

# BIOSTRATIGRAPHIC STUDIES OF LOCKHART LIMESTONE, CHANGLAGALI AREA, NATHIAGALI- MURREE ROAD, HAZARA, NORTHERN PAKISTAN

Shahid Jamil Sameeni, \*Muhammad Haneef, \*Farhan Shabbir, Naveed Ahsan and Nazir Ahmad  
Institute of Geology, Punjab University, Lahore-54590

\*Department of Geology, University of Peshawar

E-mail: sameeni@yahoo.com

**ABSTRACT:** The Lockhart Limestone is well exposed in Hazara along Nathiagali-Murree road. A section at Changlagali is measured and sampled for paleontological studies, where its lower contact with Hangu Formation and upper contact with Patala Formation is sharp and conformable. The total observed thickness is 118 meters and 26 samples were collected from bottom to top at different levels, 70 thin sections were studied. 10 species of larger forams including age diagnostic *Miscellanea miscella*, *Lockhartia haimeii* were recorded along with *Millioliids*, *Planktons* as well as *Gastropods*, *Pelecypods*, *Ostracodes*, *Dasycladacean algae*, *Echinoderms* and *Sponges* were also observed. On the basis of recorded fauna the age of Lockhart Limestone in this area is Thanetian i.e. Upper Paleocene.

**Key Words:** Lockhart Limestone, Changlagali, Nathiagali, Forams, *Miscellanea*, *Lockhartia*

## INTRODUCTION:

The Hazara Mountains, a NE- SW trending crescent shaped trough, forms the western border of the Hazara Kashmir Syntaxis. It is the northernmost extremity of the sedimentary succession along the northwestern margin of the Indian Plate. Its northern margin is bounded by the Panjal Thrust, while its southern border is marked by the Main Boundary Thrust (MBT) from the adjacent hydrocarbon bearing Potwar Basin. The town Balakot a gateway to the Higher Himalayas (Kaghan Valley) forms the northern tip of the Hazara Mountains (Fig-1).

The Changlagali area is easily accessible from Islamabad via Murree-Nathiagali road, located between lat. 34°03'N and long. 73°17'E where Paleocene-Eocene rocks are well exposed. Latif [1&2] has given the name "Mari Limestone" to the well exposed thick bedded to massive, nodular fossiliferous limestone of Paleocene age. Stratigraphic Committee of Pakistan [3] has extended the name "Lockhart Limestone" of Davies [4] in Kohat area to the Hazara area.

Waagen and Wynne [5] are pioneers of work in this area. They have explained the basic geology of the area. Waagen [6] worked in the Changla Gali, Chumbi Peak and Khaira Gali area and differentiated the stratigraphic units into broad groups like Spiti Shales, Sandstone Series and Nummulitic Limestone Series. Wynne [7] worked on the geology of northern Punjab and explained the geology of Murree Hills and its surroundings. Waagen [6] gave a comprehensive study of geology of Sirban Mountains near Abbotabad. Middlemiss [8] was the first person to prepare the geological map giving the stratigraphical and structural details. Pinfold [9] explained the structure and stratigraphy of northern and western Punjab. Cotter [10] gave a brief description of geology around the Attock area. Eames [11 & 12] explained the Eocene rock of the western Pakistan. Latif [1 & 2] mapped the Hazara area and explained the detailed stratigraphy and micropaleontology of all the rocks from Pre-Cambrian to recent. Butt [13] discussed the problems of stratigraphic nomenclature of the Hazara area. Latif [14] has given a comprehensive account of micropaleontology of Gallis Group of Hazara. Ghazanfar *et al* [15 & 16] have established the different stratigraphic provinces as well as

the geology and structure of the Hazara area. Shahnawaz [17] have described the preliminary microfacies of the Margla Hill Limestone of Jabri area. Sameeni [18] gave a comprehensive study of microfauna of the Margala Hill Limestone of Bandi area. Mirza *et al* [19] explained the stratigraphy and the microfauna of the Patala Formation of the Jabri area. Munir *et al* [20] have explained the stratigraphy and microfauna of the Paleogene rocks of Hazara and Kashmir.

## METHODOLOGY:

Upper and lower contact of the selected section of Lockhart Limestone was marked first, then thickness of Lockhart Limestone was measured carefully to prepare stratigraphic column, lithology was observed and written accordingly. Samples were collected from each bed and approximately at equal intervals. Total 26 samples were collected which were transported to lab. And thin sections were prepared for paleontological studies.

## OBSERVATIONS:

The Lockhart Limestone is well exposed along the Nathiagali-Murree road near Changlagali where it overlies the early to middle Paleocene Hangu Formation and underlain by Patala Formation, both upper and lower contacts are sharp and conformable. The Lockhart Limestone is 118 meters thick and lithology as observed from bottom to top is, at its base 11 meters thick bedded highly fossiliferous limestone with occasionally calcite filled fractures, followed by 0.8 meter thick band of dark grey coloured calcareous shale, then 14 meters thick bedded fossiliferous nodular limestone of grey to dark grey in colour, 05 meters thin bedded nodular limestone, 10 meters thick bedded nodular limestone with occasionally interbedded clays and calcite filled fractures, 06 meters thin bedded limestone of grey colour, 01 meter band of dark grey calcareous shale, 15 meters thick bedded fossiliferous nodular limestone with a few interbeds of clays and occasionally calcite filled fractures, 08 meters thin bedded nodular fossiliferous limestone, 23 meters thick bedded highly fossiliferous nodular limestone with occasionally calcite filled fractures and minor interbeds of clays, 02

meters thick band of dark grey coloured calcareous shale, 07 meters thin bedded nodular limestone and at the



Fig. 1: Location Map of the Study Area

top there is 15 meters thick brecciated highly fossiliferous limestone with occasionally calcite veins and interbeds of clay is observed (Fig-2). A total 26 samples were collected from bottom to top at different level and total 70 thin sections were prepared for the study of fauna and microfacies. The recorded species of larger foraminifera are as follows (Fig-3).

- *Miscellanea miscella* (d'Archaic & Haime)
- *Lockhartia haimeii* (Davies)
- *Lockhartia tipperi* (Davies)
- *Lockhartia conditi* (Nuttall)
- *Ranikothalia sindensis* (Davies)
- *Ranikothalia sahnii* (Davies)
- *Operculina subsalsa* Davies & Pinfold
- *Operculina salsa* Davies & Pinfold
- *Discocyclus ranikotensis* Davies
- *Assilina subspinosa* Davies & Pinfold

#### SYSTEMATIC PALEONTOLOGY:

*Miscellanea miscella* (d'Archaic  
(Plate-1e, Plate-3 a,b)

*Miscellanea miscella* (d'Archiac and Haime), Pfender 1934. Bull. Soc. Geol. France, vol. IV, pp.231-235 and Text figs. 1-4, pl. 11, figs. 6-7, pl.13, figs. 2-4.

**Remarks:** This is the most common species present throughout the formation from bottom to top. Microspheric and megalospheric both types were observed.

*Lockhartia haimeii* (Davies)

(Plate -1a)

*Lockhartia haimeii* (Davies) Davies & Pinfold 1937. Mem. Geol. Surv. India, Pal. Indica, New Series, vol.24(1), pl.7, figs.9-13,15.

**Remarks:** This species is a guide fossil for upper Paleocene rocks and very common in this formation from bottom to top.

*Lockhartia conditi* (Nuttall)

(Plate-1c)

*Lockhartia conditi* (Nuttall) Davies 1932. Trans. Roy. Soc. Edin. Vol.57P1. 2, fig. 7; P1. 4, fig.7.

**Remarks:** Although this species is common to upper Paleocene and lower Eocene and but is observed only in the lower part of formation in this area.

*Lockhartia tipperi* (Davies)

(Plate-1d)

-*Lockhartia tipperi* (Davies) Davies 1932. Trans. Roy. Soc. Edin., vol. 57.

**Remarks:** This species is recorded throughout the formation from bottom to top

*Ranikothalia sindensis* (Davies)

(Plate-1b)

-*Nummulites sindensis* (Davies), Davies & Pinfold 1937. Mem. Geol. Surv. India, Pal. Indica, New Series, vol.24(1), pi.4, fig. 21.

**Remarks:** This species is common to the upper Paleocene and lower Eocene deposits and recorded from the formation from bottom to top.

*Ranikothalia sahnii* (Davies)

(Plate-2a)

-*Nummulites sahnii* Davies 1927, Quart. Journ.

Geol.Soc. Lond, vol.83, pl. 19, figs.10-13.

**Remarks:** This species is not so common, only recorded from the middle upper part of the formation.

*Operculina salsa* Davies & Pinfold

(Plate-2c)

--*Operculina salsa* Davies & Pinfold 1937. Mem. Geol. Surv. India, Pal. Indica, New Series, vol.24(1), pl.5, figs. 1,3, 7,10,15

**Remarks:** This species is recorded from the upper and lower part of the formation.

*Operculina subsalsa* Davies & Pinfold

(Plate-2c)

-*Operculina subsalsa* Davies & Pinfold 1937. Mem. Geol. Surv. India, Pal. Indica, New Series, vol.24(1), pl.5, figs. 6,17-19, 26.

**Remarks:** This species is recorded only from the upper most part of the formation

*Assilina subspinosa* Davies & Pinfold

(Plate-3c)

-*Assilina subspinosa* Davies & Pinfold 1937. Mem. Geol. Surv. India. Pal. Indica New Series, vol. 24(1), pl.4, figs. 19-20, 23-26.

**Remarks:** This species is recorded throughout the formation from bottom to top.

#### CONCLUSION:

The above mentioned recorded species of larger foraminifera characterize the shallow shelf marine environments of Paleocene age and the presence of *Lockhartia haimeii* confirm the Thantian (Upper Paleocene) age of Lockhart Limestone. Sameeni (1997) recorded *Glomalveolina dachalensis* from Lockhart Limestone of Salt Range along with the species recorded mentioned above and according to Shallow Benthic Biozones, the age assigned to Lockhart Limestone was SBZ-4. Although Alveolinids were not observed from this section but SBZ-4 age may be assigned to Lockhart Limestone in this area.

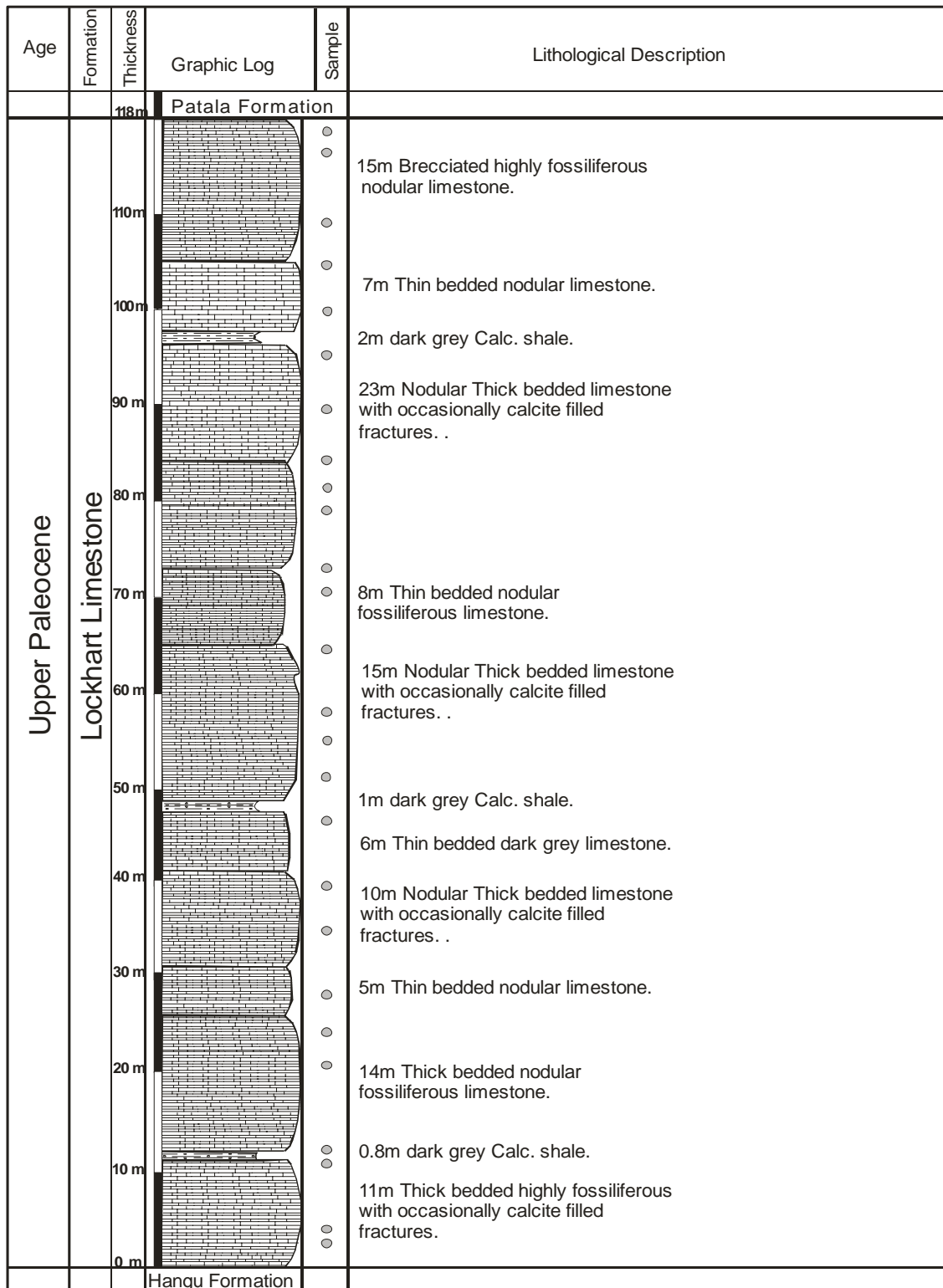


Figure 2 Stratigraphic Section of Lockhart Limestone, Changagali.

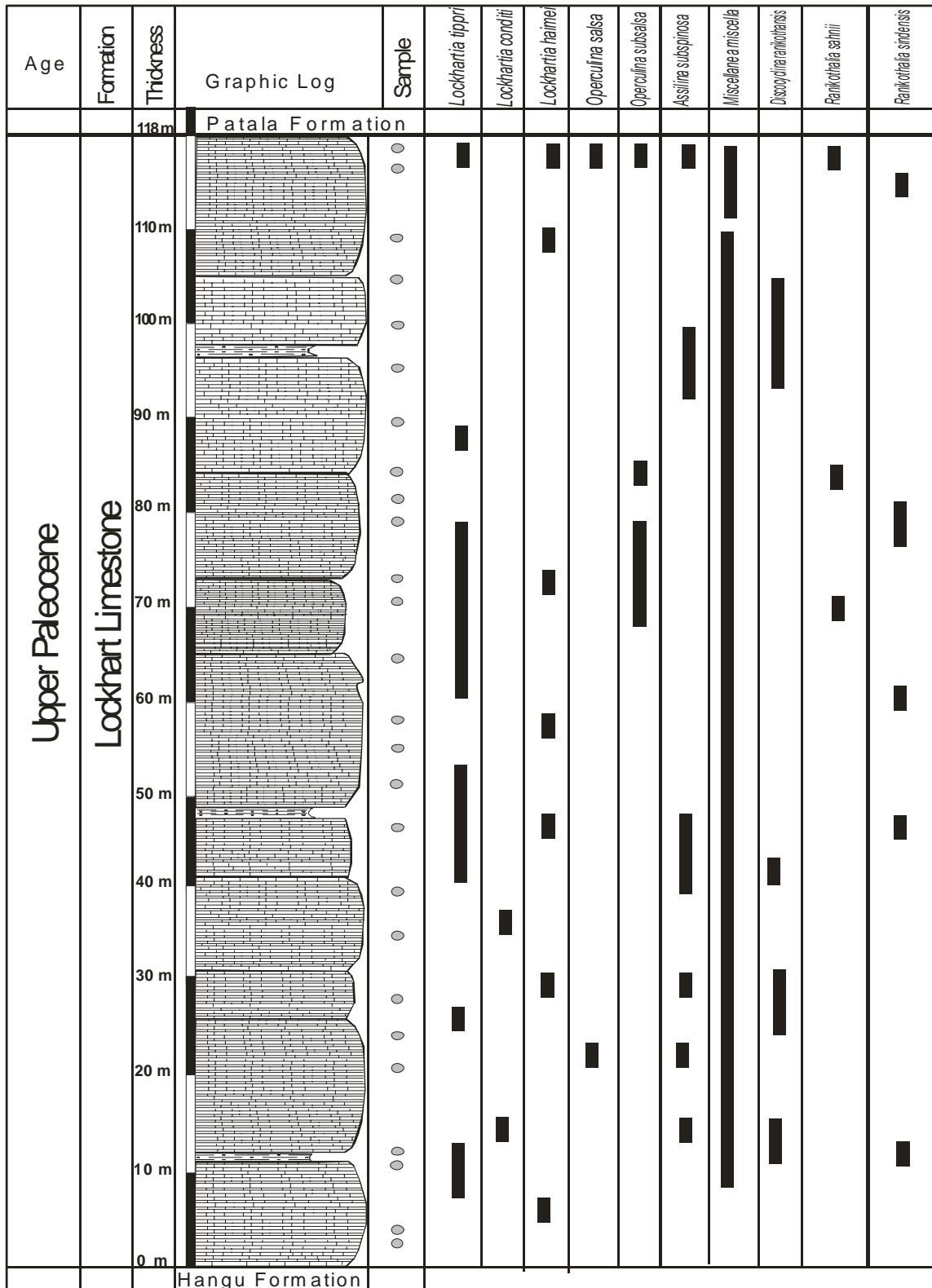


Figure 3 Distribution of foraminiferas recorded in Lockhart Limestone, Changagali.



**PLATE-1**



a). *Lockhartia haimeii* (Davies) top Milliolid (lower)



b). *Ranikothalia sindensis* (Davies)



c). *Lockhartia conditi* (Nuttal)



d). *Lockhartia tipperi* (Davies)



e). *Miscellanea miscella* (d'Archaic & Haime)

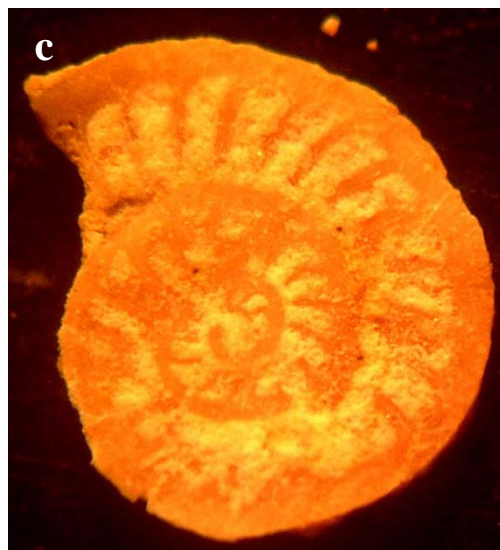
**PLATE-2**



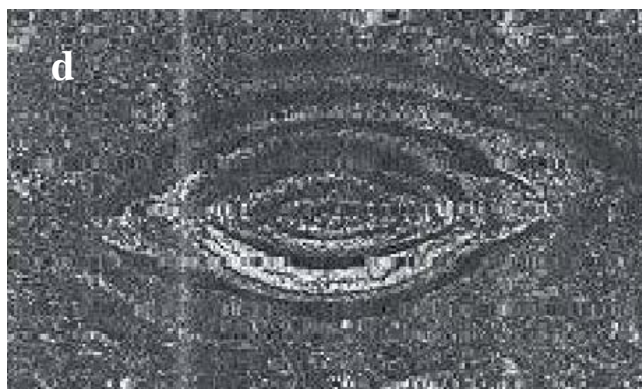
a). *Ranikothalia sahnii* (Davies)



b). *Discocyclus ranikotensis* Davies



c). *Operculina salsa* Davies & Pinfold



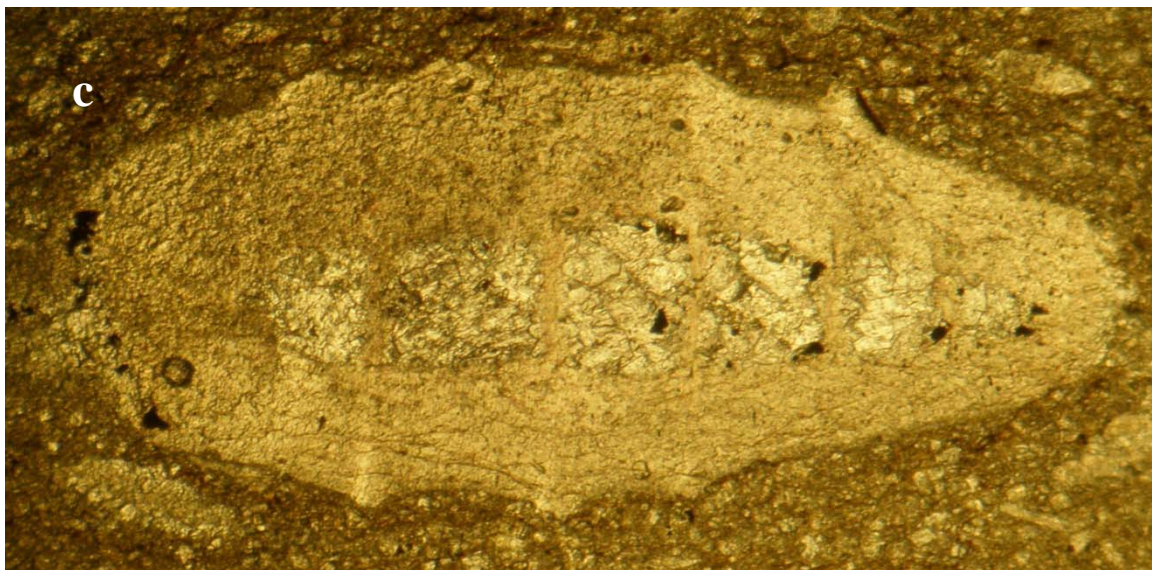
d). Milliolid



**PLATE-3**



a,b) *Miscallanea miscella* (d'Archaic & Haime)



c)- *Assilina subspinosa* Davies & Pinfold

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