

Distributed Optical Fibre Sensing for Production Log and VSP Offshore Rig-less Well Intervention in Highly Deviated Hot Wells

case study



Introduction

Distributed optical fibre sensing involves using a topside interrogator connected to a downhole optical fibre cable to gather temperature and acoustic information along the entire cable length. Since the optical fibres act as the sensor array the system is inherently reliable and so offers a more cost effective means to gather critical in-well information about the reservoir and producing conditions.

Where the well does not have a permanently installed optical fibre cable it is possible to introduce one to the wellbore as an intervention. In this case the customer wanted an intervention solution to access highly deviated and high temperature offshore wells for the purpose of gathering production information and to evaluate the capability of the method for borehole seismic acquisition.

Integrated Solution

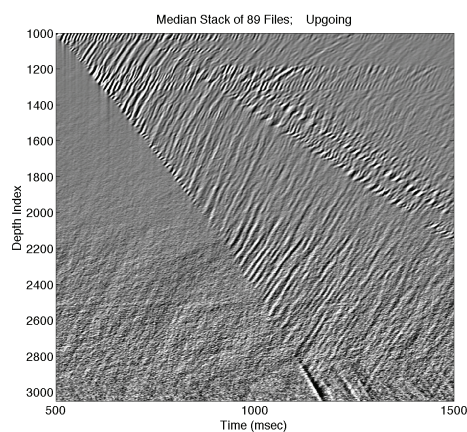
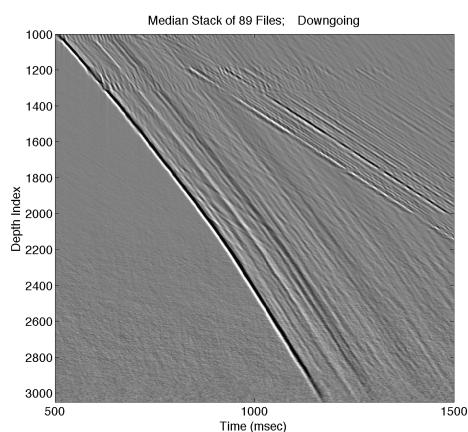
To address the challenges presented by the well geometry and environmental conditions Silixa developed a large diameter optical fibre cable capable of withstanding the high temperatures expected. The increased outer tubing diameter meant that the cable behaved similarly to a micro-coiled tubing string allowing it to be injected into the well using convention coiled tubing equipment as shown in the above photograph. The result was a continuous sensor array that could be deployed into the wellbore beyond the accessibility of wireline conveyed sensors yet with an overall equipment footprint suitable for rig-less operations on small offshore platforms.

With the sensor array deployed beyond 10,000ft and 60° deviation Silixa then utilised its iDAS™ and ULTIMA™ DTS systems to gather high resolution acoustic and temperature data respectively from individual optical fibres within the cable during a series of differing flowing conditions. The combined information provided a unique insight into the dynamic performance of each production interval in a way that conventional logging cannot achieve with point sensors.

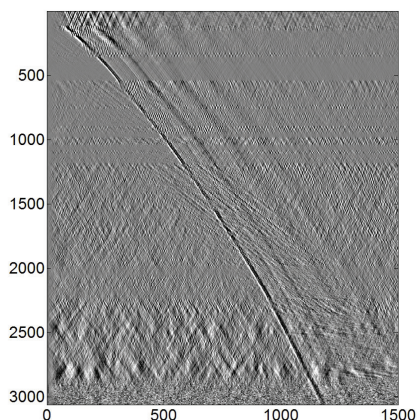
Seismic Acquisition in a Producing Well

This rig-less intervention method provided an opportunity to gather densely sampled seismic data in a production well that would typically be off-limits to conventional borehole seismic technologies. A platform deployed airgun source was triggered by the intelligent Distributed Acoustic Sensor system and repeat shots were performed under both well-flowing and shut-in conditions. The ability to stack repeat shots for enhanced signal is a key differentiator of the iDAS as by design it records phase coherent amplitude information, or true acoustics.

The below plots show the separated downgoing and upgoing wavefields from a stack of 89 zero offset source shots taken with the well shut-in. Data acquisition occurred simultaneously at all depths without the need to move the cable.



Also shown is an example of stacked shot data obtained under well flowing conditions.



- High quality seismic data obtained under flowing conditions
- Production flow monitoring executed in parallel with seismic acquisition

Conclusion

This case highlights practical intervention possibilities that are opened up when conventional sensor technologies are replaced by distributed optical fibre sensing. It demonstrated that acoustic and temperature data together can offer powerful new ways to describe the zone by zone performance of a well and it proved that, when coupled with Silixa's iDAS, an optical fibre cable conveyed into the well and with no positive coupling force to the borehole wall can provide high quality borehole seismic data for velocity profiling or reflector imaging even when the well is flowing.

Reference:

Tom Parker, Sergey Shatalin, Mahmoud Farhadiroushan (2014). Distributed Acoustic Sensing - A New Tool for Seismic Applications, First Break, Vol 32, No 2, February 2014, pp. 61 - 69.

Silixa Ltd

230, Centennial Park,
Elstree, Hertfordshire

WD6 3SN, UK

t: +44 (0) 20 8327 4210

f: +44 (0) 20 8953 4362

Silixa LLC

16203 Park Row,
Suite 185, Houston

TX 77084, USA

t: +1 832 772 3333

f: +1 832 772 3530

Silixa LLC

3102 W Broadway St,
Suite A, Missoula,

MT 59808, USA

t: +1 406 204 7298

f: +1 406 204 7499

silixa.com

© Silixa Ltd 2023

