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'Foraminiferal linings' from Late Cretaceous–Palaeocene sediments of Ohafia-Ozu Abam area, Nigeria

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Foraminiferal linings are chitinous remains representing the inner tests of certain foraminifera and are frequent occurrences in palaeo-palynological preparations. Their presence in sediments confirms marine influences. They have not been studied in as great detail as other microfossils and thus have remained a neglected and non-conventional fossil group. Since dispersed organic matter has been given a lot of importance in recent years, it has become imperative to consider the significance of these linings in biostratigraphic and palynofacies studies of a sedimentary basin during exploration for hydrocarbon resources. Here we report the foraminiferal linings encountered in the Nsukka Formation of Ohafia-Ozu Abam area in Nigeria and discuss their use in stratigraphical and palaeoecological interpretation.

WHILE studying the microfossil assemblages (fauna and flora) of outcrops belonging to the Nsukka Formation occurring in the Ohafia-Ozu Abam area of Imo state in Nigeria (Figure 1), we observed a large number of diversified foraminiferal linings in palynological preparations of shale samples collected from exposed sections between Ozu-Abam and New Nkwebi Road.

Foraminiferal linings are acid-resistant organic remains and have been referred to in many palynological communications as microforaminifera, a term coined by Wilson and Hoffmeister[1]. Although these forms have been reported earlier, only recently have their taxonomy and application in biostratigraphy and palaeoecology been highlighted by Stancliffe[2], with particular reference to British Oxfordian sediments. Since foraminiferal linings contribute to the organic component and 'palynodebris' of a microfossil assemblage, their occurrence and diversity could be used along with other conventional microfossil groups to study the palynofacies; it would also facilitate interpretation of the depositional environment. Although mention of microforaminifera is common in palynological reports of West Africa[3] and India[4–6], no attempt has been made to study them in such detail as to enable researchers to exploit fully the organic component of the sediments in which they are found for palaeoenvironmental analysis and proper evaluation of the hydrocarbon potential of a sedimentary basin. Our aim is therefore to report the occurrence of foraminiferal linings and highlight their importance in the Late Cretaceous–Palaeocene sediments of south-eastern Nigeria. The other objective of this communication is to generate interest among micropalaeontologists and palynologists to tap the resources contributed by foraminiferal linings in sedimentary rocks for a synergistic approach, as suggested by Venkatachala[7], in dealing with hydrocarbon potential of source rocks in petroliferous basins. Study of foraminiferal linings must be carried out on a systematic basis for an understanding of the total sedimentological picture of a basin for hydrocarbon exploitation.

The foraminiferal linings reported here were obtained in palynological preparations of strew mounts of three samples collected from Ozu-Abam black shale (source 1, Figure 1,*b*), Nkwebi/Ozu-Abam road section (source 2) and a section exposed at the 'stopping point' along Ozu-Abam Road (source 3). Of the six samples of shales belonging to Nsukka Formation, only three showed foraminiferal linings and other palynomorphs. However, sample number 6 of clay shale showed rare occurrence of peridinoid dinoflagellates.

As stated earlier, there is neither a classification nor a formal descriptive scheme to assign and refer foraminiferal linings. Therefore they cannot be referred to a generic or specific level. However, *Trochilisca* Deak is the only genus known, but this too has been cited under genera of uncertain status by Loeblich and Tappan[8]. Foraminiferal linings referable to *Ammonia*

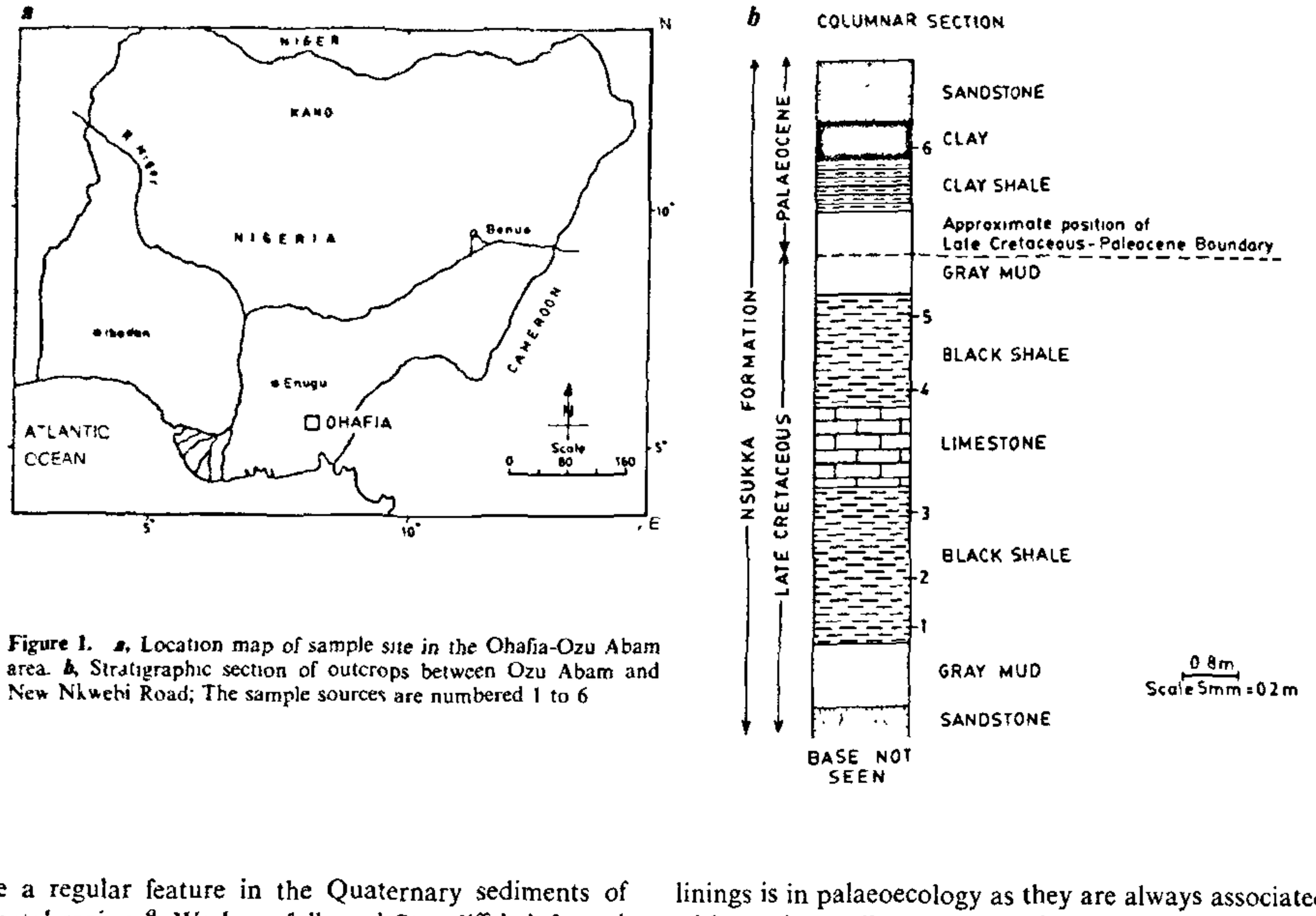

Figure 1. *a*, Location map of sample site in the Ohafia-Ozu Abam area. *b*, Stratigraphic section of outcrops between Ozu Abam and New Nkwebi Road; The sample sources are numbered 1 to 6

are a regular feature in the Quaternary sediments of coastal regions[9]. We have followed Stancliffe's informal descriptive scheme to assign the foraminiferal linings encountered in the sediments of Nsukka Formation. The various morphological forms observed are referred to three major types, viz. uniserial (Figure 2, *a–c*), coiled (Figure 2, *e–p*) and compound (Figure 2, *d–q*). Although isolated chambers occur in the Nsukka Formation, we are rather hesitant to assign them to the 'single-chamber' category of Stancliffe because of their doubtful origin. They could be either fragments of other linings or may be of some other origin (acritarchs or fungal spores). Within the above major groups one can distinguish different types also. The most dominant forms are the coiled ones and both planispiral as well as trochospiral types were recognized. A detailed report on the different morphological types and their classification will be published elsewhere.

There has not been any work on the use of foraminiferal linings in biostratigraphy although they have been recorded from sediments of Permian to Recent age. Within the Nsukka Formation their relative abundance is much more in the bottom samples than samples of higher stratigraphic level. We wish to reserve further comments on stratigraphic application of these linings until we study a few more sections of Late Cretaceous-Palaeocene for better and precise interpretation

The most important application of foraminiferal linings is in palaeoecology as they are always associated with marine sediments. No evidence of mineralization was observed on any of the linings. Secondary damages, possibly caused by the acids used in preparation, bacterial attacks, or by random mechanical breakages, were observed in many of the linings. Such features are seen as pitting and pyrite impressions on the chamber walls. The overall preservation of the foraminiferal linings is as good as that of other palynomorphs, viz. dinoflagellates, spores and pollen. Most of the foraminiferal linings, particularly the uniserial forms, could be stained very well with safranin like the vegetal debris (phytoclasts) found in palynodebris. Thus the level of organic maturation of the linings and other palynomorphs is almost the same as far as the forms of Nsukka Formation are concerned. The other important observation made here concerns their relative abundance in the overall palynomorph assemblage. The dinoflagellates and acritarchs constitute the bulk of the assemblage compared to foraminiferal linings and spores and pollen, especially at lower stratigraphic level. The quantity and quality of the assemblage of dinoflagellates and foraminiferal linings decrease as the sampling goes higher up in the stratigraphic column. This clearly indicates a decrease in salinity as well as the transitional nature of deposition towards the Late Cretaceous–Palaeocene boundary in the Ohafia–Ozu Abam area[10].

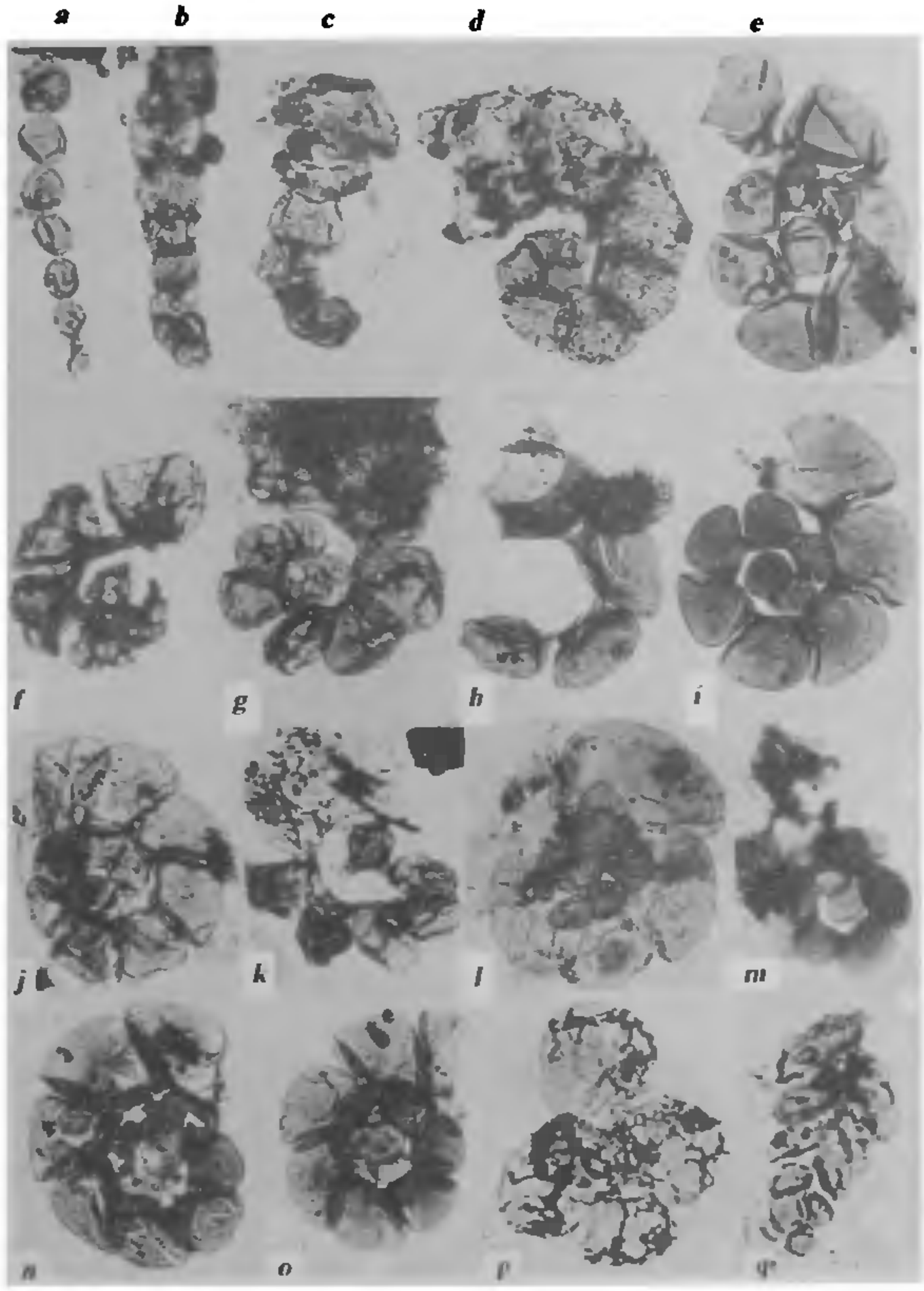

Figure 2. Photomicrographs of foraminiferal linings from the Late Cretaceous–Palaeocene sediments of Ohafia Ozu Abam area, Nigeria. *a*, Uniserial Type I (3–1, 97 × 46), *b*, Uniserial Type II (1–2, 102 × 50). *c*, Uniserial Type II (1 2, 102 × 44); *d*, Compound coiled uniserial (1–2, 99 × 47); *e*, Coiled planispiral chamber overlap Type II (3–1, 93 × 39). *f*, Coiled planispiral Type II with crenulated chamber outline (2–5, 108 × 39), *g*, Coiled planispiral form Type II (2-5, 99 × 51). *h*, Coiled planispiral form Type II initial whorl not preserved (3–2, 108 × 60); *i*, Coiled planispiral form Type II (3–1, 108 × 41); *j*, Coiled planispiral form Type II (3 4, 104 × 58); *k*, Coiled trochospiral form Type I (2–5, 99 × 48), *l*, Coiled trochospiral form Type I (3–4, 103 × 56). *m*, Coiled planispiral form Type II (2–2, 109 × 35); *n*, Coiled trochospiral form Type I (3–4, 102 × 42); *o*, Coiled trochospiral form Type I (3–1, 103 × 54); *p*, Coiled planispiral Type II (2–5, 91 × 44); *q*, Compound coiled biserial (1–3, 99 × 54) The photomicrographs were taken using a Nikon Labophot Pol Microscope. Magnification ca. 500×. The numbers in parentheses are slide numbers and coordinates on a Leitz Laborlux D microscope. The specimens are available for reference at the Department of Geology and Palaeontology, Maharashtra Association for the Cultivation of Science, Pune.

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