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LITHOSTRATIGRAPHIC UNITS AND TECTONICS OF THE SOUTHWESTERN PART OF DADAY-DEVREKANİ MASSIVE, WESTERN PONTIDES, TURKEY

Durmuş BOZTUĞ*

ABSTRACT. - Metamorphic, magmatic and sedimentary rocks, outcropping in the southwestern part of Daday-Devrekani massive, were differentiated in to 12 lithostratigraphic units. The Precambrian Dorukyayla gneiss, comprising high-grade metasediments and dykes of asidic and intermediate composition, constitutes the basement. The Samatlar group, consisting of very low-grade metasediments Lower to Middle Paleozoic in age, unconformably overlies the Precambrian Dorukyayla gneiss. The Samatlar group, with a total thickness of approximately 4000 m , consists, from bottom to top, of the Yayladere (Cambrian), Dotla (Ordovician), Zirze (Silurian) and Kureihadit (Devonian) formations. The Permo-Triassic (?) Kirtulaz formation represents a broken formation structure which is composed of strongly faulted-crushed rocks. The Middle Jurassic Kürek granitoid, a plutonic body from the Kastamonu granitoid belt, is made up of granite, granodiorite, quartz monzonite and dykes of quartzolite, aplite and microdiorite. These units are overlain unconformably by the Yukarıköy and Çatak formations of Yaralıgöz group respectively represented by limestones and flyschoidal sediments with respective ages of Upper Jurassic-Lower Cretaceous and Lower Cretaceous. The Soğanlı formation of Middle Eocene age and the conglomerate-sandstone-siltstone-claystone alternation of the Cemalettin formation, Upper Eocene-Lower Oligocene in age, are unconformable, like the Yaralıgöz group, on the other units. Karabuzey formation of Neogene age, consisting of semi-consolidated and consolidated clastic rocks, is the youngest unit of the consolidated section The youngest unit in the mapped area is the Quaternary alluvium especially observed in the valleys. As for the structural elements, the foliation planes in the Precambrian Dorukyayla gneiss are interpreted to have been formed in a pre-Alpine period. All other structural elements such as folds, thrust and strike-slip faults are considered to have been formed synchronously with N-S compression after Lower Cretaceous. The main unconformities, also reflecting significant variances of ductile deformation, are observed between the Dorukyayla gneiss and Samatlar group and, between the Samatlar group and Yaralıgöz group.

INTRODUCTION

The studied area takes place in the northern part of Samatlar (Iğdır) village, some 20 km. west of Araç town of Kastamonu province in the northern Anatolia (Fig. 1). This paper deals mainly with the lithostratigraphic

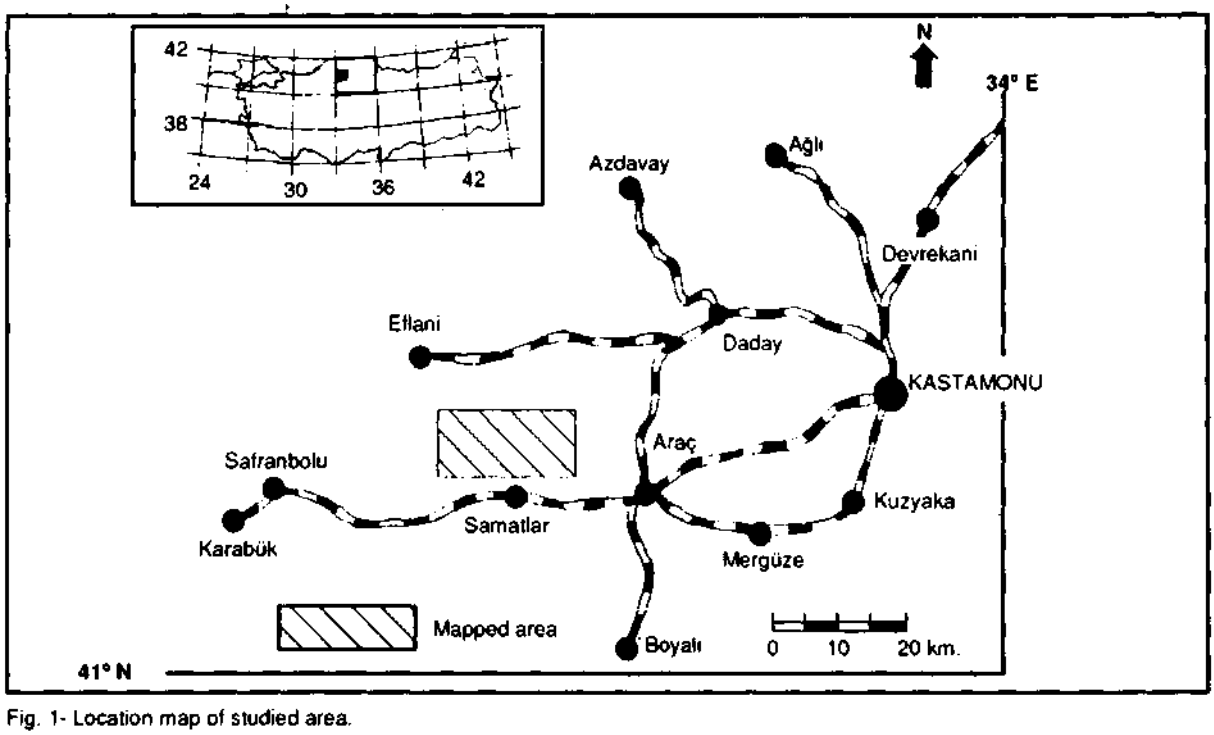

Fig. 1- Location map of studied area.

determination and general structural features of the rock units which have already been studied for the mineralogical-petrographical and geochemical investigation (Boztuğ, 1988). The previous works, in the mapped area, are those of Arpat et at. (1978), Aydın et al., (1986, 1987). On the other hand, some other studies, have been carried out related to basement geology, mineralogy-petrography, geochemistry and gepdynamic modelling, by Blumenthal (1948), Yılmaz (1979, 1980, 1981, 1983), Boztuğ (1983), Boztuğ and Yılmaz (1983), Boztuğ et al. (1984), Yılmaz and Boztuğ (1985, 1986, 1987), Yılmaz and Tüysüz (1984), Tüysüz (1985, 1986), Yılmaz and Tüysüz (1988) and-Şengün et al. (1990) in the surrounding areas.

Table 1 represents the chronostratigraphic-lithostratigraphic comparison of the Mesozoic and older units from the mapped area and surrounding taking place in the outer zone (Adamia et al., 1980) of the Pontide tectonic unit (Ketin, 1966). In the regional geological setting, The Precambrian Daday-Devrekani metasedimentary group, outcropping in the northeastern and southwestern parts of the Daday-Devrekani massiv, comprises high-grade metasediments and constitutes the basement unit in the mapped area. The Paleozoic very low grade metasediments, depositionally overlying the Daday-Devrekani metasedimentary group, show an epicontinental character, whereas the Lower Mesozoic rock units show both of the epicontmental and epiophiolitic features depending on the deposition locations. The pre-Lower Jurassic Çangal metaophiolite typically forms the oceanic crust material. The consuming of this oceanic crust, i.e. subduction zone, has concluded to emplace the Çangal metaophiolite, to induce an Early Alpine regional metamorphism (Bonhomme and Yılmaz, 1984, Yılmaz and Bonhomme, 1991) and to create an arc plutonism called Kastamonu granitoid belt (Boztuğ et al., 1984; Yılmaz and Boztuğ, 1986). The Middle-Upper Jurassic to Lower Cretaceous Yaralıgöz group (Yılmaz, 1980) characterizes the sedimentary rocks deposited in the intermountam basins.

LITHOSTRATIGRAPHIC UNITS

The metamorphic, magmatic and sedimentary rock units, ranging from Precambrian to Neogene, have been mapped as 12 lithostratigraphic units in the southwestern part of the Daday-Devrekani massiv (Fig. 2, 3a, 3b). The common characteristics of these units, from bottom to top, can be summarized as follow:

Dorukyayla gneiss (Precambrian)

Description and typical locality. _ Dorukyayla gneiss has been firstly determined by Boztuğ (1988). It crops out better in the Dorukyayla district and its western prolongation; Soğukçam dere, Çatan dere locations and in the Karadere valley (Fig. 3a).

Lithology. - Dorukyayla gneiss, outcropping in the Karadere valley, consists mainly of the alternation of amphibole/pyroxene gneiss and mica gneiss with a prevailing amphibole/pyroxene gneiss lithology. In the Karadere valley, these rocks also include a lot of pegmatitic-aplitic veins. Just to the east of Karadere valley, namely in the Gökgöl dere district, these amphibole/pyroxene gneisses represent well developed gneissosity due to metamorphic differentiation. The gradational enrichment of biotite minerals can be easily noticed towards the eastern part of the Gökgöl dere district particularly through the Yayladere valley in these gneisses, and even it can be possible to identify the two zones such as amphibole/pyroxene gneiss and amphibole-mica gneiss only in one hand specimen. In the area between the Gökgöl dere and Dögemle yayla, the lowermost, middle and uppermost parts of the Dorukyayla gneiss are composed of biotite gneiss, muscovite-biotite gneiss and muscovite gneiss, respectively. Just in the Dögemle yayla district, however, the main rock type of Dorukyayla gneiss is the quartz-feldspar gneiss. Thus, it can be concluded that the Dorukyayla gneiss consists of, from bottom to top, the amphibole/pyroxene gneiss, mica gneiss and quartz-feldspar gneiss with some acidic and intermediate vein rocks of a few meters in thickness.

Lower and upper boundaries. - The lowermost part of the Dorukyayla gneiss is exposed in the Karadere valley, and it is the basement rock unit of the studied area. As for the upper boundary, it is seen to be depositionally overlaid by the Paleozoic Samatlar group (Fig. 2, 3a, 3b).

Age. - The Dorukyayla gneiss has been considered to have a Precambrian age because of covering by the anchimetamorphic-epimetamorphic Lower to Middle Paleozoic units.

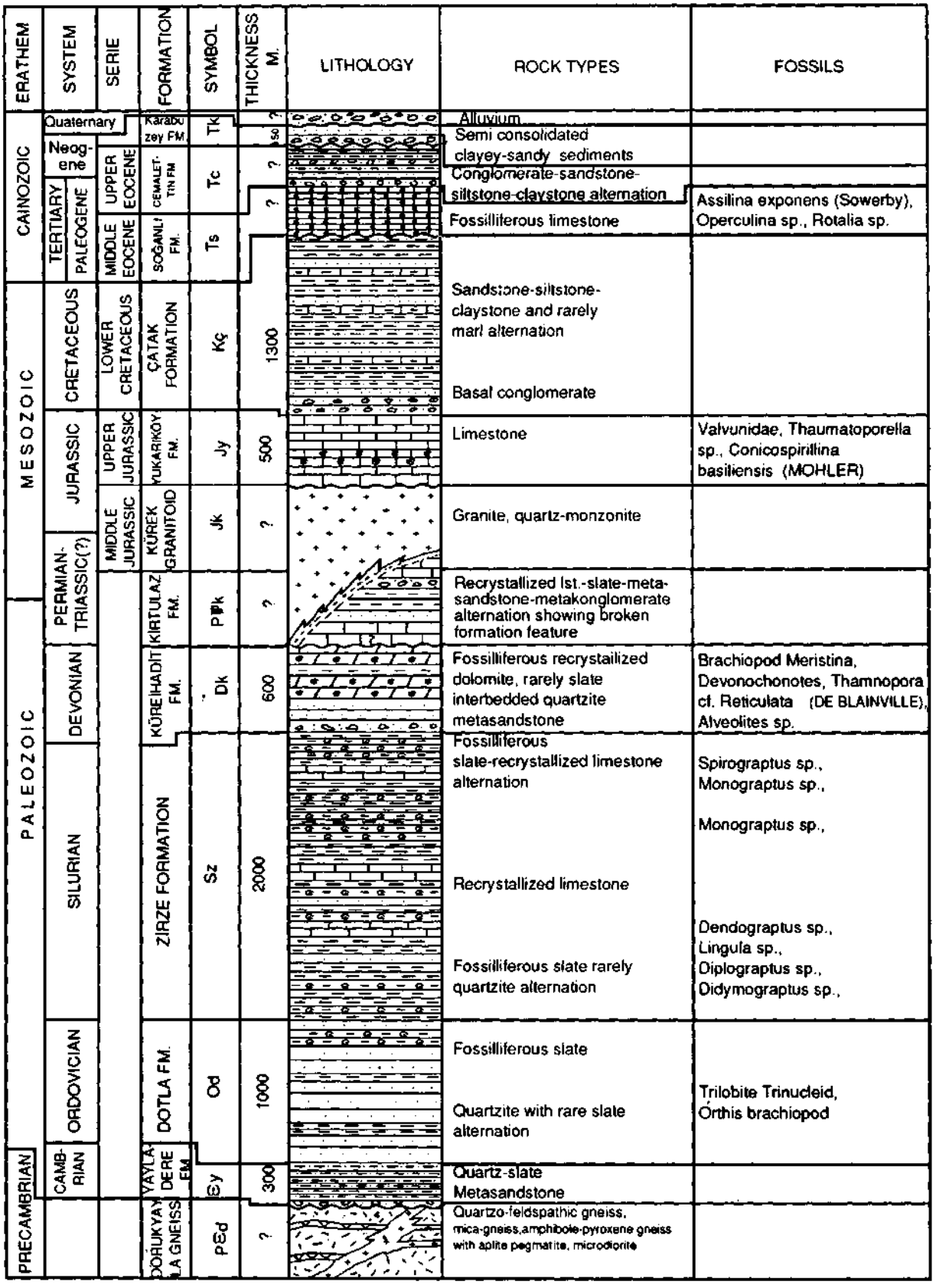

Fig. 2- Generalized stratigraphic columnar section of the SW part of Daday-Devrekani massive.

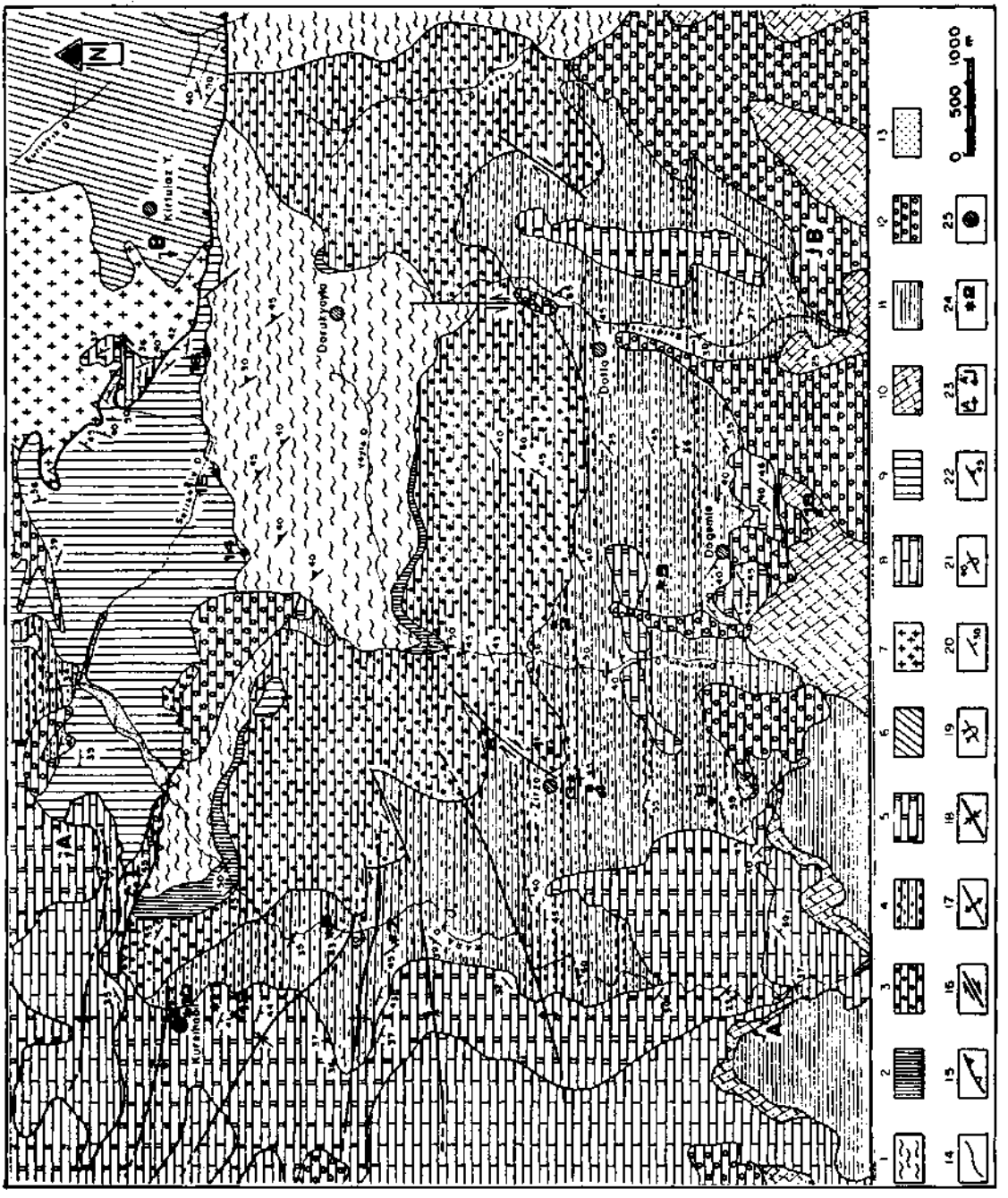

Fig. 3a- Geological map of the SW part of Daday-Devrekani massive.
1- Dorukyayla gneiss (Precambrian), 2- Yayladere formation (Cambrian), 3- Dotla formation (Ordovician), 4- Zirze formation (Silurian), 5- Küreihadit formation (Devonian), 6- Kirtulaz formation (Permo-Triassic?), 7- Kürek granitoid (Middle Jurassic), 8- Yukarıköy formation (Upper Jurassic-Lower Cretaceous), 9- Çatak formation (Lower Cretaceous), 10- Soğanlı formation (Middle Eocene), 11- Cemalettin formation (Upper Eocene-Lower Oligocene), 12- Karabüzey formation (Neogene), 13- Quaternary alluvium, 14- Formation boundary, 15- Thrust, 16- Strike-slip fault, 17- Anticline axis, 18- Syncline axis, 19- Overturned syncline axis, 20- Strike and dip, 21- Overturned bedding, 22- Foliation, 23- Cross section line, 24- Fossil location, 25- Villages.

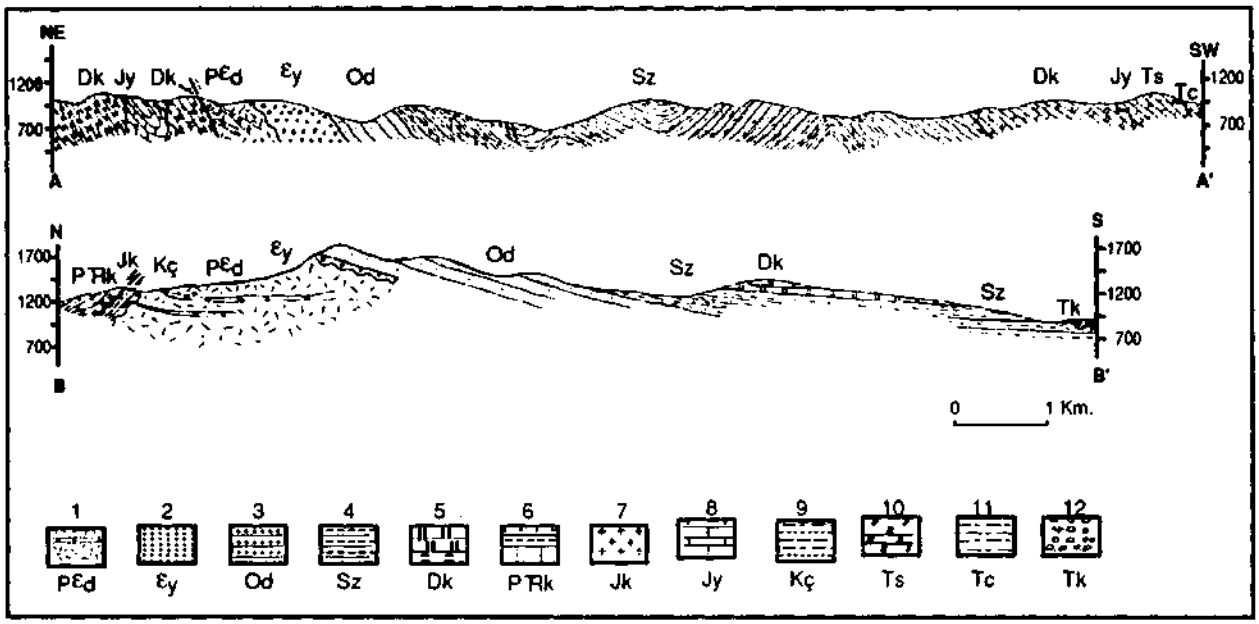

Fig.3b- Geological cross sections (Fig. 3a for the cross section line).
1- Dorukyayla gneiss, 2- Yayladere formation, 3- Dotla formation, 4- Zirze formation, 5- Küreihadit formation, 6- Kirtulaz formation, 7- Kürek granitoid, 8- Yukarıköy formation, 9- Çatak formation, 10- Soğanlı formation, 11- Cemalettin formation, 12- Karabüzey formation.

Regional correlation. _ As seen from Table 1, the Dorukyayla gneiss can be evaluated as the equivalent of the Gürleyik gneiss (Yılmaz, 1980) and the Yedigöller formation (Aydın et al., 1986).

SAMATLAR GROUP

The Lower to Middle Paleozoic Samatlar group, firstly described by Boztuğ (1988), is composed of, from bottom to top, the Yayladere (Cambrian), Dotla (Ordovician), Zirze (Silurian), and Kureihadit (Devonian) formations.

Yayladere formation (Cambrian)

Description, type locality and section. ~ The Yayladere formation, firstly described by Boztuğ (1988) is exposed better in the Karadere valley, Yayladere valley and Geyikoynağı tepe districts of the studied area (Fig. 3a, 3b). Total thickness of the formation, measured within the Yayladere valley, is of some 300 m. (Fig. 4).

Lithology. - The lowermost part of the Yayladere formation, taking unconformably place on top of the amphibole/pyroxene, gneiss and amphibole-biotite gneisses of the Dorukyayla gneiss, is composed of coarse grained metasandstone with a thickness of 30 m. (Fig. 4). The major constituents of these rocks comprise coarse graine sized (1 to 5 mm. in diameter) sandy materials and they can be misunderstood as the quartz-feldspar gneiss in the first approach. When they have been carefully studied in hand specimen with the aid of handlense, the detrital quartz, feldspars and large flakes of micas can be distinguished in a silky groundmass due to sericite growth. Grain sizes of the constituents of these coarse grained metasandstones, considered as the first depositional products on top of the Dorukyayla gneiss, gradationally decreses towards to upper parts of the unit, and then, these coarse grained metasandstones appear as normal metasandstones in grain size. A grayish-greenish quartz argillite and argillite level, with a total thickness of 70 m., takes place on top of these metasandstones (Fig. 4). These greenish argillites are followed by the reddish-purple quartz argillite-argillite level, with a total thickness of 200 m., showing mm.-dm. bedding and including visible mica flakes with unaided eye.

Lower and upper boundaries. - The Yayladere formation unconformably overlies the Precambrian Dorukyayla gneiss, and is conformably covered by the Ordovician Dotla formation (Fig. 2, 3a, 3b, 4).

Age. - There has not been found any fossil in the Yayladere formation in the mapped area, however, Arpat et al. (1978) mentioned something about the existence of Lower Cambrian brachiopods in this formation. The Yayladere formation has been considered to have the Cambrian age, since taking place in the lowermost part of the Samatlar group.

Depositional environment. — The Yayladere formation-characterizes the transitional zone between terrestrial and shallow marine environment.

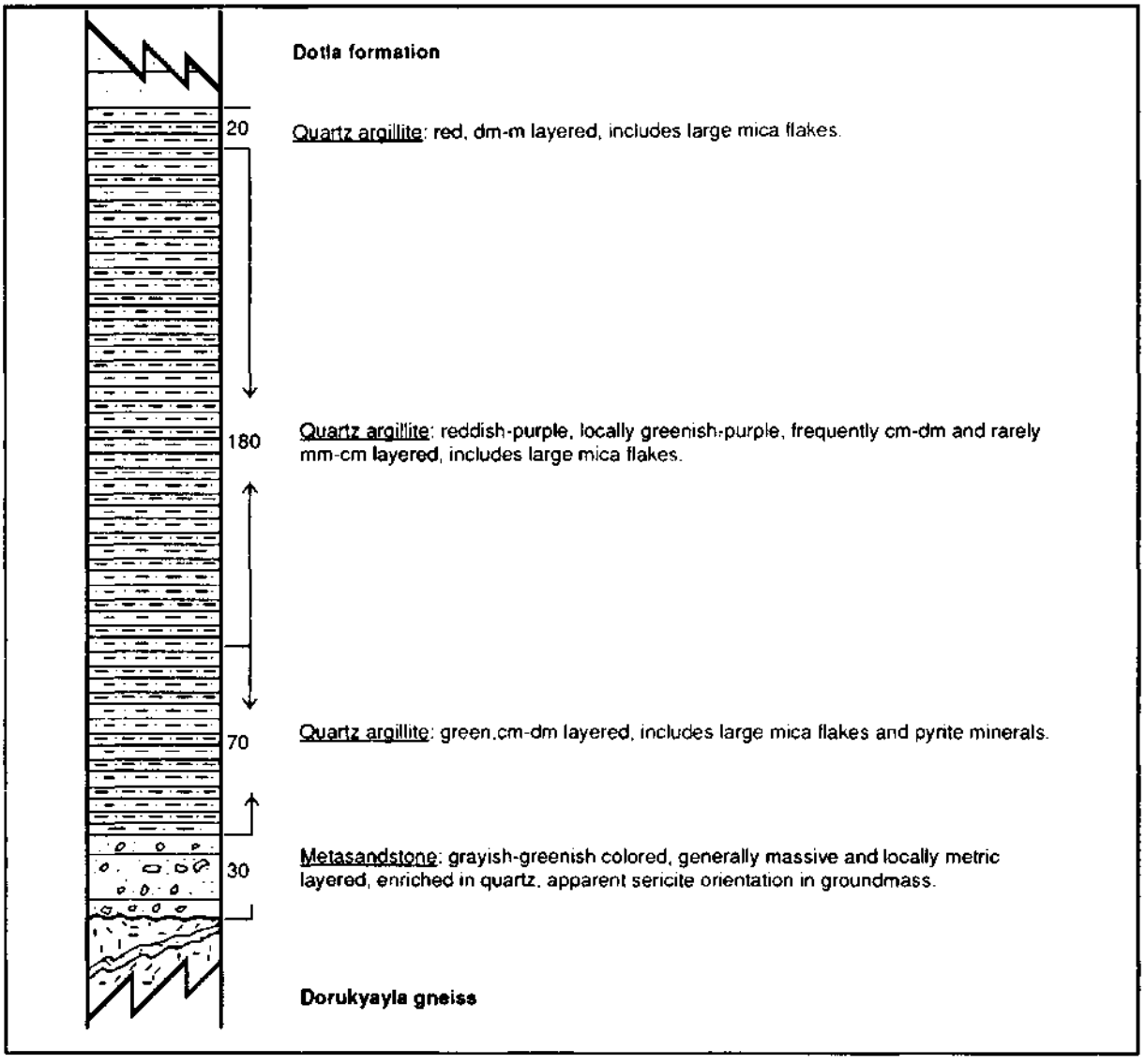

Fig. 4- Type section of the Yayladere formation.

Regional correlation. — The Yayladere formation, considered to have the Cambrian age, is evaluated the equivalent of the Kocatöngel formation (Table 1) described by Aydın et al. (1986).

Dotla formation (Ordovician)

Description, type locality and section. _ The Dotla formation firstly described by Boztuğ (1988), is seen to be exposed better around the Dotla village and Yayladere and Karadere valleys. The type section of the Dotla formation has a thickness of 1000 m. in the Yayladere valley (Fig. 5).

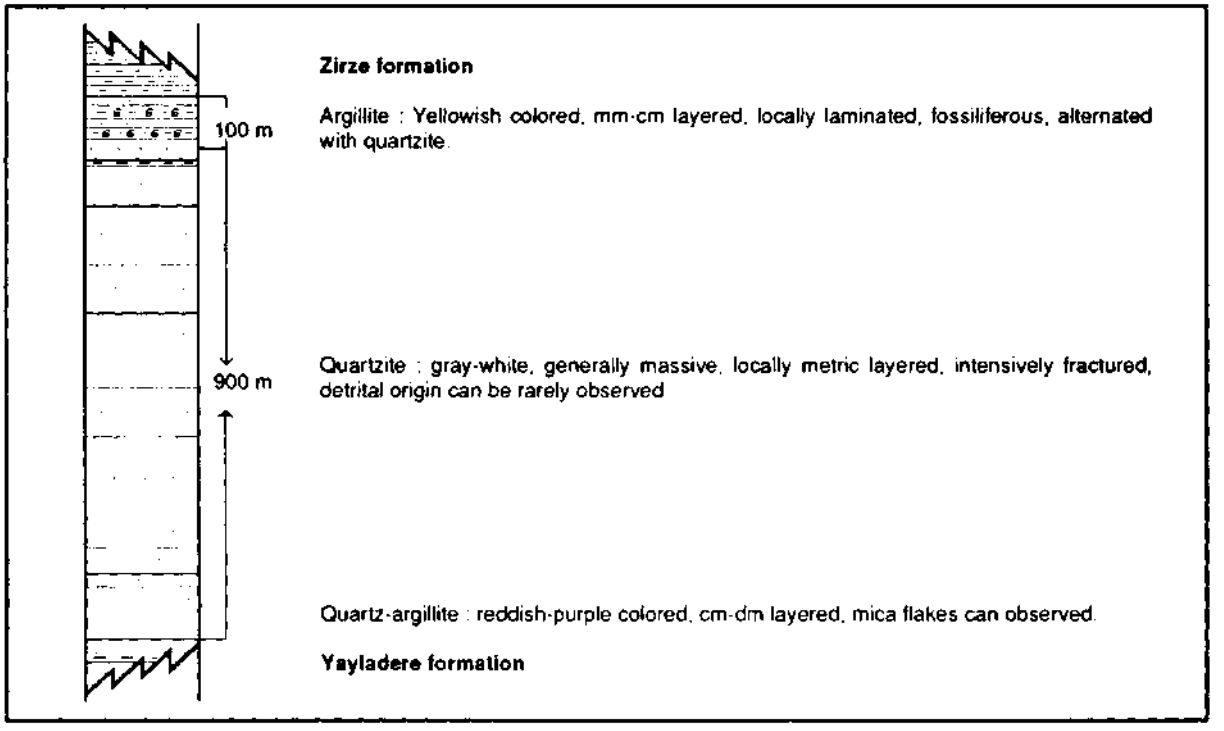

Fig. 5- Type section of the Dotla formation

Lithology. _ There is a gray-white colored quartzite level with a thickness of 100 m. total thickness in the lower parts of the formation. This quartzite level shows a well preserved detrital origin in hand specimen. A reddish-purple quartz argillite/argillite band, 20 m. in thickness, takes places on top of this gray-white quartzite. These argillites are followed by another gray-white massive quartzite, with a total thickness of 800 m., representing locally preserved sedimentary bedding of metric thickness (Fig. 4). The uppermost part of the Dotla formation is made up of the alternation of argillite and quartzite with a thickness of 100 m.

Lower and upper boundaries. - The Dotla formation conformably overlies the Yayladere formation and is conformably covered by the Silurian Zirze formation (Fig. 2, 3a, 3b, 5).

Age. - The fossils, found in the ZZ-42A rock sample from the argillite-quartzite alternation in the uppermost part of the Dotla formation, yield the Upper Ordovician-Lower Silurian age, ZZ-42A (Fig. 3a, location number is 1): a brachypoda from-primitive, Orthis group, Trilobite Trinucleid. The age of the Dotla formation has been evaluated as the Ordovician since these fossils have been found in the uppermost part of this formation. Moreover, some other fossils indicating the Lower Ordovician age have been already mentioned by Arpat et al. (1978) in this unit.

Depositional environment. - The Dotla formation seems to be deposited in a beach environment.

Regional correlation. - The Dotla formation is considered to be the equivalent of the Bakacak and Kurtköy formations, and also the equivalent of the lower parts of the Aydos formation (Table 1) described by Aydın et al. (1986).

Zirze formation (Silurian)

Description, type locality and section -Zirze formation has been firstly described by Boztuğ (1988). It is observed to be outcropped better around Zirze village and in the Bahçecik dere to the southeast of the Dotla village. The type section of this formation, measured in the Ketencik dere situated to the southeast of Zirze village, showed that the total thickness of this unit was of approximately 2000 m. (Fig. 6).

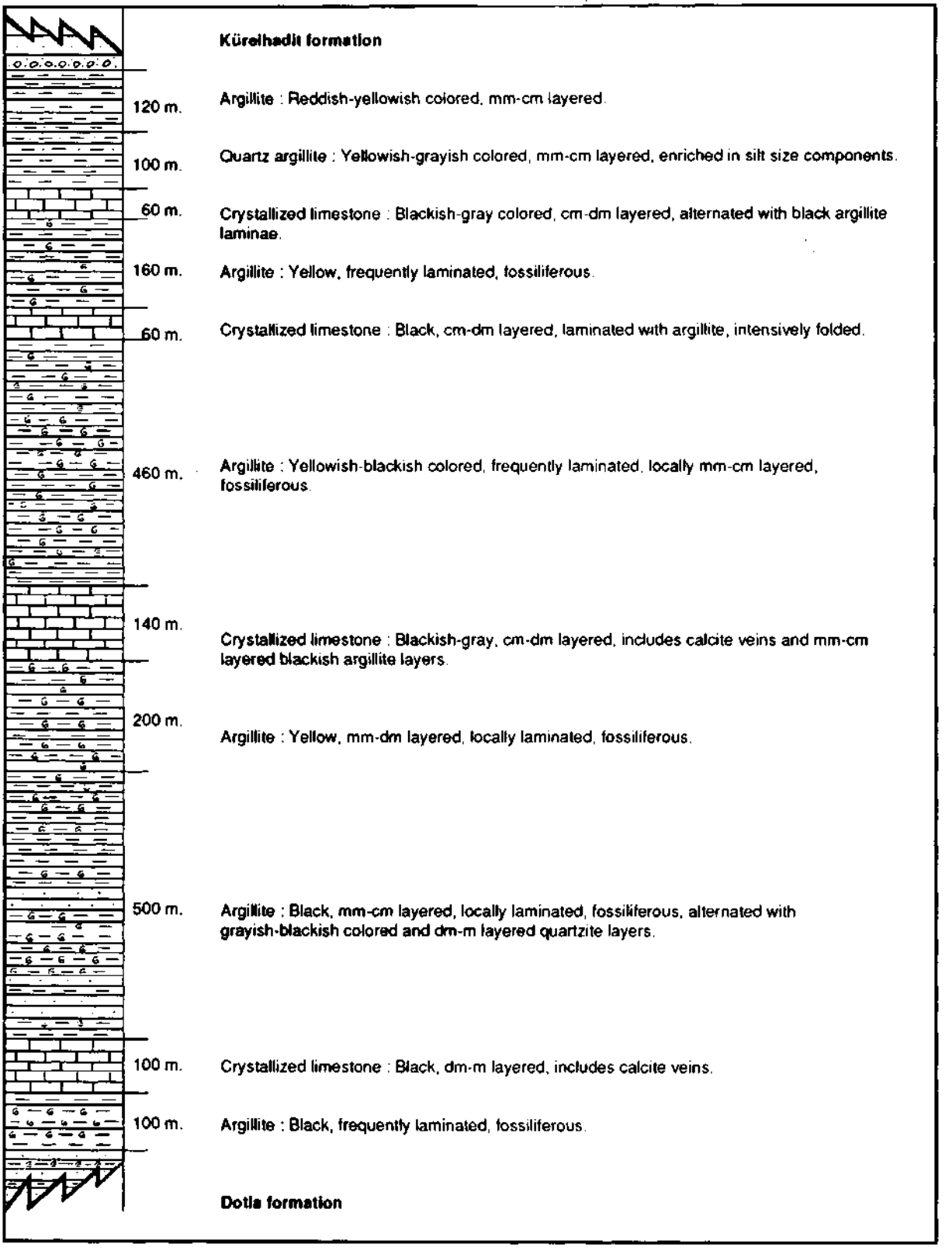

Fig. 6- Type section of the Zirze formation.

Lithology. - The prevailing lithology of the Zirze formation is argillites as seen in Figure 6. However, it locally includes the grayish-white quartzite and blackish-grayish crystallized limestone beds, too. The argillites of Zirze formation represent bedding which is ranging typically from mm. to dm. in thickness. As for the color of these argillites, the blackish, yellowish-brown and yellowish-pinkish colors are dominant in the lower, middle and upper parts of the unit, respectively.

Lower and upper boundaries. - The Zirze formation conformably overlies the Dotla formation and is overlaid by the Küreihadit formation.

Age. - Some fossils have been found in the Zirze formation which yield typically Lower and Upper Silurian ages. The rock samples including the Lower Silurian fossils are as follow:

DG-296A-B (four specimens) (location 2 in Fig. 3a):

Dendograptus sp. (resembling tree branches),

Lingula sp. (an ill-preserved brachiopoda).

ZZ-20 (location 3 in Fig. 3a):

Diplograptus sp.

ZZ-21A, B (two specimens) (location 4 in Fig. 3a):

Didymograptus sp.

Apart from these Lower Silurian fossils, there are some other fossils which may only indicate an age of Silurian rather than the stages of Silurian below:

DG-451 (location 5 in Fig. 3a):

Monograptus sp.

ZZ-67 (location 6 in Fig. 3a):

Monograptus sp.

ZZ-101 (location 7 in Fig. 3a):

Monograptus sp.

On the other hand, the Upper Silurian fossils of the Zirze formation are as follow:

ZZ-180 (location 8 in Fig. 3a):

Monograptus sp.

ZZ-187 (location 9 in Fig. 3a):

Spyrograptus sp.

Depositional environment. - The Zirze formation characterizes a deep marine environment.

Regional correlation. - The Zirze formation can be correlated, as seen in Table 1, with the ferriferous clayey sandstone (Tokay, 1952), the Işığandere formation (Görmüş, 1982), the Fındıklı and upper parts of the Aydos formations (Aydın et al., 1986).

Kureihadit formation (Devonian)

Description, type locality and section. - The Küreihadit formation, firstly described by Boztuğ (1988), outcrops better around Küreihadit village and in the Karadere valley. The type section of Küreihadit formation, measured in the Karadere valley, is of 600 m. in total thickness (Fig. 7).

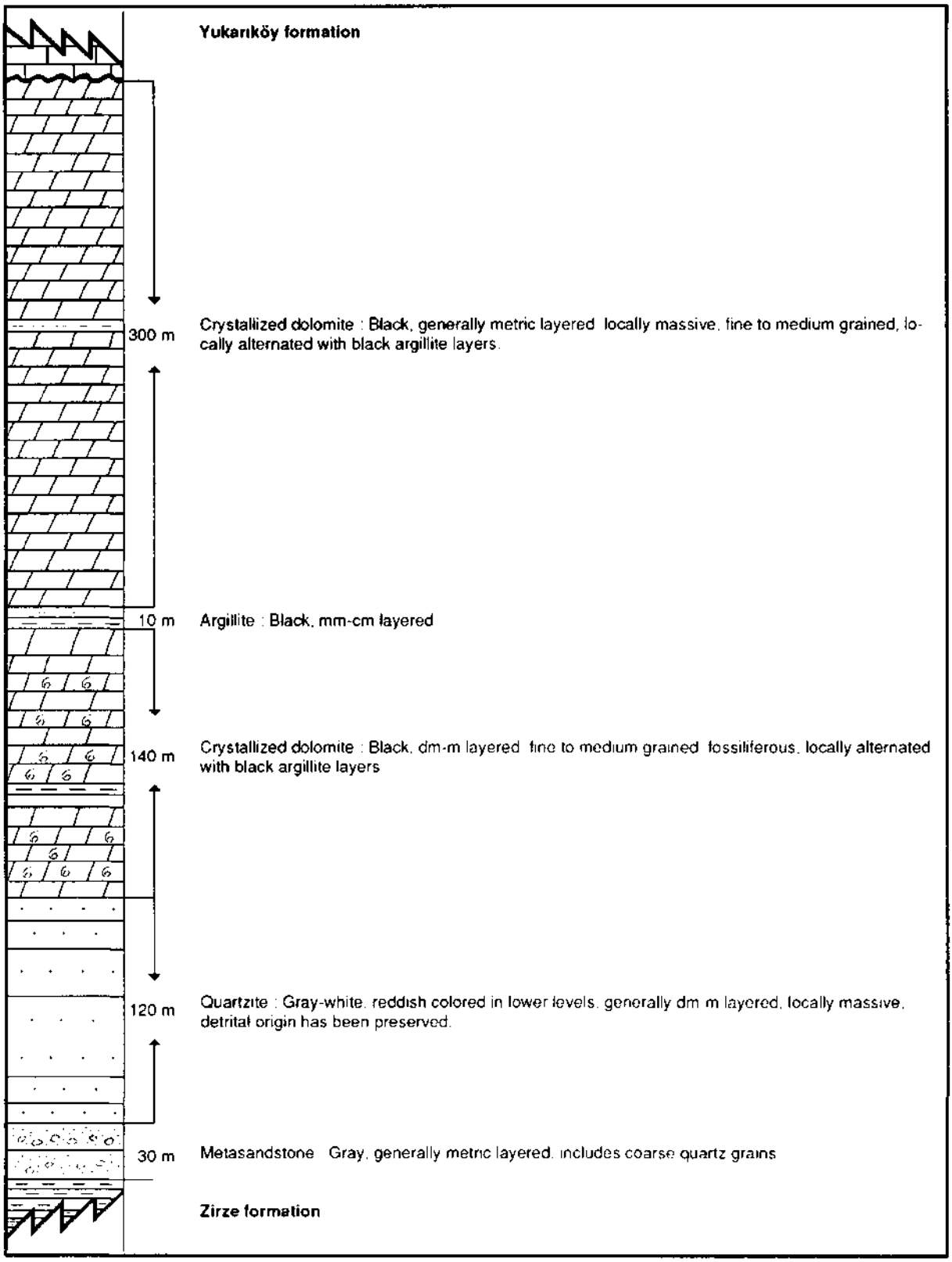

Fig. 7- Type section of the Küreihadit formation

Lithology. -There is a metasandstone level, with a thickness of 30 m., in the lowermost part of Küreihadit formation (Fig. 7). These metasandstones consist mainly of quartz grains, 5 mm. or more in grain sizes, cemented by a siliceous material. On top of these metasandstones, there is a quartzite level representing well preserved sedimentary bedding and detrital origin with a total thickness of 120 m. The lower part of these quartzites show reddish color due to iron enrichment, whereas the upper parts, with a layering dm.-m. in thickness, possess grayish-white color (Fig. 7). This quartzite level is followed by the brownish-black colored and locally bituminous smelling dolomitic rocks with a total thickness of 450 m. Some black colored argillite levels, ranging from 5 to 10 m. in thickness, can also be locally observed within these dolomitic rocks (Fig.7).

Lower and upper limits. - The Küreihadit formation covers the Zirze formation and underlies the Upper Jurassic-Lower Cretaceous Yukarıköy formation.

Age. - Some fossils, characterizing the Middle to Upper Devonian, have been found in the middle and upper parts of the crystallized dolomitic rocks of Küreihadit formation. The Upper Devonian fossils are as follow:

ZZ-91A, B, C (three specimens) (location 10 in Fig. 3a):

Algeas microfossils.

ZZ-94A, B (two specimens) (location 11 in Fig. 3a):

Brachiopoda Meristina.

The fossils indicating Devonian age are as follow:

ZZ-95D, E (two specimens) (location 12 in Fig. 3a):

Devonochonotes.

ZZ-90/1D (location13 in Fig. 3a):

Thamnopora sp.

Rugos soliter fragment.

ZZ-90/1E (location 13 in Fig. 3a):

Alveolites sp.

ZZ-90/1F (location 13 in Fig. 3a): .

Alveolites sp.

ZZ-90/1K (location 13 in Fig. 3a):

Tabular coral fragments.

ZZ-90/1L (location 13 in Fig. 3a):

Alveolites sp.

ZZ-94C (location 11 in Fig. 3a):

Alveolites sp.

Apart from all these fossils, there have also been found some characteristic fossils yielding Kuvinian-Frasnian (Upper-Middle Devonian) age in the Küreihadit formation as follow:

ZZ-90/1G (location 13 in Fig. 3a):

Thamnoporact. reticulata (De Blainville).

ZZ-90/1M (location 13 in Fig. 3a):

Thamnopora cf. *reticulata* (De Blainville).

Depositional environment. _ The Küreihadit formation characterizes shallow marine environment with a gradational increasing of energy.

Regional correlation. - As seen from Table 1, the Küreihadit formation is considered to be the equivalent of the "quartzitic calcareous rocks" and "dolomitic calcareous rocks" described by Tokay (1952) in Zonguldak area, of the Kocadere, Hacıyardere and Değ3irmendere formations described by Görmüş. (1982) in Bolu region, and the Kartal formation and the lower parts of Yılanlı formation described by Aydın et al. (1986).

Kirtulaz formation (Permo-Triassic?)

Description and type locality. - The Kirtulaz formation, firstly described by Boztuğ (1988) is observed better in the Kirtulaz yayla and surroundings in the NE part of mapped area (Fig. 3a).

Lithology. — The Kirtulaz formation is made up of various rock types such as grayish-blackish crystallized limestones, grayish-white quartzites, red-green argillites, greenish metagraywackes and metaconglomerates composed mainly of white quartzite pebbles and blocks cemented by a red wine colored clayey cement. Most of these rock types show cataclastic features. There is no any regularly continued observable rock type in this unit. All the rocks, mentioned above, are always seen to be fractured and faulted, and they always have tectonic boundaries with each other. For example, when the crystallized limestone, is followed, it suddenly disappears and the argillite appears with a tectonic contact. That is why the Kirtulaz formation is thought to be a broken formation (Hsu, 1968; Berkland et al., 1972) on the basis of these features (oral communication with Dr. B. Batman, Hacettepe Univ., Ankara).

Lower and upper boundaries. - The lower boundary of the Kirtulaz formation is seen to be a faulted contact. Along this E-W faulted contact, this unit is thrusted, from north to south, into the Dorukyayla gneiss and Dotla formation (Fig. 3a). As for the upper boundary of the unit, it is out of mapped area, around the Daday region.

Age. - There has not been found any fossil in the rocks of the Kirtulaz formation. However, it is assumed to have an age older than Middle Jurassic because of cutting and thermally metamorphosed by the Middle Jurassic Kürek granitoid. On the other hand, the lithological correlation of the Kirtulaz formation with some units in regional geological framework may suggest an age of Permo-Triassic (?).

Depositional environment. _ The environmental interpretation of Kirtulaz formation seems to be very hard due to intensive and extensive faulting and fracturing of the rocks. However, the rock types of this unit should be deposited in different environments ranging from transitional to shallow and deep marine environments.

Regional correlation. - The Permo-Triassic (?) Kirtulaz formation is thought to be the equivalent of the "Middle Triassic limestone" and partly "Börümce schists" (Blumenthal, 1948), the "Lower Jurassic-Triassic limestone" and partly "old flysch" (Geiss, 1954), the lower parts of Börümce formation (Yılmaz, 1980), Domuzdağ metamorphic complex and partly Akgöl formation, Gümüşoluğu formation and Bekirli metamorphite (Tüysüz, 1986), Çakraz formation and lower parts of Akgöl formation (Aydın et al., 1986), and of the Paleozoic Akılçalman formation (Şengün et al., 1990).

Kürek granitoid (Middle Jurassic)

Description and type bcality. - The Kürek granitoid has been firstly described by Yılmaz and Boztuğ (1986), and studied in detail by Boztuğ (1988). The name of this pluton comes from the Kürek village just to the north of mapped area. It outcrops better around Köyyeri village in the mapped area (Fig. 3a).

Lithobgy. - The Kürek pluton consists mainly of granite, granodiorite and quartz monzonite on the basis of chemical-mineralogical nomenclature (Boztuğ, 1988). These medium to coarse grained magmatic rocks can also be determined as granodiorite in hand specimens during fieldworks. The rocks of the Kürek granitoid, possessing fresh exposures in the western and eastern parts of the Köyyeri village, are observed to be enriched in the contents of mafic minerals and plagioclases rather than K-feldspars in hand samples. As for the vein rocks of this pluton, they are made up mainly of quartzolites (Streckeisen, 1976), aplites and microdiorites.

Lower and upper boundaries. - The Kürek granitoid intrudes the Permo-Triassic (?). Kirtulaz formation and transformes into contact metamorphic rocks (i.e. forsterite-marble; Boztuğ, 1988) along the contact zone. It is depositionally covered by the Upper Jurassic-Lower Cretaceous Yukarıköy formation in the northeastern part of the Çonlar village.

Age. - The Kürek pluton is considered to be one of the members of the Middle Jurassic Kastamonu granitoid belt, since it is overlaid by the Upper Jurassic-Lower Cretaceous Yukarıköy formation, and it is geologically, mineralogically-petrographically and also geographically associated with the Kastamonu granitoid belt (Boztuğ et al., 1984; Yılmaz and Boztuğ, 1986; Şengün et al., 1990). The Middle Jurassic age of the Kastamonu granitoid belt has also been clarified with the K-Ar radiometric age datings on the Asarcık diorite (Bonhomme and Yılmaz, 1984; Yılmaz and Bonhomme, 1991) and Ahiçay-Elmalıçay granitoid (Boztuğ and Yılmaz, 1991).

Environmental interpretation. — The Kürek granitoid is a member of the Middle Jurassic Kastamonu granitoid belt. The geological, mineralogical-petrographical and geochemical studies, carried out on the Kastamonu granitoid belt, showed that this belt was related to arc magmatism and even some felsic plutons from this belt, were related to crustal thickening towards the end of arc magmatism (Boztuğ et al., 1984; Yılmaz and Boztuğ, 1986).

Regional correlation. _ As seen from Table 1, The Kürek granitoid can be correlated with "South Evrenye Intrusive Complex" (Geiss, 1954), Asarcık diorite (Yılmaz, 1980), Çangal granite (Tüysüz, 1986) and Dirgine granite (Aydın et al.. 1986). On the other hand, the Kürek granitoid also continues towards the north of mapped area where this pluton has called Jurassic Soğüdek granitoid by Şengün et al. (1990). In their regional geological study Şengün et al. (1990) mention that there are some granitic rocks covered by Lower Jurassic rocks, however, there has not been found any granitic pluton covered by Lower Jurassic rocks in the Araç-Karadere area.

Yukarıköy formation (Upper Jurassic-Lower Cretaceous)

Description and type locality. — The Yukarıköy formation has been firstly described by Yılmaz (1980) around the Yukarıköy village, east of Devrekani town. This unit, also constituting one of the Yaralıgöz group (Yılmaz, 1980), outcrops around the Küreihadit, Küpelik, Saltuklu and Çonlar villages in the studied area.

Lithology. _ The typical rock type of Yukarıköy formation is graytsh colored limestone. These limestones, with the blackish-gray colors in the lower part of unit, also represents layering dm.-m. in thickness despite karstic erosion.

Lower and upper boundaries. - The Yeniköy formation unconformably overlies the Küreihadit formation, and it is conformably overlaid by the Lower Cretaceous Çatak formation.

Age. - Yılmaz (1980) has found some fossils yielding Upper Jurassic-Lower Cretaceous age in the Yukarıköy formation. The fossils, found in the mapped area, also determine Upper Jurassic-Lower Cretaceous, although, some of them indicate only Malm age (i.e. DG-151 and DG-217 B numbered rock samples). These fossiliferous rocks and their fossil contents are as follow:

DG-59 (location 14 in Fig. 3a):

Valvunidae,

Thaumatoporella sp.

DG-104 (location 15 in Fig. 3a):

Ammobaculites sp.,

Nautiloculina sp.,

Textularidae, Echinoidea, macro shelve sections.

DG-151 (location 16 in Fig. 3a):

Conicospirillina basiliensis Mohler

Nautiloculina sp.,

Pseudocyclammina sp.,

Algeas, Echinoidae, macro shelve sections.

DG-217 B (location 17 in Fig. 3a):

Donacosmilia Corallina de Fromentel.

Depositionalenvironment. -The Yukarıköy formation typically characterizes the shelf carbonates.

Regional correlation. - The Yukarıköy formation is equivalent to the "Yaralıgözdağı carbonate" (Blumenthal, 1948), "cover carbonates and basal conglomerate" (Geiss, 1954), and the Inaltı formation (Tüysüz, 1986; Aydın et al., 1986) as seen in Table 1.

Çatakformation (Lower Cretaceous)

Description and type locality. _ The Çatak formation, firstly described by Yılmaz (1980) around Çatak village, east of Devrekani town, is seen to be exposed better in the Salihoğlu dere and around the Aşağıbusup and Köle Hasan villages in the mapped area (Fig. 3a).

Lithology. - The Çatak formation consists typically of flyschoidal rocks comprising the alternation of black colored sandstone-siltstone-claystone and locally marl layers, cm. to dm. in thickness. There is also a calcirudite level, up to 50 m. in total thickness, in the lower parts of the unit in the southern part of Köle Hasan village.

Lower and upper boundaries. - The Çatak formation conformably overlies the Yukarıköy formation, and it is unconformably covered by Middle Eocene Soğanlı formation.

Age. — There has not been found any fossil in the Çatak formation, however, Yılmaz (1980) has found some Lower Cretaceous fossils in this unit.

Table 1 - The comparision of the Mesozoic and older chronostratigraphic-lithostratigraphic units in the studied area and surrounding

		Blumenthal, 1948	Tokay, 1952	Geiss, 1954	Yılmaz, 1980,1981,1983	Görmüş, 1982	Tüysüz, 1986	Aydın et al., 1986	Boztuğ, 1988
MESOZOIC	CRETACEOUS MAASTRICHTIAN	Marly-limestone Globotruncana	Alapli marl-lst. Sarıkorkmaz bed	Andesite	Kaygunca fm.	Hızardere fm.	Kargı ophiolite assemblage	Namazlıtepe fm.	
	CAMPANIAN	Devrekanı basın (Sand.-limest facies)	Liman tuff and volcanics	Marl, andesite, limestone	Kırensöküsü fm.			Yemişlıçay fm.	
	SANTONIAN		Lower serie	?			F	Kapanboğazı fm.	
	CONIACIAN		Upper blue marl	Young flysch				Çağlayan fm.	
	TURONIAN	Yazılıhisar Sandstone-marl facies	Sand. glauconite				Çağlayan fm.		
	CENOMANIAN		Velibey sand.	L. Cretaceous marl			İnaltı fm.	İnaltı fm.	Çatak fm.
	ALBIAN		Cretaceous basal. conglom.	Limestone and basal conglomerate	Çatak fm		Bürnük fm.		Yukarıköy fm.
	APTIAN				Yukarıköy fm.		Çangal granite	Bürnük fm	
	BARREMIAN	Yaralıgöz dağı limestone		Küre intrusive, S of Evrenye complex,- Dikmendağ	Muzrup fm		Akgöl fm. Gümüşoluğu fm. Bekirli metamor.	Dirgine granite	Kürek granite
	HAUTERIVIAN				Asarcık diorite			Akgöl fm.	?
	VALANGINIAN							?	
	BARRIASIAN			Old flysch Göynükdağı massif	Börümce fm.		Yılanlı group Domuzdağ comp.	Çakraz fm.	Kırtulaz fm.
	JURASSIC MALM	Conglomerate			?				?
	DOGGER	Börümce schist		L. Jurassic Triassic limestone					
	LIAS	M. Triassic lmst. ?		Dikmendağ conglomerate	F		F	Zonguldak fm.	
	TRIASSIC							Yılanlı fm.	
PALAEOZOIC	PERMIAN	Göynükdağı massive	Arıtdere fm.		Çangal metaophiolite	Değirmendere fm.	Devrekani metamorphite continental assemblage	Kartal fm.	Küreihadit fm.
	CARBONIFEROUS	Daday massive	Karadon, Kozlu, Alacaağzı		1. Karadere metabasite	Hacıyardere fm.		?	
	DEVONIAN	1. Serpentinite	Dolomite lst.		2. Dibekdere metaultramafite	Kocadere fm.		Fındıklı fm.	Zirze fm.
	SILURIAN	2. Diabase	Quartzite lst.			Işığandere fm.		Aydos fm.	
	ORDOVICIAN	3. Gneiss and micaschist	Ferriferous clayey sand.			?		Kurtköy fm. Bakacak fm. Kocatöngel fm.	Dotla fm.
	CAMBRIAN	4. Granite	?		F				Yayladere fm.
PRECAMBRIAN					Daday-Devrekani metased. group 1. Başakpınar metacarbonate 2. Gürleyik gneiss			Yedigöller fm. metabasite metagranite amphibolite	Dorukyayla gneiss qtz-feld gneiss mica-gneiss amphibole-pyroxene gneiss

Depositional environment. - The Çatak formation characterizes an environment which is shallow marine with a high energy at the beginning, and a deep marine environment later.

Regional correlation. - The Çatak formation is seen to be the equivalent, in Table 1, of the "Cretaceous basal conglomerate" (Tokay, 1952) and the lower parts of Çağlayan and upper parts of Inaltı formations (Tüysüz, 1986). On the other hand, this unit may be assumed to be correlated with the Çağlayan formation (Aydın et al., 1986), although, there is no any Albian-Aptian fossils in the Çatak formation.

Soğanlı Formation (Middle Eocene)

Description and type locality. - The Soğanlı formation, firstly described by Aydın et al. (1986), outcrops around the Saltuklu, Dögemle and Mirigürne villages in the studied area (Fig. 3).

Lithology. — The Soğanlı formation is composed up typically of yellowish-orange colored fossiliferous limestones showing layering dm. in thickness.

Lower and upper boundaries. — The Soğanlı formation unconformably overlies the Çatak formation in the north of studied area (out of mapped area), the Yukarıköy formation around the Saltuklu village, and the Küreihadit and Zirze formations around the Dögemle and Mirigürne villages in the mapped area, respectively. As for the upper boundary of Soğanlı formation, it is conformably overlaid by the Cemalettin formation.

Age. - The Soğanlı formation, already aged as Middle Eocene by Aydın et al. (1986), includes some fossils indicating the same age in the mapped area, too.

DG-294 (location 18 in Fig. 3a):

Some forms similar to *N. beaumonti, Assilina exponens (Sowerby),*

Operculina sp.,

Rotalia sp.

uepositionalenvironment. -The Soğanlı formation characterizes the shallow marine environment.

Cemalettin formation (Upper Eocene-Lower Oligocene)

Description and type locality. ~ The Cemalettin formation, firstly described by Aydın et al. (1986), outcrops around the Oycalı and Saltuklu villages in the mapped area.

Lithology. - The Cemalettin formation consists of grayish-green conglomerate, coarse sandstone, sandstone, siltstone, claystone and marly rocks. In the southern part of Yukarıkarabüzey village, it is made up essentially of grayish sandstone, siltstone and claystone alternation.

Lower and upper boundaries. - The Cemalettin formation conformably overlies the Soğanlı formation around the Oycalı, Saltuklu and Yukarıkarabüzey villages, and it is unconformably covered by the Karabüzey formation in the studied area.

Age. —There has not been found any fossil in this unit, however, it has been determined to have an age of the Upper Eocene-Lower Oligocene by Aydın et al. (1986).

Depositional environment. _ The Cemalettin formation characterizes locally the fluviatile and locally shallow marine environment with high energy. Aydın et al. (1986) also point out that it includes some braided stream sediments.

Karabüzey formation (Neogene)

Description and type locality. _ The Karabüzey formation has been firstly described by Boztuğ (1988). It is seen to be outcropped better around the Karabüzey, Yeniköy, Harmancık and Süzey villages in the mapped area.

Lithology. - The Karabüzey formation comprises quartzite pebbles and blocks at bottom which are followed by the semi-consolidated and red colored sandy-silty and clayey sediments up to 150 m. in total thickness around Karabüzey village. It is observed to have been formed by unconsolidated quartzite pebbles and blocks around the Yeniköy, Harmancık and Süzey villages. Apart from these lithological characteristics, it is composed of semi-consolidated conglomerates cemented by clayey materials around the Vakıfgürne village. Finally, it is seen to be formed by reddish-yellowish clayey and silty materials around the Kuloğlu village.

Lower and upper boundaries. - The Karabüzey formation takes unconformably place on top of the older units than Neogene in the mapped area. There is no any unit overlying the Karabüzey formation except the Quaternary alluvium which should be stratigraphically on top of this unit.

Age. - The Karabüzey formation, without any fossils, is suggested to have a Neogene age due to stratigraphical setting and lithology.

Depositional environment. - The Karabüzey formation is characterizes by the terrestrial material.

Quaternary alluvium

This occurrence, consisting of recent alluvial materials in the big valleys, is seen better in the northern part of the Karadere valley (Fig. 3). These sandy-pebbly materials have been operating by the native people for concrete materials in constructions.

TECTONICS

The structural elements are distinguished to have been formed in two different stages, i.e. the Alpine and pre-Alpine stages, in the mapped area. The foliation planes due to ductile deformation under the conditions of medium-to highgrade metamorphism (diopside-gneiss; Winkler, 1979) are the products of the pre-Alpine deformation, since they can only be seen in the Dorukyayla gneiss. This ductile deformation in the Dorukyayla gneiss does not affect the Lower to Middle Paleozoic Samatlar group, i.e. neither the mineral paragenesis, nor planar-linear structural elements. Thus, the deformation of the Dorukyayla gneiss is considered to be pre-Alpine age. As for the Alpine deformations, both of the Paleozoic and Mesozoic rocks have been folded and faulted altogether from those deformations. That is the reason why the Paleozoic units are considered to have been also deformed in the Alpine periode.

Folds

The fold axes, with the strikes of approximately E-W, are observed to fold all the Paleozoic and Mesozoic rock units altogether in the northwestern and western parts of the mapped area (Fig. 3a). The Çatak formation, however, possesses many meso-folds which can not be mapped to the scale of 1:25.000 during fieldwork. There is an interesting sycline in the north of Küreihadit village taking place in the western part of studied area. The western part of this sycline is seen to have a normal sycline axe, whereas the eastern part is observed to be an overturned sycline axe due presumably to the reverse fault which is just to the south of this sycline (Fig. 3a, 3b) in the Inciğez village. These Alpine foldings are thought to be formed by N-S compressional forces sometimes around Lower Cretaceous, since they have also folded the Upper Jurassic-Lower Cretaceous Yukarıköy formation, too. .

Faults

The major faults, observed in the studied area, are composed mainly of reverse (thrust) and strike-slip faults. As clearly seen in Figure 3a, both of the Kürek granitoid and Yukarıköy formation have been thrusted onto the Çatak formation, from north to south, and the Kirtulaz formation has been thrusted onto the Çatak formation, Dorukyayla gneiss and Dotla formation from north to south along the E-W reverse fault zone in the northeastern part of the mapped, area. In the northwestern part of the studied area, the Dorukyayla gneiss, Yayladere and Dotla formations have been altogether thrusted onto the Küreihadit formation from south the north along another E-W reverse fault zone (Fig. 3a). However, Dorukyayla gneiss is observed to have been thrusted onto the Çatak formation along the eastern prolongation of this reverse fault plane. There are also intensive and extensive cataclastic rocks developed along these reverse fault zones in the mapped area. The youngest unit, affected from these E-W reverse faults, is the Çatak formation as clearly seen from all these observations. Thus, these E-W reverse faults are also thought to be derived from the N-S compressional forces sometimes around Lower Cretaceous as well as E-W fold axes.

As for the strike-slip faults, they have mainly affected the Dotla and Zirze formations (Fig. 3a). These faults are considered to be maximum lateral dilatation planes due to N-S compression.

Unconformities

The unconformities, observed in the mapped area, can be summarized as followed: The most important unconformity is that of between the Precambrian Dorukyayla gneiss and Lower to Middle Paleozoic Samatlar group. This unconformity also indicates a big difference in deformation styles of the Dorukyayla gneiss and Samatlar group (Boztuğ, 1988). In other words, the Dorukyayla gneiss represents a ductile deformation style occured under the conditions of medium to high-grade metamorphism (Winkler, 1979), whereas the Samatlar group shows a deformation style occured under the conditions of very low-grade metamorphism (Winkler, 1979). Another unconformity in the mapped area is seen between the Samatlar and Yaralıgöz groups. This unconformity also remarks some differencies in the physical conditions of deformations affected these groups, i.e. the Samatlar and Yaralıgöz group represent very low-grade metamorphic and diagenetic mineral assemblages, respectively (Boztuğ, 1988). The Middle Eocene Soğanlı formation unconformably overlies all the pre-Senozoic units as mentioned earlier. Around the Çonlar village situated in the northern part of studied area, the Yukarıköy formation unconformably covers the Kürek granitoid. This unconformity plane between the Yukarıköy formation and Kürek granitoid helps to approach the geological age of the Kürek pluton which sould be older than the Yukarıköy formation, i.e. Upper Jurassic. On the other hand, there has not been found any stratigraphical evidence about the lower and upper limit relations of the Permo-Triassic (?) Kirtulaz formation, since it shows a broken formation feature moreover, its lower boundary is already seen to be faulted. However, the Kirtulaz formation may be assumed to take unconformably place on top of the Samatlar group, and affected by the same deformation style of Samatlar group. Illite crystallinity and vitrinite reflectance studies showed that the physical conditions of the deformations affecting these two units were similar to each other, i.e. anchimetamorphism to epimetamorphism.

GEOLOGICAL EVOLUTION

Such an evolution model can be suggested when the geological data, obtained from the southwestern part of Daday-Devrekani Massive by Boztuğ (1988), are evaluated with those of other authors.

The oldest unit of the studied area, the Precambrian Dorukyayla gneiss, consisting of high-grade metasediments, characterizes a typical continental crust material. The Dorukyayla gneiss is considered to constitute the southernmost tip of Eurasian plate (Boztuğ et al., 1984; Yılmaz and Boztuğ, 1986; Koçyiğit, 1989). The Samatlar group, composed of Yayladere (Cambrian), Dotla (Ordovician), Zirze (Silurian) and Kureihadit (Devonian) formations, has been deposited in an epicontinental domain constituted by the Dorukyayla gneiss. The Permo-Triassic (?) Kirtulaz formation may also be thought to be a part of the Samatlar group. Thus, there is

an epicontinental cover of Paleozoic-Lower Mesozoic in age on top of the Dorukyayla gneiss. An oceanic crust, must have been existed at least in Lower Mesozoic, has been developing with its local epiophiolitic cover (i.e. Çangal metaophiolite; Yılmaz, 1980, 1983) during the deposition of such an epicontinental cover mentioned above. For example, the Lower Mesozoic flyshoidal rocks are seen to be epiophiolitic cover on top of the ophiolitic rocks in the Küre region (Bailey et al., 1967; Yılmaz and Tüysüz, 1984; Aydın et al., 1986). From this point of view, the epicontinental cover of the Dorukyayla gneiss has either epicontinental or epiophiolite characters particularly in Lower Mesozoic. The oceanic crust has induced a northward subduction zone (Boztuğ et al., 1984; Yılmaz and Boztuğ, 1986; Şengün et al., 1990; Ustaömer et al., 1991; Robertson et al., 1991) by consuming beneath the Dorukyayla gneiss and its epicontinental cover towards the middle stage of Lower Mesozoic. The Paleozoic-Lower Mesozoic epicontinental cover, taking place next to subduction zone has been metamorphosed in the conditions of low grade facies of this regional metamorphism induced by subduction zone in the active margin (Best, 1982; Fig. 12-21, p. 434) (i.e. Ilgaz metasedimentary group, Yılmaz and Boztuğ, 1986). However, the affects of this regional metamorphism is decreasing towards the north away from the subduction zone and it is remarked to be a very low grade metamorphism in the Samatlar group in the mapped area. Far away from the subduction zone, in other words area. Far away from the subduction zone, in other words in the northernmost parts such a regional metamorphism can not be detected, since the coal bearing Paleozoic rocks in the Zonguldak basin indicate only diagenetic conditions. The first arc plutonism (Best, 1982) product of this subduction zone has formed the Middle Jurassic Kastamonu granitoid belt (Boztuğ et al., 1984; Yılmaz and Boztuğ, 1986). The Kürek pluton, in the studied area, is the part of this granitoid belt. The Middle-Upper Jurassic to Lower Cretaceous Yaralıgöz group has been deposited in intermountains basins developed due presumably to the diapirically rising up and emplacement of the plutons of the Kastamonu granitoid belt. After the deposition of Yaralıgöz group, the Late Alpine structural elements have been created by the N-S compressional forces sometimes around Lower Cretaceous. These Late Alpine deformations can also be observed in the Paleozoic units as the foldings and faultings. The Tertiary units, in the mapped area, have been deposited in the terrestrial and shallow marine environments. The Neogene Karabüzey formation consists of semi-consolidated and terrestrial rocks. As for the Quaternary alluvium, it is only seen in the recent stream valleys.

CONCLUSIONS

The conclusions obtained in the southwestern part of Daday-Devrekani massive can be summarized as follow:

1- The litostratigraphic units, in the mapped area, consists, from bottom to top, of the Dorukyayla gneiss (Precambrian), Yayladere (Cambrian), Dotla (Ordovician), Zirze (Silurian), Küreihadit (Devonian), Kirtulaz (Permo-Triassic?) formations, Kürek granitoid (Middle Jurassic), Yukarıköy (Upper Jurassic-Lower Cretaceous), Çatak (Lower Cretaceous), Soğanlı (Middle Eocene), Cemalettin (Upper Eocene-Lower Oligocene), Karabüzey (Neogene) formations and of Quaternary alluvium.

2- Dorukyayla gneiss, Yayladere, Dotla, Zirze and Küreihadit formations, constituting the Samatlar group, have been firstly described in this study. On the other hand, it is suggested to study an area between the Daday town and mapped area here by means of geological mapping and mineralogy-petrography and geochemistry for the classification of the stratigraphical setting of Kirtulaz formation.

3- The Paleozoic and Mesozoic units have been folded and faulted by the N-S compressional forces sometimes around Lower Cretaceous in the mapped area. The fold axis and reverse faults possess mainly E-W strikes, whereas the strike-slip faults have mainly NE-SW trends. The reverse faults have also formed some intensive and extensive mylonitic rocks in the studied area.

4- The main unconformities in the area consist of those between the Dorukyayla gneiss and Samatlar group, between the Samatlar and Yaralıgöz groups, and between the Yaralıgöz group and Tertiary units.

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REFERENCES

Adamia, S.; Bergougnan, H.; Fourquin, C.; Haghipour, A.; Lordkipanidze, M.; Özgül, N.; Ricou, I.E. and Zakariadze, G., 1980, The Alpine Middle East between the Aegean and the Oman traverses: 26° Congr geol. internal. Paris, Coll, C5 Geologie des chaines alpines issues de la Tethys, Mem. BRGM no. 115., 122-136.

Arpat, E.; Tütüncü, K. and Uysal, S., 1978, Safranbolu yöresinde Kambriyen-Devoniyen istifi: Türkiye Jeol. Kur., 32. Bilimsel Teknik Kurultayı Bildiri Özleri, p. 67.

Ataman, G.; Yılmaz, O. and Ertürk, O., 1977, Diyajenez-ankimetamorfizma geçişinin illit kristallik derecesi ile araştırılması (Batı Pontidlerde bir deneme): Yerbilimleri, 3, 145-160.

Aydın, M.; Şahintürk, Ö.; Serdar, H.S.; Özçelik, Y.; Akarsu, İ.; Üngör, A.; Çokuğraş, R. and Kasar, S., 1986, Ballıdağ-Çangaldağı (Kastamonu) arasındaki bölgenin jeolojisi: Bull, of the Geol. Soc of Turkey., 29, 2, 1-16.

———; Serdar, H.S.; Şahintürk, Ö.; Yazman, M.; Çokuğraş, R.; Demir, O and Özçelik, Y., 1987, Çamdağ (Sakarya)-Sünnicedağ (Bolu) yöresinin jeolojisi: Bull, of the Geol. Soc. of Turkey ., 30, 1-14.

Bailey, E.H.; Barnes, J.W. and Kupfer, D.H., 1967, Geology and ore deposits of the Kure district, Kastamonu province, Turkey: Cento Summer Training Program in Geological Mapping Techniques, Küre, Turkey, 1966, Office of United States Economic Coordinator for Cento Affairs, 104 p.

Berkland, J.O.; Raymond, L.A.; Kramer, J.C.; Moores, EM and O'Day, M., 1972, What is Franciscan? Am. Assoc. Petroleum Geol. Bull., 56, 2295-2302.

Best, M.G., 1982, Igneous and metamorphic petrology: Freeman and Co., San Francisco, 630 p

Blumenthal, M., 1948, Bolu civarı ile Aşağı Kızılırmak mecrası arasındaki Kuzey Anadolu silsilelerinin jeolojisi: MTA Publ., B-13, Ankara, Turkey.

Bonhomme, M.G. and Yılmaz, O., 1984, First K-Ar data from the Daday-Devrekani and Ilgaz massives and the Kastamonu granitoid belt, northern Turkey: Terra Cognita, 4, 199-200

Boztuğ, D., 1983, Daday-Devrekani masifi kuzeyindeki Büyükçay-Elmalıçay granitik sokulumu: HÜ Yük. Müh. tezi, 149 p., add. 2, (Unpublished), Ankara, Turkey

———,1988, Daday-Devrekani masifi güneybatı kesiminin mineralojik-petrografik ve jeokimyasal incelenmesi: HÜ Doktora tezi, 232 s., 1 ek, (Unpublished), Ankara, Turkey

———and Yılmaz, O., 1983, Büyükçay-Elmalıçay granitoyidi (Kastamonu) ve çevre kayaçlarının mineralojik-petrografik ve jeokimyasal incelenmesi: Yerbilimleri, 10, 71-88

———and———, 1991, K-Ar geochronology of the fine fractions from the Göynükdağı contact aureole A mixed age due to inherited muscovite, Kastamonu, N Turkey: Mahmut Sayın Kil Mineralleri Sempozyumu, 2-4 Mayıs 1991, Bildiriler kitabı (inpress), Adana,Turkey.

———; Debon, F.; Le Fort, P. and Yılmaz, O., 1984, Geochemical characteristics of some plutons from the Kastamonu granitoid belt (northern Anatolia, Turkey): Schweiz Mineral Petrogr Mitt , 64, 389-403

Geiss, H.P., 1954, Karadeniz taşkömürü prospeksiyon dahilinde İnebolu-Küre-Abana sahasında yapılan jeolojik löve neticeleri: MTA Rep., 2973 (Unpublished), Ankara, Turkey.

Görmüş,, S., 1982, Yığılca (Bolu KB) yöresinin stratigrafisi: Yerbilimleri, 9, 91-110.

Hsu, K.J., 1968, Principles of melanges and their bearing on the Franciscan-Knoxville paradox. Geol. Soc. Am. Bull., 79, 1063-1074.

Ketin, I., 1966, Tectoric units of Anatolia: MTA Bull., 66, 23-34, Ankara, Turkey.

Koçyiğit, A., 1989, Suşehri basin: an active fault-wedge basin on the North Anatolian Fault Zone, Turkey: Tectonophysics, 167, 13-29.

Robertson, A.H.F.; Dixon, J.E.; Aktaş., A.; Clift, P.D.; Degnan, P.; Jones, G.; Morris, A.; Pickett, E.; Sharp, I. and Ustabmer, T., 1991, Tectonic reconstructions of the Eastern Mediterranean region: Controversies, alternatives and possible solutions. Terra Abstracts, 3, 322.

Streckeisen, A., 1976, To each plutonic rock its proper name: Earth-Sci. Rev , 12, 1-33.

Şengün, M.; Keskin, H.; Akçören, F.; Altun, I.; Sevin, M.; Akat, U.; Armağan, F. and Acar, Ş., 1990, Kastamonu yöresinin jeolojisi and Paleotetisin evrimine ilişkin sınırlamalar: Bull, of Geol Soc of Turkey., 33, 1-16.

Tokay, M., 1952, Karadeniz Ereğlisi-Alaplı-Kızıltepe-Alacaağzı bölgesi jeolojisi. MTA Bull., 42/43, 35-78, Ankara, Turkey.

Tüysüz, O., 1985, Kargı masifi ve dolayındaki tektonik birliklerin ayırdı ve araştırılması (Petrolojik İnceleme): IÜ Doktora tezi, 431 p. (Unpublished), Istanbul.

_____, 1986, Kuzey Anadolu'da iki farklı ofiyolit topluluğu: Eski ve yeni Tetisin artıkları: Doğa Tu Müh. ve Çev. D., 10, 2, 172-179.

Ustaömer, T.; Robertson, A.H.F. and Yılmaz, Y., 1991, Paleotethyan tectonic evolution of the central Pontides, northern Turkey: Terra Abstracts, 3, 256.

Winkler, H.G.F., 1979, Petrogenesis of metamorphic rocks: 5th ed., Springer-Verlag, Berlin, 348 p.

Yılmaz, O., 1979, Daday-Devrekani masifi kuzeydoğu kesimi metamorfitleri HÜ Doç. tezi, 243 p., add. 4, (Unpublished), Ankara, Turkey.

_____1980, Daday-Devrekani masifi kuzeydoğu kesimi litostratigrafi birimleri ve tektoniği: Yerbilimleri, 5, 6, 101-135.

————1981, Daday-Devrekani masifi Ebrek metamorfitinin petrografisi ve tumkayac, kimyası: Yerbilimleri, 8, 71-82.

_____, 1983, Çangal metaofiyolitinin mineralojik-petrografik incelenmesi ve metamorfizma koşulları: Yerbilimleri, 10, 45-58.

————and Bonhomme, M.G., 1991, K-Ar isotopic age evidence for a Lower to Middle Jurassic low-pressure and a Lower Cretaceous high-pressure metamorphic events in north-central Turkey: Terra Abstracts, 3, 501.

_____and Boztuğ, D., 1985, Göynükdağı metamopfiti: TÜBITAK Arş, Projesi Rap., TBAG-569, 121 p., add. 1, (Unpublished), Ankara, Turkey.

———and———, 1986, Kastamonu granitoid belt of northern Turkey: First arc plutonism product related to the subduction of the paleo-Tethys: Geology, 14, 179-183

———and————, 1987, Göynükdağı (Kastamonu) yöresinin jeolojik ve mineralojik-petrografik incelenmesi: Doğa Tu Müh. ve Çev.D.,.11,1-, 91-114.

Yılmaz, Y. and Tüysüz, O., 1984, Kastamonu-Boyabat-Vezirköprü-Tosya arasındaki bölgenin jeolojisi (Ilgaz-Kargı masiflerinin etüdü): MTA Rep , 7838 (Unpublished), Ankara

———and———, 1988, Kargı masifi ve dolaylarında Mesozoyik tektonik birliklerinin düzenlenmeleri sorununa bir yaklaşım: TPJD Bült.. 1.1.73-86.