Frontier Exploration in Mongolia (and the search for oil-stained marmots)
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Mongolia
1. Where it is
2. Country Overview
3. Exploration History
4. Proven Petroleum Systems
5. Exploration Potential
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7. Why You Should Care
Location

- 2nd largest land locked country on the planet
- Area 1.6 million km² (2½ the size of France)
- Only two neighbours: China and Russia
- Population c. 3 million. 50% in Ulaan Baatar
- On average 1 person per 1.9 km² (a global low)
- Major religion Buddhism
- Nomadic lifestyle still exists

- Mining is the dominant industry
- Coal the dominant energy source (80%)
- Oil production c. 17,000bopd (2018)
- A net oil importer
- Industry Regulator: Mineral Resources and Petroleum Authority of Mongolia (MRPAM)
Overview

• A stable Central Asian democracy after 70 years as a Soviet satellite
• Annual GDP c. $12Bn and to date is heavily reliant on the mining sector
• Produces 17,000 barrels of oil/day (2018) from fields in Eastern Mongolia close to the Chinese border
• Exports 100% of produced crude to China at a price benchmarked to globally traded crude
• Pays a high price for refined products from Russia which has a monopoly on supply
• Energy independence is a priority for the government
• Industry giants Petro China and Sinopec plus Petro Matad are the only internationally recognized E&P players operating in country although some 28 Production Sharing Contracts are currently valid
• Very little petroleum exploration activity despite having numerous prospective basins adjacent, and geologically similar, to prolific oil producing basins in China
Exploration History

Early 1920s - Mongolian geology excites dinosaur fossil hunters

1928 - Formation of the Mongolian People’s Republic

1928 to 1991 - Mongolia is a satellite state of the Soviet Union. During this period:

- Field geology and gravity surveys, core hole drilling but no significant oil exploration. Certainly none by international companies
- 1940s - Zuunbayan a small field in a seeping surface anticline, developed for military purposes

Early 1990s - Independence

- Petroleum Law and PSC regime put in place
- Major International Companies scout but do not enter
- 1993 Soco signs the first PSCs chasing extension of the Hilar basin from China
- 1997 Soco makes the first discovery in Block XIX. Develops discoveries. Onstream in 1998. Low flow rates per well

21st Century

- Limited international interest continues
- 2005 Soco sells its interests in Mongolia to Petro China
- Production peaks at 25,000 bopd (2015)
- Smaller/non-core players sign PSCs
References
- The Cretaceous Play and the exploration potential of the East Gobi Basin, Mongolia. 2015, Qin Et al.
- Analysis of the distribution of onshore sedimentary basins and hydrocarbon potential in China. 2015. Jiang Z. Et Al
- Tellus Database Contract: ca 2012, CGG Robertson's www.cgg.com

Proven Petroleum System in Mongolia and China

- PETRO MATAD
  Proven Petroleum Systems
  - Junggar Basin 10 Bbbls Rec
  - Tarim Basin 14 Bbbls Rec
  - Turpan Basin 0.5 Bbbls Rec
  - Qaidam Basin 2 Bbbls Rec
  - Santanghu Basin 0.5 Bbbls Rec
  - Erdos Basin 0.62 Bbbls Rec
  - Tianshan Basin 0.05 Bbbls Rec
  - Hilar-Tamsag Basin 0.5 Bbbls Rec
  - Erlian Basin 0.62 Bbbls Rec
  - East Gobi Basin 0.05 Bbbls Rec
  - Bo Hai Basin 40 Bbbls Rec
  - Bohai Basin 40 Bbbls Rec
  - Quilan Basin Productive, No Data
  - Yingen Basin Productive, No Data
  - Santanghu Basin Productive, No Data
  - Quilan Basin Productive, No Data

- Petro Matad acreage

- Recent Discovery
  - Quilan Basin Productive, No Data
  - Yingen Basin Productive, No Data
  - Santanghu Basin Productive, No Data
Geological Overview

- Lacustrine depositional environment
- Half-graben and sag basins with up to 4000m Mesozoic – Tertiary fill
- Proven Late Jurassic – Early Cretaceous Petroleum System, additional older potential
- Alluvial, fluvial and lake turbidite reservoir fairways predominant
- Proven source rocks in East and now Central Mongolia – present day maturity
- Complex structural history but multiple trap styles proven effective

Modified from P. Zhang et al, 2014
Three Mega Sequences recognized across Mongolia
- MS-3: Upper Cretaceous to Recent (fluvial-alluvial)
- MS-2: Upper Jurassic - Mid Cretaceous (fluvial-lacustrine)
- MS-1: Upper Carboniferous - Jurassic (fluvial-alluvial-lacustrine)

All Mongolian production to date comes from MS-2
- Source: World Class Lacustrine Source Rocks - Confirmed
- Reservoir: Effective Reservoir Rocks - Confirmed
- Seals: Vertical and lateral (fault) seals - Confirmed
- Prolific Analogues Basins in Mongolia and China
  - Songliao and Erlian Basins of eastern China
  - Tamtsag /Hilar Basin of NE Mongolia/China

Secondary Petroleum System potential in MS-1
- Unproven to date in Mongolia but...
- Mature source and effective reservoir potential at outcrop
- Significant preservation of this sequence imaged on seismic beneath MS-2 basin areas
- Stacked petroleum system potential
- Prolific Analogues Basins in Western China - Junggar, Turpan and Santanghu Basins
# Geological Overview - Structural History

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<thead>
<tr>
<th>Age</th>
<th>Petroleum System Elements</th>
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<td>Mega Sequence 1</td>
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- **Source**
- **Reservoir**
- **Seal**

**Far Field Himalayan**

**Sag Phase**

**Post-Rift Overlap**

**Minor Contraction**

**Strike-Slip Transition**

**Widespread Crustal Extension**

**Major Crustal Shortening**

**Accretion**

**Foreland Contraction**
• 25 blocks under contract, many are dormant with inactive operators. Many PSCs are available for farming or will soon be relinquished
• Prospective acreage available for licensing. Western Mongolia is largely unexplored

2 = Number of wells drilled per block to date

Map Source: MRPAM Website
Known and reported oil shows / bitumen/oil shales

- Extensive reports of naturally occurring seeps in the southern Mongolian Basins
- Associated with Upper Jurassic/Lower Cretaceous and Permo-Triassic rocks
  Indicative of working petroleum systems
- Although the actual seeps can be elusive...

Data Source: Petroleum Potential of Mongolia (MGT/EAIT report 1990)
Fiscal Terms

- Exploration Term up to 12 years (8+2+2)
- Exploitation Term up to 35 years (25+5+5)
- E&A/P&D costs are low
  - Exploration wells in the $3MM to $8MM range
  - Development wells to 2000m costing $2MM or less
- Royalty 5-10%
- Contractor Production Share 45-60% depending on production rate
- Production share not affected by rate of return or reserve size, therefore Contractor shares fully in upside
- Cost Recovery of all costs, capped at 40% of Gross Revenue
  Unlimited carry-forward of unrecovered costs
- No corporate taxes on oil/gas sales
- Contractor can freely dispose of its production share
- No sales of oil at reduced prices for domestic market are required
- Oil price linked to internationally traded marker crude
Ranking of Asian/African PSCs

Source: Palantir Solutions plus others
Conclusions

• Mongolia is highly prospective for oil but significantly under-explored
• It has been overlooked primarily for geopolitical reasons
• Exploration and development costs are low
• Reserves potential is very high and prospective basins/land abundant
• Fiscal terms are very attractive
• Commercialisation precedents exist and are in reliable operation
• Mongolia offers something for everyone from the Majors to the Micro-caps
• The Mongolian Government is keen to encourage investment in the sector
• If you want some low cost, high impact exploration in your portfolio Mongolia has a lot to offer
• Petro Matad is a London listed, Mongolia experienced, well-connected in country operator with whom you could consider partnering
Frontier Exploration in Mongolia

баярлалаа  Thank You