

# **The Evolution and Deployment of Land FWI in PDO: Background/History (2010-2023), Accelerated Delivery, Challenges, Latest Preferred Workflow, Highlighting the Need for eFWI and the Shift to FWI-Imaging and QIFWI**

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## **Abstract**

Although Full Waveform Inversion (FWI) has its own inherent challenges when deployed on onshore data due to the dramatic impact of surface and near surface effects, PDO has made tremendous efforts in this front. Throughout the past decade, PDO processing team and its partners has leveraged and matured resilient FWI workflows in north and south Oman despite different challenges. Historically, various trials and tests were run to test diving waves-based inversions and reflection waves in acoustic and elastic modes.

These efforts have resulted in FWI becoming a key enabler to reduce projects turnaround time and produce more sensible and accurate subsurface velocity models. This is why FWI is now being standardized in our project's workflow as the first step to build an accurate initial velocity model for the subsequent travel time tomographic updates. In this paper, we will showcase a number of successful trails of using different FWI workflows on various type of land surveys across the PDO concession that had seen different challenges.

In the first case study, we will share results of using phase-only based and time-shift based FWI inversions to address subsurface sinkholes that have been known to cause serious drilling hazards and imaging distortions in north Oman. The implementation of the kinematic FWI and phase-only reflection based FWI workflows contributed to resolving imaging complexities around the sinkholes, hence positively impacted the seismic imaging and operations around the oil field area where the project was executed.

In the second case study, we will demonstrate how the team has overcome one of the key FWI fundamental requirements; low frequencies. The case example is from a relatively old survey that was acquired with a sweep starting from 6HZ. In this project, good velocity model building was enabled through the deployment of phase- only wave inversion FWI. The excellent imaging uplift resulting from the velocity model building workflow led to better understanding of the geology around a very complex fault system. In addition to that, this success paved the way for the team to replicate the flow in other areas with similar challenges and limitations resulting again in more success.

We will also present similar case studies, where advanced FWI technologies helped to improve the image under complex overburden and improved salt imaging for different geological settings.

In the end we would like to acknowledge the fact that despite all of these recent successes, FWI in land data remains a challenge especially in some circumstances and different geological settings (especially when the elastic effects are way too large to address), which often not only require careful pre-conditioning and good starting model but also the deployment of more compute Hungary elastic-FWI workflows. The later, together with FWI-Imaging and QI-FWI are workflows that the PDO processing team are currently working on to test and advance with the aim of stabilizing them towards more production mode deployment.