

UPPER PALEOCENE LARGER BENTHIC FORAMINIFERA-LOCKHART LIMESTONE FROM WESTERN AND CENTRAL SALT RANGE, PAKISTAN

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Abstract: Upper Paleocene larger benthic foraminifera of the Lockhart Limestone were identified from Western and Central Salt Range, Pakistan. Three sections were studied: Section 1 (21m thick) in Nilawahan Gorge, Central Salt Range, section 2 (26m thick) in Kalarwahan Gorge, Central Salt Range and section 3 (32m thick) along the road side in Nammal Gorge, Western Salt Range. A total of more than 140 samples were collected from the three sections at suitable intervals covering all lithological variations of Lockhart Limestone. A number of 145 thin sections were prepared to study the internal structures of important larger foraminifera and identified the following genera: Lockhartia, Operculina, Assilina, Miscellanea, Discocyclus, Ranikothalia, Bigenerina and Milliolids

Keywords: Lockhart, Nammal, Paleocene, Salt Range

INTRODUCTION

Lockhart Limestone [1&2], Paleocene in age, is yellowish brown, medium to thick bedded and stands high in relief by virtue of less resistant underlying Hangu Formation and the overlying Patala Formation. It gives nodular appearance. The Lockhart Limestone is widely distributed in the Salt Range, Hazara and Kala Chitta areas. Previous studies show that the formation is rich in benthic foraminifera [3]. Davies [4] in the Samana Range and in Davies and Pinfold [1] in the Salt Range discuss the characteristic of Early to Late Paleocene benthonic larger foraminifera species. Weiss [5] worked on larger and planktonic foraminifera of the Cretaceous and Paleogene rocks in the Salt Range, Kohat and Sulaiman Range. Afzal and Daniels (1991) worked on Paleocene rock unit (Patala Formation) and Eocene rock unit (Nammal Formations) from Khairabad East area of Salt Range and Yaseen *et al.* [6] described the micropaleontology of Paleocene rock unit (Lockhart Limestone) in Central Salt Range. In the present work three sections of Lockhart Limestone have been studied in Central and Western Salt Range.

Section 1 has been studied from Nilawahan Gorge (lat. 32° 10' N, long. 72° 36' 30" E; Topo-Sheet No. 43 D/ 10), Central Salt Range (Fig. No.1). Lockhart Limestone exposed in Nilawahan Gorge is 21 meters (Fig. No.2) and is mainly composed of fine to medium and medium to thick bedded limestone with subordinate marl. A total of 53 samples were collected for present studies. Section 2 has been studied from Kalarwahan Gorge (Lat. 32° 36' 57", Long. 72° 27' 22"; Topo-Sheet No. 43 D/ 6) Central Salt Range (Fig. No.1). Its thickness is 26 meters (Fig. No.3). A total of 49 samples were collected. The distribution of different larger foraminifera species from Kalarwahan Gorge is shown in (Fig. No.3). This section is highly fossiliferous and mainly composed of foraminifera. Small sized larger foraminifera can be seen on weathered surface, which are age diagnostic feature for the formation under study. Section 3 has been

studied from along the road side in Nammal Gorge (Lat 32° 40' 45", Long 71° 47' 06"), Western Salt Range (Fig. No.1) and portion lies in the Topo-Sheet No. 38 P/ 14 of Survey of Pakistan. This section is located on Talagang Mianwali Road and can also be accessed via Motorway. The measured sections of Lockhart limestone in Nammal Gorge is approximately 31 meters thick (Fig. No. 4). In this section the Lockhart Limestone is typically nodular in appearance. The formation conformably overlies and underlies the Hangu Formation and the Patala Formation respectively. The upper part of the Lockhart limestone is mostly composed of medium to thick bedded nodular limestone. A total of 43 samples were collected; representing all lithological changes along the section. The distribution of different larger foraminifera species from Nammal Gorge is in (Fig. No. 4).

METHODOLOGY:

The sections of Lockhart Limestone were measured and lithological description was recorded in data recording sheet. Thin sections were prepared for systematic studies of fauna

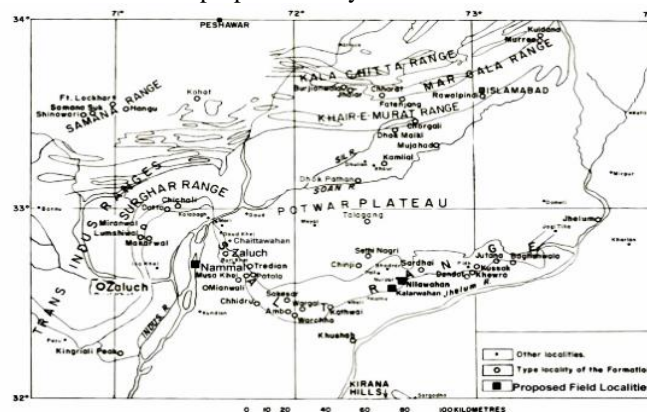


Fig.1. Location map of measured sections [7]

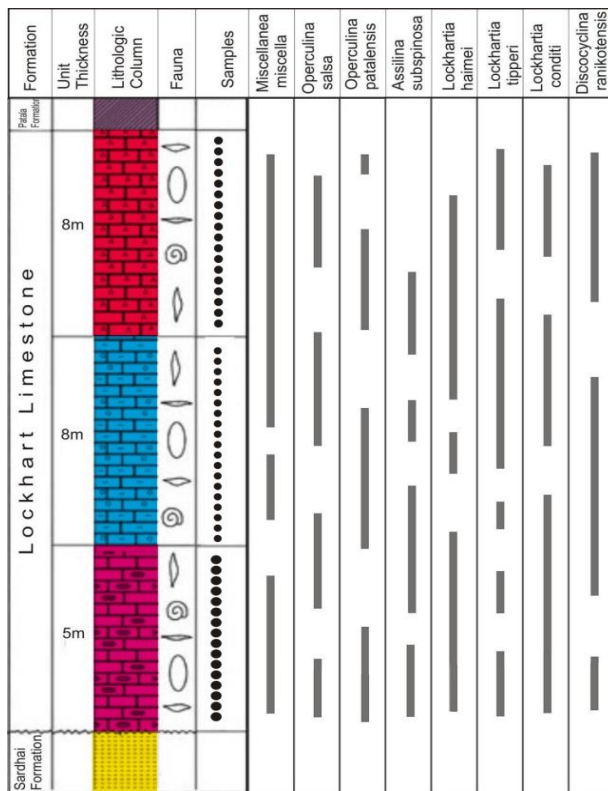


Fig. 2. Lithological log of the measured section of Lockhart Limestone and Distribution of foraminiferal species in section 1.

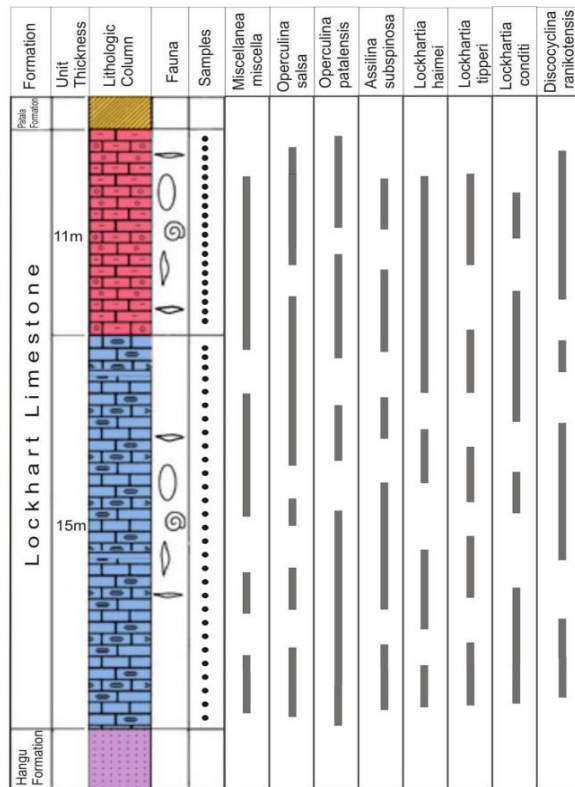


Fig. 3. Lithological log of the measured section of Lockhart Limestone and Distribution of foraminiferal species in section 2.

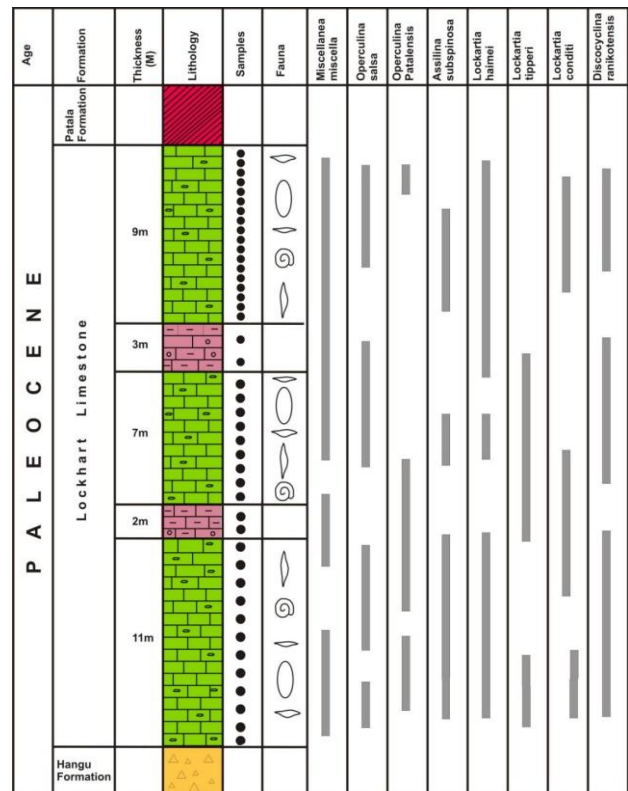


Fig. 4. Lithological log of the measured section of Lockhart Limestone and Distribution of foraminiferal species in section 3.

SYSTEMATIC DESCRIPTION:

The benthic foraminiferal species such as *Miscellanea miscella* (D' ARCHIAE & HAIME) with association of *Lockhartia haimei* (DAVIES), *Operculina subspinosa* DAVIES & PINFOLD and *Lockhartia conditi* NUTTALL with *Ranikothalia indensis* (DAVIES), *Ranikothalia nuttalli* (DAVIES), *Operculina patalensis* DAVIES & PINFOLD, *Discocyclina ranikotensis* DAVIES & PINFOLD, *Lockhartia tipperi* (DAVIES) and *Assilina subspinosa* DAVIES & PINFOLD suggesting an Upper Paleocene age. The Paleocene Lockhart limestone is rich in microfossils especially larger benthic foraminifera. In the present study a total of more than 140 samples of Lockhart Limestone from Nilawahan, Kalarwahan and Nammal Gorge were studied with special reference to larger benthonic foraminifera. The majority of the larger foraminiferal species from study areas belong to family Nummulitidae and Rotaliidae, whereas Miliolidae and Textularidae are also present. The thin sections preserved the internal structures of important larger foraminifera and different genus of benthonic foraminifera such as *Lockhartia*, *Operculina*, *Assilina*, *Miscellanea*, *Ranikothalia* and *Discocyclina*. Red algae, Green algae, Pieces of corals, Bryozoans, Miliolids, *Bigenerina* sp. and Sponges spicules can also be seen. The larger benthonic foraminifera species recorded from these sections are as follows:

Miscellanea miscella D' ARCHIAC & HAIME
(Plate No. 1; Fig. No. 1-2)

Operculina salsa DAVIES & PINFOLD (Plate No. 1; Fig. No. 3-4)

Operculinapatalensis DAVIES & PINFOLD (Plate No. 1; Fig. No. 5-7)

Lockhartiahaime (DAVIES) (Plate No. 1; Fig. No. 2-3)

Assilinasubspinosa DAVIES & PINFOLD (Plate No. 2; Fig. No. 1)

Lockhartiaconditi NUTTALL (Plate No. 2; Fig. No. 2-3)

Discocyclinaranikotensis DAVIES & PINFOLD (Plate No. 2; Fig. No. 4-5)

Lockhartiatipperi (DAVIES) (Plate No. 2; Fig. No. 6-9)

Ranikothaliasindensis (DAVIES) (Plate No. 2; Fig. No. 10-11)

Miliolids sp. (Plate No. 2; Fig. No. 12-13)

Bigennerina sp. (Plate No. 2; Fig. No. 14-15)

CONCLUSIONS:

Based on the field evidences and laboratory (microscopic) studies of thin sections of the representative rock samples of the studied sections it is concluded that:

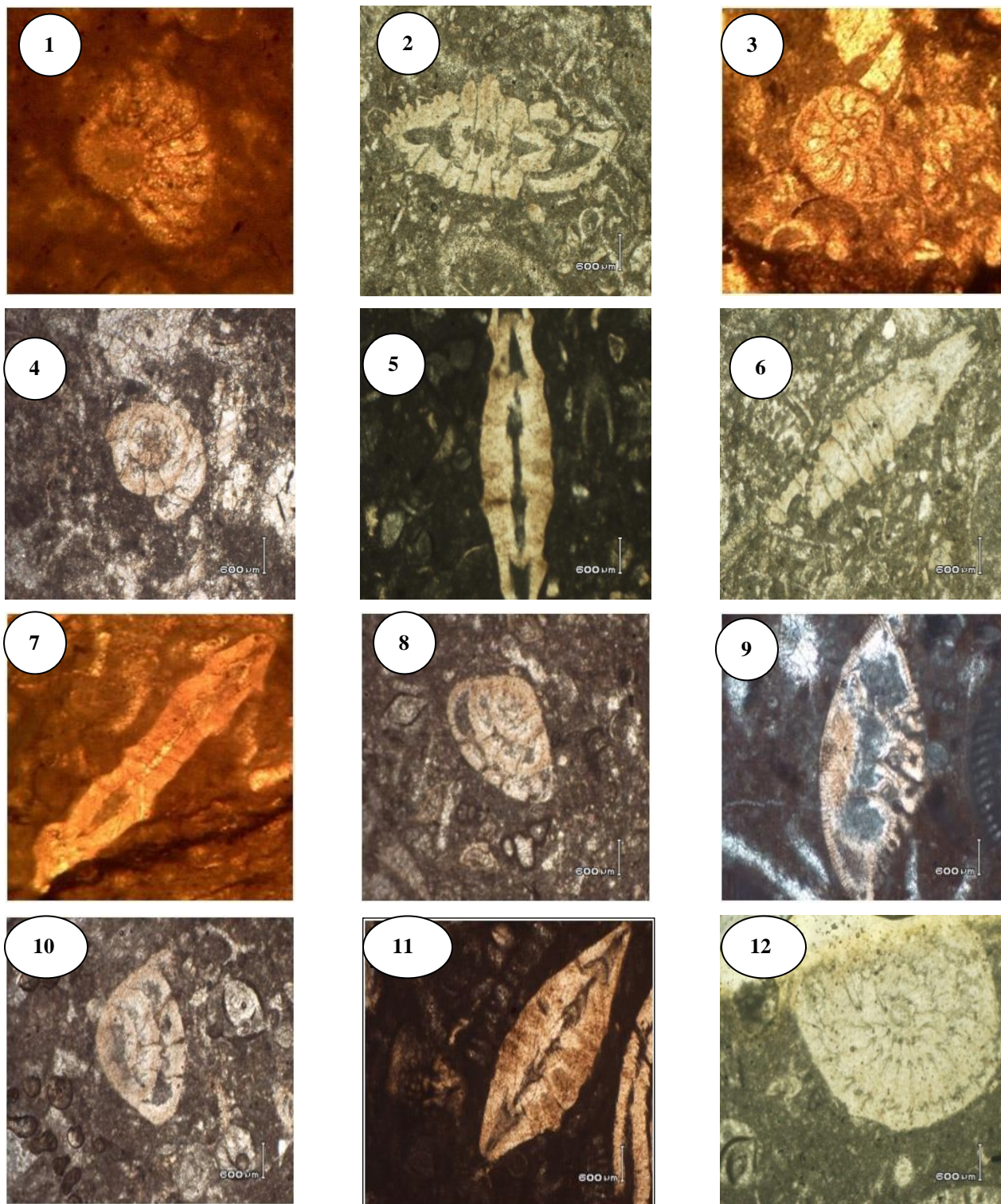
- The carbonates and shale sequence of Lockhart Formation was deposited in marine realm. Limestone and shale contains abundant paleocene larger benthic foraminifera.
- Total five Genera and eight age diagnostic species of large benthonic foraminifera have been identified in studied sections which includes *Miscellanea miscella* (d' ARCHIAC & HAIME), *Operculina salsa* DAVIES & PINFOLD, *Operculinapatalensis* DAVIES & PINFOLD, *Lockhartiahaime* (DAVIES), *Assilinasubspinosa* DAVIES & PINFOLD, *Lockhartiaconditi* NUTTALL, *Discocyclinaranikotensis* DAVIES,

Ranikothaliasindensis (DAVIES) and *Lockhartiatipperi* (DAVIES).

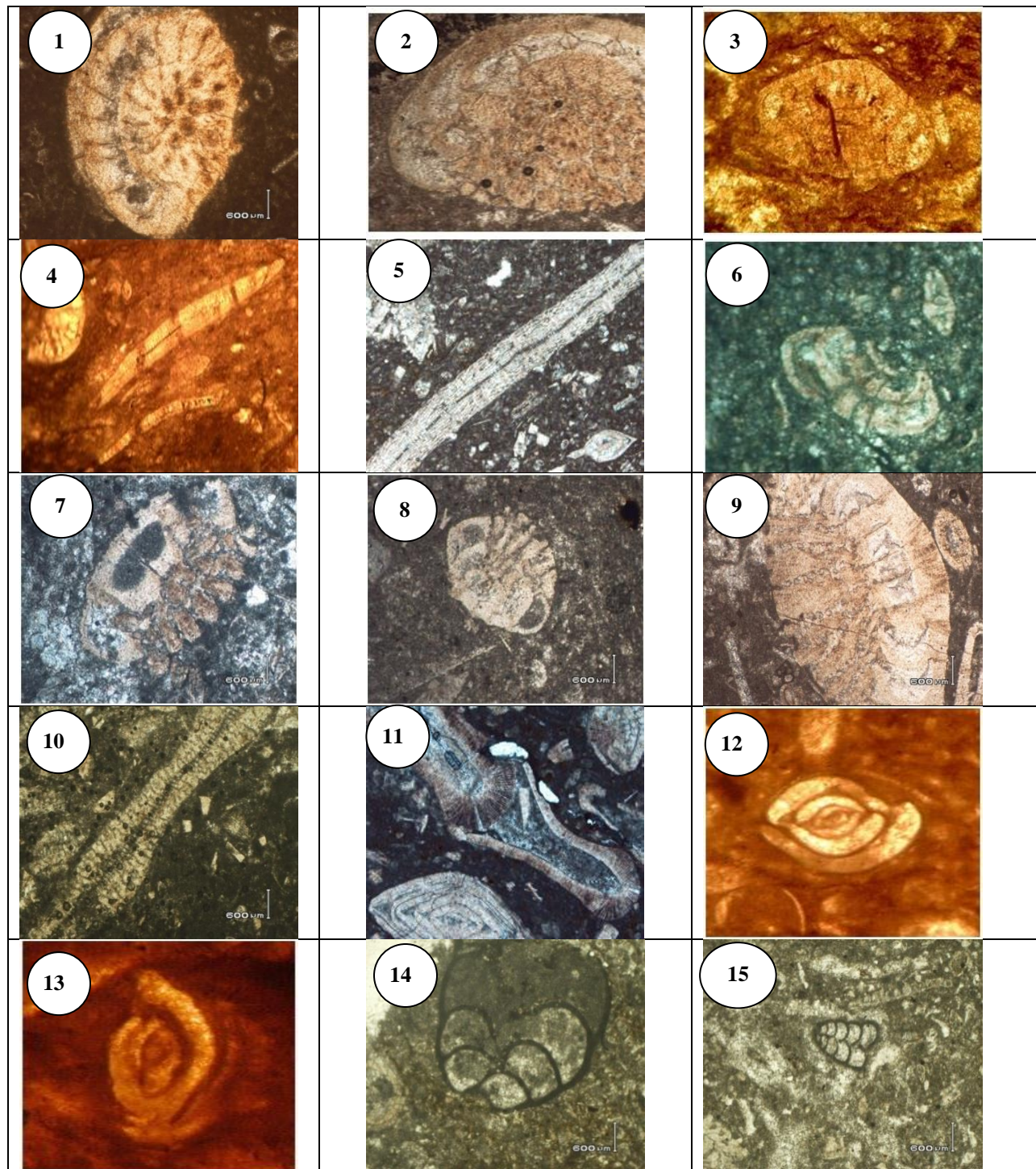
- On the basis of observed fauna in the formation it can be concluded that the deposition of Lockhart Limestone took place in open marine, shallow shelf environments.

REFERENCES

- [1] Davies, L. M. and E.S. Pinfold. (1937). The Eocene beds of the Punjab Salt Range. Me. Geol. Surv. India, Pal. Indica, New Ser. 24 (1), p.1-79.
- [2] Fatmi, A. N., (1973). Stratigraphy of Jurassic and Lower Cretaceous rocks and Jurassic Ammonites from northern areas of West Pakistan. British Mus. Nat. Hist., Bull. (Geol), 20 no. 7, pp. 299-380.
- [3] Shah, S. M. I. (1977). Stratigraphy of Pakistan. Geol. Surv. Pakistan. Mem. 12, p. 137.
- [4] Davies, L. M. (1930a). The fossil fauna of the Samana Range and some neighboring areas. Part 1, An introductory note: Geol. Surv. India Memoir, Paleont. Indica, New Series 15: 15p.
- [5] Weiss, W. (1988). Larger and Planktonic biostratigraphy of the Cretaceous and Paleogene in the Salt Range, Pakistan. HDIP- BGR Technical cooperation project No. 83.2068.1. Federal Institute of Geo Science and Natural resources, Germany. Pp. 57 (Unpublished).
- [6] Yaseen, A., Rajpar, A.R., Munir, M., Roohi, G., and Rehman, K., (2011). Micropaleontology of Lockhart Limestone (Paleocene), Nilawahan Gorge, Central Salt Range, Pakistan. Journal of Himalayan Earth Sciences 44 (2), pp. 9-16.
- [7] Shah, S. M. I. (1980). Stratigraphy and economic geology of Central Salt Range of Pakistan. Geol. Surv. Pakistan. Rec. 52

PLATE 1Fig. 1 -2 *Miscellanea miscella* D' ARCHIAC & HAIMEFig. 3-4 *Operculina salsa* DAVIES & PINFOLDFig. 5-7 *Operculinapatalensis* DAVIES & PINFOLDFig. 8-10 *Lockhartiahaime* (DAVIES)**PLATE 2**

March-April

Fig. 1 *Assilina subspinososa* DAVIES & PINFOLDFig. 2-3 *Lockhartia conditi* NUTTALLFig. 4-5 *Discocyclina ranikotensis* DAVIES & PINFOLDFig. 6-9 *Lockhartia tipperi* (DAVIES)Fig. 10-11 *Ranikothalia sindensis* (DAVIES)Fig. 12-13 *Miliolids* sp.Fig. 14-15 *Bigennerina* sp.