WS2-A02

Broadband Seismic - Uplift to the Interpreter

N.A. O'Dowd* (PGS) & P.G. Carolan (PGS)

SUMMARY

The geophysical uplift of broadband data is widely reported as are the benefits it brings to reservoir characterisation. However there are also benefits to the qualitative interpreter which go beyond improved resolution and structural imaging. In addition to the benefits to efficiency and accuracy whilst auto-picking, the manual interpreter can gather more geological information from the texture within the data than just having improved confidence in the structural and stratigraphic image. The broad bandwidth of frequencies within the data produce a texture to the data which can highlight geological packages which may have been previously masked within conventional data. There is geological understanding and information which may be inferred and when accurately tied to well information can increase confidence in model building and help to focus further quantitative interpretation.

As exploration becomes increasingly focused on finding subtle traps, the need to effectively map the subsurface is critical. The interpreter is increasingly required to produce a more and more accurate description of the subsurface in order to fully evaluate the prospectivity. To achieve this, the interpreter requires data that has precision imaging of the subsurface. In recent years there has been a significant improvement in the data quality available with broadband technology leading the way.

The geophysical benefits of recording true broad bandwidth of frequencies have been discussed in great detail, but what does that actually mean to the interpreter?

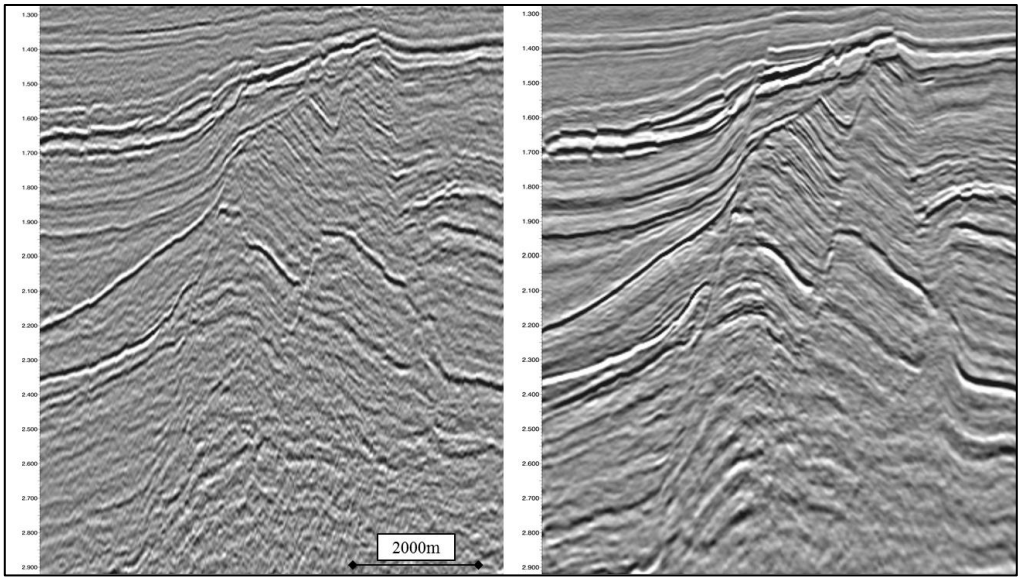

Figure 1. The improvement to the image goes further than just noise reduction and higher resolution for the broadband dataset. The continuity and character of the events/reflectors increase confidence producing a reliable structural / geological model.

One of the primary uses of seismic data is for regional structural and stratigraphic mapping. The improvements in resolution and depth penetration, brought about by acquiring broad bandwidth seismic are widely reported. This is clear in the image above (Figure 1) where the broadband data shows improved resolution of important shallow features such as thin beds and subtle sedimentary traps. The improvement in fault plane definition resulting from clear reflector terminations is also well defined in addition to the clearer imaging of horizon truncations at erosional surfaces and increase in level of detail where reflectors converge and beds pinch out. These are not only a result of the higher frequencies within the data but also the sharper wavelets and reduced side-lobes obtained from the low frequencies and are all beneficial to the interpreter increasing efficiency and confidence in building the structural model.

Traditional interpretation techniques involve a combination of manual- and auto-picking. Both methods rely on data quality; continuity and similarity of seismic character to track the event. Due to the wavelet character in broadband data, there is a vast improvement in auto-picking efficiency and quality. However, there is much more to be gained from the manual interpreter's viewpoint. The low frequencies retained in the broadband data generate a texture which is not present in conventional data. Where the increase in resolution aids the interpreter's ability to make decisions regarding horizon tracking, this perceived texture enables the interpreter to begin to extract more geological information and understanding from the seismic.

For example, in Figure 2, there is a sediment package draped over the rotated fault blocks that is clearly imaged on the broadband dataset. The feature, which is highlighted within the white box, has a

sharp definition to its shape allowing the top and the base to be clearly seen, which is especially important where it thins out over the syn-sedimentary shales. This package also appears to stand proud from the surrounding stratigraphy and there is some internal character within it which is imaged due to the reduction of the side lobe effects on the wavelet in the broadband seismic. This is in contrast to how it is imaged on conventional dataset, where it is barely distinguishable. The clearer definition of features similar to this, due to the texture produced with broadband data, may result in the identification of previously overlooked prospects.

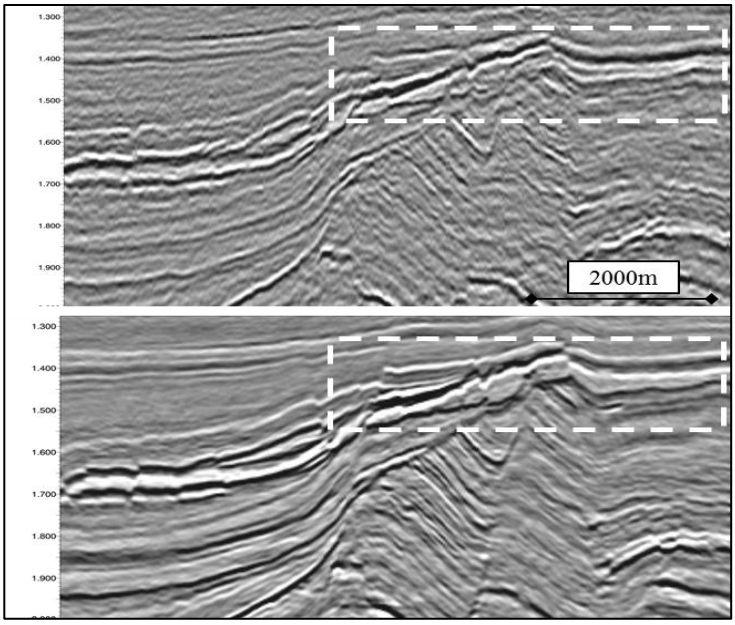

Figure 2. A close-up view of the shallower section where a previously quiescent zone stands proud of the surrounding stratigraphy in the broadband dataset.

At this stage in the interpretation, the broadband seismic may only allow identification of features of potential interest. However, to actually determine lithology and rock properties, the seismic data needs to be calibrated using well data with more detailed seismic reservoir characterisation studies.

At the seismic interpretation stage, a good well tie is crucial. This provides the principle means of relating seismic waves to the stratigraphy and rock properties of the subsurface. Due to the broader wavelet with broadband data, the well to seismic correlation is vastly improved and more reliable for the full stack and pre-stack seismic data. The more robust signal seen in the gathers again increases confidence when interpreting out from the wells, correlating across structures and predicting the rock and fluid properties. This is beneficial to aid focusing of the more detailed reservoir characterization projects around suitable targets. This is the foundation to a reliable interpretation study which is an integral part of exploration and development.

Conclusion

Prior to any reservoir characterization analysis and the benefits that broadband data offers in this discipline, there is uplift to be had by the conventional interpreter. Broader bandwidth not only improves the image of known structures but also illuminates previously hidden thin beds, subtle structural and stratigraphic geometries. It is also believed that more geological understanding can be inferred through the textural appearance inherent in broadband data.

Acknowledgements

Many thanks to PGS for permission to publish this work and present the data and all that have assisted with the discussions surrounding this publication.