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A NEW GEOLOGICAL MAP FOR FORMATION DISTRIBUTION ON SOUTHERN PART OF SOUTH CHINA SEA: WEST KALIMANTAN, INDONESIA

*Husnul Kausarian[1], Shao Lei[2], Goh Thian Lai[3], Yuchi Cui[2], Batara[1]

[1]Geological Engineering Department, Universitas Islam Riau, Indonesia; [2]School of Ocean and Earth Science, Tongji University, China; [3]Geology Program, National University of Malaysia, Malaysia

*Corresponding Author, Received: 25 Feb. 2019, Revised: 28 March 2019, Accepted: 23 April 2019

ABSTRACT: West Kalimantan province is located in Kalimantan Island. It is bounded by the East Malaysian state of Sarawak at the north and Indonesian provinces of East Kalmantan at the northeast and Central Kalimantan at the southeast. The Muller Mountains and the Schwaner Mountains run sequentially from northeast to southwest. Geological setting in the Kalimantan occurs is a result of Mesozoic accretion of ophiolitic, island arc and microcontinental fragments of south China and Gondwana origin. The aim of this study is to observe and update the geological conditions in West Kalimantan. The distribution and significance of sediment and igneous rocks were not known to the few exposures in the West Kalimantan (Pontianak, Sanggau, Sintang, and Sambas) were sampled and analyzed. There are 5 units or formations; Alluvium (Q), Oligocen sediments (Po), Cretaceous sediments (K), Lower Cretaceous Meta-Igenous (Kl2), and Pre-Carboniferous Pinoh Metamorphic (Pzm). In the western part of West Kalimantan there lying alluvium deposit that consists of gravel, sand, silt and peat. Po is a sedimentary rock unit that has an Oligocene age consists of sandstone, siltstone and mudstone that spread from western to the eastern part of West Kalimantan. Cretaceous sediments (K) exposed at the northwest part of West Kalimantan consist of an alternation of sandstone, siltstone and mudstone. Distribution of Lower Cretaceous Meta-Igneous (Kl2) is on the western part of West Kalimantan consist of granite-granodiorite and tonality. Pre-Carboniferous Pinoh Metamorphic (Pzm) exposed randomly at the western and center part of West Kalimantan. This geological survey is able to update new information for the geological condition in West Kalimantan.

Keywords: West Kalimantan, Mesozoic, Igneous rock, Sedimentary rock

1. INTRODUCTION

The main focus of this study is in West Kalimantan. West Kalimantan has a total area of 146.807 km² or 7.53% from area Indonesia. This region is the biggest province number four after Papua, Central Kalimantan, and East Kalimantan. Therefore the geological condition in this area is poorly known because difficult to get access to enter this tropical forest and lack of reliable fossil data in sedimentary rocks. Generally, Borneo/ Kalimantan island is the result of Mesozoic accretion of ophiolitic, island arc and microcontinental fragments of south China and Gondwana origin, with their sedimentary cover, onto the Paleozoic continental core of the Schwaner Mountain in the southwest of the island [1]-[3] (Fig 1A). At the beginning of the Cenozoic Borneo formed a promontory of Sundaland at the eastern margin of Eurasia [4], partly separated from Asia by an oceanic crust of a proto-South China Sea (Fig 1B).

West Kalimantan is one of the areas that has been known as a gold-producing region, especially alluvial gold. Mining in this area began around 1986 - 1987 carried out by local people for alluvial gold and is still ongoing to date in several locations such as Takalong Miru area, Taye area, Lubuk Pawon area and the Malenggang village road by hydraulicking method. The Geological information for West Kalimantan is very least. The study area is focused at onshore of West Kalimantan which has a very complex geological condition. Updated research is needed to improve the information of West Kalimantan to increase the accuracy of the geological condition at West Kalimantan.

2. METHODOLOGY

This research conducted through 3 steps, literature study, field observation, and laboratory analysis. The first step is literature study to get information of regional geology at study area which consists of some formations namely Alluvium, Oligocene sediments (Po), Cretaceous sediments (K), Lower Cretaceous Meta-Igneous (Kl2), and Pre-Carboniferous Pinoh Metamorphic (Pzm).

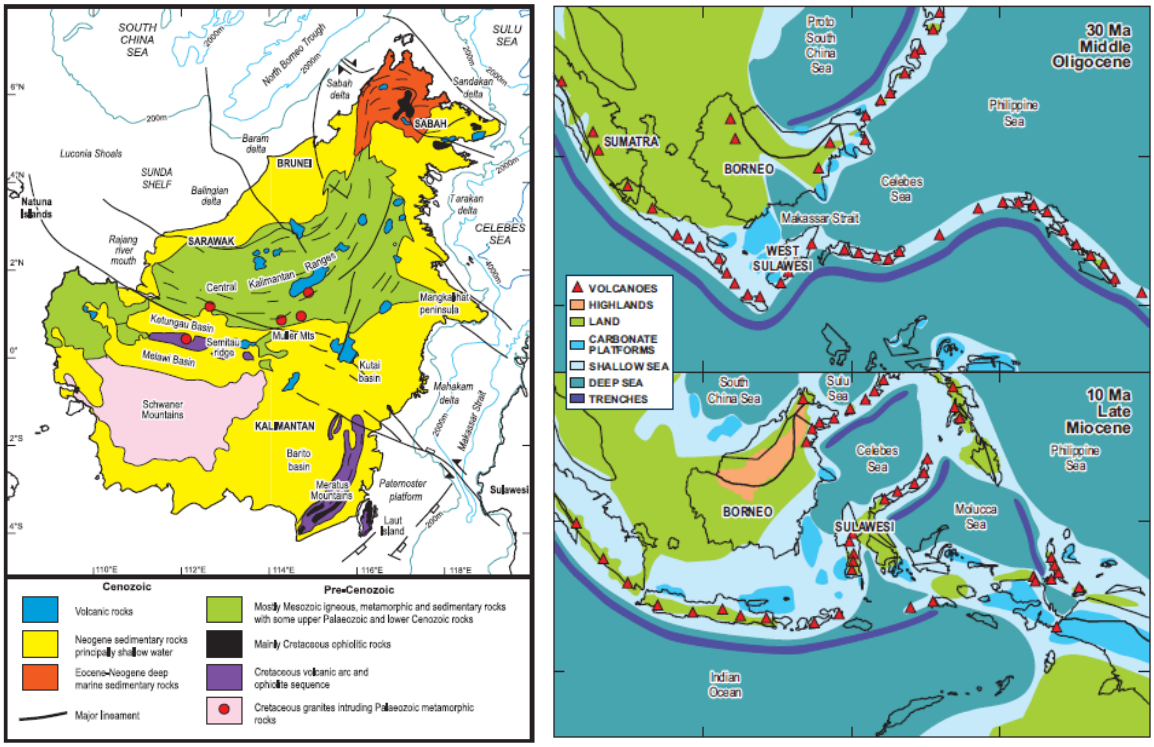

Fig.1 (A) Simplified geology of Borneo (modified from Hamilton 1979), Moss and Wilson (1998) [5]; (B) Plate tectonic reconstructions of SE Asia at 30 Ma and 10 Ma (from Hall 1996). Distribution topography and bathymetry is from Hall (2001).

The next step is gathering sample by fieldwork or field observation to get geological authentic data of the study area. Field observation performs with tracking the road using handheld GPS [6]-[9]. Geological data collected focused on the identification of lithology at the outcrop to determine the rock formation of it.

The final step is laboratory analysis done by comparing the result of field observation with geological maps of West Kalimantan which has existed. In this case, the map that made as references are Geological Map of Borneo Island, Kalimantan [10] with scale 1:250.000 (Fig 2). From the comparing field data and the geological map will result in a new updated geological map of West Kalimantan.

3. RESULT AND DISCUSSION

There are 64 outcrops that have been found in the field (quarry and cutting hills). After analyzing rocks sample in the lab and compared with the reference maps show some changes in the boundary between some formations of the study area. An updated geological map of formation distribution on West Kalimantan can be seen in Fig 3.

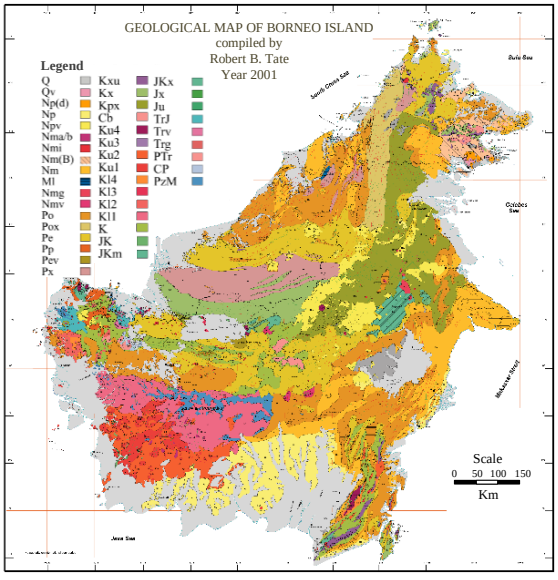

Fig.2 Geological Map of Borneo and West Kalimantan compiled by Robert B. Tate 2001.

3.1 Alluvium (Q)

Alluvium spread at west and south part of West Kalimantan regions such as Sambas, Singkawang, North Kayong, and Ketapang. Alluvium deposit at study area consists of gravel, sand, silt, and peat.

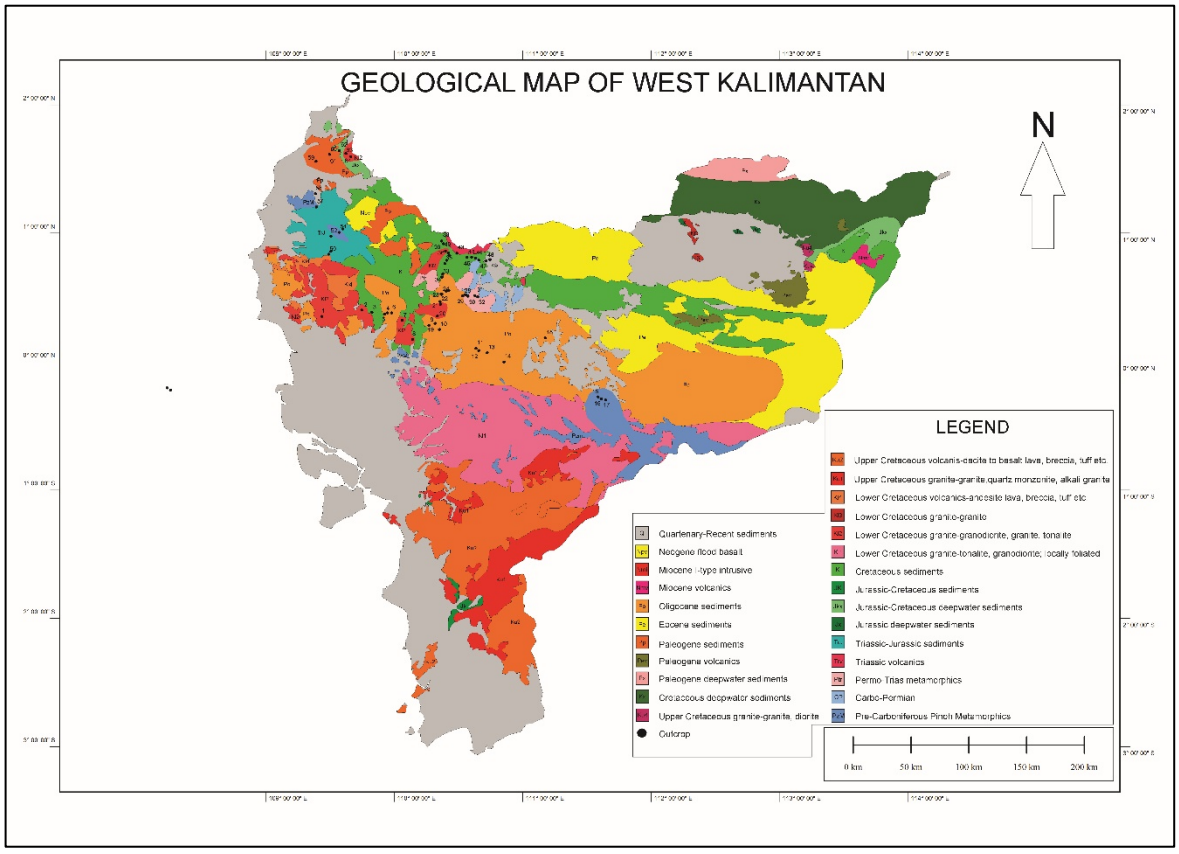

Fig.3 Geological map of formation distribution on West Kalimantan result of this study.

The only possible source for the sediment is Borneo itself. Although some of the Paleogene sediments is Borneo could have been supplied by river systems from Indochina [3].

3.2 Oligocene Sediments (Po)

Oligocene sediments (Po) widespread from western to eastern part of West Kalimantan. Lithology that dominated in this formation consists of sandstone, siltstone, and mudstone. There was an outcrop of with various structure sediment such as graded bedding conglomerate with sandstone and channel structure interlayer of sandstone (location 4 and 12) in Fig.4. Many types of sandstone found such as yellowish to reddish (weathered) sandstone and fine grain (location 5 and 13), sandstone with the trace fossil (location 6). This analysis was compared from reference maps and also observation in the field and there are 16 outcrops which have similar lithology in this formation (Po).

3.3 Cretaceous Sediments (K)

Cretaceous sediments (K) exposed at the northwest part of West Kalimantan. This formation consisting of an alternation sandstone, siltstone, and mudstone (location 33). The sediment structures that can be found are fining upward, normal fault and anticline (location 34, 35 and 40). Besides that, an outcrop of shale found with high organic matter (location 38) Fig 5.

3.4 Lower Creaceous Granite-Granodiorite, Tonalite (Kl2)

A lot of Cretaceous granitic plutons are exposed in Kalimantan, Indonesia, and separated into two groups; in the south forms granite batholiths and in the north forms an isolated granite-belt. Distribution of Kl2 is on the western part of West Kalimantan. Kl2 consist of granite-granodiorite and tonalite. Four meta-igneous rocks from southeast of Pontianak (Pontianak-Sanggau-Landak) were analyzed and described. The first sample is granite with light-medium Grey color, and medium-coarse texture (location1). The second sample is Granodiorite, with light-medium grey color, and fine-medium texture (location 2). The third sample is granodiorite, with dark grey color, and medium-coarse texture (location 8). Fourth is Granite, light grey color, and fine-medium texture (location 64) Fig 6.

3.5 Pre-Carbonifeorus Pinoh Metamorphic (Pzm)

Fig.4 Oligocene sediments (Po); left: graded bedding conglomerat loc, right: Trace Fossil.

Fig.5 Cretaceous sediments (K); clockwise Alternation of sandstone, siltstone, and mudstone; Fining upward sandstone; Carbon shale; Normal Fault.

Un-dated Pinoh Group metamorphic rocks in the Schwaner Mountains were known to be intruded by Cretaceous granitoid and were interpreted to be a pre-Triassic basement, possibly predating the Carboniferous period [11]-[15]. Pinoh Metamorphic (Pzm) exposed randomly at the western and central part of West Kalimantan. Some locations that expose Pinoh Metamorphic rock namely 16, 17 and 52. From references map, the pinoh metamorphic rock did not expose at the center part of West Kalimantan but from field observation pinoh metamorphic found at locality 16, 17, and 52 which located at the southeast of Sintang Regency and Bengkayang Regency. Quartzite found in locality 16 and 17, that was exposed in an abandoned mine (Fig.7).

Fig.6 A-D Lower Cretaceous granite-granodiorite, tonalite Kl2.

Fig.7 Pinoh Metamorphic Pzm and Quartzite (right below).

4. CONCLUSION

From the field observations, there are 64 outcrops or localities that spread out at West Kalimantan. The analysis of the study has been carried out by using the identification of rock samples and reference from the geological map compiled by Robert B Tate (2001). Eventually, there are 5 units or formations of rocks that can be found; Alluvium (Q), Oligocene sediments (Po), Cretaceous sediments (K), Lower Cretaceous Meta-Igneous (Kl2), and Pre-Carboniferous Pinoh Metamorphic (Pzm). In the western part of West Kalimantan there lying alluvium deposit that consists of gravel, sand, silt, and peat (similar like in Sumatra Island [16]-[17]). Po is a unit of sedimentary rock that has an Oligocene age. Po consists of sandstone, siltstone, and mudstone that spread from western to the eastern part of West Kalimantan. Cretaceous sediments (K) exposed at the northwest part of West Kalimantan. K consists of an alternation of sandstone, siltstone, and

mudstone. Distribution of Lower Cretaceous Meta-Igneous (Kl2) is on the western part of West Kalimantan. Kl2 consist of granite-granodiorite and tonalite. Pre- Carboniferous Pinoh Metamorphic (Pzm) exposed randomly at the western and central part of West Kalimantan. In locality 16 and 17 has been found the sample of rocks Quartzite these rocks from Pinoh Metamorphic Unit (Pzm). When referred from the previous geological map this locality is in Oligocene sediments unit or formation. At last, there is a change in the boundary of Pzm area. This study is expected to be ably updated or created new information for geological condition and geological map in West Kalimantan region.

5. REFERENCES

[1] Hamilton, W. 1979. Tectonics of the Indonesian region. U.S. Geological Survey, Professional Papers. 1078.

[2] Hutchison, C.S., 1989. Geological Evolution of South-east Asia. Clarendon Press, Oxford, 180, 304-309.

[3] Metcalfe I. 1996. Pre-Cretaceous evolution of SE Asian terranes. Geol. Soc. Lond. Spec. Publ. 106:97–122

[4] Hall R. 1996. Reconstructing Cenozoic SE Asia. Geol. Soc. Lond. Spec. Publ. 106:153–84.

[5] Moss, S. J., & Wilson, M. E. 1998. Biogeographic implications of the Tertiary palaeogeographic evolution of Sulawesi and Borneo. Biogeography and geological evolution of SE Asia, 133-163.

[6] Lubis, M.Z., Anurogo, W., Hanafi, A., Kausarian, H, Taki, H.M., Antoni, S. 2018, Distribution of benthic habitat using Landsat-7 Imagery in shallow waters of Sekupang, Batam Island, Indonesia, Biodiversitas.

[7] Kausarian, H., Sumantyo, J. T. S., Kuze, H., Karya, D., & Panggabean, G. F., 2016. Silica Sand Identification using ALOS PALSAR Full Polarimetry on The Northern Coastline of Rupat Island, Indonesia. International Journal on Advanced Science, Engineering and Information Technology 6(5), 568-573.

[8] Kausarian, H., Sumantyo, J. T. S., Kuze, H., Karya, D., & Wiyono, S. (2016). The origin and distribution of silica mineral on the recent surface sediment area, Northern Coastline of Rupat Island, Indonesia. ARPN Journal of Engineering and Applied Sciences, 12(4), 980-989.

[9] Kausarian, H., Sri Sumantyo, J.T., Kuze, H., Aminuddin, K., & Waqar, M.M., 2017. Analysis of Polarimetric Decomposition, Backscattering Coefficient, and Sample Properties for Identification and Layer Thickness Estimation of Silica Sand Distribution Using L-Band Synthetic Aperture Radar. Canadian Journal of Remote Sensing 43(2), 95-108.

[10] Tate, R.B., 1991, Cross-border correlation of geological formations in Sarawak and Kalimantan: Bulletin of the Geological Society of Malaysia, 28, 63-96.

[11] Van Bemmelen, R.W., 1949, The Geology of Indonesia. Government Printing Office, Nijhoff, The Hague (2nd edition, 1970), 732 pp.

[12] Haile, N.S., 1974, Borneo, In Spencer, A.M., ed., Mesozoic-Cenozoic Orogenic Belts, Geological Society of London Special Publication, 4, 333-347.

[13] Tate, R.B. and Hon, V., 1991, The oldest rocks in Borneo; a note on the Tuang Formation, West Sarawak and its importance in relation to the presence of a "basement" in West Borneo: Warta Geologi, Geological Society of Malaysia Newsletter, 17, 221-224.

[14] Lubis, M.Z., Pujiyati, S.R.I., Pamungkas, D.S, Anurogo, W., Kausarian, H. 2018. Coral reefs recruitment in the stone substrate on Gosong Pramuka, Seribu Islands, Indonesia, Biodiversitas.

[15] Lubis, M. Z., Anurogo, W., Kausarian, H., Choanji, T., Antoni, S., & Pujiyati, S. 2018. Discrete EquiSpaced Unshaded Line Array method for target identification using side-scan sonar imagery. In IOP Conference Series: Earth and Environmental Science (Vol. 176, No. 1, p. 012025). IOP Publishing.

[16] Widodo, J., Izumi, Y., Takahashi, A., Kausarian, H., Perissin, D., & Sumantyo, J. T. S. 2019. Detection of Peat Fire Risk Area Based on Impedance Model and DInSAR Approaches using ALOS-2 PALSAR-2 Data. IEEE Access.

[17] Widodo, J., Izumi, Y., Takahashi, A., Kausarian, H., Kuze, H., & Sumantyo, J. T. S. 2018. Detection of Dry-Flammable Peatland Area by Using Backscattering Coefficient Information of ALOS-2 Data L-Band Frequency. In 2018 Progress in Electromagnetics Research Symposium (PIERS-Toyama), 916-920.