

Application of Ultraseis 3D Seismic to Deep Gold Mine survey

Target

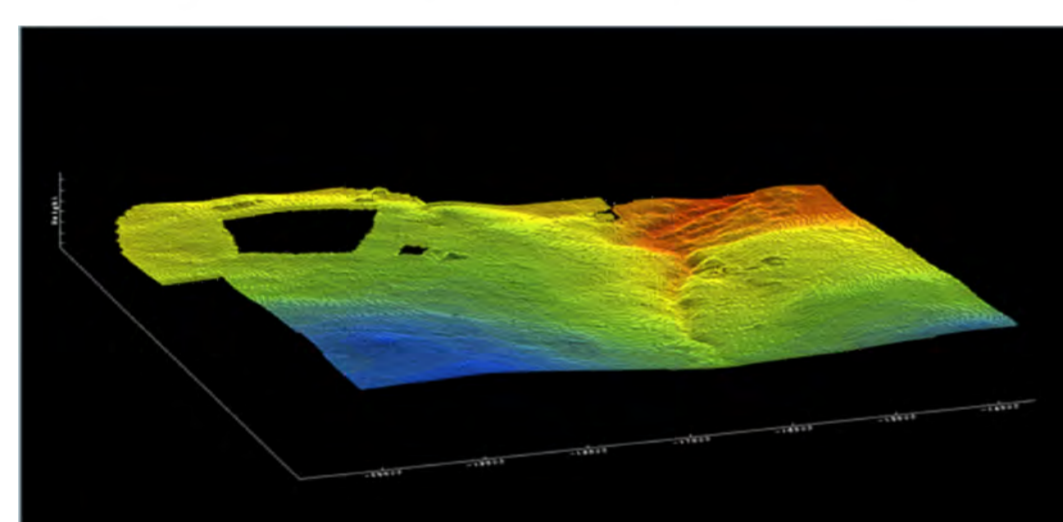
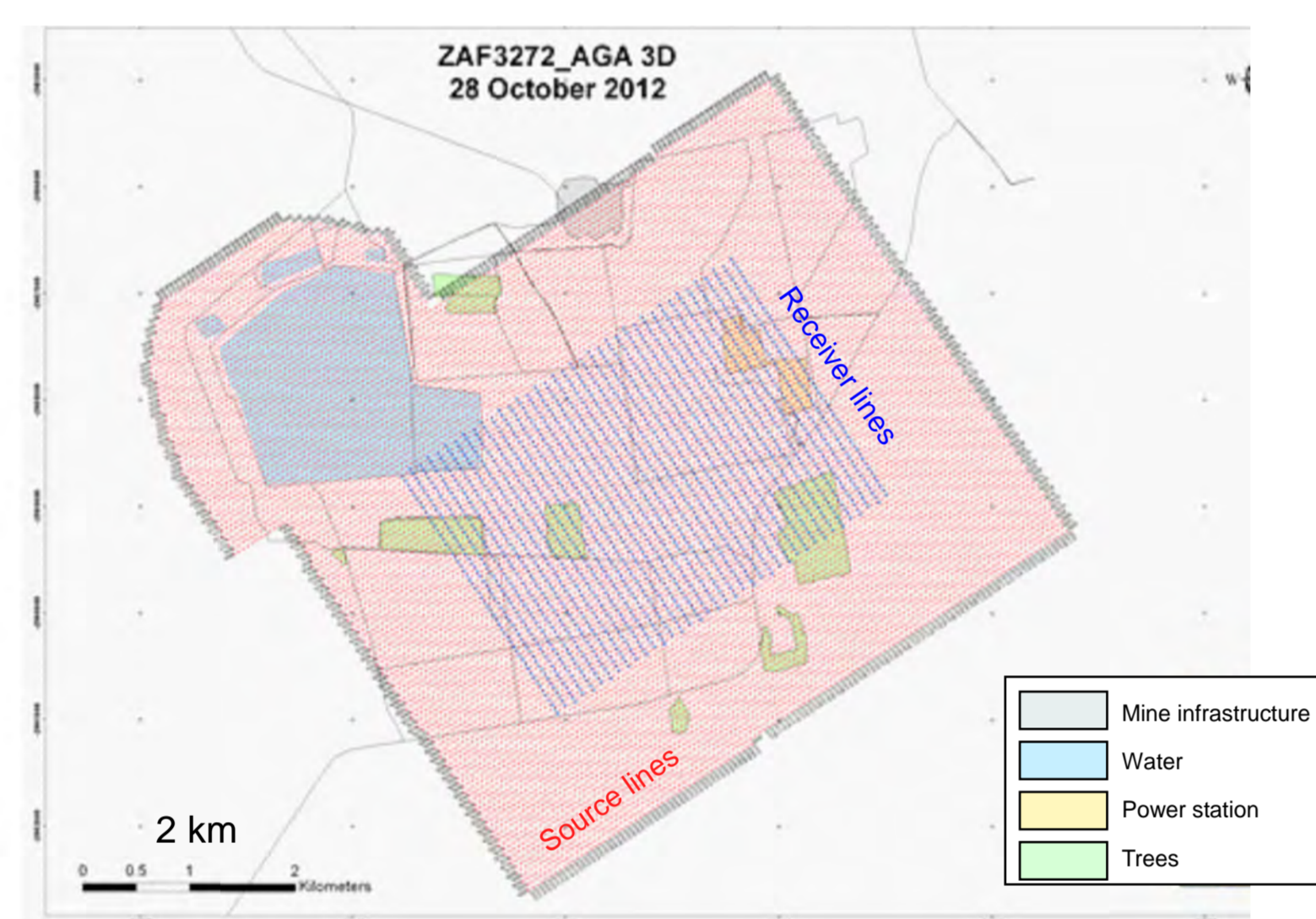
● In order to test the most advanced seismic acquisition and processing techniques, AngloGold Ashanti has required a new 35 km² 3D patch in Zaaiploats. The prospect is located near Orkney in the North West province of South Africa, 170 km SW of Johannesburg where a previous conventional 3D survey took place in 1996.

Acquisition challenges

In the prospect area, the main challenges for seismic acquisition are farmlands, grassland, slimes dam, Moab mine infrastructures, power lines and dense blue gum trees.

The slimes dam is located to the North-West of the prospect, 1038 VPs & 33 RP's have been cancelled inside and extra VP's were added around the slimes dam. Just above the slimes dam are three little lakes, VP's inside are also cancelled. To the North East of the slimes dam is a mine, VP's inside are cancelled. Compensating for RPs lost inside the slime dam would have been difficult due to small spacing of both lines and points.

RP's were laid out inside the dense blue gum trees but VP's inside the trees were cancelled as the vibrator truck would not move inside the trees.



The topography was relatively flat and vehicle access was quite easy due to the large amount of roads within the prospect area made to service the farms and mines.

Parameters comparison

As compared to 1996 parameters, the new set is based on an Ultraseis high fold design with a much denser grid of source and receiver points and a S4 (single source single sensor) approach combined with a broadband EmphaSeis™ sweep of 5.5 octaves bandwidth.

	Reference 1996	Broadband 2012
Receiver Lines Number	8	38
Total live channels	480	2052
Bin size (m ²)	25x25	12,5x12,5
Receiver Line Interval	300m	100m
Source Line Interval	300m	50m
Aspect Ratio	0.8	1
Maximum offset(m)	1846	4595
Fold	20	>300 at 3km
Million traces per Km ²	0.032	1,92
Sweep	10-90 Hz	3-160 Hz

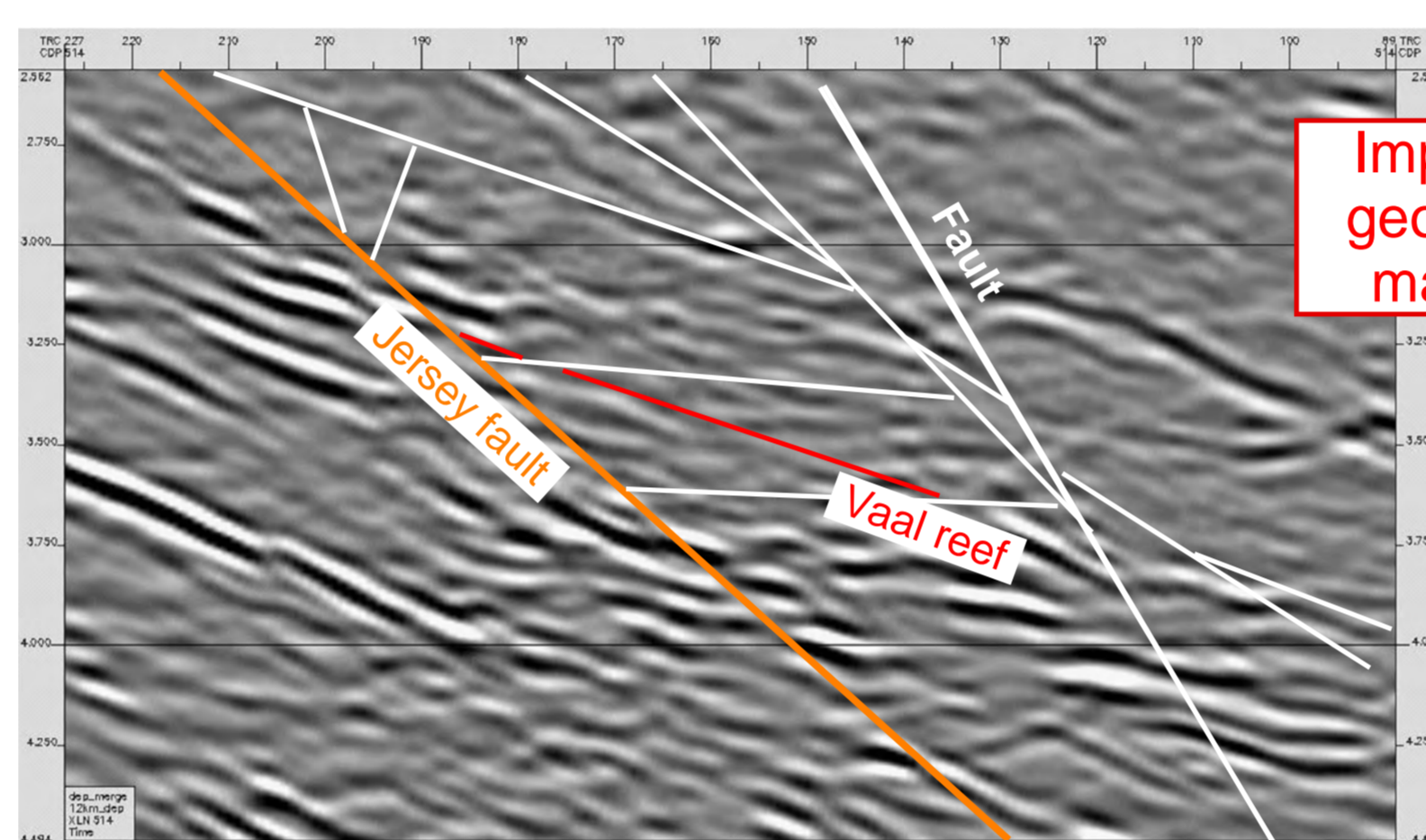
Aims

● The target for the exploration was the **Vaal Reef**, dipping towards SW with depth ranging from 2.7 to 3.2km. The aim was to image the formations below and above the Vaal Reef as the target itself does not have much seismic reflectivity. Any faults in the area that might offset the formations were of interest as well. Above the Vaal Reef are the Black Reef and the Ventersdorp groups whereas the West Rand group with a strong seismic characteristic and uniform dip is underneath the Vaal Reef.

● A previous 3D survey was recorded in 1996 with light parameters. The aim of this new survey is to validate a dense acquisition program with enhanced band pass

● This established a cost effective acquisition sampling scenario

1996 3D seismic interpretation

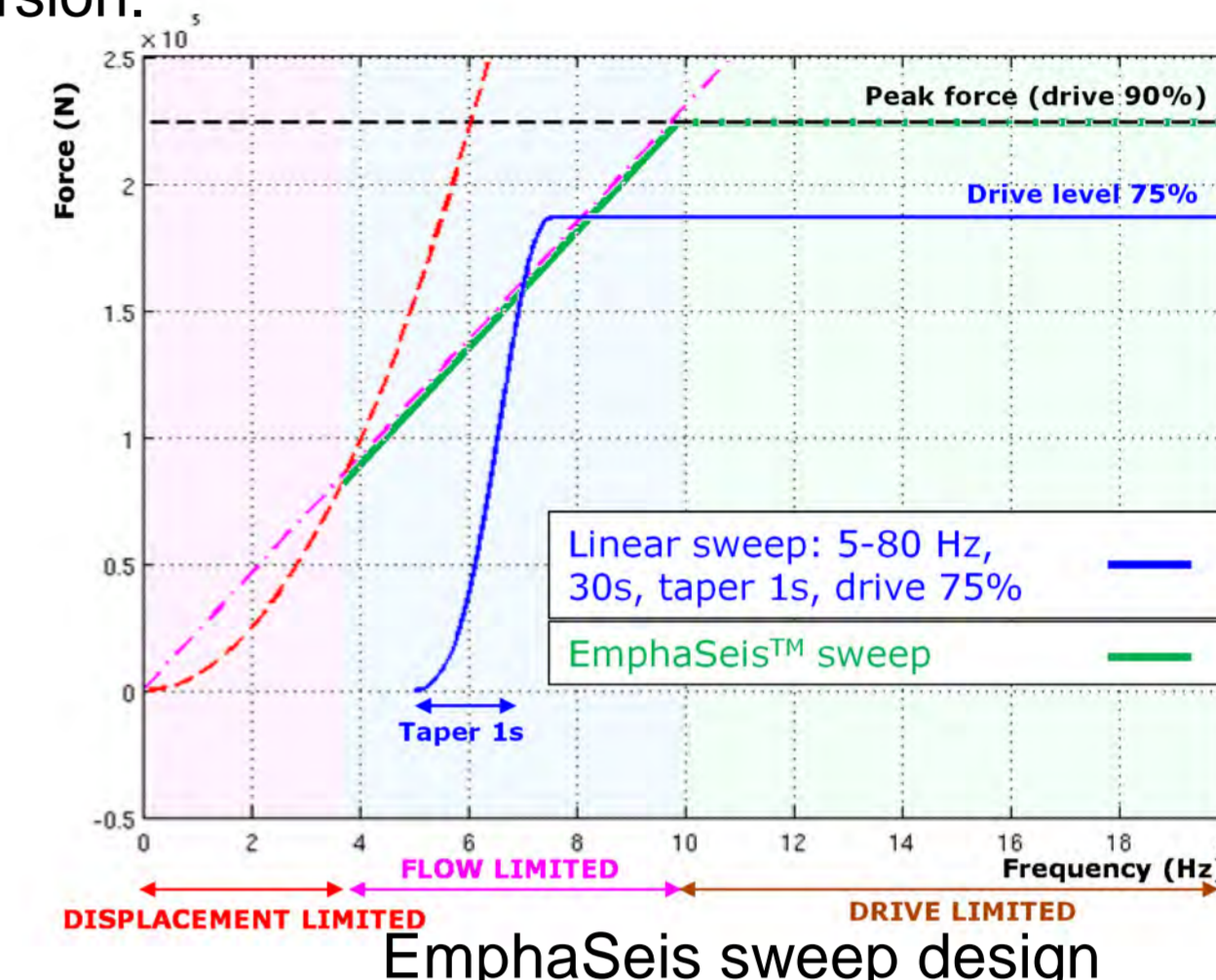


Interpretation from 1996 survey.

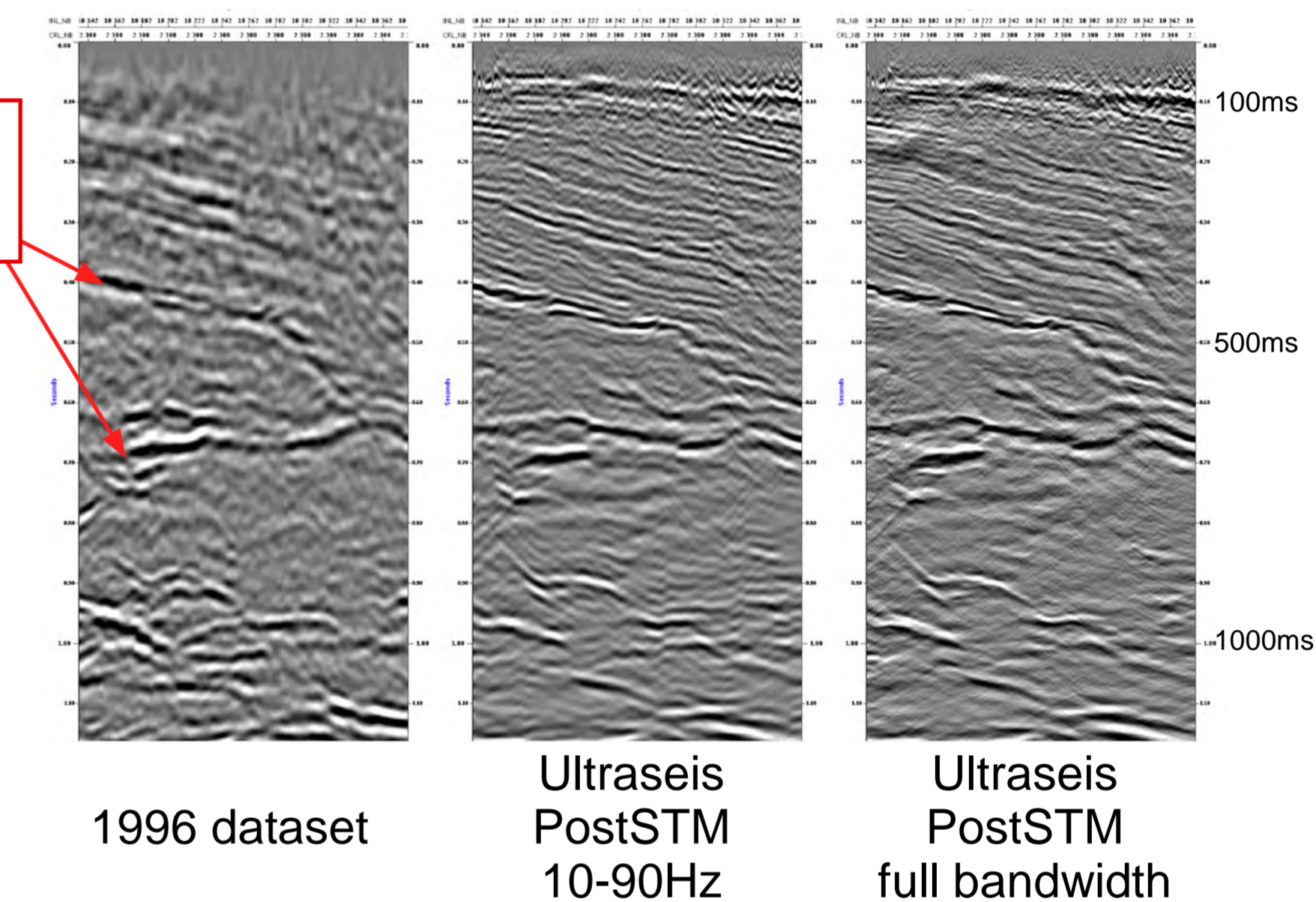
Broadband source

The importance of low frequencies is well-acknowledged by interpreters. Low frequencies allow faster interpretation that is mainly data-driven, i.e., with limited manual intervention. Images appear more continuous and reveal numerous stratigraphic details.

The vertical resolution of the seismic wavelet is proportional to the number of emitted octaves. For a given maximum frequency, the addition of low frequencies allows us to reduce the seismic wavelet side lobes to the benefit of the inversion.



Results comparison



Conclusion

The expectations from dense acquisition are confirmed by an outstanding imaging quality for all depth levels, simultaneously for ultra-shallow and ultra-deep targets. This in turn leads to significantly improved depth velocity models for a simultaneous optimal focalization and positioning of the seismic reflections.

The broadband source achieves remarkable seismic wavelet compression with a sharp main lobe and minimum side lobes. This leads to a textured image with unprecedented stratigraphic details available for the interpretation.

Land broadband can be seen as a mirror solution of marine broadband, a technique based on three axes: equipment, acquisition design, and processing software. The acquisition geometry and vibroseis signal must follow specific rules; the equipment is designed to handle a very dense and broadband datasets.

