OIL PRODUCTION HISTORY IN ALBANIA OIL FIELDS AND THEIR PERSPECTIVE

Dhimitraq Marko and Aleksander Moci

Technological Institute for Oil & Gas, Patos, Albania

ABSTRACT

In this paper we will make a general presentation for oil fields in Albania, actual state, and their perspective.

BACKGROUND DATA

Production History of Existing Albanian Oil fields

Production commenced in Albania in the Kucova field in 1929. Additional significant reserves were discovered and placed on production as follows:

Reservoir name	Reservoir type	Year
Driza (Marinza field)	Sandstone	1939
Marinza #2	Sandstone	1957
Marinza #1	Sandstone	1963
Visoka	Limestone	1963
Gorisht-Kocul	Limestone	1966
Ballsh-Hekal	Limestone	1967
Arrza	Sandstone	1974
Cakran Mollaj	Limestone	1978
Amonica	Limestone	1980
Delvina	Limestone	1989

Other smaller sandstone reservoirs have been identified but are not the subject of this study.

The most important fields in Albania today are Patos-Marinza, Kucova, Cakran-Mollaj, Ballsh, and Gorisht fields. Production of oil and gas is from Jurassic, Cretaceous, and Eocene carbonates as well Oligocene though Pliocene sandstones (see Figure 1).

Oil exploration began in Albania in 1918 near the surface bituminous sandstones which crop out near the town of Fieri. Oil was discovered in the Miocene Driza sandstone on the Patos-Marinza monocline in 1928. These fine grained, poorly cemented sandstones have high porosities and permeabilities.

The depth of the Driza formation varies from 100 meters to over 1800 meters in the Patos-Marinza field. The oil in the Driza sandstone is heavy (10–12 API) and was discovered beneath the Driza formation in the deeper and more consolidated Marinza sandstones (Table 1).

Total oil in place in the Patos-Marinza monocline is in excess of 240 million tons, however, only 15.3 million tons have been produced to date.

Similar to the Patos-Marinza field, the Kucova field, located northeast of Patos-Marinza field, was discovered in 1928 in lenticular Miocene Tortonian sandstones. The oil in Kucova field also is heavy and the estimated oil place is 68 million tons, of which only 3.2 million tons have been produced to date (Tables 2 and 3).

In 1963, an oil-bearing Paleocene limestone was discovered in the Patos-Marinza monocline. This discovery, later called Visoka field, stimulated further exploration in carbonate reservoirs in Albania. Several new fields were found, including Gorisht-Kocul (1966) and Ballsh (1967). During the 1970s, additional oil and gas discoveries were made including the Divjaka and Frakulla gas fields and the Cakran-Mollaj and Amonica oil fields. Flow rates in excess of 250 tons per day from porous and/or fractured limestones were common during the early production histories of these fields. In fact, initial production rates from the Cakran-Mollaj field were estimated to be in excess of 1,100 tons per day in Well #37. Unfortunately, this rate was an uncontrolled blowout which caught fire and burned for three years. One of the results of the blowout was to dramatically decrease the reservoir pressure in the field, which in turn lowered production rates and ultimate recovery factors in the field as a whole. Blowouts also occurred during the drilling of the initial wells in Ballsh, Gorisht, and Frakulla fields, and the Marinza 2 formation in the Patos-Marinza field. Flow rates from Well #542 in the Marinza 2 formation were estimated to be 1,500 tons per day as measured after the fire was extinguished (Table 4).

Record keeping in the Albanian oil fields has been meticulous with respect to production data and individual well histories. Production is regularly recorded by stock tank measurements and maintained current by ledger or, increasingly, by input into computer data bases. A significant percentage of the well data has been input into a computer data base that plays an important part in this study in both the primary and Enhanced Oil Recovery production methods determined to be technically viable in this review.

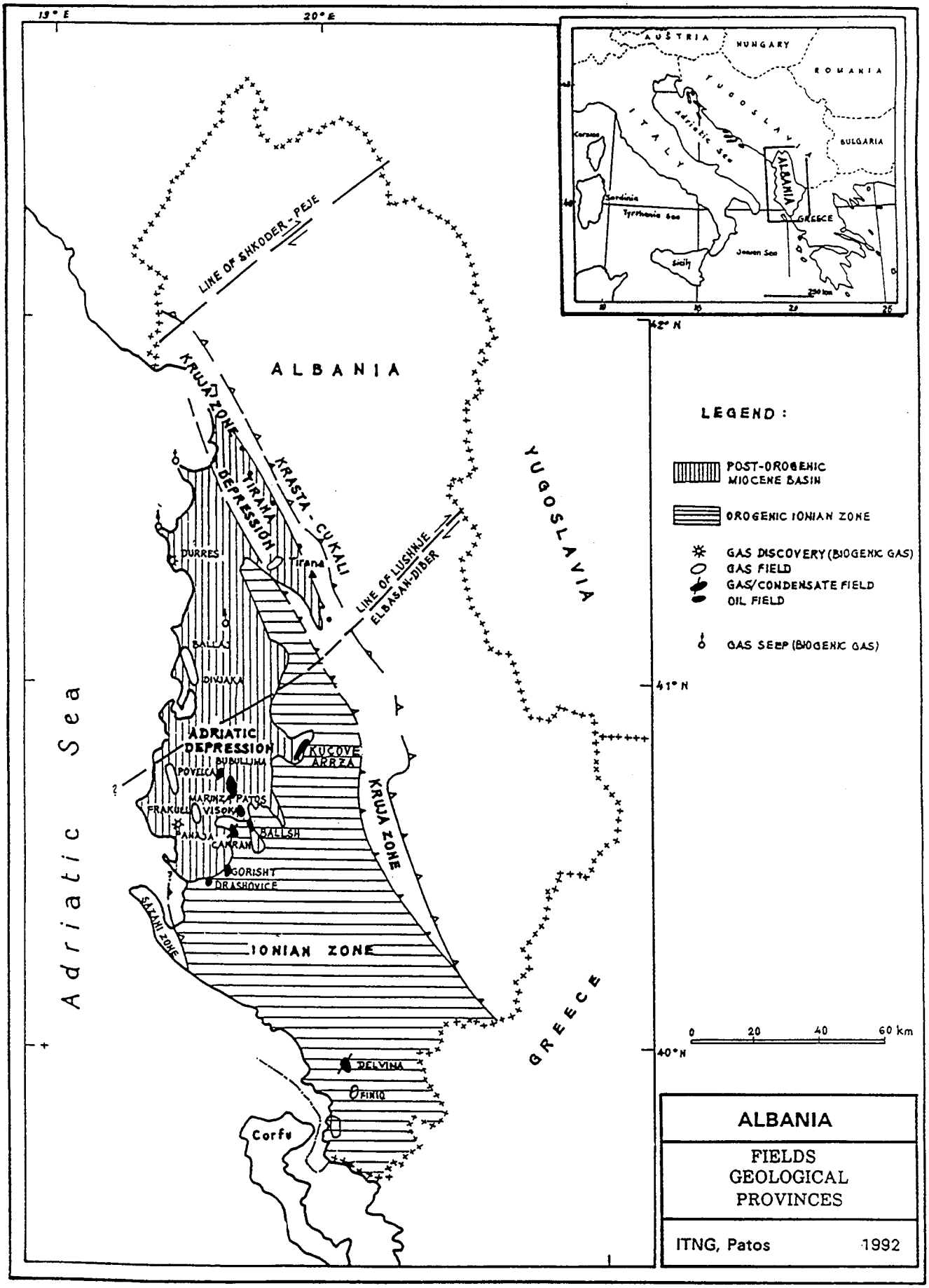


Figure 1. Oil and gas fields and geological provinces of Albania.

Table 1. Data of the reservoirs and some properties of fluids

Reservoir object	Depth to top pay	Net thickness of reservoir (average) (m)	Gross thickness of reservoir (m)	Number of layers	Gravity °API	Oil viscosity (cp)	
						surface cond 20°C	reservoir cond
Marinza 2	1480–1750	14.5	1–52	2	16.5–35 5	10–300	4–110
Marinza 1	1480–1750	28	1–70	6	9–24	100–20000	10–2500
Driza	+100–1850	21	1–120	6	9–12	20000–600000	960–3500
Kucova	+150–1400	35	10–160	2–30	14.5–22	150–1200	60–280
Arreza	900–1350	4.6	2–19	1	12–17	520–2300	140–290
Visoka	800–1700	200–300			5–16	1000–2000	
Ballsh–Hekal	450–1700	350			13–	2000	
Gorisht–Kocul	400–1250	350–450			13–16	200	
Cakran–Mollaj	1650–3700	400–800			11.5–37	10–2630	
Amonice	2000–2500	up to 200			14.5–22	150–2300	

Table 2. Data of the reservoirs until 01/01/1992

Reservoir object	Discovery year	Oil in place million ton	Gas in place $\times 10^6$ Nm^3	Cumulative oil production		Cumulative gas production	
				million ton	%	million ton	%
Marinza no. 2	1957	8.40	800	2.7117	32.28	250.00	31.25
Marinza no. 1	1957	32.00	1600	3.9327	12.29	196.60	12.29
Driza	1939	200.00	6000	9.0682	4.53	272.05	4.53
Goran	1975	20.00	400	0.0775	0.38	3.72	0.93
Kallem-Verri Neogen	1975	2.00	750	0.369	18.45	500.00	66.67
Kucova	1927	70.00	2800	3.2617	4.66	100.00	3.57
Arreza	1975	4.60	184	0.0351	7.63	17.55	9.54
Pekisht-Rasa		1.10	11	0.0107	0.97	0.21	1.91
Sandstones (total)		338.10	12545	19.0976	5.85	1340.13	10.66
Visoka	1963	24.00	960	5.191	21.16	200.00	20.83
Gorisht-Kocul	1966	36.00	1440	10.7725	29.92	450.00	31.25
Ballsh-Hekal	1967	19.00	1053	4.5605	24.00	350.00	33.24
Cakran-Mollaj	1977	27.00	15000	3.3388	12.36	6000.00	40.00
Amonice	1980	2.80	140	0.5516	19.70	25.00	17.86
Zharres Limestone	1977	3.00	90	0.3004	10.01	10.00	11.11
Limestones (total)		111.80	18683	19.5238	22.11	7035.00	37.65
Totals (S + L)		**449.90**	**31228**	**38.6214**	**9.89**	**8375.13**	**26.82**

Table 3. Albanian oil field reserves until 01/01/1993 (MM tons)

Field/reservoir	OOIP	Recovery reserves	Prod	Remain reserves	Percent oil prod		Calc prim rec	Difference
					of OOIP	of rec		
Kuchova	68	10.9	3.2	7.7	0.05	0.29	0.16	0.11
Driza	200	20	9.2	10.8	0.046	0.46	0.1	0.054
Marinza #1	32	4.9	3.87	1.1	0.12	0.78	0.15	0.03
Marinza #2	8.4	3	2.75	0.25	0.327	0.91	0.36	0.093
Visoka	24	5.8	5.2	0.6	0.22	0.9	0.24	0.02
Gorisht-Kocul	36	14	10.8	3.2	0.3	0.77	0.39	0.09
Ballsh-Hecal	19	6.4	4.55	1.85	0.24	0.71	0.34	0.1
Arrza	5	0.75	0.34	0.41	0.07	0.45	0.15	0.08
Cskran-Mollaj	27	4.8	2.84	1.96	0.1	0.59	0.18	0.08
Amonica	2.8	1.5	0.5	1	0.18	0.33	0.54	0.36
Goran	20	1.6	0.0775	1.52	0.003	0.05	0.08	0.077
Neog K-V	2	0.5	0.369	0.131	0.18	0.74	0.25	0.07
Total	444.2	74.15	43.70	30.521	0.1	0.59	0.17	0.07

Table 4. New field initial production data

Limestone reservoirs			
Ballsh-Hekal	35 tons/day first 2 wells, best well 90 tons/day	700 meters	1967 discovery
Gorisht-Kocul	90 tons/day first 2 wells, 60 tons/day first 10 wells	800 meters	1966 discovery
Cakran-Mollaj	250 tons/day first 2 wells, 113 tons/day first 11 wells		
	Well 37 1100 tons/day first year (blowout)	3200 meters	1979 discovery
Visoka	37 tons/day first 25 wells	1000 meters	1963 discovery
Sandstone reservoirs			
Marinza 2	100 tons/day first 6 wells, Well #542: 1520 tons/day	1600 meters	1957 discovery
Marinza 1	45 tons/day first 40 wells, best well 100 tons/day	1550 meters	1959 discovery
Driza	10 tons/day	1300 meters	1939 discovery
Kucova	7 tons/day, first 14 wells	200 meters	1928 discovery
Bubullima	90 tons/day, first well	2000 meters	1975 discovery

Regional Geology

The petroleum industry is one of the oldest industries in Albania. Oil and gas seeps have been know since ancient times. As early as Roman times, bitumen was mined near the town of Vlore. The first acceleration of Albania's modern petroleum industry came during World War I when oil was discovered at Drashovice. But real growth in production was not achieved until the late 1920s, when Italy again invested money into the search for petroleum in Albania. As a result of this investment, oil was discovered in 1928 in what is today the Patos-Marinza field and the Kucova field. Annual Albanian oil production, in fact, is one of the chief reasons for Mussolini's invasion of Albania in 1939.

After Word War II, oil production declined and exploration and production were managed by a joint Albanian-Yugoslavian company. In 1948, annual production was 174,000 tons, and increasingly, the Soviet Union established a dominant role in the Albanian petroleum industry. This relationship continued until 1961, when Albania severed diplomatic and trade relations with the Soviet Union. China immediately began providing financial and technical aid to Albania, and production reached an all-time maximum in 1974 of 2.2 million tons (6000 tons per day). Four years later, in 1978, Albania ceased diplomatic relations with China (Figures 2 and 3).

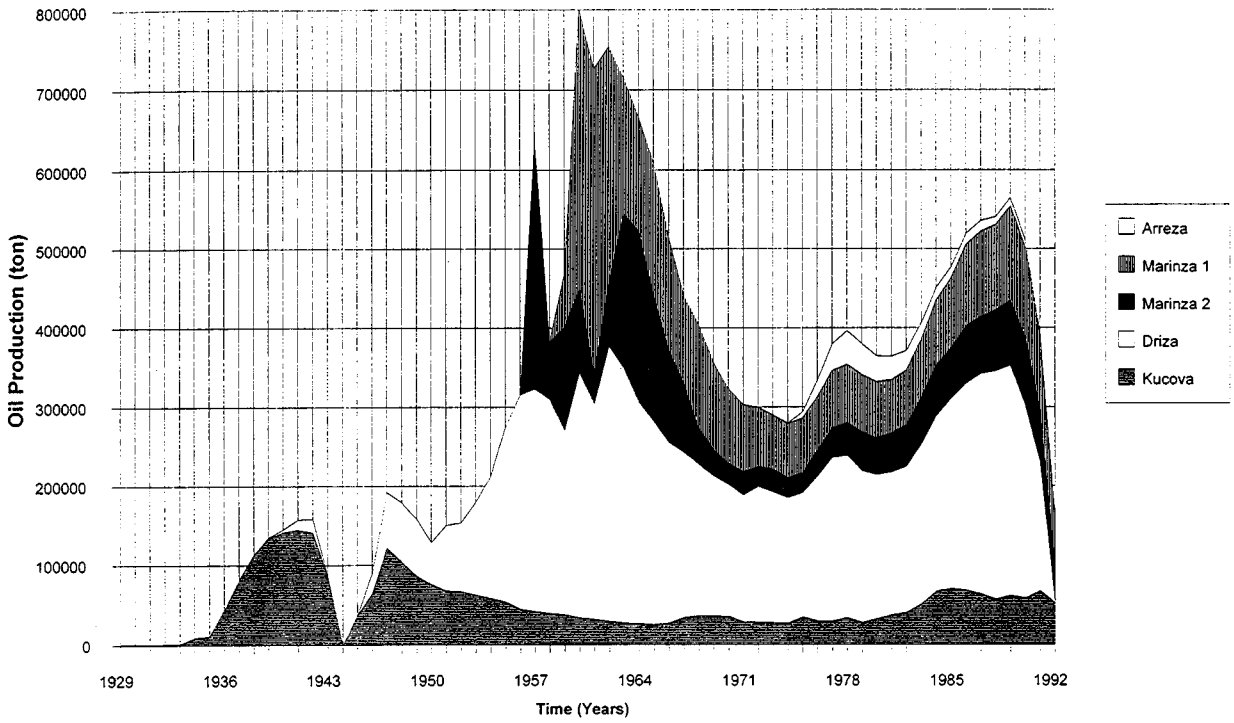


Figure 2. Oil production history of sandstone oil fields.

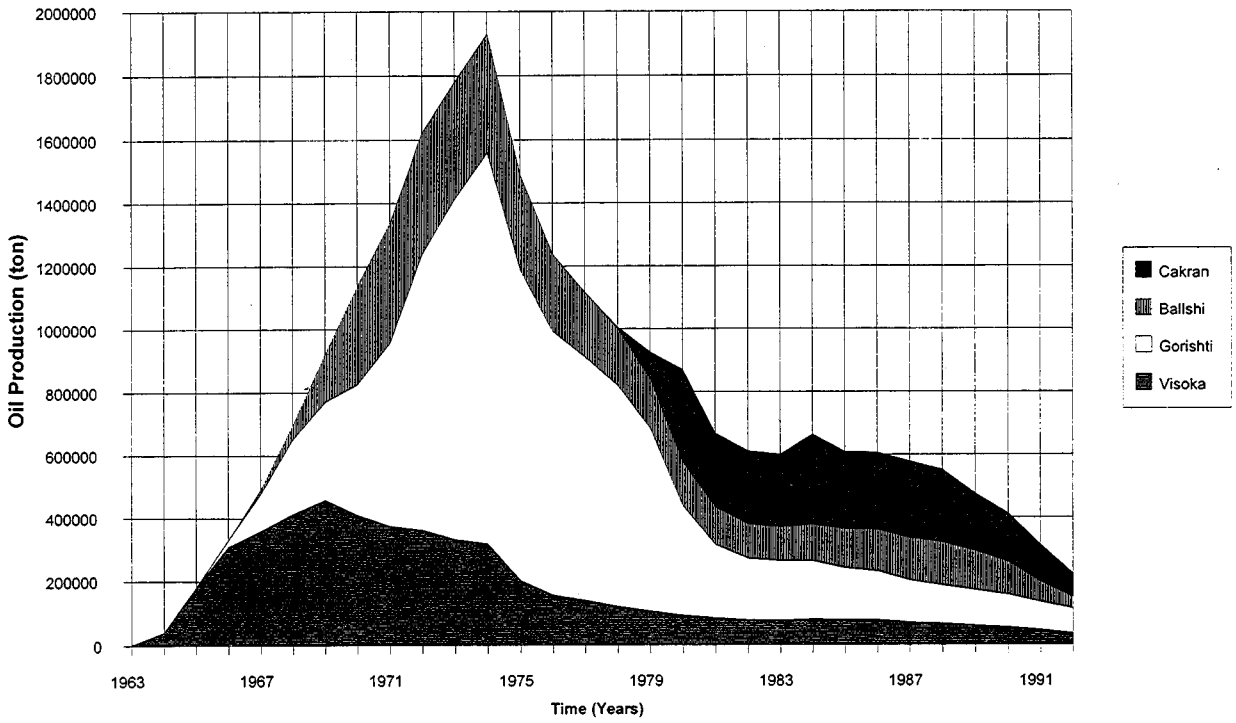


Figure 3. Oil production history of limestone oil fields.

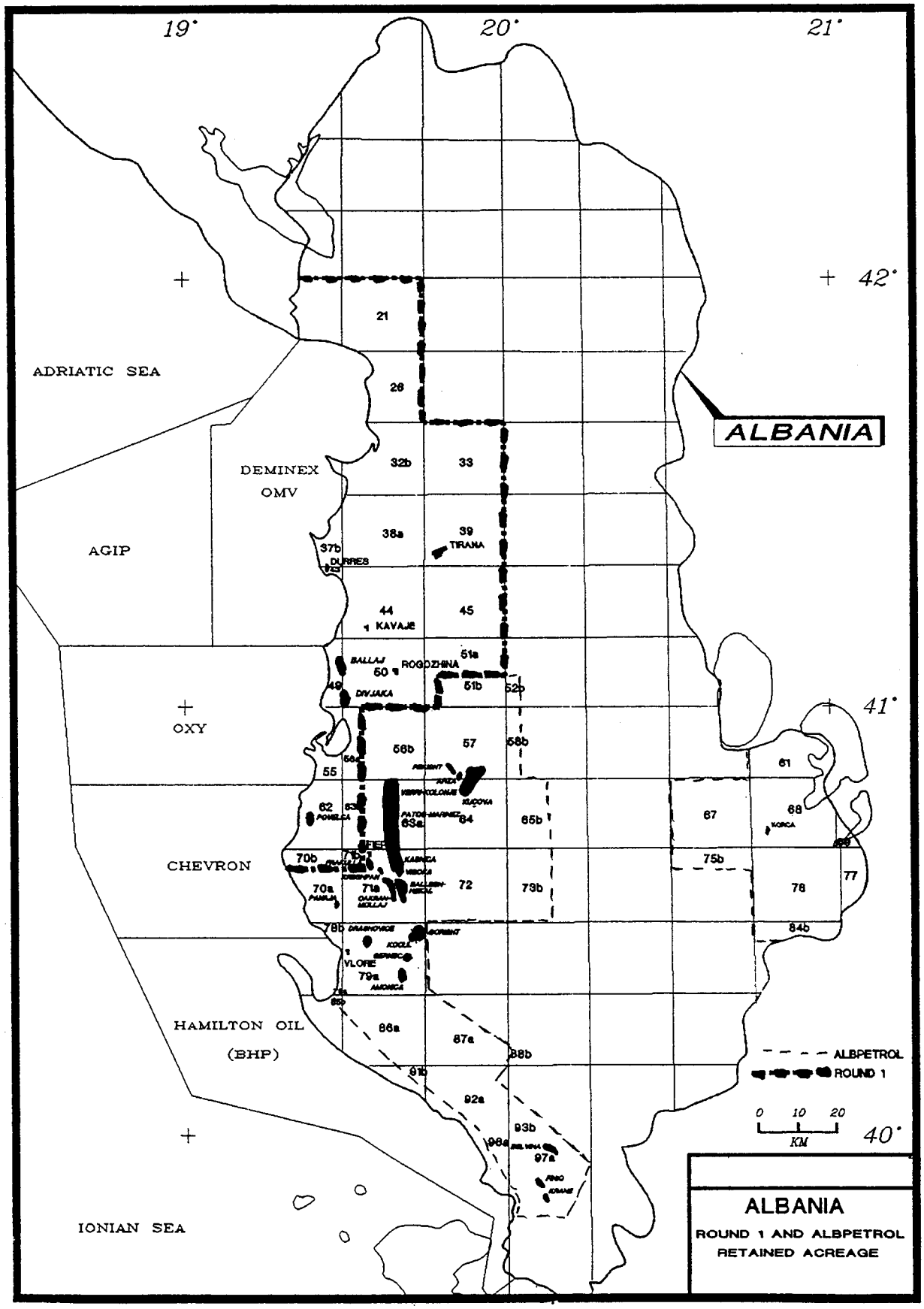


Figure 4. Lease block grid, Round 1 lease offering, and area retained by Albpetrol.

More recently, in 1989, total annual oil production was approximately one million tons (2800 tons per day). In March 1994, the total oil production for Albania was 1300 tons per day. This steep decline is attributed primarily to lack of materials and social problems within the work force, along with natural decline. Therefore, ALBPETROL, the state owned oil company, needs to find ways to increase production from existing fields while, at the same time, encouraging exploration in new and old areas alike.

ALBPETROL, formerly called DPNG, was reorganized in 1992. ALBPETROL has exclusive rights for all hydrocarbon activities in Albania. ALBPETROL has recently divided the country into a grid of approximately 360 square kilometers (see Figure 4). Twenty blocks have been nominated for Round 1 of onshore bidding and ALBPETROL has retained approximately 22% of all blocks for its own activities.

Regarding Round 1, ALBPETROL has enlisted the services of Western Geophysical to reprocess the existing seismic, prepare the data packages for sale, and market these packages on behalf of ALBPETROL. These data packages will be for sale from November 1992, through February 1993. All data must be evaluated and bids submitted to ALBPETROL no later than June 30, 1993. The timing of later bid rounds will be decided at on May 30, 1994. Regarding ALBPETROL's retained acreage, ALBPETROL does not have sufficient capital or materials to explore these blocks entirely on its own. The companies are currently working with them to formulate an agreement and exploration program to properly evaluate these areas.

Albania may be divided into seven different geologic regions or provinces which are listed below (see Figure 1):

1. Alpine Province
2. Korabi Mountains
3. Mirdita Province (Burreli Basin and Korca Basin)
4. Krasta-Kucali Zone
5. Kruja Zone
6. Ionian Province
7. Sazan Zone

The Alpine Province, located in the far northern portion of Albania, is the southern extension of the European Alps. This province is characterized by rugged mountains which are composed of Triassic, Jurassic, and Cretaceous rocks which were uplifted, faulted, and eroded during the late Alpine orogeny.

Similarly, the Korabi Mountains, located in the northeastern portion of Albania, consist of Mesozoic carbonates, Permian evaporites, and early Paleozoic clastic and metamorphic rocks. Some of the mountain peaks in the Korabi Mountains are in excess of 2,800 meters. The hydrocarbon potential of both of these geologic provinces is unknown without additional study, but must be considered poor due to the magnitude of the late Tertiary tectonics and erosion.

The Mirdita Province, located along the eastern border of Albania, is also rugged and mountainous. Generally, this province is composed of sedimentary, metamorphic, and igneous rocks of Paleozoic and Mesozoic age. These include Permian sandstones, argillites, and limestones as well as coarse Triassic clastics and cherty limestones. Other Mesozoic rocks in the province are massive Jurassic limestones. Within the folded and faulted Mirdita Province are two isolated basins, namely the Burreli and Korca Basins. Neogene clastic rocks have been mapped at the surface of both of these basins, but both basins remain virtually unexplored for petroleum and must be evaluated in the future to assess their petroleum potential.

The Krasta-Kucali Zone and Kruja Zone are long, NNW-SSE trending fault zones where the generally older Mesozoic rocks of eastern Albania have been thrusted into and over the younger Mesozoic and Cenozoic sediments of the Ioanian Province. The timing of these compressional tectonics is late Alpine, probably middle to late Miocene. The petroleum potential within these fault zones will be dependent on the magnitude of the faulting and uplift is locally intense, then structures will be breached and the hydrocarbon potential will be low. However, less intense faulting; uplift will create excellent fracture porosity and permeability in the Mesozoic carbonates, thereby allowing late oil migration and excellent rates of production.

The Ionian Province is one of the most important provinces in Albania, because it contains nearly all the know oil and gas fields discovered in Albania to date. In addition, most of the food is grown here and the majority of the population resides in this area. The Ionian Province consists of Mesozoic and Cenozoic sedimentary rocks which have been gently folded and faulted during the late Alpine compressional tectonics. Onshore, the Ionian Province is divided into two distinct areas. The northern and more coastal area is called the Durres Basin. The Durres Basin consists of gently folded and faulted clastics of Neogene age underlain by Oligocene flysch deposits and Eocene through Jurassic carbonates. Almost all the existing production in Albania is located in the Durres Basin. The topography of the Durres Basin is generally low relief with small hills and broad valleys, and this area is extensively farmed.

Within the Durres Basin, a large circular plug of Permian-Triassic salt and evaporites has pierced the entire sedimentary section and crops out at the surface. The areal distribution of salt and salt-related structures in Durres Basin is unknown, but the presence of salt structures and oil seeps surrounding this structure enhances the exploration potential in the area.

The southern and extreme eastern portion of the Ionian Zone is much more rugged and consists of faulted carbonates and clastics of Eocene through Jurassic age with little Neogene sediment cover. No major fields have been found in this region to date, although the gas condensate Delvina field, discovered in 1989, proves that this region has reasonably good exploration potential.

The offshore Durres Basin has been completely licensed by major international oil companies in their search for hydrocarbons. The upper Tertiary sedimentary section is thought to thicken dramatically offshore. Tertiary shales are thought to be excellent source rocks and depth of burial should be sufficient to put these shales into the oil window. Exploration targets are thought to be within the Miocene and later sandstones.

The Sazant Zone is a thin strip of land along the coast (Figure 1) which is fault-separated from the Ionian Zone. Geologic surface exposure in this area shows steeply dipping Cretaceous carbonates thrusted over high-angle Tertiary limestones and clastic sediments.

EXPLORATION POTENTIAL

Regional Geology

The exploration potential for Albania is excellent. Good source rocks are already proven, as evidenced by the existing oil and gas fields and by the more than 300 oil and gas seeps found in the country. The best known source rocks are limestones of Paleocene and Cretaceous age, but good source rocks are also found in limestones of Jurassic age. The potential for high quality crude oils is good in the deeper carbonate reservoirs. The heavy oil found in Patos-Marinza field is due to biodegradation and escape of the lighter fractions due to breaching of the structure. Good source rocks have also been reported in Tertiary age shales, but due to their shallow depth of burial over most of the known producing fields, these Tertiary source rocks are immature. However, since this Tertiary section attains much greater thickness in the northern portion of the Durres Basin and offshore as well, these good organic shales in the Oligocene and Miocene may be the primary source rocks.

Reservoir rocks are found throughout the stratigraphic column, in Jurassic, Cretaceous, Paleocene -Eocene carbonates, and Neogene clastics, including some of the sandstones within the Oligocene flysch sequence. Many of the carbonates have some primary porosity but this is a function of the original depositional environment. Many other carbonates reservoirs owe their reservoir properties entirely to fracturing, which created sufficient porosity and permeability for excellent initial oil flow rates from 250–2000 tons per day. This fracture porosity was created during a major mid-Miocene tectonic episode which folded, faulted, and uplifted large sections of the Durre Basin and the rest of Albania as well. Oil migration may have taken place early or late in this episode depending on the fields in question. Obviously, oil migration into the Tortonian sandstones must have taken place during the Pliocene.

Seals and structures are ubiquitous in Albania. Seals consist of tight Cretaceous and Eocene limestones and Tertiary shales. Structural traps tend to be gently folded closed anticlines in the carbonate reservoirs, but the traps in the younger sandstones often have a strong stratigraphic component. For example, hydrocarbons in Kuchova field are trapped in lenticular sandstones within a syncline. Hydrocarbons in Patos-Marinza field are stratigraphically trapped in sandstones which pinch out updip in the Patos-Marinza monocline. The seismic data which is being reprocessed in London by Western Geophysical will hold the key to defining the best structures,, where source rocks and reservoirs are at the optimal depths to create large accumulations of good quality oil. This seismic data must be examined and interpreted in both the Round 1 blocks and in the retained areas as well to define the best leads in both areas. The greatest risk in Durres Basin is the breaching of good structures as a result of the most recent late Alpine orogenic cycle.

Future play types in Albania may be in subtle stratigraphic types or in obvious deeper anticlinal structures. Stratigraphic traps may be in sandstones or limestones, in the middle of the basin or even a basin-edge play. Some structures may be salt-induced while others will be depositional. Tectonic history of Albania has created numerous potential hydrocarbon which will yield significant future hydrocarbon reserves.

ENHANCED OIL RECOVERY POTENTIAL

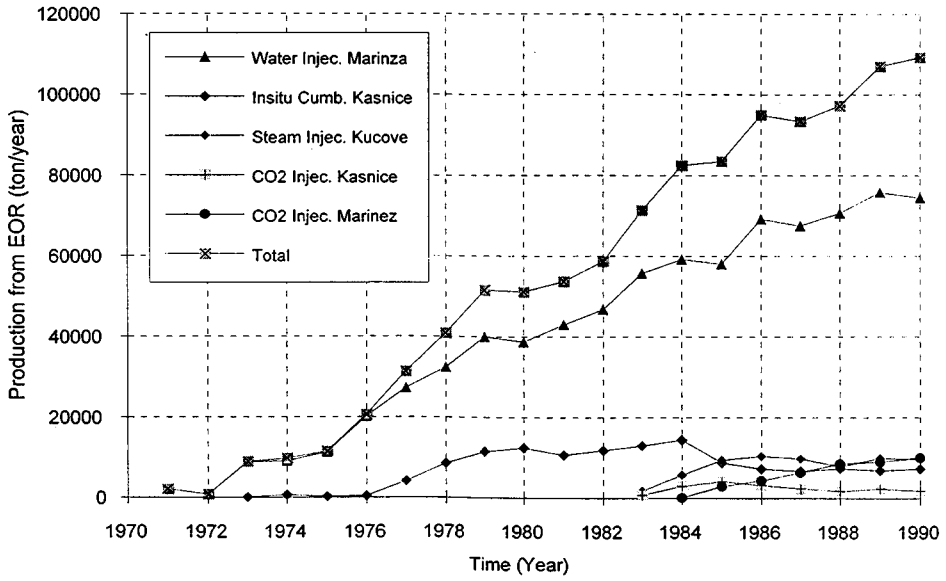
EOR pilot projects have resulted in technical successes in the past. Even through these attempts to increase oil production have been on a small scale, it is clear that incremental oil can be produced by any of several EOR methods (Table 5). This table shows that *in situ* combustion, huff-and-puff steam injection, water flooding, CO_2 injection, caustic flooding, and surfactant injection have been applied in Albania.

Our opinion is that EOR methods may be important to overall production in Albania.

For the Driza formation, these include steam flooding and hot water flooding. For Marinza 2 and Marinza 1, the use of polymer flooding will be successful to improve sweep efficiency.

Table 5. Production history from EOR methods

Viti	Water injection in Marinza (ton)	In situ cumbition Kasnice (ton)	Steam injection Kucove (ton)	CO_2 injection Kasnice (ton)	CO_2 injection Marinez (ton)	Alkalin water inj Arrez (ton)	Carbonate water inj Ob. 1 Marinez (ton)	Ciclyce CO_2 injection Patos (ton)	Treatment water Ballsh (ton)	Total (ton/year)
1971	2130									2130
1972	825									825
1973	8885	108								8993
1974	9109	680								9789
1975	11332	232								11564
1976	20149	455								20604
1977	27229	4147								31376
1978	32422	8557								40979
1979	40028	11535								51563
1980	38720	12446								51166
1981	43006	10690								53696
1982	46802	11900								58702
1983	55666	13000	1815	820						71301
1984	59186	14390	5752	2991	108					82427
1985	58014	8780	9444	4171	3002	80				83491
1986	69181	7297	10442	3230	4380	441				94971
1987	67503	6689	9832	2403	6398	582				93407
1988	70665	7360	7851	1809	8601	455			561	97302
1989	75791	6838	9958	2376	9044	562	1420		1034	107023
1990	74441	7272	9711	1858	10076	662	2164	1858	1272	109314



RELATIONSHIP WITH FOREIGN COMPANIES

Albania is now cooperating with foreign companies to explore offshore. The Adriatic Sea is divided in five blocks. The foreign companies are: AGIP, DEMINEX (OMV), OXY, CHEVRON, HAMILTON OIL (BHP). Up to now, AGIP has drilled two wells and OXY is drilling one well. We are awaiting their results.

CONCLUSIONS

Technical review suggests that the aspects of the onshore and offshore Albanian oil industry that have the potential to produce incremental oil and gas are:

1. Existing field rehabilitation.
2. Exploration potential in onshore and offshore Albania.
3. Enhanced oil recovery.