Palynofacies Analysis and Hydrocarbon Generation Potential of Dokan and Gulneri Formations (Upper Cretaceous) from selected wells in Northern Iraqi Oil Fields

Dler H. Baban and Razawa H. Sarraj
College of Science - University of Sulaimani

Abstract

Sixty five cutting samples from Dokan and Gulneri Formations in three subsurface sections from Khabbaz, Jambour and Taq-Taq oil fields at Northern Iraq have been selected to be studied optically and analytically from Palynofacies points of view. Four palynofacies types have been determined depending on the ratio of the existed palynomorphs, phytoclasts, amorphous and opaque organic materials. The suggested paleoenvironment of deposition for Dokan and Gulneri Formations is seems to be deposited in proximal to distal shelf environment and that depending on the ratio of the palynomorphs, amorphous and phytoclasts to each other. The optical examination of the organic matter revealed the slightly mature to mature condition of the organic matter (TAI between 3 and +3). The GC analysis also supported such a maturity condition as the Pr/Ph ratio for the studied sections was greater than 1 while the Carbon Preference Index (CPI) less than 1. TOC values of different depths have been determined and types of amorphous organic matter from their ability to hydrocarbon potential also pointed out optically. By connecting between maturity stage, quality and quantity of the organic matters in the Formations of Dokan and Gulneri in the studied sections a number of oil and condensate-wet gas zones have been detected at certain depths of each section.

Introduction

The Dokan Formation was formerly included in the Kometan Formation (Jassim & Buday, 2006). It was first described by Lancaster Jones in 1957 (Bellen et al., 1959). The type locality is on the site of Dokan Dam in the High Folded Zone NNW of Sulaimaniya NE Iraq. It is composed of four meters light grey or white; white- weathering oligostigenal limestones, locally rubbly, with glauconitic coatings of constituents pebble-like masses, locally worm- riddled. However in the subsurface sections, the color of the limestone is mostly dark grey, shaley or marly. The formation thickens to the SW reaching 150m in the Chamchamal wells (Buday,1980).Further west it is (5–30m) thick in Kirkuk, Bai Hassan, Demir Dagh, Qara Chauq areas(Jassim & Buday,2006) Gulneri Formation was first described by Lancaster Jones in 1957from the site of Dokan Dam in the high folded zone, where it consists of about 2m of black, bituminous, finely laminated, calcareous, shale with some glauconite and cellophane in the lower part (Bellen et al., 1959). The high bitumen content and dwarfed fossils indicate the formation was deposited in a euxinic environment(Jassim&Buday,2006).

The age of the formation is Early Turonian as recorded by Bellen et al. (1959). The formation is separated by unconformities with both the underlying Dokan and the overlying Kometan Formations (Buday, 1980).

The Study Area

The study area composed of(3)wells within the three oil fields of Khabaz, Jambour and Taq –Taq. The location of the studied sections is shown in Fig.(1)and the U.T.M coordinates of the three sections are as follows:

Kz-1Well	3927 036.751 N	424 513.579 E
Ja-50 Well	3892 577.230 N	456 399.080 E
Tq-1 Well	3984 150.400 N	456 583.300 E

Sample Collection and Methodology

A sum of (65) cutting samples of Dokan and Gulneri Formations have been selected from the wells of Khabaz-12 (Kz-12), Jambour-50 (Ja-50) and Taq-Taq-1 (Tq-1). The interval of the selected samples ranged from 23 cm to 6 m depending on the thickness of the formations and the availability of the samples. The selected rock samples have been treated following the common procedure of preparing palynological slides using HF and HCl acids. Generally, all the selected samples considered to be poor (less than 25%) in their richness of palynomorphs.

Fig. (1): Location map of the studied sections.

Previous Studies

No previous detail palynological studies have been carried out until now on Dokan or Gulneri Formations in Iraq. Most of the studies are within the internal reports of Northern Oil Company which generally deal with either lithological description or reservoir characteristics of these two formations in the wells that penetrated them.

Classification of Sedimentary Organic Matter

There are many classifications of Sedimentary Organic matter (Staplin, 1969, Bujack et al., 1977, Combaz, 1980, Masran & Pocock, 1981, Whitaker, 1984, Hart, 1986--------- etc). Pittet and Gorin (1997), in their study about distribution of sedimentary organic matter in a mixed carbonate – siliciclastic platform environment of Oxfordian in Swiss Jura Mountains, and in order to make palynofacies a cost-effective routine tool in paleoenvironmental and sequence stratigraphic investigations; proposed a sufficiently simple classification for observations in transmitted light microscopy. The classification took into account some important variables, mainly the biological origin of constituents, their preservation state and any significant variation in size, morphology or density likely to affect the hydrodynamic behavior of particles. The classification proposed by Pittet and Gorin (1997) was actually adapted from that of Whitaker (1984) and was modified with simplification from Steffen and Gorin (1993a, b) to retain eight constituent categories. In this study, the classification of Pittet and Gorin (1997) is suggested to be used (as it is simple and practicable) in distinguishing between the different constituents of the sedimentary organic matter, although their classification did not include Amorphous Organic Matter as a separate category because their worked samples were poor of it.

Palynofacies

The concept of palynofacies was first introduced by Combaz, 1964 (Tyson, 1995). His definition may be paraphrased as the palynological study of the total assemblage of particulate organic matter contained in sediment, following removal of the sediment matrix by (HCL & HF). Palynofacies analysis involves the integrated study of all aspects of the organic matter assemblages: identification of the individual particulate components, assessment of their absolute and relative proportions, their size and preservation states. Powell et al. (1990), in Tyson (1995), define palynofacies as distinctive assemblages of HCL & HF insoluble particulate organic matter (Palynoclasts) where composition reflects a particular sedimentary environment. Tyson (1995) defined palynofacies as a body of sediment containing a distinctive assemblage of palynological organic matter thought to reflect a specific set of environmental conditions, or to be associated with a characteristic range of hydrocarbon- generating potential. Tyson's definition of Palynofacies analysis is the palynological study of depositional environments and hydrocarbon- source rock potential based upon the total assemblage of particulate organic matter. In this study (4) types of palynofacies have been identified depending on the estimated ratio of the existed organic matter components as been mentioned by Pitted and Gorin (1997) (Figs.2-4). The detail of each Palynofacies components is as follows:-

1. Palynofacies 1 (P.F.1)

This palynofacies observed in Dokan Formation at depths from 2912 to 2933 m in Kz-12 well, from 2542 to 2555 m and 2570 to 2587 m in Ja-50well, and from 1954 to1957m in Tq-1 well. This palynofacies is characterized by presence of equidimensional phytoclast (about 3-32%), blady phytoclast (about 1-9%), amorphous organic matter (about 60-93%) and palynomorphs (about 1-10%, dominance of fungal spores, spores and pollen, and foraminiferal test lining). The lithology is mainly composed of grey Limestone and a less amount of Shale.

2. Palynofacies 2 (P.F.2)

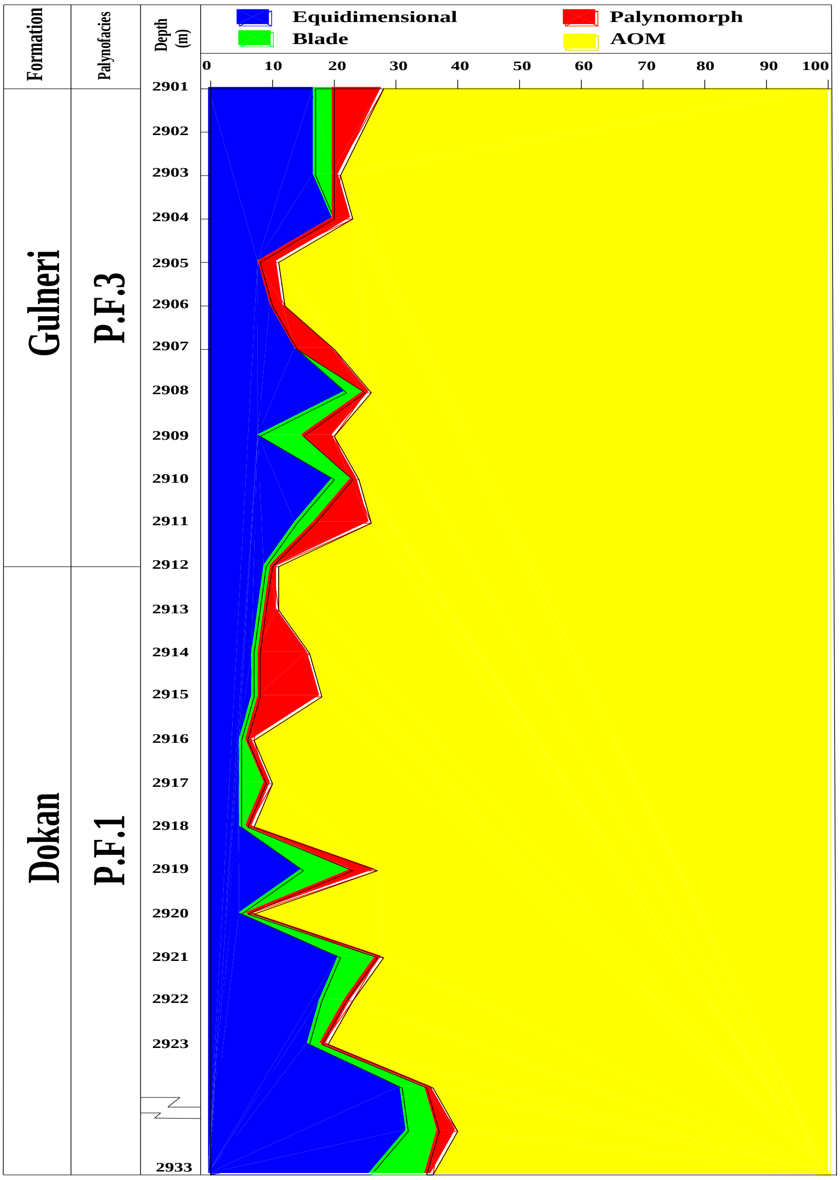
This palynofacies is observed at Ja–50 only at depths from 2525 to 2540m and from 2560 to 2565m. It is characterized by the presence of equidimensional phytoclast (about 13–26%), blady phytoclast (about 5–12%), amorphous organic matter (about 50-73%) and palynomorphs (about 4 – 15 %) which is composed mainly of fungal spores and dinoflagellates, spore and pollen. The lithology composed largely of limestone and shale.

3. Palynofacies 3 (P.F.3)

This palynofacies is observed at depths from 2901 to 2911m in Kz-12 well, from 2506 to 2519m in Ja-50 well, and from 1949 to 1953m inTq-1 well. This palynofacies is charecterized by the presence of equidimensional phytoclast (about 6-22%), blady phytoclast (about 0-9%), amorphous organic matter (about 65-89 %) and palynomorphs (about 1-13%, fungal spores and foraminiferal test lining with some spore and pollen). It is lithologically composed of Black Shale and less Limestone.

4. Palynofacies 4 (P.F.4)

This palynofacies is observed at Tq-1 well only at depths from 1946 to 1948 m .It is characterized by the presence of equidimensional phytoclast (about 22-26%), blady phytoclast (about 8-10%), amorphous organic matter (about56-62%) and palynomorphs (about 5-9%, composed of fungal spores, foraminiferal test lining, spore and pollen).This palynofacies is Lithologically, composed of grey limestone and shale. The correlation between the four different palynofacies in the studied sections is shown in the figure (5).



Figure(2): Percentages of the organic matter components in Kz-12 well

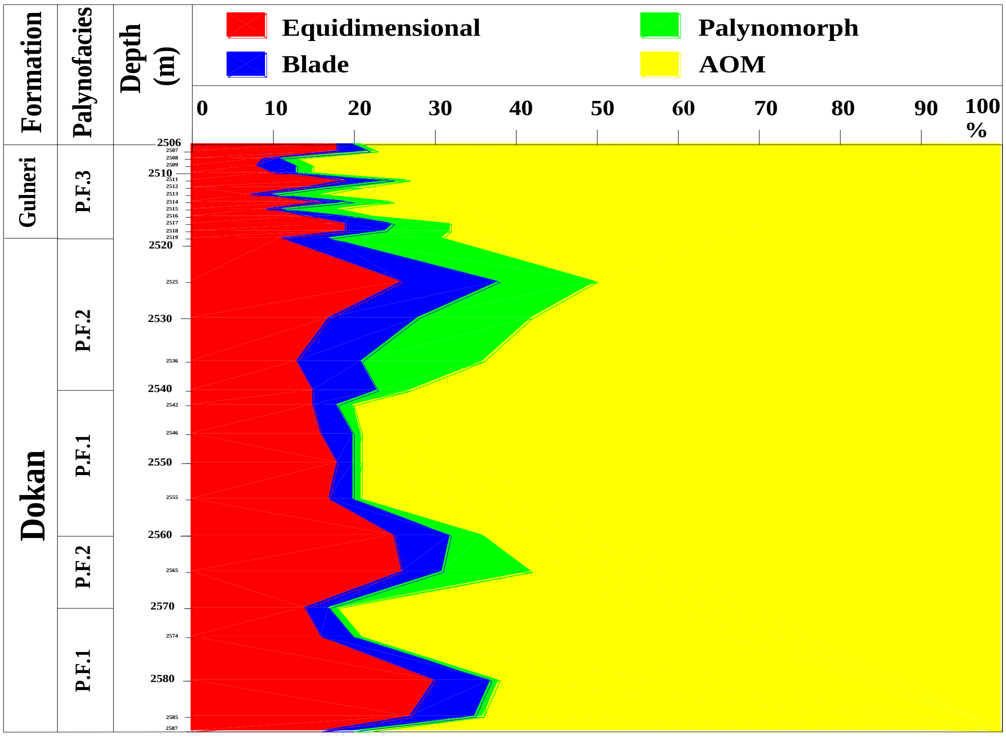


Fig.(3): Percentages of organic matter components in Ja-50

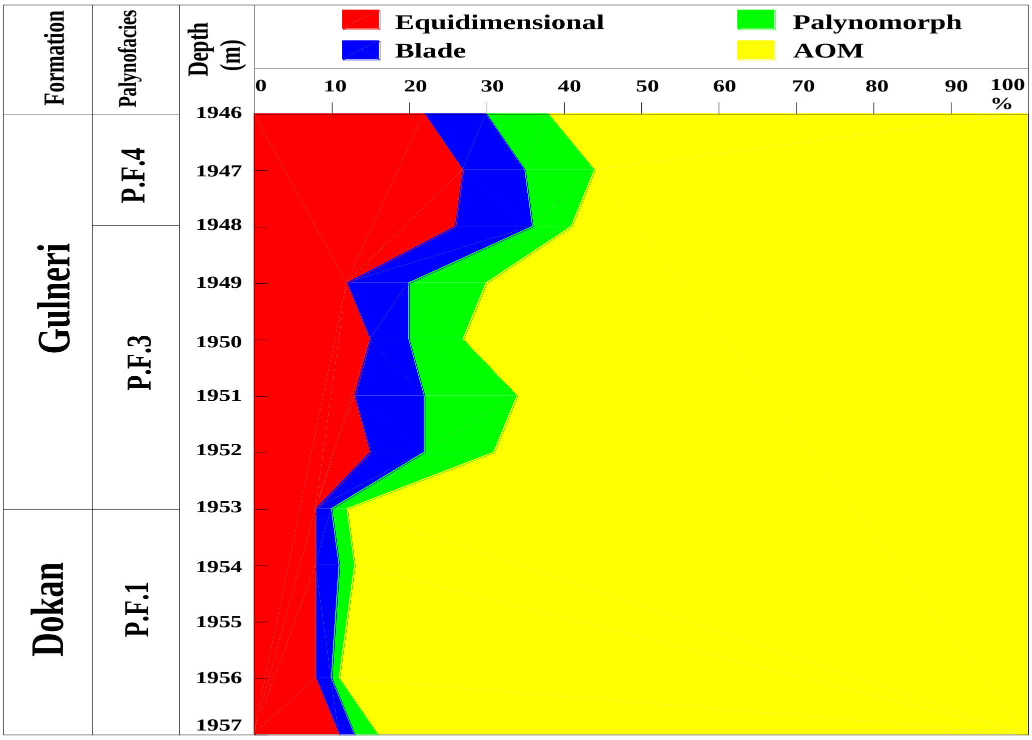


Fig.(4): Percentages of organic matter components in Tq-1

Table (1): The Percentage of the Organic Matter Components in Kz-12 Well (A) and Ja-50 well (B), and Tq-1 well (C).

(A)

Formation	Depth m.	Phytoclast %		Palynomorph %	AOM %
		Equi-dimensional	Blade		
Gulneri	2901	17	3	8	72
	2903	17	3	1	79
	2904	20	0	3	77
	2905	8	0	3	89
	2906	10	0	2	88
	2907	14	0	6	80
	2908	22	3	1	74
	2909	8	7	5	80
	2910	20	3	1	76
	2911	14	3	9	74
Dokan	2912	9	1	1	89
	2913	8	1	2	89
	2914	7	1	8	84
	2915	7	1	10	82
	2916	5	1	1	93
	2917	5	4	1	90
	2918	5	1	1	93
	2919	15	8	4	73
	2920	5	1	1	93
	2921	21	6	1	72
	2922	18	4	1	77
	2923	16	2	1	81
	2925	31	4	1	64
	2930	32	5	3	60
	2933	26	9	1	64

(B)

Formations	Depth m.	Phytoclast %		Palyno-morph %	AOM %
		Equi-dimensional	Blade		
Gulneri	2506	18	2	1	79
	2507	18	4	1	77
	2508	9	2	2	87
	2509	8	5	2	85
	2510	10	3	2	85
	2511	19	6	2	73
	2512	14	3	4	79
	2513	7	3	6	84
	2514	16	4	5	75
	2515	9	2	7	82
	2516	15	5	3	77
Dokan	2517	19	9	7	65
	2518	19	5	8	68
	2519	11	6	14	69
	2525	26	12	12	50
	2530	17	11	14	58
	2536	13	8	15	64
	2540	15	8	4	73
	2542	15	3	2	80
	2546	16	4	1	79
	2550	18	2	1	79
	2555	17	3	1	79
	2560	25	7	4	64
	2565	26	5	11	58
	2570	14	3	1	82
	2574	16	4	1	79
	2580	30	7	1	63
	2585	27	8	1	64
	2587	16	4	2	78

(C)

AOM %		62	56	59	70	73	66	70	88	87	89	84
Palyno-morph %		8	9	5	10	7	12	9	2	2	1	3
Phytoclast %	Blade	8	8	10	8	5	9	6	2	3	2	2
	Equi-dimensional	22	27	26	12	15	13	15	8	8	8	11
Depth m.		1946	1947	1948	1949	1950	1951	1952	1953	1954	1956	1957
Formation		Gulneri									Dokan	

Palynofacies and Paleoenvironmental Interpretation

Tyson,(1995)summarized a number of ternaries which are of much use in determining the paleoenvironment of deposition,depending on Palynofacies data; for example, Ternary of Microplankton- Spore- Pollen palynomorph plot by(Federova,1977;Traverse,1988 and Duringer& Doubinger, 1985) to indicate onshore-offshore depositional environments and transgressive-regressive trends.Pocock et al.(1988)used a structured phytoclast- biodegraded phytoclast - (yellow + grey AOM) plot to indicate the style degradation, with supposed transitions from structured to biodegraded in oxidizing environments, and from structured to amorphous in reducing environments. A ternary composed of Alginite+Amorphous,Herbaceous+Pollen+spores,and Woody- coaly is supposed by Shimazaki,(1986)in(Omura,2004) from which the fluvial, estuarine, prodeltaic, shelf,sub-marine fan and basin floor sediments can be identified and distinguished. Tyson,(1985,1989,and 1993) in Tyson,(1995) used an AOM-Phytoclast-Palynomorph (APP) plot to characterize kerogen assemblages.The plot can pick out the differences in relative proximity to terrestrial organic matter sources, kerogen transport paths and the redox status of the depositional subenvironments that control AOM preservation. Relatively high palynomorph percentages(>10%)and high phytoclast percentages(> 50%) are apparently characteristic of only some shallow shelf settings.

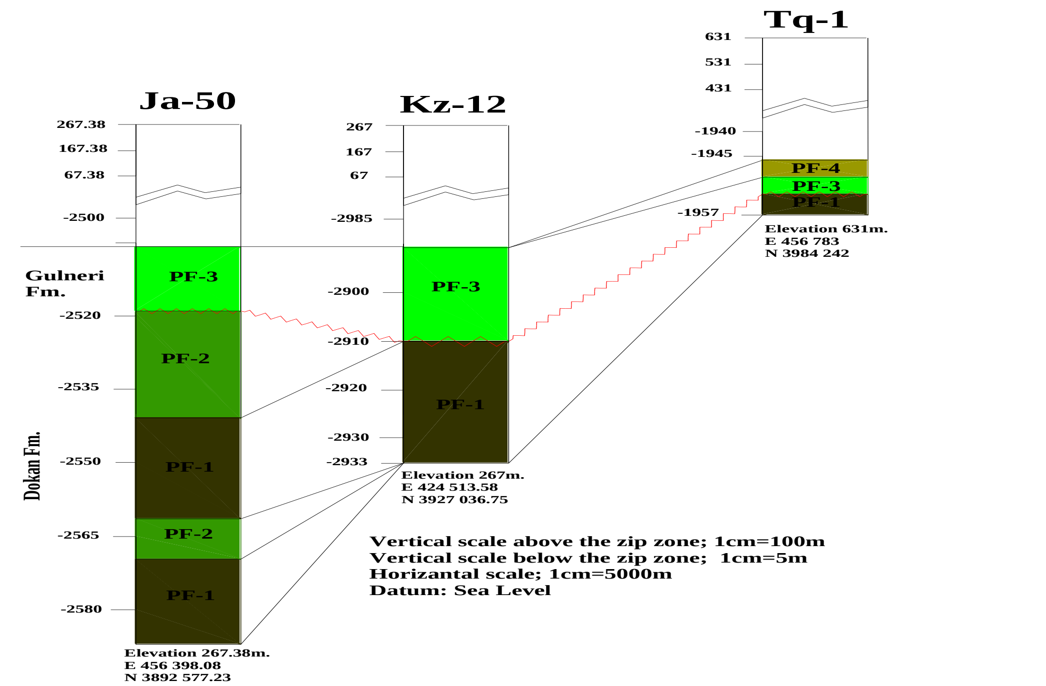
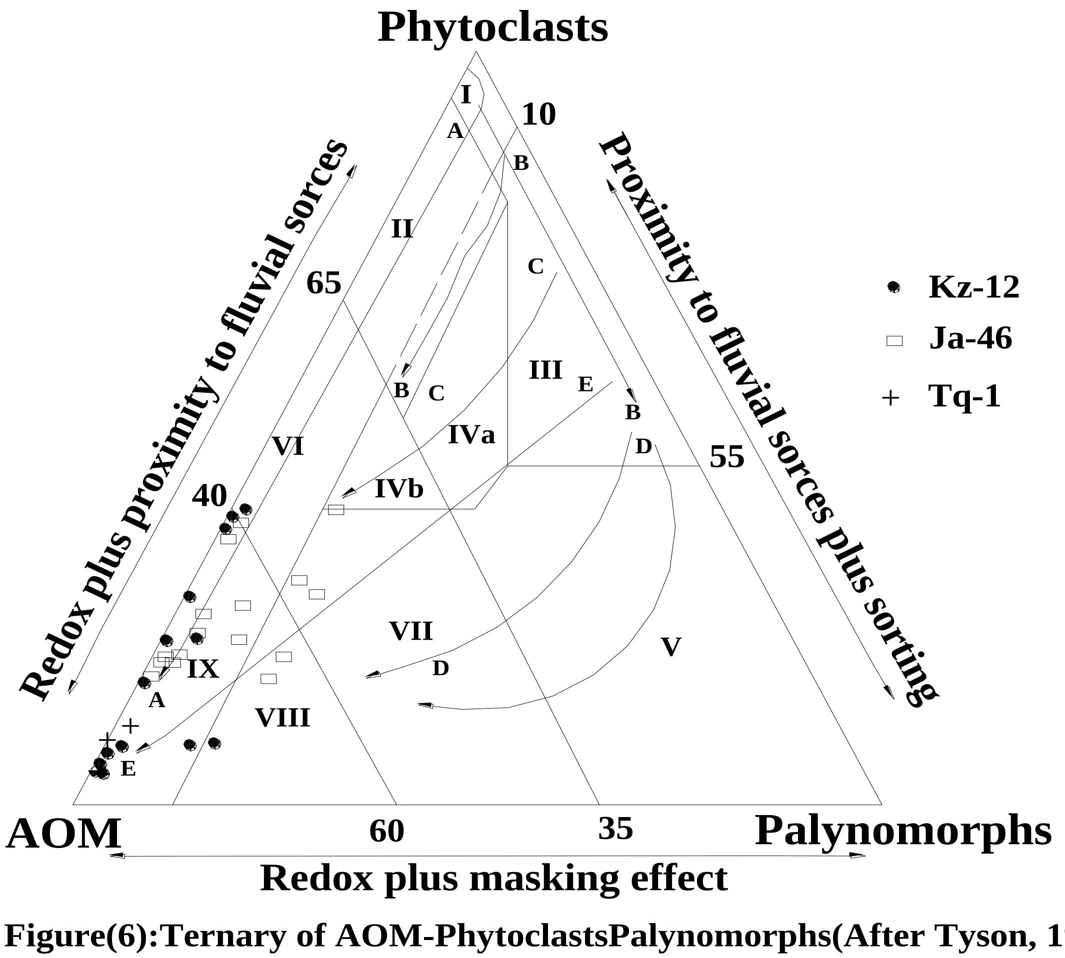
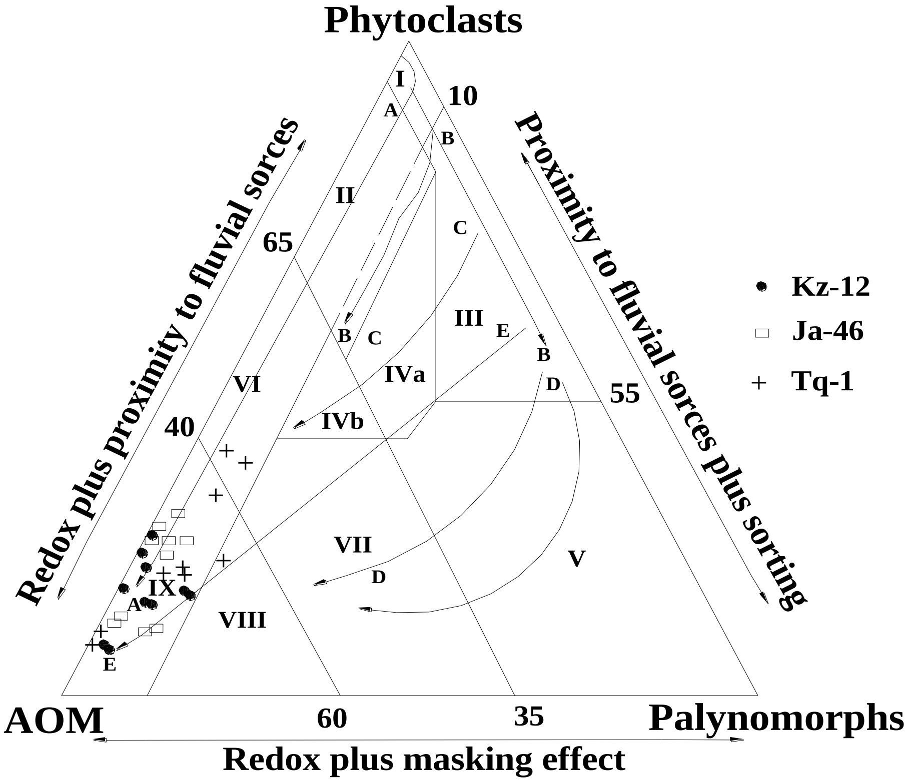


Fig.(5):Shows the correlation between the identified Palynofacies within the studies section

The estimated ratios of the sedimentary organic matter components for the two formations of Dokan and Gulneri in the studied sections plotted on the mentioned ternary of Tyson, (1995) separately, figures (6 and 7). From the resulted ternaries, it is clear that the paleodepositional environment of the two formations (P.F. 1&3) are mainly represented by distal suboxic-anoxic basin (IX field). According to Tyson's comments on this field,it is of AOM dominated assemblages, low abundance of palynomorphs partly due to masking. Frequently alginate-rich, deep basin or stratified shelf sea deposits, especially sediment starved basin. The field is also of low spore and prasinophyte content and of type I&II kerogen (II>I), and is highly oil prone. The recorded variations in the paleodepositional environment for Dokan Formation can be seen in Ja-50 (P.F.2). This Palynofacies is represented mainly by distal dysoxic-anoxic shelf (VII field) and partly by distal dysoxic- oxic shelf (VIII field).



Figure(6):Ternary of AOM-PhytoclastsPalynomorphs(After Tyson, 1995) for Dokan formation inKz-12, Ja-50, and Tq-1 sections.



Figure(7):Ternary of AOM-PhytoclastsPalynomorphs(After Tyson, 1995) for Gulneri formation inKz-12, Ja-50, and Tq-1 sections.

Tyson's descriptions for those two environments is that Distal dysoxic-anoxic shelf(VII)is of moderate to good AOM preservation, low to moderate palynomorphs, dark colored, slightly bioturbated mudstones are typical,of low spore and moderate to common dinocyst content and of type II kerogen, oil prone. While his description for Distal dysoxic-oxic shelf (VIII)is that it is of AOM-dominated assemblages, excellent AOM preservation, low to moderate palynomorphs(partly due to masking), typical of organic-rich shales deposited under stratified shelf sea conditions, of low spore and moderate to common dinocyst content and of type II >> I kerogen, oil prone.Relating to Gulneri Formation, it also shows a variation in its paleodepositional environment in the section of Tq-1, representing by P.F.4. This Palynofacies seems to be deposited in proximal suboxic - anoxic shelf(VI field).Tyson (1995)described this environment as it is of high AOM preservation due to reducing basin conditions. Absolute phytoclast content may be moderate to high due to turbiditic input and /or general proximity to source, variable, low to moderate spore content, low to common dynosist dominant, with a type II kerogen (oil prone).

Hydrocarbon Generation Potential

Six samples from Dokan & Gulneri formations (Two samples from each section) were analyzed by GC and the results are in Table (2).By projecting the measured Pr/ n-C17 and Ph/ n-C18 on special cross plot proposed by Shanmugam (1985)(Fig.8),it is clear that both formations of Dokan and Gulneri in the studied sections contain organic matter of a marine to mixed source (kerogen II). From the same plot and regarding the maturation states of the existed organic matters, it seems that they are within the moderately mature stage. The Pr/ Ph ratios are generally less than 1(generally 0.7) and a slight even Carbon Preference Index(CPI < 1)(generally 0.85), such a condition indicates a free algal / bacterial organic detritus in the kerogen of a marine source rock deposited under less reducing condition. Total Organic Carbon for the selected samples have been measured as an aid for estimating the quantity of the existed organic matters within the two formations. The average of TOC content for Dokan Formation in the studied sections are 1.06%, 0.46%, 1.645% for Kz-12, Ja-50, and Tq-1 sections respectively. While the average TOC content for Gulneri Formation was 1.45%, 1.525%, 0.7% for the same sections respectively.A quality evaluation also has been attempted optically for the organic matter content by distinguishing the different types of the Amorphous Organic Matters according to Thompson and Dembecki,1986's classification and their ability for generating hydrocarbons (oil and gas).The color change of the palynomorphs also followed optically by estimating the Thermal Alteration Index (TAI) according to Pearson, 1990, for determining the state of maturity of the organic matters. The examined organic matters optically all show a mature stage with a colors ranged between Yellow brown and Brown(TAI, 3 and +3)(Fig. 9). Actually the Dokan Formation showed much mature stage than Gulneri Formation. Such a common condition is a result of more depth of burial and older age.

Table(2): Gas Chromatography Analysis for selected samples from both Dokan & Gulneri Formations in the studied sections.

Sections	Formations	Depths (m)	Pr /n 17	Ph / n 18	CPI	Pr / Ph
Kz- 12	Dokan	2915	0.80	1.30	0.856	0.752
Kz- 12	Gulneri	2905	0.86	1.39	0.883	0.734
Ja- 50	Dokan	2570	0.81	1.45	0.903	0.767
Ja- 50	Gulneri	2515	0.92	1.22	0.842	0.703
Tq- 1	Dokan	1957	0.75	1.44	0.824	0.711
Tq- 1	Gulneri	1946	0.81	1.38	0.853	0.73

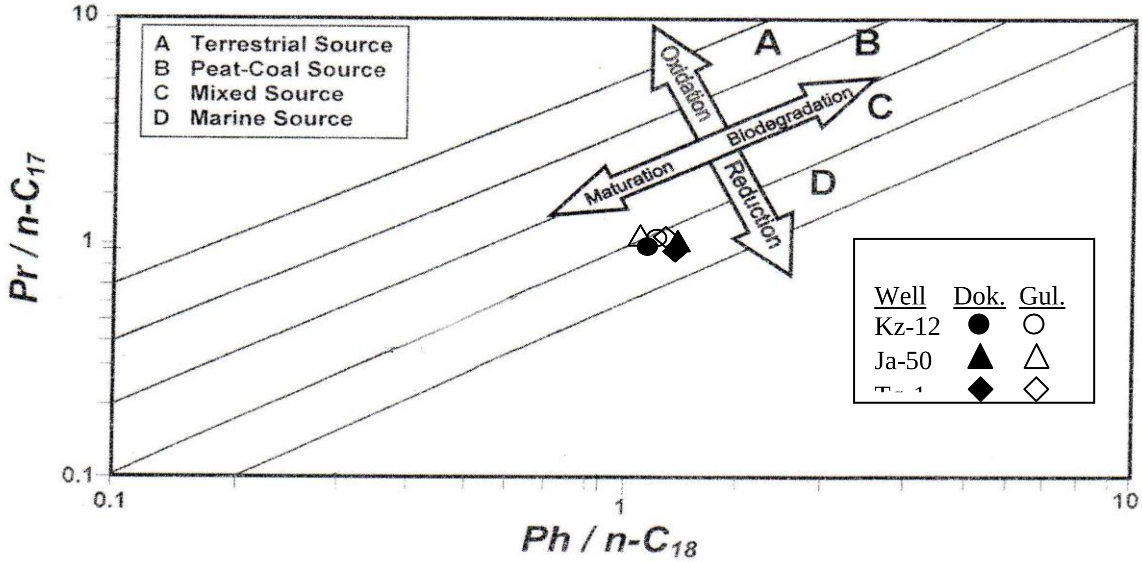
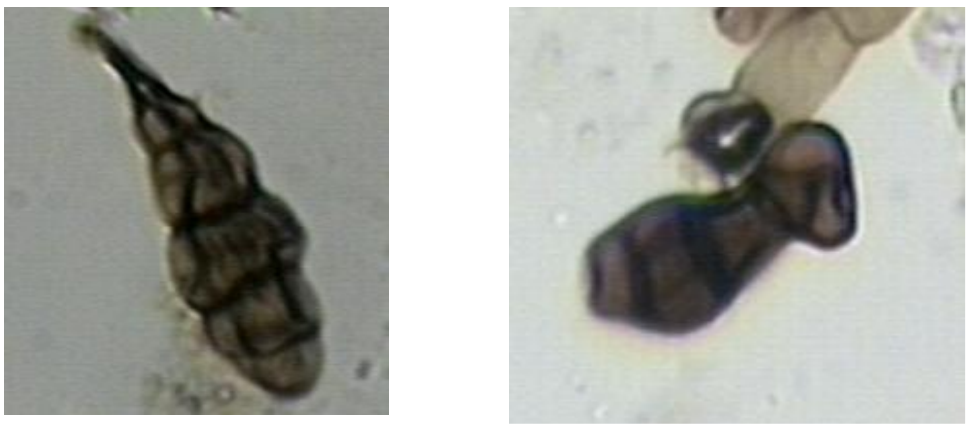


Figure (8): Relationship between Isoprenoids and n-alkanes showing Source and Depositional Environments for Dokan and Gulneri Formations in the studied sections. (The plot after Shanmugam, 1985)



A **B**

Figure 9: A) *Quilonia typicus* Jain & Gupta 1970, Sec. Kz-12; Depth: 2914m; Slide no.13; Dokan Fm. A Fungul spore shows a maturity stage of 3 TAI.

B) *Pluricellaesporites typicus* Van der Hammen 954, Sec.Kz-12; Depth: 2915m; Slide no.14; Dokan Fm. A Fungul spore shows a maturity stage of +3 TAI.

Conclusions

- Generally, Dokan and Gulneri can consider as rich formations from organic matter content point of view, and the amorphous organic matter comprises the greatest part among their components.
- Dokan and Gulneri Formations are generally poor in their palynomorph content, which consist mainly of Dinoflagellates, Fungi Spores, and Pollens in addition to Foraminiferal test linings.
- The preservation of the palynomorphs can consider as of a bad state due to degradation, and may be the fungi had a roll in that degradation.
- The components of the sedimentary organic matter within the two formations vary in their ratio along the studied sections representing different Palynofacies.
- The paleodepositinal environment of the Dokan Formation seems to be distal suboxic-anoxic shelf and partly distal dysoxic-oxic shelf as appeared from the results of the plotting the ratio of the main organic components (Palynomorphs, Phytoclasts, and AOM) on APP triangle of Tyson (1995). While the paleodepositional environment of Gulneri Formation detected to be distal suboxic-anoxic shelf and partly proximal suboxic – anoxic shelf depending on the same procedure.
- The kerogen within the two formations seems to be greatly of type II, oil prone.
- By connecting the quantity, quality and maturity parameters at each of the studied sections (Tables 3,4&5); the hydrocarbon generating potential of both Dokan and Gulneri Formations detected and concluded that Gulneri Formation in the present time has the ability of generating liquid oil in Tq-1 well, while it generates oil and gas in the wells of Kz-12 and Ja-50 because of the difference in the type of organic matter content. Relating to Dokan Formation; it concluded that the formation generates liquid oil in Tq-1 well and generates oil and gas in the wells of Kz-12 and Ja-50 (in Ja-50 only the lower part of the formation generates hydrocarbons because the upper part contains no sufficient quantity of organic matters).

Table (3): Hydrocarbon generation potential of DoKan &Gulneri formation in K_Z-12 well

Formation	Lithology	Palynofacies	Depth (m)	Philips Petroleum Company (Pearson, 1990) Color	TAI	Equivalent Ro	Paleo-temprature (C°) (Cradott& Lambert,1985)	Maturation	GC Pr/Ph	GC CPI	Type of AOM	TOC%	Hydrocarbon Generation Potential
			2901								D	1.16	
			2902										
			2903								D& B	1.14	
			2904									1.44	
			2905						0.734	0.883	A	1.85	
Gulneri		P.F.3	2906	Yellow-brown	3	0.98							
			2907									1.33	
			2908									1.68	
			2909									1.56	
			2910								A& B	1.56	
			2911									1.33	
			2912									0.30	
			2913										
			2914								D&C	0.30	
			2915						0.752	0.856	A& B	1.04	Oil and gas generation
			2916										
			2917				120-170	Mature			B	1.23	
			2918									1.29	
			2919								A& B	0.92	
			2920										
Dokan		P.F.1	2921	Brown	+3	1.16					A& D	0.98	
			2922								A& B	1.04	
			2923								B&A	1.23	
			2924										
			2925								D&A	1.65	
			2926										
			2927										
			2928										
			2929										
			2930								D& B		
			2931										
			2932										
			2933								D& B	1.75	

Table(4): Hydrocarbon generation potential of DoKan &Gulneri formation in Ja-50 well

Formation	Lithology	Palynofacies	Depth (m)	Philips Petroleum Company (Pearson, 1990) Color	TAI	Equivalent Ro %	Paleotemprature (C°) (Cradott & Lambert, 1985)	Maturation	GC Pr/Ph	CPI	Type of AOM	TOC %	Hydrocarbon Generation Potential
Gulneri		P.F.3	2506–2520	Yello-brown	3	0.98	120-170	Mature	0.703	0.842	B&A D&C A&B D&A B&A D&A A&B D&A A&B	1.23 1.53 1.69 1.61 1.38 1.69 1.46 1.61 0.65 0.76 0.17	Liquid oil generation
Dokan		P.F.2 (2520–2540) P.F.1 (2540–2560) P.F.2 (2560–2570) P.F.1 (2570–2590)	2520–2590	Brown	+3	1.16			0.767	0.903	D D&A D D B&A D&C B&A D&C D&C B&C B B&C B D&A D&A	0.08 0.08 0.08 0.17 0.62 0.53 0.35 0.88 0.26 0.88 0.44 0.62	Non

Table (5): Hydrocarbon generation potential of DoKan &Gulneri formation in Tɑ-1 well

Formation	Lithology	Palynofacies	Depth (m)	Philips Petroleum Company (D.L. Pearson, 1990) Color	TAI	Equivalent Ro	Maturity	Paleotemprature(C°) (Cradott& Lambert, 1985)	GC Pr/Ph	CPI	Type of AOM	TOC %	Hydrocarbon Generating Potential
Gulneri		P.F.4	1946	Yellowbrown	3	0.78	Mature	120-170	0.73	0.853	D	0.18	Liquid Petroleum Generation
			1947								D&C	1.24	
		P.F.3	1948								D&C	1.09	
			1949								D&C		
			1950								D&B	0.27	
			1951								D&A	0.54	
			1952								D&B	0.18	
		P.F.1	1953								D&A		
			1954								D&A	1.39	
			1955										
Dokan			1956	Brown	+3	0.98			0.711	0.824	D&A	1.73	
			1957								D&A	1.56	

References

- Bellen, R.C.,Dunninigton, H. V.,Wetzel, R. and Morton, D. M., (1959): Lexique stratigraphique international, Asie, Fasicule 10, Iraq, (Centre National de la Research scientifique, Paris), 333p.
- Buday, T.,(1980): the regional geology of Iraq. Vol. 1, Stratigraphy & Paleogeography, State Organization for Minerals, Baghdad, 445p.
- Bujack, J.P., Brass, M.S. and Williams, G.L., (1977): Offshore East Canada's organic type and color and hydrocarbon potential, parts I and II, Oil and Gas Journal, Vol.75, pp.198-202, pp.96-100.
- Hart, G. F., (1986): Origin and classification of organic matter in clastic systems, Palynology, Vol.10, pp. 1-23.
- Jassim, S.Z. & Buday, T.,(2006): Chapter 11(Late Tithonian-Early Turonian Megasequence AP8) in Jassim and Goff (edts.), Geology of Iraq, Dolin, Pregue and Moravian Museum, Brno, 341p.
- Omura, A. & Koichi, H., (2004): Relationships between compositions of Organic Matter, Depositional environments, and Sea – level changes in Backarc Basins, Central Japan.Journal of Sedimentary Research, Vol.74, pp.620-630.
- Masran, T.C. & Pocock, S.A.J., (1981): The classification of plant-derived particulate organic matter in sedimentary rocks, in Brooks (edt.), Organic Maturation Studies and Fossil Fuel Exploration Academic Press, London, pp.145- 176.
- Pearson, D.L.,(1990): Pollen/ Spore color 'standard'(vre.2): bartelsville (Phillips Petroleum Co., Geology Branch).
- Pittet, B. & Gorin, G. E.,(1997): Distribution of Sedimentary Organic matter in a mixed carbonate-siliciclastic platform environment: Oxfordian of the Swiss Jura Mountains. Sedimentology, Vol. 44, pp. 915-937.
- Pocock, S. A.J., Vasanthy, G. And Venkatachala, B. S., (1986): Introduction to the study of Particulate Organic Materials and Ecological Prospective, Journal of Palynology,Vol.23-24, pp.167-188.
- Shanmugam, G.,(1985): Significance of coniferous rain forests and related oil, Gippsland Basin, Australia, AAPG Bull., Vol.69, pp.1241-1254.

- Staplin, F.L.,(1969): Sedimentary Organic Matter, Organic Metamorphism and oil and gas occurrence, Bull. Canad. Petrol. Geol., Vol.17, pp.47-66.
- Steffen, D. and Gorin, G. E.,(1993 a): Palynofacies of the Upper Tithonian- Berriasian deep- sea carbonates in the Vocantian Trough (SE France) Bull. Centres Rech. Explor.-Prod. Elf. Aquitaine, Vol. 17, pp.235-247.
- Steffen, D. and Gorin, G. E.,(1993 b): Sedimentology of organic matter in the Upper Tithonian- Berriasian deep- sea carbonates of southeast France: evidence of eustatic control, in Katz and Pratt (edts.) Source Rocks in a Sequence Stratigraphic Framework, AAPG, Vol.37, pp.49-65.
- Thompson, C. L. & Dembicki, H. Jr., (1986): Optical characteristics of Amorphous Kerogens and the Hydrocarbon- Generating Potential of Source Rocks. Int. J. of Coal Geology, Vol. 6, pp.229- 249.
- Tyson, R.V., (1995): Sedimentary organic Matter, Organic facies and Palynofacies, Chapman and Hall, 615p.
- Whitaker, M. F., (1984): The usage of Palynostratigraphy and Palynofacies in definition of Troll Field geology.

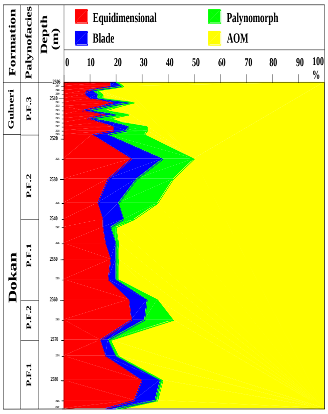


Figure:(3) Percentage of the organic matter components in Ja-50 well.

__2007__

تحليل السحنات البالينوا

وكلناري (الكريتاسي

دلير

الخلاصة

تم اختيار (٦٥) نموذجاً من تكويني دوكان وكلناري من ثلاثة مقاطع تحت سطحية في حقول خباز وجمبور وطق طق النفطية ليتم دراستها بصرياً وتحليلياً لغرض تحديد السحنات البالينولوجية فيها. فقد تم تمييز اربع سحنات البالينولوجية في التكوينين اعتماداً على مكوناتها من الاشكال الحياتية العضوية والقطع النباتية والمكونات العضوية عديمة الاشكال والمواد العضوية المعتمة. البيئة الترسيبية القديمة للتكوينين تراوحت بين الجزء القريب الى الجزء البعيد من الرف اعتماداً على النسب الموجودة من الاشكال الحياتية العضوية والمواد عديمة الاشكال والقطع النباتية. اظهرت الدراسة البصرية للمواد العضوية بأنها قليلة النضوج حرارياً أو ناضجة (معامل التبدل الحراري بين٣ و+٣) وقد تم دعم درجة النضوج هذه من خلال التحليل الكروموتوغرافي للغاز للنماذج حيث اظهرت نسبة البرستين/الفايتين قيماً اكبر من(١) بينما معامل التفاضل الكاربوني كان أقل من (١).احتسب قيم اجمال الكاربوني العضوي في النماذج قيد الدراسة اضافة الى تحديد نوعية المواد العضوية عديمة الاشكال من حيث قدرتها على توليد الهايدروكاربونات. بالاعتماد على ما تم تحديده من درجة النضوج الحراري ونوعية وكمية المواد العضوية للنماذج المدروسة من تكويني دوكان وكلناري امكن التنبؤ بوجود عدة انطقة لتوليد النفط والمكثفات – غاز رطب عند اعماق مختلفة من المقاطع التي تم دراستها.