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Research Article

Faunal Assemblages of the Middle Jurassic Samana Suk Formation, Chichali Gorge Section, Surghar Range, Sub-Himalayas, Pakistan

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Abstract | The present paper focuses on "Faunal Assemblages of the Middle Jurassic Samana Suk Formation, Chichali Gorge Section, Surghar Range, Sub-Himalayas-Pakistan". The Samana Suk Formation is a carbonate sequence of the Middle Jurassic age and is widely distributed in the Upper Indus Basin, northern Pakistan. This formation belongs to the Baroch Group and is mainly comprised of limestones, which were thought to be a prospective fossils archive. The Samana Suk Formation with a primary thickness of 43.27m is exposed at the Chichali Gorge Section. A total of 108 limestone rock samples were collected from 51 beds. The formation was investigated by a detailed petrographic analysis to ascertain its faunal assemblages in the Chichali Gorge Section. These investigations revealed that the limestones of this formation are a good repository of faunal fossils. The fossil contents found in the Samana Suk Formation display a wide range of faunal species. The documented species are comprised of: foraminifers, gastropods, pelecypods, bryozoans, echinoids, sponges, brachiopods, and corals.

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Introduction

The Samana Suk Formation is mainly comprised of micritic, oolitic and bioclastic limestones, partially dolomites and dolomitic patches along with subordinate argillaceous contents. It is prominent Middle Jurassic found across a wide area of northern Pakistan (Shah, 1977, Bender and Raza, 1995; Kazmi and Jan, 1997). This formation is widely exposed in the Hazara Mountains, Cis-Indus Salt Ranges, Trans Indus Ranges, Samana Range and Kala Chitta Range (Shah, 1977; Kazmi and Jan, 1997). These are the most important sedimentary rocks indicating the shallow shelf carbonates in the Mesozoic strata of the Upper Indus Basin (Bender and Raza, 1995). No studies (literature) focusing on the faunal assemblages of Samana Suk Formation have been conducted for the documentation of fossils record based on petrographic investigations and no related reports are found in literature. In the present study the Samana Suk Formation was investigated in Chichali Gorge Section, Surghar Range. The main objective of this paper is to investigate the faunal assemblages of the Samana Suk Formation. Mensink *et al.* (1988), Fatmi *et al.* (1990) and Mertmann and Ahmad (1994) reported that the rocks of the Jurassic succession are exposed at many localities in the Trans Indus Ranges and focused on microfacies and depositional environments of the Samana Suk Formation of Surghar and Salt Ranges area. Mertmann and Ahmad (1994) worked to find out the lithofacies and depositional environments of Shinawari and Samana Suk formations

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from the Surghar and Salt Ranges and presented an excellent overview of the stratigraphic succession deposited during the Jurassic period. Fatmi *et al.* (1990) worked on "Occurrence of the Lower Jurassic Ammonoid Genus Bouleiceras from the Surghar Range The Jurassic shelf sedimentation and sequence stratigraphy of the Surghar Range was discussed by Ahmed *et al.* (1997).

The literature survey revealed that no research work has been attempted to study the faunal assemblages of the Samana Suk Formation prior to the present investigation. Hence, it is the first of its kind work undertaken by the present author with extensive research on the faunal assemblages of the Samana Suk Limestone from the Chichali Gorge Section, Surghar Range. Therefore this report is the first one so far with the aforementioned objectives.

Materials and Methods

Study Area

The Chichali Gorge Section, Surghar Range, is located 10km southwest of Kala Bagh town, District Mianwali (Figure 1). Geographically, the area is part of the Punjab Province. Approximately the location of this section is at latitude 35° 00′ 30″ N and longitude 71° 24′ 25″ E (Topographic Sheet No. 38 O/8 at a scale of 1:50,000, Survey of Pakistan, Rawalpindi). The Chichali Gorge Section could be approached from Mianwali city to Kala Bagh via Bannu Road and then from Kala Bagh to Chahpari village through a rural link road.

The Samana Suk Formation exposed at the Chichali Gorge Section with a primary thickness of 43.27m, consists of thin to thick and massive limestones along with dolomite and argillaceous contents (shale). Field work was carried out during March, 2006. The first stage included field observations and samples procurement relevant to objectives of this study on this formation. The samples were taken from each bed and a total of 108 limestone rock samples were collected from 51 individual beds. Sixty-five (65) thin sections of limestones were examined for present research work and studied under polarized microscope (James Swift).

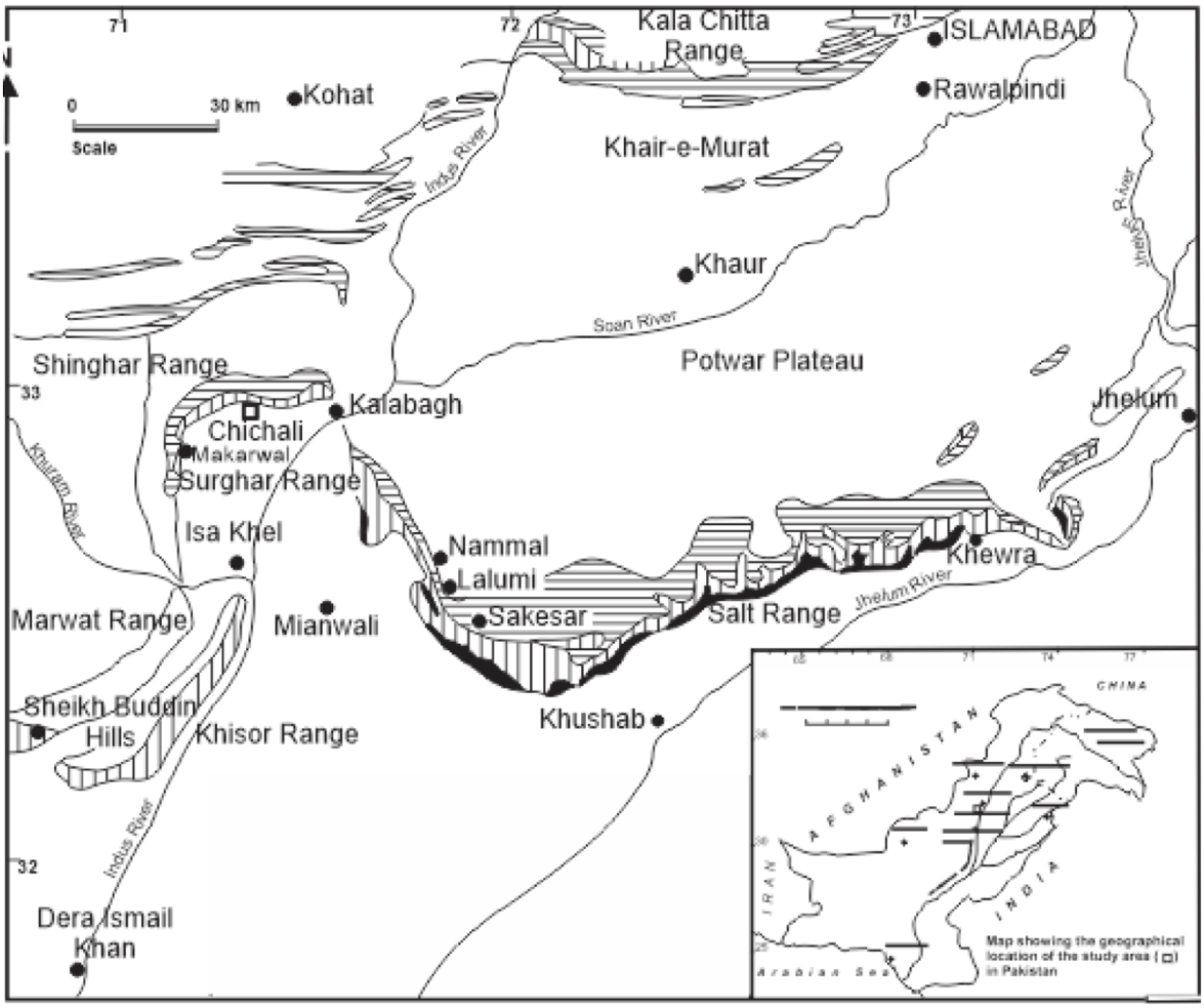

Figure 1: Showing the location map of Chichali Gorge Section, Surghar Range, Sub-Himalayas, Pakistan (Modfied after Gee, 1989).

This research work was carried out by following the standard field and laboratory techniques. The methodology employed in investigating sections of sedimentary rocks were determined by the standard procedures mentioned in the literature. Details of the various procedures are given by Compton (1962), Krumbein and Sloss (1963), Kottlowski (1965), Tucker (1988). Bhattacharyya *et al.* (2000), McClay (2000) and Tucker (2000). The outcrop observations, field photography and section measurement were all performed by standard field procedures. Laboratory investigations involved thin sections preparation and study using light microscope, chemical staining with Potassium Ferricyanide and Alizarin Red S and digital photomicrography.

Results and Discussion

The organisms flourishing in a variety of environments are found as fossils in limestones and other rock strata. The fossils are preserved and recognizable remains or traces of activity of living organisms and provide clues to paleo-environments. The limestones of Samana Suk Formation were deposited in shallow shelf environment. This environment is prone to pulses of sediment accumulation, rapid burial and availability of carbonate minerals, like, calcite and aragonite, etc., for build-up of tests, shells and hard parts of biota. All of which strongly favor preservation of fossils in shallow marine environment (Brett and Thomka, 2013). The well-preserved skeletal shells and fragments were recorded in facies deposited in shelf lagoon with low energy water circulation. The shells and skeletal fragments of gastropods, pelecypods and brachiopods are found in bioclastic mudstone/wackestone/packstone microfacies and display faunal diversity due to deposition in shallow water with open circulation close to wave base. In the peloidal packstone/grainstone microfacies the foraminiferal tests are found in association with peloids and sometimes with other shells and skeletal fragments. These microfacies were deposited in environment of shelf with moderate water circulation. The shells and skeletal fragments recorded, particularly in bioclastic facies and those associated with peloids belong to mollusks, brachiopods, corals, sponges and foraminifera. The open marine subtidal environment is a conducive environment for the flourishment of marine life. The limestones deposited in this environment are found richly and diversely fossiliferous. The open marine subtidal environment hosts bioclastic wackestone, packstone, and grainstone, which characterize faunal and floral diversity. The recorded skeletal shells and fragments from these microfacies belong to foraminifera, gastropods, pelecypods, corals, sponges, echinodermsbrachiopods and bryozoans.

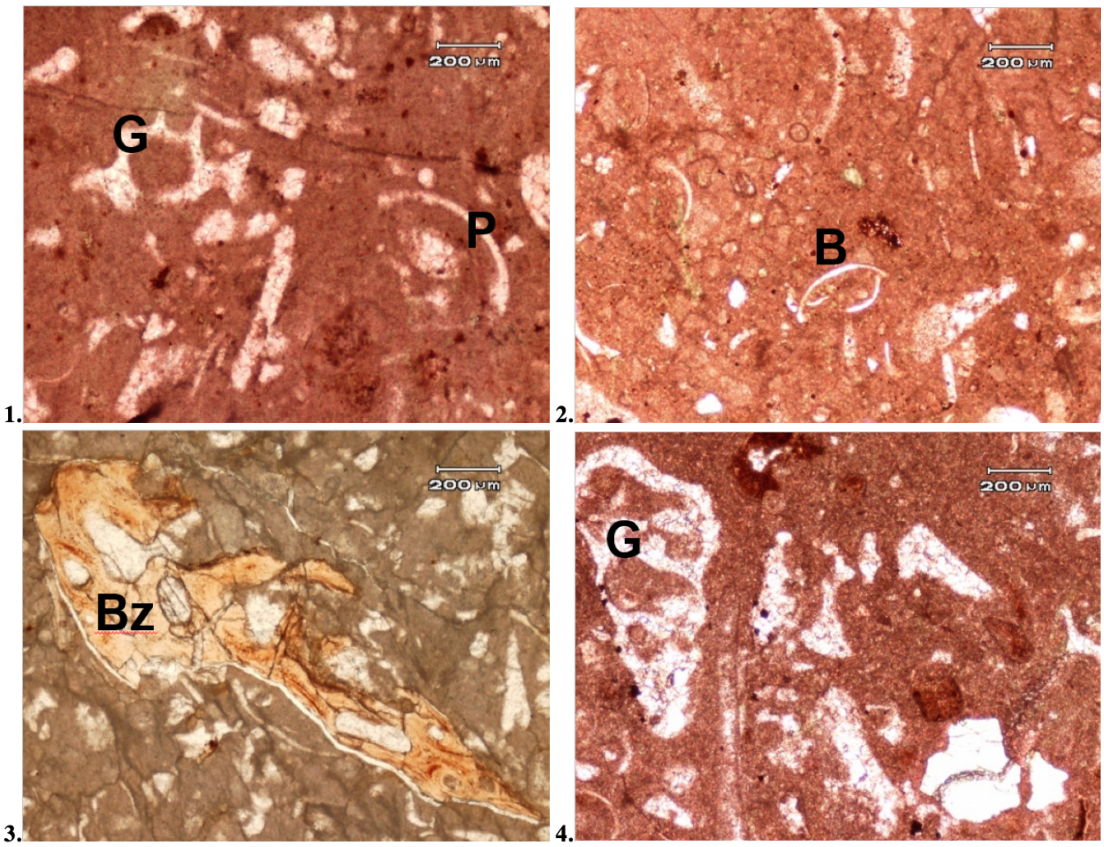

Plate 1: The photomicrographs showing in bioclastic limestones in Fig. 1: Gastropod (G) and pelecypod (P) clasts (PPL, stained), Sample No. CHN 23, Fig. 2: Brachiopod (B) shells (PPL, stained), Sample No. CHN 25, and in Fig. 3: Bryozoan (Bz) shells (PPL, unstained) Sample No. CHN 31, and in Fig. 4: Gastropod (G) shell (PPL, stained), Sample No. CHN 35.

The recorded faunal fossils in the studied samples of limestone of the Middle Jurassic Samana Suk Formation, Chichali Gorge Section, in the Surghar Range, Sub-Himalayas, Pakistan, belong to the invertebrate group of animals and represent seven (7) phyla as listed below:

Phylum Retaria (Cavalier-Smith, 1999)
Phylum Mollusca (Linnaeus, 1758)
Phylum Bryozoa (Ehrenberg, 1831)
Phylum Echinodermata (Klein, 1734)
Phylum Porifera (Grant, 1836) and
Phylum Brachiopoda (Duméril, 1806)
Phylum Cnidaria (Hatschek 1888)

Foraminifers: The foraminifers belong to the Phylum: Retaria (Cavalier-Smith, 1999) and Subphylum: Foraminifera (d'Orbigny, 1826). These were recorded in Plate 3, Figs. 2 and 4, and Plate 4, Fig. 1.

Gastropods: The gastropods belong to the Phylum Mollusca (Linnaeus, 1758) and Class Gastropoda (Cuvier, 1795). These were found in Plate 1, Figs. 1, and 4, Plate 2, Figs. 1, 3 and 4.

Pelecypods: The pelecypods, also, belong to the Phylum Mollusca (Linnaeus, 1758), Class Bivalvia (Linnaeus, 1758). These were noted in Plate 1, Fig. 1, Plate 2, Fig. 1 and Plate 4, Fig. 2.

Bryozoans: The bryozoans belong to the Phylum Bryozoa (Ehrenberg, 1831). These were observed Plate 1, Fig. 3.

Echinoids: The echinoids belong to the Phylum Echinodermata (Klein, 1734). These were identified in Plate 3, Fig. 3.

Sponges: The sponges belong to the Phylum Porifera (Grant, 1836). These were documented in Plate 2, Figs. 2 and 3.

Brachiopods: The brachiopods belong to the Phylum Brachiopoda (Duméril, 1806). These were documented in Plate 1, Fig. 2 and Plate 3 Fig.4.

Corals/Coral Polyps: The corals belong to the Phylum Cnidaria (Hatschek, 1888) and Class: Anthozoa (Ehrenberg, 1831). These were documented only at one stratigraphic level in Sample No. CHN 61 (Plate 3, Fig.1).

The documented faunal assemblages are comprised of foraminifers, gastropods, pelecypods, bryozoans, echinoids, sponges, brachiopods, and corals.

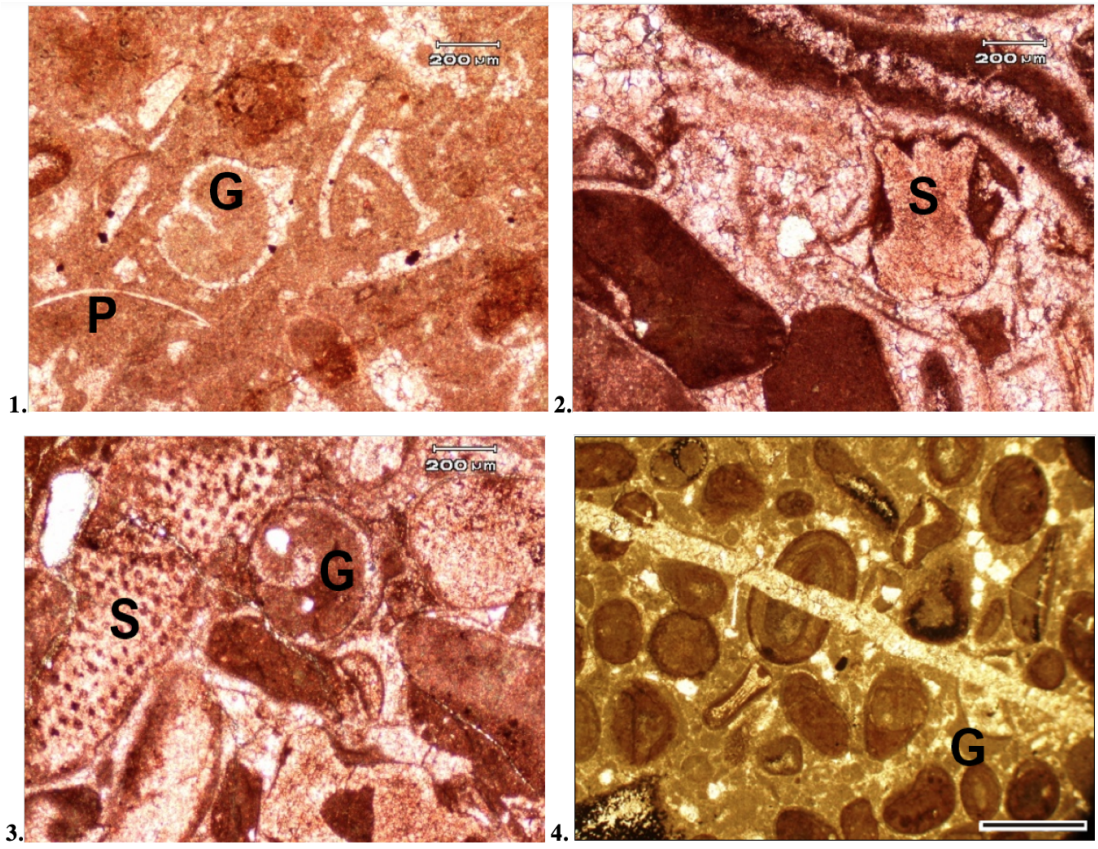

Plate 2: The photomicrographs showing in bioclastic limestones in Fig. 1: Gastropod (G) shell and pelecypod (P) fragments (PPL, stained), Sample No. CHN 38, Fig. 2: Sponge (S) shells (PPL, stained), Sample No. CHN 39, Fig. 3: Sponge (S) and gastropod (G) shells (PPL, stained), Sample No. CHN 60, and in Fig. 4: A gastropod (G) shell in an ooidal limestone (PPL, stained, Scale bar=250 µm), Sample No. CHN-61

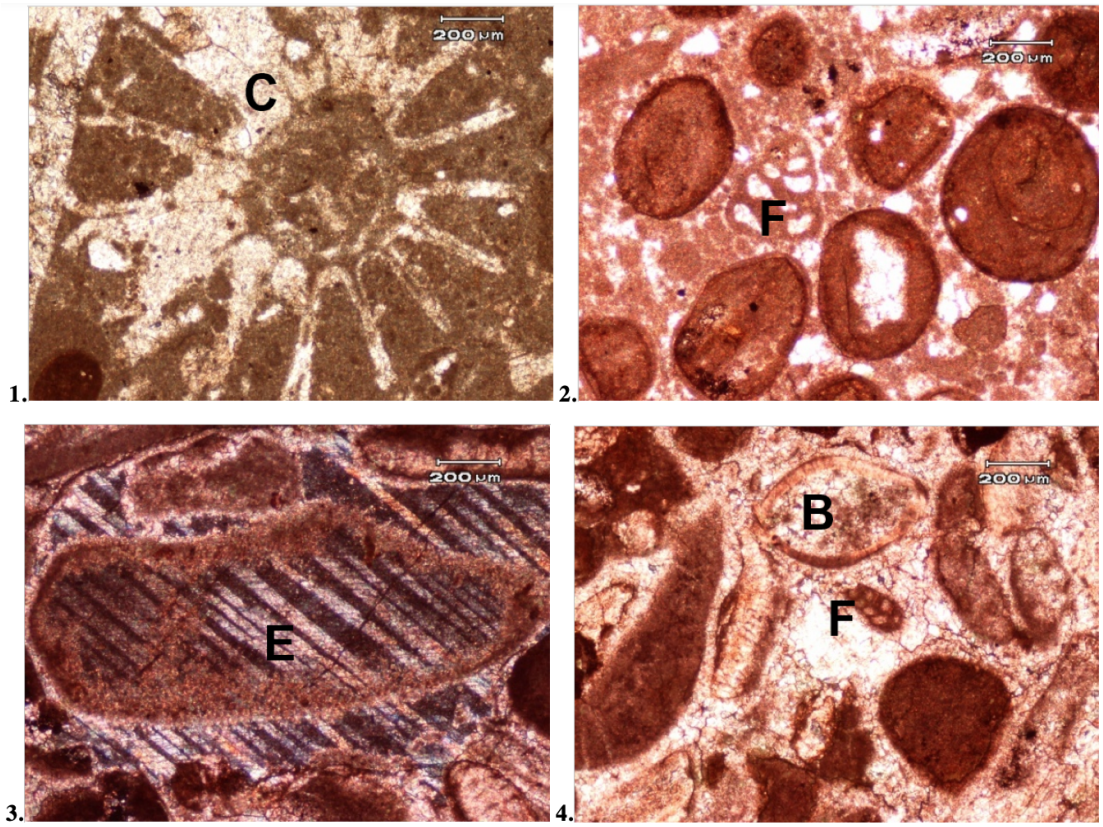

Plate 3: The photomicrographs showing in bioclastic limestones in Fig. 1: A large coral (C) shell (PPL, unstained), Sample No CHN 61, Fig. 2: A bi-serial (F) foraminifera (PPL, stained), Sample No CHN 61, Fig. 3: An echinoderm (E) grain exhibiting diagnostic single crystal structure extinction (XN, stained), Sample No. CHN-64, and in Fig. 4: Brachiopod (B) and bi-serial foraminifera (F) shells (PPL, stained), Sample No CHN 64

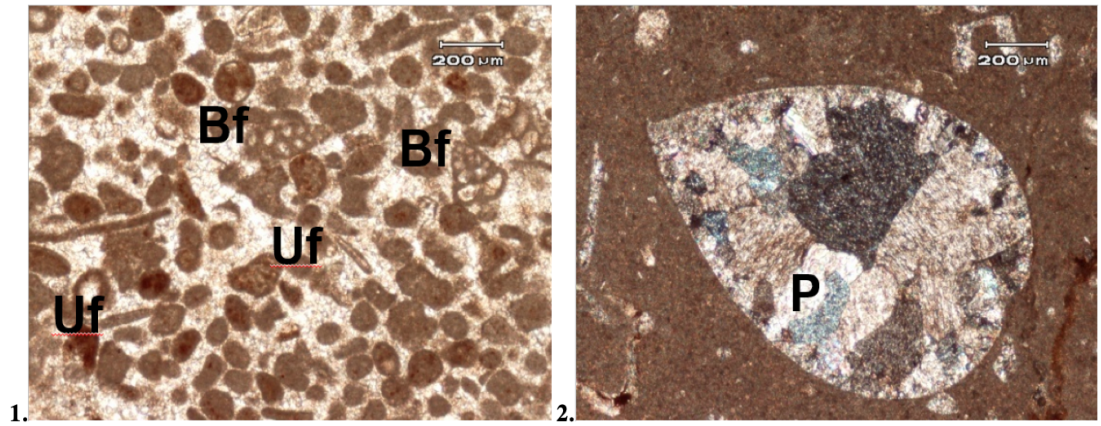

Plate 4: The photomicrographs showing in Fig. 1: A few shells of uniserial (Uf) and bi-serial foraminifers (Bf) in a pelloidal limestone (XN, unstained), Sample No. CHN-67 and in Fig. 2: A well preserved pelecypod (P), shell (XN, unstained), Sample No. CHN 98

Conclusion

The petrographic studies led to the identification of faunal assemblages belonging to seven (7) phyla representing the Invertebrate animals. The documented fossils include: foraminifers, gastropods, pelecypods bryozoans, echinoids, sponges, brachiopods and corals. Based on the laboratory investigations it was concluded that the limestone of this formation has proven to be a good repository of faunal fossils and represent a wide diversity of faunal species. The majority of limestone beds of this formation have been recorded as highly fossiliferous horizons.

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