

# Derisking exploration through an integrated interpretation workflow from legacy seismic to reliable AVO: Lessons from West African basins

Felicia Winter<sup>1\*</sup>, Thomas Hansen<sup>1</sup>, Roberto Ruiz<sup>1</sup> and Jon Rogers<sup>1</sup> examines how integrated and iterative workflows combining modern reprocessing, rigorous AVO quality control, rock physics analysis, and seismic attribute screening can be used to assess whether amplitude fidelity improvements are both real and fit for purpose.

## Abstract

Reprocessing legacy 3D seismic data with modern broadband imaging workflows has become a powerful tool for improving structural resolution and amplitude fidelity in frontier and mature basins alike. However, enhanced seismic detail does not automatically translate into improved exploration decisions, particularly when evaluating amplitude versus offset (AVO) and amplitude versus angle (AVA) responses calibrated to borehole data. This article examines how integrated and iterative workflows combining modern reprocessing, rigorous AVO quality control, rock physics analysis, and seismic attribute screening can be used to assess whether amplitude fidelity improvements are both real and fit for purpose.

Using case studies from offshore the Republic of Ghana, the Republic of Guinea, Sierra Leone, and Côte d'Ivoire, we demonstrate how modern broadband reprocessing, including deghosting and full waveform inversion, stabilises pre-stack seismic responses and improves well to seismic ties. We show that higher fidelity data often reveal geological complexity previously unresolved in legacy volumes, providing robust calibration using rock-physics-based AVO modelling, and that relative elastic impedance attributes enable confident discrimination between lithological and fluid-related anomalies. The results highlight that improved imaging shifts exploration uncertainty away from data quality and toward genuine geological risk, enabling more reliable AVO-driven prospect evaluation across regional seismic datasets.

## Introduction

Advances in seismic processing over the past decade have fundamentally changed the value of legacy marine seismic datasets. Modern workflows incorporating full deghosting, advanced demultiple techniques and the growing suite of Full Waveform Inversion (FWI) techniques deliver seismic volumes with improved resolution, enhanced low and high frequency content and more stable amplitude behaviour across offset and angle (Araman and Paternoster, 2014; Wei et al., 2023). These

developments are particularly significant in deepwater settings, where historical acquisition geometries, streamer depths and processing limitations often compromised AVO compliance and quantitative interpretation (QI) (Rutherford and Williams, 1989; Simm and Bacon, 2014).

As a result, there is a growing expectation within exploration teams that reprocessed seismic data automatically leads to improved AVO reliability and reduced exploration risk. In practice, however, enhanced imaging and amplitude fidelity do not guarantee clearer interpretation. Revisiting exploration wells using modern reprocessing often reveals geological complexity that was previously unresolved in legacy datasets. This is valid for successful exploration wells and for dry wells, whilst for the former, situations of full basin reimaging is less often the case and, hence, this may be less apparent until further tests or developments are conducted. When seismic attributes begin to approach the level of variability observed in borehole measurements, amplitude-based interpretation can become more ambiguous rather than more straightforward.

A fundamental challenge, therefore, remains: how to distinguish genuine fluid-related amplitude responses from lithology and pore space-driven effects once data quality is no longer the dominant source of uncertainty? Without rigorous calibration, improved seismic amplitudes may simply provide a more detailed pore space-related view of subsurface variability. Whilst high resolution and high-fidelity seismic attribute analysis will be more reliable and confident regarding mapping anomalies, without calibration of these anomalies against background and brine trends or the absolute rock physics calibration at the reservoir from borehole data, ambiguity is still an inherent part of their interpretation as being fluid-related. The interpretation of such high-fidelity datasets becomes more precise, whereas the accuracy of any conclusions may have become more ambiguous and requires more context. This risk is particularly acute in settings affected by cementation, calcification or volcanic influence, where elastic contrasts between brine and hydrocarbon-filled reservoirs can be significantly reduced by calibration.

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This paper addresses the above-mentioned challenge by demonstrating that improvements in seismic imaging must be accompanied by equally robust AVO quality control to be fit for purpose for exploration decision making, along with any rock physics calibration having been improved, still being required for absolute conclusions from any interpretation. We present an integrated and iterative workflow that combines modern broadband reprocessing, systematic AVO QC, rock-physics-based AVO modelling at well locations, and impedance domain seismic attribute screening at the survey and prospect scale. Rather than treating processing, calibration and interpretation as sequential steps, the workflow emphasises continuous feedback between these elements.

Using case studies from offshore the Republic of Ghana, the Republic of Guinea, Sierra Leone and Cote d'Ivoire, spanning both mature and frontier exploration settings, we show that modern reprocessing workflows consistently stabilise pre-stack seismic amplitudes and improve well to seismic ties. However, once amplitude fidelity is assured, the dominant source of uncertainty shifts from data quality to genuine geological and rock physics variability. Through calibrated AVO analysis and relative elastic impedance attributes, we demonstrate how this complexity can be understood and leveraged, enabling more reliable discrimination between lithological and fluid-related anomalies and supporting confident, AVO-driven prospect evaluation across vast coverage seismic datasets.

### Methodology: Integrated AVO and imaging workflows

The methodology applied in this study integrates four complementary elements: (1) rock-physics-driven AVO analysis at well locations, (2), modern broadband reprocessing, (3) with systematic AVO QC, and (4) seismic attribute screening using relative elastic reflectivity and impedance techniques. These elements are applied iteratively rather than sequentially, allowing insights gained at each stage to inform both processing and interpretation decisions. Figure 1 shows a schematic of such an integrated interpretation workflow.

#### Rock-physics-based AVO analysis at wells

Rock-physics-driven AVO analysis begins with detailed conditioning and quality control of well log data, including compressional and shear velocities, density and petrophysical interpretations. Borehole and acquisition conditions corrections

and log editing are performed prior to integrating available core, cuttings and mineralogical information. This step is essential, as AVO responses are highly sensitive to subtle variations in elastic properties and pore space characteristics (Avseth et al., 2010; Simm and Bacon, 2014).

Petrophysical models are constructed to estimate mineral volumes, porosity and fluid saturation, which are then translated into calibrated rock physics models. These models allow elastic properties to be perturbed systematically, enabling the simulation of geological scenarios and the evaluation of their impact on AVO response. Forward modelling of brine, oil and gas cases provides critical insight into the expected separation of fluid effects from lithological variations in intercept-gradient space for the presented reservoir properties (Rutherford and Williams, 1989; Went, 2021).

This approach highlights situations where nonfluid effects, such as cementation, calcification or volcanic influence, significantly reduce  $V_p/V_s$  contrast and narrow the separation between brine and hydrocarbon responses. Seismic AVO anomalies in these settings can be ambiguous and to avoid misinterpretation, such calibration provides awareness of these special cases.

#### Broadband reprocessing and full waveform inversion

Broadband signal recovery is a prime objective of modern seismic reprocessing, as improved bandwidth directly impacts both vertical resolution and amplitude stability across offset and angle. Deghosting removes spectral notches caused by interference between primary and ghost reflections at the source and receiver, enabling recovery of both low and high frequency energy (Rickett et al., 2014). This broader effective bandwidth improves wavelet stability and enhances the interpretability of amplitude versus offset behaviour, particularly at higher angles where legacy data often suffer from bandwidth loss and phase instability.

Equally critical to amplitude fidelity is the treatment of multiple energy. Surface-related and interbed multiples can interfere constructively or destructively with primary reflections, leading to artificial amplitude dimming, brightening or apparent AVO effects that are unrelated to lithology or fluid content. In the context of AVO and AVA analysis, incomplete multiple attenuation is particularly problematic, as residual multiple energy tends to increase with offset and can bias intercept-gradient relationships. Modern demultiple workflows, including high-resolution radon-based techniques, convolutional and wave-equation multiple modelling approaches, are therefore applied prior to imaging to ensure that amplitude variations observed in prestack data are dominated by primary reflections. The effectiveness of demultiple is assessed as part of the AVO quality control workflow through near, mid and far angle spectral consistency, near-far correlation analysis and inspection of amplitude decay with offset. By reducing multiple contamination prior to migration, demultiple processing contributes directly to improved AVO stability and more reliable calibration between seismic and well-based AVO models.

FWI further enhances amplitude fidelity by improving the subsurface velocity model using the full recorded wavefield. Compared to conventional tomography, FWI provides a more

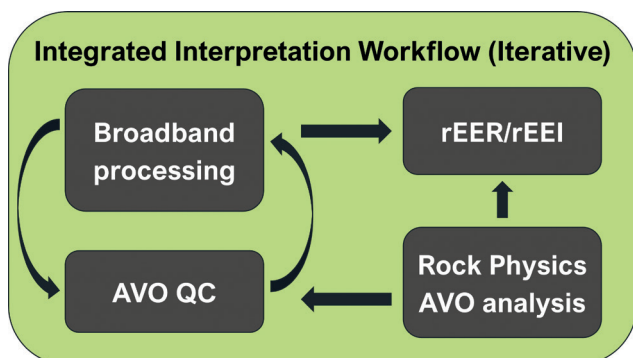
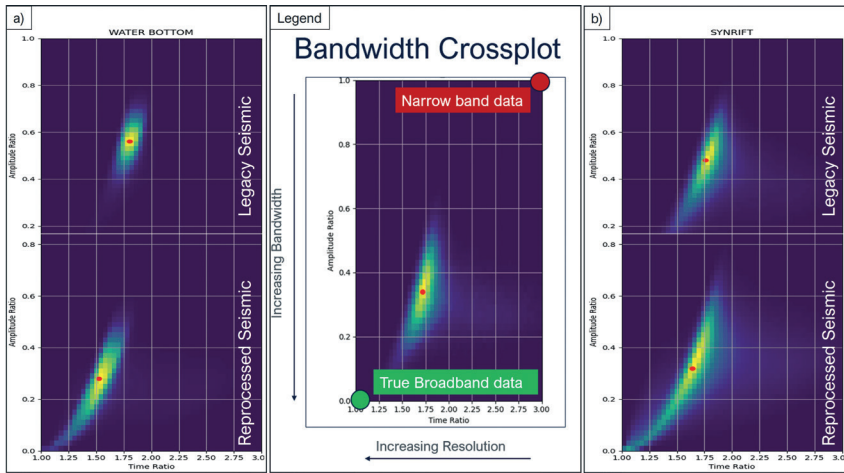


Figure 1 Schematic representation of the integrated interpretation workflow.



**Figure 2** Bandwidth crossplot example of deghosted and FWI reprocessed data bandwidth recovery by comparing to the legacy 3D full-stack offshore Sierra Leone. The uplift is demonstrated at different stratigraphic levels, such as seabed (a) and top synrift (b).

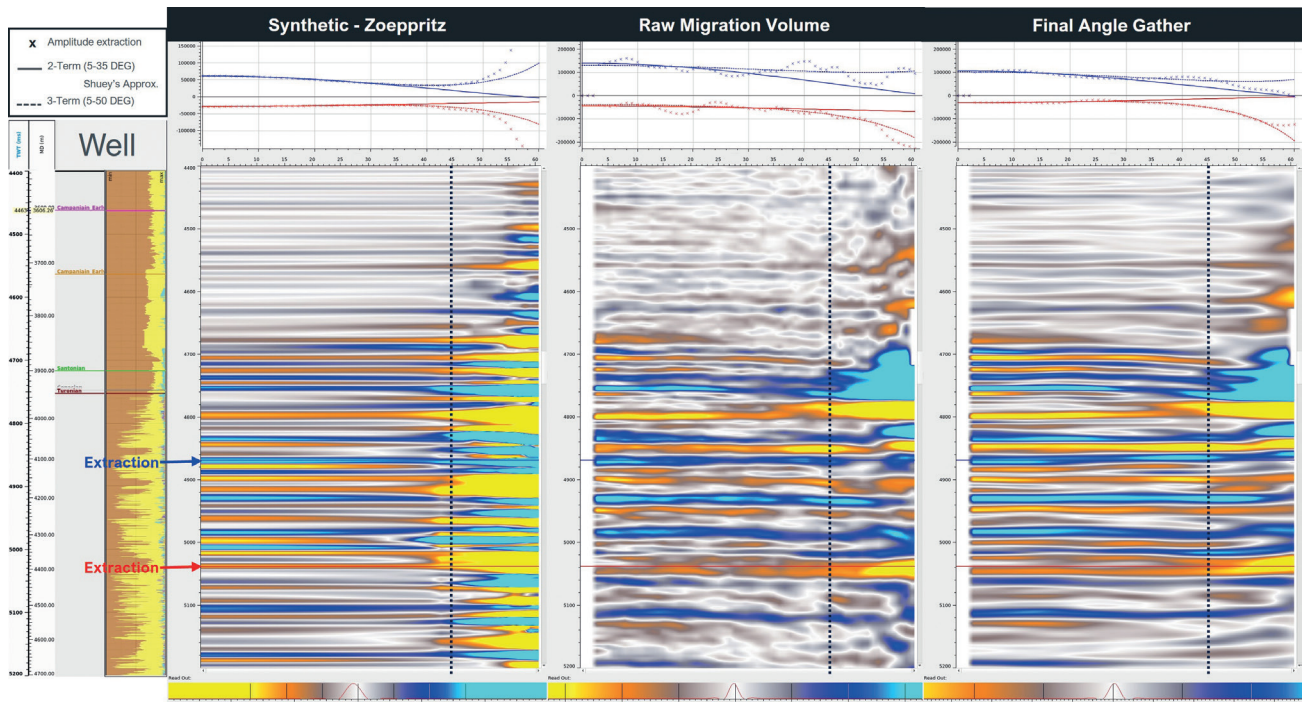
accurate description of lateral and vertical velocity variations, resulting in improved imaging, better event focusing and more consistent amplitude behaviour across offsets (Sirgue et al., 2011; Warner et al., 2013; Wei et al., 2023).

The combined application of demultiple, deghosting and FWI produces seismic gathers with stabilised moveout and phase, forming a robust foundation for subsequent AVO analysis and impedance domain attribute generation. The resulting improvement in amplitude consistency is observed not only at well locations but across the entire survey, supporting reliable screening for AVO anomalies. The impact of broadband recovery is illustrated by bandwidth cross-plots and spectral comparisons at key stratigraphic levels, which demonstrate significant uplift relative to legacy processed data in an example from offshore Sierra Leone (Figure 2).

*AVO quality control*

Systematic AVO QC is essential to demonstrate that amplitude fidelity improvements are real and robust. QC metrics include spectral analysis on near, mid and far stacks; instantaneous phase stability; near-far correlation and time shifts; signal-to-noise estimates; and bandwidth evaluation at multiple stratigraphic levels (Araman and Paternoster, 2014). When multiple legacy surveys are combined, these metrics provide quantitative indicators of how acquisition differences have been reconciled during reprocessing.

Additional QC steps include well-to-seismic tie analysis, amplitude decay studies, and stability testing of AVO responses through successive processing and velocity model building iterations. These QC measures are critical to demonstrating that the seismic dataset is fit for purpose for quantitative interpretation.



**Figure 3** AVO stability modelling at well location, which is done at all stages towards the end of the reprocessing production and velocity model-building workflow. The Zoepritz modelling is performed with a wavelet extracted from final gathers and highlights potential post-critical amplitudes coming in below 45 degrees, when comparing an early 'Raw Migration Volume' to 'Final Angle Gather'. Blue and Red Zoepritz curves are extracted at the marked levels of the well column (offshore Sierra Leone).

Figure 3 shows the AVO stability between the raw and final migrated volumes offshore Sierra Leone.

*Relative elastic reflectivity and impedance (rEER / rEEI)*

Direct comparison between forward-modelled AVO responses and pre-stack seismic data is often hindered by noise, imperfect wavelet estimation and residual moveout errors, particularly at far offsets. To mitigate these effects, reflectivity angle stacks are transformed into impedance domain using relative extended elastic reflectivity (rEER) and relative extended elastic impedance (rEEI) techniques (Went and Hedley, 2023; Harris and Young, 2024).

By inverting reflectivity into impedance using a flat background model, wavelet effects are minimised and stability is improved. This allows anomalies to be evaluated without reliance on low-frequency models derived from wells and enables efficient screening of 3D seismic volumes across large areas. Figure 4a illustrates the transformation of angle-dependent reflectivity into impedance domain and the corresponding intercept-gradient representation used to compare seismic responses with rock-physics-based forward models. Figure 4b shows impedance anomalies evaluated on a cross-plot, illustrating how lithological effects can overlap fluid responses using an example from the Gulf of America.

The geophysical validity of using the rEER and rEEI methodology in clastic basins globally away from borehole control has been successfully tested in the past and proven. In the case of the Isabella field, anomalous seismic amplitudes may have had indications on the full stack response, whilst on the inverted rEEI at 45° or 27° attribute cube, the anomaly is prominent and correlates to the 35-m oil column of the Isabella discovery (Went and Hedley, 2023).

**Case studies**

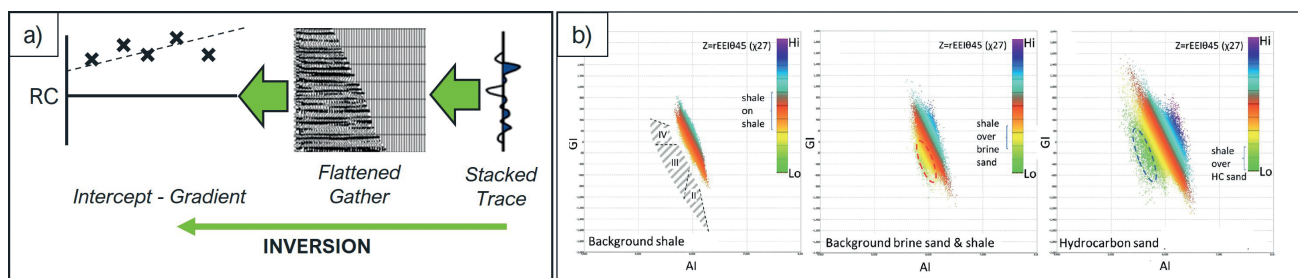
To demonstrate the benefit of the integrated AVO analysis workflow we showcase the different stages across several studies from offshore West Africa. The first part focuses on studies from offshore the Republic of Ghana and the Republic of Guinea, to illustrate how amplitude-based interpretation is non-unique when faced with geological complexities such as anomalous mineralogical effects in the clastic pore space, even when modern seismic data are available. Whilst the mapping of the seismic amplitudes is valid and correct on fit-for-purpose data sets, the conclusions drawn from that interpretation can be ambiguous, and these first examples motivate the need for an integrated workflow that

combines rock physics calibration, AVO quality control and impedance domain attribute analysis. The second part of the section establishes how such an integrated approach, when applied after successful AVO QC of the input data sets, can confirm and validate interpretation from seismic attributes by correlating with rock-physics-based AVO analysis from available borehole data, using examples from Sierra Leone and Côte d’Ivoire.

*Geological complexity in a mature basin: Republic of Ghana*

The Tano Basin offshore the Republic of Ghana, a well-known world-class prolific basin, provides an abundance of large- and small-scale geophysical data sets and, therefore, good control on the subsurface evaluation. The case study, however, provides a contrasting example from this mature deepwater siliciclastic province with extensive well control and established AVO calibration. In clean, well-sorted reservoir sands, well-based rock physics modelling and synthetic-to-seismic ties demonstrate predictable AVO behaviour. Brine-filled sands exhibit hard full-stack responses, while oil and gas-filled equivalents are expected to appear progressively softer in Vp/Vs space (Figure 5a). In partially calcified sands, fluid substitution modelling still enables separation between wet and oil-filled reservoirs, and corresponding seismic anomalies can be confidently mapped (Figure 5b).

Despite this strong calibration framework, the Ghana case also illustrates the limits of amplitude-based interpretation once geological complexity increases. In proximity to volcanic extrusives and associated diagenetic alteration, pore space modification due to calcification, dolomitisation and pyrite enrichment significantly reduces elastic contrasts. Rock physics modelling shows that brine, oil and gas-filled sands cluster tightly in intercept-gradient space, producing class III or class IIp behaviour with limited fluid discrimination (Figure 5c and Figure 5d). Although seismic anomalies remain visible on full-stack and partial angle data, their diagnostic value may well be out of context when the reservoir quality and mineralisation change significantly. This example demonstrates that even in a mature basin, improved seismic fidelity can expose geological controls that complicate AVO interpretation rather than simplifying it. In which case, the additional step of calibrating the seismic AVO responses to reservoir mineralogy and pore space characteristics places the mapped anomalies into the specific geological context of their reservoir provenance and depositional setting.

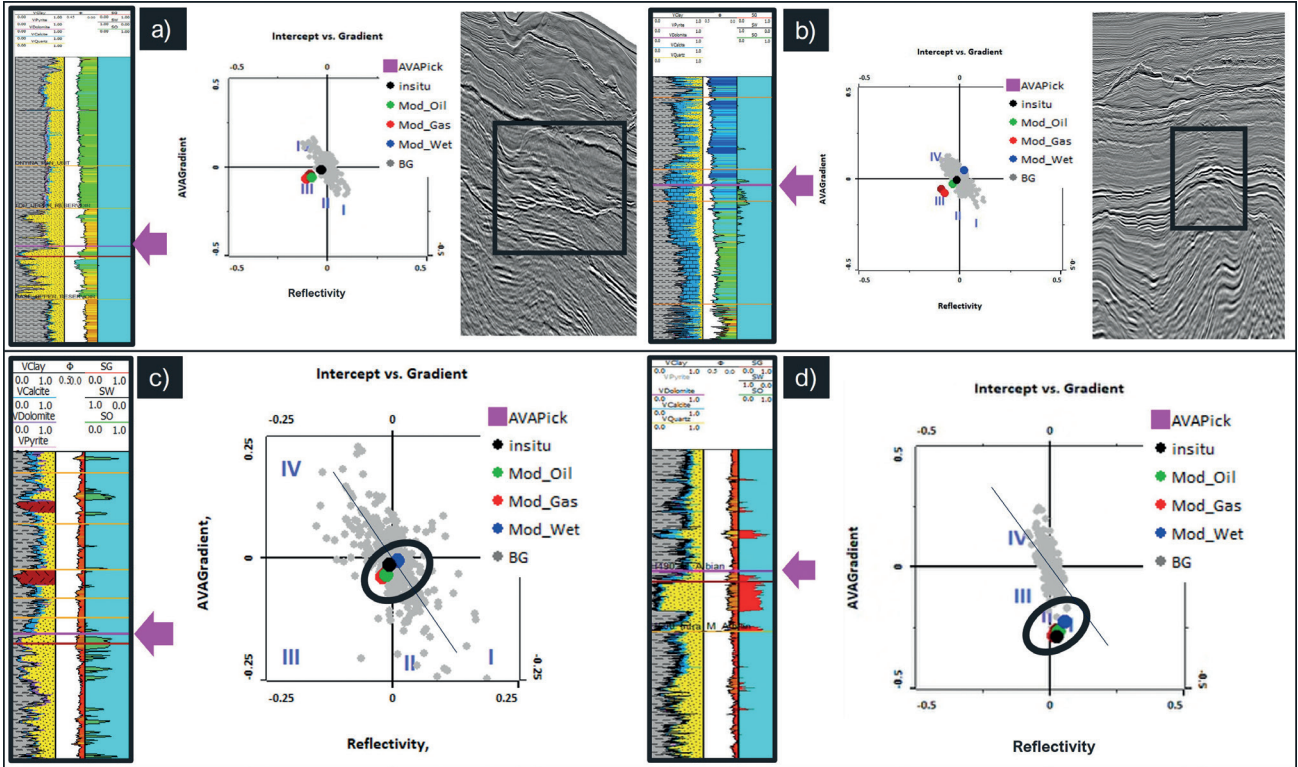


**Figure 4** Went and Hedley (2023) have previously showcased a) the workflow of inverting from reflectivity post-stack data back to impedance domain, which can be visualised as relative extended elastic volume in rotated impedance domain, or in intercept and gradient cross-plots, and b) impedance anomalies from the seismic attribute volumes and how to evaluate them in the cross-plot space (modified from Went and Hedley, 2023).

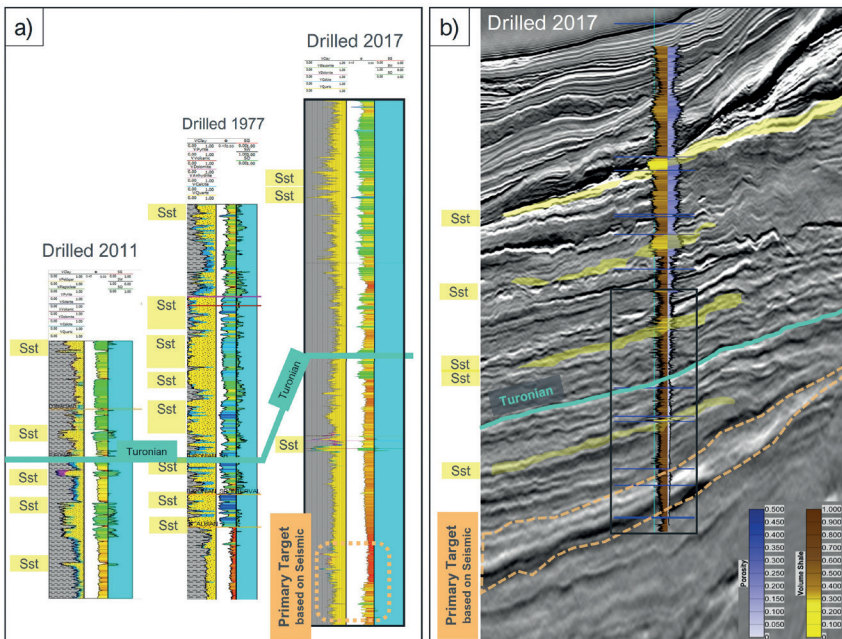
Frontier basin ambiguity: Republic of Guinea

The offshore Republic of Guinea represents a frontier exploration setting characterised by sparse well control and elevated geological uncertainty. Counterintuitively, this case study shows how the localised and great detail of borehole data and its analysis does pose a valuable benefit in an underexplored

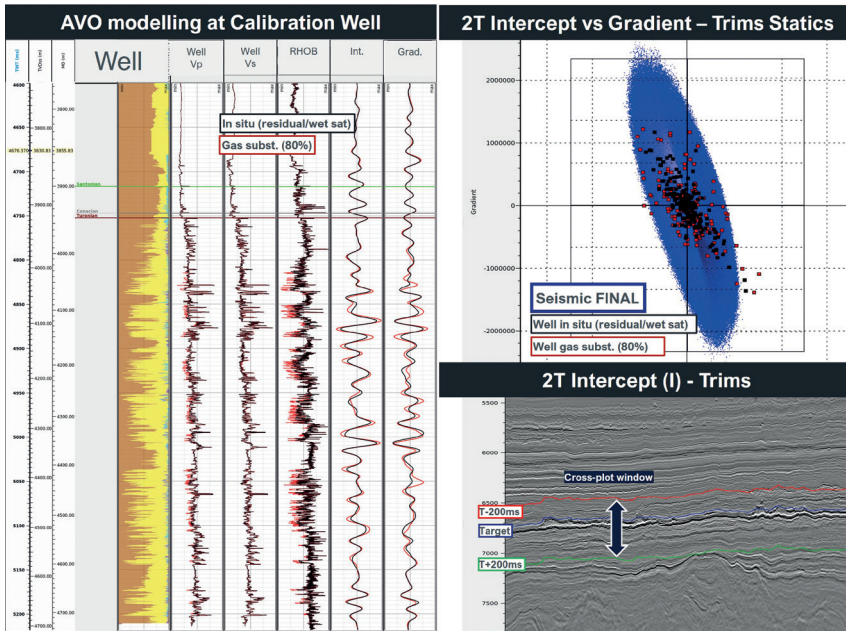
basin for drawing the right conclusions on fairway mapping early. Historical wells drilled in 1977 and 2011 confirm the presence of reservoir sandstones at several stratigraphic levels, encouraging interpretation of fanlike seismic features as potential additional hydrocarbon targets (Figure 6a). On seismic data, these features exhibit soft amplitude responses



**Figure 5** In the Ghana Tano Basin the AVO at wells shows hydrocarbon and brine responses separating nicely as shown in the following examples. a) A dry well with good reservoir quality: the in situ brine anomaly from the well Vp/Vs as expected does not display an additional anomaly over the hard top fairway on the seismic full stack. b) An oil show in a calcareous sequence plots as oil anomaly on the well and has a potential soft anomaly on seismic over the trap. But even in this well-understood basin, when looking at wells in the vicinity of the transform fault, pore space alterations due to pyrite and dolomite associated with extrusives in the system reduce the spread between modelled brine, oil and gas anomalies on the cross-plot like in well c) where due to the lower reservoir porosities, compared with the previous examples, the amplitude difference become so narrow that any anomaly on the seismic data will be hard to differentiate from the background lithological response, whether it corresponds to a class III or class IIP as in well d).

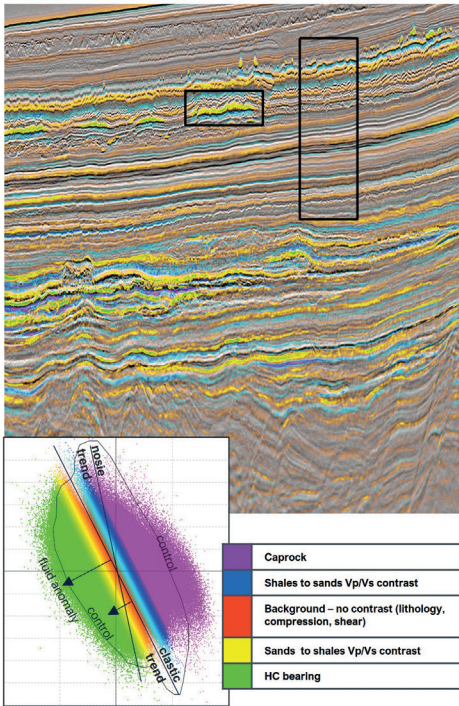


**Figure 6** Wells offshore the Republic of Guinea show reservoir sandstones deposited at several stratigraphic levels. Despite the pre-drill model of the 2017 well with a primary target interpreted on seismic 3D as soft response sands, indicating possible hydrocarbon charge, this sequence did not drill sandstone. a) Wells from 1977 and 2011 justified interpreting sands in the Ceno-Turonian sequence. b) Porosity and volume of clay interpreted on the 2017 well clearly show that the soft fan response of the primary target corresponds to a low-compaction silty clay.

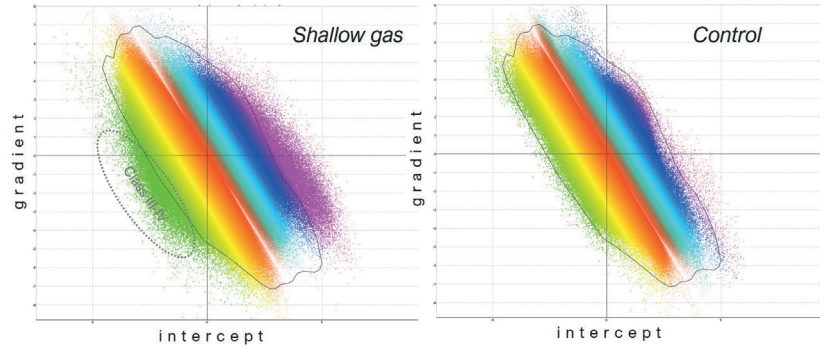


**Figure 7** Offshore Sierra Leone, the quality control of Vp/Vs consistency across angles by AVO analysis at calibration well location. With the 2-term Shuey's intercept gradient cross-plot of the final seismic 3D full stack plotted against the calibration well synthetics, in situ Vp/Vs, and fluid substitution for a gas-filled reservoir at that location with these rock properties in the sequences shows a stable response. The well sits at around 2.1 km of water depth with the target sequence around 2 km TVD bml. The undrilled prospect on the same reprocessed volume sits at around 1.6 km bml. Synthetic modelling shows limited discrimination between the wet and gas saturated case, although the intercept attribute is relatively more sensitive to fluid effects.

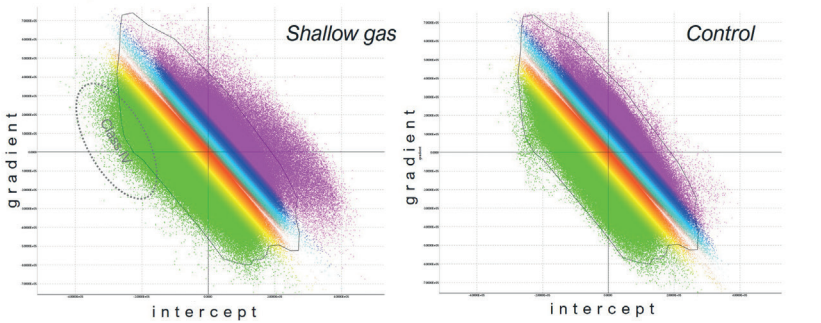
**a) Probes for cross-plot in b) and c)**



**b) Legacy (to 30° offset)**



**c) Reprocessed (to 40° offset)**



**Figure 8** a) Shallow gas offshore Sierra Leone as marked on the seismic section with the reER overlay on reprocessed full-stack depth to time domain has been evaluated alongside a control probe over shale/clastics. The cross-plot of intercept vs. gradient over both those probes does show an anomaly, on the legacy data set (b) as an indiscernible class III-IV, whereas on the reprocessed depth to time ultrafar angle stacks the anomaly seems to clearly move to a class IV anomaly (c).

that are consistent with pre-drill expectations for charged turbidite sands.

However, detailed post-drill analysis of the 2017 well shows that such amplitude responses are not uniquely diagnostic of hydrocarbon presence. Rock physics and petrophysical evaluation show that cementation, low compaction and elevated clay content can generate elastic responses that closely mimic those expected from hydrocarbon-filled sands. In the key example shown in

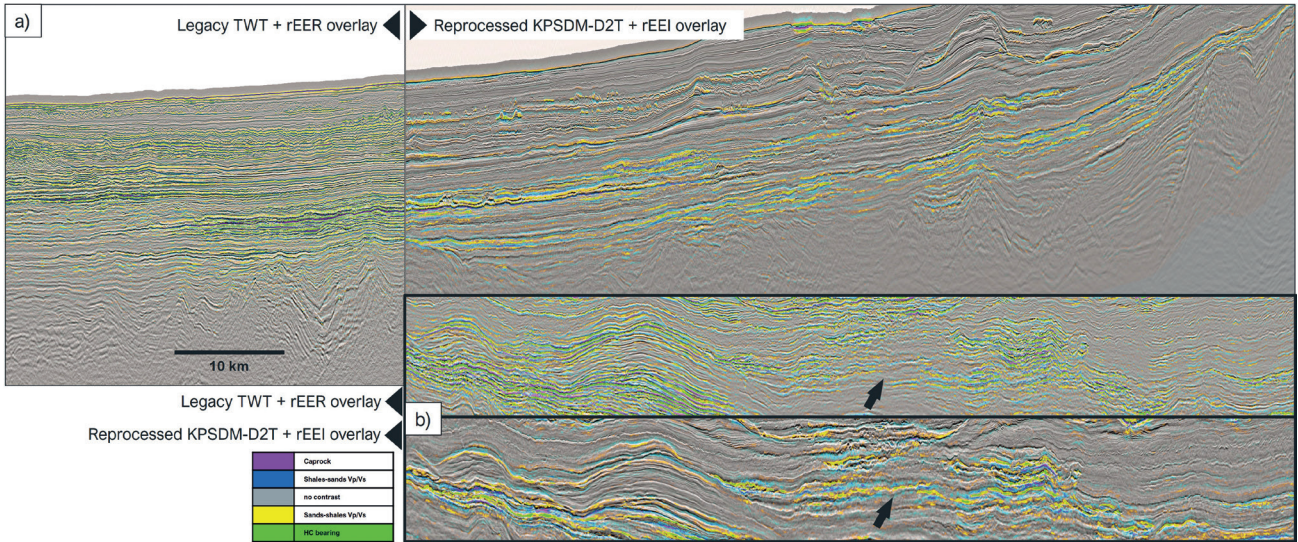
Figure 6b, a prominent pre-drill seismic anomaly corresponds to a silty clay interval rather than a reservoir sand. This case highlights the risk of interpreting amplitude anomalies in frontier basins without robust understanding of the rock physics. Be it on the reEI reliably calibrating a suspected fluid anomaly with a brine and background response probe, or the robust borehole rock physics calibration of the reservoir level of interest. This demonstrates that improved seismic imaging alone is insufficient

to resolve lithology-fluid ambiguity if not put into the context of the basin-specific mineralogical and depositional processes. This case highlights the critical role of rock-physics-based calibration in frontier basins, and how beneficial it is when being able to differentiate clastic systems and how AVO anomalies like this are key to derisking the prospectivity in this underexplored area.

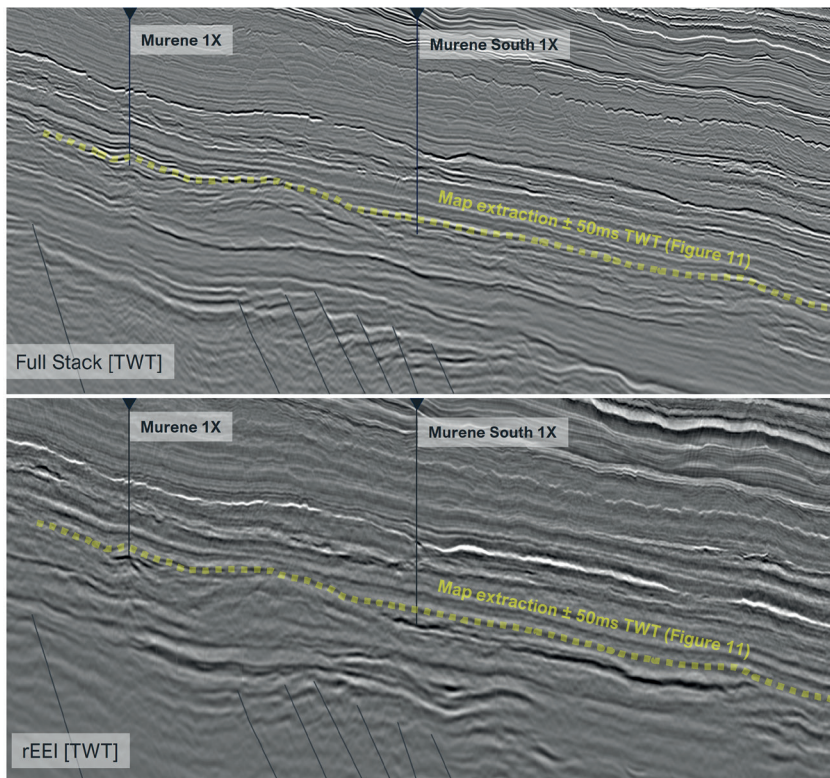
Together, the Ghana and Guinea examples establish the central motivation for this study: once amplitude fidelity improves, the dominant source of uncertainty shifts from data quality to geological and rock physics variability, requiring an integrated interpretation approach.

*Integrated workflow validation during reprocessing: Sierra Leone*

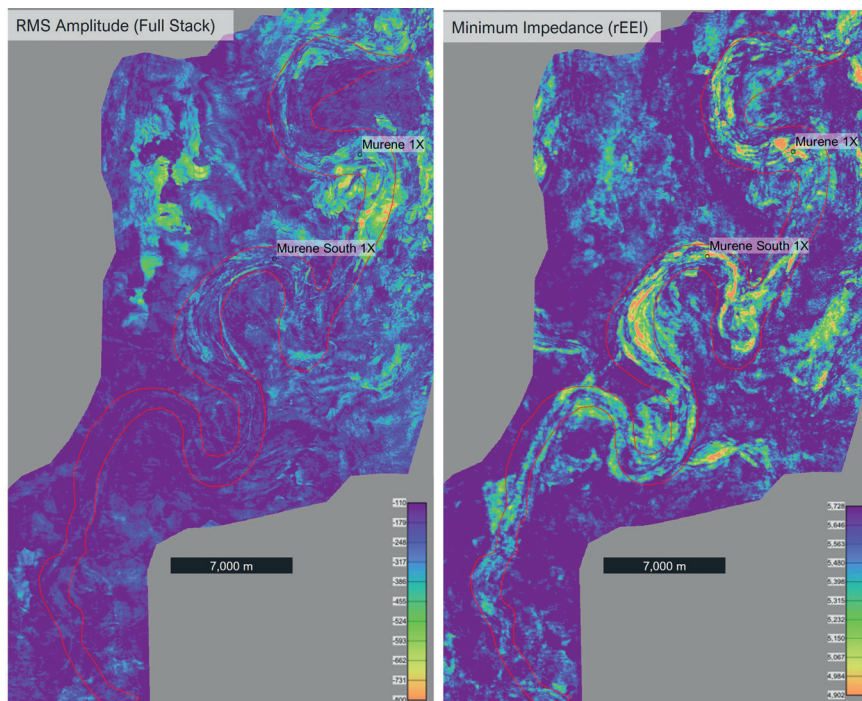
Offshore Sierra Leone provides a clear example of how an integrated workflow can be used to establish amplitude fidelity and support reliable AVO interpretation. Legacy 3D seismic data were reprocessed in 2025 using modern broadband workflows incorporating deghosting, advanced demultiple and FWI-based velocity model-building. Systematic AVO quality control demonstrates stabilised pre-stack amplitudes across offset and angle, with consistent  $V_p/V_s$  behaviour observed once reprocessing was complete (Figure 7).



**Figure 9** Offshore Sierra Leone, comparisons of rEER overlay on legacy time stack (left) and 2025 reprocessed Kirchhoff depth migrated stack to time (right). The section in a) shows improved consistency in seismic facies and attributes, where mainly the fairways and gas caps show an anomaly compared to the legacy stack, lighting up in different magnitudes over the entire sediment column. The zoom-ins of b) show improved continuity at the target levels, which also means removal of false positives in the surrounding matrix (top legacy stack, bottom reprocessed stack).



**Figure 10** Offshore Cote d'Ivoire, comparing the full stack section (top) with the rEEI attribute (bottom) over the 2025 and 2026 discoveries shows that the target can confidently be mapped in the relative impedance space.



**Figure 11** Offshore Côte d'Ivoire, comparing the RMS amplitude extraction from the full stack (left) with the absolute minimum extraction of the inversion (right) demonstrates the successful mapping of the Calao channel complex on the latter, which is not possible on the full stack.

Shallow gas accumulations provide an independent validation case. On legacy seismic data, these anomalies are ambiguous and difficult to classify in intercept-gradient space. After reprocessing, the same events display consistent class IV behaviour on partial angle stacks and impedance domain attributes (Figure 8). Near-far correlation, spectral consistency and intercept-gradient stability confirm that the observed amplitude behaviour is controlled by subsurface elastic contrasts rather than processing artefacts. Importantly, the improvement is not restricted to well locations: enhanced continuity and consistency of seismic facies and impedance attributes are observed across the survey (Figure 9), demonstrating that the dataset is fit for purpose for regional AVO analysis.

#### *Basin-wide application and scouting: Côte d'Ivoire*

The Côte d'Ivoire example illustrates how the integrated workflow can be applied predictively across multi-sensor 2018 seismic data set as a regional scouting tool once amplitude fidelity and calibration principles are established. In this setting, in some sequences the channelised clastic reservoirs exhibit a low impedance contrast relative to surrounding mudstones, resulting in a subtle or absent expression on full-stack seismic data (Figure 10). After confirming AVO stability across offsets, the seismic data was transformed into impedance space using relative extended elastic impedance (rEEI) attributes.

The impedance domain reveals the fairway geometry, depositional architecture and internal heterogeneity of the channel complex clearly in comparison to conventional amplitude extractions (Figure 11). Fluid-related anomalies and reservoir continuity that are not discernible on full-stack data become evident in rEEI space, enabling confident mapping of the Calao channel complex and identification of additional leads in the Cenomanian and Turonian intervals. This case study not only demonstrates how rEEI attributes provide a practical bridge between well-scale

rock physics understanding and regional exploration screening in areas of limited well control, but also how targets can be feasibly mapped once the AVO robustness on the seismic volumes is established. Specifically, to further calibrate targets in the Turonian and Cenomanian for reservoir-specific geophysical responses, further traps within this particular reservoir fairway can be identified in addition to the borehole locations.

#### **Discussion and conclusions**

The West African case studies demonstrate that modern broadband seismic reprocessing fundamentally changes the nature of AVO and AVA interpretation. While advances such as deghosting, demultiple and full waveform inversion (FWI) consistently improve pre-stack amplitude stability and bandwidth, enhanced data quality does not automatically lead to simpler or less ambiguous interpretation. Instead, improved imaging often reveals geological complexity that was previously unresolved in legacy datasets, shifting the primary source of uncertainty from data quality to subsurface geology and rock physics variability.

Across all basins examined, systematic AVO quality control is shown to be essential for establishing whether reprocessed seismic data are fit for purpose for quantitative interpretation. Metrics such as spectral consistency, near-far correlation and intercept-gradient stability provide objective evidence that the assumptions underlying AVO theory are satisfied. Once this compliance is demonstrated, residual ambiguity in amplitude behaviour can no longer be attributed primarily to processing artefacts and must instead be interpreted in terms of lithology, reservoir quality, diagenesis and pore space evolution.

The examples from offshore the Republic of Guinea and the Republic of Ghana illustrate why this distinction is critical. Most clearly shown in the mature Tano Basin offshore Ghana, which is well calibrated, are the textbook AVO responses in

clean sands with high contrast, where increasingly ambiguous behaviour observed near volcanic extrusives points to pore space modification significantly reducing elastic contrasts between brine, oil and gas-filled reservoirs. In the frontier basins of the Guinea Plateau, detailed rock-physics is providing crucial input for early fairway understanding. Post-drill analysis reveals that cementation and clay-rich lithologies can produce synthetic reflectivity responses that closely mimic those of porous or hydrocarbon-charged sands. In this context, modern imaging does not ‘fail’ but instead provides the opportunity to correctly reclassify seismic facies once borehole data are integrated. In both cases, modern seismic imaging does not ‘fail’; rather, it exposes geological controls that must be explicitly accounted for to avoid misinterpretation of amplitude anomalies.

The Sierra Leone and Côte d’Ivoire case studies demonstrate how an integrated interpretation workflow successfully manages increased subsurface complexity and translates improved data fidelity into exploration value. In Sierra Leone, modern reprocessing combined with rigorous AVO QC establishes a robust foundation for interpretation, validated by shallow gas accumulations in relative elastic reflectivity (rEER) that evolve from ambiguous responses on legacy data to consistent class IV behaviour on reprocessed partial angle attributes. Importantly, these improvements extend beyond individual well locations, supporting reliable regional screening with confidence in amplitude fidelity.

In Côte d’Ivoire, impedance domain attributes such as relative extended elastic impedance (rEEI) provide an effective bridge between well-scale rock physics understanding and regional exploration scouting. By reducing sensitivity to wavelet effects and evaluating seismic responses in a domain closely linked to intercept-gradient behaviour, these attributes enable subtle reservoirs and fluid effects to be mapped where conventional full-stack amplitudes are insufficient. This demonstrates the practical value of integrated workflows in areas of limited well control and subtle impedance contrast.

Taken together, the case studies show that modern imaging workflows fundamentally shift the focus of exploration uncertainty. Legacy seismic data often masked geological complexity through limited bandwidth, unstable amplitudes and incomplete offset coverage, resulting in seemingly cleaner data but ultimately masking key risks associated with reservoir quality, diagenesis and pore space evolution, potentially leading to misinterpretations. Modern broadband reprocessing removes many of these limitations, producing datasets that are demonstrably fit for purpose from a geophysical perspective but more sensitive to geological variability. Integrated and iterative interpretation workflows provide a structured and scalable approach to recognising this shift and to derisking exploration decisions.

Ultimately, modern imaging does not simplify the subsurface; it reveals it more accurately. Where borehole and modern seismic data may independently provide a more precise interpretation, interpreting with renewed accuracy is only feasible

by adopting integrated workflows early and iteratively, rather than treating them as a post-processing validation step. Exploration teams can leverage improved seismic fidelity to better understand geological complexity, place amplitude anomalies in their correct context, and make more informed, risk-aware exploration decisions.

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