2022 : O&G Exploration
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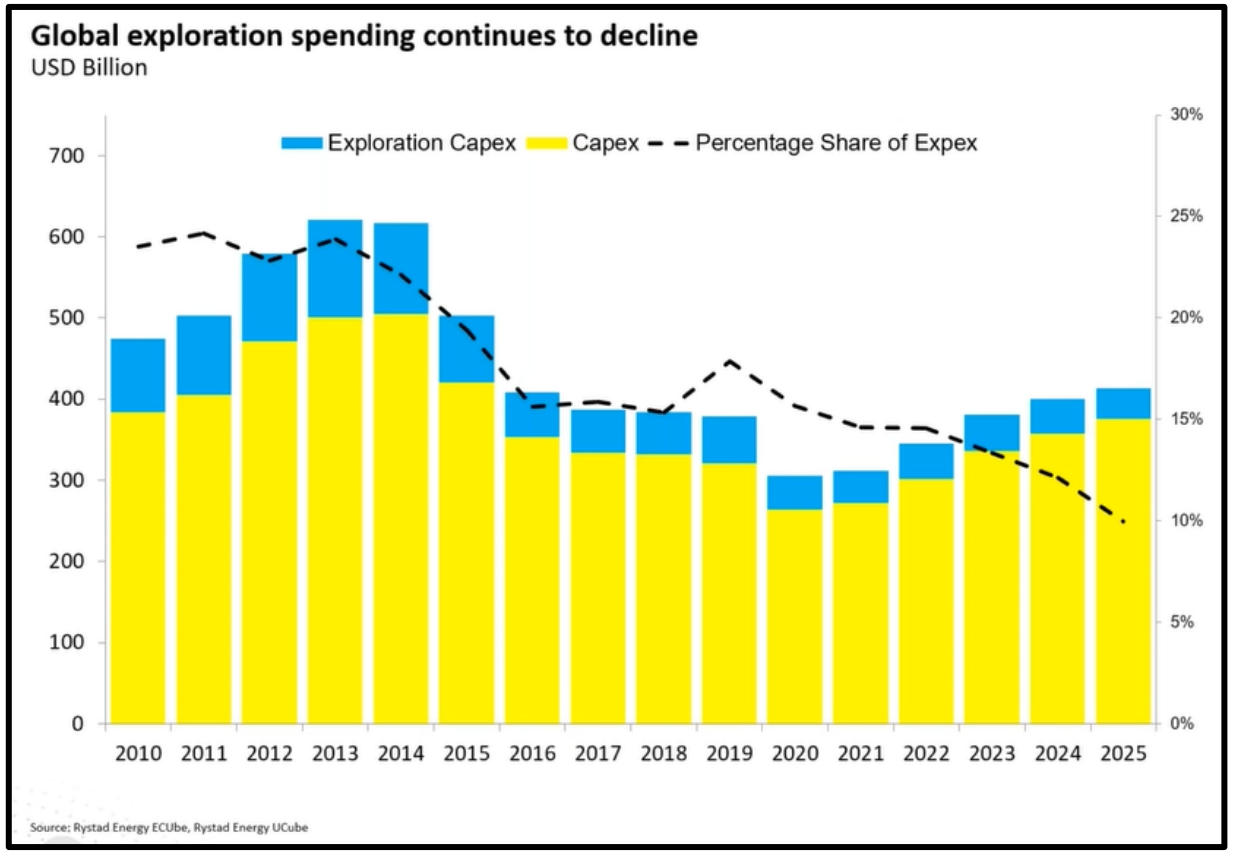
Marc Blaizot

marc.blaizot@gmail.com

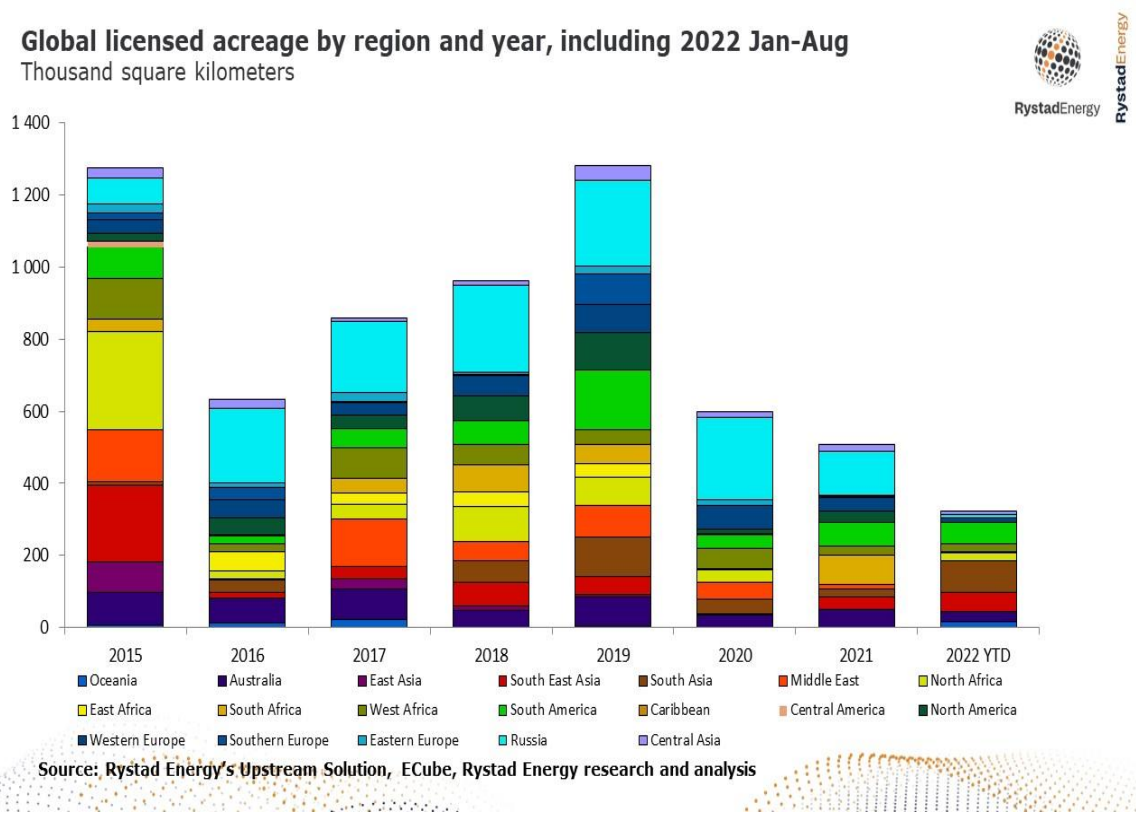
O&G Exploration Investments : a strong concern for short-term O&G production

A strong and real fear for future as Exploration spending decreases both in absolute and relative amounts.
The light CAPEX increase planned for next years, **is NOT dedicated to exploration.**
Even if the correlation between spending and discoveries is not absolute , it matters.

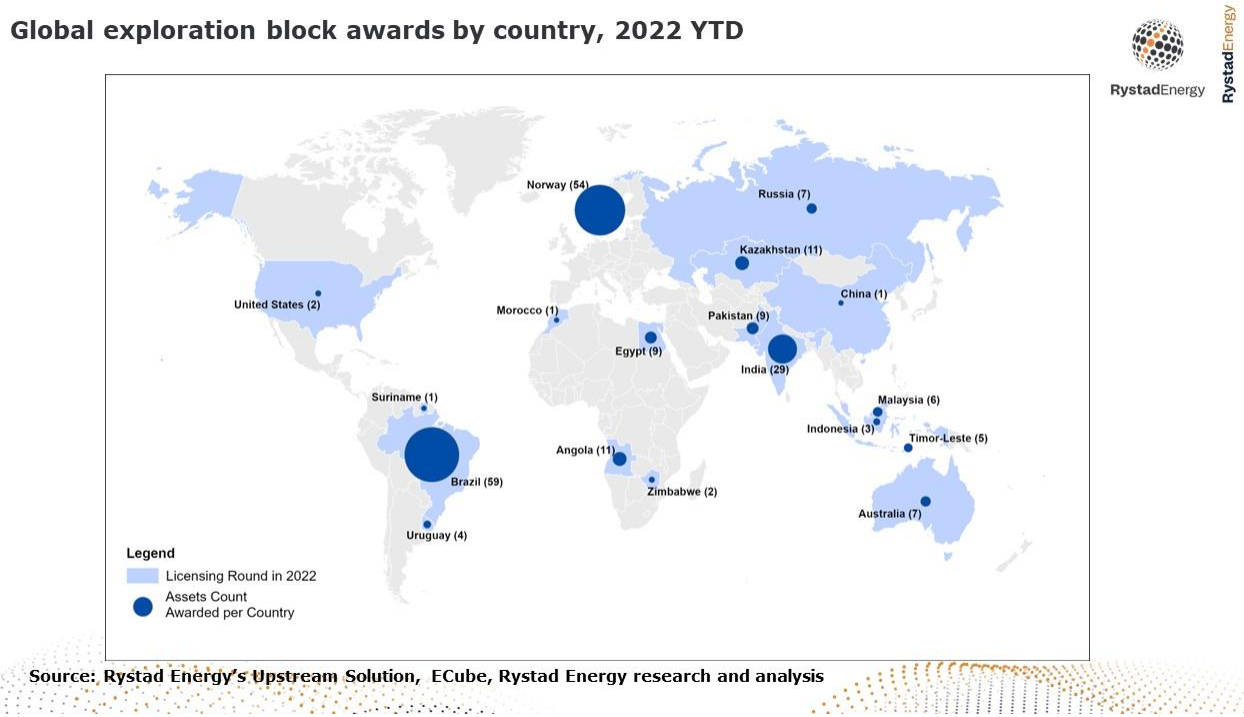
The hurdles :
1- the societal, political and financial hostility « on the « dirty » hydrocarbons,
2- despite high O&G prices and mountains of profits, the majors' strategy towards **low cost/high rewards assets**, and diversification to low carbon energies
3-The decreasing hunting grounds and the decreasing size and number of discoveries



Hunting grounds shrinkage not recovering PreCovid figures : very low new acreages



Source: Rystad Energy's Upstream Solution, ECube, Rystad Energy research and analysis

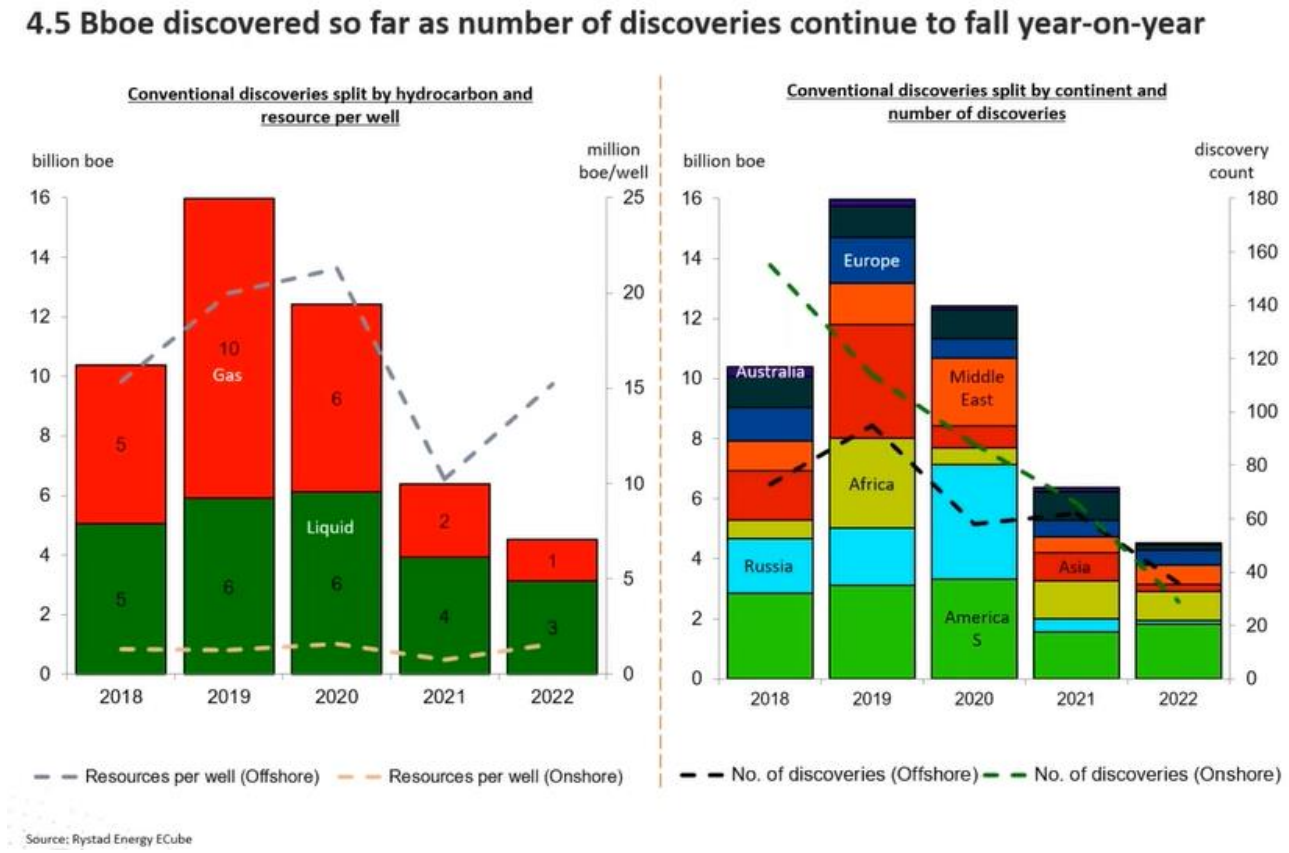


Source: Rystad Energy's Upstream Solution, ECube, Rystad Energy research and analysis

Africa strongly affected : no licensing rounds….

Towards a low result in 2022 : 5 to 8 Gboe

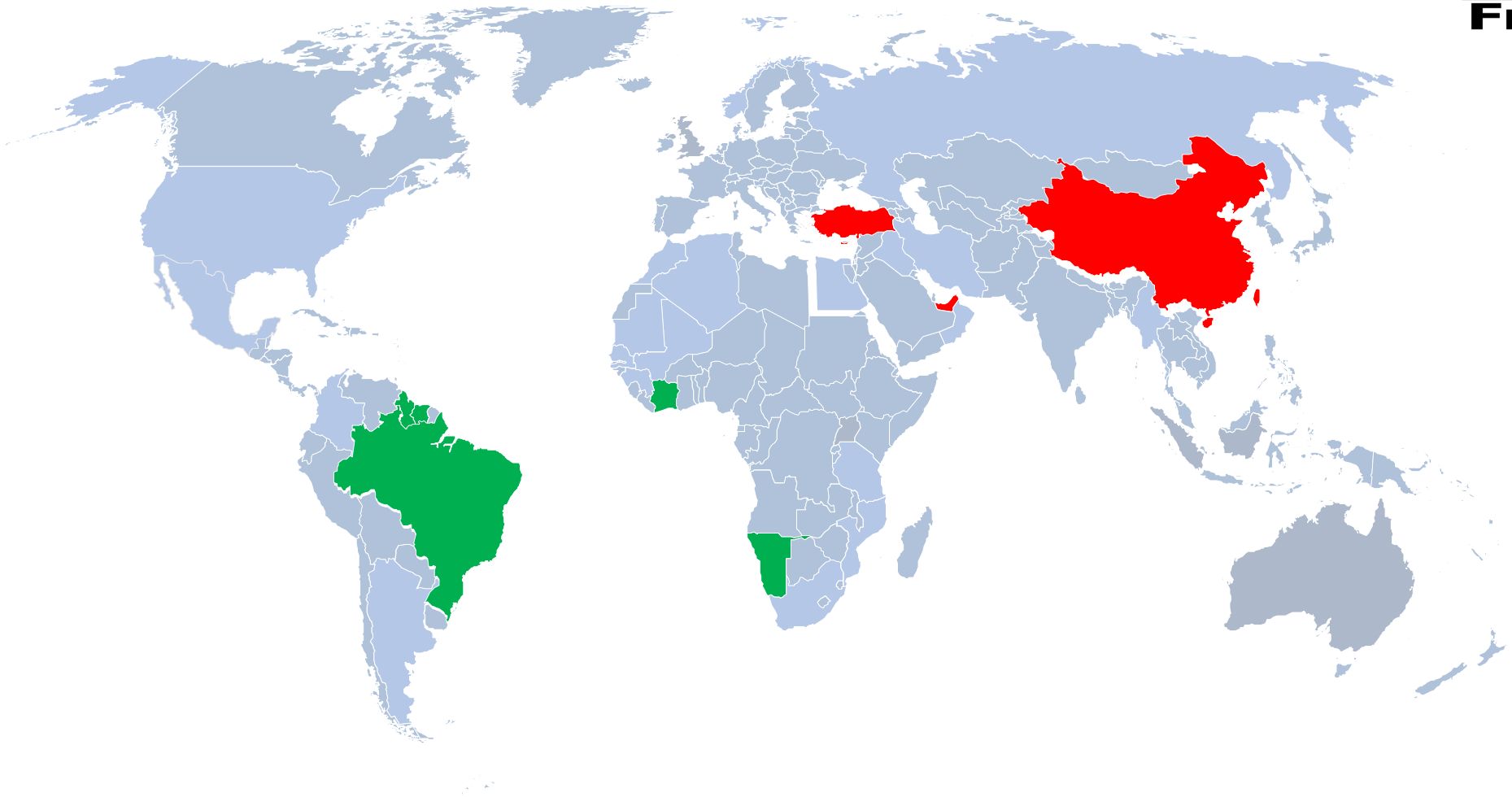
August 2022 From Rystad Energy ! Only 4, 5 Boe discovered mainly oil,
Not many dicoveries then
If we except Namibia nugget no major success
Lack of Russian activities explain the low gas discovered, as well as no GOM oil discovery so far



2022 EXPLORATION SYNTHESIS

New major discoveries

OIL
GAS



Oil :Guyana-Suriname/Namibia/Brazil (Santos)-Ivory Coast

Gas: Turkey/East Med (Cyprus)/China/UAE

Turkey Black Sea :TPAO Sakaraya Appraisal-2022

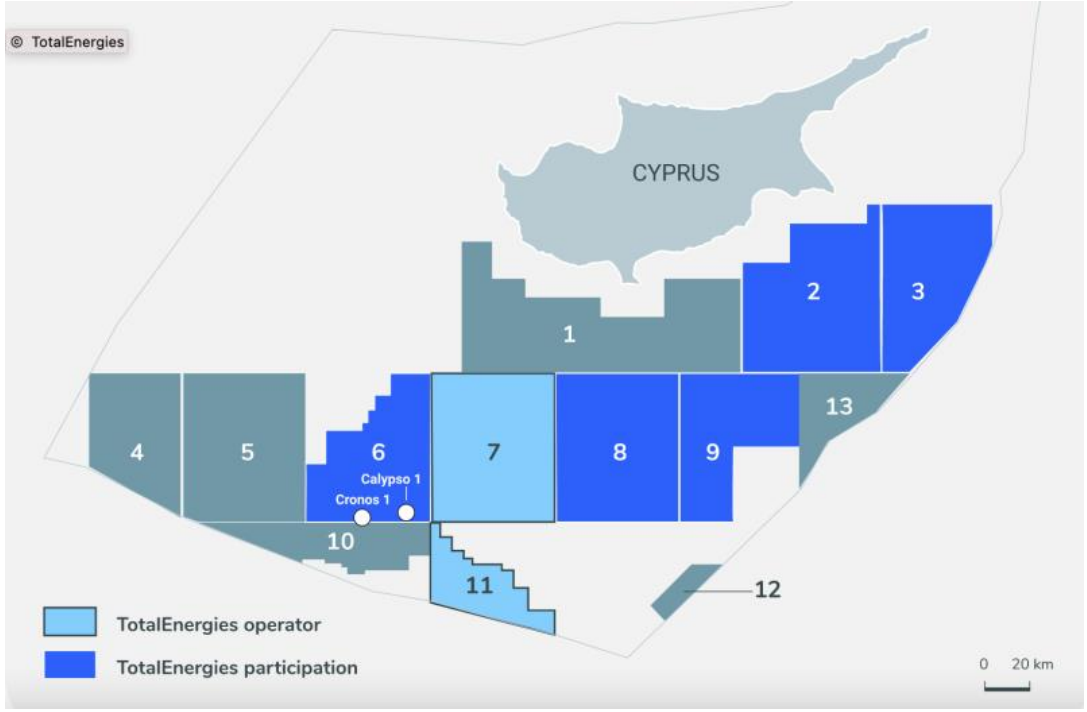
1-Sakarya 1 WD of 2,115m; TD 4,525m
More than 100m of the natural gas-bearing reservoir in Pliocene and Miocene sandstones,gas reserves of 320 Gm3 of lean gas, which is the largest gas reserves discovered in the Turkish EE Zone as well as in the Black Sea.
2-TPAO made a second discovery **Amasra 1, deeper at a depth of 4,775m in 2,117m** WD. Additional 30m of gas play in sandstones of the early-Pliocene to late-Miocene ,
Amasra gas field discovered 135 Gm3 gas,
3-in 2022 TPAO tested Sakaraya field with Turkali 1 well
Two tests : 1.15 Mscm and 0.62 M scm respectively , good to medium quality reservoirs
4-the cumulative natural gas reserves of the fields Sakaraya and Amasra is of to 540 Gm3 of gas
5-TPAO contracted Schlumberger/Subsea 7/Saipem and…SOCAR for developing the fields through a 170 km GTS project ! With first gas in mid 2023 at 10 Mm3/d (10 wells ?) to be extended in 2025 to 40 Mscm/d

Cyprus : new gas Discovery in East Med

Gas discovery about 2.5 trillion cubic feet of GIP, in the **Cronos-1 well** (ENI op 50%, TE 50 %), Block 6, around 100 miles off coastline with WD : 2300 m
An important gas column in a carbonate reservoir of fair to excellent properties, gas net pay of more than 260 m .

Cronos-1 is the fourth exploration well drilled by Eni Cyprus and the second well in Block 6, following the gas discovery of Calypso-1 in 2018 which was announced as a “promising” gas discovery and confirmed the “Zohr like” play extension,

“Studies on a fast-track development options of the discoveries are already ongoing”, Eni said.

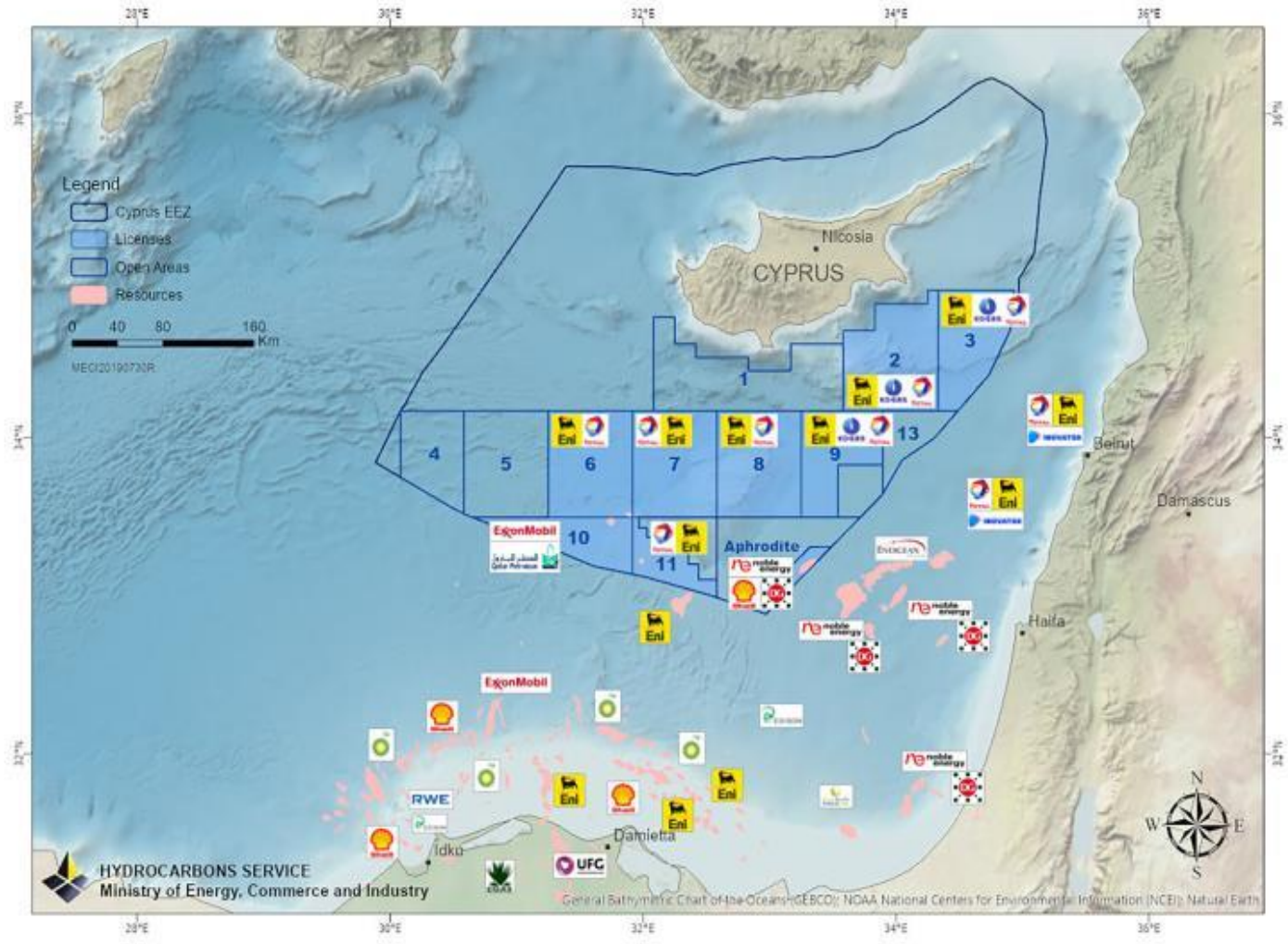


2015-2020 / East Med Gas discoveries : Israel/Cyprus/Egypt/Lebano : A mare nostrum ?

Huge discoveries : 80 Tcf
Egypt Zohr
Israel : Leviathan, Tamar, Karish, etc,,,
Cyprus : Glaucus,Aphrodite,

Very rapid appraisal and production start-up
Production in Israel started in 2013 : Tamar- 1 bcfd then Leviathan in 2016 at 1,2 bcfd
Production in Egypt started in 2017 on Zohr reached 3.2 bcf/d in 2022,

Complicated stories to unlock production and export to Europe
Turkey/Cyprus and Israel/Libanon disputes/ Many partners /Long route for East Med pipe to Europe
Easiest LNG way
Egypt recovered 8 Mt/y GNL export in 2022



East Med gas discoveries : next supply for Europe ?

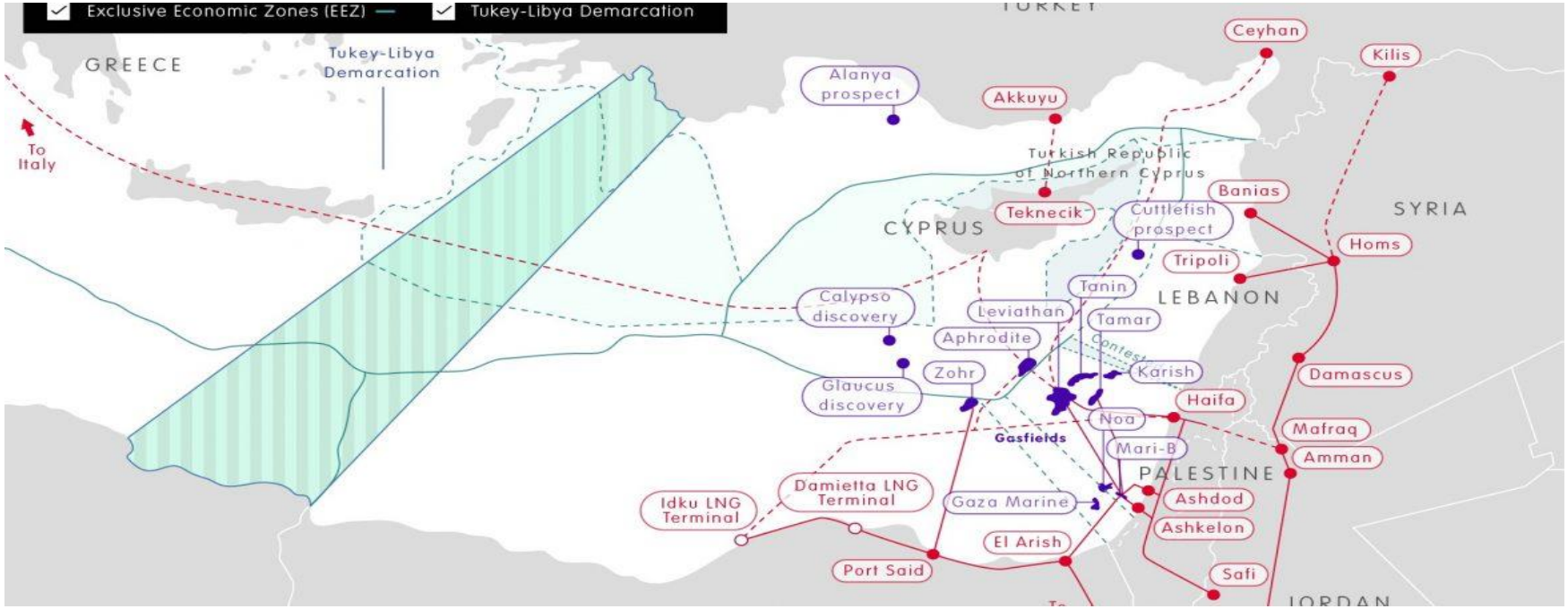
Today : GNL

Thanks to Zohr field contribution (3,2 bcf/d) Egyptian production reached 6.5 bcf/d mid 2022 **and Egypt will export 8 Mt of GNL in 2022 ; could be double after upgrading pipes from Zohr and Israel (already exporting 0,7 bcf/d) and LNG plants.** But be aware that Egyptian consumption is 6 bcf/d average and growing

What 's next ? Pipe ? BUT when ?

Cyprus, Greece and Israel agreed in 2018 to build a gas pipeline, c**alled East Med.**

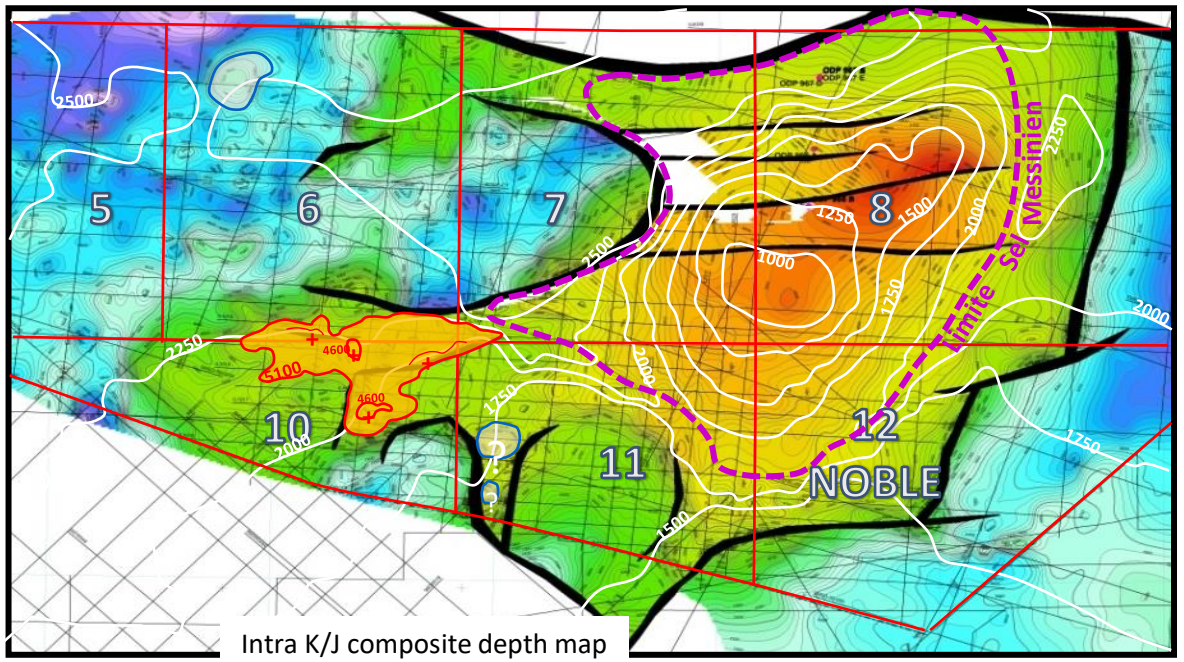
This 2200 km pipeline would pass offshore Cyprus and end in Otranto-Italy after crossing Crete and Greece.The cost of its construction is estimated at $7 G and it could transport **20 billion m3 of natural gas annually.**



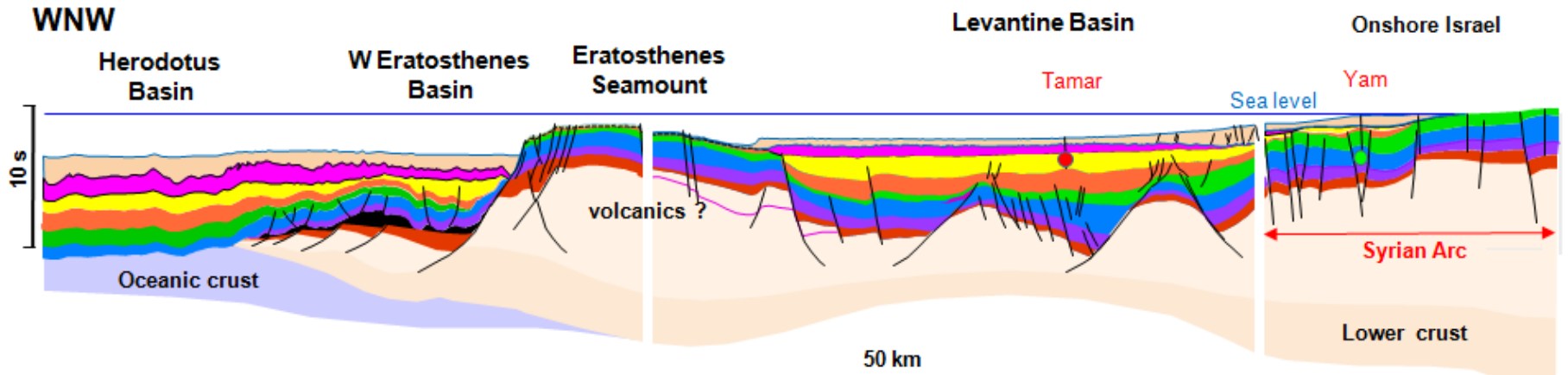
Cyprus : ENI Mare Nostrum ; more to come ?

Last results in Cyprus confirm the excellent positionning of ENI after giant Zohr discovery in Egypt, on the shallow waters carbonate from UK to Miocene sealed by Messinian evaporites able to trap large dry biogenic gas.

When a well on the giant (4000 km2) Eratosthen Mount Structure ? very risked because Messinian absent, lying on block 7 and 8 attributed in mid 2019 ?



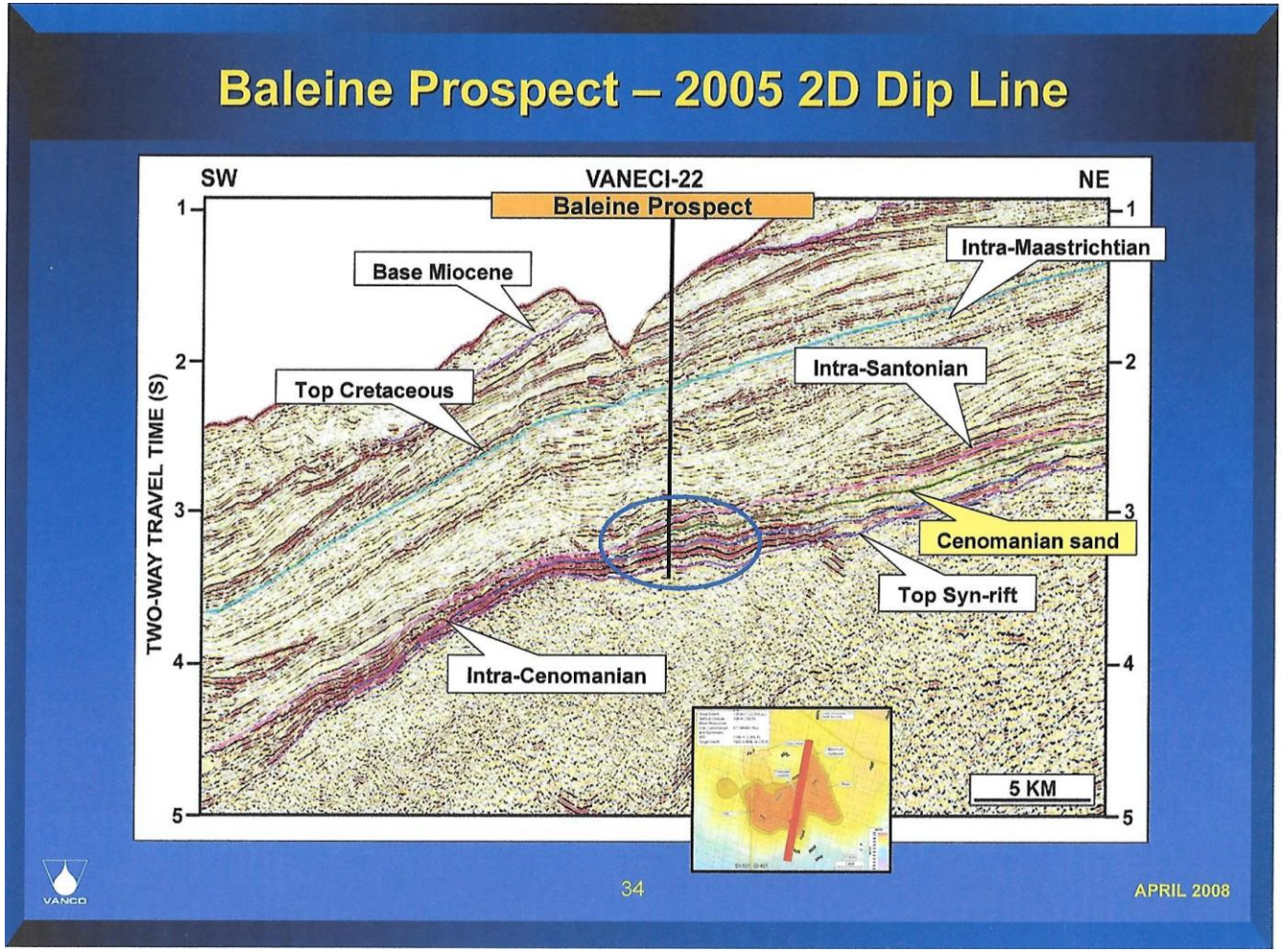
Intra K/J composite depth map



Ivory Coast- Major O&G discovery- CI 101 block by ENI in 2021

Baleine 1 well ENI 90 %; Petroci 10 %
TD : 3445 m
light oil-bearing intervals (40° API) of Santonian and Cenomanian-Albian age. Cenomanian-Albian level shows discrete to good reservoir and has been successfully tested to production. Very probable extension in block CI-802 (ENI op)

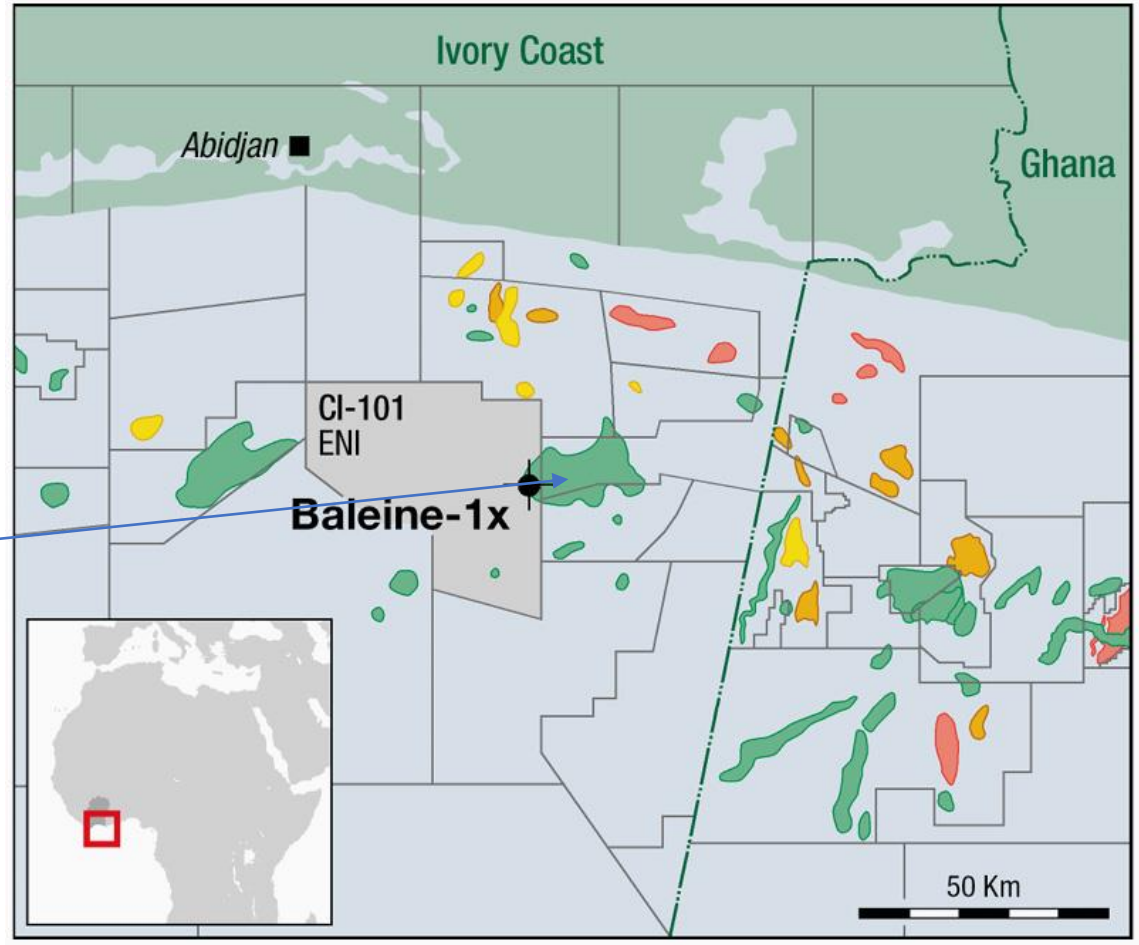
IOIP 1.5 to 2 Gbo
IGIP 1.8 to 2.5 Tcf



Ivory Coast-Baleine Field –Appraisal 2022

Appraisal-extension drilled mid 2022 at Baleine-East 1X by ENI ON block CI-802 , 5 km east of discovery well
Excellent results increasing the IOIP from 1.5 to 2.5 Gbo and IGIP from 2 to 2.5 Tcf
First oil fast track development expected end of 2023

Baleine Est- 1
Appraisal on CI-802

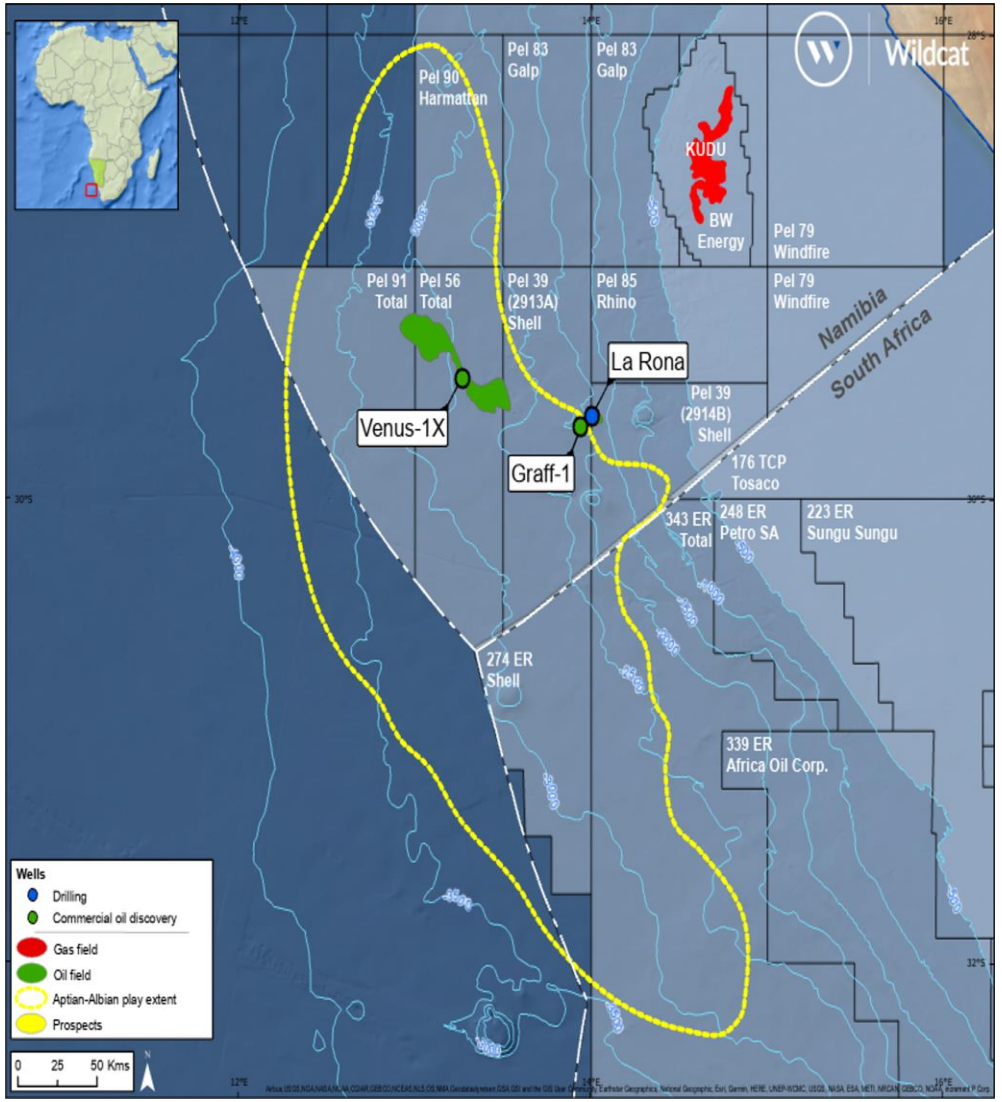


Namibia : Orange Basin : a new oil province in deep offshore Africa

Two discoveries annouced 1st Quarter 2022

- **Graff 1 by Shell** : WD 2000 m ; TD : 5375 m Mixed Cenomano-turonian Cretaceous Turbidites plays –
- 300 Mbo to 1 Gbo Reserves ? Appraisal called La Rona has been drilled : no report yet

- **Venus 1 by TotalEnergies 40 % (QP 30 %/Impact 20 %, Namcor 10 %) :** Wd : 3000 m ; TD ; 6300 m Albian basin floor fan with 84 m of oil net pay
- Huge reservoir extension with AVO and DDC : 600 Km2 !
- **Reserves 800 Mb to 3 Gbo ?** But not tested : Permeability ? GOR ?
- Appraisal well (with test) to come



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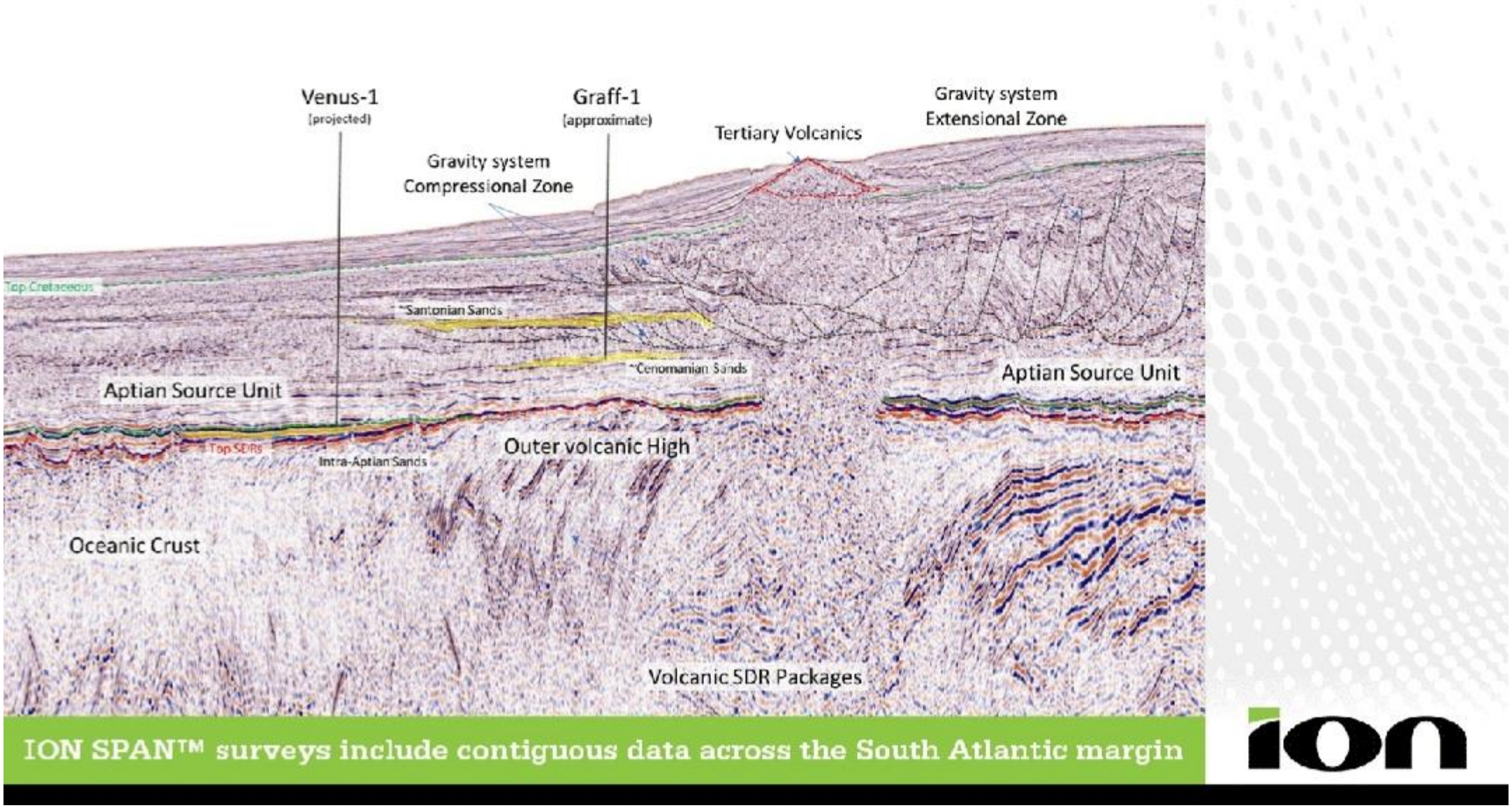
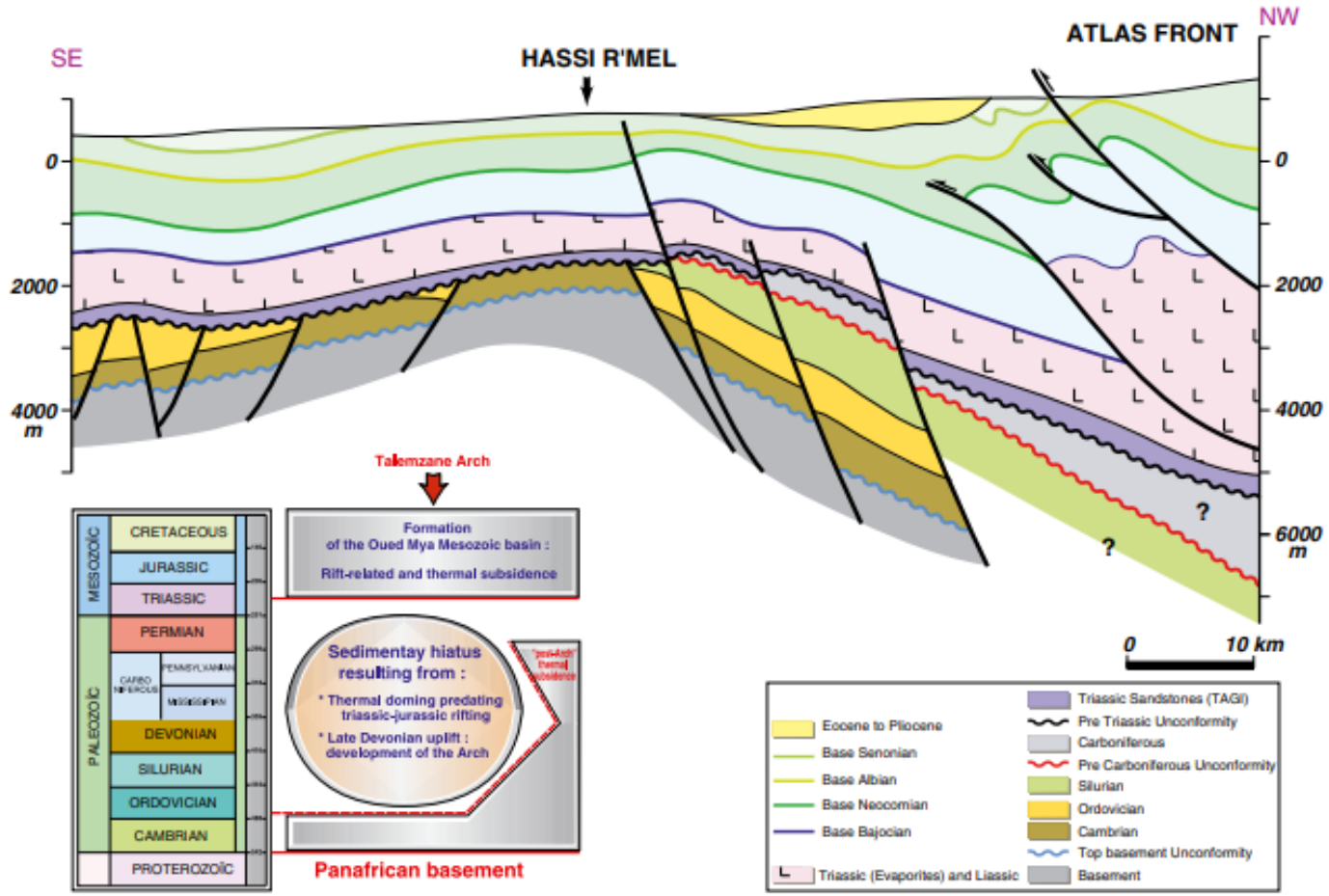


Algeria : Hassi R'Mel gas/condensate discovery ?

June 2022 SONATRACH announced a newly-discovered formation –Lias carbonate- close or above ! its giant Triassic Hassi R'Mel field contains **from 4 to 12tcf**; with fast-track development to boost production by 3.7bcm/y from later this year !

Very strange announcement : how so much gas could have passed the evaporite seal ? Why this has not been detected before (hundreds of wells since 1956 discovery ?



igure 5. The structural context of the Hassi R'Mel area (Talemzane Arch, Algeria). (top) Composite

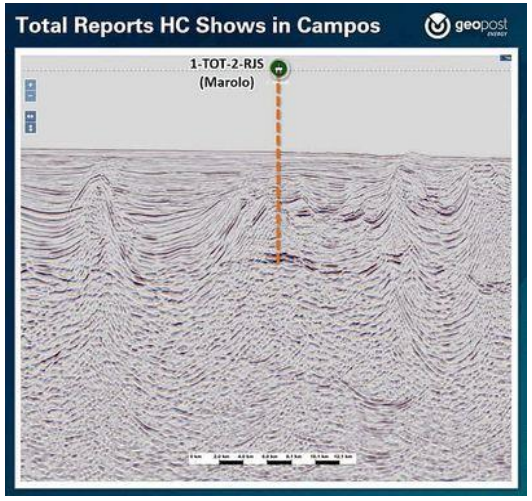
Brazil : a new exploration step towards UDO with major risks : facies and sour gas

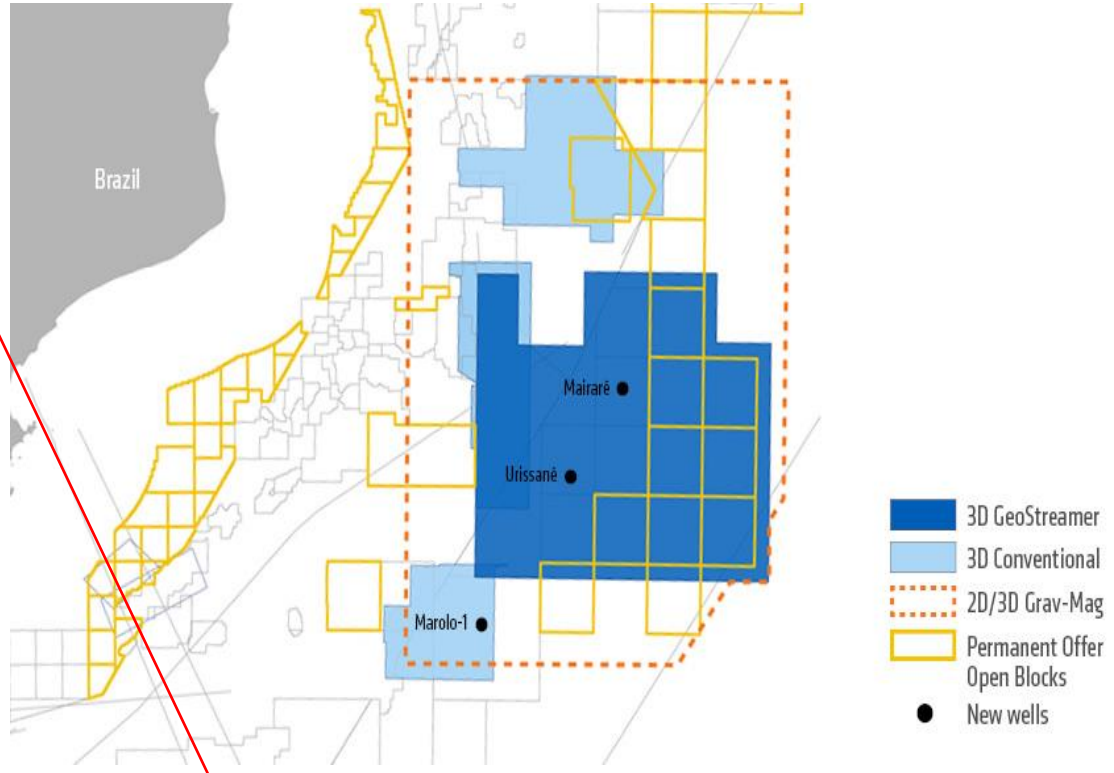
Opal 1 by Exxon (CM-789) WD : 2680 m; minor oil shows

Urissané 1 (2021) by Petrobras 50 % (Exxon 50%) WD : 2950 m, Oil shows ?

Mairare 1 by Exxon ? Petrobras ? WD : 2850 m CM-346

Marolo 1 (2022) by TotalEnergies (next Ubaia 1 ?) : oil shows ? WD : 2950 m



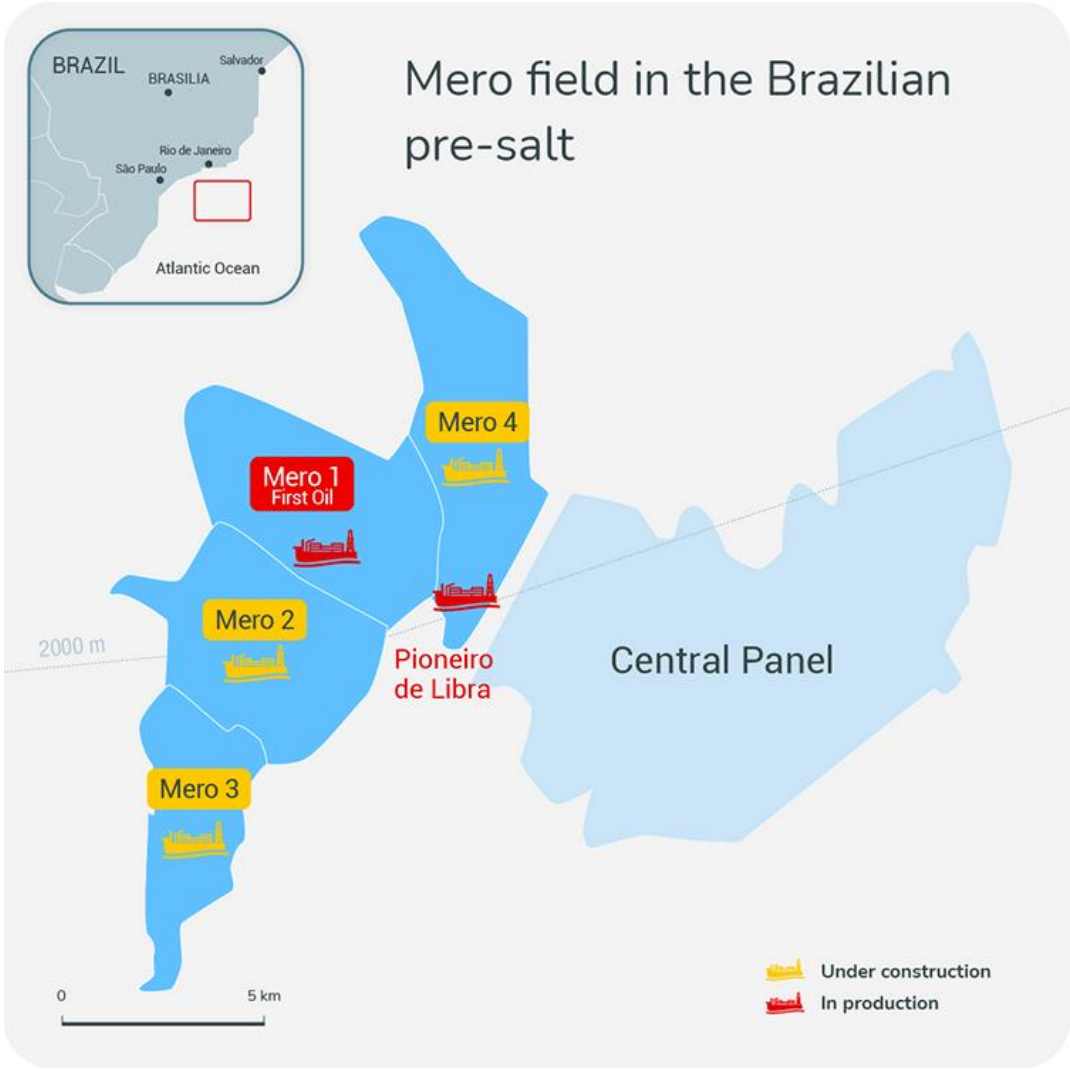


Development/Production of Mero (ex Libra)

In May 2022, the first development phase of the giant Mero field in the Libra block, 150 km off the coast of Rio de Janeiro, in the pre-salt area of the Santos Basin, went on stream : Mero-1-FPSO has a production capacity of 180,000 bopd.
3 additional development phases planned : Mero-2, Mero-3 and Mero-4 FPSOs (each at 180,000 bopd) with production start-ups between 2023 and 2025.

The Mero field has been in pre-production since 2017 with the 50,000 barrels of oil per day Pioneiro de Libra FPSO.

Mero and Buzios should allow Brazil to quickly increase total production from
3,8 Mbopd in 2021 to 5,5 Mbopd in 2028

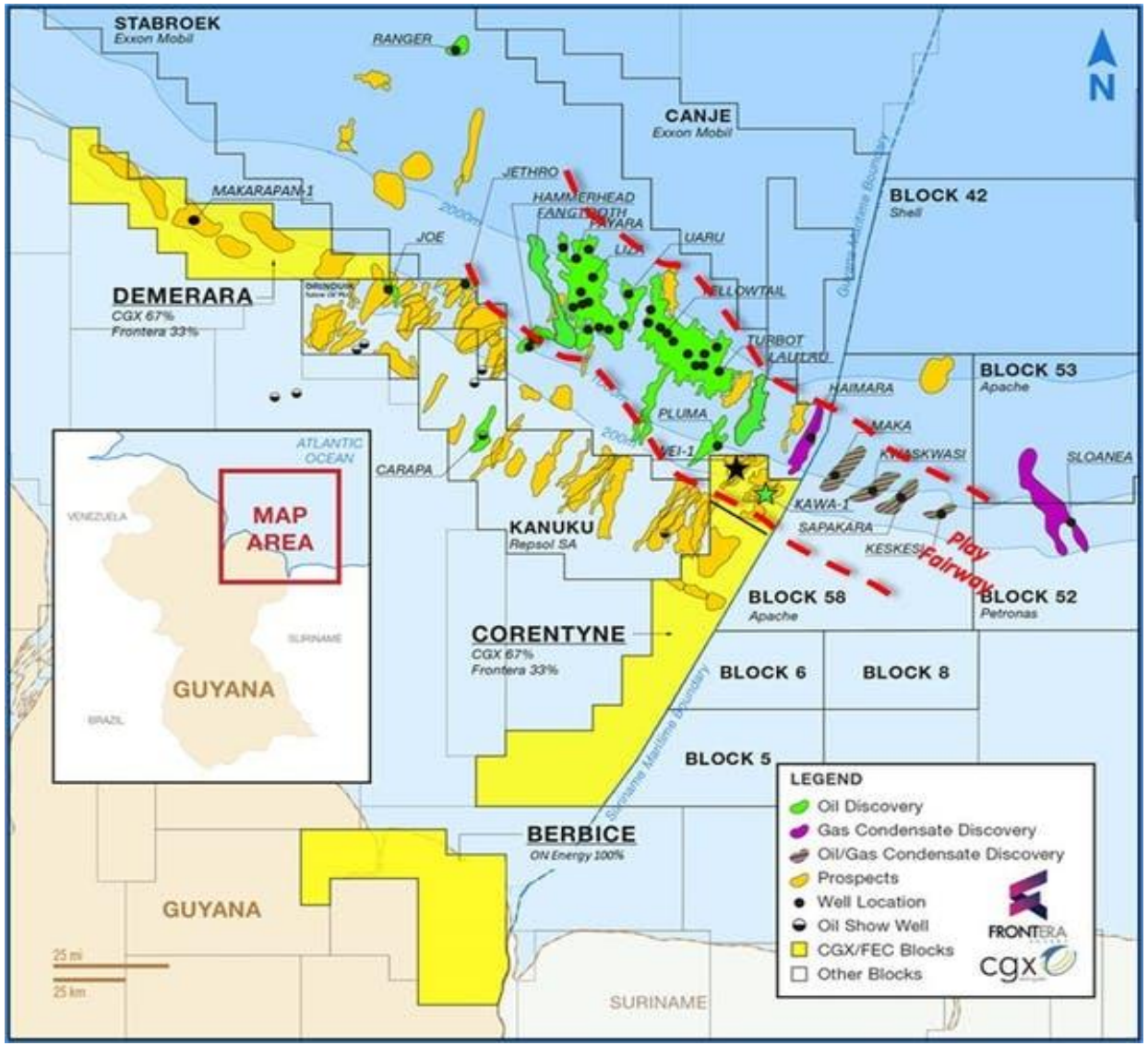


Guyana-Surinam bassin : multi-sources Cretaceous sandy turbidites

- Guyana and Surinam réservoirs seem to be different from the few published maps
- Younger and shallower in Guyana
- Large deep sea fans in Guyana like Lizza
- Restricted feeders in Surinam
- Multi source points : large ranges of poro-perm values ?

- Higher GOR in Surinam

- **11 Gbo in Guyana ; 2 Gboe in Surinam ?**



GUYANA-Exxon- Stabroek block update (October 2022)

Exploration : Exxon-Mobil : 45 % ; Hess 30 % and CNOOC 25 %,
ExxonMobil made another 7 **oil discoveries in 2021/2022** and increased its estimate of **the 2P reserves close to 10 billion barrels with other multibillions additional exploration stakes. T**he 30 significant discoveries is very impressive for a 26800 km2 block.

Production : average 340 000 bopd in 2022 with the **Liza Destiny FPSO** in production, since December 2019 (4y and ½ after discovery !) , at around 120,000 bopd. **Liza Unity FPSO** became Guyana's 2nd offshore production unit, moored in January 2022 at WD of 1,600 meters, and should produce 220,000 bopd, with a gas treatment capacity of 400 million cftpd and water injection capacity of 250,000 bwpd. The FPSO will be able to store approximately 2 million barrels of crude oil.

Singapore's Keppel started work on **the third FPSO unit**, the **Prosperity FPSO** destined for the Payara development. **At least five FPSOs are expected to be online in the Stabroek block by 2057** with the potential for up to **10 FPSOs on the block** to develop the discovered reserves. **1 000 000 bopd production in 2030 !**

Gas-to-Shore project, the conceptual studies for a construction of a 50 MMscftd pipeline from the Liza Phase 1 and Liza Phase 2 FPSO vessels to an onshore natural gas liquid (NGL) and natural gas processing (NGP) plant for domestic needs,

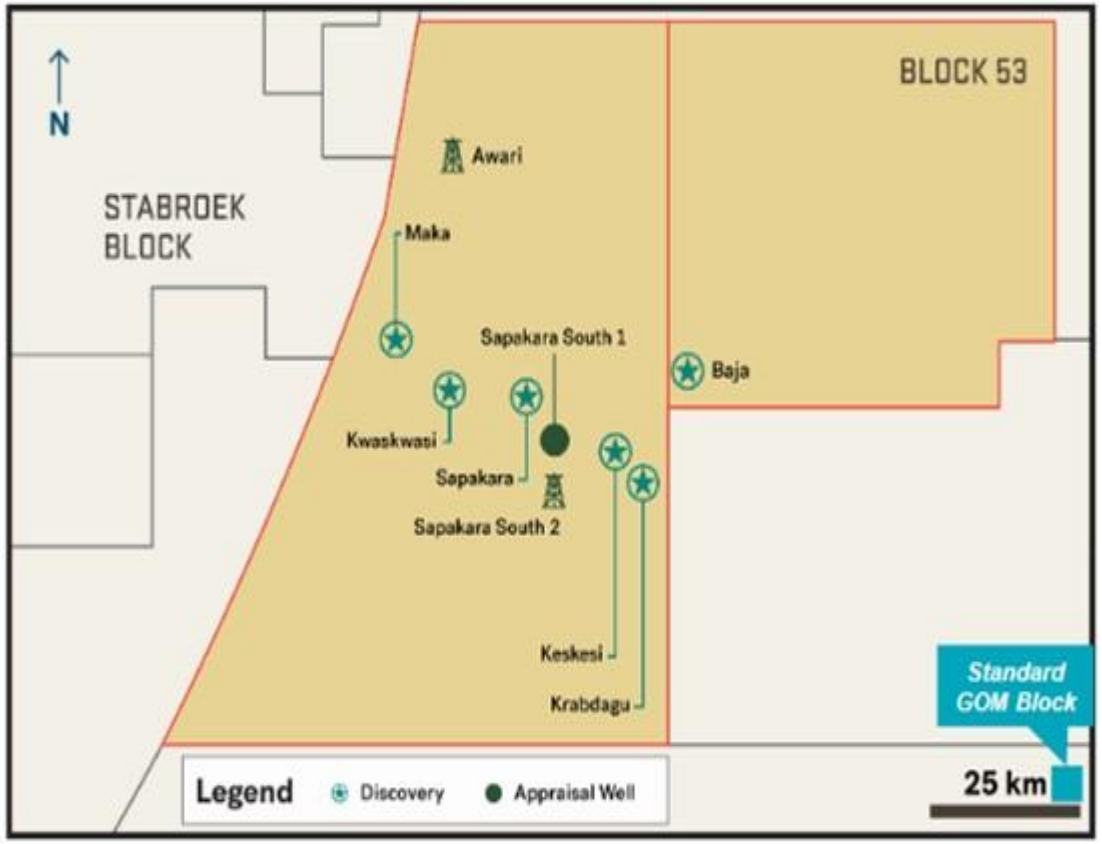
Suriname –TOTAL Apache- Blocks 58 and 53

Maka-Kwaskwasi-Sapakara-Keskesi and Krabdagu discoveries in 2020/2021/2022 confirm excellent oil trend SE of Starbroek block in Guyana

Sapakara South-1 appraisal 4 km from the discovery well. SPS-1 "A restricted flow test averaged **4,800 bopd of 34-degree API** with GOR 1100 scf/bbl,
Saparara South 2 drilling in progress

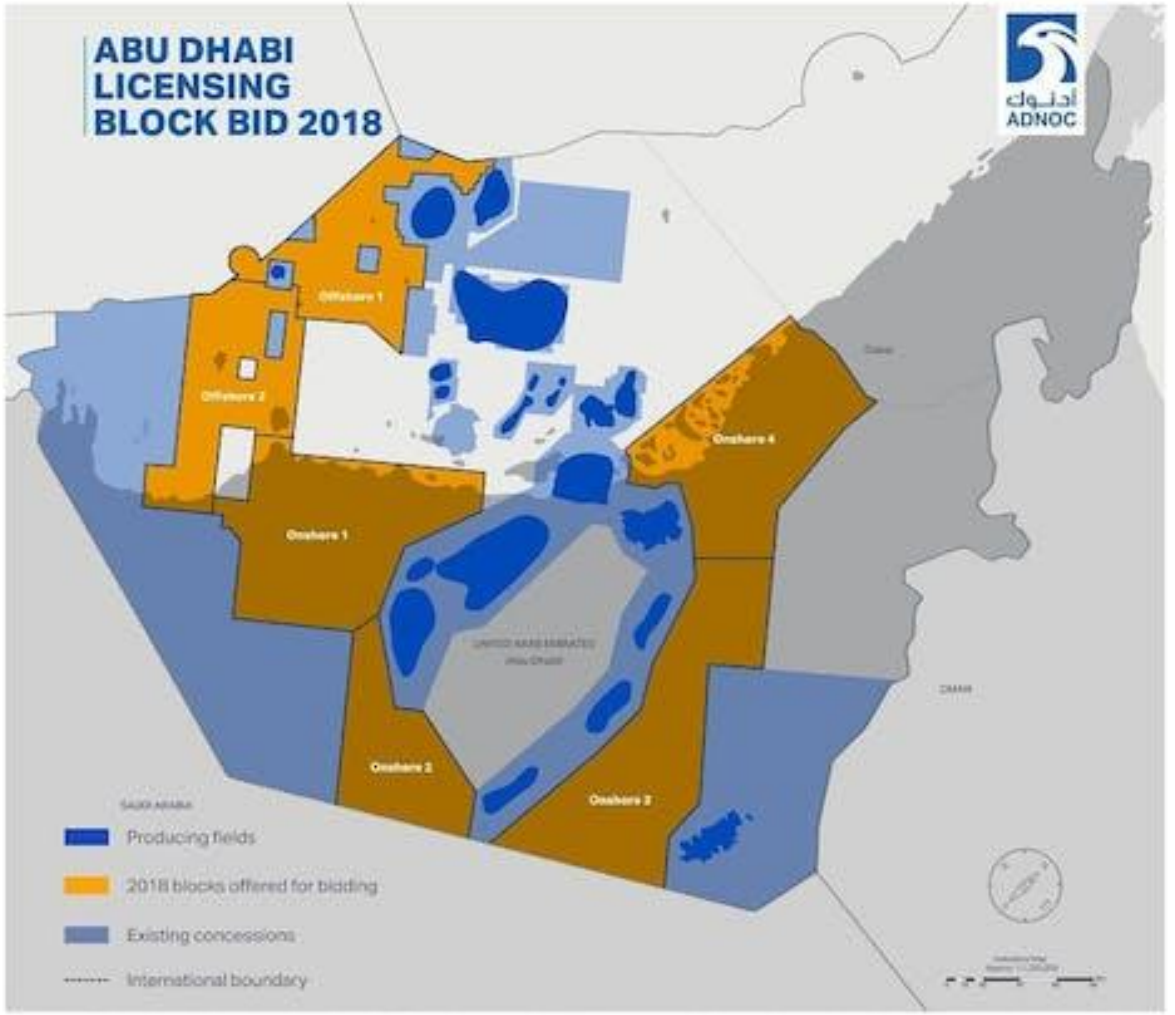
After Bonboni 1, Awari exploration is also dry in the North,

Baja 1 in block 53 is the first discovery (Apache 45%¨Petrona 35% and CEPSA 25 %), WD : 1150 m TD : 5290 m with 35 m net oil pay column in a Campanian sansdstones,
GOR : 2000 scf/b, Light oil,



Oil and gas discoveries in UAE

- Onshore block3 by Occidental : 100 Mbo
- Onshore block 4 by INPEX : 1 Gboe
- Offshore block 2 by ENI : 2 Tcf in shallow Fm and 1-2 Tcf in deep Jurassic Fm



Sichuan Gas Shales (1)

In october 2022 , SINOPEC announced the discovery of a new shale gas in the Jinshi 103 well in SW Sichuan Basin (Weiyuan area south of Chengdu) , in the deep Cambrian Qiongzhusi Fm **at TD : 3250 m with a Horizontal drain of 2300m,**
Tested at 260000 cm3/d,
It is the first commercial flow in this Fm, which could add significative reserves (13 Tcf) to the already known and producing Silurian Longmaxi Fm

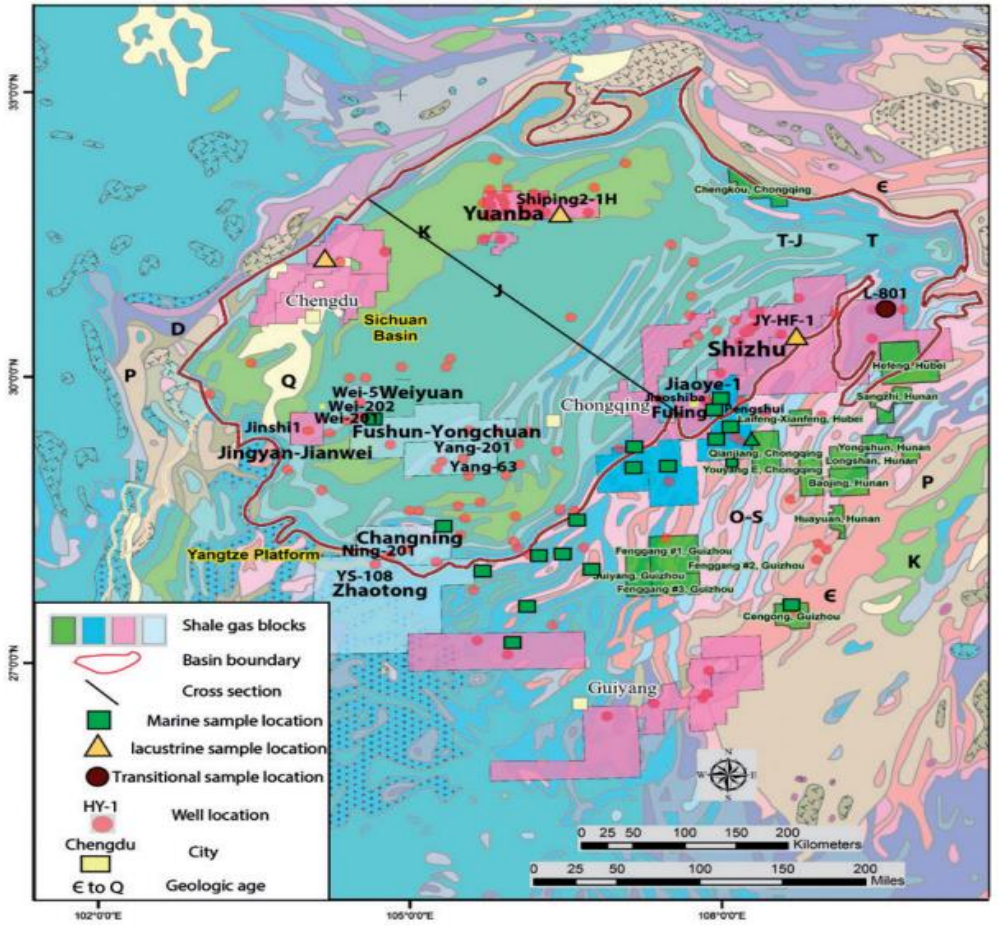


Figure 1. Geologic map of the Sichuan Basin, modified from Ryder et al. (1991). The sampling locations for marine and lacustrine shales and key wells used in this article are also shown on the map. The NW-SE oriented line is location of cross-section in Figure 2. Є: Cambrian; O: Ordovician; S: Silurian; D: Devonian; C: Carboniferous; P: Permian; TR: Triassic; J: Jurassic; K: Cretaceous; Q: Quaternary.

Sichuan (marine) Gas shales (2)

1- To date

the Lower Silurian Longmaxi shale has high TOC, high maturity, high brittle mineral content and high gas content, similar to the Barnett shale .

The Fuling Gas Field (Silurian Longmaxi) in the eastern Sichuan Basin started production in 2014. Geological reserves were considered at 3.8 TCF with technically recoverable reserves of 1 TCF . End of 2015, China has considerably revised the size of proven reserves to 13.4 TCF after having drilled and fracked a total of 142 wells and tested at industrial gas flows (maximum 500000 m3/d in HD). Production : 40 G.m3 in ten years.

2- Next ?

the Cambrian shale is a new shale gas Fm with even higher TOC and maturity . Known since 1966! well Wei-5 in the Weiyuan area experienced a high well-kick while drilling into the Qiongzhusi shale at 2797 m. A daily output of 24,600 m3 was estimated at a hydrostatic pressure of 290 bars.

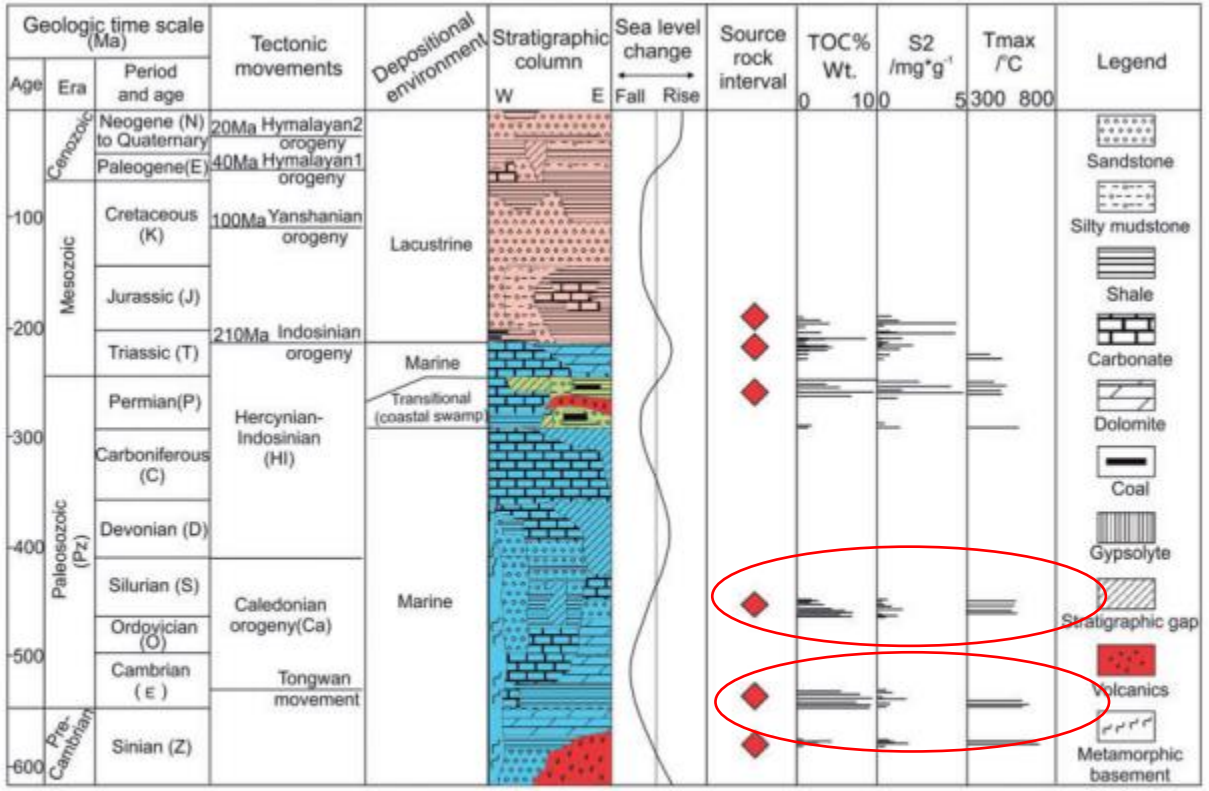


Figure 3. The integrated stratigraphic column, tectonic evolution, and shale source rock intervals of Sichuan Basin (modified after Zou et al., 2010). TOC: total organic content; S2: the amount of hydrocarbons generated through thermal cracking of nonvolatile organic matter; T_{max}: the temperature at which the maximum release of hydrocarbons from cracking of kerogen occurs during pyrolysis (top of S2 peak).

After Shu Jianf et ali- 2016-Geology and shale gas resource potentials in the Sichuan Basin, China,