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GEOMORPHOLOGY OF THE LAKE TORTUM and ITS IMMEDIATE SURROUNDINGS (NE TURKEY)

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GEOMORPHOLOGY OF THE LAKE TORTUM and ITS IMMEDIATE SURROUNDINGS (NE TURKEY)

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Introduction

The study area is located within the North Anatolia Orogenic Belt, especially in the East Blacksea Mountain. The region is of 80 km inland from the Black Sea. The Tortum River is one of the main tributary of the Çoruh River flowing into the Black Sea.

In the area, the long, narrow mountain chains alternate with deep-set, trough-like and canyon valleys. The Lake Tortum, resulted from the landslide, was formed in the Tortum valley.

Mean annual precipitation of the given area is about 300-350 mm, and nearly 60 % of the total precipitation falls in the spring and in the first month of the summer. Average annual temperature is about 12-13°C. And the temperature gradually decrases to the highland. Especially during the summer period the north - winds are dominant. The moist - winds decrease the summer drought.

Azonal and intrazonal soils are common, and the soils are thin, stony and of inmature in nature. The limely brown forest soils are being developed on the undulating surface of the mountains with the Pinus silvestris. Most of the soils eroded and especially the parent materials are exposed on the steep slopes. The hydromorphic alluvial soils common on the delta of Tortum river, formed the southern part of the lake.

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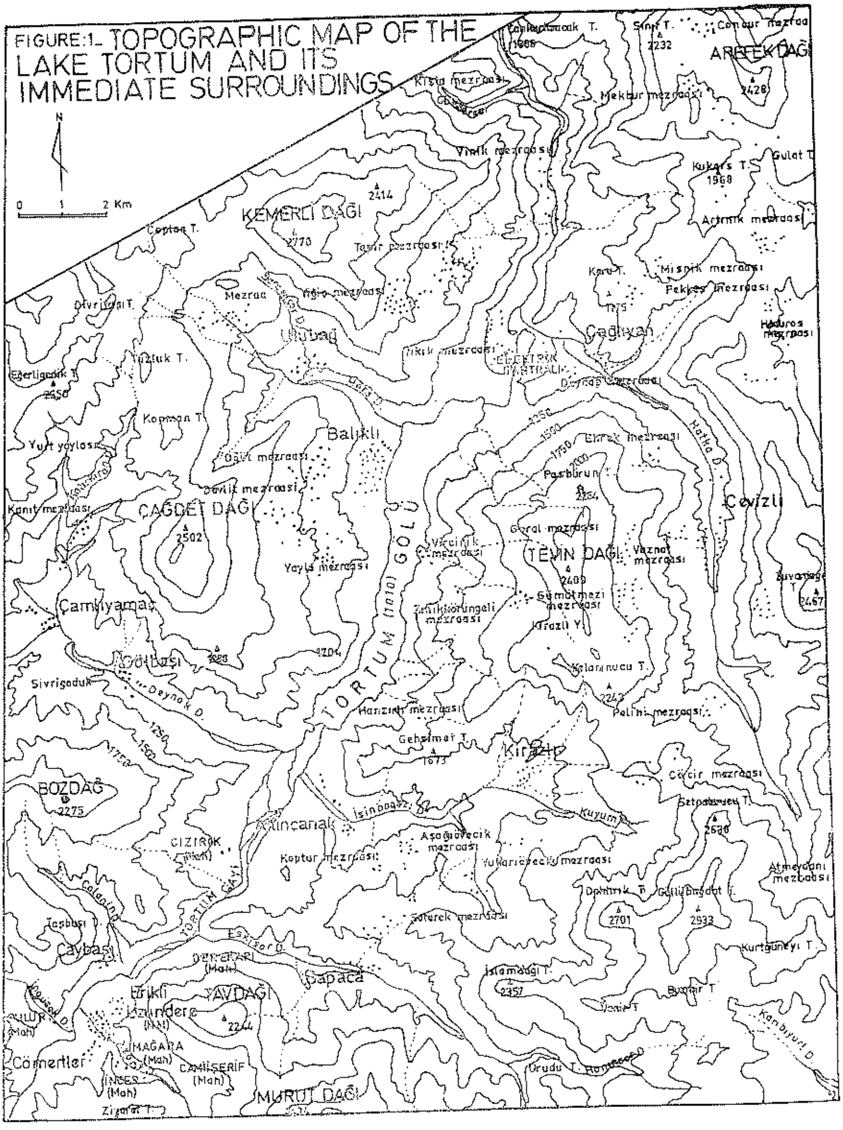


FIGURE:1_ TOPOGRAPHIC MAP OF THE LAKE TORTUM AND ITS IMMEDIATE SURROUNDINGS
N
0 1 2 Km
KEMERLI DAĞI
ÇAĞDET DAĞI
TEVIN DAĞI
TORTUM GÖLÜ
BOZDAĞ
YAVDAĞI
MURUT DAĞI
Balıklı
Çamlıyamaç
Gölbaşı
Çağlayan
Cevizli
Kirazlı
Kınçanak
Çaybaşı
Cömertler
Sivrigeduk
Deynek D.
TORTUM ÇAYI
Eskiser D.
Sapaca
Uzundere
MAĞARA (Mah)
CAMİŞERİF (Mah)
CIZIRIK (Mah)
2502
2275
2244
2409
2414
2770
2428
2701
2933
2357
2467
1673

In the given area, along the Tortum valley, the Juniperus sp., Quercus sp., Rosa canina, other shrubs and antropogen stepic species are common. Above about 1200-1300 m, the Pinus silvestris forests are widespread. But natural vegetation of the area has been modified and destructed by man either directly through the established cultuvation systems or indirectly through the excessive grazing of the animals.

The area ise one of the rarely populated regions of the Eastern Anatolia. People live in the small villages which are situated on the narrow floor and slope of the valley. The villages are generally the cluster settlements. The majority of the populations is engaged both in farming and animal raising. The suitable farmlands are very limited due to the very rugged terrains. The animal raising is also very important from the view point of overall husbandry. Every village has several mezras. Such «mezras» which are temporary settlement region, are used for both farming and animal raising.

GEOLOGIC SETTING

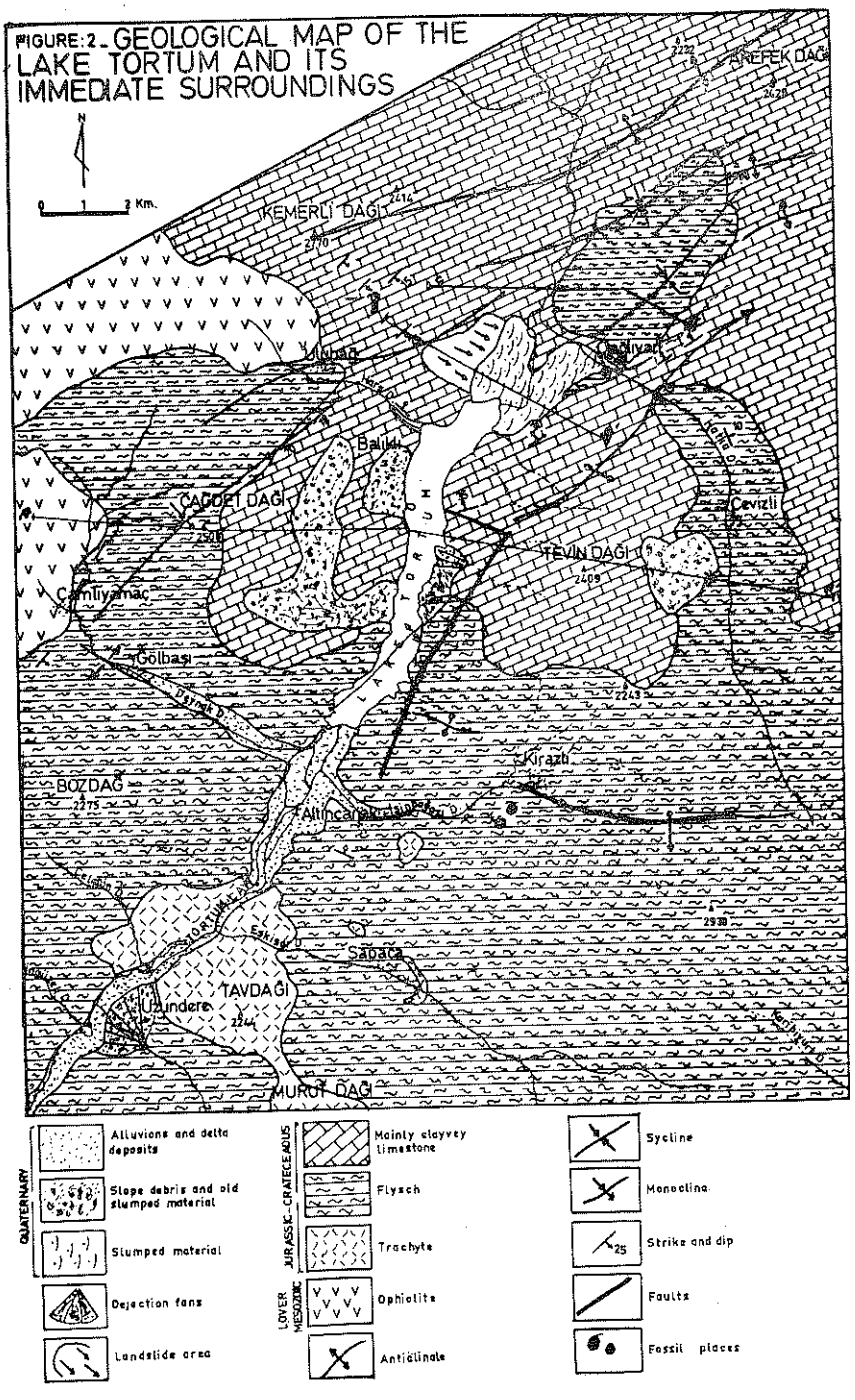
The geologic formations of the given area, as a whole, are predominantly of Mesozoic (Jurassic-Cretaceous) flysch and limestones. The flysch and limestones alternate. The anticline and sycline folding systems roughly extend in direction of NE-SW (Figure 2). On the other hand the trachyte lenses and layers are in the flysch strata. The rocks are seen in the S and SW parth of the area. The Tav Mountain that is situated in this area is completely composed of trachyte (Photo 4).

The ophiolites which were composed of serpantine-peridotite and gabbro-basalts, exposed in the western part of the area (Photo 1). In the eastern sections of Çağdet and Tevin Mountain, the old slumped and debris materials are common. The thick alluvials and delta deposits occur in the southern part of the lake.

GEOMORPHOLOGIC PROPERTIES

The geomorphologic peculiarities of the given area were affacted by the geologic structure and the fluvial erosion. The mesozoic

FIGURE: 2 - GEOLOGICAL MAP OF THE LAKE TORTUM AND ITS IMMEDIATE SURROUNDINGS



formations were deeply dissected by the Tortum River and its main tributaries. There is a considerable height between the floor of the valley and the upper section of the mountains (Photo 3). For example, in the northern section of the area, the height of the tortum valley is about 800 metres, whereas Kemerli Mountain rise up to 2700 m. The study area, from the view point of geomorphologic study, can be divided into three units: 1— mountains, 2— valleys and 3— Lake Tortum.

1— *Mountains* :

During the Mesozoic Era, the area was occupied by the Tethys geosycline. The very thick geosycline sediments were folded as sycline and anticline by the pre-Alpine and Alpine orogenic movements, and in addition probably in the end of the Tertiary and during the Quaternary the area was uplifted by the epeirogenic movements. Thus, the origination of the mountains are the result of the folding of the sedimentary strata.

On the both side of the Tortum valley there are some mountain chains: Kemerli M. 2770 m., Çağdet M. 2502 m., Boz M. 2275 m., and Arefek M. 2428 m., Tevin M. 2409 m. and Güllübağdat H. 2933 m (Figure 1, 4 and 5). Generally, the slope of the mountains are very steep and the mountains, composed of flysch, were dissected by the deep gullies such as the southern section of the Çağdet and Tevin Mountains (Figure 4), whereas the Tav Mountain which was made up of trachyte is like a cone. Especially, along the steep slopes dissected by the gullies, the debris avalances are seen rarely.

On the upper parts and the varing levels of the mountains there are some undulating and flat surfaces, developed on the landslide mass and the layers of limestone and sycline axis, extending both on the eastern section of Tevin M. in the altitute of 2000-2500 and on the eastern part of Çağdet M. in the height between 1500-1750 m. The relatively flat surface located in the Misnik Mezra, corresponding to the sycline axis (Figure 3 and 4).

Above mentioned mountain chains are bordered by the deep river valley, and the slope of the ranges are generaly more than 40

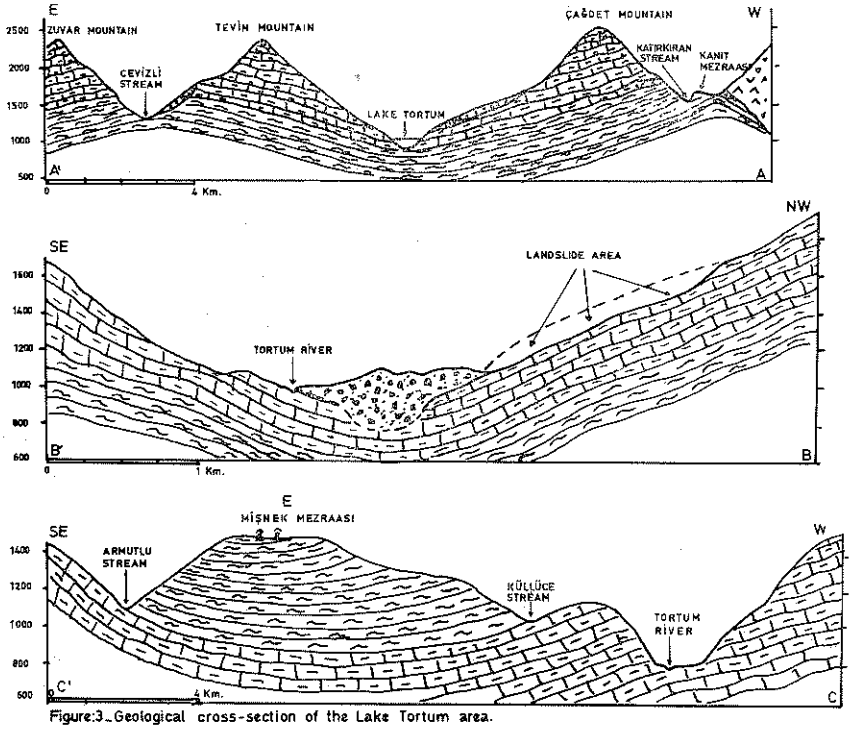


Figure:3_Geological cross-section of the Lake Tortum area.

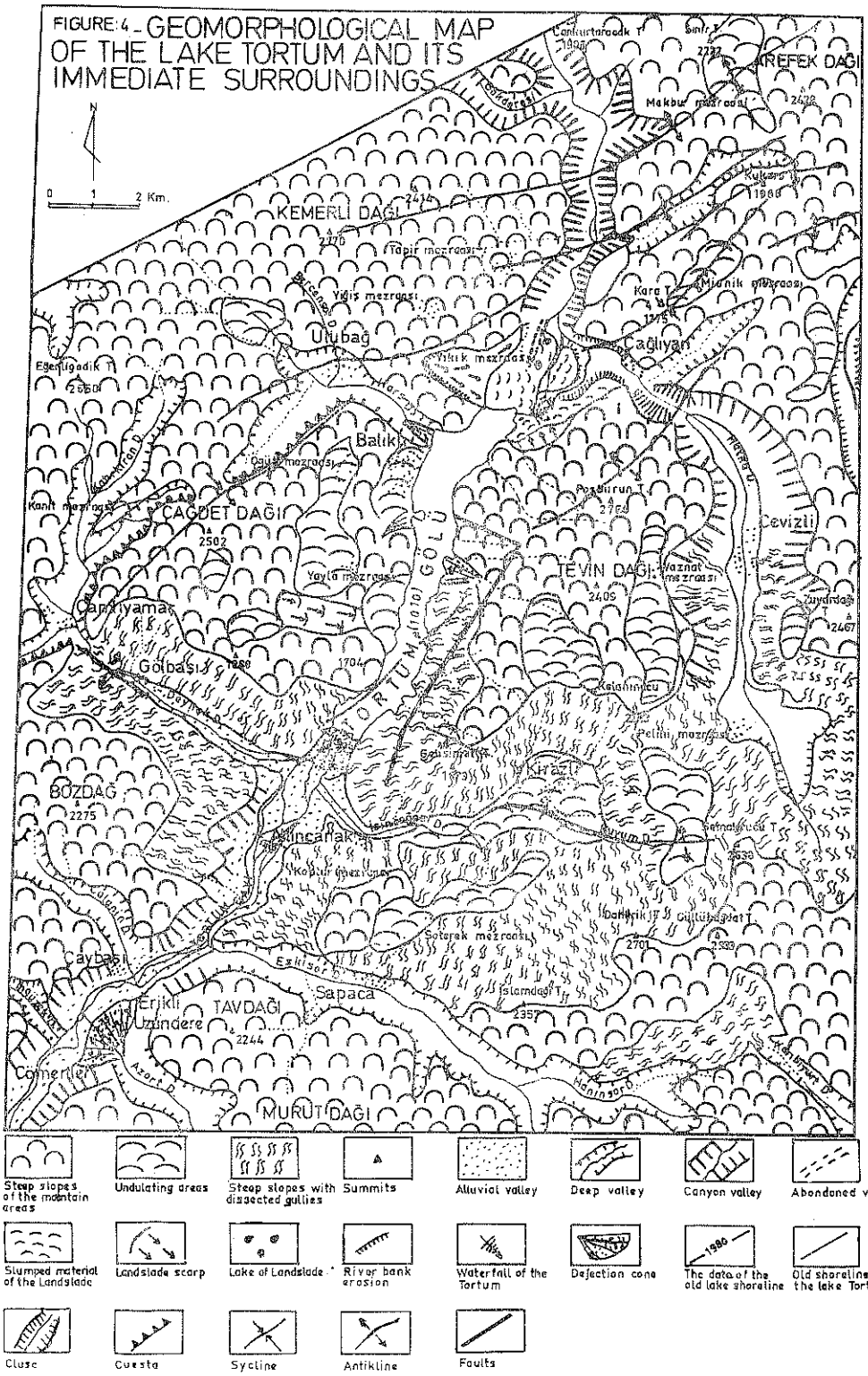


FIGURE: 4 - GEOMORPHOLOGICAL MAP OF THE LAKE TORTUM AND ITS IMMEDIATE SURROUNDINGS
N
0 1 2 Km.
KEMERLİ DAĞI
2770
Tapir mezrası
Yiğis mezrası
Ulubağ
Batıkı
Eğerligadık T.
2660
Kanlı mezrası
ÇAĞDET DAĞI
2502
Yayla mezrası
Çamlıyamaç
Gölbaşı
1704
GÖLÜ
Kirazlı
BOZDAĞ
2275
Aşıncaraklı
Çaybaşı
Erikli
Uzundere
TAVDAĞI
2244
Sapaca
Çomenler
MURUT DAĞI
Çandırtarağı T.
2195
Sınır T.
2232
KREFEK DAĞI
Makbul mezrası
2428
Kuşçam T.
1988
Kara T.
1315
Mlanik mezrası
Çağlıyan
Pazarun T.
2764
Cevizli
TEVİN DAĞI
2405
Vaznat mezrası
Uyardağ T.
2467
Kelahmucu
Selimi mezrası
Gölsuyurtu
Dalkırık T.
2701
Güllübaşat T.
2639
Sapaca
İslamdağı T.
2357
Steep slopes of the mountain areas
Undulating areas
Steep slopes with dissected gullies
Summits
Alluvial valley
Deep valley
Canyon valley
Abandoned valley
Slumped material of the Landslide
Landslide scarp
Lake of Landslide
River bank erosion
Waterfall of the Tortum
Dejection cone
1980
The date of the old lake shoreline
Old shoreline of the lake Tortum
Cluse
Cuesta
Syncline
Antikline
Faults

per cent. On the other hand the upper section of the mountains mainly fits to the anticline axis and the monocline ridges.

2— *Valleys* :

Towards the end of the Mesozoic Tethys Sea regressed from the given area and thus the river systems, as a conform, initiated on the land. As a result the uplifting of the area by the post-alpine tectonic movements, the river system developed. The uplifting of the area caused the backward erosion of the running water. The rivers or streams which were founded on the Mesozoic formations, carved their own valleys in a deep gorge. Indeed, Tortum river and its main tributaries were dissected and deepened their own valleys in the depth of 600-700 metres (Photo 5 and 6).

In the study area the trasverse profile of the valleys are of two types: the canyon and canyon-like Tortum valley which extends towards the northern part of the lake, was formed on the limestones, while «V» shaped valleys were formed on the flysch formations (Photo 3, 5 and 6; Figure 4).

The canyon, canyon-like and the «V» shaped transverse profile of the valleys indicate that the formation falls either into the stage of morphological juvenesence or from the view point of fluvial geomorphology, the end of the first erosion cycle.

On the other hand, the main drainage network of the study area does not fit to the structural system or the anticline and the sycline direction of the area. For example, the Tortum River cut across the anticline and sycline axises and the anticline plane; the anticlinale extending in direction of E-W, in the SE part of the area, was incised by the Kuyum stream (Photo 2). But the secondary streams were developed on the weak and fracture zone. For example, Armut stream carved its own valley in the contact of flysch and clayey limestone (Figure 3). Some streams such as Katırkıran and Kıtlasor streams developed on the monocline ridges and «cuesta» forms were formed by the streams, and in this zone the dips of the clayey limestone and flysch layers towards the east are about in the degree of 10-25 (Figure 3, 4 and 5).

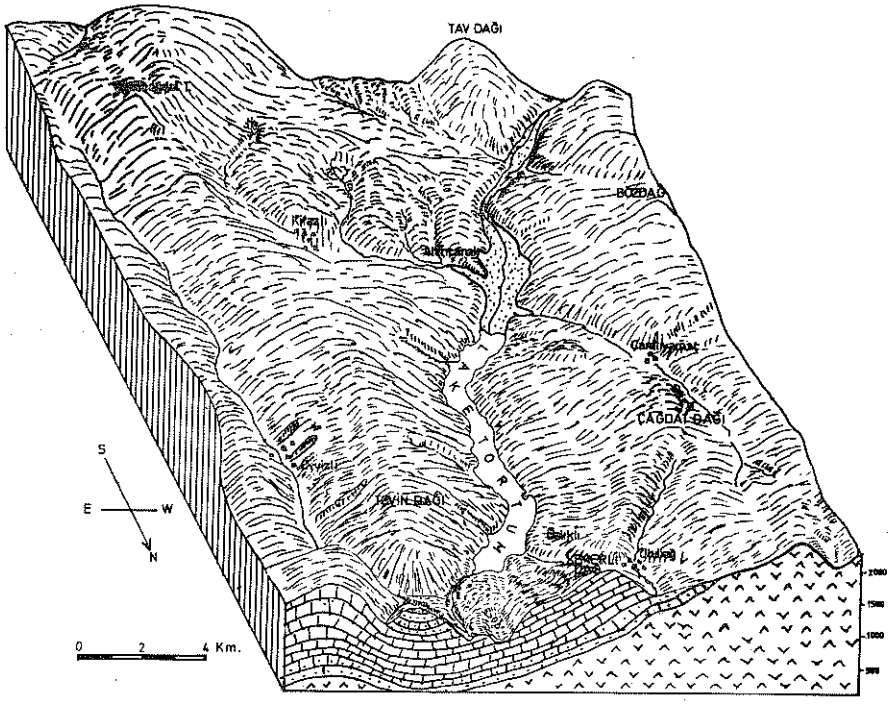


Figure 5

In addition, in the northern part of the Lake Tortum waterfall, the sycline, which extends in direction of NE, is higher than the anticline (Figure 3); as known this formation is termed as «relief inversion».

3— *The Lake Tortum :*

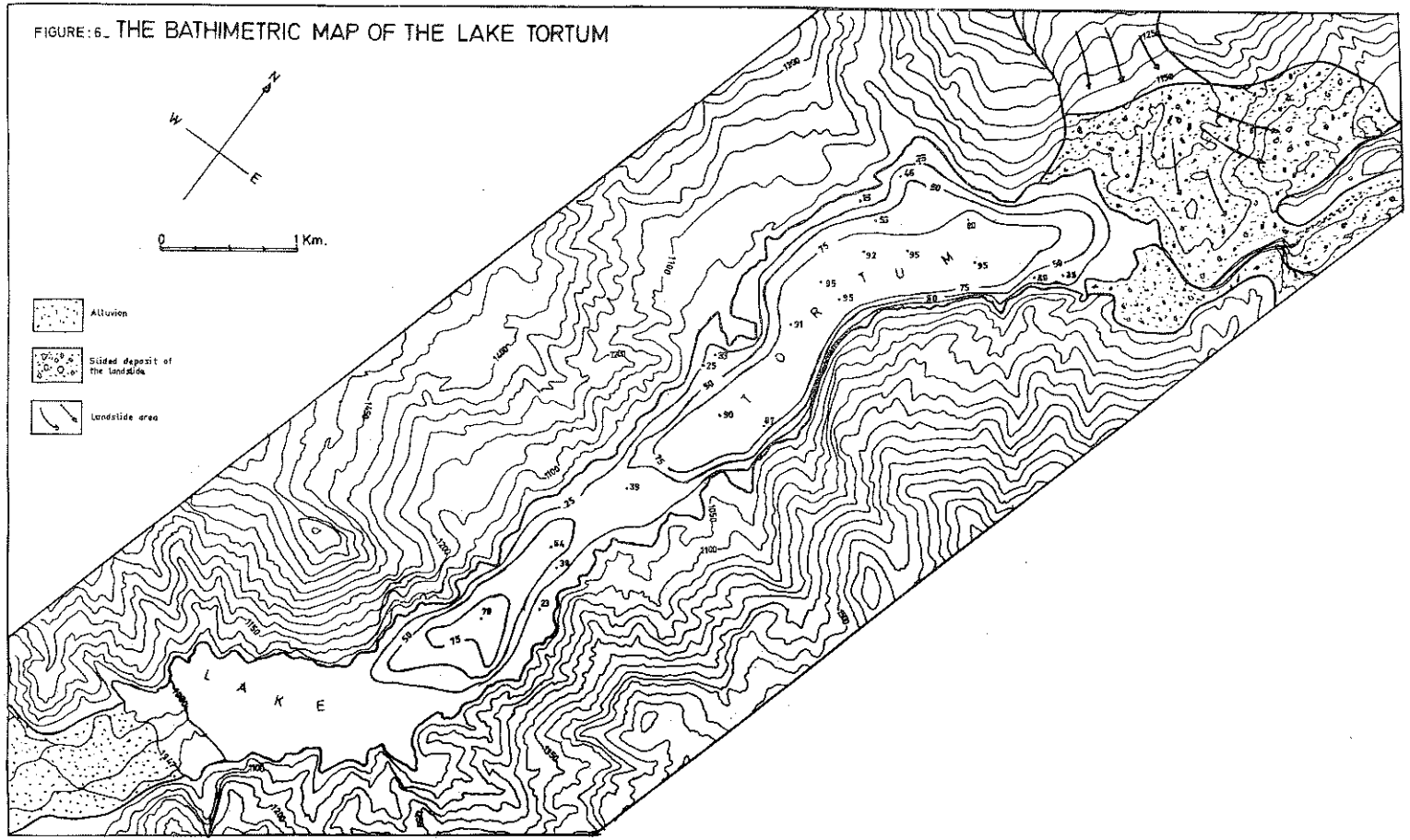
The Lake Tortum is one of the most important landslide lakes of Turkey. The weathered flysch deposits which were covered on the eastern flanks of Kemerli Mountain, slided into the Tortum valley. But, the date of the landslide is exactly unknown, probably the landslide may have been occured seven centuries ago. Here, the eastern section of the Kemerli M. is an anticline flank with the dip of the clayey limestones towards the east in the degree of 25-35. After the landslide, the Tortum valley was completely filled by the slumped materials. Indeed, in the tortum valley, the thickness of the slumped material is up to 300 m., and its lenght is nearly 2050 m, and the wide ness of the slumped material is about 1200 m. On the other hand, the volume of the slided mass in approximately 200 millions cubic metre.

After the landslide the Lake Tortum was formed behind the slided material. The waters of the lake run out from the eastern part of slumped material. Here, the slided mass was carried away trough the new course of the lake, and Tortum waterfall which is 50 metres in the height, formed on the limestone.

After the landslide it can be said that the lenght of the lake was approximately 18 km, and it lied as far as İngüzekkapı localite in the south. And in the northern section of the lake, the maximum depth of the lake was about 200 m. Because, in the northern section of the slumped material, the height of the valley-floor is about 800 metres (Photo 5).

According to my studies carried out in July 1980, the lenght of the lake is 7900 m, and its width is 1700-525 m. The deepest part of the lake is about 95 metres, and deep sections of the lake vary between 90 and 95 metres. The height of the water surface of the lake is 1010 m (Figure 6). At present the water capacity of the lake is nearly 3 750 000 cubic metres.

FIGURE: 6_ THE BATHIMETRIC MAP OF THE LAKE TORTUM



The siltation of the lake basin : At present in the lake tortum basin a very intense siltation has been prevailed. Indeed, after the formation of the lake, especially in the southern portion of the lake, the intense sedimentation and the formation of delta have begun (Photo 3, 4). Güresinli (1978) had studied the sediment yield of the Tortum River, and he found that the average annual sediment yield of the river was about 1 759 000 m^3 at the Dikyar locality which is situated 5 km away in the south of lake. Additionally nearly 700 000 tons of sediments are annually transported into the lake via the other streams. Thus the sediment accumulation in the lake basin approximately goes up to 2.5 millions cubic metres / year. There of in the lake basin, the intense sedimentation and the lake delta grow rapidly. Indeed, between 1975 and 1980, the delta of Lake Tortum extended more about 2875 m. According to these data the average expansion rate of the delta is 27 metres in due course a year. But, between 1935 and 1977, 1075 metres of the lake was filled and the expansion rate of the delta was nearly 24 m/ year. On the other hand, during the period of 1947 and 1980 the 325 m of the Lake was completely filled, and the average advance rate of the delta is nearly 10 m/year.

It is assumed that the expansion of the lake delta or the filling of the lake is about 20 metres/year.

The Tortum River watershed area is one of the most important erosion regions of Turkey. The soil cover of the basin had been carried away from the original surface, and especially on the steep slopes the parent materials were exposed. The unconsolitaded colluvial, the dejection fans and the flysch formations are being dissected by the rills and gullies. The average annual sediment yield of the basin is about 2536 tons/km^2/year. The average annual sediment yield of Turkey is nearly 600 tons/km^2/year or more than 1500 tons/ sq mi/ year (Atalay, 1978).

According to the classification made by Holeman on the ton/ year/sq mi basis, 500 tons are considered high, between 200 and 500 tons moderate and under 200 tons low. According to this classification, the sediment yield of the Tortum River basin is very excessive. Consequently it can be said that the Lake Tortum would be completely filled after 200-250 years.

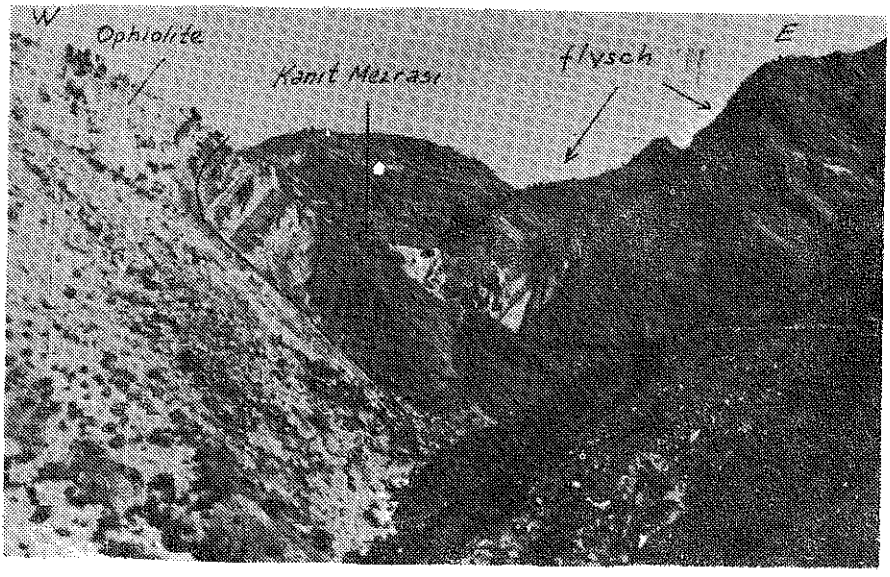


Photo 1 : The contact zone of the flysch (Jurrasic-Cretaceous) and the ophiolite, in the western part of the region. The Katırkıran stream was formed along the contact zone.

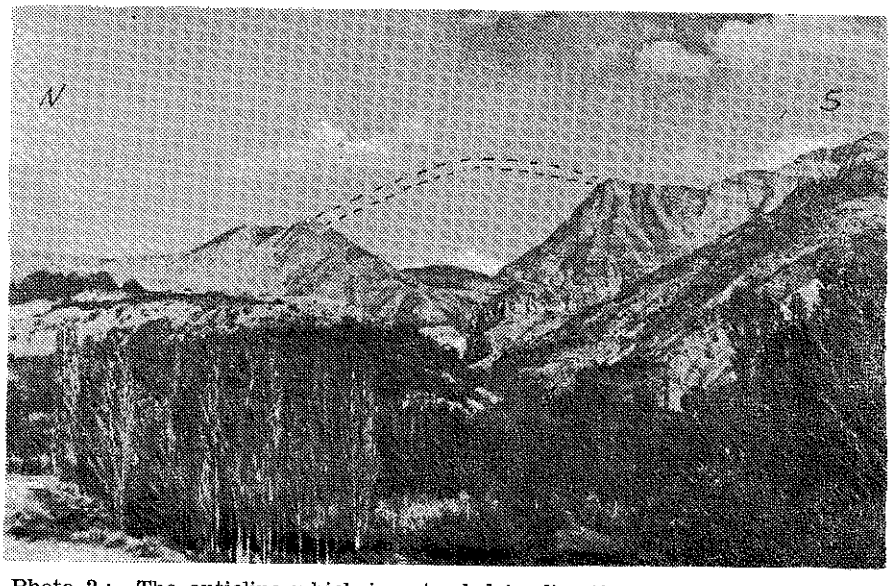


Photo 2 : The anticline which is extended in direction of E-W, was incised by the Kuyum stream, in the SE part of the area.

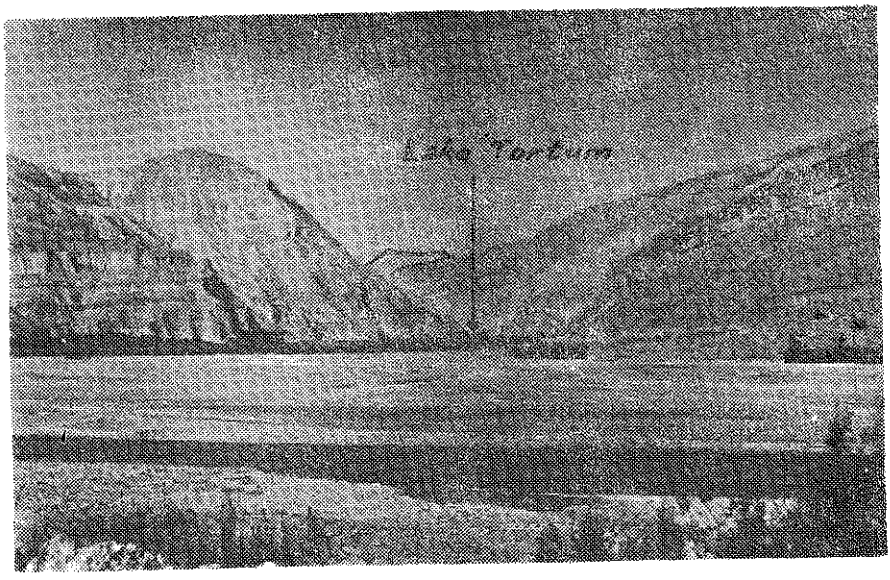


Photo 3 : Looking towards the valley of Tortum from the south to the north. In the foreground, the old delta of Tortum River is seen.

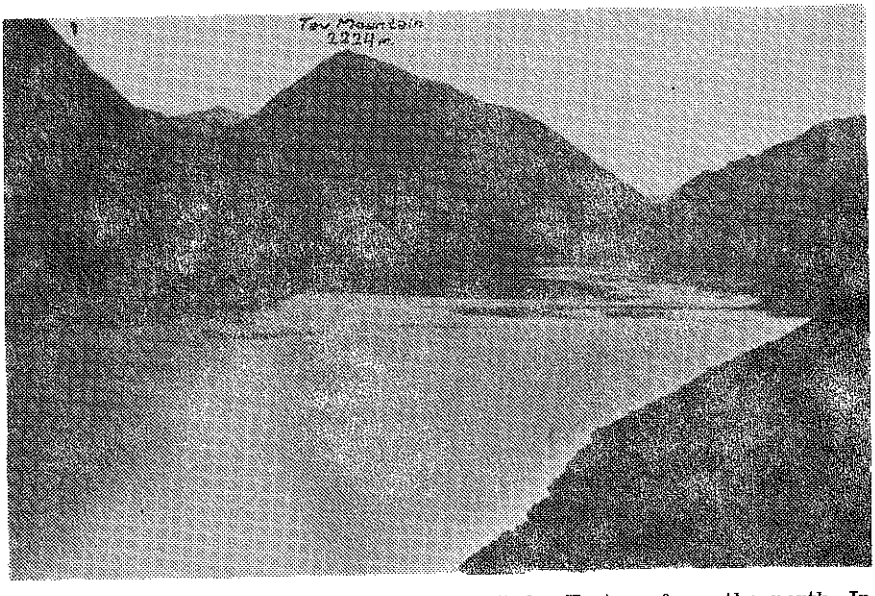


Photo 4 : Looking towards the end of the Lake Tortum from the north. In the background, the Tav Mountain, composed of tracnyte, is seen.

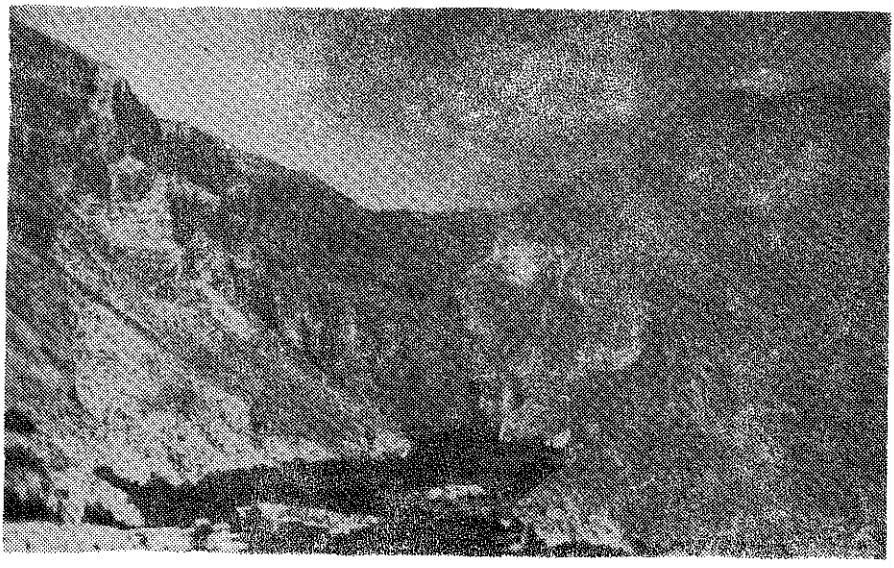


Photo 5 : Looking towards the canyon-Tortum valley from the south. The valley was developed on the anticline flank. At the left side of the picture, the remnants of the slided materials of the landslide is seen.

Photo 6 : The canyon valley of the Tortum River. The picture was taken at the 10 km north of the lake.

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