DOĞU TÜRKİYEDEKİ RAMAN, GARZAN VE KENTALAN STRÜKTÜRLERİNİN KRETASE SAHRE ÜNİTELERİNİN FASİESLERİ VE KORELASYONU

F. BENDER

Hülâsa

Üst kretase serisinin detaylı tefsiri için sahreler ünitelere ayrılmıştır. Raman, Garzan ve Kentalan strüktürlerindeki bu sahre üniteleri arasındaki korelasyon gösterilmiştir. Bu kore-lasyonda litoloji, erimiyen maddeler ve elektrik loğları esas olarak alınmıştır. Raman'dan Garzan ve Kentalan istikametinde muayyen sahre ünitelerindeki fasies değişikliği müşahede edilmiştir. Garzan ve Kentalan'daki petrol zonlarının Batman'daki istihsal zonuna tekabül etmediği gösterilmiştir.

FACIES AND CORRELATION OF THE UPPER CRETACEOUS ROCK UNITS OF THE RAMAN, GARZAN, AND KENTALAN STRUKTURES IN EASTERN TURKEY

F. BENDER

Abstract

For detailed interpretation of the Upper Cretaceous sequence, rock units were established.

A correlation is shown between these rock units of Raman? Garzan and Kentalan structures. It is based on lithology, successive measuring of insoluble residues? and electric logs.

A change of facies of certain rock units is observed from Raman towards Garzan and Kentalan.

It is shown that the oil zones of Garzan and Kentalan are not the exact stratigraphie equivalents of the Raman producing zone.

Introduction:

During the period from October 1952 until January 1954 the author worked on the fresh samples of the wells drilled in the mentioned structures. He had also the opportunity to study the outcrops of the drilled sequence in the area of the «Border Foldings» between the Bitlis Mountains and the Arabian Shield. For making these studies possible thanks are due to the M.T.A. Institute.

Since some of the limy and porous sediments of the Upper Cretaceous are known to be oil-bearing horizons in this region, a detaild correlation of these beds is valuable for further exploration.

It is thought that detailed sections should indicate the relalationships between the beds of the different structures, even for those beds, where certain changes of facies should be observed.

Successive measuring of the insoluble residue obtained fom the calcareous sediments has been found to be very useful in establishing the boundaries of the rock units. [*]

In the detailed interpretation of the profiles, the selfpotentiai and resistivity curves of the penetrated heds were also used.

A correlation between the typical rock units of Raman via Garzan (25 km) to Kentalan (30 km) using ail observable well data has been given in the following section of this paper.

The Upper Cretaceous of Raman:

a) The Shale-Marlstone Intercalations.

The Upper Cretaceous (Maestrichtian) sediments of the Raman area begin at the top with homogeneous gray shales. This shale disintegrates

[*] For determination of the «insoluble residue» the following method was used: Indigneous cutting were picked oat of washed samples, dried, pulverized and 10 cm^3 of this rock powder were treated with concentrated liidrochlorid acid. After having dissolved all carbonates, the insoluble residue was washed in the filter, dried and again, measured. This procedure was generally followed for each 10 meters interval, combining the indigaeous cuttings of samples every 2 meters drilled. The resulting percentages of residues were drawn as a graphic log. By treating this relatively large quantity of cuttings, an average of the carbonates of the penetrated sediments was obtained. Also using this large quantity reduces errors from caving.

to laminated pieces after being kept in water for several days, but no substantial increase of its volume is noticed, (Different from the otherwise similar Palaeocene shales.) The fracture is laminated or splintery. Under the microscope one observes some pyrite in small idiomorph crystalls, and locally, finely. disseminated whitish particles (? kaoline). Well preserved key forams BOLIVINA INCRASSATA GIGANTEA and GLOBOTRUNCANA STUARTI are abundant. All the shale contains a certain amount of carbonate. After dissolving it in concentrated HCl. The remaining insoluble residue is about 70-90%.

This shale alternates with medium gray layers of homogeneous maristones, which are harder and denser than the shale itself.

The thickness of this rockunit is about 150 m.

b) The Marlstone Unit.

With depth there is a steady increase of these marlstone layers. The increase of the carbonate content of the sediment, along with its increase of hardness and density is indicated by the increase of the resistivity curve and in a lesser degree, by a tendency towards a decrease on the curve of the insoluble residue.:

About 30-50 m above the top of the so called Orbitoid Limestone (local name for the rock unit below), these marlstone layers become an almost compact marlstone unit, divided only by a few thin shale intercalations. This marlstone unit is homogeneous, too, its color changed to somewhat gray-brownish. It does net break into laminated pieces after having been kept in water In general, the fracture is irregular. Under the microscope, one notices more disseminated pyrite and kaoline (?) particles than in the shales above. The insoluble residue was found to be between 50 and 80%, This resistivity curve shows an increase which ib useful for correlation.

Genetically and Detrographically this marlstone belongs to the lock unit above but not to the «Orbitoid Limestone below.

The rock units (a) and (b) represent the «Lower Germav Beds» which ıs a local name for all gray shales and marlstone of Maestrichtian age.

c) The Marly Limestone Unit.

This unit called «Orbitoid Limestone» in all former profiles and sections is characterized by its typical content of clastic insoluble materials rather than by the orbitoid fossils. The reason is that the orbitoids found in this section are also present in the lower rock units.

The qualities of this marly limestone unit clearly showing the difference from the overlying unit should be emphasized here for further correlation:

Decrease of the insoluble residue from 50-80% to 10-30%, change of crystallinity from microcrystalline to medium-or even coarsely crystalline.

Change of color from gray-brownish to lightgray-creamish, increase of pyrite content.

Presence of some live oil in coarsely crystalline pockets, presence of Orbitoids, particularly in the middle of this unit, another increase of the resistivity curve at the top of it.

The decrease of the insoluble residue is indicative of the change from marlstone to marly limestone [1].

This unit is in general not thicker than 50 m. Thicknesses of up to 100 m. mentioned in some former well reports probably include the lower portion of the marlstone unit.

d) The Black Shales and the Red and Green Marlstones:

Wells drilled along the crest of the Raman structure passed directly from the marly limestone (c) into the «Massive Limestone» (e). However? black shales aboot 2 to 18 m in thickness were found locally between these both units. This exceedingly fissile black shale is strongly bituminous and contains much asphalt in paperthin layers, It is also rich in organic matter and pyrite. It is quite apparent that this shale represents the reef surface.

Towards the flanks of the anticline bluegreen and locally red marlstone were observed between the marly limestone and the «Massive Limestone». These marlstones are known up to 70 m in thickness down at

[1] About definition and range of marlstones and marly limestones: BARTH, COREENS, ESKOLA: Entstehung der Gesteine, 1989, and J. PETTIJOHN: Sedimentary Rocks, 1949.

the North flank.

e) The Porous, Pure Limestone, (Upper Massive Limestone).

The oilbearing horizon of Raman is a reef limestone. [2] A few meters of white, friable chalk overlie the reef knoll. Characteristically the chalk alternates irregularly with a pure limestone which is hard and dense as porcelain.

The characteristics of the underlying reef limestone can be summarized as follows:

Insoluble residue less than 2 %,

decrease of its pyrite content as compared to the marly limestone above,

abundance of Orbitoids sp., corals, coral shaped valves of hippurites sp,

and the following qualities as a reservoir rock:

1 — Numerous small vacuoles, often covered with coarsely crystalline calcite,

2 — Coarsely crystalline stripes, thin layers and pockets,

3 — Soft, chalky layers and pockets,

4 — Saccharoidal crystalline dolomitic layers,

5 — Porous hippurites and accumulations of coral fragments,

6 —Fissures, cracks and stylolites in the denser portions.

The first 3 of the factors mentioned above decrease gradually after having penetrated 30-100 m of the payzone.

f) The Dense, Pure Limestone. (Lower Massive Limestone).

Below the payzone, a pure or slightly marly limestone is drilled. This section is impregnated only locally with a little oil in fissures, cracks and stylolites. This dense limestone does not show the characteristics of a reef. It is somewhat darker gray colored than the unit above. The fracture is splintery. It is in general homogeneous but some pyrite crystalls and asphalt particles are mostly observable under the microscope. It shows a slight increase of the insoluble residue towards depth.

[2] M. TAŞMAN, M. T. A. - Bullet. 40, Ankara 1950,

There is no sharp boundary between the reef knoll and the underlying limestone, it is a gradual transition.

No electrologs have yet been run in the Dense Pure Limestone Unit of Raman.

The Upper Cretaceous of Garzan:

a) The Shale-Marlstone Intercalations:

All the lithologie details described in chapter 1 a) for Raman have also been observed in Garzan, which is situated about 25 km NE of the Raman area. As in Raman, this unit contains the key forams BOLIVINA INCRASSATA GIGANTEA and GLOBOTRUNCANA STUARTI, although species found are not as numerous as in Raman and are mostly poorly preserved.

b) The Marlstone Unit:

As in Raman, the marlstone layers become an almost compact unit about 50-60 m above the marly limestone (c). Its insoluble residue (clay content) characterizes this unit clearly among the marlstones.

However, a certain change of facies is observed: The marlstone is somewhat more crystalline, harder and lighter gray brownish than its equivalent in Raman. Its resistivity curve is. higher, too, but still shows the same typical trends as one sees in Raman. (see fig. 1).

Therefore this marlstone unit becomes somewhat similar to the marly limestone unit

(Orbitoid Limestone) of Raman.This apparent similarity may easily represent the reason for combining a portion of this marlstone unit with the marly limestone below as «Orbitoid Limestone».

c) The Maryg Limestone Unit. (Orbitoid Limestone).

As in Raman the marly limestone is distinctly characterized and differentiated from the units above and below by its insoluble residue of about 8-20 %.

However, the change of facies previously noted in the marlstone unit above, is strongly marked also in the marly limestone.

It contains less argillaceous material than in Raman, it is in general more crystalline and therefore somewhat more porous. Locally, several thin layers of a polymikt fineconglomerate were observed, (well Garzan 5).

Because of its porosity this unit acquired the quality of a poor reservoir rock? to the contrary of its corresponding unit in Raman. Actually, a substantial percentage of the Garzan oil is produced, from this marly limestone unit. The change of fades and especially the oil content might have been the reasons for correlating some portion of this marly limestone with the reef limestone (Massive Limestone) of Raman, Particularly would, this correlation tend to follow where the marlstone unit above had already been interpreted as «Orbitoid Limestones».

d) Black Shales or Red and Green Marlstones_ have not yet been, observed in the Gat zan area:

e) The Porous, Pure Limestone. (Upper Massive Limestone)

The typical decrease of the curve of insoluble residue from themarly limestone unit (c) to the porous, pure, limestone (e) is strongly marked, in Garzan as in Raman. However, the porous, pure limestone was only locally encountered in Garzan. It seems to be missing in parts of the crest area, especially in the Eastern part of the structure. When entered, it is found much thinner than in Raman. In some places tectonic movements and the preservation of the reef characteristics (well Garzan 9) may cause an excellent porosity and permeability of this unit.

f) The Dense, Pure Limestone. (Lower Massive Limestone),

In Garzan, the marly limestone unit (c) usually directly overlies the dense, pure limestone (f), which is in general only impregnated with some live oil in fissures, cracks and stylolites. The dense, pore limestone shows the same lithology. as in Raman. (1, f.)

Because of the local hiatus of the porous massive limestone, .and because of the porosity of the marly limestone unit (which is in general more porous than its equivalent

Raman) it is quite apparent, that a substantial part of the oil is migrated to this marly limestone unit (c).

The Upper Cretaceous of Kentalan:

a) The Shale-Marlstone Intercalations:

Owing to the structural altitude of the Kentalan anticline theses beds below the base of the Palaeocene can be studied in outcrops. They can be correlated with Kaman and Garzan without difficulties.

b) The Marlstone Unit:

The marlstone unit at the base of the Lower Germav Beds is found as in Garzan, i.e, somewhat more crystalline, harder and lighter gray-brownish than in Raman. Its insoluble residue range of 50-70 % characterizes it clearly as a marlstone.

Previous to the drilling of the well Kentalan 5 this marlstone unit was established as Orbitoid Limestone. This interpretation might have been mainly based on the abnormal increase in the resistivity curve in approaching this unit. This anomaly in the curve resembles indeed very much the resistivity curve obtained for the orbitoid Limestone of Raman. (see fig. 1).

c) The Marly Limestone Unit. (Orbitoid Limestone).

The marly limestone unit of Kentalan shows the change of facies from Raman towards NE even more than its corresponding horizon in Garzan. It contains less argillaceous material and it is more crystalline. Particulary, in its upper portion there is a certain intergranular «pin point porosity» (no permeability) in a few coarsely crystalline pockets. Its insoluble residue range of 8-15 % and the lithologie change to the pure limestone below are sufficient criteria for establishing it as the marly limestone unit.

The thickness of this unit increases from Raman towards Kentalan (about 55 km NE) to about 70 m as far as known from the hitherto drilled wells.

Most of the residual hydrocarbons and much asphalt of Kentalan: are found in the limestone unit.

d) Black Shales or Red and Green Maristones have not been observed in Kentalan wells.

e) The Porous, Pure Limestone. (Upper Massive Limestone)

As locally in Garzan, the «Upper Massive Limestone» with reef characteristics seems te be missing completely in Kentalan.

f) The Dense, Pure Limestone, (Lower Massive Limestone).

The marly limestone unit (c) directly overlies the dense, pure limestone (f) in this area. This statement is based mainly on the fact, that below the marly limestone unit a pure limestone is encountered which shows the same lithology as described as «Lower Massive Limestone» (l. f and2, f) in Raman and Garzan, In all Kentalan wells, the «Lower Massive Limestone» was penetrated. Because of the existing similarity with the marly limestone unit (c) above, both units were formerly combined and correlated as « Massive Limestones». The only way to divide both units is to measure successively the insoluble residue. Using this method, the lithologie break was definitely found first in well Kentalan 5.

It can be observed that all resistivity curves show a decrease followed by an abrupt increase at the section, where the marly limestone overlies the dense? pure limestone. (see fig. 1),

In lower levels of the dense, pure limestone of Kentalan, several thin, porous layers were found? bearing some live oil.

Summary and Conclusions:

1 — For detailed interpretation of the Upper Cretaceous profile, rock units were established:

	Local names in former reports:
a) The Shale-Marlstone Intercalations,	« Germav Shales »
b) The Marlstone Unit,	" "
c) The Marly Limestone Unit,	« Orbitoid Limestones »
d) Black Shales, Red and Green Marls	« Red and Green Shale »
e) The Porous, Pure Limestone,	«Massive Limestone »
f) The Dense, Pure Limestone.	" "

2 — These rock units typical in Raman were also found in Garzan and Kentalan, except the unit (d) in Garzan, and the units (d) and (e) in Kentalan.

3 — The marlstone unit (b) and the marly limestone (c) become more calacareous and more crystalline towards Garzan-Kentalan (NE).

4 — The marly limestone (c) which is almost dense in Raman tends to become more porous ip Garzan and Kentalan.

5 — In the highest parts of the Garzan and Kentalan structures this marly limestone unit (c) mostly directly overlies the dense, pure limestone (f).

6 — Because of the local hiatus of the porous, pure limestone (e) and because of the porosity of the marly limestone (c), a substantial part of the Garzan oil was accumulated in this marly linestone unit.

7 — In this same unit, residual hydrocarbons and much asphalt are found in Kentalan.

8— A transgression of the «Orbitoid Sea» (where the marly limestone unit (c) was sedimented) may be deduced from:

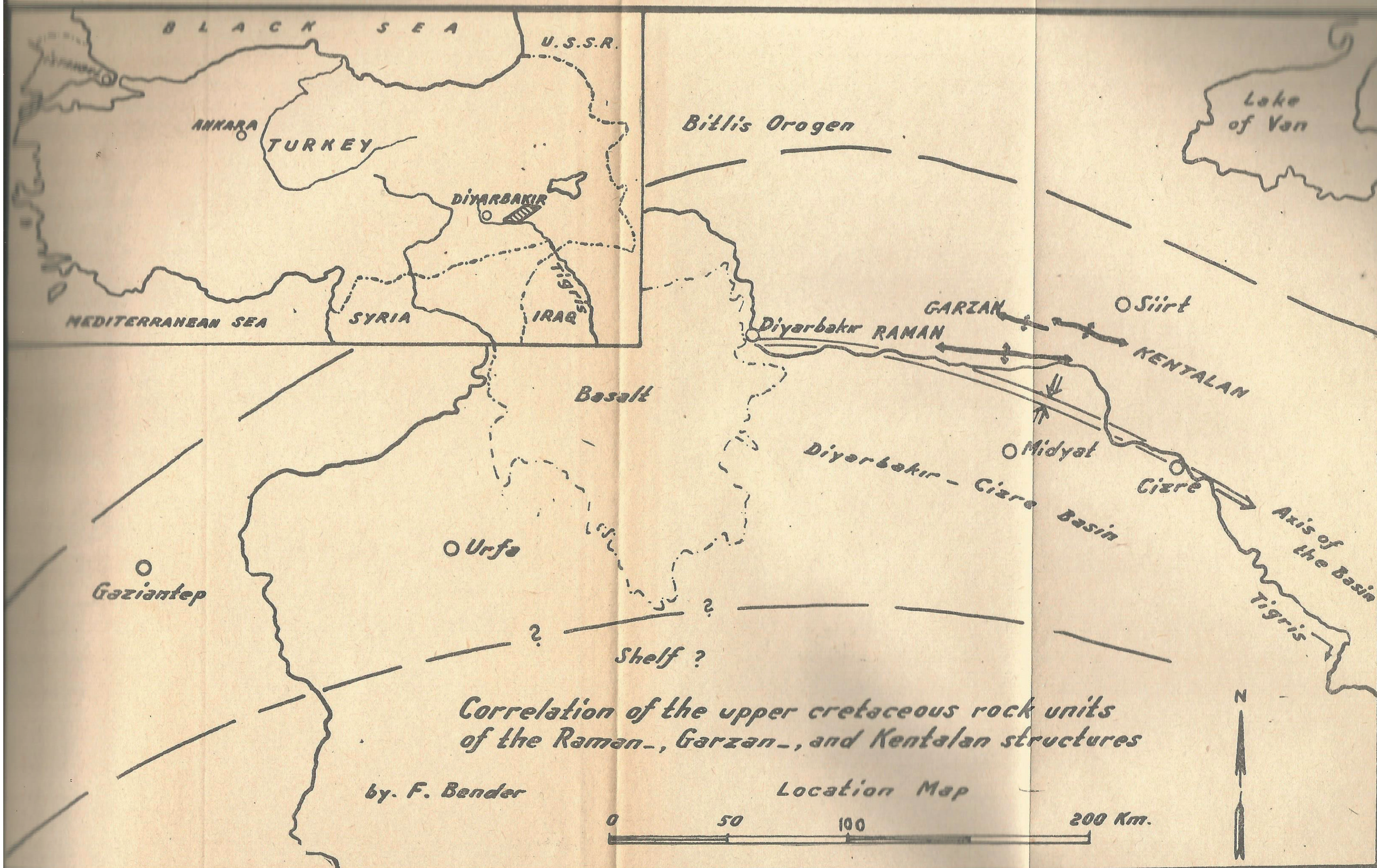
the thinning of the Red and Green Marlstones towards the crest of the Raman anticline, the local hiatus of the Upper, Porous Massive Limestone and the missing of the black shale in the crest area of Garzan and Kentalan, the conglomeratic layers observable locally in the marly limestone (c).

It is apparent that the structurally highest sediments were eroded by this transgression, in Garzan and Kentalan to a lower stratigraphie level than in Raman.

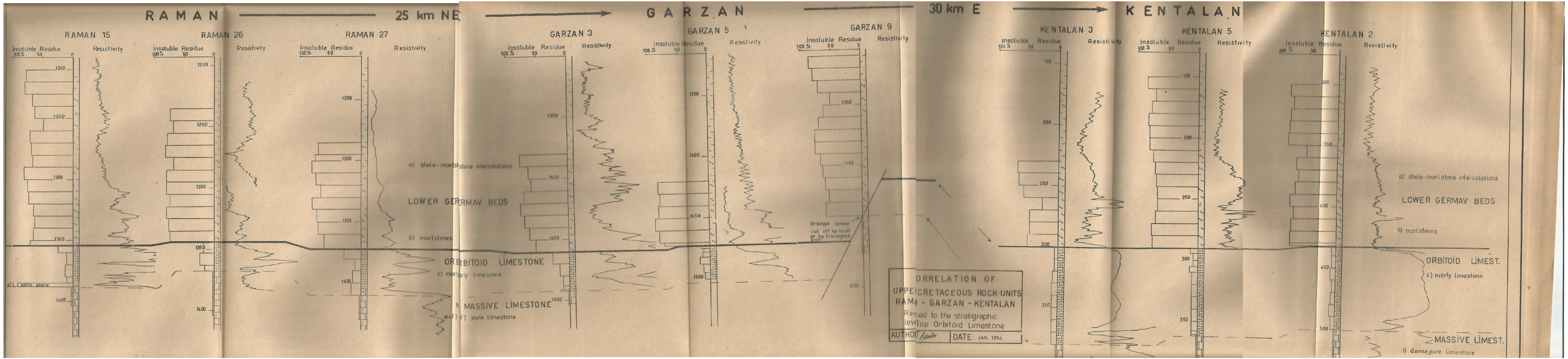
9 — Owing to tectonic movements previous to the transgression of the «orbitoid Sea» the porous, pure limestone (e) of Garzan may be not eroded locally in the crest area. Furthermore, it may be encountered in wells further down the flanks.

10 — Considerations for further exploration:

The possibility of a productive marly limestone (c) above the-Massive Limestone (e + f) should be investigated in the structures NE of Raman.



Correlation of the upper cretaceous rock units of the Raman-, Garzan-, and Kentalan structures



RAMAN
25 km NE
GARZAN
30 km E
KENTALAN
RAMAN 15
RAMAN 26
RAMAN 27
GARZAN 3
GARZAN 5
GARZAN 9
KENTALAN 3
KENTALAN 5
KENTALAN 2
Insoluble Residue
Resistivity
a) shale-marlstone intercalations
LOWER GERMAV BEDS
b) marlstones
ORBITOID LIMESTONE
c) marly limestone
d) black shale
MASSIVE LIMESTONE
f) pure limestone
Orbitoid limest. cut off by fault or by transgression
ORBITOID LIMEST.
MASSIVE LIMEST.
f) dense, pure limestone
ORRELATION OF
UPPE CRETACEOUS ROCK-UNITS
RAM - GARZAN - KENTALAN
Top Orbitoid Limestone
AUTHOR
DATE: JAN. 1954

Each well in Garzan and in other structures NE of Raman should penetrate the pure limestone section, at least for a depth of 20-60 m, depending, of course, upon the location of the water table.

Flank wells should be drilled in those structures, where the Upper, Porous Massive Limestone is found to be missing in the crest area.