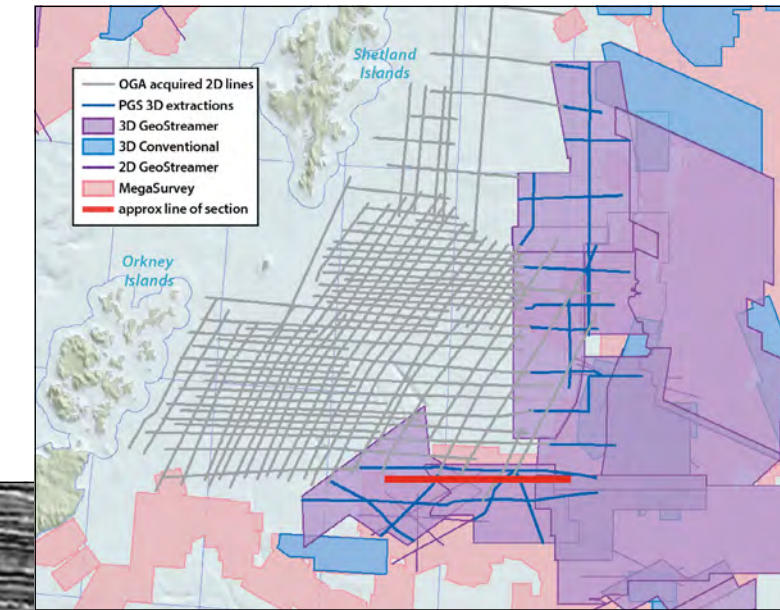


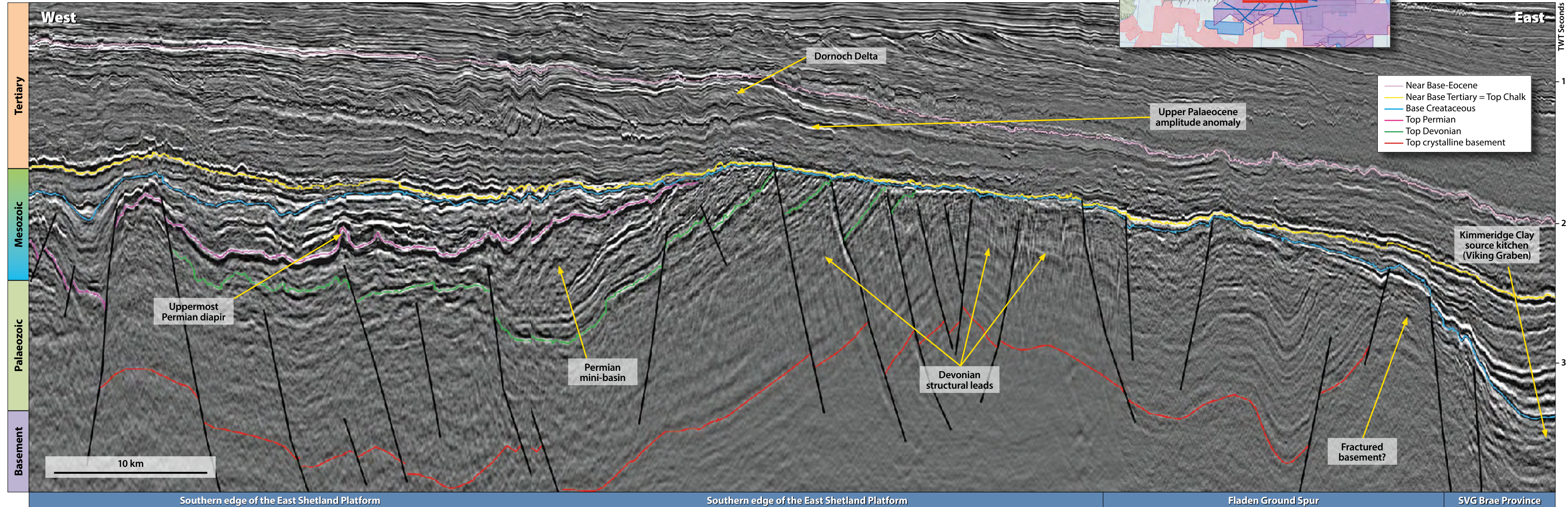
# The East Shetland Platform

The next large frontier – on the periphery of a world-class mature basin.

With exploration focus shifting from the mature basins to frontier areas once again for the 31st UKCS offshore licensing round, the East Shetland Platform (ESP) is a key area situated at the periphery of the mature graben axes of the North Sea rift system. PGS multi-client 3D GeoStreamer data has imaged a number of large Palaeozoic structures with a prospective working petroleum system in this area.



PGS has provided a number of extractions from its 3D multi-client library on the ESP to provide well ties for the UK Oil and Gas Authority's recently acquired 2D lines, which will be made available ahead of the next licensing round.



# The East Shetland Platform: Illuminating Sub-BCU

New 3D data allows the true geological story of the Palaeozoic of the East Shetland Basin to be unravelled.

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Due to the limitations of legacy seismic and despite significant discoveries within Palaeogene-age reservoirs, the East Shetland Platform (ESP) has been historically conceived as a broad and flat high, with shallow basement and few visible structures. Mesozoic units are generally thin or absent whilst Palaeozoic reflectors were often interpreted as basement on legacy seismic. Several 3D multi-client GeoStreamer® dual-sensor broadband seismic surveys were acquired by PGS between 2011 and 2016 over a total area of 17,200 km<sup>2</sup> (UKCS Quadrants 3, 8–9, 14–16), and these have allowed for clearer imaging, which it is believed could open up a whole new era of exploration potential.

These new GeoStreamer surveys clearly illuminate sub-BCU (Base Cretaceous Unconformity) Palaeozoic structures and potential closures in areas where legacy 2D and 3D seismic mostly showed no discernible sub-BCU reflectors (see below). In other cases, the new seismic has helped make sense of old well results, including reported Devonian oil shows and source rock penetrations.

## Petroleum System Summary

PGS has been studying the ESP for the past three years, and findings have been previously published in First Break (Patruno and Reid, 2016, 2017). These PGS studies show that the ESP petroleum system comprises multiple proven and potential reservoir and source intervals, with viable play fairways and possibly mature source rocks. The ESP

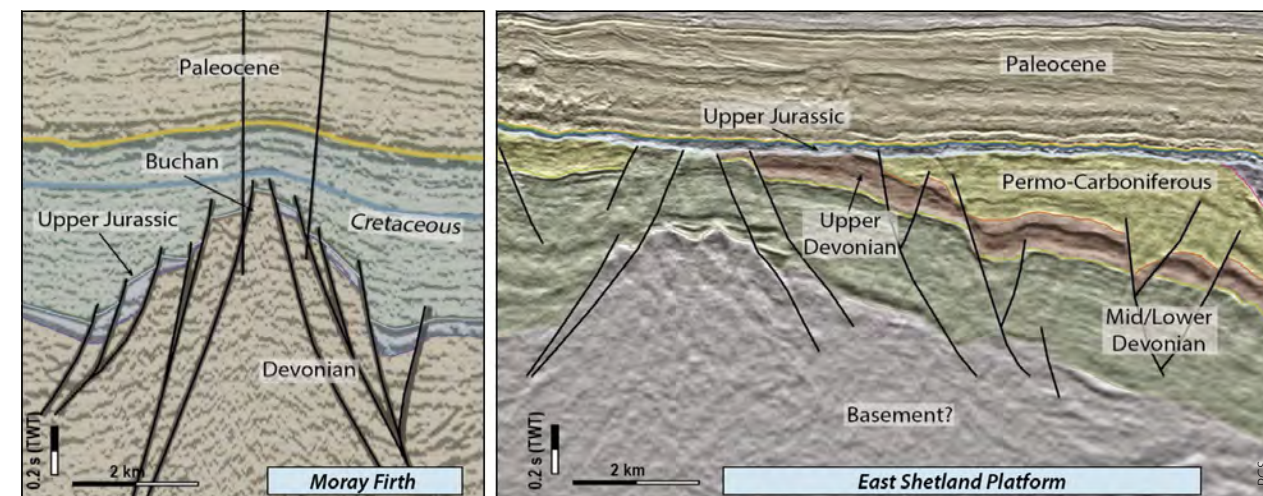
comprises persistent basement highs and predominantly subsiding Permo-Triassic depocentres, which contain a nearly continuous Palaeozoic-Mesozoic succession (e.g., the newly-defined 'Crawford-Skipper Basin').

Existing hydrocarbon discoveries and shows on the ESP are in the vicinity (less than 7 km) of intra-platform Permo-Triassic basin margins. Exploration close to such basins is inherently less risky due to possible positive influences on deep-seated structures in the petroleum system. These influences include the formation of Meso-Cenozoic closures; the maturity of the Devonian source and the presence of simple fault-related migration pathways; and the viability of sub-Cretaceous reservoir-trap-seal configurations.

## Fluid Escape Features

More recently, numerous vertical seismic amplitude anomalies have been observed within the Cenozoic succession of the ESP (top of facing page), which are interpreted to be a result of hydrofracturing associated with vertical fluid migration through the sedimentary rocks. Anomalies seen over the Greater ESP are for the most part clustered in association with the south-eastern edge of the Crawford-Skipper Basin and other Permo-Triassic fault-bounded depocentres. This additional evidence strengthens the suggestion that the preserved intra-platform Permo-Triassic basin fill plays a pivotal role in the maturation of the Devonian source rock and the upward and outward migration of hydrocarbons.

Devonian Buchan Field in the neighbouring Moray Firth showing similarities to undrilled structures in the Permo-Triassic intra-platform basins (redrafted after Edwards, 1991).



## Quantitative Interpretation

A successful quantitative seismic interpretation of rocks as deep and as old as the Devonian was undertaken as part of the ongoing study of the area. This confirms that GeoStreamer dual-sensor broadband acquisition and processing enables geoscientists to derive reliable pre-stack information (acoustic impedance and Vp/Vs), even at depth. A very high correlation between the wells and seismic in the Palaeozoic section was observed and there were also clear indications that Upper Devonian rocks are characterised by surprisingly high effective porosities, up to 22% (below). Well analysis suggests that relative acoustic impedance for the upper Devonian is a proxy for effective porosity, as successfully tested on this broadband seismic data.

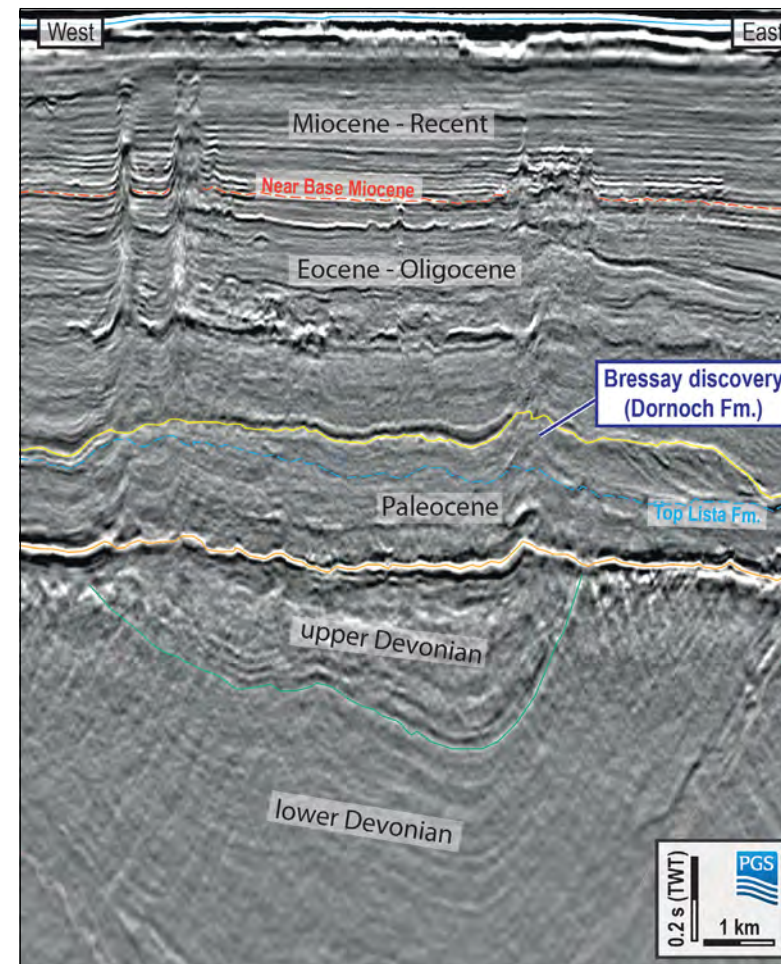
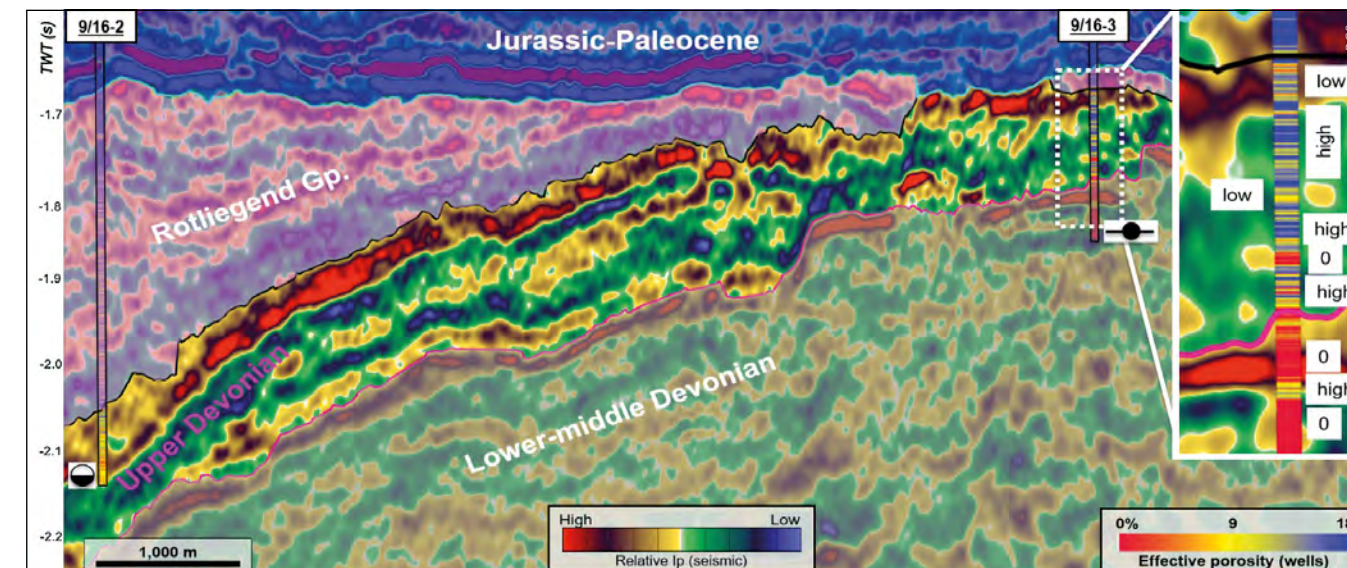
## Greater Clarity

Due to the imaging limitations of vintage seismic data, the East Shetland Platform was once poorly understood. With the acquisition by PGS of several recent 3D multi-client dual-sensor broadband surveys there is now a unique opportunity to view the Palaeozoic reflectors with significantly more clarity than has been possible in the past, allowing the true geological story to be unravelled.

PGS has identified a number of sub-BCU targets and highlighted the presence of multiple reservoir intervals. A mature and working source might be present, as highlighted by direct well penetrations and indirect evidences (e.g., vertical amplitude anomalies and seep surveys). Intra-platform Permo-Triassic basins with a more complete stratigraphic succession are present, and represent inherently less risky exploration areas. Quantitative interpretation has been used

to further de-risk Palaeozoic plays at reservoir scale. ■

Relative impedance can be used as a proxy for effective porosity. Hard impedances correspond to low porosities and soft impedances to high porosities (PGS 3D GeoStreamer BYLM2013).



Two vertical seismic anomalies associated with vertical fluid migration (PGS 3D GeoStreamer PGS15010).

to further de-risk Palaeozoic plays at reservoir scale. ■

## References:

Patruno, S. and Reid, W., Dec. 2016 and Jan. 2017. New plays on the Greater East Shetland Platform (UKCS Quadrants 3, 8–9, 14–16) (part 1 and 2). First Break, 34–35.



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