Amsterdam '14

WS2-C01

The Benefits of Broadband Seismic Data

B. Krokan* (Statoil ASA)

SUMMARY

To improve bandwidth and resolution in seismic data has been a priority since the early days of the seismic method. The last years the industry has made great strides forward in terms of providing techniques that contribute to enhanced seismic resolution, deeper penetration into the earth, more quantitative and reliable reservoir inversion, simplified interpretation and clearer facies discrimination. This presentation provides evidence for the improvements by case studies with recently acquired marine broadband data. It will also address a few R&D challenges.

Introduction

To improve bandwidth and resolution in seismic data has been a priority since the early days of the seismic method. The last years the industry has made great strides forward in terms of providing techniques that contribute to enhanced seismic resolution, deeper penetration into the earth, more quantitative and reliable reservoir inversion, simplified interpretation and clearer facies discrimination. This presentation provides evidence for the improvements by case studies with recently acquired marine broadband data. It will also address a few R&D challenges.

Benefits of BroadBand Seismic

New broadband seismic acquisition solutions have opened up unique possibilities in seismic data processing, imaging, interpretation and monitoring. The advantages of broadband seismic have been demonstrated world-wide at all stages in the exploration and production cycle.

Broadband data provides both low and high frequencies. This opens up for improved imaging in the exploration phase since potential targets at all depth levels can be imaged. The improved bandwidth better defines stratigraphy. The additional low frequencies better contrasts the major lithology variations. Broadband data also provide significant benefits for seismic inversion workflows, especially in terms of low-frequency bandwidth extension.

For time lapse seismic data acquisition, the new streamer technologies hold the potential to improve repeatability between two seismic surveys.

Examples

During the presentation, a number of examples will be shown. In this abstract, we briefly address two.

In August 2012 a seismic survey using multisensor towed-streamer technology was acquired at the Mariner field, a shallow heavy-oil field located in the UK sector of the North Sea. An important factor for using multisensor streamer is the geological complexity of the overburden at Mariner and the ability of the multisensor streamer recordings to reconstruct the pressure wavefields in the crossline direction. It holds the potential for creating multi-purpose seismic data usable for reservoir targets as well as shallow hazard assessment.

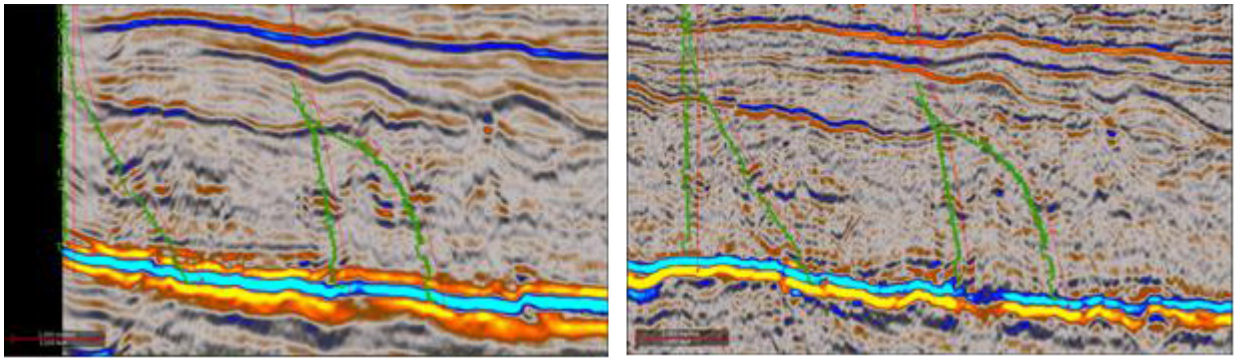

Figure 1 *Example of seismic sections over the Mariner field. Left: OBC data. Right: Broadband data (preliminary). The thick sand observed in the second well from the left is most accurately mapped with the broadband data.(Figure adapted from Sundvor et al., 2014).*

Ocean bottom seismic has a long tradition to exploit the low-frequency benefits of the recordings. The Oseberg South area has produced oil for more than 10 years but with poor seismic images. An OBC seismic survey shot in 2010 has overcome many of the seismic imaging challenges, with improvements in seismic quality that have made us to change our geologic understanding of part of the area. A major contributor to the improvement of seismic quality is assigned to the low frequency content in the data.

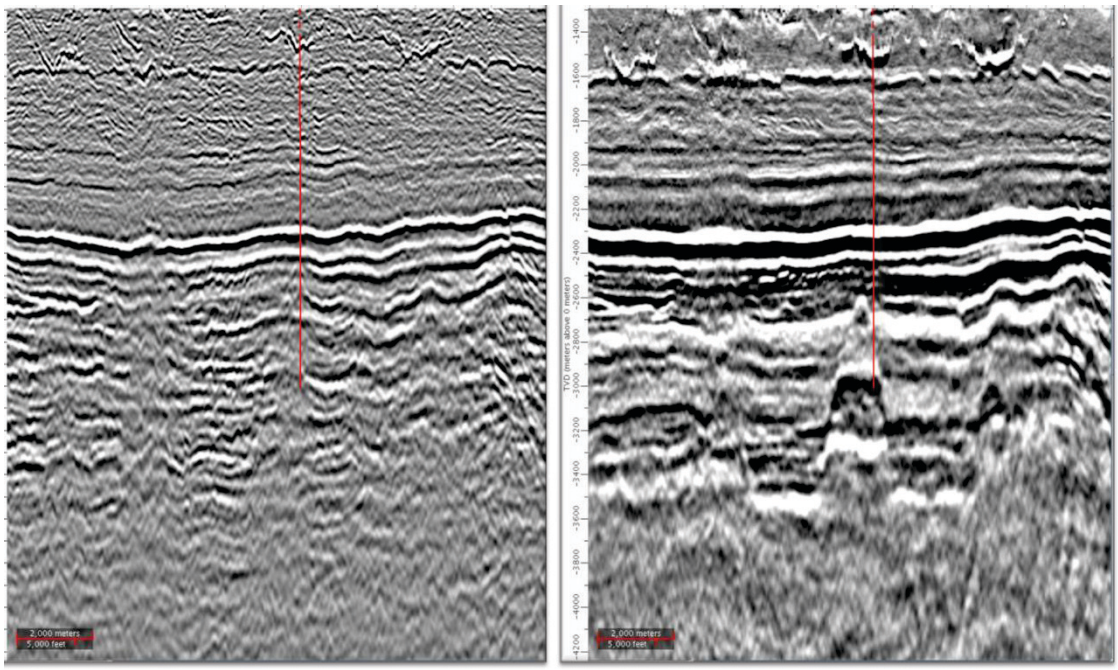

Figure 2 *Example of seismic sections from the Oseberg Sør C-Structure showing the difference between conventional streamer seismic (left) and OBC. (Figure adapted from Dangerfield et al. (2012).)*

R&D Challenges

The recent interest in broadband seismology has triggered more research and investigations focusing on methods aimed at enhancing the low frequency output from seismic sources (see e.g., Landrø and Amundsen, 2014, who discuss the possibility of ultra-low frequency signals being generated by large air guns). The broadband methods have also created a number of data processing challenges, where key issues are deghosting (see Amundsen et al., 2014), the source designature and handling of the challenges associated with the low frequencies in the broadband data. Finally, research is needed on how to better extract, utilizing broadband seismic, quantitative information about rock properties, along with information about the fluid content of potential reservoirs.

References

Amundsen, L., Robertsson, J., and Pedersen, Ø [2014] Wave equation processing and imaging of marine multicomponent data beyond traditional RTM: EAGE, submitted.
Dangerfield, J., Daniels, J., Sese, H., Alvheim, S., Mathewson, J., and Evans, D. [2012] Rejuvenating Understanding of Structure and Sand Distribution in a Difficult and Declining North Sea Area: EAGE, Z019.
Landrø, M., and Amundsen, L. [2014] A mechanism for generating ultra-low frequencies from air guns: EAGE, submitted.
Sundvor, E., Spjuth, C., McFadzean, P., Østmo, S., Amundsen, L. [2014] Broadband seismic – an acquisition solution for the Mariner field? The Biennial Geophysical Seminar, Kristiansand.