International Journal of Scientific Research in Science and Technology
Available online at : www.ijsrst.com
Print ISSN: 2395-6011 | Online ISSN: 2395-602X
doi : https://doi.org/10.32628/IJSRST25123140

Systematic Description of Ammonites from the Jumara Formation at Jara Dome, Kachchh Mainland

Rinku A. Patel[1, 2*], Paras M. Solanki[2]

[1]Research Scholar, Gujarat University, Ahmedabad, Gujarat, India

[2]Department of Geology, M. G. Science Institute, Ahmedabad, Gujarat, India

ARTICLEINFO

Article History:

Accepted : 10 June 2025
Published: 17 June 2025

Publication Issue :
Volume 12, Issue 3
May-June-2025

Page Number :
1263-1272

ABSTRACT

The Jara Dome, situated in the Lakhpat Taluka of Kachchh District, Gujarat, represents a significant geological structure within the Kachchh Mainland and provides exceptional exposure of Middle to Upper Jurassic strata. This study documents ammonite-bearing horizons within the Dhosa Oolite Member of the Jumara Formation, composed of fossiliferous oolitic limestones interbedded with shales and ferruginous beds. Detailed field investigations and systematic sampling yielded five ammonite taxa, all recovered from stratigraphically constrained intervals. Taxonomic identification was conducted through comparative morphological analysis, revealing a diverse assemblage that contributes to refining the biostratigraphic framework of the region. The presence of genera such as Perisphinctes, Cadoceras, and Macrocephalites provides key insights into ammonoid evolution and regional stratigraphic correlation. Structurally, the study area is influenced by the Kachchh Mainland Fault and associated neotectonic activity, which have played a role in shaping the sedimentary and structural architecture of the Jara Dome. The integration of paleontological, stratigraphic, and structural data enhances our understanding of Jurassic depositional environments and basin evolution in western India.

Keywords: Ammonites, Jumara Formation, Jara Dome, Western Kachchh, Gujarat, India

I. INTRODUCTION

The Kachchh Peninsula, occupying the westernmost region of India, constitutes the entire Kachchh district of Gujarat state. It lies between latitudes 22.72°–24.68°N and longitudes 68.10°–71.80°E, covering an expansive area of approximately 45,612 square kilometres. This makes it not only the largest district in Gujarat but also the second-largest in India (Biswas, 1973). The peninsula is about 320 km in length and 170 km in width, with the Tropic of Cancer traversing through it.

Kachchh is geologically significant and often described as a tectonic "island" resembling a tortoise, from which the name Katchua or Kachbo is derived. The region is known historically as Kutchdweep or Kutchbet, emphasizing its insular character. The Kachchh basin is one of the most important sedimentary basins in India, particularly for understanding Mesozoic stratigraphy and paleoenvironments.

The Mesozoic sequence of Kachchh is prominently exposed in the mainland and is divided into four key formations in ascending order: Jhurio, Jumara, Jhuran, and Bhuj (Biswas, 1973; 1977). The Jhurio Formation, rich in marine fossils such as brachiopods, ammonites, and corals, represents intertidal to subtidal depositional environments. Overlying this is the Jumara Formation, characterized by gypsiferous shales and the fossiliferous Dhosa Oolite Member, indicating deposition in a deeper subtidal zone. The Jhuran Formation, defined by alternating sandstone and shale beds, shows a transition from marine to terrestrial facies. It becomes less fossiliferous eastward and reflects a paralic depositional setting. The youngest is the Bhuj Formation, composed of thick non-marine sandstones and sub-divided into Lower and Upper Members. This formation lacks marine fossils but contains abundant plant remains, suggesting a shift to fluvial-deltaic systems, with deposition directed from east to west (Biswas, 1977).

The unique combination of tectonic, sedimentological, and paleontological features makes Kachchh a key region for geological research. Its well-preserved Mesozoic strata serve as a window into the paleoenvironmental and paleogeographic history of western India.

II. GEOLOGICAL SETTING

Jara village, situated within Lakhpat Taluka of Kachchh District, Gujarat, occupies a strategic position in the western extremity of the Indian subcontinent, with geographic coordinates 23°42′43.25″N and 69°01′03.51″E. The village lies approximately 98 km west of the district headquarters, Bhuj, and proximal to the Arabian Sea, forming part of the structurally significant Jara Dome. This dome represents a key morphological and stratigraphic unit within the Kachchh Mainland and provides an excellent window into the Middle to Upper Jurassic sedimentary record of the region (Biswas, 1993).

The stratigraphic succession of the study area comprises well-exposed units of the Jumara and Jhuran Formations, which are representative of marine to marginal marine depositional settings. In the Jara Dome, Ridge Sandstone Member, Gypseous Shale Member, Dhosa Oolite Member of the Jumara Formation are discernible, whereas Shelly Shale Member is not exposed. Gypseous Shale Member is characterized by laminated ferruginous shales with occasional siltstone and intraformational conglomerates, while Dhosa Oolite Member is typified by fossiliferous Oolitic limestones interbedded with shale horizons. The Dhosa Oolite Member, a prominent regional marker bed, forms the uppermost unit of the Jumara Formation and is richly fossiliferous, containing diverse ammonite taxa including Macrocephalites, Perisphinctes, Phylloceras, and Dactylioceras, among others (Biswas, 1977; 1993).

The overlying Jhuran Formation is predominantly arenaceous and comprises alternating sequences of sandstone, siltstone, and shale. The Lower Member exhibits a substantial increase in sandstone thickness, while the Upper Member is dominated by massive, cross-bedded sandstones (Fig. 1). A doleritic dyke of basic composition, interpreted as an intrusive equivalent of the Deccan Trap, transects the Mesozoic strata within the dome, providing further evidence of post-depositional igneous activity.

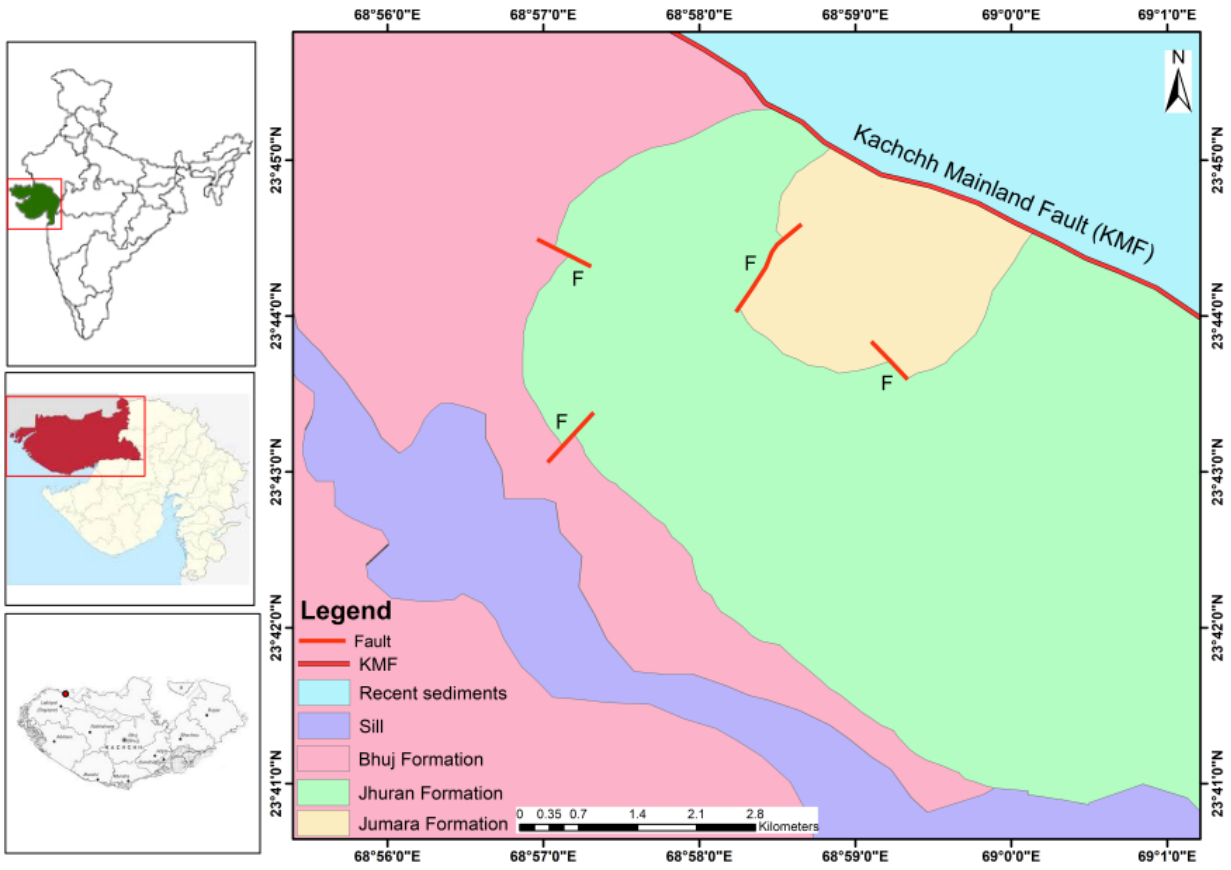

Fig. 1. Geological map of Jara Dome (Patel *et al.*, 2022).

Structurally, the region is influenced by the Kachchh Mainland Fault (KMF), a major E–W trending crustal-scale discontinuity. The KMF is characterized by significant strike-slip displacement, as evidenced by geomorphic features such as linear fault scarps, offset drainage systems, sag ponds, shutter ridges, and pressure ridges. These tectonic expressions suggest both pre-Quaternary and Quaternary reactivations along transverse fault systems intersecting the KMF (Maurya et al., 2003). Such tectonic dynamics underscore the complex neotectonic framework of the region and its role in shaping the geomorphology and structural architecture of the Jara Dome.

III.METHODS AND MATERIAL

A total of 5 ammonite specimens, representing 5 distinct taxa, were identified during the preliminary paleontological investigation of the Jara Dome, located in Lakhpat Taluka of Kachchh District, Gujarat. All specimens were systematically collected from stratigraphically constrained horizons during detailed fieldwork and are currently curated in the Museum of the Department of Geology, M.G. Science Institute, Ahmedabad.

Prior to taxonomic assessment, the specimens were prepared using ammonium chloride sublimate coating, which aided in enhancing morphological contrast and minimizing sedimentary encrustation, following standard paleontological preparation protocols (cf. Lehmann, 1981). Taxonomic identification was primarily based on comparative morphological analysis, including features such as shell geometry, ribbing pattern and density, suture line complexity, whorl cross-sections, umbilical width, aperture morphology, and overall ontogenetic development.

While many specimens exhibit well-preserved diagnostic features, a portion of the assemblage is

notably affected by taphonomic degradation, including fragmentation, compression, and partial mineral replacement. As a result, some specimens could only be tentatively assigned to genus level due to the absence of complete diagnostic characters.

Despite preservation constraints, the ammonite assemblage provides valuable insights into the biostratigraphy and paleoecology of the Jumara Formation within the Jara Dome and contributes to ongoing regional correlations within the Jurassic sequences of the Kachchh basin. All the body fossils found from the study area belongs to Dhosa Oolite bed of Jumara Formation (Fig.2).

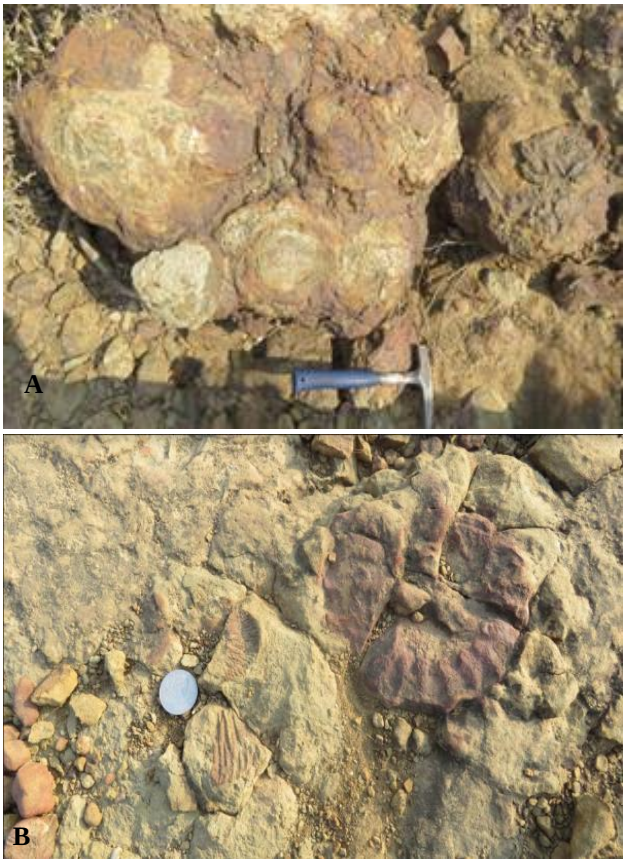

Figure 2: A. Topmost band of Dhosa Oolite Member of Jumara Formation. B. Close up view of highly fossiliferous Dhosa Oolite bed.

Scale: Diameter of 1 rupee coin: 2.5 cm, Length of the hammer: 32 cm.

IV. SYSTEMATICS

Class Cephalopoda Cuvier, 1797
Order Ammonoidea Zittel, 1884
Superfamily Perisphinctaceae Steinmann, 1890
Family Perisphinctidae Steinmann, 1890
Subfamily Perisphinctinae Steinmann, 1890
Genus Perisphinctes Waagen, 1869
Species Perisphinctes indogermanus Arkell, 1956

1) *Material*: One specimen from the Dhosa Conglomerate bed, Dhosa Oolite Member, Jumara Formation, Jara Dome, Western Kachchh (JFK2020/239) (Fig. 3A-B).
2) *Description*: *Perisphinctes indogermanus* is characterized by moderately evolute coiling, compressed whorl section, and bifurcating ribs arising from prominent umbilical tubercles. Secondary ribs continue over the venter uninterrupted, which is rounded and lacks a keel (Arkell, 1956). The ornamentation includes dense, fine ribbing with a clear distinction between primary and secondary ribs (Spath, 1931).
3) *Stratigraphic Range*: Middle to Upper Callovian, Jurassic (Arkell, 1956; Spath, 1931).
4) *Remarks*: The species shows close affinity with other perisphinctid ammonites of the Indo-Madagascan faunal province. Its diagnostic ribbing pattern and whorl shape distinguish it from other coeval *Perisphinctes* species (Arkell, 1956). Primarily documented from the Kachchh basin of western India, with possible affinities in Madagascar and the Middle East (Waagen, 1869; Westermann, 1964). It serves as a useful biostratigraphic marker within the Callovian stage in western India (Westermann, 1964).

Class: Cephalopoda Cuvier, 1797
Subclass: Ammonoidea Zittel, 1884
Order: Ammonitida Hyatt, 1889
Superfamily: Perisphinctoidea Steinmann, 1890
Family: Perisphinctidae Steinmann, 1890
Genus: *Perisphinctes* Waagen, 1875
Subgenus: *Arisphinctes* Buckman, 1921
Species: *Perisphinctes (Arisphinctes) indogermanus* Krantz, 1926

1) *Material*: One specimen from the Dhosa Conglomerate bed, Dhosa Oolite Member, Jumara Formation, Jara Dome, Western Kachchh (JFK2019/63) (Fig. 3C-E).
2) *Description*: The shell is moderately evolute. Whorl section is compressed with a height slightly greater than the width. Ribs are fine, closely spaced, and bifurcate from the umbilical shoulder toward the mid-flank, then continue over the venter. No tubercles are present. The umbilicus is moderately deep and wide. The specimen measures approximately 8.4 cm in maximum diameter, 2.1 cm in umbilical diameter, and 3.2 cm in whorl height. Rib count per half whorl is approximately 20–24.
3) *Stratigraphic and Geographic Range*: This species is restricted to the Middle to Upper Callovian stage of the Jurassic. It is primarily known from the Jumara Formation of the Kachchh basin, Gujarat, Western India. The type locality is in Baluchistan (Pakistan), but subsequent finds and revisions have firmly established its occurrence in multiple localities within the Kachchh basin including the Jara, Keera, and Jumara Domes (Spath, 1931; Krishna and Cariou, 1993; Pandey and Callomon, 1997).
4) *Remarks:* The specimen exhibits all the key morphological characteristics of *Perisphinctes (Arisphinctes) indogermanus* as described by Krantz (1926). It compares well with the specimens documented from the Oxfordian strata of Kachchh by Jaitly et al. (1995) and is consistent with the zonal framework outlined by Pandey and Prasad (2004). The fine bifurcate ribbing and the involute nature of the shell, along with the absence of tubercles and a rounded venter, are diagnostic features of this species. According to Arkell et al. (1957), species of *Arisphinctes* are widely distributed and serve as important biostratigraphic markers.

Class: Cephalopoda Cuvier, 1797
Subclass: Ammonoidea Zittel, 1884
Order: Ammonitida Zittel, 1884
Superfamily: Stephanoceratoidea Neumayr, 1875
Family: Cardioceratidae Siemiradzki, 1891
Genus: *Cadoceras* Fischer, 1837
Species: *Cadoceras sublaeve* Meek, 1876

1) *Material*: One specimen from the Dhosa Conglomerate bed, Dhosa Oolite Member, Jumara Formation, Jara Dome, Western Kachchh (JFK2019/186) (Fig. 3F-H).
2) *Description*: The Indian specimen displays classic *Cadoceras* features: a compressed, involute whorl section; a deep umbilicus expanding on the body chamber; and distinct ribbing pattern. The septal suture lines are preserved as fine, wavy sutures on the mold, characteristic of ammonoid phragmocones. The aperture is simple and delineated by a well-defined constriction. *Cadoceras sublaeve* is characterized by a sub-globular, involute shell with strong ribbing, a broadly rounded venter, and a deep umbilicus. Ribs arise from the umbilical shoulder, bifurcate mid-flank, and continue uninterrupted over the venter. The body chamber comprises no less than three-fourths of the final whorl and ends in a simple crescent-shaped aperture (Mitta, 2011).

In more specialized forms, the whorl section becomes compressed, and a crenulated keel or marginal channels may develop (Zittel, 1937). Costation resembles that of the Stephanoceratinae but often includes dual lines of tubercles. The species shows ontogenetic changes in rib spacing and umbilical shoulder roundness.

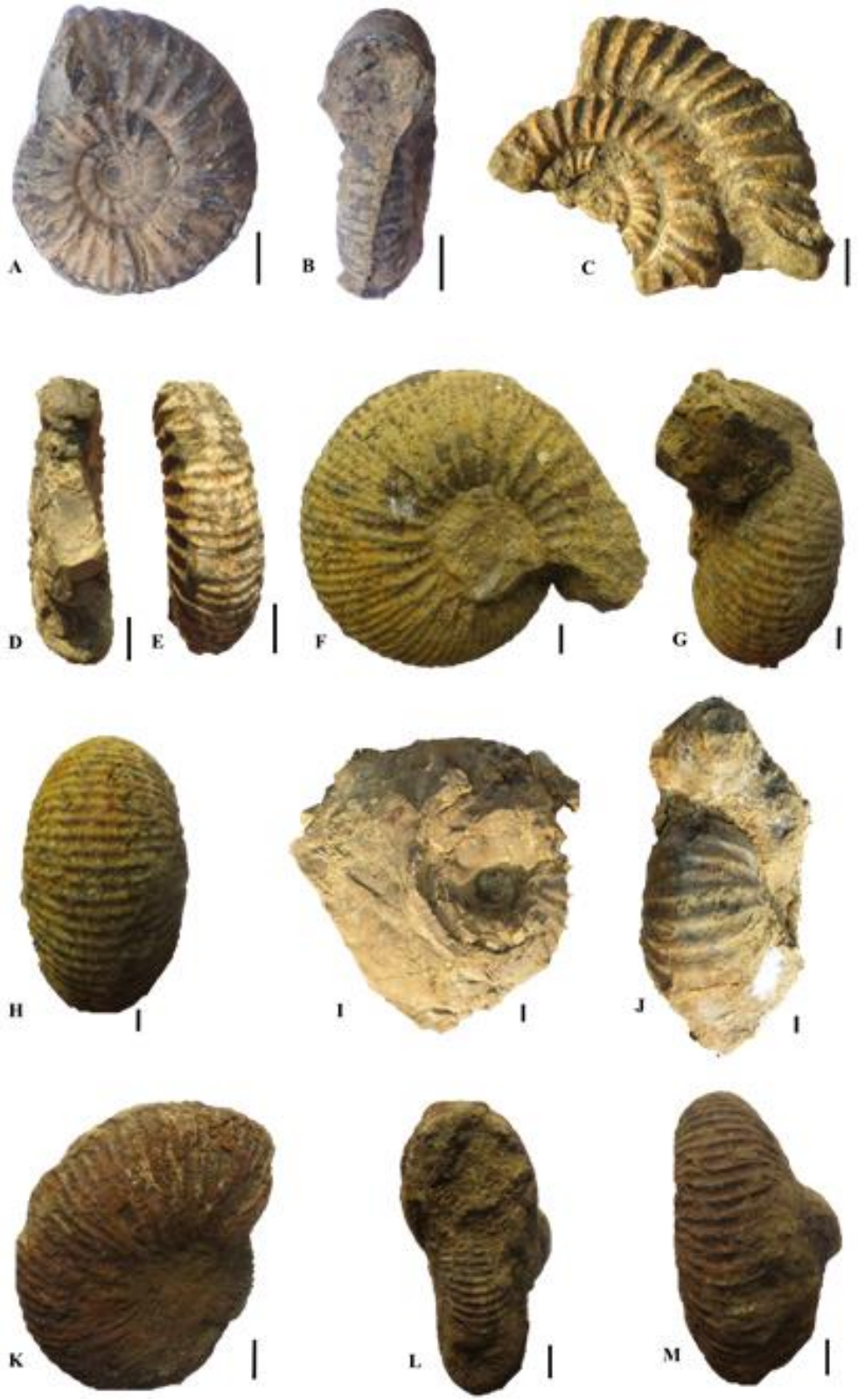

Figure 3: (A-B) *Perisphinctes indogermanus Arkell, 1956*: **(A-B)** lateral and apertural view (JFK2020/239). **(C-E)** *Perisphinctes (Arisphinctes) indogermanus* Krantz, 1926: **(C)** lateral view (JFK2019/63). **(D-E)** lateral and ventral view (JFK2019/63). **(F-H)** *Cadoceras sublaeve* Meek, 1876: **(F)** lateral view (JFK2019/186), **(G-H)** apertural and ventral view (JFK2019/186); **(I-J)** *Cadoceras* sp., **(I-J)** lateral and apertural view (JFK2019/118); **(K-M)** *Macrocephalites macrocephalus* Sowerby, 1840, **(K)** lateral view (JFK2019/93), **(L-M)** apertural and ventral view (JFK2019/93). Scale bars = 1 cm.

3) *Stratigraphic and Geographic Range*: The genus *Cadoceras* is widespread during Late Bajocian to the Early Callovian (Mitta, 2000; Mitta, 2015). Fossils of *Cadoceras sublaeve* have been reported from Russia, Canada, Germany, and now from Kachchh, Western India.
4) *Remarks: Cadoceras* is an index genus for Boreal Jurassic successions. Its evolutionary succession is of great stratigraphic significance, particularly in correlating Boreal and Tethyan sequences during the Callovian (Mitta, 2015). In stratigraphy, the co-occurrence of *Cadoceras* species with *Kepplerites* aids in constructing zonal and subzonal schemes in Boreal Europe and Russia. The Kachchh occurrence extends its known range and biostratigraphic applicability into the Indo-Tethyan margin.

Class: Cephalopoda Cuvier, 1797
Order: Ammonoidea Zittel, 1884
Suborder: Ammonitina Hyatt, 1889
Family: Cardioceratidae Siemiradzki, 1891
Subfamily: Cadoceratinae Hyatt, 1900
Genus: *Cadoceras* Fischer, 1882
Species: *Cadoceras* sp.

1) *Material*: One specimen from the Dhosa Conglomerate bed, Dhosa Oolite Member, Jumara Formation, Jara Dome, Western Kachchh (JFK2019/118) (Fig. 3I-J).
2) *Description*: The shell is large, subglobular, and involute in coiling. Whorl section varies from rounded to trapezoidal in profile. The umbilicus is small but deep, with a steep and straight umbilical wall. The venter is broadly rounded. Ornamentation comprises strong, thick primary ribs that originate from the umbilical shoulder and bifurcate or continue across the flanks, eventually crossing the venter. The ribs are regularly spaced and radial. The body chamber is broad, rounded, and globular, and terminates at an aperture which is crescent-shaped ("smile-like"), a typical feature of the genus. No lappets or keel structures are observed. Preservation of sutural lines is poor, preventing species-level identification.
3) *Stratigraphic and Geographic Range*: Middle Jurassic (Lower–Middle Callovian). The genus is widely distributed across Europe, Russia, Kazakhstan, and western India (Kachchh basin).
4) *Remarks:* The specimen is assigned to *Cadoceras* Fischer, 1882 based on its subglobular form, involute coiling, and strong primary ribbing, all of which are characteristic of the genus. Similar forms have been previously reported from the Middle Callovian strata of the Kachchh basin (Kalia & Kapoor, 1981; Krishna, 1991). The presence of *Cadoceras* in the Jumara Formation supports earlier interpretations of Boreal-Tethyan faunal mixing during the Middle Jurassic in western India (Sharma & Pandey, 2009).

Class: Cephalopoda Cuvier, 1797
Subclass: Ammonoidea Zittel, 1884
Order: Ammonitida Zittel, 1884
Superfamily: Stephanoceratoidea Neumayr, 1875
Family: Macrocephalitidae Hyatt, 1900
Genus: *Macrocephalites* Zittel, 1884
Species: *Macrocephalites macrocephalus* Sowerby, 1840

1) *Material*: One specimen from the Dhosa Conglomerate bed, Dhosa Oolite Member, Jumara Formation, Jara Dome, Western Kachchh (JFK2019/93), measures approximately 7.5 cm in diameter with a marginal thickness of 3 cm (Fig. 3K-M).
2) *Description*: *Macrocephalites macrocephalus* is typified by a strongly ribbed, involute shell with a compressed discoidal profile and rounded venter. The umbilicus is moderately narrow, and the whorl section is higher than wide. Early whorls bear dense, bifurcating primary ribs originating at the umbilical shoulder and extending uninterrupted across the venter. Tubercles are generally absent. Ribbing tends to weaken in the later growth stages, often

disappearing on the adult body chamber (Arkell et al., 1957; Zittel, 1937).

The venter remains consistently rounded, and the suture pattern is complex, comparable to that seen in Dactylioceratidae but with more developed lobes and saddles (Zittel, 1937).

3) *Stratigraphic and Geographic Range*: *Macrocephalites macrocephalus* is found in the Lower to Middle Callovian stages of the Jurassic period. The genus is widely distributed across Europe, India, and the western Tethyan margin. In India, significant finds are from Kachchh, especially Jumara, Keera, and other localities within the Chari and Patcham formations (Krishna and Cariou, 1993).
4) *Remarks: Macrocephalites* is a significant taxon in Kachchh biostratigraphy due to its widespread presence and morphological variability. *M. macrocephalus* exhibits considerable intraspecific variation, particularly in the ribbing density and umbilical features. This species was once considered distinct from forms like *Macrocephalites chariensis*; however, later analyses show the latter to be a variant of M. formosus (Arkell et al., 1957).

Paleobiogeographic evidence suggests the origin of *Macrocephalites* lies in the southwestern Pacific during the Bathonian, with later migration into the Tethyan domain during the Upper Bathonian eustatic sea-level rise (Krishna and Cariou, 1993). Their evolutionary radiation across Eurasia during the Callovian provides valuable biostratigraphic markers for intercontinental correlation.

V. CONCLUSION

The ammonite assemblage recovered from the Dhosa Conglomerate bed of the Jumara Formation in the Jara Dome provides significant paleoenvironmental and stratigraphic insights into the Middle to Upper Callovian marine conditions of the Kachchh basin. The diversity of taxa—including *Perisphinctes*, *Cadoceras*, and *Macrocephalites*—reflects deposition in a fully marine, open-shelf environment with moderate to high energy conditions, as inferred from the oolitic and conglomeratic nature of the host lithology.

The well-preserved oolitic textures and abundant marine macrofossils imply shallow, agitated, warm marine conditions favorable for carbonate precipitation and organismal proliferation. These findings, therefore, support the interpretation of a shallow epicontinental sea with periodic connections to deeper marine settings, allowing for the accumulation and preservation of richly fossiliferous carbonate beds.

Collectively, the lithological features and taxonomic composition of the ammonite assemblage reflect a dynamic depositional system during the Middle Jurassic, characterized by ecological heterogeneity and paleobiogeographic connectivity within the Kachchh basin.

REFERENCES

[1]. W. J. Arkell, Jurassic Geology of the World. Oxford, UK: Oxford University Press, 1956.

[2]. W. J. Arkell, B. Kummel, and C. W. Wright, “Mesozoic Ammonoidea,” in Treatise on Invertebrate Paleontology, Part L, Mollusca 4, R. C. Moore, Ed. Geological Society of America and University of Kansas Press, 1957.

[3]. S. K. Biswas, “Geology of Kutch,” Bull. Geol. Soc. India, vol. 10, pp. 1–56, 1973.

[4]. S. K. Biswas, “Mesozoic stratigraphy of Kutch, western India,” Mem. Geol. Soc. India, vol. 3, pp. 1–110, 1977.

[5]. S. K. Biswas, “Geological framework, structure and tectonics of Kutch Basin, Western India,” J. Geol. Soc. India, vol. 41, no. 4, pp. 325–346, 1993.

[6]. Census of India, Primary Census Abstract – Kachchh District. Office of the Registrar General & Census Commissioner, India, 2011.

[7]. P. Fischer, Manuel de Conchyliologie et de Paléontologie Conchyliologique. Paris: Librairie F. Savy, 1882.

[8]. A. Hyatt, "Cephalopoda," in Textbook of Paleontology, vol. 1, K. A. Zittel, Ed. London: Macmillan, 1900, pp. 502–592.

[9]. A. K. Jaitly, J. H. Callomon, and D. K. Bhatt, "Callovian–Oxfordian ammonite fauna from Kachchh (Western India)," Mem. Geol. Surv. India, vol. 49, 1995.

[10]. P. Kalia and H. M. Kapoor, "Middle Jurassic ammonite fauna from western Kachchh (India) and their biostratigraphic significance," J. Paleontol., vol. 55, no. 4, pp. 789–807, 1981.

[11]. J. Krishna, "The Jurassic of Kachchh—A sequence stratigraphic approach," J. Palaeontol. Soc. India, vol. 36, pp. 1–42, 1991.

[12]. J. Krishna and E. Cariou, "Macrocephalitins of the Callovian (Middle Jurassic) of India: Evolution and Biogeography," Geobios, vol. 26, no. 2, pp. 153–165, 1993.

[13]. J. Krishna and E. Cariou, "The Callovian–Oxfordian Boundary in Kachchh, Western India," Geobios, vol. 26, no. 5, pp. 579–592, 1993.

[14]. F. Krantz, "Beiträge zur Kenntnis der Juraablagerungen von Kachchh (Indien)," Neues Jahrb. Mineral., Geol. Paläontol., 1926.

[15]. U. Lehmann, The Ammonites: Their Life and Their World. Cambridge, UK: Cambridge University Press, 1981.

[16]. D. M. Maurya, L. S. Chamyal, and R. Raj, "Tectonic geomorphology of the Kachchh Mainland Fault, Western India using remote sensing and GIS," J. Geol. Soc. India, vol. 62, pp. 187–198, 2003.

[17]. F. B. Meek, A Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country, vol. 9. U.S. Geol. Surv. Territories, 1876.

[18]. V. V. Mitta, "The Genus Cadoceras and the Cadoceratinae Subfamily (Ammonoidea) in the Middle Jurassic of Russia," Paleontol. J., vol. 34, no. 3, pp. 259–266, 2000.

[19]. V. V. Mitta, "Ammonites and Biostratigraphy of the Lower Callovian (Jurassic) in Central Russia," Russ. J. Geol. Geophys., vol. 52, no. 5, pp. 463–475, 2011.

[20]. V. V. Mitta, "Boreal Zonal Standard and Biostratigraphic Correlation of the Lower Callovian," Stratigr. Geol. Correl., vol. 23, no. 3, pp. 215–225, 2015.

[21]. D. K. Pandey and J. Prasad, "Oxfordian ammonite biozones of the Jara Dome, Kachchh, India," J. Asian Earth Sci., vol. 24, no. 1, pp. 35–49, 2004.

[22]. D. K. Pandey and J. H. Callomon, "Callovian ammonite fauna from the Chari Formation of Keera Dome, Kachchh, Western India," Palaeontol. Indica, vol. 62, pp. 1–55, 1997.

[23]. R. A. Patel, M. B. Sabhaya, and P. M. Solanki, "Oxfordian ammonites from Dhosa Oolite of Jara Dome, western Kachchh, India," J. Palaeontol. Soc. India, vol. 67, no. 2, pp. 251–261, 2022.

[24]. R. Sharma and D. K. Pandey, "Biogeographic implications of Jurassic ammonoid distribution in the Kachchh Basin, India," Gondwana Geol. Mag., vol. 24, no. 2, pp. 111–118, 2009.

[25]. A. Siemiradzki, "Ueber Cardioceras," Verh. Russ. Kaiser. Mineral. Ges. St. Petersburg, ser. 2, vol. 27, pp. 97–105, 1891.

[26]. J. Sowerby, Descriptions of Jurassic Ammonites, vol. 7. The Mineral Conchology of Great Britain, 1840.

[27]. L. F. Spath, "Revision of the Jurassic Cephalopod Fauna of Kachh (Cutch), Part VI," Mem. Geol. Surv. India, Palaeontol. Indica, ser. 9, vol. 3, 1931.

[28]. W. Waagen, "The Fossils of the Ceratites Beds of the Salt Range, Part I," Mem. Geol. Surv. India, Palaeontol. Indica, ser. 13, 1869.

[29]. G. E. G. Westermann, “The Jurassic Ammonite Fauna of Kachchh (India),” Neues Jahrb. Geol. Paläontol., 1964.

[30]. C. W. Wright, J. H. Callomon, and M. K. Howarth, Treatise on Invertebrate Paleontology, Part L, Mollusca 4, Revised, Vol. 4: Cretaceous Ammonoidea. Geological Society of America and University of Kansas Press, 1996.

[31]. K. A. von Zittel, Handbuch der Palaeontologie. I. Abtheilung: Palaeozoologie, Band II, Mollusken. Munich: R. Oldenbourg, 1884.

[32]. K. A. von Zittel, Textbook of Paleontology, vol. 2, Cephalopoda, C. R. Eastman, Trans. & Ed. London: Macmillan, 1937.