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DELINEATION OF CHARGED DELTAIC ROCK GENETIC TYPES IN ALGYŐ-2 HYDROCARBON RESERVOIR, HUNGARY; BASED ON LOG CURVE SHAPES

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ABSTRACT

Most of the deltaic sandstone reservoirs exhibit complex lithofacies as well as petrophysical variations in both time and space. Facies analysis and reconstruction of facies patterns for the Algyő-2 reservoir rocks encountered in fourty five bore-holes have been elucidated, using the log curve shapes. Vertical profiles of the log response against the studied intervals were categorized for three superimposed, deltaic rock types in most bore-holes. Thereupon, the defined vertical units were mapped to show their geographical distribution. This will throw light on both the location of the palaeoshoreline and the deltaic phase relationships.

Also, the defined facies marker horizons reflect the orientation, geometry and palaeogeographic distribution of the Algyő-2 sandstone.

INTRODUCTION

The Algyő oil field lies at the south-eastern part of Hungary; about 10 kms north of town Szeged (Fig. 1). This field was discovered by the Hungarian oil and gas Trust (OKGT) in 1965.

This paper deals only with the study of the Upper Pannonian (Upper Pliocene) Algyő-2 reservoir, which is one among 21 superimposed potential sandstone reservoirs encountered within all the drilled wells in the studied field.

The Algyő-2 sandstone shows fundamental lithofacies changes. The sedimentary sequence is characterized by a general upward increase in the number of cycles and amount of intergranular clay and silt size particles. Sandstone microlenses of 20-30 cm length and 25-50 cm thickness are commonly present.

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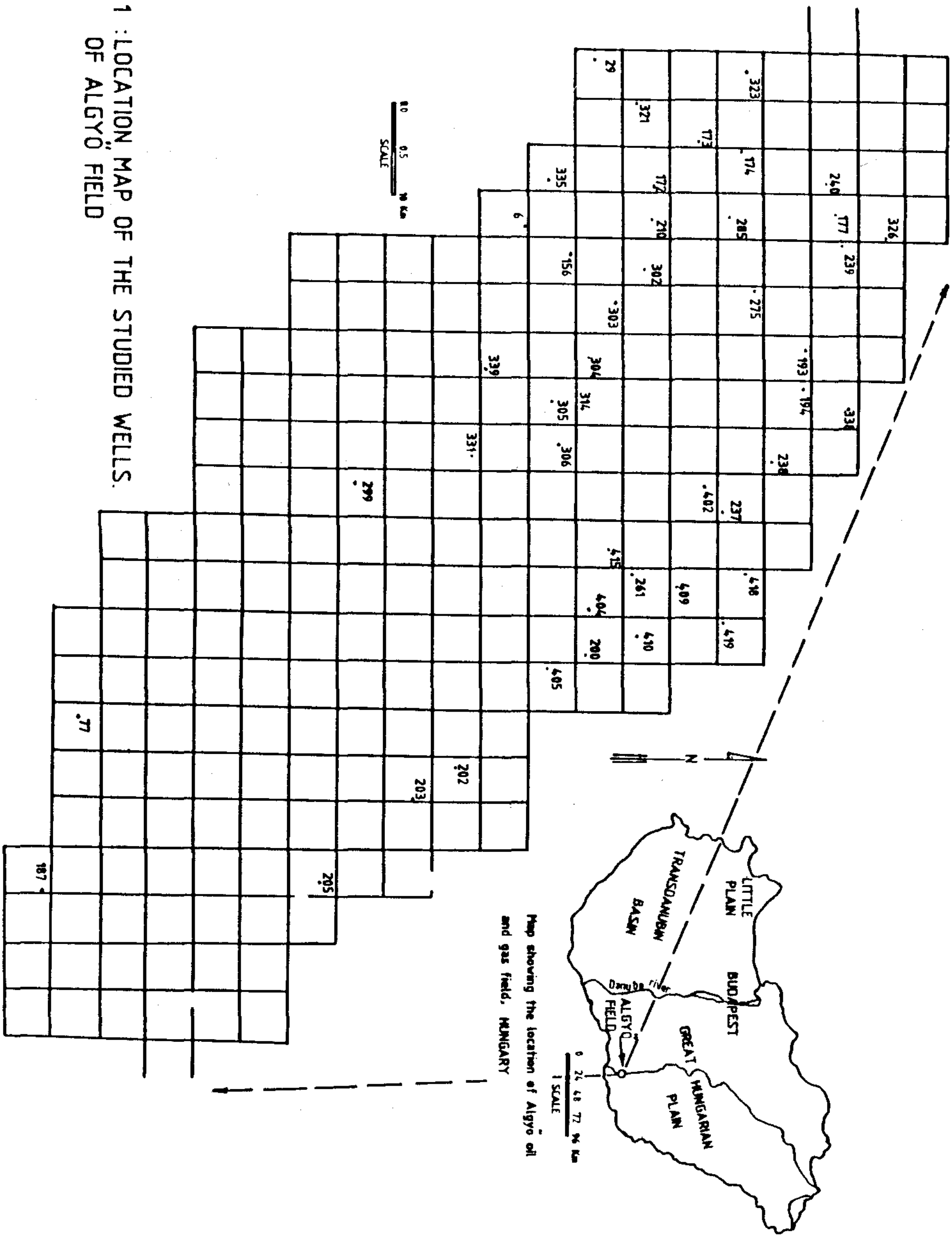


FIG 1 : LOCATION MAP OF THE STUDIED WELLS. OF ALGYÖ FIELD

The dark-brown coal as well as carbonaceous clay interclations are rather frequent. The environment of deposition of the Algyő-2 sandstone has already been differently outlined by different authors (e.g. Mucsi, 1973; Musci and Révész, 1975, Magyar and Révész, 1976 and El-Sayed, 1981). They used the interpretation of the depositional sedimentary facies (lithology, sedimentary structures, palaeocurrents, and fossils) in combination with the grain size parameters. This has led to the conclusion that the Algyő-2 sandstone is a shallow-lacustrine deposit (Mucsi and Révész, 1975). While El-Sayed, (1981) concluded that the most likely depositional environment is a fluvially dominated delta.

For each bore-hole, a direct calibration between log motifs and vertical profile of a median grain size must be made to check rock type up on log response. The response of several wire line logs (spontaneous potential, gamma and resistivity) is very helpful in reservoir zonation and deltaic rock genetic type identification (Le Blance, 1977).

If the log motifs are harmonically concord with the rock type, then the log curve shapes can be directly related to the rock genetic types, its associated textures and primary structures. The reservoir rock interval is commonly subdivided both vertically and horizontally into pay zones that are either completely or partially separated by impermeable rocks. The palaeogeographic distribution of reservoir rock genetic types in combination with their vertical separation and identification of various separate units are important in reservoir description as well as in planning optimum hydrocarbon recovery operations and predicting reservoir performance more economically.

In the present work, both spontaneous potential and the short-normal resistivity curves opposite the various intervals of the Algyő-2 sandstone encountered in fourty five bore-holes have been used for recognizing different reservoir rock genetic types in both vertical profiles and areal distributions.

METHODS AND TECHNIQUES

Interpretation of sand bodies and their environment of deposition, using both vertical grain size profiles and the response of several geophysical logs, have already been discussed by a number of investigators (Galloway, 1968; Fisher, 1969; Pirson, 1981; and Selley, 1982) and widely applied in oil industry (Sneider and others, 1977; Berg, 1979; and El-Sayed, 1981). Different deltaic rock types have been recognized by observing the physical criteria by which these may be distinguished on spontaneous potential and resistivity curves. Several recognizable patterns of spontaneous potential curve shapes for charged sandstone reservoirs have been categorized by both Gilreath and Stephens (1975); and Swanson (1980).

The vertical profiles of the Algyő-2 reservoir log curves (in fourty five drilled wells) have been investigated, categorized and mapped in both time and space (with respect to well locations) and two stratigraphic cross-sections have been constructed in order to meet the objectives of the present study.

RESULTS AND DISCUSSIONS

A comparison of the log curve shapes with the lithologic succession in the studied intervals shows that the rock types can be interpreted from a combination of the median grain size with both the spontaneous potential and the resistivity curves. Typical relationships between rock types and log curve shapes are shown in Fig. 2. The permeable beds exhibit moderate to well developed spontaneous potential curve. While, the non-permeable zones show characteristically hashy separation on the microlog curve. In addition, the fine grained sediments exhibit low resistivity, while the increasing in grain size is accompanied by a gradual increasing in resistivity.

The log curve shapes of the studied rock sequences were investigated and categorized according to their depositional energy (Table 1). These were found to be characteristically distinguishable by both their grain size and spontaneous potential versus depth curves in which, different genetic sand bodies could be depicted (Table 1). Some of these sand bodies were missed or repeated in some of the studied wells, but regional correlation could be easily established.

In the studied wells, the rock sequence was found to be rather heterogeneous, i.e. the sand bodies of more than one genetic type are found in a cyclical regime. The prevalent superimposed genetic sand units depicted are channel, river mouth bar, deltaic front, and barrier bar (Table 2).

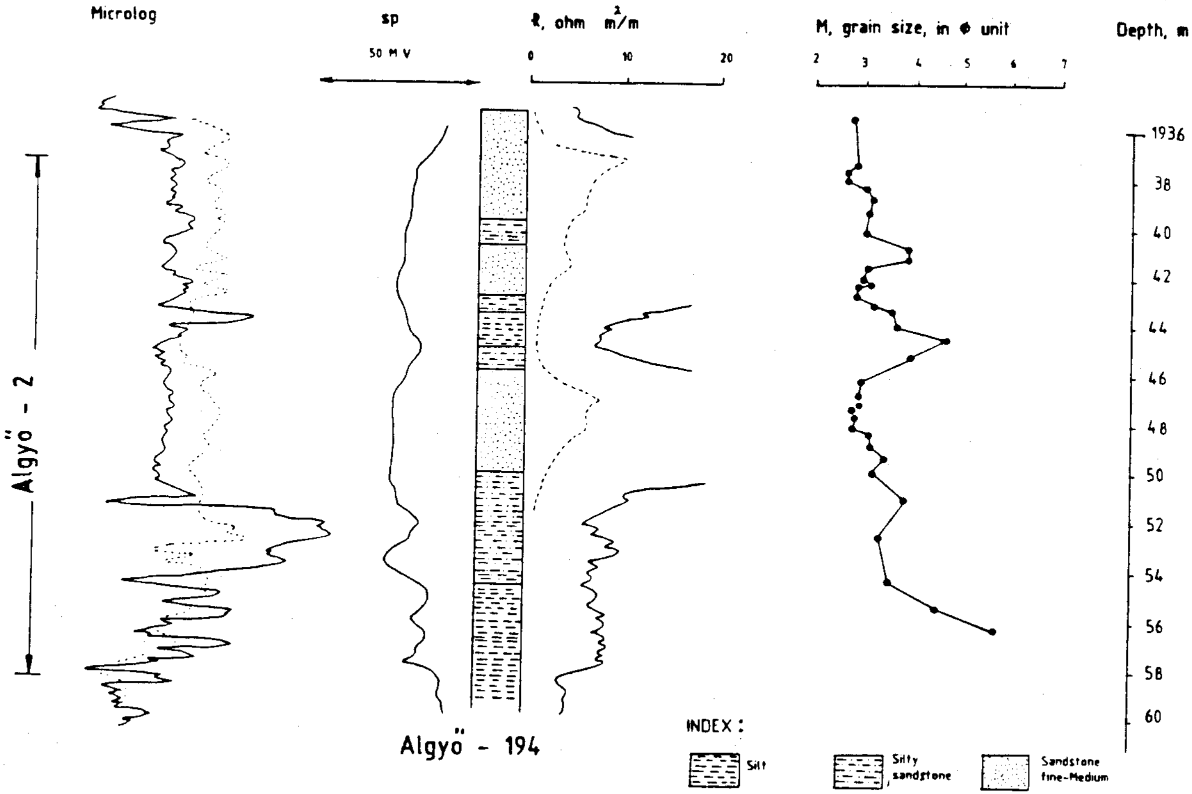


FIG. 2 LOG RESPONSE OF THE PENETRATED ROCK SEQUENCE.

Table 1 : Log curve shapes of the encountered Algyő-2 rock sequence.

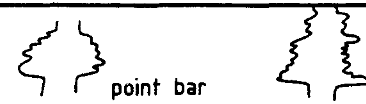
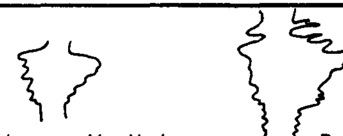
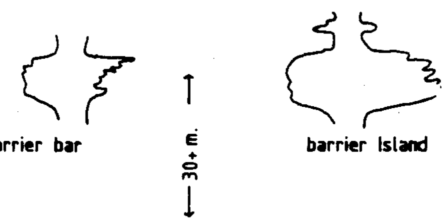
	ENVIRONMENTS			LOG CURVE SHAPE	Ref.
TRANSATIONAL ENVIRONMENT ← increasing water depth	DELTAIC	UPPER DELTAIC PLAIN	Channels and point bars		well-205 well-261
		LOWER DELTAIC PLAIN	Distributary Channels		well-194
		DELTAIC FRINGE	River- Mouth bars and Delta front		well-321 well-418
	COASTAL INTERDELTAIC	COASTAL PLAIN	Barrier Island and Barrier bars		well-405

Table 2
Delta Rock Genetic Types Depicted in the Studied Wells

Well No.	Algyő – 2 Rock Genetic types		
	Upper	**Middle**	**Lower**
240	shore–face	stream–mouth bar	stream–mouth bar
302	barrier bar	stream–mouth bar	stream–mouth bar
321	stream–mouth bar	stream–mouth bar	stream–mouth bar
285	channel sands	sand bar type	shore–face
331	braided stream	shore–face	point bar
299	distributary channel	barrier bar	point bar
174	braided stream	braided stream	braided stream
177	multistory point bar	stream mouth bar	shore–face
419	lagoonal	stream–mouth bar	shore–face
6	distributary channel	sand bar type	shore–face
418	barrier bar	stream–mouth bar	shore–face
275	multistory channel	channel fill	bay lagoon
326	multistory point bar	stream–mouth bar	shore–face
410	stream–mouth bar	stream–mouth bar	shore–face
329	braided stream	braided stream	braided stream
77	turbidite	turbidite	turbidite

continue

Table : 2 cont.

Well No.	Algyő – 2 Rock Genetic types		
	Upper	**Middle**	**Lower**
187	distributary channel	distributary channel	distributary channel
203	turbidite	turbidite	shore–face
205	channel fill	channel fill	channel fill
193	braided stream	braided stream	braided stream
194	distributary channel	distributary channel	distributary channel
172	channel fill	channel fill	channel fill
200	stream–mouth bar	stream–mouth bar	stream–mouth bar
173	distributary channel	distributary channel	delta front
303	barrier bar	lagoonal	lagoonal
210	distributary channel	sand bar type	shore–face
304	barrier island	barrier bar	stream–mouth bar
202	aluvial fan	aluvial fan	shore–face
306	stream–mouth bar	distributary channel	distributary channel
261	point bar	stream–mouth bar	shore–face
314	stream–mouth bar	point bar	delta front
323	stream–mouth bar	stream–mouth bar	stream–mouth bar
338	distributary channel	distributary channel	distributary channel
402	barrier bar	stream–mouth bar	stream–mouth bar

continue

Table : 2 cont.

Well No.	Algyő – 2 Rock Genetic types		
	Upper	**Middle**	**Lower**
404	barrier bar	sand bar type	shore face
405	barrier bar	sand bar type	shore face
415	multistory channel	multistory channel	multistory channel
156	distributary channel	delta front	delta front
239	braided stream	braided stream	braided stream
237	braided stream	meander channel	meander channel
238	braided stream	meander channel	meander channel
335	barrier bar	transgressive marine	delta front
305	barrier bar	stream-mouth bar	stream-mouth bar
339	multistory channel	multistory channel	multistory channel
409	barrier bar	multistory bar type	shore face

An attempt was made to subdivide the hybrid genetic sand units in each bore-hole into three major periods of delta development. Thereupon, the obtained rock genetic types (Table 2) were mapped as older, middle, and younger Algyő-2 deltaic phase (Fig. 3). This map shows that the delta palaeoshoreline can be distinguished and that both the geometry and the distribution of the reservoir genetic sand units can be predicted in time as well as in space. The direction of the drawn arrows represents the probable directions of the movement of the palaeoshoreline with time and can indicate the most likely directions of the deltaic fluvial flow during the deposition of the recognized deltaic phases with varied flow rate. Both the regressive and the transgressive marine cycles were found to be generally different in direction during the time of deposition of the Algyő-2 sediments.

rate. Both regressive and transgressive marine cycles were found to be generally different in direction during the time of deposition of Algyo-2 sediments.

The beginning of both the older and the younger prograding delta phases can be attributed to a regressive palaeoshoreline (the serrated curve type) while the smooth log curve shape can be attributed to stable palaeoshorelines as presented in some wells (Nos. 6, 29, 202 & 299). A transgressive palaeoshoreline type (Table 3) is indicated in well - 77 but the middle delta phase seems to be the dominant one in the Algyő-2 prograding delta with marine regression and sediments introduced at points on the delta periphery (Fig. 3) of a water body, faster than it can be removed by coastal waves. This phase can be attributed to a regressive palaeoshoreline.

The stratigraphic cross-sections (Fig. 4) reveal that the Algyő-2 reservoir sand bodies are geometrically arranged in a lateral-stacking manner, while in some places, especially in the southern and south-eastern parts of the field, the vertical stacking type of reservoir geometry is predominant. Several genetic sand units have been identified (channel and barrier bar rock type) on the basis of the curve shape patterns. These display phenomena of sand pinching-out in which a favorable hydrocarbon entrapment situation could be developed. Fig. 4 shows, on one hand, a good reservoir continuity in both the north and north-western directions towards the delta upstreams and on the other hand, a bad reservoir continuity in both the south and south-western parts of the investigated area.

CONCLUSIONS

1. The Algyő-2 reservoir is rather heterogeneous in both time and space.
2. The Algyő-2 reservoir rocks are genetically subdivided into three superimposed deltaic phases, while they were mapped as their geographical distribution.
3. Both the Algyő-2 reservoir geometry and continuity were depicted.

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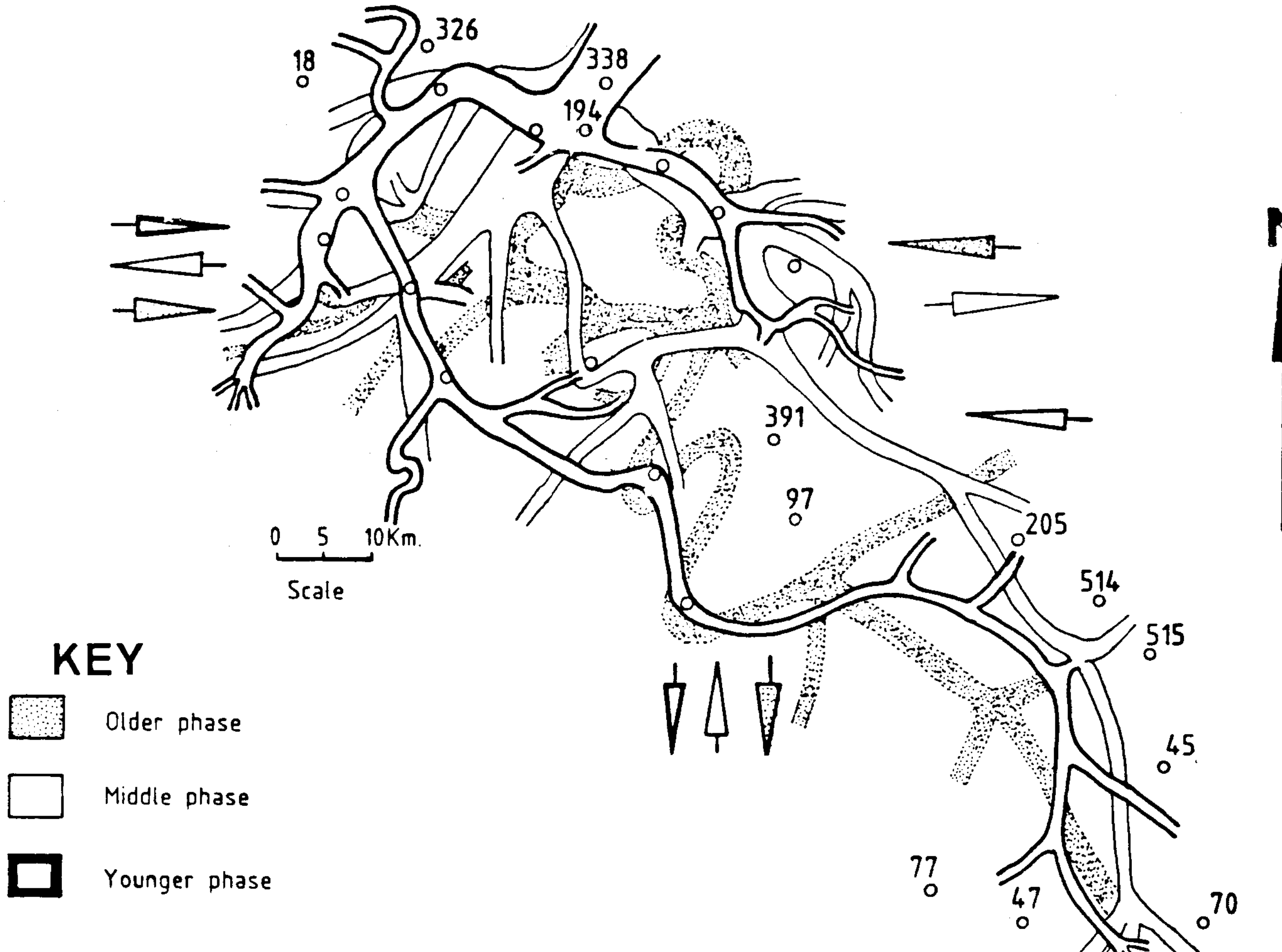
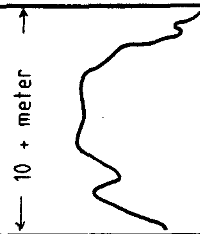
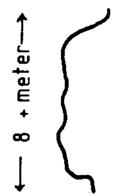
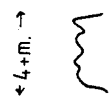
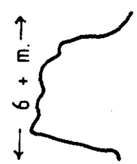
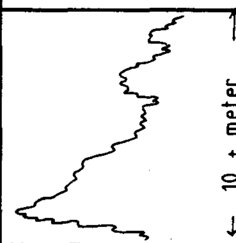


Fig.(3) Depositional Patterns of Algyő - 2 Sandstone

TABLE(3) LOG PATTERNS OF ALGYŐ-2 SANDSTONE FACIES.

PALAEO_SHORE LINE TYPE	LOG CURVE SHAPE		REFERENCE	PREDOMINANT IN :
	SMOOTH	SERRATED		
TRANSGRESSIVE			WELL No. 285 FOR SMOOTH WELL No. 314 FOR SERRATED	EARLY & YOUNGER DELTA PHASE
STABLE SHORE LINE			WELL No. 25 FOR SMOOTH WELL No. 193 FOR SERRATED	ALL DELTA PHASES
REGRESSIVE			WELL No. 314 FOR SMOOTH WELL No. 73 FOR SERRATED	MIDDLE DELTA PHASE

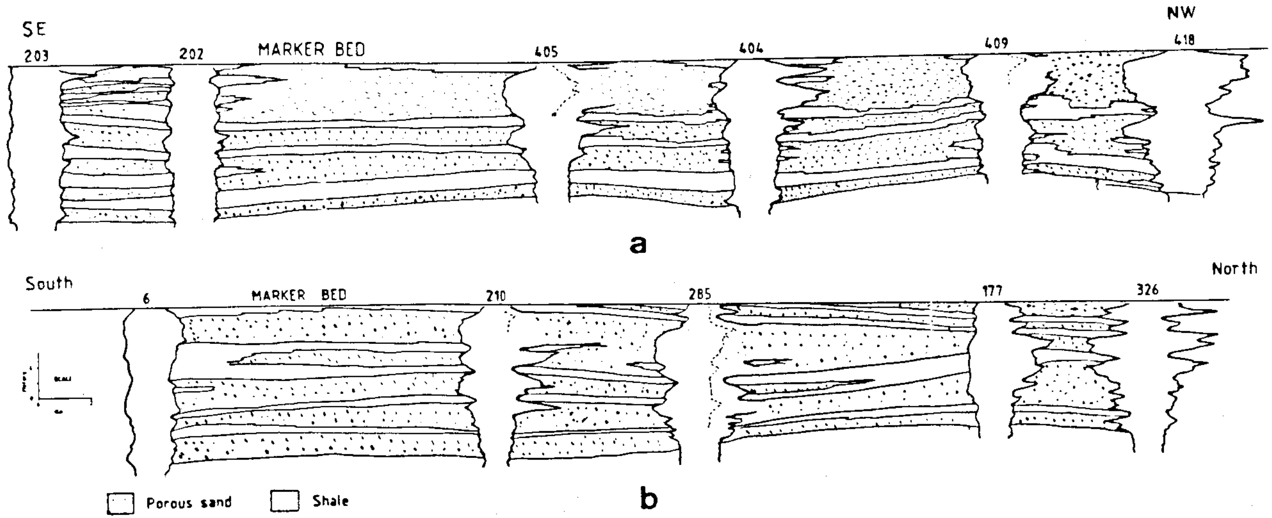


Fig.(4) Stratigraphic cross-sections (a&b) for Algyö-2 sandstone reservoir.

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تحديد الأنواع الأصلية لرواسب الدلتات الحاوية للهيدروكربونات باستخدام أشكال منحنيات التسجيلات خزان ألجو - ٢ - الجر

عبد المقتدر عبد العزيز السيد

تم التعرف على الأنواع الأصلية للرواسب الدلتائية في خزان ألجو - ٢ وذلك في ٤٥ بئراً محفوره بدراسة القطاع الرأسي لمنحنيات التسجيلات الكهربية والجهد الذاتي .

وقد قسمت الأنواع الأصلية للرواسب الدلتائية إلى ثلاثة أطوار رسمت على خرائط لتوضح توزيعها الجغرافي القديم وإمتدادات هذه الرواسب وكذا أشكالها الهندسية ، كما تلقي الضوء على أماكن خط الشاطئ القديم وعلاقته بالأطوار الدلتائية المذكورة .