

ID 2564

BLUE STAR PETROLEUMS  
LIMITED

BR - 40 - BL PERMIT

ADRIATIC ZONE "B" ITALY

GEOLOGICAL EVALUATION

ROME - FEBRUARY, 1971

## INTRODUCTION

The BR-40-BL Permit is located on the Mid-Central portion of the Adriatic Sea, East of the Town of Vasto. It is offset by permits of Blue Star on the land, and permits of ELF, British Petroleum, Hamilton Bros. and Italian Resine off-shore. The area of the Permit is 17,920 hectares or approximately 42,000 acres. Sufficient seismic was done on this permit to select a location. A large Cretaceous structure exists on the Permit with several hundred feet of closure. The main objective of exploration is to test the gas and oil potential of these major structures. The closed structures of Cretaceous, Miocene and Pliocene outlined by the seismic data offer an opportunity to drill for large gas reserves. Because the presence of oil shows and free oil in the Cretaceous and Miocene sediments in wells near Permit BR-40-BL were detected, the discovery of commercial quantities of oil is possible. A test drilled to 8500 ft. depth is recommended to explore the Pliocene Miocene and the Cretaceous sediments. A tentative location is designated on the enclosed maps.

Considering the present gas prices, the value of probable and possible reserves of this Permit is estimated between 300 - 500 million dollars.

ENCLOSURES

1. Index map - Oil and Gas Fields of Italy
2. Lithofacies Map and Depositional Environment of Cretaceous Formations  
Scale: 1:4,000,000
3. Seismic Coverage of Permit BR-40-BL  
Scale: 1:100,000
4. Structural and Stratigraphic Cross Section
5. Structure Map within Cretaceous  
Scale: 1:50,000
6. Structure Map; Miocene Unconformity  
Scale: 1:50,000
7. Structure Map; Lower Pliocene Productive Sand  
Scale: 1:50,000
8. Composite Map, Gas and Oil Prospects  
Scale: 1:100,000
9. Stratigraphy Casalborselli Well  
- Schematic Section
10. Representative Seismic Line across the Play.

Drilling cost to the desired depth is estimated to be \$1.2 million. Comparing the possible ultimate value of this property with the risk and development capital required, the project offers a ratio of 1:100 return or better.

### GENERAL GEOLOGY

The Blue Star offshore exploration permit is located in the Southern part of the Abruzzi Pliocene basin. This segment is the continuation of the Po Valley gas bearing Pliocene basin.

West to this basin, in the foothills of the Appennine Mountains, Eocene and Cretaceous sediments outcrop. The Eastern fringe of the Pliocene basin is formed by Cretaceous sediments outcropping on the Gargano Peninsula. On the Eastern edge of the Pliocene basin a Triassic salt dome penetrates the younger sediments on the Lessina Lake area.

### STRATIGRAPHY

In the immediate area of the Blue Star permit the Mesozoic substratum is topped by a thin layer of Miocene calcarenites, often reefoidal in character averaging hundred meters in thickness, and laying unconformably on oil prospective carbonate sediments of Cretaceous, Jurassic and Triassic age.

The Triassic, according to the section known in the Foresta Umbra well (on the Gargano Peninsula East of the Permit) consists of a thick upper evaporitic section which covers a porous oil bearing dolomite. This Triassic dolomite is probably in a depth of 4500 - 5000 meters in the Blue Star Permit.

area, therefore, it is considered too deep for oil exploration. The Jurassic consist of a thick, partially porous dolomite section.

The Cretaceous sediments of this area consist of organic limestones. In the Casalbordino No. 1 Well, and in the Cassa Borselli No. 1 Well down dip from the Permit three shale interbeds can be correlated each 100-150 ft. thick, separating 300 - 400 meters thick limestone sequences. The porous limestone section under the second shale is oil bearing West from the Permit and gas bearing to the Northwest. From the same horizon at the St. Giorgio Mare 60 million cu. ft. per day wet gas is produced. Pay horizons are 400 - 600 ft. thick. This oil and gas bearing carbonate unit is present under the Blue Star Permit and its thickness is estimated to 900 ft. As the enclosed facies map demonstrates the Permit is laying similarly as the St. Giorgio Mare gas producing area on the Eastern margin of the shallow basinal facies belt of the Cretaceous which is bordered on the East by the "shelf facies" consisting of thick fractured carbonates. The hydrocarbons probably accumulate in structures on the up dip edge of this facies belt.

Moderately thin beds of Pliocene shale covers the Miocene substratum and acts as an excellent cap rock for accumulation of oil and gas underneath. The Miocene reservoir has produced oil as well as gas, in the Molise and Abruzzi basins. The Pliocene and Quaternary formations are divided into five sedimentary units in the report area.

The lower unit consists of thin bedded marls and shales lying unconformably on the Miocene. The thickness of the unit varies considerably and is controlled by structural or topographic features of the underlying carbonate substratum. This unit grades upward into a Lower-Middle Pliocene shale and sand unit averaging forty meters in thickness.

The third unit consists of a sand and shale sequence which represents the producing horizons of the S. Stefano Mare gas field off-shore and the St. Salvo gas field on-shore. This unit is absent in the Vasto Mare No. 1 and No. 2 Wells due to non-deposition.

Above the third unit the Upper-Pliocene shale sequence follows with local sand interbeds. Average thickness is approximately 500 meters. This unit has a transgressive sand and pebble cover of Upper-Pliocene and Quaternary age, grading into marine shales.

#### STRUCTURES OF THE PERMIT

In the immediate area of the Blue Star Permit the structural character of the carbonate substratum is of the stable shelf type and is represented by normal faults, horsts and grabens and structural closures against normal faults.

The structures in the Pliocene covering the carbonates are seldom harmonic with the underlying Mesozoic series and the faults die out in the Lower-Pliocene shales. Also gravity slides and swelling within the plastic Pliocene series accentuates the disharmony between the rigid substratum and the overlying soft beds.

Seismic interpretation maps have been prepared on the lowermost sand unit of the Pliocene, on the top of the Miocene-Cretaceous substratum and on a weak reflection horizon within the Cretaceous. The most prominent structural feature on the area of the Permit is a NW-SE trending normal fault.

On the up-thrown side of the fault the Cretaceous sediments dip to the Northeast. This condition sets up a Cretaceous closure of 900 ft. or more, centered around the Vasto Mare Wells. This major fault controlled or at least effected the distribution of Middle, Upper-Pliocene sands. The sands pinch out against the higher portions of the faulted trend.

#### OIL AND GAS PROSPECTS

The most important gas and oil prospect of the Blue Star Permit is within the Cretaceous. The Vasto Mare No. 1 Well reached the Cretaceous sediments in 1310 meters subsea depth and drilled approximately 350 meters further into the Cretaceous dolomitic limestone. The oil and gas bearing Cretaceous section, below the second shale break, is 800 - 900 meters below the top of Cretaceous and the top 500 meters; part of which was penetrated by this Well is usually barren of any showings of hydrocarbons.

Two-third of the closed broad Cretaceous structure, bordered on the Southeast by a fault, falls within the area of Blue Star Permit. The anticipated reservoir is 900 ft. thick. If the

structure proves to be gas bearing, the gas reserves falling within the borders of the Permit will be more than a trillion cu. ft. in the Cretaceous alone. The 9600 acres basic area of the Cretaceous structure could trap 1.5 - 2 billion barrels recoverable oil reserves.

The pinching out edge of the Pliocene is well determined by the seismic and with the help of the structure map drawn on the top of the sand the extension of the gas play is outlined. Calculating with an average pay zone of 60 ft. total reserves of the Pliocene sands is estimated to 79 billion cu. ft. The possible Pliocene reservoir is located in two separate pools within the area of the Permit. The larger is SW from the Vasto Mare Well; the smaller is located along the fault at the SW border of the Permit.

The Miocene calcarenite yielded gas in non-commercial quantities from the Vasto Mare No. 1 Well. We seismic data is not encouraging to find large gas pools in the Miocene, however, the several structures present probably will produce commercial quantities.

The Cretaceous, Miocene and Pliocene oil and gas prospects are all on or surround the major NW-SE fault. Based on the seismic data a tentative location was selected between seismic lines BBS 2 and BBS 3 where all three prospective horizons could be productive. Estimated total reserves of the various horizons taped at this point are as follows:



Cretaceous

---

1.35 trillion cu. ft.	}	160-250 million bbls (100 ft. pay)
		940-2250 million bbls (900 ft. pay)

Miocene 45 billion cu. ft. -----

Pliocene 61 billion cu. ft.

#### HISTORY OF EXPLORATION

The general area of the Permit has been considered as one of the best gas and oil prospects on this part of the Adriatic by Professor M. Pieri. Marine seismic work was carried out by AGIP, Montecatini and ELF prior to 1967. Two Wells have been drilled by AGIP in 1959, Vasto Mare No. 1 and No. 2. Both wells have been too shallow to test the Cretaceous and missed the edge of the Pliocene sand. The No. 1 Well tested 1 MMcf/day gas from Miocene with salt water. The interest toward this structure remained intense because the two Wells did not test the plays but rather closer outlined the prospects. This interest was reflected in the strong competitive applications filed for this Permit beside Blue Star in 1968, by the following companies: British Petroleum, Sarom, Sicilian Petroleum Refinery, ELF Italiana, Calamonaci Mineraria, FIAT, Gulf Oil, Hamilton Bros., Placer

Mineraria, Whiterock Explorations, Tia Petroleum, Adriatic Hydrocarbons, Chevron and Texaco, - representing 15 independent corporations.

After Blue Star obtained the Permit on January 12, 1970, a seismic interpretation was done based on an approximate 200 km. lines and 52 km. new survey.

#### RECOMMENDED FURTHER EXPLORATION

The seismic at hand is sufficient to map the main faulted structure. Before a location is prepared, however, an additional 35 km. survey is advised. Further survey will probably be useful on the Northern part of the Permit. A well should be drilled near the selected location marked on the enclosed maps.

#### ANTICIPATED STRATIGRAPHIC SECTION

0	-3480 ft.	)	Quaternary and Lower Pliocene Shale and Sand.
3480-3700	ft.	)	Productive Lower Pliocene Sand Beds.
3850-4000	ft.	)	Productive Miocene Limestone Beds.
4000-6450	ft.	)	Upper Cretaceous Limestone and Dolomite.
6450-6500	ft.	)	Shale Interbed.
6500-8600	ft.	)	Productive Cretaceous Porous Carbonates.

The cost of such a well is estimated between \$1 - \$1.2 million U.S. funds. Completion cost is estimated to an additional \$0.8 - \$1.0 million U.S. funds.

#### ECONOMIC CONSIDERATIONS

The Blue Star Permit has what is considered the second most attractive structure for major Cretaceous gas and/or oil accumulation within the Adriatic off-shore. The structures South of Ancona at St. Giorgio Mare produce from Cretaceous at a rate of 30 MMcf per day per well. AOF from these wells were reported to be 60 MMcf per day.

Present gas contracts offer 7 Lire per cubic meter for gas. A 30 MMcf well brings a gross revenue of \$2.5 million plus per year. Therefore, in case of a Cretaceous discovery, pay out expected in less than a year.

The adjacent Pliocene off-shore gas field - the St. Stefano Mare is on production since December, 1970. ELF delivers 6 MMcf gas per day from each well to the National Gas System for about 30¢ per thousand cu. ft.

The Pliocene is considered a secondary objective in the first well to be drilled on the Blue Star Permit. However, if the more ambitious objective to find gas and/or oil in the Cretaceous fails, the Pliocene gas production will pay for the well within two years.

Oil discovery in the Cretaceous would have very great significance on this area. The writer considers as a minimum requirement for commercial production no less than 100 million bbls recoverable reserves and a daily production of 750 bbls per well on this near shore structure. The oil in the Cretaceous is mostly heavy in the near wells, however, medium gravity crude also known in the Cretaceous. Considering the size of the structure present, the aforementioned minimum commercial requirement is a possibility.

The Blue Star Permit is near to an area where several gas and some small oil fields are on production many years. The nearby San Salvo (Cupello - Lentella) gas field produces from Middle Pliocene sands, Miocene Calcarenite and Upper Cretaceous limestone - from depths between 1000 meters and 1700 meters, and is considered as one of Italy's most profitable gas fields. Estimated recoverable reserves approximate one trillion cu. ft.

Based on the foregoing, it can be stated that the Blue Star Permit is a low risk, high profit objective.

. . . . .