Outcrops Conservation of Tanjung Baru or Lower Talang Akar Formation, Baturaja City of Palembang Area - South Sumatra Basin: How important?

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ABSTRACT

Tanjung Baru Formation only outcropped in one location so called Tanjung Baru, Palembang, South Sumatra. In total this formation is expossed in an area of about one acre. The outcrop is a quartz sandstone quarry, which has become smaller in size rapidly because of intensive mining activities by the local community. The formation is also called Gritsand Member (GRM) of the Lower Talang Akar Formation/Lemat Formation/Lahat Formation. A different name from Talang Akar Formation was given to this formation because it has an important role in the tectonostratigraphy context. Tanjung Baru Formations has different genetic, location and section type from that of Talang Akar Formation. The formation consists of conglomeratic sandstone of channel deposit. The sections indicate five times of channeling with each channel has a geometry of 20 m long and 9 m thick. This lag sedimentary deposit consists of fine- to very coarse-grained sandstones. The erosional base contact has polymictic conglomeratic sandstone outcrop with gradded bedding and planar crossbedding that indicate high energy deposition like channelized environment in shallow marine. The fining upward succession was a result of lateral accretion of channel shifting or a fluvial channel system depositional environment. The very fine sand of channel plug was deposited in a very low energy environment before the channel was abandoned. Some parts have shaly and coal streaks with mafic and feldspatic minerals. This formation has an indication to be an excellent reservoir.

The geology of Tanjung Baru Formation is an important object to study because it is the one and only outcrop that needs to be conserved. The objective is to save this outcrop from extinction. A socialization to the Governor of South Sumatra Province and Head of Palembang Regent needs to be done. The government has to create a regulation to stop the mining activities, build a boundary for the outcrops with plantation and put an information board to explain that it's a conservation area. Let all geology students and also people of all generations to have a possibility to learn Tanjung Baru Formation from this outcrop as a geopark.

Introduction

Hydrocarbon production in the South Sumatra Basin is ranked at the 2nd place after Kutei Basin in term of total productions. The primary reservoirs are within the Talang Akar, Baturaja and Gumai Formations and a smaller amount in the fractured basement. The uplifted areas and paleohighs, including the Mesozoic and Eocene fractured and weathered basement granite and quartzite, are effective reservoirs in ten fields in South Sumatra with gas reserves totaling 106 MMBOE ultimate recoverable reserves (Sardjito, et al, 1991; Petroconsultants, 1996). This fact is very important and it is therefore absolutely urgent for the goverment of Baturaja District, South Sumatra Province to conserve and to protect the outcrops of the Lower TAF. The outcrops have very important value to Earth Sciences and exploration in geology, mining and petroleum engineering. The aim of the conservation is to avoid outcrop mining for other purposes.

An integrated study (fieldtrip and core analysis) was held by P.T. Medco E&P Indonesia (PT. MEPI) for the Graduate Geoscientists Training 2-2008 at sections Baturaja-Muara Dua-Palembang and Palembang Core Storage. The methodology of outcrop description has been conducted for the basement rocks to the top formation in South Sumatra Basin.

The Lemat (Old and Young) Formation has outcropped in the sandstone quarry at Tanjung Baru (proposed as locality type and strato type) and Napalan river in Baturaja City, Palembang, South Sumatra Province. The outcrop of Lemat Formation is found in Tanjung Baru Sandstone Quarry (TAF equivalent the Gritsand Member). The siliciclastic sediments outcropped in this area should be named Tanjung Baru sections or stratotype and it is also the type locality of Tanjung Baru Formation. The location where the best siliciclastic sediment outcrop exists is almost 1 km south of the Baturaja town (Figure 1).

The promotion of GRM into Tanjung Baru Formation is necessary due to its tectonostratigraphy importance. Hutchinson (1996) concluded that the Eocene to

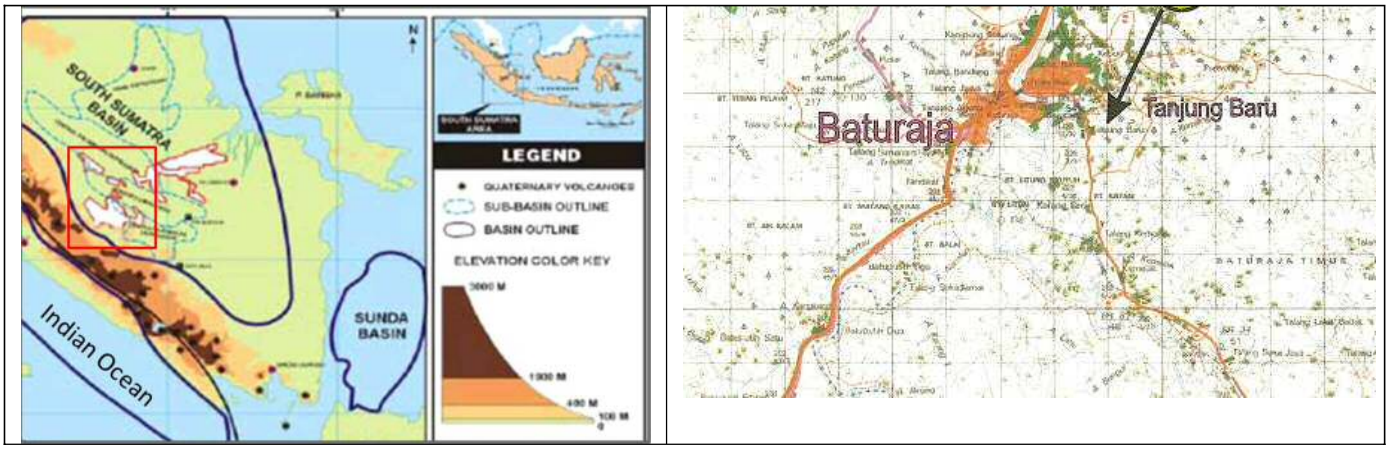


Figure 1. *Left: South Sumatra Basin configurations. Right: Quarry location of Tanjung Baru sandstone outcrops (See arrow)*

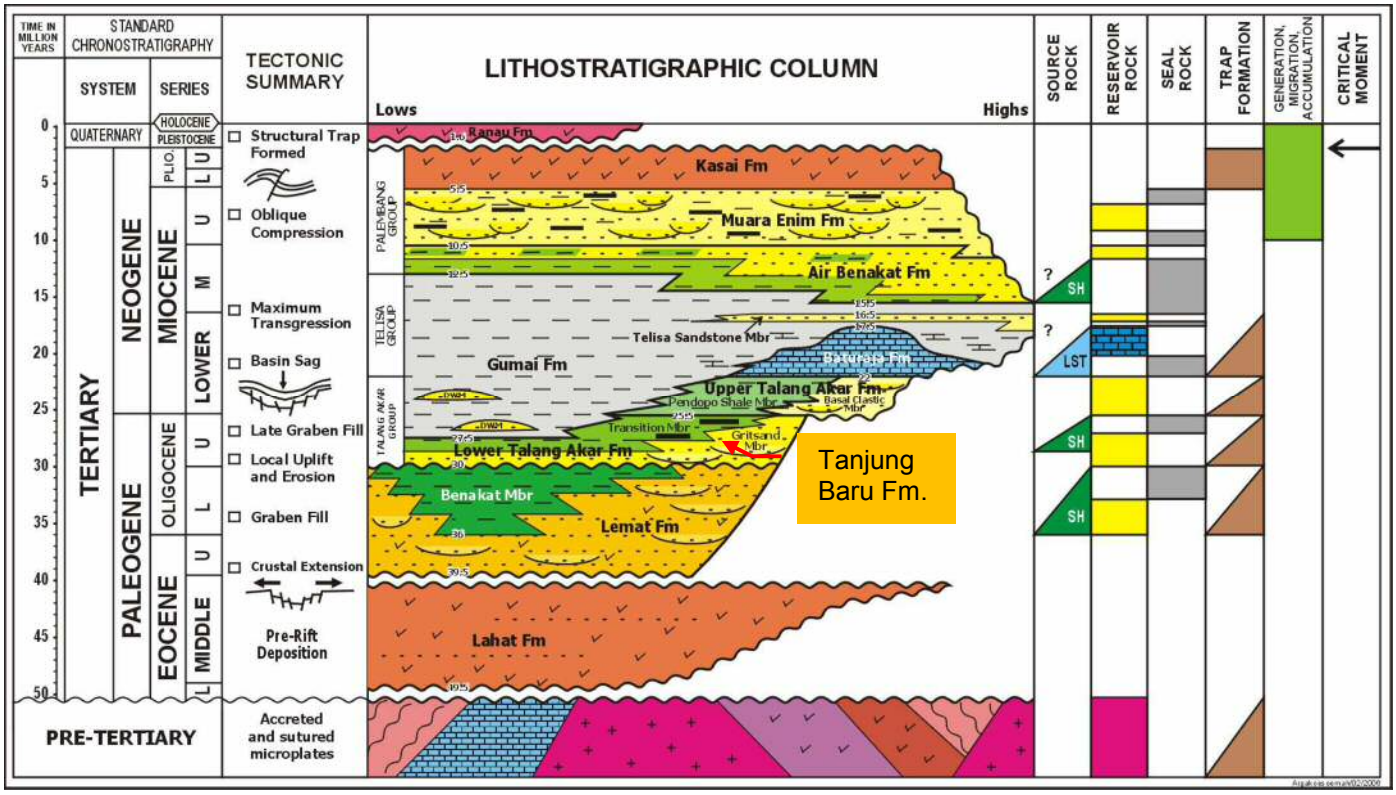


Figure 2. *Regional Stratigraphy of South Sumatra Basin (Argakoesoemah and Kamal, 2005). Stratigraphic position of Lemat Formation or Tanjung Baru outcrops*

Oligocene Lahat Formation is composed of synrift deposits that are as much as 700 - 1,070 m thick. The formation was deposited in continental, lacustrine, and brackish lacustrine depositional settings. This reservoir accounts for nearly 88 MMBOE of ultimate recoverable reserves (Petroconsultants, 1996). The oldest facies of the Young Lemat is granite wash overlain by coarse clastic deposits consisting of sandstones and breccias with abundant rock fragments, claystones, coals, and tuffs (Hutchinson, 1996).

Firstly, the proposed name of Tanjung Baru Formation is an increase from a member status of the conglomeratic quartz sandstone of Lower Talang Akar Formation (Ryacudu, 2005) or the Gritsand Member (GRM). However, the upper member of the Talang Akar Formation called the Transition Member (TRM) is included the Talang Akar Formation. Lithostratigraphically, in accordance with SSI (1996), the complete outcrop of Tanjung Baru Sandstone should be determined as Tanjung Baru Formation because of the lithology, mappable, stratigraphic contact and either lateral or vertical distribution.

Every year, the outcrops have less volume due to mining by thelocal community. These highly valuable outcrops of the Tanjung Baru Formation have given stratigraphy and sedimentation models the Oligo-Miocene age has had outcropped. The outcrops have just one complete section as type locality and strato type. They have excellent porosity and permeability and are analogues to the reservoir rocks in the South Sumatra Basin. The comparison with tonase economic value for mining, the quartz sandstone remains about 1000 m3. The outcrops should be very rare therefore it is crucial to be conserved and protected.

Geology of Baturaja

The South Sumatera Basin is one of a series of Tertiary back arc basin located in Sumatera and Java. The basins occupy a geologic position between the stable micro-continental block, known as the Sunda Platform, and the active subduction zone caused by the northward moving Indian Ocean Plate. The basin was formed during the Eocene-Oligocene when a series of northerly trending grabens developed in response to east-west interplate extensional movements. These grabens were filled with locally sourced volcanoclastics sandstones and shales of the Lemat Formation in depositional environments ranging from alluvial fan, to fluvial and lacustrine.

The geology of the studied area, particularly the Musi Platform, is a structural high area formed during the Eocene-Oligocene graben-forming period. It appears to behave as a rigid structural block through most of the Tertiary. There is direct evidence to which the area has been subjected to widespread deformation. To the west, the platform gradually shallows due to uplift associated with rising volcanic arc. Baturaja Limestone is exposed at the foothills of the Gumai Mountains. The northwestern and southwestern margins of Musi Platform are controlled by major faults which bound the Eocene-Oligocene grabens. The northeastern edge of the block is in the present day Lematang Trough, a syncline between the Musi Platform and the Plio-Pleistocene Lematang fault which has thousands of feet of overthrusting from the north. Seismic interpretation of the Lematang Trough that forms the northeastern margin of Musi Platform is limited by its proximity to the overthrust fault.

Stratigraphy

The Tertiary succession overlying the Mesozoic metamorphic basement consists of Lemat Formation filling the early half grabens, unconformably overlain in turn, by Talang Akar Formation, Baturaja Limestone, Telisa Formation and Palembang Formation (Figure 2).

Lemat Formation







Figure 3 *(Upper) Outcrops of Tanjung Baru quartz sandstone quarry of Lower Talang Akar (TAF)-Baturaja City of Palembang. (Lower) Left: The outcrops has been dug and remains mining's tools track. Right: Planar cross bedding of quartz polimictic conglomeratic sandstone.*

Within the Musi Platform, the Lemat Formation consists of volcanoclastic sandstones and shales, typical of the unit. The formation is also known from the graben areas around the platform and has been intersected in wells in the Pigi Trough, to the north, and in the Saungnaga Area, to the southwest.

Talang Akar Formation

As the subsidence associated with graben formation waned during the Middle to Late Oligocene, the interbedded sandstones, shales and coals of Talang Akar Formation were deposited across the South Sumatra Basin. This unit was derived from the northeast based on the compositional imprint of its granitic source areas on Sunda Platform. A general depositional environment sequence from fluvial in the northeast, to deltaic and later basinal facies in the southwest can be reconstructed from sedimentological and paleontologic evidences. There are evidences of cyclic deposition within Talang Akar Formation providing excellent hydrocarbon reservoirs. The organic rich shales and coals of the Talang Akar Formation are considered to be the major oil source for reservoirs in this unit and the overlying Baturaja Limestone. The thicker areas of deposition continued to be controlled by more rapid subsidence over the Oligocene grabens, and as with Lemat Formation, deposition was either thin or non-existent on the structurally higher platform and horst areas.

Generally over the Musi Platform, the Talang Akar Formation or Baturaja Limestone lies unconformably on pre-Tertiary basement. Talang Akar Formation is interpreted to be a lacustrine unit deposited on the eroded basement surface. It is separated from the more typically sand-prone Talang Akar Formation deposited on the eastern side of the basin, by the deep water, shaly sediments which fill Benakat Gulley. Because of its isolation from the coarse clastic sediment source to the northeast, the Talang Akar on the Musi Platform represents an environment which is typical for the deposition during this period. Pre-Telisa clastics in the Pigi Trough are often tuffaceous and usually lack of good reservoir quality. As the basin continued to subside during the lower Miocene, deposition of the predominantly non-marine Talang Akar Formation was replaced by widespread marine deposition of the Telisa Formation.

Tanjung Baru Formation Outcrops

1. Lithology and Stratigraphic Positions

The outcrop of Tanjung Baru Formation consists of fine- to very coarse-grained sedimentary rock. It has almost 100 m wide and 20 – 25 meters thick (Figure 3) and consists of clean quartz conglomerate sandstone, quartz sandstone, siltstone and intervals of coals without fossils. Their stratigraphic position is determined at the lower part of Talang Akar Formation by fault and erosional or unconformity contact to the Upper Oligocene Lahat Group. The presence of paleosoils and basal conglomerates indicates an unconformity contact. So, the Tanjung Baru Formation or Lemat Formation is approximately Lower Miocene in age.

Quartz conglomerate sandstone; grayish white color, medium sand to granule grain size, moderate to poor sorted, subangular - subrounded, matrix supported, polymictic conglomerate with quartz dominant as the fragments, non calcareous, rare basalt and andesites, feldspar, carbon and mafic minerals; matrix: quartz, opaque minerals; silicates cements, 4 – 6 meter thickness. Observed sedimentary structure includes graded bedding and in the base there is an erosional base contact. This outcrop has initial dip oriented to northwest (N230 o E/30o). Sediment succession of the upper

part of the Lag Deposit Sandstone (Figure 3) has planar cross bedding structure, channel plug (very fine grain size) and some fractures (uncemented, loose) and shows a fining upward sequence (Figure 4).

Quartz sandstone; white, fine – medium sand, grain-supported, moderate to poorly sorted, and subangular to subrounded, quartz (abundant), some parts are siltstone of a few centimeter thick. The light grey siltstone with silicate cement and without fossils is distributed in the upper part of the fining upward sequence. Coals have been found occasionally and they are a few centimeter thick.

2. Depositional Environment

Non calcareous sandstone with planar cross bedding structure, and fining upward sequences that shows decreasing energy towards the top can be interpreted as a fluvial channel system depositional environment. It shows at least four depositional sequences which conglomerate as a lag deposit and very fine sand as channel plug which was deposited in a very low energy deposition before channel was abandoned.

Based on the planar cross bedding sedimentary structure, the sandstone was deposited by traction current mechanism and was influenced by highly turbulent current (Allen, 1988). In the bottom conglomerate, there was an erosional base-contact which indicates that this sandstone was deposited in highly erosional processes environment such as in channelized environment (Selley, 1970).

The conglomerate at the bottom of this sequence is predicted as lag deposit which is channel floor deposit, while fining upward succession is the result of lateral accretion of channel shifting (Selley, 1970). Based on all of interpretations, it is concluded that the sandstone was deposited in braided channel which have five, observed channel shifting. This sandstone has an excellent reservoir quality.

Genetically, the development of Tanjung Baru Formation (Gritsand Member) mostly differed to the TRM Member: the channel sediments that filled in rift basin after syn-rift phase. Tectonostratigraphically, the terminology called: immediate post-rift (Prosser, 1993) or passive rift fill; however Talang Akar Formation (TRM) as a transitional deposits to shallow marine. It characterized an early regional transgressive phase in the South Sumatra Basin. This formation's development is restricted in the deep zone, but the Talang Akar Formation is in the platform or basin margin.

3. Outcrop Conservations

The outcrop of Tanjung Baru Formation (Early Miocene) has been characterized as lithology of excellent reservoir. It is very ideal and urgent to be conserved. The aims of the conservation are as follow: a). a very rare of ideal reservoir characterization for HC production in the basin; b. Tanjung Baru Formation has ideal channel system sedimentation; c). as a learning object for old reservoirs in the South Sumatra Basin. In contrast, the sandstone mining will extinguish the formation records.

Particularly for learning object, the local government is as follow: Governor, Head of Baturaja Region (Bupati) have to stop the sandstone quarry. It is very urgent to protect and create regulations to stop the mining. The outcrop should be proposed as a Geopark. Actually, it is necessary to have plantation surrounding the outcrops.

Acknowledgment



***Figure 4**. (Upper) Left: Tanjung Baru Formation is found at least four (fining upward) sequence of sandstone. Right: Conglomeratic sandstone of channel deposit in Tanjung Baru sandstone quarry. (Lower) Left: Siltstone of channel deposits, about 10 cm thick in between the massive quartz sandstone. Right: Lag deposits of channel, with thin orientation of quartz pebble in between the massive quartz sandstone.*

My thanks to the Management of (PT. MEPI), Mr. Edi Bambang Setyobudi, Mr. Asril Kamal, Mr. Dindot Subandrio and Graduates Geoscientist Training (GGT 2008) for their valuable suggestions, supports and discussions.

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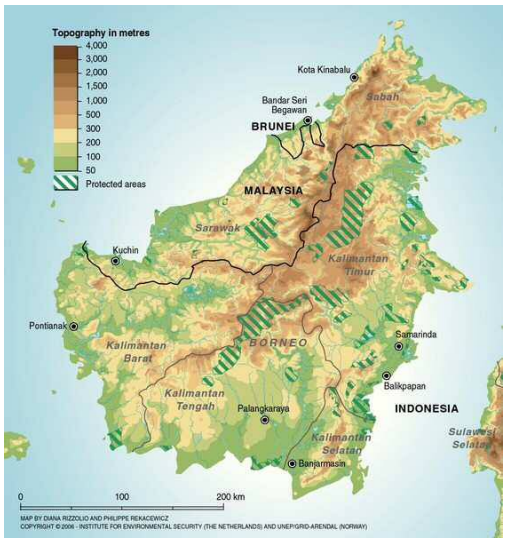
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Berita Sedimentologi #21 Borneo

The next bulletin will focus on Borneo. Several articles are being prepared to cover the basins under Indonesia, Malaysia and Brunei territory Typically the articles will cover outcrop and field works, seismic related article, and book review. You are welcome to contribute articles. Please get in touch with the editors.