Outcrops of West Crocker Formation – A Field Visit

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Introduction

West Crocker Formation is located in Northwest Sabah of Borneo (Kalimantan) Island. This formation was deposited during Late Paleogene (Oligocene) and is undoubtedly the best exposed example of a classic submarine fan system in the Asian region (Crevello, 1999).

A field visit had been done in August 1999 to view the outcrops of West Crocker Formation. These have been well-exposed in Kota Kinabalu and its vicinity. In fact, the field trip had been held to also visit other Paleogene and younger Neogene rocks in Labuan Island and Brunei areas. In this text, only the outcrops of West Crocker Formation will be discussed.

Outcrop Observation

When the field visit was being run, several outcrops of West Crocker Formation were exposed in the vicinity of Kota Kinabalu (Sabah). The localities were in quarries, construction areas (housing complex, industrial factory), and road cuts.

The West Crocker Formation basically consist of two major rock types, i.e. gray sandstone and various colored shale, interbedded with each other forming a very thick sequence (Crevello, 1999).



Figure 1: Vertically-bedded sandstone facies of West Crocker Formation

Figure 1 shows part of nearly 200 meters exposure of folded sand-shale repetition. The age of the rocks is going younger to the left side. Starting from bottom (right side), the fining and thinning upward sequences of granular to coarse-grained sandstone is shown, interpreted as fan channel. This is overlain and truncated by more shale containing of levee and overbank sediments.

Internal sedimentary structures such as convolute, lamination, large flute structure, bedding plane slump, shale-clast (in sandstone), and debris flow were observed. Overall, this big outcrop could be classified as a sand-rich fan. More than 50% of net sand is available and could be as a good reservoir in a petroleum exploration.



Figure 2: Poorly sorted sandstone with grain size varies from very fine to very coarse

Going closer to one of sand beds of the above big outcrop (right part), as displayed on Figure 2, grain sizes (very fine to very coarse) of the sand are observed. Sands of West Crocker Formation are typically poorly sorted and its grains are angular to sub-rounded. The sandstone beds are mostly quartz-rich lithic greywackes or quartz-rich feldspathic greywackes (Crevello, 1999) and consist of about 60-80% quartz, 5-30% feldspar (mostly K-feldspar), and 5-10% lithic fragments (chert, low grade metamorphic, and basalt).

Intensive fractures are also extensively observed easily in sandstone beds as shown in Figure 2 and Figure 3. This give us an indication that these rocks have been strongly folded (certainly because some of the outcrops have vertical dipping, e.g. the outcrop on Figure 1).

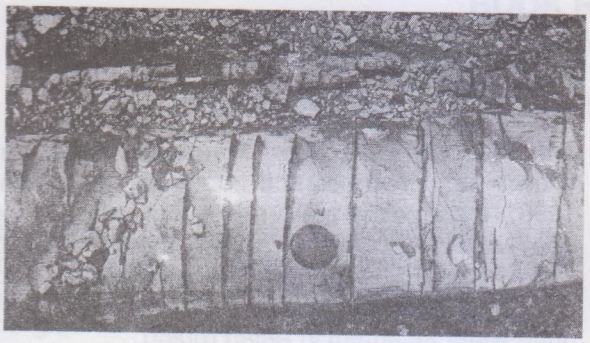


Figure 3: Intensely fractured sandstones.

Figure 4 (outcrop in a construction area) shows a sandy type of the alternation of sandstone and shale, while Figure 5 (exposure in a road cut) displays a shaly type. These sandy and shaly types could be interpreted that they were deposited as proximal and distal thin-bedded turbidite sandstones, respectively.



Figure 4: High frequency sand-shale alterations of proximal turbidite



Figure 5: Shale prone distal turbidite

Parallel lamination and low angle cross bedding are observed in the sand beds of the sandy type rocks as shown in Figure 6. Horizontal bioturbations or burrows are also recognized at its bottom as displayed in Figure 7. The brush in both figures is 5 inch wide.

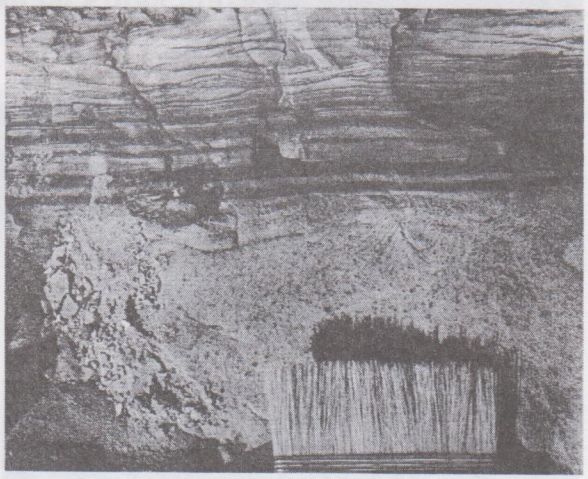


Figure 6: Low angle cross-bedding and horizontal lamination



Figure 7: Horizontal bioturbation at the sandstone base

Figure 8 is an example of thickening and coarsening upward sequence that was exposed in a road cut. Although deep-water turbidite deposits are much less commonly characterized by this pattern (coarsening upward)(Posamentier, 1999), this pattern could still be observed at the distal edge of a seaward-building turbidite lobe deposit (Posamentier, 1999).

As opposite of Figure 8, Figure 9 displays an outcrop that was exposed in another road cut showing 3 thinning and fining sequences of very fine to medium grained sandstones. This outcrop could be interpreted to be deposited at the distal of leveed channel.

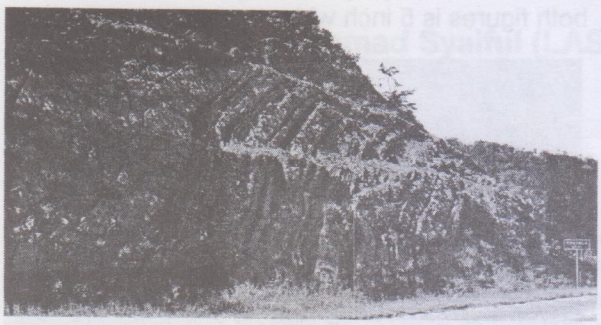


Figure 8: Thickening and coarsening upward sequence



Figure 9: Thinning and fining upward sequence

Conclusion

Although West Crocker Formation have not shown any hydrocarbon potential (Crevello, 1999), these rocks are an excellent example for deep-water deposit. It is a very good chance to visit its outcrops, especially for geoscientists who are being active in a petroleum exploration of deep-water sediment in Asian region.

References

Crevello, P., 1999, Turbidite and Deep-water Depositional Systems Field Trip, NW Borneo, Petroleum Geoscience International Field Trip Guidebook, 61 p.

Posamentier, H.W, and Allen, G. P., 1999, Siliciclastic Sequence Stratigraphy – Concepts and Applications, SEPM Concepts in Sedimentology and Paleontology #7, 210 p.

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