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Advanced Applications of Distributed Acoustic Sensing

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SUMMARY

A Distributed Acoustic Sensor (DAS) is capable of measuring the acoustic field at every point along an optical fibre. Applications of this technology are becoming increasingly mature, with many companies making commercial decisions based on DAS data. In the geophysical field DAS is being used routinely to acquire VSP measurements either using wireline deployed or permanently installed fibre optic cables and active sources. The results in this paper show some comparisons with data from conventional sensors and highlight the benefits of these types of measurements.

Introduction

A Distributed Acoustic Sensor (DAS) is capable of measuring the acoustic field at every point along an optical fibre. Applications of this technology are becoming increasingly mature, with many companies making commercial decisions based on DAS data. In the geophysical field DAS is being used routinely to acquire VSP measurements either using wireline deployed or permanently installed fibre optic cables and active sources. The results in this paper show some comparisons with data from conventional sensors and highlight the benefits of these types of measurements.

More recently, improvements in DAS performance have enabled passive seismic measurements to be acquired. DAS technology, with a wide aperture and fine spatial resolution array, is very well suited to detection of microseismic events and earthquakes. Some recent survey results are shown that highlight the potential for passive measurements with DAS to provide much higher levels of detail than conventional sensors.

As technology continues to develop and the latest advancements have the potential to provide a significant step-change in performance. Details of a new system will be given that offers at least a 20dB reduction in the noise floor over the existing system.

Example

A VSP survey was conducted in China using a fibre optic cable within a conventional wireline cable. The wireline cable was deployed in a vertical well and recorded a series of dynamite shots. The shot pattern is shown in Figure 1 (left). The fibre deployment schematic is shown in Figure 1 (right).

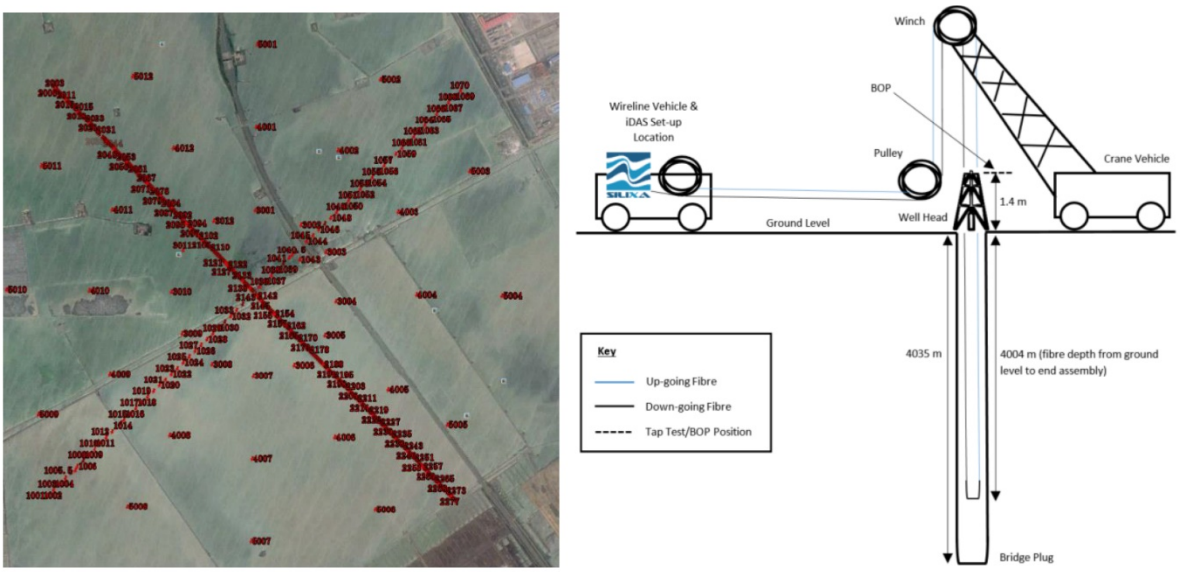

Figure 1 *(Left) Dynamite Shot Position Map the well is located at the centre of the 'X', (Right) Fibre Deployment Schematic.*

The data was pre-processed and then migrated to produce a 3D image of the formation around the wellbore. This was compared to previous surface seismic data collected previously on conventional geophones. Figure 2 shows the surface seismic data result and Figure 3 shows the DAS data overlaid on the surface seismic data for comparison.

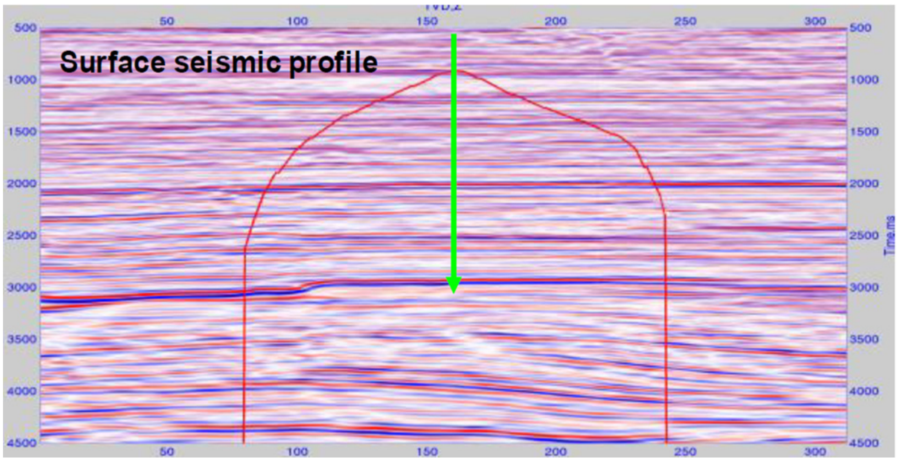

Figure 2 *Surface seismic data only, red line indicates extent of DAS image.*

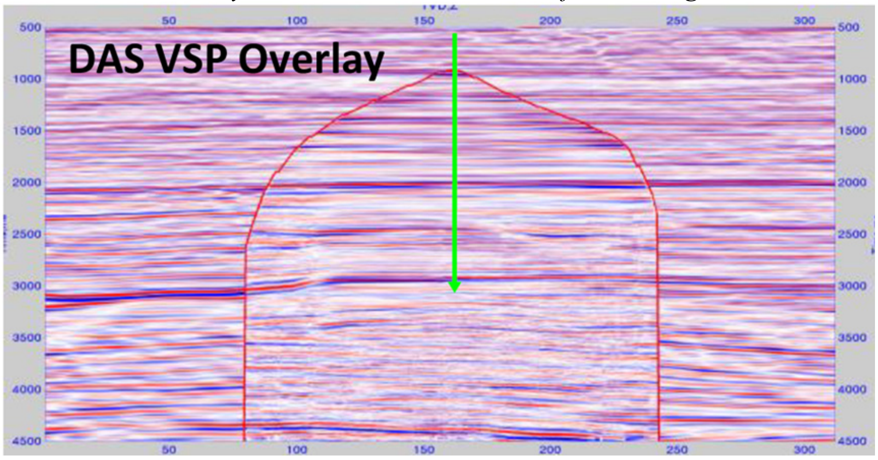

Figure 3 *DAS image overlaid on surface seismic data.*

The DAS VSP data showed excellent depth matching with the large reflection features. In addition, it provided much improved resolution and detail in the imaged zone, potentially identifying formation features that had not previously been visible in the surface seismic data alone.

References

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