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# POST-EOCENE TECTONICS OF THE CENTRAL TAURUS MOUNTAINS

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ABSTRACT.— In post-Eocene time, the Central Taurus mountains have been subjected to four episodes of compression in probably Upper Eocene — Lower Oligocene, Langhian, Upper Tortonian, and Upper Pliocene to recent times. In the Upper Eocene — Lower Oligocene compressional period, Ecemiş, and Beyşehir conjugate faults which have both vertical and lateral components have been formed after a N - S compression. In the Langhian compression period, the Lycian nappes were emplaced from the NW to SE and this tectonic movement has also effected the Antalya and the Adana Miocene basins. In the Upper Tortonian compression period, firstly a WSW-ENE compression has resulted in the formation of Aksu thrust, Kırkkavak oblique reverse fault, Köprüçay syncline, Beşkonak anticline, Radyoring anticline, Taşağıl syncline and Kargı reverse faults. In this period a later phase of N — S compression has formed Çakallar folds, Gökçeler normal fault, the smooth anticline in Mut-Karaman and the syncline in Ulukışla. In the latest compressional period from Upper Pliocene to recent, first on E — W compression which can be recognized by some mesoscopic faults, has been developed and later a N — S compression resulted in the formation of the active faults on Ecemiş and Gökçeler faults, and the Antalya bay graben.

## INTRODUCTION

Central Taurus mountains which extend from Ecemiş fault (Blumenthal, 1952), to Antalya Miocene basin and to the western end of Antalya Upper Miocene-Pliocene basin (Akay et al., 1985) ; are not very well known in terms of post-Eocene tectonic characteristics although this part of the Taurus belt has long been subject of intense studies. Structural implications of the field works carried out in 1981 - 1983 have been evaluated together with some tectonic and stratigraphical features related to the other regions in the Central Taurus in order to establish the post - Eocene structural evolution of the region. Evolution described here is mainly based on macrotectonics with few exceptional microtectonic considerations.

Poisson (1977) described the Lycian phase but his data about the Aksu thrust were limited. Dumont and Kerey (1975) studied the Kırkkavak fault. On the other hand, the Beyşehir fault (Akay 1981a; Özgül, 1976), the Ecemiş fault (Metz,1956; Arpat ve Şaroğlu, 1975; Yetiş, 1984), the Ulukışla basin (Demirtaşlı et al .,,1984) and rather smooth anticline in Mut are (Şaroğlu et al., 1983) studied for the evolutionary tectonic history of the dentral Taurus. N-S compression of the Central Taurus following a E-W compression is also discussed in order to contribute the debate on the Anatolian plate movements.

## PRE - OLIGOCENE STRUCTURAL FEATURES OF THE REGION

Central Taurus region is formed by several units featuring different stratigraphic, lithologic, tectonic and metamorphic characteristic (Fig. 1). Autochthonous Geyikdağı (Özgül, 1976) rock units range in age from Infra - Cambrian (Dumont, 1978) to Eocene (Özgül, 1976; Monod, 1977). On the other hand, other autochthonous unit, Beydağlan, comprises platform carbonates ranging in age from Jurassic to Miocene (Poisson, 1977). Antalya nappes lying between these two autochthonous units comprise mostly deep sea sediments and are originated from a basin between two autochthons (Poisson et al., 1984). Antalya nappes exposed between the Geyikdağı unit and Alanya metamorphits however, are originated from a basin between these two tectonic units Lycian nappes are transported from the NW to SE and emplaced in the Miocene time (Poisson, 1977), The Bozkır unit - Beyşehir Hoyran nappes, which are composed of pelagic limestones of Triassic - Cretaceous and the ophiolite nappe, are emplaced on the partlj metamorphic Bolkar unit comprising rocks of Devonian - Upper Cretaceous (Özgül, 1976 ;Demirtaşlı, 1983) in the Upper Cretaceous (Özgül, 1984; Tekeli et al., 1984; Demirtaşlı et al., 1984). These four, units are retransported and emplaced on the Geyikdağı unit in Upper Lutetian - Lower Priabonian (Özgül, 1976 ; Monod, 1977). The Niğde massif exhibiting high grade metamorphism is composed of Paleozoic-Mesozoic rocks (Göncüoğlu. 1981).

To the east of Ecemiş, fault, Aladağ nappes comprise an ophiolitic nappe and sedimentary rocks ranging in age from Devonian to Cretaceous (Tekeli etal.,1984).

In the Aladağ region, thin, volcanics-free Lutetian deposits transgressively overlie the basement rocks (Yetiş, 1984). On the other hand, to the west of Ecemiş fault, a thick volcano - sedimentary sequence of Upper Maastrichtian - Middle Eocene age, which is quite different from the eastern sequence, is widespread (Oktay, 1982; Demirtaşlı et al., 1984).

Furthermore, to the south of Ulukışla basin, the Bolkar unit is thrusted northwards over the Paleocene - Lower Eocene deposits where an Upper Lutetian sequence covers the thrust contact uncomformably (Demirtaşlı et al., 1984).

## POST - EOCENE TECTONIC FEATURES

Central Taurus belt is subjected to four compressional episodes in Upper Eocene - Oligocene, Langhian, Upper Tortonian and Upper Pliocene.

In the Upper Eocene - Oligocene compressional period, Beyşehir and Ecemiş, faults moved considerably. The lack of any sedimentary sequence indicative of a basin existed before the Upper Oligocene - Miocene basin, shows that the region was uplifted during this compressional period.

In the Langhian period, Lycian and Davraz mountain thrusts, which are covered by the Tortonian sediments, were developed.

In the Upper Tortonian period, the whole region was subjected to an intense compression and gained important structural features. In the post - compressional stage, Messinian:- Pliocene deposits of the Antalya basin covered, these structural features.

The Upper Pliocene-recent compressional period which is defined by some mesoscopic faults exhibits a rather weak activity in the Central Taurus as a whole.

### Ecemiş fault

This fault zone, which is also known as Ecemiş. corridor in the literature, is said to have an important lateral offset (Blumenthal, 1952).

Yetiş, (1984) reports that the Ecemiş fault zone has been developed in post-Paleocene but pre-Lutetian times. However, his data to omit the probability of the development of the fault zone in later times is not sufficient.

To the east of Ecemiş fault, there exist a nonmetamorphic ophiolite and several sedimentary nappe.s formed by disintegration of a platform (Tekeli et al., 1984). Overiying these nappes in a limited area, is the sedimentary sequences of the Lutetian transgression (Yetiş, 1984). On the other hand, to the immediate west of the fault, there are, high grade metamorphic Niğde massif (Göncüoğlu, 1981), low grade metamorphic rocks of Bolkar mountain and an Upper Cretaceous ophiolitic melange (Demirtaşlı et al., 1984). Volcano-sedimentary rocks of Ulukışla basin ranging in age from Upper Maastrichtian to Lutetian overlie both Bolkar mountain metamorphics and the ophiolitic melange (Oktay, 1982; Demirtaşlı et al., 1984). Juxtaposition of metamorphic and nonmetamorphic units nessecitates several tens of lateral offset along the fault zone. Additionally, thin, volcanits free Lutetian deposits (Yetiş, 1984) in the east completely differ from the basinal characteristics of the western Upper Maastrichtian - Lutetian volcano - sedimentary sequences (Oktay, 1982; Demirtaşlı et al., 1984). This situation, therefore, implies that the basins may be juxtaposed by virtue of the fault movement. That is to say that a lateral offset of tens of kilometers should have occurred in or post-Upper Eocene times.

Metz (1956) proposed that the structural evolution of the Ecemiş, corridor occurred after depo-

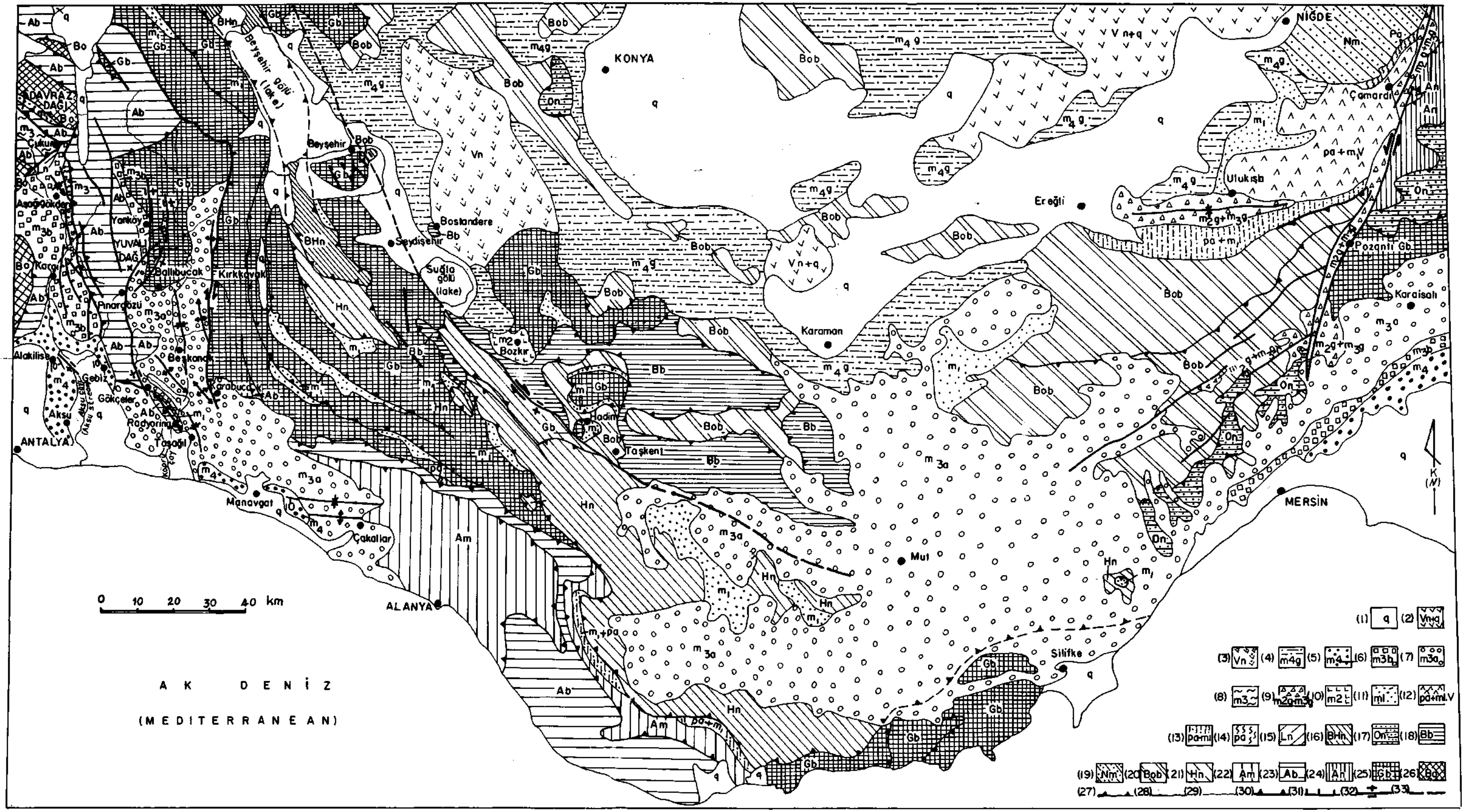


Fig.1– Geologic map of the Central Taurides. 1– Quaternary deposits; 2– Neogene-Quaternary volcanits; 3– Neogene volcanits; 4– Continental Pliocene deposits; 5– Marine Pliocene deposits; 6– Tortonian deposits; 7– Miocene deposits; 8– Lower-Middle Miocene deposits; 9– Oligocene-Miocene deposits; 10– Oligocene deposits; 11– Eocene deposits; 12– Paleocene-Eocene volcanits; 13– Paleocene-Eocene deposits; 14– Paleocene deposits; 15– Lycian nappes; 16– Beyşehir-Hoyran nappe; 17– Ophiolite nappe; 18– Bozkır unit; 19– Niğde massif; 20– Bolkar unit; 21– Hadim nappe; 22– Alanya metamorphits; 23– Antalya unit; 24– Aladağ nappes; 25– Geyikdağı unit; 26– Beydağları autochthon; 27– Pre-Oligocene nappe contact and overthrust; 28– Pre-Oligocene faults; 29– Contact; 30– Post-Eocene overthrust; 31– Post-Eocene reverse fault (A down; Y, up); 32– Post-Eocene normal fault (+) upthrow, (–) downthrow block; 33– Post-Eocene covered structures. (General geology : Göncüoğlu, 1981; Tekeli et al., 1984; Demirtaşlı, 1983; Demirtaşlı et al., 1984; Gedik et al., 1979; Demirtaşlı, 1984; Özgül, 1984; Monod, 1977; Akay, 1981 a; Akay and Uysal, 1985; Akay et al., 1985; Gutnic et al., 1979; Poisson, 1977; Akbulut, 1977; Dumont et al., 1980.)

sition of the Cretaceous sediments but before the Paleogene deposition and Oligocene sediments covered the structural imprints. These Oligocene sediments are equivalent to the Kılan group of Oktay (1982) which are continental sediments overlying the Ulukışla formation (Paleocene - Upper Eocene) with an angular unconformity. Oligocene sediments are dated according to that of Blumenthal (1955) proposed which is Chattian-Aquitanian, Furthermore, Oktay (1982) reports that sedimentation is likely to be continued even in the Lower Miocene. According to these data, the Ecemiş, fault zone should have experienced its major activity at least before the deposition of the Oligocene - Lower Miocene basinal sediments.

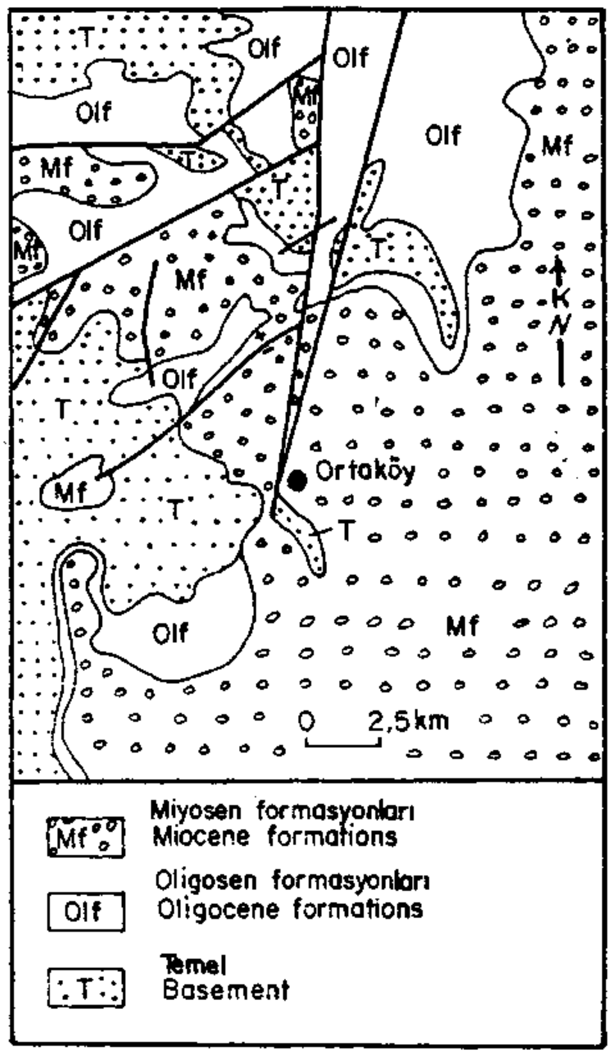


Fig.2 -- Geologic map of the vicinity of Ortaköy (Demirtaşlı, 1983).

In the geological map of Ortaköy region to the south of Ecemiş, fault (Fig. 2), the fault activity is seen to be confined in the shallow-marine Miocene limestone formations. Activity of the fault could be more intense in the north. In this case, the major movement of the fault should have occurred before the deposition of Oligocene formations which are overlain conformably by the Miocene formations.

On the other hand, the Miocene formation in the Ulukışla basin are effected by this movement. The Ecemiş, fault which is oblique to the E-W trending fold (Demirtaşlı et al., 1984) in the Aktoprak formation, dated by Blumenthal (1955) as Chattian-Aquitanian, should have been reactivated dextrally deforming the Miocene formations during this folding. In fact, in Figure 2, the Miocene formations to the south of the fault are seen to be deformed.

Along the fault zone, 10 km to the east of Çamardı, an active fault is found to be lying in the fault trend direction for 10 km. The fault plane is dipping towards the mountains and its mountain side is downthrown without any indication of movement direction (Arpat and Şaroğlu, 1975). Therefore, the Ecemiş, fault zone is a still active zone.

Beyşehir fault

Beyşehir fault which extends from Beyşehir to Taşkent — Mut in Central Taurus, is an important structural element of the Upper Eocene - Lower Oligocene compressional period.

The fault juxtaposes allocthonous and autochthonous lithologies in Beyşehir region (Fig.3)In the Konya sheet of the 1:500.000 scale geological map of Turkey, around Bostandere 10 km to the north of Seydişehir, the map unit which is shown as of Dogger-Malm, is composed of Mesozoic pelagic limestones and green volcanics. They should belong to the Bozkır unit (Özgül, 1976). Beyşehir fault should, therefore, be between these units and the autochthone to the south of Seydişehir. On the other hand, the normal fault which was located in the south of Bozkır - Hadim-Taşkent by Özgül (1976) is the prolongation of Beyşehir fault.

In Beyşehir region, the important offset of the fault is defined by nearly side by side position of the nappes (Monod, 1977) on the Eocene deposits and the autochthonous Ordovician sediments. The Cambrian dolomites of the autochthone extends for about 4 km to the west of another fault to the west of the Beyşehir fault (Fig. 3). However, there is no Cambrian dolomite between these two faults. This, henceforth, shows that the autochthonous slice between the faults has been transported there from elsewhere at a distance of at least 4 km. On the other hand, in the Hadim region cross section of Özgül (1976), the northeastern block of the fault is seen to be considerably downthrown.

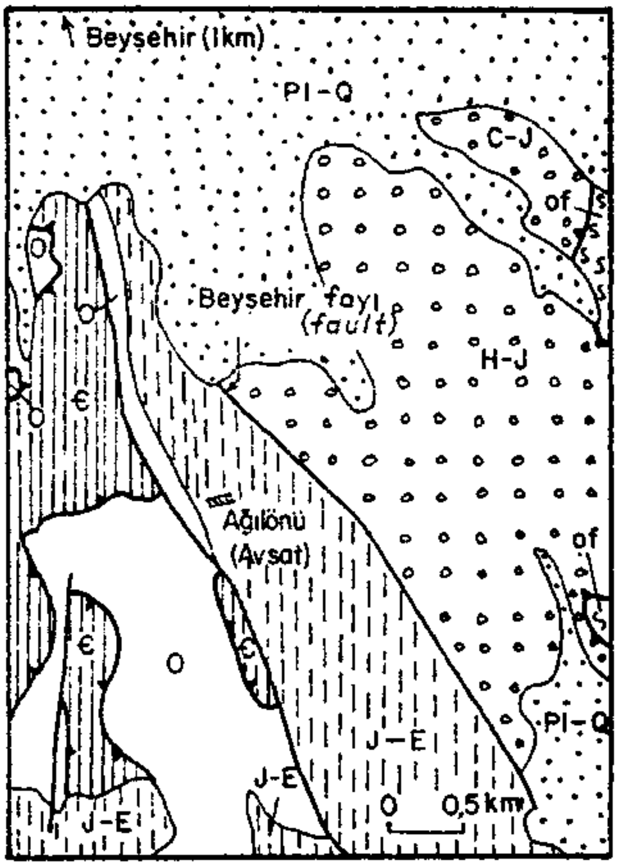


Fig.3— Geologic map of south of Beyşehir : Autochthon: Cambrian dolomite; O- Ordovician detritus; J-E- Deposits from Jurassic to Eocene. Allochthonous : H-J- Deposits from Carboniferous to Jurassic; Of- Ophiolite; PL-Q- Pliocene - Quaternary deposits.

The fault, in Beyşehir region, has been developed after the emplacement of Beyşehir - Hoyran nappes in Upper Lutetian - Lower Priabonian (Monod, 1977) and thus, juxtaposed allochthons and autochthons by its normal slip. The fault itself is covered by Upper Pliocene deposits (Blumenthal:, 1947; Akay, 1981a). Therefore, the fault has been formed during/after the Upper Eocene and before the Upper Pliocene. In the Konya sheet of 1:500,000 scale geological map of Turkey, Miocene limestones cover the fault 14 km to the southeast of Taşkent (N. Özgül 1980 pers. comm.; A.Z. Bilgin 1986, pers. comm.). Actual age of the Miocene deposits has been reported to be (Gedik et al., 1979) as Langhian-Serravalian in the south. Thus, the fault has been developed before the Langhian in this region.

## Emplacement of the Lycian nappes

Lycian nappes, in Isparta region, have been emplaced onto Beydağları and Antalya nappes from the northwest to southeast and they are later covered transgressively by Tortonian deposits (Gutnic et al., 1979). In the same study, it is proposed that the Aksu thrust passes through the south of Kargı - Çukur - Davraz and Isparta region.

However, in the geological map of Çukur region (Fig. 1) the Tortonian deposits of Antalya Miocene basin cover the Davraz mountain sediments, Beydağları Miocene basin deposits and the Lycian nappes. This shows that the Aksu thrust does not continue northwestwards after Çukur. Therefore, the thrust fault passing through the northern end of Beydağları Miocene basin deposits has not been developed as a consequence of Aksu fault as proposed by Gutnic et al. (1979) but as a consequence of Lycian nappe emplacement from the northwest to southeast. Davraz mountain is, thus, partly carried together with the Lycian nappes and emplaced on the Langhian sediments (Poisson, 1977) of Beydağları Miocene basin (Akay et al., 1985).

## Kırkkavak fault

Kırkkavak fault (Dumont and Kerey, 1975) is a N — S trending tectonic line with which the Geyikdağı unit (or Anamas — Akseki autochthone; Monod, 1977) Mesozoic sediments and Antalya Miocene basin (Akay et al., 1985) sediments are juxtaposed. The fault terminates to the south of Kızıldağ before reaching the sea.

Field observations reveal that the Mesozoic sediments overlie Antalya Miocene basin deposits with a high angle fault plane (Fig. 1). There are en-echelon folds has a southwards knee shape, the middle one is symmetrical and the northern fold has high angle flanks. The southern and middle folds make an angle of 35° to the fault whereas the northern fold makes 10°. There is another fold to the east of the fault in Karabucak extending for 2 km parallel to the fault.

On the other hand, to the immediate east of Kırkkavak fault on the northern flank of Yarımkavak stream passing through Kırkkavak, there are north vergent Miocene polygenetic deposits transgressively overlying the Triassic elastics. These deposits have nothing to do with the monogenetic lithology which was reported as the basal breccia of the Miocene basin by Dumont and Kerey (1975). Therefore, the breccia levels should be older.

The fault is formed by the tectonics which is responsible for termination of the sedimentation in Antalya Miocene basin in Tortonian (Akay et al., 1985). Therefore, as a consequence of the tectonic regime (ENE-WSW compression) which is responsible for the development of the Köprüçay folds, the fault has been developed as an oblique fault with both right lateral strike - slip and reverse components.

Dumont and Kerey (1975) report that the fault initially, in or during the Burdigalian, has moved with a right lateral strike - slip and then, in Tortonian, has been subjected to compression.

Dumont and Kerey (1975) assume the brecciated limestones with monogenetic fragments observed along the Kırkkavak fault as the basal lithology of the Miocene basin. The right lateral movement of the fault is proposed according to the structural study of this breccia level. However, as it is indicated before, this level should be older. Therefore, the tectonics effected the breccia level may be older than the proposed age. On the other hand, transgressive occurrence of the Miocene deposits on the Triassic elastics necessitate a considerable erosion of the Jurassic - Cretaceous - Paleogene sediments of the Geyikdağı unit before the Miocene transgression. However, except the Upper Lutetian - Lower Priabonian tectonics (Monod, 1977), any important tectonic episode which could be responsible for this erosion is not known yet in this region. Furthermore, the position of the Kırkkavak fault (Fig. 1) which is compatible with the Upper Lutetian - Lower Priabonian macrostructures (Monod, 1977) indicates that the development of the right lateral movement in Upper Lutetian - Lower Priabonian is very likely if it is compared to the Dumont and Kerey's (1975) proposal.

Occurrence of the Triassic elastics on the Miocene deposits with a high angle fault plane, compatible position of the overturned Miocene deposits along Yanmkavak stream and existance of a 2 km long fold parallel to the fault indicate the reverse movement along the fault. The en-echelon folds related to the fault development are, in turn, indicative of a strike-slip component. Therefore, the Kırkkavak fault which lies at a high angle to the compression direction, should have been active as an oblique fault with a right lateral strike-slip and a reverse components. The compression direction, deduced from the Köprüçay folds, is from ENE to WSW.

Köprüçay folds

The Köprüçay folds comprise Köprüçay syncline, Beşkonak anticline, Radyoring anticline and Taşağıl syncline (Fig. 1).

Radyoring anticline has an axis plunging in both directions and high angle flanks. Its axial trend is NW - SE for 15 km. There are also some small scale folds observed along its continuity towards the sea.

The Taşağıl syncline is 13 km long in NNW-SSE direction. Its eastern flank is gentle whereas the western flank is steep.

The syncline along Köprüçay is an approximately N-S trending, 30 km long and a rather flat syncline.

If the axial trends of all these folds are considered, an ENE-WSW compression can be deduced for this region. The tectonic features mentioned above are, in turn, the results of the tectonic episode which destroyed the Tortonian deposits of the Antalya Miocene basin (Poisson, 1977).

**Aksu thrust**

The thrust lies along a paleosuture zone between the Geyikdağı unit and the Beydağları autochthon, from which the Antalya nappes are believed to have been originated (Poisson et al., 1984).

Gutnic et al. (1979) report that the Aksu thrust, passing through Kargı - Çukur - Isparta region, has been developed with a left lateral movement. However, after some macroscopic observations, it is now known that its extention and the nature of its movement show some differences than previous descriptions.

The thrust can be well traced from Gökçeler in the south to Çukur in the north. It terminates in the south of Gökçeler and does not continue southwards anymore. Gutnic et al,(1979) join the Aksu thrust to another thrust fault in the south of Davraz mountain to the immediate north of Çukur. However, as it can be easily seen on the map (Fig. 1), the Davraz mountain thrust is covered by the Tortonian deposits of the Antalya Miocene basin (Akay et al.,1985) and the Aksu fault which deforms these deposits continues towards north.

The thrust, as observed in Fig. 1, has been developed together with the other thrusts and reverse faults. Between Gebiz and Gökçeler, the rock sequences belonging to the Antalya nappes occur as thrusted over the Antalya Miocene basin sediments. In the south, there is at least 10 km of transportation. It is likely, although without significant data, that the fault is transformed into a reverse fault towards north. The oblique position of a NW-SE fold in Asağı - gökdere in the north indicates that the thrust, in this region, probably moved with a right lateral component. As a consequence of the compression from ENE to WSW which has formed the Kırkkavak fault and the Köprüçay folds, the Aksu thrust has been developed. Existence of a northwards right lateral component is probable. In the light of this interpretation, a left lateral component of the thrust, as proposed by Gutnic et al. (1979), can not be considered.

**Kargı reverse faults**

In the west of Aksu thrust, the lower levels of the Antalya Miocene basin are of conglomerates while in the upper levels they are of sandstone-siltstone alternation (Akay et al., 1985). Therefore, lithological difference and together with bedding position is an important criterian in distinguishing the reverse faults. There are five reverse faults distinguished in Kargı region. There is a 2 km long peridotite exposure along the fault plane in the reverse fault to the north of Gebiz, Antalya nappes lithologies are exposed beneath the hanging wall. Furthermore, in the southernmost parts of this fault, garnet schists together with serpentinite and the other rock units belonging to the basement.

In Kargı region, the thickness of the Antalya Miocene basin deposits is at least 1500 m. Exposure of the basement rocks beneath such a thick cover after reverse faulting necessitates a considerable vertical displacement.

Therefore, the Kargı reverse faults are structural features lying in NNW—SSE direction and which are formed by deformation of Tortonian deposits (Poisson, 1977) and whose eastern blocks are uplifted.

**Çakallar folds**

An anticline and a syncline are observed between Manavgat and Çakallar (Fig. 1). Although the folded Miocene formations are eroded at a great extend, a folding in the order of 25 km is observed.

An anticline of flat and symmetrical folds has a burried prolongation up to the south of Manavgat (Canadian Superiour Oil Ltd., 1973). This, in turn, indicates an E - W trending folding for at least 50 km.

Folding should have developed in the Antalya Miocene basin after the basinal sedimentation conditions which lasted up to Tortonian (Akay et al., 1985). Also, the Upper Miocene - Pliocene basin deposits in the western continuation of the folds (Fig. 1) form a monoclinal towards the south. The lack of the effects of Çakallar folds in these deposits indicates that the Pliocene sediments should have deposited after the folding. Therefore, the Çakallar folds are structures showing considerable E-W elongation and which are formed before the deposition of Upper Messinian - Upper Pliocene sediments of the Antalya Neogene basin.

G6k9eler fault

This vertical fault, trending north to south, passes through Gökçeler and Pınargöz and extends to Yanköy (Fig.l).

The Miocene deposits in Gökçeler, to the east of fault was approximately displaced downward 1000 m. Along the footwall block, some small discontinues Miocene deposites can be traced laterally (Akay and Uysal,1985). To the east of Yuvalı mountain on the north; this fault has been formed as the result of hundreds of meters downward displacement of the eastern block drawing a sharp boundary between basement rocks of Yuvalı mountain and Miocene deposites. The fault to the west of Ballıbucak, in and to the east of Yanköy, however, show different features. Here, the normal faults indicate that the western side of the fault is downthrown.

There is even a fault plane, situated on the extension of fault 4 km east of Yanköy, trends N60°W and dips62°southwest. The latter can be observed in a very young scree deposits located on the western side of Sarpdağ and 1 km south of Katrandiş, area at the elevation of 1700 m. The slickensides on the fault plane make angles of 10° — 20° with the dip direction. There is also a possibility that all the faults east of Yanköy have been active during Quaternary.

North - south trending Gökçeler fault has been generated by the deformation of the Tortonian deposits in the Antalya basin (Akay et al.,1985). This fault dips to the west on the north, and to the east on the south and has been active locally on the north.

Gebiz - Aksu monocline and Manavgat monocline

These monoclines can be seen in the Upper Messinian and Upper Pliocene deposits of the Antalya. basin (Akay et al.,1985). The Gebiz - Aksu monocline dips 5° - 10° to the southwest around Alakilise, Gebiz and Aksu. The fault passing through Alakilise indicates that northwestern side of the break has displaced* downward 50 to 100 meters. The Pliocene deposits around and especially to the east of Manavgat dip 5° - 10° to the south. These structural features do not give much clues about the tectonic which results in the development of Upper Pliocene regressive deposites (Akay et al.,1985). Around Gebiz some small scale strike - slip and thrust faults in the Messinian limestone, however, indicate east - west compressional strain (Fig. 4). According to the micro-tectonic studies of Dupoux (1983) ; there is a young east - west shortening in the large area to the north of Antalya Upper Messinian - Upper Pliocene basin. This latter compressional event is younger than the Tortonian tectonic resulted in Aksu thrust. This contractional province also accounts for the formation of the regressive beds of the basin deposits during the Upper Pliocene time (Akay et al.,1985). On the Aksu - Antbirlik road, small scale faults in the Upper Pliocene deposits, on the other hand, show north-south extension (Fig.4). The area around Aksu and probably in the sea basin to the south indicate that this region developed under north-south extensional regime during the late stage of contractional province.

All the Quaternary deposits in the Antalya Neogene basin are, however, flat and do not give any compressional clues.

TECTONIC EVOLUTION

The compressional strain of post- Lutetian in the Centra] Taurus mountains might be divided into four main phases; namely a Late Eocene-Early Oligocene, a Langhian, a Late Tortonian and a Late Pliocene to present.

The compressional cycle of Late Eocene-Early Oligocene

During this compressional period, Beyşehir and Ecemiş faults, which are now known, have been formed and all the Central Taurus region have been influenced.

One of the most important fault of this cycle is Ecemiş fault and the movement on it has occurred in different times.

In or post-Eocene, before the deposition of Oligocene-Miocene basin, this fault must probably

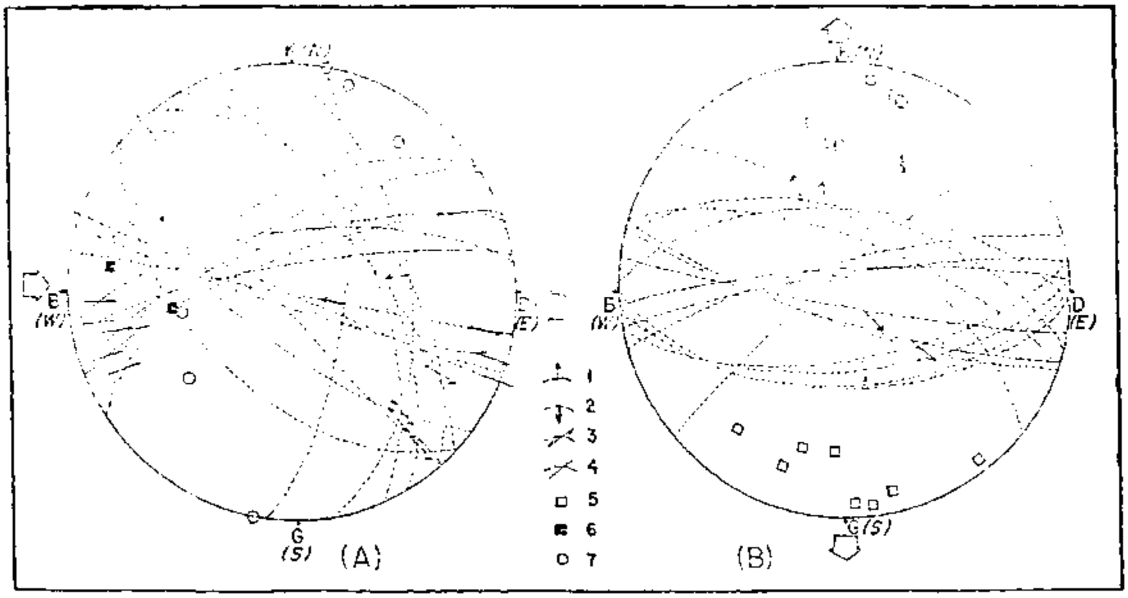


Fig.4 – The fault plane diagrams have been measured in the Messinian limestone on south-east of Gebiz (A) and in detritic deposits of the Upper Pliocene on the Aksu Antbirlik road (B).
1 – Normal fault; 2 – Reverse fault; 3 – Sinistral fault; 4 Fault line; 5 Normal fault pole trace; 6 Reverse fault pole trace; 7 – Sinistral fault pole trace.

have experienced its major sinistral displacement as the first movement. Beyşehir fault, extending along Beyşehir - Taşkent, started to move just before the deposition of Langhian sequence and had at least 4 kilometers lateral movement after the emplacement of Upper Lutetian - Lower Priabonian Beyşehir-Hoyran nappes. The geometric position of Ecemiş, and Beyşehir faults look like they are conjugate faults and they must have moved in the same kinematic. The explanations given above may, therefore, indicate that these faults have been formed by the north-south compression. This contractional regime appears to have developed after the nappes emplacement stage occurred during the Late Lutetian-Early Priabonian times and might be considered as the result of Late Eocene-Early Oligocene orogenic phases which do not have any clues in the study area. Furthermore, the thrusting to the north, covered by Upper Lutetian sequence and on the south of Ulukışla basin, seem to have developed during this time as northerly removement (Demirtaşlı et al, 1984).

Beydağları, Antalya, Mut, Adana Miocene and Ulukışla Oligocene-Miocene basins could be generated just after the relaxation period of Late Eocene-Early Oligocene phase.

Langhian compressional period

This contractional cycle results in emplacement of Lycian nappes and has also affected Beydağları Miocene basin completely (Akay et al. 1985) and Adana Miocene basin partly (Yalçın and Görür, 1984).

The deposition of Beydağları Miocene basin lasted up the Upper Langhian (Poisson, 1977) by the emplacement of Lycian nappes (coming) from north-west to southeast recarried Antalya nappes and replacement of Davraz mountain sequence. During this time, the deposition was continued in Antalya Neogene (Akay et al, 1985), possibly in Ulukışla Oligocene - Miocene (Oktay, 1982; Demirtaşlı et al, 1984) and Mut Miocene basins (Gedik et al, 1979). The deposition in Adana Miocene basins, however, stopped partly (Yalçın and Görür, 1984).In other ward, Langhian phase affected Beydağları Miocene basin completely and Adana Miocene basin partly while deposition was continued in other basins.

After the Langhian phase, affected the area partly, a relaxation cycle developing Antalya Miocene (Akay et al.,1985) and Adana Miocene basins (Yalçın and Görür, 1984; Gürbüz et al,,1985) and deposited transgressive Tortonian deposits. During this time, the deposition (conditions) were continued to the east of Antalya Miocene basin (Akay et al, 1985), in Mut, in Ulukışla and in the south of Adana basin (Yalçın and Görür, 1984).

Upper Tortonian compressional period

The deposits Antalya Neogene basin, caused by the relaxation cycle of Serravalian (Poisson, 1977) — Early Tortonian, were deformed by the strong Late Tortonian phase. The WSW-ENE compressional system has resulted in the formation of Kırkkavak oblique - slip reverse fault, Köprüçay syncline, Beşkonak anticline, Radyoring anticline, Taşağıl syncline, Aksu thrust and Kargı reverse faults. During the late stage of east-west compression, this area has been under north-south working contractional regime and has, therefore, started to develope Çakallar folds and Gökçeler fault. East-west extending folds of Oligocene-Lowpr Miocene deposits in Ulukışla basin (Demirtaşlı et al, 1984) and large scale smooth fold in Miocene limestone (Şaroğlu et al, 1983) around Mut-Karaman were developed during this time. Meanwhile, Ecemiş fault has started to move.and deformed Miocene deposits partly on the south.

After the Upper Tortonian phase, the area has partly been under the relaxation cycle. During this time, transgressive basine sequence has deposited in Antalya Upper Messinian-Pliocene (Akay et al, 1985) and in Adana Pliocene basin (Yalçın and Görür, 1984; Evans et al.,1979). Continental deposits has accumulated on the north of Central Taurus as the result of this period (Fig.l). Upper Miocene - Pliocene volcano-sediments has also developed around Hoyran lake area (Koçyiğit, 1983).

Upper Pliocene to recent compressional period

Upper Pliocene deposits in Antalya basin (Akay et al., 1985) dip 5° to 10° to southwest (Fig.L). Pliocene sequence around Manavgat also dip 5° to 10° to south. Furthermore, observed mesoscopic faults in the Gebiz limestone, which is the base of Upper Messinian-Upper Pliocene deposits in Antalya basin, indicate east-west compressional system. Dupoux (1983), on the other hand, points out that there is a east-west compressional system, which is younger then Tortonian phase, in the northern side of Antalya basin. It is, therefore, possible to conclude that after the relaxation cycle developed during post-Tortonian events, there has been a rather weak E-W compressional deformation influenced the Central Taurus area in Late Pliocene time. During the later stage of this young compressional event, the area has been under the north-south working system. As a result of these, some recent movements have occurred on the Gökçeler and Ecemiş faults and have formed a north-south trending graben in Antalya basin (Özhan, 1983).

Besides, Evans et al (1979) indicates that the southerly thrusting of Messinian evaporites and knee-like folds within the zone, which are controlled by the east-west trending structural features in Adana basin south of Silifke, have been developed as the results of the sliding events within evaporite bedding planes.

In summary, the Central Taurus and the sea basin between Anatolia and Cyprus have been under N — S compressional system since Late Pliocene as indicated before by McKenzie(1972).

## RESULTS

Ecemiş, and Beyşehir faults are two conjugate faults, and their first main movements occurred during the Late Eocene - Early Oligocene orogenic phase.

Lycian nappes were emplaced onto Beydağları in Langhian (Poisson, 1977), and these events affected Antalya and Adana Miocene basins weakly.

During the Late Tortonian compressional period, firstly east northeast-west southwest compression has resulted in the formation of Aksu thrust, Kırkkavak oblique-slip reverse fault and the other structures associated with it as first events. Şengör (1980), on the other hand, indicates that the Central Anatolia has been under east-west compressional system because of the contractional province in Eastern Anatolia.

Antalya Miocene basin has been affected as the result of this compression. Furthermore, North Anatolian Fault (NAF) and East Anatolian Fault (EAF) appear to have developed during this time due to observed convergence in Central Anatolia. After a ENE — WSW compressional regime in Central Taurus, a N — S (working) compression has affected this area and has resulted in the formation of Çakallar fold, smooth fold in Mut (Şaroğlu et al, 1983) and syncline in Ulukışla (Demirtaşlı et al, 1985).

After the short relaxation cycle of post - Tortonian, the deformation in the area, has been east-west compressional again, but rather weak activity. During this time, NAF and EAF, which were formed in Late Tortonian, have experienced their second movements. The latest stage of the east - west compression in Antalya Neogene basin points out that all the area have been under north-south working system. As the result of this north-south compression, some recent movements have occurred on the Gökçeler and Ecemiş, faults, and formed a graben in Antalya bay (Özhan, 1983). It is, therefore, concluded that the Central Taurus region is now north-south compressional system as proposed earlier by McKenzie (1972).

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