DISTRIBUTION OF MINERAL RESOURCES AND AGGREGATES IN SAMBAS WATERS, WEST KALIMANTAN PROVINCE

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ABSTRACT

Marine sediments of Sambas Waters, West Kalimantan, contain of five groups of minerals such as hydroxide oxides, silicates, sulfides, and carbonates. The dominant mineral in hydroxide oxides group is magnetite that composes about 0.00720% and lowest is 0.00310% of the sediments, followed by hematite, limonite, and rutile.

Augite being the dominant mineral in silicate group was found in six samples with highest percentage of 0,.0091%, followed by casiterite and hornblende. Phyrite from the sulfide group, is present in six samples of seven sediment samples with average percentage of <1%.

Dolomite is the only mineral that represents carbonate group and it was found in 7 samples with average percentage of less than 1%. While Mica minerals that occur in the study area are muscovite. Muscovite was observed in four sample of seven samples analysed, with highest percentage of 0.000771% and the lowest 0.00018%.

Aggregates that have been exploited in the study area are andesite, dacite and sands that compose the alluvium and old volcanic units.

SARI

Sedimen permukaan dasar laut Perairan Sambas, Kalimantan Barat, mengandung 5 kelompok mineral yaitu mineral-mineral hidroksida, silikat, sulfida, dan karbonat. Mineral dominan dari Kelompok hidroksida adalah magnetit, dengan kadar tertinggi sekitar 0,00720 % terendah 0,00310% dari seluruh sedimen, kemudian diikuti oleh hematit, limonit dan rutil.

Augit adalah mineral yang dominan di kelompok silikat dan dijumpai dalam 6 contoh sediment dengan persentase tertinggi 0,0091, diikuti oleh kasiterit, dan hoirnblende. Pirit dari kelompok mineral sulfide terdapat dalam 6 contoh sedimen dari 7 contoh yang dianalisa, dengan kadar rata-rata lebih kecil dari 1 %.

Dolomit adalah satu-satunya mineral yang dijumpai dari kelompok mineral karbonat dan terdapat dalam 7 contoh yang dianalisa dengan prosentase rata-rata dibawah 1 %, sementara kelompok mineral mika yang terdapat di di daerah penelitian adalah muskofit. Muskofit dijumpai dalam 4 contoh sedimen dari 7 contoh yang dianalisa dengan prosentase tertinggi adalah 0,000771% dan terendah 0,00018%.

Agregat yang telah dieksploitasi di daerah penelitian adalah andesit, dasit dan pasir dari endapan alluvial dan batuan vulkanik tua.

INTRODUCTION

The study area is located between $1^{O}05'$-$1^{O}16'$ N and $108^{O}53'20"$-$109^{O}00'00"$ E, is under the adminstration of Pemangkat, the regency of Sambas, West Kalimantan Province. The extent of the study area is about 110 km^2, including 27 km long shoreline.

Fourty sediment samples were obtained from the coastal and marine waters. Mineral analysis of 7 samples, show indication of heavy mineral occurrence. The samples are evenly distributed and hence can be considered to represent the whole area.

The aim of this study is (1) to find heavy mineral resources indication that may occur in Sambas Waters, and (2) to catalog aggregate resources such as stones, sands, gravels, reclamation

material, that were needed by local government to develop the area to support industries that are growing in the western part of Sambas (fish pond and tourism).

Heavy mineral is defined as minerals with specific gravity (SG) > quartz's SG of 2.65 or feldspar 2.54 – 2.76. Heavy mineral is also defined as minerals heavier that 2.8 (Brenininkmeyer, 1978 and Folk, 1980).

METHODS

Sediment sampling in the shore involved sampling of different types of sediments. Sampling of seafloor sediments was conducted systematically following the grids of study area using by grab sampler. Sampling position was determined by GPS Garmin 120 (Figure 1).

Heavy mineral analysis was carried out on very fine grain sand (<3 phi) in each samples. Magnetic minerals were separated by hand magnet, while non magnetic minerals were separated by bromoform. Minerals identification was conducted by using binocular microscope.

REGIONAL GEOLOGY

2.1. Physiographic

Generally physiographic of the surveyed area can be divided into 5 units as follows :

1. ***Beach Line (Beach row/Lajur Pantai)*** occupied along coast line of surveyed area, laying between 1,5 km to 13,4 km from coast line toward land direction. This unit was believed forming during higest sea level (3-6 metres above now sealevel) in regression Holocene 5500 years ago.
2. ***Alluvial Plain (Dataran Aluvial)*** is very dominant unit that was covering big part of surveyed area.Alluvial plane consist of valley swamp which is water flooded, that characterized by very fine sand, graywish clay, rich of organic materials.
3. ***White sand Plane (Undak Pasir Putih*** is groupy spreading laying in the north and south of Sambas River Mouth.
4. ***Low Wavy Hill (Perbukitan Bergelombang Rendah)*** occupied in the east of surveyed area with 100 meters high fro sea level and is formed during Mezozoic
5. ***Cliff Hill (Perbukitan Curam)*** is groupy sprea located in the south of Sambas River Mouth.This unit is intrution has began from Trias to Tertiary.

2.2. Stratigraphic

Based on Geological Map of Sambas/Siluas Sheet with scale 1 : 250.000 (E Rusmana , et.al.,1993) the stratigraphic of surveyed area can be differentiated into six units from young to old as follows :

Age	Unit	Lithology.
Quarternary	Alluvial Deposits and Swamp (*Qa*) < 35 meters	Mud, gravel, sand, plant materials
Quarternary	Litoral Deposits (*Qc*) < 20 meters	Mud, gravel, sand, limestones and plant materials
Late Oligocene - Early Miocene	Sintang Intrussion (*Toms*)	Diorite, granodiorite, dacite, andecite.
Late Cretacious	Granite Pueh (*Kup*)	Adamellite, granitbiotite, monzogranite, medium to coarse grains, hipidiomorfic, uniform grains and rich of senolite.
Late Triassic - Early Jurasic	Bengkayang Group (*TrJb*)	Sandstone, mudstone, siltstone, conglomerate, shale, tuffaceous sandstone, tuff commonly carbonaceous
Late Triassic	Sekadau Volcanic Rock (*Tr USK*)	Basalt, dolerite, andesite, tuff, breccia, agglomerate.

- ***Alluvial Deposits*** (Qa) covering almost r 50% of whole surveyed area.
- ***Litoral Deposits*** (Qc) spreading a long coast line of surveyed area with wide spread between 1.5 km – 9 km
- ***Sintang Intrusion*** (Tomj) groupy spreading in the south of Sambas River Mouth.
- ***Granite Pueh*** (*Kup*) founded solitary in the sea and shore line northern part of surveyed area.
- ***Bengkayang Group*** (*TrJb*) and ***Sekadau Volcanic Rock*** (*Tr USK*) solitary groupy spreading founded in the south of Sambas River Mouth.

MINERAL RESOURCES INDICATION AND DISCUSSION

Five groups of mineral were found in study area those are oxides, hydroxides, silicates, sulfides and carbonates, based on optical mineralogy classification (Paul F Kerr, 1963). Oxides are the most common groups found (Table 1).

Table 1. Minerals Analysed Results

SAMPLES NO. MINERALS	PMK-05 %	PMK-08 %	PMK-10 %	PMK-11 %	PMK-16 %	PMK-17 %	PMK-PNT1 %
Dolomite	0,03657	0,00162	0,00143	0,00688	0,0071	0,00578	0,00544
Limonite	-	-		0,00117	-	0,00173	0,00145
Magnetite	0,00480	0,00330	0,00320	0,00310	0,00330	0,00270	0,00720
Hematite	0,01828	-	0,00158	0,00181	-	0,00231	-
Rutile	0,00609	-	-	-	-	-	-
Cangkang	0,02742	0,00040	0,00095	0,00452	0,00092	0,00520	0,00326
Muskovite	-	0,00018	-	0,00072	0,00018	0,00077	-
Casiterite	-	0,00013	0,00269	0,00380	-	0,00694	0,00435
Augite	0,00914	0,00013	0,00047	0,00090	-	0,00096	0,00036
Phyrite	0,01219	0,00018	0,00063	0,00145	0,00009	-	0,00072
Quart	-	0,00036	0,00047	0,00126	-	-	-
Hornblende	-	-	0,00032	-	-	-	-

Oxides

Minerals representing this group are magnetite ($Fe^{II}Fe_2^{III}O_4$) hematite (F_2O_3), ilmenite ($FeTiO_3$), rutile (TiO_2), and cassiterite (SnO_2). The prevalent mineral of this group is magnetite with percentage ranges between 0.00310% and 0,00720%. The lowest content was found in PMK-11 while the highest occurred in PMK-PNT1 from Jawae. In general, the percentage of magnetite in seafloor sediments is lower than beach deposits.

Following magnetite is hematite with percentage ranges from 0.00158% (PMK-10) to 0,01828 (PMK-05). The content of hematite in beach deposits is even, while in seafloor sediments it varies greatly.

Rutile was observed in one of seven samples containing heavy mineral, with content 0.00609% founded in PMK-05.

Casiterite is the second most commonly occurring mineral and was observed in five samples with percentage ranges between 0.00013% (PMK-08) and 0.00694% (PMK-17).

Magnetite is multiple oxides mineral within the spinel group, is common in most igneous and metamorphic rock. In igneous rock it is a late magmatic mineral. It is a common detrital mineral in sand accumulated along modern or ancient strand lines.

Hematite is rare as an original contitutent of igneous rocks, but is an important mineral, ilmenite a widely distributed mineral in some types of igneous rock , more especially diabases and dolorite, it is an important constitutent of titanium-bearing sand, and often associated with magnetite in iron ore.

Rutile is rather widely distributed eccessory mineral in various metamorphic rocks, rutile also occurs as a dentrital mineral.

Cassiterite occurs in granite pegmatite, in greisen and in high temperature veins, the usual are quartz, muscovite, schorlite and topaz.

Hydroxides

Hydroxides mineral in study area is representing by limonite { $H_2Fe_2O_4(H_2O)_x$ }, it is the third commonly mineral that was founded in three samples. The lowest content of limonite, 0.00117%, was observed in beach sediment, PMK-11. The highest content, 0.00173%, was observed in PMK-17.

Limonite is secondary mineral product, ordinary the result of oxidation or weathering. It may form a cement for sand grains. It is often present on the surface of rock.

Silicates

The prevalent mineral of this group is augite $Ca(Mg,Fe)(SiO_3)_2\{(AL,Fe)_2O_3\}_x$, which was found in six samples from seven analysed samples. The highest percentage of augite occurred in PMK-05 (0,.00914%), while the lowest occurred in PMK-PNT-1 (beach deposits) was about 0.00036%.

Augite is silicates chain structures mineral, within pyroxene group and very common mineral in subsilicic igneous rock such as auganites, gabbros, basalt and olivine gabbros, peridoties and pyroxene andesite. Locally it is found in gneisses and granulites of high metamorphic grade. Augite is also a common detrital mineral.

Another silicates mineral was founded in the study area is Muscovite (Silicates : sheet structure within the Mica group) was observed in four of seven samples analysed with lowest percentage of 0.00018% (PMK-06m and PMK-16) and the highest of 0.00077% (PMK-17)

The third mineral that was commonly occurred is quart that was found in three of seven samples analysed. The samples are PMK-08 (0.00036%), PMK-10 (0.00047%), and PMK-11 (0.00126%).

Another mineral that was observed is hornblende, which is the indicator of intensity and type of metamorphism in the host rock. This mineral was observed in PMK-10 (0.00036%).

Sulfides

Sulfides mineral is represented by pyrite (FeS_2) that was observed in six of seven samples observed. Pyrite composes <1% of sediment with the highest percentage of 0.01219% (PMK-05) and the lowest 0.00009% (PMK-16). Pyrite is the most common sulfide mineral, it occurs in many rock type, in vein, and in replacement deposits. Where oxidation has been present pyrite be altered to limonite.

Carbonates

Dolomite ($CaCO_3$) represents the carbonates mineral within calcite group, was observed in all samples analysed. The highest percentage is 0.03657% (PMK-05) and the lowest 0.000143% (PMK-10). Dolomite is very common mineral, it occurs in veins and replacement deposits, in sedimentary dolomite rocks and limestones, and in the metamorphic dolomite rock

Aggregate Resources

The study area contains abundant aggregate resources such as rocks and sands.

Rock

Abundant rock material in the study area consists of andesitic, dacitic and basltic intrusions. A few andesitic and dacitic intrusions have been exploited traditionally for building material in Kecamatan Pemangkat. The most significant rock mining is in Ujung Batu Village that produces 15 – 20 medium trucks for building material in areas in and around Pemangkat.

Sand

Sand is abundant in the northern part of study area (Jawae) and also a few inTajung Bila in the southern part. Good quality sand is from Recent alluvium, fine to coarse-grained sand, that covers the coasts and river edges. Sand covering the low-lying areas belongs to old volcanic formation consists of sand intercalated with pumice and tuff and also tuffaceous sandstone. Sands for building material are usually coming from sand deposits in the coastal area , for example in Jawae Beach, and Tanjung Bila.

DISCUSSION

In generally magnetite is most igneous and methamorphic rocks. In gneous rock it is a late megmatic mineral. It s common detrital mineral in sands accumulated a long modern or ancient strand lines. Magnetites that was founded in study area, occuring may possibly be related to the contact metamorphism of dacite, andesite and basalt intrusions (sintang Intrusion) of Late Oligocene - Early Miocene

CONCLUSION

1. Mineral resources in Sambas Waters consist of minerals from five groups mineral those are oxides mineral,

hydroxides, silicates, sulfides, and carbonates.

2. The most commonly found mineral in oxides mineral is magnetite that was observed in all samples analysed with highest percentage of 0.00720% and lowest is 0.00310%. Following magnetite is hematite, ilmenite, and rutile.
3. Representing of the hydroxides mineral is limonite 0.00117%, was observed in beach sediment, PMK-11. The highest content, 0.00173%, was observed in PMK-17.
4. Silicates is represented by augite and muscovite. Augite that was observed in six samples with highest percentage of 0,.0091%, while muscovite was observed in four sample of seven samples analysed, with highest percentage of 0.000771% and the lowest 0.00018%.
5. Sulfides mineral is represented by pyrite that was observed in six of seven samples with average percentage of < 1%.
6. Aggregates that have been exploited in study area are rock with andesitic and dacitic composition and sand that comes from alluvium and old volcanic products.

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REFERENCES

Abdul Wahib drr, 2004, *Kajian Agregat di Perairan Muara Sungai Sambas, Kabupaten Sambas, Kalimantan Barat*, Pusat Pengembangan Geologi Kelautan Bandung, tidak dipublikasi

Brenninkmeyer, B.M., 1978, *Heavy Mineral, The Encyclopedia of Sedimentology, Encyclopedia of Earth Sciences*, Volume VI. Ed. By W Rhodes W. Fairbridge & Joanne Bourgeois, Dowden, Huttington & Ross Inc., pp 400-402

Cronan, D.S., 1980, *Underwater Mineral*, Academic press, 362p.

E Rusmana, drr., 1993, *Peta Geologi Lembar Sambas / Siluas, Kalimantan Sekala 1 : 250.000*, Puslitbang Geologi, Bandung

Paul F. Kerr,1961, *Optical Mineralogy*, Colombia University

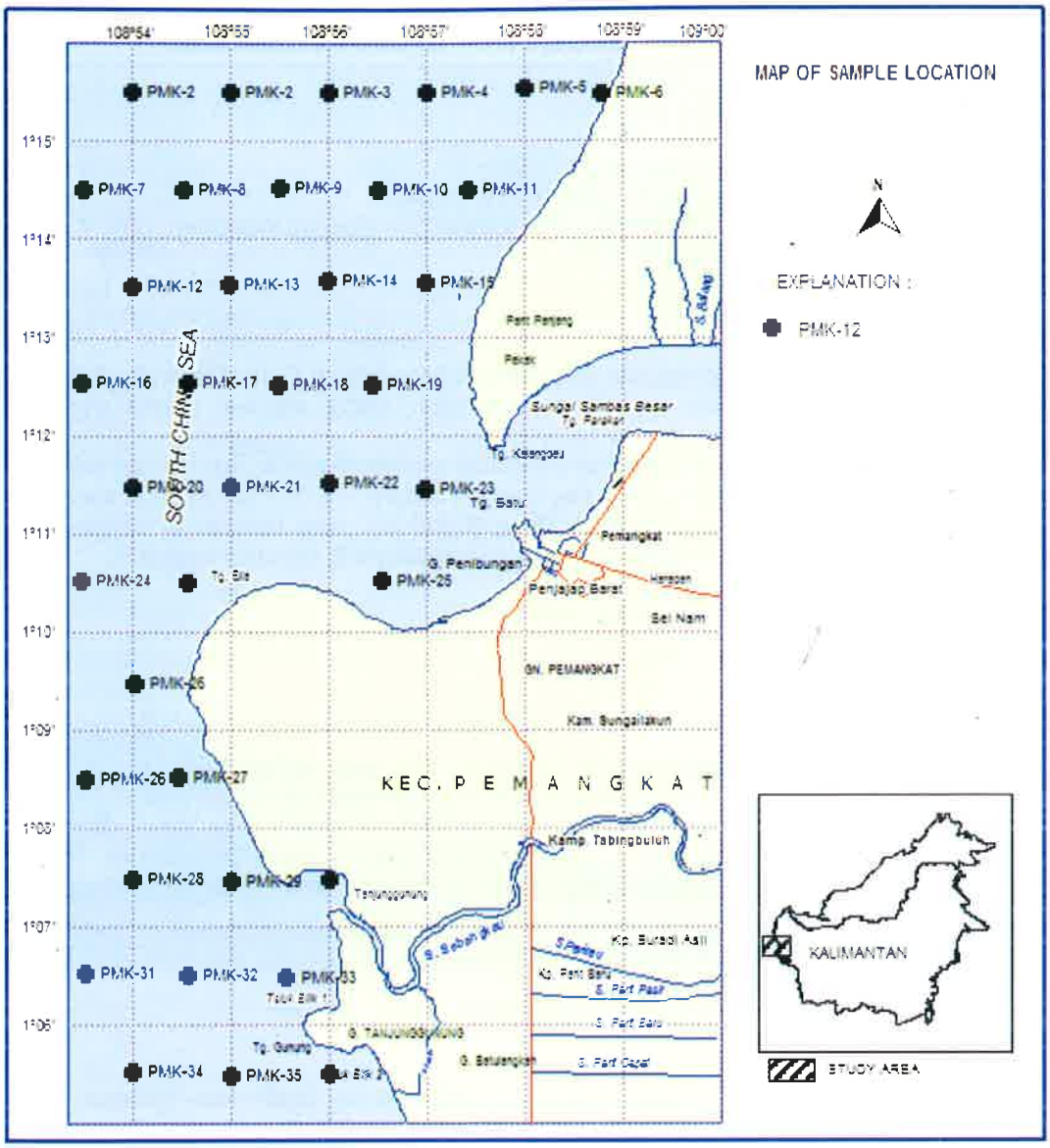

Figure 1. Map of the sampling sediment