The Existence of Tin Placer Relation With Tin Belt In Kundur Waters Area Riau archipelago Province

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Abstract. Placer mineral is mineral deposits that have channels transportation as particles of grains mineral in the river and on the ocean floor. The most common and plentiful placer mineral are rutile, tin, magnetite, ilmenite, zircon and many gems. The existence of ancient rivers flooded after the end of the ice age, of the ancient river many deposited heavy minerals from rocks around the island of Sumatra and Kalimantan. The existence of an ancient channel formed at the Holocene is thought to be a valley that has the potential as mineral deposits to be transported and deposited in the same time with the sediments that fill the valleys. Tin Gravel is one of the heavy minerals in Sunda shelf deposited above the ancient valleys of granite rock The type of granite in Sunda shelf is granite I type (east belt) and S type (middle belt). The granite belt (tin belt) is related to the heavy mineral associations found in the study area, whether derived from granite I type or granite S Type is still a subject of debate among researchers. The granite type classification is based on opaque minerals. The magnetite series comprises of: magnetite, ilmenite, hematite and pyrite, while the ilmenite series consists of: cassiterite, ilmenite, and graphite. Granite in Indonesia islands containing tin mineral included in the middle belt (type S), and east belt (type I). Occurred on a Carbon, Perm and also Triass age. Granites are distributed almost along the coastal to offshore of Kundur Island. Tin (SnO2), or tin include oxide group, brownish, prismatic. Tin deposited is associated with acid igneous rock formed on pegmatites accumulation. In Study area tin founded in 16 samples of seabed surface sediments with the largest content of 0.04124% and the smallest 44 of 0.0006%. The purpose of this study is to know the existence of placer tin content in marine sediments in Kundur waters, its relation with tin belt (granite type), whereas the purpose of the study is to know the source of tin placer.
1. Introduction

Offshore minerals that are economical or not economical deposits at this time, someday is possibility being economic value. The potential level will be determined by the law of demand and supply. The research area is located in West Kundur area at coordinates, 0° 39' 00" N and 103° 10' 00" E. (Figure 1)

Placer Minerals is mineral deposits that have run into transportation as mineral granules in rivers and seabed. Placer Minerals are high density heavy minerals and resistant to transport, erosion, chemical processes, and weathering (Cronan, 1980). Placer deposits are physically accumulated by fluvial and marine processes in coastal area. (Setiady, 2010).

![Figure 1. Study area](image)

The research area is the tin Granite belt in Southeast Asia found along the zone around 4000 Km from Burma (Myanmar) to the Indonesian archipelago. There are two granitic units in Lingga island Riau region: the S-type Muncung Granite and Tanjungbuku I-type. (Irzon, 2015). The granite of the Malaysian Southeast Asian tin belt were divided into I-type–dominated Eastern province and transitional I/S-type Main Range province, separated by the Bentong-Raub suture zone. (Charusiri, 1993).

**Difference between I Type I and S. Type granite:**

**I-Type Granite:**
- Derived due to partial melting of igneous proloith.
- Deep seated igneous or metaigneous rocks of lower continental crust subjected to partial melting due upwelling of mantle material to higher levels.

**S-Type Granite:**
- Derived due to partial melting of sedimentary and metasedimentary rock.
- S-type are more common in collision zones.
- These are peraluminous granites.
- S-type granites are characterised by presence of muscovite, biotite and marginally higher SiO2 contents.
Some problems concerning heavy mineral assemblages in a Holocene sediment in the Sunda Shelf, that heavy minerals are from islands or sediment placer from surrounding islands of study area. Heavy mineral association in coastal and offshore sediment relation with source Rock surrounding that area. (Setiady, 2010). The importance of heavy minerals in identifying sediment sources, grain sorting processes, of transporting agents and sediment provenance (Frihy, 2016). The tin deposit in Riau Archipelago (Karimun island) is related to the granite tin belt which extends from Thailand to Indonesia (sunda shelf). (Irzon, 2017).

The Sunda Shelf of paleo river system are widely submerged river systems that present-day river systems and interpreted to follow sea bottom morphology lows in a down-slope direction. (Voris, 2000). Sunda Shelf which has been sunk since the Last Glacial. (Solihuddin, 2014; Setyawan and Nuryana, 2016).

Figure-3, shows Sunda paleo-rivers regional system surrounding Sunda Shelf during last glacial maximum. (Darmadi, 2007). All paleo channels connected in rivers of sunda shelf during glacial. (Hananto, 2010)
Based on the Geological Map in Kundur – Karimun area (Cameron, et al., 1982), consist of Alluvium deposits, Intrusive rocks, (Granite) Malarco Formation, Papan Formation and Bintang Formation. (Figure-4)

Alluvium at study area can be divided into two type are Old and young Surface deposit. Old surface deposit consist of clay, silt, gravelly clay, and granite sand. Young surface consist of clay, silt, peat and coral reefs. Papan Formation consist of shale, sandstone and quartz conglomerate while Intrusive rocks consists of granite and gabro.

Figure 3. Regional overview of Sunda Shelf (after Darmadi et al. 2007; Reijenstein et al. 2011)

Figure 4. Geological Map in study area (after Cameron at al. 1982)

Granites in Indonesian islands containing Tin are included in the main range and eastern provinces. It occurs on a Carbon-Permian-Triassic. The types of granite in Sunda shelf is granite I type (east belt) and S type
(middle belt). The granite belt (Tin belt) is related to the heavy mineral association found in the study area, whether derived from granite type I or granite type S is still a subject of debate among researchers. The granite type classification is based on opaque minerals. The magnetite series comprises of magnetite, ilmenite, hematite and pyrite, while the ilmenite series consists of cassiterite, ilmenite, and graphite.

The purpose of this study is to know the existence of placer tin content in marine sediments in Kundur waters, its relation with tin belt (granite type), whereas the purpose of the study is to know the source of tin placer.

2. Method

Research method conducted are Positioning, seafloor sediment sampling, seafloor morphology measurement, coastal characteristic map, laboratory analysis such as grain size analysis, and chemical analysis.

Position data using GPS that can be monitored from the computer. The surficial sediment sampling using gravity corer and grab sampler. Grain size analysis is to determine the statistical parameters and to know of sediment texture horizontally and vertically. Grain size analyses using dry sieving method with sieve holes diameter between -4 phi to 4 phi, (Folk, 1980).

Seafloor morphology measurement is carried out using an echo sounder, to determine the depth of the seabed at the sediment sampling and seafloor morphology. Coastal characteristics are carried out qualitatively descriptively based on geological data, reliefs, shoreline characteristics and coastal processes.

3. Result And Discussion

Sediment samples were taken using a grab sample are 46 sediment samples and using gravity core are 14 examples. Sea bottom sediments in research area can be divided into five kind of namely are: sandy gravel (gS), sand (S) sandy silt (zS), silt (Z), and mud (M) (Figure-5).

**Sandy gravel** (gS). Sandy gravel are covering 15% of research area. Sandy gravel is present a maximum 23 m water depth. Percentage of gravel and sand are 31.8 to 71.2% and 28.8 to 68.2%.

**Sand** (S). Sand unit covers 10% of the research area. Sand is present in 10 m to 18 m water depths. Percentage of gravel : sand : silt : clay are 0.2 to 28.3%, 42.9 to 96.2%, 0 to 45.2% and 0 to 0.8%.

**Sandy silt**, Sandy silt covering 10% of the research area. Sandy silt present from 4 to 12 m and 8 to 12 m water depths. Based on Grain size analysis results showed that percentage between sand : silt : clay are 10.3 to 49.9%, 48.5 to 89.5% and 0.2 to 1.6%.

**Silt**. Silt has covering nearly 55% of total research area. Silt present at 4 m - 17 m water depths. Based on Grain size analysis results showed that the percentage of silt : sand : clay are 89.1 to 98.2%, 0.8 to 9%, and 0.5 to 2.7%.
Figure 5. Sediment distribution Map

Mud (M), Mud covers 10% of the research area. Mud located from 10 m to 14 m water depths. Percentage of mud (silt + clay) : ravel : sand was 72.8 to 93.4%; 0.1 to 3%, and 6.5 to 26.1%. The megascopic characteristics of mud is similar with silt, but the difference between mud and silt can be seen from most sample mud contain of fine- very coarse grains quartz sand.

Bathimetry

Total of seafloor morphology measurement survey is 252 450 km length. Bahtimetry results after correction of transducer position and tides influence is made sea bottom morphology map with 1 meter depth interval contour. Bathimetry in research area show varies morphology. (Figure-6) In north Mendol island seafloor morphology relatively gradual changes. In some places seafloor surface morphology showed as steep morphology. In west Kundur waters seafloor morphology showed an irregular morphology, especially from Lalang Island to Ketapang Waters. In coastal west Kundur Island there is a granite rock outcrop. At several places granite outcrop forming a small island.
Coastal Characteristic Map.

The geological resources at Kundur Beach from coastal characteristic map, composed of granitic Rocks, sandy beach and muddy beach are located around Ketapang, Layang and Lubuk. (Figure-6). While sandy beach consist of tin and quartz sand in Kundur island. Granite is distributed along the west coast of Kundur Island from Ketapang, Kundur, Kobel Tuar to Sawang and Lubuk, while in the offshore granite rock is forming granite islands. Based on coastal characteristic map, granite on the coast of Kundur Island has undergo weathering, transportation and sedimentation towards the coast. The sediment contains economically transported minerals (Mineral Placer). Mineral analysis, in beach and offshore sediments obtained 24 types of heavy minerals, namely: Magnetite, Cassiterite, Zircon, Monasite, Xenotime, Pyrochloric, Apatite, Ribekit, Garnet, Hornblenda, Tourmaline, Muskovite, Wolframite, Sphene, Pyrite, Ilmenite, Hematite, Topas, Scheelit, Columbian, Siderit, Alunit, Leokosen, Chamosit. Since the occurrence of sea flooding due to the melting of ice from global temperature changes, the region has changed to the sea and is referred as a part of the Java Sea. The rivers flowing in the Sunda mainland were finally buried under the sea. At the present time that appear as islands, such as: Riau Islands, Bangka, Belitung and others.

In relation to various problems concerning heavy mineral assemblages in a Holocene sediment in the Sunda Shelf, the heavy minerals in the area of investigation are from nearby islands or are sediment debris from a
system of exposure

**Tin (cassiterite)**

Cassiterite contents in study area are found in 16 samples of seabed surface sediment. The largest cassiterite content in KDR-11 at 0.04124% and the smallest content in KDR 44 at 0.0006%. The highest cassiterite content is in gravelly sand sediments, in the north of the study area, namely KDR-11, getting to the south the smaller grain size are sandy silt.

Cassiterite distributed from the west Kundur waters to offshore between 10 m-24 m depth. The relationship between % cassiterite content and the type of sediment grains. (Figure-7). It can be seen that the dominant mineral content of cassiterite is found in the grain size of sand and gravelly sand (gS).

Whereas in silt and mud sediments are very small. This is due to the high specific gravity of the cassiterite mineral between 6.8 - 7. It is more dominant in large grain sizes, namely sand - gravel. The mineral content of the cassiterite sample number 03, (south of the study area) is very small, while the sample 11, 12, (north of the study area) is large this indicates that the source of rock is from from the north of study area. This is supported by the depth of the seabed depth contour in the north near Kundur is relatively deep (steep).

Cassiterite (tin) including group oxide (SnO2), brownish red, identical to rutile, synonymous with tin ore, Cassiterite deposits are associated with acid freezing stones, especially granit formed in pegmatite accumulation, metasomatic and hydrothermal contact deposits. Cassiterite is used for soldering ceramics, tin in cooper mixtures.

Based on this, the cassiterite mineral is found predominantly in sediments with grains of sand to gravel. This is in accordance with data from granite megascopic description of Kundur granite, generally roughly sized with megacrystals.

Tin Gravel is one of the heavy minerals in Sunda shelf deposited above the ancient valleys of granite rock. In relation to various problems concerning heavy mineral assemblages in a Holocene sediment in the Sunda shelf, the heavy minerals in sudy area are from nearby islands.

Cassiterite mineral is a mineral that source is from granite rocks, where granite rocks found along the coast Kundur Island or on the surface of the seabed undergo weathering, transported and sedimentation. Source rock of cassiterite are from S/I type. In type I (magnetite series) which is rich in Fe, Sn content in magma will be replaced by Fe and Ti to form minerals such as magnetite, and hornblend, so that it will not be enough to form economical tin deposits. Whereas in type S (Ilmenit series) which is not rich in Fe, Sn will not be replaced by Fe and Ti, allowing Sn deposits to form economical tin deposits. Whereas in type S (Ilmenit series) which is not rich in Fe, Sn will not be replaced by Fe and Ti, allowing Sn deposits to form.

![Figure 7. Cassiterite mineral content in surficial sediment Kundur Waters area](image-url)
The source rock from sea sand in the Kundur waters is a rock that belongs to the granite clan which is widely spread around the Riau Islands.

Conclusion

Cassiterite is found sand to gravel sediments, indicating that the transport process has not been so far from the source rock. Cassiterite deposited by big currents from the north to the south. It is supported by the presence of bathymetric contours that are relatively north to the south.

Source rock of cassiterite are from S type. In type I (magnetite series) which is rich in Fe, Sn content in magma will be replaced by Fe and Ti to form minerals such as magnetite, and Hornblend, so that it will not be enough to form economical tin deposits. Whereas in type S (Ilmenit series) which is not rich in Fe, Sn will not be replaced by Fe and Ti, allowing Sn deposits to form.

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