IDENTIFICATION OF THE GUDE OIL LEVEL IN THE GEOLOGICAL SECTION OF MARINZA-3111 WELL

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Abstract. Accumulations in the Marinza complex oilfield especially within Miocene deposits are related to the Patos – Verbas anticline. This structure is included in the Kurveleshi Belt of theJonian zone. The Patos – Verbas anticline represents the west – northern and deeper part of Ionian orogene. The oil accumulations occur in limestone reservoirs and sandstone reservoirs within the flysch deposits, while the accumulations in Miocene deposits are dispersed in conformity with five formations such as "Bubullima", "Marinza", "Kucova", "Gorani", and "Driza", where accumulations are within the classic reservoirs. Two oil levels were identified in two formations: the "Kuçova" formation and the deepest formation of "Marinza".All types of oil field deposits encountered in Marinza oil field include oils of a broad spectrum. Both levels of natural reservoirs have been exploited at the same time. The maximum crude oil production was in September 1996. Two main migration phases of HC are determined, which are in conformity with tectonic phases. The earliest massive oil migration has occurred during the tectonic phase Middle Miocene and the second during Post – Pliocene time. During exploration process around the Patos – Verbas anticline, gas samples from oil accumulations of Miocene deposits were taken where methane was rich in isotopic carbon (C^{13} of CH_4 up to – 26%). Values of stable carbon isotope of methane are characteristics for the thermogenous gas. There is not a good correction between C^{13} of methane and with others geochemical parameters. We have concluded that the youngest migration phase of thermogenic gas happened during Post – Pliocene time through a heterogeneous medium. This process has contaminated oil accumulations and deposits around the oil fields mentioned above. The Marinza-3111 oil trap is small after reducing the natural reservoirs, which is located on the contour of the oiltrap.The data were taken from the Marinza-3111 well file.

Keywords: Crude oil, reservoirs, formation, geochemical parameters.

Rezumat. Identificarea nivelului petrolului brut în secțiunea forajului Marinza-3111. Acumularea în câmpul petrolifer complex Marinza, în special în depozitele miocenice, este legată de anticlinele Patos - Verbas. Această structură este inclusă în zona BeltKurveleshi din zona Jonian. Anticlinalul Patos - Verbas reprezintă partea de nord-vest, mai adâncă, a orogenului ionian. Acumularea de petrol se produce în rezervoarele de calcar şi în rezervoarele de gresie din depozitele de fliş, în timp ce acumulările din depozitele miocene sunt dispersate în conformitate cu cinci formații precum ,,Bubulima", ,,Marinza", ,,Kucova", ,,Gorani" şi ,,Driza" , unde acumulările se află în rezervoarele clasice. Două niveluri de petrol au fost identificate în două formațiuni: formațiunea ,,Kuçova" şi cea mai profundă formare a ,,Marinza". Toate tipurile de depuneri de câmp petrolifer întâlnite în câmpul petrolifer Marinza includ petrol de un spectru larg. Ambele nivele de rezervoare naturale au fost exploatate în acelaşi timp. Producția maximă de țiței a fost în septembrie 1996. Se determină două faze principale de migrație ale HC, care sunt în conformitate cu fazele tectonice. Cea mai veche migrație masivă a petrolului a avut loc în timpul fazei tectonice Miocen mediu,iar cea de-a doua în timpul post Pliocen. În timpul procesului de explorare din jurul anticlinalului Patos - Verbas, au fost prelevate probe de gaze din acumularea de petrol din depozite miocenice, unde metanul era bogat în carbonizotopic (C13 de CH4 până la 26%). Valorile izotopului de carbon stabil al metanului sunt caracteristice pentru gazul termogen. Nu există o corelație bună între C13 al metanului şi alți parametri geochimici. Am concluzionat că cea mai tânără fază de migrare a gazului termogen sa produs în timpul post-Pliocen printr-un mediu eterogen. Acest proces a contaminat acumulările de petrol şi depozitele în jurul câmpurilor petroliere menționate mai sus. Capcana de petrol Marinza-3111 este mică după reducerea rezervoarelor naturale, care se află pe conturul capcanei de petrol. Datele au fost preluate din fişierul Marinza-3111.

Cuvinte cheie: Petrol brut, rezervor, formare, parametrii geochimici.

GEOLOGICAL SECTION PENETRATED BY MARINZA-3111 WELL

The Marinza oilfield is among the largest in Europe in sandstone reservoirs. Its orientation is southeast and is located in the geological section of the Adriatic Depression.

The Marinza-3111 well was drilled on the northeastern contour of the Marinza oilfield. It can be called the contour well (Fig. 1). It has passed a reduced geological section.

The lithological description of the geological section of the well will be treated according to previously conducted studies (PRIFTI & DORRE, 2015).

Marinez Formation. This formation lies discordantly on the buried erosion surface (Fig. 2).

The lithofacies is represented by massive beds of loose sandstones containing carbonate sandstone concretions. The lithofacies is represented by massive beds of loose sandstones containing carbonate sandstone concretions (PRIFTI & DORRE, 2015). Accumulations of crude oils can be found on the upper part of this formation, at a depth of 1506-1516 m and 1520-1529.2 m. Sandstones alternate with clays containing carbonate concretions. The thickness is 150 m.

Driza and Gorani Formations. In Marinez, the section is mainly argillaceous alternating with sandstones. It is represented by an alternation of loose sandstones up to gravel with clays and carbonate aleurites. During the drilling and the testing process, no oil traps have been identified. Their thickness is 220 m.

Kuçova Formation is propagated all over the region and lies normally on Gorani Formation. It is represented by an alternation between clays and loose sandstones. In the depth of 1168.8-1179.6 m there are identified oil traps. The thickness is 230m.

Polovina Formationis eroded by Pliocene transgression. It is characterized by the alternation between clays and loose sandstones. The thickness is 150m.

Pliocene deposits. They include two lithological formations: Helmes and Rrogozhina.

Helmes Formation lies by transgression on the Messinian deposits, represented by clays and aleuritic clays withsandstones and aleurites intercalations. While Rrogozhina formation there is no interest in oil production.

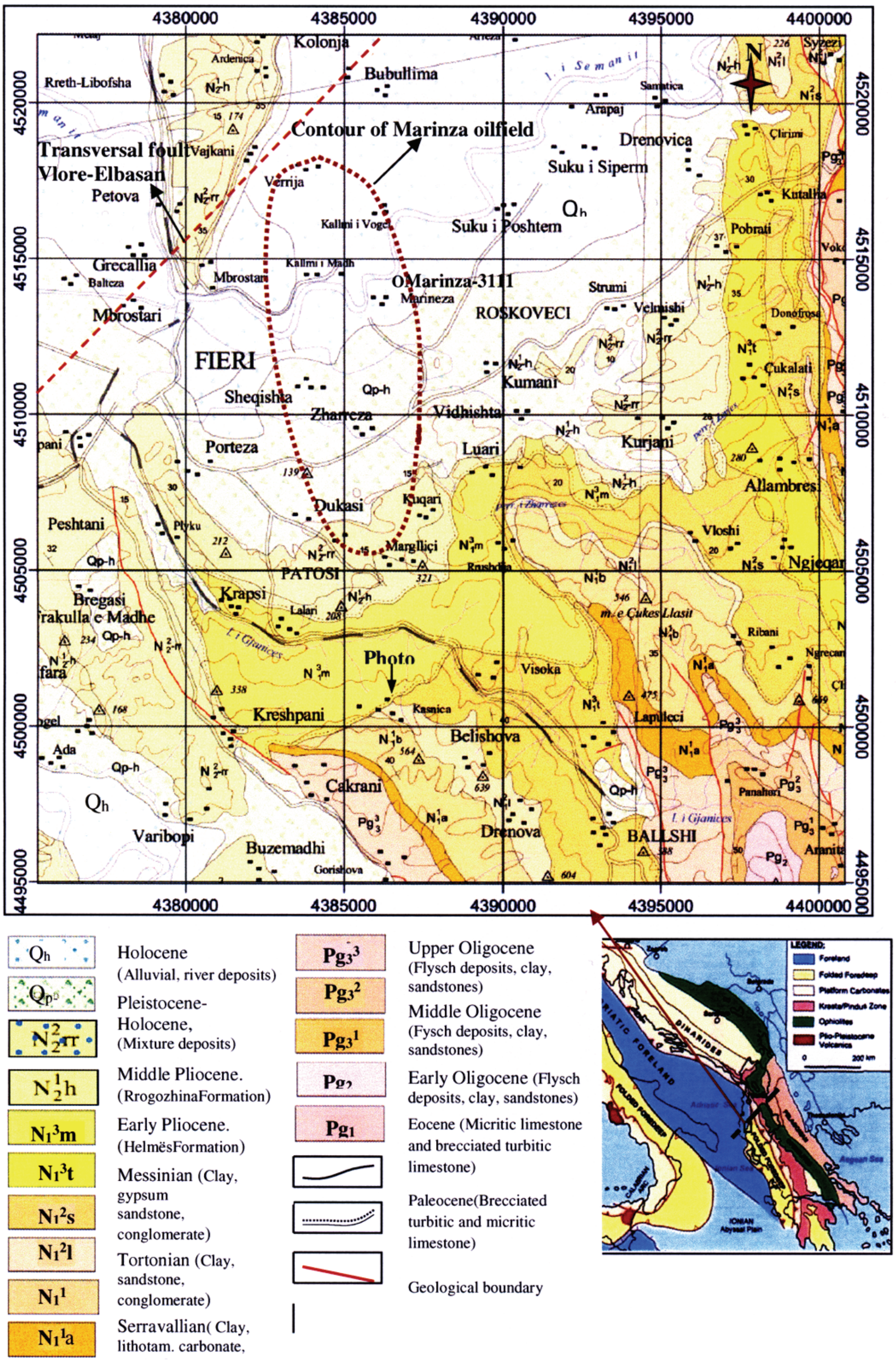

Figure 1. Position of Marinza oilfield and Marinza-3111 well on geological map (scale:1/200 000, based on PRIFTI & DORRE, 2015, modified by Seitaj).

PROSPECTING OF OIL ACCUMULATIONS BY GEOCHEMICAL PARAMETERS OF HC GASSES

Thermogenic gases have been met for the first time in the Kolonja-8 well. This well is drilled to the north of the Marinza oilfield complex and exploits the oil from the carbonate reservoirs (eroded Patos-Verbas anticline). Precisely this was the reason we carried out the study during the drilling of the Marinza-3111 well to verify the presence of thermogene gasses in the northern part of the Marinza oilfield complex.

We have analyzed thermovacuum gasses derived from mud in interval 1060 (m) – 1660 (m) during drilling by two methods, gaschromotography (content of hydrocarbon gasses from methane to hexane) and methane stable carbon isotope ratio (Table 1).

Table 1. Hydrocarbon composition of gaseous samples from mud during drilling of Marinza-3111 well.

Depth (m)	Content (ml/l)		Hydrocarbon composition (%)									
	CH4	C2H6	CH4	C2H6	C3H8	iC4H10	nC4H10	C4H8	iC5H12	nC5H12	C6H14	C7H16
1120	2.7675	0.0646	99.558	0.24	0.027	0.005	0.006	0.059	0.01	0.001	0.002	0.022
1150	2.3394	0.0204	96.119	0.838	0.445	0.664	0.317	0.044	0.548	0.042	0.493	0.451
1190	5.2762	0.0539	90.975	1.01	0.029	1.537	0.472	0.138	2.36	4.379	1.976	1.219
1210	0.95553	0.00884	86.676	0.804	0.507	1.471	0.696	0.041	2.973	0.378	3.409	2.893
1240	1.12462	0.00906	89.231	0.719	0.098	1.053	0.409	0.179	2.634	0.373	2.881	2.217
1270	1.09299	0.00645	91.318	0.542	0.303	0.746	0.365	0.157	2.147	0.338	2.383	1.341
1300	0.8445	0.0038	90.54	0.489	0.293	0.371	0.303	0.139	1.929	0.377	2.467	2.681
1330	2.15354	0.00694	97.207	0.314	0.113	0.123	0.094	0.052	0.41	0.071	0.721	0.76
1360	2.1297	0.0037	90.649	0.321	0.072	0.101	0.061	0.059	0.406	0.287	0.952	1.181
1390	5.92327	0.02398	97.453	0.395	0.209	0.216	0.132	0.014	0.217	0.184	0.638	0.504
1420	5.4955	0.0251	97.238	0.444	0.301	0.216	0.246	0.023	0.297	0.232	0.581	0.347
1460	2.1735	0.0327	91.348	1.379	1.286	0.538	1.049	0.035	0.78	0.718	1.688	1.147
1480	5.8068	0.0188	94.269	1.003	0.942	0.355	0.833	0.021	0.493	0.493	0.946	0.6
1500	4.8755	0.0655	94.495	1.273	1.182	0.228	0.453	0.024	0.509	0.466	0.914	0.411
1540	6.52573	0.09994	89.472	1.371	1.243	0.538	1.382	0.043	1.192	1.263	2.404	1.07
1560	2.426	0.0706	83.618	2.178	1.537	0.214	0.897	0.083	2.08	2.376	4.872	2.072
1600	3.5775	0.2867	77.808	6.247	2.172	0.796	1.793	0.036	1.666	1.821	4.826	2.928

Geochemical properties of HC gasses samples are determined by parameters such as; C1/ C2, C1/ C2+, C2/C3 and C^{13} of methane (Table 2). Methane stable carbon isotope has a different behavior compared to others parameters and is not a good correction between them (PRIFTI & BITRI, 1992).

Based on the hydrocarbon composition of gasses the following indicators are calculated:

1. C1/C2 = Methane (CH4)/Ethane (C2H6),
2. C1/C2+ = Methane /(Ethane+Propane + Butane+ Pentane+Hexane+Heptane),
3. C2/C3 = Ethane/ Propa

In conformity with C1/C2 and C1/C2+ (Table 1, Fig. 2), all types of HC gasses are present (very dry, dry, wet and very wet gasses). The first level (1115 m – 1180 m, including the first production interval) is reflected very weak because the geological section is argillised.

In the interval 1300 (m) - 1390 (m) the values of C1/C2 and C1/C2+, increase immediately and HC gasses are included in dry to very dry gasses. This phenomenon is conditioned by two factors:

- HC gasses are generated from Miocene deposits.
- Or a new migration phase of methane gas from deeper part has occurred during Post – Pliocene time.

Table 2. Parameters of hydrocarbon gasses and Carbon isotopic ratio of methane (C^{13}).

Depth (m)	C1/C3	C1/C2+	C2/C3	Carbon isotopic ratio of methane (C^{13}- ‰)
1120	42.84056	267.629	8.888889	-32,8
1150	114.6765	25.01796	1.883146	
1190	97.88868	6.93407	34.82759	-35,25
1210	108.0916	6.580322	1.585799	
1240	124.1302	8.447505	7.336735	-34,5
1270	169.4558	10.97308	1.788779	-31,1
1300	222.2368	10.00553	1.668942	
1330	310.3084	36.57148	2.778761	-30,9
1360	575.5946	26.35145	4.458333	
1390	247.0088	38.84137	1.889952	-31,11
1420	218.9442	36.18831	1.475083	-30,85
1460	66.46789	10.59722	1.072317	-28,45
1480	308.8723	16.57914	1.064756	
1500	74.43511	17.30678	1.076988	-30,2
1540	65.29648	8.516276	1.102977	
1560	34.36261	5.127108	1.417046	-27,2
1600	12.4782	3.491497	2.876151	-29,1
1660	13.29994	3.653106	2.039411	-26,4

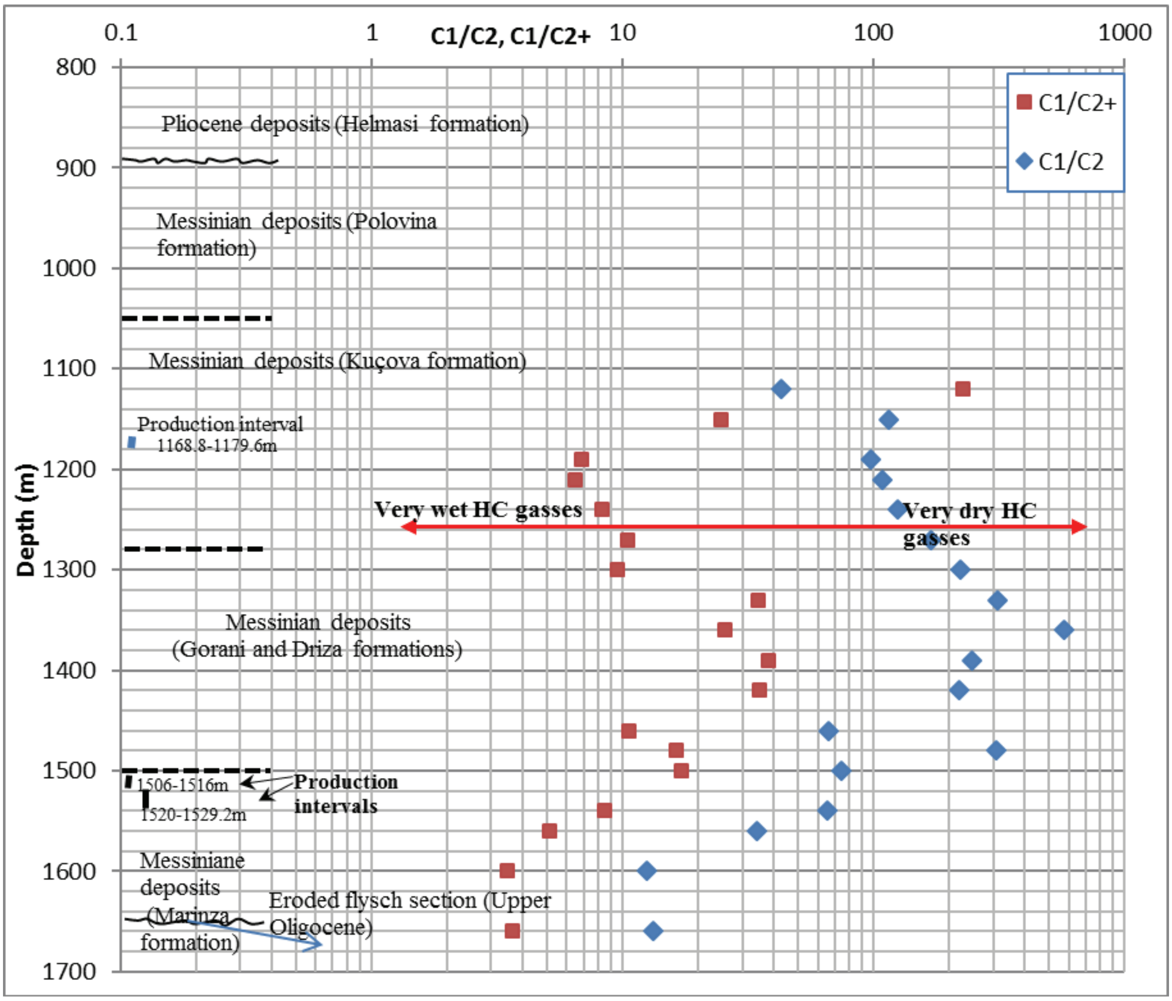

Figure 2. Type of geochemical HC gasses on geological section of Marinza-3111 well.

In deeper section more than 1390 (m) the values C1/C2 and C1/C2+, decrease and HC gasses become wet and very wet one, which express e gaseous anomaly caused by oil accumulation in 1506 (m) – 1529 (m) interval (Fig. 2). Oil accumulation is expressed more clearby C2/C3 ration, because lower are typical for oil associate gas (Fig. 3).

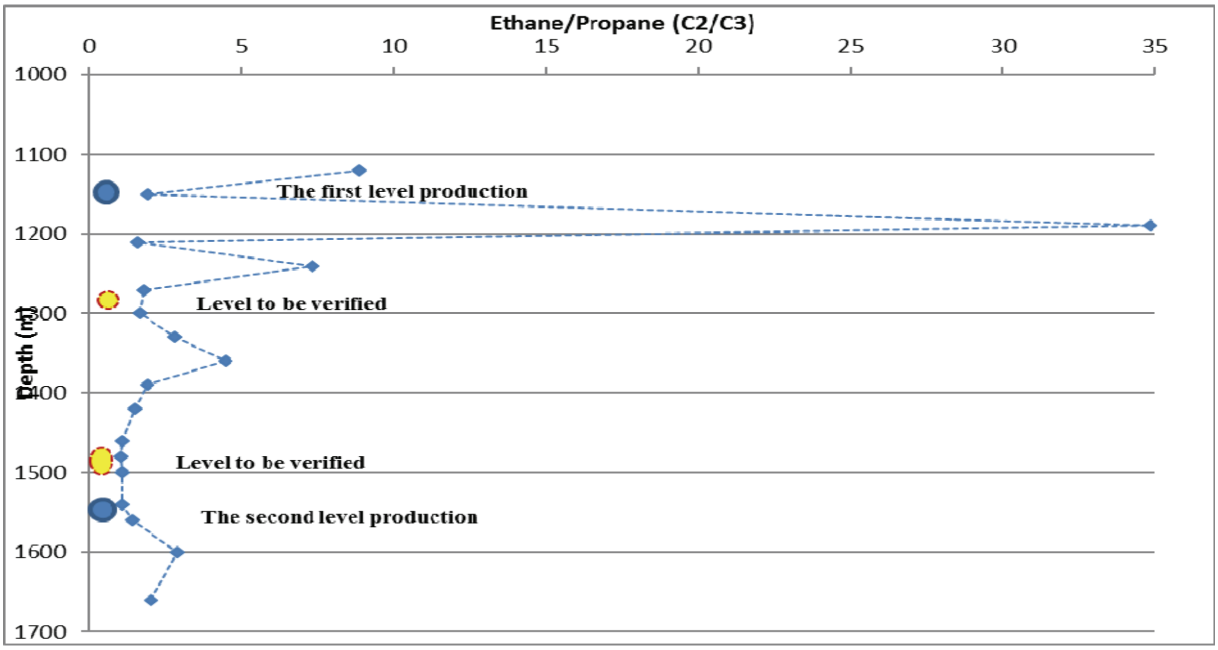

Figure 3. Determination of oil accumulations in the geological section of Marinza-3111 well by C2 / C3 ratio.

Different values of these parameters depend on some conditions:

- Gas samples where C2/C3>5 are generated from Middle Miocene deposits and are not influenced by oil accumulation.
- HC gasses were migrated.
- Decreasing of C2/C3 ratio in deeper section is caused by oil accumulation on "Marinza" formation.

The non-compliantsurface has contributed to the decrease of the C2/C3 ratio because matured hydrocarbon gaseshad migrated from this surface d (PRIFTI & BITRI, 1998).

The carbon isotopic ratio of methane (C^{13}) values ranges from -35.28 % to -26.84 % which express high level of maturity. Based on this parameter, a separation in matured HC gases is also allowed (C^{13} of CH4 = -31.65% + -26.84%) (Fig. 4).

The first group is taken from the shallow part of the geological well (up to 1390(m) and the second from deeper part (under 1390 m), therefore methane stable carbon isotope values increase with depth. High values of this parameter exclude the possibility of generation from Miocene deposits (PRIFTI & MUSKA, 1994).

There is no proper connection between C^{13} of methane and other geochemical parameters of HC gasses. On the top of geological section (1060(m) – 1390(m)) there isn't any connection with gaseous parameters. It does not exist in nature matured HC gases with high content of iso-butane and iso-pentane (Table 1).

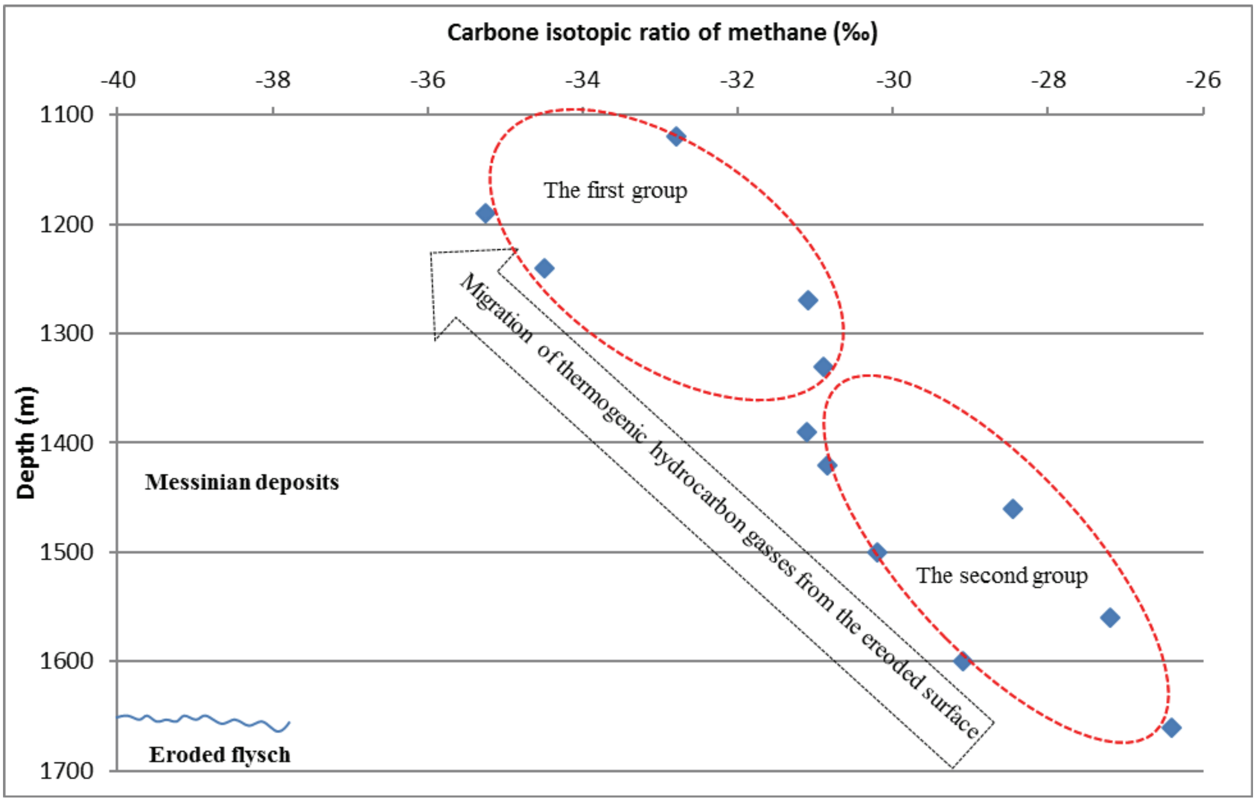

Figure 4. Variations of the carbon isotopic ratio of methane to the geological section of the Marinza-3111 well.

HC gasses which are taken from interval 1390(m) – 1660(m) are overmatured (C^{13} of CH4) and include in thermogene gasses, while according to other geochemical parameters (C1/C2 and C1/C2+), become wet and very wet.

There is no connection between them because thermogenic gasses are dry and very dry. The non-compliance of C^{13} of CH4 with other parameters results from a general contamination in the Marinza oilfield during the youngest migration phase of thermogene HC gasses.

Source rocks of Miocene deposits are immature, generate only biological gas (Carbon isotopic ratio of methane-C^{13}< -55‰) (Fig. 5).

Source rocks of the Ionian zone are within the "oil window",while the deeper blocks content over matured source rocks, which generate mature hydrocarbon gas (SHKURTAJ et al., 2002)

The first group of hydrocarbon gasses isgenerated by source rocks which are in stage of "**Condensates and wet gas generation** (δC_1^{3}= -37°/oo ÷ -31°/oo)". This group of hydrocarbon gases correlates with those of the Kolonja-8 well.

The second group of hydrocarbon gasses are generated by source rocks which are in stage of "**Stage of thermogene gas generation** (δC_1^{13}>-32°/oo)".

Hydrocarbon gases with high of carbon isotopic ratio of methane (C^{13}) values are generated from over matured source rocks.

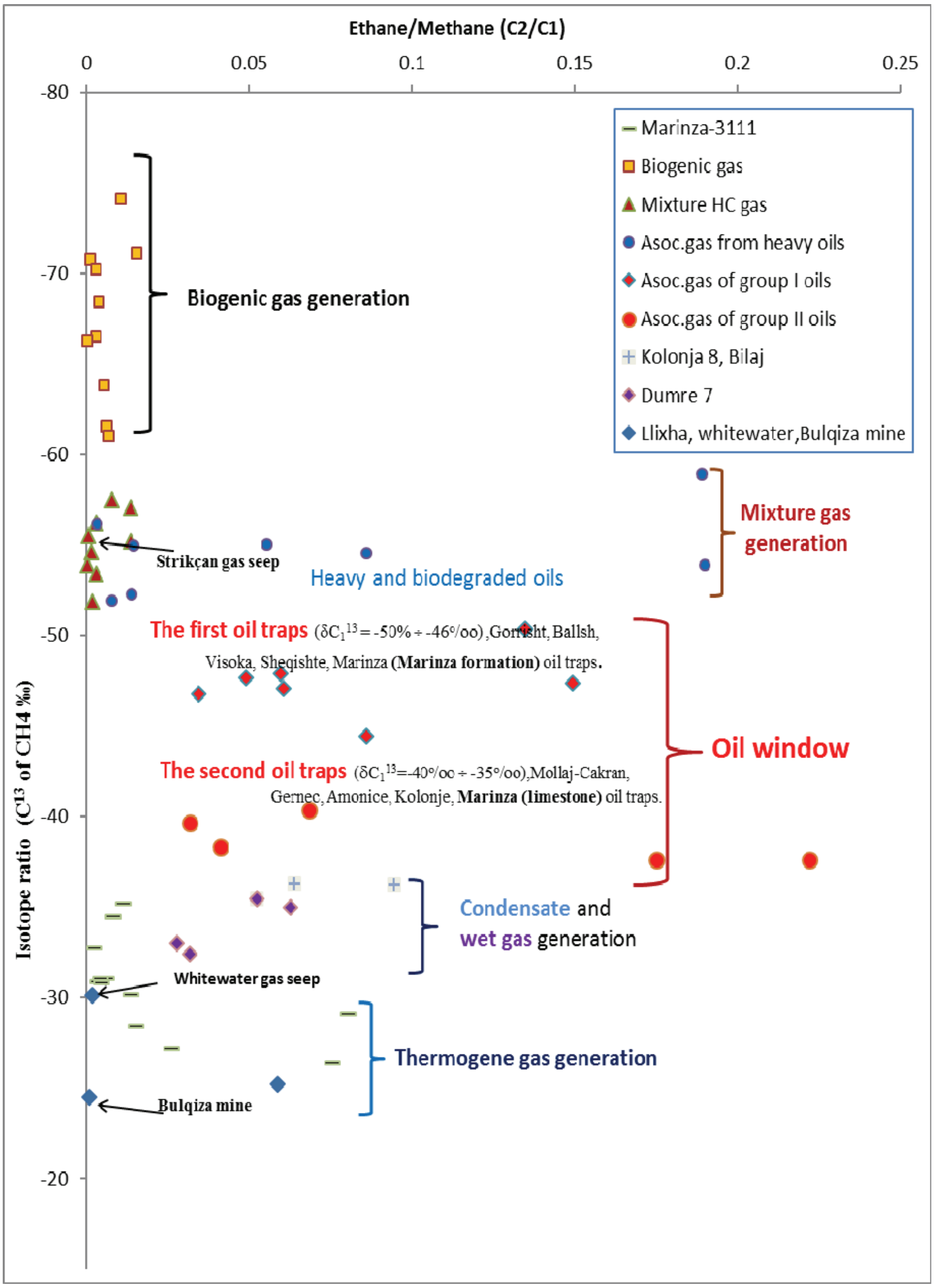

Figure 5. The position of hydrocarbon gasses from the Marinza-3111 well on the geochemical model of petroleum generation (based on SHKURTAJ et al., 2002, modification by Prifti and Seitaj).

THE PRODUCTION RHYTHMS OF THE MARINZA-3111 WELL

The oil production process of a well is carried out according to several cycles:

The first cycle utilizes the internal energy of the oil trap,

The second cycle continues with the application of the second methods,

In the third cycle begins the drilling of horizontal wells,

The fourth cycle is the repetition of the second cycle.

Once the oil extraction reserves have been extracted from the well, then technological water and CO2 injections start. The Marinza-3111 well was drilled into the northeastern contour of the Marinzaoilfield. It can be called the contour well. After the drilling, the well started producing crude oil in June 1996 (File of Marinza-3111 well).

We have studied the first cycle of oil production in the Marinza-3111 well. The duration of the first cycle is dependent on several factors: the physical-chemical characteristics of the crude oil (light petroleum tend to be the shortest time), the elasticity of the reservoir and the fluids, the energy of the hydrocarbon gas dissolved in the crude oil (the gas factor is high rhythm of energy), the energy of the capillary, the energy of the bottom water, the dimensions of the oiltrap. The Marinza-3111 oil trap is small after reducing the natural reservoirs. This is related to the well position, which is located on the contour of the oiltrap, where the lithological section of the Micene deposits is clayed.

The ones we discussed above have affected the fact that the first production cycle has short time.

There are cases when the first cycle has not been completedsince 1935 (wells of heavy crude oil in Kuçova oilfield) (GJOKA et al., 2002).

The communication of the natural crude oil reservoir with the column of the well was achieved after three months of work. This was reflected in the increased quantity of crude oil produced. The production rhythm was preserved the same until February 1997 (Table 3).

At this stage, the communication paths between the reservoir and the wells columns began to get blocked. This is the result of the arrival of the sand in the well column. Communication routes are unblocked with the upgrade process. This process is related to cleaning the sand from the well's forehead. The same working method was carried out in the month of August 1997. Oil production from the well continued until the end of 1997. Subsequently, the well was transferred to another company's property and second methods were applied for the production of crude oil. After this time we are not authorized to publish the data. But other levels have been tested, as we have recommended. New secondary methods have been applied. The results were very good and more crude oil was produced (Fig. 6).

Table 3. Crude oil production by Marinza-3111 well.

Nr	year	Month	Grude oil (ton)	Gas (000/m^3)
1	1996	June	6.6	7.2
2	1996	July	8.7	12.6
3	1996	August	60.8	4.32
4	1996	September	197.8	5.58
5	1996	October	125.6	5.27
6	1996	November	116.4	5.51
7	1996	December	121.9	3.72
8	1997	January	98.8	3.36
9	1997	February	79.6	3.72
10	1997	March	102.7	3.48
11	1997	April	111.1	3.72
12	1997	May	112.6	3.6
13	1997	June	96.7	3.72
14	1997	July	57.5	2.76
15	1997	August	98.4	3.36
16	1997	September	95.4	3.6
17	1997	October	39.7	3.48
18	1997	November	7.2	0.96

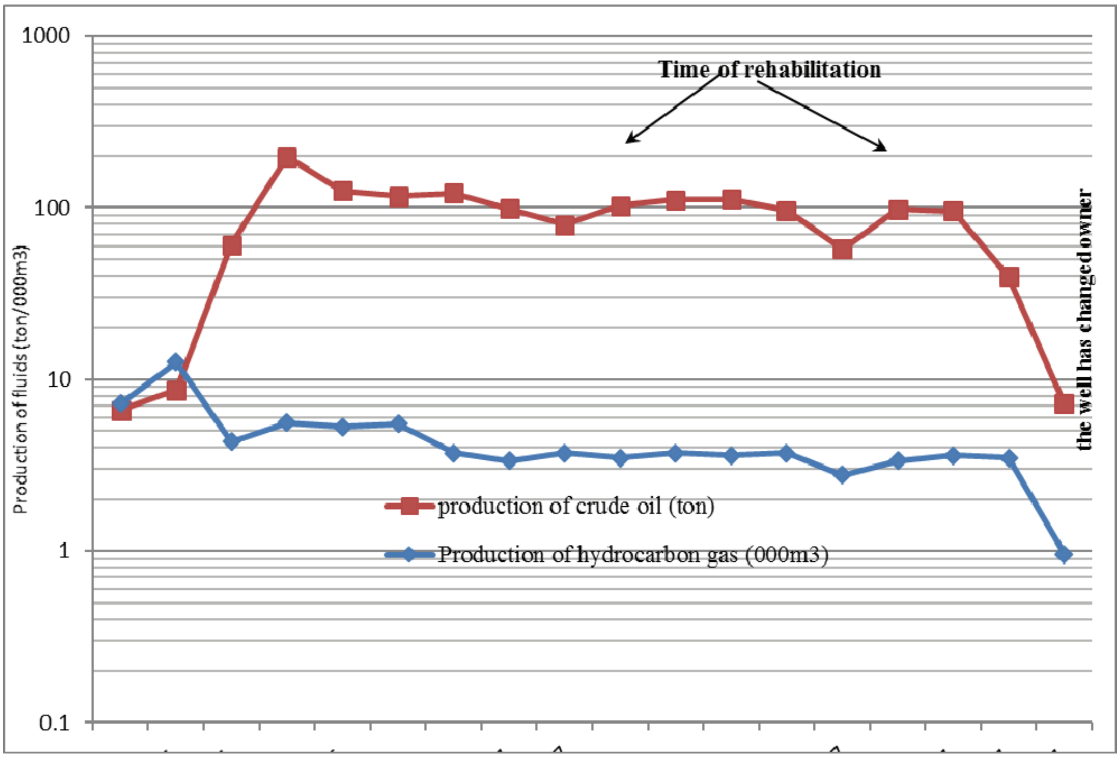

Figure 6. Crude oil production by Marinza-3111 well.

CONCLUSIONS

The geological section reached by the Marinza – 3111 well is reduced.Reducing the geological section is the result of the well position on the eastern side ofMarinza oilfield.

From geochemical investigations on the geological section reached by the Marinza – 3111 we shall draw some important conclusions regarding the interpretations of geochemical parameters for putting in evidence the oil accumulations and the prospecting for gas accumulations in deeper part of limestone section.

According to geochemical parameters (C1/ C2, C1/ C2+, C2/ C3), oil accumulations are identified in two levels of Miocene deposits, while for the two other levels they should be verified by the testing process.

Values of methane stable carbon isotope in oilfield complex in Marinza range from -47.9% to -26.84%.

A general contamination of oil accumulations and geological section from thermogene HC gasses occurred during the post-Pliocene migration phase.

Thermogene HC gases was mixedwith oil associate gases in deeper (under 1390 m) of Miocene deposits in Marinza 3111 well, so that the values of $C^{13}$of CH4 are higher.

Oil production from the well has been at acceptable rates since cutting is generally argillised.

Rehabilitation processeswere related to cleaning the sand from the well's forehead. These processes were carried out when the oil production was blocked.

During the interpretation of geochemical indicators two levels were identified in the depth of 1290 m and 1490 m. These levels should be subjected to the testing process.

Based on the above discussion, we conclude thatthermogenic gas traps must exist in the north of the Marinza oilfield.

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