REPORT ON THE GEOLOGICAL FIELD TRIP TO MAHAKAM DELTA AND BALIKPAPAN BAY (AUGUST 31ST TO SEPTEMBER 4TH, 2018), ORGANIZED BY FOSI-IAS-SEPM AS PART OF REGIONAL SEMINAR: PAST & PRESENT SEDIMENTATION IN TROPICAL REGION

Report by Tri Handayani

Overview

The Mahakam Delta and Balikpapan Bay Field Trip was held on August 31st to September 4th, 2018 and lead by Dr. Erlangga Septama (G&G Advisor for Pertamina EP asset 5 at that time). Pertamina EP Asset 5 has carried out several fieldworks in the Mahakam Delta, Balikpapan Bay and surrounding area since 2013 to improve the understanding of subsurface reservoir geometry, internal architecture and potential sand connectivity in a less constrained style (e.g. surface outcrop vs. core or wireline log data). The study, as also our field trip; aimed to characterize the facies and stratigraphy of the deltaic sequence from outcrops and correlates them to the subsurface data in Sangasanga Field. This field based study is required to fill the knowledge gap due to the scarcity of the subsurface data in the existing oilfields.

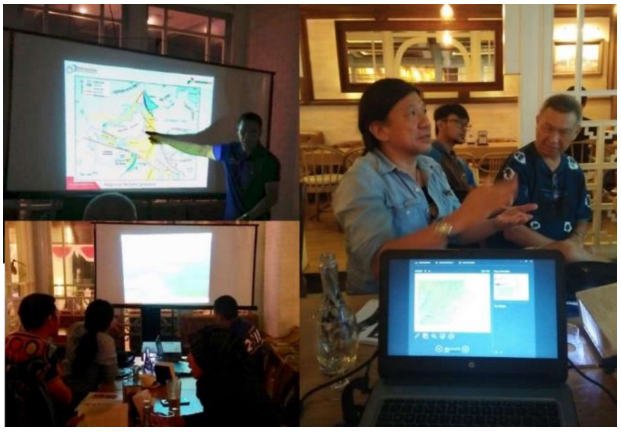

Figure 1. *The pre-fieldtrip presentation and evening discussion*

Day 1, Friday August 31, 2018, Arrival and preface

Prior to the trip commencement, participants were prepared with a guidebook and an opening presentation about subjects covered to pertaining what we will examine during the field trip, what is expected by the participants and several discussions over soto betawi and coffee and last but not least the safety briefing and overview of potential hazards during the field trip.

Day 2, Saturday September 1st, 2018, Boat trip around Balikpapan Bay

Our first day of field trip started by trip across the Balikpapan Bay using traditional long boat, where we head up to the first stop-site in the Pulau Balang approximately 17 kilometers northwest of Balikpapan City. All the way up to Pulau Balang we try to spot pesut (Irrawady dolphin, Orcaella brevirostris) by possibly sighting of their dorsal fin out of the water surface. Unfortunately there are no pesut encounter during that day, maybe because their population is declining into critically endanger species, less than 100 species remaining in the entire Balikpapan Bay and they are actively migrate inside and out of the bay.

Pulau Balang outcrop locality is a location type for Pulau Balang Formation (Tmpb in geology map). This stop-site is located in the middle of the Balikpapan Bay. In these localities we have visited two major exposures namely Pulau Balang Kecil and Pulau Balang Besar. Both exposures are northeast-southwest oriented and comprises of 1 hectares (33 x 320 meters) and 160 hectares (890 x 1800 meters) area respectively. The outcrops in Pulau Balang Besar mostly located on the northwest side of the island; most of the outcrop ridges are densely vegetated. The outcrop structurally lies on the western flank of the Samarinda anticlinorium and is steeply dipping (30-400) toward northwest. The purposes of the visit to this stop-site are to learn about the typical succession of the slope channel deposit, interpret the ancient slope setting via paleo-current measurement, and discuss about the possibility of this particular package as a a next exploration target in the subsurface Paleogene reservoir. The discussion about whether this outcrop is mistakenly interpreted as a deepwater deposit or not is also sparked by Dr. Guntoro and result in the further recommendation to elaborate the biostratigraphy data.

Second stop-site is at is located in Tanjung Jenebora, about 2 hours boat trip from Pulau

Balang complex, to study the modern deposit side bar. This stop-site actually is a contingency stop as a replacement for the Pulau Gusung stop-site that unreachable that day due to the rough wave. In this stop-site we are discussed about the construction of the side bar, whether the tidal and current or the terrigenous sedimentation took a major effect on the depositional. It turns out from the ripple mark direction and the fact that the rivers in Balikpapan Bay are mainly intermittent and no longer simultaneously deliver the medium grained sediment, we have assumed that the tidal effect is more dominant factor. To see the complete 3D profile of the bar deposit we also trenching perpendicular to the sedimentation direction. During the excavation, much to our - amazement, we found the remains of Cheetos plastic wrap that has been buried for more than 20 cm, explained of how rapid the sedimentation processes took place.

On the way back to Balikpapan City, we stop by to see bekantan (Proboscis monkey, Nasalis larvatus) colony in the primary mangrove forest in the one of the estuary area through tidal channel passage in Graha Indah complex. All the way down the forest canopy, those of us in the boat were entertained by the appearance of these funny looking monkeys in the river side and also the tale about the alpha male bekantan rumored by the 'ekowisata' guide.

Figure 2. *Balikpapan Bay activities, September 1st, 2018*

Day 3, Sunday, September 2nd, 2018, Modern Mahakam Delta

The focus of the second day is studying modern sedimentation in Mahakam Delta. All participants crossed the Mahakam Delta on a seatruck to the south-eastern promontory of distributary channel, through Sei Meriam, Tanjung Bukang area and Pulau Datuk, from head of facies through small distributary channel passage. Participants investigate the nature of the Mahakam Delta in situ through some observation such as the observation of vegetation change along the rivers, from lowland heterogenous forest to monospecific Nypa and Mangrove species, the morphology of channel and water depth using echo-sounder, the water-salinity using conductivity meter measurement, sedimentary grab sample in several channel sections (e.g. Sei Meriam, on the way to Tanjung Bukang and Pulau Datuk area) to observed its grain size, and on the distal end of the Mahakam delta plain, participants jump to the sub-aerial exposed mouth bar and do the sample coring in the mouth bar. Participants examined the sedimentary structures and textures that can be seen in the mouth bar and discussed about its process and mechanism. The main objectives of this second day cruise is to understand the geometry of the channel and the sediment deposit associate with particular facies and compare them with the ancient deposit from outcrops; and observe the sedimentation process on the modern delta system, including the tidal prism, hydrodynamic lift effect, and modern surficial sedimentary structures.

Figure 3. *Modern Mahakam Delta activities, September 2nd, 2018*

Day 4, Monday, September 3rd, 2018 Examine the complete system, from fluvial to deepwater outcrop around Samarinda

The final leg of this trip was spent in Samarinda City, studying the impressive ancient sedimentary deltaic units in four main outcrop complexes. The Stadion Utama is located in the Samarinda seberang area (southern side of Mahakam River). The 250 meters dip parallel outcrop is exposed on both sides of the main access toward the Stadion Utama Palaran. The outcrop display several repetition of deltaic parasequences and present a clear view of the deltaic facies changes from the fluvial dominated upper delta plain, to the strongly tidal influenced lower delta plain and delta front. This outcrop provides excellent opportunity to learn about the ideal deltaic succession without any significant erosional disturbance and also to observe various external controls on the depositional architecture, included morphology, biogenic and oceanographic aspect in the lower distributary and delta front area.

The succession at Palaran City Housing exposes a 120 meters thick dip view of a meandering fluvial point bar which is overlying the delta front mouthbar deposit (total succession is approximately 150 meters). This outcrop is interpreted as a fully terrigenous depositional system although in the middle and upper section seems to be characterized by a specific intertidal burrow. This terrigenous deposit is interpreted as a part of a large and extensive fluvio-deltaic depositional system that extend relatively west to east in the main belt of ancient Mahakam River system. Several phases of channel growth and abandonment are observed in the outcrop. The medium to large size lateral accretion and sedimentary structure such as trough cross bedding, planar cross bedding and current ripple is observed in the upper section of the outcrop.

In the third stop site we observed the Gunung Batuputih quarry from the distance. The carbonate platform and build up is inferred to be growth along the structural paleo-high ridge adjacent to the shelf break. In the eastern extend of the outcrop, shallow marine to the shelf break stratigraphic succession is observed and could be clearly visible as a paleo-landscape if observed from hills west of the Gunung Batuputih. The slump feature, limestone debris and boulder in Green Palm residence suggest the slope depositional settings. The outcrop consists of thick (more than 100 meters) shale deposit, with locally thin silt and sand ribbons. The large carbonate boulder is interpreted to be deposited as a mass transport deposit delivered directly from the shelf break to the deepwater basin.

The mud volcano is interpreted to be occurred in the prodelta to the outer shelf environment as a result of the loading effect of the overburden from thick sediment. The mud-flow mostly travels along the weak zone such as thrusting zone or anticlinal crest. The mud volcano in Batuputih has dated equivalent to the Early Miocene (N6), with benthic foraminfera typical to the bathyal paleo-environment, thus represent the oldest and the deepest depositional system compared to the entire stratigraphic succession in our study area
The trip to mudvolcano was also complement with the visit to current ripple mark outcrop in the side-road of the North Samarinda ring road. The approximately 4 meters high outcrop exhibit an excellent and well preserved ripple marks, primarily sinuous to linguoid shaped ripple appear as a tongue like projections point to the current direction. In this stop-site, participants are tried to compare one that they have observed yesterday in the modern mouthbar deposit.

Finally, we are concluded our trip in Grand Taman Sari Kalan circuit outcrops. This outcrop exposes an ideal succession of fluvial-deltaic in the lower part to marine deposit in the upper part. This outcrop is a good example of the fast changing depositional environment and could become a “miniature laboratory” that represents the entire sites we had visit during the last 2 days (minus the deepwater system). In this outcrop we did a small exercise on the stratigraphic measuring section, sequence stratigraphy and system tract. In order to ease the learning processes, we are using the high resolution landscape photography of the outcrop where participants could draw and overlay their idea of interpretation on it. The trip was closed by wrap up presentation and discussion to review and conclude the whole section we visited during this three days.

Day 5, Tuesday, September 4th 2018

The group hit the road back to Balikpapan City and finally flew to Yogyakarta and attends the FOSI-IAS-SEPM as part of Regional Seminar: Past & Present Sedimentation in Tropical Region. FOSI-IAS-SEPM would like to thank to the trip leaders Dr. Erlangga Septama, and all participants for their enthusiasm, shared expertise and initiation of scientific discussions which sometimes lasted through the night. Finally, feel free to visit FOSI-IAGI website to know more about our activities. (www.iagi.or.id/fosi/).

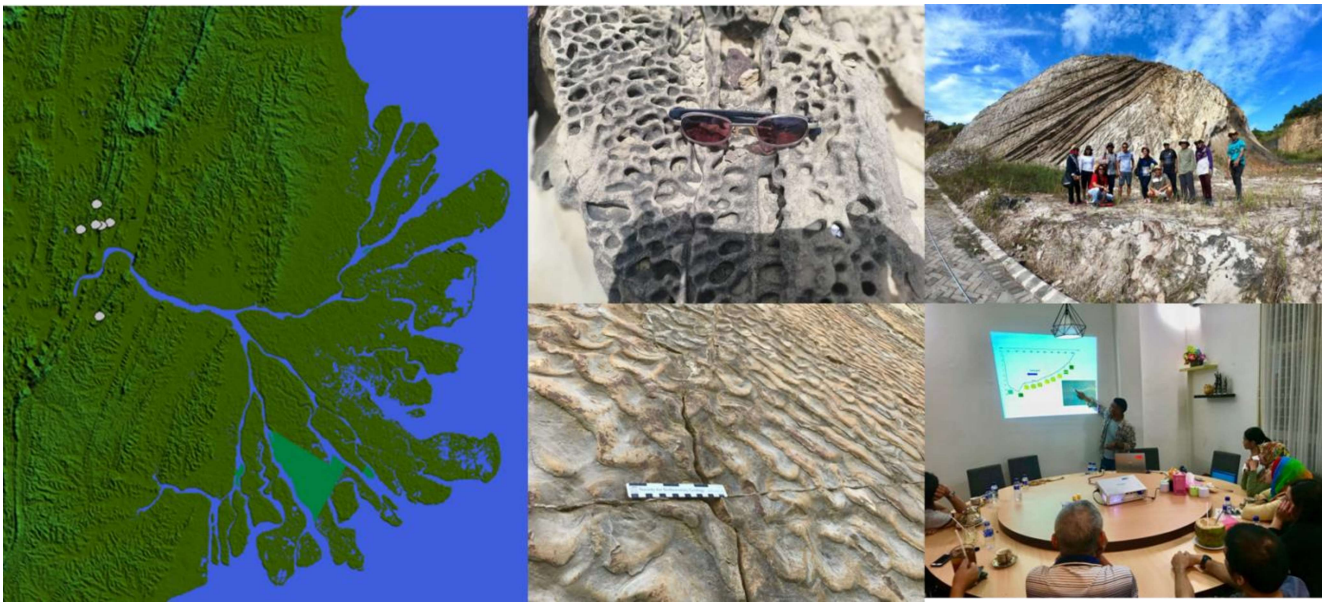

Figure 4. *Ancient Delta outcrops in Samarinda City, September 3rd, 2018*

Disclaimer: the information present in this report is not confidential and summarized accordingly. Please find the associated field trip guidebook for more detailed information about each visited sites.