

Oxfordian ammonites from Dhosa Oolite of Jara Dome, western Kachchh, India

RINKU A. PATEL^{1,2*}, MEHULA B. SABHAYA² & PARAS M. SOLANKI²

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The study area, Jara Dome comprises the rocks of the Mesozoic age, which is situated on the northwestern fringe of the northern flexure zone of the Kachchh Mainland. The present study addresses the collection and identification of ammonites from the Oxfordian succession of the Jara Dome. As per field study Member IV (Dhosa Oolite) of the Jumara Formation is exceedingly fossiliferous with the most frequent fossil assemblage of ammonites. In the present findings, three genera have been identified *Peltoceras*, *Metapeltoceras*, and *Perisphinctes*. Total 11 fossil specimens assigned to 10 taxa are: *Peltoceras ponderosum*, *Metapeltoceras armiger*, *Metapeltoceras* cf. *kumagunense*, *Perisphinctes* (*Kranaosphinctes*) *subevolutus*; *Perisphinctes* (*Arisphinctes*) *kheraensis*; *Perisphinctes* (*Arisphinctes*) *polymorphus*; *Perisphinctes* (*Arisphinctes*) cf. *trifidus*; *Perisphinctes* (*Dichotomoceras*) *sparsicostatus*; *Perisphinctes* (*Dichotomoceras*) *virguloides*; *Perisphinctes* (*Dichotomoceras*) *rotoides*. Consequently, based on the occurrence of plentiful ammonites in one horizon and coeval stratigraphic distribution reaffirms the age of the fossils as an Oxfordian age.

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¹Gujarat University, Ahmedabad, India; ²Geology Department, M. G. Science Institute, Ahmedabad, India. *Corresponding author's email: rinkupatel8866@gmail.com

INTRODUCTION

Kachchh sedimentary basin developed on the western margin of the Indian plate comprises a thick succession of sediments deposited during the Early Jurassic to Pleistocene. The basin formed during the early break-up of Gondwana land, with rifting between India and Africa from the Late Triassic onwards (Biswas, 1982, 1991). The stratigraphic succession of the Kachchh Basin encompasses the rocks ranging in age from Early Jurassic to Recent. The Jurassic sequence of Kachchh Basin is divided into three areas: Kachchh Mainland- conquering the central part of the basin, The Island Belt- occupying the central part of the Great Rann of Kachchh and The Wagad uplift in the eastern boundary (Fürsich *et al.*, 2013; Pandey *et al.*, 2013). The stratigraphic sequence of Kachchh Mainland is divided into four formations named the Jhurio, Jumara, Jhuran, and Bhuj Formations in ascending order (Biswas, 1977). The extensive fossil assemblage of Kachchh is attracting Palaeontologists from all over the world. Cephalopods of the Kachchh Basin in western India have been studied for more than a century by well-known previous workers Waagen (1873 - 1875), Spath (1927 - 1933), and many others. In continuation with this study, to enlarge the knowledge of stratigraphy and its correlation with other areas in the Kachchh and in the world, detailed work on the ammonite taxonomy has been studied intensely by (Fürsich *et al.*, 2001; Pandey *et al.*, 2012; Alberti *et al.*, 2013, 2015; Jain and Desai, 2014). Many previous

workers were confined to the Jumara Formation of Kachchh because of their extensive fossil assemblage. Highly fossiliferous oolitic limestone bands occur at the top of the Jumara Formation, which is called the "Dhosa Oolite beds" by earlier workers (Biswas, 1977). It is the marker horizon, assigned to Oxfordian in age, in the mainland stratigraphy separating Jumara and Jhuran Formation (Biswas, 1993). The Oxfordian succession of Kachchh Mainland is very significant for the study of fossils, especially ammonites. Varieties of ammonites, belemnites, brachiopods, bivalves, corals, and gastropods are found. Due to its wide range of accumulation, the present study is one in a series to enlarge our knowledge of the Oxfordian ammonites in the confined area of the Jara Dome of western Kachchh.

GEOLOGICAL SETTING AND STRATIGRAPHIC FRAMEWORK OF JARA DOME

Jara is a half-cut Dome structure located in Lakhpat taluka of Kachchh district of Gujarat state. Stratigraphy of the Jara Dome is represented by the rocks of Mesozoic in age with 869 m thick succession, of which Jumara Formation constitute 154 m (Biswas, 1993) and Jhuran Formation with 715 m (Fürsich *et al.*, 2021). Stratigraphically, the rocks of Jumara and Jhuran Formation are exposed in the study area. Jumara Formation conquers the core part of the Jara Dome, while

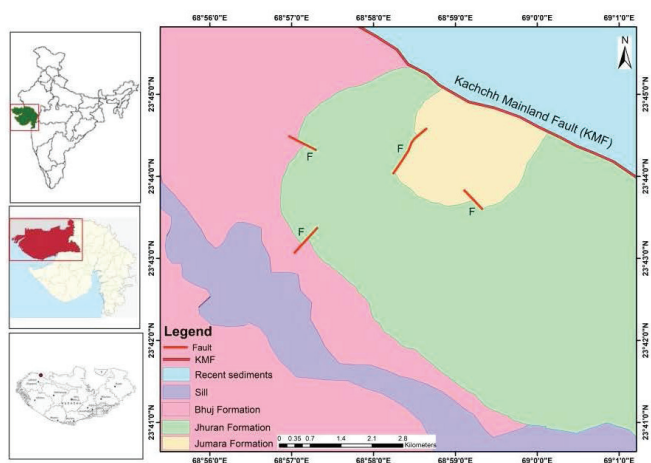


Figure 1. Geological map of Jara Dome.

the periphery is occupied by the rocks of Jhuran Formation (Fig. 1). Member I of Jumara Formation is not exposed here, while Member II and III are indistinguishable because both the members comprise a shale sequence (Biswas, 1993). Member II and III consist of fine-grained, white, and thin red ferruginous bands of shale with thin beds of siltstone and intraformational conglomerates. Member IV - the topmost member of Jumara Formation is characterized by the oolitic, hard, and yellowish to greenish limestone that intercalated with shales (Fig. 2). The top-most band of Jumara Formation is occupied by oolitic limestone with conglomeratic nature known as “Dhosa Conglomerate Bed”. It is in form of a distinct marker horizon that separates Jumara Formation from Jhuran Formation (Biswas, 1977) and can be traced for more than 100 km throughout the Kachchh Mainland (Alberti *et al.*, 2013). Member IV is highly fossiliferous here, especially the top-most conglomerate bed, and particularly ammonites are most abundant. As per (Alberti *et al.*, 2013) Dhosa Conglomerate bed consists of the typical feature of reworked, concretionary slabs, which contains a huge accumulation of taxa of perisphinctids. The vast fossil assemblage is assigned to Oxfordian in age (Fürsich *et al.*, 2001). Jhuran Formation comprises a thick sequence of alternating beds of sandstone and shale. The Jhuran Formation is defined by the Dhosa Oolite Member (Member IV) below and the non-marine sandstones of Bhuj Formation above (Biswas, 1977). Here, the formation is chiefly arenaceous and can be divisible into Lower, Middle, and Upper Member (Biswas, 1993).

SYSTEMATICS

In our preliminary evaluation of the study area 11 ammonites are described which have been assigned to 10 taxa. All the specimens were collected during field visits to the Jara Dome. Specimens were treated with Ammonium Chloride for distinct morphological features and removal of sediment cover. The collected specimens during the field study, are currently housed at the Museum of Geology

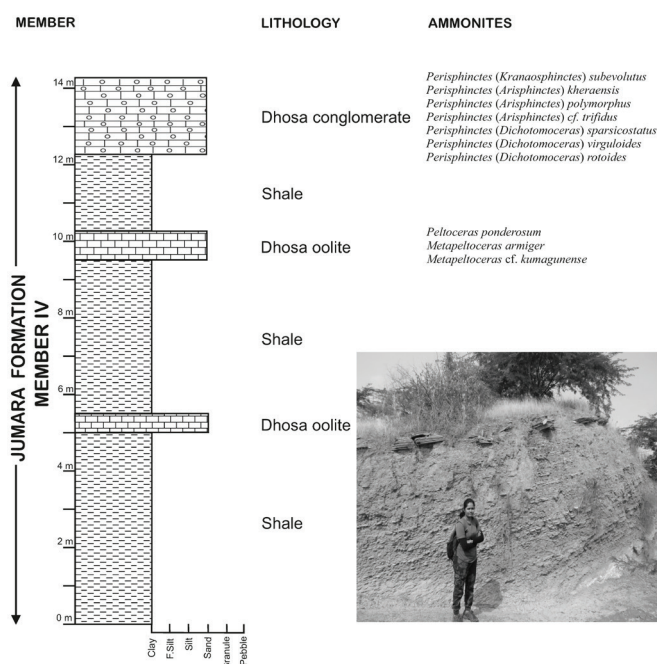


Figure 2. Lithosection of Member IV of Jumara Formation.

department, M. G. Science Institute, Ahmedabad. The identification of this study is based on morphology such as the form of the shell, ribs and their density, suture line, whorl sections, umbilicus, aperture, and other morphological features. In contrast, the material from the study area suffers from a series of limitations concerning the preservation quality of the material. Hence, in some cases, the fragments could be assigned to their appropriate taxa only tentatively.

Class Cephalopoda Cuvier, 1797
 Order Ammonoidea Zittel, 1884
 Suborder Ammonitina Hyatt, 1889
 Superfamily Perisphinctaceae Steinmann, 1890
 Family Aspidoceratidae Zittel, 1895
 Subfamily Peltoceratinae Spath, 1924
 Genus *Peltoceras* Waagen, 1871

Species *Peltoceras ponderosum* Waagen, 1875
 (Pl. I, Fig. 1)

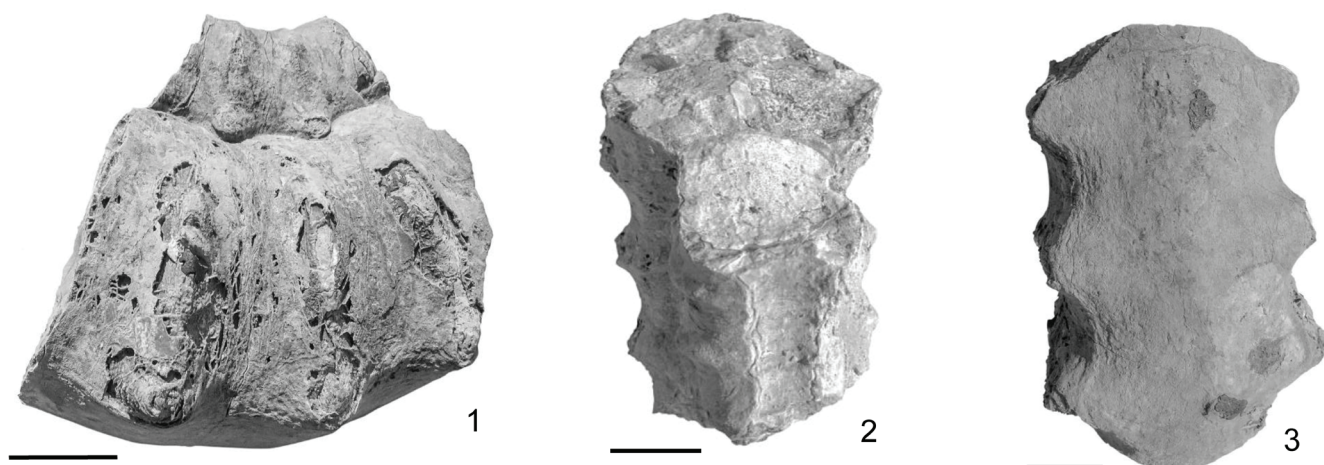
Aspidoceras ponderosum Waagen, 1875, p. 94, pl. 20, fig. 1a, b, pl. 21, fig. 2.

Peltoceras ponderosum (Waagen) – Spath, 1931, p. 569, pl. 108, fig. 4a, b, pl. 112, fig. 3.

Peltoceras ponderosum (Waagen) – Pandey *et al.*, 2015, p. 6, pl. II, fig. 1a, 1b.

Material: One specimen from the Dhosa Oolite bed, Member IV, Jumara Formation, Jara Dome, Western Kachchh (JFK2019/113).

Description: Shell large, evolute, fragmented shell. The whorl section sub-rounded is slightly above the umbilicus shoulder which is slightly inflated and elongated on the lateral side. Ornamentation consists of thick primary ribs with two rows of tubercles in the inner and middle whorls. The inner row of tubercles at the region of maximum inflation is slightly above the umbilical shoulder. The outer row of tubercles is



EXPLANATION OF PLATE I

1. *Peltoceras ponderosum* (Waagen, 1875) lateral view; 2. *Peltoceras ponderosum* (Waagen, 1875) whorl section; 3. *Peltoceras ponderosum* (Waagen, 1875) ventral view of wholly septate fragment specimen (JFK2019/113). Scale bar for each specimen = 2 cm.

on ventrolateral side of the whorl and tubercles are slightly circular and conical in shape. Umbilical wall moderately high, umbilical shoulder rounded.

Remarks: The present specimen is compared with *Peltoceras ponderosum* (Waagen) of Pandey *et al.* (2015). The fragmented specimen of *Peltoceras ponderosum* was previously described by (Spath, 1931). As the present specimen is fragmented, more features of ornamentation are not preserved and it is difficult to identify the shape and size of the umbilicus.

Genus *Metapeltoceras* Spath, 1931

Metapeltoceras armiger (J. de C. Sowerby, 1840)
(Pl. II, Fig. 1)

Ammonites armiger J. de C. Sowerby, 1840, pl. 23, fig. 13, text-fig. 11.

Metapeltoceras armiger (J. de C. Sowerby) – Spath, 1931, p. 574, pl. 110, figs. 4a, b, 8a, b, pl. 114, fig. 1a, b.

Metapeltoceras armiger (J. de C. Sowerby) – Pandey *et al.*, 2015, p. 6, pl. II, fig. 2a, 2b, 3a, 3b.

Material: One specimen from the Dhosa Oolite bed, Member IV, Jumara Formation, Jara Dome, Western Kachchh (JFK2019/121).

Description: Shell is large, evolute. Whorl section sub-oval to sub-rectangular at tubercles with slightly arched flanks merging smoothly into rounded venter. The body whorl is large with thick primary ribs. The ornamentation consists of primary ribs with two rows of tubercles. Inner row with small tubercles and the outer row with broad, rounded tubercles.

The primary ribs are thick towards the outer row of tubercles on the ventrolateral shoulder and the inner row of tubercles elongated on the umbilical shoulder. Venter is slightly rounded, arched, and smooth. The whorl height of Jara specimen is about 65 to 70 mm.

Remarks: However, during the field in the study area it

is very difficult to find the entire developed specimen. From fragmented specimens, the identification of ornamentation with umbilicus shape and size is very difficult. The present specimen match with the *Metapeltoceras armiger* (J. de C. Sowerby, 1840) as described by Pandey *et al.* (2015).

Metapeltoceras cf. *Kumagunense* (Spath, 1931)
(Pl. II, Fig. 2)

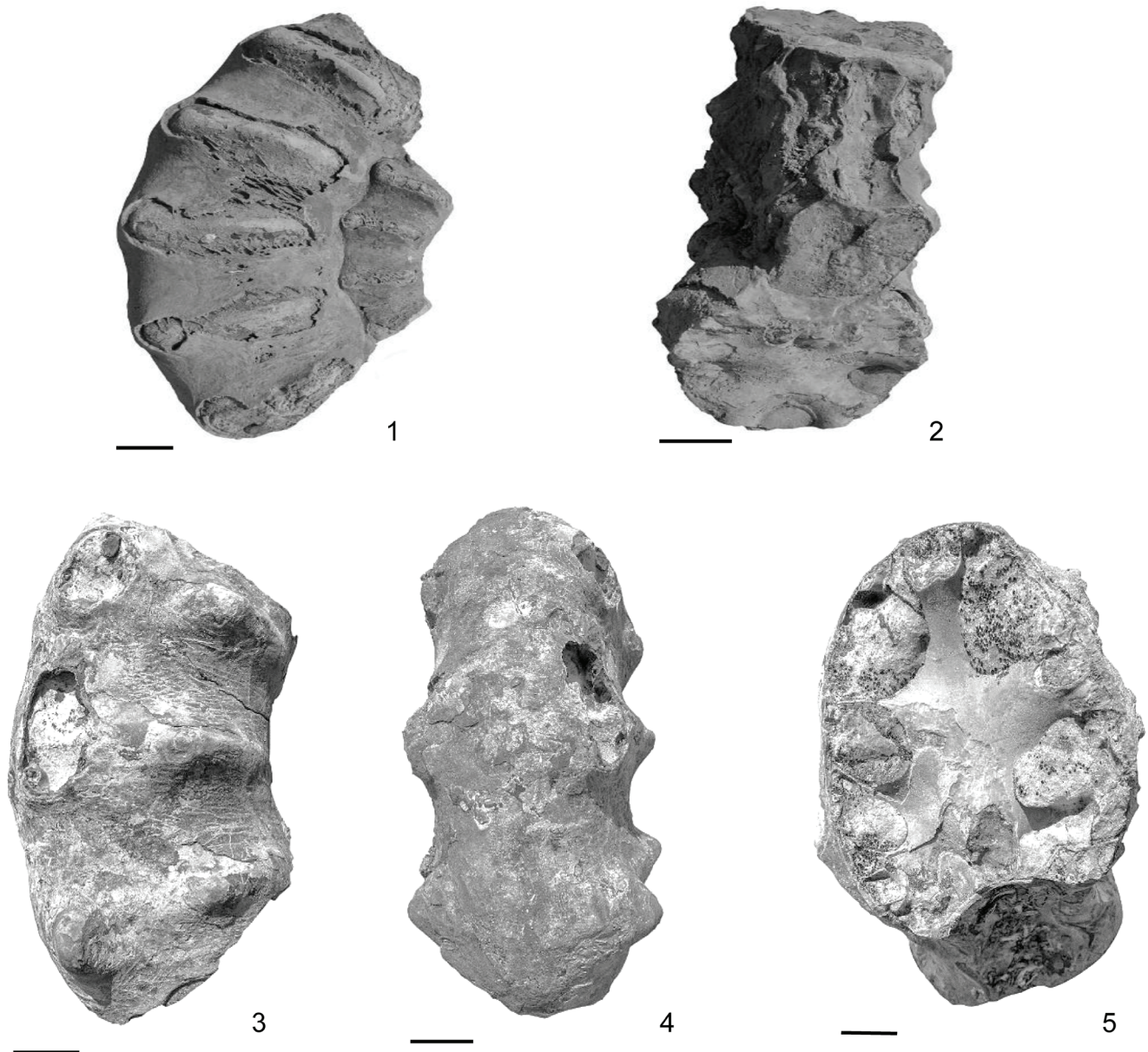
cf. *Peltoceras kumagunense* Spath, 1931, p. 566, pl. 109, figs. 4, 8, pl. 111, fig. 1a, b.

Metapeltoceras cf. *kumagunense* (Spath, 1931) – Pandey *et al.*, 2015, p. 8, pl. VI, fig. 1a, 1b.

Material: One specimen from the Dhosa Oolite bed, Member IV, Jumara Formation, Jara Dome, Western Kachchh (JFK2019/136).

Description: Shell small to large, evolute, fragmented shell is slightly compressed. The whorl section is sub-rounded, venter is slightly rounded with a smooth margin. Ornamentation comprises two rows of tubercles. On the outer whorl, the outer row of tubercles is mainly large, rounded, conical, and slightly pointed. The inner row of tubercles, which is slightly above the umbilical shoulder, is elongated and parallel to the ribs. The outer tubercle at the ventrolateral shoulder is more circular, pointing slightly backward. As the specimen is fragmented other ornamentation is not preserved.

Remarks: The specimen is fragmented and only the whorl shape is perceptible. The species is identified by Pandey *et al.* (2015). As to the previous study, the ornamentation of this specimen is similar to members of the genera *Peltoceras* and *Metapeltoceras*, which have been assigned to the Oxfordian part of the succession (Alberti *et al.*, 2011). However, the present specimen is different in the preservation of tubercles from the genera *Peltoceras*. Hence, the fragmented specimen was assigned as a *Metapeltoceras*. Despite that, the specimen is assigned to this species only tentatively because of the poor preservation of the specimen.



EXPLANATION OF PLATE II

1. *Metapeltoceras armiger* (Sowerby, 1840) lateral View; 2. *Metapeltoceras armiger* (Sowerby, 1840) ventral view of the wholly septate fragmented specimen (JFK2019/121); 3. *Metapeltoceras* cf. *Kumagunense* (Spath, 1931) lateral view; 4. *Metapeltoceras* cf. *Kumagunense* (Spath, 1931) ventral view; 5. *Metapeltoceras* cf. *Kumagunense* (Spath, 1931) whorl section view of the wholly septate fragmented specimen (JFK2019/136). Scale bar for each specimen = 2 cm.

Class Cephalopoda Cuvier, 1797
 Order Ammonoidea Zittel, 1884
 Superfamily Perisphinctaceae Steinmann, 1890
 Family Perisphinctidae Steinmann, 1890
 Subfamily Perisphinctinae Steinmann, 1890
 Genus Perisphinctes Waagen, 1869
 Subgenus Kranaosphinctes Buckman, 1921
Perisphinctes (*Kranaosphinctes*) *subevolutus* Waagen, 1875
 (Pl. III, Fig. 1)

Perisphinctes subevolutus Waagen, 1875c. p. 179, pl. 45, fig.3a, b (holotype).

Pachyplanulites subevolutus Waagen, – Spath, 1931a.p.428, pl. 52, fig. 4a, b, pl. 62, fig. 2a, b, pl. 65, fig. 6.

Kranaosphinctes (*Pachyplanulites*) *subevolutus* Waagen, – Collignon, 1959b. pl. 89, figs. 352, 353.

Perisphinctes (*Kranaosphinctes*) *subevolutus* Waagen, 1875 -Pandey *et al.*, 2012, p. 494, pl.V, fig. 1 - 11.

Material: One specimen from the Dhosa Conglomerate



EXPLANATION OF PLATE III

1. *Perisphinctes* (*Kranaosphinctes*) *subevolutus* (Waagen, 1875) lateral view; 2. *Perisphinctes* (*Kranaosphinctes*) *subevolutus* (Waagen, 1875) ventral view of the specimen (JFK2019/44); 3. *Perisphinctes* (*Arisphinctes*) *kheraensis* (Spath, 1931) lateral view; 4. *Perisphinctes* (*Arisphinctes*) *kheraensis* (Spath, 1931) whorl section; 5. *Perisphinctes* (*Arisphinctes*) *kheraensis* (Spath, 1931) ventral view of wholly septate fragment specimen (JFK2019/68). Scale bar for each specimen = 2 cm.

bed, Member IV, Jumara Formation, Jara Dome, Western Kachchh (JFK2019/44).

Description: Shell small, evolute, depressed, and septate. The whorl section is rounded to sub-quadrangular and the venter is smooth and rounded. Shell is slightly compressed and the umbilical area is short, not distinct. Ornamentation consists essentially of primary ribs which are moderately thick, varicostate, primary ribs started at umbilical shoulders and endure up to ventrolateral shoulders. Primary ribs split into two or three finer secondaries at the ventrolateral region and the secondary ribs cross the venter with slight convexity on the outer whorls. In the present specimen, the inner whorls primary branches into two secondaries at the ventrolateral region with infrequently the third secondary rib being free. Sutures are distinct on the venter with pairs of saddles and lobes.

Remarks: The present specimen match with the subgenera

Kranaosphinctes Buckman (1921) based on ornamentation. The species of the genera *Perisphinctes* generally display similar morphology, hence sometimes it is very difficult to separate. Identification of this specimen is wholly based on previous work done by various authors (Pandey *et al.*, 2012, Waagen, 1875c, Spath, 1931a). Specimens of *Perisphinctes* (*Kranaosphinctes*) *subevolutus* were also collected by the above workers from Jara Dome area and they assigned this species as Oxfordian age.

Subgenus *Arisphinctes* Buckman, 1924

Perisphinctes (*Arisphinctes*) *kheraensis* Spath, 1931
(Pl. III, Fig. 2)

Perisphinctes kheraensis Spath, 1931a. p. 420, pl. 74, fig. 5a, b (non pl. 95, fig. 3).

Perisphinctes kheraensis Spath, 1931- Pandey *et al.*, 2012, p.502, pl.IX, fig. 1 – 7.

Material: One specimen from the Dhosa Conglomerate bed, Member IV, Jumara Formation, Jara Dome, Western Kachchh (JFK2019/68).

Description: Shell small, evolute, depressed, septate. Whorl section sub-rounded to sub-quadrangular with slightly convex venter. Inner whorl slightly depressed. Ornamentation consists of moderately thick primary ribs near the umbilical shoulder which is branch regularly into two secondary ribs in the ventrolateral region. The primary ribs are sharp near the umbilical shoulder and sometimes branch into three on the ventrolateral region and cross the venter regularly. Sutures are not distinct but present on the umbilical shoulder and also on the venter.

Remarks: The present specimen is very small and also fragmented. Based on ornamentation, this specimen match with *Perisphinctes kheraensis* Spath, 1931 as per Pandey *et al.* (2012). Unfortunately, the poor preservation of sutures does not match their specimen. However, as per them, the style of ribbing and whorl section suggests that *kheraensis* is a macro coach. According to previous work, this specimen was also identified by Spath (1931a) from Keera and Jhura Dome, and Pandey *et al.* (2012) from the Jara and Habo Dome.

Perisphinctes (Arisphinctes) polymorphus Spath, 1931
(Pl. IV, Fig. 1)

Alligaticeras polymorphum Spath, 1931a, p. 409, pl. 73, figs. 3a, b (holotype), pl. 99, fig. 2.

Alligaticeras polymorphum Spath, – Collignon, 1959a pl. 43, fig. 220.

Perisphinctes (Arisphinctes) polymorphus Spath, 1931- Pandey *et al.*, 2012, p.504, pl.VIII, fig. 2-5.

Material: One specimen from the Dhosa Conglomerate bed, Member IV, Jumara Formation, Jara Dome, Western Kachchh (JFK2019/52).

Description: Shell small, evolute, septate and compressed. Whorl section rounded to sub-quadrangular with slightly rounded venter. The present specimen is with two to three inner whorls and a slightly large body whorl with a distinct aperture. The shape of the aperture is rounded to sub-rounded. Ornamentation consists variocostate ribbing patterns in which the style of ribbing changes from fine or moderately thick on the inner whorls to very thick or fold-like on the outer whorls or the body whorl. This change is very gradual in *Arisphinctes*. On the outer whorl, primary ribs are moderately thick and sharp near the umbilical shoulder which branches into two fine secondary ribs just short of the ventral region. Ribbing density is moderate. Sutures are present on the venter and indistinct on the umbilical shoulder.

Remarks: The present specimen is preserved with a body chamber and distinct aperture. The ornamentation of the present specimen matches the *Perisphinctes (Arisphinctes) polymorphus* Spath, 1931 Pandey *et al.* (2012). As per earlier records from the Kachchh Basin, this species was identified by Spath (1931a) and also collected by Pandey *et al.* (2012) from Jara Dome and Jumara Dome.

Perisphinctes (Arisphinctes) cf. trifidus (J. Sowerby, 1821)
(Pl. IV, Fig. 2)

Ammonites trifidus J. Sowerby, cf. 1821. p. 194.

Perisphinctes helenae de Riaz, cf. 1898. p. 15, pl. 8, fig. 1.

Dichotomosphinctes helenae (de Riaz). – Spath, cf. 1931a. p.436, pl. 68, fig. 9, pl. 70, fig. 5.

Perisphinctes (Arisphinctes) helenae de Riaz. – Arkell, cf. 1939. p. 149, pl. 30, figs. 7, 8, pl. 31, figs. 1-3, textfigs. 48, 49.

Arisphinctes helenae de Riaz. – Collignon, cf. 1959b. pl.67, fig. 295.

Perisphinctes (Arisphinctes) helenae (de Riaz). –Enay, cf. 1966. p. 413, pl. 20, figs. 1-4, textfigs. 118, 119.

Perisphinctes (Arisphinctes) helenae de Riaz. –Gygi, cf. 2000. p. 82, pl. 3, fig. 2, textfig. 43.

Perisphinctes (Arisphinctes) helenae de Riaz. –Gygi, cf. 2001. p. 29, figs. 36, 37.

Perisphinctes trifidus (J. Sowerby). – Glowinski, cf. 2002. p. 321, pl. 10, figs. 2-3, pl. 11, figs. 1-3, pl. 12, figs.1-2, textfigs. 8, 10, 11

Perisphinctes (Arisphinctes) cf. trifidus (J. Sowerby, 1821) - Pandey *et al.*, 2012, p.506, pl.XII, fig. 6, 7.

Material: One specimen from the Dhosa Conglomerate bed, Member IV, Jumara Formation, Jara Dome, Western Kachchh (JFK2019/78).

Description: Shell small, evolute, complete with body chamber. Whorl section compressed to quadrate. Umbilical shoulder rounded, laterals nearly flat, ventrolateral shoulder rounded, venter broadly arched. The present specimen is with two to three inner whorls and a slightly large body whorl with a distinct aperture, ribs distinct, mostly biplicate. Primaries from just below the umbilical shoulder, sharp and strong, almost straight on laterals, while secondaries from above the 2/3rd of whorl height, sharp and strong as primaries projected forward and uninterrupted on venter. Ribbing density is moderate. Sutures are present on the body whorl and distinct on the venter with pairs of saddles and lobes.

Subgenus *Dichotomoceras* Buckman, 1919

Perisphinctes (Dichotomoceras) sparsicostatus
(Collignon, 1959)
(Pl. V, Figs. 1, 2)

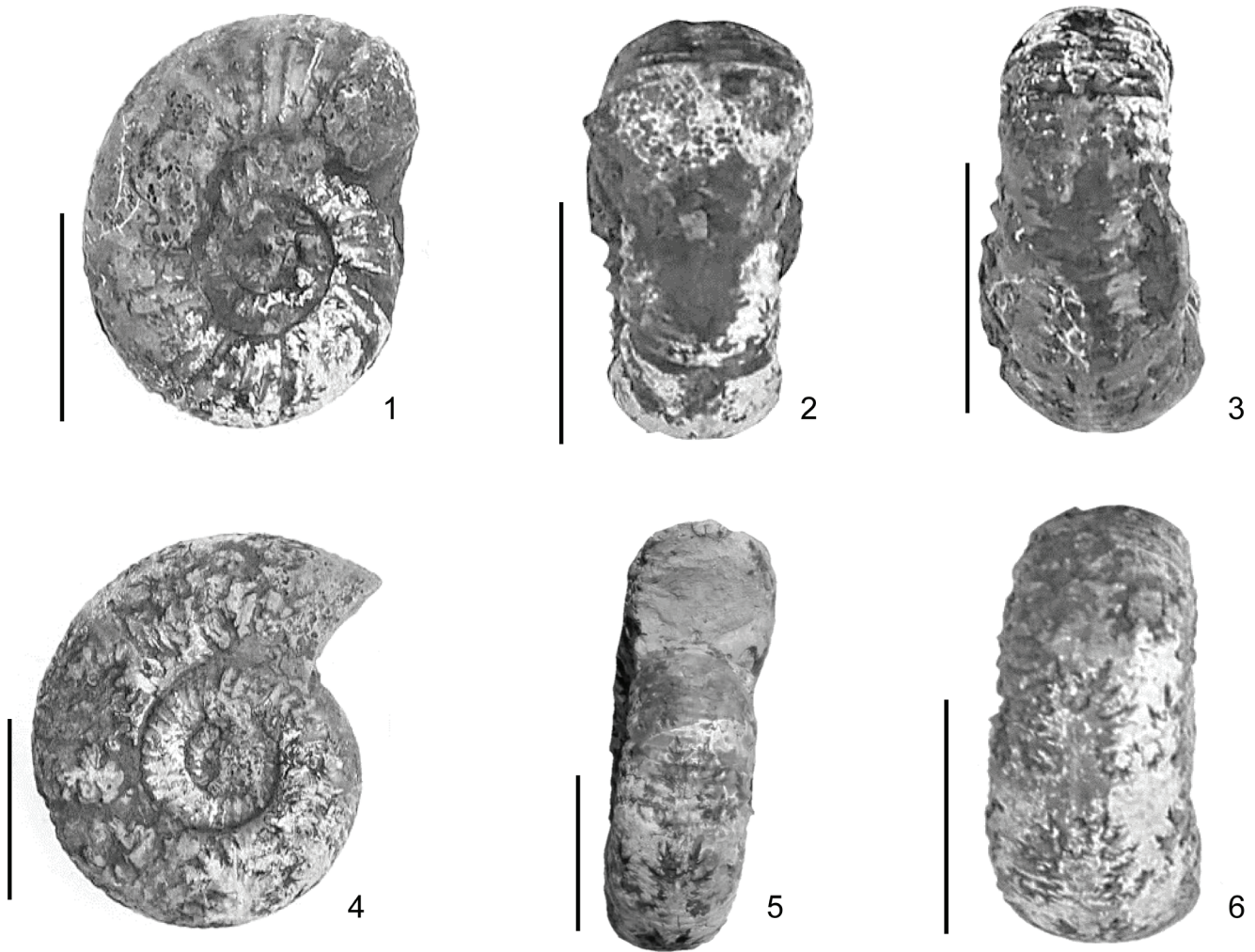
Dichotomoceras sparsicostatum Collignon, 1959b. pl. 66, fig. 294.

Perisphinctes (Dichotomoceras) sparsicostatus (Collignon, 1959) - Pandey *et al.*, 2012, p.524, pl. XVII, fig.1-9.

Material: Two specimens from the Dhosa Conglomerate bed, Member IV, Jumara Formation, Jara Dome, Western Kachchh (JFK2019/69, 71).

Description: Shell small, evolute, septate, incomplete, and moderately compressed. Umbilical shoulder rounded, laterals convex, ventrolateral shoulder rounded, venter rounded. The present specimens with two to three inner whorls and slightly small body whorl with distinct, sub-quadrangular aperture. Ornamentation consists variocostate ribbing pattern with primary ribs on the umbilical shoulder which is a branch into two secondaries on the ventro-lateral shoulder. Secondaries cross the venter with convexity to some extent. Ribbing density is low. Sutures are present on the venter and indistinct on the umbilical shoulder.

Remarks: The present examples strongly resemble the holotype of *Perisphinctes* in parentheses (*Dichotomoceras) sparsicostatus* (Collignon, 1959) - Pandey *et al.*, 2012, p.524, pl.XVII, fig. 1-9 in morphology and ornamentations particularly in rib density and ribbing pattern. Present specimens are very small in size. Hence, identification is based on ornamentation mostly on Ribbing pattern and whorl shape. In spite of that, the specimens are assigned to this species only tentatively because of the poor preservation of the specimens.



EXPLANATION OF PLATE IV

1. *Perisphinctes (Arisphinctes) polymorphus* (Spath, 1931) lateral view; 2. *Perisphinctes (Arisphinctes) polymorphus* (Spath, 1931) apertural view; 3. *Perisphinctes (Arisphinctes) polymorphus* (Spath, 1931) ventral view of the specimen (JFK2019/52); 4. *Perisphinctes (Arisphinctes) cf. trifidus* (J. Sowerby, 1821) lateral view; 5. *Perisphinctes (Arisphinctes) cf. trifidus* (J. Sowerby, 1821) apertural view; 6. *Perisphinctes (Arisphinctes) cf. trifidus* (J. Sowerby, 1821) ventral view of wholly septate fragment specimen (JFK2019/78). Scale bar for each specimen = 2 cm.

Perisphinctes (Dichotomoceras) virguloides Waagen, 1875
(Pl. VI, Fig. 1)

Perisphinctes virguloides Waagen, 1875c, p. 203, pl. 49, fig. 1a, b (non pl. 47, fig. 4a, b; compare Spath, 1931a, p. 451).

Prososphinctes virguloides (Waagen) – Spath, 1931a, p. 441, pl. 70, fig. 3, pl. 90, fig. 4.

Prososphinctes virguloides (Waagen) – Collignon, 1959b, pl. 88, fig. 351.

Perisphinctes (Dichotomoceras) cf. virguloides Waagen, 1875 - Pandey *et al.*, 2012, p.520, pl.XIV, fig. 1-9.

Perisphinctes (Dichotomoceras) virguloides Waagen, 1875 - Pandey *et al.*, 2013, p.158, Pl. XI, figs 1-3; Pl. XII, figs 1-4.

Material: One specimen from the Dhosa Conglomerate bed, Member IV, Jumara Formation, Jara Dome, Western Kachchh (JFK2019/36).

Description: Shell small, evolute, septate, incomplete,

and abstemiously compressed. The present specimen has three whorls and whorl sections primarily depressed and oval. Inner whorls are mainly thinner which is gradually becoming thick into the outer whorl with flat lateral flanks and narrowly rounded venter in outer whorls. Ornamentation consists of regularly varicostate, sharp, long, dense, and distinct primary ribs in inner whorls and moderately coarse, long, biplicate primary ribs on outer whorls. On outer whorls, primary ribs branch into two secondaries slightly above the ventrolateral shoulder and without interruption cross the venter. The faintly thinner secondaries cross the venter with faint forward-directed convexity.

Remarks: The specimen is well preserved but fragmentary. The present specimen match *P. (Dichotomoceras) virguloides* Waagen (1875) with Pandey *et al.* (2013) on the center of ornamentation. However, fragmentary nature



EXPLANATION OF PLATE V

1. *Perisphinctes (Dichotomoceras) sparsicostatus* (Collignon, 1959) lateral view; 2. *Perisphinctes (Dichotomoceras) sparsicostatus* (Collignon, 1959) ventral view; 3. *Perisphinctes (Dichotomoceras) sparsicostatus* (Collignon, 1959) apertural view of specimen (JFK2019/69); 4. *Perisphinctes (Dichotomoceras) sparsicostatus* (Collignon, 1959) lateral view; 5. *Perisphinctes (Dichotomoceras) sparsicostatus* (Collignon, 1959) ventral view of wholly septate fragment specimen (JFK2019/71). Scale bar for each specimen = 2 cm.

of the specimen, it has been assigned to this species only tentatively. As compared to the previous study the size of the present specimen is smaller than the previous specimen collected by Waagen (1875) and Pandey *et al.* (2013). As per a previous study Waagen (1875c) described the species from the Kanthkot Sandstone (Wagad Uplift) and Gangta Bet. As described by Pandey *et al.* (2013) the inner whorls of the present specimens are also similar to *P. (Dichotomoceras) bifurcatoides* Enay (1966), but the Outer whorls in *bifurcatoides* are more compressed, more evolute and have a less distinct umbilical edge.

Perisphinctes (Dichotomoceras) rotoides Ronchadze, 1917
(Pl. VI, Fig. 2)

Perisphinctes rotoides Ronchadze, 1917. p.11, Pl. I, fig. 8.

Perisphinctes variens Oppenheimer, Ronchadze, 1917. p.37, Pl. V, figs. 41-42.

Perisphinctes (Dichotomosphinctes) rotoides Ronchadze, Arkell, 1937. p.447.

Perisphinctes (Dichotomosphinctes) rotoides Ronchadze, Arkell, 1937. p.90, Pl. XVI, figs. 1-7.

Perisphinctes variens Ronchadze, Collignon, 1959. p.37, Pl. V, figs. 41-42.

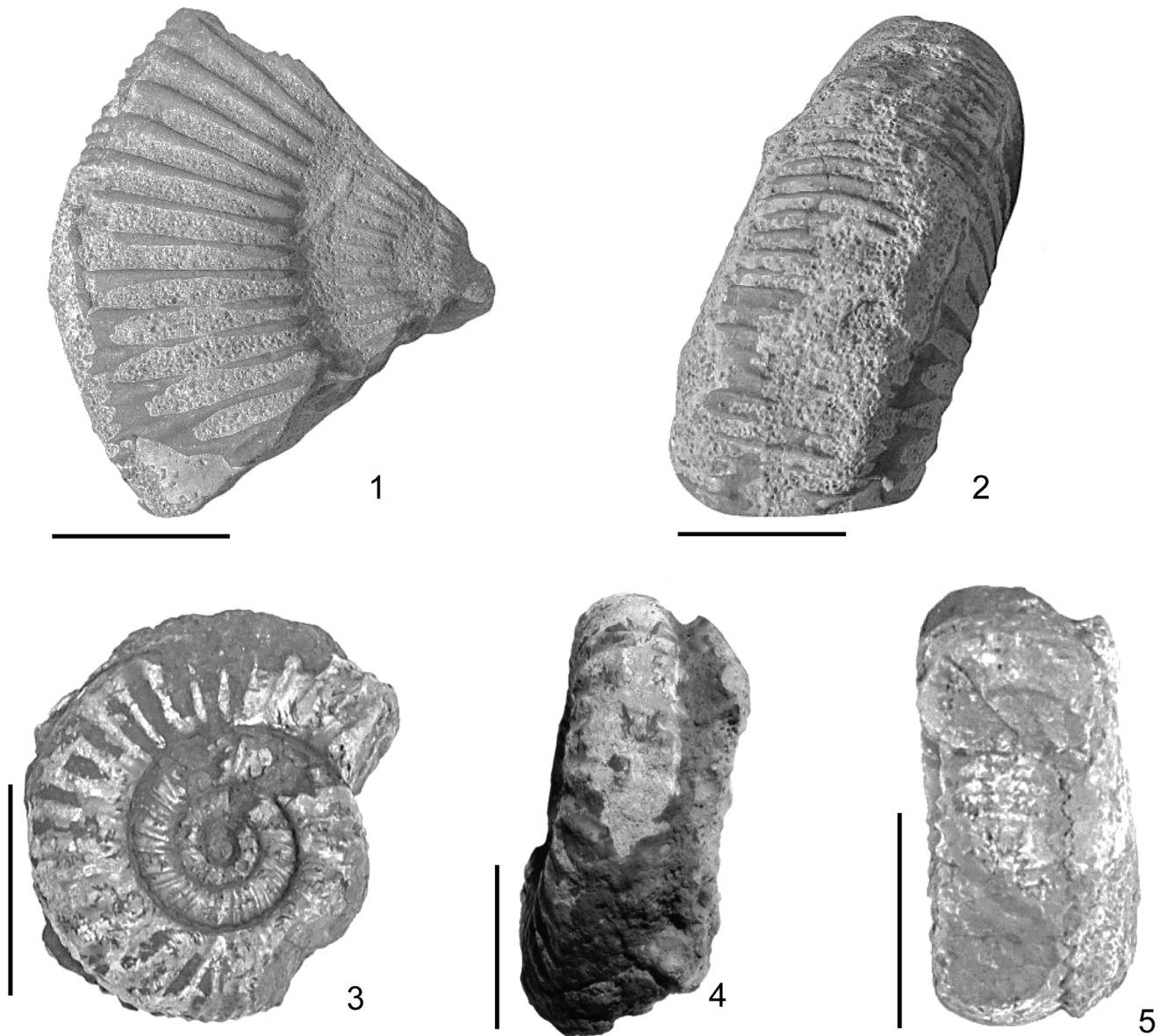
Perisphinctes (Dichotomosphinctes) rotoides Ronchadze, Enay, 1966. p.467, Pl. 27, figs. 9-11.

Perisphinctes (Dichotomosphinctes) rotoides Ronchadze, - Tarkowski, 1984. Pl.14, fig. 6.

Perisphinctes (Dichotomoceras) rotoides Ronchadze - Gygi, 2000. p.84, Pl. 9, fig. 1.

Dichotomoceras rotoides Ronchadze 1917– Krishna *et al.*, 2009, p.473, pl. I, fig. 2a, b; 4a, b; 5a, b.

Material: One specimen from the Dhosa Conglomerate bed, Member IV, Jumara Formation, Jara Dome, Western Kachchh (JFK2019/83).



EXPLANATION OF PLATE VI

1. *Perispinctes (Dichotomoceras) virguloides* (Waagen, 1875) lateral view; 2. *Perispinctes (Dichotomoceras) virguloides* (Waagen, 1875) ventral view of specimen (JFK2019/36); 3. *Perispinctes (Dichotomoceras) rotoides* (Ronchadze 1917) lateral view; 4. *Perispinctes (Dichotomoceras) rotoides* (Ronchadze 1917) ventral view; 5. *Perispinctes (Dichotomoceras) rotoides* (Ronchadze 1917) apertural view of wholly septate fragment specimen (JFK2019/83). Scale bar for each specimen = 2 cm.

Description: Shell small, evolute, moderately compressed, wide umbilicus with slightly broad body whorl. Inner whorls are slightly depressed. Whorl sections are sub-rounded to sub-quadrangular. Umbilical shoulder rounded, laterals convex, ventrolateral shoulder rounded, venter rounded. Ornamentation consists of thin primary ribs in the inner whorl and gradually become thick and sharp on the outer whorl. Primary ribs start near to umbilical shoulder dense, strong, and remain straight on laterals. Primary biplicet in secondaries from slightly above the ventrolateral shoulder

and cross the venter with slight convexity. Rib density is moderate. Sutures are faintly visible on the lateral side but indistinct.

Remarks: The present example strongly resembles the holotype of *D. rotoides* (Ronchadze), 1917, Krishna *et al.*, 2009, p.473, pl. I, fig. 2a, b; 4a, b; 5a, b. Based on morphology and ornamentation present specimen closely resemble the Krishna *et al.* (2009). Despite that, the size of the previous specimen is larger than the present one.

CONCLUSIONS

The prime consequence of the present research is the definite discovery of the ammonites from the confined study area from the Jara Dome of western Kachchh. For the present study, the authors have collected around hundred specimens from the study area during the field visits and from that, identified 11 ammonites that have been assigned to 3 different genera: *Peltoceras* Waagen, 1871, *Metapeltoceras* Spath, 1931 and *Perisphinctes* Waagen, 1869 based on the morphology. These fossils were collected from the Dhosa Oolite bed of Member IV of the Jumara Formation of the Jara Dome. The topmost member of Jumara Formation is highly fossiliferous and in western Kachchh, in the study area, this bed is very thin but has remarkable fossil assemblage found from the Dhosa Conglomerate bed. The most abundant genera *Peltoceras* Waagen, 1871 and *Metapeltoceras* Spath, 1931; members of the family Peltoceratinae Spath, 1924 are collected from the Dhosa Conglomerate bed of the Jumara Formation of the Jara Dome. Three taxa have been recorded are *Peltoceras ponderosum*, *Metapeltoceras armiger*, and *Metapeltoceras* cf. *kumagunense*, which have been assigned to the Oxfordian part of the succession. Seven taxa of perisphinctids have been recorded from the Dhosa

Conglomerate bed of Member IV, Jumara Formation at Jara Dome. Dhosa conglomerate bed consists of the typical feature of reworked, concretionary slabs, which contains a huge accumulation of taxa of perisphinctids. From these beds, seven taxa of the genera *Perisphinctes* and three Subgenera *Kranaosphinctes* Buckman, 1921; *Arisphinctes* Buckman, 1924 and *Dichotomoceras* Buckman, 1919 are recorded. *Perisphinctes* (*Kranaosphinctes*) *subevolutus*; *Perisphinctes* (*Arisphinctes*) *kheraensis*; *Perisphinctes* (*Arisphinctes*) *polymorphus*; *Perisphinctes* (*Arisphinctes*) cf. *trifidus*; *Perisphinctes* (*Dichotomoceras*) *sparsicostatus*; *Perisphinctes* (*Dichotomoceras*) *virguloides* and *Perisphinctes* (*Dichotomoceras*) *rotoides* representing Early (Cordatum Zone) Oxfordian.

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