CAMPANIAN PLANKTONIC FORAMINIFERS AND OSTRACODES FROM HOBETSU, HOKKAIDO, NORTHERN JAPAN
PART 1. PLANKTONIC FORAMINIFERS

KUNIO KAIHO
Institute of Geology and Paleontology, Tohoku University, Sendai, 980 Japan

ABSTRACT—Sixteen species of planktonic foraminifers are discriminated in the upper part of the Upper Yezo Group, distributed along the Sanushube River in the northwestern part of Hobetsu-cho, south-central Hokkaido. This fauna, dominated by species belonging to Globotruncana and Archaioglobigerina, is related to those of the Intermediate province of Sliter (1972) and indicates that the studied interval of the group, to which an Campanian age is assigned, was deposited at outer sublittoral or deeper water depths.

Key words: Planktonic foraminifera, Cretaceous, Campanian, Hokkaido, Japan

INTRODUCTION

Late Cretaceous sublittoral and bathyal mudstones are widely distributed in central Hokkaido, Japan. These strata provide a treasury of well-preserved calcareous microfossils that reveal the preserved spectrum of various groups of microfossils from that time period. The present author selected the Sanushube River section for a study of calcareous microfossils out of various sections measured in Hokkaido, which is located in the northwestern part of Hobetsu-cho, south-central Hokkaido (the western part of a NNW-SSE-trending overturned anticline (Takahashi and Wada, 1985)) and yields well-preserved calcareous microfossils in abundance (Fig. 1). Along this section there exposed is the upper half of thick marine Upper Cretaceous (Turonian to Maastrichtian) sediments containing rich fossils, developed in Hobetsu-cho (Takahashi and Wada, 1985), and it is stratigraphically separated into the Upper Yezo and Hakobuchi Groups. The Upper Yezo Group consists of a dark gray soft mudstone which contains Inoceramus shell fragments, foraminifers, radiolarians, calcareous nanofossils, ostracodes, ammonites (Fig. 1) and pleiosaurian fossils (Nakaya, 1989). It is conformably overlain by shallow marine sediments of the Hakobuchi Group, characterized by sandstone, alternations of siltstone and sandstone, coal measures and rare fossils. The Upper Yezo Group would have been about 1000 m in thickness if it were not disturbed by faulting, but, in reality, may be separated and overlapped due to faults (Kito et al., 1986). The studied samples were taken from the upper half of the Upper Yezo Group.

Microfossils have never been described from this area, although some authors described foraminifers and radiolarians from other areas of Hokkaido (Takayanagi, 1960; Takayanagi and Iwamoto, 1962; Taketani, 1982). Although the present author obtained in 1979 well-preserved calcareous foraminifers and ostracodes from the section at five localities, the number of specimens was not sufficient for detailed studies. Accordingly, he collected a large quantity of sample (about 10 kg) from each of the two localities (SNS02 and SNS07) in the following year.

In the laboratory, 200 g (about 10 kg for the above two samples) of dry sediments were disaggregated by using a sodium sulphate and a naphtha solution (Maia and Inoue, 1973), wet sieved through a 63-μm screen and dried again. Foraminifers were then picked up from the processed samples and identified. The type specimens of
Takayanagi (1960) and Saito’s collections of planktonic foraminifers from DSDP cores were examined for comparative studies.

The present paper, dealing with faunas of planktonic foraminifers, age assignment, depositional water depths and faunal provinces, represents the first one in a series on Cretaceous microfossils from the section: calcareous nanoforaminifers and many well-preserved benthic foraminifers that the present author obtained will be reported elsewhere.

SYSTEMATIC DESCRIPTION

Sixteen species of planktonic foraminifers were discriminated among about 2000 specimens from the Upper Yezo Group distributed along the Sanushube River section. The faunal composition is consistent throughout the studied section. *Globoturrana, Archaeoglobigerina* and *Dicarinella* species predominate the fauna.

All the species encountered are presented below. The scheme of suprageneric classification used herein is that which Loeblich and Tappan (1988) proposed. Synonyms are limited to the original reference and some additional references which either brought about taxonomic changes or provided high-quality illustration. All the figured specimens are deposited in the collections of the Institute of Geology and Paleontology, Tohoku University, Sendai (IGPS 101258 to 101283).

Suborder Globigerinina Delage and Hérouard, 1896
Superfamily Heterohelicacea Cushman, 1927
Family Heterohelicidae Cushman, 1927
Subfamily Heterohelicinae Cushman, 1927
Genus *Heterohelix* Ehrenberg, 1843

*Heterohelix lata* (Egger)

Figs. 2-1a–b

*Guebelina lata* Egger, 1899, p. 35, pl. 14, figs. 12, 13, (197) (*fide* Ellis and Messina, 1940 et seq.); Cushman, 1938, p. 12, pl. 2, fig. 11.


*Type.*—Hypotype, IGPS 101258, sample SNS07.

*Remarks.*—A few specimens tentatively referred to *H. lata* have a more compressed test and more highly oblique sutures to the test axis than in *Heterohelix reussi*.

*Previous record.*—Upper Cretaceous of Bavaria, Germany (Egger, 1899; Cushman, 1938; Gallitelli, 1957).

*Occurrence in study area.*—Rare in samples SNS02 and 07.

*Heterohelix reussi* (Cushman)

Figs. 2-2a–b

*Guebelina reussi* Cushman, 1938, pl. 2, figs. 6–9; Cushman, 1946, p. 104, pl. 44, figs. 18a–19.

*Heterohelix reussi* (Cushman). Pessagno, 1967, p. 263, pl. 85, figs. 1–9, pl. 86, figs. 1–2; Douglas, 1969, p. 158–159, pl. 11, fig. 15; Caron, 1985, p. 60, text-figs. 24-10a–11b.

*Type.*—Hypotype, IGPS 101259, sample SNS07.

*Remarks.*—This species differs from *H. striata* in having more compressed chambers and finer costae. The present specimens have more compressed chambers than the holotype specimen.

*Previous record.*—Turonian to Santonian or Campanian (Cushman, 1946; Pessagno, 1967); Turonian to Santonian (Caron, 1985).

*Geographical distribution.*—Mexico (Turonian to Santonian) (Cushman, 1983; Pessagno, 1967); California (Coniacian to Santonian) (Douglas, 1969).

*Occurrence in study area.*—Rare in sample SNS07.

*Heterohelix striata* (Ehrenberg)

Figs. 2-3a–4b

*Textularia striata* Ehrenberg, 1840, p. 135, pl. 4, figs. 1 a, 1 a prime, 2 a, 3 a, (not 9 a).

*Guebelina striata* (Ehrenberg). Egger, 1899, p. 33, pl. 14, figs. 37–39, (not 5–7, 10, 11); Cushman, 1946, p. 104, 105, pl. 45, figs. 4, 5; Bandy, 1951, p. 510, pl. 75, figs. 8a–b, 9a–b.

*Pseudoguebelina striata* (Ehrenberg). Brünnimann and Brown, 1953, p. 154, text-fig. 6.

*Heterohelix striata* (Ehrenberg). Graham and Clark, 1961, p. 109, pl. 5, figs. 4a–b; Pessagno, 1962, p. 358, pl. 1, fig. 5; Martin, 1964, p. 85, pl. 11, figs. 1a–b; Takayanagi, 1965, p. 198, pl. 20, figs. 4a–b; Pessagno, 1967, p. 264, pl. 78, figs. 4–5, pl. 88, figs. 3–7, pl. 96, figs. 16; Douglas, 1969, p. 159, pl. 11, figs. 4, 7–8; Smith and Pessagno, 1973, p. 19, pl. 3, figs. 8–11, pl. 4, figs. 1–4; Masters, 1977, p. 356–358, pl. 3, figs. 2–3.

*Type.*—Hypotype, figs. 3a–b, IGPS 101260, sample SNS07; hypotype, figs. 4a–b, IGPS 101261, sample SNS07.

*Remarks.*—This species is characterized by having globo-lobar chambers, sutures nearly perpendicular to the test axis and many longitudinal costae. It resembles *Heterohelix globulosa* (Ehrenberg), but is distinguished in having well-developed medium costae.

*Previous record.*—Campanian and Maastrichtian (Caron, 1985).

*Geographical distribution.*—See Masters (1977, text-fig. 19); Tethyan to Intermediate province in the north-eastern Pacific margin (Sliter, 1972).

*Occurrence.*—Few in samples SNS01, 02 and 07.

Family Globigerinelloides Longoria, 1974
Subfamily Globigerinelloidae Longoria, 1974
Genus *Globigerinelloides* Cushman and ten Dam, 1948

*Globigerinelloides eschleri* (Kaufmann)

Figs. 2-5a–b

*Nonionina eschleri* Kaufmann, 1865, p. 198, text-figs. 110a–e. (*fide* Ellis and Messina, 1940 et seq.).


*Type.*—Hypotype, IGPS 101262, sample SNS07.

*Remarks.*—This species is characterized by its planispiral coiling and 6 subglobo-lobar chambers in the last whorl.

*Previous record.*—Late Albian (?), Turonian to Maastrichtian (Masters, 1977).

*Geographical distribution.*—See Masters (1977, text-fig. 44); Shikoku, Japan (Santonian and Campanian) (Takayanagi et al., 1982).

*Occurrence in study area.*—Few in sample SNS07.

*Globigerinelloides ultramica* (Subbotina)

Figs. 2-6a–b

*Globigerinella ultramica* Subbotina, 1949, p. 33, pl. 2, figs. 17–18. (*fide* Ellis and Messina, 1940 et seq.).

*Globigerinelloides japonicus* Takayanagi, 1960, p. 131, pl. 9, figs. 12a–b, text-figs. 22a–e.
Figs. 2-1a–12c. Scale bars=100 μm. 1a–b. Heterohelix lata (Egger), IGPS 101258, sample SNS07. 2a–b. Heterohelix reussi (Cushman), IGPS 101259, sample SNS07. 3a–4b. Heterohelix striata (Ehrenberg). 3a–b, IGPS 101260. 4a–b, IGPS 101261. Both from sample SNS07. 5a–b. Globigerinelloides escherti (Kaufmann), IGPS 101262, sample SNS07. 6a–b. Globigerinelloides ulramicra (Subbotina), IGPS 101263, sample SNS02. 7a–c. Hedbergella holmedeniensis Olsson, IGPS 101264, sample SNS02. 8a–9c. Whiteinella baltica Douglas and Rankin. 8a–c, IGPS 101265. 9a–c, IGPS 101266. Both from sample SNS07. 10a–c. Whiteinella paradubia (Sigal), IGPS 101267, sample SNS07. 11a–c. Conusotriangulina formicana (Plummer), IGPS 101268, sample SNS02. 12a–c. Globotruncanina arca (Cushman), IGPS 101269, sample SNS07.
Globigerinelloides ultramica (Subbotina). Masters, 1977, p. 413, pl. 12, figs. 3-5; Takayanagi et al., 1982, p. 108, pl. 19, figs. 5a-b; Caron, 1985, p. 47-48, text-figs. 29-18a-19c.

Type.—Hypotype, IGPS 101263, sample SNS02.

Remarks.—The species is distinguished from other Globigerinelloides species by its small size and a large number of chambers (7 to 8 in the last whorl).

Previous record.—Mid-Aptian to Maastrichtian (Masters, 1977); Late Albain to Early Maastrichtian (Caron, 1985).

Geographical distribution:—See Masters (1977, text-fig. 47); Shikoku, Japan (Sanitoin and Campanian) (Takayanagi et al., 1982).

Occurrence in study area.—Common in samples SNS02 and 07.

Superfamily Rotaliporaceae Sigal, 1958
Family Hedbergellidae Loeblich and Tappan, 1961
Subfamily Hedbergellinae Loebich and Tappan, 1961
Genus Hedbergella Brönnimann and Brown, 1958
Hedbergella holmdelensis Olsson

Figs. 2-7a-c

Hedbergella holmdelensis Olsson, 1964, p. 160, 161, pl. 1, figs. 1, 2; Caron, 1985, p. 59, text-figs. 25-10a-11c.

Hedbergella planispira (Tappan). Olsson, 1964, p. 161, 162, pl. 1, figs. 4, 5 (not of Tappan).

Type.—Hypotype, IGPS 101264, sample SNS02.

Remarks.—This species has many characteristic features: very low trochospiral, nearly planispiral appearance, compressed test and ovate chambers with neither poreless margin nor a peripheral keel. Its wall is finely perforate and smooth. This species differs from Hedbergella delrioensis in its low spiral side and from Hedbergella planispira (Tappan) in having 5-6 chambers, instead of 7-8 chambers, forming the last whorl.

Previous record.—Coniacian to Maastrichtian (Caron, 1985).

Geographical distribution:—Tethyan to Intermediate province in northeastern Pacific margin (Sliter, 1972); Mexico, Texas and Arkansas (Olsson, 1964).

Occurrence in study area.—Rare in sample SNS02.

Genus Whiteinella Pessagno, 1967
Whiteinella baltica Douglas and Rankin

Figs. 2-8a-9c

Whiteinella baltica Douglas and Rankin, 1969, p. 197, 198, fig. 9; G.T.E.F.P., 1979a, p. 169-174, pl. 35, figs. 1a-5, pl. 36, figs. 1a-2b; Takayanagi et al., 1982, p. 109, pl. 20, figs. 3a-c; Caron, 1985, p. 79, text-figs. 37-1a-3b.

Types.—Hypotype, figs. 2-8a-c, IGPS 101265, sample SNS07; hypotype, figs. 2-9a-c, IGPS 101266, sample SNS07.

Remarks.—This species is characterized by its globose chambers with a spinose surface and 4-4 1/2 chambers in the last whorl. It differs from Whiteinella archiaeocrectae Pessagno in its smaller numbers of chambers (4-4 1/2 as compared with 5-5 1/2) in the last whorl.

Previous record.—Late Cenomanian to early Santonian (Caron, 1985).

Geographical distribution:—Gulf Coast and Caribbean region (Turonian to lower Santonian), Germany and Poland (Douglas and Rankin, 1969); Shikoku, Japan (Turonian to Santonian) (Takayanagi et al., 1982).

Occurrence in study area.—Few in samples SNS02, 04 and 07.

Whiteinella parabudia (Sigal)

Figs. 2-10a-c

Whiteinella parabudia Sigal, 1952, p. 28, text-fig. 28. (fide Ellis and Messina, 1940 et seq.); Masters, 1977, p. 467-469, pl. 23, figs. 2-4, pl. 24, fig. 1.

Whiteinella parabudia (Sigal). G.T.E.F.P., 1979a, p. 181-184, pl. 39, figs. 1a-2c; Caron, 1985, p. 79, text-figs. 37-8a-9c.

Type.—Hypotype, IGPS 101267, sample SNS07.

Remarks.—The high trochospire is a typical feature of this species. The present specimens may be juvenile forms because they have only 2 instead of 3 whorls, so they have only 4 1/2 chambers instead of 5-8 chambers (adult) in the last whorl.

Previous record.—Mid-Cenomanian-Santonian (Masters, 1977); Late Cenomanian-Early Coniacian (Caron, 1985).

Geographical distribution:—See Masters (1977, text-fig. 78).

Occurrence in study area.—Rare in samples SNS02 and 07.

Superfamily Globotruncanacea Brożten, 1942
Family Globotruncanidae Brożten, 1942
Subfamily Globotruncaninae Brożten, 1942
Genus Contusotruncanina Korchagin, 1984
Contusotruncanina fornicata (Plummer)

Figs. 2-11a-c

Contusotruncanina fornicata Plummer, 1931, p. 198, pl. 13, figs. 4a-c (holotype); Masters, 1977, p. 564-566, pl. 44, figs. 4-6; Takayanagi et al., 1982, p. 113, pl. 23, figs. 1a-c.

Rostia fornicata (Plummer). Robaszynski et al., 1984, p. 250, pl. 38, figs. 1a-5c; Caron, 1985, p. 67, figs. 28-3a-4c.

Contusotruncanina fornicata (Plummer). Loeblich and Tappan, 1988, p. 468, pl. 503, figs. 4-7.

Type.—Hypotype, IGPS 101268, sample SNS02.

Remarks.—This species is distinguished from allied double-keeled species by having a low trochospiral test with elongate, crescentic and gently folded dorsal chambers.

Previous record.—Middle Santonian to middle Maastrichtian (Caron, 1985).

Geographical distribution:—See Masters (1977, text-fig. 115); Tethyan to Intermediate province in the northeastern Pacific margin (Sliter, 1972).

Occurrence.—Few in samples SNS01, 02 and 04.

Genus Globotruncanina Cushman, 1927
Globotruncanina arca (Cushman)

Figs. 2-12a-c

Globotruncanina arca Cushman, 1926, p. 23, pl. 3, figs. 1a-c.

Globotruncanina arca (Cushman). Plummer, 1931, p. 195-198, pl. 13, figs. 3a-c, (not figs. 7a-c, 9a-c, 11a-c); Cushman, 1946, p. 150, pl. 62, figs. 4a-c, (not figs. 5a-c); Pessagno, 1967, p. 321-323, pl. 79, figs. 5-8; Plummer, 1931, p. 43, 44, pl. 18, figs. 1-6; Masters, 1977, p. 536-540, pl. 38, figs. 1-2, 4; Caron, 1985, p. 50, figs. 19a-4a-8b.

Type.—Hypotype, IGPS 101269, sample SNS07.

Remarks.—This species differs from Globotruncanina lapparenti in having a more convex spiral side. The outer and inner rims of chambers are parallel. The present
specimens have 7 chambers in the last whorl.

Previous record.—Campanian to Maastrichtian (Masters, 1977); Late Santonian to Maastrichtian (Caron, 1985).

Geographical distribution.—See Masters (1977, text-fig. 102); Tethyan to Boreal province in northeastern Pacific margin (Sliter, 1972).

Occurrence in study area.—Few in samples SNS01, 02, 04 and 07.

Globotruncana lapparenti Broten
Figs. 3-1a-c
Rosalina linnei d’Orbigny, de Lapparent, 1918, p. 1–17, pl. 1, figs. 1, 7 (not figs. 2–4, pl. 2, fig. 2), pl. 6, figs. 2, 3, pl. 8 (part), pl. 9, figs. 2, 3 (not fig. 6), text-figs. 1a–h (p. 4), text-fig. 2a, d, m, n (p. 5), text-fig. 3 (p. 10), (not text-fig. 5d (p. 13)).

Globotruncana lapparenti Broten, 1936, p. 175–176; Pessagno, 1967, p. 344–346, pl. 71, figs. 6–13, pl. 97, figs. 8, 9; Caron, 1985, p. 50, text-figs. 20-3,4c.

Type.—Hypotype, IGPS 101270, sample SNS07.

Remarks.—This species has a slightly convex test on the spiral side, is more convex than G. linneiana, and is less convex than G. arca. It has 6 to 8 chambers (usually 7) in the last whorl.

Previous record.—Late Santonian to early Maastrichtian (Caron, 1985).

Geographical distribution.—See Masters (1977, text-fig. 122).

Occurrence.—Abundant in samples SNS01, 02, 03, 04 and 07.

Globotruncana linneiana (d’Orbigny)
Figs. 3-2a–c
Rosalina linneiana d’Orbigny, 1839, p. 101, pl. 5, figs. 10–12.

Globotruncana linneiana (d’Orbigny). Subbotina, 1953, p. 176, pl. 5, figs. 7–9, pl. 6, figs. 1–4; Pessagno, 1967, p. 346–349, pl. 72, figs. 1–4, pl. 97, figs. 11–13; Douglas, 1969, p. 181–182, pl. 3, figs. 1a–c; Masters, 1977, p. 583–585, pl. 46, figs. 3, 5, 6; Takayanagi et al., 1982, p. 114, pl. 23, figs. 3a–c; Caron, 1985, p. 50, text-figs. 20-3,4c.

Types.—Hypotype, figs. 2a–c, IGPS 101271, sample hypotype, figs. 3a–c, IGPS 101272, sample SNS07.

Remarks.—This species is characterized by its box-like shape with two widely spaced keels in side view. It differs from G. lapparenti in its flat spiral side and widely spaced keels and from Marginotruncana pseudolineeiana in the umbilical position of the primary aperture. The species has 6 to 7 chambers in the last whorl. It has smaller numbers of chambers in the last whorl than does G. lapparenti on the average.

The present specimens show a variable convexity on its umbilical side. A specimen of Figures 2a–c is a typical form and one of Figures 3a–c is the end member in the degree of test convexity. Its spiral side is flat like that of a typical G. linneiana, but it has a more inflated umbilical side.

Previous record.—Campanian (Masters, 1977); Late Santonian to early Maastrichtian (Caron, 1985).

Geographical distribution.—See Masters (1977, text-fig. 124); Tethyan to Boreal province in the northeastern Pacific margin (Sliter, 1972).

Occurrence in study area.—Abundant in samples SNS01, 02, 03, 04 and 07.

Family Rugoglobigerinidae Subbotina, 1959
Genus Archaeoglobigerina Pessagno, 1967
Archaeoglobigerina blowi Pessagno
Figs. 3-4a–c
Archaeoglobigerina blowi Pessagno, 1967, p. 316, pl. 59, figs. 5–7; G.T.E.F.P., 1979b, p. 169–172, pl. 79, figs. 1a–2b; Caron, 1985, p. 43, text-figs. 16-3a–4c.

Type.—Hypotype, IGPS 101273, sample SNS07.

Remarks.—This low trochospiral species has a rounded periphery, four chambers in the last whorl and two faint keels which may be absent on the last chamber.

Previous record.—Late Coniacian to Maastrichtian (Caron, 1985).

Geographical distribution.—Mexico (Campanian), Texas (Coniacian and Santonian) and Arkansas (Pessagno, 1967).

Occurrence in study area.—Common in samples SNS02–04 and abundant in sample SNS07.

Archaeoglobigerina cetacea (d’Orbigny)
Figs. 3-6a–8c
Globigerina cetacea d’Orbigny, 1840, p. 34, pl. 3, figs. 12–14.

Globotruncana cetacea (d’Orbigny). Banner and Blow, 1960, p. 8–10, pl. 7, figs. 1a–c (lectotype); Masters, 1977, p. 551–555, pl. 41, figs. 3–4, pl. 42, fig. 1.

Archaeoglobigerina cetacea (d’Orbigny). Pessagno, 1967, p. 317–318, pl. 70, figs. 3–8, pl. 94, figs. 4–5; G.T.E.F.P., 1979b, p. 173–176, pl. 78, figs. 1a–3b, pl. 80, figs. 1a–c; Caron, 1985, p. 43, text-figs. 1b-1a–2c.

Rugoglobigerina cetacea (d’Orbigny). Bandy, 1967, p. 21, text-fig. 10–1.

Types.—Hypotype, figs. 6a–c, IGPS 101274; hypotype, figs. 7a–c, IGPS 101275; hypotype, figs. 8a–c, IGPS 101276. All from sample SNS07.

Remarks.—This species differs from A. blowi in having 5–6 instead of 4 chambers in the last whorl.

Previous record.—Turonian to Maastrichtian (Masters, 1977); Coniacian to early Maastrichtian (Caron, 1985).

Geographical distribution.—See Masters (1977, text-fig. 108); Tethyan to Boreal province in the northeastern Pacific margin (Sliter, 1972).

Occurrence in study area.—Abundant in samples SNS01, 02, 03, 04 and 07.

Family incertae sedis
Genus Dicarinella Porthault, 1970
Dicarinella japonica (Takayanagi)
Figs. 3-5a–c
Globotruncana japonica Takayanagi, 1960, p. 135–136, pl. 10, figs. 4a–c.

Dicarinella japonica (Takayanagi). Takayanagi et al., 1982, p. 111, pl. 19, figs. 5a–c.

Type.—Hypotype, IGPS 101277, sample SNS07.

Remarks.—The species differs from A. blowi in having a less lobulate peripheral outline and more distinct keels. The development of keels is variable. The figured specimens have more distinct keels than in the holotype.

The subspecies G. japonica robusta, proposed by Takayanagi (1960), is referable to the genus Globotruncana, because of its truncate periphery with double keels and the development of a U-shaped umbilical keels in every chamber.

Previous record.—Urackawan and Hetonaian in Hokkaido (Takayanagi, 1960); Santonian part of the
Figs. 3-1a–8c. Scale bar=100 μm. 1a–c. *Globotruncanella lapparentii* Broten, IGPS 101270, sample SNS07. 2a–3c. *Globotruncanella limviana* (d’Orbigny). 2a–c, IGPS 101271. 3a–c, IGPS 101272. Both from sample SNS07. 4a–c. *Archaeoglobigerina blowi* Pessagno, IGPS 101273, sample SNS07. 5a–c. *Dicarinella japonica* (Takayanagi), IGPS 101277, sample SNS07. 6a–8c. *Archaeoglobigerina cretacea*. 6a–c, IGPS 101274. 7a–c, IGPS 101275. 8a–c, IGPS 101276. All from sample SNS07.
Kaiho, Kunio

Kajisako Formation, Shikoku, Japan (Takayanagi et al., 1982).

Occurrence in study area.—Common in samples SNS01, 02 and 07.

Dicarinella hanzawai (Takayanagi)

Figs. 4-1a–6c
Globotruncana hanzawai Takayanagi, 1960, p. 136–137, pl. 10, figs. 6a–c.

Types.—Hypotype, figs. 4-1a–c, IGPS 1091278, hypotype, figs. 4-2a–c, IGPS 101279; hypotype, figs. 4-3a–c, IGPS 101280; hypotype, figs. 4-4a–c, IGPS 101281; hypotype, figs. 4-5a–c, IGPS 101282; hypotype, figs. 4-6a–c, IGPS 101283. All from sample SNS02.

Remarks.—This species differs from A. cretacea in having a larger test and more distinct double keels. The development of keels and convexity on the spiral side is very variable, but that on the umbilical side is not so variable (Figs. 4-1a–8c). It has 5–6 chambers in the last whorl. It is similar to Dicarinella imbricata (Mornod) but differs in its less concave test on the umbilical side, a larger umbilicus and tangential, instead of radial, sutures on the umbilical side.

Previous Record.—Upper Yezo Group, Upper Urakawan in Hokkaido (Takayanagi, 1960).

Occurrence.—Abundant in samples SNS01, 02, 03, 04 and 07.

Age Assignment

Kito et al. (1986) assigned an early Campanian age to the middle part of the Upper Yezo Group (SNS01): plesiosaurian locality treated in the present study on the basis of radiolarians, planktonic foraminifers, ammonites and Inoceramus. Calcareous nanofossils from the uppermost part of the Upper Yezo Group (SNS08) in the same section also show a Campanian age (Murota pers. com.).

Discriminated planktonic foraminifers range in age as shown in the systematic description. Among them, H. striata, G. arcá, G. linneiana, G. laparenti, and C. fornicata are useful age indicators (Caron, 1985). Joint occurrences of these species indicate a Campanian to early Maastrichtian age.

In consequence, the upper half of the Upper Yezo Group exposed along the Sanushube River section is believed to be Campanian in age.

Depositional Water Depth

Depth-related distribution patterns and oxygen isotope analyses of Upper Cretaceous planktonic foraminifers (e.g., Sliter, 1972; Douglas and Savin, 1978) indicate that deep-water habitats (>100 m) were dominated by globotruncanids, with less common heterohelicids, Hedbergellids and Globigerinelloids, and shallow-water habitats (<100 m).
m) were dominated by heterohelicids, globigerinelloids and hedbergellids. Accordingly, abundant occurrences of globotruncanids and rare occurrences of heterohelicids, globigerinelloids and hedbergellids show that the geologic formations in the Sanushube River section were deposited at outer sublittoral or deeper water depths.

FAUNAL PROVINCE

Sliter (1972) recognized four Late Cretaceous (late Campanian to early Maastrichtian) faunal provinces—Tethyan, Central, Intermediate and Boreal—along the northeastern Pacific margin. The fauna of the Sanushube River section is most closely related to the fauna of the Intermediate province (35°N to 45°N; paleolatitude 39°N to 52°N) because of the presence of such species as C. fornicata, H. holmdelensis, and H. striata, which were distributed from the Tethyan province to the Intermediate province, and the absence of forms restricted to the Tethyan or Central province. The occurrences of Globotruncanidae arca, G. linneiana and A. cretacea, which were distributed from the Tethyan to the Boreal provinces, support the above inference.

CONCLUSION

The planktonic foraminiferal faunas from the upper half of the Yezo Group in Hobetsu, Hokkaido are dominated by Globotruncanidae arca, Globotruncanidae lapparenti, Archaeoglobigerina creta, Dicarinella hanzawai, Globigerinelloides ultramicrata, Archaeoglobigerina bowei and Dicarinella japonica with less common Heterohelix striata, Hedbergella holmdelensis, Whiteinella baltica, Contusotruncanina fornicata and Globotruncanidae arca.

The faunal composition indicates that the strata in the studied section were deposited at depths greater than 100 m in the Intermediate province (between the Central and Boreal provinces: 39°N to 52°N) in Campanian time, as defined along the northeastern Pacific margin.

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