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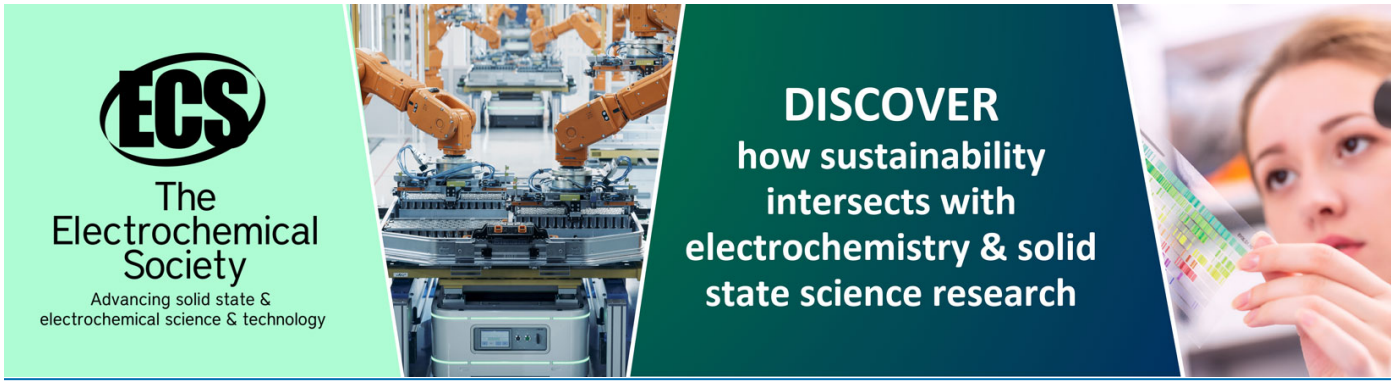

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Geosite identification in Karangbolong High to support the development of Karangsambung-Karangbolong Geopark candidate, Central Java

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Abstract. Geopark is an area that has an outstanding geological evidence, including archaeological, ecological and cultural values in which local people are invited to participate in protecting and enhancing the function of natural heretage. Its sustainable development concept has proven to increase economic and conservation benefits. Geopark introduces the earth's heritage, protected areas, geo-development, economic development and implementation of various science and technology. Geoparks have unique geological, cultural and biological that can be utilized for conservation and geotourism. Indonesia has 2 global geoparks, 4 national geoparks and 15 geopark candidates. Karangsambung-Karangbolong area is one of the geopark candidates which is a subduction zone that underwent an uplift and now is dominated with conical hills karst. The Kebumen local government is preparing a master plan for Karangsambung Geopark except Karangbolong, and LIPI is supporting the scientific studies. To initiate the development of Karangsambung-Karangbolong Geopark, an integrated geosite identification has to be done. Field observation of geodiversity, bio diversity and culture diversity, followed by rating of geosite based on scoring method using weighting 3 for geodiversity, 2 for biodiversity and 2 for culture diversity. Geosite of Karangbolong High includes geosite of karst-nonkarst morphology of Wanalela Hill and Tugu Village. Cave geosites are Barat, Petruk and Jatijajar caves. Beach geosite include Lampon, Menganti, G. Hud, Logending, Karangbolong and Karangagung beaches. Very good geosites are Petruk cave, Hud hill and Barat cave. Good geosite includes Lampon, Menganti, Karangpamuran, Pelus, Jatijajar, Wanalela, Logending and Karangbolong. Geosite at Karangbolong High provides good support for the development of Karangsambung-Karangbolong Geopark.

1. Introduction

Geopark is a protected area with outstanding geological elements including the archaeological, ecological and cultural values where local communities are invited to participate in protecting and improving the function of the natural heritage [1]. Major elements include geodiversity, biodiversity and cultural diversity with the ultimate goal of protecting the Earth's diversity (geodiversity), environmental conservation and broader earth-science education (Figure 1). A UNESCO Global Geopark uses its geological heritage, in connection with all other aspects of the area's natural and cultural heritage, to enhance awareness and understanding of key issues facing society in the context of the dynamic planet we all live in; mitigating the effects of climate change and reducing the impact of natural disasters. By raising awareness of the importance of the area's geological heritage in history and society today, UNESCO Global Geoparks give local people a sense of pride in their region and strengthen their identity with the area. The creation of innovative local enterprises, new jobs and high

quality training courses are stimulated as new sources of revenue and are generated through sustainable geotourism, while the geological resources of the area are protected [3].

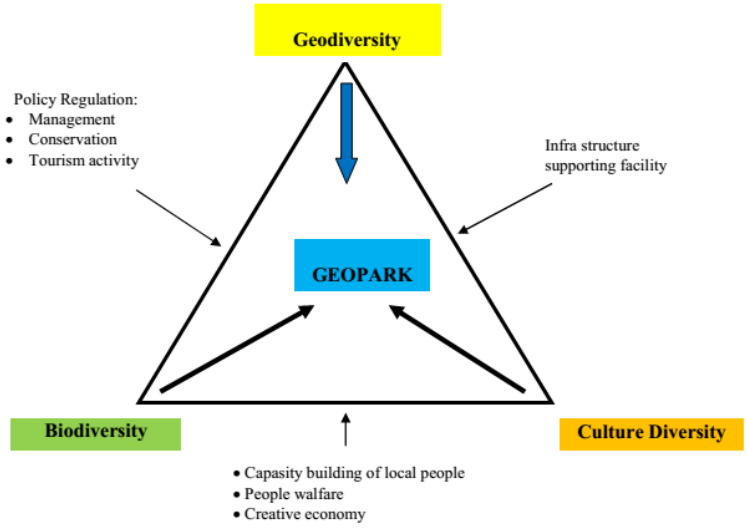

Figure 1. Concept of Geopark involves various stakeholders for the conservation of areas that have geodiversity, biodiversity and culture diversity.

The geopark region should have a number of important geological heritage sites that have a beauty appeal and scarcity that can be developed as part of the concept of integration of conservation, education and local economic development. Briefly geopark is a form of space utilization of protected areas to achieve sustainable development. Community knowledge and understanding of knowledge is essential to achieve policy implementation in effective protected or conserved areas. Therefore, beside conservation and local economic development, education is also one of the basic elements that a geopark must possess. The purpose of geopark establishment is to explore, develop, and celebrate the relationship between geological heritage, and all aspects of protected areas, cultures, and intangible heritages. Therefore, in a geopark there is not only a geological heritage, but also a cultural heritage, archeology, and biodiversity. Geopark is a concept of sustainable regional development that integrates all natural components for conservation, education and local economic value growth [2].

Geodiversity encompasses the diversity of geological environments, morphology and active processes that form landscapes, rocks, minerals, fossils, soils, and other deposits that provide a framework for life on earth [3]. Geology is an important aspect in the planning project because geology is part of all natural systems. In the use of space, we should pay attention to the importance of geological sites, their usefulness, and their maintenance [3]. Therefore, in the spatial planning, geological aspects are important aspect to be considered and need to be protected.

Geotourism activities run by communities in a Geopark are important components that support the successful management of Geopark. Geotourism is a special interest of tourism that exploiting the potential of geologic natural resources such as landform, rocks, structure, and the history of the earth that focus to enrich the insight and the understanding natural physical phenomena [4]. The key to the successful development and management of Geopark is in the role and active participation of local communities and the understanding of the geoparks itself.

Karangsambung - Karangbolong area is one of the potential areas developed into Geopark. The local government of Kebumen at 2016 has established a National Geopark Development Coordination team /TKPGK that has produced a geopark plan map covering Karangsambung, Sempor and Karangbolong areas (Figure 2). In 2017 the local government is conducting a study on making Karangsambung master plan geopark.

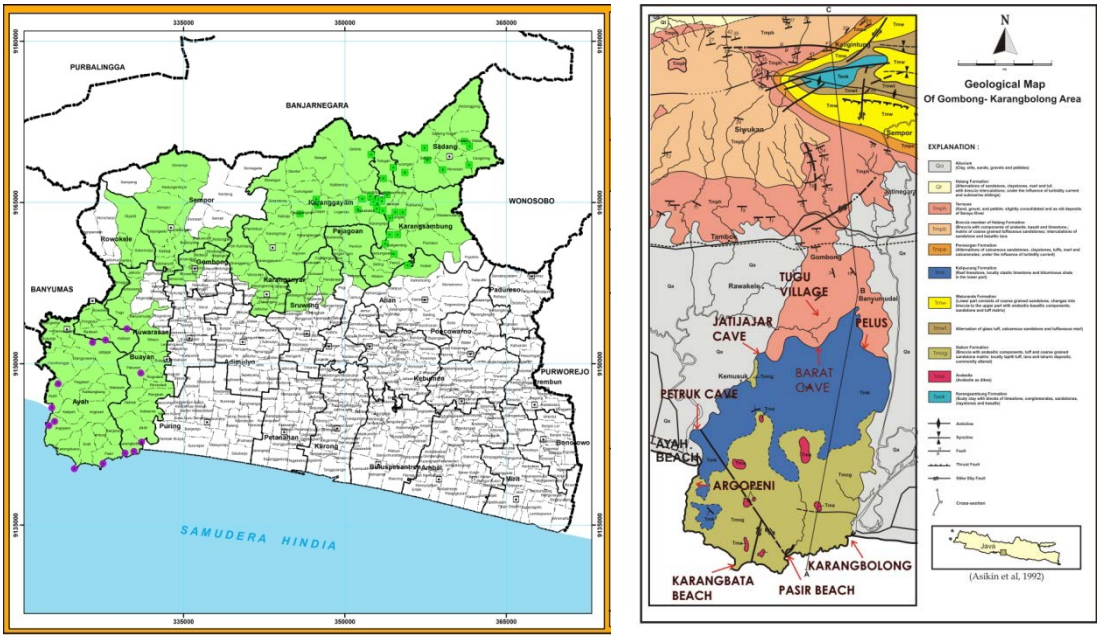

Figure 2. The geopark planning area of Karangsambung-Karangbolong, Kebumen regency, covers 12 sub-districts, 117 villages (Bappeda Kebumen, 2016) and geological map of Karangbolong High.

The geology of the research area is composed by Gabon Formation, Kalipucang Formation, Halang Formation and Alluvial with interesting karst morphology [5]. There are nine material deposits which include; good quality limestone 389,250,000 metric ton, phosphate, manganese, andesite 106,130,975 m3, bentonite, kaoline, trass, gold, and oil shale [6]. Based on ESDM regulation No: 17/2012, the protected area of karst landscape about 4089 Ha. The result of Bappeda Kebumen formulation planned the National Geopark of Karangsambung-Karangbolong. To get the distribution of the location, condition and appeal of each geosite then do the identification and assessment so that can be determined main geosite that must be developed.

2. Methods

Field observations include geodiversity, biodiversity and culture diversity description followed by analysis and synchronization data to obtain selected geosite. Table 1, methods of geosite rating based on scoring using weighting on geodiversity (weight 3), biodiversity (weight 2) and culture diversity (weight 2).

Table 1. Scoring method of geosite.

RATING		PARAMETER AND WEIGHT			SCORE
		GEODIVERSITY	BIODIVERSITY	CULTURE DIVERSITY	
		3	2	2	
Very poor	1	3	2	2	< 7
Poor	2	6	4	4	8 to 14
Moderate	3	9	6	6	15 to 21
Good	4	12	8	8	22 to 28
Very Good	5	15	10	10	> 28

3. Result and Discussion

3.1. Karst Morphology, Tugu Villagge

There is a marked difference in highly relief karst morphology in the south part with unrelieved hills morphology in the north (Figure 3). The hills at karst morphology appear convex rounded with relatively uniform sizes separated by cockpit topography. Beside lithological controlled, large crack or joint around N130°E which forms the pattern of underground rivers and caves. The undulating topographyat the north part is composed by alternating between tuffaceous sandstone and claystone of the younger Halang Formation with a position of N240°E/19°.Differences between fertility and plant species observed at the karst and non kars topography, local culture also found in the Tugu village.

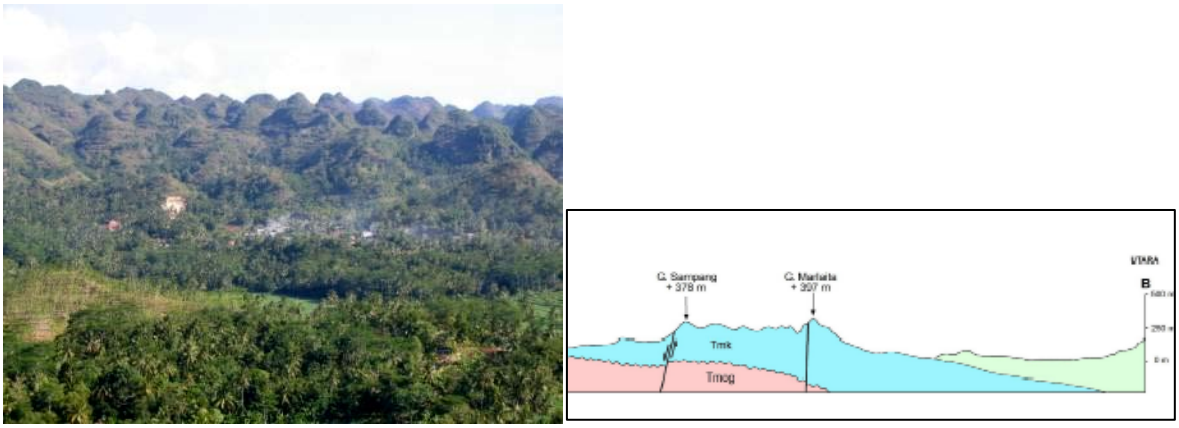

Figure 3. The morphological differences between karst cockpit (limestone F. Kalipucang) with wavy morphology (tuffaceous sandstones, Halang Formation) due to exogenous and endogenous process interactions.

3.2. Barat Cave

It is a horizontal cave with a long underground drainage pattern. At the entrance hall was dry hole in a phosphate excavation. After that, there is an underground river with N310° Edirection, water depht about 0.5-1.0 m. In this zone there are gordyn typeof stalactites (Figure 4), rapid underground river, waterfalls and branches of the river. The length of cave has been mapped by FINSPAC team reaches not less 3,305 m as underground streams, waterfalls and steep walls. Ekploring this cave can take about 2 days. There are differences between inside and outside faunas, some peoples used this cave for certain rituals.

Figure 4. Gourdam, large stalactites that form tassels and overdrafts in underground rivers that produce waterfalls up to 3 m height in the Barat Cave.

3.3. Jatijajar Cave

It is a mainstay of tourism object at Kebumen Regency. It is a horizontal cave with 250 m length, 25 m width and 15 m height at limestone rock of Kalipucang Formation. This formation unconformity above breccia of Gabon Formation. At the mouth of the cave found compact limestones. Cave ornaments are generally not active, except at the middle part. There are 32 statues depicting legend of Raden Kamandaka (Figure 5). There is a sediment containing mollusk fossils (gastropods and

pelecypods) preserved in brownish brown clay sediments at the right of the entrance. A visible canopy remains a line of pelecypoda fossils, north-south-trending, parallel to the direction of the cave alley. Spring water Mawar, Kantil and Jombor are an underground river that is sanctioned by local people with legend R. Kamandaka, K. Klantung and Mrs. Dewi Nawang Wulang.

Figure 5. Jatijajar Cave with legend of R. Kamandaka is widely used for public tours.

3.4. Petruk Cave

Including 450 m long horizontal cave, it is ideal to provide morphological, hydrological, cave fauna, and the origin mechanism of a limestone cave. For adventure tourism (speleologist) will be very challenging and fun. Spheleotheme that flourish along the cave has been named as shape like breaststones, panthers, semar, crocodile, maria park, beard, stone stamps and others. It has also provided cave tour guide packages combined with other geotourism objects, besides enjoying panorama in the cave also get an explanation of cave ornaments process (Figure 6). Cave tracking about 1.5 hours through the slippery, watery alleyways and sometimes has to creep in underground rivers. In dark zones containing cave fauna such as bats, this cave often used for local community rituals.

Figure 6. Active flow stone on the Petruk Cave that forms macro gourdam.

3.5. Logending Beach

The eastern side of the coast is very steeply karst topography, while the western and northern sides are coastal slopes filled with alluvial deposits and coastal sand (Figure 7). In the southern part, the steep morphology of Majingklak hill is composed by volcanic breccia, resistant to abrasion of the sea waves. There is not sand dunes, it is due to the lack of sedimentary input from land. The estuary of Bodo river found mangrove forest that has been used as tourist destination. Larungan and offerings are still routinely run by local people.

3.6. Kalbut Stone Cultural Heritage

Kalbut stone is also known as Lingga or Pujaan stone. In this area there are three objects made from andesite. The first object is Lingga – Yoni, the others objects are hollow stones that may function as stone grave chests (Figure 8). The two objects are different where one of them engraved the head of Javanese dragon and the other is in the form of plain. In addition to the two stones, in the same place there are also some scraps of plate rocks scattered. Many people come here to rituals.

Figure 7. Karst morphology observed on Logending Beach and mangrove touring at Bodo River.

Figure 8. Kalbut Stone Heritage Site with Yoni relics and other artifacts.

3.7. Wanalela Hill Morphology

Meandering of Bodo river caused by the sea waves in the west area stronger than the east, so that the flow of water easily turn to the east ward. Besides that can be observed the differences of karst topography with mountaineous volcanic morphology of Gabon Formation (Figure 9). Volcanic mountains look more regular, highest topography with Andesite intrusion of Poleng Mts.

Figure 9. Morphology of Logending coastal plain with bend of S. Bodo, karst morphology with irregular shape and volcanic mountains with G. Poleng intrusions protruding in the middle.

3.8. Karangagung Beach

The upper part of the beach is karst topography while the lower part is composed by volcanic breccia ofGabon Formation. White sand beach and isolated hill resembling a small island with dimensions of about 100x20x30 m accompanied by a shady tree. This small hill is composed of lava and volcanic breccia formed by erosion and abrasion processes in the volcanic rock.

3.9. Menganti Beach

Geologically these beaches and cape are found in the Gabon Formation composed by an Oligocene Andesite breccia with multiple intrusion bodies (Figure 10). Around the Karangboto cape found igneous rock like the paving block.It is product of lava flow that experienced a contractionary force and formed a pole crack as columnar joint (rectangular polygonal fractures when viewed on the surface). White coast sand, it is limestone fragment caried by river and spread by the waves. If we look eastward, will be seen very strong waves on the wall of a fault steep coast at volcanic breccia. Traces of Syech Maulana Maghribi and Nyai Blorong on the cave overlooking the beach is often used by the public for ritual.

Figure 10. Morphology of menganti beach with columnar joint as Karangboto.

3.10. Lampon Beach

This beach scenery is very charming, If we look in the other direction, we will get different scenery. Natural bridge is formed due to sea abrasion process on the coastal wall composed by an andesite breccia with sandstone at Gabon Formation (Figure 11). The different variations of lithology and the intensity of the coastal waves resulted in different looks that formed Grojogan Beach, Tanjung Karang Penganten and Wora Wari Cave. Every year this place is always done alms sea with leather puppet performances.

Figure 11. Natural bridge at Lampon beach withPasir beach background area.

3.11. Hud Hill (Soekarno Hill)

Composed by alternating between volcanic breccia and sandstone that are affected by abrasion to give the appearance of like a chicken's comb. Alternating between breccia and sandstone at the buttom of Hud hill, while at the top is composed of coral limestone (Figure 12). Limestone outcrop above the volcanic breccia found around the location of Gedogan Jaran, all year spring and Peak of Hud (sometimes peole say Peak of Sukarno). There is a trail of R. Arumbinang (the founder of kebumen) who once visited Indonesia's first president Soekarno, who is still often used for community ritual.

Existing fauna in the form of monkeys and bats are still founds in teak forests around the top of the mountain.

Figure 12. Waves along the coast seen from the top of G. Hud in Kebumen-Yogyakarta graben zone.

3.12. Pamuran Beach/Karangbolong Cape

Is the initial location of bird's nest finds, used as a bird's nest swift cave which became the forerunner of Kebumen district logo (Figure 13). The first inventor of the swallow's nest at Karang Bolong is K. Surti who is the duke of Kartasura Sultan. Karangbolong Cave, formed by the process of abrasion of sea waves in the intercalation of volcanic breccia with sandstone from Gabon Formatio.

Figure 13. Karangbolong capeand formed at breccia and sandstone bracket F. Gabon.

3.13. Karangbolong Beach

On the left side of the beach there is a cave arranged by the joint between the volcanic breccia with sandstone, abrasion and erosion so as to form a translucent cave up to the mouth of Cincing Guling river (Figure 14). Breccias are composed of 2 - 100 cm fragments, fragments of lava, bad sorting. At the mouth of the cave made a miniature process of swallow nest download. The existence of Karangbolong beach can not be separated with the story of the Queen of Ratu Kidul, near the entrance there isGuesthouse of Ratu Kidul.

Figure 14. Karangbolong beach viewed from the west, protruding rock at the bottom of beach it is a volcanic breccia.

3.14. Pelus water springs

This location is cultural heritage due to the existence of 5 pelus fish, 1 male pelus and 4 woman pelus that sacred. Water splits out through a long crack that passes through rocks to the west. There is contact between breccias and limestone. Breccia derived from faulting lava,thus forming cracks filled with carbonatand as ornamental stone. Some times we can found a greenish-green talk. In the contact area with limestone does not change anything. Intensive brecciation and filling of carbonates only on the upper parts of contact with limestone. Breccia is found only on the top of contact with limestone, while at the bottom of the andesite lava. The identification of each geosite uniqueness and its weighting can be seen in Tables 2 and 3 and Figure 15.

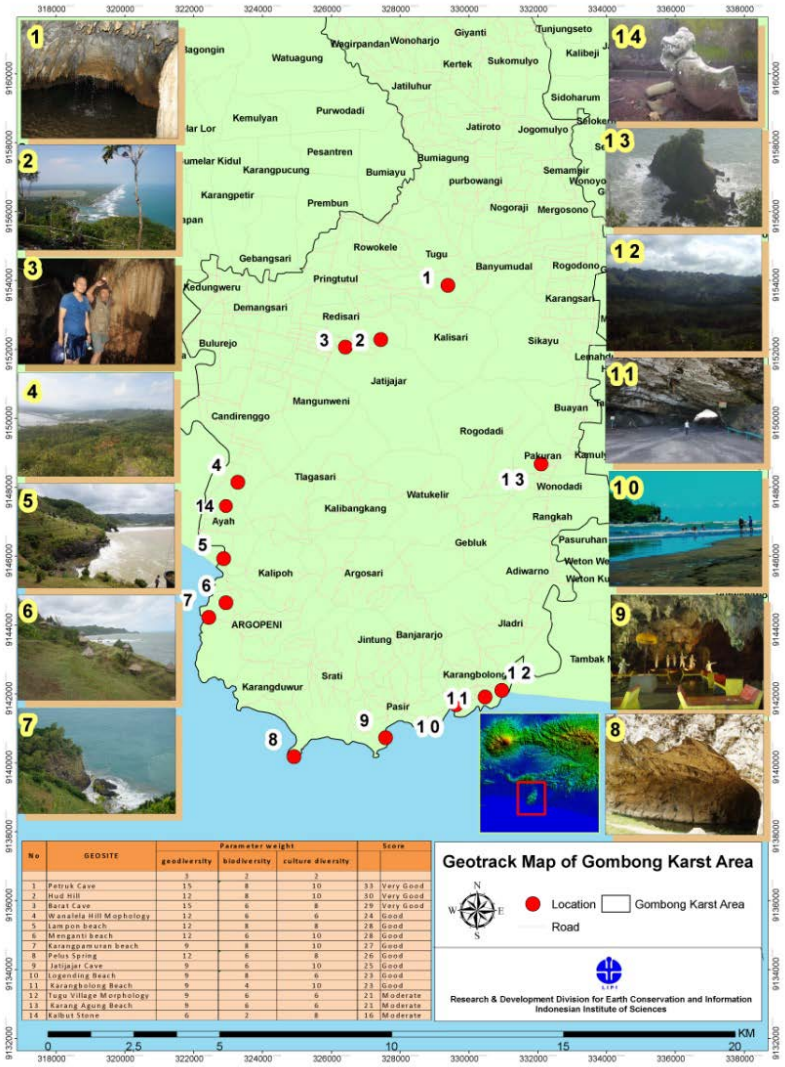

Figure 15. Geosite at Karangbolong High, Kebumen area.

Table 2. Identification of geosite at Karangbolong High.

No	Geosite	Short description	uniqueness		
			Geodiversity	Biodiversity	Culture
	Morphology				
1	**Wanalela Hill**	- Explain the morphological differences between karst and non karst	- morphological differences between karst with non karst mountains - The process of karstification	- land use / plant deferences between karst and	-

		as well as other aspects related to the karstification process, the utilization of mining commodities and processes along the coast - Eye catching	- Structural control of karstification - Conservation zone - Limestones that form karst and non karst - Morphology of Ayah coastal plain - Geological process along the coast - Tsunami - Intrusion and the process of volcanism	non karst areas	
2	**Tugu Village**	- Explain the morphological differences between karst and non karst and other aspects related to the process of karstification and utilization of mining commodities	- morphological differences between karst (F. Kalipucang) with non karst (F. Halang) - The process of karstification - Kockpit karst - Structural control of karstification - Conservation zone	- land use / plant deferences between karst and non karst areas	-
	Cave				
1	**Barat cave**	- Cave adventure with high difficulty level while understanding endokarstic phenomenon	- Underground river - Underground waterfall - Stalactites and stalagmites with slight variations / shapes - Many contain sensations - High difficulty level (upper hall, middle, bottom) - Must wear adequate tracking / safety equipment and skilled guides - The length is about 3,305 m	- The difference between animals (Cricketsand centipede cave) near the entrance, dusk zone and night zone (dark all time)	- The spiritual value with its sacredness is relatively low
2	**Petruk Cave**	- Cave adventure with moderate difficulty level while understanding endokarstic phenomenon	- Underground river - Stalactites and stalagmites are well developed - Many interesting speleothem - Slightly sensational - Medium difficulty level - Length approximately 300 m - Need simple security equipment - Suitable for beginner cave learning and search - It takes 1.5 hours to search	- The difference between animals (Cricketsand centipede cave) near the entrance, dusk zone and night zone (dark all time)	- The spiritual value with its sacredness is relatively moderate
3	**Jatijajar Cave**	- Cave adventure with moderate difficulty level while understanding endokarstic phenomenon	- Underground river - Stalactites and stalagmites are less developed - speleothem not interesting - Slightly sensational - Low difficulty level (many building introductions) - Length about 250 m - Suitable for public travelers while getting to know the formation of the cave - It takes 45 minutes to search	- The existence of white sacred animals are sacred in the dark zone	- High spiritual value (puser bumi, cantilever, and rose water spring) - The Legend of Kamandaka and K.Klantung
	Beaches				
1	**Lampon beach**	- Understanding the process of the beach while traveling	- coastal morphology (bay, cape) - Natural bridge - Effect of sea abrasion on different rock resistance - Breccia, sandstone and limestone - Tectonics and formation of Karangbolonghigh - Long shore current - eye catching - every corner has a different panorama - Road access is relatively easy	- Acacia mangium - Tectono grandis - deer, panther, ape	- There is puppet show as annual ritual - Legend of lampon and blue whale

2	**Menganti beach**	- Understanding the process of the beach while traveling	- Steep coastal morphology - There is lava with columnar joint structure - Miocene volcanism - Tectonics and karangbolong hight formation - Coast processes and long shore currents - eye catching with adequate facilities	-	- Hight spiritual value of Menganti Cave (Maulana Maghribi)
3	**Peak of Hud**	- Understanding the process of the beach while traveling	- Step coastal morphology - Effect of sea abrasion on different rock resistance - Breccia, sandstone and limestone - Tectonics and karangbolong high formation - Long shore current - eye catching - Every corner has a different panorama - Road access is rather difficult	- Acacia mangium - Tectonograndis - Monkey	- A spiritual value with moderate degree of sanctity - Water spring year, top of Soekarno, - Trail of Arumbinang
4	**KarangPamuran**	- Understanding the process of the beach while traveling	- Steep coastal morphology - Effect of sea abrasion on different rock resistance - Breccia, sandstone - Long shore current - Hard road access	- Swallow bird	- Lagend of K. Surti and bird swallow download
5	**Ayah/Logending**	- Understanding the process of the beach while traveling	- Differences of karst morphology with coastal plains - The process of karstification - Beach process - Geological / tsunami disaster threats - The fluvial process of K. Bodo	- Mangrove forest and its ecosystem	-
6	**Karangbolong**	- Understanding the process of the beach while traveling	- Coastal morphology (bay and cape) - Long shore current - Effect of sea abrasion on different rock resistance - Breccia and sandstone layered		- High spiritual value (guest house of Queen RatuKidul) - Download wallet nest rhythm
7	**Karangagung**	- Understanding the process of the beach while traveling	- In layer hill - Coastal abrasion - Gabon bresccia	-	-
	Others				
1	**Pelus spring water**	- Process of spring water and karst hydrology	- Coral limestone (Kalipucang Formation) which is above of Gabon Formation) - Multy color breccia - Karst Hydrology	- Dried fish	- - Annual ritual - Spring that was saved by the keeper of the dried fish
2	**Batukalbut**	- The cultural heritage used to worship	- Artifacts made of andesite rocks	-	- medium spiritual value

Tabel 3. Geosite scoring at research area.

No	GEOSITE	Parameter weight			Score	
		geodiversity	biodiversity	culture diversity		
		3	2	2		
1	Petruk Cave	15	8	10	33	Very Good
2	Hud Hill	12	8	10	30	Very Good
3	Barat Cave	15	6	8	29	Very Good
4	Lampon beach	12	8	8	28	Good
5	Menganti beach	12	6	10	28	Good
6	Karangpamuran beach	9	8	10	27	Good
7	Pelus Spring	12	6	8	26	Good
8	Jatijajar Cave	9	6	10	25	Good
9	Wanalela Hill Mophology	12	6	6	24	Good
10	Logending Beach	9	8	6	23	Good
11	Karangbolong Beach	9	4	10	23	Good
12	Tugu Village Morphology	9	6	6	21	Moderate
13	Karang Agung Beach	9	6	6	21	Moderate
14	Kalbut Stone	6	2	8	16	Moderate

4. Conclussions

The Karangbolong Heigh has varies geosite from geodiversity, culture and biodiversity. Geosite with very good geodiversity are Baratand Petruk cave while good biodiversity includes Petruk cave, Hud Hill, Lampon Beach and Karangpamuran. Culture diversity is excellent in Petruk Cave, Jatijajar Cave, Bukit Hud, Menganti Beach, Karangbolong Beach and Karangpamuran Beach. Main geosite includes Petruk Cave, Bukit Hud, West Cave, Wanalela Hill, Menganti Beach and Lampon Beach. Geosite located in Karangbolong area is very good to support the development of Karangsambung-Karangbolong geopark candidates so that they are complementary and become one unity of geodiversity, culture diversity and biodiversity.

Acknowledgments

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