

DEFORMATIONAL STAGES OF THE UPPER CRETACEOUS-TERTIARY ROCKS IN THE AREA AROUND ORHANIYE AND MEMLİK VILLAGES-NORTHWEST ANKARA

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ABSTRACT:

In the investigated area successive deformations are exhibited in the Upper Cretaceous-Miocene series due to the subduction and continental collision in the Northern branch of Neotethys. Four deformational stages (D1-4) can be recognized in the series, the first two (D1-2) of which may represent the independent events. The main deformation (D3) takes place towards the end of Mid-Miocene time in this period due to continental collision. Last stage affected the previous structures as the late events of D3. The tectonic linaments of the region extend in NE-SW and NW-SE directions.

INTRODUCTION

The area in the northwest of Ankara (Figure 1) includes a series of rocks ranging in age from Upper Triassic to Pliocene. The whole region had been controlled by tectonic regimes in different character during the pre-Liassic, Liassic-Maestrichtian and Maestrichtian-Tortonian (?) times. Maestrichtian-Tortonian time interval is the closing period of the northern branch of Neotethys (Şengör and Yılmaz, 1981). The rocks had been deformed successively by the stresses, mainly in compressive character in this period in the region.

In spite of numerous studies carried out in this area and its near vicinity, the published ones are fairly less (Erol, 1954; 1956; 1961; Erk, 1957; Ünalın, 1981). The aim of this short paper is to present the structures of the Upper Cretaceous-Tertiary rocks in particular in the area between Orhaniye and Memlik villages (Figure 2) based on mapping on a scale of 1/25 000.

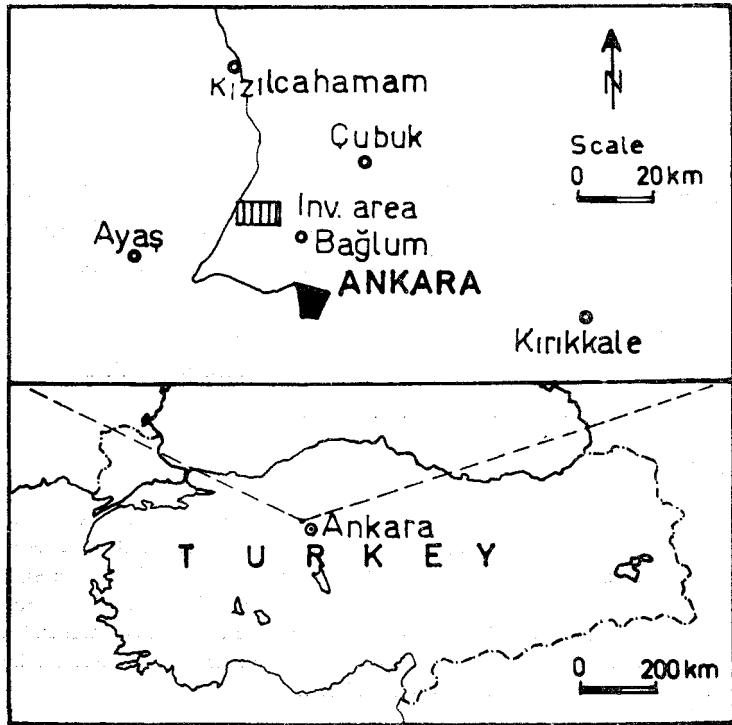


Figure 1. Location map of the investigated area.

OUTLINE OF GENERAL STRATIGRAPHY

The oldest rock unit of the region is the epimetamorphic occurrences of the Middle and Upper Triassic age (Akyürek et al., 1984). This unit (Dikmen greywackes of Erol, 1956) composed of meta-sandstone, metagreywackes and clayey schist alternations, is overlain by a polygenic conglomerate of Liassic age. However this unit does not specifically present a typical basal conglomerate features (Varol, 1982 personal comm.), but documents the opening of the Northern branch of Neotethys. Liassic is followed by red coloured marls alternated with clayey limestones (ammonitico-rosso) and white coloured cherty limestones of Middle and Upper Jurassic ages concordantly. The following lithostratigraphical unit is ophiolitic melange occurrences of Senonian time (Ünalın, 1981) which exhibit tectonic contacts with the older units. The ophiolitic melange is covered by a sandy

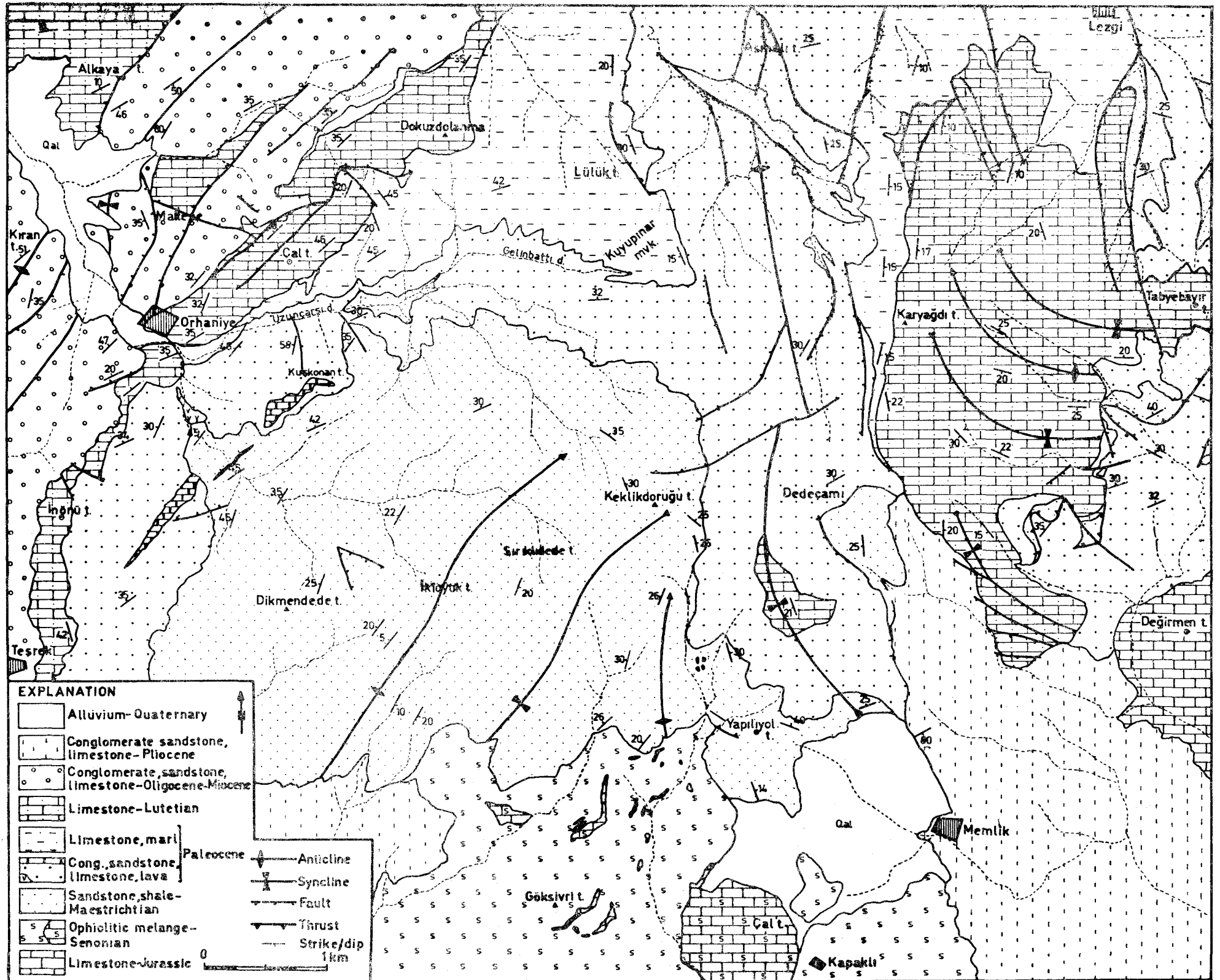


Figure 2. Geological map of the investigated area.

flysch sedimentation of Maestrichtian age. The continental Paleocene deposits take place on the top of Maestrichtian. While the general stratigraphic relation between Upper Cretaceous and Paleocene is concordant around Orhaniye village, a low-angled angular unconformity is seen at the southeast of Lezgi village. The Paleocene series transitionally pass through the Lutetian fossiliferous marine limestones. A thick sequence of the limnic and fluvial sediments follow the Lutetian marine deposits concordantly. These continental series are overlain by volcanic tuff and tuffite intercalated limnic occurrences of Upper Miocene age (Erol, 1986 personal comm.). Thus the series of Lutetian to Upper Miocene age, have been considered as Oligocene-Mid-Miocene in this study. The rock units of the Pliocene time expose particularly in the southern part of the region. The thickness of the Upper Cretaceous-Miocene series is about 3000 m.

DEFORMATIONAL STAGES

In this section the successive deformations of the Upper Cretaceous-Miocene rocks are introduced. The whole region had passed through a compressive tectonic regime by a northward subduction in the northern branch of Neotethys commencing from Senonian time (Şengör and Yılmaz, 1981). Maestrichtian flysch sedimentation ends in a regressive character at the top of the sequence. Uplifting of the region had been the predominant tectonic event in the period between the end of Maestrichtian and the end of Paleocene. This situation should be related to the isostatic uplifting of the continental crust due to the subduction, which can be evaluated as an early deformational stage.

First Deformational Stage (D 1)

This stage is represented by very local and small folds which are seen in a limnic clayey limestone level in three meters thick towards the upper levels of the Paleocene (East and north side of Kuşkonan hill at the west of Orhaniye village). The axial traces of D 1 deformation has an orientation in N 80 E direction revealing there is no relation in origin with D 3 main deformational stage (Photo 1). Deformation should have happened towards the end of Paleocene. The bedding schistosity (S 1) had developed in these clayey rock units accompanying with D 1 stage (cf. Haselock et al., 1982; Strachan, 1985).

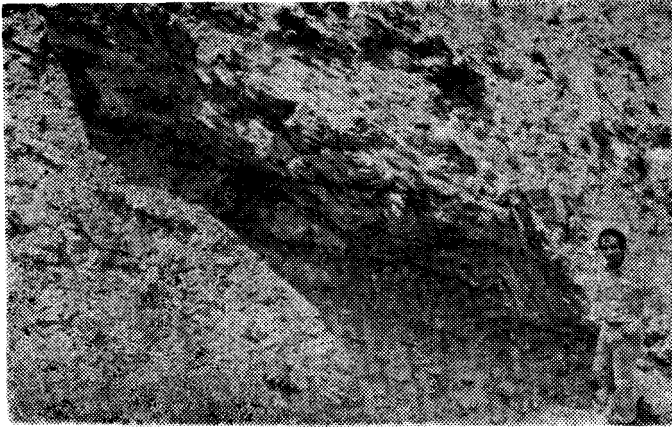


Photo 1. Intraformational folds in the limnic series of Paleocene representing D1 stage at the southeast of Orhaniye village.

Second Deformational Stage (D 2)

These are also small and local, overturned and sometimes re-cumbent folds which refolded by the D 3 main stage (Figure 3). These

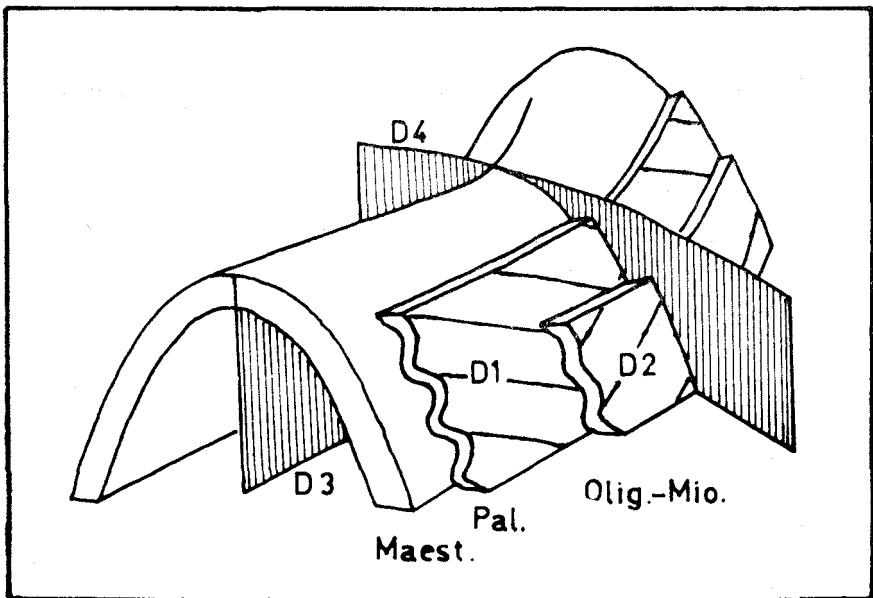


Figure 3. Schematic representation of the successive deformations in the area.

folds can be seen in the limnic limestones of the Oligocene-Miocene series and particularly in the bereccia beds (The district of Kirantepe at the west of Orhaniye village), which are clearly demonstrable by the flattened and elongated angular limestone pebbles. The discordance between the axial traces of these folds and D 3 main stage shows that there is no relation in origin, and the folding should have happened in the Miocene time.

Third Deformational Stage (D 3)

This is the main deformational stage in the region. The major fold axis have two different orientation in Orhaniye and the north of Memlik village in the investigated area (Figure 2). The fold traces in the Orhaniye section have N 30–45 E trends as compatible to those of in the whole region. These are symmetrical upright or slightly asymmetrical folds (Billings, 1972) having fairly long culminations and steeply-dipping limbs (Photo 2). An important syncline axis in NE-

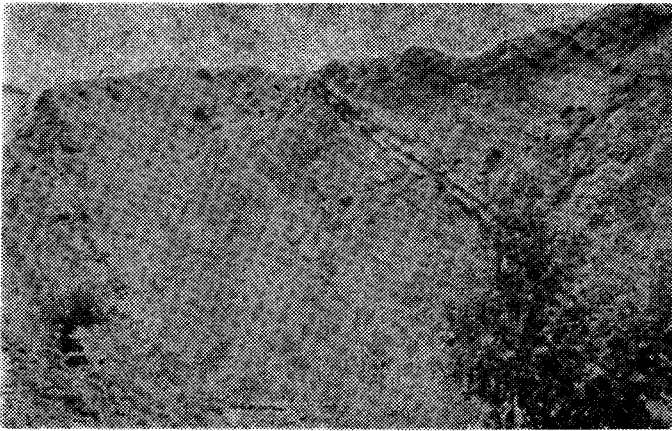


Photo 2. Northward dipping Upper Cretaceous flysch beds representing the D3 stage, at the south of Orhaniye village.

SW direction takes place between the Alkaya hill and Maltepe at the northwest of Orhaniye village. The series in the syncline base are of Miocene age. Another important axial trace in the same direction, extends between İkiyuk hill and Sırıkhdede hill at the southwest of Orhaniye. Upper Cretaceous flysch beds expose in the core of this anticline.

As for in the second sector at the north of Memlik village, the axial traces show N 20–30 W trends. These are symmetrical upright or slightly asymmetrical folds having short culminations, and plunge to the NW and SE, approximately at an angle of 20 degree.

Some deformational structures had developed accompanying with this stage in the series. The S 1 open spaced axial plane cleavage in right angle to S 0 can be seen particularly in sandstone layers of the Upper Cretaceous flysch. As for in the hemipelagic beds of the flysch, close-spaced S 1 cleavages oblique to the S 0 are common and they are not exactly axial planar. The S 2 shear joint sets in two directions at an angle of clearly 30 degree to the main stress can frequently be seen in the sandstone layers of the flysch relating to the late stage of the D 3 deformation. The best examples of these S 2 structures are presented in the outcrops exposed at the south of Kuşkonan hill. D 3 deformation should have happened during the Mid-Miocene (?) time.

Fourth Deformational Stage (D 4)

This stage is the axial plane folding time of the major folds of the region. The axial traces of these folded axial planes have E-W trend around Orhaniye and show approximately N 45 E orientation at the north of Memlik village. While a left-lateral shear strain character is seen around Orhaniye, a right-lateral strain is exhibited at the north of Memlik.

Other Deformational Structures

Some other deformational structures particularly relating to D 4 stage are coincided in the series and present complementary informations about the character of the deformation. One of them is shear joints which are seen in the pebbles of the olistostromic conglomerates of the Upper Cretaceous flysch sediments at the southwest of Deveboynu hill in the east. These fractures cut both the pebbles and the matrix and extend in N 40 W direction (Photo 3). These joints should have been formed by a shear stress in approximately N 70 W direction (Figure 4). The right-lateral shear strain form of the deformation implies that they may be related to the D 4 stage.

One other interesting structure is seen in the fossils of the Lutetian marine limestones. These fossils had been deformed in the main de-

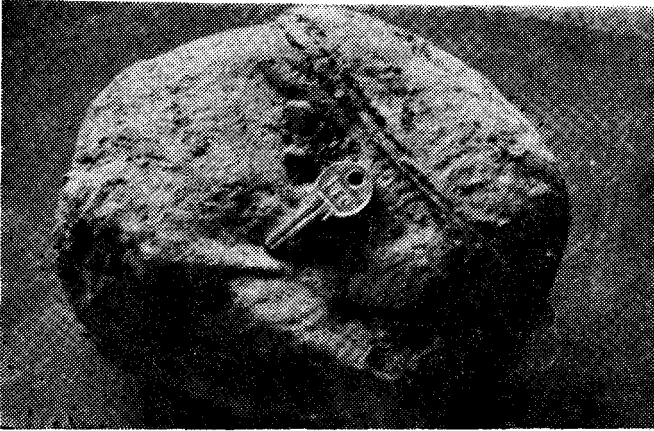


Photo 3. Shear joints on the limestone pebble taken from Upper Cretaceous olistostromal conglomerates.

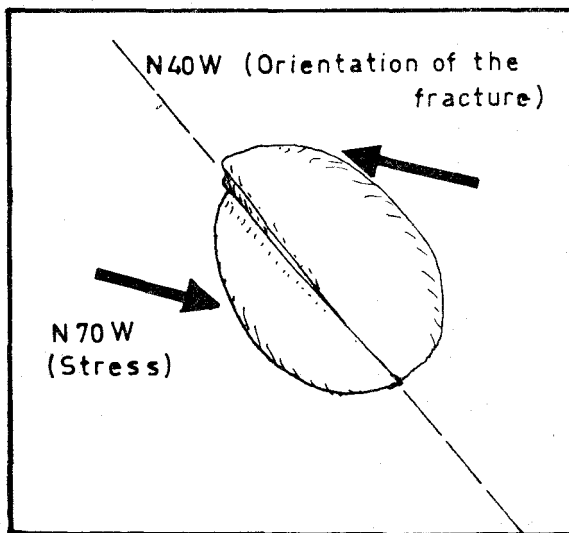


Figure 4. The orientation of the shear stress in the pebbles of the Upper Cretaceous conglomerates.

formational stage and also in the D 4, and shows angular shear strain by loosing their bilateral symmetry (particularly echinids and some pelecypods). The geometrical analysis of these deformations will be given in another paper.

Late Faulting

However the structure of the region had been mainly formed by the folds, some thrust faults had also been formed accompanying with D 3 and D 4 deformations. The general trend of a few thrusts are more or less parallel to the major fold axis. Thrusts had been formed by moving of the blocks from north to the south. One of the thrust takes place at the northwest of the investigated area where a high-angle reverse fault had formed between Lutetian and Miocene series (at the south of Alkaya hill). Another thrust is seen at the south of Deveboynu hill in the east of the area where Upper Cretaceous flysch thrusts over the Paleocene series from the north (Figure 2).

The deformations in the neotectonic period after Mid-Miocene (?) time are seen as gravity faults in the region (Photo 4).

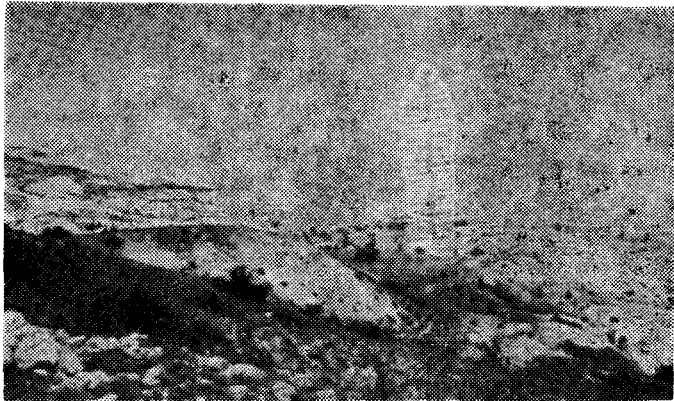


Photo 4. Gravity faults which affected the Lutetian series possibly in the Neotectonic period around Lezgi village.

CONCLUSIONS

First of all across most of the area the pattern of deformation is simple but nevertheless in some localities such as in the Armutlu creek in the east and at the 500 m northwest of Çaltepe in the west, fairly complicated shear strains are seen in the Upper Cretaceous flysch sediments. The deformations which developed during the Upper Cretaceous-Mid-Miocene (?) interval, related to the events happened during the closure of the northern branch of Neotethys. The uplifting

of the region should had been caused by the northward subduction of this oceanic crust. The general southward transportation trend of the Upper Cretaceous flysch sediments and also south and eastward trends in the fluvial sediments of Miocene time point out that the initial emergence of the environment had taken place in the north during this period. The low-angled angular unconformity between the Upper Cretaceous flysch and Paleocene series in some localities has not been evaluated as the result of a folding process, so this stand is interpreted in the early deformational phase related to the irregular uplifting of the region.

The main deformational stage (D3) had happened during Mid-Miocene(?) time which may be related to the continental collision. During the collision, the boundary between the Upper Cretaceous flysch and underlying ophiolitic melange should had behaved as a shear surface. The compressive stresses had operated in NW-SE direction during D3 deformation. Different deformational trends at the north of Memlik village may had been caused by irregular collisional front. The stresses during D4 had again operated in NE-ZSW direction relating to the late stages of the collision.

As for the first two deformations (D1 and D2) could be either independent structural events or compressive stresses related to the subduction (cf. Webb, 1975).

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