The past, present, and future of FWI at Woodside

Henry A. Debens[1]
[1] *Woodside Energy Ltd*
henry.debens@woodside.com.au
ORCID: orcid.org/0000-0002-2751-0196

Full-waveform inversion (FWI) is a deterministic data-fitting procedure that seeks to generate high-resolution high-fidelity models of subsurface properties from pre-stack seismic data. Despite the numerical complexity and computational burden associated with FWI, since its original formulation by Lailly (1983) and Tarantola (1984), FWI has matured from the realm of academia to become a staple of seismic processing workflows in both exploration and exploitation settings.

For all its promise, however, the majority of FWI application across the oil and gas industry to-date has been to improve the shallow overburden in acoustic velocity models, with the aim of generating an improved image following migration. Principally, this is because FWI's original formulation – referred to here as classical FWI – is reliant on wide-angle forward-scattered measurements for generating long-wavelength kinematic updates to the macro-model. This has meant, in turn, that the success of classical FWI has been constrained strongly by acquisition geometry and geologic environment. This is not to say that, under the right circumstances, classical FWI cannot have a significant impact on business outcomes – with the change in volumetrics at the Atlantis and Scarborough fields being two of the most prominent public examples.

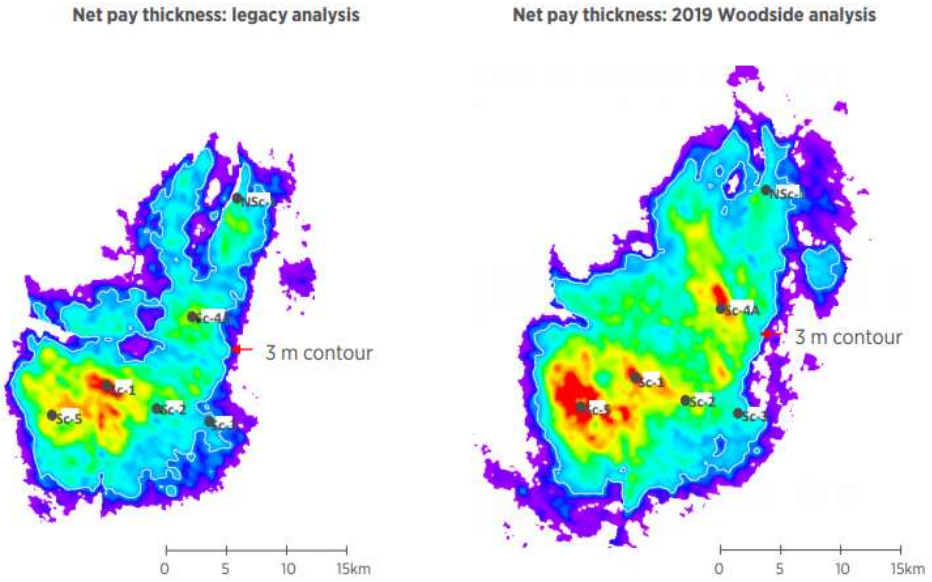

Figure 1. Change in recoverable resource (2C) at the Scarborough field following a systematic re-evaluation of the complete subsurface dataset (Woodside Energy, 2019). A key element in the re-evaluation process was the use of high-frequency FWI.

This presentation will explore the role that FWI has had at Woodside, focussing on some of the ways in which FWI technology has impacted the business (Fig. 1) and some of the ways that Woodside are working to evolve FWI such that it can fulfil its early promise. The presentation will cover aspects of algorithm design, data acquisition, and software deployment, while considering how these can be taken advantage of to get more-accurate images into the hands of interpreters sooner after acquisition.

Acknowledgement
The author would like to thank Woodside for permission to present this work.
References
Lailly, P., 1983, The seismic inverse problem as a sequence of before stack migration: Conference on Inverse Scattering, Theory and Application, SIAM, Expanded Abstracts, 206-220.
Tarantola, A., 1984, Inversion of seismic reflection data in the acoustic approximation: Geophysics, 49, 1259-1266.
Woodside Energy, 2019, Investor Briefing Day 2019, https://www.woodside.com.au/news-and-media/stories/story/annual-investor-briefing-day, accessed 8 January 2020.