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Age, Palaeoenvironment, and Palaeogeographic Implications of Ostracod Fauna from Upper Nimar Sandstone (Bagh Group) of Jhabua and Alirajpur Districts, Madhya Pradesh

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Abstract: **The rocks of Nimar Sandstone Formation directly restover Pre-Cambrian basement rocks exposed at several places near Pipaldehla, Sajwani (Gola Chhoti) Dhekal Badi, Tikadi Moti, Ranapur, Rajla, Para, Akholi, Udaigarh (Kanas) and many more places in Jhabua and Alirajpur Districts of Madhya Pradesh. The present paper deals with the ostracods fauna recorded from the Pipaldehla (N 22°46' E 74°39'), Sajwani (N 22°69' E 74°59'), Dhekal Badi (N 22°71' E 74°56'), Tikadi Moti (N 22°70' E74°55'), Ranapur (N 22°38' E 74°32'), Udaigarh (N 22°52' E 74°54') localities. Fifty ostracod species belonging to twenty-six genera have been reported from upper calcareous Nimar Sandstoneof these twenty-eight species are assigned to previously known species, while the remaining nineteen species are new and three species are left in open nomenclature. The overall ostracod fauna suggests an early Turonian age. Palaeobiogeography and age are discussed based on ostracods and other faunal groups recorded from the Bagh Group.**

Index Terms: **Nimar Sandstone, Ostracod, Upper Cretaceous, Turonian, Palaeobiogeography**

I. Introduction

The Bagh Group, popularly known as the Bagh Beds of the Upper Cretaceous age, is exposed along the Narmada valley at various places in western-central India. The isolated exposures of the Bagh Group are found in the vicinity of the Narmada Valley extending from Bilthana, Rajpipla area (Gujarat) in the west to about 300 km away Barwaha in Khargone District (M.P.) in the east (Kennedy et al., 2003) "fig.1".

In most of the areas, the Bagh Group of rocks rest along an angular unconformity above the Precambrian basement rocks and in turn, are overlain by the Deccan Trap Volcanics.

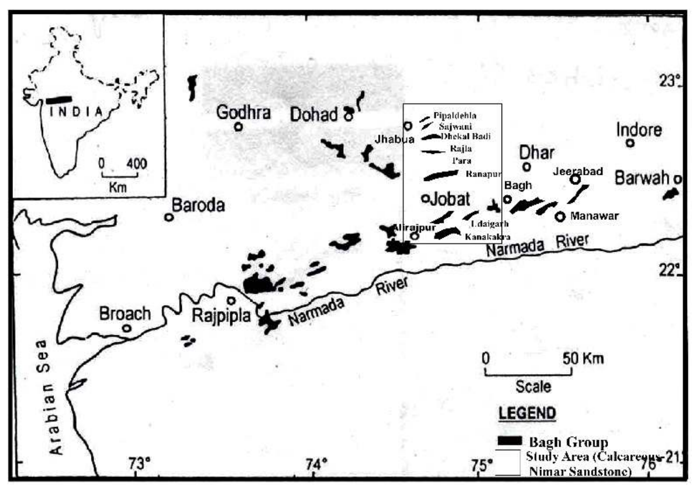

Fig. 1. Outcrops of the Bagh Group along Narmada River Valley (modified after Kundal and Sanganwar, 2000).

The Bagh Group of rocks, characterized by thick siliciclastic and calcareous sediments, were deposited during the Late Cretaceous global sea-level rise in a shallow epicontinental sea or an embayment. This sea invaded the western and central parts of India from the west along the Narmada Valley (Singh, 1981; Singh and Srivastava, 1981; Saha et al., 2010; Jaitly and Ajane, 2013; Bhattacharya et al., 2020). Earlier, Sahni (1983) also proposed a 'Trans Deccan Straits' which followed the Narmada as well as the Godavari rift zones. Recently, Kumari et al., (2020) and Keller et al., (2021) reiterated two marine seaways that might have joined through the Narmada-Tapti and Krishna Godavari rifts forming a Trans India Seaway which was formerly proposed by Sahni 1983). The Bagh Group comprises three formations, which in ascending order are: (i) Nimar

Sandstone, (ii) Nodular Limestone, and (iii) Coralline Limestone (Tripathi, 2006; Jaitly and Ajane, 2013).

The proposed study area of Bagh Group in Narmada Valley constitutes a lower lithological unit i.e. Nimar Sandstone Formation (upper calcareous unit) deposited during marine transgression. The Nimar Sandstone can be separated into two groups based on lithological characteristics: the lower Nimar Sandstone (lNS) and the upper Nimar Sandstone (uNS).

The Nimar Sandstone Formation (Cenomanian), bears signatures of the contemporary global sea level rise in west-central India (Jha et al., 2017). The Bagh Group exhibits clear signs of the Late Cretaceous marine transgression that are well supported by a variety of proxies, including sedimentary attributes, micro and mega palaeontological data, palaeobotanical data, and ichnological data(Murty et al., 1963; Chiplonkar and Ghare, 1975; Raiverman, 1975; Badve and Ghare, 1980; Singh and Srivastava, 1981; Jafar, 1982; Bose and Das, 1986; Ganguly and Bardhan, 1993; Sanganwar and Kundal, 1997; Khosla et al., 2003; Smith, 2010; Jaitly and Ajane, 2013; Bhattacharya and Jha, 2014; Jha et al., 2017; Bansal et al., 2019).

The Bagh Group rocks have been widely separated into the following three major regions based on the difference, which the detached members of these marine formations so clearly display.

Eastern exposure: These extend almost uninterrupted from Barwaha through Man Valley (Jeerabad) and Bagh in Madhya Pradesh.

Central exposure: The exposure of Nimar Sandstone is present in Jhabua and Alirajpur districts, Madhya Pradesh, which is the central part of the Bagh group. Here the Nimar Sandstone can be separated into two groups based on lithological characteristics: the lower Nimar Sandstone (lNS) and the upper Nimar Sandstone (uNS) “Fig. 2”. Lower Nimar Sandstone consists of mainly conglomerate, sandstone, and carbonaceous clay which is a freshwater environment and is devoid of fossils. Upper Nimar Sandstone consists of calcareous sandstone, a shallow marine environment consisting of marine fossils like Ostracods, Foraminifers, Algae, Bivalves, Ichnofossils, etc.

Western exposure: These extend west of Alirajpur through Kawant up to Rajpipla in Broach District, Gujarat. The "Nimars" continue to occur here with increasing thickness and fossils become rare.

It has been reported that the marine exposures in the eastern and central part of the Narmada Valley are significantly different from those in the western part of the river valley in terms of lithology.

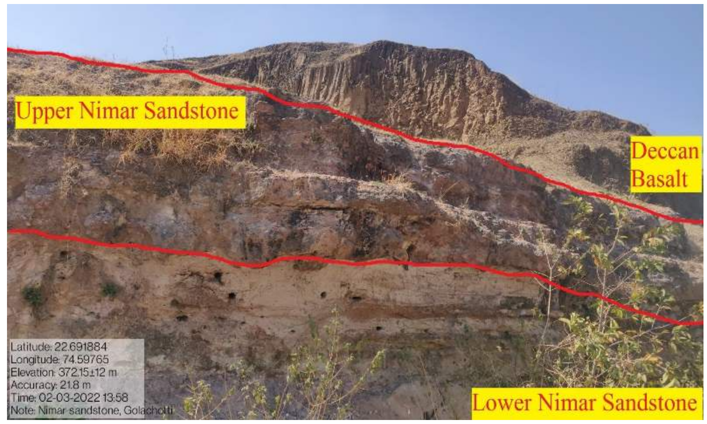

Fig. 2. Field photograph of Sajwani (Gola Chhoti) locality, Jhabua district, Madhya Pradesh

II. STRATIGRAPHY

The first generalized stratigraphic succession was given by Blanford (1869) from Chirakhan. Bose (1884) resurveyed the area and gave a more detailed stratigraphic succession. With time, several modifications in the stratigraphic succession were made by various workers. Rode and Chiplonkar (1935) made some changes to that proposed by Bose (1884). They divided the Coralline Limestone into the lower and the upper units, separated by the Deola Chirakhan Marl.

The Bagh Group comprises three formations, which in ascending order are: (i) Nimar Sandstone, (ii) Nodular Limestone, and (iii) Coralline Limestone (Tripathi, 2006; Jaitly and Ajane, 2013). Later, the dispute on the proper status of the Deola Chirakhan Marl was discussed and fixed by Jaitly and Ajane (2013), who delineated a threefold classification of the Bagh Group “Table I”.

Table I.Generalized lithostratigraphy of the Bagh Group (after Jaitly and Ajane, 2013)

	Age	Group	Formation	Member
Late Cretaceous	Maastrichtian	Deccan Trap		
		Lameta Group		
	Coniacian	Bagh	Coralline Limestone	
	Turonian		Nodular Limestone	Chirakhan
				Karondia
	Cenomanian		Nimar Sandstone	
Unconformity/fault				
Precambrian Gneisses, Granodiorites, and crystalline rocks of Bijawar Supergroup				

Recently Saha and Shukla (2022), based on lithofacies and trace fossil characters, subdivided Nimar Sandstone into ferruginous sandstone in the lower part as the lower Nimar Sandstone (lNS) and calcareous sandstone as the upper Nimar Sandstone (uNS) in the upper part.

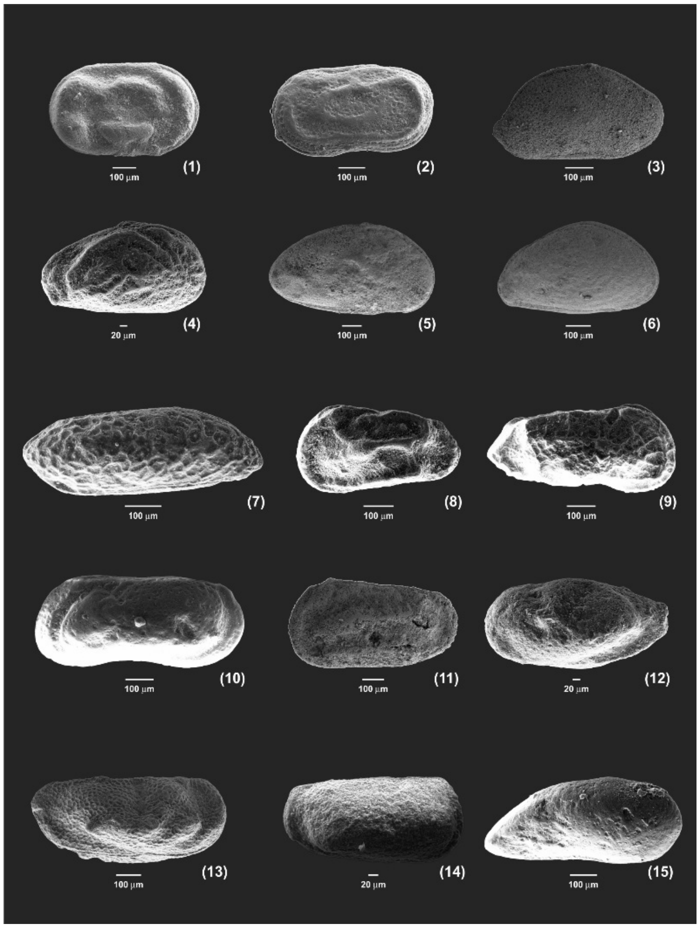

Plate I **1.***Cytherelloidea raoi* Jain, SUGDMF No.1473. A right valve, lateral view, scale bar -100 µm;**2.***Cytherelloideathuatiensis* Jain, SUGDMF No. 1474. A complete carapace, left valve view, scale bar - 100 µm; **3.** *Bairdoppilata* sp., SUGDMF No.1460. A complete carapace, right valve view, scale bar -100 µm; **4.** *Perissocytheridea batei* (Jain), SUGDMF No. 1475. A female carapace, right valve view, scale bar -20 µm; **5.** *Ovocytheridea baghensis* Chaudhary and Nagori, SUGDMF No.1476. A complete carapace, right valve view, scale bar - 100 µm; **6.***Rostrocytheridea jaisalmerensis* Singh, SUGDMF No.1477. A complete carapace, right valve view, scale bar -100 µm; **7.** *Neocytherideis reymenti*Jain,SUGDMF No.1478. A complete carapace, right valve view, scale bar -100 µm; **8.** *Haughtonileberis derooi* (Jain),SUGDMF No.1479. A complete carapace, left valve view, scale bar -100 µm; **9.** *Haughtonileberis thuatiensis* (Jain), SUGDMF No.1480. A complete carapace, right valve view, scale bar -100 µm; **10.***Makatinella thuatiensis* Jain, SUGDMF No.1481. A complete carapace, left valve view, scale bar -100 µm; **11.***Veeniacythereis raoi* (Jain), SUGDMF No.1471. A complete carapace, left valve view, scale bar -100 µm; **12.** *Cytheropteron hanumanpuraensis* Chaudhary and Nagori,SUGDMF No.1482. A complete carapace, left valve view, scale bar -20 µm; **13.** *Bythoceratina tewarii* (Jain), SUGDMF No.1483. A complete carapace, right valve view, scale bar -100 µm; **14.** *Microceratina ratitalaiensis* (Chaudhary and Nagori), SUGDMF No.1484. A complete carapace, right valve view, scale bar -20 µm; **15.** *Paracypris auctocaudata* Rosenfeld, SUGDMF No.1485. A complete carapace, right valve view, scale bar -100 µm.

III. AGE

The age of the Bagh Group of the Narmada Valley is based on different faunal groups viz. Ammonites, echinoids, bivalves, algae, foraminifers, ostracods, nanoplanktons, and bryozoans. Ammonites in the collection of Bose (1884) were studied by Vredenburg (1907), who assigned a Cenomanian age to them.

According to Dassarma and Sinha (1975), in the western part of the Narmada Valley, i.e., in the Kawant area, three genera of placenticeratids occur in the Oyster Bed, along with four species of Coilopoceras. Coilopoceras makes its appearance first in the Oyster Bed of Kawant and shows a stage of development indicating a Pre-Coniacian age, and the species ranges from Aptian to Maastrichtian. Coilopceras is absent in the eastern part of the river valley. The age of the Bagh Group was originally assigned as Turonian–Coniacian based on the ammonoid Placenticeratids (Chiplonkar and Ghare, 1976).

Based on ammonite and inoceramid evidence, Kennedy et al., (2003) dated the Bagh Group as Late Turonian to Coniacian. Based on placenteritid ammonites. Chiplonkar, et al., (1977) assigned a Coniacian-Turonian age to the Nodular Limestone, Coralline Limestone, and Albian–Cenomanian age to the basal Nimar Sandstone.Jaitly and Ajane (2013) predicted a Turonian age for the Nodular Limestone while examining *placenticeras mintoi* (Vredenberg, 1907). Kennedy et al., (2003) recorded *Prionocyclus germeri*, an index of the Late Turonian from the middle part of the Nodular Limestone. The report of *Barroisiceras onilahyense* from the overlying Coralline Limestone helps in placing this unit in the Coniancian (Gangopadhyay and Bardhan, 2000; Jaitly and Ajane, 2013).

Foraminifers from the calcareous top portion of the Nimar Sandstone from Pipaldehla, Jhabua District first time reported byNayak (1987), who reported *Lenticulina exarata var. anubiana, Ticinella albiana, Ticinella coronae, and Hedbergella amabilis* assigned Albian-Cenomanian age to the calcareous Nimar Sandstone. Rajshekhar (1987; 1991) reported species of foraminifera from the same locality of Jhabua district assigned a Turonian age. In (1995) he observed that most of the members of the foraminiferal community are long-ranging with the dominance of Turonian components. Very recently Keller et al. (2021) while dealing with OAE2 deposition in the western Narmada Basin reported planktic foraminifers viz. *Whitenella baltica, Whitenella archaeocretacea. Whitenella brittonensis, Dicarinella hagni, Dicarinella imbricata, Muricohedbergella delrioensis, Muricohedbergella hoelzli, Muricohedbergella simplex, Planohetrohelix, Hetrohelixmurico hedbergella* from Late Cenomanian-Early Turonian beds and following ostracods species viz. *Amicytheridea bilthanensis, Rostrocytheridea* *jaisalmerensis, Rostrocytheridea divergens, Haughtonileberis thuatiensis, Paracypris jaini, Sapucariella cf. subtriangulata, Cytherella okadai, Paijenborchella jeerabadensis* from Late Cenomanian-Early Turonian beds of Biltahna and Bhundmariya localities of Gujarat.

Badve and Nayak (1983) reported five new species of the algal genus *Halimeda*, and in (1984b), they reported six species of Dasycladacean algae found at the top of the Nimar Sandstone in the Jhabua district. Sanganwar and Kundal (1996) later recorded ten species of melobesioideancalcareous algae from the calcareous top of Nimar Sandstone exposed at Pipaldehla, Jhabua District. The above algal assemblages were found in association with cynophycean, coralline, halimedian, and dasycladacean algae, suggesting that they were deposited at a depth of 10-12 meters below low tide level in tropical regions. Kundal and Sanganwar (1998a) conducted a more comprehensive study that reported 72 algae species from the calcareous top of the Nimar Sandstone Formation at Pipaldehla in the Jhabua District of Madhya Pradesh. These algae belong to 26 genera of Cyanophyta, Rhodophyta, and Chloraphyta. The overall algal assemblages suggest a Cenomanian-Turonian age, with sediments deposited in tropical waters at a depth of 10-12 meters below low tide level. The setting was moderate energy with moderate turbulence, and the water had normal salinity levels.

The pelecypod fauna indicates an Aptian to Senonian age (Chiplonkar 1939b), while Chiplonkar and Badve (1976) interpreted pelecypod affinities with species from Turonian and Coniacian of Europe. Chiplonkar (1982) based on inoceramids and ostriids assigned a Cenomanian to Turonian age. Badve and Nayak (1984a) reported the discovery of two new genera, *Striomodiolus* and *Jhabotrigonia* while working on the calcareous top of the Nimar Sandstone from Jhabua District. These genera are believed to be of Cenomanian-Turonian age.Nayak (2000)based on a bivalve study assigned the Cenomanian-Turonian age for the Nimar Sandstone of the Jhabua District.

The studies on the echinoids of the Bagh Group were carried out by Duncan (1865), Fourteau (1918), Chiplonkar (1937, 1939a), Dassarma and Sinha (1975), and Srivastava et al., (2011), indicate a late Albian–Cenomanian– Campanian age for the Bagh sediments.

Chiplonkar, who has pioneered and done taxonomic studies on most of the invertebrate groups and ichnofossils, preferred a Cenomanian age for the Bagh Group of rocks in his early studies (Chiplonkar 1937, 1938, 1939a, b, c, 1941).After further research, in collaboration with his co-researchers, he observed that the deposition age should be between the Albian and the Turonian (Chiplonkar, 1987).Recently Shaha and Shukla (2022), based on ichno assemblage assigned Cenomanian age for Nimar Sandstone.

Jafar (1982), based on calcareous nannoplankton assemblage, assigned a Turonian age to the upper calcareous part of the formation. Most other types of fossils indicate a broad affinity to faunas from the Cenomanian-Turonian.

Based on ostracods Jain (1961, 1975); Chaudhary (2017); Chaudhary et al., (2017a, b, 2019), Chaudhary and Nagori (2019) and Keller et al., (2021) concluded that an age ranging from late Cenomanian to Coniacian for the deposition of Bagh sediments. However, our findings indicate an Early Turonian age based on the ostracods found in the upper calcareous Nimar Sandstone.

Fig. 3. Field photograph showing calcareous Nimar Sandstone at Dhekal Badi

Fig. 4. Field photograph showing calcareous Nimar Sandstone at Tikadi Moti village

IV. PALAEOENVIRONMENT AND PALAEOGEOGRAPHIC IMPLICATIONS

To better understand the formation of the Indian Shield from the supercontinent Pangaea, it is important to study the sequence of tectonic events that led to its final carving. This can also shed light on the possibility of the sea deeply penetrating the area during the Turonian and Late Maastrichtian-Danian periods.

During the early Jurassic period (around 185 million years ago), the Proto-Indian Ocean was formed as a result of extensive volcanism in East Africa, Antarctica, and Madagascar, along with the rifting of Madagascar-Seychelles-India-Australia-New Zealand. During the Early Cretaceous period, around 145 million years ago, rifting occurred which led to the formation of the eastern Indian Ocean, including aulacogens and triple junctions at the marginal basins of Cauvery, Palar, Krishna-Godavari, and Mahanadi due to Rajmahal volcanism (Jafar, 1996, 2016a, b). It should be noted that Madagascar, which was once connected to Africa and India, has now moved to its current position. Over time, the Indian Ocean grew and caused further separation of Australia–New Zealand from Antarctica (Albian ca.105 Ma ago). One of the most significant plate tectonic events occurred when India-Seychelles broke away from Madagascar. This event also caused a sub-aerial Large Igneous Province (LIP) to occur around 93.9 million years ago, according to the latest radiometric dating of Mahajanga Flood basalts in Madagascar by Cucciniello et al., (2021). This event is closely connected with the Early Turonian age (around 93.9 million years ago) and the deep sea incursion (>300 km) along the Narmada lineament.

In addition to other events, there was only one other intrusion of the deep sea on the Indian shield. This occurred due to the Réunion hotspot-induced eruption of the Deccan Flood Basalt (LIP 66 Ma) during the Late Maastrichtian-Danian period. This volcanic activity covered an area of 500,000 square kilometers in the Indian Shield, and it gained worldwide attention for its exceptionally well-preserved fossil fauna and flora. These fossils were found in intertrappean lacustrine sediments that span the Cretaceous/Pg boundary (Jafar, 2016a, b; Khosla & Verma, 2015). No other evidence of deep sea incursion via the Narmada lineament or Krishna-Godavari lineament has been found, except along the Lesser Himalayan Subathu-Dogadda lineament. This region contains evidence of Late Maastrichtian-Danian fossils, including rich calcareous nannofossils. This information has been documented in several studies, such as Jafar & Kapoor (1988), Jafar & Singh (1992), Mathur et al. (2008), and Thakur et al. (2013).

The upper calcareous part of the Nimar Sandstone Formation has yielded fifty ostracod species belonging to twenty-six genera. Ostracods are mostly benthic organisms lacking pelagic larvae and having poor dispersal properties. Babinot & Colin (1988) put forward the interpretation that a too-deep central Tethys ocean, and also unfavourable currents, could be probable causes of reduced north-south migrations between the northern and southern Tethys rims. The palaeogeography and palaeoecology have been discussed based on ostracods in the present work.

During the early Albian period, around 105 million years ago, several palaeogeographical and palaeoceanographical changes occurred, including the opening of pole change. This change probably caused the formation of deep water passages along the Falkland Plateau-Southern Africa fracture zone. As a result, oxygenated waters were able to flush the previously dysaerobic temperate South Atlantic, which led to the emergence of new species and their rapid distribution in the Albian period along the Southern margins of Gondwana (Ballent and Whatley, 2006). At the same time, some old or original element of the South Gondwana fauna such as *Rostrocytheridea* made their way to Madagascar, India, New Zealand, and Australia. During the latest Jurassic-Berriasian, the opening of a shallow intermittent epicontinental seaway between southern South Africa and Southern Argentinian Patagonia favoured faunal interchange.

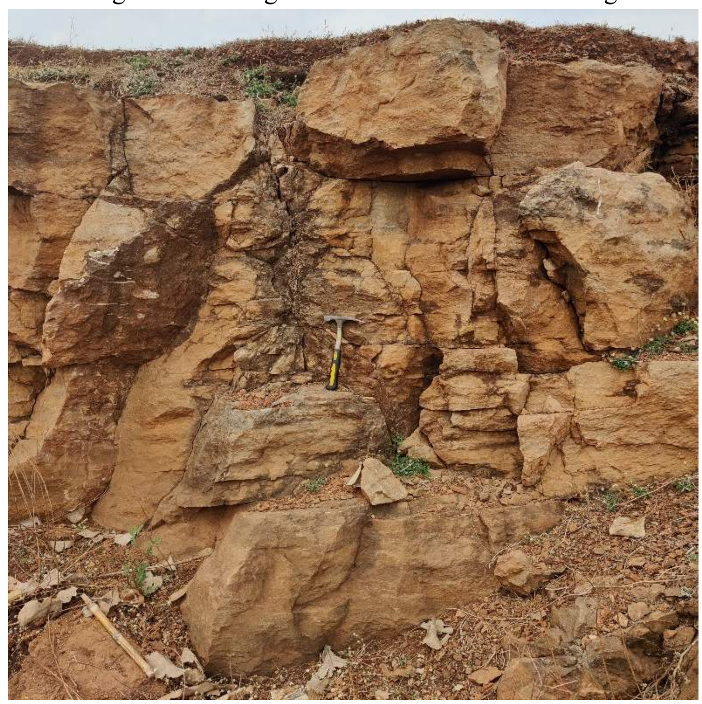

Fig. 5. Field photograph showing calcareous Nimar Sandstone, Pipaldehla, Jhabua district

According to Ballent and Whatley (2007), the distribution of the *Rostrocytheridea* genus is limited to Gondwanan regions. Dingle (2009) identified one species of this genus, *Rostrocytheridea pukehouensis*, which was found in the cool outer shelf/upper slope of Pukehou during the latest Maastrichtian period in New Zealand. In India, *Rostrocytheridea* was found in the Albian-Turonian of Jaisalmer Basin (Singh, 1997; Andreu et al., 2007), while in the Narmada Basin, it appeared during the late Cenomanian period up to Coniacian and was represented by six species (Chaudhary et al., 2019). According to the available records, *Rostrocytheridea* was an opportunistic, retrothermal organism that existed in both cool and warm, normal salinity and shallow water environments. This is evident from the studies conducted by Ballent and Whately (2007), and Dingle (2009).

Furthermore, the presence of *Rostrocytheridea* in the Antarctic, which is typically a tropical region, and the co-occurrence of the thermophile *Cytherelloidea* Alexander, once again support the notion of warm climates in high-latitude regions during the late Cretaceous period. In the Bagh Basin, most of the *Cytherelloidea* species are endemic. However, the discovery of *Cytherelloidea oudiapurensis* Jain 1975b, which bears resemblance to *Cytherelloidea* sp. 1 described by Rosenfeld and Raab in 1974 from the Judea Group (upper Cenomanian) of Israel, suggests the migration of at least a few species from one basin to another via shallow sea routes.

The *Bairdoppilata* can be found in various aquatic environments, ranging from very shallow to very deep waters (Morkhoven, 1963; Maddocks, 1969), although they tend towards greater abundance in warm and shallow carbonate environments (Kornickor, 1961; Horne, 2005). *Bairdoppilata* also occurs at depths that vary between 100 and 1000 m (Maddock, 2015).

Fig. 6. Field photograph showing calcareous Nimar Sandstone at Ranapur

Benson (1975) also notes that blind ostracods tend to live at depths below 800 m, though there are exceptions, such as species of the genera *Semicytherura*, *Cytherelloidea*, *Neocythere*, *Haughtonileberis*, *Perissocytheridea*, which are known to inhabit shallow marine environments. According to Rosenfeld and Raab (1984), the mix of deep and shallow water ostracods could be indicative of a transitional environment between the continental platform and the slope.

According to Dingle (1984, 1996), the genus *Makatinella* was considered to be endemic to the Aptian to Cenomanian marine deposits of South Africa. However, Andreu et al. (2007) discovered species of the genus in the Turonian period of the Jaisalmer Basin in northwestern India. More recently, Chaudhary (2017) reported three species of *Makatinella* – *Makatinella bilthanaensis*, *Makatinella punctata*, and *Makatinella thuatiensis* (Jain) - from the Bagh Group.

Paracypris is a genus that exclusively lives in marine environments. It is commonly found in depths ranging from infraneritic to bathyal (Morkhoven, 1963). According to Babinot and Colin (1983), *Paracypris* usually inhabits external carbonate platform environments. Andreu (1991) has observed this genus in both restricted littoral and open ocean contexts.

Fig. 7. Close-up view of calcareous Nimar Sandstone, Sajwani (Gola Chhoti)

Nigeroloxoconcha is a commonly found genus in South Tethyan faunas, which are primarily located in Africa and South America. It appears in the Aptian of Morocco and evolves from the Albian to Miocene in Morocco, Algeria, Tunisia, Gabon, Niger, Ivory Coast, Nigeria, Egypt, and Libya (Viviers et al., 2000). There are also known species of *Nigeroloxoconcha* in Brazil from the Cenomanian-Santonian period, as reported by Piovesan et al. (2013). Andreu et al., (2007) reported *Nigeroloxoconcha* sp. from the Turonian of Jaisalmer Basin. Chaudhry and Nagori (2019) also reported two species of the genus from the Bagh Group of Madhya Pradesh, India.

The genus *Cytheropteron* suggests deep marine environments (Oertli, 1972; Joy and Clark, 1977; Rosenfeld and Bein, 1978; Dingle, 1980; Zaho et al., 2000).

Morsi and Wendler, 2010 observed that many of the elements recorded in Jordan are also known from different North African and Middle East countries. The different species of *Bairdoppilata*, *Paracypris*, (?) *Monoceratina,* and *Veeniacythereis,* which are widely distributed in the marine Cenomanian sediments along the Southern Tethys.

Species of *Neonesidea* are typically found in shallow waters, typically less than 100 meters deep. They are characteristic members of epifaunal assemblages on marine algae, grasses, sponges, and to a lesser extent, dentrial accumulations and associated sandy sediments. They are particularly abundant in reef and platform habitats, primarily below low tide levels. This genus can be found all over the world, with a predominant presence in tropical and subtropical regions (Morknoven, 1963).

In the Cenomanian-Turonian period, the genus *Neocytherideis* was commonly found in Europe and North America but is rarer in North Africa and the Middle East. Recent species of the genus *Neocytherideis* inhabit epi-neritic environments (Morknoven, 1963).

Fig. 8. Field photograph of calcareous Nimar Sandstone (Bagh Group), Udaigarh (Kanas)

The genus *Amphicytherura* is found in both Laurasia and Gondwana, specifically in the Albian-Campanian of North America and the Gulf Coast (Crane 1965; Moysey and Maddocks 1982). In Europe, in the Hauterivian of Germany (*Amphicytherura arcuata* Luppold 2001) and the Cenomanian of France (*Amphicytherura berbiguierensis* Colin 1974, *Amphicytherura falloti* Donze and Thomel, 1972); from the Portlandian to the Cenomanian in East Gondwana: Morocco, Algeria, Tunisia, South Africa, Israel, Mozambique (Babinot and Colin, 1988; Andreu, 1991), and in the Albian-Cenomanien of West Africa and Brazil. *Amphicytherura* aff. A. *yakhiniensis* Rosenfeld 1974 (Rosenfeld and Raab, 1974), from the Coniacian, is morphologically close to *Amphicytherura* (*Sondagella*) *gigantodistincta* Andreu (1991) from the Aptian-Cenomanian of Morocco, and probably to *Fissocarinocythere*? *hexagona* Singh 1997 from the Cenomanian of the Jaisalmer Basin.

The genus *Perissocytheridea* is commonly found in mixohaline, marginal marine environments in large numbers (Colin et. al 1996, Tibert et al., 2003, 2003; Morsi and Wendler, 2010). In contrast, *Perissocytheridea istriana* species have been interpreted as reflecting fresh-water influence (Bartov et al. 1980; Rosenfeld et al. 1988; Flexer et al. 1989; Bauer et al. 2003). Recent species of the genus *Perissocytheridea* have been associated with sandy mud substrates in a euryhaline environment, favouring the mesohaline zone with large and quick salinity changes (Keyser 1977).

The species of *Ovocytheridea* also occur in marginal marine environments (Rosenfeld and Raab, 1974; Sahin, 1991 and El-Nady et al., 2008). The above mixohaline assemblages occur in intertidal/supratidal and lagoonal facies. *Ovocytheridea* species have been found in mid to outer-shelf environments. They are usually associated with *Cytherelloidea*, *Paracypris*, *Bairdoppilata*, and *Parakrithe*. Piovesan (2008) and Gebhardt (1999b) discovered this genus in both the shelf and upper bathyal environments.

The species of the genus *Microceratina* inhabit different depths, between 20 and 750 m (Mazzini and Gliozzi, 2000; Namiotko et al., 2004).

Babinot, (1995) reported species of the genus *Bythoceratina* from lagoons/shallow to open marine environments of the Tethys Sea.

According to Gebhardt, (1999a)genus *Soudanella semicostellata* has been found in the upper bathyal environment in the Upper Cretaceous of Nigeria.

The late Cretaceous records of *Rostrocytheridea* and ostracod genera reveal clear links between Western Australia, Argentina, the Antarctic Peninsula, South Africa, Madagascar, and India. The Cenomanian-Turonian species were commonly found in the Jaisalmer Basin, Narmada Basin (Bagh Group), and the southern margin of the Tethys. These findings enable us to establish a link between the Jaisalmer Basin, West Rajasthan shelf, and Narmada Basin to the "North African-Middle East paleobiogeographical province" that was established during the early Cretaceous period and extended to the South-Tethyan margin in the Cenomanian, as defined by Andreu (1993), or to the South Tethyan ostracod province proposed by Luger (2003). Andreu et al., (2007) named it a new province - the Cenomanian-Turonian "South Tethyan ostracod province" - which incorporates the North African, Middle East Province, India, Madagascar, South Africa, and South America.

In the early Turonian period, just after the Oceanic Anoxic Event 2 (OAE2), there was a decrease in taxonomic diversity. However, the level of oxygenation and paleoproductivity increased along with the supply of nutrients. As a result, the water became hypoxic in outer ramp environments that spread over the entire platform. Additionally, the climate became hot and humid (Andreu et al., 2013).

During the late Cenomanian-Early Turonian period, there was easy communication between the carbonate platforms of the Kawant-Bilthana region and the Jhabua and Bagh-Jeerabad regions. The number of ostracod species common to both areas ranged from five to eleven respectively.

Conclusion

The age and palaeoenvironment of the sediments of the Bagh Group with emphasis on the upper calcareous part of Nimar Sandstone of the Bagh Group are discussed based on ostracods and other faunal assemblages. The overall ostracod assemblages indicate an early Turonian age. The most dominant ostracod genera recorded are *Neocytheredeis*, *Bairdoppilata*, *Rostrocytheridea*, *Haughtonileberis,* *Perissocytheridea*, *Paracypris*, *Makatinella,* etc. Further palaeogeographic implications have been discussed based on genera *Rostrocytheridea*, *Bairdoppilata*, *Cytherelloidea*, *Makatinella*, *Ovocytheridea*, *Perissocytheridea*, *Nigeroloxoconcha*, *Paracypris*, *Semicytherura*, *Neocythere,* *Haughtonileberis,* *Cytheropteron*, *Neonesidea*, *Neocytherideis*, *Parakrithe*, *Microceratina*, and *Bythoceratina*. All the above genera are exclusively marine form and inhabit epi-neritic to mixohaline environments. The above mixohaline assemblages occur in intertidal/supratidal and lagoonal facies.

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