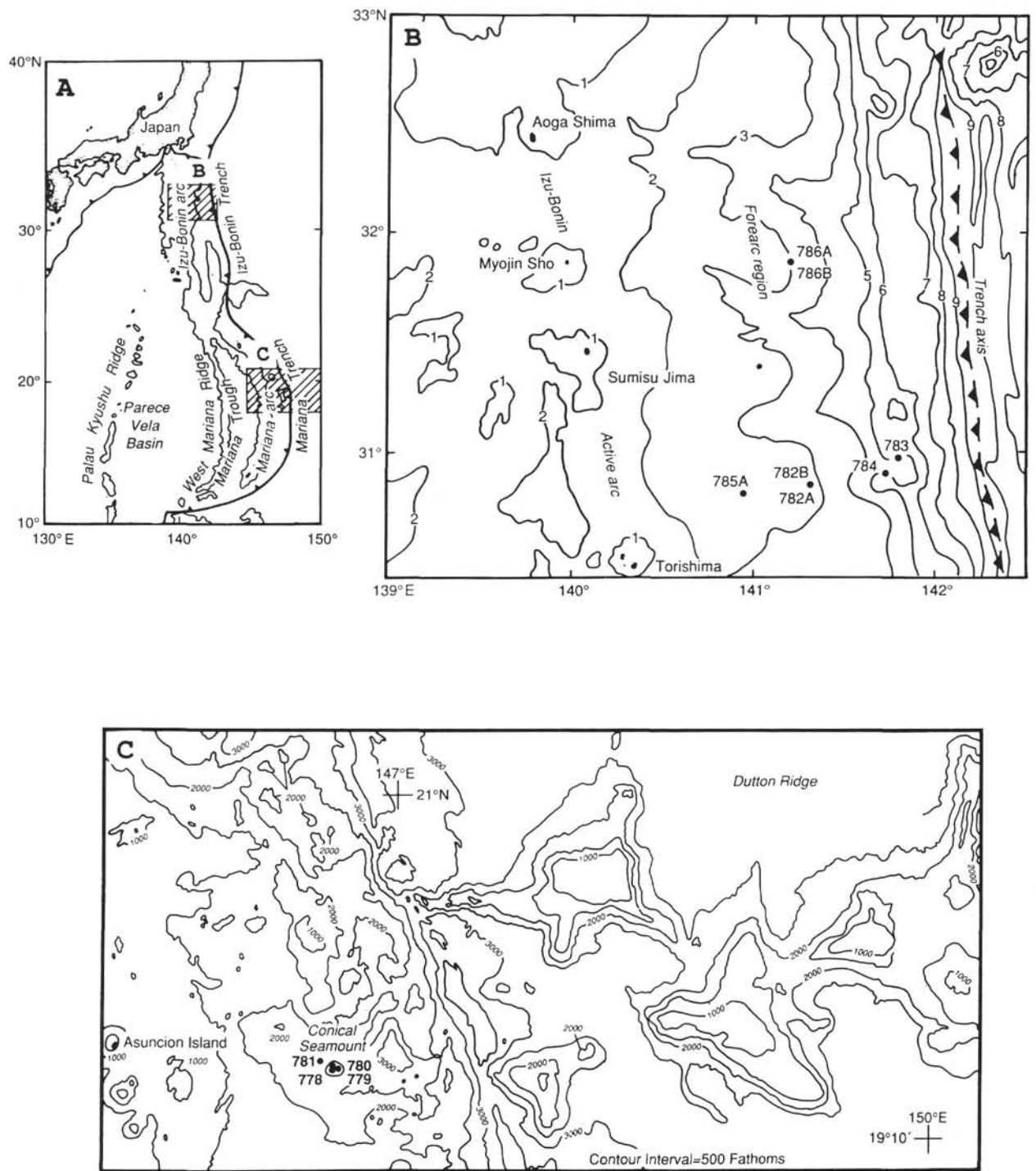


Figure 1. ODP Leg 125 sites investigated in the Izu-Bonin and Mariana area. **A.** Regional setting. **B.** Precise setting of drill sites (Sites 782 through 786) in the Izu-Bonin region. **C.** Precise setting of drill sites (Sites 778 through 781) in the Mariana region.

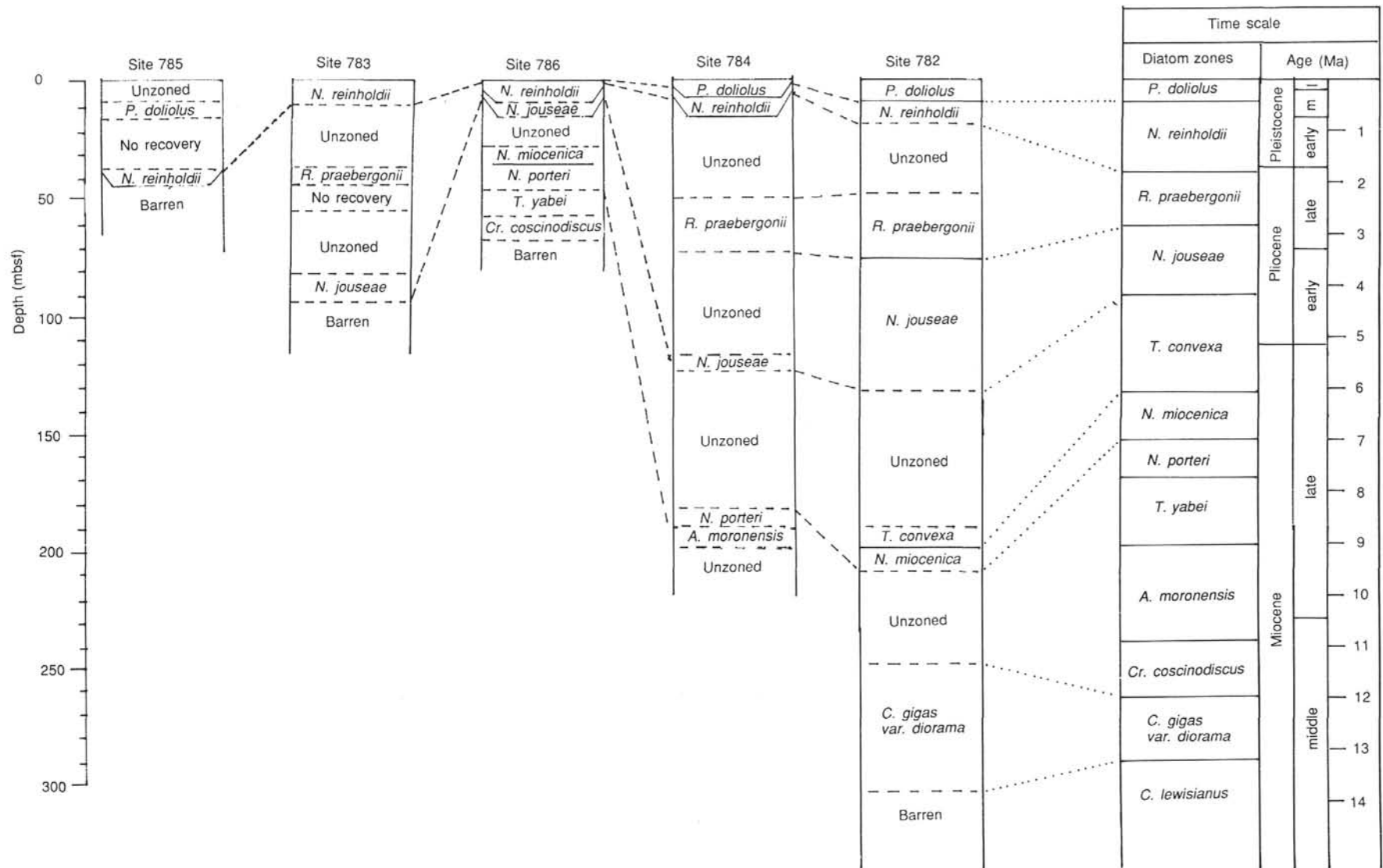


Figure 2. Diatom biostratigraphic results from Sites 782 through 786. Diatom zonation with ages modified from Barron (1985b).

Site 784

Site 784 (30°54.49'N, 141°44.27'E; water depth, 4900.8 m) is located about 4 nmi away from Site 783 on the lowermost, western flank of the same seamount, on the inner wall of the Izu-Bonin Trench (Fig. 1). Hole 784A penetrated to 425.3 mbsf. The scattered occurrence of age-diagnostic species left several intervals unzoned; as a whole the sedimentary interval ranges from late Pleistocene to earliest middle Miocene. The interval below Core 125-784A-31R-CC is devoid of diatoms.

Sample 125-784A-1R-1, 10–20 cm, was assigned to the *Pseudoeunotia doliolus* Zone by the occurrence of *P. doliolus* without *Nitzschia reinholdii* (Fig. 2). *N. reinholdii*, together with *P. doliolus*, was found in Sample 125-784A-1R-1, 81–82 cm, which places this sample in the *N. reinholdii* Zone.

Rhizosolenia praebergonii is present in Sample 125-784A-7R-1, 23–24 cm, and occurs together with *Neodenticula koizumii* (*Denticula seminae*) and *Nitzschia jouseae* in Sample 125-784A-9R-3, 114–115 cm, so that this interval can be assigned to the late Pliocene *R. praebergonii* Zone. *Neodenticula* (*Denticulopsis*) *kamtschatica*, *Nitzschia jouseae*, and *Rossiella tatsunokuchiensis* are present in Sample 125-784A-14R-5, 43–44 cm, and place this interval in the *N. jouseae* Zone.

Thalassiosira burckliana without *Thalassiosira* (*Coscinodiscus*) *yabei* is present from Sample 125-784A-21R-3, 39–40 cm, to -21R-CC, and thus, this interval was assigned to the late Miocene *Nitzschia porteri* zone. *Denticulopsis hustedtii* and *Thalassiosira* (*Coscinodiscus*) *yabei*, together with *Hemidiscus cuneiformis*, were recorded in Samples 125-784A-22R-6, 24–25 cm, to -22R-CC; these occurrences place this sample in the *Actinocyclus moronensis* Zone.

Site 785

Site 785 (30°49.47'N, 140°55.17'E; water depth, 2660.8 m) is located in the center of the Izu-Bonin forearc basin about 40 nmi east-northeast of the active volcano, Torishima (Fig. 1). Hole 785A reached 104.7 mbsf.

Only two samples contained age-diagnostic species. Sample 125-785A-2H-CC was assigned to the *Pseudoeunotia doliolus* Zone (Fig. 2) because of the presence of *P. doliolus* and the absence of *Nitzschia reinholdii*. Both *P. doliolus* and *N. reinholdii* are present in Sample 125-785A-5X-CC, so that this sample can be assigned to the *N. reinholdii* Zone.

Site 786

Site 786 (31°52.48'N, 141°13.58'E; water depth, 3058.1 m) is located in the center of the Izu-Bonin forearc basin about 120 nmi east of the active volcano, Myuojin Sho (Fig. 1). Hole 786A penetrated to 166.5 mbsf.

The upper sample, 125-786A-1H-1, 0 cm, was assigned to the *Nitzschia reinholdii* Zone (Fig. 2) by the occurrence of *N. reinholdii*, *Pseudoeunotia doliolus*, and *Rhizosolenia praebergonii*.

Nitzschia jouseae is present in Sample 125-786A-1H-CC, and this sample can be assigned to the late Pliocene (lower *R. praebergonii*-) *N. jouseae* Zone.

Nitzschia miocenica occurs in Sample 125-786A-4X-CC, which was assigned to the late Miocene *N. miocenica* Zone. *N. porteri* was found in Sample 125-786A-5H-CC; this sample has been tentatively placed in the *N. porteri* Zone. *Thalassiosira* (*Coscinodiscus*) *yabei* and *Thalassiosira plicatus* occur in Sample 125-786A-6H-CC, which was assigned tentatively to the *C. yabei* Zone. Sample 125-786A-7X-CC contains *Crucidenticula punctata* (*Denticulopsis punctata* f. *hustedtii*), allowing one to assign this sample to the earliest middle Miocene *Craspedodiscus coscinodiscus* Zone.

CONCLUSIONS

Sites 778 through 781 in the Mariana region are characterized by rare occurrences of diatoms, with the exception of common to abundant *Ethmodiscus rex* fragments. Age-diagnostic species were not observed.

In the Izu-Bonin region, diatoms occur from the earliest middle Miocene *Coscinodiscus gigas* var. *diorama* Zone to the present. The sporadic occurrence of age-diagnostic species, however, left several unzoned intervals. The three sites have a diatom biostratigraphy that extends to the Miocene (Sites 782, 784, and 786). When combined, all diatom zones in the earliest middle Miocene to Holocene interval are represented.

The occurrence of middle- to high-latitude species, such as *Rossiella tatsunokuchiensis*, *Neodenticula kamtschatica*, and *N. koizumii*, indicates a northern (colder) influence during the early Pliocene.

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