The Content of Placer Heavy Mineral and Characteristics of REE at Toboali Coast and Its Surrounding Area, Bangka Belitung Province

Kandungan Mineral Berat Letakan dan Karakteristik Unsur Tanah Jarang di Pantai Toboali dan sekitarnya, Provinsi Bangka Belitung

Noor Cahyo D. Aryanto and Udaya Kamiludin

Marine Geological Institute, Ministry of Energy and Mineral Resouces of Indonesia

Corresponding author : cahyo@mgi.esdm.go.id

(Received 05 January 2016; in revised from 14 January 2016; accepted 23 May 2016)

ABSTRACT: Bangka Island and surrounding areas (including coast and seabed sediments) is known as main tin producer (cassiterite) in the world as these part of the Southeast Asia Granitic belt, but in fact, other than as a producer of tin, Bangka Belitung is also as heavy mineral placer (as accessories mineral) and REE potential producer which one based on the geological conditions.

The potential of accessories minerals on sediment coast, other than cassiterite that occurs around Betumpak Cape, i.e: magnetite (7.86 %), ilmenite (4.9%), zircon (2.51%) and apatite (1.07%) respectively with content. While the content of monazite by using a hand drill has the potential content of up to 67.8 g/m^3, while the content of monazite hypothetical resources off the coast of Bangka approximately 471,087,689 m^3. As for the content of monazite hypothetical resources off the coast of South Bangka are approximately 23,995,820 m^3.

At Toboali coast, South Bangka the presence of REE in sediments are above the Earth's crust generally. They're concentrations, such as La (5.07 to 199 ppm), Ce (106-394 ppm), Pr (5.11-59.7 ppm), Nd (16.5-201 ppm), Sm (9.97-52.3 ppm), Eu (0.18-1.55 ppm), Gd (9.11-39.3 ppm), Tb (1.35-8.14 ppm), Dy (9.01-56.3 ppm), Ho (1.89-12.3 ppm), Er (5.19-33.9 ppm), Tm (0.77-5.62 ppm), Yb (3.3-37.5 ppm) and Lu (0.71-5.41 ppm). LREE (La-Eu) highest content is generally found in the location of the tailings sludge (TBL-13C), not so in HREE (Gd-Lu), the highest content is widely available on the sandy beach sediments (TBL-13B). Tectonic environment of Toboali granitoid rocks by plotting a spider diagram refers to the chondrite normalization is continental magmatic arc.

Keywords: Placer heavy mineral, REE, Granitic Belt, Bangka Belitung Province.

ABSTRAK: *Pulau Bangka dan daerah sekitarnya (termasuk di pantai dan sedimen dasarlaut) telah lama dikenal sebagai penghasil timah (kasiterit) utama di dunia sebagai dari bagian Jalur Granit Asia Tenggara, selain mineral berat sebagai pembawa unsur tanah jarang (UTJ) sangat dimungkinkan mengingat kondisi geologinya.*

Potensi mineral ikutan di sedimen pantai selain kasiterit, seperti di pantai Muntok antara lain, seperti magnetit (7,86%), ilmenit (4,9%), zirkon (1,32%) dan apatit (1,07%). Adapun kandungan monasit berdasarkan hasil pemboran tangan memperlihatkan kandungan hingga 67,8 g/m^3 dengan kandungan potensi sumber daya di seluruh Pantai Bangka sekitar 471.087.689 m^3 dengan potensi sumberdaya hipotetik di Pantai Bangka Selatan mendekati 23.995.820 m^3.

Di Pantai Toboali, Bangka Selatan kehadiran Unsur Tanah Jarang (UTJ) dalam sedimen, umumnya di atas konsentrasi kerak bumi. Kandungan unsur tanah jarang tersebut, seperti La (5,07 - 199 ppm), Ce (106-394 ppm), Pr (5,11-59.7 ppm), Nd (16,5-201 ppm), Sm (9,97-52,3 ppm), Eu (0,18-1,55 ppm), Gd (9,11-39,3 ppm), Tb (1,35-8,14 ppm), Dy (9,01-56,3 ppm), Ho (1,89-12,3 ppm), Er (5,19-33,9 ppm), Tm (0,77-5,62 ppm), Yb (3,3-37,5 ppm) dan Lu (0,71-5,41 ppm). Kandungan tertinggi unsur tanah jarang ringan (UTJ-R) seperti La hingga Eu umumnya dijumpai pada lokasi tailing (TBL-13C) berbeda halnya dengan unsur tanah jarang berat (UTJ-B), kandungan tertingginya dijumpai pada sedimen pantai pasiran (TBL-13B). Berdasarkan hasil perajahan pada diagram laba-labanya, memperlihatkan bahwa lingkungan tektonik granit Toboali merupakan busur benua magmatik.

Kata kunci: *Mineral berat letakan, Unsur Tanah Jarang (UTJ), Jalur Granit, Provinsi Bangka Belitung*

INTRODUCTION

The Islands of Bangka and Belitung and the surrounding area, has been known since a long time ago as a main tin-producing area in Indonesia. Geologically, due to granite presence - this study area also has potential of rare minerals, such as monazite, xenotime, apatite, pyrochlore and zircon that strategically as a radioactive carrier. These heavy minerals which initially only in tailing form, but nowadays with the development of technology can be processed more efficiently from originally a by-product into the main-product.

The trend demand of sand and minerals increased rapidly along with the rapid development in all sectors. Mineral resources potency at coastal and offshore areas, become an alternative choice due to the increasingly limited exploration target reserves and resources in mainland and it has the potential to improve the economy of region. Tin minerals based on its geological characteristics, always present with its association minerals, that have been imposed only as tailings that has not been used optimally. But through time where tin is no longer can be expected as a *'primadona'* product, it would be found other minerals that could taking over the role of local goverment income contributor. For that required a study, which is focused to aspects of mineralogy to determine the content of other minerals found in marine sand sediments.

Study area is located around the Bangka Strait water, belong to Toboali District, Bangka Belitung Province. In the western and southern parts, the study area is bordered by Bangka Strait, whereas the north by Air Gegas District and Central Bangka Regency. Furthermore, the eastern part is bordered by Lepar Island and Sea Lepar (Figure 1). The study area can be reached by vehicles, it take approximately 3.5 hours from Pangkalpinang due to good road conditions.

Regional geology of Bangka Island of the eastern (eastern range) and primary (main range) provinces granitoid that also composed of rocks on Malaya and Sumatera Gulf. Triassic Granite is associated with the formation of tin that stretches from the Thailand-Malaysia Peninsula-the Riau Islands and Bangka-Belitung to West Kalimantan as Granite Tin Belt (Cobbing, et al., 1986; Figure 2). The boundary between the main and east provinces and continuous to the south which may be encountered in Sumatra, and is believed to borders of Tin island and the eastern part Sumatra as Sibumasu Block (Siam-Burma-Malaysia-Sumatera) - (Wikarno et al, 1988).

The literature review of research granite on the Bangka island, especially for the major elements data applied in various geochemical diagram to determine its petrogenesis which concluded that the rocks as Biotite Granite which is divided into two granitoid provinces, namely: Main Range, include granite in West Bangka (Menumbing), North Bangka (Belinyu), Pemali and Permisan while Eastern Range covering of Central Bangka (Pading) and South Bangka (Toboali); (Schwartz et al, 1995 in Widana et al, 2015).

I and S-type granites occur and distribute in Bangka and Belitung islands. I-type granite in Bangka, both geologically and geochemically are different from the I-type in the Riau Islands. S-type granite in North

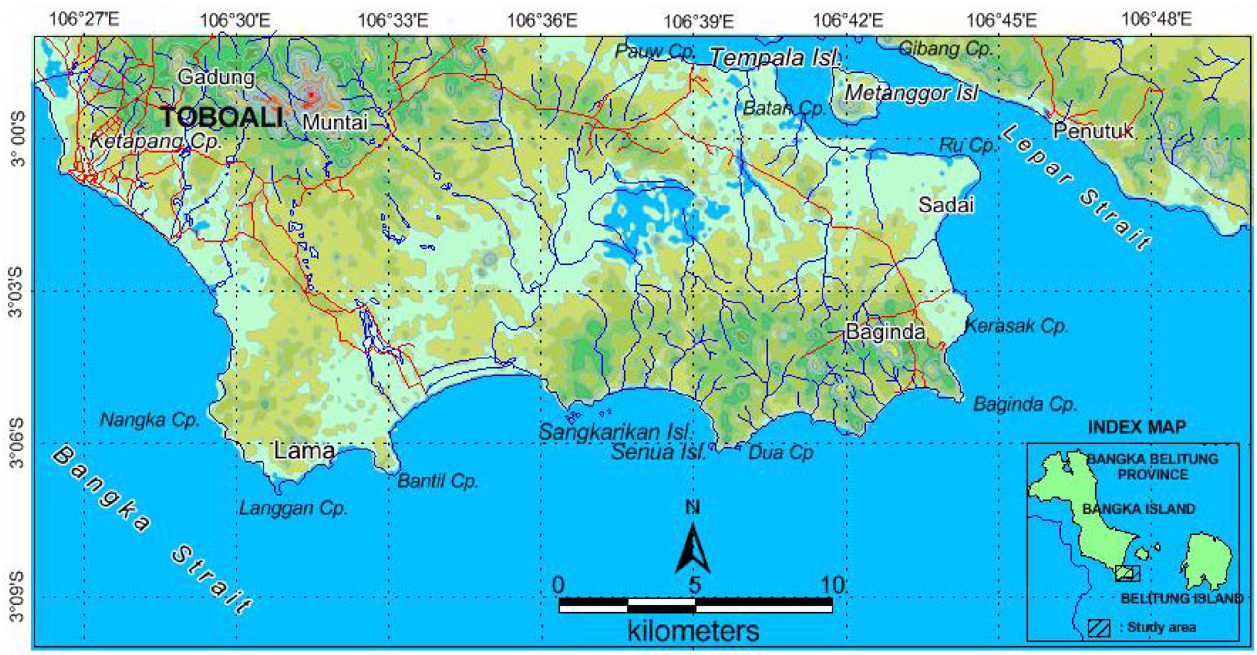


Figure 1. Map of study area (Aryanto, 2015)

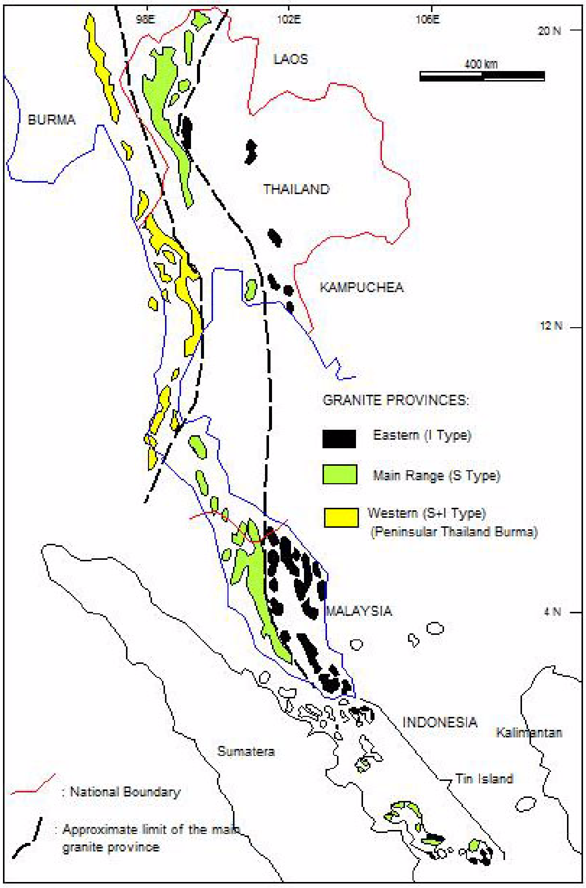


Figure 2. Granite province distribution on Southeast Tin Belt (Cobbing et al, 1986)

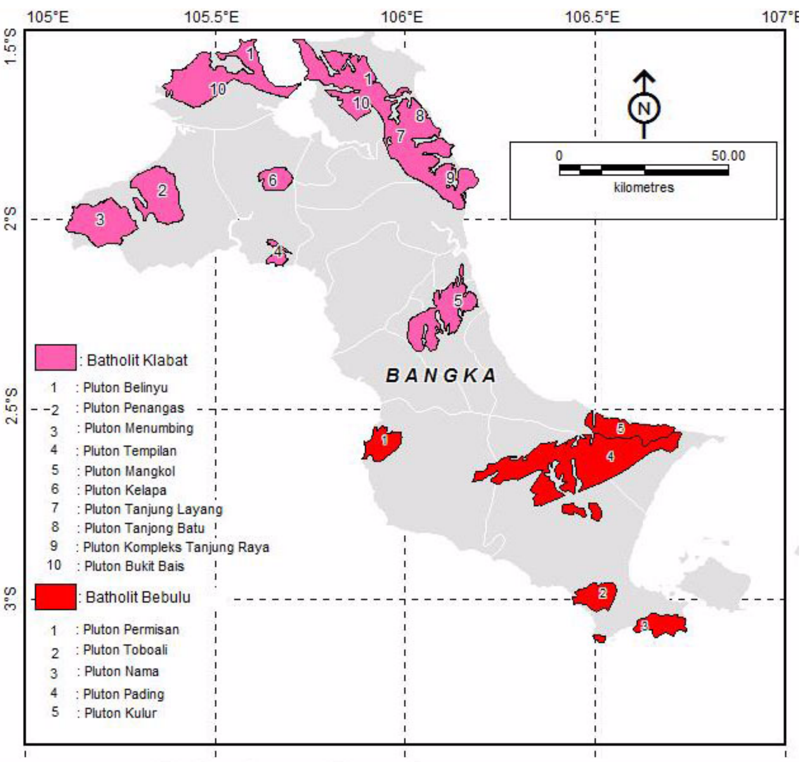


Figure 3. Map of granites distribution at study area (Cobbing, 1986)

Bangka is similar to the main granite belt that came from Peninsular Malaysia, and classified as a Klabat Batholite suites. While, South Bangka Granite are S and IS-type that named Bebulu Suite where along to eastern part to Belitung, such as S-types Tanjung Pandan plutonic. Some of granite that derived from these two belts associated with tin mineralization. All granites is Bangka island most had S and IS-types, exceptually of Kelapa pluton which has I-type (Cobbing, et al., 1986).

Klabat Batholit is the most extensive granitoid and curvilinier belt form which 100 kms long at along the north coast of Bangka consisting of 10 plutons, they are: Belinyu, Penangas, Menumbing, Tempilang, Mangkol, Kelapa, Tanjung Layang, Tanjung Bato, Tanjung Raya complex and Bukit Bais pluton. Bebulu Batholit is an important batholit that occur on southern part of Bangka and widespread, consists of five plutons, namely Permisan, Toboali, Nama, Pading and Kulur Pluton (Figure 3).

Rare earth elements (REE) are elements belonging to the lanthanides with atomic numbers 57 to 71 and due to similar chemical properties, including the yttrium (Y) of atomic number 39. The elements that are included in the rare earth elements are lanthanum (La), cerium (Ce), praseodymium (Pr), neodymium (Nd), promethium (Pm), samarium (Sm), europium (Eu), gadolinium (Gd), terbium (Tb), dysprosium (Dy), holmium (Ho), erbium (Er), thulium (Tm), ytterbium (Yb), and lutetium (Lu). Rare earth elements can be divided into light rare earths (LREE) that is the La, Ce, Pr, Nd, Sm, Eu element and heavy rare earths element (HREE) are elements of Gd, Tb, Dy, Ho, Er, Tm, Yb, and Lu (Villaseca et al, 2007).

The oldest rock in the study area is Paleo-Perm metamorf Pemali Complex (CPp) consisted of: phyllite, schist with quarzite intercallation and calcareous lenses. Penyabung diabase is younger than Pemali Complex (Permo-Trias, PTrd), composed of: diabase that intrudes Pemali and then is intruded by Klabat Granite (TrJkg). In the early Triassic, along with the formation of diabase was formed Penyabung Tanjunggenting Formation (Trt) which is composed of interlayered metasandstone, sandstone, clayeysandstone and claystone with lenses of limestone, widely spread covering almost all parts of the island of Bangka. In late Triassic to middle Jurassic, magma activity formed Klabat Granite (TrJkg) that intrudes all early rock units. In Pliocene, Ranggam formation (TQr) is deposited consisted of interlayering sandstone and claystone, while in quartenary (holocene) formed alluvial deposit (Figure 4).

Geological structures developed on the island of Bangka consist of reverse fault, shear faults, normal faults, fold structures, fracture and some others structural lineaments. Fold structures are generally formed in the Permian aged rocks. According to Margono (1995), deformation in this region occurred in 3 phases, beginning in the Late Paleozoic with structure trending northeast-southwest and characterized by diabase intrusion, then (the phase-2) in the Upper Triassic - Jurassic with structure trending northwest - southeast and re trending northeast - southwest is marked by granite dikes. The phase-3 or the youngest in Cretaceous, structures that trending north to south.

METHODS

Sea floor sediment samples had been taken using a gravity corer and a grab sampler which spacing between 800 to 1400 m. Heavy mineral analysis using bromoform heavy liquid and isodynamic separator was carried out at laboratory of Geological Agency, while grain size analysis and mineral micrograph had been done at laboratory of Marine Geological Institute (MGI) and applied Eclipse LV 100 polarization microscope. Whilst, Inductively Coupled Plasm (ICP) is used to define of rare earth element (REE) types and its concentrations. Analysis in this way has several advantages, among others; this tool is able to analyze samples are stable in the periodic table except gas, both qualitatively and quantitatively simultaneously. Another important advantage is the operating conditions in the determination of elements with each other does not change and measurement techniques in multi element (more than 10 elements in a single measurement), with faster speed, precision, and with high sensitivity. In addition, the ability of ICP is very wide concentration range of parts per billion (ppb) to percent (%), without dilution and changes in condition and has a very low detection limit. (Hartati, 1996). Thus, the use of ICP-MS method is very well needed for measuring the content of REE in the levels of the trace. REE obtained by the analysis, to determine its characteristics then normalized to chondrite (Sun, and Donough, 1989) assuming that the chondrite as the material forming the origin of the earth so that normalization is done more representative.

RESULT AND ANALYSIS

Based on observations of the location conducted along the coast, generally the outcrop condition and types that found at study area, namely: (1) Plutonic magmatic rock such as Klabat Granite (Triassic-Jura) and (2) Metasediment rock in Early Triassic that characterized by interlayered metasandstone, sandstone, clayey-sandstone and claystone with lenses of limestone. The Klabat Granite as megascopically is characterized by grayish white, coarse phaneric, holocrystalline, equigranular and major mineral compositions are Plagioclase, quartz, biotite and some opaq minerals. Quartz vein is 5 - 7 cm thickness, milky white (Figure 5).

Granite at Nangka Coast (TBL-01A) as petrographically is characterized by a medium-size, hollocrystalline textured, equigranular, hipydiomorf. Its

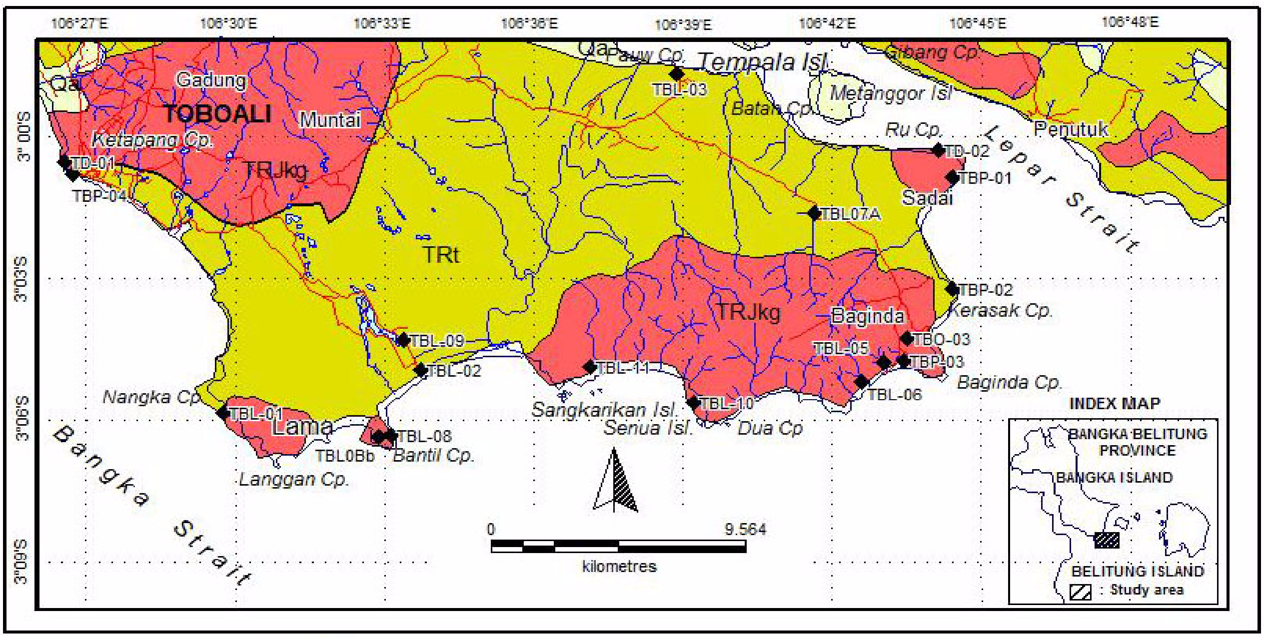


Figure 4. Geological map and sample location at study area

(a)

(b)

Figure 5. (a) Granite outcrop condition at Nangka coast (TBL-01); (b) handspesiment

mineralogy is composed of quartz, plagioclase, orthoclase, biotite and opaque minerals with accessories mineral, apatite and zircon. This outcrop has hydrothermal alteration produces mineral alteration such as: sericite, clay minerals, chlorite and biotite secondary (Figure 6).

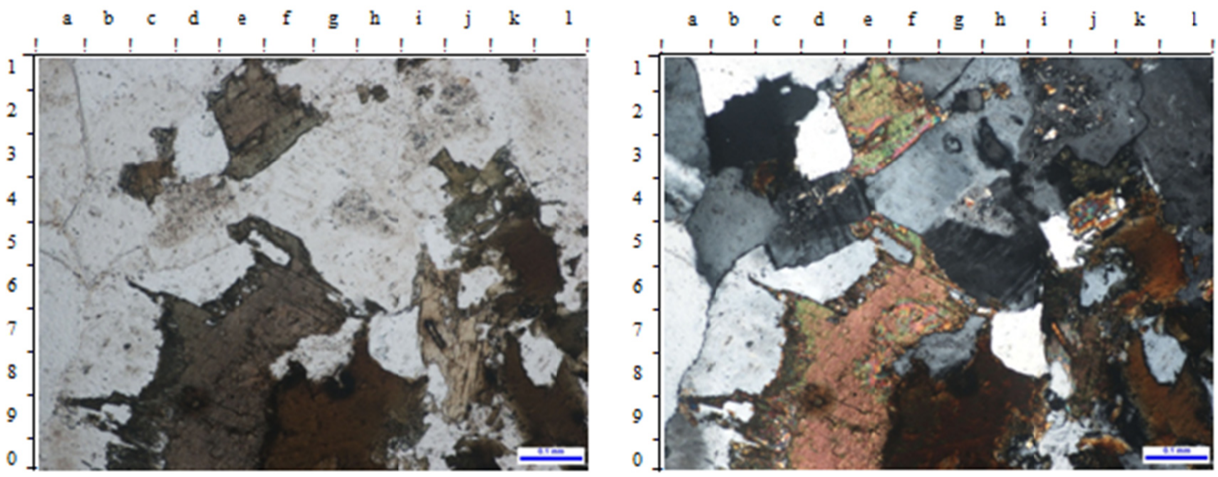
At Baginda Cape Coast and surrounding areas (TBP-02), encountered of crystalline limestone outcrops, white muddy, block sized that are considered in the form lenses in Tanjunggenting Formations (Figure 7).

Characteristics and heavy mineral associations in Tin belt or in the granitic rocks, generally is heavy mineral that resulted by erosion that produces zircon, monazite, xenotime, rutile and ilmenite and (sometimes) tungsten. On Betumpak Cape, North Bangka, the heavy minerals found (Rohendi et al, 2012), such as: magnetite (0.82-7.86 wt%), ilmenite (0.29 to 4.9 wt%), zircon (0.1 to 2.51 wt%), and apatite (0.94-1.07 wt%). Generally, the highest concentration of heavy minerals accummulated at 115-170 fraction (coarse sand).

Heavy minerals in question in this paper were heavy minerals containing rare earth elements (REEs) in common is being used in the industry in this regard thorium and cerium, namely monazite. Monazite concentration obtained in several drill holes are resulted by hand drilling, while the total content of REEs are obtained based on of theoretical content.

According to the table below (Table 1) it can be seen concentration of REEs total on average 9.5 g/m^3. The monazite's location and distribution do with the Gamma Spectrometer RS-125 interpretation were verified with a hand drill data (BS01-BS18), it is known monazite distribution at Toboali (site H) is 28,300 Ha (Widana et al, 2014) and other locations.

Based on the XRF analysis result at 3 coastal sediment sample sites, the content of tin (SnO_2), other



PN XN

Figure 6. Granite photomicrograph, hollocrystalline, equigranular, hypidiomorf. Quartz, lath plagioclase, orthoclase, biotite. Subhedral (polysyntetic twin), K-Fsp (orthoclase), perthitic, changed into clay minerals and sericite. Biotite, pleochroism yellowish to brownies. Quartz, anhedral, not altered, wavy extinction.

Figure 7. Crystalline limestone outcrops around of Baginda coast (TBP-02)

than to the tailings deposits (TBL-13C) are also found in sedimentary sand beach at Bantil Cp (TBL-08C) and at the Sadai coastal (TBL-07). The contents of tin (SnO_2) as shown in the table below (Table 2).

According to REEs and Trace elements analysis result using an ICP method at 10 samples of sediment (7 locations) and outcrops (3 locations), as shown in the table below (Table 3) that the distribution of REEs (lower concentration) most commonly found in the sand sediments around the north-east coast of Bantil Cp (TBL-02), while the highest concentration of REEs are generally found at Ketapang Cp around the wash dry facility's (TBL-13C).

Based on the above table, the trace element's distribution and its content range as follows:

The content of Tantalum (Ta) ranged from a lowest is 0.06 ppm, found in the sand sediment (TBL-09) and the highest was 285 ppm in the tailings deposits (TBL-13C) at Ketapang Cp; Scandium (Sc) ranged from 0.26 to 64.6 ppm; Galinium (Ga) between 0.91 ppm and 267 ppm; Strontium (Sr) ranges from 34.8 ppm were found in sediments of sand at Bantil Cp (TBL-08C) to 819 ppm at (TBL-09A); Ytrium (Y) with a range of content between 1.45 ppm (TBL-02) to 288 ppm (TBL-13B); Cesium (Cs) ranged from 0.18 ppm to

Table 1. Monazite concentration and the total content of REE

Sample Number	Depth of Bore (m)	Monazite Weight (g)	Monazite Concentration (g/m^3)	Total of REE (g/m^3)
BS01	6	Trace	Trace	-
BS02	5.8	3.82	21.2	19.08
BS03	6	Trace	Trace	-
BS04	7	0.64	2.9	2.61
BS05	8.5	Trace	Trace	-
BS06	9	3.19	11.4	10.26
BS07	10	Trace	Trace	-
BS08	7.5	Trace	Trace	-
BS09	9	Trace	Trace	-
BS10	8.2	0.65	2.5	2.25
BS11	6	0.58	3.1	2.79
BS12	7	Trace	Trace	-
BS13	6	Trace	Trace	-
BS14	7	5.37	24.7	22.23
BS15	5	4.08	26.3	23.67
BS16	7	14.72	67.8	61.02
BS17	6	1.68	9.0	8.1
BS18	4	2.69	21.6	19.44

Table 2. The content of Tin (SnO_2) at Toboali coast and its surrounding area

Sample No.	Oxides	Unit	Amount	Elements	Unit	Amount
TBL-07	SnO_2	ppm	4,620	Sn	ppm	3,640
TBL-08C	SnO_2	ppm	196	Sn	ppm	154
TBL-13C	SnO_2	ppm	16,700	Sn	ppm	13,200

Table 3. The content of REE and trace at Toboali Coast and its surrounding

No.	REE & TE (ppm)	Sample Number									
		1	2	3	4	5	6	7	8	9	10
		TBL-01A	**TBL-02**	**TBL-05B**	**TBL-06**	**TBL-07**	**TBL-08C**	**TBL-09A**	**TBL-13A**	**TBL-13B**	**TBL-13C**
1	Ta	2.78	0.21	0.87	0.54	0.19	0.11	0.06	2.74	7.82	285
2	Sc	5.34	0.26	4.91	0.81	9.24	1.07	0.64	5.71	5.56	64.6
3	Ga	24.9	0.91	20.4	2.09	19.9	2.56	2.15	22.6	38	267
4	Sr	58.3	57	44	40.5	38.9	34.8	819	130	90.6	44.8
5	Y	106	1.45	132	3.32	12.7	2.62	3.83	65.3	288	190
6	Cs	4.57	0.52	3.44	0.41	1.4	0.49	0.59	3.49	0.34	0.18
7	Nb	18.8	2.6	19.3	4.42	10.9	9.39	3.54	32.2	71.2	2342
8	Ba	50.5	16.7	208	20.6	222	24.4	25.2	302	33.7	117
9	La	59.3	1.95	90.9	5.83	24.4	5.07	5.72	61.7	199	1173
10	Ce	125	6.98	116	13.4	157	10.6	12.2	106	394	2270
11	Pr	16.2	0.43	24.9	1.27	5.11	1.08	1.34	13.6	59.7	265
12	Nd	57.2	1.56	88.5	4.25	16.5	3.48	4.72	46.2	201	822
13	Sm	15.3	0.28	18.4	0.83	3.08	0.67	0.99	9.97	52.3	201
14	Eu	0.18	0.03	1.55	0.08	0.6	0.07	0.07	0.67	0.31	1.46
15	Gd	10.4	0.28	12.2	0.64	4.11	0.49	0.66	9.11	39.3	116
16	Tb	2.32	0.04	2.21	0.09	0.34	0.07	0.1	1.35	8.14	13.9
17	Dy	12.9	0.19	14.9	0.49	1.48	0.42	0.58	9.01	56.3	51.8
18	Ho	2.49	0.04	3.28	0.1	0.26	0.08	0.11	1.89	12.3	9.04
19	Er	6.63	0.11	9.35	0.26	0.7	0.22	0.3	5.19	33.9	22.5
20	Tm	0.95	0.02	1.38	0.04	0.11	0.04	0.05	0.77	5.62	3.25
21	Yb	6.24	0.13	8.85	0.26	3.3	0.27	0.3	4.84	37.5	23.6
22	Lu	0.9	0.02	1.36	0.04	0.11	0.04	0.05	0.71	5.41	3.7

explanation:

REE : Number 9 to 22
TE : trace element, number 1 to 8

Table 4. Concentration of LILE and HFSE (ppm) on tailing deposits at Ketapang Cp.

Oxides	Amount	Elements	Amount
ZrO_2	2.1600	Zr	16,000
HfO_2	0.0322	Hf	273
V_2O_5	0.1490	V	834
Cr_2O_3	0.0193	Cr	132
ThO_2	0.1230	Th	1,080
U_3O_8	0.0160	U	136
MoO_3	0.0165	Mo	110
WO_3	0.0256	W	203

4.57 ppm; Neobium (Nb) its content ranges from 2.6 to 2342 ppm and Barium (Ba), ranging from 16.7 to 302 ppm.

The REE contents are as follows:

Lanthanum (La), its content range is 1.95 to 1173 ppm. For the lowest for the content of sand sediments around Bantil Cp (TBL-02), while the highest content in the tailings deposits on beaches around Ketapang Cp (TBL-13C); Cerium (Ce) its content ranged from 6.98 to 2270 ppm; Praseodymium (Pr) ranging from 0.43 to 265 ppm; Neodymium (Nd) ranged from 1.56 to 822 ppm; Samarium (Sm) ranged from 0.28 to 201 ppm; Europium (Eu) between 0.03 to 1.55 ppm; Gadolinium (Gd) ranged from 0.28 to 116 ppm; Terbium (Tb) ranged from 0.04 to 13.9 ppm; Dysporsium (Dy) its content ranged from 0.19 to 56.3 ppm; Holmium (Ho) has a content ranging from 0.04 to 12.3 ppm; Erbium (Er) its content ranged from 0.11 to 33.9 ppm; Thulium (0.13 to 37.5 ppm and Lutetium (Lu) have a range of content between 0.02 ppm to 5.41ppm. If at LREE (La-Eu) highest content is generally found in the location of the tailings sludge (TBL-13C), not so in HREE (Gd-Lu), the highest content is widely available on the sandy beach sediments (TBL-13B).

Especially for tailings deposition in wash dry locations at Tanjung Ketapang (TBL-13C) also contain various elements of Large Ion Lithophile (LILE) and High Field Strength Elements (HFSE); (Table 4). The use of these elements adapted to the application and purposes.

The content of REE and Granitoid characteristics by plotting on a spider diagram refers to the chondrite normalization of Sun and Mc. Donough (1989). The spider diagram pattern of REE's Toboali granitoid similar to the western part batholiths of Peninsula, Cascade Range, North America with depletion characters of HREE that shows the Toboali granitoid rocks genesis on the continental arc tectono_ magmatic suite patterned are characterized by LREE enrichment by chondrite 250 to 400 times, whereas HREE 30-60 times chondrite (Figure 8). Typology of granitoid with reference to the order of the tectonic batholiths formed as I-type based on the ratio of isotopes $^{87}Sr/^{88}Sr$ < 0.706 (Gromet, et., 1987 in Widana, et al., 2015). While it is common, chondrite normalized patterns in the REE of Klabat granitoid, that indicating sloping enrichment of LREE to HREE (Widana, et al., 2014).

In the picture shows a negative anomaly in the element of Eu presumably related to the process of crystallization of plagioclase in the magma liquid (Wilson, 1989).

The proportion of the elements Zr and the ratio of Zr/Y of Toboali granite is 1.73 which includes of High-K Calc Alkaline affinity.

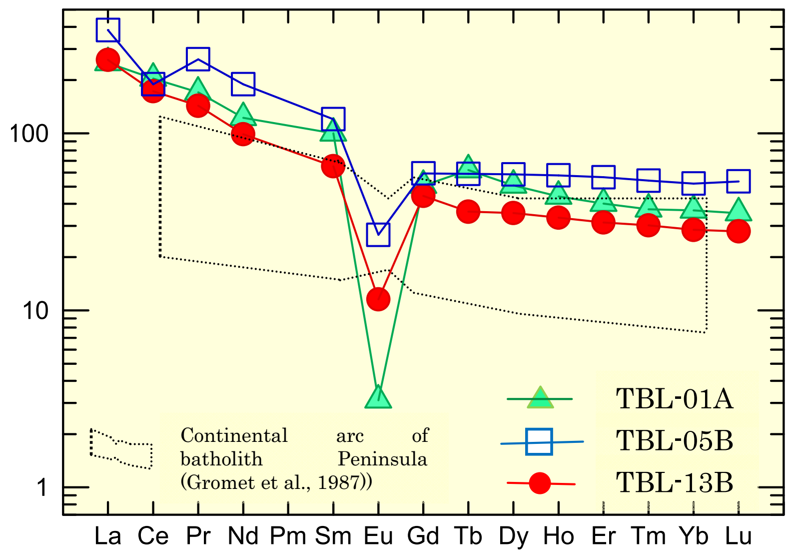


Figure 8. Plotting REE of Toboali granitoid at chondrite normalized

DISCUSSION

Based on REE normalization of Toboali granitoid that plotted on a spider diagram then be compared to the Peninsula Batholiths, Cascade Range, which has contintal arc tectonic settings, show that the Toboali granitoid has typology of I-type; however based on the ratio of Zr/Y, shows High-K Calc Alkaline affinity as Magma characteristic of S-type. This fact suggested that the magmatism source and granitoid magma affinity is influenced by two sources.

CONCLUSIONS

The content of monazite in South Bangka by hand drill data ranged from trace to 14.72 grams. Tin SnO_2 content, which accumulates in the sand sediment ranged from 196 ppm to 16,700 ppm. REE distribution that is lowest is generally found in the sand sediment around the Bantil Cp coast (TBL-02), while concentration of highest REE, generally found at Ketapang Cp beach, arounds the wash dry facility (TBL-13C). The highest content of LREE (La-Eu) is generally found in the location of the tailings sludge (TBL-13C), not so in HREE (Gd-Lu) with the highest content there are a lot on the sandy beach sediments (TBL-13B).

Granite Characteristics of Toboali granitoid rocks by plotting a spider diagram refers to the chondrite normalization show LREE enrichment 250 to 400 times chondrite, while HREE 30-60 times chondrite which is continental magmatic arc characteristic patterned similar to Peninsula batholiths, Cascade Range (I-type), while its affinity form of High-K Calc Alkaline that magma characteristic of S-type and negative anomalies in Eu element in granitoid's spider diagram allegedly associated with plagioclase crystallization process in magma liquid.

AKNOWLEDGEMENTS

The author would like to thank to the Head of Marine Geological Institute, Agency for Research and Development Mineral and Energy Resources of Indonesia, and all team members involved in the field and in the laboratory during the analysis process.

REFERENCES

Aryanto, Noor C.D., Kamiludin, U., Mustafa, M.A., Setyanto, A dan Surachman, M., 2015. Content of Mineral Research Plaser and REE (Survey Review) in Coastal and Toboali Waters, Bangka Belitung. *Internal report*, Marine Geological Institute, Bandung.

Cobbing, E.J., Mallick, D.I.J., Pitfield, P.E.J., and Teoh, L.H., 1986. The Granites of Southeast Asian Tin Belt. *Journal of Geological Society,* 143, 537-550.

Ghani, A., Yussouff, I., Hassan, M., and Ramli, R., 2013. Geochemical Study of Volcanic and Associated Granitic Rocks from Endau Rompin, Johor, Penninsula of Malaysia. *Journal of Earth System Science,* 122-1, 65-78.

Gromet, P., and Siver, L.T., 1987. REE Variations Across the Peninsula Ranges Batholith: Implications for Batholithic Petrogenesis and Crustal Growth in Magmatic Arcs. *Journal of Petrology,* 28, 75-125.

Hartati R.D., 1996; *ICP dan Aplikasinya dalam Contoh Geokimia, Studi Pendahuluan,* Laporan Internal Pemaparan Kolokium Direktorat Sumberdaya Mineral.

Margono, U., 1995. *Geology of South Bangka Island.* Geological Research and Development Centre, Bandung.

Rohendi, Edi and Aryanto, Noor C.D., 2012. Seafloor Sediment Characteristics and Heavy Mineral Occurrences At Betumpak Cape and Adjacent Area, Bangka Strait, Bangka Belitung Province. *Bulletin of The Marine Geology* Vol 27. No.1, ISSN: 1410-6175.

Schwartz, M.O., Rajjah, S.S., Askury, A.K., Putthapiban, P., and Djaswadi, S., 1995. The Southeast Asian Tin Belt, *Earth-Science Reviews,* 48, 285-293.

Sun, S.S., dan Mc. Donough W.F. (1989) : Chemical and isotopic systematics of oceanic basalt: implications for mantle composition and processes. In: Saunders A.D. and Norry M.J (eds.), *Magmatism in ocean basins.* Geol. Soc. London. Spec. Pub. 42, 313-345.

Villaseca, C., Orejana, D., and Paterson, B.A., 2007. Zr–LREE rich minerals in residual peraluminous granulites, another factor in the origin of low Zr–LREE granitic melts?. *Lithos Journal, Elsevier*, Volume **96**, Issues 3–4, July 2007, Pages 375–386.

Widana, K, S., Priadi, B., and Handayani, Y, T., 2014. *Rare Earth Elements Profile of Klabat Granitoid in Bangka Island by Neutron Activation Analysis.* Eksplorium, Vol. 35, No. 1, pp 1-12.

Widana, K, S., and Priadi, B., 2015. *Characteristics of Trace Elements in Granitoid Magmatism Discrimination on Bangka Island.* Eksplorium, Vol. 36, No. 1, pp 1-16.

Wilson, M., 1989. Igneous Petrogenesis, *Springer*, Netherlands, 1st edition, 466p.

Wikarno, U., Suyama, D.A.D., and Sukardi., 1988. Granitoids of Sumatera and The Tin Islands. *In: Hutchison, C.S., (Editor): Geology of Tin deposits in Asia and the Pacific; Mineral Concentrations and Hydrocarbon Accumulations in the ESCAP region.* Springer, New York, NY, 3, 571-589.