THE EVALUATION OF THE PETROLEUM POTENTIAL IN DUMRE REGION (ALBANIA) BASED UPON DUMRE-7 WELL RESULTS

PRIFTI Irakli, SHKURTAJ Bilal, BOÇARI Arben, ÇAUSHI Alfred, YMERI Agim

Abstract. Dumre diapir is one of the largest in Albania. It meets Kuçova and Rasë-Pekisht oilfields in its west and south parts, with Messinian sandstones as reservoirs. In the diapir area, several wells have been drilled.These wells are mostly oriented on its periphery. The object of petroleum exploration has been the sedimentary section tectonically supported by the diapir body. Most of the wells stopped in the evaporate deposits. Dumre-7 well is the only one which passed beyond the diapir body at the depth of 6,101 m. Its end is in theLower Oligocene flysch. During the drilling, hydrocarbon gas shows occurred, with the gas stream going up to the top of the drilling tower. Similar performances appeared in other wells too.The geochemical study was conducted during and after the drilling process, on coaly shales and on hydrocarbon gas that emerged during the drilling of Dumre-7. The geochemical study is based on the following methods: Rock-evaluation studies of coaly shale in the evaporate deposits; the petrologic study of coaly shale; gas chromatography study of hydrocarbon gases; isotopic determination of carbon methane. The total organic carbon of coaly shale ranges up to 38.73%.The volume of hydrocarbons that formed during the thermal pyrolysis is lower than103.8 mg HC/ g rock. The type of organic matter is III-II (HI <319). Type III-II is confirmed by petrologic study, where gelinite macerals predominate. Based on vitrinite reflectivity (Ro<0.446%), Tmax (Tmax<427^{o}C) and the productivity index (PI<0,141), it was confirmed that the organic matter is immature. In Dumre-7 well, there predominate wet and dry hydrocarbon gases (C_1/C_2<100; C_1/C_{2+}<50). Based on carbon isotope ratio of methane (δ^{13}C-CH_4>-35.49‰) it was indicated that the hydrocarbon gases are more matured than the ones in the around oilfields. Hydrocarbon gas shows of evaporate formation do not represent gas trap, but "imprisoned" gases during the penetration of the diapir body. In this study, one cannot present well logs for three reasons: a. The diapir evaporate formation is chaotic; b. The logs are confidential; c. The region is in an international tender for petroleum exploration. Based on the geochemical indicators interpretation, relevant conclusions to oil exploration in the region have emerged.

Keywords: free hydrocarbon gas, thermal vacuum gas, evaporate formation, wetness ratio.

Rezumat. Evaluarea potențialului petrolier în regiunea Dumre (Albania) pe baza rezultatelor forajului Dumre-7. Diapirul Dumre este unul dintre cele mai mari din Albania. În partea sudică și vestică întâlnește câmpurile petroliere Kuçova și Rasë-Pekisht cu gresii de vârstă messiniană în bază. În zona diapirului au fost efectuate câteva foraje. Aceste foraje sunt în mare parte la periferia sa. Explorarea pentru rezervele de petrol a fost făcută mai ales în secțiunea sedimentară susținută tectonic de corpul diapirului. Mare parte a forajelor s-au oprit în depozitele de evaporite. Forajul Dumre-7 este singurul care a trecut de corpul diapirului și a atins adâncimea de 6.101 m. Acesta s-a oprit în flișul care datează din Oligocenul inferior. Pe parcursul forării au apărut scăpări de hidrocarburi gazoase. Astfel de cazuri s-au înregistrat și la alte foraje. Studiul geochimic a fost efectuat în timpul și după finalizarea procesului de forare, pe șisturile cărbunoase și hidrocarburile gazoase care au apărut în timpul forării la Dumre-7. Studiul geochimic se bazează pe următoarele metode: studii de evaluare a șisturilor cărbunoase din depozitele de evaporite; studiul petrologic al șisturilor cărbunoase; studiu prin cromatografie în fază gazoasă a hidrocarburilor gazoase; determinarea izotopică a metanului. Carbonul organic total din șisturile cărbunoase ajunge la 38.73%. Volumul hidrocarburilor format în timpul pirolizei termice este mai redus de 103.8 mg HC/ g rocă. Tipul de materie organică este III-II (HI <319). Tipul III-II este confirmat de studiul petrologic prin predominarea gelinitelor macerale. Pe baza vitrinitului de reflexie (Ro<0.446%), Tmax (Tmax<427^{o}C) și a indicelui de productivitate (PI<0,141) s-a stabilit că materia organică este imatură. În forajul Dumre-7 predomină hidrocarburile gazoase umede și uscate (C_1/C_2<100; C_1/C_{2+}<50). În funcție de raportul de izotopi de carbon ai metanului (δ^{13}C-CH_4>-35,49‰) s-a stabilit faptul că hidrocarburile gazoase sunt mai maturizate decât în jurul câmpurilor petroliere. Hidrocarburi gazoase din formațiunea evaporitelor nu reprezintă pungi de gaze, ci gazele „închise” în timpul penetrării corpului diapir. În acest studiu nu se pot prezenta bine jurnalele din trei motive: a. Formațiunea evaporitelor din diapir este haotică; b. Jurnalele sunt confidențile; c. Regiunea face obiectul unei licitații internaționale pentru explorarea rezervelor de petrol. Pe baza interpretării indicatorilor geochimici, s-a ajuns la o serie de concluzii cu privire la explorarea petrolului din regiune.

Cuvinte cheie: hidrocarburi gazoase libere, vacuum gazos termal, formațiunea evaporitelor, raportul de umiditate.

INTRODUCTION

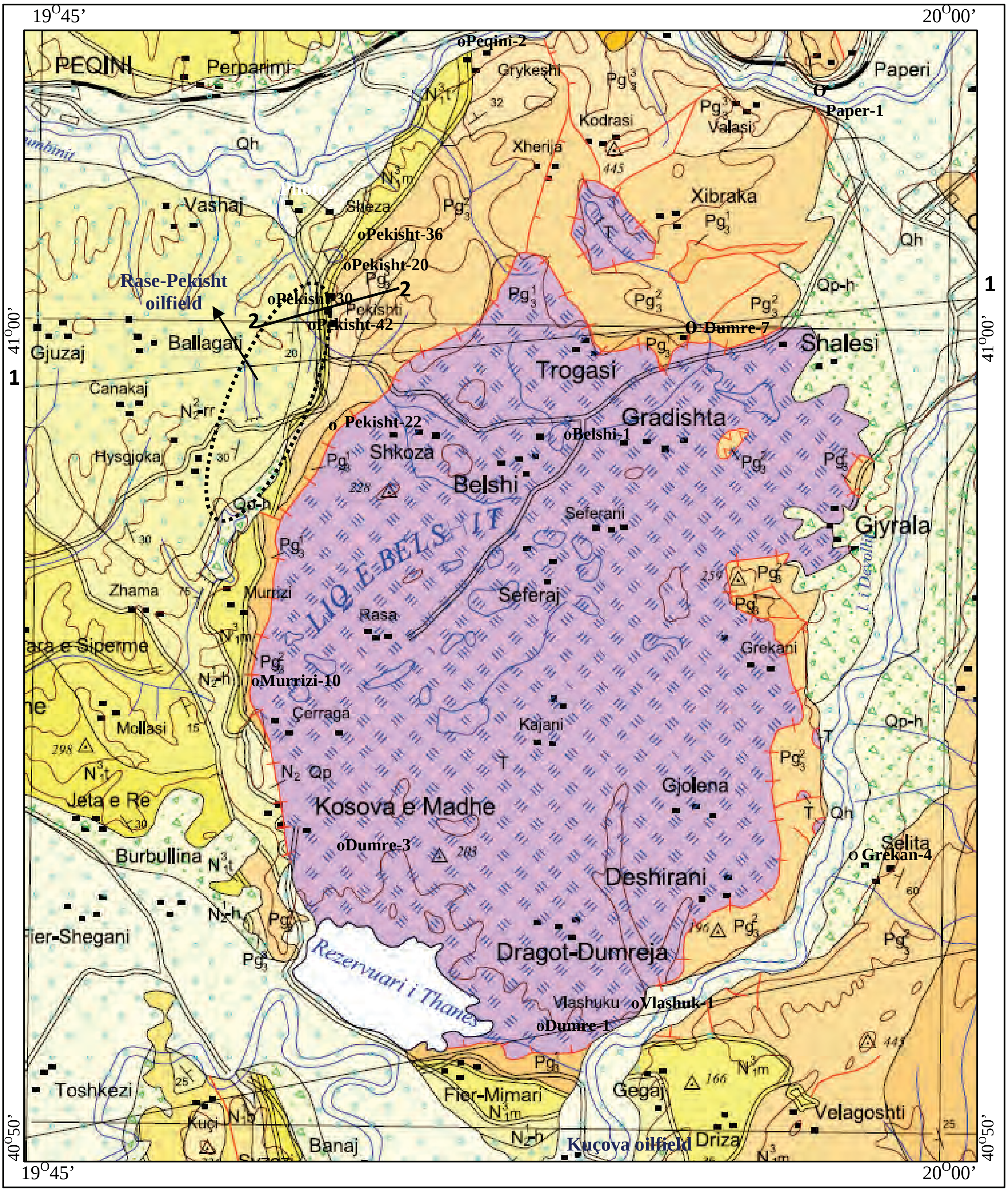
Dumre region (Fig. 1) presents a high interest for the exploration of hydrocarbons in Albania. This refers to the geological construction and results of Dumre-7 well.

The geochemical characteristics of the region were identified during the drilling of the well and then studied based on cuttings, as well as on the geochemical properties of crude oil of Rase-Pekisht and Kucova oilfields and relations with them. Hydrocarbon gases are not mainly generated by evaporate section, but in deeper sedimentary section.

The lower contact body diapir represents an anomaly only by C_2H_6/C_3H_8 ratio, while the other indicators do not reflect any anomaly. The Miocene tectonic block located west of the diapir and the anticline covered by evaporate formation are important in terms of oil exploration.

Dumre diapir is placed in the continuation of the northern part of the anticline belt of Berati subzone. The evaporate formation of Dumre is of an earlier age than the Upper Triassic or the Permian-Triassic periods (DIAMANTI et al.**,** 1998; Albanian Geological Survey, 2002).

GEOLOGICAL SETTING



Legend

Qp - Holocene

Qp-h - Pleistocene - Holocene

N_2^2-rr - Middle Pliocene (Rrogozhina formation)

N_2^1-h - Lower Pliocene (Helmesi formation)

N_1^3m - Messinian

N_1^3t

N_1^2s - Serravallian

N_1^2l - Langhian

Pg_3^3 - Upper Oligocene

Pg_3^2 - Middle Oligocene

Pg_3^1 - Lower Oligocene

- Geological boundary

- Unconformity boundary

-- Tectonical line

- Over thrust

- Tectonic block

Figure 1. Geological map of Dumre region (based on geological map of Albania, sc: 1/200 000).

The rising of the diapir occurred on the western part of Maraku anticline (northern anticline of Berati subzone), with greater intensity, expressed as the most advanced westward diaper (Fig. 2). The current form is shown after the Pliocene tectonic phase (PRIFTI et al., 2013; VELAJ, 2015). This was confirmed by seismic studies and the drilling of Dumre-7 well (PRIFTI et al., 2014).

In Dumre region, many wells were drilled for oil exploration and minerals (gypsum, salts in the evaporate deposits). Only nine wells met evaporate deposits, which are shown on the geological map. The deeper well passed beyond the body of the diapir is Dumre-7 (File of Dumre-7 well; BANDILLI et al., 2003).

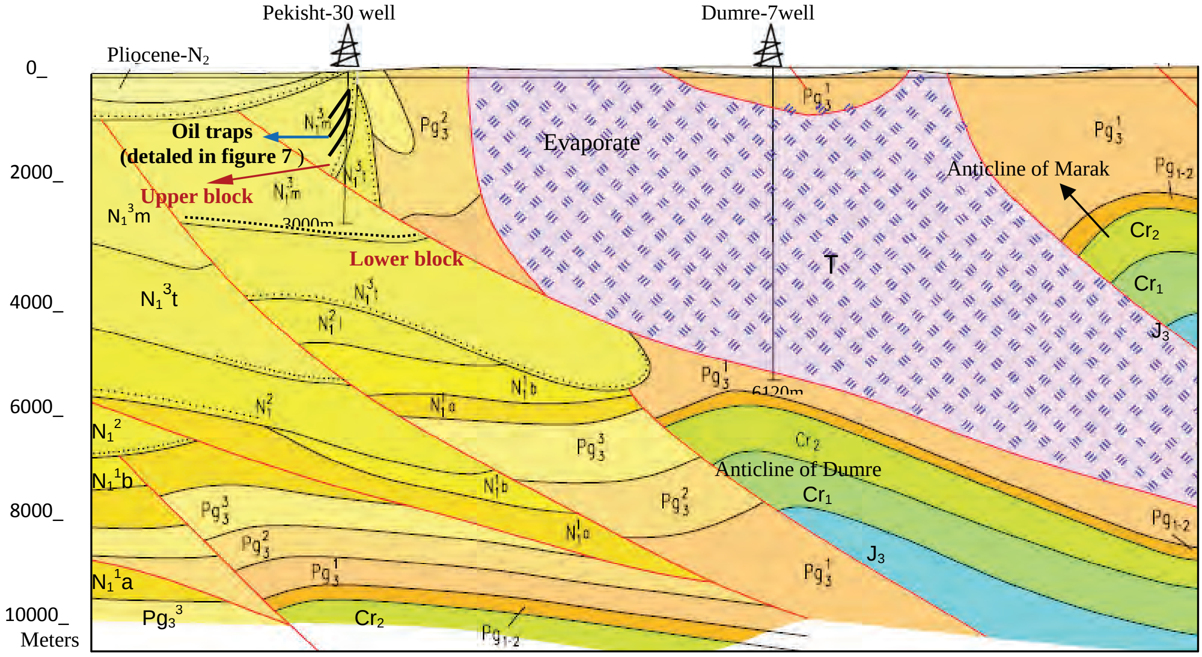


Figure 2. Diapir of Dumre crossed by Dumre-7 well (PRIFTI et al., 2013).

The well Dumre-7 was designed to detect oil trapped in Dumre anticline (under the diapir body). During the drilling, there were many technological problems caused by the lithological nature of evaporates, which are represented by anhydrides, salts, clays, dolomites, tectonic blocks with different orientations and displays of hydrocarbon gases.

The well penetrated this geological section:

0 ÷ 450m, Lower Oligocene flysch (Pg_3^1);

450m ÷6,101m, UpperTriassic (T_3);

6,101m ÷6,120m, Lower Oligocene flysch **(Pg_3^1).**

During the drilling geochemical determinations of hydrocarbon gases (free hydrocarbon gases, thermal vacuumed hydrocarbon gases and mud logging gas) were conducted.

Recently, we have studied some coal samples that were taken from the stored cuttings. Their level does not seem clear in the chart logs because they are thin layers of coal and coaly shale.

MATERIAL AND METHODS

The geochemical study was carried out at the depths 4,458-5,290 m and 5,673-5,980 m, while the interval 5,290 m-5,673 m was not studied because it coincided with the time of signing contracts related to exploration companies and exchanging of operators. Also, in specific intervals, pyrolysis (Rock-Eval) and petrologic studies of coaly shale were conducted. The geochemical interpretation of the well is realised by the experience of the Oil and Gas Geological Institute of Albania (OGGI) as methane/ethane (C_1/C_2), methane/homologues of methane (C_1/C_{2+}) and ethane/propane (C_2/C_3) ratios.

The geochemical study was based on the geochemical determinations:

1. Pyrolysis result of coal and coaly shale identified in cuttings.
2. Organic petrology of coal and coaly shale(maceral analysis and vitrinite reflectivity).
3. Geochemical method of gaseous hydrocarbons definitions by gaschromatography.

Method and carbon isotope ratio of methane ($\delta^{13}C$-CH_4).

Pyrolysis results of coal samples from Dumre-7 well (evaporate formation, Table 1).

Table 1. Rock-eval data of coal and coaly schist in Dumre-7 well.

Depth (meters)	Type of samples	Lithology	S_1, Fre HC (mgrHC/gr.rock)	S_2, generated (mgrHC/gr.rock)	T_{max}	PI	TOC	HI
4,745-4,750	Sample	Coal schist	10.0	60.90	425	0.141	36.56	166
4,750-4,755	“	“	6.29	43.79	421	0.126	33.53	130
4,785-4,790	“	“	11.3	72.4	423	0.135	37.2	194
4,790-4,795	“	“	10.89	70.19	427	0.134	31.12	225
4,830-4,835	“	“	8.75	78.87	412	0.100	36.82	212
4,905-4,910	“	“	3.8	87.82	409	0.041	29.29	299
5,230-5,235/1	Cuttings	Coal schist	0.45	103.8	407	0.004	32.47	319
5,230-5,235/2	“	“	10.5	69.4	416	0.131	38.73	179

The study of hydrocarbon gases in the well was conducted in the three forms of their occurrence:

- Free hydrocarbon gases appearing during drilling.
- Hydrocarbon gases in mud, isolated by the thermal vacuum degassing scheme.
- Hydrocarbon mud logging and evaluation of gas hydrocarbon and its constituents.

The pyrolytic study of coal and coaly shale samples identified in cuttings were performed by "Oil Show

Analyzer" equipment. By means of this method, there are defined:

- S_0 (mg HC/g rock) for free gas hydrocarbons present in the sample before the analysis;
- S_1 (mg HC/g rock) - The free hydrocarbons present in the sample before the analysis;
- S_2 (mg HC/g rock) - The volume of hydrocarbons formed during the thermal pyrolysis of the sample;
- $T_{max(}{}^{o}C)$-Temperature of peak S_2 maximum;
- TOC-Total organic carbon;
- HI (Hydrogen index)-S_2/TOC*100;
- PI (petroleum index)- $S_1/(S_1+S_2)$;

The petrologic study of coal and coaly shale was conducted by means of "Microphotometer MPV3", using the reflected light method. Through this method, the separation of the maceral groups (liptinite, vitrinite and inertinite) and the measurements of vitrinite reflectivity (Ro) were carried out.

Gas chromatography studies are conducted for free hydrocarbon gases, thermal vacuumed hydrocarbon gases and results from hydrocarbon mud logging (ABLANDET al., 2012). By means of the first two methods, the series of methane up to C_7H_{16} (heptanes) by "Carlo Ebra STRUMENTAZIONE" were defined. By means of the hydrocarbon mud logging, gas hydrocarbons are set up to butane (C_4H_{10}). This does not mean that there are no more heavy gas hydrocarbons, but the method is designed to record up to C_4 (butane). Taking into consideration this statement, the following geochemical indicators were examined: **C_1 / C_2, C_2 / C_3** and **i-C_4 / n-C_4**.

It should be noted that in the depths where hydrocarbon gases appeared, samples were taken from the mud.

The study of different forms of the gas occurrences requires different analytical techniques of gas extraction and individual hydrocarbon gas composition (PRIFTI et al**.**, 1994; SHKURTAJ & BITRI, 2008).

By this method, the maturity of hydrocarbon gases is estimated through isomerisation ratio ($iC_4H_{10}/nC_4\,H_{10}$).

Also, in free hydrocarbon gas samples, it is defined the carbon isotope ratio of methane ($\delta^{13}C\text{-}CH_4$). These determinations were carried out by the laboratories of the oil companies in accordance with the ISO standard.

Based on the methods of study, on the geological structure, on the results of wells, on the presence of Rasë-Pekisht oilfield and bituminous sandstones at the base of the Messinian deposits, one arrives at some opinions regarding the petroleum potential of Dumre-region.

DISCUSSION

1. Properties of organic matter. Based on the above mentioned geochemical determinations, we could not prepare the geochemical logs of evaporate formation because the diaper body is in a chaotic situation.

In the evaporate formation of wells, there are identified coal and coaly shale. In Dumre-7 well, there are three levels of coal and coaly shale at the depths of 4,745÷4,795 m, 4,905÷4,910 m and 5,230÷5,235 m.

Total organic carbon (TOC) ranges from 29.29% to 38.73%, which is typical for coaly schists (Table 2). The type of organic matter is determined by the hydrogen index (HI), which is typical for III-II type (HI=130÷319). This is due to the high content of free lipid compounds (S_1 = 0.45 to 11.30 mg HC/g rock) and residual genetic potential (S_2 =43.79÷103.8 mg HC/ g rock).

Type III-II is confirmed by petrologic study, where gelinite macerals predominate (Table 2), which derived from inferior plants in wetland environments (PRIFTI, 2014).

Table 2. Groups of macerals and reflectance of vitrinites of coaly schists met at Dumre-7 well.

Depth (m)	Liptinite (%)	Vitrinite (%)	Inertinite (%)	Reflectance of vitrinites. Ro (%)	Remarks
4,745-4,750	5.94	86.14	7.92	0.446	Gelinite (predominate in coal schists)
4,750-4,755	2.12	72.79	25.09	0.412	Semifusinite (coal schists)
4,775-4,780	15.84	84.16	trace	-	Are gelinite, no Ro (coal schists)
4,780-4,785	5.17	91.38	3.45	-	Are gelinite, no Ro (coal schists)
4,785-4,790	15.68	80.39	3.92	-	Are gelinite, no Ro (coal schists)
4,790-4,795	18.36	70.97	10.67	0.402	Gelinite (predominate incoalschists)
4,790-4,795	10	90	trace	0.402	Gelinite (predominate in coalschists)
4,830-4,835	9.04	90.96	trace	-	Are gelinite, no Ro (coalschists)
4,845-4,850	7.79	91.21	trace	-	Are gelinite, no Ro (coalschists)
4,850-4,855	7.04	92.96	trace	-	Are gelinite, no Ro (coalschists)
4,905-4,907	7.01	90.07	2.92	0.423	Gelinite (predominate in coalschists)
5,230-5,235	trace	100	trace	-	Are gelinite, no Ro (coalschists)

The maturity of organic matter was evaluated by the vitrinite reflectance (Ro). This indicator varies in the range of 0.402÷0.446%. So, the organic matter is immature and is included in subbituminous coal rank (mixed hydrocarbon gas generation).

The low level of maturity of the organic matter of the evaporate formation confirms the information received from pyrolytic data. So, Tmax is less than 435°C, which indicates immature organic matter (Fig. 3).

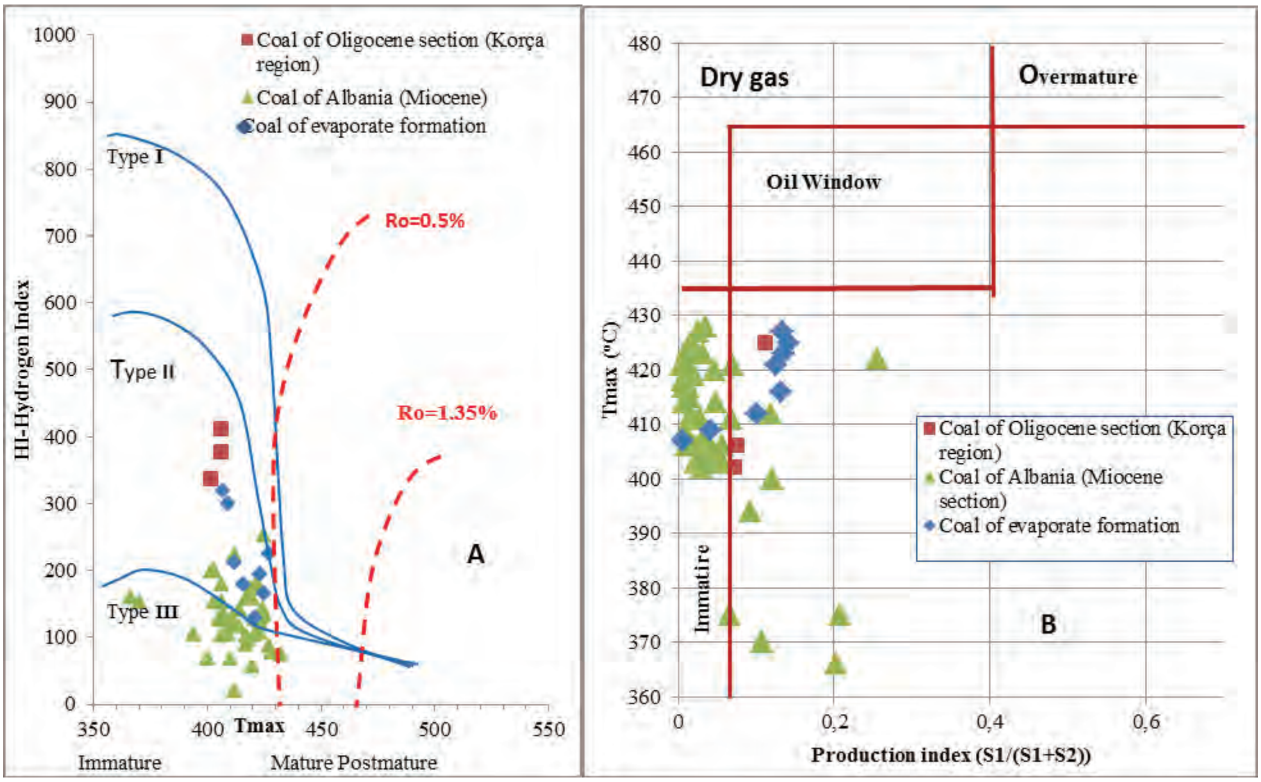


Figure 3. Type of organic matter (A) and maturity (B) from rock-eval data of coaly matter in Albania.

The maturity of the organic matter is also interpreted by the productivity index ($PI = S_1/ S_1 + S_2$). By different authors, this indicator has been interpreted in different ways. So, matured organic matter is included in the oil window in the limits 0.1÷0.3; 0.2÷0.4. We accept 0.1÷0.4 as the limits of the oil window. In the coal and coaly shale of the evaporate formation, there is noted that the productivity index (in most samples) that is included in the range between 0.1÷0.4. The high values of PI are related to the free lipid in coaly matter and not to their maturity level.

The low level of maturity is due to the high thermal permeability of the evaporate section, which, also, has a low thermal capacity. Evaporate deposits are very good thermal conductors, so they increase the maturity of cover rocks. When the diapir emerges, the cooling of the basin begins (PRIFTI et al., 2014).

This is the only reason that the drilled wells on the Dumre diapir have lower temperatures. The phenomenon of low gradients in evaporate section is proven in Grekan-4 well.

During the drilling of Dumre-7 well hydrocarbon gases were met in the evaporate formation. The geochemical types of hydrocarbon gases are determined according to the experience of Oil and Gas Geological Institute (OGGI) as C_1/C_2 (CH_4/C_2H_6), C_1/C_{2+} (CH_4/C_2H_{6+}).

The geochemical type of hydrocarbon gases is given in Figure 4. The hydrocarbon gases were studied by means of three methods:

A) Free gases are taken during the drilling, manoeuvres and the circulation (4,524÷5,290 m). Their composition included the full range of gaseous hydrocarbons (C_1÷C_7). The main component is methane, which represents 62.768% to 97.328% (relative percentage). Based on the geochemical indicators (C_1/C_2, C_1/C_{2+}), free hydrocarbons gases are mostly dry gas type, two samples are wet gas type (4,684 and5,256 m) and one sample is dry gas (5,290 m). Free hydrocarbon gases in the Rasë-Pekisht oilfield are wet hydrocarbon gases (Fig. 4).

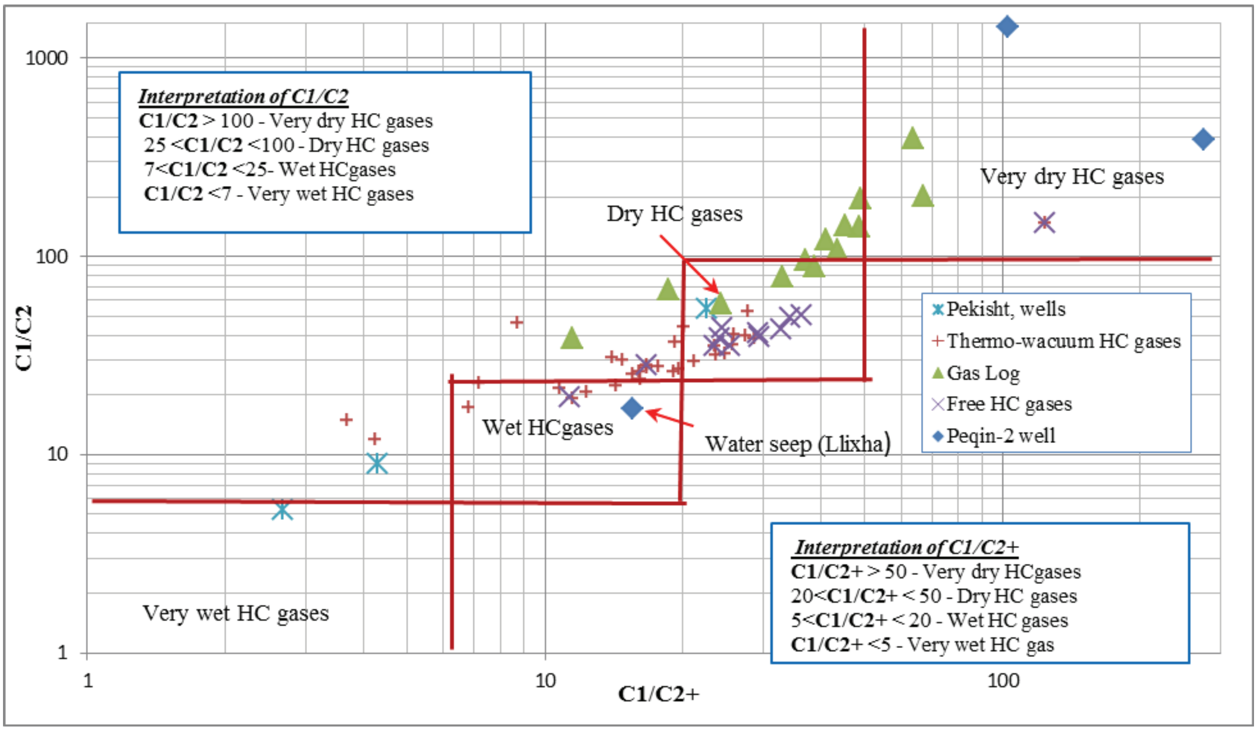


Figure 4. Geochemical type of hydrocarbon gases (HC) by OGGI indexes.

Table 3. Geochemical gaseous hydrocarbons indexes of Dumre-7 well (diapasons).

Type of Gas	C_{2+}	OGGI geochemical indexes			$i\text{-}C_4/n\text{-}C_4$	$i\text{-}C_5/n\text{-}C_5$	Wh	Bh	Ch	$\delta^{13}C$ (‰)
		C_1/C_2	C_1/C_{2+}	C_2/C_3						
ThVG	0.8-19.05	11.48-148	4.25-124	1.01-12.64	0.44-0.92	1.30-2.36	0.78-18.84	6.48-933.6	0.58-3.97	-35.49 ÷-32.5
Free Gas	0.44-10.0	11.46-147.72	8.96-123.6	2.59-12.3	0.53-0.92	1.51-3.03	0.78-10.04	35.76-914.63	0.52-1.08	
GasLog	0.54-3.22	38.86-396	11.46-67.27	0.68-4.15	0.48-1.14					

As it regards the composition of hydrocarbon gases related to lithology, there is observed that they belong to the dry and very dry types (C_1/C_2 = 16.68÷201.81, C_1/C_2 + = 6.14÷78.05). Two gas samples are included in the wet type.

Considering as a whole the composition of hydrocarbon gases (free hydrocarbon gases, thermal vacuumed hydrocarbon gases and mud hydrocarbon gases), there is observed the tendency that with the increase of the depth, hydrocarbon gases pass from wet and dry types into the dry and very dry types (DIAMANTI et al., 1998; PRIFTI, 2014).

The maturity of hydrocarbon gases. The degree of maturity of hydrocarbon gases is evaluated by two indicators: carbon isotope ratio of methane ($\delta^{13}C\text{-}CH_4$) and isomerisation ratio ($i\text{-}C_4H_{10}/n\text{-}C_4H_{10}$).

The Carbon isotope ratio of methane ($\delta^{13}C\text{-}CH_4$) ranging from-32.4‰ to-35.49‰ indicates that the hydrocarbon gases are more matured (DIAMANTI et al., 1998; SHKURTAJ et al., 2002).

Hydrocarbon gases with high level of maturity are generated by the source rocks that passed the oil window, or more precisely, that generated condensate and wet hydrocarbon gases. The highest value of this indicator ($\delta^{13}C$ = -25.23‰) characterises the hydrocarbon gas of thermal water sources in Llixha. Water sources appear in northeast of the diapir body and are influenced by it.

The carbon isotope ratio of methane ($\delta^{13}C\text{-}CH_4$) is defined in the hydrocarbon gases of two oilfields; one in the Rasë-Pekisht oilfield ($\delta^{13}C\text{-}CH_4$=-53.887‰,) and the other in Kuçova oilfield ($\delta^{13}C\text{-}CH_4$=-44.43‰,). This difference speaks out of:

• Different levels of maturity of crude oils;

• Crude oil of Rasë-Pekisht oilfield is not affected by the new generation of the Pliocene - post-Pliocene time (GJOKA et al., 2002).

Isomerisation ratio has mainly the value of i-C_4H_{10}/n-C_4H_{10}<1, also the ratio (i-C5/n-5) has a low value, which indicates the matured hydrocarbon gases. Only two samples of mud hydrocarbon gases, where isomeric forms prevail over normal ones, are an exception; they are immature and are generated by organic matter of the evaporate formation.

Geochemical correlation is carried out taking into account the following criteria:

a. Geochemical features and maturity of fluids (oil, gas),

b. Geochemical features and maturity of the source rocks.

In the evaporate formation crossed by Dumre-7 well, mainly matured hydrocarbon gases are met. Also, there are met coaly shale, which are not matured. Given the different levels of their maturity, it is concluded that hydrocarbon gases are not generated by evaporate section but by another sedimentary section, which passed the "oil window" and contacted the diapir body in depth, while hydrocarbon gases that have high isomerisation ratio (i-C4/C4n>1) are generated from the coaly shale of the evaporate formation.

Earlier studies determined that crude oils of Rasë-Pekisht oilfield (as all crude oils of the Ionian zone) are generated by the source rocks of carbonate section where the Triassic-Jurassic source rocks are the main contributors (PRIFTI & MUSKA, 2013). The low value of the carbon isotope ratio of methane of crude oils of Rasë-Pekisht oilfield indicates the early stages of hydrocarbon generation (GJOKA et al**.**, 2002).

So, the oilfield of Rasë-Pekisht is not affected by the new generations and migration stages, as a result of the interruption of relations with the source of supply. However, detailed studies are needed to determine the origin of the crude oils of Rasë-Pekisht oilfield.

The accumulation of gas hydrocarbons. Manifestations of hydrocarbon gases are met almost in the evaporite section of the Dumre-7 well. Their origin is related mainly to older sedimentary section that passed the "oil window".

The diapirism of evaporate formation included gaseous hydrocarbons, which are stored within the body of the diapir. These hydrocarbons are stored in the tectonic blocks of dolomites, limestones and other rocks that have porosity.

The main task of the organic geochemistry science is to determine whether these rocks represent gaseous hydrocarbons traps. To this purpose six geochemical indicators are calculated, three indicators (the first) are under World experience, while the other indicators have been interpreted by the experience of Oil and Gas Geological Institute of Albania (OGGI):

1. Hydrocarbon Wetness Ratio (Wh),
   $Wh=(C_2+C_3+iC_4+nC_4+iC_5+nC_5)/(C_{1+}C_2+C_3+iC_4+nC_4+iC_5+nC_5)*100$
2. Hydrocarbon Balance Ratio, **$Bh=(C_{1+}C_2)/ C_3+iC_4+nC_4+iC_5+nC_5)$,**
3. HydrocarbonCharacter Ratio, **$Ch=(iC_4+nC_4+iC_5+nC_5)/ C_3$,**
4. Methane/Ethane Ratio **= C_1/C_2,**
5. Ethane /Propane Ratio = **C_2/ C_3,**
6. Ethane/ iso butane Ratio = **C_2/i-C_4**

The accumulation of hydrocarbons will be examined by determining all the above indicators.

The definitions of hydrocarbon gases carried by the station unit (mud logging unit) are limited up to butane, so we cannot calculate the first three indicators. By consequence, instead of these determinations, other indicators shall be interpreted.

According to "Wh", in the evaporate section there exist accumulations of hydrocarbon gases. These accumulations are actually called "imprisoned gases" by the diapirism of the evaporate formation. This term is included for the first time in the science of organic geochemistry. Although such accumulations have some reserves, they are unusable.

There is not a trend of geochemical indicators (Wh, Bh, Ch) in the evaporate formation section. Geochemical indicators do not show any anomaly of oil trap covered by the evaporate formation (Fig. 5).

Ethane/Propane ratio (Ep = C_2/C_3) is interpreted as an index of maturity and biodegradation of crude oils by foreign researchers (ABLAND et al., 2012).

Therefore, its growth is related to the maturity of hydrocarbon gases. In the studies carried out at the Oil and Gas Geological Institute of Albania (OGGI), this indicator is interpreted for the purpose of evaluating the anomaly of oil and gas traps.

So, high values are characteristic for the aureole of gas hydrocarbons traps; 2 <C_2/C_3<3 is characteristic of the aureole of condensation traps and C_2/C_3<2 is a peculiar feature of the aureole of oil traps (the increase of propane). This model is appropriate for hydrocarbon traps in the carbonate section of the Ionian Zone (PRIFTI et al., 1994). The Ionian Zone is made up of sedimentary rocks from the Triassic up to the Miocene age and was affected by many tectonic phases.

Based on Ethane/Propane ratio there must be remaining oils on special intervals of the section (4,500m÷4,700m and 5,700m÷6,000m).

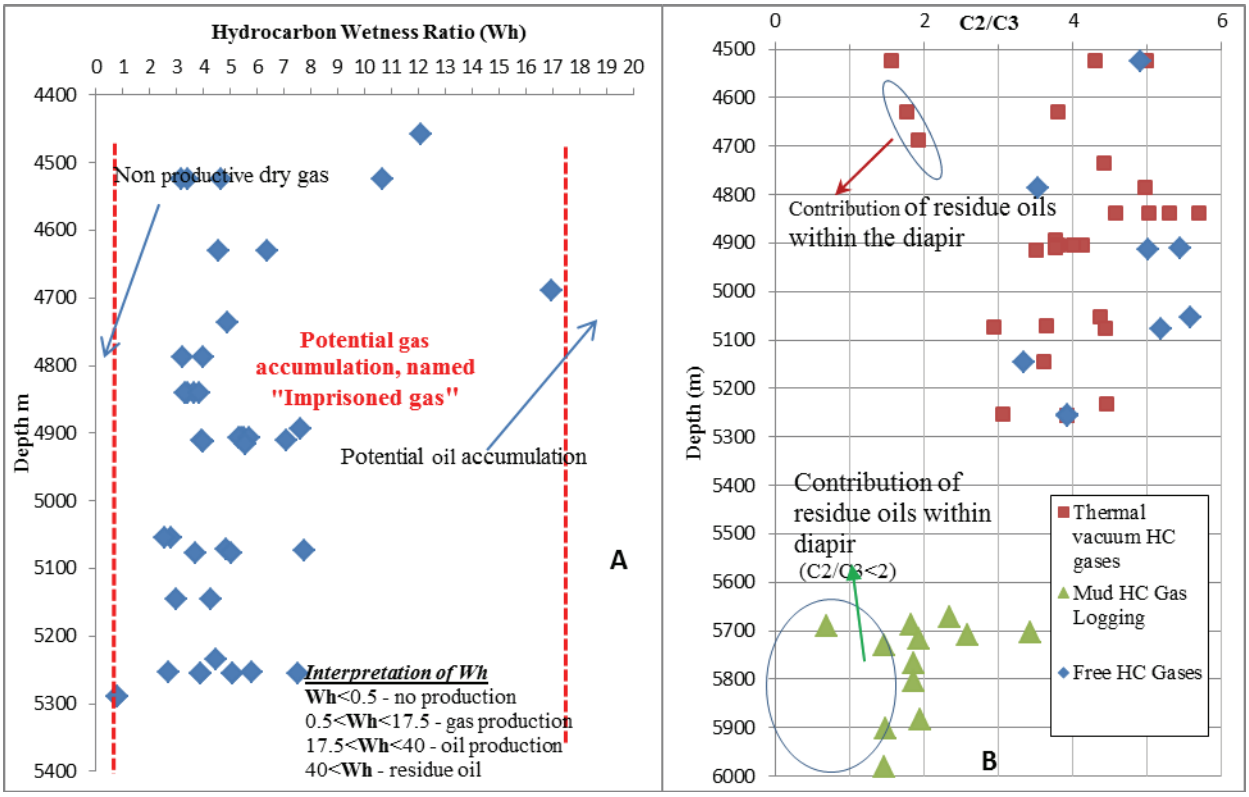


Figure 5. Gas accumulation of Dumre-7 well based on Hydrocarbon Wetness (A)and C_2/C_3 ratio (B).

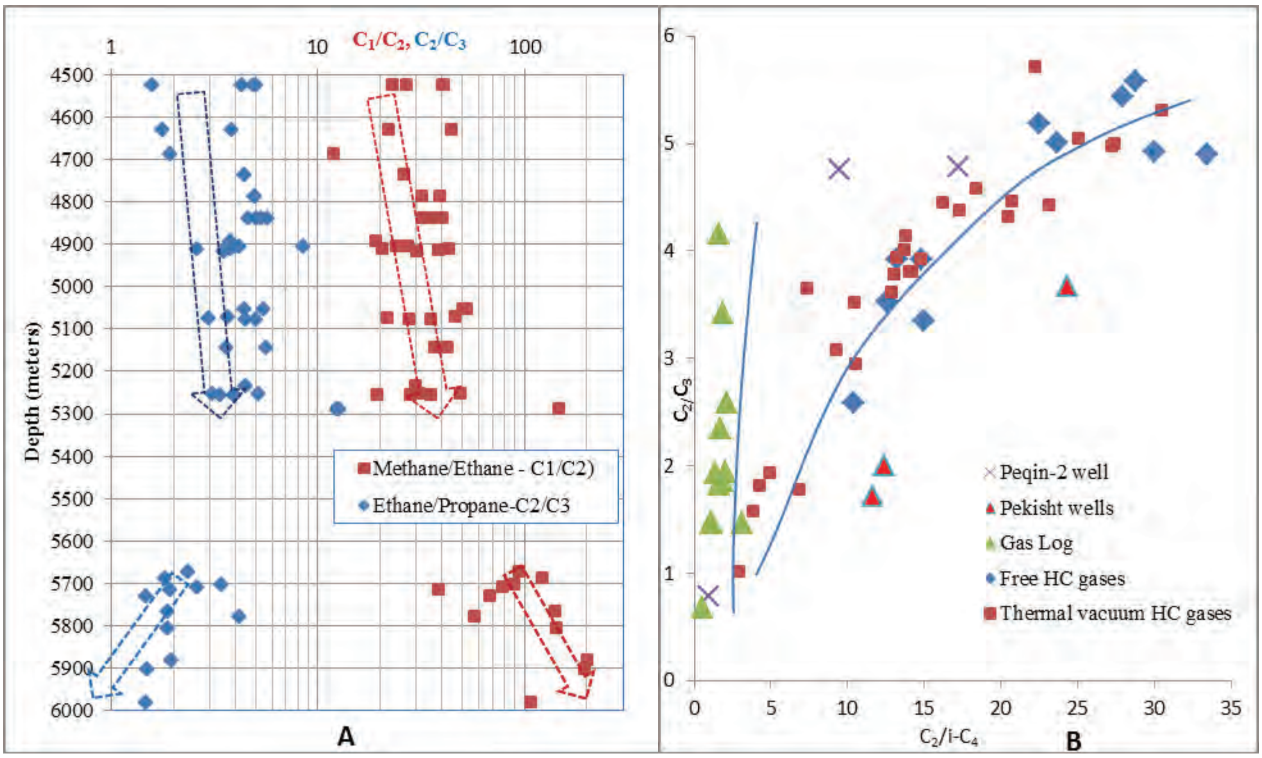


Figure 6. Correlation of C_2/C_3; C_1/C_2withdepth (A) and C_2/C_3 with $C_2/i\text{-}C_4$(B) in section of Dumre-7 well.

There is an interesting correlation of this ratio with$C_2/i\text{-}C_4$ ratio (ethane/iso-butane). There were observed two trends (Fig. 6):

- Major changes of C_2/C_3 associated with small changes of $C_2/i\text{-}C_4$ in mud logging gases.

- In the other forms of hydrocarbon gases there is aregular correlation between indicators.

In the geochemical study of the SH2-well in the southwest of the diapir, a concordance of hydrocarbon gases of the anomaly with those of the oil trap is observed (DUKAJ et al., 2014).

Based on the geochemical experience, there is observed a right correlation between the C_2/C_3 and C_1/C_2. In the hydrocarbon gases studied by means of Mud gas logging (5,673m÷5,980m), this trend is not observed. This means that the lower section of evaporates currently do not serve as seal rocks. We consider that the high values of C_2/C_3 (characteristic of gas anomalies related to oiltrap), could denote two possibilities:

a. That they are influenced by any oiltrap on the eastside and the diapir body shifted it westward. This is because the diapir body is always in a westward motion.

b. Or the lower tectonic contact of the diapir serves as a hydrocarbon migration route.

In these conditions, we think that the evaporate section do not serve as seal rocks for any oil trap. For the oil traps in the Ionian zone, this role is performed by flysch deposits. There have not been conducted geochemical determinations on the flysch section of Dumre-7 well under the tectonic contact of the diaper. In the SH2 well the two parameters reflect the oil traps in the reservoir rocks and the anomaly in the seal rocks (flysch formation).

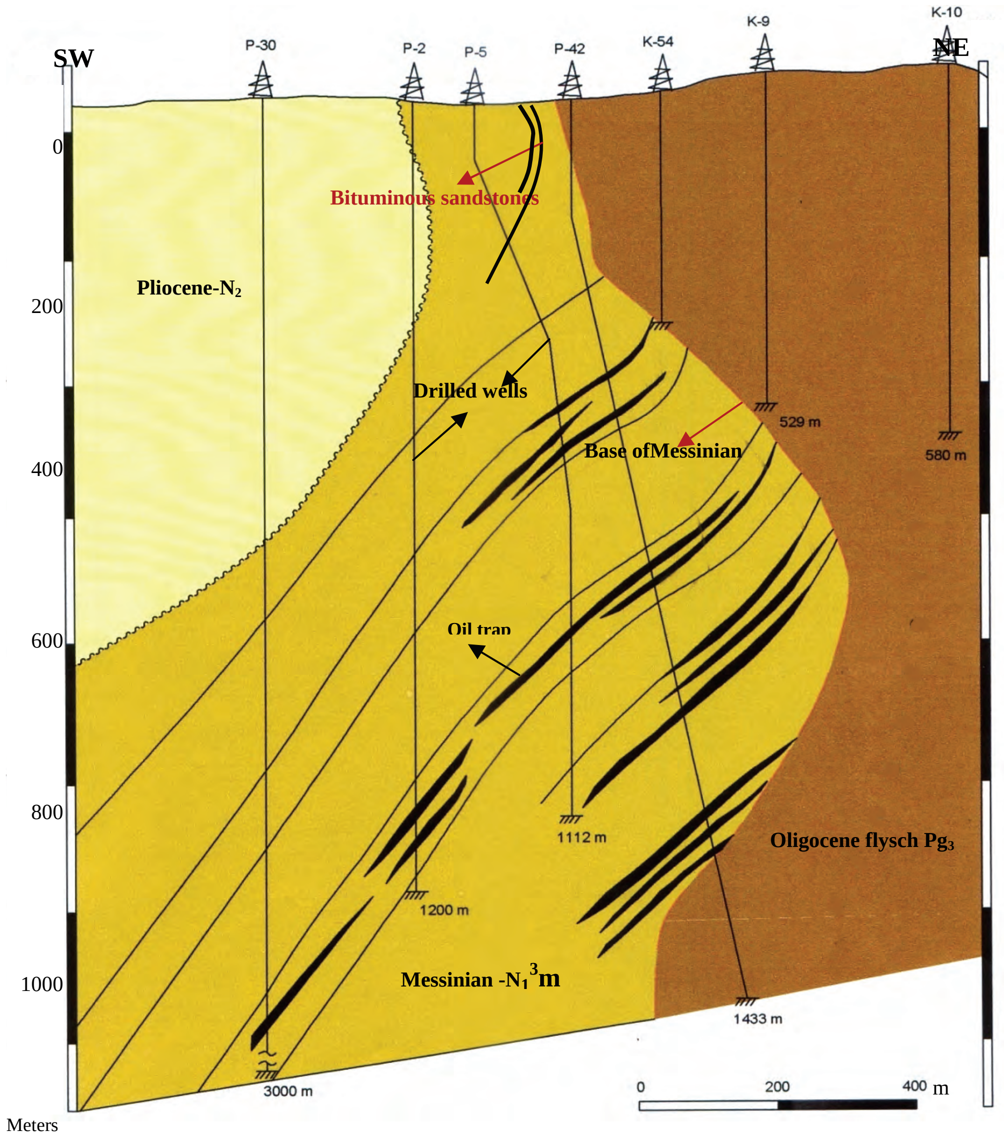


Figure 7. Geological profile of Rase-Pekisht oilfield (Gjoka et al, 2002, modified Prifti).

The presence of oil trap in the limestone reservoirs causes a decrease of the geochemical parameters, such as C_2/C_3 and C_1/C_2 in the seal rocks and has the same tendency. This phenomenon does not occur at the lower section of the evaporate formation.

The accumulation of liquid hydrocarbons. Along the tectonic contact that encompasses the diapir, up to now, there are not observed traces of oil. The diapir body may have remaining oil in the depth, where the ratioC_2/C_3presents low values. These oils are supposed to be involved in the evaporate section during the outbreak of the diapir through the carbonate section of the Ionian zone.

In western side of the diapir, bituminous sandstones at the base of the Miocene transgression are met on the eroded Oligocene flysch. Southwards it lies Kuçova oilfield.

Rasë-Pekisht oilfield lies in the north-west of Dumre diapir. Its reservoir rocks are the Messinian sandstones (Fig. 7). The proximity of the oil trap to the transgression base of Messinian is linked with the westward pressure of Dumre diapir. The vertical position of the oil trap is in direct relation to the force of this pressure.

Crude oils of Rasë-Pekisht oilfield are lighter compared with those of Kuçova. Scientific debate about the origin of crude oils of the Rasë-Pekisht oilfields is in these directions:

a. The oil has migrated from the eroded carbonate anticline of Kuçova thought a nearly horizontal secondary migration of sandstone reservoirs. Along the distances there happened a natural chromatographic effect, so in Rasë-Pekisht oilfield, lighter oils occur (PRIFTI, et al**,** 2014).

This questionable opinion may be discussed. Conducted studies have justified this conclusion with the same depth of the oilfields (GJOKA et al.**,** 2002). For this opinion there are some discrepancies:

- Rasë-Pekisht oilfield presents a tectonic block (overhead block), while the lower block, where oil traps can be found, is hidden by the diapir. Thus, current depth of oil traps is the result of Dumre diapir.
- Sandstone reservoirs of both oilfields are different, finer grained and more carbonate cement in case of Rasë-Pekisht oilfield.
- Sedimentation environment was the same, but we think they represent two different deltas.

b. Crude oils of Rasë-Pekisht oilfield are more naphthenic than those of Kuçova. This indicates either natural chromatography or there existed different supply sources. The oil of Rrasë-Pekisht oilfield is characterized by higher content of the distillation fractions (PRIFTI et al. 2015).

- The presences of different types of crude oils is also supported by hydrocarbon omposition of bituminous sandstones (sandstone of Kuçova: Saturate hydrocarbon=16.9%; Aromatics=58.4%; NSO=18.8%; Asphalt=7.9%, sandstone of Pekisht: Saturate hydrocarbon=25.33%; Aromatics=39.47%; NSO=15.57%; Asphalt=8.02%).
- Based on these discussions, the crude oil of Rasë-Pekisht oilfield migrated from other eroded anticline hidden by the diapir. This may be Dumre anticline. Erosion could have occurred during the Tortonian. So,the oil migrated from the carbonate section to the Tortonian and Messinian section.
- The carbon isotope ratio of methane of Rasë-Pekisht oilfield is low ($\delta^{13}C\text{-}CH_4$=-53.887‰, lower value). These values were interpreted as related with the earlier generation of oils and Rasë-Pekisht oilfield was not affected by new phases of migration during the Pliocene-post-Pliocene stages (GJOKA et al.**,** 2002). This could be a strong reason that the Tortonian and Messinian sandstones of the lower tectonic block may present large oil reserves.

CONCLUSIONS

Kuçova and Rasë-Pekisht oilfields were discovered in the diapir southern and western parts. The natural reservoirs are the sandstones of the Messinian section.

In Dumre region, many wells have been drilled so far, but only nine of them were drilled in evaporate deposits. One of them, Dumre-7 well, crossed the diapir body at 6,101m depth.

Three levels of coaly shale at depths of 4,745m÷4,795m, 4,905m÷4,910m and 5,230m÷5,235m, in evaporate section were met. A coaly shale was studied by petrologic and pyrolysis methods. Based on their data, organic matter is of the third and second types. Its maturity level is low (Ro=0.4%).

During the drilling of Dumre-7 well, hydrocarbon gases appeared and were studied by the gas chromatography methods. Through this method three types of hydrocarbon gases were studied: free hydrocarbon gases, thermal vacuumed hydrocarbon gases from mud and mud logging gases. By geochemical indicators, hydrocarbon gases are of dry and wet types. Based on the carbon isotope ratio of methane ($\delta^{13}C\text{-}CH_4$), hydrocarbon gases are mature, generated by the source rocks that passed the oil window. So, they are not generated by the section of the diapir evaporates.

As it regards the isomerisation ratio ($i\text{-}C_4/n\text{-}C_4$), only two gas samples are generated from the organic matter of the evaporate formation. Hydrocarbon gas shows of the evaporate formation do not represent gas trap, but "imprisoned" gases during the penetration of the diapir body through the carbonate formation. Lower values of C_2/C_3 ratio of the diapir body (4,524 m, 4,630 m, 4,689 m, 5,687 m ÷ 5,980 m) may be the result of oil remaining in the depth during the diapirism process. Rasë-Pekisht oilfield is assumed to be formed by the petroleum migration from the eroded Kuçova anticline or the eroded Dumre anticline (the conclusion of the authors).

Rasë-Pekisht oilfield is not affected by the new migration phase of the Pliocene-post-Pliocenet ime. This indicates that the lower tectonic block must have petroleum reserves.

Given the importance of the petroleum exploration in Dumre region, a geological and geochemical study in western front of the diapir is recommended.

ACKNOWLEDGES

We thank to the National Agency of Natural Resources, Faculty of Geology and Mining, Albanian Geological Service that enabled us to refer to their archived studies.

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Prifti Irakli
Polytechnic University of Albania
Faculty of Geology and Mining, Department of Earth Sciences
Rruga e Elbasanit, Tiranë, Republic of Albania
E-mail: irakliprifti@yahoo.com

Shkurtaj Bilal
"Ismail Qemali" University of Vlora, Albania
Research Scientific Center
Skele, Vlore, , Republic of Albania
E-mail: bshkurtaj@yahoo.com

Boçari Arben, Çaushi Alfred
Agriculture University of Tirana
Faculty of Economics and Agribusiness, Department of Mathematics and Informatics
KoderKamez, Tiranë, Republic of Albania
E-mail: bbocari@yahoo.com;alfredcaushi@hotmail.com

Ymeri Agim
Kosovo Energy Corporation J.S.C.
Prishtine, Kosovo
E-mail: Agim.Ymeri@kek-energy.com

Received: March 01, 2017
Accepted: July 20, 2017