# New Perspectives on Seismic Sequence Imaging in the Geologically Challenging Frontier M9 West, Offshore Myanmar*

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## Abstract

M9 West, offshore Myanmar is located in the Moattama basin, which is approximately 95 km southeast from Yadana field (Figure 1). The water depth ranges from 70 to 500 meters. Modern bathymetry, extracted from 3D broadband seismic data acquired in 2017, illustrates that M9 West is situated on the continental shelf to slope. Basin evolution is related to a volcanic arc complex between a fore-arc deep to the west and a back-arc basin to the east of Moattama basin. Remarkable was the development of Burman Limestone formed in shallow marine environment over an existing arc when tectonic activities were minimal. However, they are not likely to continue into M9 West area probably due to disturbance by volcanic activity. Late Oligo. - Early Mio. units in M9 West probably comprise mixed carbonate-volcanic lithology. Possible limestone unit in M9 West is correlated to Middle Miocene Nilar Formation.

This paper aimed to explore for new stratigraphic plays in the subtle structural closures and enhance further hydrocarbon recovery by giving more detailed information about facies variations in M9 West area, Moattama Basin. Identified seismic facies are interpreted based on the recently acquired and processed 3D broadband seismic data in 2017 over 3,086 km$^2$. Two wells, Zatila-1 and Bagwa Siddhi-1 have been used in the study to support the geological correlations and seismic to well calibrations.

From seismic conventional and seismic broadband data comparison, imaging of Carbonate and Volcanic features and clastic variation are enhanced with broadband data. Figure 2 shows that deep Carbonate stratigraphy, volcanic intrusions and LST submarine fan can be interpreted with more confidence. Fault planes are enhanced and can be identified all the way through the broadband seismic data. Small faults are highlighted especially in the carbonate reservoir. Facies variations in the clastic interval are clearly visible and highlighted. Moreover, there is a clearer imaging over slope progradation.

As observed in conventional data, the reflector is hardly visible. This emphasizes the role of low frequencies in interpreting regional scale stratigraphy in M9 West area. The remaining potential of the M9 West lies within the subtle stratigraphic traps and pinch-outs in the clastic

interval. This is where broadband technology will play a major role. The higher frequency content pushes the boundaries of the tuning effect further. It helps to resolve thin beds and pinch-outs that have never been seen before in the conventional data. The low frequencies also play an important part as they help in interpreting facies transitions.

Figure 3 shows a time slice comparison at 800ms TWT extracted from a broadband 3D data. It is obvious that shallow channels are much better observed. The high frequency content is key in defining the sharp edges of the channels. On the other hand, the low frequency content helps differentiate the bedrock from channel fill deposits, which appear below the bottom of channel. Such high-resolution seismic data are of great assistance for preliminary site surveys and identification of shallow hazards. Also, these shallow channels produce rapid velocity variations that affect seismic ray path modelling. The use of broadband data then becomes very important to carefully model these channels and get the best out of the PSDM processing sequence.

Another objective of this paper is to investigate the character and genesis of depositional elements and erosive features associated with a Plio-Pleistocene progradational shelf margin in M9 West area. In this study, seismic facies analysis and seismic geomorphology were complemented by analysis of shelf-edge trajectories in order to determine base-level fluctuations during the deposition of each of the seismic facies recognized (Figure 4).

Understanding the implications of shelf break architecture and unconformity impact on a sequence-by-sequence basis, allowed for identification of reservoir/seal couplets in the deep marine slope and basin floor depositional systems. This comprehensive treatment enabled play maturation progressing to interpreting and documenting leads in spatial and stratigraphic levels (Figure 5).

The use of broadband seismic data is the key to unlocking the remaining hydrocarbon potential of the M9 West frontier area. By definition, this technology provides a much broader frequency range to final seismic images enabling the interpreter to (1) Discriminately interpret rock stratigraphy, facies distribution and subtle structures, which is benefit from the high frequency content. (2) Produce a clearer interpretation that is benefit from the low frequency content. (3) Extract the “true” seismic signature of the geological formations by removing the wavelet side - lobes-benefit from both the low and high frequencies. All these benefits will help exploration geophysicist and geologists to access the existing play concepts in the M9 West frontier area in greater detail and define some new potential.

In conclusion, reliable seismic sequence stratigraphy is highly valuable in this frontier area and help to derisk M9 West exploration due to the bandwidth extension from broadband technique. This leads seismic interpreter to step closer to be able to discern the rock properties, reservoir distribution and fluid content of potential reservoirs. Moreover, it might be changed the understanding of the basin and hopefully unveil its great potential in Moattama basin.

## Selected References

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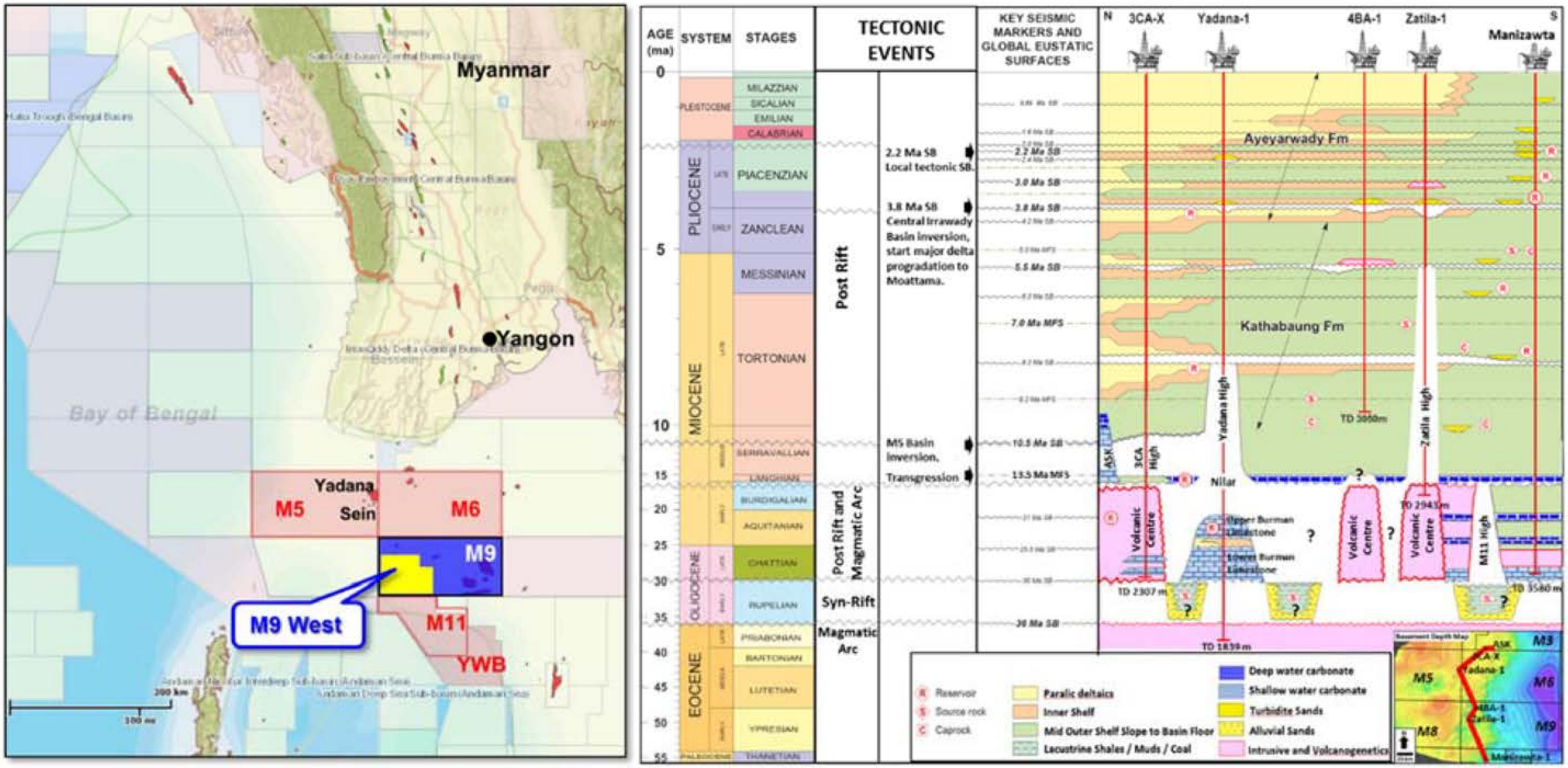


Figure 1. M9 West location, offshore Myanmar and Stratigraphic chart of Moattama basin (PTTEP Modified after 2007 ISIS seismic sequence stratigraphy, 2018).

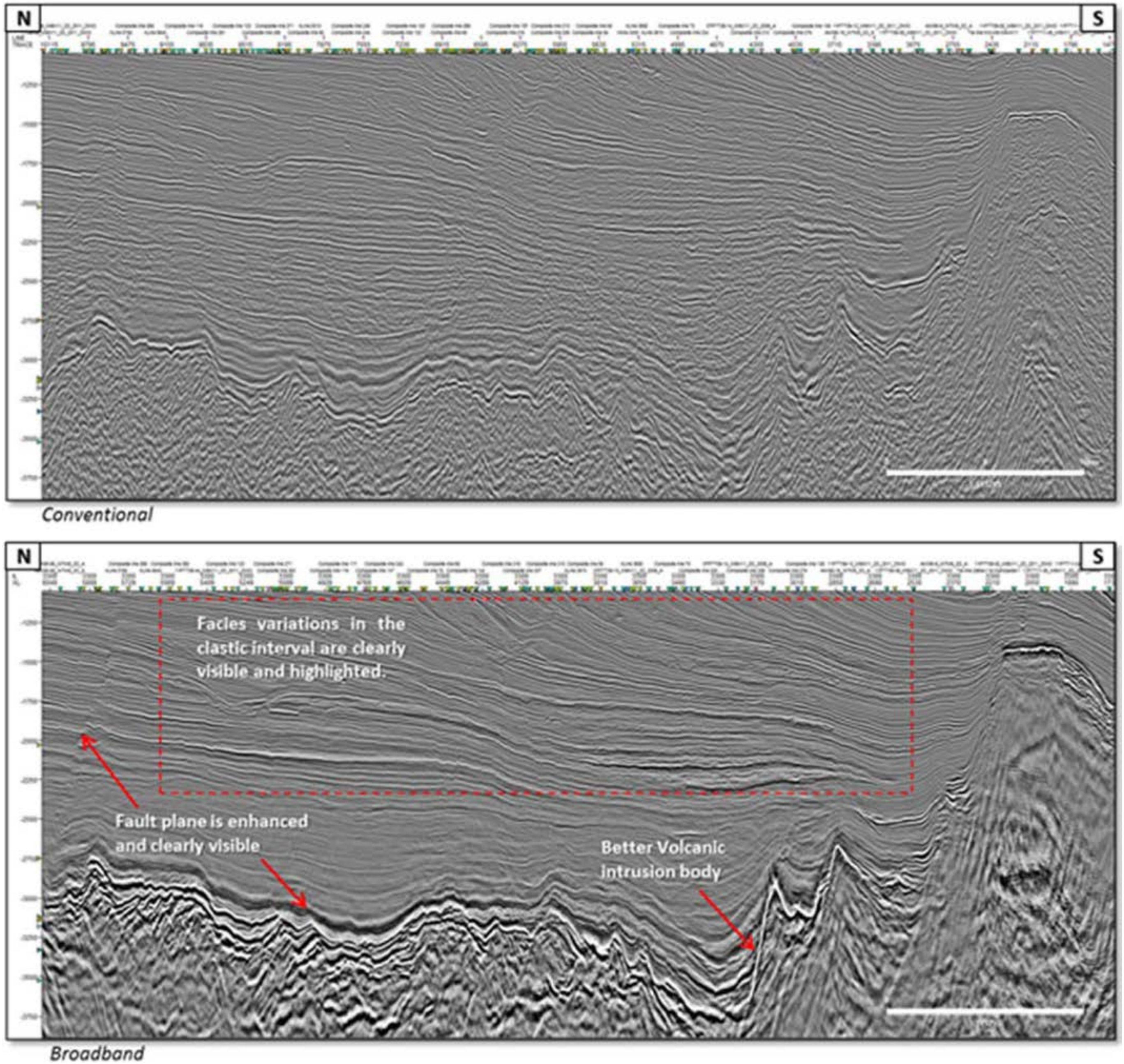


Figure 2. M9 West seismic imaging comparison.

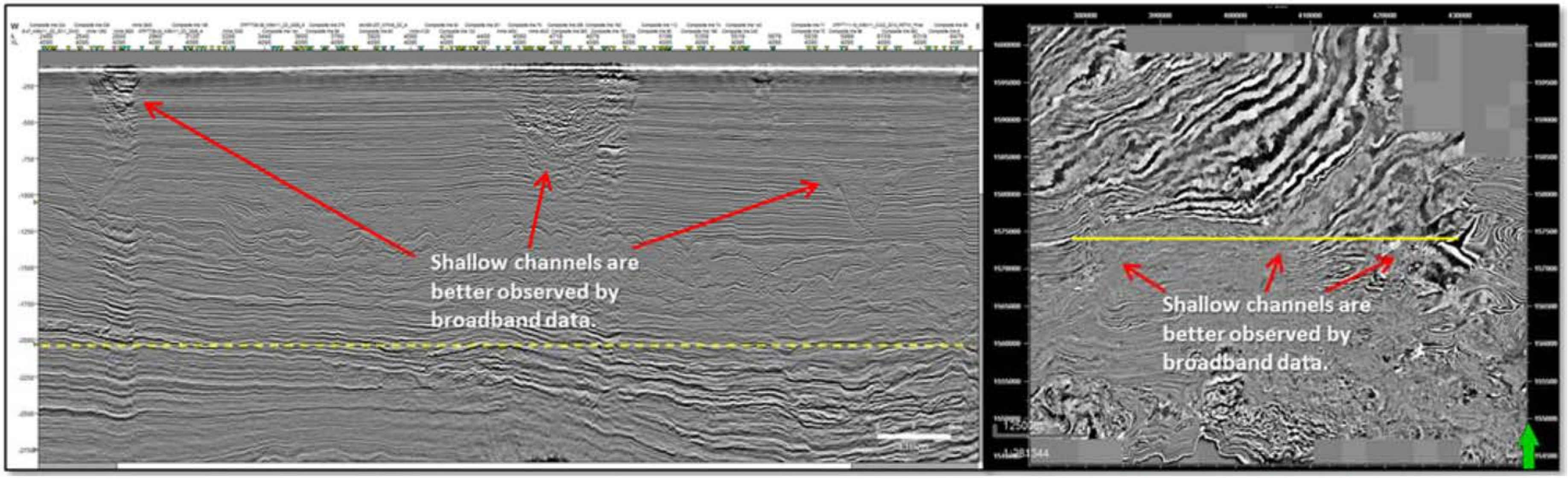


Figure 3. The shallow channel is much better observed by broadband data.

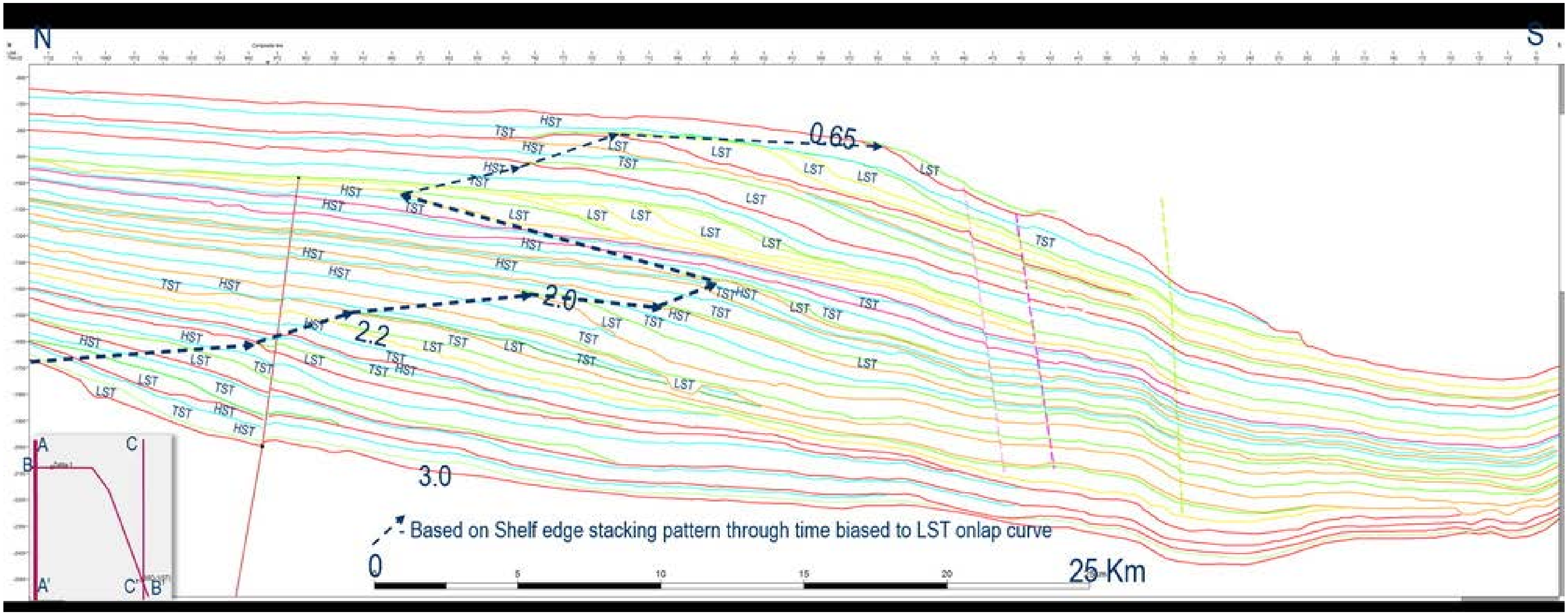


Figure 4. Geological interpretation of seismic profile A-A’: Relict Shelf Break Trajectory (PTTEPI and SLB, 2018).

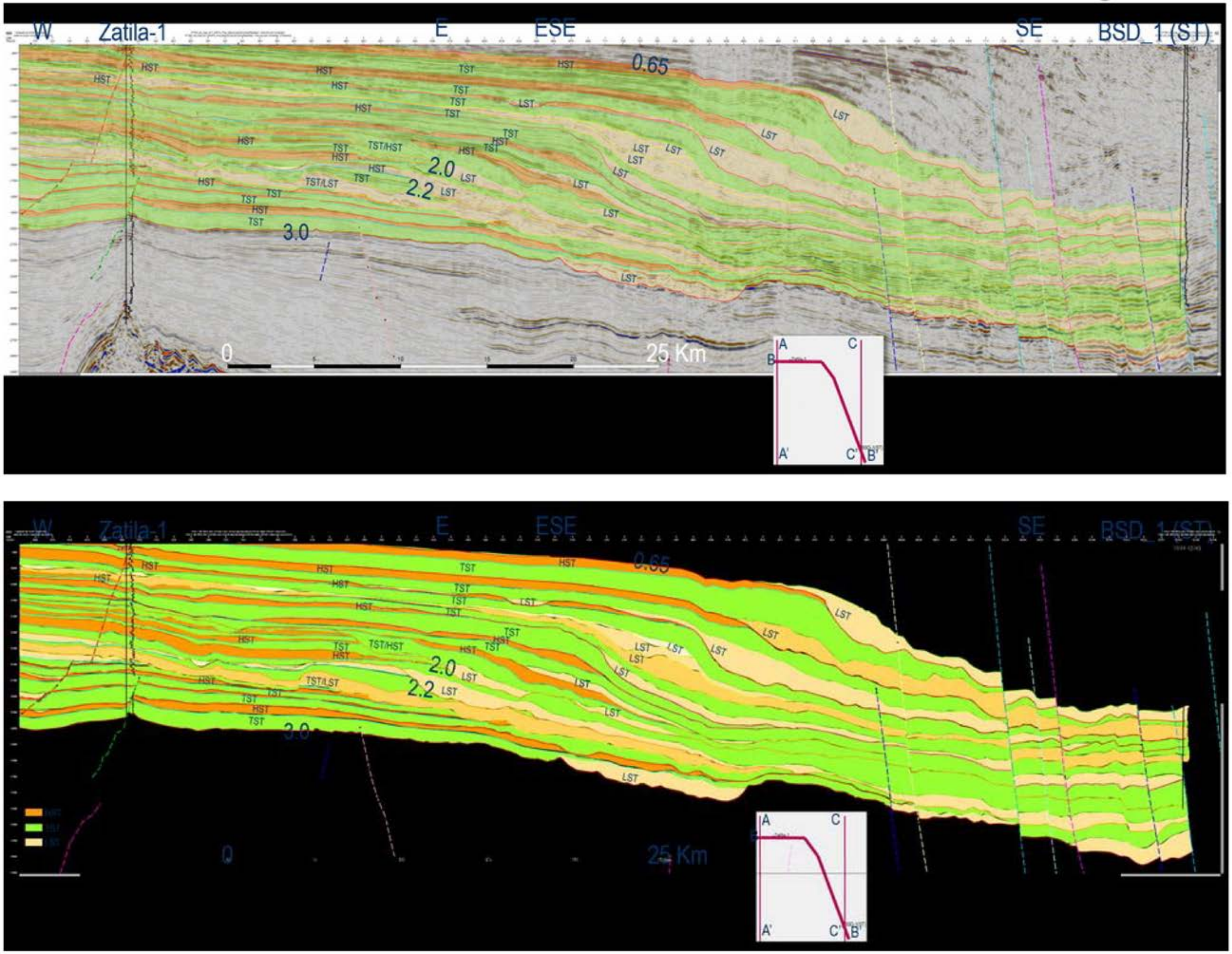


Figure 5. Seismic Profile B-B': LST, TST and HST sequence by sequence (PTTEPI and SLB, 2018).