Structure System and It Controls to Mineralization of Primary Tin Deposit, Airdibi Area, Jebus Subdistrict, West Bangka, Bangka and Belitung

Faiz Akbar Prihutama¹, Muhammad Syarifuddin¹, Angger Imas Ashhidiqie Faric Ryandhika¹, Suprapto Angga Widya Yogatama², Reza Aviandono³

¹ Universitas Pembangunan Nasional “Veteran” Yogyakarta, Jalan SWK 104, Condongcatur, Depok, Sleman District, Daerah Istimewa Yogyakarta
² PT. Timah, Tbk.

faizakp8@gmail.com

Abstract. Bangka Island is one of the most potential areas with abundant mineral resource in Indonesia. The main commodities in the exploration of metal mineral deposits on Bangka Island are tin. Tin deposits located on Bangka Island are formed from acid magma produced of collision. The research location is in Airdibi area, Jebus subdistrict, West Bangka regency, Bangka and Belitung province. The objective of this research is to know the characteristics of primary tin deposit by observing the geological aspect, and the distribution of alteration and mineralization. Research method are used is surface geological mapping. Analyzes performed to process surface geological data are petrographic analysis, mineral graphic analysis, ASD analysis (Analytical Spectral Devices), and XRF (X-Ray Fluorescence) analysis. Stratigraphy of this research areas from the old to the young, namely the Complex Pemali Uni, the Tanjunggenting Sandstone Unit, the Fine Grain Granite Klabat Unit and Alluvial Deposit. Assemblages Minerals alteration at the study sites results from an ASD analysis showing the minerals resulting from a hydrothermal process consisting of six zone there are Tourmaline + Muscovite + Chlorite + Illite + Smectite, Silica + Tourmaline, Illite + Smectite + Chlorite + Tourmaline, Illite + Smectite + Tourmaline, Muscovite + Quartz + Illite + Smectite + Halloysite, Kaolinite + Illite + Smectite. From the XRF analysis showing the various grade of tin on the vein. The geologic structure that developed in the research area is highly controlling the primary tin mineralization process. Veins with a relatively NW-SE direction which is an extension faults product has a higher level than a sheeted veins with a Relatively NE - SW direction which is a compression faults product. Based on field data and the results of laboratory analysis, deposit type greisen deposits in the vein phase.

1. Introduction
According to [1], Bangka Island physiography is one of the largest islands of a group of islands belonging to the Sunda Shelf with Belitung Island, Singkep Island and several islands such as the Natuna Islands, Anambas, Karimata, Bawean and Tambelan. Bangka Island enters the Asian Tin Belt line that stretches Malaya peninsula, Riau Islands (Singkep Island, Karimun Island, Kundur Island), Bangka Island and Belitung Island.
In relation to tin deposit, Bangka Island physiographically is the largest island in Sundaland (Sundaland) and is a Sundanese Peneplain, characterized by hilly terrain with the height of bedrock limiting the South Sumatra Basin in the east and the Sunda Basin in the north, Bangka Island including Tin Islands, located on Sundaland Craton of the Eurasian Plate [2], and is part of the Southeast Asian Tin Belt [3] [4] (Fig 1).

2. Regional Geology

2.1. Regional Tectonic
Bangka island is part of the East Malaya block that became one of the compilers of Sundaland. The East Malaya Block is a microcontinent derived from Gondwana that experienced separation in Early Devon [5] (Fig 2)

2.2. Regional Stratigraphy
The formation that composes the stratigraphy of Bangka Island, as as follow:

- **Qa** (Aluvium) composed by boulder, couble, pebble, sand, clay dan peat
- **Qs** (Swamp Deposit) composed by mud, silt and sand
- **Qak** (Quartz Sand) composed by white quartz sand, coarse – moderate grain, open, subrounded - rounded, exposed along the east coast of Sumatra Island around Tanjung Jati
- **TQr** (Ranggam Formation) composed by sandstone with crossbedding structure.
- **Rkkg** (Klabat Granite) composed by biotite granite, granodiorite and gneissed granite.
- **Rt** (Tanjunggenting Formation) composed by interbedding sandstone and claystone.
- **CPp** (Pemali metamorphic complex) composed by phylite, quartzite, schist.

3. Methodology
The purpose of the research is knowing the main geological structure that control the mineralization of tin deposit. Generally, the methodology used to know the structural control divided into 3 steps. The first step is literature study, the second step is geological mapping and the third steps are laboratorium analysis using XRF portable, ASD portable, petrography and mineragraph.

4. Result and Discussion

4.1. Structural Geology of the Research Area
The geological structure that developed at the location of the study was the accumulation of tectonic activity that occurred in Bangka Island. The geological structure that developed at the location of the study was the field of layering, foliation, joint and fault. The geological structure at the research site greatly affected alteration and mineralization, because later alteration and mineralization patterns would develop following the zone of geological structure zone in the form of joint and fault.

According to [6], there were three times of tectonic deformation that occurred on Bangka Island and formed stagnant patterns from each of its deformations. Based on field data at the research site, there were 11 developing faults namely LP fault 1, 8, 24, 40, 43, 45, 62, 70A, 70B, 88 and 91.

4.2. Alteration and Mineralization
The mineral assemblage zone zone in the research site was divided into 6 mineral assemblage zone zones. Sorted based on the formation temperature from high temperature to low temperature were Silica + Tourmaline Zone, Tourmaline + Muscovite + Chlorite + Illite + Smectite Zone, Illite + Smectite + Chlorite + Tourmaline Zone, Illite + Smectite + Tourmaline Zone, Muscovite + Quartz + Illite + Smectite + Halloysite Zone, and Kaolinite + Illite + Smectite Zone. (Fig 3)

Mineralization at the research site developed in the geological structure zones in the form of joint filled with Tourmaline, Silica, Silica – Tourmaline, and Kaolinite, in the form of sheeted veins, jogs,
and lode veins. The mineralization process was related to the formation of ore minerals. The ore minerals could be found out by mineralographic sections. To determine the content of the elements in each vein, XRF (X-Ray Fluorescence) analysis was performed. After obtaining various elements in each vein, geological interpretation based on vein geometry and geochemical analysis was carried out to be able to determine the genetic characteristics of mineralization at the research site. The elements used to do geological interpretation and geochemical analysis were Sn, Cu, W, Zn, Pb with Sn element as the most important element for geological interpretation. Sn elemental levels in each vein varied, ranging from 16 ppm to 756,000 ppm.

The presence of ore minerals could be found out by using the analysis of minerography in veins that indicated the presence of tin deposits associated with Tourmaline (Fig 4), Quartz and Dyke. Mineragraphy analysis results showed some ore minerals such as Pyrite, Cassiterite, Chalcopyrite, Malachite, and some oxide minerals in the form of Hematite and Gutite.

Sn element’s mineralization in the research site was found in disseminated form in rocks and in the form of veins in the form of sheeted veins, jogs, lode veins, massive veins, and granite dyke. After XRF (X-Ray Fluorescence) analysis was obtained, the content of Sn elements was different in each vein geometry. Sn content with levels of less than 100 ppm was found in the dissemination of stones and veins with sheeted vein geometry in the Southwest-Northeast direction, while Sn elements with levels of more than 100 ppm to more than 1000 ppm were found in veins with jogs and lode vein geometry with the direction of Northwest-Southeast (Fig 5).

4.3. Discussion

The main fault that formed at the time of mineralization was the right horizontal fault with a northwest-southeast direction that produced follow-up faults and fractures as hydrothermal fluid pathways to produce a tin deposit system. From the right horizontal fault, a fault zone was formed that controlled mineralization at the research site, which was right horizontal fault with a relative direction of Northwest-Southeast to East-West as a synthetic result of the main fault. This right horizontal fault also produced minor faults that produced mineralization at a small scale at the research site. In addition, a fault that was almost perpendicular to the main fault was formed, which was the left horizontal fault as an antitetic fault that was a jointy-rigid extension fault as the main controller of mineralization at the research site. Then, the mineralized genes were refocused on the right horizontal fault zone with a left horizontal fault that produced veins with a large form of jogs or could be called lode and produced flexure veins filled with Tourmaline minerals associated with Cassiterite as lead carrier minerals. Both of these faults were formed from the results of the force caused by regional faults at the research site so as to produce jointy extensions filled with Tourmaline and Cassiterite minerals and as an intrusion line filled with Tourmaline minerals associated with Cassiterite as lead carrier minerals. Both of these faults were formed from the results of the force caused by regional faults at the research site so as to produce jointy extensions filled with Tourmaline and Cassiterite minerals and also as granite dyke intrusion lines that were associated with Tourmaline and Cassiterite. (Fig 7)

Conclusion

The primary type of tin mineralization was in the form of fillings in hollow, massive, flexure, jogs, and lode veins, and the content of lead with Sn content reaching more than 100 ppm was in the tourmaline veins and quartz in the Northwest-Southeast direction. On the other hand, veins with levels of less than 100 ppm to Barren were present in tourmaline veins and quartz veins with a relatively southwest-northeast direction.

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References
[1] van Bemmelen R W 1949 *The Geology of Indonesia* (The Hague, Govt.)
[2] Barber and Crow 2005 Sumatra: geology, resources and tectonic evolution (references) *Tectonics* **21** 1040
[3] Taylor R G 1979 *Geology of Tin Deposits* (New York: Elsevier Scientific Publishing Company)
[4] Corbett G 1997 SOUTHWEST PACIFIC RIM GOLD-COPPER SYSTEMS: Structure, Alteration, and Mineralization *Short Course Man.* **6**
[5] Metcalfe I 2011 Tectonic framework and Phanerozoic evolution of Sundaland *Gondwana Res.* **19** 3–21
[6] Katili J A 1967 Structure and age of the indonesian tin belt with special reference to Bangka *Tectonophysics* **4** 403–18