



**Day: Friday 28 April**  
**Time: 10:30am**

**Session: 9**

## **Hidden Basins and Undrilled Anticlines: The Legacy of Early Oil Exploration in Indonesia**

Chris Atkinson<sup>1\*</sup>, Tony Wain<sup>3</sup>, Hening Sugiarno<sup>2</sup> and Sean Hayes<sup>3</sup>

<sup>1</sup>*Sonoro Energy Inc., Stockbridge Oil and Gas Limited, Singapore.*

<sup>2</sup>*Sonoro Energy Inc., Stockbridge Oil and Gas Limited, Jakarta. Indonesia*

<sup>3</sup>*EmZed Exploration Services Inc., Calgary, Canada*

There's an old adage in the oil industry first coined by Parke A. Dickey in 1958 that... "We usually find oil in a new place with old ideas. Sometimes we find oil in an old place with a new idea, but seldom do we find much oil in an old place with an old idea. Several times in the past we thought we were running out of oil, when actually we were running out of ideas". A similar expression from the Mining industry is also of note "...the best place to look for a new mine is next to an old mine". The world abounds with many successful exploration stories backing up these two observations and most Explorationists have their own particular favourite they will reel out over dinner or in the pub after enjoying a few loosening drinks. For instance, who cannot fail to be impressed by the clever chaps (and chapettes) who put together the Nelson, Miller and Buzzard discoveries in the North Sea or what about those brave souls who defied prevailing logic of the inversion anticline theory and drilled the synclines in-between to discover the Ramba, Jene and Singa Batu Raja reefs in South Sumatra. For non-Explorationists these stories can often be a struggle to listen to but for us in the "game" they are folklore, richly cherished and often very keen to emulate.

In this talk we wish to expand upon this type of thinking by discussing a couple of examples of recent work in Indonesia. The first comes from the western part of the Barito Basin in South Kalimantan and the second from the Lariang Basin of West Sulawesi.

The Barito Basin has long been an enigma in the exploration story of Indonesia. There is no doubt it's eastern portion comprises an extremely large and generating source kitchen lying in the foreland of the Meratus mountains yet only one major field (Tanjung, 1937) has been discovered to date despite over 100 years of exploration. What's going on? Most basin modeling studies agree that billions of barrels of oil must have been generated from the Eocene Tanjung Formation source rocks but where has it all gone? Historical evidence of oil seepage occurs throughout a vast area of South Kalimantan ranging from the Meratus foothills in the east to Sungai Pagar, 70km NW of Palangkaraya in the west. This attracted a great deal of interest in the area in the early part of the 20th century as soon as it was practical to explore the terrain. Both BPM (Shell) and Standard Oil (NKPM) vied for a position and large blocks were licensed and huge field based exploration campaigns mounted in the 1930s. The early explorers noted that a large depocentre existed throughout the region (Barito Basin) and went on to drill several shallow wells based upon crude gravity data using primitive drilling techniques. Most wells only penetrated a few hundred metres and were largely dry.

By the late 1930s with the impending upheaval surrounding the approaching World War, exploration appears to have been abandoned. Or was it? Tantalizing glimpses of the thinking of

BPM (Shell) at this time are most interesting. In their summary report on the Amuntai Block (Kupper, 1939) they talk of the apparent "...lack of folded structures..." and "...the possible presence of stratigraphic stairs between the western boundary of the block and the Amuntai Negara..." and very astutely "...the outwedging young and old tertiaries can be used as objects (sic).." They probably didn't know it at the time but they were describing a classical stratigraphic pinch out play along the western margin of the Barito Basin which flush with charge could have been a good place to look for a major accumulation. In their own words "We are therefore of the opinion, that the survey of the western part of the Amuntai Block has now come to a stage in which compulsorily (sic) a deep drilling is to be conducted" (Kupper 1939).

What happened next is something of a puzzle. Did BPM (Shell) proceed to follow up on this idea? NKPM (Standard) did drill a deeper test well at Kuripan-1 in 1940 but this well is not really testing the pinch out play BPM (Shell) were describing. One would have needed to drill much further to the west along the Kapuas and Kahayan Rivers where some early shallow drilling had taken place in 1934-35 (Hulu Mengkutup 1,2 and Kahajan 1 wells). The story now enters the murky depths of re-discovered long lost maps and drilling logs and the tale of a suitcase full of faded and tattered data found under an old widow's bed in central Java. According to the widow the data was given to her husband's father by a friend who had worked on the large exploration campaigns along the Kapas and Kahayan rivers in the late 1930s. The data pointed to the potential existence of many drilled and tested wells which had been destroyed by the Dutch before the impending invasion. He claims the friend carried the maps and well data back to Java and hid them and over the years never returned to collect them. Stuff of legend more akin to fables like King Solomon's Mines you might think. Who knows what is fact and what is fiction but what is tantalising is the idea of a western Barito stratigraphic pinch out play whose scale and geological setting is incredibly similar to the llanos Basin, Colombia and the super-giant Rubiales Field discovered in the late 1980s.

In 2010 a predecessor company Petcon Borneo were given access to the dusty maps and drilling logs and quickly moved to attempt to verify them. A field party was called for in early 2011 and duly set off to find the old wells. Although some evidence was found including what appeared to be an old drilling cellar, nothing was conclusive and only traces of the shallow wells already known to have been drilled by BPM were positively located. The work did however find traces of oil leaking from two old Dutch wellheads, new uncharted oil seeps and Gore Sorber geochemical sampling conducted as part of the programme showed interesting anomalies in several areas. This new evidence in conjunction with a new detailed gravity survey showed that the thinning Barito Basin succession could in fact be interpreted to extend into the area of interest. When coupled with the results of detailed geological mapping and reconnaissance of Tanjung and Berai outcrops to the North an application was made for a direct award of what became the Palangkaraya PSC in July 2012. The block eventually passed into the ownership of ConocoPhillips in late 2013 and the rest of the story is well described in the IPA paper published in 2015 by Kleibacker et al. ConocoPhillips went on to drill the Nangka-1 well in the PSC in 2015 and rumour has it that long distance migration and the Barito pinch out play may still have merit.

Our second example comes from the Lariang Basin which lies on the coast of West Sulawesi almost directly opposite Balikpapan within the Budong Budong PSC. Initial interest in the area was related to the discovery of a series of oil seeps in deep jungle towards the end of 19th century. This resulted in capital being raised in the Netherlands and the Doda Oil Company being formed. It went on to drill a series of shallow wells around the seeps none of which appear to have been linked to any geological theory. All found hydrocarbons and the field actually produced small volumes of oil from 1890 to the early 1900s. Doda eventually went bankrupt and the area fell into the hands of BPM (Shell) in the late 1920's/early 1930s. They conducted an extensive field mapping programme which lasted until the late 1930s and identified two large surface anticlines with crestal oil seeps (Bula Bae and Madjene). For whatever reason they were not drilled although

as with the Barito the pending Japanese invasion may have been a worry. Post WW2 the acreage laid dormant until 1970 when Gulf obtained a huge concession covering most of the southern half of the island of Sulawesi which included the Lariang Basin. Gulf acquired around 100km of 2D seismic in the Lariang area and drilled a stratigraphic hole one (Lariang-1S) from a drilling barge at the coast as the inland area was still largely jungle at that point.

The next company to arrive on the scene was BP who farmed into the Gulf acreage and decided to "ground truth" the old BPM work with their own field party. BP enlisted the services of a rather young and fresh faced geologist by the name of Robert Pile recently arrived from Aberdeen and conducted an extensive field programme in 1975-6 which confirmed BPM's original findings with regards the Bula Bae and Madjene surface structures. They also acquired some poor quality coastal 2D (coastal areas being deforested at that time) and went on to drill what turned out to be a ghost feature on the data (Tike-1 well) which drilled the steeply dipping flank of a monocline. The well intersected almost 8,000ft of parallel to bedding strata in the Miocene Lisu Formation. However, despite some interesting oil shows BP then switched their attention to the southern part of the PSC and the northern area was forgotten about and not re-awarded till 1995 when Chevron picked up the Lariang PSC but acquired no new seismic nor drilled any further wells.

Chevron relinquished the area in 1997 and it was not until ten years later that the area was awarded to Tately as the Budong Budong PSC. Together with their partner Harvest, Tately's idea was to reach the Eocene objectives being drilled in the deepwater offshore Makassar in a cheaper onshore location. They acquired new 2D seismic and drilled two deep wells (LG-1 and KD-1, 1ST) at huge cost, never reached the Eocene objective and completely ignored the original shallow structures defined by BPM and confirmed by BP. Luckily the LG-1 well was drilled on the flank of a shallow 4-way structure clearly defined by their new 2D grid and the top 750m of this well had great oil and gas shows, significant pore pressures and actually took a significant gas kick at one point. They had to eventually control the well with 22 lb/gal equivalent mud before they could set casing and according to the actual drilling engineer on the job "they did all they could not to flow hydrocarbon at the shallow levels"

In 2015 Sonoro's predecessor company Stockbridge Oil and Gas Limited purchased the Budong Budong PSC from the then owners Harvest and Tatley. Sonoro followed up on the LG-1 well and remapped the shallow 4-way anticline. Shallow anticlines of this type were frequently drilled with great success throughout onshore Sumatra and Java in the early days of oil exploration and it was this play that BPM (Shell) had actually mapped in this area in the late 1930s. Ironically, despite over 100 years of oil exploration in the Lariang Basin this classic "surface anticline" play remains undrilled despite the clear evidence of charge (there are abundant seeps), reservoir presence and seal (there is a very thick interbedded sequence of Mio-Pliocene sandstones and marine shales comprising the target Lisu Formation). In fact, the only real unknown is reservoir quality. To address this we have re-examined the PhD work undertaken by Stephen Calvert (2000) on the nearby outcrops of the target Lisu Formation. This work has resulted in a reinterpretation of Calvert's depositional setting for the Lisu placing it in within a slope/channel turbidite system fed from the rising mountain front to the east. Importantly, Calvert's work demonstrated the presence of a more quartz-rich Pliocene section in the Lisu, which we interpret to be linked to tectonic "unroofing" of Eocene quartzose clastics in the mountain front to the East. Thus Pliocene section has been tied to the 2D seismic within the closure of the LG-1 structure.

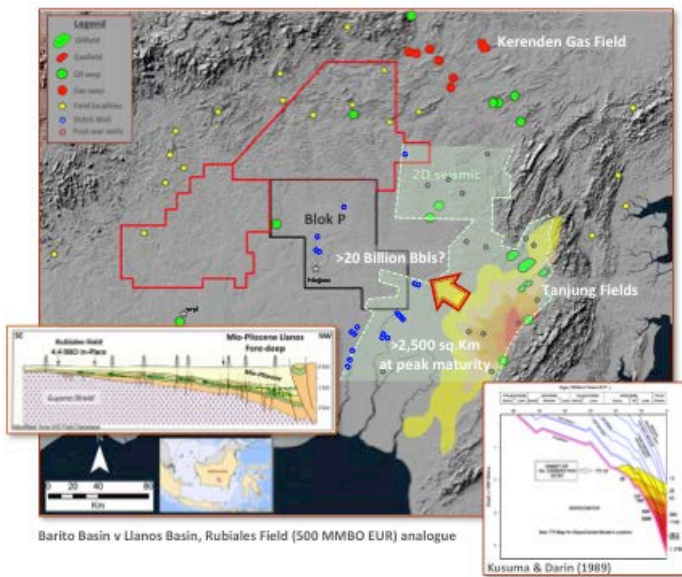
The result is that the LG updip is a 20 million barrel recoverable prospect with a crest some 110m updip from the original LG-1 well. Importantly all pay intervals lie from 200 to 500m depth and can be tested with a well costing less than US\$1.5 million in the current market. To repeat: "That is US\$1.5 million to test a concept which works incredibly well elsewhere in Indonesia (old idea/new area)". Success would result not only in the de-risking of the LG structure, but also sets

up the chance to drill at least 4-5 similar undrilled surface features (including BPM's original large Madjene structure) throughout the PSC. In the words of the renowned Chris Kamara surely that's "Unbelievable, Jeff!" and with the well aiming to be drilled in June/July 2017 we don't have long to wait to test the "new" idea.

## Figures

# West Barito: Blok-P (& associated JSA's)

*"Why has a basin with good source rocks, good reservoirs, multiple trap forming tectonic events and a setting and history similar to more prolific surrounding basins so far produced so little oil? We call this the "Barito Dilemma" - Mason et al., 1993*



## Where did it all go?

- Lost, 1930's legacy data infers a Giant was discovered
- JSA carried out with BPKK-Migas
- P.T. Petcon (Sonoro) awarded Blok-P in 2012
- +Kualakurun & Kasongan JSA's
- Primary source: Eocene coals & lacustrine mudstones (Tanjung Group)
- Previous work: > 2,500 sq km of Barito Basin is at "Peak Maturity"
- Tanjung Fields: Only ~800 MM STOIP established to date
- Conservative estimate of liquids generated: > 20 Billion Barrels
- Long Distance Migration 150 km
- Llanos Basin, Colombia used as an analogue

... Blok-P?

# Treasure maps & Ancient wellheads



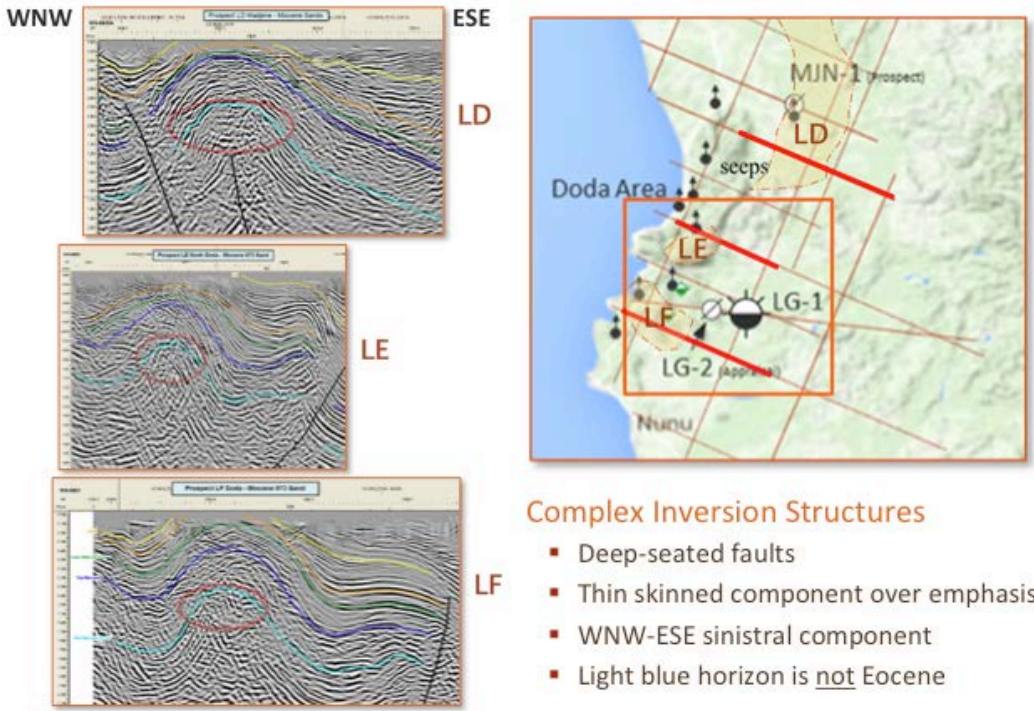
*Trend report (1985) indicates that 31 wells were drilled in the western Barito area in the early 1930's (a total of 12,420 metres drilled). The first concession in the area was not granted to BPM until 1937.*

... and a couple of good seeps

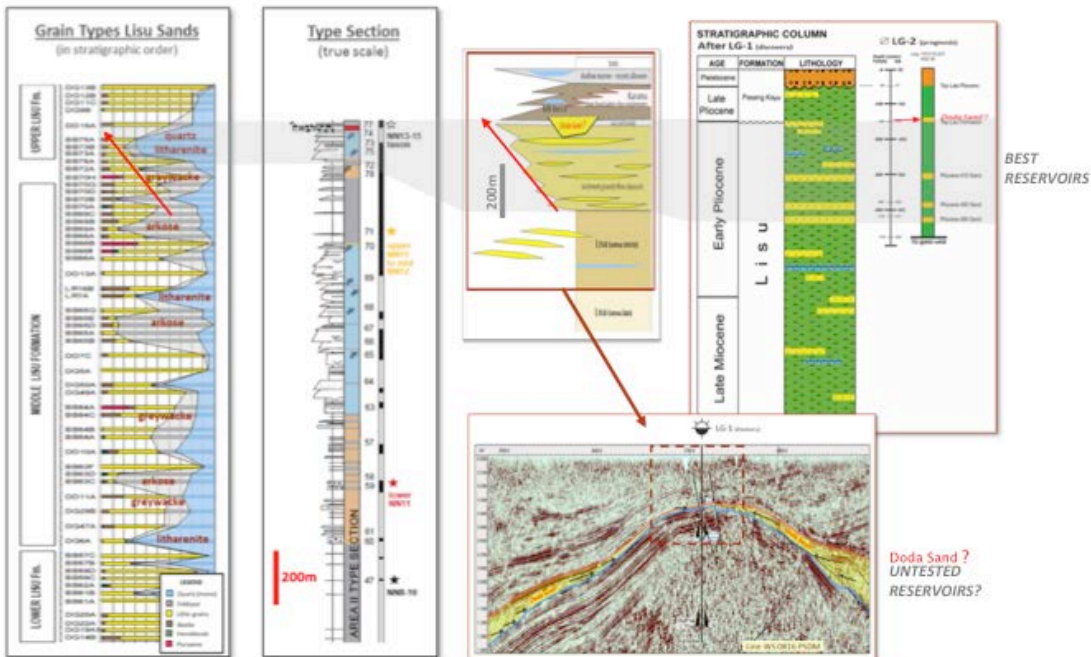


**Shallow wells drilled with steam powered Cable Tool Rig to maximum depth of 250m (1898 to 1901)**  
All Wells reported significant oil and gas shows with several blow-outs ...

# Doda – Lariang Leads: Seismic Data



## LG Structure: Best Pliocene Reservoirs



## **References**

Calvert, S.J. 2000 The Cenozoic geology of the Lariang and Karama regions, western Sulawesi, Indonesia. Unpublished PhD Thesis, Department of Geology, Royal Holloway, University of London.

Kleibacker, D, R. Tasrianto & A. Saripudin 2015 Long distance migration in Central Kalimantan: A solution to the Barito dilemma? Proc. Indonesian Petroleum Association, 39th Annual Convention, Jakarta, May 2015.

Kupper, H. 1939 The Amuntai Block (Past and Future Exploration Works) N.V. de Bataafsche Petroleum Maatschappij (BPM), Balikpapan, Geological Report 18302 7th January 1939.