



JURASSIC BENTHIC FORAMINIFERAL BIOSTRATIGRAPHY – AN AGE-CONSTRAINED TEMPLATE FOR LOCAL, REGIONAL AND GLOBAL CORRELATION

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ABSTRACT

This contribution presents the first and the largest ammonite age-constrained benthic foraminiferal dataset from the Indian Jurassics. This dataset from Jaisalmer (Rajasthan, western India) is based on a study of 77 samples yielding 149 species (22 superfamilies, 33 families and 58 genera) spanning the Bajocian to Early Tithonian interval. Due to its high resolution and large time span covered, this dataset is also ideal to document the biostratigraphic relevance, if any, of benthic foraminifers that so far have only been documented from short time intervals. Here, 18 species are common with the British Jurassic, the most with any dataset, and marginally above (19) with the adjoining Kachchh Basin; surprisingly, only 7 are common between the latter and the British Jurassic. Although the benthic foraminifers are well known to be long ranging, but, the commonness of some species with the British Jurassics suggest their biostratigraphic usefulness. These include *Brizalina liassica*, *Ammobaculites agglutinans*, *Ammobaculites coprolithiformis*, *Citharina colliezi*, *Citharina flabellata*, *Dentalina gumbeli*, *Epistomina rugularis*, *Falsopalmulina deslongchampsii*, *Fronicularia franconia*, *Lenticulina münsteri*, *Lenticulina quenstedti*, *Lenticulina subalata*, *Nodosaria hortensis*, *Ophthalmidium carinatum*, *Pseudonodosaria vulgate*, *Reinholdella crebra*, *Vaginulina barnardia* and *Verneulinoides tryphera*. Additionally, because of higher ammonite dating capability of the present study, the foraminiferal species are grouped into Stage based stratigraphic categories of Restricted, First and Last Occurrences. This categorization will enable a ready and robust age-limited template of benthic foraminiferal dataset for future local, regional and global correlation.

Keywords: India, Jurassic, benthic foraminiferal biostratigraphy, correlation

INTRODUCTION

The Jaisalmer region (Rajasthan, western India; Fig. 1) exposes a thick sedimentary succession of Jurassic-Cretaceous sediments. Although richly fossiliferous, detailed foraminiferal studies are scarce and restricted to few sections (Subbotina et al., 1960; Misra, 1973; Bhatia and Mannikeri, 1977; Kalia and Chowdhury, 1983; Garg and Singh, 1983, 1986; Dave and Chatterjee, 1996; Garg and Jain, 2012). More recently, Dave and Chatterjee (1996) carried out a somewhat detailed study of foraminiferal assemblages and proposed an integrated foraminiferal-ammonite biozonation. They documented a rather impoverished microfauna identifying 13 biozones for the Bathonian-Lower Tithonian sediments exposed around the Jaisalmer region (Fig. 1). However, the placements of most of the age diagnostic ammonite taxa are tentative; for example the index ammonite *Sivajiceras congener* Waagen is placed in Early Callovian rather than in its nominal Zone in the Late Bathonian (Callomon, 1993; Fürsich et al., 2001; Jain, 2007, 2008, 2012). Similarly typical *Epimayaites* of the Early Oxfordian are placed in the Late Callovian and *Dhosaites* largely of Early Oxfordian age (Pathak and Krishna, 1993) are in the Middle Oxfordian. Additionally, their (Dave and Chatterjee, 1996) lithostratigraphy and lithosections are broad; most faunal identifications are at the generic level and some specific identifications are at best considered tentative. Hence, their dataset only serves to indicate the rich presence of benthic foraminifers in these Jurassic sediments.

This contribution presents the first ammonite age-constrained (Jain, 2012) rich benthic foraminiferal dataset (Garg, 1983) from Jaisalmer (Rajasthan, western India; Fig.

2). Due to its high resolution and large time span covered, the dataset is ideal to document the biostratigraphic usefulness, if any, of benthic foraminifers from the Indian Jurassics that so far have only been documented from restricted short time intervals studies and from selected sections only.

MATERIAL AND METHOD

The present dataset is also the largest from the Indian Jurassics and is based on a study of 77 samples yielding 149 species (58 genera, 33 families and 22 superfamilies) spanning Bajocian to Early Tithonian (Fig. 2). Of the thirty three families (Table 1), Vaginulinidae is the most dominant with 25 species (16.9% of the total number of species) followed by Nodosariidae with 18 species (12.2%), Lituolidae with 13 species (8.8%), Trochamminidae with 10 (6.8%) and Eggerellidae with 10 species (6.8%; Table 1).

Additionally, because of the integration with precise age estimated ammonite data of the present study, the foraminiferal species are grouped into Stage based (for example Bathonian, Callovian, etc.) stratigraphic categories of Restricted, First and Last Occurrences. This categorization has enabled a ready and robust age-limited benthic foraminiferal dataset that can be used as a template for future local, regional and global correlation. These categories are: (a) Species that are restricted to a particular stage (for example Bathonian, Callovian, etc.), (b) Species that have their first occurrence (FO) in a particular stage and (c) Species that have their last occurrence (LO) in a particular stage. Of the three, the restricted category (a) is biostratigraphically most useful. The distribution of the number of species stage wise is enumerated in Fig. 3 and detailed in Table 2. Dominant foraminiferal species are illustrated in Plate I.

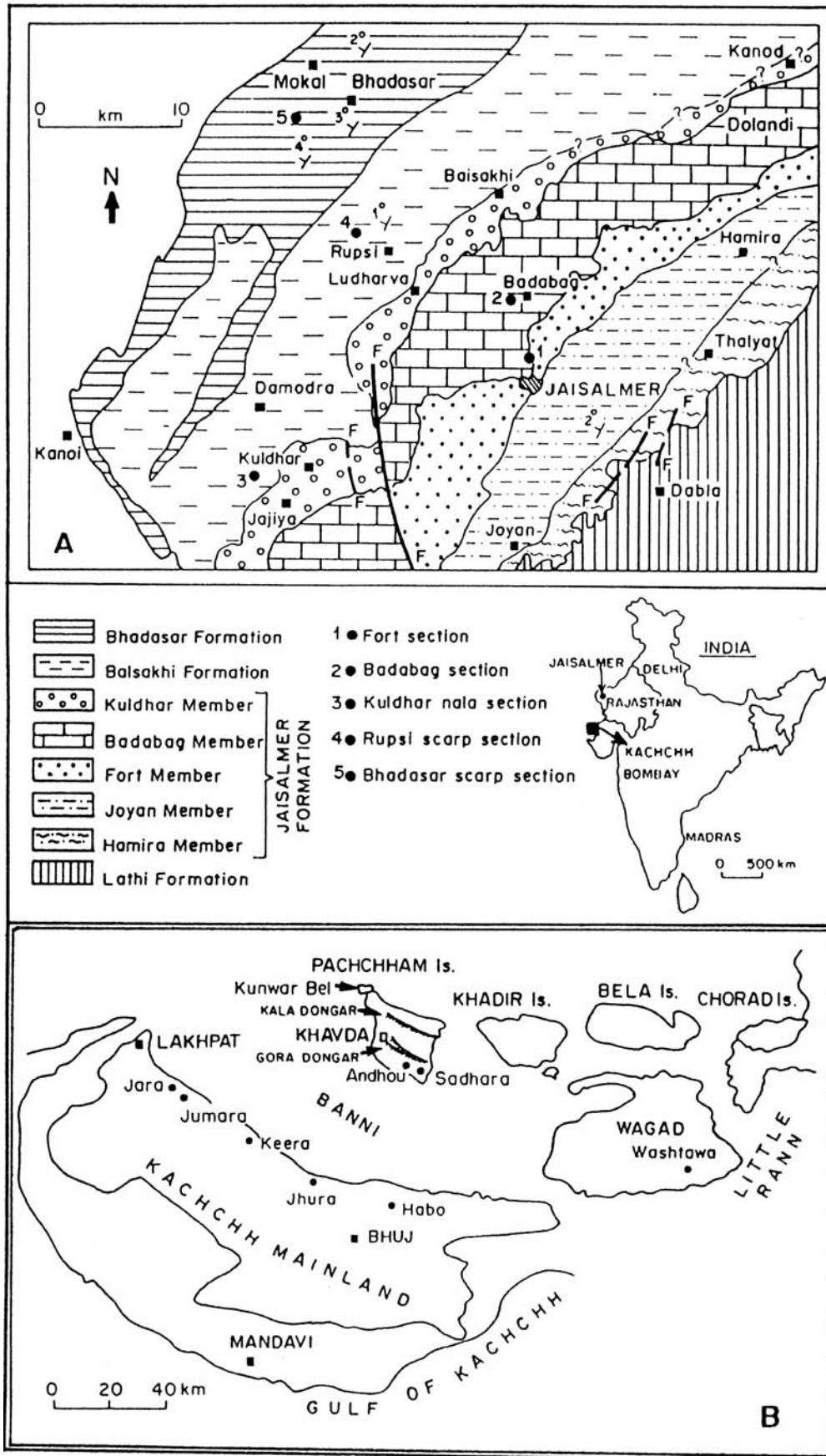


Fig. 1. Map of western India showing localities of Jaisalmer (Modified after Dave and Chatterjee 1996) and Kachchh.

Table 1: Superfamily composition from Jaisalmer (this study).

	Family	#	%	Genus	#	%	Superfamily	#	%
		species			species			species	
1	Vaginulinidae	25	16.9	Ammobaculites	10	6.8	Nodosariacea	50	33.8
2	Nodosariidae	18	12.2	Trochammina	10	6.8	Lituolacea	17	11.5
3	Lituolidae	13	8.8	Nodosaria	10	6.8	Verneulinacea	11	7.4
4	Trochamminidae	10	6.8	Pseudomarsonella	8	5.4	Textulariacea	11	7.4
5	Eggerellidae	10	6.8	Lenticulina	8	5.4	Trochamminacea	10	6.8
6	Prolixoplectidae	7	4.7	Riyadhella	7	4.7	Astrorhizacea	9	6.1
7	Lagenidae	5	3.4	Dentalina	5	3.4	Miliolacea	5	3.4
8	Saccamminadae	4	2.7	Citharina	5	3.4	Ataxophragmiacea	5	3.4
9	Haplophragmoididae	4	2.7	Lagena	5	3.4	Spirillinacea	4	2.7
10	Verneulinidae	4	2.7	Haplophragmoides	4	2.7	Ceratobuliminacea	4	2.7
11	Pfenderinidae	4	2.7	Vaginulina	4	2.7	Haplophragmiacea	3	2.0
12	Spirillinidae	4	2.7	Marginulina	4	2.7	Duostominacea	3	2.0
13	Ammosphaeroidinidae	3	2.0	Lagenammina	3	2.0	Spiroplectamminacea	2	1.4
14	Duostominidae	3	2.0	Pfenderina	3	2.0	Robuloidacea	2	1.4
15	Epistominidae	3	2.0	Epistomina	3	2.0	Involutinacea	2	1.4
16	Houerinidae	3	2.0	Spirillina	3	2.0	Hormosinacea	2	1.4
17	Rhabdamminidae	2	1.4	Rhabdammina	2	1.4	Conorboidacea	2	1.4
18	Psammosphaeridae	2	1.4	Psammosphaera	2	1.4	Ammodiscacea	2	1.4
19	Ammodiscidae	2	1.4	Ammodiscus	2	1.4	Squamulinacea	1	0.7
20	Hormosinidae	2	1.4	Reophax	2	1.4	Rzehakinacea	1	0.7
21	Spiroplectamminidae	2	1.4	Ammosphaeroidina	2	1.4	Bolivinacea	1	0.7
22	Polymorphinidae	2	1.4	Verneulinoides	2	1.4	Gen. indet.	1	0.7
23	Robuloididae	2	1.4	Lingulina	2	1.4			
24	Conorboididae	2	1.4	Saracenaria	2	1.4			
25	Involutinidae	2	1.4	Eoguttulina	2	1.4			
26	Miliolechinidae	2	1.4	Singhamina	2	1.4			
27	Bathysiphonidae	1	0.7	Falsopalmulina	2	1.4			
28	Rzehakinidae	1	0.7	Conorboides	2	1.4			
29	Ataxophragmidae	1	0.7	Trocholina	2	1.4			
30	Textulariidae	1	0.7	Quinquiloculina	2	1.4			
31	Bolivinidae	1	0.7	Bathysiphon	1	0.7			
32	Ceratobuliminidae	1	0.7	Rhizammina	1	0.7			
33	Ophthalmidiidae	1	0.7	Thurammina	1	0.7			
34				Miliammina	1	0.7			
35				Flabellamina	1	0.7			
36				Triplasia	1	0.7			
37				Subbdelloidina	1	0.7			
38				Recurvoides	1	0.7			
39				Ammobaculoides	1	0.7			
40				Morulaepecta	1	0.7			
41				Gaudrinella	1	0.7			
42				Verneulina	1	0.7			
43				Arenobulimina	1	0.7			
44				Kurnubia	1	0.7			
45				Dorothia	1	0.7			
46				Eggerella	1	0.7			
47				Textularia	1	0.7			
48				Brizalina	1	0.7			
49				Fronicularia	1	0.7			
50				Marginulinopsis	1	0.7			
51				Astacolus	1	0.7			
52				Tandonina	1	0.7			
53				Reinholdella	1	0.7			
54				Conicospirillina	1	0.7			
55				Triloculina	1	0.7			
56				Palaeomiliolina	1	0.7			
57				Ophthalmidium	1	0.7			
58				Gen indet.	1	0.7			

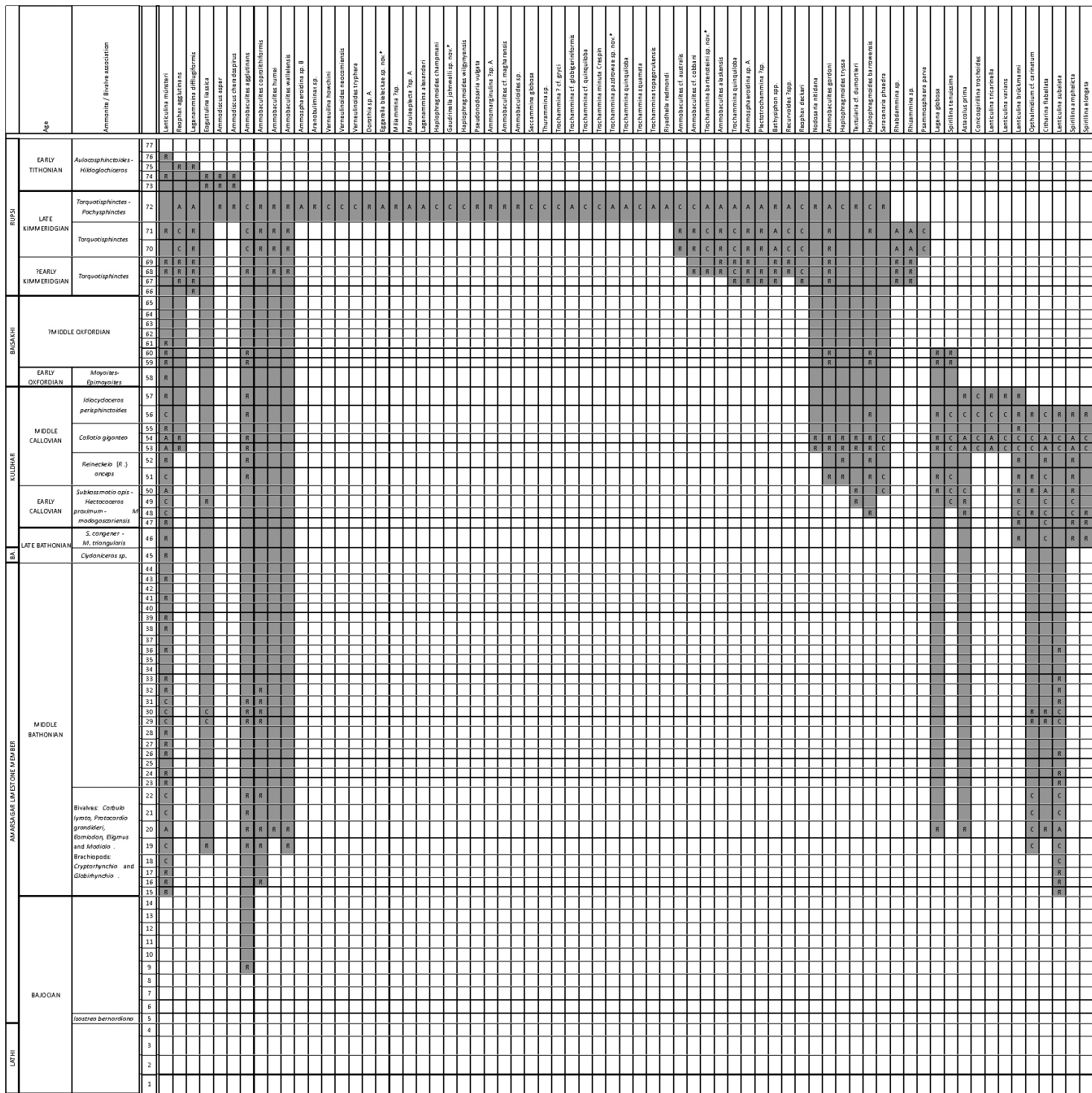


Fig. 2. Biostratigraphic chart of the benthic foraminiferal fauna from Jaisalmer. R, C and A = Rare, Common and Abundant. R = 1-5 specimens; C = 6-10 and A = >10

RESULTS

Stratigraphically, at the species level (Fig. 3), maximum first occurrences are noted for Bathonian (77) and Kimmeridgian (44), whereas maximum last occurrences for Callovian (34) and Kimmeridgian (10). The maximum number of restricted species within a Stage are also for Bathonian (50) and Kimmeridgian (43) followed by Callovian (28). Thus, major changes at the species level are noted for Bathonian and Kimmeridgian and to a lesser extent during the Callovian (Fig. 3).

Stages	SPECIES			GENUS		
	RESTRICTED	FO	LO	RESTRICTED	FO	LO
Tithonian	3	0	3	0	0	5
Kimmeridgian	43	44	10	7	21	24
Oxfordian	0	0	2	0	0	2
Callovian	28	27	34	0	7	11
Bathonian	50	77	0	16	32	0
Bajocian	0	1	0	0	0	0

Fig. 3. Stage-wise distribution of species and genera (this study).

The Bathonian is unique at both genus and species level as it is marked by the highest number of restricted (16 and 50 respectively) and first occurrence forms (32 and 77 respectively) with no last occurrences (Fig. 3). The Callovian, at both the genus and species level is marked by higher number of LO (11 and 34 respectively) and somewhat lower FO (7 and 27 respectively). None of the genera are restricted to the Callovian (Fig. 3) whereas at the species level (Fig. 3), they slightly outnumber the first occurrences (28 and 27 respectively). The Kimmeridgian for the genus shows the maximum number of LO (24) followed by FO (21) and restricted (7) genera (Fig. 3), whereas at the species level, both FO (44) and restricted species (43) dominate with the former slightly outnumbering the latter (Fig. 3). Thus, as at the species level, major changes are also noted at the genus level at Bathonian and Kimmeridgian and to a lesser extent at the Callovian (Fig. 3).

DISCUSSION

In the present study, in an attempt to provide a more robust and expanded view of the stratigraphical distribution of the benthic foraminiferal faunal from western India (Jaisalmer and adjoining Kachchh basin), data from meaningful previous studies (Subbotina et al., 1960; Kalia and Chowdhury, 1983; Dave and Chatterjee, 1996) are integrated and compared (Fig. 4). Within the Jaisalmer basin, only 12 species are found

to be common and 19 when compared with the Kachchh basin (Bhalla and Abbas, 1978; Pandey and Dave, 1993; Talib and Gaur, 2008; Gaur and Talib, 2008) (Fig. 4). Three reasons are speculated for this dissimilarity with the Kachchh fauna: (a) lack of an apparent taxonomic standardization, (b) difference in sampling resolution and (c) that the Jaisalmer benthic foraminiferal fauna is exceedingly rich and diversified, yielding more different species each time, rather than the same.

Although benthic foraminifers are long ranging, however the commonness of species with the ammonite-constrained British Jurassic fauna (Jenkins and Murray, 1981) is most striking. The present Jaisalmer Basin dataset has 18 species common with the British Jurassic and hence these are also considered biostratigraphically important (Fig. 5). The species are *Brizalina liassica*, *Ammobaculites agglutinans*, *Ammobaculites coprolithiformis*, *Citharina colliciei*, *Citharina flabellata*, *Dentalina gumbeli*, *Epistomina rugularis*, *Falsopalmulina deslongchampsii*, *Frondicularia franconia*, *Lenticulina münsteri*, *Lenticulina quenstedti*, *Lenticulina subalata*, *Nodosaria hortensis*, *Ophthalmidium carinatum*, *Pseudonodosaria vulgate*, *Reinholdella crebra*, *Vaginulina barnardia* and *Verneulinoides tryphera*.

Interestingly, when all the Kachchh dataset is pooled together only 7 species are found common with the British Jurassic (Fig. 5). These are *Citharina colliciei*, *Dentalina gumbeli*, *Epistomina rugularis*, *Lenticulina quenstedti*, *Lenticulina subalata*, *Vaginulina barnardia* and *Verneulinoides tryphera*. Thus, in spite of higher sampling resolution and equally large dataset (Fig. 4), the Jaisalmer fauna has closer affinity with the British fauna. Such similarity of foraminiferal species in benthic assemblage from distant epicontinental Jurassic seas across the Tethys is quite remarkable.

EXPLANATION OF PLATE I

Camera Lucida figures made by Rahul Garg.

1-10: *Ammobaculites coprolithiformis* (Schwager). 9: side view, 10: edge view, LUGMJF 735, all x35; 11: side view, LUGMJF 736, x50; 12: side view, 13: top view, LUGMJF 740, all x125; 14: side view, 15: top view, LUGMJF 739, all x125; 16: side view, 17: top view, LUGMJF 737, all x75; 18: side view, LUGMJF 738, x75.

11-17: *Ammobaculites agglutinans* (d'Orbigny). 11: top view, 12: edge view, 13: side view, LUGMJF 725, all x65; 14 and 16: opposite side views, 15: top view, LUGMJF 727, all x65; 17: side view, LUGMJF 726, all x100.

18-21: *Dentalina gumbeli* Schwager (all x100). 18: side view, LUGMJF 632; 19: side view (broken specimen), LUGMJF 633; 20: top view, 21: side view (broken specimen), LUGMJF 634.

22-26: *Nodosaria hortensis* Terquem. 22: top view, 23: side view, LUGMJF 623, all x100; 24: side view, LUGMJF 624, x100; 25: side view, x100 26: top view, x160, LUGMJF 625.

27-28: *Pseudonodosaria vulgate* (Bornemann). 28: top view, 29: side view, LUGMJF 647, all x100.

29-31: *Vaginulina barnardi* Gordon. 29: side view, 30: top view, LUGMJF 639, all x100; 31: side view, LUGMJF 640, all x135.

32: *Citharina flabellata* (Gümbel), side view, LUGMJF 644, x100.

33-34: *Citharina colliciei* (Terquem). 33: side view, 34: top view, LUGMJF 643, x135.

35-37: *Lenticulina subalata* (Reuss) (all x65). 35: edge view, 36: side view, LUGMJF 607; 37: edge view, LUGMJF 606.

38-40: *Lenticulina münsteri* (Roemer) (all x65). 38: edge view, 39: side view, LUGMJF 603; 40: side view, LUGMJF 602.

41: *Reinholdella cf. crebra* Pazdro. Umbilical view, LUGMJF 572, x135.

42-43: *Epistomina rugularis* Terquem. 42: spiral view, 43: umbilical view, LUGMJF 562, x135.

44: *Ophthalmidium cf. carinatum* Kubler and Zwingli. Side view, LUGMJF 594, x100.

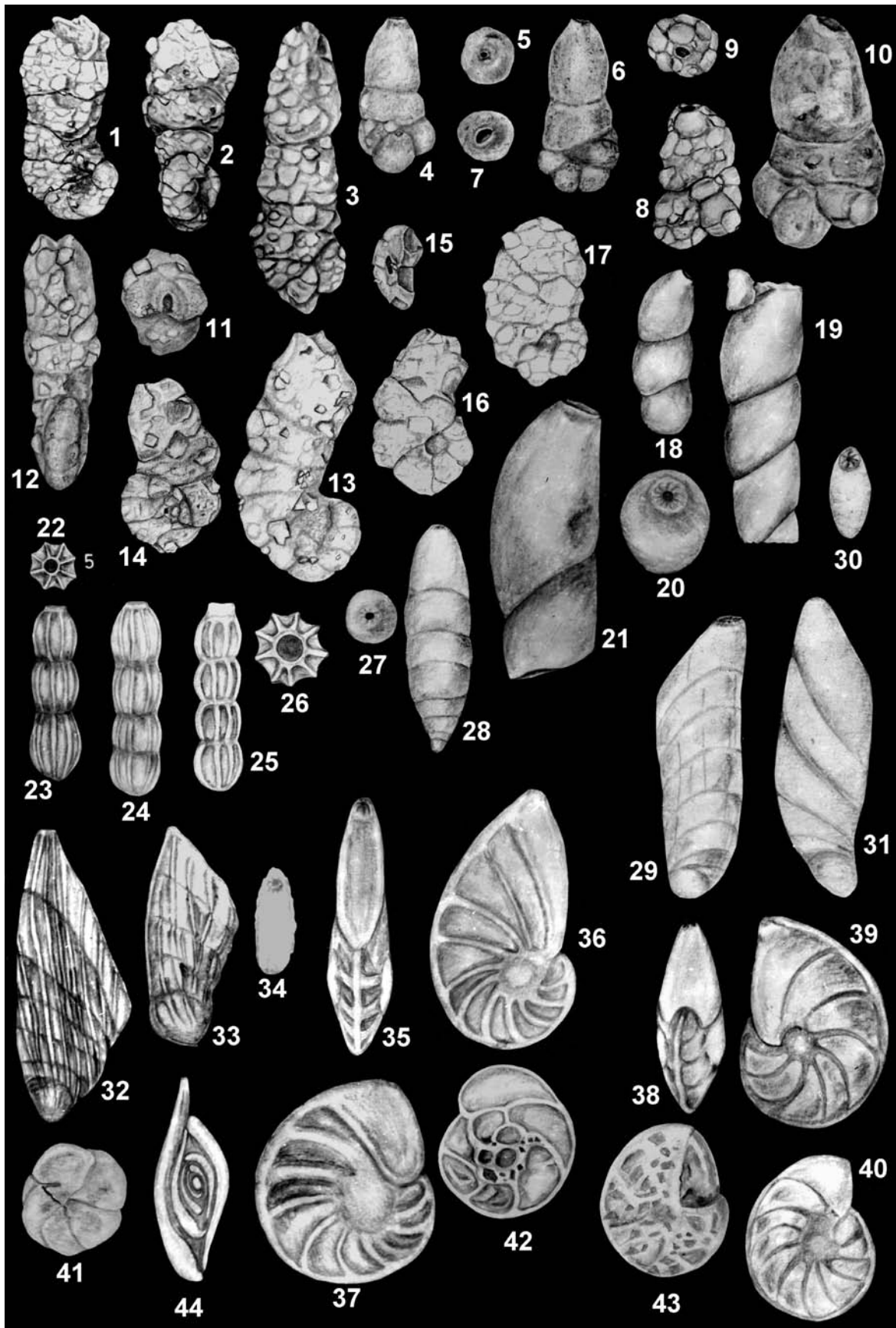


Table 2: Stratigraphic categories of Restricted, First and Last Occurrences of benthic foraminiferal species and genus from Jaisalmer (this study).

Species			Genus		
Restricted	First Occurrence (FO)	Last Occurrence (LO)	Restricted	First Occurrence (FO)	Last Occurrence (LO)
	FO in Bajocian				
	Ammobaculites agglutinans				
Restricted to Bathonian	FO in Bathonian	LO in Callovian	Restricted to Bathonian	FO in Bathonian	LO in Callovian
Brizalina cf. liassica	Ammobaculites coprolithiformis	Astacolus prima	Brizalina	Vaginulina	Astacolus
Citharina colliezi	Ammobaculites humei	Citharina flabellata	Conorboides	Ammobaculites	Citharina
Citharina hetropleura	Ammobaculites wallelensis	Citharina rhomboidea	Epistomina	Astacolus	Conicospirillina
Citharina micilenta	Astacolus prima	Conicospirillina trochoides	Kurnubia	Brizalina	Dentalina
Conorboides ashoki	Brizalina cf. liassica	Dentalina bartensteini	Palaeomiliolina	Citharina	Falsopalmulina
Conorboides jaisalmeriensis	Citharina colliezi	Dentalina gumbeli	Pfenderina	Conorboides	Flabellamina
Dentalina cf. tenuistriata	Citharina flabellata	Falsopalmulina deslong-champsi	Pseudomarsonella	Dentalina	Frondicularia
Dentalina ejuncta	Citharina hetropleura	Falsopalmulina subparallela	Quinquiloculina	Eoguttulina	Lingulina
Epistomina coronata	Citharina micilenta	Flabellamina vitrea	Reinholdella	Epistomina	Marginulina
Epistomina rugularis	Conorboides ashoki	Frondicularia franconia	Singhamina	Flabellamina	Ophthalmidium
Epistomina turgiaula	Conorboides jaisalmeriensis	Lenticulina brückmanni	Spiroloculina	Frondicularia	Vaginulina
Kurnubia cf. variabilis	Dentalina bartensteini	Lenticulina quenstedti	Subdelloidina	Kurnubia	
Lagena globosa	Dentalina cf. tenuistriata	Lenticulina subalata	Tandonina	Lagena	LO in Oxfordian
Lenticulina polygonata	Dentalina ejuncta	Lenticulina suturifusus	Triloculina	Lenticulina	Lagena
Lingulina nodosaria	Dentalina gumbeli	Lenticulina tricarinnella	Triplasia	Lingulina	Spirulina
Nodosaria cf. mita	Dentalina tortilis	Lenticulina varians	Trocholina	Nodosaria	
Nodosaria corallina	Eoguttulina oolithica	Lingulina laevissima		Ophthalmidium	
Nodosaria sp.	Epistomina coronata	Marginulina epicharis	Restricted to Kimmeridgian	Palaeomiliolina	LO in Kimmeridgian
Palaeomiliolina sp.	Epistomina rugularis	Marginulina haynesi	Ammosphaeroidina	Pfenderina	Ammobaculites
Pfenderina cf. gracilis	Epistomina turgiaula	Marginulina oxfordiana	Bathysiphon	Pseudomarsonella	Ammobaculoides
Pfenderina cf. neocomiensis	Flabellamina vitrea	Marginulina scapha	Plectotrochammina	Quinquiloculina	Ammomarginulina
Pfenderina inflata	Frondicularia franconia	Marginulinopsis misrensis	Psammosphaera	Reinholdella	Ammosphaeroidina
Psammosphaera sp.	Kurnubia cf. variabilis	Nodosaria belteata	Recurvoidea	Riyadhella	Arenobulimina
Pseudomarsonella biangulata	Lagena aphela	Nodosaria hortensis	Rhabdammina	Saracenaria	Bathysiphon
Pseudomarsonella bipartita	Lagena globosa	Nodosaria mecista	Rhizammina	Singhamina	Dorothia
Pseudomarsonella inflata	Lagena globosa	Nodosaria sculpta		Spirillina	Eggerella
Pseudomarsonella media	Lagena ovata	Nodosaria setulosa		Spiroloculina	Gaudrinella
Pseudomarsonella primitiva	Lagena sulcata	Nodosaria simplex		Subdelloidina	Haplophragmoides
Pseudomarsonella reflexa	Lenticulina brückmanni	Ophthalmidium cf. carinatum		Tandonina	Miliammina
Quinquiloculina compressa	Lenticulina polygonata	Pseudonodosaria vulgata		Triloculina	Morulaeplecta
Quinquiloculina sp.	Lenticulina subalata	Spirillina amphelicta		Triplasia	Nodosaria
Reinholdella cf. crebra	Lingulina laevissima	Spirillina elongata		Trocholina	Plectotrochammina
Riyadhella aff nana	Lingulina nodosaria	Trochammina squamata			Pseudonodosaria
Riyadhella arabica	Nodosaria cf. mita	Vaginulina compsa		FO in Callovian	Recurvoidea
Riyadhella elongata	Nodosaria corallina			Conicospirillina	Riyadhella
Riyadhella intermedia	Nodosaria hortensis	LO in Oxfordian		Falsopalmulina	Saccamina
Riyadhella regularis	Nodosaria mecista	Lagena globosa		Haplophragmoides	Saracenaria
Riyadhella rotundata	Nodosaria sculpta	Spirillina tenuissima		Pseudonodosaria	Textularia
Saracenaria cornucopiae	Nodosaria simplex			Reophax	Thurammina
Singhamina jaisalmeriensis	Nodosaria sp.	LO in Kimmeridgian		Textularia	Trochammina
Singhamina rajasthanensis	Ophthalmidium cf. carinatum	Ammobaculites agglutinans		Trochammina	Verneuilina
Spiroloculina sp.	Palaeomiliolina sp.	Ammobaculites coprolithiformis			Verneulinoides
Subdelloidina cf. mariei	Pfenderina cf. gracilis	Ammobaculites gordoni		FO in Kimmeridgian	
Tandonina paula	Pfenderina cf. neocomiensis	Ammobaculites humei			LO in Tithonian
Triloculina sp.	Pfenderina inflata	Ammobaculites wallelensis		Psammosphaera	Ammodiscus
Triplasia australias	Psammosphaera sp.	Haplophragmoides barrowensis		Rhabdammina	Eoguttulina
Trocholina conica	Pseudomarsonella biangulata	Haplophragmoides tryssa		Rhizammina	Lagenammina

Trocholina solecensis	Pseudomarsonella bipartita	Nodosaria nitidana		Recurvoides	Lenticulina
Vaginulina anomala	Pseudomarsonella inflata	Saracenaria phaedra		Plectotrochammina	Reophax
Vaginulina jurassica	Pseudomarsonella media	Textularia cf. dumortieri		Ammosphaeroidina	
	Pseudomarsonella primitiva			Bathysiphon	
Restricted to Callovian	Pseudomarsonella reflexa	LO in Tithonian		Arenobulimina	
Citharina flabellata	Quinqueloculina compressa	Lagenammina difflugiformis		Ammobaculoides	
Citharina rhomboidea	Quinqueloculina sp.	Lenticulina münsteri		Ammomarginulina	
Conicospirillina trochoides	Reinholdella cf. crebra	Reophax agglutinans		Dorothia	
Dentalina tortilis	Riyadhella aff. nana			Eggerella	
Falsopalmulina deslongchampsii	Riyadhella arabica			Miliammina	
Falsopalmulina subparallela	Riyadhella elongata			Gaudrinella	
Lagena aphela	Riyadhella intermedia			Thurammina	
Lagena ovata	Riyadhella regularis			Verneuilina	
Lagena sulcata	Riyadhella rotundata			Verneulinoides	
Lenticulina brückmanni	Saracenaria cornucopiae			Morulaeplecta	
Lenticulina quenstedti	Singhamina jaisalmeriensis			Saccammina	
Lenticulina subalata	Singhamina rajasthanensis			Ammodiscus	
Lenticulina suturifusus	Spirillina amphelicta			Lagenammina	
Lenticulina tricarinnella	Spirillina elongata				
Lenticulina varians	Spiroloculina sp.				
Marginulina epicharis	Subdelloidina cf. mariei				
Marginulina haynesi	Tandonina paula				
Marginulina oxfordiana	Triloculina sp.				
Marginulina scapha	Triplasia australias				
Marginulinopsis misrensis	Trocholina conica				
Nodosaria belteata	Trocholina solecensis				
Nodosaria mecista	Vaginulina anomala				
Nodosaria setulosa	Vaginulina barnardia				
Ophthalmidium cf. carinatum	Vaginulina compsa				
Pseudonodosaria vulgata	Vaginulina jurassica				
Trochammina squamata					
	FO in Callovian				
Restricted to Kimmeridgian	Dentalina tortilis				
Ammodiscus asp.er	Lagena ovata				
Ammodiscus cheradospirus	Lagena sulcata				
Ammosphaeroidina sp. B	Lagena aphela				
Arenobuliminax sp.	Falsopalmulina deslongchampsii				
Verneuilina howchini	Falsopalmulina subparallela				
Verneulinoides neocomiensis	Nodosaria setulosa				
Verneulinoides tryphera	Pseudonodosaria vulgata				
Dorothia sp. A	Marginulina oxfordiana				
Eggerella bieleckae sp. nov	Marginulina scapha				
Miliammina ?sp.	Marginulinopsis misrensis				
Morulaeplecta ?sp. A	Marginulina epicharis				
Lagenammina alexanderi	Trochammina squamata				
Haplophragmoides champmani	Nodosaria belteata				
Gaudrinella johnwalli sp. nov	Citharina rhomboidea				
Haplophragmoides wilgynensis	Lenticulina suturifusus				
Pseudonodosaria vulgata	Marginulina haynesi				
Ammomarginulina ?sp. A	Conicospirillina trochoides				
Ammobaculites cf. magharenensis	Lenticulina tricarinnella				
Ammobaculoides sp.	Lenticulina varians				
Saccammina globosa	Nodosaria nitidana				
Thurammina sp.	Ammobaculites gordoni				

Trochammina ? cf. gryci	Haplophragmoides tryssa				
Trochammina cf. globigerini-formis	Textularia cf. dumortieri				
Trochammina cf. quinquiloba	Haplophragmoides barrowensis				
Trochammina minuta	Saracenaria phaedra				
Trochammina pazdrowae sp. nov	Reophax agglutinans				
Trochammina quinquiloba					
Trochammina squamata	FO in Kimmeridgian				
Trochammina topagorukensis	Rhabdammina sp.				
Riyadhella redmondi	Rhizammina sp.				
Ammobaculites cf. australis	Psammosphaera parva				
Ammobaculites cf. cobbani	Ammosphaeroidina sp. B				
Trochammina bartensteini sp. nov	Arenobuliminax sp.				
Ammobaculites alaskensis	Verneuilina howchini				
Trochammina quinquiloba	Verneulinoides neocomiensis				
Ammosphaeroidina sp. A	Verneulinoides tryphera				
Plectotrochammina ?sp.	Dorothia sp. A				
Bathysiphon sp.	Eggerella bieleckae sp. nov.				
Recurvoides ?sp.	Miliammina ?sp.				
Reophax deckeri	Morulaeplecta ?sp. A				
Rhabdammina sp.	Lagenammina alexanderi				
Rhizammina sp.	Haplophragmoides champmani				
Psammosphaera parva	Gaudrinella johnwalli sp. nov.				
	Haplophragmoides wilgynyensis				
Restricted to Tithonian	Pseudonodosaria vulgata				
Eoguttulina liassica	Ammomarginulina ?sp. A				
Ammodiscus asper	Ammobaculites cf. magharensis				
Ammodiscus cheradospirus	Ammobaculooides sp.				
	Saccammina globosa				
	Thurammina sp.				
	Trochammina ? cf. gryci				
	Trochammina cf. globigeriniformis				
	Trochammina cf. quinquiloba				
	Trochammina minuta Crespin				
	Trochammina pazdrowae sp. nov.				
	Trochammina quinquiloba				
	Trochammina squamata				
	Trochammina topagorukensis				
	Riyadhella redmondi				
	Ammobaculites cf. australis				
	Ammobaculites cf. cobbani				
	Trochammina bartensteini sp. nov.				
	Ammobaculites alaskensis				
	Trochammina quinquiloba				
	Ammosphaeroidina sp. A				
	Plectotrochammina ?sp.				
	Bathysiphon spp.				
	Recurvoides ?spp.				
	Reophax deckeri				
	Ammodiscus asper				
	Ammodiscus cheradospirus				
	Lagenammina difflugiformis				

Basins	JAISALMER					KACHCHH				
	This study	Kalia and Chowdhary, 1983	Dave and Chatterjee, 1996	Subbotina et al. (1960)	Compared with this study and all previous data	Pandey and Dave, 1993	Talib and Gaur, 2008; Gaur and Talib, 2008	Bhall and Abbas, 1978	Compared with this study and all previous data	
Authors	LATHI - BHADASAR FM.	LATHI - BHADASAR FM.	LATHI - BHADASAR FM.	JAISALMER-BHADASAR FM.	LATHI - BHADASAR FM.	BHADIAN-UMIAIAN	PATCHAM-CHARI	PATCHAM-KATROL	PATCHAM-KATROL	
Sections investigated	149	47	32	34	72	65	51	62	149	
No. of species recorded	77	8	46	4	135	190	19	70	279	
Ages/Revised ages	Bajocian-Early Tithonian	Late Bathonian-Middle Callovian	Bajocian-Early Tithonian	Bathonian-Callovian	Bajocian-Early Tithonian	Bajocian-Early Tithonian	Bathonian-Callovian	Bathonian-Callovian	Bathonian-Callovian	
No. of species common with the present study	7	7	7	2	12	11	2	10	19	
SPECIES COMMON WITH THE PRESENT STUDY	Ammobaculites coprolithiformis Dentalina guembeli Lenticulina münsteri Lenticulina quenstedti Lenticulina tricarinella Lingulina laevisima Saracenaria phaedra	Citharina rhomboidea Dentalina gumbeli Lenticulina münsteri Lenticulina quenstedti Lenticulina tricarinella Marginulina haynesi Quinquiloculina sp.	Ammobaculites coprolithiformis Lenticulina münsteri	Ammobaculites coprolithiformis Lenticulina münsteri	Ammobaculites coprolithiformis Citharina rhomboidea Dentalina gumbeli Lenticulina münsteri Froncularia franconia Lenticulina brückmanni Lenticulina münsteri Lenticulina quenstedti Lenticulina tricarinella Saracenaria phaedra	Bathysiphon sp. Epistomina coronata Epistomina regularis Lenticulina quenstedti Lenticulina subalata Lenticulina münsteri Lenticulina subalata Lenticulina suturifusus Lenticulina tricarinella Marginulina haynesi Nodosaria sp. Quinquiloculina sp. Vaginulina barnardi	Dentalina gumbeli Lenticulina subalata Saracenaria cornucopiae Triloculina sp.	Citharina hetropleura Dentalina gumbeli Lenticulina münsteri Lenticulina quenstedti Lenticulina subalata Lenticulina suturifusus Lenticulina tricarinella Lenticulina varians Marginulina haynesi Vaginulina barnardi	Bathysiphon sp. Citharina colliciei Citharina hetropleura Dentalina gumbeli Epistomina coronata Epistomina regularis Lenticulina quenstedti Lenticulina subalata Epistomina coronata Epistomina regularis Lenticulina quenstedti Lenticulina subalata Lenticulina suturifusus Lenticulina tricarinella Lenticulina subalata Lenticulina suturifusus Lenticulina tricarinella Lenticulina varians Marginulina haynesi Lenticulina tricarinella Lenticulina varians Marginulina haynesi Nodosaria simplex Nodosaria sp. Quinquiloculina sp. Saracenaria cornucopiae Triloculina sp. Vaginulina barnardi Verneulinoides tryphera	

Fig. 4. Comparison of Jaisalmer and Kachchh benthic foraminiferal studies.

AGE	Toarcian	Bajocian	Bathonian	Callovian	Oxfordian	Kimmeridgian	Tithonian
SPECIES	BRITISH JURASSIC						
British Jurassic	THIS STUDY						
Jaisalmer							
Brizalina liassica							
Brizalina cf. liassica							
Falsopalmulina deslongchampsii							
Falsopalmulina deslongchampsii							
Lenticulina subalata							
Lenticulina subalata							
Nodosaria hortensis	?	?					
Nodosaria hortensis							
Citharina colliezi							
Citharina colliezi							
Lenticulina quenstedti							
Lenticulina quenstedti							
Epistomina rugularis							
Epistomina rugularis							
Ophthalmidium carinatum							
Ophthalmidium cf. carinatum							
Reinholdella crebra							
Reinholdella cf. crebra							
Ammobaculites agglutinans							
Ammobaculites agglutinans							
Ammobaculites coprolithiformis							
Ammobaculites coprolithiformis							
Verneulinoides tryphera							
Verneulinoides tryphera							
Citharina flabellata							
Citharina flabellata							
Dentalina gumbeli							
Dentalina gumbeli							
Frondicularia franconia						?	
Frondicularia franconia							
Vaginulina barnardia							
Vaginulina barnardia							
Pseudonodosaria vulgata							
Pseudonodosaria vulgata							
Lenticulina münsteri							
Lenticulina münsteri							

Fig. 5. Comparison of Jurassic benthic foraminiferal species from present study (Jaisalmer basin) and British Jurassic (Jenkins and Murray, 1981).

CONCLUSIONS

Thus, in summary, this contribution bears out three important points: (a) the age-limited, well-constrained benthic foraminiferal dataset from Jaisalmer can be used as a template for future local, regional and global correlation, (b) major changes both at the genus and species level are noted at Bathonian and Kimmeridgian stages and, to a lesser extent, at the Callovian and (c) between Kachchh and Jaisalmer benthic foraminiferal faunas, the latter has closer affinity with the British Jurassic fauna.

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