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GEOLOGY OF THE SİVAS-ERZİNCAN TERTIARY BASIN

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ABSTRACT. - The Tertiary basin situated between Sivas and Erzincan in Eastern Anatolia display complex sedimentary and tectonic features. Munzur limestones lies to the south of the basin whereas, in the northwest lies the Karaçayır formation. Intrusion of the Refahiye ophioliiic complex took place between Lower Campanian-Lower Maastrichtian and are overlain unconformably by Upper Maastrichtian aged neritic carbonate sediments. These carbonates conformably pass into Paleocene- Eocene aged deep-sea sediments with olistostromal flysch characteristics. Oligo-Miocene and Lower-Middle Miocene aged elastics and carbonates unconformably cover the older units. A fore said elastics and carbonates were deposited in marine, lagunar and continental environmental conditions and the environs in the region are transitional laterally and vertically with each other. Upper Miocene aged evaporitic elastics unconformably cover the lower units. Plio-Quatemary is represented by continental deposits. Lateral movement of the Refahiye ophiolitic complex intruded in the region between Lower Campanian-Lower Maastrichtian took place intermittently and repeated few times with interruptions. As a result of lateral movement (transfer) of the Refahiye ophiolitic complex, a large pan of the Eocene aged Gülandere formation was thrusted over itself in north-south direction and pan of it was enclosed by the ophiolitic complex lower beds were thrusted over the Oligo- Miocene and Lower-Middle Miocene aged units, thus forming overturned folds with East-West strike. During Neotectonic period strike-slip faults of Tecer and Düzyayla were formed.

INTRODUCTION

The Tertiary basin situated between Sivas and Erzincan in East Anatolia, display complex sedimentary and tectonic features. This basin was studied by several researchers and valuable data were gathered (Baykal, 1953, 1966; Blumenthal, 1937; Okay, 1952; Kurtman, 1973; Arpat, 1964; Tatar, 1974; Akkuş. 1964; Norman, 1964; Pisoni, 1965; Demirmen, 1%5; Bulut, 1965; Koşal. 1970; Sestini, 1968; Gökçen, 1976). However as these studies were not directed to the whole basin, satisfactory solutions could not be given to the important problems of the region.

Study area includes Sivas, Ulaş, Divriği, Kemaliye, Kemah, Erzincan, Refahiye, İmranlı and Zara regions (Fig.l). Tertiary basin situated to the north of Erzincan, Kemah, Divriği and Ulaş line is represented by deep sea, shallow sea.

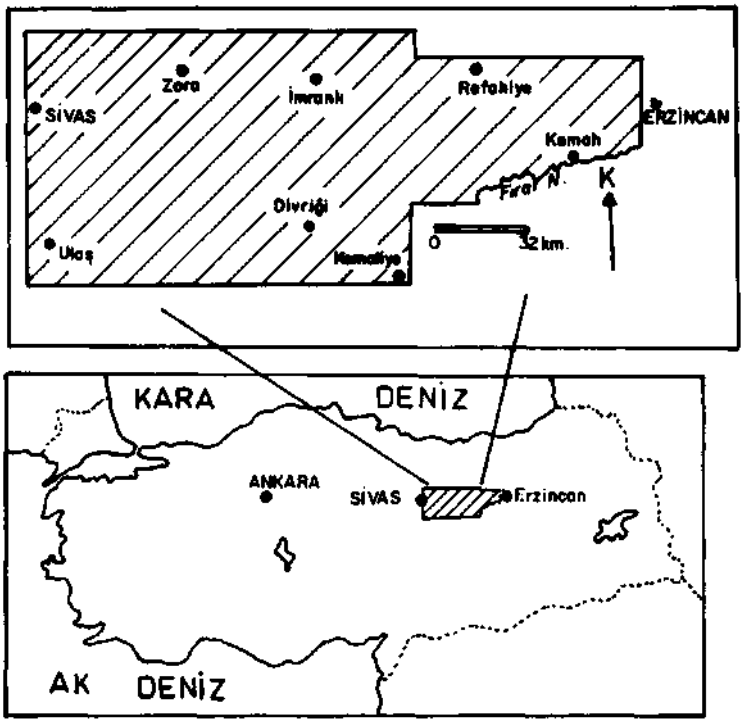

Fig. 1 - Map of the study area.

lagunar and continental sediments between Upper Maastrichtian; and Upper Miocene. The Basin to the south of this line is represented by continental sediments after Maastrichtian. As objective of this study is to exhibit basic geological characteristics of the Tertiary basin situated between Sivas and Erzincan units in the southern Basin were only briefly described. Information for this brief description were taken from the works of Aktimur, 1986; Aktimur and others, 1988; Aktimur, 1988 *a,b* and Tütüncü and Aktimur, 1988.

GEOLOGICAL SETTING OF SİVAS-ERZİNCAN TERTIARY BASIN

On the base of the Tertiary basin covering most of the study area lies the Mesozoic aged Munzur limestones in the south and in the northwest lies the Paleozoic-Mesozoic aged Karaçayır formation. The Refahiye ophiolitic complex which was intruded in the region between Lower Campanian-Lower Maastrichtian overlies these units with tectonic contacts. North Anatolian Fault borders the region in the northeast.

Refahiye ophiolitic complex are overlain by Upper Maastrichtian - Paleocene aged Tecer limestone and Çerpaçindere formation. This formation passes to Eocene aged Gülandere formation with olistostromal flysh character. Oligo-Miocene and Miocene aged marine, lagunar and continental detritics with evaporites and carbonates, are deposited.unconformably on all these units. Plio-Quatemary is represented by continental deposits and by volcanites (Fig.2).

PRE-TERTIARY STRATIGRAPHY OF THE BASIN

Karaçayır formation, Munzur limestone and Refahiye ophiolitic complex occur in the base of the Sivas-Erzincan basin.

The Karaçayır formation

The unit consists of white, brown coloured medium to thick bedded, foliated calc schist, quartz-epidote-albite schist, marble and quartzite conglomerate interlevels, developed in low degree metamorphism. It's thickness is 800 m (Yılmaz, 1981).

Index fossil could not be found in the unit But by comparing Tokat massive, accepted as Paleozoic in age by Yılmaz (1981), with the formation, the formation could be taken as between Upper Paleozoic-Lower Mesozoic in age (Aktimur, 1988).

Munzur limestone

The unit generally consisting of shelf type carbonates is located in the south of the Sivas-Erzincan Tertiary basin Fig.3). According to Özgül (1981), Munzur limestone from bottom to top includes neritic carbonates, oolitic limestones, flint, limestone, limestone with Lamellibranchiate and Gastropoda, reef limestone and pelagic limestone reaching 1200 m's thinckness, and it is deposited between Upper Trias-Upper Cretaceous. Refahiye ophiolitic complex overlies these with tectonic contacts (Özgül, 1981; Aktimur, 1986).

Refahiye ophiolltic complex

The unit, pan of which was also studied by Yılmaz (1975), outcrops in the environs of Erzincan, Refahiye, Kızıldağ, Çavuşdağ, Tecer dağı, Söğütlü, Divriği and in the base of Tertiary basin in the north foot of the Munzur mountains. Refahiye ophiolitic complex generally having mixtures of dark green, dark brown, dark grey coloured, hard, blocky disintegrated dunite, peridotite, serpentinite, amphibolite, gabro also has mixtures of: a) Metamorphites both in green and blue schist facies represented by multi coloured (light brown, grey, dark grey, dark green), thinly foliated, platy, altered, jointed chlorite-muscovite schist, epidote schist, granat schist, calc schist, serizite schist, actinolite-chlorite-albite schist and glaucophane schists; b) Multi coloured (white, whitish yellow, paleblue, dark grey) with breccia structure in lower pans; c) Pink, red coloured, hard, thin to medium bedded, folded radiolarites; d) Multi coloured (green, red, dark grey), in places pillowy structured spilite mixed in place by pelagic limestones; e) Multi coloured (light brown, dark grey, purple, dark red, dark green), pillowy structured, thick bedded, meta-volcanite outcropping with Jurassic limestones; f) Dark grey coloured, hard, jointed, blocky altered metadiabase; g) Dark grey, grey coloured hard, thick bedded, Triassic-Jurassic pseudosparitic limestones bearing fossils of. *Trochammina* sp., *Endothyra* sp., *Doustominidae* sp., *Involutina* sp., *Miliolipora* sp.; h) Cream, grey, light

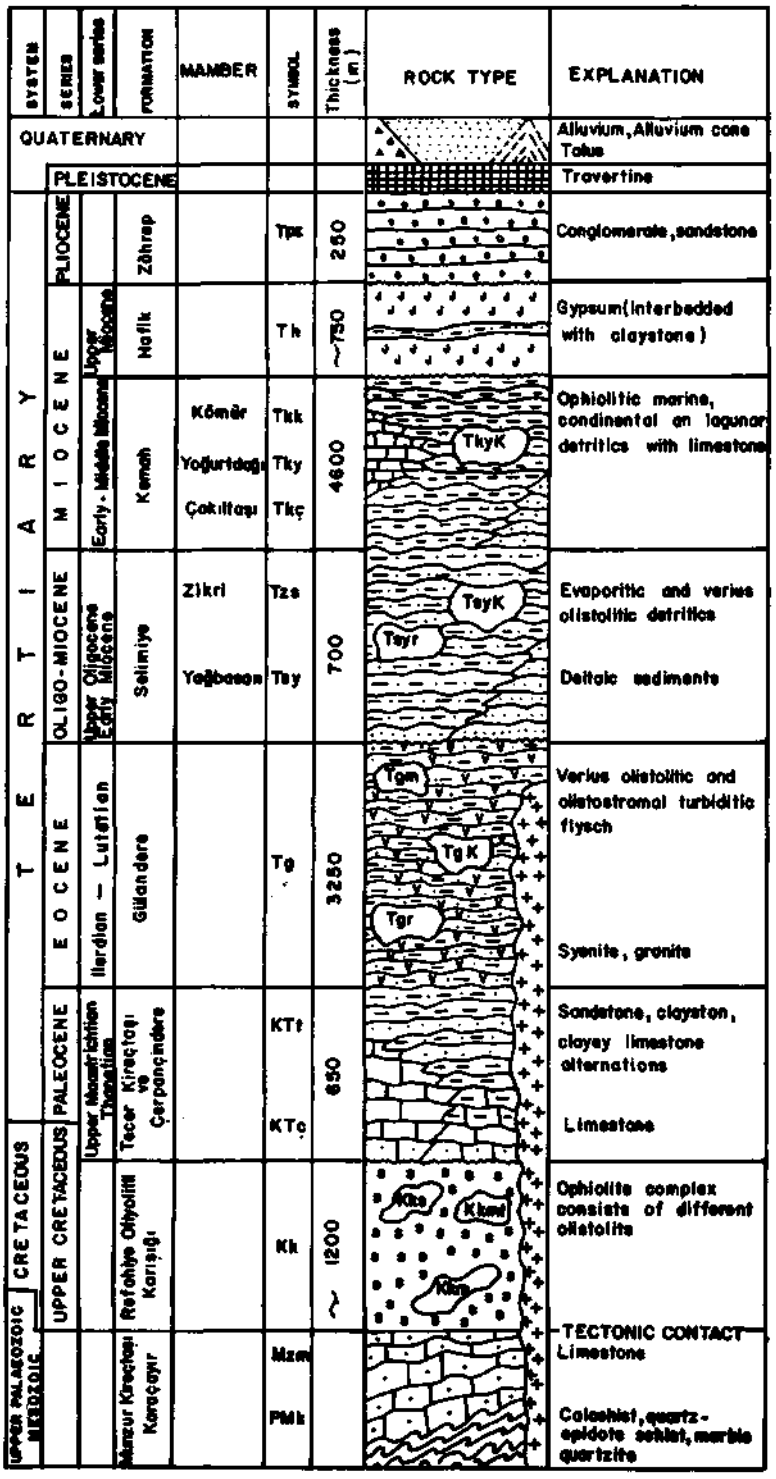

Fig. 2 - Generalized stratigraphic section of the Tertiary basin between Sivas-Erzincan.

gray coloured, thick bedded, calcite veined, colitic, siliceous Jurassic-Lower Cretaceous microsparitic limestone bearing fossils *of Trocholina* sp., *Textularia* sp., Pseudocyclammina, and *Robulus* sp.; i) Black-grey coloured, thin to thick bedded, silica-nodular, platy altered, calcite veined biomicritic Cretaceous limestones bearing fossils of Textularidae, Alg, Opthalmidiidae, *Orbitolina* sp., *Cuneolina* sp., Litualidae, Miliolidae, *Globotruncana tricarinata* (Quereau), *Globotruncana* sp., *Globigerlna* sp., *Globotruncana raselta* (Rarsey); j) Pink-red coloured, thinly bedded, pelagic limestones bearing fossils of *Globotruncana* sp., *Globigerina* sp. Gabros in place cut the rock ur. s they are associated with. Regular slip surfaces are seen in the ophiolitic complex. These surfaces where serpentinization and frequent crushed zones are seen are also important in mineralization aspects:

Refahiye ophiolitic complex was intruded in the region between Lower Campanian-Lower Maastrichtian (Özgül, 1981; Aktimur 1986). But repeated their movement few times until to the end of Miocene (Arpat and Tütüncü, 1978; Aktimur, 1986; Tütüncü and Aktimur, 1988). The unit, overlaying Munzur limestone and Karaçayır formation by tectonic contacts are overlain unconformably by Tecer limestone and Çerpaçindere formation.

TERTIARY STRATIGRAPHY OF THE BASIN

Sivas-Erzincan Tertiary basin in the region, begin with Upper Maastrichtan-Paleogene aged Tecer limestone and Çerpaçindere formation. Çerpaçindere formation gradually pass into Eocene aged Gülandere formation of olistostromal flysh character. Oligo-Miocene aged Selimiye formation and Lower-Middle Miocene aged Hafik and İslamkenti formations deposited unconformably on Kemah formation. Old units are all covered with Pliocene aged continental detritics (Fig.2).

Tecer limestone

The unit outcropping near Tecer and Gürleyik mountains are named as Tecer limestones by Blumenthal (1937). They consist of gray-dark grey, black coloured, medium to thick bedded, jointed, micritic textured limestones in places with alg and fossil fragments.

Thickness of Tecer limestone changes frequently and although seen in places with bedding outcrops of 50 cm's can also be seen with 700 to 750 m's thicknesses. The unit bearing fossils *of Cuneolina* sp., *Discocyclina* sp., *Alveolina* sp., Dasycladacea, *Volvulammina* sp., *Laffitteina bibensis* Marie (A form), *Laffitteina* sp., is aged as Upper Maastrichlian-Paleocene. Furthermore, in a detailed study in Tecer mountain; İnan and İnan (1988) determined the unit to be deposited between Upper Maastrichtian and Thanetian.

Tecer limestone deposited unconformably on Refahiye ophiolitic complex reached it's present location by secondary transfer of the ophiolites in Eocene (Aktimur, 1988). Therefore contact of both Tecer limestone and the underlying ophiolitic complex with the Eocene aged Gülandere formation in places is represented by slip surfaces (Aktimur and others, 1988). This contact was mapped as thrusts by other researchers. Laterally uncontinuous Tecer limestones discontinue under young deposits (Aktimur, 1988).

Çerpaçindere formation

The unit outcrops near Fıdıl mountain, Karadağ, Gülandere and Çerpaçindere. Formation is examined in two sections: Çerpaçin member having successions of conglomerate, sandstone, sandy limestone, clayey limestone and Karadağ basalt having andesite, basalt, tuff and agglomerates.

Çerpaçin member. - The unit comprising successions of sandstone, conglomerate, claystone, clayey limestone, sandy limestone and tuff is generally gray, green, reddish coloured, calcite veined and cross-bedded. Although variable, unit has thickness of 500-600 m's. In upper parts, Çerpaçin member passes gradually into Eocene aged Gülandere formation. This contact in some places are represented by slip surfaces.

In the examples collected from the unit from bottom to top fossils of *Vaccrites ultimus, Pseudopolyconites* sp., *Globorotalia* cf. *pseudobulloides, Globorotalia* cf. *compressa, Discocyclina* sp., *Heterohelix* sp., *Duberretia Kelleri* were determined. According to these fossils units age is Upper Maastrichtian-Paleocene.

Karadağ basalts. - Comprises andesites, basalts, tuff and agglomerates which were extruded in Çerpaçindere formation during deposition parallel to the deposition. Dominant rock is basalt and the unit outcrops near Karadağ.

The unit has a thickness of 250-300 m's and it's contact with Çerpaçin member is represented by a slip surface.

Gülandere formation

Gülandere formation described by Aktimur (1986) consists of the Kozluca formation, Bahçecik conglomerates, Bozbel formation and Kösedağ formation as distinguished by Kurtman (1973). This unit is also the equivalent of Akıncılar and Karataş formations described in the northeast of the basin by Yılmaz and others (1985).

The formation generally having sedimentary rocks of turbiditic flysh character consists of successions of sandstone, claystone, conglomerate, siltstone, tuffs and agglomerates. Unit having andesitic and basaltic lavas also bears olistostromal levels resembling blocks of Refahiye ophiolitic complex.

The formation strecthing in the Tertiary basin between Sivas and Erzincan in some places reaches a thickness of 4500m's. The multicoloured (gray, brown, red, green, blue), thin medium to thick bedded, folded, faulted and jointed unit deposited under different conditions in different localities, as indicated by is the abrupt ending of conglomerate and agglomerate levels, intraformational local discordances and repetitions caused by slip surfacess.

The Gülandere formation transgresses gradually to the Çerpaçindere formation which was deposited in deep sea environment suitable for flysh deposition. Horizontal movements of slip causing repetitions in the sequence and the andezitic-basaltic volcanism, is contemporaneous with deposition. These horizontal movements also dragged the large units (olistolites) broken from Refahiye ophiolitic complex to the deposition basin. According to the fossils of *Discocyclina* sp., *Nummulites* spp., *Ranikothalina* spp., *Alveolina* spp., *Cuvillierina* sp., *Sphaeergypsina* sp., *Globorotalia* sp., *Distichoplax biserialis* (alg) described from various levels of the formation, the units age is Lower-Middle Eocene.

Söğütlü conglomerate

It was defined as Söğütlü complex by Arpat (1964). But due to the unit having only conglomerate, it was named as Sögütlü conglomerate by the authors. In this study area the unit only outcrops in some places near Söğütlü where it is blackish green, red coloured and thickly bedded. Having a thickness of 50m's, pebbles and matrix of the Söğütlü conglomerate consist of serpentinites. Serpentinite cement is replaced by carbonate sediments in upper levels.

The unit overlaying Refahiye ophiolitic complex which was deposited in a mobile medium consists of fossils of *Nummulites* sp., *Operculina* sp., *Discocyclina* sp., *Orbitolites* sp., *Gypsina* sp. According to these fossils, the unit, is Eocene aged.

Selimiye formation

This formation overlaying unconformably Gülandere formation and gradually transgressing in to Kemah formation was first described by Kurtman (1973). Aktimur and others (1988), studied this formation by dividing into Yağbasan and Zikri members.

Yağbasan member. - The member outcropping near Ulaş, Beypınarı, Beydağı and Yağbasan is represented by successions of sandstone, claystone, mudstone, gypsum and conglomerate. It is multicoloured (red, gray, greenish, white), thin to medium bedded, jointed and in places overturned folded. The member deposited in shallow sea, lagunar and continental environs, varies in thickness. The unit having a thickness of 800-900m's begins with conglomerate in some places and with gypsum in others. It's contacts beginning with gypsums, generally include strontium.

The Yağbasan member was deposited in a mobile environment. The unit over thrusted upon itself by slip surfaces formed by the result of the movements which occured during deposition and these movements formed intraformational local discordances. Depending upon these conditions, olistolites of lower beds similar to Refahiye ophiolitic complex, entered the deposition basin.

Fossils of *Peneroplis* sp., *Operculina* sp., *Amphistegina* sp., *Textularia* sp., *Alveolina* sp., Miliolidae were gathered from the examples compiled from Yağbasan member. With these fossils a definite age can not be given. But the unit passing

gradually into Lower Miocene aged Kemah formation is accepted as Upper Oligocene-Lower Miocene (Aktimur and others, 1988).

The Zikri member. - The member generally consists of red-dark red coloured, thin to thick bedded, conglomerate, sandstone and siltstone. Frequent cross -beddings and cross- lamination is observed and the unit has a thickness of 200m's.

Index fossils could not be found in the member which was deposited in deltaic conditions. However it was taken as Oligo-Miocene as it transgresses horizontally to Yağbasan member (Tütüncü and Aktimur, 1988).

Kemah formation

The unit was described by Özgül (1981) and generally consist, of conglomerates siltstone, sandstone and limestones. The formation have some blocky levels, as a result of over thrusting along slip surfaces and then by bending on itself, intra-formational local discordances were formed. Correlated with these characteristics by Selimiye formation, Kurtman (1973) defined the unit as Karacaören, unconformably overlying Selimiye formation.

According to various researches made in the basin, the Kemah formation, was observed to be transgressing horizontally to Selimiye formation and was unconformably covered by Hafik formation. Kemah formation was studied by the members of Çakıltaşı, Kömür and Yoğurtdağı (Aktimur and others, 1988).

The Çakıltaşı member. - The member mostly outcropping near Kemah and generally consisting reddish, green, in places grayish coloured, medium to thick bedded, clay and carbonate cemented, good sorted conglomerate and sandstones transgress vertically and horizontally to The Kömür member.

The Kömür member. - Outcrops near Kemah, Kömür, Kuruçay, Çengellidağ, Beydağı and Sivas. The unit formed by successions of sandstone, claystone, mudstone, clayey limestone and siltstone is multicoloured (red, yellow, white, gray, green) thin to thick bedded, folded, jointed, over turned folded in places, friable and soily altered. It also contains thin carbonate and coal levels.

The Kömür member deposited in continental, lagunar and marine environments has variable thicknesses. In places where repetitions caused by slip surfaces, are seldomly seen, thickness reaches 4500m's.

The unit having fossils of Lepidocyclina *(L. Eulepidina cliatata), Lepidocyclina* sp., *Miogypsina* sp., *Heterostegina* sp., *Miolepidocyclina* sp., *Textularia* sp., *Rotalia beccarii, Globigerinoides trilobus, Robulus vortex, Amphistegina* cf. *haue-rina, Borelis melo, Asterigerina* sp., *Siphonina* sp., and *Ophthalmidium* sp. is aged between Aquitanian- Langhian.

The Yoğurdağı member.- Outcrops near Kemah, Çerpançindere, Kızıldağ, Çengellidağ, Beydağı, the unit formed by limestones is white, dark white coloured, medium to thick bedded, calcite veined, jointed and conchoidal fractured. Limestone in places sandy and clayey has characteristics of intrasparite and biomicrite with alg. Cement is sparry calcite. The Yoğurtdağı member deposited in shallow marine evironment transgresses horizontally to Kömür member. It's thickness is about 700m's.

The member having remains of echinoid and lamellibranchiate also has fossils *of Lepidocyclina sp., Miogypsina* sp., *Amphistegina* sp., *Textularia* sp., *Globigerina* sp., *Peneroplis* sp., *Miogypsina* cf. *globulina* and *Miolepidocyclina* sp. Age of the member is between Aquitanian-Burdigalian.

The Hafik formation

The formation was described by Kurtman (1973) generally outcrops near Kızılırmak valley and Kuruçay. The unit having dominant rock unit of gypsum is formed by white coloured gypsum and successions of multicoloured (red, dark red, green, blue) claystone and sandstone.

The Hafik formation, having a thickness of about 700-750m's, was deposited in a lagunar environment. The unit is overlain unconformably by Zohrep formation.

Fossils *of Amphistegina* spp., *Rotalia beccarii, Robulus vortex, Aurilina* sp., *Krithe* sp. and *Bairdia* sp. were detected in the Hafik formation (Aktimur and others, 1988). Formation is probably Upper Miocene (Tortonian) aged.

The İslamkenti formation

The unit outcropping in northeast of Kuruçay in the west of Erzincan and in the south of Refahiye generally consists of red coloured, medium to thick bedded, conglomerate having pebbles of 2 to 20 cm's in diameter and yellow coloured thin to medium bedded sandstone and tuffs.

Index fossil coult not be found in the formation which unconformably overlies the Kemah formation. But the units age is thought to be Upper Miocene because it is overlaying the Kemah formation and it's correlation with Pliocene aged Zöhrep formation (Aktimur, 1986).

The Divriği formation

The unit only outcrops in the south of Tertiary basin near Divriği. The formation generally starting with pink coloured, thick bedded, good sorted, clay cemented conglomerate is formed by the successions of clayey limestone, claystone, siltstone and sandstone. The unit seen in places with gypsum intercalations and having lake gastropod's and plant remains, is horizontally bedded. An index fossil could not be detected in the Divriği formation which has a thickness of 250m's. But formation is thought to be of Lower Miocene in age (Aktimur and others, 1988).

The Kavak formation

The unit outcrops in the south of the basin near Kavak and Ula$. The Kavak formation approximately having a thickness of 200m's consists of successions of conglomerates, sandstone, clayey limestones and is coaly in places.

An index fossils could not be detected in the unit which is horizontally bedded and deposited in calm lake environments. But with the formation overlain unconformably by Pliocene aged Zöhrep formation, it is thought to be of Middle-Upper Miocene aged.

Zöhrep formation

The unit is represented by grey-greyish coloured loosely cemented conglomerate and sandstones interbedded in places with clay and carbonate.

The formation having a thickness of 150-200m's overlies unconformably the Hafik and the Kavak formations. The unit having fossils of *Candona angulata G.* W.Müller, *İlgocypris gibba* (Ramd), *Condona* sp., *Valvata Atropidina* cf. *pulchella* (Studer) is Pliocene aged.

The Dumluca formation

The unit having pinkish gray tuffs at the bottom has dark coloured basalts at the top.

Due to tuffs, lateraly transgression to Zöhrep formation, units age is taken as PIio-Quaternary.

MAGMATISM AND VOLCANISM

Magmatism

A unit with rocks of syenite, granite and granodioritc, outcrops near Divriği, in the south of the Tertiary basin. This unit, which is a product of Eocene magmatism and having mineralized zones, effected the Munzur limestones, Refahiye ophiolitic complex, Çerpaçindere formation and Gülandere formations.

Volcanism

From time to time; In the stratigraphy section andesitic and basaltic volcanism products are mixed in to the depositional environment.

TECTONIC FEATURES OF THE REGION

In the Tertiary basin between Sivas-Erzincan four structural stages, namely the Pre-Upper Maastrichtian, the Pre-Upper Lutetian, the Pre-Tortonian and the Upper Miocene-Present were observed.

The Pre-Upper Maastrichtian stage

Between the Lower Campanian-Lower Maastrichtian the Refahiye ophiolitic complex overlies the Mesozoic aged Munzur limestone situated in the south of the Tertiary basin and the Paleozoic-Mesozoic aged Karaçayır formation situated in the north west of the basin (Özgül, 1981; Aktimur, 1986). After the intrusion of the ophiolite to the region, detritics of depositional period beginning with Upper Maastrichtian were developed by post-tectonic events. The overlies the lower units with angular unconformity.

The Pre-Upper Lutetian stage

After the intrusion of the ophiolite, in the region, in the beginning, a shallow basin, where rudist could live, was formed. Later this basin was transformed into deep sea basins, suitable for flysh deposition. This basin is probably a depression in the front of an ophiolite nappe advancing from north to south. The carbonate deposition coritinued in the basin's margins between Upper Maastrichtian-Thanetian period (Tecer limestone).

Together with the development of the above-mentioned basin, and as a result of significant gravity slides an olistostrom carrying all kinds of olistolites from the formerly deposited formations in the vicinity began to develop. In the end Refahiye ophiolitic complex in the region was again thrusted probably in Lutetian. As a result of this over thrust Tecer limestone together with the underlaying ophiolites moved in to the Eocene basin to be located at its present location and most of the Gülandere formation was over thrusted over itself by sliding in the north-south direction and a part of the formation was incorporated in the ophiolitic complex.

The Pre-Tortonian stage

At this stage, Upper Oligocene, Lower-Middle Miocene aged marine, lagunar, continental detritics and carbonates were deposited unconformably on the lower series. The units deposited in all three environments transgresses vertically and horizontally with each other and processes with characteristics resembling the ones of Pre-Lutetian stage were also developed at this stage. Third over thrust of the ophiolitic complex started probably between Aquitanian-Burdigalian and entered the deposition basin as an olistolite. Rock associations in the basin over thrusted over themselves resulted in repetitions. In the end, Refahiye ophiolitic complex and with the successions deposited between Maastrichtian Lutetian, thrusted over Oligo-Miocene and Lower-Middle Miocene aged deposits along east-west trends and caused, over turns in the northern limbs of the Miocene synclines.

The Upper Miocene-Present stage

At this stage Upper Miocene aged marine, lagunar, continental detritics and carbonates were deposited unconformably on the lower units and Pliocene aged continental detritics were also deposited unconformably on these. As a result of probably Pre-Pliocene aged North-South compression, Upper Miocene aged Hafik formation was folded with east-west strike. After these events, transform fault of North Anatolia and East Anatolia were formed and started the movement of Anatolian continent in the west direction (Şengör, 1980; Şaroğlu and others, 1987). All these events caused to form strike slip faults of Tecer and Düzyayla and travertine deposition started as a result of these faults (Fig. 3).

CONCLUSIONS

Ophiolitic complex was intruded in the region between Lower Campanian-Lower Maastrichtian. But repetitive over thrusting of the ophiolitic complex with interruptions continued until the end of Lower Miocene.

The vertical transgressing of the Upper Maastrichtian-Paleocene-Eocene aged detritics overlying ophiolitic complex were determined.

Oligo-Miocene and Lower-Middle Miocene aged detritics with carbonates deposited in marine, lagunar and continental environmental conditions were determined to be transgressing vertically and horizontally in themselves.

In Pre-Tortonian stage the lower units were thrusted upon Oligo-Miocene and Lower-Middle Miocene deposits in the east-west direction.

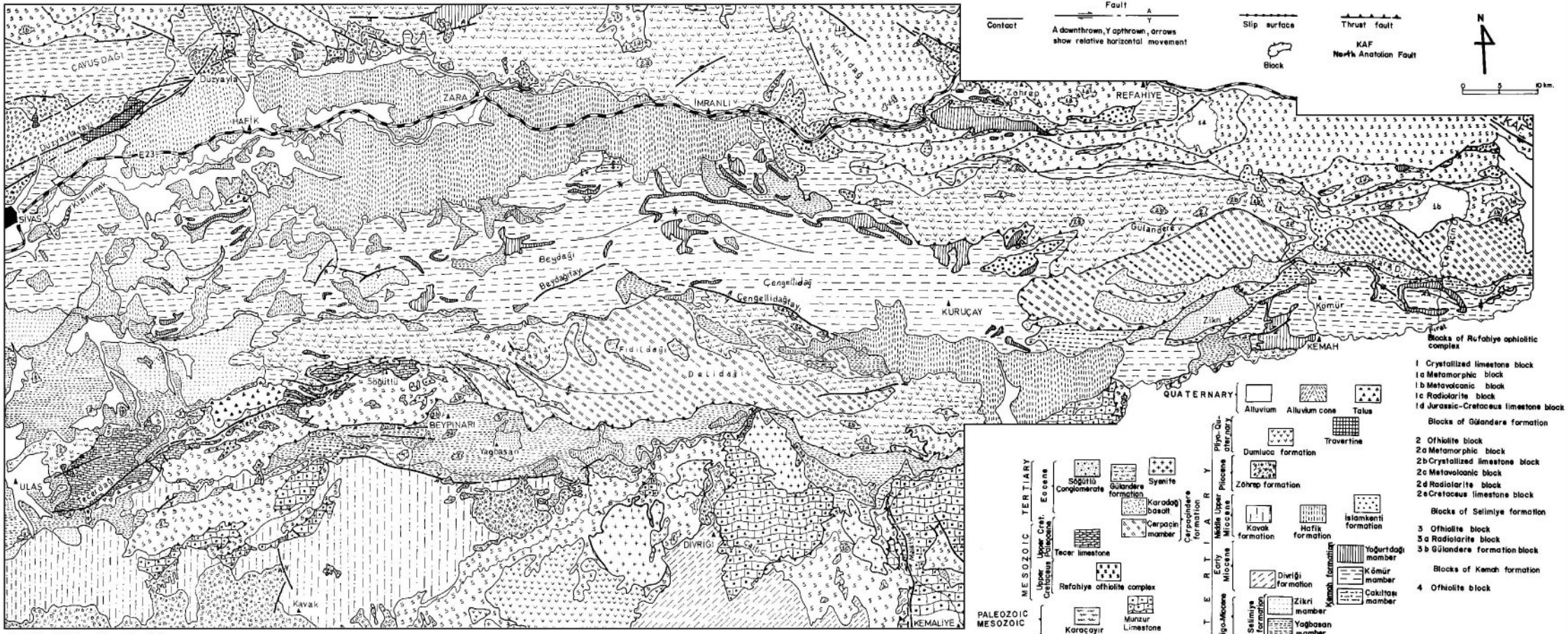

Fig. 3 - The geological map of between Sivas-Erzincan

Land forming in the region starting partly in Upper Lutetian, completed it's development in Upper Miocene.

Strike-slip faults of Tecer and Düzyayla were formed during neotectonic period and travertines relating to these faults were deposited.

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