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**


The History of Petroleum Exploration in the Union of Myanmar

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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.
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

4 Fields with > 100 MMBOEUR

After Racey & Ridd, 2015
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**
Pumping hand-dug wells

~ 1855

Burmese Oral History: first production 905 AD

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

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

Corley, 1983
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.
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.
Central Burma Basin: up to 27 pay sands

Most Prolific Oil Basin in Myanmar: Four 100 MMBOEUR fields

After Racey & Ridd, 2015
Central Burma Basin: Surface Anticlines

After Racey & Ridd, 2015

Mt. Popa
Sittaung Faults
Shan Plate

Irrawaddy
Gwegyo-Tetma
Mt. Popa
Chauk
Yadwet
Transfer Fault

Yenangyaung
Peppi
Htauksabin

Yenangyat-Ayadaw
Oil and gas shows

Pagan

1 (1991)
Oil and gas shows

Unocal

After Racey & Ridd, 2015

DEM
Yenangyaung Anticline: Where It All Began

Production
Peaked in 1918
At 17,000 BOPD

Burmese exported
First crude to India
In 1855, before Burmah Oil

EUR = 200 MMBO
Cum (1992) = 187

Early Hand-dug Well Production

33–38 API and contains around 7.5% wax (candle making)

Still the top producing field in Burma at 1940 bopd

After Racey & Ridd, 2015
Chindwin Basin: Map and Stratigraphy

Hand-dug wells Still producing 28-35 API from Eocene Sandstones

- Patalon
- Indaw
- Yenan

DEM

After Racey & Ridd, 2015
Drilled Traps In Chindwin Basin: Compressional

Early–Middle Miocene Sandstones

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

After Racey & Ridd, 2015
Hukawng Basin: Frontier

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?

After Racey & Ridd, 2015
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

After Racey & Ridd, 2015
• 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

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

**Apyauk gas wells**

- 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


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

Main source of gas for Rangoon.

259 B Liquids/day & 19 MMSCD

- Currently producing (2015) 5.94 MMSCD & 29 BCPD

After Racey & Ridd, 2015
Offshore South Exploration History

• Offshore exploration started in 1969, 3CA (later Yadana Field) “discovered” by bad blowout on 3rd 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.
Stratigraphy and Fields: Offshore South

After Racey & Ridd, 2015

Yadana & Sein
Nilar believed to be deeper water M. Mioc. limestone

Badamyar

Note source of gas in Yadana Field. Upper Burman limestone is from the Upper Burman depositional to the east.

Phyi Thar (mixed biogenic & thermogenic gas)
Yadana & Badamayer (gas)

Zawtika (biogenic)

Yatagun (thermogenic gas and condensate)

ANDW-1 Discovery (biogenic gas)
Moattama & Tanintharyi Regions: Fields & Plays

Lower Miocene Carbonate Play Karstified towards top

Yadana: In mid-2014 the field was producing 700 MMscfd with a recoverable resource of 6.41 TCF

Yetagun: 4.2 TCF? (MOGE, 2011)

Regional Top Seal

Zawtika Field

Yetagun Field

Yadana Field

NW

Cocos Basin

Yadana and M8 Highs

Martaban Basin

Yetagun Field

Tanintharyi Basin/Shelf

Subduction Zone

Coca Island (projected)

M8-A-1

Mq-4BA1

M9-4AA1

M10-A1

M10-B1

Myik-1

Yemahnaung-1

Subducting India Plate

Preparis High (regional antiform)

Burma Platelet

M8 high east part

Accretionary Prism and Trench

Arc (Western Basement High)

Back Arc Basin

Late Oligo.–E. Mioc.
shallow marine
and rift clastic Play

U. Miocene–Pliocene
Clastic Play

1.44 TCF

PTTEP

Yetagun Field

MOGE, 2011

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.
- 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

IHS Energy in Basu et al., 2010

Basu et al., 2010; after San Lwin et al., 2004 and Neirem et al., 2003
Shwe Gas Field Cluster: 9.1 TCF Proven Reserves

Myanmar’s Biggest Gas Field Complex
MOGE Presentation, 2011

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

Trans-Myanmar Pipeline Route
1989-1990: My Involvement

Today: Peak of Exploration for Country

Block F
3CA (Yadana)
Thanks for Acreage Maps.


Room in Schwedagon Pagoda, Rangoon

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