812. A NEW SPECIES OF INOCERAMUS (CORDICERAMUS) (BIVALVIA) FROM THE UPPER CONIACIAN (CRETACEOUS) OF HOKKAIDO*

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Abstract. In this paper, a new species Inoceramus (Cordiceramus) kawashitai is established. The specimens were occurred from the Upper Coniacian of the Oyuhari, Ikushumbets and Obira areas of Hokkaido. The variation of selected characters are examined quantitatively on the basis of measurements and statistics, in addition to traditional observation. The average relative growth of two relations (shell height vs. shell length and shell height vs. breadth) are also examined. On the ground of its considerably inflated equivale shell, subquadrate or pentagonal marginal outline and development of three radial ridges, this species is certainly assigned to the subgenus Cordiceramus. But the ontogenetic change of the certain characters does not agree with that of any known species. I point out the significance of the occurrence of Cordiceramus from the Upper Coniacian of Japan, in that it represents the lower part of the range of the subgenus. The phylogenetic relationships with allied species are, however, put off, at present, as a further problem.

Introduction

In 1980, a large specimen of Inoceramus was unexpectedly obtained in a pebble of the Misojino-sawa, a tributary of the Ikushumbets River, by Mr. Yoshitaro Kawashita of Mikasa City. Its peculiar form has attracted my interest. But it has been very insufficient to establish a new species, because the stratigraphic position is unknown. Subsequently he collected a specimen with the same characters from a cliff of the right bank of Penkehorokayuparo-zawa, about 50 m upstream from the confluence with the Yubari River. In summer of 1981, Matsumoto, Kawashita and I investigated the stratigraphy along the Misojino-sawa and obtained a similar specimen with the former collection by Kawashita from a pebble in the sequence of the Zone of Inoceramus mihoensis. On the other hand, in 1982, Mr. Kenji Sanada of Sapporo City collected some similar specimens with Kawashita's collection from the pebbles of the Pombets-Gono-sawa. Next year, Matsumoto and I investigated the stratigraphy precisely with the help of others along the Gono-sawa, and obtained still more specimens from the middle part of the Upper Yezo Group. In this paper, these specimens are described under a new specific name which is dedicated to Mr. Yoshitaro Kawashita in appreciation of kindness for offering a number of specimens for this study.

Before going further, I express my sincere thanks to Emeritus Professor Tatsuro Matsumoto of Kyushu University for his cordial guidance in the field and laboratory, useful advice and critical reading of the typescript. I wish to thank Messrs. Yoshitaro Kawashita, Takemi Takahashi of Mikasa City, Kenji Sanada of Sap-
poro City, Shigehiro Uchida and Toshio Shimakuni of Iwamizawa City for their help in the field work and for their kindness of offering some valuable specimens for this study. A part of the expense of this study was defrayed from the Shimonaka Commemorative Foundation (1984) and the Grant-in-Aid for Scientific Program (1984, No. 59916035), the Ministry of Education, Science and Culture.

Method

In addition to the traditional method, the statistic analyses for some biometric characters are examined, that is, the mean values of l/h, b/h and s/l and the angles α, β, γ and δ, their standard deviations, Pearson’s coefficient of variation and the ontogenetic change of selected characters. The average relative growth of shell height to shell length, and shell height to breadth are also examined. The basic morphology and measurements are shown in Text-fig. 1.

For the measurements, the procedure of statistics and biometric analysis, see Hayami (1969), Hayami and Matsukuma (1971) and Noda (1975, 1983).

Palaeontological description

Family Inoceramidae Zittel, 1881
Genus Inoceramus Sowerby, 1814
Subgenus Cordiceramus Seitz, 1961

For subgenus Cordiceramus, see Seitz (1961, p. 110) and Noda (1979, p. 110, 114).

Inoceramus (Cordiceramus) kawashitai, sp. nov.

Pl. 69, Figs. 1a–1d; Pl. 70, Figs. 1a–2b;
Pl. 71, Figs. 1a–3; Pl. 72, Figs. 1a–2b;
Pl. 73, Figs. 1a–5.

Text-fig. 1. Basic morphology for measurements.

h: shell height, l: shell length, H: maximum length from umbo to ventral extremity, ga: growth axis, b: breadth of right and left valves respectively, s: length of hinge-line, α: anterior hinge angle, β: angle of umbonal inflation, γ: posterior hinge angle, δ: obliquity, angle between the growth axis and hinge-line, Ra: anterior radial ridge, Rm: median radial ridge, Rp: posterior radial ridge.
Types.—The repositories of the type specimens are as follows: KW: Yoshitaro Kawashita Collection and JG: Jonan Geological Association, Oita. Holotype: KW2002, loc. Y32, a cliff of the right bank of Penkehorokayuparozawa, about 50 m upstream from the confluence with the Yubari River, Oyubari area, Hokkaido. Sandy siltstone bed, the middle part of the Upper Yezo Group. Upper Coniacian. Paratypes: KW2001, loc. Ik9p, Misojino-sawa, a tributary of the Ikushumbets River, Mikasa area, Hokkaido. Stratigraphic position uncertain. KW2003, lower reaches of Echinai-zawa, a tributary of the Shimokinenbets River, Obira area, Rumoi-gun, Hokkaido. JG.H2893, loc. Ik10p, Misojino-sawa, in the sequence of the Zone of I. mihodensis, stratigraphic position precisely unknown. JG.H2876—2892, locs. Ik2707, 2708, cliffs of the left bank of the upper reaches of Gono-sawa (=Takiyoshi-zawa or Takino-sawa), a tributary of the Pombets River, Mikasa area. Middle part of the Upper Yezo Group. The localities of the Oyubari and Mikasa areas are shown in Text-figs.

Text-fig. 2. Map showing localities of Inoceramus (Cordiceramus) kawashitai, n. sp. in the Ikushumbets area (Mikasa area), Hokkaido. A: Ikushumbets, B: Oyubari, C: Obira.

Text-fig. 3. The type locality of Inoceramus (Cordiceramus) kawashitai, n. sp. in the Oyubari area, Hokkaido.

Explanation of Plate 69

Figs. 1a—d. Inoceramus (Cordiceramus) kawashitai, sp. nov.
2 and 3.

Material.—Twenty-one specimens are concerned with the description, of which 14 are used for measurements and statistics.

Diagnosis.—Shell of medium size, equi valve or subequi valve and considerably inflated. Anterior part broad, abruptly bent from the flank and perpendicular to the valve plane. Marginal outline subpentagonal to subquadrature. Wing-like area developed with steep slope from the main part of the flank. Hinge-line long about two thirds of shell length.

Surface ornamented with concentric ribs of irregular intensity. Three ridges developed radially from the umbonal region. The anterior one most prominent and demarcates sharply the anterior part from the flank, the median ridge conspicuous along the growth axis in young stage and gradually weakened with growth, and the posterior one borders the posterior slope and the main part of flank.

Description.—In general, either of two valves is displaced dorso-ventrally along the commissure plane, giving consequently a superficially inequivalve aspect. For example, in the specimens JG.H2876 (Pl. 71, Figs. 1a—d) and 2877 (Pl. 72, Figs. 1a—d), the right valve is slipped toward the venter, and the left umbo is considerably projected above the hinge-line; to the contrary, in the specimens JG.H2883 (Pl. 71, Fig. 2) and 2884 (Pl. 72, Figs. 2a—b), the left valve is displaced toward the venter. The specimen JG.H2881 (Pl. 73, Fig. 5), which is not displaced secondarily, shows clearly the equivalence. As is demonstrated in Text-figs. 5 and 6, in some specimens (i.e., JG.H2877 and 2890), shell is considerably inflated along the growth axis and antero-posteriorly in younger stages and gradually decreasing its convexity with growth, whereas in the full grown individuals, such as KW2001 and KW2002, the shell convexity changes abruptly at variable growth stages. Umbo is terminal, considerably curved inwards and forwards. Anterior part is truncated, broad, and bent angularly from the main part of the flank and concaved in itself, forming an obtuse angle with the valve plane. Postero-dorsal part inclined steeply, passing to the wing-like area. The boundary between postero-dorsal and wing-like areas is comparatively clear in the specimens KW2001 and 2002, but

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Text-fig. 4A. Diagram showing the average relative growth of breadth to shell height in I. (C.) kawashitai, n. sp. 4B: Diagram showing the average relative growth of shell length to shell height in I. (C.) kawashitai, n. sp.
in the specimens from Gono-sawa, that is, JG.H2877, 2893, 2887, 2890, 2891, and 2892, the two parts gradually pass from each other without any sharp boundary.

Anterior margin is long and straight, forming nearly a right angle with the ventral margin. In younger individuals, such as JG.H2880, 2885, 2888 and 2890, the ventral margin is bent with an obtuse angle at about the center which corresponds to the end of the growth axis, and passed gradually into a broadly rounded postero-ventral margin. In the full grown individuals, such as KW2001, 2002, JG.H2891 and 2893, the ventral margin is nearly straight; postero-ventral margin narrowly curved and posterior margin forms an angle of about 100°–117° with the hinge-line which is about two thirds of shell length on average.

Concentric ribs are low, acute-topped, separated by concave interspaces, and generally irregular in intensity. In the umbonal region they are fairly crowded but in some individuals much weakened and hardly discernible. In some specimens (e.g., JG.H2877, 2891), minor concentric riblets are developed on the interspaces. Concentric ribs continue from the main part of flank to the postero-dorsal slope, being gradually weakened on the wing-like area and hardly visible at near the hinge. They are also comparable weakened on the anterior part. Three radial ridges run from about 20 mm behind the umbo to the ventral margin. The anterior one is most prominent and demarcates sharply the boundary between the flank and anterior region. The median one runs along the growth axis, which is much conspicuous in the young shell of about 40 – 60 mm in height, and it becomes weak gradually with growth and inclines somewhat posteriorly. The posterior one is less conspicuous, demarcating the postero-dorsal slope from the flank. Concentric ribs are bent at the intersections with the radial ridges. On some specimens (e.g., JG.H2876, 2877), many granular substances are scattered irregularly on the inner surface of shell, which may be pearl-like substance.

**Biometry**.—The measurements and biometric characters are shown in Tables 1 and 2, respectively. The relative growth between two relation shows generally allometric. In general, it is more satisfactory that the allometric characters are

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**Explanation of Plate 70**

Figs. 1a—2b. *Inoceramus (Cordiceramus) kawashitai*, sp. nov.

Figs. 1a—c. Holotype, KW2002, from loc. Y37, a cliff of the right bank of the Penkehorokayuparo-zawa about 50 m upstream from the confluence with the Yubari River, Oyubari area, Hokkaido. Stratigraphic position: middle part of the Upper Yezo Group (collected by Kawashita, 1981). a: lateral view, b: anterior view and c: dorsal view, natural size.

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Text-fig. 6. Cross section of I. (C.) kawashitai, n. sp.
A: vertical section along the growth axis.
B: transverse section from anterior to posterior.

compared at a certain growth stage. However, on the present species, even if the allometric characters are examined under such a condition, the numerical values calculated statistically would not be so significant, because the shell convexity and the marginal outline change abruptly at various stages of growth. This allows us to summarize totally the characters regardless of the difference in growth stage of the examined specimens.

The average relative growth is examined on the two relations, shell height (h) versus shell length (l), and shell height (h) versus breadth (b). (h) in abscissa and (l) and (b) in ordinate are plotted on logarithmic graph papers. The slope of the reduced major axes (α) and also Y intercepts (β) and the correlation coefficients (r) are calculated, respectively. These are shown in Table 3. Based on Table 3, the reduced major axes are demonstrated in Text-figs. 4a and 4b. The growth indices (α), the null hypothesis of isometry cannot be rejected considering the correlation coefficient and sample size (see Hayami and Matsukuma, 1971, p. 150–151).

The ontogenetic change of shell convexity in the selected specimens is shown in Text-fig. 5. The transverse section and vertical section along the growth axis of the same specimens are demonstrated in Text-fig. 6.

Remarks.—As is evident from Text-figs. 5 and 6, the ontogenetic change of shell convexity and the intensity of median ridge are closely related to the changes of transverse section, vertical section and marginal outline. These characters are variable among individuals and with growth stages.

To sum up, the present species shows a considerable extent of variation not only in the biometric characters but also in the characters hardly examined numerically. As is clarified from Table 2, the Pearson's coefficient of variation (v) of the angles α, β, γ and δ, and a simple ratio
Table 1. Measurements of *Inoceramus* (*Cordiceramus*) *kawashitai*, n. sp. linear dimension in mm.

<table>
<thead>
<tr>
<th>specimen</th>
<th>v</th>
<th>h</th>
<th>l</th>
<th>b</th>
<th>s</th>
<th>α</th>
<th>β</th>
<th>γ</th>
<th>δ</th>
<th>l/h</th>
<th>s/l</th>
<th>b/h</th>
<th>remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>KW2001</td>
<td>R</td>
<td>121.2</td>
<td>115.0</td>
<td>56.8</td>
<td>58.0</td>
<td>99°</td>
<td>82°</td>
<td>105°</td>
<td>68°</td>
<td>0.95</td>
<td>0.77</td>
<td>0.48</td>
<td></td>
</tr>
<tr>
<td>KW2002</td>
<td>L</td>
<td>100.5</td>
<td>92.0</td>
<td>44.6</td>
<td>53.4</td>
<td>117°</td>
<td>75°</td>
<td>100°</td>
<td>65°</td>
<td>0.92</td>
<td>0.58</td>
<td>0.44</td>
<td></td>
</tr>
<tr>
<td>KW2003</td>
<td>L</td>
<td>121.4</td>
<td>111.2</td>
<td>36.6</td>
<td>57.0</td>
<td>98°</td>
<td>75°</td>
<td>118°</td>
<td>68°</td>
<td>0.92</td>
<td>0.51</td>
<td>0.32</td>
<td></td>
</tr>
<tr>
<td>JG.H2876</td>
<td>R</td>
<td>52.3</td>
<td>45.7</td>
<td>16.9</td>
<td>-</td>
<td>116°</td>
<td>80°</td>
<td>-</td>
<td>73°</td>
<td>0.87</td>
<td>-</td>
<td>0.36</td>
<td></td>
</tr>
<tr>
<td>JG.H2876</td>
<td>L</td>
<td>52.5</td>
<td>45.7</td>
<td>25.0</td>
<td>-</td>
<td>117°</td>
<td>81°</td>
<td>-</td>
<td>74°</td>
<td>0.87</td>
<td>-</td>
<td>0.48</td>
<td></td>
</tr>
<tr>
<td>JG.H2877</td>
<td>R</td>
<td>67.5</td>
<td>67.7</td>
<td>25.4</td>
<td>41.0</td>
<td>97°</td>
<td>80°</td>
<td>100°</td>
<td>68°</td>
<td>(1.00)</td>
<td>0.61</td>
<td>0.38</td>
<td></td>
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<tr>
<td>JG.H2877</td>
<td>L</td>
<td>85.0</td>
<td>67.7</td>
<td>30.4</td>
<td>41.0</td>
<td>97°</td>
<td>80°</td>
<td>100°</td>
<td>76°</td>
<td>0.80</td>
<td>0.61</td>
<td>0.36</td>
<td></td>
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<tr>
<td>JG.H2879</td>
<td>R (119.3)</td>
<td>(90.7)</td>
<td>-</td>
<td>54.5</td>
<td>(96°)</td>
<td>(79°)</td>
<td>116°</td>
<td>(77°)</td>
<td>(0.84)</td>
<td>(0.56)</td>
<td></td>
<td>crushed</td>
<td></td>
</tr>
<tr>
<td>JG.H2883</td>
<td>L</td>
<td>63.6</td>
<td>51.4</td>
<td>23.0</td>
<td>39.7</td>
<td>98°</td>
<td>78°</td>
<td>107°</td>
<td>72°</td>
<td>0.81</td>
<td>0.77</td>
<td>0.36</td>
<td></td>
</tr>
<tr>
<td>JG.H2885</td>
<td>R</td>
<td>51.4</td>
<td>36.3</td>
<td>18.0</td>
<td>25.0</td>
<td>115°</td>
<td>79°</td>
<td>98°</td>
<td>71°</td>
<td>0.71</td>
<td>0.69</td>
<td>0.35</td>
<td></td>
</tr>
<tr>
<td>JG.H2887</td>
<td>R</td>
<td>54.3</td>
<td>46.6</td>
<td>-</td>
<td>33.4</td>
<td>98°</td>
<td>81°</td>
<td>113°</td>
<td>70°</td>
<td>0.90</td>
<td>-</td>
<td>0.69</td>
<td></td>
</tr>
<tr>
<td>JG.H2888</td>
<td>R</td>
<td>37.4</td>
<td>31.6</td>
<td>12.5</td>
<td>23.0</td>
<td>105°</td>
<td>83°</td>
<td>105°</td>
<td>65°</td>
<td>0.84</td>
<td>0.73</td>
<td>0.33</td>
<td></td>
</tr>
<tr>
<td>JG.H2890</td>
<td>L</td>
<td>36.6</td>
<td>30.8</td>
<td>18.0</td>
<td>20.3</td>
<td>116°</td>
<td>78°</td>
<td>117°</td>
<td>68°</td>
<td>0.84</td>
<td>0.66</td>
<td>0.49</td>
<td></td>
</tr>
<tr>
<td>JG.H2893</td>
<td>R (97.3)</td>
<td>(91.5)</td>
<td>(26.5)</td>
<td>48.5</td>
<td>(118°)</td>
<td>(87°)</td>
<td>109°</td>
<td>(74°)</td>
<td>(0.94)</td>
<td>(0.53)</td>
<td>(0.27)</td>
<td>crushed</td>
<td></td>
</tr>
</tbody>
</table>

v: valve, h: shell height, l: shell length, b: breadth, s: length of hinge-line, α: angle between anterior margin and hinge-line, β: angle of umbonal inflation, γ: angle between posterior margin and hinge-line, δ: obliquity, angle between growth axis and hinge-line, l/h: simple ratio of shell length to shell height, s/l: simple ratio of hinge-line to shell length, b/h: simple ratio of breadth to shell height, L: left valve, R: right valve.

l/h are all of small values, which indicate probably the stable characters for the species.

Every species assigned to *Cordiceramus* is characterized by peculiar marginal outline, convexity and surface ornamentations, which are, in general, hardly expressed biometrically, however these characters are rather important for the specific criteria. Furthermore, the ontogenetic change of these characters may be useful for the consideration of phylogenetic relationships with allied species.

*Comparison.*—The young specimens of the present new species is similar to *Inoceramus* (*Cordiceramus*) *cordiformis purus* Seitz, 1961,

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**Explanation of Plate 71**

Figs. 1a—3. *Inoceramus* (*Cordiceramus*) *kawashitai*, sp. nov.

Paratypes, from loc. Ik2708, upper reaches of the Pombets Gono-sawa (=Takiyoshi-zawa or Takino-sawa), Mikasa area (Ikushumbets area), Hokkaido. Stratigraphic position: middle part of the Upper Yezo Group (collected by Matsumoto, Uchida, Takahashi and Noda, 1983), natural size.

Figs. 1a—d. JG.H2876, closed valves, right valve displaced towards the venter along the commissure plane. a: lateral view of right valve, b: lateral view of left valve, c: anterior view and d: dorsal view.

Fig. 2. JG.H2883, closed valves, left valve displaced towards the venter along the commissure plane. Lateral view of left valve.

Fig. 3. JG.H2887, right valve.
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Table 2. Biometric characters of *Inoceramus* (Cordiceramus) kawashitai, n. sp.

<table>
<thead>
<tr>
<th></th>
<th>α</th>
<th>β</th>
<th>r</th>
<th>δ</th>
<th>1/h</th>
<th>s/1</th>
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<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>10</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>m</td>
<td>106.6°</td>
<td>79.3°</td>
<td>107.3°</td>
<td>69.8°</td>
<td>0.875</td>
<td>0.662</td>
<td>0.369</td>
</tr>
<tr>
<td>s</td>
<td>9.41°</td>
<td>3.78°</td>
<td>7.24°</td>
<td>3.46°</td>
<td>0.0678</td>
<td>0.0837</td>
<td>0.0640</td>
</tr>
<tr>
<td>v</td>
<td>8.83</td>
<td>4.77</td>
<td>6.98</td>
<td>4.96</td>
<td>7.91</td>
<td>12.64</td>
<td>16.16</td>
</tr>
</tbody>
</table>

N: sample size, m: mean value, s: standard deviation, u: Pearson's coefficient of variation.

Table 3. Data of the average relative growth of *Inoceramus* (Cordiceramus) kawashitai, n. sp.

<table>
<thead>
<tr>
<th></th>
<th>α</th>
<th>β</th>
<th>logβ</th>
<th>H'</th>
<th>Π'</th>
<th>B'</th>
<th>r</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>l and h</td>
<td>1.077</td>
<td>0.626</td>
<td>0.20344</td>
<td>1.84412</td>
<td>1.78268</td>
<td>0.9844</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>T and h</td>
<td>0.997</td>
<td>0.397</td>
<td>0.40200</td>
<td>1.81984</td>
<td>1.41165</td>
<td>0.9359</td>
<td>11</td>
<td></td>
</tr>
</tbody>
</table>

α: growth index (slope of the reduced major axis), β: Y intercept, H': mean of h' (h'=log h), Π': mean of Π' (Π'=log Π), B': mean of b' (b'=log b), r: correlation coefficient, N: sample size.

from the Santonian of Henrichenburg, West Germany, in the pentagonal margin with three radial ridges, considerably inflated shell and weak concentric ornamentations but gradually differs from that subspecies with growth. For instance, in the present new species the concentric ribs become more conspicuous and the median radial ridge is weakened with growth. The full grown specimen of this new species is clearly distinguished from that subspecies in its subquadrate marginal outline and trapezoidal transverse section.

The present new species also resembles *I. (C.) cordiformis gravis* Seitz, 1967, from the Middle to Upper Santonian of Galdebeck and other areas in West Germany, in its much inflated shell, ontogenetic change of the shell convexity, three radial ridges, truncated anterior part and irregular surface ornamentation, but discriminated from the subspecies in that its umbo is terminal, anterior margin nearly straight or slightly concave, the median and posterior ridges not so strong as those of *L. (C.) cordiformis gravis* and the depression between the two radial ridges is inconspicuous.

The specimens from the lowest part of the Middle Santonian of the Niobrara Formation, Colorado were assigned to *I. (C.) cordiformis* and its affinity by Scott and Cobb (1964, pl. 7, figs. 1, 2; pl. 10, figs. 3, 5). Scott (1965, p. 131) regarded these specimens as belonging to a group of *I. (C.) cordiformis* with some comments. A specimen USNM 131513 (Scott and Cobb, 1964, pl. 7, fig. 1) somewhat resembles the specimens of the present species, but the American specimen is clearly discriminated from those of the present species in the following characters, that is, the anterior ridge is more prominent, a radial groove runs somewhat posteriorly along the anterior ridge, and a shallow depression develops between the median and posterior ridges. Another specimen USNM 131514 also resembles the specimens of the present species but it differs from the latter in its small beak angle (β'=ca. 65°) and clearly demarcated posterior wing.

A specimen JG.H2884 which is somewhat deformed secondarily, resembles the specimens of *Inoceramus ernsti* Heinz, 1928 (Woods, 1911, text-fig. 45; Heinz, 1933, p. 250, pl. 19, fig. 1;
I. deformis of Scott and Cobb, 1964, pl. 1, see Seitz, 1965, p. 130; Tröger, 1967, p. 128, pl. 14, figs. 1–6) from the Coniacian of Europe, North America and Madagascar in the weak radial ridges, small beak angle and truncate anterior region, but it differs from that species in its terminal umbo, and somewhat crowded and irregular concentric ornaments. Considering the secondary deformation, the specimen seems to be within the extent of variation of the present species.

The present new species somewhat resembles Inoceramus selwyni McLern, 1926 (p. 122, pl. 21, figs. 8–9) from the Scaphites venicosus Zone of the Smoky River Formation, Alberta, Canada, in the anteriorly situated umbo, truncated anterior part, nearly straight or slightly concave anterior margin and high outline, but the Canadian species has a weak groove along the growth axis, coarser concentric ornaments, circular ventral margin and no radial ridge.

The specimens JG.H2877 and 2887, which are crushed diagonally towards the posterior part, resemble I. (C.) brancoiformis Seitz, 1961 from the Upper Santonian of Recklinghausen, West Germany, and also a specimen figured by Scott and Cobb (1964, pl. 10, fig. 5). But it would be superficial resemblance caused by secondary deformation.

Inoceramus iburiensis Nagao et Matsumoto, 1939 from the upper part of the Middle Turonian to the lower part of the Upper Turonian also closely resembles the present new species, in transverse section at a certain stage of growth (see Matsumoto, 1981, p. 18, fig. 1; p. 20, fig. 3) and higher marginal outline with nearly straight ventral margin, but I. iburiensis is inequivalve and belongs to I. (Inoceramus) and has much coarser concentric ribs and radial depression on the flank and no radial ridge on the umbonal region.

The young specimen of the present new species is similar to Inoceramus yuusai Noda, 1974 from the Campanian of Shikoku in the anteriorly placed umbo, pentagonal margin, abrupt change of shell convexity and the presence of radial ridges. I. (C.) kawashitai is distinct from the latter in its more inflated umbonal region which has weaker ornaments, small angle of α and γ, less obliquity and subquadrate outline in the adult stage.


Explanatory of Plate 72

Figs. 1a–2b. Inoceramus (Cordiceramus) kawashitai, sp. nov.
Paratypes, from locs. Ik2707, 2708, upper reaches of the Pombets Gono-sawa (=Takiyoshizawa or Takino-sawa), Mikasa area, Hokkaido. Stratigraphic position: middle part of the Upper Yezo Group, natural size.

Figs. 1a–d. JG.H2877 from loc. Ik2708, closed valves, right valve displaced towards the venter along the commissure plane. a: lateral view of left valve, b: lateral view of right valve, c: anterior view and d: dorsal view (collected by Sanada, 1982).

Figs. 2a–b. JG.H2884 from loc. Ik2707 somewhat higher than Ik2708, closed valves, left valve displaced towards the venter along the commissure plane. a: lateral view of right valve, b: lateral view of left valve (collected by Matsumoto, Uchida, Takahashi and Noda, 1983).

Conclusion

To sum up, the present new species, Inoceramus (Cordiceramus) kavashitai, is not identical with any other allied species previously described so a new species is established in this paper and the specific name is dedicated to Mr. Yoshitaro Kawashita.

The occurrence of numerous specimens of the species from the Upper Coniacian is very significant not only as the zonal index of that stage but also to consider the phylogeny of the subgenus Cordiceramus because the present occurrence represents a lower part of the range of the subgenus as Kauffman (1977) pointed out.

Noda and Matsumoto (1976) have already shown the range of I. cordiformis from Japan without palaeontological description, but it is necessary to describe more clearly the taxonomy and succession of I. (Cordiceramus) species of Japan. This is beyond the scope of the present paper.

References


— (1975): Succession of Inoceramus in the


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Echinai-zawa エチナイ沢, Gono-sawa 五の沢, Ikushumbets 平井別, Iwamizawa 岩見沢, Kitakyushu 北九州, Mikasa 三笠, Minami-Oita 南大分, Misojino-sawa 三十路の沢, Obira 小平, Obirasibe 小平初, Oita 大分, Oyubari 大矢張, Penkehorokayuparo-zawa ペンケホロカユウバラ沢, Pombets 墳別, Rumoi-gun 留萌郡, Sapporo 札幌, Shimantorogawa 四万十川, Shimokinenbets 下記念別, Takino-sawa 湧の沢, Takishita 湧下, Takiyoshi-zawa 湧吉沢, Yezo エゾ, Yubari 夕張．

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**Explanation of Plate 73**

Figs. 1—5. *Inoceramus (Cordiceramus) kawashitai*, sp. nov.

Paratypes from locs. Ik2707, 2708, upper-reaches of the Pombets Gono-sawa (=Takiyoshi-zawa or Takino-sawa), Mikasa area, Hokkaido. Stratigraphic position: middle part of the Upper Yezo Group, natural size.

Fig. 1. JG.H2891 with weak radial ridges.

Fig. 2. JG.H2888.

Figs. 3a—b. JG.H2890, a: lateral view, b: anterior view.

Fig. 4. JG.H2885 showing the regular, somewhat crowded concentric ribs.

Fig. 5. JG.H2881, closed valves, anterior view showing the equivalveness. Posterior half eroded out (collected by Matsumoto, Uchida, Takahashi and Noda, 1983).

Figs. 6a—c. *Inoceramus (Cordiceramus)* sp. cf. *I. (C.) kawashitai*, sp. nov.

JG.H2901, from floated nodule in the Obirashibe River, at Takishita, Obira area, Hokkaido. Stratigraphic position uncertain, x0.8. a: left valve, b: right valve, c: posterior view showing the equivalveness (collected by Shimanuki, 1984).
NODA: A new species of Coniasian Inoceramid

Plate 73
北海道コニアシアン階上部から産出した Inoceramus (Cordiceramus) の新種について：
北海道大夕張、篠長別、小平地域に露出するコニアシアン階上部の地層から産出した Inocer-
amus にはきわめて特徴ある形態を示すものがある。これについて、従来の研究方法に加えて、
生物測定学的手法により、いくつかの形質の変異や平均相対成長の検討を試みた。その結果、
等核ないし等核に近く、大きな膨らみ、四辺形または五角形の輪がゆ、放射状に発達する 3
条の稜などは Inoceramus の亜属 Cordiceramus の模式種である I. (C.) cordiformis Sower-
by の特徴と共通する点が多いが、類縁種と詳細に比較するとき、成長にともなう輪がゆや装
飾の変化など、これまでに知られた何れの種にも該当しないので、ここに新種として記載する。
種名 Inoceramus (Cordiceramus) kawashitai は本研究に協力いただいた川下由太郎氏に献
名したものである。本種は、北海道各地のコニアシアン階上部から Inoceramus mihoensis
Matsumoto や I. (Platyceramus) yubariensis Nagao et Matsumoto にともなって産産する
ので、将来、他の地域からも検証されるならば、有効な帯指示化石の 1 つとなることが期待さ
れる。また、本種は Cordiceramus としては産出層準が古く、その系統発生を考察する上に
重要であるが、これについては本論では論及せず、その検討を今後に委ねた。 野田雅之