Filling the Information Gap with Broadband Seismic

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Introduction

In the past years, numerous efforts have been made to increase the bandwidth of seismic data, both for the low and the high frequencies. Seismic data has gained two octaves in the low frequencies (from 10 Hz down to 2.5 Hz) and more than one octave in the high frequencies (from 80 Hz to 160 Hz and up to 200 Hz). This has the potential to fill the information gap described by Claerbout (1985). The aim of this paper is to discuss this gap and present two real data examples of variable-depth streamer acquisition where this goal has been achieved.

Background

Impedance seismic inversion is based on the relationship between reflectivity r and impedance I:

$$r = \frac{1}{2}(\log I)'$$

Conventional seismic data recovers the reflectivity r above 10 Hz and can estimate the impedance $I=\rho v$ below 2 Hz from the seismic interval velocity v and empirical laws giving the density ρ from v, thus leaving a 2 Hz -10 Hz gap which has to be filled in seismic inversion by the impedance log of wells, making the result less reliable between wells. Broadband seismic can recover reflectivity down to 2.5 Hz and the velocity can be recovered up to about 6 Hz (both from the increased maximum frequency of the data and from more precise velocity estimation). So, in theory, the gap is filled with broadband seismic.

Data examples

A variable-depth streamer acquisition was acquired offshore West Africa and acoustic inversion was performed with the low frequency impedance model computed from the interval velocity model derived from r.m.s. velocities. The impedance well log was used only for QC purpose. Another survey was acquired offshore West Australia and elastic inversion was performed similarly, with a litho-classification computed from the impedance and Poisson ration, the result in Figure 1 showing a good mapping of the gas sands between the wells.

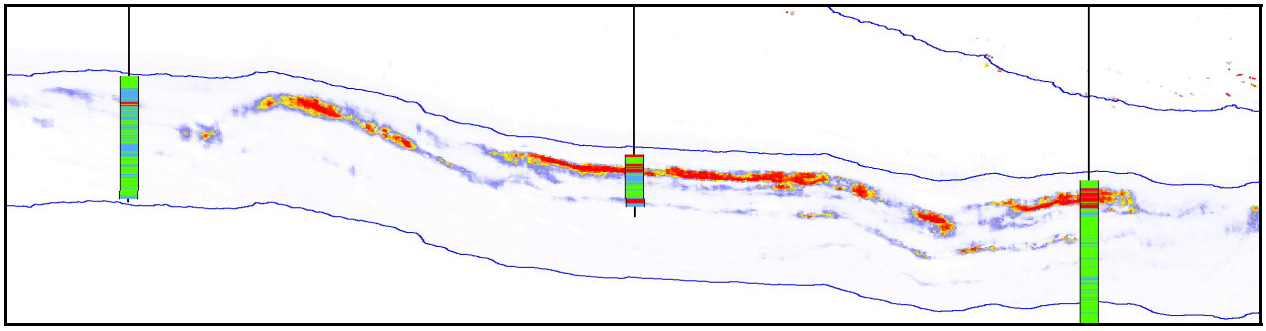

Figure 1 *Gas sand probability (white 0%, red 100%) obtained from impedance and Poisson ratio attributes inverted from seismic and a training dataset consisting of the logs at the three wells.*

References

Claerbout, J.F. [1985] *Imaging the earth's interior*. Blackwell Science Ltd.