

Discovery of Lower Berriasian (Lower Cretaceous) Ammonoid Genus *Argentincer* from Kachchh (India) and its Relevance to Jurassic/Cretaceous Boundary

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with 1 plate, 2 figures and 4 tables

Abstract. The ammonoid genus *Argentincer* SPATH 1924 (= *Andesites* GERTH 1925) is described and illustrated from Umia Member (Green Oolitic bed) North of Lakhapar, Western Kachchh, Gujarat. The genus *Argentincer* is a Lower Berriasian form known so far only from South America (Colombia, Peru, Chile, Argentina) and Antarctica (Alexander Island) i.e. the Andean marine faunal province (also known as S. American or SE Pacific) and it is considered a good marker of Lower Berriasian. This is the first report of this genus from anywhere outside the Andean Province. Its discovery in Jurassic/Cretaceous passage beds helps more precise and better delineation of the Jurassic/Cretaceous boundary in Kachchh. Further, together with the earlier reports of some South American Upper Tithonian genera from India, the present discovery also strengthens the evidence of direct marine connection between Andean and Indo-East-African marine faunal provinces near the Jurassic/Cretaceous boundary.

Résumé. Le genre *Argentincer* SPATH 1924 (= *Andesites* GERTH 1925) découvert dans le membre Umia (couche oolithique verte) au Nord de Lakhapar (Gujarat, Ouest de l'Inde) est décrit et illustré. D'âge Berriasien inférieur, il était connu jusqu'à présent uniquement du Sud de l'Amérique (Colombie, Pérou, Chili, Argentine) et de l'Antarctique (Ile Alexander), c'est-à-dire de la province andine. Le genre est considéré comme un bon marqueur stratigraphique du Berriasien inférieur et pour la première fois est cité en-dehors de la province andine, dans les couches de passage Jurassique-Crétacé. Il permet de mieux préciser cette limite dans le Kachchh. Avec la reconnaissance récente de certains sud-américains du Tithonique supérieur en Inde, cette découverte renforce l'idée d'une connection marine directe entre les provinces indo-est-africaine et andine par le canal de Mozambique vers la limite Jurassique-Crétacé.

Kurzfassung. Die Ammonitengattung *Argentincer* SPATH 1924 (= *Andesites* GERTH 1925) wird erstmals aus dem Unia Member (Green oolitic beds) nördlich Lakhapar, West-Kachchh, Gujarat, Indien) beschrieben und abgebildet. Diese Gattung ist eine Leitform des unteren Berriasium, die bisher nur aus Südamerika (Kolumbien, Peru, Chile, Argentinien) und aus der Antarktis (Alexander-Insel) bekannt war, d. h. aus der andinen (= südamerikanische oder nordostpazifische) Faunenprovinz. Sie wird hier erstmals außerhalb der andinen Provinz nachgewiesen. Ihre Entdeckung an der Jura-Kreide-Grenze in Kachchh hilft bei der genauen Ermittlung dieser Grenze in diesem Gebiet. Zusammen mit früheren Nachweisen südamerikanischer Gattungen des Ober-Tithoniums in Indien belegen die neuen Funde das Vorhandensein einer marinen Verbindung zwischen der andinen und der indo-ostafrikanischen Faunenprovinz an der Jura-Kreide-Grenze.

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Introduction

Study of the Jurassic ammonoids of Kachchh goes back to SOWERBY (in GRANT, 1840) who described and illustrated a few ammonoids collected by GRANT. Monographic works on Jurassic and Lower Cretaceous ammonoids of Kachchh by WAAGEN (1871, 73–75) and SPATH (1924, 27–33) made Kachchh Jurassic sequence famous all over the world as of primary importance in context of the Jurassic stratigraphy and ammonoid fauna. In recent past many workers have described and discussed Kachchh Jurassic ammonoids but belonging invariably to pre-Tithonian age. SPATH never visited India, yet he provided an extensive taxonomic treatment of the Kachchh ammonoids, and also dated the successive assemblages with the precision available in his time. He was limited however by the broad and vague stratigraphic data provided by the fossil collectors inclusive of amateurs. Thus, hardly any revised account is available of Tithonian and younger ammonoids with stratigraphic control as desired in present times.

It was STOLICZKA (in WAAGEN 1871) who for the first time on the basis of extensive field studies (1869, unpublished) provided a sound stratigraphic framework, which was later included in the large work of WAAGEN because of the untimely death of STOLICZKA. The stratigraphic framework incorporated four divisions: Patcham, Chari, Katrol and Umia 'groups' in ascending order. RAJNATH (1932, 1942) mapped the Kachchh Jurassic-Cretaceous sequence, particularly in Western Kachchh in some detail. He subdivided the youngest Umia 'group' into several divisions and also created Bhuj 'Series'/'Stage' as the topmost subdivision within the Umia 'group'. The post-Oxfordian Mesozoic stratigraphy of Kachchh has been subject of discussion over the last two decades among later workers (BISWAS 1977, KRISHNA 1983b and others). KRISHNA initiated studies on the Kachchh Mesozoic sequences in 1980 and in a series of publications (KRISHNA 1983a, 1983b, 1984, KRISHNA 1987, KRISHNA et al. 1983, KRISHNA & CARIOU 1990, KRISHNA & PATHAK 1989, KRISHNA & WESTERMANN 1985 and 1987 and CARIOU & KRISHNA 1988) has described, discussed and considerably refined the stratigraphy with special emphasis on precision collecting and ammonoid based stage, substage and zonal time boundaries. The refined stratigraphic framework (after KRISHNA and coworkers 1983–90) is given in Tables 1 to 3.

The specimens of *Argentincerias* SPATH described and illustrated here belong to the basal beds of the lowermost member (Umia Member) of the Umia Formation. The Umia Member is

Table 1. Subdivisions of Umia Formation (After KRISHNA 1983b).

	Bhuj Member 250–300 m	Middle to Upper Albian
	Ukra Member 35 m	Aptian to Lower Albian
Umia Formation	Ghneri Member 400–450 m	Hauterivian to Barremian
	Umia Member 35 m	Upper Tithonian to Valanginian

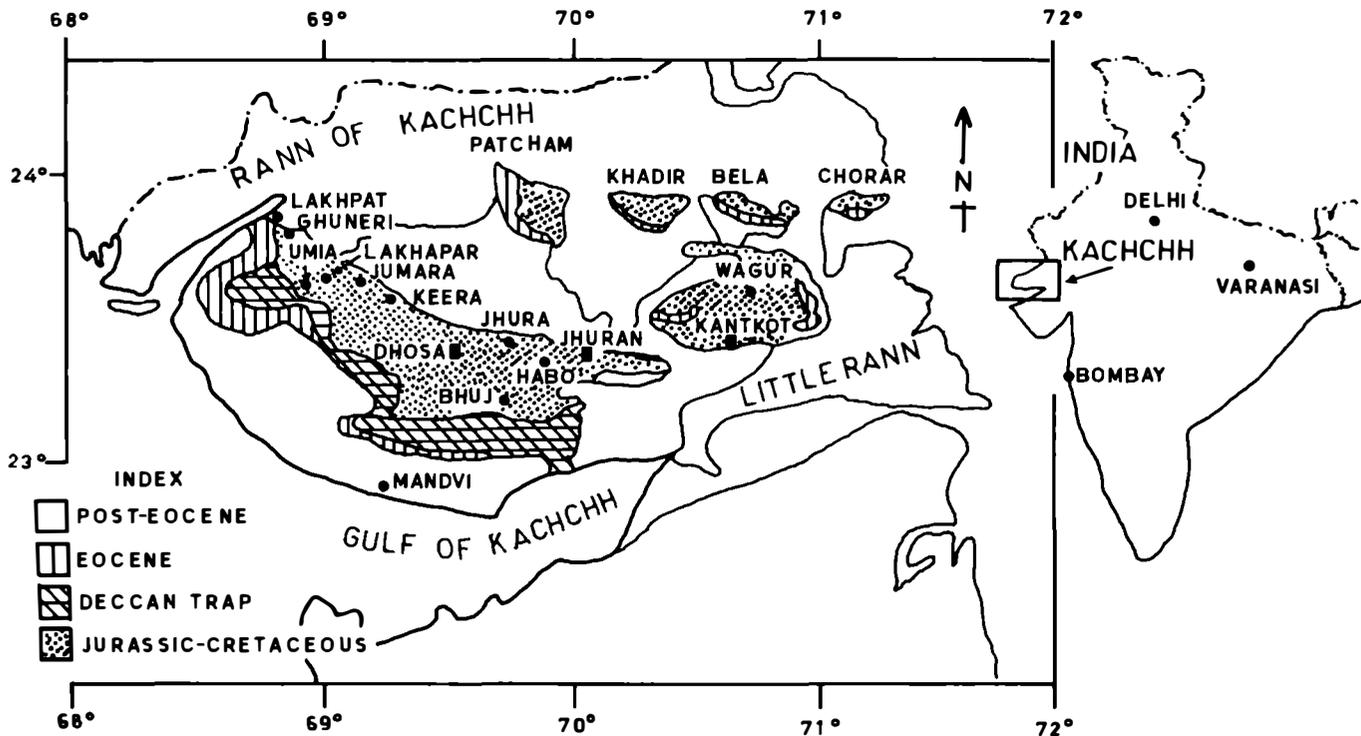


Fig. 1 Simplified geological map of Kachchh with names of Lakhpar and other villages.

Table 2. Subdivisions of basal part of Umia Member.

	1c	Shale Glaucconitic sandstone
Umia Member (basal part 30 m)	1b	Shale Glaucconitic sandstone
(not to scale)	1a	Shale Glaucconitic sandstone

Table 3. Ammonoid zonation in Kachchh (after KRISHNA and coworkers 1983-90).

Lithostratigraphic Unit	Kachchh Zones	Age	
Umia Formation (in part)	<i>Micracanthum</i> Zone		
Katrol Formation	unnamed	Tithonian	
	unnamed		
	<i>Pottingeri</i> Zone	Kimmeridgian	
	<i>Hybonotum</i> Zone		
	<i>Katrolensis</i> Zone		
Chari Formation	<i>Bathyplocus</i> Zone	Kimmeridgian	
	<i>Acanthicum</i> Zone		
	<i>Alterneplicatus</i> Zone	Oxfordian	
	unconformity		
	unnamed		
	<i>Maya</i> Zone	Oxfordian	
	<i>Semirugosus</i> Zone		
	Patcham Formation	unconformity	Callovian
		unnamed	
		<i>Athleta</i> Zone	
<i>Coronatum</i> Zone		Callovian	
<i>Anceps</i> Zone			
<i>Opis</i> Zone			
<i>Semilaevis</i> Zone			
<i>Formosus</i> Zone			
<i>Chrysoolithicus</i> Zone			
<i>Madagascariensis</i> Zone			
unnamed (in subcrops only)	<i>Triangularis</i> Zone	Bathonian	
	<i>Gracilisphinctes</i> etc.		
	<i>Leptosphinctes</i>	Bajocian	
	palynomorphs	Low. Jurassic	

about 35 m thick. The basal beds (Bed I) include three glauconitic, ferruginous, oolitic sandstone bands (Ia, Ib and Ic) rich in ammonoids and bivalves. These bands alternate with shales in the stratigraphic section 2 km NE of Lakhapar examined by the author. The youngest oolitic (Ic) has yielded two specimens of *Argentincer* SPATH, while the two underlying bands (Ia and Ib) prolifically contain ammonoids of Upper Tithonian *Micracanthum* Zone such as *Micracanthoceras*, *Aulacosphinctes*, *Virgatosphinctes* etc..

The purpose of this paper besides recording and describing the significant find of the South American genus *Argentincer* SPATH is to discuss the Jurassic/Cretaceous boundary in Kachchh in light of the present discovery and also briefly comment upon the marine connection between the Andean and Indo-East-African faunal provinces. The genus *Argentincer* SPATH belongs to the family Neocomitidae SALFELD and has been known earlier from Lower Berriasian (Lower Cretaceous) of S. America (Colombia, Peru, Chile, Argentina) and Antarctica (Alexander Island). It is being reported for the first time from anywhere outside the Andean province.

Taxonomy

The classification followed here is of DONOVAN, CALLOMAN & HOWARTH (1981).

Perisphinctacea

Neocomitidae

Berriasellinae

Genus : *Argentincer* SPATH 1924

Type species : *Odontoceras malarguense* STEUER 1897

Similar looking genera *Argentincer* SPATH and '*Andesites*' GERTH were created in successive years (1924 and 1925) respectively by SPATH and GERTH presumably without knowledge of each other. *Argentincer* was based on the species *Odontoceras malarguense* STEUER which according to SPATH (1924) was not related to *Steuoceras* COSSMANN and instead represented a new stock showing bundelling of ribs in inner whorls. On the other hand '*Andesites*' GERTH was based on *Perisphinctes loncochensis* STEUER another species of the same lineage from the same association and locality. In the genus '*Andesites*' GERTH included several species of the same lineage namely '*Andesites fasciculatus*' (STEUER), '*Andesites noduliferus*' (STEUER), '*Andesites turgidus*' (STEUER), '*Andesites curvatus*' (GERTH). The treatise on Ammonoidea (MOORE et al. 1957) lists them as two separate genera under the subfamily Berriasellinae SPATH, family Berriasellidae SPATH. However, in WIEDMANN (1980) *Argentincer noduliferum* (STEUER), *Argentincer fasciculatum* (STEUER) (T. 1b, p. 55) are included in *Argentincer* instead of '*Andesites*'. Moreover in the same work is also indicated the presence of *Argentincer* in many other SE Pacific areas (Colombia, Peru, Chile, Argentina, Alexander Island). It appears that '*Andesites*' by many including WIEDMANN is considered as junior synonym of *Argentincer*. This lineage of South American ammonoids needs revisive study by the specialists of the region having the best access to the material. However, here we consider *Argentincer* and '*Andesites*' as the same genus and thereby support the suppression of the latter as the junior synonym of *Argentincer*.

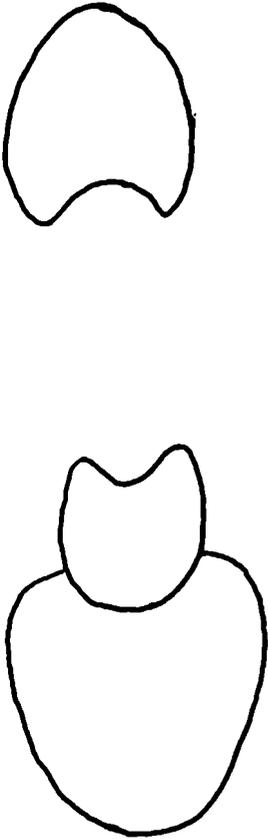


Fig. 2. Whorl section of *A. loncochensis* (STEUER) (sp. n. MU/3).

Table 4. Measurement of *Argentinceras loncochensis* (STEUER).

Sp. No.	D	H	h	W	w	U	u	W/H	N/2	n/2
MU/3	111.38	38.34	0.34	32.50	0.29	45.60	0.40	0.85	13	36
MU/3	80.40	29.10	0.34	27.26	0.33	31.36	0.39	0.93	14	35
LU/28	45.82	11.48	0.25	22.88	0.49	20.26	0.94	1.93	11	20

(measurements are in mm.)

D, H, W, U; h, w, u; N/2 and n/2 respectively indicate diameter, whorl height, whorl width, umbilicus; height, width and umbilicus in percentage of diameter; and number of primaries and secondaries per half whorl.

Argentinceras (= *Andesites*) *loncochensis* (STEUER)

(Pl. 1, figs. 1-2)

Synonymy: *Perisphinctes loncochensis* STEUER 1897, p. 61, v. II *Andesites loncochensis* (STEUER), GERTH 1925, p. 75, v. IX.

Material: Two moderately preserved specimens from glauconitic sandstone, Umia Member, Samples LU/28 and MU/3).

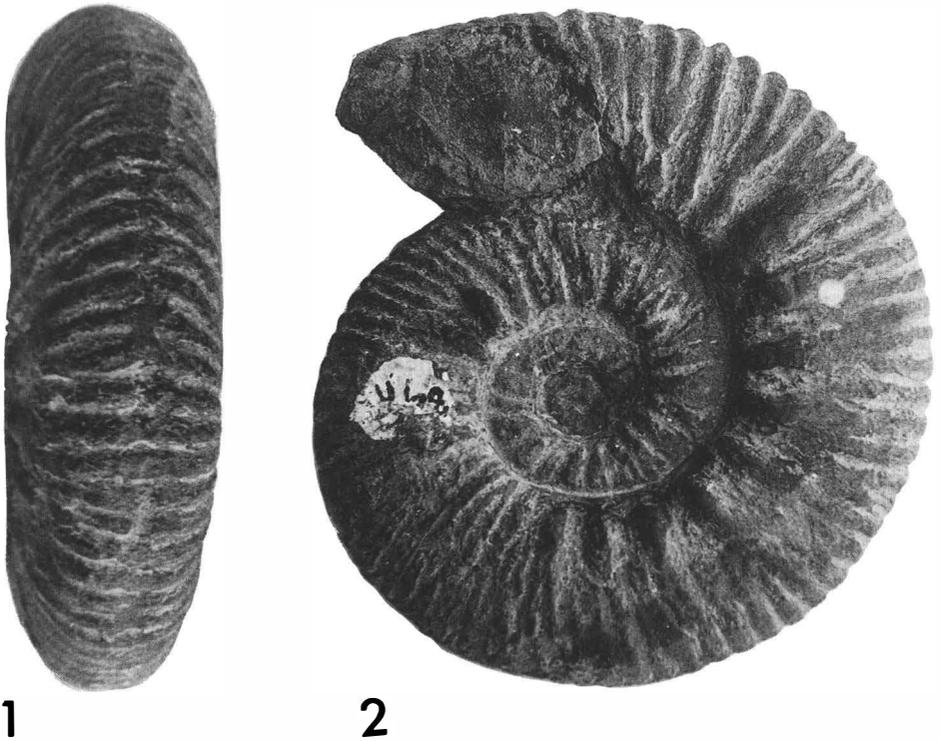


Plate 1. Figs. 1 and 2 respectively indicate lateral and ventral views (no. MU/3 in natural size) of *Argentiniticeras loncochensis* (STEUER) from bed 1c (basal part of Umia Member), 2 km. NE of Lakhapar, Western Kachchh (Gujarat), India.

Locality: 2 km NE of Lakhapar, Western Kachch, Gujarat, India.

Description: Shell almost complete (last 3/4th whorl representing the body chamber), discoidal, compressed, moderately evolute, umbilicus moderate, wall steep, shoulder curved, maximum width near umbilical shoulder, laterals slightly convex, ventrolateral shoulder highly curved, ventre only broadly curved, primaries short, thick, bullate (specially on the body chamber) divide into 2 or 3 secondaries at 1/3rd or less than half the whorl height, ribbing very slightly interrupted in the chambered portion but continuous across the ventre on the body chamber, secondaries rather thick and blunt specially in the latter part of the body chamber, intercalatory and simple ribs also present, ribbing relatively coarse and less dense on the body chamber, whorl section elliptical, higher than wide, suture undecipherable.

Remarks: The present specimens resemble '*Andesites*' *loncochensis* (STEUER) from the Lower Berriasian of Argentina, in nature of coiling, shell morphology and ornamentation. On the last half whorl 36 secondaries correspond to 13 primaries in the specimen no. LU/28 compared to 45 secondaries and 11 primaries in the type illustrated by STEUER at corresponding size which

indicates that the ribbing is relatively denser in the STEUER's type of the species. STEUER's type is described as entirely septate while our specimen (LU/28) is nearly complete with 3/4th of the last whorl probably representing the body chamber. It is felt that the relatively coarse and distant ribbing in our sample is only on account of the body chamber which is not present in the STEUER's type. The specimens differ much when compared with the illustrations of the other related species of STEUER included by GERTH in 'Andesites' at the time of creating the genus.

Discussion

Jurassic/Cretaceous boundary: In spite of more than normal global interest over the last two decades, the Jurassic/Cretaceous boundary still remains poorly defined and disputed among specialists the world over (ZEISS 1983, JELETZKY 1984). This difficult state of affair is mainly due to strong faunal provincialism and lack of precise correlation among the different faunal provinces near the Jurassic/Cretaceous boundary. *Argentincerases* SPATH 1924 (= *Andesites* GERTH 1925) and species in discussion here can be safely and undisputedly considered to indicate early part of Lower Berriasian (WIEDMANN 1980, JELETZKY 1984). The species '*Andesites*' *loncochensis* (STEUER) was initially described from lowest Berriasian of Argentina. It along with other related species [*Andesites*' *argentinus* (STEUER), '*Andesites*' *fasciculatus* (STEUER), '*Andesites*' *nuduliferus* (STEUER), '*Andesites*' *turgidus* (STEUER), '*Andesites*' *curvatus* (GERTH)] was assigned to *Argentincerases* SPATH and similar looking '*Andesites*' GERTH. These species have since been also recorded (in WIEDMANN 1980) from the Lower Berriasian of Colombia, Peru, Chile, Argentina and Alexander Island and Antarctica) region of the Andean province. It is significant to note that the genus *Argentincerases* in Kachchh has been found in the youngest (Ic) of the three glauconitic sandstone bands while the two underlying bands (Ia and Ib) have yielded distinct fauna of the Upper Tithonian *Micracanthum* Zone. In the Indian context specially Kachchh, KRISHNA (1983b) tentatively placed the Jurassic/Cretaceous boundary in between the glauconitic sandstones and the overlying trigonid bearing sandstone above the youngest of the three glauconitic bands i. e. above Ic which was based on the thinking that all the three glauconitic sandstone bands only contain the characteristic *Micracanthum* Zone ammonoid fauna. It may be noted that ammonoids were never earlier collected from the said 3 bands separately with precision. Thus in light of present discovery of *Argentincerases* from band Ic Jurassic/Cretaceous boundary in Kachchh can be more precisely placed within the glauconitic sandstone bands between Ib and Ic instead of above the band Ic between the glauconitic bands and the trigonid bearing sandstones as thought earlier.

Marine Connection: The genus *Argentincerases* is a characteristic South American form of lowest Berriasian. Its presence in the Jurassic/Cretaceous boundary beds of Kachchh together with earlier reported presence of South American Upper Tithonian forms ?*Substewroceras*, *Pronicerases* from Kachchh (KRISHNA 1984) and *Corongoceras* from Kumaon Himalaya by KRISHNA (1983a) supports the presence of a persistent direct marine link between the Andean sea and the Indo-East-African sea only from the beginning of Upper Tithonian onwards. It may be noted here that until the beginning of Upper Tithonian there were hardly any common ammonoid genera between the two distant areas. Further, pre-Upper Tithonian faunas were also characterized by many endemic genera. Faunal similarity determined on the basis of

distribution of ammonoid genera (KRISHNA 1983, 1984, 1987) between the said two areas is low from Lower Callovian to Middle Tithonian but suddenly increases from the start of Upper Tithonian onwards. This was possibly the result of the creation of shallow straits before the continental separation at the southern end of the Western and Eastern Gondwana land near the Jurassic/Cretaceous boundary. It may be pointed out that in contrast to the above consistently held views of KRISHNA many European and other Jurassic biogeographers (ENAY 1973, WESTERMANN & RICCARDI 1976, HALLAM 1977) have either suspected, postulated or favoured a direct link between the above two seas round the South African margin from as early as early Middle Jurassic, although without substantive evidence. Some of the above and other workers (WESTERMANN 1980, ENAY 1980, 1982) in their recent studies do not seem to any longer favour such a connection in Lower or Middle Jurassic. In a recent work WIEDMANN (1980) has suggested such a connection also during Upper Tithonian and Berriasian.

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References

- BISWAS, S. K. (1977): Mesozoic rock-stratigraphy of Kutch. Q. Jl. Geol. Min. Met. Soc. Ind., 49 (3 & 4): 1-52; Calcutta.
- CARIOU, E. & J. KRISHNA (1988): The tethyan Reineckeinae of Kachchh and Jaisalmer (West India): Systematic, biostratigraphic and biogeographic implications, Palaeontographica Abt. A., 203, (4-6): 149-170; Stuttgart.
- DONOVAN, D. T., J. H. CALLOMON & M. K. HOWARTH (1981): Classification of the Jurassic Ammonitina; In: The Ammonoidea, The Syst. Assoc. of Acad. Press, 18: 101-156, London.
- ENAY, R. (1973): Upper Jurassic (Tithonian) ammonites. - In HALLAM, A. (ed.): Atlas of Paleobiogeography, London, (Oliver and Boyd).
- (1980): Paléobiogéographie et ammonites Jurassiques: "Rhythmes Fauniques" et variations du niveau marin, voies d'échanges, migrations et domaines biogéographiques. - Livre Jubilaire, Soc. Géol. France, 10: 261-281; Paris.
- (1982): Dynamique biogéographique et évolution des faunes d'ammonites au Jurassique. - Bull. Soc. Géol. de France, 5-6: 1025-1046; Paris.
- GRANT, C. W. (1840): Memoir to illustrate geological map of Kutch. - Trans. Geol. Soc. London, s. 2: 5; London.
- HALLAM, A. (1977): Biogeographic evidence bearing on the creation of Atlantic seaways in the Jurassic. - In: R. W. WEST (eds.): Paleontology and Plate Tectonics 2: 23-29.
- JELETZKY, J. A. (1984): Jurassic-Cretaceous boundary beds of Western and Arctic Canada and the problem of the Tithonian-Berriasian stages in the Boreal realm. - Spl. Pap., Geol. Assoc. Canada, 27: 175-255; Ottawa.
- KRISHNA, J. (1983a): Callovian-Albian ammonoid stratigraphy and paleobiogeography in the Indian subcontinent with special reference to the Tethys Himalaya. - Himal. Geol., 2: 43-72.
- (1983b): Reappraisal of the marine and/or "mixed" Lower Cretaceous sedimentary sequences of India. - Ind. Assoc. Palynostrat.: 94-119, Lucknow.

- (1984): Current status of the Jurassic stratigraphy of Kachchh, Western India. – O. MICHELSON & A. ZEISS (eds.): Internat. Symp. on Jur. Stratigr., Erlangen: 3: 731–742; Copenhagen.
- (1987): An overview of the Mesozoic Stratigraphy of Kachchh and Jaisalmer Basins. – Jour. Pal. Soc. Ind., 32: 136–149; Lucknow.
- KRISHNA, J. & E. CARIOU (1990): Ammonoid faunal exchanges during Lower Callovian between the Indo-East-African and Submediterranean provinces. Implications for the long distance East-West correlations. – Newsl. Stratigr., 23,2: 109–122; Stuttgart.
- KRISHNA, J. & D. B. PATHAK (1989): Kimmeridgian in Ler-Katrol area of Kachchh, Western India. Ammonoid systematics and biochronology (abstr.). – 28th Internat. Geol. Congr. 2: 228–229; Washington.
- KRISHNA, J., I. B. SINGH, J. D. HOWARD & S. A. JAFAR (1983): Implication of new data on Mesozoic rocks of Kachchh, Western India. – Nature, 305: 790–792; London.
- KRISHNA, J. & G. E. G. WESTERMANN (1985): Progress report on the Middle Jurassic ammonite Zones of Kachchh, Western India. – Newsl. Stratigr., 14(1): 1–11; Stuttgart.
- KRISHNA, J. & G. E. G. WESTERMANN (1987): Faunal associations of the Middle Jurassic ammonite genus *Macrocephalites* in Kachchh, Western India. – Can. J. Earth Sci., 24: 1570–1582; Ottawa.
- MOORE, R. C. et al. (1957): Treatise on Invertebrate Paleontology, Part L, Ammonoidea, Geol. Soc. Amer. and Univ. Kansas Press, L1-490; Kansas.
- RAJNATH (1932): A contribution to the stratigraphy of Cutch. – Q. Jl. Geol. Min. Met. Soc. Ind., 4: 161–174; Calcutta.
- (1942): The Jurassic rocks of Cutch. Their bearing on some problems of India Geology (Presidential address). – Proc. 29th Ind. Sci. Congr., 2: 93–106.
- SPATH, L. F. (1924): On the ammonites of the Speeton clay and the subdivisions of the Neocomian. – Geol. Mag., 61: 73–89; London.
- (1927–33): Revision of the Jurassic cephalopod fauna of Kachchh (Kutch). – Paleont. Ind., N.S., 9(2): 1–945; Calcutta.
- THIERRY, J. (1976): Paléobiogéographie de quelques Stephanoceratacea (Ammonitina) du Jurassique moyen et supérieur, une Confrontation avec la théorie mobiliste. – Geobios, 9: 291–331; Lyon.
- WAAGEN, W. (1971): Abstract of results of examination of the ammonite fauna of Kutch, with remarks on their distribution among the beds and probable age. – Rec. Geol. Surv. Ind., 4: 89–101; Calcutta.
- (1873–75): The Jurassic fauna of Cutch. – Mem. Geol. Surv. Ind., Paleont. Ind., 1 (125): 1–247; Calcutta.
- WESTERMANN, G. E. G. (1980): Ammonite biochronology and biogeography of Circum Pacific Middle Jurassic. – Systematics Association Special, 18: 469–498; London.
- WESTERMANN, G. E. G. & A. C. RICCARDI (1976): Middle Jurassic Ammonite distribution and the affinities of the Andean faunas. – Prim. Congr. Geol. Chileno, 1: C23–C39.
- WIEDMANN, J. (1980): Palaeogeographie und Stratigraphie im Grenzbereich Jura/Kreide Südamerikas. – Münsterische Forschungen in Geologie und Paläontologie, 51: 27–61; Münster.
- ZEISS, A. (1983): Zur Frage der Äquivalenz der Stufen Tithon/Berrias/Wolga/Portland in Eurasien und Amerika. Ein Beitrag zur Klärung der weltweiten Korrelation der Jura/Kreide-Grenzsichten im marinen Bereich. – Zitteliana, 10: 427–438; München.

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