



THE PROCESS OF ESTABLISHING AND ACTIVITIES OF THE ANAK KRAKATAU MOUNTAIN

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Abstract

Anak Krakatau is one of the legendary mountains which was the result of the eruption of Mount Krakatau in 1883. The Krakatau area is divided into three regions, Krakatau Island, Sertung Island, and Mount Anak Krakatau. The activity of Mount Anak Krakatau in 1929 tended to be active because in a year, Anak Krakatau could experience eight eruptions. This can be seen in visual observations starting from 1929 - 2000 experiencing a fairly rapid development. At the end of 2018, Anak Krakatau erupted again, where the eruption caused a landslide to part of the mountain's side. As a result, the debris from the landslide, made the waters of the Sunda Strait unstable, thus forming a tsunami wave. The eruption did not only happen in 2018 in which recently, Anak Krakatau became active again in 2020 by releasing its volcanic ash. The activity of Anak Krakatau underlies the purpose of this study, namely knowing the formation process and activities of Mount Anak Krakatau. The analysis process used is a literature study using related journal articles and data on the cataclysmic events of the Anak Krakatau volcano eruption, so that in the future, further research can be carried out related to disaster mitigation efforts from the eruption of Mount Anak Krakatau in the area around the mountain.

Keywords: The process of formation, activity, Anak Krakatau.

A. Introduction

Indonesia is a country surrounded by 68 active volcanoes, one of which is Mount Anak Krakatau. In the middle of 2020, the eruption of Mount Anak Krakatau occurred on April 10, 2020. The event occurred at 22:35 WIB, the ash height reached 657 masl with the intensity of the thick ash column leaning north (National Disaster Management Agency, 2020). This phenomenon did not cause casualties or damage. At the end of 2018, Mount Anak Krakatau experienced an eruption which resulted in the collapse of part of the mountain body into the waters of the Sunda Strait. This caused a tsunami wave that killed hundreds of people.

Anak Krakatau is the result of an ancient volcanic eruption, namely Mount Krakatau which erupted in 1883. Mount Krakatau has existed since prehistoric times and its existence

ended in 1883 due to a massive eruption at that time. However, this eruption resulted in a new caldera formation which is now one of the forerunners to the birth of Mount Anak Krakatau. Anak Krakatau began to surface in 1929, growing very rapidly until recently. This can be seen from the activity of the volcano based on the data of volcanic eruptions.

Based on the data from the Mount Anak Krakatau disaster, it is necessary to know the formation process and how much power the resulting eruption was. One of the efforts to find this out is by looking at the history of its development and the formation process of the Anak Krakatau. The next urgency can be used as an effort to mitigate the eruption of the Anak Krakatau. Moreover, the location of Anak Krakatau is in the waters, so there is a high probability that a volcanic tsunami will recur and threaten the surrounding population.

B. Methodology

1. Research Design

The activity of Anak Krakatau which underlies the purpose of this research, namely to know the formation process and activities of Mount Anak Krakatau. The analysis process used is a literature study using related journal articles and data on the cataclysmic events of the Anak Krakatau volcano eruption. So that in the future further research can be carried out related to disaster mitigation efforts from the eruption of Mount Anak Krakatau in the area around the mountain.

2. Instruments

The instrument or data used is secondary data through satellite imagery. In addition, there are several figures' assumptions related to the growth and development of Anak Krakatau which become supporting data to facilitate the analysis.

3. Technique of Data Analysis

The analysis carried out was seen from the development and activity of Mount Anak Krakatau based on data on incidents of volcanic eruptions that had occurred. The results of the assumptions of several figures regarding the development of Anak Krakatau will be compared with the volcanic tsunami phenomenon in 2018.

C. Findings and Discussion

1. Findings

Gunung Api Anak Krakatau (GAK) is a mountain located in a water area and has no land other than a mountain body. Mount Anak Krakatau is the result of the eruption of Mount Krakatau that occurred in 1883. Mount Anak Krakatau is located in the Sunda Strait and is included in the South Lampung region. Anak Krakatau is one of the active volcanoes in Indonesia which is included in the 7,000 km active volcano route from Sumatra to Maluku (Sutawidjaja, 2006). Mount Anak Krakatau is included in the Krakatau complex, which is astronomically located at 6° 6' 5.8" LS 105° 25' 22.3" East Longitude (Ariani, Haryanto, Hutabarat, & Yudhicara, 2019). The location of Mount Anak Krakatau is also close to several cities, including Lampung Province (Kalinda) and Banten Province (Merak, Anyer, and Labuan).

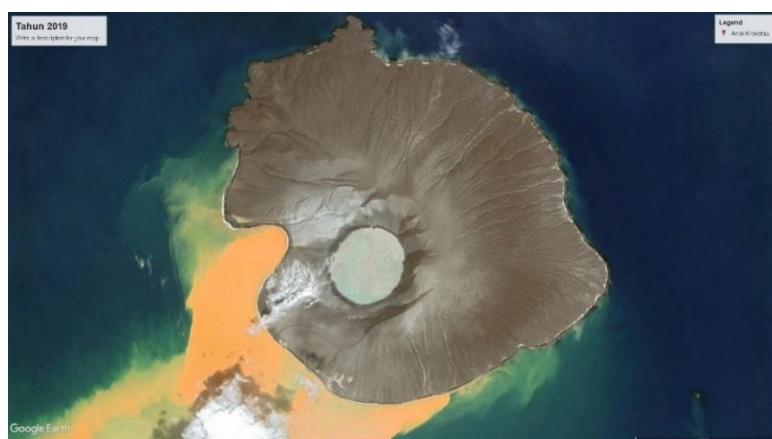


Figure 1. Mount Anak Krakatau After Eruption
(Source: Google Earth, 2019)

2. Discussion

Characteristica of Mount Anak Krakatau

Mount Anak Krakatau has a height of up to 300 masl with a width of 2 km. Anak Krakatau has one active cone and as the center of the caldera with an eruption period of 1-8 years (Sutawidjaja, 2006). The eruption types in Anak Krakatau are Strombolian and Vulkanian, with material characteristics such as pyroclastic falls, pyroclastic flows, and lava flows.

Anak Krakatau underwent a five-stage process of formation and led some experts to interpret that Anak Krakatau had several magma chambers in it. In Figure 2. Assume a pyroclastic flow with a density of -0.06 gr/cc at a depth of about 800 m (Oemaiya & Santoso, 2018). The magma chamber is believed to be the remnants of the magma chamber of Mount Rakata, Mount Danan, and Mount Perbuatan. So, if the assumption is correct, it is possible that the explosion power of Anak Krakatau will be greater than the eruption of Mount Krakatau.

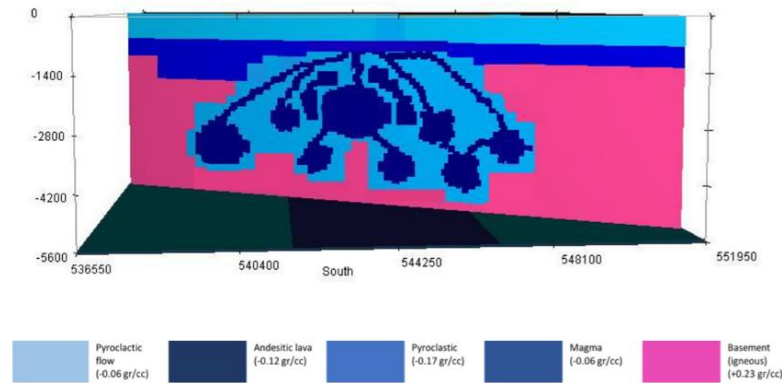


Figure 2. Schematic of Magma Chamber on Mount Anak Krakatau
(Source: Oeimaya, 2019)

Another assumption is that the location of the magma chamber owned by Anak Krakatau tends to be towards southwest (Oemaiya & Santoso, 2018). This can be seen in Figure 3, namely in the form of engineering the appearance of the inside of Mount Anak Krakatau. The illustration is based on a geological map that is used to determine the density level of each rock type.

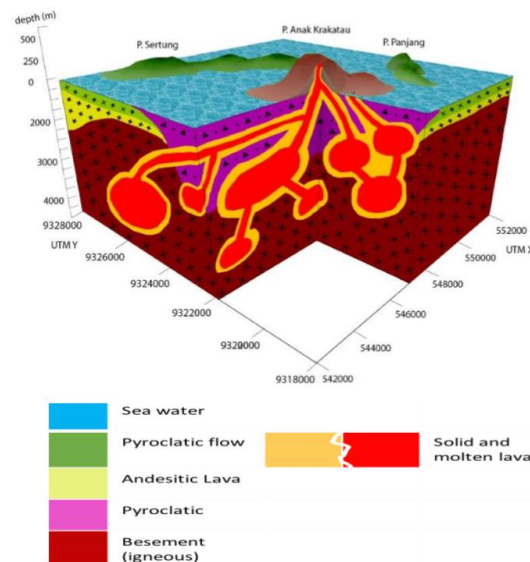


Figure 3. 3D View of the inside of Mount Anak Krakatau
(Source: Oeimaya, 2019)

The process of forming Mount Anak Krakatau

Mount Krakatau Purba is one of the active volcanoes in Indonesia which erupted in 1883. The impact of the eruption resulted in high wave pressure which was recorded on the barographic (Strachey, 1888). The sound of the eruption produced by Mount Krakatau was heard as far as 5000 km away and was recorded in a pressure wave that was thought

to be an infrasound discovery (Evers & Haak, 2010). As a result of the eruption of Mount Anak Krakatau, it produced a new caldera formation in the Krakatau Volcanic Complex.

On December 29, 1927, an underwater eruption occurred, after passing a period of rest from its fierce eruption on August 27, 1883. The eruption caused a burst of sea water from the center of the Krakatau Volcano Complex until January 15, 1929. According to Stehn, a volcano expert, monitoring volcanic activity after the eruption on January 20, 1929, there was a pile of material that emerged to the surface to form a small island or now known as Mount Anak Krakatau. (Stehn, 1929).

Before the body of Mount Krakatau was destroyed in 1883, the Krakatau area was divided into three mountains, namely Rakata Volcano (822 masl), Danan Volcano (450 masl), and Perbuatan Volcano (120 masl). (Sutawidjaja, 2006). The three mountains grow to a depth of 200 meters below sea level. So that when an eruption occurs, it causes the entire body of the mountain to be destroyed and a shock occurs which results in high sea waves (tsunami). The tsunami waves hit Lampung and West Java or now Banten Province.

Morphologically, the Mount Krakatau area is formed from the remains of a strato volcano with one active volcanic cone. The Mount Krakatau complex has rock formations based on periods of mountain activity. According to Effendi, there are five processes to produce volcanic rock formations in the Mount Krakatau area, namely: (Sutawidjaja, 2006)

1. Phase I Prehistoric development of Krakatau
2. Phase II Destruction of prehistoric Krakatoa
3. Phase III Community Development, Danan, Perbuwatan
4. Phase IV Partial destruction of the three mountains
5. Phase V The formation of a new mountain body, namely Anak Krakatau

The existence of Anak Krakatau comes from the underground space which is broken down by magma to the deepest part, this is as a result of the subduction process and several magma chambers appear. The multi-magma found in Anak Krakatau is due to its location at the intersection of Java and Sumatra subduction which has resulted in many faults.

Mount Anak Krakatau Activity

Mount Anak Krakatau was born around 1929 and has experienced 80 eruptions. The eruptions that often occur every year are both explosive eruptions and effusive eruptions. Each year Anak Krakatau can experience six eruptions with a rest period of 1-8 years.

Mount Anak Krakatau is a mountain composed of a cross between lava flows and pyroclastic deposits. So that the layer forms a cone up to a height of 315 m. The Anak Krakatau Volcano Complex consists of four islands, namely Rakata, Sertung, Panjang, and Anak Krakatau. The four islands are the result of the eruption of Mount Krakatau in 1883.

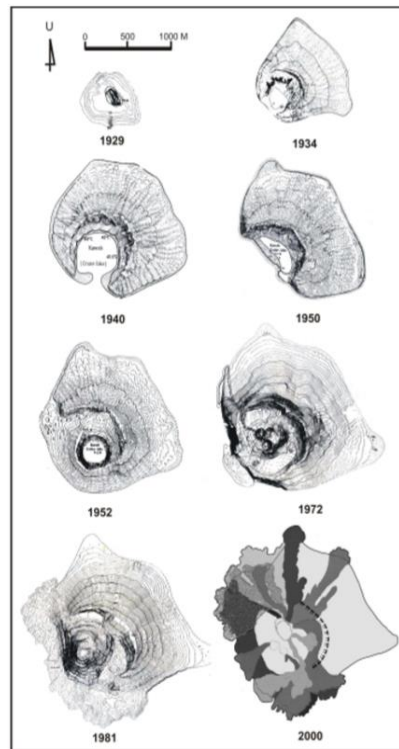


Figure 4. Changes in the shape body of Mount Anak Krakatau
(Source: Sutawidjaja, 2006)

Anak Krakatau grows in the center of the Krakatau region which comes from 180 meters below sea level. The growth rate of Anak Krakatau is 4 meters per year. Bronto calculates the growth acceleration of Anak Krakatau, namely $51.25 \times 10^{-3} \text{ km}^3/\text{year}$ (Bronto & Hamidi, 1990). Based on the results of these calculations, it is estimated that by 2040 the volume of Mount Anak Krakatau can exceed the volume of Mount Rakata, Danan Volcano, and Perbuwatan Volcano. In 2000, Anak Krakatau made dimensional measurements which had a height of 315 meters with a volume of 5.52 km^3 .

Since the birth of Anak Krakatau, eruptions have been recorded frequently. From 1927 - 1981 the body volume of Mount Anak Krakatau reached 2.35 km^3 . Then in 1983 the volume increased to 2.87 from the seabed (Sudrajat, 1983). The growth of Anak Krakatau continued to grow until 2000, its volume reached 5.52 km^3 (Sutawidjaja, 2006). The growth of Anak Krakatau, which is growing very rapidly, allows for the next period of destruction, such as the eruption in 1883. This is of course a big threat in the modern century that will hit the Sunda Strait Area, which is now filled with residential areas and industrial areas.

From 2000 to 2018 the activities of Anak Krakatau did not cause major disasters for the residents around the Sunda Strait. Even though on October 17, 2018, Anak Krakatau released volcanic ash and material but it did not have a major impact on the area around the island. The rock throws only inside the mountain complex or about a 3 km radius from the center of the eruption. The eruption activity also produced thick smoke with a height of 100 to 1000 m. However, the activities of Anak Krakatau peaked on December 22, 2018, at 21:30 WIB which killed 437 people and injured $\pm 31,000$ people from the coastal communities of Banten and Lampung (Smithsonian Institution National museum of Natural History Global Volcanism Program, 2020).

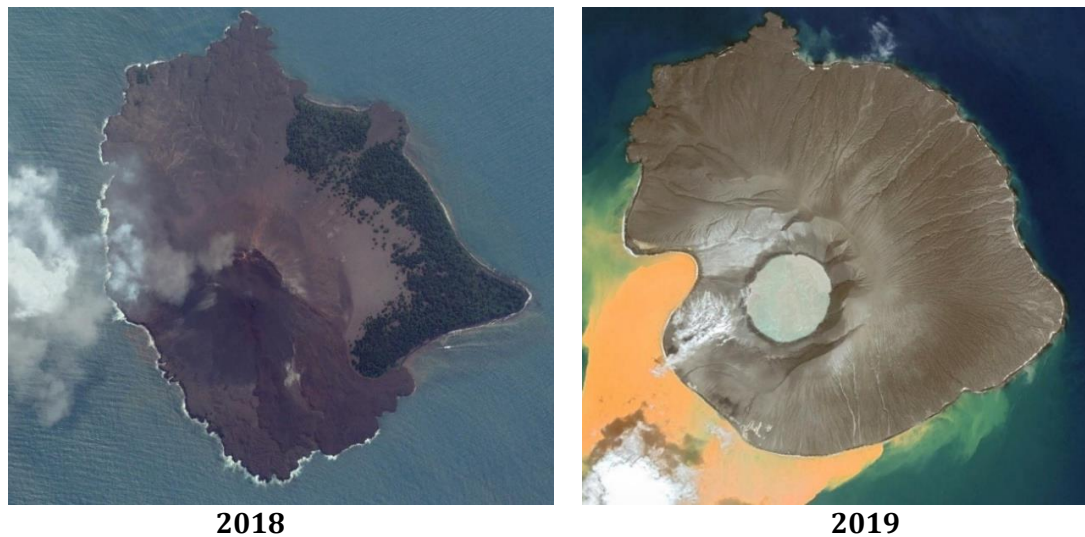


Figure 5. Transformations of Anak Krakatoa before and after eruption
(Source: Google Earth, 2019)

The eruption caused landslides on the southwest side of the mountain, especially since the main crater is not right in the middle of the mountain body. The location of the main crater tends to the southwest, making this side prone to landslides. The landslide moved a large volume of water, because it fell into the water area. As a result, local tsunami waves occurred in several coastal areas around Mount Anak Krakatau, namely Serang (Banten) and Lampung regencies.

The tsunami phenomenon that occurs due to volcanic activity is a rare phenomenon that is poorly understood. According to Latter, there are ten volcanic tsunami mechanisms. One of them can have a large impact damage caused by pyroclastic flows towards the sea accompanied by avalanches from volcanic activity, where this phenomenon rarely occurs. (Latter, 1981). Meanwhile, according to Paris, volcanic tsunamis can be caused due to several factors, namely underwater explosions, pyroclastic flows, earthquakes, flank failure, caldera, air waves, lava, and the presence of lava flows. (Paris, Switzer, Belousova, & et al., 2014).

Judging from the volcanic tsunami that occurred in 2018, the main cause was the debris of rock fractures from the body of the mountain that fell into the sea. This caused high waves and swept away several islands around the mountain. The height of the mountain has changed, from 338 meters to 110 meters.

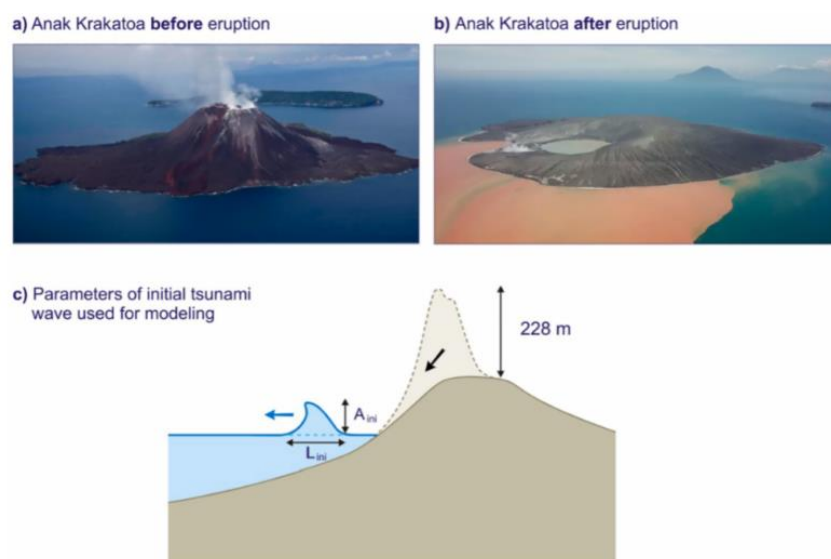


Figure 6. Transformations of elevation Mount Anak Krakatau
(Source: M. Heidarzadeh et al, 2020)

Height Eruption Column of Anak Krakatau

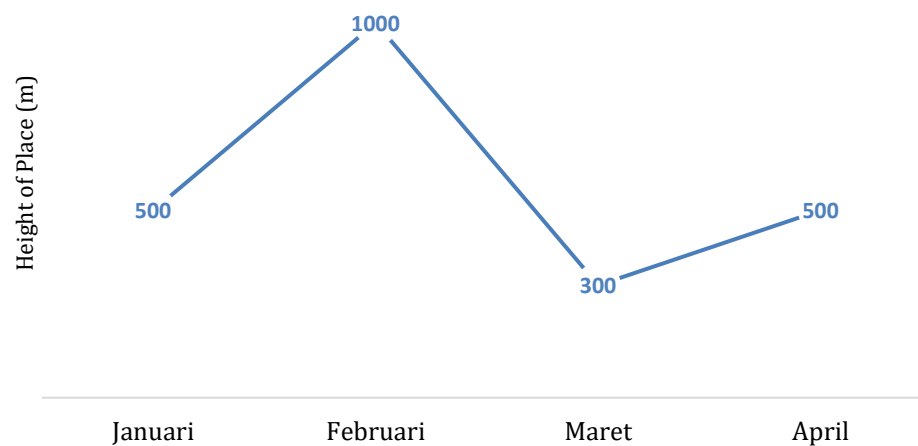


Figure 7. Height Eruption Column of Mount Anak Krakatau

Based on data from the Center for Volcanology and Geological Disaster Mitigation (PVMBG), Mount Anak Krakatau experienced four eruptions during January 2020. This activity resulted in a gray white cloud from above the peak with an altitude of 500 meters (Graph 1.1). Looking at the graph results, it can be seen that the activity of Mount Anak Krakatau is not yet stable. The type of fluid present in the January-March 2020 eruption was gas (Smithsonian Institution National Museum of Natural History Global Volcanism Program, 2020).



Figure 8. The shape of Mount Anak Krakatau after eruption in 2018

(Source: Venzke, E (ed.). Smithsonian Institution)

On April 10, 2020, it was an incandescent rock material that came out to the surface with an intensity that was not significant and far from the eruption in December 2018. The material ejected from the activity of Mount Anak Krakatau was in the form of lava flows and heavy ash rain within a radius of 2 km from the center of the crater. The resulting throw of material is in the form of incandescent material that is only scattered around the crater. The eruption of Mount Anak Krakatau will continue to have the potential, but the intensity of the eruption cannot be detected (Indonesian Center for Volcanology and Geological Hazard Mitigation (CVGHM), 2020). The report from the PVMBG stated that during April 21-28, Anak Krakatau's activities often produced white clouds as high as 25-50 meters. The condition of Mount Anak Krakatau on May 16, 2020 is normal. This can be seen in the strength of the radiation produced is in a weak condition, with mountain status level II (alert).

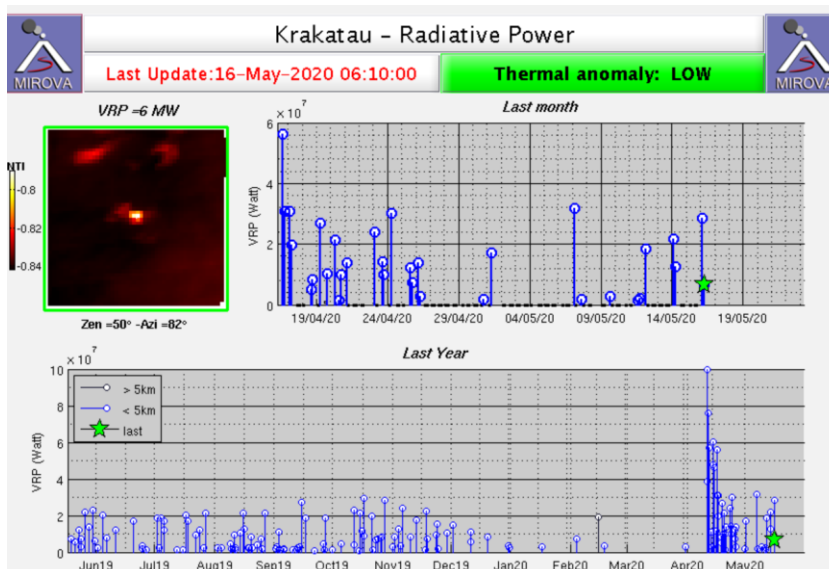


Figure 9. Conditions of Radiation Anak Krakatoa in May 2020
(Source: National Museum of Natural History Smithsonian Institution)

D. Conclusion

Mount Anak Krakatau is located in the Sunda Strait and is included in the South Lampung region. This mountain has an altitude of up to 300 meters above sea level with a width of the mountain body reaching 2 km. Mount Anak Krakatu is a volcanic island with one active cone at the center of the caldera which has an eruption period of between 1-8 years. Mount Anak Krakatau has Strombolian and Vulkanian eruption types. As well as having the characteristics of the eruption material, namely pyroclastic falls, pyroclastic flows, and lava flows. Anak Krakatau is also included in the group of active mountain routes along 7000 km, which stretches from the northern region of Sumatra, Java, Nusa Tenggara, to Maluku. The growth of this mountain is so fast that it causes frequent eruptions each year. The average growth rate of Anak Krakatau is 4 meters / year. So that the current conditions caused an eruption on April 10, 2020, this gave an incandescent rock material that came out to the surface with an intensity that was not yet significant and far from the eruption in December 2018. The material ejected from the activities of Mount Anak Krakatau is in the form of lava flows and heavy ash rain within a radius of 2 km from the center of the crater. Even though now the mountain has returned to normal, it is not impossible that, at any time, there could be more powerful explosions than the eruption in 1883.

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