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NEW OBSERVATIONS ON PERMIAN STRATIGRAPHY IN GREECE AND GEODYNAMIC INTERPRETATION

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ABSTRACT

New detailed stratigraphic and micropaleontological works on the famous exposures of Permian rocks in Hydra rich in Foraminifera, allows to define the stratigraphy of other outcrops in Aegina, Salamis, Attica and Chios. A synthetic section is presented which is characterized by the development of 3 successive carbonate platforms during the Permian and by 4 main tectonostratigraphic events. The youngest of these events marks the closure of the Paleotethyan ocean and the collision of a former Gondwanian/Cimmerian passive margin in the S with an active margin in the N.

INTRODUCTION

Occurences of fossiliferous Permian rocks in Greece have been recognized since the beginning of this century (Hydra island, RENZ, 1910). They usually correspond to marine facies with characteristic compact dark-coloured neritic limestones, observed in discontinuous outcrops of various sizes, either as sedimentary lenses-intercalations or as olistholites-olisthostromes, within volcano- sedimentary sequences generally underlying the Middle or the Late Triassic shallow-water marine carbonates. These volcano- sedimentary sequences complexes, ranging in general from late Paleozoic to Middle Triassic, occur at the base of several nappes of the Hellenides (Mani unit in Crete, Tripolis unit, Cycladic units, "Subpelagonian" unit etc.). Intense alpine deformations, with development of penetrative s-structures, together with the primary complexity of the lithologies, do not permit a more detailed stratigraphic subdivision with distinction of the late Paleozoic levels from those of Early and Middle Triassic.

In a few areas in Greece (Hydra island, NE Chios island, E.Orthrys Mountains, Fodele area in Crete), carbonate platform sedimentation had already begun in the Permian, but areas with continuous carbonate sedimentation up to the Late Triassic are not known.

A brief review of the literature related to this problem shows that for a long period of time, neither detailed stratigraphic sections and columns nor detailed geological maps were available. It is remarkable that at the beginning of this century almost all the late Paleozoic formations in Greece were attributed to the Carboniferous (Euboea island: DEPRAT, 1904, Orthrys Mountains:

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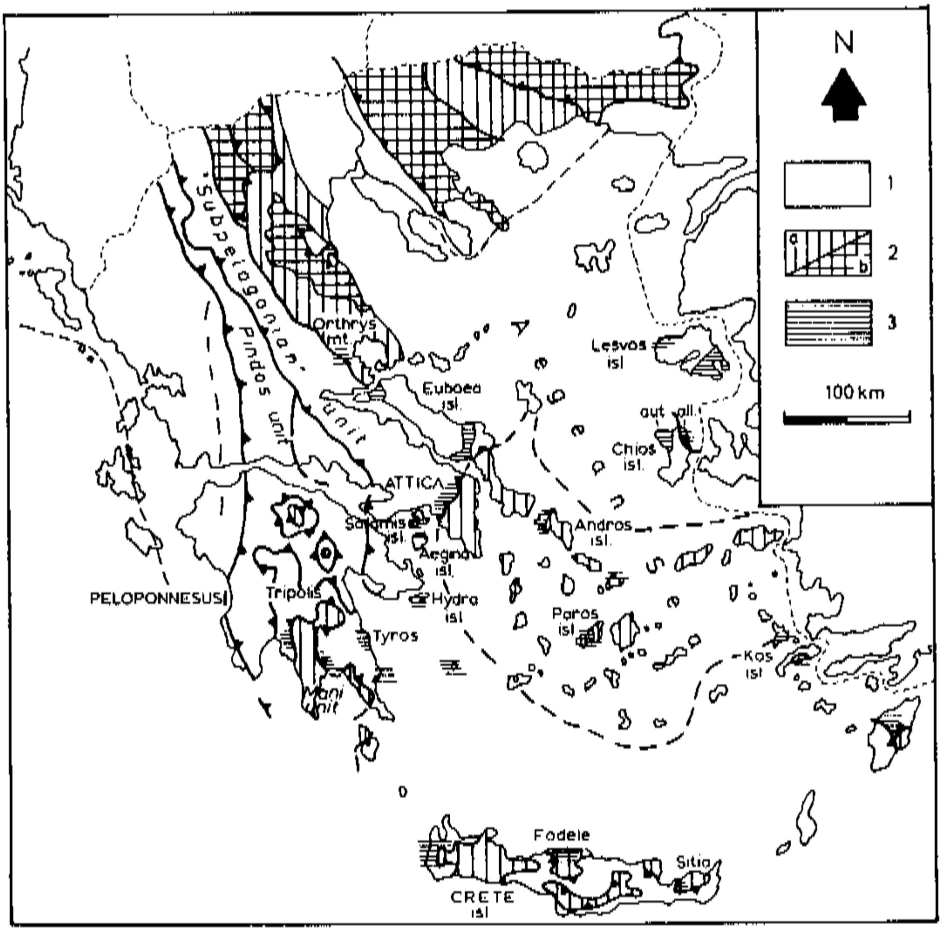

Figure 1 Geological sketch map of the Aegean area
1: Non metamorphic Hellenides
2a: Metamorphic Hellenides
2b: Crystalline probably pre-Alpine basement
3: Upper Paleozoic to Lower Triassic

RENZ, 1908, Salamis island: RENZ, 1912, Aegaleo Mountains: VOREADIS, 1929, etc.) on the basis of microfossils such as "Fusulina", Staffella, etc.. These foraminifers were subsequently redetermined and a Permian age was proved. Later on numerous fossiliferous sites of Permian age have been found (Fig.1), most of them restricted to Eastern Greece, around the Aegean Sea, from the first half of our century (for further information see the review articles of RENZ & REICHEL,

1945, RENZ, 1955, MARINOS & REICHEL, 1958), until the recently reported datations of Permian within metamorphic rocks in Andros and Paros islands (Cyclades) by PAPANIKOLAOU (1978, 1980) as well as in non-metamorphic rocks in Aegina island (GAITANAKIS & TSAILA-MONOPOLIS, 1978) and Karavia islets (TATARIS, 1989). Additionally, more recent works showed that some detritic formations occuring at the base of the "Subpelagonian" unit, previously considered as late Paleozoic, are of early Triassic age because the fossiliferous limestones of Permian and Carboniferous age included in them are olistholites and not sedimentary lenses (PAPANIKOLAOU & BAUD, 1982, PAPANIKOLAOU & SIDERIS, 1983a, SIDERIS, 1986, TATARIS & SIDERIS, 1989).

The above new observations had important geodynamic implications with a change from the concept of a wide epicontinental sea development during Permian - Early Triassic times over a Variscan basement (ARGYRIADIS, 1975, 1978, KAUFMANN, 1976, ARGYRIADIS et al., 1978), to a new concept of an orogenic activity (SIDERIS, 1986, 1989), probably related to the Cimmeride orogenic system (SENGOR, 1984), supported by (i) the existence of early Triassic flysch-type sediments with olistholites and (ii) the presence of ? early-middle Triassic calc-alkaline volcanics, indicating a paleovolcanic arc (SKARPELIS, 1982, PE-PIPER, 1982).

Except in the Autochthon of Chios, where the Lower Paleozoic rocks are within olisthostromes (PAPANIKOLAOU & SIDERIS, 1983b), it should be noticed that sequences older than Carboniferous have not been dated with fossils anywhere in Greece with the questionable exception of Kos island (Dodecanese in southestern Aegean Sea) where the existing literature on the Paleozoic of the island (DESIO, 1930, 1931, DURR et al. 1978) does not permit any satisfactory approach to its stratigraphy, the only fact being the existence of the reported Silurian and Carboniferous rocks. In addition, some probably pre-alpine metamorphic units are incorporated into the Tertiary nappe pile. Thus, the nature of the prealpine basement of the Hellenides remains still largely unknown (see also SIDERIS, 1989).

The new results obtained from the authors during the last 8 years point to the existence of characteristic facies in dispersed Permian outcrops all over the peri-Aegean area which may permit a better understanding of the paleogeographic configuration and paleogeodynamic conditions in this problematic segment of the Tethys.

HYDRA ISLAND.

The Permian of Hydra island (base of the "Subpelagonian" unit) is characteristic of the shallow-water carbonate platform sedimentation in Greece. RENZ (1910) was the first to report the existence of Permian in Hydra. Later on he reported new findings together with a geological sketch (see RENZ & REICHEL, 1945, RENZ, 1955). More recently RÖMERMANN (1968, 1969, 1981) studied the whole island and presented a geological map at 1/50.000 scale. He described a continuous Late Paleozoic sequence comprising : (i) Late Carboniferous clastics with some carbonate intercalations, (ii) Early Permian limestones, (iii) Middle Permian reddish pelites passing up to (iv) Late Permian neritic carbonates, and the sequence is terminated by (v) some sandstones, pelites and sandy limestones, marking the contact to the slightly disconformable Middle Triassic shallow-water marine carbonates (Eros Kalk). Several notes have also been published, mainly dealing with the rich and unique Permian fauna of Hydra (RENZ & REICHEL, 1945, RENZ, 1955, GRANT, 1972, NESTELL & WARDLAW, 1987, JENNY-DESHUSSES & BAUD, 1989).

During the years 1987, 1988 and 1989, field studies have been made by two of us (A.B. & C.J.) and 5 detailed Permian profiles have been measured. Detailed geological cartography made by Escher (Lausanne) and his students is still under completion. The main problem with the geology of Hydra is the poor knowledge of the tectonic structures, particulary the geometry and the number of superimposed thrust sheets, the position of the decollement levels and the mode and age of emplacement. The first result of detailed cartography shows the existence of at least 4 superimposed thrust sheets ("Schuppen") with an E-W trend and a general northward dip. The most complete sections have been observed not in the lowest but in the second thrust sheet that crops out on the southern flank of the island between Episkopi and Cap Rigas and in the overlying third thrust sheet in the Cap Bisti area. A synthetic stratigraphic sketch is given in figures 2 and 3. In the stratigraphic section and in this study we use the subdivision in early and Late Permian. The Early Permian comprises the Asselian, Sakmarian, Artinskian and Kubergandinian stages and the Late Permian, the Murgabian, Midian, Dzhulfian and Dorashamian stages.

From the Early Permian to the early Middle Triassic we propose a subdivision in 11 formations and in 4 groups (I to IV) separated by unconformities (fig. 2).

The base of Group I is unknown and at least 4 formations in this group can be observed. The lowest one, the Nisisa formation corresponds to the Cs unit of the RÖMERMANN map (1981) and outcrops only along the shore ENE of Nisisa with a succession of brown to light grey pelitic shales, siltites and greywackes. Presently no fauna has been observed.

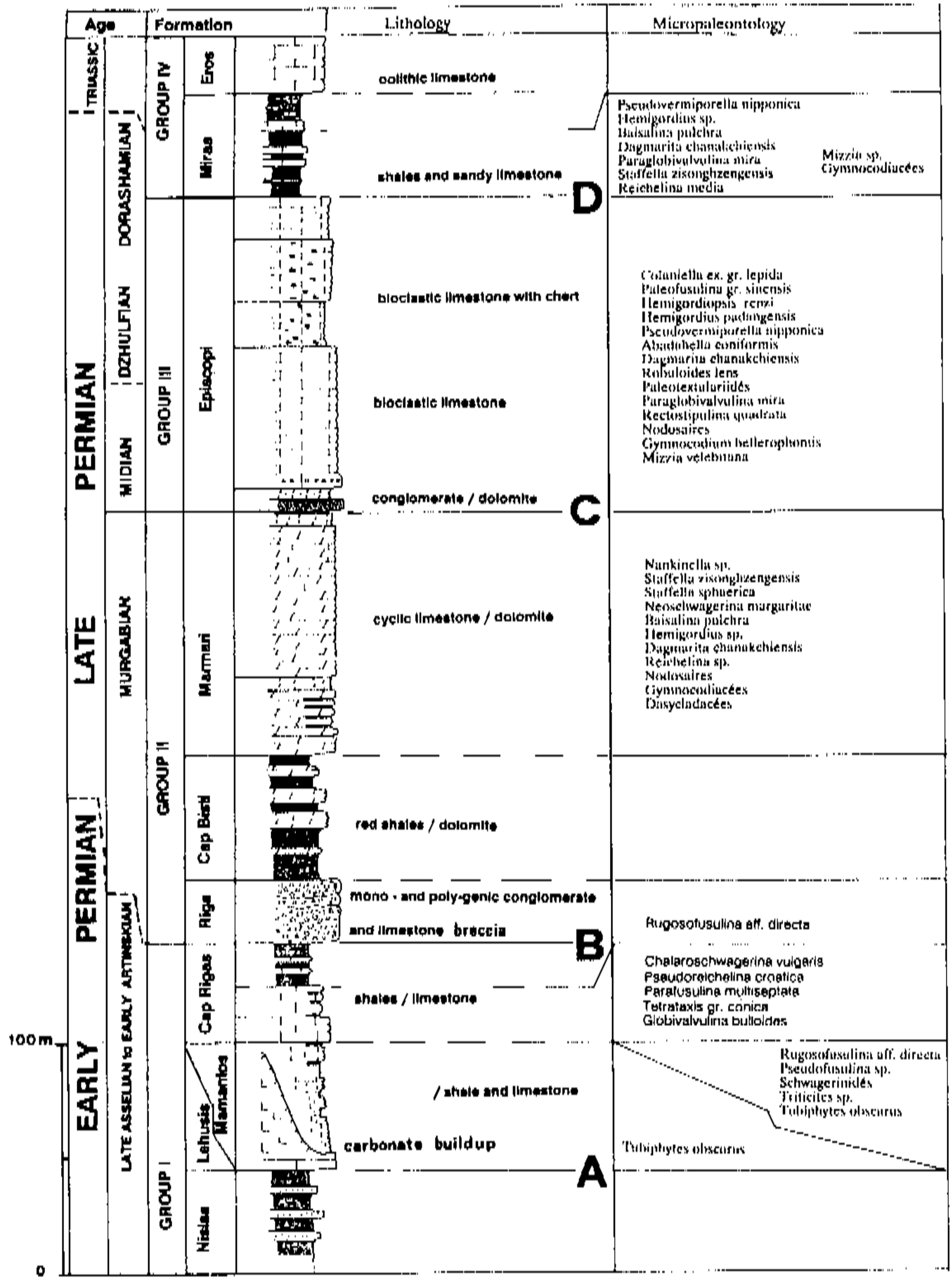

Fig. 2 Synthetic stratigraphic Permian section in the Hydra Island with the distribution of the main Foraminifera. A to D, tectono-stratigraphic events (cf. text)

Above, the Lehusis formation (50-100m thick) shows at its base thick bedded bioclastic packstone to rudstone with crinoïd stems and corals debris. Fusulinids are present with Schwagerinids as *Occidentoschwagerina* sp. (RENZ, 1955). Within the upper part of this formation, we observed in the area between Nisisa and Cap Rigas at least 5 carbonate (Tubiphytes-algal-sponges) buildups (microfacies in pl. 1/2) forming about 100m large to 30-80m high mounds. Pervasive dolomitisation of the top and the flanks of the mounds is frequent. Fusulinids with a *Boultonia* sp. and *Triticites* aff. *montiparus* ROZOVSKAIA (pl. 1/4) assemblage (fig. 2) indicate a middle to late Asselian age.

Between the mounds, the Mamantos formation has a variable thickness (30-80m) infilling a paleotopography. This formation consists of thin bedded black bioclastic lime packstone to grainstone with thin intercalations of silty shales and quartzitic limestones. Fusulinids with a *Rugosofusulina directa* BENSCH and *Pseudoschwagerina* sp. assemblage (fig. 2) suggest a Sakmarian age.

Overlying the Lehusis mounds and the Mamantos formation, the Cap Rigas formation (28m thick) is subdivided in a lower calcareous, a middle calcareous and shally and an upper shally part. Well bedded light bioclastic lime packstone to grainstone characterize the lower part (6m). At the base, the *Chalaroschwagerina vulgaris* , *Parafusulina multiseptata* and *Pseudoreichelina croatica* assemblage indicates an early Artinskian age (late Yashtashinian stage of Leven, 1981). The middle part (11m) consists of thick bedded bioclastic calcarenite with abundant calcareous Algae and Foraminiferas and red to yellowish argilitic intercalations. We note a rich fusulinids fauna (fig. 2) with *Parafusulina* sp., *Paraschwagerina* sp, *Pseudofusulina* sp., *Schubertella* sp. and the "small" Foraminifera "*Politaxis*". Near the top , the apparition of *Neofusulinella grandis* (DEPRAT) with a *Darvasites* sp., *Neoendothyra* sp. and *Pseudoreichelina* sp. assemblage dates the late early Artinskian (Bolorian stage of LEVEN, 1981). The calcareous and encrusting Algae are also abundant with *Gyroporella* cf. *longithalla*, *Girvanella permica*, *Girvanella* sp., *Tubiphytes* sp. and *Neoanchicodium catenoïdes* together with the encrusting Foraminifera *Pseudovermiporella* sp.. The upper part of the Cap Rigas formation consists of red and brown argilites with very few thin limestone beds intercalations. No diagnostic fauna has been observed. The 3 above described formations correspond to the Pi-k unit of RÖMERMANN (1981). We thank here D. Vachard (Lille, France) for determination of the Early Permian fusulinids and Algae.

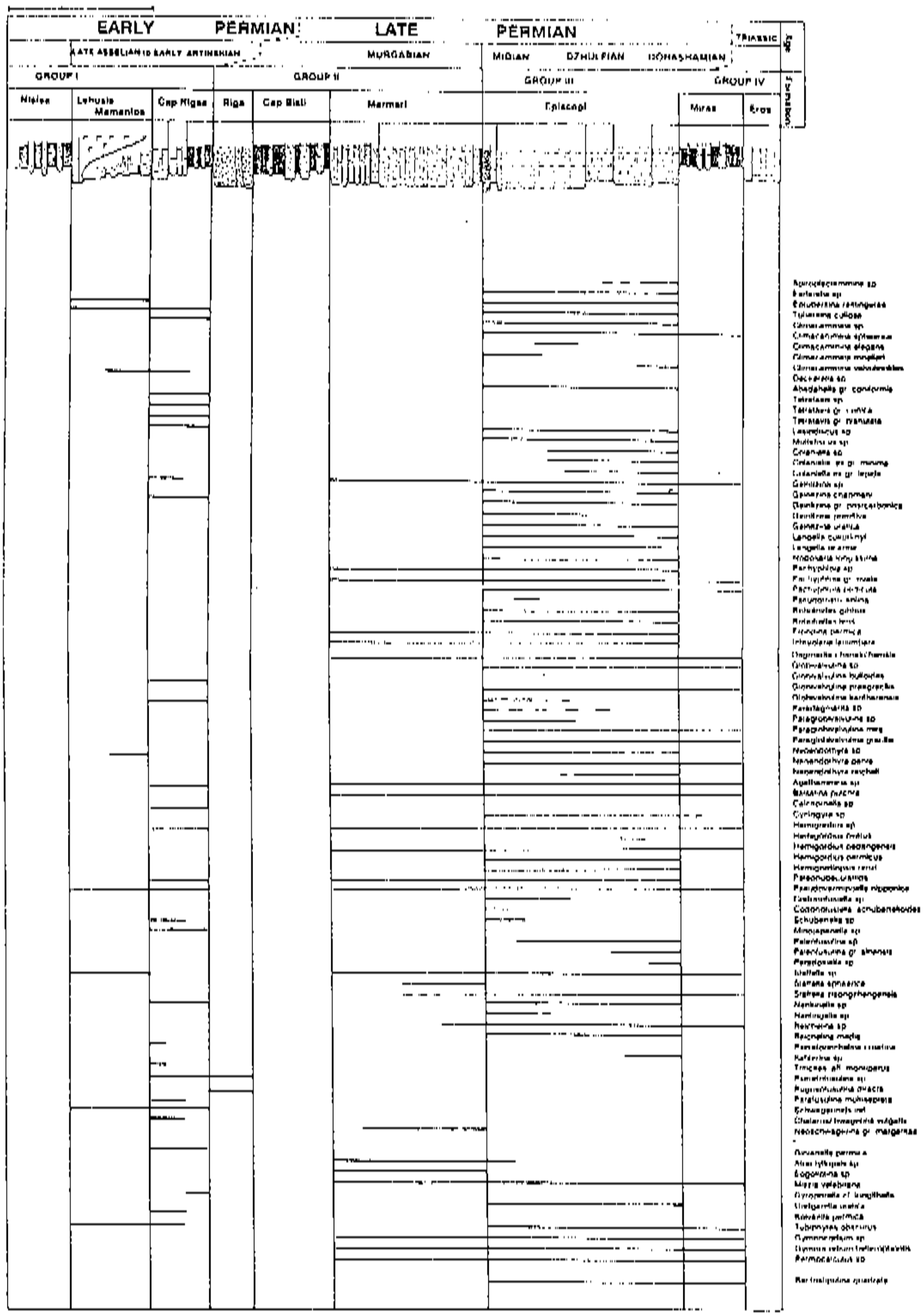

Fig. 3 Stratigraphic range of Permian Foraminifera and Algae in the Hydra Island. Same lithological section as Fig. 2

With a slight unconformity in the Cap Rigas area, the Group II, 150 to 300m, thick, is subdivided in 3 formations, Riga, Cap Bisti and Marmari. Due to tectonic disturbances, this group is difficult to study. The basal part is best developped in the Cap Rigas area, the middle part in the Cap Bisti area and the upper part in the area above the sea shore, S of Episkopi. The Riga formation consists of 3 superposed deca- to hectometric lenses of breccia units of maximum 20m thick. The lower and the upper lenses are made of calcareous and rare dolomitic clasts reworked from the underlying formations (Asselian to Early Artinskian limestones). The middle unit is a conglomerate with quartzitic and cherty clasts and very few carbonate clasts. It is interesting to note that these Riga breccias seem to be deposited at the same time (Late Artinskian) and within the same geodynamic process than the Sexten and Tarvis breccia of the Carnic Alps (FLUGEL & KRAUS, 1986).

Due to tectonic deformations (local decollement levels), no complete section of the following Cap Bisti formation has been observed and the thickness is highly variable (0-100m).A great part of this formation as observed in the Cap Bisti area consists of red shale with yellow, subevaporitic dolomicrite intercalations, without fossils.

In the overlying Marmari formation, well developped on the lower slope S of Episkopi, we note the presence of 2 main peritidal calcareo-dolomitic cycles of respectively 50m and 100m thick. The main facies consists of dolomitic, bioclastic wackestone-packstone with subordonate foraminiferal lime packstone-grainstone. Monogeneric accumulations are not rare and some horizons contain a large concentration of *Hemigordius* sp. (pl. 1/1), other of *Staffella sphaerica* (ABICH) or *Staffella zisonghzengensis* (SHENG) and *Nankinella* sp. (pl. 2/4). Large amount of calcareous Algae with *Mizzia* sp. and *Gymnocodium* sp. and nests full of the gastropod *Bellerophon* have been observed. In some areas, the accumulation of the Foraminifera is some time so considerable that it represents a characteristic feature for this formation in the field. The presence of the index fusulinid *Neoschwagerina margaritae* DEPRAT (pl. 1/3) in the middle and upper part of this formation indicates a late Murgabian age. Subevaporitic thin bedded dolomicrite are caracteristic of the regressive uppermost part of each cycle. The small Petassi inlet, NW of Hydra shows a massive, unbedded boundstone facies of a carbonate buildup with about same age *Neoschwagerina* sp., *Kahlerina* sp. and *Rugosochusenella* sp. (Römermann, 1969). This is a lateral reef facies of the peritidal Marmari formation.

To summarize, the environmental evolution of this Group II is beginning with continental alluvial fan, followed by protected nearshore deposits, then by protected and open lagoon with peritidal sequences, returning at the top to a regressive subevaporitic end of cycle. Open marine reef sequences are present to the NW.

The next Episkopi Group (III) is fully developped S of Episkopi with a thickness of about 200m and is resting with a small unconformity on the Marmari formation that is clearly truncated in the Cap Rigas area. Two main facies occurs in the basal 15m: - conglomerates with well rounded dolomitic pebbles reworked from the underlying group and thin bedded dolomicrite.

In the cliff forming well stratified Episkopi limestone (Episkopi formation *s.s.*) it is important to note the successive index Foraminifera appearance from the oldest to the youngest: - *Paraglobivalvulina mira* REITLINGER,- *Paleofusulina* gr. *sinensis* DEPRAT,- *Colaniella* ex.gr. *lepida* WANG (fig. 2 and tab. 1).

The Episkopi limestone shows at the base about 5m of calcareous breccia with black limestone and light dolomitic clasts in a bioclastic matrix with corals and calcareous Algae debris. Foraminifera are very aboundant (list in fig. 3) and the apparition of the *Paraglobivalvulina mira* REITLINGER and *Codonofusiella* aff. *schubertelloïdes* REITL. assemblage with *Nanlingella* sp. and *Reichelina* sp. indicates a late? Midian age. The first 90m of the Episkopi limestone is thick bedded and consist of high energy bioclastic lime packstone-grainstone with silicifications, rich in calcareous Algae, small Foraminifera and fragments of bryozoan, gastropods and corals. One of these has been identified as *Waagenophylum virgalense* (WAAGEN & WENTZEL) by Gräf in RÖMERMANN (1969). The apparition of the index Fusulinid *Paleofusulina* gr. *sinensis* DEPRAT (pl. 2/3) occurs only 40m above the base in the Episkopi section.

The following 55m is characterized by flat to round shaped cherts in the fine grained bioclastic lime packstone with sponge spicules, crinoïds, calcareous Algae and Foraminifera. From a biostratigraphical point of view it is interesting to note that the *Colaniella* ex gr. *lepida* WANG (pl. 2/2) appears in this cherty limestone, 120m above the base of the formation. Following NESTELL & WARDLAW (1987) it is about in the same level that the early Dzhulfian conodont *Neogondolella leveni* has been found (tab. I).

The cherty limestones are followed by 10m of grey nodular lime wackestone and by 30m of well bedded lime wackstone-packstone with marly interbeds. Fauna includes sponges, crinoïds, bryozoans and Foraminifera with the *Paleofusulina* - *Colaniella* assemblage. At the top of the formation occurs the famous brachiopods horizon studied by RENZ & REICHEL (1945). A list is given in RÖMERMANN (1969) and systematic description is found in GRANT (1972). Conodonts are ab undant with *Neogondolella orientalis* and *Hindeodus julfensis* (NESTELL et al. 1987), a Late Dzhulfian to Early Dorashamian assemblage (tab. 1).

SERIES	ETAGES	AMMONOIDES ZONES	CONODONTES ZONES		Hydra Island (Greece) Small benthic foraminifera		Fusulinids
TRIASSIC	GRIESBACHIAN	*Otoceras*	*A. parvus*				
LATE PERMIAN	DORASHAMIAN	*Pleuronodoceras* *Paratirolites* *Phisonites*	*N. subcarinata* *L. tarazi*	*H. julfensis*	G A P		
	DZHULFIAN	*Vedioceras* *Araxoceras*	*N. orientalis* *N. leveni*	*H. julfensis*	Colaniella ex. gr. lepida	Paraglobivalvulina mira	Paradoxiella sp. Paleofusulina gr. sinensis
	MIDIAN	*Anderssonoceras* *Eoaraxoceras* *Timorites*	*M. divergens* *M. praedivergens*	*N. bitteri*	Hemigordiopsis renzi	Paraglobivalvulina mira	Codonofusiella aff. schubertelloides
	MURGABIAN	*Waagenoceras*	*S. sweeti* *N. serrata*	*N. bitteri*	Hemigordius ssp.		Neoschwagerina margaritae Staffella zisonghzengensis Staffella sphaerica

Tab. 1: Age of the index Foraminifera found in the Marmari and Episkopi formations (Hydra Island). Late Permian stratigraphical chart from BAUD in JENNY-DESHUSSES & BAUD (1989, tab. 5)

The last Group (IV) comprises 2 formations, Miras and Eros. Only Miras will be examined here. This lower formation lies unconformably on the Episkopi limestones that can be eroded even completely on tilted blocks. Then, the Miras formation is transgressing directly on the Marmari formation as in the 3rd thrustsheet, S. of Vlichos. The Miras formation, 30m to more than 100m thick, consists of brown to dark red shales with intercalations of various lenses or blocks:

- quartzitic lime packstone,
- quartzitic sandstone or microconglomerate,
- red micritic limestone,
- oolitic grainstone,
- olistostrome with Permian limestone or dolostone clasts
- Permian limestone olistholites

These last 2 facies are well developped in the NW part of the island (RÖMERMANN, 1969, ARGYRIADIS, 1978). The quartzitic limestone facies present in the lower part of the formation is quite different than the Episkopi limestone facies and the Foraminifera are characterized by a *Staffella* sp., *Hemigordius* sp. (pl. 2/1), *Baisalina* sp. and *Paraglobivalvulina mira* assemblage. We note here the complete absence of *Paleofusulina* and *Colaniella* and the older aspect of the microfauna (see fig. 2). This can be related to environmental changes associated with a global fall of sea level as observed elsewhere. For example in the Salt Range (Pakistan) a similar lithological evolution with sudden terrigenous influx has been observed, but there the Colaniella fauna does not seem affected.

The red limestone facies occuring in the upper part of the Miras formation in the Episkopi area was dated by conodonts as late Spathian (early Triassic)in RÖMERMANN (1969). The thick overlying Eros limestone (mainly oolitic) is Anisian in age.

A good knowledge of the Permian sections in Hydra (fig. 2) and of the stratigraphic distribution of the Foraminifera is essential to understand the Permian of Aegina, Salamis, Attica and Chios. The synthetic profile that we have discussed here (fig. 2) is characterized by 4 main events and the development of 3 successive carbonate platforms during the Permian. The first event (A in fig. 2) is the onset of the Lehusis carbonate platform over the fine terrigenous offshore sediments during late Asselian time. The second event (B in fig. 2) is paleotectonic with the uplift (or tilting) of part of this platform and the Riga breccia deposition (late Artinskian?). We have no information for the Kubergandinian and early Murgabian (gap?). The third event (C in fig. 2) is recorded by the basal Episkopi unconformity and the conglomerate deposition due to tilting and uplift of part of the Marmari carbonate platform that occurs between the late Murgabian and the late Midian. The last event (D in fig. 2) is the sudden terrigenous influx on the deformed Episkopi open marine carbonate platform during the early Dorashamian. A paroxism of the deformations with the Permian olistholites emplacement occurs during the early Triassic time.

AEGINA ISLAND.

Only in 1978 GAITANAKIS & TSAILA-MONOPOLIS discovered a small outcrop of black limestone in the northern part of Aegina island below the Plio-Quaternary volcanics and dated it as late Permian, on the base of *Parafusulina* ? sp. and *Codonofusiella* sp.. A new profile discovered near Mesagros has been studied in detail and part of the microfaunal content is presented in JENNY-DESHUSSES & BAUD (1989, p.890). This isolated section is about 50m thick and consists of badly stratified bioclastic packstone with some cherts and silicified corals in the lower part and massive lime boundstone with bryozoans, corals and calcisponges in the upper part. Levels with reef breccia are also present in both the lower and the upper part. The index genus *Paleofusulina* is present all along the section from the base to the top with *P. minima*, *P.* aff. *fusiformis* and *P.* gr. *sinensis*. Another index foraminifer *Colaniella* ex. gr. *parva* appears only at the top. The correlation with the upper Episkopi limestone is good and the age is early Dzhulfian (BAUD & JENNY-DESHUSSES, in prep.). These two outcrops belong to the same geotectonic unit as do the neighbouring islands of Hydra and Salamis.

SALAMIS ISLAND.

The existence of fossiliferous Permian in Salamis island was first reported by RENZ (1912) in Perani area at the southern part of the island (reported as "Carboniferous" but later on proved to be Permian, RENZ, 1955). VOREADIS (1929) reported new findings together with a geological sketch whereas RENZ & MISTARDIS (1938) and TATARIS (1972) studied the geological position of the Perani formation and the probable correlation with formations of Attica. PAPANIKOLAOU & BAUD (1982) described at Kaki Vigla bay (Eastern coast of Salamis) a late Permian sedimentary sequence with slope and basinal characters comprising a flysch-type sedimentation in the lower part and a deep slope carbonate sedimentation in the upper part. It is remarkable that the previously described fossils of the very fossiliferous upper part of Kaki Vigla section (RENZ, 1955, NAKAZAWA et al., 1975) are, according to PAPANIKOLAOU & BAUD (1982), redeposited in a deep water radiolarian rich lime mudstone-wackestone and are coming from an Episkopi carbonate platform and slope during the late Permian. The same authors confirmed the presence of early Triassic microfossils (Spirorbis and Glomospires) over and in tectonic contact with the late Permian black, slumped limestones with *Paleofusulina* and also the existence of different blocks in the Perani area, floating within a terrigenous and volcanic matrix.

New detailed studies at Kaki Vigla have been done recently and the main results have been published in BAUD & al. (1989) for the geological context and the stable carbon isotope studies and in JENNY & BAUD (1989, p. 890-891) for the foraminiferal assemblage. We can add the discovery of *Paleofusulina prisca* DEPRAT and *Reichelina criptoseptida* ERK (BAUD & JENNY-DESHUSSES, in prep.) to the previous reported Paleofusulina gr. *sinensis* DEPRAT and *Colaniella* ex.gr. *parva* (COLANI).

ATTICA

A widespread formation consisting of a volcano-sedimentary matrix with discontinuous occurrences of very fossiliferous dark-coloured limestones of middle Carboniferous and Permian ages (RENZ, 1908, RENZ & REICHEL, 1945, CLEMENT et al., 1971, CLEMENT, 1983, etc.) occurs at the base of the Subpelagonian nappe in northern Attica (Beletsi-Parnes, Aegaleo, Pateras Mountain). This formation, mapped for the first time by RENZ (in RENZ & REICHEL, 1945), was regarded as Late Paleozoic in age and his position over the metamorphics of Attica would be a proof for the pre-Carboniferous age of the latter. Documented fossils of Mesozoic age in the metamorphics and the alpine nappe structure changed this view. Recently BAUD & PAPANIKOLAOU (1981) reported that the fossiliferous limestones within the volcanoclastics of Parnes and Pateras Mountains are blocks - olistholites and, therefore, the age of the formation should be Early or Middle Triassic. TATARIS & SIDERIS (1989) confirmed the olistholite interpretation of the Permian limestones for the case of Aegaleo Mountain.

After our recent investigations on the microfacies and the microfauna of the Permian limestone blocs and the reinterpretation of the detailed work of CLEMENT (1983), we can propose a carbonate platform origin, destroyed during the closure of the Paleotethys (see last chapter). The early Permian blocs are from a Lehusis - Cap Rigas platform type and the late Permian are from an Episkopi platform type. The Marmari carbonate platform did not provide recognizable elements.

CHIOS ALLOCHTHON

This geotectonic unit, occurring in the NE part of Chios island, comprises an Upper Carboniferous to Upper Permian sequence, underlying a Liassic shallow-water carbonate platform (KAUFFMANN, 1969, BESENECKER et al., 1968). PAPANIKOLAOU & SIDERIS (1983b) emphasized that from an essentially flysch-type part of the sequence during Late Carboniferous - Early Permian, we get to a neritic carbonate platform sedimentation during Late Permian. Our recent works on this shallow water carbonate platform have shown that the foraminiferal assemblage and the depositional environment are very close to those of the Late Murgabian Marmari formation of Hydra and that in the Chios Allochthon there are no younger Permian deposits.

In the "Autochthon", blocks of Ordovician to Early Carboniferous rocks are floating within a Permian *p.p.* flyschoid sequence (PAPANIKOLAOU & SIDERIS, 1983 b).

These Paleozoic (par)autochthonous and allochthonous series of Chios can be regarded as pertaining to an active margin setting, the northern margin of the Paleotethys. The imbrication of Paleotethyan exotics in a matrix of greywacke would point to a location in the outer slope of an accretionary complex (see also STATTEGGER, 1984). The exotic material derived from the paleotethyan oceanic floor consists mainly of deep water facies ranging in age from Ordovician to early Permian, with some volcanics and platform carbonates possibly derived from seamounts. Radiolarites blocks of late Paleozoic age are abundant up to the top of these series.

Within the Allochthon, these terranes are covered unconformably by shallow water carbonates of late Permian age. They can be regarded as a sealing the deformation affecting the prism. Although they do not mark the real end of the deformation (the Permian beds being covered unconformably by Liassic limestone) these deformation could have started during a late Variscan phase of continent/continent collision marking the closing of Paleotethys.

Whithin the "Autochthon" the Paleozoic series is covered by early Triassic limestone showing a rapid deepening (Hallstatt facies). This thick Triassic seriesis absent in the Allochthon. One is most likely dealing here with syn-collisional rifting mechanism possibly cutting the suture area at an angle. At the Liassic level both "Autochthon" and Allochthon are covered by platform carbonates, marking the end of all tectonic activities.

PALEOTETHYAN SUTURE AND GEODYNAMIC INTERPRETATION.

Greece is situated between the Western European Hercynides and the Middle-East Cimmerides. Collision between Gondwana and the European active margin is well dated ,for example, in Morocco as Visean (JENNY & al., 1983). In Iran, collision of the Cimmerian micro-continent with the same Eurasian active margin started during the Carnian (BAUD & STAMPFLI 1989). As shown by Iranian example one is not necessarily dealing with a "proper" orogen with nappes and important metamorphism, but rather with a gentle "docking", in a transpressive mode, between an old passive margin and a large accretionary prism.

The ocean being closed during that diachronous collision was the Paleotethys which seems to have been generated after a late Ordovician rifting phase (STAMPFLI & al., in press).

Therefore this collision process involves a passive margin initiated in Ordovician times and an active margin with a complex history of accretion, containing numerous accreted terranes with a convergence history starting in the Caledonian cycle.

One can suggest that a Paleotethyan " suture" should exist in Greece. Volcano-sedimentary sequence of Late Permian to Early Triassic age containing large olistoliths or olistostromes could certainly be used as witness of such a collision process between an active margin to the N producing the volcano-sedimentary matrix and a passive margin to the S producing the carbonate platform olistoliths.

As shown by the numerous outcrops described in this paper the collision process could start during a Late Variscan phase to end up in an Early Cimmerian phase of deformation, showing how obsolete the folding phase concept can be in a such context of diachronous collision.

The Permotriassic formation with Upper Paleozoic olistholites extended in the internal Hellenides and the Pontides (PAPANIKOLAOU & DEMIRTASLI, 1987) can be also related to a rifting phase initiating the northward drift of some tectonostratigraphic terranes of the northern gondwanian margin (PAPANIKOLAOU, 1989). The olistholites of Lower Paleozoic age occuring within the Permotriassic clastic formation are of problematic origin: nearby formations from below the Upper Paleozoic platforms of the gondwanian fragments or distant formations from the active European margin?

The Chios outcrops are certainly unique in that context as they allow to trace the accretion history and to prove that the accreted exotics were very likely derived from the Paleotethys. The Carboniferous and Permian olistoliths found elsewhere certainly belong to the Paleotethyan passive margin and were part of large carbonate platform which got caught in the collision processes.

In conclusion, Late Paleozoic outcrops of Greece certainly represent milestones in the convergence process of the Eurasian and Gondwanian landmasses. Their study should receive more attention as the Late Paleozoic framework is certainly responsible for the paleogeographic settings of the Mesozoic history of Greece.

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Plate 1

Fig. 1 - Individuals of the genus *Hemigordius* and dasycladal algae in the Marmari Formation. Section of Lehusis Hydra Island. Sample 48624.

Fig. 2 - *Tubiphytes obscurus* (a), *Eotuberitina reitlingerae* 8b) in bioclastic mound of the Lehusis Formation. Section of Cap Rigas, Hydra Island. Sample 50249.

Fig. 3 - *Neoschwagerina margaritae* DEPRAT in the Marmari Formation. Section of Lehusis, Hydra Island. Sample 48619.

Fig. 4 - *Triticites* aff. *montiparus* ROZOVSKAYA in limestone of the Marmantos Formation. Section of Cap Rigas, Hydra Island. Sample 50148.

Scale : 500 μ

Plate 2

Fig. 1 - Individuals of the genus *Hemigordius* and quartz. Miras Formation. Episcopi section. Sample 50241.

Fig. 2 - *Colaniella* ex gr. *lepida* WANG. Episcopi Formation in Episcopi stratigraphical section. Sample 50222.

Fig. 3 - *Paleofusulina* gr. *sinensis* DEPRAT. Episcopi Formation. Episcopi stratigraphical section. Sample 50217.

Fig. 4 - *Staffella zisoghzengensis* (SHENG) in the Marmari Formation. Section of Lehusis, Hydra Island. Sample 48622.

Section : 500 μ

Plate 1

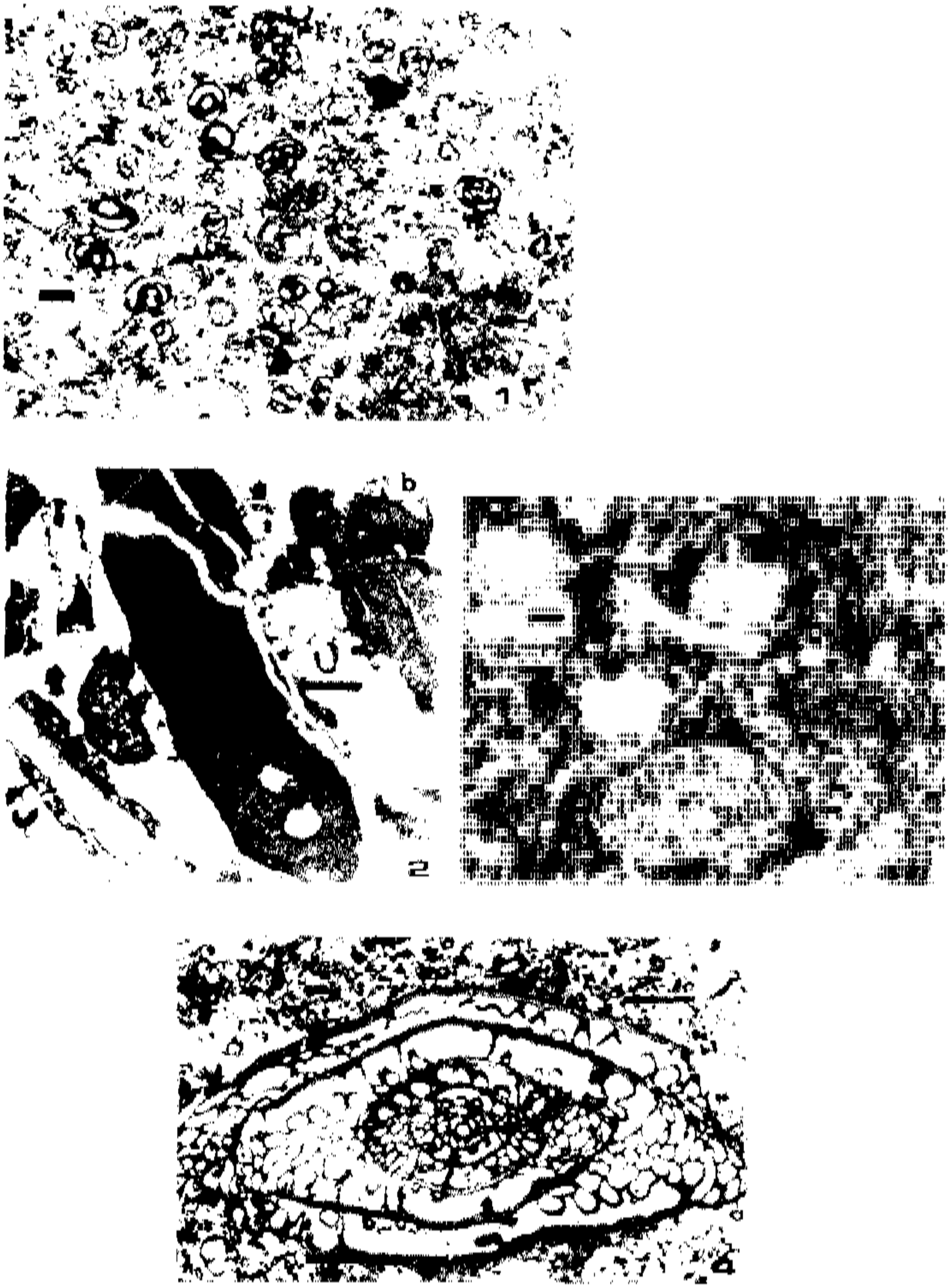

Plate 2