

## Development of Funginite on Muaraenim and Lower Members of Telisa Formations at Central Sumatra Basin - Indonesia

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### Abstract

Petrography analysis of coal is the study organic and inorganic components of coal bearing formations. This research conducted observation method under microscopic of thin incision to identify organic maseral group. The organic composition of coal from Muaraenim Formation is known to average for vitrinite maseral group 79.30% inertinite 10% liptinite 3.4% and non-organic 7.3% While the composition of coal from the Bottom Members of Telisa Formation for the average of vitrinite maseral group 66.4% mineral matter 30.32% inertinite 3.26% The liptinite maseral group is not present as a coal component in the study area. The funginite development of the Muaraenim Formation is quite abundant 2.8% indicating peat swamp ecosystem in wet-dry conditions in ph 3 -5. In contrast, the development of funginite Lower Members of Telisa Formation is known to be absent which is replaced by the presence of framboidal pyrite and indicates peat ecosystem in wet conditions at ph 6 - 7.

**Keywords:** Funginite, Inertinite, Maceral, Petrographic, Telisa Formation.

### 1. Introduction

The astronomical part of Indonesia is at 0 ° 0'00" - 10 ° 0'00" 0'00" LU and 0 ° - 10 ° 0'00" LS separated by the equator and 90 ° 00' 00" BB - 140 ° 0'00" BT. Indonesian region based on geographical conditions has a tropical climate and is at the Eastern hemisphere. Indonesia has two seasons only in every year, rainy season and dry season. In general, the intensity of peat accumulation is affected by the tropical climate (Dehmer, 1993; Grady et al, 1993; Esterle and Ferm, 1994; Hawke et al. and Dehmer, 1999).

Funginite / Sclerotinite as coal component influenced many geological characteristics including swamp forest ecosystems during the decomposition of organic matter takes place.. Funginite / Sclerotinite is an organic component of coal origin (Tertiary) Sclerotinite (Paleogene). In Tertiary coals, a variety of forms are present as sclerotinite; sclerotia (resting spores), teleutospores, mycorrhizomes (symbiotic associations of fungal tissue with higher plant roots) and stromata/fungal fruiting bodies (Suarez-Ruiz et al., 2012).

This study will be discussed in more detail with respect to the development funginite / Sclerotinite

on tertiary coal deposits (Member of the Lower Telisa and Muaraenim Formation).

### 2. Geological Setting

The research area has the tectonic framework of Sumatra which located at the Central Sumatra Basin. Regional Geology of research area is based on the Geological Research and Development Center, Bandung detail at the Geological Map of Rengat sheets (Suwarna, Budhitrisna, 1994) and Geological Map of Solok Sheet of Lower Members of Telisa Formation (Silitonga, PH & Kastowo, 1994). The Muara Enim Formation as a coal carrier formation has characteristic ripple structure composed of clastic sedimentary material in the form of fine clays of lignite coal insertion which precipitated the phase of regression at the end of the Miocene. Whereas the Lower Members of the Telisa Formation have characteristic of intercalation between the shale and very fine sand of sub-bituminous coal type "A" lenses deposited on maximum transgression phase at the Beginning to Mid Miocene (Barber and Crow, 2005) Regional Geological Maps on research location are shown in Fig. 1.

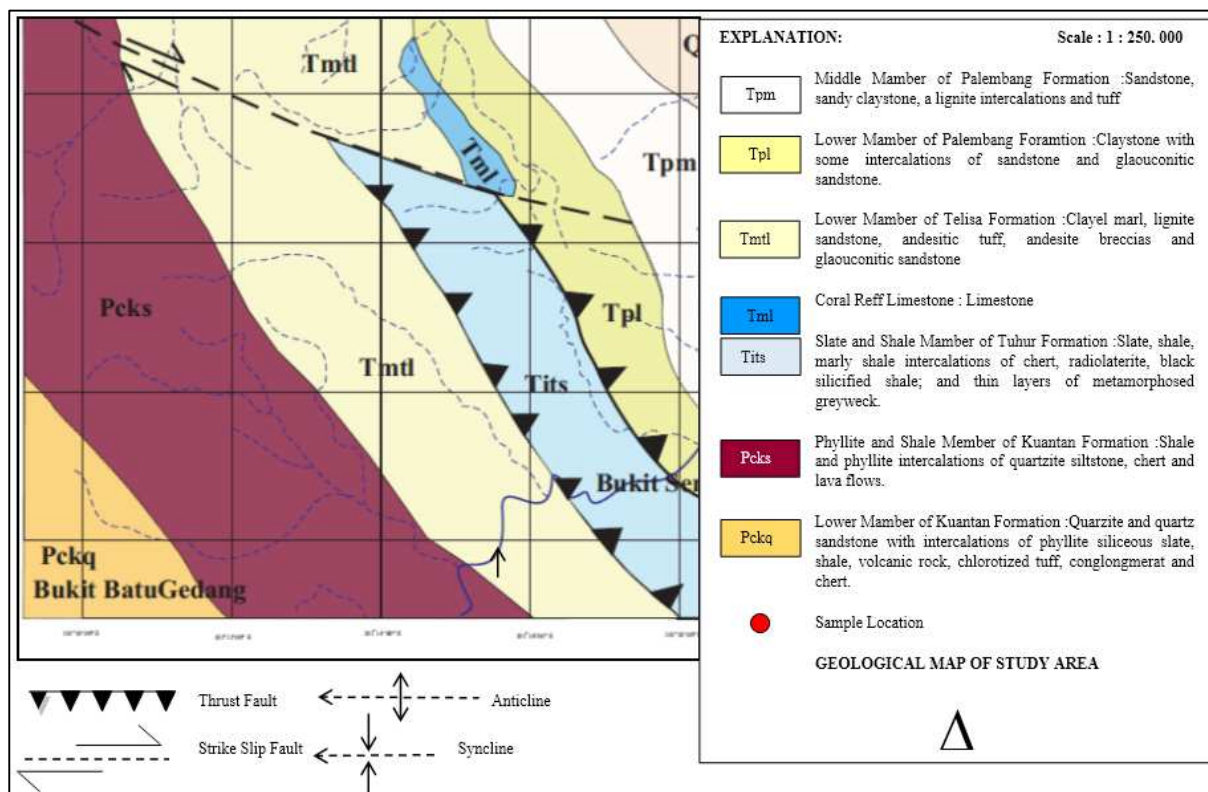
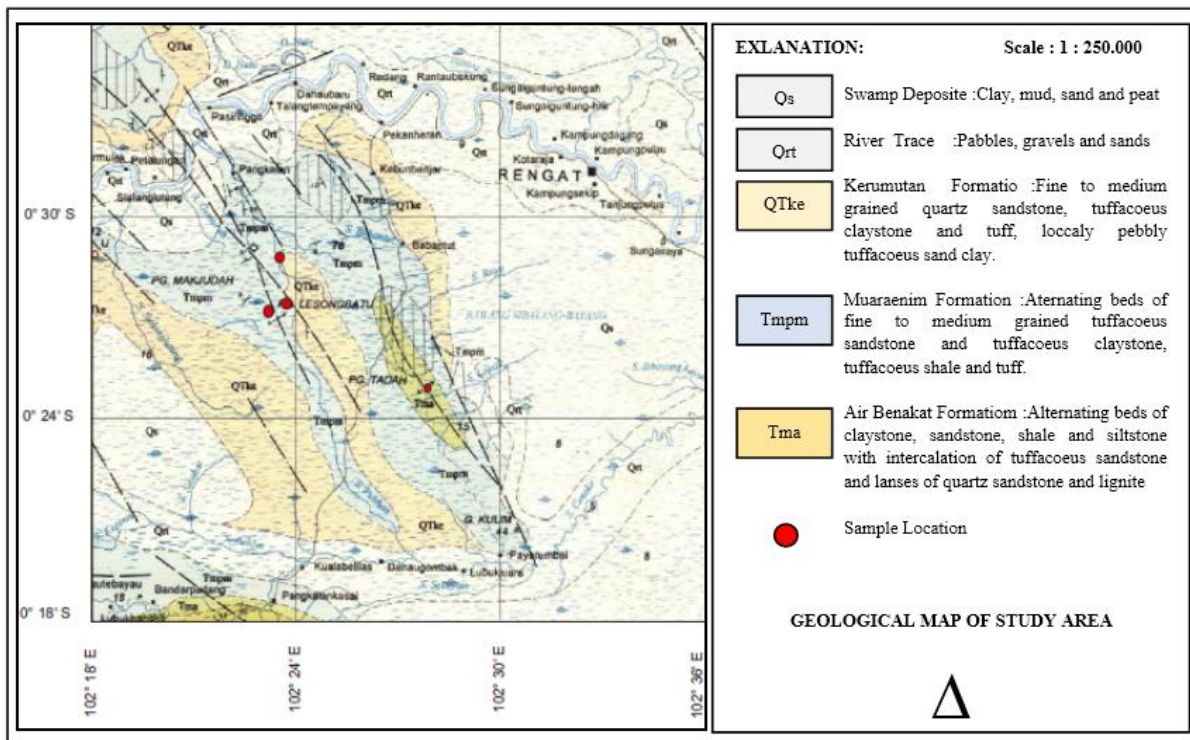


Fig 1. (above) Geological Maps of Rengat (Suwana, Budhitrinsa, 1994); (below) Geological Maps of Solok (Slitonga, PH & Kastowo, 1994)

Table 1. The composition of analysis result group of maceral and Mineral Matter

$\Sigma$ Composition Group of Maceral and Mineral Matter					
No	No Sampel	Vitrinite (%V)	Liptinite (%V)	Inertinite (%V)	Mineral (%V)
1	871/2015	81.0	1.4	6.0	11.6
2	872/2015	78.6	7.0	9.4	5.0
3	873/2015	82.0	3.0	6.6	8.4
4	874/2015	75.6	2.2	18.0	4.2

Table 2. The composition of analysis result group of maceral and Mineral Matter

$\Sigma$ Composition Group of Maceral and Mineral Matter					
No	No Sampel	Vitrinite (%V)	Liptinite (%V)	Inertinite (%V)	Mineral (%V)
1	2P/1/16	58.00	2.6	-	39.40
2	3P/1/16	52.24	2.6	-	45.16
3	4P/1/16	<b>89.00</b>	<b>4.6</b>	-	<b>6.40</b>

Table 3. The composition of the coal maceral

Composition of Coal Maceral (%)					
Maseral Group	Nama Maseral	871/2015	872/2015	873/2015	874/2015
VITRINITE (HUMINITE)	Telocolinite	5.4	10.4	4.6	6.4
	Densinite	4.4	3.0	1.0	2.6
	Desmocollinite	66.8	62.8	75.0	65.0
	Corpogelinite	4.4	2.4	1.4	1.6
LIPTINITE (EXINITE)	Sporinite	-	0.8	0.4	-
	Cutinite	0.4	1.6	0.6	-
	Resinite	1.0	3.6	0.6	2.2
INERTINITE	Fusinite	0.6	4.4	-	5.2
	Funginite	4.0	2.6	6.0	7.6
	introdetrinite	1.4	2.4	0.6	4.0
MINERALSMATTER	pyrite	1.0	1.6	1.0	1.6
	clay	10.6	3.4	7.4	2.6

Table 4. The composition of the coal maceral

Composition of Coal Maceral (%)					
Maseral Group	Maseral	1P/1/16	2P/1/16	3P/1/16	4P/1/16
VITRINITE (HUMINITE)	Telocolinite	-	11.0	11.0	27.0
	Densinite	16.0	21.0	18.0	1.0
	Desmocollinite	20.4	26.0	23.4	60.4
	Corpogelinite	-	-	-	0.6
LIPTINITE (EXINITE)	Sporinite	-	-	-	-
	Cutinite	1.6	1.0	-	2.6
	Resinite	1.6	1.6	2.6	2.0
INERTINITE	Funginite	-	-	-	-
	Oksida	-	-	-	-
MINERALSMATTER	Pyrite	32.4	28.4	34.0	6.4
	Clay	28.0	11.0	11.0	-

### 3. Methods

The method for this research, starting with crushed the coal samples into a maximum size of 1 mm and placed in resin blocks. The sample blocks were polished with a specified polisher. Microscopic investigation was carried out with a Carl Zeiss Microscope and Point Counter Model F was conducted to determine the micro-organic components of coal (fig. 2). During maceral analysis, 500 points with a minimum distance of huminite particles under oil immersion. Fifty points of huminite reflectance were made on each sample.



Fig 2. Carl Zeiss Microscope and Point Counter Model F with 500 x magnification

The sample selection in this research uses "channel sampling" method from selected ideal coal samples as well as representing research area. The sample selection also bases on quality and quantity to meet the standard of test fixation. Treat samples from coal bodies, less likely to avoid direct oxidation in a long time to keep capillary moisture as well as coal surface. The sample sampling preparation for microscopic observation was taken from the sample to be analyzed, then crushed until it passed the 1 mm filter and carried out the division so as to obtain 15 gram representative samples for petrographic analysis. The 1 mm sample is mixed with epoxy / transsopctic powder resin, printed in rectangular or rounded mold. After hard the surface is rubbed with a 600, 800 and 1200 emery paper, then polished to obtain a smooth coal surface for petrographic analysis. The maseral analysis is performed under a microscope using the immersion oil on the surface of the sample. This analysis uses 25x, 32x, 50x or even 60x lenses and an automatic 0.4 mm transverse counting machine and 0.5 mm vertical. Approximately 500 points were observed excluding visible resins and minerals. Maseral can be observed or counted as a group of maseral or as sub-maseral. In performing a duplicate analysis of 3% difference for each accepted maseral. The reflection measurements are performed on the surface of vitrinite particles, in monochromatic green light, wavelength 546 nm. All equipment should be lit at least half an hour before calibration. To measure maximum reflection, the polarizer is set in position 45°. Next turn the 360° microscope and do the

reading. To measure this reflection the lens used is high magnification (50 or 60x) and should be placed right in the middle. The readings are repeated from 50 to 100 readings (Petrology, 2011).

### 4. Result and Discussion

In general, the main organic composition of coal is dominated by vitrinite group which is the main ingredient of wood and bark tissue. While inertinite, liptinite and mineral matter groups may be higher or lower than others.

The composition of the coal mine The Muaraenim formation is known to average for vitrinite maseral group 79.30%, inertinite 10%, liptinite 3.4% and non-organic 7.3%. While the composition of coal Coal Members Bottom Line Telisa for the average of vitrinite maseral group 66.4%, mineral matter 30.32%, inertinite 3.26%. The liptinite maseral group is not present as a coal component in the study area. The coal coal composition is given in tables 1 and 2. The development of funginite maseral from the inertinite maseral group, is known to spread quite abundantly and is colonial among fusinite thin wall cells berk wok turmeric white to yellowish.

The development of funginite from Muaraenim Formation coal is given in 3a and 3b. In general, the development of funginite can be caused by surface moisture or capillary of a material between wet and dry or pH 3 - 5. Coal Formation Muaraenim based on the calculation of maseral composition obtained facies of limnic deposits that turn into limnotelmatic in the atmosphere of the swamp ecosystem is poor will supply water / Ombrotropic mires (Prayitno, 2016a). Such a condition allows the water supply or surface line to the peat layer to vary according to the supply or rainfall during peat decomposition.

The condition of peat swamps that rely solely on water supply from rainfed can ultimately lead to the development of bacterial as an important component responsible for the decomposition process of organic matter to be disrupted, in this case will have an effect on the effectiveness of decomposition of organic matter. Moreover, the topographic changes from the limnic to the limnotelmatic conditions influence the groundwater level limit to be lower than the surface layer or peat layer, so that the peat layer is more wet to dry (Anggayana et al., 2014).

The development of funginite maseral is not only influenced by local factors such as water supply, pH value, depth of peat layer to water surface, also determined by more global tectonic motion such as basal decline and sea level change, in this case succession of sedimentation. Sediment materials are affected by transgression or regression conditions. In contrast to the Muaraenim Formation deposited in the regression phase, which causes the ineffectiveness of the decomposition and gelification process of peat materials, the Lower



Members of Telisa Formation are precipitated at the peak phase of transgression.

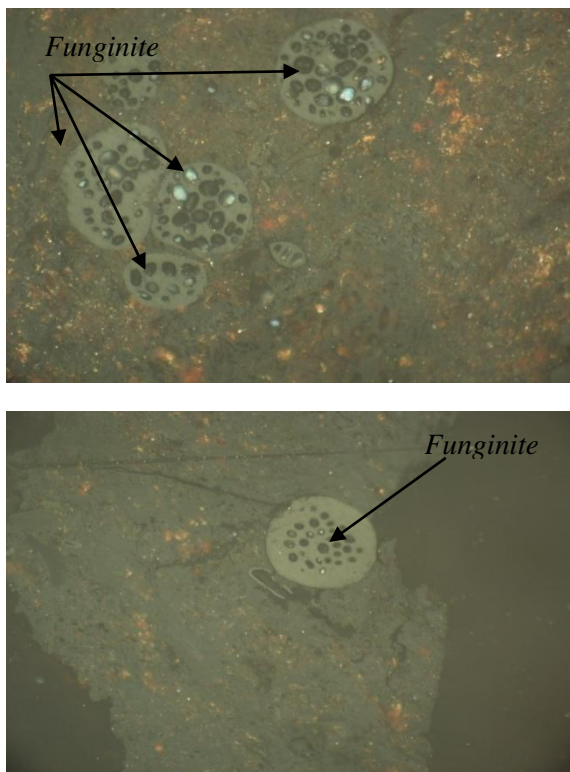


Fig. 3 (above) Funginite and mineral matter asosiation with desmocollinite coal,reflectant white light, 500x. (below) Funginite asosiation with desmocollinite coal, reflectant white light, 500x.

Coal on Lower Members Telisa Formation based on calculation of organic maseral composition obtained facies of limnic deposition in an atmosphere rich in water supply / rheotrophic mire (Prayitno, 2016b) Table 2. Rheotrophic Mires is a peat swamp that has a water supply from two sources. First supali water that comes from rain-fed, usually the volume increases with the rainy season. Both come from ground water which is a process of infiltration through rock pores or rock fractures. During the dry season, this type of peat swamp is possible still in wet conditions. Development of funginite Lower Members Telisa Formation based on microscopic observation is known not present as a coal-forming component.

Peat swamps in the rheotrophic mire atmosphere allow the peat layer to be always well below the water surface and in ph 6 - 8 This causes the development of funginite can not develop properly. However, the mineral matter content of mineral pyrite is quite abundant to form the framboidal pyrite structure which indicates the average surface water far above the peat surface. Abundance of mineral matter Coal Members Bottom Line of Telisa Formation is given in the Fig 4.a.b.c.

Thus the relationship between funginite development and mineral matter abundance may be inversely proportional. The formation of pyrite

minerals can be as syngenetic pyrite or epigenetic pyrite. The abundance of mineral matter in the form of syngenetic pyrite and funginite development can be attributed to the basic active basin motion in a certain period so that local and regional tectonic factors can be an important factor for the development of both.

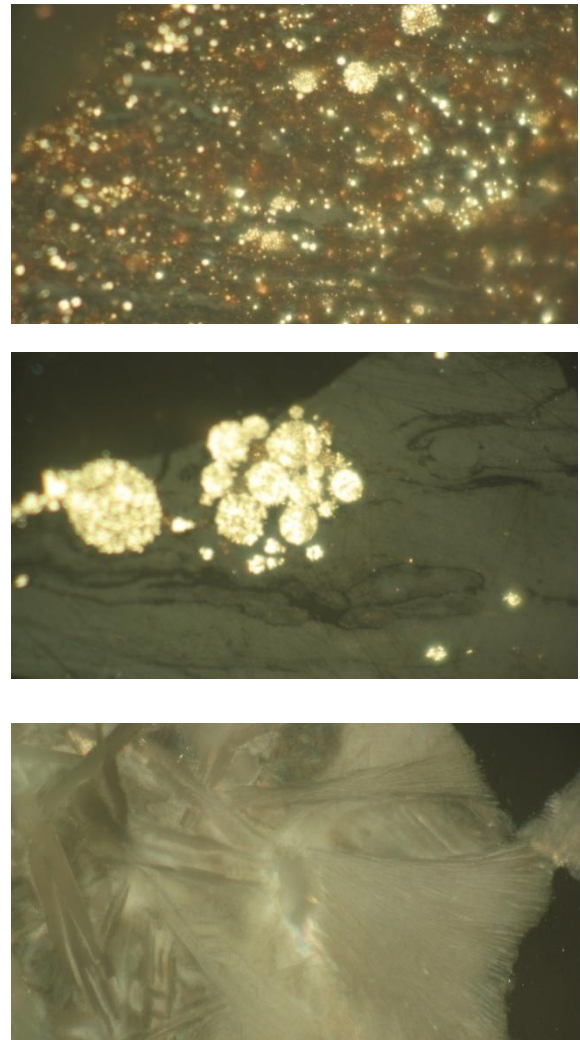


Fig 4. (above) Pyrite and resinite associated with desmocollinite in coal, reflectant white light, 500x. (middle) *Pyrite framboidal* associated with desmocollinite in coal, reflectant white light. 500x. (below) Mineral matter in coal, reflectant white light, 500x.

## 5. Conclusions

The development of funginite locally can be influenced by chemical, biological and chemical conditions of settling environment. While the global factor is more determined by the basin motion. The development of funginite and mineral matter in a deposition period can indicate certain climatic conditions at the time of deposition.

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#### References

- Anggayana, K., Rahmad, B., Hede, A.N.H., Widayat, A.H., 2014. Limnic condition in ombrotrophic peat type as the origin of Muara Wahau coal, Kutei basin, Indonesia. *J. Geol. Soc. India* 83, 555–562. doi:10.1007/s12594-014-0083-5
- Barber, Crow, 2005. Sumatra: geology, resources and tectonic evolution (references). *Tectonics* 21, 1040. doi:10.1029/2001
- Dehmer, 1993; Grady et al, 1993; Esterle and Ferm, 1994; Hawke et al., 1999, Dehmer, 1999. Petrology and organic geochemistry of peat samples from a raised bog in Kalimantan (Borneo). *Organic Geochemistry* 1999.
- Petrology, O., 2011. ICCP Training Course on Dispersed Organic Matter CHAPTER 2 MICROLITHOTYPES 1–71.
- Prayitno, B., 2016a. Limnic Condition In Rheotrhopic Peat Type As the Origin of Petai Coal , Central Sumatra Basin , Indonesia. *J Geoscience, Engineering, Environment, and Technology* 1, 63–69.
- Prayitno, B., 2016b. MASERAL BATUBARA LESONGBATU DAN SEKITARNYA KECAMATAN RENGAT BARAT KABUPATEN INDRAGIRI HILIR PROPINSI RIAU - INDONESIA. *Pros. Semin. Nas. Geofis.* 2016.
- Silitonga, PH & Kastowo, D., 1994. Peta Geologi Lembar Solok.
- Sua'rez-Ruiz, I., Flores, D., Mendon??a Filho, JG., Hackley, P.C., 2012. Review and update of the applications of organic petrology: Part 1, geological applications. *Int. J Coal Geol.* 99, 54–112. doi:10.1016/j.coal.2012.02.004
- Suwarna, Budhitrisna, S and A.M., 1994. Peta Geologi Lembar Rengat.