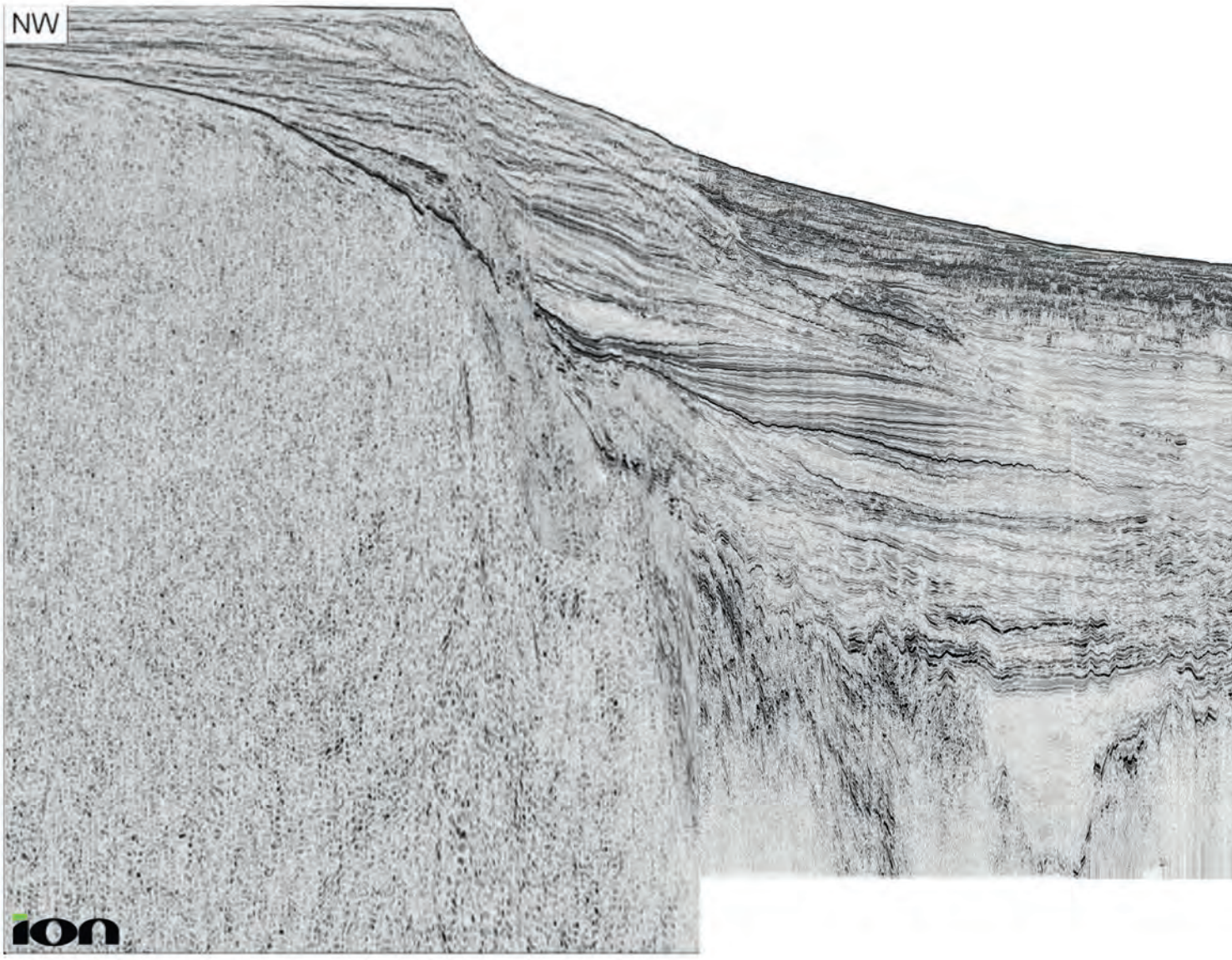
# The Rise of Venus in Uruguay's Pelotas Basin



**In a ceaseless battle for the attention of passionate explorers, the Orange Basin currently holds court after the Venus-1 and Graff-1 discoveries of 2022. Yet, exploration for analogue plays can be sought not only within the same basin, but also where similar conditions of formation have reproduced the same plays: The Uruguay conjugate margin.**

*Seismic reconstruction showing the correlation of proven Aptian source rock between the conjugate Orange and Pelotas Basins. Left: Ancap's PSDM seismic section, Pelotas Basin offshore Uruguay and Right: Searcher's pseudo-depth seismic section, Orange Basin offshore South Africa.*

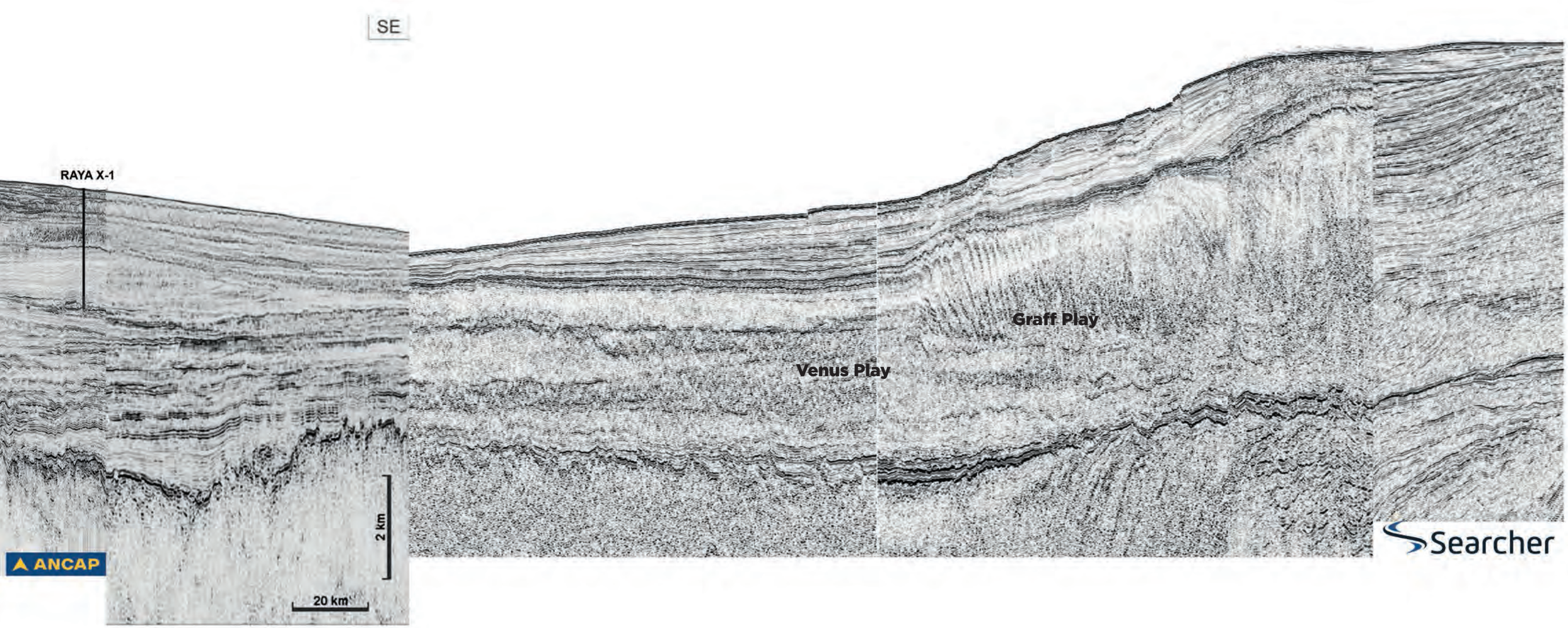



Illustration: Searcher

# Uruguay Plays Namibia on Number 1 Court

**Text:** Karyna Rodriguez, Neil Hodgson (Searcher), Pablo Rodriguez, Bruno Conti & Hector de Santa Ana (ANCAP).

The "Most interesting Basin in the World" ball has been batted across the Atlantic regularly for the last 30 years. Early deep-water success in the **Campos Basin of Brazil**, followed by the **Tano Basin of Ghana**, then across to the **Guyana-Suriname Basin** has led to the latest success in the **Orange Basin** of Namibia and South Africa.

This rally of ever bigger discoveries has occurred as explorers ventured into ever deeper water and is set to continue as courageous companies are lining up to enter offshore Uruguay, the conjugate to the Orange Basin, to bring glory back across the pond.

Like super-star tennis aces, the Orange Basin plays have unique and novel properties, but exploration for these defining characters can be sought not only within the same basin, but also where similar conditions of formation have reproduced the plays: across the Atlantic on the Conjugate Margin (see seismic line on this page).

## NEW BALLS PLEASE

Yet, are the Orange Basin plays really only for the courageous? On the face of it, the ultra-deep-water counter regional dipping Cretaceous sand fans and channels of **the Venus play** might seem exotic – but still that is only because the steady progression into deeper water only now allows us to access this inherently low-risk play: well-sorted sands sitting on mature source rock in counter regional structures covered with several kilometres of clay.

Likewise, the contourite-constrained slope channel traps of **Graff** are only now being recognized as seismic imaging improves and more deep-water mixed system discoveries are being made: high quality winnowed constrained channel turbidite sands updip of mature thick source rock with contourite drift top and lateral seal.

Whilst both plays are low risk, they are unproven in Uruguay, even though direct analogues to the discoveries of Venus and Graff respectively in the Orange Basin are recognized. Most importantly, they both have the potential for huge reserves in good reservoirs – key for deep-water "advantaged" resources which can be developed and brought to market quickly.

It has been reported that **the Venus discovery** could contain in excess of **13 Bboe** (World beater: TotalEnergies' Venus discovery in Namibia may be biggest ever deep-water find | Upstream Online), which would make it the world's largest deep-water field. The two discoveries in Namibia have the resource potential of the entire Guyana-Suriname or Tano Basins, discovered with just two wells.

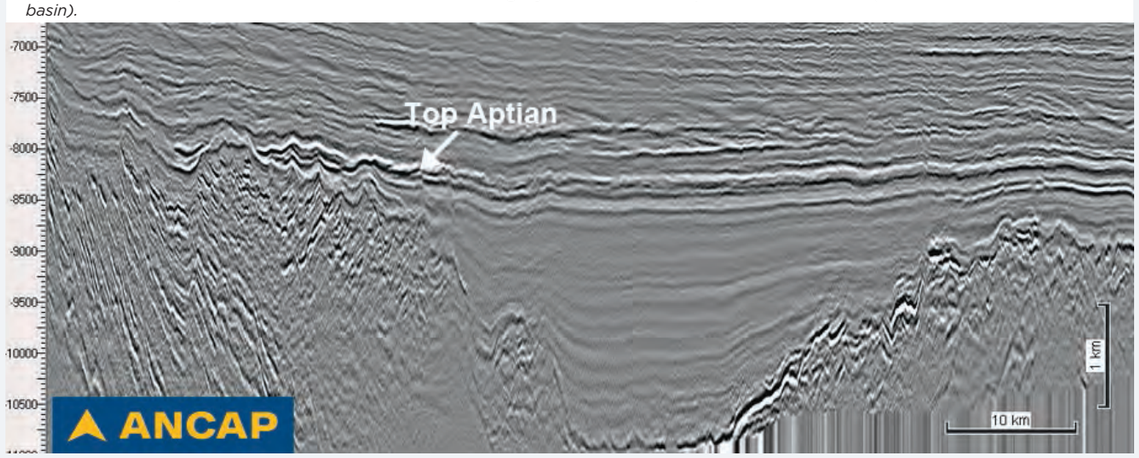
Similarly, on the conjugate margin in Uruguay, a prospective resources study for leads and prospects identified offshore Uruguay (Reporte de Recursos Prospectivos de Petróleo y Gas, Uruguay (ancap.com.uy)) published ahead of the Venus discovery, identified analogous deep-water opportunities each with best estimate resources in excess of **1.4 Bboe**.

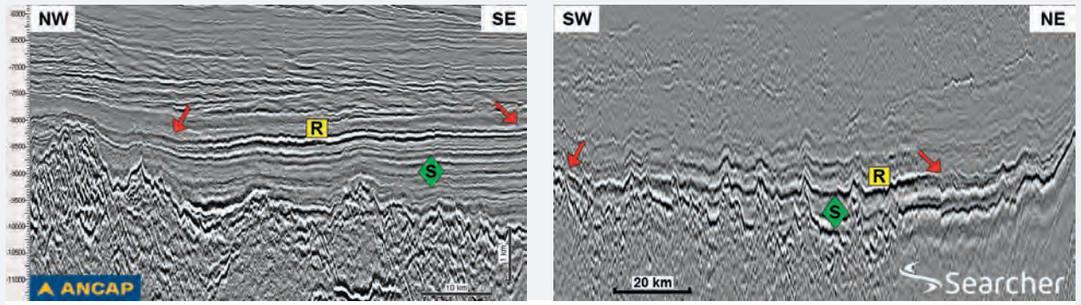
## FIRST SERVE: SOURCE ROCK ACE

In both of the Orange Basin plays the source rock is Aptian in age, sitting on oceanic crust and deposited in a restricted marine basin. This basin formed not long after drift began, and marine transgression switched the SDR (seaward dipping reflector) machine off and allowed Penrose Oceanic crust to form.

These Aptian basins are likely to be relatively shallow water (see DSDP 361) and anoxic, allowing the preservation of organic material. The same conditions of shallow water-restricted marine basins would have formed on both sides of the proto–Mid-Atlantic ridge, and indeed

*Aptian source rock proven offshore Namibia extends into Uruguay where it is found up to 3 km in thickness (PSDM section from Pelotas basin).*




*Left: Offshore Uruguay seismic section in depth over Delmira Prospect showing high amplitude event labelled as R (reservoir) overlying a thick Aptian source rock section (S). Right: Venus discovery extension into South Africa, showing a high amplitude anomaly overlying proven Aptian source rock. Note both sections are in Depth showing counter regional dip offshore at reservoir level.*

are clearly visible in the Pelotas basin offshore Uruguay. Here, the Aptian source rock, which can reach up to 3,000 m in thickness, has the same characteristics as the Orange basin equivalent unit.

The same diagnostic characteristics of a good quality mature source rock (Davison et al., 2018) are observed in Uruguay. These sequences can be mapped along the Uruguayan margin at the base of the slope and have Direct Source Indicators (DSI's) as ubiquitous low frequency, type IV AVO characteristics indicating the presence of thick organic rich source rocks.

Although it is straightforward to map out the isopach of sediments on top of this Aptian source rock, and high grade the areas with more than 3,000 m of sediment, due to a lack of well penetrations the geothermal gradient is an uncertainty.

It has been widely reported that the geothermal gradient at reservoir level over oceanic crust at Venus-1 was high, ca 35°C/km. It has also been rumoured that the geothermal gradient at TD (Total Depth) of Raya-1 (with TD at Oligocene, where a lack of faults that connect the Cretaceous source rock with Cenozoic reservoirs as well as thick Paleocene shales, prevent hydrocarbons from migrating towards Cenozoic reservoirs) was similarly high. To constrain this, the isopach of the extensive gas-hydrate layer (forming a Bottom Simulating Reflector (BSR)) offshore Uruguay, has been mapped to derive a base BSR-geothermal gradient, which has in turn been used to model thermal maturity at Aptian level.

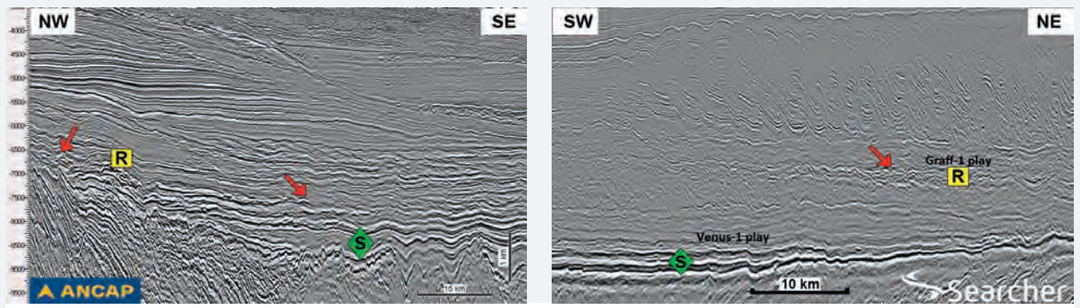
The results indicate widespread hydrocarbon generation with present day oil generation in the ultra-deep-water realm. Such oil generative basin modelling is unsurprising in the area as there are direct analogies to the proven Namibian margin and Direct Hydrocarbon Indications from fluid inclusions in the Cretaceous sequence of Lobo and Gaviotín wells, gas chimneys recognized in seismic, and microseeps detected in surface geochemistry studies, all of which demonstrate a working petroleum system.

## SECOND SET: PLAY TYPE COMPARISON

The Venus discovery in Namibia comprises two thick fans totalling gross 137 m of sand deposited directly onto the Aptian source rock. These fans are deposited in counter regionally dipping structures, where the distal end of the fan provides the pinch out. The dip is controlled by plate subsidence and loading, and so structures and traps are ubiquitously huge. Whilst it is speculated that these fining upward units are deep-water sandstones of turbidite apron-fan association, it is also possible that these comprise relatively shallow water pro-delta deposits.

At the time of deposition, the Aptian basin had not flooded back over the SDRs of the Orange Basin outer-high (when that happens in the Albian there is a possible carbonate build-up play established there) suggesting water depths of less than 200 m at the basin floor.

Fluvial systems could carry mature sands out through gaps or canyons between SDR edifices in the outer high. This is very likely to be similar to the depositional system of the Uruguayan Margin where thick fan-like sequences are mapped on 3D datasets in addition to intricate aggrading channel belts




*Left: Offshore Uruguay seismic section in depth over Chafalote Prospect, with total recoverable resources over 2 Bboe (Gristo et al., 2021), showing high amplitude event labelled as R (reservoir) overlying a thick Aptian source rock section (S). Right: Graff discovery extension into South Africa (water depth compensated 2D seismic line).*

prograding out onto the basin floor.

Contourite drifts and other mixed systems abound on this margin. Younger sediments of Albian and Late Cretaceous age are winnowed and sculpted by contourites to create plays and traps as yet untested on a series of terraces up the slope. These, charged by Aptian source rock, provide exciting and new low risk traps on this margin.

In recent years, the role of sea bottom currents flowing parallel to the shore (contourite currents) has been recognized in their interactions with turbidite gravity driven currents which create 'mixed' or 'hybrid turbidite-contourite systems'. Significantly, contourite currents can winnow the turbidites, stripping out the fine clastic component, leaving the turbidite enriched in coarse clastic content.

These hybrid systems have been associated with significant discoveries such as the **Mamba** and **Coral** fields offshore **Mozambique** with an accumulation in the order of 80 TCF (13.8 Bboe).

It has been reported that the secondary objective at the Graff-1 well was a play associated with a mixed or hybrid system (Bijkerk et al., 2021) and from reported results it is inferred that an accumulation was encountered in this play with a potential of over 3 Bboe. An analogous play has been identified by ANCAP offshore Uruguay, where impressive contourite drifts confirm interaction between turbidites and contourite currents.

## CONJUGATE MATCH POINT: ADVANTAGE URUGUAY

With energy security and energy independence at the top of many nations' political agenda, it has become urgent to find new significant accumulations. Deep-water plays keep defying paradigms and yielding the largest discoveries. These discoveries are to be found in deep-water not only on the West African Coast in analogous situations to Venus and Graff, but also on the South American Atlantic Margin – where similar depositional environments and geology have created comparable low risk traps. The game is on for explorers to take the analogue set of plays in deep-water and match the discoveries on the path to exploration glory, and the world's future low-carbon advantaged energy.

References provided online. ■

# One well

## While onshore Uruguay has seen four exploration wells drilled, the offshore sector has had just one exploration attempt so far.

Uruguay has not been lucky on the global exploration stage. The only company that tested the hydrocarbon potential of Uruguay's offshore is **TotalEnergies**. The French company drilled the dry **Raya-1** well in 2016 in a record-breaking water-depth of 3,400 m.

Onshore, a few more wells were drilled, but as this article in GEO ExPro (2018, No. 6) explains, one of the most recent wells (**Cerro Padilla-1**, drilled by Schuepbach Energy Uruguay in 2017) only found 2 metres of oil-saturated reservoir in Permian sandstones. Albeit uncommercial, the well was the first to bring oil to surface in the country.

Hopes for economic quantities of oil recently increased again following the discovery of oil in Namibia. This has now led to the award of three new offshore licences in June this year by Uruguay's oil refining and fuel distribution company **ANCAP**. UK-based company **Challenger Energy Group** (CEG) was already awarded their licence in 2020.

Given that Shell is the operator of the **Graff** discovery offshore **Namibia**, it is no surprise to see that the company is one of the operators now also having a foothold in Uruguay. TotalEnergies, the company behind the **Venus** discovery offshore Namibia, is seemingly taking a more careful approach on the opposite side of the continental margin, probably driven by some intelligence obtained before.

It will be Apache's (APA) task to prove that the block they were awarded is in fact prospective where TotalEnergies failed to prove hydrocarbons. The American company's program includes a well commitment, while Shell's includes licensing of already available seismic data. ■

*HENK KOMBRINK*