

THE GEOLOGY OF THE AREA BETWEEN KÜTAHYA AND GEDİZ

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ABSTRACT. — Geological structures encountered in our area of study are generally represented by Paleozoic, Mesozoic, Neogene and Quaternary formations. Namely :

Paleozoic : Phyllites, argillaceous schists, sericite-schists, graywackes;

Mesozoic : Marbles and crystalline limestones;

Neogene : White-colored, continental lake deposits;

Quaternary : New alluviums.

So far as magmatism is concerned, our area was exposed to underwater initial volcanic activities that took place during the Mesozoic era. As a result of this, ophiolites (green rocks), products of underwater volcanism, are plentiful in the area.

Here the oldest Paleozoic formations of the main foundation were exposed to Hercynian movements; while respectively Mesozoic and Neogene formations were exposed to Laramian and alpine movements.

INTRODUCTION

Our work covered an area of 2000 square kilometers that entirely filled the 1/100,000-scale Map-section No. 72/1, a part of the 1/500,000 scale Map-section of Izmir.

There had been no study of this area to date, complete with a geological map and a report. First geological study that ever included this area, within a larger one, was conducted by A. Philippon (7) and the results were referred to in the making of the 1/800,000-scale Geologic Map of Turkey. This work was followed by the Morphological Map of Western Anatolia, again by A. Philippon (8). In addition a 1/100,000-scale geological map was prepared by Dr. Galip Sağıroğlu in 1947.

I feel indebted both to Dr. Cahit Erentöz for his valuable suggestions and encouragements and to Dr. L. Dubertret for helping me out during my field work. I also owe many thanks to Dr. L. Erentöz who made the necessary paleontological determinations and to Dr. C. Markus who made the petrographical determinations.

GEOGRAPHY

The area under study, contained in the Map-section No. 72/1, lies as shown in Fig. 1 in the Western Anatolia, stretched from south of Kütahya to the NE of Gediz.

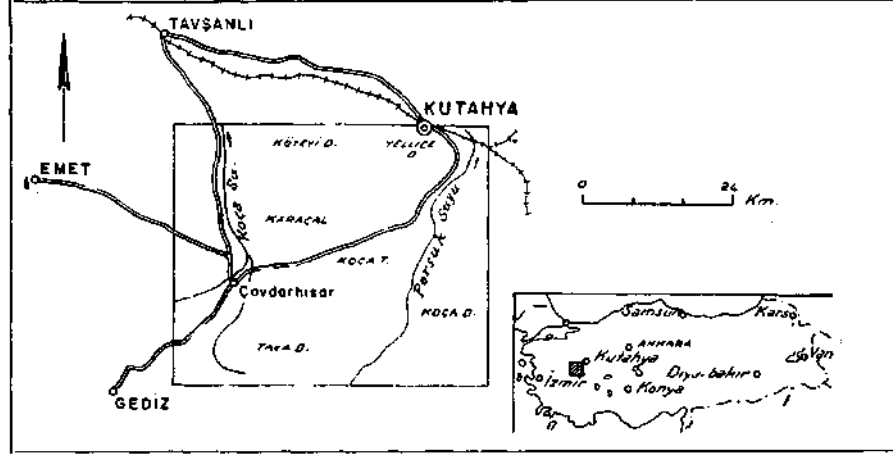


Fig. 1 - Geographical location of the area under discussion

Morphological features of the area may be said to form three groups as follows :

1. High mountains of old (Paleozoic, Mesozoic) formations;
2. Flat terrains and rounded hills (Neogene);
3. Alluvial plains.

In general the central section of the area consists of moderately rough, rather flat land, while the parts toward the boundaries, show a more or less marked elevation and a mountainous character.

Mountain ranges in the north lie in an approximately E-W direction. The remaining ones have NE-SW trend. Kōteği Dağı with an elevation of 1902 meters above sea is the highest point in the north. Next higher mountains and peaks of the area are Tava Dağı (1590 m.), Kocatepe (1557 m.) and Karaçal-Saraygediği Tepesi (1397 m.).

Streams follow a northerly course through the valleys between mountain ranges that lie parallel to each other. More important ones are the Kocasu and tributaries in the west and the Porsuk Suyu and tributaries in the east.

Kütahya-Gediz highway runs right through the middle of the area. In the west is the Çavdarhisar-Emet-Tavşanlı highway and in the east Kütahya-Afyon highway. Railroad only crosses the northeast corner of the region.

Although it would not enter the scope of this report, there exist some old ruins of historic interest in Çavdarhisar.

STRATIGRAPHY

In general Paleozoic, Mesozoic, Neogene and Quaternary formations appear in stratigraphic sequence in this area (Fig. 2, 3 and Pl. I).

Paleozoic

Basal formations of the Paleozoic age consist of phyllites, argillaceous schists, sericite-schists and chlorite-muscovite schists and cover wide extensions in the

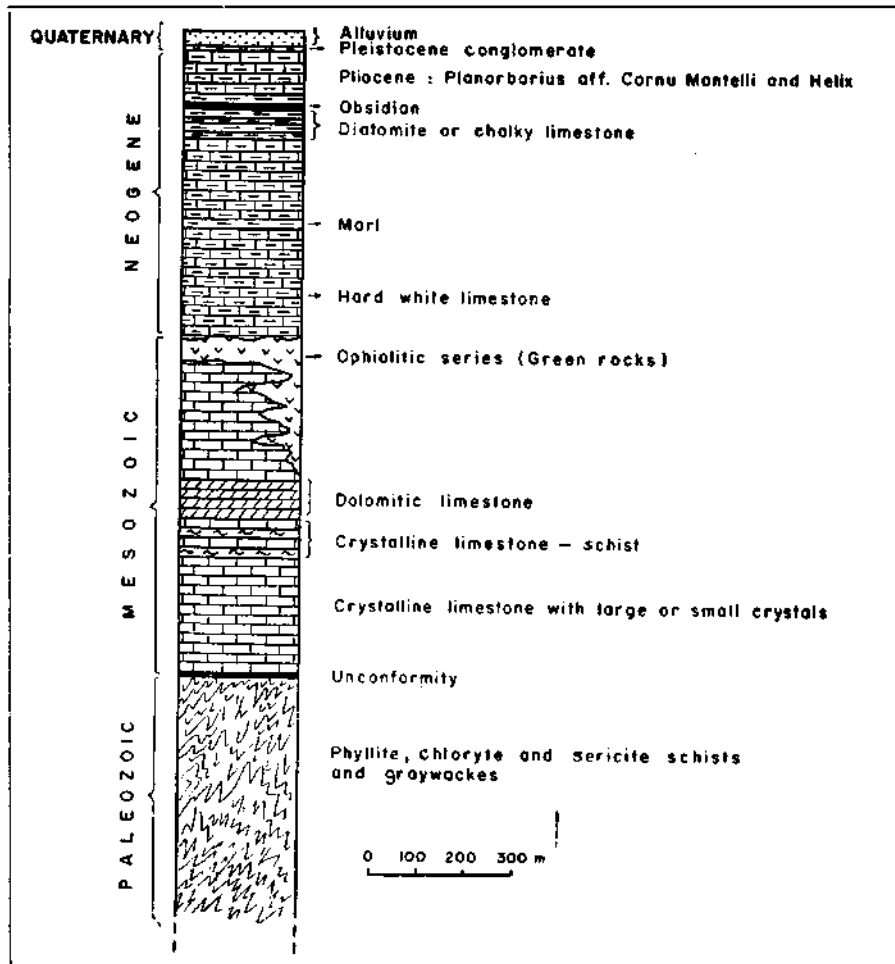


Fig. 2 - Approximative vertical section across the map-sheet 72/1

northern and southern parts of the area and also form high mountain ranges. In the northwest section of the map, between Saraygediği and Karagal Tepesi, graywackes, showing a schistosity, and often greenish in color, occur from place to place. Originally sediments of a geosyncline, these formations were subjected to regional metamorphism under horizontal deformation and took shape in the epi-zone. The fact that the main rock is composed of phyllite and sericite-schists and that these rocks contain characteristic minerals of the epi-zone, such as actinolite (Tava Mountains), quartz, chlorite and mica (mostly sericite) confirms our viewpoint outlined above.

Unfortunately there were no fossils in the samples brought in to be used for age determination. According to our observations in the field we estimate their age to come within the Paleozoic. Unconformably overlying these Paleozoic schists and graywackes, are the outcropping Mesozoic limestones.

Mesozoic

The marbles and limestones whose age cannot be told for certain, but may at least be Mesozoic, form individual hills, as well as big and wide massifs.

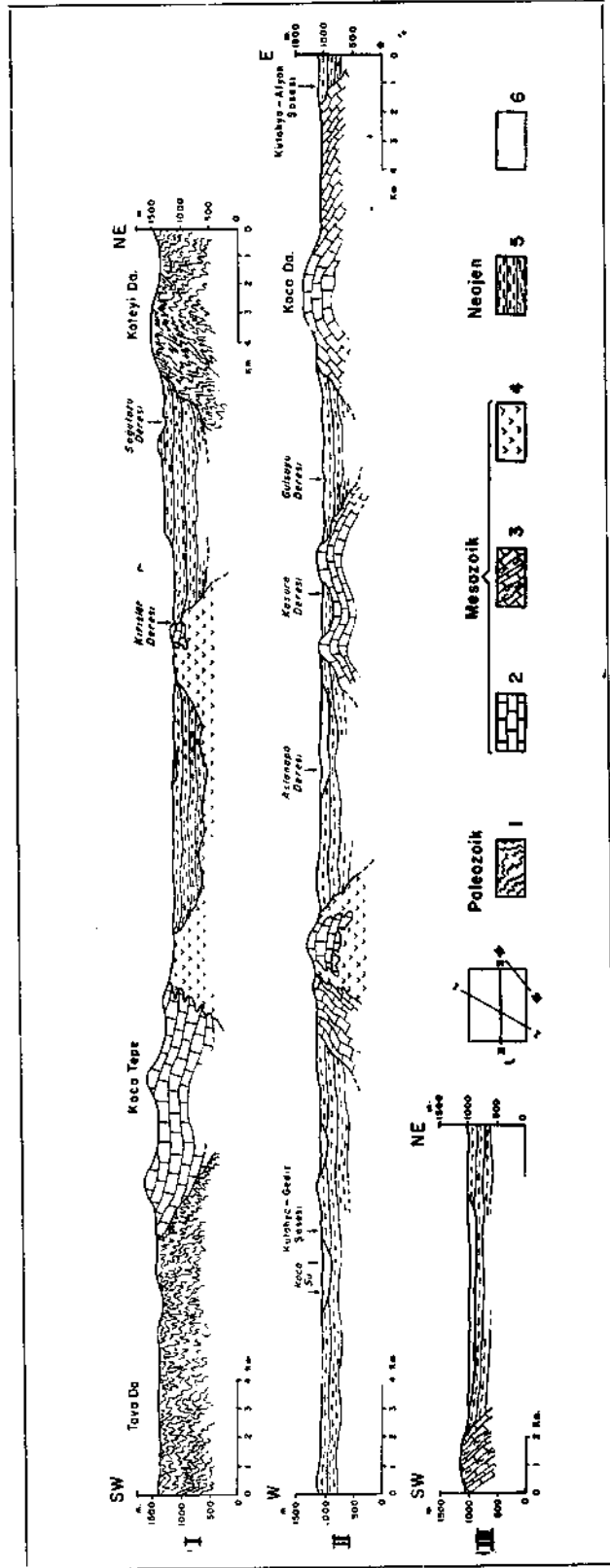


Fig. 3 - Geologic sections of the map-sheet 72/1
 1 - Phyllite, argillaceous schist, chlorite-schist, graywacke; 2 - Crystalline limestone; 3 - Crystalline limestone-schist intercalated;
 4 - Ophiolitic series; 5 - Limestone-marl (continental); 6 - Alluvium.

Limestones occur both in light and dark grey colors with larger or fragments of crystallization.

Crystalline limestones which we ascribe to the Mesozoic, unconformably overlie the Paleozoic schists beneath. This relation was observed in the NW corner of the map-section going along Kocasu Creek from the village of Esatlar to the village of Kökler. In this locality the top part of the schists, that is where they come in contact with the limestones, is a yellowish-gray sandstone containing angular quartz grains. This is overlain by a series of limestones, with a layer of conglomerate in between, composed of a sandy matrix containing angular quartz grains and elongated limestone pebbles. This relation was also noticed by L. Dubertret on the same spot.

In the northeast of Tava Mountains which are located to the SW of our area, at the contact of crystalline limestones and schists, limestones strike approximately E-W and dip 20°N, while the schists strike NW and dip 40°-55° north.

Although tectonic movements may first be suspected to have caused the steep-dipping angles encountered in the schists, our own field observations led us to believe that an angular unconformity existed between the two formations.

We further believe that a continuous sedimentation between the Paleozoic and Mesozoic series did not exist and that each series had gone through a separate orogenic phase, as it will be explained farther down when tectonic movements are discussed.

Spilites which we place with the ophiolitic series (green rocks), serpentines and radiolarites are closely related to the limestones. Green rocks are intercalated with crystalline limestones. They also exhibit lateral interfingering and sometimes they cut right through the limestones (Fig. 4).

As seen on Sivri Tepe, 1-1 ½ km. north of the village of Pazarcık, radiolarites usually occupy the upper parts of the green rocks.

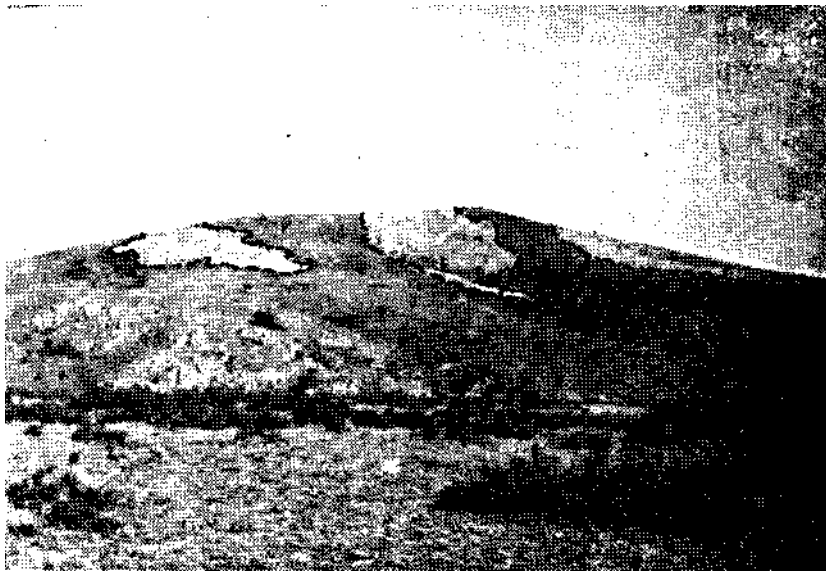


Fig. 4 - The ophiolite-limestone interrelation as seen in the hills to the east of the point where Gediz highway intersects Aslanapa highway

On the hills east of Akçaköy, lying to the south of the two villages Kürtköyü and Geyicikköyü, which are in the SE part of our area, fine or coarse-grained crystalline limestones are intercalated with the sericite-schists and quartzitic mica-schists.

Such occurrence of the limestones and schists is simply a result of change of facies and would not bring about any break in sedimentation.

As the marbles and limestones in this area were overly crystalline none of the samples brought in did contain fossils. Within the map-section 54/4 touching the NW corner of our area, Dr. Holzer (5) located limestone beds with fossils belonging to the Upper Cretaceous. We may think of our limestones as a continuation of these latter. Furthermore, the relation between limestones and green rocks bears witness to underwater volcanic activities, during the deposition of the limestones. In various places in Turkey this type of facies may be encountered both in the lower Middle Cretaceous and lower Upper Cretaceous.

In view of these two points, we can not go any farther than an indirect determination of age for our limestones, that age being the Mesozoic.

What is more, the little hill just west of the village of Çeşme in the SE corner of our area is built of black dolomitic limestones with a fine crystalline texture. This dolomitization, we believe, is the result of tectonic effects.

Neogene

Continental (lake-deposited) Neogene formations that outcrop mostly in rather flat or moderately rough country are widespread in our area. They are usually composed of hard white and soft marly limestones the latter being lake deposits. In some places, these hard white limestones alternate with the soft marly (lacustrine) limestones. At a point about one km. from Gelinkayası inn, going toward Gediz, on the side of the highway, are found 1-1 ½ m. thick chalky limestone layers intercalated with 5-10 cm. thick clay beds (montmorillonite).

The following fossils were identified by L. Erentöz :

Internal or external molds of

Limnaea

Planorbis

in samples picked up from the vicinity of Tepecik village.

Ena (Ena)

Planorbarius aff. cornu mantelli (Dunker)

Burdigalian - Upper Miocene

Helicidae (Helix or Cepaea)

in samples of light-colored marls coming from the banks of the Porsuk River, along the Kütahya-Gediz highway.



Fig. 5 - Schematic drawing showing the contact between crystalline limestones and schists on the hill east of Akçaköy

1 - Crystalline limestones; 2 - Sericite-schists and quartzitic mica-schists; 3 - Neogene

At a locality about 10-12 km. SW from this one, near the village of Kasura, limestones of identical character were found to contain the same fossils. Fossils described as *Planorbarius cornu mantelli* during the identification, showed certain similarities to the *Planorbarius thiollierei* (Michaud) Pliocene, but in our specimens apertures were found more elongated.

Here we share Dr. L. Erentöz's opinion about the age of the specimens and agree that the presence of *Planorbarius cornu mantelli* actually indicates the age of Burdigalian — Upper Miocene. But the abundance of *Helix* coupled with the resemblance of *Planorbarius cornu mantelli* to *P. thiollierei* (Michaud) suggests a Lower Pliocene age as more suitable.

So in the light of the points just brought forth and our previous field observations, Neogene formations of the area are marked to be of Lower Pliocene age.

Quaternary

In this area, Quaternary is represented by extensive and fertile plains consisting of Pleistocene conglomerates and young alluvial sediments.

Pleistocene conglomerates are found especially near the Esatlar village, just to the NE of it, overlying soft, white, marly Neogene limestones.

As for the younger alluviums, they form the Çavdarhisar, Virancık, Susuzkaya and Aslanapa plains along the highway from Kütahya to Gediz. Before sediments filled them out into plains, these were depression areas.

MAGMATISM

The green rocks in the area, like hornblende-keratophyre-splites, hornblende-natronkeratophyre-splites, quartz containing natronkeratophyre-splites and keratophyre-splites which we place in the ophiolitic series, are formed as a result of Na metasomatism and they occupy large areas in the middle part of the northern half of our map-section. These green rocks indicate that initial underwater magmatic activities took place in this district. As previously mentioned in the paragraph about stratigraphy (Mesozoic), the green rocks are related to the limestones and in different places they show intercalations and lateral interpassings or, as is in the south of the village of Kırışlar, they cut through the limestones. Thus, underwater initial magmatic activities took place from time to time, while these limestones were deposited.

Because of their relation to one another, green rocks and Mesozoic crystalline limestones must be of the same age, namely, close of Mesozoic (Late Cretaceous).

In addition to the initial magmatic activities, here we notice evidence of acidic volcanism as well.

To the east and north of the Alayunt railroad station, in the NE corner of our area, 10-15 cm. thick obsidian (glass) intercalates with diatomite layers. This intercalation with Neogene layers indicates that the volcanism must have occurred during that time.

TECTONIC MOVEMENTS

The area under study does not usually depict such a complex picture as far as the tectonics are concerned. The high mountains of the north formed by phyllites, schists and graywackes lie in a general E-W direction, while mountains of the same formations (Paleozoic) in the southern part of our area have a NE-SW direction. All of these formations generally strike NW-SE and dip 20-55° north.

Under the strain of tectonic movements, these formations are strongly folded and fractured. The Paleozoic basal structure was exposed mostly to horizontal deformation.

Mesozoic limestones, as a rule, show good layering but they also go to form massifs. General direction of the mountain ranges they make is N-S.

As pointed out back in the stratigraphy paragraph, there exists an unconformity between Paleozoic and Mesozoic formations occurring in the area. Paleozoic formations have undergone effects of the Hercynian orogeny (also indicated by the direction of layers) while those of Mesozoic were exposed to the Laramian orogeny, toward the close of late Cretaceous period.

The Neogene limestones of the lake facies cover wide areas and generally lie horizontally. Only in canyons and near the old massifs (schists and crystalline limestones), they dip from 10° to 20°. That these formations have gone through the alpine movements is beyond doubt. In fact, the entire bulk of these old and new formations has been subjected to the effects of the alpine movements.

The Çavdarhisar plain, that covers wide areas in the region, and others similar to it lying side by side in the direction of Kütahya-Gediz highway, are separated from each other by slightly elevated terrace-like strips of land of Neogene and Mesozoic limestones; the plains themselves forming shallow depression areas caused by vertical displacements.

PALEOGEOGRAPHY

The area under study was lying in a geosyncline during the Paleozoic. It was raised above sea in the course of the Hercynian orogeny, then sank down again to be a part of the Thetys Geosyncline.

The last uplift of the region occurred during the Laramian orogeny. That it never subsided again up to the present, is evidenced by the lack of any marine sedimentation overlying the Mesozoic limestones.

As noted before, the interrelations between the green rocks and Mesozoic limestones (intercalations, lateral passages, etc.) indicate that underwater eruptions also occurred while these limestones settled down to form the geosyncline.

Although the region, after its final uplift in the course of the Laramian orogeny, did never go down again, for a long time during the Neogene, it stayed covered with lakes.

Accordingly, typical lake-deposited limestones are plentiful in the area. What is more, in view of the presence of carbonification encountered from place to place in these limestones, the climate during that period must have been rather rainy and humid.

ECONOMIC GEOLOGY

Except marbles and kieselghur, there are no mineral deposits of economic interest in the area. However some manganese occurrences may be worth noting.

Manganese

In this district, which displays no significant economic importance, a number of small manganese occurrences were, however, located on the Sivri Tepe, to the north of Pazarcık village along the Kütahya-Gediz highway.

These are either shapeless or lenticular in form and embedded in radiolarite. From ore bodies, as described, a grading into manganese containing radiolarites is observed. Accordingly the origin of the manganese mineralizations seems to be sedimentary. Yet, taking into consideration both the relation of radiolarites with ophiolites and proximity of these latter to the ore occurrences, one is inclined to state that magmatism too must have played an important part in the making.

Marbles

White or light-blue marbles with large crystals, that outcrop right north of the small town of Virancık, which partly lies within our area, have been exploited since long ago and still meet the regional demands.

Kieselguhr

Kieselguhr (diatomite) beds lie 1-1.5 km. east of the Alayunt railroad station, situated in NE corner of the area. They intercalate with obsidian beds 10-50 cm. thick.

This material has fine but hard grains suitable for polishing metals. As it is finely porous it is also used as an absorbent for nitroglycerin in dynamite. It can further serve as a refractory material. These reserves are now privately owned and operated.

Oil possibilities

No structural or stratigraphic indications leading toward a possible oil reservoir or trap were encountered within the district, neither was any suitable reservoir rock found. Dr. C. Erentöz and Dr. Z. Ternek in their joint article «Oil Possibilities in Turkey» (4) had already included this district into the category of «least favorable» for oil.

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