GEOLOGY OF THE MUT REGION*

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ABSTRACT. — This region is situated in the southern part of Anatolia with a border line going through the towns of Silifke, Gülnar, Ermenek and Karaman. Here Paleozoic, Mesozoic (Cretaceous), Tertiary (Lower Miocene, Middle Miocene, Pliocene) and Quaternary are represented in the form of sedimentary rocks. In addition, there are serpentines probably of Upper Cretaceous age.

During the greater part of Paleozoic time the region was covered by sea. Towards the end of the era, as a result of folding and gradual uplift, the region must have emerged from under this sea and remained above water until the beginning of the Cretaceous. It was only after a long period of erosion that the Cretaceous sea invaded this area, which subsequently came up and following an other period of erosion sank once again under the Miocene sea. When toward the close of the Middle Miocene the sea started to recede for the last time, lakes were formed and fresh-water limestones deposited in these lakes.

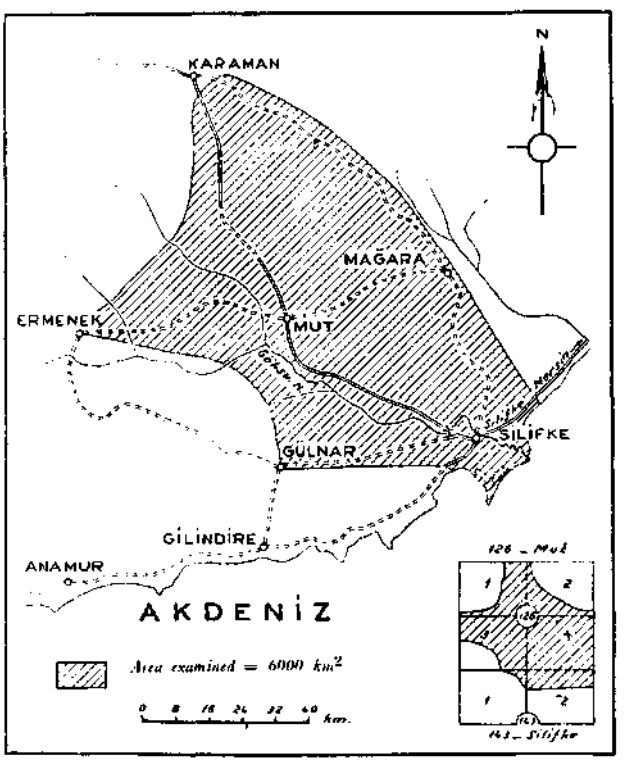

Fig. 1 - Index map showing location of the area studied

The strike of the layers and major faults in the area are found to lie parallel to the axes of anticlines and synclines. This must be a result of alpine movements.

A search for oil in the Lower Cretaceous may be worth while. Likewise, Lower and Middle Miocene formations may also be considered favorable for oil accumulation.

INTRODUCTION

Our study is based on the data compiled during a four-month field work in the Summer of 1954. It covered some 6000 km^2 (Figs. 1 and 6).

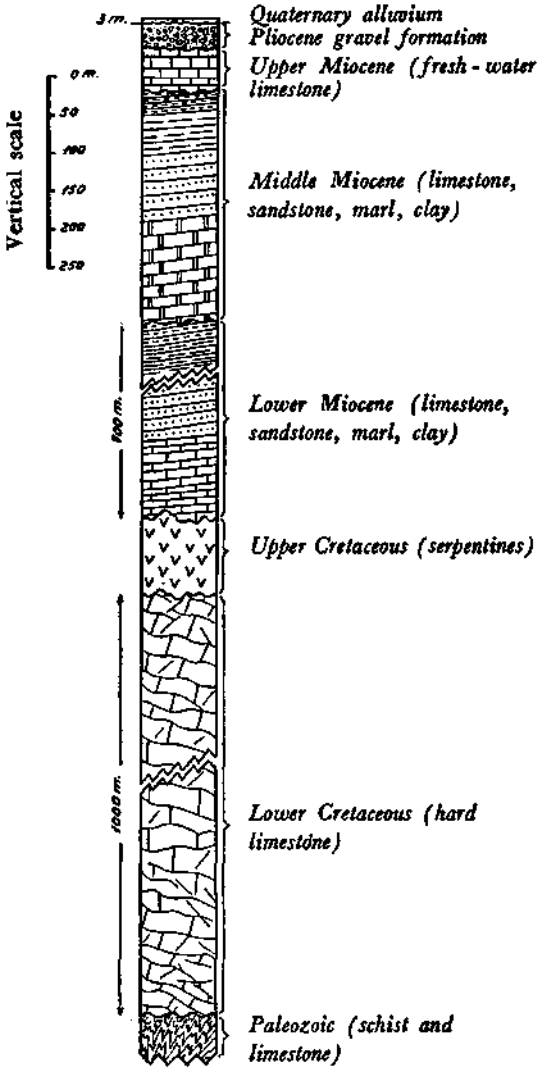

Fig. 2 - Profile of Mut District

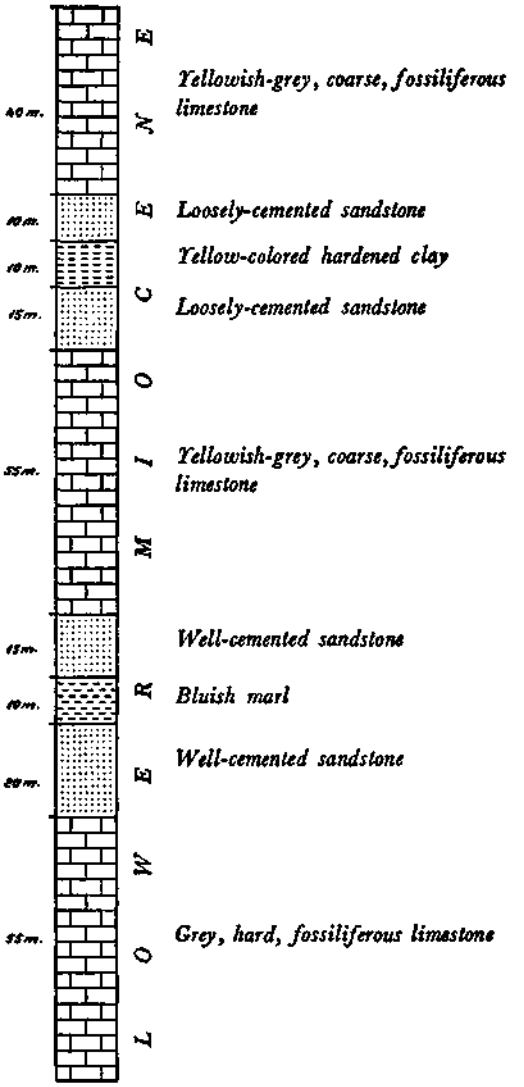

Fig. 3 - Lower Miocene formation at the south-western part of Şihyunus Mountain

GEOGRAPHY

The area under study falls approximately between 36°7' and 36°21' Lat. and 32°56' and 33°56' Long (Plate I, Photos 1 and 2).

GEOLOGY

A. STRATIGRAPHY

1. *Paleozoic.* — Paleozoic formations comprise yellowish-brown and blue argillaceous schists and limestones. The schists form a part of the epi-zonei Contacts have been noticed on some of the Paleozoic outcrops. The visible non-fossiliferous section, about 50 meters thick, which lithologically appears to belong to the Paleozoic age. is discordantly overlain by Lower Cretaceous limestones (Fig. 2).

2. *Lower Cretaceous.* — The Lower Cretaceous is represented by hard, grey— occasionally beige-colored — limestones of a fine texture, which are often crystallized. They lack a well-defined stratification. Generally crushed and frac-

tured in the upper layers, these limestones show red color due to iron oxide in some sections.

In these generally non-fossiliferous limestones, which lithologically appear to be of the Cretaceous age, only some *Dasycladaceae* fragments were found. Under the effect of younger serpentines here and there the limestones of the Lower Cretaceous have acquired a baked brick-like appearance. The thickness of the visible section of the Lower Cretaceous limestones is about 1000 meters. These are overlain, in a discordant fashion, by Lower Miocene limestones. A clearly visible contact zone between Lower Cretaceous and Lower Miocene is encountered in the Masara River bed (Plate III, Photo 5).

3. *Lower Miocene.* — In general limestones make up the Lower Miocene, but occasionally sandstone, clay and marl layers are also found between the limestone strata well exposed southwest of Şıhyunus Mountain (Fig. 3). Lower Miocene limestones have an estimated total thickness of some 700 meters. These limestones of the Lower Miocene series differ in structure and type (Fig. 4). Fossils listed below were found within this Lower Miocene series.

Neoalveolina sp.[1]
Globigerina sp.
Robulus sp.
Nonion sp.
Neoalveolina melo sp.
Pyrgo
Amphistegina sp.
Lithophyllum cf. *prelichenoides* Lemoine[2]
L. glangeaudi Lemoine
cf. Miogypsina
Rupertia
Textularia
Operculina
Globigerina
Biloculina

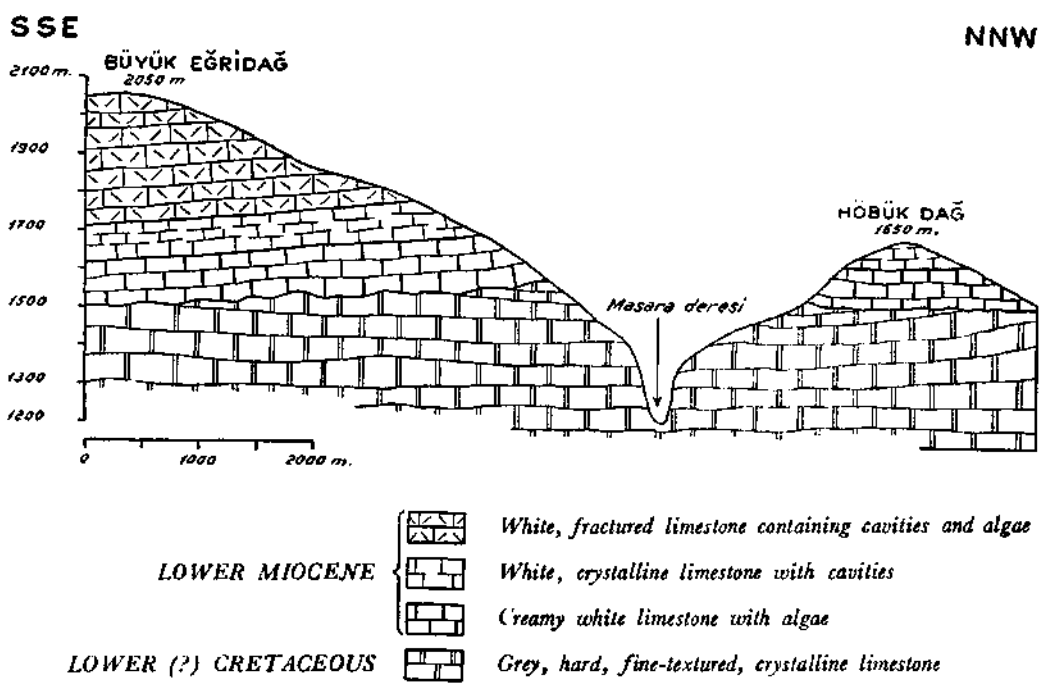

Fig. 4 - Geologic cross-section between Höbükdağ and Büyük Eğridağ

and *Archaias malabaricus* (Garter), a characteristic fossil for Lower Miocene in Turkey was first found in this area by the author.

Macrofossils :

Amussium cristatum (Bronn)[3]
Venus sp. (aff. *Venus multilamella* Lk.)
Pecten subarcuatus Tournouer
Thracia convexa (W. Wood)
Linga columbella (Lamarck)
Ostrea gryphoides Schlotheim
O. lamellosa Brocchi

4. *Middle Miocene.*— The upper layers of the Middle Miocene are formed by white and yellow marly limestones, containing few fossils and showing a stratification. The lower layers consist also of limestones, with marls, sandstones, concretions and coral fossils. In sandstones cross-bedding is usually observed (Fig. 5). The Middle Miocene layers, discordantly overlying the Lower Miocene, are estimated to have a 300-meter thickness. In some sections there are limestones so rich in Lamellibranches that they might be called lumachel limestones. In these series are found fossils characteristic of the Middle Miocene, such as :

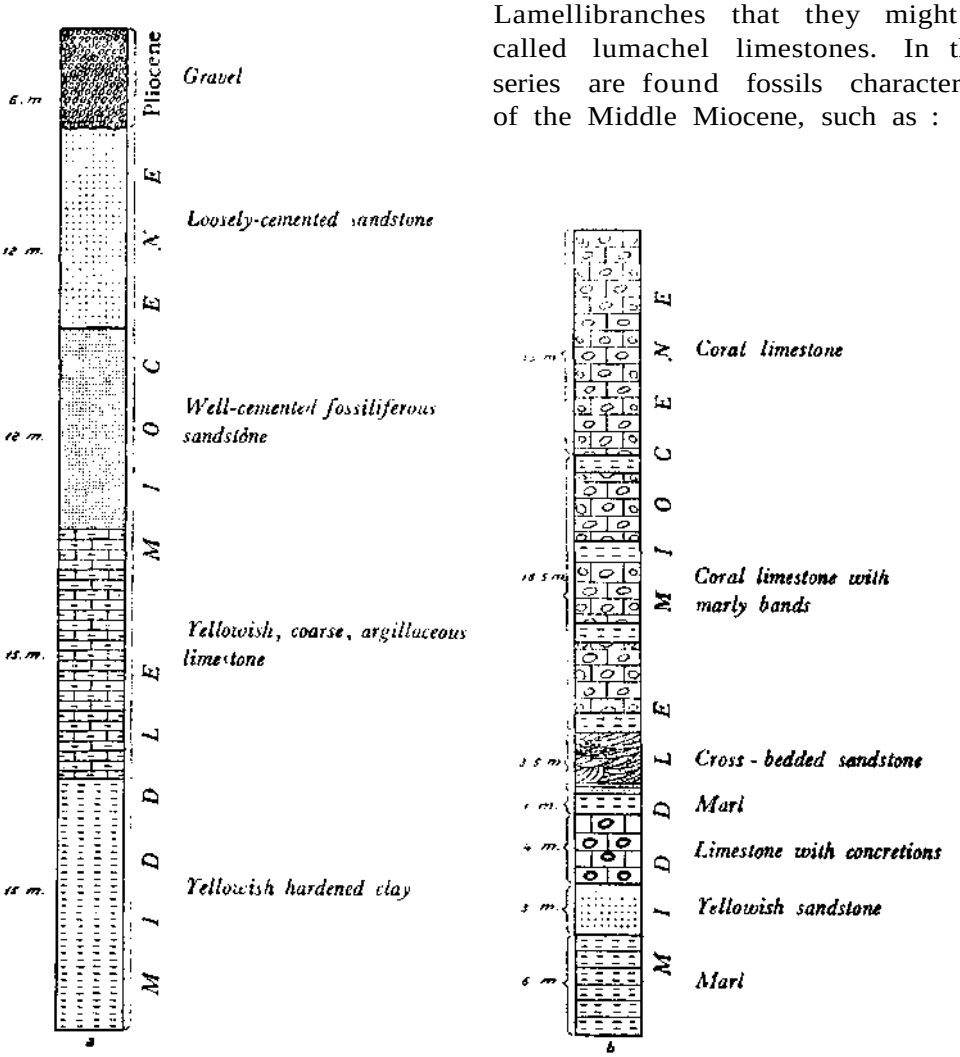

Fig. 5 - *a*. Cross-section of the Middle Miocene formation in the Ağıllıkoyak Creek which is located 1 km north of Alaçam village; *b*. Cross-section of the Middle Miocene formation at the intersection of Masara Creek and Kırkpınar Creek

Microfossils :

Globigerina bulloides d'Orb.[4]
Cibicides sp.
Textularia sp.
Gyraidina soldanii d'Orb.
Robulus calcar d'Orb.
Beygina sp.
Marginulina rugosa-costata d'Orb.
Cancris sp.
Frondicularia sp.
Nodosaria cf. *badensis*
Martinottielli communis d'Orb.
Miliolideae[5]
Bryozoa
Quinqueloculina
Rupertia
Amphistegina
Miogypsina
Operculina

Macrofossils :

Chlamys calcaritana (Meneghini)[6]
Cardium(Ringicardium)subhians Fischer
Turritella (Archimediella) bicarinata Eichwald var. *percingulata* Erentöz

5. *Fresh-water Neogene formations.* — The formation is made up of marl and clay containing limestone layers. As this formation occurs above the Middle Miocene strata, with an erosion surface in between, it is younger than this latter. Plant remains may be found in these layers. Fossils are rare. *Cyprideis* sp.[7] is encountered in the argillaceous layers of this formation, which shows a thickness of about 50 meters.

6. *Pliocene.* — This is represented by some 30 meters of loosely-cemented gravel.

7. *Quaternary.* — Quaternary formation is represented by terraces and alluvium.

B. MAGMATIC ROCKS

Serpentine. — Of the magmatic rocks serpentine is the only one showing outcrops (Plate II, Photo 3 and Plate III, Photo 7).

C. TECTONICS

Direction of strikes. — Formation layers strike NE-SW and NW-SE and dipping changes between 5 and 45 degrees. The axes of anticlines and synclines run about parallel to the direction of strikes.

Faults. — This district was exposed to strong orogenic movements causing marked obliterations, especially in certain sections. Faults run parallel to the strikes.

Different phases of orogeny. — It is observed that Paleozoic rocks in the area were subject to pre-Alpine tectonic movements.

Sub-Hercynian foldings are predominant in the Cretaceous. A stratigraphic gap is noticed from Upper Cretaceous to the Miocene.

As a result of the post-Miocene tectonic movements the beds formed during the Miocene have acquired their present shape.

D. PALEOGEOGRAPHY

The studied area was entirely covered by sea during the Paleozoic. It is likely that this region, which emerged towards the close of the era, remained above water until the beginning of the Cretaceous. Then came the Cretaceous sea. Following its withdrawal the region was lifted again to constitute a land and this lasted till the early Miocene time with a marked erosion period. At the beginning of the Lower Miocene

GEOLOGIC MAP OF MUT AND SURROUNDINGS

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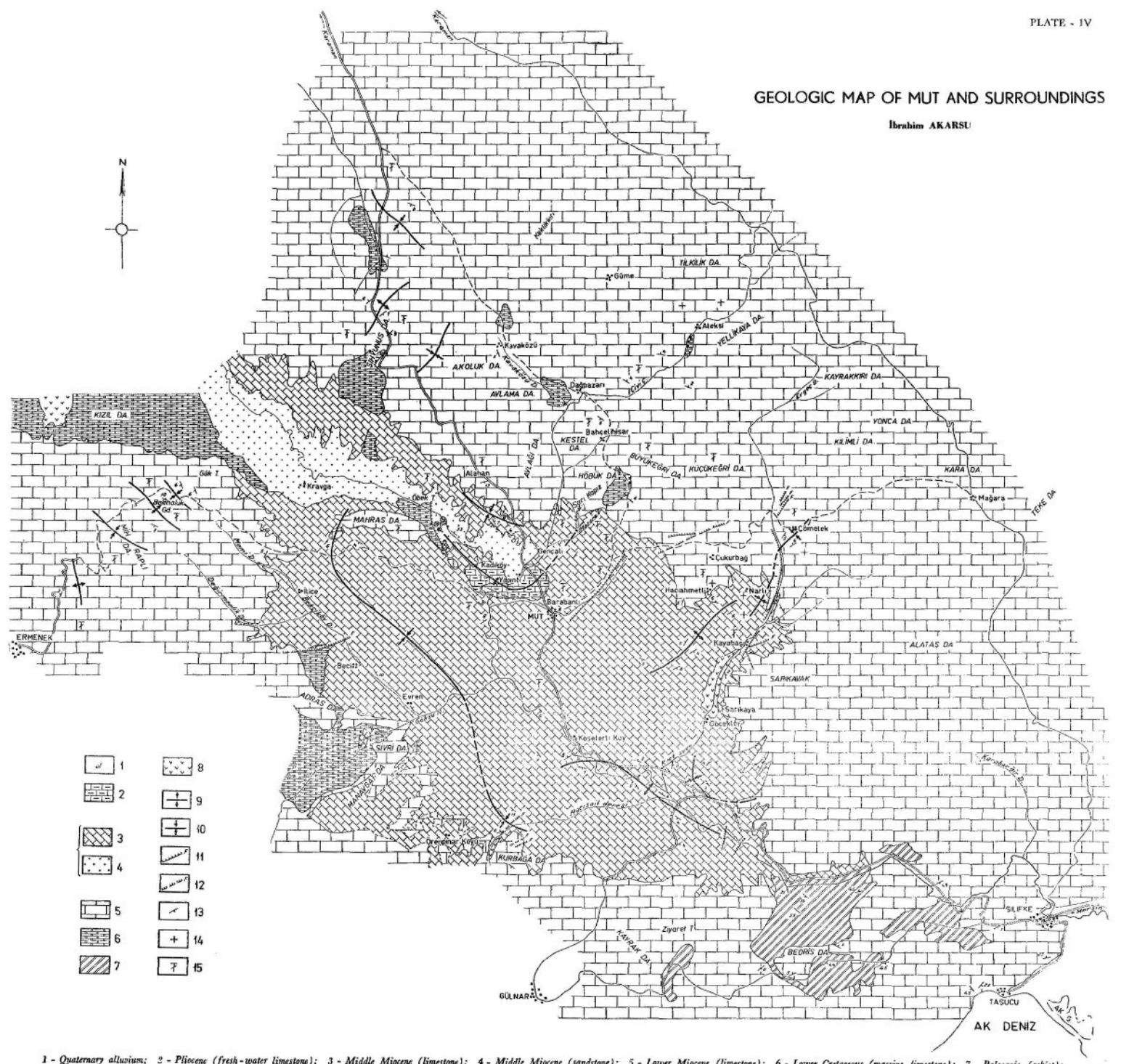

1 - Quaternary alluvium; 2 - Pliocene (fresh-water limestone); 3 - Middle Miocene (limestone); 4 - Middle Miocene (sandstone); 5 - Lower Miocene (limestone); 6 - Lower Cretaceous (massive limestone); 7 - Paleozoic (schist); 8 - Serpentine; 9 - Anticline axis; 10 - Syncline axis; 11 - Fault; 12 - Probable fault; 13 - Dip and strike of layers; 14 - Horizontal layers; 15 - Section rich in fossils.

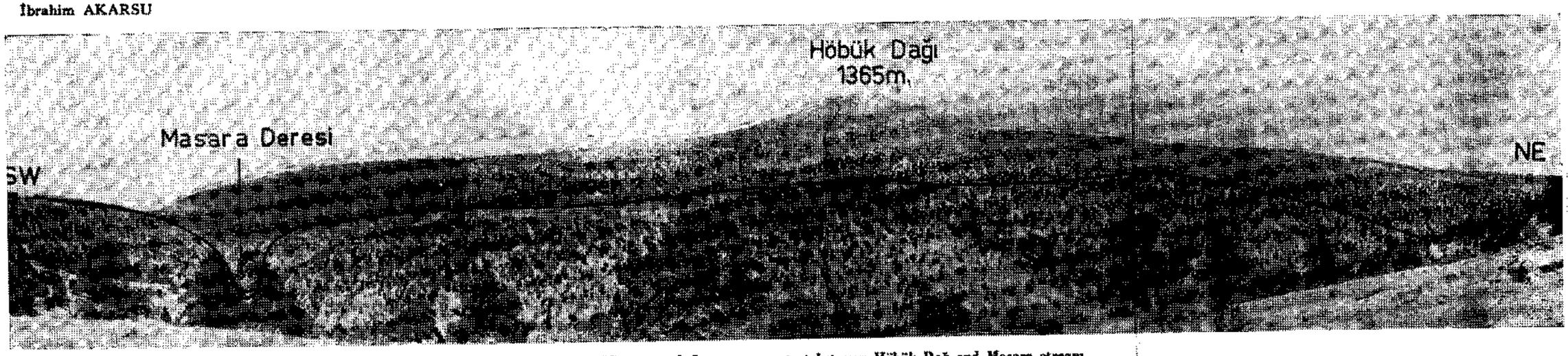

Photo 5 - Lower Miocene and Cretaceous contact between Höbük Dağ and Masara stream

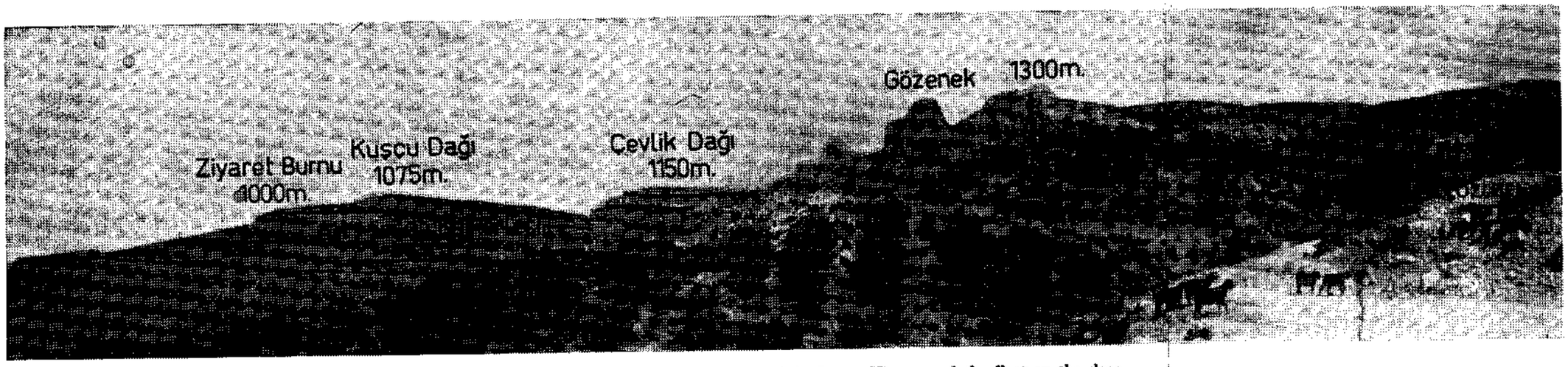

Photo 6 - Broken and fractured limestone of the Lower Miocene and the float on the slope

Photo 7 - A view from Kurbağa Mountain

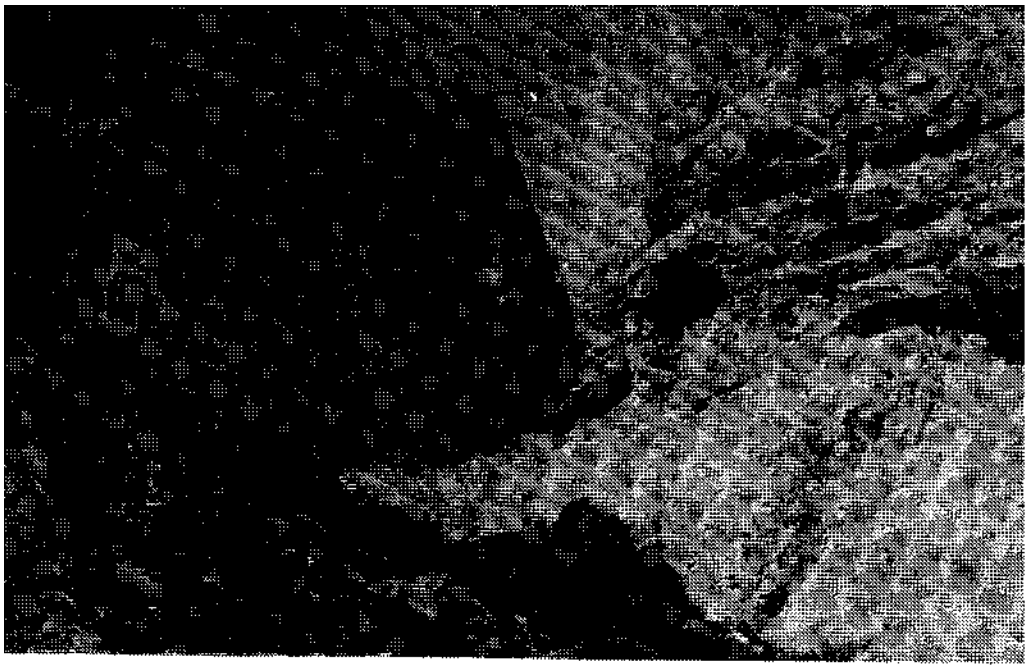

Photo 1 - A view from Dere köyü Canyon

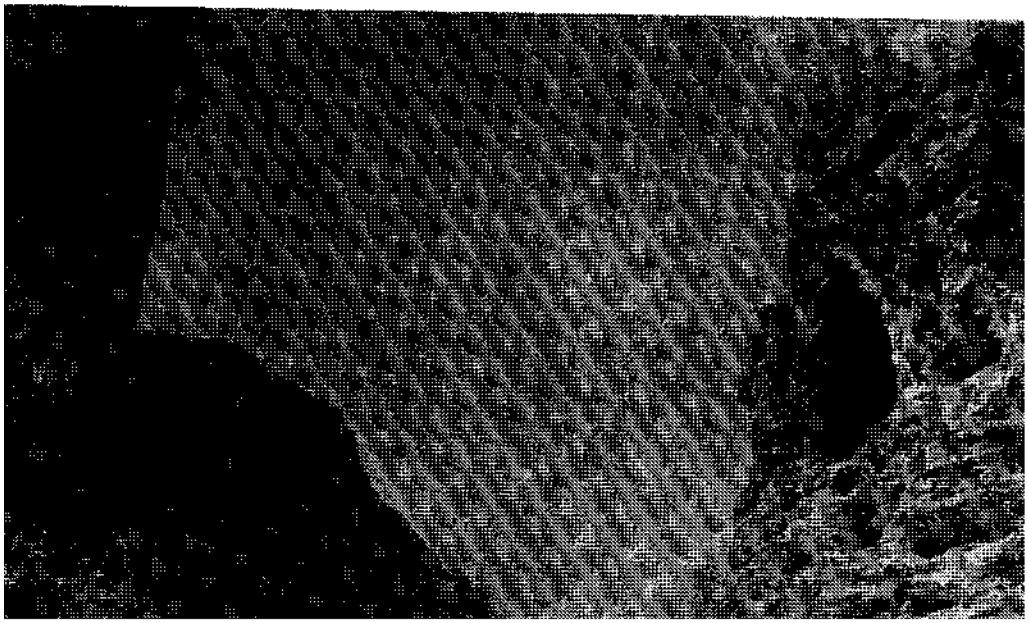

Photo 2 - An other view from Dere köyü Canyon

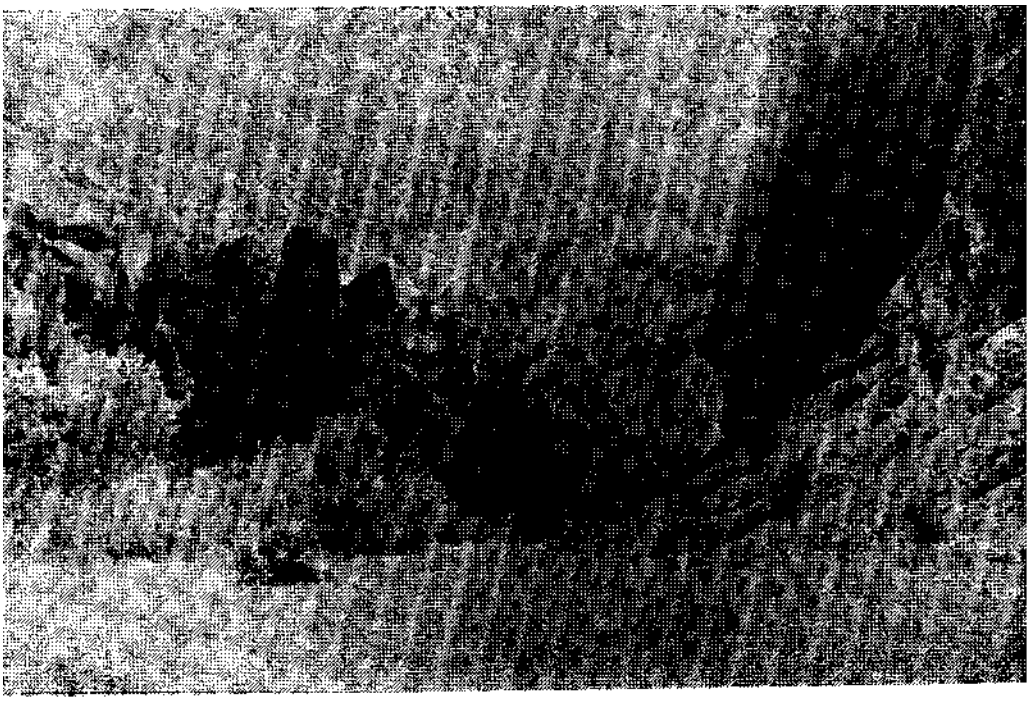

Photo 3 - Serpentine outcrops at Kocabilk. Kurtoyu Valley

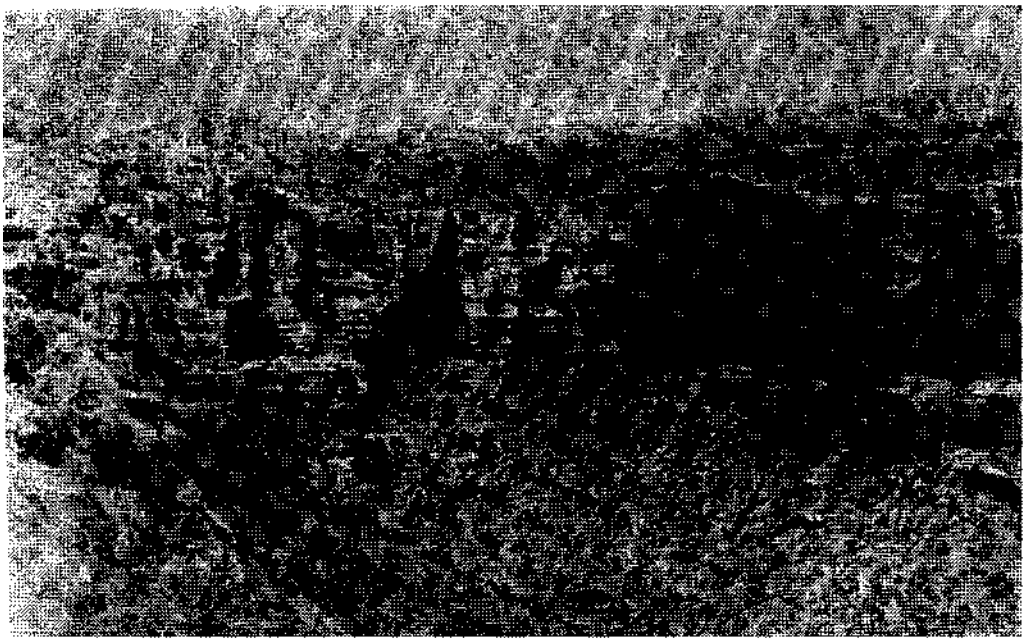

Photo 4 - Serpentine and magnesite occurrence in Kurtoyu Valley

the area was suddenly flooded anew. After the waters drained away the Middle Miocene sea came to fill the central part of the area. When, finally, the region was freed from sea waters and destined to remain above water to the present, some fresh-water lakes started to form and it was in these lakes that the fresh-water limestones, as we call them, came to take shape. These lakes were eventually gone to leave a land exposed to general erosion up until now.

E. ECONOMIC GEOLOGY

Some rock fragments in the Paleozoic formations contained iron. In the same formations, 15-20 km west of Silifke, at a locality called Gelin Suyu, specularite was encountered. Some of the serpentines outcropping in the Kurtderesi Valley have shown magnesite (Plate II, Photo 4).

A search for oil within the Cretaceous limestones may prove worth while. Lower and Middle Miocene formations may also be considered as favorable for oil accumulation.

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