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Late Carboniferous (Kasimovian and Gzhelian) fusulines of the Ichinotani and Mizuyagadani formations in the Fukuji area, Hida Marginal Terrane, central Japan

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Abstract. Fusuline biostratigraphy and faunal composition of the upper part the Ichinotani Formation and lower part of the Mizuyagadani Formation in the Fukuji area, central Japan are reexamined and compared to those of previous works. The upper part of the Upper Member of the Ichinotani Formation is composed mainly of the upper Kasimovian and lower Gzhelian strata, and is characterized by the partial reappearance of Moscovian strata dominant in the lower part of the Upper Member, suggesting a more complicated geological structure of the formation than previously assumed. Fusulines apparently correlatable to the middle part of the Kasimovian have not been found in the Fukuji area. The species *Carbonoschwagerina morikawai* is restricted to the lower part of the Mizuyagadani Formation. Faunal composition and correlation of age-diagnostic fusuline species are reviewed paleobiogeographically between the Fukuji and other areas especially of the Akiyoshi Limestone. Described herein are two species of non-fusuline foraminifers and nine species of fusulines including *Montiparus japonicus* sp. nov.

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Introduction

The Upper Paleozoic in the Hida Marginal Terrane has notable lithologic and paleobiogeographic features with a continental margin affinity, as revealed by those strata of the Carboniferous Ichinotani Formation (Igo, 1956, 1960, 1961) in the Fukuji area. Igo (1956, 1957) considered that the formation is a continuous succession from the upper Lower to Upper Carboniferous without any conspicuous stratigraphic breaks. He divided the Ichinotani Formation and the overlying Mizuyagadani Formation into six fusuline zones from lower to upper: *Eostaffella*, *Profusulinella*, *Fusulinella*, *Fusulina*, *Triticites*, and *Pseudoschwagerina*. The species *Pseudoschwagerina morikawai* Igo, 1957 had long been considered as an index species of the earliest Permian not only in the Fukuji area but also throughout Japan (e.g. Toriyama, 1967). Later, T. Ozawa and Kobayashi (1990), T. Ozawa *et al*. (1991), and Watanabe (1991) revealed that the C–P boundary in Japan should be drawn at the first appearance of *Sphaeroschwagerina fusiformis* (Krotow, 1888) in the Asselian Stage as well as in the stratotype sections of the Urals and Tethyan regions.

Previous workers (Igo, 1957; Niikawa, 1978; Igo *et al*., 1984) thought that the uppermost part of the Ichinotani Formation consists exclusively of the Upper Carboniferous (Kasimovian and Gzhelian), and is overlain by the Lower Permian (Asselian) Mizuyagadani Formation. Watanabe (1991) assigned the lower part of the Mizuyagadani Formation to the Gzhelian. The studied area along the middle reaches of the Ichinotani valley is occupied by the upper part of the Upper Member of the Ichinotani Formation mainly of late Kasimovian and early Gzhelian ages. This stratigraphic interval, however, is also characterized by the reappearance of Moscovian strata with *Beedeina* and *Ozawainella* dominant in the lower part of the Upper Member of the formation and by the absence of strata with reliable middle Kasimovian fusulines, suggesting a more complicated geologic structure in the uppermost part of the Ichinotani Formation than assumed previously. Furthermore, there are some biostratigraphic and taxonomic problems in the case of the comparison of previous works to my paleontologic data of the formation accumulated in the late 1970's, mid-

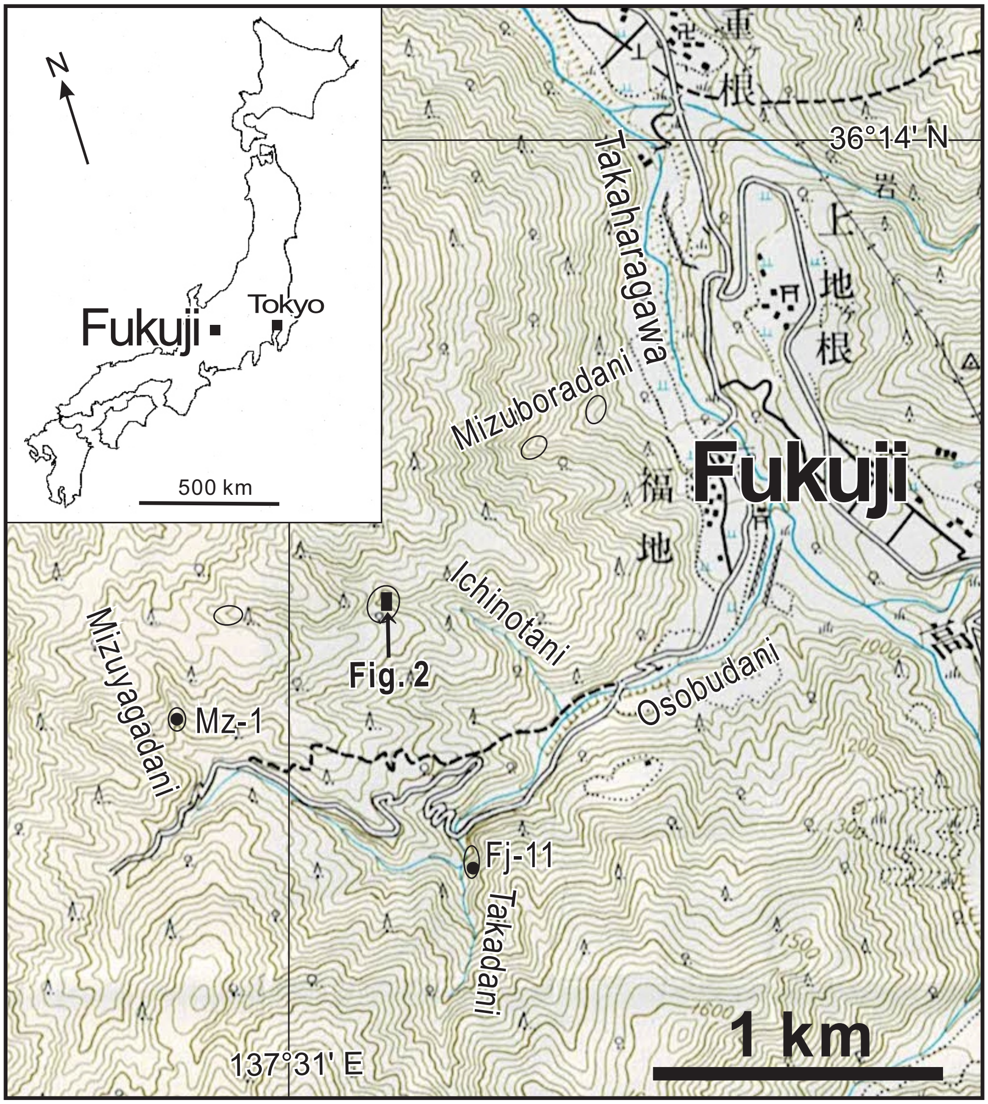

Figure 1. Map showing the distribution of Kasimovian and Gzhelian fusuline localities (oval-shaped lines), and locations of Figure 2 and samples Fj-11 and Mz-1 in the Fukuji area. Those of the Mizuboradani valley and upper reaches of the Ichinotani valley are based on Niikawa (1978). Topographic map is from 1:50,000 maps "Kamikochi" published by the Geospatial Authority of Japan.

dle 2000's, and middle 2010's.

The main purpose of this paper is (1) to describe the fusuline biostratigraphy and faunal composition of the uppermost part of the Ichinotani Formation along the middle reaches of the Ichinotani valley, (2) to compare the faunal composition of age-diagnostic fusuline species between the Fukuji and other areas especially of the Akiyoshi Limestone, and (3) to describe two species of non-fusuline foraminifers and nine species of fusulines incuding *Montiparus japonicus* sp. nov. Limestone thin sections used in this paper are stored in the Museum of Nature and Human Activities, Hyogo (Fumio Kobayashi Collection, MNHAH), with prefix Ic, Fj, and Mi.

Samples and biostratigraphy

The Ichinotani Formation of about 350 m thick, and lithostratigraphically divided into three members (Adachi, 1985), is typically developed along the Ichinotani valley (Figure 1). It is overlain by the "Lower Permian" Mizuyagadani Formation (Kamei, 1952; Igo, 1956, 1957; Niikawa, 1978, 1980; Adachi, 1985). Strata exposed around the junction of upstream tributaries northward and westward in the middle reaches of the Ichinotani valley (Figures 1, 2) correspond to the upper part of the Upper Member of the Ichinotani Formation (Adachi, 1985). Biostratigraphically, they are equivalent to the *Triticites*

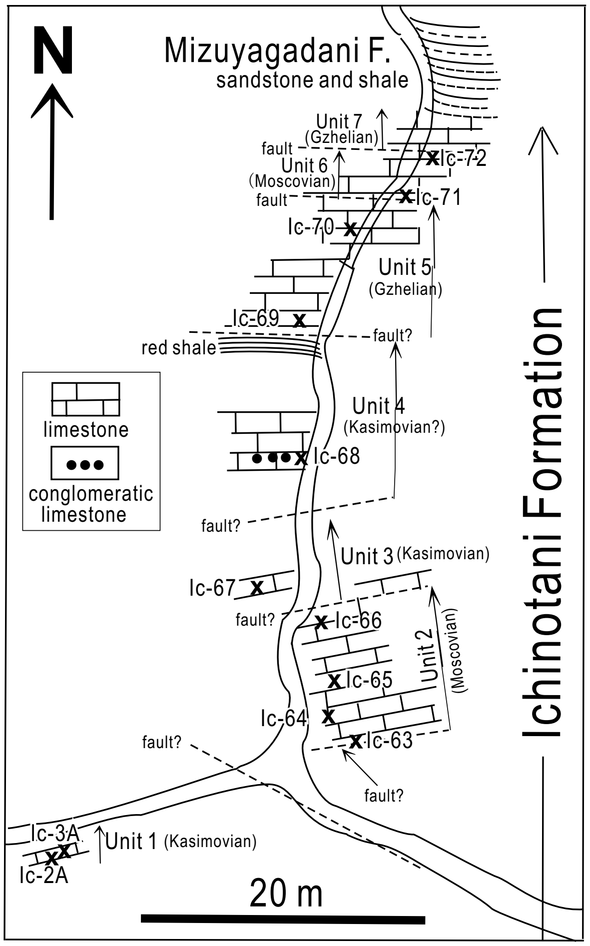

Figure 2. Sample localities of the Ichinotani Formation around the junction of upstream tributaries northward and westward in the middle reaches of the Ichinotani valley.

Zone of Igo (1957) and Niikawa (1978), and *Triticites exculptus–T. hidensis* Zone of Igo *et al*. (1984). All of the Kasimovian fusulines illustrated in Watanabe (1991) from the formation originated from this area.

The strata bounded by a fault or faults(?) in the studied section are provisionally divided into the Unit 1 to Unit 7 seemingly from lower to upper (Figures 2, 3) based on fusuline biostratigraphy.

Two samples Ic-2A and Ic-3A were collected from the lowest limestone (Unit 1) exposed in the mapped area (Figures 2, 3). They are dark grey to black fusuline packstone with many late Kasimovian to early Gzhelian fusulines such as *Carbonoschwagerina katoi* (Niikawa, 1978), *Rauserites exculptus* (Igo, 1957), and *Montiparus japonicus* sp. nov. Four float limestone samples, Fj-7–10 were collected along the westward tributary where Ic-2A and Ic-3A were collected. Moscovian foraminifers occur in grey bioclastic packstone of Fj-8 (Figures 4.7–4.10). *Carbonoschwagerina katoi*, *Rauserites exculptus*, *R. saurini* (Igo, 1957), and others are contained in the dark grey to black limestone of Fj-9. Samples Fj-7 and Fj-10 consist of dark gray limestone with *Rugosofusulina alpina* (Schellwien, 1898), *Quasifusulina longissima* (von Möller, 1878), and *Schubertella kingi* Dunbar and Skinner, 1937 suggesting an early Gzhelian age. The sources of these four float samples, however, were not confirmed in the field. Additionally, Watanabe (1991) reported "*Pseudoschwagerina*" *morikawai* from his float limestone sample collected near the localities of these four float samples.

Because of no exposures, the stratigraphic relationship is uncertain between the limestone from which samples Ic-2A and Ic-3A were collected, and the underlying limestone beds cropping out 30 to 40 m SE of Ic-63 (Figure 2). The latter limestone beds consist of grey to dark grey, oolitic and sparitic limestone and contain late Moscovian (Myachkovian) fusulines (Figures 4.11–4.13, 4.15, 4.16, 4.18, 4.20–4.22) including *Fusulinella rhomboidalis* Niikawa, 1978 and *Fusulinella soligalichi* Dalmatskaya, 1961. Their stratigraphic interval is equivalent to the upper part of the Upper Zone of *Fusulinella–Fusulina* by Niikawa (1980), and to the middle part of the *Fusulinella soligalichi* Zone by Igo *et al*. (1984). Igo *et al*. (1984) divided Igo's (1957) Zone of *Fusulina* into the lower *Beedeina ichinotaniensis* Zone and the upper *Fusulinella soligalichi* Zone. The early Kasimovian *Protriticites variabilis* Bensh, 1972, was reported by Watanabe (1991) from the dark grey biosparitic limestone without illustrations. *P.* cf. *variabilis* (Figure 7.12) is present in a float limestone sample collected by the present author in late 1970's near the Watanabe's (1991) locality. According to Watanabe (1991, p. 23, 24), this early Kasimovian limestone lies about 10 m above the limestone with *Fusulinella rhomboidalis*.

The original stratigraphic order and thickness along the upstream tributary of the Ichinotani valley extending northward (Units 2 to 7, Figures 2, 3) are not determined exactly on account of bedded limestones dipping steeply to almost vertically and reversed in parts. The stratigraphic interval from the southernmost part of limestone from which sample Ic-63 was collected, to the top of the Ichinotani Formation is subdivided by Igo *et al*. (1984) and Adachi (1985) into the units 54 to 61 of the Upper Member of the formation. The interval from the sample locality Ic-63 to the level of red shale is named by Watanabe (1991, 2001) as the "Barren Zone" above the limestone with *Protriticites variabilis* of Watanabe (1991). Fusulines shown by Igo *et al*. (1984) from the unit 55 are inferred to be collected by them from the same unit exposed along the upstream tributary of the Ichinotani valley extending westward, not northward, under my

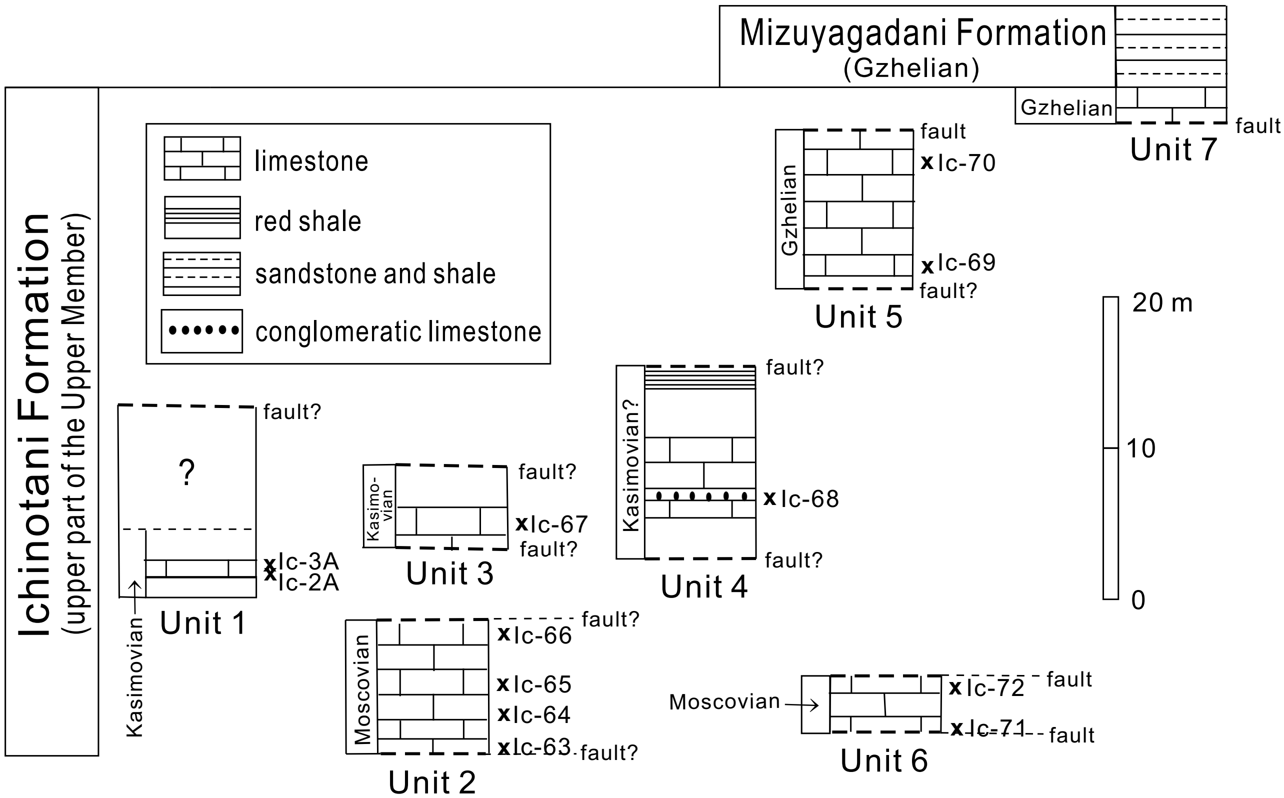

Figure 3. Stratigraphic columns of the Ichinotani Formation around the junction of upstream tributaries northward and westward in the middle reaches of the Ichinotani valley.

assumption of their species composition.

Foraminifers are rarely found in the dark grey to grey bedded limestones from which samples Ic-63–65 (oolitic limestone, Figures 4.1, 4.2) were collected. Among them, the occurrence of large-sized *Fusiella* comparable to *F. hayashii* Igo, 1957 is important, because the species is restricted to the Moscovian in the Ichinotani Formation. *Fusulinella* cf. *asiatica* Igo, 1957 (Figure 4.17), *Fusulinella* sp. (Figure 4.27), and others suggesting also a Moscovian age occur in sample Ic-66 (Figure 4.3). Poorly-oriented *Protriticites* sp. and *Eostaffella* sp. (Figure 4.23) probably assignable to early Kasimovian occur in sample Ic-67, a grey crinoidal grainstone. The conglomeratic limestone (sample Ic-68) (Figure 4.4) in the Unit 4 rarely contains fusulines that are questionably assigned to *Protriticites*. Foraminifers are also scarce in the bedded grey limesone of Unit 5. *Schubertella*? sp. and *Endothyra*? sp. are very rarely found in the grey limestone of sample Ic-69. Dark grey limestone (sample Ic-70) yields *Triticites noinskyi plicatus* Rozovskaya, 1950 (Figures 7.5, 7.6) suggesting an early Gzhelian age. This species also occurs in the Mizuyagadani valley (Figures 7.7, 7.8?) in association with *Carbonoschwagerina morikawai* (Figures 8.3, 8.6).

The sample Ic-71, a dark grey algal crinoidal wackestone, is assigned to the upper Moscovian based on the occurrence of a large-sized *Ozawainella* (Figure 4.31) that is probably referable to the species *O. vozhgalica* Safonova in Rauzer-Chernousova *et al.* (1951) characteristic and restricted to the *Beedeina ichinotaniensis* Zone of Igo *et al*. (1984). Noteworthy is the occurrence of the Podolskian *Beedeina* cf. *lanceolata* (Lee and Chen in Lee *et al*., 1930) (Figures 4.29, 4.30) from sample Ic-72 in association with *O*. cf. *vozhgalica* (Figures 4.14, 4.24–26) and others. In the stratigraphic interval from sample Ic-72 to the base of the Mizuyagadani Formation (Unit 7), Igo *et al*. (1984) showed the presence of *Triticites sadai* (*nomen nudum*), *T. saurini*, *Pseudoschwagerina morikawai praemorikawai* (*nomen nudum*), *Rugosofusulina alpina*, and others, all of which are hand-drawn specimens. The first and the third taxa were newly proposed by them without description. Based on these fusulines, Igo *et al*. (1984) assumed the uppermost part of the Ichinotani Formation along the Ichinotani valley as transitional strata between the Upper Carboniferous and the basal Permian. However, more evolved *Carbonos-*

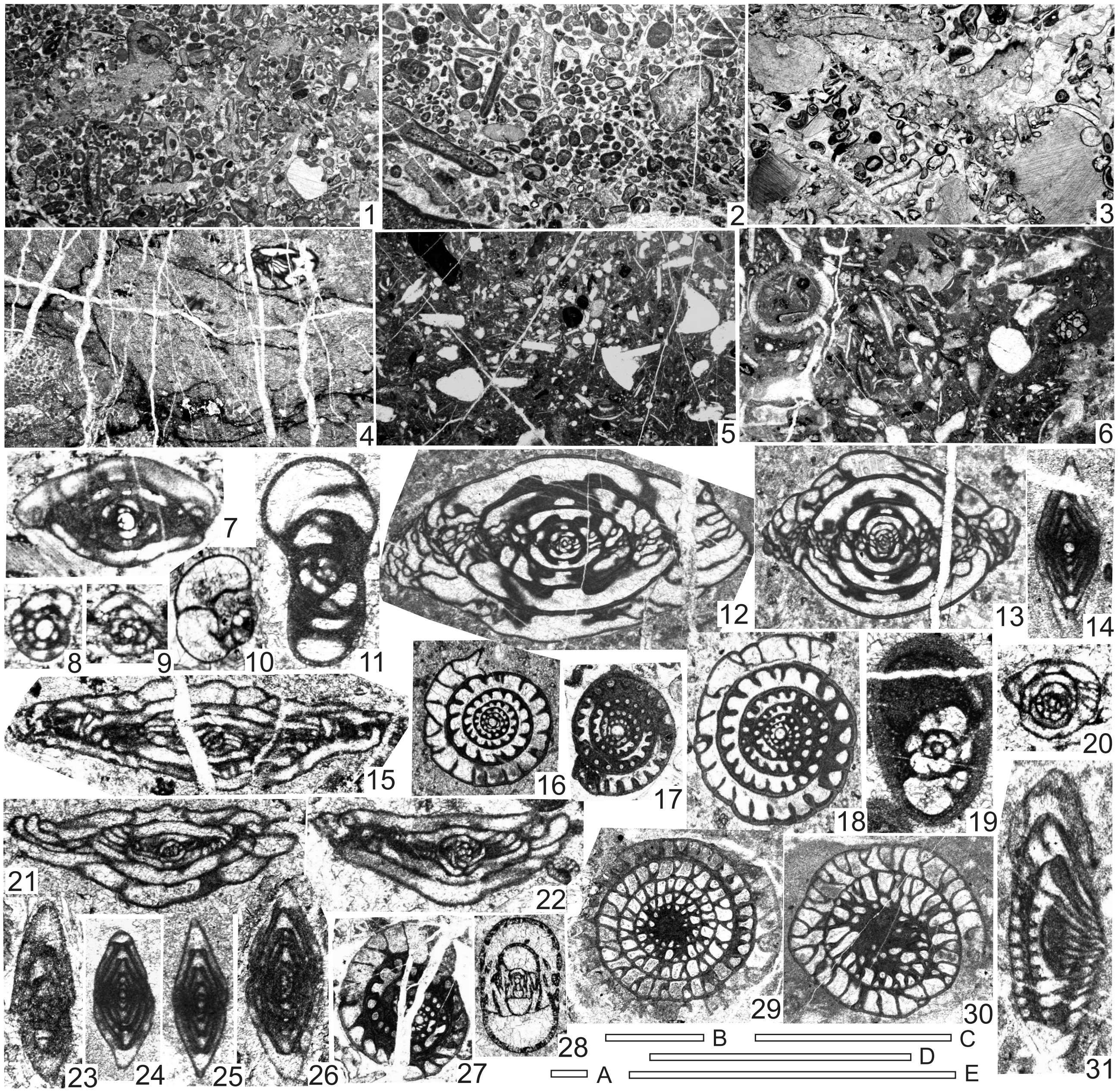

Figure 4. Limestone lithology and some Moscovian foraminifers. **1,** Ooid grainstone D2-059530, Ic-63. **2,** Bioclastic oolitic grainstone, D2-059537, Ic-64. **3,** Oolitic crinoidal grainstone, D2-059557, Ic-66. **4,** *Protriticites*?-bearing conglomeratic limestone, D2-059569, Ic-68. **5,** algal crinoidal wackestone, D-059587, Ic-71. **6,** *Beedeina*-bearing algal wackestone/packstone, D2-059608, Ic-72. **7, 16,** *Fusulinella* spp.; 7, D2-035710, Fj-8; 16, D-059441, Ic-58 (about 34 m below Ic-63). **8, 9,** *Eoschubertella obscura* (Lee and Chen in Lee *et al*., 1930), both D-035708, Fj-8. **10,** *Globivalvulina moderata* Reitlinger, 1949, D-035708, Fj-8. **11, 19,** *Rectoendothyra* sp.; 11, D2-059488, Ic-61(about 29 m below Ic-63); 19, D2-059528, Ic-63. **12, 18,** *Fusulinella rhomboidalis* Niikawa; 12, D2-059440, Ic-58; 18, D2-059476, Ic-61. **13,** *Fusulinella soligalichi* Dalmatskaya, D2-059477, Ic-61. **14, 24–26,** *Ozawainella* cf. *vozhgalica* Safonova; 14, D2-059601; 24, D2-059643; 25, D2-059641; 26, D2-059630; all Ic-72. **15, 21, 22,** *Fusiella hayashii* Igo; 15, D2-059514; 21, D2-059499; 22, D2-059515; all Ic-62. **17,** *Fusulinella* cf. *asiatica* Igo, D2-059554, Ic-66. **20,** *Eoschubertella* sp., D2-059520, Ic-62 (about 30 m below Ic-63). **23,** *Eostaffella* sp., D-059565, Ic-67. **27,** *Fusulinella* sp., D2-059556, Ic-66. **28,** *Bradyina regularis* Lin, 1978; D-059500, Ic-62. **29, 30,** *Beedeina* cf. *lanceolata* (Lee and Chen); 29, D2-059629; 30, D2-059602; both Ic-72. **31,** *Ozawainella vozhgalica* Safonova, D2-059592, Ic-71. Scale bar is 1 mm; bar A for 1–6; bar B for 12, 13, 16–18, 27–30; bar C for 15, 21, 22; bar D for 7, 14, 24–26, 31; bar E for 8–11, 19, 20, 23.

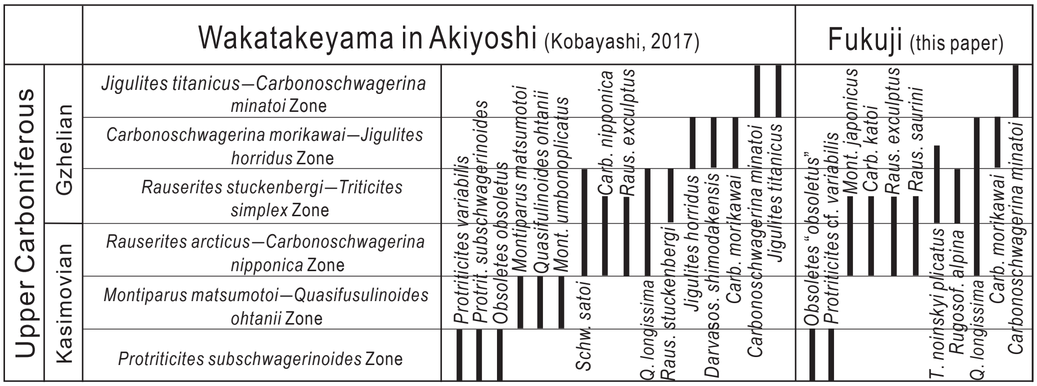

Figure 5. Fusuline zonation and biostratigraphic distribution of some Kasimovian and Gzhelian fusulines in the Wakatakeyama area of the Akiyoshi Limestone (Kobayashi, 2017), and ranges of some coeval fusuline species in the Fukuji area. *Q. longissima* = *Quasifusulina longissima*; *Protrit.* = *Protriticites*; *Mont.* = *Montiparus*; *Schw.* = *Schwagerina*; *Carb.* = *Carbonoschwagerina*; *Raus.* = *Rauserites*; *Darvasos.* = *Darvasoschwagerina*.

chwagerina, "*Pseudoschwagerina*" *minatoi* Kanmera, 1958 than "*P*." *morikawai* illustrated by Watanabe (1991) from the Mizuyagadani valley is not reported by Igo *et al*. (1984) from the Ichinotani valley. Three specimens named *Schwagerina*? *satoi* Y. Ozawa, 1925 were illustrated by Watanabe (1991, figs. 24.28–24.30) from the top of the Ichinotani Formation along the Ichinotani valley. These fusulines have more advanced test characters than *Schwagerina*? *satoi* that were illustrated from Watanabe's float limestone samples in his "Barren Zone". Although these fusulines reported by Igo *et al*. (1984) and Watanabe (1991) from the top of the Ichinotani Formation (Unit 7) could not be found by the present author, they are thought to be an early Gzhelian age.

Summarizing the above discussion, the upper part of the Upper Member of the Ichinotani Formation along the middle reaches of the Ichinotani valley is not composed throughout of only the upper Kasimovian and lower Gzhelian, but also includes the Moscovian strata of several meters thick in at least two horizons. More Moscovian beds are presumable in the mapped area from the presence of float samples containing Moscovian fusulines. The Moscovian beds in the northern part of the mapped area (Units 2 and 6) are inferred to be fault-bounded with the underlying and overlying strata having Gzhelian or Kasimovian fusulines. These points of biostratigraphic information suggest more complicated geological structure of the formation than previously assumed.

Limestone assigned to the "*Pseudoschwagerina*" Zone along the Ichinotani valley is confined to the float sample of Watababe (1991) as mentioned above. *Triticites elongatus* Niikawa, 1978 proposed newly from the lenticular limestone of this zone and occurring along the upper reaches of the valley (Niikawa, 1978, loc. 46) should be reassigned to an elongate form of *Jigulites* that is common in the middle to upper Gzhelian of the Tethyan regions. In addition to the species "*Pseudoschwagerina*" *morikawai* and "*P*." *minatoi*, a transitional form from "*P*." *morikawai* to "*P*." *minatoi* was illustrated by Watanabe (1991) from strata along the Mizuyagadani valley. *Carbonoschwagerina minatoi* is the index species of the uppermost Gzhelian of Japan (T. Ozawa *et al*., 1992; Kobayashi, 2017). *Carbonoschwagerina* described herein from the lower reaches of the Takadani valley (Figure 1) belongs to a primitive form of *C. morikawai*. Many individuals of non-fusuline foraminifers such as *Climacammina*, *Tetrataxis*, *Bradyina*, and *Pseudojanischewskina* also occur in the Takadani valley. Further biostratigraphic studies should be done around the Mizuyagadani valley, where Niikawa (1978, 1980) showed fault-bounded relations between the Zone of *Triticites* and the Zone of *Pseudoschwagerina*, and the Upper and Lower Zones of *Fusulinella–Fusulina*.

Biostratigraphic correlation and faunal implications

As noted above, the fusuline biostratigraphy of the Kasimovian and Gzhelian is described based on my data mainly along the middle reaches of Ichinotani valley in comparison to previous works in the Fukuji area. Although the biostratigraphic ranges of fusulines are not exactly determined independently in the Fukuji area, they are roughly estimated based on age-diagnostic species common between the Fukuji area and other areas especially of the Akiyoshi Limestone (Kobayashi, 2017). Approximate ranges of some of them in the former are shown on the basis of the biostratigraphic correlation between the former and the latter (Figure 5).

Obsoletes obsoletus (Schellwien, 1908) reported by Niikawa (1978) is more related to *O. grosdilovae*

(Miklukho-Maklay, 1949) described from the lower Kasimovian of the southern Fergana by Bensh (1972). An occurrence of the species supports the presence of the lower Kasimovian in the Fukuji area along with *Protriticites* cf. *variabilis*, and is not in conflict with that of *Fusulinella rhomboidalis* and *F. soligalichi* from the lowerlying Moscovian beds. *F. rhomboidalis* is confined to the Myachkovian in the Akiyoshi Limestone, and *F. soligalichi* was originally described from the upper Podolskian and the lower Myachkovian along the Volga of the Russian Platform (Dalmatskaya, 1961).

Fusulines apparently correlatable to the middle Kasimovian are not found in the Fukuji area. Dark grey to black limestone beds containing *Carbonoschwagerina katoi*, *Rauserites exculptus*, and others are assigned to the upper Kasimovian to lower Gzhelian based on the biostratigraphic range of *R. exculptus* in the Akiyoshi Limestone. Although the faunal composition somewhat resembles that from the late Kasimovian to early Gzhelian, *Rugosofusulina alpina* and *Triticites noinskyi plicatus* characteristic in the Fukuji area are unknown from Akiyoshi. On the contrary, middle Gzhelian *Jigulites horridus* (Kanmera, 1958) and late Gzhelian *J. titanicus* Kobayashi, 2017 are more dominant than coeval *Carbonoschwagerina morikawai* and *C. minatoi*, respectively, in the Akiyoshi Limestone, and are completely absent in the Fukuji area, along with *Darvasoschwagerina shimodakensis* (Kanmera, 1958) and *Pseudofusulina kumasoana* Kanmera, 1958 also characteristic in the middle and upper Gzhelian of the Akiyoshi Limestone.

More conspicuous faunal dissimilarities at the generic level are recognized in the Moscovian between the Fukuji and Akiyoshi areas. *Neostaffella* and *Hidaella* are absent in coeval strata throughout Japan except for the Ichinotani Formation. Early Moscovian *Akiyoshiella*, late Moscovian *Kanmeraia*, and middle Kasimovian *Quasifusulinoides* characteristic to the Akiyoshi Terrane are absent in the Fukuji area. *Carbonoschwagerina morikawai* and *C. minatoi* are common throughout the Gzhelian of Japan. Kasimovian to Gzhelian inflated schwagerinids exemplified by *Carbonoschwagerina* and *Tumefactus* have particular implications to late Carboniferous paleobiogeography and faunal provincialism. *Tumefactus*, proposed by Leven and Davydov (2001) as a subgenus of the genus *Schwageriniformis* and distributed in the western Paleo-Tethys, is a counterpart of *Carbonoschwagerina* and is related morphologically, but unrelated phylogenetically (Kobayashi, 2017).

Faunal similarities and dissimilarities summarized above should also be affected strongly by paleoenviromental controls typified by the exclusive occurrence of reddish shale and sharpstone conglomerate in the Ichinotani Formation throughout Japan (Igo, 1960, 1961). They are also attributed to the origin of the Japanese terranes, the continental margin of ancient North China in the Hida Marginal Terrane versus the Panthalassan seamounts accreted to ancient South China in the Akiyoshi Terrane, and are important for the tectonic evolution and amalgamation of East Asia from the Late Paleozoic to the Middle Mesozoic.

Description of species

Genus ***Bradyina*** von Möller, 1878

Type species.—*Bradyina nautiliformis* von Möller, 1878.

Bradyina nautiliformis von Möller, 1878

Figure 9.29, 9.30, 9.34–9.36, 9.39

Bradyina nautiliformis von Möller, 1878, p. 83, pl. 3, fig. 4a–d; pl. 10, fig. 3a, b; Lee and Chen in Lee *et al*., 1930, p. 104, pl. 5, figs. 5–9; Rauzer-Chernousova *et al*., 1940, p. 47, pl. 8, figs. 1–3; pl. 9, figs. 1–3; Putrya, 1956, p. 371, pl. 1, figs. 9–11; Lin, 1978, p. 36, pl. 7, fig. 16; Igo and Adachi, 1981, p. 110, pl. 6, fig. 15 (= Adachi, 1985, p. 115, 116, pl. 18, fig. 1); Kobayashi, 2019, p. 6, 7, 9, figs. 5.1–5.14; Kobayashi and Vachard, 2019, p. 367, 369, pl. 1, figs. 62, 63; pl. 3, figs. 1–6, 30.

Remarks.—Size and shape of the test, degree of depth of umbilicus, thickness of wall, and perforation of pseudokeriotheca are considerably variable from specimen to specimen in the present material. They are supposed to represent the intraspecific variations of *Bradyina nautiliformis*, as suggested by Kobayashi (2019). This species is distinguished from *Bradyinelloides pseudonautiliformis* (Reitlinger, 1950) illustrated herein in Figure 9.31–9.33 by its thinner and not so coarsely alveolar thick wall.

Genus ***Pseudojanischewskina*** Mamet and Pinard, 1990

Type species.—*Pseudojanischewskina multicribrata* Mamet and Pinard, 1990.

Pseudojanischewskina sp. A

Figure 9.27, 9.28

Remarks.—This unnamed species is assigned to *Pseudojanischewskina* based on its thinner wall consisting of a tectum and much more finely porous layer. Remnants of septa and lamellae are sporadically present in association with the main septa that gently curved outward. These characters are also recognized in *Pseudojanischewskina* sp. B (Figure 9.25, 9.26), but the test of *P.* sp. A is almost spherical. *P.* sp. A and *P.* sp. B differ from the known species of the genus by their smaller test and fewer number

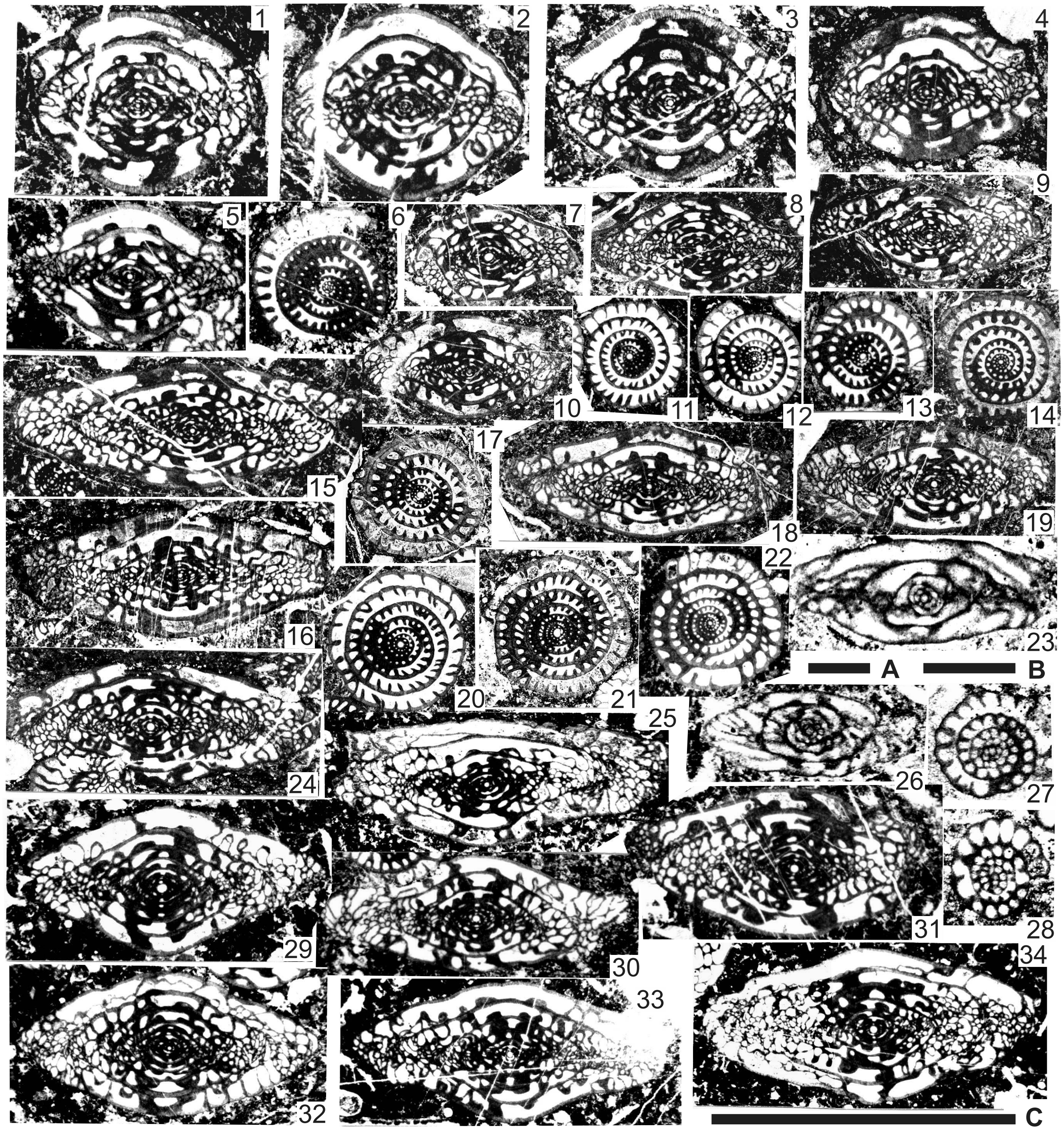

Figure 6. **1–6, 11, 12,** *Carbonoschwagerina katoi* (Niikawa, 1978); 1, D2-004042; 2, 3, D2-004041; 4, D2-035728; 5, D2-004043; 6, D2-004045; 11, D2-004038; 12, D2-004046; 4, Fj-9, others Ic-2A; **7–10, 13, 14,** *Rauserites exculptus* (Igo, 1957); 7, D2-035728; 8, D2-035733; 9, D2-035722; 10, D2-035715; 13, D2-004040; 14, D2-035717; 13, Ic-2A, others Fj-9; **15–21, 24,** *Rauserites saurini* (Igo, 1957); 15, D2-035731; 16, D2-035730; 17, D2-035716; 18, D2-035725; 19, D2-035734; 20, D2-035724; 21, D2-035732; 24, D2-035719; all Fj-9; **22, 25, 29–34**, *Montiparus japonicus* sp. nov.; 22, D2-004062; 25, D2-004037; 29, D-004036; 30, D2-004039; 31, D2-004064; 32, D2-004065; 33, D2-004063; 34, D2-004061; 25, 29, 30, Ic-2A; others Ic-3A; 34: holotype, others: paratypes; **23, 26–28,** *Schubertella kingi* Dunbar and Skinner, 1937; 23, 27, D2-035697; 26, D2-035753; 28, D2-035695; 26, Fj-10; others Fj-7. Scale bar is 1 mm; bar A for 7–22, 24, 25, 29–44; bar B for 1–6; bar C for 23, 26–28.

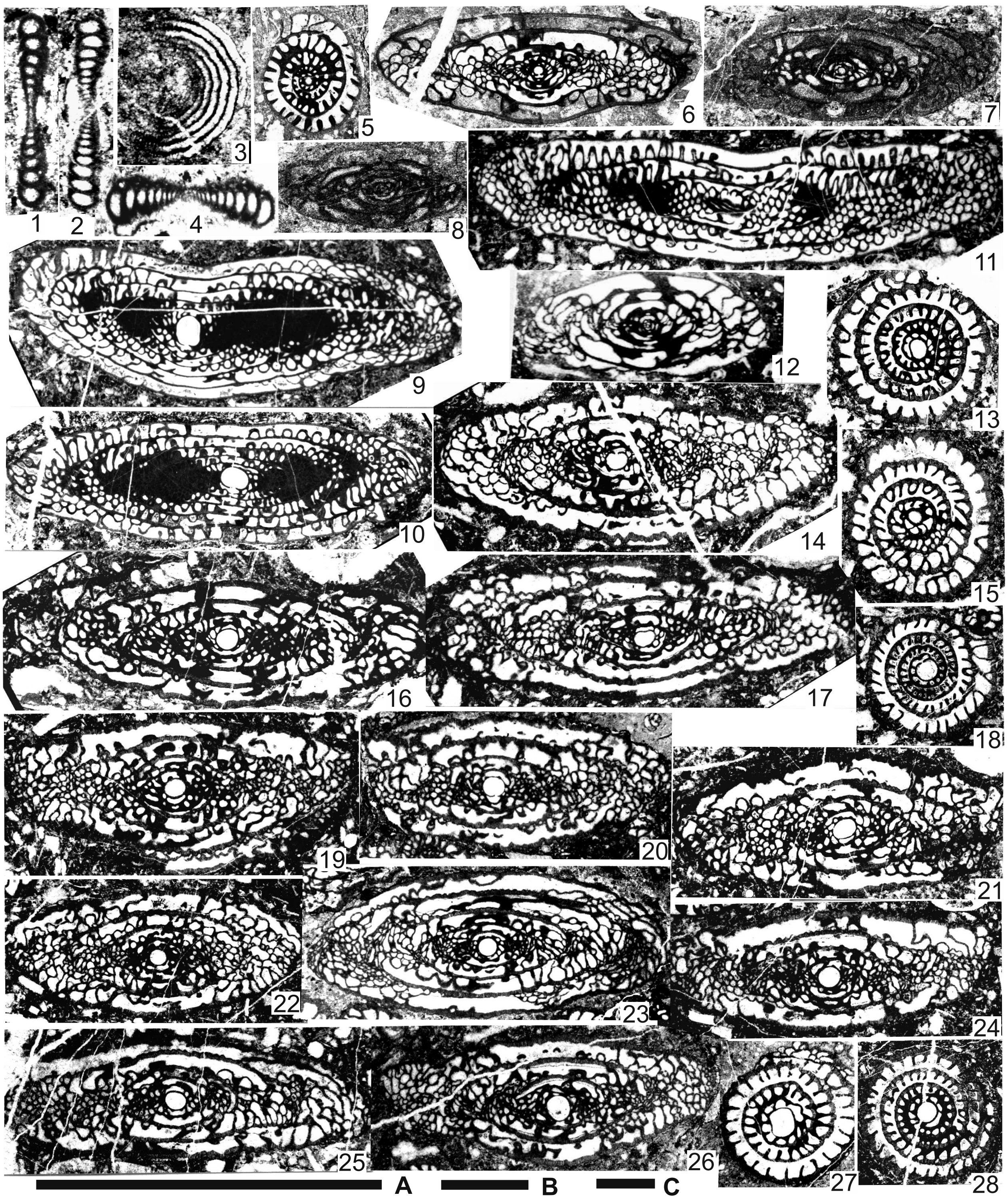

Figure 7. 1–4, *Lasiodiscus*? sp.; 1, D2-035752; 2, D2-035739; 3, D2-035766; 4, D2-035743; all Fj-10; **5–7, 8?,** *Triticites noinskyi plicatus* Rozovskaya, 1950; 5, D2-059581, Ic-70; 6, D2-059582, Ic-70; 7, D2-059665, Mz-1; 8, D2-059656, Mz-1; **9–11,** *Quasifusulina longissima* (von Möller, 1878); 9, D2-035704; 10, D2-035759; 11: D2-035746; 9, Fj-7; others Fj-10; **12,** *Protriticites* cf. *variabilis* Bensh, 1972, D2-004136, Ic-9A; **13–28,** *Rugosofusulina alpina* (Schellwien, 1898); 13, D2-035765; 14, D2-35695; 15, D2-035696; 16, D2-035758; 17, D2-035755; 18, D2-035743; 19, D2-025740; 20, D2-035701; 21, D2-035766; 22, D2-035753; 23, D2-035699; 24, D2-035751; 25, D2-035745; 26, D2-035702; 27, D2-035700; 28, D2-035760; 14, 15, 20, 23, 26, 27, Fj-7; others Fj-10. Scale bar is 1 mm; bar A for 1–4, bar B for 12, bar C for 5–11, 13–28.

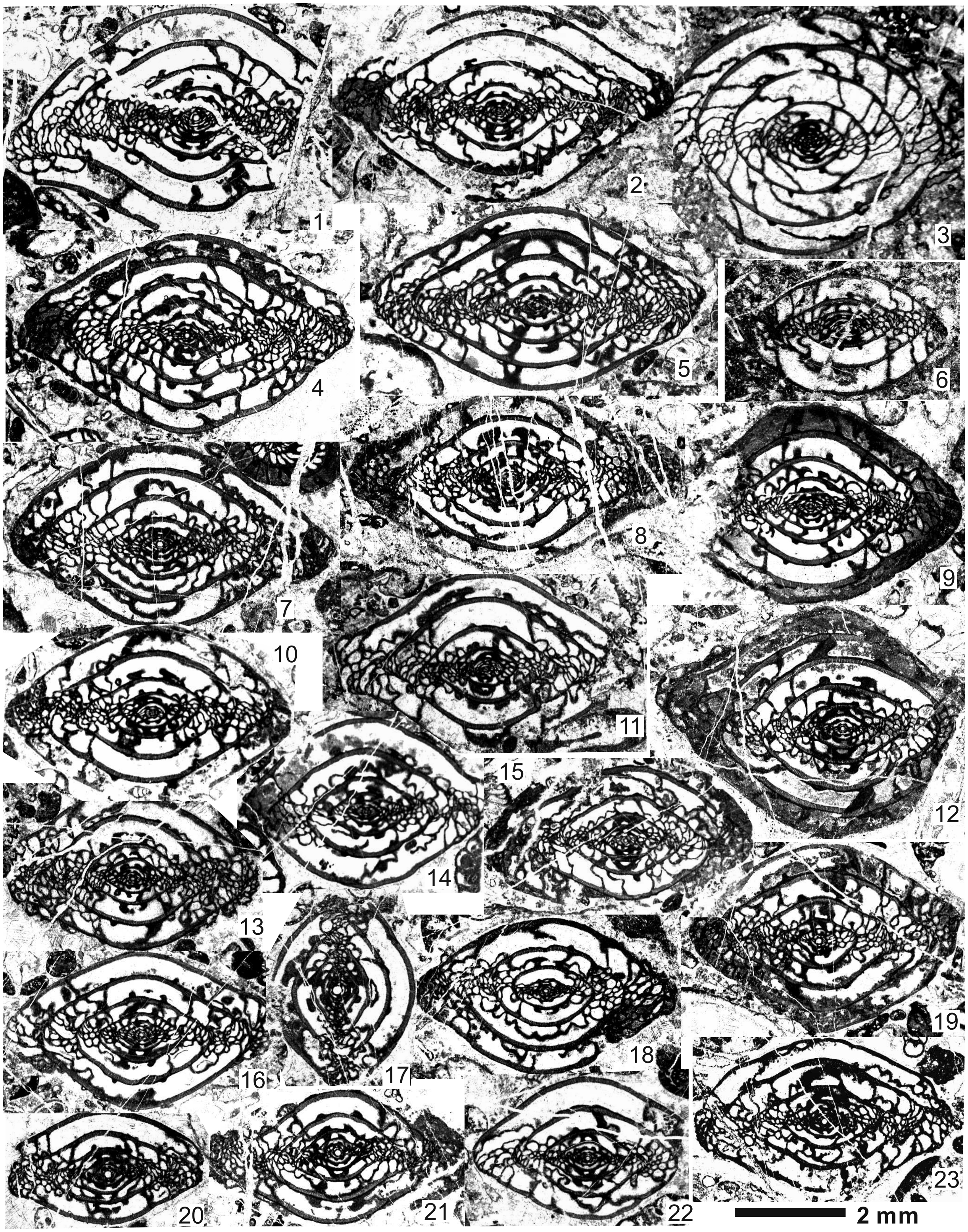

Figure 8. **1–23,** *Carbonoschwagerina morikawai* (Igo, 1957); 1, D2-035839; 2, D2-035784; 3, D2-059653; 4, D2-035829; 5, D2-035767; 6, D2-059662; 7, D2-035832; 8, D2-035820; 9, D2-035794; 10, D2-035792; 11, D2-035783; 12, D2-035781; 13, D2-0358338; 14, D2-035789; 15, D2-035788; 16, D2-035782; 17, D2-035805; 18, D2-035828; 19, D2-035779; 20, D2-035801; 21, D2-035787; 22, D2-035803; 23, D2-035776; 3, 6, Mz-1; others Fj-11. Scale bar of 2 mm for all.

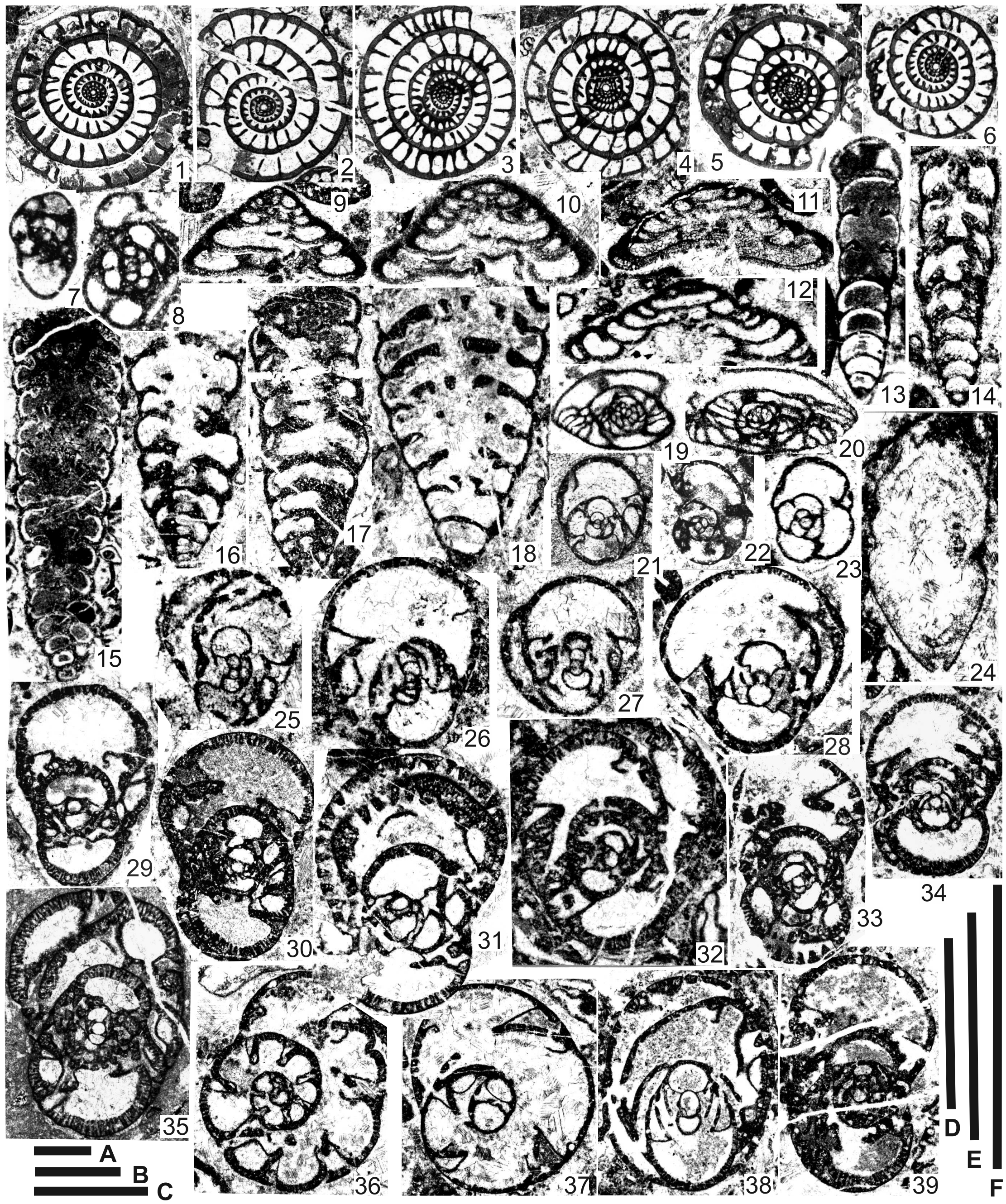

Figure 9. **1–6,** *Carbonoschwagerina morikawai* (Igo, 1957); 1, D2-035836; 2, D2-035809; 3, D2-035799; 4, D2-035806; 5, D2-035786; 6, D2-035777; all Fj-11; **7,** *Endothyra*? sp. A, D2-035811, Fj-11; **8,** *Endothyra*? sp. B, D2-035835, Fj-11; **9–12,** *Tetrataxis* sp.; 9, D2-035806; 10, 12, D2-035843; 11, D2-035798; all Fj-11; **13,** *Deckerella* sp., D2-035777, Fj-11; **14–17,** *Climacammina* cf. *procera* Reitlinger, 1950; 14, D2-035842; 15, D2-035768; 16, D2-035838; 17, D2-035811; all Fj-11; **18,** *Climacammina* sp., D2-035838, Fj-11; **19, 20,** *Schubertella* cf. *mjachkoensis* Rauzer-Chernousova in Rauzer-Chernousova *et al*., 1951; 19, D2-035839; 20, D2-035803; both Fj-11; **21, 22,** *Bradyina minima* Reitlinger, 1950; 21, D2-59578, Ic-70; 22, D2-035803, Fj-11; **23,** *Pseudobradyina*? sp., D2-035826, Fj-11; **24,** *Reitlingerina* sp., D2-035800, Fj-11; **25, 26,** *Pseudojanischewskina* sp. B; 25, D2-035841, Fj-11; 26, D2-035702, Fj-7; **27, 28,** *Pseudojanischewskina* sp. A; 27, D2-035827; 28, D2-035829; both Fj-11; **29, 30, 34–36, 39,** *Bradyina nautiliformis* von Möller, 1878; 29, D2-035780; 30, D2-035802; 34, D2-035786; 35, D2-059580; 36, D2-035772; 39, D2-035825; 35, Ic-70; others Fj-11; **31–33,** *Bradyinelloides pseudonautiliformis* (Reitlinger, 1950); 31, D2-035793, Fj-11; 32, D2-035743, Fj-10; 33, D2-035781, Fj-11; **37, 38,** *Bradyina papilionacea* Lin, 1978; 37, D2-035767, Fj-11; 38, D2-35700, Fj-7. Scale bar is 1 mm; bar A for 1–6; bar B for 15, 18, 29, 30, 34–36, 38, 39; bar C for 17, 31–33, 37; bar D for 9–14, 16, 21, 22, 24; bar E for 19, 20, 25–28; bar F for 7, 8, 23.

Table 1. Measurements of *Rugosofusulina alpina* (Schellwien, 1898).

Figure	No. whorl	Length	Width	Form ratio	Proloculus	Length of whorl					Width of whorl				
						1	2	3	4	5	1	2	3	4	5
7.16	4	6.46	2.22	2.91	0.39	0.96	2.14	4.18	6.47		0.61	1.00	1.52	2.22	
7.17	4.5	7.75	2.43	3.19	0.37	0.94	2.36	4.76	6.86		0.57	0.98	1.49	2.15	
7.19	4.5	6.4?	2.80	2.3?	0.42	1.05	1.94	3.86	5.97		0.63	1.10	1.74	2.38	
7.20	4	5.6?	2.34	2.4?	0.40	0.99	2.25	4.12	5.6?		0.62	1.03	1.60	2.34	
7.21	4	5.95	2.46	2.42	0.46	0.95	2.01	3.97	5.95		0.60	1.09	1.66	2.46	
7.22	4	5.21	2.21	2.36	0.28	0.85	1.88	3.10	5.21		0.58	1.04	1.52	2.21	
7.23	5	6.34	2.57	2.47	0.35	0.73	1.75	3.13	4.91	6.34	0.52	0.79	1.24	1.86	2.57
7.24	4	5.83	2.19	2.66	0.41	0.86	1.90	3.83	5.83		0.64	0.95	1.50	2.19	

Figure	No. whorl	Length	Width	Form ratio	Proloculus	Number of septa					Width of whorl				
						1	2	3	4	5	1	2	3	4	5
7.13	4.3	—	2.80	—	0.41	10	21	26	27	13>	0.68	1.17	1.77	2.56	
7.15	3.8	—	2.95	—	0.32	10	22	27	27>		0.83	1.37	2.10		
7.18	3.9	—	2.24	—	0.40	11	25	27	27>		0.69	1.13	1.74		
7.27	3.2	—	2.23	—	0.53	10	21	24	6>		0.99	1.57	1.96		
7.28	4.3	—	2.39	—	0.38	8	21	28	29	13>	0.68	1.12	1.61	2.45	

of whorls in mature stage.

Genus ***Quasifusulina*** Chen, 1934

Type species.—*Fusulina longissima* von Möller, 1878.

Quasifusulina longissima (von Möller, 1878)

Figure 7.9–7.11

Fusulina longissima von Möller, 1878, p. 59–61, pl. 1, fig. 4; pl. 2, fig. 1a–c; pl. 7, fig. 1a–c.

Quasifusulina longissima (von Möller). Chen, 1934, p. 92, 93, pl. 5, figs. 6–9; Igo, 1957, p. 224, 225, pl. 8, figs. 13–18; pl. 11, figs. 12, 13; Niikawa, 1978, p. 561, 562, pl. 11, figs. 5, 7, 9, 10, 12; Watanabe, 1991, fig. 31.6–31.11; Watanabe, 1997, p. 101–106, pl. 11, figs. 1–16; Kobayashi, 2017, p. 43, pl. 11, figs. 25–36.

Remarks.—Specimens assigned to this species in the Fukuji area are described from the *Triticites* Zone and *Pseudoschwagerina* Zone by Igo (1957) and Niikawa (1978), and illustrated from the "*Pseudoschwagerina*" *minatoi* Zone by Watanabe (1991). *Quasifusulina* is not found in sample Fj-11 with *Carbonoschwagerina morikawai*. The illustrated specimens herein were obtained from float samples Fj-7 and Fj-10 in association with *Rugosofusulina alpina*. The largest specimen in sample Fj-10 is more than 9.5 mm in length. Longer diameter of proloculus in sample Fj-7 and Fj-10 ranges from 0.25 to 0.48 mm. The present specimens are closely similar to those described by authors. Watanabe (1997, p. 106) transferred Niikawa's (1978) *longissima* specimens and Igo's (1957) one specimen to *Q. longissimi ultima* Kanmera, 1958 based on a larger proloculus.

Genus ***Rugosofusulina*** Rauzer-Chernousova, 1937

Type species.—*Fusulina prisca* Ehrenberg, 1842.

Rugosofusulina alpina (Schellwien, 1898)

Figure 7.13–7.28

Fusulina alpina var. *communius* Schellwien, 1898, p. 245–247, pl. 17, figs. 5–7.

Schellwienia alpina (Schellwien). Lee, 1927, p. 94–96, pl. 15, figs. 1–11.

Rugosofusulina alpina (Schellwien). Rauzer-Chernousova, 1937, pl. 2, fig. 7; Igo, 1957, p. 239–242, pl. 14, figs. 11–15; pl. 15, figs. 1, 2; Shcherbovich, 1969, p. 26, 27, pl. 7, figs. 4–6.

Measurements.—Shown in Table 1.

Description.—Test elongate fusiform with broadly arched periphery, straight to slightly convex lateral sides, and rounded poles. Periphery and lateral sides of the test more or less undulated. Test consists of four to five whorls, 5.21 to 7.75 mm in length and 2.19 to 2.95 mm in width, giving a form ratio 2.3? to 3.19. Proloculus is spherical to subspherial and its longer diameter 0.28 to 0.53 mm. Length, width, and form ratio of whorls gradually increase outwards. Wall, smooth to slightly undulate in inner whorls, becomes thicker and distinctly undulate in most of middle and outer whorls, and consists of a tectum and alveolar keriotheca. Thickness of the wall is 0.08 to 0.15 mm in the thickest middle and outer whorls.

Septa closely spaced throughout whorls, irregularly and intensely folded in polar regions, and planar to weakly folded in tunnel regions. Septal counts from the first to fifth whorls 8 to 11, 21 to 25, 24 to 28, 27 to 29, and more than 13 in the illustrated five sections, respectively. Septal sutures distinct in general in outer whorls. Tunnel low and narrow in inner whorls, gradually higher outwards. Its path becomes irregular and wider in outer whorls. Chomata absent except on poloculus and inner few whorls.

Remarks.—Sixteen specimens illustrated herein are closely similar to those identified by Igo (1957) with this species in many respects. This species was originally divided into three varieties, *Fusulina alpina* var. *antiqua*, *F. alpina* var. *fragilis*, and *F. alpina* var. *communius* by Schellwien (1898). Among the three, the Fukuji specimens are closely similar to *F. alpina* var. *communius*, though having a more undulated wall and larger proloculus. Lee (1927) noted the difficulty of the taxonomic separation of the varieties. Rauzer-Chernousova (1937) considered the independency of *Fusulina alpina* var. *communius* from two other varieties and reassigned *alpina* to *Rugosofusulina*. Size and shape of the test and proloculus, degree of undulation and thickness of the wall are more or less variable in the Fukuji material. These differences gradually changing from specimen to specimen are due to the intraspecific variations of this species. This species is similar to *Rugosofusulina prisca ovoidea* Bensh, 1972 proposed from the Kasimovian of the southern Fergana (Bensh, 1972), but has a larger proloculus and thicker wall.

Genus ***Carbonoschwagerina*** T. Ozawa, Watanabe, and Kobayashi, 1992

Type species.—*Pseudoschwagerina morikawai* Igo, 1957.

Remarks.—See Kobayashi (2017, p. 102, 104).

Carbonoschwagerina katoi (Niikawa, 1978)

Figure 6.1–6.6, 6.11, 6.12

Triticites katoi Niikawa, 1978, p. 565, 566, pl. 14, figs. 1, 2.
Triticites ichinotaniensis Niikawa, 1978, p. 566, 567, pl. 13, figs. 8, 9.
Triticites paramontiparus Niikawa, 1978, p. 564, pl. 13, figs. 1, 2.
Schwagerina? *satoi* Y. Ozawa, 1925. Watanabe, 1991 (*pars*), fig. 24.19–24.27. (*non* 24.28–24.30)

Remarks.—Niikawa (1978) proposed three new species of *Triticites* listed above from the same sample. They are safely reassigned to *Carbonoschwagerina*. Relative to other species of the genus, they are characterized by a smaller test, larger proloculus, and thicker wall throughout growth. These three new species are not easily differentiated from each other based on more or less differences in size of the test and proloculus, degree of inflation of the test, and thickness of the wall, as done by Niikawa (1978). Watanabe (1991, p. 26) suggested that they are conspecific. Likewise, Kobayashi (2017) recognized close similarities among *Triticites katoi*, *T. ichinotaniensis*, and *Carbonoschwagerina nipponica* Kobayashi, 2017. *C. nipponica* was distinguished from the first and second species by having larger test and thinner wall (Kobayashi, 2017). *Triticites paramontiparus* is also treated as synonymous with *T. katoi*, since slight morphological differences among *T. katoi*, *T. ichinotaniensis*, and *T. paramontiparus* are presumed to be intraspecific variations of *T. katoi*.

Among 12 specimens identified as *Schwagerina*? *satoi* by Watanabe (1991) from the Ichinotani Formation, nine are associated with *Rauserites exculptus* and *R. hidensis* (Igo, 1957), and came from float samples. They have a smaller test, and smaller length and width in corresponding whorls than other three specimens named also as *Schwagerina*? *satoi* by Watanabe (1991) from the top of the formation that are thought to be a more evolved form of *Carbonoschwagerina* than *C. katoi*. Specimens questionably assigned to *Schwagerina* by Watanabe (1991) including *S.*? *satoi* from the Akiyoshi Terrane and the Ichinotani Formation are transferred from *Schwagerina*? to *Carbonoschwagerina*. The septa are folded throughout the test in the topotypes of *Schwagerina satoi* from the upper Kasimovian and lower Gzhelian of the Akiyoshi Limestone (Kobayashi, 2017, p. 90, 92, pl. 23, figs. 6–31).

Carbonoschwagerina morikawai (Igo, 1957)

Figures 8.1–8.23, 9.1–9.6

Pseudoschwagerina morikawai Igo, 1957, p. 238, 239, pl. 15, figs. 11–17; Kanmera, 1958, p. 177–179, pl. 27, figs. 1–11; Niikawa, 1978, p. 568, pl. 14, figs. 5–8.
"*Pseudoschwagerina*" *morikawai* Igo. T. Ozawa and Kobayashi, 1990, pl. 4, figs. 19, 20; Watanabe, 1991, figs. 26.1–26.14; figs. 27.1–27.11; figs. 28.3–28.5.

Table 2. Measurements of *Montiparus japonicus* sp. nov.

Figure	No. whorl	Length	Width	Form ratio	Proloculus	Length of whorl 1	2	3	4	5	6	7	Width of whorl 1	2	3	4	5	6	7
6.25	6	5.8?	2.08	2.8?	0.09	0.34	0.76	1.27	2.10	4.16	5.8?		0.22	0.34	0.63	1.03	1.55	2.08	
6.29	6.5	5.17	2.42	2.14	0.19	0.42	0.80	1.18	1.74	2.58	3.96		0.27	0.45	0.71	1.04	1.46	2.08	
6.30	6	5.06	1.95	2.59	0.15	0.22	0.51	0.98	1.97	3.46	5.06		0.22	0.33	0.54	0.93	1.39	1.95	
6.31	6.5	5.24	2.45	2.14	0.16	0.24	0.63	1.00	1.82	3.16	4.56		0.22	0.32	0.60	0.96	1.43	2.16	
6.32	7	4.96	2.41	2.06	0.07	0.21	0.44	0.86	1.47	2.15	3.44	4.96	0.13	0.28	0.56	0.83	1.23	1.74	2.41
6.33	6.5	5.30	2.29	2.31	0.11	0.23	0.46	0.95	1.74	2.75	4.20		0.21	0.30	0.54	0.96	1.43	2.01	
6.34	7	5.54	2.63	2.11	0.13	0.28	0.65	1.11	1.78	2.88	4.22	5.54	0.20	0.35	0.56	0.92	1.40	1.94	2.63

Carbonoschwagerina morikawai (Igo). T. Ozawa, Watanabe, and Kobayashi, 1992, p. 396, 397, figs. 10.8–10.12; Kobayashi, 2017, p. 106, 108, pl. 14, figs. 5–16; pl. 15, figs. 1–13.

Remarks.—Type specimens of *Carbonoschwagerina morikawai* from the Mizuyagadani valley (Igo, 1957) and the present ones from the Takadani valley have a smaller test and larger proloculus than those from the Yayamadake Limestone (Kanmera, 1958) and the Akiyoshi Limestone (Watanabe, 1991; Kobayashi, 2017). *C. morikawai* of the Fukuji area, however, cannot be separated from that of the Yayamadake and Akiyoshi limestones on the species level by slight differences of other test characters such as the number of juvenile whorls and degree of expansion of the test, along with thickness of the wall, mode of septal folding, development of chomata, and their ontogenetic changes.

The described species is distinguished from *C. minatoi* (Kanmera, 1958) as mentioned in Kanmera (1958), Watanabe (1991), and Kobayashi (2017). Watanabe (1991) recognized a transitional form from *morikawai* to *minatoi* and showed the one-way trend of evolution from *C. morikawai* to *C. minatoi*. Comparison of these two species between Japanese and foreign materials were discussed by Watanabe (1991) and Kobayashi (2017). Moreover, Kobayashi (2017) pointed out *Carbonoschwagerina nakazawai* (Nogami, 1961) is an ancestral form of *C. morikawai*. In addition to two specimens from the Mizuyagadani valley, many specimens from the Takadani valley are illustrated herein to compare to those referable to the genus reported in and outside Japan.

Genus ***Montiparus*** Rozovskaya, 1948

Type species.—*Fusulina montipara* von Möller, 1878.

Montiparus japonicus sp. nov.

Figures 6.22, 6.25, 6.29–6.34

ZooBank lsid: urn:lsid:zoobank.org:act:0D26D019-19C8-4975-B9DB-1EB62B186D01

Etymology.—From Japan.

Type specimens.—Holotype, MNHAH D2-004061, axial section from Ic-3A (Figure 6.34). Paratypes: six axial sections from Ic-2A and Ic-3A (Figures 6.25, 6.29–6.33), and one sagittal section from Ic-2A (Figure 6.22). Register numbers of seven paratypes are shown in the explanation of Figure 6.

Type locality.—Middle reaches of Ichinotani valley, Fukuji area, Takayama City, Gifu Prefecture.

Diagnosis.—Inflated fusiform *Montiparus* consisting of relatively tightly coiled inner whorls followed by gradually expanding outer whorls with an arched periphery and rounded to bluntly pointed poles. Septa closely spaced, intensely folded in the polar regions resulting many irregularly-shaped and irregularly-sized loops, and almost planar to very weakly folded in the median part of the test. Chomata are massive and well-developed.

Measurements.—Shown in Table 2.

Description.—Test inflated fusiform with an arched periphery, straight to slightly concave lateral sides, and rounded to bluntly pointed poles. Mature test has six to seven whorls, 4.96 to 5.8? mm in axial length and 1.95 to 2.63 mm in median width, giving a form ratio of 2.06 to 2.8?.

Proloculus is spherical, 0.07 to 0.19 mm in diameter. The first to the second whorls subspherical to inflated fusiform and succeeded by outer whorls gradually increasing their length and width. Poles of middle and outer whorls are rounded to more or less pointed.

Wall is thin and not differentiated in inner one or two whorls, and gradually thickened outward and consists of a tectum and finely alveolar keriotheca. Thickness of the wall is 0.015 to 0.028 mm in inner one or two whorls and 0.051 to 0.097 mm in outer two whorls. Septa are closely spaced throughout the test, strongly folded in the polar regions of middle and outer whorls resulting many irregularly-shaped and irregularly-sized loops, and almost planar to very weakly folded in the median part of the test. Septal counts from the first to seventh whorl 9, 16, 19, 23, 26, 27, and more than 25 in the paratype.

Tunnel is less than half as high as chambers in inner two whorls, and becomes somewhat higher in outer whorls. Its path is narrow and almost straight to irregularly zigzag. Chomata are massive, well-developed, and about a third as high as chambers in most specimens. They appear in contact with the roof of chambers is due to secondary deposits in specimens. Axial fillings are not present.

Remarks.—This new species resembles *Montiparus subcrassulus* proposed by Rozovskaya (1950) from the middle Kasimovian of the Moscow Basin in size and shape of the test. The former is distinguished from the latter by having more strongly folded septa in the polar regions and more massive chomata in the inner and middle whorls. It is also similar to *Montiparus umbonoplicatus* (Rauzer-Chernousova and Belyaev in Rauzer-Chernousova and Fursenko, 1937) originally described from Samara Bend, Russia, later from the Donetz Basin (Putrya, 1940) and the Moscow Basin (Rozovskaya, 1950), and recently from the Akiyoshi Limestone (Kobayashi, 2017). However, *M. japonicus* has a more inflated fusiform test and more strongly folded septa in the polar regions. It is distinguished from *M. montiparus*, type species of the genus, by its larger test, and more intensely and more irregularly folded septa. *M. japonicus* is similar to some specimens of the *Montiparus matsumotoi inflatus* Watanabe (*nomen nudum*) illustrated from the middle Kasimovian of the Omi Limestone without description (Watanabe, 1991, figs. 18.1–18.6). However, the former has a larger test, not so tightly coiled inner whorls, and more strongly folded septa than the latter.

The new species differs from *Protriticites globulus* Putrya, 1948, designated as the type species of the genus (Putrya, 1948) by its mode of septal folding: very weakly folded in the median part of the test and more intensely folded in polar regions. Likewise, it is not assigned to *Rauserites* because of its almost planar to very weakly folded septa in the median part of the test and more developed chomata.

Genus ***Protriticites*** Putrya, 1948

Type species.—*Protriticites globulus* Putrya, 1948.

Protriticites cf. ***variabilis*** Bensh, 1972

Figure 7.12

Cf.

Protriticites variabilis Bensh, 1972, p. 22, 23, pl. 1, figs. 1–4; Kobayashi, 2017, p. 46, 47, pl. 9, figs. 18–33.

Remarks.—The illustrated specimen is compared to *P. variabilis* originally described from the lower Kasimovian (*Protriticites pseudomontiparus*-*Obsoletes obsoletus* Zone) of the southern Fergana by Bensh (1972) and recently from the lower Kasimovian of the Akiyoshi Limestone by Kobayashi (2017). They somewhat resemble each other in their well developed chomata, weakly folded septa in the polar regions, and finely perforate layer between the tectum and lower tectorium in outer whorls. More well-oriented specimens are needed for further comparison.

Genus ***Rauserites*** Rozovskaya, 1950

Type species.—*Triticites stuckenbergi* Rauzer-Chernousova, 1938.

Rauserites exculptus (Igo, 1957)

Figure 6.7–6.10, 6.13, 6.14

Triticites exculptus Igo, 1957, p. 225, 226, pl. 12, figs. 1–17.
Triticites exculptus var. *naviformis* Igo, 1957, p. 228–230, pl. 12, figs. 18–24.
Rauserites exculptus (Igo). Kobayashi, 2017, p. 52, 54, pl. 18, figs. 20–49.

Remarks.—This species was distinguished from *Triticites exculptus* var. *naviformis* in its smaller test and less complicated septal folding by Igo (1957). However, both taxa are not easily separated each other based on slight differences of size and shape of the test, and mode of septal folding. *T. exculptus* is reassigned to *Rauserites* based on its mode and strength of septal folding. *Rauserites hidensis* (Igo, 1957) might be distinguished from *R. exculptus* by its larger test, larger proloculus, and more strongly foled septa, though its strict distinction from *R. exculptus* is not easy.

Some morphological resemblances between *Triticites exculptus* and *T. matsumotoi* Kanmera, 1955 were indicated by Igo (1957). However, the latter is distinguishable from the former by more developed chomata, more finely alveolar keriotheca even in outer whorls of the test, and weakly folded septa in the polar regions. Based on the mode and strength of septal folding, *T. matsumotoi* is reassigned to *Montiparus*.

Rauserites saurini (Igo, 1957)

Figure 6.15–6.21, 6.24

Triticites saurini Igo, 1957, p. 230–232, pl. 14, figs. 1–9; Niikawa, 1978 (?), p. 564, 565, pl. 13, figs. 4–7.

Remarks.—Specimens with a larger and more elongate test, and greater length and width in corresponding whorls than *Rauserites exculptus* are identical with *Triticites saurini* also reassignable to *Rauserites*. The mode of septal folding and development of chomata are similar between these two species. In spite of the similar mode of septal folding, species identification with *Triticites saurini* by Niikawa (1978) is questionable because of highly variable length and width of corresponding whorls and somewhat corrugated wall in his illustrated specimens that are associated with *Carbonoschwagerina morikawai*. Kobayashi (2017) assumed that *R. saurini* might be conspecific with *R. hidensis*. However, many mature specimens, some of which are illustrated herein, suggest the taxonomic separation of *R. saurini* from *R. hidensis* based on larger and more elongate test in *R. saurini*.

Genus ***Triticites*** Girty, 1904

Type species.—*Miliolites secalicus* Say in James, 1823.

Triticites noinskyi plicatus Rozovskaya, 1950

Figure 7.5–7.7, 7.8?

Triticites noinskyi plicatus Rozovskaya, 1950, p. 26, pl. 5, figs. 13–16.

Remarks.—Rozovskaya (1950) proposed *Triticites noinskyi plicatus* from the upper Kasimovian and lower Gzhelian of the Russian Platform by its more intensely folded septa than of *Triticites noinskyi* Rauzer-Chernousova, 1938. Though well-oriented specimens are few in sample Ic-70 and sample Mz-1, they are identified with *T. noinskyi plicatus* by their similarities of the mode of septal folding, length and width of the test, size of proloculus, and thickness of the wall to those of the original Russian ones.

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