

The Great Explosion of the Krakatau Volcano ("Krakatoa") of August 26, 1883, in Indonesia

George Pararas-Carayannis

The Great Volcanic Explosion of Krakatoa

Introduction

Over a century ago, on August 26, 1883, the island volcano of Krakatau ("Krakatoa") in Indonesia, a virtually unknown volcanic island with a history of violent volcanic activity, exploded with devastating fury. The eruption was one of the most catastrophic natural disasters in recorded history. The effects were experienced on a global scale. Fine ashes from the eruption were carried by upper level winds as far away as New York City. The explosion was heard more than 3000 miles away. Volcanic dust blew into the upper atmosphere affecting incoming solar radiation and the earth's weather for several years.

A series of large tsunami waves generated by the main explosion, some reaching a height of nearly 40 meters (more than 120 feet) above sea level, killed more than 36,000 people in the coastal towns and villages along the Sunda Strait on Java and Sumatra islands. Tsunami waves were recorded or observed throughout the Indian Ocean, the Pacific Ocean, the American West Coast, South America, and even as far away as the English Channel.

Location and Geologic Setting of the Krakatau (Krakatoa) Volcano

Krakatau (Krakatoa) is located in the Sunda Strait, 40 km off the west coast of Java on the island of Rakata in Indonesia. The geographical coordinates of Krakatoa are 16.7 S. Latitude and 105.4 E. Longitude. Krakatoa is one of the volcanoes of the Sunda volcanic arc. The volcano was formed by the subduction of the Indian-Australia Plate under the Eurasian Plate.



At its peak, Krakatoa reached a height of 790 m (2,600 ft.) above sea level. Its first known eruption occurred in 416 A. D. However, this eruption destroyed the volcano of Krakatoa which collapsed and formed a 4-mile wide caldera. The islands of Verlaten and Lang are remnants of this older volcano. Subsequently, three volcanoes combined to form the island of Krakatau.

Thus Krakatoa was the remnant of the old volcano which had not erupted for 200 years. Prior to the great 1883 eruption of Krakatoa, Rakata island was made of three volcanoes and at least one older caldera. The volcanic cones aligned in a north-south direction. The northernmost was called Poeboewetan and the southernmost was called Rakata. Overall approximate dimensions of Krakatoa were 5 by 9 Kilometers.

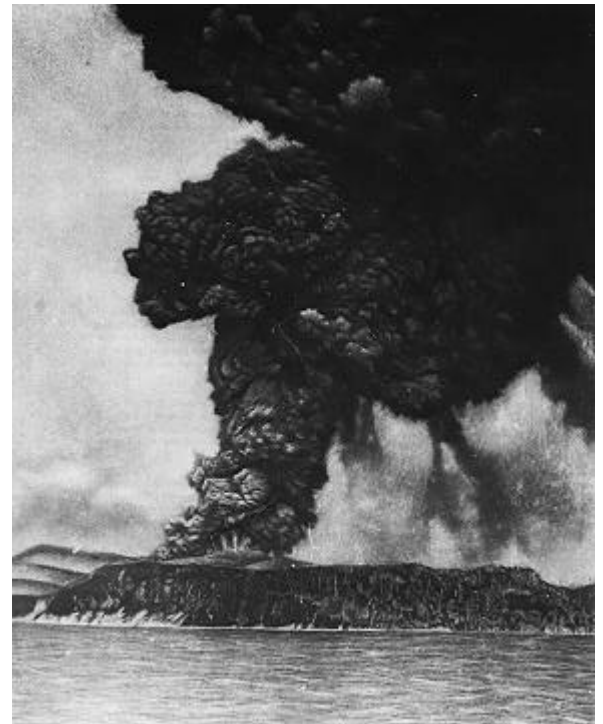
Chronology of Events Prior to the Great August 26, 1883 Eruption

After a long period of inactivity (about 200 years), Krakatoa became active again in early 1883. The first indication that something was happening on Krakatoa was when a large earthquake struck the area. Seismic activity became stronger until May 20, 1883, when the volcano abruptly came to life. The initial explosive eruptions of Krakatoa could be heard 160 km away. Steam and ash could be seen rising 11 km above the summit of the volcano. By August 11, 1883, three vents were actively erupting. Eleven other vents were ejecting smaller quantities of steam, ash and dust.

Around 1 pm on the 26th of August 1883, the explosions became more frequent occurring on the average every 10 minutes. Sailors on a ship, 120 km away from the island reported a black cloud of smoke rising above the volcano. At the time the rim of Krakatoa's crater was approximately 1,000 meters in diameter and had an average depth of 50 meters. The volcano's central vent was blocked by a plug of solid lava and underneath it pressure was rapidly building up.

The Great Eruption

The renewed activity in May 1883 culminated in four gigantic explosions on August 26 and 27 of the same year. On the afternoon of August 26, 1883, (27 August local date) at 17: 07 Greenwich time (GMT), the first of these four violent explosions begun. A black cloud of ash was initially observed. It rose 17 miles (27 kilometers) above Krakatoa. In the morning of the next day, on August 27, 1883, at 05:30, 06:44 and 10:02 GMT, three more violent eruptions occurred. It was the paroxysmal eruption which occurred at 10:02 which blew away the northern two-thirds of the island. This was the most severe violent volcanic explosion on Earth in modern times. The explosion was followed by the collapse of the unsupported volcanic chambers of Krakatoa forming the huge underwater caldera. It was this explosion and collapse of



Krakatoa that generated catastrophic tsunami waves as high as 37 meters. (120 ft.) that caused havoc and destruction in the Sunda Strait.

A Phreatomagmatic Event

Krakatoa's paroxysmal explosion was "phreatomagmatic" . Ocean water entered the magmatic chambers of the volcano when its walls begun to rupture. Super heated steam built tremendous pressure which, in turn, resulted in the large explosion of the volcano. The violent explosion of released gases blasted huge quantities of ash, cinders, pumice, bombs, and larger blocks skyward. The explosion was followed by the collapse of the volcanic remnants into the empty magmatic chambers, thus forming a submerged caldera.

Magnitude of the 1883 Eruption of Krakatoa

The 1883 eruption of Krakatoa has been assigned a Volcanic Explosivity Index or VEI of 6 which rates as "colossal". To be assigned a VEI rating of 6, a volcanic eruption must have a plume height over 25 km and a displacement volume ranging between 10 and 100 km³ (cubic kilometers). Eruptions of this size occur only once every few hundred years on earth.

The total energy released by the four main events of the 1883 eruption was equivalent to 200 megatons of TNT. Most of this energy was released by the third paroxysmal explosion which has been estimated to be equivalent to an explosion of 150 megatons of TNT. To understand the magnitude of the Krakatoa explosion, it will suffice to say that the Hiroshima atomic bomb was only about 20 kilotons).

Volume of Material Ejected by the Volcanic Explosion

The amount of ejected material from the eruption of Krakatoa into the atmosphere is estimated to have been about 21 cubic km (appr. 11 cubic miles)

What was left of Krakatoa after the Explosion

When Krakatoa erupted in 1883, the entire northern portion of the island was blown away.

After the explosions and the collapse of unsupported remnants into the newly formed caldera, only 1/3 of the volcano remained above sea level. What remained were a few small islands marking the previous cone of the volcano and some small new islands of steaming pumice and ash to the north. One of the small islands that were born was "Anak Krakatau" or Krakatoa's Child which is at present an extremely active young volcano, which at some point in the distant future may explode with the same violence as Krakatoa.

Local and Global Effects of the August 26, 1883 Krakatoa Eruption

Effects in the Immediate Vicinity

Blast waves cracked walls and broke windows up to 160 km. away. Vibrations smashed shop windows as far as 80 miles away. Ships navigating the seas near Krakatoa reported that in certain areas floating pumice had formed a layer about 3 meters thick. Other ships, 160 miles off, reported that their decks were covered with volcanic dust three days after the end of the eruption.

The dust cloud from the eruption completely covered the area, and it was dark even 257 miles away from the volcano. Darkness covered the



Sunda Straits from 11 a.m. on the 27th until dawn the next day. This darkness lasted more than 24 hours at places which were 130 miles away and 57 hours at places which were 50 miles away. In the immediate area, total darkness continued for three days.

Rain of Volcanic Ash and Pumice

There was a rain of volcanic ash and pumice from the eruptions. In the nearby islands everything was buried under a thick layer of ash. Plant and animal life did not begin to reestablish itself to any degree in these nearby islands for nearly five years.

Near the volcano huge masses of pumice from the eruption floated in the sea and were thick enough to interfere with navigation. Pumice formed large and thick floating rafts some of which crossed the Indian Ocean in a 10 month period. Others such rafts of pumice reached Melanesia, and were still afloat two years after the eruption. Volcanic ash and such debris from Krakatoa's eruption reached as far west as the island of Madagascar. Quantities of dust from the eruption precipitated on the decks of vessels as far as 1,600 miles away. Ash fell on Singapore, which was 840 km away, and on Cocos Island (Keeling) 1,155 km to the SW. Similar precipitation of ash occurred on ships at sea more than 6,000 Km away in a WNW direction.

Krakatoa's Explosion Heard More than 2,000 Miles Away

Krakatoa's tremendous explosions were heard throughout the area and beyond, over 1/3rd of the earth's surface. They were heard as far away as 2,200 miles (3,540 kilometers) away in Australia, and even as far away as Rodriguez Island which is 2,908 miles (4,653 km) away to the west-southwest, in the Indian Ocean about 1,000 miles (1,600 km) east of Madagascar. People on Rodrigues Island described the sounds to be like the distant roar of firing canons. The sounds continued at intervals of three to four hours during the night.

Atmospheric Shock Waves Recorded Throughout the World

Atmospheric pressure shock waves from the explosions of Krakatoa circled the earth seven times and were recorded by barographs throughout the world. Barographic records documented the shock waves from the paroxysmal explosion of Krakatoa by as many 7 times, as these waves bounced back and forth between the site of the eruption site and its antipodes on the earth for 5 days following the explosion.

Upper Atmosphere Effects

Ash from the eruptions was propelled to a height of 50 miles (80 kilometers) in the upper atmosphere blocking the sun and plunging the surrounding region into darkness for two and a half days.

Dust and ash from the eruption encircled the Earth in 13 days forming a cloud which, by September 9, 1883, had covered completely the upper atmosphere along a belt in the equatorial zone. Three months after the eruption this belt of volcanic dust of fine particles of dust had spread to higher latitudes causing unusually spectacular red sunsets and other interesting atmospheric effects. Blue and green suns were also observed. Breathtaking sunsets were observed during the winter months of 1884 in both American and Europe. Unusual sunsets continued for almost 3 years.

Climatic Changes

It has been estimated that at least 21 cubic Km (appr. 11 cubic mile) was ejected from the eruption of Krakatoa and that at least 1 cubic mile of the finer material was blown to a height of about 17 miles (27 Km). The volcanic dust blown into the upper atmosphere was carried several times around the earth by air currents. This volcanic dust veil not only created the spectacular atmospheric effects described previously but acted also as a solar radiation filter, reducing the amount of sunlight reaching the surface of the earth. In the year following the eruption, global temperatures were lowered by as much as 1.2 degree Centigrade on the average. Weather patterns continued to be chaotic for years and there were major climatological changes which affected the entire globe.

Temperatures did not return to normal until five years later, in 1888.



Eruptions of Krakatoa Prior to 1883

Violent volcanic activity has been known to exist in this region of Indonesia since early historic ages. In about 416 A.D., according to ancient Javanese scriptures, a great eruption" of Krakatau (Krakatoa) must have taken place. It was this violent early eruption that formed the three islands of Rakata, Panjang, and Sertung and created a 4-mile (7-km) wide caldera. The islands of Krakatau, Verlaten, and Lang are remnants of this volcano.

The earliest recorded eruption of Krakatoa was a moderate one between May 1680 and November 1681. This eruption destroyed all of the lush vegetation on the island. Large quantities of rock pumice and ash fell into the sea.

Subsequent and Recent Eruptions of Krakatoa

As reported previously, prior to the 1883 eruption, Krakatoa was an island made of three volcanoes and at least one older caldera. The eruption of 1883 destroyed most of the island, leaving only a remnant.

For the next few years, what used to be Krakatoa was relatively quiet until, on January 25, 1925, a small volcanic cone broke through the water in the caldera of old Krakatoa. Krakatoa not only was not dead but had given birth. The new volcanic island was named Anak Krakatau or Child of Krakatoa. In 1927, occasional weak eruptions of this small volcano began. In later years, the small eruptions became more frequent gradually building up this new island volcano to a much larger size.

In December of 1959, Anak Krakatau became very active. The renewed activity attracted a great deal of attention. In January of 1960, a team of scientists visited Anak Krakatau to study this renewed activity. They reported that Anak Krakatau had grown to a minimum diameter of about one mile and was 545 ft. tall. They reported that the crater on the south side of the island was 2,000 ft. in diameter and contained a growing cinder cone which was 300 ft. in diameter and 150 ft. high. This new cinder cone had formed in about a month, since the resumption of activity. The scientists observed that the explosive eruptions were of the Vulcanian-type and, at the time, they were occurring at intervals ranging from 1/2 to 10 minutes. They reported that the new explosive eruptions included pyroclasts ranging in size from fine ash to boulders and that the largest explosions produced turbulent clouds of ash that rose 4,000 ft. above the volcanic vent. This renewed activity of Anak Krakatau lasted for almost four years, ending in 1963.

Since 1963, according to reports, Anak Krakatau had at least nine episodes of activity most lasting less than one year. The volcano's activity continued into the 1990's. As of the writing of this report, the most recent episode of eruption began in March of 1994 and continued to March of 1995. This activity was very similar to the 1959-1963 eruptions.

The 1883 Eruption of Krakatoa was not the Largest Known in Recorded History

Although large and catastrophic, the 1883 eruption of Krakatoa was not the largest known in recorded history. The explosion of the volcano of Santorin (Thera) which occurred in the Aegean Sea in the fifteenth century BC, although assigned also a VEI of 6, was at least six and one half times greater than that of Krakatoa. Also the volcanic explosion of Mount Vesuvius in 79 A.D was greater than that of Krakatoa.

Future Great Eruptions of Anak Krakatau, the Child of Krakatoa

Undoubtedly the eruptions will continue and Anak Krakatau, the Child of Krakatoa will keep on growing in size. Undoubtedly, at some time in the future, perhaps a few hundred years from now, a large explosion similar to that of 1883 can be expected. It is only a question of time.

