To ZEHRA ÖNDER , with affection

Top copy

UNIVERSITY OF SOUTHAMPTON

NEW MICROPALAEONTOLOGICAL DATA AND STRATIGRAPHICAL INVESTIGATION OF THE TRIASSIC ROCKS OF THE CENTRAL TAURUS MOUNTAINS - TURKEY

by

FUAT ÖNDER

A Thesis submitted in the University of Southampton
for the degree of Doctor of Philosophy

Department of Geology. October, 1982

UNIVERSITY OF SOUTHAMPTON

ABSTRACT

FACULTY OF SCIENCE

GEOLOGY

Doctor of Philosophy

NEW MICROPALAEONTOLOGICAL DATA AND STRATIGRAPHICAL INVESTIGATION OF THE TRIASSIC ROCKS OF THE CENTRAL TAURUS MOUNTAINS - TURKEY

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Petrographical study of the Triassic rocks from eight measured outcrops has determined the framework grains, their type and size, as well as composition and texture. The marine limestones which dominate the succession have been petrographically classified into several basic types, after Folk (1962) and Dunham (1962). For petrographic and palaeontologic interpretation, a total of 432 samples were collected from the eight localities and 850 thin sections were prepared. Of these samples, 20 were shales; they were processed for microfauna but were found to be barren. As far as the palaeontological study of the rocks is concerned, conodonts, foraminifers and holothurian sclerites have been identified, but particular attention has been given to the conodonts. 56 large limestone samples were processed for conodonts, of which 14 were barren. From a total of 84·435 kg. of rock, 3575 conodont specimens were recovered. 2177 specimens were identifiable; they are attributed to 15 existing genera, 50 species and 3 sub-species. In addition, 3 new species of existing genera have been recognized, as well as a new monotypic genus.

The conodont faunas are restricted to biomicrites, although not all biomicrites contain conodonts. The 16 identifiable genera of conodonts are:

	Number of species	Number of specimens of these species
Cratognathodus Mosher	2	139
Cypridodella Mosher	4	22
Didymodella Mosher	1	10
Diplododella Ulrich & Bassler	1 sp.indet.	8
Ellisonia Müller	2	5
Enantiognathus Mosher & Clark	2	17
Epigondolella Mosher	14	683
Gladigondolella Müller	3	212
Neocavitella Sudar & Budurov	1	1
Neogondolella Bender & Stoppel	16	522
Neohindeodella Kozur	2	25
Parachirognathus Clark	2	5
Prioniodella Ulrich & Bassler	3	35
Prioniodina Ulrich & Bassler	2	174
Xaniognathus Sweet	1	15
A new monotypic genus	1 sp.indet.	4

ACKNOWLEDGEMENTS

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I much appreciate the help given by all members of staff and research students in the Department of Geology, Southampton University. My thanks go to Barry Marsh and Robin Saunders for instructing me in the arts of conodont photography and electron-micrography (SEM).

I would also like to thank all members of staff of the Basic Research Department of MTA for officially making possible this research, for the use of transport and field-equipment, and for providing laboratory facilities to complete this study. I have benefited from fruitful discussion with my friends and colleagues in MTA. I am particularly happy to record my thanks to Mr. E. Arpat, Dr. M. Şenalp, Dr. S. Talu, Mr. S. Özer and his project colleagues, Mr. B. Ürgün, Mr. A. Işık and many others who helped me in several ways in connection with this research.

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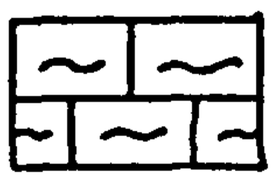
LIST OF SYMBOLS

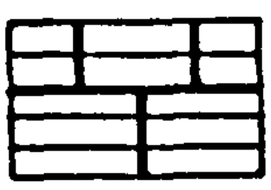
Fossil symbols:

	Foraminifers
	Sparse foraminifers
	Algae
	Cauliflower-type algae
	Stromatolites
	Lamellibranchs
	<u>Claraia</u> sp.
	<u>Pentacrinus</u> sp.
	Crinoids
	Ammonites
	Gastropods
	Conodonts
	Ostracods
	Trace fossils
	Corals
	Bryozoa
	Belemnites
	Echinoderms

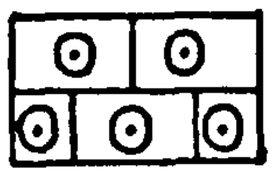
Rock symbols:



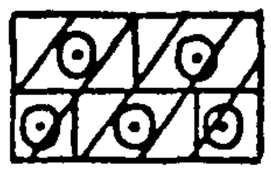
Algal limestone



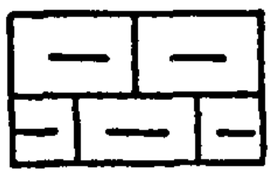
Stromatolitic limestone



Oolitic limestone

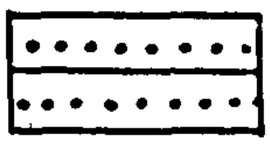


Oolitic limestone with small scale cross lamination.

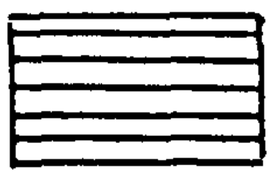


Argillaceous limestone

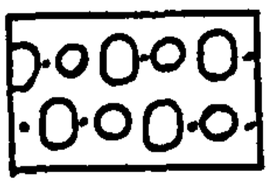
Dolomite



Sandstone



Shale



Conglomerate

Edgewise conglomerate

Allochems:

Oncolites

Oolitns

Intraclasts

Bioclasts

Pellets

PART I - NEW MICROPALAEONTOLOGICAL DATA AND STRATIGRAPHICAL INVESTIGATION OF THE TRIASSIC ROCKS OF THE CENTRAL TAURUS MOUNTAINS - TURKEY

CHAPTER 1 : INTRODUCTION

1.1: General Statement

This study was initiated by "The Basic Research Department of the Mineral and Exploration Institute of Turkey" to provide information on the marine Triassic rocks which outcrop in the Central Taurus Mountains. With their cooperation this project was brought to the University of Southampton, where sedimentological and palaeontological studies have been undertaken on samples from the three localities examined. Because the marine Triassic stratigraphy and sedimentary environments of the Taurus Mountains have not been well researched, Triassic limestones from the Central Taurus have been measured and examined at outcrop and in the laboratory. In general, these outcrops consist of shallow water limestones and shales. Locally there is also conglomerate and sandstone.

There are no reports of the detailed sedimentology and palaeontology, and this thesis is therefore the first report covering these aspects.

1.2: Geological Features of the Taurus Orogenic Belt

A tectonic subdivision of Turkey was proposed by Ketin (1966). This was modified by Şengör *et al*. (1980), who recognised five major structural units: the Pontides (divided into Western and Eastern), Anatolides, East Anatolian Accretionary Complex, Taurides and Border Folds (Fig.1). The Taurides, which consist of a number of allochthons, extending along the southern part of Anatolia, have also been sub-divided after Blumenthal (1963). Figure 2 shows this sub-division:

1. Occidental Taurides:
   - A - Lycian Taurus
   - B - Pisidian Taurus
   - C - Occidental Taurus
2. Central Taurides
3. Oriental Taurides.

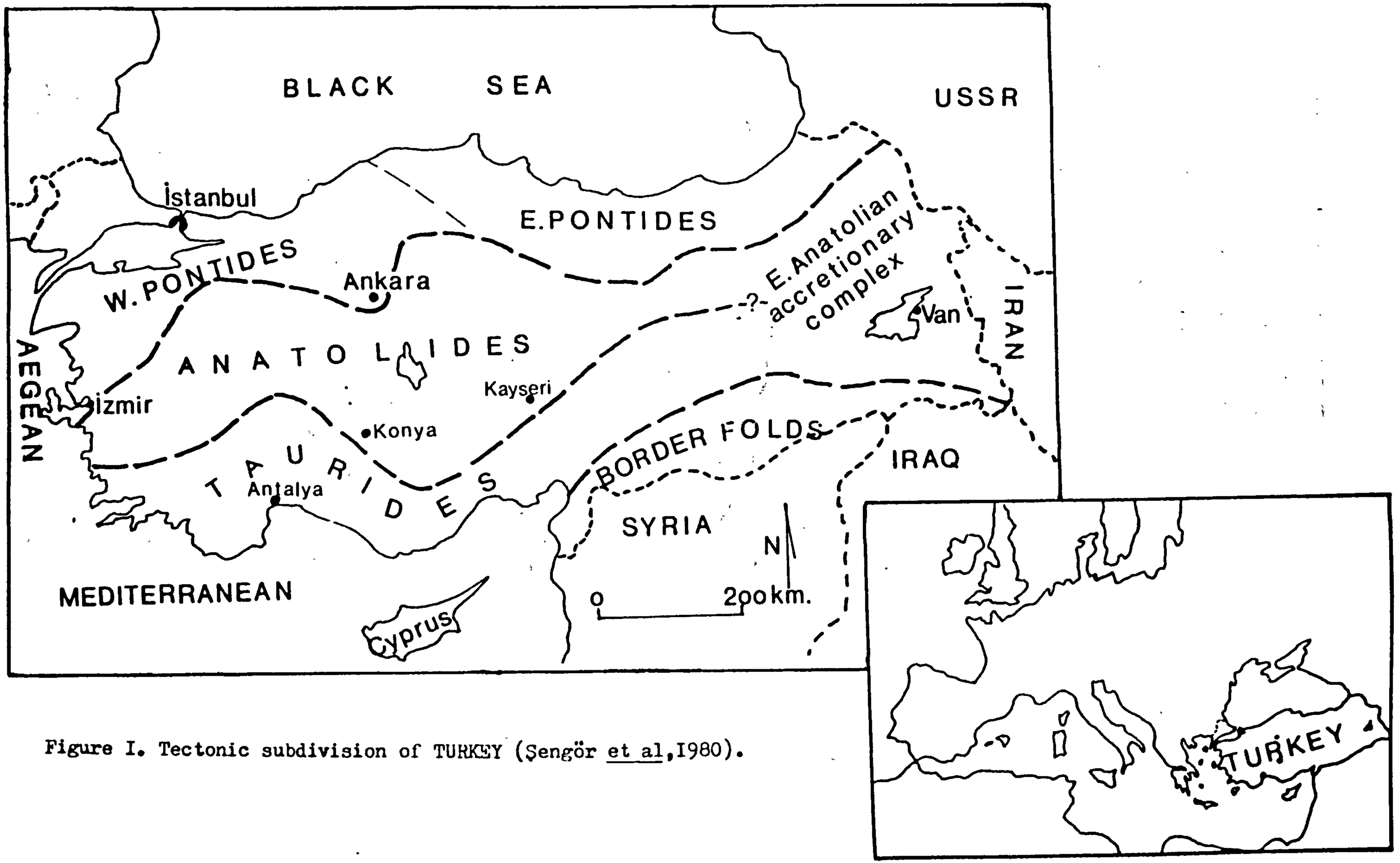


Figure I. Tectonic subdivision of TURKEY (Şengör et al,1980).

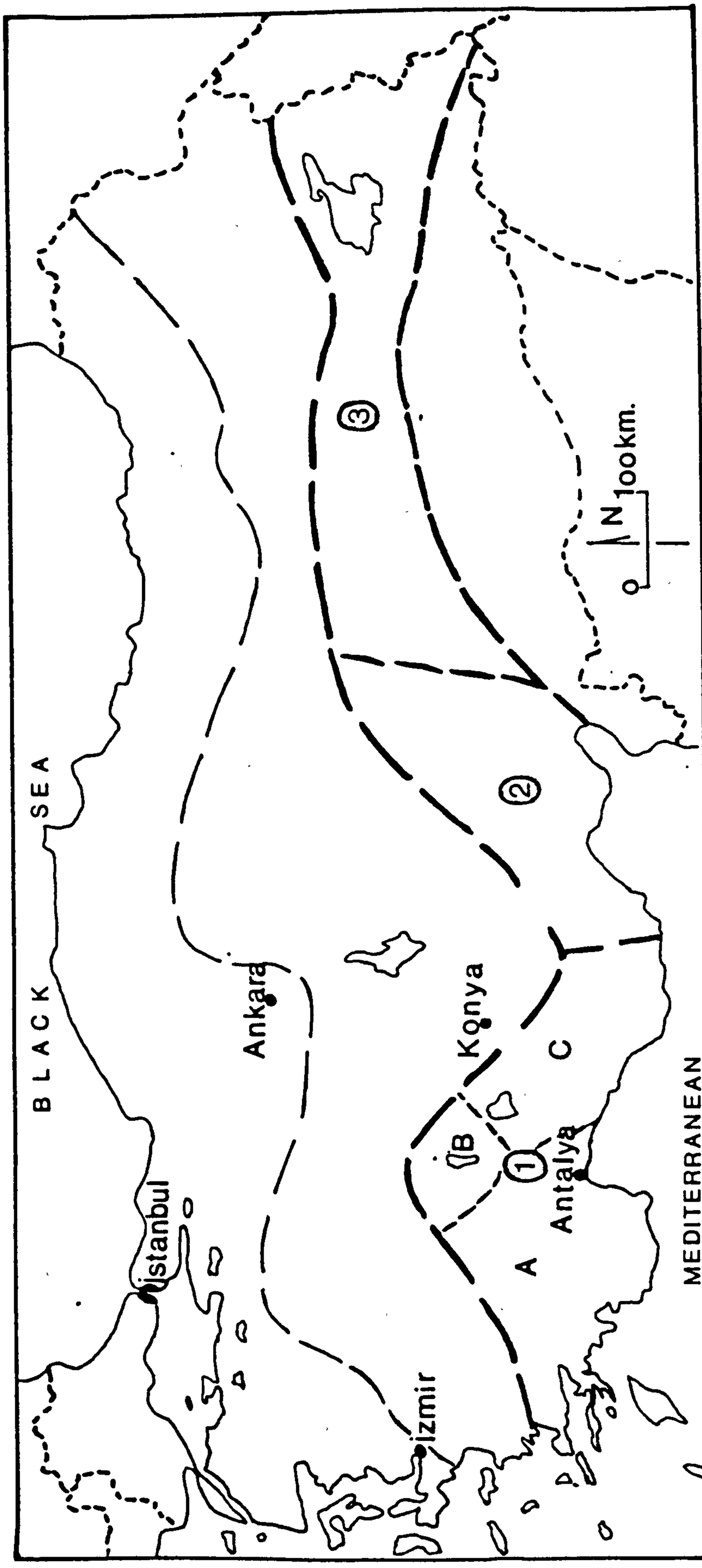


Figure 2. Subdivision of Taurides (modified after Blumenthal,1963):
1-Occidental Taurides:A-Lycian Taurus,B-Pisidian Taurus,C-Occidental Taurides.
2-Central Taurides.
3-Oriental Taurides.

(The term 'central' as used in this thesis includes Region 1C - the Occidental division of the Occidental Taurus and Region 2 - the Central Taurus.)

The first geological surveys in the Taurus belt were undertaken by M.M. Blumental between 1940 and 1963. The Taurus Mountains include rocks ranging in age from Cambrian to Tertiary, deposited in a number of discrete basins with differing stratigraphic successions (Blumenthal, 1963; Özgül, 1971). Özgül (1971, 1976) has defined six units within the area, distinguished from each other by their stratigraphic position, character of metamorphism and present structural situation: Bolkardağı Unit, Aladağ Unit, Geyik Dağı Unit, Alanya Unit, Bozkır Unit and Antalya Unit. All of the exposed units extend laterally for hundreds of kilometres, with tectonic contacts between them and they commonly form allocthonous covers over each other (Fig.3).

Özgül has been working on the tectonics and lithostratigraphy of the Taurides since 1967, and either his papers or my personal communication with him form the basis of the present research. However, in the last two decades a number of French geologists have undertaken a broad survey of the stratigraphy and tectonics of the Taurides of Southern Turkey (Poisson, 1967; Brunn et al., 1971; Brunn, Poisson et al., 1976; Marcoux, 1976, 1978; Monod 1977 and others).

Opinions have converged about the ophiolitic and radiolaritic sequences, which are defined as the Antalya Nappes. They lie upon the outer part of the autochthonous zone of the Taurids, and consist of sedimentary, igneous and metamorphic rocks ranging in age from Ordovician to Tertiary (Brunn et al., 1970, 1971; Dumont et al., 1972). Marcoux (1973) investigated the broad stratigraphical succession of the Triassic Formations in the Antalya Nappes which include rocks ranging from Ordovician to Lower-Middle Cretaceous. He has concentrated on the stratigraphy and tectonics of the Triassic System within the Radiolarite and Ophiolitic Nappes of Antalya (Marcoux, 1970, 1976, 1978). Marcoux (1976) has shown that,although the Trassic rocks in individual nappes are usually of one facies, sufficient transitional facies exist to enable their environmental reconstruction throughout the Taurides. The environments identified range from continental edge to a more "oceanic" domain. Brunn et al. (1976) gave a comprehensive account of the

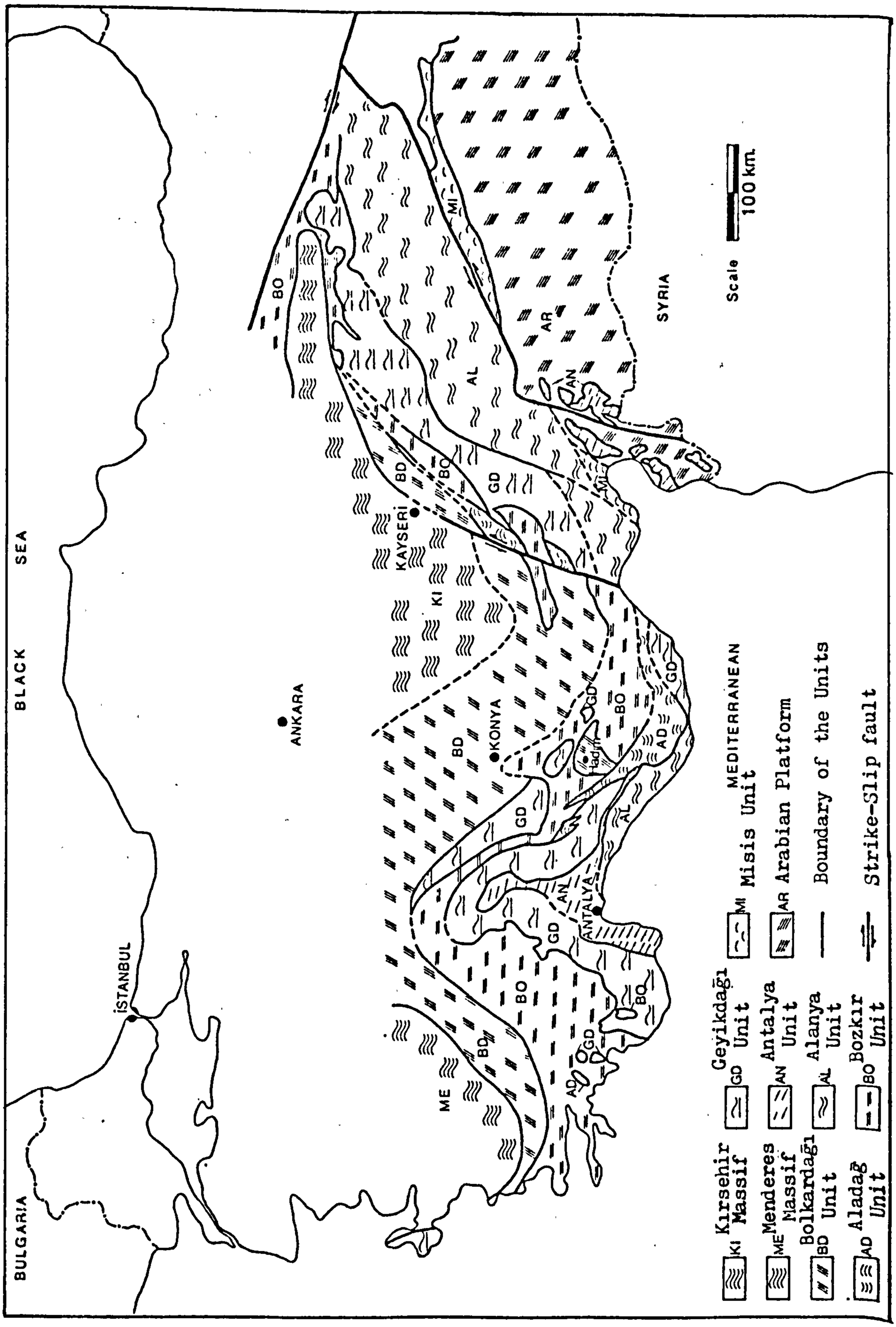


Figure 3. Outline map showing the distribution of units in the Taurus belt(Özgül,1976).

Taurides and Hellenides. Brunn (1976) extended his studies eastwards from the Taurides to the Zagros Mountains of Iran to propose a dynamic model for the formation of arcs in the Alpine Fold Mountains System and other ranges. Letouzey et al. (1976) researched a satellite photogeological sketch map and field studies for structural synthesis of the Mediterranean area. Brunn (1978) and Marcoux (1978) have continued their studies on the Alpine ranges. Marcoux's most recent paper (1979) discusses the structural setting and general stratigraphy of the Antalya Nappes, and attention is given particularly to the subject of their Triassic evolution. Other studies also published on the tectonic and stratigraphic features of the Antalya Complex are by Robertson and Woodcock (1979, 1980a-b, 1981a-b).

1.3: Late Palaeozoic and Early Mesozoic Conodont Researches

Conodonts have been recovered from widely distributed members of Permian and Triassic strata. They have been reported from North America (Müller, 1956; Clark, 1957 and 1959; Clark & Ethington, 1962; Clark & Mosher, 1966; Clark & Behnken, 1971; and Mosher, 1970, 1973,etc.); in Europe from Austria (Huckriede, 1958; Mosher, 1968; Mostler, 1968; Hirsch, 1969; Kozur & Mostler, 1971a; Kozur, 1972; Krystyn et al., 1971a, b; and Krystyn, 1973, etc.), Bulgaria (Budurov 1960, 1973; Budurov & Stefanov 1973, Budurov & Ganev, 1979, etc.), Czechoslovakia (Budurov & Pevny, 1970; Kozur, 1972; Kozur & Mock, 1972), Germany (Kozur, 1968, 1971; Kozur & Mostler, 1970, 1971, etc.), Greece (Bender, 1967, 1970), Hungary (Kozur, 1971; Kozur & Mostler, 1971); Spain (Boogaard & Simon, 1973, etc.), Poland (Szaniawski, 1969; Dzik & Trammer 1980, etc.) and Turkey (Gedik, 1975, 1977, 1981); Asia (Nogami, 1968; Hayashi, 1968; Igo et al., 1965; Sweet, 1970b; Koike, 1973, 1979, 1982; Koike et al. 1971; Nakazawa 1975; Stoppel 1976; Goel 1977, etc.), Middle East (Sweet 1970a; Huddle 1970; Hirsch 1972, etc.), Australia (McTavish 1973), Near East-USSR (Barskov & Koroleva 1970, etc.), Africa (Diebel 1956; Sweet et al. 1971).

The first conodonts of Permian age were reported by Branson (1932), but no exclusively Permian faunas were reported until Youngquist et al. (1951). Triassic specimens of Neogondolella mombergensis (Tatge) were first described and illustrated from the Muschelkalk of Germany as Paleozoic forms by Branson and Mehl (1941). Eicher (1946) pointed out the presence of conodonts in the Middle Triassic rocks of North-eastern

Egypt. Youngquist (1952) reported specimens of diagnostic form from the Lower Triassic from South-eastern Idaho. Eicher's and Youngquist's conodonts were not described in detail nor illustrated; however they are accepted as Triassic.

The first systematic information on Triassic faunas was reported by Müller (1956) from the Lower Triassic of Nevada. Tatge, in the same year, published descriptions of some Triassic conodonts from the Muschelkalk of Germany. Huckriede (1958) and Hirschmann (1959) described species of Triassic conodonts from Austria and Germany. Additional data concerning the European Triassic is available in Huckriede (1959) and Pilger & Schöneberg (1958). In the last two decades numerous papers have been published with descriptions of conodont specimens from the European Triassic. Budurov (1960, 1961) and Budurov and Stefanov (1972, 1974, 1975) have described and illustrated Triassic conodonts from Bulgaria. Kozur (1968, 1974), Kozur and Mostler (1970) and Kovacs (1977) have reported some additional faunas from Central Europe. Krystyn (1973, 1980) and Krystyn & Mariolakos (1975) have published descriptions of Triassic conodonts from the Northern Calcareous Alps as well as from the Hallstatt Limestone in Austria. Conodont specimens have also been described and illustrated from the Hallstatt Limestone located within the Taurus Mountains, Saklıbeli (Turkey) by Kristan - Tollmann and Krystyn (1975). Another early paper on the Triassic conodonts from Northern Turkey was published by Gedik (1975). He also reported (1977, 1981) some conodont faunas from the Triassic rocks of the Taurus Mountains (Turkey).

Conodonts have been known from Permian and Triassic rocks since the early fifties, but knowledge of the taxonomy and distribution of many species is still confused and many problems remain to be solved. These problems relate to taxonomy and classification. There are many synonyms at both the generic and specific levels. The uncertainty of nomenclature is well illustrated by reference to the form genera of the gondolellids. In this study, the following generic names are used:

a - Neogondolella Bender & Stoppel, 1965.
[Named as Gondolella by Stauffer & Plummer, as Paragondolella by Mosher, and as Metapolygnathus by Hayashi and many other authors.]

b - Epigondolella Mosher, 1968.
[Named as Metapolygnathus by Hayashi, as Tardogondolella by

Bender, as Ancyrogondolella by Budurov, and as Carinella by Budurov and many other authors.]

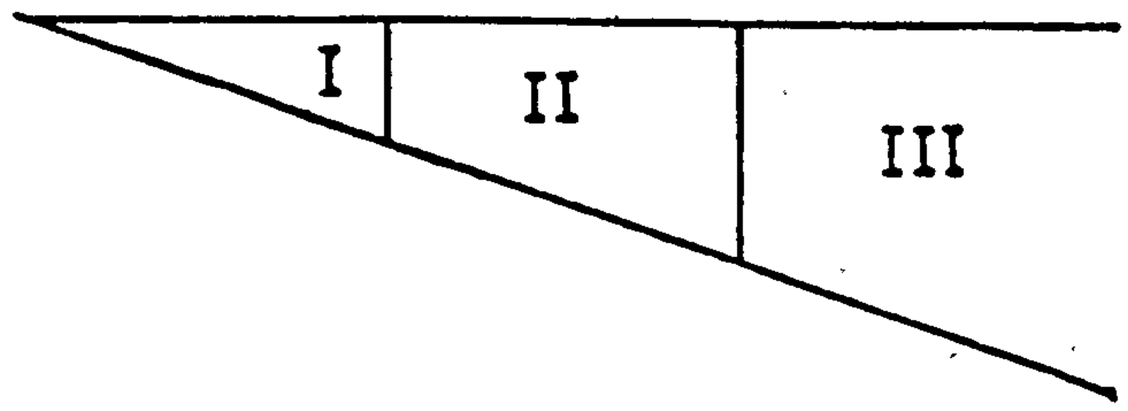
These problems of classification will be discussed later in Chapter 6. Several recent papers have increased our knowledge of Permian and Triassic conodont taxonomy and classification; for example, von Bitter and Merill (1980), von Bitter (1982), Clark (1977, 1979), Clark et al. (1979, 1982), Collinson et al. (1976, 1978), Kozur (1980), Kovacs et al. (1980), Koike (1981, 1982), Mosher (1971, 1973) and Sweet (1973, 1976).

1.4: Conodont Palaeoecology

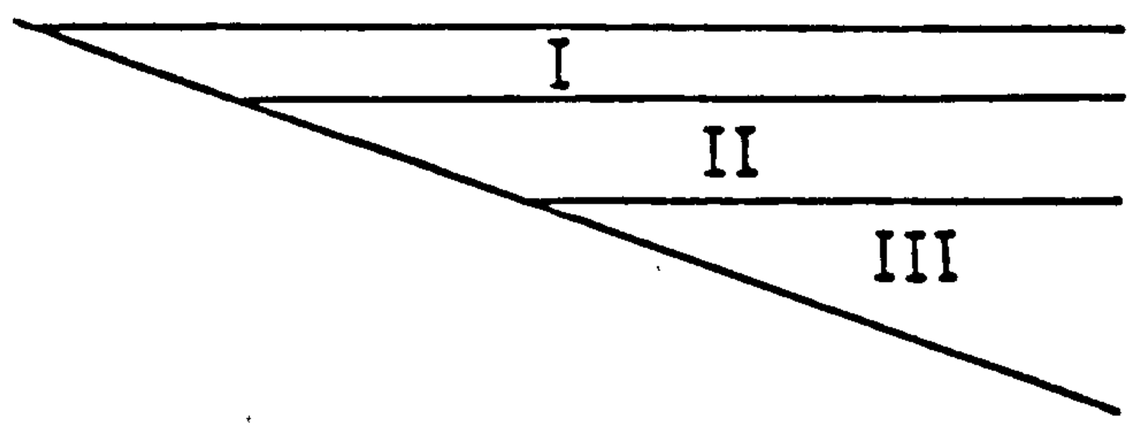
With increasing research and the construction of biostratigraphic subdivisions using conodonts, the palaeoecologic distribution of conodonts has been the subject of a great deal of study.

Merrill (1961), explaining the distribution of some Upper Carboniferous conodonts, was the first conodont worker to evoke environmental control as an important factor affecting the distribution of conodonts. Subsequently other workers have realised that consideration of palaeoecology is a necessary requirement, both for improving biostratigraphy and for recognition of multi-element taxonomy.

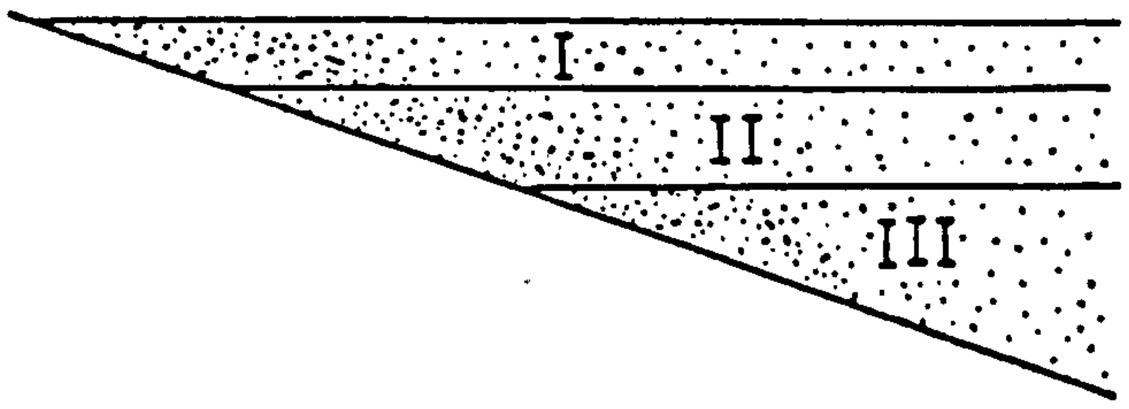
Druce (1970) suggested a model with shallow water faunas and deep water faunas (Fig.4A) reflecting distance from the shoreline. A different explanation was given in a depth-stratification model proposed by Seddon (1970, see Fig.4B). In this depth-stratification model, some conodont-bearing organisms were limited to irreversibly deeper water zones, and others to surface waters. Basinal sediments could actually contain conodonts from all depth zones. Druce (1973) modified his model after Seddon and Sweet (1971) had suggested that most conodonts were nektonic organisms stratified by depth in the early Palaeozoic. Druce (1973) modified the model to give a nearshore concentration of conodonts in the shallower biofacies (Fig.4C). He noted that shallower water species were not the same as those represented in deeper deposits. He also added that there was diminution of biomass away from the bottom for each bathymetric zone. Later a simple bathymetric model was proposed by Merrill and von Bitter (1976). This model has generally been accepted among conodont researchers, but there are also some critical views (see Merrill & von Bitter, 1976). Davis (1975) suggested a model to explain



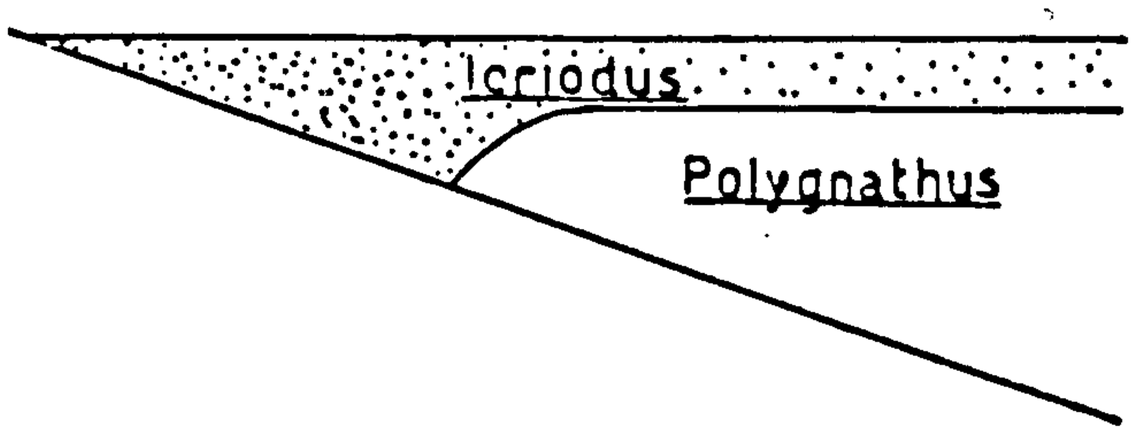
A. Original suggestion of DRUCE(I970)



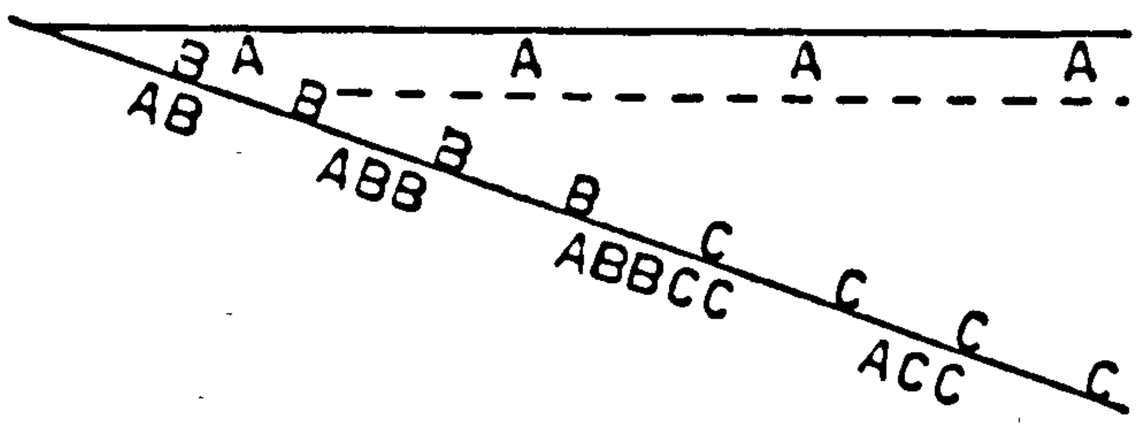
B. Suggestion of SEDDON (I970),SEDDON & SWEET (I97I)



C. DRUCE(I973) (Relative darkness is relative abundance)



D. DAVIS(I975)



E. BARNES & FAHRAEUS (I975)

Figure 4.Simplified Diagrams for biofacies and distribution of conodonts as suggested by different authors(see text).

Polygnathus/Icriodus ratios from the Devonian of the eastern United States. He indicated that Icriodus may have occupied a deeper life-zone nearer shore than it did offshore, at the expense of the life-zone of Polygnathus, because of its greater tolerance to salinity and temperature fluctuations (Fig.4D). Another model was proposed by Barnes and Fahraeus in 1975 (Fig.4E). This model was based on their studies of Ordovician conodonts. They pointed out that most Ordovician conodont-bearing organisms were benthonic or nektobenthonic, and they suggested that temperature as well as salinity were the main factors of palaeo-ecology. Von Bitter (1976a) interpreted a Cavusgnathus windsorensis biofacies which was characterised by an environmental condition with shallow water, often high energy and remarkable salinity variations. Klapper and Barrick (1978), who studied the distribution of sparse recent benthonic and planktonic organisms opposed the use of distribution patterns as the sole criterion for the recognition of the mode of life of the conodont organism.

Thus there are many models for conodont palaeoecology; the nektobenthonic model was given much support at the Symposium on Conodont Palaeoecology (Barnes, 1976).

The comprehension of biofacies is extremely difficult in the Triassic and there have been few palaeoecologic studies to date. Triassic conodont-bearing organisms are marine. From the Germanic basin Kozur and Mostler (1971) recognized that certain conodonts can be found in brachyhaline and hypersaline marine deposits as well as euhaline marine deposits. They recognized two groups of conodonts with regard to salinity. Gladigondolella tethydis, for instance, belongs to a steno-haline marine environment. It is always found in the euhaline marine environment but not in brachyhaline, nor hypersaline environments. Pseudofurnishius and some species of Neospathodus belong to the eury-haline marine environment. These also occur in the brachyhaline and/or the hypersaline marine environments. Kozur (1971a,b) and Kozur & Mostler (1971) pointed out that many species of Neogondolella(Gondolella) occur in euhaline and brachyhaline environments. According to Kozur, the occurrence of Triassic conodont-bearing organisms is also affected by water depth. Kozur (1972c) illustrated a descriptive bathymetric zona-tion of the Triassic conodonts. He believes that Triassic conodonts might be abundant in carbonate which was deposited under slightly deeper water conditions containing sparse dasycladacean algae. He concluded

that conodonts were most abundant in sediments which were deposited at depths of 10-150m. The distribution of Triassic conodonts, according to Kozur (1973), is influenced by water temperature. He explained that Gladigondolella was strongly stenothermic, and restricted to the tropical Tethyan Province. Neogondolella(Gondolella) and Neospathodus were eurythermic, occurring in the Tethyan as well as in the boreal provinces. Druce (1973) commented on Mosher's (1968a,b) Triassic faunas and considered them as biofacies, rather than provincial entities. He suggested that the Neogondolella mombergensis assemblage was limited to the shallow waters of the Muschelkalk sea and would be biofacies II in Figure 4C. The Gladiogondolella tethydis assemblage, which is the geosynclinal Alpine fauna, would be biofacies III in Figure 4C. Druce indicated also that the Neogondolella mombergensis assemblage could show different biofacies. This would certainly suggest true provincialism. Kozur (1974, 1975) has summarized that the occurrence and generic composition of the Triassic conodonts are controlled by the salinity, water temperature, water depth and to a lesser degree by the level of energy, as well as oxygen content of the water. He suggested that there were no conodonts in very shallow water intratidal sediments. They were rare also in reef limestones and other hard bottom sediments. Except for sparse conodonts, which were found in psychrospheric (deep-water) deposits, many conodonts were recovered in limy euhaline marine soft bottom sediments. Conodont-bearing animals might also live in water with relatively small oxygen content. He also stressed that there were no more than 3 or 4 natural Triassic conodont species occurring in one environment at one place. Kozur finally added that conodont-bearing organisms were not planktonic or pseudoplanktonic, that they were bottom dwellers, at least during part of their life-cycle, that they were able to swim and that they were very similar to primitive chordata (Acrania, Agnatha).

Clark and Rosser (1976) studied the ratios of species of the genera Parachirognathus and Furnishius from the Triassic rocks of Utah and Nevada and concluded that Furnishius and Parachirognathus evolved at about the same time, but that Furnishius attained widespread distribution from the deeper part of the basin to the tidal-flat, shoreline area. They recognised also that as an alternative attractive interpretation Furnishius could be restricted to shallow water facies (cross-bedded, near shore), whilst Parachirognathus occupied more offshore

environments, and this was supported in part by the Parachirognathus/ Furnishius ratios.

1.5: Purpose of the Study

Earlier workers have concentrated on the lithostratigraphy and tectonics of the Triassic System of the Taurus Mountains, whereas the sedimentological and palaeontological aspects have been largely overlooked. A principal objective of this study is to fill this gap and achieve a better understanding of Triassic facies distribution and its faunal composition. The scope of this work can be summarized as follows:

A - to study the sedimentary petrography of the limestones and classify them;

B - to identify and describe the sedimentary facies and environments;

C - to identify some of the fossils which are found in the limestones and to construct a systematic palaeontology of Triassic conodonts.

The main emphasis in this study was placed on the sedimentology of the Triassic limestones as well as their contained faunas, but for the interbedded conglomerate, sandstone and shales, a more general approach was adopted since they are mostly unfossiliferous. Their petrology is discussed in general terms and their regional significance is explained. Particular attention is given to the conodonts and their classification.

The succession under study ranges in age from topmost Permian to topmost Triassic, and consists essentially of shallow water calcareous sequences, principally limestone.

1.6: Methods of Investigation

1.6.1: Field Investigation

Although this study did not produce stratigraphical ranges for the conodonts obtained, through the lack of identifiable ammonites in the outcrops, very close sampling was followed for petrographic purposes. Sample-spacing varies according to the megascopic lithological changes in the beds sampled. Samples were collected at 50 cm. to 2m. intervals, or whenever a lithological change was noticed; this led to bed-by-bed

sampling in many instances. Such sampling was undertaken in three localities throughout the exposed Triassic section, a total of 432 samples being collected for thin-section studies of petrography and micropalaeontology. For conodont studies 56 large samples were processed, 42 of which contain very rich conodont faunas.

During the summers of 1977, 1979, 1980 and 1981 eight outcrop sections in the Central Taurus Mountains (a total thickness of more than 2,200 m.) were measured in detail, using Jacob staff and Abney level. In some places, where the lithology is uniform and the tectonic dip constant, a 3-metre measuring tape was used. For each bed the following parameters were recorded: sedimentary structures, lithology, modal grain size, colour, bedding thickness, structural relationships and fauna. Any special features of individual beds were also recorded. Thicknesses of the sections are sometimes approximate, especially in the poorly exposed parts, but this does not affect the interpretation of the sedimentary environments, which can be defined accurately on the basis of grain type, fossils and sedimentary structures.

1.6.2: General Laboratory Investigation

Normal size thin sections were used and a total of 850 thin sections were studied. Polished slabs were used when stromatolitic algal structure was observed, and these were more useful than thin sections. A few samples were stained with Alizarin Red S for carbonate mineral identification. Others not suitable for staining were subjected to XRD analysis.

Thin sections were examined under two types of microscope: a student polarizing microscope at low magnification for a quick survey of the components, and a Zeiss Universal-Pol microscope for detailed investigations; the latter was also used for photomicrographs. A Scanning Electron Microscope (SEM) was used to photograph conodonts, after unsuccessful attempts had been made with the Zeiss microscope. Conodont specimens to be photographed with SEM were mounted on a circular aluminium stub 1·2 cm. in diameter, coated with a graphite suspension, which is conductive and ensures a continuous conducting layer between the specimens and the surface of the stub. These specimens were lightly coated with gold in a vacuum jar to eliminate reflections and to enhance surface details.

Several negative prints were made from selected thin sections using a low magnification wide field industrial microscope, the Shadowmaster. This method gave the best results for studying the relationships of fragments, their grain size and total fabric. This use of such negative prints in association with thin sections is very rewarding and should be used more commonly.

1.6.3: Laboratory Procedure for Conodont Recovery

Techniques for conodont recovery are well established (Collinson, 1963). The most widely used technique is to disintegrate calcareous rocks by monochloracetic, formic or acetic acid. Limestone is the most consistently conodont productive rock type, therefore calcareous horizons were sampled preferentially in the field. The following is a summary of the procedure for conodont recovery:

field sampling of limestone, dolomite
↓
crush sample (approximately 2 cm^3)
↓
place crushed sample in bucket, add 10% acetic acid, plus boiling water
↓
await reaction for 1-2 days
↓
wet sieve using 120-60-25 mesh sieves
↓
dry samples by heat
↓
separation of light and heavy residues in Bromoform
↓
filter off light and heavy fractions
↓
pick and mount specimens from heavy fraction
↓
storage.

The samples of calcareous rock were first weighed in the laboratory. Approximately 1·5 kg. samples were fed through a jaw crusher and broken down to fragments of 2 cm^3 in size. Each sample was placed in a lidded plastic bucket to which was added 10% acetic acid and boiling water. The samples were then left until completely broken down. Normally this takes about 48 hours, but may need to be repeated at 24-hour intervalswhere the rocks contain large amounts of dolomite. After disintegration, the insoluble residues were collected

by wet-sieving on the 120-mesh sieve. After drying and cooling the residues were separated into light and heavy fractions using Bromoform. After removal of the Bromoform with solvents, the heavy fraction was searched using a binocular microscope. Conodonts and other fossils present were picked out with a fine brush and placed on a filter paper within a petri dish.

1.7: Terminology

1.7.1: Terminology and Classification of Carbonate Rocks

Two different classifications of limestone have been followed in this study. The first classification is based on characteristics determinable in the field, the second is on binocular inspection and thin section studies. In the field the analysis was based upon the Wentworth-Udden grain size scale (Pettijohn, 1957) which divided the carbonate rocks into calcirudite, calcarenite, calcisiltite and calcilutite, representing consolidated lime gravels, sands and muds. Calcirudites and calcarenites must be grain supported (Table 2).

In the laboratory the petrographic identification and classification of the carbonate rocks was based on Folk (1959, 1962, 1965 and 1973) and Dunham (1962) (Table 3). In the classification proposed by Folk the following terms are used:

I - Terrigenous constituents, which include all materials derived from erosion of source lands bordering the basin of deposition and transported as solids to the sediments. Examples: quartz sand and silt, feldspar, clay minerals, zircon.

II - Allochems: Allochem is a collective word for all varieties of discrete carbonate aggregates, most of which have undergone some transport in their predepositional history. They are always the dominant components of limestones and have formed by initial biochemical precipitation followed by mechanical breakdown and sometimes by reorganization. The most important allochems are as follows: bioclasts, recognizable fragmented shells and intraclasts, ooliths (including pisolites) and pellets (peloids), all formed from lime mud.

(i) Intraclasts: These generally range from very fine sand (0·2 mm) up to boulders, and are usually fragments of weakly consolidated lime mud that has originated within the

metres	bedding & parting	lamination	millimetres
1	v.thick	v.thick	100
0.3	thick		
0.1	medium	thick	30
0.03	thin	medium	10
	v.thin	thin	3
		v.thin	

Table I. Classification of bedding, parting and lamination after Campell(1967).

Size (mm)	Grade	Particle	Sediment	Carbonate Sediment
256		boulder	RUDITE	CALCIRUDITE
128	coarse	cobble		
64	fine			
32	very coarse	pebble		
16	coarse			
8	medium			
4	fine			
2	extremely coarse	sand	ARENITE	CALCARENITE
1	very coarse			
1/2	coarse			
1/4	medium			
1/8	fine			
1/16	very fine			
1/32	coarse	silt	SILTITE	CALCISILTITE
1/64	medium			
1/128	fine		LUTITE	CALCILUTITE
1/256	very fine			
		clay		

Table 2. Particle size scale (after Pettijohn, I957).

Group Name			SPARITES	MICRITES				Bioherm rocks
Sparry Cement/ Lime Mud			Sparry Cement > Lime Mud	Lime Mud > Sparry Cement			Lime Mud Only	
Allochems			Grain-Supported		Lime Mud-Supported			
					>10%	1% - 10%	1%	
Volumetric Composition of Allochems	>25% Intraclasts		intrasparite	packed intramicrite	sparse intramicrite	intraclastic micrite	micrite	biolithite
	<25% Intraclasts	>25% Ooliths	oosparite	packed oomicrite	sparse oomicrite	oolitic micrite		
		<25% Ooliths: Bioclasts: pellets 3 : 1	biosparite	packed biomicrite	sparse biomicrite	bioclastic micrite		
		<25% Ooliths: Bioclasts: pellets 3:1 - 1:3	biopelsparite	packed biopelmicrite	sparse biopelmicrite			
		<25% Ooliths: Bioclasts: pellets 1 : 3	pelsparite	packed pelmicrite	sparse pelmicrite	pelletiferous micrite		

most abundant allochem

Table 3. Classification of Carbonate Rocks modified after Folk(1959,1962) and Dunham(1962).

area of deposition, where it has since been eroded to form new fragments, at various stages of consolidation.

(ii) Ooliths: These curiously uniform, spherical to ellipsoidal particles always show either radial and/or concentric laminated structure around a nucleus. The size, shape and mineral composition of the nucleus is very variable. To date, many theories have been proposed to clarify the ooliths' origin, and it is thought that they formed through a high rate of precipitation in shallow, warm, agitated waters; most occur in tidal channels, shelf edge, sand bars, etc. (Simone, 1981). Some fragments may be derived from contemporary algal growth, become rounded then subject to renewed peripheral oncolitic algal growth.

(iii) Bioclasts: Originally called fossils by Folk, including both sedentary and transported fragments. After Cole (1975), in this study it also seems that it is quite logical to include here non-carbonate fossil fragments such as conodonts, fish remains.

(iv) Pellets: These particles are ovoid to spherical grains, consisting of lime mud. They usually show uniformity of shape, good sorting and small size ranging between 0·04 and 0·08 mm; and have no ordered internal structure, unlike ooliths and some intraclasts.
Pellets, which are the most controversial of the non-skeletal components, are thought to be of fecal origin by Folk.

III - Orthochems: This term originally included lime mud and post-depositional cements, thought by Folk to be precipitates which formed within the depositional basin or within the rock itself. He defined three types of orthochems: micrite, sparite and calcite replacement or recrystallization.

(i) Micrite: microcrystalline calcite ooze, formed of grains less than 4 μm. in size. It may occur as a pure deposit or contain 1-10% of allochems.

(ii) Sparite: generally forms as a simple pore-filling calcite cement with crystals 10 μm or more in diameter. It is distinguishable from micrite by its clarity and coarser crystal size.

(iii) Microspar: is the intermediate size between micrite and sparite, averaging 5-15 μm in diameter, generally equidimensional and uniform in size.

Folk extended the principles of his classification in 1962, when he proposed the Carbonate Textural Spectrum, defending the boundary line of 50 per cent allochems between sparse micrites and packed micrites. Dunham's (1962) recognition of grain-support and mud-support, with a boundary at about 10 per cent allochems, is more satisfactory. In this study, a modified classification of carbonate rocks, combining that of Folk and Dunham, has been preferred (see Table 3).

The other terms used in this study are as follows:

RECRYSTALLIZATION: refers to previous crystal units of a distinctive size and morphology changing to new crystal units of differing grain size or morphology, the mineral itself remaining identical before and after recrystallization (Folk, 1965). The four major types of recrystallization recognised by Folk (1965) are as follows:

1 - Recrystallization (inversion) of originally aragonitic fossils to calcite, matrix unaffected;

2 - Recrystallization of an original micrite to microspar, allochems unaffected;

3 - Recrystallization of allochems to coarse spar, allochems completely affected;

4 - Recrystallization of original ooze matrix to coarse spar, allochems unaffected.

DOLOMITE and DOLOMITIZATION: At any stage after deposition, limestones may be modified by dolomitization. In most cases, total dolomitization occurs. In general, dolomitization of limestone is brought about by solutions containing a high ratio of magnesium to calcium, giving a reaction of the type:

$$2CaCO_3 + Mg^{++} \rightleftharpoons \underset{\text{dolomite}}{CaMg(CO_3)_2} + Ca^{++}$$

It is now generally recognized that dolomite, in the form of a protodolomite ooze, can occur as a primary sediment, for example in the Coorong in South Australia (von der Borch & Lock, 1979), but forms mostly very early in diagenesis by the replacement of aragonite and calcite allochems, normally in the supratidal zone. Later diagenesis by connate waters also occurs. Thus two types can be distinguished:

a - Penecontemporaneous dolomitization

b - Post-depositional dolomitization.

REPLACEMENT: This is a term which has been used in the past to cover a variety of processes. In this study, it is restricted to the process whereby a mineral is replaced by another of different gross composition (Folk, 1965). For instance, dolomitization of a limestone involves the replacement of calcite by dolomite.

MICRITIZATION: was proposed by Bathurst (1966) for the process of gradual centripetal replacement of a grain by micrite. Evidence for micritization generally comes from the presence of skeletal grains with micrite envelopes.

Stratigraphic terminology throughout this report complies as closely as possible with the recommendations made by the International Subcommission on Stratigraphic Classification (ISSC, 1976).

1.7.2: Terminology for the Morphology of Triassic Conodonts

Most specimens of Triassic conodonts recovered in this study correspond closely to previous descriptions of the elements, and shown in diagrammatic form, in Figure 5, is the terminology in use for characteristic genera.

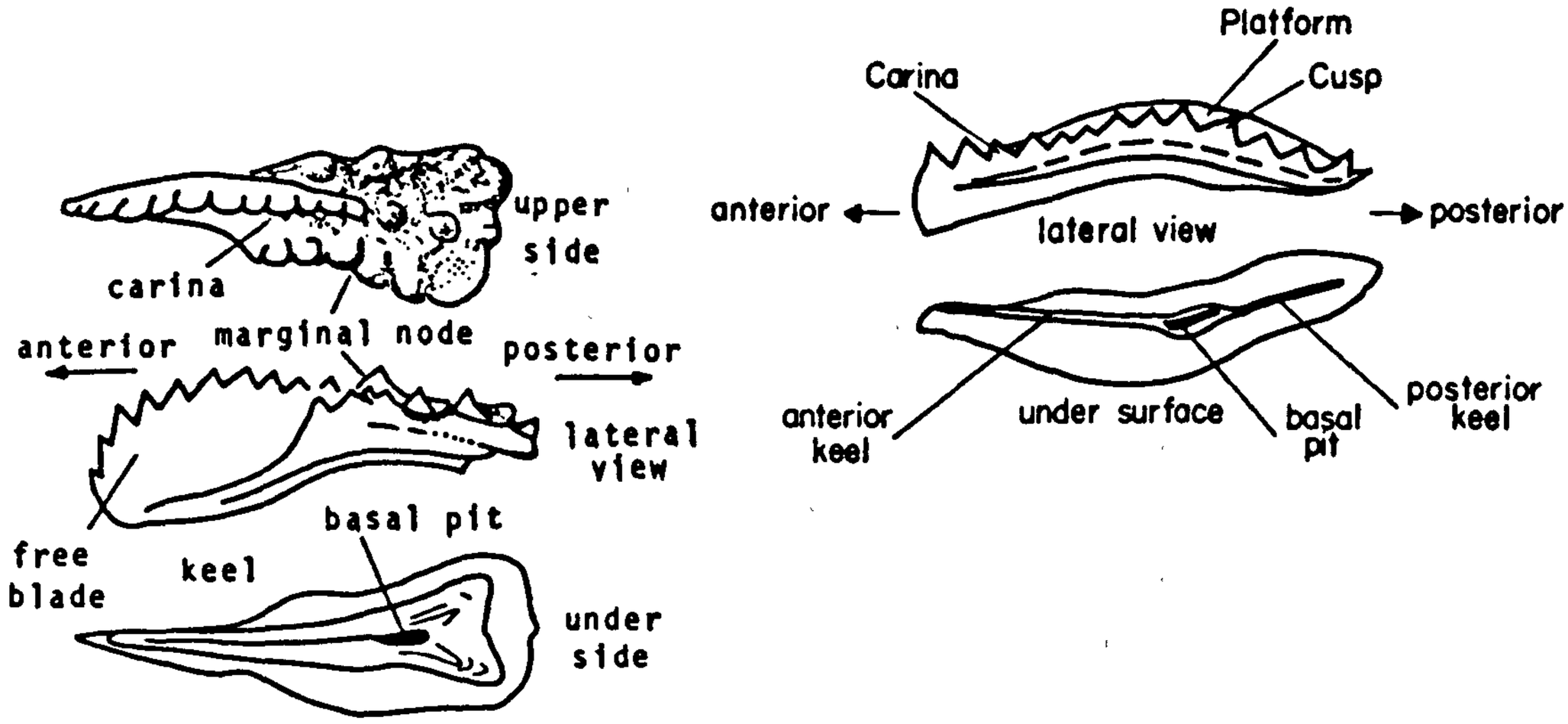


Figure 5. Morphological terminology for Triassic conodonts belonging to the genera Epigondolella, Gladigondolella and Neogondolella.

1.8: Locations of Study Areas

The Taurus Mountains, an area of Cambrian to Tertiary outcrops, extend along the southern part of Anatolia. They show tectonic and sedimentary complications due to the overlapping of several units. Nevertheless, Turkey has the advantage that three-dimensional facies relationships can be worked out along substantial tracts of the margin (see Robertson and Woodcock, 1981).

To date, there has been no study of variations in palaeontology from the Triassic rocks; therefore the investigation was undertaken. Three different areas near Konya, Antalya, Kayseri, where a number of sections have been measured, are located in the central part of the Taurus Mountains. Figure 6A shows the locations of the outcrops at which the sections shown in the plates were measured, and Figure 6B shows locations as well as a geological map of the studied areas. The sections in the Konya area lie near the small town of Hadim; those in the Kayseri area are near the towns of Pinarbaşı and Yahyalı. There is no significant town nearer than Antalya in the second area.

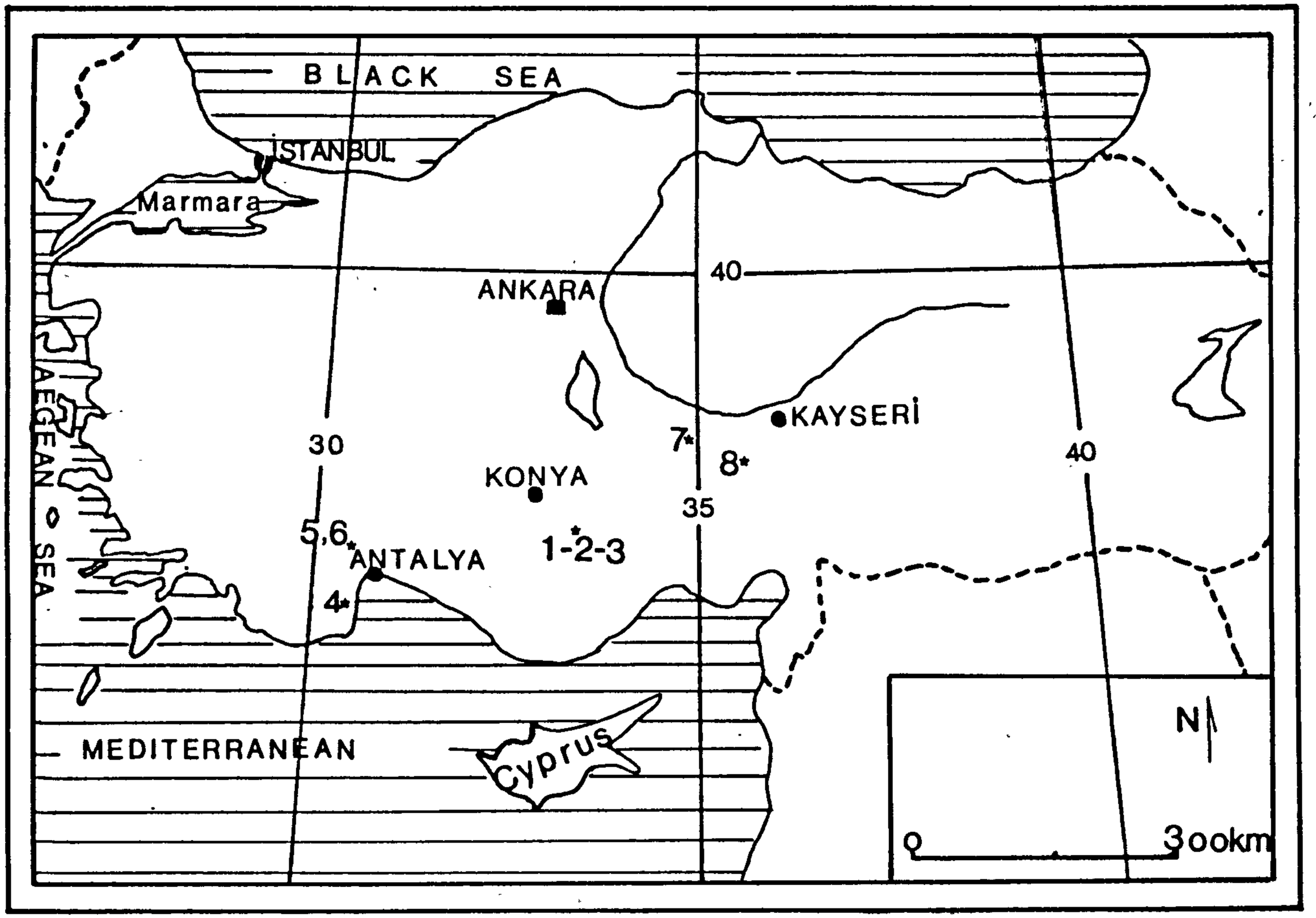


Figure 6A. Location map showing the present study areas(numbers indicate location of the columnar sections,see texts).
KONYA area:1-Soğuk Pınar Dere (THA)
2-Ekinlik Yayla (THB 1)
3-Karabayır Yayla (THB 2)
ANTALYA area:4-Teke Dağı (TT)
5-Saklıkent (TS)
6-Dömek Tepe (TD)
KAYSERI area:7-Pınarbaşı (TPK)
8-Yahyalı (TYKK)

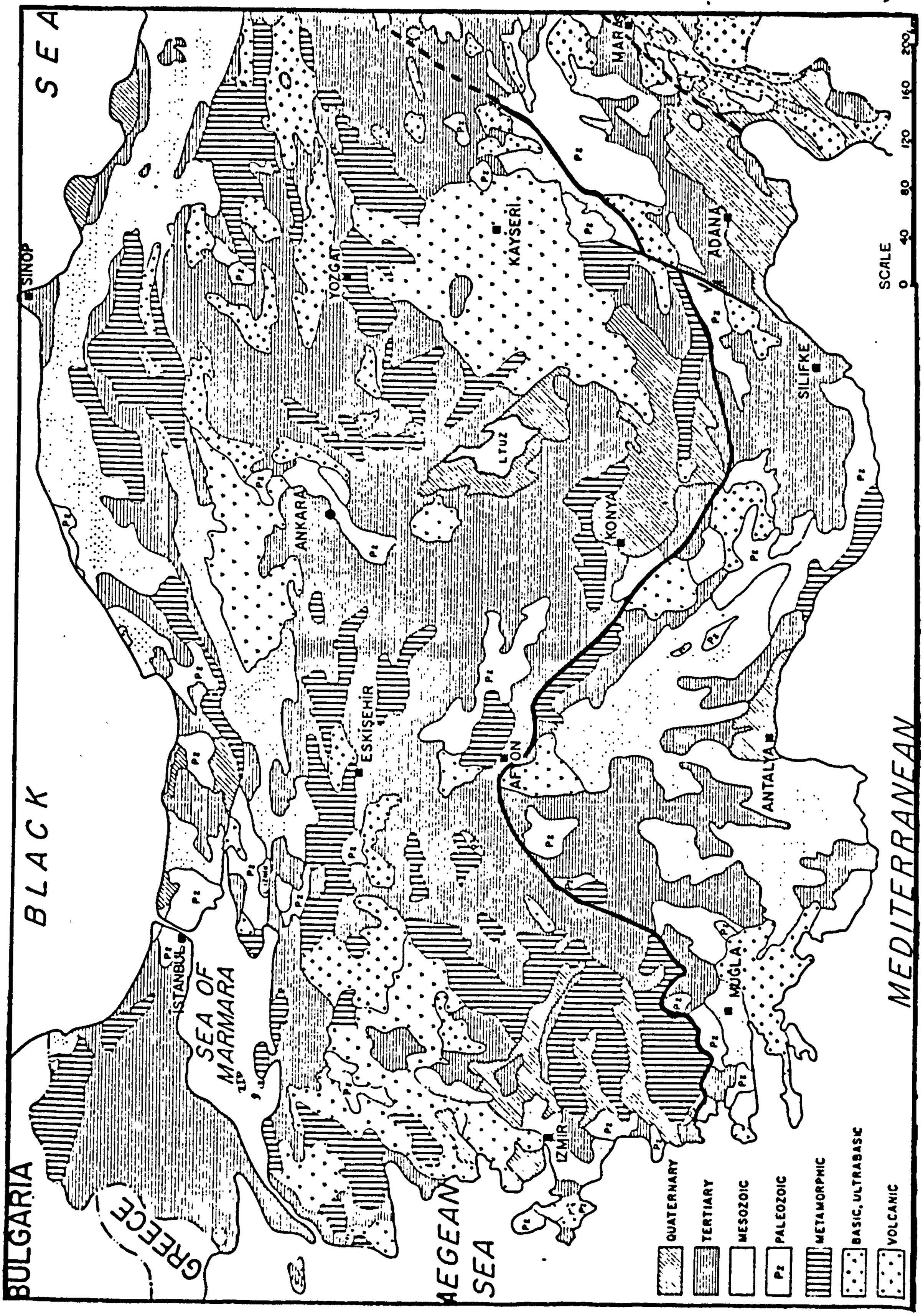


Figure 6B. Geological map of Western Turkey (after Erentöz, 1966).

CHAPTER 2: HADIM AREA

2.1: Introduction

This is an area in the Central Taurus Mountains of southern Turkey which has been divided into a number of structural units representing different basin conditions (Özgül 1971, 1976. See Fig.3). Özgül has defined the various units within the area in the following terms: Bolkardağı Unit, Aladağ Unit, Geyikdağı Unit, Alanya Unit, Bozkır Unit and Antalya Unit. These are distinguished by their stratigraphic position, character of their metamorphism and present structural position (Özgül, 1976).

Three sections (THA, THB 1 and THB 2) have been measured in the Hadim area (Fig.7); THA represents the Aladağ Unit, THB 1 and THB 2 the Bolkardağı Unit. The Aladağ Unit of Hadim is one of the most accessible sections of Triassic rocks, as defined by Özgül (1976)(Fig.8). The Soğuk Pınar Dere Section (THA) of Hadim belongs to the Aladağ Unit and spans the Triassic system in the approximately 1,500 m. thickness. Overlying Upper Permian limestones, algal calcarenite under stromatolitic fine-grained calcarenite, the Lower Triassic begins with fine-grained oolitic calcarenite. In the Lower Triassic there are interbedded variegated shales and very fine-grained calcarenite. Edgewise conglomerate is also recognized in the same stage. A few hundred metres above, there is very fine-grained calcilutite which contains ammonites and conodonts, the possible age being topmost Lower to Middle Triassic. At this level there are also massive algal fine-grained calcarenite and calcilutite, overlain by interbedded sandstone-shale which, in turn, is overlain by calcarenite. Above there are 400 to 500 metres of conglomerate, red silty clay and sandstone. Outcrop at this level is poor, and the inter-relationships of the rocks are not known. At the top, there is fine-grained oolitic calcarenite with foraminifera, which indicate an Upper Triassic age. The overlying Lias (Lower Jurassic) begins with dolomite. In this section, it is impossible on present evidence to divide the Triassic System with precision.

The other two measured sections from the Hadim area, Ekinlik Yayla (THB 1) and Karabayır Yayla (THB 2) belong to the Bolkardağı Unit. THB 1 consists of calcilutite, interbedded variegated shale and limestone, and bioclastic calcilutite. Although it is impossible to

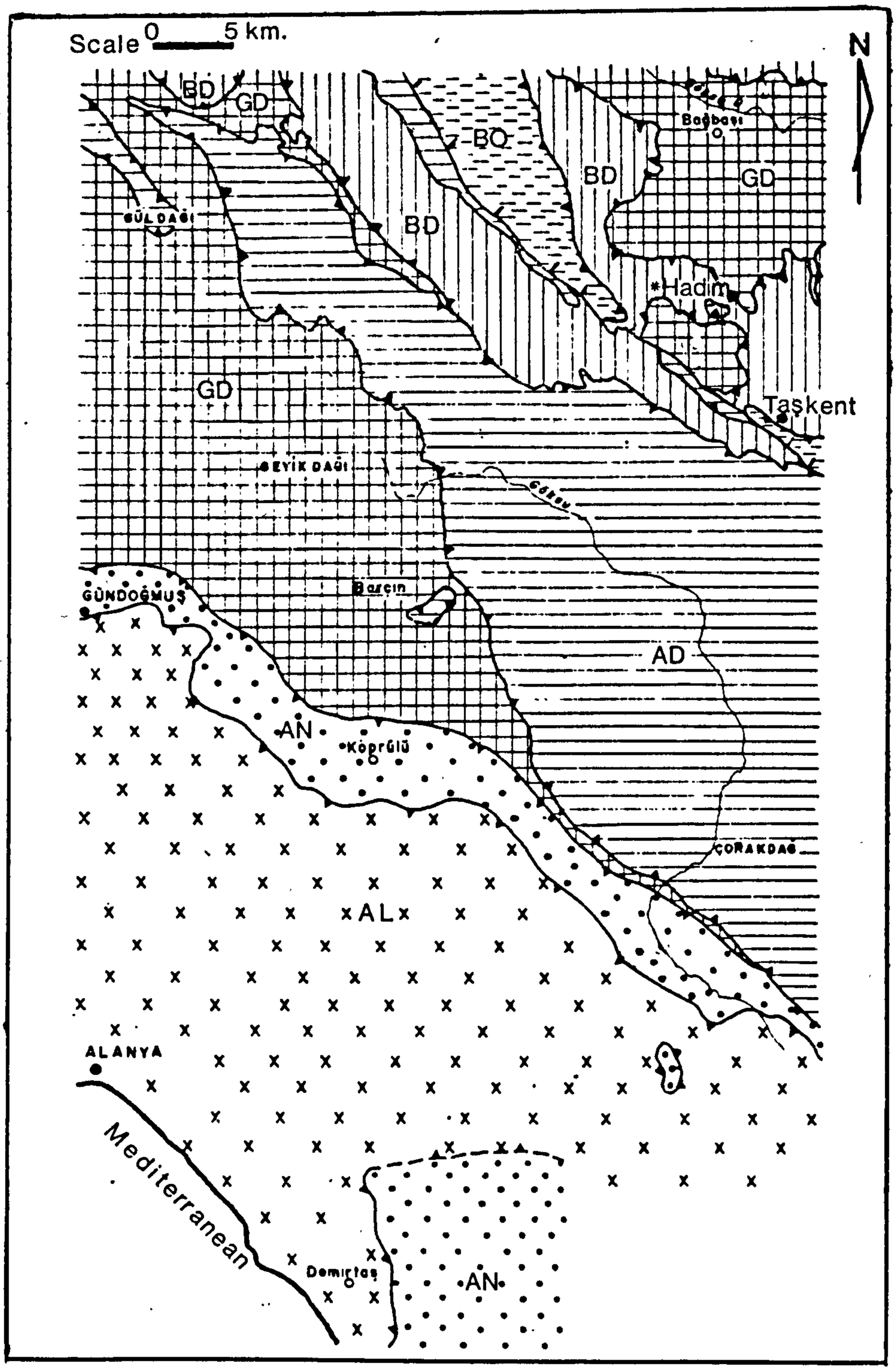


Figure 7. Outline map showing the distribution of structural untis in the Hadim area (Özgül, I976).

AL- Alanya Unit
AN- Antalya Unit
AD- Aladağ Unit
GD- Geyikdağı Unit
BD- Bolkardağı Unit
BO- Bozkır Unit

distinguish Lower and Middle Triassic in this section, calcirudite at the top contains foraminifers which indicate an Upper Triassic age. THB 2 consists of the same type of sedimentary rocks within which it is again difficult to distinguish the stagesof the Triassic System. None of the writer's samples from these two sections contains conodonts.

2.2: ALADAĞ UNIT

The field area of Hadim, which is located in the northern part of the Central Taurus Mountains, comprises the Aladağ, Bolkardağı and Geyikdağı Units. The Aladağ Unit, named after the highest mountains in the Eastern Central Taurus, contains carbonates and detrital rocks ranging from Upper Devonian to Upper Cretaceous in age. According to Özgül (1971 onwards), the Aladağ allochthonous Unit covers all the others and is thought to have been deposited in a shelf environment. In this unit, the Triassic usually consists of oolitic limestone, clayey limestone, variegated shales, sandstone and conglomerate. Jurassic and Cretaceous rocks, mostly carbonates, also occur. Figure 8 (Özgül, 1976: Fig.3) illustrates the succession.

2.2.1: Soğuk Pınar Dere Section (THA)

The locality named here lies to the south of Hadim, situated on the Taşkent-Gevne Road. Outcrops extending along both sides of Soğuk Pınar Dere (stream) belong to the Aladağ Unit (Plate 1A). The regional geology of this area is only very generally understood and the only structural mapping that covered most of the area was that of Özgül (Fig.7), which was carried out from 1971 to 1976. Although little has been written concerning other fields of geology, this is of no importance since the emphasis of this thesis is on thelithostratigraphy and microfaunal succession. Unlike other outcrops of Triassic rocks in Turkey, this section shows a great scarcity of fossils. This seems to be caused by tectonics, since whenever fossils have been found, they are not well preserved.

The Soğuk Pınar Dere Section (THA; Fig.9.1), approximately 1,500m. thick, has been closely sampled, to provide detailed descriptions of the environments of deposition. In the four summers of field work, this section has been sampled three times: in 1977 samples THA-77-1 to 154; in 1980 samples THA-80-1 to 6 and in 1981, samples THA-81-1 to 8

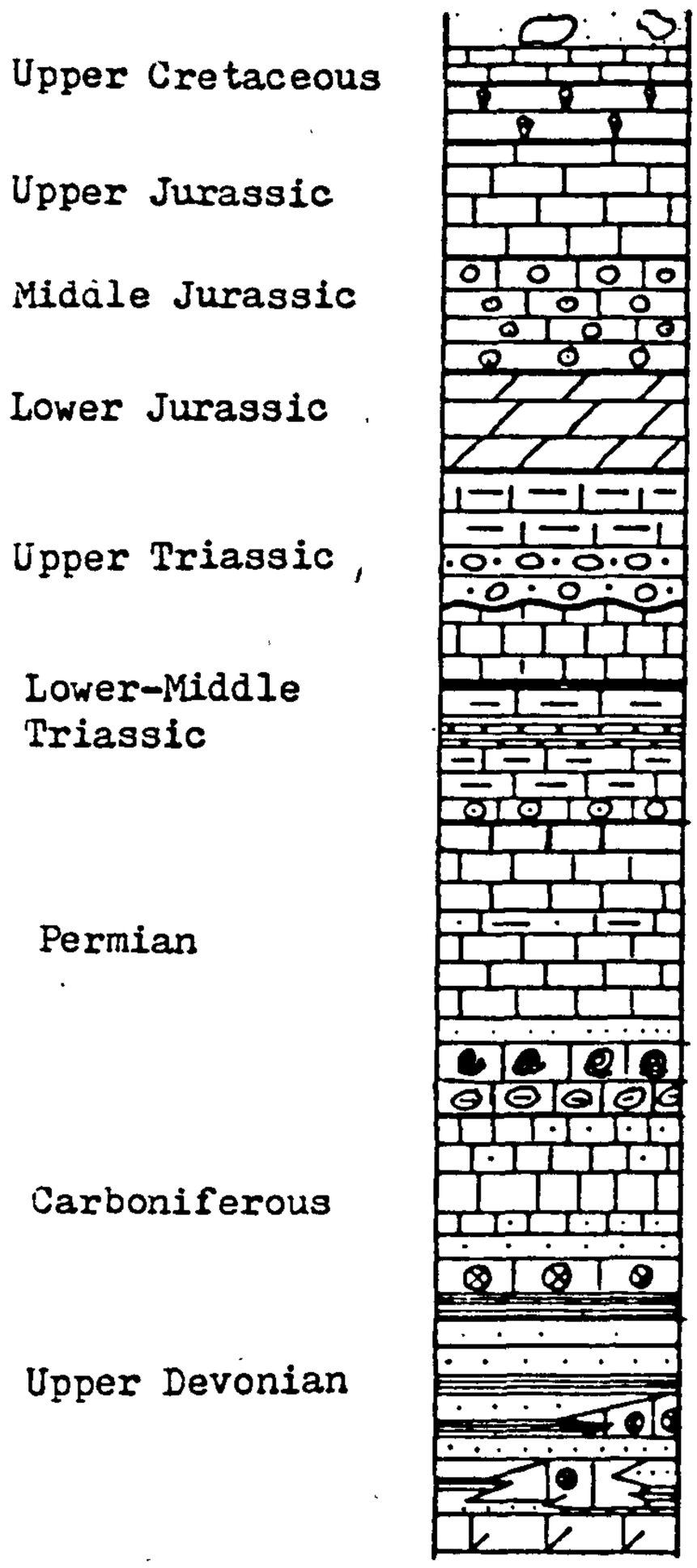


Figure 8. Columnar sketch section of the Aladağ Unit of the Hadim region (Özgül I976, not to scale).

Abbreviations: ls. Limestone
ss. Sandstone
cong. Conglomerate
sh. Shale
ds. Dolostone
qzt. Quartzite

(Figs.9a to r) were taken. The Triassic rocks here consist mainly of limestone which is generally recrystallized. At some levels, variegated shales are interbedded with thin limestones. There is also cobble conglomerate, sandstone horizon intercalated with shales in this section. Only at one level, thought to be Lower Triassic, are there conodonts.

In this study THA is proposed as the type section of the Triassic rocks of the Hadim region. The section is described in ascending stratigraphic order, age-assignments being given where possible. Because of the scarcity of microfaunas as well as macrofaunas, it is difficult to place the Lower-Middle and Upper Triassic boundaries. The lithostratigraphic terminology follows Folk (1959, 1962) for limestone types, uses the Wentworth scale of grain size, and divides bedding-thickness as in Table 1. Twelve negative prints have been made for showing the relationship of fragments, their grain size and total fabric (see Neg. Microph. 1 to 12).

UPPER PERMIAN - LOWER TRIASSIC

In recent years increasing knowledge from field investigation of well-exposed critical sections and close-spaced sampling have clarified the position of the Permo-Triassic boundary, as well as the sub-division of the Lower Triassic around the world. Of the many alternative classifications of the Triassic System now available, the one that best suits the writer's purpose is that of Silberling and Tozer (1968, Table 1). Discussion of its relative merits as an International Standard for the Triassic System is beyond the scope of this study (see Table 4). Figure 9.1 shows vertical sequences of the Triassic rocks in the region studied. An expanded section of the Lower Triassic rocks is shown in Figure 9.2

FORMATION A: Upper Permian

Medium to thick-bedded algal biomicrosparite 70m. thick; usually dark grey to black on fresh surfaces, weathering yellowish grey (Plate 3A). Poorly preserved algae (Mizia sp.) and sparse foraminifers (Glomospira sp., Nodosaridae) can be seen in thin section. At the top there is a continuous passage into thin or medium bedded stromatolite, approximately 10m. thick. This shows moderate crenulated lamination (Plate 1B, 3B) clearly visible on outcrop or on polished faces, but indistinct in thin section. Algae have not been seen in thin section. Stratigraphic continuity and ghosts of planispirally coiled foraminifers

SERIES	STAGES & SUBSTAGES	ZONES (Standard Zones)	
	RHAETIAN	Choristoceras MARSHI	
	UPPER NORIAN	Rhabdoceras SUESSI	
	MIDDLE NORIAN	Himavatites COLUMBIANUS Drepanites RUTHERFORDI Juvavites MAGNUS	
UPPER TRIASSIC	LOWER NORIAN	Malayites DAWSONI Mojsisovicsites KERRI	
	UPPER CARNIAN	Klamathites MACROLOBATUS Tropites WELLERI Tropites DILLERI	
	LOWER CARNIAN	Sirenites NANSENI Trachyceras OBESUM	
	UPPER LADINIAN	Frankites SUTHERLANDI Maclearnoceras MACLEARNI Meginoceras MEGINAE	
	LOWER LADINIAN	Progonoceratites POSEIDON Protrachyceras SUBASPERUM	
MIDDLE TRIASSIC	UPPER ANISIAN	*Gymnotoceras OCCIDENTALIS *Gymnotoceras MEEKI *Gymnotoceras ROTELLIFORMIS	Frechites CHISCHA Gymnotoceras DELEENI
	MIDDLE ANISIAN	*Balatonites SHOSHONENSIS *Acrochordiceras hyatti beds	Anagymnotoceras VARIUM
	LOWER ANISIAN	Lenotropites CAURUS	
	SPATHIAN	*Neopopanoceras HAUGI *Subcolumbites beds *Columbites & Tirolites beds	Keyserlingites SUBROBUSTUS Kazakhstanites PILATICUS
LOWER TRIASSIC (SCYTHIAN)	SMITHIAN	Wasatchites TARDUS Euflemingites ROMUNDERI	
	DIENERIAN	Vavilovites SVERDRUPI Proptychites CANDIDUS	
	UPPER GRIESBACHIAN	Proptychites STRIGATUS Ophiceras COMMUNE	
	LOWER GRIESBACHIAN	Otoceras BOREALE Otoceras CONCAVUM	
PERMIAN			

Table 4. Triassic time scale (Silberling & Tozer, 1968-tab.I)

of the same type as in the underlying beds suggest that this stromatolite may still be Upper Permian.

It is currently accepted that modern blue-green algae are major stromatolite formers, mostly in the shallow marginal waters of marine basins and saline lakes. The presence of foraminifers in Formation A indicates a marine environment. The principal sites for recent marine stromatolites span the supratidal, intertidal and shallow subtidal zones. Mizia is probably a subtidal form, so the sequence records an upward shallowing.

FORMATION B: Basal Lower Triassic

Mostly fine-grained oolitic calcarenite (oosparite) with very small scale unidirectional cross-lamination (Figs. 9.1, 9.2, 9.b); microsparite, argillaceous biomicrite and micrite also occur (Plates 1A, 1B, 3B, 3C, 4A). This formation is about 230 metres thick. The oolitic limestone is usually well sorted with scattered coarser grains up to 1·2 mm. in diameter and occasional graded laminae where the coarser grains are more abundant (Plates 3C, 3D). There are also thin beds of coarse calcisiltite. On some joint faces in the calcisiltites fenestral texture has been recognized. Interbedded shale and limestone overlying the oolitic beds are mostly conformable but show widely spaced knee-folds with amplitudes of up to 2m. In thin section, the ooliths are entirely of carbonate, their nuclei mostly bioclasts, e.g. echinoderms, bivalves. The ooliths, closely packed in sparry calcite cement, are generally 0·25 to 1 mm. in diameter, but sometimes with secondary enlargement. They are usually well preserved and sorted. Post-depositional compaction is rarely seen, although there are a few spastoliths (distorted oóliths). Degrading neomorphism to microsparite with ghost grains is common, and at some levels intense dolomitization has occurred.

The oosparite lithofacies bears a strong resemblance to the oolite lithofacies of the Great Bahama Bank, a resemblance already recognised in the Triassic limestones of the Apennines by D'Argenio et al (1975). Recent ooliths form prferentially in an area of active, sometimes reversible tidal currents which tend to maintain the grains where frequent movements can occur. Deposition generally occurs in tidal deltas or in on-bank submarine dunes in water depths less than 3m. Cross lamination in the tidal deltas is mostly unidirectional, whereas bipolar (herringbone)

cross-lamination prevails in the dunes. In Formation B, therefore, the oosparites are more likely to have been deposited on a tidal delta. This associates well with the underlying stromatolites, but requires slightly deeper water.

FORMATION C: Lower Triassic, Upper Griesbachian Stage

Interbedded argillaceous limestone and variegated shale is the distinctive and characteristic lithofacies at this level (Figs. 9.1, 9.2 and 9.c). This formation consists mainly of variegated, very fine-grained quartz arenite (Plate 4B) with occasional interbeds of oosparite (sometimes dolomitized) and edgewise conglomerate. Thin to medium bedded fossiliferous argillaceous biomicrite can also occur, as in Formation B. In both formations, these contain large numbers of lamellibranchs and frequent trace fossils. Claraia clarai (Figs. 9.2 and 9c), which indicates the Upper Griesbachian Stage of the Lower Triassic (Table 4), has been recognized near the base of this formation. There is nothing to show how far up Formation C the Griesbachian Stage extends, nor if any higher stages of the Lower Triassic are present. Similar lack of definition of Lower Triassic stages exists in many other Alpine-Mediterranean Triassic areas.

Formation C is well exposed in the study area, with a thickness of about 270m. The limestones are thin, well-bedded and light grey on fresh surfaces, weathering yellowish grey. The fine-grained quartz arenite shows very thin parallel lamination and varies in colour through red, violet, green, grey to yellowish green. The yellowish quartz arenites are well sorted, fine to medium grained (about 250 μm) and are carbonate-cemented. The quartz grains are usually angular, and there are similar sized clasts of clay minerals among them. Reddish quartz arenite is also well sorted, contains less carbonate, and the quartz grains are smaller (100 μm) and show some carbonate-replacement.

The fossiliferous biomicrite and oosparite were deposited in similar environments to those of Formation B, shallow marine, probably in a tidal lagoon. The variegated shales and sandstones require a connected environment, although their colour suggests supratidal conditions. They also require a land connection to supply the abundant detritus. Coastal lagoons in an arid or semi-arid climate, such as the modern Persian Gulf, would produce this type of interbedded deposit,

especially if the sea was mostly excluded. Closure of the tidal channels by abundant landwork deposits would so exclude the sea. It would also build up the sediment surface above the water table, thus permitting oxidation and the development of variegation (compare Patterson & Kinsman, 1981). It is worth noting that the grain size of the sands is in the most easily eroded range commonly found in desert dunes, though the sand grains of Formation C are angular.

FORMATION D: Lower Triassic

Lithologically variable, consisting of variegated quartz arenite, oosparite (Plate 5B), micrite and foraminiferal biosparite. Micrite is sometimes inverted to microsparite and shows many stylolites. Most of the stylolites are sub-parallel to bedding but vertical ones have been seen. In places they develop an anastomosing network which gives the rock a brecciated appearance. Shales from this formation contain bioclasts and are thinly laminated. The medium bedded limestones also have very small scale lamination and sometimes are poorly dolomitized. They consist of micritized intraclasts and bioclasts, sometimes with Lower-Middle Triassic foraminifers such as Ammodiscus cf. parapriscus Ho (Plates 4C, 4D, 5A; Figure 9d).

Formation D is less than 40 metres thick. It contains similar rock types to Formation C, but has a higher proportion of limestone and includes fossiliferous shale. The presence of foraminifers in Formation D requires a shallow marine environment, such as a lagoon. The environment must have been similar to that of Formation C - a land-connected lagoon, but with a lesser tendency for lagoon-filling with terrigenous sediment and a more persistent connection to the sea, to allow access to foraminifers.

FORMATION E: Lower and ?Middle Triassic

In the 150m. thick Formation E, the predominant facies are biomicrite, bioclastic micrite, intramicrite, micrite, intrasparite and oosparite (Plates 5C, 5D, 6A, 2B). Small amounts of shale can also occur. Skeletal remains and intraclasts are recognized in varying quantities. Ammonites and gastropods are abundant in some of the limestone beds, particularly in the thicker beds (Figs. 9.1 and 9e). These are dark grey on fresh surfaces, weathering pale grey. Conodonts(Tab.5), including Ellisonia triassica, E.teicherti, Ellisonia spp. Parachiro-

TABLE 5: Numerical Abundance of Conodonts in Samples collected from Soğuk Pınar Dere (Hadim, THA section)

	LOWER TRIASSIC		
CONODONTS	Samples	THA-80-1	THA-81-6	Totals
Ellisonia teicherti		1	1	2
Ellisonia triassica		-	3	3
Ellisonia sp.		2	1	3
Parachirognathus cf. ethingtoni		1	1	2
Parachirognathus obliqua		1	2	3
Parachirognathus sp.		3	4	7
Totals		8	12	

gnathus cf. ethingtoni, P. obliqua, Parachirognathus sps. (Plate 21), occur near the base of the formation in ammonite-bearing beds. They are of Lower Triassic age.

The abundance of fossils in the other beds of Formation E varies considerably, the commonest being corals, bryozoans, belemnites, crinoids, gastropods and foraminifers. At the top of this formation algal limestone is also recognized (Neg. Micropho. 1. to 11).

Locally the fossiliferous biomicrites are pervasively micritized. They are thin to medium bedded and composed of large bioclasts (up to 10 mm. long by 20 µm thick) parallel to lamination. At this level there is also medium bedded, very fine-grained intramicrite, showing macro lamination. Thinly bedded clayey limestones, up to 80 cm. thick, occur at intervals. Many thin sections from Formation E show stylolites and recrystallization. In the well bedded oolitic rocks near the base, ooliths are closely packed in sparry calcite cement. They are usually well sorted. Overlying those are thinly laminated and interbedded limestone-shale, apparently unfossiliferous and not bioturbated. The grain size ranges from clay to coarse silt, though single beds are usually well sorted. At the top, below the algal calcarenite, there is a persistent richly fossiliferous zone of calcarenite, 50 cm. thick, which contains all the macro-fossils mentioned above. Unfortunately, none of the fauna indicates the precise stratigraphic horizon. It may still be Lower Triassic or basal Middle Triassic.

The environments of Formation E begin with oolitic limestones similar to those of Formation B, and these were probably deposited on a sub-tidal delta. The more varied marine fauna of these oolites implies a normal marine salinity, unlike that deduced for Formation B. The interbedded limestone and shale must have been deposited in a restricted environment inimical to life and thus either foetid or hypersaline. The latter is most likely in the absence of pyrite. The upper part of Formation E, with its very varied fauna, is clearly open, shallow sea sediments of normal salinity.

MIDDLE TRIASSIC

Over the whole area the Middle Triassic exhibits a shallow marine facies of limestone which interbeds with sandstone and shale (Fig. 9.3).

In the THA section, the Middle Triassic rocks lie conformably upon Lower Triassic, Formation E. Elsewhere in the Hadim area, Middle Triassic rocks of Formation F rest on Upper Palaeozoic rocks. The Lower Triassic is missing. Although this stage is moderately fossiliferous (ammonites, gastropods), the fossils are generally not well preserved. Because of this, ammonite zones have not been established by any author. In this study, some problematical Lower-Middle Triassic conodonts have been found, but they too are not good enough to separate the Lower and Middle Triassic.

FORMATION F: Middle Triassic

Formation F, 50 metres (Figs. 9.1 and 9f), lying conformably on Formation E or disconformably on Upper Palaeozoic limestones, consists of biomicrite, dolomitized intraclastic biosparite, quartz arenite and shale. At the base, thin to medium bedded grey biomicrite occurs, weathering greyish yellow or yellow. It forms a conspicuous marker bed over the Hadim area. Above it, thin bedded dolomitized calcarenite occurs. It is grey on fresh surfaces, weathering light grey. Above it, the upper part of the formation is interbedded shale and algal limestone with thin quartz arenite, which are generally light grey on fresh surfaces but weather reddish.

In thin section the lowest part of the biomicrite is recrystallized. It comprises a few pellets, small intraclasts, ostracods, crinoids and foraminifers (Glomospira sinensis) in a micrite matrix (Plate 6B, 6C, 6D). It shows a fairly uniform texture. Above the dolomitized calcarenite, in which textures are almost totally lost, biomicrite again appears. It contains lamellibranchs , gastropods and brachiopod shells infilled with crinoid debris. At this level, partial dolomitization and stylolites are observed. Some of these micrites show thin lamination. The few algal limestones in this formation contain only sparse algal remains.

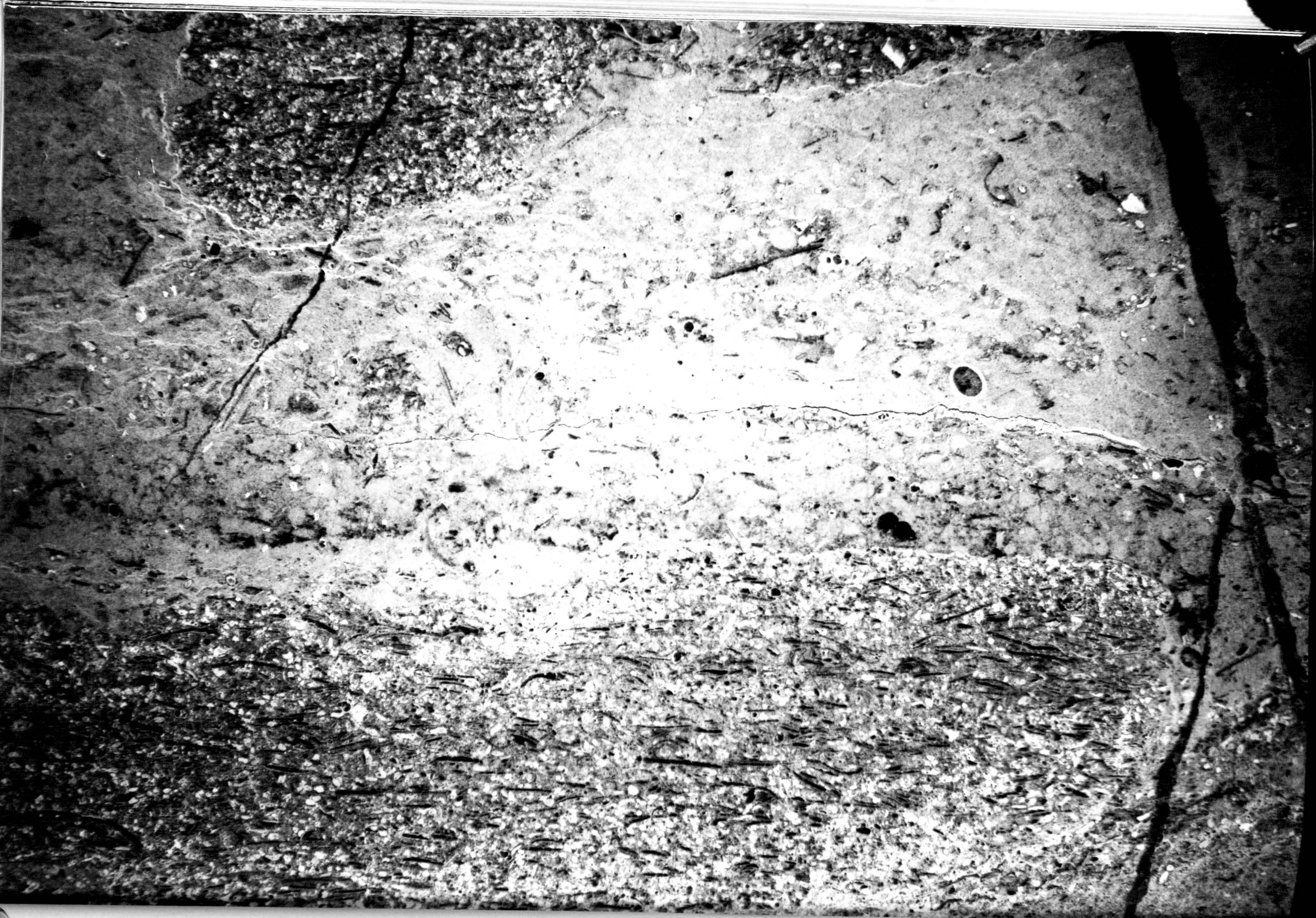
Formation F was deposited in open sea conditions, as indicated by the varied fauna. These seas were more extensive than in the late Lower Triassic, indicating that a local transgression had occurred. Shallowing upwards is suggested by the incoming of algae and probably by the quartz arenite, which must have come from the hinterland, either directly or by re-working of Lower Triassic sheet flood deposits

NEGATIVE MICROPHOTOGRAPHS:

Twelve negative prints have been made from selected thin sections from Hadim-THA area using a low magnification wide-field industrial microscope (Shadowmaster). They are useful for showing the relationship of fragments, their grain size and total fabric. Photonegatives are illustrated in ascending stratigraphic order from topmost Lower Triassic through Middle Triassic. Except for sample THA-77-131 (taken from Formation M) all samples have been collected from Formation E. All the negative photomicrographs are magnified X10.

1 - Sample: THA-77-72 is very fine calcarenite containing thin intraclasts and bioclasts in a microspar matrix. The photograph shows two areas of primary sediment each showing a strong preferred grain-orientation. Both are similar in grain size, fine calcarenites with subequant grains from 0·1 to 0·2 mm. and abundant platy bioclasts up to 1·2 mm. long and 0·1 mm. thick. Between those two areas is a zone of micrite with sparse allochems ofsimilar size and shape to the primary sediment and a very few longer rounded clasts up to 1 mm. in diameter. One is clearly a gastropod. Microstylolites are abundant in this micrite zone. They cross-cut calcite veins and are therefore later.

The boundaries between the micrite zone and the areas of primary sediment are extremely irregular, involving relief of several millimetres and perpendicular changes of orientation. They do not appear to be original depositional boundaries; nor does the random orientation of clasts in the micrite zone. Thus the micrite zone is an area of post-depositional disturbance within the sediment. Its shape is too irregular for a burrow, so the disturbance was probably inorganic - a partial fluidization of sediment below the surface. X10.



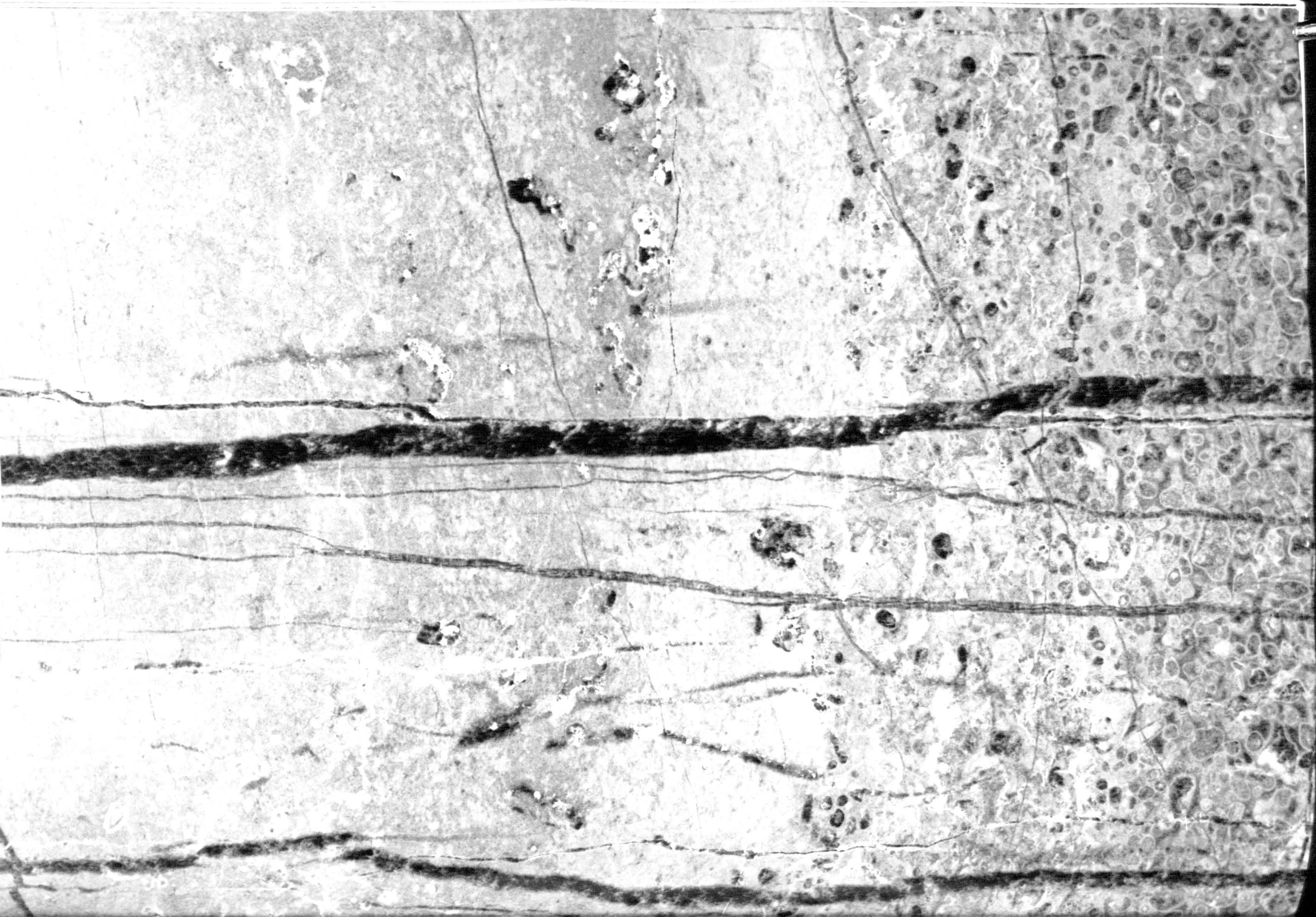
2 - <u>Sample: THA-77-73A</u> - poorly sorted intraclastic limestone showing varying grain size and shape. Most of the intraclasts are pure micrite but one of the largest is clearly a sparse biomicrite. Platy intraclasts are probably derived from laminated lime muds but those of irregular rounded shape may have been stromatolite/oncolite. X10.

3 - Sample: THA-77-74: Fine grained well sorted calcarenite (rounded grains 0·1 to 0·2 mm.) with scattered large very thin platy bioclasts up to 9 mm. showing a common orientation (bedding) and "bridging" with development of geopetal fabrics on their undersides. X10.
They indicate way-up of photomicrograph.

4 - Sample: THA-77-76 is biomicrite containing intraclasts, bioclasts, micrite lumps and small gastropods. Two micrite intraclasts, one top left, the other bottom right on the plate, show straight-sided, tapering areas filled with clear spar and micrite fragments. It is possible that those are crystal moulds of primary gypsum. X10.

5 - Sample: THA-77-79: Two distinct laminae are shown in the plate, both composed of calcisiltite around 50 μm in diameter. The separating lamina-plane is emphasised by a concentration of spar and, now hidden by the binding, the occurrence of a discoidal gastropod 1·5 mm. in diameter. The upper lamina contains diffuse-edged vertical tubes 1 mm. in diameter and up to 8 mm. long, probably burrows.X10.

6 - Sample: THA 77-82. Three laminae are visible. The lowest is a well washed calcarenite, grains 0·5 to 1 mm. with a few coarser, dominated by intraclasts. Microstylolites obscure the lamina-plane with the overlying coarse calcisiltite which is 5 mm. thick. It has a diffuse contact with overlying, slightly darker and mottled calcisiltite which contains sparse small bioclasts.X10.



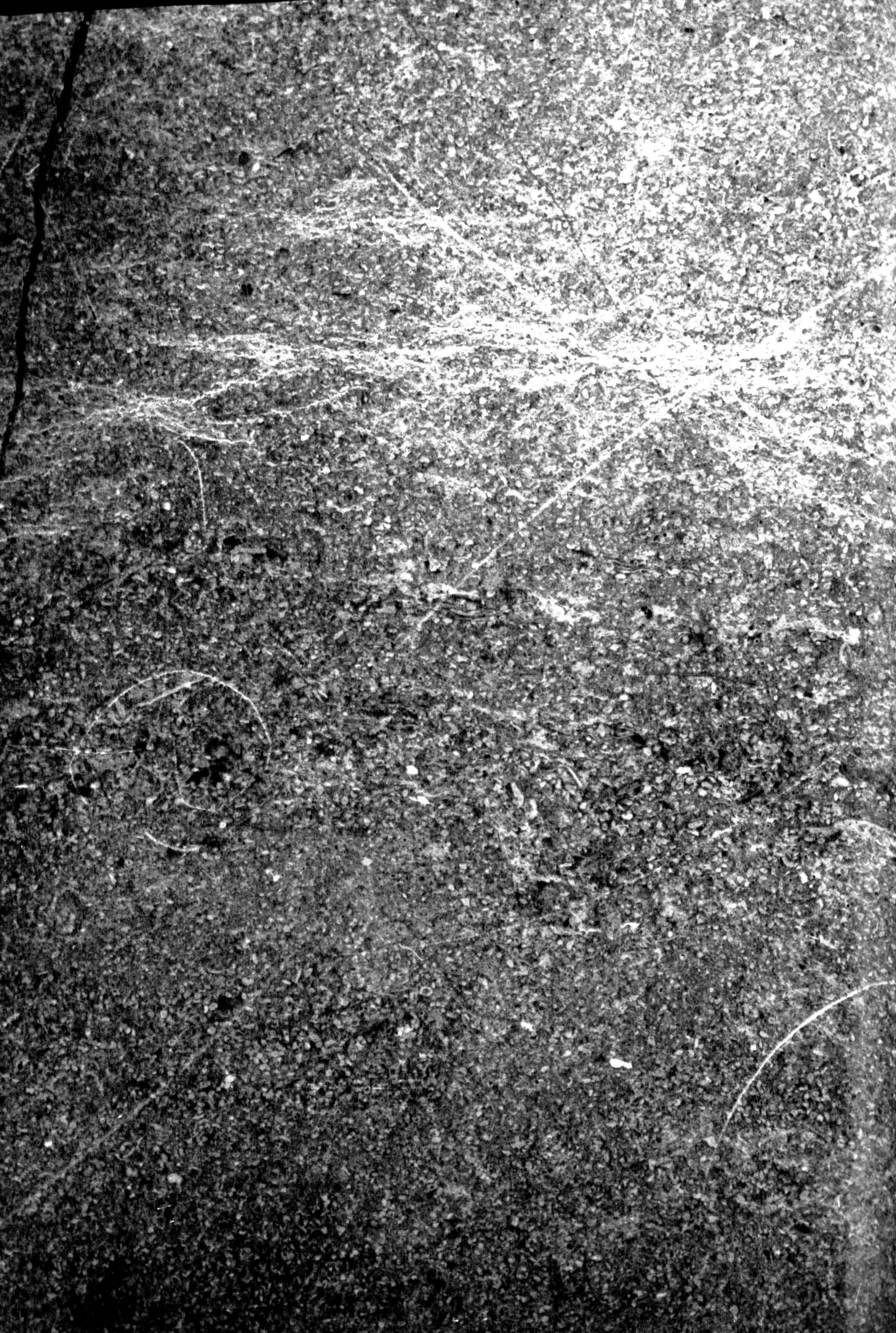
7 - Sample: THA-77-84 is intramicrite showing sparry infill of most bioclasts. Well developed micro-stylolites can also be seen.X10.

8 - Sample: THA-77-87: Poorly sorted intrasparrudite with a strong preferred orientation of clasts. The coarsest clast, a laminated very fine-grained calcarenite, is 13 by 7 mm. Smaller, more platy, clasts of the same type are also present with other similar clasts of coarse calcisiltite. An even larger clast, at least 30 mm. long and of laminated micrite, is now lost in the binding. On the original thin section, this clast is 32 mm. In the bottom right hand corner of the plate is a slightly curved clast. This may indicate that the source sediments were subjected to desiccation on an intratidal flat before incorporation in the present rock.X10.

9 - <u>Sample: THA-77-90</u>: Arcuate areas of micrite in a calcisiltite matrix. The convex side of each arc shows a sharp boundary of micrite against aparite but the concave side is very irregular. In a few cases a thin line of calcite spar marks the convex side. This may be a thin shell. A very similar rock texture is illustrated in Plate XIX-1 of Perconig(1968) where it is identified as a packed pelecypod biomicrite. Sample THA-77-90 is also thought to be a pelecypod (bivalve) biomicrite.X10.

10 - Sample: THA-77-92: Laminated coarse calcisiltite showing parts of three laminae, the central one 8 mm. thick. The allochems include bioclasts, one up to 3 mm. long, and micrite lumps up to 100 µm. These are either intraclasts, pellets or fragments of micritized bioclasts. None are large enough to be properly identified. The circular bodies 1 to 1·5 mm. in diameter are haloes of dark grey pigment around very dark central areas in the thin sections. They appear to be oxidation haloes, possibly around former pyrite crystals. X10.

11 - Sample: THA-77-95: Very fine-grained well sorted intramicrite, 100 to 200 µm grain size. A poorly defined lamina 5 mm. thick in the middle of the Plate contains small platy bioclasts which are not present elsewhere. Below this lamina are many microstylolites.X10.



12 - Sample: THA-77-131: Texture very similar to sample THA-77-90, except fine-grained. Faint traces of pelecypod valves confirm that this was a packed pelecypod biomicrite. Microstylolites are abundant.X10.

beneath the transgressing sea.

FORMATION G: Middle Triassic

Formation F is overlain by 75 metres of limestone (Figs.9.1 and 9g), bioclastic micrite and pelsparite in the lower part, giving way to algal limestone, particularly rich in cauliflower type stromatolites above. They are medium to thick bedded and grey to dark grey in colour. In the pelsparites, pellets show typical uniformity of size and shape as well as tight packing. Sparry calcite cement is very finely crystalline, due to the small size of available pores and the very small crystal sizes within the pellets (Plates 1C, 7A).

These fine-grained calcarenites, devoid of sedimentary structures such as channelling and large scale cross-bedding, indicate that they are low energy deposits. The stromatolites are intertidal to supratidal, thus demonstrating shoaling and emergence of the depositional surface.

FORMATION K: Middle Triassic

Dirty yellow interbedded sandstone and shale of approximately 50m. thickness overlie the algal limestones of Formation G (Fig.9k, Plate 1D). Parallel lamination and thin bedding are the only structures seen. In a coastal lagoon environment this type of sediment might be produced.

FORMATION M: Middle Triassic

Formation M consists of 240 metres of limestone (Figs. 9.1 and 9m). At the base, overlying the clastics of Formation K, is medium bedded biomicrite, pale pink on fresh surfaces, weathering yellowish pink-grey. This locally recrystallized calcarenite contains intraclasts, bioclasts and algal fragments in a micrite matrix. Gastropods, brachiopods? and sparse foraminifers are also recognizable (Endothyranella sp.). The upper beds of this formation are calcirudites, containing oncolites. In thin section, the oncolite structures are merely "ghosts" in a fine or medium carbonate base. A few of them, however, preserve concentric layers in the form of fine, dark carbonaceous rings. The uppermost beds contain intraclasts in sparry cement. All allochems are generally micritized. Stylolites are also observed in many of the thin sections (see Neg. Micropho. 12).

This formation is overlain by conglomerate (Fig.9.1).

The rather restricted fauna of this formation suggests a restricted marine environment. Algae, particularly oncolites, indicate that this is a very shallow marine environment, similar to the interior of the Great Bahama Bank.

UPPER TRIASSIC

Upper Triassic Formations (N and P) are best seen on the other hill in this area, which is a few kilometres to the west of Soğuk Pinar Dere (Hadim, THA). Its stratigraphic sequence is shown in Figures 9.1, 9.4 and 9n. As far as can be seen in a rather poor exposure, it consists of about 400m. of red silty clay with channel-like lenticles and sheets of conglomerate and sandstone, and a few thin beds of calcilutite. (The age of the silty clay is unknown.) These are capped by about 50m. of clayey limestone, which contains Upper Triassic foraminifers.

FORMATION N: Upper Triassic

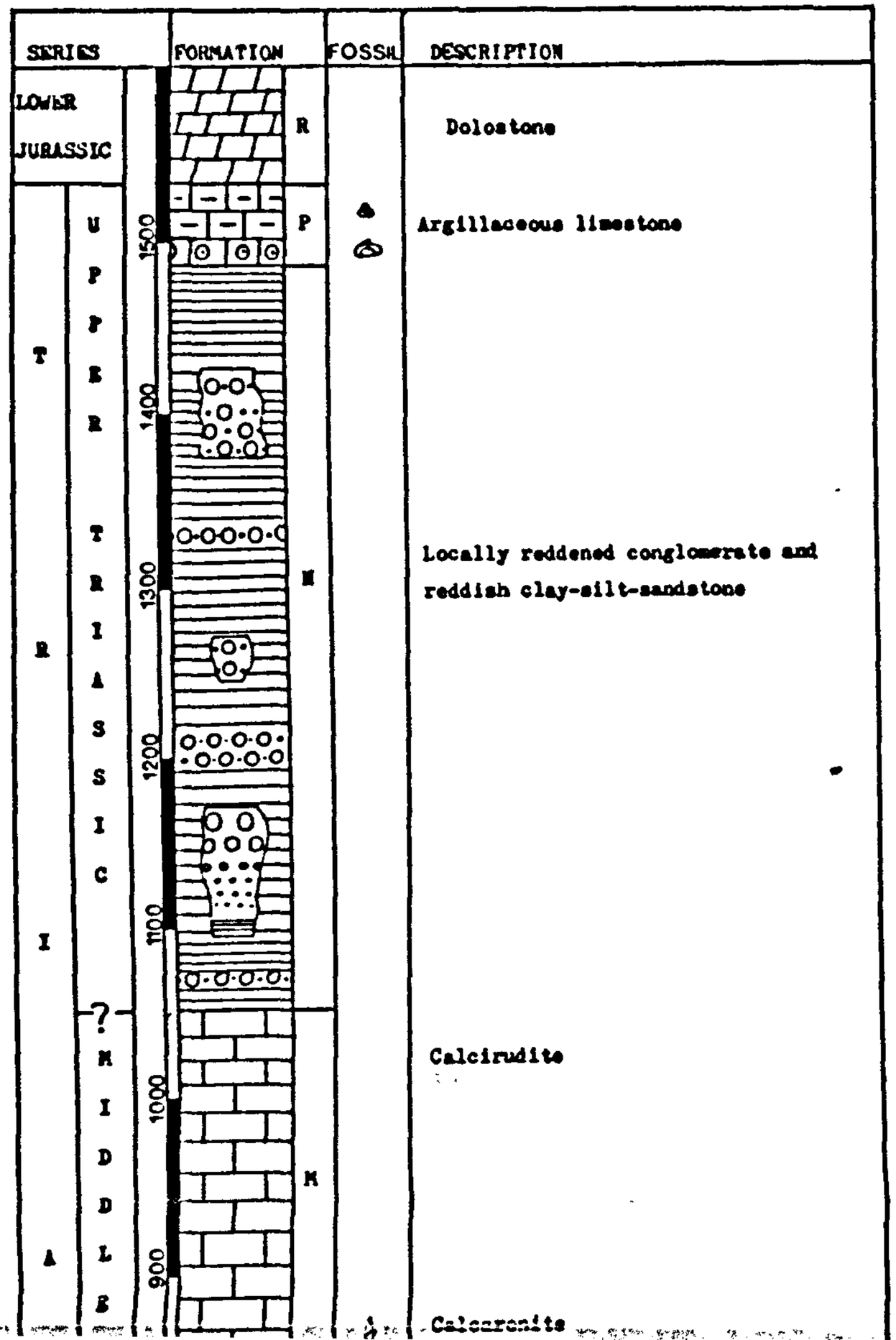
In the 400-500m. thickness of Formation N, many different sedimentary facies are found: conglomerate, well-sorted reddish clayey sandstone, clayey silt and calcilutite. Conglomerate is usually found in lenses. This clast-supported conglomerate (Plate 2A) facies characteristically consists of well-sorted, moderately to well-rounded limestone pebbles or cobbles in a limestone matrix. Green volcanic clasts, rare schist clasts and feldspar crystals are also observed. Occasional clasts are reddened, but amount to 1% or less of the total. Locally some beds are characterized by a pebble framework with an infiltrated matrix of sand and small pebbles. The limestone pebbles are light to dark grey, black, white and red. Their size ranges from 10 to 70 mm.; their lithology, both in hand specimen and thin section, resembles that of the Upper Palaeozoic limestones in the area. Sub-angular clay clasts, 50 to 100 mm. in diameter, were also recognised. Some of the conglomerate beds are apparently structureless, but others show grading, from large pebbles at the base to coarse sand at the top. Interbedded with the conglomerate are fine-grained calcilutite, silt and clay layers. At the top of Formation N are sandstones and open-work pebble conglomerate.

Formation N was deposited in a variety of related environments.

The red silty clays suggest desert or semi-desert conditions similar to those of Late Triassic north-east Europe. The conglomerates require extensive rock outcrops and an adequate gradient between those outcrops and the area of deposition. Coastal marine with rugged hinterland or a sea-cliff are the most likely possibilities. Some of the conglomerates have a limestone matrix and must therefore have been deposited in the sea. All show some degree of sorting: there is no silt or clay matrix; the sand matrix is often so much finer-grained that it could have infiltrated into an original openwork gravel. Such openwork gravels do exist. Others are now cemented with coarse calcite spar, probably derived from component limestone lithoclasts by post-depositional solution. The most probable environment would seem to be a river system draining a rugged hinterland and flowing sufficiently to deliver bed load gravels to the sea, where coastal re-working improved the sorting and occasionally provided a limestone matrix. The red silty clays would thus be terrestrial alluvium, deposited sufficiently quickly to prevent major soil formation, since a semi-arid soil profile would include calcretes and there are no signs of evaporites in any part of the local Triassic rocks, such as a fully arid climate would be expected to produce. It is also possible that red silty clays were deposited on extensive tidal mud flats similar to those described by Walker (1967) at the west of the modern Baja-California. The climate required for the Upper Triassic Formation N was less arid, since there is no evidence of gypsum.

FORMATION P : Upper Triassic

Limestone, apparently calcilutite, is the only rock-type in this formation (Figs. 9.1 and 9p); showing grey to light grey on weathered surfaces, pale grey-white on fresh surfaces. These limestones have a total thickness of about 50m. They are well bedded and locally dolomitized, the individual beds varying from 10 to 30 cm. Thin interbeds of reddish clayey limestone commonly recrystallized and showing no faunas also occur. The apparent calcilutite, in thin section, contains abundant ooliths and is locally rich in intraclasts cemented by fine-grained sparry calcite. They are mostly oosparite. Minor components are: small ostracods, foraminifers and unidentifiable bioclasts. Foraminifers usually form the nuclei of the ooliths (Plates 7B, 7C, 7D). Oosparites pass upwards, apparently conformably into Lias (Lower Jurassic) which is exclusively dolostone (Formation R, Figs. 9.1 and 9r).


SERIES
FORMATION
FOSSIL
DESCRIPTION
LOWER JURASSIC
TERRIASSIC
UPPER
MIDDLE
R
P
M
1500
1400
1300
1200
1100
1000
900
?
Dolostone
Argillaceous limestone
Locally reddened conglomerate and reddish clay-silt-sandstone
Calcirudite
Calcarenite

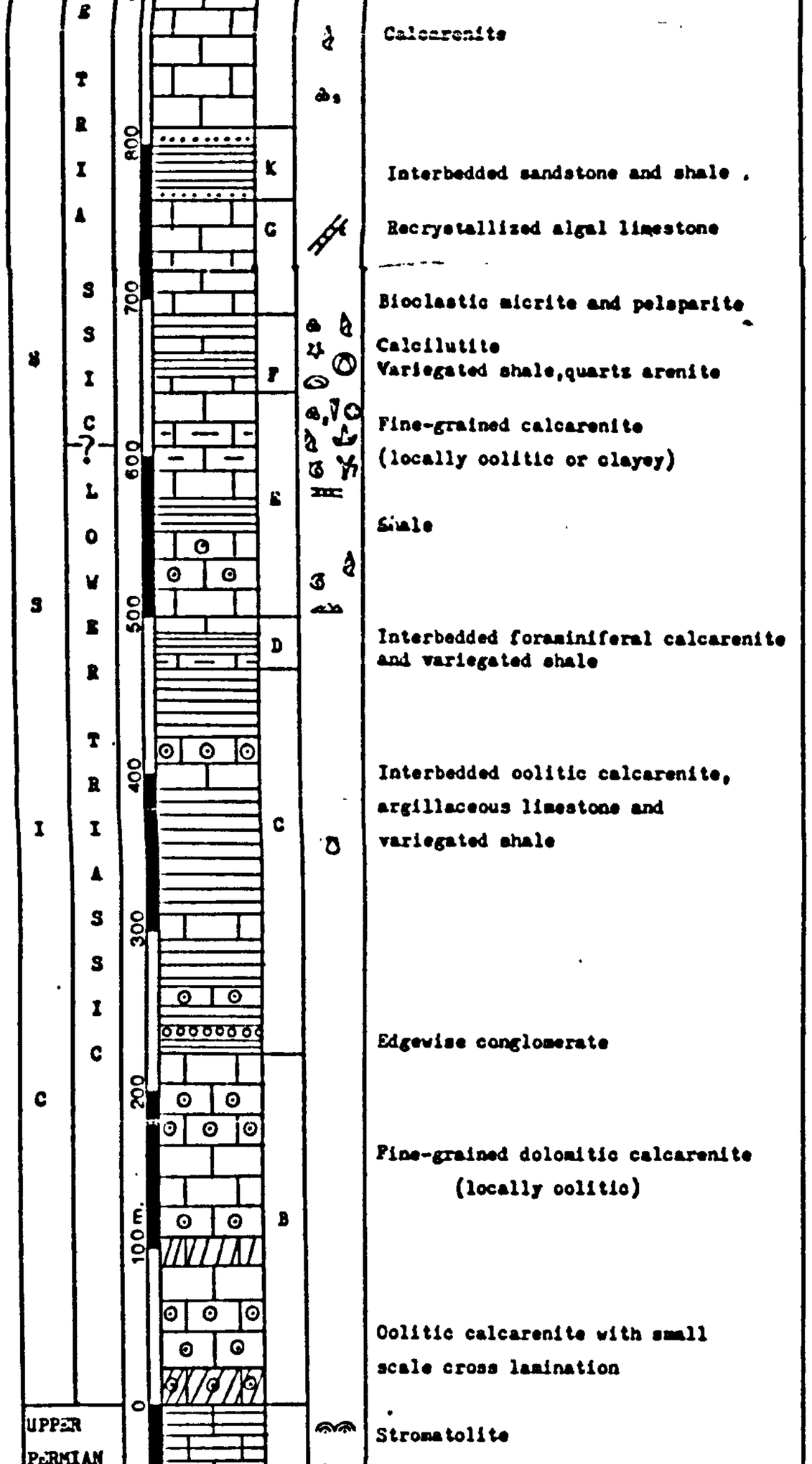


Figure 9.I Columnar section of SOĞUK PINAR DERE (THA).
Scale in meters.

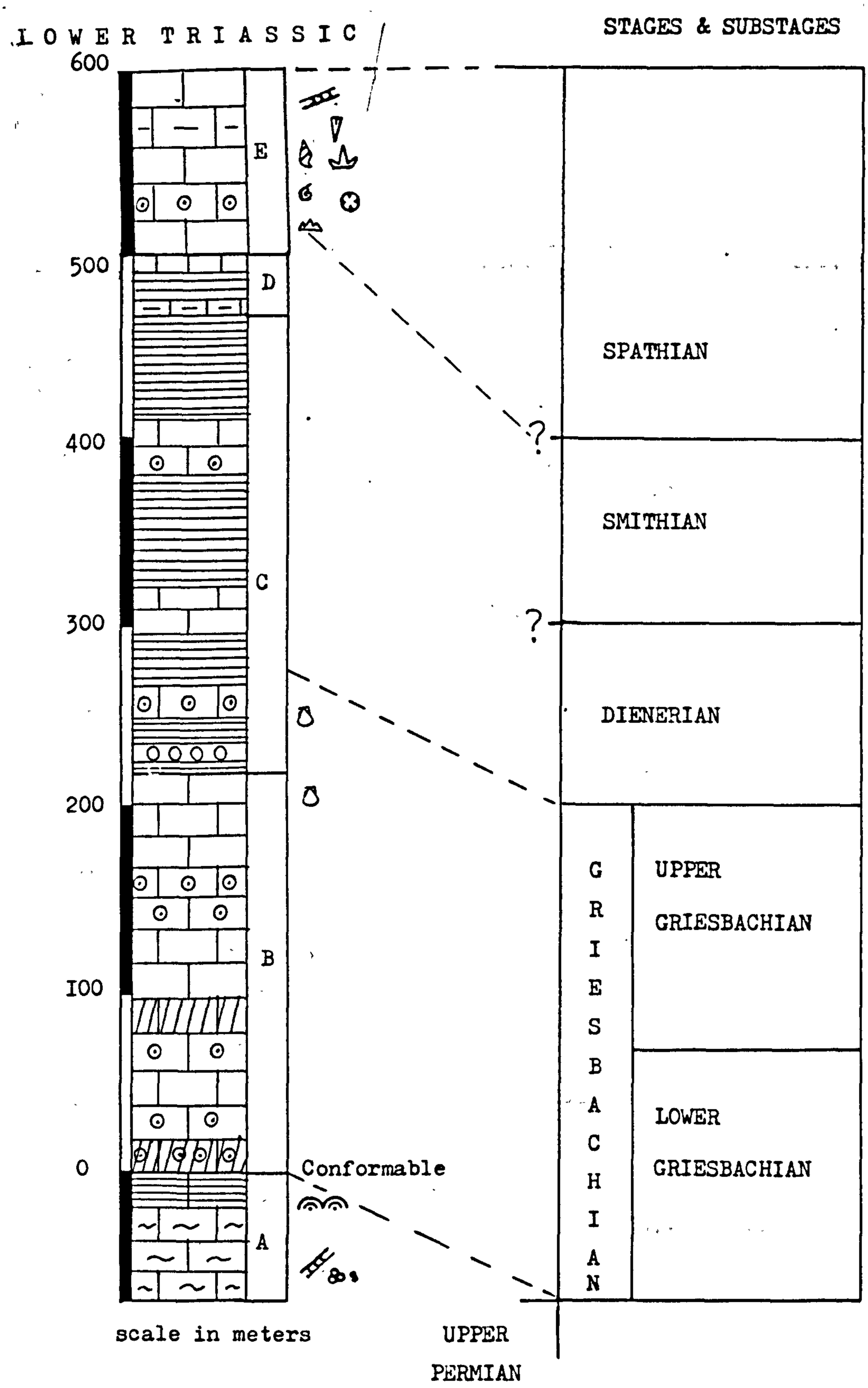


Figure 9.2 Lower Triassic Stages & Substages in the THA section.

M I D D L E T R I A S S I C

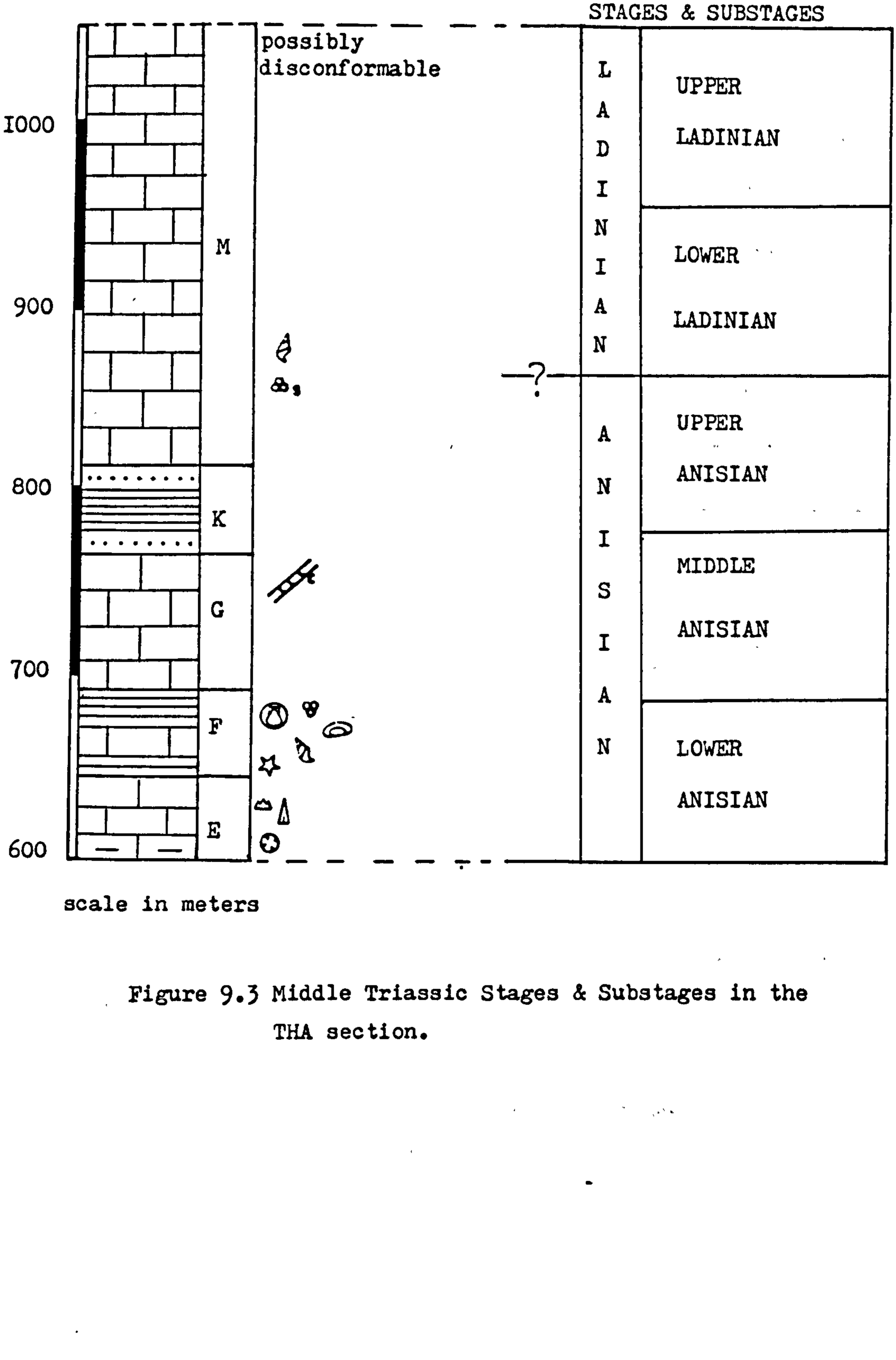


Figure 9.3 Middle Triassic Stages & Substages in the THA section.

U P P E R T R I A S S I C

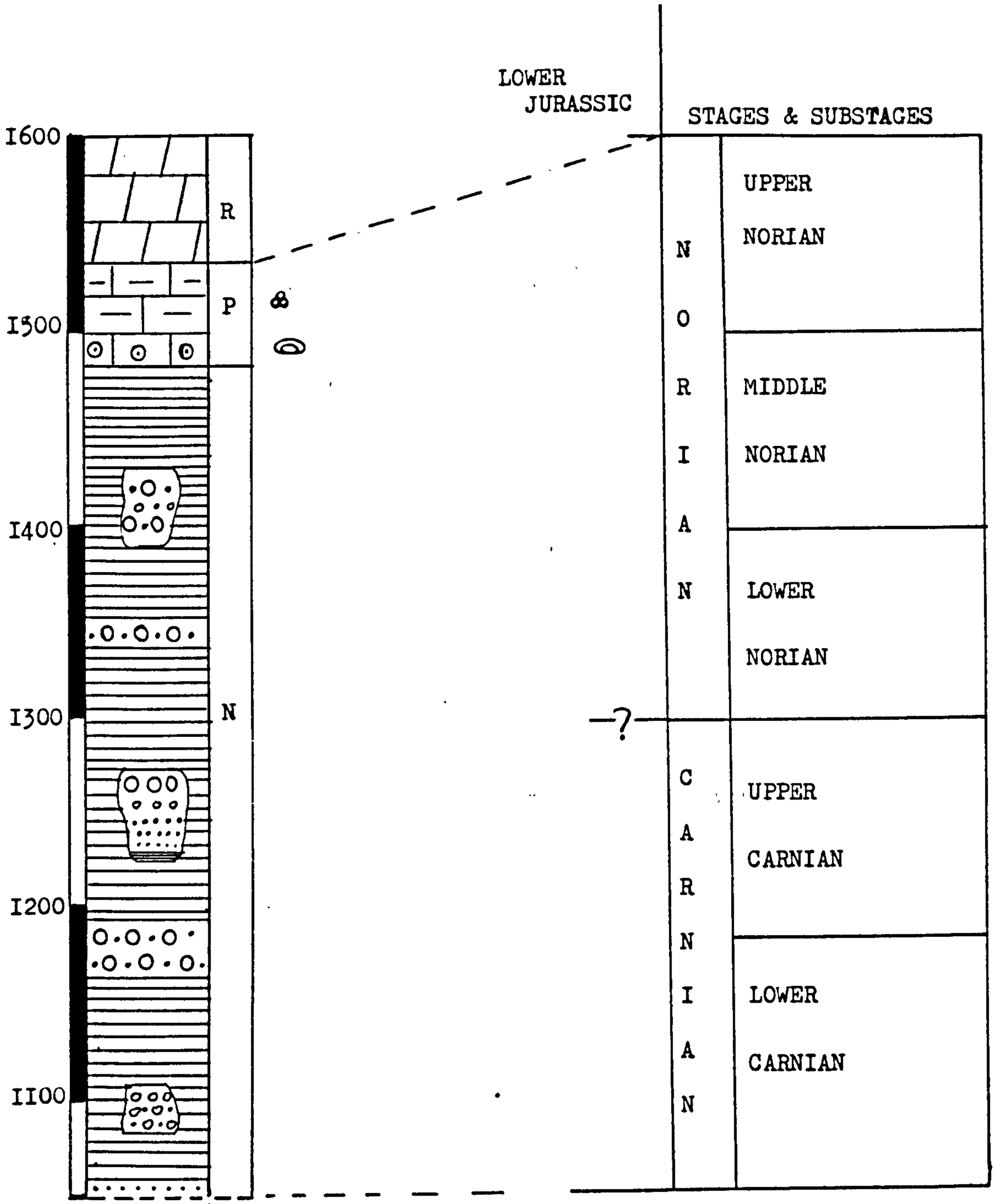


Figure 9.4 Upper Triassic Stages & Substages in the THA section.

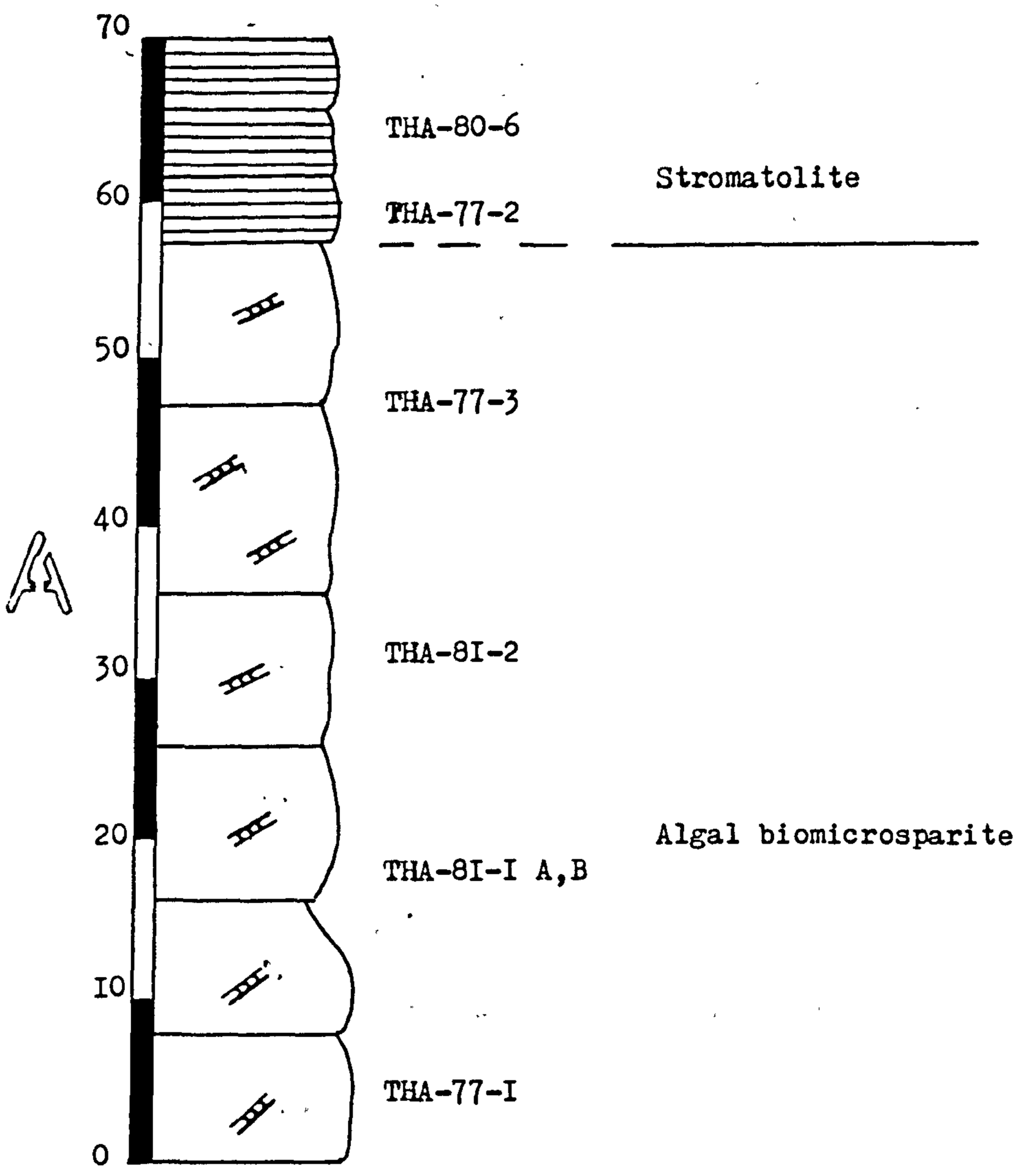


Figure 9.a . Section THA, Formation A- sampled horizons.

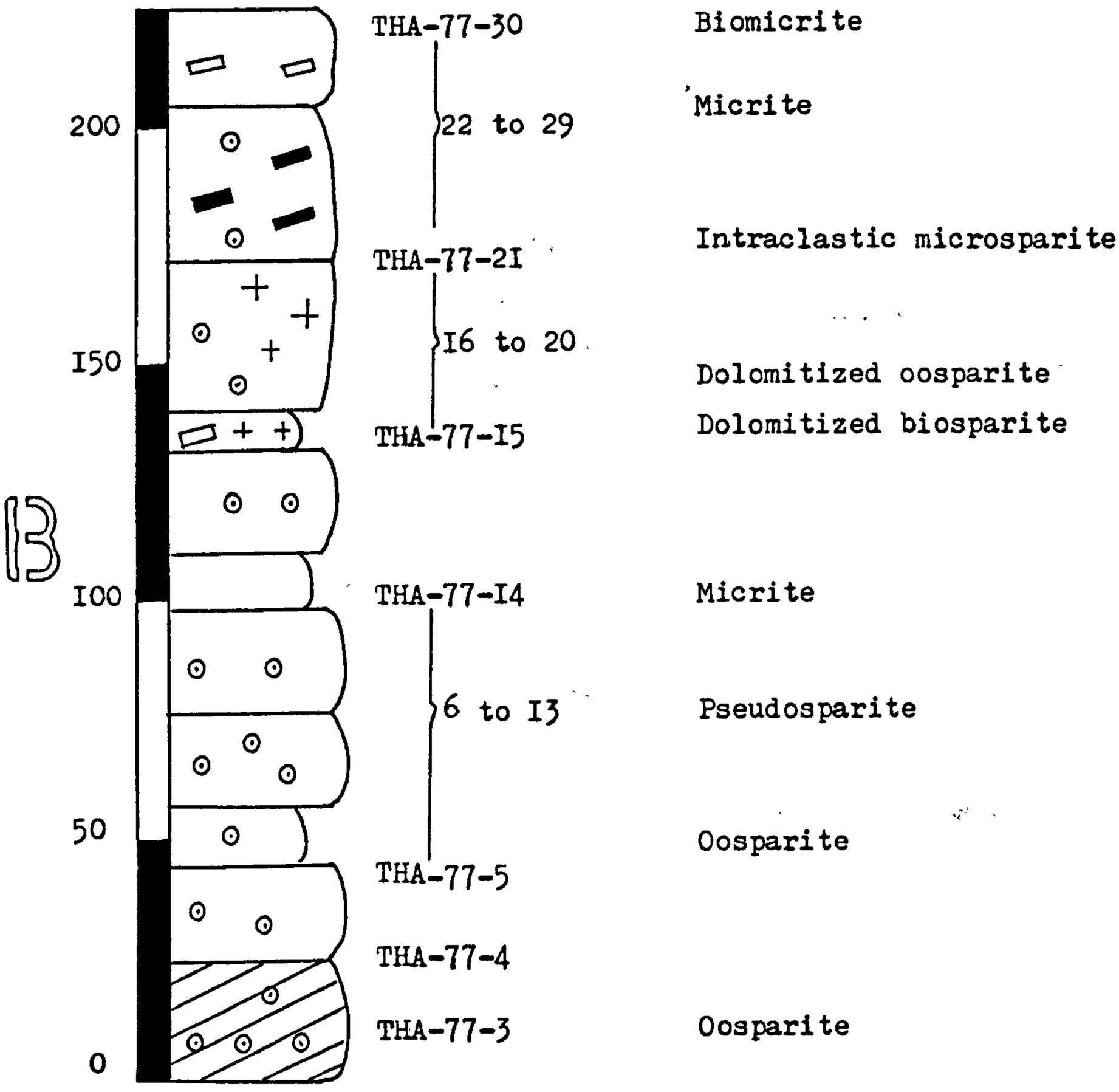
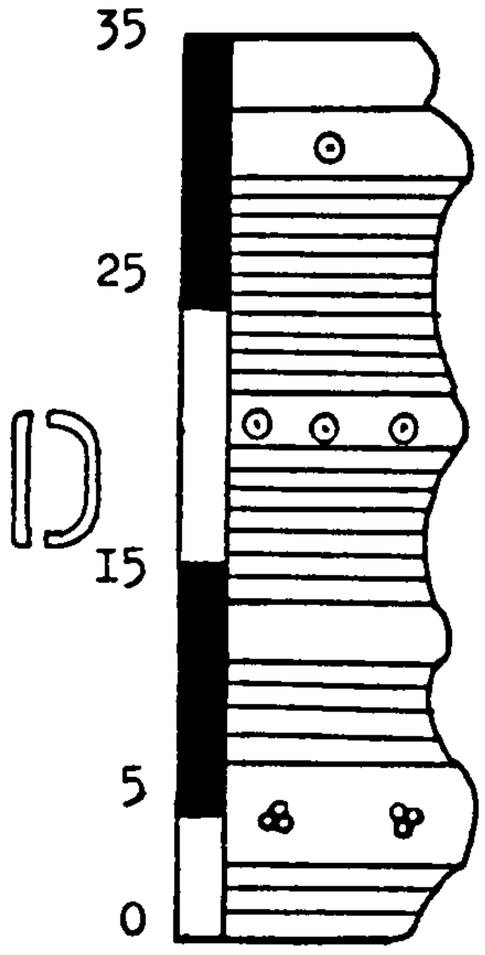


Figure 9.b Section THA, Formation B- sampled horizons.



THA-77-46 — Variegated shale

40 to 45 — Oosparite

THA-77-41 — Micrite

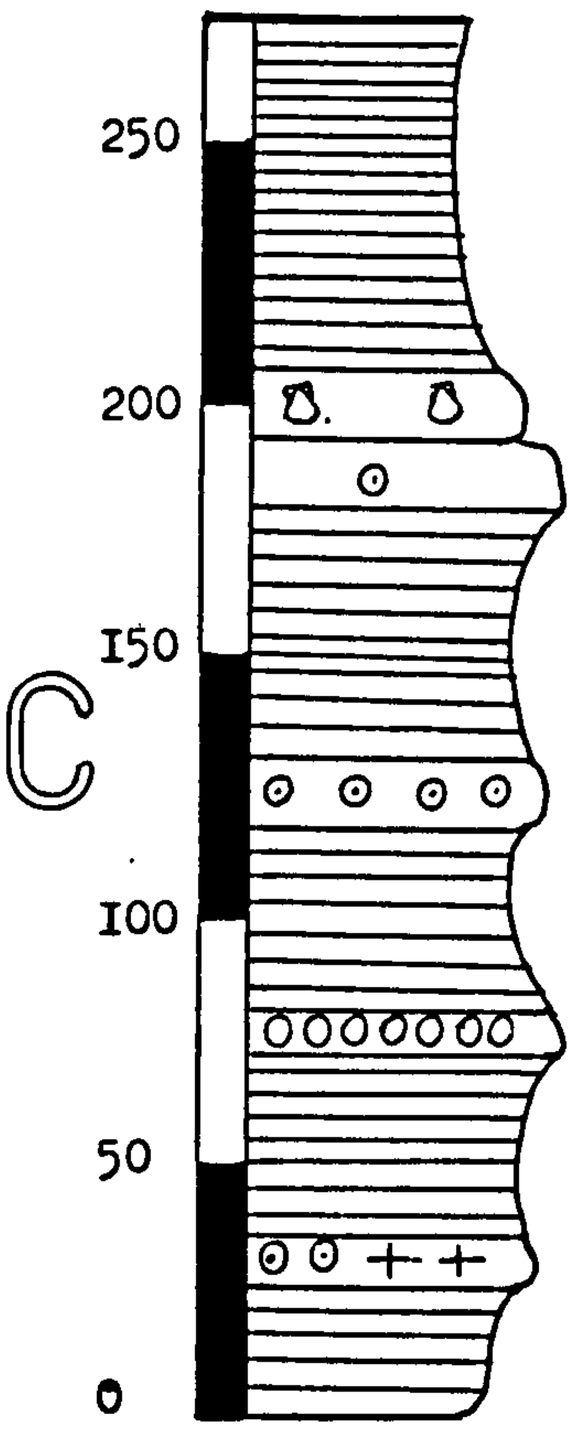
THA-77-40 — Microsparite

38 and 39 — Foraminiferal biosparite

THA-77-37 — Variegated shale

scale in meters

Figure 9.d



THA-77-36 — Variegated shale

THA-77-35 — Oosparite

THA-77-34

THA-77-33

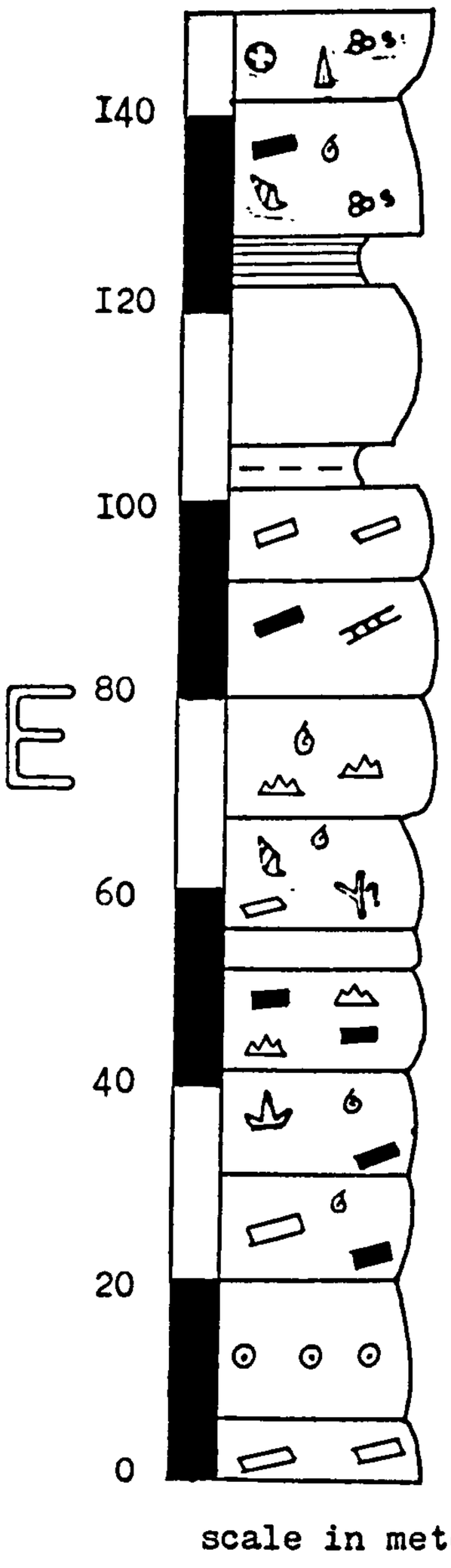
THA-8I-4 — Edgewise conglomerate

THA-77-32 — Dolomitized oolite

THA-77-3I — Variegated shale

scale in meters

Figure 9.c Section THA, Formations C and D-sampled horizons.



THA-77-96 — Biomicrite

86 to 95 — Intrasparite

THA-77-85 B — Intramicrite

68 to 85 A — Shale

Biomicrite

THA-77-67 — Interbedded clayey limestone

THA-77-66 A and B

Intramicrite

THA-80-I

THA-77-65 — Biomicrite

57 to 64 — Micrite

THA-77-56 — Intrasparite
Micrite

THA-8I-5 and 6 — Intrasparite

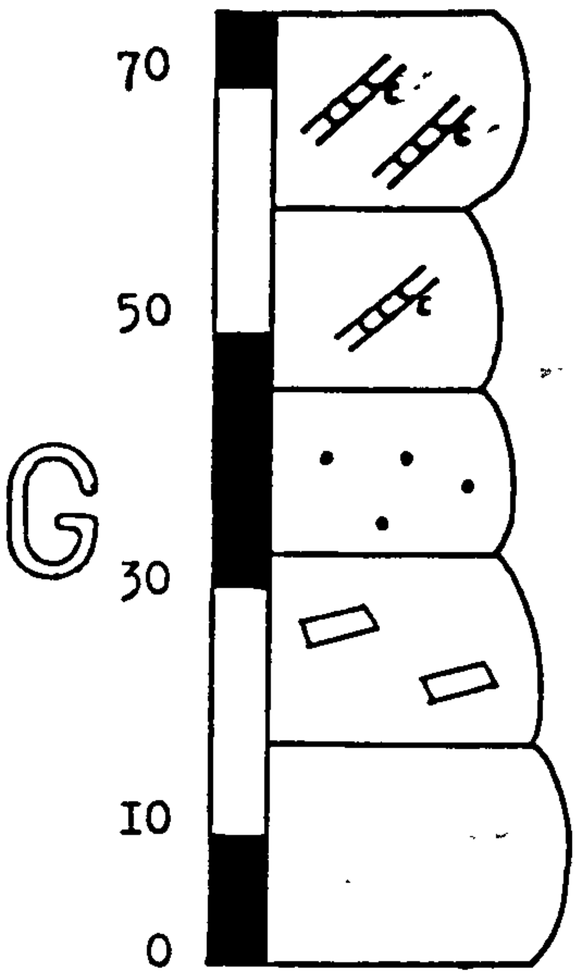
THA-77-55

48 to 54 — Oosparite

THA-77-47 — Biomicrite

scale in meters

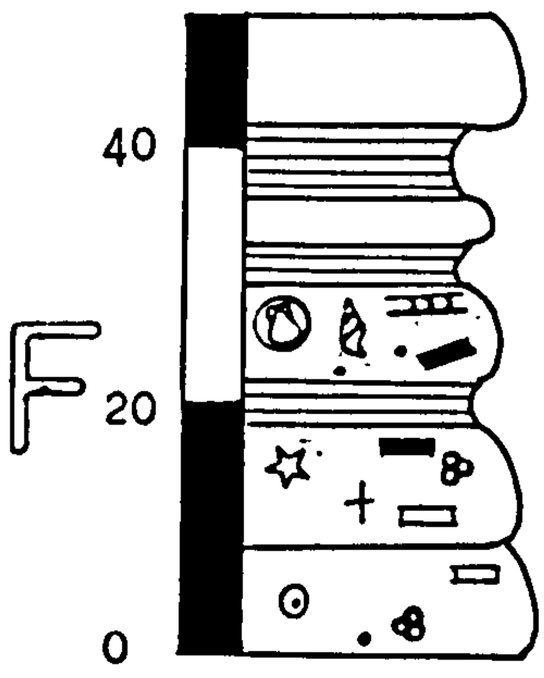
Figure 9.e Section THA, Formation E-sampled horizons.



THA-77-I20	Cauliflower-type algal limestone (recrystallized)
II6 to II9	
THA-77-II5	Pelsparite
THA-77-II4	Bioclastic micrite
THA-77-II3	
THA-77-II2	

scale in meters

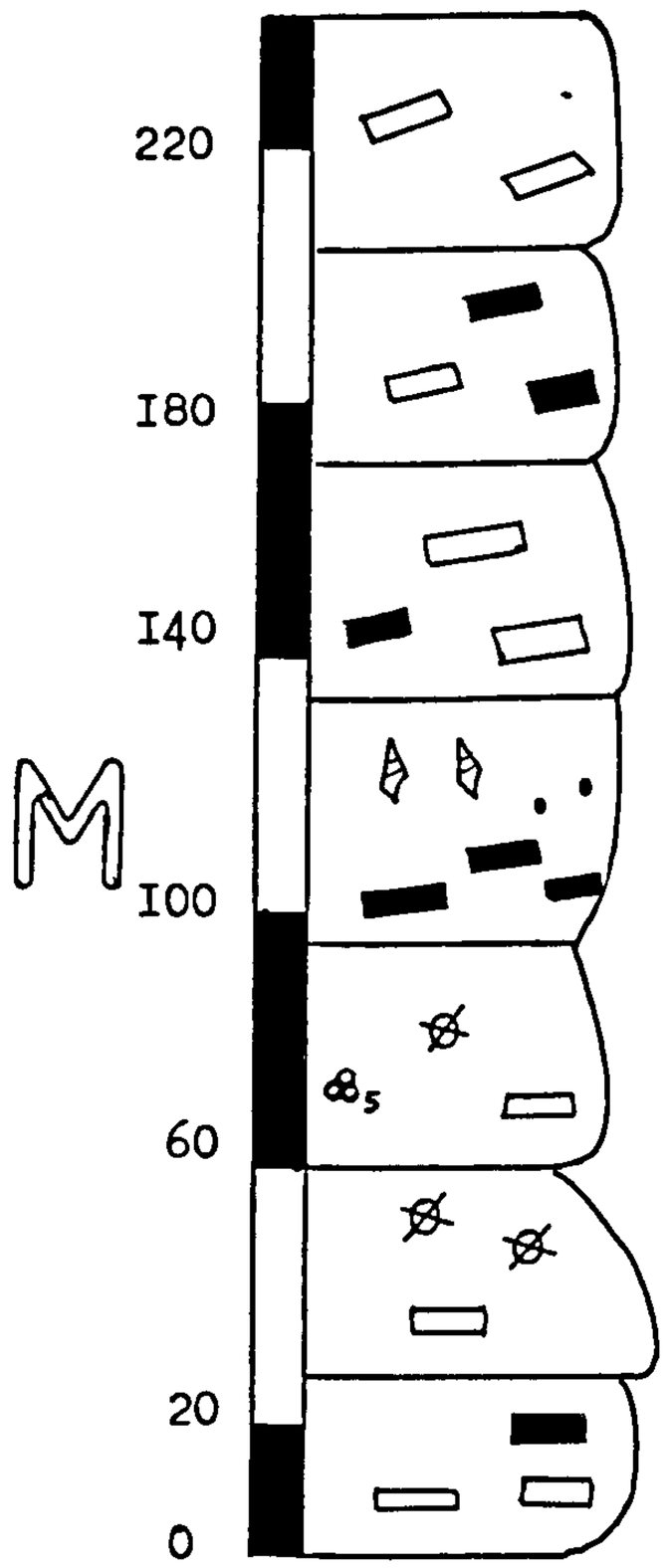
Figure 9.g



THA-77-II0 and III	Quartzite
THA-8I-7	
THA-77-I09	Shale
I06 to I08	Quartzite
THA-77-I05	Shale
I0I to I04	Biomicrite
THA-77-I00	Dolomitized intraclastic biosparite
98 and 99	
THA-77-97	Biomicrite

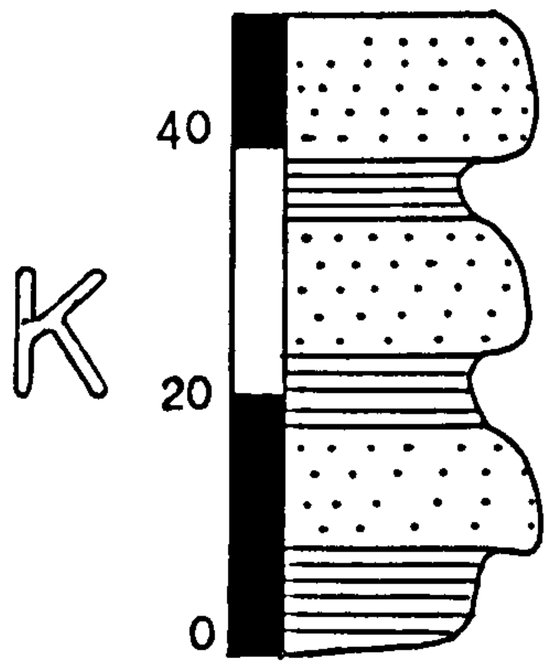
scale in meters

Figure 9.f Section THA, Formations F and G-sampled horizons.



THA-77-I39
I35 to I38 — Intrasparite
THA-77-I34
I30 to I33 — Biomicrite
THA-77-I29
THA-77-I28 — Oncolitic intrasparite
THA-77-I27 A and B — Oncolitic biomicrite
THA-77-I26
THA-77-I25
THA-77-I24 — Biomicrite

Figure 9.m



THA-77-I23 — Sandstone
THA-8I-8
THA-77-I22
THA-77-I2I — Shale

Figure 9.k Section THA, Formations K and M-sampled horizons.

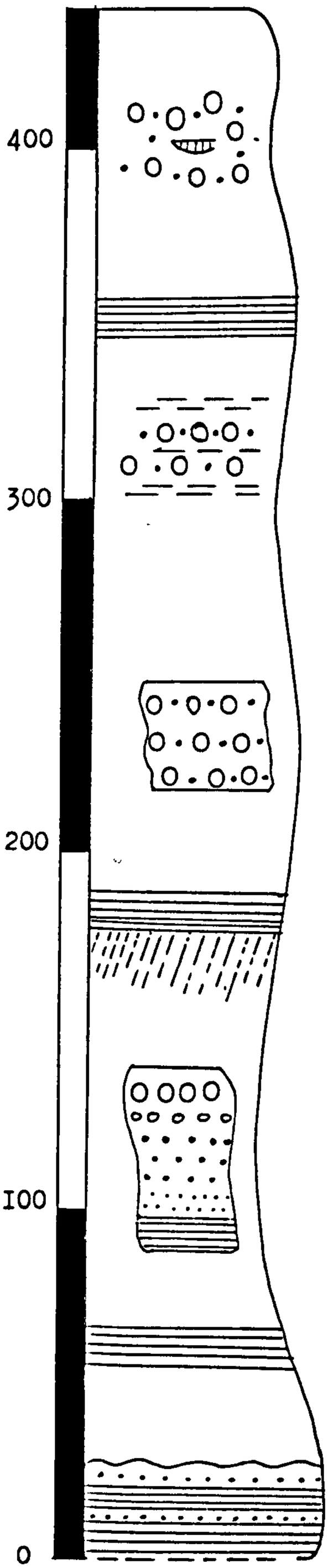
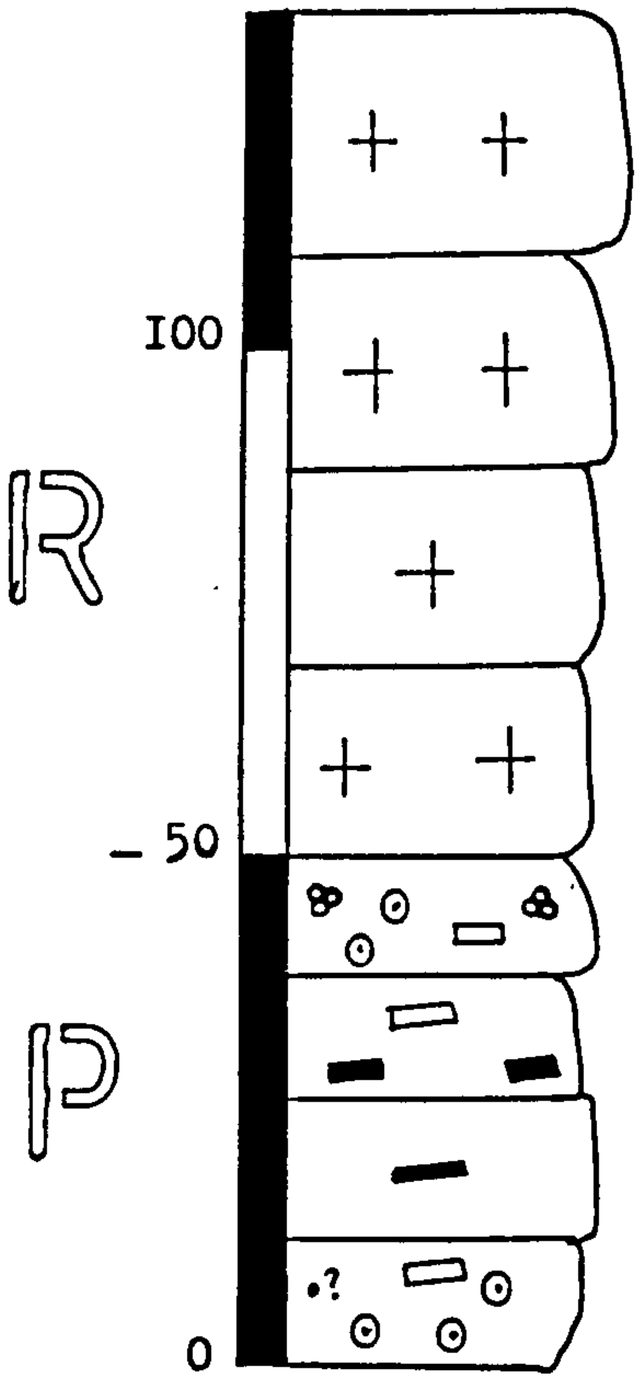


Figure 9.n Section THA, Formation N-sampled horizons.



THA-80-5		
	3 and 4	
THA-80-2		
THA-77-I54		Foraminiferal oosparite
THA-77-I53		
	I47 to I52	Intrasparite
THA-77-I46		Dolomitized oosparite

Dolostone

scale in meters

Figure 9.p Section THA, Formations P and R-sampled horizons.

The environment of deposition must have been marine, clear water without terrigenous input but a supply of foraminiferal sand to provide the nuclei of the ooliths. The bedding suggests deposition as flat sheets rather than subaqueous dunes, hinting at tidal deltas as the probable environment. A semi-enclosed sea seems likely.

2.2.2 Microfaunas from the THA Section

Micropalaeontological examination of this outcrop has discovered foraminifers and conodonts. Foraminifers have only been studied in thin section; the preserved tests are not available. All the thin sections which contain foraminifers are extensively recrystallized, so that microfossils are not well preserved. Foraminifers are also relatively few in number. Therefore the taxonomic analysis of conodonts only will be given in the palaeontological part of this thesis. Most of the Triassic foraminifers listed here belong to well-known taxa and will not be morphologically described. They are extensively illustrated by photographs, so that they may be compared with world-wide Triassic assemblages. However, the age of the Triassic formations in the studied areas has not previously been determined. In this study, the age of formations is based on both foraminifers and conodonts, where they are available. In their absence only a rough approximation of age is possible. The microfossil content of formations is given in sample order.

Microfaunas from Soğuk Pınar Dere Section (Hadim, THA):

Sample: THA-77-37 was collected from Formation D, which consists of variegated quartz arenite, oosparite, micrite and foraminiferal biosparite. Sample 37 is biosparite containing Ammodiscus cf. parapriscus Ho, 1959. The rock itself is richly foraminiferal (> 25%), usually micrite coated (Plates 4C, 4D and 5A).

Age: Lower Triassic.

Sample: THA-80-1. Conodont bearing rocks have only been recovered from Formation E, which consists of biomicrite, bioclastic micrite, intramicrite, micrite, intrasparite and oosparite. Small amounts of shale can also occur in this formation. Samples containing conodonts are badly

recrystallized and hard to identify, but were probably originally micrite. Sample 1 contains poorly preserved conodonts such as Ellisonia cf. teicherti Sweet 1970, Ellisonia sp., Parachirognathus obliqua (Staesche 1964), Parachirognathus cf. ethingtoni Clark 1959 and Parachirognathus sp.(Tab.5). The genera Ellisonia and Parachirognathus have been mostly reported from Lower Triassic rocks (Plate 21, Figs. 1 to 14).

Age: Lower Triassic.

Sample: THA-81-6. This rather large sample was collected from Formation E with the specific intention of recovering more conodont specimens. Unfortunately conodonts(Tab.5) were extremely sparse in this sample. It is a similar type of rock to THA-80-1, which contains similar conodonts as well as Ellisonia triassica Müller 1956 (Plate 21, Figs. 3 to 5). Recently E.triassica and P.ethingtoni have been reported from the Smithian and Spathian Sub-stages of the Lower Triassic (Solien, 1979, p.300; Koike 1982, p.40).

Age: Top Lower Triassic.

Samples: THA-77-97 and 98 were collected from recrystallized biomicrites of Formation F, which also contains quartz arenites and shales. The limestone samples are rich in foraminifers such as Glomospira sinensis Ho 1959 (Plates 6B, 6C, 6D). It is mostly reported from the topmost Lower Triassic and Middle Triassic rocks of Europe and Asia (e.g. Zaninetti 1976, p.92, pl.2, Figs. 3-10).

Age: Lowermost Middle Triassic.

Sample: THA-77-129 is sampled from Formation M, which is a thick sequence of calcarenite and calcirudite. The only foraminifer which was recovered from biomicrite beds of this formation is Endothyranella sp.

Age: Middle Triassic.

Samples: THA-77-153 and 154: These oosparite samples from Formation P contain foraminifers which occur only as the nuclei of ooliths (Figure 9 p). They are badly altered, comprising Glomospira or Glomospirella sp. and Involutina? sp. (Plates 7B, 7C, 7D).

Age: Upper Triassic.

2.2.3: Environmental Interpretation

LOWER TRIASSIC

During Upper Permian and Lower Triassic times, the following sequence of events took place in the THA region:

Event(i) Upper Permian - Deposition of fine-grained calcarenite with sparse foraminifers and algae (Mizia sp.);

Event (ii) Upper Permian - Deposition of medium sequences-stromatolite;

Event(iii) Lower Triassic - Deposition of oosparite (locally dolomitized);

Event(iv) Lower Triassic - Deposition of land-derived sediments (sand, silt);

Event(v) Lower Triassic - Deposition of interbedded argillaceous limestone with lamellibranchs and foraminifers;

Event(vi) Lower Triassic (possibly basal Middle Triassic at top) - Deposition of oosparite, interbedded limestone-shale and then fossiliferous fine-grained calcarenite;

Event(i): Late in the Upper Permian a shallow marine environment with abundant algae existed in the THA area. The restricted fauna implies that salinities were not normal marine, probably they were slightly hypersaline. A very shallow bay or semi-enclosed tidal lagoon is the suggested environment.

Event (ii): Conformably overlying the algal calcarenites are stromatolites, probably of intertidal origin in a lagoon. Two sites are favoured by modern stromatolites: the inner shore of the lagoon and the rear of the lagoonal barrier (Patterson & Kinsman, 1981). The change in environment from sub-tidal to intertidal is achieved simply by the deposition of sediment without erosion or tectonic intervention.

Event (iii) Conformably overlying the intertidal stromatolites are oosparites, other limestones and poorly laminated mudstones for which a sub-tidal delta environment is most likely. There is a strong link between tidal deltas and lagoon barriers, but little association between tidal deltas and the minor-shore of the lagoons. This suggests that all the events so far described took place at the seaward side of the lagoon, close to the barrier. Sub-tidal deltas imply that there were channels through the barrier. Such channels are known to migrate laterally in modern lagoons and do not require localized subsidence for their initiation.

Event (iv) Tidal deltas continue through Formation C but are intercalated with much thicker units of variegated shales and quartz arenites, showing only very thin bedding and parallel lamination. A sub-aerial, hence supratidal, environment directly connected to a land mass is required. By comparison with the Persian Gulf (Patterson & Kinsman, 1981), the terrigenous sediment was deposited by sheet-floods from the land. Clearly it filled the lagoon from time to time, so that tectonic subsidence is required to re-open it and permit the re-establishment of the sub-tidal delta. Tectonic uplift of the hinterland would increase the supply of terrigenous detritus, so is probably involved in this event.

Event (v) Lagoonal infilling by variegated shales continued but was much less; the tidal delta environment also continued, and a new environment occurred in which laminated shelly shale was deposited. The preservation of shells and of primary lamination in this new environment indicates a non-tidal delta site and suggests an adverse sub-tidal environment in which scavengers could not exist. Such environments do not support primary faunas either, so the shells must have been worked in from nearby - shell banks are a common feature of lagoons away from detrital inputs such as rivers or tidal deltas.

Event (vi) This is really a series of events linked by the occurrence of typically open marine faunas, including ammonites and

Figure 10. Schematic environmental interpretation of the Lower Triassic of Soğuk Pınar Dere section(HADIM,THA).

corals. It begins with oolitic limestones very similar to those of Event (iii), and thus of sub-tidal deltas. The presence of ammonites requires that the tidal inflows were of normal marine salinity. Overlying this tidal delta are thinly laminated limestone-shale interbeds which, in their lack of fauna and of bioturbation, suggest a reversion to a hypersaline environment. It can only have been short-lived, since the upper part of the formation was clearly deposited in fully marine, shallow sub-tidal conditions with an abundant fauna. The long-persisting lagoon had, by now, been totally obliterated and the coastline has regressed across it and probably beyond it on to the hinterland.

These events are summarized in Figure 10.

The total thickness of Upper Permian and Lower Triassic rocks studied is over 700m. These have been preserved because of tectonic subsidence of the area of deposition, or through eustatic rise of sea level, or a combination of the two processes. It is not possible to identify eustatic changes in the limited area studied, but tectonic movements of the appropriate magnitude are well documented in many places. It will therefore be assumed that tectonic subsidence was the major cause of the preservation of the Triassic sediments studied. As Özkaya (1982) indicates in his revised work on the origin and tectonic setting of some melange units in Turkey, the Dikmen melange (a part of the Ankara Melange Belt) is overlain unconformably by carbonates of Triassic-Jurassic age, on which a slab of ophiolite is resting. This feature provides independent evidence of intense tectonic activity during the Triassic in the area around Hadim.

The environments of deposition in the Lower Triassic in the Hadim area are marginal marine, very shallow water to sub-aerial, and therefore very sensitive to tectonic movement, either up or down, and equally sensitive to sediment input. Taking them in sequence:

Event (i) requires shallow sea with restricted environment which limited the fauna by increasing the salinity through solar evaporation. Such processes operate today on the Great Bahama Bank, where salinity $> 40‰$ occurs frequently.

The Hadim area is therefore judged to have lain on the landward side of a shoal. This shoal, whether it lay at a shelf edge or near to a shoreline, would have inhibited wave action, including sediment removal, as soon as it formed, and before it grew above sea level. It is therefore shown conventionally as a submarine shoal.

Event (ii) can readily be achieved by sediment accretion, assisted by mat-forming algae, on the rear crest and flanks of the shoal, without any interruption in the overall slow tectonic subsidence. Minor tectonic uplift of no more than 5 metres cannot be excluded.

Event (iii) requires a sub-aerial shoal forming an almost continuous barrier, but broken by at least one tidal channel from the mouth of which grew a sub-tidal delta. Such a barrier system prevents the removal of virtually any sediment from the lagoon. Deposition is made easier because the barrier excludes all open sea waves. Tectonic subsidence at an overall rate equal to the rate of deposition is required to maintain the lagoon.

It is during this event that the hinterland begins to supply terrigenous sediment to the lagoon in the form of clays deposited sub-aqueously. This may indicate the beginning of tectonic uplift in the hinterland.

Event (iv) Barrier and tidal channel continue, as is recorded by the continuing tidal delta deposits. The terrigenous input increases dramatically in quantity as well as in grain size. The prevailing variegated colour requires sub-aerial deposition,and since such deposits bury the tidal delta, it seems that the lagoon was completely filled. Prevailing thin bedding (< 10 cm.) and virtual exclusion of cross-lamination suggest that deposition occurred either in very gentle flow conditions or by sheet flood. The latter seems to be more likely. Such vast quantities of terrigenous sediment can best be explained by tectonic uplift of the hinterland, perhaps assisted by uplift of the lagoon, although overall subsidence continued to accumulate nearly

300m. of sediment during this event.

Event (v) is the re-estɒblishment of the lagoon and its tidal delta as the hinterland supply of terrigenous sediment faded. In a thickness of only 30 metres the last variegated shale of sub-aerial origin is deposited. Subsidence must have dominated deposition at this time.

Event (vi) - A: continues the lagoon - barrier - tidal channel - tidal delta environment initially. The tidal delta sediments now include marine fossils which would imply fairly normal marine salinities unlike the earlier hypersaline conditions. Submergence of the barrier causing widening of the tidal channels seems likely.

Event (vi) - B: Subsequently the channel system became blocked, since all signs of the tidal delta disappear and deposition of thinly interbedded limestone and shale with no fauna or bioturbation takes over. This suggests a totally isolated lagoon with an adverse environment, probably slightly hyper-saline again.

Event (vi) - C: Sees the disappearance of the lagoon and hence of its barrier, permitting the invasion of the area by an open sea and a very varied fauna - ammonites, belemnites and corals in particular.

Overall the rate of subsidence must have been increasing, letting in open sea over the old lagoon site. Event (vi)-B does suggest a local minor uplift to isolate the lagoon for a short time.

MIDDLE TRIASSIC

Taking Middle Triassic events in sequence:

Event (i) Transgression and deposition of interbedded quartz, arenite, shale and calcilutite with a varied marine fauna.

Event (ii) Deposition of bioclastic micrite, pelsparite and algal limestone.

Event (iii) Deposition of interbedded sandstone and shale, showing no

fossils or bioturbation.

Event (iv) Deposition of poorly fossiliferous calcarenite and oncolitic calcirudite.

Event (i): The marine transgression during this event extended the shallow open sea over an area of horizontal Upper Palaeozoic limestones and shales, which had previously been the edge of the hinterland. Quartz arenite and shale probably came from the hinterland, either directly or by the re-working of a thin cover of Lower Triassic sheet flood deposits covering the Upper Palaeozoic limestone surface. It is also possible that they were produced by sub-aerial weathering and erosion of the Upper Palaeozoic limestone terrain, since this sequence contains thin shales and thin quartz arenites. The sea had normal marine salinity.

Event (ii): Conformably overlying micrite and pelsparite without major sedimentary structures indicate that they are low energy deposits. The overlying stromatolite indicates intertidal to supratidal conditions, thus demonstrating upward shoaling. Such shoaling can be achieved by deposition without subsidence or with subsidence at a rate less than deposition. It suggests the re-establishment of a marginal lagoon.

Event (iii): Terrigenous clastics overlie the stromatolites. Unlike those of the Lower Triassic they are grey to buff in colour, hence sub-aqueous, but show no signs of bioturbation; the environment must, therefore, have been adverse to organisms. Freshwater flushing of the marginal marine lagoon would account for this. It suggests that a permanently flowing river system was established at this time. Some confirmation of this has been reported by M. Kuşcu (University of Selçuk), who has a photograph of cross-laminated sandstones at this level. A permanently flowing river would require an elevated hinterland, suggesting that uplift occurred there at this time.

Event (iv): Renewal of limestone deposition indicates a return of the sea and probably an end of the river flow. The limited fauna implies a partially enclosed sea with slightly elevated

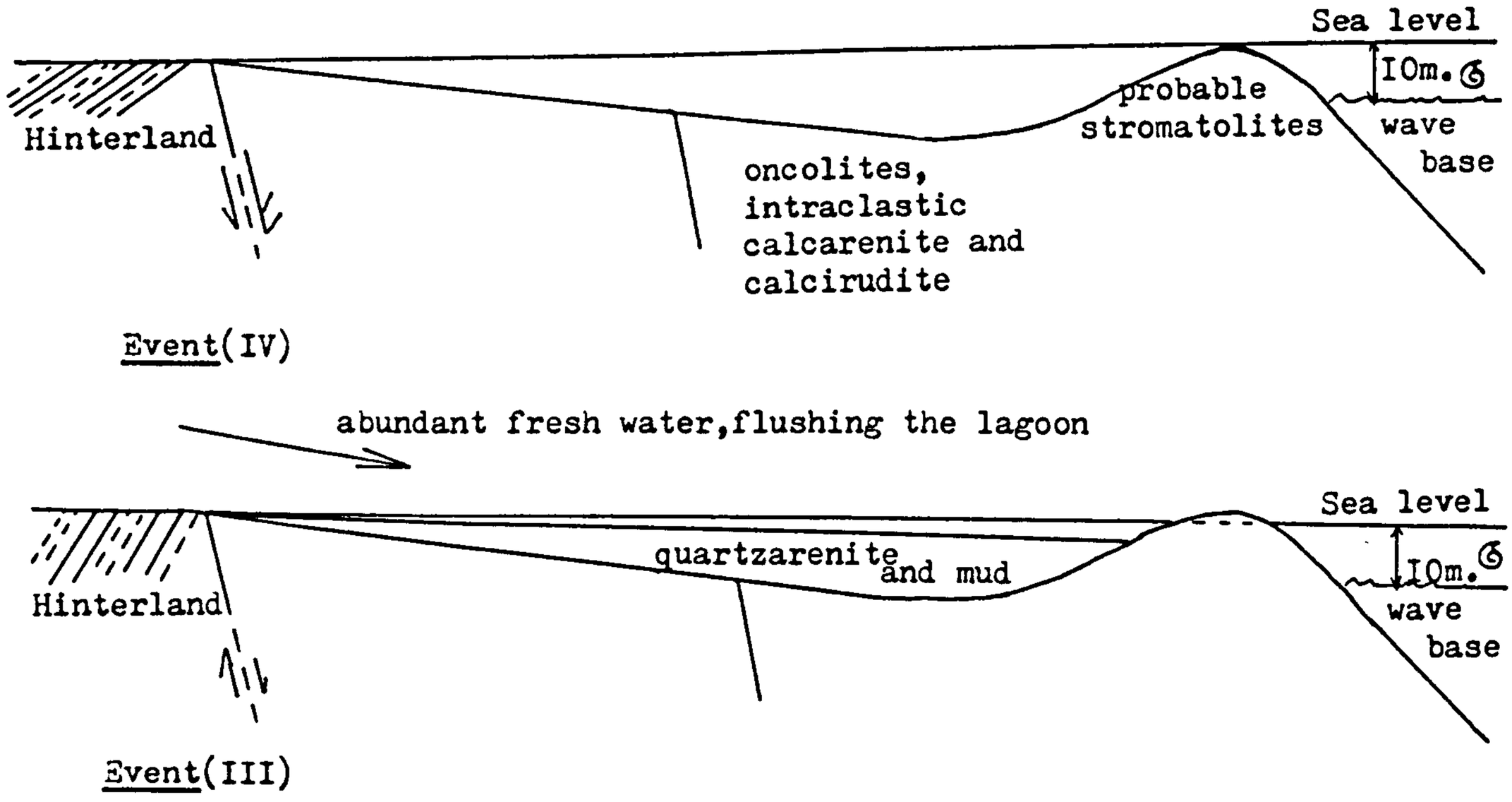


Figure II. Schematic environmental interpretation of the Middle Triassic of Soğuk Pınar Dere section(HADIM, THA).

salinities. This also suggests that the river had ceased to flow into the lagoon. Abundant intraclasts and oncolites require some bottom turbulence, hence shallow water (< 5m.). It suggests conditions similar to the more open parts of the Great Bahama Bank.

These events are summarized in Figure 11.

The total thickness of Middle Triassic rocks studied is about 400 m. A corresponding amount of tectonic subsidence is required to preserve them. This subsidence was more extensive than in the Lower Triassic, involving the former margins of the land mass, floored by horizontal Upper Palaeozoic rocks. The terrigenous clastics require that the hinterland source was not involved in this transgression, and suggest that it underwent elevation in Event (iii). Block faulting in the hinterland would account for both the transgression, by the foundering of a marginal block whose top layer was horizontal Upper Palaeozoic limestones, and the clastic input, by elevation of an interior block which contained clastic source rocks. Eustatic rise of sea-level may account for the transgression, though a depth increase of 400m. in the world oceans seems unlikely. It is hard to see how it could account for the sudden clastic input of Event (iii).

UPPER TRIASSIC

Upper Triassic sedimentation can be divided into two events, the first of very variable facies, the second of a single facies, as follows:

Event (i) ? Upper Triassic - Deposition of conglomerate, well-sorted clayey sandstone, clayey silt and thin calcilutites.

Event (ii) Upper Triassic - Deposition of fossiliferous limestones, mainly oosparites with local intrasparite.

Event (i): requires a massive clastic input, including lithoclasts of unweathered bed-rock up to cobble size. The lithoclasts persist to the top of the formation, requiring that the source was equally persistent. The lack of reddening and of clay and silt in their matrix indicate considerable sorting of the sediment and therefore precludes deposition in an alluvial

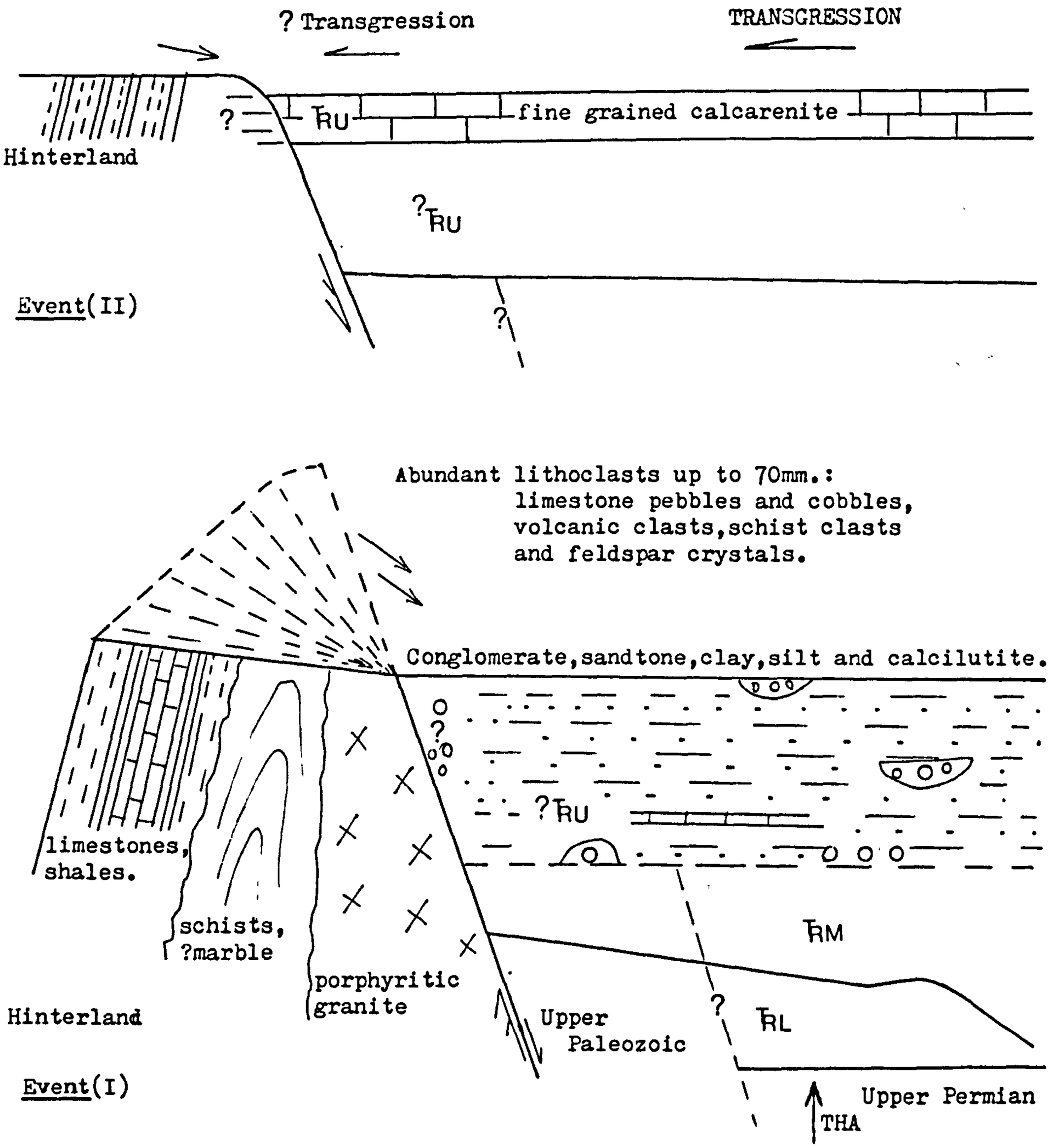


Figure I2. Schematic environmental interpretation of the Upper Triassic of Soğuk Pınar Dere section(HADIM,THA).

fan. Limestone matrix suggests that deposition probably occurred at the coastline, with wave re-working at least in part. Walker (1967, Fig.2) illustrates but does not describe low tide terrace sands (one of which overlies alluvial fan sediments and develops a lag gravel at the contact) inter-bedded with intertidal muds (Fig.14). An intermittent river in a semi-arid climate, draining a rugged hinterland not too far from the coast, seems to be the most likely environment. Temporary deltas might form at the river mouth during flow, but would be eroded and converted into low tide terraces between flows. A topography similar to that in northern Baja California (Walker, 1967), but with greater rainfall, would be required. The red silty clays would then correspond to the landward side of the intertidal mud flats described by Walker (1967, p.361), where rapid weathering of Fe-rich silicates produces a red stain in the sediments. On such tidal flats, slight increases in the rate of tectonic subsidence would cause temporary marine incursions, permitting deposition of thin calcilutites.

The sudden incursion of the clastics points to an equally sudden creation of the source area, best achieved by tectonic uplift of the hinterland. This event is similar to earlier phases of clastic input in the Lower and Middle Triassic, but much stronger. Any weathered zone would have been quickly eroded through to expose bed-rock, which included Upper Palaeozoic limestones, various metamorphic rocks, volcanics and probably acid plutons. The abundance of red silty clay suggests that weathered material continued to be eroded.

Event (ii) shows no signs of clastic input. Oolitic and slightly intraclastic calcarenites were deposited in a shallow sea. The fauna was very restricted. Foraminifers occur, but only as oolite nucleii, for which they would have to be dead. Ostracods occur, which hints at slightly elevated salinities, as possibly do the intraclasts. A shallow, partially restricted sea similar to that in the upper part of the Middle Triassic and also comparable to the open part of the Great Bahama Bank is suggested. The sudden disappearance of the

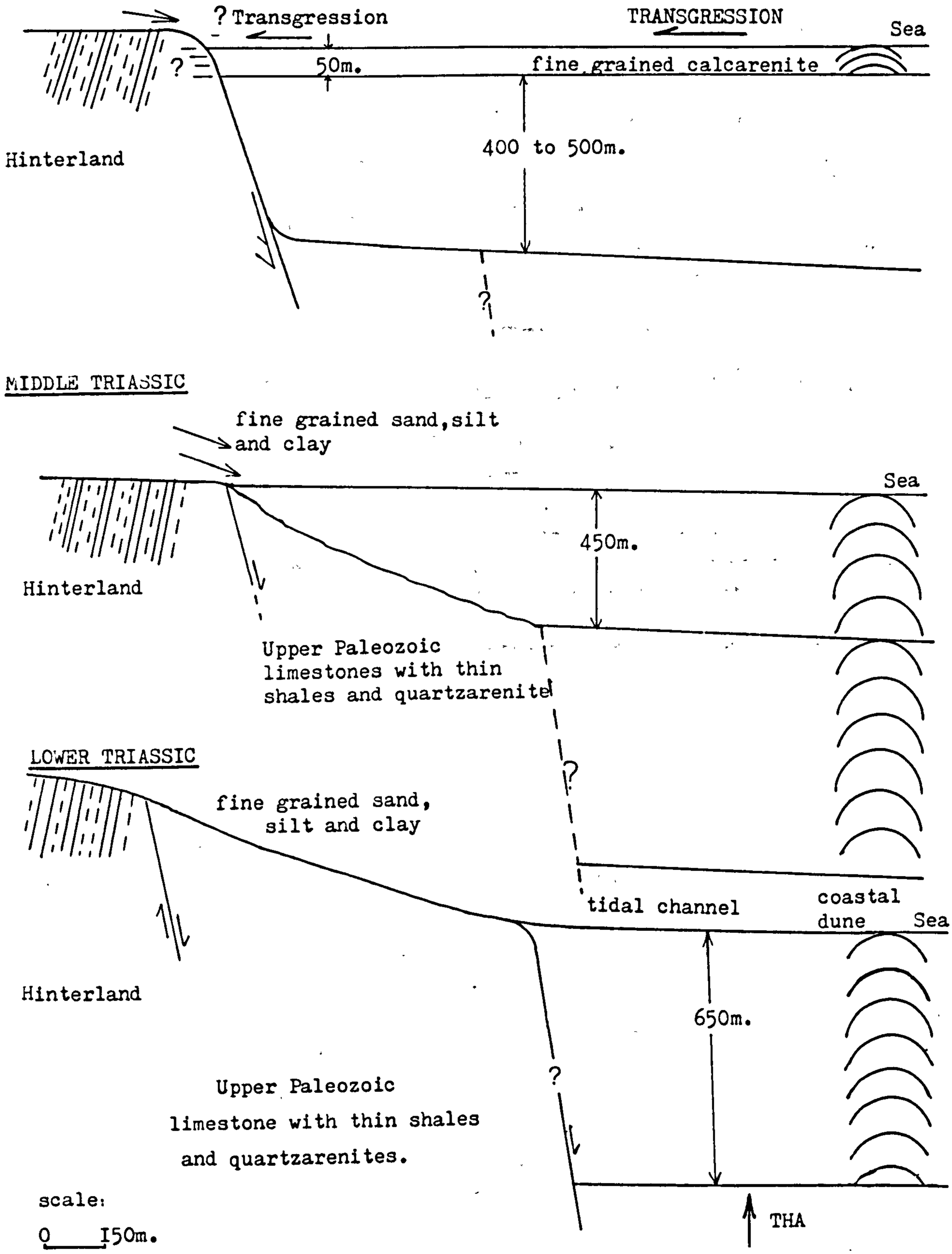
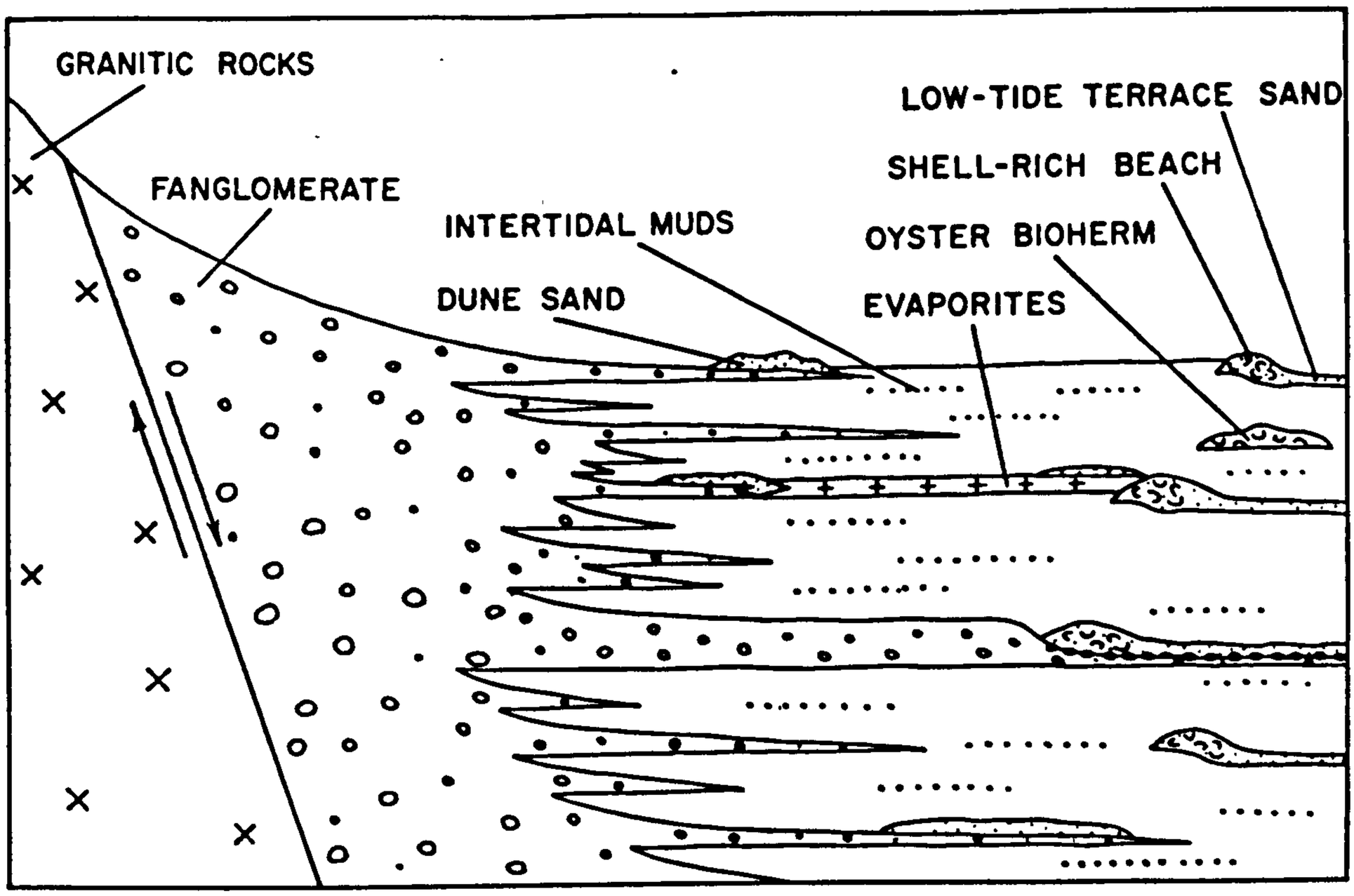


Figure 13. Schematic environmental interpretation of the Lower, Middle and Upper Triassic of Soğuk Pınar Dere section (HADIM, THA).



Diagrammatic cross section showing facies relationships of Recent, Pleistocene, and Pliocene sediments, northeastern Baja California, Mexico (WALKER 1967, fig.2)

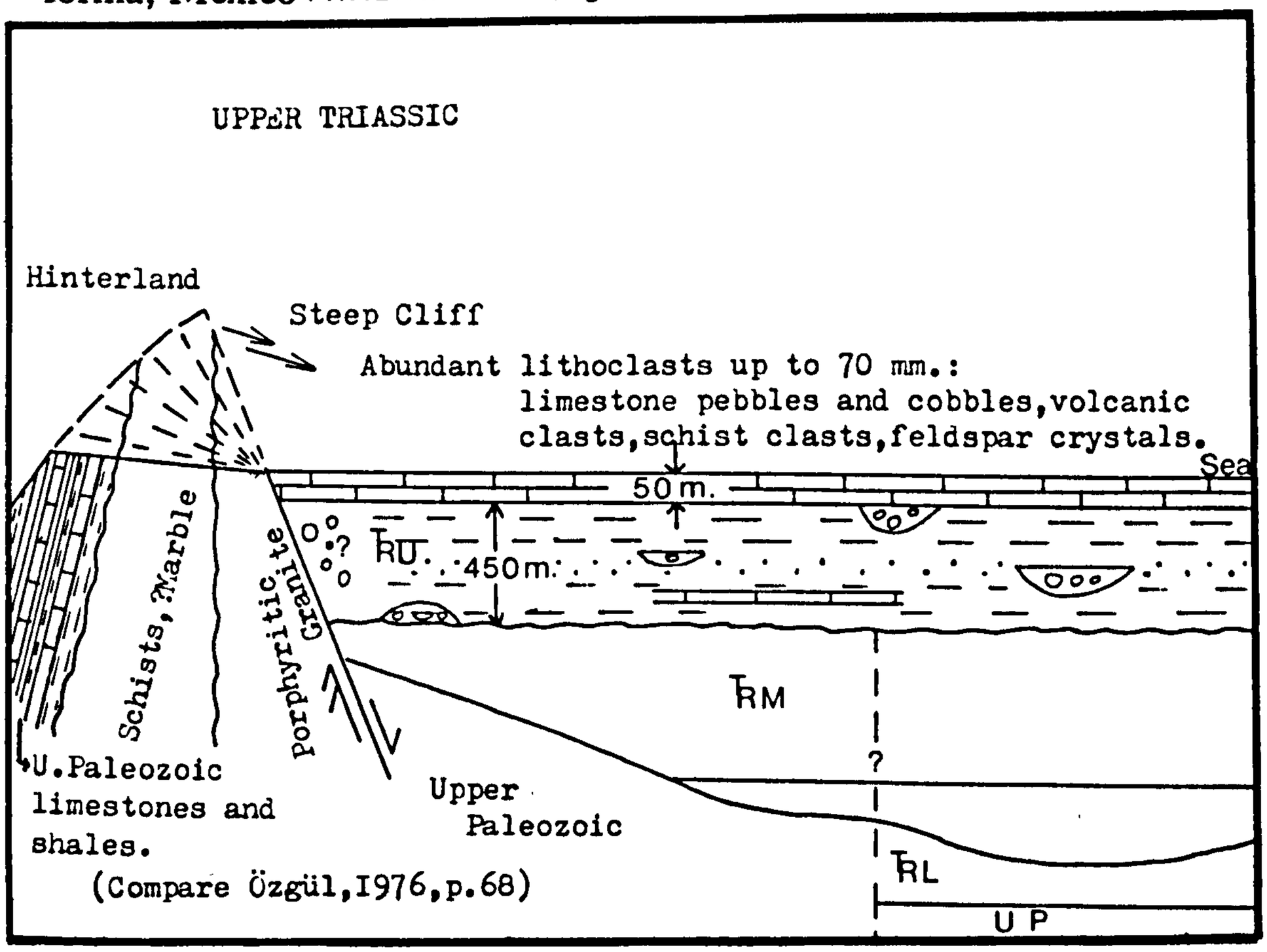


Figure 14. Reconstruction of U.Triassic facies in the Hadim area.

clastic input probably indicates tectonic subsidence of the hinterland source.

These events are summarized in Figure 12.

The total thickness of the Upper Triassic rocks studied is 400 to 500 metres. A major tectonic uplift is required to produce them [Event (i)]. Also required is a tectonic subsidence of 400 to 500m. in the area to preserve that much sediment. The uplift would need to have been pulsatory to maintain the supply of lithoclasts through 400-500 metres of deposition. Tilting of the hinterland would require less energy than total uplift.

The beginning of Event (ii) was marked by sufficient subsidence of the depositional area to let in the sea. Simultaneously the clastic input stopped. Subsidence of the hinterland would achieve this. Transgression of the sea over the former hinterland would be even more effective. During Event (ii), 50 metres of limestone of very shallow water origin accumulated. Subsidence kept pace with deposition; both were probably very slow, by comparison with the Great Bahama Bank (see Figs. 13 and 14).

2.3: BOLKARDAĞI UNIT

In the area of the Taurus belt in south Turkey, the Bolkardağı Unit is characterized by carbonates and detrital rocks, which are thought to have been deposited in a shelf environment (Özgül, 1976). Bolkardağı is one of the highest mountains in the West Taurus, composed of all the distinctive rock types of this unit. In addition to limestone, this unit contains green schist metamorphics, quartz arenite and dolostone ranging from Middle-Upper Devonian to Lower Tertiary. The oldest formation of the Bolkardağı Unit, which contains Devonian corals and brachiopods, is schists and marbles. The Triassic exposures are a thick sequence of marine limestone, dolostone, quartz arenite and shale. One of Özgül's columnar sections of the Bolkardağı Unit from the Hadim region explains the general stratigraphy of this unit (Fig.15).

2.3.1: Ekinlik Yayla Section (THB 1)

Ekinlik Yayla is located in a valley a few kilometres south-west of Hadim; a columnar section is measured from east of the Ekinlik Yayla

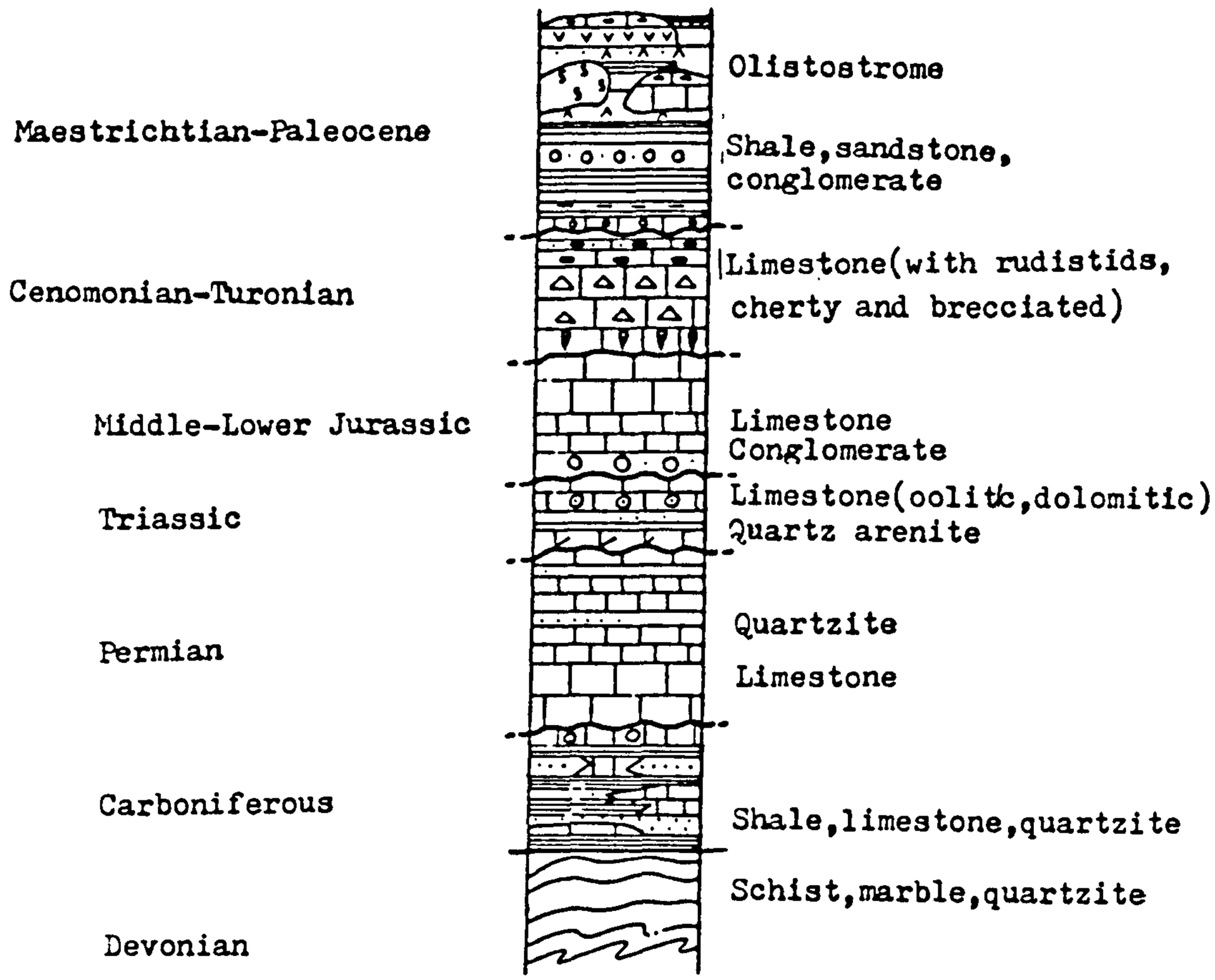


Figure I5. Schematic columnar section of the Bolkardağı Unit from the Hadim region (Özgül I976, not to scale).

settlements to the south-east (Plate 8A). In this area, belonging to the Bolkardağı Unit, there is a thick series of limestone, sandstone and shale comprising Carboniferous, Permian and Triassic strata. Based on the field and petrographic evidence, it can be stated that in the apparently conformable succession from Lower Carboniferous to Lower Jurassic, only Viséan (Lower Carboniferous), Anisian (Middle Triassic) and Norian (Upper Triassic) have been identified by foraminifers and algae. Several samples were processed for conodonts but unfortunately none were recovered.

The Ekinlik Yayla section (THB 1; Fig.16), approximately 500 m. thick, has been closely sampled as follows: THB1-77-101 to 189; THB1-80-1; THB1-81-1.

In the limestones the sampling interval was 1-2 metres. Only a few samples were collected from the shales. A viséan age was proved for the bottom of the sequence, separated by unfossiliferous but apparently conformable limestones from proved Middle Triassic (Anisian stage). These unfossiliferous limestones resemble Permian limestones in adjacent areas and are different from the proven Lower Triassic limestones of THA. No Lower Jurassic conglomerate is seen at the top of this section, but is exposed in neighbouring areas (Fig.16).

CARBONIFEROUS AND PERMIAN

Only a few samples were collected from Carboniferous and Permian rocks. They have not been studied in detail.

FORMATIONS A and B: Carboniferous and Permian

Recognized Carboniferous rocks consist of interbedded yellowish grey clayey limestone, dark grey limestone and variegated shale (mainly grey, dark purple and yellowish), totalling about 70m. (Formation A, Fig.16a). The rocks are pelmicrite, intraclastic biomicrite and algal biomicrite, the latter containing Koninckopora sp. (Plate 10A), indicating a Viséan (Lower Carboniferous) age. Foraminifers have also been found: Haplophragmella irregularis, Endothyra convexa, Archaediscus krestovnikovi and Endothyra sp. (Plates 9A, 9B, 9C, 9D). Locally, algal biomicrite contains some intraclasts (up to 4 to 7 mm. in diameter), coated ooliths micrite lumps and ?oncolites. Fragments of echinoids, crinoids, gastropods and bryozoans are also recognizable in thin section.

The probable Permian rocks consist of limestones with interbedded shales which thin and die out upwards(Plate 10b). The sequence is about 80m. thick (Formation B, Fig.16b). No diagnostic microfossils were found in the studied area, therefore the age is fixed only by stratigraphic position. The limestones are recrystallized grey calcarenite and laminated calcisiltite, presumably micrite. They are generally thin to medium bedded, light grey on fresh surfaces, weathering grey to dark grey. Thin sections usually show ghosts of allochems, possibly intraclasts and oncolites. The topmost member of those Permian limestones contains more bioclasts, small intraclasts and ostracods. Stylolites and microlamination are more noticeable.

The environments of deposition of the Carboniferous and presumed Permian rocks are all shallow marine to intertidal. The Viséan limestones of Formation A, micrites with pellets, intraclasts and algal debris, all suggest shallow waters of low energy, probably a semi-enclosed lagoon protected by a shoal on which the Koninckopora grew. Semi-isolation would imply slightly raised salinities and thus account for the absence of macrofauna. It would also account for the intercalation of variegated shales, these being tidal mudflat deposits comparable to those of the Triassic sequence of THA, already compared with modern Baja-California (p.63). The presumed Permian rocks show a similar style of deposition, though they are much more altered and therefore difficult to identify. The existence of parallel lamination indicates a lack of burrowing organisms and thus an unfavourable bottom environment. In the absence of pyrite to indicate strong reducing conditions, hypersalinity is probable.

MIDDLE TRIASSIC

The Middle Triassic is illustrated in Figure 16 as Formations C, D and E, a total thickness of approximately 190m. Thin to medium bedded grey limestone and clayey limestone of Middle Triassic age overlie the presumed Permian strata with apparent conformity. There is no indication of Lower Triassic rocks. Evidence of a Middle Triassic age is limited to sparse foraminifers in Formation C; these are referred to the Anisian Stage. Formations D and E are unfossiliferous, but probably belong to the other stages of the Middle Triassic, by comparison with THA (p.36). The top of the Middle Trassic is taken as the top of Formation E, where continuous limestones with only minor shales are

overlain by interbedded yellowish micrite and reddish quartz arenite which suggest Upper Triassic again by comparison with THA (p.39).

FORMATION C: Middle Triassic - Anisian Stage

At the base of Formation C there is dolomite and above it fine-grained calcarenite about 60 m. thick. This medium bedded calcarenite is dark grey to black on fresh surfaces, weathering grey. Samples which have been collected from this level comprise micritized shells, unidentifiable coated allochems (100 μm in diameter) and some foraminifers, including Glomospirella triphonensis and Glomospirella cf. irregularis which indicate the Anisian Stage (Plates 10C, 10D, 11A).

The environment of deposition of Formation C was again shallow marine, probably somewhat restricted. Micritization and micrite-coating of grains require very slow deposition and bottom currents strong enough to prevent mud from settling. The absence of terrigenous clastics suggests that no hinterland erosion area was available. This, coupled with the absence of Lower Triassic rocks, indicates that this area, and probably its hinterland, subsided below sea level at the beginning of the Middle Triassic.

FORMATION D: ? Middle Triassic

Thin bedded yellowish grey limestone, locally clayey and about 60m. thick, conformably overlies Formation C (Figs. 16 and 16d). Only two types of limestone are present: micrite and biomicrite. Micrite beds locally contain large allochems, some possibly bioclasts 100 μm in diameter, and rounded micrite lumps up to 300 μm in diameter. The upper part of this formation shows recrystallization and secondary cavity-filling. No microfossils have been found.

The micrite beds suggest that the environment is shallow sea of low energy. The absence of foraminifers indicates abnormal salinities, either brackish or hypersaline. The absence of terrigenous clastics favours the hypersaline environment.

FORMATION E: ? Middle Triassic

This formation, about 75m. thick, is made up of medium bedded grey limestone, as shown in Figures 16 and 16e. It is usually micrite which locally contains dark micritic fragments (possibly micritized bioclasts)

and ghosts of intraclasts (50 μm) which increase in size to 200 μm at the top (Fig.16e).

The micrites of this formation suggest a shallow, restricted marine environment such as a shelf lagoon. Micritization indicates very slow deposition. Lagoonal environments seem to have persisted throughout the Middle Trias. In the early stages the lagoon was of normal marine salinity or nearly so and foraminifers occurred. Later the lagoon became restricted, carbonate sands were supplied at a very low rate and the grains became heavily micritized. The restriction probably caused an increase in salinity. No terrigenous input is recorded.

UPPER TRIASSIC

The Upper/Middle Triassic boundary is placed, without any faunal justification, at the junction between Formations E and F (Fig.16). Diagnostic foraminifers are only found in Formation K. They are species of Involutina Terquem, indicating the Norian Stage.

FORMATION F: ? Upper Triassic

Medium bedded yellowish grey micrite overlain by purple or purplish-red fine-grained quartz arenite and clay, showing no bioturbation, constitute Formation F, which is approximately 50m. thick (Fig.16f). The reddish sandstone-clay alternations locally show small scale cross-lamination. The contact of these terrigenous clastics with the underlying micrite is always tectonically disturbed in the outcrops examined (Plate 2C).

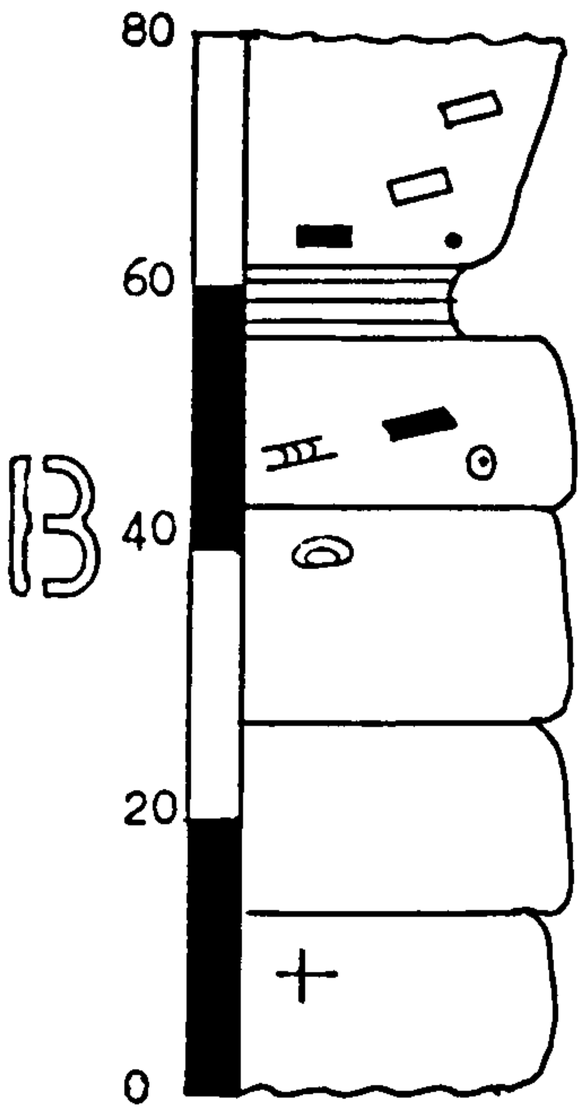
The environment of deposition was still a restricted lagoon, filled from time to time with land-derived material. The terrigenous clastic input requires an effective uplift of the hinterland at the beginning of the Upper Triassic. A similar, but more pronounced uplift has been suggested for the THA region at this time.

FORMATION K: Upper Triassic - Norian Stage

Formation K is medium bedded limestone about 30m. thick. It consists of interbedded micrite and biomicrite showing variable colours from grey to yellow, red or purplish. Micrite locally shows well exposed parallel lamination (Plate 2D) and burrows. Purplish sandstone and clay

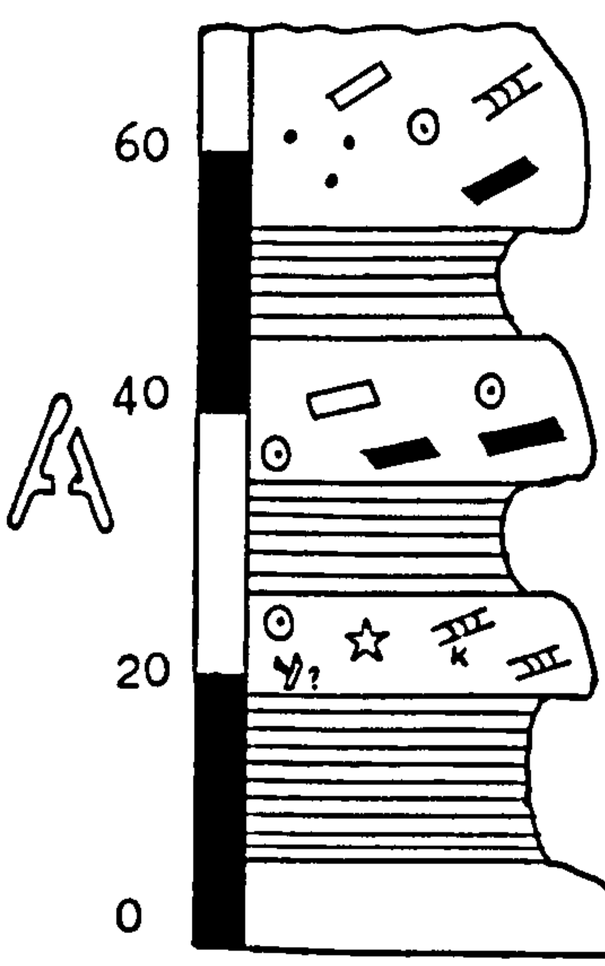
SERIES			FORMATION		FOSSIL	DESCRIPTION
LOWER JURASSIC			500	N		Dolostone(according to Özgül,I980)
T R I A S S I C	UPPER TRIASSIC	RHAETIAN				
		NORIAN	450	M		Thin to medium bedded grey calcirudite
				K		Grey,purplish and yellowish micrite and biomicrite-Purple sandstone and clay
		CARNIAN	400	F		Purplish-reddish quartz arenite,clay
						Medium bedded yellowish grey micrite
	MIDDLE TRIASSIC	?	350			
		LADINIAN		E		Thin to medium bedded,grey-pale grey micrite
			300			
		ANISIAN	250	D		Yellowish clayey micrite and biomicrite
			200	C	&	Dark grey calcarenite (very micritized grains)
		?	150			Dolomite
PERMIAN			100m.	B		Grey calcarenite and laminated calcisiltite
						Shale
						Very light grey calcarenite and laminated calcisiltite
LOWER-UPPER CARBONIFEROUS		?				
		VIZIAN		A		Interbedded dark grey calcarenite, clayey limestone and shale

Figure I6. Columnar section of EKİNLİK YAYLA (THB I)
Scale in meters.



scale in meters

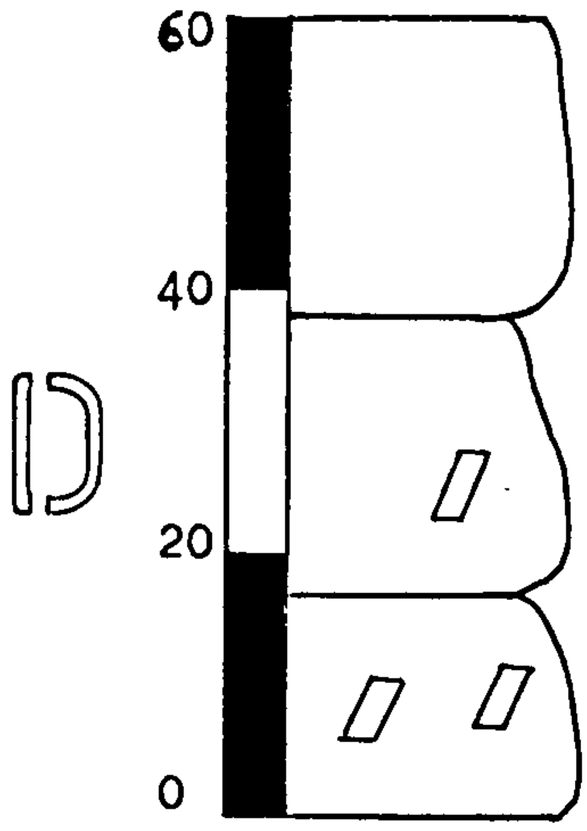
Figure I6.b



scale in meters

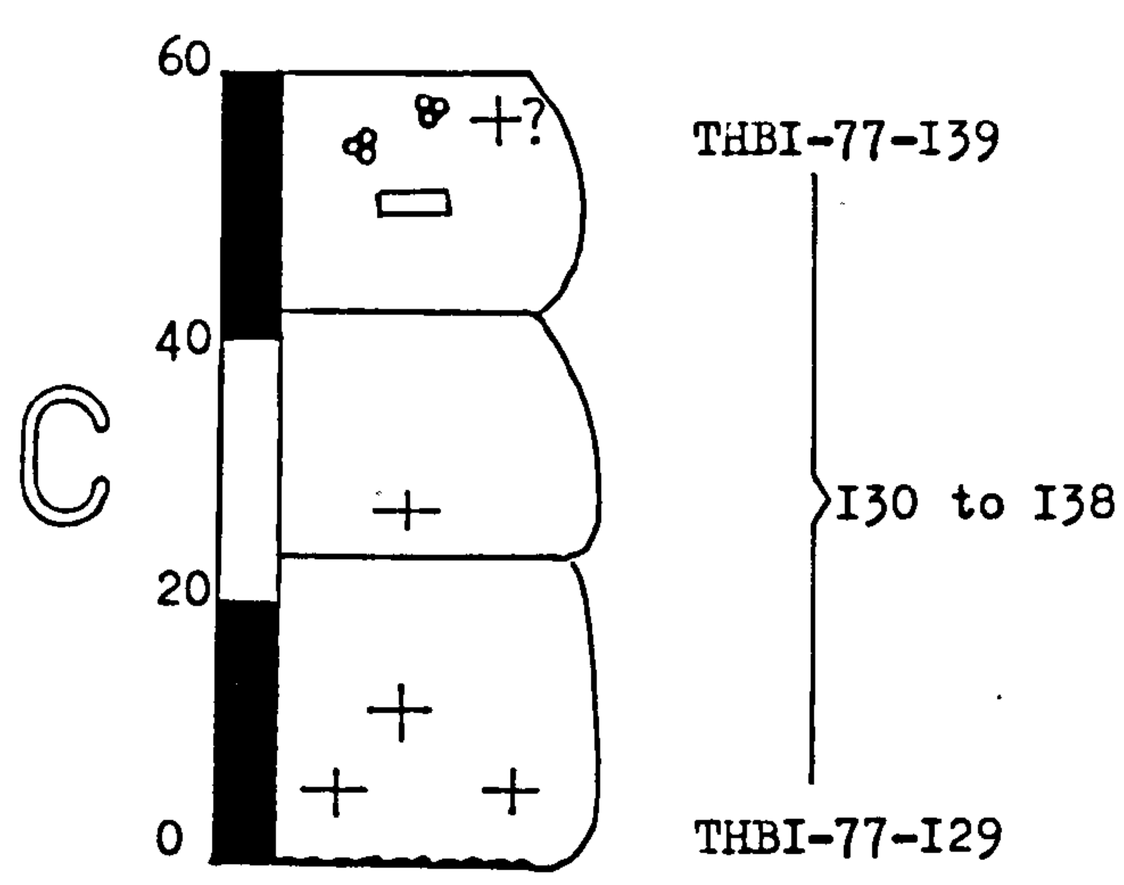
K Koninckopora sp.

Figure I6.a Section THB I, Formations A and B-sampled horizons.



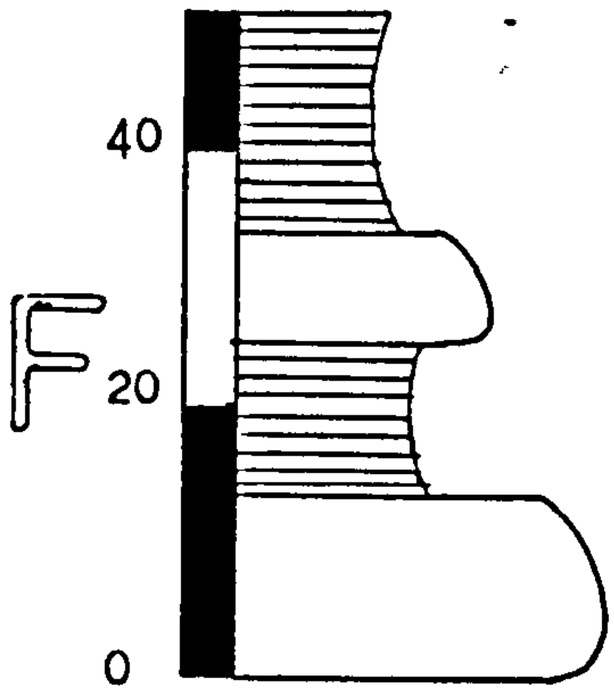
scale in meters

Figure I6.d



scale in meters

Figure I6.c Section THB I,Formations C and D-sampled horizons.



THBI-77-I7I

THBI-77-I70 A,B — Quartz arenite

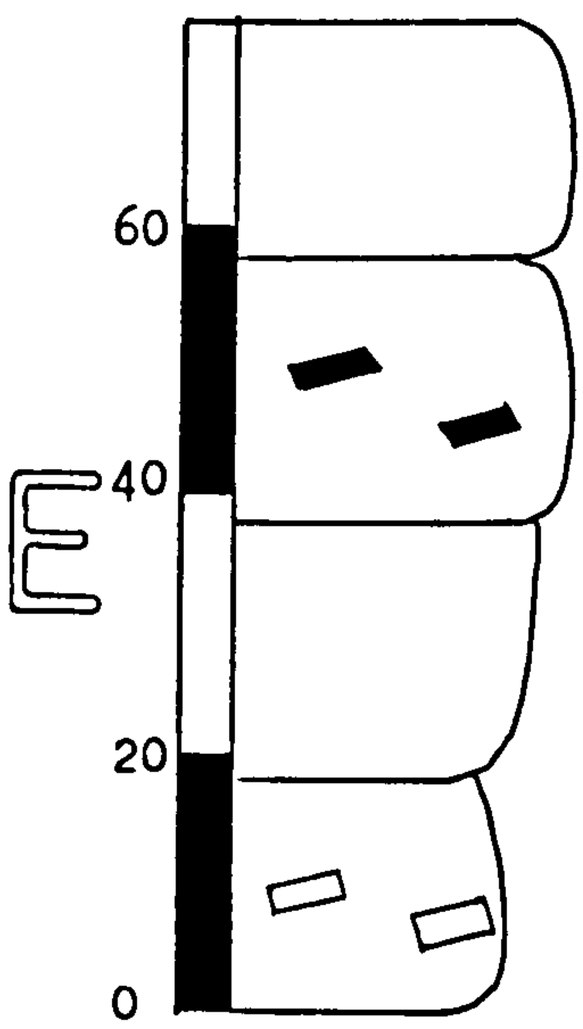
THBI-77-I69 — Purple sandstone-clay

THBI-77-I68

THBI-77-I67 — Micrite

scale in meters

Figure I6.f



THBI-77-I66

I48 A,B to I65

THBI-77-I47

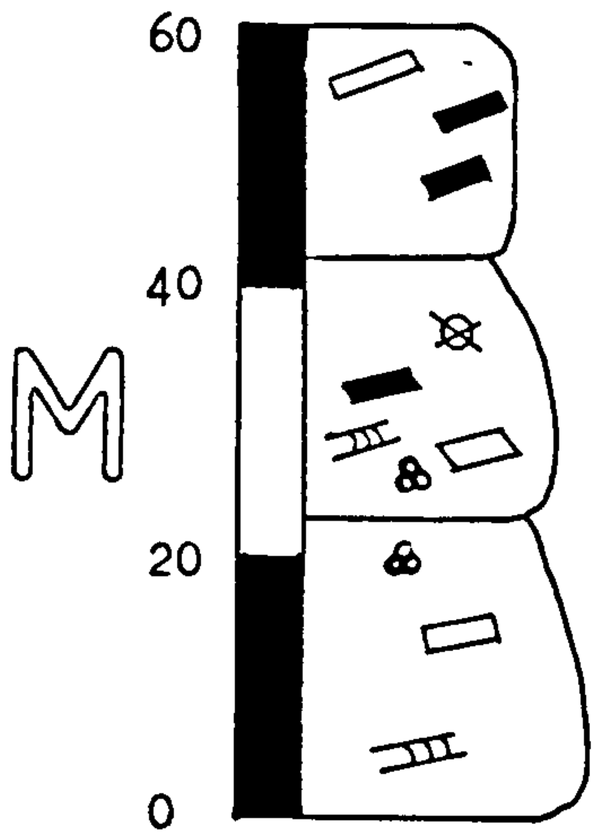
Micrite

THBI-77-I46 A,B

THBI-77-I45

scale in meters

Figure I6.e Section THB I, Formations E and F-sampled horizons.

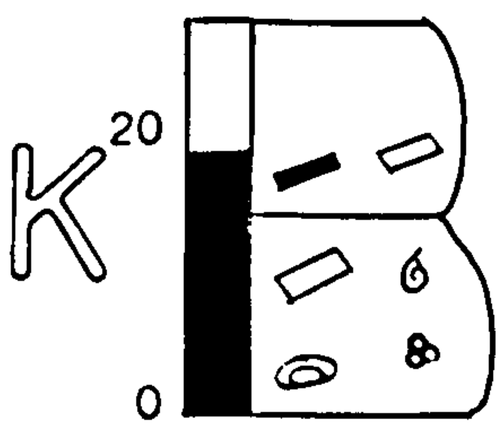


THBI-77-I89
I83 to I88
THBI-77-I82
THBI-80-I and 2
THBI-77-I8I
THBI-77-I80
THBI-77-I79

Intrasparite
Foraminiferal biosparite
Biomicrite

scale in meters

Figure I6,m



THBI-77-I78
I73 to I77
THBI-77-I72

Biomicrite
Micrite

scale in meters

Figure I6.k Section THB I. Formations K and M-sampled horizons.

beds are found at this level in tectonic contact with micrites, both above and below. There is a restricted fauna in the overlying biomicrite consisting of sparse algae (solenoporae), ammonites, ostracods and foraminifers, which include Involutina minuta, Involutina sp. and Ammodiscidae, indicating the Norian Stage (Plate 11B).

Formation K suggests a very shallow marine environment with minor terrigenous clastics. The fauna, particularly the ammonites, require a more open sea connection than previously.

FORMATION M: Upper Triassic

The topmost Upper Triassic formation is 60 metres of grey calcirudite which contains algae, bioclasts, intraclasts and micrite lumps (Plates 11C, 11D). Sparse foraminifers (Varistomatidae) are also found. At the base of Formation M there is thin biomicrite, but most of the formation is oncolitic intrasparite. Trace fossils (presumably Scolithos) have been seen. Thin sections from the intrasparites show macro-vugs with drusy linings. The Upper Triassic formations are overlain unconformably by Lower Jurassic conglomerate in the Bolkardağı Unit (Özgül 1980, personal communication).

Algae in this formation suggest an intertidal to supratidal environment. The trace fossil Scolithos also requires a very shallow water environment, though not supratidal, this supporting intertidal. At the top, oncolitic intrasparite indicates moderately high energy in these intertidal waters. This oncolitic facies resembles the Late Triassic of the Northern Limestone Alps of Southern Europe.

2.3.2: Karabayır Yayla Section (THB 2)

Karabayır Yayla is located to the south of Hadim; the section was measured between the Karabayır Yayla (summer posture on high ground) and Bayla Dere (stream) (Plate 8B). This section, which also belongs to the Bolkardağı Unit, is characterized by limestone and reddish-yellowish shaley arenite totalling approximately 400m. It has been closely sampled as follows: THB2-77-201 to 250; THB2-80-1 and 2 (Fig.17).

The rocks are remarkably unfossiliferous. Sparse unidentifiable gastropods occur at two levels, one in Formation B, the other in Formation C. Foraminifers have been found near the top of the limestones in Formation B. These are Glomospira sp. indet. and indicative merely of the

Triassic System. Near the top of the measured section, high in Formation D, Nautiloculina oolithica (Plate 12D) and Ataxophragmiids indicate Rhaetian Stage or Lower Jurassic. On such fragmentary evidence, it is not possible to state firmly that all the sub-divisions of the Triassic System are present. Comparison with the THA section, where variegated clastic rocks are limited to the Upper and Lower Triassic only suggests that either the sequence is complete, or that only Upper Trias is present. However, oolitic limestones in the THA section are confined to the Lower Trias. This could assign Formations B and C of the present section to the Lower Trias, in which case Formation D is either a very condensed Middle and Upper Triassic representative, or there is an unseen disconformity, probably at the base of Formation D, in which the whole of the Middle Triassic is omitted.

UPPER PERMIAN

Formation A comprises thin to medium bedded grey limestones, as illustrated in Figures 17 and 17a. This altered and odd-looking sequence might have been originally micrite and pelsparite. It is conformably overlain by oolitic Triassic limestones of Formation B.

LOWER TRIASSIC

At the base, interbedded limestone and arenite, approximately 275m. thick, are poorly fossiliferous. Diagnostic faunas are missing. Only sparse, long-ranging foraminifers have been found, indicating the Triassic System. Samples processed for conodonts were found to be barren.

FORMATION B:

This formation is about 115m. thick, composed of interbedded limestone and shale. Medium to thick bedded oolitic limestone is a common rock-type. At the base, oosparite (Plate 12A) containing broken ooliths and small amounts of intraclasts occur. Above this, oosparite, oolitic intrasparite and intrasparite are found. Sparse micrite-coated bioclasts are noticed at this level. All allochems are usually pervasively micritized. Locally, biosparite rich in gastropods also occurs. At the top of this formation there is a very altered, odd-looking pelmicrite with foraminifers such as Glomospira sp. (Plate 12B).

Intercalated with these limestones is reddish-yellow shaly arenite,

which appears twice in Formation B and is observed at only one horizon in Formation C. Generally speaking, these beds are rich in carbonate minerals (Fig.17b).

The oosparites were most likely deposited on a tidal delta resembling the oolite lithofacies of the Great Bahama Bank. The variegated arenite requires a land connection to supply the abundant clastics.

FORMATION C:

Approximately 160 metres thick, Formation C consists of grey limestone and red shaly arenite. At the base, thin to medium bedded grey limestone is pervasively micritized, and neither allochems nor cement is identifiable. Higher beds show that this badly altered rock possibly contains micrite-coated bioclasts, gastropods and thin intraclasts. In the middle of this formation, oosparite and oolitic intrasparite with micro cross-lamination are seen. Ooliths are generally algal-coated and show gradation. Above them are micrite layers. At the top of Formation C, a thick sequence of red shaly arenite is found. It is rich in carbonate minerals (Fig.17c).

The environments of this formation, as well as underlying Triassic, resemble those of the THA section; a semi-restricted marine lagoon, connected to the hinterland, is required.

UPPER TRIASSIC

The top formation of this sequence THB 2 comprises the light grey or grey limestone considered here as Upper Triassic. Approximately 125m. thick, this limestone contains sparse foraminifers at the top, diagnostic of topmost Upper Triassic (Rhaetian). Soft-sediment deformation structures, which can be seen both in outcrop and in thin section, are a common feature of Upper Triassic strata. There is a conformable passage to the Lower Jurassic.

FORMATION D: ? Upper Triassic

Thin to medium bedded grey limestone of Formation D overlies Formation C apparently conformably. Approximately 120m. thick, this formation shows remarkable secondary lamination (Plate 12C). In thin section, it is noticed that all allochems are squashed and unidentifiable

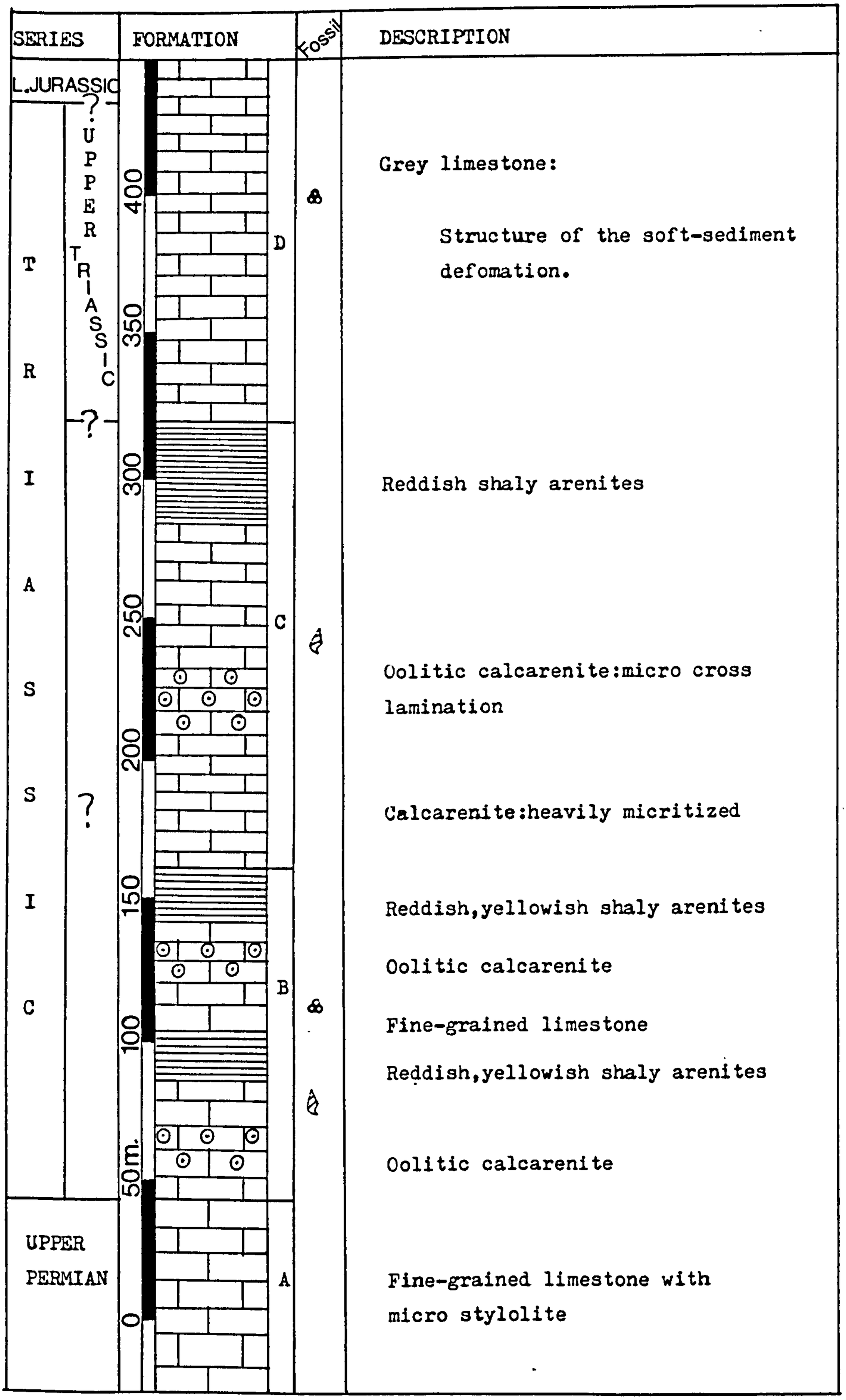
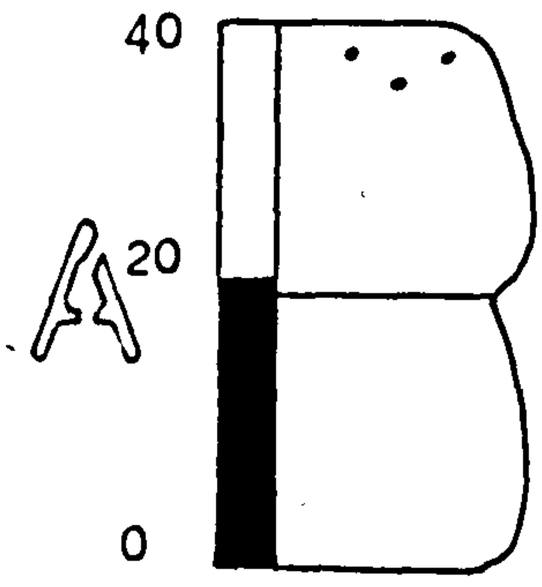


Figure I7. Columnar section of KARABAYIR YAYLA (THB 2).
Scale in meters.



THB2-77-203

Fine-grained pelsparite

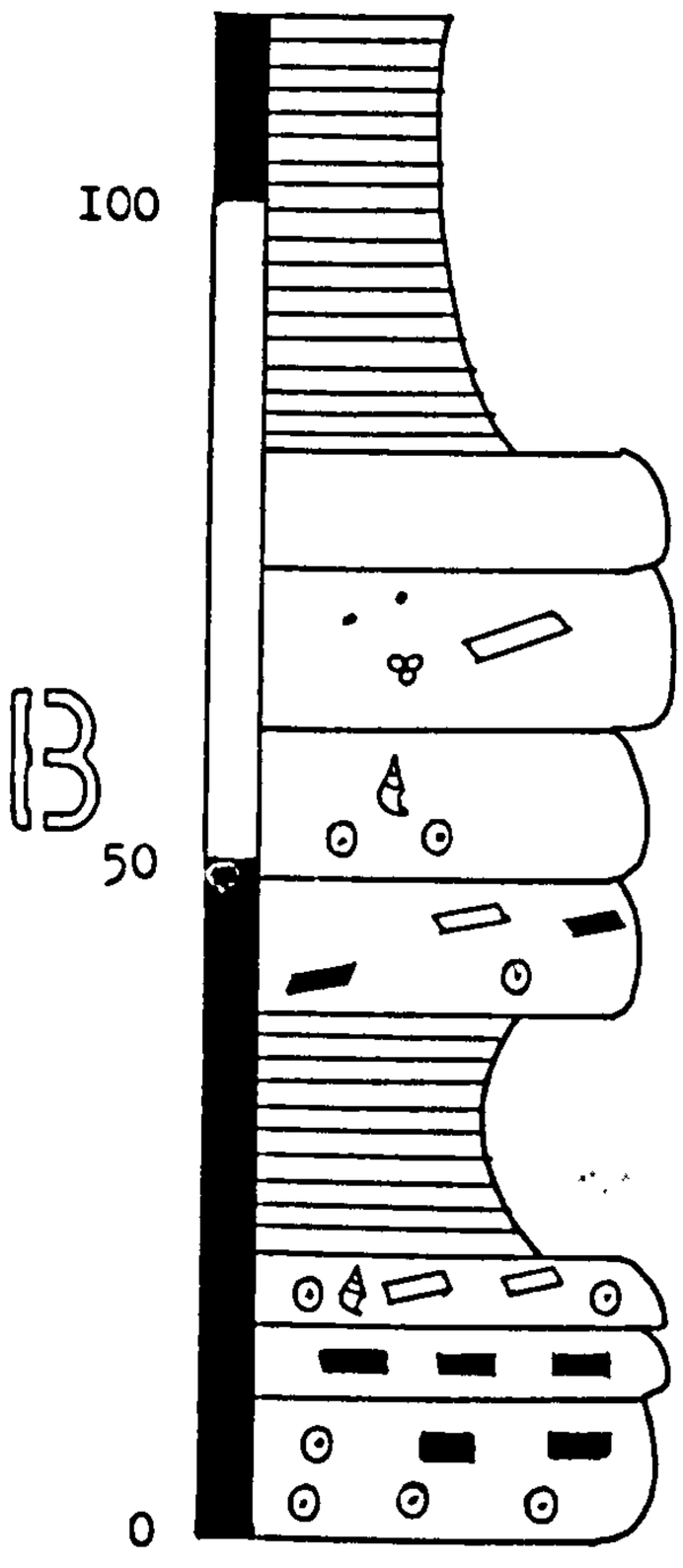
THB2-77-202

Micrite

THB2-77-20I

scale in meters

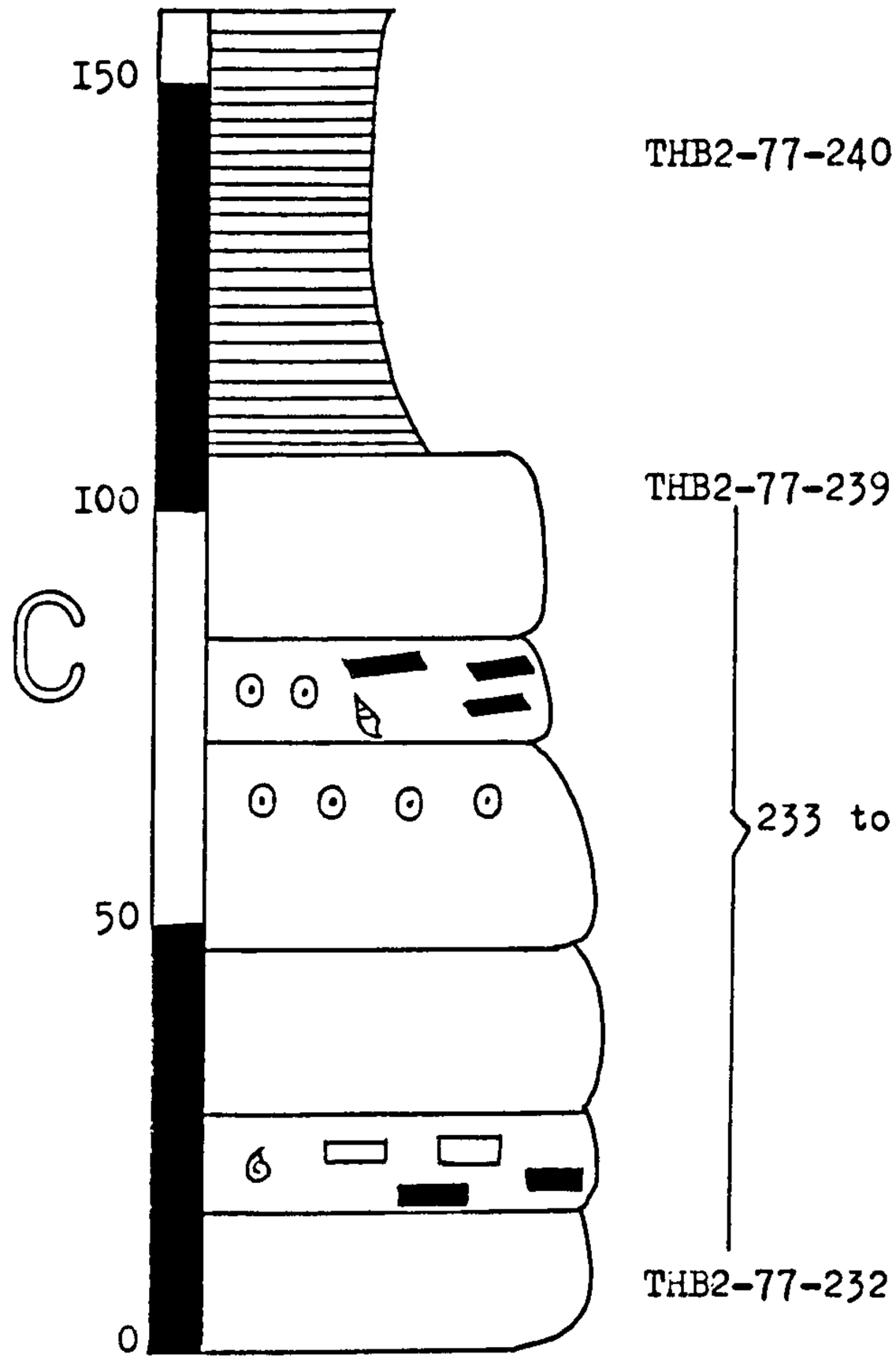
Figure I7.a Section THB 2, Formation A-sampled horizons.



THB2-77-23I		Yellowish and reddish fine-grained shaly arenite
THB2-77-230		
THB2-77-229		
THB2-77-228		Foraminiferal pelmicrite
	222 to 227	Oosparite
		Oolitic intrasparite
THB2-77-22I		
THB2-77-220		Reddish arenite (rich in carbonate minerals)
THB2-77-2I9		Biooosparite
	205 to 2I8	Intrasparite
		Oolitic intrasparite
THB2-77-204		Oosparite

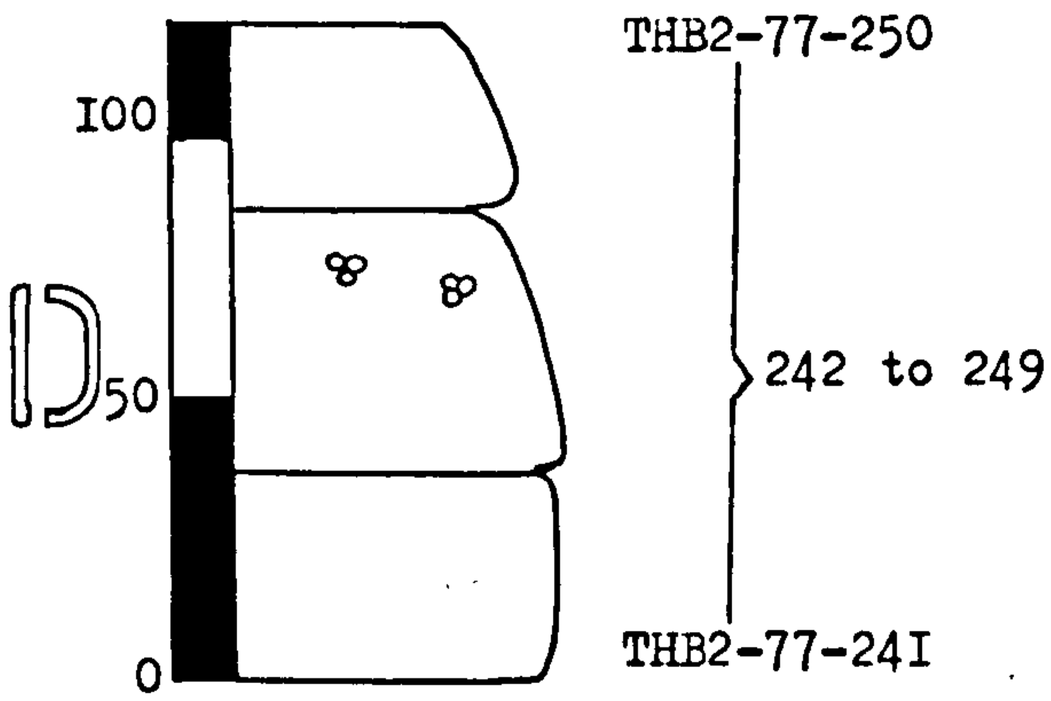
scale in meters

Figure I7.b Section THB 2, Formation B-sampled horizons.



scale in meters

Figure I7.c Section THB 2, Formation C-sampled horizons.



All thin sections show secondary lamination due to tectonic deformation. All allochems were squashed and except for a few foraminifers, they are unidentifiable.

Figure 17.d Section THB 2, Formation D-sampled horizons.

(Fig.17d). At the top of this formation, some foraminifers, also squashed, have been recovered. Nautiloculina oolithica is still identifiable, but Ataxophragmiids have lost their diagnostic internal structures (Plate 12D). This fauna indicates topmost Upper Triassic to Lower Jurassic.

The environment in which Formation D was deposited was shallow marine without any land-derived clastics.

2.3.3: Microfaunas from THB 1 and THB 2

Sparse but various foraminifers have been recovered from the THB 1 and THB 2 regions of Hadim. A few of them are stratigraphically important, such as species of Ammodiscidae and Involutinidae. The preservation of foraminifers in Permian and Carboniferous beds from the THB 1 region is remarkably better than Triassic ones.

Microfaunas from Ekinlik Yayla Section (Hadim, THB 1):

Samples: THB1-77-107, 108 and 109 are Carboniferous specimens taken from Formation A. The rocks include algal biomicrite containing Koninckopora sp. (Plate 10A) (a Dascyladacean calcareous alga). Foraminifers, which are generally well preserved, have been recovered from locally oolitic biomicrite. They are indicative of Lower Carboniferous as follows: Haplophragmella irregularis Rauser-Chernoussova 1936, Endothyra convexa Rauser-Chernoussova 1948, Endothyra sp., Archaediscus krestovnikovi Rauser-Chernoussova 1948 (Plates 9A, 9B, 9C, 9D).

Age: Visean Stage (Lower Carboniferous).

Sample: THB1-77-138: Collected from the upper part of Formation C, which is fine-grained calcarenite. Sparse species of Ammodiscidae have been found indicating Middle Triassic. They are of Glomospirella triphonensis Baud, Zaninetti & Brönnimann 1971 and Glomospirella cf. irregularis (Moeller 1880) (Plates 10C, 10D, 11A).

Age: Anisian Stage (Middle Triassic).

Samples: THB1-77-173 and 178: These samples belong to Formation K of the Ekinlik Yayla section, occurring mostly in biomicrite, which locally contains sparse algae and foraminifers. The latter comprise Involutina minuta Koehn-Zaninetti 1968, Involutina sp. and unidentifiable species of Ammodiscidae, indicating an Upper Triassic age (Plate 11B).

Age: Upper Triassic.

Microfaunas from the Karabayır Yayla Section (Hadim, THB 2):

Sample: THB2-77-226 collected from pelmicrite beds of Formation B containing Glomospira sp. (Plate 12B).

Age: Triassic.

Sample: THB2-77-244 collected from Formation D which is grey limestone. It shows secondary, tectonic lamination, and all allochems including foraminifers are squashed. One specimen of Nautiloculina oolithica Mosher 1938 and sparse indeterminate Ataxophragmiidae are recognisable, indicating topmost Upper Triassic throughout Jurassic (Plate 12D).

Age: Upper Triassic (possibly Rhaetian)

2.3.4: Environmental Interpretation

In the Ekinlik Yayla section (THB 1) only Middle and Upper Triassic were proved by the means of foraminifers. Lack of Lower Triassic supports the idea that the marine transgression during the Middle Triassic extended the shallow open sea over an area of Upper Palaeozoic rocks, which had formerly been part of the hinterland. The environment of deposition of the Middle Triassic is shallow, restricted marine such as a shelf lagoon. Pervasive micritization and micrite-coating of grains in Middle Triassic formations suggest very slow deposition with some bottom currents to hinder mud from settling. Although at the beginning of the Middle Triassic the lagoon was of normal marine salinity, in the later stages salinity increased, producing a hypersaline environment. The absence of land-derived clastics during the Middle Triassic, as well as non-deposition of Lower Triassic rocks, indicates that the hinterland subsided below sea level during the Middle Trias.

The environment of deposition of the Upper Triassic was still a restricted marine lagoon invaded by terrigenous sediments brought in by

sheet-floods from the land during this time. Occasionally the lagoon was completely filled by these sheet-flood deposits, but reinstated by subsidence. Tectonic uplift of the hinterland is required to supply the terrigenous clastics at the beginning of the Upper Triassic. This has also been required in the THA region, showing only local differences. The marine fauna, particularly the ammonites, indicates that the salinity was normal.

In the Karabayır Yayla section, the interbedded oolitic limestone and variegated clastics resemble the Lower Triassic rocks of the THA region, consequently oosparites were most likely deposited on a tidal delta, as explained earlier (p.56). As with the THA and THB 1 sections, the environment of deposition in THB 2 is more likely a semi-restricted marine lagoon with a connection to the hinterland. The only local difference in the ?Upper Triassic of the THB 2 region is that the terrigenous input ceased before the end of Upper Triassic time and only limestone was being deposited.

Generally speaking, the environment of deposition of Triassic rocks from the Hadim area was a tidal lagoon, which has already been explained in detail in part 2.2.3. The enclosing barrier shoal varied from time to time; when it was more submerged, marine faunas entered the lagoon; at its most emergent, the lagoon was probably nearly isolated from the sea and became very shallow and hypersaline. At no stage did the lagoon dry out completely; hence no desiccation cracks nor evaporites. Intermittently the lagoon was filled with terrigenous sediments, deposited by sheet-floods from the land. Several phases of tectonic uplift and subsidence of both hinterland and depositional area are required throughout Triassic events.

PLATE 1

A - General view of the THA section at Soğuk Pınar Dere (Hadim). The lowermost Lower Triassic oolitic calcarenite rests conformably on the underlying Upper Permian stromatolite and algal calcarenite.

B - Close up of stromatolite showing conformable contact with overlying oolitic calcarenite.

C - General view of medium to thick bedded cauliflower-type algal limestone in THA section.

D - General view of interbedded sandstone and shale resting directly on recrystallized algal limestone (Hadim, THA).

A

B

C

D

PLATE 1

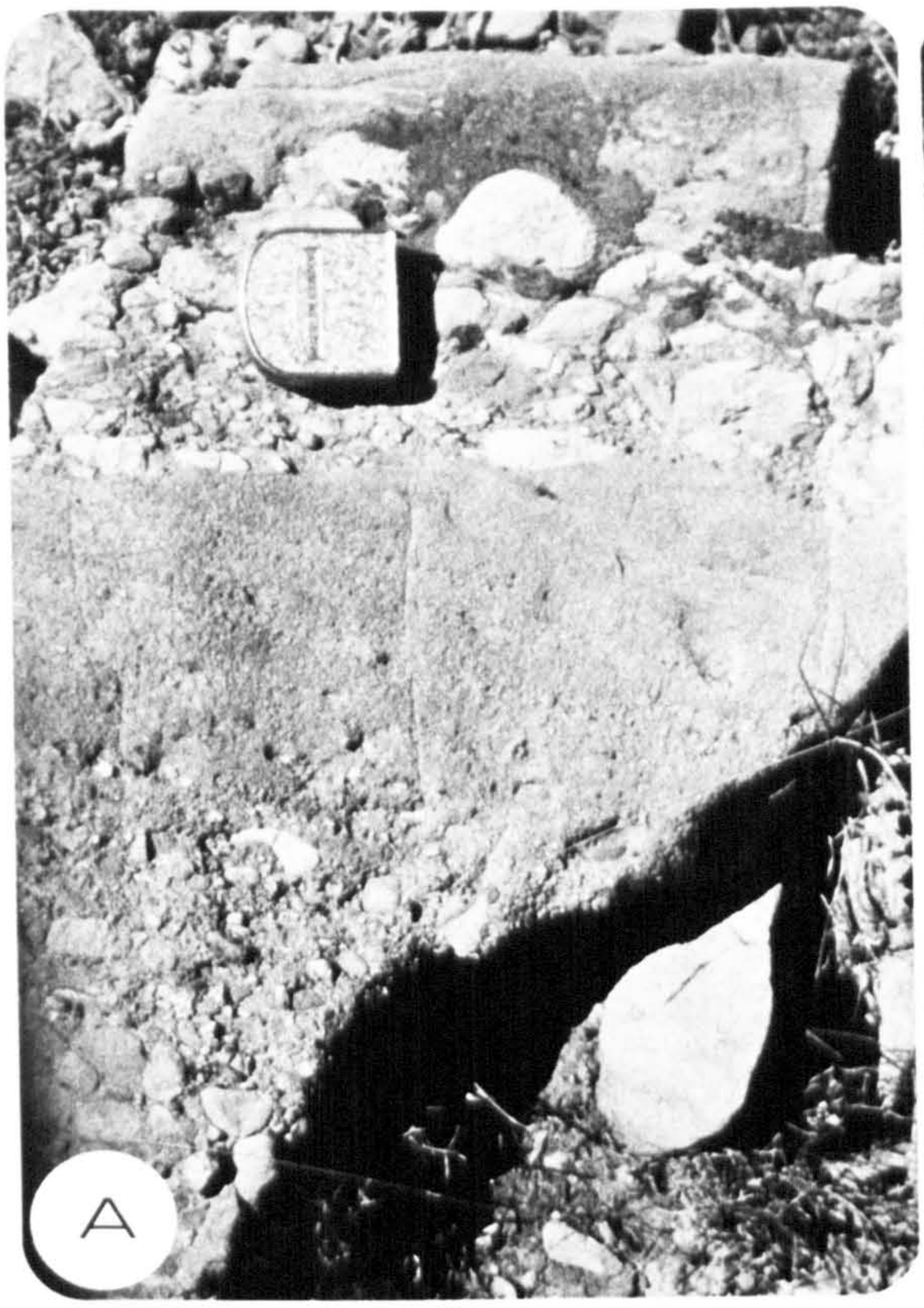
PLATE 2

A - Conglomerate beds, Soğuk Pınar Dere (Hadim, THA). This clast-supported conglomerate facies consists of well-sorted, moderately to well-rounded limestone pebbles and cobbles in a limestone matrix. Green volcanic clasts, sparse schist clasts and feldspar crystals are also observable. Locally it shows grading, from large pebbles at the base to coarse sand at the top.

B - Close up view of the top of a fine-grained calcarenite in THA section, showing burrows.

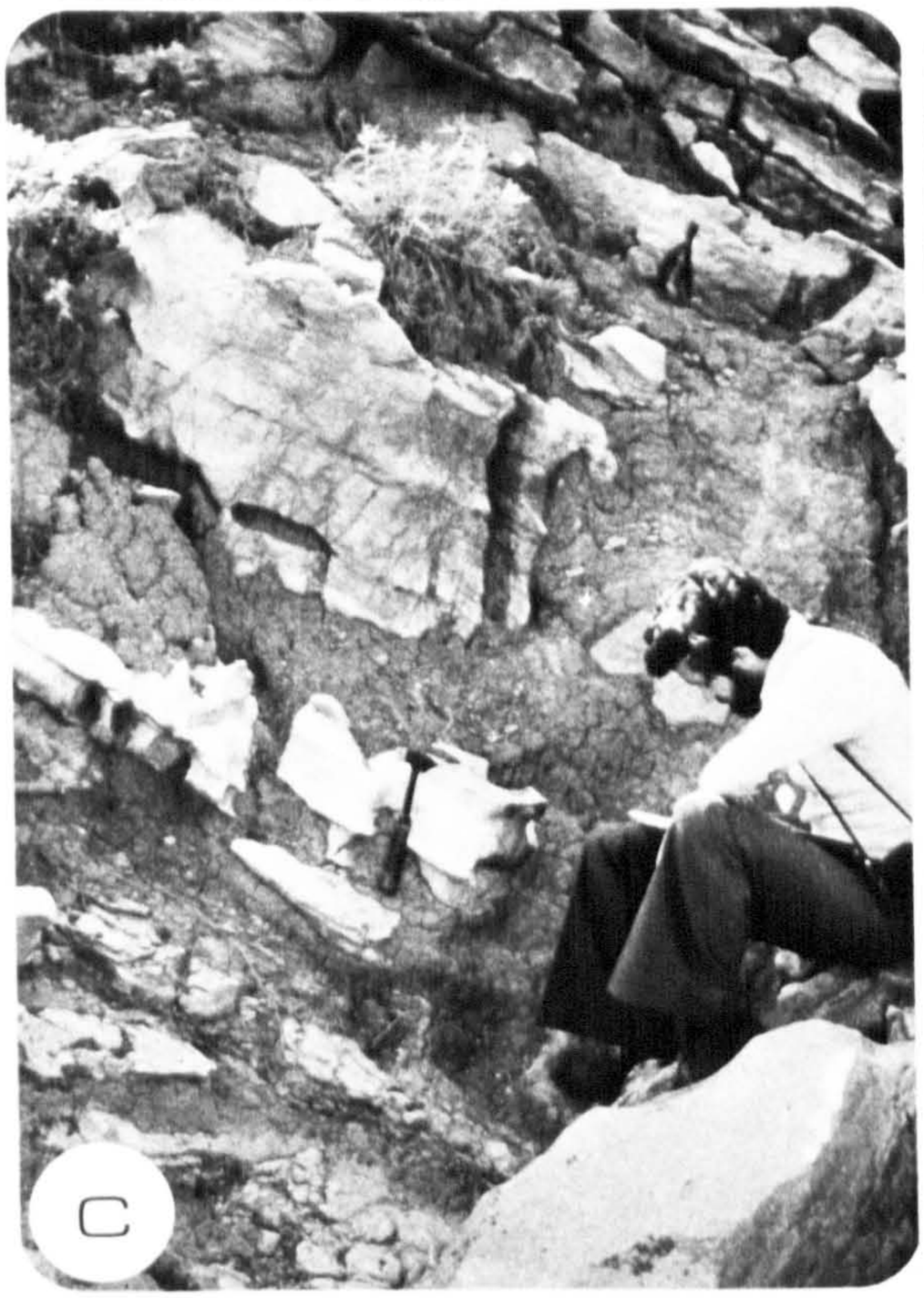
C - General view of interbedded purplish-reddish quartzarenite, clay and grey-yellowish micrite, biomicrite at Ekinlik Yayla (Hadim, THB 1).

D - General view showing parallel lamination in grey calcarenite at Ekinlik Yayla (Hadim, THB 1).



A

B



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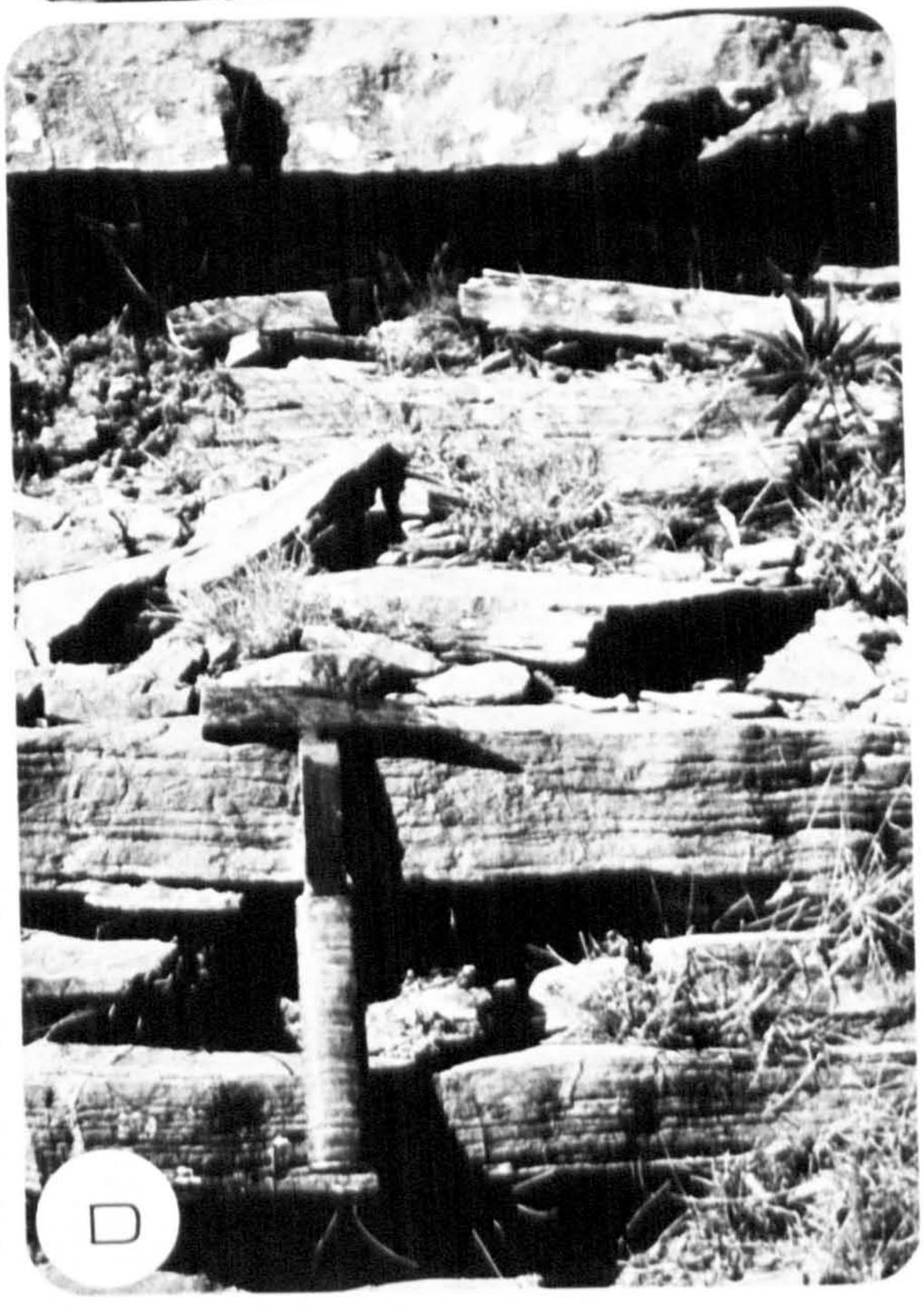


D

PLATE 2

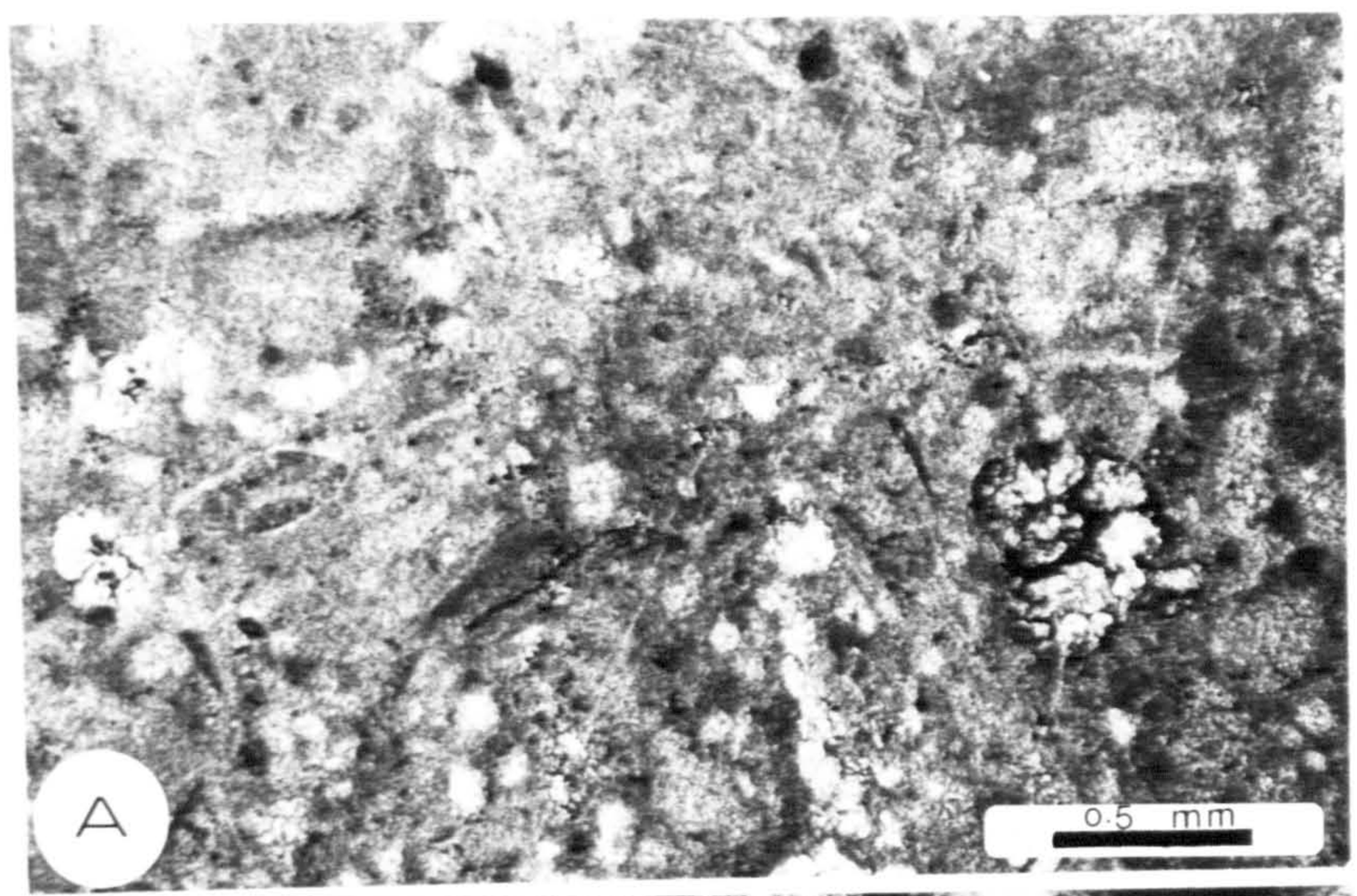
PLATE 3

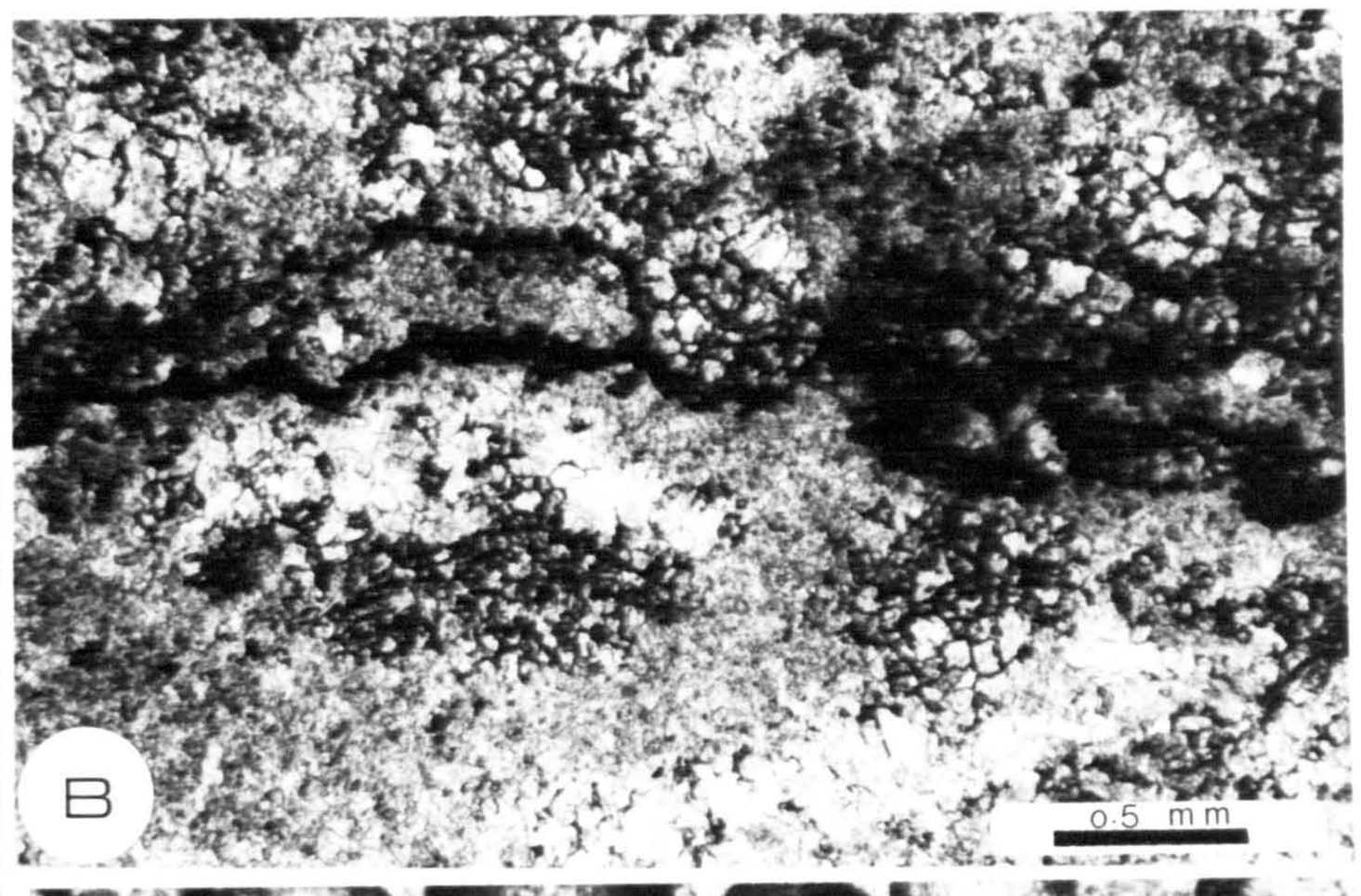
A - Photomicrograph of Upper Permian fine-grained calcarenite showing poorly preserved, planispirally-coiled foraminifers (Hadim, THA-77-1).

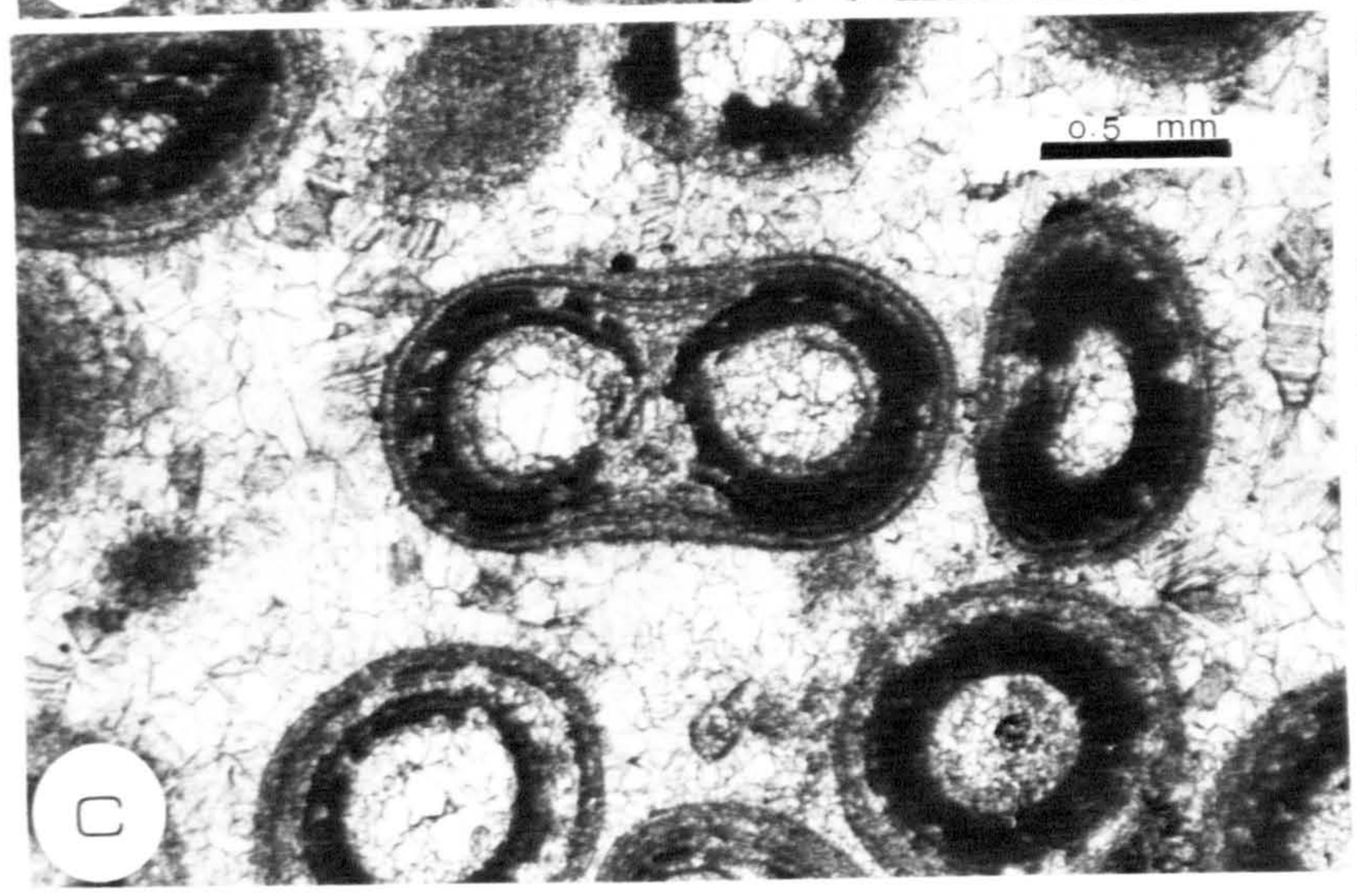
B - Photomicrograph of stromatolite showing ghosts of similar foraminifers to Plate 3A (Hadim, THA-77-2).

C - Photomicrograph of oosparite showing an ellipsoidal oolith with two nuclei and well laminated envelope (Hadim, THA-77-7B).

D - Rounded and closely packed ooliths in sparry calcite cement. Note that under cross-polarized light many of the ooliths show monocrystalline nuclei which are probably echinoderm fragments (Hadim, THA-79-10).







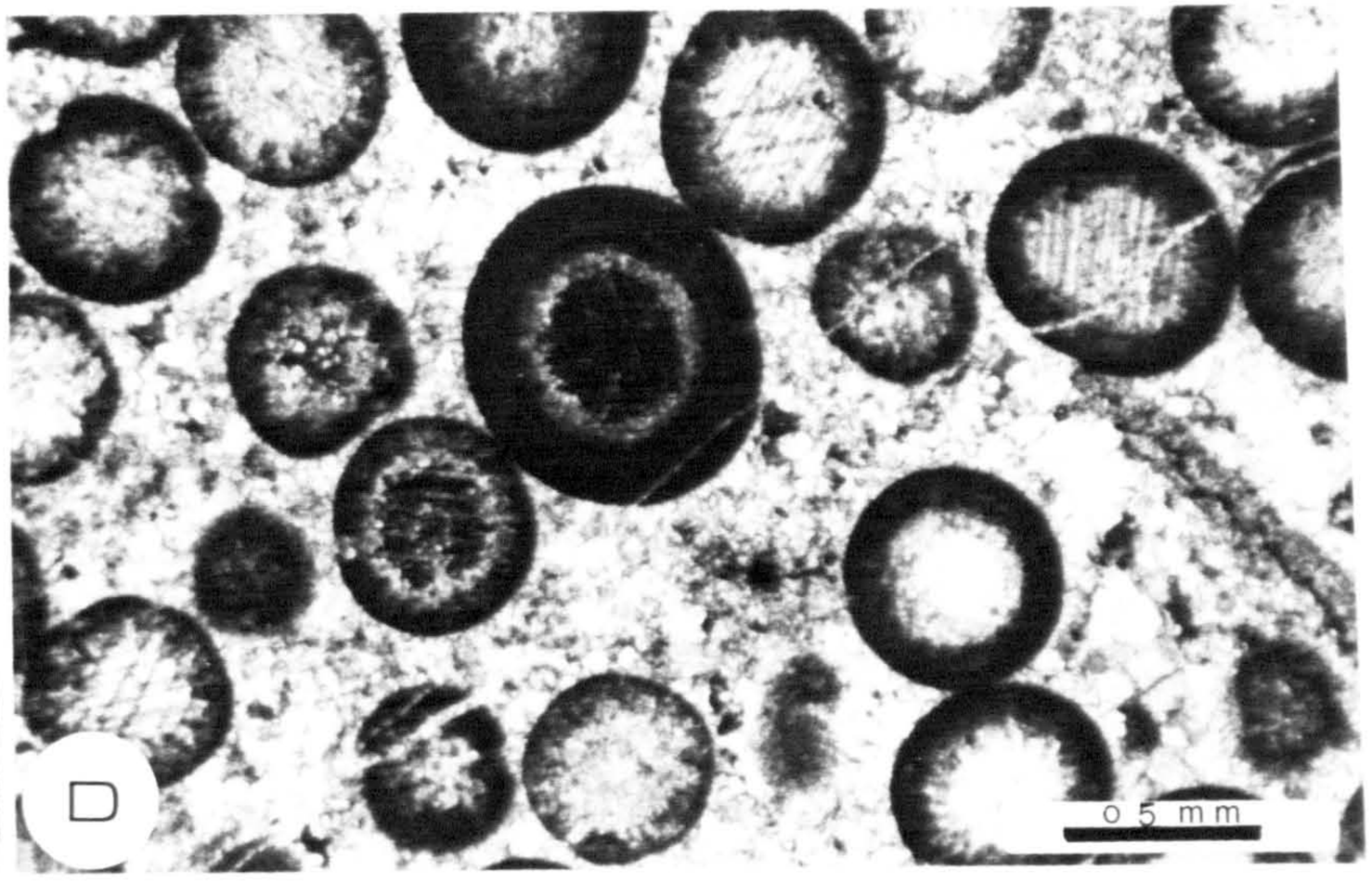


PLATE 3

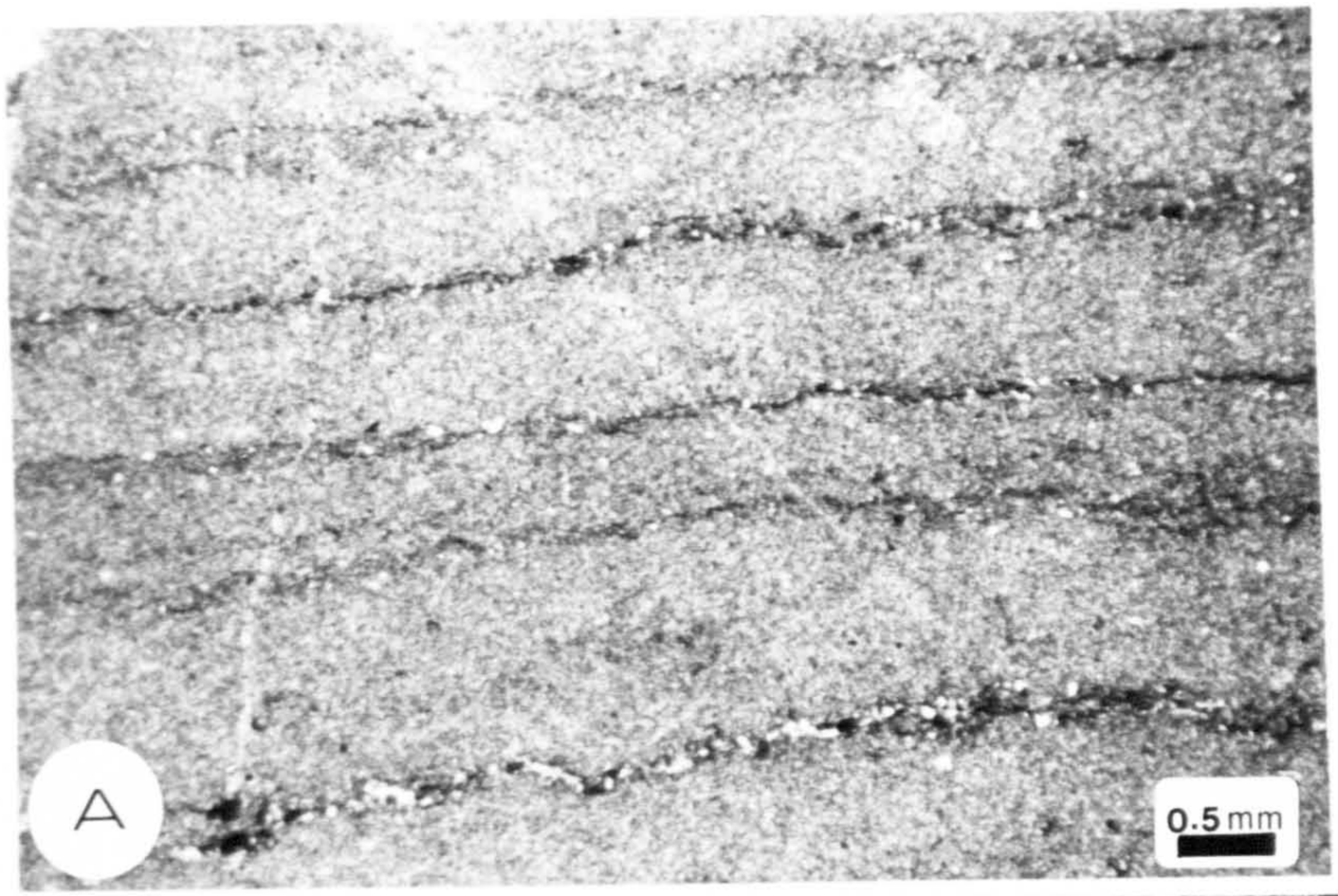
PLATE 4

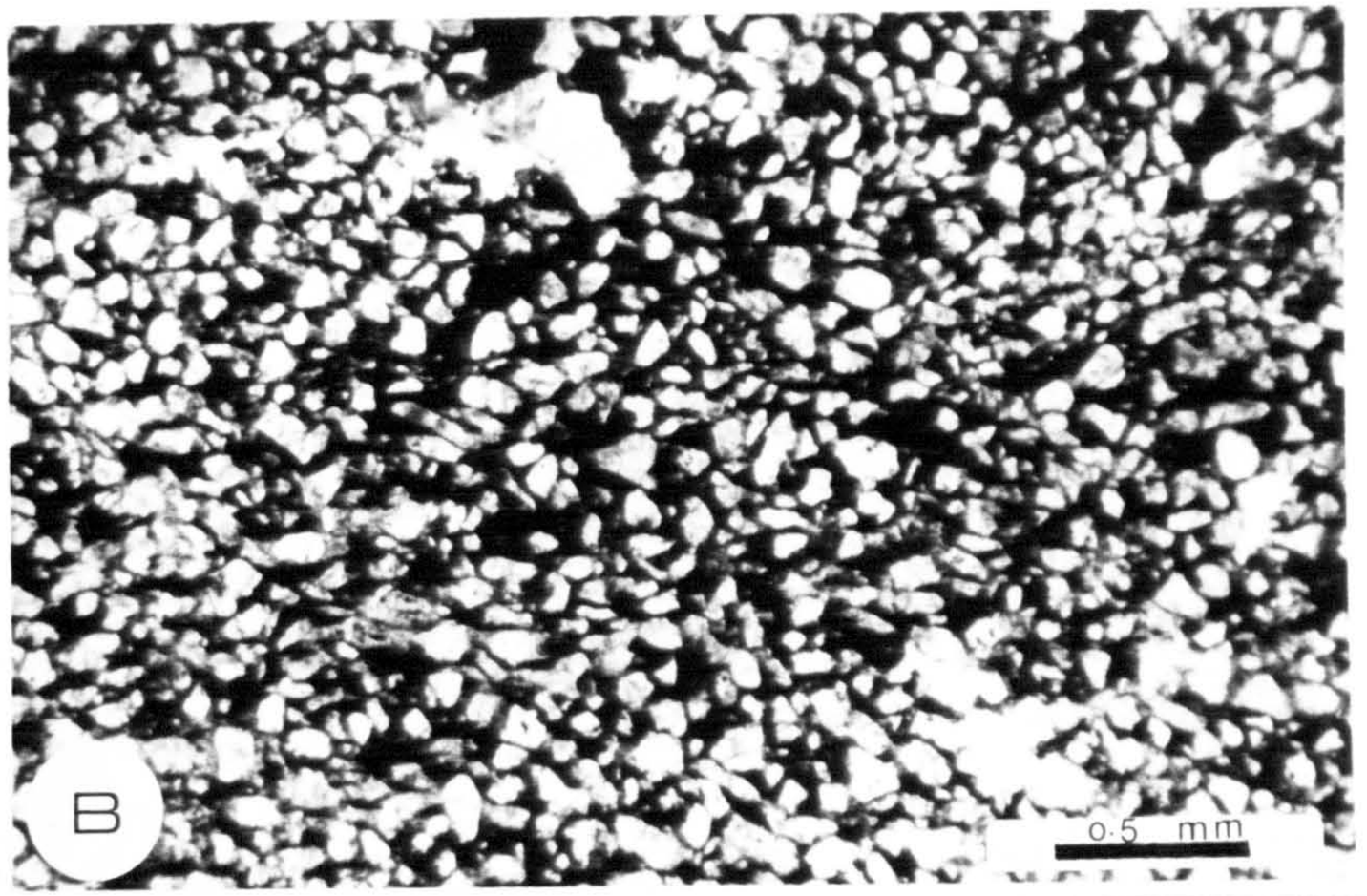
A - Photomicrograph of fine-grained calcarenite showing small scale parallel lamination, from the same horizon as the Lower Triassic oolitic calcarenite of Plate 3C and 3D (Hadim, THA-81-3).

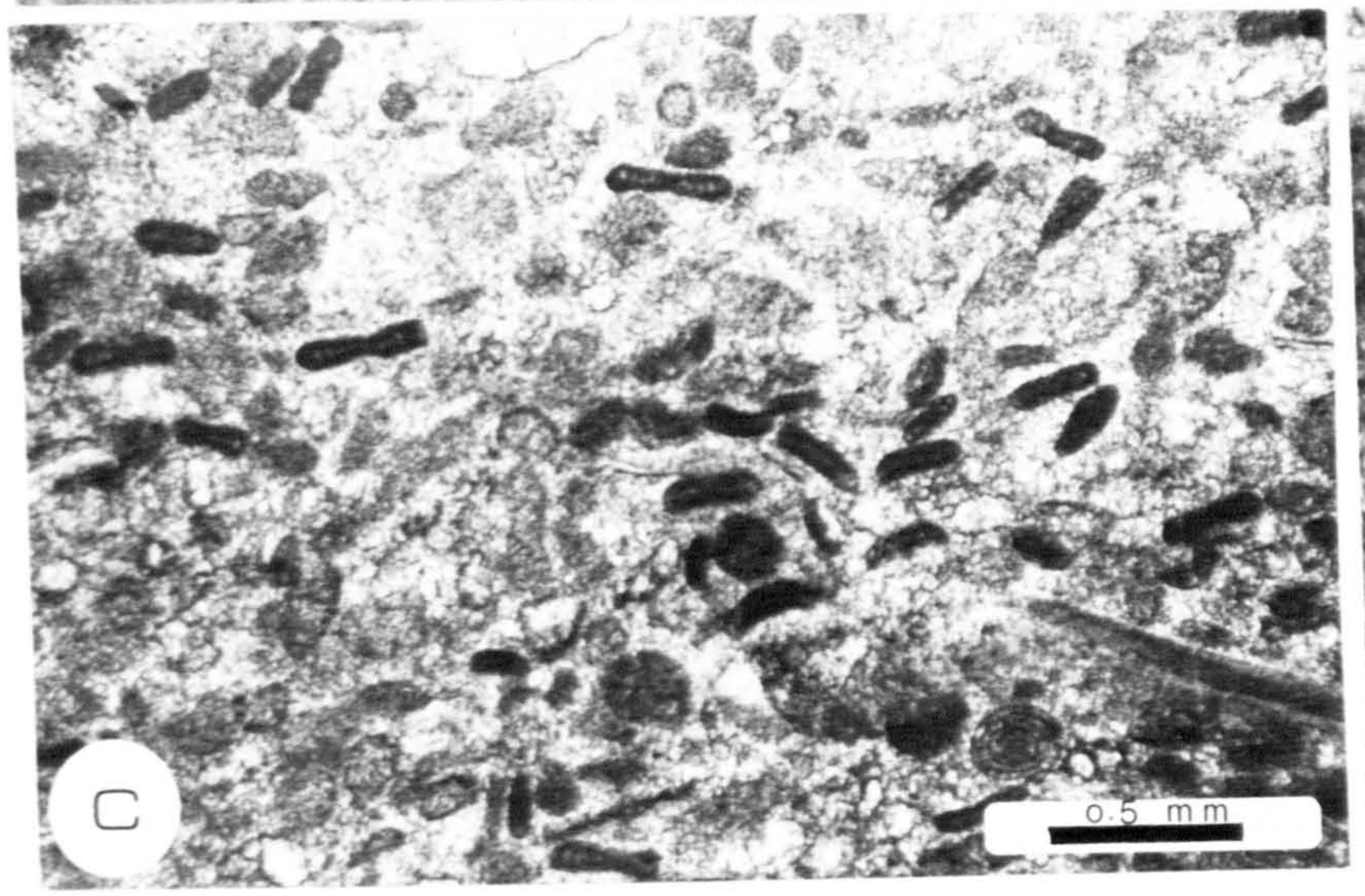
B - Photomicrograph of variegated quartz arenite showing angular quartz grains and mud clasts of similar size [THA, Hadim (B)].

C - Photomicrograph of biosparite with abundant foraminifers: Ammodiscus cf. parapriscus Ho (Hadim, THA-77-37).

D - Close up view of the foraminifers in Plate 3C (Hadim, THA-77-37).







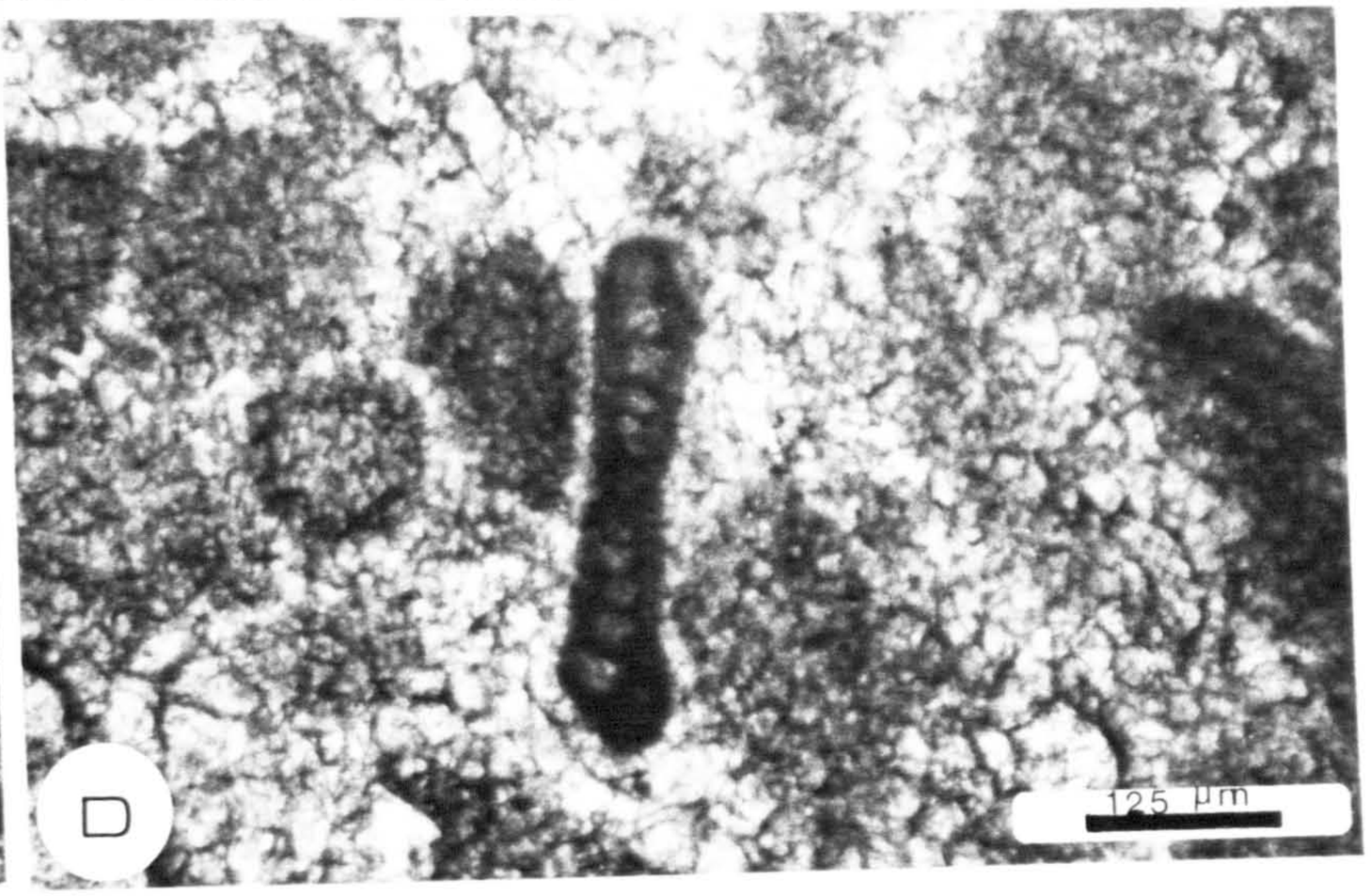


PLATE 4

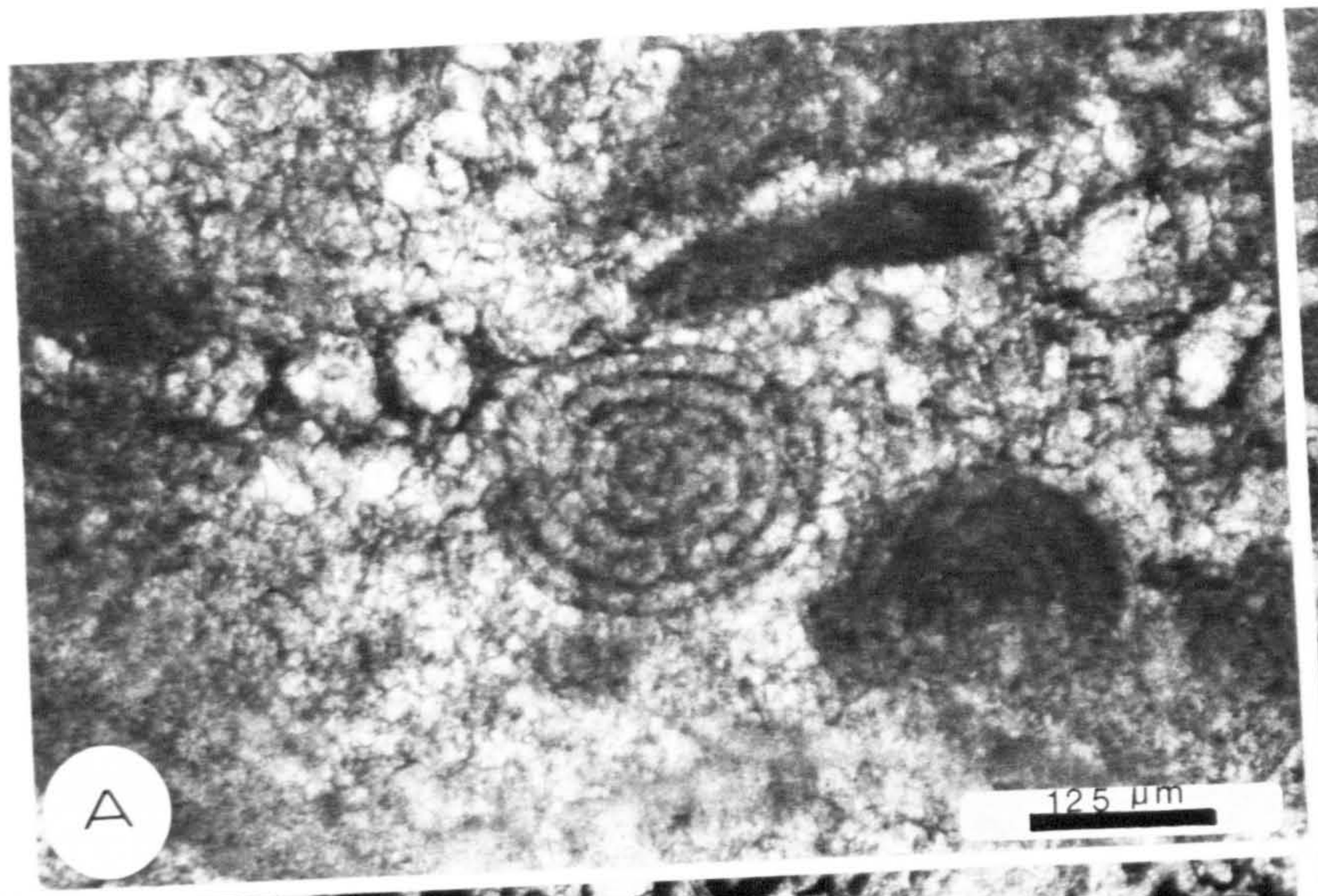
PLATE 5

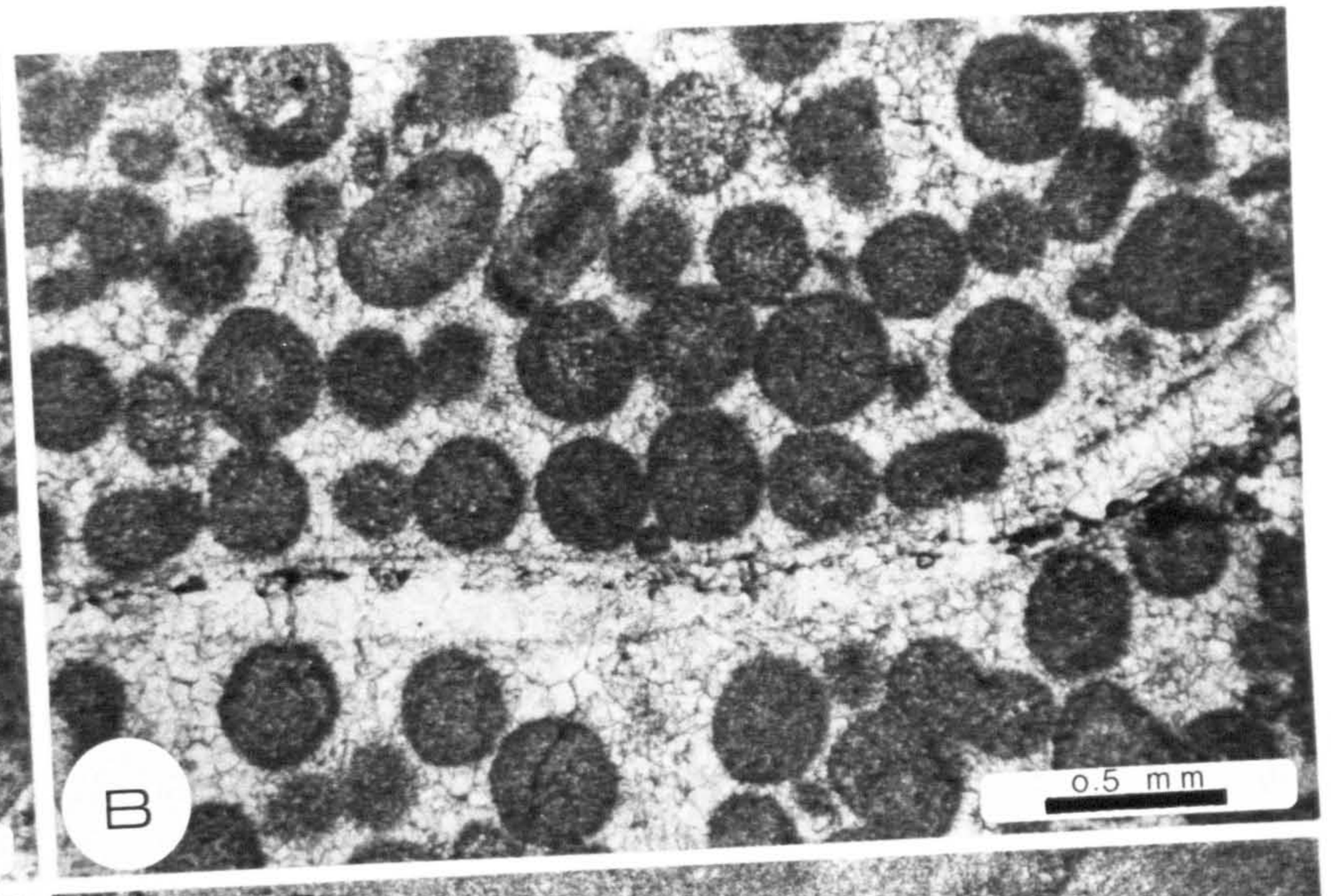
A - Close up view of a median section of Ammodiscus cf. parapriscus Ho (Hadim, THA-77-37).

B - Photomicrograph of oosparite showing well-rounded and well-sorted micritized ooliths and a large shell fragment, ? molluscan (Hadim, THA-77-44).

C - Photomicrograph of oolitic intrasparite with sparse gastropods, one of which forms part of an intraclast. Several of the ooliths have elongate bioclasts as nuclei (Hadim, THA-77-58).

D - Photomicrograph of micrite showing microstylolites (Hadim, THA-77-61).





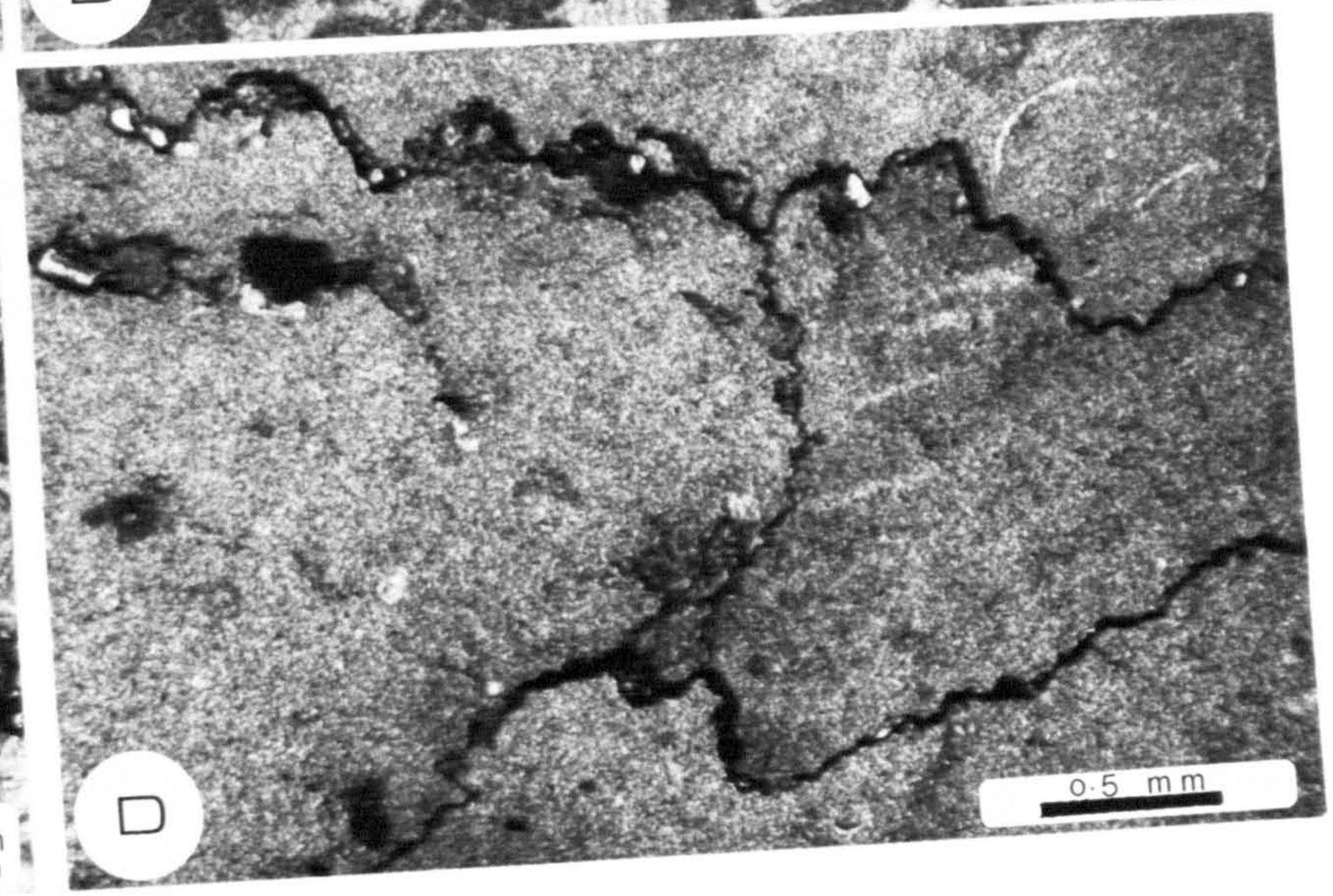


PLATE 5

PLATE 6

A - Photomicrograph of intrasparite. Intraclasts which range from 4 mm to 5 µm are of locally derived micrite. The matrix is dusty spar (Hadim, THA-77-87, see negative microphotograph 8).

B - Photomicrograph of recrystallized biomicrite showing a few foraminifers and pellets, possibly a foraminiferal biomicrite originally. The black ring on the picture locates a foraminifer: Glomospira sinensis Ho (Hadim, THA-77-97).

C - Detail of the thin section shown in Plate 6B, with enlargement of a nearly equatorial section of Glomospira sinensis Ho (Hadim, THA-77-97).

D - Detail of the thin section shown in Plate 6B, showing an axial section of Glomospira sinensis Ho (Hadim, THA-77-97).

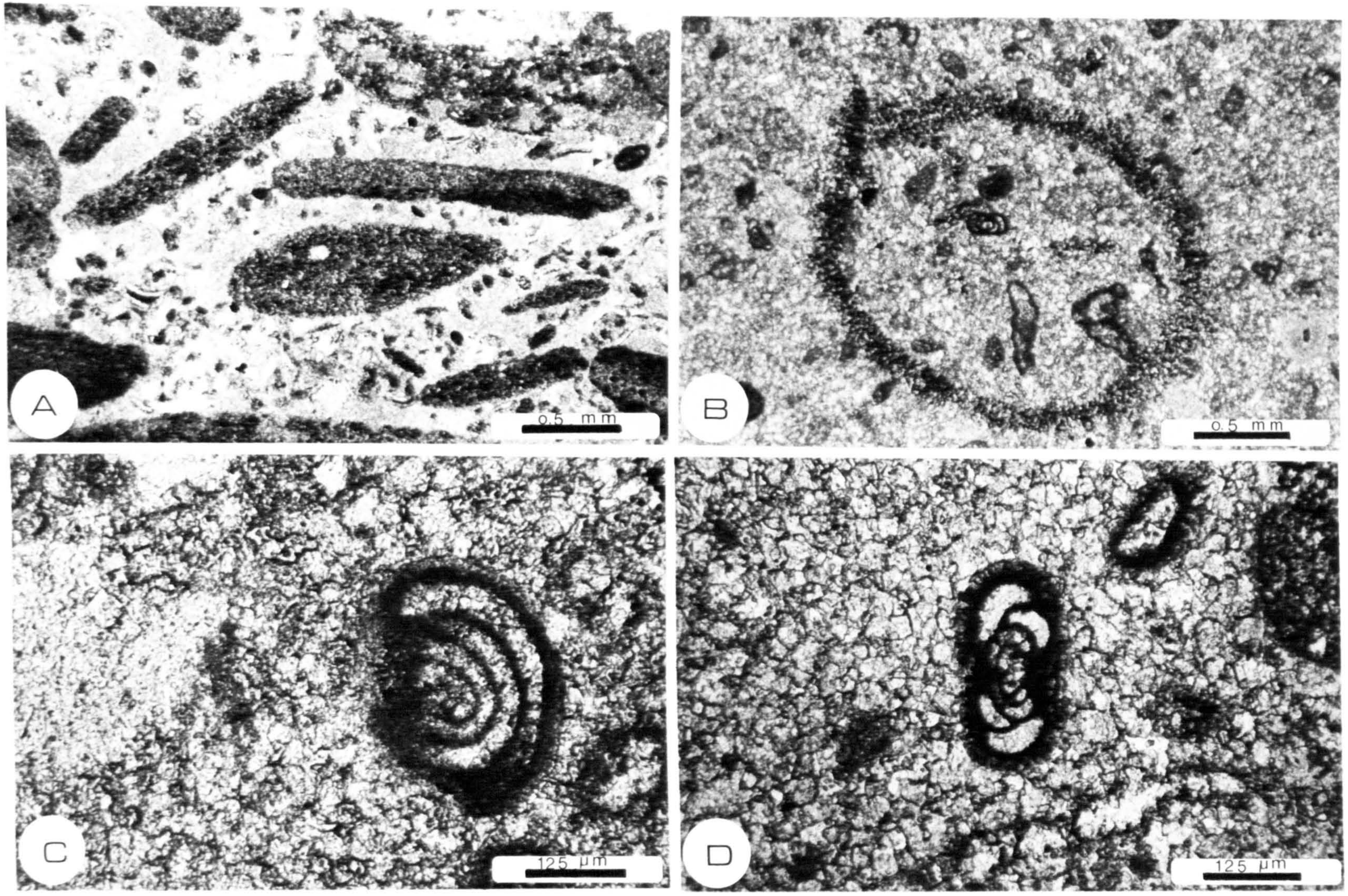
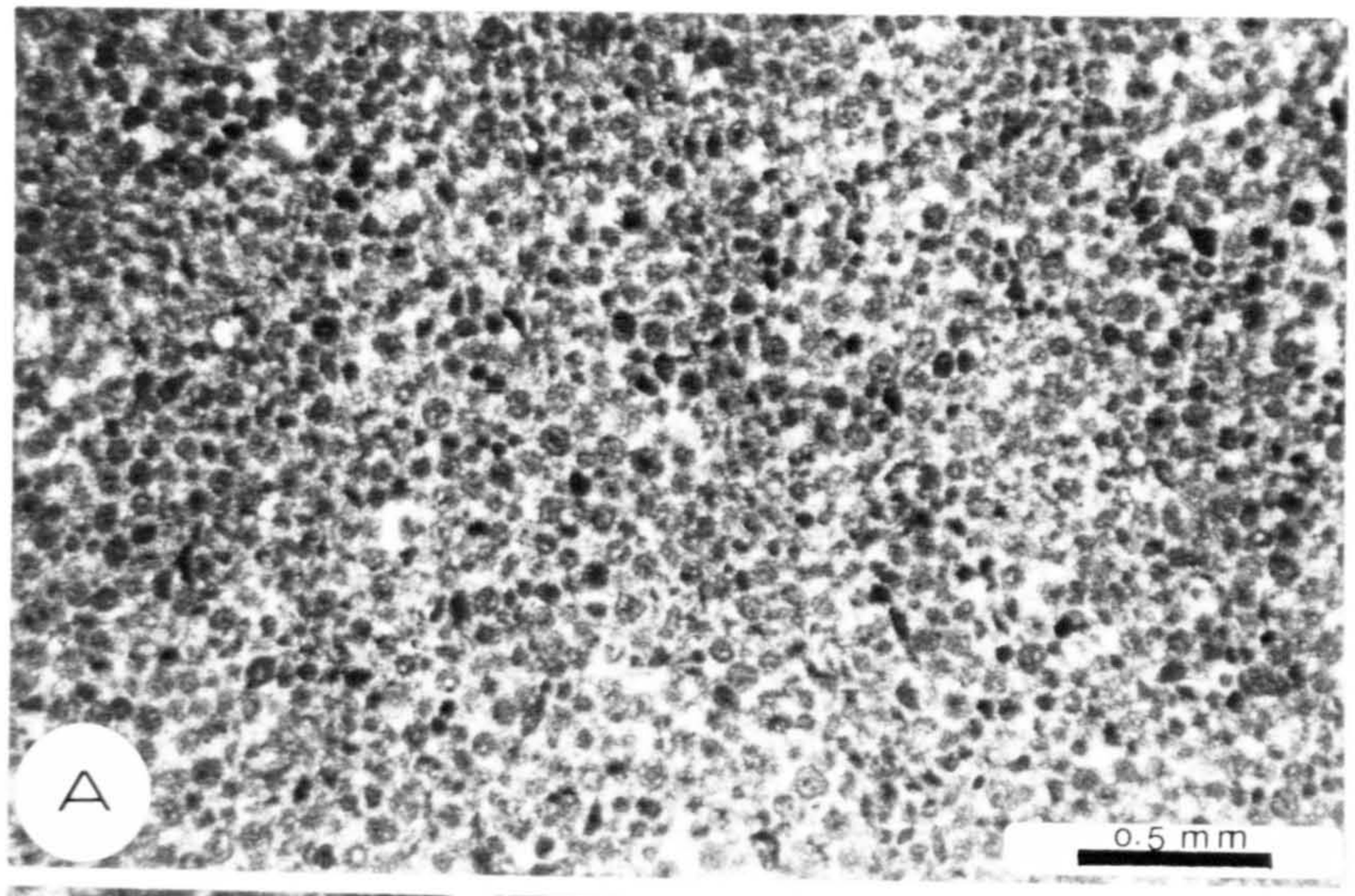


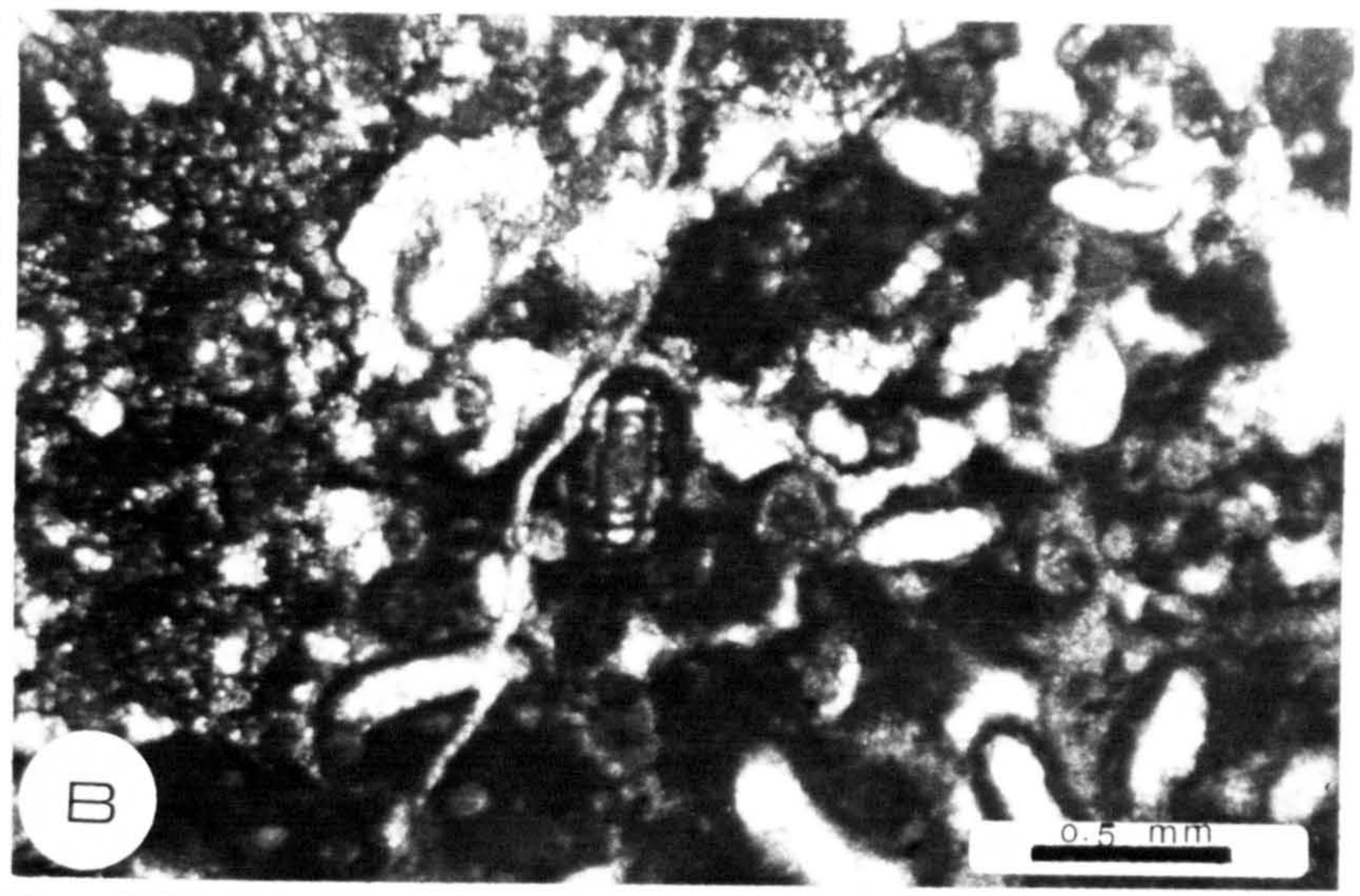
PLATE 6

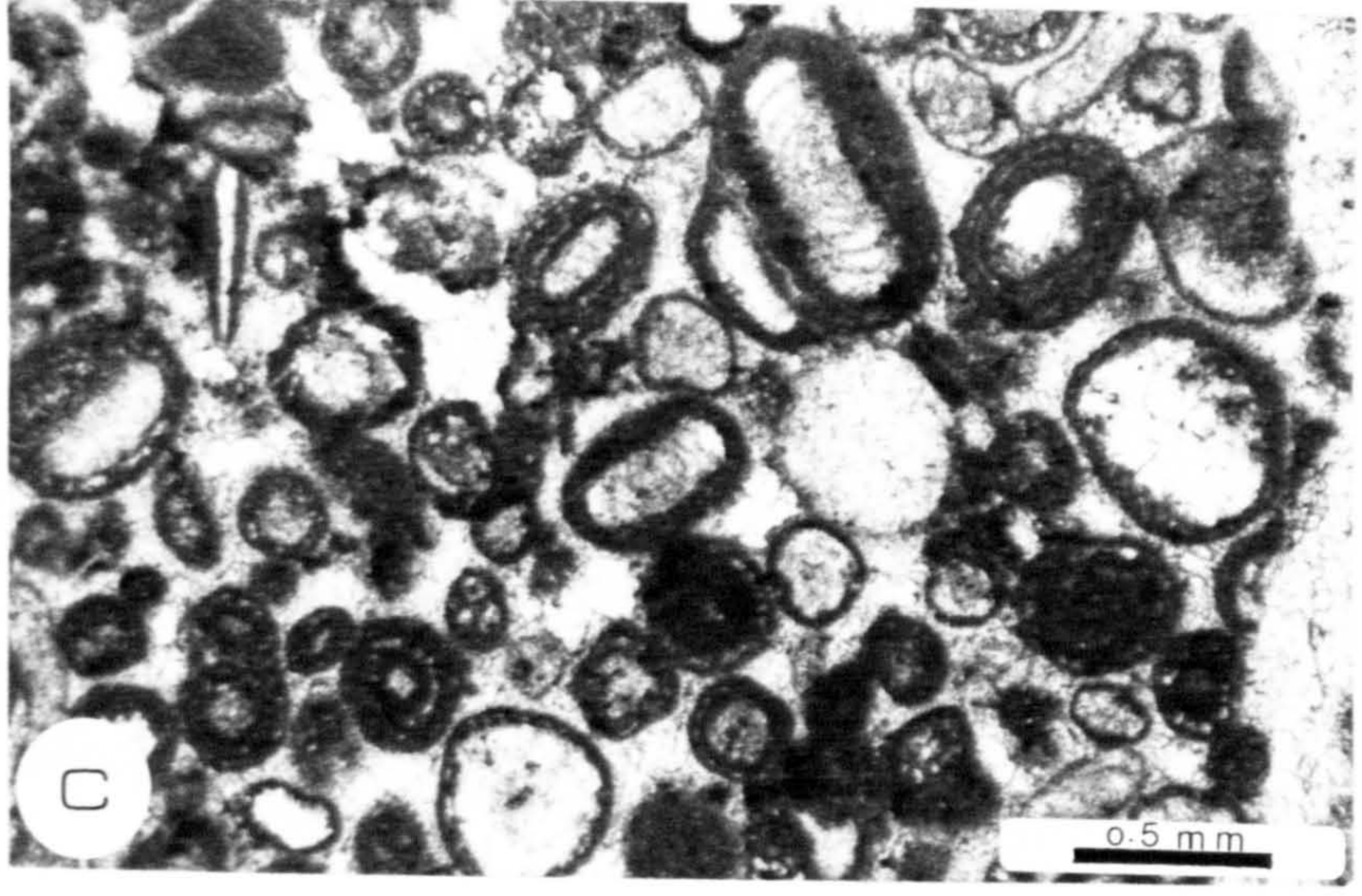
PLATE 7

A - Photomicrograph of pelsparite from the Middle Triassic of THA. Pellets show typical uniformity of shape and size as well as close packing. Sparry calcite cement is very finely crystalline because of the small size of available pores (Hadim, THA-77-115).

B, C and D - Various views of foraminiferal oosparite from the Upper Triassic of THA. Although partially recrystallized, in places foraminifers can be seen forming the nuclei of ooliths. These poorly identifiable foraminifers are Glomospira or Glomospirella sp. and ? Involutina sp. The diffuse black ring on the centre of Figure D locates these foraminifers, and an oolith with a pellet nucleus (Hadim, THA-77-154).







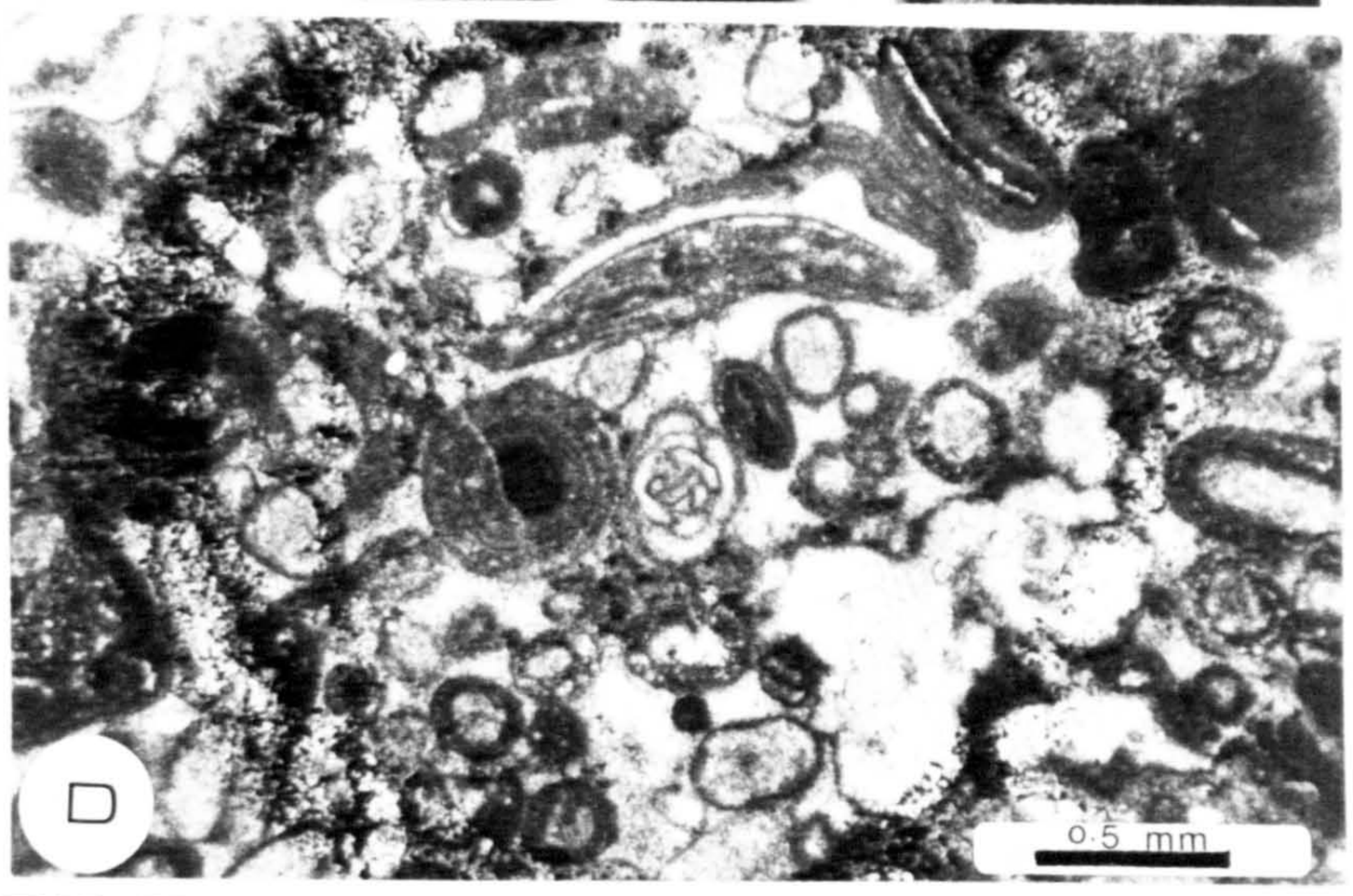
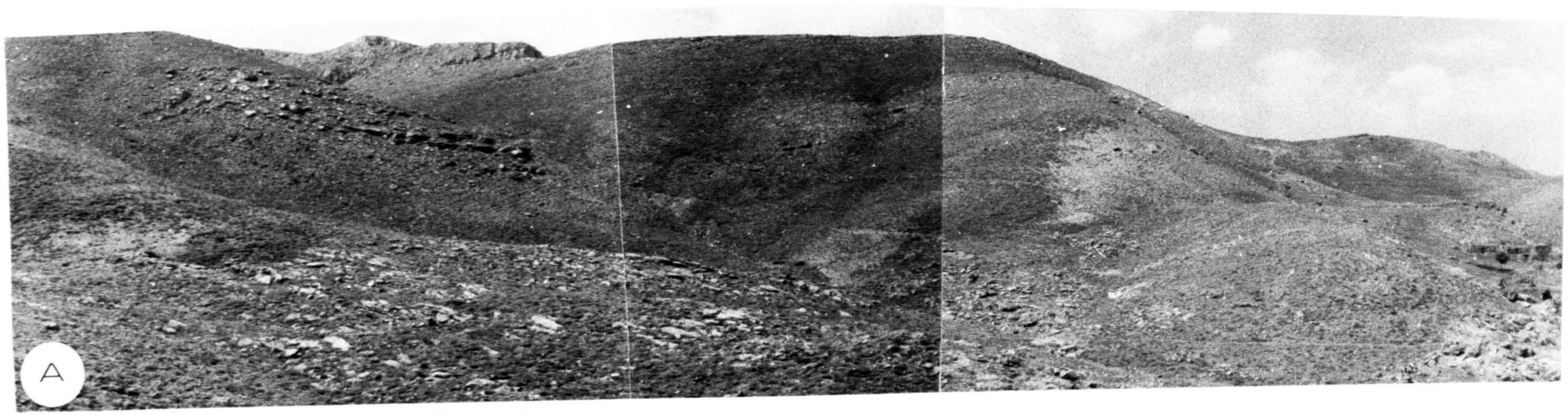


PLATE 7

PLATE 8

A - Ekinlik Yayla section, Hadim (THB 1).
General view of Ekinlik Yayla showing Triassic marine limestones and interbedded shales.

B - The Karabayır Yayla section, Hadim (THB 2).
General view of Karabayır Yayla showing Triassic marine limestone which interbeds with reddish-yellowish clastics.



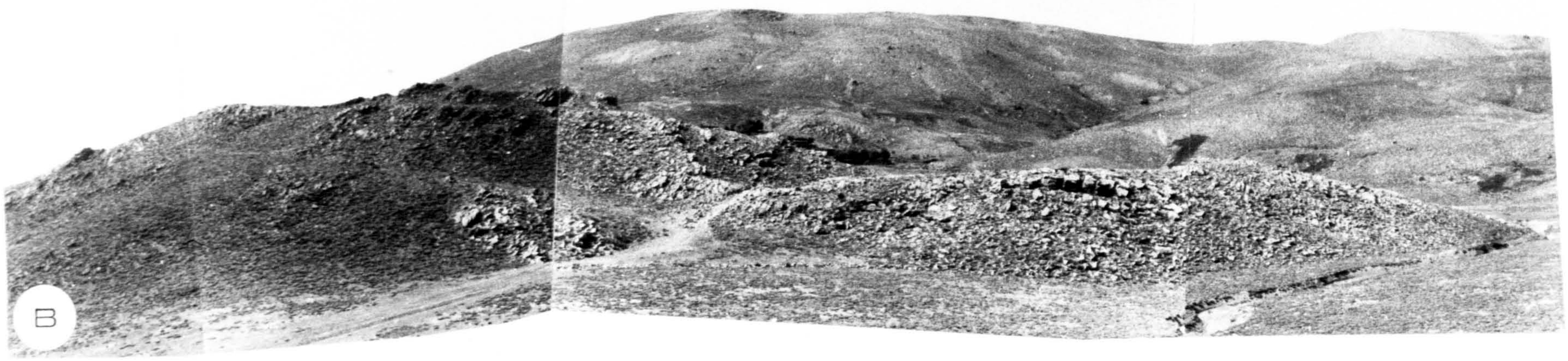


PLATE 8

PLATE 9

A - Photomicrograph of recrystallized Lower Carboniferous calcarenite showing close up view of Haplophragmella irregularis Rauser-Chernoussova. The photograph illustrates the uncoiled and uniserial portion of this foraminifer (Hadim, THB 1 - 77 - 107).

B - Photomicrograph from the same sample as Plate 9A, showing the same species of foraminifer, but the irregularly coiled portion demonstrating whorls (Hadim, THB 1 - 77 - 107).

C - Photomicrograph of recrystallized Lower Carboniferous calcarenite showing close up view of Endothyra convexa (Rauser-Chernoussova). The median section demonstrates the coiled whorls and chambers. The outer whorl is more or less planispiral (Hadim, THB 1 - 77 - 108).

D - Photomicrograph of intraclastic Koninckopora-bearing algal calcarenite, showing Endothyra convexa (Rauser-Chernoussova) (top centre) and the involutus stage of Archaediscus krestovnikoui (Rauser-Chernoussova) (lower centre). (Hadim, THB 1 - 77 - 109)

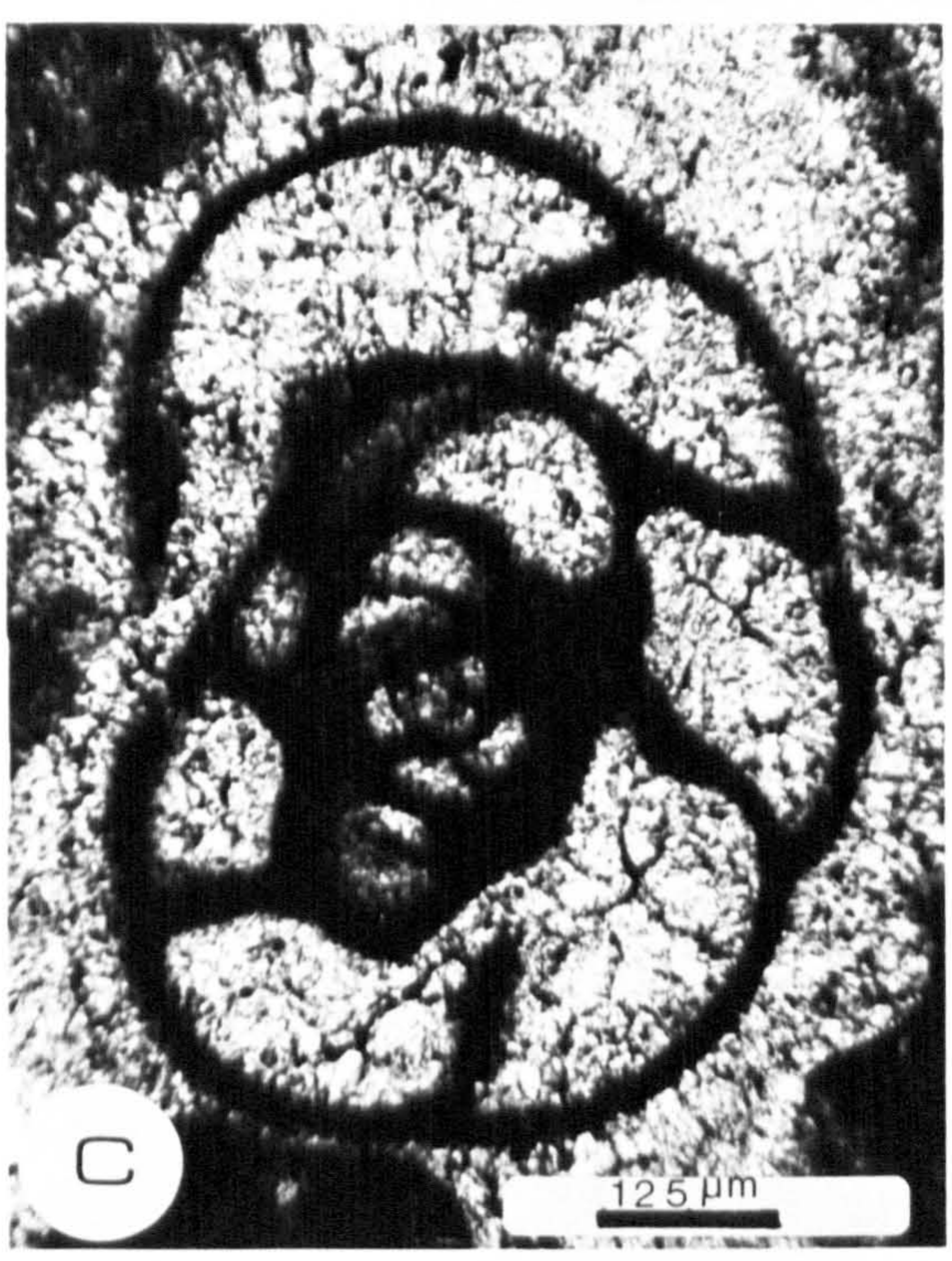


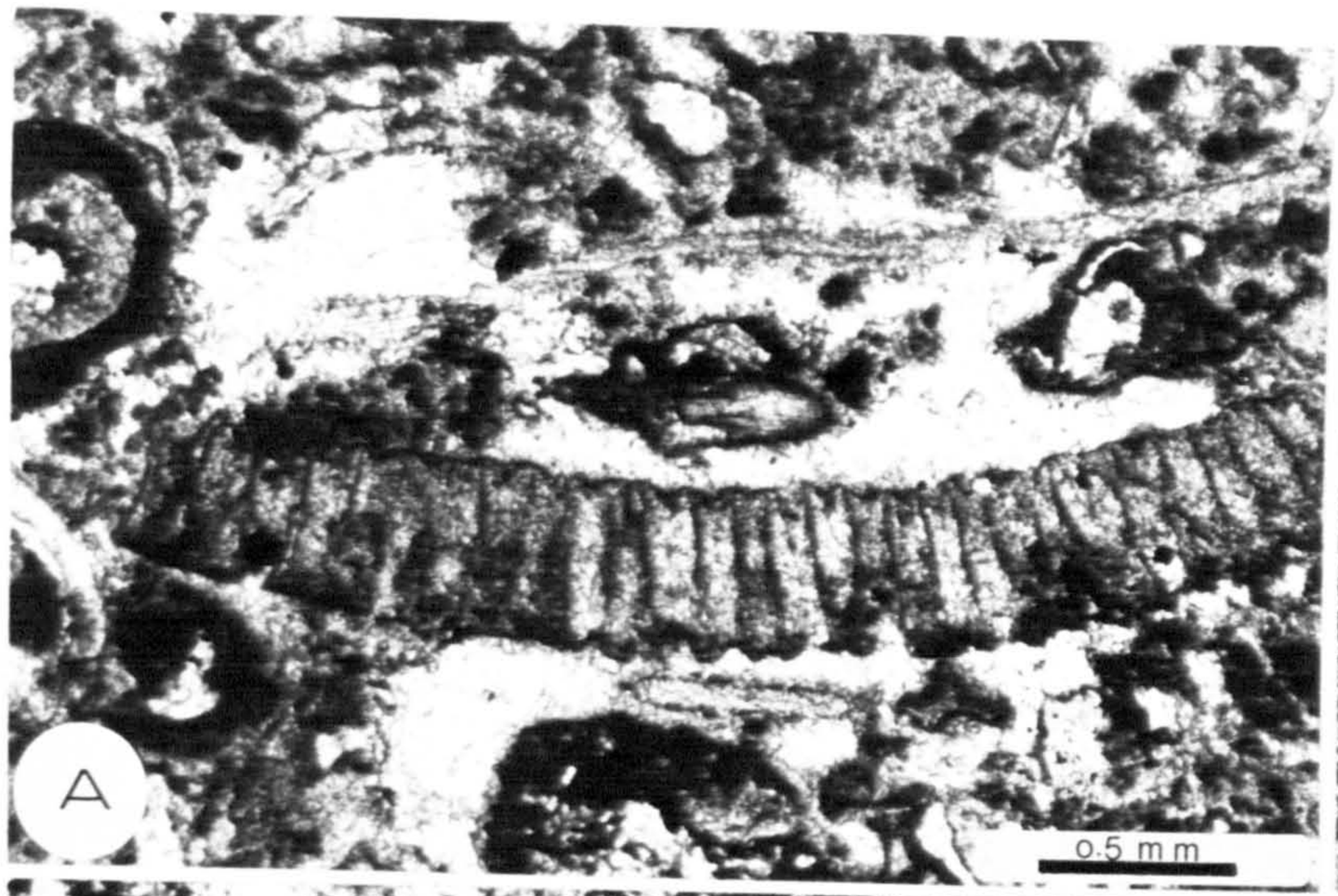
PLATE 9

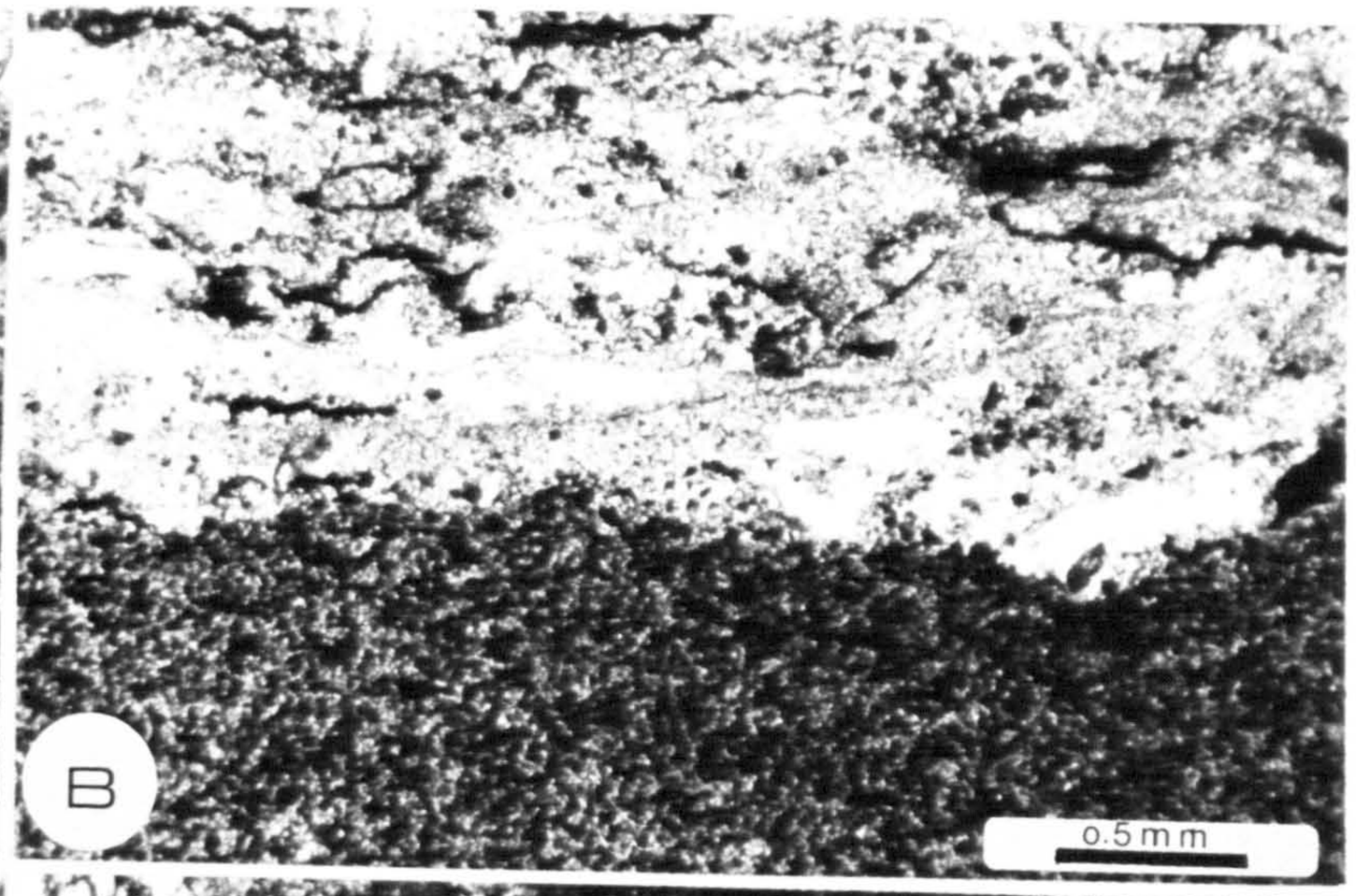
PLATE 10

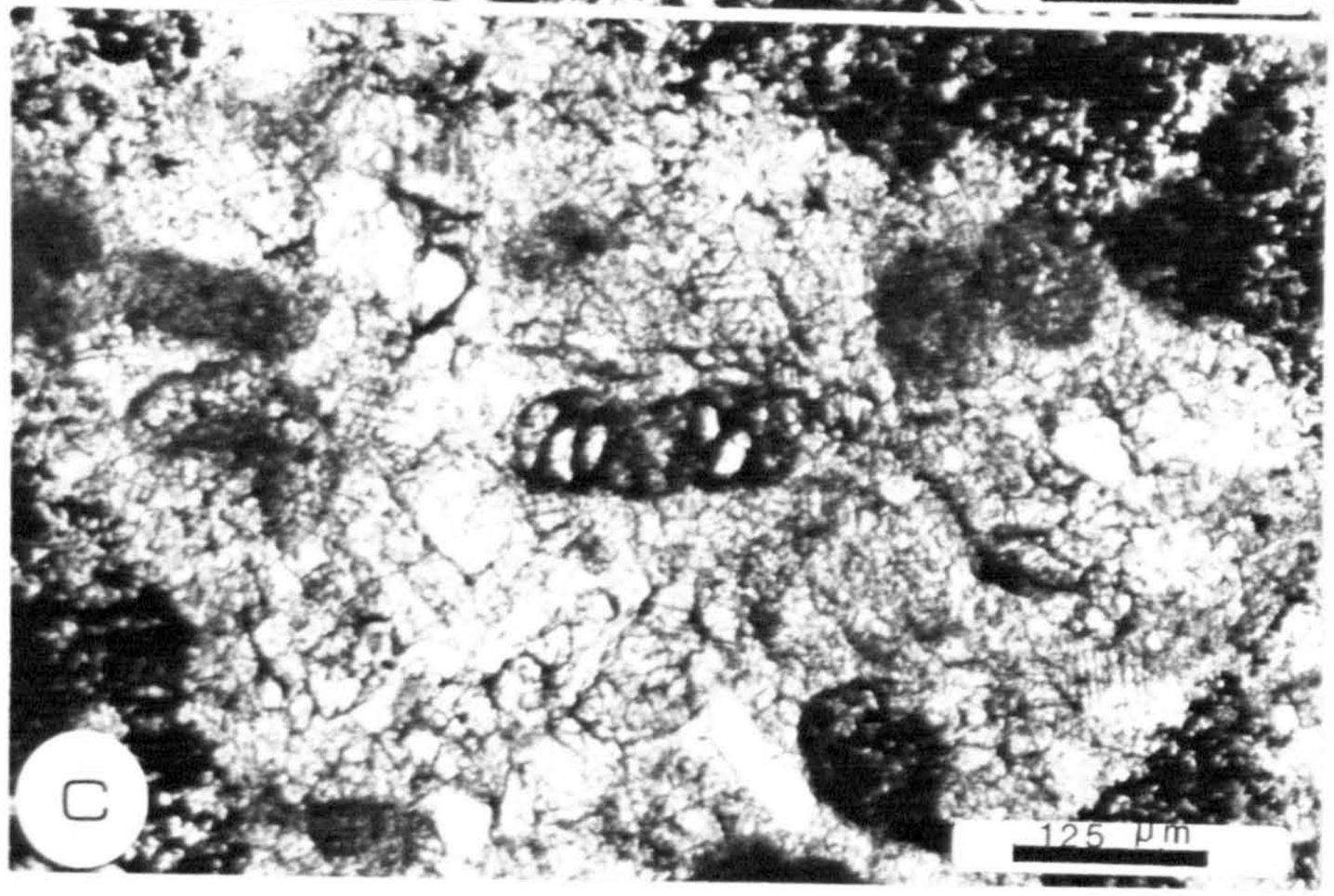
A - Photomicrograph of Lower Carboniferous recrystallized calcarenite (same sample as Plate 9D), showing a cross-section of Koninckopora sp. across the middle of the plate (Hadim, THB 1 - 77 - 109).

B - Photomicrograph of limestone-shale contact from Ekinlik Yayla (Hadim, THB 1 - 77 - 121A).

C and D - Photomicrographs of foraminiferal fine-grained calcarenite which shows pervasive micritization, with close up view of Glomospirella cf. irregularis (Moeller) in the centre of Figure C, and Glomospirella triphonensis (Baud, Zaninetti and Brönnimann) in the centre of Figure D (Hadim, THB 1 - 77 - 138).







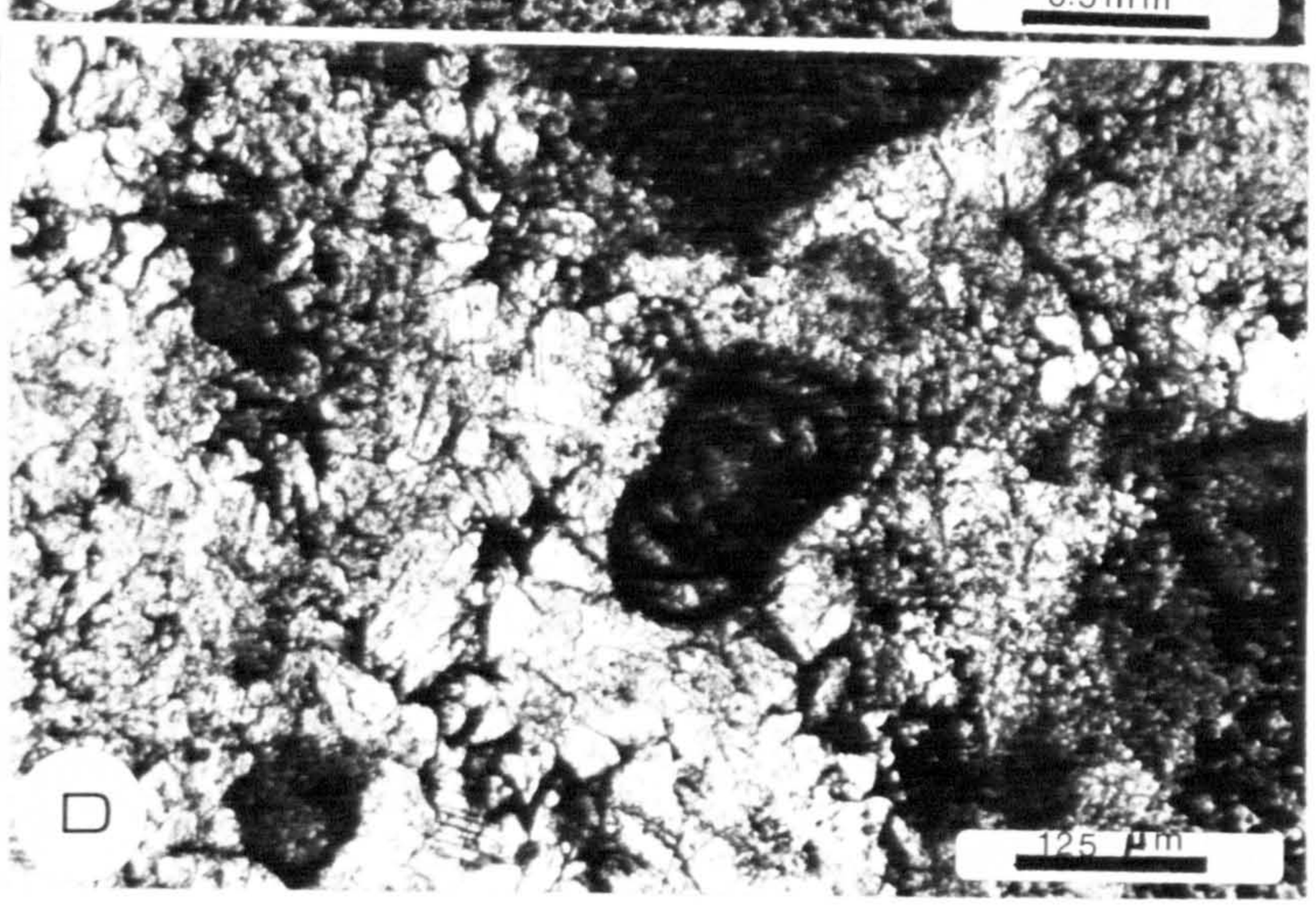


PLATE 10

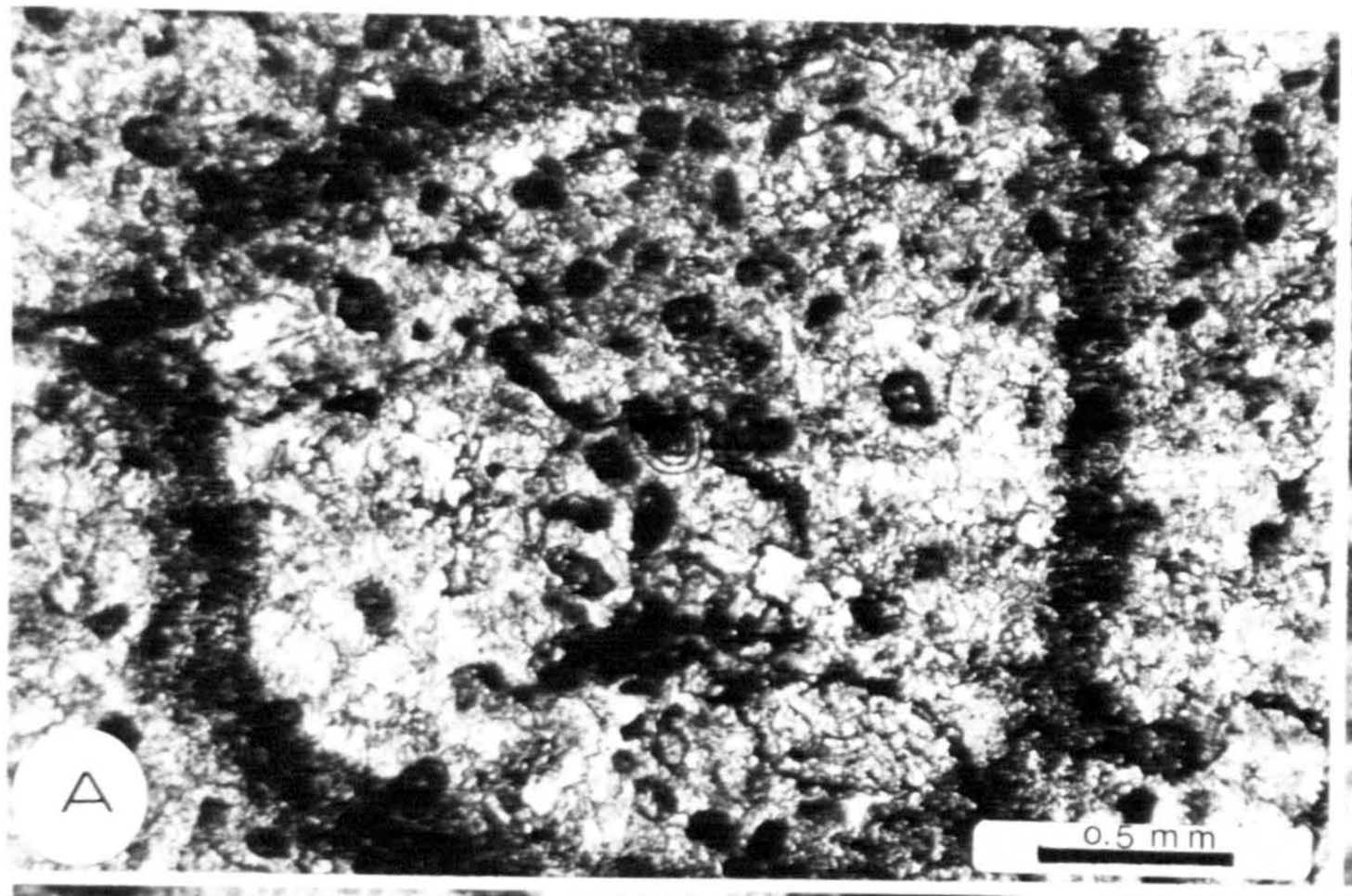
PLATE 11

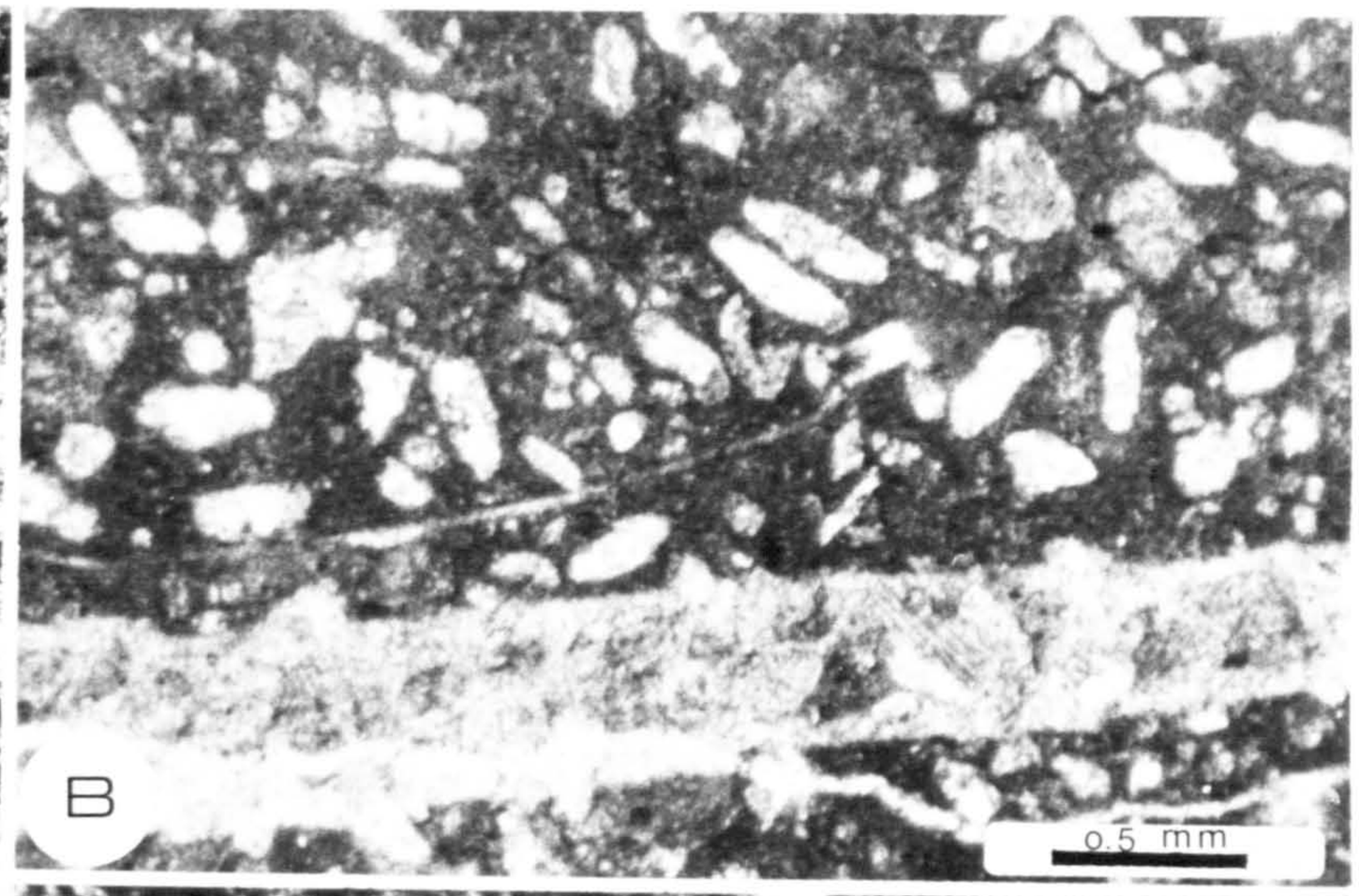
A - Photomicrograph of the same sample as in Plate 10C and D (THB1-77-138) with black ring locating a median section of Glomospirella cf. irregularis (Moeller).

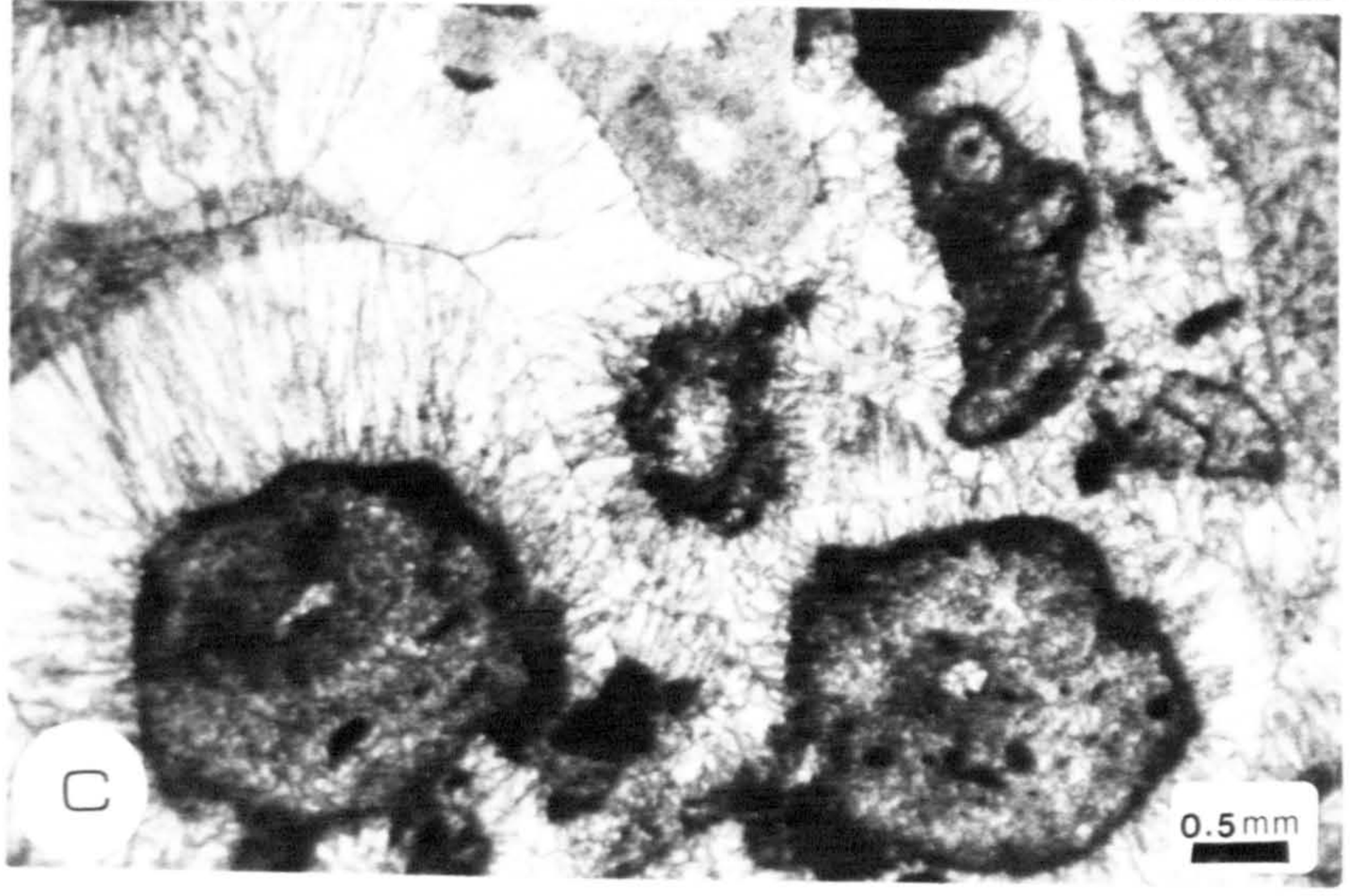
B - Photomicrograph of biomicrite from near the top of the Ekinlik Yayla section showing several poorly preserved small foraminifers; all Involutina minuta Koehn-Zaninetti (Hadim, THB 1 - 77 - 178).

C - Photomicrograph of calcirudite showing particles of micrite-coated dasycladacean algae. Note the coarse, centripetally oriented crystals of sparry cement (Hadim, THB 1 - 77 - 182).

D - Photomicrograph of intraclastic biosparite containing a few foraminifers. The diffuse black ring on the centre of the plate locates a poorly preserved varistomatid foraminifer (Hadim, THB 1 - 77 - 185).







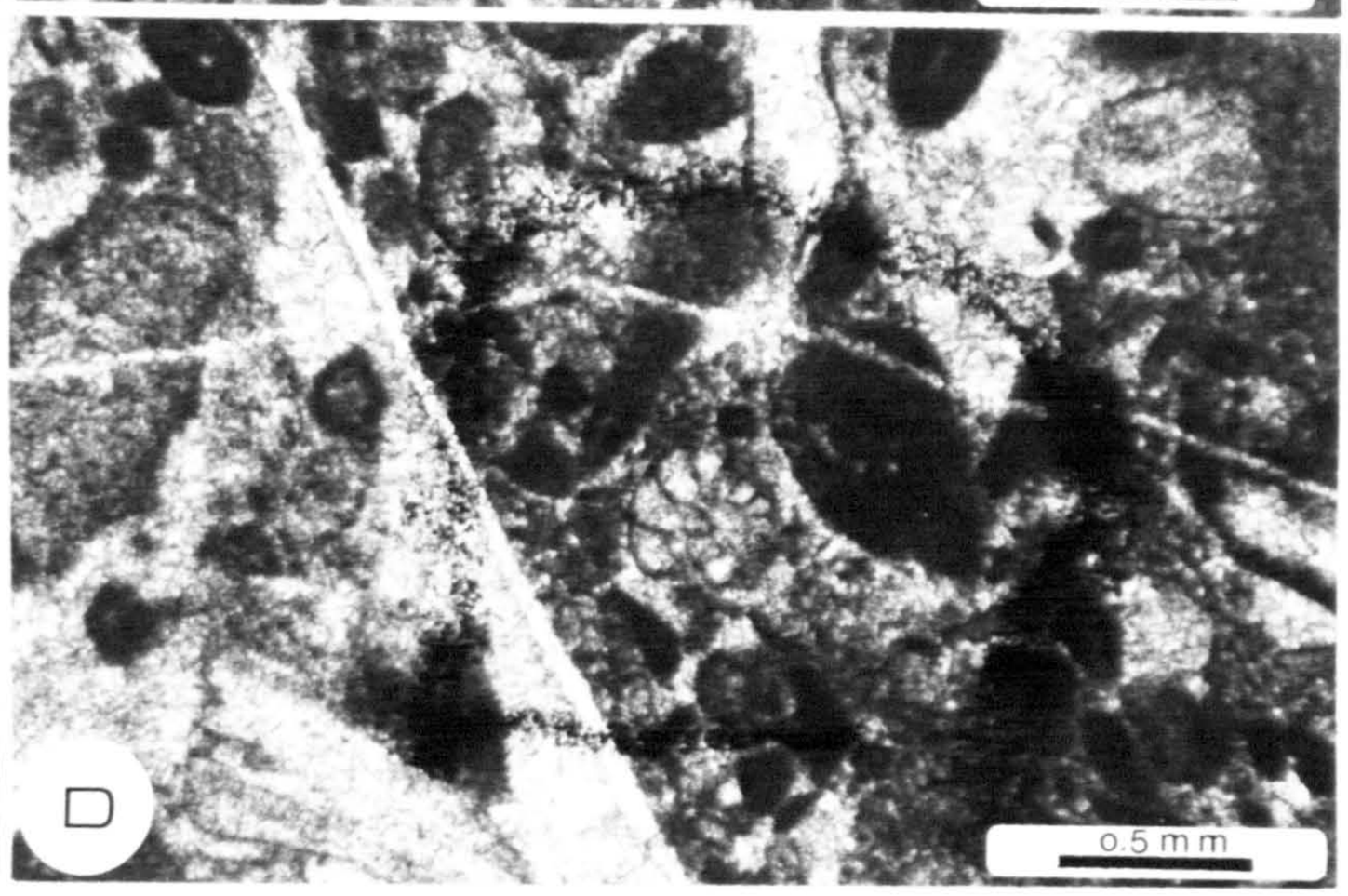


PLATE 11

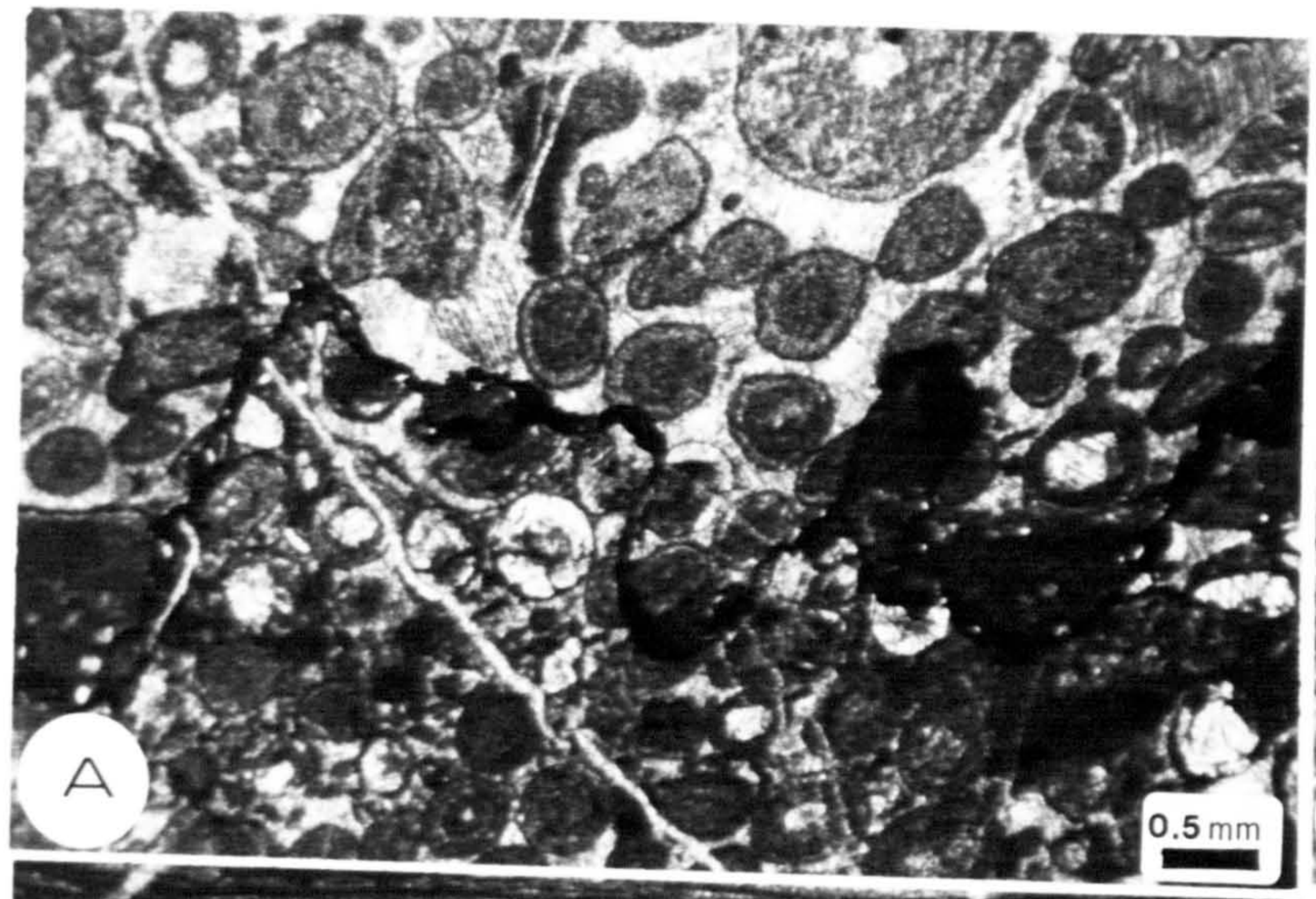
PLATE 12

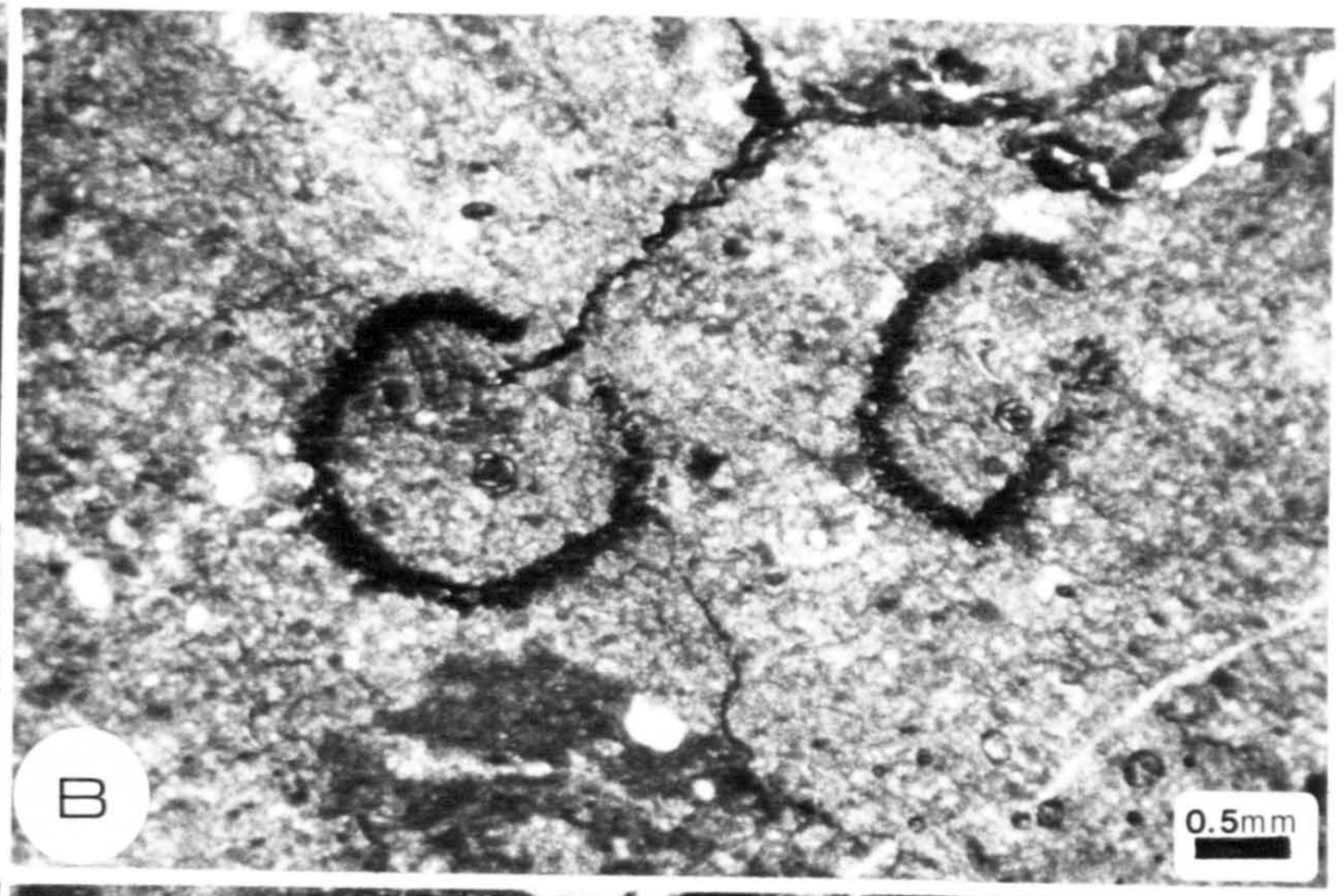
A - Photomicrograph of extensively recrystallized oosparite from Karabayir Yayla, showing microstylolites (Hadim, THB 2 - 77 - 204).

B - Photomicrograph of foraminiferal pelmicrite with sparse Glomospira sp. located by the black rings (Hadim, THB 2 - 77 - 226).

C - Photomicrograph of grey limestone showing pseudomicrolamination resulting from shearing and a later microstylolite (Hadim, THB 2 - 77 - 242).

D - Photomicrograph of limestone taken from less than a metre above sample 242, also showing pseudolamination. All allochems are sheared and, except for sparse foraminifers, unidentifiable. The foraminifers include Ataxophragmiid (not in the picture) and Nautiloculina oolithica Moshler (centre of the picture) (Hadim, THB 2 - 77 - 244).





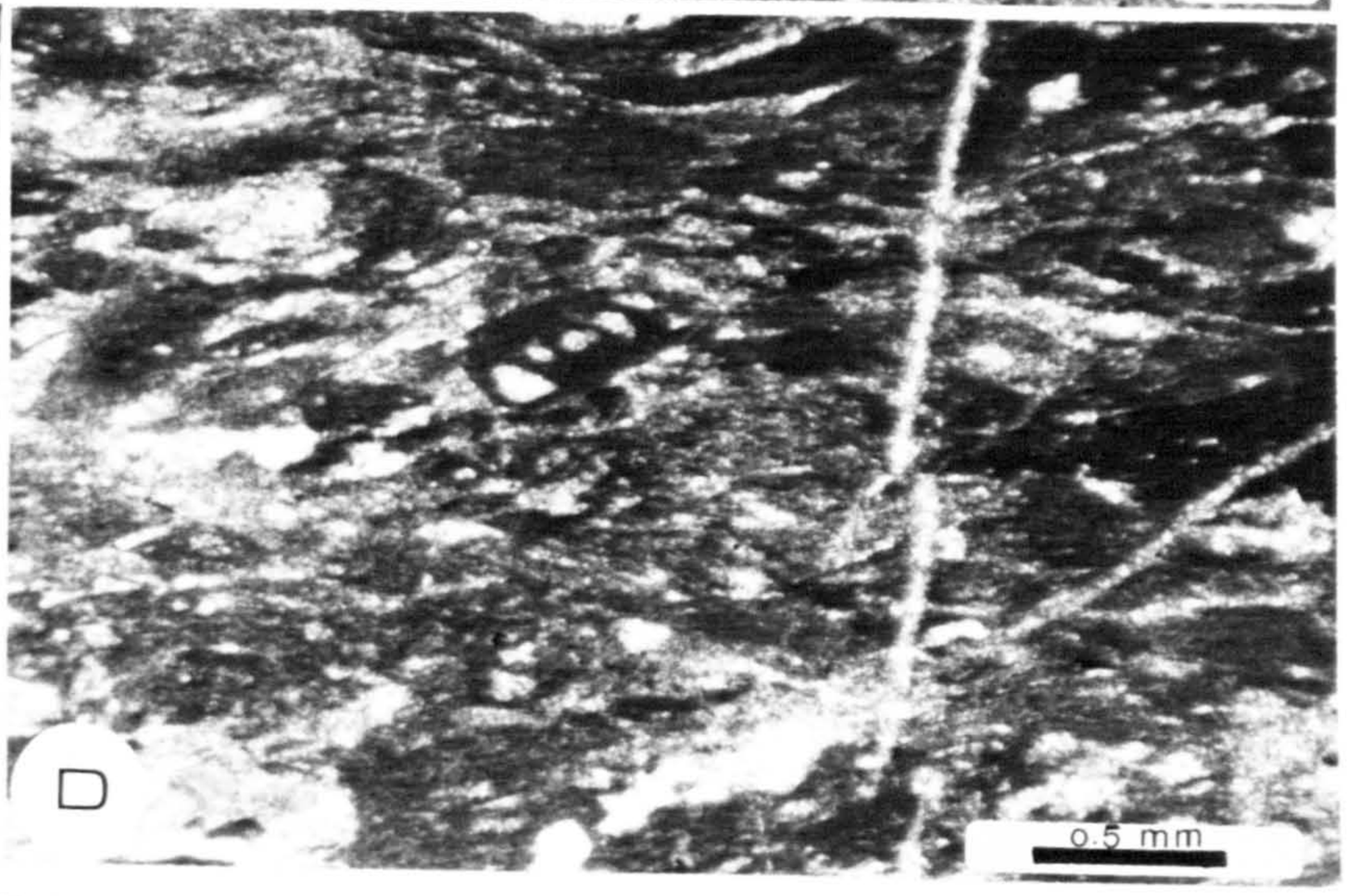


PLATE 12

CHAPTER 3: ANTALYA AREA

3.1: Introduction

The rocks of the Antalya area have only attracted the attention of geologists for the last decade or so. Most of the recent investigators have agreed on the ophiolitic and radiolaritic sequences which are considered as "NAPPES" overlying both the platform units and the metamorphic massives. The "ANTALYA NAPPES" are composed of sedimentary rocks, extrusive and intrusive mafic igneous rocks and volume_trically minor metamorphic rocks, together ranging from Ordovician to Tertiary in age (Brunn et al., 1970, 1971; Dumont et al., 1972).

Structurally, two of the measured sections, Teke Dağı (TT) and Saklıkent (TS), belong to the Upper Antalya Nappes and the third, Dömek Tepe (TD) belongs to the Middle Antalya Nappes (for locations see Figs.6A and18) Section TS comprises red or buff and grey biomicrite, both of which contain ammonites and conodonts. According to the conodonts, it belongs to the Anisian and Ladinian Stages, Section TD consists of grey, mottled red biomicrite which also contains conodonts. They indicate an Upper Triassic age (U.Carnian - L.Norian Stages). In the Teke Dağı section (TT), the sequence is as follows:

- at the base, variegated shales, edgewise conglomerate (?) and clay limestone are thinly interbedded; they are possibly Lower Triassic in age.

- the overlying vermicular marly biomicrite contains poor conodonts. It is Middle Triassic (possibly Anisian Stage).

- above are highly fossiliferous red nodular biomicrites, occurring in association with ferromanganese crusts or as a marly nodular facies. These rocks are analogous to their Jurassic counterparts, containing similar faunas except for the conodonts, which are present only in the Triassic rocks. According to these conodonts, the red nodular biomicrite is top Middle and Upper Triassic age.

This facies has been described in great detail from the type region of the Hallstätt Limestone in the Eastern Alps of Austria (Krystyn and others, 1971; Wendt 1969b, Zankl 1971, etc.).

- at the top is grey biomicrite (white in colour on fresh surfaces); it contains a rich conodont fauna as well as foraminifers, which both

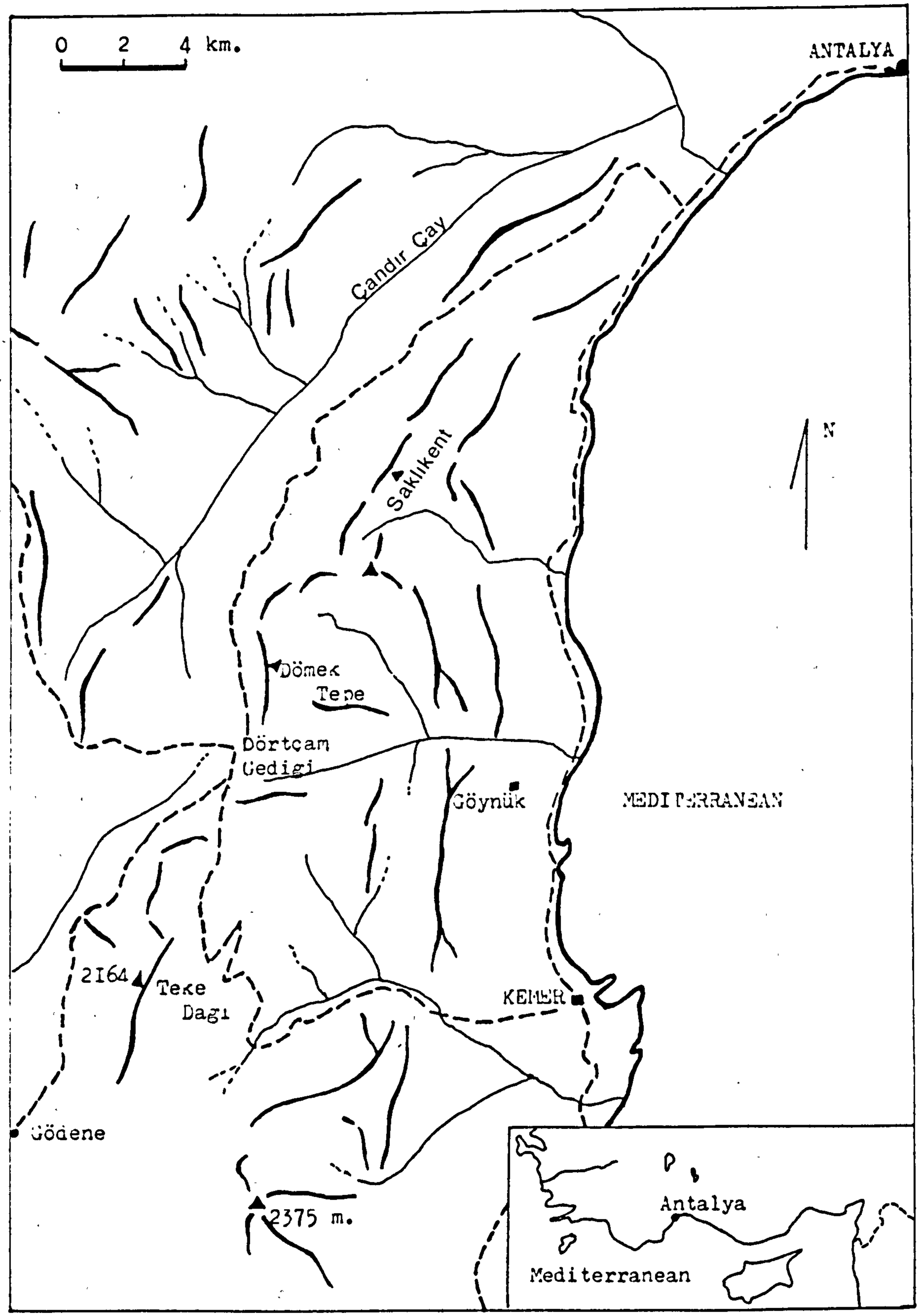


Figure I8. Location map of the Antalya area (Teke Dagı"TT", Dömek Tepe"TD" and Saklıkent"TS" sections).

indicate the Upper Norian-Rhaetian Stages. Certain outcrops show a continuous passage (without apparent unconformity) from Upper Triassic into the Lowest Jurassic.

3.2: Antalya Unit

In the Antalya area (southern Turkey, see Fig.19) the sequence of deep sea sediments, ophiolites and submarine basic volcanic rocks range in age from Cambrian to Upper Cretaceous. This unit has been named after one of the biggest cities in the area, which exposes widespread outcrops of this unit (Özgül, 1976).

Some of these outcrops, which were exposed in Western Antalya, were named the ANTALYA NAPPES by Lefèvre (1967). Marcoux (1977) divided the Western Antalya into the several structural stratigraphic units shown in Figure 20, where his original terminology is retained. In this study, however, it is believed that the Antalya Unit should be divided into several super-groups and/or groups instead of using the term "unit". Briefly, there are unsorted blocks and allochthonous rock units, both containing shallow and deep sea sediments, grouped together in this unit. Submarine volcanic rocks (peridotite, gabbro, diabase), ophiolites, pelagic sediments and a thick sequence of neritic carbonates are also recognised.

3.2.1: Teke Dağı Section (TT)

No previous palaeontological work has been reported from the Triassic outcrops in Antalya. During the present study, conodonts and sparse foraminifers have been found. These provide a sufficient micro-palaeontological base for future biostratigraphical studies.

In southern Turkey, south-west of Antalya City, Teke Dağı is a prominent peak inland from the coastal resort of Kemer, and to the west of the village of Bölücektaşı. In this study TT is proposed as the type section of the Triassic rocks in the Antalya region. The section of Teke Dağı Limestone (Plate 13A), illustrated in Figure 21, contains very rich microfaunas. This area is probably the best documented for Triassic conodonts in the Antalya area. Samples processed for conodonts were collected from a thin sequence of highly fossiliferous Hallstätt-type limestone, ranging in age from Lower to Upper Triassic, and passing conformably upwards into more massive limestones of Jurassic age.

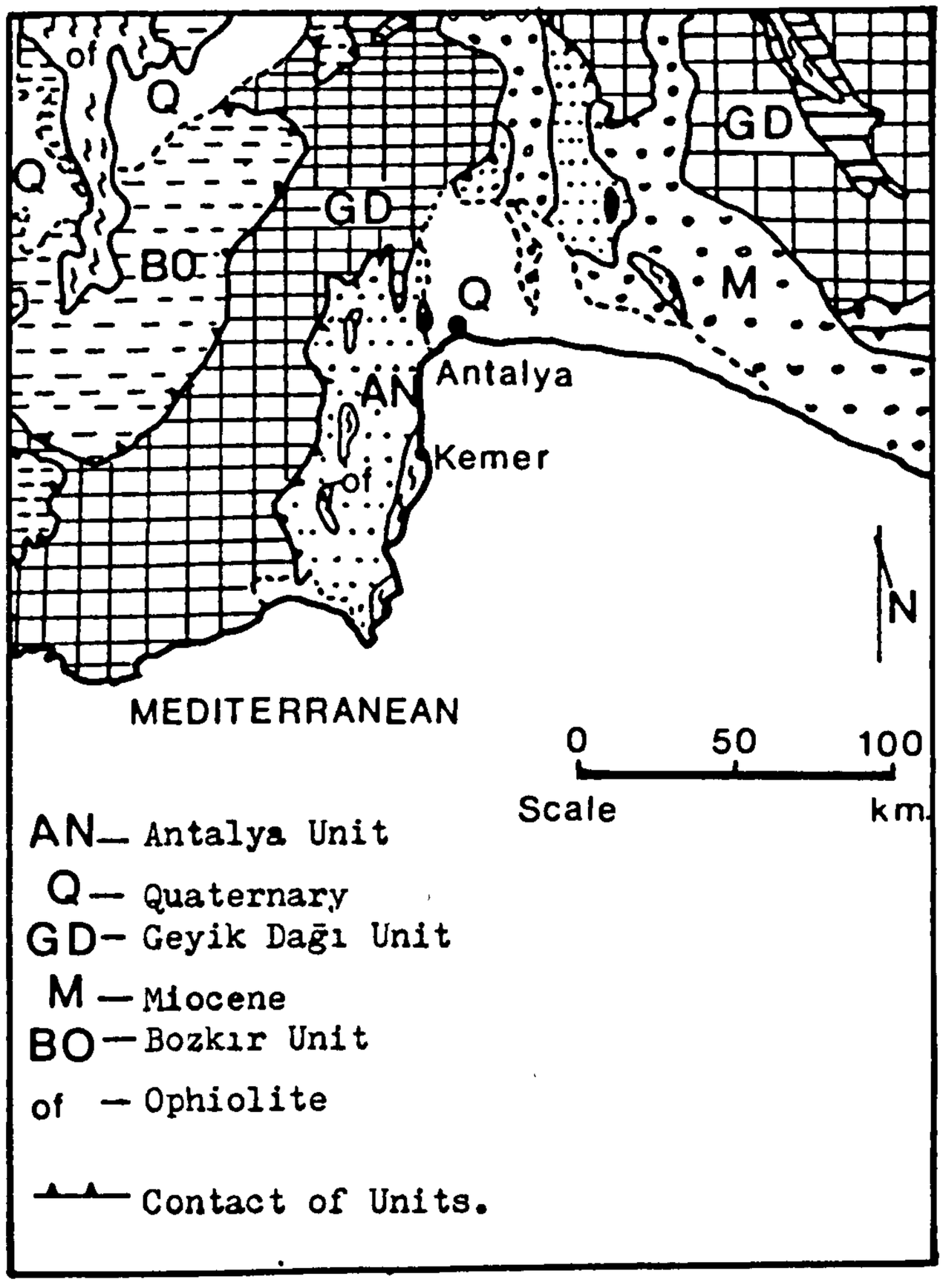


Figure I9. Schematic map showing the distribution of units in the ANTALYA area (Özgül,1976).

FIGURE 20: Tectonic Sketch of the South West Part of the Antalya Nappes (Marcoux, 1977).

A: Beydağlari Unit: Autochthonous sequence, limestones and detritals (Upper Cretaceous to Tertiary).

B: Dereköy Unit (Çatal Tepe Unit): Lower Antalya Nappe, radiolarites, marls and limestone (Upper Triassic to Maestrichtian).

C: Alakır Çay Unit: Median Antalya Nappe, radiolarites, turbidite sandstones, Halobia-bearing limestones (essentially Upper Triassic).

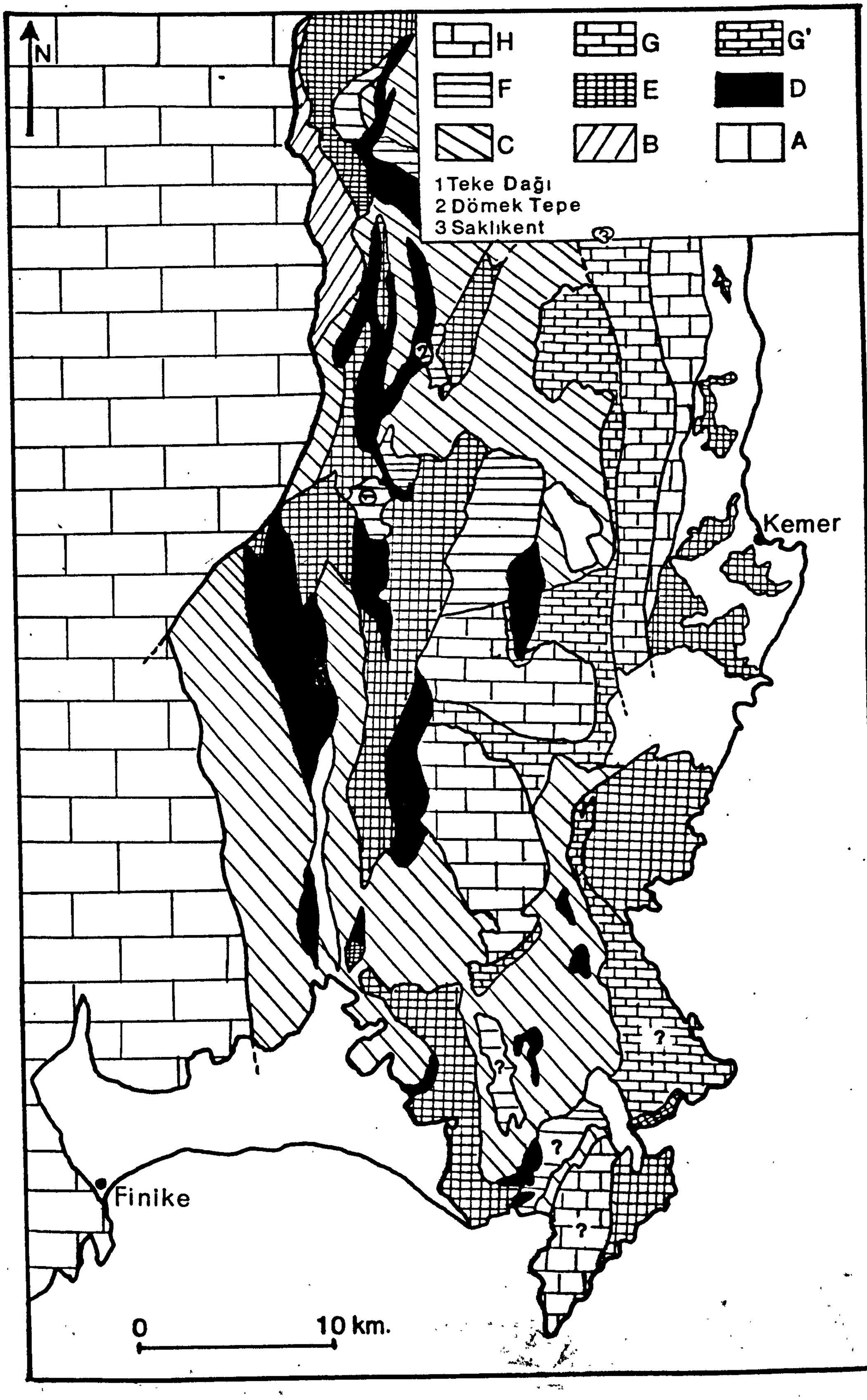
D: Karadere Unit: Median Antalya Nappe, Pillow-lavas (Upper Triassic).

E: Ophiolitic Unit: Median Antalya Nappe, tectonites, peridotites, cumulates, gabbros.

F: Bakirli Dağ Unit: Upper Antalya Nappe, essentially limestones (Upper Permian to Cretaceous).

G,G': Kemer Unit: Upper Antalya Nappe, Epibaikalian Palaeozoic basement, Mesozoic sequence generally pelagic limestone (Lower Ordovician to Maestrichtian).

H: Tahtali Unit: Upper Antalya Nappe, Mesozoic shallow water carbonates transgressive on lower Ordovician.


N
H
G
G'
F
E
D
C
B
A
1 Teke Dağı
2 Dömek Tepe
3 Saklıkent
Kemer
Finike
0
10 km.

LOWER TRIASSIC

FORMATION A: Lower Triassic

This formation comprises poorly exposed interbedded yellowish grey shales and micrite, totalling about 3m. in thickness (Fig.21a). Edgewise conglomerate has been reported from neighbouring areas, but has not been seen here. Neither conodonts nor foraminifers have been found. No evaporites have been observed, although some researchers indicate that there is evaporite in neighbouring areas. Unfossiliferous micrite beds show only microstylolites in thin sections; the stratigraphy of this sequence is based on lithologic comparison and stratigraphic position.

The environments of deposition of the Triassic rocks from the Antalya area are unclear from internal evidence. They will be considered at the end of this section.

MIDDLE TRIASSIC

In the Middle Triassic the L.Anisian Stage is recognised by vermicular limestone, which typifies this stage throughout the Alpine zone. This bed contains sparse conodonts, 3 or 4 per 2 kg. sample. A few metres above, there is a sequence of well-bedded, red nodular limestone ranging from the M.U Anisian Stage to the Rhaetian Stage. This is much more richly fossiliferous than the vermicular limestone; yield 50 to 100 conodonts per 2 kg. sample. Other microfossils also occur.

FORMATION B: Middle Triassic, Anisian Stage

This vermicular limestone consists of 1m. of thin, well-bedded biomicrite, considered to be the Anisian Stage. Only a few conodonts have been found in this formation (Fig.21b): Enantiognathus lotus, Enantiognathus ziegleri, Neogondolella bifurcata, Neogondolella navicula navicula, Neogondolella sp., Neohindeodella sp., Cypridodella sp., Xaniognathus sp.(Tab 6).

MIDDLE-UPPER TRIASSIC

In the present study of Teke Dağı, Middle-Upper Triassic is distinguished by red, nodular calcarenite, which is richly fossiliferous, especially in conodonts. This facies was described in detail from the type region of the Hallstätt Limestone in Austria (Krystyn et al., 1971; Lein, 1975). It is also known, in some places associated with volcanics,

from Yugoslavia, Greece and the Carpathians.

This red nodular limestone ranges from the Anisian Stage (Upper? Anisian) to the Norian or Rhaetian (?) Stage, and passes into the Lower Jurassic without apparent unconformity, but with change of facies.

FORMATION C: Middle-Upper Triassic, Anisian to Norian Stages

The red type of Ammonitico Rosso at places in the studied area (cf. Hallstätt Limestone) is a red packed biomicrite (Fig.21c). It is approximately 4m. thick. Thin to medium, well-bedded red packed biomicrite is composed of ammonites, gastropods, conodonts and foraminifers. On the basis of its microfossil content, it ranges from the Upper(?) Anisian Stage to the Norian or Rhaetian (?) Stage. Many of the shells show disintegration by post-depositional compaction, particularly at the base of Formation C (Plates 14A, 14B, 14C, 16A).

Besides the conodonts and foraminifers, some stratigraphically important samples from the Upper Triassic have yielded holothurian sclerites. Ages of all the rocks have been determined by means of conodonts and foraminifers together. The following conodonts have been recovered from this formation:

Neogondolella longa, Neogondolella mombergensis, Neogondolella navicula navicula, Neogondolella cf. bulgarica, Neogondolella constricta, Neogondolella hanbulogi, Neogondolella polygnathiformis, Neogondolella excelsa, Neogondolella sp., Gladigondolella tethydis, Gladigondolella malayensis malayensis, Gladigondolella malayensis budurovi, Gladigondolella sp., Cratognathodus posterognathus, Cratognathodus kochi, Prioniodina libita, Prioniodina petrae-viridis, Prioniodella pectiniformis, Prioniodella decrescens, Prioniodella prioniodellides, Neohindeodella triassica, Neohindeodella sp., Cypridodella venusta, Cypridodella mediocris, Cypridodella cf. pronoides, Cypridodella spengleri ?, Cypridodella sp., Didymodella alternata, Diplododella sp., Enantiognathus ziegleri, Neocavitella cavitata, Neocavitella sp., Xaniognathus tortilis, Xaniognathus sp., Epigondolella sp.(Tab.6).

A few foraminifers have been recovered also:
Ophthalmidium chialingchiangense ?, Ophthalmidium sp.

FORMATION D: Upper Triassic

Medium to thick-bedded light grey calcarenite conformably overlies

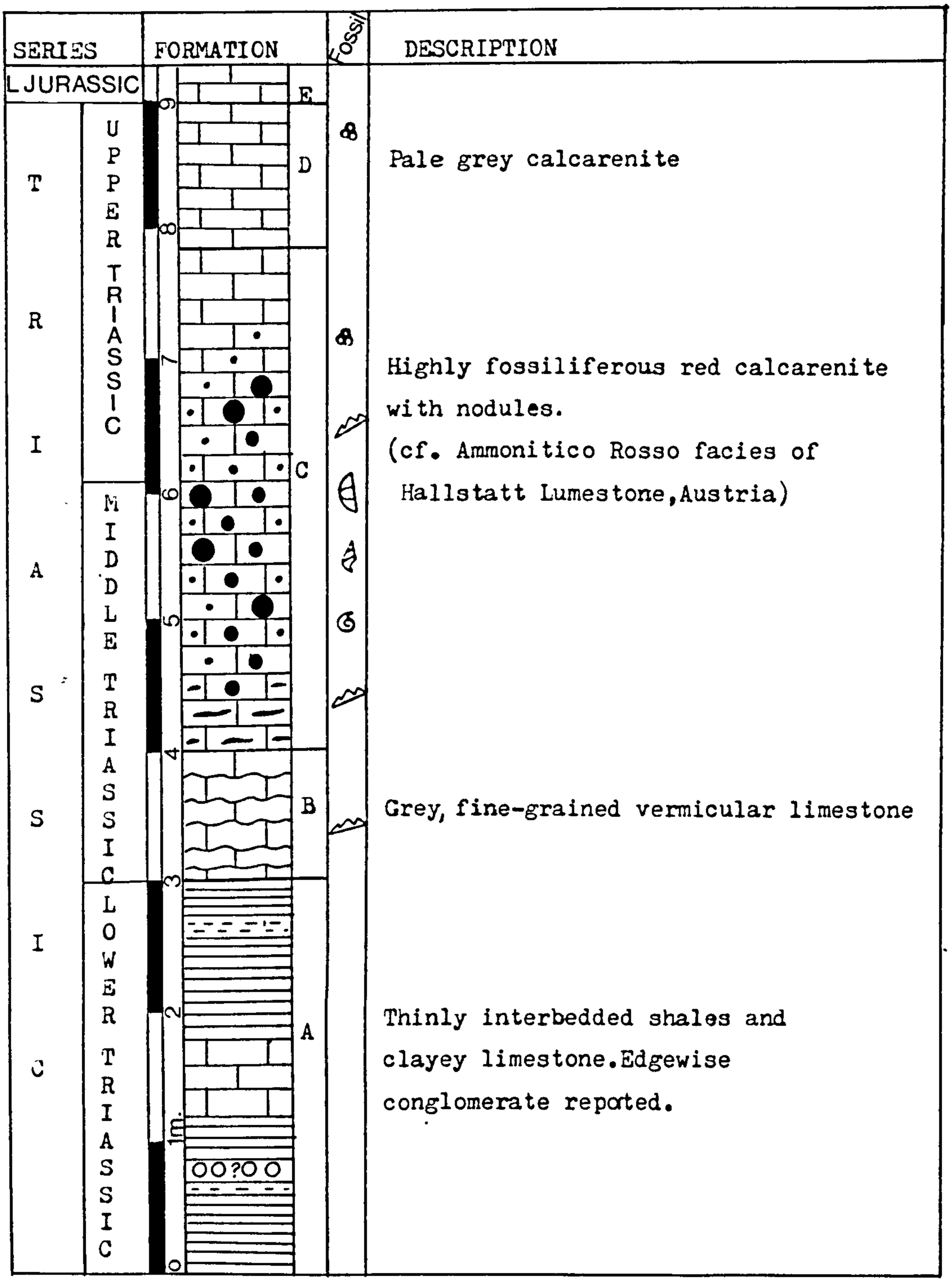
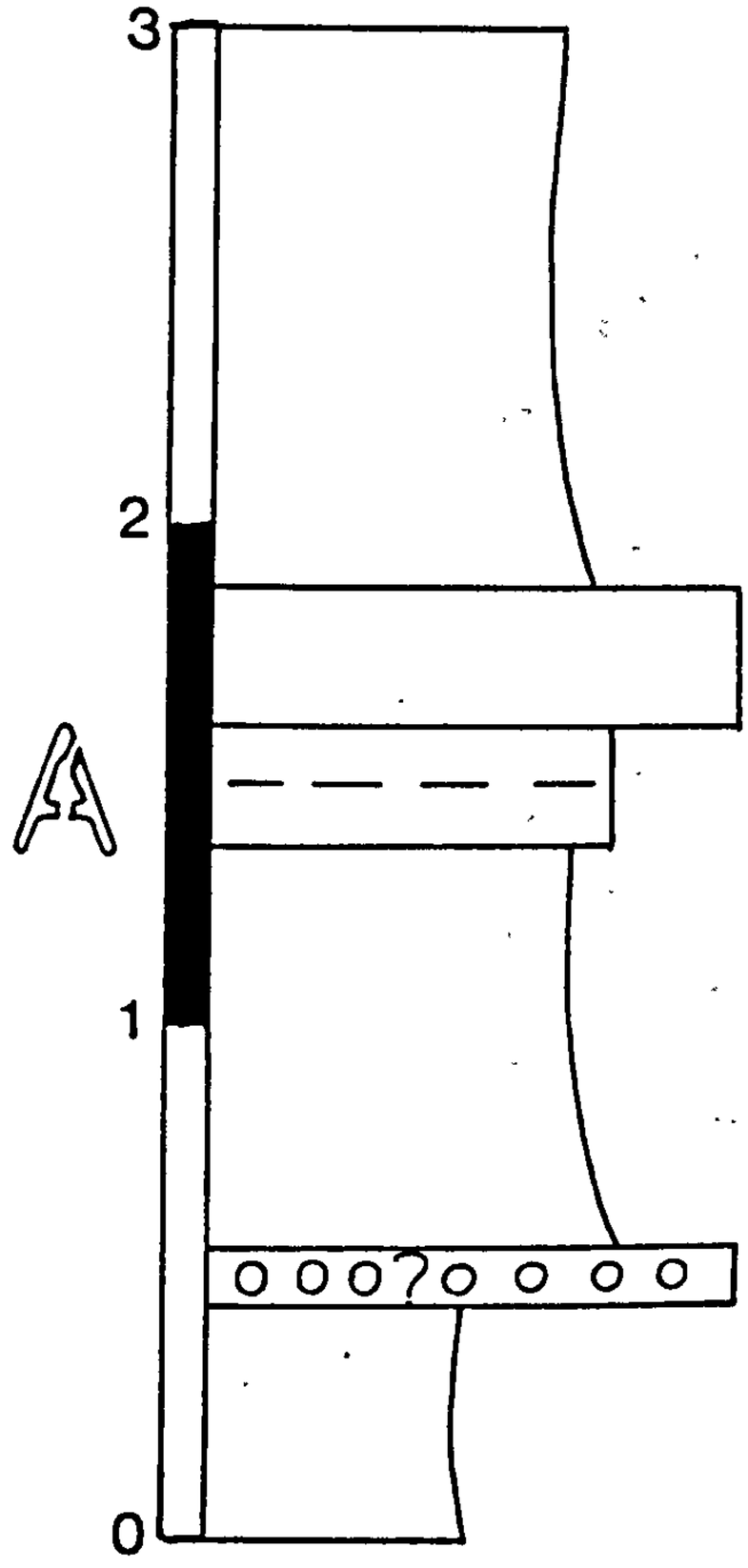


Figure 2I. TEKE DAĞI (TT) stratigraphic columnar section.
Scale in meters.

L O W E R T R I A S S I C



scale in meters

Fig.2Ia to 2Id show the Triassic fomations of Section TT and samples which have been taken from each fomation.

Figure 2I a. Section TT, Formation A-sampled horizons.

M I D D L E T R I A S S I C

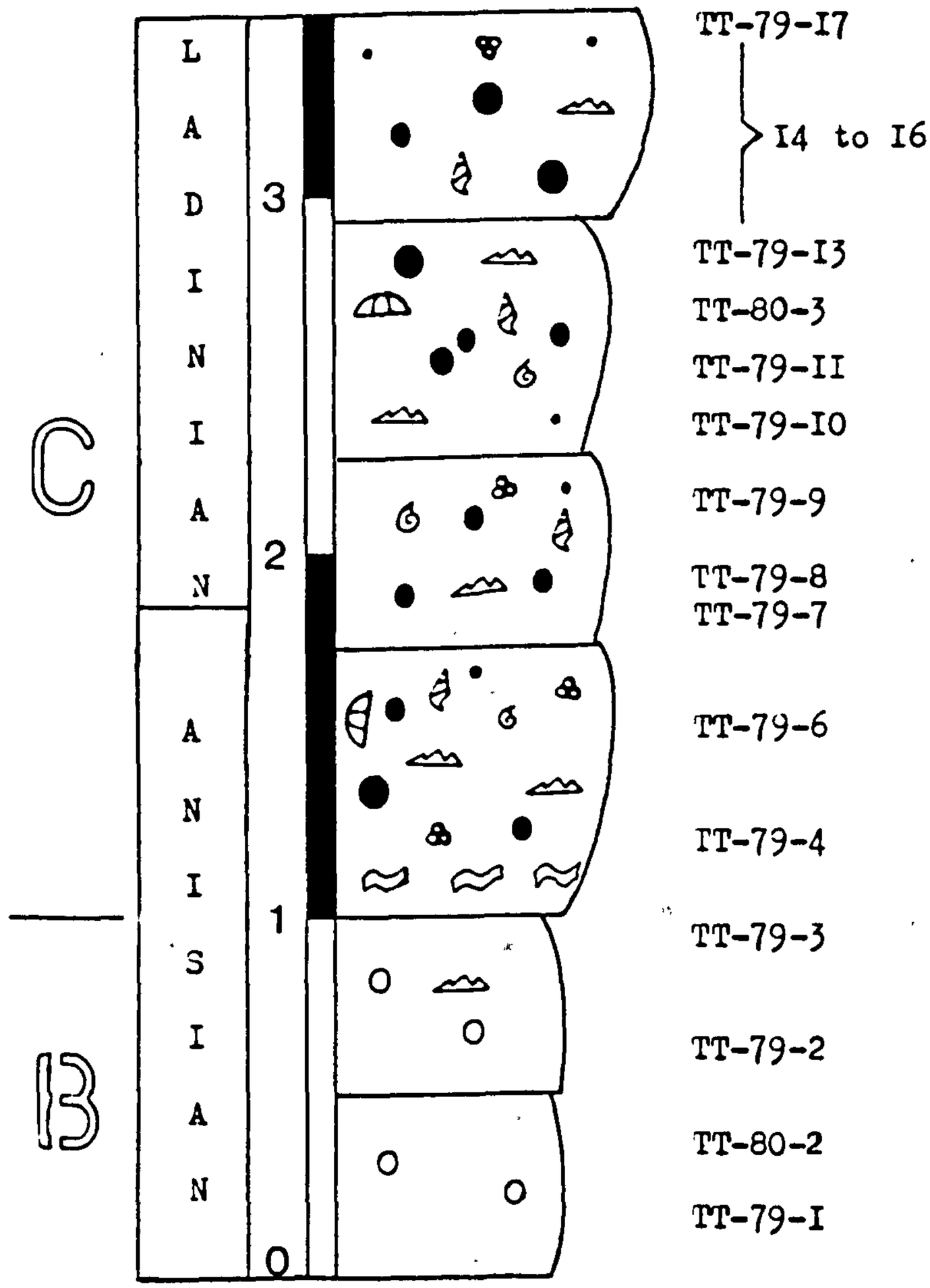


Figure 2I b. Section TT, Formations B and C-sampled horizons.

U P P E R T R I A S S I C

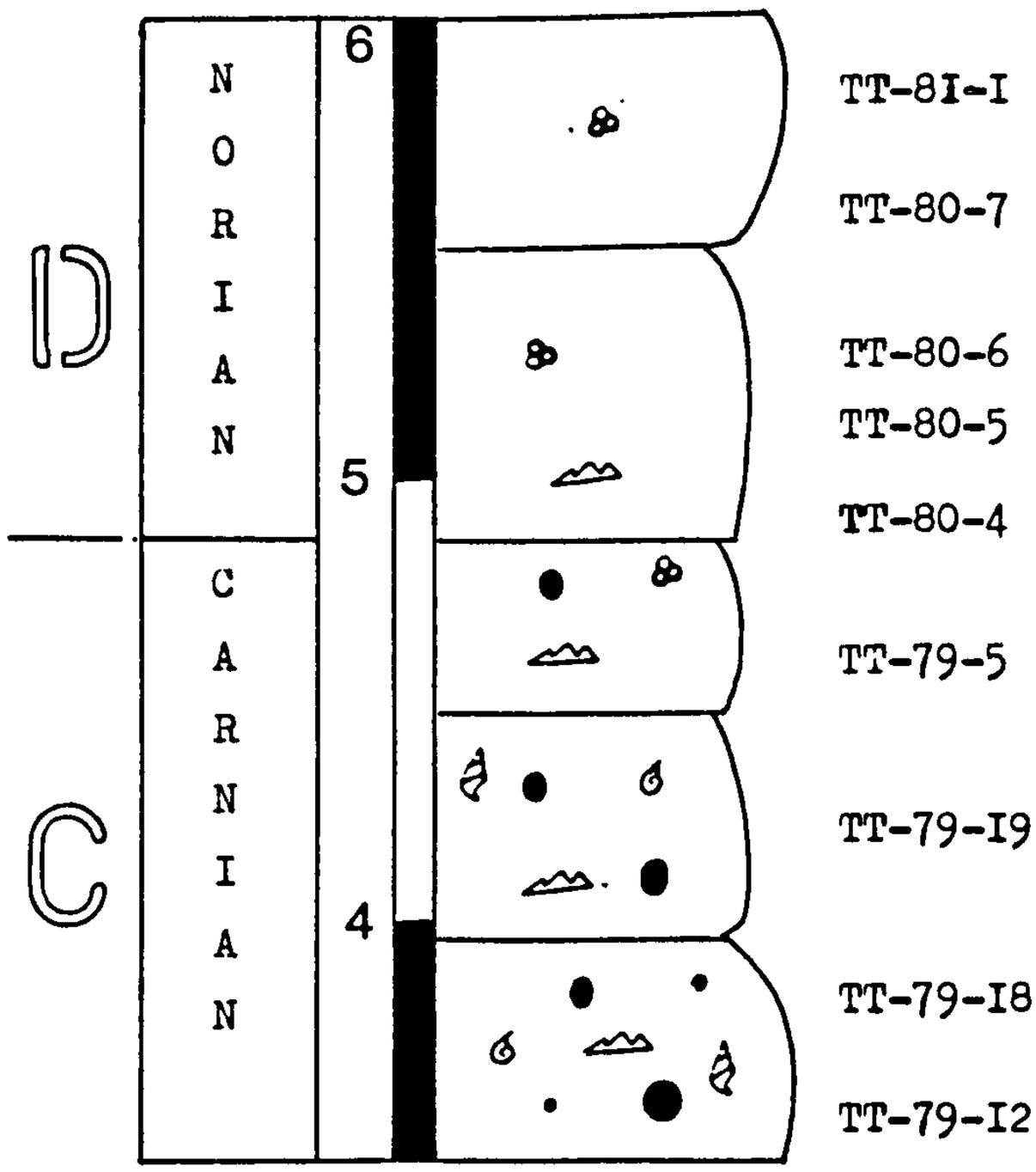


Figure 2I c. Section TT, Formations C and D-sampled horizons.

the red nodular calcarenite. This is also packed biomicrite, but white in colour on fresh faces and not visibly nodular. This formation also contains conodonts: Neogondolella polygnathiformis, Neogondolella constricta, Neogondolella kozuri, Neogondolella sp., Neogondolella sp.B, Epigondolella abneptis, Epigondolella carnica, Epigondolella baloghi, Epigondolella aff. baloghi, Epigondolella parva, Epigondolella aff.parva, Epigondolella permica, Epigondolella cf. permica, Epigondolella nodosa, Epigondolella postera, Epigondolella primita, Epigondolella triangularis, Epigondolella sp., Epigondolella nsp.A, Epigondolella nsp.B, Enantiognathus ziegleri, Enantiognathus sp., Cratognathodus posterognathus, Cratognathodus kochi, Gladigondolella malayensis malayensis, Prioniodina libita, Prioniodina petrae-viridis, Prioniodella pectiniformis, Xaniognathus tortilis, Xaniognathus sp., Diplododella sp., Neohindeodella dropla, Neohindeodella sp., Cypridodella sp., Gen. et Sp.indet A (Tab.6).

Foraminifers include: Involutina gaschei praegaschei, Involutina sinuosa pragsoides, Trocholina? permodiscoides and Vidalina sp. (Plates 14D, 15A, 15B, 15C, 15D). In addition to these microfossils, holothurian sclerites are also found at the top of this formation as Theelia immisorbicula, Theelia cf. immisorbicula, Theelia sp. (Plate 29, Figs.9, 10, 11).

3.2.2: Microfaunas from TT

Foraminifers, holothurian sclerites and conodonts have been recovered from the Triassic rocks of Antalya. Holothurian sclerites, occurring in only one horizon of the TT section, and foraminifers are relatively sparse, and are listed below without palaeontological analysis. Prolific faunas of conodonts have been recovered from the Middle and Upper Triassic rocks, and taxonomic analysis of them will be given later in Chapter 6. The ages of formations in this area are based on both foraminifers and conodonts, where they are available. Foraminifers are restricted to only three horizons of the TT section. Neither conodonts nor foraminifers have been recorded from the Lower Triassic. All the rocks which contain conodonts are biomicrites (for abundance data see tab.6 A to D).

The microfossil content of formations is given in sample order.

Microfaunas from Teke Dağı Section (Antalya, TT):

Sample: TT-79-1 is collected from Formation B, characterized by grey, fine-grained limestone with vermicular texture. Only one

TABLE 6A: Numerical Abundance of Conodonts in Samples collected from Teke Dağı (Antalya, TT section)

CONODONTS	MIDDLE TRIASSIC																		UPPER TRIASSIC									
	Anisian								Ladinian										Carnian				Norian					
Samples	TT-79-1	TT-79-2	TT-79-3	TT-79-4	TT-80-2	TT-79-6	TT-79-7	TT-79-8	TT-79-9	TT-79-10	TT-79-11	TT-80-3	TT-79-13	TT-79-14	TT-79-15	TT-79-16	TT-79-17	TT-79-12	TT-79-18	TT-79-19	TT-79-5	TT-80-4	TT-80-5	TT-80-6	TT-80-7	TT-81-1	Totals
Cratognathodus kochi							4	3		5	5		12	7		1?		16									53
C.posterognathus								6		4	5	2	3	6	3	1?	1?	16									47
Cypridodella mediocris										3	3																6
Cypridodella cf.pronoides														2													2
Cypridodella spengleri														2?													2
Cypridodella venusta								3							1												4
Cypridodella sp.			2		4		7	4		2		4		5			4	15	2		3						52
Didymodella alternata									2	1	1		2														6
Diplododella sp.											2		2					4									8
Enantiognathus lotus	2	1																									3
Enantiognathus ziegleri					1					3					1					1		5					11
Enantiognathus sp.																						6	1		2	1?	10
Epigondolella abneptis																		98	4	28		49	62	84	72	24	421
E.baloghi																		20									20
E. aff. baloghi																		5				5					10
Totals refer to Tables 6A,6B,6C,6D	2	5	7	12	22	12	23	53	14	90	61	40	83	89	37	14	20	380	17	32	10	241	81	85	90	28	

TABLE 6B: Abundance Data for Conodont Taxa from TT (contd.)

	MIDDLE TRIASSIC																	UPPER TRIASSIC										
	Anisian								Ladinian									Carnian				Norian						
CONODONTS	Samples	TT-79-1	TT-79-2	TT-79-3	TT-79-4	TT-80-2	TT-79-6	TT-79-7	TT-79-8	TT-79-9	TT-79-10	TT-79-11	TT-80-3	TT-79-13	TT-79-14	TT-79-15	TT-79-16	TT-79-17	TT-79-12	TT-79-18	TT-79-19	TT-79-5	TT-80-4	TT-80-5	TT-80-6	TT-80-7	TT-81-1	Totals
Epigondolella carnica																		11									11
E. nodosa																		21									21
E. parva																							2				2
E. aff. parva																		2				30					32
E. permica																		41			3						44
E. postera																					2		3		8		13
E. primita																						40					40
E. triangularis																						6					6
Epigondolella sp.																	5				3	57	4				69
Epigondolella nsp.A																						20					20
Epigondolella nsp.B																		8									8
Gladigondolella tethydis						3	3	4	2				3														15
G.malayensis budurovi				2																							2
G.malayensis malayensis											9	12	21	2				55									99

TABLE 6C: Abundance Data for Conodont Taxa from TT (contd.)

CONODONTS	Samples	MIDDLE TRIASSIC																	UPPER TRIASSIC									Totals
		Anisian							Ladinian										Carnian				Norian					
		TT-79-1	TT-79-2	TT-79-3	TT-79-4	TT-80-2	TT-79-6	TT-79-7	TT-79-8	TT-79-9	TT-79-10	TT-79-11	TT-80-3	TT-79-13	TT-79-14	TT-79-15	TT-79-16	TT-79-17	TT-79-12	TT-79-18	TT-79-19	TT-79-5	TT-80-4	TT-80-5	TT-80-6	TT-80-7	TT-81-1	
Gladigondolella sp.											2		8															10
Neocavitella cavitata																	1											1
Neocavitella sp.A													1															1
Neocavitella sp.B																2												2
Neogondolella bifurcata				4		8																						12
N. cf. bulgarica					2																							2
N. constricta									5		18	18		23	44	13	4	3	18	5								151
N. excelsa										9		1																10
N. hanbulogi												1																1
N. kozuri																						2				4		6
N. longa					1																							1
N. mombergensis					4																							4
N. navicula navicula		4	12	3							4			1														13
N. polygnathiformis											9	5			3			4	13	3			20					57
Neogondolella sp.						3		2	3	1				5		2			1	3						4	1	25

TABLE 6D: Abundance Data for Conodont Taxa from TT (contd.)

	MIDDLE TRIASSIC																		UPPER TRIASSIC									
	Anisian								Ladinian										Carnian				Norian					
CONODONTS	Samples	TT-79-1	TT-79-2	TT-79-3	TT-79-4	TT-80-2	TT-79-6	TT-79-7	TT-79-8	TT-79-9	TT-79-10	TT-79-11	TT-80-3	TT-79-13	TT-79-14	TT-79-15	TT-79-16	TT-79-17	TT-79-12	TT-79-18	TT-79-19	TT-79-5	TT-80-4	TT-80-5	TT-80-6	TT-80-7	TT-81-1	Totals
Neohindeodella dropla																							4				4
Neohindeodella triassica									2			1		3			4	3									13
Neohindeodella sp.						2									2	3			3					1?		2	13
Prioniodella decrescens											3																3
P.pectiniformis									8		7			3	2				8								28
P.prioniodellides																1											1
Prioniodina libita											1		2	1	2				3								9
Prioniodina petrae-viridis							7	15		28	9	11	4	12	3	1		20									110
Xaniognathus tortilis											1					2						1					4
Xaniognathus sp.					4	9										8						2	5				28
Gen.et sp.indet. A																		2									2

conodont has been recovered:

Enantiognathus lotus Kozur & Mostler 1970

(Plate 22, Fig.16).

Age: Middle Triassic: Anisian Stage.

Sample: TT-79-2 sampled from Formation B, containing very few conodonts:

Enantiognathus lotus Kozur & Mostler 1970

Neogondolella navicula navicula (Huckriede 1958)

Plate 22, Fig.16, and Plate 28, Figs. 6a,b; 7a,b).

Age: Middle Triassic: Anisian Stage.

Sample: TT-79-3 also from Formation B, comprising some more conodonts:

Neogondolella bifurcata (Budurov & Stefanov 1972)

Neogondolella navicula navicula (Huckriede 1958)

Cypridodella sp.

(Plate 27, Figs.3,4 and Plate 28, Figs.6a,b; 7a,b).

Age: Middle Triassic: Anisian Stage.

Sample: TT-79-4 from Formation C, which is red packed biomicrite containing:-

Neogondolella longa Budurov & Stefanov 1973

Neogondolella mombergensis (Tatge 1956)

Neogondolella navicula navicula (Huckriede 1958)

Neogondolella cf. bulgarica (Budurov & Stefanov 1975)

Gladigondolella malayensis budurovi Kovacs & Kozur 1980.

(Plate 28, Figs. 3a,b,c; 4; Plate 28, Figs. 5a,b,c; Plate 28, Figs. 6a,b; 7a,b; Plate 27, Figs. 5a,b,c; 6; and Plate 26, Fig.8).

Age: Middle Triassic: Anisian Stage.

Sample: TT-79-5 This sample is not in stratigraphic order. It was taken from loose debris at a level where the underlying bedrock is attributed to the Upper Triassic. The rock itself is packed biomicrite, containing both conodonts and foraminifers.

Foraminifers:

Opthalmidium chialingchiangense ? (Ho 1959)

Opthalmidium sp.

(Plates 14A, 14B).

Conodonts:

Epigondolella postera (Kozur & Mostler 1971)

Epigondolella cf. permica (Hayashi 1968)

Neogondolella kozuri Gedik 1981

Cypridodella sp.

(Plate 25, Figs. 7a,b; 8; Plate 25, Figs.4a,b;5,6 and Plate 28, Figs. 2a,b,c).

Age: Foraminifera-Triassic long ranging

Conodonts -Upper Triassic: Carnian Stage.

Sample: TT-79-6 from Formation C, containing:

Gladigondolella tethydis (Huckriede 1958)

Xaniognathus sp.

(Plate 26, Figs. 14a,b; 15, 16,17).

Age: Middle Triassic: Anisian Stage.

Sample: TT-79-7 is recrystallized limestone from Formation C. It contains:

Gladigondolella tethydis (Huckriede 1958)

Cratognathodus kochi (Huckriede 1958)

Prioniodina petrae-viridis (Huckriede 1958)

Cypridodella sp.

Neogondolella sp.

(Plate 26, Figs. 14a,b; 15,16,17; Plate 22, Figs. 7,8 and Plate 23, Figs. 16, 17, 18, 19, 20, 21).

Age: Middle Triassic: Anisian Stage.

Sample: TT-79-8 from Formation C, mainly red packed biomicrite. This sample contains:

Cratognathodus posterognathus Mosher 1968

Cratognathodus kochi (Huckriede 1958)

Prioniodina petrae-viridis (Huckriede 1958)

Prioniodella pectiniformis Huckriede 1958

Neohindeodella triassica (Müller 1956)

Gladigondolella tethydis (Huckriede 1958)

Neogondolella constricta (Mosher & Clark 1965)

Neogondolella sp.

Cypridodella venusta (Huckriede 1958)

Cypridodella sp.

(Plate 22, Figs.9,10,11; Plate 22, Figs.7,8;
Plate 23, Figs. 16,17,18,19,20,21; Plate 23, Figs.9,10,11;
Plate 23, Fig.6; Plate 26, Figs. 14a,b; 15,16,17;
Plate 27, Figs.7,8,9,10 and Plate 22, Figs. 5,6).

Age: Middle Triassic: Ladinian Stage.

Sample: TT-79-9: from Formation C, containing:

Gladigondolella tethydis (Huckriede 1958)
Didymodella alternata (Mosher 1968)
Neogondolella excelsa (Mosher 1968)
Neogondolella sp.
(Plate 26, Figs. 14a,b; 15,16,17; Plate 22, Figs.12,13,14
and Plate 27, Figs. 11, 12, 13).

Age: Middle Triassic: Ladinian Stage.

Sample: TT-79-10 from Formation C, red nodular limestone rich in conodonts:

Prioniodina petrae-viridis (Huckriede 1958)
Prioniodina libita Mosher 1968
Prioniodella pectiniformis Huckriede 1958
Prioniodella decrescens Tatge 1956
Didymodella alternata (Mosher 1968)
Enantiognathus ziegleri (Diebel 1956)
Cratognathodus kochi (Huckriede 1958)
Cratognathodus posterognathus Mosher 1968
Neogondolella constricta (Mosher & Clark 1965)
Neogondolella navicula navicula (Huckriede 1958)
Neogondolella polygnathiformis (Budurov & Stefanov 1965)
Cypridodella mediocris (Tatge 1956)
Cypridodella sp.
Gladigondolella sp.
(Plate 23, Figs. 16,17,18,19,20,21; Plate 23, Figs.13,14;
Plate 23, Figs.9,10,11; Plate 23, Fig.8; Plate 22, Figs.12,13,14;
Plate 22, Fig.17; Plate 22, Figs. 7,8; Plate 22, Figs.9,10,11;
Plate 27, Figs. 7,8,9,10; Plate 28, Figs. 6a,b; 7a,b;
Plate 29, Figs. 1,2,3,4,5,6 and Plate 22, Fig.2).

Age: Middle Triassic: Ladinian Stage.

Sample: TT-79-11 from Formation C, containing:

Neogondolella hanbulogi (Sudar & Budurov 1979)
Neogondolella excelsa (Mosher 1968)
Neogondolella polygnathiformis (Budurov & Stefanov 1965)
Neogondolella constricta (Mosher & Clark 1965)
Xaniognathus tortilis (Tatge 1956)
Gladigondolella malayensis malayensis Nogami 1968
Prioniodina petrae-viridis (Huckriede 1958)
Cratognathodus kochi (Huckriede 1958)
Cratognathodus posterognathus Mosher 1968
Neohindeodella triassica (Müller 1956)
Didymodella alternata (Mosher 1968)
Cypridodella mediocris (Tatge 1956)
Diplododella sp.
(Plate 28, Figs. 1a,b; Plate 27, Figs. 11,12,13;
Plate 29, Figs. 1,2,3,4,5,6; Plate 27, Figs.7,8,9,10;
Plate 23, Fig.4; Plate 26, Figs. 9,10,11a,b; 12,13;
Plate 23, Figs. 16,17,18,19,20,21; Plate 22, Figs.7,8;
Plate 22, Figs. 9,10,11; Plate 23, Fig.6;
Plate 22, Figs. 12,13,14; Plate 22, Fig.2 and Plate 22, Fig.15).

Age: Middle Triassic: Ladinian Stage.

Sample: TT-79-12 biomicrite from Formation C (not in stratigraphic order). One of the richest samples containing:

Cratognathodus kochi (Huckriede 1958)
Cratognathodus posterognathus Mosher 1968
Gladigondolella malayensis malayensis Nogami 1968
Neogondolella constricta (Mosher & Clark 1965)
Neogondolella polygnathiformis (Budurov & Stefanov 1965)
Prioniodina petrae-viridis (Huckriede 1958)
Neogondolella sp.B
Prioniodina libita Mosher 1968
Prioniodella pectiniformis Huckriede 1958
Epigondolella carnica Krystyn 1975
Epigondolella baloghi (Kovacs 1977)
Epigondolella aff. baloghi (Kovacs 1977)
Epigondolella aff. parva (Kozur 1972)
Epigondolella permica (Hayashi 1968)
Epigondolella abneptis (Huckriede 1958)

Epigondolella nsp. B
Diplododella sp.
Neohindeodella sp.
Cypridodella sp.
Gen. et sp. indet. A
(Plate 22, Figs. 7,8; Plate 22, Figs. 9,10,11;
Plate 26, Figs. 9,10,11a,b; 12,13; Plate 27, Figs.7,8,9,10;
Plate 29, Figs. 1,2,3,4,5,6; Plate 23, Figs.16,17,18,19,20,21;
Plate 23, Figs. 13,14; Plate 23, Figs.9,10; Plate 24, Figs.11,12;
Plate 24, Figs.9a,b; 10,13,14,15,16; Plate 25,Figs.3a,b,c;
Plate 25, Figs. 4a,b; 5,6; Plate 24, Figs.1,2,3,4,5,6,7,8a,b;
Plate 26, Figs. 4,5,6; Plate 22, Fig.15 and Plate 23, Fig.7).

Age: Upper Triassic : Carnian Stage.

Sample: TT-79-13 recrystallized limestone from Formation C, containing:

Didymodella alternata (Mosher 1968)
Neohindeodella triassica (Müller 1956)
Gladigondolella tethydis (Huckriede 1958)
Gladigondolella malayensis malayensis Nogami 1968
Prioniodella pectiniformis Huckriede 1958
Prioniodina libita Mosher 1968
Prioniodina petrae-viridis (Huckriede 1958)
Cratognathodus kochi (Huckriede 1958)
Cratognathodus posterognathus Mosher 1968
Neogondolella constricta (Mosher & Clark 1965)
Neogondolella navicula navicula (Huckriede 1958)
Neogondolella sp.
Diplododella sp.
(Plate 22, Figs. 12,13,14; Plate 23, Fig.6;
Plate 26, Figs. 14a,b; 15,16,17; Plate 26, Figs.9,10,11a,b;
12,13; Plate 23, Figs. 9,10,11; Plate 23, Figs. 13,14;
Plate 23, Figs. 16,17,18,19,20,21; Plate 22, Figs. 7,8;
Plate 22, Figs. 9,10,11; Plate 27, Figs.7,8,9,10;
Plate 28, Figs. 6a,b ; 7a,b and Plate 22, Fig.15).

Age: Middle Triassic: Ladinian Stage.

Sample:TT-79-14 biomicrite from Formation C (Pl. 16A, containing:

Prioniodina petrae-viridis (Huckriede 1958)

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Prioniodina libita Mosher 1968
Cratognathodus kochi (Huckriede 1958)
Cratognathodus posterognathus Mosher 1968
Gladigondolella malayensis malayensis Nogami 1968
Prioniodella pectiniformis Huckriede 1958
Neogondolella constricta (Mosher & Clark 1965)
Neogondolella polygnathiformis (Budurov & Stefanov 1965)
Cypridodella cf. pronoides (Budurov 1971)
Cypridodella spengleri? (Huckriede 1958)
Cypridodella sp.
Neohindeodella sp.
(Plate 23, Figs. 16,17,18,19,20,21; Plate 23, Figs. 13,14;
Plate 22, Figs. 7,8; Plate 22, Figs. 9,10,11;
Plate 26, Figs. 9,10,11a,b; 12,13; Plate 23, Figs.9,10,11;
Plate 27, Figs. 7,8,9,10; Plate 29, Figs. 1,2,3,4,5,6;
Plate 22, Fig.1 and Plate 22, Figs. 3,4).

Age: Middle Triassic: Ladinian Stage.

Sample: TT-79-15 from Formation C, containing:

Cypridodella venusta (Huckriede 1958)
Prioniodella prioniodellides (Tatge 1956)
Cratognathodus posterognathus Mosher 1968
Prioniodina petrae-viridis (Huckriede 1958)
Enantiognathus ziegleri (Diebel 1956)
Xaniognathus tortilis (Tatge 1956)
Neogondolella constricta (Mosher & Clark 1965)
Neogondolella sp.
Neohindeodella sp.
Neocavitella sp. B
(Plate 22, Figs. 5,6; Plate 23, Fig.12; Plate 22, Figs.9,10,11;
Plate 23, Figs. 16,17,18,19,20,21; Plate 22, Fig.16;
Plate 23, Fig.4; Plate 27, Figs. 7,8,9,10 and Plate 23,Fig.3).

Age: Middle Triassic: Ladinian Stage.

Sample: TT-79-16 from Formation C, containing:

Neocavitella cavitata Sudar & Budurov 1979
Neogondolella constricta (Mosher & Clark 1965)
Neohindeodella triassica (Müller 1956)

Cratognathodus kochi (Huckriede 1958)
Cratognathodus posterognathus Mosher 1968
Xaniognathus tortilis (Tatge 1956)
Prioniodina petrae-viridis (Huckriede 1958)
(Plate 23, Fig.1; Plate 27, Figs. 7,8,9,10; Plate 23, Fig.6;
Plate 22, Figs. 7,8; Plate 22, Figs. 9,10,11; Plate 23, Fig.4;
Plate 23, Figs. 16,17,18,19,20,21).

Age: Middle Triassic: Topmost Ladinian Stage.

Sample: TT-79-17 from Formation C, packed biomicrite, containing:

Cratognathodus posterognathus Mosher 1968
Neohindeodella triassica (Müller 1956)
Neogondolella polygnathiformis (Budurov & Stefanov 1965)
Cypridodella sp.
Epigondolella sp.
(Plate 22, Figs. 9,10,11; Plate 23, Fig.6;
Plate 29, Figs. 1,2,3,4,5,6).

Age: Middle Triassic: Topmost Ladinian Stage.

Sample: TT-79-18 from Formation C, containing:

Epigondolella abneptis (Huckriede 1958)
Neogondolella polygnathiformis (Budurov & Stefanov 1965)
Neogondolella constricta (Mosher & Clark 1965)
Neogondolella sp.
Cypridodella sp.
(Plate 24, Figs. 1,2,3,4,5,6,7,8a,b; Plate 29, Figs. 1,2,3,4,
5,6; Plate 27, Figs. 7,8,9.10).

Age: Upper Triassic: Carnian Stage.

Sample: TT-79-19 from Formation D, biomicrite resembling Sample TT-80-7 but without foraminifers; containing:

Enantiognathus ziegleri (Diebel 1956)
Epigondolella abneptis (Huckriede 1958)
Epigondolella sp.
(Plate 22, Fig.17; Plate 24, Figs. 1,2,3,4,5,6,7,8a,b).

Age: Upper Triassic: Carnian Stage.

Sample: TT-80-2 recrystallized biomicrite from Formation B, containing:

Enantiognathus ziegleri (Diebel 1956)
Neogondolella bifurcata (Budurov & Stefanov 1972)
Neogondolella sp.
Neohindeodella sp.
Cypridodella sp.
Xaniognathus sp.
(Plate 22, Fig.17; Plate 27, Figs. 3,4).

Age: Middle Triassic: Anisian Stage.

Sample: TT-80-3 from Formation C (Plate 14C) containing:

Cratognathodus posterognathus Mosher 1968
Prioniodina libita Mosher 1968
Prioniodina petrae-viridis (Huckriede 1958)
Gladigondolella malayensis malayensis Nogami 1968
Gladigondolella sp.
Cypridodella sp.
Neocavitella sp.A
(Plate 22, Figs. 9,10,11; Plate 23, Figs. 13,14;
Plate 23, Figs. 16,17,18, 19,20,21; Plate 26,Figs.9,10,
11a,b; 12,13).

Age: Middle Triassic: Ladinian Stage.

Sample: TT-80-4 from Formation C, containing both foraminifers and conodonts. Foraminifers poorly preserved, not identifiable to generic level.

Foraminifers:

Nodosaridae indet.
Valvulinidae indet.

Conodonts:

Neogondolella polygnathiformis (Budurov & Stefanov 1965)
Epigondolella primita Mosher 1970
Epigondolella abneptis (Huckriede 1958)
Epigondolella triangularis (Budurov 1972)
Epigondolella parva (Kozur 1972)
Epigondolella aff. baloghi (Kovacs 1977)
Epigondolella nsp A.
Epigondolella sp.

Enantiognathus ziegleri (Diebel 1956)

Enantiognathus sp.

Xaniognathus tortilis (Tatge 1956)

Xaniognathus sp.

(Plate 29, Figs. 1,2,3,4,5,6; Plate 25, Figs.10a,b; 11a,b;
Plate 24, Figs. 1,2,3,4,5,6,7,8a,b; Plate 25, Figs.9a,b;
Plate 25, Figs. 1,2; Plate 24, Figs. 13,14,15,16;
Plate 22, Fig.17 and Plate 23, Fig.4).

Age: Upper Triassic: Norian Stage

Sample:TT-80-5 from Formation C, containing:

Holothurian sclerites:

Theelia immisorbicula Mostler 1968

Theelia cf. immisorbicula Mostler 1968

Theelia sp.

(Plate 29, Figs. 9,10,11).

Conodonts:

Neohindeodella dropla (Spasov & Ganev 1960)

Epigondolella abneptis (Huckriede 1958)

Epigondolella postera (Kozur & Mostler 1971)

Epigondolella parva (Kozur 1972)

Epigondolella sp.

Enantiognathus sp.

Xaniognathus sp.

(Plate 23, Fig.5; Plate 24, Figs. 1,2,3,4,5,6,7,8a,b;
Plate 25, Figs. 7a,b; 8; Plate 25, Figs. 1,2).

Age: Upper Triassic: Norian Stage.

Sample: TT-80-6 biomicrite from Formation D, containing:

Epigondolella abneptis (Huckriede 1958)

Neohindeodella sp.

(Plate 24, Figs. 1,2,3,4,5,6,7,8a,b).

Age: Upper Triassic, Norian Stage.

Sample: TT-80-7 biomicrite from Formation D, containing:

Foraminifers:

Involutina gaschei praegaschei? Koehn-Zaninetti 1968

Involutina sinuosa pragsoides (Oberhauser 1964)

Trocholina? permodiscoides Oberhauser 1964

Nodosaridae indet.
(Plates 14D, 15A, 15B, 15C, 15D).

Conodonts:

Epigondolella abneptis (Huckriede 1958)
Epigondolella postera (Kozur & Mostler 1971)
Neogondolella kozuri Gedik 1981
Neogondolella sp.
Enantiognathus sp.
(Plate 24, Figs. 1,2,3,4,5,6,7,8a,b; Plate 25, Figs.7a,b,8; Plate 28, Figs. 2a,b,c).

Age: Upper Triassic: Norian Stage.

Sample: TT-81-1 from Formation D containing:

Foraminifers:

Vidalina sp. indet.

Conodonts:

Epigondolella abneptis (Huckriede 1958)
Neohindeodella sp.
Neogondolella sp.
Enantiognathus sp.
(Plate 24, Figs. 1,2,3,4,5,6,7,8a,b).

Age: Upper Triassic: Norian Stage.

3.2.3: Saklıkent Sections (TS)

In the south-west of Antalya, about 2500 metres above sea level, lies Saklıkent (meaning "hidden settlement") where a ski resort has recently been built. Triassic rocks crop out along the skyline just above the resort.

Samples have been collected from three different localities in this area as shown in Figure 18. The precise stratigraphical relationships of the samples are often not clear, in consequence of the tectonic complexity of the area. In spite of this complexity, the present study has clarified the age of these rocks, and has determined, for the first time, the sedimentary environment of each sample.

MIDDLE TRIASSIC

In the TS section, which consists of thin to medium bedded grey

and reddish limestone, only Middle Triassic is recognized. Three sites have been sampled (Fig.22):

I - At the first site, the lowest exposure is grey biomicrite, containing ammonites, conodonts and a few foraminifers in the upper part of it. The lower part is badly altered and does not contain any microfossils. In thin section, the rocks are extensively micritized, and it is very difficult to identify allochems. They are conformably overlain by reddish, sparse biomicrite (Plates 16C, 16D). The following conodonts have been recovered:

Neogondolella navicula navicula, Neogondolella excelsa, Neogondolella cf. bakalovi, Neogondolella mombergensis, Neogondolella basisymmetrica, Neogondolella longa, Neogondolella sp., Prioniodina petrae-viridis, Prioniodina libita, Prioniodina sp., Gladigondolella tethydis, Gladigondolella sp., Cypridodella venusta, Cypridodella spengleri, Cypridodella sp., Didymodella alternata, Enantiognathus ziegleri, Enantiognathus sp., Prioniodella pectiniformis, Cratognathodus posterognathus, Cartognathodus kochi, Cratognathodus sp., Neohindeodella triassica, Neohindeodella sp., Xaniognathus tortilis, Xaniognathus sp.(Tab.7).

Age: Middle Triassic: Anisian Stage.

II - In the second locality (Fig.22) only half a metre of grey limestone crops out. It is extensively recrystallized and contains no identifiable allochems. Conodont extraction was unsuccessful.

III - This sample point is closer to the ski-resort, on a steep slope littered with loose rock, but with very sparse outcrop consisting of grey biomicrite rich in ammonites, conodonts and foraminifers, conformably overlain by reddish packed biomicrite with a similar fauna.

Conodonts: Gladigondolella malayensis malayensis, Gladigondolella tethydis, Prioniodina petrae-viridis, Prioniodina libita, Prioniodina sp., Prioniodella prioniodellides, Cypridodella venusta, Cypridodella sp., Neogondolella longa, Neogondolella mombergensis, Neogondolella polygnathiformis, Neogondolella excelsa, Neogondolella foliata, Neogondolella bulgarica, Neogondolella navicula navicula, Neogondolella basisymmetrica, Neogondolella sp., Didymodella alternata, Cratognathodus kochi, Cratognathodus posterognathus, Cratognathodus sp., Enantiognathus ziegleri, Xaniognathus sp., Gen.nov.et. sp. indet. B (Tab.7).

Age: Middle Triassic: Ladinian Stage.

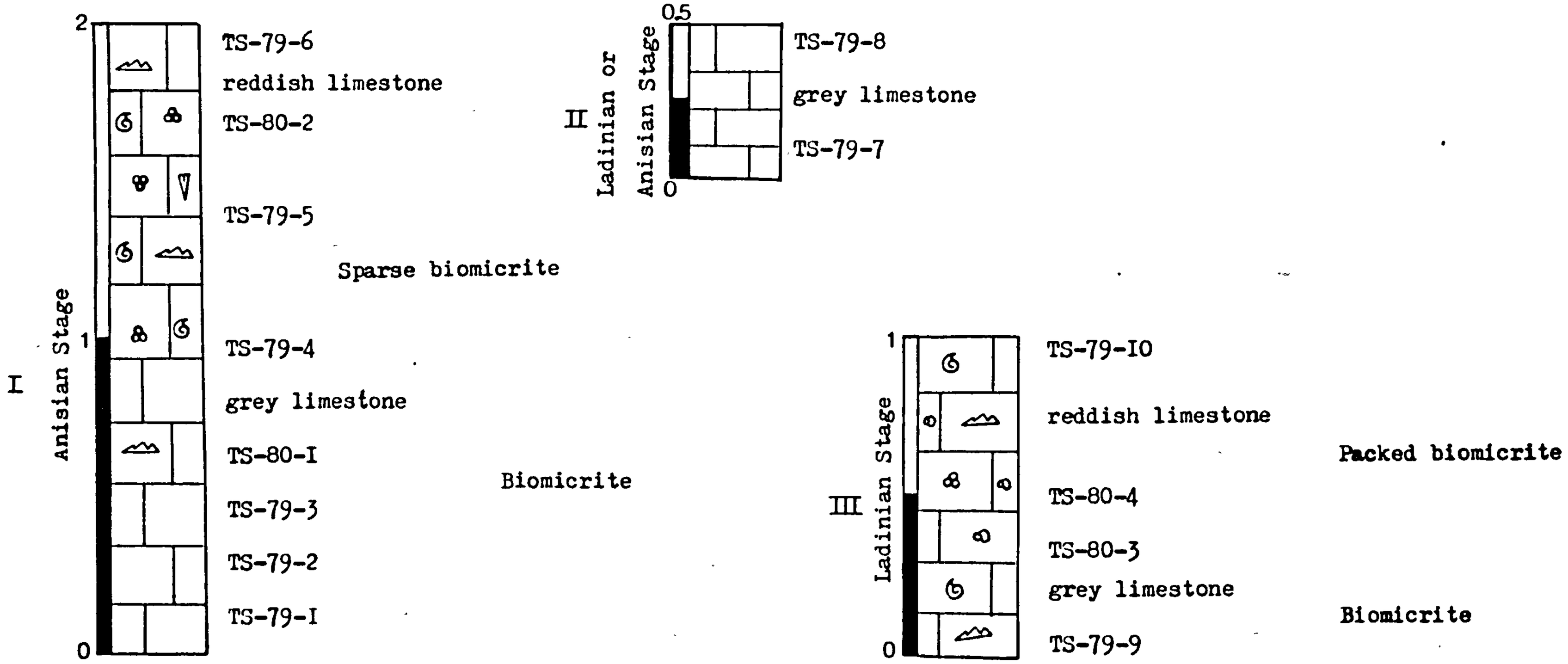


Figure 22. Stratigraphic sections from the SAKLIKENT area (TS).
Scale in meters.

TABLE 7A: Numerical Abundance of Conodonts in Samples collected from Saklıkent (Antalya, TS section)

CONODONTS	MIDDLE TRIASSIC										
	Anisian						Ladinian				
	Samples	TS-79-4	TS-79-5	TS-79-6	TS-80-1	TS-80-2	TS-79-9	TS-79-10	TS-80-3	TS-80-4	Totals
Cratognathodus kochi				7				5		12	
C. posterognathus				3				15	9	27	
Cratognathodus sp.				4				10	4	18	
Cypridodella spengleri				5						5	
Cypridodella venusta				2		1				3	
Cypridodella sp.				10				20	6	36	
Didymodella alternata				3				1		4	
Enantiognathus ziegleri				2					1	3	
Enantiognathus sp.	3									3	
Gladigondolella tethydis				43	7	11	1	23	7	92	
G.malayensis malayensis						4				4	
Gladigondolella sp.			1	20						21	
Neogondolella cf. bakalovi				3						3	
N. basisymmetrica				6	2				11	19	
N. bulgarica								15	13	28	
Totals refer to Tables 7A & 7B	23	3	2	180	15	49	2	167	90		

TABLE 7B: Abundance Data for Conodont Taxa from TS (contd.)

CONODONTS	MIDDLE TRIASSIC										
	Anisian						Ladinian				
Samples	TS-79-4	TS-79-5	TS-79-6	TS-80-1	TS-80-2	TS-79-9	TS-79-10	TS-80-3	TS-80-4	Totals
Neogondolella excelsa				4	2			3	1?	10
N. foliata								14	2	16
N. longa				11	3	8		1?		23
N. mombergensis				10		2				12
N. navicula navicula	12			2					20	34
N. polygnathiformis								12		12
Neogondolella sp.	6	2	1	7		13		15	14	58
Neohindeodella triassica				3						3
Neohindeodella sp.				1		2				3
Prioniodella pectiniformis				2						2
P. prioniodellides									1	1
Prioniodina libita				2				3	1	6
P. petrae-viridis		1		18	1	2		27		49
Prioniodina sp.				6				1		7
Xaniognathus tortilis				3						3
Xaniognathus sp.	2			3		2	1	2		10
New Gen. et sp.indet.B						4				4

3.2.4 Dömek Tepe Section (TD)

In the south-west of Antalya, Dömek Tepe is located to the north-west of Göynük, beyond Sögüt Yayla. Thin to medium bedded grey-red mottled limestones have been identified as Upper Triassic (Fig.23, Plate 13B). In the nearby outcrops on Tiryaki Tepe, similar limestones overlie pillow lavas. No pillow lavas have been seen on the Dömek Tepe outcrops, but they are shown in Figure 23, as a result of personal communication with Özcan (MTA).

UPPER TRIASSIC

The grey-red mottled limestone consists of thin to medium well-bedded, sparse biomicrite containing abundant ammonites, gastropods, conodonts and foraminifers near the base. Some gastropods show geopetal structures in thin section, indicating way-up (Plate 16B). Pervasive micritization of the higher limestones in this outcrop has obliterated virtually all traces of allochems, including microfossils.

Conodonts: Epigondolella abneptis, Epigondolella permica, Epigondolella primita, Epigondolella nsp.C, Epigondolella sp., Neogondolella oertlii, Neogondolella polygnathiformis, Neogondolella sp., Neohindeodella dropla, Neohindeodella triassica, Xaniognathus sp.(Tab.8 .)

Age: Upper Triassic: Upper Carnian-Lower Norian.

3.2.5 Microfaunas from TS and TD

A few indeterminate foraminifers and well preserved conodonts have been found from these two sections. The rocks are usually biomicrite, although they are recrystallized and scarcely identifiable (abundance data for conodonts see 7 A,B and 8).

The microfossil content of formations is given in sample order:

Microfaunas from Saklikent Section (Antalya, TS):

Sample: TS-79-4 is pervasively micritized biomicrite containing:

Neogondolella navicula navicula (Huckriede 1958)

Neogondolella sp.

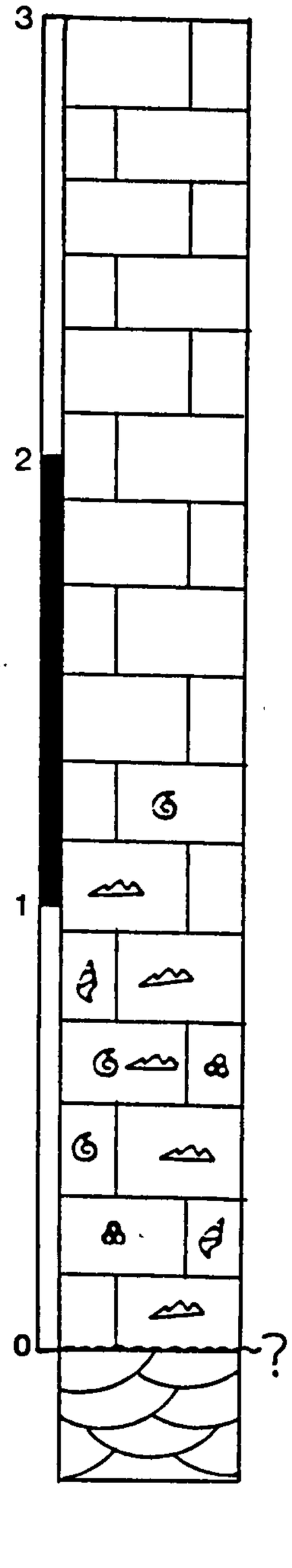
Xaniognathus sp.

Enantiognathus sp.

(Plate 28, Figs. 6a,b; 7a,b).

Age: Middle Triassic: Anisian Stage.

U P P E R T R I A S S I C



TD-79-5

TD-79-4

grey-red mottled limestone | sparse biomicrite

TD-79-3

TD-80-2

TD-80-I

TD-79-2 A and B

TD-79-I

Pillow lava

Figure 23. Stratigraphic columnar section from DÖMEK TEPE (TD).Scale in meters.

TABLE 8: Numerical Abundance of Conodonts in Samples collected from Dömek Tepe (Antalya, TD section)

CONODONTS	UPPER TRIASSIC						
	Upper Carnian - Lower Norian						
	Samples	TD-79-1	TD-79-2A	TD-79-2B	TD-80-1	TD-80-2	Totals
Epigondolella abneptis		10	2		3		15
E. permica		4				3	7
E. primita						12	12
Epigondolella nsp.C						1	1
Epigondolella sp.		6		4	2		12
Neogondolella oertlii				4			4
N. polygnathiformis		7	1	4			12
Neogondolella sp.		3			6		9
Neohindeodella dropla		3					3
Neohindeodella triassica				1	1		2
Xaniognathus sp.					1		1
Totals		33	3	13	13	16	

Sample: TS-79-5 is biomicrite, containing:

Prioniodina petrae-viridis (Huckriede 1958)
Neogondolella sp.
(Plate 23, Figs. 16,17,18,19,20,21).

Age: Middle Triassic: Anisian Stage.

Sample: TS-79-6 is sparse biomicrite containing indeterminate foraminifers and poorly preserved conodonts:

Gladigondolella sp.
Neogondolella sp.

Age: Middle Triassic: possibly Anisian Stage.

Sample: TS-79-9 is biomicrite containing:

Gladigondolella malayensis malayensis Nogami 1968
Gladigondolella tethydis (Huckriede 1958)
Prioniodina petrae-viridis (Huckriede 1958)
Cypridodella venusta (Huckriede 1958)
Neogondolella longa Budurov & Stefanov 1973
Neogondolella mombergensis (Tatge 1956)
Neogondolella sp.
Neohindeodella sp.
Xaniognathus sp.
Gen.nov.et.sp. indet.B.
(Plate 26, Figs. 9,10,11a,b; 12,13; Plate 26, Figs.14a,b;15,16,17;
Plate 23, Figs. 16,17,18,19,20,21; Plate 22, Figs. 5,6;
Plate 28, Figs. 3a,b,c; 4; Plate 28, Figs.5a,b,c;
Plate 29, Figs. 8a,b).

Age: Middle Triassic: Ladinian Stage.

Sample: TS-79-10 is reddish packed biomicrite containing:

Gladigondolella tethydis (Huckriede 1958)
Xaniognathus sp.
(Plate 26, Figs. 14a,b; 15,16,17).

Age: Middle Triassic: possibly Ladinian Stage.

Sample: TS-80-1 richly fossiliferous biomicrite, containing:

Didymodella alternata (Mosher 1968)

Enantiognathus ziegleri (Diebel 1956)

Prioniodina petrae-viridis (Huckriede 1958)

Prioniodina libita Mosher 1968

Prioniodina sp.

Cypridodella spengleri (Huckriede 1958)

Cypridodella venusta (Huckriede 1958)

Cypridodella sp.

Prioniodella pectiniformis Huckriede 1958

Gladigondolella tethydis (Huckriede 1958)

Gladigondolella sp.

Cratognathodus kochi (Huckriede 1958)

Cratognathodus posterognathus Mosher 1968

Cratognathodus sp.

Neohindeodella triassica (Müller 1956)

Neohindeodella sp.

Xaniognathus tortilis (Tatge 1956)

Xaniognathus sp.

Neogondolella mombergensis (Tatge 1956)

Neogondolella excelsa (Mosher 1968)

Neogondolella cf. bakalovi Budurov & Stefanov 1972

Neogondolella basisymmetrica Budurov & Stefanov 1972

Neogondolella longa Budurov & Stefanov 1973

Neogondolella navicula navicula (Huckriede 1958)

Neogondolella sp.

(Plate 22, Figs. 12,13,14; Plate 22, Fig.17; Plate 23, Figs.16, 17,18,19,20,21; Plate 23, Figs. 13,14; Plate 23, Fig.15; Plate 22, Figs. 3,4; Plate 22, Figs. 5,6; Plate 23,Figs.9,10,11; Plate 26, Figs. 14a,b; 15,16,17; Plate 22, Figs. 7,8; Plate 22, Figs. 9,10,11; Plate 23, Fig.6; Plate 23, Fig.4; Plate 28, Figs. 5a,b,c; Plate 27, Figs.11,12,13; Plate 27, Figs. 1a,b; Plate 27, Figs. 2a,b,c; Plate 28, Figs. 3a,b,c; 4; Plate 28, Figs. 6a,b).

Age: Middle Triassic: Anisian Stage.

Sample: TS-80-2 is biomicrite containing

Gladigondolella tethydis (Huckriede 1958)

Prioniodina petrae-viridis (Huckriede 1958)

Neogondolella longa Budurov & Stefanov 1973

Neogondolella basisymmetrica Budurov & Stefanov 1972

Neogondolella excelsa (Mosher 1968)

(Plate 26, Figs. 14a,b; 15,16,17; Plate 23, Figs.16,17,18, 19,20,21; Plate 28, Figs. 3a,b,c;4; Plate 27, Figs. 2a.b.c; Plate 27, Figs. 11,12,13).

Age: Middle Triassic: Anisian Stage.

Sample: TS-80-3 is recrystallized grey limestone taken from the same horizon as TS-79-9. It contains:

Didymodella alternata (Mosher 1968)

Gladigondolella tethydis (Huckriede 1958)

Cratognathodus kochi (Huckriede 1958)

Cratognathodus posterognathus Mosher 1968

Cratognathodus sp.

Prioniodina petrae-viridis (Huckriede 1958)

Prioniodina libita Mosher 1968

Prioniodina sp.

Neogondolella polygnathiformis (Budurov & Stefanov 1965)

Neogondolella excelsa (Mosher 1968)

Neogondolella foliata (Budurov 1975)

Neogondolella bulgarica (Budurov & Stefanov 1975)

Neogondolella longa Budurov & Stefanov 1973

Neogondolella sp.

Cypridodella sp.

Xaniognathus sp.

(Plate 22, Figs. 12,13,14; Plate 26, Figs. 14a,b; 15,16,17; Plate 22, Figs. 7,8; Plate 22, Figs. 9,10,11; Plate 23, Figs.16, 17,18,19,20,21; Plate 23, Figs. 13,14; Plate 29, Figs. 1,2,3, 4,5,6; Plate 27, Figs. 11,12,13; Plate 27, Figs. 14a,b,c; Plate 27, Figs. 5a,b,c;6; Plate 28, Figs. 3a,b,c; 4).

Age: Middle Triassic: Ladinian Stage.

Sample: TS-80-4 is reddish packed biomicrite containing:

Enantiognathus ziegleri (Diebel 1956)

Prioniodella prioniodellides (Tatge 1956)

Prioniodina libita Mosher 1968

Gladigondolella tethydis (Huckriede 1958)

Neogondolella excelsa (Mosher 1968)

Neogondolella foliata (Budurov 1975)

Neogondolella bulgarica (Budurov & Steganov 1975)

Neogondolella navicula navicula (Huckriede 1958)

Neogondolella basisymmetrica Budurov & Stefanov 1972

Neogondolella sp.

Cratognathodus posterognathus Mosher 1968

Cratognathodus sp.

Cypridodella sp.

(Plate 22, Fig.17; Plate 23, Fig.12; Plate 23, Figs. 13,14;
Plate 26, Figs. 14a,b; 15,16,17; Plate 27, Figs. 11,12,13;
Plate 27, Figs. 14a,b,c; Plate 27, Figs. 5a,b,c;6;
Plate 28, Figs. 6a,b;7a,b; Plate 27, Figs. 2a,b,c;
Plate 22, Figs. 9,10,11).

Age: Middle Triassic: Ladinian Stage.

Microfaunas from Dömek Tepe Section (Antalya, TD):

Sample: TD-79-1 is sparse biomicrite containing:

Foraminifers:

Nodosaridae indet. (Plate 16B).

Conodonts:

Epigondolella permica (Hayashi 1968)

Epigondolella abneptis (Huckriede 1958)

Epigondolella sp.

Neogondolella polygnathiformis (Budurov & Stefanov 1965)

Neogondolella sp.

Neohindeodella dropla (Spasov & Ganev 1960)

(Plate 25, Figs. 4a,b; 5,6; Plate 24, Figs. 1,2,3,4,5,
6,7,8a,b; Plate 29, Figs. 1,2,3,4,5,6; Plate 23, Fig.5).

Age: Upper Triassic: U.Carnian - L.Norian Stages.

Sample: TD-79-2A from the same horizon as sample TD-79-1, containing:

Epigondolella abneptis (Huckriede 1958)

Neogondolella polygnathiformis (Budurov & Stefanov 1965)

(Plate 24, Figs. 1,2,3,4,5,6,7,8a,b; Plate 29, Figs.1,2,3,4,5,6).

Age: Upper Triassic: U.Carnian - L.Norian Stages.

Sample: TD-79-2B same as sample TD-79-2A, containing:

Neohindeodella triassica (Müller 1956)

Neogondolella polygnathiformis (Budurov & Stefanov 1965)
Neogondolella oertlii (Kozur 1980)
Epigondolella sp.

(Plate 23, Fig.6; Plate 29, Figs. 1,2,3,4,5,6;
Plate 28, Figs. 8a,b; 9a,b).

Age: Upper Triassic: U.Carnian - L. Norian Stages.

Sample: TD-80-1 is grey-red mottled limestone containing:

Neohindeodella triassica (Müller 1956)
Epigondolella abneptis (Huckriede 1958)
Epigondolella sp.
Neogondolella sp.
Xaniognathus sp.

(Plate 23, Fig.6; Plate 24, Figs.1,2,3,4,5,6,7,8a,b).

Age: Upper Triassic: U.Carnian - L.Norian Stages.

Sample: TD-80-2 from the same horizon as sample TD-80-1, containing:

Epigondolella primita Mosher 1970
Epigondolella permica (Hayashi 1968)
Epigondolella nsp.C

(Plate 25, Figs.10a,b; 11a,b; Plate 25, Figs. 4a,b;5,6).

Age: Upper Triassic: U.Carnian - L.Norian Stages.

3.2.6 Environmental Interpretation

The Triassic limestones of Antalya contain virtually no sedimentary structures on which an environmental reconstruction could be based. However, they resemble limestones of comparable age in other Mediterranean countries and the Austrian Alps, where detailed studies have been made (Zankl, 1971; Bernoulli & Jenkyns, 1974; Wilson 1975 and others).

The marine limestones from Teke Dağı (TT) are typical of the Alpine-type Triassic; in a few metres they contain all the Triassic stages and sub-stages. The Lower Triassic rocks are poorly exposed interbedded micrite and yellow-grey terrigenous clastics, showing no bioturbation nor evaporites, although comparable sequences in the Austrian Alps show remarkable evaporite developments (Bernoulli & Jenkyns, 1974). The occurrence of micrite indicates an absence of currents that could winnow away the lime mud; the absence of burrows and fauna suggests conditions

unfavourable for normal marine life, both in the water and in the underlying sediment. Conditions were also unfavourable for flysch sedimentation.

Above the Lower Triassic the Anisian stage of the Middle Triassic is represented by vermicular marly limestone containing a fairly restricted conodont fauna. No other organisms are found. This might be due to adverse salinity in the waters or to post-mortem solution of biogenic carbonate in deep waters. If so, it would imply that deposition occurred at about the Carbonate Compensation Depth. The absence of terrigenous sediments hints at tectonic events between Antalya and the source that had supplied the Lower Triassic terrigenes.

The topmost Middle Triassic and Upper Triassic sediments in Teke Dağı (TT) form a stratigraphically condensed sequence of red, nodular biomicrite and cream-coloured, non-nodular biomicrite. In the latter, faunas consist only of conodonts and foraminifers, whereas in the red nodular biomicrite, they comprise ammonites, gastropods, conodonts, echinoderms, thin-shelled bivalves and foraminifers. The red nodular biomicrite facies resembles the Hallstätt Limestone in Austria. There are opposing ideas for the depositional environment of this red limestone: deep-water (Fischer, 1964) or photic (shallow)water (Wendt, 1969b; Krystyn et al., 1971; Zankl,(1971),who suggested a water depth of 50 to 200 metres). Bernoulli and Jenkyns (1974) considered them to be pelagic sediments deposited on sea-mounts within ocean basins. Their ideas seem to fit the Antalya sediments better. The lack of any indication of current-activity, the prevalence of unbroken shells of large, free swimming organisms with thin shells, and the absence of colonial organisms and other types beside fauna, are all evidence in favour of pelagic deposition but against shallow, wave disturbed conditions.

The Middle Triassic rocks from Saklıkent (TS) show some local differences. They are characterized by grey biomicrite and reddish packed biomicrite, both of which contain rich faunasof ammonites, conodonts and foraminifers. There are no nodules or other lithological similarities to Teke Dağı. The fauna indicates normal marine salinity. Probably these compare with the basin-type sediments described by Bernoulli and Jenkyns (1974).

The Upper Triassic rocks from Dömek Tepe (TD) are grey and red mottled limestone containing ammonites, gastropods, conodonts and foraminifers.

This sparse biomicrite does not show any nodular structures. No microfossils have been recovered from the upper part of this outcrop; the rocks are pervasively micritized. The environment of deposition is more or less the same as the previous ones. The occurrence of Neogondolella (Conodontophorida) in all the sampled sections in Antalya supports the idea of a deep-water environment.

PLATE 13

A - General view of the measured section in Teke Dağı (Antalya, TT). The red-nodular Triassic limestone sequence is visible in the lower right of the photograph; the more massive limestones in the upper half of the photograph are Jurassic.

B - Close up view of Upper Triassic limestone at Dömek Tepe (Antalya, TD).

C - General view of the topography in Kartal Kayası Tepe (Kayseri, TYKK).

D - Cross-section of poorly preserved megalodonts (Megalodontidae: Mesozoic bivalve family) from Kartal Kayası Tepe (Kayseri, TYKK).

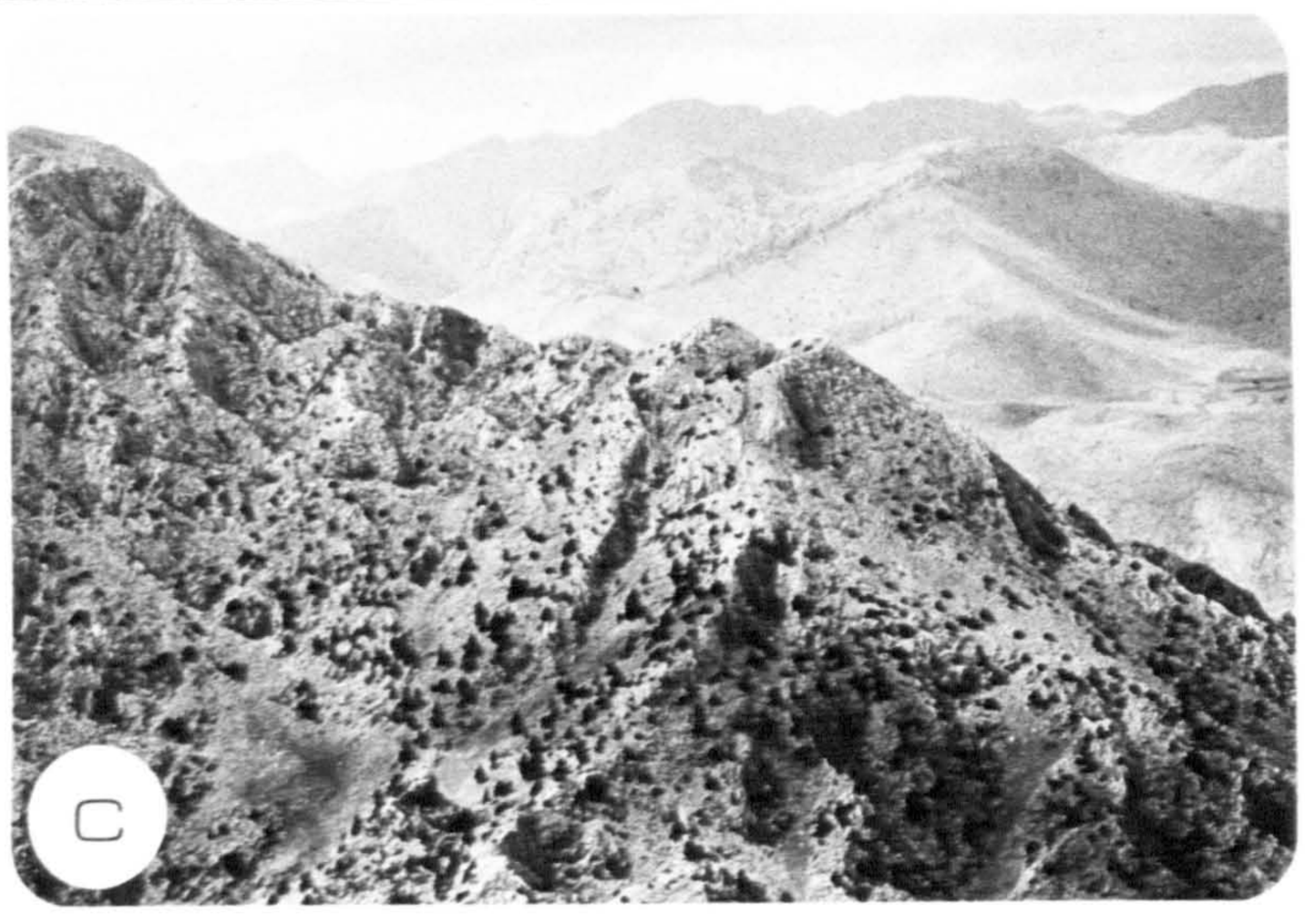


PLATE 13

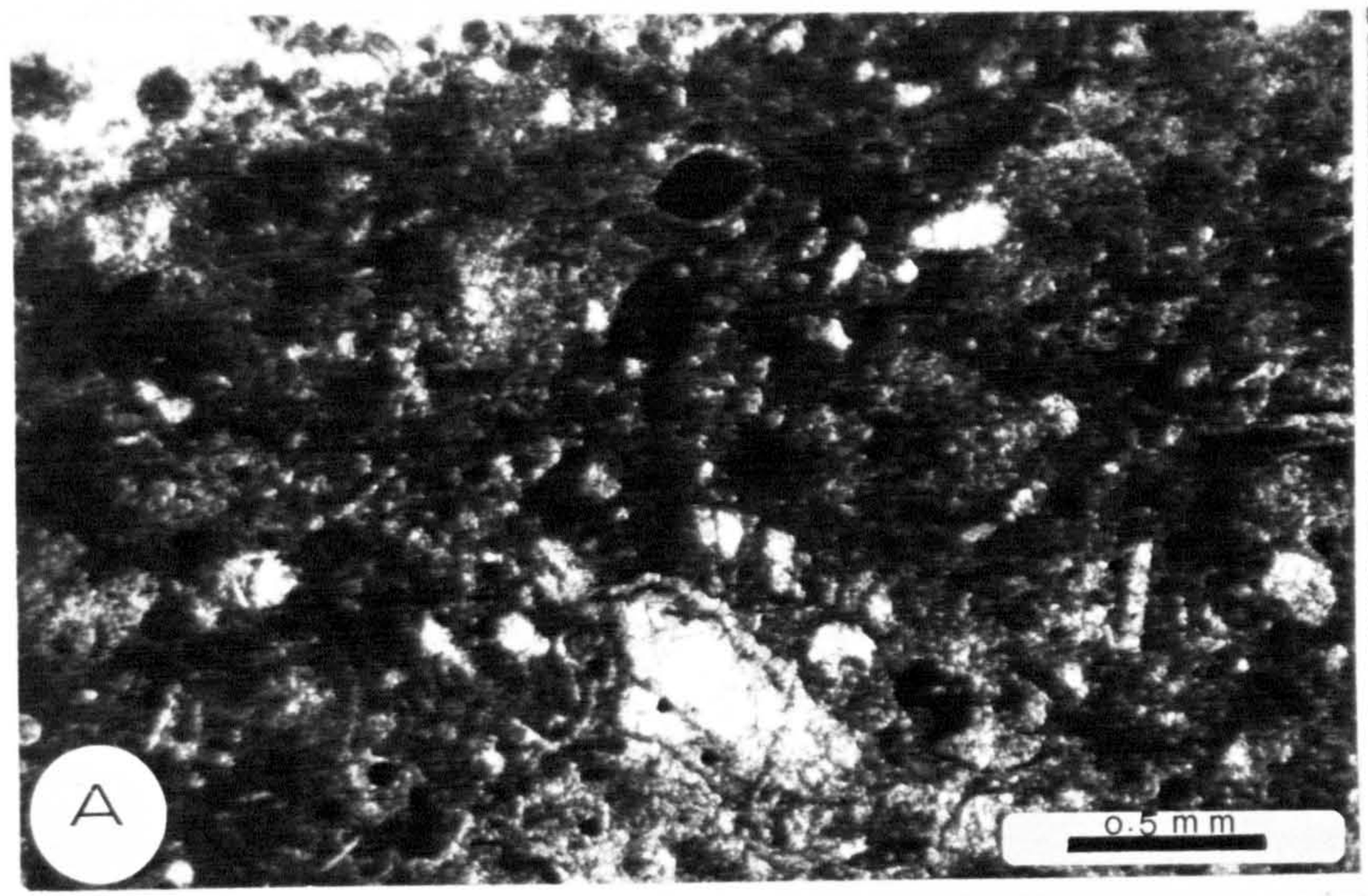
PLATE 14

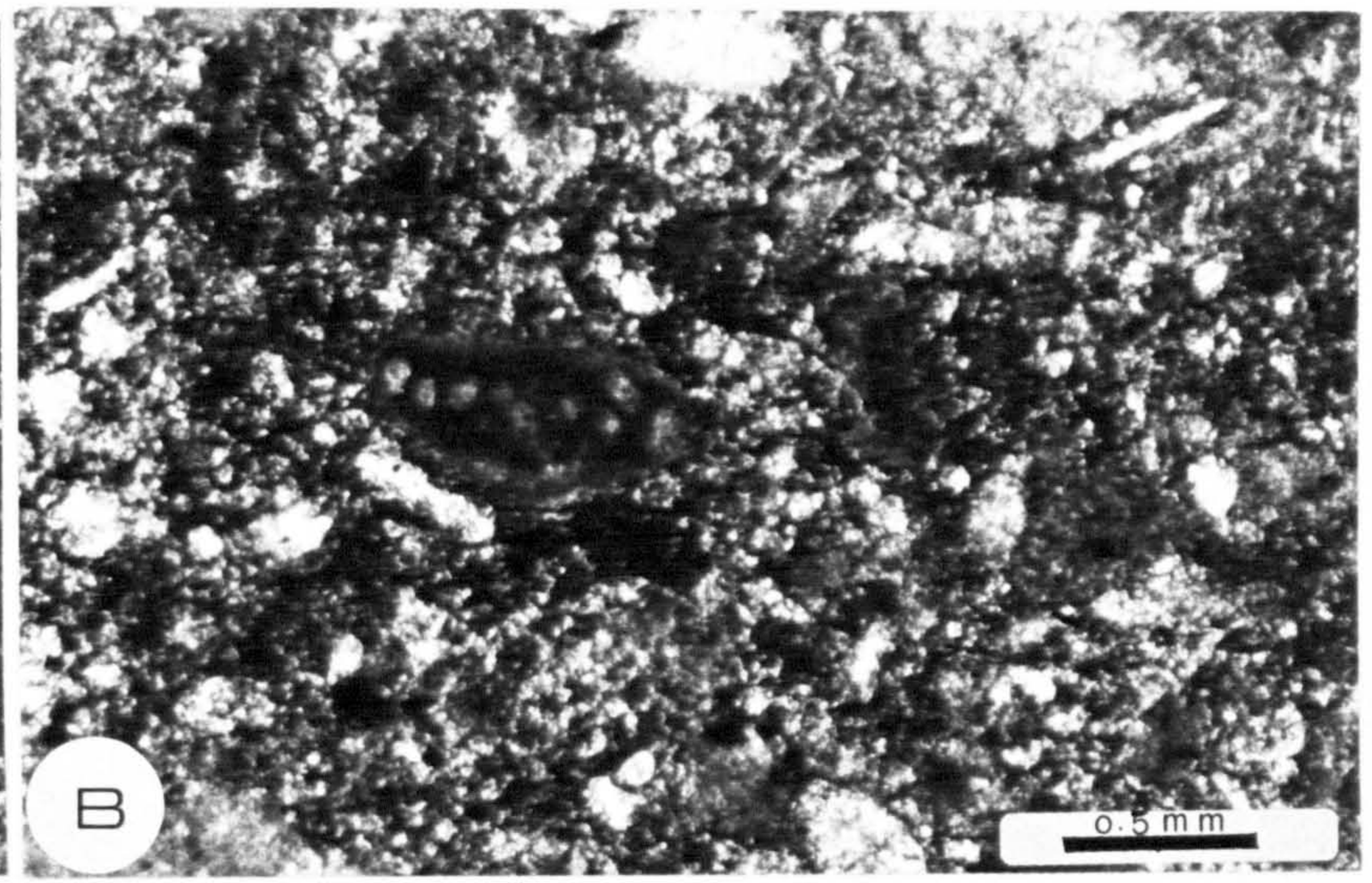
A - Photomicrograph of fossiliferous red-nodular calcarenite from Teke Dağı, containing foraminifers: Ophthalmidium sp. (top centre). This sample also contains conodonts (Antalya, TT-79-5).

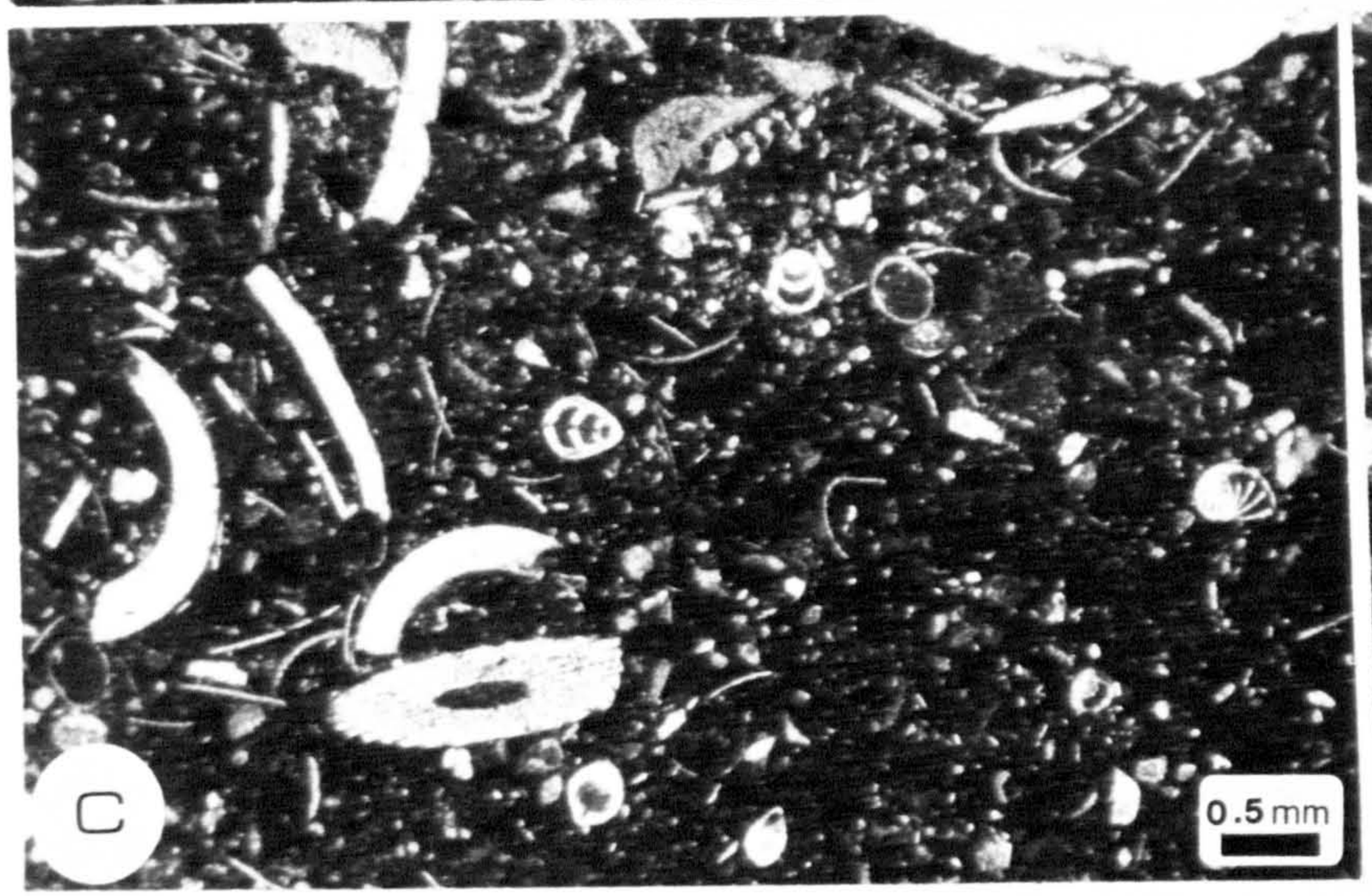
B - Photomicrograph of same sample as Plate 14A, showing Ophthalmidium chialingchiangense? Ho, near centre (Antalya, TT-79-5).

C - Photomicrograph of packed biomicrite containing ammonites, gastropods, echinoids and a few Nodosarid foraminifers. This sample is also moderately rich in conodonts (Antalya, TT-80-3).

D - Photomicrograph of packed biomicrite, rich in echinoids, ostracods, conodonts and foraminifers including Nodosariids and Involutinids.
This photomicrograph shows Involutina gaschei cf. praegaschei Koehn-Zaninetti (about centre) (Antalya, TT-80-7).







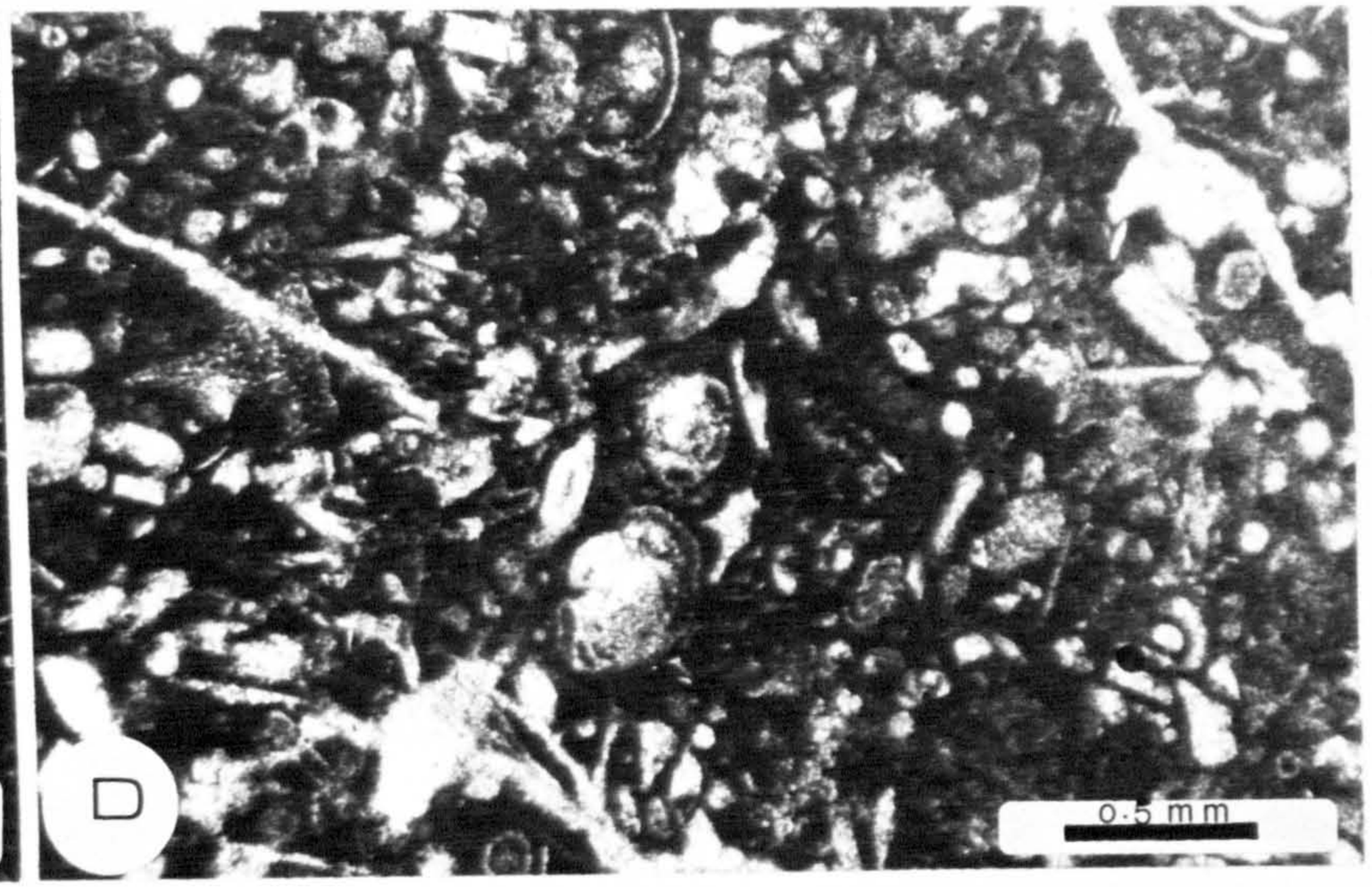


PLATE 14

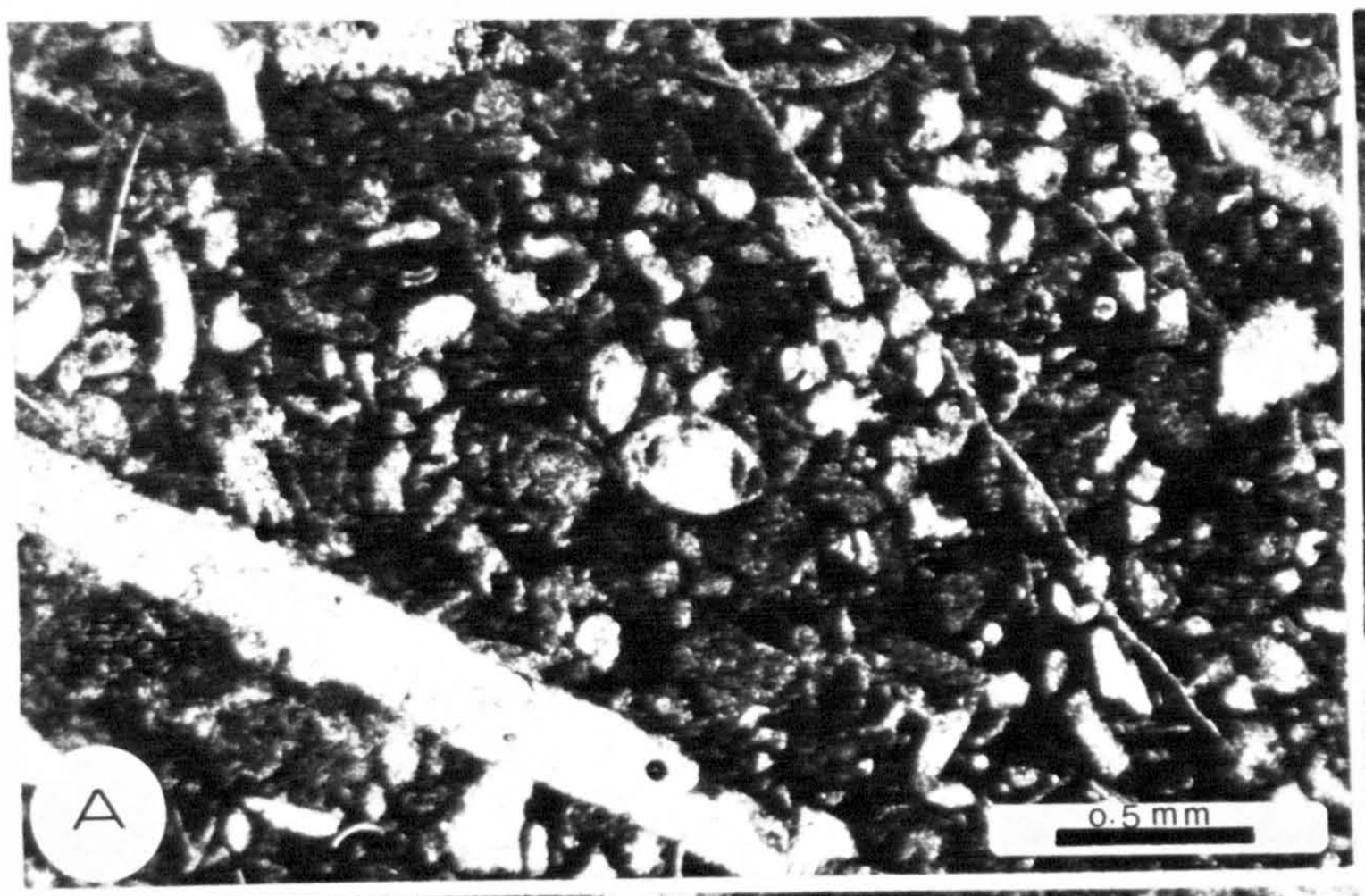
PLATE 15

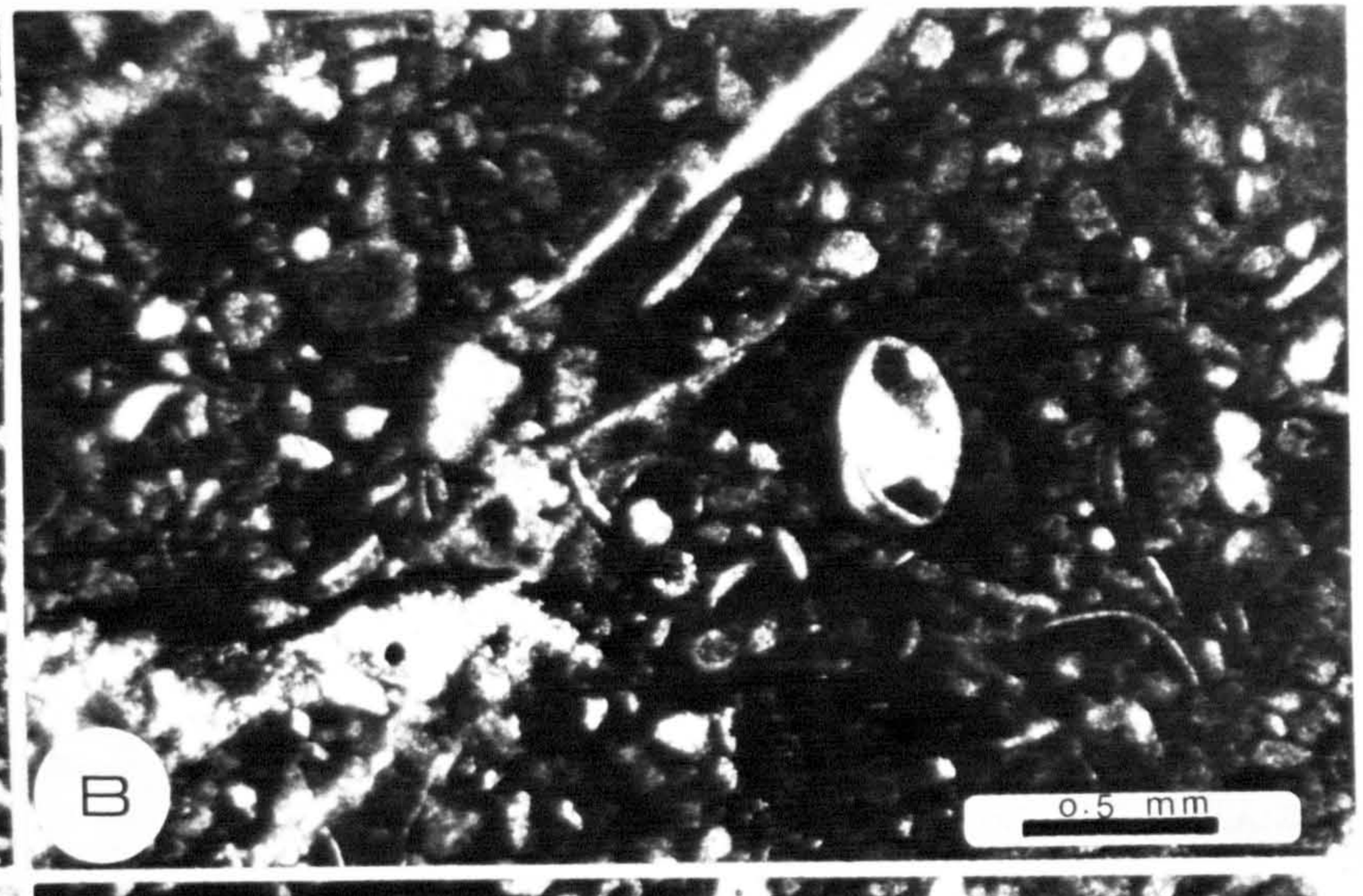
A - Photomicrograph of same sample as in Plate 14D, showing Involutina sinuosa pragsoides (Oberhauser) in the centre (Antalya, TT-80-7).

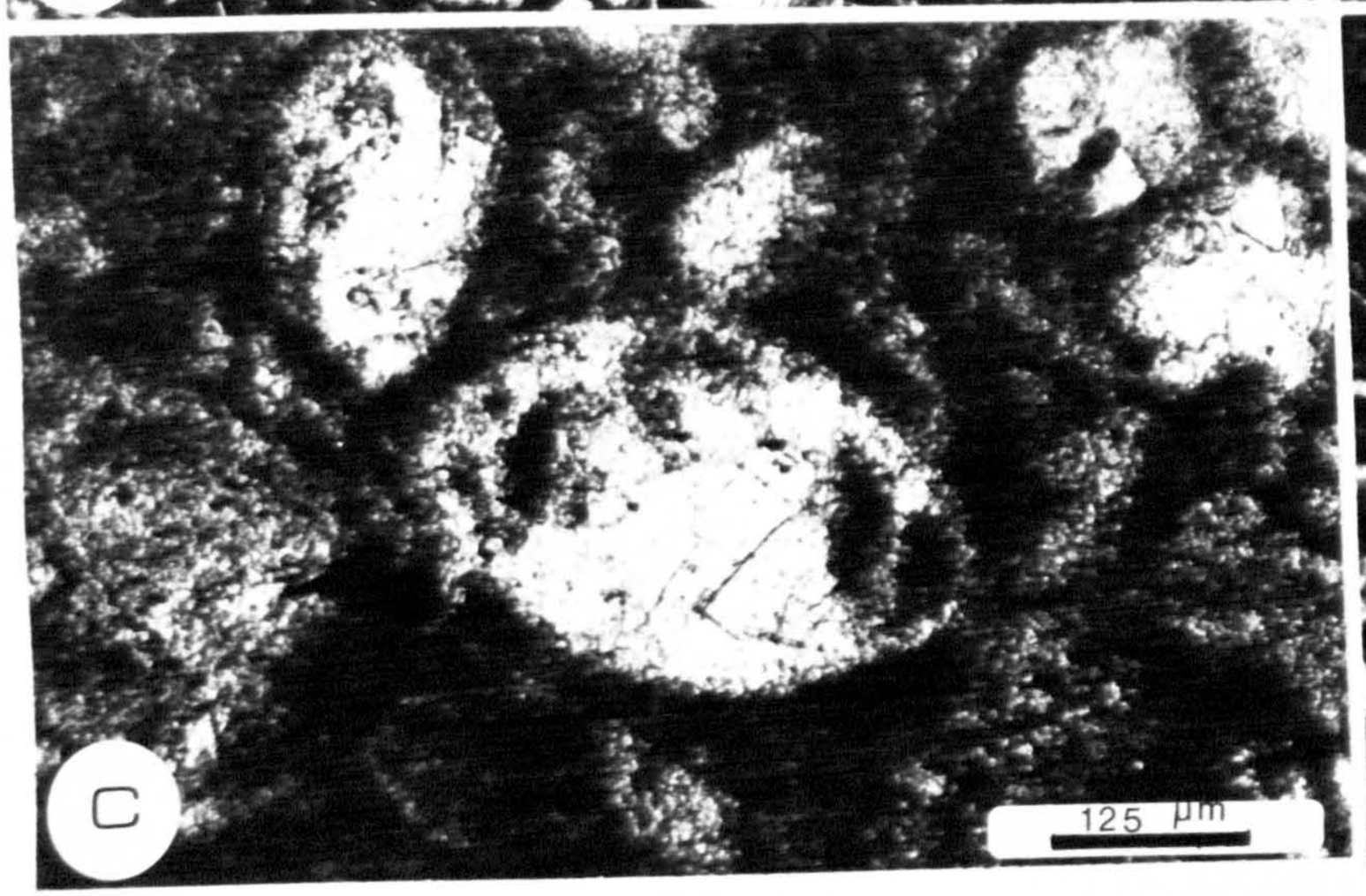
B - Photomicrograph of same sample as above showing Trocholina? permodiscoides Oberhauser (right centre).

C - Close up view of Plate 15A showing Involutina sinuosa pragsoides (Oberhauser).

D - Photomicrograph of same sample showing another view of the same species of Involutina (Antalya, TT-80-7).







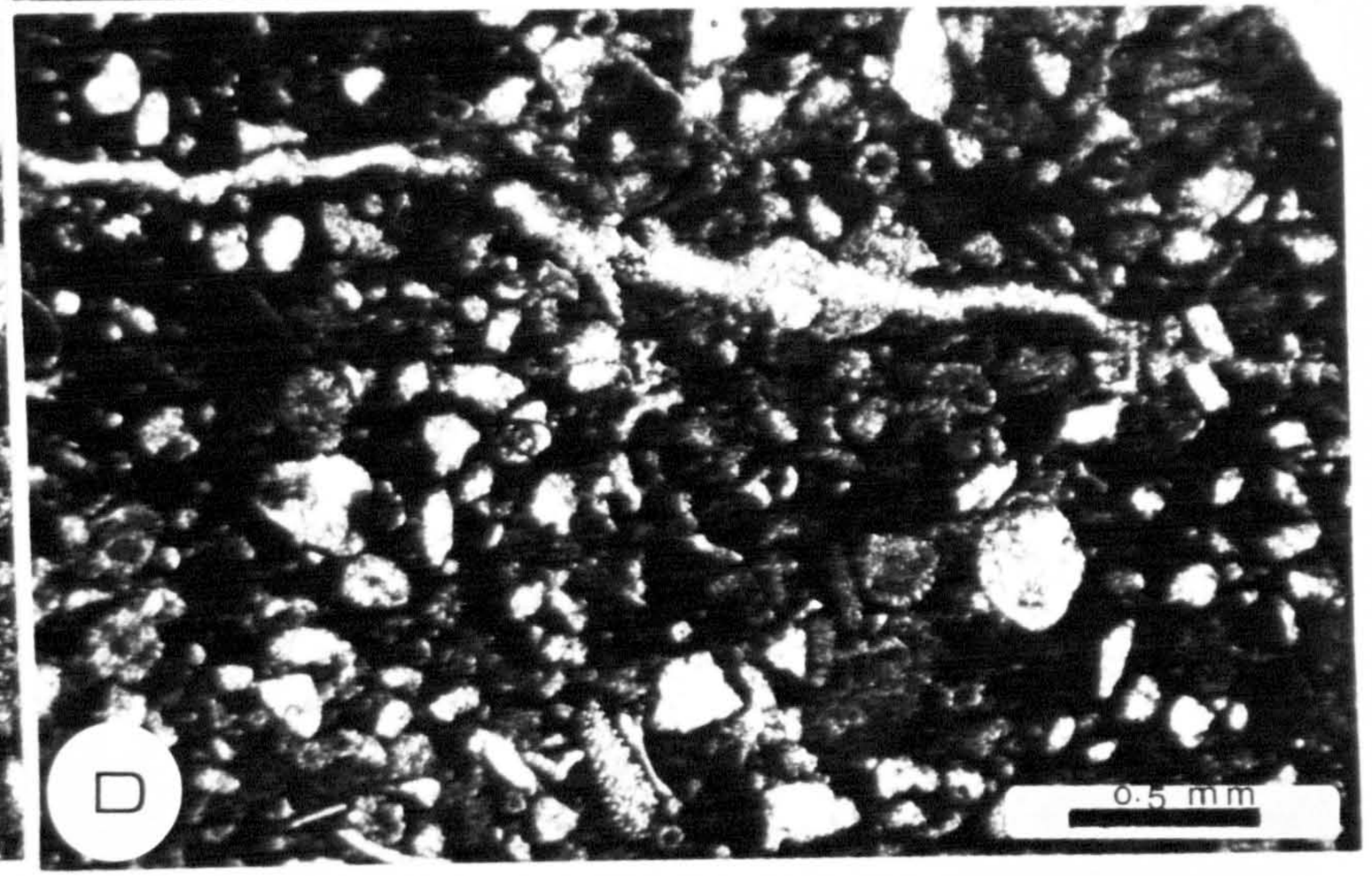


PLATE 15

PLATE 16

A - Photomicrograph of biomicrite from Teke Dağı, showing a geopetal structure in the gastropod near the centre of the photomicrograph. This sample contains conodonts (Antalya, TT-79-14).

B - Photomicrograph of sparse biomicrite from Dömek Tepe, showing a geopetal structure in the small circular shell near the centre of the plate. This sample also contains conodonts (Antalya, TD-79-1).

C - Photomicrograph cf poorly sorted bioclasts in micrite matrix from the Saklıkent area. This sample is moderately rich in conodonts (Antalya, TS-80-1).

D - Photomicrograph of sparse biomicrite showing Nodosariids and foraminifers. This sample contains conodonts too (Antalya, TS-80-2).

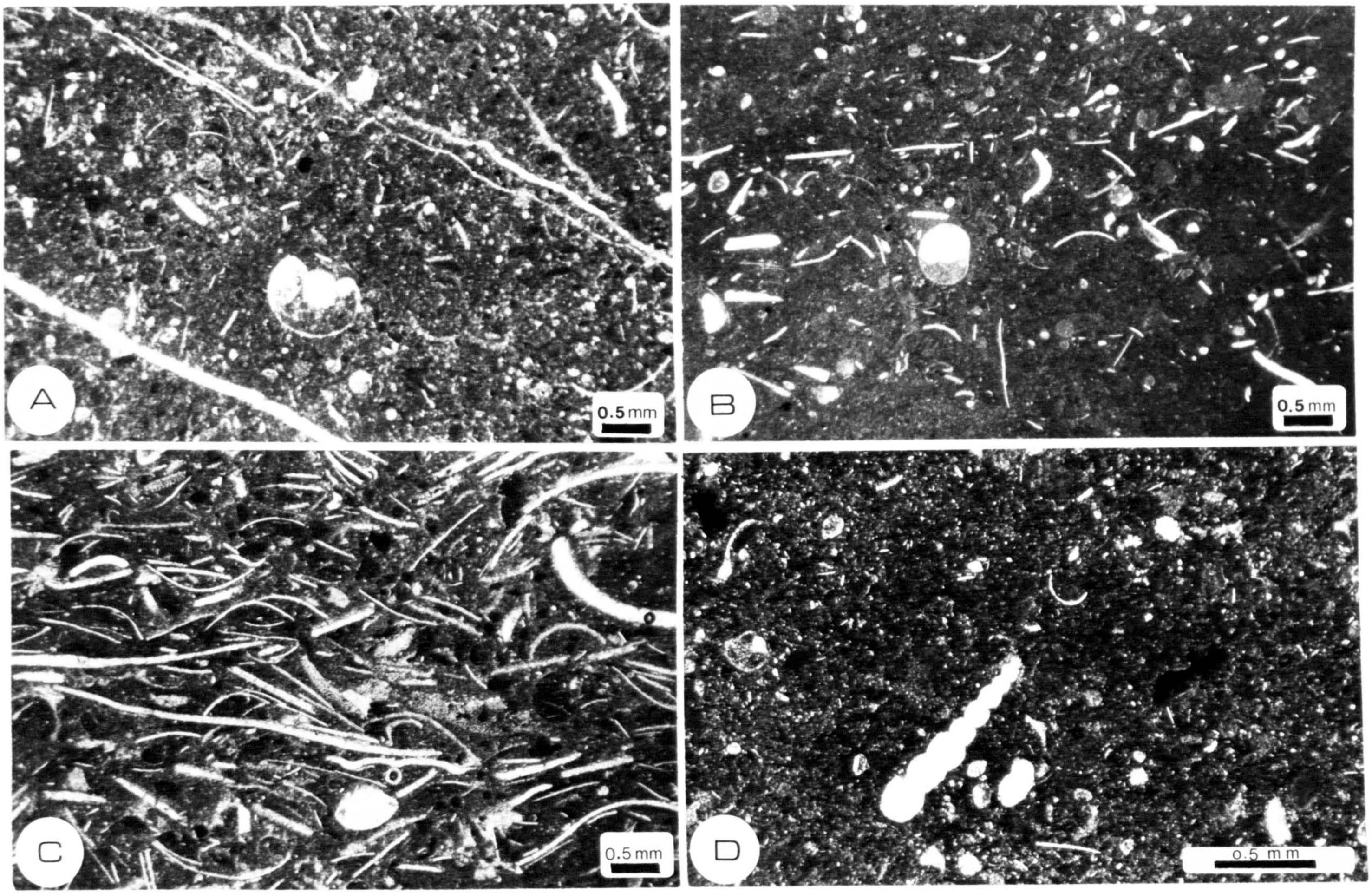


PLATE 16

CHAPTER 4: KAYSERI AREA

4.1: Introduction

Although the rocks from this area have not yielded conodonts, the remaining stratigraphical sections which have been measured to complete this study of Triassic stratigraphy have been taken from the PINARBAŞI and YAHYALI regions (Figs. 3,6A,6B,24 and 26).

The general geology of the Pinarbaşı area has recently been investigated by S. Özer and his colleagues from MTA (report; Basic Geology of Sarız-Sarkışla-Gemerek-Tomorza, September 1978; MTA unpubl.). The Yahyalı area has also been investigated (project of Taurus Ophiolite, Aladağlar 1980; MTA unpubl.) by O. Tekeli et al. The two columnar sections of this study have been taken from these localities, and compared with the Triassic limestones of the Dachstein facies in the Alpine region, where the Dachstein facies consists of megalodont-bearing grainy limestone with other molluscs, foraminifers and algae (oncolites rather than algal stromatolites).

At the initial stage of this research, the writer was informed by colleagues in MTA that the limestones in this area did not contain conodonts. The outcrops were reported to be of good quality and the limestones contained foraminifers. This area was therefore included in the present investigation, to examine the limestone facies present and their foraminifer content.

4.2: Pınarbaşı Section (TPK)

A columnar section has been measured in the Köşger Kaya Tepe Limestone member (Özer et al., 1978), which is an allochthonous member located on Köşger Kaya Tepe, which lies to the north of Melikgazi and Yeregeçen (Fig.24). Because this area has experienced intense tectonic activity, the rocks are strongly jointed and shatter easily, so that it is difficult to find rocks in place. Outcrops are, in any event, not well bedded, and the hill slope where this section was measured is rubble covered. Thicknesses are, therefore, unreliable and the relationships of the limestones to volcanic rocks, which occur lower down the hillside, are obscure (Fig.25). Earlier workers have suggested that the volcanics are part of the autochthone, but that the limestones are allochthonous. Thus the contact should be tectonic.

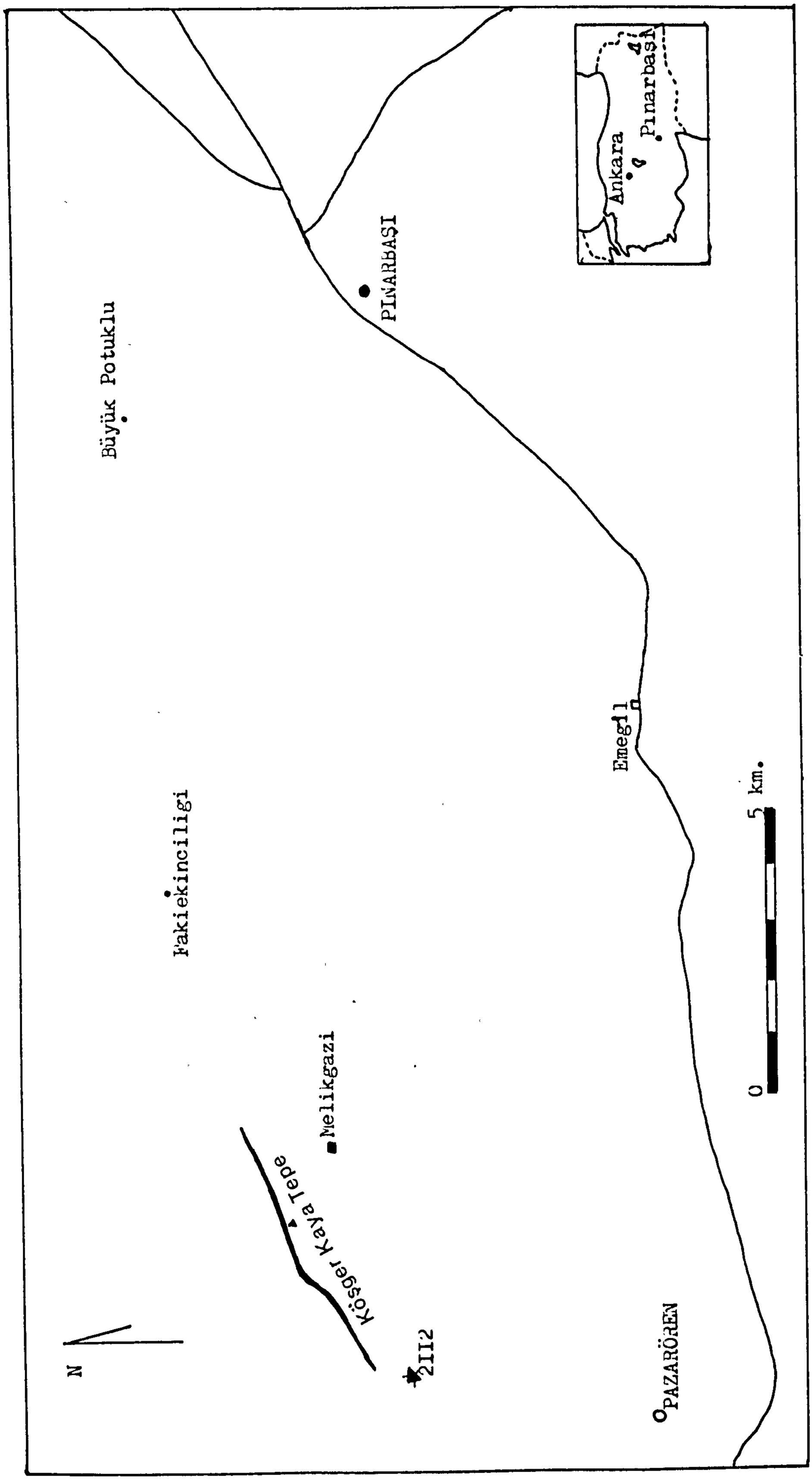


Figure 24. Location map of Köşger Kaya Tepe section (PINARBAŞI,TPK).

MIDDLE-UPPER TRIASSIC

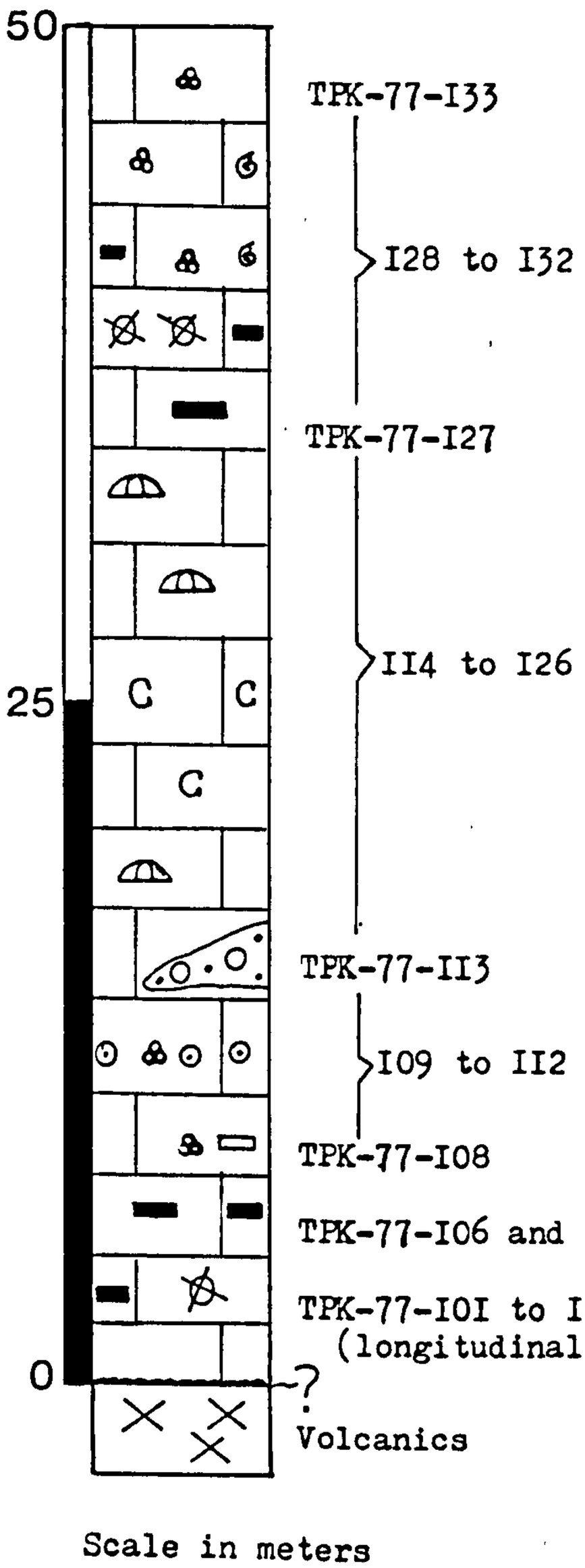


Figure 25. Columnar section of the KÖŞGER KAYA TEPE MEMBER (TPK).

The samples collected from this area contain foraminifers of Middle-Upper Triassic age.

MIDDLE-UPPER TRIASSIC

Outcrops of TPK, which is mostly grainy limestone, contain foraminifers (mostly species of Involutinidae), megalodonts and algae. The limestones are not well bedded, and are deeply fractured and karstified. They resemble the Dachstein Limestone of Austria, which is well known for its rich megalodont faunas.

The lower part of this member comprises grey, locally light grey to yellow, limestone which is recrystallized and disintegrated. The samples which have been collected from the lower part of this member show no original texture in thin section, but might originally have been micrite. Above this bed there is fine-grained foraminiferal microsparite, pervasively micritized, but locally showing ooliths, a few large intraclasts and bioclasts. Some thin sections show oncolitic structures also. A lens of intraformational limestone conglomerate, about half a metre thick and a few metres long, occurs in these beds. It consists mainly of angular grains and lithoclasts. Most of the clasts are sub-angular and some were derived from red limestone, which contains small white circular organic bodies. This is interpreted as a pelagic limestone, and such pelagic limestones must have cropped out on the source area, along with other limestones and quartz-bearing terrigenous rocks.

The upper part of the Kösger Kaya member, grey to light grey biomicrite, overlies the lower beds conformably. Locally the matrix is fine-grained spar and the rock is rich in echinoderms. These beds also contain micritized bioclasts, rather poorly sorted, a few large intraclasts and badly altered grains in general. Thin sections show pervasive micritization. At this level, traces of megalodonts have been seen on the outcrops. Light grey to white foraminiferal microsparite overlies the previous layers and contains sparse intraclasts, gastropods, species of Involutinidae and oncoliths. This grainy limestone is generally poorly sorted and extensively recrystallized. Thin sections usually show replacement texture with allochem ghosts. Locally the rock is composed of large intraclasts, 4 mm. or even bigger, with rhomboidal crystals indicating de-dolomitization. In spite of the intense alteration, TPK contains

some foraminifers, which indicate an Upper Triassic age (possibly Norian Stage):

Glomospirella friedli Kristan-Tollmann
Involutina communis? (Kristan)
Involutina sinuosa pragsoides (Oberhauser)
Involutina gaschei (Koehn-Zaninetti-Brönimann)
Involutina sp.
Trocholina sp.
Endothyranella sp.
Valvulinidae indet.
(Plates 17B, 17C, 17D; 18A, 18B, 18C, 18D).

The environment of deposition of these rocks was shallow marine. The well preserved echinoderms indicate an open sea connection and normal marine salinities. Oncoliths and ooliths indicate a moderately high energy environment. The absence of evaporites, desiccation structures and sheet stromatolites indicate persistent sub-tidal conditions.

4.3: Yahyalı Section (TYKK)

This section has been measured on the north side of Kartal Kayasi Tepe located in the Aladağlar (Plate 13C) part of the Central Taurus Mountains between the cities of Adana and Kayseri. The samples have been collected from Mesozoic limestone outcropping amongst peridotite (Fig.26). The stratigraphic position is unclear, but is being investigated at the present time by MTA geologists. This area is not well endowed with stratigraphic sections in which the sequence of Triassic rocks can be measured, nor which contain fully identifiable microfossils. For this reason, the Triassic outcrops and their foraminiferal content will be described without illustrating a columnar section. The foraminifers, which indicate an Upper Triassic (Carnian-Norian Stages) age, are as follows:

Involutina sinuosa oberhauseri (Salaj)
Involutina sinuosa sinuosa (Weynschenk)
Trocholina multispira? Oberhauser
"Trocholina" procera (Liebus)
Trochammina alpina Kristan-Tollmann
Trochammina sp.
Endothyranella sp.

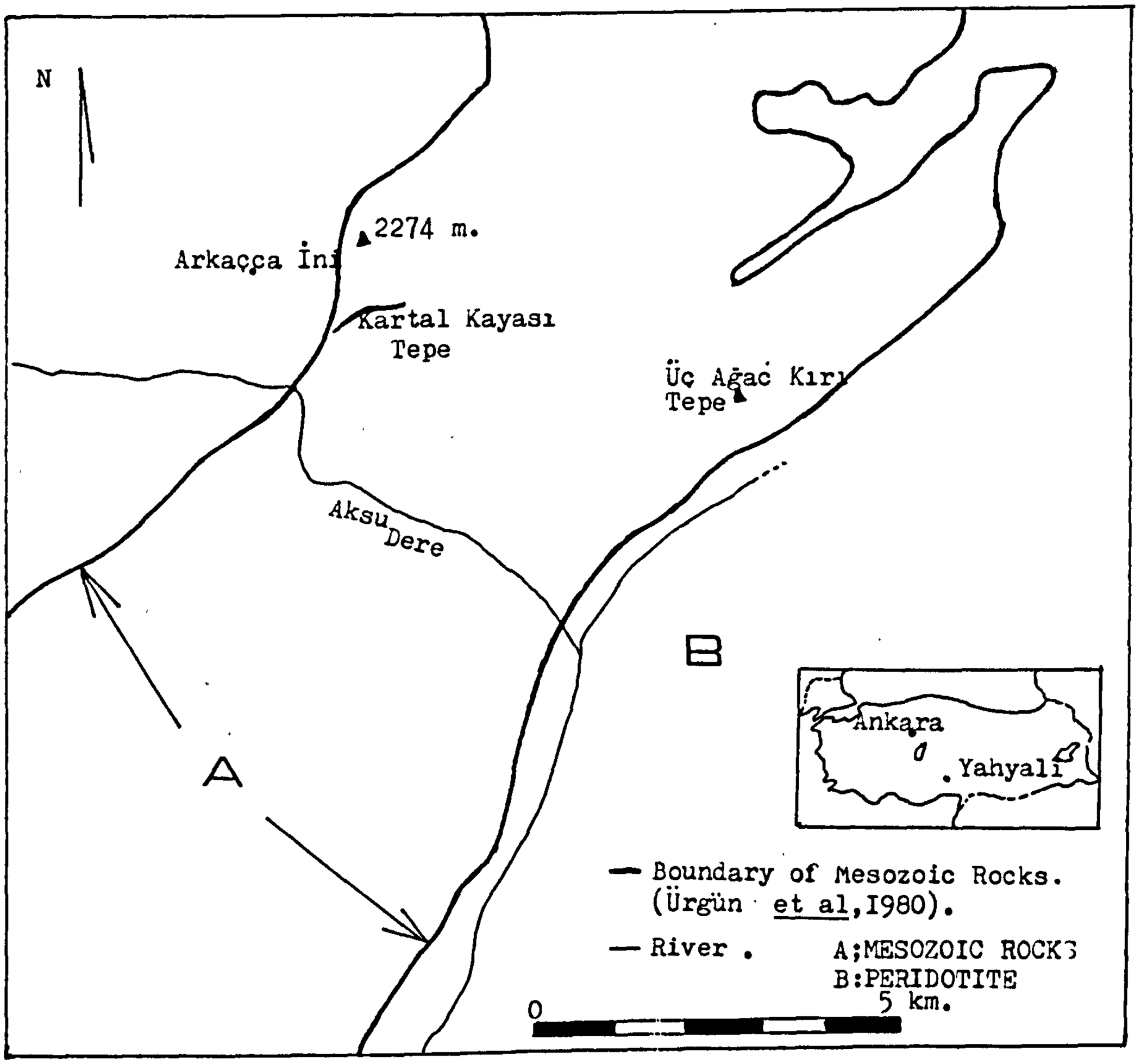


Figure 26. Location map of Kartal Kayası Tepe section (YAHYALI,TYKK).

Varistomatidae indet.

Textularidae indet.

(Plates: 19A,19B,19C,19D; 20A,20B,20C,20D).

UPPER TRIASSIC

A thick, medium bedded, monotonous sequence of grainy limestone, of grey - light grey and locally brownish grey colour, prevails in the Upper Triassic and Lower Jurassic. There is an abundant fauna with megalodonts (Plate 13D), gastropods and foraminifers. Thin sections usually show pervasive micritization. The matrix and allochems can rarely be identified. In general, the matrix would seem to have been micrite in the lower beds, but microspar to spar in the upper beds. The dominant allochems, which have been identified from biomicrosparites, are intraclasts possibly of algal origin, bioclasts such as gastropods, foraminifers, algae (oncolitic structures as well) and unidentified shell fragments. Some thin sections show allochem-ghosts and frequent stylolites. The Triassic rocks from this area resemble the "Dachstein facies" in Austria, as mentioned in the introduction to Chapter 4.

Rocks from the TYKK region suggest that this was a shallow marine platform environment, as Zankl postulated for the Dachstein facies of Austria (1971, p.157).

4.4: Microfaunas from TPK and TYKK

Only sparse foraminifers have been recovered from the Kayseri area. The rocks themselves are usually recrystallized and barely identifiable. Age determination of the Triassic limestones is based on foraminifers where they are available. The microfossil content of the rocks is given in sample order:

Microfaunas from the Kösger Kaya Tepe Section (Kayseri, TPK):

Sample: TPK-77-106 from the base of the section; foraminiferal microsparite, but foraminifers are barely identifiable. It contains Involutina sp. indet.

Age: M.-U.Triassic

Sample: TPK-77-111 is foraminiferal oomicrosparite with unidentifiable foraminifers.

Age: Not determinable.

Sample: TPK-77-127 contains foraminifers, possibly Involutina sinuosa pragsoides (Oberhauser 1964).
(Plate 17C)

Age: M.-U.Triassic

Sample: TPK-77-128 foraminiferal microsparite from near the top of this section, containing:

Foraminifers:

Trocholina sp.
Endothyranella sp. (Plate 17D)
Valvulinidae indet.

Algae:

Dasycladacea indet.

Age: Possibly Upper Triassic.

Sample: TPK-77-129 from the same horizon as sample TPK-77-128; contains Involutina gaschei (Koehn-Zaninetti-Brönimann 1968) (Plate 18A).

Age: Upper Triassic (possibly Norian Stage)

Sample: TPK-77-130 from the top of this section; foraminiferal microsparite containing:
Glomospirella friedli Kristan-Tollmann, 1962.
Involutina sinuosa pragsoides (Oberhauser, 1964)
Involutina cf. communis (Kristan, 1957)
Involutina sp.
(Plate 18B,18C,18D).

Age: Upper Triassic: Norian Stage.

Microfaunas from the Yahyalı Section (Kayseri, TYKK):

The samples are usually intensely recrystallized and unidentifiable; some biomicrosparites occur. A few foraminifers have been identified from samples taken from the top of this section.

Sample: TYKK-77-589 contains sparse foraminifers:

Endothyranella sp.
Trochammina sp.
Varistomatidae indet.
(Plate 19B,19C).

Age: Possibly Upper Triassic

Sample: TYKK-77-594 contains Involutina sinuosa sinuosa (Weynschenk,1956) (Plate 19D).

Age: Possibly Upper Triassic

Sample: TYKK-77-600 contains:

Involutina sinuosa oberhauseri (Salaj 1967)
Trochammina alpina Kristan-Tollmann, 1964
Trocholina multispira? Oberhauser 1957
"Trocholina" procera (Liebus, 1942)
Textularidae indet.
(Plate 20A,20B,20C,20D).

Age: Upper Triassic

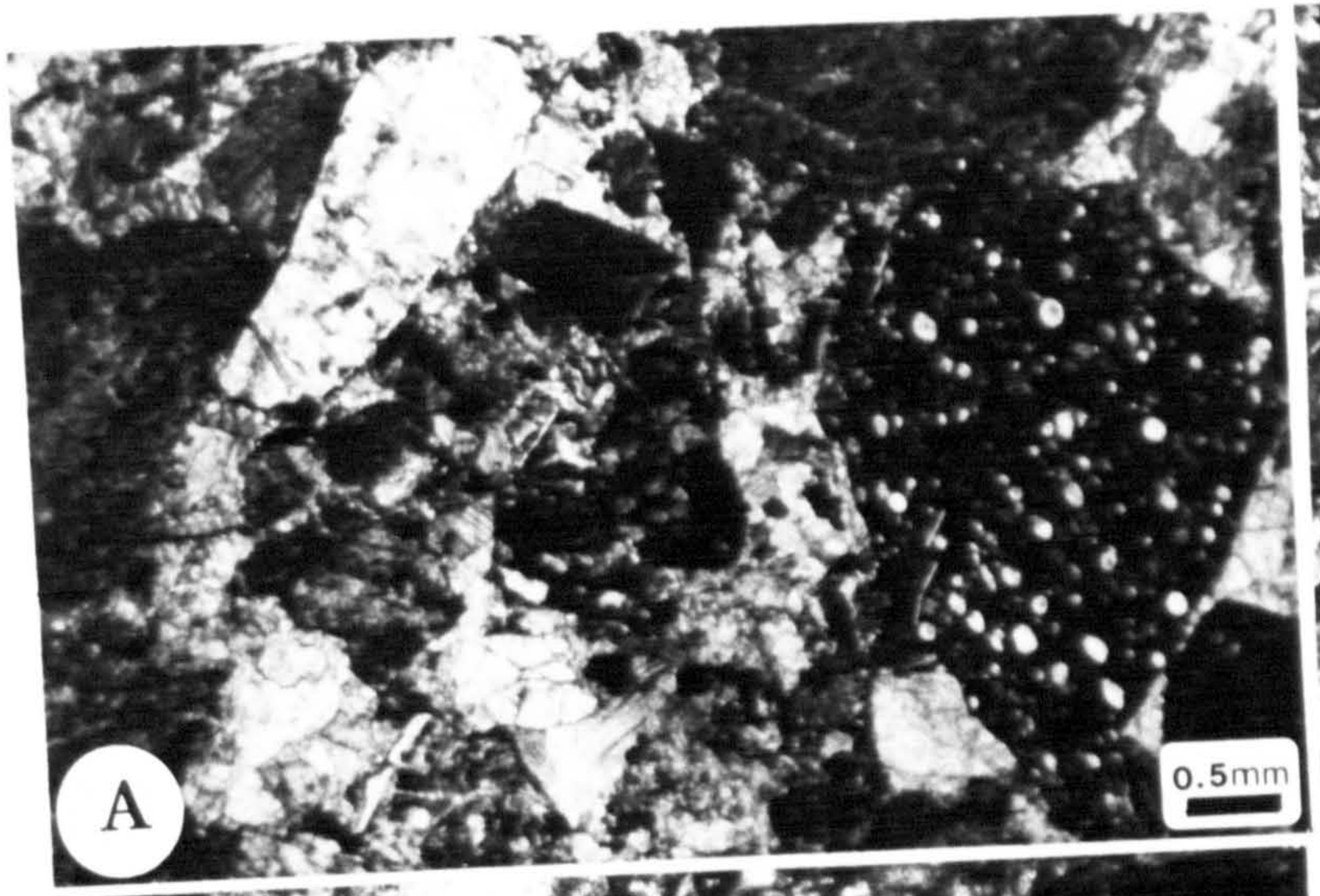
PLATE 17

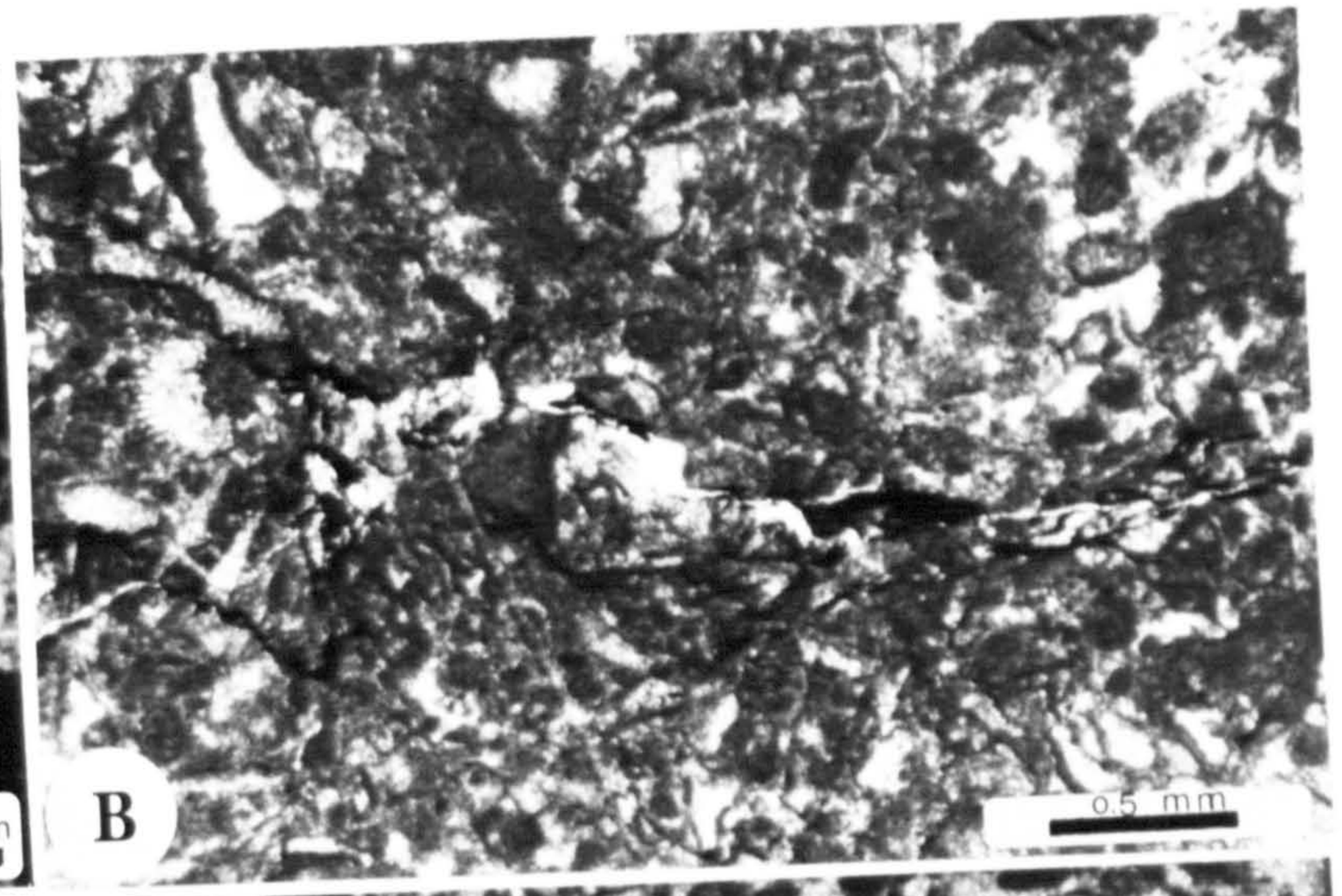
A - Photomicrograph of intraformational limestone conglomerate in the Köşger Kaya Tepe Member. Note the large, subangular, red limestone clast containing small, white, circular organic bodies on the right edge of the photomicrograph (Kayseri, TPK-77-113).

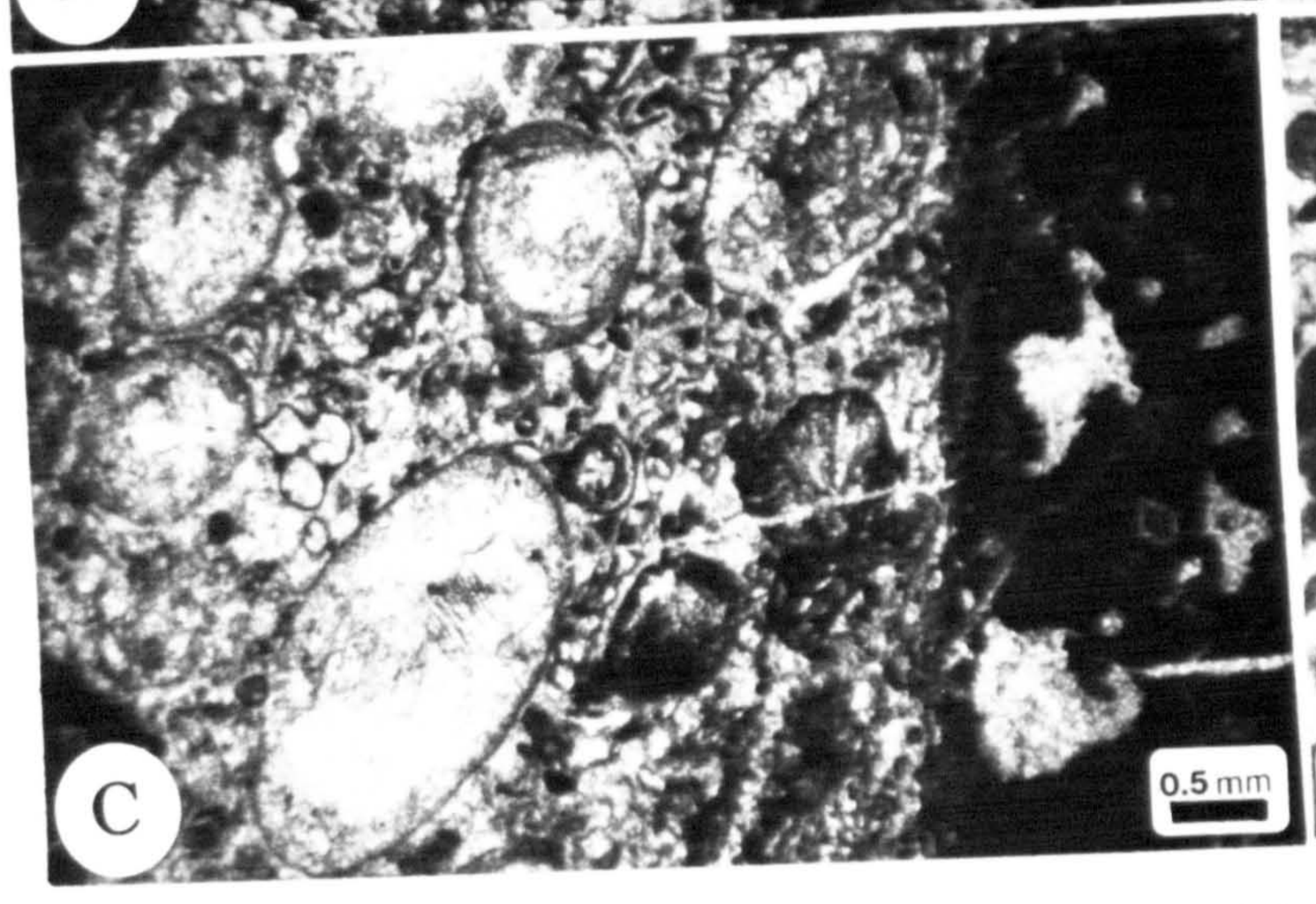
B - Photomicrograph of biomicrospar showing echinoids debris in microspar (Kayseri, TPK-77-116).

C - Photomicrograph of poorly sorted grainy limestone showing large intraclasts (bigger than 5 mm) and foraminifers: Involutina sinuosa pragsoides (Oberhauser) with internal structures destroyed by recrystallization (ellipsoidal or circular shapes in the left half of the plate). Note the large intraclast on the right containing rhomboidal crystals which indicate dedolomitization (Kayseri, TPK-77-127).

D - Photomicrograph of poorly sorted foraminiferal microsparite showing Endothyranella sp. and algal lumps (Kayseri, TPK-77-128).







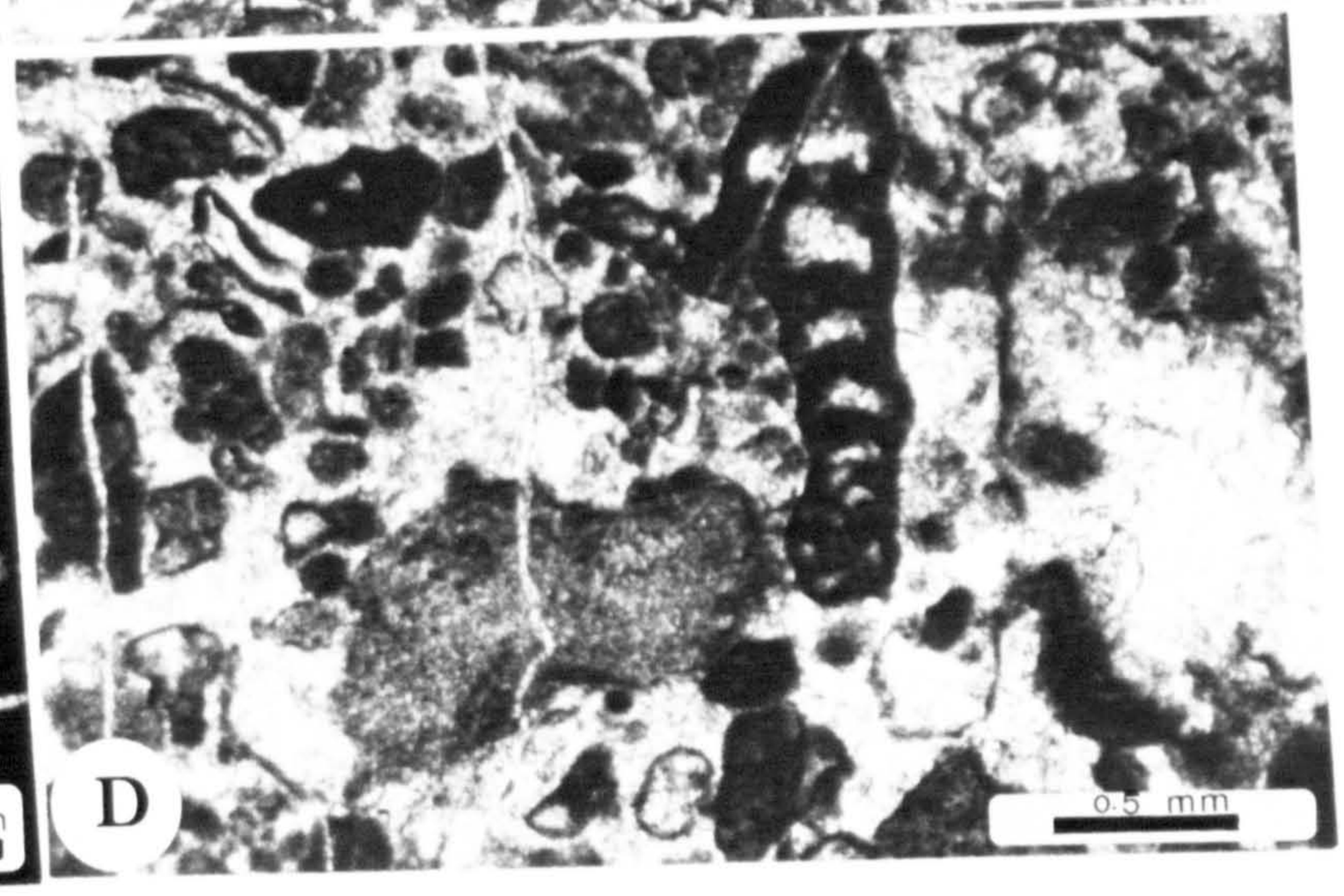


PLATE 17

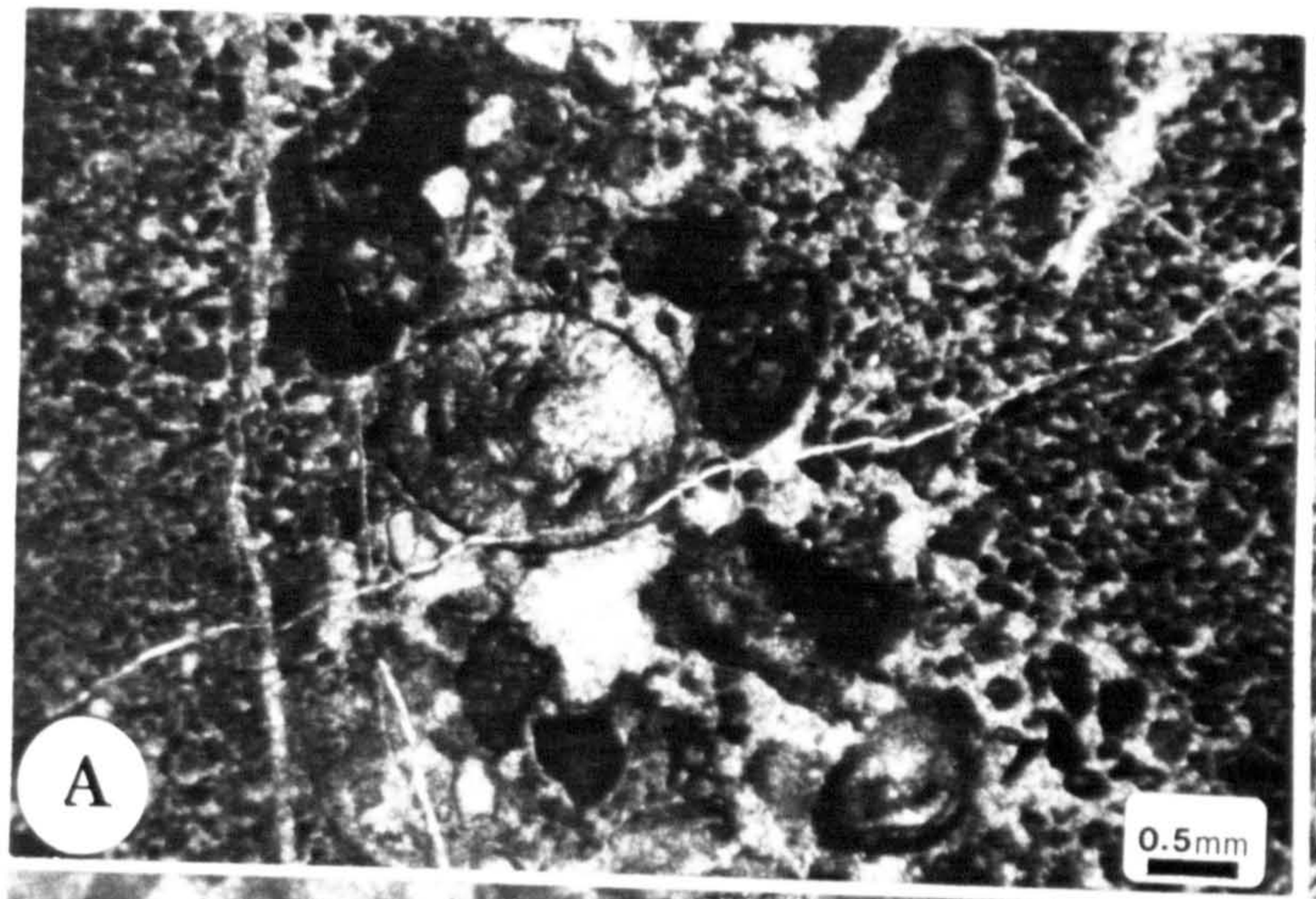
PLATE 18

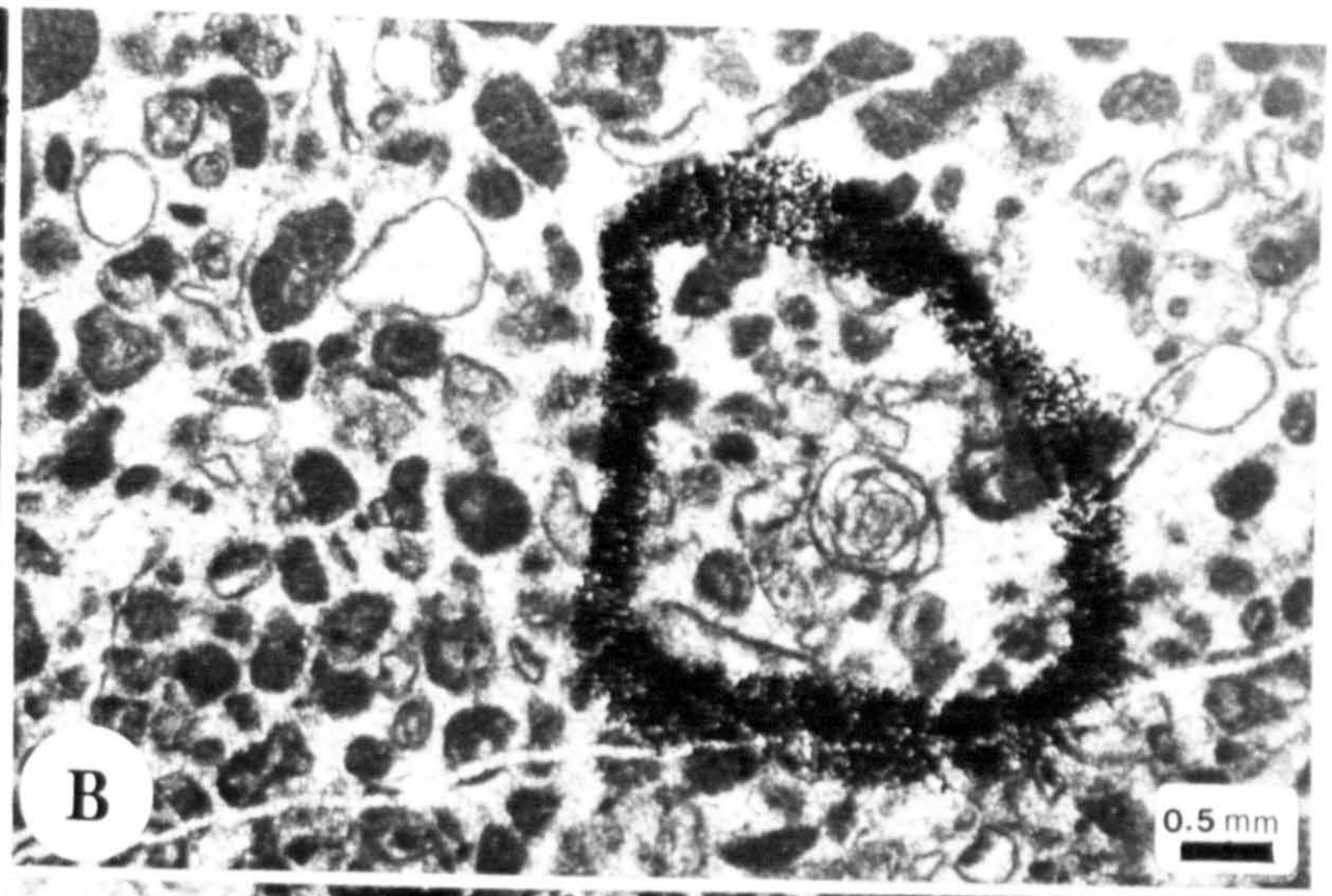
A - Photomicrograph of poorly sorted foraminiferal microsparite from Kartal Kayası Tepe containing oolitic algal structures and Involutina gaschei (Koehn-Zaninetti-Brönimann) on the centre (Kayseri, TPK-77-129A).

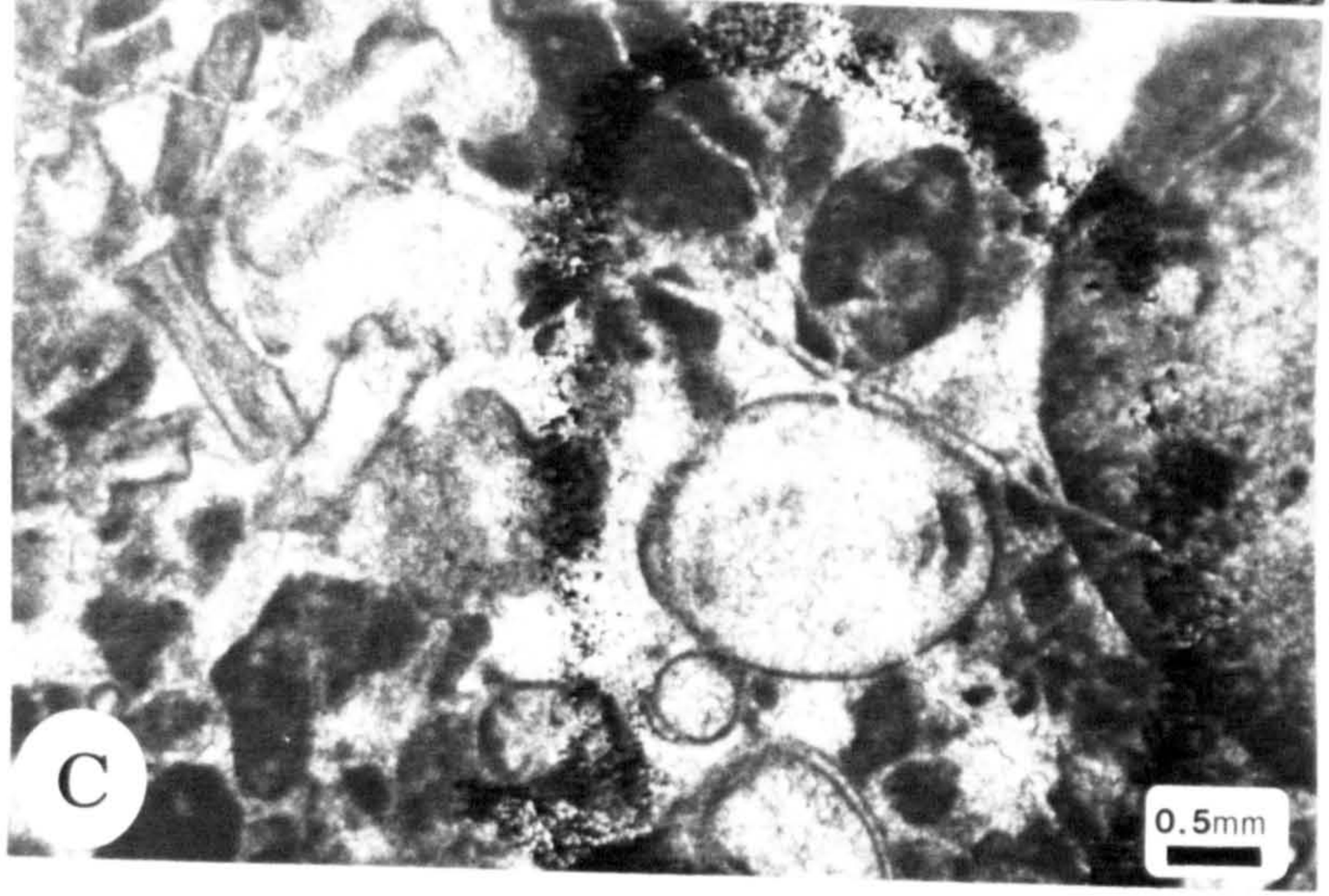
B - Photomicrograph of foraminiferal microsparite containing a few pellets. The black ring locates Glomospirella friedli Kristan-Tollmann (Kayseri, TPK-77-130).

C - Photomicrograph of the above sample showing Involutina sinuosa pragsoides (Oberhauser).

D - Photomicrograph of same poorly sorted microsparite showing Involutina cf. communis (Kristan) located by black ring in the top left of the plate (Kayseri, TPK-77-130).







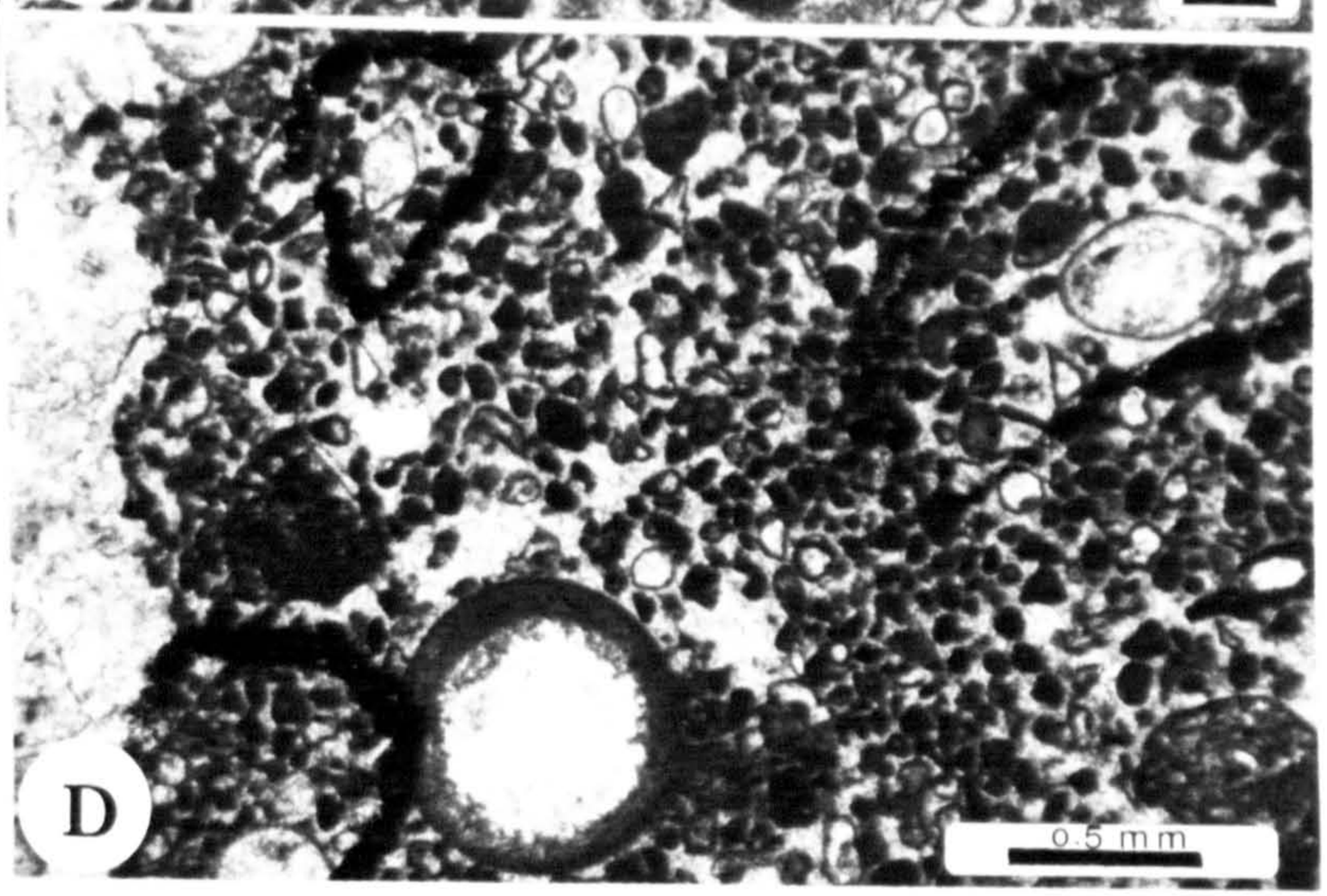


PLATE 18

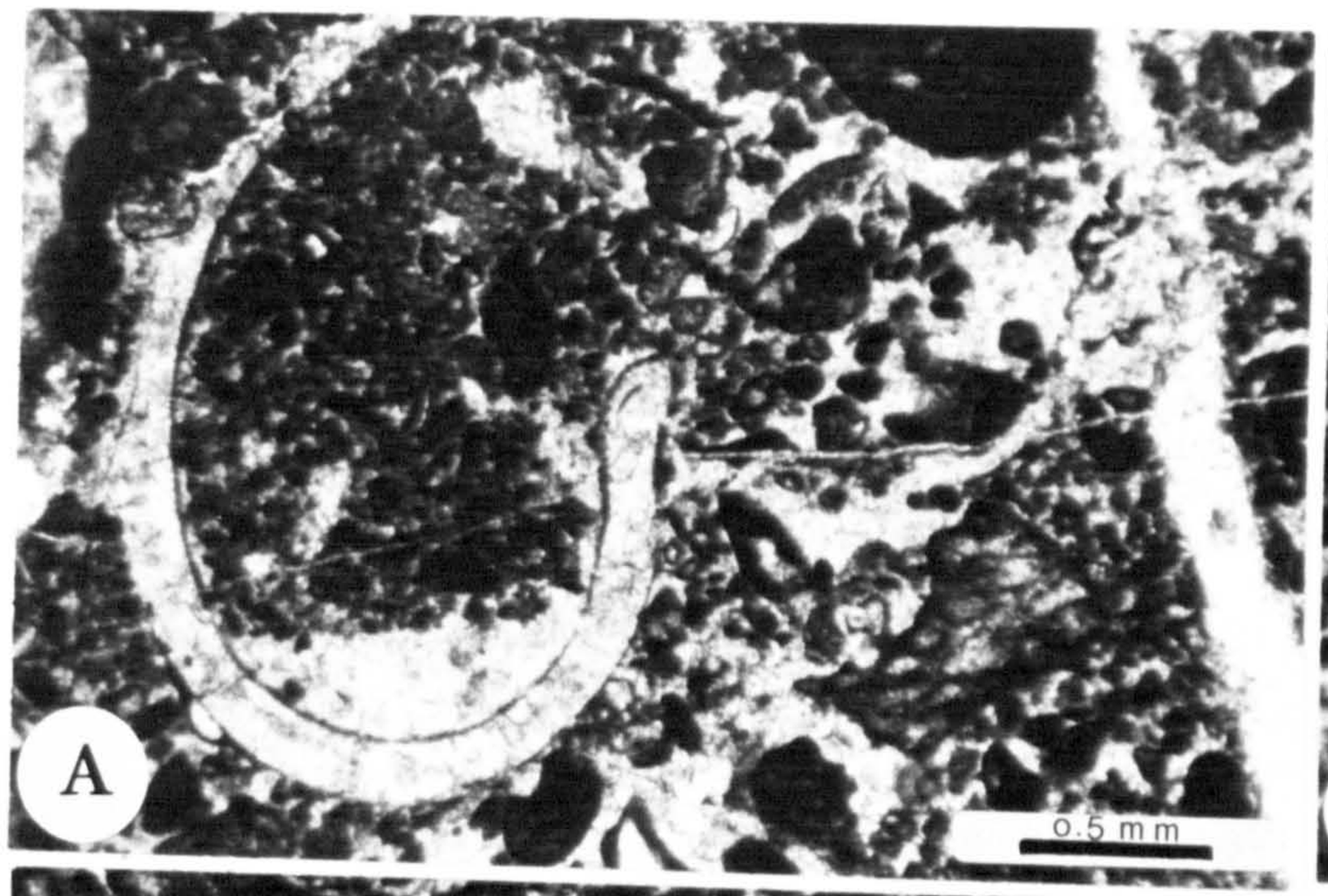
PLATE 19

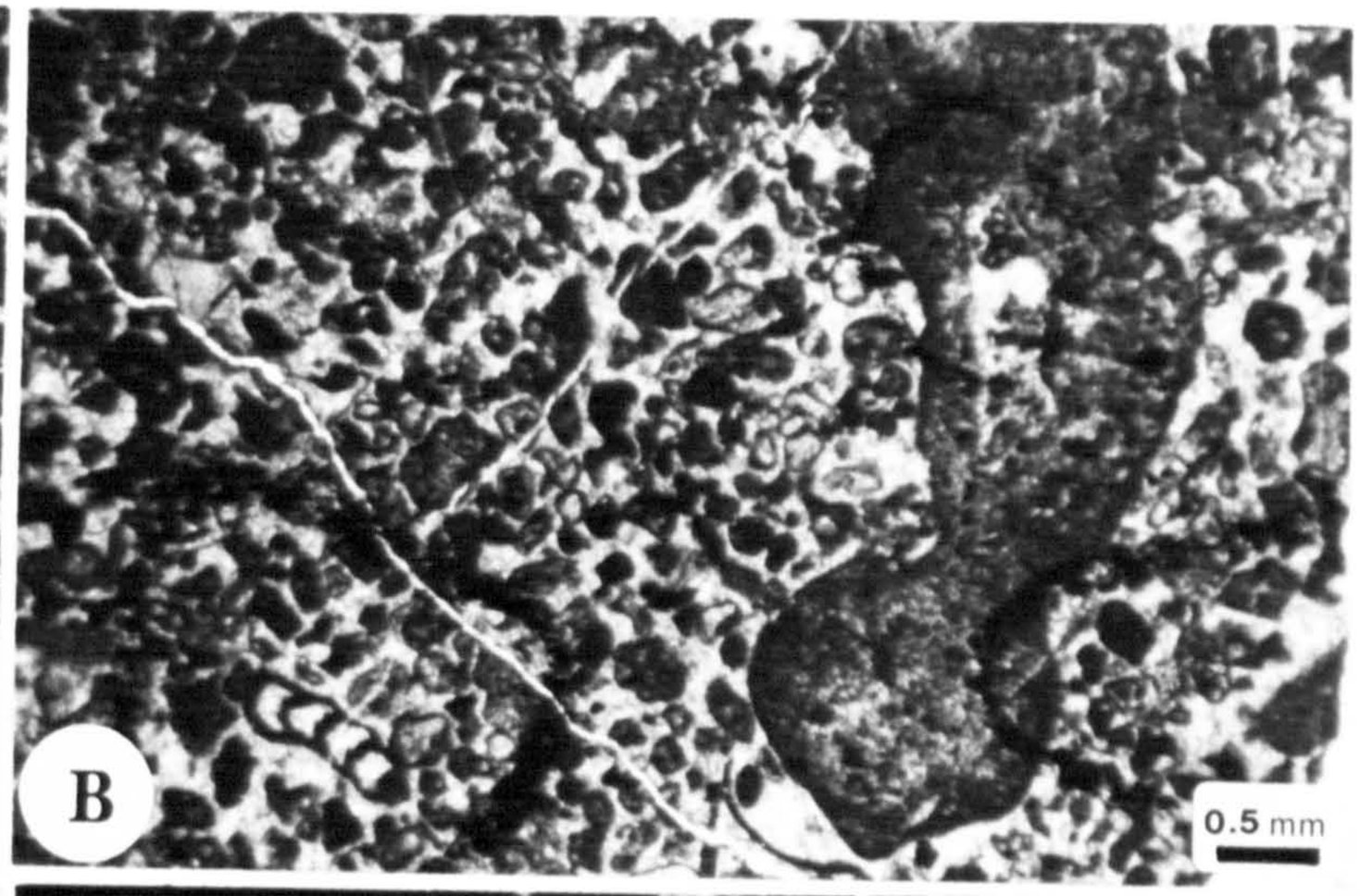
A - Photomicrograph of poorly sorted intraclastic microsparite from Yahyali showing large curved shell fragment which contains internal sediments forming a good geopetal structure. It indicates that the photomicrograph is upside down. The thin section shows pervasive micritization (Kayseri, TYKK-77-588).

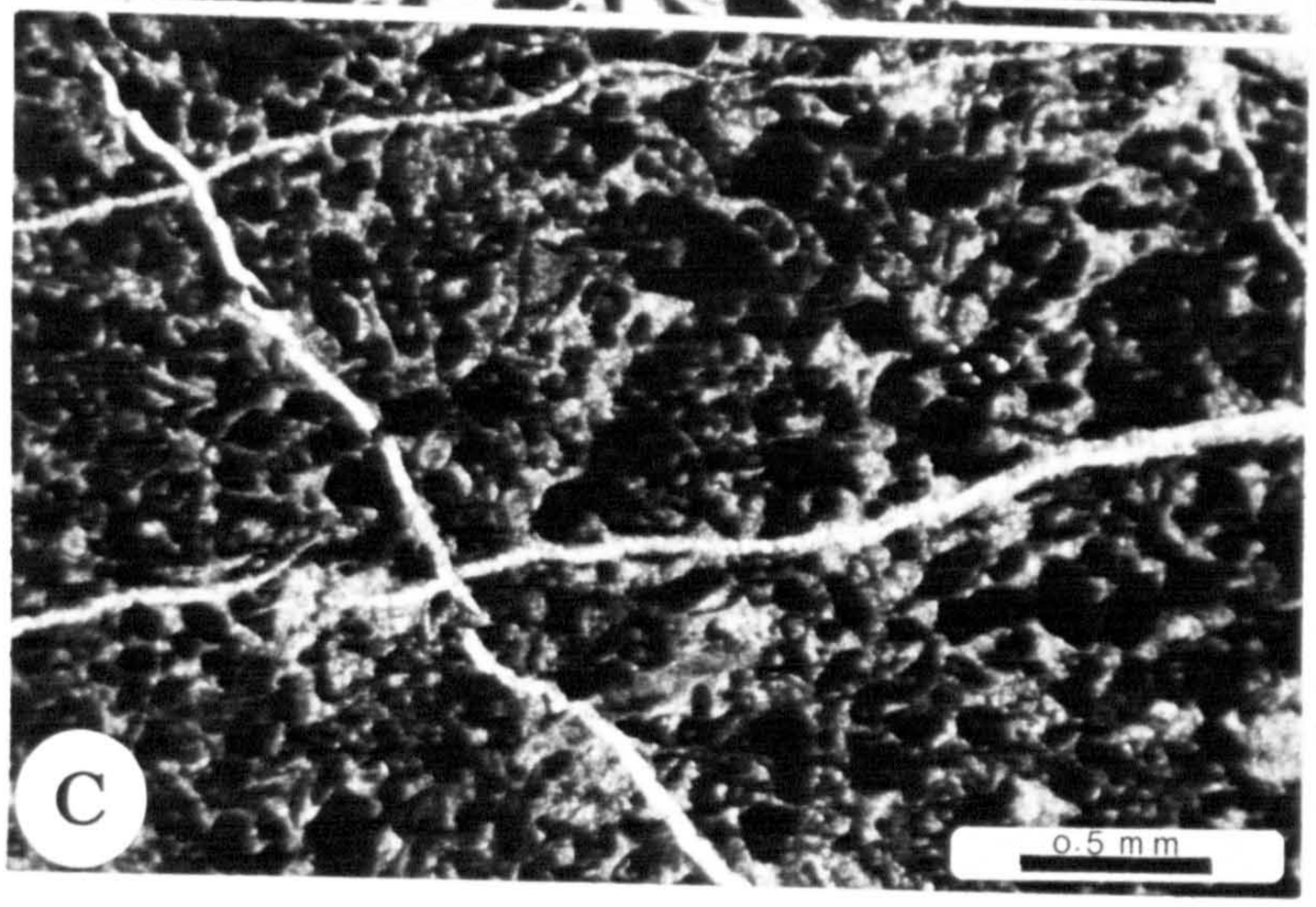
B - Photomicrograph of pervasively micritized intraclastic limestone showing algal lumps and foraminifers, the latter located by black rings. Endothyranella sp. (lower left corner), Trochammina sp. (top right, inside the algal intraclast) [Kayseri, TYKK-77-589].

C - Photomicrograph of above sample showing a Varistomatid foraminifer, near the centre of the plate (Kayseri, TYKK-77-589).

D - Photomicrograph of intensely micritized limestone (TYKK-77-594) showing foraminifers: Involutina sinuosa sinuosa (Weynschenk).







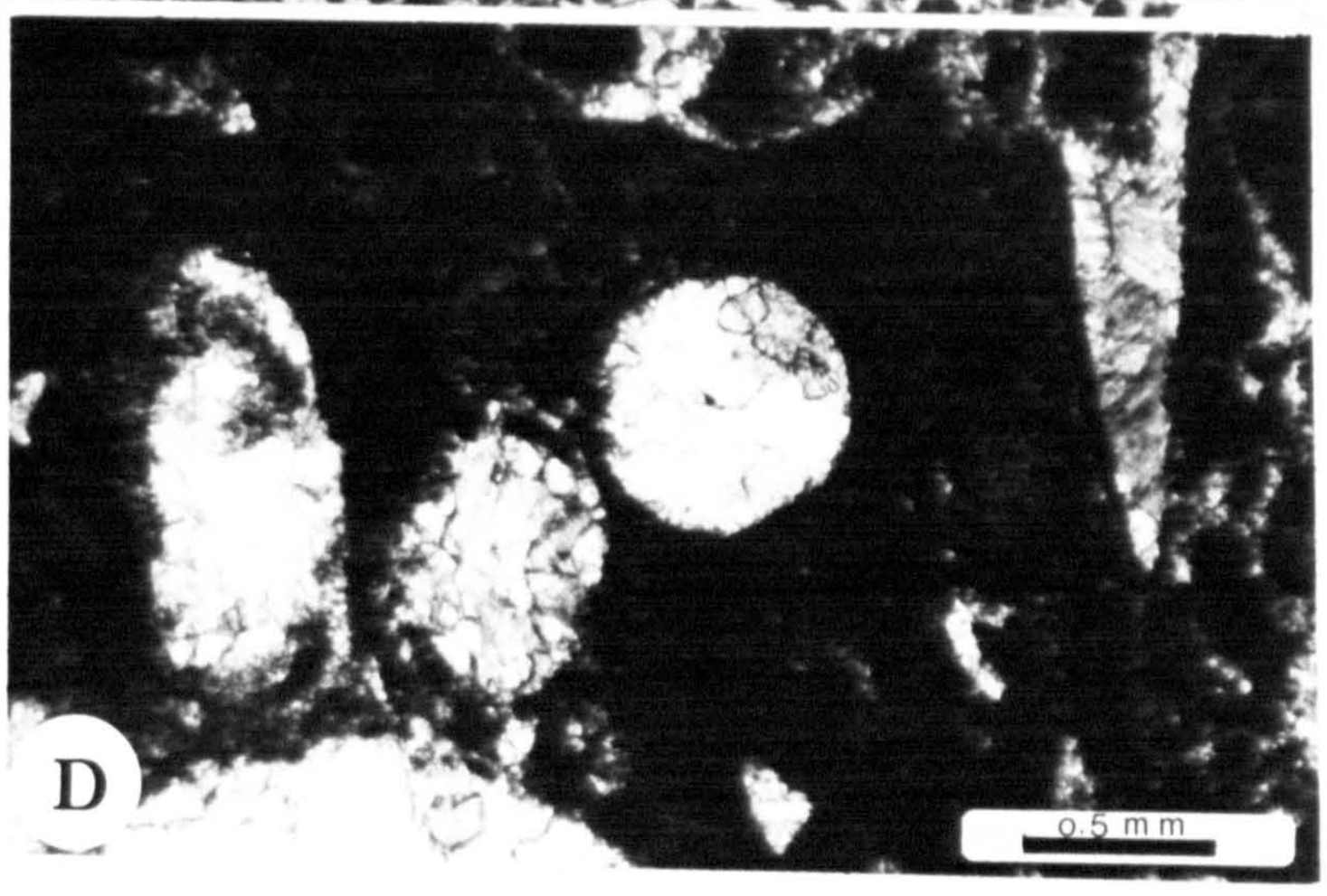


PLATE 19

PLATE 20

A, B, C and D - Photomicrographs of extensively recrystallized limestone from Yahyalı, showing several foraminifers located by black rings (Kayseri, TYKK-77-600).

A: Involutina sinuosa oberhauseri (Salaj) and Texturalids.

B: Trocholina multispira? Oberhauser (right) and Textularids.

C: Trochammina alpine Kristan-Tollmann

D: "Trocholina" procera (Liebus).

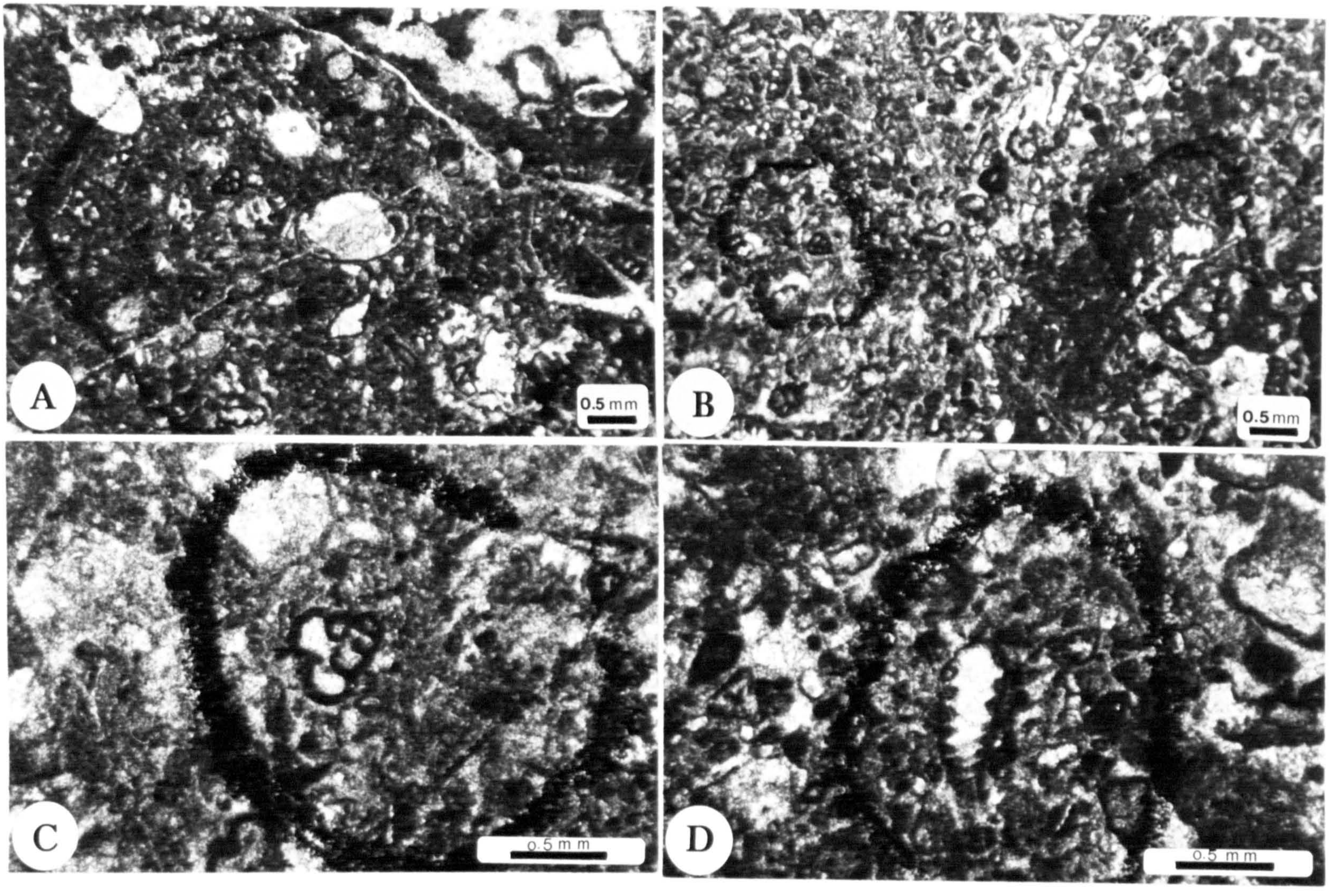


PLATE 20

CHAPTER 5: STRATIGRAPHY AND ENVIRONMENT

A number of columnar sections, described and illustrated in previous chapters, were measured in different parts of the Central Taurus Mountains. The Triassic rocks of the studied areas are seen to overlie Upper Palaeozoic strata only in the Hadim area. In this area conformable passage from the Upper Permian to the Lower Triassic can clearly be seen in Soğuk Pınar Dere (THA). In this section, Lower Triassic marine limestones are interbedded with terrigenous sediments totalling about 600 metres. Only the Griesbachian Stage of the Lower Triassic has been positively identified by the occurrence of Claraia clarai; the other stages of the Lower Triassic are probably present but not identified. This region is the only place where Lower Triassic rocks are distinct. In general, the Lower Triassic succession is characterized at the base by oolitic calcarenite and fine-grained dolomitic calcarenite. They are overlain by interbedded argillaceous limestones, foraminiferal calcarenites and variegated shales. At the junction with the Middle Triassic a varied marine fauna including ammonites, gastropods, conodonts and foraminifers has been recovered from calcarenite beds (Formation E). The environment of deposition in the Lower Triassic of the Hadim area was marginal marine, very shallow water to sub-aerial, and therefore extremely sensitive to tectonic movement, either up or down, and equally sensitive to clastic-input.

In the Antalya area the probable Lower Triassic succession is exposed on Teke Dağı (TT), where it totals only about 3 metres. It consists of poorly exposed, interbedded shales and micrites with neither fossils nor evaporites. Permian rocks crop out some distance below it and it is conformably overlain by fossiliferous Middle Triassic limestone; hence its assignment to the Lower Triassic.

The Triassic Succession in Karabayır Yayla of Hadim (THB 2), totalling approximately 400 metres, is remarkably unfossiliferous, so that the age of the rocks remains obscure. At the base, probable Lower Triassic rocks, totalling about 275 metres, consist of interbedded calcarenite (locally oolitic) and variegated shales. The environment of deposition of these rocks resembles that of the Soğuk Pınar Dere area - a semi-restricted marine lagoon, connected to the hinterland.

The Middle Triassic rocks show local variations in thickness and

lithology within and between the studied areas. In Hadim, the Middle Triassic rocks of Soğuk Pınar Dere comprise approximately 400 metres of limestone, interbedded with sandstone and shale. The dominant limestone types in this succession are fine-grained calcarenite (bioclastic micrite with local pelsparite), recrystallized cauliflower-type algal limestone and calcirudite. Rich macrofaunas have been found from only one horizon (Formation F) where it yielded lamellibranchs., gastropods, ostracods and brachiopods. Very poorly preserved foraminifers have been found in two other horizons. Calcirudite, which is placed at the top of the Middle Triassic succession, is overlain by conglomerate assigned for convenience to the Upper Triassic. The environment of deposition of the Middle Triassic in this area was shallow marine, probably a marginal lagoon, which was larger than that of the Lower Triassic but still subject to incursions of terrigenous sediment. Occasional marine transgressions extended the shallow open sea over this area. Tectonic subsidence was more extensive than in the Lower Triassic. At times (Event iii, see Part 2.2.3) a semi-permanent river is suggested to supply some of the terrigenous sediments.

From another locality in the Hadim area the Middle Triassic outcrops have also been studied. The Triassic succession in Ekinlik Yayla contains only Middle and Upper Triassic rocks, overlying the presumed Permian strata with apparent conformity. The Middle Triassic limestone, a little less than 200 metres thick, is dolomitized at the base. It passes up into fine-grained calcarenite containing sparse foraminifers, overlain by clayey micrite and biomicrite showing intense recrystallization. The top beds of the Middle Triassic formations are thin to medium bedded unfossiliferous micrite showing pervasive micritization. The environment of deposition of these rocks was restricted shallow marine, such as a shelf lagoon. The local absence of terrigenous sediments, as well as the non-deposition of Lower Triassic rocks, indicates partial subsidence of the former hinterland, transgression of a shallow open sea over an area of Upper Palaeozoic rocks during the Middle Trias.

The Middle Triassic rocks of Teke Dağı in Antalya, approximately 3 metres thick, are characterized at the base by vermicular marly limestone, containing very sparse conodonts, assigned to the Anisian Stage. It is overlain by red nodular biomicrite containing a rich fauna of ammonites, gastropods, conodonts and foraminifers. The basal part of

these red nodular beds is assigned to the Anisian and Ladinian Stages of the Middle Triassic; the upper part to the Carnian and Norian Stages of the Upper Triassic. In the Antalya area, the Middle Triassic rocks have also been studied at Saklikent, where they crop out along the crest just above the ski resort. They are found in three neighbouring outcrops, showing 1 or 2 metres thickness. The rocks are grey biomicrite and reddish, packed biomicrite. Both contain ammonites, foraminifers and conodonts. The marine Middle Triassic limestones from Antalya are typical of Alpine-type Triassic, and are thought to be pelagic sediments deposited on sea-mounts within ocean basins.

The Middle-Upper Triassic succession of the Pınarbaşı section in Kayseri, which belongs to the Köşger Kaya Tepe Limestone Member, consists of usually deeply fractured and karstified limestone. The lower part of this allochthonous succession is grey or pale grey, intensely recrystallized limestone resting on volcanics and overlain by foraminiferal microsparite showing pervasive micritization. A lens of intraformational limestone conglomerate occurs in the recrystallized limestone. The microsparite is conformably overlain by pale grey biomicrite rich in echinoderm debris and with traces of megalodonts. This, in turn, is overlain by pale grey to white foraminiferal microsparite containing oncolitic algal structures and some foraminifers, diagnostic only of the Middle to Upper Triassic (see Part 4.4). The environment of deposition of these rocks was shallow marine with an open sea connection. It resembles the Dachstein facies of the Austrian Alps.

Upper Triassic rocks are usually limestone throughout the studied areas. Conglomerate, sand, silt and clay are apparently confined to the Soğuk Pınar Dere area of Hadim. The estimated thickness of the Upper Triassic rocks in this area is 400-500 metres. At the base, well sorted reddish clayey sandstone, clayey siltstone, calcilutite and lenticular conglomerate are the main rock types. They are overlain by foraminiferal argillaceous limestone, locally intraclastic but mostly oosparite. The environment of deposition for these Upper Triassic rocks was coastal marine with a rugged hinterland or seacliffs. Reddening of the sandstones suggests a semi-arid climate, and the terrigenous sands and clays are intermittent to semi-permanent river system. In the late Upper Triassic the environment of deposition became clear water marine without terrigenous input. Subsidence of the hinterland and marine transgression

produced an extensive, semi-enclosed shallow sea.

The Upper Triassic rocks of Ekinlik Yaya in Hadim are approximately 140 metres thick. At the base they comprise interbedded sandstone, shale, clay, micrite and biomicrite. These are overlain by medium bedded grey calcirudite. Diagnostic foraminifers have been found at only one horizon (Formation K). The environment of deposition was a restricted marine lagoon. As in the Soğuk Pınar Dere area, tectonic uplift of the hinterland is required to supply the terrigenous sediments of the early Upper Trias.

In the Hadim area, possible Upper Triassic limestones, without interbedded terrigenous sediments, have also been studied on Karabayır Yayla, where they show remarkable secondary lamination. All these allochems are usually tectonically squashed, and, except for a few foraminifers, are unidentifiable. The environment of deposition of these rocks was clear water, shallow marine.

In Antalya, the Upper Triassic rocks have been studied at two locations. In Teke Dağı, the Upper Triassic limestone, about 4 metres thick, is characterized by red, well bedded packed biomicrite (cf.nodular Ammonitico Rosso facies) at the base and by pale grey calcarenite at the top. The red nodular beds contain ammonites, gastropods, conodonts and foraminifers. The grey beds are also richly fossiliferous, containing conodonts, foraminifers and holothurian sclerites. In the second location, Dömek Tepe, the Upper Triassic succession, 2-3 metres thick, is grey-red mottled biomicrite containing ammonites, gastropods, conodonts and foraminifers. These rocks are similar to the Hallstätt facies of the Austrian Alps, for which deposition as pelagic limestones on seamounts in an ocean basin has been suggested.

Upper Triassic rocks have also been studied in the second locality of the Kayseri area, at Kartal Kayası Tepe (Yahyalı). They are mainly a monotonous sequence of grainy limestone with an abundant fauna of megalodonts, gastropods and foraminifers. Pervasive micritization has obliterated much of the matrix and allochems. The rocks are biomicrosparite where identifiable. The environment of deposition was a shallow marine platform environment, resembling the Dachstein facies of the Austrian Alps.

In general, Triassic rocks are limestone-dominated throughout the

studied areas. Interbedded terrigenous clastics are present in the Lower Triassic wherever it occurs, but otherwise are restricted to the Upper Triassic of the THA and THB 1 sections of Hadim. The Lower-Middle Triassic rocks of Hadim were deposited in a persistent tidal lagoon, invaded from time to time by marine faunas when the enclosing barrier shoal was breached. At other times, the lagoon became very shallow and hypersaline but never dried out completely. Occasionally the lagoon was filled with clastics deposited by sheet-floods from the land. At the beginning of the Upper Triassic, tectonic uplift of the hinterland resulted in a massive supply of terrigenous gravels and sand to the marginal lagoon. When this supply ceased, marine influence reasserted itself, forming a semi-enclosed sea.
In the Antalya area, the Middle-Upper Triassic rocks are always limestone, pelagic sediments deposited on sea-mounts within ocean basins.
In the Kayseri area the Middle-Upper Triassic limestones resemble the Dachstein limestone of the Austrian Alps, deposited in a shallow marine carbonate platform environment.

PART II - PALAEONTOLOGY

CHAPTER 6: SYSTEMATIC PALAEONTOLOGY OF CONODONTS

6.1: General Review

Conodonts are the tooth-like parts of an unknown marine organism, and are one of the dominant fossil groups used in biostratigraphic and palaeoecologic studies. They have been found in most marine rocks around the world, ranging from early Cambrian and possibly late Precambrian to late Triassic. Most conodont-bearing animals were bilaterally symmetrical, probably not more than a few centimetres in largest dimension. Their hard parts comprise microscopic elements a few millimetres in greatest dimension. Conodonts, being composed of carbonate apatite, are soluble in hydrochloric, sulphuric and nitric acids, but insoluble in acetic, formic and citric acids. Conodonts also consist of organic material related to a sediment with a long and complex sedimentalogic history. Therefore, the organic composition of conodonts is still uncertain. Unweathered conodonts show colour variation from pale yellow, light to dark brown, black, grey, opaque white or crystal clear. During the beginning of metamorphism (50-300°C) conodonts change colour from pale yellow to brown to black, but if the thermal metamorphism continues they change from black to grey to white to crystal clear (Harris, 1979). The micromorphology of conodonts also varies. Recent studies with the Scanning Electron Microscope make possible observations of some important micro-ornamentations, which are much smaller than well-known optic features such as nodes, denticles, ridges and ribs. More obvious structural observations have been known since Pander (1856). These include the lamellar structure, white matter, fibrous structure, growth axis and basal filling. Six types of primary micro-ornament, smooth surface, fine striation, coarse striation, basal wrinkles, longitudinal furrow and microdenticles-dental pits have been described and discussed recently (Lindström & Ziegler, 1971; Lindström et al., 1972; Barnes et al., 1973; Barnes & Slack, 1975).

6.2: Systematic Palaeontology

LOWER TRIASSIC

When the first Lower Triassic blade and bar-like conodonts were described, a form-taxonomy was used (Müller, 1956; Clark, 1959). Later, Staesche (1964) formulated a new multi-element nomenclature which was

based on his collection of specimens representing the genera Hadrodontina and Pachycladina. Sweet (1970b) proposed a revised morphological multi-element taxonomy for the bar and blade-like conodonts of the Lower Triassic. He grouped them within one single multi-element genus Ellisonia, which was originally described by Müller (1956). Despite all the reclassifications which have been proposed to date, the natural taxonomy and evolution of Lower Triassic forms are still not clear.

In this study, a rather limited and poorly preserved fauna has been recovered. This collection is not good enough to solve the taxonomic problems which have been mentioned above. Only a few conodont elements from the Lower Trias are described and illustrated here, from the Soğuk Pınar Dere area (Hadim, THA section).

Tables 5 to 8 give the numerical abundance of conodont specimens and taxa represented in each of the samples.

Multi-element Taxonomy

Order CONODONTOPHORIDA Eichenberg 1930

Genus ELLISONIA Müller 1956

1956 Ellisonia Müller, p.822.

Type species: Ellisonia triassica Müller 1956

Remarks. Müller (1956) has given a detailed description of this genus. More recently Sweet (1970b) revised the genus based on this material from the Lower Trias of West Pakistan. He recognized that Ellisonia is a multi-element genus consisting of cypridodelliform, enanthiognathiform, hibbardelliform, hindeodelliform, lingonodiform, lonchodiniform and prioniodiniform elements. Denomination and description of component elements follow the terminology of Sweet (1970b).

Ellisonia cf. teicherti Sweet 1970

Remarks. Only LB elements of this multi-element apparatus have been recovered.

LB element

Pl.21, figs.1 and 2

1958 ?Lonchodina n.sp.A Huckriede, p.153, pl.10, fig.3

1965 ?Hindeodella sp. Bender & Stoppel, p.344, pl.15, fig.6

1969 Ellisonia teicherti (nom.nud.) Stefanov et al., p.64

1970a Ellisonia teicherti n.sp. Sweet, p.8, pl.1, figs.3,4,7,8,12

1970b Ellisonia teicherti Sweet, p.232, pl.4, figs.20-28

1973 ?Ellisonia teicherti Sweet; Mosher, p.156, pl.17, figs.19,25

Material studied: 2 specimens

Stratigraphic range: Lower Trias of Soğuk Pınar Dere (Hadim, samples THA-80-1 and THA-81-6)

Ellisonia triassica Muller 1956, sensu Sweet 1970

Remarks. Only LB elements of this species have been recovered.

LB element

Pl.21, figs.3,4,5

1956 Ellisonia triassica Müller, p.822, pl.96, figs. 12-14

1956 Hibbardella subsymmetrica Müller, p.825, pl.96, fig.11

1956 Lonchodina triassica Müller, p.828, pl.96, fig.10

1956 Hindeodella nevadensis Müller, p.826, pl.96, figs.2,3

non 1956 Hindeodella triassica Müller, p.826, pl.96, figs.4,5

1956 Hindeodella raridenticulata Müller, p.826, pl.96, fig.1

1956 ?Ozarkodina sp. Müller, p.820, pl.95, fig.23; pl.96, fig.18

1958 Lonchodina mülleri Tatge; Huckriede, p.151, pl.10, figs.9,16,17

1958 Lonchodina discreta Ulrich & Bassler; Huckriede, p.150, pl.10, figs.21,25

1958 ?Lonchodina sp. Huckriede, p.153, pl.10, fig.4

1970b Ellisonia triassica Müller; Sweet, p.235, pl.5, figs.9,13-15, 17,18,20-22

1973 Ellisonia triassica Müller, sensu Sweet; Mosher, p.156, pl.17, figs. 9,12,15,17,32

1979 Ellisonia triassica Müller, sensu Sweet; Solien, p.300, pl.1, figs. 2,3,6,7,9

Material studied: 3 specimens

Stratigraphic range: The Lower Trias of Soğuk Pınar Dere (Hadim, samples THA-80-1 and THA-81-6)

Ellisonia sp. indet.

Pl.21, fig.6

Broken elements occur in the same sample as Ellisonia triassica Müller and Ellisonia teicherti Sweet. These individuals belonging to Ellisonia cannot be identified to specific level and therefore have been

included in this category.

Material studied: 3 specimens

Stratigraphic range: Lower Trias of Soğuk Pınar Dere (Hadim, samples THA-80-1 and THA-81-6)

Genus PARACHIROGNATHUS Clark 1959

1959 Parachirognathus Clark, p.311

Type species: Parachirognathus ethingtoni Clark 1959

Remarks. A diagnosis for this genus was given by Clark (1959). He suggested this genus for a hand-shaped conodont with a cupped or concave inner surface. The representatives of this genus consist of a large blade which has 7 to 15 discrete needle-like to lenticular denticles on the upper surface. These denticles are unequal in size. The genus ranges from the Lower Triassic (Clark, 1959) to the Middle Triassic (Mosher, 1973). The stratigraphic and morphologic limits of the genus are not yet known.

Parachirognathus cf. ethingtoni Clark 1959

Pl.21, fig.7

1959 Parachirognathus ethingtoni Clark, p.311, pl.45, figs. 3,5,7
1959 Parachirognathus geiseri Clark, p.312, pl.45, figs. 4,8,10,11
1968 Parachirognathus cf. ethingtoni Clark, p.1079, pl.3, fig.20?
1971 Parachirognathus ethingtoni Clark; Sweet et al., pl.1, fig.39
1973 Parachirognathus ethingtoni Clark; Budurov & Pantic, p.57, pl.1, figs.30? 31?; pl.2, figs.(1-6)?
1979 Parachirognathus ethingtoni Clark; Clark et al., p.180, pl.1, fig.16
1979 Parachirognathus ethingtoni Clark; Solien, p.304, pl.1, figs. 10,14,15,19
1982 Parachirognathus ethingtoni Clark; Koike, p.40, pl.10, fig.10

Remarks. This species was suggested as the type species of the genus Parachirognathus by Clark (1959). It isohand-shaped species characterized by the posteriorly inclined denticles which are of unequal size.

Material studied: 2 specimens

Stratigraphic range: Lower Trias of Soğuk Pinar Dere (Hadim, samples THA-80-1 and THA-81-6)

Parachirognathus obliqua (Staesche 1964)

Pl.21, figs. 8,9,10

1964 *Pachycladina obliqua* Staesche, p.279, figs.46,47; pl.29, figs.2-4

1973 *Parachirognathus obliqua* (Staesche); Budurov & Pantic, p.58, pl.3, figs.1-13

1975 *Pachycladina obliqua* Staesche; Hirsch, p.41, pl.1, figs.1-4

Remarks. The diagnosis of this species was given by Staesche (1964).

Material studied: 3 specimens

Stratigraphic range: Lower Trias of Soğuk Pınar Dere (Hadim, samples THA-80-1 and THA-81-6)

Parachirognathus sps. indet.

Pl.21, figs.11,12,13,14

Some broken individuals belonging to this genus cannot be identified to species level, therefore they have been included in this category.

Material studied: 7 specimens

Stratigraphic range: Lower Trias of Soğuk Pınar Dere (Hadim, samples THA-80-1 and THA-81-6)

MIDDLE-UPPER TRIASSIC

Non-Platform Conodonts

Discrete element Taxonomy

Order CONODONTOPHORIDA Eichenberg 1930

Genus CRATOGNATHODUS Mosher 1968

1968a *Cratognathodus* n.gen. Mosher, p.918

Type species: *Prioniodina kochi* Huckriede 1958

Remarks. This genus was considered by Mosher (1968 a) as constituting a valid record of Middle Triassic strata from both Europe and North America.

Three species, including the type species, are included within this genus. Representatives of this genus are blade-like conodonts characterized by the presence of a short, but broad and strong main denticle having a widely expanded basal cavity. Cratognathodus differs from Pb and M elements of Ozarkodina (Branson & Mehl) by the rather stronger denticles, the existence of a large basal cavity and groove, and by the position and restriction of the white matter to the ends of the denticles. This genus is known only from Middle Triassic strata, except for one recent reference which suggests that Cratognathodus sweeti (Kozur & Mostler) has been recovered from the Carnian and Lower Norian as well as from the Middle Triassic (Koike, 1981).

Cratognathodus kochi (Huckriede 1958)

Pl.22, figs.7,8

1958 Prioniodina kochi Huckriede, p.159, pl.11, fig.37; pl.12, figs.11,12; pl.14, fig.4

1960 Prioniodina kochi Huckriede; Spassov & Ganev, p.89, pl.1, fig.23; pl.2, fig.12

1960 Prioniodina kochi Huckriede; Budurov, p.121, pl.2, figs.14a,b, 15-18, 19a,b

1962 Prioniodina kochi Huckriede; Stefanov, p.85, pl.2, figs.3,4,20

1965 Prioniodina kochi Huckriede; Catalov & Stefanov, pl.1, fig.13

1968a Cratognathodus kochi (Huckriede); Mosher, p.919, pl.113,figs.3,4,7

1970 Prioniodina kochi Huckriede; Bender, p.527, pl.5, fig.12

1971 Cratognathodus kochi (Huckriede); Jenkins and Jenkins, p.782, fig.5, No.29

1974 Cratognathodus kochi (Huckriede); Sahni and Chhabra, p.263, pl.3, figs. D,E,F,I

1975 Cratognathodus kochi (Huckriede); Gedik, p.111, pl.5, fig.23

1976 Cratognathodus kochi (Huckriede); Wang and Wang, p.396, pl.3,fig.18?

1976 Cratognathodus kochi (Huckriede); Budurov,pl.4, fig.29

1977 Cratognathodus kochi (Huckriede); Sudar, pl.5, fig.4

1978 Cratognathodus kochi (Huckriede); Catalov & Budurov, pl.1, fig.8

1978 Cratognathodus kochi (Huckriede); Mirauta and Gheorghian, pl.1, fig.25

1981 Cratognathodus kochi (Huckriede); Koike, pl.1, fig.21

1982 Cratognathodus kochi (Huckriede); Koike, p.20, pl.ix, figs.15,16

Remarks. A detailed synonymy was given by Mosher (1968a). He differentiated this species from other Anisian forms by the lack of white matter and by the relatively less inclination of the denticles.

Material studied: 65 specimens

Stratigraphic range: Middle - possibly Upper Trias of Teke Dağı section (Antalya, samples TT-79-7,8,10,11,12,13,14,16?), Middle Trias of Saklıkent section (Antalya, samples TS-80-1 and 3)

Cratognathodus posterognathus Mosher 1968

Pl.22, figs.9,10,11

1968a Cratognathodus posterognathus Mosher, p.919, pl.113, figs.10,14
1971 Lonchodina angulata Budurov, p.28, pl.1, figs. 1,2,5-9,12
1971 Lonchodina? posterognathus (Mosher); Kozur & Mostler, pl.1, fig.10
1972 Lonchodina? posterognathus (Mosher); Kozur & Mostler, p.19, pl.10, figs. 6,7,11
1973 Cratognathodus posterognathus Mosher; Koike, p.98, pl.17, figs.30,31
1975 Cratognathodus posterognathus Mosher; Budurov & Stefanov, pl.1, fig.35?
1975 Cratognathodus posterognathus Mosher; Gedik, p.112, pl.5, figs.19,22,23
1981 Cratognathodus? posterognathus Mosher; Koike, pl.1, fig.30
1982 Cratognathodus? posterognathus Mosher; Koike, p.20, pl.ix, figs.20,21

Remarks. The first description of this species was given by Mosher (1968a). According to him the most characteristic feature of this element is the strong lateral curvature of the unit.

Material studied: 74 specimens

Stratigraphic range: From the Middle Trias and possibly Upper Trias of Teke Dağı section (Antalya, samples TT-79-8,10,11, 12,13,14,15,16?,17?; TT-80-3) and Middle Trias of Saklıkent section (Antalya, samples TS-80-1,3,4)

Cratognathodus sp. indet.

18 broken elements have been found from the Saklıkent area. These specifically unidentifiable conodonts are included within this genus.

Material studied: 18 specimens

Stratigraphic range: Middle Trias of Saklıkent section (Antalya, samples TS-80-1,3,4)

Genus CYPRIDODELLA Mosher 1968

1968a Cypridodella n.gen. Mosher p.920

Type species: Cypridodella conflexa Mosher 1968

Cypridodella mediocris (Tatge 1956)

Pl.22,fig.2

1956 Metalonchodina? mediocris Tatge, p.136, pl.6, fig.6
1958 Prioniodina mediocris (Tatge); Huckriede, p.160, pl.11, fig.10; pl.14, figs. 43,44
1959 Prioniodina mediocris (Tatge); Hirschmann, p.64, pl.5, figs.21,23
1960 Prioniodina mediocris (Tatge); Spassov & Ganev, p.88, pl.2, fig.11
1960 Prioniodina mediocris (Tatge); Budurov, p.121, pl.5, figs.3,4,20,21,31
1962 Prioniodina mediocris (Tatge); Stefanov, p.85, pl.1, fig.12
1965 Prioniodina mediocris (Tatge); Mosher & Clark, p.564, pl.66, fig.3
1968 Prioniodina mediocris (Tatge); Budurov & Zagortschev, pl.1, fig.4
1968a Cypridodella mediocris (Tatge); Mosher, p.920, pl.113, fig.26
1970 Prioniodina mediocris (Tatge); Bender, p.526, pl.5, figs.10,15
1971 Cypridodella mediocris (Tatge); Jenkins & Jenkins, fig.5, No.19,20
1973 Cypridodella mediocris (Tatge); Koike, p.99, pl.16, figs.35,36
1973a Cypridodella mediocris (Tatge); Mosher, p.154, pl.17, fig.4
1974 Cypridodella mediocris (Tatge); Sahni & Chhabra, p.268, pl.3, fig.A
1975 Cypridodella mediocris (Tatge); Gedik, p.114, pl.7, figs.12,13,19,25
1982 Cypridodella mediocris (Tatge); Koike, p.21, pl.7, fig.46

Remarks. A detailed synonymy can be found in Mosher, 1973a. This species is characterized by a long posterior process with several denticles. All the denticles, including the main denticle and those of the posterior bar curve inward distinctly.

Material studied: 6 specimens

Stratigraphic range: Middle Trias of Teke Dağı section (Antalya, biomicrite samples TT-79-10 and 11)

Cypridodella cf. pronoides (Budurov 1971)

Pl.22, fig.1

1971 Prioniodina proniodes Budurov, p.29, pl.1, figs.10,11

1975 Cypridodella pronoides (Budurov); Gedik, p.115, pl.7, figs.4-6

1982 Cypridodella pronoides (Budurov); Koike, p.22, pl.7, figs.48,49

Remarks. Detailed synonymies were given by Gedik (1975) and Koike (1982). Previously it has been reported (Koike, 1982) that this species does not have a prominent posterior process, but one of our 2 specimens shows a posterior process although it is broken.

Material studied: 2 specimens

Stratigraphic range: Middle Trias of Teke Dağı section (Antalya, sample TT-79-14)

Cypridodella spengleri (Huckriede 1958)

Pl.22, figs.3,4

1958 Lonchodina spengleri Huckriede, p.152, pl.10, figs.54,55; pl.11, fig.6; pl.12, fig.9; pl.13, figs.1,6,10; pl.14, fig.11

1960 Lonchodina spengleri Huckriede; Spassov & Ganev, p.83, pl.1, figs.25,28

1960 Lonchodina spengleri Huckriede; Budurov, p.114, pl.1, figs.1-8; pl.5, fig.2

1962 Lonchodina spengleri Huckriede; Budurov, p.119, pl.1, figs.5-8

1962 Lonchodina spengleri Huckriede; Stefanov, p.82, pl.2, fig.11

1965 Lonchodina spengleri Huckriede; Mosher & Clark, p.562, pl.66, fig.5

1966 Lonchodina mülleri forma b Van den Boogaard, p.5, pl.1, fig.1

1968a Cypridodella spengleri (Huckriede); Mosher, p.922, pl.113, figs. 18-20,25

1972 Hindeodella (Metaprioniodus) spengleri (Huckriede); Kozur & Mostler, p.16, pl.7, fig.11; pl.10, fig.4; pl.15, figs.1,5

1973 Cypridodella spengleri (Huckriede); Koike, p.100, pl.16, fig.31

1975 Prioniodina (Flabellignathus) spengleri spengleri (Huckriede); Gedik, p.146, pl.7, figs.23,31,33

1975 Prioniodina (Flabellignathus) spengleri sapanlii Gedik, p.146, pl.7, figs. 22,26,27,30

Remarks. A detailed synonymy was given by Mosher (1968a) This species is characterized by the thin bar, by the long sub-rounded main denticle

and by the compressed minor denticles which bend laterally.

Material studied: 7 specimens

Stratigraphic range: Middle Trias of Teke Dağı Section (Antalya, biomicrite sample TT-79-14?) and Middle Trias of Saklıkent section (Antalya, sample TS-80-1)

Cypridodella venusta (Huckriede 1958)

Pl.22, figs.5,6

1958 Lonchodina venusta Huckriede, p.152, pl.11, fig.25

1960 Lonchodina venusta Huckriede; Spassov & Ganev, p.82, pl.1, figs.15-17

1960 Lonchodina venusta Huckriede; Budurov, p.113, pl.2, figs. 1-5; pl.3, fig.6

1968 Synprioniodina spp. Hayashi, p.74, pl.4, fig.16

1968a Cypridodella venusta (Huckriede); Mosher, p.922, pl.114, figs. 1,7,13

1970 Lonchodina venusta Huckriede; Bender, p.514, pl.3, figs.18-20

1971 Prioniodina (Cypridodella) venusta (Huckriede); Kozur & Mostler, pl.1, fig.4

1972 Prioniodina (Cypridodella) venusta (Huckriede): Kozur & Mostler, p.32, pl.11, figs. 16,24; pl.12, fig.11; pl.15, fig.3

1975 Prioniodina venusta (Huckriede); Catalov & Budurov, p.1248, pl.1, fig.12

1975 Cypridodella venusta (Huckriede); Gedik, p.115, pl.7, figs.16-18

1976 Prioniodina venusta (Huckriede); Budurov, pl.4, figs.23-26

1977 Prioniodina venusta (Huckriede); Sudar, pl.5, fig.9

1978 Prioniodina venusta (Huckriede); Catalov & Budurov, pl.1, fig.1

1979 Prioniodina venusta (Huckriede); Budurov, pl.2, fig.3?

1982 Cypridodella venusta (Huckriede); Koike, p.23, pl.7, fig.47

Remarks. A detailed re-description was given by Mosher (1968à) The representatives of this species are large in size and distinctive. The posterior bar is very long so that it breaks easily. The main characteristic of these elements is the very thin unit with a number of greatly separated denticles.

Material studied: 6 specimens

Stratigraphic range: Middle Trias of Teke Dağı section (Antalya, sample TT-79-8) and Middle Trias of Saklıkent

section (Antalya, samples TS-79-9, TS-80-1).

Cypridodella sp. indet.

Some broken individuals belonging to this genus cannot be identified to species level; therefore they have been included in this category.

Material studied: 88 specimens

Stratigraphic range: Middle Trias and possibly Upper Trias of Teke Dağı section (Antalya, samples TT-79-3,5,7,8,10, 12,14,17,18; TT-80-2 and 3), Middle Trias of Saklıkent section (Antalya, samples TS-80-1,3,4)

Genus DIDYMODELLA Mosher 1969

1968a Dichodella n.gen. Mosher, p.923

1969 Didymodella Mosher, p.1441

Type species: Dichodella alternata Mosher 1968

Didymodella alternata (Mosher 1968)

Pl.22, figs. 12,13,14

1958 Hindeodella petrae-viridis ("pathological") Huckriede, pl.14,fig.7

1968a Dichodella alternata Mosher, p.923, pl.114, figs. 3,9,10

1969 Didymodella alternata (Mosher); Mosher, p.1441

1971 Didymodella alternata (Mosher); Kozur & Mostler, pl.1, fig.7

1972 Didymodella alternata (Mosher); Kozur & Mostler, p.6, pl.10, fig.5; pl.12, figs. 7,8; pl.14, figs. 1-3,6

1973 Didymodella alternata (Mosher); Koike, p.101, pl.16, figs. 37,38

1975 Didymodella alternata (Mosher); Gedik, p.116, pl.4, fig.31

1976 Didymodella alternata (Mosher); Budurov, pl.3, fig.19

1976 Didymodella alternata (Mosher); Gupta & Rafek, p.199, pl.2, figs. 2,b,c

1982 Didymodella alternata (Mosher); Koike, p.24, pl.9, fig.14

Remarks. The specimens are incomplete but they are included in this taxonomic category on the evidence of the flexed process with the denticles showing two directions of inclination.

Material studied: 10 specimens

Stratigraphic range: Middle Trias of Tele Dağı section (Antalya,

samples TT-79-9,10,11,13) and Middle Trias of Saklıkent section (Antalya, samples TS-80-1 and 3)

Genus DIPLODODELLA Bassler 1925

1925 Diplododella Bassler, p.219

Type species: Diplododella bilateralis Bassler 1925

Diplododella sp. indet.

Pl.22, fig.15

Incomplete individuals belonging to this genus cannot be identified to species level; therefore they have been included in this category.

Material studied: 8 specimens

Stratigraphic range: Middle-Upper Trias of Teke Dağı section (Antalya, samples TT-79-11,12,13)

Genus ENANTIOGNATHUS Mosher & Clark 1965

1965 Enantiognathus n.gen. Mosher & Clark, p.558

Type species: Apatognathus inversus Sannemann 1955

Remarks. This genus was first suggested by Mosher & Clark (1965). It is distinguished from Apatognathus Branson & Mehl and Cypridodella Mosher by the strong posterior direction of the lateral process. Representatives of the genus Enantiognathus range from the Permian and through the Triassic.

Enantiognathus lotus Kozur & Mostler 1970

Pl.22, fig.16

1970 Enantiognathus lotus Kozur & Mostler, p.434, pl.2, figs.16-19

Remarks. A full description of this species is given in Kozur & Mostler (1970). The characteristic features of this species are the large downward projecting posterior bar with 11-17 denticles, and the large, main denticle. The present material resembles closely the original description of this species which was first recovered from the Lower Muschelkalk of Germany (Lower Anisian).

Material studied: 3 specimens

Stratigraphic range: Middle Trias of Teke Dağı section (Antalya, samples TT-79-1 and 2)

Enantiognathus ziegleri (Diebel 1956)

Pl.22, fig.17

1956 Apatognathus ziegleri Diebel, p.433, pl.5, figs. 1,2

1956 Apatognathus longidentatus Tatge, p.130, pl.5, figs.18,19

1958 Apatognathus ziegleri Diebel; Huckriede, p.146, pl.11, fig.32; pl.12, fig.37

1959 Apatognathus cf. ziegleri Diebel; Hirschmann, p.43, pl.3, fig.2

1960 Apatognathus ziegleri Diebel; Spassov & Ganev, p.79, pl.1, figs.1,2

1960 Apatognathus ziegleri Diebel; Budurov, p.110, pl.4, figs.4,5

1962 Apatognathus ziegleri Diebel; Budurov, p.115, pl.1, figs.1-4

1962 Apatognathus ziegleri Diebel; Stefanov, p.79, pl.1, figs.1-3

1962 Apatognathus tribulosus Clark & Ethington, p.107, pl.1,figs.3,7,13,17

1963 Apatognathus ziegleri Diebel; Mirauta, p.491, pl.3, fig.1

1964 Apatognathus ziegleri Diebel; Budurov & Vrabljanski, pl.1, figs.10,14

1965 Enantiognathus ziegleri (Diebel): Mosher & Clark, p.560, pl.66, figs.12,15

1965 Apatognathus ziegleri Diebel;Spassov , p.26,pl.1, fig.16

1966 Apatognathus ziegleri Diebel; Catalov & Stefanov, pl.1, figs.12,13

1966 Gnamptognathus ziegleri Van Den Boogaard, p.4, pl.1, fig.4

1968 Enantiognathus ziegleri (Diebel); Budurov & Kulaksâzov, pl.1, figs. 1,2,9

1968 Enantiognathus ziegleri (Diebel); Budurov & Zagortschev, pl.1, figs.28,29

1968 Enantiognathus ziegleri (Diebel); Hayashi, p.68, pl.4,figs.28,29

1968a Enantiognathus ziegleri (Diebel); Mosher, p.925, pl.114, figs.2,8

1968 Enantiognathus ziegleri (Diebel); Kozur, p.1072, pl.1, fig.10

1970 Apatognathus ziegleri Diebel; Bender, p.502, pl.1, figs.9,12

1970 Enantiognathus ziegleri (Diebel); Budurov & Pevny, pl.17, figs.1-3

1970 Enantiognathus ziegleri (Diebel); Zawidzka, pl.2, fig.2

1971 Enantiognathus ziegleri (Diebel); Mock, pl.2, figs. 2,3

1971 Enantiognathus ziegleri (Diebel); Trammer, pl.1, fig.1

1972 Enantiognathus ziegleri (Diebel); Kozur & Mostler, p.9,pl.9, fig.26; pl.14, figs.11,15

1972 Enantiognathus ziegleri (Diebel); Sakagami & Watanabe, pl.2,figs.8-11

1973 Enantiognathus ziegleri (Diebel); Koike, p.102, pl.16, figs.26-29

1974 Enantiognathus ziegleri (Diebel); Budurov & Stefanov, p.95, pl.1 figs.1-4, 12

1974 Enantiognathus ziegleri (Diebel); Eicher & Mosher, p.732, pl.1, figs.21,22

1974 Enantiognathus ziegleri (Diebel); Koike & Ishiibashi, pl.57, fig.22
1974 Enantiognathus ziegleri (Diebel); Sahni & Chhabra, p.271, pl.4, figs. P,Q,R
1975 Enantiognathus ziegleri (Diebel); Budurov & Stefanov, pl.1, figs. 5-9
1975 Enantiognathus ziegleri (Diebek); Gedik, p.118, pl.5, figs.3,4
1975 Enantiognathus ziegleri (Diebel); Zawidzka, pl.36, figs.4,8
1976 Enantiognathus ziegleri (Diebel); Wang & Wang, p.403, pl.2, figs. 10-12
1977 Enantiognathus ziegleri (Diebel); Sudar, pl.5, fig.1
1978 Enantiognathus ziegleri (Diebel); Wang, p.216, pl.1, figs.8,9
1982 Enantiognathus ziegleri (Diebel); Koike, p.27, pl.7, figs.16,17?

Remarks. Detailed synonymies were given by Mosher & Clark (1965), Kozur & Mostler (1972), Budurov & Stefanov (1974) and Gedik (1975). This species possesses a lateral process which shows all gradations from short and smooth to long and denticulate. Specimens obtained in this study conform closely to previous descriptions of this species.

Material studies: 14 specimens

Stratigraphic range: Middle-Upper Trias of Teke Dağı section (Antalya, samples TT-79-10,15,19; TT-80-2,4) and Middle Trias of Saklıkent section (Antalya, samples TS-80-1,4)

Enantiognathus sp. indet.

Thirteen enantiognathiform elements recovered in this study can only be identified to generic level.

Material studied: 13 specimens

Stratigraphic range: Upper Trias of Teke Dağı section (Antalya, samples TT-80-4,5,7; TT-81-1) and Middle Trias of Saklıkent section (Antalya, sample TS-79-4)

Genus NEOCAVITELLA Sudar & Budurov 1979

1979 Neocavitella n.gen. Sudar & Budurov, p.49

Type species: Neocavitella cavitata Sudar & Budurov 1979

Remarks. Sudar & Budurov (1979) established a new genus characterized by a large and remarkably deep basal cavity which forms an elliptical shape.

Neocavitella comprises a series of considerably low denticles showing equality in height. The denticles are uniformly distinct and rather numerous (15 to 18). The length of the element is nearly three times its height. The main denticle is terminal in position and is a little longer and larger in size than the other denticles.

The genus is distinguished from all the gnathodiform conodonts as well as Neospathodus Mosher by its typical basal cavity. It differs from Misikella Kozur & Mock by its bigger and longer size, compressed appearance (it is not an elevated conodont), the presence of numerous relatively low denticles and by the heart-like section of the cavity.

To date, only the type species of this genus is known. Neocavitella? tatrica (Zawidzka) has recently been included in this genus, but it differs significantly from the type species of Neocavitella on the basis of the position, shape and size of its basal cavity as well as the main denticle (Kovacs & Kozur, 1980b).

Neocavitella cavitata Sudar & Budurov 1979

Pl.23, fig.1

1979 Neocavitella cavitata Sudar & Budurov, p.49, pl.1, figs. 1-8

Remarks. These are long blade-like conodonts which are characterized by a deep basal cavity. The single specimen comprises 16 flattened denticles showing equality in height. The main denticle is located at the posterior end and is a little longer than the remaining denticles. The length-height ratio of the element is 3:1. An elliptical cavity occupies nearly all the length of the element. It resembles slightly the Gnathodus type of conodont, but at present there are no known relationships or transitions with other Triassic conodonts. It is only known from the Carnian (Lower Upper Trias).

Material studied: 1 specimen

Stratigraphic range: Topmost Middle Trias of Teke Dağı section (Antalya, sample TT-79-16)

Neocavitella sp.A indet.

Pl.23, fig.2

Only one specimen is included in this taxonomic category. It differs from Xaniognathus Sweet by the presence of a deep cavity and by

the position of the main denticle.

Material studied: 1 specimen

Stratigraphic range: Middle Trias of Teke Dağı section (Antalya, sample TT-80-3)

? Neocavitella sp.B indet.

Pl.23, fig.3

Two specimens recovered in this study closely resemble Neocavitella? tatrica (Zawidzka) but, because of the position of the basal cavity and the main denticle, they may belong to the genus Sweetocristatus Szaniowski (1979), or an undescribed genus.

Material studied: 2 specimens

Stratigraphic range: Middle Trias of Teke Dağı section (Antalya, sample TT-79-15)

Genus NEOHINDEODELLA Kozur 1968

1968 Neohindeodella Kozur, p.1077

Type species: Hindeodella triassica Müller 1956

Neohindeodella dropla (Spassov & Ganev 1960)

Pl.23, fig.5

1960 Prioniodella dropla Spassov & Ganev, p.94, pl.2, figs.7,10
1960 Prioniodella dropla Spassov & Ganev; Budurov, p.119
1960 Hindeodella triassica Müller; Budurov, p.111, pl.2, fig.6
1966 Hindeodella sp.A,B Gessner, pl.7, figs. 9,11,12
1968a Hindeodella uniforma Mosher, p.929, pl.114, fig.14
1972 Neohindeodella dropla (Spassov & Ganev); Kozur & Mostler, p.21, pl.4, figs.9,12,14,15,17-19; pl.13, figs.3,5; pl.15, fig.14.
1975 Neohindeodella dropla (Spassov & Ganev); Zawidzka, pl.35,figs.13,14
1976 Hindeodella dropla (Spassov & Ganev); Budurov, pl.4, fig.15
1981 Neohindeodella dropla (Spassov & Ganev); Koike, pl.1, fig.16
1982 Neohindeodella dropla (Spassov & Ganev); Koike, p.33, pl.8, fig.32

Remarks. A detailed synonymy for this species was given by Gedik (1975). It is characterized by the presence of 3 or 4 inclined denticles on the anterior part of the element and by the numerous discrete denticles on the posterior part of the element. The cusp is indistinct.

Material studied: 7 specimens

Stratigraphic range: Upper Trias of Teke Dağı and Dömek Tepe (Antalya, samples: TT-80-5 and TD-79-1).

Neohindeodella triassica (Müller 1956)

Pl.23, fig.6

1956 Hindeodella triassica Müller, p.826, pl.96, figs. 4,5

1958 Hindeodella triassica Müller; Huckriede, pl.10, figs.48,50; pl.14,fig.8

1959 Hindeodella triassica Müller; Hirschmann, p.57, pl.4, fig.14

1960 Hindeodella triassica Müller; Spassov & Ganev, p.81, pl.1, fig.5

1962 Hindeodella triassica Müller; Stefanov, p.80, pl.1, figs.7-9

1965 Hindeodella triassica Müller; Mosher & Clark, p.562, pl.65, fig.5

1965 Hindeodella triassica Müller; Igo et al., p.10, pl.2, figs.4,5

1966 Hindeodella triassica Müller; Catalov & Stefanov, p.271, pl.1, fig.1

1966 Hindeodella triassica Müller; Ishii & Nogami, pl.1, fig.13

1966 Hindeodella triassica Müller; Gessner, pl.7, fig.6

1967 Hindeodella triassica Müller; Ganev & Stefanov, p.91, pl.1, figs.8,13

1968a Hindeodella triassica Müller; Mosher, p.929, pl.114, fig.22

1968 Hindeodella (Neohindeodella) triassica triassica (Müller); Kozur, p.10, pl.2, figs.10,11

1970 Hindeodella triassica Müller; Bender, p.510, pl.2, fig.22; pl.3, fig.1

1972 Neohindeodella triassica triassica (Müller); Kozur & Mostler, p.24, pl.1, fig.24; pl.4, fig.13; pl.7, figs.12,13; pl.8, fig.30; pl.13, figs.10,13

1973 Neohindeodella triassica triassica (Müller); Koike, p.107, pl.16, fig.17; pl.17, fig.24

1973 Neohindeodella triassica (Müller); Kozur & Mock, pl.1, fig.11

1974 Hindeodella triassica (Müller); Budurov & Stefanov, p.97, pl.2, figs.1,5,7-9

1974 Hindeodella triassica (Müller); Sahni & Chhabra, p.275, pl.4,fig.B?

1975 Hindeodella triassica (Müller); Budurov & Stefanov, pl.1, figs.11,14

1975 Neohindeodella triassica triassica (Müller); Zawidzka, pl.36,fig.3

1975 Neohindeodella triassica (Müller); Gedik, p.136, pl.6, figs.12?,16,23

1976 Hindeodella triassica Müller; Budurov, pl.4, figs.4,5,6?,8

1976 Hindeodella triassica Müller; Gupta & Rafek, p.201, pl.2, fig.8?

1976 Hindeodella triassica Müller; Wang & Wang, p.393, pl.1, fig.1?

1977 Neohindeodella triassica (Müller); Sudar, pl.2,fig.5?; pl.5, fig.8

1977 Neohindeodella triassica (Müller); Gedik, p.43, pl.4, figs.14,15, non 10

1978 Neohindeodella triassica triassica (Müller); Mirauta & Gheorghian, pl.1, fig.29

1981 Neohindeodella triassica (Müller); Koike, pl.1, fig.25

1982 Neohindeodella triassica (Müller); Koike, p.35, pl.8, figs.21-30

Remarks. Detailed synonymies of the species were given by Gedik (1975) and Koike (1982). The characteristic features of this species are the thin and arched basal edge and the presence of a large main denticle near the anterior end. The main denticle is separated from the neighbouring denticles. Denticles which are placed near the posterior end increase in size and become almost the same size as the main denticle.

Material studied: 18 specimens

Stratigraphic range: Middle-Upper Trias of Teke Dağı section (Antalya, samples TT-79-8,11,13,16,17; TT-81-1?) and Upper Trias of Dömek Tepe section (Antalya, samples TD-79-2B, TD-80-1)

Neohindeodella sp. indet.
Pl.23, fig.7

Some incomplete specimens which cannot be identified to species level are included in this category.

Material studied: 16 specimens

Stratigraphic range: Middle Trias of Teke Dağı section (Antalya, samples TT-79-12,14,15; TT-80-2,6?) and Middle Trias of Saklıkent section (Antalya, samples TS-79-9, TS-80-1)

Genus PRIONIODELLA Bassler 1925

1925 Prioniodella Bassler, p.219

Type species: Prioniodella normalis Basler 1925

Prioniodella decrescens Tatge 1956
Pl.23, fig.8

1956 Prioniodella decrescens Tatge, p.111

1958 Prioniodella decrescens Tatge; Huckriede, p.158, pl.11, figs.43,48,49; pl.14, figs.37-39

1959 Prioniodella decrescens Tatge; Hirschmann, p.73, pl.5, figs.31,32

1960 Prioniodella decrescens Tatge; Spassov & Ganev, p.85, pl.1, figs. 18,19

1960 Prioniodella decrescens Tatge; Budurov, p.118, pl.2, fig.32; pl.3, figs. 9,10,13; pl.4, figs.21-23

1962 Prioniodella decrescens Tatge; Stefanov, p.84, pl.2, figs.8-10

1965 Prioniodella decrescens Tatge; Mosher & Clark, p.563, pl.66, fig.4

1966 Prioniodella decrescens Tatge; Budurov & Vrabljanski, pl.4, fig.20

1968ə Prioniodella decrescens Tatge; Mosher, p.933, pl.114, fig.27

1968 Prioniodella decrescens Tatge; Budurov & Kulaksasov, pl.1, figs. 8,10,11

1968 Prioniodella decrescens Tatge; Budurov & Zagortschev, pl.1, figs.10-12

1973a Prioniodella decrescens Tatge; Mosher, p.175, pl.17, fig.29

1975 Prioniodella decrescens Tatge; Behnken, p.312, pl.2, fig.25

Remarks. This species is a blade-like element which is characterized by a gradual decrease in elevation of the denticles from the anterior to the posterior.

Material studied: 3 specimens

Stratigraphic range: Middle Trias of Teke Dağı section (Antalya, sample TT-79-10)

Prioniodella pectiniformis Huckriede 1958
Pl.23, figs.9,10,11

1958 Prioniodella pectiniformis Huckriede, p.158, pl.13, figs.18,19

1960 Prioniodella pectiniformis Huckriede; Spassov & Ganev, p.86, pl.2, fig.12

1960 Prioniodella pectiniformis Huckriede; Budurov, p.118, pl.1, figs. 13,14; pl.3, figs. 18,19a,b; pl.5, fig.35

1965 Prioniodella pectiniformis Huckriede; Mosher & Clark, p.563, pl.66, fig.6

1968 a Prioniodella pectiniformis Huckriede; Mosher, p.933, pl.115, fig.30

1969 Prioniodella pectiniformis Huckriede; Hirsch, p.89, fig.8

1970 Prioniodella pectiniformis Huckriede; Bender, p.525, pl.5, fig.7

1971 Hindeodella (Metaprioniodus) pectiniformis (Huckriede); Kozur & Mostler, pl.1, fig.5, non 8.

1976 Hindeodella (Metaprioniodus) pectiniformis (Huckriede); Kemper et al., p.106, pl.6, fig.7

Remarks. A detailed synonymy for this species was given by Mosher & Clark (1965). This species, which is characterized by the long and straight bar, possesses a number of discrete denticles which decrease in size anteriorly and curve upward.

Material studied: 30 specimens

Stratigraphic range: Middle-Upper Trias of Teke Dağı section (Antalya, samples TT-79-8,10,12,13,14) and Middle Trias of Saklıkent section (Antalya, sample TS-80-1)

Prioniodella prioniodellides (Tatge 1956)
Pl.23, fig.12

1956 Angulodus? prioniodellides Tatge, p.130, pl.5, fig.6
1958 Prioniodella prioniodellides (Tatge); Huckriede, p.159, pl.10, fig.19; pl.11, figs.5,45
1959 Prioniodella prioniodellides (Tatge); Hirschmann, p.74, pl.5, figs. 33,34
1960 Prioniodella prioniodellides (Tatge); Spassov & Ganev, p.87, pl.1, fig.29
1960 Prioniodella prioniodellides (Tatge); Budurov, p.119, pl.1, fig.11
1962 Prioniodella prioniodellides (Tatge); Stefanov, p.84, pl.2, fig.14
1962 Prioniodella prioniodellides (Tatge); Budurov, p.120, pl.1, figs. 21-23
1965 Prioniodella prioniodellides (Tatge); Mosher & Clark, p.563, pl.65, fig.10
1968 Prioniodella prioniodellides (Tatge); Budurov & Zagortschev, pl.1, fig.32
1968ə Prioniodella prioniodellides (Tatge); Mosher, p.933, pl.114, figs.23,26
1968a "Prioniodella" prioniodellides (Tatge); Kozur, pl.3, fig.17; pl.1, fig.23
1968b "Prioniodella" prioniodellides (Tatge); Kozur, p.1079
1970 Prioniodella prioniodellides (Tatge); Bender, p.525, pl.1, figs.1,2
1970b "Prioniodella" prioniodellides (Tatge); Sweet, p.261, pl.5, fig.11
1970 Prioniodella prioniodellides (Tatge); Budurov & Pevny, pl.17, figs.27-29
1973a Prioniodella prioniodellides (Tatge); Mosher, p.175, pl.17, fig.18
1973 Prioniodella prioniodellides (Tatge); Koike, p.110, pl.16, fig.21

1975 Prioniodella prioniodellides (Tatge); Gedik, p.141, pl.4, figs. 20,21,30

1975 "Prioniodella prioniodellides" (Tatge); Zawidzka, pl.39, figs.4,8

Remarks. A detailed synonymy for this species was given by Mosher (1968). The characteristic feature of this species is the bar which curves down anteriorly and bears a number of compressed denticles. There is no distinct main denticle.

Material studied: 2 specimens

Stratigraphic range: Middle Trias of Teke Dağı and Saklıkent sections (Antalya, samples TT-79-15 and TS-80-4)

Genus PRIONIODINA Bassler 1925

1925 Prioniodina Bassler, p.219

Type species: Prioniodina subcurvata Basler 1925

Prioniodina libita Mosher 1968

Pl.23, figs.13,14

1968a Prioniodina libita Mosher, p.934, pl.115, figs. 17,26,29

Remarks. This species was described from the Schregeralmkalk of Austria by Mosher (1968a). To date it is only known from the European stocks of the Upper Anisian Stage . The material herein referred to this species agrees well with the description and illustration of the holotype given by Mosher (1968a). The species is characterized by the long and curved denticles which project backward and laterally. The main denticle is located near the posterior of the laterally compressed unit. Terminal denticles are usually shorter. There is a compressed basal cavity beneath the main denticle. The anterior bar projects downward and curves laterally. The short posterior bar bears two or three small denticles. Mosher (1968) distinguished this species from Prioniodina latidentata Tatge on the basis of its large basal cavity and distinctive appearance at the anterior end of the bar.

Material studied: 15 specimens

Stratigraphic range: Middle-Upper Trias of Teke Dağı and Saklıkent sections (Antalya, samples TT-79-10,12,13,14, TT-80-3. TS-80-3,4)

Prioniodina petrae-viridis (Huckriede 1958)

Pl.23, figs. 16,17,18,19,20,21

1958 Hindeodella petrae-viridis Huckriede, p.149, pl.11, fig.26; pl.13, figs.7-9,11,12,14; pl.14, fig.6

1958 Lonchodina spengleri Huckriede, pl.1, fig.56

1960 Hindeodella petrae-viridis Huckriede; Spassov& Ganev, p.81, pl.1, figs.3,4; pl.2, fig.3

1960 Lonchodina spengleri Huckriede;Spassov & Ganev, pl.1, fig.20

1960 Hindeodella petrae-viridis Huckriede; Budurov, p.112, pl.3, fig.17; pl.4, figs.1a,b, 2,3,7,8,9a,b, 10; pl.5, fig.34

1965 Hindeodella petrae-viridis Huckriede; Mosher & Clark, p.562, pl.65, fig.9

1966 Hindeodella petrae-viridis Huckriede; Ishii & Nogami, pl.1, fig.14

1966 Hindeodella petrae-viridis Huckriede; Catalov & Stefanov, pl.1, fig.16

1966 Lonchodina latidentata Huckriede; Catalov & Stefanov, pl.1, fig.6

1968a Prioniodina petrae-viridis (Huckriede); Mosher, p.934, pl.116, figs. 28-31

1969 Hindeodella petrae-viridis Huckriede; Hirsch, p.89, fig.4

1970 Parachirognathus petrae-viridis (Huckriede); Bender, p.524, pl.5, figs.1-6, non 8,9

1971 Enantiognathus petrae-viridis (Huckriede); Kozur & Mostler, pl.1, fig.14

1976 Enantiognathus petrae-viridis (Huckriede); Kempel et al., p.105, pl.6, fig.8

1977 Prioniodina (Flabellignathus) sp. Gedik, p.44, pl.4, fig.18

1981 Diplododella petraeviridis (Huckriede); Koike, pl.1, fig.26

Remarks. The taxonomy of Prioniodina petrae-viridis is in a confused state, but nevertheless it is a well studied species. A revised description was given by Mosher (1968a). This species is very abundant in our collections. Specimens are usually large in size, so that they break easily, either within the body of the organism or when freed into the sediment. In this study more than a hundred specimens have been recovered, but none is complete. The elements of this species are characterized by the long anterior bar which bears several denticles, an adjacent large main denticle and by the short posterior bar which is smooth, or may bear one or two small denticles. Denticles which are on the anterior bar incline towards the main denticle and decrease in size.

Material studied: 159 specimens

Stratigraphic range: Middle-Upper Trias of Teke Dagı section (Antalya, samples TT-79-7,8,10,12,13,14,15,16; TT-80-3) and Middle Trias of Saklikent section (Antalya, samples TS-79-5,9; TS-80-1,2,3)

Prioniodina sp. indet.

Pl.23, fig.15

A few incomplete specimens are included in this category.

Material studied: 7 specimens

Stratigraphic range: Middle Trias of Saklıkent section (Antalya, samples: TS-90-1 and 3)

Genus XANIOGNATHUS Sweet 1970

1970 Xaniognathus n.gen. Sweet, p.261

Type species: Xaniognathus curvatus Sweet 1970

Remarks. Sweet (1970) suggested this new genus for conodonts with distinctive skeletal elements of a single morphologic type. They are characterized by the blade-like unit with a long anterior process bearing denticles. The anterior process shows a mid-lateral rib, but the short posterior process does not have such a feature.

Xaniognathus tortilis (Tatge 1956)

Pl.23, fig.4

1956 Ozarkodina tortilis Tatge, p.138, pl.5, figs. 10,11

1958 Ozarkodina tortilis Tatge, Huckriede, p.154, pl.10, figs.44,47; pl.11, figs.21-24,26,28,30; pl.14, figs.15,45,46

1959 Ozarkodina tortilis Tatge; Hirschmann, p.67, pl.5, figs.25,26

1960 Ozarkodina tortilis Tatge; Spassov & Ganev, p.84, pl.1, fig.31; pl.2, fig.20

1960 Ozarkodina tortilis Tatge; Budurov, p.115, pl.2, figs.20-22; pl.4, figs. 25, 26

1962 Ozarkodina tortilis Tatge; Budurov, p.120, pl.1, figs.28-33

1962 Ozarkodina tortilis Tatge; Stefanov, p.84, pl.1, figs. 15,16

1965 Ozarkodina tortilis Tatge; Bender & Stoppel, p.348, pl.15, figs. 16a,b, 17

1965 Ozarkodina tortilis Tatge; Mosher & Clark, p.563, pl.66, fig.11
1968a Ozarkodina tortilis Tatge; Mosher, p.932, pl.115, fig.23
1968a Ozarkodina tortilis Tatge; Kozur, pl.3, figs. 12,13
1968b Ozarkodina tortilis Tatge; Kozur, p.1078
1968 Ozarkodina tortilis Tatge; Budurov & Kulaksasov, pl.2, fig.2
1969 Ozarkodina tortilis Tatge; Hirsch, p.7, fig.18
1970 Ozarkodina tortilis Tatge; Bender, p.521, pl.4, figs.12,14,18,19 21,22
1970 Ozarkodina tortilis Tatge; Zawidzka, pl.2, fig.4
1970 Ozarkodina tortilis Tatge; Budurov & Pevny, pl.17, fig.23
1971 Ozarkodina tortilis Tatge; Mock, pl.1, fig.7
1971 Ozarkodina tortilis Tatge; Clark & Behnken, p.433, pl.2, fig.18
1971 Ozarkodina tortilis Tatge; Trammer, pl.2, fig.3
1972 Ozarkodina tortilis Tatge; Kozur & Mostler, p.26, pl.5, fig.11; pl.6, figs. 5,6
1973 Xaniognathus tortilis (Tatge); Koike, p.110, pl.16, figs. 19,20
1975 Xaniognathus tortilis (Tatge); Behnken, p.313, pl.2, fig.13
1977 Ozarkodina tortilis Tatge; Gedik, p.43, pl.4, figs.3,16
1981 Xaniognathus tortilis (Tatge); Koike, pl.1, fig.20

Remarks. Blade-like skeletal elements with a long anterior process which bears denticles. Denticles show a uniform inclination. The posterior bar is short and twisted. There is a basal cavity beneath the main denticle in specimens of our collection.

Material studied: 15 specimens

Stratigraphic range: Middle-Upper Trias of Teke Dağı section (Antalya, samples TT-79-11,15,16; TT-80-4) and Middle Trias of Saklıkent section (Antalya, sample TS-80-1)

Xaniognathus sp.indet.

Incomplete species of Xaniognathus, which could not be identified to special level, are placed in this taxonomic category.

Material studied: 31 specimens

Stratigraphic range: Middle-Upper Trias of Teke Dağı section (Antalya, samples TT-79-6; TT-80-2,4,5), Upper Trias of Dömek Tepe section (Antalya, sample TD-80-1) and Middle Trias of Saklıkent section (Antalya, samples TS-79-4, 9,10; TS-80-1,3)

MIDDLE-UPPER TRIASSIC

Platform Conodonts

Discrete Element Taxonomy

Order CONODONTOPHORIDA Eichenberg 1930

Genus EPIGONDOLELLA Mosher 1968

1968a Epigondolella n.gen. Mosher, pp.935-936
1970 Tardogondolella n.gen. Bender, p.530
1972a Ancyrogondolella n.gen. Budurov, pp.855-856
1973 ?Carinella n.gen. Budurov, p.799

Type species: Polygnathus abneptis Huckriede 1958

Remarks. Mosher (1968a, p.935) defined Epigondolella as a platform-like conodont with a high, anterior free blade and with marginal node-like projections on the platform. Representatives of this genus have also a node placed sub-centrally on the platform. Minor denticles may occur on a carina developed posterior to the node. The carina usually decreases abruptly in height to the posterior near the anterior margin of the platform. The undersides of specimens of this genus possess a broad keel, which bears a narrow groove that ends in a pit which, in some specimens, is terminal in position on the keel. In all adult specimens, the keel lies mainly to the anterior end of the unit. Growth occurs posteriorly as well as anteriorly.

Relationships. This genus is distinguished and differentiated from Gladigondolella Müller and Neogondolella Bender & Stoppel by the high free blade, the denticulated platform margins and by the basal pit which is located some distance anterior of the posterior margin of the platform. Representatives of Epigondolella have been distinguished by Mosher (1973) from Metapolygnathus Hayashi, but there is still remarkable confusion over the taxonomy of Metapolygnathus Hayashi. Mosher (1973) concluded that Epigondolella, and its evolutionary precursor Metapolygnathus, constitute a bio-series which demonstrates a gradual evolutionary change in the Upper Trias, with all known species of the genus being linked.

Mosher (1968) selected a typical specimen of Polygnathus abneptis Huckriede as the type species for Epigondolella. Hayashi (1968) proposed a new genus Metapolygnathus, with Metapolygnathus communisti Hayashi

being selected as the type species for Metapolygnathus. In the Catalogue of Conodonts (Ziegler, 1977), Metapolygnathus was considered to be a junior subjective synonym of Neogondolella Bender & Stoppel with its type species a junior synonym of Neogondolella polygnathiformis (Budurov & Stefanov). Kovacs and Kozur (1980) presented a different opinion. According to them Metapolygnathus communisti Hayashi is a typical representative of Epigondolella Mosher. Epigondolella proposed by Mosher in July 1968 was considered by Kovacs and Kozur (1980) to be a synonym of Metapolygnathus Hayashi, which was first reported in February 1968.

Mosher (1973) separated Metapolygnathus from Neogondolella and Epigondolella, indicating that Metapolygnathus was the ancestor for Epigondolella. Budurov (1977) also differentiated Epigondolella and Metapolygnathus as two different genera on the basis of their basal structures.

In spite of this confusion, there is general agreement on the other taxonomic names which have been proposed: Tardogondolella Bender is the junior synonym of Epigondolella Mosher, because Bender's paper, although bearing a 1967 date, was not available until 1970. Ancryrogondolella Budurov 1973 and Carinella Budurov 1973 are also synonymous with Epigondolella Mosher 1968.

In the present study, Epigondolella and Neogondolella are considered as two different and distinct genera. Metapolygnathus is considered to be a junior synonym of Neogondolella. The reasoning will be explained later under the remarks for the genus Neogondolella.

Stratigraphic occurrence: To date, examples of Epigondolella Mosher have only been reported from the Upper Trias (Carnian to Norian). This genus appears to be widely distributed geographically, but has a limited stratigraphic distribution. It is commonly believed therefore that the genus has a stratigraphic value, with species of the genus being useful fossils for the determination of Upper Trias age.

Epigondolella abneptis (Huckriede 1958)

Pl.24, figs. 1,2,3,4,5,6,7,8a-b

1958 Polygnathus abneptis Huckriede, p.156, pl.12, figs. 30-34; pl.14, figs. 1,2,12,13,16-22,27,32,47-57

1960 Polygnathus abneptis Huckriede; Budurov, p.117, pl.1, fig.26

1964 Polygnathus abneptis Huckriede; Lindstrom, fig.22L

1965 Gladigondolella abneptis (Huckriede); Zankl, pl.1, figs.6g-i

1965 Polygnathus abneptis Huckriede; Spassov, p.29, pl.1, figs.12-14

1966 Polygnathus abneptis Huckriede; Budurov & Vrabljanski, pl.4, fig.22

1966 Gladigondolella cf. abneptis (Huckriede); Ishii & Nogami, pl.1, figs. 3-5

1967 Gladigondolella abneptis (Huckriede); Nohda & Setoguchi, p.232, pl.2, figs.1,2,5,7

1968 Gladigondolella abneptis (Huckriede); Nogami, p.122, pl.8, figs.1-5

1968a Gladigondolella abneptis (Huckriede); Hayashi, p.68, pl.2, figs.6,7

1968a Epigondolella abneptis (Huckriede); Mosher, p.936, pl.118, figs.22-30

1968b Epigondolella abneptis (Huckriede); Mosher, pl.120, figs. 17-27

1970 Epigondolella abneptis (Huckriede); Mosher, pl.110, figs.14,15,20,21

1970 Tardogondolella abneptis (Huckriede); Bender, p.531, pl.4, fig.29

1970 Polygnathus abneptis Huckriede; Budurov & Pevny, pl.17, figs.13,14

1971 Epigondolella abneptis (Huckriede); Sweet et al., pl.1, figs. 18,27.

1971 Tardogondolella abneptis (Huckriede); Kozur & Mostler, pl.2, figs.7,9

1971 Tardogondolella abneptis (Huckriede); Mock, pl.4, figs.2,4,6,11; pl.5, figs. 3,4,12

1971 Epigondolella abneptis (Huckriede); Hayashi, pl.2, figs.1?,4

1972 Epigondolella abneptis (Huckriede); Kozur & Mostler, pl.2, figs.9-15

1972 Metapolygnathus abneptis abneptis (Huckriede); Kozur, pl.6,figs.20-21; pl.7, figs. 12-18

1972 Metapolygnathus spatulatus spatulatus (Hayashi); Kozur, pl.4, figs. 4,6-8; pl.5, figs. 1-4

1973a Epigondolella abneptis (Huckriede); Mosher, p.159, pl.18, figs. 6,12-14, 16,17

1973 Epigondolella abneptis (Huckriede); Durdanovic, pl.6, fig.25

1973 Epigondolella abneptis (Huckriede); Kozur & Mostler, pl.2, figs.9-15

1973 Epigondolella abneptis (Huckriede); Krystyn, pl.4, figs. 1-3

1975 Tardogondolella abneptis abneptis (Huckriede); Mirauta & Gheorghian, p.55, pl.6, fig.2; pl.8, figs. 1,2,4,6; pl.9, figs. 1-3

1976 Epigondolella abneptis (Huckriede); Wang & Wang, p.403, pl.4, figs.17-19

1976b Epigondolella abneptis (Huckriede); Budurov, p.103, pl.2, figs.22,23

1977 Epigondolella abneptis (Huckriede); Budurov, p.42, pl.1, figs. 1,2

1977 Metapolygnathus abneptis (Huckriede); Mello & Mock, pl.8, fig.2

1977 Metapolygnathus abneptis (Huckriede); Kozur & Mock, pl.3, figs.1-12

1977 Epigondolella abneptis (Huckriede); Ziegler, p.151, Epigondo.-plate 1, figs. 4a,b

1977 Metapolygnathus abneptis (Huckriede); Misik et al., pl.7, figs. 5,6,10

1978 Epigondolella abneptis (Huckriede); Ramovs, p.52, pl.2, fig.3

1978 Metapolygnathus abneptis (Huckriede); Gupta, p.174, pl.1, fig.3

1978 Metapolygnathus abneptis abneptis (Huckriede); Gupta et al., p.592, pl.3, fig.1; pl.4, figs. 6,7,9,10

1979 Epigondolella abneptis (Huckriede); Clark et al., pl.1, fig.5

1979 Epigondolella abneptis (Huckriede); Kolar, p.314, pl.2, fig.4

1980a Metapolygnathus abneptis abneptis (Huckriede); Kovacs & Kozur, p.557, pl.3, figs.2-5; pl.4, figs. 1-3

1980b Metapolygnathus abneptis abneptis (Huckriede); Kovacs & Kozur, pl.14, figs. 1,2,3,4

1980 Metapolygnathus abneptis abneptis (Huckriede); Kovacs & Scheffer, p.592, pl.3, fig.1; pl.4, figs. 6,7,9,10

1980 Metapolygnathus abneptis spatulatus (Hayashi); Kovacs & Scheffer, p.592, pl.2, fig.1; pl.3, figs. 2-9

1980 Epigondolella abneptis (Huckriede); Matsuda, plate-fig.1

1980 Epigondolella abneptis (Huckriede); Isozaki & Matsuda, plate-fig.4?

1981 Epigondolella abneptis (Huckriede); Ishida, pl.6, figs.4-6

1981 Epigondolella abneptis (Huckriede); Koike, pl.2, figs.26-28

1982 Epigondolella abneptis (Huckriede); Isozaki & Matsuda, p.111, pl.1, figs. 4,5; pl.2, figs. 2?,3,4?,6,7?,8

Remarks. Examples of this species occur as the most abundant element in the Upper Trias biomicrites of the Teke Dağı region (Antalya, TT). Huckriede (1958) was the first to group many species together under the name of Polygnathus abneptis. Later, numerous generic names were suggested, and various species were proposed on the basis of the growth stages of this taxon. Mosher (1968a) introduced a new generic name, Epigondolella, citing "Polygnathus abneptis" as the type species. Although there is still confusion and misunderstanding amongst conodont researchers about this taxon, our specimens closely resemble those of Mosher's collection from both Europe and North America.

Detailed descriptions of this species can be found in Mosher (1968a,

p.936; 1973a,p.159) and Ziegler (1977, p.151). Briefly, the elements of Epigondolella abneptis are characterized by a broad platform, which varies in shape from square to rectangular to spatulate, by the nodes and denticles on the upper surface of the platform and by the clear bifurcation of the posterior part of the keel on the lower surface.

Material studied: 436 specimens

Stratigraphic range: Upper Trias of Teke Dağı section (Antalya, samples TT-79-12,18,19; TT-80-4,5,6,7; TT-81-1); Upper Trias of Dömek Tepe section (Antalya, samples TD-79-1,2A; TD-80-1)

Epigondolella baloghi (Kovacs 1977)
Pl.24, figs. 9a-b,10

1975 Epigondolella carnica Krystyn, p.273, pl.3, fig.4 only
1977 Metapolygnathus baloghi Kovacs, p.79, pl.3, fig.2; pl.4, fig.1; pl.5, figs. 1,2; pl.7, figs. 1,2

Remarks. Specimens which have been recovered from the Teke Dağı region (Antalya) closely resemble material illustrated by Kovacs (1977). This species is characterized by the very wide platform which tapers posteriorly.

Material studied: 20 specimens

Stratigraphic range: Upper Trias of Teke Dağı section (Antalya, sample TT-79-12)

Epigondolella aff. baloghi (Kovacs 1977)
Pl.24, figs.13,14,15,16

Remarks. Ten elements recovered from Teke Dağı are tentatively referred to this species. The specimens in our collection are characterized by a wide, almost square platform. The posterior end is usually aquare in outline but with rounded corners. The platform margins are slightly upturned. There are always several nodes on the two sides of the posterior part. The posterior end may or may not contain nodes. The carina, which is composed of 7-8 denticles,rapidly decreases in height posteriorly. Although the basal field of the recovered elements is usually broken, it appears to project forward at the anterior end and to broaden at the posterior end.

The material which has been recovered in this study differs from Kovacs' figured specimens in that they possess a wide, nearly square platform with several nodes on both sides of the posterior part of the platform in addition to those at the posterior end.

Material studied: 10 specimens

Stratigraphic range: Upper Trias of Teke Dağı section (Antalya, samples TT-79-12; TT-80-4)

Epigondolella carnica Krystyn 1975

Pl.24, figs. 11,12

1975 Epigondolella carnica Krystyn, p.273, pl.3, figs.1-4

Remarks. The elements of this species are characterized by a broad platform which bears elongated nodes at its margins. The posterior end of the platform is slightly rectangular in outline with rounded corners. It shows a high, free carina, which bears pointed denticles. The denticles of the carina decrease in elevation gradually posteriorly, as well as anteriorly. The posterior-most denticle of the carina is developed as a strong terminal node. The anterior margins of the platform are slightly upturned, giving an appearance similar to Epigondolella abneptis (Huckriede). On the lower surface there is a broad keel which bears a groove that ends in a posteriorly located, oval, basal pit. Epigondolella carnica is distinguished from other species of the genus by its rounded platform, the few non-pointed nodes on the platform margins and by the keel, which does not bifurcate on the lower surface beneath the terminal node.

Material studied: 11 specimens

Stratigraphic range: Upper Trias of Teke Dağı section (Antalya, sample TT-79-12)

Epigondolella nodosa (Hayashi 1968)

Pl.24, figs.17,18a-b

1958 Gladigondolella nsp. Huckriede, p.147, pl.12, figs. 25-27

1958 Polygnathus abneptis Huckriede, pl.12, fig.35; pl.14, fig.26

1968a Gladigondolella abneptis nodosa Hayashi, p.69, pl.2, figs. 9a-c

1968a Paragondolella polygnathiformis (Budurov & Stefanov); Mosher, p.939, pl.118, figs. 12,13 only

1968b Paragondolella polygnathiformis (Budurov & Stefanov); Mosher, pl.120, figs. 11,14 only

1970 Tardogondolella abneptis (Huckriede): Bender, p.531, pl.5, fig.21

1971a Tardogondolella diebeli Kozur & Mostler, p.13, pl.2; figs. ?3a,b

1972 Metapolygnathus nodosa (Hayashi); Kozur, pl.3, fig.9

1973 Epigondolella nodosa (Hayashi); Krystyn, p.138, pl.3, figs.2-4

1974 Epigondolella nodosa (Hayashi); Koike & Ishibashi, p.435, pl.57, figs. 9,11-14, 19

1977 Epigondolella nodosa (Hayashi); Gedik, pl.3, figs.11,12,18?,19?

1977 Metapolygnathus nodosus (Hayashi); Misik et al., pl.8, fig.8

1977 Metapolygnathus nodosus (Hayashi); Kozur & Mock, pl.2, figs.2-4?, 5,6?,7?,9,10

1977 Epigondolella nodosa (Hayashi); Ziegler, p.183, Epigondo. - plate 2, fig.5

1979 Epigondolella nodosa (Hayashi); Kolar, p.315, pl.3, figs.3,4

1979 Epigondolella nodosa (Hayashi); Metcalfe et al., pl.97, fig.6

1980 Epigondolella nodosa (Hayashi); Krystyn, pl.12, figs. 1,4,5

1980 Epigondolella nodosa (Hayashi); Matsuda, plate- fig.4?

1980 Epigondolella nodosa (Hayashi); Isozaki & Matsuda, plate - fig.3

1981 Neogondolella nodosa (Hayashi); Koike, pl.2, figs.20,21

1982 Epigondolella nodosa (Hayashi); Isozaki & Matsuda, p.109, pl.1, figs. 1,2

Remarks. Detailed synonymies for the species have been given by Koike and Ishibashi (1974), Ziegler (1977) and Metcalfe et al. (1979). The concept of Epigondolella nodosa is based on Gladigondolella abneptis nodosa Hayashi. This species is characterized by the oval to sub-parallel platform which possesses weak transverse ridges. Carina bears ten or more fused denticles which decrease in height posteriorly. The elements of this species conform to the opinion of Mosher (1973) who differentiated between Epigondolella nodosa (Hayashi) and Epigondolella primita Mosher.

Material studied: 13 specimens

Stratigraphic range: Upper Trias of Teke Dağı section (Antalya sample TT-79-12)

Epigondolella parva (Kozur 1972)

Pl.25, figs. 1,2

1972 Metapolygnathus parvus Kozur, p.8, pl.6, figs. 2-5

1977 Epigondolella parva (Kozur); Ziegler, p.185, Epigondo.- Pl.1, figs. 5a-b

1980 Metapolygnathus parvus Kozur; Kovacs & Kozur, pl.11, figs. 1-3

Remarks. This species was first suggested by Kozur (1972) from a study of rocks in Czechoslovakia. To date, it is only documented from the locus typicus (Silica Brezova). A translation into English of its original diagnosis can be found in Ziegler (1977). The platform is characterized by smooth margins shorter than half the overall length of the element. The greatest width of the platform is either at the mid-length or in the anterior third. The elements bear a high carina with 4-8 fused denticles which are free in their upper half. There are 2-3 short, discrete denticles on the posterior part of the carina. In the lower part the basal pit is located near the middle of the platform. Epigondolella parva is distinguished from other species of the genus by the position of its basal pit and by possessing a platform with smooth margins. The specimens from Teke Dağı (Antalya) referred to Epigondolella parva agree well with the type material illustrated by Kozur (1972).

Material studied: 32 specimens

Stratigraphic range: Upper Trias of Teke Dağı section (Antalya, samples TT-80-4,5)

Epigondolella aff. parva (Kozur 1972)
Pl.25, figs. 3a,b,c

Remarks. Two of the specimens which have been recovered in this study differ from Kozur's (1972, pl.6, figs.2-5) illustrated material. The posterior part of their platforms is more rectangular in shape, and they possess a keel which appears to bifurcate beneath the terminal node.

Material studied: 2 specimens

Stratigraphic range: Upper Trias of Teke Dağı section (Antalya, sample TT-79-12)

Epigondolella permica (Hayashi 1968)
Pl.25, figs.4a-b,5,6

1958 Polygnathus abneptis Huckriede, p.156, pl.12, figs.36a,b

1968 Gladigondolella abneptis permica Hayashi, p.69, pl.2, figs.3a-c

1972 Metapolygnathus abneptis permicus (Hayashi); Kozur, pl.7, fig.22

1973 Epigondolella permica (Hayashi); Krystyn, p.140, pl.3, fig.5; pl.5, figs.1-3
1973 Epigondolella permica (Hayashi); Kozur & Mostler, pl.2, fig.5
1977 Epigondolella permica (Hayashi); Gedik, p.42, pl.3, figs.4,7,10, 13,14,20,24,25
1977 Epigondolella permica (Hayashi); Ziegler, p.187, pl.1, figs.7a-c
1978 Epigondolella permica (Hayashi); Ramovs, p.56, pl.2, figs.1,4,6; pl.3, fig.6

Remarks. Hayashi (1968) considered a constricted platform to be the characteristic feature of this element. Subsequently Krystyn (1973) has reported transitional forms which occur in his collection with or without such features. It is more likely, however, that Epigondolella permica includes elements gradational between Epigondolella nodosa (Hayashi) and Epigondolella abneptis (Huckriede).

Material studied: 51 specimens

Stratigraphic range: Upper Trias of Teke Dağı section (Antalya, samples TT-79-5?,12) and Upper Trias of Dömek Tepe section (Antalya, samples TD-79-1, TD-80-2)

Epigondolella postera (Kozur & Mostler 1971)

Pl.25, figs.7a-b,8

1968a Epigondolella abneptis (Huckriede); Mosher, pl.118, figs.20,21 only
1968b Epigondolella abneptis (Huckriede); Mosher, pl.120, figs.25,26 only
1971a Tardogondolella abneptis postera Kozur & Mostler, p.14, pl.2, figs. 4-6
1972 Metapolygnathus posterus posterus (Kozur & Mostler); Kozur, pl.6, fig.23
1972 Metapolygnathus n.sp. Kozur, pl.7, figs. 1a-c
1972 Metapolygnathus aff. posterus (Kozur & Mostler); Kozur, pl.7, figs. 2a,b
1973 Epigondolella postera postera (Kozur & Mostler); Kozur & Mostler, pl.4, fig.1
1973 Epigondolella postera (Kozur & Mostler); Krystyn, p.141, pl.5, figs. 5,6
1977 Epigondolella postera (Kozur & Mostler); Budurov, p.43, pl.5, figs. 25,26
1977 Epigondolella postera (Kozur & Mostler); Ziegler, p.189, Epigondo.-pl.1, figs. 3a-c

1979 Epigondolella postera (Kozur & Mostler); Kolar, p.316, pl.2, fig.3?

1979 Metapolygnathus posterus (Kozur & Mostler); Gazdzicki et al., pl.5, fig.14

1980 Epigondolella postera (Kozur & Mostler); Isozaki & Matsuda, plate - figs.6,7

1980a Metapolygnathus posterus (Kozur & Mostler): Kovacs & Kozur, p.574

1980b Metapolygnathus posterus (Kozur & Mostler); Kovacs & Kozur, pl.14, fig.7

1980 Metapolygnathus posterus (Kozur & Mostler); Kovacs & Scheffer, p.593, pl.2, figs. 7,8; pl.5, figs. 1-9

1980 Metapolygnathus posterus (Kozur & Mostler); Krystyn, pl.13, figs. 15-18

1981 Epigondolella postera (Kozur & Mostler); Ishida, pl.7, figs. 1,2

1981 Epigondolella bidentata Mosher; Koike, pl.2, figs.30,31

1982 Epigondolella bidentata Mosher; Isozaki & Matsuda, p.115, figs.2 - 3 - 4?

Remarks. A translation in English of the original diagnosis for this species was given by Ziegler (1977, p.189). This species is characterized by the broad platform which shows a pointed posterior extremity. There are a few marginal denticles on the platform. The elements of this species from the Teke Dağı region compare well with those illustrated by Kozur and Mostler (1971). According to the latter authors, Epigondolella postera is intermediate in form between Epigondolella abneptis (Huckriede) and Epigondolella bidentata Mosher. Subsequently Krystyn (1973) has suggested that Epigondolella postera developed from Epigondolella permica (Hayashi) as shown by the reduction in the platform. Continued development of this trend led to Epigondolella bidentata Mosher.

Material studied: 13 specimens

Stratigraphic range: Upper Trias of Teke Dağı section (Antalya, samples TT-79-5; TT-80-5,7)

Epigondolella primita Mosher 1970

Pl.25, figs. 10a-b, 11a-b

1968 Gladigondolella abneptis (Huckriede); Nogami, pl.8, fig.8

1970 Epigondolella primita Mosher, p.740, pl.110, figs.7-13,16,17

1971 Epigondolella n.sp. A Sweet et al., pl.1, figs. 8, 10

1971 Tardogondolella nodosa nodosa (Hayashi); Kozur & Mostler, pl.2, figs. 10,11,13

1973 Epigondolella nodosa (Hayashi); Krystyn, p.138, pl.3, figs.2-4
1973a Epigondolella primita Mosher; Mosher, p.161, pl.18, figs.1-5,7-11
1980b Metapolygnathus nodosus (Hayashi); Kovacs & Kozur, pl.7, fig.7; pl.12, figs. 1,2?,4
1981 Epigondolella primita Mosher; Ishida, pl.5, figs. 4,5; pl.6, figs.1-3

Remarks. Examples of this species conform to the description given by Mosher (1970). This species is characterized by the relatively broad platform. Anterior parts of the platform margins are denticulated. Mosher reported that Epigondolella primita developed from Neogondolella polygnathiformis (Budurov & Stefanov), as shown by the development of nodes on the anterior margin of the platform. Kozur and Mostler (1971) based their concept of Tardogondolella nodosa nodosa on the species of Epigondolella nodosa (Hayashi), hence they regarded Epigondolella primita as a junior synonym of Epigondolella nodosa. According to Mosher (1973a, p.161) "Epigondolella primita can be distinguished from Gladigondolella abneptis nodosa Hayashi by a greater length to width ratio and by a constriction of the mid-platform region".

Material studied: 52 specimens

Stratigraphic range: Upper Trias of Teke Dağı section (Antalya, sample TT-80-4), Upper Trias of Dömek Tepe section (Antalya, sample TD-80-2)

Epigondolella triangularis (Budurov 1972)

Pl.25, figs.9a-b

1958 Polygnathus abneptis Huckriede, p.156, pl.14, figs. 3,5,14
1968 Gladigondolella abneptis (Huckriede); Hayashi, p.68, pl.2, fig.8
1972 Ancyrogondolella triangularis Budurov, p.857, pl.1, figs.3-6
1972 Epigondolella triangularis (Budurov); Kozur & Mostler, pl.2, figs. 7a-c
1976 Ancyrogondolella triangularis Budurov; Budurov, pl.3, fig.8
1977 Ancyrogondolella triangularis Budurov; Budurov, p.40, pl.3, figs.1-4; pl.4, figs.1-4; pl.5, figs.20,21
1977 Epigondolella triangularis (Budurov); Ziegler, p.203
1981 Epigondolella triangularis (Budurov); Koike, pl.2, fig.39

Remarks. Well-preserved specimens with a characteristic ornamentation of nodes have been recovered in this study. The species comprises elements with a free blade which divides from the central denticle and crosses the

platform in the form of two node-series. The lower surface shows a keel which bifurcates posteriorly.

Material studied: 6 specimens

Stratigraphic range: Upper Trias of Teke Dağı section (Antalya, sample TT-80-4)

Epigondolella sp. indet.

Broken and poorly preserved epigondolelliform elements which cannot be identified to the species level are included here.

Material studied: 81 specimens

Stratigraphic range: Upper Trias of Teke Dağı section (Antalya, samples TT-79-17,19; TT-80-4) and Upper Trias of Dömek Tepe section (Antalya, samples TD-79-1,2B and TD-80-1)

Epigondolella n.sp. A

Pl.26, figs.1a-b,2,3

Remarks. These elements possess a long, elongated platform with a few unfused nodes marginally. There are no nodes on the posterior end. The platform margins are slightly upturned and resemble Epigondolella carnica Krystyn in lateral view. The platform margins of the element show a characteristic curvature on one side at the anterior end of the unit. The elements bear a high carina with 8-10 fused denticles, which are free in their upper part. The posterior part of the carina shows 3-4 short, discrete denticles. A broad keel on the under side has a narrow groove that widens into a sub-central basal pit.

Material studied: 20 specimens

Stratigraphic range: Upper Trias of Teke Dağı section (Antalya, sample TT-80-4)

Epigondolella n.sp. B

Pl.26, figs.4,5,6

Remarks. These elements resemble Epigondolella parva (Kozur), but they have a widened posterior extremity. They also possess a carina, which bears 9-13 denticles and extends up to the margin of the unit at the posterior end. The denticles are all equal in size, so there is no distinct

central node.

Material studied: 8 specimens

Stratigraphic range: Upper Trias of Teke Dağı section (Antalya, sample TT-79-12)

Epigondolella nsp. C

Pl.26, figs.7a-b

Remarks. A specimen from Dömek Tepe (Antalya) resembles Epigondolella permica (Hayashi), but it exhibits no distinct denticulations on the margins. Moreover, there is a conspicuous constriction at the posterior end. The strong constriction has rounded corners. This element may be a transitional form between Neogondolella polygnathiformis (Budurov & Stefanov) and Epigondolella permica (Hayashi).

Material studied: 1 specimen

Stratigraphic range: Upper Trias of Dömek Tepe section (Antalya, sample TD-80-2)

Genus GLADIGONDOLELLA Müller 1962

1962a Gladigondolella ngen. Müller, p.116

Type species: Polygnathus tethydis Huckriede 1958

Remarks. Müller (1962) proposed a new genus Gladigondolella for Polygnathus-like forms which have a free blade similar to that of Gondolella. Species assigned to this genus are platform-like conodonts possessing a keel which continues over the whole length of the unit. The basal cavity is located at a distance from the posterior extremity.

Stratigraphic occurrence: Previously specimens of this genus have been recovered from late Lower Trias to early Upper Trias age rocks.

Gladigondolella malayensis malayensis Nogami 1968

Pl.26, figs.9,10,11a-b,12,13

1968 Gladigondolella malayensis Nogami, p.122, pl.9, figs.11-18; pl.11, fig.7

1973 Gladigondolella malayensis Nogami; Krystyn, p.142, pl.1, figs.4,5

1973 Neogondolella malayensis (Nogami); Koike, p.105, pl.15, figs.31-38

1973 Gladigondolella malayensis Nogami; Budurov, p.801, pl.1, figs.10-12

1975 Gladigondolella malayensis Nogami; Gedik, p.120, pl.3, figs.27,28

1978 Gladigondolella malayensis Nogami; Catalov & Budurov, p.92, pl.11, figs. 1-3

1979 Gladigondolella malayensis Nogami; Metcalfe et al., p.744, pl.97, fig.10

1981 Gladigondolella malayensis Nogami; Koike, pl.1, fig.41

1981 Gladigondolella malayensis Nogami; Gedik, pl.1, fig.11

Remarks. Detailed synonymies for the species have been given by Gedik (1975) and Metcalfe et al. (1979). This sub-species is characterized by the large, ellipsoidal platform. Its widest point occurs at nearly the mid-length.

Material studied: 103 specimens

Stratigraphic range: Middle Trias of Teke Dağı section (Antalya, samples TT-79-11,12,13,14; TT-80-3), Middle Trias of Saklikent section (Antalya, sample TS-79-9)

Gladigondolella malayensis budurovi Kovacs & Kozur 1980

Pl.26, fig.8

1960 Polygnathus tethydis Huckriede; Budurov, p.117,pl.2, figs.28,30?

1966 Gladigondolella tethydis (Huckriede); Ishii & Nogami, pl.1, fig.2

1970 Gladigondolella carinata Bender, p.504, pl.1, figs.17-19; pl.2, fig.1

1973b Gladigondolella carinata Bender; Budurov, p.800, pl.1, figs.8,9

1973 Gladigondolella tethydis (Huckriede); Koike, p.103, pl.15, fig.43

1973 Gladigondolella tethydis (Huckriede); Kozur & Mock, pl.1, fig.3

1975 Gladigondolella tethydis (Huckriede); Sladictrifunovic & Ljubovic, p.170, pl.2, figs. ?1-3, figs.9-11

1976 Gladigondolella tethydis (Huckriede); Kemper et al., p.105, pl.6, fig.1

1976b Gladigondolella carinata Bender; Budurov, p.102, pl.2, fig.32

1977? Gladigondolella cf. carinata Bender; Sudar, p.285, pl.6, figs.15,16

1977 Gladigondolella tethydis (Huckriede); Sudar, pl.6, figs.17,26-29

1980a Gladigondolella malayensis budurovi Kovacs & Kozur, p.542, pl.1, figs.1,2; pl.2, figs.1-5

Remarks. A detailed description of this sub-species can be found in Kovacs & Kozur (1980a). Examples of this sub-species are characterized

by a rounded posterior termination to the platform. Upper and lower views of these elements show a clear lateral bending in the posterior part of the platform. Two specimens have been found in this study which resemble those described by Kovacs and Kozur. To date, it has been reported from rocks of the Middle-Upper Anisian Stage.

Material studied: 2 specimens

Stratigraphic range: Middle Trias of Teke Dağı section (Antalya, sample TT-79-4)

Gladigondolella tethydis (Huckriede 1958)

Pl.26, figs.14a,b 15,16,17

1958 Polygnathus tethydis Huckriede, p.157, pl.11, figs.39,40; pl.12, figs. 1,38; pl.13, figs. 2-5

1960 Polygnathus tethydis Huckriede; Spassov & Ganev, p.85, pl.1, figs. 26,27 pl.2, fig.16

1960 Polygnathus tethydis Huckriede; Budurov, p.117, pl.2, figs. 28,30, 33

1962 Gladigondolella tethydis (Huckriede); Müller, p.116

1965 Polygnathus tethydis Huckriede; Mosher & Clark, p.563, pl.66 fig.13

1966 Gladigondolella tethydis (Huckriede); Ishii & Nogami, p.94, pl.1, figs. 1,2

1967 Gladigondolella tethydis (Huckriede); Nakazawa & Nogami, pl.1, fig.14

1968a Gladigondolella tethydis (Huckriede); Hayashi, p.69, pl.3, figs. 8a-b

1968 Gladigondolella tethydis (Huckriede); Nogami, p.123, pl.9, figs.1-10; pl.11, figs. 5,6

1968a Gladigondolella tethydis (Huckriede); Mosher, pl.116, figs.1,2,5,8

1968b Gladigondolella tethydis (Huckriede); Mosher, pl.119, figs.7-10

1969 Gladigondolella tethydis (Huckriede); Hirsch, pl. - figs.1-3

1970 Polygnathus tethydis Huckriede; Budurov & Pevny, pl.17, figs.15,16

1970 Gladigondolella tethydis (Huckriede); Bender, p.505, pl.2, figs.2-6

1973 Gladigondolella tethydis (Huckriede); Budurov, p.802, pl.1, figs.4-7

1973 Gladigondolella tethydis (Huckriede); Koike, p.103, pl.15, figs. 42-45

1974 Gladigondolella tethydis (Huckriede); Sahni & Chhabra, p.292, pl.6, figs.2,14

1975 Gladigondolella tethydis (Huckriede); Gedik, p.120, pl.3, figs.15-17

1975 Gladigondolella tethydis (Huckriede); Kemper et al., p.105, pl.6, figs.1a-b

1976 Gladigondolella tethydis (Huckriede); Gupta & Rafek, p.208, pl.1, fig.10

1976 Gladigondolella tethydis (Huckriede); Stoppel, p.105, pl.6, fig.1

1976 Gladigondolella tethydis (Huckriede); Budurov, p.102, pl.2, fig.19

1978 Gladigondolella tethydis (Huckriede); Mirauta & Gheorghian, pl.1, fig.32

1979 Gladigondolella tethydis (Huckriede); Budurov, pl.2, fig.6

1979 Gladigondolella tethydis (Huckriede); Mietto & Petroni, p.8, pl.1, fig.4; pl.2, fig.4

1979 Gladigondolella tethydis (Huckriede); Pisa et al., p.816, pl.60, figs. 3a,b,c

1980 Gladigondolella tethydis (Huckriede); Isozaki & Matsuda, plate - fig. 8

1980b Gladigondolella tethydis (Huckriede); Kovacs & Kozur, pl.3,figs.5,6

1980 Gladigondolella tethydis (Huckriede); Matsuda, plate - fig.5

1982 Gladigondolella tethydis (Huckriede); Koike, p.29, pl.4, figs.26-32

1982 Gladigondolella tethydis (Huckriede); Matsuda, pl.5, figs.1,2

Remarks. This well known species has been described by many authors previously (Mosher, 1968a; Gedik 1975 etc.). The examples of this species are characterized by the long curved platform which possesses a large posterior part.

Material studied: 107 specimens

Stratigraphic range: Middle Trias of Teke Dağı section (Antalya, samples TT-79-6,7,8,9,13), Middle Trias of Saklıkent section (Antalya, samples TS-79-9,10; TS-80-1,2,3,4)

Gladigondolella sp. indet.

Thirty-one broken specimens, which represent the anterior or posterior parts of a Gladigondolella have been placed in this taxonomic category.

Material studied: 31 specimens

Stratigraphic range: Middle Trias of Teke Dağı section (Antalya, samples TT-79-10; TT-80-3), Middle Trias of Saklıkent section (Antalya, samples TS-79-6; TS-80-1)

Genus NEOGONDOLELLA Bender & Stoppel 1965

1965 Neogondolella n.gen. Bender & Stoppel, p.343
1968 Metapolygnathus n.gen. Hayashi, p.72
1968a Paragondolella n.gen. Mosher, 938
1968 Celsigondolella n.gen. Kozur, p.930

Type species: Gondolella mombergensis Tatge 1956

Remarks. Following Bender & Stoppel's German publication (1965), Sweet (1970b, p.239) has published a concise description of this genus which provides an explanation of many of the salient features caused by the previously unclarified diagnosis of Neogondolella. Elements of Neogondolella are considered to represent a single element species. The elements are elongate, paired and individually asymmetric. They have a denticulate carina, a terminal or sub-terminal posterior cusp and commonly an unornamented platform-like lateral extension, which is generally joined posteriorly by a fairly well-developed brim that surrounds the posterior end of the carina. The underside of these specimens is marked by a longitudinally grooved keel that broadens posteriorly to enclose a pit under the cusp.

Relationships. Many researchers, because of morphologic similarities, have included neogondolelliform conodont elements from rocks of Permian and Triassic age within the genus Gondolella Stauffer & Plummer. The genus Neogondolella was proposed for elements from European Triassic conodont stocks, more than three decades after Gondolella was proposed. There are still some palaeontologists who believe that Gondolella and Neogondolella are synonymous. Bender and Stoppel (1965) proposed the name Neogondolella for a well-known species Gondolella mombergensis Tatge. Subsequently Bender (1967, p.516, but note that it was not available before 1970) selected a different type species Neogondolella aegaea Bender for Neogondolella. This species was regarded later as a junior subjective synonym of Neospathodus timorensis (Nogami) by Kozur (1971, p.112). The status of this species, however, does not affect the validity of the name Neogondolella, since it was first introduced in relation to

Gondolella mombergensis Tatge by Bender & Stoppel. Sweet et al.(1970) also considered the establishment of Neogondolella to be valid and assigned to Neogondolella elements which were previously named as Gondolella.

There is still much confusion and misunderstanding amongst conodont researchers. According to Kovacs and Kozur (1980), none of the characteristics of Neogondolella, as cited by Bender and Stoppel (1965) and Sweet (1970b), is sufficiently diagnostic to enable the separation of this genus from Gondolella Stauffer & Plummer. Recently, von Bitter (1982) has clarified the differences between Gondolella and Neogondolella as follows:

	Gondolella Stauffer & Plummer	Neogondolella Bender & Stoppel
Distribution:	Restricted - North America Japan, USSR	Apparently cosmopolitan
Range:	Pennsylvanian	Permian-Triassic; with one probable species in the Pennsylvanian
Environment:	Shallow water	Deeper water
Apparatus composition:	Six to seven element types	Six element type apparatus exceedingly rare; ramiform elements difficult to homologize with those of Gondolella apparatus; generally "platform only"
Morphology of platform elements:	Pitted ultra-structure: Restricted to lateral edges	Pitted structure covers oral surface
Oral ornamentation:	Generally ridged	Generally smooth
Anterior brim:	Absent	Present
Basal filling:	Absent	Present
Basal groove:	Noticeably elevated, relatively deep	Slightly elevated, relatively shallow
Aboral loop:	Large, flaring	Small to medium-sized, restricted.

The introduction of the name Neogondolella by Bender & Stoppel (1965) was a short, inadequate but nevertheless valid statement. On this basis, Neogondolella mombergensis (Tatge) is considered to be the type species of the genus Neogondolella.

Confusion concerning taxonomy has also arisen with regard to the genera Epigondolella Mosher, Metapolygnathus Hayashi and Neogondolella Bender & Stoppel. The genus Metapolygnathus was proposed by Hayashi (1968) for a species present in cherts of the Adoyama Formation, Shio Mountains, Japan. Metapolygnathus communisti Hayashi was nominated as the type species of this genus. A brief summary of the features of this genus was presented later by Mosher (1973). He placed both Metapolygnathus polygnathiformis (Budurov & Stefanov) and Metapolygnathus excelsa Mosher within Metapolygnathus and suppressed the name Paragondolella Mosher.

As mentioned earlier, in the Catalogue of Conodonts (Ziegler, 1977), Metapolygnathus Hayashi is considered to be a junior subjective synonym of Neogondolella Bender & Stoppel. Metapolygnathus communisti Hayashi is also regarded as a junior synonym of Neogondolella polygnathiformis (Budurov & Stefanov).

Kovacs and Kozur (1980) have presented a complicated conclusion. They consider all species of Epigondolella Mosher to fall within the concept of Metapolygnathus Hayashi. Budurov (1977) has indicated that the position of the basal pit and the loop, which forms a very important biostructure, are important taxonomic features. He suggested that the number of growing layers might possibly turn out to be another taxonomic feature, and should be used for separation of the genus Metapolygnathus Hayashi from other genera.

In general, only the most significant features should be used for defining a new genus; distinctive accessory features may be used for defining species of the genus. Applying this concept of significant and accessory features to Epigondolella Mosher and Neogondolella Bender & Stoppel, then these can be maintained as two separate genera. The general external morphology and taxonomic features of Metapolygnathus Hayashi suggest that this is a junior synonym of Neogondolella Bender & Stoppel. Nevertheless, at a future International Conodont Congress, discussion of this matter will be necessary in order to understand the relationship of these three genera.

In this study the writer has presented better pictures of the representatives of the genera Epigondolella Mosher and Neogondolella Bender & Stoppel by the use of Scanning Electron Microscope (SEM) illustrations that were not usually available in the previous publications. These pictures may be helpful for a careful comparison, thus clarifying the above points.

Stratigraphic occurrence: Neogondolella Bender & Stoppel has been reported mostly from Permian and Triassic strata. Recent research indicates, however, that species of Neogondolella are not as restricted and possibly they are also present in the early Pennsylvanian (von Bitter, 1977 and 1982).

Neogondolella cf. bakalovi Budurov & Stefanov 1972

Pl.27, figs.1a-b

1972 Neogondolella bakalovi Budurov & Stefanov, p.836, pl.4, figs.1-8, text - fig.4

1974 Neogondolella bakalovi Budurov & Stefanov; Budurov & Stefanov, pl.2, figs. 22-24

1975 Neogondolella bakalovi Budurov & Stefanov; Ziegler, p.215

1980 Gondolella bakalovi (Budurov & Stefanov); Kovacs & Kozur, pl.4, figs. 15,16

Remarks. A translation in English of the original diagnosis can be found in Ziegler (1975). The specimens from Saklıkent (Antalya) are very slightly different on the lower surface from those illustrated by Budurov and Stefanov (1972). These specimens also resemble Neogondolella transita (Kozur & Mostler) in appearance when viewed from the basal field and from the posterior end. Neogondolella bakalovi is thought to represent an extreme development of the "mombergensis" group.

Material studied: 3 specimens

Stratigraphic range: Middle Trias of Saklıkent section (Antalya, sample TS-80-1)

Neogondolella basisymmetrica Budurov & Stefanov 1972

Pl.27, figs.2a,b,c

1972 Neogondolella basisymmetrica Budurov & Stefanov, p.837, pl.3, figs.1-8; text - fig.5

1974 Neogondolella basisymmetrica Budurov & Stefanov; Budurov & Stefanov, pl.2, figs. 28, 29

1975 Neogondolella basisymmetrica Budurov & Stefanov; Ziegler, p.217

1979 Neogondolella basisymmetrica Budurov & Stefanov; Budurov et al., pl.1, figs. 3,4

1980b Gondolella basisymmetrica (Budurov & Stefanov); Kovacs & Kozur, pl.4, fig.2

Remarks. The diagnostic feature of this species is the basal field which divides in a heart-like manner at the posterior end. The elements of this species are distinguished from Neogondolella cornuta Budurov & Stefanov by the basal field, the free posterior margin of the platform, and by the arching of the blade.

Material studied: 19 specimens

Stratigraphic range: Middle Trias of Saklıkent section (Antalya, samples TS-80-1,2,4)

Neogondolella bifurcata (Budurov & Stefanov 1972)

Pl.27, figs.3,4

1972 Paragondolella bifurcata Budurov & Stefanov, p.843, pl.1, figs. 1-25; pl.2, figs. 1-9; text - fig.8

1974 Paragondolella bifurcata Budurov & Stefanov; Budurov & Stefanov, pl.2, figs. 25,26

1975 Gondolella bifurcata (Budurov & Stefanov); Zawidzka, pl.40, fig.2,3; pl.43, fig.1

1975 Neogondolella bifurcata (Budurov & Stefanov); Ziegler, p.219

1979 Paragondolella bifurcata Budurov & Stefanov; Budurov et al., pl.1, figs. 1,2

1980b Gondolella bifurcata (Budurov & Stefanov); Kovacs & Kozur, pl.2, figs.5-7

Remarks. This species is characterized by the basal field which at the posterior end, broadens and opens in a triangular manner.

Material studied: 12 specimens

Stratigraphic range: Middle Trias of Teke Dağı section (Antalya, sample TT-79-3. TT-80-2)

Neogondolella bulgarica (Budurov & Stefanov 1975)

pl.27, figs.5a,b,c,6

1958 Gondolella navicula Huckriede, p.147, pl.11, figs. 1,14

1960 Gondolella navicula Huckriede; Spassov & Ganev, p.79, pl.1, figs. 11,12

1962 Gondolella navicula Huckriede; Budurov, p.116, pl.1, figs.34-38

1974 Paragondolella bulgarica Budurov & Stefanov, pl.2, fig.27

1975a Paragondolella bulgarica Budurov & Stefanov; Budurov & Stefanov, p.794, pl.1, figs. 1-23

1975b Paragondolella bulgarica Budurov & Stefanov; Budurov & Stefanov, pl.15, pl.2, figs.1-15

1975 Neogondolella unilobata Gedik, p.133, pl.1, figs. 9-25

1977 Neogndolella bulgarica (Budurov & Stefanov); Nicora, p.100, pl.5, figs.8-14

1979 Paragondolella bulgarica Budurov & Stefanov; Budurov & Ganev, pl.1, figs.1-7

1979 Neogondolella bulgarica (Budurov & Stefanov); Pisa et al., p.817, pl.60, figs. 1a,b; pl.61, figs. 1-12

1980 Gondolella bulgarica (Budurov & Stefanov); Kovacs & Kozur, pl.2, figs. 1,2

1981 Neogondolella bulgarica (Budurov & Stefanov); Koike, pl.2, figs. 1-3

1982 Neogondolella bulgarica (Budurov & Stefanov); Koike, p.32, pl.4, figs. 1-19,22-24

Remarks. Detailed synonymies have been given by many previous workers. Elements of this species found in this study conform to the description of Nicora (1977). This species is characterized by the curved platform and by the curved blade with denticles.

Material studied: 30 specimens

Stratigraphic range: Middle Trias of Teke Dağı section (Antalya, sample TT-79-4?), Middle Trias of Saklıkent section (Antalya, samples TS-80-3,4)

Neogondolella constricta (Mosher & Clark 1965)

Pl.27, figs.7,8,9,10

1965 Gondolella constricta Mosher & Clark, p.560, pl.65, figs.11,14,15,18, 19,21,22,24,25

1966 Gondolella constricta Mosher & Clark; Clark & Mosher, p.390, pl.47, figs.1-3,5,6

1968a Gondolella constricta Mosher & Clark; Hayashi, p.70, pl.1, fig.1

1971 Neogondolella constricta (Mosher & Clark); Sweet et al., pl.1, figs.4,5

1973 a Neogondolella constricta (Mosher & Clark); Mosher, p.165, pl.19, figs.30,31

1973 Neogondolella constricta (Mosher & Clark); Ziegler, p.131, Neogondo. - plate 1, fig.4

1975 Gondolella constricta Mosher & Clark; Zawidzka, pl.42, figs.1,3

1975 Neogondolella constricta (Mosher & Clark); Budurov & Stefanov, p.15, pl.3, figs. 1,2

1977 Neogondolella constricta murtitchiensis Gedik, p.43, pl.3, figs. 2,5,8

1978 Neogondolella constricta (Mosher & Clark); Catalov & Budurov, p.89, pl.1, figs.9-12

1981 Neogondolella constricta (Mosher & Clark); Chhabra & Sahni, pl.2, figs. 18a,b,c; 19, 21a,b,c; 22a,b

Remarks. This species is differentiated from other species of this genus by the characteristic constriction at the posterior end. The elements of Neogondolella constricta, also, are of relatively small size. Thus there is a comment in Ziegler (1973) that the species may be based on early growth-stage elements of some other species.

This species is known only from rocks of the Middle Trias (late Anisian - early Ladinian). The stratigraphic range of Neogondolella constricta in Turkey may be greater than is known (Gedik, 1977; p.43). In this study, many specimens have been obtained together with other long range conodont genera from rocks of the Middle-Upper Trias (see Table 6).

Material studied: 151 specimens

Stratigraphic range: Middle-Upper Trias of Teke Dağı section (Antalya, samples TT-79-8,10,11,12,13,14,15,16,17)

Neogondolella excelsa (Mosher 1968)

Pl.27, figs.11,12,13

1960 Gondolella navicula Huckriede; Budurov, pl.1, figs.24a,b,c,d

1965 Gondolella navicula Huckriede; Budurov & Stefanov, pl.2, figs.5-7,9

1965 Gondolella navicula Huckriede; Mosher & Clark, pl.66, figs.14,16

1968a Paragondolella excelsa Mosher, p.938, pl.118, figs.1-8

1968b Paragondolella excelsa Mosher, pl.120, figs. 1-7
1968 Neogondolella navicula (Huckriede); Bender, pl.58, fig.2
1969 Gondolella navicula (Huckriede); Hirsch, pl.1, fig.12
1972 Paragondolella excelsa Mosher; Budurov & Stefanov, p.844, pl.2, figs.15-26
1973a Metapolygnathus excelsa (Mosher); Mosher, p.164, pl.120, fig.8
1973 Paragondolella excelsa Mosher; Koike, p.110, pl.15, figs.39-41
1973 Neogondolella excelsa (Mosher); Ziegler, p.135, Neogondo. plate 1 fig.10
1974 Paragondolella excelsa Mosher; Budurov & Stefanov, pl.2,figs.11,12
1975 Metapolygnathus excelsus (Mosher); Gedik, p.129, pl.3, figs.1-9
1975 Paragondolella excelsa Mosher; Budurov & Stefanov, p.15, pl.2, figs.16-19
1980b Gondolella excelsa (Mosher); Kovacs & Kozur, pl.3, fig.7
1981 Paragondolella excelsa Mosher; Chhabra & Sahni, pl.2, fig.14
1981 Neogondolella excelsa (Mosher); Koike, pl.2, figs.4-6

Remarks: Detailed descriptions have been given by many previous authors (Mosher 1968a; Ziegler 1973 and Gedik 1975, etc.). This species is characterized by the platform which is widest near the posterior extremity, and by the high anterior carina.

Material studied: 20 specimens

Stratigraphic range: Middle Trias of Teke Dağı section (Antalya, samples TT-79-9,11), Middle Trias of Saklıkent section (Antalya, samples TS-80-1,2,3,4?)

Neogondolella foliata (Budurov 1975)
Pl.27, figs. 14a,b,c

1968 Gondolella navicula Huckriede; Hayashi, p.70, pl.1, figs.9-11
1975 Paragondolella foliata Budurov, p.79, pl.1, figs.1-22
1975 Gondolella excelsa (Mosher); Krystyn, pl.3, fig.7 only.
1976 Paragondolella foliata Budurov; Budurov, p.97, pl.2, figs.18,35
1977 Gondolella foliata (Budurov); Kovacs, p.80, pl.6, figs.2,3
1978 Paragondolella foliata Budurov; Catalov & Budurov, p.90, pl.1, figs.13-15
1980b Gondolella foliata (Budurov); Kovacs & Kozur, pl.6, figs.3,5
1981 Neogondolella foliata (Budurov); Koike, pl.2, figs.16,17

Remarks. Elements of this species represented in the present collection show a rounded platform end and a loop. According to Kovacs (1977)

Neogondolella foliata represents the transition between Neogondolella excelsa (Mosher) and Neogondolella polygnathiformis (Budurov & Stefanov).

Material studied: 16 specimens

Stratigraphic range: Middle Trias of Saklikent section (Antalya samples TS-80-3 and 4)

Neogondolella cf. hanbulogi (Sudar & Budurov 1979)
Pl.28, fig.1a,b

1962 Gondolella mombergensis Tatge; Budurov, p.116,pl.1, figs.39-42; pl.2, fig.21

1979 Paragondolella hanbulogi Sudar & Budurov; p.50, pl.1, figs.9,10; pl.2, figs.1-9; pl.3, figs.1-12

Remarks. One specimen has been found in this study which resembles the paratypes of the species illustrated by Sudar and Budurov (1979). It shows a diagnostic platform which is large and wide centrally with a rounded posterior part. Only the thickened and upturned platform margins are slightly different from the material of Sudar and Budurov.

Material studied: 1 specimen

Stratigraphic range: Middle Trias of Teke Dağı section (Antalya sample TT-79-11)

Neogondolella kozuri Gedik 1981
Pl.28, figs.2a,b,c

1980 Gondolella sp. Isozaki & Matsuda, plate - fig.11

1981 Neogondolella kozuri Gedik, p.4, pl.1, figs.1-3

Remarks. This species has recently been established by Gedik (1981). It is one of the representatives of the "mombergensis" group. This species is characterized by the position of the main denticle, by the slightly upturned platform margins and by the loop located at the end of the posterior portion beneath the main denticle. The lower surface shows a longitudinally grooved keel, and a broad shallow loop which encircles the pit. The platform is widest near the posterior extremity and tapers abruptly. It does not surround the most posterior node of the carina. Gedik (1981) has recovered this species from the Central Taurus Mountains indicative of the Lower Carnian Stage.

Material studied: 6 species

Stratigraphic range: Upper Trias of Teke Dağı section (Antalya, samples TT-79-5 and TT-80-7)

Neogondolella longa Budurov & Stefanov 1973

Pl.28, figs.3a,b,c, 4

1973 Neogondolella longa Budurov & Stefanov, p.805, pl.1, figs.16-22

1974 Neogondolella longa Budurov & Stefanov; Budurov & Stefanov, pl.2, figs. 20,21

1975b Neogondolella longa Budurov & Stefanov; Budurov & Stefanov, pl.2, figs. 9-13

1979 Neogondolella longa Budurov & Stefanov; Budurov et al., pl.2, figs. 3,4,13,14

Remarks. The elements of this species possess a long, narrow, slender and distinctive platform, which is well rounded. The rounded posterior extremity bends slightly downward. Another characteristic feature is the distinctive blade with 15-18 high denticles. There is no distinct main denticle at the posterior portion. On the lower surface there is a narrow basal field with a projected keel and loop. According to Budurov & Stefanov, this species developed from Neogondolella mombergensis (Tatge).

Material studied: 24 specimens

Stratigraphic range: Middle Trias of Teke Dağı section (Antalya, sample TT-79-4), Middle Trias of Saklıkent section (Antalya, samples TS-79-9; TS-80-1,2,3?)

Neogondolella mombergensis (Tatge 1956)

Pl.28, figs.5a,b,c

1956 Gondolella mombergensis Tatge, p.132, pl.6, figs. 1,2

1958 Gondolella mombergensis Tatge; Huckriede, p.147, pl.10, figs.42,43

1958 Gondolella mombergensis Tatge; Hirschmann, p.47, pl.4, figs.5-12

1962 Gondolella mombergensis Tatge; Clark & Ethington, p.108, pl.1, fig.14

1965 Gondolella mombergensis Tatge; Mosher & Clark, p.560, pl.65, figs. 20,23,26-29

1966 Gondolella mombergensis Tatge; Clark & Mosher, p.391, pl.47, figs.4,7,8,19

1966 Gondolella mombergensis Tatge; Catalov & Stefanov, pl.1, fig.9

1968 Gondolella mombergensis Tatge; Nogami, p.125, pl.9, figs.19-23; pl.11, fig.2

1968a Gondolella mombergensis Tatge; Mosher, p.937, pl.116,figs.6,9,12,14

1968 Gondolella mombergensis mombergensis Tatge; Kozur, p.932, pl.2, figs.1,3,4; pl.3, fig.8

1970 Neogondolella mombergensis (Tatge); Bender, p.517, pl.4, fig.3

1971 Neogondolella mombergensis (Tatge); Sweet et al., pl.1, fig.24

1972 Neogondolella mombergensis (Tatge); Budurov & Stefanov, p.841, pl.3, figs.16-19

1973a Neogondolella mombergensis (Tatge); Mosher, p.167, pl.19,figs.4-6,8

1973 Neogondolella mombergensis (Tatge); Koike, p.105, pl.15, fig.46?

1974 Neogondolella mombergensis (Tatge); Budurov & Stefanov, pl.2, figs.18,19

1975 Neogondolella mombergensis (Tatge); Gedik, p.131, pl.1, figs.1-3; pl.2, figs. 14,15,27

1975b Neogondolella mombergensis (Tatge); Budurov & Stefanov, pl.3, figs.14,15

1975 Gondolella mombergensis mombergensis Tatge; Zawidzka, pl.41, figs.1-2; pl.42, fig.7?; pl.43, figs.4,7; pl.44, fig.5

1976 Neogondolella mombergensis (Tatge); Kemper et al., pl.6, figs.5a-c

1977 Neogondolella mombergensis (Tatge); Goel, p.1099, pl.3, figs.12-15

1978 Neogondolella mombergensis (Tatge); Trammer, pl.1, figs.3,4; pl.2, figs.6-8

1979 Neogondolella mombergensis (Tatge); Clark et al., pl.1, fig.8

1979 Neogondolella mombergensis (Tatge); Ishida, pl.2, figs.5-7

1980b Gondolella mombergensis Tatge; Kovacs & Kozur, pl.4, figs.4-6

1981 Neogondolella mombergensis (Tatge); Koike, pl.2, figs.8,9

Remarks. Detailed synonymies and descriptions have been given by many previous authors (Mosher 1968a,1973a;Gedik 1975, etc.). This species is characterized by the fairly broad platform which is rounded posteriorly. The platform forms a point at the anterior end. The carina is not high.

Material studied: 14 specimens

Stratigraphic range: Middle Trias of Teke Dağı section (Antalya, sample TT-79-4), Middle Trias of Saklıkent section (Antalya, sample TS-79-9)

Neogondolella navicula navicula (Huckriede 1958)

Pl.28, figs.6a-b,7a-b

1959 Gondolella navicula Huckriede, p.147, pl.11, figs.2-4,13,15-17, 27,35; pl.12, fig.10

1960 Gondolella navicula Huckriede; Spassov & Ganev, pl.2, figs.19,23,24

1960 Gondolella navicula Huckriede; Budurov, p.111, pl.1, figs.21-26

1965 Gondolella navicula Huckriede; Mosher & Clark, p.560, pl.66, figs.14,16

1965 Gondolella navicula Huckriede; Zankl, p.299, pl.1, fig.6

1965 Gondolella navicula Huckriede; Budurov & Stefanov, p.117, pl.2, figs.8-10, pl.3, figs.1,2

1966 Gondolella navicula Huckriede; Ishii & Nogami, pl.1, figs.6-8

1966 Gondolella navicula Huckriede; Clark & Mosher, p.391, pl.47, fig.20

1968 Gondolella navicula Huckriede; Nogami, p.126, pl.8, figs.12-16

1968 Gondolella navicula Huckriede; Hirsch, p.7, plate - figs.9-16

1968a Paragondolella navicula navicula (Huckriede); Mosher, p.939, pl.116, figs.20-27; pl.117, figs.1-5

1968b Paragondolella navicula navicula (Huckriede); Mosher, pl.119, figs.11-23

1970 Neogondolella navicula (Huckriede); Bender, p.518, pl.4, figs.4,5,8

1972 Paragondolella navicula navicula (Huckriede); Budurov & Stefanov, p.884, pl.2, figs.10-14

1973a Neogondolella navicula navicula (Huckriede); Mosher, p.168, pl.20, figs.11,18

1975 Neogondolella navicula navicula (Huckriede); Gedik, p.132, pl.1, figs.7,8; pl.2, figs.19-24

1975b Paragondolella navicula (Huckriede); Budurov & Stefanov, p.15, pl.2, figs.26,27

1977 Neogondolella navicula navicula (Huckriede); Goel, p.1099, pl.3, figs.16-19

1980b Gondolella navicula Huckriede; Kovacs & Kozur, pl.13, fig.2

Remarks. This well known species has been described by many previous authors (see Mosher 1973a, Gedik 1975 etc.). This species is characterized by the large platform which surrounds posterior denticles and by the low carina bearing several denticles.

Material studied: 47 specimens

Stratigraphic range: Middle Trias of Teke Dağı section (Antalya, samples TT-79-2,3?,4), Middle Trias of Saklıkent section (Antalya, biomicrite samples TS-79-4; TS-80-1,4)

Neogondolella oertlii (Kozur 1980)

Pl.28, figs.8a-b,9a-b

1958 Gondolella navicula Huckriede, pl.12, fig.18

1973 Gondolella navicula Huckriede; Kozur & Mock, pl.1, fig.12

1973 Gondolella polygnathiformis Budurov & Stefanov; Krystyn, pl.2, fig.2

1980 Gondolella oertlii Kozur, p.153, Text - figure 2

Remarks. This species has recently been established by Kozur (1980) with reference to its characteristic platform. It possesses a broader and longer platform than other species of this genus, and has an angular posterior extremity. The carina is high on the anterior side of the platform with indistinct denticles. The last, main, posterior denticle of the carina is developed as a strong knob. On the lower surface there is a longitudinally, faintly grooved keel. The platform margins are slightly thickened, upturned and resemble Neogondolella polygnathiformis (Budurov & Stefanov) in appearance. This species also resembles Neogondolella carpathica (Mock). It can be differentiated easily from them by the relatively long platform and by the position of the main node. To date, it is only known from rocks of the Carnian Stage

Material studied: 4 specimens

Stratigraphic range: Upper Trias of Dömek Tepe section (Antalya, sample TD-79-2B)

Neogondolella polygnathiformis (Budurov & Stefanov 1965)

Pl.29, figs.1,2,3,4,5,6

1965 Gondolella polygnathiformis Budurov & Stefanov, p.118, pl.3, figs.3-7

1966 Gondolella polygnathiformis Budurov & Stefanov; Budurov & Vrabljanski, pl.5, figs. 3,4,8

1968a Paragondolella polygnathiformis (Budurov & Stefanov); Mosher, p.939, pl.118, figs.9-17,19

1968a Metapolygnathus communisti Hayashi, p.72, pl.3, fig.11

1968a Metapolygnathus linguiformis Hayashi, p.72, pl.3, fig.9

1968a ?Metapolygnathus noah Hayashi, p.72, pl.3, fig.10

1970 Neogondolella palata Bender, p.519, pl.4, figs.6,7,11,17

1971 Paragondolella polygnathiformis (Budurov & Stefanov); Sweet et al. pl.1, fig.50

1972 Gondolella polygnathiformis Budurov & Stefanov; Kozur & Mostler, pl.3, figs.3-7

1973 Paragondolella polygnathiformis (Budurov & Stefanov); Koike, p.109, pl.15, figs.16-30

1973 ə Metapolygnathus polygnathiformis (Budurov & Stefanov); Mosher, p.164, pl.20, fig.7,12

1973 Neogondolella polygnathiformis (Budurov & Stefanov); Ziegler, p.145, Neogondo. - plate 1, fig.8

1974 Metapolygnathus polygnathiformis (Budurov & Stefanov); Eicher & Mosher, p.736, pl.1, figs.27,28,30,34,39,40; pl.2, fig.6

1974 Paragondolella polygnathiformis (Budurov & Stefanov); Budurov & Stefanov, p.301, pl.1, figs.11,12,27,28

1977 Metapolygnathus polygnathiformis (Budurov & Stefanov), Gedik, p.42, pl.3, fig.15

1977 Gondolella polygnathiformis Budurov & Stefanov; Kovacs, pl.6, fig.4

1977 Neogondolella polygnathiformis (Budurov & Stefanov); Goel, p.1099, pl.3, figs.(20-23)?

1978 Paragondolella polygnathiformis (Budurov & Stefanov); Budurov & Stefanov, p.90, pl.2, figs.7,8,11,12,15,16,22; pl.3, figs.1-6, 12,13,15,16

1978 Gondolella polygnathiformis Budurov & Stefanov; Ramovs, p.58, pl.3, fig.1

1979 Neogondolella polygnathiformis (Budurov & Stefanov); Clark et al., pl.1, fig.7

1980 Gondolella polygnathiformis Budurov & Stefanov; Krystyn, pl.11, fig.7

1980 Metapolygnathus communisti Hayashi; Krystyn, pl.12, figs.8-19

1981 Neogondolella polygnathiformis (Budurov & Stefanov); Koike, pl.2, figs.15?,22-24

1981 Neogondolella polygnathiformis (Budurov & Stefanov); Ishida, pl.5, figs.1?,2,3

1981 Neogondolella polygnathiformis (Budurov & Stefanov); Isozaki & Matsuda, pl.5, figs. (3,4)?

Remarks. This species is characterized by the shorter and broader platform which shows a slight constriction in the middle. The platform is "squared off" posteriorly. Detailed synonymies of this species can be found in previous publications (Mosher 1968a).

Material studied: 81 specimens

Stratigraphic range: Middle-Upper Trias of Teke Dağı section (Antalya, samples TT-79-10,11,12,14,17,18; TT-80-4), Upper

Trias of Dömek Tepe section (Antalya, samples TD-79-1,2A,2B), Middle Trias of Saklıkent section (Antalya, sample TS-80-3)

Neogondolella sp.A indet.

Moderately common incomplete elements which occur with undoubted specimens of Neogondolella are included here on the basis of their preserved posterior or anterior portions and their platform-like lateral extensions.

Material studied: 91 specimens

Stratigraphic range: Middle-Upper Trias of Teke Dağı section (Antalya, samples TT-79-7,8,9,15,18; TT-80-2,7; TT-81-1), Upper Trias of Dömek Tepe section (Antalya, sample TD-79-1) and Middle Trias of Saklıkent section (Antalya, samples TS-79-4,5,6,9; TS-80-1,3,4)

Neogondolella sp.B indet.

Pl.29, figs.7a,b,c

Remarks. One specimen which has been recovered in this study does not resemble any previously described material. It is characterized by a pear-shaped platform, which is almost circular in the posterior portion and gradually tapers anteriorly into the free blade. There is a constriction at the posterior extremity like a small knob. The carina comprises about 10 indistinct denticles. The lower surface has an indistinct keel which widens to the posterior into a circular shape beneath the brim-like portion of the platform where it forms a loop. The loop narrows and extends to the anterior.

Material studied: 1 specimen

Stratigraphic range: Upper Trias of Teke Dağı section (Antalya, sample TT-79-12)

Gen. et sp. indet. A

Two specimens which have a broken anterior portion cannot be identified to generic and specific level. Therefore they are included in this category. These specimens show oval posterior portions tapering tothe posterior extemity.

Material studied: 2 specimens

Stratigraphic range: Upper Trias of Teke Dağı section (Antalya, sample TT-79-12)

Gen nov. et sp. indet.B

Pl.29, figs.8a,b

Remarks. This cone-type of conodont differs from any previously described. It is characterized by a long and thick cusp, curved posteriorly in the basal part. The outer lateral surface bears several nodes in the form of two node-series. The inner surface shows several fine, longitudinal furrows. The basal cavity is very shallow.

Material studied: 4 specimens

Stratigraphic range: Middle Trias of Saklıkent section (Antalya, sample TS-79-9)

Holothurian sclerites

Pl.29, figs.9,10,11

Sparse holothurian sclerites (a group of Echinodermata) have been recovered at the near top of the Teke Dagı section. They are referred to Theelia immisorbicula Mostler 1968, Theelia cf. immisorbicula Mostler 1968 and Theelia sp. indet.

Material studied: 10 specimens

Stratigraphic range: Upper Trias of Teke Dağı section (Antalya, samples TT-80-5,6)

CHAPTER 7: FAUNAL LIST

The microfauna which has been obtained in this study is listed below, alphabetically:

A - FORAMINIFERS:

	Sample Number	Plate
Ammodiscus cf. parapriscus	THA-77-37	4C, 5A
Archaediscus krestovnikovi	THB-77-109	9D
Endothyra convexa	THB-77-108	9C,9D
Endothyranella sp.	TYKK-77-589	19B
	TPK-77-128	17D
	THA-77-129	-
Glomospira sinensis	THA-77-97	6B,6C,6D
	THA-77-98	-
Glomospira sp.	THB2-77-226	12B
	THA-77-154	7B,7C,7D
Glomospirella friedli	TPK-77-130	18B
Glomospirella cf. irregularis	THB1-77-138	10C,11A
Glomospirella triphonensis	THB1-77-138	10D
Haplophragmella irregularis	THB1-77-107	9A,9B
Involutina communis ?	TPK-77-130	18D
Involutina gaschei	TPK-77-129A	18A
Involutina gaschei praegaschei ?	TT-80-7	14D
Involutina minuta	THB1-77-178	11B
Involutina sinuosa sinuosa	TYKK-77-594	19D
Involutina sinuosa oberhauseri	TYKK-77-600	20A
Involutina sinuosa pragsoides	TPK-77-130	18C
	TPK-77-127	17C
	TT-80-7	15A,15C,15D
Involutina sp.	TPK-77-106	-
Nautiloculina oolithica	THB2-77-244	12D
Ophthalmidium chialingchiangense	TT-79-5	14B
Ophthalmidium sp.	TT-79-5	14A
Trochammina alpina	TYKK-77-600	20C
Trochammina sp.	TYKK-77-589	19B

	Sample Number	Plate
Trocholina multispira ?	TYKK-77-600	20B
Trocholina? permodiscoides	TT-80-7	15B
"Trocholina" procera	TYKK-77-600	20D
Vidalina sp.	TT-81-1	-

B - CONODONTS:

	Plate	Figure
Cratognathodus kochi	22	7,8
Cratognathodus posterognathus	22	9,10,11
Cratognathodus sp.	-	-
Cypridodella mediocris	22	2
Cypridodella cf. pronoides	22	1
Cypridodella spengleri	22	3,4
Cypridodella venusta	22	5,6
Cypridodella sp.	-	-
Didymodella alternata	22	12,13,14
Diplododella sp.	22	15
Ellisonia cf. teicherti	21	1,2
Ellisonia triassica	21	3,4,5
Ellisonia sp.	21	6
Enantiognathus lotus	22	16
Enantiognathus ziegleri	22	17
Enantiognathus sp.	-	-
Epigondolella abneptis	24	1 to 7; 8a,b
Epigondolella baloghi	24	9a,b; 10
Epigondolella aff. baloghi	24	13,14,15,16
Epigondolella carnica	24	11,12
Epigondolella nodosa	24	17,18a,b
Epigondolella parva	25	1,2
Epigondolella aff. parva	25	3a,b,c
Epigondolella permica	25	4a,b; 5,6
Epigondolella postera	25	7a,b; 8
Epigondolella primita	25	10a,b; 11a,b
Epigondolella triangularis	25	9a,b
Epigondolella sp.	-	-
Epigondolella nsp.A	26	1a,b; 2,3

	Plate	Figure
Epigondolella nsp.B	26	4,5,6
Epigondolella nsp.C	26	7a,b
Gladigondolella malayensis malayensis	26	9,10,11a,b;12,13
Gladigondolella malayensis budurovi	26	8
Gladigondolella tethydis	26	14a,b;15,16,17
Gladigondolella sp.	-	-
Neocavitella cavitata	23	1
Neocavitella sp.A	23	2
Neocavitella sp.B	23	3
Neogondolella cf. bakalovi	27	1a,b
Neogondolella basisymmetrica	27	2a,b,c
Neogondolella bifurcata	27	3,4
Neogondolella bulgarica	27	5a,b,c; 6
Neogondolella constricta	27	7,8,9,10
Neogondolella excelsa	27	11,12,13
Neogondolella foliata	27	14a,b,c
Neogondolella hanbulogi	28	1a,b
Neogondolella kozuri	28	2a,b,c
Neogondolella longa	28	3a,b,c; 4
Neogondolella mombergensis	28	5a,b,c
Neogondolella navicula navicula	28	6a,b; 7a,b
Neogondolella oertlii	28	8a,b; 9a,b
Neogondolella polygnathiformis	29	1 to 6
Neogondolella sp.A	-	-
Neogondolella sp.B	29	7a,b,c
Neohindeodella dropla	23	5
Neohindeodella triassica	23	6
Neohindeodella sp.	23	7
Parachirognathus cf. ethingtoni	21	7
Parachirognathus obliqua	21	8,9,10
Parachirognathus sp.A,B,C	21	11; 12,13; 14
Prioniodella decrescens	23	8
Prioniodella pectiniformis	23	9,10,11
Prioniodella prioniodellides	23	12

	Plate	Figure
Prioniodina libita	23	13,14
Prioniodina petrae-viridis	23	16 to 21
Prioniodina sp.	23	15
Xaniognathus tortilis	23	4
Xaniognathus sp.	-	-
Gen. et sp. indet. A.	-	-
New Gen., sp.indet.B	29	8a,b

C - HOLOTHURIAN SCLERITES:

	Sample Number	Plate	Figure
Theelia immisorbicula	TT-80-5	29	10
Theelia cf. immisorbicula	TT-80-5	29	11
Theelia sp.	TT-80-5	29	9

PLATE 21

All figures are Scanning Electron Micrographs

Fig.1 Ellisonia cf. teicherti Sweet: Lateral view of LB element (specimen: THA-247-E53) X 110.

Fig.2 Ellisonia cf. teicherti Sweet: Lateral view of LB element (specimen: THA-248-E54) X 110

Fig.3 Ellisonia triassica Müller: Lateral view of LB element (specimen: THA-258-E46) X 65

Fig.4 Ellisonia triassica Müller: Lateral view of LB element (specimen: THA-259-E47) X 80

Fig.5 Ellisonia triassica Müller: Lateral view of LB element (specimen: THA-260-E31) X 65

Fig.6 Ellisonia sp. indet. Posterior view of specimen THA-257-E63 X 85

Fig.7 Parachirognathus cf. ethingtoni Clark: Lateral view of specimen THA-250-E56 X 110

Fig.8 Parachirognathus obliqua (Staesche): Posterior view of specimen THA-251-E57 X 110

Fig.9 Parachirognathus obliqua (Staesche): Posterior view of specimen THA-263-F4 X 85

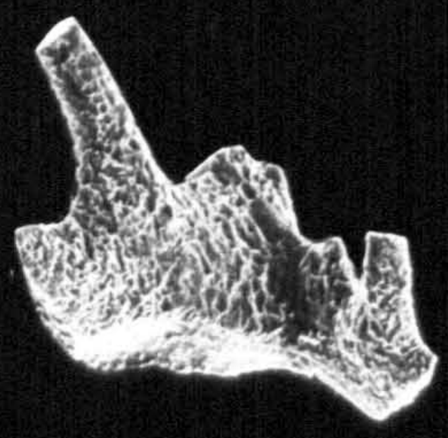
Fig.10 Parachirognathus obliqua (Staesche): Poterior view of specimen THA-261-F2 X 85

Fig.11 Parachirognathus sp. indet. A. Lateral view of specimen THA-265-F6 X 80

Fig.12 Parachirognathus sp. indet. B. Lateral view of specimen THA-245-E51 X 110

Fig.13 Parachirognathus sp. indet. B. Lateral view of specimen THA-268-F9 X 85

Fig.14 Parachirognathus sp. indet. C. Lateral view of specimen THA-267-F8 X 60



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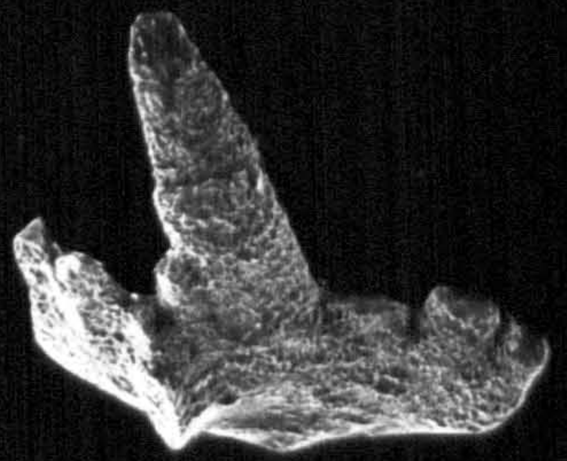

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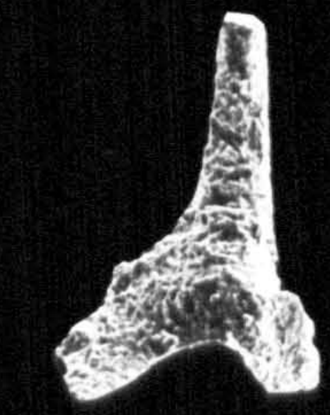

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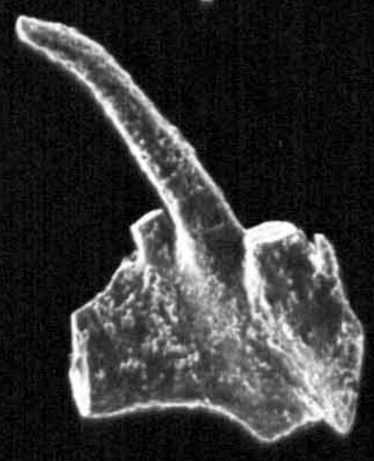

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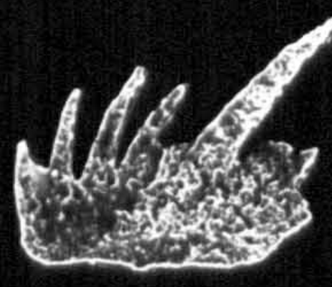

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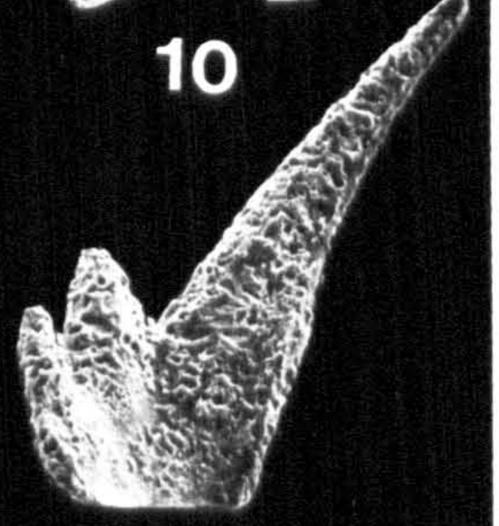

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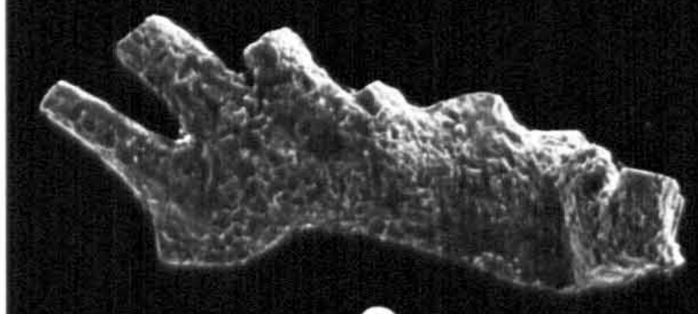

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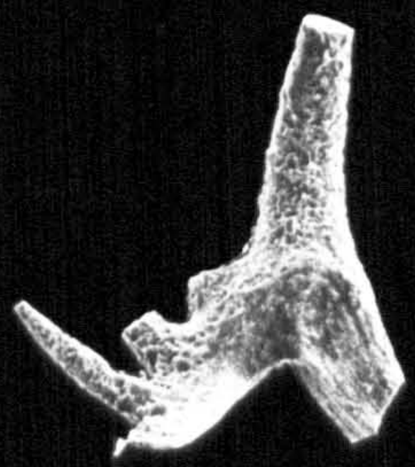

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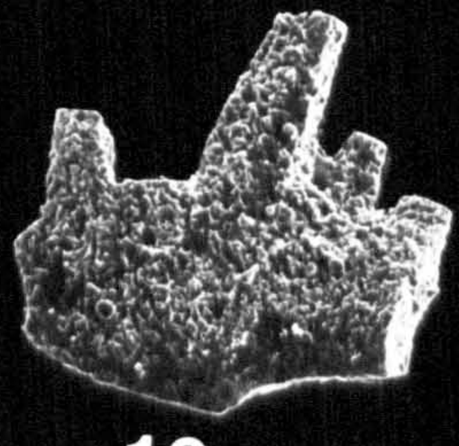

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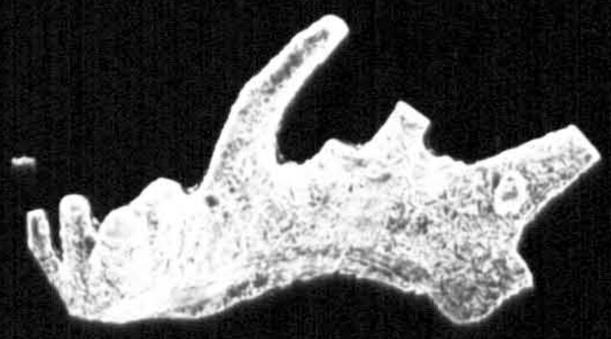

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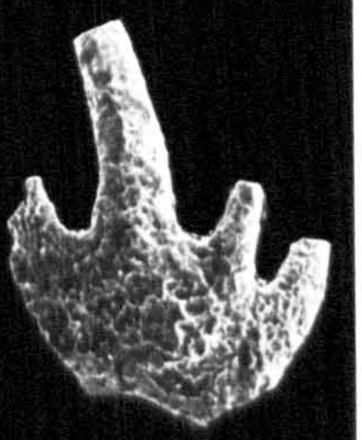

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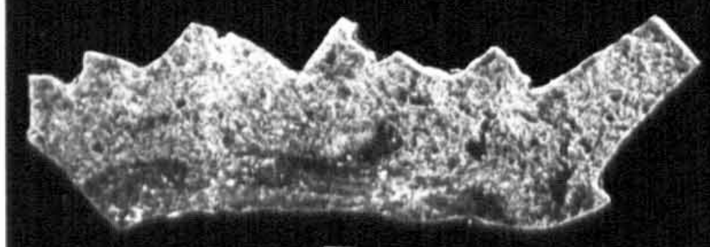

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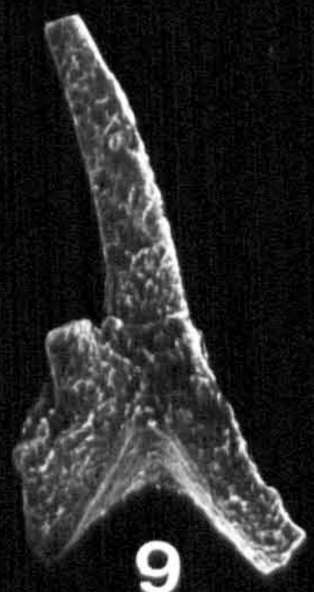

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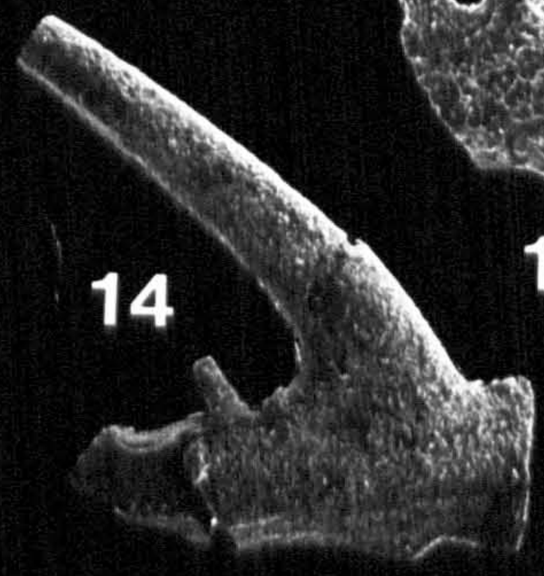

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PLATE 21

PLATE 22

All figures are Scanning Electron Micrographs

Fig.1 Cypridodella cf. pronoides (Budurov): Lateral view of specimen TT-178-D22 X 110

Fig.2 Cypridodella mediocris (Tatge): Lateral view of specimen TT-71-B28 X 55

Fig.3 Cypridodella spengleri (Huckriede): Lateral view of specimen TS-281-F26 X 45

Fig.4 Cypridodella spengleri (Huckriede): Lateral view of specimen TS-277-F22 X 45

Fig.5 Cypridodella venusta (Huckriede): A broken fragment of earlier growth stage (specimen TS-282-F27) X 45

Fig.6 Cypridodella venusta (Huckriede): A broken fragment of earlier growth stage (specimen TT-186-D34) X 60

Fig.7 Cratognathodus kochi (Huckriede): Lateral view of specimen TT-21-A36 X 110

Fig.8 Cratognathodus kochi (Huckriede): Lateral view of specimen TT-22-A37 X 110

Fig.9 Cratognathodus posterognathus Mosher: Lateral view of specimen TT-98-B55 X 110

Fig.10 Cratognathodus posterognathus Mosher: Lateral view of specimen TT-28-A41 X 110

Fig.11 Cratognathus posterognathus Mosher: Lateral view of specimen TT-27-A40 X 110

Fig.12 Didymodella alternata (Mosher): Lateral view of specimen TT-169-D10 X 115

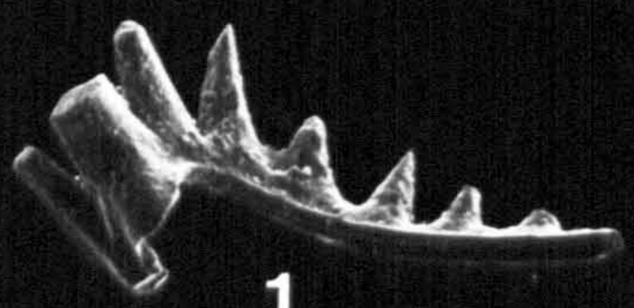
Fig.13 Didymodella alternata (Mosher): Lateral view of specimen TT-168-D9 X 115

Fig.14 Didymodella alternata (Mosher): Lateral view of specimen TT-72-B29 X 55

Fig.15 Diplododella sp. indet. Lateral view of specimen TT-96-B53 X 130

Fig.16 Enantiognathus lotus Kozur & Mostler: Inner lateral view of specimen TT-1-A18 X 110.

Fig.17 Enantiognathus ziegleri (Diebel): Outer lateral view of specimen TS-325-G8 X 110



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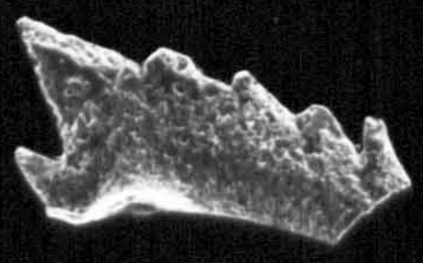

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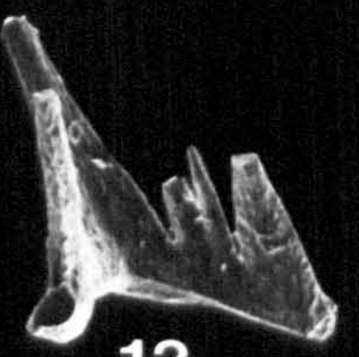

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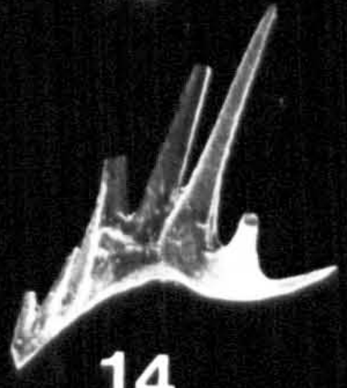

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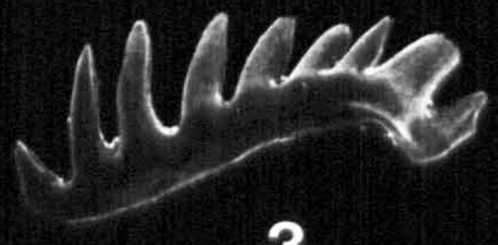

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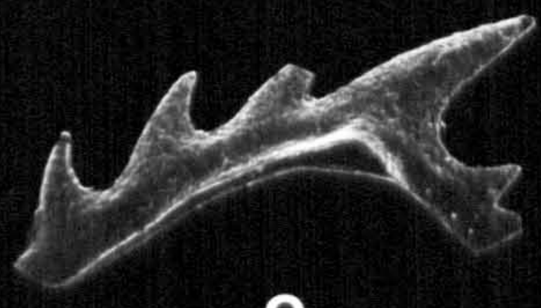

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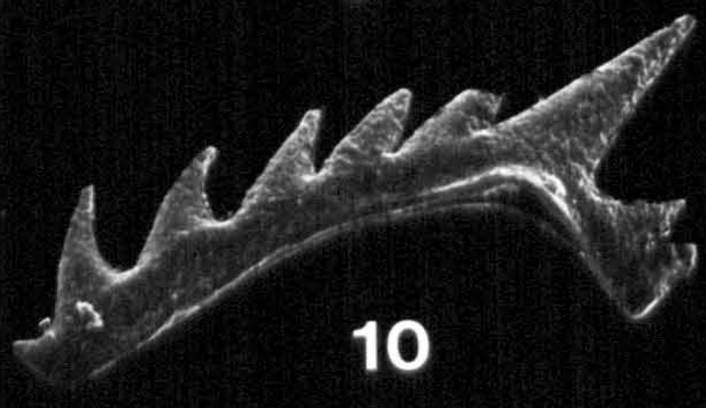

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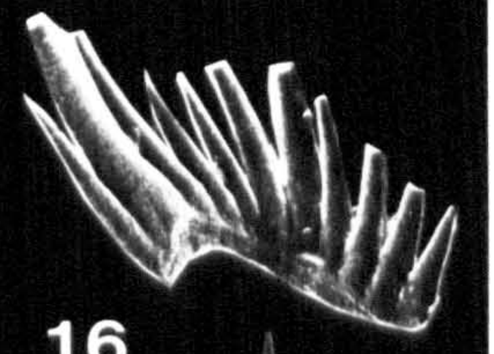

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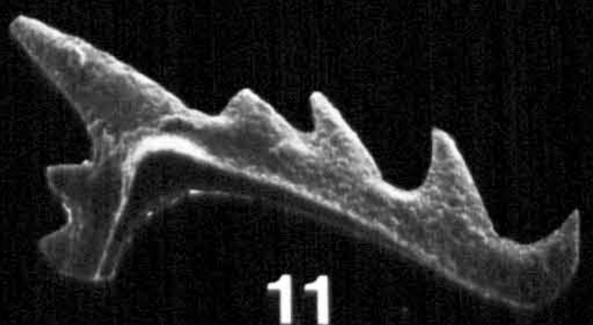

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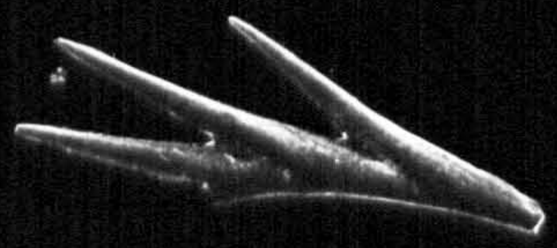

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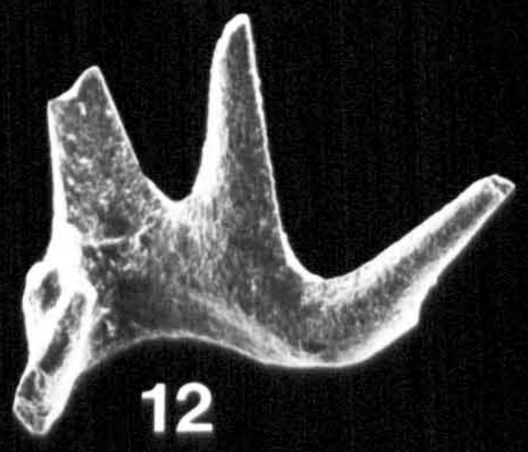

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PLATE 22

PLATE 23

All figures are Scanning Electron Micrographs

Fig.1 Neocavitella cavitata Sudar & Budurov: Lateral view of specimen TT-192-D40 X 100

Fig.2 Neocavitella sp.A indet. Lateral view of specimen TT-60-B13 X 100

Fig.3 Neocavitella? sp.B indet. Lateral view of specimen TT-188-D36 X 120

Fig.4 Xaniognathus tortilis (Tatge): Lateral view of specimen TT-91-B47 X 70

Fig.5 Neohindeodella dropla (Spassov & Ganev): Lateral view of specimen TD-350-G30 X 120

Fig.6 Neohindeodella triassica (Müller): Lateral view of specimen TT-190-D38 X 100

Fig.7 Neohindeodella sp. indet. Inner lateral view of specimen TT-175-D19 X 120

Fig.8 Prioniodella decrescens Tatge: Lateral view of specimen TT-68-B25 X 100

Fig.9 Prioniodella pectiniformis Huckriede: Lateral view of specimen TT-29-A42 X 40

Fig.10 Prioniodella pectiniformis Huckriede: Lateral view of specimen TT-65-B22 X 70

Fig.11 Prioniodella pectiniformis Huckriede: Lateral view of specimen TT-64-B21 X 40

Fig.12 Prioniodella prioniodellides (Tatge); Lateral view of specimen TS-326-G9 X 40

Fig.13 Prioniodina libita Mosher: Lateral view of specimen TT-5-B4 X 70

Fig.14 Prioniodina libita Mosher: Lateral view of specimen TT-62-B19 X 70

Fig.15 Prioniodina sp. indet. Inner lateral view of specimen TS-270-F11 X 50

Fig.16 Prioniodina petrae-viridis (Huckriede): Lateral view of specimen TS-309-F51 X 50

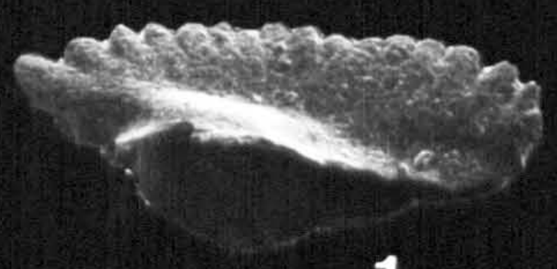
Fig.17 Prioniodina petrae-viridis (Huckriede): Lateral view of specimen TT-63-B20 X 70

Fig.18 Prioniodina petrae-viridis (Huckriede): Lateral view of TT-66-B23 X 40

Fig.19 Prioniodina petrae-viridis (Huckriede): Lateral view of specimen TT-67-B24 X 70

Fig.20 Prioniodina petrae-viridis (Huckriede): Lateral view of specimen TS-274-F19 X 40

Fig.21 Prioniodina petrae-viridis (Huckriede): Lateral view of specimen TT-19-A34 X 100



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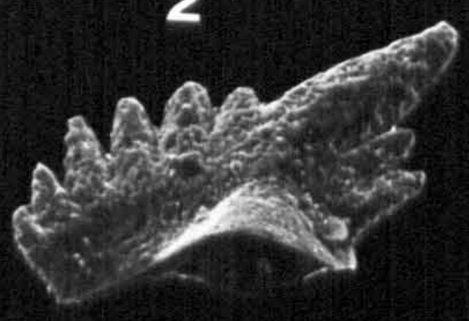

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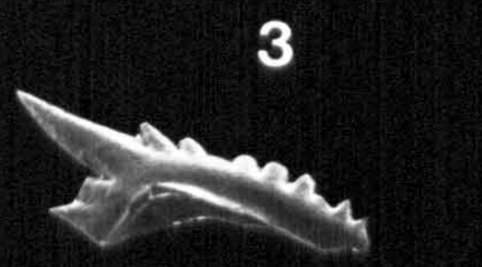

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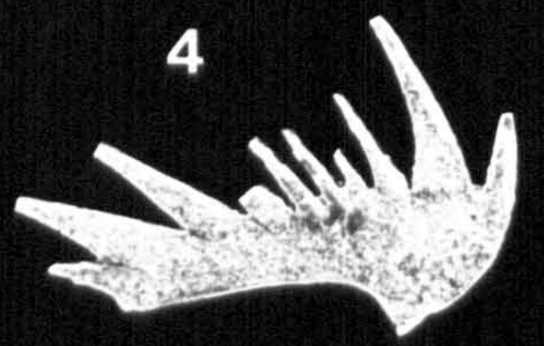

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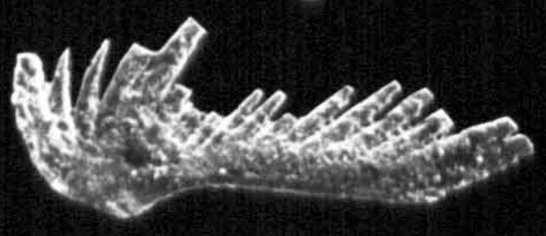

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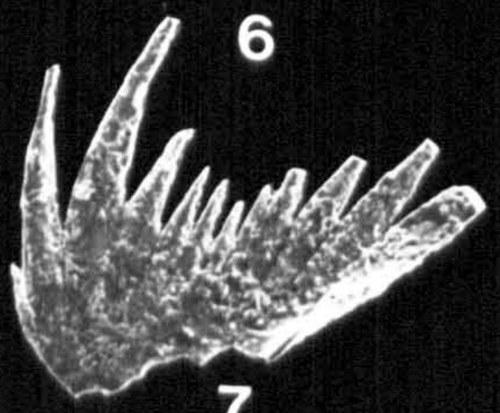

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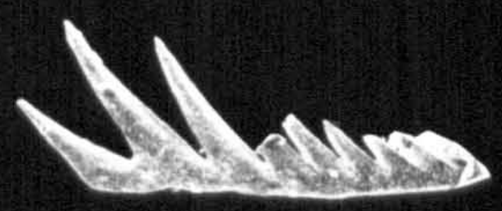

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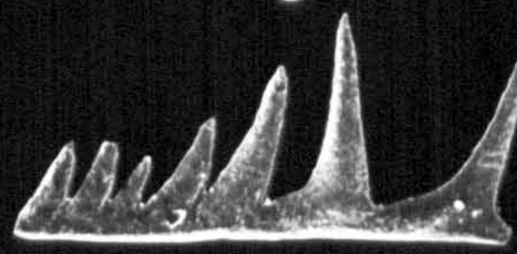

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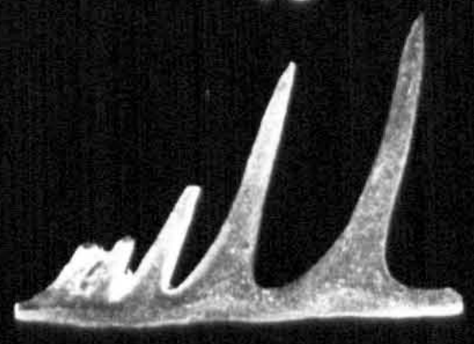

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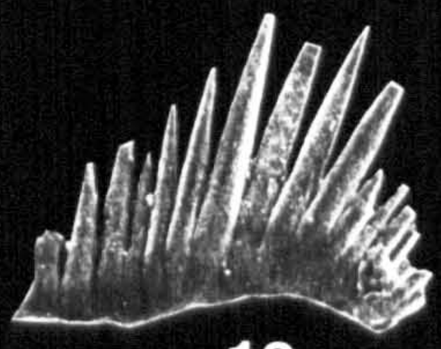

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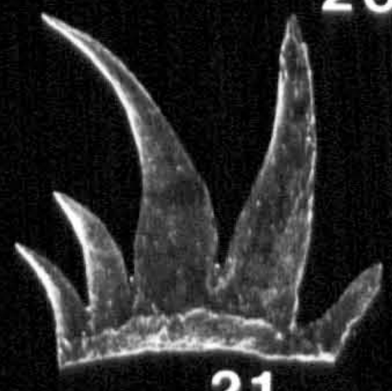

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PLATE 23

PLATE 24

All figures are Scanning Electron Micrographs

Fig.1 Epigondolella abneptis (Huckriede): Aboral view of specimen TT-238-E38 X 120

Fig.2 Epigondolella abneptis (Huckriede): Oral view of specimen TT-239-E39 X 120

Fig.3 Epigondolella abneptis (Huckriede): Oral view of specimen TT-214-E8 X 100

Fig.4 Epigondolella abneptis (Huckriede): Oral view of specimen TT-199-D51 X 45

Fig.5 Epigondolella abneptis (Huckriede): Lateral view of specimen TT-213-E7 X 100

Fig.6 Epigondolella abneptis (Huckriede): Lateral view of specimen TT-232-E28 X 120

Fig.7 Epigondolella abneptis (Huckriede): Aboral view of specimen TT-240-E40 X 100

Fig.8a,8b Epigondolella abneptis (Huckriede): Oral and aboral views of specimen TT-206-D56 X 70

Fig.9a,9b Epigondolella baloghi (Kovacs): Oral and lateral views of specimen TT-109-C5 X 120

Fig.10 Epigondolella baloghi (Kovacs): Oral view of specimen TT-111-C6 X 120

Fig.11 Epigondolella carnica Krystyn: Oral-lateral view of specimen TT-125-C23 X 100

Fig.12 Epigondolella carnica Krystyn: Aboral view of specimen TT-126-C24 X 120

Fig.13 Epigondolella aff.baloghi (Kovacs): Lateral view of specimen TT-139-C40 X 100

Fig.14 Epigondolella aff. baloghi (Kovacs): Oral view of specimen TT-138-C39 X 120

Fig.15 Epigondolella aff. baloghi (Kovacs): Aboral view of specimen TT-137-C38 X 120

Fig.16 Epigondolella aff. baloghi (Kovacs): Oral view of specimen TT-203-D54 X 100

Fig.17 Epigondolella nodosa (Hayashi): Lateral view of specimen TT-117-C12 X 100

Fig.18a,18b Epigondolella nodosa (Hayashi): Aboral and oral views of specimen TT-159-C58 X 100

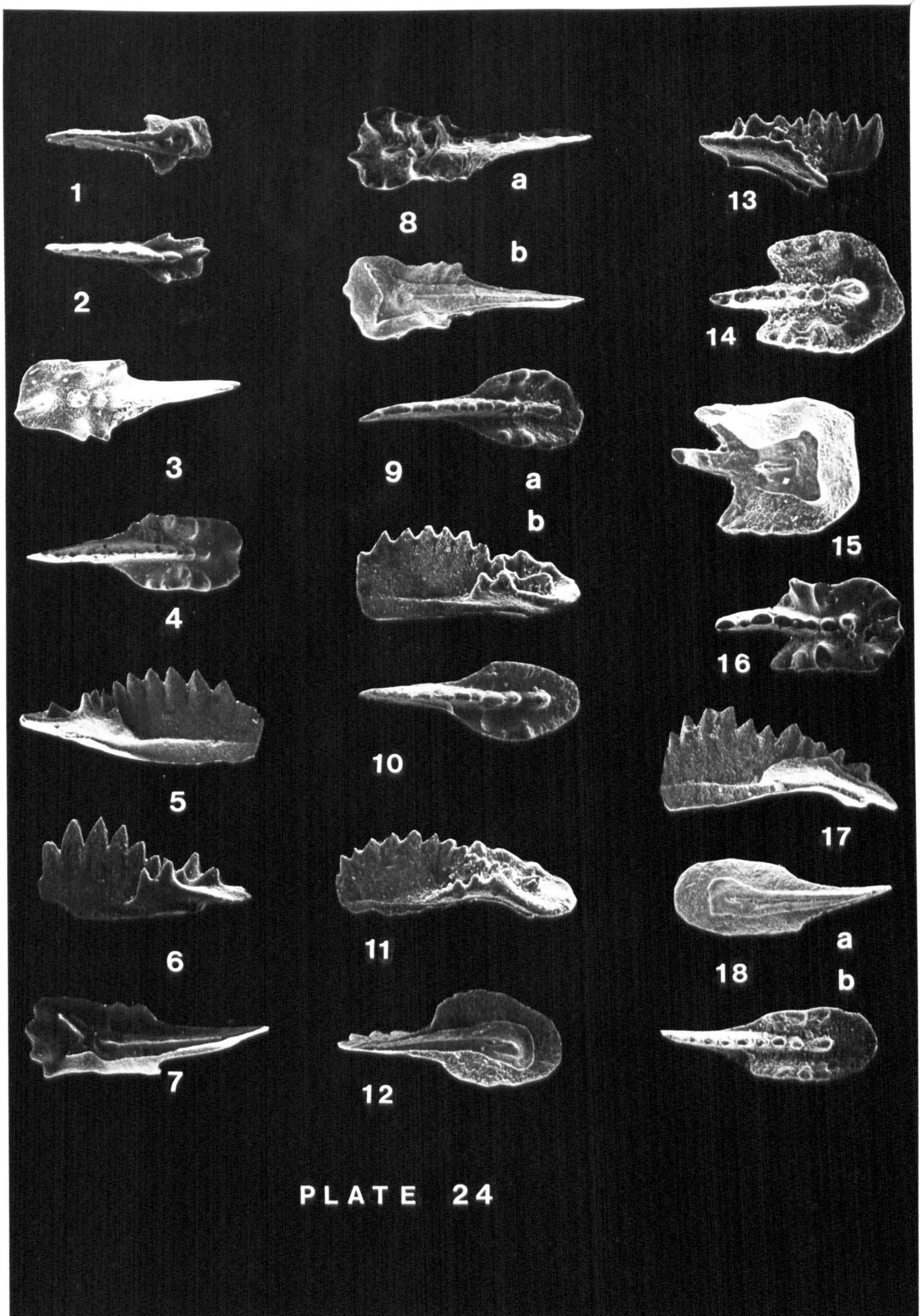


PLATE 24

PLATE 25

All figures are Scanning Electron Micrographs

Fig.1 Epigondolella parva (Kozur): Oral-lateral view of specimen TT-210-E4 X 80

Fig.2 Epigondolella parva (Kozur): Aboral view of specimen TT-212-E6 X 110

Fig.3a,3b,3c Epigondolella aff. parva (Kozur): Oral, lateral and aboral views of specimen TT-156-C56 X 110

Fig.4a,4b Epigondolella permica (Hayashi): Lateral and aboral views of specimen TT-15-A28 X 110

Fig.5 Epigondolella permica (Hayashi): Lateral view of specimen TT-144-C45 X 110

Fig.6 Epigondolella permica (Hayashi): Oral view of specimen TS-349-G29 X 120

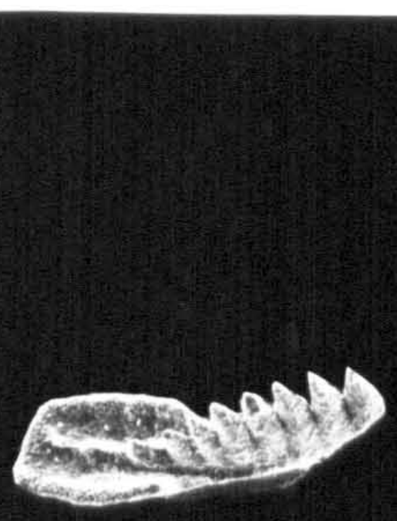
Fig.7a,7b Epigondolella postera (Kozur & Mostler): Oral and lateral views of specimen TT-17-A30 X 110

Fig.8 Epigondolella postera (Kozur & Mostler): Aboral view of specimen TT-18-A31 X 110

Fig.9a,9b Epigondolella triangularis (Budurov): Oral and aboral views of specimen TT-198-D47 X 60

Fig.10a,10b Epigondolella primita Mosher: Lateral and oral views of specimen TD-367-G43 X 130

Fig.11a,11b Epigondolella primita Mosher: Aboral and oral views of specimen TD-360-G38 X 80



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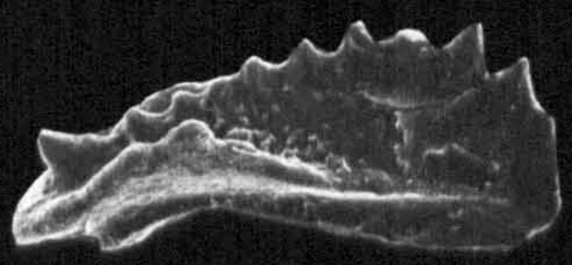

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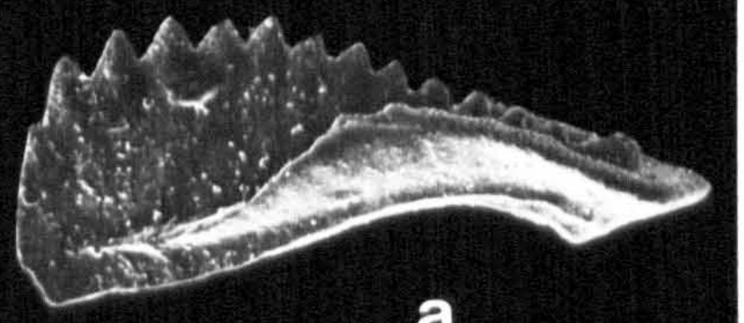

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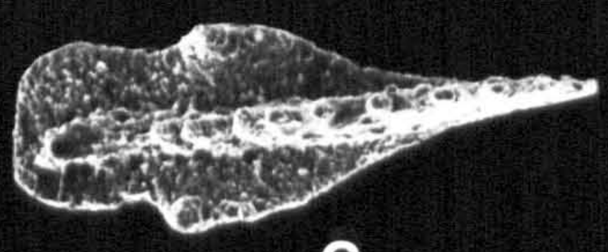

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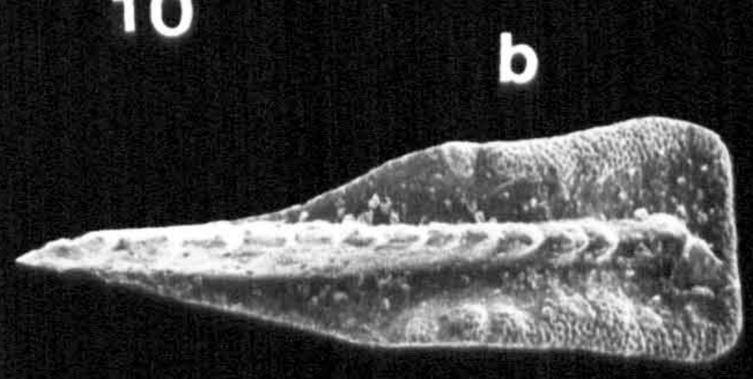

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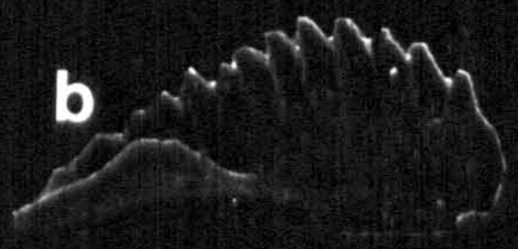

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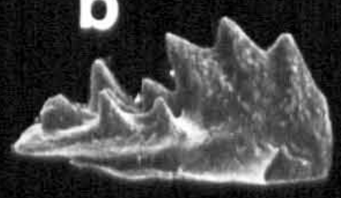

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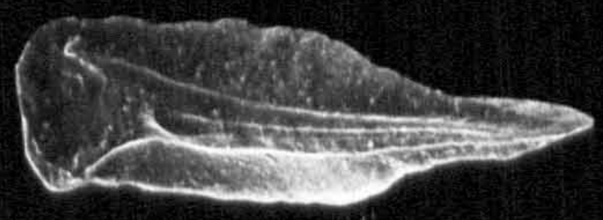

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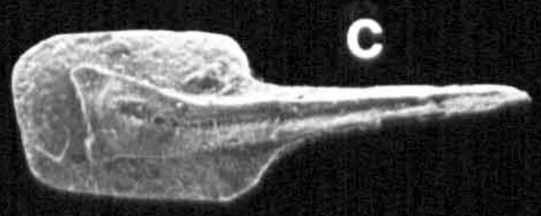

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PLATE 25

PLATE 26

All figures are Scanning Electron Micrographs

Fig.1a,1b *Epigondolella* sp.nov.A. Lateral and oral views of specimen TT-201-D53 X 70

Fig.2 *Epigondolella* sp.nov.A. Oral view of specimen TT-224-E21 X 70

Fig.3 *Epigondolella* sp.nov.A. Aboral view of specimen TT-209-E3 X 70

Fig.4 *Epigondolella* sp.nov.B. Oral view of specimen TT-217-E11 X 100

Fig.5 *Epigondolella* sp.nov.B. Lateral view of specimen TT-216-E10 X 100

Fig.6 *Epigondolella* sp.nov.B. Aboral view of specimen TT-222-E19 X 100

Fig.7a,7b *Epigondolella* sp.nov.C. Oral and aboral views of specimen TD-366-G42 X 120

Fig.8 *Gladigondolella malayensis budurovi* Kovacs & Kozur: Oral view of specimen TT-9-A24 X 100

Fig.9 *Gladigondolella malayensis malayensis* Nogami: Oral view of specimen TT-55-B8 X 70

Fig.10 *Gladigondolella malayensis malayensis* Nogami: Aboral view of specimen TT-56-B9 X 70

Fig.11a,11b *Gladigondolella malayensis malayensis* Nogami: Lateral and oral views of specimen TT-92-B50 X 70

Fig.12 *Gladigondolella malayensis malayensis* Nogami: Oral view of specimen TT-99-B56 X 100

Fig.13 *Gladigondolella malayensis malayensis* Nogami: Aboral view of specimen TT-100-B57 X 100

Fig.14a *Gladigondolella tethydis* (Huckriede): Aboral view of specimen TS-308-F57 X 50

Fig.14b,15 *Gladigondolella tethydis* (Huckriede): Lateral and oral views of specimen TS-306-F56 X 50

Fig.16 *Gladigondolella tethydis* (Huckriede): Aboral view of specimen TS-284-F29 X 40

Fig.17 *Gladigondolella tethydis* (Huckriede): Oral view of specimen TS-288-F37 X 40

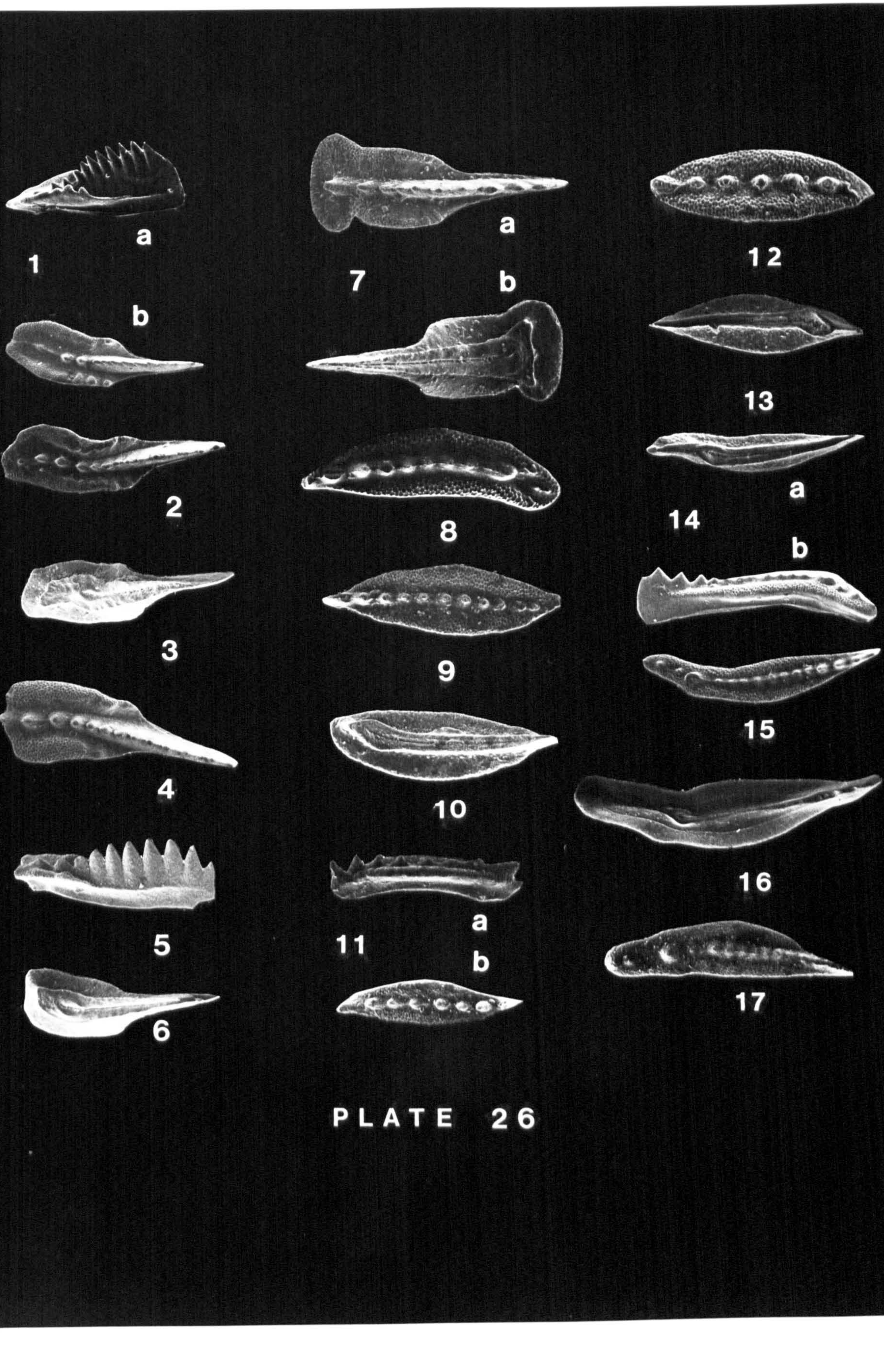

PLATE 26

PLATE 27

All figures, except 3 and 4, are Scanning Electron Micrographs

Fig.1a,1b — Neogondolella cf. bakalovi Budurov & Stefanov: Aboral and oral views of specimen TS-299-F44 X 80

Fig.2a,2b,2c — Neogondolella basisymmetrica Budurov & Stefanov: Oral, aboral and lateral views of specimen TS-298-F43 X 80

Fig.3 — Neogondolella bifurcata (Budurov & Stefanov): This specimen coated with ammonium chloride and magnified X 45. Oral view of specimen TT-80-2a

Fig.4 — Neogondolella bifurcata (Budurov & Stefanov): This specimen coated with ammonium chloride and magnified X 45. Aboral view of specimen TT-80-2b

Fig.5a,5b,5c — Neogondolella bulgarica (Budurov & Stefanov): Lateral, aboral and oral views of specimen TS-322-66 X 80

Fig.6 — Neogondolella bulgarica (Budurov & Stefanov): Lateral view of specimen TS-327-G10 X 60

Fig.7 — Neogondolella constricta (Mosher & Clark): Oral view of specimen TT-78-B37 X 110

Fig.8 — Neogondolella constricta (Mosher & Clark): Lateral view of specimen TT-87-B44 X 110

Fig.9 — Neogondolella constricta (Mosher & Clark): Oral view of specimen TT-94-B52 X 130

Fig.10 — Neogondolella constricta (Mosher & Clark): Aboral view of specimen TT-89-B45 X 130

Fig.11 — Neogondolella excelsa (Mosher): Oral view of specimen TT-83-B41 X 110

Fig.12 — Neogondolella excelsa (Mosher): Aboral view of specimen TT-41-A53 X 110

Fig.13 — Neogondolella excelsa (Mosher): Oral-lateral view of specimen TT-45-A56 X 110

Fig.14a,14b,14c — Neogondolella foliata (Budurov): Oral, aboral and lateral views of specimen TS-317-G2 X 110

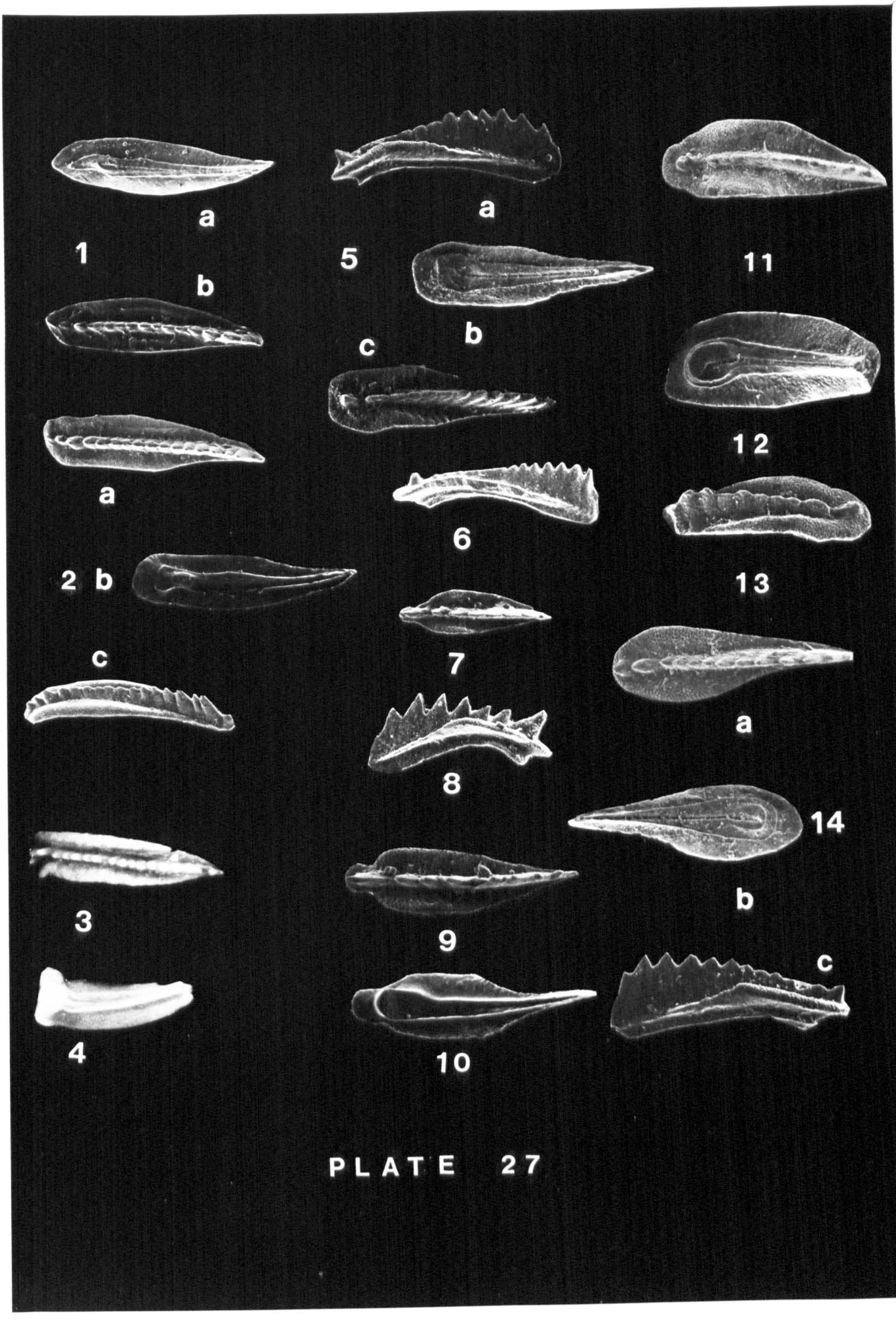

PLATE 27

PLATE 28

All figures are Scanning Electron Micrographs

Fig.1a,1b — Neogondolella cf. hanbulogi (Sudar & Budurov): Lateral and aboral views of specimen TT-86-B43 X 100

Fig.2a,2b,2c — Neogondolella kozuri Gedik: Oral, aboral and lateral views of specimen TT-242-E42 X 70

Fig.3a.3b.3c — Neogondolella longa Budurov & Stefanov: Lateral, aboral and oral views of specimen TS-302-F46 X 70

Fig.4 — Neogondolella longa Budurov & Stefanov: Aboral view of specimen TT-10-A25 X 100

Fig.5a,5b,5c — Neogondolella mombergensis (Tatge): Oral, aboral and lateral views of specimen TT-12-A27 X 90

Fig.6a.6b — Neogondolella navicula navicula (Huckriede): Oral and lateral views of specimen TS-329-G11 X 70

Fig.7a,7b — Neogondolella navicula navicula (Huckriede): Aboral and lateral views of specimen TS-331-G12 X 70

Fig.8a.8b — Neogondolella oertlii (Kozur): Oral and oral-lateral views of specimen TD-356-G37 X 70

Fig.9a,9b — Neogondolella oertlii (Kozur): Lateral and aboral views of specimen TD-356-G37 X 70

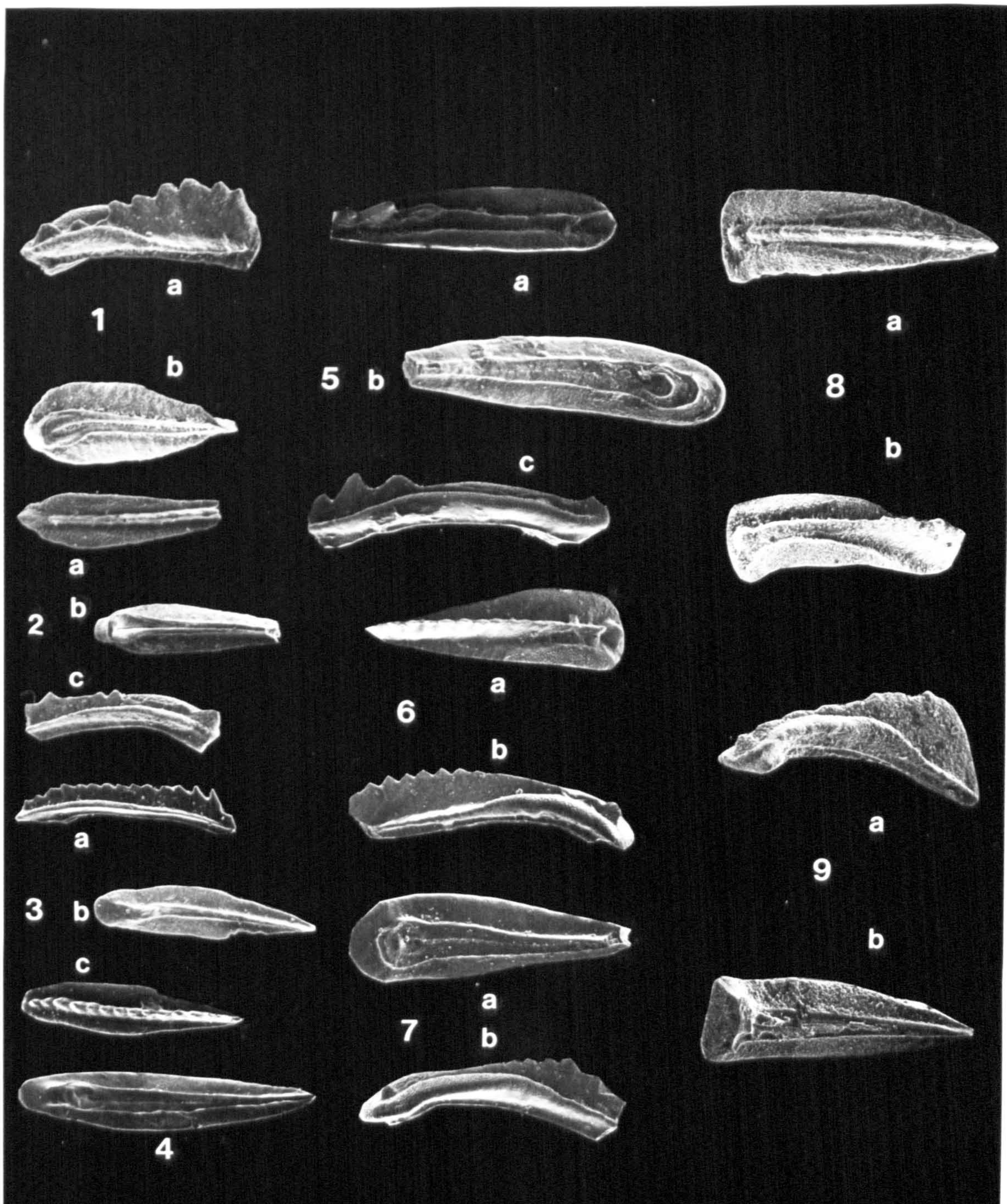

PLATE 28

PLATE 29

All figures are Scanning Electron Micrographs

Fig.1 — Neogondolella polygnathiformis (Budurov & Stefanov): Oral-lateral view of specimen TT-76-B35 X 70

Fig.2 — Neogondolella polygnathiformis (Budurov & Stefanov): Aboral view of specimen TT-153-C54 X 100

Fig.3 — Neogondolella polygnathiformis (Budurov & Stefanov): Oral view of specimen TD-355-G36 X 100

Fig.4 — Neogondolella polygnathiformis (Budurov & Stefanov): Lateral view of specimen TD-353-G35 X 70

Fig.5 — Neogondolella polygnathiformis? (Budurov & Stefanov): Oral-lateral view of specimen TT-218-E12 X 70

Fig.6 — Neogondolella polygnathiformis? (Budurov & Stefanov): Aboral view of specimen TT-219-E13 X 70

Fig.7a,7b,7c — Neogondolella sp.B. indet. Aboral, oral and lateral views of specimen TT-141-C42 X 120

Fig.8a,8b — Gen.nov.et sp. indet.B. Lateral views of specimen TS-335-G20 X 230 and X 50

Fig.9 — Theelia sp. indet. (specimen TT-229-E25) X 220

Fig.10 — Theelia immisorbicula Mostler (specimen TT-231-E27) X 160

Fig.11 — Theelia cf. immisorbicula Mostler (specimen TT-230-E26) X 400

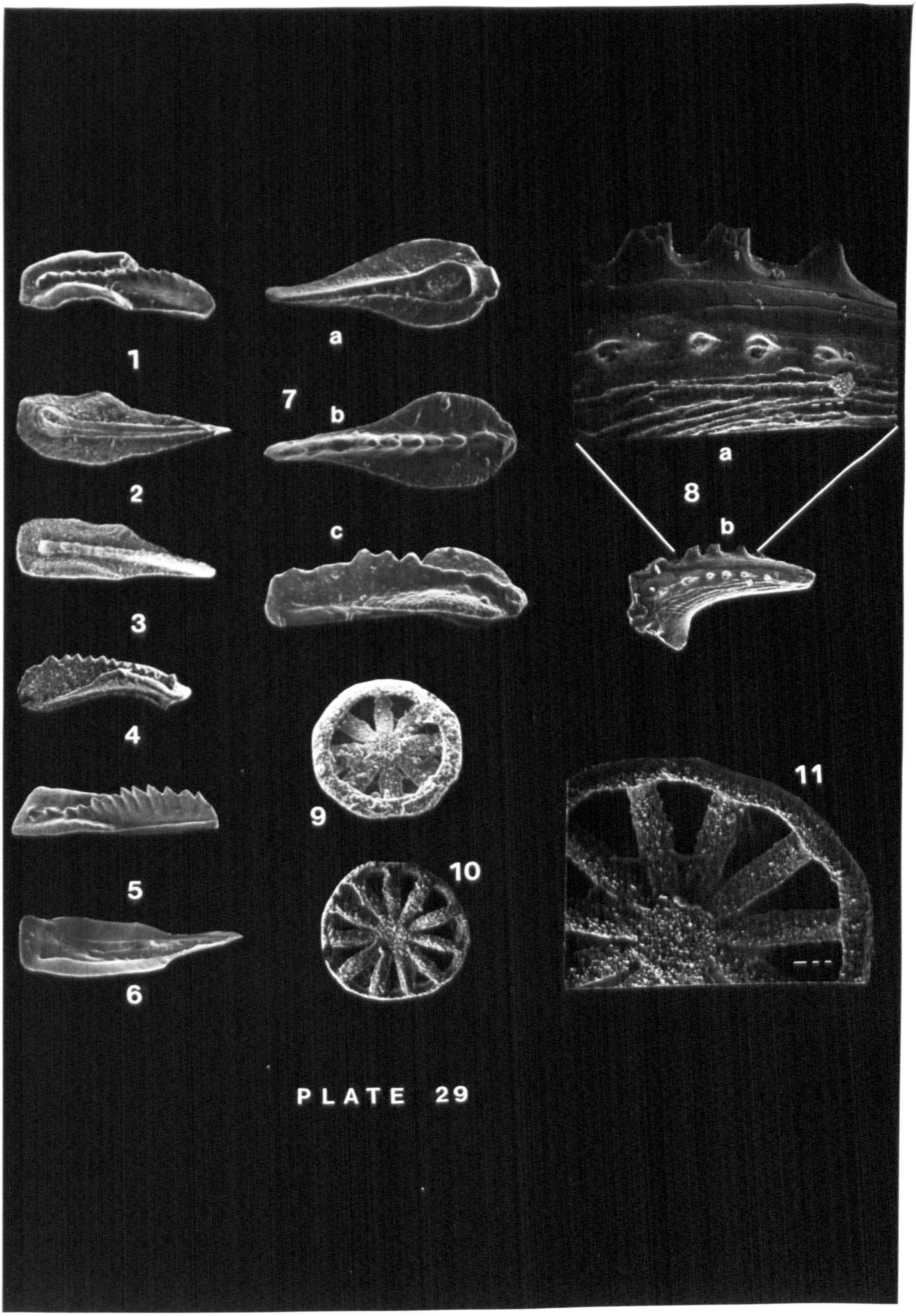

PLATE 29

PART III - SUMMARY AND CONCLUSIONS

CHAPTER 8: SUMMARY AND CONCLUSIONS

1 - A total of 56 large limestone samples from throughout the Triassic sequence in the Central Taurus Mountains (localities 1 to 6 in Fig.6A) were collected; 42 of them have yielded conodonts, 14 are barren. From a total of 84·435 kg. of rock (average sample size 1.5 kg., ranging from 0·500 gr. to 3,400 gr.). 2,177 identifiable conodonts have been recovered. They are referred to 2 multi-element genus, 4 multi-element species, 13 form-genera, 50 form-species (including 4 new form-species) and 3 form-subspecies. A new monotypic *genera* is also recognized.

2 - The paucity of conodont-bearing horizons and poor preservation of these fossils in the Lower Triassic of Hadim is reflected in the restricted information obtained from the conodonts of this stage. Detailed information has been obtained from the conodont-bearing horizons of the Middle and Upper Triassic in the Antalya area.

3 - In Hadim, the Lower Triassic conodonts Ellisonia cf. teicherti, Ellisonia triassica, Parachirognathus cf. ethingtoni and Parachirognathus obliqua occur in the shallow-water limestones which dominate this marginal lagoon sequence.

4 - In Antalya, several species of the Middle-Upper Triassic conodonts Crathognathodus, Cypridodella, Didymodella, Diplododella, Enantiognathus, Epigondolella, Gladigondolella, Neocavitella, Neogondolella, Neohindeodella, Prioniodella, Prioniodina and Xaniognathus occur in the deep water, probably pelagic limestones.

5 - In spite of recent progressive interest and the fact that conodonts have been known from late Palaeozoic and early Mesozoic rocks for at least 50 years, the taxonony and distribution of conodonts through the Triassic System is still obscure. In this study, the most available and valid names which conform to International Commission for Zoological Nomenclature ruling have been followed, and specific taxonomic problems of some genera are discussed in Part 6.2.

6 - In this study, Triassic rocks have been collected from three different areas, where eight columnar sections were measured, having a total thickness of approximately 2,200 metres. For petrographic and palaeontologic interpretation, 850 thin sections have been prepared from a total of 432 collected samples.

7 - The Triassic rocks from the Hadim area consist usually of oolitic limestone, clayey limestone, variegated shales, sandstone and conglomerate. The Soğuk Pınar Dere section (THA) is proposed as the type section of the Triassic rocks in this region. It is described in detail and illustrated in Part 2.2.1. The Triassic rocks from the Antalya area consist mainly of limestone; interbedded shales have only been seen in the Lower Triassic of Teke Dağı. The Teke Dağı section (TT) is proposed as the type section of the Triassic rocks in this region. It is described in detail in Part 3.2.1.

8 - In the Hadim region, seventeen limestone types (micrite, intramicrite, biomicrite, bioclastic micrite, oosparite, dolomitized oosparite, foraminiferal biosparite, dolomitized biosparite, intrasparite, intraclastic microsparite, microsparite, algal biomicrosparite, stromatolite, dolomitized intraclastic biosparite, oncolitic intrasparite, foraminiferal oosparite and pelsparite) have been defined on the basis of petrographic examination. For each limestone type, all allochems have been described; dolomitization, recrystallization and micritization have been interpreted. The environments of deposition have been discussed, and a new facies model for this region has been reconstructed.

9 - For the Hadim region, a tidal lagoon has been suggested as the environment of deposition. Several events from this shallow-water, marginal lagoon environment have been described in detail and illustrated in Figures (see Part 2.2.3).

10 - In the Antalya region, eight limestone types (micrite, biomicrite, packed biomicrite, red packed biomicrite, pale grey packed biomicrite, sparse biomicrite, red sparse biomicrite and pale grey sparse biomicrite) have been defined on the basis of petrological characteristics. For each limestone type, all allochems have been

described; dolomitization, recrystallization and micritization have been interpreted. The rocks resemble parts of the Triassic/ Jurassic sequence (Hallstätt facies) of the Austrian Alps, and the proposed environment of pelagic sediments deposited on sea-mounts within ocean basins has been supported.

11 - The Triassic foraminifers have been mostly recovered from the Upper Triassic limestones of the Soğuk Pınar Dere section (THA), the Upper Triassic limestones of the Teke Dağı section (TT) and from the Kayseri area, which consists mainly of recrystallized or dolomitized Upper Triassic limestones.

12 - Studied areas in this thesis contain very important but little known Triassic outcrops, so that less may be said about the Triassic history than is desirable. Nonetheless, this attempt is made to provide a base for future investigations. Clearly, this study cannot give a complete picture of the Triassic history of the Taurus Mountains in Turkey, but it does provide an important foundation for future detailed work. Of particular interest will be the complete Triassic history together with the exploration of the Tethyan Ocean and its continental margins in the Taurus belt.

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APPENDIX I - INDEX AND REGISTER OF FIGURED SPECIMENS

Conodont Species	Specimen No.	Sample No.
Cratognathodus kochi	TT-21-A36	TT-79-7
Cratognathodus kochi	TT-22-A37	TT-79-7
Cratognathodus posterognathus	TT-98-B55	TT-79-12
Cratognathodus posterognathus	TT-28-A41	TT-79-8
Cratognathodus posterognathus	TT-27-A40	TT-79-8
Cypridodella mediocris	TT-71-B28	TT-79-10
Cypridodella cf. pronoides	TT-178-D22	TT-79-14
Cypridodella spengleri	TS-281-F26	TS-80-1
Cypridodella spengleri	TS-277-F22	TS-80-1
Cypridodella venusta	TS-282-F27	TS-80-1
Cypridodella venusta	TT-186-D34	TT-79-15
Didymodella alternata	TT-169-D10	TT-79-13
Didymodella alternata	TT-168-D9	TT-79-13
Didymodella alternata	TT-72-B29	TT-79-10
Diplododella sp. indet.	TT-96-B53	TT-79-12
Ellisonia cf. teicherti	THA-247-E53	THA-80-1
Ellisonia cf. teicherti	THA-248-E54	THA-80-1
Ellisonia triassica	THA-258-E46	THA-81-6
Ellisonia triassica	THA-259-E47	THA-81-6
Ellisonia triassica	THA-260-E31	THA-81-6
Ellisonia sp. indet.	THA-257-E63	THA-81-6
Enantiognathus lotus	TT-1-A18	TT-79-1
Enantiognathus ziegleri	TS-325-G8	TS-80-4
Epigondolella abneptis	TT-238-E38	TT-80-6
Epigondolella abneptis	TT-239-E39	TT-80-6
Epigondolella abneptis	TT-214-E8	TT-80-4
Epigondolella abneptis	TT-199-D51	TT-80-4
Epigondolella abneptis	TT-213-E7	TT-80-4
Epigondolella abneptis	TT-232-E28	TT-80-5
Epigondolella abneptis	TT-240-E40	TT-80-6
Epigondolella abneptis	TT-206-D56	TT-80-4
Epigondolella baloghi	TT-109-C5	TT-79-12
Epigondolella baloghi	TT-111-C6	TT-79-12
Epigondolella aff. baloghi	TT-139-C40	TT-79-12
Epigondolella aff. baloghi	TT-138-C39	TT-79-12
Epigondolella aff. baloghi	TT-137-C38	TT-79-12

Conodont Species	Specimen No.	Sample No.
Epigondolella aff. baloghi	TT-203-D54	TT-80-4
Epigondolella carnica	TT-125-C23	TT-79-12
Epigondolella carnica	TT-126-C24	TT-79-12
Epigondolella nodosa	TT-117-C12	TT-79-12
Epigondolella nodosa	TT-159-C58	TT-79-12
Epigondolella parva	TT-210-E4	TT-80-4
Epigondolella parva	TT-212-E6	TT-80-4
Epigondolella aff. parva	TT-156-C56	TT-79-12
Epigondolella permica	TT-15-A28	TT-79-5
Epigondolella permica	TT-144-C45	TT-79-12
Epigondolella permica	TD-349-G29	TD-79-1
Epigondolella postera	TT-17-A30	TT-79-5
Epigondolella postera	TT-18-A31	TT-79-5
Epigondolella primita	TD-367-G43	TD-80-2
Epigondolella primita	TD-360-G38	TD-80-2
Epigondolella triangularis	TT-198-D47	TT-80-4
Epigondolella nsp. A	TT-201-D53	TT-80-4
Epigondolella nsp. A	TT-224-E21	TT-80-4
Epigondolella nsp. A	TT-209-E3	TT-80-4
Epigondolella nsp.B	TT-217-E11	TT-80-4
Epigondolella nsp.B	TT-216-E10	TT-80-4
Epigondolella nsp.B	TT-222-E19	TT-80-4
Epigondolella nsp.C	TT-366-G42	TD-80-2
Gladigondolella malayensis budurovi	TT-9-A24	TT-79-4
Gladigondolella malayensis malayensis	TT-55-B8	TT-80-3
Gladigondolella malayensis malayensis	TT-56-B9	TT-80-3
Gladigondolella malayensis malayensis	TT-92-B50	TT-79-11
Gladigondolella malayensis malayensis	TT-99-B56	TT-79-12
Gladigondolella malayensis malayensis	TT-100-B57	TT-79-12
Gladigondolella tethydis	TS-308-F57	TS-80-1
Gladigondolella tethydis	TS-306-F56	TS-80-1
Gladigondolella tethydis	TS-284-F29	TS-80-1
Gladigondolella tethydis	TS-288-F37	TS-80-1
Neocavitella cavitata	TT-192-D40	TT-79-16
Neocavitella sp.A indet.	TT-60-B13	TT-80-3
Neocavitella sp.B indet.	TT-188-D36	TT-79-15
Neogondolella cf. bakalovi	TS-299-F44	TS-80-1

Conodont Species	Specimen No.	Sample No.
Neogondolella basisymmetrica	TS-298-F43	TS-80-1
Neogondolella bifurcata	TT-80-2a,b	TT-80-2
Neogondolella bulgarica	TS-322-G6	TS-80-3
Neogondolella bulgarica	TS-327-G10	TS-80-4
Neogondolella constricta	TT-78-B37	TT-79-10
Neogondolella constricta	TT-87-B44	TT-79-11
Neogondolella constricta	TT-94-B52	TT-79-11
Neogondolella constricta	TT-89-B45	TT-79-11
Neogondolella excelsa	TT-83-B41	TT-79-11
Neogondolella excelsa	TT-41-A53	TT-79-9
Neogondolella excelsa	TT-45-A56	TT-79-9
Neogondolella foliata	TS-317-G2	TS-80-3
Neogondolella cf. hanbulogi	TT-86-B43	TT-79-11
Neogondolella kozuri	TT-242-E42	TT-80-7
Neogondolella longa	TS-302-F46	TS-80-1
Neogondolella longa	TT-10-A25	TT-79-4
Neogondolella mombergensis	TT-12-A27	TT-79-4
Neogondolella navicula navicula	TS-329-G11	TS-80-4
Neogondolella navicula navicula	TS-331-G12	TS-80-4
Neogondolella oertlii	TS-356-G37	TD-79-2B
Neogondolella polygnathiformis	TT-76-B35	TT-79-10
Neogondolella polygnathiformis	TT-153-C54	TT-79-12
Neogondolella polygnathiformis	TD-355-G36	TD-79-2B
Neogondolella polygnathiformis	TD-353-G35	TD-79-2B
Neogondolella polygnathiformis?	TT-218-E12	TT-80-4
Neogondolella polygnathiformis?	TT-219-E13	TT-80-4
Neogondolella sp.B indet.	TT-141-C42	TT-79-12
Neohindeodella dropla	TD-350-G30	TD-79-1
Neohindeodella triassica	TT-190-D38	TT-79-15
Neohindeodella sp. indet.	TT-175-D19	TT-79-14
Parachirognathus cf. ethingtoni	THA-250-E56	THA-80-1
Parachirognathus obliqua	THA-251-E57	THA-80-1
Parachirognathus obliqua	THA-263-F4	THA-81-6
Parachirognathus obliqua	THA-261-F2	THA-81-6
Parachirognathus sp.A indet.	THA-265-F6	THA-81-6
Parachirognathus sp.B indet.	THA-245-E51	THA-80-1
Parachirognathus sp.B indet.	THA-268-F9	THA-81-6

Conodont Species	Specimen No.	Sample No.
Parachirognathus sp.C indet.	THA-267-F8	THA-81-6
Prioniodella decrescens	TT-68-B25	TT-79-10
Prioniodella pectiniformis	TT-29-A42	TT-79-8
Prioniodella pectiniformis	TT-65-B22	TT-79-10
Prioniodella pectiniformis	TT-64-B21	TT-79-10
Prioniodella prioniodellides	TS-326-G9	TS-80-4
Prioniodina libita	TT-51-B4	TT-80-3
Prioniodina libita	TT-62-B19	TT-79-10
Prioniodina petrae-viridis	TS-309-F51	TS-80-3
Prioniodina petrae-viridis	TT-63-B20	TT-79-10
Prioniodina petrae-viridis	TT-66-B23	TT-79-10
Prioniodina petrae-viridis	TT-67-B24	TT-79-10
Prioniodina petrae-viridis	TS-274-F19	TS-80-1
Prioniodina petrae-viridis	TT-19-A34	TT-79-5
Prioniodina sp. indet.	TS-270-F11	TS-80-1
Xaniognathus tortilis	TT-91-B47	TT-79-11
Gen.nov.et spec. indet.B	TS-335-G20	TS-79-9
Holothurian sclerites		
Theelia immisorbicula	TT-231-E27	TT-80-5
Theelia cf. immisorbicula	TT-230-E26	TT-80-5
Theelia sp. indet.	TT-229-E25	TT-80-5

APPENDIX II - CONODONT SAMPLES AND THEIR WEIGHT

Samples	Weight (gr.)
TT-79-1	840
TT-79-2	850
TT-79-3	763
TT-79-4	1,102
TT-79-5	1,278
TT-79-6	950
TT-79-7	1,450
TT-79-8	1,165
TT-79-9	1,185
TT-79-10	1,135
TT-79-11	1,050
TT-79-12	1,142
TT-79-13	860
TT-79-14	1,325
TT-79-15	790
TT-79-16	913
TT-79-17	703
TT-79-18	1,078
TT-79-19	1,106
TT-80-1	1,822
TT-80-2	2,994
TT-80-3	2,993
TT-80-4	2,717
TT-80-5	2,475
TT-80-6	2,170
TT-80-7	1,910
TT-81-1	3,100
THA-80-1	2,405
THA-81-6	3,400
THB1-77-123	672
THB1-77-137	405

Samples	Weight (gr.)
THB2-77-225	501
THB2-77-226	590
TS-79-1	1,240
TS-79-2	1,426
TS-79-3	1,100
TS-79-4	1,135
TS-79-5	943
TS-79-6	1,679
TS-79-7	1,206
TS-79-8	1,216
TS-79-9	2,320
TS-79-10	1,337
TS-80-1	3,420
TS-80-2	2,453
TS-80-3	2,775
TS-80-4	3,526
TD-79-1	1,510
TD-79-2A	570
TD-79-2B	640
TD-79-3	942
TD-79-4	1,165
TD-79-5	950
TD-79-6	850
TD-80-1	2,383
TD-80-2	1,870

Total: 84,435 gr.