EVIDENCE OF PLIOCENE-PLEISTOCENE UNCONFORMITY IN EASTERN BOGOR TROUGH, SUMEDANG-WEST JAVA

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ABSTRACT

Recent measuring stratigraphic observation in Cikandung River has revealed the Late Pliocene stratigraphic and tectonic event. Research area is located in easter Bogor Trough. Previously, it was stated controversially pertaining to the stratigraphic relationship between Kaliwangu and Citalang Formations. The outcrop-based remark has never been explained, slightly intuitive. Making strike and dip measurements and stratigraphic analysis using tape and compass traverse were done to unveil the role of Plio-Pleistocene tectonic regime in stratigraphic-filling of the basin. Strike azimuths recorded from several locations of Citalang and Kaliwangu Formations show angular geometry and both of those sedimentary facies within formations indicate the significant and rapid change in depositional process. But interestingly, the angular geometry is only founded in the southern part of study area. To the north, angular relationship becomes parallel. This geometrical distribution implies the strong influence of tectonic regime in Late Pliocene interval. The evidence from outcrops observation conclude the unconformity between Citalang and Kaliwangu Formations.

Keywords: Stratigraphic unconformity, Citalang and Kaliwangu Formations, Plio Pleistocene Tectonic

INTRODUCTION

In Martodjojo (2003), regression pattern of Cicauh Member is part of Subang Formation. The depositional regime of Subang Formation is interpreted as the result of transitional environment, that was tidal-flat. Meanwhile, Kaliwangu Formation is the upper part of tidal-flat environment and Citalang Formation is non-marine depositional environment. Endarto (1976) mentioned the lower boundary feature between Citalang and Kaliwangu Formations is marked by the presence of conglomerate. This conglomerate has been ever studied by Ludwig (1933). At the other sites, the contact between the Kaliwangu and Citalang Formations is similar to that just described, but it lacks the black claystone (Rizal, 2004). Ludwig (1933) intepreted the unconformity between Kaliwangu Formation and Citalang Formation, in contrast, Endarto (1976) argued that boundary is interpreted as diastemic surface.

All of the formations mentioned have been faulted and folded (Djuri, 1973; Noer Azis, 1993) and most of the layers dip between 40^0 and 75^0 (Rizal, 2004). In physiographic zone, the study area is located in Bogor Zone. The Bogor Zone is mainly composed of Neogene sediment. This zone is complex belt, consisting of anticlinorium to the east and Neogene folded and faulted rock. The core of those structural feature is appearantly inherited by Miocene sediment with lower up to upper part of Pliocene and Pleistocene sediment on the limb of anticlinorium.

In previous studies, the last tectonic period affecting in the research area is Plio-Pleistocene Tectonic. However, the younger sediment at Citalang Formation indicates neotectonic involvement to the later period. The low angle-structural dipping observed in Citalang Formation outcrops are widely spread in the eastern Bogor Trough. Also, the depositional environment from Kaliwangu Formation to Citalang Formation changed to be shallowing facies, from shallow marine environment to non marine environment. The shallowing facies change is also possible due to normal regression or forced regression as the compensation of sea-level drop or tectonic enforcement. All of these genetic scheme is obviusly exciting to have comprehensive conclusion.

REGIONAL GEOLOGY

Regional geology of research area had been ever mapped previously (van Bemmelen,

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1949; Silitonga, 1973; Martodjojo, 2003). Based on Stratigraphic fence diagram of Rajamandala–Purwakarta and–Paparan Sunda, research area is located in eastern Bogor Trough (Figure 1). The oldest formation is Early Miocene of Cibulakan Formation that consist of sandstone, marl, and limestone, overlain by Middle Miocene of Parigi Formation. The following formation is Subang Formation that characterized by shale and Kaliwangu Formation with the assembalge zone of mollusc bed as the main feature. The sedimentation in Pleistocene Citalang Formation was interupted by volcanic event, laharic debris-flow, of Tambakan Formation. The Kaliwangu Formation was deposited in the eastern part of Bogor Trough (Martodjojo, 2003).

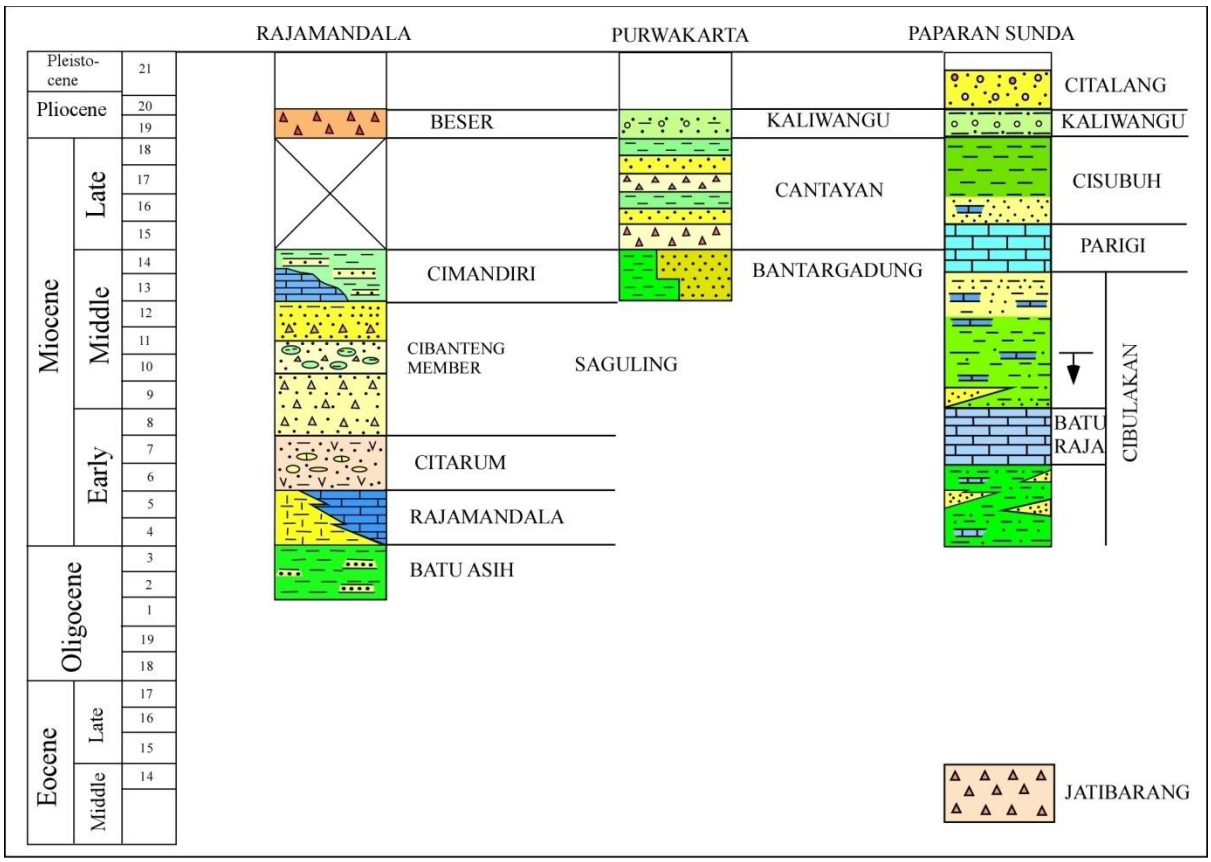

Figure 1. Stratigraphy of Rajamandala–Purwakarta–Paparan Sunda of Bogor Trough (modified from Martodjojo, 2003).

Tectonic of Late Miocene might be said to be more active than previous period. Koesoemadinata (1963) has divided Bogor Zone into five region based on structural geology constraint, the northern Banten Zone, Bogor and Purwakarta Transition Zone, the narrow zone between Purwakarta and Majalengka, surrounding region of Mount Ciremai and several region of Central Java. Cikandung River is in part of the narrow zone between Purwakarta and Majalengka. Moreover, Koesoemadinata, (1963) set out criteria reflecting structural zone;

1. Anticline known as Cidadap Formation that equal to Subang Formation (Sudjatmiko, 1972; Djuri, 1973; Silitonga, 1973) as the oldest formation within folded rock and Kaliwangu Formation as its limb of anticline
2. Steeply dipping of northern limb of anticline than southern limb formed monocline to the south
3. Going to the east, folded formation is being thrusted and folded which spread over more than 70 kilometers in northwest-southeast from Subang to Ciremai
4. Transversal fault in north-south direction and perpendicular to the folded formation.

Based on those zonation, it could be shown that Bogor Zone has undergone two tectonic period, there were Mio-Pliocene and Plio-Pleistocene (van Bemmelen, 1949; Koesoemadinata, 1963). The Mio-Pliocene tectonic is development period of geanticlinal of Java in the south of Java Island with

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northing direction. This period occured after Middle Miocene of Cidadap Formation. It was proven by the unconformity between Cidadap Formation and Early Pliocene of Kaliwangu Formation (Silitonga, 1973) and Middle Pliocene of Citalang Formation (Sudjatmiko, 1972). The unconformity between Subang Formation and Kaliwangu Formation can be observed in the northern Bogor Zone.

The Plio-Pleistocene tectonic generated fault thrusting through the northern Bogor Zone as a longitudinal zone between Subang and Mount of Ciremai. This longlitudinal zone is well known as Baribis Thrust. The Baribis Thrust plays a role in the existence of strike-dip of Citalang Formation and a few of Kaliwangu Formation. To the easternmost and northernmost, the steeply dipping slope of Citalang Formation is commonly found due to thrusted by Baribis Fault.

One of the unconformities is recognized by the spatial distribution occurs in strike-dip pattern and the basal erosional surface in the lower Citalang Formation. These erosional unconformities have less regional extent than those spread out in other area of eastern Bogor Trough. The unconformity is only well developed locally in the southern part of Bogor Trough. The outcrops represent a critical and distinctive interval to be studied.

MATERIAL AND METHODS

Several rivers as a stratigraphic traverse are chosen that having downstream direction to the Cikandung main river. Using tape and compass traverse, two stratigraphic sections were done in Cipedes and Cikandung Rivers. Stratigraphic thickness in Cikandung River is 80 m and 42 m from Cipedes River. In Cikandung River, the stratigraphic traverse is in north-south direction, while Cipedes River occupies east-west direction. Strike-dip pattern and stratigraphic contact between Citalang Formation and Kaliwangu Formation was recorded in the stratigraphic section. The integration both in map (Figure 2) and section assisted the further analysis of stratigraphy, moreover, the development of Plio-Pleistocene unconformity in the eastern Bogor Trough.

Strike-dip pattern on the map also show the possibility of neotectonic that have affected the dipping of involving formations. However, Baribis Thrust-Fault as the major structure is also possible to have a role in affecting the dipping of Citalang, Kaliwangu and Subang Formations. The strike-dip distribution map (Figure 2) implies the new evidence of stratigraphic unconformity in the Plio-Pleistocene, between Citalang and Kaliwangu Formation. In the study area, the stratigraphic contact is sufficient to provide conclusion about stratigraphic relationship between Citalang Formation and Kaliwangu Formation. Not only stratigraphy but also sedimentologic observation such as facies features between these two formations are clearly to distinguish the sedimentation process and their significant change.

RESULT AND DISCUSSION

Since previous study about stratigraphic relationship between Citalang and Kaliwangu Formations was not proven by critical data, such as strike-dip of outcrops, figure 2 indicates the angular unconformity that clearly observed based on strike-dip distribution map. The strike-dip of Kaliwangu Formation (green color) has parallel pattern to the strike-dip of Subang Formation (purple color). None of stratigraphic contact was found and none of significant change of lithology between shale of Kaliwangu and Subang Formations, making it difficult to prove their obvious stratigraphic relationship. However, the distinctive character of Kaliwangu Formation is by the occurence of shell bed. The formation truncated by angular unconformity are definitely observed in the southwest of study area. The stratigraphic contact with sharp boundary between Citalang and Kaliwangu Formations is identified and exposed in the Cipedes River. Strike and dip measurements of Citalang Formation were obtained in Cipedes river and their spatial distribution indicate a slightly perpendicular to the Kaliwangu Formation. The strike of Citalang Formation is ranging from N 182^0 E to N 232^0 E with dip value is ranging from 12^0 to 28^0. Meanwhile, the strike of Kaliwangu Formation is ranging from N 110^0 E to N 132^0 E with dip value is ranging from 28^0 to 35^0.

The Citalang Formation observed in study area are composed of medium to coarse sandstone, mudrock with coal parting, conglomeratic sandstone, and conglomerate. Cross-bedding, parallel lamination, ripple, silicified wood, leaf imprint, bar deposit are

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presence as the sedimentary structures in Citalang Formation. In contrast, Kaliwangu Formation has extremely different features in sedimentary structures and textures, mostly in fine-grained lithology or knwon as shell bed. The physical character of Kaliwangu Formation is constitued by crude or poorly stratified carbonaceous shale with abundance of mollusks such as *Chyterca sp, Murex sp, Turitella sp, Chama sp,* and *Arca sp*. Based on sedimentologic features, sedimentation between Citalang and Kaliwangu Formation is obviously different. The sedimentation of Citalang Formation is more influenced by traction current, possible in fluvial environment, rather than Kaliwangu Formation.

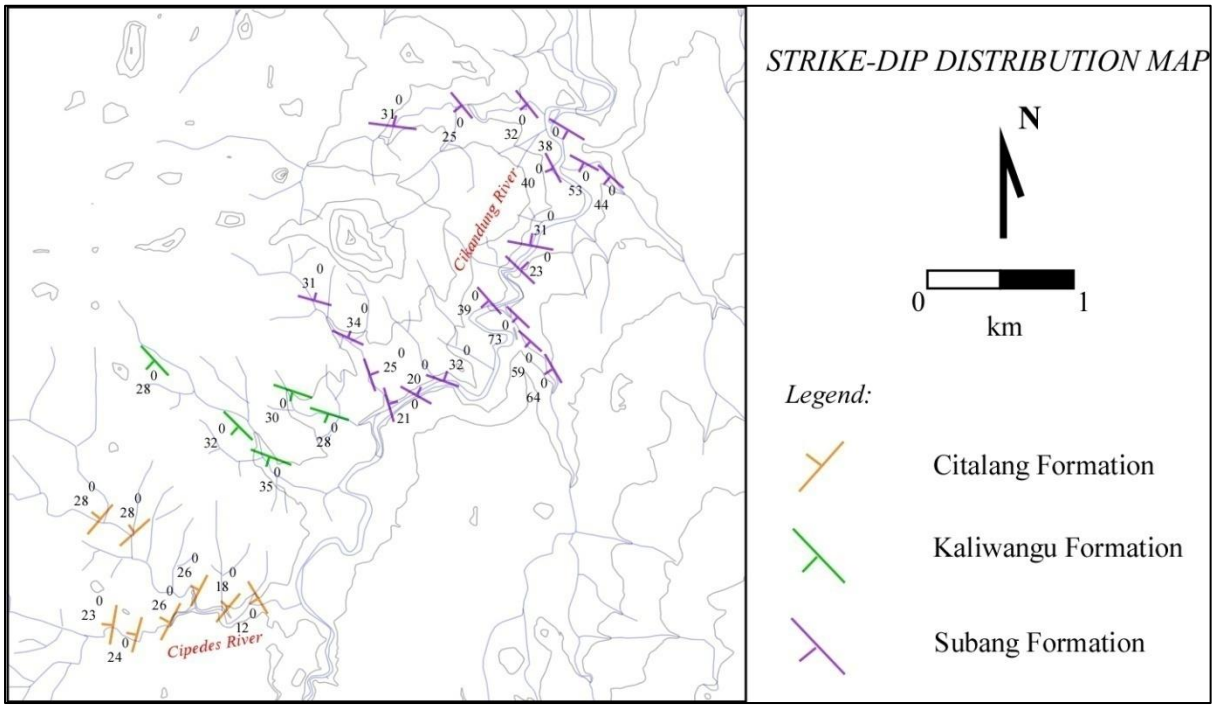

Figure 2. Strike-dip distribution map of Citalang, Kaliwangu, and Subang Formations

The stratigraphic section in Cipedes River has been figured out in Figure 3. The true stratigraphic thickness in this section is 42 m, including stratigraphic unit in Kaliwangu Formation and Citalang Formation separated by sharp and erosional contact. The mollusks bed is found in the lower part of the section and truncated by the erosional surface of Citalang Formation. The Citalang Formation began with conglomerate bed having no internal structure interpreted as debrite. To the upper part of this section, the flow regime changed to the lower flow regime, as migrating in the form of cross bed. The parallel lamination indicated truction current sedimentation. Locally found mudrock as indication of flood plain deposit by the presence of leaf imprint and coal fragment within the mudrock layer.

The change of sedimentation regime from Kaliwangu Formation and Citalang Formation must be triggered by certain process, e.g. the first factor is the change of accomodation space by subsidence or tectonic uplift, and the second factor is the change of accumulation rate by sediment supply. However, the study of interpreting accumulation rate of stratigraphic unit is assisted by analytical tool using decompaction modeling (Alam *et al.*, 2019). In other hand, the increasing of accomodation space is accepted due to subsidence and tectonic uplift decreases the accomodation space.

In Plio-Pleistocene interval, the transition between Kaliwangu Formation to Citalang Formation, it has experienced the shallowing depositional environment from marine influence environment in Kaliwangu Formation to non-marine deposit (Setiadi, 2001) in Citalang Formation and in corresponding to the reduction of paleo-

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water depth. Another plausible reasoning to this event is tectonic. This stratigraphic event is correlable to the tectonic event also in Plio-Pleistocene. The Plio-Pleistocene tectonic had uplifted previous sediment, Kaliwangu and Subang Formations, and then overlain by Citalang Formation. While the trend or pattern of strike and dip of Subang-Kaliwangu Formation remain the same parallel but non-parallel or angular to the strike and dip of Citalang Formation, their origin and significance to the recent study are problematic. In the northern part of the study area, the angular unconformity is not clearly observed. It more looks like parallel configuration between the Kaliwangu Formation and Citalang Formation. It could be said that might be the angular unconformity occured as the local unconformity. Yet howvever, the Plio-Pleistocene tectonic event that yield folding and faulting is acceptable and reasonable to the development of angular unconformity as seen in strike and dip distribution map of the study area.

Interestingly, the younger Citalang Formation has a dip value in direction to the northwest relatively (Figure 2). The structural configuration in Citalang Formation is different to the structural configuration in Subang and Kaliwangu Formations. This anomaly is possible that it reflects neotectonic event resulting the dipping of Citalang Formation or reactivation of previous the last major Baribis Fault. What other geologic phenomenon to explain the strike-dip distribution of the study area unless the stratigraphic angular unconformity.

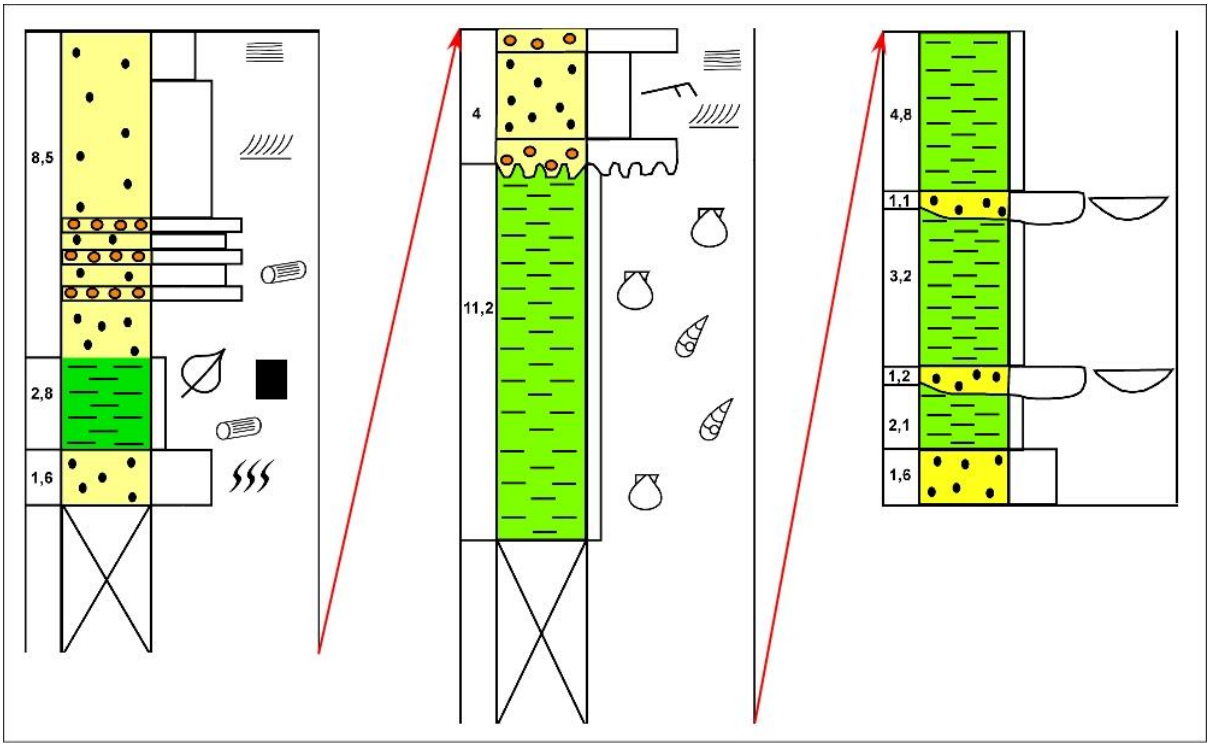

Figure 3. Stratigraphic measured section of Citalang Formation in Cipedes River

CONCLUSION

Angular unconformity has been observed in part of Cikandung and Cipedes Rivers Recent also close to Pliocene-Pleistocene boundary. Stratigraphic consideration based on outcrops investigation in the Pliocene and Pleistocene sediment of eastern Bogor Trough have restated the controversial stratigraphic relationship between Kaliwangu Formation and Citalang Formation. The strike and dip distribution in the research area indicated angular unconformity between both of those formations.

Plio-Pleistocene tectonic event has role in the erosional surface and uplifted sediment of Kaliwangu Formation. The stress field in this period was strongly affecting strike-dip pattern not only Kaliwangu Formation but

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also Subang Formation in northwest-southeast direction. Recent tectonic activity or neotectonic was plausible control in the configuration of dipping sediment in Citalang Formation.

The depositonal change of shell/mollusks bed Kaliwangu Formation to fluvial Citalang Formation and the angular nature of Plio-Pleistocene unconformity indicate the significant uplift occured and deformed this formation, most evidents are exposed in eastern Bogor Trough under compressional regime. It also marks the rapid change of sedimentation regime from more distal facies Kaliwangu Formation to more proximal facies as cropped out in Citalang Facies. However, other analaytical tool must be considered in further research to figure out the role of accumulation and accomodation rate.

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