

# **The History of Oil Exploration in the Union of Myanmar\***

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## **Abstract**

The Union of Myanmar (nee Burma) has experienced oil exploration since the first hand-dug wells were drilled in the Central Burma Basin around 900 BC. In 1755, when Myanmar was part of the British colonial empire of India, early British soldier-diplomats visited some of the hand-dug wells in the Central Burma Basin, located in the vicinity of Yenangyaung. In 1886 the British colonial Rangoon Oil Company, registered in Scotland, was organized, which later became the foundation of the storied Burmah Oil Company. Burmah drilled the first cable tool wells in 1889 in Yenangyaung, which resulted in the “discovery” of the Yenangyaung Oil Field. From 1886-1901, Burmah Oil Company held a colonial monopoly in the country, until Standard Oil gained the first lease in 1901. As the Japanese were invading, seeking a source of oil, British troops destroyed all producing wells. After the end of WWII Burmah Oil Company enjoyed an exclusive monopoly on exploration until Union Oil Company and General Exploration Company combine obtained a huge lease for most of the Central Burma Basin outside of Burmah's producing fields in 1961 and began field work to assess how to proceed with their exploration efforts. With the nationalization of the oil industry in 1963, Burmah Oil and Union Oil lost their leases, and the newly formed state oil company, later called the Myanmar Oil and Gas Enterprise (MOGE) assumed all operations. MOGE successfully delineated the older fields and found smaller fields from their own exploration. In 1988, the government opened oil and gas exploration to foreign oil companies, and Unocal again acquired a huge block in the same location. Many other companies explored the country during this first foreign involvement, but only Shell tested any significant petroleum. In 1992, TOTAL acquired a previously-discovered 3DA gas field in offshore Burma in the Irrawaddy Delta, later called Yadana Gas Field. TOTAL was joined by Unocal Corporation as a

partner. This gas field continues to produce today, with well over 5 TCF of recoverable reserves. Texaco, Premier Oil and Nippon Oil discovered the Yetagun Gas Field in 1992, and it began production in 2000. In 2000 Daewoo International acquired exploration acreage in Western Myanmar offshore where they discovered nearly 5 TCF of gas in the Shwe Project. Other exploration efforts, both onshore and offshore, have not yielded economic success to date, but the long saga of oil and gas exploration in Myanmar continues.

### **Selected References**

Corley, T.A.B., 1983, A history of the Burmah Oil Company, 1886-1924: Heinemann, London.

Harun, Siti Nurul Farieza, Francesco Zainetti, and Gary A. Cole, 2014, The Petroleum system of the Central Burma Basin, onshore Myanmar: AAPG Asia Pacific Region AAPG/MGS Conference, Yangon, Myanmar, August 14-15, 2014. AAPG Search and Discovery Article #41439 (2014).

[http://www.searchanddiscovery.com/documents/2014/41439harun/ndx\\_harun.pdf](http://www.searchanddiscovery.com/documents/2014/41439harun/ndx_harun.pdf)

Longmuir, Marilyn, 1998, Twinzayo and Twinza: Burmese “Oil Barons” and the British Administration: Asian Studies Review, v. 22/3, p. 339-356.

Racey, A., and M.F. Ridd, 2015, Petroleum geology of Myanmar: Geol. Soc., London, Memoir 45.

# The History of Petroleum Exploration in the Union of Myanmar

by Scott E Thornton

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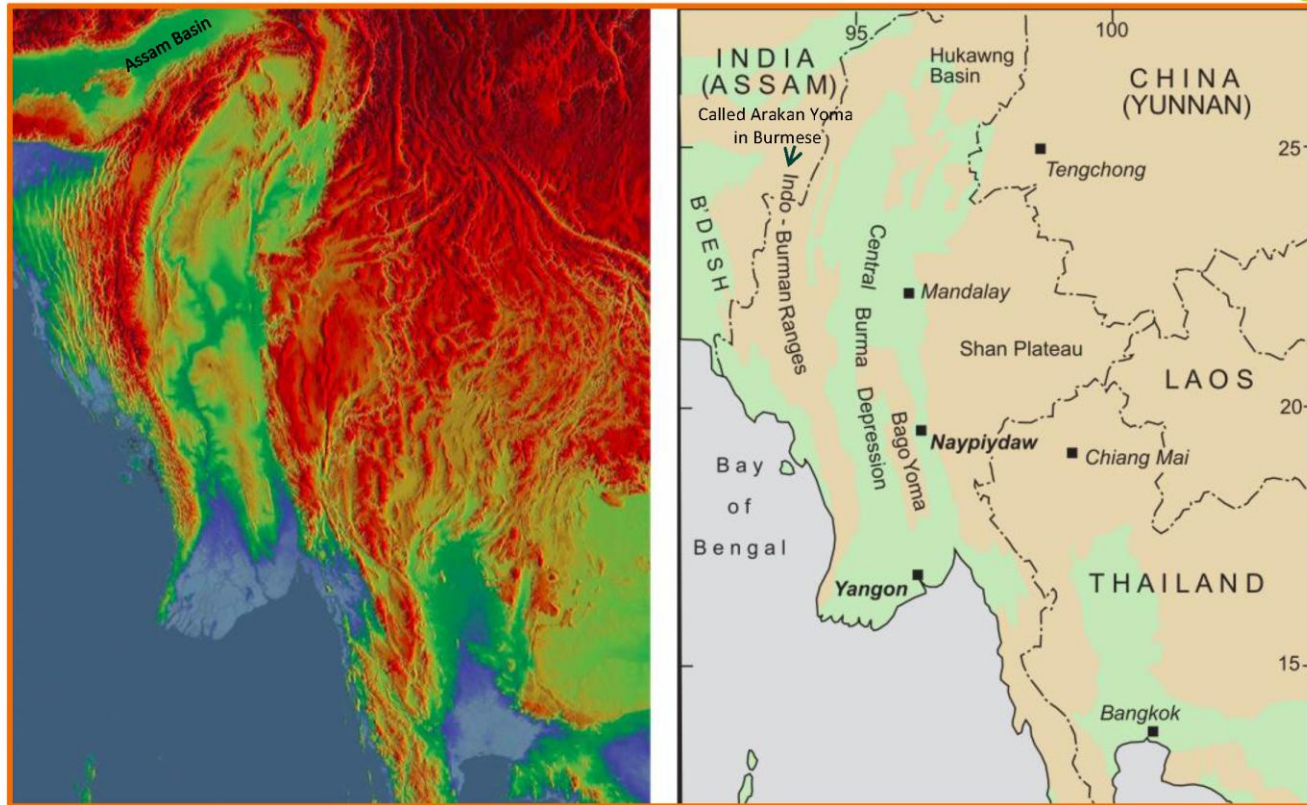
AAPG-SEG ICE, Melbourne

14 September, 2015

Department of Earth Sciences  
University of Southern California



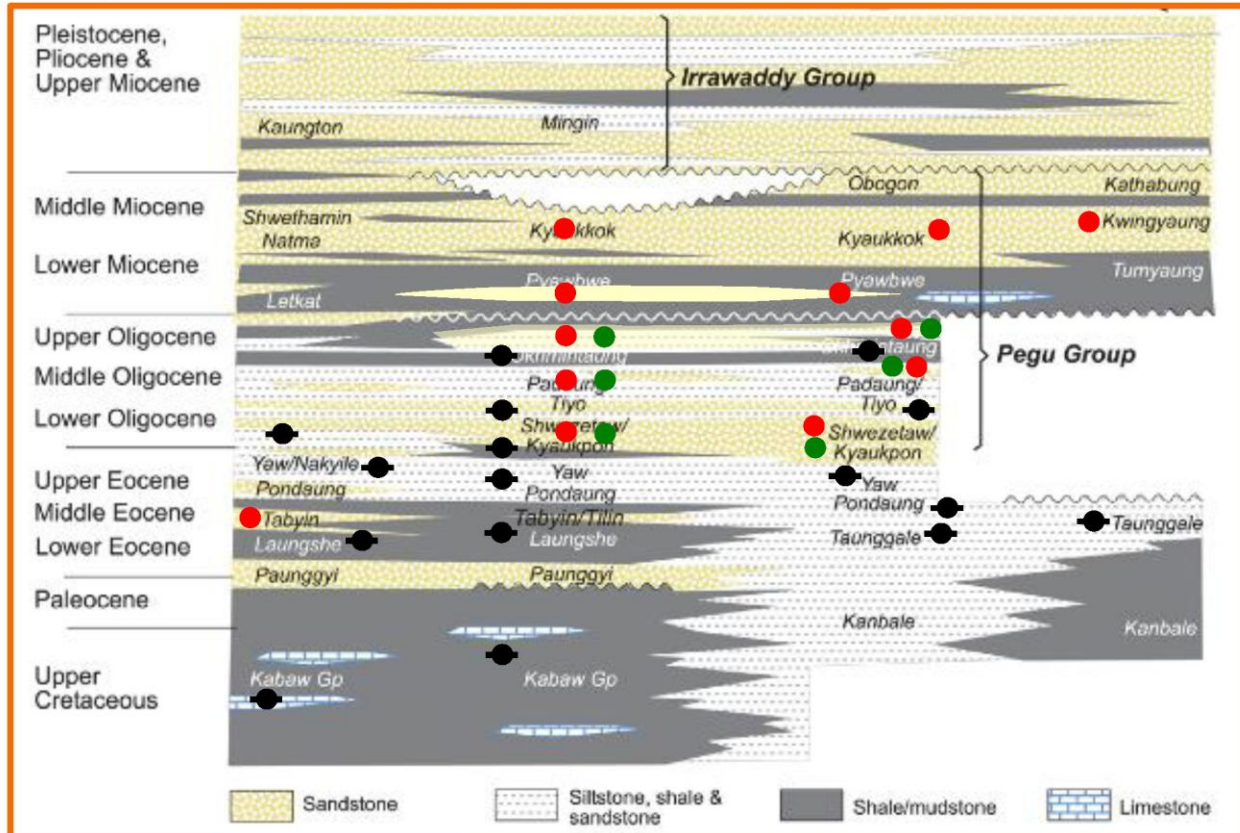
# Overview of Basins



After Racey & Ridd, 2015

Notes by presenter: We can see dramatically, on this DEM image on the left, the basins and fold belts of the Union of Myanmar. W-E the Chittagong Fold Belt and extension into the Rhakhine coast, the Central Burma Depression basins, and the Shan Plateau.

Irrawaddy  
Onshore



- Oil Production
- Gas Prod.
- Source Rocks

After Racey & Ridd, 2015  
Harun, et al. 2014

Notes by presenter: Oil production, gas production and source rocks are shown in the legend on the right. For the basins of the Central Burma Depression, we can see abundant fluvial-deltaic sandstone reservoirs and multiple source rocks.

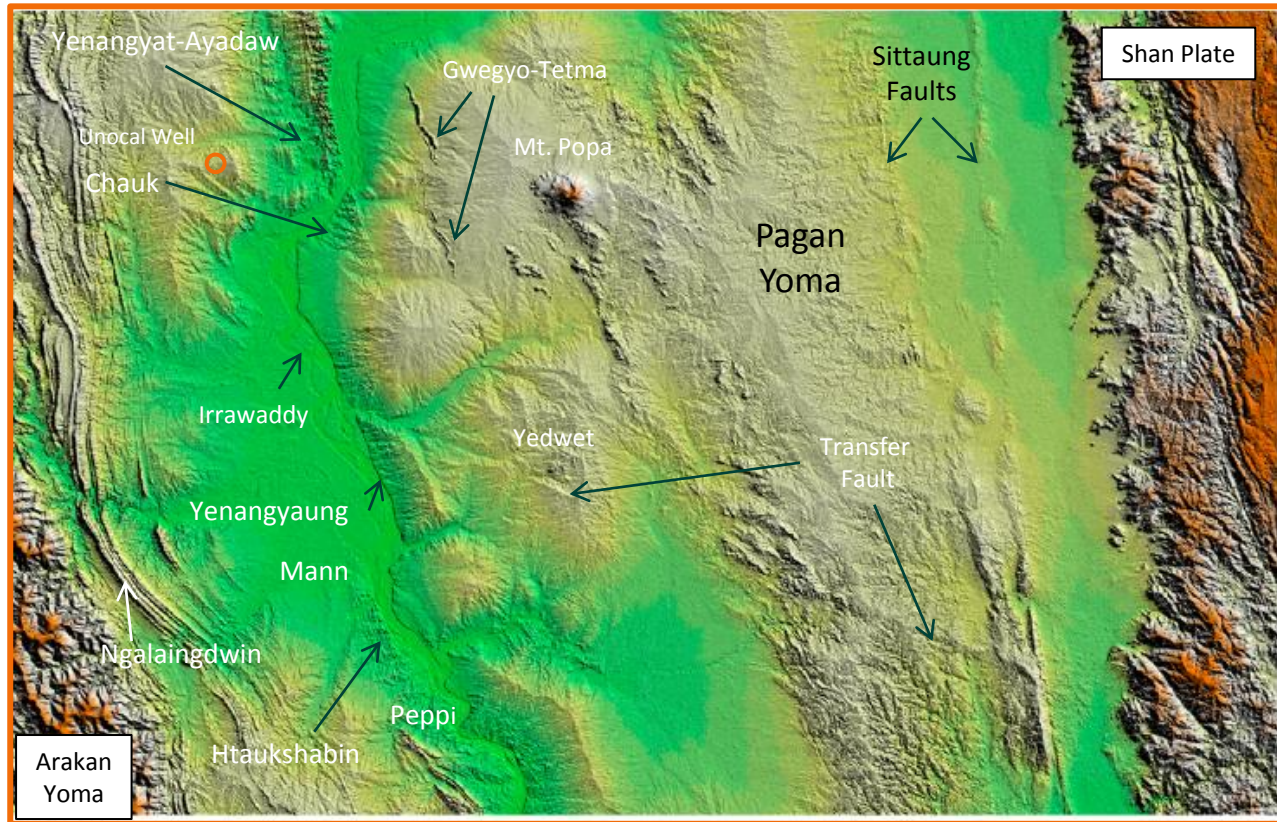
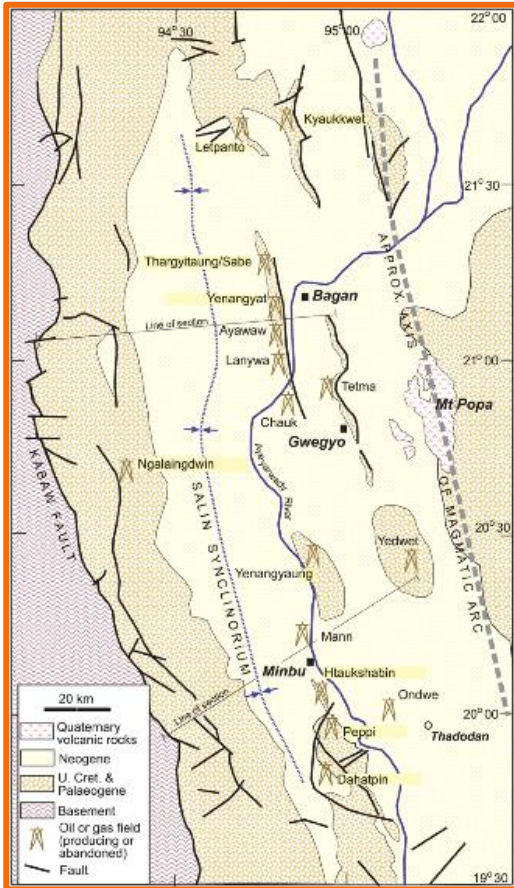
# Central Burma Basin Exploration History



- Hand-dug wells in since 905 AD. First exports in 1855 by indigenous companies from Yenangyaung to India for burning in lamps.
- First modern well in 1887 on Yenangyaung anticline by Burmah Oil: surface anticline with many hand-dug wells. Near total monopoly from 1887-1962, with a few other British independents.
- Subsequent exploration by Burmah Oil: surface mapping, nationalized in 1962.
- 1961: Union Oil of California & General Exploration Co. of California acquire large lease in Central Burma Basin outside of Burmah's fields. Nationalized in 1962 after extensive field work, airphoto interpretation and well log studies completed. Trainee on project (U Aung Din) ater Chief Geologist, MOGE in 1989 when onshore bid round takes place
- MOGE exploration: aeromagnetics (Mann Field), surface mapping and limited seismic data.
- Onshore Bid Round in 1989: Competitive, but only one well tested any flowing hydrocarbons. Majors and larger independents exit, not to come back onshore.
- Unocal beat out Exxon and Mitsubishi for highly coveted Central Burma Basin Block F. Drilled on good anticlinal trap with oil shows (migration path failure) and exits, but MOGE's good relationship with Unocal leads later to The Company joining Total in the Yadana Field venture, including exploration wells.



# Central Burma Basin: Surface Anticlines



After Racey & Ridd, 2015

4 Fields with > 100 MMBOEUR

# The Anticlinal Theory: Born in Myanmar



In 1855, an Anglo-Irish geologist, Thomas Oldham, working in Burma as a geologist for the Indian Geological Survey, *pointed out that* “...the oil from the Yenangyaung field, then being produced from wells dug by hand, was connected with the highest part of an upfold—or anticline—in the earth’s strata”.

Later called the **Anticlinal Theory of Petroleum Accumulation**

Thomas Oldham



Thomas Oldham

Born

4 May 1816

Dublin

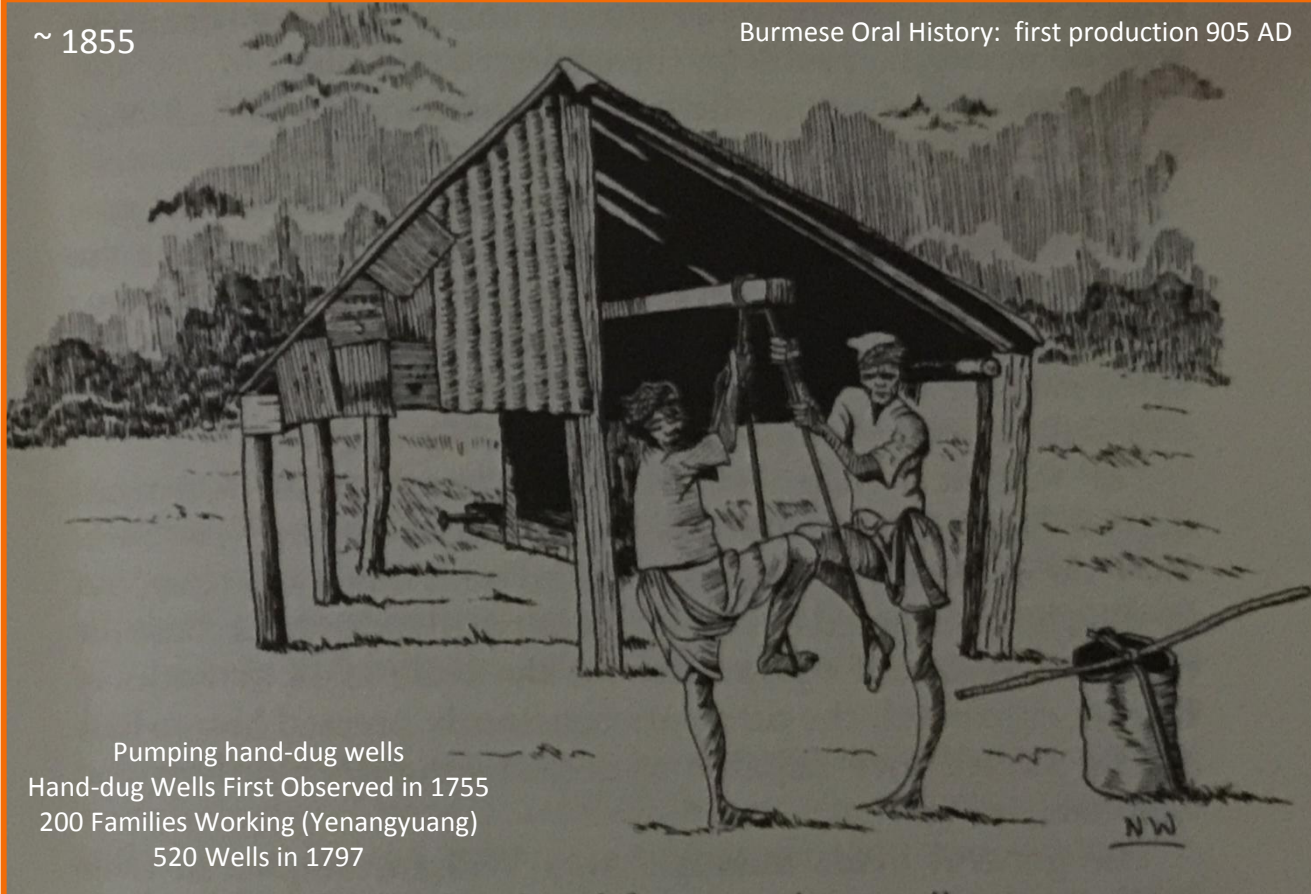


# Pumping hand-dug wells



~ 1855

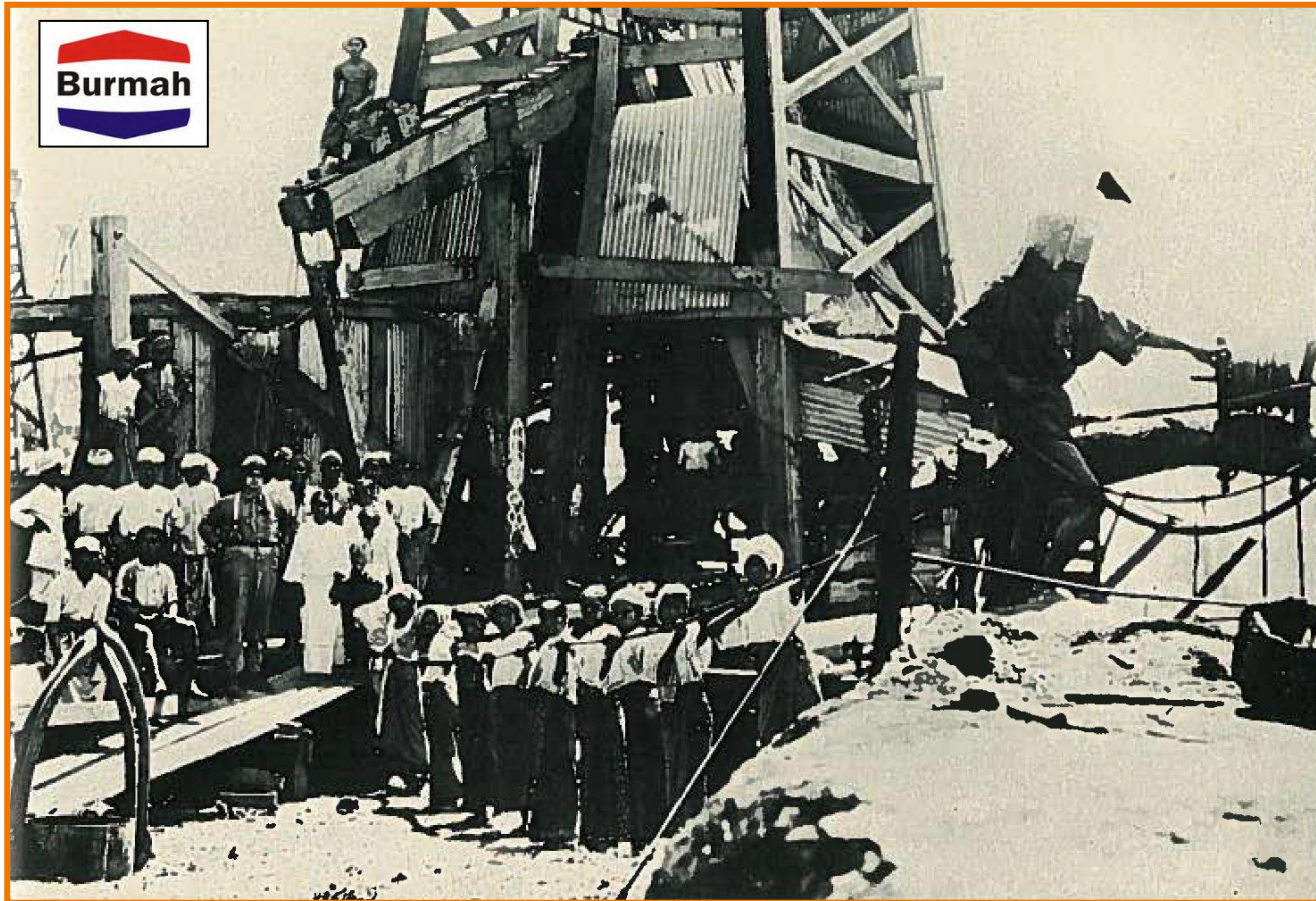
Burmese Oral History: first production 905 AD



Pumping hand-dug wells  
Hand-dug Wells First Observed in 1755  
200 Families Working (Yenangyuang)  
520 Wells in 1797

Corley, 1983  
Longmuir, 1998  
Ba Kyaw, 1982

# Old vs. New: Cable Tool & Hand Dug



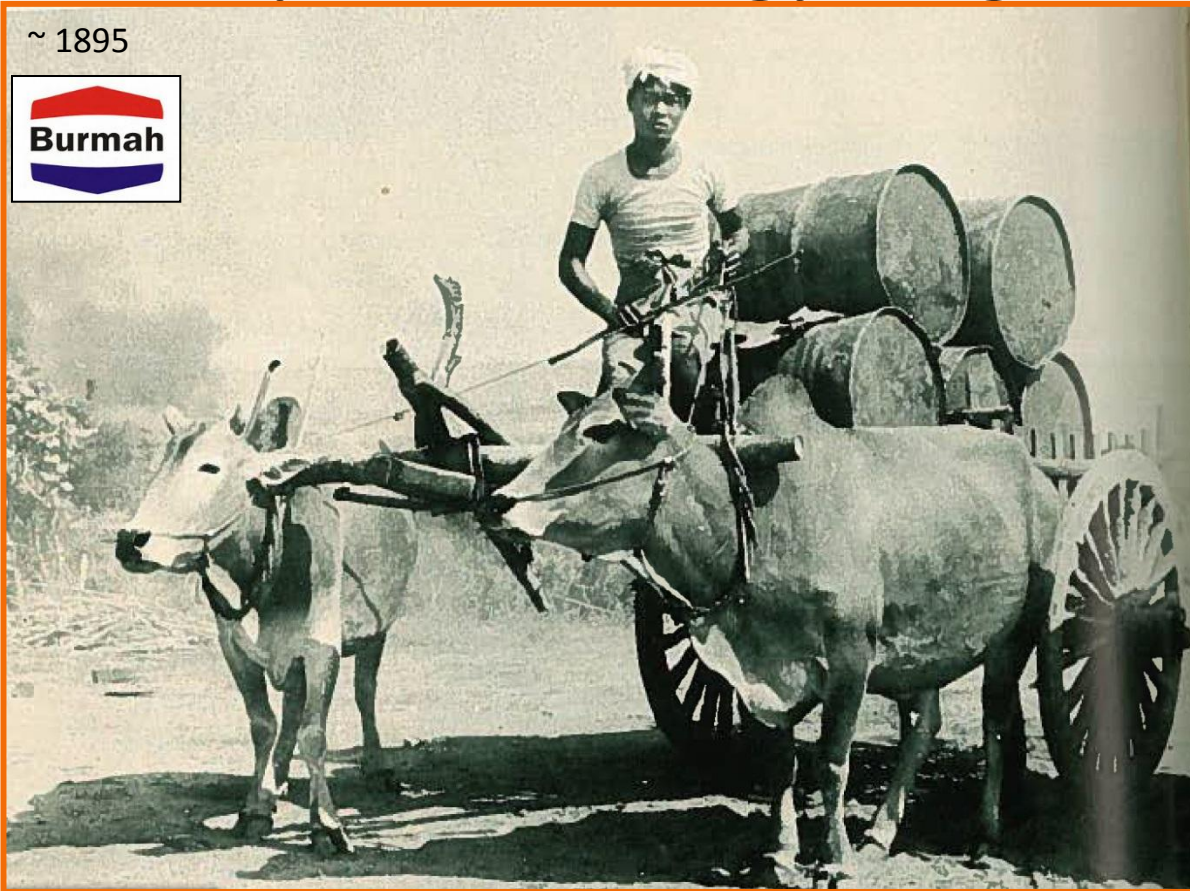
Corley, 1983



# Crude Transport: Yenangyaung Field

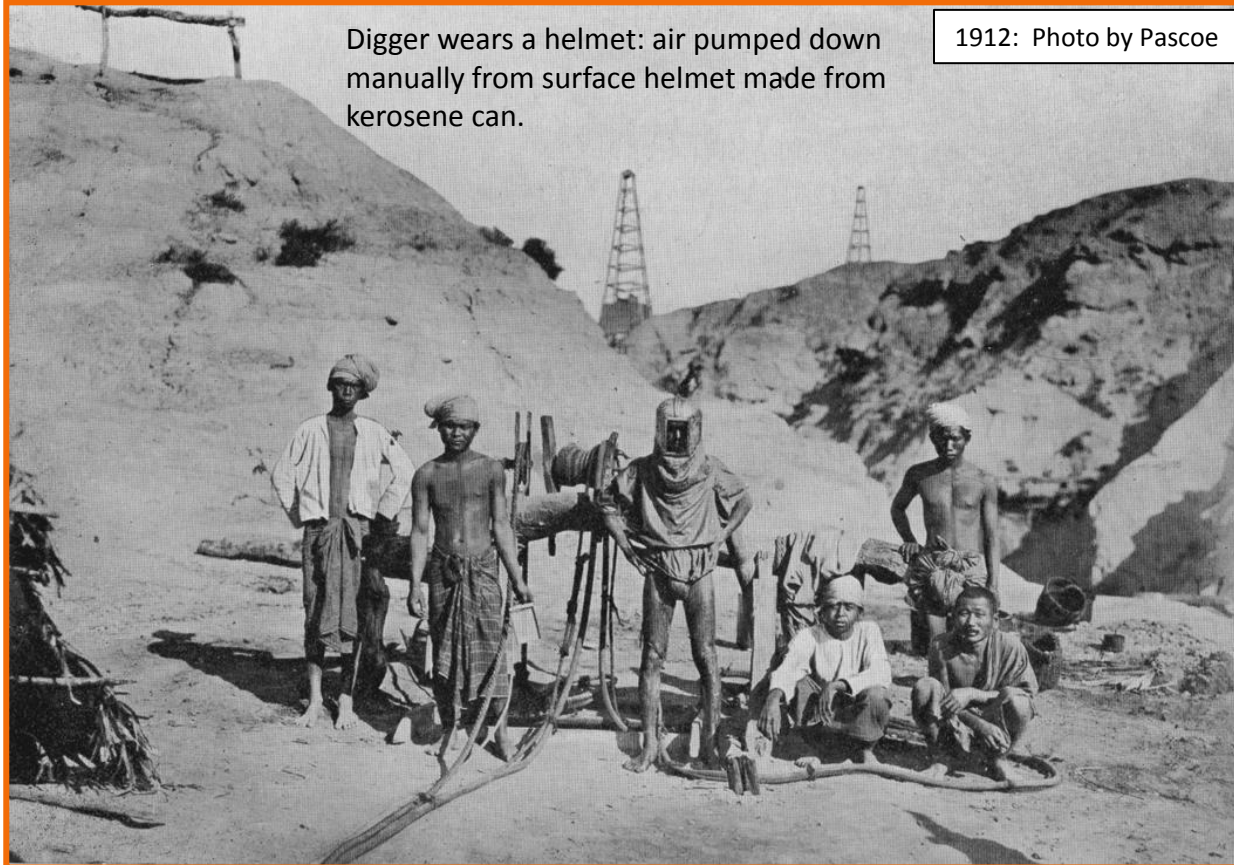


~ 1895



Corley, 1983

# Safely hand drilling with a helmet



Digger wears a helmet: air pumped down manually from surface helmet made from kerosene can.

1912: Photo by Pascoe



## Yenangyaung in 1915: over 4,000 Wells



Burmah Oil Company  
photograph, courtesy  
of BP Archive

Racey & Ridd, 2015

Notes by presenter: Note the numerous reservoirs, seals and source rocks in the stratigraphic succession. Really a fairly simple basin with two producing anticlines on the east, and to the south, really just one: focus of charge.

# Locally Made Rotary Well vs. Hand-dug

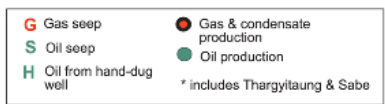


A villager operates an engine to lower a drill into an oil well at Bandau Pen village in Thayet Township, Magway Division. (Photo: Vincenzo Floramo / The Irrawaddy)



A view of Bandau Pen village where hundreds of poor families search for crude oil using old pump engines and makeshift drills. (Photo: Vincenzo Floramo)

For several decades however, groups of poor families have come here to explore for oil and exploit any finds. If they can collect oil they are obliged to pay local landowners a concession fee, which is set at between US \$500 to \$2,000 for the use of a roughly 20 square-meter plot.



**WEST** **EAST**

Western Outcrops Ngaingdwin Yenangyat-Chauk Gwegyo

MSL MSL

5000 5000

10,000 10,000

15,000 15,000 metres

Basement

U. CRET. PALEOCENE & EOCENE { Tlin  
Laungshwe  
Puangyi  
Kebaw

Yaw  
Ponzaung  
Tabyin

Irwaddy Gp

Pysubwe-Kyeukkok  
Padaung-Okhmintaung  
Shwazebaw

OLIGOCENE - MIOCENE

**10 km**

**WEST** **EAST**

Western Outcrops Mann Oilfield Yedwet

MSL MSL

5000 5000

10,000 10,000

15,000 15,000 metres

Basement

Irwaddy Gp

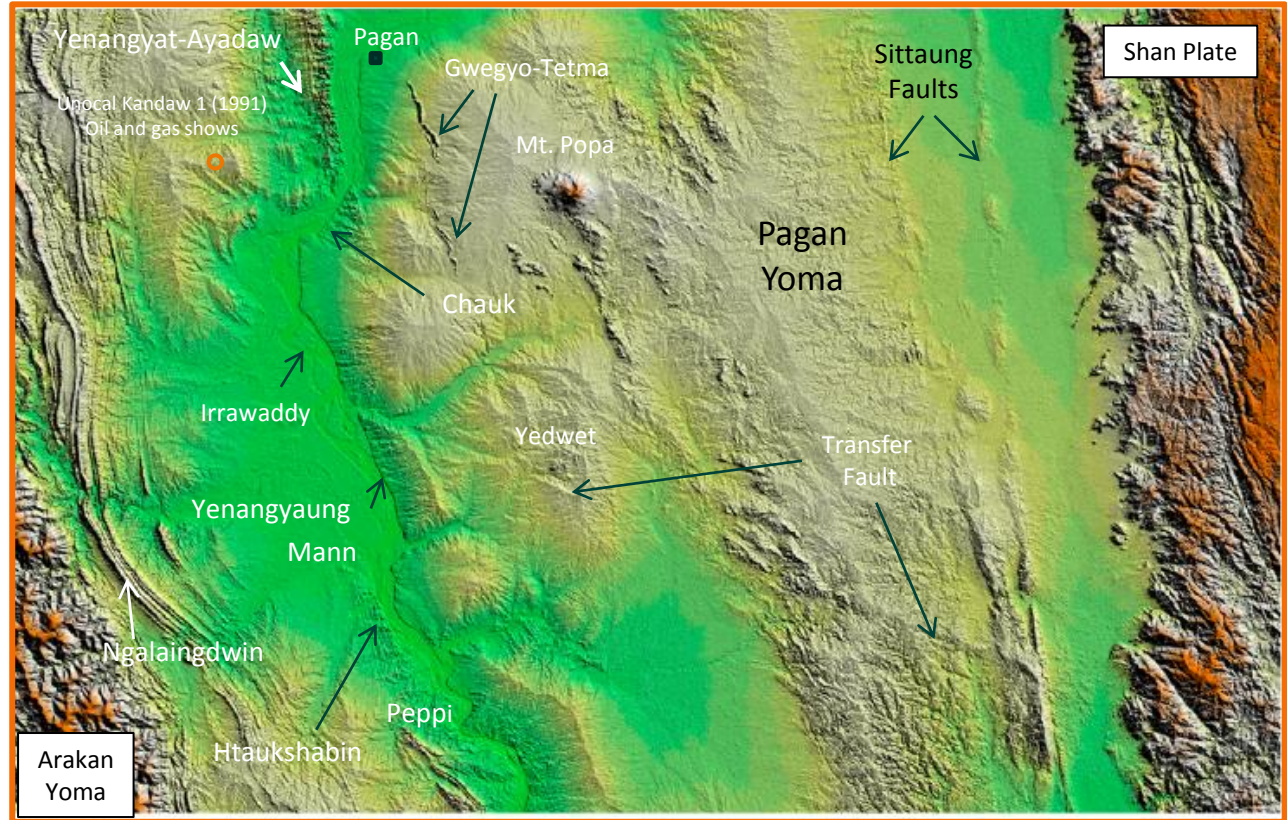
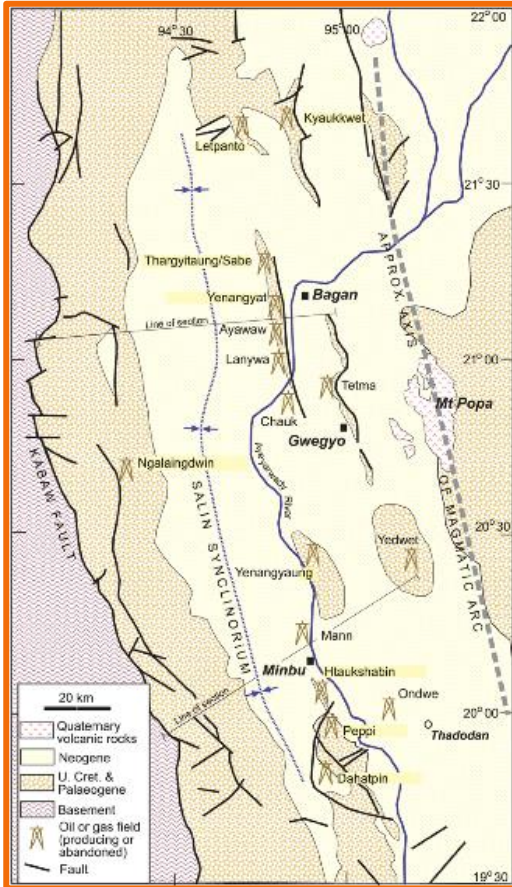
Pysubwe-Oboagon  
Kyeukkok

**10 km**

After Racey & Ridd, 2015



# Central Burma Basin: Surface Anticlines

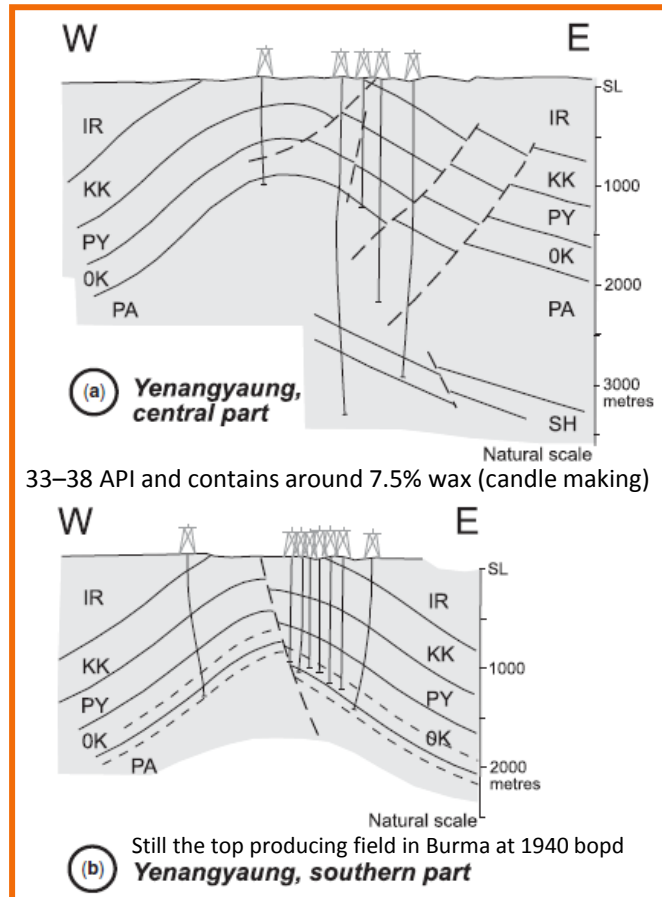
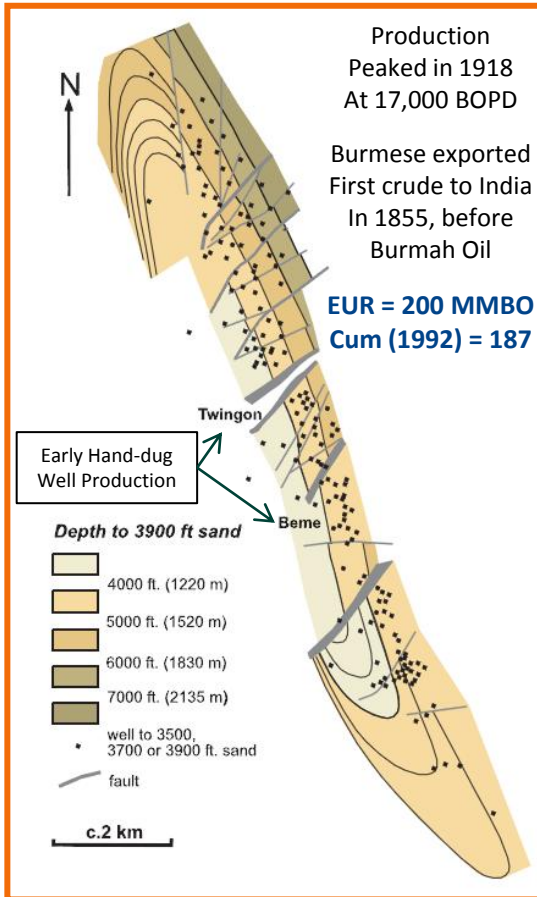


After Racey & Ridd, 2015

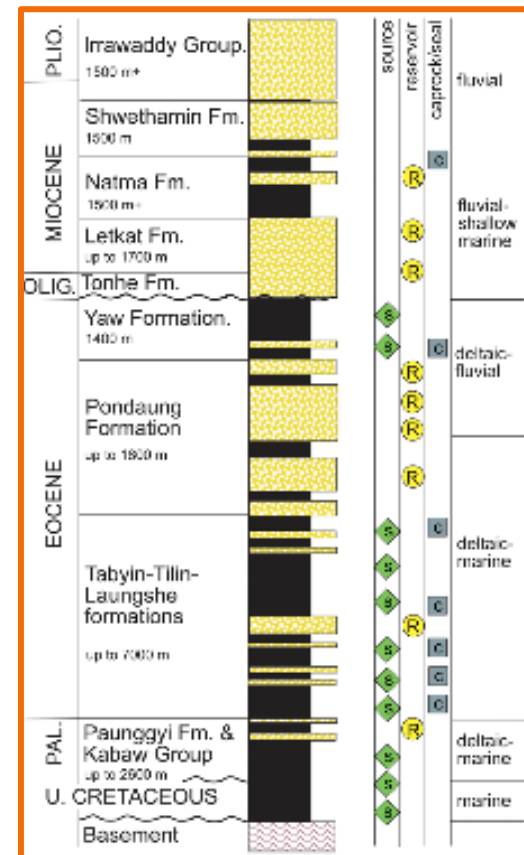
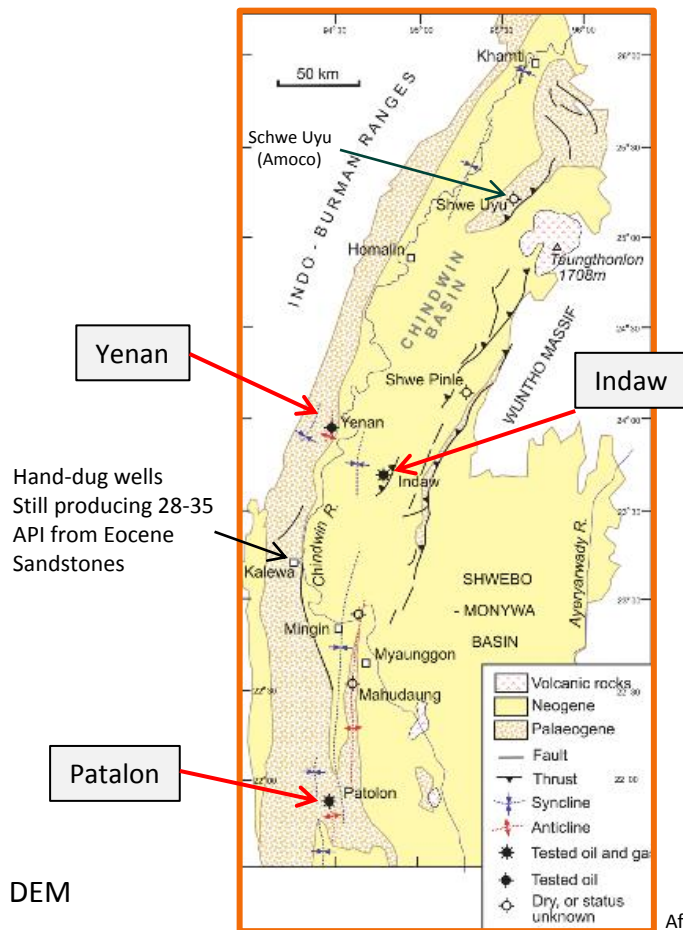
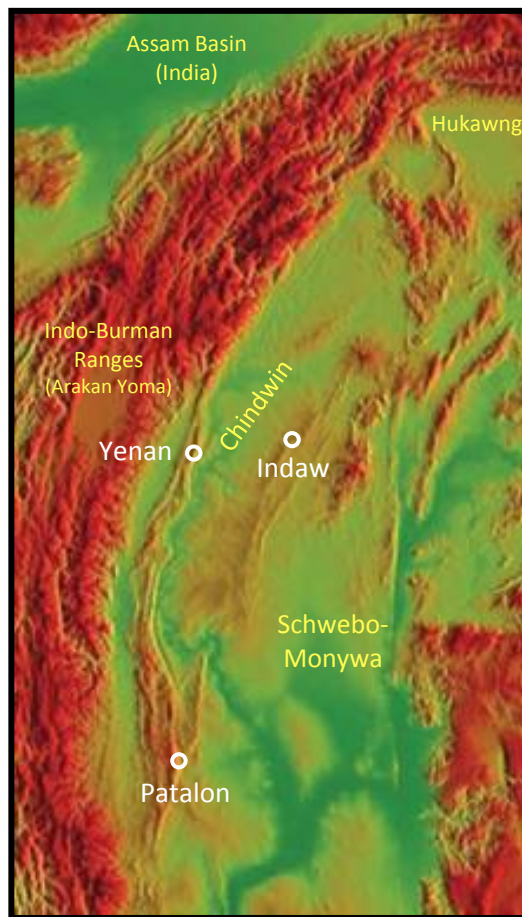
DEM



# Yenangyaung Anticline: Where It All Began

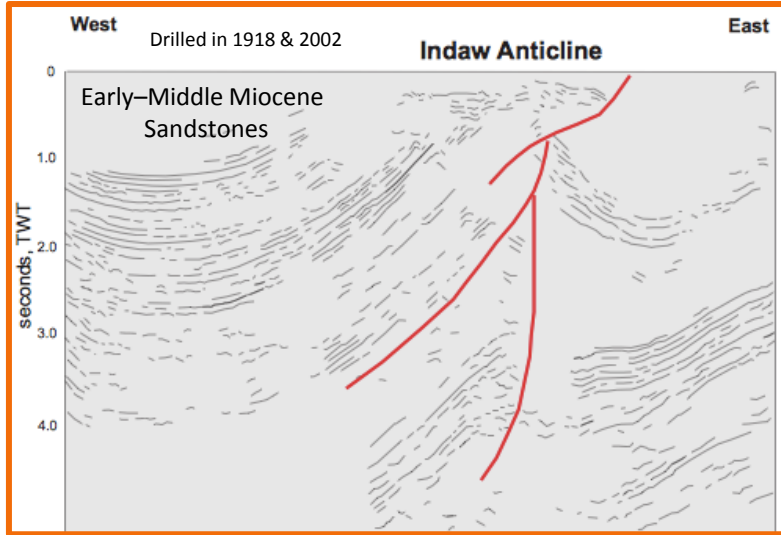


# Chindwin Basin: Map and Stratigraphy



After Racey & Ridd, 2015

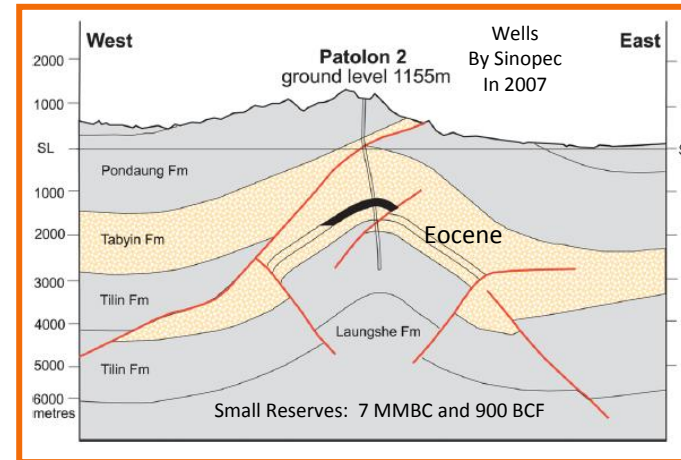
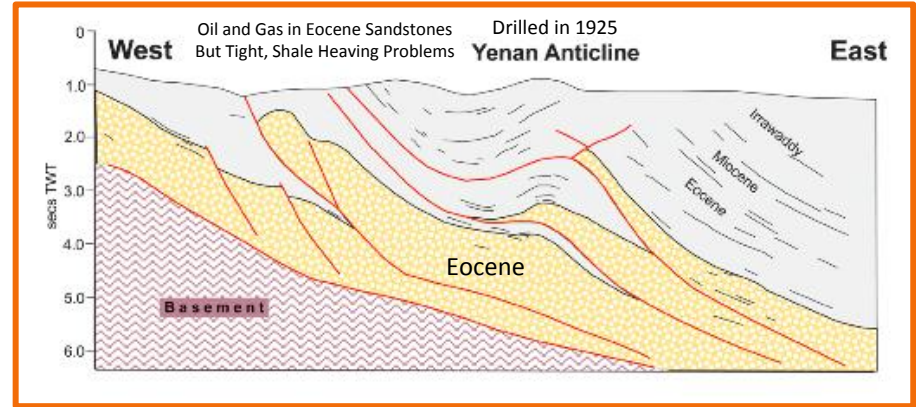
# Drilled Traps In Chindwin Basin: Compressional



Produced 1.2 MMBO Until destroyed during WWII  
75 Wells Drilled, each producing 10-12 BOPD. Small local refinery.  
Problems with overpressure in later wells drilled by Burmah, Yukong and MOGE. One blowout. Mud volcanoes at surface.

Why has this large basin yielded so little oil?

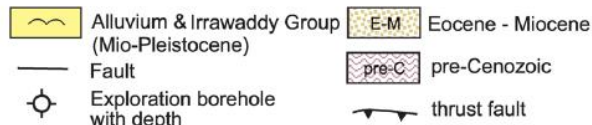
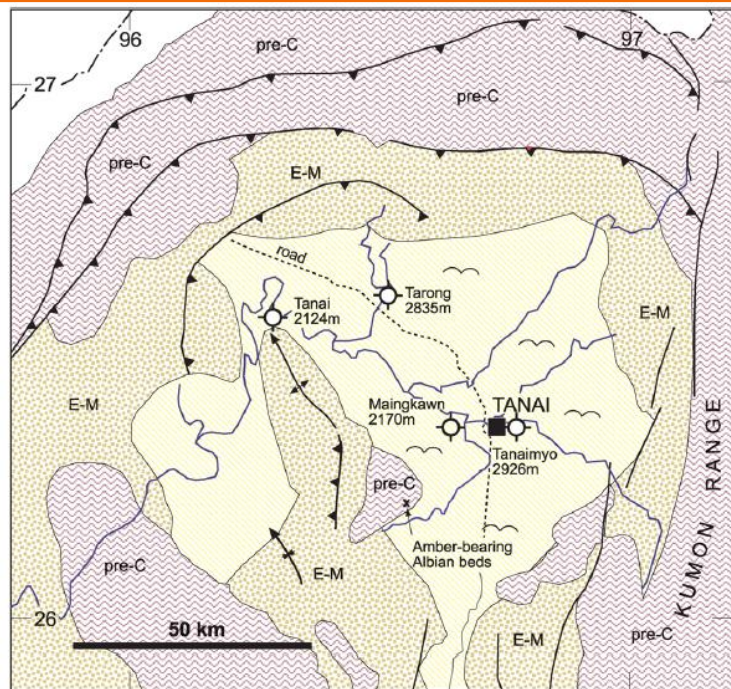
1. Charge limited: structures underfilled
2. Disruption of traps by tectonics (preservation)
3. Tight reservoirs



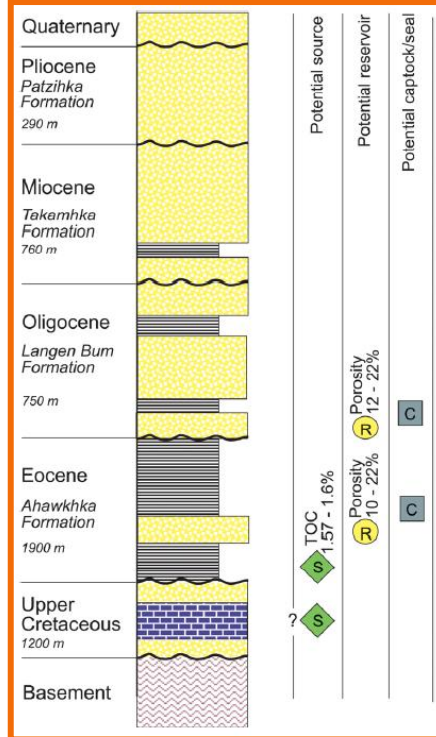


# Hukawng Basin: Frontier

Geological Map with Wells



Stratigraphy



After Racey & Ridd, 2015

Location

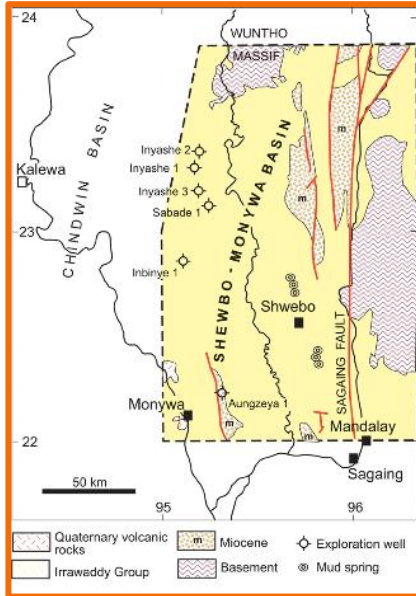


Cause of failure of 4 wells by MOGE in Hukawng is problematic:

- Source rocks present in area: ~ 1.6 %, lean, although coaly M. Cretaceous rocks near by should be better.
- Drilled on valid traps?
- Were there shows? Along migration path?
- Reservoirs good to very good: 10-22% porosity for Oligocene and Eocene
- Seals?



# Schwebo-Monywa Basin: Charge Limited?

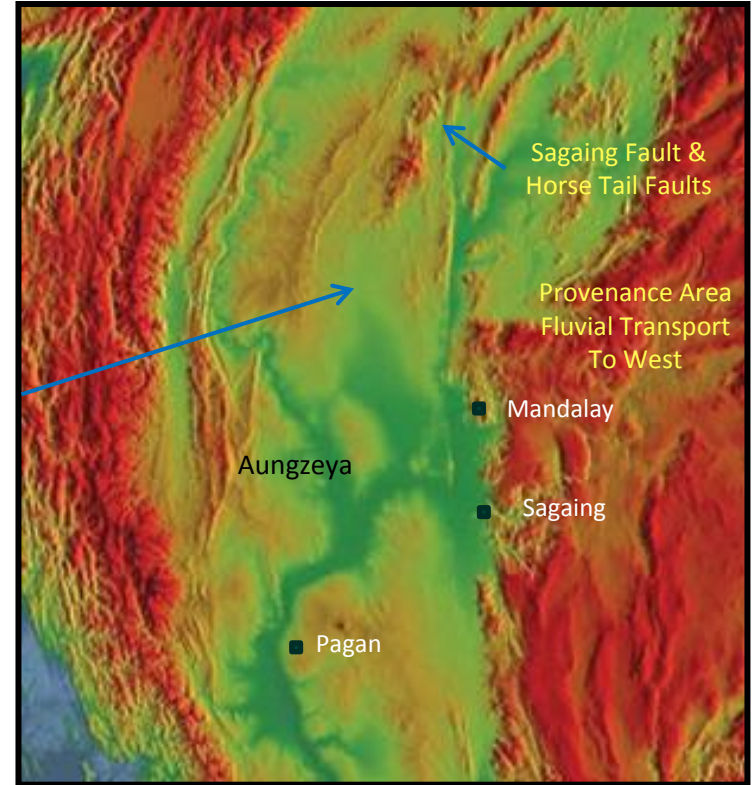
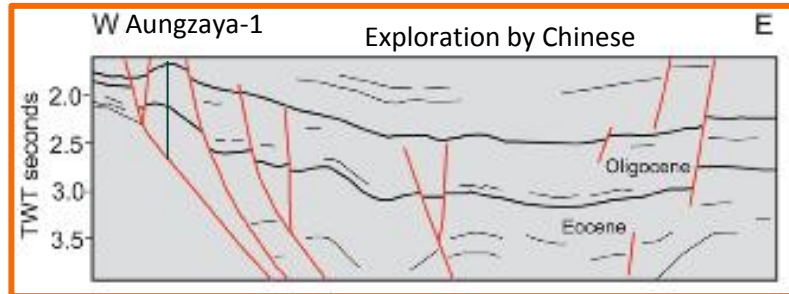


Mostly broad plain at surface

Rank frontier, 2011  
Exploration

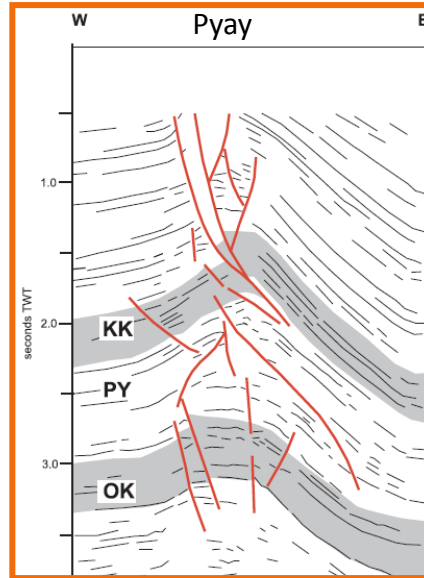
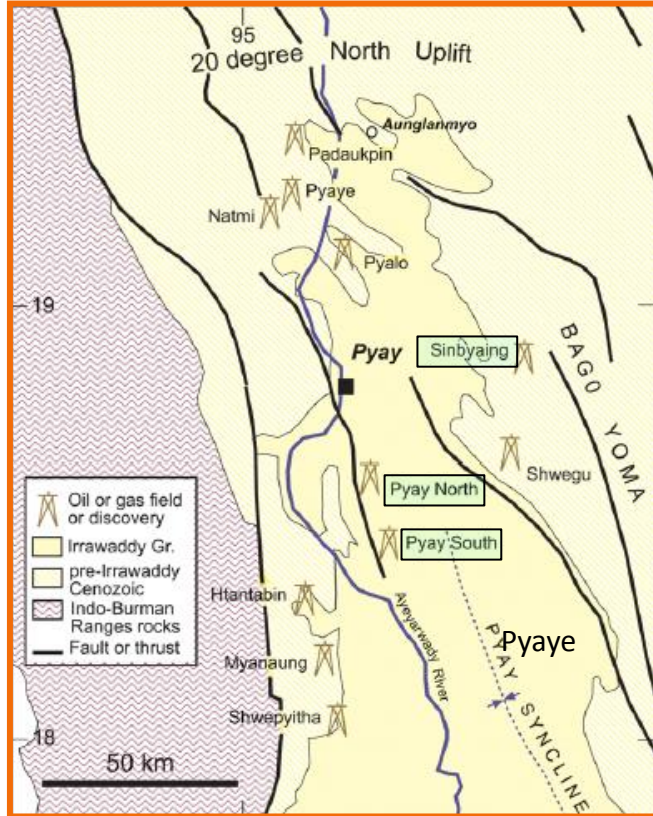
On Trend with Pegu  
Yoma Fold Belt

Tertiary too proximal to  
provenance for source  
rock development?



After Racey & Ridd, 2015

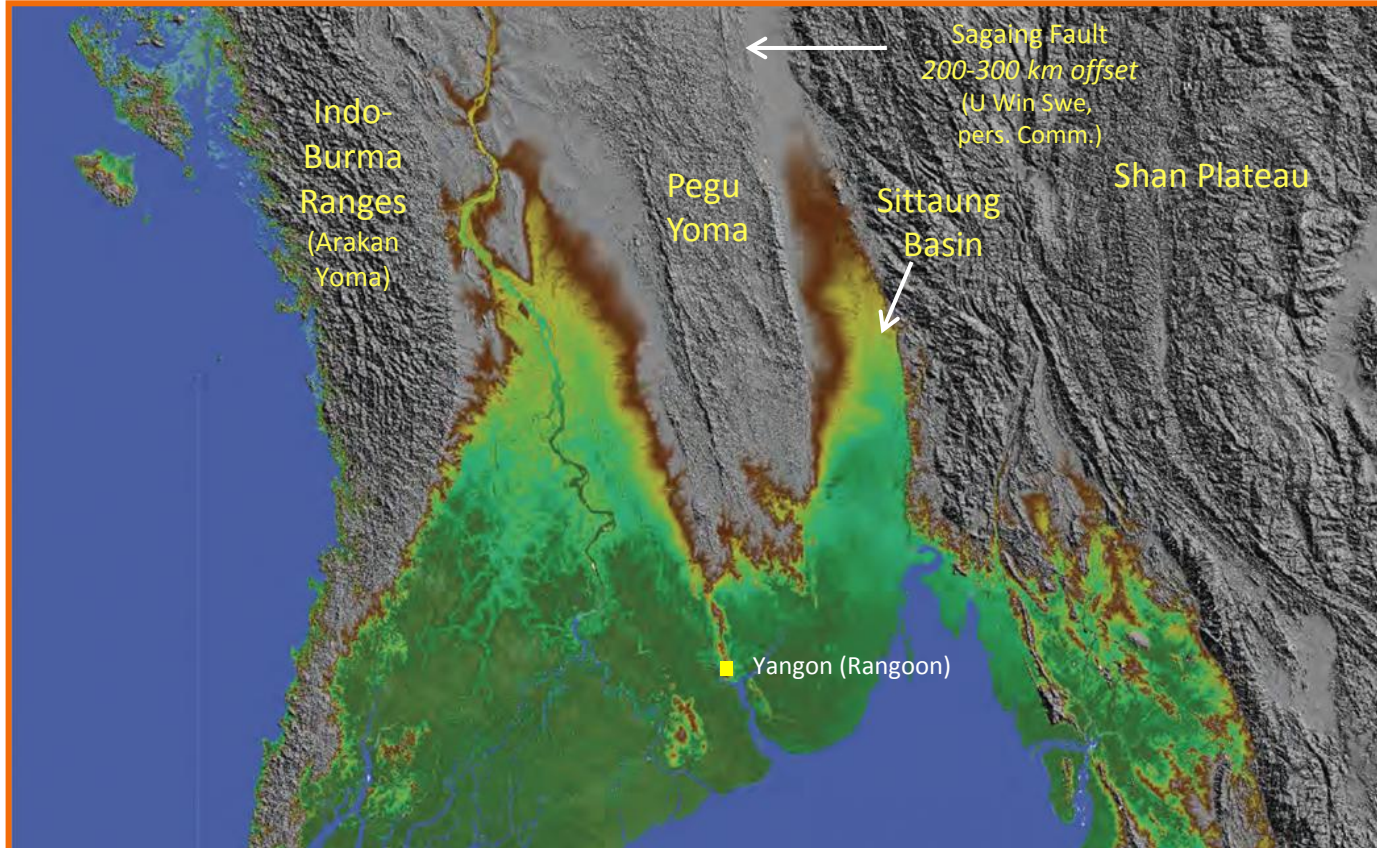
# Lower Burma (Pyay) Basin: Very Small Oil & Gas Fields



- Long, narrow anticlines cut by strike-slip faults
- Discovered beneath mud volcanoes with gas seeps
- Drilling 1920s-1980
- First wells with limestone containing hydrocarbons in country
- Small traps

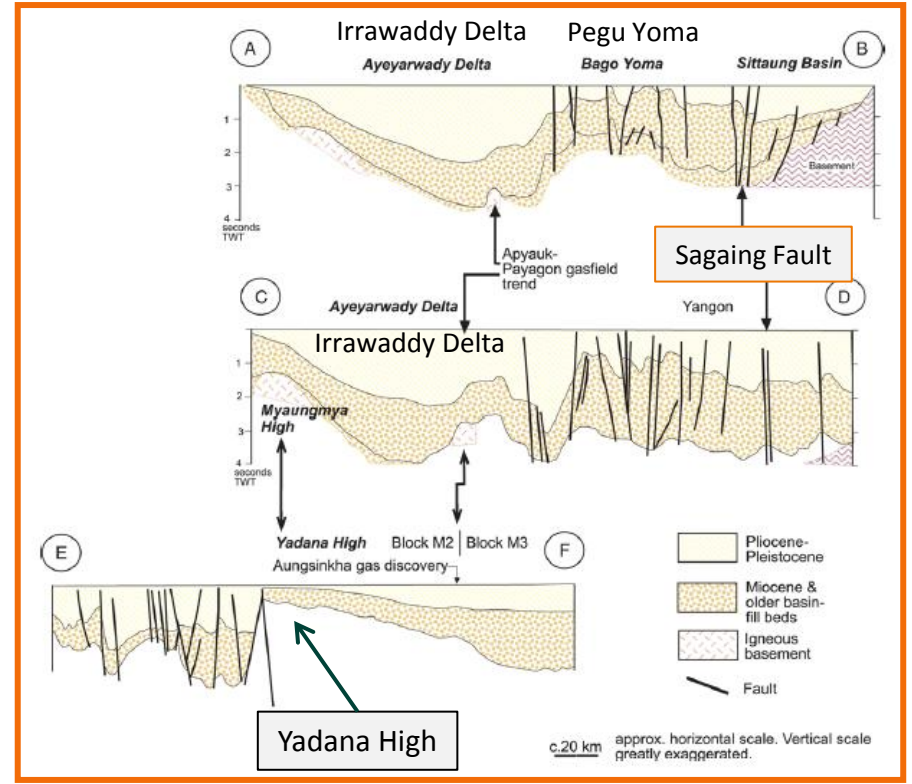
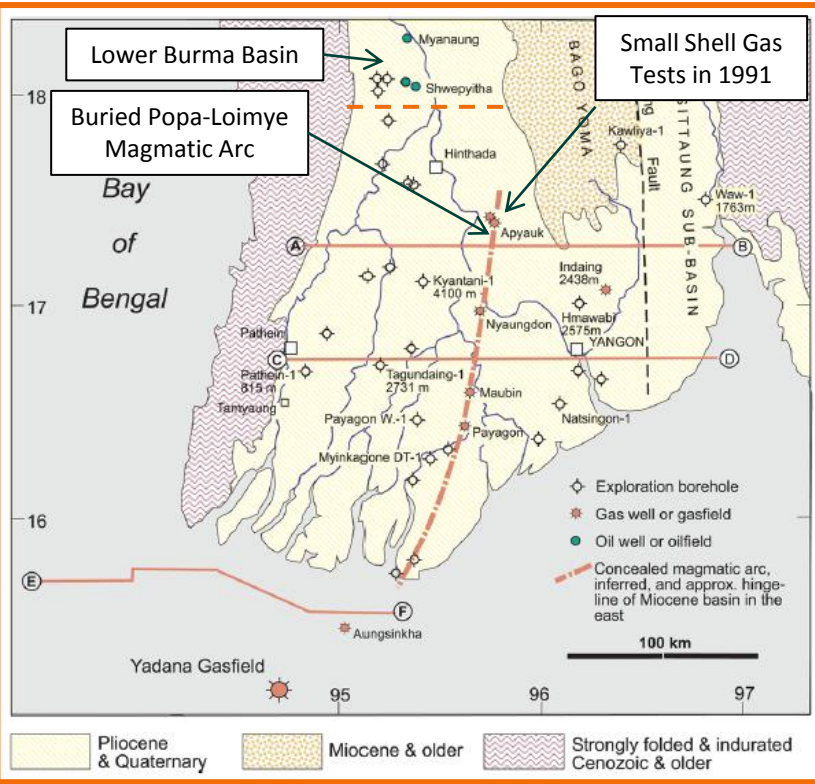


# Onshore Irrawaddy Basin



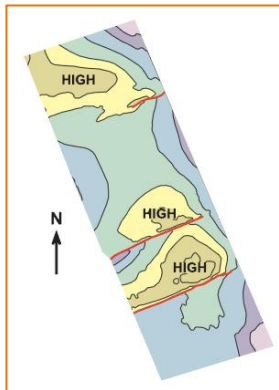
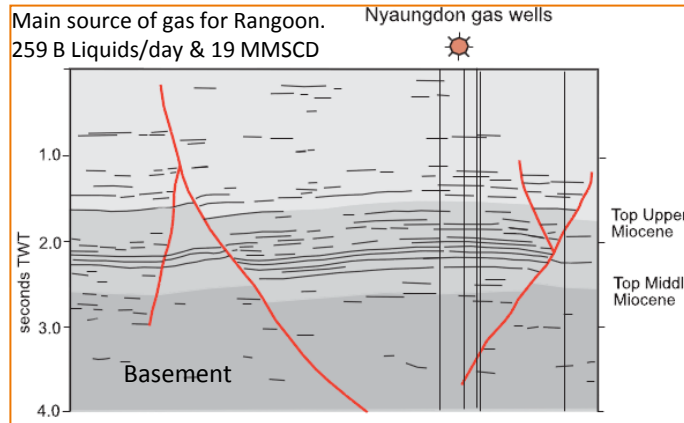
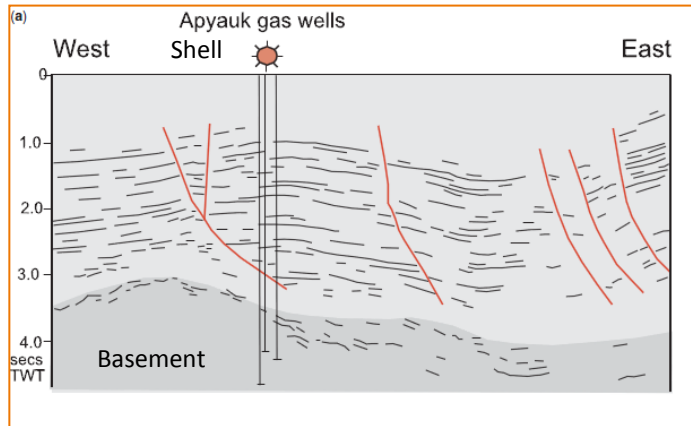


# Onshore Irrawaddy Basin



All Gas Discoveries, except Indaing, are above the buried Popo-Loimye Magmatic Arc (Yadana & Aungsinkha, also)

# Onshore Irrawaddy Gas Discoveries



18 M.-U. Miocene and Pliocene gas sands

Porosity of 20-25%, gross=180 m.

450 BCF BCFEUR (Nyi Nyi Soe, 2014 U.N.—100 BCFEUR

Currently producing (2015)  
5.94 MMSCD & 29 BCPD

**Pegu Yoma:** impressive fold-thrust belt with exposed Miocene. No seeps. *Very tight* rocks (Unocal field work, 1989). Questionable charge, hammer-ringing sandstones, continued structural deformation. 2 wells: Petrocanada/Unocal and BHPBilliton. Gas shows in very tight sandstones in Petrocanada/Unocal well in northern Pegu Yoma.

**Sittang Basin:** deep sedimentary fill, carbonate play, 2 wells, no shows (?). Presumably carbonate play. Grossly underexplored.

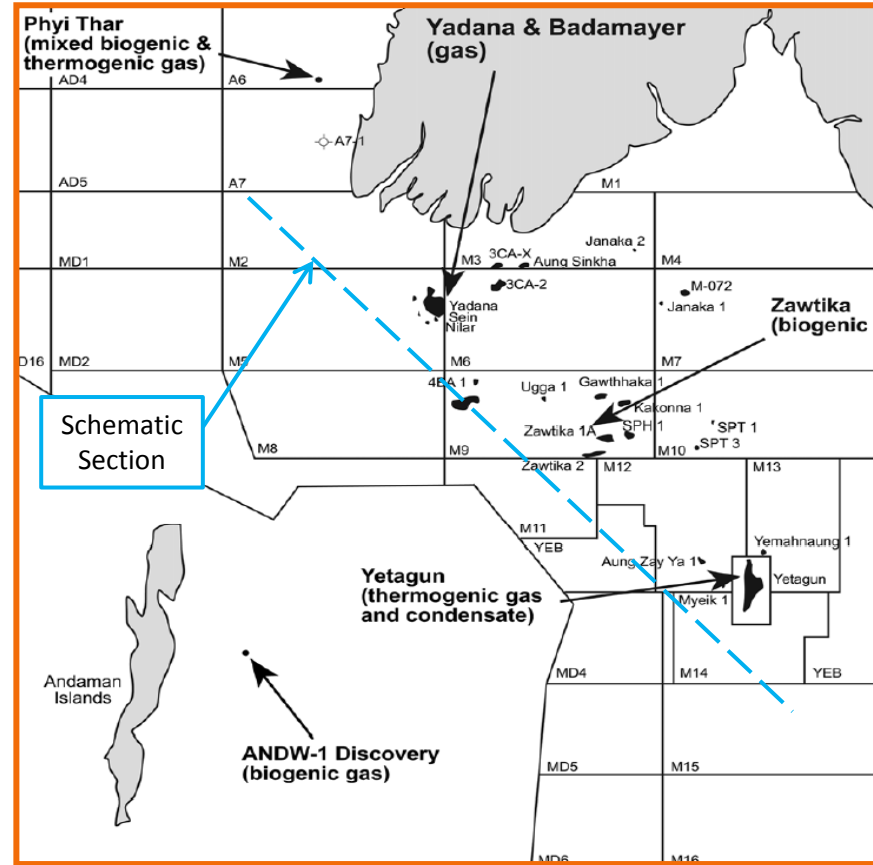
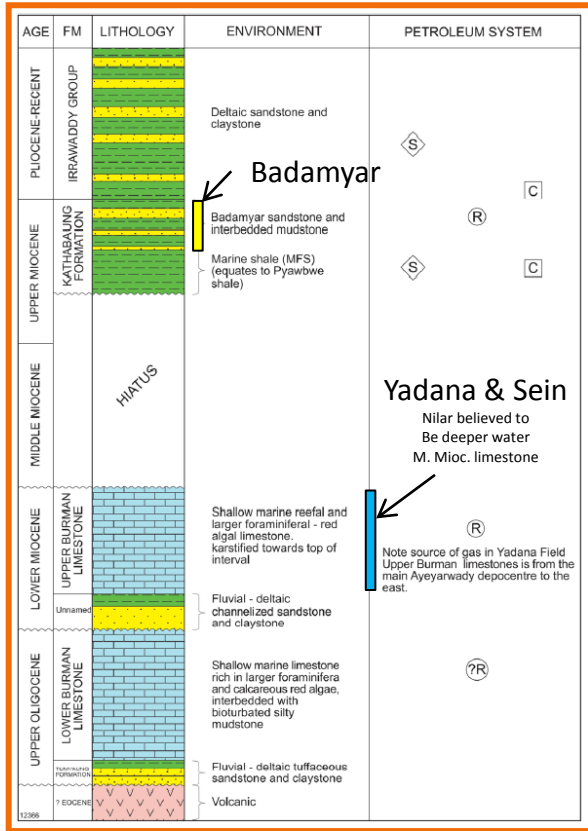
# Offshore South Exploration History



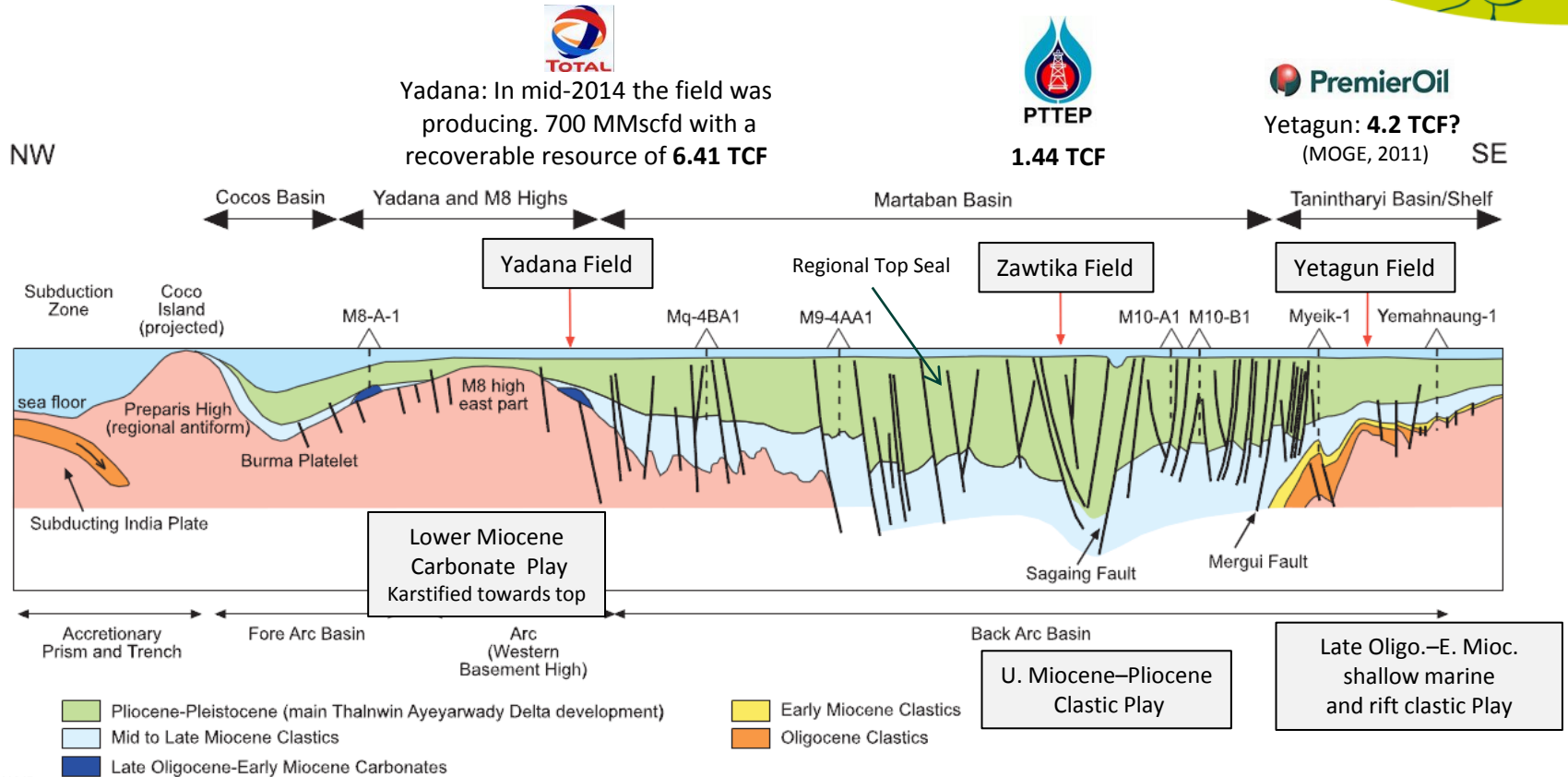
- Offshore exploration started in 1969, 3CA (later Yadana Field) “discovered” by bad blowout on 3<sup>rd</sup> well.
- 1973: Gulf of Martaban service contract offering. 4 consortia, 19 wells drilled, only one tested gas. All foreign companies pulled out by 1977.
- 1981-1986: Gulf of Martaban seismic and drilling by MOGE. Yadana discovery well (3DA-XA successfully tested. 1 exploration wells, and 2 appraisals. Several discoveries.
- 1988:Unocal is asked by MOGE to consider exploiting the 3DA discovery (later Yadana) and company concludes recoverable resources are 5.4 TCF, declines offer, seeking oil exploration opportunities in onshore Myanmar.
- 1992: Yetagun by Texaco/Premier. 2007 -- 460 MMCFPD, 1996-1997—other discoveries by Total/Unocal and Arco.
- 1998: Startup of Yadana production by Total/Unocal/PTTEP/MOGE. Commercial production in 2000. 2007 – 759 MMCFPD. Yetagun and Yadana combined – 12,000 bcpd.



# Stratigraphy and Fields: Offshore South

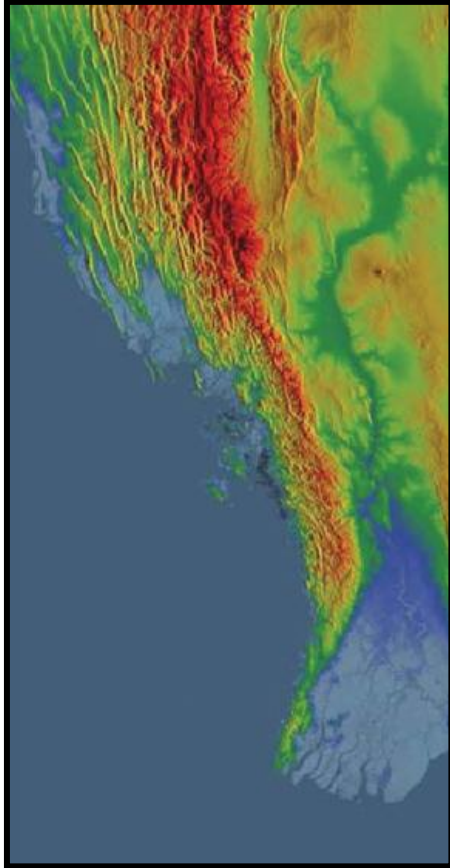


# Moattama & Tanitharyi Regions: Fields & Plays



After Racey & Ridd, 2015

# Offshore West Exploration History



- Local Arakanese hand-dug production since at least 1850s: drilled near seeps and mud volcanoes.
- First modern well 1878—9 years before the first modern well in Yenangyaung. Oil Springs, Ontario—1858.
- Several small companies, including the Australian Oil Company had exploration efforts onshore: small production which declined rapidly.
- 1975: 6 wells by Japanese, 1 by Total 1 by Cities Service. No success.
- 2004: Daewoo discovers Shwe Field.



# “Modern” Production: Ramree Island



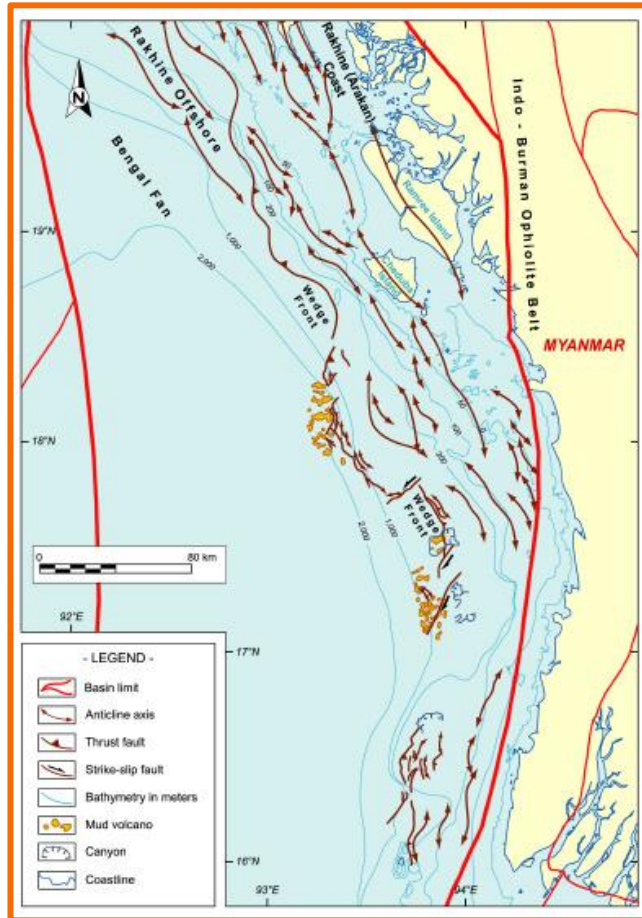
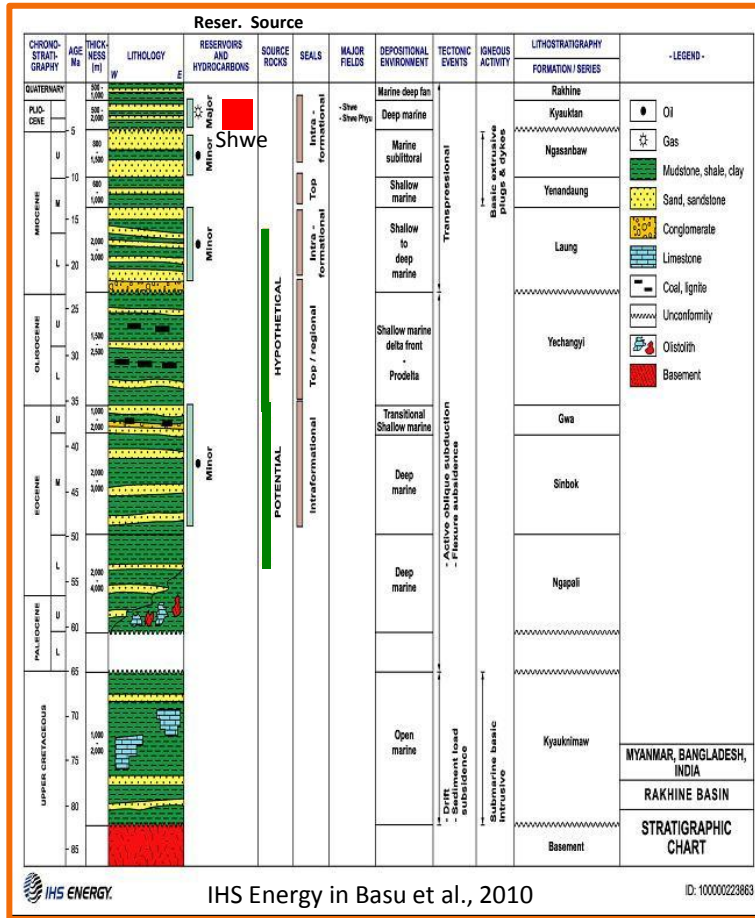
Very Light Oil: refined locally and sold to motorbike and car drivers. Still 5,000 traditional wells on Ramree Island  
Wells go up to 500 ft.

“The cost of drilling equipment is high, upwards from \$400, and is shared by five to seven households,”

Oil Mountain, Ramree Island, Rhakhine coast

National Geographic  
2013

# Rakhine Offshore Structure and Stratigraphy

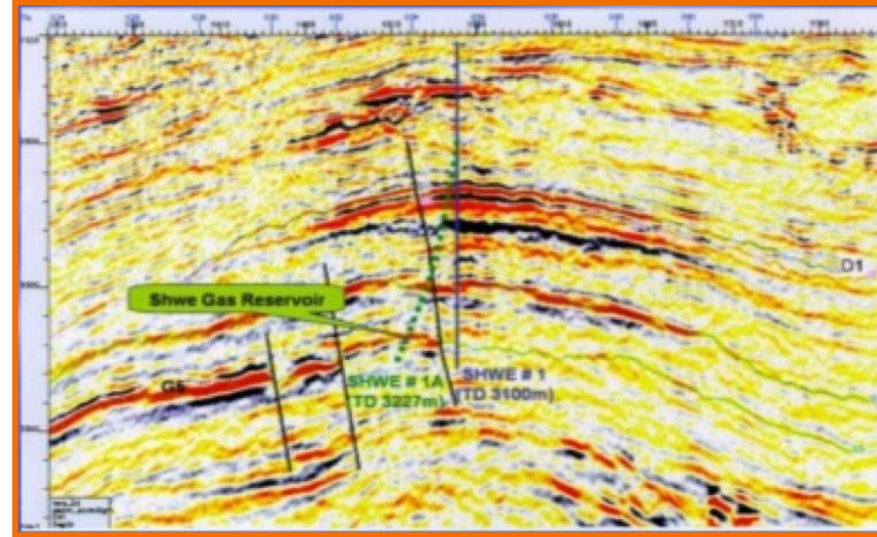
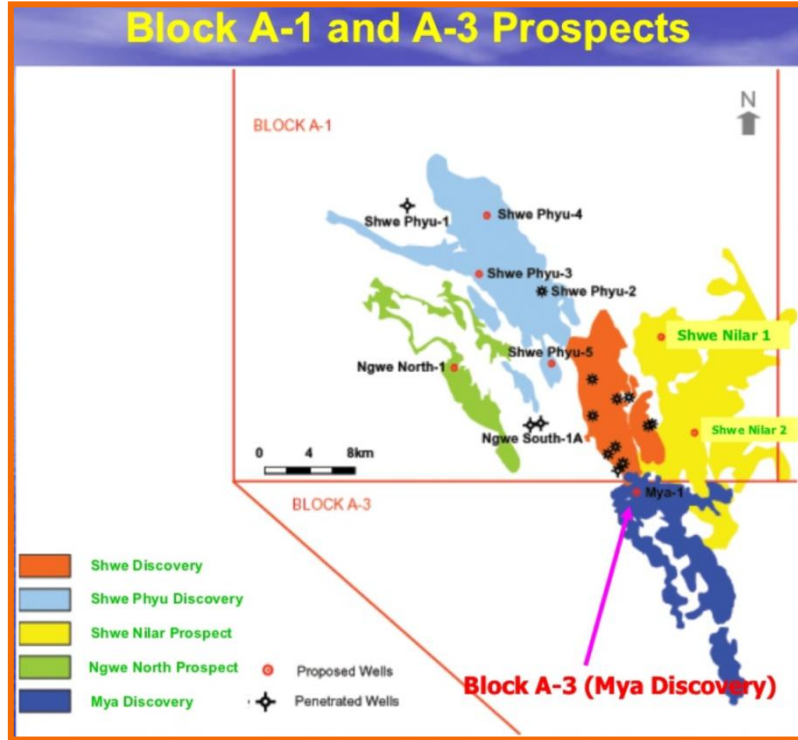


Basu et al., 2010; after San Lwin et al., 2004 and Neirem et al., 2003

# Shwe Gas Field Cluster: 9.1 TCF Proven Reserves



Shwe 1 & 1A



Reservoir: Basin Floor  
Fan Deposits with  
Injectites  
Cossey et al., 2013

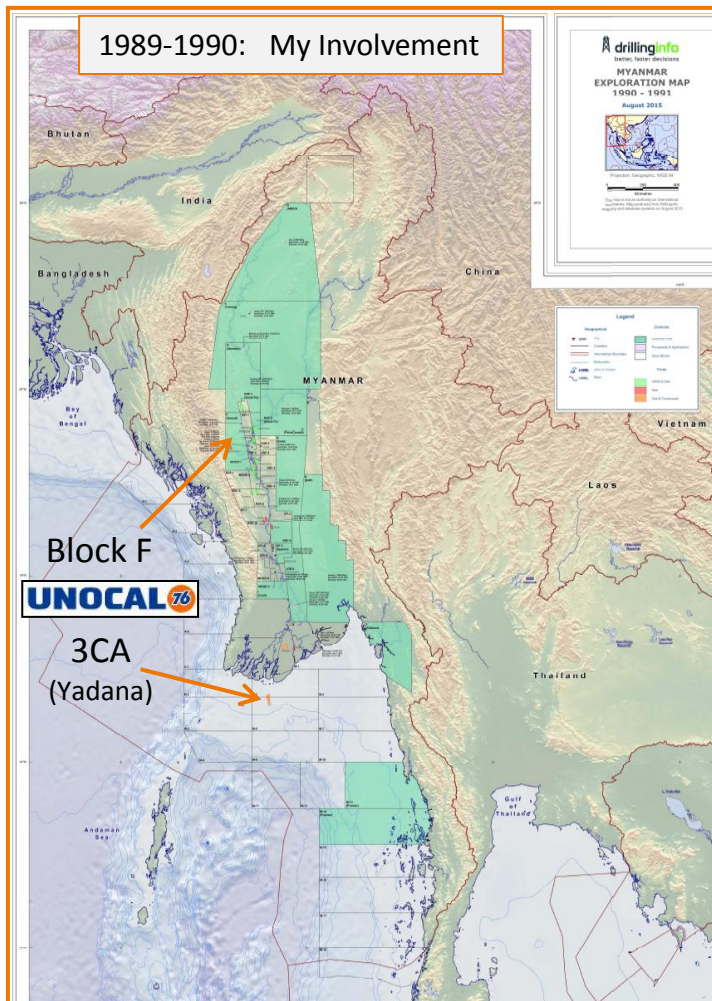


Trans-Myanmar  
Pipeline Route

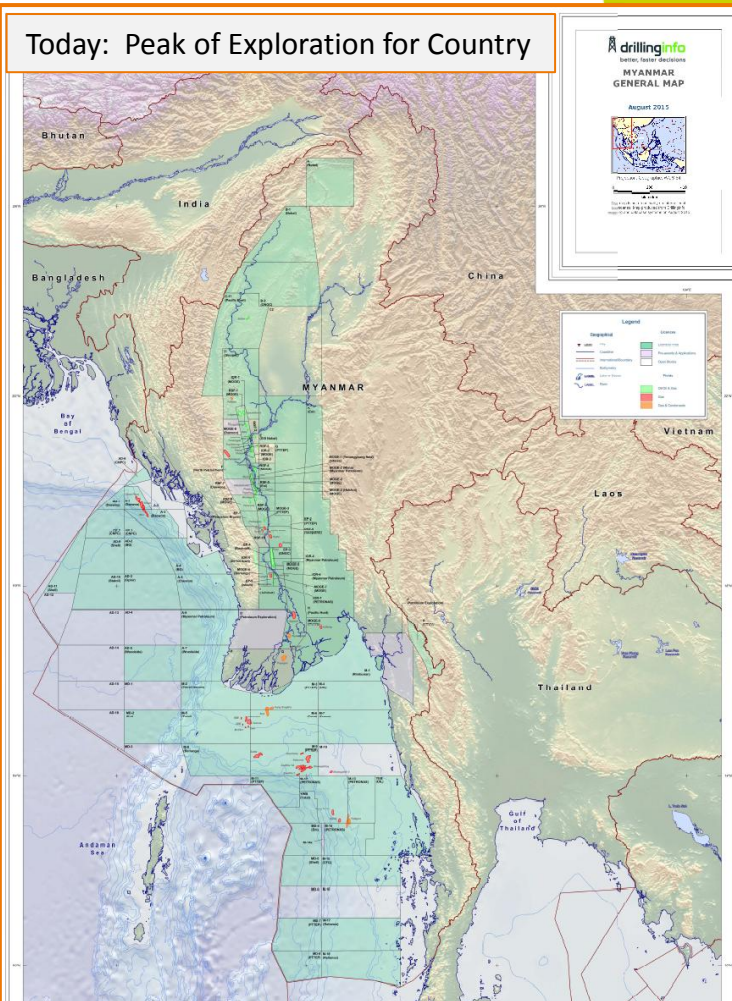
Myanmar's Biggest Gas Field Complex  
MOGE Presentation, 2011



## 1989-1990: My Involvement



## Today: Peak of Exploration for Country





Room in Schwedagon Pagoda, Rangoon

Thanks to Ecopetrol for Support in Giving This  
Paper and Paying My Way Down Under



Racy and Kidd, 2015: a *must buy* if you  
are working on Myanmar:  
Petroleum Geology of Myanmar,  
Geol. Soc., London, Mem. 45