BIOSTRATIGRAPHY OF CHORGALI FORMATION, JHALAR AREA, KALA CHITTA RANGE, NORTHERN PAKISTAN

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ABSTRACT: *Chorgali Formation is hydrocarbon producing rock in Kohat-Potwar area. The well exposed section of Chorgali Formation at Jhalar Railway station in the Kala Chitta Range was measured and sampled for biostratigraphic study. The total thickness of Chorgali Formation at Jhalar railway station is 17.7 meter where it overlies the Margala Hill Limestone and underlies the Kuldana Formation. 12 samples were collected and 35 thin sections were prepared for biostratigraphic studies to calculate the exact age of Chorgali Formation according to Modern Shallow Benthic Biozones. Total 8 species of larger foraminifera were recorded including* Alveolina Indicatrix Hottinger 1960 **[1]** *and* Nummulites djodjokartae Martin 1881 [2] *(reported first time from Chorgali Formation of this area). According to modern shallow benthic biozones, the exact age assigned to Chorgali Formation is SBZ-9 (Upper Ilerdian).*

***Key Words**: Chorgali, Jhalar, Kala Chitta, Shallow benthic Biozones SBZ, Kohat-Potowar, Alveolina, Nummulites*

INTRODUCTION:

Paleocene-Eocene rocks are major source of hydrocarbon in Kohat- Potwar Basin, northern Pakistan. Paleocene-Eocene rocks are exposed in Salt Range, Khair-e-Murat Range, Kala Chitta Range and Hazara area. Chorgali Formation is one of the most important rocks of Eocene age having hydrocarbon potential. Chorgali Formation acts as reservoir rock in some major oil fields of Kohat-Potwar area.

Jhalar section situated adjacent to Jhalar railway station in Kala Chitta Range (Long:33° 38′ 01.61 N, Lat:72° 20′ 00.27 E). The Kala Chitta Range forms the northern edge of Potwar Basin (fig-1) and is in alignment with the Hazara Mountains in the east (more commonly merging into Margala Hills) and the Samana Range towards west. The eastern limit of Kala Chitta range ends approximately six kilometers of Sangjani village. The total thickness of Chorgali Formation at this section is 17.7 meters. The base is highly fossiliferrous, the middle and upper part consists of flaggy limestone and shale (fig-2).

Davies and Pinfold [3] worked on a sequence of alternate flaggy limestone and shale beds, at the top compact limestone in central Salt Range and gave them the name as "Bhadrar beds". Before this, same carbonate rocks were studied by Pascoe [4] in the Khair-e-Murat range and he used the name "Chorgali beds" which was taken from the Chorgali pass in the Khair-e-Murat range, Attock district of Punjab province. In Fatmi [5] the Stratigraphic Committee of Pakistan formalized the name "Chorgali beds" of Pascoe [4] as Chorgali Formation and extended it to the Salt Range and other parts of Kohat-Potwar area. Pinfold [6], declared the same sequence as "Passage beds" in Attock area. Gee [7], gave the name as "Bhadrar beds" in the Salt Range. The name, Lora Formation was given by Latif [8], to the same sequence in the Hazara area.

A rich fossil assemblage, including foraminifers, mollusks and ostracods, has been discussed by Davies and Pinfold [3]. Gee's description, 1932, in Gill [10] is that "on the Salt Range Platform, the Hill Limestone are overlain by 15 to 25 m thick of fine green shales and thin limestone with numerous foraminifera. Cotter [11] described these beds as 'passage beds' consisting of argillaceous limestone, marl and shales, sometimes 6 m thick or so, overlyingthe "massive Hill limestone". Davies and Pinfold [3] recorded some foraminifera from the Bhadrar beds in central Salt Range. Detailed work of Gill [10] on faceis and fauna in Bhadrar beds, presently designated as Chorgali Formation, of Salt Range, give only some brief descriptions of this rock unit. This was the first detailed field studies of this rock unit, in the Salt Range area, which was carried out by the same worker [10]. According to his findings "the upper layers of the Sakesar Limestone (Early Eocene) of the western and central Salt Range pass eastward into the lower Bhadrar shales, which shows an approach to the margin of the basin of deposition". He further [10] divided Bhadrar beds into two parts upper Bhadrar and lower Bhadrar. Upper Bhadrar represents mostly *Alveolina* facies with compact limestone with an increasing element of argillaceous, dolomitic limestone in the west; and was probably deposited in lagoons. The lower Bhadrar beds, in contrast, constitute shale facies in the east with westerly increase of calcareous rocks. He concluded that the lower Bhadrar shales, form a distinct lithological and faunal unit in the eastern Salt Range. According to him [10] "the point of deposition the easterly development of shale facies probably relates to an approach to the edge of the basin of deposition with shallower water and more land derived detritus".

According to Wells [12],"Chorgali Formation comprises near shore deposits of Early Eocene age and shows a single regression late in the Early Eocene that left the land dry during Middle Eocene".

On the basis of the detailed study of the Chorgali Formation at its type locality (Chorgali Pass in Khair-e-Murat Range), Jurgan *et al* [13] suggested to " use the term Chorgali Formation for the lower 80-90 m thick thin bedded dolomite sequence, and to include the upper 70 m thick greenish shale within Kuldana Formation. The contact is conformable with the underlying Sakesar/Margala Hill Limestone and the overlying Kuldana Formation".

As per Jurgan *et al* [14] study, Chorgali Formation was deposited in intertidal to supratidal environments during an overall regression of the Early Eocene sea. Akhtar [15] has also concluded that the Lora Formation of the Hazara area is also a fully marine deposit, and therefore should be excluded from the Chorgali Formation. Akhtar and Butt [16]described

the stratigraphy and sedimentology of the early tertiary rocks of Kala Chitta area. Sameeni and Hottinger [17 & 18] worked in detail on Chorgali Formation in the central Salt Range to assign the exact age of Chorgali Formation. On the basis of its micropaleontological studies, Sameeni declared its age SBZ-9 according to Modern Shallow Benthic Biozones (SBZ). This was the first study which involves the detailed taxonomic study of the Alveolinids and their biostratigraphic significance. According to that Shallow Benthic Biozonation (SBZ) were established from SBZ-5 to SBZ-9 for the Eocene succession of the Salt Range. Total twelve species of *Alveolinids*, including two species of *Glomalveolinids*, one new species of *Alveolina conradi* and one new sub species *Alveolina rotundata bhadrarensis* were reported.

METHODOLOGY:

Thickness of the selected section was measured for the preparation of stratigraphic column and the detail of lithology was also written along with the stratigraphic column. Rocks samples were collected from the bottom to top at equal distance. The distance between two samples was managed in such way that at least one sample was collected from each bed. Hard samples were taken from fresh outcrop with the help of geological hammer. Loose samples were also collected for the extraction of microfossils and thin sections were prepared from hard samples for micropaleontological studies.

RESULT AND DISCUSSION:

At Jhalar section, the lower contact of Chorgali Formation is with Margala Hill Limestone and the upper contact is with Kuldana Formation. The total thickness of Chorgali Formation at this section is 17.7 meter. The lithology observed is, at the base there is thick bedded, brecciated and highly fossiliferrous limestone. In the middle there are thick beds of very compact limestone having light grey colour less fossiliferrous. At the top there are alternate beds of limestone and shale which are poorly fossiliferrous. Total twelve samples were taken from this section as shown in fig-2 and thirty thin sections were prepared for micro-paleontological study.

The recorded species of Foraminifera are as follows:

- *Alveolina indicatrix* HOTTINGER, 1960**.**
- *Nummulites mamillatus* (FICHTEL & MOLL)
- *Nummulites atacicus* LEYMERIE 1846
- *Nummulites globulus* LEYMERIE 1846
- *Nummulites djodjokartae* MARTIN 1881
- *Assilina laminosa* GILL 1953
- *Assilina spinosa* DAVIES & PINFOLD 1937
- *Assilina granulosa* (d'ARCHIAC)

Systematic Paleontology:

Alveolina indicatrix HOTTINGER, 1960.
Plate-1a-c, Plate-2a, Plate-5a.
Alveolina indicatrix HOTTINGER L., 1960, p.100, pl.5,Figs 1-2, text figs 51a, b, 52.
REMARKS: This species is recorded from the lower and upper part of Chorgali Formation from the Jhalar raiway station section. The stratigraphic range of this species is SBZ-9 and questionable occurrence in upper part of SBZ-8 and lower part of SBZ-10 .

Nummulites mammilatus (FICHTEL & MOLL)
Plate-2a, Plate-3b, Plate-4b & d.
Nummulites mammilatus (FICHTEL & MOLL), NUTTAL, 1925, p. 445, pl. 27, figs. 1-3.
REMARKS: This species is recorded almost throughout Chorgali Formation from bottom to top from Jhalar station section. The stratigraphic range of this species is from SBZ-5 to SBZ-15.

Nummulites atacicus LEYMERIE 1846
Plate-5b & c.
Nummulites atacicus LEYMERIE, 1846, p.p. 358, pl. 13, fig. 13.
REMARKS: This species is recorded almost throughout Chorgali Formation from bottom to top from Jhalar railway station section. The stratigraphic range of this species is from SBZ-6 to SBZ-15

Nummulites globulus LEYMERIE 1846
Plate-3c & d.
Nummulites globulus LEYMERIE, 1846. p.359, pl. 13, Figs. 14a, 14d.
REMARKS: This species is recorded from the middle,lower and upper part of Chorgali Formation, from the Jhalar railway station sections. The stratigraphic range of this species is from SBZ-9 to SBZ-15 and questionable occurrence in upper part of SBZ-8.

Nummulites djodjokartae MARTIN, 1881
Plate -4b & c.
Nummulites djodjokartae Martin,K, 1881. Tertiaer Versteinerungen von OstlichenJave. Sammlungen des Geologischen Reichsmuseums in Leiden 1: 105-130.
REMARKS: This species is recorded in both Chorgali Pass and Jhalar station sections from the middle part of Chorgali Formation. And its stratigraphic range is from SBZ-10 to SBZ-15 and has questionable occurrence in upper part of SBZ-9.

Assilina laminosa GILL 1953
Plate-1b & d.
Assilina laminosa GILL, 1953, p. 83, pl. 13, figs. 14-17.
REMARKS: This species is recorded from the base of Chorgali Formation from Jhalar railway station sections. The stratigraphic range of this specie is SBZ-5 to SBZ-15 .

Assilina spinosa DAVIES AND PINFOLD, 1937
Plate-4d.
Assilina spinosa; DAVIES AND PINFOLD, (1937), Geol. Surv. India Mem.Palaeont.Indica New Series, Voll.24, Mem. 1, p. 31-33, pl.4, figs.11-12, 16-17
REMARKS: This species is recorded in lower part of Chorgali Formation in Jhalar railway station sections. Its geological range is SBZ-5 to SBZ-13.

Assilina granulosa **(**d'ARCHIAC)
Plate -2b, Plate-3a, Plate-4a.
*Assilina granulosa (*d'ARCHIAC) 1937.Mem. Geol. Surv. India, Pal. Indica, New Series, vol.24(1), pl.4, figs. 19-20,23-26.
REMARKS: This species is recorded from the middle and upper part of the formation from Jhalar railway station

sections and its stratigraphic range is from SBZ-5 to SBZ-13.

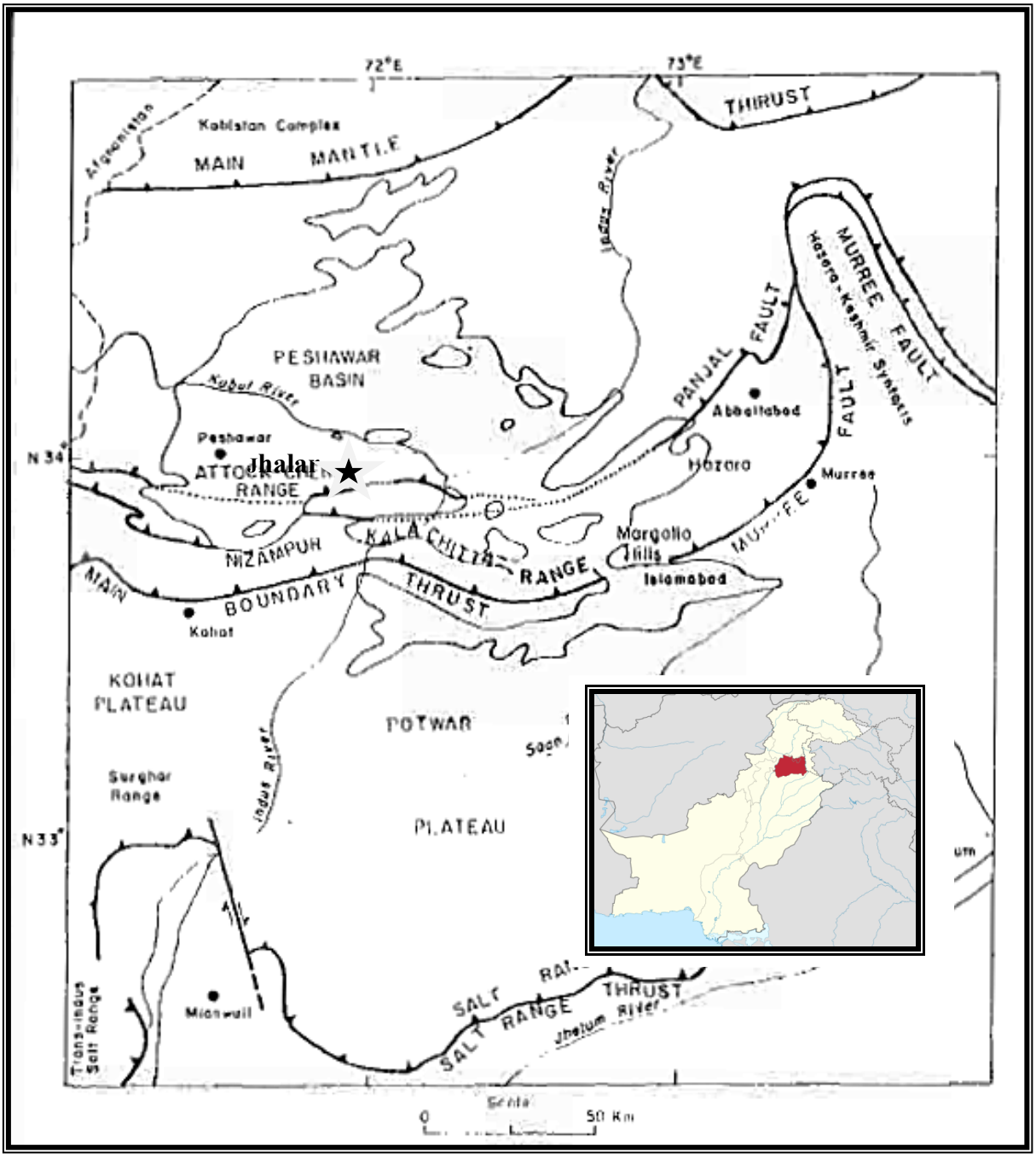

Fig. 1: Location Map of Kohat-Potowar Basin and Jhalar area

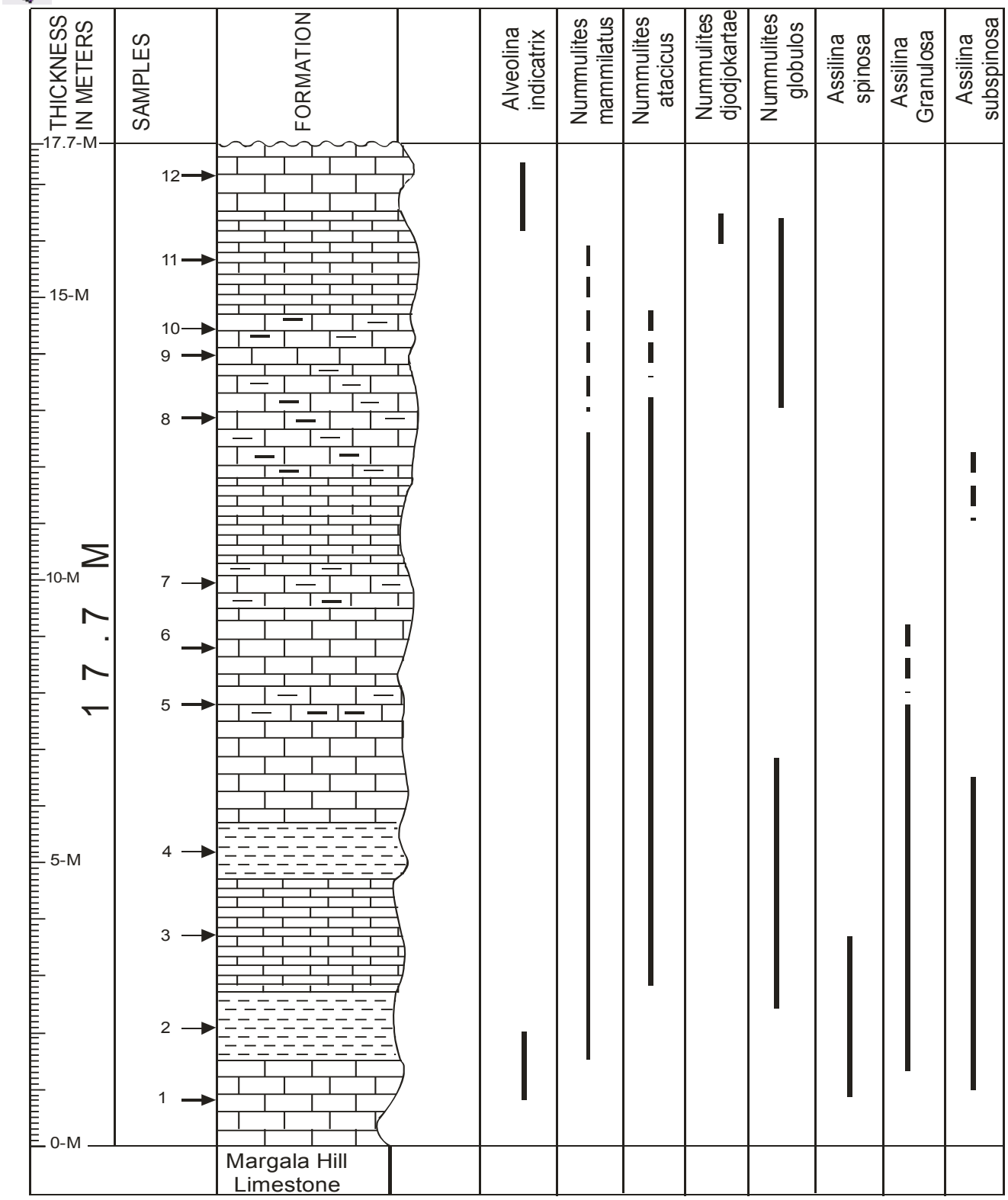

Fig. 2 Stratigraphic Column of Chorgali Fornmation Jhalar Station Section showing Foraminiferal Species recorded.

Age			Shallow Benthic Biozones (SBZ)	FORMATION
Eocene	Lutetian		SB-15	
			SB-14	
			SB- 13	
	Ypresian	Cusian	SB-12	
			SB-11	
			SB-10	Kuldana Formation
		Ilerdian	SB-9	Chorgali Formation
			SB-8	Margalla Hill Limestone
			SB-7	
			SB-6	
			SB-5	
Paleocene	Thanetian		SB-4	
			SB-3	
			SB-2	
	Danian		SB-1	

Fig. 4 Stratigraphic Position of Chorgali Formation according to SB Zones

PLATE-1

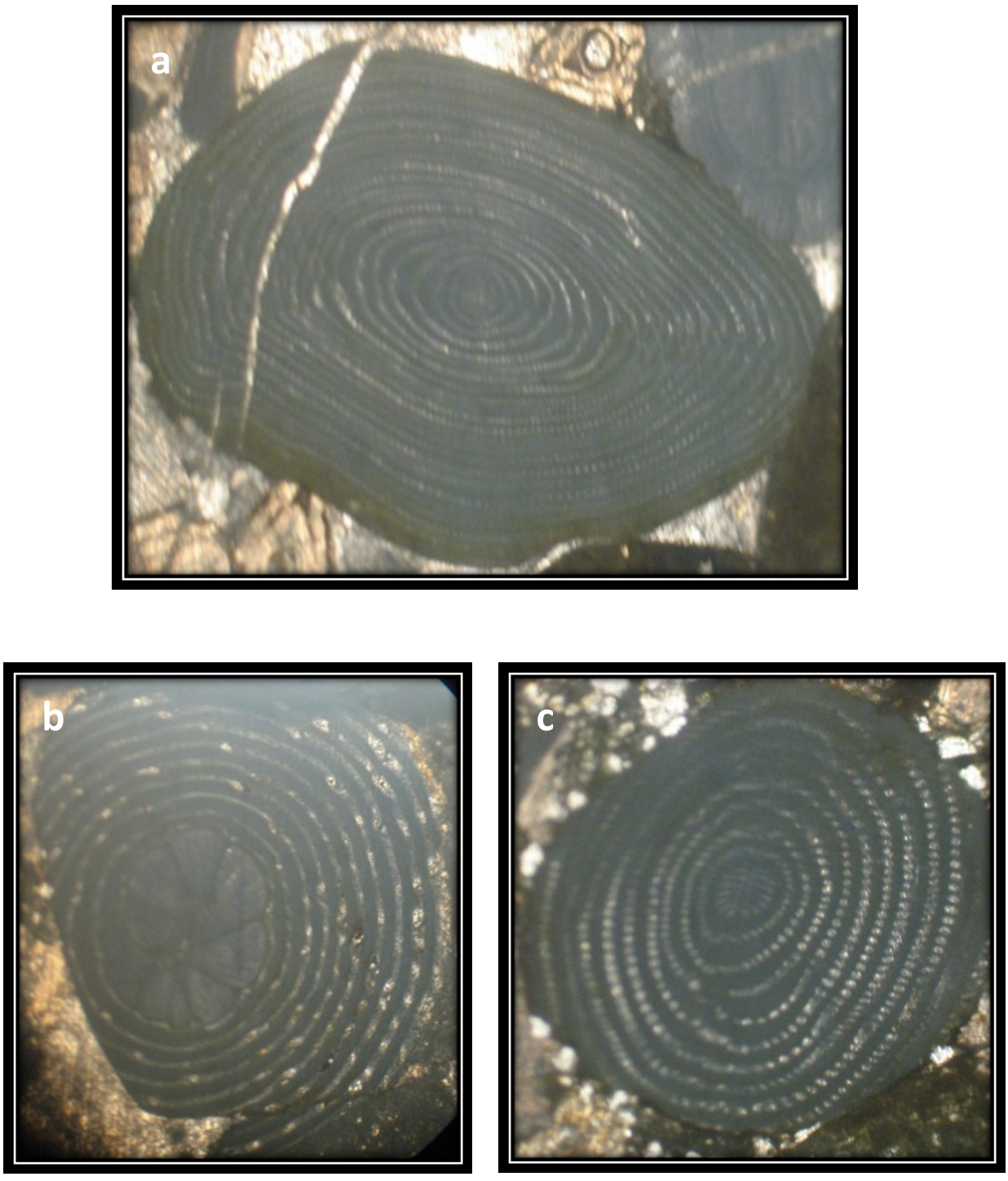

Fig. a-c: *Alveolina indicatrix* Hottinger 1960, a and c: equatorial section, b: cross section.

PLATE-2

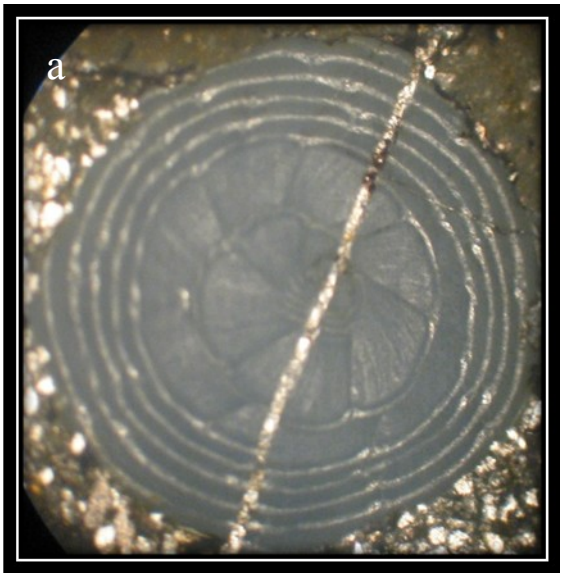

Fig. a: *Alveolina indicatrix* Hottinger 1960 (cross section)

Fig. b: *Assilina laminosa* Gill 1953 (left), *Assilina granulosa* (d' Archaic) (right)

Fig. c*: Nummulites mamillatus* (Fichtel & Moll)

Fig. d: *Assilina laminosa* Gill 1953

PLATE-3

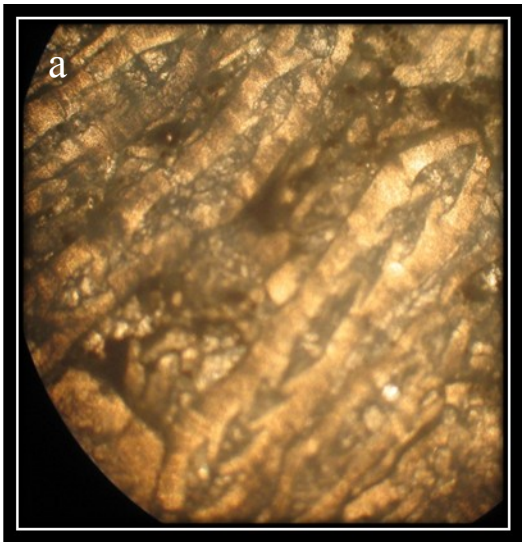

Fig. a: *Assilina granulosa* (d' Archaic)

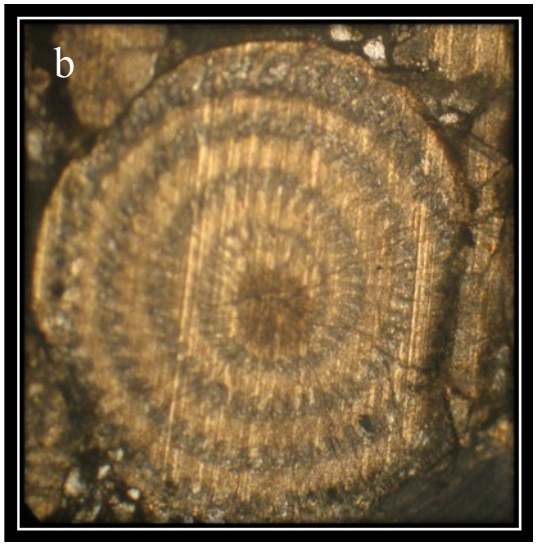

Fig. b: *Nummulites mamillatus* (Fichtel & Moll)

Fig. c, d: *Nummulites globulus* Leymerie 1846

PLATE-4

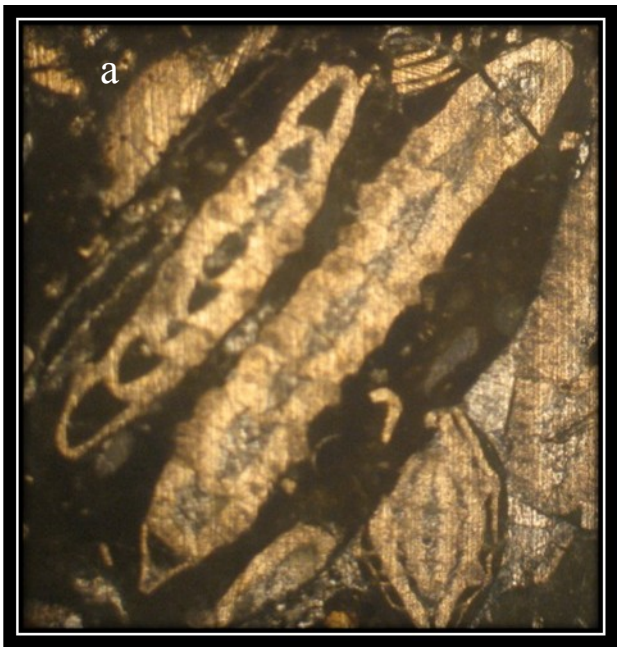

Fig. a: *Assilina granulosa* (d' Archaic)

Fig. b: *Nummulites mamillatus* (Fichtel & Moll) top *Nummulites djodjokartae* Martin 1881 (bottom)

Fig. c: *Nummulites djodjokartae* Martin 1881

Fig. d: *Nummulites mamillatus* (Fichtel & Moll) left *Assilina spinosa* Davies & Pinfold 1937 (right)

PLATE-5

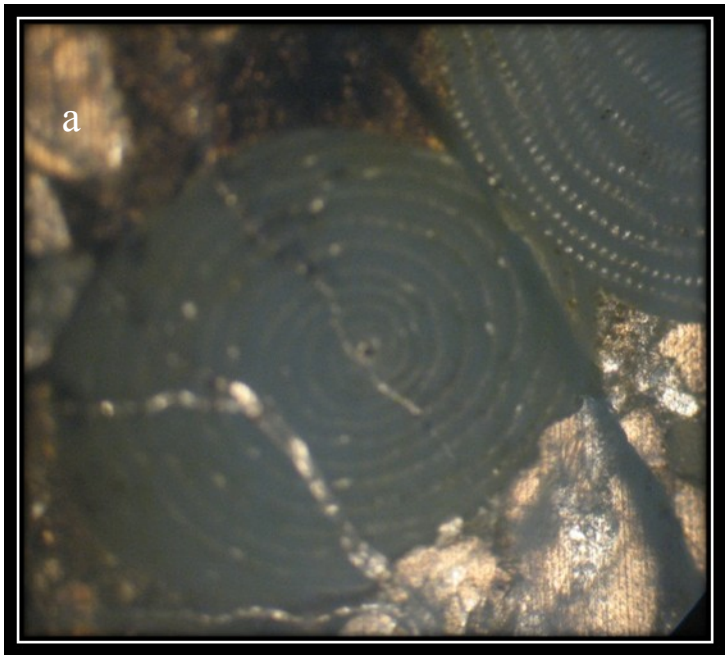

Fig. a: Hottinger 1960*Alveolina indicatrix*

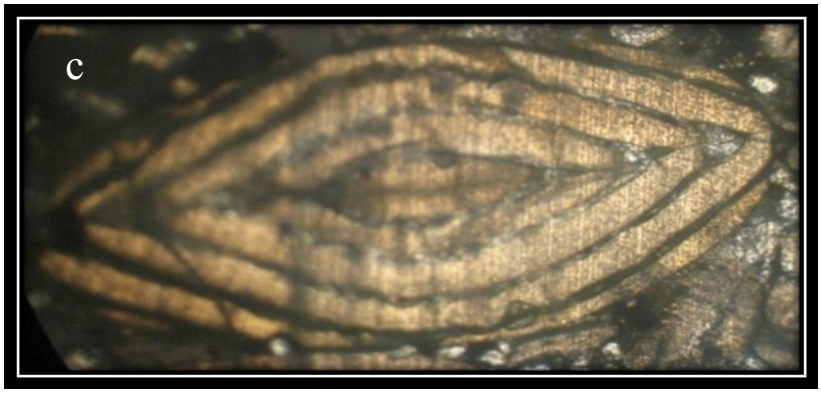

Fig. b,c: *Nummulites atacicus* Leymerie 1846

CONCLUSION

Alveolina indicatrix HOTTINGER,1960 is recorded from lower and middle part of Chorgali Formation, from Jhalar station section. The stratigraphic range of *Alveolina indicatrix* HOTTINGER, 1960 is from the upper part of SBZ-8(questionable) to lower part of SBZ-10 (questionable) and confirmed in SBZ-9. All other recorded species of *Nummulites* and *Assilinids* have long stratigraphic range. Hence on the basis of *Alveolina indicatrix* HOTTINGER, 1960 the exact age assigned to Chorgali Formation is SBZ-9 (upper Ilerdian) as shown in Fig. 3. *Nummulites djodjokartae* Martin 1881 is first time recorded from Chorgali Formation of this area.

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