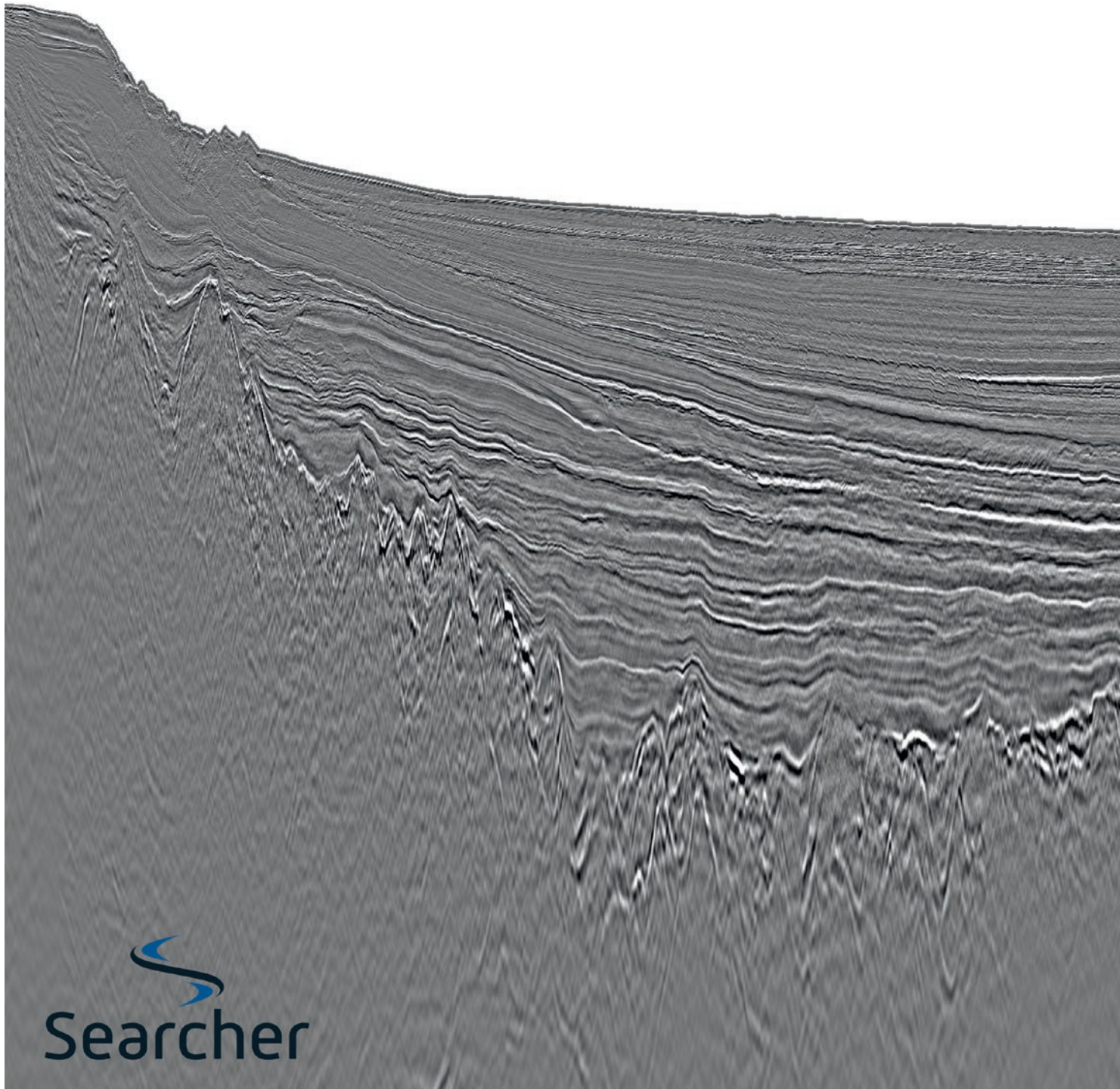
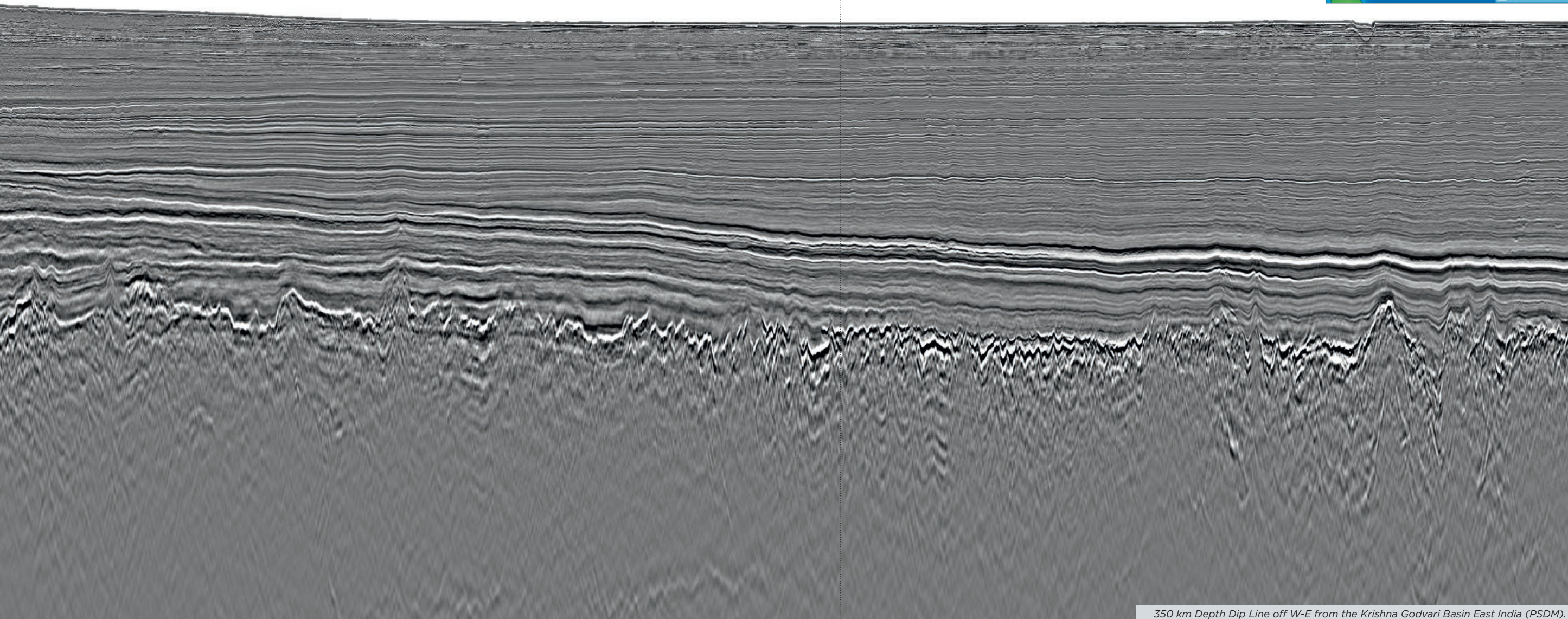
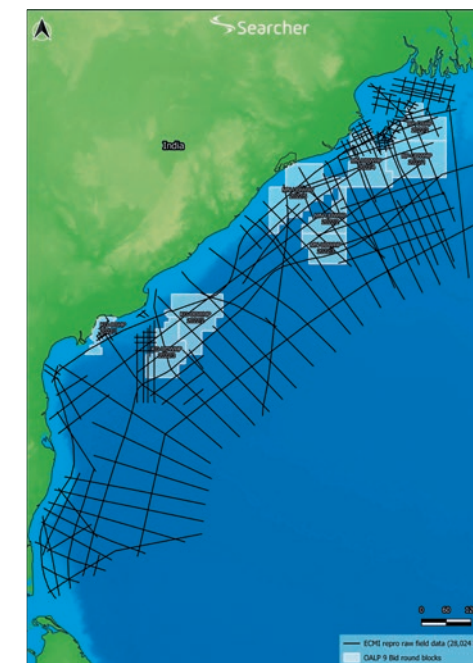


# **The Gateway to India: OALP-IX Offers Industry Access to East India's Extraordinary Hydrocarbon Basins**





Searcher is reprocessing 10,000 km of regional 2D data offshore East India, bringing 2022 processing technology to bear in the hunt for source rock and sedimentology sweet spots. There is a dire need for additional low-carbon energy on the eastern margin of the largest nation (by population), with one of the fastest-growing economies on earth.



350 km Depth Dip Line off W-E from the Krishna Godvari Basin East India (PSDM).



# Accessing a Seat at the Low-Carbon Energy Table on India's Eastern Margin

In June 2022, the DGH India announced the OALP Bid Round IX (2022/3) Licence Round which includes 9 blocks East of India in the Krishna Godavari, Mahanadi and Bengal Basins. These blocks cover both shallow and deep water, they are by any standards huge (2,800-14,000 sq km) and largely or completely unexplored.

■ **Text:** Neil Hodgson, Peter Hoiles and Karyna Rodriguez; **Searcher**

Situated close to one of the world's fastest-growing economies, where a population of 1.2 billion is eager for low-carbon energy provided by domestic production, the **OALP Bid Round IX** will certainly draw the attention of investors all around the world. Large commercial oil and gas discoveries and the industry's progression in deep-water drilling records should cause serious interest in accessing acreage in these three basins.

## SUCCESS ON THE SHOULDERS OF GIANTS

Success offshore **East India** will be found by standing on the shoulders

of previous explorers and looking through a lens of improved seismic data to see further than was previously possible. It starts with a regional play understanding as both the margin and the blocks on offer in OALP-IX are so large.

The path to ensure that the offered acreage is high-graded starts by using a regional seismic dataset to better understand the distribution of source rocks through the analysis of carefully processed gathers. Then, the distribution of reservoirs through de-ghosting data and an assessment of the true nature of plays and traps is carried out.

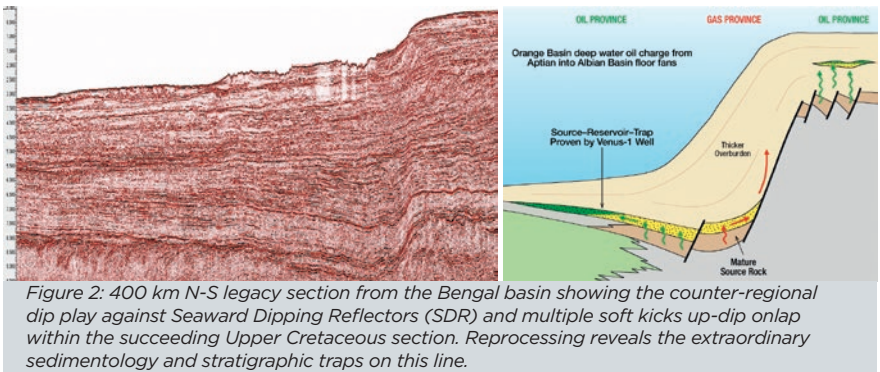
To support the Licence Round, **Searcher** has rectified (post-stack equalization, navigation verification) a large 28,000 km 2D legacy regional dataset across the **Krishna-Godavari, Mahanadi** and **Bengal basins**. Based on data acquired between 1995 and 2006, the company also reprocessed a strategically selected regional 10,000 km subset through a modern de-ghosting PSTM sequence (Figure 1 and Foldout line (PSDM)). The regional reprocessed grid is specifically designed to allow high grading of the Licence Blocks on offer in OALP-IX.

## SOURCE ROCK GEOLOGY

The **Eastern Margin of India** formed in the Early Cretaceous when a Karoo-fabric-following rift allowed India and Antarctica to separate. **Aptian source rocks** are found in wells drilled on the shelf in syn-rift lacustrine rifted half-grabens. These lacustrine source rocks were inundated at the start of drift by marine incursions, depositing a restricted marine source rock.

In the Seaward Dipping Reflector (SDR) domain in the northern **Mahanadi** and **Bengal basins**, such a "first-flood" source rock was deposited after the first marine transgression had penneplained irregularities off the upper SDR surface. Continuous loading caused by **Ganges** and **Brahmaputra** sediments subsequently created a succession of counter-regional dip geometries of onlapping Upper Cretaceous clastics (Figure 2).

This counter-regional geometry, directly below onlapping pro-delta fans, is similar to the play system



recently proven by the **Venus-1** well in **Namibia**. Such plays are low risk because the up-dip pinch-out of sands is a certainty and prospects are typically game-changingly huge. This play is to date untested in East India although it is developed extensively on the Bengal Basin to Mahanadi margin.

To the southwest, in the non-magmatic part of the rift (Nemcok, et. al., 2013), source rocks in syn-rift half grabens and the overlying thick Upper Cretaceous sequence are unexplored as is much of the overlying Tertiary (see Foldout line). Beyond the extended crust on this part of the margin, it is also likely that restricted marine Aptian-Albian source rocks will be encountered, in addition to several Cretaceous and Lower Tertiary global Ocean Anoxic Event (OAE) source rocks (Singh, et al 2022).

Reprocessed lines over the **Krishna Godavari** syn-rift show the potential for a working hydrocarbon system with deeply buried Lower Cretaceous source rocks in extraordinary detail (Figure 3).

The secret to identifying source rocks on seismic, which has been revealed by many global studies that have validated the technique, relies on the presence of seismic intervals that are:

- Soft compared to the underlying and overlying sequences;
- Relatively high-amplitude but lower frequency (see Figure 3) and
- Exhibiting a dramatic reduction in amplitude with offset (a Class IV AVO anomaly).

Developed using the **UKCS Kimmeridge Clay Formation** (Loseth et. al., 2011) and employed in **Namibia's Orange Basin** and its **conjugate Pelotas Basin** (Eastwell et. al., 2016, Rodriguez et. al., 2016) this was a major de-risking tool in the validation of the source rock for the super-giant Venus-1 discovery in 2022.

## UNCERTAINTY COLLAPSE

Identifying sweet spots within the extent of source rock distribution is key on this margin. By analogy, the source rock in both deep-water Guyana and deep-water Namibia was identified, but considered a pre-drill risk before Liza and Venus were drilled, simply because no wells had been drilled in those specific areas to prove presence and effectiveness.

Looking back, it is easy to separate the uncertainty from any negative evidence, but prior to exploration drilling, this was not the case. On the east coast of India, the situation is similar as source rocks can be identified on seismic and once the presence of mature generative source rock is proven the uncertainty collapse will allow exploration prospect risk to be viewed as solely trap dependent. In the presence of counter-regional dip

stratigraphic plays (Venus-1 Namibia and Figure 2), or regional channel truncation (deep-water Guyana), such trap styles allow prospect risks to become very low ensuring repeatability of success.

Offshore East India, the uncertainty in Lower and Mid-Cretaceous source rock distribution can be rapidly reduced by mapping the AVO response at these undrilled stratigraphic horizons. To do this, however, the re-processing of the raw data using a modern processing flow to produce accurate, flat gathers from long offset datasets is imperative, as legacy datasets and extrapolative datasets do not offer reliable indicators of variations in AVO Class IV anomalies.

## THE FASTEST GROWING ENERGY MARKET

Exploration for domestic gas resources in the world's hungriest and fastest-growing energy market that otherwise would be reliant on utilisation of its native coal reserves is seen as a critical step in the human race's journey to low-carbon energy sustainability. The OALP-IX Licence round allows international investors to access Searcher's reprocessed regional dataset to high-grade and cherry-pick the most prospective blocks on this super-margin.

We would like to thank our colleagues at Shearwater Geoservices for producing the amazing seismic images utilised in this article.

References provided online. ■

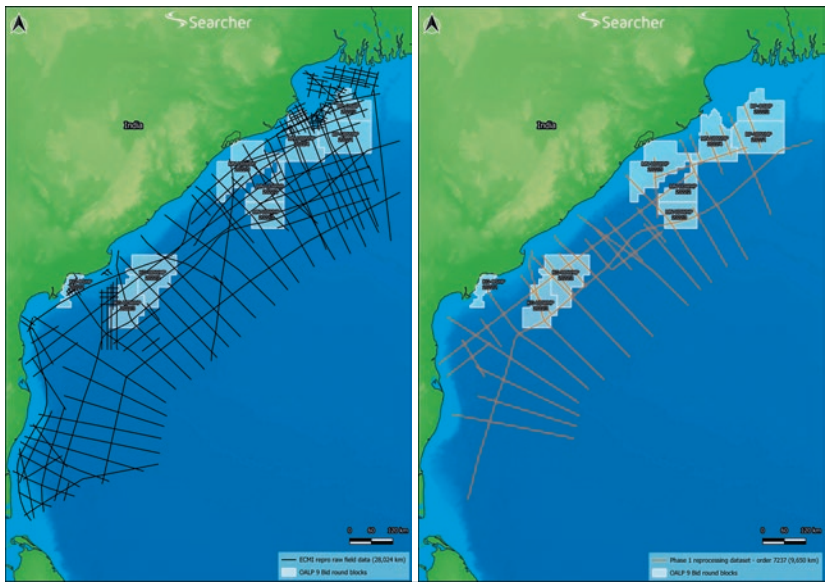


Figure 1: Left: Searcher's 28,000 km sAismic rectified regional dataset. Right: Searcher's 10,000 km 2022 reprocessed dataset.

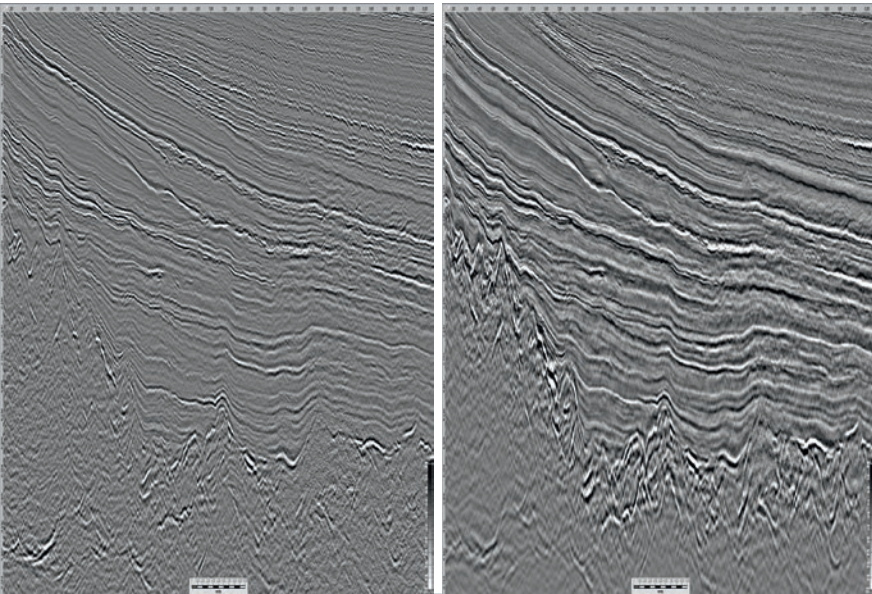


Figure 3: 2D TWT Legacy (LHS) versus 2020 Reprocessed Syn-rift section from deep-water Krishna Godavari Basin - see also Foldout line PSDM.