

IMPORTANCE OF EKINVEREN FAULT IN OIL EXPLORATION IN THE BOYABAT (SINOP) BASIN

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ABSTRACT

The Boyabat (Sinop) basin is one of the important sedimentary zone in oil exploration in the Pontide belt. Presence of source, reservoir rock, seals, oil and gas show at Ekinveren, üzümlü and Uzunöz localities makes the investigated area an important oil exploration target.

The Ekinveren Fault is a big thrust fault, advancing from north to south and thrusting the northern sedimentary units on to the Boyabat autochthonous units. Due to these thrust movements, the pay zones of the Boyabat basin series have been stayed buried under the advancing units.

During our field work, it has been observed that the thickest basal Çağlayan sandstones are continuous from Ekinveren to Uzunöz where are overlain by Yemişliçay volcanics. Furthermore, the gas, which has been observed at Uzunöz, show witnesses presences of buried Çağlayan reservoir sandstones and İnaltı limestone under the overlying Yemişliçay formation.

As a general rule, although the volcanic activities are considered as a negative factor for oil exploration, our geological observations indicate that the Çağlayan sandstones and İnaltı limestones could be pay zones under Yemişliçay volcanics. In summary, the Ekinveren Fault has an important role on the hydrocarbon entrapment in the studied area. The southern and northern zones of the Ekinveren Fault zone and extensional area of the Çağlayan and İnaltı formations under Yemişliçay formation can be considered important exploration in the Boyabat basin.

INTRODUCTION

The study area is located at the among of Boyabat town Kayaboğazı, Uzunöz, Bürnük and Bayamca villages (Figure-1). The area is called as Boyabat basin where is the southern part of Sinop basin located within Pontide belt.

First scientific researches in this area started in 1942. These researches have been started with different purposes and are still being conti-

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nued. Economic sides of these researches have become important recently. For this reason, TPAO (Turkish National Petroleum Company) has going on researches in this basin.

Main target of our research was to determine the petroleum possibilities. Researches of this basin have been started at the summer of 1987. 1/25.000 scaled geological map has been prepared and some stratigraphical sections were measured. Our research is still going on. Some gas out-puts were determined on the Ekinveren fault. We had paid special attention at these points.

Akgöl, Bürnük, İnaltı, Kusuri, Boyabat and Cemalettin formations are observed (Figure - 2,3). Especially Ekinveren fault is one of the biggest thrusts in the area and have petroleum trapping peculiarities (Figure - 4,5,6,7,8 and 9). Petroleum traces at the northern part of Ekinveren village and natural gas out-puts near the üzümlü and Uzunöz villages were determined. Main part of this research was related to the role of Ekinveren fault in petroleum trapping. The data of Boyabat-2 well and seismic cross-sections. Which are taken from TPAO are used for this research.

STRATIGRAPHY

Most of the researches carried out in the area were related to general geology and described the lithostratigraphic units. Therefore special care was not paid to the stratigraphy but important peculiarities in petroleum researches were presented. Geological units which are observed in this area are as follows from the oldest to the youngest (Figure - 3). *Boyabat Methamorphites (M)*

Researchers who are study Boyabat Methamorphites, are used different names for them (Gedik et al, 1981; Ericson, 1938; Blumental, 1940; Eren, 1979; Yılmaz, 1980). The formation is generally seen at the southern part of the research area and among Boyabat, Taşköprü and Durağan.

Akgöl Formation (TRa)

Ketin and Gümüş (1963) and Gedik et al. (1981) used same name for this formation. This formation is lies along a narrow band Bürnük, between Alaman and Ekinveren-Alıç districts, northern part of Çukursökü district, under the İnaltı limestones at the among of Kozkule, Hacılar and Uzunöz.

The unit is composed of sandstone, millstone, quartzite and shale successions. Shale is dominant. The unit the metamorphism of the unit understood by its peculiarities. Sandstones and quartzites are very hard, gray-dark gray colored, hard textured and fine-medium grained. Thickness of the layers are change between 2 cm. and 20 cm. Shales are dark gray-black colored, very hard, laminated and include rich organic materials. Also having oiled appearance. They consists of either not carbonate or have very little carbonate. According to the lithological peculiarities, it is accepted that formation of turbiditic is happen in the research area.

Outside appearance of shales given an idea about that it is an ideal petroleum source. Bürnük dan İnaltı formation which are upper layer of Akgöl formation, again located disconformitily boundary with of Bürnük formation was measured as 250 m. Age of the Akgöl formation was accepted as lower Jurassic (Liassic) by the former researchers.

Same name was used for the unit at previous researchs (Ketin and Gümüş, 1963; Gedik et al., 1981).

Bürnük Formation (Jb)

This formation is generally observed at Bürnük vicinity. Under the İnaltı limestones it is also seen as thin bands. Besides at outcrops the formation is observed at Alçlı district and surroundings the vicinity of Kozlu-Hacılar districts and Uzunöz village and Çokran village surroundings. Type location is Bürnük village. Therefore type section was measured at Bürnük. Unit appearance basal conglomerate and is composed of pebbles in a sandstone matrix. Also formation is identified easily by its red color and typical lithology. It has limestone bands. Pebbles are polygenetic elements, bad sorted and well rounded. Their sizes can reach up to 40–50 cm.

Bürnük formation basal sits discordantly on the Akgöl formation. Upper boundary of the Bürnük formation is concordant with the İnaltı limestones. Thickness of the unit at Bürnük is 200 m. Average thickness of the unit is around 100 m.

İnaltı Formation (Ji)

This unit was called as İnaltı formation by Ketin and Gümüş (1963) and as Akkaya formation by Gedik et al. (1981). Besides, Badgley (1959) and Blumental (1940) used different names.

The unit is extending from southern part of Alaman district, Located at north, through Alç district, üzümlü village, following northern Semeler village to northern Kozkule and Manlar district and Uzunöz village. As for south, it is also seen at some places of southern Yaylaçık village.

Formation is composed of gray colored, very hard and massive apperianced limestones. It has lots of cracks filled calcites. It sometimes has lots of fossils. But reefial peculiarities could not be observed. Limestones have micritic and sparitic spetications. Generally they exhibite a pelletical structures. At bottom the formation is discordant with Bürnük formation. There are some places in which Bürnük formation is not seen, this time the formation has a concordant boundary with Akgöl formation.

As for top boundary a concordant is seen between the İnaltı and Çağlayan formations. Boundary of these formations are generally faultly at the research area. Age of the İnaltı formation was determined as Middle-Upper Jurassic (Doğger-Malm) by Burşuk and Tari.

According to the lithological peculiarities and fossils group, a shallow marine envirnoment may be accepted as depositional environment.

Çağlayan Formation (Kç)

The formation was called by Badgley (1959) as dark gray shales, by Blumental (1940) as Fındıklı layers and by Ketin and Gümüş (1963) as Çağlayan formation. Because of its petroleum source and reservoir roks peculiarities. This formation was choosen as target level in our research.

This formation shows great extent in the research area. Especially it has a great extent at north-northeast of Ekinveren fault. The formation also takes place at Durağan. Type place of the formation is between Semeköy and Eshiyeli. Type section were measured here. Because of faulting, bottom of the unit is not seen. At a section measured at Semeköy district, in an area surrounded by a tectonical contact on İnaltı limestone unit starts with gray-dark gray colored a shale level average thickness of shale level is 150 m. Thick and massive sandstone-shale succesion take place upon this shale level. These are quite thick and their thickness reach up to 50 m. This level gradulaly becomes shale dominated levels from bottom to top. Generally from bottom to top, shale percentage increases, sandstone percentage degreases. Size of grains

also decrease, sandstones on bottom are medium-coarse grains having pebbles. These sandstones replace with fine-medium sandstones having 1-40 cm. thickness. Especially at massive and thick sandstones on bottom level cross bedding and grading are common. At sandstones on top levels, coarse grading are also seen very much. Four different levels are observed at measured deposits of the area. Gradual passings are seen among these levels sandstones are cracked and porous especially bottom level.

According to the laboratory analyses, porosity values are around 10-19 %. These values are getting smaller while going up these sandstones seen bottom levels of the unit are gray, grayish-yellow which are the typical colors of the unit. As to shale deposits of the units, these are gray and greenish and dark gray at medium levels. Çağlayan formation is sitting on İnalta limestones with an angular unconformity. Upper boundary of the formation is concordantly covered by Kapanboğazı formation. Thickness of the unit on the section measured between Semeköy and Espiyeli is around 4000 m. It has poor fossil content. According to the found fossils, age is Lower Cretaceous (Barremian-Albian).

Sedimentological and lithological peculiarities of the formation shows that unit has been deposited under a shallow type marine environment. Dominancy of sand and shale units in the formation shows that environment has been getting deeper. By this specification near turbiditic material goes through a distal material. It is possible to observe this peculiarity on measured section. Thick and massive sandstone are observed at bottom levels (Walker, 1978).

Kapanboğazı Formation (Kk)

Name was firstly used by Ketin and Gümüş (1963). This formation is known by its typical red color. It is observed at southern part of Çokran and Bürnük vicinity at the research area. Dominant lithology of the unit is dark red colored micritic limestones. It has some greenish colored and chert bands. Thickness of these limestones are thin-medium. Upper levels of the formation around Bürnük. It has agglomeratic levels. These may be bottom levels of Yemişliçay formation.

Kapanboğazı has a concordant boundary with Çağlayan formation at bottom and a discordant boundary with Yemişliçay formation at top. Thickness of the formation is around 40-100 m. at Bürnük vicinity. According to the found fossils, age is Upper Cretaceous (Santonian-

Campanian). Lithological specification and fossil group show that formation has been deposited under deep marine environment.

Yemişliçay Formation (Ky)

The name was given by Ketin and Gümüş (1963). Formation is seen at the eastern part of the research area such as Dodurga, Kozkule, Manlar and Uzunöz vicinity. Besides, it is seen as dike at Cepni distret. In addition, it is possible to observe at Mehtili, Kayaboğazı and Dariözü vicinity. Unit has a great spreading between north of Kayaboğazı village and south of Yaylacık village. It is also possible to observe at Çokran, Kozkule and Ahıska vicinity. Formation has vulcano-sedimentar peculiarities and some dikes. Vulcano-sedimentar unit content is as follows, tuff, tuffite, sandstone including vulcanic materials, limestone including sandstones and many fossils, agglomera, methamorphic sedimentars including vulcanic materials, basaltic and dacitic dikes. Especially basaltic and decitic dikes are seen between Dodurga, Kozkule and Uzunöz. Sedimanter structures are seen at sandstones. The levels including many fossils and detrital limestones are seen at north and north-west of Esbiyeli village.

There is no measured section which gives the thickness of outcropped formation at the research site. But, it could be said that it reaches up to 500 m. thickness.

Yemişliçay formation has concordant contacts with Kapanboğazı formation at bottom and Gürsökü formation at top. According to the fossils seated inside the sedimentar levels, age is Upper Cretaceous (Campanian-Maestrichtian).

Lithological peculiarities of the formation show that it has been deposited different deep levels marine environment. Fossil content and sedimentary peculiarities are reflecting shallow deep marine environment under the effects of turbiditic currents. Because of big and small dikes at occurency time of the formation, there was vulcanic activity at Dodurga, Kozkule, Hacılar and Uzunöz vicinity. Our research is going on because this activity may effect on petroleum maturity.

Gürsökü Formation (Kg)

Name was first used by Ketin and Gümüş (1963). Gedik et all. (1981) called it as Cankurtaran formation. Blumental (1940) called it as medium flishe.

Gürsökö formation is located at northern part of Ekinveren fault between Ekinveren and Kayaboğazı villages. Besides it has a great spreading Çokran, Kozkule and Uzunöz. Formation lithology is composed of sandstone, shale and some thin limestone successions. Shale is dominant. Thickness of sandstone layers are changed between 1-2 cm. and 40 cm. With this appearance, formation exhibits a typical flish specifications. Sandstones are gray colored, hard textured and finemedium grained. Limestones are micritic specifications. Shale are gray-dark gray and greenish. Sedimentary structures and grading are seen at the bottom and inside of the sandstones. Gürsökö formation has gradual passings between Akveren formation at the top and Yemişliçay formation at the bottom. At the measured sections in side the tectonic line at northern side of the Ekinveren fault, the formation thickness reaches up to 100 m. The thickness in the main spreading area is more than this value.

According to the fossils found inside the formation, age is Upper Cretaceous (Upper Campanian-Lower Maestrichtian). Typical lithology and fossil content with sedimentary structures of the sandstones of the formation shows that the formation is comsed of flishe type sedimentary deposits which deposited in an deep marine environment (Dzulynski and Smith, 1964; Dzulynski and Walton, 1965).

Akveren Formation (KTa)

The same name was used before by Badgley (1959), Ketin and Gümüş (1963) and Gedik et al. (1981). It is observed but sometimes discontinued at the north side of the Ekinveren fault. The is because of fault effect. Main spreading of the formation is out of the our research site such as at north between Gerze and Tangal.

Formation is composed of limestones, marl and shales. Limestones are dominant. Limentones are gray white colored, hard, very hard, rigit and have silica and chert concretions. Thisickness of deposits are changed between 5 cm and 2 m. According to the petrographical analyses, limestone is micritic, detritic, sometimes silicious and have to many fossils. Thickness of the formation inside the research area is around 50 m. Akveren formation has concordantly boundaries with Gürsökö formation at bottom and Atbaşı formation at bottom and Atbaşı formation at top. Fossils group in Akveren formation are extremely sophisticated. The formation has shallow marine fossils to gather deep marine fossils. These fossils are foraminiferas which are found shallow and deep marine en-

vironments, chalk algae and some organisms which live as colonies. According to the fossils, age is Cretaceous-Paleogene. The lithology and fossils group show that the formation has been deposited in a further shelf environment. Probably, the fossils group, which are reflecting shallow environment conditions, may be moves towards the deeper side and sometimes has reef characteristics.

Atbaşı Formation (Ta)

The same name was used by Ketin and Gümüş (1963) and Gedik et al. (1981). Blumental (1940) called it as speckled fish of Tangal.

The formation is seen together with Akveren formation at the some places through the Ekinveren fault. Main spreading is at northern side of the research area at Tangal vicinity. Atbaşı formation has been observed in some places in the research area but typical lithology of the formation could not be determined. It is seen by reddish-green colors including different colored marl-shale deposits.

It is imposible to see regular deposit because of fault zone, the formation has a transitive boundary with Akveren formation at bottom and discordant boundary with Kusuri formation at top. Maximum thickness of the formation within the research area is 20 m. According to the fossil group in the formation age is Lower Eocene which is decided by Sirel and Sözeri.

Lithological specifications and pelagical fauna content of the formation show that it has been deposited in a deep marine environment.

Kusuri Formation (Tk)

Firstly it was examined by Ketin and Gümüş (1963) as Ayancık and Kusuri formations. Gedik et al. (1981) examined the formation as member inside the Yenikonak formation.

Kusuri formation inside the rearch area is limited by Ekiveren fault at the north. It has a great spreading at southern parth of the fault especially at Boyabat-Durağan direction.

Lithological specifications of the formation is examined at four groups.

1. Group: It starts with bad sorted, bad rounded massive sandstones Towards upper levels, it becomes fine-medium sandstone layers. There are a few mill and shale levels between sandstone levels Sand and

gravel levels are gray colored has very much gradings and medium-rough elements are polygenetic. Limestone, silica, vulcanica and metamorphic rock fragments were meet as the elements.

2. Group: Unit is composed of sandstone shale successions. Shale is dominant lithology, sandstones which are fine grains have approximately 5 cm. layer thickness. Shales are gray-dark gray and greenish colored and very thicks. Gradings are seen in sandstones.

3. Group: This unit has similar specifications with first unit. Element size of the gravelly levels reach up to 10 cm. Gradings and base structures are seen in sandy units.

4. Group: Lower unit goes to upper unit. Unit goes on as sandstone-shale successions here. Shally levels are dominant. Sandstones are less than shales and have maximum 5 cm. thickness. Massive and thick layered sandstones are observed at the top of the unit. These sandstones are fine sized, hard textured and fractured. Sortings and base structures are seen inside the sandstones. Shales and marl stones are gray-dark gray and brown. Laminated deposits and sand lens were observed.

Kusuri formation has a discordant boundary at bottom with Atbaşı measured section is around 2000 m. According to the fossil group, age is Middle Eocene (Lutetian).

Base of the Kusuri formation is not seen in the research area. The formation is cut by Ekinveren fault. According to the lithological specifications and sedimentary structures of the unit, a turbiditic occurrence can be accepted. Dominancy of the shale and sandstone specifications point that unit is a distal turbid (Walker, 1978). Lithological specifications of the massive sandy and gravelly levels, semimentar structures, becoming less thick at sideways, indicate that these levels are channel fills.

Boyabat Formation (Tb)

The formation was firstly described by TPAO (1986).

Some outcropts are seen on methamorphics at south of the research area such as Boyabat-Durağan vicinity. Besides it is also seen at west near Bayameca village.

The formation in the researhc area is composed of limestones which are gray-light gray, with colored, hard, very porous and massive and have more or less 150 m. thickness at Boyabat caster. Spreading area of the

formation has on the developed methamorphic series at south and shallow marine environment. According to the fossils group in the formation, the age is Middle-Upper Eocene. The formation has discordantly boundaries with Kusuri formation at bottom and Cemalettin formation at top.

Cemalettin Formation (Tc)

This formation was firstly described by TPAO (1986).

Spreading area of the unit is quite large. The formation begins to be seen at the vicinity of Cemalettin village and goes on towards Boyabat at south and Kayaboğazi and Durağan at southeast.

Cemalettin formation has a gradual boundary with Kusuri formation at bottom but has a clear angular disconformity with it. Lithological difference is clearly seen lithology of the formation is composed of pebbles-sandstones and marl. Pebbles are dominant. Pebbles are massive, irregular deposited and have had sorting lots of crossbeddings and pressure structures. The elements which are formation of the pebbles are poligenetic. Marlstones are dominant at top of the formation. These specifications were observed on measured stratigraphical section at between Mathi and Cemalettin villages.

According to the samples taken from coally levels of the formation age is accepted as upper Eocene-Oligocene. Lithological specifications of the formation show that it has deposited a continental environment conditions.

STRUCTURAL GEOLOGY

Alpina orogenic movements were quite effective at vicinity of the research area. Laramic with pyreneic and savic movements formed today's tectonical structure of the area and caused volcanical activities. These movements spreaded all over the Türkiye and it is accepted as a result of collision of Anatolian and Russian plates (Fig. 9).

Being very large of volcanic activity during Upper Cretaceous is understood from Yemişliçay formation which has volcanic effects.

It is possible to observe the results of orogenic movements which show it self as being pressed at N-S direction (Fig. 2). Because of these movements, one of the big event in the area is Ekinveren fault. This fault probably begin to from during Upper Cretaceous and continued its

effects up to end to Miocene. During these movements units deposited of the basin exposed to be carried a long way from north to south. Spilltes and basalts seen at Ekinveren fault zone show that this was quite effective and came from deep places. Owing to these movement results, Boyabat basin was seperated from Sinop basin. According to the surface and subsurface data, during being pressed of the basin at N-S direction, some faults developed at equal time with Ekinveren fault (Fig. 4,5,6,7,8). If geological cross-sections of the area are examine the events can be clearly interpered. Either at the basin or at the research area, thrustings, faultings and foldings were created by orogenic movements. Owing to the results of these events anticlinal and syclinal structures at N-S direction inside the research are under the Ekinveren faulting zone are seen.

Marking 1/25000 scaled detailed geological map has shown following peculiarities: While Atbaşı and Akveren formations is been followed in front of the faulting zone at south of Ekinveren village at west towards east much deeper levels of the deposits are seen. Espiyeli and Karaboğaz villages vicinity, older unites between Gürsökö and Akgöl formations are seen at the faulting zone.

These observations show that tectonical events increased towards east at north of the Duragan. This conclusion is supported by volcanic Yemişliçay formation which has great spreading. Geological interpretations based on upper conclusion show that Ekinveren fault effect increased towards east and dimension also increased towards east.

PETROLEUM POSSIBILITIES

Occurance of sedimentary basins in Pontits are related to tectonical movements of Anatolian, Russian and Arabic plates. These movements started from Paleozoic and continued up to end of Miocene. Because of especially oceanic movements started from Triassic and reached its maximum level at Upper Cretaceous. Sediments with high probably petroleum possibility has deposited in depression sites and their thickness reach up to 7000 m. These depression sites are surrounded by faults which generally have reverse thrust fault spesifications. These had been developed inside the Ekinveren faulting zone which is lying between Ilgaz massive at north and north Anatolian fault at sout in Boyabat basin. There are lots of simultaneous tectonical events with Ekinveren fault at surface and depths of the basin.

As tectonical activities has developed towards south from north, petroleum possibilities of the Boyabat basin have variations based on environmental differences in depositional basin. Because of tectonical activities during Upper Cretaceous and Miocene periods, northern part of the basin had been buried more than southern part and then petroleum and source rock specificied units which had rich organic materials produced hydrocarbon.

During the carrying out 1/25000 scaled geological map, tectonic of Ekinveren faulting zone were researched from west to the east. By outcropping of older formation like Akveren formation, it was understood that tectonical activities increased towards east.

Besides Gürsöku formation, which is one the Upper Cretaceous units, has approximately 300 m. thickness and fossiliferous characteristics, indicates some clues about depositional environments of petroleum source and reservoir rock characted units at the bottom.

Petroleum source rock characted deposits came to where we are thinking as deep sites. At deep places, Akgöl and Çağlayan formations, for which petroleum source rock specifications were determined by using geochemistical analyses and stayed under the deposits of Jurassic-Miocene periods interval, created living petroleum and gas traces at Uzunöz with between Ekinveren and üzümlü villages (Fig. 10). These living petroleum and gas traces indicate that there are petroleum rock which reached maturity level in organic materials.

Some results found by using organic geochemistical analyses performed by us are as follows. Total organic material amount of Çağlayan formation is 1.80 % and in katagenetic phase. Total organic material amount of Akgöl formation samples is 0.60 % and in metagenesis phase.

There are petroleum source rock characted units under the Ekinveren faulting zone at northern part of the basin and there are petroleum reservoir rock characted clastic and carbonates rocks at border of southern part of the basin (Fig. 9). Especially towards deep zones sandy units become shale units by lateral lithofacies changes inside the Çağlayan formation. These developments are important peculiarities in petroleum migrations and trappings.

According to the model which show hydrocarbon occurrence and migration ways, hydrocarbons occurred in deep zones inside the Akgöl and Çağlayan formations may probably migrate up towards petroleum

reservoir rock characterized Çağlayan formations sandstones units and İnaltı limestones (Fig. 10). At this model, hydrocarbon migrated south from north at the research area.

One of the factors effected organic material maturity is vulcanic activities which was very effective at east and developed in Yemişliçay formation.

Vulcanic activity at the period of Cretaceous end of Miocene effects on hydrocarbon occurrence inside the petroleum source rock characterized units were thought and our proceeding researchs will be focused on this matter.

Source Rock Facies

Akgöl, Çağlayan and Gürsöku formations have petroleum source rock appearances at the research area (Fig. 3). These are composed of thick shale which are gray, dark gray and sometimes black colored.

Organic geochemical analyses of the samples taken from Akgöl and Çağlayan formations show that units have enough organic materials which reach to efficient maturity levels.

Amount of total organic material of Akgöl formation is approximately 0.60 %. The formation is on matagenetic phase and may give gas. Amount of total organic materials of Çağlayan formation samples is around 1.80 %. The formation is on katagenesis phase and may produce gas and petroleum. According to these data, it is accepted that there are petroleum source rock facies reached maturity level at the area.

Reservoir Rock Facies

There are a number of units having petroleum reservoir rock characters at the area. These are İnaltı, Çağlayan, Yemişliçay, Akveren, Kusuri, Boyabat and Cemalettin formations (Fig. 3). Limestone, sandstone, sandy pebble and pebble levels of the units are thought as reservoir rocks.

Some samples were taken from limestone and sandstone levels of Akveren, İnaltı, Çağlayan, Kusuri, Boyabat, Yeğişliçay and Gürsöku formations.

Laboratory analyses were performed on these samples. Analyses results show that porosity values for the formation are as follows, 2-17 % for Çağlayan and Yemişliçay, 3 % for İnaltı, 2-8 % for Gürsöku, 2-10 % for Boyabat, 4-12 % for Kusuri and 2 % for Akveren formation.

These result indicate that only Çağlayan and Yemişliçay formations have medium degree poros levels at some places spreading area of reservoir rock spesifications having unit which is bottom level of Çağlayan formation is shown in fig. 11.

Cover Rock Facies

If we consider lithological peculiarities of deposits in the area, shale, marl and micritic limestone levels have cover rock spesifications.

Petroleum Traps

It has been decided that there are lots of structural trap existences in the area. An anticlinal structure, which had been developed at south-westeren part of Ekinveren faulting zone but is not l clear at south of the fault, developed as long and narrow anticlinal.

Besides, other structural traps are also important at the area. It should be thought that these structures goes towards east under Yemişliçay formation and may provide occumulation gas rises of üzümlü and Uzunöz point out the importances of these structures.

Besides, if we consider deposition conditions at the basin. There are lateral lithofacies variations which cerate lithology traps .As a sample for this idea, sandstone unit inside the Çağlayan formation have these kinds of spesifications at sout that is at the border of the basin and may have probably places for petroleum trappings. A drilled well named Boyabat - 2 and seismic cross-sections support our idea. On the other hand disconformities between İnaltı and Çağlayan and also Çağlayan and Kapanboğazi indicate discordans type traps. By using these knowledges, four sites are though as prospect sites (Fig. 12). Taking care of these sites, petroleum researchs will be most fruitful.

Second aim of our research is to determine petroleum source and reservoir rock spesifications of target levels at the area, Because of this reason, our laboratory studies is going on.

CONCLUSION

By this research following results were determined:

1. Because of movements of Anatolian and Russian plates during the time interval of Cretaceous-Miocene, Boyabat basin was seperated from Sinop basin.

2. Ekinveren fault and other fault parallel to Ekinveren played important roles in occurrences of structural and stratigraphical traps at the area.

3. Ekinveren petroleum leakage and üzümlü and Uzunöz gas rises were observed at the area.

4. Lateral and vertical lithofacies variations at lithostratigraphical units were observed.

5. It is thought that, there is a probability the anticlinal structures which are important in petroleum researchs go on under Yemişliçay formation

6. Thick sandstone levels of lower part of the Çağlayan formation which is accepted as reservoir rock in the area may create prospect areas under the Yemişliçay formation.

7. It was observed that activity of Ekinveren fault increased towards east, a hydrocarbon migration model was established.

By using these knowledges, a detailed seismic survey must be carried out in determining accurate spreadings of the formations.

It is concluded that base sandstones of Çağlayan formation and ocluded structures should be determined by using geophysical methods, if it is so, results will be most fruitful.

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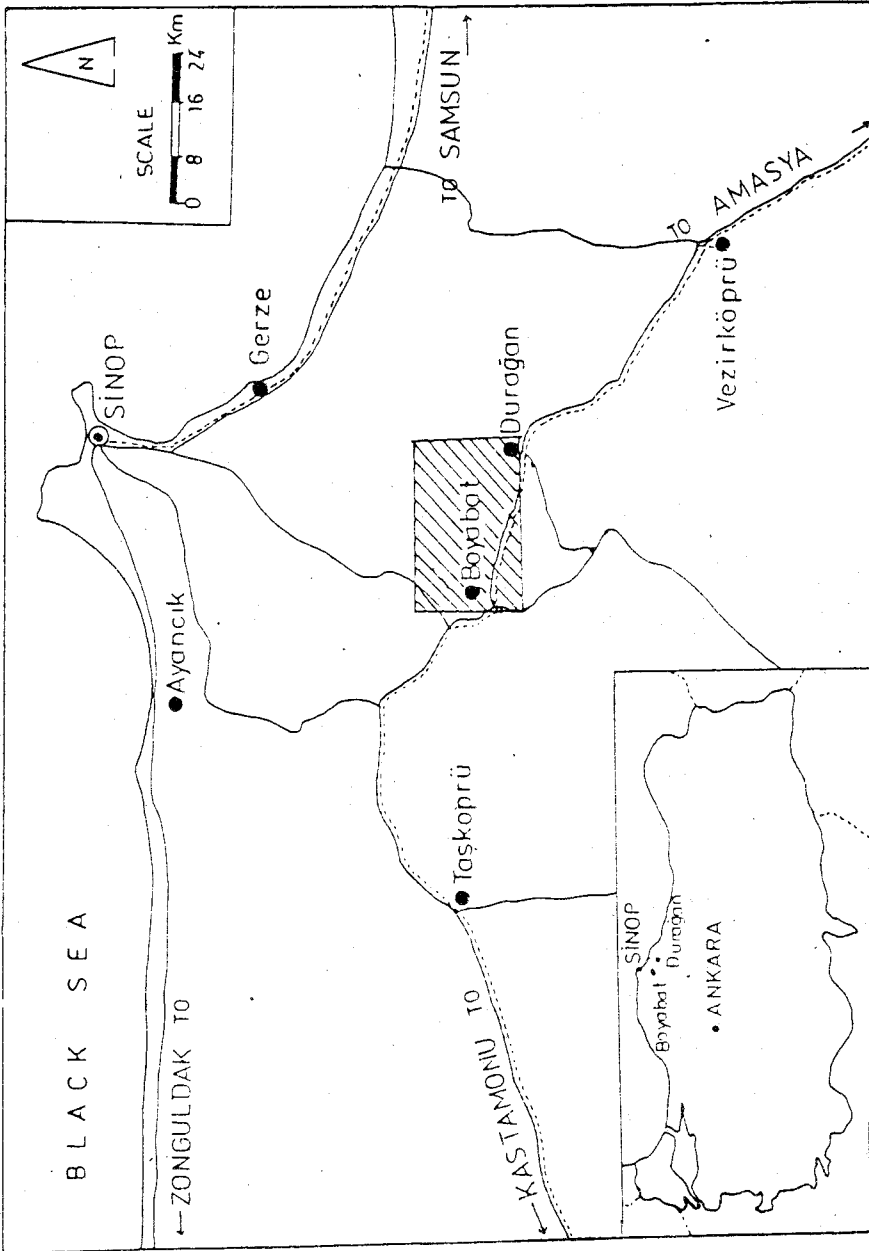


Figure 1- Location map of studied area

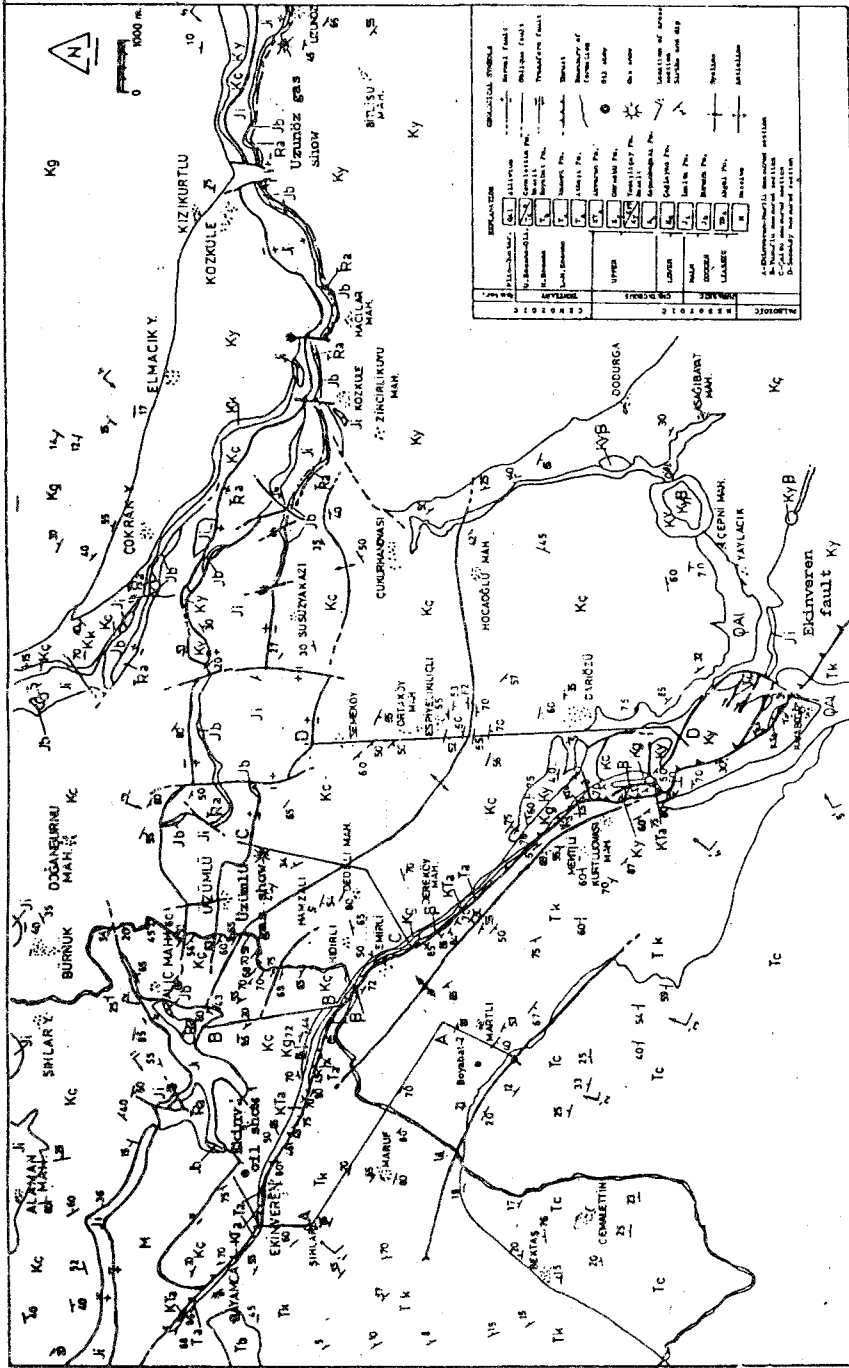


Figure 2- Geological map of the Northeast Boyabat (Sinop) area

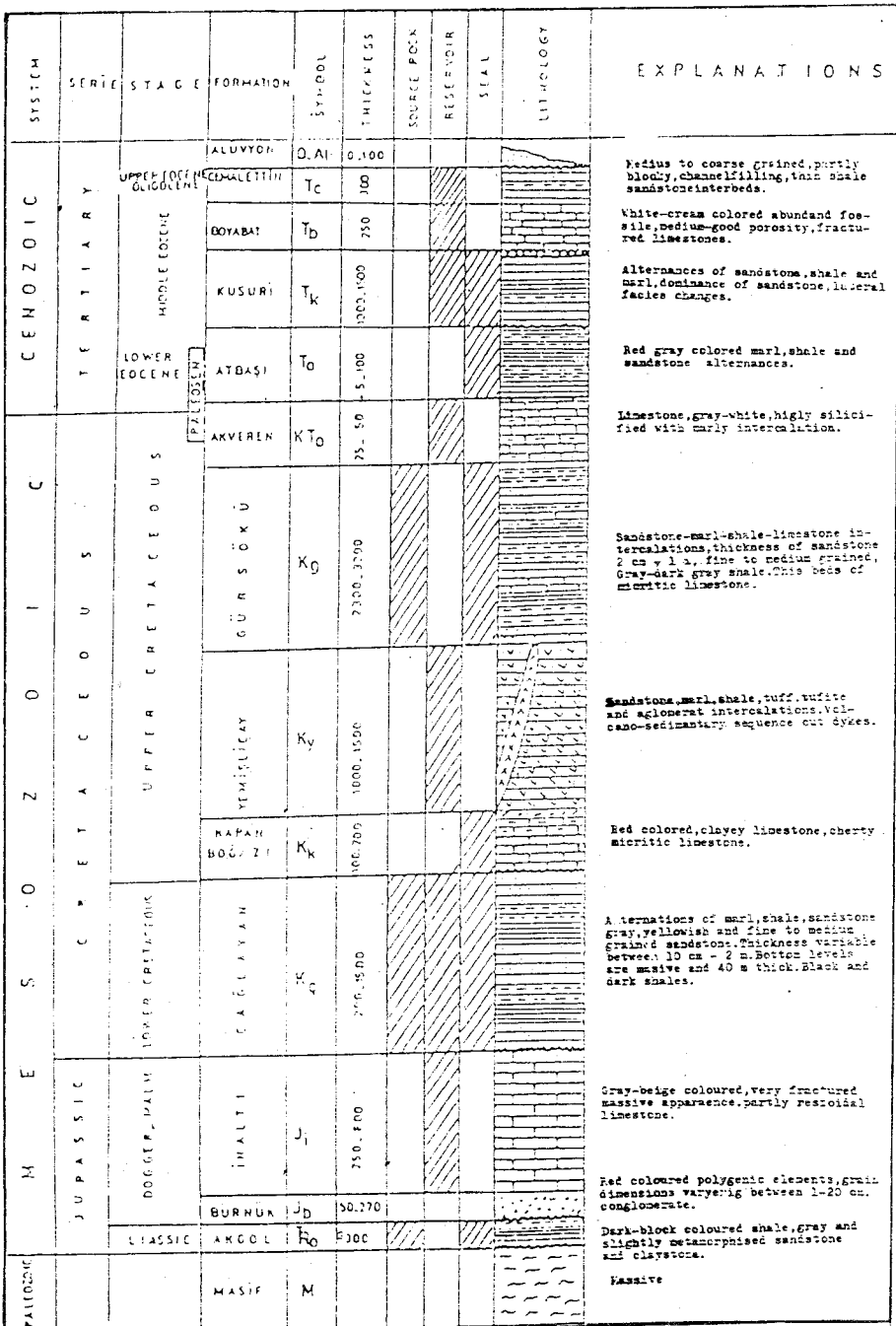
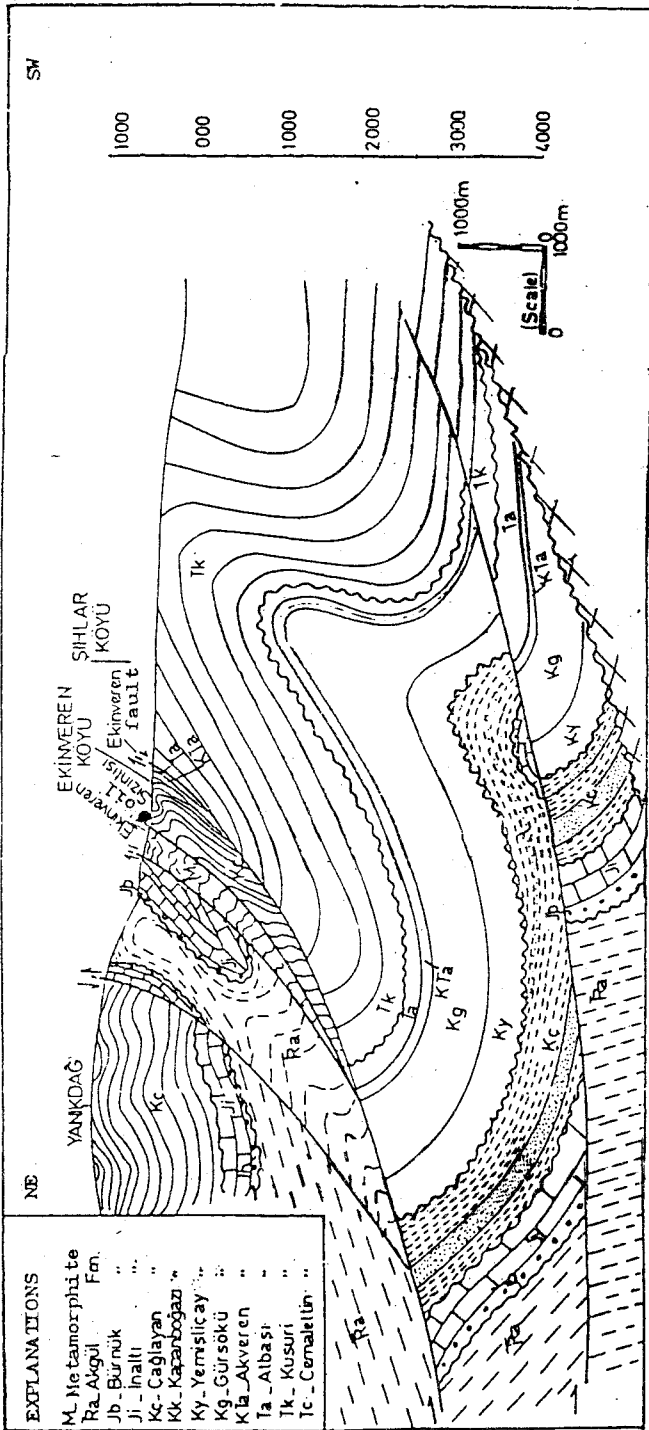


Figure 3- Generalized stratigraphic columnar section of the Boyabat area



EXPLANATIONS

M.	Metamorphic
Ra.	Ağul Fon.
Jb.	Bürnük
Ji.	İnalti
Kc.	Çağlayan
Kk.	Kazanboğazı
Ky.	Yerrisliçay
Kg.	Gürsöku
KLa.	Akveren
Ta.	Albasi
Tk.	Kusuri
Tc.	Cemalettin

Figure 4-1-1' Geological cross-section based on seismic data

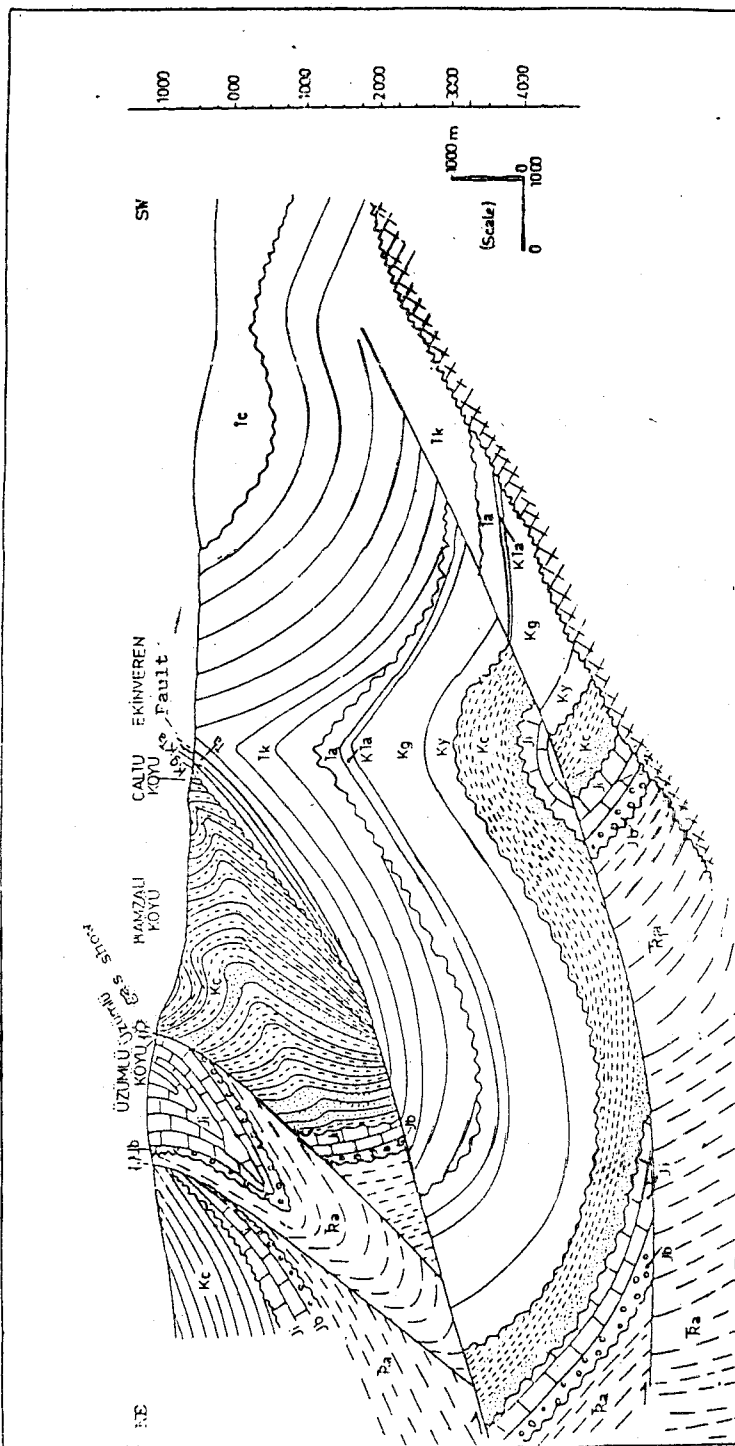


Figure 6-3-3' Geological cross-section based on seismic data

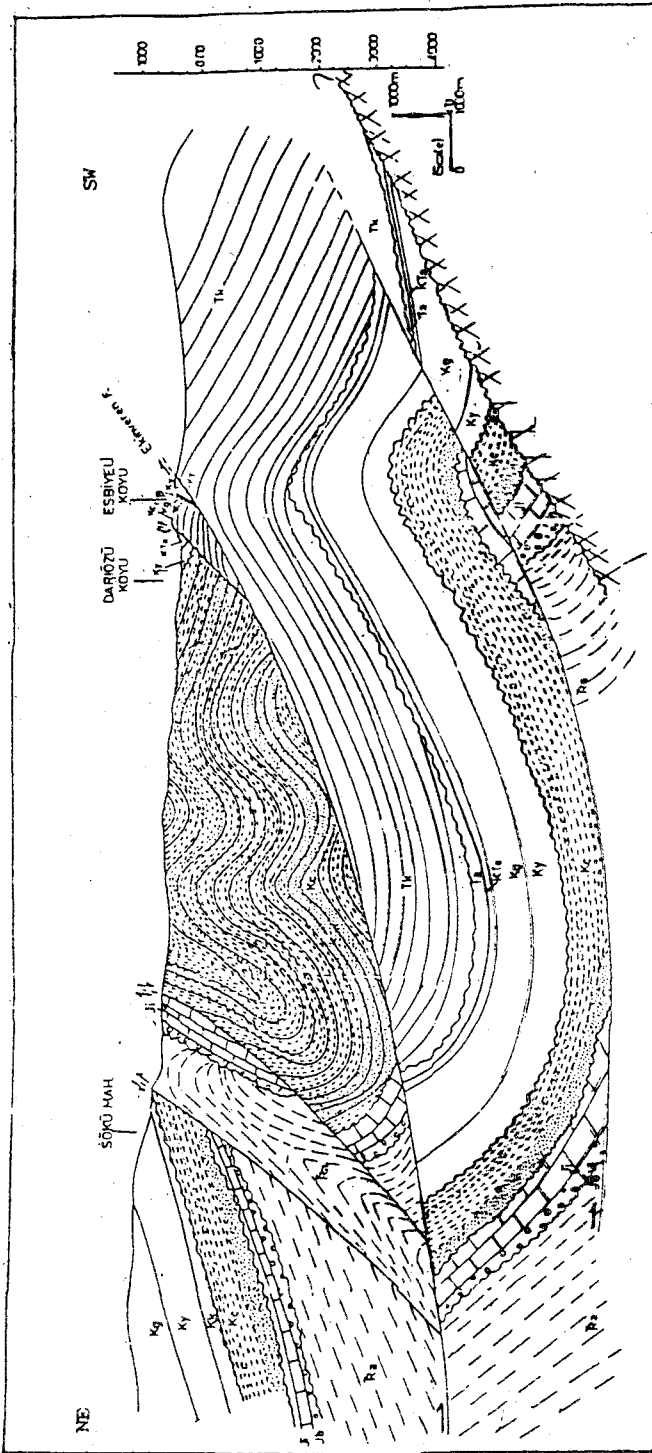


Figure 7-4-4' Geological cross-section based on seismic data

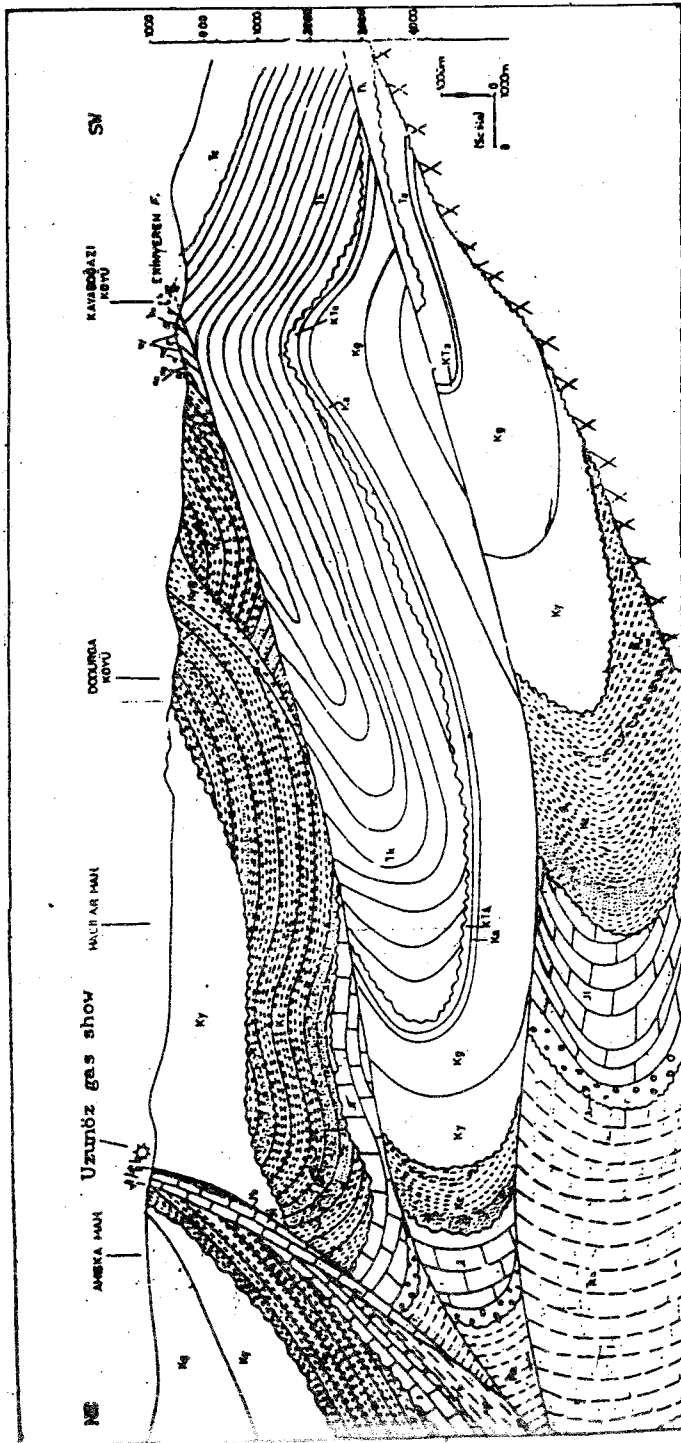


Figure 8-5-5' Geological cross-section based on seismic data

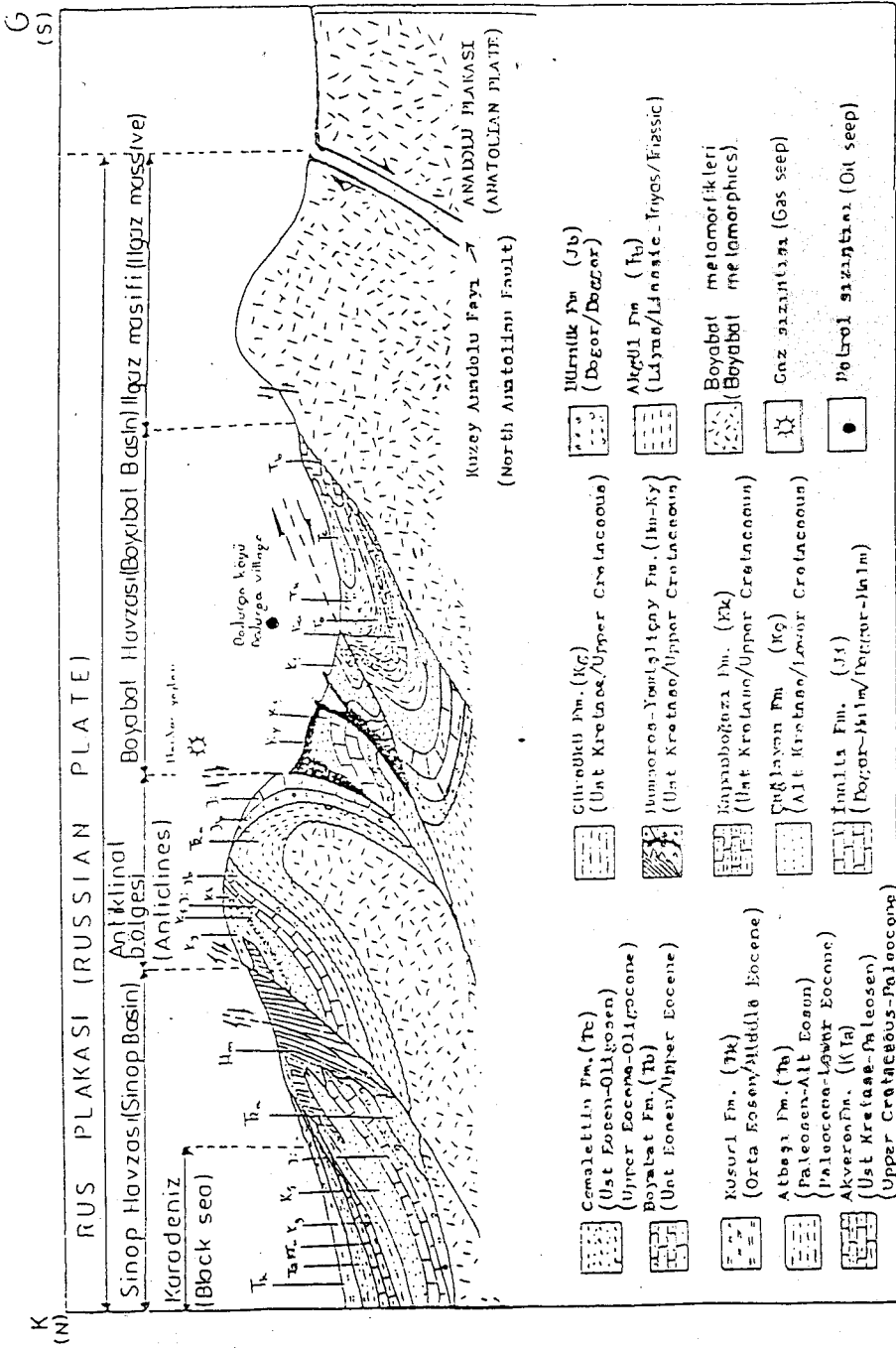


Figure 9- Generalized N-S structural cross-section in the Pontid mountains.

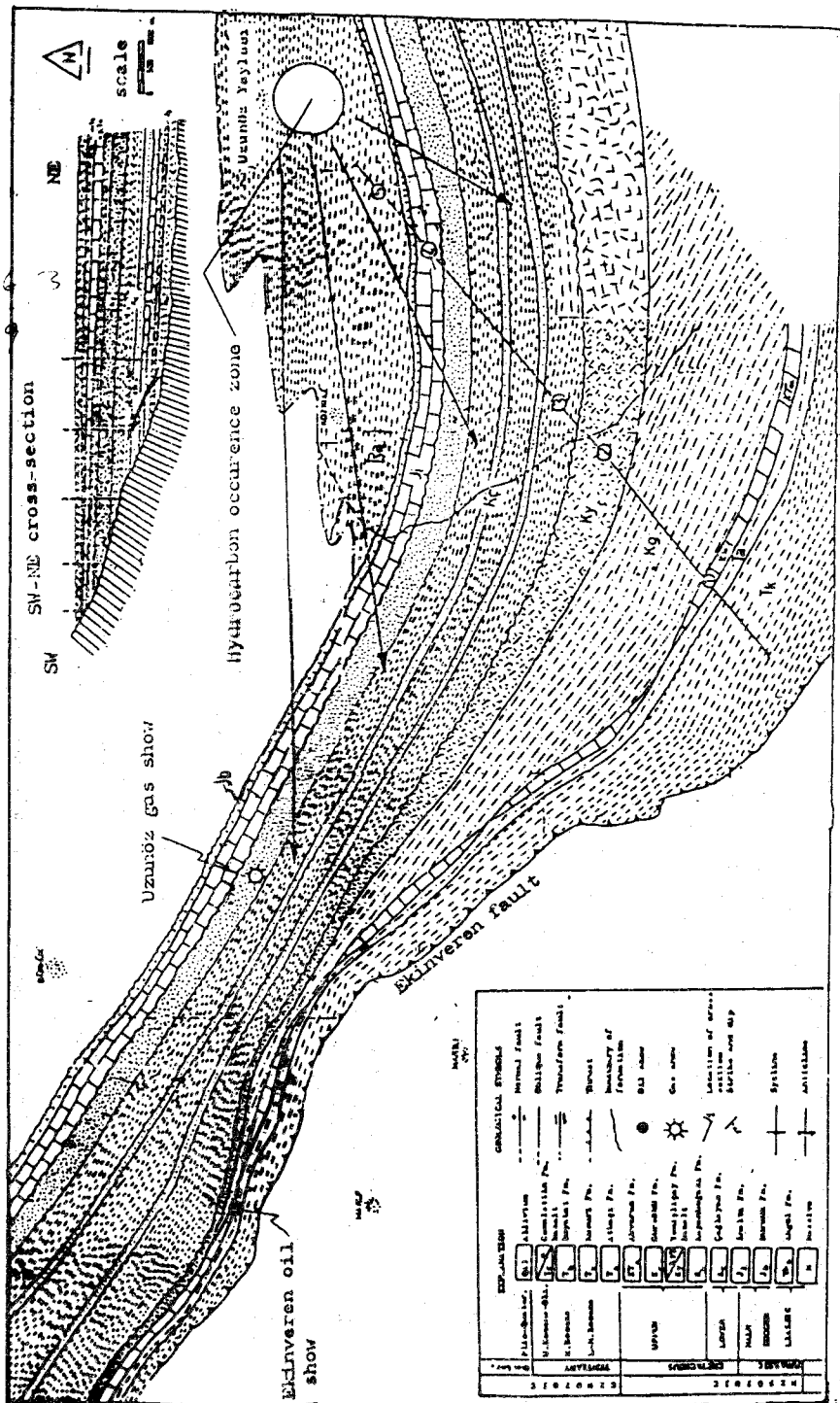


Figure 10- Possible situation of the different units under the Ekinveren Fault zone hydrocarbon generation zone and migration paths.

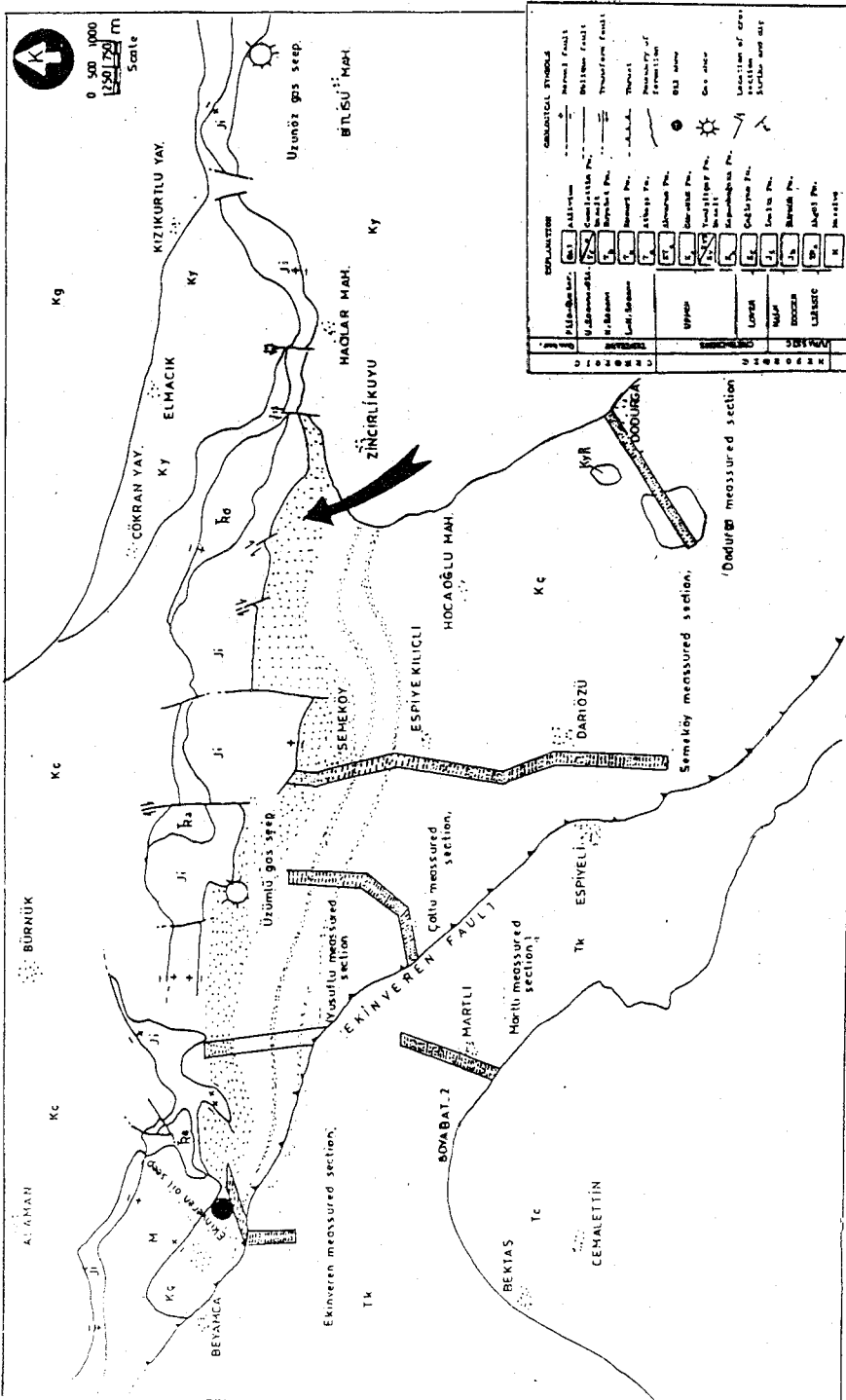


Figure 11- Showing reservoir characteristics and extension of basal thick sandstones Çağlayan Formation

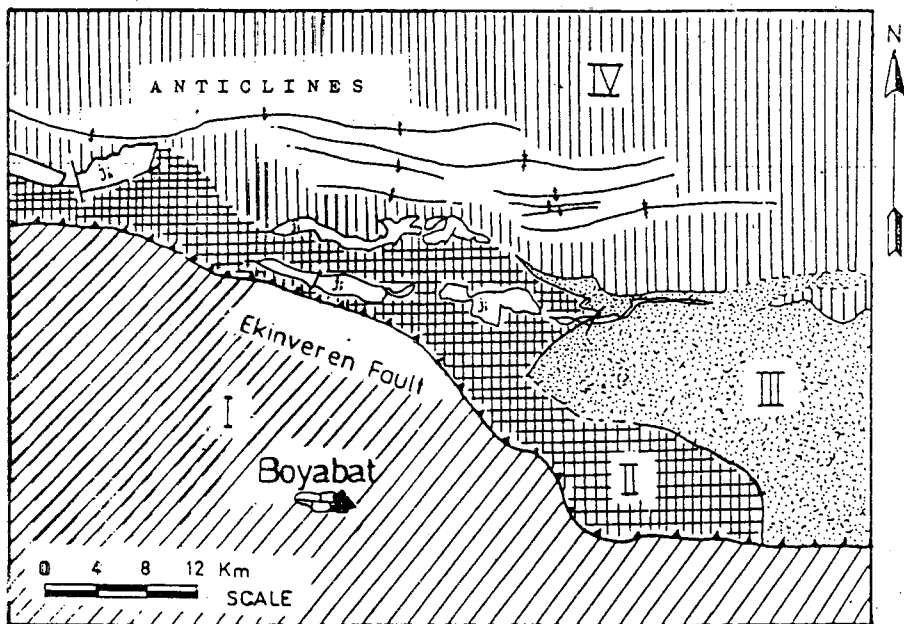


Figure 12- Possible exploration zones in the Boyabat basin

- I- Boyabat Limestone exploration zone
- II- Ekinveren fault zone exploration area
- III- Exploration zone under Yemişliçay Formation
- IV- Exploration zone anticlines

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INSTRUCTIONS FOR AUTHORS

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- A short abstract must be added to each submitted article.
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- Inclusive of figures and tables, manuscripts must at most be 25 type-written pages long.
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- Figures must be drawn neatly in indian ink. Original or glossy prints may be submitted. Photographs must be sharp glossy prints. Lettering and numbering must be neatly printed. The running title of the manuscript and the name(s) of the author(s) must be written in pencil on each figure or photograph.
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