Santonian ammonites from the Köpingsberg-1 borehole, Sweden

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A 510 meter succession of siltstones and fine sandstones in the Köpingsberg-1 borehole, Sweden yielded a distinctive suite of Santonian ammonites; ammonites of this age are otherwise known in significant numbers in Scandinavia only on Bornholm. The assemblage is dominated by taxa best known from North Germany, and includes Hauericeras cf. pseudogardeni (Schlüter, 1872), Scalarites sp., Baculites sp. group of capensis Woods, 1906, Baculites sp. 1, Boehmoceras krekeleri (Wegner, 1905), Boehmoceras arculus (Morton, 1834), and Scaphites kieslingswaldensis fischeri Riedel, 1931.


Introduction

A series of cores from the Köpingsberg-1 borehole, Sweden (Fig. 1), cut in grey, sometimes glauconitic micaceous siltstones and sandstones yielded a small suite of ammonites of Santonian age. In view of the paucity of ammonite assemblages of this age in Scandinavia, where they are otherwise known mainly from Bornholm: (Kennedy & Christensen, 1991), the present material, though limited, merits description. The borehole was drilled in 1967 and described or commented upon by Anderegg, Norling & Skoglund (1968), Norling (written comm. January 12 1970) and Chatziemmanouil (1982). It is situated in the southeastern part of the Vomb Trough in Scania, Sweden about 9 km eastnortheast of Ystad (Fig. 1). The trough is a narrow, elongated, asymmetrical graben initiated in the Early Mesozoic (Norling 1982, Chatziemmanouil 1982). The length of the trough is about 80 km and its width is about 7 km towards the northwest and 11 km towards the southeast. The Herrestad Uplift, an east-west trending horst in the southeastern part of the trough, divides the trough into two parts.

About 1000 m of Cretaceous rocks, consisting mainly of glauconitic, calcareous, clayey siltstones spanning the Hauterivian-Maastrichtian, were recorded from the borehole. The thickness of the Upper Cretaceous sedimentary strata is a little less than 800 m, and all Upper Cretaceous stages are represented. The stratigraphical dating of the borehole was made mainly on the basis of foraminifera (Norling op. cit., Chatziemmanouil 1982). On the basis of these studies the borehole was subdivided in the following way: Pleistocene 0–20 m, Lower Maastrichtian 20–71 m, Campanian 71–230 m, Santonian 230–600 m, Coniacian 600–670 m, Turonian 670–742 m, and Cenomanian 742–805 m.

Christensen (1986) described the Upper Cretaceous belemnites from five classic outcrops and one borehole in the trough, and these were placed in the international stratigraphic framework on belemnite evidence.

Chatziemmanouil (1982) analysed the Upper Cretaceous of the trough on the basis of five boreholes, including Köpingsberg-1, placed along the axis of the trough. The analysis was based upon seismic methods, sedimentological analysis, and palaeontological/ecological studies of foraminifera.

The fossils are all crushed and fragmentary composite moulds, a few with traces of powdery phosphatized shell. The assemblage is dominated by Baculites, mostly indeterminate, which range from depths of 132.35–132.44 m down to 642.62–642.69 m.

Detailed records are as follows:

132.35–132.44 m Baculites sp.?
251.70–251.75 m Baculites sp. group of capensis
314.80–314.86 m Baculites sp.?
315.18–315.23 m Baculites sp.?
Kennedy & Christensen: Santonian ammonites

Age of the Assemblage

The interval between 132.35 and 481.26 m cannot be dated precisely. The nodose Baculites present are of the B. capensis (Woods, 1906) group, which range from Upper Coniacian to Upper Santonian (Klinger & Kennedy, 1977), suggesting, given the Upper Santonian age of the underlying sediments, that these too are Upper Santonian. The presence of Scaphites (Scaphites) kieslingswaldensis fischeri (Riedel, 1931) at 397 m is compatible with such an age; this species ranges from Lower Santonian to Lower Campanian in Germany (see discussion in Kennedy & Christensen, 1991).

The presence of Boehmoceras arculus (Morton, 1834) at 481.26–481.35 m, and Boehmoceras krekeleri (Wegner, 1905) between 527.74 and 530.13 m provide a precise dating, for Schönfeld (1985) has refined previous records, showing the species to occur in association with the pelagic crinoid Marsupites in the Marsupites granulata Zone in the Münster Basin. This same zone yields Hauericeras pseudogardeni (Schlüter, 1872), a possible example of which is present at 433.84–433.86 m. Poorly preserved Scaphites (Scaphites) kieslingswaldensis fischeri at 624.87–624.95 m suggest that the interval to this depth is also Santonian, although foraminiferal data (Chatziemmanouli 1982) placed the Coniacian-Santonian boundary at a depth of 600 m. This may simply reflect differing definitions of the boundary.

Systematic Palaeontology

Order Ammonoidea Zittel, 1884
Suborder Ammonitina Hyatt, 1889
Superfamily Desmocerataceae Zittel, 1895
Family Desmoceratinae Zittel, 1895
Subfamily Hauericeratinae Matsumoto, 1938
Genus Hauericeras de Grossouvre, 1984
[= Schluteria Rollier, 1922, p.359, non Fritsch in Fritsch & Kafka, 1887, p.33; Pseudogarneria Tomlin, 1930, p.23; Gardeniceras Matsumoto & Obata, 1955, p.134]
Fig. 2. A, Hauersiceras cf. pseudogardeni (Schlüter, 1872) 433.84–433.86 m. B, Scalarites sp. 524.87–525.03 m. C, Baculites sp. 1. 338.79–338.74 m. D–H, Boekmoceras krekeleri (Wegner, 1905); D, E, 526.58–526.66 mm. F, 524.87–525.03 m. G, 530.11–530.13 m. H, 526.08–526.17 m.
Type species: *Ammonites gardeni* Baily, 1855, p.450, pl.11, fig. 3, by original designation.

*Hauericeras cf. pseudogardeni* (Schlüter, 1872)  
Fig. 2A  
compare: 1872 *Ammonites pseudogardeni* Schlüter, p.54, pl.16, figs. 3-6.

Description: The specimen is the composite mould of the umbilicus and part of a septate whorl, occupying the whole of the surface of the core, 55 mm in diameter. Coiling is very involute, the umbilicus very shallow, with a low, flattened wall and sharp umbilical shoulder. The flanks, so far as preserved, are flat, smooth, with traces of a deeply incised suture line of desmoceratacean type.

Discussion: Although rather unpromising, the Upper Santonian age of this specimen, suture, coiling, very shallow umbilicus and smooth shell surface suggest it to be a part of a *Hauericeras*, probably *H. pseudogardeni*. A faint radial ridge (corresponding to a groove on the surface of the internal mould) can be felt at one point on the surface, and this is a typical feature of the genus. We have been unable to trace the original of Schlüter's figure of the shell of this species (1872, pl.16, figs. 3, 4), but the specimen upon which he based his illustrations of the suture (1972, pl.16, figs. 5, 6), from Dülmen, Westphalia, is in the collection of Geologisches und Paläontologisches Institut, Bonn (GAB48), and compares closely with the present fragment.

Occurrence: Köpingsberg borehole, 433.84–433.86 m. *H. pseudogardeni* has been recorded from both Upper Santonian and Lower Campanian, with records from northern England, Germany, European Russia, and the Crimea. *Hauericeras cf. pseudogardeni* is recorded from Ignaberga and Eriksdal by Birkelund & Bromley (1979), and from the Höllviken-2 borehole by Ödum (1953).

Suborder Ancyloceratina Wiedmann, 1966  
Superfamily Turrilitaceae Gill, 1871  
Family Diplomoceratidae Spath, 1926  
Subfamily Diplomoceratinae Spath, 1926  
Genus *Scalarites* Wright & Matsumoto, 1954  
Type species: *Helicoceras scalare* Yabe, 1904, p.9, pl.3, fig. 2, by original designation

*Scalarites* sp.  
Fig. 2B

Description: The single specimen shows all of the flank of one side of the shell, 55 mm long, with a maximum preserved whorl height of 18 mm. Ornament is of sharp, distant feebly prorsiradiate ribs that are weakened on the dorsum, but strengthen markedly on the venter, where some appear to be accentuated and flared; the rib index is 6.

Discussion: The present specimen compares closely in ribbing style with one of the specimens of *Crioceras serta* Müller and Wollemann, 1906 (pl.10, fig. 4), differing only in being straight rather than curved.

Occurrence: Köpingsberg borehole, 524.87–523.03 m.  
Family Baculitidae Gill, 1871  
Genus *Baculites* Lamarck, 1799  
Type species: *Baculites vertebralis* Lamarck, 1801, p.80, by subsequent designation by Meek, 1876, p.391.

*Baculites* sp. group of *capensis* Woods, 1906  
Fig. 4A

Fig. 3. The lectotype of *Boehmoceras arculus* (Morton, 1834), in the collections of the Academy of Natural Sciences of Philadelphia, and from the 'older Cretaceous strata of Greene County, Alabama', that is to say, the Tombigbee Sand Member of the Eutaw Formation. All figures are × 1.
Discussion: Although *Baculites* are the commonest ammonites in the Köpingsberg borehole, the material is all poorly preserved, with only limited diagnostic features. Small specimens with conical dorsolateral nodes that give rise to feeble, rapidly effacing concave ribs on the middle and ventral parts of the flank most closely resemble the widely occurring Upper Coniacian to Lower Santonian *Baculites capensis* group (see discussion in Klinger & Kennedy, 1977, and Kennedy & Cobban, 1991).

Occurrence: Köpingsberg borehole, 251.70-251.75 m, 491.91-491.96 m, 524.87-525.03 m.

*Baculites* sp. 1
Figs. 2C, 4B, E, I

Discussion: A second, larger *Baculites* has a whorl height of up to 42 mm. The shell varies widely occurring at depths of 316.78–642.69 m.

Genus *Boehmoceras* Riedel, 1931

*Boehmoceras krekeleri* (Wegner, 1905)
Figs. 2D-H, 4C, D, H, J

1905 *Ancyloceras krekeleri* Wegner, p.210, pl.8, fig. 2
1931 *Boehmoceras krekeleri* (Wegner): Riedel, p.691, pl.77, figs. 3-5; pl.78, figs. 1, 2.
1979 *Boehmoceras krekeleri* (Wegner); Summesberger, p.118, pl.2, fig. 14; text-figs. 7, 8.
1983 *Boehmoceras* Kennedy & Wright, p.866.
1985 *Boehmoceras krekeleri* (Wegner); Schönfeld, pl.2, fig. 4.
1987 *Boehmoceras krekeleri* (Wegner); Kennedy, p.778, text-figs. 3a, b.

Types: These appear to be lost. They were from the Santonian of the Münster Basin, Germany.

Discussion: Specimens consist of curved shafts with whorl heights of between 8 and 27 mm. On small specimens (e.g. Figs. 2F-H, 4C, D, I) ornament is of blunt, prospiriferate concave ribs that are strongest on the dorsolateral flank, sweeping forwards and declining on the ventral flanks and strengthening over the venter, which is markedly crenulate in profile; the rib index is 4. In the largest specimen (Fig. 2D, E) the style of ornament is similar, but the ribs weaken and are much more crowded, with a rib index of 6 and occasional shorter intercralated ribs.

Occurrence: Upper Santonian, Recklinghäuser Mergel, Marsupites/granulata Zone of the Münster Basin, Germany. Upper Santonian ‘sandsteinbank’ of the Gosau Basin. In the Köpingsberg borehole, we have specimens from 524.74–524.78 m, 524.87–525.03 m, 525.18–525.29 m, 526.08–526.17 m, 526.58–526.66 m, 527.12–527.23 m, and 530.11–530.13 m.

*Boehmoceras arculus* (Morton, 1834)
Figs. 3, 4L
1834 *Hamites arculus* Morton, p.44, pl.15, figs. 1, 2.
1834 *Hamites arculus* var. A, Morton, p.45.
1937 *Boehmoceras löscheri* Riedel, p.692, pl.78, figs. 3–6.
1971 *Boehmoceras löscheri* Riedel; Ulbrich, p.5, fig. 4.
1979 *Boehmoceras löscheri* Riedel; Summesberger, p.119, pl.2, figs. 15, 16, 18; text-figs. 9–12.
1983 *Boehmoceras* Kennedy & Wright, p.866.
1985 *Boehmoceras* sp., Kennedy, pl.2, fig. 1.
1985 *Boehmoceras löscheri* Riedel; Schönfeld, pl.2, fig. 6.
1987 *Boehmoceras loescheri* Riedel; Kennedy, p.777, pl.82, figs. 4-16; text-fig. 2.
1991 *Boehmoceras arculus* (Morton); Kennedy & Cobban, p. 182, figs. 6:2, 8; 8:9-15. 18-22; 9:1, 2, 11-52; 10:20, 21, 24-26; 12:3.

Types: Morton illustrated two specimens, and Richards (1968) refers to 2-5 cotypes (one missing) in the collections of the Academy of Natural Sciences of Philadelphia, and from the “older Cretaceous strata of Greene County, Alabama”, that is to say the Tombigbee Sand Member of the Eutaw Formation. We here designate the cotype shown in Fig. 3 lectotype of the species.

Description: The specimen consist of a curved fragment 48 mm long, with a maximum preserved whorl height of 18 mm. Ornament consists of strong, concave, narrow, crescentic, distant dorsolateral bullae that give rise to a narrow rib that effaces across the ventral part of the flanks. The interspaces bear numerous minor ribs that are best developed on the venter, giving it a feebly crenulate appearance when viewed in profile.

Discussion: The present specimen differs in no significant respects from the lectotype (Fig. 3), and falls well within the range of variation documented by Kennedy & Cobban (1991). The very distant umbilicolateral bullae and numerous minor ribs between immediately distinguish it from the evenly ribbed *Boehmoceras krekeleri*, described above.

Occurrence: Upper Santonian *Texanites shiloensis* Zone in Mississippi, Alabama, and the Big Bend area of Texas in the USA, Upper Santonian Recklingshauser Mergel, *Marsupites/Granulata* Zone of the Münster Basin, Germany (Schönfeld, 1985), but said to be longer-ranging in the Subhercynian Cretaceous Basin (Ulbrich, 1971). Assizes M2 and N2 in the Aquitaine Basin. Upper Santonian ‘Sandsteinbank’ of the Gosau Basin. In the Köpingsberg borehole we have a single specimen from 481.26–481.35 m.

Superfamily Scaphitaceae Gill, 1871
Family Scaphitidae Gill, 1871
Subfamily Scaphitinae Gill, 1871
Genus and Subgenus *Scaphites* Parkinson, 1811
Type species: *Scaphites equalis* J. Sowerby, 1813, p.53, pl.18, figs. 1–3; by subsequent designation by Meck (1876, p.413).

*Scaphites* (*Scaphites*) kieslingswaldensis *fischeri* Riedel, 1931
Figs. 4F, G, M, N
1931 *Scaphites fischeri* Riedel, p.704, pl.79, figs. 5, 6.
1991 *Scaphites fischeri* Riedel: Kennedy & Christensen, p.222, pl.2, figs. 1, 2;
pl.5, fig. 2; pl.6, figs. 2,3,4,7; pl.7, figs. 2.4.

Lectotype: The original of Riedel, 1931, pl.79, fig. 6, designated by Kennedy & Christensen, 1991, 223.

Discussion: We recently described and discussed this species at length (1991, p.222). The present material consists of one well-preserved fragment of the early body chamber (Figs. 4F, G) and two fragments of the late body chamber (Figs. 4M, N).

Occurrence: Lower Santonian to Lower Campanian of the Münster Basin and elsewhere in Germany. It occurs in the Köpingsberg-1 borehole at 397 m, 561.13–561.6 m and 624.87–624.95 m.

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Dansk sammendrag
Ammonitterne fra et 510 m interval i Köpingsberg-1 boringen i Vomb truet i Skåne beskrives. Faunaen består af følgende taxa: *Hauericeras cf. pseudogardeni*, *Scalarites sp.*, *Baculites sp.* group of *capensis*, *Baculites sp. 1*, *Boehmoceras krekeleri*, *Boehmoceras arculus* og *Scaphites kieslingswaldensis fischeri*. Denne fauna er af Santonien alder og kendes bedst fra Tyskland. I Skandinavien er Santonien ammonitter sjældne bortset fra forekomsten på Bornholm.

References


Morton, S. G. (1834): *Synopsis of the organic remains of the Cretaceous groups of the United States.* Illustrated by nineteen plates, to which is added an appendix containing a tabular view of the Tertiary fossils discovered in America.


