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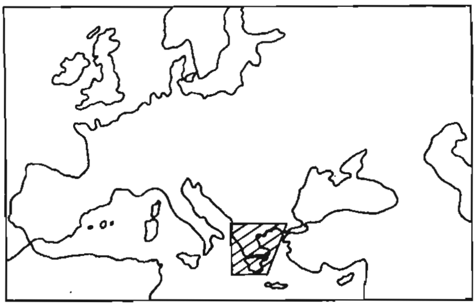
CRITICAL REVISION OF THE AGE OF THE BASAL VIGLA LIMESTONES (IONIAN ZONE, WESTERN GREECE), BASED ON NANNOPLANKTON AND CALPIONELLIDS, WITH PALEOGEOGRAPHICAL CONSEQUENCES

V. KARAKITSIOS and L. KOLETTI

Key words: Nannofossils, calpionellids, biostratigraphy, paleogeography, Early Cretaceous, Vigla Limestones, Ionian Basin, Greece.



Abstract:

The age of the base of the Vigla Limestones Formation (Ionian Zone, western continental Greece) in the Ionian Basin is revised, based on the study of nannofossils and calpionellids. The revised age indicates that the depositition of the Vigla Limestones started during the Early Berriasian and that this event was synchronous over all the basin. As a consequence, the Vigla Limestones represent the beginning of post-rift deposition in the Ionian Basin.

1. Introduction

This study concerns the Vigla pelagic limestones of the Ionian Basin, which crop out in Epirus, western Greece (Figs. 1, 2). This formation was called "Viglaeskalk" by PARTSCH (1887) and attributed to the Jurassic; STEFANI (1894) gave an Eocene age; RENZ (1955), maintaining the term "Viglaeskalk", assigned the whole formation to the Malm-Eocretaceous. AUBOUIN (1959) dated this unit as Late Jurassic-Early Senonian and noted that the sedimentation of these deep-water deposits was continuous.

Prof. V. KARAKITSIOS, dr. L. KOLETTI, Dept. of Geology, Lab. of Hist. Geology and Paleontology, National University of Athens, Greece.

The authors of the IGRS-IFP (1966) defined the formation as a succession of thin-layered (5-20 cm), sublithographic, white-cream limestones, with abundant radiolaria and frequent cherty beds with radiolaria. In the upper part of the formation (Albian-Cenomanian) they also defined a "superior siliceous zone" (cherty beds with green or red clay interbedding, sometimes shaley). The Vigla Limestones were attributed to the Tithonian-Early Senonian on the basis of a rich microfauna, containing calpionellids and globotruncanids. They described the uniformity of the depositional conditions of the formation all over the Ionian and Preapulian (Paxos) Zones, and its great thickness variations, from a few tens of meters to 900 m. They further noted that the calpionellids indicate synchronous onset of sedimentation in the Tithonian, except in of the Petalia area (Corfu), where the base of the formation is Neocomian. They concluded that the base of this formation represents an important transgressive phase, submerging all previous geographical highs.

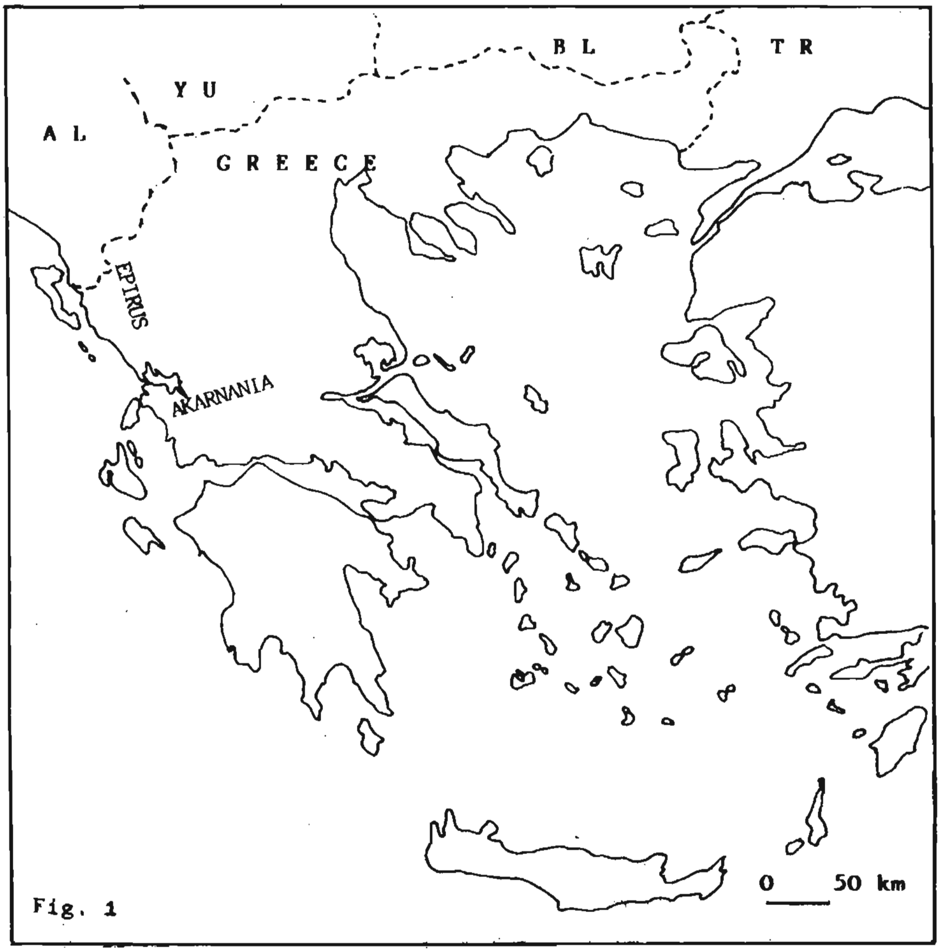


Fig. 1: Simplified map of Greece and location of Epirus and Akarnania regions on it. AL) Albania. YU) Yugoslavia. BL) Bulgaria. TR) Turkey.

Later studies attributed the onset of Vigla Limestone deposition to the Late Tithonian (BERNOULLI and RENZ, 1970 in Epirus) or to the Berriasian (BP, 1971 in Akarnania; XHOMO et al., 1971; DALIPI et al., 1971 in Albania), also based on calpionellids. The radiolarian fauna from the lowermost part of the Vigla Limestones shows that these strata were deposited after the Middle Tithonian (KARAKITSIOS et al., 1988), while DANELIAN (1989), also using radiolaria, suggested diachronous deposition of the Vigla Limestones in Epirus.

In this study, we give a more precise age to the base of the Vigla Limestones and thus we can better address the question of its synchronous/diachronous nature in the Ionian Basin.

2. Paleogeographical importance of the onset of deposition of the Vigla Limentones

Stratigraphically the age of the base of the Vigla Limestones is considered to be of great importance in the different Ionian Zone domains. The uniformity of depositional conditions throughout the Ionian Zone, indicated by the Vigla Limestones and the possible synchronous onset of their sedimentation in this region is also considered to be of great paleogeographical importance. The deposition of the limestones marks the end of the internal differentiation that characterized the area during the Upper Lias-Malm interval. In that period, distentional tectonics, associated with the latest opening of the Tethyan Ocean, occurred (KARAKITSIOS, 1990). Intense listric block-faulting affected the Lower Liassic shallow platform (Pantokrator Limestones) and resulted in the formation of several small, structurally-controlled basins. This is evidenced by facies and thickness variations in the

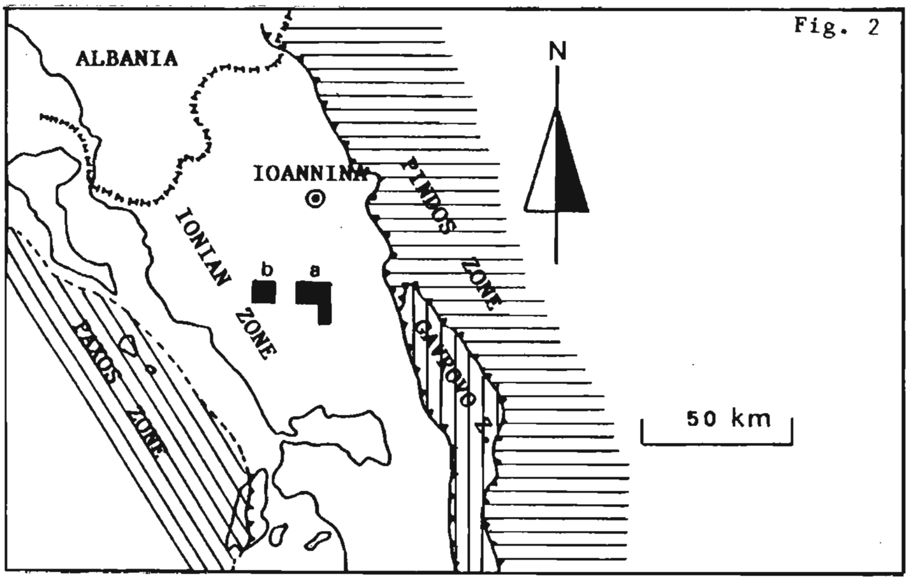


Fig. 2: Location of the studied areas.

Middle Liassic to Malm deposits (Siniais or Louros Limestones, Ammonitico Rosso or lowermost Posidonia Beds, Limestones with Filaments, Upper Posidonia Beds), and by the direction of synsedimentary tectonic features (slumps, faults). Prismatic synsedimentary wedges in these basins vary in thickness along an E-W direction and underline the facies distribution (hiatuses are located on top of tilted blocks and the Ammonitico Rosso and lowermost Posidonia Beds Formation is located in the deeper parts of the half-grabens).

3. Micropaleontogical data

The base of the Vigla Limestones, as mentioned above, was variously attributed to the Tithonian (IGRS-IFR, 1966), the Late Tithonian (BERNOULLI and RENZ, 1970), or the Berriasian (BP, 1971) on the basis of the presence of calpionellids. The association (*Calpionella alpina* and *C. elliptica*) cited by the IGRS-IFP authors is today attributed to the Early Berriasian and the association cited by BERNOULLI and RENZ (1970) has to be reconsidered carefully (*C. elliptica* does not coexist with *Crassicollaria brevis* and *C. intermedia* (KARAKITSIOS et al., 1988)). DALIPI et al. (1971) and XHOMO et al. (1971) consider the base of the Vigla Limestones to be of Early Berriasian age (based on the presence of *C. alpina* and *C. elliptica*).

Five sections were studied from the SE to NW (Figs. 3, 4). The microfacies are characterized by mudstones with microfossil associations, dominated by calpionellids.

Small forms of *Calpionella alpina* and abundant C. *elliptica* are present in the first meters of the base of Vigla Limestones in all sections. Therefore, the samples indicate Zone C of REMANE (1985), which is Early Berriasian in age.

In the same samples, the nannofacies is characterized by oligotypic calcareous nannofossils, with variable abundance, and in particular by the genus *Watznaueria*, which is one of the most resistant to diagenetic dissolution. *Cyclagelosphaera margerelii*, *Watznaueria britannica*, *W. communis* and *W. barnesae* were observed together with *Conusphaera mexicana*, *Nannoconus colomii*, *N. steinmannii*, *Diazomatolithus lehmanii*, *Biscutum constans*, *Lithraphidites carniolensis* and *Manivitella pemmatoidea* (Pls. 1, 2). In most of the studied samples nannoconids form the principal element of the micrite, which is characteristic of Lower Cretaceous nannofloras (zones CC1-CC2 pp).

We can conclude, from the micropaleontological analyses of several sections, and from the revision of the previous age determinations, that the onset of Vigla Limestone sedimentation is isochronous throughout the Ionian Zone and is Early Berriasian in age.

4. Conditions of sedimentation and conclusions

The Vigla Limestones represent continuous, pelagic deposition (AUBOUIN, 1959), from the beginning of the Cretaceous to the Senonian, confirmed by the fossil associations. The deposit is characterized by a high sedimentation rate (BERNOULLI and RENZ, 1970). THIEBAULT (1982) estimated that the base of the Vigla Limestones was

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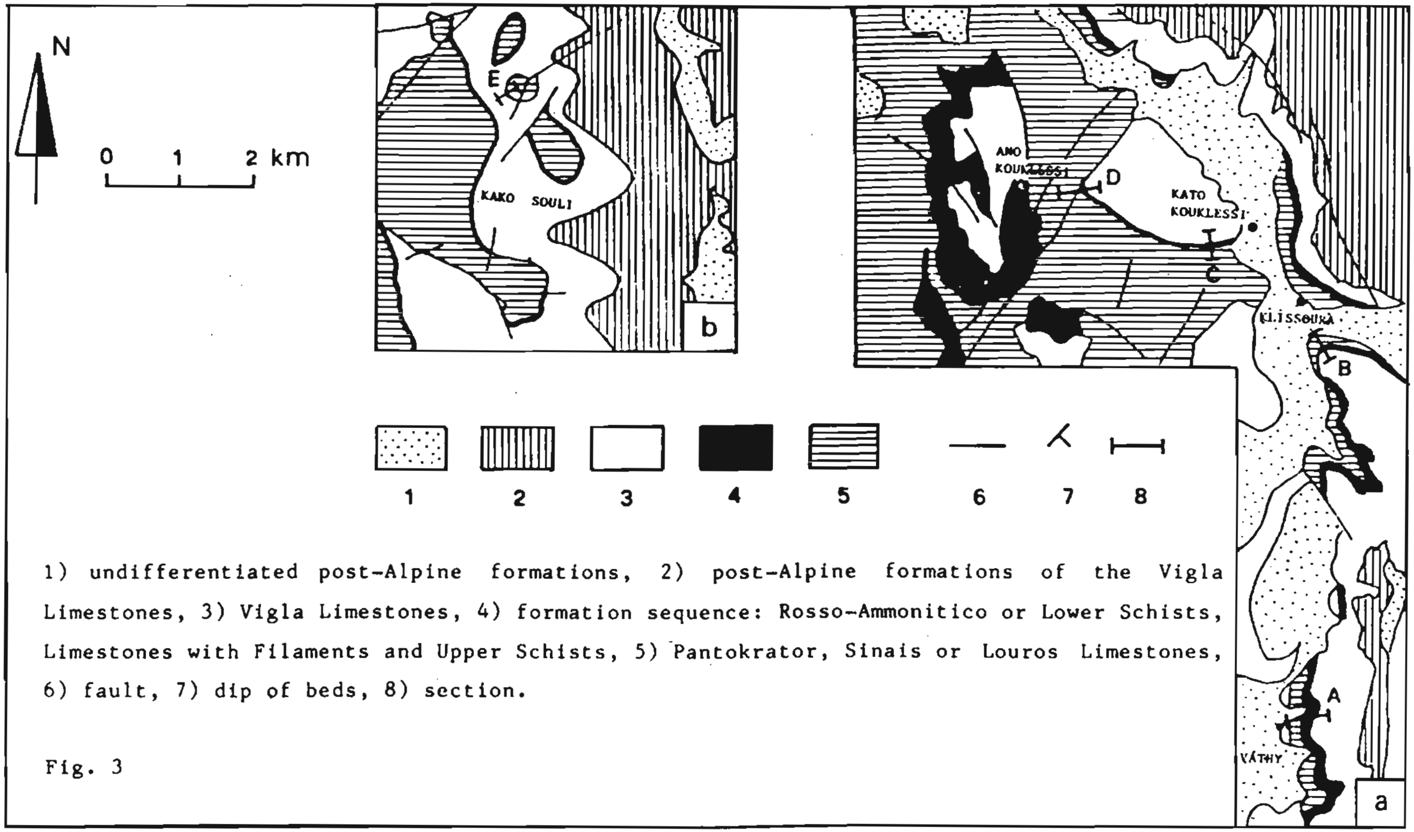
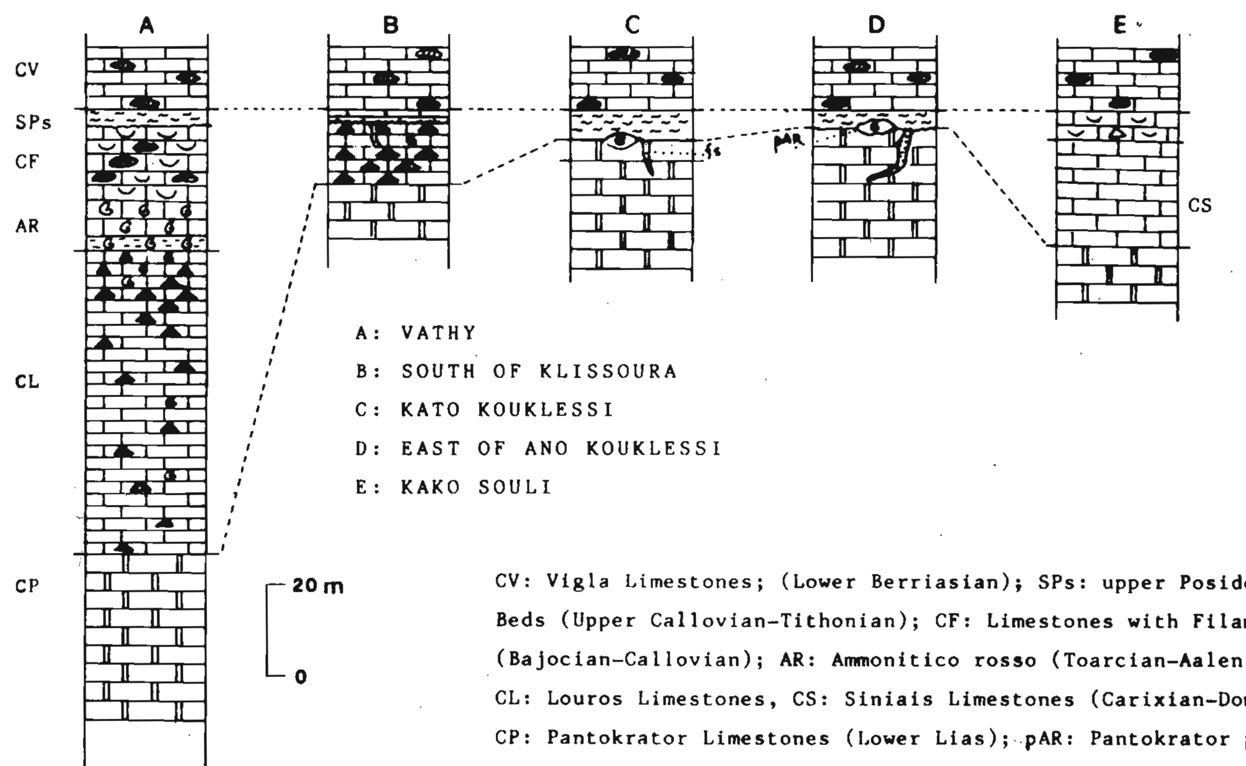
Fig. 3: Simplified geological maps of the areas located in Fig. 2 and location of the studied sections (A, B, ... E).



1) undifferentiated post-Alpine formations, 2) post-Alpine formations of the Vigla Limestones, 3) Vigla Limestones, 4) formation sequence: Rosso-Ammonitico or Lower Schists, Limestones with Filaments and Upper Schists, 5) Pantokrator, Sinais or Louros Limestones, 6) fault, 7) dip of beds, 8) section.

Fig. 3

Fig. 4



CV: Vigla Limestones; (Lower Berriasian); SPs: upper Posidonia Beds (Upper Callovian-Tithonian); CF: Limestones with Filaments; (Bajocian-Callovian); AR: Ammonitico rosso (Toarcian-Aalenian); CL: Louros Limestones, CS: Siniais Limestones (Carixian-Domerian); CP: Pantokrator Limestones (Lower Lias); pAR: Pantokrator pocket with Ammonitico rosso (Toarcian); fs: sedimentary dykes.

deposited at a rate 5 or 6 times greater than the sediments of the Upper Jurassic. The uniformity of the sedimentation conditions throughout the Ionian Zone, together with the high sedimentation rate, show that the sea submerged the ancient structural highs and that theVigla Limestone infilled the basins, blanketing the submarine topography. Continuing differential subsidence during deposition of the Vigla Limestones, as shown by the wide variation in thickness of this formation (IGRS-IFP, 1966), is probably due to the continuation of halokinetic movement of the Ionian Zone evaporitic substratum, which started during the Middle Lias (KARAKITSIOS, 1990).

We advance two hypotheses to explain the submersion of the ancient topography:

1. Rising sea-level due to eustatic processes.
2. Sinking of the Ionian Basin.

The first hypothesis can be rejected, because a widespread sea-level rise would have manifested itself in the adjacent Gavrovo Zone, which instead has shallow-water facies during the Cretaceous.

The second hypothesis seems most likely. The Vigla Limestones correspond to a general subsidence of the entire basin. The relatively abrupt change from a siliceous facies (Upper Posidonia Beds = radiolarian chert facies) to a mostly calcareous one (Vigla Limestones), which seems to be in contradiction with the steady sinking of the Ionian Basin, is due to the simultaneous lowering of the CCD (calcite compensation depth) at the end of the Jurassic (BOSELLINI and WINTERER, 1975) to below the maximum basin depth. This phenomenon was not restricted to the Ionian Basin but occurred over the whole Western Tethys (ROTH, 1986; BOWN et al., 1991).

In conclusion, the Vigla Limestones represent the first post-rift sediments of the Ionian Basin, rather than the "Limestones with Filaments" as proposed by DANELIAN (1989) ("Limestones with Filaments": a lenticular formation not present in several parts of the Ionian Basin, KARAKITSIOS, 1990). However, the upper part of the Upper Posidonia Beds and their equivalents may represent the beginning of the end of the syn-rift period, which is completed with the Vigla Limestones deposition.

Therefore, we conclude that the beginning of the Vigla Limestone deposition is isochronous in the Ionian Zone and starts in the Early Berriasian. The Vigla Limestones largely blanket syn-rift structures (KARAKITSIOS, 1990) and in some cases, they directly overlie the pre-rift sequences (i. e. Pantokrator Limestones) (Fig. 4). As a consequence, the base of the Vigla Limestones represents the break-up unconformity of the post-rift sequence of the Ionian Zone.

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Fig.4: Stratigraphical columns of the sections located in the Fig. 3.

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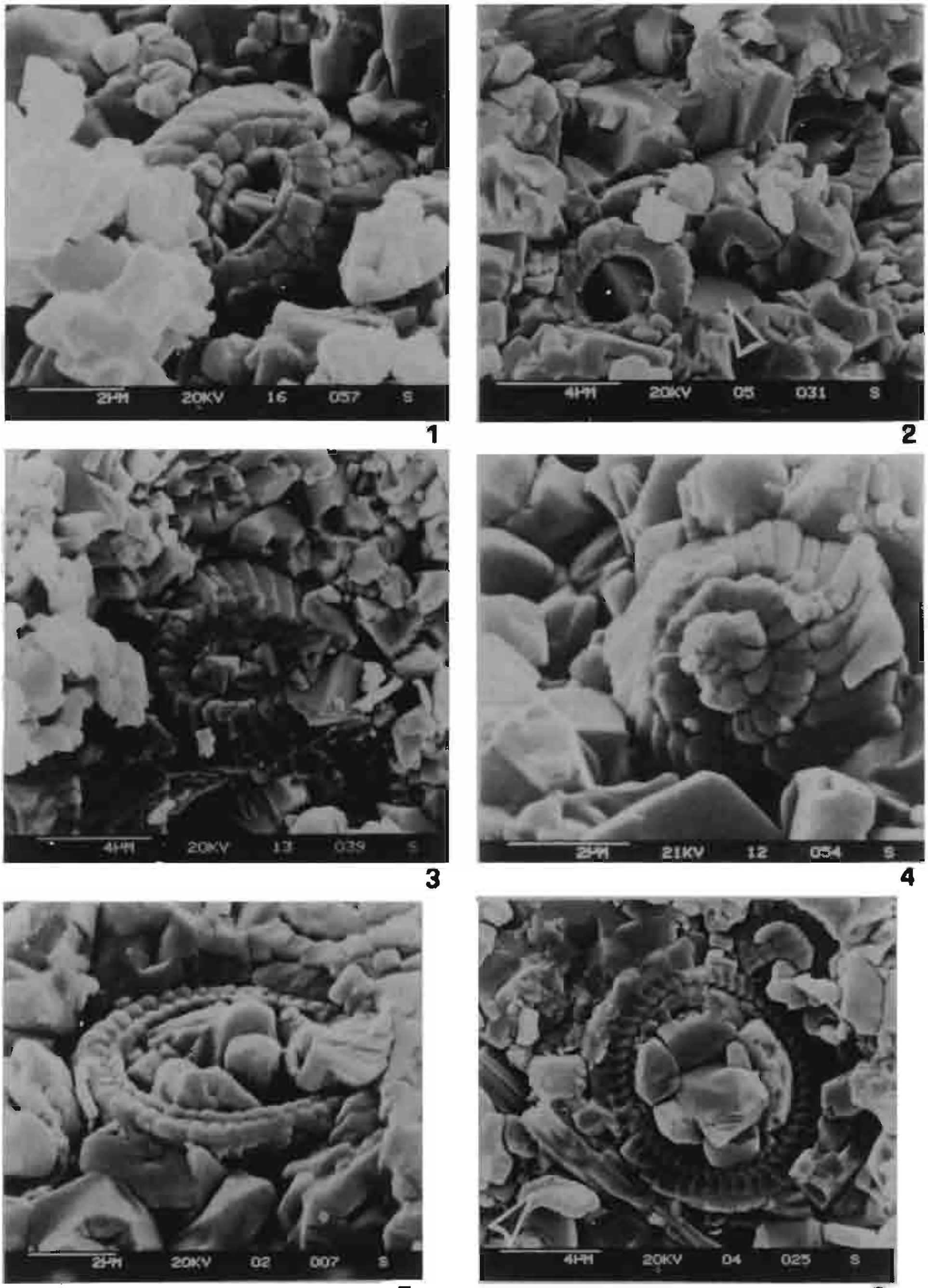
Fig. 1: *Watznaueria britannica* (STRADNER).
Fig. 2: *Biscutum constans* (GÓRKA).
Fig. 3: *Watznaueria communis* REINHARDT.
Fig. 4: *Cyclagelosphaera margerelii* NOEL.
Fig. 5: *Manivitella pemmatoidea* (DEFLANDRE).
Fig. 6: *Lithraphidites carniolensis* DEFLANDRE.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1 2 3 4 5 6

Pl. 1

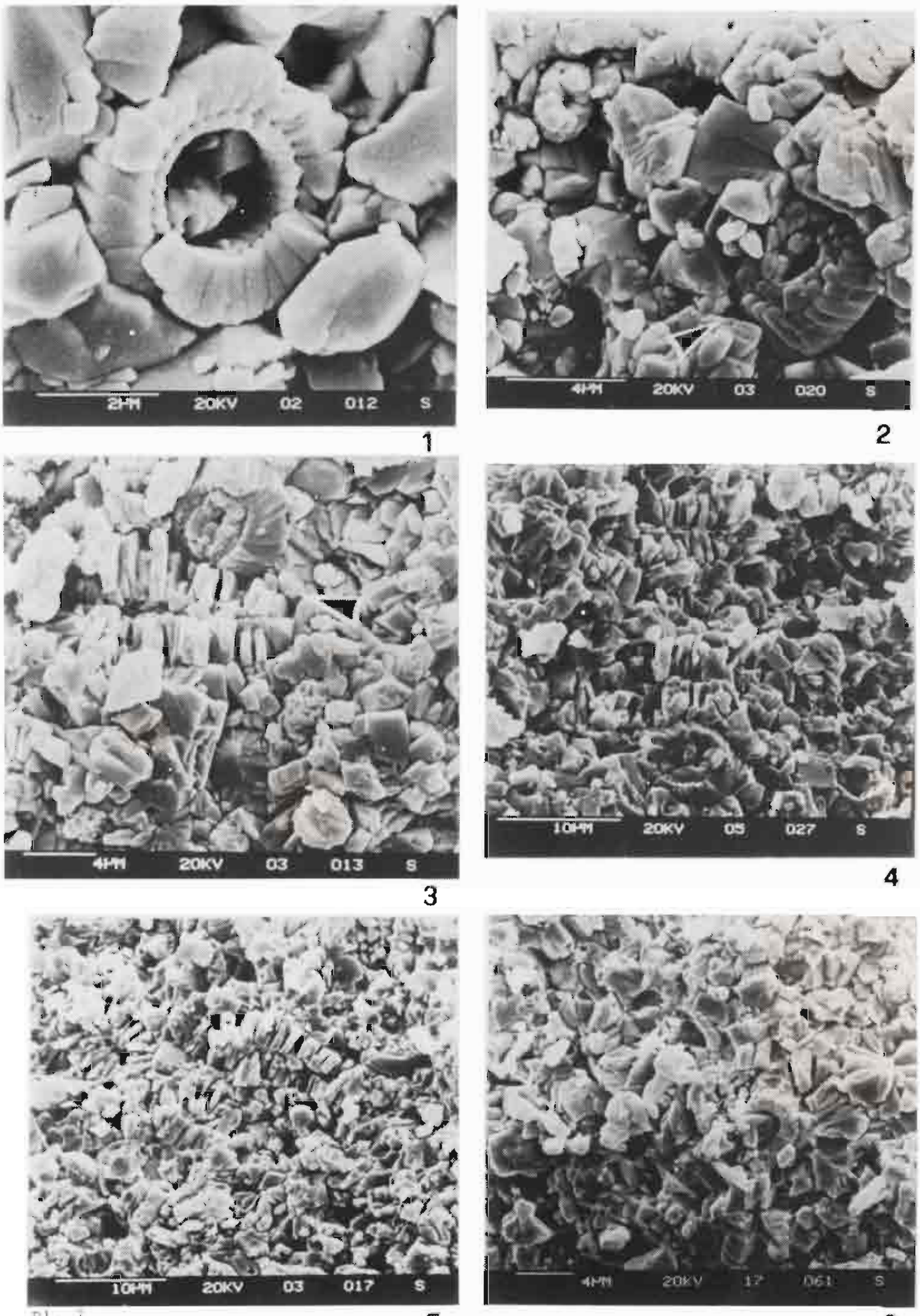
PLATE 2

Fig. 1: *Diazomatolithus lehmanii* NOEL.

Fig. 2: *Watznaueria barnesae* (BLACK).

Fig. 3: Nannofacies with nannoconids and *Watznaueria*.

Fig. 4, 5, 6: Typical nannomicrite from the Vigla Limestones Formation. The bulk of the micrite consists of nannoconids.



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4µM 20KV 17 061 S
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Pl. 2