Geol. Soc. Malaysia, Bulletin 47, December 2003; pp. 77-83

Seismic interpretation of carbonate turbidites in Central Luconia

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INTRODUCTION

Central Luconia, offshore Sarawak, has long been recognized as a prolific carbonate province with large hydrocarbon reserves. Carbonate reefs growth initiated mainly on structural highs formed during Late Oligocene rifting. The main phase of carbonate growth occurred during the mid to late Miocene (Fig. 1). Some of these carbonate build-ups are aerially very extensive and cover several hundred square kilometers. Eustatic sea-level changes during the Miocene influenced the growth rate of, and facies distribution within carbonate build-ups. Recently, with increasing understanding of the Central Luconia carbonate system, a new carbonate sedimentation mechanism has been recognized that of carbonate turbidite deposition. These carbonate turbidites are present in palaeo-lows between Miocene/Pliocene carbonate platforms.

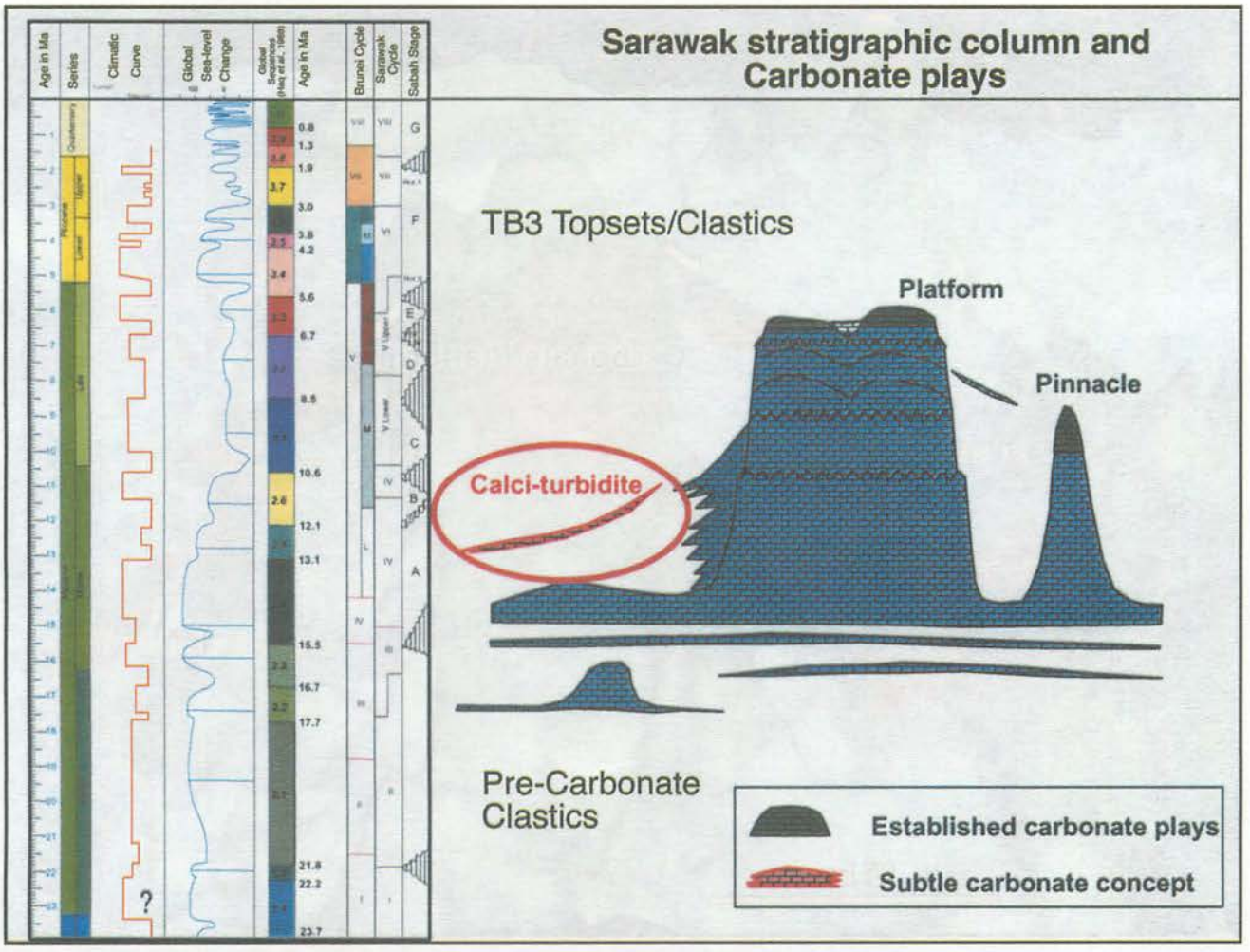

Figure 1. Sarawak stratigraphic scheme.

Paper presented at GSM Petroleum Geology Conference & Exhibition 2002

SEISMIC EVIDENCE

With the aid of high-resolution 2D seismic data widely distributed, stacked turbidites have been identified from anomalous seismic amplitudes in Central Luconia: carbonate turbidites were transported from carbonate platforms a considerable distance into peripheral basins. The seismic anomalies can be traced to lows and canyons on the carbonate platform (Figs. 2 and 3), which indicates that they are the seismic response of carbonate sediments sourced by and shed-off from the build-ups (Figs. 4, 5 and 6).

Figure 5 shows the different depositional realms of carbonate *talus scree* deposits and the carbonate turbidites. In Central Luconia carbonate talus and debris accumulated on the flanks of major build-ups and distance of transportation is short, hence aerial distribution of debris is limited.

DEPOSITIONAL MODEL

The carbonate depositional system of Central Luconia is controlled by an interplay of sea-level history, carbonate sediment production rate and tectonic subsidence. Carbonate platforms in general undergo several phases of growth before being terminated by subaerial exposure or platform drowning (Fig. 7). During the initial platform flooding, carbonate growth starts on the structural highs. Once the carbonate factory is well established, it starts to catch up with the accommodation space created by a continuing sea-level rise. During this phase, the platform aggrades

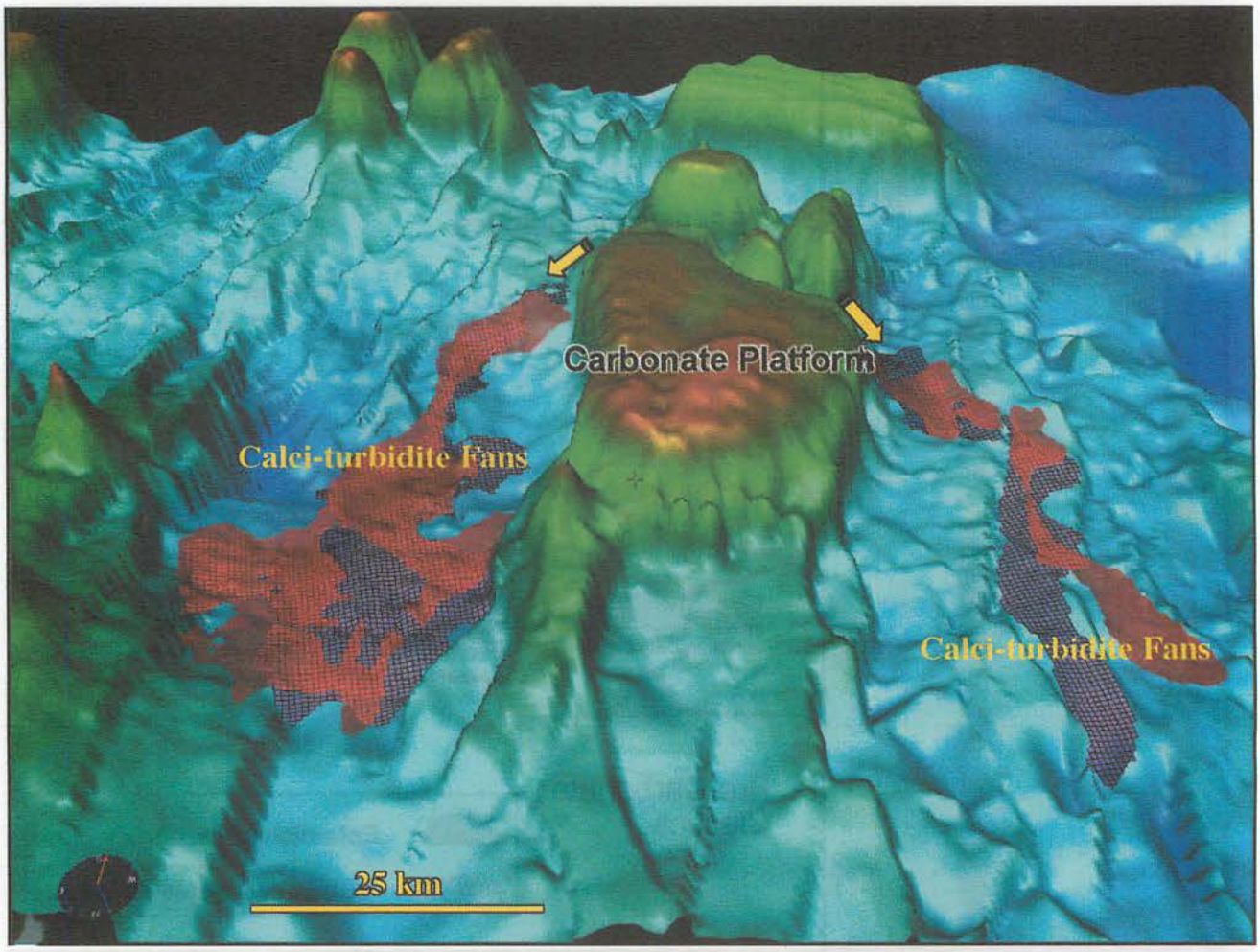

Figure 2. 3D Model — Carbonate turbidite fans (view direction from south).

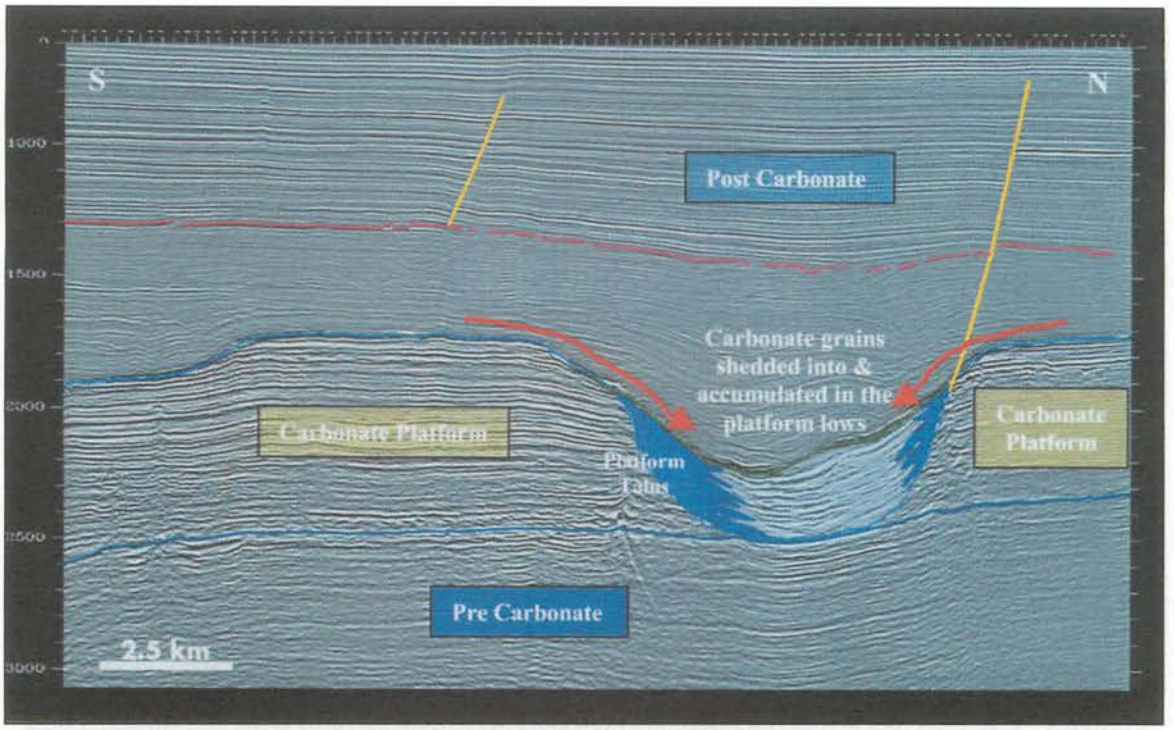

Figure 3. A seismic line across the source canyon.

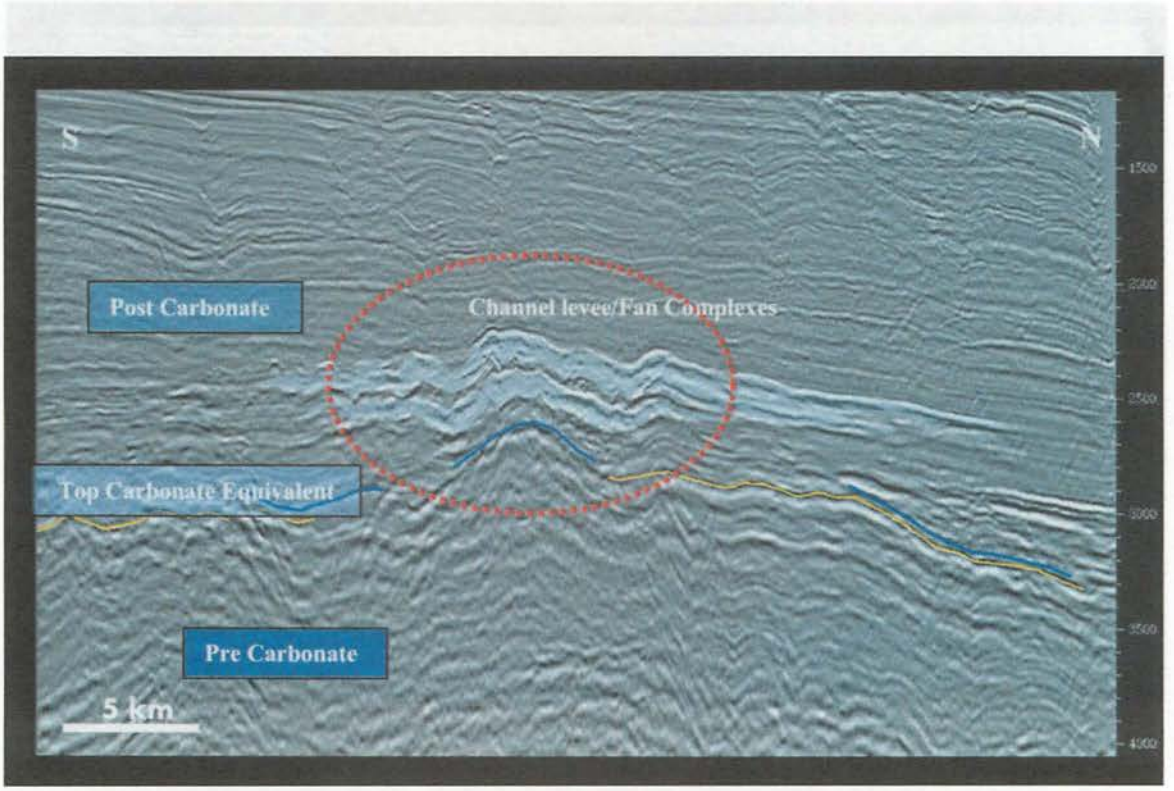

Figure 4. A seismic line across the proximal turbidite fans.

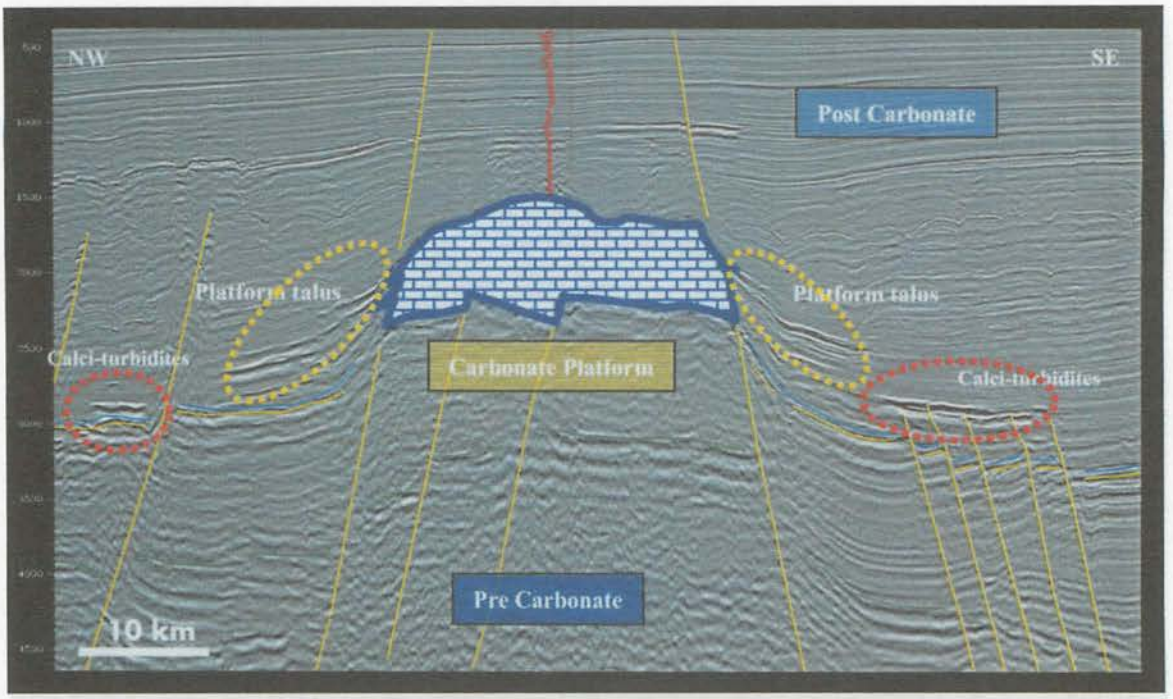

Figure 5. A seismic line across the carbonate high showing carbonate talus scree and turbidite fans.

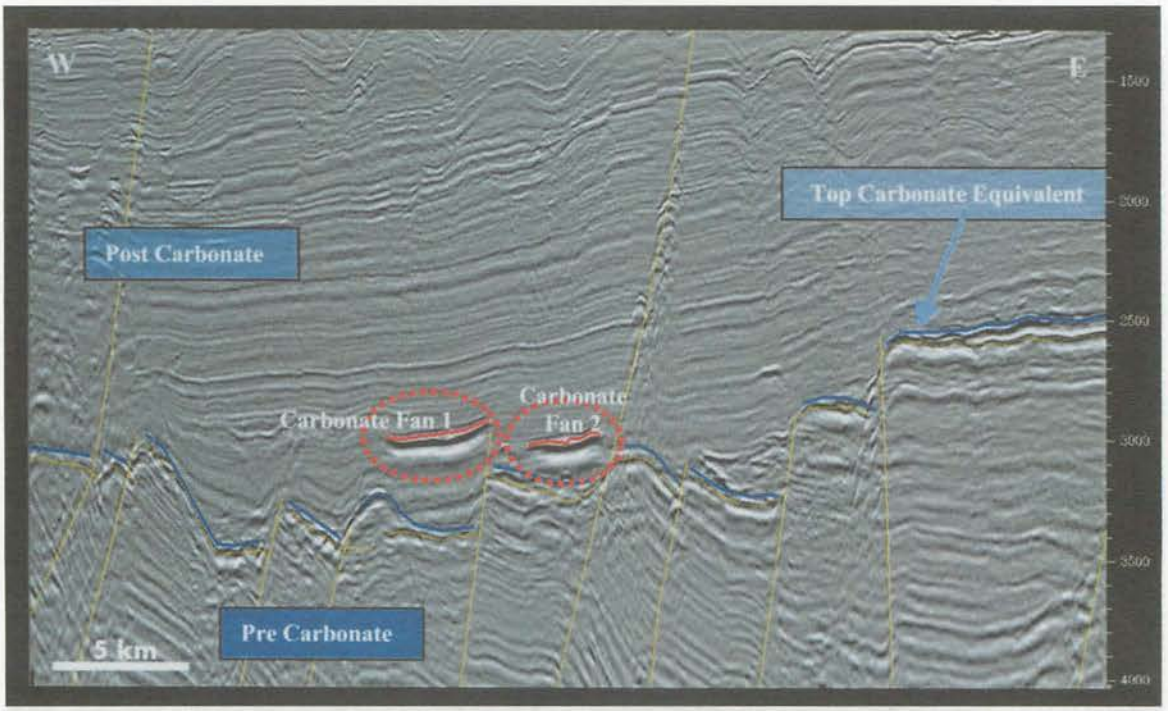

Figure 6. A seismic line across the distal turbidite fans.

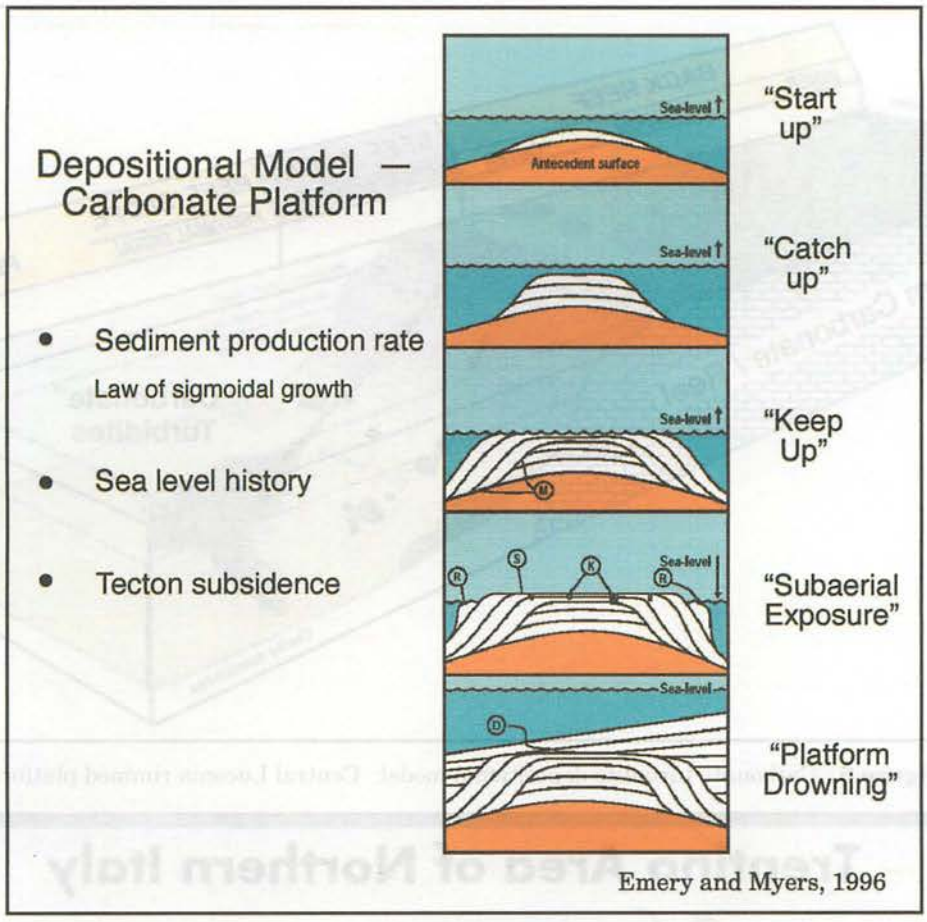

Figure 7. Schematic model for an isolated carbonate platform.

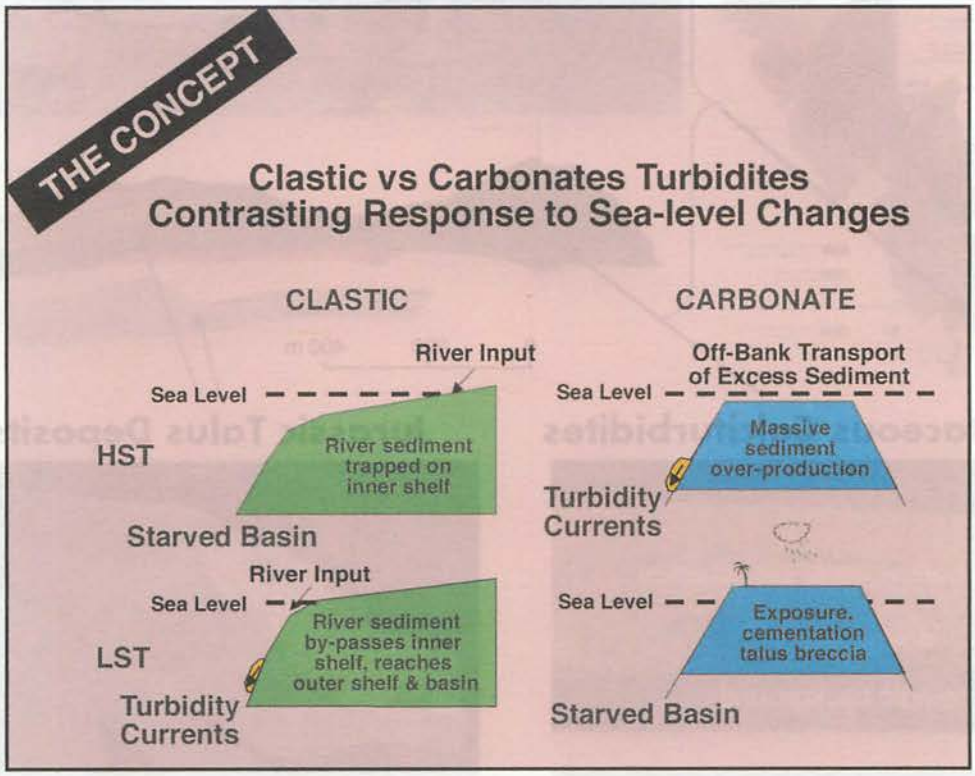

Figure 8. Concepts of carbonate turbdites.

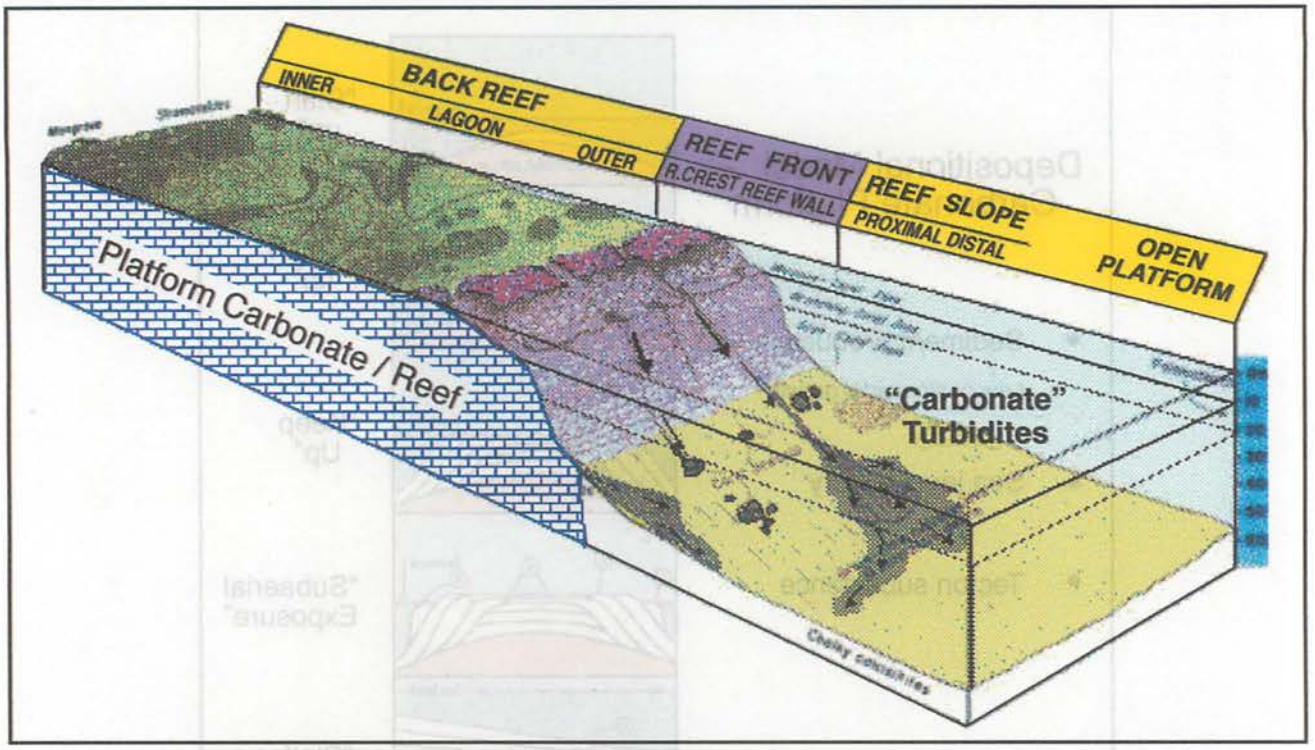

Figure 9. Carbonate turbidite depositional model: Central Luconia rimmed platform.

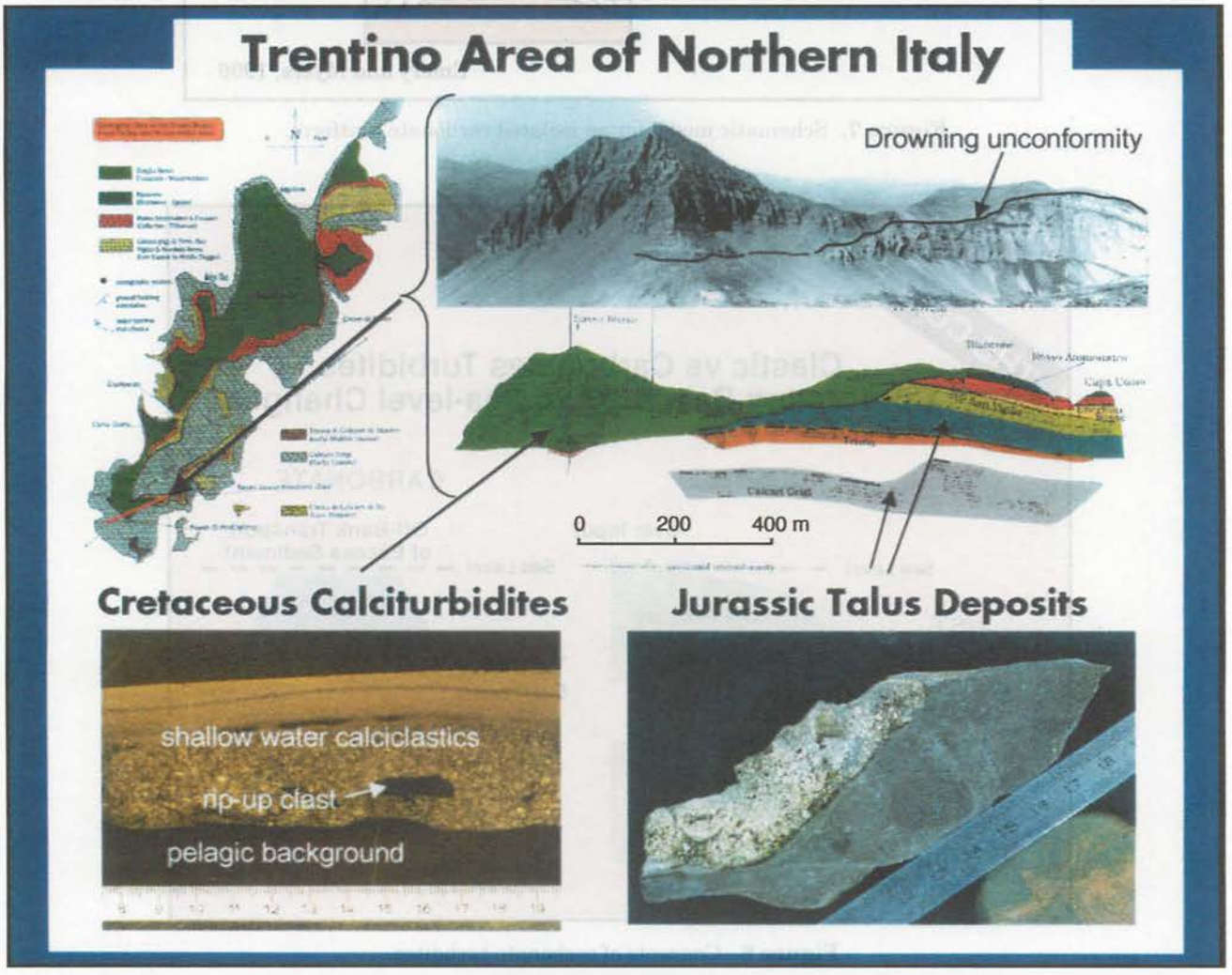

Figure 10. Carbonate turbidite outcrop analogue: Southern Alps, N.Italy (Lehner, 1994).

vertically.

During a sea-level highstand, carbonate growth out-strips accommodation causing the steep platform margins to prograde. Significant amounts of carbonate grains and "sands" accumulated on the platforms and their fringes. Occasional storm events then trigger the unstable sands and transport these carbonate "sands" further into adjacent basins in the form of turbidites. This is in contrast to lowstand shedding so characteristic of siliciclastic regimes (Fig. 8). Carbonate turbidites can be transported more than 50 km from the source and are generally ponded in the lows between major build-ups. Deposition of individual fans seems to be controlled by syn-sedimentary faulting within the basins (Fig. 6).

ANALOGUE

Carbonate turbidites in the Central Luconia Carbonate province have been mapped for the first time. They have previously been described in many different geologic provinces around the world. Examples include the modern analogues around the Great Bahama Bank to ancient deposits in the Permian Basin of West Texas and the Trentino area of Northern Italy (Fig. 10).

CONCLUSION

This paper looks at, and discusses the seismic evidences and depositional system of carbonate turbidites in Central Luconia. The high efficiency of carbonate producing processes leads to massive, off-platform transport of sediments into surrounding deep basinal environments during sea-level highstands, forming carbonate turbidites.

ACKNOWLEDGEMENTS

The authors of this paper would like to thank PETRONAS, PETRONAS Carigali Sdn. Bhd. and Sarawak Shell Bhd. for permission to present and publish this paper, and thank their colleagues for help and support and valuable discussion during preparation of this interpretation.

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Manuscript received 28 January 2003