• OFFSHORE EXPLORATION FOR HYDROCARBONS IN INDONESIA

by

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ABSTRACT

Indonesian offshore areas in 1985 are still the loci of an active exploration program. Exploration activities are anticipated to be at the same level as in 1984. A new oil field in the East Java Sea (the Madura field) began production in September 1985 with initial production of 10,9 MBOPD. The month of August 1985 is marked by the significant oil and gas discovery in the Banggai basin, offshore East Sulawesi, where the Tiaka-1 exploratory well flowed 3864 BOPD (29° API) and 1,1 MMSCF gas (60 ppm H_2S) from Middle Miocene platform carbonates. Together with exploration drillings in the area beyond the continental shelf which have been started since February 1984 such as in the area north of Lombok, the discovery will encrease enthusiasm for exploration of the frontier areas especially in the geologically complex region of Eastern Indonesia. It also reveals that potential accumulation of hydrocarbons could also occur within the collision complex.

I. INTRODUCTION

Indonesia remains as one of the busiest part of the Far East region for offshore hydrocarbon exploration. As of December 1984, 27 Production Sharing Contractors were active in 36 offshore contract areas and a total of 290 prospects and 413 leads have been identified. During the first half of 1985, commercial discoveries were made by Kodeco in the offshore East Java Sea, in an area previously relinguished by Cities Service. Subsequently, producing wells were completed and the field (known as the Madura oil field) was placed on production at a rate of 10,9 MBOPD, added to the 6 already producing offshore oil fields. The most significant discovery was made by Union Texas in the Banggai basin, offshore East Sulawesi. In addition, several exploration drillings have also been carried out in the area beyond the continental shelf, e.g. north of Lombok island. Undoubtedly, those efforts will encourage exploration activities especially in the frontier areas of Eastern Indonesia.

II. EXPLORATION ACTIVITY

A. Seismic Survey and Exploration Drilling

Until the first half of 1985, 6, 423 line-km of seismic traverses were made and 85 exploratory wells were completed (Figs. 1 and 2). It is anticipated that exploration activity remains at the same level as in 1984. Looking back to the seventies, the highest offshore seismic activity was recorded in 1969 which included 110,428 line-km but with only 20 exploratory wells drilled. Seismic survey decreased to the lowest point at 5,000 line-km in 1978, then increased to 52,550 line-km in 1983. On the other hand, exploratory wells were increased to 103 in 1974, then decreased to only 26 in 1977 which correspond with the decreasing seismic activity. Since 1977, exploratory wells increased to the highest level at 160 in 1983. Since then both seismic survey and exploration drilling appear to be diminished.

The high level of exploration drilling in the period of 1969 – 1977 (Fig. 2) was due to the vol-

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uminous seismic data obtained within that period (Fig. 1), which led to the discovery of several offshore oil fields. The increasing of seismic activity with corresponding exploration drilling in the period of 1977 - 1983 did not resulted in significant addition to the already existing fields. Although a high success ratio was recorded, discoveries were made usually in the already known prolific areas. Except the Udang field (Conoco), the Lalang field (Hudbay) and the Madura field (Kodeco) which began production in 1979, 1984 and 1985 respectively, all other offshore fields were developed prior to 1977, i.e. offshore Southeast Sumatra (IIAPCO - 1971), offshore Northwest Java (ARII - 1971), Makassar Strait (Union Oil - 1972 and Total Indonesie - 1974) and offshore Madura (Cities Service - 1975). The latter (the Poleng field) was abandoned since 1979, having produced only a total of 2,482,000 bbl of oil.

B. Offsh e Production

Offshore production (in MBOPD) since 1971 is depicted in Fig. 3. Since the first production by IIAPCO and ARII in 1971 (10,9 MBOPD), it was sharply encreased to the highest level (602,2 MBOPD) in 1977. Since then, production tend to decrease to an average of 539 MBOPD which is the expected production rate this year, with the lowest level at 478,5 MBOPD in 1983.

III. FRONTIER AREAS

In the Banggai basin, Union Texas has completed 2 exploratory wells, of which 1 is of commercial value. Tiaka-1 well yielded oil on 5 drill stem tests (0,5 inch choke) and flowed oil at rates up to 3864 BOPD of 29°API and 1,1 MMSCF gas (60 ppm H_2S)

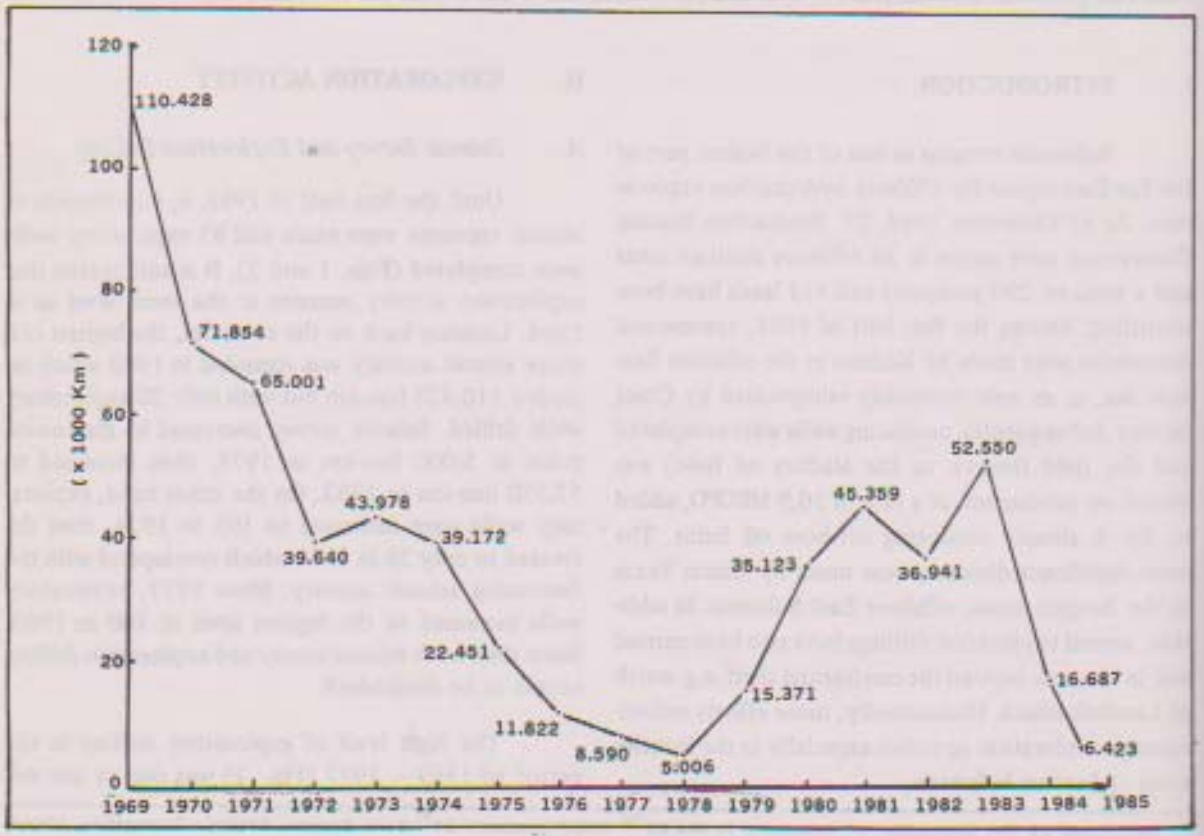

Figure 1
Offshore seismic survey

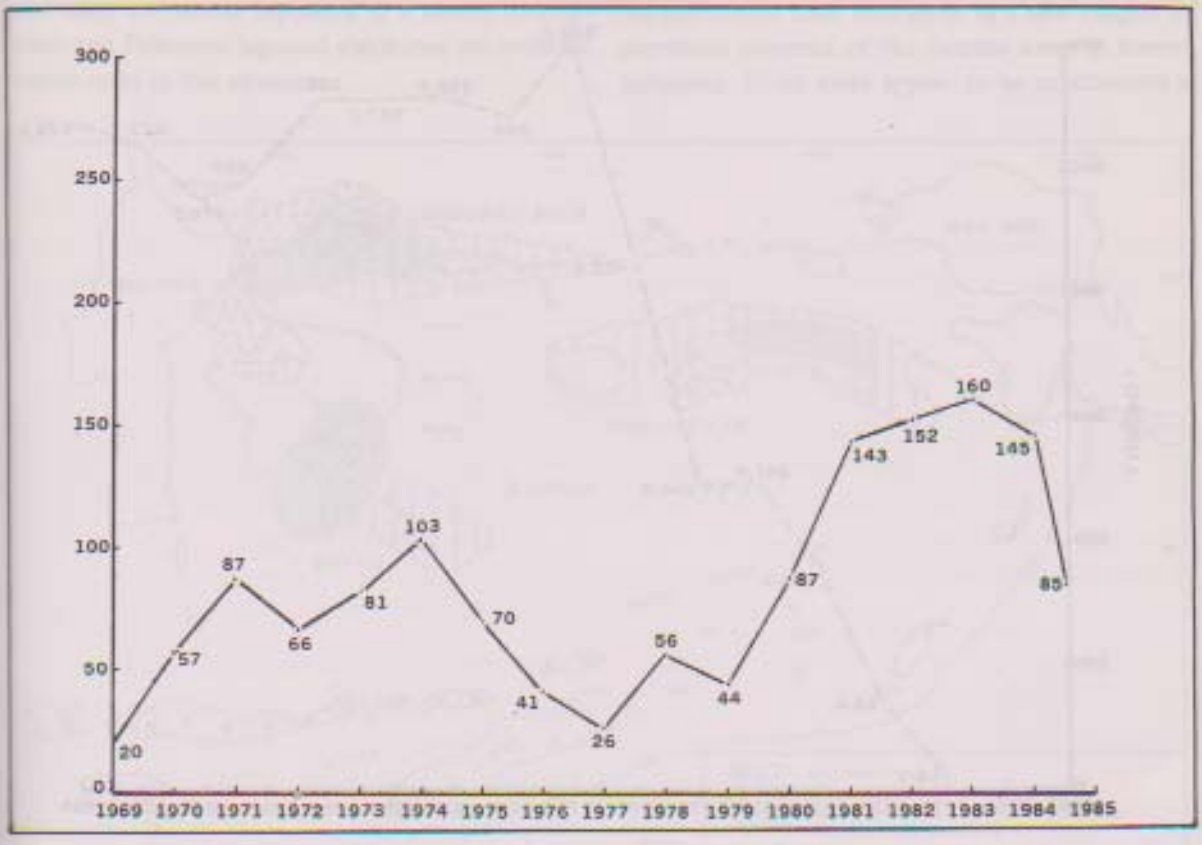

Figure 2
Offshore exploratory wells

from a 78 feet zone of Middle Miocene platform limestone unit. This is the first discovery ever made in frontier area with a very complex geology which typified the Eastern Indonesia.

The Bunggai basin is situated in the collision zone between the Banggai-Sula microcontinent and the East Arm of Sulawesi where extensive imbricate ultrabasic and Mesozoic-Tertiary rocks and ophiolite belt are found (Fig. 4). The general stratigraphy of the Banggai basin includes Paleozoic and early Mesozoic granitic and metamorphic basement, Jurassic black shales overlying a basal quartz sandstone, Cretaceous clastic sediments and marls, Paleogen carbonates, Miocene shelf and reefal carbonates with quartz sandstone in the lower part and topped by the Pliocene flysch and molasse sediments (Pigram & Panggabean, 1983; Silver *et.al.*, 1983). The geologic similarity with the Bird's Head region of Irian Jaya, especially in Paleozoic, Mesozoic and lower Tertiary stratigraphy suggests that the Banggai-Sula microcontinent was once part of the Australian crust of northern Irian Jaya. The microcontinent has been displaced westward along transcurrent faults, i.e. the Sorong Fault Zone to its present position and collided with the ophiolite belt of East Sulawesi (Katili, 1974; Hamilton, 1979; Smith, 1983).

The significance of the Tiaka-1 oil and gas discovery is that it opens a new phase in application of plate tectonics for hydrocarbon exploration in Indonesia. The collision zone could be as prolific as other converntional oil-bearing basin. The terrane concept (e.g. Jones *et.al.*, 1977) seems to hold not only aca-

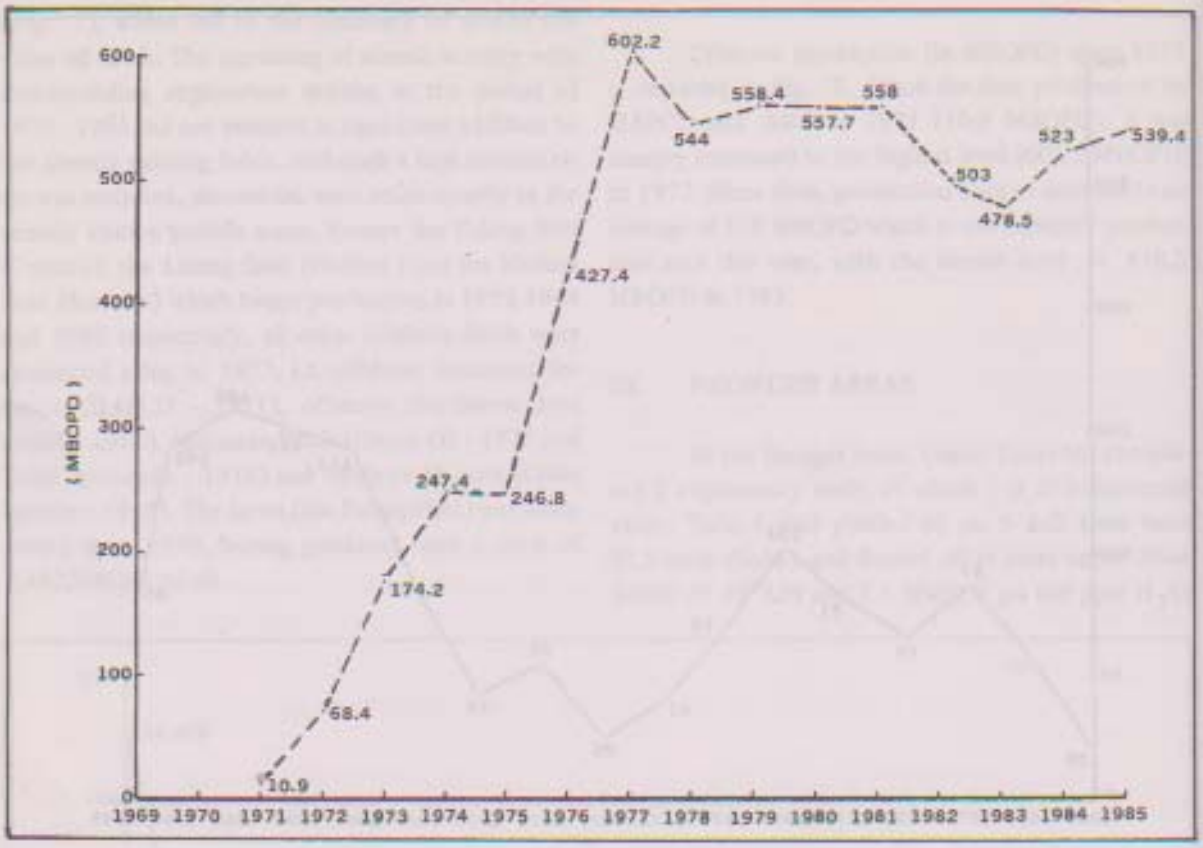

Figure 3
Offshore production

demic value but also has implication for hydrocarbon occurrence. As shown in Fig. 4, there are at least two other microcontinents in Eastern Indonesia, i.e. the Buru-Seram and Buton microcontinents. The Bula field of the Bula basin at the eastern end of the Buru-Seram microcontinent has long been known as commercial oil field. The other basins surrounding those microcontinents could also be prospective. In this respect, further detailed geological and geophysical study is necessary.

One other aspect warrant mention : exploration drilling in the area beyond the continental shelf where the water depth is greater than 200 m. Amoco Indonesia spudded the L 40-1, L 49-1 and L 46-1 exploratory wells in the Central Lombok block, with the water depth of 1303', 987' and 1580' respectively. The L 40-1 exploratory well was bottomed at 12,010' in Early Eocene shales, the L 49-1 reached a total depth of 8,176' in Pretertiary metamorphic basement consisting of serpentinized ultrabasic rocks, whereas the L 46-1 was terminated at 11,325' in Cretaceous (?) melange. The first two wells did not encountered any significant reservoir layers with hydrocarbon shows. On the contrary, the L 46-1 exploratory well penetrated an oil sand in the Eocene section with further indications of oil and gas in the Paleocene clastic sediments. This result is encouraging, and subsequently the L 46-2 exploratory well was drilled in a water depth of 1547'. The well reached a total depth of 11,347' in Paleocene sandstones and shales. Hydrocarbon indications were noted in the Paleocene sediments. Organic geochemical studies indicate that Paleocene lignites

and coaly claystones deposited in a swamp environment and Paleocene lagoonal claystones are probable source rocks in that structure.

the continental shelf have given us a new insights on petroleum potential of the frontier areas in Eastern Indonesia. Those areas appear to be as attractive as

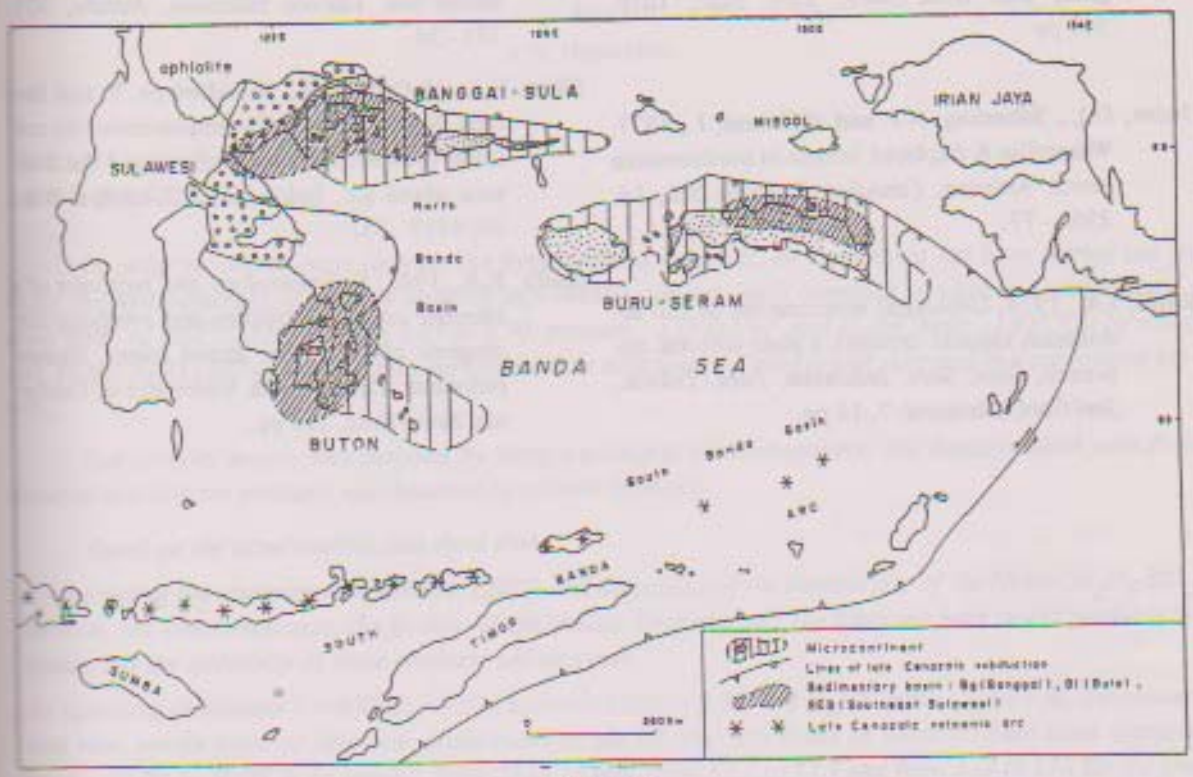

Figure 4
Distribution of microcontinents and associated sedimentary basins in Eastern Indonesia (modified after Pigram & Panggabean, 1983)

All those activities form part of an effort in locating potential hydrocarbon traps in frontier areas of Eastern Indonesia.

Western Indonesia and are awaiting further intensive geological and geophysical studies.

IV. CONCLUSIONS

Offshore exploration for hydrocarbons in Indonesia remains active with discoveries usually located in well known petroliferous areas. Exploration activities, for the most part, are still in the Western Indonesian basinal areas. Obviously, the Tiaka-1 discovery and the results of geochemical analysis from exploratory wells that have been drilled in the area beyond

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REFERENCES

Hamilton, W., 1979, Tectonics of the Indonesian region, *U.S. Geol. Surv., Prof. Pap.*, 1078, 345 pp.

Jones, D.L., Silberling, N.J. and Hillhouse, J., 1977, Wrangellia-A displaced terrane in northwestern North America, *Canadian J. Earth Sci.*, 14, 2565 - 77.

Katili, J.A., 1974, Geological environment of the Indonesian mineral deposits, a plate tectonic approach, *Geol. Surv. Indonesia, Publ. Teknik, Seri Geol. Ekonomi*, 7, 18 pp.

Pigram, C.J. and Panggabean, H., 1983, Age of the Banda Sea, Eastern Indonesia, *Nature*, 301, 231 - 34.

Silver, E.A., McCaffrey, R., Joyodiwiryo, Y. and Stevens, S., 1983, Ophiolite emplacement by collision between the Sula platform and the Sulawesi island arc, Indonesia, *J. Geophys. Res.*, 88, 9419 - 35.

Smith, R.B., 1983, *Sedimentology and tectonics of a Miocene collision complex and overlying late orogenic clastic strata, Buton Island, Eastern Indonesia*, Ph.D. Thesis, University of California, Santa Cruz, 255 pp.