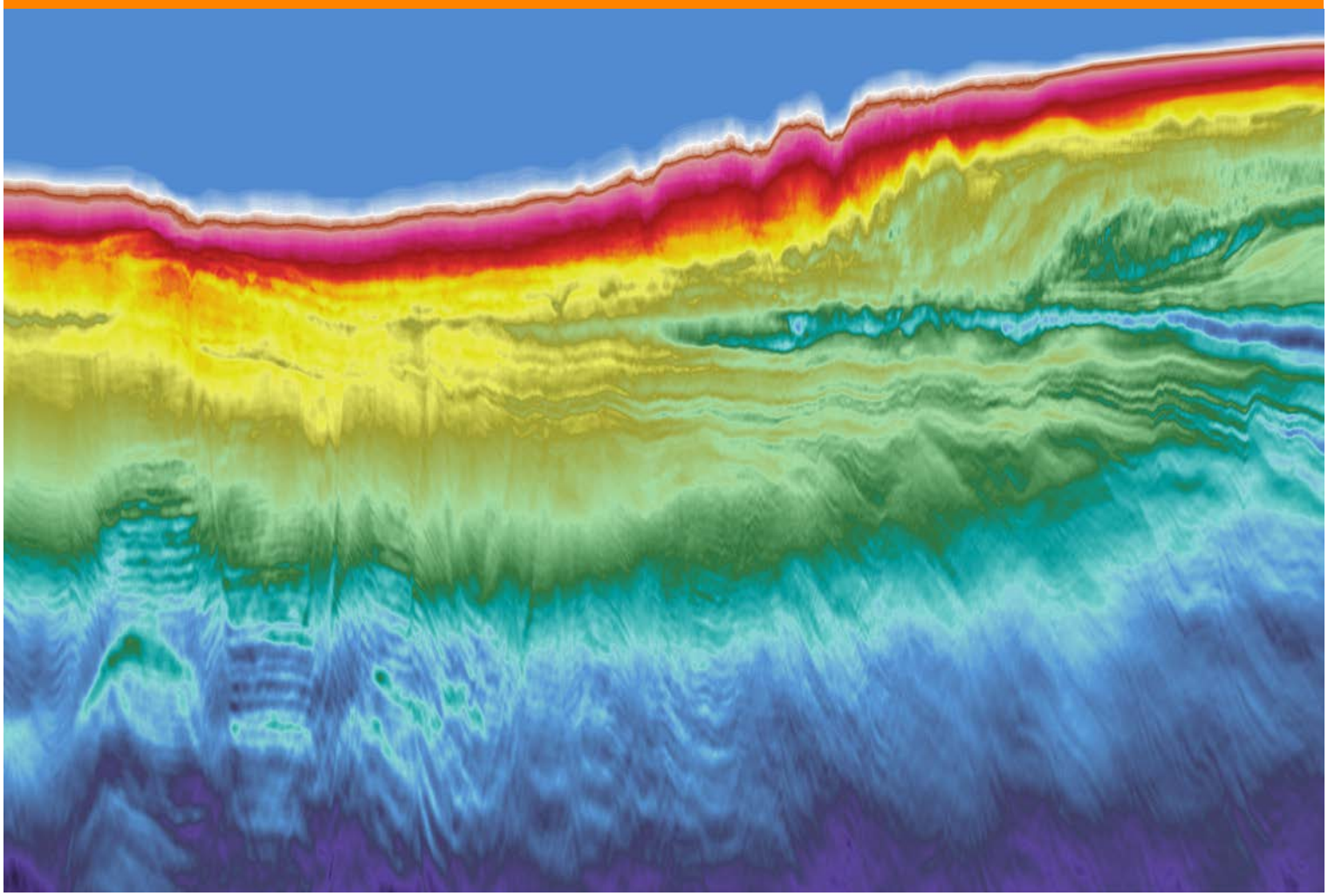
FULL WAVEFORM INVERSION (FWI)



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HIGH FREQUENCY FWI UTILISES THE ENTIRE SEISMIC WAVEFIELD TO GENERATE REFINED, HIGH-RESOLUTION VELOCITY MODELS FOR IMAGING AND CHARACTERISATION

At a high level, what FWI tries to do is actually quite simple. It iteratively updates an initial model by forward modelling synthetics and comparing them to field data.

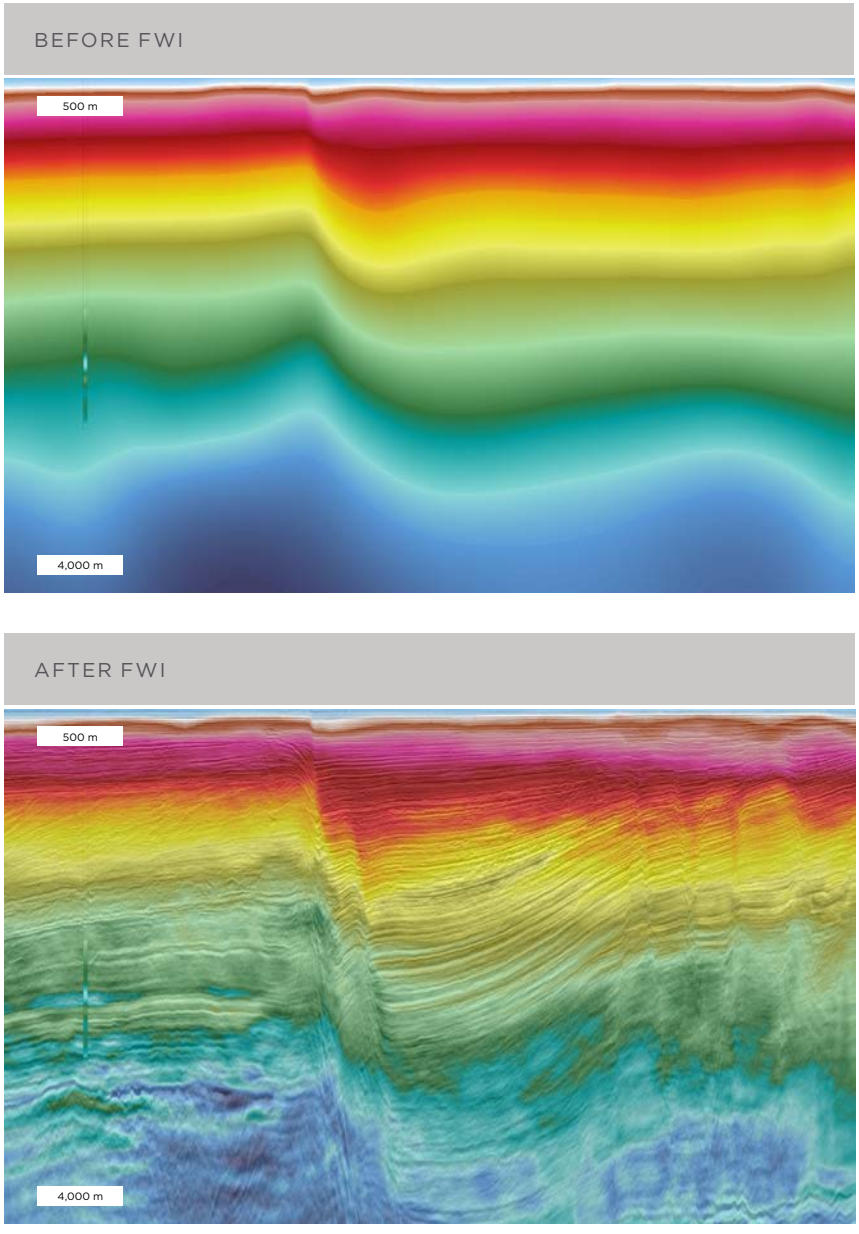
Advances in supercomputing make wave equation-based inversions like Reverse Time Migration and Full Waveform Inversion a lot more practical. As the name suggests, Full Waveform Inversion, or FWI, inverts for a high-resolution earth model (typically velocity), using the entire seismic wavefield. Just as the physics of wave propagation is non-linear, FWI is a highly non-linear parameter estimation problem.

In order to generate synthetics, we have to reproduce the seismic experiment that we carried out in the field.

This requires knowledge of the source wavelet, the acquisition geometry, and the physics of 3D wave propagation.

The objective function is then straight forward. We want to optimise our earth model parameters, such as the P-wave velocity, to minimise the difference between the synthetics and the field data.

Our FWI implementation can be used in 2D or 3D and can handle isotropy, VTI or TTI.



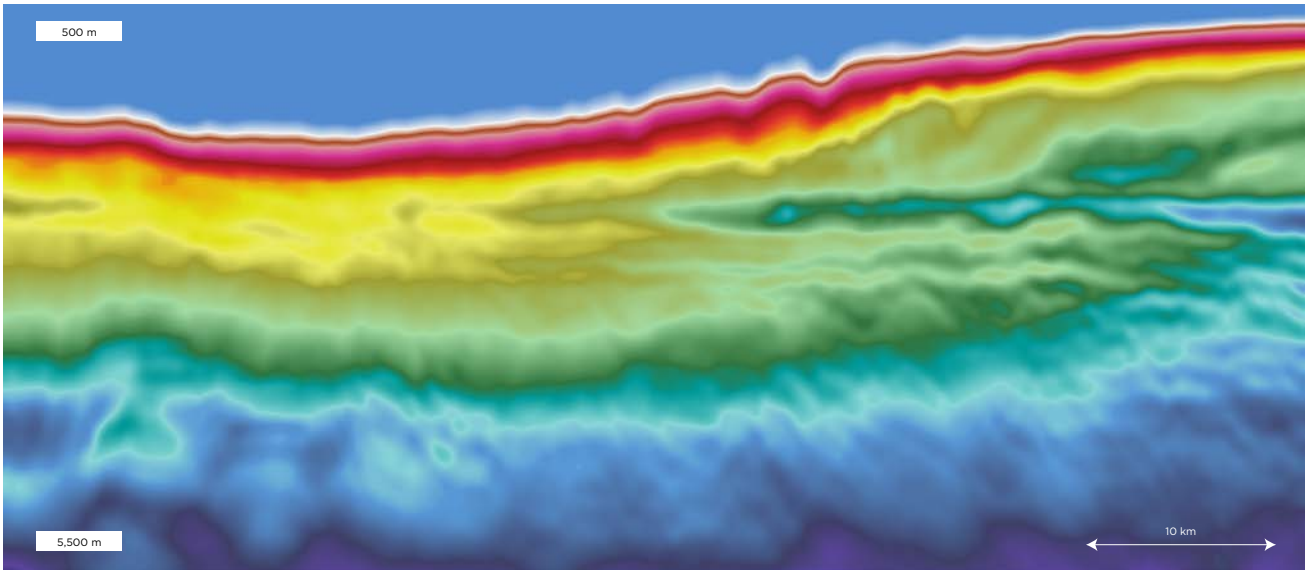
01. Smooth starting velocity model prior to FWI (top) and after FWI, co-rendered with the seismic data in the background (bottom). Note that the stratigraphic and structural details in the FWI velocity model are consistent with the seismic data. Data courtesy of Shell NZ.

High frequency FWI generates high-resolution models for interpretation and characterisation.

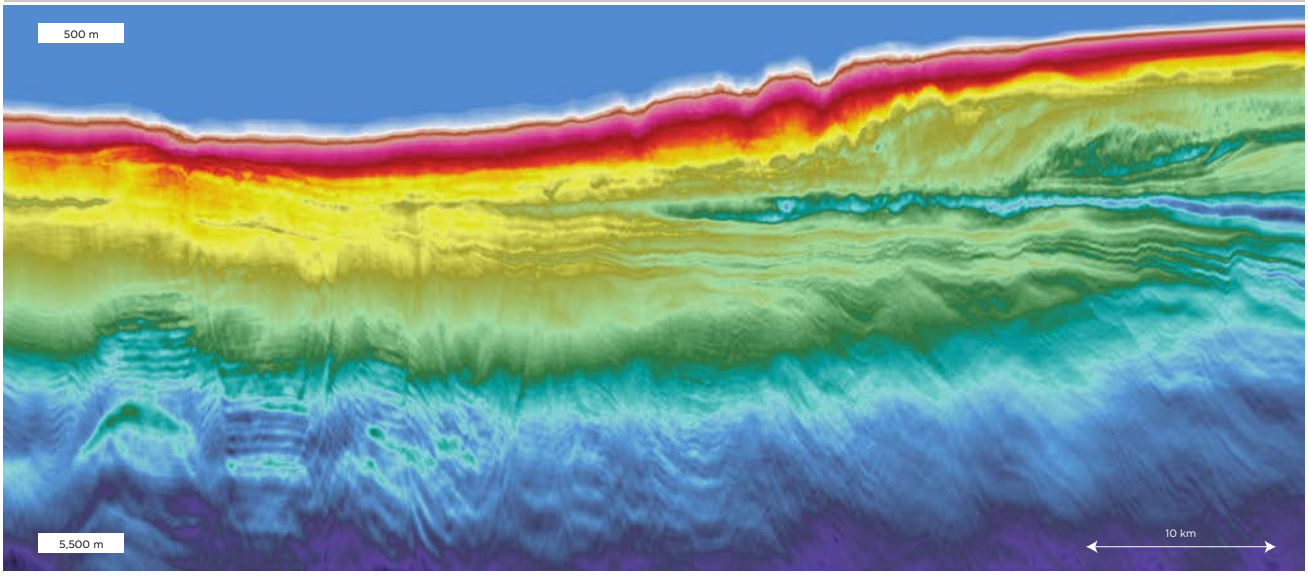
At high frequency the benefits of FWI extend beyond imaging towards interpretation and characterisation. As can be seen in the figures below detailed structural and stratigraphic details are resolved in the FWI model.

DUG boasts some of the largest supercomputers in the world with high-tech data centres in Perth, Houston, London, and Kuala Lumpur. We have our own dielectric fluid-cooling solution which has greatly reduced our energy usage, increased the life and efficiency of our hardware, and given us some of the greenest compute centres on the planet. This is a key factor which enables us to deliver cutting-edge imaging technologies such as high-frequency FWI.

CONVENTIONAL LOW FREQUENCY FWI MODEL



HIGH FREQUENCY FWI MODEL



02. Conventional low frequency FWI model (top) and high frequency FWI model (bottom). Note the increasingly sharp stratigraphic and structural details in the high frequency model. Capreolus 3D data courtesy of TGS.

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