Preliminary Observations on Ramandağ Field Based on Subsurface Data (*)

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Ramandag field situated 92 kilometers east of Diyarbakır has drawn national and international interest being the first oil field of Turkey. Drilling started in 1939 and non-commercial oil was discovered in 1940. But the history of Ramandağ as an oil field begins with the completion of well Ne. 9 in March 1948.

Stratigraphic Summary

Ramandağ structure itself is located on the Midyat limestone, which is of middle Eocene in age. This limestone is underlain by the Gercüş Red Beds which are also of the middle Eocene age.

Underlying the Red Beds are grey colored Kermav shales. The upper most part of the Kermav shales are middle Eocene, the middle portion lower Eocene, and the lower most part is Senonian in age.

Kermav shales are underlain by the Turonian limestone. In some of the wells this limestone section is separated by a unit of Red and Green marls and the part of the limestone above this unit is called the *Otbitoid* limestone, and the one below it is the productive Massive limestone. These two limestone sections wheather separated or not, lithologically are different from each other.

The Significance of Oil Shows in the Gercüş Beds.

In all of the Raman wells the Gercüş Beds are generally sandy and in parts, especially towards the base, and at the uppermost part of the grey colored Kermav shales there are white colored, calcareous, glauconitic sandstone streaks. These sandstones in some of the wells are asphaltic or petroliferous in varying amounts, It has been observed that wells which have shown strong indication of oil or asphalt in these sandstones encountered the Massive limestone carrying the oil in commercial quantities. We can cite the well Nos. 7, 8, 9, 10, 11, 12, 14, 18 and 19. The indications of 9, 11, 12 were strong and they made the best producers of Ramandağ structure; No. 8 was fairely so and its production is less than the wells mentioned before. Raman No. 7 showed poor indications at the glauconitic sandstones, and although its production is not known for certain, we know that after encountering some oil at a depth of 1420 meters it hit the water zone somewhere between 1444 and 1446 meters. Raman No. 14 has not yet been tested. Although it has penetrated 98 meters of petroliferous horizon nothing can be said about its actual production. If the oil indications in the glauconitic sandstones have any meaning as we think

it might, in spite of a thick petroliferous column the production in this well should not be very high compared with Nos. 9, 11, 12 because the indications in the sandstones were not very strong.

In Raman No. 18 and 19 almost no indications are observed and the wells hit water showing only traces of oil.

From the old wells drilled Nos. 1, 5, and 6 had slgiht indications. Nos. 1, and 5 gave some oil, but No. 6 had not been tested - only it was apparently something like No. 7 or even less. The other wells Nos. 2 and 3 showed no signs of oil or asphalt in the sanstones and the wells were dry holes.

Red and Green Marls

Below the *Orbitoid* limestone and underlying it some of the drills on the Ramandağ structure have encountered a unit of very cavy marls the upper part of which is bright red in color and the lower portion is bright bluish green and in places rich in pyrite crystals. They both are non-foraminiferal. These beds are not found in the wells drilled on the highest part of the structure and along the axis line. They are present only on the flanks of the anticline and pinch out towards the apex. Since the line connecting most of the wells drilled on the structure is more or less parallel to the axis, if we study the E-W- section (Fig. 1) of the structure this pinching out can be observed. The thickness of the Red and Green marls in R. No. 3 which is the lowest well on the west plunging side of the anticline, is 64 metres. Towards the apex, following the wells in order, Nos. 2, 1, 5, 6, and 7 we see that the marl unit thins out and finaly at No. 8 we do not encounter any. Leaving out the well No. 6 which passed through a reverse fault so that the Red and Green marls were repeated, the thickness of the beds from No. 3 to No. 7 are 64 m, 56 m, 45 m, 27 m, and 28 m respectively.

If we study the section perpendicular to the axis of the anticline (Fig. 2) we observe the same phenomena both on the northern and southern flanks of the anticline.

In the wells drilled on the east plunging side of the anticline these marls have not yet been encountered. However, if a well should be drilled about 2500 meters to the east of Raman No. 14 it might be expected that the drill should encounter the Red and Green marls with about the same thickness as in Nos. 7 and 6.

The Red-and Green marls make perfect cover rooks and whrever they are present no indications of oil are observed in the *Orbitoid* limestone. On the other hand the wells drilled on the apex where no Red and Green marl section is encountered oil indications have been observed. This fact has been explained by some geologists with two petroliferous horizons being present in the section, first one in the *Orbitoid* limestone and the second in the Massive limestone. But the author believes that the presence or absence of the Red and Green marl section explains the situation perfectly well. Where they are absent there being nothing to seal up the oil in the Massive limestone as to prevent its upward migration, we find some indications of oil in the *Orbitoid* limestone itself. As a matter of fact no production has ever been made from the *Orbitoid* limestone excepting the R. No. 5, but that was merely due to the pre-

sence of a reverse fault causing the migration of oil into the *Orbitoid* limestone along the fault plane.

In view of the above discussion the observation of the presence or absence of oil shows in the *Orbitoid* limestone can be considered as a reliable indication whether the Red and Green beds should be encountered below the *Orbitoid* limestone or not, giving a clue as to where set the casing. As the marls cave very badly, and especially so when the well is drilled with the oil base mud, casing should never be set in the hole above these marls.

Origin of the Massive Limestone

The Massive limestone, according to the author's opinion, is a reef knoll. Although no detailed work has yet been done concerning this view point, the subsurface map (Fig. 3) drawn on top of this limestone and the cross-section (Figs. 1 and 2) indicating the abrupt drops of the flanks, the fact that it is bordered by Red and Green marls, and that the Red marls contain carbonized plant remains thus being black in color towards the apex of the anticline, and some particles of broken corals being found in the well cuttings filled with oil, might confirm the opinion.

Lithologically it is mostly chalky White in color, very soft, porous, brithe and easily recognized in the cuttings even in the wells where it is not separated from the *Orbitoid* limestorie by the marl unit. In the drills when the Massive limestone is encountered circulation is lost almost immediately and in many cases to regain circulation it is necessary to use tons and tons of mud. This is also due, according to the writer, to the cavernous nature of the reef limestone.

Faults on the Structure

The main faults which run more or less parallel to the axis of the anticline are clearly observed, on the structure. Besides these two faults there are several others which are either perpendicular or parallel to them but are small and do not extend for long distances. Most of these faults are tension faults and do not reach the deeper horizons, and never the Massive limestone. They generally go as far down as to the *Lockhartia, Vaginulina* zones, Eocene - Cretaceous contact, and seldom to the *Orbitoid* limestone. Raman No. 5 is the only exception to this; here the limestone has been encountered 18 meters lower than No. 1 while all the rest of the lithologic, and paleontologic key horizons were much higher.

The Echinoid Horizon

The E**chinoid** horizon is a paleontologic marker on the surface of the structure within the Midyat limestone. This key horizon was first discovered by I. Ortynski in 1943. Since much has been said and written about it and so much importance has been given to it that the new locations are made on the basis of it and even the estimated oil reserve of the structure has been calculated on its extent.

The author believes that the importance given to it is exaggerated. Its being only a marker bed at the surface ought to be taken into consideration. Various observations on all the wells drilled have brought out the fact that whatevar the conditions of the upper zones, including the *Lockhartia, Vaginulina* zones, and even Eocene - Cretaceous contact might be, the Massive limestone behaves generally independently. If, when the *Lock-*

hartia, or *Vaginulina* zone is high in & well, we cannot expect the Massive limestone to be also high as may be gathered from the inspection of the log chart (Fig. 1), for the same reason we ought not to expect the **Echinold** horizon on the surface of the structure to be a safe guide as to the attitude of the Massive limestone.

As it is discussed above, the structure is a reef knoll which has been coveted up by plastic sediments. The thickness of these sediments is less on the top of the structure and greater towards the flanks. If we study the section (Fig. 1) we can see very clearly that the highest part of the structure is from well No. 8 to well No. 12, the elevation of the Massive limestone between these two wells being - 119, - 69, - 71, - 88 meters and the thickness of the section covering the Massive limestone up to the **Echinoid** zone being 1279, 1215,1220, and 1233 meters respectively. Towards west from R. No. 8 and east from R. No. 12 the Massive limestone already starts plunging and the sediments covering it get thicker, being 1876 m in R. No. 7 and 1343 m in No. 14.

Now taking the **Echinold** horizon itself into considration, R. No. 8 is on the highest point of this zone which is 1160 meters. The Massive limestone in this well has been encountered at-119 meters. Raman No. 9 is at 1140 meters, and therefore it ought to encounter the Massive limestone at a depth 20 meters below the R. No. 8, but on the contrary it reached the Massive limestone 40 meters higher which makes 60 meters of difference from what theoretically should be expected. On the other hand both R. No. 9 and R. No. 14 are on the same **Echinoid** contour line (1140 m.), therefore they both ought to encounter the Massive limestone at the same depth. But the fact is that the R. No. 14 hit the limestone at a depth 134 meters lower than R. No. 9.

These facts indicate that the surface evidences do not exactly reflect the subsurface situation and therefore not undue importance should be given to the **Echinold** horizon. Its significance is not more than that of any of the markers we pass through in the course of drilling.

Bounderies of the Petroliferous Area on the Structure

To estimate the oil reserves of the Ramandağ structure We must admit that we do not have data concerning the possibilites and the limits of the anticline, and also the question of porosity and permeability of the producing formation have not as yet been settled. Therefore, any calculation we make could only be a rough guess.

Under these conditions, the author believes that in drawing the estimated, boundery line of the petroliferous area of the structure the Red and Green marls which seem to be quite insignificant at first hand play an important role. It has been observed that the wells drilled on the highest parts of the structure where no Red and Gren beds exist have proved to be the better producers. On the other hand the wells that encountered this marl section, have always been flushed with water. Therefore if we can draw a line between the area which includes the Red and Green marls and the area which does not, we can have an idea about the area which contains prolific oil and no danger of encountering water.

Raman No. 14 is the well which hit the Massive limestone at the dee-

pest horizon (- 203 m.) without encountering any Red and Green, marls. On the other hand R. No. 7 on the east side and No. 10 on the north flank are the two wells which encountered the Massive limestone at highest levels after passing through the marls (-268 m. and - 260 m.). Taking this into consideration we can theoretically accept a contour line which passes on the top of the Massive limestone at an elevation of - 240 meters as the maximum outskirts of the area which does not include the Red and Green marls. Such a line can be drawn about 2700 meters W from R. No. 9 and 2800 meters Eform the well No. 11 which are the two highest wells, and thus presuming about 6000 meters for the length. Raman No. 10 which is 450 meters N of R. No. 8 and R. No. 19 which is 350 meters SW of it have encountered the Red and Green marls at the depths of -196 m, and - 292 meters respectively. Therefore we can presume a width of about 500 meters for the most for this area.

The area of secondary importance is the part of the structure which is left between the - 240 and - 320 meters contour lines that are drawn on top of the Massive limestone. The wells drilled within this area are always subject to the danger of water flush after encountering the oil. The boundery line of this area should pass from R. No. 1 on the west and about 2.5 kilometers east of Raman No. 14.

The wells that reach the Massive limestone at the depth of - 320 or - 380 meters or after, are considered to be outside the petroliferous area and have given only water after a trace of oil.