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Ammonite fauna and genesis of the Santonian/Campanian (Upper Cretaceous) boundary beds of northwestern Kamchatka (North-East Russia)*

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With 4 figures and 1 table in the text

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Abstract: The untypical Santonian/Campanian boundary sequence near Penzhina Bay, northwestern Kamchatka, contains many well-preserved fossils, especially poorly known ammonites with a predominance of scaphitids. New investigations indicate that these interesting strata comprise deep-water mudstones, and shallow-water turbidites and storm deposits in between. The unusual composition and the modified size of faunas may be connected with hydrodynamical conditions in the oceanic basin.

Zusammenfassung: Eine untypische Sedimentfolge der Santon/Campan-Grenze nahe der Penzhina-Bucht, NW-Kamchatka, enthält zahlreiche wohlerhaltene Fossilien, insbesondere wenig bekannte Ammoniten mit der Vorherrschaft von Scaphiten. Neuere Untersuchungen lassen erkennen, daß diese Grenzschichten Tiefwasser-Tonsteine enthalten, zwischen die sich Flachwasser-Turbidite und Sturm-Ablagerungen einschalten. Die ungewöhnliche Zusammensetzung und Größe der Faunen scheint von den hydrodynamischen Bedingungen im ozeanischen Becken bestimmt zu werden.

1. Introduction

The Santonian/Campanian transitional beds are widespread in North-East Russia along the eastern periphery of the Eurasian continent (southern Sakhalin, northern Kamchatka and Korjak Upland). Usually, they consist of interbedded sandstones and siltstones and contain rich faunas of slowly evolving ammonites (ALABUSHEV & WIEDMANN, in press), mainly monomorphic and heteromorphic lytoceratids (Fig. 1).

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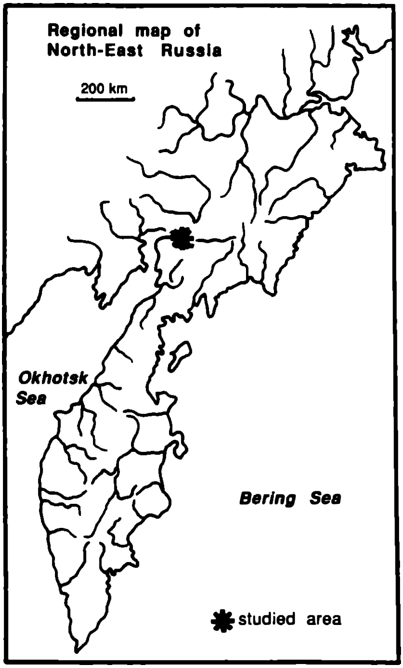

Fig. 2. Regional map of North-East Russia showing the studied area.

However, the studied Santonian/Campanian transitional beds near Penzhina Bay, northwestern Kamchatka, include mudstones, shallow marine turbidites and storm deposits. These strata are exposed continuously at about 12 km along the Lower Talovka Valley.

Structurally, the Upper Cretaceous rocks are forming a monoclinal slope dipping with 3–5 degrees towards the N-NW. The section through the structure from North to South gives a possibility to trace a transition from coarse-grained nearshore deposits to stratigraphically equivalent inner-shelf deposits.

This interval of the Upper Cretaceous sequence contains very well-preserved fossils, especially poorly known ammonites. Small-sized specimens dominate among the fossilized ammonites and inoceramids, which are collected from calcareous concretions. All illustrated forms are deposited in the Geologisch-Paläontologisches Institut, Tübingen (GPIT) and in the North-Eastern Interdisciplinary Scientific Research Institute, Magadan (NEIM).

2. Geological setting

The studied Santonian/Campanian section is situated 6 km south of the Talovka River mouth, near Penzhina Bay, northwestern Kamchatka

(Fig. 2). Four stratigraphic units are recognized within the boundary interval by differing lithologies (Fig. 3).

The lower as well as the upper mudstones (units A, D) are enriched in Fe and Ti. This enrichment is probably connected with the erosion of diabases, gabbros and pyroxenites which are exposed and widespread SE of the examined area.

The shallow-water turbidites (unit B) are characterized by grading of the individual layers and by sharp lower and gradational upper contacts. They typically form coarsening and thickening upward successions of siltstones interbedded with sandstones. Sandstone beds deposited in the lower part of unit B commonly exhibit complete or partial Bouma sequences of (a) massive, (b) parallel laminated and (c) ripple cross-laminated fine-grained sediments. Higher up, coarse-grained sandstones exhibit hummocky cross-stratification, flat lamination and wave ripples.

The Bouma sequences were formed under waning, purely unidirectional flows in greater depth below the effective storm wave base, whereas the hummocky cross-stratification and wave ripples were formed offshore by strong oscillatory fluid motion in shallow water depth above the effective storm wave base.

The storm deposits (unit C) are characterized by disconformities and discontinuities of coarse-grained beds with erosional boundaries, hummocky cross-stratification, wave ripple marks and massive bioturbation. The storm deposits are represented by numerous progradational sequences which include at least two genetically distinct facies:

1. nearshore conglomerate-dominated, badly sorted, facies, including only bioclasts, and

2. inner-shelf sandstone-dominated, well-sorted, facies, containing well-preserved fossils.

The inner-shelf storm deposits consist of fair- and bad-weather deposits. The former include massive, locally pebbly, very fine-grained sandstones, whereas the latter consist of interbedded cross-stratified

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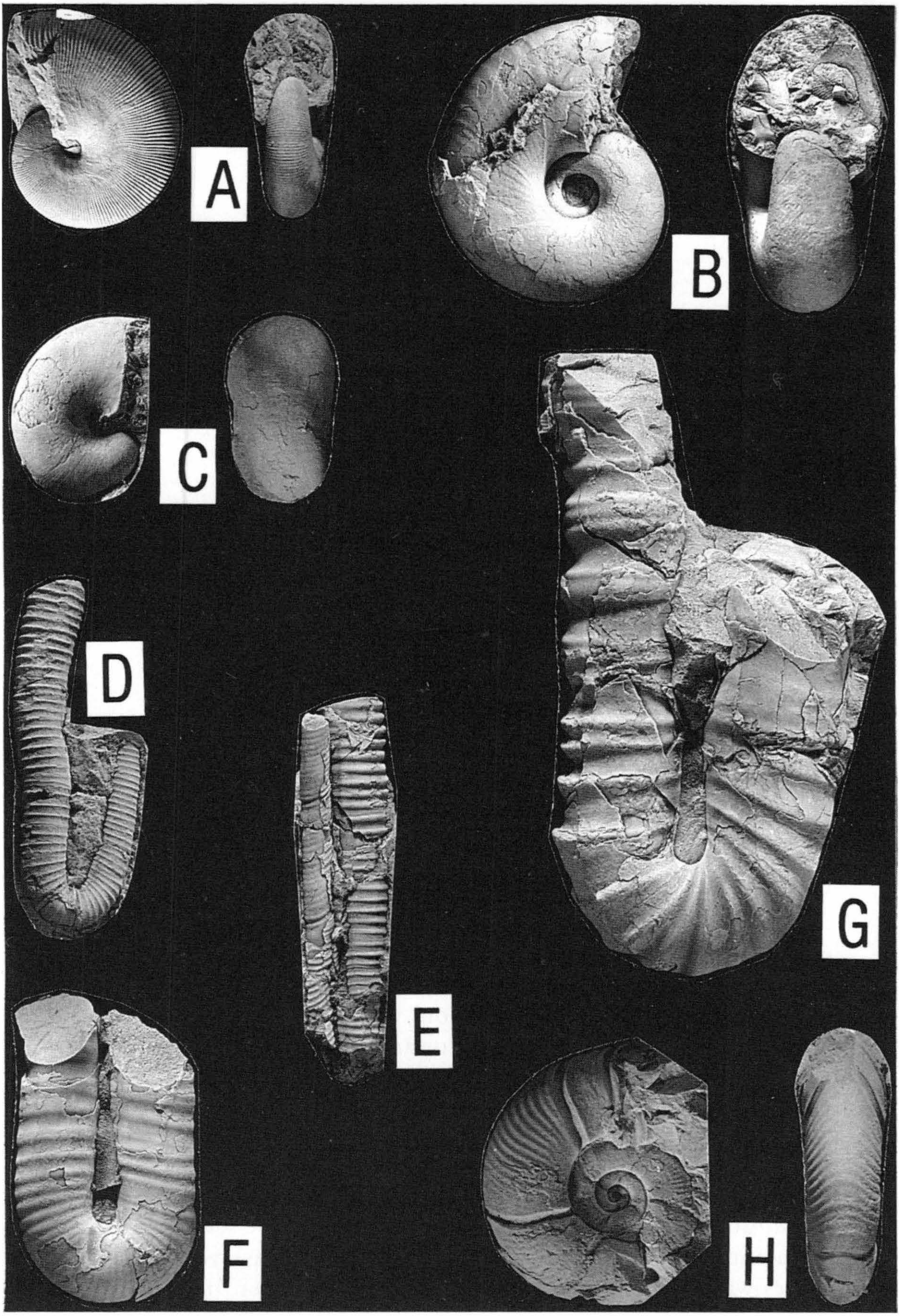
Fig. 1. Typical ammonites from the Santonian/Campanian boundary strata of North-East Russia. A – *Neophylloceras ramosum* (Meek), GPIT 1735/2, southern Sakhalin; B – *Pseudophyllites indra* (Forbes), NEIM 22s/2620, ibidem; C – *Phyllopachyceras ezoense* (Yokoyama), GPIT 1735/9, ibidem; D – *Diplomoceras notabile* Whiteaves, GPIT 1735/53, ibidem; E – *Polyptychoceras pseudogaultinum* (Yokoyama), GPIT 1735/99, ibidem; F – *Subptychoceras vancouverense* (Whiteaves), GPIT 1735/105, ibidem; G – *Subptychoceras yubarense* (Yabe), GPIT 1735/104, ibidem; H – *Neopuzosia ishikawai* (Jimbo), GPIT 1735/75, ibidem. All specimens are in natural size.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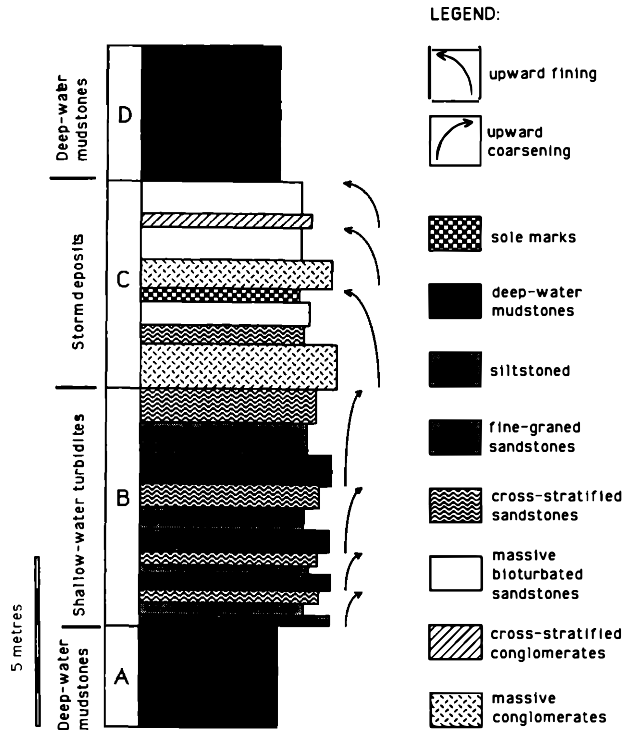


Fig. 3. Generalized section of the studied Santonian/Campanian boundary beds.

(landward oriented) conglomerates and hummocky cross-stratified coarse-grained sandstones.

The generalized direction of ripple crests, orientations of sole marks, current ripples, and other indicators from cross-stratified beds reflect the fact that these strata were deposited along the shore-line, oriented W-SW to E-NE. The mean dip (imbrication) vector of the clasts is towards the W-SW, implying dominant flow towards the E-NE.

3. Ammonite faunas

The lower stratigraphic unit A contains rare Santonian ammonites as *Pseudoxybeloceras quadrinodosum* (Jimbo), *Heteroptychoceras obatai* Matsumoto and inoceramids. Units B and C include several horizons of calcareous concretions containing rich and well-preserved faunal assemblages with predominance of scaphitoid ammonites. In the overlaying unit D Campanian ammonites and inoceramids are common.

Thus, the units B and C have an importance for tracing the Santonian/Campanian boundary by their rich but peculiar faunas. The lower unit B contains numerous *Yokoyamaoceras jimboi* MATSUMOTO (Fig. 4A–B), *Epigoniceras glabrum* (JIMBO), *Scaphites* (*Otoscaphites*) *puerculus* JIMBO (Fig. 4D–F), *Eorhaeboceras derivatum* ALABUSHEV (Fig. 4G–K), and rare *Neophylloceras ramosum* (MEEK), *Desmophyllites diphylloides* (FORBES), *Gaudryceras tenuiliratum* YABE. The upper one contains besides the listed forms *Saghalinites teshioensis* MATSUMOTO, *Phyllopachyceras ezoense* (YOKOYAMA), *Diplomoceras notabile* WHITEAVES and *Scaphites* (*Scaphites*) *talovkensis* ALABUSHEV & WIEDMANN (Fig. 4C). Among the bivalves, two stratigraphically important taxa have been recognized as far: *Inoceramus naumanni* YOKOYAMA (unit B) and *I. yokoyamai* NAGAO & MATSUMOTO (unit C).

Biostratigraphically, the Santonian/Campanian boundary beds can be placed between unit B and unit C. The overlying strata contain *Inoceramus orientalis* SOKOLOV of middle Lower Campanian age.

4. Discussion

The good preservation of complete ammonite shells indicates that post-mortem transportation or drift did not succeed. The collected ammonites exhibit all internal structures. A rapid burial by suspended matter is the most probable interpretation of this thanatocoenoses.

A critical analysis of these boundary beds and the fossil contents indicates that three features are characteristic for the examined faunas:

1. The spatial distribution of the ammonite faunas is connected with the inner-shelf facies.

2. The prevalence of small-sized specimens among the fossils is noteworthy.

3. A predominance of scaphitids is obvious.

Scaphitids are a group of heteromorphic ammonites with uncoiled final body chamber marking the adult stage. The most frequent *Scaphites* (*Otoscaphites*) *puerculus* JIMBO is an abundant form in the silty mudstone facies, ranging from the Turonian of Hokkaido to the Santonian/Campanian boundary of Kamchatka. Generally, occurrence of the species is more conspicuous in the northwestern alignment than in the southeastern one.

In general, the size of adult organisms is a function of many factors, e. g., food supply, population density, bottom sediment, turbidity, salinity, temperature, oxygen content, exposure to waves (HALLAM 1965). The last four factors may influence on the ammonite life habit.

The composition and fabric of deposits as well as the nature of the faunal assemblages indicate that the cause for the stunting of the ammonites could be waves and currents, only (Table 1).

Table 1. Possible causes of the observed stunting of ammonites.

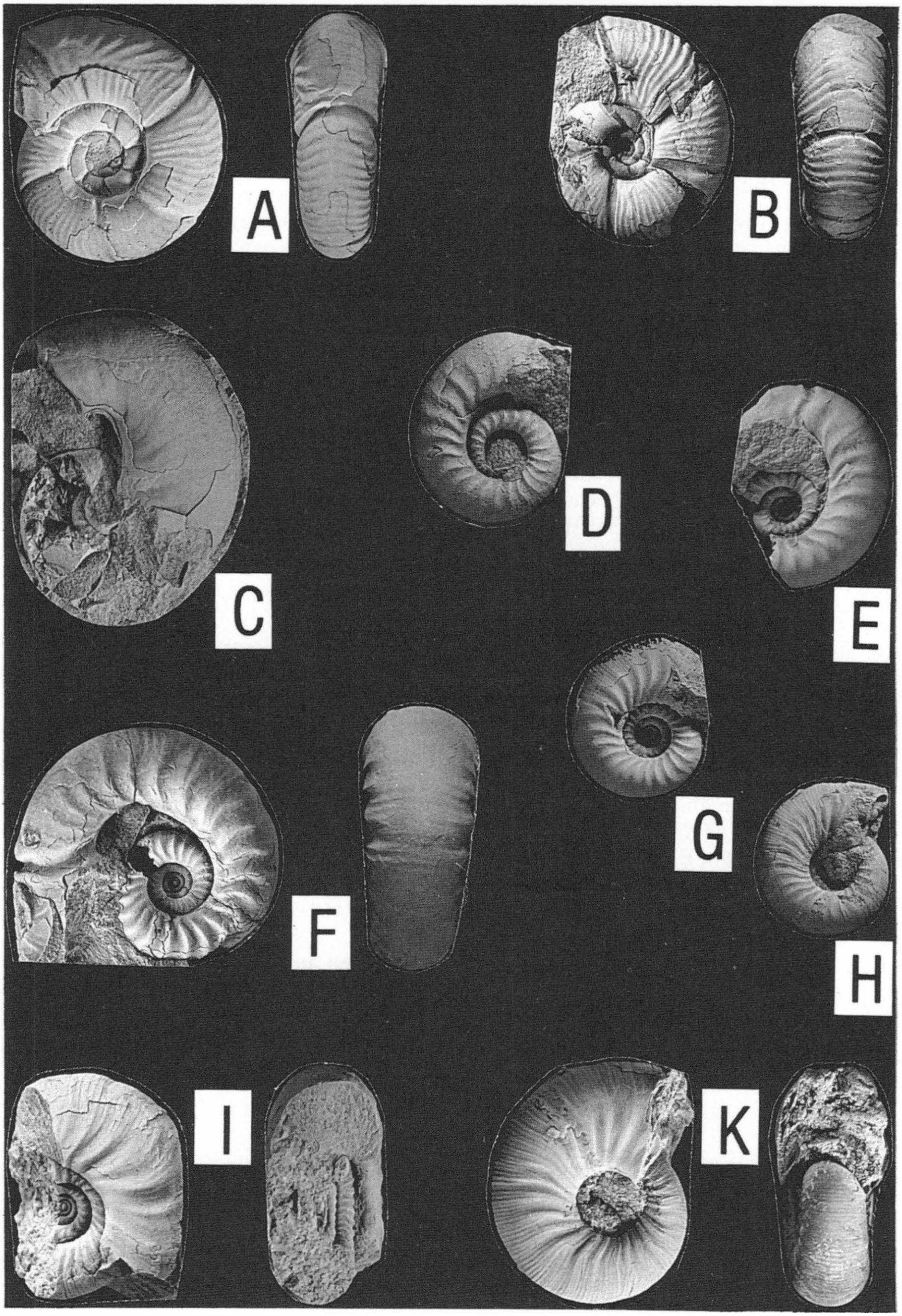
Hypothetical causes	Contradictions
1. Abnormal salinity	The presence of stenohaline groups such as cephalopods, brachiopods and echinoderms
2. Temperature	The presence of normally-sized fossils above and below examined beds
3. Oxygen content	Intensive waves and oscillatory currents contribute to normal oxygen circulation
4. Exposure to wave action	No contradictions

According to recent interpretations (TANABE 1979, WESTERMANN 1990), most scaphitids were mainly vertical migrants with slow horizontal mobility in neritic habitats. Their hydrodynamics were conditioned with the size and shape of their body chamber.

The shortened shaft and hook of the studied *Scaphites* (*Otoscaphites*) *puerculus* JIMBO (in comparison with standard forms) made these organisms hydrostatically more stable in oscillating water by approachement of the centres of buoyancy and gravity. Thus, the modified form of the collected *Scaphites* (*Otoscaphites*) *puerculus* may be connected with hydrodynamical requirements in an oceanic basin.

Yokoyamaoceras jimboi MATSUMOTO (Fig. 4A) and *Gaudryceras tenuiliratum* YABE collected together with *Sc.* (*O.*) *puerculus* exhibit traces of shell recovery which may indicate exposure to high current activity. Other heteromorphs (*Pseudoxybeloceras* and *Heteroptychoceras* from older deposits and *Diplomoceras* from younger ones) were mesopelagic drifters and have not been exposed to strong currents.

Fig. 4. Unusually small-sized ammonite fauna from the Santonian/Campanian boundary beds of northwestern Kamchatka. A–B – *Yokoyamaoceras jimboi* MATSUMOTO: A – GPIT 1735/84, uppermost Santonian; B – GPIT 1735/83, lowermost Campanian; C – *Scaphites talovkensis* ALABUSHEV & WIEDMANN, GPIT 1735/34, holotype, lowermost Campanian, ×2. D–F – *Scaphites* (*Otoscaphites*) *puerculus* JIMBO: D – GPIT 1735/36, uppermost Santonian, ×2; E – GPIT 1735/43, ibidem, ×2; F – NEIM 22s/2660, lowermost Campanian, ×2. G–K – *Eorhaeboceras derivatum* ALABUSHEV: G – GPIT 1735/50, uppermost Santonian, ×2; H – GPIT 1735/49, ibidem, ×2; I – NEIM 22s/152-1, holotype, lowermost Campanian, ×2; K – NEIM 22s/8820a-1, ibidem, ×2.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5. Conclusions

1. The examined ammonite faunas were fossilized in an inner-shelf setting during high wave activity.

2. Deposits of relatively deep water above and below the studied beds indicate that sea level fluctuations in this basin took repeatedly place near the Santonian/Campanian boundary.

3. Short-term dynamic events (i.e. servere storms) are important for high-resolution correlation.

4. These events could be the cause of the unusual composition and the modified size of faunas and may reflect the need for higher hydrodynamic efficiency.

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References

Alabushev, A. & Wiedmann, J. (in prep.): Upper Cretaceous ammonites from southern Sakhalin and northwestern Kamchatka (North-East Russia). – Palaeontographica, A.

Hallam, A. (1965): Environment causes of stunting in living and fossil marine benthonic invertebrates. – Palaeontology, **8** (1): 132–155.

Tanabe, K. (1979): Palaeoecological analysis of ammonoid assemblages in the Turonian *Scaphites* facies of Hokkaido, Japan. – Palaeontology, **22** (3): 609–630.

Westermann, E. G. (1990): New developments in ecology of Jurassic-Cretaceous ammonoids. – [In:] Pallini, G. et al. (eds.): Fossili, Evoluzione, Ambiente. – Atti II Conv. Int., Pergola, 1987. Estrato: 459–478.

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