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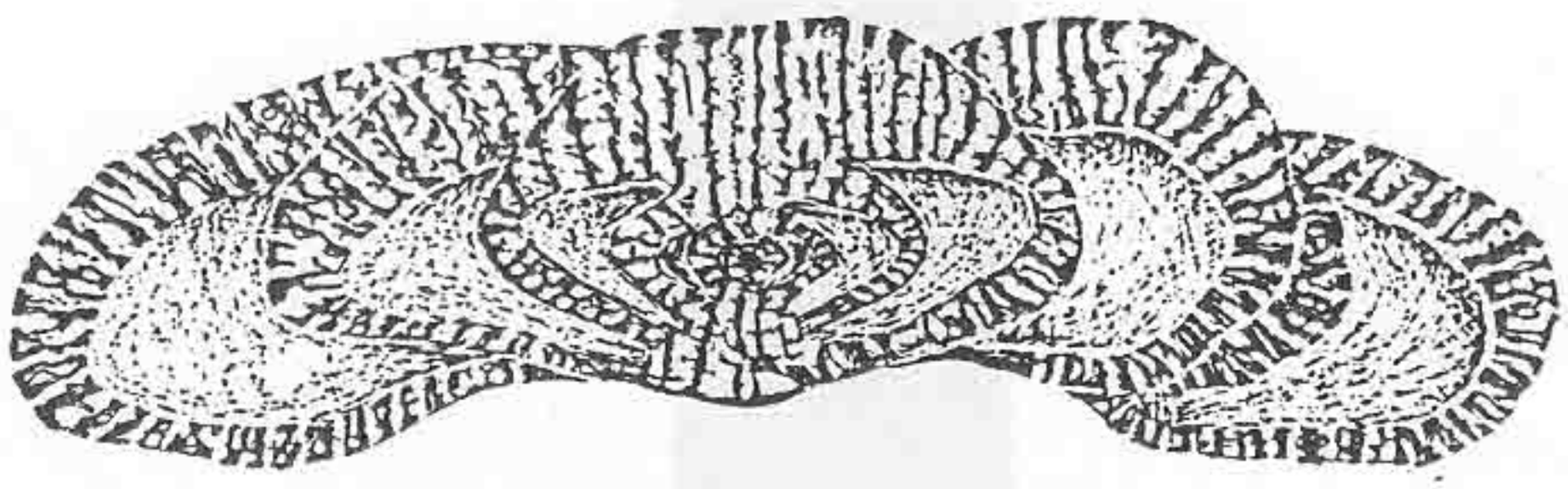

INTRODUCTION TO THE EARLY PALEOGENE OF THE HAYMANA - POLATLI BASIN

FIELD - TRIP GUIDEBOOK

GENERAL DIRECTORY OF MINERAL RESEARCH AND EXPLORATION

STRUCTURAL AND STRATIGRAPHIC FRAMEWORK OF THE CENTRAL ANATOLIAN TERTIARY BASINS

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INTRODUCTION

Anatolia,which is located on the Alpine-Himalayan System, displays the general features of a collision belt. The geology of this area has been developed by continued and very complex convergence of various microplates between the Laurasian continent to the north and Gondwana to the south. The oceanic realm between these continents is called Tethys "sensu lato" (Şengör, 1989) which includes all Tethyan strands without connotation of age, thus including both the Palaeo-and Neo-Tethys. All along its geological history, the diverse entities of this collage represented by numerous suture zone complexes, island-arcs, marginal basins, etc, are thought to have been amalgamated to form an orogene.

To decipher the geological evolution of this mosaic-like structure there had been numerous suggestions (Şengör and Yılmaz, 1981, Robertson and Dixon, 1985). A consensus has not really emerged from these models, despite most being wide-ranging syntheses. On many of the critical issues, such as the number of the oceanic branches, their location, the polarity of subductions, the type of the plate-boundaries etc, there are still many disagreements. The aim of this paper is not to offer our own preferred options but to try to give a simple picture on the tectonic setting of Tertiary Basins in the regional tectonic frame of Anatolia, based on previous work.

MAJOR TECTONIC UNITS AND THEIR CHARACTERISTICS

In NW Central Anatolia, the İzmir-Ankara Suture (İAS), which is generally accepted as being the main Neotethyn suture, separates three major tectono-stratigraphic entities (Fig. 1). These are: Sakarya Microcontinent to the NW, Tauride-Anatolide Block to the SW and S and Kırşehir Block to the SE.

İAS represents the remnants of the northern branch of Neotethys, whose age of opening and closing is quite controversial. It had been consumed by northward subduction resulting in Late Cretaceous-Early Tertiary subduction-related calc-alkaline magmatism in the northern active margin (Galatean arc on Fig. 1). A series of accretionary forearc basins (Görür et al, 1984; Koçyiğit et al,1988) and ensimatic island-arcs (Norman, 1984 ; Tüysüz and Dellaloğlu, 1992) within the İAS, witness the complex nature of the closure. Almost all Tertiary basins we will describe in the following chapter are developed either on top of these accretionary wedge as post tectonic basins or they represent remnant basins of syn-tectonic origin.

Sakarya Microcontinent, which is presently observed asa thrust sheet on the İAS-complex and its Early Tertiary cover,characterizes the northern active margin of the northern branch of Neotethys. İt is composed of a pre-Liassic metamorphic basement, apparently made up of several poorly known (Okay,1989) tectonic units, juxtaposed during the closure of the various strands of Palaeo-Tethys. This basement is overlain with a major unconformity by Liassic clastics which passes up to Middle Jurassic-Lower Cretaceous open shelf- slope carbonates and finally to the Upper Cretaceous sedimentary melange. Early Middle Campanian-Middle Eocene sequences on the sedimentary melange are interpreted as accretionary fore arc basin deposits (Görür et al,1984; Norman, 1984; Koçyiğit et al, 1988; Koçyiğit, 1991). The close relationship of these Tertiary basins on both the İAS and Sakarya Microcontinent is accounted for the initiation of the northward subduction at or very close to the continent/ocean interface along the southern margin of Sakarya Microcontinent (Yılmaz, 1981).

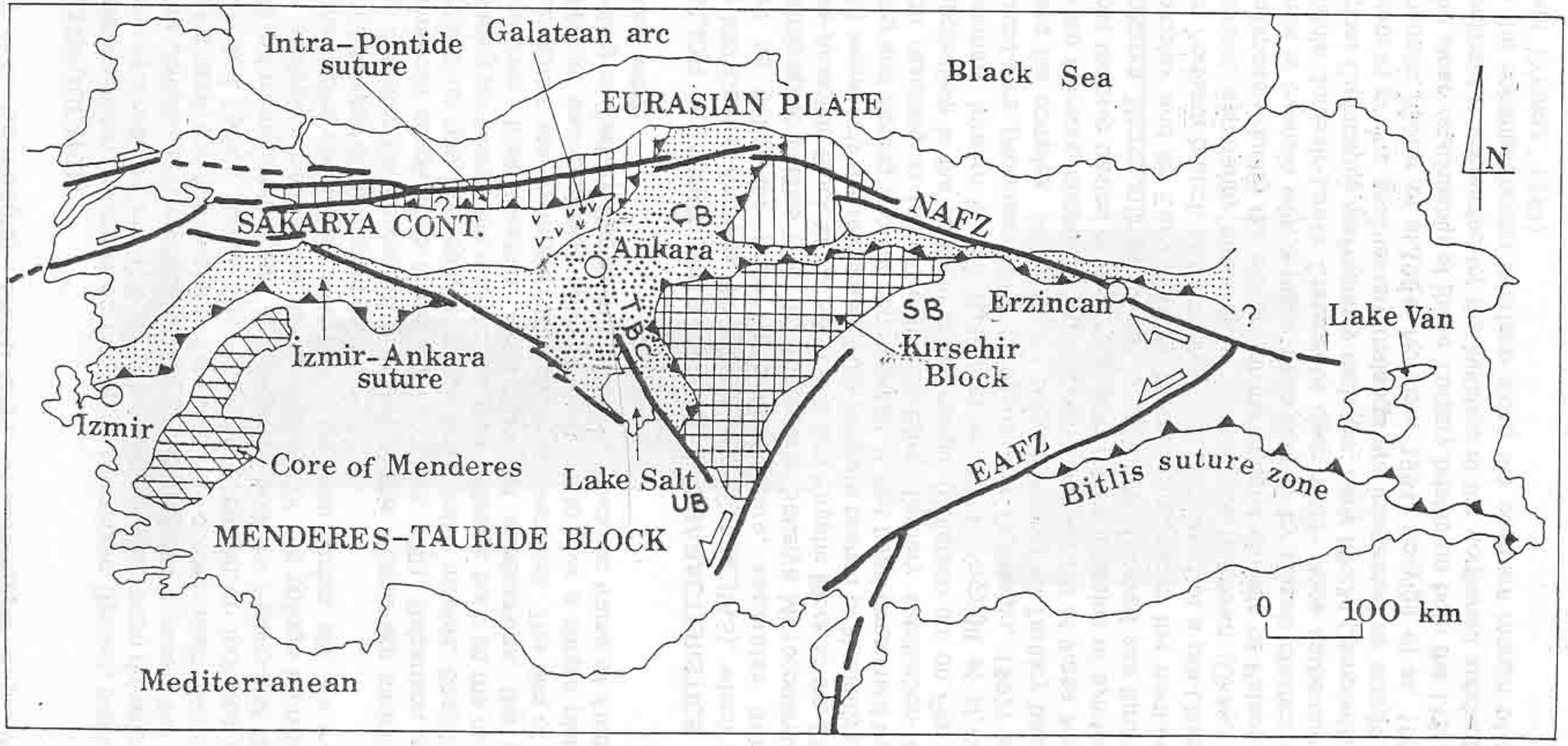
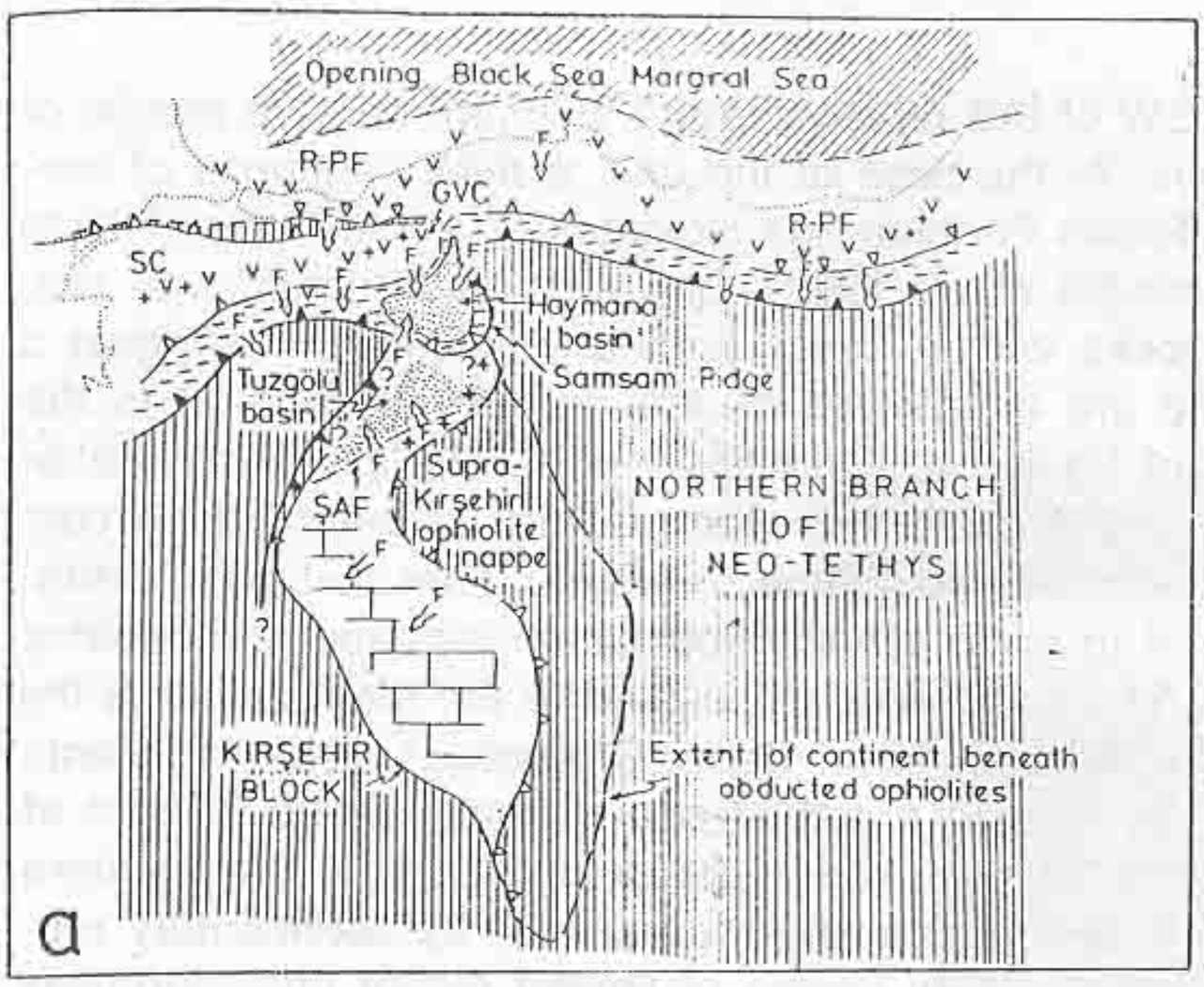


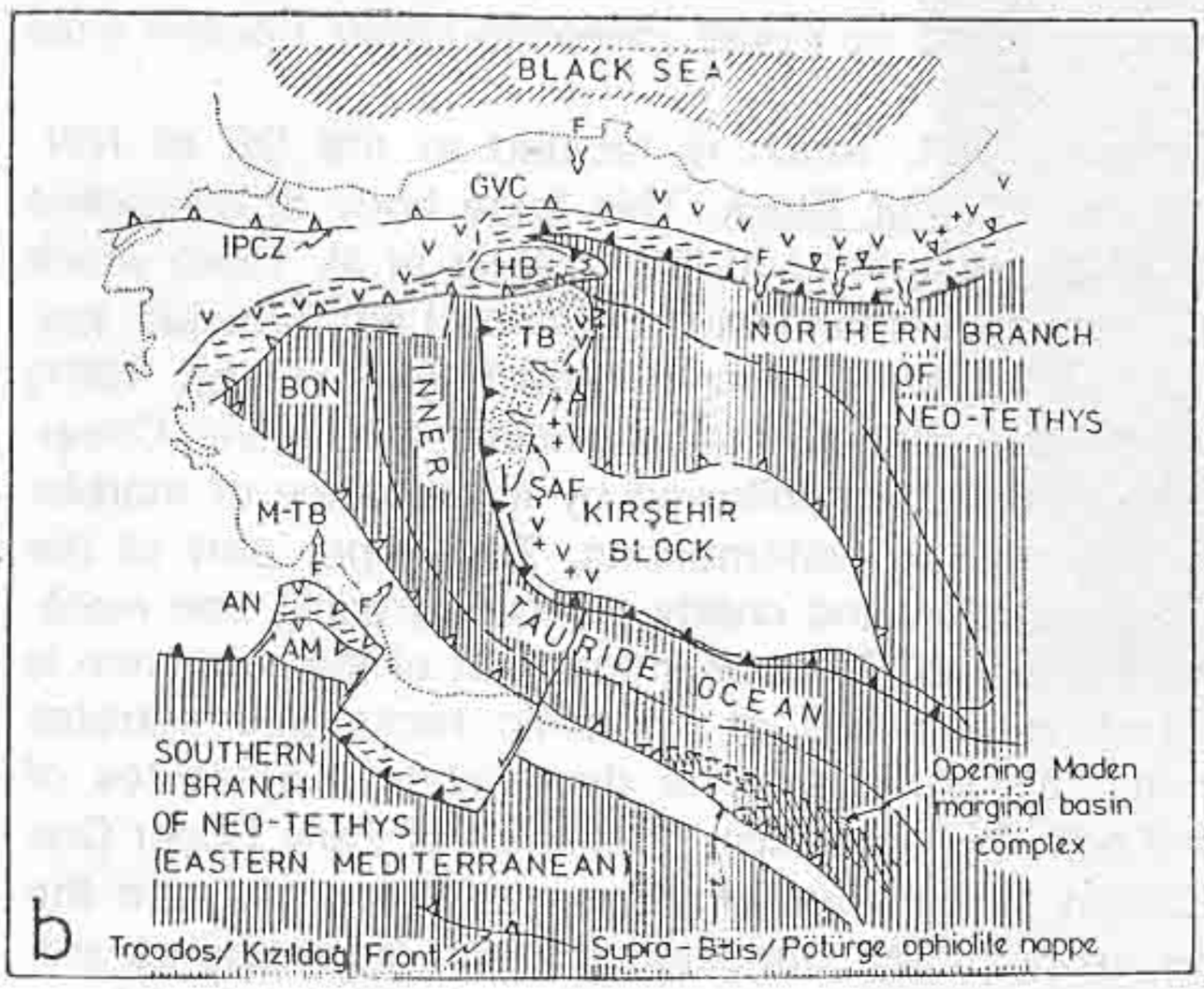
Figure 1. Tectonic map showing the main tectonic units and the location of Central Anatolian Tertiary Basins.Stippled area: İzmir-Ankara Suture ; TBC: Tuzgölü Basin Complex; UB: Ulukışla Basin; SB: Sivas Basin; ÇB: Çankırı Basin; NAFZ: North Anatolian Fault Zone; EAFZ: East Anatolian Fault Zone (after Koçyiğit, 1991).

Tauride-Anatolide Block to the SW of İAS represents the southern passive margin of the northern branch of Neotethys. At the base of the unit, a thick sequence of low-grade metamorphics of Carboniferous-Permian age indicates an Early Palaeotethyan event (Özcan et al,1988; Göncüoğlu et al, 1992). Lower Triassic continental red-beds overlying the basement rocks with a major angular unconformity suggest a rapid uplifting in the region and are interpreted as the rift-deposits related to the opening of the northern branch of Neotethys (Göncüoğlu et al, 1991) between Sakarya Microcontinent to the north and Tauride-Anatolide platform to the south. A continuous and almost complete carbonate sequence of Middle Triassic-Lower Cretaceous age, displaying restricted to open shelf depositional features conformably cover the Lower Triassic units. This sequence is assigned to the stabilization of the northward facing passive margin of the platform. Upper Cretaceous slope sediments following the platform carbonates indicate a subsidence of the platform in front of the southward advancing ophiolitic nappes, which are originated from the northern branch of Neotethys during its initial closure and represented by sedimentary melanges of Upper Maastrichtian age. Tertiary basins of limited extent unconformably overlying the melange units are represented by Upper Paleosen-Lower Eocene shallow marine sediments (Özcan et al, 1989).

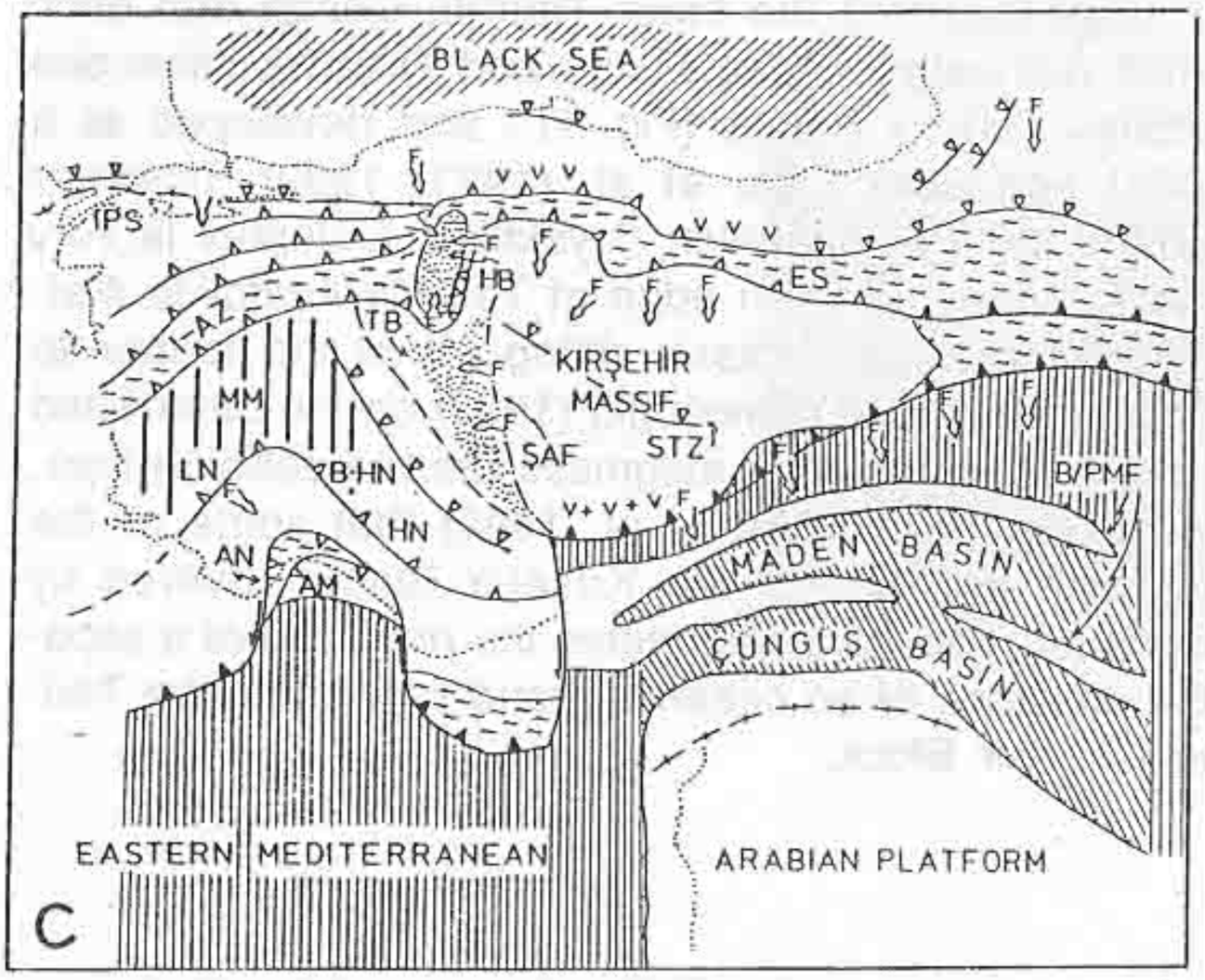
The third major tectono-stratigraphic unit, which is located to the SE of NW-Central Anatolian Tertiary basins, is Kırşehir Block. This huge body of crystalline rocks is suggested to be a microplate (Şengör et al,1981; Görür et al, 1984) which is separated from the Tauride-Anatolide Platform at least since Late Jurassic, leaving a narrow oceanic strand (Inner Tauride Ocean of Şengör and Yılmaz, 1981) behind (Fig. 2). The Block, collectively called Central Anatolian Crystalline Complex consists of high grade gneisses at its base,followed by a sequence of marble-gneiss-amphibolite and calcsilicate -marble alternations. The upper part of the sequence is characterized by thick marbles and cherty marbles grading into meta-cherts, schists and marbles of pelagic origin. The uppermost part of the sequence is represented by metaolistostromes with blocks of ophiolitic rocks and marbles (Göncüoğlu, 1977,1981; Seymen, 1981). A nappe of dismembered ophiolites of Upper Cretaceous age is thrusted onto this sequence. Granitoids of Early Upper Cretaceous (Göncüoğlu,1985) to Latest Cretaceous (Ataman, 1972) age intrude the metamorphics and the ophiolites, respectively. Considering these granitoids as arc-magmatics, Görür et al (1984) suggested that the Inner Tauride Ocean had been consumed by eastward subduction (beneath Kırşehir Block) and Tuzgölü Basin-one of the most prominent SW Anatolian Tertiary Basins (Fig. 1) - was developed as a fore-arc basin. Göncüoğlu (1985) and Göncüoğlu et al. (1991, 1992), however have shown that the stratigraphy of Central Anatolian Crystalline Complex is very similiar to that of the less metamorphosed northern edge of Tauride-Anatolide platform, so that there isn't any indication for a Jurassic rifting off of the former to give way to the Inner Tauride Ocean. Türeli and Göncüoğlu (1992) on the other hand suggested that the granitoides in the region are not magmatic arc but collision type. Recent fieldwork, moreover, indicates (Göncüoğlu, et al, 1992) that some of the metamorphics, previously considered as parts of the Kırşehir Block, covered by Neogene, are allochtonous in character. This data connotates the presence of a separate "Kırşehir Block" and thus the presence of an oceanic strand separating the Tauride-Anatolide Platform and the Kırşehir Block.



(a) Palaeotectonic map of the Late Cretaceous: R-PF = Rhodope-Pontide fragment, SC = Sakarya Continent.

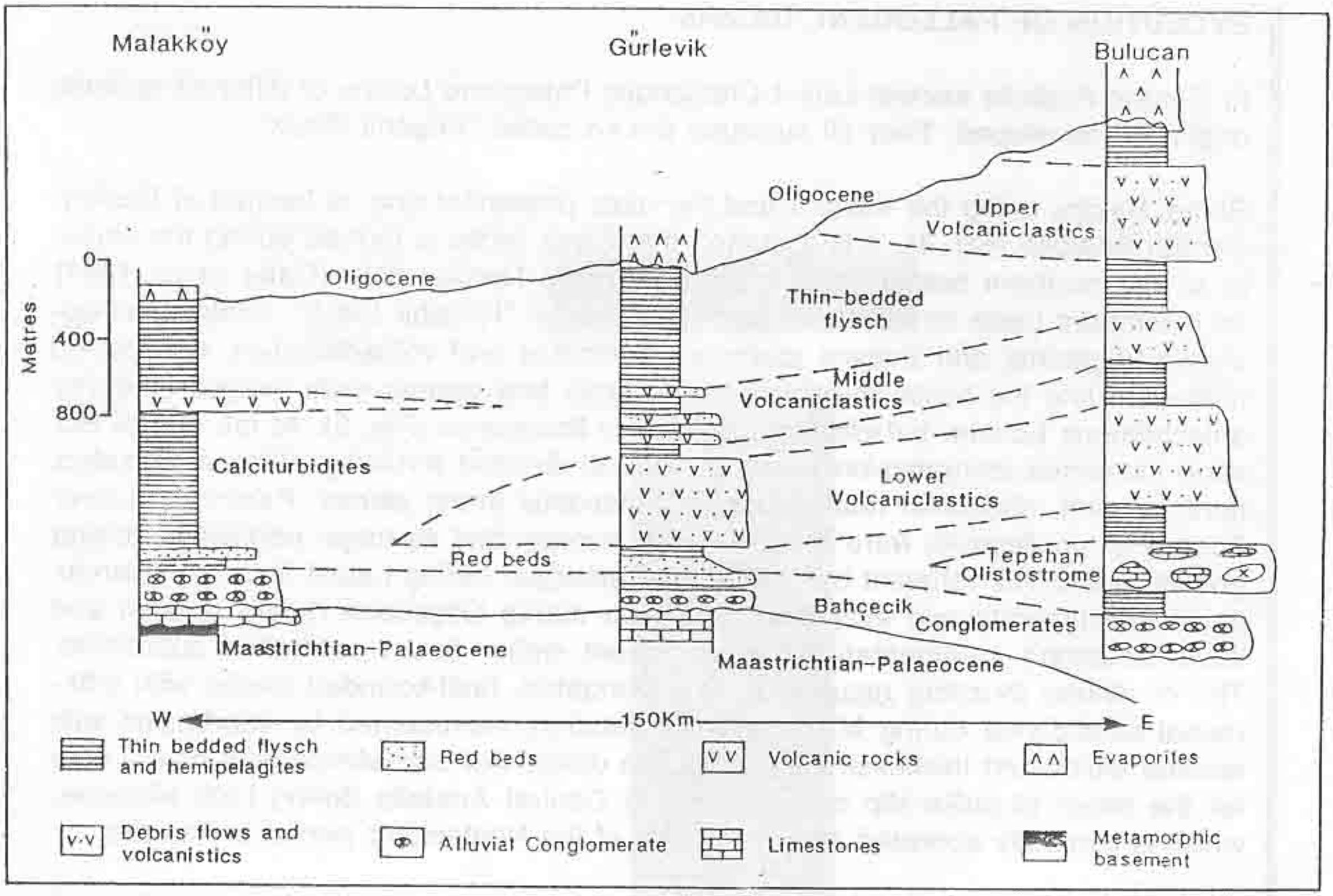


(b) Palaeotectonic map of the Palaeocene: GVC = Galata Volcanic Complex, IPCZ = Intra-Pontide Convergence Zone, HB = Haymana Basin. TB = Tuzgölü Basin, ŞAF = Şereflikoçhisar/Aksaray fault, BON = Bozkır ophiolite nappe, M-TB = Menderes–Taurus block, AN = Antalya Nappes, AM = Alanya Massif.



(c) Palaeotectonic map of the Early–Middle Eocene: IPS = Intra-Pontide suture, I-AZ = İzmir-Ankara Zone, MM = Menderes Massif, LN = Lycian nappes, B-HN = Beyşehir-Hoyran nappes, HN = Hadim nappes, STZ = Savcili thrust zone, B/PMF = Bitlis/Pötürge massif fragments.

Figure 2. Paleotectonic Maps depicting the tectonic evolution of Tuzgölü Basin Complex from Late Cretaceous to Eocene. Stippled area: turbidite depocentres; horizontal discontinious lines: non-turbiditic shales; vv: arc volcanics; ++: arc plutonics (after Görür et al., 1984).



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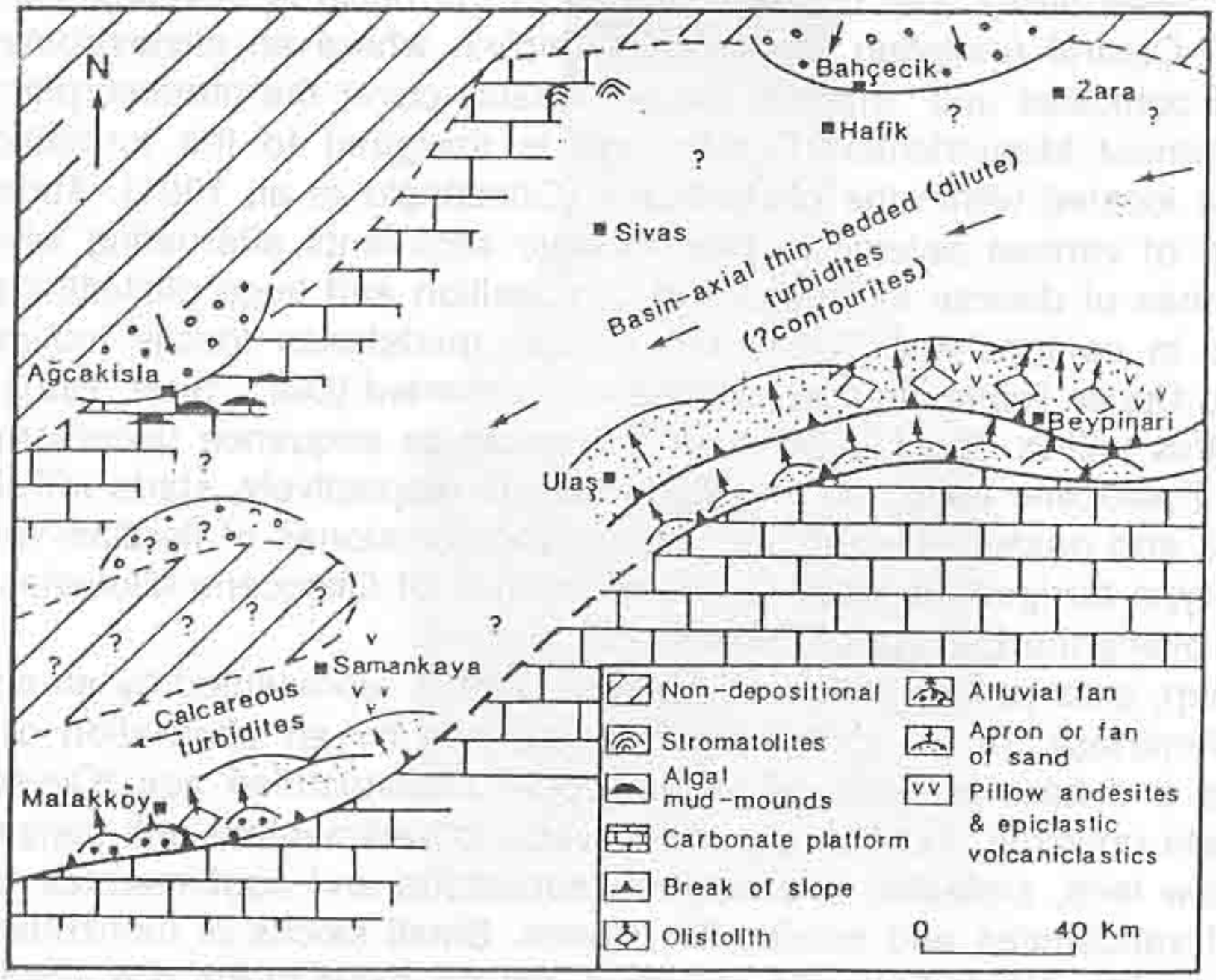

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Figure 3. Stratigraphy (a) and paleogeographic reconstruction (b) for the Eocene of the Sivas Basin (after Cater et al., 1991).

EVOLUTION OF PALEOGENE BASINS

In Central Anatolia several Latest Cretaceous-Paleogene basins of different tectonic origin are developed. They all surround the so called "Kırşehir Block".

Sivas Basin; being the eastern and the most prominent one, is located in Eastern Central Anatolia (Fig. 1). It is assumed that Sivas basin is formed during the closure of the northern branch of Neotethys in Early Tertiary time (Cater et al, 1991) as a remnant basin between the Pontides and the "Kırşehir Block". Cretaceous ophiolitic fragments and Eocene platform carbonates and volcaniclastics, transported northward into the basin as olistoliths and grain flow aprons were incorporated into autochthnous Eocene turbidites and bioclastic limestones (Fig. 3). At the end of Eocene increased compression resulted in north-directed thrusting along reactivated, north-vergent, obduction related Upper Cretaceous thrust planes. Paleocene-Lower Eocene slope deposits were collapsed and incorporated as major northward moving gravity slides. The remnant basin filled and emerged during Latest Eocene, whereas basal unconformity and evaporite deposition during Oligocene record erosion and fluvio-lacustrine sedimentational environment within thrust controlled subbasins. The continued thrusting resulted in N-S elongated, fault-bounded blocks with differential subsidence during Miocene sedimentation, represented by sub-basins with marked facies and thickness variations. The differantial subsidence may give a clue for the onset of strike-slip displacement in Central Anatolia during Late Miocene, which is generally accepted as the initiation of the Neotectonic period in Anatolia.

Ulukışla Basin is located to the south of Central Anatolia, between the Central Taurides and the "Kırşehir Block". İt is separated by the left lateral Ecemiş Zone from the Sivas basin. The northern margin of the basin is developed on the Niğde Massif of Central Anatolian Crystaline Complex, where an olistostrome with huge blocks of ophiolites and marbles unconformably cover the metamorphic basement. An Uppermost Maastrichtian-Danian age is assigned to the turbiditic siltstones which are located within the olistostrome (Göncüoğlu et al, 1991). Above comes a sequence of various pelagic to hemi-pelagic sediments alternating with polygenic olistostromes of diverse thickness and composition and huge olistoliths of andesitic to spilitic in composition. Within the pelagic mudstones fossils indicating Upper Danian to Upper Thanetian age has been documented (Det. : Sirel, 1991). The thickness of this unit is about 2000 m. A transgressive sequence unconformably overlying the Paleocene units and the Niğde Massif, respectively, starts with basal conglomerates and grades upwards into nummulitic limestones of İlerdian-Ypresian age. Molasse-type terrigenous clastics and evaporites of Oligocene-Miocene age unconformably overly the Eocene sediments.

In the deep, axial part of the basin the basement is represented by an ophiolitic melange (Demirtaşlı, et al. 1975) which is covered by an alternation of pelagic limestones and basaltic lavas of Middle-Upper Maastrichtian age (Çevikbaş 1991). They grade upwards and laterally into a volcano-sedimentary unit consisting of basaltic pillow lava, andesite, volcanogenic sandstone and agglomerates with intercalations of sandstones and micritic limestones. Small stocks of monzonite-syenite in composition are intruded into the volcanics. On the basis of the rich fossil content an Early Paleocene to Early Eocene depositional age has been assigned to this sequence (Çevikbaş 1991). The volcanoclastic sequence grades into a turbiditic unit of Lutetian to Bartonian in age. The Paleocene-Eocene volcanics of the Central Ulukışla Basin were interpreted by Oktay (1982) as arc-volcanics, formed by northward subduction of an oceanic crust (Inner Tauride Ocean of Şengör et al. 1982) beneath the "Kırşehir Massif". Recent petrological work on the Ulukışla volcanics, however,

has shown that they are mainly within-plate-type and obviously not arc-related (Çevikbaş, 1991).
Along the southern margin of the basin the deposition starts on low grade metamorphics of Bolkardağı Unit, which represent the northern margin of Tauride-Anatolide Platform. A sequence of the reefal limestones, Upper Maastrichtian-Lower Paleocene in age, is conformably followed by sandy limestones of Lower-Middle Paleocene and flyschoidal rocks of Lutetian (Demirtaşlı et al, 1975).

Tuzgölü Basin Complex, consisting of Polatlı-Haymana and Tuzgölü sub-basins (Görür et al, 1984) is located in the west and northwest Central Anatolia (Fig. 1). Samsam High, an Upper Cretaceous ridge, separates them. Polatlı-Haymana sub-basin will be described in another paper in detail (Günalan, this volume). In Tuzgölü sub-basin numerous geological and geophysical studies have been carried out because of its supposed hydrocarbon potential (Arıkan, 1975; Uygun, 1981; Görür, 1981; Görür, et al, 1984; Oktay and Dellaloğlu, 1991). It is generally accepted that the margin of the basin is formed by Kırşehir Massif. The basin is assumed (Görür et al, 1984) to have a fore-arc setting, although the presence of the fore-arc activities can not be established yet. In the axial parts, Maastrichtian to Middle Eocene distal turbidites are the dominating rock-type.Along the eastern margin (Fig. 4), however, Late Maastrichtian deposition is characterized by terrestrial clastics with coal and evaporite lenses. Upwards and laterally these grade into shallow-marine clastics and limestones, rich in fossils. Upper Paleocene-Upper Eocene deposition starts with an angular unconformity (Oktay and Dellaloğlu, 1991) on Upper Maastrichtian sediments. The lower part of the sequence is represented by continental clastics grading into turbidite and olistostrome bearing open-deep marine sequences. ?Upper Eocene-Oligocene molasse-type deposits with fluvial red clastics and evaporites indicate that the basin was gradually filled by clastic influx from the east (Görür, 1981). During Miocene the terrigenous deposition has continued in small basins where coal-bearing muds alternating with clastics and evaporites are observed. From Tortonian onwards the Neotectonic Regime generated large and shallow intra-cratonic basins, which were controlled by complex fault-systems and were filled by epi-and pyroclastics sediments.

Çankırı Basin, is located to the north of "Kırşehir Block" it is suggested (Tüysüz and Dellaloğlu, 1992) that the basin is developed on top of an orogenic mosaic, consisting of continental microblocks such as Kırşehir and Sakarya and an ensimatic island-arc of Upper Cretaceous-Paleocene age. A transgressive sequence starting with coal bearing continental clastics grade into Nummulite-bearing sandstones of Upper Paleocene-Lower Eocene age. Above comes a flyschoidal sequence of Lower to Middle Eocene (Şenalp, 1980). Olistostromes with huge blocks, derived from the ensimatic arc and ophiolites are conformably followed by Middle Eocene aged clastics. A second cycle of olistostromal clastics with allochthonous blocks and grain-flow deposits is conformably followed by flyschoidal rocks. The uppermost part of the cycle is represented by a regressive sequence characterized by fluvial sediments (Fig.5). Andesites and basaltic andesites alternating with pyroclastic and epiclastic rocks are observed mainly within the Lower Eocene to Middle Eocene sediments. Molasse-type clastic and evaporites of Oligocene age unconformably overly the Eocene deposits, thus indicating the closure of the Çankırı Basin.

AGE		FORMATION UNIT		(m)	LITHOLOGY	EXPLANATION	FOSSILS
HOLOCENE							
PLIOCENE		CİHANBEYLİ		> 100		Mudstone-sandstone alternation (Cyclic meandering river sediments)	
MIOCENE		KOÇHISAR		> 300		Mudstone layered gypsum, clayey limst-sandstone alternation (lacustrine and playa deposites)	
						Brown muds with coal	
OLIGOCENE		YASSIPUR	AKBOĞAZ	120		Evaporites and playa sediments	
				> 200		Conglomerate-sandstone-mudstone (cyclic meandering river sediments)	
EOCENE		KARAPINARYAYLASI	KARAMOLLAUŞAĞI	20–565		Para-conglomerates, sandstone proximal turbidites olistostromes, olistolites, mudstone mud limst	Miscellanea sp Distichoplax biserialis Discocyclina sp. Globoreglia cf tmpressa " cf ehrenbergi " angulata Globigerina cf nilocolinoides " carpulenta " cf. bulloides " eocenea " pseudoeocanea " inaequispira " nilocolinoides Acarinina crassiformis Glomospira charroides Operorbitolites sp. Nummulites sp. Alveolina sp. Orbitolites sp. Cuvillierina sp.
				500 – 1500		Mega-cycles of turbiditic sandstone, thickening upwards	
						Para-conglomerate-turbiditic sandstone, submarine gravity flow deposites	Biantolithus sparsus Cruciplacolithus tenius Markalius inversus Discoaster binodosus " lodoensis " barbadensis " deflandrei " elegans " sniperensis Sphenolithus radians Discoaster gemmifer Fasciculithus papillatum
						Mudstone	
						Algeal limst	
U.PALEOCENE		KARASAYTEPE		15–105		Para-conglomerate-conglomeratic sandstone, debris flow, chanell deposites	
MAASTRICHTIAN		ASMABOĞAZI		> 200		Alternation of conglomerate-sandy limst-mudstone turbiditic sandstone with carbonate banks	Orbitoides medius Siderolites calcitrapoides Orbitoides apiculatus Lepidorbitoides sp. Hedbergella sp. Rulites solutus Vaccinites loftusi Hippurites cornucopiae
		AYYAYLASI		> 100		Para-conglomerate-conglomerate mudstone chaliche alternation, red colored, cyclic debris and mudflow and flood plane deposites	
						Central Anatolian Crystalline Complex and ophiolites	

Figure 4. Generalized stratigraphic column of the Tuzgölü Basin (after Oktay and Dellaloğlu, 1987).

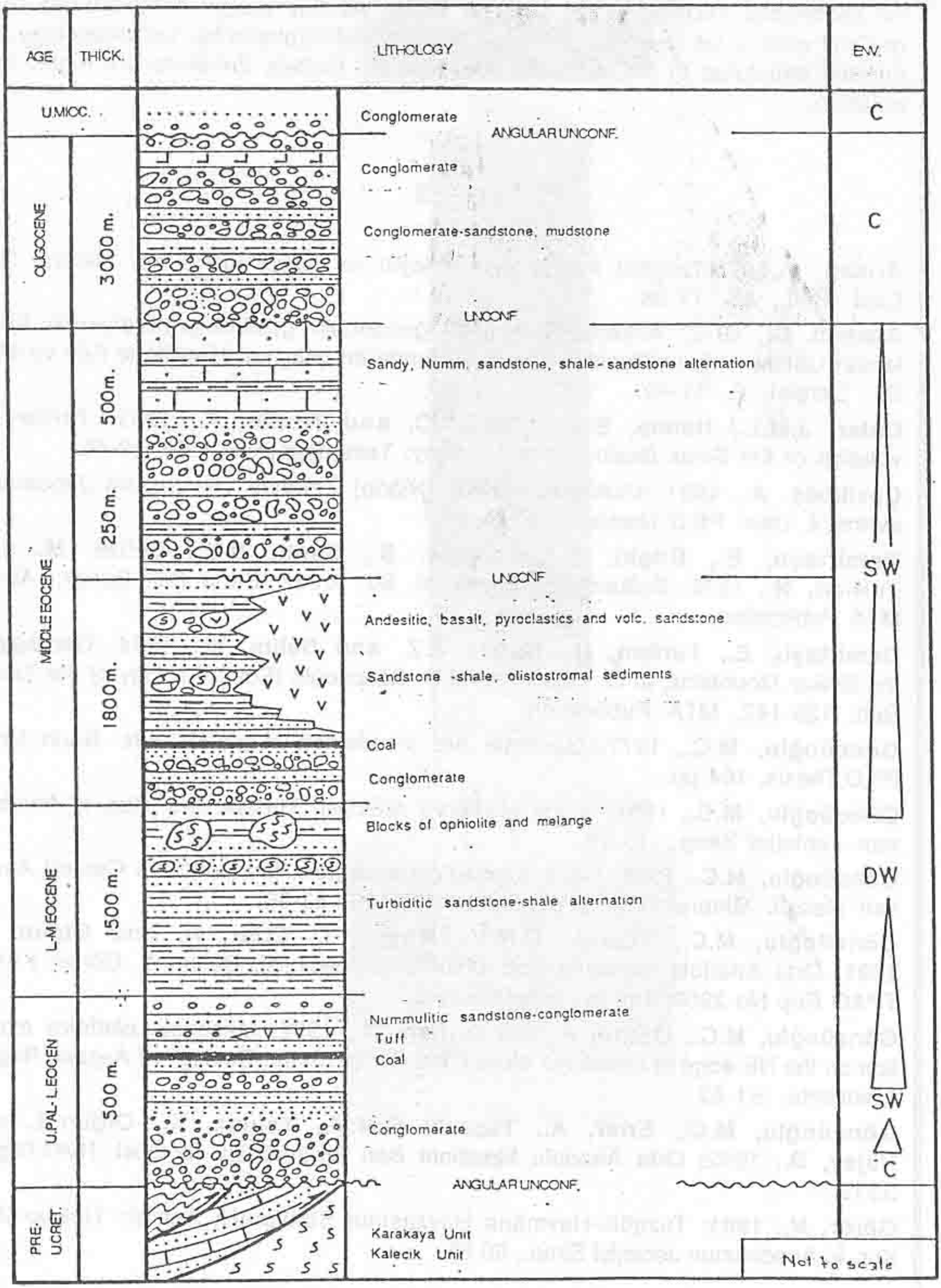

Figure 5. Generalized stratigraphic column of the Çankırı Basin.C: continental; SW: shallow marine; DW: deep marine (after Tüysüz and Dellaloğlu, 1992).

CONCLUSIONS

In Central Anatolia a number of independent but coeval basins are formed during the closure of the northern branches of Neotethys. The most prominent ones are: the Sivas Basin in eastern Central Anatolia, Ulukışla Basin to the south, Tuzgölü Basin Complex to the west and Çankırı Basin to the north. The only common feature of all these basins is that they are formed on accretionary complexes, surrounding a central continental microplate: the Kırşehir Block. As this review demonstrates there are still quite a lot of uncertainties on the detailed stratigraphy, sedimentology and internal structures of these basins. Evolutionary models therefore are highly speculative.

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