CORRELATION OF ADANA WELLS BY MEANS OF QUANTITATIVE ANALYSIS OF FORAMINIFERA *

Mehlika TAŞMAN

INTRODUCTION AND HISTORICAL

During the course of general reconnaissance work being done in Turkey for the purpose of discovering potential petroleum prospects, the Adana region drew the attention of the early workers by the report of indications of oil and gas in its vicinity. This, together with a sedimentary section several thousand meters thick, lead the pioneers to concentrate on this area.

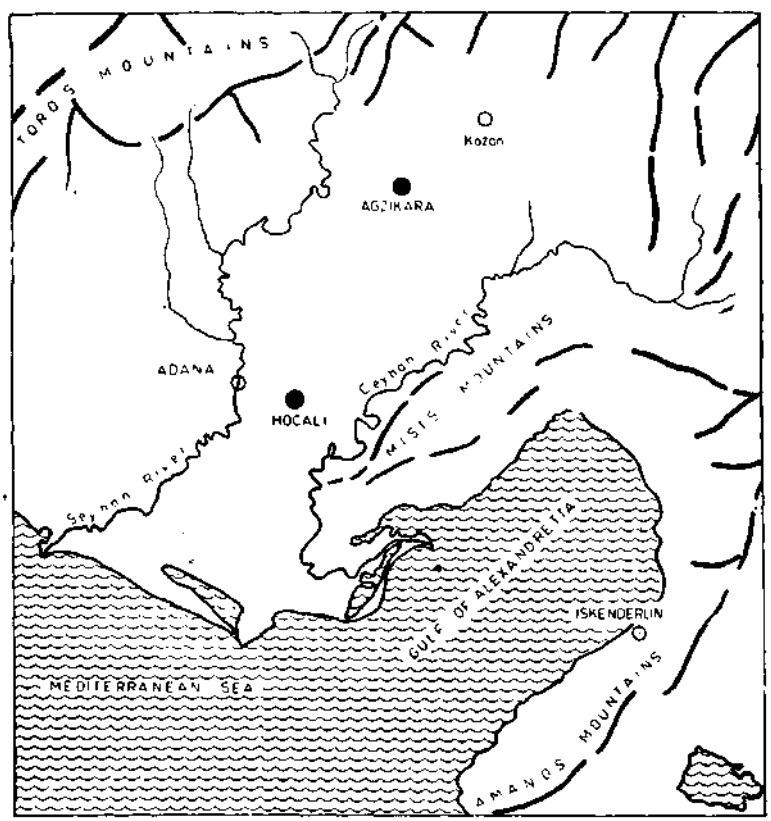


Fig. 1

The performance of geological and geophysical work, drilling some structural wells, and conquering the problems of heaving shale, and the interference of the World War Second delayed the uninterrupted drilling in the area until 1950.

RESUME OF GENERAL GEOLOGY

Though the term of Alexandretta Gulf Basin has ben used in the literature, here by Adana Basin we refer to the part of the area west of the Misis Mountains to the east and bordered by the Taurus ranges to die north and west.

The oldest rocks of this area are represented by Paleozoic on Misis Mountains. Mesozoic has developed mainly as Cretaceous in the calcareous facies. Eocene is found at the foot-hills of Misis and the Taurus Mountains. The

principal development of the Tertiary, however, is in the Miocene. The wells Ağzıkara No. 1, Hocalı Nos. 2, 3, and 4 which is the subject of our discussion are located in this thick Miocene sedimentary basin.

DISCUSSION OF THE WELLS

Besides the three structural wells drilled on Hocalı Dome and the two deep tests that had to be abandoned at shallow depths because of heaving shale trouble, three deep wells on Hocalı structure, two of them exceeding three thousand meters, and one on Ağzıkara structure — nearly two thousand meters deep — have been drilled in this basin since 1950. As deep as they are, all four of them and particularly the Hocalı wells, however, had to be abandoned due to technical difficulties before they reached their objectives.

The subject of our discussion, in the order of extension on NE - SW line, is Hocalı Nos. 2, 4 and 3. Because the area represents great facies changes in short distances the correlation among the surface outcrops as well the wells drilled on the structures seemed almost impossible.

By making quantitative analysis of the foraminiferal content of the cuttings and representing the results on charts it has been possible to bring out a clear picture which made the correlation possible in spite of lithologic differences in the formations penetrated by the bore holes.

The distance from No. 3 to 4 is 2 kilometers and from 4 to No. 2 is about 5 kilometers. Although all three of the wells start from 'the same formation the lithology of No. 2 is as much different from the other two wells as to make" one think of them starting from different formations.

Hocalı No. 2 starts from grey, greenish - bluish grey colored, very fine - textured Upper Shales. That same lithology continues as far down to 1034 meters where the formation changes almost immediately by encountering the coarse-grained, thick sandstone beds with distinct character of the Flaggy Beds we see elsewhere on the surface at outcrops. That same formation continues as far down to the bottom of the hole only containing more marly intercalations towards the bottom. The clay section at top of Flaggy Beds is so fine-grained that when the samples are washed the residue consists of only foraminifera.

No. 4 and 3 start from rocks which very much resemble the Flaggy Beds in their lithologic character. The formation in No. 3 is more sandy and the grains coarser, whereas in No. 4 around the same levels it contains more marly intercalations. Around 260 and 300 meters (respectively) they both contain thin layers of limestone beds which carry abundant, shallow water fauna. Below that level both of the wells have been drilled through grey-bluish-greenish grey colored marl and thin sandstone intercalations, the sandstone layers somewhat increasing towards the bottom of the hole. In the case of Hocalı No. 3 and 4, therefore, it is not possible to separate the formations as Upper Shales and Flaggy Beds as we did in No. 2.

As a result of detailed study of the foraminiferal contents of three of the wells by method of quantitative analysis some zones of faunal associations are established which are helpful in correlation and also one index fossil, *Globigerina heltcina,* is found that can be used dependably for the long-distance correlations within the basin.

Hocalı 2, 4 and 3 as far down to 1280, 1010, and 1070 meters respectively, in spite of their different lithologic as-

pects are time equivalents as far as their contents of faunal associations are concerned. No. 3 of the three wells being much closer to the shore line, particularly at its uppermost part, is composed mostly of coarse - grained sandstones with thin layers of marls and contains a very rich brakish water fauna, besides a few benthonic forms, and some pelagic foraminifera indicating its slight connection with the open sea. In No 2 the lithology is entirely different being composed of very fine clay material suggesting a deposition further away from the shore line to where the river waters could not carry their coarse material any more but only the finest particles could be deposited. Although the formation is abundantly fossiliferous, the sediments do not carry even the remnants of the brakish fauna which have so fully developed in Nos. 3 and 4. The family *Lagenidae, Buliminidae, Rotalidae* and other benthonic forms are very well developed and represented by many different genera and species. Judging from the much greater abundance of the pelagic foraminifera present, No. 2 must have had a better connection with the open sea.

The well No. 4 is still close enough to the shore line as it contains a rich brackish water fauna. However, its content of benthonic foraminifera which is also present in No. 2 being almost equally abundant that particular well seems to be at the interfingering point of the two facies, thus forming a link between No. 2 and No. 3. If we did not have the No. 4 well drilled it would have been rather difficult to figure out the correlating points between No. 2 and 3.

During the deposition of Upper Shales there has been several oscillations of the sea two of which are more prominently marked by invasion of the planktons with great or small quantities 'depending upon the degree of connection of the location of each well with the open sea. In general No, 2 well seems to have a better connection as indicated by its greater amount of *Globiyerina* and *Orbulinas* at both events. Nevertheless, all three of the wells had the invasion by the planktons hence the connection with the open sea at the same time, and their correlation on the resume chart prepared from the quantitative analysis charts is clearly seen.

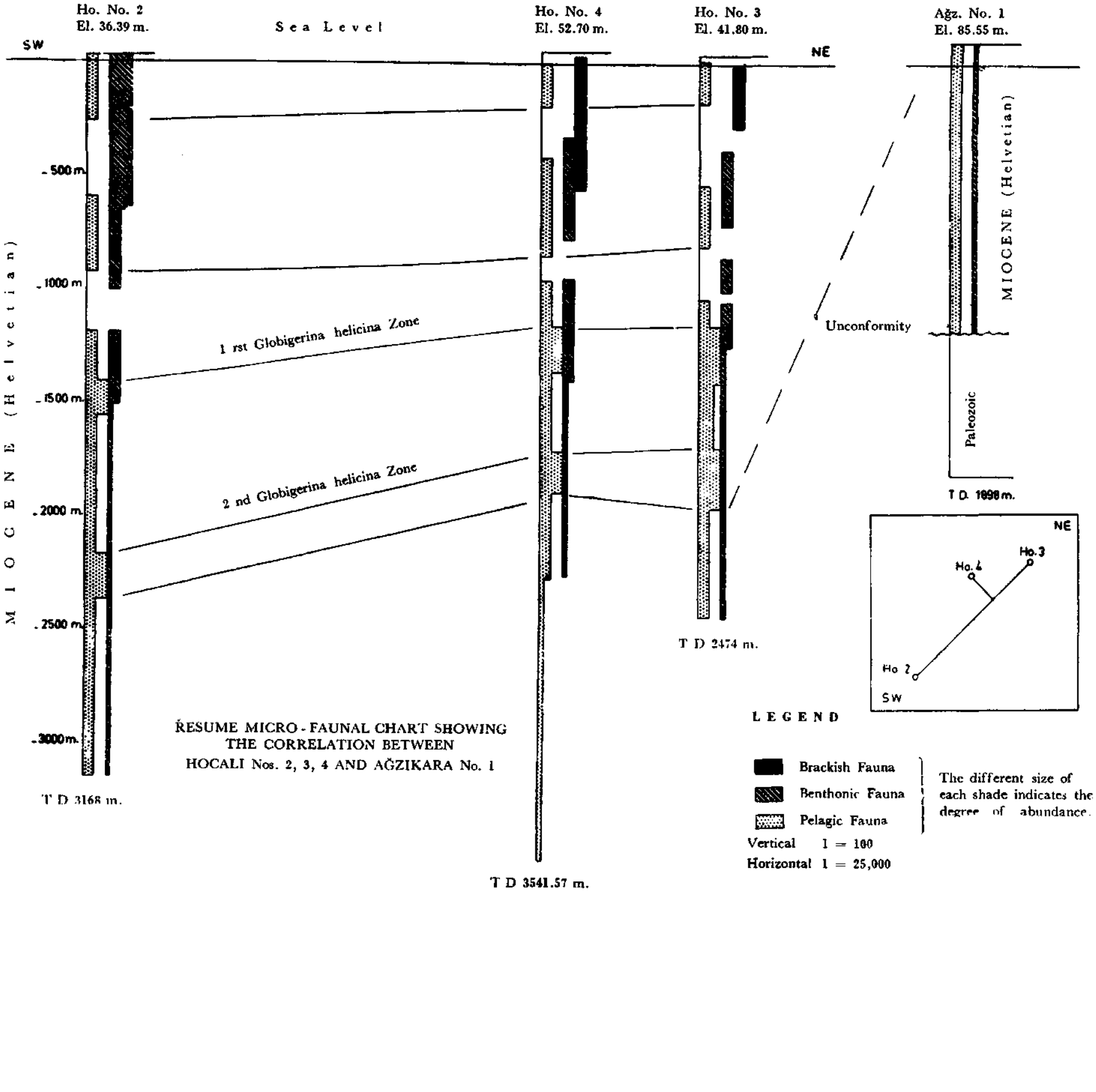
The next invasion is at the top of the Flaggy Beds, then about two hundred meters below it the pelagic foraminifera almost suddenly appears in great abundance, and the open sea conditions begin fully to prevail.

The top of the Flaggy Beds in well No. 2 is easily recognized by its lithologic aspect. The same formation, however, in Nos. 3 and 4 cannot be distinguished so readily. The quantitative analysis chart, however, brings out a clear picture of the point where those beds started.

As the open sea condition starts prevailing in its fullest most of the benthonic forms start disappearing. Only the *Buliminas* persistently keep on accompanying the planktons. This association which is also present in Agzikara well No. 1, proves its usefulness for long-distance correlations within this basin.

In Hocalı No. 4 at the depth of 2330 meters this association disappears almost suddenly. In Hocalı 2 and 3 no such sudden change is observed, but a gradual decrease in the amount of *Buliminas, Globigerinas* and *Orbulinas* is evident.

Ağzıkara No. 1 which is about 60 kilometers NE of Adana and 17 kilometers SW of Kozan starts from the



RESUME MICRO - FAUNAL CHART SHOWING
THE CORRELATION BETWEEN
HOCALI Nos. 2, 3, 4 AND AĞZIKARA No. 1

lower part of the Flaggy Beds. We arrive to this conclusion because of the resemblance of its faunal association to the lower parts of the Hocalı Flaggy Beds. *Globigerfnas* and *Orbulinas* are never over-flooded as they are at the two horizons at the upper part of the Flaggy Beds. They are common and seldom abundant. *Globigerina helicina* which starts to appear from the abundant zone on is present but again in small quantities, and the *Buliminas* characteristically accompany the planktons.

The lowermost part of the Flaggy Beds present in Hocalı No. 4 where the *Buliminas, Orbulinas* and the *Globigerinas* disappear almost abruptly and which probably is Lower Miocene in age, is not present in Ağzıkara No. 1. The formation following the Miocene Flaggy Beds, contrary of expectations is neither Burdigalian, nor Eocene or Cretaceous. After a hundred meters thick unconformity zone the Paleozoic rocks have been encountered. In the presence of abundant *Glomdspiras, Gymnocodiums* and *Mizzia* the age of these hard limestones with calcite veins is attributed to the Permian and particularly Upper Permian. Below 1700 meters together with the limestones some black, carbonaceous shales have been encountered. Although no characteristic fossils are found in those shales, because of their perfect lithologic resemblance to the Düzağaç Shales they are suspected to be Carboniferous in age. The black shales after about 30 meters of quartzitic sandstones are followed by cream - white colored, sugary-textured, dolomitic limestones and dolomites. These are suspected to be Devonian in age but have no fossil evidences.

CONCLUSIONS

The absence of Cretaceous and Eocene formations can be interpreted in three ways : 1) the Cretaceous, Eocene and Burdigalian seas have not invaded this area, 2) they were deposited, but later before the Middle Miocene seas reached those places they were eroded away, 3) during the invasion of the seas some of the high points of the old Paleozoic formations remained above the sea level as islands and while the Mesozoic and Tertiary sediments were being deposited at the flanks of those islands their portion above the sea was being subjected to a long and continuous erosion. Bearing in mind that some Cretaceous, Eocene and Burdigalian limestone formations are present at the foothills of the surrounding mountains and taking that thick section of unconformity zone into consideration the writer is more inclined to accept the third in'erpretation. Therefore, the full invasion of the Miocene sea towards the north of the basin has taken place after the Burdigalian. Towards the south the case may not be so. It is rather difficult to predict what formations we might encounter below the thick Miocene sediments. From the oil prospecting point of view the flanks of the buried hills are probably the more reasonable places to look for oil.