

## XVI. CALCAREOUS NANNOFOSSIL BIOSTRATIGRAPHY OF SURFACE SEDIMENTS OFF TOKAI AREA

Yuichiro Tanaka

Semi-consolidated and consolidated mud sediments were collected off Tokai area during the GH97 cruise and were examined for calcareous nannofossil biostratigraphy.

### Samples and method of study

The sediments treated in this report were collected by grab sampler and rock core sampler.

Sampling locations are shown in Fig. XVI-1. Smear slides were examined for nannofossils under the light microscope at a magnification of 1,500x.

The relative abundance of the nannofossil flora are using the criteria modified from Gartner (1992):

- A = abundant (10-100 specimens per field of view);
- C = common (2-10 specimens per field of view);
- F = few (1 specimens per 1-10 fields of view);
- R = rare (1 specimens in 11-50 fields of view).

The preservation of the nannofossils was recorded using the criteria of Steinmetz (1979):

- G = good; fossil lack evidence of dissolution or overgrowth;
- M = moderately good preservation; the majority of the specimens is slightly etched (fine structures are missing, but no diagnostic changes of form are evident in light microscopy; all taxa may be easily identified)
- P = poor; the majority of the specimens is deeply etched (identity of many centerless and fragmental specimens is questionable)

### Results and discussion

Twenty-two samples, out of 44 collected samples, yielded well-preserved and abundant calcareous nannofossils (Table XVI-1). Calcareous nannofossil assemblages in those sediments are recognized different from those of modern. The samples are divided into five age groups based on nannofossil biostratigraphy (Table XVI-2).

Group I is characterized by the occurrence of *Discoaster berggrenii* and *Discoaster quinqueramus*, and corresponds to the CN9 Zone of Okada and Bukry's (1980) scheme. The assemblage is correlated to that of the Sagara Formation in the western part of Shizuoka Prefecture. According to the occurrence of *Gephyrocapsa oceanica* and *Pseudoemiliania lacunosa* in six samples, Group II samples are all placed in the middle Pleistocene and referred to the CN14a Zone. Some of the Group II (sites 115,

---

Keywords: calcareous nannofossil, biostratigraphy, off Tokai area

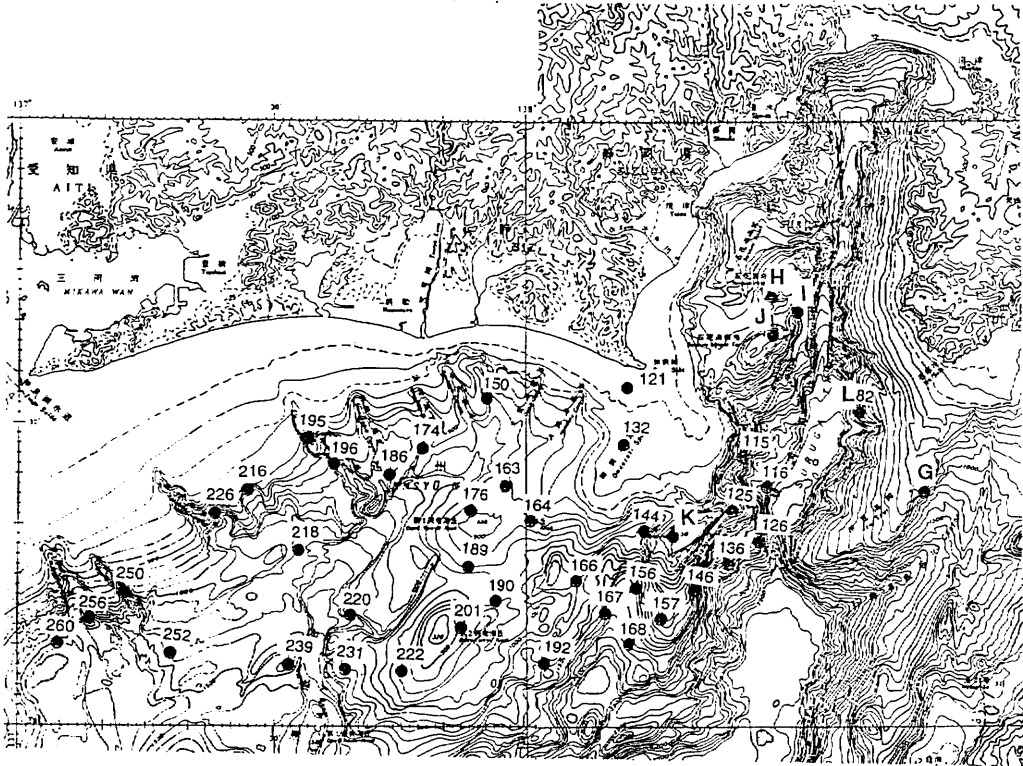


Fig. XVI-1 Sampling locations of semi-consolidated and consolidated mud sediments off Tokai area.

116 and 126) samples were from the south of Suruga Trough.

Occurrence of *G. oceanica* and absence of *P. lacunosa*, *Emiliania huxleyi* indicate the age of Group III to be early Late Pleistocene, the CN14b Zone of Okada and Bukry (1980). Samples from sites I and J in this group are from the west of Suruga Trough.

Occurrence of *E. huxleyi* indicates the age of Group IV to be Late Pleistocene corresponding to the CN15 Zone of Okada and Bukry (1980). Group IV samples are from the gentle slope region.

Group V samples are characterized by the presence of *Reticulofenestra pseudoumbilicus*, *Discoaster brouweri*, *P. lacunosa*, *Sphenolithus abies*, and *Sphenolithus neoabies*. Therefore, these samples indicate Neogene in age and are reworked from the older formations. Especially, the occurrence of *R. pseudoumbilicus* and *P. lacunosa* designate the CN11 Zone at site 125. This group is located on the slope from 500 m to 1000 m water depth in the study area.

Table XVI-1 Calcareous nannofossil assemblages from semi-consolidated and consolidated mud sediments off Tokai area  
 + : presence of species, r: reworked species, Barren: no nannofossils.

Sample	82L	115	116	121	125	126	132	136	144	146	150	156	157	163	164	166	167	168	174	176	186	189	190	192	195	196	201
Abundance	F	C	C	A	R	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Preservation	P	M	M	G	P	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
<i>Calcidiscus leptoporus</i>	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Calcosolenia murrayi</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Coccolithus pelagicus</i>	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Discoaster bergrenii</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>D. brouweri</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>D. pentaradiatus</i>	=	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>D. quinqueramus</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>D. surculus</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>D. variabilis</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Discolithina japonica</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Emiliana huxleyi</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Florispheara profunda</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Gephyrocapsa caribbeunica</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>G. oceanica</i>	+	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>G. spp (small)</i>	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Helicosphaera carteri</i>	B	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Neosphaera coccolithomorpha</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Oolithus fragilis</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Pseudemiliania lacunosa</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Relicolofenestra perplexa</i>	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>R. producta</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>R. pseudoumbilicus</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Rhabdosphaera clavigera</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Shenolithus abies</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>S. heteromorphus</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>S. neobabies</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Syracuspheara pulchra</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Umbellispheara irregularis</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>U. tenuis</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Umbilicosphaera sibogae</i>	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Nannofossil Zone (CN-)	14a	14a	9	15	14a	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	14?

Table XVI-1 (continued)

Sample	218	220	222	216	231	239	250	252	256	260	I1	J	K	G19	I-1	I-2	I-3
Abundance	C	R	A	C	A	A	A	A	A	R	C	C	C	C	F	F	F
Preservation	G	M	G	M	G	G	G	G	G	I'	M	M	M	M	M	M	M
<i>Calcidiscus leptoporus</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Calcosolenia murrayi</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Coccolithus pelagicus</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Discoaster berggrenii</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>D. brouweri</i>	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>D. pentaradiatus</i>	.	.	.	.	□	.	.	.	.	.	.	.	.	.	.	.	□
<i>D. quinqueramus</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>D. surculus</i>	.	.	.	.	□	.	.	□	.	.	.	.	.	.	.	.	□
<i>D. variabilis</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Discolithina japonica</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Emiliania huxleyi</i>	+	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.
<i>Florispheera profunda</i>	+	.	+	.	.	+	+	.	.	.	.	.	.	.	.	.	.
<i>Gephyrocapsa caribbeanica</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>G. oceanica</i>	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>G. spp (small)</i>	.	+	+	+	□	.	.	.	.	.	.	.	.	.	.	.	.
<i>Helicosphaera carteri</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Neosphaera coccolithomorpha</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Oolithotus fragilis</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Pseudoemiliania lacunosa</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Reliculofenestra perplexa</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>R. producta</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>R. pseudoubilicus</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Rhabdosphaera clavigera</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Shenolithus abies</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>S. heteromorphus</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>S. neobies</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Syracosphaera pulchra</i>	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Umbellosphaera irregularis</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>U. tenuis</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Umbellosphaera sibogae</i>	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Nannofossil Zone (CN-)	15	14a	14b	14a	15	15	15	15	14a	15	14b	14a	14b	14b	14b	14b	14b

Table XVI-2 Sample grouping of semi-consolidated and consolidated mud sediments based on the calcareous nannofossil assemblages.

	Sample number	Nannofossil zone
Group I	121	CN9
Group II	115, 116, 126, 216, 220, 260, K	CN14a
Group III	G-9, I-1, I-3, J	CN14b
Group IV	156, 164, 167, 168, 186, 186, 189, 196, 239, 250, H	CN15
Group V	125, 132, 144, 150, 157, 163, 192, 195, 218, 256,	CN15 and reworked

### Reference

- Gartner, S.(1992) Miocene nannofossil chronology in the North Atlantic, DSDP Site 608. *Mar. Micropaleont.*, **18**, 307-331.
- Okada, H. and Bukry, D.(1980) Supplementary modification and biostratigraphic zonation (Bukry, 1973, 1975). *Mar. Micropaleont.*, **5**, 321-325.
- Steinmetz, J. C.(1979) Calcareous nannofossils from the North Atlantic Ocean, Leg 49, Deep Sea Drilling Project. In Luyendyk, B. P., Cann, J. R., *et al.*, *Init. Repts. DSDP*, **49**, Washington (U.S. Govt. Printing Office), 519-531.