The ethological study of *Glossifungites* ichnofacies in the modern & Miocene Mahakam Delta, Indonesia

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INTRODUCTION

The *glossifungites* facies is an ichnofacies which represents an assemblage of burrows that occur in firm, -not lithified- ground. Some geologists believe that the presence of a *Glossifungites* ichnofacies surface is an evidence of a break between erosion and deposition (Pemberton & MacEachern, 1995), which is a boundary of a sequence stratigraphic unit.

Although firm ground assemblages are well understood, the *Glossifungites* ichnofacies concept generates some debates amongst geologists (Gingras et al., 2000), because firm grounds represent intermediate gradational state between soft ground and hard ground. The level of compaction and dewatering of substrate are varies and controlled by different factors.

Arifullah (2005) studied *Glossifungites* ichnofacies in East Kalimantan, which are common in both modern and Miocene Mahakam Delta system (Figure 1). The identification of *Glossifungites* ichnofacies in this study is based on ethology and morphological observation of the bioturbations.

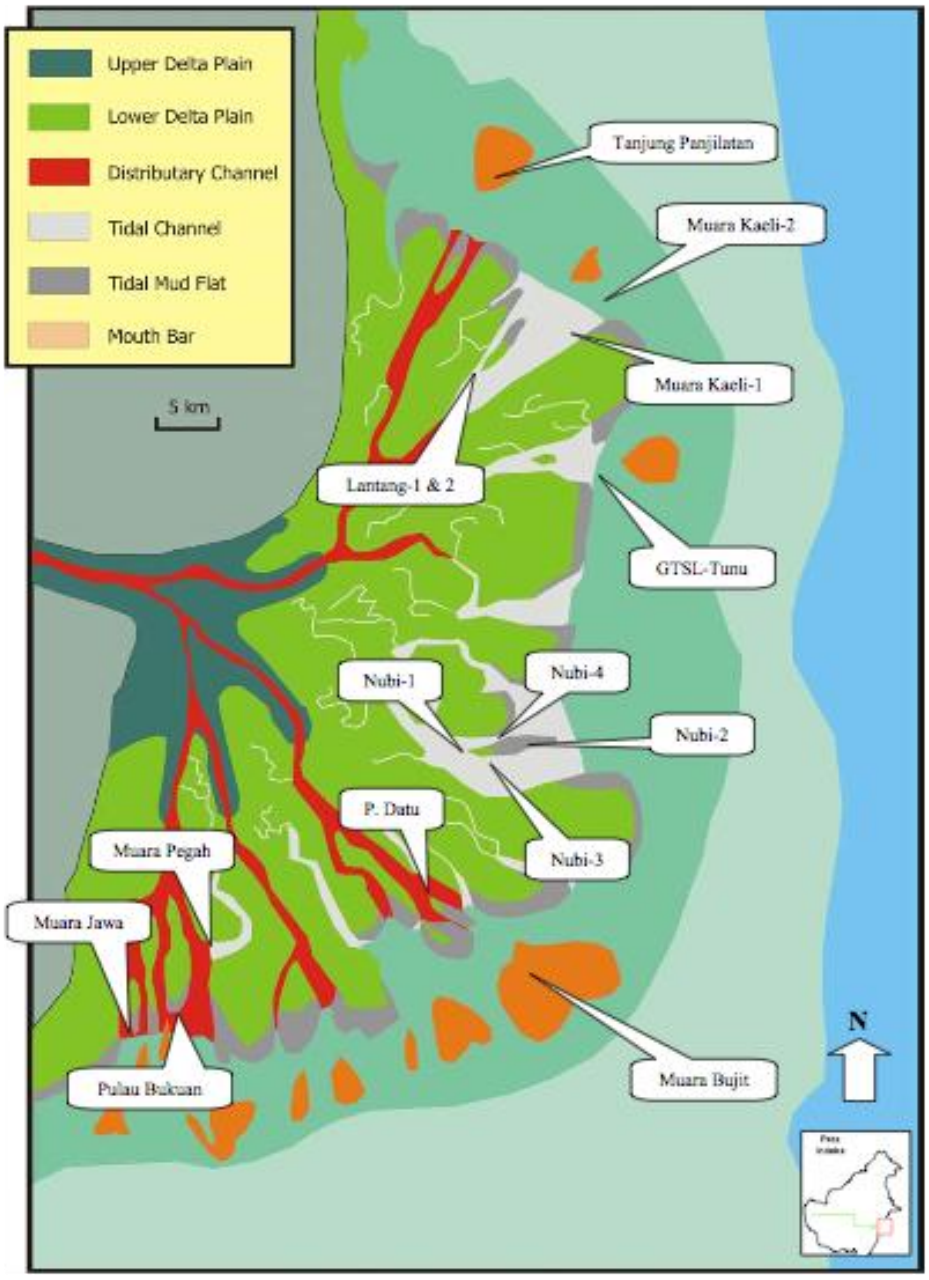


Figure 1. *Observation Map of Modern Mahakam Delta, Glossifungites ichnofacies findings was located at Lantang-1 & 2 (After Arifullah, 2005).*

MODERN MAHAKAM DELTA

Lantang Island is located in the north of modern Mahakam Delta (Figure 1). In this island, Arifullah (2005) has identified a location with high index and diversity of bioturbations. On the ichnofacies distribution map (Figure 3), Lantang Island and surrounding area have the highest variability of ichnofacies. *Skolithos*, *Cruziana* and *Zoophycos* ichnofacies, which formed *Glossifungites* ichnofacies assemblages are common in here.

Correlation of Lantang-1 to Lantang-2 cores give a better picture of the lateral distribution of sedimentary facies. Figure 4 shows the mud flat had been exhumed after the sandflat eroded. This mud flat - "Hm" lithofacies unit- is dominated by lenticular, wavy or tidal rhytmites mud.

The burrows of *Glossifungites* ichnofacies respond to substrate stability of firm ground. Such condition has made erosion opened unlined burrows and filled it with sand and shell fragment, which characterized *Glossifungites* ichnofacies. Meanwhile the firm ground, and the cohesiveness of "Hm" lithofacies would not be eroded easily as burrows without lining (construction without strengthen material, i.e. coarser materials) despite the high energy condition on the water column (Figure 5).

MIOCENE MAHAKAM DELTA

Glossifungites ichnofacies assemblage studied at Kesejahteraan Quarry, is associated with erosional surface sedimentary structure (Figure 2). This ichnofacies cross cut the pre-existing Hm lithofacies unit. A hummocky cross stratification sandstone unit was deposited on top of this ichnofacies surface (Figure 6). The surface of the *Glossifungites* ichnofacies could be observed up to 300 meters laterally. It could be used as bounding surface or parasequence surface for stratigraphic correlation.

The "Hm" lithofacies unit looks like soft ground ichnofacies, but the biota built vertical or semi vertical burrows ("J"-like) without lineing in the mud. Analogue studies on modern traces in Lantang Island with similar ethology indicated that the traces were developed in firm ground environment instead of soft ground.

CONCLUSION

The presence of *Glossifungites* ichnofacies indicate cohesive or more lithified substrate environment. Therefore, the presence of *Glossfungites* ichnofacies surface does not always related to sequence boundary, but more reasonable as event surface.

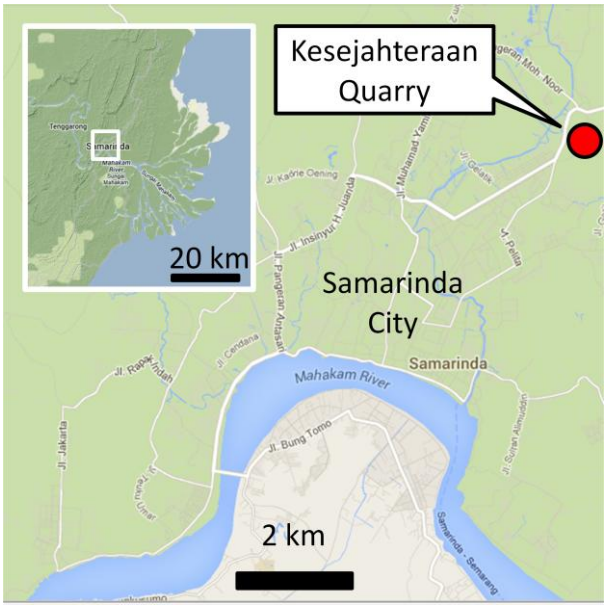


Figure 2. *Kesejahteraan Quarry in the suburb of Samarinda City. The cliff of the quarry could be determined up to 300 meters (from © 2013 Google Digital Globe).*

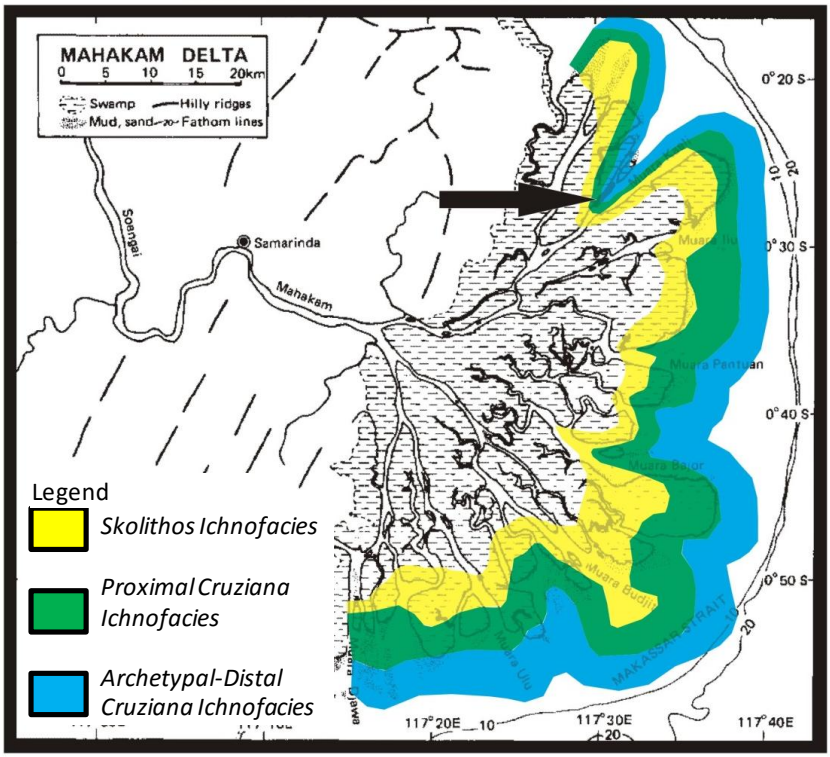


Figure 3. *Predictive ichnofacies distribution map of Mahakam Delta showing the ichnofacies distribution difference between the northern and southern part of Mahakam Delta. Cruziana ichnofacies has wider distribution at the delta front of southern part. Cruziana & Zoophycos ichnofacies distributed at the lower delta plain of the northern part. Lantang island (black arrow) is located in Archetypal - Distal Cruziana zone. Photograph by TOTAL E & P (After Arifullah, 2005).*

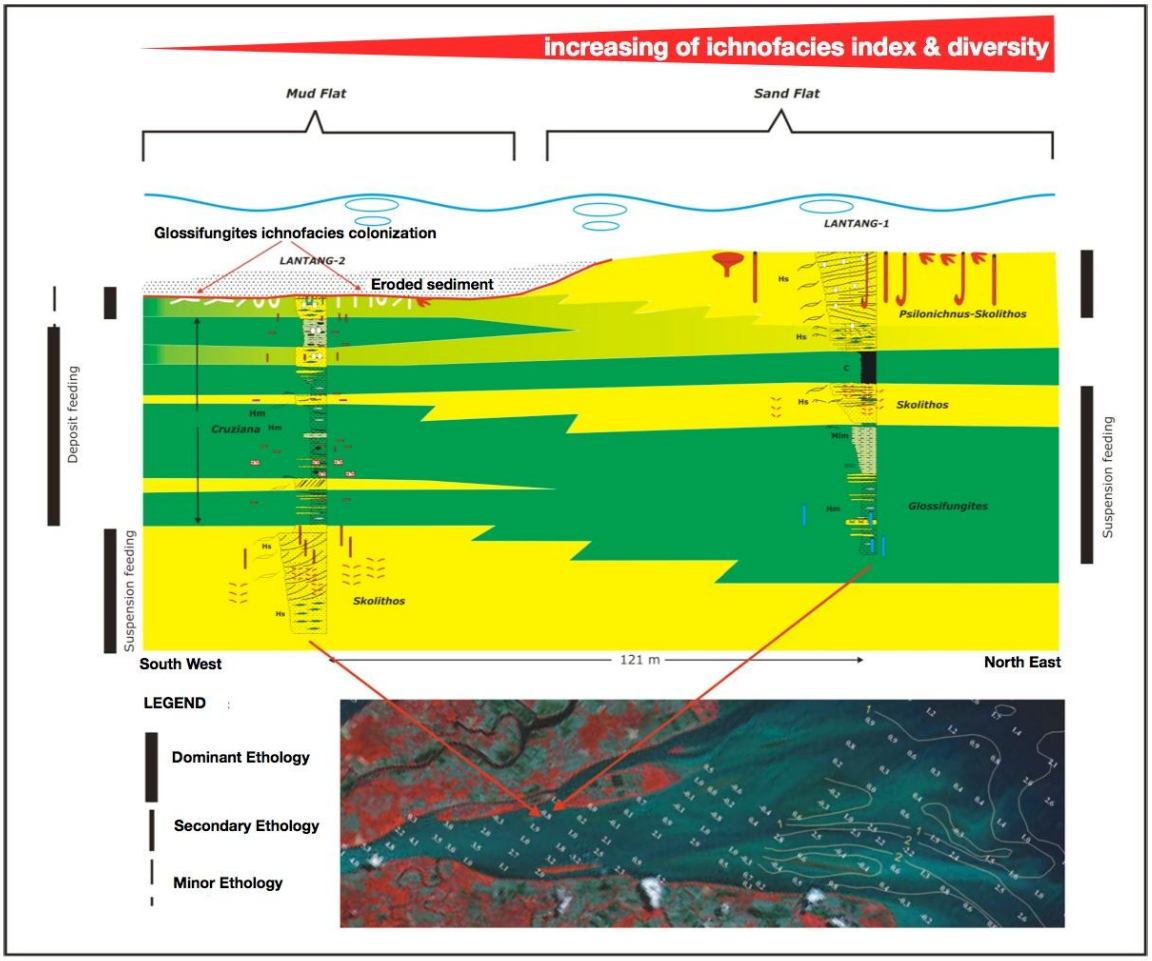


Figure 4. *Lantang island lateral and vertical profiles. It was observed that ichnofacies index & diversity increase to the mudflat. It was strongly different between mudflat that colonized by Cruziana ichnofacies and Skolithos ichnofacies colonize the sandflat. Glossifungites ichnofacies localized at the mudflat only (After Arifullah, 2005).*

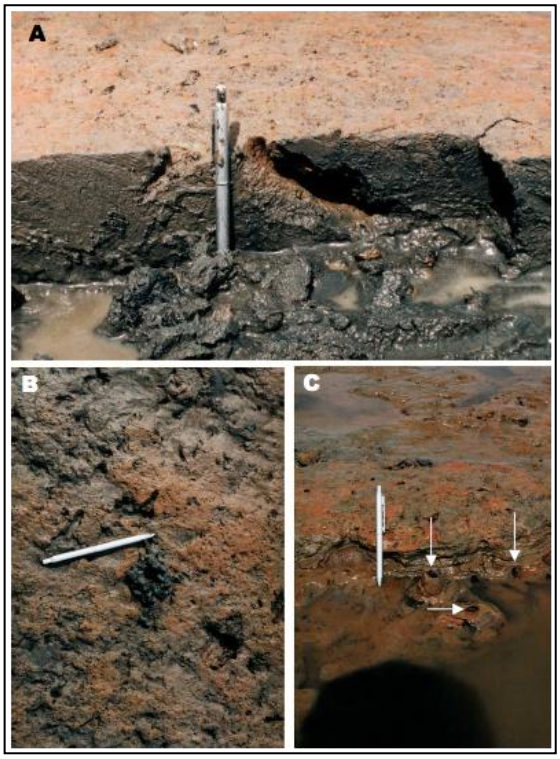


Figure 5. *Glossifungites ichnofacies: A) Skolithos, B) mud pellet excavation, C) Thallasinoides.Unlined construction used by organism to respond the firmground substrate (After Arifullah, 2005).*

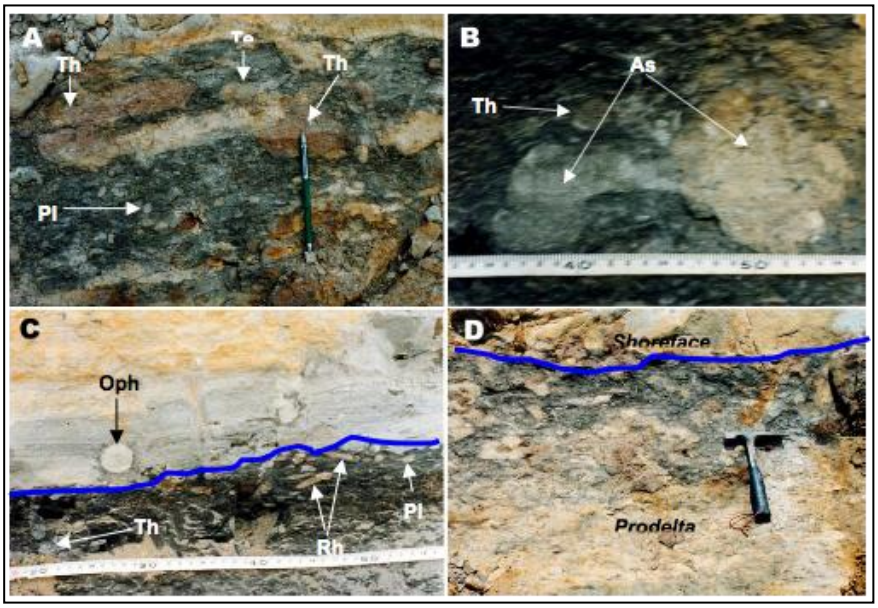


Figure 6. *Prodeltaic ichnofossil. A) Thallasinoides (Th), Teichichnus (Te), and Planolites (Pl); B) Asterosoma (As) and Thallasinoides (Th); C) Erosional structure (blue line) between prodeltaic deposit (bottom) and shoreface deposit (top). Prodeltaic deposit totally bioturbated by Rhizocorallium (Rh), Planolites (Pl) and Thallasinoides (Th), they are part of Glossifungites ichnofacies. Shoreface deposit colonized by Ophiomorpha (Oph) specifically (look at figure 7C). (After Arifullah, 2005).*

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REFERENCES

Arifullah, E., 2005, Karakteristik Ichnologi dan Sistem Pengendapan Delta, Studi Kasus: Delta Mahakam Modern dan Miosen Cekungan Kutai Kalimantan Timur: Thesis Program Magister, Institut Teknologi Bandung.

Bachtiar, A., 2004, Kerangka Stratigrafi Sekuen dan Karakter Batuan Induk Miosen Awal di Cekungan Kutai Hilir, Kalimantan Timur: Desertasi Program Doktor, Institut Teknologi Bandung.

Gingras, M.K., Pemberton, S.G., and Saunders, T., 2000, Firmness profiles associated with tidal-creek deposit: the temporal significance of Glossifungites assemblage: Journal of Sedimentary Research, vol. 70, No.5, p. 1017 – 1025.

Pemberton, S.G., and MacEachern, J.A., 1995, The Sequence stratigraphic significance of trace fossils: example from the cretaceous foreland basin of Alberta, Canada in Sequence Stratigraphy of Foreland Basin Deposits: J.C. Van Wagoner and G.T. Bertram (eds), AAPG Memoir #64, p.429-475.

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Southeast Asia



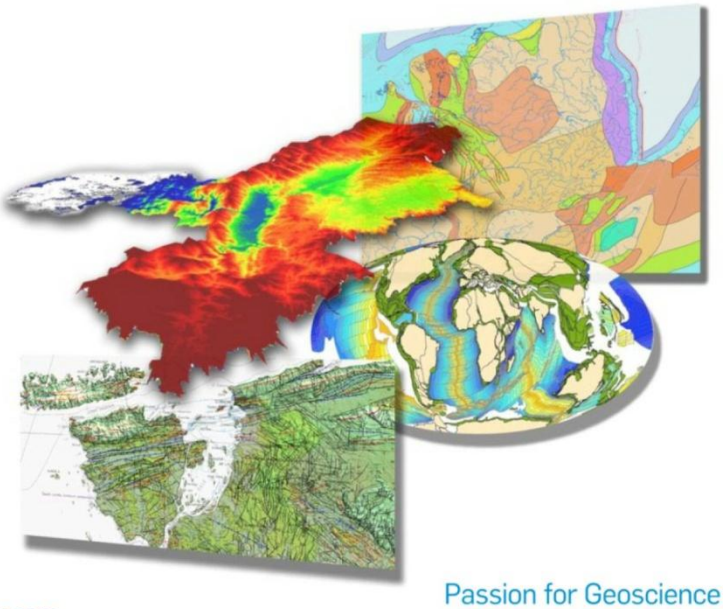
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