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FORAMINIFERA FROM THE EXOTIC PERMO-CARBONIFEROUS LIMESTONE BLOCKS IN THE KARAKAYA COMPLEX, NORTHWESTERN TURKEY

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Riassunto. Il Complesso di Karakaya nella Turchia settentrionale è una associazione tettonica di rocce di età Permo-Triassica, fortemente deformate, costituita da vulcaniti mafiche e rocce clastiche, che rappresentano complessi di subduzione-accrezione della Paleo-Tetide. Esso forma una fascia allungata e discontinua di oltre 1000 km in direzione est-ovest e costituisce il basamento della successione debolmente deformata delle Pontidi. Nella Turchia nord-occidentale vengono distinte quattro unità nell'ambito del complesso di Karakaya. Una sequenza basale, con metabasiti, marmi e filladi, un'unità con arcose ed olistostromi, un'unità di grovacche ed infine un'unità di lave mafiche, tufi ed olistostromi. Le ultime tre unità contengono numerosi blocchi esotici di calcari Carboniferi e Permiani. In questo articolo sono studiati i foraminiferi di oltre 180 blocchi e sono anche identificate tre nuove specie di Fusulinidi. Sono testimoniate tutte le età del Carbonifero e del Permiano, con l'eccezione di Tournesiano, Kasimoviano e Boloriano. Tuttavia, più dell'80% dei blocchi ha età da Murgabiana a Midiana. Dal confronto con le successioni coeve delle Anatolidi e dei Tauri, i blocchi calcarei del Complesso di Karakaya sono caratterizzati da più ricche associazioni di Fusulinidi e da successioni più complete. Si suggerisce che essi si siano deposti a nord della piattaforma Anatolidi-Tauri, sulle sponde sia settentrionali che meridionali della Paleo-Tetide. Il fatto che la massima concentrazione di olistostromi sia in prossimità della sutura con le Anatolidi-Tauri sembra indicare che questi blocchi calcarei provengano dal margine meridionale della Paleo-Tetide. Tuttavia i Fusulinidi del Complesso di Karakaya mostrano affinità con quelli degli Urali, del Pamir settentrionale e del Darvaz, unanimemente considerati essere situati sul margine settentrionale della Paleo-Tetide. Si potrebbe interpretare questa apparente contraddizione come legata ad una larghezza ridotta della Paleotetide all'altezza della Turchia, che avrebbe annullato le differenze paleobiogeografiche tra le due sponde della Paleo-Tetide.

Abstract. Karakaya Complex in northern Turkey is a tectonic assemblage of strongly deformed Permo-Triassic mafic volcanic and clastic rocks, representing subduction-accretion complexes of the Paleo-Tethys. It forms an over 1000 km long discontinuous east-west trending belt and constitutes the basement to the little deformed Jurassic-Cretaceous sequence of the Pontides. In northwest Turkey four tectonic units are differentiated within the Karakaya Complex. A basal metabasite-marble-phyllite sequence, an arkosic sandstone-olistostrome unit, a greywacke unit and a mafic lava-tuff-olistostrome unit. The latter three units comprise numerous exotic blocks of Permo-Carboniferous limestone ranging up to one kilometre in size. Foraminifera from over 180 blocks from these three Karakaya Complex units are studied, many in oriented sections. The rich fusulinid and small foraminifer assemblage in the blocks of the Karakaya Complex with three new fusulinid species, *Triticites* (?) *kozakensis*, *Palaeofusulina* (*Paradunbarula*) *okayi* and *Palaeofusulina* (*Paradunbarula*) *ottomana*, indicate the presence of all the Carboniferous and Permian stages with the exception of Tournaisian, Kasimovian and Bolorian. However, the majority of the limestone blocks (> 80%) are of Murgabian to Midian age. Compared to the Upper Paleozoic sequences from the Anatolide-Taurides, the limestone blocks in the Karakaya Complex are characterised by richer fusulinid assemblages and a more complete synthetic sequence suggesting that they were deposited to the north of the Anatolide-Tauride platform along the southern or northern margin of the Paleo-Tethys. The concentration of the olistostromes along the suture with the Anatolide-Taurides suggests that the limestone blocks were derived from the southern margin of the Paleo-Tethys. However, fusulinid assemblages of the Karakaya Complex show similarities to those from Urals, northern Pamir and Darvaz, all thought to be located along the northern margin of the Paleo-Tethys, suggesting an opposing view. This could be due to the narrow width of the Permian Paleo-Tethys in the Turkish paleo-longitude, which might have obliterated faunal differences in fusulinid assemblages from both sides of the ocean.

Introduction.

Turkey consists of various continental fragments that were assembled during the Alpide orogeny. Each of these continental fragments, originally separated by oceanic crust, is characterised by distinct stratigraphic, deformational, metamorphic and magmatic features. Three such fragments, the Strandja Massif, the Istanbul and Sakarya zones, make up the Pontides (Fig. 1, Sengör & Yilmaz, 1981; Okay, 1989; Okay et al., 1996). During the Paleozoic and Mesozoic the Strandja Massif and the Istanbul Zone are believed to have been located along the southern margin of Laurasia (Okay et al., 1994), while the paleogeographic affinity of the Sakarya Zone is ambiguous. These zones are separated by the Neo-Tethyan Izmir-Ankara suture from the Anatolide-Taurides, which comprises tectonic zones of Gondwa-

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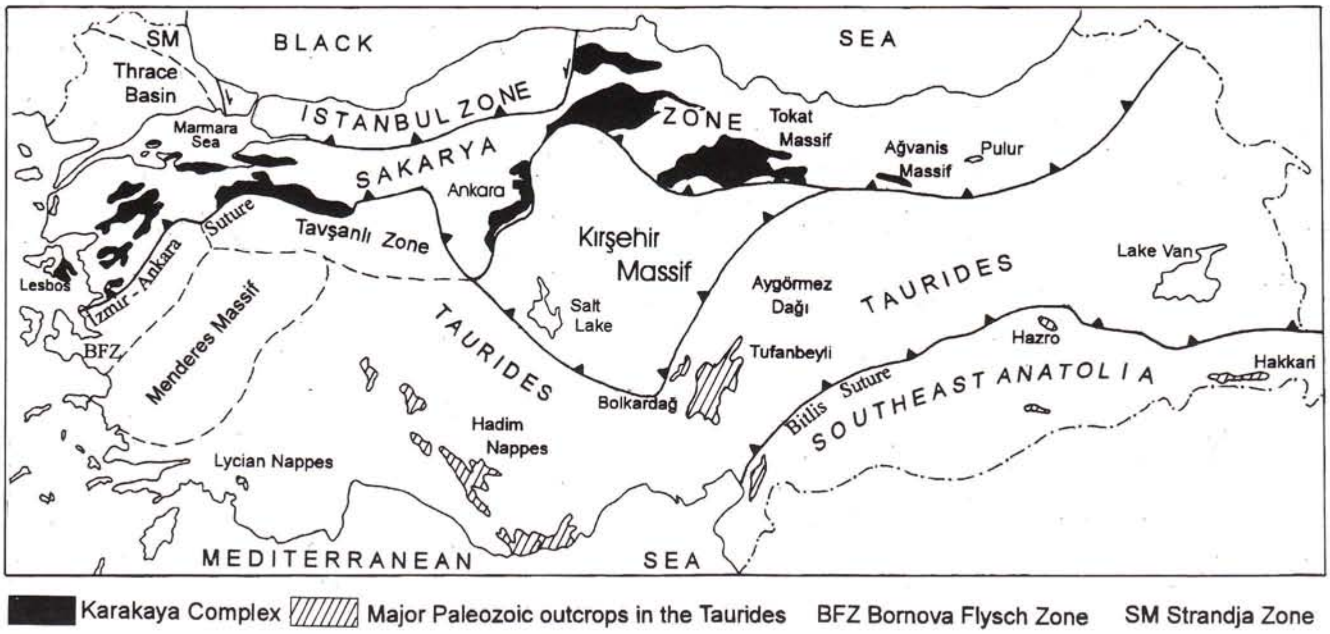


Fig. 1 - Tectonic map of Turkey showing the major tectonic units and outcrops of the Karakaya Complex and important Upper Paleozoic sequences in the Taurides and southeast Anatolia. The heavy barbed black lines show Neo-Tethyan sutures with subduction polarities.

nian paleogeographic affinities. In the west immediately south of the Izmir-Ankara suture is a zone of latest Cretaceous-Paleocene flysch with up to several kilometres large limestone blocks of Triassic to Cretaceous age (Okay & Siyako, 1993). This Bornova Flysch Zone is in tectonic contact in the northeast with a regional blueschist metamorphic belt with mid-Cretaceous metamorphic ages (Tavsanli Zone of Fig. 1) and in the southeast with the Menderes Massif, a metamorphic dome of Paleozoic and Mesozoic sediments with Eocene Barrovian regional metamorphism. The Taurides farther south comprise a generally south-vergent nappe pile of Paleozoic and Mesozoic sediments. They are separated by the Bitlis suture from southeast Anatolia, which constitutes the northern margin of the autochthonous Gondwanian Arabian platform (Fig. 1).

With the exception of the Istanbul Zone, where there is a well developed Ordovician to Carboniferous sedimentary sequence (e.g., Tokay, 1952; Haas, 1968; Ketin, 1983), autochthonous Upper Paleozoic rocks are rare in the Pontides. The Permo-Carboniferous limestones described from various regions in the Sakarya Zone (e.g., Erk, 1942; Erol, 1956; Aygen, 1956; Skinner, 1969; Kahler & Kahler, 1979) are now regarded as exotic blocks in a Permo-Triassic clastic and volcano-clastic complex, called the Karakaya Complex (Sengör et al., 1984; Okay et al., 1991, 1996). Here we describe foraminifera from these exotic Permo-Carboniferous limestone blocks over a region of 25 000 km^2 in northwest Turkey and discuss their origin and significance within the Tethyan realm. Samples from the limestone blocks were collected during a regional mapping programme of northwest Turkey during the years 1985-1990, the main results of which are summarised in Siyako et al. (1989), Okay et al. (1991, 1996) and Okay & Siyako (1993). During the present study 207 fossiliferous samples from over 180 limestone blocks were studied in thin sections. Large number of oriented sections were made from intriguing samples (see Tables 1 and 2), and our main paleontological conclusions are largely based on the study of these oriented thin sections.

Karakaya Complex

Karakaya Complex is a tectonic assemblage of strongly deformed and partly metamorphosed Permo-Triassic clastic and mafic volcanic rocks in the Sakarya Zone of the Pontides. It is unconformably overlain by little deformed Liassic sandstones (e.g., Altiner et al., 1991). The Karakaya Complex is at present regarded as subduction-accretion complexes of the Paleo-Tethys (Tekeli, 1981; Okay et al., 1991, 1996) and forms the basement to the Jurassic-Cretaceous sedimentary sequence of the Sakarya Zone (Fig. 1). In northwest Turkey the Karakaya Complex comprises at least four Permo-Triassic tectonostratigraphic units each with characteristic lithological, stratigraphic and structural features. These are the Nilüfer, Çal and Hodul units and the Orhanlar Greywacke (Fig. 2, Okay et al., 1991, 1996).

Nilüfer Unit.

The basal Karakaya unit, named as the Nilüfer Unit, is an over three kilometres thick coherent sequence of mafic tuffs and lavas with pelagic and hemi-pelagic limestone and shale intercalations (Okay et al., 1991, 1996). In some localities the mafic tuffs pass up to a several hundred metres thick sequence of shale, siltstone and limestone. The Nilüfer Unit is strongly deformed with upright isoclinal folds and internal thrusts, and has undergone a high-pressure greenschist-facies regional metamorphism. It rests tectonically on high-grade gneisses with mid-Carboniferous isotopic ages, as observed in the tectonic windows in the Uludag and Kazdag ranges (Fig. 2 and 3, Okay et al., 1996). The limestones in the Nilüfer Unit are poorly fossiliferous, and only Kaya & Mostler (1992) report Middle Triassic conodonts from limestones interstratified with mafic tuffs in the upper part of the Nilüfer unit in the Kozak range in northwest Turkey (Fig. 3). An intra-oceanic fore-arc to intra-arc depositional setting is favoured for the Nilüfer Unit based on the dominance of mafic tuffs, general absence of intrusive magmatic rocks and the interstratification of limestone and mafic tuffs (Okay, 1984; Okay et al., 1996). Similar volcanoclastic sequences interstratified with carbonates are described from Permian (Houghton & Landis, 1989) and recent (e.g., Hathway, 1994) volcanic arcs. The Nilüfer Unit was probably stratigraphically overlain by the Hodul Unit and Orhanlar Greywacke, however, the present day contacts between these units are almost always tectonic with the exception of that in the Kozak range, where a stratigraphic contact between the Nilüfer and Hodul units is observed (Akyürek & Soysal, 1983; Okay & Siyako, 1993). The Nilüfer Unit shows steeply dipping fault contacts with the Çal Unit.

Çal Unit.

The Çal Unit consists dominantly of mafic volcanic and pyroclastic flows, sheet like debris flow conglomerates, volcanogenic sandstone and shale. Well-bedded calciturbidite, pelagic limestone, radiolarian chert and Middle Triassic shallow water limestone also occur in minor amounts in the Çal Unit (Fig. 2). In the Biga Peninsula the Çal Unit rests with a thrust contact over the Upper Triassic clastic rocks of the Hodul Unit, and in the same region it is unconformably overlain by the undeformed late Liassic basal sandstones with *Bositra* (syn. *Posidonia*) *bronni*.

The debris flow conglomerates of the Çal Unit comprise poorly sorted Upper Permian neritic limestone clasts and blocks in a mafic volcanic or volcanogenic sandstone matrix. The Upper Permian limestones range from a few millimetres to a maximum a few hundred metres in size. The microfauna of the blocks (see below) indicates the presence of Lower Kubergandian, Murgabian-Midian and Midian-Dzhulfian stages (Fig. 4). The thinly to medium bedded calciturbidites consists of transported Permian limestone clasts. The Çal Unit has a highly disrupted internal structure that ranges from broken formation to melange. In many cases it is not clear whether the more component lithologies are exotic blocks or represent an original part of the now disrupted stratigraphic sequence. Such a "block" of red and green radiolarian chert from southeast of Çan (Fig. 3) has yielded an Early Permian (Sakmarian-Yahtashian) radiolarian fauna of *Latentibifistula* cf. *triacanthophora*, *Holdisphaera* sp., *Praedeflandrella* sp. and *Copicyntra* sp. (Okay & Mostler, 1994), providing the first evidence of pelagic Permian facies in Turkey. The neritic Middle Triassic blocks, up to one kilometre large, contain an Anisian foraminiferal [*Glomospira densa* (Pantic), *Glomospirella grandis* (Salaj) and *Meandrospira dinarica* Kochansky-Devidé & Pantic] and conodont assemblage (*Gladigondolella* sp. and *Neospathodus timorensis*) similar to those described by Altiner & Koçyigit (1993) from the Karakaya Complex in the Ankara region.

The close intermixing of mafic volcanic rocks and Upper Permian limestone clasts suggests that the limestone deposition was penecontemporaneous with the mafic volcanism indicating a Late Permian age for part of the sequence. The Lower Permian radiolarian chert may represent the stratigraphic base to this volcanic-dominated Upper Permian sequence, while the Middle Triassic limestones may represent an interval of carbonate deposition following the cessation of the volcanism. Therefore, the age of the Çal Unit probably ranges from Early Permian to at least Middle Triassic (Fig. 2).

The dominance of mafic pyroclastic rocks and debris flow deposits in the Çal Unit suggest deposition on the flanks and aprons of an oceanic seamount or an island arc that was partly capped by Upper Permian limestone. This oceanic seamount was incorporated during the Late Triassic into an accretionary complex, represented by the Çal Unit. Similar volcanic and volcaniclastic sequences associated with debris flow conglomerates with Permian limestone clasts were described from the eastern Klamath terrane in California and are interpreted as being deposited on the flanks of an Early Permian island arc (e.g. Watkins, 1993).

Hodul Unit.

The Hodul Unit consists of several kilometres thick Upper Triassic quartzo-feldspathic sandstones with shale intercalations (Fig. 2). These clastic sequences with highly disrupted internal structures range from proximal to distal turbidites. Along a 20 km wide and 280 km

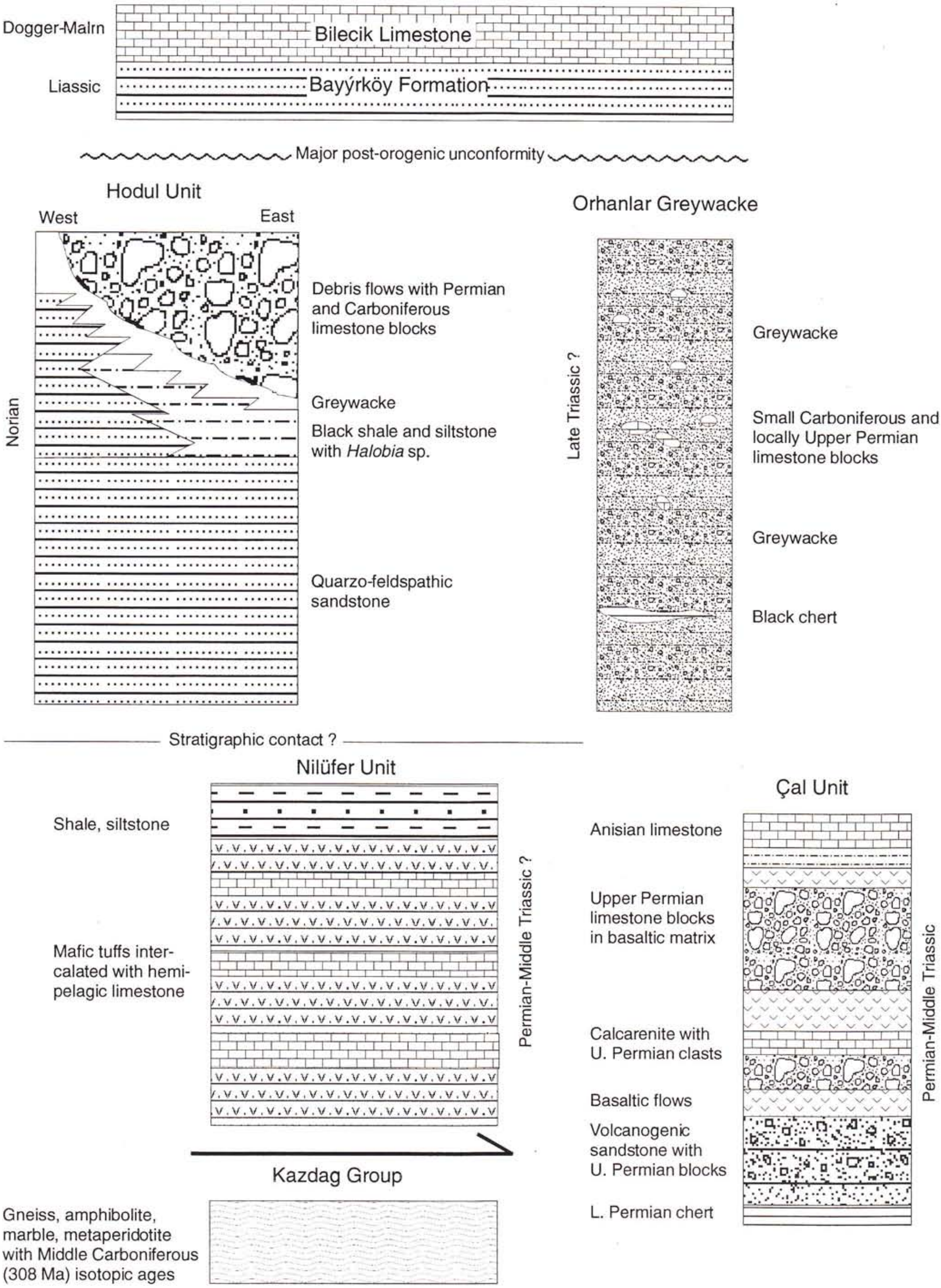


Fig. 2 - Generalised synthetic stratigraphic columns of the Karakaya Complex (The Nilüfer, Hodul and Çal units and the Orhanlar Greywacke) and their tectono-stratigraphic position.

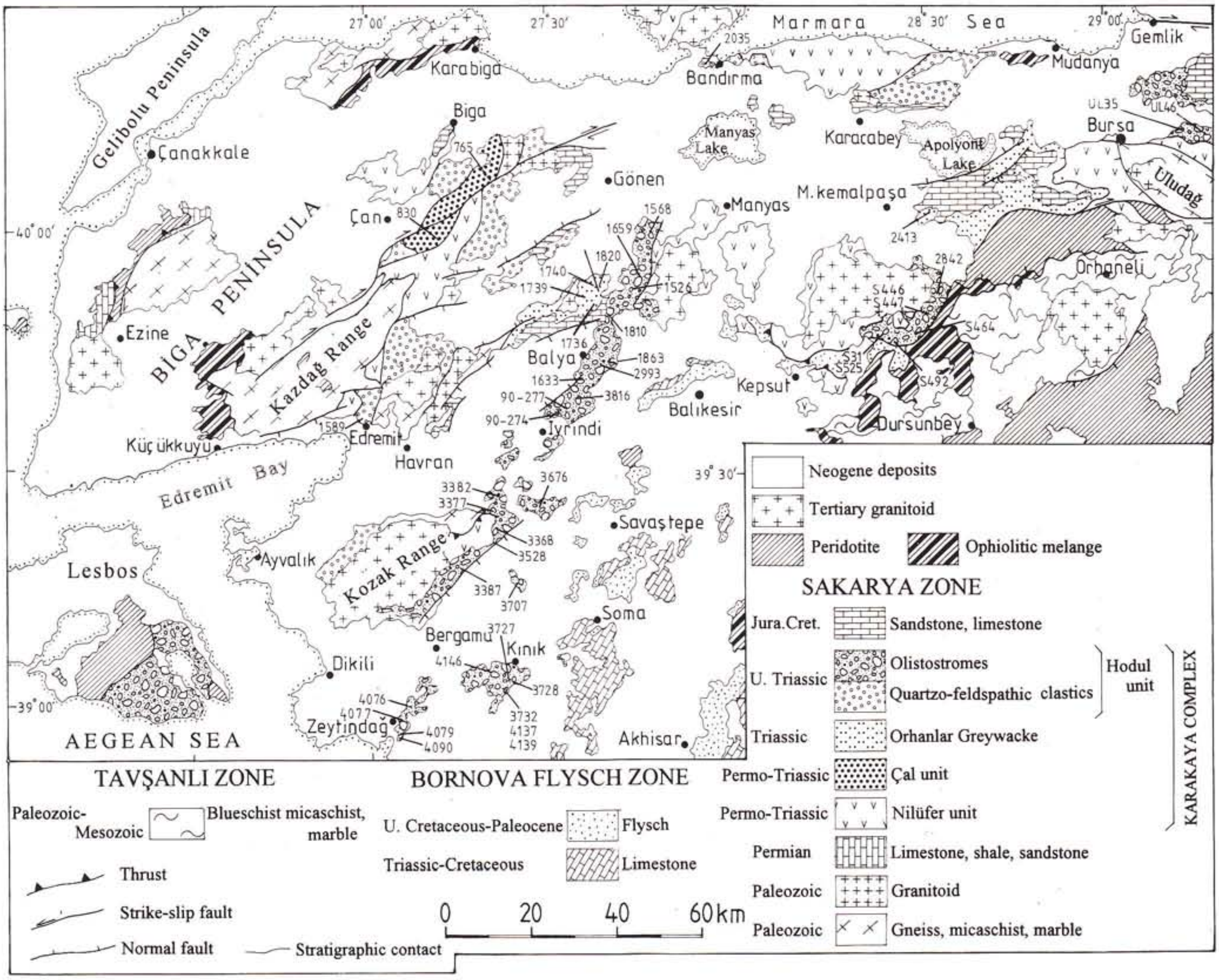


Fig. 3 - Geological map of northwestern Turkey showing the distribution of the Karakaya Complex units and the location of investigated samples (modified from Okay et al., 1996).

long belt immediately northwest of the Izmir-Ankara suture the quartzo-feldspathic clastics pass up to extensive Norian olistostromes with exotic Permo-Carboniferous limestone blocks in a greywacke-type matrix (Fig. 2 and 3, Okay et al., 1991, 1996). The upward coarsening stratigraphic succession from dark shales with *Halobia* sp. to siltstones and sandstones with small Permian limestone pebbles to large Permian blocks can be observed in several localities in northwest Turkey (Okay et al., 1991), and suggests that, unlike the case in the Çal Unit, the blocks were formed in a compressive tectonic regime. The olistostromal belt can be traced from the mainland to the island of Lesbos in the Aegean Sea, where a disrupted greywacke-shale sequence with Lower Carboniferous and Permian limestone blocks was also described (Fig. 3, Hecht, 1972). The clastic matrix to the blocks is dated in three regions through macrofossils. In Balya region the siltstones and shales immediately under the olistostromes comprise a Norian macrofauna with *Halobia suessi* Mojsisovics, *Pinacoceras postparma* (Mojsisovics) and *Pseudocardioceras acutum* (Mojsisovics). A similar macrofauna was also described from the Balya region by Neumayr (1887), Bittner (1892) and Aygen (1956). South of Ivrindi the Upper Permian limestone blocks are associated with dark shales with *Halobia styriaca* (Mojsisovics) and with sandstones containing brachiopod and nautiloid fossils indicative of Middle to Upper Norian: *Zugmayerella* sp., *Anadontophora* cf. *griesbachi* (Bittner), *Amonotis* (?) sp. and *Gonionautilus securis* (Dittmar). Similar dark shales with *Halobia styriaca* (Mojsisovics) underlie the olistostromes in the Igdir region north of Bursa (Erk, 1942).

The neritic, massive to thickly bedded Permo-Carboniferous limestone blocks, that may reach up to several kilometers in size, make up over 95% of the olistoliths. The microfauna in the limestone blocks show the presence of Bashkirian, Moscovian, ?Gzhelian, Asselian-Sakmarian, Yahtashian, Kubergandian, Lower Murga-

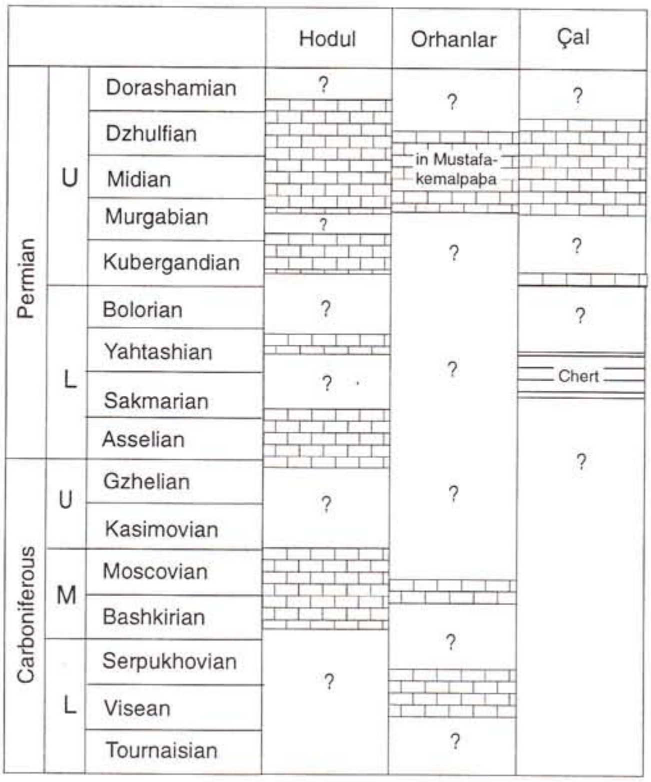


Fig. 4 - Synthetic section showing the age range of the blocks in the Karakaya Complex units.

bian, uppermost Murgabian-Midian, ?Dzhulfian and Dorashamian stages (Fig. 4). Although almost all stages of Middle-Upper Carboniferous and Permian are represented in the limestone blocks, the overwhelming majority of the blocks (>80%) are of Late Permian age (Murgabian to Midian). There are also interesting regional differences. The studied limestone blocks in the Zeytindag and Kinik regions are all of Midian to Dzhulfian age, while the large olistostrome belt from Kozak to Manyas is dominated by Murgabian to Midian limestone blocks (Fig. 3).

Apart from the dominant neritic limestone blocks there are also rare and small blocks of fine-grained aphyric mafic volcanic and pelagic sedimentary rock in the Hodul unit. A two meters large block of intercalated red pelagic limestone and radiolarian chert in the greywackes northeast of Balya has yielded Middle Carboniferous (Bashkirian) conodonts: *Idiognathoides* cf. *optimus*, *Ozarkodina* sp. and *Hindeodus* sp. (Okay & Mostler, 1994).

The Hodul Unit in the Biga Peninsula to the west of the olistostromal facies belt contains only minor debris flows with small and rare Permian limestone fragments. This suggests that the blocks were derived from a thrust slice of Upper Paleozoic limestone, which was approaching from the southeast from the direction of the Anatolide-Tauride platform (Fig. 3). A possible remnant of this major thrust slice occurs northwest of Ezine in the Biga Peninsula (Fig. 3). It is a coherent apprx. 1600 m thick sequence of recrystallised carbonates that have yielded in its upper part Upper Permian fusulinids, *Neoschwagerina* sp. and *Staffella* sp. (Ezine Zone of Okay et al., 1991, 1996). This Permian carbonate sequence is tectonically overlain through a flysch interval by peridotites. Recent isotopic data from the subophiolite metamorphic rocks suggest that the obduction of the peridotites over the Permian carbonates is mid-Cretaceous in age (Okay et al., 1996) rather than Permo-Triassic (Okay et al., 1991).

In the Kozak region the arkosic clastic rocks of the Hodul Unit rest stratigraphically on the mafic volcanoclastic rocks of the Nilüfer Unit, and north of Havran in the Biga Peninsula Norian quartzo-feldspathic rocks and shale, similar to those in the Hodul Unit but without any limestone blocks, rest unconformably over a granite dated as earliest Devonian (Fig. 3, Okay et al., 1991, 1996).

Orhanlar Greywacke.

The Orhanlar Greywacke consists of homogeneous, strongly sheared greywackes, which in its type outcrop locality north of Balya (Fig. 3), contain rare, up to a few meter large, exotic blocks of dark Lower and Middle Carboniferous limestone rich in corals, brachiopods and foraminifera (Okay et al., 1991). The Orhanlar Greywacke is easily distinguished from the clastic rocks of the Hodul Unit through its greywacke type sandstone composition and through the presence of scarce and small dark limestone blocks.

Orhanlar Greywacke outcrops also widely between Bursa and Mustafakemalpasa under the Jurassic sandstones and limestones (Fig. 3). In this region the limestone blocks in the Orhanlar Greywacke are very rare and give a broad Carboniferous-Permian age. South of Mustafakemalpasa the density and size of the blocks increase rapidly, and here the Orhanlar Greywacke is represented by extensive olistostromes similar to those observed in the Hodul Unit. The limestone blocks in this region, up to several-hundred-meters large, are largely of Murgabian-Midian age (Fig. 4).

Southwest of Bursa the Orhanlar Greywacke rests tectonically over the mafic volcanoclastic rocks of the Nilüfer Unit and is unconformably overlain by the Liassic fluviatile to shallow marine sandstones (Fig. 3, Altiner et al., 1991). The age of the Orhanlar Greywacke is not directly known, however, the presence of Upper Permian limestone blocks and the unconformably overlying Liassic sandstones constrain its age as Triassic.

Foraminiferal assemblages from the exotic limestone blocks of the Karakaya Complex

Fusulinids from the region under consideration were reported by Erk (1942) from north of Bursa and by Aygen (1956) from the Balya region. Later, Lys (1971) and Kahler & Kahler (1979) described several genera and species from the Bergama and Balya regions (Fig. 3). Both thought that the fusulinids came from autochthonous limestone sequences, although Kahler & Kahler (1979) pointed out that in some cases fusulinids were found in limestone blocks embedded in the clastic rocks. The fusulinids described in the cited works belong to the Moscovian Stage of the Middle Carboniferous, the Yahtashian or Bolorian Stage of the Lower Permian, the Kubergandian, Murgabian and Midian stages of the Upper Permian.

Our studies indicate that, with the possible exception of a small region in the northwestern part of the Biga Peninsula (Ezine Zone of Okay et al., 1991), all fusulinids in western Anatolia are confined to limestone blocks enclosed in the Permian and Triassic clastic and volcanoclastic units of the Karakaya complex. Microfauna was studied from the Hodul olistostrome unit (117 samples), from the Çal Unit (51 samples) and from the Orhanlar Greywacke (39 samples).

Fusulinids and small foraminifers from our collection indicate the presence of all Carboniferous and Permian stages with the exception of Tournaisian, Kasimovian and Bolorian within the exotic limestone blocks in the Karakaya Complex (Tables 1 and 2, and Plates 1-10).

Lower Carboniferous.

Visean Stage (Plate 1).

Foraminifers of this age were found in samples 1739D, 1740A,1820 and 1826. All come from small (<0.5 m) black limestone clasts in the Orhanlar Greywacke. The assemblage is abundant and comprises the following forms: *Mediocris mediocris* (Vissarionova), *M. brevicula* Ganelina, *Eostaffella proikensis* Rauser, *E. mirifica* Brazhnikova, *Pseudoendothyra simplex* Vdovenko (fusulinids), as well as *Eotuberitina* sp., *Tuberitina* sp., *Diplosphaerina* sp., *Earlandia elegans* (Rauser & Reitlinger), *Ammovertella* sp., *Forschia mikhailovi* Dain, *F. subangulata* (Moeller), *Ammodiscus* sp., *Eolasiodiscus maximus* (Potievskaya), *Howchinia gibba* (Moeller), *Tetrataxis quasiconica* Brazhnikova, *Valvulinella* aff. *pozhiensis* Grozdilova & Lebedeva, *Archaediscus moelleri gigas* Rauser, *A.* ex gr. *krestovnikovi* Rauser, *A. magnus* Schlykova, *Endothyra similis* Rauser & Reitlinger, *E. rotai* Dain, *Globoendothyra* sp., *Bradyina* sp., *Palaeotextularia* sp. (small foraminifers). The assemblage is fairly typical comprising forms of wide geographical distribution.

Serpukhovian Stage (Plate 1).

The foraminiferal assemblage of this age was found in sample 1740B from the Orhanlar Greywacke. In terms of fossil assemblage it differs insignificantly from the Visean limestone blocks but contains some forms like *Eostaffella ikensis* Vissarionova (fusulinids), *Biseriella parva* Tschernyscheva, *Glomospira* sp. (small foraminifers), which allow us to consider it as Serpukhovian. Besides the forms mentioned above, there are also *Eostaffella proikensis* Rauser, *Pseudoendothyra* cf. *propinqua* (Vissarionova), *Eotuberitina* sp., *Earlandia* sp., *Globivalvulina* sp., *Archaediscus* sp., *Endothyra* ex gr. *similis* Rauser & Reitlinger, *Endothyranopsis* sp.

Middle Carboniferous.

Bashkirian Stage.

Bashkirian foraminifers were found in samples 1863A and UL46 from the limestone blocks in the Hodul Unit. Determined among these are: *Mediocris* sp., *Eostaffella* sp., *Pseudostaffella antiqua* (Dutkevich) (fusulinids) and *Eotuberitina* sp., *Diplosphaerina* sp., *Monotaxinoides transitorius* Brazhnikova & Jartzeva, *Palaeonubecularia* cf. *rustica* Reitlinger, *Globivalvulina* sp., *Asteroarchaediscus* sp., *Neoarchaediscus* sp., *Endothyra* sp. (small foraminifers). Though the list of microfauna is not representative, co-occurrence of *P. antiqua*, *Eostaffella* sp. and *Neoarchaediscus* sp. in this assemblage indicates clearly the lower substage of the Bashkirian Stage.

Moscovian Stage (Plate 2).

The Moscovian fusulinids were found only in two samples from the Hodul olistostrome Unit (samples 1568 and UL35C). The first sample comprises *Eostaffella* sp., *Pseudoendothyra* sp., *Verella* sp., *Profusulinella latispiralis* Safonova, *P.* aff. *parva* (Lee & Chen) (fusulinids) and *Eotuberitina* sp., *Tuberitina* sp., *Diplosphaerina* sp., *Globivalvulina* sp., *Monotaxinoides* sp. (small foraminifers). The Moscovian Stage is confirmed by species of the genus *Profusulinella* characteristic of its lower part. *Profusulinella* is found in sections of the East European platform, Tien Shan, South China and Indochina (Lee et al., 1930; Rauser-Chernousova et al., 1951; Igo, 1972; Dzhenchuraeva, 1993). Occurrence of the Lower Moscovian limestones in blocks in the Hodul sequence is in accordance with the data in Kahler & Kahler (1979), who found in their specimen 5147 *Eofusulina* [*Fusulina* cf. *mosquensis* according to Kahler & Kahler (1979)] and *Ozawainella* cf. *vozhgalica* Safonova typical of this age.

Sample UL35C is overfilled with the *Fusulinella* tests, among which are determined *Fusulinella bocki bocki* Moeller, *F. bocki timanica* Rauser, *F.* cf. *curtissima* Bogush, *F. praebocki* Rauser, *F. asiatica* Igo. Such association of *Fusulinella* is characteristic in many sections of the upper part of the Moscovian Stage, including the Moscow syneclise, the stratotypical area of the Moscovian Stage. Besides the mentioned samples, sample 1823 from the Orhanlar Unit seems to belong to the lower part of the Moscovian Stage. From this sample *Eostaffella* sp., *Pseudoendothyra* cf. *pseudosphaeroidea* (Dutkevich), *Schubertella* sp., *Profusulinella* sp. (fusulinids), as well as *Earlandia* sp., *Ammovertella* sp., *Eolasiodiscus* sp., *Globivalvulina* sp., *Glomospira* sp. (small foraminifers) have been determined.

Upper Carboniferous.

Gzhelian ? Stage (Plate 2).

Possible fusulinids of this age were found only in one clast of the Hodul olistostrome Unit (sample 3528), which can be assigned with little confidence to the Upper Carboniferous. These are represented by one specimen *Daixina* (*Ultradaixina*) *postgallowayi* Bensh, as well as *Alpinoschwagerina* ? sp., *Triticites* ? *kozakensis* sp. n., *Pseudofusulina* aff. *hovunensis* Davydov. The first species is characteristic of the uppermost zone of the Gzhelian Stage in the sections of Donbass, South Urals, Darvaz and China (Chen, 1934; Davydov, 1984, 1990; Popov et al., 1985) but was originally described from the Sakmarian of north Fergana (Bensh, 1962). Usually, *hovunensis*-type pseudofusulinas are confined to the same level. The other two species are endemic. Their stratigraphic level is consistent with Late Gzhelian age.

Lower Permian.

Asselian-Sakmarian stages (Plate 3).

One clast from the Hodul Unit (sample 3368D) comprises the following foraminiferal assemblage: *Ozawainella* sp., *Rugosofusulina stabilis* Rauser, *R.* ex gr. *dastarensis* Bensh (fusulinids) and *Eotuberitina* sp., *Tetrataxis* sp., *Climacammina* sp., *Bradyina* sp. (small foraminifers). *Rugosofusulina* from the group *stabilis* are abundant in the Asselian and Sakmarian deposits of the Urals, East-European platform and Tethys (Tchuvashev et al., 1986), which allows us to attribute to this sample the same age. *R. dastarensis* was described by Bensh (1972) from the Upper Carboniferous of Fergana. This

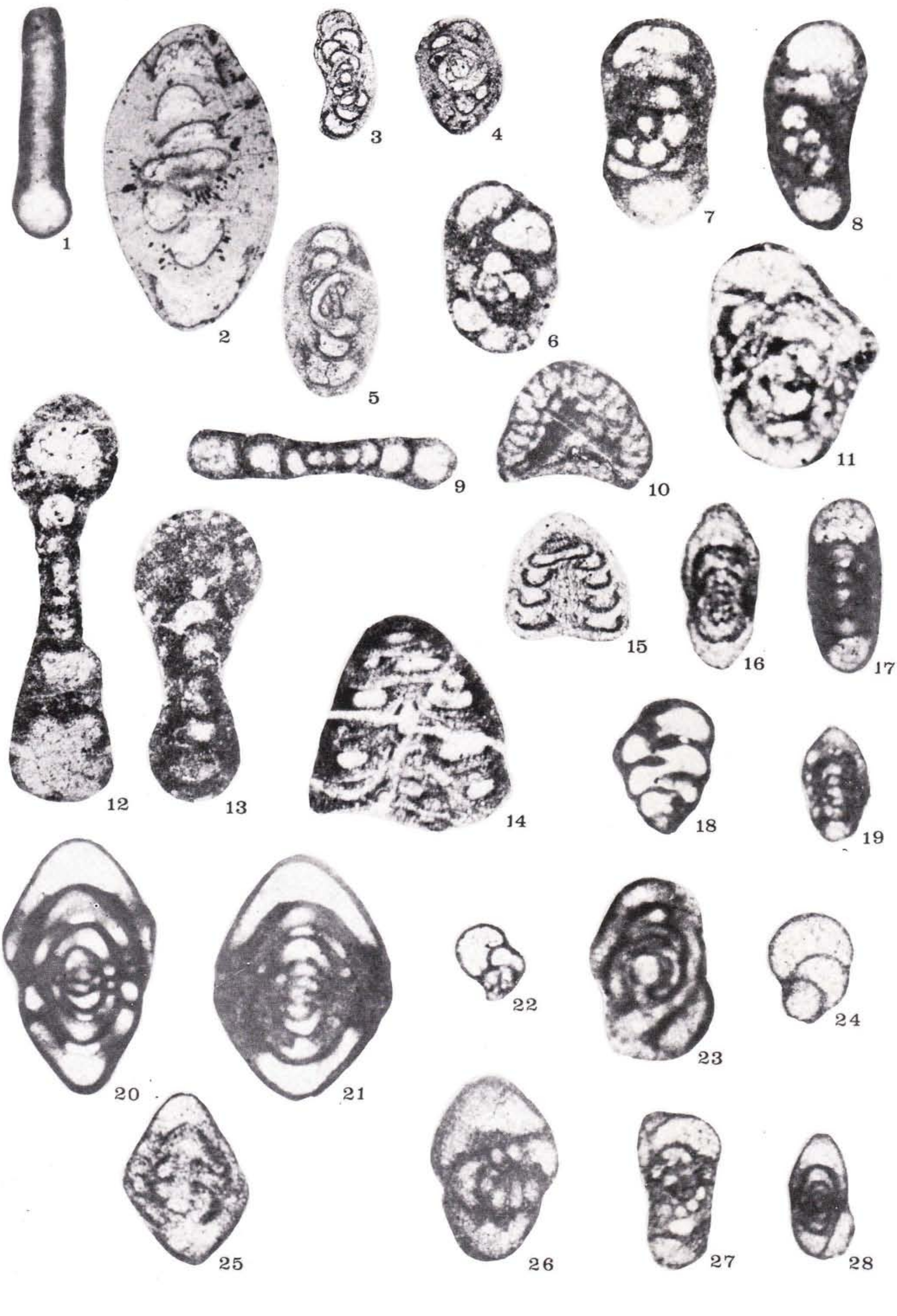
PLATE 1

Lower Carboniferous, Visean.

Fig. 1 - *Earlandia elegans* (Rauser & Reitlinger). Balya, Orhanlar Greywacke, sample 1820B; x 100.
Fig. 2 - *Archaediscus moelleri gigas* Rauser. The same locality, sample 1820B; x 50.
Fig. 3 - *Archaediscus magnus* Schlykova. The same locality, sample 1740A; x 100.
Fig. 4 - *Archaediscus* ex gr. *moelleri* Rauser. The same locality, sample 1739D; x 100.
Fig. 5 - *Archaediscus* ex gr. *krestovnikovi* Rauser. The same.
Fig. 6 - *Endothyra* sp. The same locality, sample 1826A; x 80.
Fig. 7 - *Endothyra similis* Rauser & Reitlinger. The same locality, sample 1740A; x 80.
Fig. 8 - *Endothyra rotai* Dain. The same locality, sample 1826A; x 80.
Fig. 9 - *Eolasiodiscus maximus* (Potievskaya). The same locality, sample 1739D; x 100.
Fig. 10 - *Valvulinella* aff. *pozhiensis* Grozdilova & Lebedeva. The same.
Fig. 11 - *Globoendothyra* sp. The same.
Fig 12 - *Forschia mikhailovi* Dain. The same locality, sample 1740A; x 80.
Fig. 13 - *Forschia subangulata* (Moeller). The same.
Fig. 14 - *Tetrataxis quasiconica* Brazhnikova. The same locality, sample 1820B; x 40.
Fig. 15 - *Howchinia gibba* (Moeller). The same locality, sample 1739D; x 80.
Fig. 16 - *Pseudoendothyra simplex* Vdovenko. The same locality, sample 1826A; x 80.
Fig. 17 - *Mediocris mediocris* (Vissarionova). The same; x 100.
Fig. 18 - *Palaeotextularia* sp. The same; x 50.
Fig. 19 - *Eostaffella* cf. *proikensis* Rauser. The same; x 80.

Lower Carboniferous, Serpukhovian.

Fig. 20 - *Eostaffella* ex gr. *ikensis* Vissarionova. Balya, Orhanlar Greywacke, sample 1740B; x 80.
Fig. 21 - *Eostaffella ikensis* Vissarionova. The same.
Fig. 22 - *Globivalvulina* sp. The same.
Fig. 23 - *Glomospira* sp. The same; x 200.
Fig. 24 - *Biseriella parva* Tschernyscheva. The same.
Fig. 25 - *Pseudoendothyra* cf. *propinqua* (Vissarionova). The same; x 80.
Fig. 26 - *Endothyranopsis* sp. The same; x 100.
Fig. 27 - *Endothyra* ex gr. *similis* Rauser & Reitlinger. The same; x 80.
Fig. 28 - *Eostaffella proikensis* Rauser. The same.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is not contrary to the presence of *Ozawainella* sp. in the same sample which although characteristic for the Middle Carboniferous, occurs in the Asselian and rarely in the Sakmarian stages. Small foraminifers in this sample are of wide stratigraphic range.

Yahtashian Stage (Plate 3).

Fusulinids of definite Yahtashian age were found in one sample (3732) from the Hodul Unit from the Kinik region, while probable Yahtashian (early Yahtashian) fusulinids occur in two samples from the same unit (1736, 90-277). The sample 3732 comprises a typical Yahtashian fusulinid assemblage including *Chalaroschwagerina globosaeformis* (Leven), *Pseudofusulina* ex gr. *nelsoni* (Thompson) and *Darvasites* cf. *contractus* (Schellwien). In sample 1736 were determined *Schubertella simplex* Lange, *Darvasites* sp., *D. pseudosimplex* (Chen), *D. eocontractus* Leven & Scherbovich, *Pseudofusulinoides instabilis* Bensh, *Pseudofusulina incomparabilis* Leven (fusulinids). The last among the listed species was described from the lower part of the Yahtashian Stage in Darvaz (Leven et al., 1992). *Darvasites* similar to those mentioned above, are found in the Sakmarian and Yahtashian stages in many Tethyan sections. As to *Pseudofusulinoides instabilis*, this species was first described by Bensh (1972) from Carboniferous-Permian boundary layers of the South Fergana section. Nevertheless, Zhao et al. (1984) showed in western Kunlun the presence of this species along with lower Artinskian conodonts *Sweetognathus whitei* (Rhodes) and *Neostreptognathodus pequopensis* Behnken. As far as the Yahtashian Stage is assumed to be correlative with the Artinskian, the considered fusulinid assemblage may be attributed to the Lower Yahtashian. However, it should be noted that isochronism of lower boundaries of the Artinskian and Yahtashian stages have not yet been proved. Moreover, the listed conodont species are encountered in the Longyin Formation of South China along with fusulinids usually considered as Sakmarian (Zhang et al., 1988; Zhou, 1988).

Sample 90-277 comprises fusulinids as follows: *Darvasites eocontractus* Leven & Scherbovich, *Pseudofusulina* cf. *kraffti* (Schellwien), *Praeskinnerella fragilis* Leven. The cited forms, although characteristic of the Yahtashian Stage, have a wider range that makes dating of the host rock uncertain.

Upper Permian.

Kubergandian Stage (Plates 3 and 4).

The Kubergandian foraminifers were found in three samples. The first (765) sample was taken from limestone clasts enclosed into the Çal Unit. The second sample (3387A) comes from the Hodul olistostrome Unit. The third sample (OK-1) was apparently taken from the same unit, its label with the number was lost during section preparation. Fusulinids are different in every specimen, which may be related to their different position within the Kubergandian Stage and to the different facies characteristics of the enclosing limestones. The first sample is the oldest. It comprises *Dutkevitchia jipuensis* (Nie & Song), *Parafusulina yunnanica* Sheng, *Robustoschwagerina* ? sp. The second species is widely developed in the Kubergandian (mainly lower Kubergandian) deposits of South China, Pamirs, Afghanistan and indicates a more precise Kubergandian age. Similar *Parafusulina* sp. are known from coeval deposits of many regions in the Tethys. *Dutkevitchia jipuensis* was described from the Tunlonggongba Formation in the southwestern Tibet where it is associated with typical Kubergandian *Parafusulina* sp. (Nie & Song, 1983). This species was recorded in the same association in Central Afghanistan (Leven, in press "a"). Forms very similar to *Dutkevitchia* sp., but assigned by Xia (1982) and Xiao et al. (1986) to the new genus *Laxifusulina*, are known in Inner Mongolia and in the Guizhou province of China along with the Upper Bolorian and Lower Kubergandian *Misellina* sp. and *Armenina* sp.

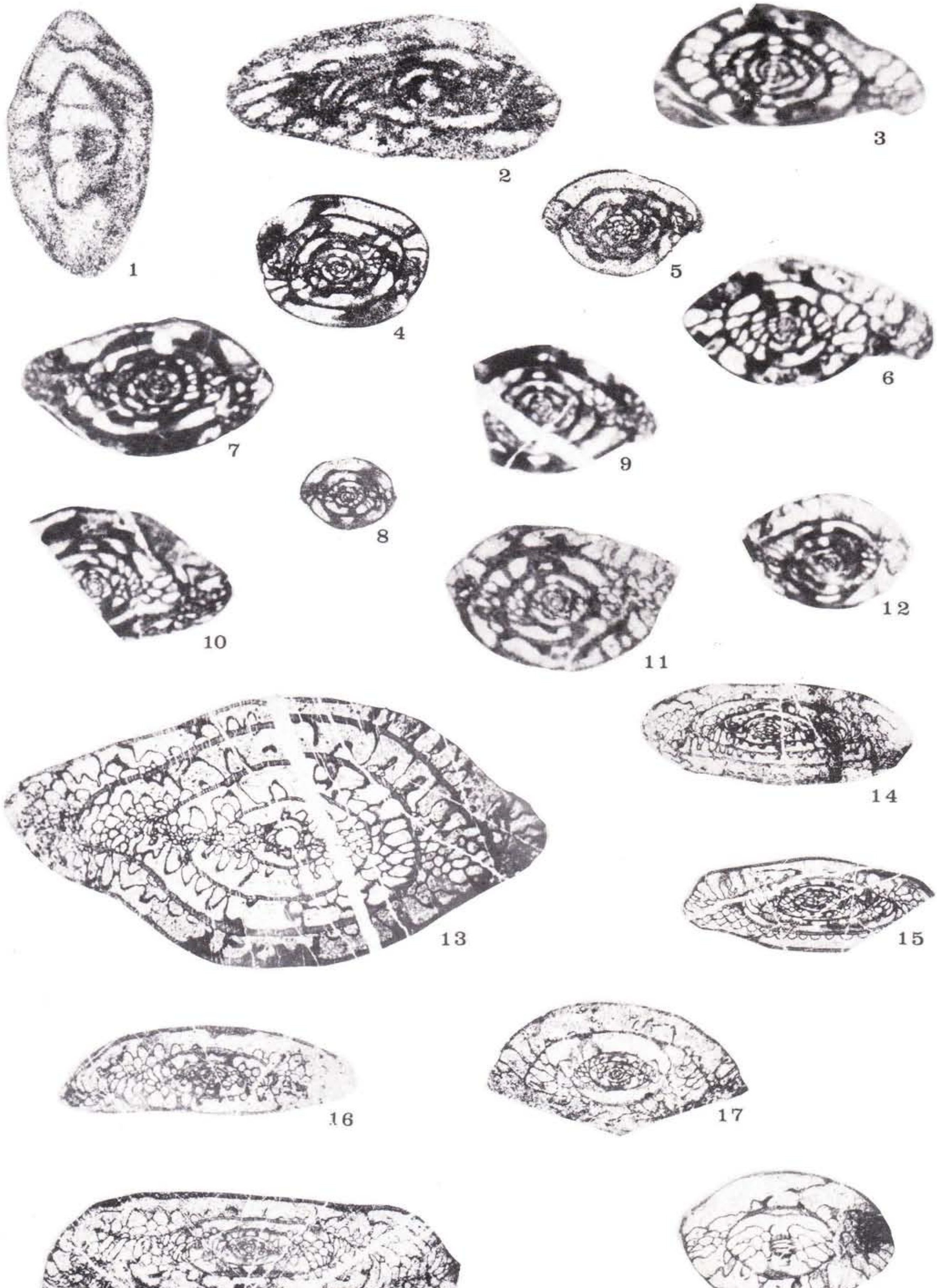
PLATE 2

Middle Carboniferous, Moscovian.

Fig. 1 - *Pseudoendothyra* sp. Balya, Hodul Unit, sample 1568; x 50.
Fig. 2 - *Verella* sp. The same.
Fig. 3, 6, 7, 9-11 -*Fusulinella bocki* Moeller. Bursa, Hodul Unit, sample UL35C; x 20.
Fig. 4, 8 - *Profusulinella latispiralis* Safonova. Balya, Hodul Unit, sample 1568; x 20.
Fig. 5 - *Profusulinella* aff. *parva* (Lee & Chen). The same.
Fig. 12 - *Fusulinella* sp. Bursa, Hodul Unit, sample UL35C; x 20.

Upper Carboniferous, Gzhelian ?

Fig. 13 - *Daixina (Ultradaixina) postgallowayi* Bensh. Kozak, Hodul Unit, sample 3528; x 10.
Fig. 14, 15- *Pseudofusulina* aff. *hovunensis* Davydov. The same.
Fig. 16, 18 - *Triticites* ? *kozakensis* sp. n. The same; x 15. Fig. 16 - axial section, GGM VI-231/1; Fig. 18 - axial section of the holotype, GGM VI-231/2.
Fig. 17, 19 - *Alpinoschwagerina* ? sp. The same; x 15.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Sample 3387A comprises the following foraminifers: *Neofusulinella* sp., *Pseudofusulina dzamantalensis* (Leven), *Parafusulina* aff. *shaksgamensis* Reichel, *Eopolydiexodina* sp., *Armenina* sp., *Cancellina* (*Shengella*) *elliptica* Yang, *C.* (*Cancellina*) *dutkevitchi* Leven (fusulinids); *Globivalvulina* sp., *Pachyphloia* sp., *Climacammina* sp. (small foraminifers). This assemblage is typical of the upper zone of the Kubergandian Stage and is encountered in many sections of the Upper Permian in the Tethys. Forms described by Kahler & Kahler (1979) as *Cancellina cutalensis* Leven, *Misellina ovalis* Deprat and *M. confragaspira* Leven and others from the Bergama region also belong to this assemblage. This assemblage probably includes fusulinids described by Lys (1971), which he dated as lowermost Murgabian.

The age of the third specimen is determined with less assurance. The specimen comprises *Schubertella* sp., *Neofusulinella* sp., *Staffella* sp., *Eopolydiexodina darvasica sogdiana* A. Miklukho-Maclay, *Cancellina* (*Cancellina*) sp. (fusulinids), as well as *Eotuberitina* sp., *Brunsia* sp., *Pseudovidalina* cf. *involuta* Zaninetti, Altiner & Çatal, *Glomospira* sp., *Nodosaria* sp., *Geinitzina* sp. (small foraminifers). All the genera listed above except for *Pseudovidalina* are characteristic of the upper part of the Kubergandian Stage but can also occur at the base of the Murgabian Stage. The Murgabian appearance of the assemblage is imparted by *Eopolydiexodina* which are mainly found in deposits of this age. However, primitive representatives of this genus, such as *E. darvasica*, are known from the Kubergandian deposits of northern Pamir and northern Afghanistan (Leven, 1965, 1967, in press "a").

Murgabian Stage (Plate 4).

It is well known that almost all fusulinid genera from the Murgabian Stage extend into the Midian Stage, which makes the separation of these two stages difficult especially if the fusulinid assemblages are not adequately represented or if determinations have been made at the genus level. Besides, no clear-cut criteria for subdivision of these stages have as yet been elaborated. About 40 samples comprised fusulinids which were dated to the Murgabian-Midian. The samples came from all the three studied units (Hodul, Orhanlar and Çal). The age determinations were precise only for the samples from which additional oriented thin sections were prepared (Table 1). Only one sample (3816) from the Hodul olistostrome Unit was precisely dated as Murgabian. It comprises a typical Lower Murgabian fusulinid assemblage, namely *Rauserella* sp., *Staffella* sp., *Schubertella* sp., *Neofusulinella*

PLATE 3

Lower Permian, Asselian or Sakmarian.

Fig. 1 - *Rugosofusulina* ex gr. *dastarensis* Bensh. Kozak, Hodul Unit, sample 3368D; x 10.
Fig. 2-4 - *Rugosofusulina stabilis* Rauser. The same.

Lower Permian, Yahtashian.

Fig. 5, 6 - *Pseudofusulina incomparabilis* Leven. Balya, Hodul Unit, sample 1736; x 10.
Fig. 7 - *Praeskinnerella fragilis* Leven. The same locality, sample 90-277; x 10.
Fig. 8-10 - *Darvasites eocontractus* Leven & Scherbovich. The same locality; x 10. Fig. 8 and 10 - sample 1736; Fig. 9 - sample 90-277.
Fig. 11 - *Pseudofusulina instabilis* Bensh. The same locality, sample 173; x 10.
Fig. 12, 13 - *Schubertella simplex* Lange. The same; x 50.
Fig. 14 - *Darvasites* aff. *pseudosimplex* (Chen). The same; x 10.

Upper Permian, Kubergandian.

Fig. 15,16 - *Parafusulina yunnanica* Sheng. Biga, Çal Unit, sample 765; x 10.
Fig. 17-19 - *Cancellina* (*Shengella*) *elliptica* Yang. Kozak, Hodul Unit, sample 3387A; x 15.
Fig. 20 - *Cancellina* (*Cancellina*) *dutkevitchi* Leven. The same.
Fig. 21 - *Cancellina* (*Cancellina*) sp. Biga Peninsula, Hodul unit, sample OK-1; x 15.

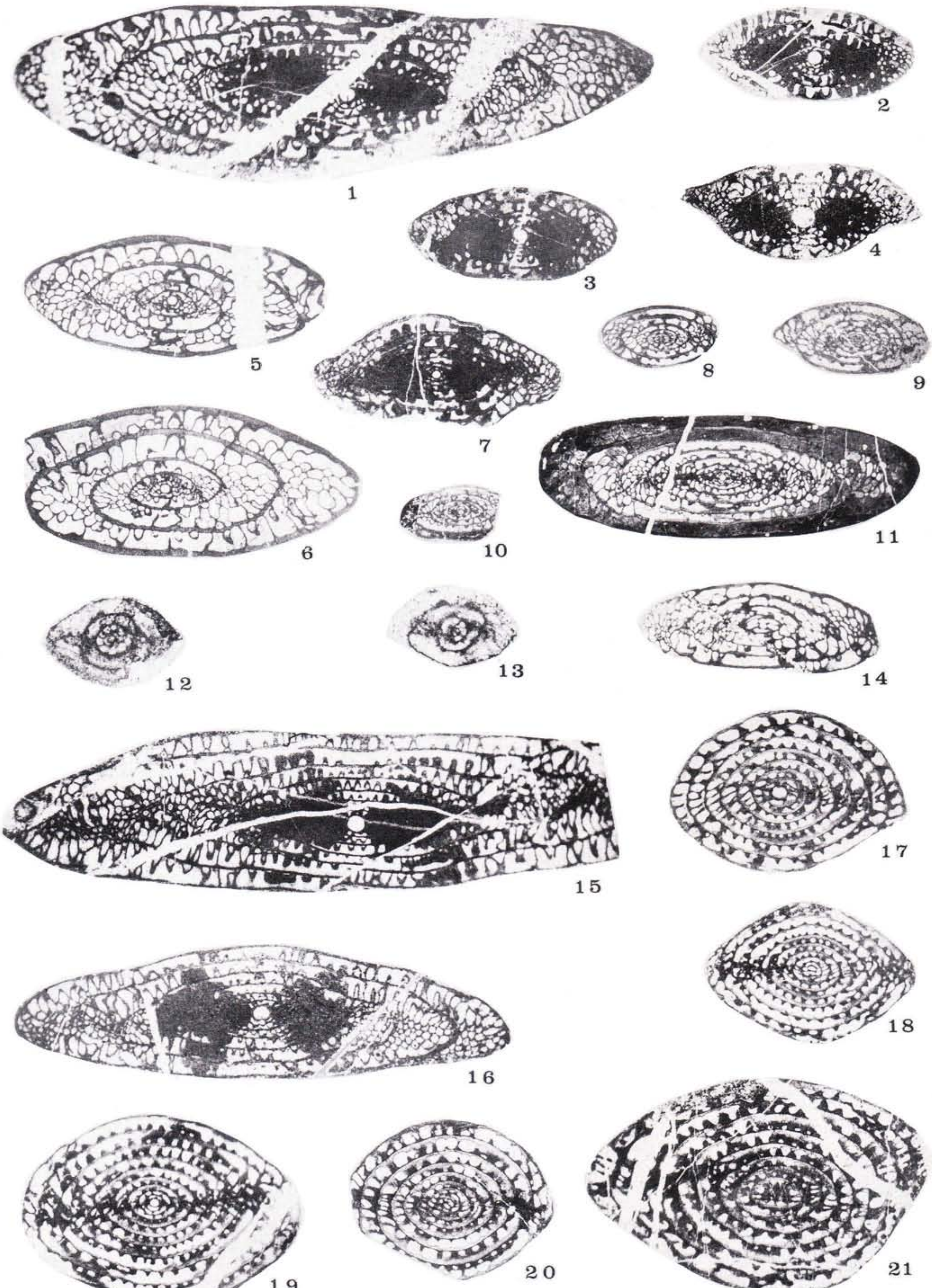
PLATE 4

Upper Permian, Kubergandian.

Fig. 1, 2 - *Eopolydiexodina darvasica sogdiana* A. Miklukho-Maclay. Biga Peninsula, sample OK-1; x 10.
Fig. 3 - *Dutkevitchia jipuensis* (Nie & Song). Biga, Çal Unit, sample 765A; x 10.
Fig. 6 - *Pseudofusulina dzamantalensis* (Leven). Kozak, Hodul Unit, sample 3387A; x 10.
Fig. 7 - *Parafusulina* aff. *shaksgamensis* Reichel. The same.

Upper Permian, Lower Murgabian.

Fig. 4 - *Cancellina* (*Cancellina*) aff. *primigena* Hayden. Balya, Hodul Unit, sample 3816; x 15.
Fig. 5 - *Neofusulinella tumida* Leven. The same; x 20.
Fig. 8 - *Neoschwagerina simplex* Ozawa. The same; x 15.
Fig. 9 - *Parafusulina edoensis* (Ozawa). The same; x 10.
Fig. 10 - *Armenina asiatica* Leven. The same; x 15.
Fig. 11 - *Pseudofusulina aghilensis* (Reichel). The same; x 10.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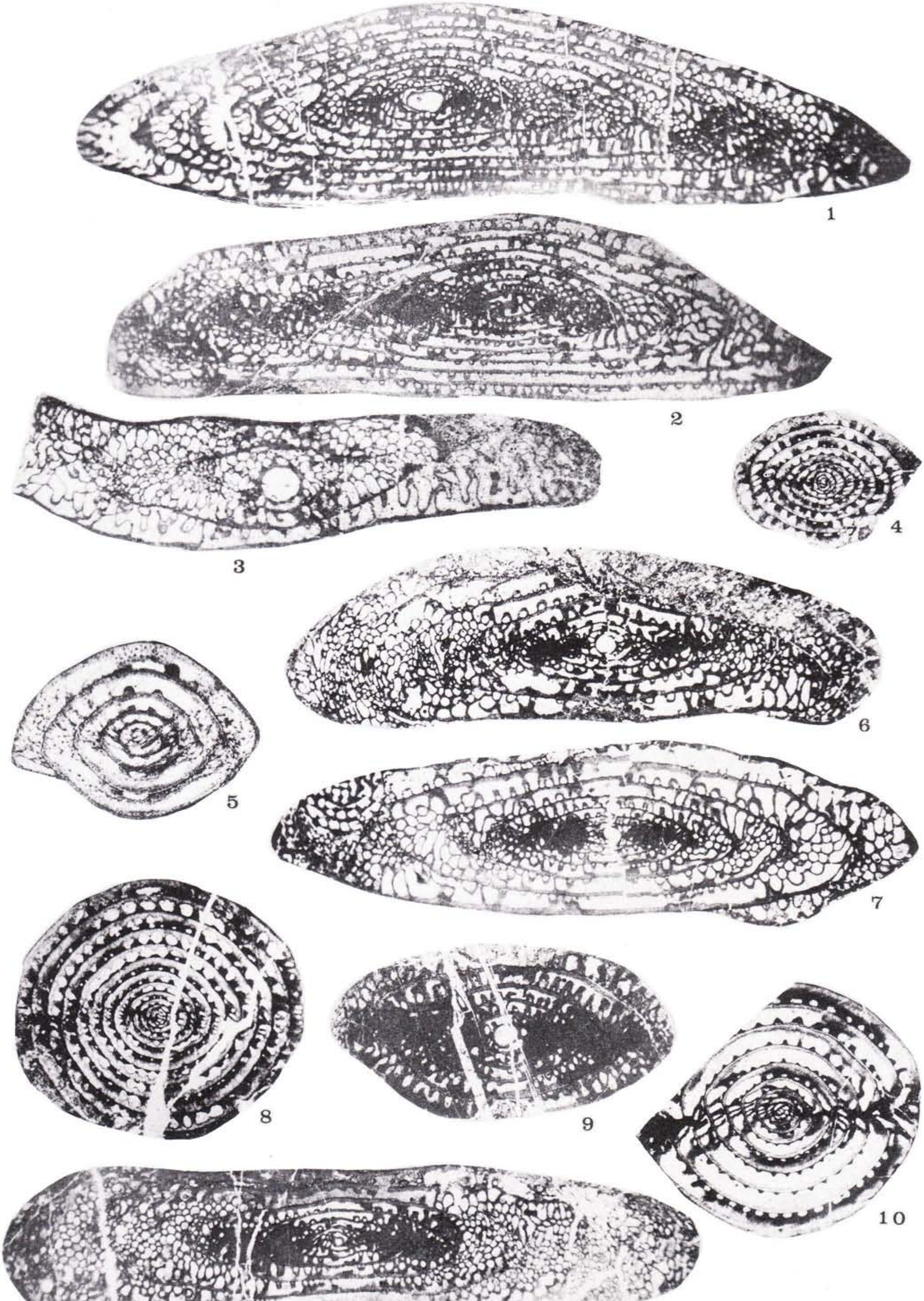


tumida Leven, *N. lantenoisi* Deprat, *Pseudofusulina aghilensis* (Reichel), *Parafusulina edoensis* (Ozawa), *Eopolydiexodina* sp., *Armenina asiatica* Leven, *Cancellina* (*Cancellina*) aff. *primigena* Hayden, *Neoschwagerina simplex* Ozawa. The last species is the index for the lower zone of the Murgabian Stage. Besides fusulinids, the following small foraminifers were encountered in the sample: *Glomospira* sp., *Globivalvulina* sp., *Deckerella* sp., *Climacammina* sp., *Tetrataxis* sp. The whole fusulinid assemblage (without *Eopolydiexodina*) is widely distributed in Eastern Tethys. With *Eopolydiexodina* it is recorded in sections of northern Pamir (Leven, 1967) and northern Afghanistan (Leven, 1982). Fusulinids of this age have been recently found in the Abadeh section in central Iran (D. Baghbani, pers. comm.). It is also known from the Permian limestone clasts in the Triassic-Jurassic flysch series of the Crimea (Miklukho-Maclay, 1957).

Midian Stage (Plates 5, 6, 7 and 8).

The Midian limestone clasts and blocks dominate in the three studied units. Three groups can be distinguished among them. The first group comprises fusulinids and small foraminifers dated as Midian with confidence. There is little confidence for the second group as the fusulinid assemblage has a transitional Murgabian-Midian age, and the Midian age was determined conditionally. The third group incorporates samples which contain no fusulinids and which were dated by small foraminifers to the Midian-Dzhulfian.

Samples 1526, 2993, 3377, 4079, 4090, 4102 and 90-274 belong to the first group. These are from the Hodul Unit and contain rich assemblages of both fusulinids and small foraminifers. Samples 90-306, 90-309, 3300 and 3382 from the Hodul Unit, 1104 from the Çal Unit, as well as S-447-1 and S-472 from the Orhanlar Unit whose Midian ages were determined by small foraminifers only, can be assigned to the same group. The fusulinid assemblage from the cited samples comprises genera and species as follows: *Pseudoendothyra* sp., *Staffella* sp., *Nankinella* sp., *Sphaerulina* sp., *Reichelina* sp., *Rauserella* sp., *Sichotenella* aff. *ussurica* Sosnina, *Kahlerina* cf. *globiformis* Sosnina, *K. pachytheca* Kochansky-Devidé & Ramovš, *Pseudokahlerina discoidalis* Sosnina, *Boultonia* sp., *Dunbarula* cf. *nana* Kochansky-Devidé & Ramovš, *D.* aff. *kitakamiensis* Choi, *Yangchienia thompsoni* Skinner & Wilde, *Pseudofusulina kueichihensis* (Chen), *P.* aff. *rhombiformis* Leven, *Chusenella* aff. *tieni* Chen, *Ch.* cf. *sinensis* Sheng, *Neoschwagerina* ex gr. *haydeni* Dutkevich & Khabakov, *N. ventricosa* Skinner, *Yabeina* ? sp., *Afghanella robbinsae* Skinner & Wilde, *Sumatrina annae annae* Volz, *S. annae brevis* Leven, *S.* cf. *longissima* Deprat, *S.* cf. *fusiformis* Sheng, *Verbeekina furnishi* Skinner & Wilde, *V. verbeeki* (Geinitz), *Pseudodoliolina ozawai* Yabe & Hanzawa.

Small foraminifers are represented by *Eotuberitina* sp., *Tuberitina* sp., *Rectostipulina quadrata* Jenny-Deshusses, *Spiroplectammina* sp., *Agathammina* sp., *Glomospira* sp., *Hemigordius* sp., *Hemigordius reicheli* Lys, *Hemigordiopsis renzi* Reichel, *Baisalina pulchra* Reitlinger, *Kamurana* ? sp., *Globivalvulina graeca* Reichel, *Pachyphloia çukurköyi* Civrieux & Dessauvagie, *P.* cf. *schwageri* Civrieux & Dessauvagie, *Geinitzina* cf. *postcarbonica* Spandel, *Langella* sp., *Nodosaria dzhulfensis* Reitlinger, *Deckerella* sp., *Climacammina* sp., *Cribrogenerina* sp., *Dagmarita chanakchensis* Reitlinger, *Tetrataxis* sp., *Abadehella coniformis* Okimura & Ishii, *Endoteba controversa* Vachard & Razgallah, *Bradyina* ? sp., *Endothyra* sp., *Neoendothyra reicheli* Reitlinger.

The Midian Stage is regarded to correspond to the genozone *Yabeina-Lepidolina*. Representatives of these genera are practically absent in the fusulinid assemblage with the exception of a small fragment of a test assigned provisionally to the genus *Yabeina*. However, the presence of such genera as *Reichelina*, *Sichotenella*, *Kahlerina*, *Pseudokahlerina* allows us to consider the age of the assemblage as Midian. This is confirmed by the high evolutionary level of species belonging to genera *Neoschwagerina*, *Afghanella* and *Sumatrina*. Most of these are found along with *Yabeina* and *Lepidolina* in different regions of Tethys. This is also true for such species as *Neoschwagerina ventricosa*, *N. haydeni*, *Sumatrina annae*, *S. longissima* (Skinner, 1969; Dutkevich & Khabakov, 1934; Ozawa, 1970).

The small foraminifer assemblage is also pronounced. Along with the forms, which extend down to the Murgabian Stage, it comprises genera and species which are not known in the deposits older than the Midian. Among these are genera *Rectostipulina*, *Hemigordiopsis*, *Kamurana*, *Baisalina*, *Dagmarita*, *Abadehella*. In combination with fusulinids, this assemblage indicates unambiguously the Midian Stage.

The foraminiferal assemblage from the second group of samples differs from that mentioned above in the presence of *Eopolydiexodina* and in the diminishing role of small foraminifers. Sample 1633E (the Hodul Unit), from which many oriented thin sections were prepared, contains a representative assemblage (Tables 1 and 2). Forms of this assemblage were also found in samples 2842, 3482H, 3676B, 3707C, 4060, 4046A, 90-280, S534-3, S446-1, which come from the Hodul and Orhanlar units. Fusulinids in these specimens are represented by *Rauserella* sp., *Staffella* sp., *Nankinella* sp., *Schubertella* sp., *Dunbarula* sp., *Yangchienia* sp., *Kahlerina* sp., *Pseudofusulina ciryi* Skinner, *P.* aff. *pingdingensis* (Sheng), *Chusenella* cf. *rabatei* Skinner & Wilde, *Parafusulina gi-*

gantea (Deprat), *P. parva* (Pitakpaivan), *Eopolydiexodina megasphaerica* (Leven), *E.* cf. *afghanensis* (Thompson), *Neoschwagerina haydeni* Dutkevich & Khabakov, *Afghanella sumatrinaeformis* (Gübler), *A. pulchella* Zhang & Dong, *A. tumida* Skinner & Wilde, *Sumatrina* cf. *annae* Volz, *Pseudodoliolina* sp., *Armenina* aff. *karinae* A. Miklukho-Maclay, *Verbeekina verbeeki* (Geinitz). Small foraminifers are represented by *Eotuberitina* sp., *Diplosphaerina* sp., *Lasiodiscus* sp., *Glomospira* sp., *Hemigordius* aff. *permicus* Grozdilova, *H. zaninettiae* Altiner, *Baisalina* sp., *Langella perforata langei* Civrieux & Dessauvagie, *Pachyphloia* sp., *Palaeotextularia* sp., *Deckerella* sp., *Climacammina* sp., *Cribrogenerina* sp., *Nodosaria dzhulfensis* Reitlinger, *Tetrataxis* cf. *conica* Ehrenberg.

The foraminifer assemblage cited above is more archaic compared to that from the first group of specimens. Although this provides reason to assume a Murgabian age for the assemblage, a Midian age seems to be preferable for the following reasons. This assemblage is similar to that from the Permian "E" layers in northern Afghanistan (Bamian and Bulola), where one can observe a combination of highly-developed *Eopolydiexodina, Neoschwagerina, Afghanella, Sumatrina* and typically Midian *Reichelina, Codonofusiella, Kahlerina* as well as characteristic small foraminifers *Abadehella, Hemigordius reicheli* Lys, *Hemigordiopsis renzi* Reichel (Lys & Lapparent, 1971; Leven, 1982; Leven in press "a"). A similar fusulinid assemblage has been recently described in Kunlun, where *Eopolydiexodina, Afghanella, Neoschwagerina* accompany the Midian *Lantschichites* (Sun, 1993). Layers with analogous combination of fusulinids are usually assigned to the *Neoschwagerina margaritae* Zone of the Murgabian Stage, but affiliation of this zone to the Murgabian Stage is doubted. The authors prefer to consider it Midian (Leven, 1993), which is substantiated in a separate paper (Leven, in press "b").

Although the differences in the foraminiferal assemblages from the first and second groups of specimens seem considerable, these are rather in facies rather than in age. Indeed, all the specimens of the first group are represented by biomicrites and biosparites, whereas in the second group the rock is a sandy limestone with slightly rounded quartz grains.

As stated above, the foraminiferal assemblage from the third group of samples (2230, 2938C, 90-270, 90-282 and others) is of Midian-Dzhulfian age. Fusulinids in it are represented by rare *Pseudoendothyra* sp., *Reichelina* sp., *Boultonia* sp., *Dunbarula* sp. The small foraminifer assemblage is more diverse and includes *Pseudovidalina involuta* Zaninetti, Altiner & Çatal, *Nodosaria sagitta* K. Miklukho-Maclay, *Pseudolangella fragilis* Civrieux & Dessauvagie, *Langella* cf. *ocarina* Civrieux & Dessauvagie, *Pachyphloia iranica* Bozorgnia, *Frondina* sp., *Glomospira* sp., *Hemigordius* aff. *zaninettiae* Altiner, *Multidiscus* sp., *Dagmarita chanakchensis* Reitlinger, *Paraglobivalvulina* ? sp.

It is readily seen that for the most part the given genera and species of the small foraminifers are encountered with the Midian fusulinids listed earlier. At the same time, many of them pass into the Dzhulfian and even Dorashamian stages (Kotlyar et al., 1983; Zhao et al., 1981). It makes the age determination possible only within the Midian-Dzhulfian, especially if we take into consideration that criteria for a clear separation of the Midian and Dzhulfian stages by foraminifers have not as yet been elaborated.

Dzhulfian ? Stage (Plates 9 and 10).

Foraminifers of presumably Dzhulfian age were found in samples 3727, 3728, 4076, 4077, 4137, 4146, 1810A from the Hodul olistostrome Unit and in sample 1589E from the Çal Unit. The complete list includes *Reichelina changhsingensis* Sheng & Chang, *R. cribroseptata* Erk, *R.* aff. *media* K. Miklukho-Maclay, *Schubertella pseudogiraudi* Sheng, *Codonofusiella* sp., *Paradoxiella* cf. *skinneri* Lys, *Palaeofusulina* (*Palaeofusulina*) cf. *nana* Li-

PLATE 5

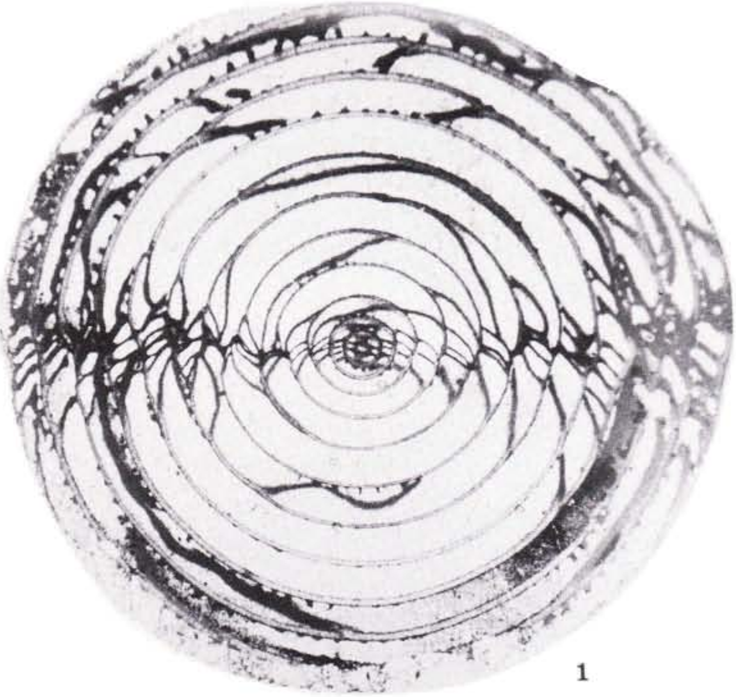
Upper Permian, Lower Midian (uppermost Murgabian?).

Fig. 1 - *Verbeekina verbeeki* (Geinitz). Balya, Hodul Unit, sample 1633E; x 15.
Fig. 2 - *Afghanella sumatrinaeformis* (Gübler). The same.
Fig. 3 - *Afghanella tumida* Skinner & Wilde. The same.
Fig. 4, 5 - *Afghanella pulchella* Zhang & Dong. The same.
Fig. 6, 8 - *Neoschwagerina haydeni* Dutkevich & Khabakov. The same.
Fig. 7 - *Pseudofusulina* aff. *pingdingensis* (Sheng). The same.

PLATE 6

Upper Murgabian, Lower Midian (uppermost Murgabian?).

Fig. 1, 2 - *Eopolydiexodina megasphaerica* (Leven). Balya, Hodul Unit, sample 1633E; x 10.
Fig. 3 - *Parafusulina gigantea* (Deprat). The same.
Fig. 4 - *Afghanella* cf. *pulchella* Zhang & Dong. The same; x 15.
Fig. 5 - *Parafusulina parva* (Pitakpaivan). The same; x 10.



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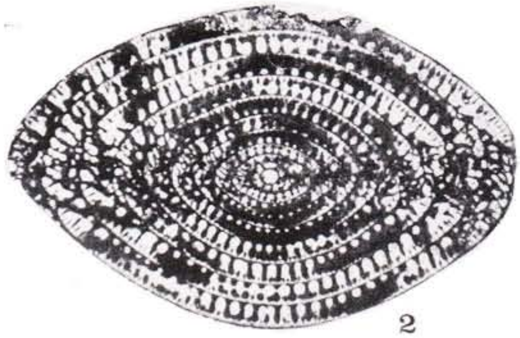

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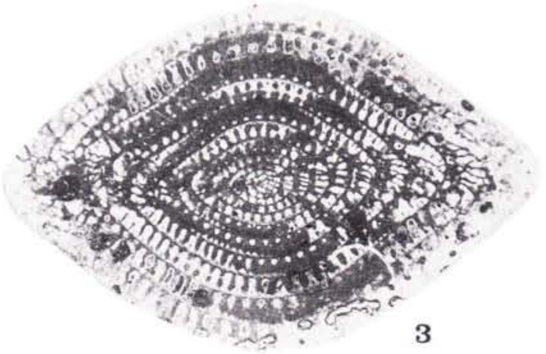

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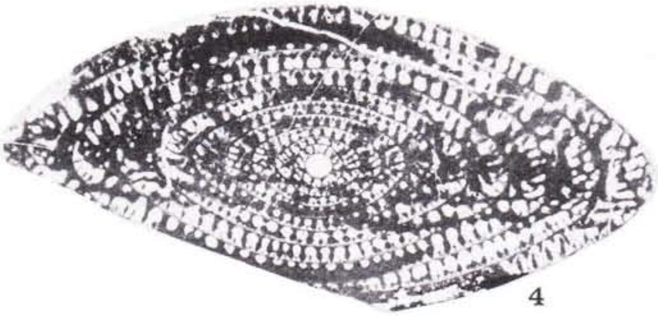

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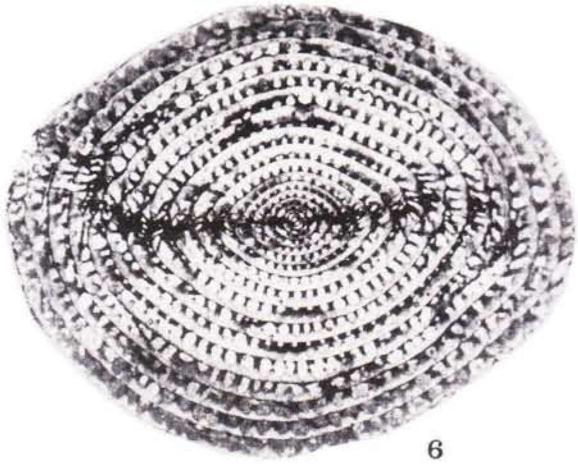

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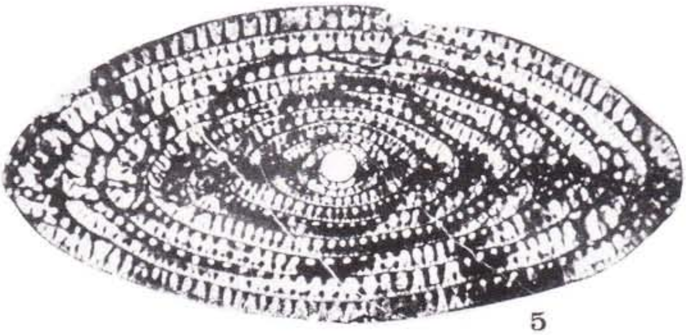

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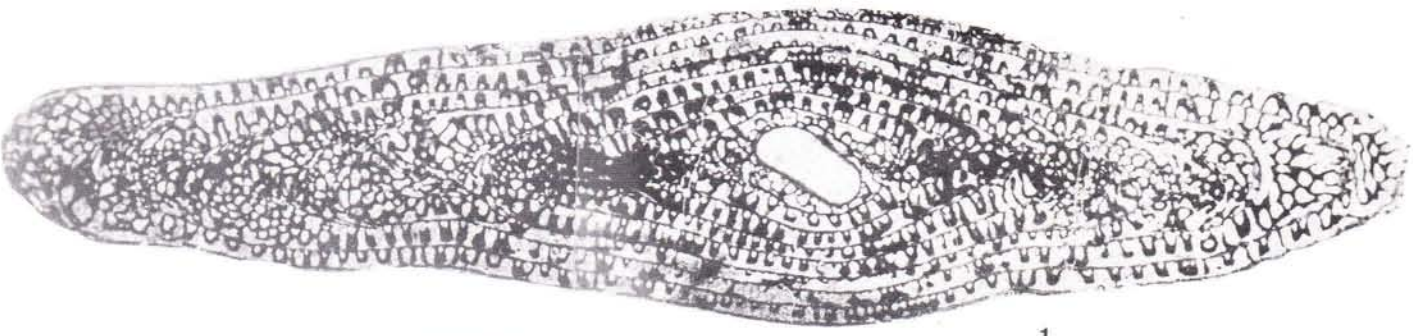

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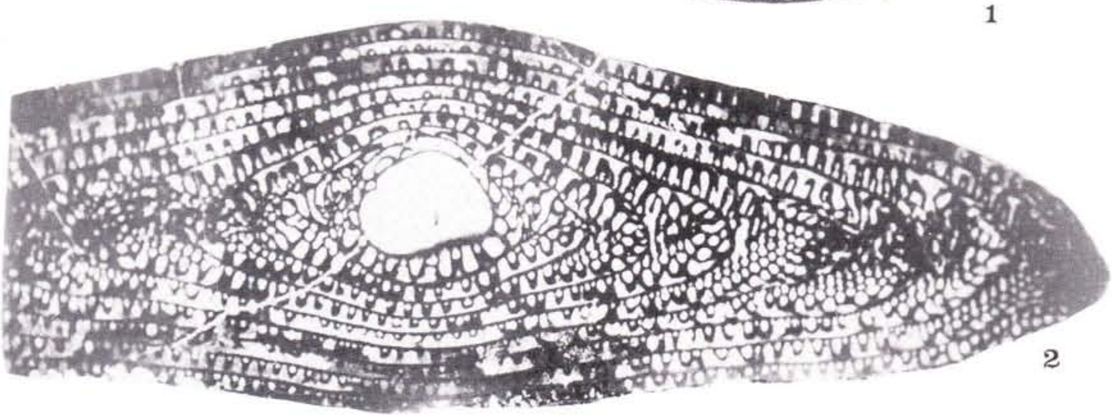

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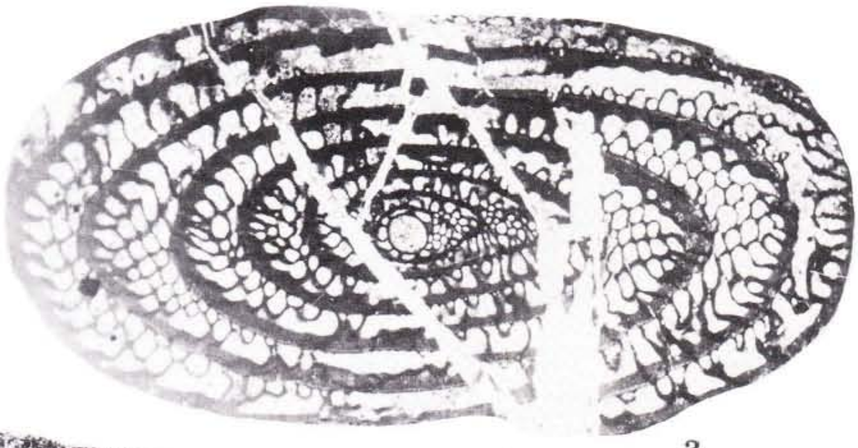

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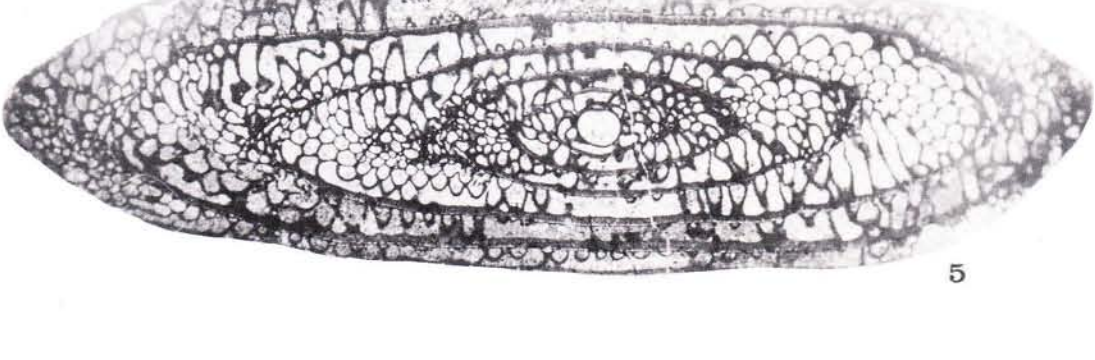

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charew, *P.(Pal.) simplex* Sheng & Chang, *P.(Pal.)* cf. *simplicata* Sheng, *P.(Paradunbarula) okayi* sp. n., *P.(Par.) ottomana* sp. n. (fusulinids) and *Eotuberitina* sp., *Tuberitina conili* Tien, *Diplosphaerina* sp., *Globivalvulina graeca* Reichel, *Paraglobivalvulina* ? sp., *Protonodosaria* sp., *Nodosaria dzhulfensis* Reitlinger, *N. caucasica* K. Miklukho-Maclay, *N. postgeinitzi* Efimova, *Pachyphloia* cf. *iranica* Bozorgnia, *P. robusta* K. Miklukho-Maclay, *P. pedicula* Lange, *Geinitzina inflata* K. Miklukho-Maclay, *G. munda* K. Miklukho-Maclay, *G.* aff. *reperta* Bykova, *G. tcherdyncevi* K. Miklukho-Maclay, *Langella ocarina* Civrieux & Dessauvagie, *Langella perforata langei* Civrieux & Dessauvagie, *Calvezina* ? sp., *Palaeotextularia* sp., *Climacammina* sp., *Cribrogenerina* sp., *Spiroplectammina* sp., *Tetrataxis* sp., *Dagmarita chanakchensis* Reitlinger, *Lasiotrochus tatoiensis* Reichel, *Glomospira* sp., *Agathammina pusilla* (Geinitz), *Hemigordius zaninettiae* Altiner, *H.* cf. *japonica* Ozawa, *H. maopingensis* (Wang & Sun), *Multidiscus padangensis* (Lange), *Robuloides lens* Reichel, *Hemigordiopsis* sp., *Kamurana* ? sp., *Baisalina* sp., *Endoteba controversa* Vachard & Razgallah, *Bradyina* ? sp., *Neoendothyra reicheli* Reitlinger (small foraminifers).

Among numerous foraminifers of the list above, *Palaeofusulina*, represented in our collection by subgenera *Palaeofusulina (Palaeofusulina)* and *P. (Paradunbarula)*, are principal indicators for age determination. The first subgenus comprises the species *P. (P.) nana* Licharew known from the Dorashamian layers of northern Caucasus and southern China (Licharew, 1939; Sheng, 1963). It can be identified with less confidence in the studied collection. The *Paradunbarula* subgenus differs from true Palaeofusulinan through less intensive and regularly septal fluting. This gives grounds to consider its age as older, i.e. as Dzhulfian. In the Pamirs, the subgenus is found in layers dated by conodonts as transitional from the Dzhulfian to Dorashamian (Kotlyar et al., 1983; Kozur et al., 1994). According to Skinner (1969), in the Ankara region, layers with *Paradunbarula* alternate with beds with *Neoschwagerina* indicating a Murgabian-Midian age. However, according to our observations, in the locality mentioned by Skinner (1969), the alternation of *Neoschwagerina* and *Paradunbarula* layers is not stratigraphic but is caused by a series of small faults, thus a post-Midian (Dzhulfian) age of the latter is not improbable.

The small foraminifer assemblage, which contains no *Colaniella* typical of the Dorashamian Stage and which is closely associated with the Midian assemblage, confirms indirectly the affiliation of the considered fusulinids to the Dzhulfian Stage.

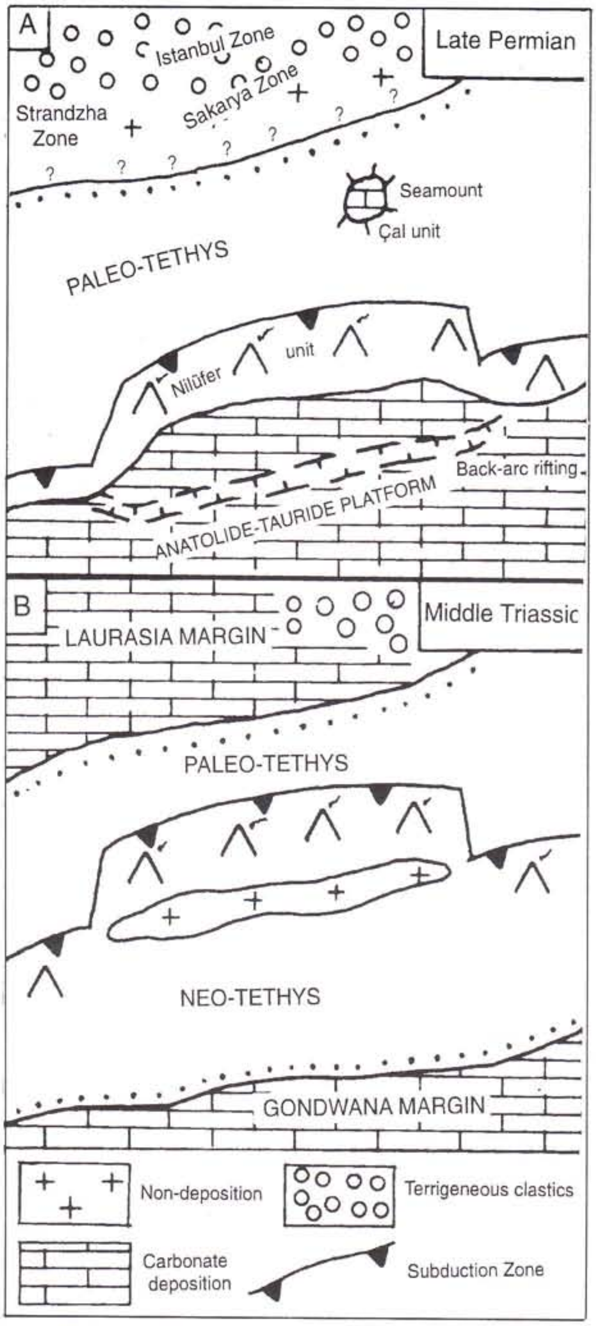
Dorashamian Stage (Plate 10).

Only one sample (3707A) from the Hodul Unit can be assigned to the Dorashamian Stage with some degree of certainty. It comprises a single poorly preserved fusulinid species resembling *Palaeofusulina (Paradunbarula) pamirica* Leven. In southeastern Pamir, this species was described from the Takhtabulak Formation, at the base of which the Dzhulfian and farther up-section Dorashamian conodonts have recently been determined (Kozur et al., 1994). The accompanying assemblage of small foraminifers in the sample 3707A, especially *Colaniella cylindrica* K. Miklukho-Maclay and *C. media* K. Miklukho-Maclay is consistent with the Dorashamian age. Other forms in this assemblage are *Eotuberitina* sp., *Tuberitina* sp., *Nodosaria delicata* Wang, *N. armeniensis* Efimova, *Pachyphloia* sp., *Geinitzina postcarbonica scalariformis* Lys, *G.* aff. *inflata* K. Miklukho-Maclay, *G.* cf. *ovata* Lange, *Lasiotrochus tatoiensis* Reichel, *Angelina* ? sp.

Foraminiferal assemblages from the eastern part of the Karakaya Complex

The foregoing foraminiferal assemblages were described from blocks in western parts of the Karakaya Complex. Eastwards, they are best studied in the Ankara region (Fig. 1), where limestones of Moscovian Stage of the Middle Carboniferous, Sakmarian and Yahtashian stages of the Lower Permian, Midian and possibly Dzhulfian stages of the Upper Permian have been determined (Skinner, 1969; Leven, 1995). According to Leven (1995), these limestones represent a section in a major tectonic block, that has apparently broken away from the edge of the Anatolide-Tauride platform and has been displaced for considerable distance to the north.

Fusulinids of the Moscovian stage from the vicinity of Ankara are not studied in detail. The Sakmarian fusulinid assemblage is similar to that from the Tauride nappes (Monod, 1977). Fusulinids from the Yahtashian sequence, which is 100 m thick in the Ankara region, are well represented (Leven, 1995). The assemblage comprises all genera and most of the species known in typical sections of southwestern Darvaz, which was located in the northern margin of the Paleo-Tethys. Neither in Turkey, nor in adjacent areas autochthonous deposits of the Yahtashian Stage have ever been reported. Fusulinids of this age were only found in limestone clasts in Karakaya Complex in the northwestern Turkey as described above. The Midian fusulinid assemblage in the Ankara region is rich and diverse, and in this respect differs greatly from complexes known in autochthonous sections of southeastern Turkey and in the Anatolide-Taurides.



Geological constraints on the origin of the exotic blocks in the Karakaya Complex

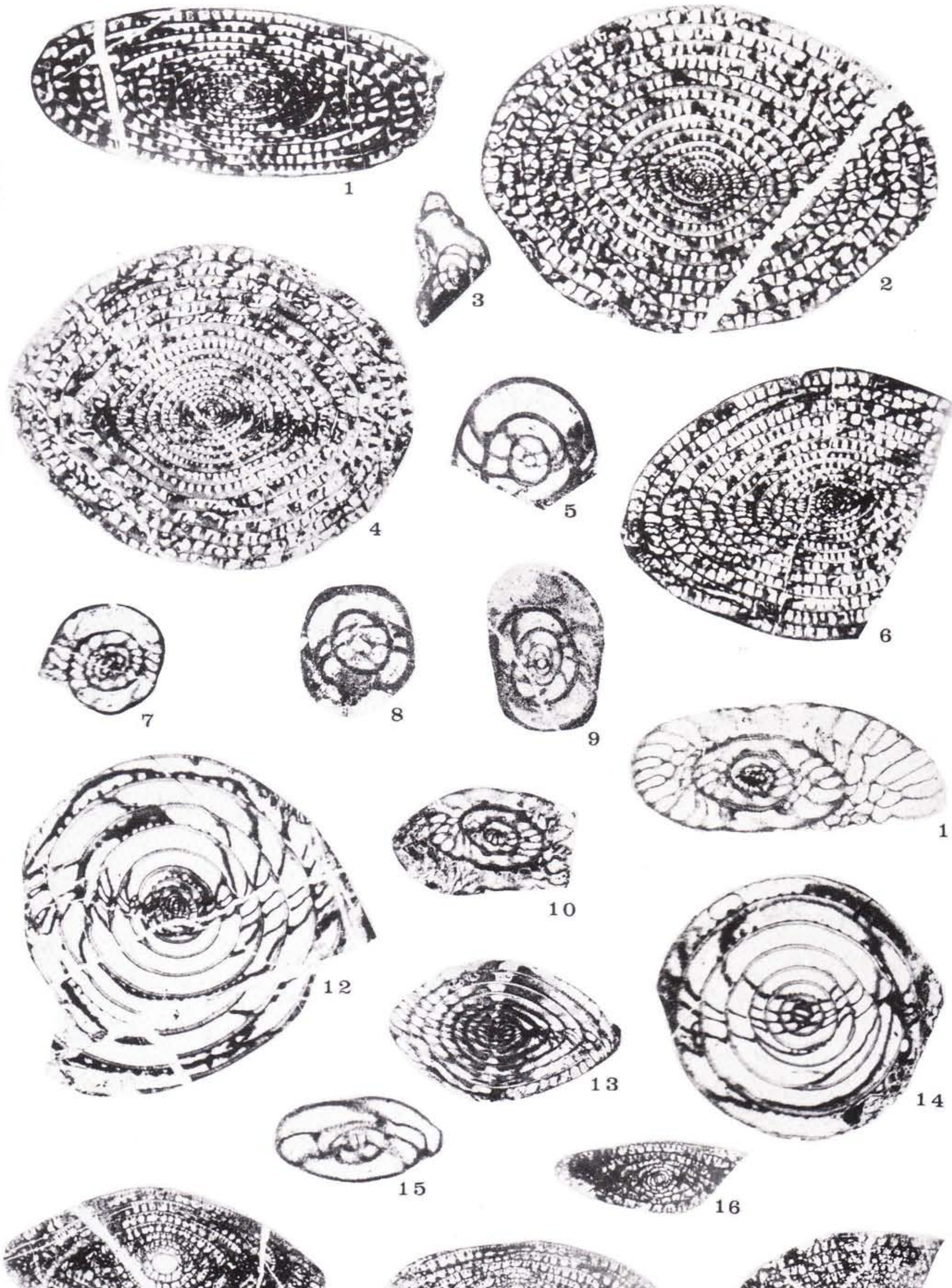
The Permo-Carboniferous limestone blocks in the Karakaya Complex were formed in two different tectonic settings. The Upper Permian limestone blocks in the Çal Unit were derived in an extensional environment from the flanks of an Upper Permian carbonate platform that probably rested on Lower Permian radiolarian cherts and eventually on oceanic crust (Fig. 5). The main evidence for this is the close spatial and temporal association of mafic volcanism and debris flow formation. The debris flow conglomerates in the Çal Unit are also distributed throughout the sequence. This can be contrasted with the Hodul Unit and to some extent with the Orhanlar Greywacke, where the limestone blocks are concentrated in the top of the sequence signifying the approach of a carbonate thrust sheet (Fig. 2). The limestone blocks in the Hodul Unit were shed from a large thrust sheet or nappe of Permo-Carboniferous limestone. The platform carbonates making up this thrust sheet must have been built up during the whole of Carboniferous and Permian as indicated by the presence of almost all stages of these two periods in the exotic limestone blocks in the Hodul Unit and Orhanlar Greywacke. The geographical distribution of the olistostromal belt suggests that the carbonate thrust sheet

Fig. 5 - Schematic model illustrating a possible origin for the Permo-Carboniferous blocks in the Karakaya Complex. A) Southward subduction of the Paleo-Tethys results in back-arc rifting of a continental sliver with a Permo-Carboniferous carbonate cover from the northern margin of the Anatolide-Tauride platform. B) The continental sliver drifts north and will eventually collide with the Laurasian margin supplying blocks to the clastics deposited in front of the subduction zone. Çal Unit, deposited along the margin of an oceanic seamount north of the subduction zone, will be incorporated in the accretionary prism.

PLATE 7

Upper Permian, Midian.

Fig. 1 - *Pseudodoliolina ozawai* Yabe & Hanzawa. Balya, Hodul Unit, sample 2993; x 15.
Fig. 2, 6 - *Neoschwagerina ventricosa* Skinner. The same locality; x 15. Fig. 2 - sample 1526B; Fig. 6 - sample 2993.
Fig. 3 - *Pseudokahlerina discoidalis* Sosnina. The same locality, sample 1526B; x 20.
Fig. 4 - *Neoschwagerina* cf.*ventricosa* Skinner. Abnormal specimen: the axis of coiling is turned on 90° in the last 6 volutions. The same locality; x 15.
Fig. 5, 8 - *Kahlerina* cf. *globiformis* Sosnina. The same locality, sample 2993; x 20.
Fig. 7 - *Dunbarula* cf. *nana* Kochansky-Devidé & Ramovš. The same locality, sample 1526B; x 25.
Fig. 9 - *Kahlerina pachytheca* Kochansky-Devidé & Ramovš. The same locality, sample 2993; x 25.
Fig.10, 11 - *Dunbarula* aff. *kitakamiensis* Choi. The same locality, sample 1526B; x 25.
Fig.12, 14 - *Verbeekina furnishi* Skinner & Wilde. The same locality, sample 2993; x 15.
Fig. 13 - *Yangchienia thompsoni* Skinner & Wilde. Zeytindag, Hodul Unit, sample 4079A; x 25.
Fig. 15 - *Rauserella* sp. The same locality, sample 4079B; x 50.
Fig. 16, 18 - *Sumatrina annae annae* Volz. Balya, Hodul Unit, sample 1526B; x 15.
Fig. 17 - *Afghanella robbinsae* Skinner & Wilde. The same locality, sample 2993; x 15.
Fig. 19 - *Sumatrina annae brevis* Leven. The same locality, sample 1526B; x 15.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was coming from the present southeast, e.g. from the direction of the Anatolide-Tauride platform. This is supported by the general westward decrease in the age of the limestone blocks in the Hodul Unit from Midian-Dzhulfian in the Zeytindag-Kinik area to Murgabian-Midian in the Manyas-Kozak olistostrome belt farther east (Fig. 3), assuming that the top of the thrust sheet was eroding first. One possible tectonic scenario is the rifting during the Late Permian/Early Triassic of a sliver of carbonate platform from the northern margin of the Anatolide-Taurides during the southeastward subduction of the Paleo-Tethys (Okay et al., 1996). This carbonate sliver moved northwest opening the Neo-Tethys in its back and closing the Paleo-Tethys in the north, and eventually collided with the Sakarya Zone during the Late Triassic providing blocks to the syn-collisional clastics of the Hodul Unit (Fig. 5). One enigmatic feature in this tectonic schema, and also of other schemas is the absence of Lower and Middle Triassic rocks in the blocks or in the matrix of the Hodul Unit. A similar problem exists in the Crimea, where Permian limestone exotics occur in the Upper Triassic-Liassic Tauridian flysch (Miklukho-Maclay, 1957; Kotanski, 1978). A possible explanation is that the rifted carbonate sliver was above sea-level during its Triassic drift across the Paleo-Tethys (Fig. 5).

Comparison of Karakaya foraminiferal assemblages with those from other Tethyan sections

The Permian and Carboniferous sequences in the Taurides and southeastern Turkey (e.g., Graciansky, 1972; Monod, 1977; Argyriadis, 1978; Fontaine et al., 1980; Altiner, 1981, 1983; Köylüoglu & Altiner, 1989), which were deposited in the southern margin of the western Paleo-Tethys, are generally poorer in fusulinid assemblages and show less complete sections as compared to the exotic limestone blocks from the Karakaya complex. No marine Permian deposits are known along the northern margin of the western Paleo-Tethys adjacent to Laurasia. In the Istanbul Zone, which is thought to be located in the southern margin of Laurasia during the Permian (Okay et al., 1994), the folded Lower Carboniferous flysch is unconformably overlain by uppermost Permian (?)-Lower Triassic red beds and basic lavas (e.g., Ketin, 1983; Ustaömer & Robertson, 1993). In Bulgaria Permian is represented by terrigenous clastic and volcanic rocks (e.g., Yanev, 1992). However, if the Paleo-Tethys was a major ocean separating Gondwana and Laurasia (e.g., Smith et al., 1981), Permian shallow marine deposits should also have accumulated along its northern margin, and it is hardly probable that all were destroyed during the closure of the Paleo-Tethys. Their presence in the form of tectonic lenses inside the Karakaya accretionary complex is quite possible, however, it would be difficult to distinguish these fragments lithologically from those derived from southern margins of the Paleo-Tethys. The analysis of the enclosed fossils has little to offer in this respect because we do not know what biocoenoses have inhabited an open shelf in the northern margin of Paleo-Tethys within the Caucasus-Mediterranean realm. Therefore, we have to resort to data from the more easterly regions - Afghanistan, the Pamirs and China, where Permo-Carboniferous rocks de-

PLATE 8

Upper Permian, Midian.

Fig.1, 2 - *Pseudofusulina* aff. *rhombiformis* Leven. Balya, Hodul Unit, sample 1526B; x 10.
Fig. 3 - *Pseudofusulina* sp. The same.
Fig. 4 - *Chusenella* aff. *tieni* Chen. The same.
Fig. 5 - *Chusenella* cf. *sinensis* Sheng. The same locality, sample 2993; x 10.
Fig. 6 - *Pseudofusulina kueichihensis* (Chen). The same locality, sample 1526B; x 10.
Fig. 7, 8 - *Hemigordiopsis renzi* Reichel. The same locality; x 25. Fig. 7 - sample 90-274; Fig. 8 - sample 90-309.
Fig. 9, 17 - *Baisalina pulchra* Reitlinger; x 25. Fig. 9 - Zeytindag, Hodul Unit, sample 4090B; Fig. 17 - Balya, Hodul Unit, sample 2993.
Fig. 10 - *Kamurana* ? sp. Balya, Hodul Unit, sample 1526B; x 50.
Fig. 11 - *Agathammina pusilla* (Geinitz). Kinik, Hodul Unit, sample 4102B; x 50.
Fig. 12-15 - *Endoteba controversa* Vachard & Razgallah. Balya, Hodul unit, sample 90-309; x 50.
Fig. 16 - *Globivalvulina graeca* Reichel. Kozak, Hodul Unit, sample 3382; x 50.
Fig. 18 - *Tuberitina conili* Tien. Zeytindag, Hodul Unit, sample 4090B; x 25.
Fig. 19 - *Diplosphaerina* sp. The same; x 50.
Fig. 20 - *Dagmarita chanakchensis* Reitlinger. The same locality,sample 4079B; x 50.
Fig. 21 - *Geinitzina* cf. *postcarbonica* Spandel. The same locality, sample 4079B; x 50.
Fig. 22 - *Rectostipulina quadrata* Jenny-Deshusses. Kinik, Hodul Unit, sample 4102B; x 70.
Fig. 23 - *Nodosaria* aff. *postgeinitzi* Efimova. Balya, Hodul Unit, sample 90-309; x 25.
Fig. 24 - *Bradyina* ? sp. The same.
Fig. 25 - *Pachyphloia* cf. *schwageri* Civrieux & Dessauvagie. Zeytindag, Hodul Unit, sample 407B; x 50.
Fig. 26 - *Geinitzina conica* K. Miklukho-Maclay. Balya, Hodul Unit, sample 90-309; x 50.
Fig. 27 - *Frondina* cf. *permica* Civrieux & Dessauvagie. The same.
Fig. 28 - *Pachyphloia* sp. Kinik, Hodul Unit, sample 4102B; x 70.


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posited on the northern margin of the Paleo-Tethys are known. In the transposition of these data to western Tethyan realm one has to be cautious as a greater width of the Paleo-Tethys in the east might have resulted in aggravation of differences between the peri-Gondwanian and peri-Laurasian biocoenosis.

The Carboniferous and Lower Permian foraminifers available in our collection are not numerous and are often poorly preserved. Most of the here described Lower and Middle Carboniferous taxa are also widely distributed within the East European platform and Donbass, located to the north of Paleo-Tethys, as well as in the peri-Gondwanian margin of the Tethys including sections in southern Turkey. In Turkey, the Upper Carboniferous is usually represented by the Kasimovian Stage or by the lower parts of the Gzhelian Stage. In contrast, fusulinids of the uppermost part of the Gzhelian but not of the Kasimovian and lower Gzhelian stages are present in our collection. Among them, species *Daixina (Ultradaixina) postgallowayi* are common along the southern margin of Laurasia (Donbass, South Urals, Fergana, Darvaz), and not yet observed in the peri-Gondwanian part of the Tethys (Bensh, 1962; Davydov, 1984, 1990; Popov et al., 1985). Foraminifers of the Asselian and Sakmarian stages of the Lower Permian are practically absent in the collection. The Yahtashian Stage is represented by several fusulinid species characteristic for the stratotype section of the Yahtashian Stage in Darvaz. It is of interest that Yahtashian deposits are not reported in the peri-Gondwanian part of the Tethys west of Pamirs but are widespread in the peri-Laurasian part (northern Pamirs, Darvaz, northern Afghanistan) (Leven et al., 1992; Leven in press "a").

Foraminifers of the Bolorian Stage are absent in the studied collection. The Kubergandian foraminifers are not abundant but represented by characteristic species of *Neofusulinella, Parafusulina* and *Cancellina*. They are common throughout the Tethys related to a fast expansion of the transgression, which had started by the late Yahtashian-Bolorian (Leven, 1993). However, Kubergandian foraminifers have not been reported from the southern Turkey up until now.

The lower Murgabian fusulinids, like Kubergandian, are scanty but typical of the entire Tethys. As was mentioned above, we failed to characterise the upper Murgabian foraminiferal assemblage. The assemblage which can be considered as transitional Murgabian-Midian (sample 1633E) is as a whole very similar to that from sections of northern Pamir and northern Afghanistan, characterised by the occurrence of the *Eopolydiexodina* and *Parafusulina gigantea* with highly developed representatives of *Neoschwagerina, Afghanella* and *Sumatrina* (Leven, in press "a"). Fusulinids of this combination are not reported from the Peri-Gondwanian margin

PLATE 9

Upper Permian, Dzhulfian ?

Fig. 1, 2 - *Palaeofusulina (Palaeofusulina)* cf. *nana* Licharew. Kinik, Hodul Unit, sample 414C; x 25.

Fig. 3 - *Palaeofusulina (Palaeofusulina)* cf. *simplicata* Sheng. The same.

Fig. 4, 5, 7 - *Palaeofusulina (Paradunbarula) okayi* sp. n. The same locality; x 25. Fig. 4 - subaxial section of the holotype, GGM VI-231/3, sample 4146C; Fig. 5 - subaxial section, GGM VI-231/4, sample 3727A; Fig. 7 - oblique section, GGM VI-231/5, sample 3728.

Fig. 6 - *Palaeofusulina (Palaeofusulina) simplex* Sheng & Chang. Kinik, sample 4146C; x 25.

Fig. 8, 10, 11, 14 -*Palaeofusulina (Paradunbarula) ottomana* sp. n.; x 25. Fig. 8 - tangential section, GGM VI-231/6; Kinik, Hodul Unit, sample 4146C; Fig. 10 - axial section of the holotype, GGM VI-231/7; the same locality, sample 3728; Fig. 11 - subaxial section, GGM VI-231/8; the same locality, sample 3728; Fig. 14 - subsagittal section, GGM VI-231/9; Edremit, Çal Unit, sample 1589E; x 25.

Fig. 9 - *Palaeofusulina (Palaeofusulina)* sp. Kinik, sample 4146C; x 25.

Fig. 12 - *Reichelina* sp. Balya, Hodul Unit, sample 1810A; x 50.

Fig. 13 - *Schubertella pseudogiraudi* Sheng. Edremit, Çal Unit, sample 1589E; x 50.

Fig. 15, 28 - *Hemigordius* cf. *japonica* Ozawa; x 25. Fig. 15 - Zeytindag, Hodul Unit, sample 4077B; Fig. 28 - Kinik, Hodul Unit, sample 4146C.

Fig. 16 - *Reichelina* cf. *cribroseptata* Erk. Edremit, Çal Unit, sample 1589E; x 50.

Fig. 17, 20 - *Reichelina changhsingensis* Sheng & Chang. Kinik, Hodul Unit, sample 3727C; x 50.

Fig. 18 - *Reichelina* aff. *media* K. Miklukho-Maclay. Zeytindag, Hodul Unit, sample 4076B; x 50.

Fig. 19 - *Codonofusiella* sp. Balya, Hodul Unit, sample 1810A; x 70.

Fig. 21 - *Hemigordius maopingensis* (Wang & Sun), Zeytindag, Hodul Unit, sample 4077; x 50.

Fig. 22, 23 - *Hemigordius zaninettiae* Altiner. Kinik, Hodul Unit, sample 4146C; x 50.

Fig. 24-26 - *Multidiscus padangensis* (Lange). Fig. 24 - Kinik, Hodul Unit, sample 4146C; x 50. Fig. 25 - Balya, Hodul Unit, sample 1810A; x 50. Fig. 26 - Zeytindag, Hodul Unit, sample 4077A; x 25.

Fig. 27 - *Endoteba controversa* Vachard & Razgallah. Kinik, Hodul Unit, sample 4146C; x 50.

Fig. 29, 30 - *Robuloides lens* Reichel. Zeytindag, Hodul Unit, sample 4076A; x 70.

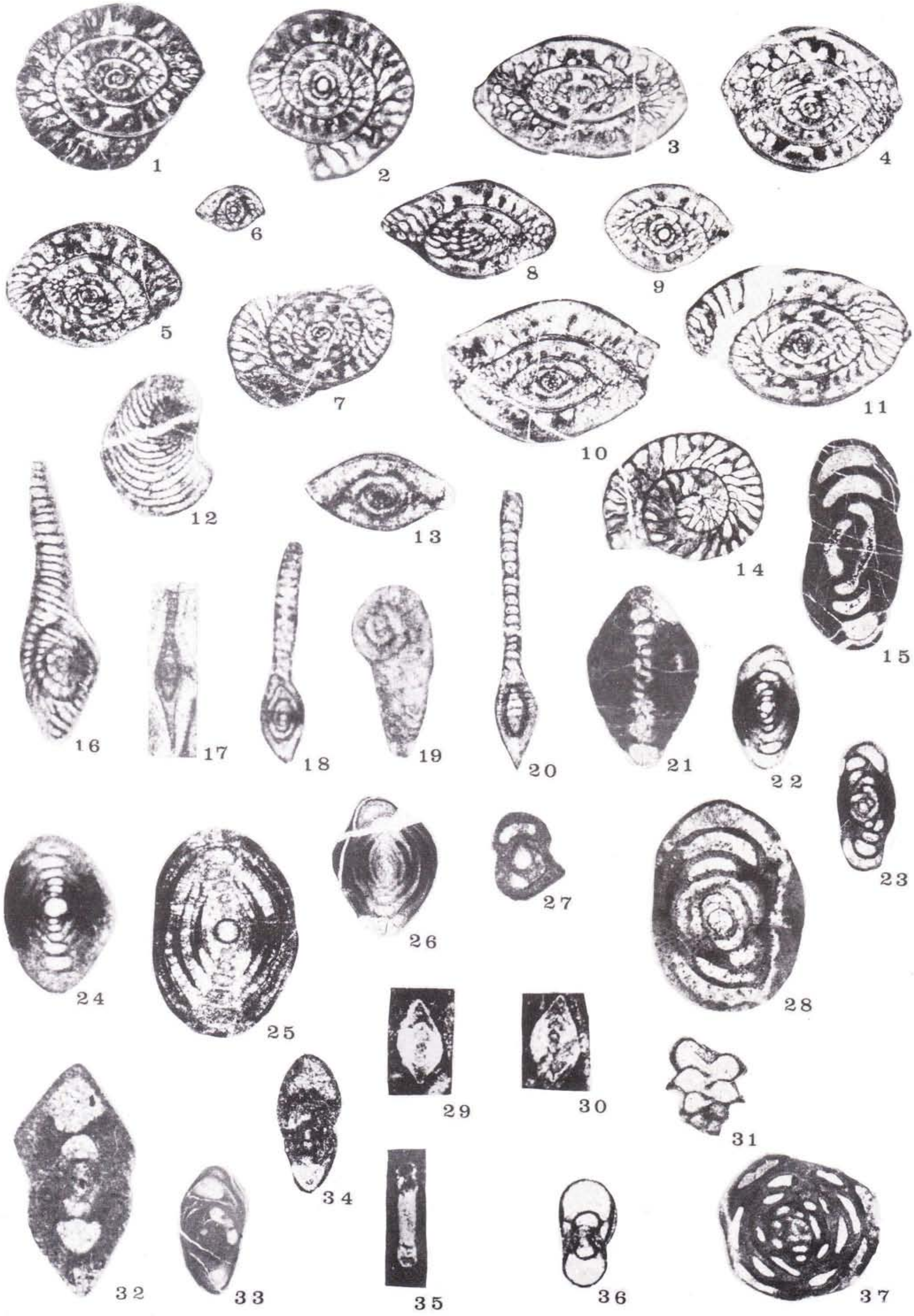
Fig. 31 - *Dagmarita chanakchensis* Reitlinger. Kinik, Hodul Unit, sample 4146C; x 50.

Fig. 32, 33, 34 -*Neoendothyra reicheli* Reitlinger. Zeytindag, Hodul Unit. Fig. 32 - sample 4077B; x 80. Fig. 33 - sample 4076B; x 25. Fig. 34 - sample 4076A; x 50.

Fig. 35 - *Angelina* ? sp. Balya, Hodul Unit, sample 1810A; x 50.

Fig. 36 - *Bradyina* ? sp. Kinik, Hodul Unit, sample 4146C; x 50.

Fig. 37 - *Kamurana* ? sp. The same; x 25.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of the Paleo-Tethys, although are known individually in many sections. Some of these genera are recorded in sections from southern Turkey, however, their fusulinid assemblages are very poor and uniform (Altiner, 1981; Köylüoglu & Altiner, 1989; Monod, 1977).

The Midian assemblages are the most representative with respect to both fusulinids and small foraminifers. Fusulinids described are widespread throughout the entire Tethys mainly due to the Midian transgression. Many species of this assemblage are also described from the vicinity of Ankara, although *Yabeina* described by Skinner (1969) from the Ankara region is not present among our fusulinids. Midian small foraminiferal assemblages, that we have described, are similar to those from southern Turkey, however, south Turkish sequences lack typical Midian fusulinid assemblages.

Fusulinids from the probable Dzhulfian assemblage from the Karakaya Complex are generally widespread throughout the Tethys, with the exception of *Palaeofusulina*, which is so far not known in sections of the peri-Gondwanian part of the Tethys. In Turkey, individual *Palaeofusulina*, as in our case, were found by D. Altiner (personal communication) in Permian limestone blocks in the Karakaya Complex and subgenus *Paradunbarula* was described by Skinner (1969) from the Ankara region. In almost all previously known localities, *Palaeofusulina* is confined to the Dorashamian Stage but is represented by more developed species than those from our collection. Dzhulfian *Palaeofusulina* is only described from the Hydra island in Greece (Nestell & Wardlaw, 1987; Grant et al., 1991; Baud et al., 1991). Assuming that the dating is correct, ours is the second description of the Dzhulfian *Palaeofusulina*. The small foraminifer assemblages are rather ordinary, although the absence of such genera as *Paraglobivalvulina, Louisettita, Paradagmarita* and *Shanita*, which are widespread in sections of the Midian, Dzhulfian and Dorashamian stages of southern Tethys is striking. The Dorashamian foraminiferal assemblage is not much representative in our collection. All the genera and foraminiferal species in this assemblage are of wide geographical distribution.

Conclusions

1. All the stages of Carboniferous and Permian with the exception of Tournaisian, Kasimovian and Bolorian, are represented in the exotic limestone blocks in

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PLATE 10

Upper Permian, Dzhulfian ?

Fig. 1 - *Langella perforata langei* Civrieux & Dessauvagie. Kinik, Hodul Unit, sample 4146C; x 50.
Fig. 2 - *Langella ocarina* Civrieux & Dessauvagie. The same locality, sample 3728; x 50.
Fig. 3 - *Pachyphloia robusta* K. Miklukho-Maclay. Zeytindag, Hodul Unit, sample 4076A; x 50.
Fig. 4 - *Pachyphloia pedicula tegenica* K. Miklukho-Maclay. Kinik, Hodul Unit, sample 3727A; x 25.
Fig. 5 - *Pachyphloia* sp. Zeytindag, Hodul Unit, sample 4076A; x 50.
Fig. 6 - *Geinitzina munda* K. Miklukho-Maclay. Kinik, Hodul Unit, sample 3728; x 50.
Fig. 7-9 - *Nodosaria* aff. *postgeinitzi* Efimova; x 25. Fig. 7 - Edremit, Çal Unit, sample 1589E; Fig. 8 - Kinik, Hodul Unit, sample 3728; Fig. 9 - the same locality, sample 4146C.
Fig. 10 - *Pachyphloia* cf. *iranica* Bozorgnia. The same locality, sample 3728A; x 50.
Fig. 11, 16 - *Nodosaria caucasica* K. Miklukho-Maclay; x 50. Fig. 11 - Edremit, Çal Unit, sample 1589E; Fig. 16 - Kinik, Hodul Unit, sample 3728.
Fig. 12 - *Protonodosaria* sp. Kinik, Hodul Unit, sample 3728; x 50.
Fig. 13, 21 - *Spiroplectammina* sp. The same locality, sample 4146C; x 50.
Fig. 14 - *Geinitzina reperta* Bykova. The same.
Fig. 15 - *Lasiotrochus tatoiensis* Reichel. The same.
Fig. 17 - *Geinitzina* cf. *inflata* K. Miklukho-Maclay. Edremit, Çal Unit, sample 1589; x 50.
Fig. 18 - *Tuberitina conili* Tien. The same.
Fig. 19 - *Geinitzina* cf. *postcarbonica* Spandel. Kinik, Hodul Unit, sample 4146C; x 50.
Fig. 20 - *Calvezina* ? sp. Edremit, Çal Unit, sample 1589E; x 50.
Fig. 22 - *Palaeotextularia* sp. Kinik, Hodul Unit, sample 4146C; x 50.

Upper Permian, Dorashamian.

Fig. 23 - *Palaeofusulina (Paradunbarula)* cf. *pamirica* Leven. Kozak, Hodul Unit, sample 3707A; x 25.
Fig. 24, 25 - *Colaniella media* K. Miklukho-Maclay. The same; x 30.
Fig. 26, 29 - *Colaniella cylindrica* K. Miklukho-Maclay. The same.
Fig. 27, 28 - *Nodosaria sagitta* K. Miklukho-Maclay. The same; x 70.
Fig. 30 - *Geinitzina*? sp. The same.
Fig. 31 - *Geinitzina postcarbonica scalariformis* Lys. The same.
Fig. 32, 35 - *Pachyphloia* sp. The same.
Fig. 33 - *Geinitzina* cf.*ovata* Lange. The same.
Fig. 34 - *Lasiotrochus tatoiensis* Reichel. The same.
Fig. 36 - *Nodosaria delicata* Wang. The same.
Fig. 37 - *Sichotenella* sp. The same.


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Period		Carboniferous							Permian																
Stage		v	s	b	b	m	m	g	as-s	yh	yh	kb	kb	m	m-md	md	md	md	md	d?	d?	d?	d?	d?	dz
Fusulinids	Samples	1820	1740B	UL46	1863B	1568	UL35C	3528	3368D	1736	90-277	765	3387A	3816	1633E	1526B	2993	4079B	90-274	1589E	3728	4076A	4146C	1810A	3707A
Mediocris brevicula		x																							
Eostafella sp.		x	x	x		x																			
E. mirifica		x																							
E. ikensis			x																						
E. proikensis			x																						
Pseudoendothyra cf. *propinqua*			x																						
Pseudostaffella antiqua				x																					
Pseudostafella sp.					x																				
Pseudoendothyra sp.						x										x			x	x			x		
Verella sp.						x																			
Profusulinella aff. *parva*						x																			
P. latispiralis						x																			
Fusulinella sp.							x																		
F. bocki bocki							x																		
F. bocki timanica							x																		
F. cf. *curtissima*							x																		
F. asiatica							x																		
F. praebocki							x																		
Schubertella sp.								x		x				x						x					
Daixina (Ultradaixina) postgallowayi								x																	
Triticites? kozakensis								x																	
Alpinoschwagerina? sp.								x																	
Pseudofusulina aff. *hovunensis*								x																	
Ozawainella sp.									x																
Rugofusulina stabilis									x																
R. ex gr. *dastarensis*									x																
Schubertella simplex										x															
Darvasites sp.										x															
D. pseudosimplex										x															
D. eocontractus										x	x														
Pseudofusulinoides instabilis										x															
Pseudofusulina incomparabilis										x															
P. cf. *kraffti*											x														
Praeskinnerella fragilis											x														
Dutkevitchia jipuensis												x													
Parafusulina yunnanica												x													
Robustoschwagerina? sp.												x													
Neofusulinella sp.													x												
Pseudofusulina dzamantalensis													x												
Parafusulina aff. *shaksgamensis*													x												
Eopolydiexodina sp.													x	x											
Armenina sp.													x												
Cancellia (Shengella) elliptica													x												
C. (Cancellina) dutkevitchi													x												
Neofusulinella timida														x											
N. lantenoisi														x											
Staffella sp.														x	x	x					x				
Rauserella sp.														x	x	x		x							
Pseudofusulina aghilensis														x											
Parafusulina edoensis														x											
Armenina asiatica														x											
Cancellina (Cancellina) aff. *primigena*														x											
Neoschwagerina simplex														x											
Nankinella sp.															x	x	x								
Dunbarula sp.															x										
Yangchienia sp.															x										

Tab. 1 - Distribution of fusulinids in the limestone blocks in the Karakaya Complex. v, Visean; s, Serpukhovian; b, Bashkirian; m, Moscovian;

Period		Carboniferous							Permian																
Stage		v	s	b	b	m	m	g	as-s	yh	yh	kb	kb	m	md	md	md	md	md	d?	d?	d?	d?	d?	dz
Fusulinids	Samples	1820	1740B	UL46	1863B	1568	UL35C	3528	3368D	1736	90-277	765	3387A	3816	1633E	1526B	2993	4079B	90-274	1589E	3728	4076A	4146C	1810A	3707A
Pseudofusulina ciryi															x										
P. aff. *pingdingensis*															x										
Chusunella cf. *rabatei*															x										
Parafusulina gigantea															x										
P. parva															x										
Eopolydiexodina megasphaerica															x										
E. cf. *afghanensis*															x										
Neoschwagerina haydeni															x										
Afghanella pulchella															x										
A. sumatrinaeformis															x										
A. tumida															x										
Sumatrina cf. *annae*															x										
Armenina aff. *karinae*															x										
Verbeekina verbeeki															x			x							
Pseudodoliolina sp.															x		x								
Sichotenella cf. *ussurica*																x									
Kahlerina cf. *globiformis*																x	x								
Pseudokahlerina discoidalis																x									
Dunbarulla cf. *nana*																x									
D. aff. *kitakamiensis*																x									
Pseudofusulina kueichihensis																x									
P. aff. *rhombiformis*																x									
Chusenella aff. *tieni*																x									
Neoschwagerina ex gr. *haydeni*																x									
N. ventricosa																x	x								
Sumatrina annae annae																x									
S. annae brevis																x									
S. cf. *longissima*																x									
Verbeekina sp.																x									
Kahlerina pachytheca																	x								
Sphaerulina sp.																	x				x	x			
Boultonia sp.																	x								
Chusenella cf. *sinensis*																	x								
Afghanella cf. *fusiformis*																	x								
A. robbinsae																	x								
Verbeekina furnishi																	x								
Pseudodoliolina ozawai																	x								
Reichelina sp.																		x		x	x	x	x	x	
Kahlerina sp.																		x							
Yangchienia thompsoni																		x							
Neoschwagerina sp.																		x	x						
Yabeina (?) sp.																			x						
Schubertella pseudogiraudi																				x					
Reichelina cribroseptata																				x					
Palaeofusulina (Paradunbarula) okayi																					x	x		x	
P. (Par.) ottomana																					x	x		x	
Reichelina changhsingensis																						x			
R. aff. *media*																							x		
Codonofusiella sp.																							x		x
Palaeofusulina (Paradunbarula) sp.																							x		
P. (Palaeofusulina) nana																								x	
P. (Pal.) cf. *simplicata*																								x	
P. (Pal.) simplex																								x	
Palaeofusulina (Paradunbarula) cf. *pamiri*																									x
Sichotenella sp.																									x

g, Gzhelian; as-s, Asselian-Sakmarian; yh, Yahtashian; kb, Kubergandian; m, Murgabian; md, Midian; d, Dzhulfian; dz, Dorashamian.

Period		Carboniferous							Permian																
Stage		v	s	b	b	m	m	g	as-s	yh	yh	kb	kb	m	m-md	md	md	md	md	d?	d?	d?	d?	d?	dz
Small Foraminifers	Samples	1820	1740B	UL46	1863B	1568	UL35C	3528	3368D	1736	90-277	765	3387A	3816	1633E	1526B	2993	4079B	90-274	1589E	3728	4076A	4146	1810A	3707A
Tuberitina sp.		x			x	x												x		x					x
Diplosphaerina sp.		x			x	x														x					
Earlandia sp.		x	x																						
E. elegans		x																							
Ammovertella sp.		x																							
Eolasiodiscus cf. *maximus*		x																							
Howchinia gibba		x																							
Tetrataxis quasiconica		x																							
Palaeotextularia sp.		x													x	x				x		x	x		
Archaediscus sp.		x	x	x																					
A. moelleri gigas		x																							
A. ex gr. *krestovnikovi*		x																							
Globoendothyra sp.		x																							
Endothyra sp.		x	x	x	x	x		x																	
Bradyina sp.		x					x		x							x									
Eotuberitina sp.		x	x		x	x			x		x				x	x	x	x			x	x	x		x
Biseriella parva			x																						
Globivalvulina sp.			x	x	x	x							x	x		x			x	x		x	x		
Glomospira sp.			x		x									x	x	x	x	x	x			x	x		
Endothyranopsis sp.			x																						
Endothyra ex gr. *similis*			x																						
Monotaxinoides transitorius					x																				
Palaeonubecularia cf. *rustica*					x																				
Asteroarchaediscus sp.					x																				
Neoarchaediscus sp.					x																				
Monotaxinoides sp.						x																			
Hemigordius sp.								x								x							x		
Deckerella sp.								x						x	x	x		x							
Climacammina sp.								x	x		x		x	x	x	x						x			
Tetrataxis sp.									x					x		x		x					x		
Pachyphloia sp.													x		x		x								x
Lasiodiscus sp.															x										
Tetrataxis cf. *conica*															x										
Hemigordius aff. *permicus*															x										
H. zaninettiae															x							x	x		
Baisalina sp.															x			x					x		
Langella perforata langei															x					x			x		
Nodosaria dzhulfensis															x	x			x			x			
Cribrogenerina sp.															x		x			x					
Pachyphloia cukurköyi																x			x						
Langella sp.																x									
Kamurana? sp.																x							x		
Abadehella coniformis																x									
Endoteba controversa																x		x					x		
Rectostipulina quadrata																	x	x							
Geinitzina sp.																	x								
Hemigordius reicheli																	x								
Baisalina pulchra																	x								
Pachyphloia cf. *schwageri*																	x								
Nodosaria sp.																		x				x		x	
Geinitzina cf. *postcarbonica*																		x				x			
Spiroplectammina sp.																		x					x		
Agathammina sp.																		x							
Globivalvulina graeca																		x						x	
Dagmarita chanakchensis																		x	x	x	x	x	x	x	x
Bradyina? sp.																		x		x			x		
Neoendothyra reicheli																		x		x	x	x	x		
Hemigordiopsis renzi																			x						
Tuberitina conili																				x					
Nodosaria caucasica																				x	x		x		
N. aff. *postgeinitzi*																				x	x		x		
Geinitzina aff. *inflata*																				x				x	x
Calvezina? sp.																				x					

Period		Carboniferous							Permian																
Stage		v	s	b	b	m	m	g	as-s	yh	yh	kb	kb	m	m-md	md	md	md	md	d?	d?	d?	d?	d?	dz
Small Foraminifers	Samples	1820	1740B	UL46	1863B	1568	UL35C	3528	3368D	1736	90-277	765	3387A	3816	1633E	1526B	2993	4079B	90-274	1589E	3728	4076A	4146	1810A	3707A
Lasiotrochus sp.																				x					
Langella ocarina																					x				
Protonodosaria sp.																					x				
Geinitzina munda																					x				
Pachyphloia cf. *iranica*																					x				
Paraglobivalvulina ? sp.																					x				
Hemigordiopsis sp.																					x				
Pachyphloia robusta																						x			
Multidiscus padangensis																						x	x	x	
Robuloides lens																						x		x	
Hemigordius aff. *japonica*																							x		
Agathammina pusilla																							x		
Pachyphloia conica																							x		x
Geinitzina reperta																							x		
Lasotrochus tatoiensis																							x		x
Nodosaria sagitta																									x
N. delicata																									x
N. armeniensis																									x
Geinitzina postcarbonica scalariformis																									x
G. cf. *ovata*																									x
Angelina ? sp.																									x
Colaniella cf. *media*																									x
C. cylindrica																									x

Tab. 2 - Distribution of small foraminifera in the limestone blocks in the Karakaya Complex. Abbreviations as in Table 1.

the Karakaya Complex. They are characterised by foraminiferal assemblages rich in fusulinids in comparison with those of the same age from the Anatolide-Tauride platform and southeastern Turkey.

2. Different ages of foraminiferal limestone blocks in the three described Karakaya Complex units (the Hodul and Çal Units and the Orhanlar Greywacke, cf. Fig. 4) suggest different sources for the blocks. The dominance of Midian limestone blocks in the Hodul and Çal Units is most probably due to the widespread late Murgabian ? - Midian transgression.

3. The most complete section is represented in blocks from the Hodul Unit. It is comparable with more complete sections in the Tauride nappes (Hadim, Bademli) though differ sharply in the abundance of Permian fusulinid assemblages. This is also true for the Midian limestone blocks found in the Orhanlar Greywacke and Çal Unit. All this indicates that limestones, which were the source for blocks, accumulated in an open outer part of a shelf as compared to the limestones poor in fusulinids which characterise sections in the Tauride nappes.

4. The question on the origin of the exotic limestone blocks in the Karakaya Complex, especially in the Hodul Unit and Orhanlar Greywacke, e.g., whether they were initially deposited in the southern or northern margin of the Paleo-Tethys, cannot be unambiguously answered. The location of the olistostromal belt along the southern margin of the Sakarya Zone argues for a southern derivation of the limestone blocks. On the other hand, apparent differences of the studied fusulinid assemblages from those in the Anatolide-Tauride platform and southeastern Turkey, as well as their similarity with assemblages known in many sections of northern peri-Laurasian areas of the Tethys suggest that the blocks were derived from north. However, Permian foraminiferal biocoenoses similar to those of northern Tethys were likely to occur in southern Tethys as well, if the Paleo-Tethys was not wide at the Turkish paleolongitude, as in this case the northern and southern shelves would fall into the same climatic zone. In such a case, the differences between the studied fusulinid assemblages and those from sections from the Tauride nappes and southeastern Turkey can be explained by the presence of barriers between the outer and inner parts of the peri-Gondwanian shelf. The probability that some of the exotic blocks in the Karakaya Complex came from the north, others from the south must also not be ruled out. Carbonate sequences covering oceanic volcanic islands in the Late Permian were probably a source for limestone blocks in the Çal Unit. A close association of clastic carbonate rocks with products of mafic volcanism indicates synchronism in their formation.

5. In the Hodul Unit, limestone blocks are confined to the upper part of the sequence, which is of Norian age. The Orhanlar Graywacke seems to be also of Triassic age. Thus, the destruction of a carbonate platform and the block formation did not start until the Triassic, probably until the end of it. According to Okay et al. (1996), olistostromes of the Hodul sequence were formed in the frontal part of a major tectonic block (microcontinent) of Upper Paleozoic limestones, which was rifted away from the northern margin of the Anatolide-Tauride platform and moved northward (Fig. 5). In the course of the northward motion of this microcontinent, the Paleo-Tethys closed, and Neo-Tethys opened in its rear. The absence of Lower and Middle Triassic rocks in the limestone blocks and in the matrix of the Hodul and Orhanlar sequences remains enigmatic. This may be due that throughout the Early and Middle Triassic the northward moving block remained above the sea level and had no sedimentation on its surface. In this context the similarity of the Karakaya Complex to the Upper Triassic-Liassic Tauridian flysch series with Permian limestone blocks in the southern Crimea is striking. In the above tectonic scenario, the Upper Paleozoic carbonate blocks in the Hodul and Orhanlar sequences are regarded as being initially deposited along the northern periphery of the Anatolide-Tauride block. However, as discussed above, such an inference is not unambiguously supported from the analysis of foraminiferal assemblages in the Karakaya Complex leaving room for other interpretations.

APPENDIX

Ernst Ya. Leven

Description of the new fusulinid species

Order Schwagerinida Dunbar & Henbest, 1930

Family *Schwagerinidae* Dunbar & Henbest, 1930

Genus *Triticites* Girty, 1904

Triticites ? kozakensis sp. n.

Pl. 2, fig. 16, 18

Holotype. Deposited in the Vernadskyi's State Geological Museum (Gosudarstvennyi Geologicheskyi Muzei imeni V.I. Vernadskogo) in Moscow with number VI-231/2; axial section; Kozak, Turkey; Late Carboniferous, Gzhelian ?

Material. 2 axial and 1 subaxial sections.

Description. Shell rather small, elongate subcylindrical, with bluntly rounded to pointed poles. Mature specimens 5 to 6 volutions; first 3 to 4 tightly coiled, followed by loosely coiled, rapidly elongating adult stage. L = 3.3-5.0 mm, D = 1.1-1.3 mm, L:D = 3-4.2. Spirotheca composed of tectum and fairly coarse keriotheca; its thickness is 0.03 mm in inner volutions and 0.07 mm in last ones. Septa are thin and slightly fluted. Septal folds relatively low, transforming into a broad region of axial reticulation. Proloculus small, sphaerical, with a diameter of 0.04-0.06 mm. Tunnel strongly expanded in the final volutions. Chomata weak but rather conspicuous, present in first 3 to 4 volutions.

Discussion. *Triticites kozakensis* differs from the other *Triticites* in its tigtly coiled and detached juvenarium, subcylindrical shape of shell, and relatively low septal fluting.

Occurrence and age. Kozak Range (sample 3528), Late Carboniferous, Gzhelian ?

Order Schubertellida Skinner, 1931

Family *Palaeofusulinidae* A. Miklukho-Maclay, 1963 emend. Liem, 1974

Genus *Palaeofusulina* Deprat, 1913

Remarks. In 1969, Skinner determined the *Paradunbarula* genus, which according to the initial diagnosis differs from the genus *Palaeofusulina* Deprat, 1913 in small central chamber and in oblique coiling of spiral whorls in juvenarium. In 1981, the *Nanlingella* genus was singled out properly with the same differences from *Palaeofusulina* (Rui & Sheng, 1981). Later, a subgenus *Shindella* differing from *Paradunbarula* subgenus in a large central chamber and a planispiral coiling of whorls in juvenarium was distinguished among *Paradunbarula* (Chedia in Kotlyar et al., 1983). *Nanlingella* is encountered in the same layers with *Palaeofusulina*, whereas *Shindella* is associated with *Paradunbarula*. Undoubtedly, we are dealing in both cases with a sexual dimorphism. Thus, a validity of genus *Nanlingella* and subgenus *Shindella* may be called into question. As far as differences between *Paradunbarula* and *Palaeofusulina* are concerned, these are more considerable than was reported by Skinner. In Chedia's opinion, whose views we share, *Paradunbarula* has a more free coiled spiral and "... a less intense fluting of septa which does not form high archs with parallel sides". Besides, *Paradunbarula* seems to occupy a lower stratigraphic level, although may also occur along with *Palaeofusulina*. Often it is difficult to discriminate between *Paradunbarula* and *Palaeofusulina*.

Thus, we see little reason for distinguishing two separate genera, and prefer to consider them as subgenera of the *Palaeofusulina* genus.

Subgenus *Paradunbarula* Skinner, 1969

Palaeofusulina (Paradunbarula) okayi sp. n.

Pl. 9, fig. 4, 5, 7

Holotype. Vernadskyi's State Geological Museum, Moscow, specimen number VI-231/3; subaxial section; Kinik, Turkey; Late Permian, Dzhulfian (?).

Material. 2 subaxial and 3 sagittal and oblique sections

Description. Shell small, inflated fusiform to subglobular, with convex lateral slopes and bluntly rounded poles; mature shell consisting of 5 to 6 volutions. Inner 1 or 2 volutions are endothyroid and coiled askew to later ones. L=1.3-1.35 mm, D=1.0-1.08 mm, L:D=1.2-1.3. Spirotheca composed of tectum, diaphanotheca and inner tectorium; in the last whorl spirotheca measures 0.03 mm in thickness. Septa intensely fluted from pole to pole; septal folds rounded or triangular and not very high. Proloculus minute. Tunnel moderately wide. Chomata are absent, but in vicinity of tunnel thin secondary deposits may be present on both inner and outer surfaces of spirotheca.

Discussion. The species described resembles *Paradunbarula dallyi* Skinner (1969) but differs from it in its smaller size, relatively test coiled spiral and more orderly septal fluting. It is named in honor of Prof. Aral Okay.

Occurrence and age. Kinik (samples 4146, 3727 and 3728), Edremit (sample 1589E), Zeytindag (sample 4076A); Late Permian, Dzhulfian (?).

Palaeofusulina (Paradunbarula) ottomana sp. n.

Pl. 9, fig. 8, 10, 11, 14

Holotype. Vernadskyi's State Geological Museum, Moscow, specimen number VI-231/7; axial section; Kinik, Turkey; Late Permian, Dzhulfian (?).

Material. 1 axial, 3 oblique, tangential and sagittal sections.

Description. Shell small, inflated fusiform, with straight to slightly convex lateral slopes and bluntly pointed poles; mature specimens have 5 to 6 volutions, coiling is loose, especially in the last volution; first 1 to 2 volutions are coiled askew to later ones; L=1.1-1.4 mm, D=0.6-0.9 mm, L:D=1.6-1.8. Spirotheca thin, composed of tectum, diaphanotheca, and inner tectorium. In the last volutions spirotheca measures 0.4 mm in thickness. Septa moderately but irregulary fluted throughout shell, arcs not high; in equatorial region septa are coated with secondary material; septal pores abundant. Proloculus mostly minute, but one of specimens has relatively large proloculus (megalospheric generation); its diameter measures 0.09 mm.

Discussion. This species differs from the other species of subgenus *Paradunbarula* in its fusiform shape of shell and in its somewhat simple septal fluting.

Occurrence and age. Kinik (samples 3727, 3728 and 4146C), Edremit (sample 1589E); Late Permian, Dzhulfian (?).

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