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FORAMINIFERA, ALGAE AND CARBONATE MICROPROBLEMATICA FROM THE LATE WUCHIAPINGIAN/DZHULFIAN (LATE PERMIAN) OF PELOPONNESUS (GREECE).

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Abstract. The origin of late Permian olistoliths found in the Glypia Cenozoic flysch must be seeked in regions located to the east of the Parnon Mountain and in units that were more internal to Pindos Unit, especially in the islets of Karavia in the Argolis Gulf, and the Episkopi Formation in Hydra Island, that display probably the largest outcrops of this age.

The most interesting olistolith is a bioclastic grainstone. It yields about forty taxa of algae, microproblematica, smaller foraminifera and fusulinids, that are briefly described.

Three markers generally not co-occurring are locally associated: *Paradunbarula (Shindella) shindensis*, *Hemigordiopsis* cf. *luquensis* and *Colaniella* aff. *minima*. The age of the *Paradunbarula (Shindella)* biozone is most probably late Wuchiapingian/Dzhulfian, although other datings have been proposed from late Capitanian to late Changhsingian. Due to this dating of the *Shindella* zone, the coexistence of the first *Colaniella* with the last *Hemigordiopsis* are not late Capitanian/Midian in age, but late Wuchiapingian.

The similarities of the Greek microfauna with that of South China and southeastern Pamirs, are incompatible with a larger Paleotethys but support the paleogeographic reconstructions which indicate a close location of these geographic units (Pangea B).

Riassunto. L'origine degli olistoliti di età permiana superiore rinvenuti nel flysch cenozoico di Glypia deve essere ricercata in regioni situate ad est delle Montagne del Parnon ed in unità che erano più interne all'Unità Pindos, in particolare nelle isolette di Karavia nel golfo dell' Argolide e nella Formazione Episkopi nell'isola di Hydra , dove affiora il più vasto affioramento di rocce di questa età.

L'olistolite più interessante è un grainstone bioclastico. Esso contiene circa 40 taxa di algae, microproblematici, piccoli foraminiferi e fusulinidi, che vengono brevemente descritti. Tre forme marker, che generalmente non si trovano in associazione, sono qui invece rinvenute insieme. Essi sono: *Paradunbarula (Shindella) shindensis*, *Hemigordiopsis* cf. *luquensis* e *Colaniella* aff. *minima*. L'età della biozona a *Paradunbarula (Shindella)* è molto probabilmente tardo Wuchiapingiano/Dzhulfiano, sebbene in passato siano state proposte anche altre datazioni, dal Capitaniano superiore al Changhsingiano superiore. Sulla base di questa datazione della zona a *Shindella*, risulta che la coesistenza delle prime *Colaniella* con gli ultimi *Hemigordiopsis* non è di età tardo Capitaniano/Midiano, bensì Wuchiapingiano superiore.

Le affinità della microfauna greca con quelle della Cina meridionale e del sud-est Pamir sono ritenute incompatibili con una Paleo-Tetide estesa, ma sono indicative di posizioni più vicine tra queste aree, fornendo argomenti per le ricostruzioni paleogeografiche secondo la configurazione Pangea B.

Introduction

On the Parnon mountain range (central eastern Peloponnesus, Greece) the Glypia Unit overlies the Alpine units of Tripolis and Pindos (Skourtsos et al. 2001) (Fig. 1). The Glypia Unit corresponds to a wild flysch of Cenozoic age including a great number of volcanic and carbonate exotic blocks.

There are four types of carbonate olistoliths: (1) large blocks (up to 50 m^3) of pelagic, micritic, reddish or yellowish limestone with alternations of dark-colored, clastic limestone with Globotruncanidae; (2) grey, medium to thick-bedded, microbrecciated limestone, very rich in Orbitolinidae and fragments of rudists, pelecypods, algae and corals; (3) elongate bodies of dolomitic breccia of unknown age; (4) the small, up to 1.5 m^3, gray to whitish, very fossiliferous late Permian olistoliths studied here (Fig. 1c). Their geological importance was previously emphasized by Skourtsos et al. *(*2002). The description of the micropaleontological assemblage, systematics of the microfossils, biostratigraphy and consequences for the late Permian Tethyan paleobiogeography, are presented.

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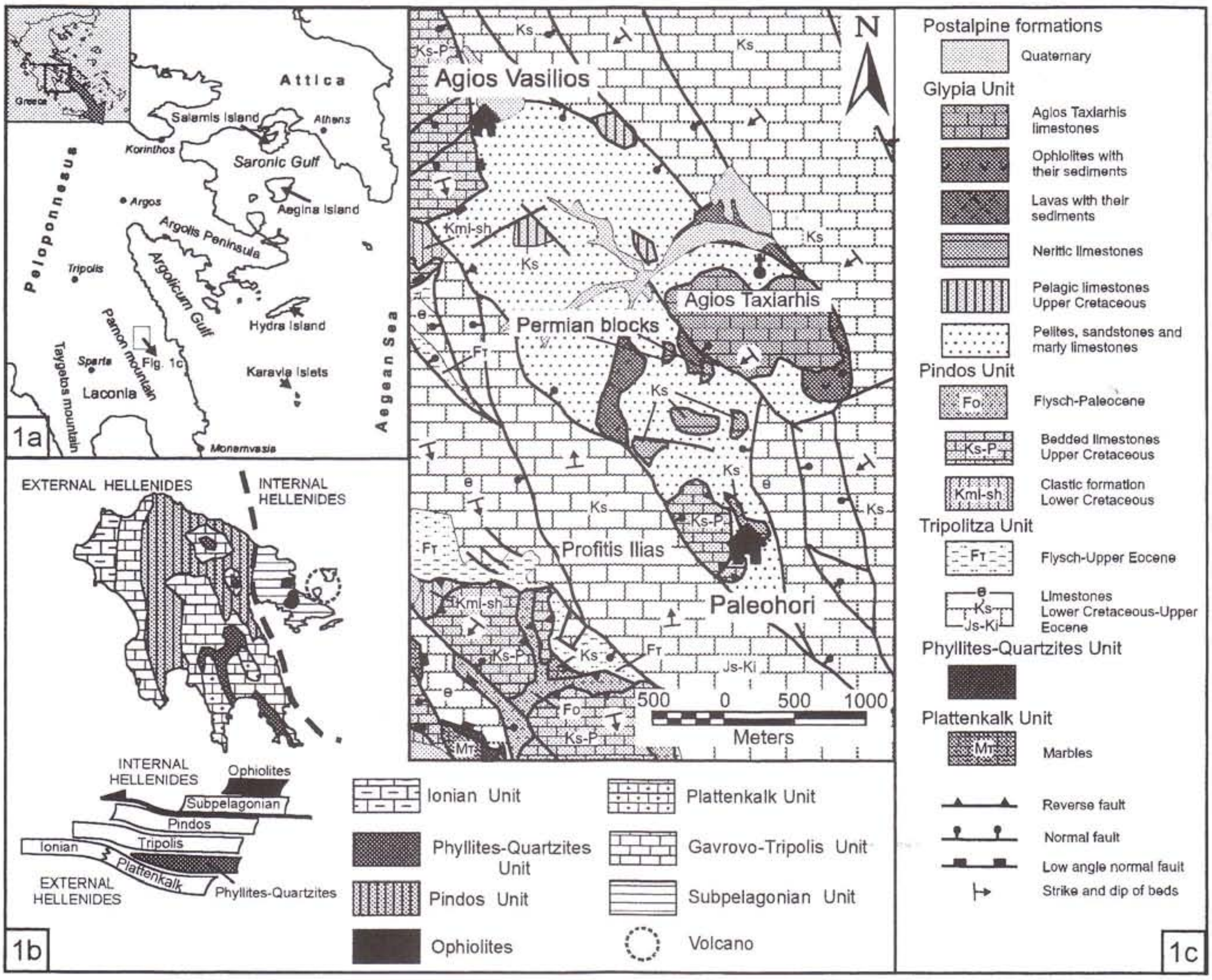

Fig. 1 - Location sketch maps of Parnon Range (Peloponnesus, Greece). 1a: Location in Greece. 1b: Geological map and structural interpretations. 1c: Stratigraphical and structural column.

Previous work

Several outcrops of wild flysch have been described in the general area of the Peloponnesus. These outcrops correspond to early Cenozoic clastic series sandwiched between the Gavrovo-Tripolitza unit carbonate platform below and overlying deep-water allochthonous Pindos Unit (Dercourt 1964; Richter & Mariolakos 1973; Fleury 1976; De Wever 1976; Lekkas 1978; Degnan & Robertson 1994). The Ermioni Complex on the Argolis Peninsula (Aranitis 1960a, 1960b; Clift & Robertson 1989; Clift 1996), the Beotic flysch (Clément 1971; Richter et al. 1996) in central continental Greece, the Arvi and Miamou nappes on the island of Crete (Bonneau 1973, 1976), represent similar examples of wild flysch formations that are internal to the Pindos Unit.

The Parnon mountain chain in the central eastern Peloponnesus consists of a number of imbricated tectonic nappes, that from bottom to top, are (Bassias 1984; Skourtsos et al. 2001) (Fig. 1b): the Plattenkalk Unit, a metamorphic carbonate series of Mesozoic-Cenozoic age with a metaflysch cover of Oligocene age; the Phyllites-Quartzites Unit, a metaclastic Permo-Triassic series with metavolcanics bodies; the Gavrovo-Tripolitza Unit that consists of a volcano-sedimentary formation at the base, followed by a Late Triassic carbonate platform with a Late Cenozoic flysch at the top; the Pindos Unit formed in an oceanic basin that rifted in the early-mid Triassic and the uppermost Glypia Unit.

The occurrences of the Glypia Unit were formerly attributed by Thiébault (1982) to the Paleochora Unit, that was defined as the uppermost member of the Gavrovo-Tripolitza Unit (Lekkas 1978). Detailed mapping of the studied area showed that the Glypia Unit overlies tectonically the Pindos Unit (Skourtsos et al. 2001), whereas the Paleochora Unit is overthrusted by Pindos Unit (Lekkas 1978).

Middle and late Permian foraminifera of Greece are rather poorly known and poorly illustrated, except for the Wordian, i.e. Murgabian (Baud et al. 1991; Grant et

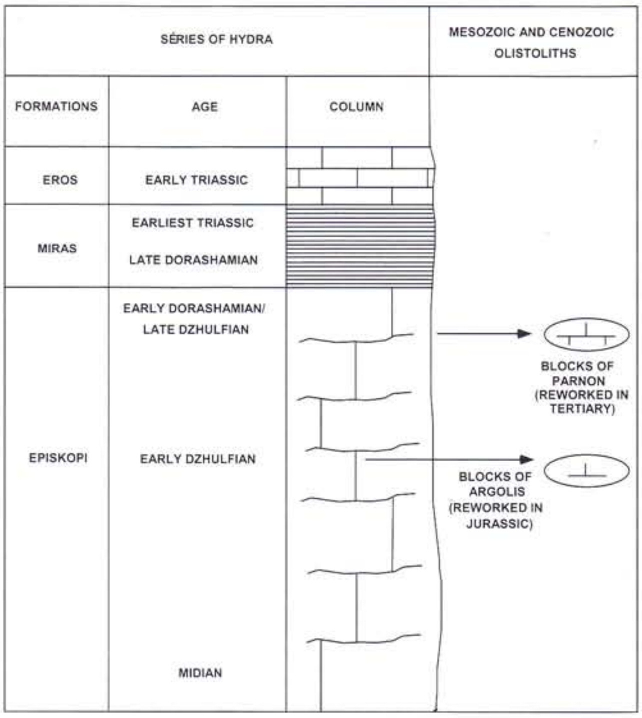

Fig. 2 - The late Permian-early Triassic Formations of Hydra (Greece), and the origin of the blocks and olistoliths reworked in the Mesozoic and Cenozoic series. (without scale).

al. 1991; Tataris 1969, 1988; Vachard et al. 1993b, 1995; with bibliography), although the major part of this stage is probably more accurately Capitanian/Midian in age according to the subsequent criteria of Leven (1992). The presence of Midian with *Neoschwagerina margaritae* and *Reichelina* sp. is mentioned in Hydra in the Marmari Formation, and in the lower part of the Episkopi Fm. (Baud et al. 1991; Grant et al. 1991), and may be also supposed in Laconia (Trifonova 1985, re-interpreted). The Wuchiapingian/Dzhulfian limestone constitutes the middle/upper part of the Episkopi Formation (Newell & Wardlaw 1987; Baud et al. 1991; Grant et al. 1991), and is subdivided into early and late Wuchiapingian by conodonts (Newell & Wardlaw 1987; Grant et al. 1991). The early Wuchiapingian is also dated by foraminifera, reworked within Jurassic breccias in Argolis Peninsula (Vachard et al. 1993a).

Finally, the Changhsingian/Dorashamian is characterized by various foraminifera: *Palaeofusulina, Globivalvulinoides, Baudiella, Paradoxiella, Colaniella* in Attica (Altiner & Ozkan Altiner 1998; Vachard et al. 1993b), and in the uppermost part of the Episkopi Fm., that contains true *Palaeofusulina* (Baud et al. 1991; Grant et al. 1991, fig. 6D).

Origin of the late Permian olistoliths

As the Glypia Unit represents the uppermost tectonic unit in the central eastern Peloponnesus and, as the imbrication of the nappes was the result of a westward movement, it is suggested that the origin of the limestone blocks rich in Permian assemblages should be seeked in regions located to the east of the Parnon Mountain, and in units that were more internal to Pindos Unit nappes. Rocks from which the Permian limestone blocks could have been derived are located on the Hydra island and on the Karavia islets in the Argolicum Gulf (Fig. 1a). In these places Permo-Triassic series have been described. These series constitute the base of the Subpelagonian Unit (Renz 1955; Römermann 1968; Fig. 1b). Another more internal unit to the Pindos nappe is mentioned in southeastern Peloponessus close to Monemvasia, by Brauer et al. (1980), Gerolymatos et al. (1982) and Danielan et al. (2000). At this outcrop first Brauer et al. (1980) described relics of the Pelagonian terrain, e. g. crystalline limestone of Anisian age, accompanied by mafic and ultramafic rocks. Within the lavas Gerolymatos et al. (1982) observed lenses of limestone that were very rich in Permian fossils. These lithoclasts must be re-examined.

The nature of the Glypia Unit shows that this unit was formed in a frontal basin along an active margin. This active margin was constituted of several imbricated nappes. According to the lithology of the exotic blocks, we consider that the nappes were consisting of rocks of different origin and age. The presence of Permian blocks, derived from the base of the Subpelagonian Unit, means that already in the early Cenozoic the base was exhumed to the Earth surface. The subsequent deformation of the Glypia Unit is due to a later shearing of the unit during the late Cenozoic when the Pelagonian terrain was overthrusted onto the Pindos Unit.

The principal candidates to the origin of late Permian olistoliths of the Glypia Unit are the Potami Formation on the Argolis Peninsula (Vachard et al. 1993a), Hydra island (Renz 1955; Römerman 1968; Baud et al. 1991; Grant et al. 1991) and the Karavia islets in the Argolicum Gulf (Tataris 1969, 1988) (Fig. 1a).

Skourtsos et al. (2001) have also mentioned the similarity of some components of the Glypia Unit with the Ermioni Complex (Aranitis 1960a, 1960b; Bannert & Bender 1968; Bachmann & Risch 1979; Gaitanakis & Fotiadis 1991; Clift & Robertson 1989; Clift 1996), and the Arvi and Miamou nappes, described from Crete by Bonneau (1973, 1976). Nevertheless, olistoliths of late Paleozoic age have not been mentioned within the above units: the oldest determined age is Kimmeridgian by corals in the Miamou nappe (Bonneau 1973, 1976), and, among the middle-late Permian stages, only the Murgabian yields foraminifera in Crete (Vachard et al. 1995).

On the Karavia islets, Tataris (1988) described whitish, thick-bedded, middle Permian limestone, very rich in fossils, such as *Neoschwagerina* sp., *Parafusulina* sp., *Pachyphloia* sp., *Palaeotextularia* sp., *Schwagerina* sp. and *Lasiodiscus* sp. This limestone is older than the investigated material, and is probably Murgabian or early

Midian in age. However, Tataris (1988) mentioned that because of an abrupt cliff, it was not possible to sample the entire section.

The assemblages of the lithoclasts described by Vachard et al. (1993a) in the Potami Formation (Argolis Peninsula) are almost similar, but a little older, because their microfauna with are more primitive (see below).

On Hydra island, Römermann (1968), Grant et al. (1991) and Baud et al. (1991) described a series of thick-bedded, bioclastic limestone and carbonate breccia that are very rich in fossils such as algae, small foraminifera and fragments of gastropods, bryozoans and corals (Episkopi Formation). Baud et al. (1991) mentioned similar sequences on Aegina island in the Saronic Gulf, where there is an occurrence of poorly stratified bioclastic packstone with some chert and silicified corals, bryozoans and calcisponges. Consequently an outcrop of the Episkopi Formation or its equivalents, is probably at the origin of the olistoliths of the Glypia Unit, as well as the carbonate blocks of Argolis Peninsula (Fig. 2). Therefore the erosion and reworking of the Episkopi Fm. and its equivalents is active during all the Mesozoic (Potami Formation, Argolis Peninsula) and the Cenozoic eras (Glypia Unit, Parnon Mountain). Due to the existence of numerous lithoclasts or olistoliths in the Dorashamian (Baud et al. 1991; Altiner & Özkan-Altiner 1998: fig. 1), the reworking of the Episkopi Fm. can begin as soon as the latest Permian.

Microfacies and assemblages

The most interesting microfacies in the investigated Permian olistoliths (sample Phi 38) is a bioclastic grainstone with two generations of cements (palissadic and coarsely granular). The assemblage is rich in algae, corresponding to an agitated environment in the photic zone, at a depth of 5-10 m, in a tropical carbonate shallow shelf (Fig. 3).

The carbonate microfossils, occurring together in the sample Phi 38 (thin sections Phi 38a to 38f), are as follows (R= rare; RC = relatively common; VR = very rare):

Metazoan remains: gastropods (RC) (including Bellerophontoidea), bivalves (R), crinoids (R), bryozoa (R), calcisponges (R).

Algae: *Parachaetetes* sp. (VR), *Permocalculus* sp. (R), *Gymnocodium bellerophontis* (Rothpletz, 1894) Pia, 1920 (R) (Pl. 4, fig. 6), *Eugonophyllum* sp. (VR), *Mizzia* cf. *yabei* (Karpinsky, 1908) (R), *Macroporella apachena* Johnson, 1951 (VR) (Pl. 5, fig. 2), *Salopekiella* sp. (VR), *Likanella* (?) sp. (VR) (Pl. 5, fig. 3), *Atractyliopsis lastensis* Accordi, 1956 (VR) (Pl. 4, fig. 2).

Pseudo-algae: *Tubiphytes* ex gr. *obscurus* Maslov, 1956 (R) (Pl. 3, fig. 5: typical morphotypes, Pl. 4, fig. 1, 4-5: atypical morphotypes similar to the foraminifer *Nodophthalmidium*), *Pseudovermiporella* ex gr. *nipponica* (Endo in Endo & Kanuma, 1954) (R) (Pl. 4, fig. 3), *Claracrusta calamistrata* Vachard, 1980 (VR), *Eflugelia johnsoni* (Flügel, 1966) Massa & Vachard, 1979 (VR), *Ungdarella* (?) sp. (R).

Smaller foraminifera: *Spireitlina conspecta* (Reitlinger, 1950) (R), *Neoendothyra* sp. (VR), *Tetrataxis conica* (Ehrenberg, 1854) (R), *Abadehella* sp. (VR) (Pl. 5, fig. 9), *Palaeotextularia* sp. (VR), *Climacammina* cf. *valvulinoides* Lange, 1925 (RC) (Pl. 5, fig. 1), *Cribrogenerina* sp. (RC), *Globivalvulina graeca* Reichel, 1945a (R), *G. vonderschmitti* Reichel, 1945a (VR), *Sengoerina* aff. *argandi* Altiner, 1999 (VR) (Pl. 4, fig. 6), *Neodiscus* sp. (R) (Pl. 1, fig. 5), *Multidiscus padangensis* (Lange, 1925) (Pl. 1, fig. 4, Pl. 3, fig. 5, Pl. 4, fig. 2, 6, Pl. 5, fig. 6-8), *Hemigordiopsis* cf. *luquensis* (Wang & Sun, 1973) (RC) (Pl. 1, fig. 7, Pl. 2, fig. 6-7, Pl. 3, fig. 1-5), *Agathammina* sp. (VR), *Nodosaria* (?) sp. (VR) (Pl. 5, fig. 5), *Geinitzina* sp. (VR), *Calvezina* (?) sp. (VR) (Pl. 5, fig. 4), *Pachyphloia* sp. (VR), *Colaniella* aff. *minima* Wang, 1966 (R) (Pl. 1, fig. 3, 6).

Fusulinids: *Sphaerulina zisonzhengensis* Sheng, 1963 (RC) (Pl. 1, fig. 2, Pl. 3, fig. 5), *Reichelina* ex gr. *media* Miklukho-Maklay, 1954 (VR), *Schubertella* sp. (VR), *Codonofusiella* ex gr. *tenuissima* Sheng, 1963 (VR), *Paradunbarula (Shindella) shindensis* Chediya in Kotlyar et al., 1983 (RC) (Pl. 1, fig. 1, 7, Pl. 2, fig. 1-5), *Nanlingella* (?) sp. (VR) (Pl. 1, fig. 3), abraded *Neoschwagerina* sp. (VR).

Biostratigraphy

The datation of the sample Phi 38 depends on the datation of the *Shindella* biozone. The age of this biozone is controversial. The biozone of *Shindella pamirica-S. simplicata* was defined in the Takhtabulak Formation of southeastern Pamirs, by Kotlyar et al. (1983), and firstly dated as latest Capitanian/Midian, but this age was completely modified by Kotlyar et al. (1999), and the formation was assigned to the late Changhsingian.

Nevertheless, an intermediate age, i.e. late Wuchiapingian/Dzhulfian dating is more justified for six reasons (Skourtsos et al. 2002): (1) the *Shindella* biozone is placed in the late Dzhulfian by Davydov et al. (1996, fig. 4); (2) the beds containing *Shindella* in the southeastern Pamirs, are located between lower Midian and lower Triassic deposits, and are not typically late Midian nor late Changhsingian in age; (3) no true *Palaeofusulina* has been found in our assemblage, and two taxa: *Nanlingella* (?) and *Sengoerina* aff. *argandi* might be phylogenetically directly related to true *Nanlingella* and to *Paradagmarita flabelliformis* Zaninetti et al., 1981, both considered as early Changhsingian microfossils; (4) in Greece a relatively similar assemblage dated early Dzhulfian (Vachard et al. 1993a), is actually more primitive because it includes *Pseudodunbarula* and *Pseudowanganella* and not *Paradunbarula (Shin-*

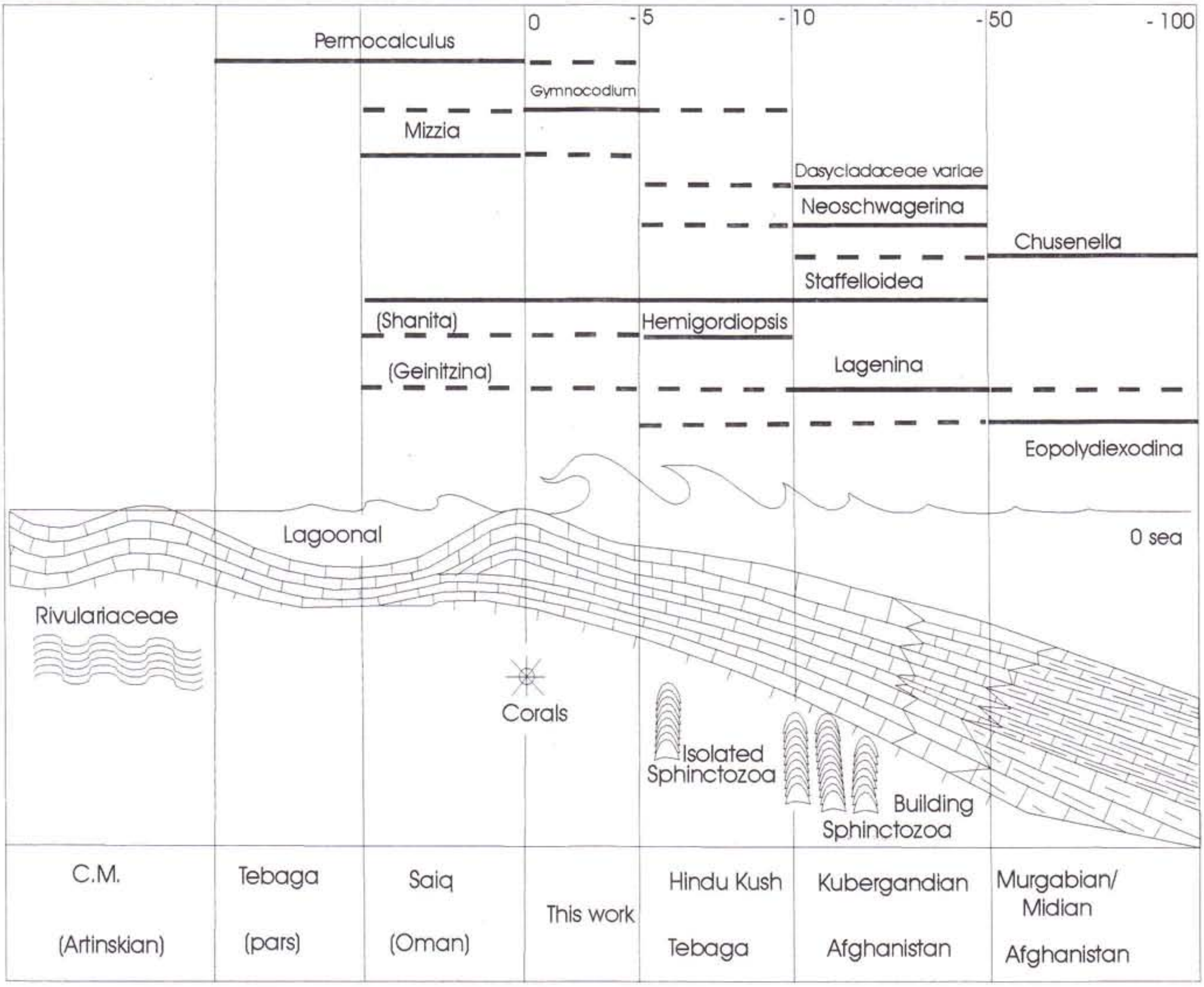

Fig. 3 - Schematic profile and foraminiferal and algal biotopes during the middle/late Permian (according to Vachard, 1980 and unpublished data). Abbreviation - C.M.: Central Mountains of Afghanistan.

della) and *Colaniella*, phylogenetically more advanced (Fig. 4); (5) the upper part of the Episkopi Fm., probable origin of the Glypia olistoliths, is clearly late Wuchiapingian/ Dzhulfian - early Changhsingian/Dorashamian, dated by conodonts (Nestell & Wardlaw 1987; Grant et al. 1991), whereas its foraminifera seem to be late Changhsingian in age, due to the presence of *Colaniella* ex gr. *lepida* and *Palaeofusulina* ex gr. *sinensis* identified by Baud et al. (1991, pl. 2, fig. 2-3) and Grant et al. (1991, fig. 6D); (6) the Episkopi Formation is separated of the early Triassic Eros Formation by the Miras Formation, which correspond consequently to the late Chianghsingian (Fig. 2).

Three principal biostratigraphic markers are associated in this local late Wuchiapingian: *Paradunbarula (Shindella) shindensis, Hemigordiopsis* cf. *luquensis* and *Colaniella* aff. *minima*. Data concerning the evolution of the three groups are summarized into Fig. 4, based on various data from Afghanistan (Vachard 1980, completed), Greece (Vachard et al. 1993a), Oman (Montenat et al. 1977; Vachard et al. 2001) and the late Midian of the former USSR (Kotlyar et al. 1983, 1989).

The proposed attribution of the *Shindella* biozone to the late Wuchiapingian in Greece has two important implications, that might explain some misinterpretations of the biostratigraphic literature on the late Permian: (a) the genus *Hemigordiopsis* survives in the late Dzhulfian, contrary to the opinion of Pronina (1995); many of these Dzhulfian *Hemigordiopsis* were probably named *Kamurana* or *Pseudobaisalina*, two poorly known genera; (b) the first appearance of *Colaniella* occurs in the late Dzhulfian, contrary to previous proposals indicating an appearance in the latest Midian (Chediya & Davydov 1982; Jenny-Deshusses & Baud 1989).

Paleobiogeography

The assemblage is also paleobiogeographically significant, and it confirm similarities between Greece,

CHRONOSTRATIGRAPHY			SMALLER FORAMINIFERS			FUSULINIDS	
			HEMIGORDIOIDS	NODOSARIOIDS	SCHUBERTELLOIDS	NEOSCHWAGERINOIDS	SCHWAGERINOIDS
LATE PERMIAN	CHANGHSINGIAN / DORASHAMIAN		*Pseudomidiella-* *Graecodiscus*	*Colaniella lepida*	*Palaeofusulina-* *Nanlingella*	post-keriotheca phase	
	WUCHIAPINGIAN DZHULFIAN	Late	*Hs.* cf. *luquensis-* *Kamurana* s.s.	*Colaniella* aff. *minima*	*Nanlingella* (?)- *Paradunbarula* (*Shindella*)		
		Early	*Graecodiscus* *Shanita*	*Pseudowanganella*	*Paradunbarula* (*Paradunbarula*) *Pseudodunbarula*		
MIDDLE PERMIAN (partim)	CAPITANIAN MIDIAN	Latest		?	Advanced *Dunbarula*	?	very rare *Chusenella*
		Late	"*Kamurana* (?)"- *Hs. orientalis*	?		*Neoschwagerina-* *Yabeina-Lepidolina-* *Neosumatrina*	Chusenellidae
		Early	*Hemigordiopsis renzi*	*Nodosinelloides* (?) spp.	Typical *Dunbarula*	*Yabeina-Neoschwagerina-* *Sumatrina*	*Chusenella*
		Earliest	*Neodiscus* spp.		Primitive *Dunbarula*	*Neoschwagerina-* Advanced. *Afghanella-* *Sumatrina*	*Chusenella-* last *Eopolydiexodina*
	WORDIAN/MURGABIAN				*Rauserella*	Typical *Afghanella-* *Neoschwagerina*	*Eopolydiexodina* *Parafusulina*

Fig. 4 - Comparative table of the main foraminifera of the middle-late Permian in the Tethyan basins from Greece to South China.

Southeast Pamir and South China.

The genus *Paradunbarula* has been described in Anatolia (Turkey) (Skinner 1969), the subgenus *Shindella* is identified in southeastern Pamirs and South China (Kotlyar et al. 1983), but absent in Transcaucasia (Kotlyar et al. 1989). *Hemigordiopsis luquensis* (Wang & Sun, 1973) is a species from South-China. Its probable synonym, *Hemigordiopsis orientalis* (Wang & Sun, 1973), exists also in Transcaucasia (Pronina 1988; Kotlyar et al. 1989). Our investigated material contains *H.* cf. *luquensis*. This taxon is relatively different of the Chinese material, because it displays less whorls (4-5 versus 5-7) for the same diameter, but it is similar to a taxon from Montenegro (Pantic 1965, pl. 5, fig. 1-4, cited under the erroneous name of *H. renzi*).

The most ancient *Colaniella* were mentioned in Pamir, South China and Salt Range, Pakistan (Wang 1966; Chediya & Davydov 1982; Okimura 1988; Jenny-Deshusses & Baud 1989).

The identity of the Greek and South-Chinese fusulinids is also documented by the early Changhsingian genus *Baudiella* (Altiner & Özkan-Altiner 1998), that is only known from two localities: in Greece (Salamis Island) and South China (Nanjing area).

Consequently, the similarities of the Greek microfauna with that of South China and southeastern Pamirs

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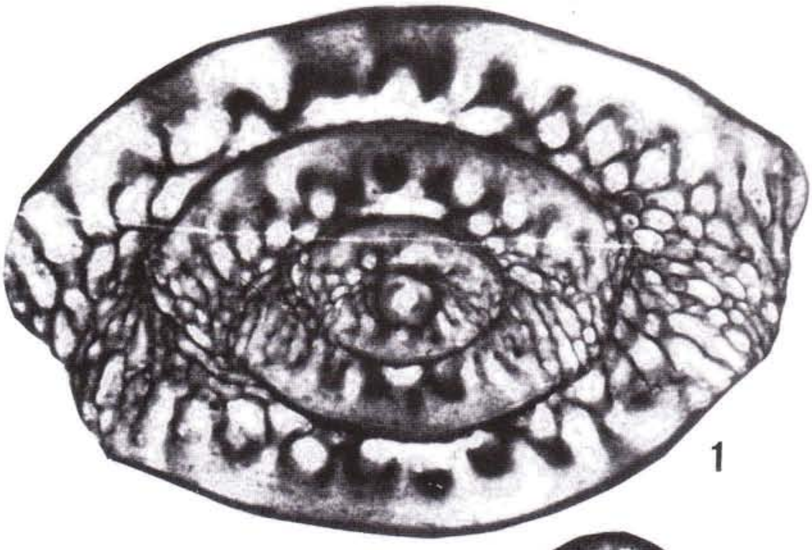
PLATE 1

Fig. 1 - *Paradunbarula (Shindella) shindensis* Chediya in Kotlyar et al., 1983. Axial section. Slide Phi 38b. x 40.
Fig. 2 - *Sphaerulina zisonzhengensis* Sheng, 1963. Oblique section. Slide Phi 38d. x 30.
Fig. 3, 6 - *Colaniella* aff. *minima* Wang, 1966. 3 - Oblique section (bottom) with a subtransverse section of *Nanlingella* (?) sp. (top). Slide Phi 38a. x 75. 6 - Oblique section. Phi 38a. x 75.
Fig. 4 - *Multidiscus padangensis* (Lange, 1925). Axial section. Slide Phi 38d. x 40.
Fig. 5 - *Neodiscus* sp. Axial section. Sample Phi 38b. x 40.
Fig. 7 - *Hemigordiopsis* cf. *luquensis* (Wang & Sun, 1973). Transverse section (bottom) with a subtransverse section of *Paradunbarula (Shindella) shindensis* (top). Slide Phi 38b. x 30.



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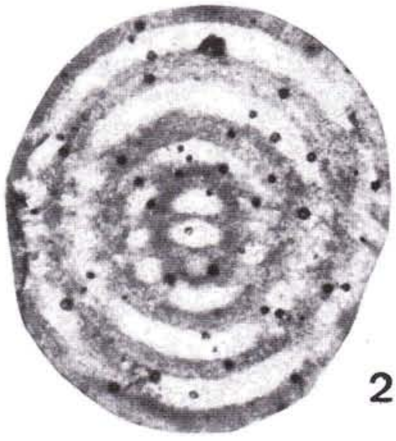

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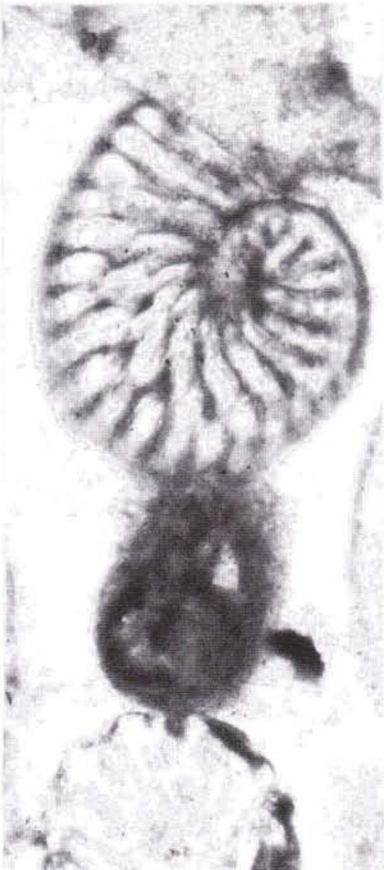

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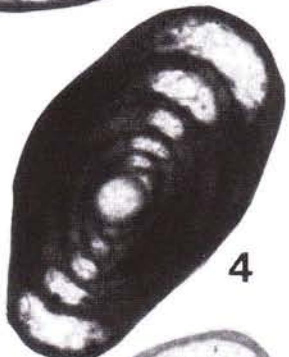

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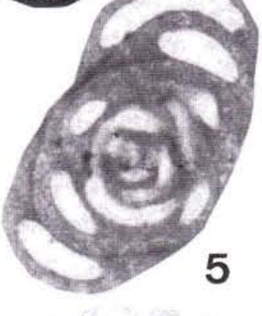

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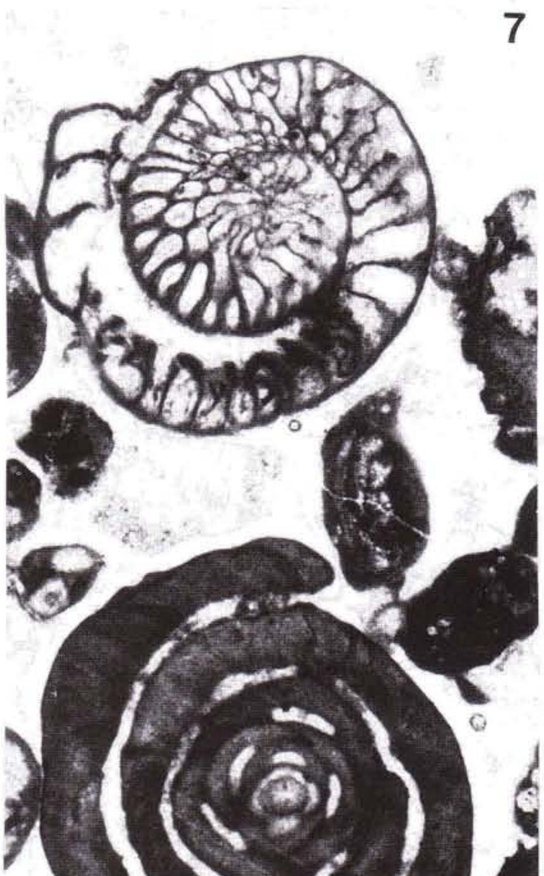

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are great, and confirm the paleogeographic reconstructions that indicate a close location of the three geographic units (Besse et al. 1998; Crasquin-Soleau et al. 2001), i.e. the Pangea B models.

The Paleotethys of the time was probably narrow and its southern shallow carbonate shelf extended in continuity from Greece to southeastern Pamirs and South China, via Turkey and southern Iran, and was situated in the same latitudinal band.

Systematic paleontology

Algae

Gymnocodium bellerophontis

Rothpletz, 1894) Pia, 1920

Pl. 4, fig. 6

- 1894 *Gyroporella bellerophontis* n. sp. Rothpletz, p. 24, fig. 4.
- 1912 *Macroporella bellerophontis* (Rothpletz) - Pia, p. 34-35, text-fig. 3, pl. 2, fig. 7-12.
- 1937 *Gymnocodium bellerophontis (*Rothpletz) - Pia, p. 832-833, pl. 95, fig. 1-6.
- 1965 *Gymnocodium bellerophontis* (Rothpletz) - Pantic, p. 159, pl. 7, fig. 1-4.
- 1991 *Gymnocodium bellerophontis* (Rothpletz) - Roux, p. 138-139, pl. 1, fig. 1 (*cum syn.*).
- 1993a *Gymnocodium bellerophontis* (Rothpletz) - Vachard et al., pl. 1, fig. 1, 5.

Remarks. Well known since the work of Pia (1912, 1920, 1937), Elliott (1955) and Roux (1991), this species is classical. Of interest are the discoveries of fertile (Vachard et al. 1993a) or bifurcate (Pl. 4, fig. 6) thalli, confirming the belonging to the red algae proposed by Pia, admitted by all the authors , although recently contested by Mamet & Préat (1994).

Dimensions. Length: up to 2.50 mm; outer diameter: 0.47-0.73 mm; inner diameter (medullar zone?): 0.20-0.40 mm; cortical zone thickness: 0.10-0.15 mm; pores: 0.05-0.10 mm.

Dasycladaceae variae

Pl. 5, fig. 2-3

Remarks. Dasyclads are rather rare in the microfacies and the generic determination of the remains is generally questionable. We identify a subaxial section of *Macroporella apachena* Johnson, 1951 (Pl. 5, fig. 2), and a possible oblique section through a verticille of *Likanella* (?) sp. (Pl. 5, fig. 3) illustrated here. The other remains belong to *Mizzia* (five oblique sections) probably *M. yabei* (Karpinsky, 1908), separated recently as a distinct genus *Yabeites* Chuvashov, 2001, not accepted here; and to *Salopekiella* sp. (three very incomplete and abraded sections). These algal microfloras of dasyclads have equivalents in Italy (Accordi 1956) and Croatia (Pantic 1965).

Atractyliopsis lastensis Accordi, 1956

Pl. 4, fig. 2

- 1937 *Atractyliopsis* n. sp. Pia, pl. 97, fig. 5-6.
- 1956 *Atractyliopsis lastensis* n. sp. Accordi, p. 80-82, pl. 8, fig. 1-3, pl. 10, fig. 1-12.
- 1966 *Acicularia* sp. (?) - Güvenç, p. 102-103, pl. 3, fig. 5.
- ?1968 *Atractyliopsis dırariensis* n. sp. Elliott, p. 24-25, pl. 2, fig. 3-5.
- 1988 *Atractyliopsis lastensis* Accordi - Sartorio & Venturini, text-fig. p. 39.
- 1993a *Atractyliopsis lastensis* Accordi - Vachard et al., pl. 1, fig. 9.

Remarks. The illustrations of Pia (1937) and Accordi (1956) show probably incomplete specimens, compared with the various sections presented by Sartorio & Venturini (1988). Consequently, the true morphology of the thallus looks probably more like *Acicularia* (?) sp. (Güvenç 1966) or *Atractyliopsis darariensis* Elliott, 1968. In this case, Permian *Atractyliopsis* are probably more related to choristospore dasyclads than endospore ones.

Dimensions. Length: 4.00 mm, width: 1.50 mm, diameter of cavities: 0.20-0.25 mm.

Microproblematica

Remarks. Two groups are present: (a) questionable consortiums of porcelaneous foraminifers and cyanobacteria: *Tubiphytes* and *Pseudovermiporella*, and (b) rare Algospongia (Termier et al. 1977) belonging to the genera *Eflugelia, Claracrusta* and *Ungdarella* (?).

Tubiphytes ex gr. **obscurus** Maslov, 1956

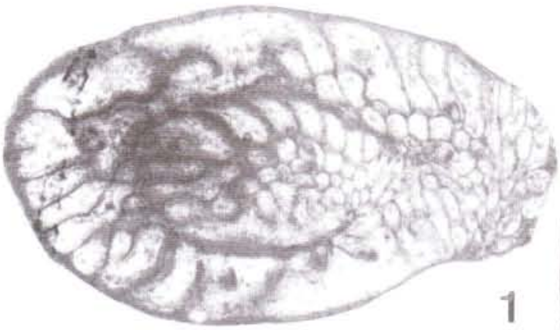
Pl. 3, fig. 5, Pl. 4, fig. 1, 4-5

- 1956 *Tubiphytes obscurus* n. sp. Maslov, p 82-84, text-fig. 22, pl. 25, fig. 1, 3, pl. 26, pl. 27, fig. 1-2.

PLATE 2

Fig. 1-5 - *Paradunbarula (Paradunbarula) shindensis* Kotlyar et al., 1983. Five subaxial sections. 1 - Slide Phi 38c. x 40. 2 - Slide Phi 38e. x 40. 3 - Slide Phi 38d. x 30. 4 - Slide Phi 38d. x 30. 5 - Slide Phi 38e. x 30.

Fig. 6-7 - *Hemigordiopsis* cf. *luquensis* (Wang & Sun, 1973). 6 - Subtransverse section. Slide Phi 38f. x 40. 7 - Subaxial section. Slide Phi 38f. x 40.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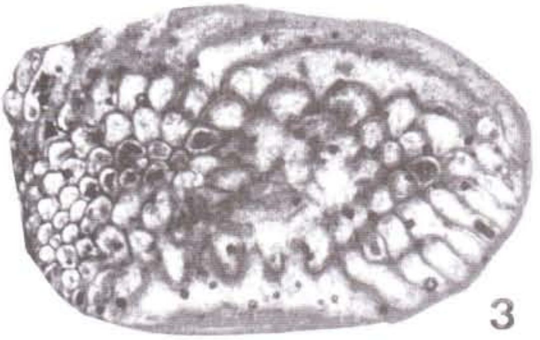
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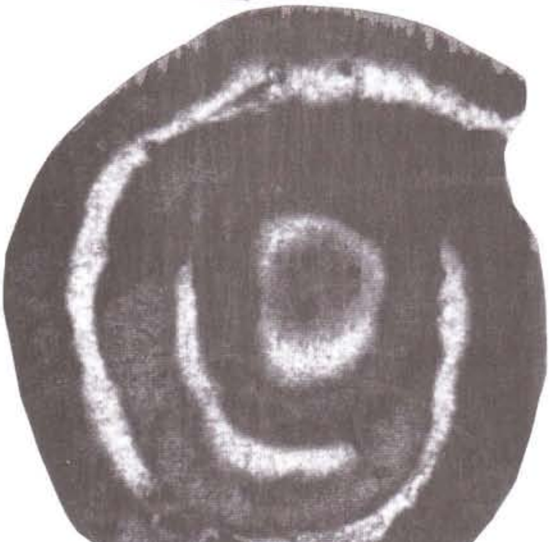
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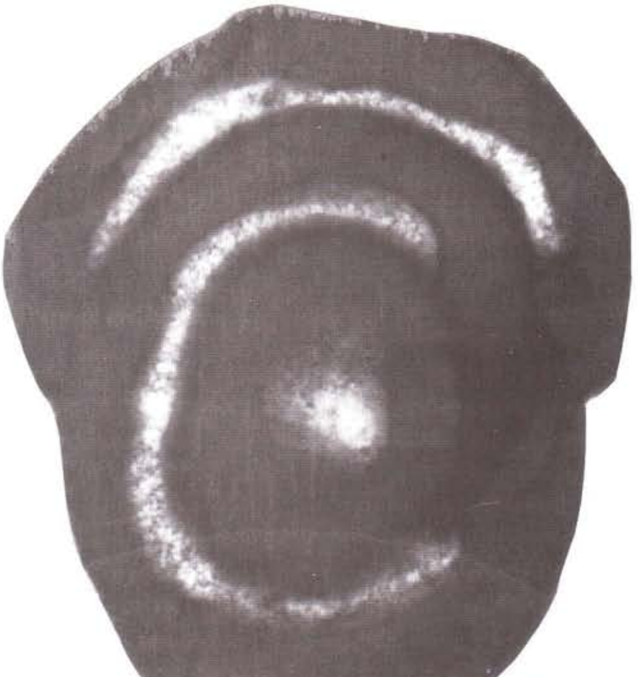
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1991 *Tubiphytes obscurus* Maslov - Razgallah & Vachard, p. 181-184, pl. 1, fig. 1-7, pl. 2, fig. 1-8, pl. 3, fig. 1, 4, 7 (cum syn.).

1992 *Tubiphytes obscurus* Maslov - Riding & Guo, pl. 1, fig. 1-4.

1993 *Tubiphytes obscurus* Maslov - Senowbari-Daryan & Flügel, p. 362-370, text-fig. 4-7, pl. 1, fig. 1-8, pl. 2, fig. 1, 3, 4?, 5-6, 7?, 8-9, pl. 7, fig. 4-8 (cum syn.).

1993a *Tubiphytes obscurus* Maslov - Vachard et al., pl. 2, fig. 6, pl. 3, fig. 1-4, pl. 4, fig. 4, 8.

1998 *Tubiphytes obscurus* Maslov - Altiner & Özkan-Altiner, pl. 4, fig. 20.

2001 *Tubiphytes obscurus* Maslov - Vachard et al., fig. 24. 1, 3-9.

2002 *Tubiphytes obscurus* Maslov - Skourtsos et al., fig. 2. 5.

Remarks. Some *Tubiphytes* in the investigated material are "typical" and similar to *T. obscurus* Maslov, 1956. The other ones are atypical and looks more like porcelaneous *Nodophthalmidium*, confirming the probable attribution to a complex microecosystem more related with porcelaneous foraminifers than algae (Bernier 1984; Pratt 1995; Vennin et al. 1997; Vachard et al. 2001). One of our section (Pl. 4, fig. 1) is a complete sequence of development with: (a) proloculus, (b) some nodophthalmidiid chambers, (c) deformation of the chambers, leading to (d) a typical *Tubiphytes*. Our other figurations illustrate the evolution from (b) (Pl. 4, fig. 5) to (c) (Pl. 4, fig. 4).

Pseudovermiporella ex gr. **nipponica**
(Endo in Endo & Kanuma, 1954)

Pl. 4, fig. 3

1954 *Vermiporella* (?) *nipponica* n. sp. Endo in Endo & Kanuma, p. 191-192, pl. 13, fig. 2-5.

1965 *Pseudovermiporella nipponica* (Endo) - Pantic, p. 160-161, pl. 10, fig. 1-3.

p. 1966 *Vermiporella nipponica* Endo - Flügel, p. 43-45, pl. 8, fig. 1-2 (non fig. 3 = *Tubiphytes*?) (cum syn.).

1993a *Pseudovermiporella* ex gr. *nipponica* (Endo) - Vachard et al., pl. 6, fig. 9, pl. 7, fig. 1.

Remarks. This other "algae incertae sedis" is more exactly a particular porcelaneous foraminifer and/or foraminiferal/algal symbiosis (Vachard et al. 2001). The foraminiferal nature was correctly interpreted by Henbest (1963), supported by Loeblich & Tappan (1964), and remains controversial (Granier & Deloffre 1994). Specimens of the investigated material are long-pitted forms and belong to the group *P. nipponica* or *longipora* (Vachard *et al.* 2001).

Class **Foraminifera** d'Orbigny, 1826
Subclass Fusulinata Wedekind, 1937
Order Endothyrida Brady, 1884

Remarks. Although the most common smaller foraminifera are porcelaneous (Miliolata) and hyaline (Lagenida), some rare survivals of the microgranular foraminifera: Endothyrida and Fusulinida are present. The Endothyrida belong to the super-families: Palaeotextularioids especially *Climacammina valvulinoides* Lange, 1925 (Pl. 5, fig. 1), Tetrataxoids, e.g. *Abadehella* sp. (Pl. 5, fig. 9) and Globivalvulinoids, particularly *Sengoerina* aff. *argandi* (Pl. 4, fig. 6). The latter taxon, that is very poorly represented in our material, and seems by wall structure to be the direct ancestor of *Paradagmarita flabelliformis* Zaninetti, Altiner & Catal, 1981.

Order **Fusulinida** Wedekind, 1937
Superfamily Staffelloidea A.D. Mikluko-Maklay, 1949
Family Staffellidae A.D. Mikluko-Maklay, 1949

Sphaerulina zisonzhengensis Sheng, 1963

Pl. 1, fig. 2, Pl. 3, fig. 5

1963 *Sphaerulina zisongzhengensis* n. sp. Sheng, p. 153-154, pl. 2, fig. 6-7.

1967 *Staffella zisongzhengensis* (Sheng) - Leven, p. 125-126, pl. 1, fig. 6-8.

non v 1977 *Staffella zisongzhengensis* (Sheng) - Lys in Montenat et al., pl. 18, fig. 10-12 (all this material corresponds in fact to the genus *Shanita*).

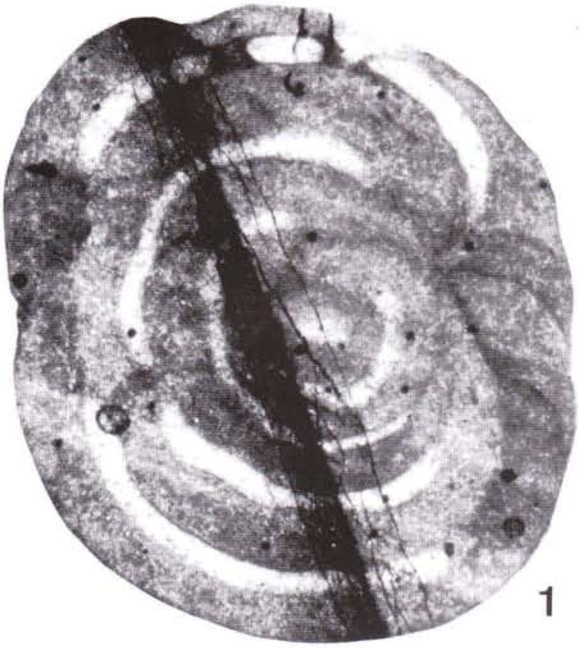
1991 *Staffella zisoghzengensis* (sic) (Sheng) - Baud et al., pl. 2, fig. 4.

Remarks. The variability of the species is great: (a) typical spherical form (Pl. 1, fig. 2), nankinelloid-form (Pl. 3, fig. 5) and (c) fusiform leelloid-tests (not illustrated; corresponding more or less to *Jinzhangia* Ueno, 2001 or *Leella armenica* Rozovskaya, 1965).

Superfamily Schubertelloidea Skinner, 1931
Family Dunbarulidae Vachard, Clift & Decrouez1993a
nom. translat. herein pro Dunbarulinae

PLATE 3

Fig. 1-5 - *Hemigordiopsis* cf. *luquensis* (Wang & Sun, 1973). 1 - Subaxial section. Slide Phi 38e. x 40. 2 - Subaxial section. Slide Phi 38c. x 40. 3 - Tangential section. Slide Phi 38a. x 40. 4 - Atypical axial section . Slide Phi 38a. x 40. 5 – Oblique section (bottom left) with a subaxial section of *Sphaerulina zisonzhengensi* (top), a subaxial section of *Multidiscus padangensis* (right center) and *Tubiphytes obscurus* (left and right). Slide Phi 38a. x 30.



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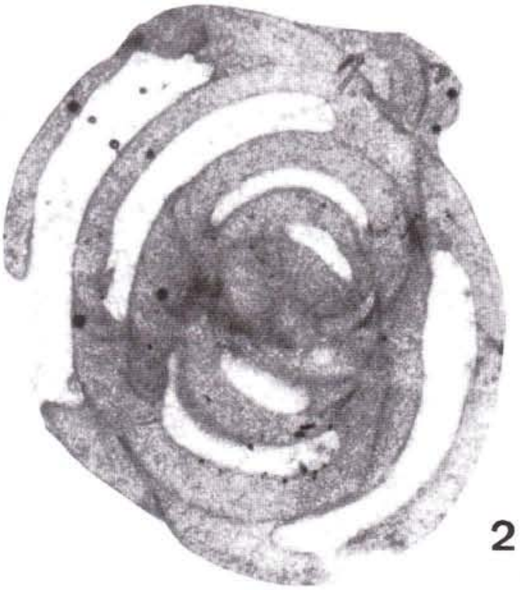

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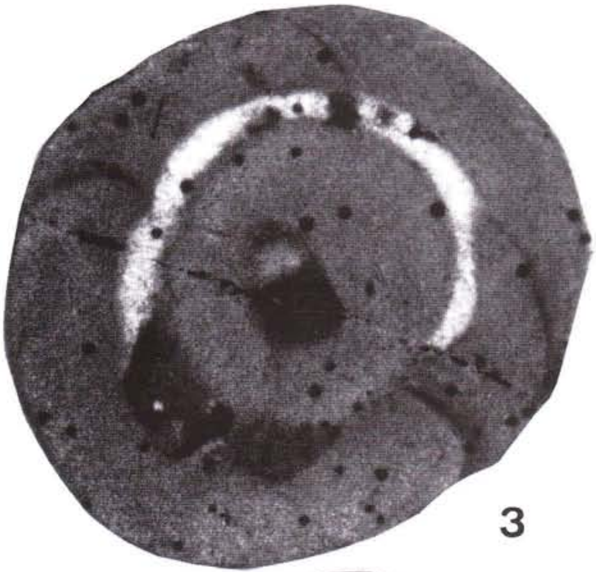

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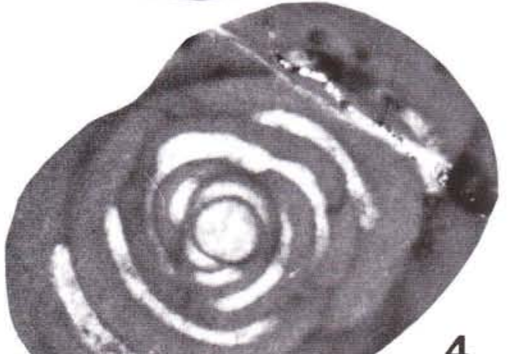

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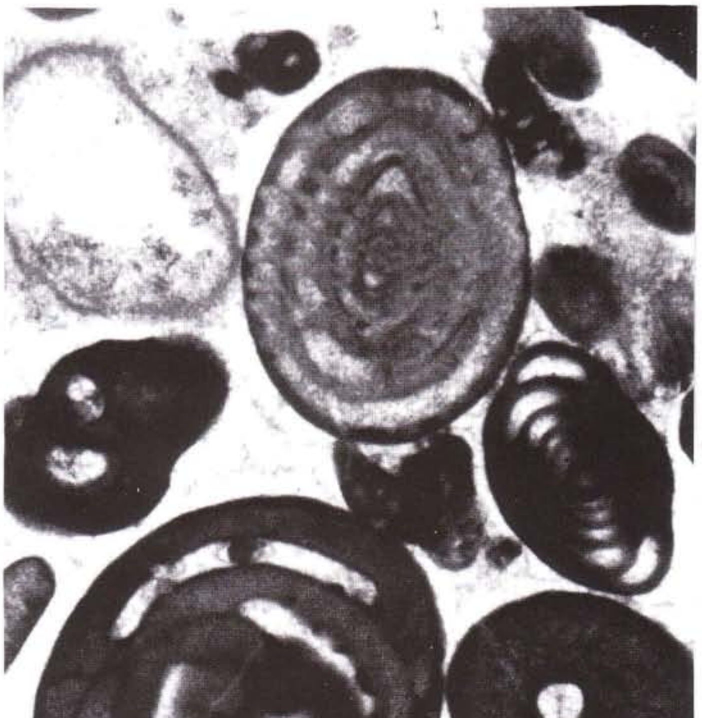

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Genus *Paradunbarula* Skinner, 1969
Subgenus *Shindella* Chediya in Kotlyar et al., 1983

Remarks. *Paradunbarula (Paradunbarula)* Skinner, 1969 was initially described in an olistolith of Cerkezhüyük, Anatolia (Turkey). The unique associated species is *Boultonia erki* Skinner, 1969, that might belong to *Pseudodunbarula*. Due to the absence of large fusulinids: Neoschwagerinoids or Schwagerinoids in the assemblage, and the biostratigraphical value of *Pseudodunbarula*, the holotype of *Paradunbarula (Paradunbarula)* is probably early Dzhulfian in age.

As the resorption of the juvenarium is an evolutionary character among the Schubertelloids: Dunbarulinae and Palaeofusulininae of the middle/late Permian (Rui & Sheng 1981), *Paradunbarula(Shindella)* is more advanced than *P. (Paradunbarula)*. Therefore, *P. (S.)* is at least late Dzhulfian (Fig. 5).

Leven (1993) indicates a Dzulfian age for *Paradunbarula*, but the taxonomy of this author is not clear, since Leven & Okay (1996) describe three species of "*Palaeofusulina (Paradunbarula)*".

Chediya in Kotlyar et al. (1983) dated *Paradunbarula (Shindella)* as late Midian. An attribution of the *Shindella simplicata-S. pamirica* zone to the late Dzhulfian was then indicated by Davydov et al. (1996, fig. 4), and we agree with this conclusion (see above). Inversely, Kotlyar et al. (1999) consider the biozone as late Changhsingian, especially because *Shindella simplicata* (Sheng, 1963) was described in the Changhsing Limestone from South-China.

In conclusion, if *Shindella* is alone, it can be considered as indicative of the late Wuchiapingian, if it is accompanied by *Palaeofusulina* it can be Changhsingian in age.

Paradunbarula (Shindella) shindensis

Chediya in Kotlyar et al., 1983
Pl. 1, fig. 1, Pl. 2, fig. 1-5

1983 *Paradunbarula (Shindella) shindensis* n. sp. Chediya in Kotlyar et al., p. 135-136, pl. 9, fig. 2-4.
1996 *Paradunbarula (Shindella) shindensis* Chediya - Rauzer-Chernousova et al., pl. 2, fig. 6.
? 1996 *Palaeofusulina (Paradunbarula)* cf. *pamirica* Leven - Leven & Okay, pl. 10, fig. 23.
? 1996 *Palaeofusulina (Paradunbarula) okayi* n. sp. Leven in Leven & Okay, p. 171, pl. 9, fig. 4-5 , 7.
1999 *Paradunbarula (Shindella) shindensis* Chediya - Kotlyar et al., p. 20 (no figuration).
2002 *Paradunbarula (Shindella) shindensis* Chediya - Skourtsos et al., fig. 2. 1-2.

Remarks. Our material is identical to *P. (S.) shindensis*, by the dimensions and the number of whorls.

Dimensions. Diameter: 1.50-1.75 mm (diagnosis: 1.68-2.13), width: 2.40-2.65 mm (diagnosis: 2.60-3.30), width/diameter: 1.4-1.5 (diagnosis: 1.4-1.6), proloculus diameter: 0.07-0.08 mm (diagnosis: 0.11-0.20), whorls: 4 (diagnosis: 4), wall thickness: 0.03 (diagnosis: 0.03).

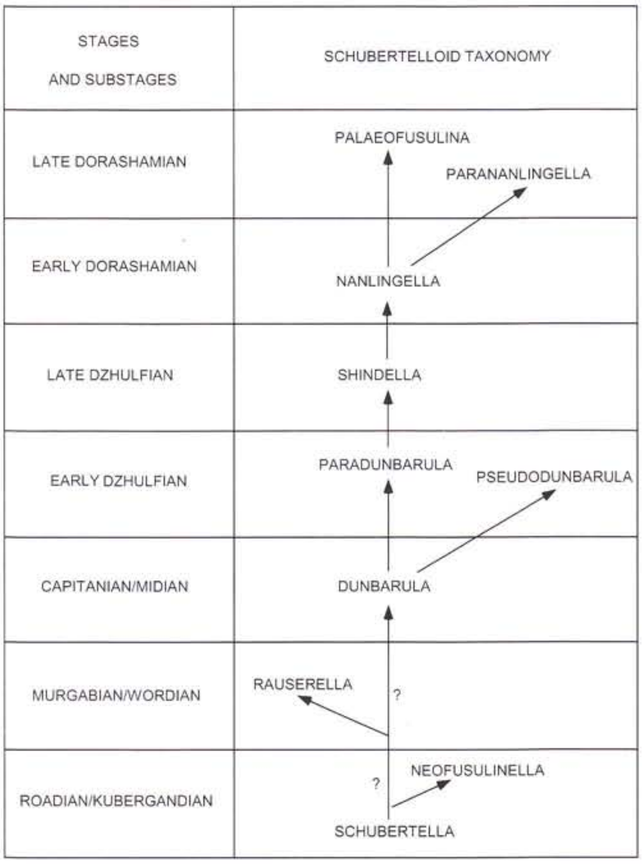

Fig. 5 - Evolutionary trends in Schubertellidae, Dunbarulinidae and Palaeofusulinidae (compiled from Rui & Sheng 1981; Kotlyar et al. 1983, Vachard et al. 1993a, and this work).

Nanlingella (?) sp.

Pl. 1, fig. 3

Remarks. Rare forms correspond to atypical *Paradunbarula*, but show some characters of *Nanlingella*: septa more numerous and more regular, indicating probably the true lineage between Dunbarulidae and Palaeofusulinidae. The figured specimen measures 0.64 mm in diameter.

Subclass **Miliolata** Delage & Hérouard, 1896
Order Hemigordiopsida Nitikina, 1969
Family Hemigordiopsidae Nikitina, 1969

Neodiscus sp.

Pl. 1, fig. 5

Remarks. Rare, this *Neodiscus* shows internal whorls of the group *N. milliloides* Miklukho-Maklay, 1953 but the last semi-evolute whorl allows also some comparisons with an immature *Graecodiscus*. An apparent pseudoseptum at the extremity of the central glomus, seems to be also a character of the genus *Pseudomidiella*, recently described by Pronina-Nestell & Nestell (2001).

Multidiscus padangensis (Lange, 1925)

Pl. 1, fig. 4, Pl. 3, fig. 5, Pl. 4, fig. 2, 6, Pl. 5, fig. 6-8

1925 *Nummulostegina padangensis* n. sp. Lange, p. 271, pl. 4, fig. 77a-b.
1953 *Multidiscus padangensis* (Lange) - Miklukho-Maklay, p. 130, pl. 6, fig. 7.
1988 *Multidiscus padangensis* (Lange) - Pronina, pl. 1, fig. 18-19.
1990 *Multidiscus padangensis* (Lange) - Lin et al., p. 207, pl. 23, fig. 7-11.
1993a *Multidiscus padangensis* (Lange) - Vachard et al., pl. 2, fig. 2, pl. 6, fig. 5.
? 1993b *Multidiscus padangensis* (Lange) - Vachard et al., pl. 8, fig. 16-18.
? 1996 *Multidiscus padangensis* (Lange) - Leven & Okay, pl. 9, fig. 24-26 (may be *M. obesus* Lin et al., 1990).

Remarks. Relatively abundant, this species exhibits: (a) typical specimens planispirally coiled (Pl. 1, fig. 4; Pl. 4, fig. 2); (b) broken individuals (Pl. 4, fig. 6); (c) specimens with some deviations of coiling (Pl. 3, fig. 5; Pl. 5, fig. 6); (d) specimens with a last whorl evolute (Pl. 5, fig. 6), and comparable to *Multidiscus (?) tauridiana* Okuyucu, 1999; (e) presence of pseudo-septation (Pl. 5, fig. 8). This tendency, which can be interpreted as a generic character, is probably comparable with a Sigal spectrum (Sigal, 1966); i.e. rare specimens of a species showing a character of a different genus. Strictly interpreted, this generic character leaded to the creation of *Septagathammina, Nikitinella, Pseudomidiella*, and various false "*Baisalina*" of the literature. This pseudo-septation appears independently in several lineages of porcelaneous foraminifera, with various types of coilings, such as *Agathammina, Neodiscus, Multidiscus, Hemigordius, Hemigordiopsis*, from the Capitanian to the Changhsingian.

Dimensions. Diameter: 1.30-1.70 mm (diagnosis: 1.25), width: 0.55-0.73 (diagnosis: 0.32 in the text, but more or less 0.80 on the photomicrograph), width/diameter: 0.42-0.63 (emended diagnosis: 0.64), whorls: 5-5.5 (diagnosis: 5.5), proloculus: 0.20 mm (diagnosis 0.15 x 0.22), wall thickness: 0.01-0.03 mm (diagnosis: 0.02).

Hemigordiopsis cf. **luquensis** (Wang & Sun, 1973)

Pl. 1, fig. 7, Pl. 2, fig. 6, Pl. 3, fig. 1-5

1965 *Hemigordiopsis renzi* Reichel - Pantic, p. 156, pl. 5, fig. 1-4.
cf. 1973 *Gansudiscus luquensis* n. gen. n. sp. Wang & Sun, p. 157, 176-177, pl. 4, fig. 5-9, 14-15.
? 1973 *Gansudiscus orientalis* n. gen. n. sp. Wang & Sun, p. 158, 177-178, pl. 4, fig. 10-12.
? 1977 *Hemigordiopsis renzi* Reichel - Lys in Montenat et al., pl. 17, fig. 9. cf. 1988 *Hemigordiopsis luquensis* (Wang & Sun) - Loeblich & Tappan, pl. 326, fig. 21-22.
cf. 1988 *Hemigordiopsis orientalis* (Wang & Sun) - Pronina, pl. 1, fig. 9-10.
cf. 1989 *Hemigordiopsis orientalis* (Wang & Sun) - Kotlyar et al., pl. 4, fig. 4.
? 1992 *Hemigordiopsis renzi* Reichel - Vachard et al. 1992, pl. 3, fig. 6.
? 1997 *Hemigordiopsis orientalis* (Wang & Sun) - Nestell & Pronina, text-fig. 2-3.
2002 *Hemigordiopsis* cf. *luquensis* (Wang & Sun) - Skourtsos et al., fig. 2. 1.

Description. Test nautiloid to subquadrate, of medium size for the genus. Proloculus spherical followed by 2 or 3 initial glomospiroid whorls, and 2-3 adult whorls. Wall thin in the proloculus, increasing in thickness at each whorl, and finally double than the height of the chamber. Irregularities of the inner and outer surfaces of the tubular chamber are obvious (Pl. 1, fig. 7, Pl. 2, fig. 6).

Dimensions. Diameter: 2.00-3.10 mm (diagnosis of *H. luquensis*: 2.10), width: 1.60-1.90 mm (diagnosis: 1.90), width/diameter: 0.73-1.15 (diagnosis: 0.90), number of volutions: 4-5 (diagnosis: 5-7), diameter of proloculus: 0.20-0.30 mm, height of the tube: 0.07-0.12 mm (diagnosis: 0.05-0.09), wall thickness: 0.20-0.40 mm (diagnosis: 0.21-0.31).

Remarks. *Hemigordiopsis renzi* Reichel, 1945b, whose type locality is situated in Cyprus, is well represented in Greece (Baud et al. 1991), but our specimens are more comparable with *H. luquensis* (Wang & Sun, 1973) and its probable synonym *H. orientalis* (Wang & Sun, 1973), by the relatively big proloculus, the small number of glomospiroid inner whorls, and few outer planispirally whorls. The total whorl number of our specimens is finally smaller 4-5 versus 5-7 for *H. luquensis*, for the same diameter.

Range. According to some authors, *Hemigordiopsis* disappears at the end of the Midian (Pronina 1995) and can be limited to the late Midian (Nestell & Pronina 1997). In the investigated material it is closely co-occurring with *Shindella* (Pl. 1, fig. 7) and consequently late Dzhulfian. *Hemigordiopis* of this age are also present in Montenegro (Pantic 1965) and Oman (Jebel Safra, Vachard, Martini & Zaninetti, unpublished). Morever, the presence of "*Hemigordiopsis*" was signalized up to the Dorashamian in Turkey (Altiner 1984, fig. 4).

Subclass **Rotaliata** Delage & Herouard, 1896

Order **Lagenida** Reuss, 1862

Superfamily Nodosarioidea Ehrenberg, 1838

Remarks. A robust *Nodosaria* (?) with finely and acutely costulate periphery (Pl. 5, fig. 5), only one section of *Calvezina* (?) sp. with curvated axis of coiling and oval uniseriate chambers (Pl. 5, fig. 4), and a few *Colaniella* have been found.

Colaniella aff. **minima** Wang, 1966

Pl. 1, fig. 3, 6

aff. 1966 *Colaniella minima* n. sp. Wang, p. 211, 219, pl. 1, fig. 1-9.
p. 1989 *Colaniella* ex gr. *minima* Wang - Jenny-Deshusses & Baud, p. 881-882, tabl. 1, fig. 2a, fig. 5c, pl. 1, fig. 11?
aff. 1990 *Colaniella minima* Wang - Lin et al., p. 248, pl. 33, fig. 13-16.
v. 1993b *Colaniella* cf. *minima* Wang - Vachard et al., pl. 8, fig. 13-14.
2000 *Colaniella* ex gr. *minima* Wang - Jenny-Deshusses et al., fig 3.1-2, 4, 7a.
2002 *Colaniella* aff. *minima* Wang - Skourtsos et al., fig. 2. 3-4.

Remarks. The material of this taxon consists of three oblique specimens, up to 0.80 mm. The relative simplicity of the internal subdivisions and small size are similar to those of *Colaniella minima*. Our taxon belongs probably to a primitive species of the group (see the descriptions of Okimura 1988), but the acme and specific differenciation of *Colaniella* occurs probably only in the Changhsingian, as compiled by Lin *et al.* (1990).

Conclusions

In the Parnon Mountain chain, central eastern Peloponnesus, the Glypia Unit represents the uppermost tectonic unit. A wild flysch (mélange) unit of Cenozoic age contains several Cretaceous and late Permian exotic blocks floating in the matrix. The olistoliths were deposited within the Glypia Unit during the sedimentation of the clastic series of the unit, when the latter was part of an active margin.

The origin of late Permian olistoliths must be seeked to regions east of the Parnon Mountain range and to units that were more internal to Pindos Unit. The islets of Karavia in the Argolis Gulf, yield a thick carbonate sequence, but little known (Tataris 1969, 1988). The Episkopi Formation, on Hydra (Baud et al. 1991; Grant et al. 1991), although only preliminary studied, may be the largest outcrop of this age, and the most probable origin of the olistoliths.

A sample of an olistolith reveals a microfacies of bioclastic grainstone, that yields more or less forty taxa of algae, microproblematica, smaller foraminifera and fusulinids.

These assemblage is remarkable, because three markers, generally not co-occurring, are here associated: *Paradunbarula (Shindella) shindensis*, *Hemigordiopsis* cf. *luquensis* and *Colaniella* aff. *minima.* The appearance-zone of *Shindella* is hypothetically attributed to the late Wuchiapingian/ Dzhulfian (but latest Capitanian and late Changhsinghian ages are also suggested). Consequently, in the late Wuchiapingian, the first *Colaniella* coexist with the last *Hemigordiopsis* (Fig. 4). This assemblage is generally indicated as late Midian in the literature.

The similarities of the Greek microfauna with that of South China and southeastern Pamirs confirm the paleogeographic reconstructions which indicate a close location of the two geographic units (Besse et al. 1998, Crasquin-Soleau et al. 2001).

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PLATE 4

Fig. 1, 4-5 - *Tubiphytes* ex gr. *obscurus* Maslov, 1956 similar to the foraminifer *Nodophthalmidium*. Three longitudinal sections. 1 - A complete sequence of development, with (a) a proloculus (bottom); (b) regular foraminiferal chambers; (c) irregular chambers; (d) a typical tubiphytid aspect (top). Sample Phi 38b. x 75. 4 - A stage with irregular chambers. Sample Phi 38e. x 75. 5 - A stage with regular chambers. Slide Phi 38b. x 75.
Fig. 2 - *Atractyliopsis lastensis* Accordi, 1956. Longitudinal section with a subaxial section of *Multidiscus padangensis* (bottom). Slide Phi 38b. x 30.
Fig. 3 - *Pseudovermiporella* ex gr. *nipponica* (Endo in Endo & Kanuma, 1954). A group of three oblique sections. Slide Phi 38a. x 30.
Fig. 6 - *Gymnocodium bellerophontis* (Rothpletz, 1894) Pia, 1920. Two thalli, one bifurcated. Longitudinal sections, with a subaxial section of *Multidiscus padangensis* (broken, bottom center) and an oblique section of *Sengoerina* aff. *argandi* Altiner, 1999 (bottom right). Slide Phi 38b. x 30.

PLATE 5

Fig. 1 - *Climacammina* cf. *valvulinoides* Lange, 1925. Subaxial section. Slide Phi 38a. x 40.
Fig. 2 - *Macroporella apachena* Johnson, 1951. Oblique section. Slide Phi 36c. x 75.
Fig. 3 - *Likanella* (?) sp. Tangential section through a verticille. Slide Phi 38e. x 30.
Fig. 4 - *Calvezina* (?) sp. Sublongitudinal section. Slide Phi 38f. x 75.
Fig. 5 - *Nodosaria* (?) sp. with spinose periphery. Transverse section. Slide Phi 38f. x 75.
Fig. 6-8 - *Multidiscus padangensis* (Lange, 1925). 6 - Subaxial section with the last whorl apparently evolute [for comparison, see *M.* (?) *tauridiana* Okuyucu, 1999]. Slide Phi 38e. x 40. 7 - Subaxial section relatively compressed. Slide Phi 38a. x 40. 8 - Subtransverse section with pseudoseptation,, i. e. a so-called generic character. Slide Phi 38d. x 30.
Fig. 9 - *Abadehella* sp. Subaxial section. Slide Phi 38a. x 75.

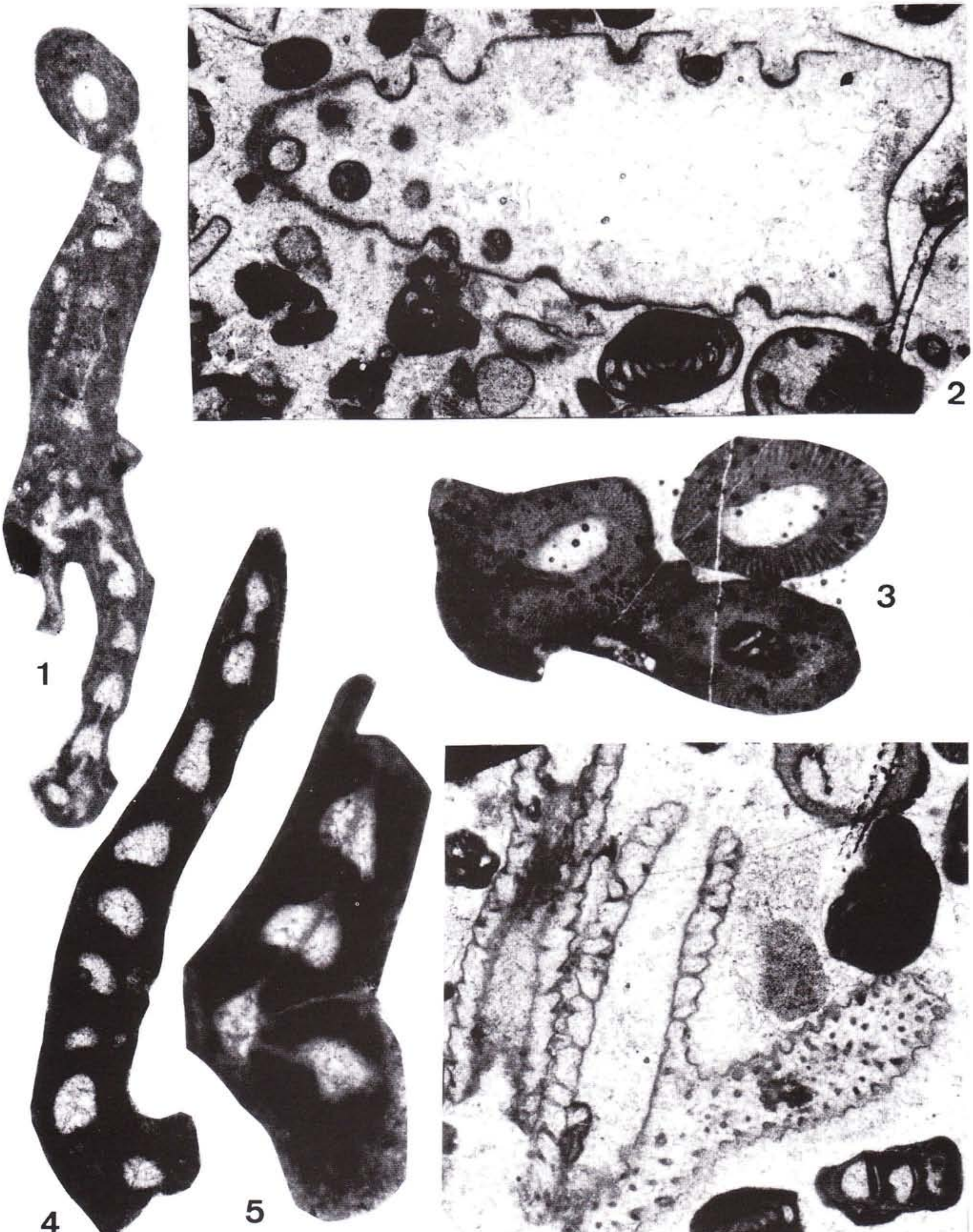

PLATE 4

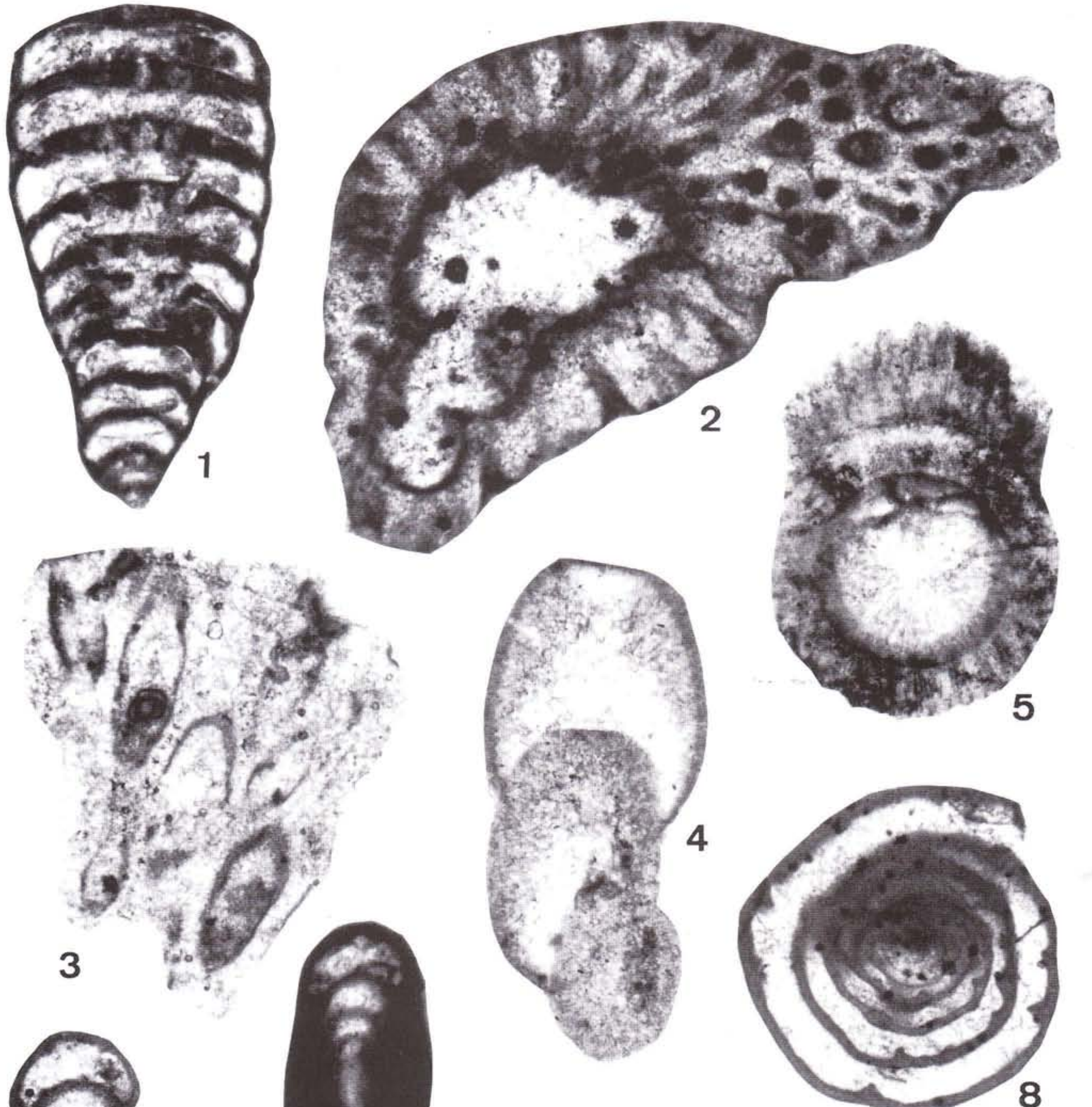

PLATE 5

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