Ammonites of the genus *Peltoceratoides* *Sp* *ath*, 1924 from the Oxfordian of Kachchh, western India

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With 13 figures and 7 tables

**Abstract:** Forty-three ammonites from the Kachchh Basin in western India have been assigned to seven taxa belonging to the genus *Peltoceratoides* *Sp* *ath*, 1924. The two most abundant morphospecies *Peltoceratoides* (*Peltoceratoides*) *constantii* and *Peltoceratoides* (*Parawedekindia*) *arduennensis* are commonly considered as the macro- and microconch, respectively of a single biospecies. The taxa are important for intrabasinal as well as intercontinental correlation due to their wide geographic range during the Early Oxfordian. The specimens occur in beds, which had been assigned to the Cordatum Zone, but also reworked in the so-called Dhosa Conglomerate Bed, which contains an array of ammonites from different ammonite zones.

**Key words:** Ammonoids, Jurassic, Kachchh Basin, India, taxonomy.

1. **Introduction**

Cephalopods of the Kachchh Basin have been studied for more than a century, the most prominent publications being the monographs by *Waagen* (1873-1875) and *Sp* *ath* (1927-1933). Both publications are still used as a base for identification of ammonites from the basin. Due to new studies on the litho- and biostratigraphy of the area (e.g. *Biswas* 1980; *Fürsich* et al. 2001) a more precise understanding of the rock succession has been reached and correlation of strata in the basin has been considerably advanced (e.g. *Singh* et al. 1982, 1983; *Pandey* & *Agrawal* 1984; *Agrawal* & *Pandey* 1985; *Krishna* & *Westermann* 1987; *Pandey* & *Westermann* 1988; *Pandey* et al. 1994; *Pandey* & *Callow* 1995; *Jain* et al. 1996; *Krishna* et al. 1996a, b, 1998, 2000, 2009a, b, c). Nevertheless, a modern and comprehensive taxonomic study including detailed illustrations of the ammonite fauna is not yet available.

During two recent field surveys in the Kachchh Basin, which mainly concentrated on the Oxfordian rock succession, more than 600 ammonoids have been collected and identified. Sections were measured and fossils were collected with high stratigraphic resolution. The present publication is the first of a projected series planned to enlarge our knowledge on cephalopods of the Upper Jurassic of the Kachchh Basin.

2. **Geological setting and stratigraphic framework**

The Kachchh Basin, situated in western India (Fig. 1), formed in the Late Triassic following rifting between Africa and India (*Biswas* 1982, 1991). Jurassic outcrops occur mainly in an E-W oriented chain of domal structures on the Kachchh Mainland, between the salt
marshes of the Great Rann of Kachchh in the north and the Arabian Sea in the south. These domes offer Jurassic outcrops from Bajocian to Tithonian in age (Fürsich et al. 2004a, b; Krishna et al. 2009a). Additionally, an island belt to the north and east of the mainland contains extensive Jurassic outcrops. However, most of these display older strata, only on Wagad and Khadir Island Oxfordian rocks occur.

The studied sections on Kachchh Mainland belong to the top of the Chari Formation (for the litho- and biostratigraphic framework see Fig. 2). They start within the Gypsiferous Shale member, which consists mainly of bioturbated argillaceous silt. Several levels of small concretions and abundant secondary gypsum occur. The Gypsiferous Shale member is coarsening upwards into the Dhosa Sandstone member which

Fig. 1. Geological sketch map of the Kachchh Basin showing the sample localities (modified after Fürsich et al. 2004a, 2005).
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consists of fine-grained sandstone beds. The sediment is bioturbated and occasionally cross-bedded indicating a slightly elevated energy-level caused by a lower water depth. Following on top of the Dhosa Sandstone is the Dhosa Oolite member, whose name derives from allochthonous, ferruginous ooids occurring in varying abundance in the sediment. This unit has received considerable attention (e.g. Singh 1989; Fürsich et al. 1992) due to its highly complex top unit, the Dhosa Conglomerate Bed. This marker bed, which can be traced throughout Kachchh Mainland for over 100 km, is highly condensed and contains abundant, though mostly reworked, ammonites. After a depositional gap, the Dhosa Conglomerate Bed is followed by the coarse-grained sandstones of the Katrol Formation.

### 3. Systematic palaeontology

Most of the 43 ammonoids described in this publication have been found on Kachchh Mainland. Only one specimen has been collected from Khadir Island (for localities see Fig. 1). The specimens have been grouped into seven taxa consisting of four species. Due to poor preservation some of the fossils have not been definitely determined.

Specimens have been measured using a Vernier Caliper. Cross-sections through certain specimens have been cut to study their allometric growth; these have been measured digitally after scanning the cross-section. Dimensions in the text are given in millimetres. The measurements and abbreviations in this publication are explained in Fig. 3. Numbers in parentheses are proportional dimensions as percentage of diameter. The material will be stored at the Department of Geology, University of Rajasthan, Jaipur, India.

Class Cephalopoda Cuvier, 1797
Order Ammonoidea Zittel, 1884
Superfamily Perisphinctoidea Steinmann, 1890
Family Aspidoceratidae Zittel, 1895
Subfamily Peltoceratinae Spath, 1924
Genus *Peltoceratoides* Spath, 1924
Subgenus *Peltoceratoides* Spath, 1924

**Type species:** *Peltoceras semirugosum* Waagen, 1875.

**Remarks:** The subgenus *Peltoceratoides* is used for macroconchs with ribs bifurcating between the umbilical shoulder and the middle of the flank in inner whorls and rows of tubercles in outer whorls (Prieser 1937; Bonnot et al. 1997).

*Peltoceratoides* (Peltoceratoides) constantii
(d’Orbigny, 1848) [M]
Figs. 4C, D, 5-6, Table 1

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Fig. 2. Litho- and biostratigraphic framework of the Upper Jurassic of Kachchh Mainland.

Fig. 3. Measured dimensions of the ammonoids and used abbreviations.

*1848 Ammonites constantii sp. nov. – d’Orbigny, p. 502; pl. 186.
1937 *Peltoceratoides constantii* d’Orbigny – Prieser, p. 88; pl. 4, fig. 12; pl. 9, fig. 4; text-fig. 10G.
1944 *Peltoceras (Peltoceratoides) constantii* (d’Orbigny) – Arkel, 290; pl. 65, fig. 2a-d; text-figs. 100-101.
1977 *Peltoceratoides constantii* (d’Orbigny) – Matyja, pl. 4, fig. 9; pl. 5, fig. 9.
1983 *Peltoceratoides constantii* (d’Orbigny) – Tarkowski, pl. 20, figs. 1, 5.
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1994 *Peltoceratoides constantii* (d’Orbigny, 1848) – Fischer, p. 164; pl. 70, fig. 1a, b.

1994 *Peltoceratoides constantii* (d’Orbigny) – Matyja, pl. 2, fig. 3.

1995 *Peltoceratoides williamsoni* (Phillips) morph con-
stantii (d’Orbigny) – Bonnot, p. 259, pl. 6, figs. 1-2.

**Holotype:** The specimen figured by d’Orbigny (1848; pl. 186, figs. 3-5) and refigured by Fischer (1994, pl. 70, fig. 1) is the holotype of the species.

**Material:** One weathered specimen from the Dhosa Oolite directly underneath the Dhosa Conglomerate Bed of the Jara Dome (GZN2010I 1088). Three moderately well preserved specimens from the Dhosa Conglomerate Bed and from the Dhosa Oolite directly underneath the Conglomerate Bed of the Jumara Dome (GZN2009II 047, 054, 056). Two specimens have been cut to measure the dimensions of inner whorls (GZN2009II 047 and 056). The fragmentary preservational state of specimen GZN2009II 054 enabled measurement of inner whorls without cutting. All specimens are wholly septate.

**Description:** Shell large, evolute. Whorl section subrectangular, flank flattened. Up to a diameter of ca. 7.5 mm depressed, then more and more compressed, outermost whorls of large specimens again less compressed. Venter slightly arched. Umbilical wall low and convex. Ornamentation consists of ribs bifurcating at the umbilical shoulder in inner whorls. In outer whorls simple ribs cross the flank and develop tubercles at the ventrolateral edge. Gradually, tubercles shift from the ventrolateral edge towards the flank. Ribs are slightly rursiradiate and occasionally appear flexuous. There are no tubercles at the umbilical edge, only a

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Fig. 5. *Peltoceratoides (Peltoceratoides) constantii* (d’Orbigny, 1848); Dhosa Oolite (A, B) and Dhosa Conglomerate Bed (C-G), Jumara Dome. A: Cross-section, x0.5; GZN2009II 056. B: Cross-section, x0.5; GZN2009II 047. C: Whorl section at ca. 215 mm diameter, x0.5; GZN2009II 054. D: Suture line at ca. 120 mm diameter, x1.5; GZN2009II 054. E-G: Ribbing pattern on left side at 100 mm (E), 150 mm (F), and 200 mm (G) diameter, x0.5; GZN2009II 054.
slight rising of the ribs. Ribs are relatively dense on inner, but become more loosely spaced on outer whorls.

Remarks: The specimens closely match the descriptions and illustrations given for Peltoceratoides (Peltoceratoides) constantii (e.g. Prieser 1937; Arkell 1944). Specimen GZN2009II 054 (Figs. 4C, 5C-G) shows the typical ornamentation of the outer whorls in forming one row of tubercles close to the ventrolateral edge.

The closest ally, well known and commonly described from the Kachchh Basin is Peltoceratoides (Peltocera-toides) semirugosus (Wagner, 1875) (e.g. Spath 1931a, b; Agrawal 1956; Desai & Patel 2009). This species develops two rows of tubercles, one at the ventrolateral edge and one at the umbilical margin. These two rows are connected by twinned ribs (compare Wagner 1875, p. 83 and pl. 14, fig. 1). This stage of twinned ribs is almost entirely absent in Peltoceratoides (P.) constantii, only ribs on the outermost whorls show a tendency of twinning close to the ventrolateral tubercle (Arkell 1944). A differentiation is therefore possible although already Wagner (1875) pointed out that at certain growth stages fragments might look very similar. Collecting and studying a larger number of adult specimens will clarify whether the described morphological differences are within the natural variability of one species. Due to the lack of necessary material, merging both taxa would be presumptuous at the moment.

Peltoceratoides (Peltoceratoides) eugenii (Raspail, 1842) has strong, coarse ribs crossing the venter, while in Peltoceratoides (P.) constantii the venter becomes smooth in outer whorls (Spath 1931b).

Peltoceratoides (P.) williamsoni develops two rows of tubercles relatively early in ontogeny, while only the outermost whorls of Peltoceratoides (P.) constantii can show a bi-tuberculare stage (Bonnot 1995).

Juvenile specimens of Peltoceratoides (P.) constantii are very similar to Peltoceratoides (Parawedekindia) arduennensis differing only in having stronger and less flexuous ribs and a less compressed whorl section. It has been proposed that Peltoceratoides (P.) constantii is the corresponding macroconch to Peltoceratoides (Parawedekindia) arduennensis (Matyja 1994; Bonnot 1995; Parent 2006).

Earlier records: The species has not been mentioned from the Kachch Basin so far.

Peltoceratoides (Peltoceratoides) cf. constantii (d’Orbigny, 1848) [M], Table 2

Fig. 6. Dimensions of Peltoceratoides (Peltoceratoides) constantii (d’Orbigny, 1848). A: Ratio of umbilical width and diameter versus diameter. B: Ratio of whorl height and whorl width versus diameter.
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**Material:** Three poorly preserved, fragmentary specimens (Table 3) from the Dhosa Conglomerate Bed and from the Dhosa Oolite directly underneath the Conglomerate Bed of the Jumara Dome (GZN2010I 1050, 1052, 1064). All specimens are wholly septate.

**Remarks:** The specimens match *Peltoceratoides (P.) constantii* in style of ornamentation, whorl shape and size, but due to their poor preservation, they have been assigned only tentatively.

*Peltoceratoides (Peltoceratoides) eugeniforme* (ArKell, 1944) [M] Figs. 4A, B, 7, Table 3

*cf. 1829 Ammonites williamsoni* sp. nov. – Phillips, p. 131; pl. 4, fig. 19.

*cf. 1944 Peltoceras (Peltoceratoides) williamsoni* (Phillips). – ArKell, p. 287; pl. 65, fig. 3; text-fig. 100.

*cf. 1944 Peltoceras (Peltoceratoides) williamsoni* var. bromptonense. – ArKell: 289; pl. 67, fig. 4; text-fig. 100.

*cf. 1944 Peltoceras (Peltoceratoides) cf. williamsoni* (Phillips). – ArKell, p. 287; pl. 65, fig. 1.

*cf. 1995 Peltoceratoides williamsoni* (Phillips) morphe williamsoni. – Bonnot, p. 259; pl. 5, figs. 5-6.

**Holotype:** The specimen figured by Phillips (1829; pl. 4, fig. 19) is the holotype of the species. The specimen figured by ArKell (1944; pl. 64, fig. 3; pl. 67, fig. 3) and called holotype should therefore be the same.

**Material:** One fragmentary specimen from the Dhosa Oolite close to Jhura Camp, Jhura Dome (GZN2009II 128). Only the right side of the wholly septate specimen is preserved.

**Remarks:** The specimen is a fragment of a large, evolute, compressed shell. Ornamentation consists of two rows of tubercles, one situated on the flank at one-fourth of lateral height and a second one at the ventro-lateral edge. In addition, there are three weak, but well preserved secondary ribs between the tubercles. Impressions of secondaries from the ventral region of the inner whorl can be seen.

The specimen is very similar to *Peltoceratoides williamsoni* morphe *williamsoni* as described by Bonnot (1995).

**Fig. 7.** *Peltoceratoides (Peltoceratoides) eugeniforme* (ArKell, 1944); top of section, southernmost Khadir Island; GZN2010I 037. A: Whorl section at ca. 40 mm diameter, x2. B: Ribbing pattern on right side at ca. 35 mm diameter, x2.
This species is characterized by the formation of two rows of tubercles on the outer whorls of which the outer one can become quite strong as is the case in the present specimen. However, *Peltoceratoides williamsoni* morphes *williamsoni* undergoes a stage in which the tubercles on the ventrolateral edge are duplicated. This stage cannot be observed in the present specimen, probably because of its fragmentary state of preservation. Therefore, it has been tentatively assigned to the species.

**Earlier records:** The species has not been described from the Kachchh Basin so far.

**Subgenus** Parawedekindia Schindewolf, 1925  
**Type species:** *Ammonites arduennensis* d’Orbigny, 1848.

**Remarks:** The subgenus Parawedekindia is used for microconchs with ribs bifurcating very close to the umbilical shoulder (Prieser 1937; Bonnot et al. 1997).

**Peltoceratoides (Parawedekindia) arduennensis**  
(d’Orbigny, 1848) [m]  
Figs. 10A-E, 11A-E, J-M, 12, Table 5

*1848 Ammonites arduennensis* sp. nov. – d’Orbigny, p. 500; pl. 185, figs. 4-7.  
1871 Perisphinctes arduennensis d’Orbigny. – Neumayr, p. 368.  
1875 *Peltoceras arduennense* d’Orbigny. – Waagen, p. 79; pl. 16, fig. 2a, b.  
1937 Peltoceratoides arduennensis d’Orbigny. – Prieser, p. 94; pl. 8, fig. 10; pl. 9, fig. 5; text-fig. 11A.  
1945 Peltoceras (Parawedekindia) arduennense (d’Orbigny), var. schlosseri Prieser. – Arkell, p. 297.  
1959 Parawedekindia arduennensis d’Orbigny. – Collignon, pl. 43, fig. 219; pl. 48, figs. 234-235.  
1977 Parawedekindia arduennensis (d’Orbigny). – Matyja, pl. 4, figs. 4-5.  
1980 Parawedekindia cf. arduennensis (d’Orbigny). – Garlicka & Tarkowski, pl. 1, figs. 6, 7.  
1981 Peltoceras (Parawedekindia) arduennense (d’Orbigny). – Enay & Boullier, pl. 2, fig. 1.  
1983 Parawedekindia arduennensis (d’Orbigny). – Tarkowski, pl. 18, fig. 1.  
1991 Peltoceratoides (Parawedekindia) arduennensis (d’Orbigny). – Schlamp, p. 74; pl. 22, fig. 3.  
1992 Peltoceratoides (Parawedekindia) cf. arduennensis (d’Orbigny). – Westermann; pl. 83, fig. 2a, b.  
1992 Parawedekindia arduennensis (d’Orbigny). – Westermann, pl. 88, fig. 4a, b.
1994 *Parawedekindia arduennensis* (d’ORBIGNY). – FISCHER, p.164; pl. 69, figs. 5, 6a-c, 7.

1994 *Parawedekindia arduennensis* (d’ORBIGNY). – MATYJA, pl. 1, figs. 1-4; pl. 2, figs. 1-2.

1994 *Peltoceratoidea* (Parawedekindia) *arduennensis* (d’ORBIGNY). – SCHLEGELMILCH, p. 117; pl. 61, fig. 4.

1995 *Peltoceratoidea williamsoni* (Phillips) morph e arduennense. – BONNOT, p. 259; pl. 6, figs. 4-5; pl. 7, figs. 1-3.

**Lectotype:** The specimen figured by d’ORBIGNY (1848; pl. 185, figs. 4-5), refigured by FISCHER (1994; pl. 69, fig. 5).

**Material:** Eleven specimens from the Dhosa Oolite directly underneath the Conglomerate Bed of the Jumara Dome (GZN2009II 031-033, 035-39, 042, 044, 053). One specimen from the Dhosa Oolite close to Jhura Camp, Jhura Dome (GZN2009II 034). Specimens GZN2009II 042 and 044 have been cut to measure the dimensions of the inner whorls. Almost all specimens are wholly septate, only specimen GZN2009II 038 seems to have parts of the body chamber preserved.

**Description:** Shell medium-sized, evolute. Whorl section variable, inner whorls more rounded and depressed (up to ca. 18 mm diameter), outer whorls becoming subrectangular and compressed with flat flanks. Venter tabulate, often with a slight median furrow. Umbilical wall low and almost vertical. Ornamentation consists of sharp primary ribs, which originate from the umbilical seam inclined backwards. Ribs attain maximum height at the umbilical shoulder, where they bifurcate into two or rarely three secondaries which slightly bend forwards on the flank, thicken towards the venter, and attain their maximum thickness on the ventral region. On the flank ribs can appear flexuous.

**Remarks:** The morphological features of the specimens match well illustrations of *Peltoceras arduennense* by WÄGEN (1875). *Peltoceratoidea* (Parawedekindia) ae-goceroides has a more depressed whorl section and much stronger ribs (WÄGEN 1875; SPATH 1931b). *Peltoceratoidea indicus* SPATH, 1931 has a much smaller umbilicus (25 % of diameter; SPATH 1931b).

*Peltoceratoidea* (Parawedekindia) *arduennensis* is very similar to the inner whorls of *Peltoceratoidea* (*Peltoceratoidea*) *constanti*, but often more compressed and ornamented with more flexuous ribs. It has been suggested that *Peltoceratoidea* (Parawedekindia) *arduennensis* is the corresponding microconch of *Peltoceratoidea* (*Peltoceratoidea*) *constanti* (MATYJA 1994; BONNOT 1995; PARENT 2006).

**Earlier records:** The species has been described from the Dhosa Oolite of Jara (DESAI & PATEL 2009) and Jhura domes (WÄGEN 1875).

*Peltoceratoidea* (Parawedekindia) cf. *arduennensis* (d’ORBIGNY, 1848) [m]

Figs. 10F, G, 11F, 12, Table 6

**Material:** One specimen from a concretionary slab in the Dhosa Conglomerate Bed of the Jara Dome (GZN2010I 1073). Eleven specimens from the Dhosa Conglomerate Bed and the Dhosa Oolite directly underneath the Conglomerate Bed from the Jumara Dome (GZN2009II 040, 041, 043, 045, 046, 048, 055, 201, GZN2010I 1046-1048). Three specimens from the Dhosa Oolite close to Jhura Camp, Jhura Dome (GZN2009II 049, 050, 177). Two specimens from the Dhosa Conglomerate Bed east of Rudra Mata temple, Habo Dome (GZN2009II 051, GZN2010I 1099). All specimens are wholly septate.

**Remarks:** The ornamentation of the collected specimens, in particular their style of ribbing, is typical of *Peltoceratoidea* (Parawedekindia) *arduennensis* as described above. The whorl section is subrectangular with flat flanks, the ventral region is only slightly arched. The estimated size of the shell is relatively small. Since all specimens are preserved as fragments only they have been assigned tentatively.

*Peltoceratoidea* sp. juv.

Figs. 10H, I, 11G-I, Table 7

**Material:** One specimen from the Dhosa Oolite directly underneath the Dhosa Conglomerate Bed from the Jumara Dome (GZN2009II 052). Three specimens from the Dhosa Oolite close to Jhura Camp, Jhura Dome (GZN2009II 029, 030, 079). All specimens are wholly septate.

**Remarks:** The collected specimens represent juveniles of *Peltoceratoidea*. The inner whorls of several species of *Peltoceratoidea* look very similar, therefore a specific identification of the specimens is not possible. Since they occur in levels where larger specimens of *Peltoceratoidea* (*Peltoceratoidea*) *constanti* and *Peltoceratoidea* (Parawedekindia) *arduennensis* are common, it is likely that they display the innermost whorls of either macro- or microconch of this biospecies.

**4. Discussion**

During the study of more than 600 ammonoids collected during two field surveys in the Kachchh Basin, 43 have been assigned to the genus *Peltoceratoidea* SPATH, 1924. Fig. 13 shows that all described taxa occur only in very restricted intervals of the measured sections.

In Europe *Peltoceratoidea* (*Peltoceratoidea*) *constanti* and *Peltoceratoidea* (Parawedekindia) *arduennensis* have been established as a dimorphic pair (MATYJA 1994; BONNOT 1995; PARENT 2006). Apart from their morphological similarities, both taxa occur in the same beds in the Kachchh Basin, which strongly supports their affiliation to a single species. Probably there are many taxa in the literature which are merely synonyms of a variable biospecies. BONNOT (1995), for example, included *Peltoceratoidea* (*Peltoceratoidea*) *constanti*, *Peltoceratoidea* (P.) *eugeniforme* and Pel-
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toceratoides (Parawedekindia) arduennensis as different morphs in the synonymy of *Peltoceratoides* (*P.*) williamsoni. However, because of the sculptural differences between these taxa (especially shape and number of tubercles), the separation into several morphospecies is herein retained.

Members of the genus *Peltoceratoides* are important for stratigraphic correlation throughout the Kachchh Basin. This is due to their widespread geographic distribution, their occurrence within a narrow stratigraphic interval, and because they are easily recognized. The Oxfordian age of the Dhosa Oolite member has been suggested early on (e.g. Waagen 1875; Spath 1931a, b; Biswas 1980, 1991; Singh 1989). Based on the occurrence of the genus and the associated ammonite fauna (predominantly perisphinctids belonging to *Arisphinctes*, *Dichotomosphinctes*, and *Kranaosphinctes*, additionally mayaitids such as *Mayaites*, *Epimayaites*, and *Dhosaites*), the beds in which members of *Peltoceratoides* occur have been assigned a late Early Oxfordian age (Cordatum Zone; compare also Krishna et al. 2000). Since the characters of the collected specimens of *Peltoceratoides* (*Peltoceratoides*) *constantii* and *Peltoceratoides* (Parawedekindia) arduennensis are rather weakly developed, it seems likely that they are from an equivalent of the Bukowskii Subzone.

Fig. 10. A–E – *Peltoceratoides* (Parawedekindia) arduennensis (*O*’Orbigny, 1848); Dhosa Oolite, Jumara Dome (A, D, E) and Jhura Dome (B, C). A: Lateral view, x1; GZN2009II 038. B: Lateral view, x1; GZN2009II 034. C: Ventral view, x1; GZN2009II 034. D: Lateral view, x1; GZN2009II 036. E: Lateral view, x1.5; GZN2009II 037. F–G – *Peltoceratoides* (Parawedekindia) cf. arduennensis (*O*’Orbigny, 1848); Dhosa Conglomerate Bed, Jumara Dome; GZN2009II 040. F: Ventral view, x1. G: Lateral view, x1. H–I – *Peltoceratoides* sp. juv.; Dhosa Oolite, Jhura Dome. H: Lateral view, x3; GZN2009II 030. I: Ribbing pattern on right side at ca. 10 mm diameter, x2; GZN2009II 029.

Fig. 11. A–E, J–M – *Peltoceratoides* (Parawedekindia) arduennensis (*O*’Orbigny, 1848); Dhosa Oolite, Jumara Dome (A–D, K–M) and Jhura Dome (E, J). A: Cross-section, x1; GZN2009II 042. B: Cross-section, x1; GZN2009II 044. C: Whorl section at ca. 55 mm diameter, x1; GZN2009II 036. D: Whorl section at ca. 60 mm diameter, x1; GZN2009II 037. E: Whorl section at ca. 51 mm diameter, x1; GZN2009II 034. F: Ribbing pattern on right side at ca. 43 mm diameter, x1; GZN2009II 034. K: Ribbing pattern on right side at ca. 45 mm diameter, x1; GZN2009II 036. L: Ribbing pattern on right side at ca. 45 mm diameter, x1; GZN2009II 037. M: Ribbing pattern on left side at ca. 65 mm diameter, x1; GZN2009II 038. F – *Peltoceratoides* (Parawedekindia) cf. arduennensis (*O*’Orbigny, 1848); Dhosa Conglomerate Bed, Jumara Dome; GZN2009II 040. Whorl section at unknown diameter, x1. G–I – *Peltoceratoides* sp. juv.; Dhosa Oolite, Jhura Dome. G: Whorl section at ca. 13 mm diameter, x1; GZN2009II 029. H: Whorl section at ca. 17 mm diameter, x1; GZN2009II 030. I: Ribbing pattern on right side at ca. 10 mm diameter, x2; GZN2009II 029.

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M. Alberti et al. (Bonnot, pers. comm. 2011). It has to be noted, however, that the ammonites of the Dhosa Conglomerate Bed are predominantly reworked. Already Singh (1989) mentioned that the establishment of an association of contemporary ammonites from the Dhosa Conglomerate Bed is not possible, because the fossils belong to various ammonite zones. Therefore, the Dhosa Conglomerate Bed is younger (probably Middle Oxfordian; Krishna et al. 1996b, 2009b, c), than the beds directly underneath with autochthonous occurrences of Peltoceratoides. The upper limit of the genus is the Cordatum Zone, since it disappeared in the upper part of this zone in Argentina, Europe and most of the Tethyan realm (Parent et al. 2006). According to Sandoval et al. (2001) the genus Peltoceratoides in the Betic Cordillera is restricted to the late Early Oxfordian.

The genus Peltoceratoides is a very widespread taxon. In Europe, Peltoceratoides (Peltoceratoides) constantii has been described from the Bukowskii and Costicardia subzones (Fischer 1994; Matyja 1994; Bonnot 1995). Towards the north the genus reached Scotland during the Early Oxfordian (Cordatum Zone, Bukowskii Subzone; Cecca et al. 2005). Towards the east it occurs in Early Oxfordian rocks of the Sula Islands, New Guinea, and the Philippines (Westermann 1992; Enay & Cariou 1999). Additionally it has been described from Oxfordian sediments of Madagascar and South America (Collignon 1959; Riccardi 1991; Westermann 1992). The genus is therefore very important for supraregional stratigraphic correlations (cf. Bonnot et al. 2002).

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The late John H. Callomon shared his knowledge on Jurassic ammonites with the authors. Birgit Leipner-Mata prepared the fossils and Marie-Luise Neufert took the photographs. Financial support has been granted by the German Research Society (FU 131/34-1). D.K. Pandey gratefully acknowledges financial support by the Alexander von Humboldt Foundation. The manuscript has been well improved by reviews of Alain Bonnot and Horacio Parent.

Fig. 12. Dimensions of Peltoceratoides (Parawedekindia) arduennensis (d’Orbigny, 1848) and Peltoceratoides (P.) cf. arduennensis (d’Orbigny, 1848). A: Ratio of umbilical width and diameter versus diameter. B: Ratio of whorl height and whorl width versus diameter.

Fig. 13. Schematic lithologs from localities yielding specimens of the genus Peltoceratoides Spath, 1924 with the stratigraphic range of the taxa. Numbers below stratigraphic ranges indicate the number of specimens collected from the interval.
Ammonites of the genus *Peltoceratoides* Spath, 1924

Kachchh Mainland

Jara           Jumara           Jhura           Rudra Mata       S-Khadir

---

**Fig. 13.**

- **DCB**
  - silt
  - silty fine sand
  - fine sand
  - medium sand
  - coarse sand
  - conglomerate
  - ferruginous ooids
  - Dhosa Conglomerate Bed

- *Peltoceratoides (Peltoceratoides) constanti*
  - *Peltoceratoides (Peltoceratoides) eugeniforme*
  - *Peltoceratoides sp. juv.*

- *Peltoceratoides (Peltoceratoides) cf. andrenensis*
  - *Peltoceratoides (Peltoceratoides) cf. andrenensis*
  - *Peltoceratoides (Peltoceratoides) cf. andrenensis*

- *Peltoceratoides (Peltoceratoides) cf. andrenensis*
  - *Peltoceratoides (Peltoceratoides) eugeniforme*

- *Peltoceratoides (Peltoceratoides) cf. williamsoni*
  - *Peltoceratoides (Peltoceratoides) cf. andrenensis*
  - *Peltoceratoides (Peltoceratoides) cf. andrenensis*
References


Ammonites of the genus *Peltoceratoides* Spath, 1924


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DHIREN德拉 K. PANDEY, Department of Geology, University of Rajasthan, Jaipur 302004, India; e-mail: dhirendrap@hotmail.com
**Appendix**

**Table 1.** Dimensions of *Peltoceratoides (Peltoceratoides) constantii* (d’Orbigny, 1848).

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**Table 2.** Dimensions of *Peltoceratoides (Peltoceratoides) cf. constantii* (d’Orbigny, 1848).

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Table 7. Dimensions of *Peltoceratoides* sp. juv.

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