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Nummulites and Assilina from the Chachura Formation, Baitadi district, far west, Nepal

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ABSTRACT

The Tertiary Group in the Shivnath-Salena area is characterized by brown quartzite with black carbonaceous shale, siltstone, purple and grey shale, and green sandstone with a lenticular bed of grey limestone containing foraminifera. The present palaeontological study, in the type locality, contributes to the identification and understanding of the formation. Five species from the two genera of *Nummulites* and *Assilina* are identified from the Chachura Formation in Chachura Section, Far West Nepal. The larger foraminiferal species, *Nummulites mamillatus, Nummulites globulus, Nummulites atacicus, Assilina granulate,* and *Assilina* sp., have been identified. These faunal and facies assemblages indicate that the Chachura Formation was deposited in the shallow-shelf open marine environment in an Early–Middle Eocene age.

Keywords: Lesser Himalaya; Baitadi; Tertiary sequence; *Nummunites*; and *Assilina*

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INTRODUCTION

The fossils are very important evidence to reconstruct the depositional environment and also indicate the age of each lithological unit. The study area is located in the Southern part of Baitadi District, Sudurpashchim Province, Nepal, between the Shivnath temple, and Salena. The Lesser Himalayan rocks of this region is represented by the stratigraphical and structural complex belt of predominantly Proterozoic sedimentary and meta-sedimentary rock sequences with some discontinuous beds of the Palaeocene-Early Miocene sedimentary rocks (Bashyal 1982, 1986; DeCelles et al. 2001; Dhital 2008, 2015, 2022; Gansser 1964; Heim and Gansser 1939; Khan 1969; Upreti 1999). Dhital (2008) reported the *Nummulite* fossils from the Tertiary beds in the area. Rocks of the Shivnath -Melauli-Salena area can be separated into three groups. They are the Dadeldhura Group, Baitadi Group, and Tertiary Groups.

The Palaeocene-Miocene rock sequences in Nepal are reported from the Baitadi, Bajura, Surkhet, Jajarkot, Dang, Sallyan, Rolpa, Tansen, and Sapta Koshi regions. The *Nummulites*, *Assilina,* and *Daviesina* of Lower Eocene age are found in the Subathu Formation, Lesser Himalaya, India (Bhandari and Agarwal 1967; Mishra et al. 2019). In the Eocene beds of Pakistan, *Nummulites, Operculina, Assilina, Dictyoconoides,* and *Alveolina*, in identified by Mirza et al. (2005). Unlike the other parts of the Himalaya, the foraminiferal fossils from the Tertiary sequence of Far-West Nepal lack detailed study. The Middle Eocene *Nummulites beaumonti* and *Assilina papillata* are reported from the Bhainskati Formation of the Tansen Group (Matsumaru and Sakai, 1989). A comprehensive study on foraminiferal fossils from the Nepal Himalaya is notably absent, apart from Matsumaru and Sakai (1989). In this study, the focus is on obtaining and identifying the Foraminiferal fossils in the Chachura Formation, Lesser Himalaya of the Baitadi district, Far West Nepal.

GEOLOGICAL SETTING

Ample research has been conducted in the Baitadi area to establish the lithostratigraphy of the area. Bashyal (1982, 1985, 1986); DeCelles et al. (2001); Dhital (2008, 2015, 2022); Thapa (1977); Upreti (1999), have worked on the stratigraphy and structure of the Far West Nepal. They found that the stratigraphic sequence of the area predominantly comprises phyllites, limestones, quartzites, dolomites, slates, gneiss, shales, and sandstones in a fold-thrust belt. To the north of the Dadeldhura Nappe, the Tertiary beds are exposed as a slice between the south-dipping North Dadeldhura Thrust (NDT) (Dhital 2015) and north-dipping Pachkora Thrust (PT) (Dhital 2008). The Palaeocene-Miocene rocks are deformed between the NDT and PT.

The Chuchura Formation (Dhital 2008) represents the Palaeocene-Miocene sequence that comprises the red-purple, grey shales, or brown mudstones interbedded with grey-green sandstone, with up to 1 m thick, light lenticular Nummulitic limestone beds. This formation has similar lithological characteristics to the Subathu Formation (Medlicott 1864; Valdiya 1980). At its type locality near Melauli, the Chachura Formation represents the shallow marine deposits at the basal part overlined by the continental deposits as indicated by the fining-upward sequence (Dhital 2008).

RESULTS AND DISCUSSION

Rocks of the Shivnath- Melauli- Salena area can be divided into three groups and five formations. They are the Dadeldhura

Group, Baitadi Group, and Tertiary Group. The psammitic schists, augen gneisses, garnet schists, quartzites, and amphibolites are the main rock types within the Dadeldhura Group; the grey laminated stromatolitic dolomites, black slates, green, red-purple, shales or slates, white, and grey, laminated to thick-bedded, fine to coarse-grained quartzites, and black, green, and grey strongly foliated slates are the characteristic lithology of the Baitadi Group; and the Tertiary Group is characterized by the presence of the fossiliferous limestones, purple shales, grey shales, and green and white sandstones, and brown quartzites (Fig. 1). The tight folds with steep and sometimes overturned limbs and thrust faults often disturb the stratigraphic sequences.

The Tertiary Group is exposed to the north of the Alauda Formation of the Dadeldhura Group. It occupies the WNW-ESE tending narrow belt, which occurs between the south-dipping North Dadeldhura Thrust, whose hanging wall is made up of the Alauda Formation, and the north-dipping Pachkora Thrust, containing the Salena Formation in its hanging wall. The Tertiary Group is essentially made up of very coarse-grained brown quartzites, green sandstones, purple, grey, and green-grey shales, and green to dark grey siltstone, and grey limestone. In this area, the Tertiary Group is represented by the Gosal Gad Formation and Chachura Formation (Dhital, 2008). The Chachura Formation translationally overlies the Gosal Gad Formation.

The Chachura Formation in its type locality is characterized by the deformed purple, and green-grey shale interbedded with a few light grey shales, laminated to medium-bedded, green sandstone, and medium- to very thick- (30 cm to 3 m) bedded, lenticular bed of fossiliferous grey limestone in the lower part (Fig. 3). The lenses compacted Bivalvia is observed in the green-grey weak shale (Fig. 4). The middle part is comprised of about 50 m thick fining upward sequence of medium to tick-bedded, fine to medium-grained, dense and hard, green sandstone interbedded with thin beds of purple shales. The uppermost section of the formation in this section consists of a thick sequence of purple shales with about 2-3 m thick beds of medium- to coarse-grained, white quartzites.

South of the Chachura village on the right bank of the gulley, about 3 m thick bands of massive light grey limestone and about 30 m fragile grey shale are observed (Fig. 5). The fossiliferous limestone contains large to micro benthic foraminifera belonging to the genera *Assilina* and *Nummulites*. These genera of the foraminifera are excellent age markers. The *Nummulites* are the index fossils of the Eocene Age. The larger foraminiferal species, *Nummulites mamillatus, Nummulites globulus, Nummulites atacicus, Assilina granulate,* and *Assilina* sp., have been found. The faunal assemblage has been confirmed that the Chachura Formation was deposited in the Early Eocene to Middle Eocene age (Boudaugher-Fadel, 2018).

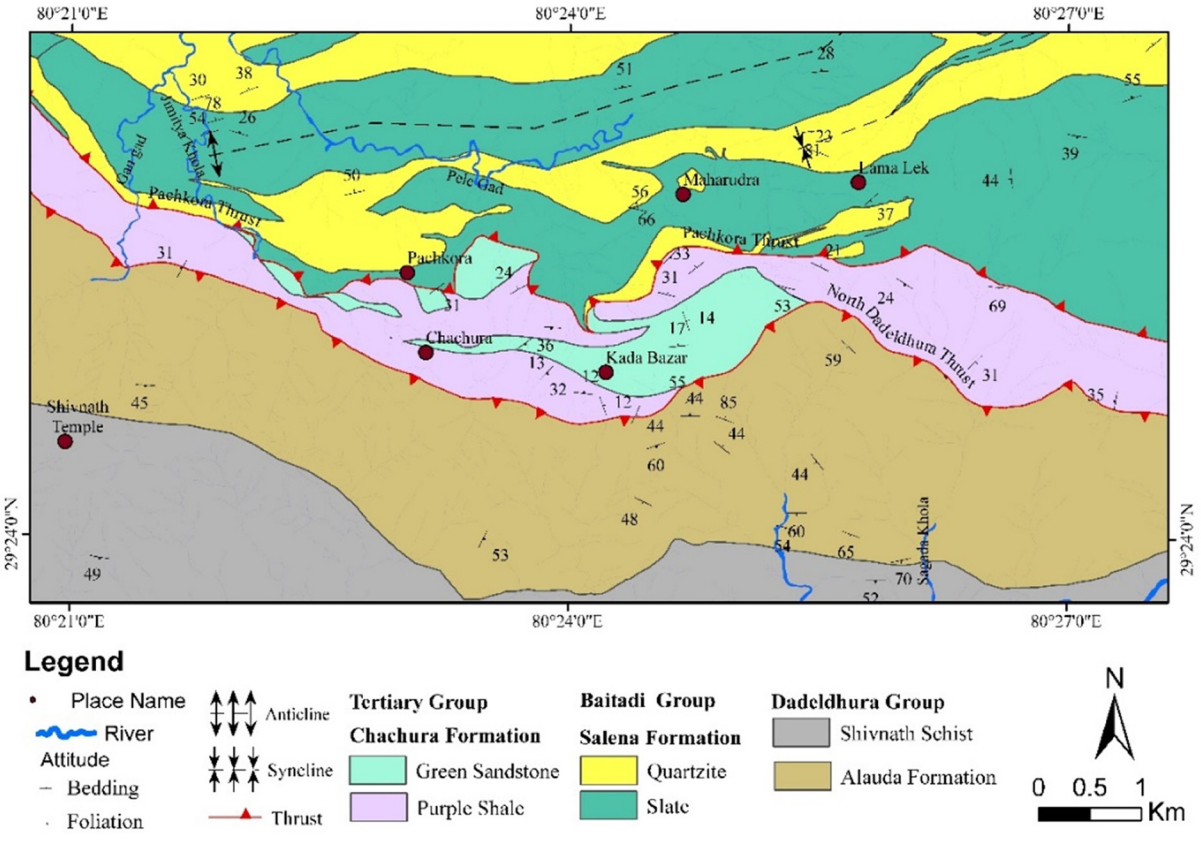

Fig. 1: Geological map of the Shivanath-Melauli-Salena area.

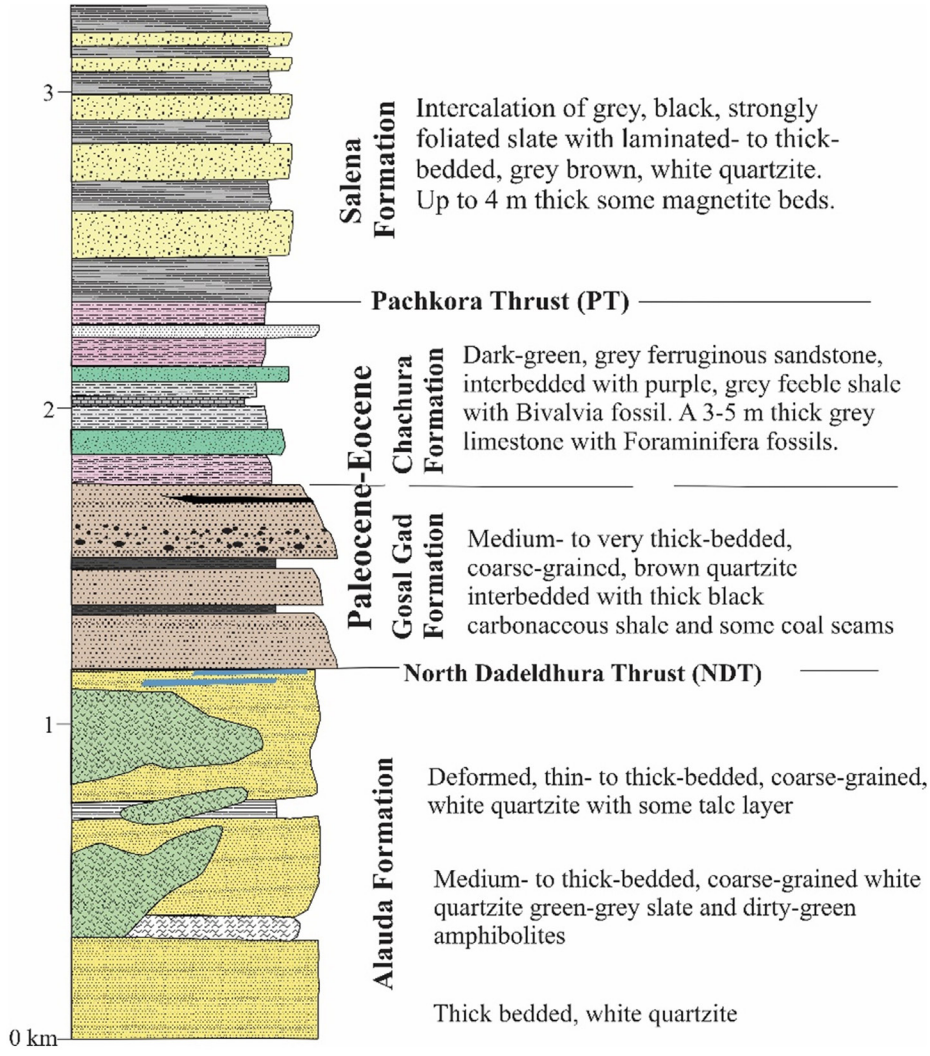

Fig. 2: Generalized tectonostratigraphic column of Salena-Melauli-Shivanath area, Lesser Himalaya.

Fig. 3: Nummulitic fossiliferous grey limestone exposed in the gulley, west of Chachura.

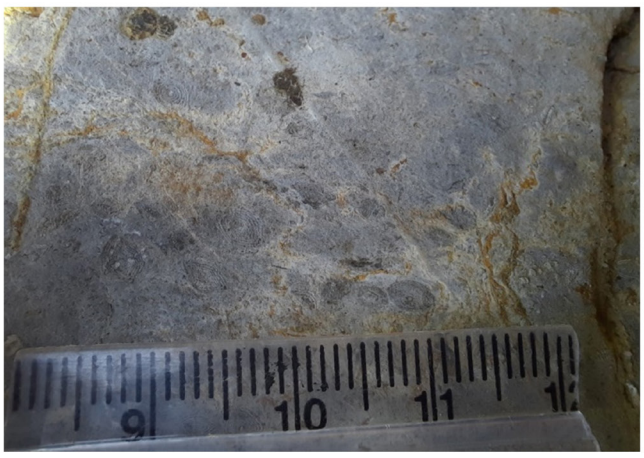

Fig. 4: Grey shale of the Chachura Formation consisting Bivalvia fossil observed near Chachura.

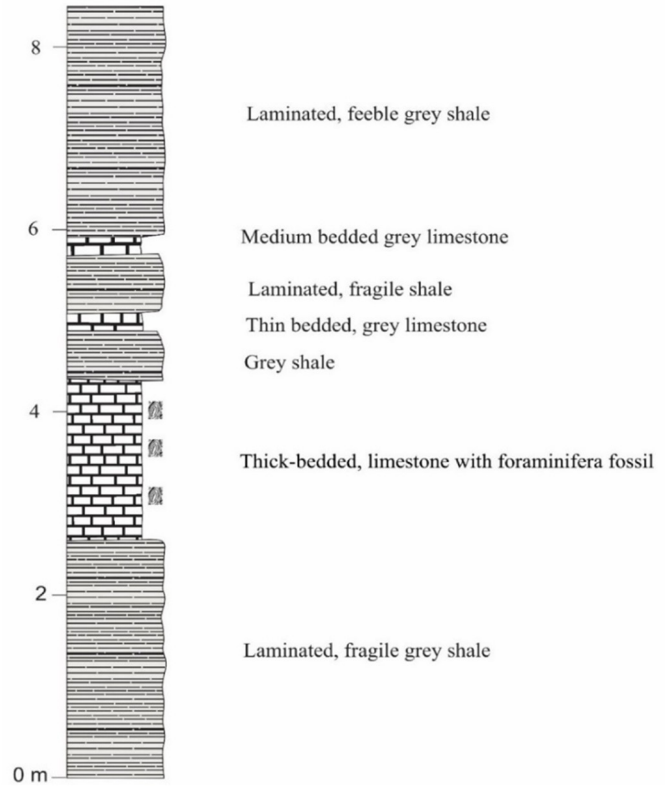

Fig. 5: Columnar section of grey shale and limestone interbedding consisting of foraminifera fossil observed on the right bank of the gulley, west of Chachura.

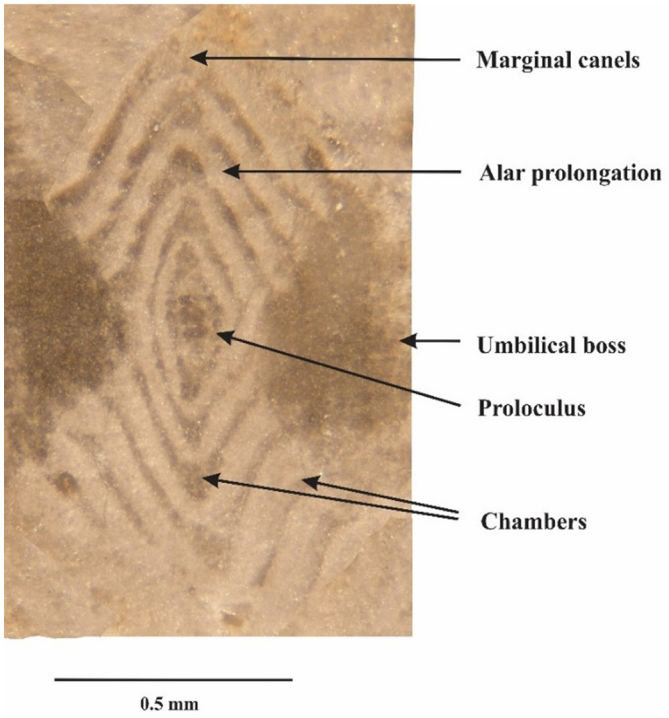

Fig. 6: Morphologic arrangement of Nummulites (Axial section).

SYSTEMATIC PALAEONTOLOGY

Genus: *Nummulites* (Lamarck 1801)

Nummulites belong to the phylum: Foraminifera, class: Globothalamea, subclass: rotaliana, order: Rotaliida, and family: Nummulitidae. Three different species of *Nummulites* have been identified.

***Nummulites mammillatus* (Fichtel and Moll 1978, Figs. 7a and 7b)**

The test is a small, biconvex shell, elliptical to subcircular proloculus, and distinct umbilical boss (Fig. 6). A thin marginal cord is present. It has a small, distinct, and prominent polar postule. The pillers are not well developed. The diameter varies from 0.8-1.6 mm.

***Nummulites atacicus*, (Leymerie 1846, Fig. 7d)**

The test is smooth. It has a biconvex shell with a larger circular prolocus. The pillers are well developed. Alar prolongations are visible. The septa filaments are thin and short. The diameter of the test varies from 1-2 mm.

***Nummulites globulus* (Leymerie 1846, Fig. 7e)**

The test is triangular to biconvex. Lenticulars to the sub-globular appearance of the shell. Pillars are well developed with small alar prolongations. It has usually a thick shell wall. The axial periphery is subacute to acute. Niddle-shaped chambers and thick lateral laminae are present. polar plunges are distinct and well-developed. This species is not very commonly seen in the polished section. The diameter varies from 0.6-1 mm

Genus: *Assilina* (D' Orbigny 1826)

Assilina belongs to the phylum: foraminifera, class: Globothalamea, order: Rotaliida, and family: Nummulitidae. Four different types of Assilina have been identified (Figs. 7c, f, g, i, and j).

***Assilina granulata* (D'Archiac 1850, Fig. 7g)**

The test shale is radial to circular. It has numerous chambers and tightly coiled tests. The chambers are nearly rectangular in shape. It had no alar prolongations. The whorl is continuous. The marginal cord is thick. The septa are radial and the septal pillars are well-developed. Proloculus is circular. The specimen is 2 mm in diameter.

***Assilina* sp. (Fig. 7j)**

The test is rod-like in shape. It has large and prominent granules. The granules are closely packed in the central part of the test. The marginal cord and septa are not distinct. The outermost whorl is smooth and not distinct. The chambers are board and enclosed. The species is 3 mm in length and 0.5 to 0.8 mm in diameter.

***Assilina* sp. (Figs. 7c and 7f)**

The test is circular in the shape axial section. Pillars are well developed. Small rectangular chambers are present. A marginal cord is well-developed. Proloculus is large. The species ranges from 0.7 mm to 1.2 mm in diameter.

***Assilina* sp. (Fig. 7i)**

The test is elliptical to circular in the axial section. It has cyclic

chambers and straight canaliculated septa. Tightly coiled test, numerous chambers per whorl, and flat are the characteristics of this species. Alar prolongation is absent. Septa are radial and the marginal cord is thick. The specimen is 0.8 mm in diameter.

Indeterminant Species (Fig. 7h)

The test is elongated with four chambers. It has linear chambers and convex canaliculated septa. The marginal cord is present. The chambers are surrounded by the marginal cord. The specimen is probably *Nummulites* or *Assilina*.

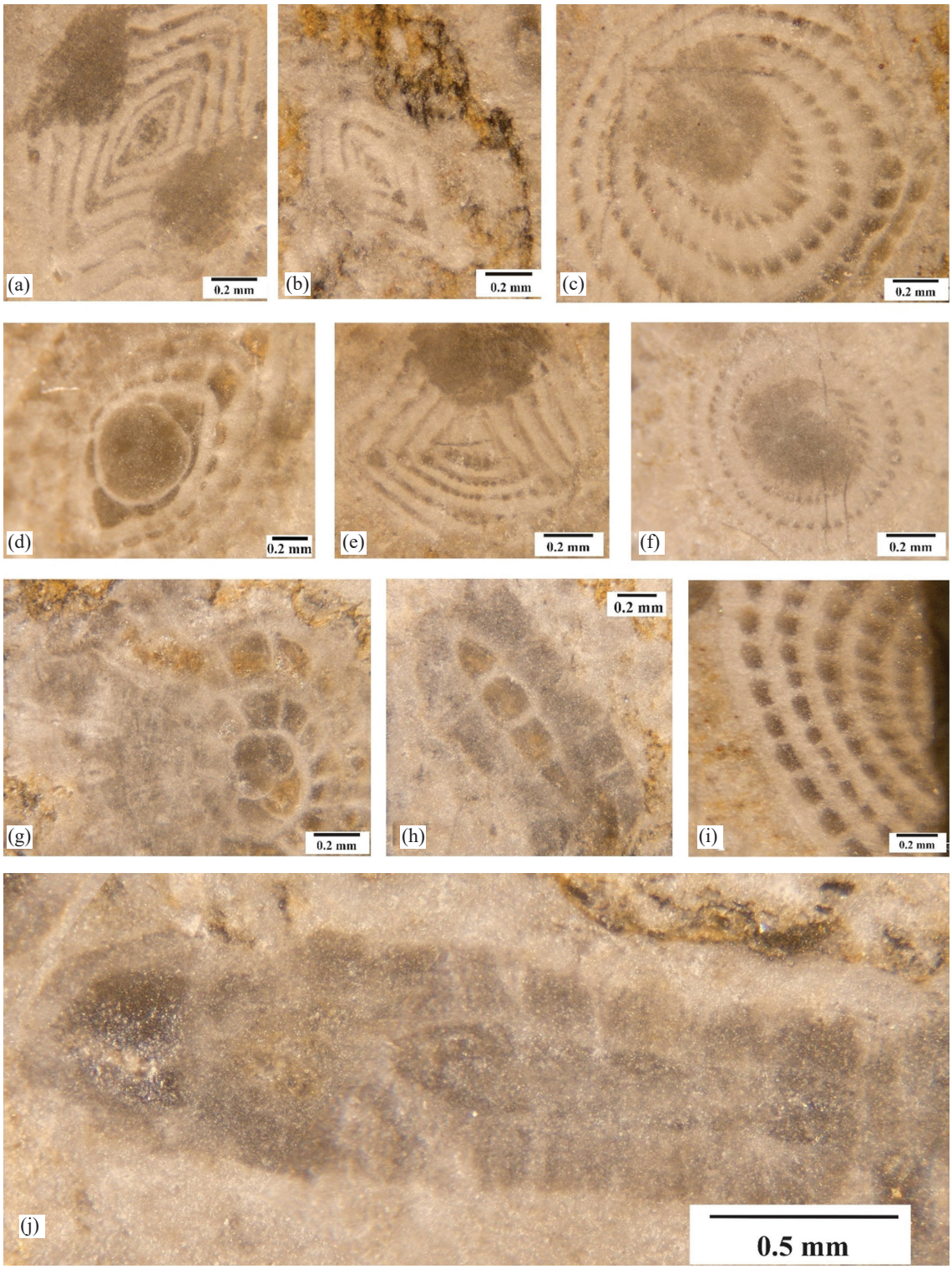

Fig. 7: Photomicrograph of axial section of a) and b) Nummulites mamillatus, c) and f) Assilina sp., d) Nummulites atacius, e) Nummulites globulus, f) Assilina granulata, h) Indet., i) Assilina sp., and j) Assilina sp.

CONCLUSION

The Middle Eocene Period is distinguished by extensive fauna and the formation of Nummulite-bank facies deposits all across the planet. The Ecoene Chachura Formation is also distinguished by Nummulite-bank facies. In the lower and middle parts of the Chachura Formation, this type of facies is widespread. The lower and middle part of the formation is characterized by primarily light grey shale and thin to thick layers of light grey to white limestones. Bivalvia and nummulitic fossils are abundant in the grey shales and limestones, respectively. In accordance with observed lithological and foraminiferal assemblage, it was determined that the Chachura Formation was deposited in the shallow-shelf open marine environment represented by marine fauna and sedimentary facies. The faunal assemblage further indicates the formation was deposited in the Early Eocene to Middle Eocene age.

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