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## **A NEW PLAY IN A MATURE BASIN: PROSPECTING FOR GAS IN PRETERTIARY BASEMENT RESERVOIRS SOUTH SUMATRA, INDONESIA**

The South Sumatra Basin, having experienced continuous exploration since the 1880's, is today considered one of Indonesia's most mature hydrocarbon provinces. Although gas reserves totaling nearly 4 TCF were discovered prior to the 1990's, the majority of these volumes were found in accumulations of less than 100 BCF, rendering major gas development projects economically unattractive.

In 1991, Gulf Indonesia discovered the first major gas field in the basin at Dayung in the Corridor PSC area. A key feature of this field is that most of the reserves are held within fractured rocks of Pretertiary age and include granite wash, highly weathered, in-situ granites, fresh granites and limestones. In rapid succession over the next 8 years, another 7 significant Pretertiary gas fields were discovered in the area representing nearly 15 TCF of raw, recoverable gas reserves. The relationship between these unique reservoirs and the Tertiary Petroleum System has been clarified through ongoing drilling and seismic activities defining this new play type.

The most unique aspect of the Pretertiary gas play is the reservoir, historically considered as economic basement rock, a formation, that when encountered, gave the signal to stop drilling. The growing inventory of reservoirs, which range in age from Triassic to late Cretaceous, are demonstrated to possess not only significant fracture porosity, but also an unusual matrix porosity apparently created within the granites through a combination of hydrothermal and near-surface leaching. Quantifying fracture porosity is done through evaluation of both drilling and logging parameters and via extended flow testing of the reservoirs. Understanding the fracture network has helped to guide well positioning for deliverability.

Traps containing the gas fields were created through a combination of early Tertiary trans-tensional faulting and late Tertiary compressional folding. Understanding the distribution of structures associated with these two events has been the key to identifying the location of the gas fields. Early stages of prospecting made effective use of regional gravity data in conjunction with existing 2D seismic to pinpoint basement-related structures. Seismic data quality at the reservoir level is affected by tight, compressional folding, low velocity contrasts between cap rock and reservoir and gas charging into the overlying Tertiary sediments. 3D data acquired over the fields, however, has proved effective in imaging the trap limits, defining the location, orientation and density of extensional fault patterns across the trap and, in some cases, differentiating different reservoirs within the Pretertiary.

Drilling has confirmed that most of the traps are filled to structural spill point which attests both to the sealing capacity of the overlying Tertiary claystones and to late charging of the structures with thermal methane. This situation has allowed for the creation of gas columns with heights up to 1000 meters. Large volumes of carbon dioxide have also been generated as a result of the high subsurface temperatures associated with the back-arc environment and this contaminant has also filled the traps to varying degrees.



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The Pretertiary play in South Sumatra is significant in that it has provided a sufficiently large gas reserve base to support economic development of the fields. High capital costs associated with the creation of new pipeline infrastructure between the fields and markets in either Central Sumatra or Singapore can be borne by long term contracts when sales volumes exceed 1 TCF of gas. An immediate benefit to Indonesia has been realized because the initial gas contracts have focused on displacing crude oil as fuel, thereby generating additional export revenues from the sale of the saved crude oil. Development of the pipeline infrastructure also opens the way for future sales from smaller fields in the basin to buyers located along the pipeline routes. In most cases, these sales will replace expensive imported liquid fuels, a business activity which can only help to strengthen the country's economy.

Geologic conditions which have allowed the Pretertiary gas accumulations to develop in South Sumatra appear to be present in other Tertiary basins of Southeast Asia. Recent Pretertiary oil and gas discoveries offshore Vietnam as well as a focus on Pretertiary reservoir objectives in both Thailand and Indonesia both confirm that the Pretertiary could play a significant role in providing large oil and gas discoveries during the next decade.