ASPO
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The main O&G conventional discoveries in 2023
Some highlights on Unconventional ventures
Marc Blaizot
marc.blaizot@gmail.com
Post COVID low level Exploration investments remain / Very deep waters appeal

- Ultra deep Offshore = 1/3 of the discoveries and majors ¼ of discoveries

But money doesn’t buy happiness!

Source: Rystad Energy's Upstream Solution, February 2024
A Rystad Energy graphic
2023 : a modest Exploration trip!
Around 10 Gboe (30% oil/70% gas)

**Oil discoveries** : China, Iran, Turkey, Guyana, Nigeria, Namibia

**Gas discoveries** : Indonesia, Malaysia, Iran, Egypt, Colombia
Two major dry gas discoveries in Adamanan Sea (Indonesia) in 2023: Timpan and Layaran (3 to 5Tcf each),

DHI's supported sandstones
2 explo wells planned in 2024: Gayo and Halwa

Medium size companies: Mubadala and Harbour Energy
Indonesia: Adaman Sea Mio-Oligocene basin

Tympan 1 well by Harbour Energy (40%), bp (30%) and Mubadala (30%)
WD: 1400 m/ TD: 4211 m

390’ Gas column in Upper Oligocene sandstones

Excellent DST
1 M.m3/d + 1800 bcpd

1 to 6 Tcf
20 to 120 Mbc
Indonesia: Deep Mahakam Discovery: Geng North-1 by Eni

Eni op 50%, Neptune Energy (38%) and Agra (12%)
WD: 1950 m TD / 5025 m

A more than 11 years journey to discovery since dry Panada drilling in 2012 (siltstones/shales in outboard Geng North)
Stratigraphic trap (fan)
Excellent 50 m net pay in Miocene sandstones

DST deliverability of 80 MMscfd with 6000 bcpd
Reserves: 3.5 Tcf/150 Mbc
Production (expected) 1 Gm3/y +3Mbo/y
Malaysia Sarawak new gas cluster -

PTTEP 60%, MITSUI 25%, PETRONAS 15%
Several sweet gas discoveries
Thick up to 200 m
Miocene/oligocene sandstones
No reserves published
China : Bohai Bay : Bozhong 26-6 discovery

CNOOC Ltd. Op , 100 %
Well Bozhong 26-6-2 south of Bohai Sea WD: 22m. TD: 4,480 m and encountered a total 320 m of oil pay zones in Archean buried hill, below Mesozoic seal; Source-Rock : Paleogene

DST flowed at an average 2,040 b/d crude light oil and 11.45 MMcf/d of gas

Reserves ; 600 Mbo + several Tcf ?
If similar to Bozhong 13-2 (see right slide) and Bozhong 19-6
IRAN: Discoveries in NE frontier basins and Giant gas find in Fars

New « frontier » basins close to Turenstan being explored with significant discoveries:
- Hirkan oil field in Golestan
- Chesmeh Al Shour gas filed in Khorazan

Mature exploration led to:
- A giant gas field in Fars province (below salt):
  Lamerd = 22 Tcf IGIP
- Two oil fields in Buskehr province: Tengoo and Genaveh
Largest Turkish oil discovery

Discovery at Sehit Aybuke Yalcin-1 well drilled by TPAO- SE Turkey

162 m gross oil pay
Top reservoir : 2770 m
High flow rate at DST : 10000 bopd
41°API oil
Fractured Cretaceous Carbonates

36 km2 folded structure
1 Gbo Oil / 350 Mbo reserves
Production forecast : 100 Kbopd
Egypt: East Med discovery: Nargis by Chevron/Eni

Nargis 1 WD: 300 m/ TD: 5000 m+
Chevron (45%), ENI (45%), Tharwa (10%)

60 m Oligocene + Miocene sandstones net gas pay

Reserves: 3 Tcf / dry gas? HP?
Total Energies’ success in Nigeria

TEPNigeria, op 40% and NNPC, 60%
Ntokon 1A and 1G discovery
in the « old » OML 102 license
33 m net oil sand in well 1A and 75 m
in well 1G

Excellent DST 5000 bopd 40°API oil
Close to OFON field: 20 km tie-back

2P reserves: 300 Mbo
Namibia: Orange Basin hot spot: Jonker 1 in 2023 and Mopane-1 in 2024

Jonker 1: Shell op 45%, Qatar Energy 45%, Namcor 10%, WD: 2210 m/TD: 6168 m
Appraisal Jonker 2 spud in December 2023

Deep discussions about the recovery factor (low permeability*illitisation)
At least 300 Mbo recoverable

Mopane 1: GALP op 80%?
Colombia : New gas discovery deep offshore

After Gorgon 2 appraisal in 2022 Shell op, 50% and Ecopetrol 50% made a discovery in Glaucus 1 in block COL-5 WD : 2340 m /TD : 4284 m Gas discovery ; several Tcf ?
Colombia: New gas discovery deep offshore

North of Panama and Colombia Thrust and Faults Belts
Upper Mezozoic and Cenozoic deposits

Origin of gas: biogenic (very dry gas) or thermogenic (La Luna UK source-rock?) deeply buried below TFB?
2020-2030: THE starting decade for unconventional production outside US?

Shale Oil/LTO: Argentina, Alaska
Shale Gas: China, Saudi Arabia, Australia
China Sichuan Shale gas exploration

Main gas shale is Ordovician-Silurian marine black siliceous shales (Wufeng and Longmaxi Fm): thick to very thick (50 to 200 m at +2% COT), overpressured (1.3 to 2). It underwent huge inversion (Himalayan Collision) in UK/Tertiary.
China Sichuan Shale gas production

Three main (extremely dry) gas shale fields discovered by SINOPEC:
- **Fuling 2012**: 30 Gm3 reserves/400 wells/200 km3/d average deliverability by well
- **Weirong (Weiyan) 2020**: 100 Gm3; 3Gm3/y in 2024
- **Changning 2011**: 6.5 Gm3/y but numerous HF-induced earthquakes

What next?: in 2022, Jinshi 103HF exploratory well yielded a gas production of 260 kcm3/d is the first commercial discovery in the Cambrian Qiongzhusi Formation
Saudia Arabia: Jafurah liquid Gas shale play

Resources: 230 Tcf and 75 Gb (Cd+NGL) (February 2024)

East of Ghawar:
**Tuwaiq Mountain Fm**: Callovo-Oxfordian Jurassic marls (17000 km² extension/2500 m depth)

**Production strategy different from the US gas shales**:
Hundreds of H drilling/tests completed since 2011 (discovery date?)
First gas 2024/2025?
Peak: 6 bcf/d + 500 kbcpd (Cd/NGL/C2)
Saudia Arabia: Jafurah liquid Gas shale play

Tuwaiq Mountain Fm Source-rock characterization:
- Eagle Ford like liquid rich gas
- 200 feet shale thickness
- 0.9 to 1.3 VRo window,
- 3 to 7 % TOC,
- $S1 = 5$ and $S2 = 5$ mg HC/g rock
- Intense Micro-fracture
- Overpressure (1 psi/ft)
- 84 to 90 % Calcite+Dolomite
Australia Betaloo Basin: oldest worldwide Shale gas

Main target is the excellent organic rich siliceous mustone Velkerri Fm (1,4 Gy) of the Ropers Group: age doesn’t matter Jean! But water does!
First results in Betaloo Basin

1-In EP 187 block, Empire Energy dilled Carpentaria 3 horizontal test and produced 3,3 Mscf/d, Audited reseves : 50 Gm3

2-In EP 98 block, Origin 70% and Falcon 30% tested -Amunegy NW-1 Horizontal well (1000 m lateral/10 frac stages) and produced 1,5 Mscf/d -Amunegy NW-3 H

In both block production could start in 2025
Argentina Vaca Muerta in Neuquen Basin

A steadily production increase: more than 350 kbopd end of 2023
2 Bcfd gas as well
YPF-Exxon-Shell-Totalenergies-Chevron-Tecpetrol-
Forecast 1000 kbopd in 2030 (Rystad scenario-left) thanks to better productivity than US shales
Alaska onshore LTO Phoenix project

After Icewine 1 and 2 drilling in 2017, and testing of Pantheon’s operated, horizontal Alkaid 2 wildcat (550 bopd of 40°API) in 2022, 48 Energy announced a discovery:

**Hickory 1 well** in Slope Fan System/TD: 10650’ 450 ft net oil pay from 7700 to 10500’; Phi: 8-12 % DST planned for winter 2024

Ressources: 1 Gbo