= Lake Toba =

Lake Toba (Indonesian : Danau Toba) is a large natural lake occupying the caldera of a supervolcano . The lake is about 100 kilometres long , 30 kilometres wide , and up to 505 metres (1 @,@ 666 ft) deep . Located in the middle of the northern part of the Indonesian island of Sumatra , with a surface elevation of about 900 metres (2 @,@ 953 ft) , the lake stretches from 2 @.@ 88 ° N 98 @.@ 52 ° E ? / 2 @.@ 88 ; 98 @.@ 52 to 2 @.@ 35 ° N 99 @.@ 1 ° E ? / 2 @.@ 35 ; 99 @.@ 1 . It is the largest lake in Indonesia and also the largest volcanic lake in the world .

Lake Toba is the site of a massive supervolcanic eruption estimated at VEI 8 that occurred 69 @,@ 000 to 77 @,@ 000 years ago , representing a climate @-@ changing event . It is the largest known explosive eruption on Earth in the last 25 million years . According to the Toba catastrophe theory , it had global consequences for human populations : it killed most humans living at that time and is believed to have created a population bottleneck in central east Africa and India , which affects the genetic make up of the human world @-@ wide population to the present .

It has been accepted that the eruption of Toba led to a volcanic winter with a worldwide decrease in temperature between 3 to 5 ° C (5 @.@ 4 to 9 @.@ 0 ° F) , and up to 15 ° C (27 ° F) in higher latitudes . Additional studies in Lake Malawi in East Africa show significant amounts of ash being deposited from the Toba eruptions , even at that great distance , but little indication of a significant climatic effect in East Africa .

= = Geology = =

The Toba caldera complex in Northern Sumatra , comprises four overlapping volcanic craters that adjoin the Sumatran " volcanic front . " The fourth and youngest caldera is the world 's largest Quaternary caldera (100 by 30 km (62 by 19 mi)) and intersects the three older calderas . An estimated 2 @,@ 800 km3 (670 cu mi) of dense @-@ rock equivalent pyroclastic material , known as the youngest Toba tuff , was released during one of the largest explosive volcanic eruptions in recent geological history . Following this eruption , a resurgent dome formed within the new caldera , joining two half @-@ domes separated by a longitudinal graben .

At least four cones , four stratovolcanoes , and three craters are visible in the lake . The Tandukbenua cone on the northwestern edge of the caldera has only sparse vegetation , suggesting a young age of several hundred years . Also , the Pusubukit (Hill Center) volcano (1971 metres above sea level) on the south edge of the caldera is solfatarically active and is a Geology Sanctuary .

= = Major eruption = =

The Toba eruption (the Toba event) occurred at what is now Lake Toba about 75000 ± 900 years ago . It was the last in a series of at least four caldera @-@ forming eruptions at this location , with earlier calderas having formed around 788000 ± 2200 years ago . This last eruption had an estimated VEI = 8 , making it the largest known explosive volcanic eruption within the last 25 million years .

Bill Rose and Craig Chesner of Michigan Technological University have estimated that the total amount of material released in the eruption was about 2 @,@ 800 km3 (670 cu mi) ? about 2 @,@ 000 km3 (480 cu mi) of ignimbrite that flowed over the ground , and approximately 800 km3 (190 cu mi) that fell as ash mostly to the west . However , based on the new method (crystal concentration and exponential) , Toba possibly erupted 3200 km ^{3} of ignimbrite and co @-@ ignimbrite . The pyroclastic flows of the eruption destroyed an area of least 20 @,@ 000 km2 (7 @,@ 722 sq mi) , with ash deposits as thick as 600 m (1 @,@ 969 ft) by the main vent .

The eruption was large enough to have deposited an ash layer approximately 15 cm (5 @.@ 9 in) thick over all of South Asia ; at one site in central India , the Toba ash layer today is up to 6 m (20 ft) thick and parts of Malaysia were covered with 9 m (30 ft) of ash fall . In addition it has been variously calculated that 10 @,@ 000 million tonnes (1 @.@ 1 × 1010 short tons) of sulfurous acid

or 6 @,@ 000 million tonnes (6 @.@ 6 × 109 short tons) of sulfur dioxide were ejected into the atmosphere by the event .

The subsequent collapse formed a caldera that , after filling with water , created Lake Toba . The island in the center of the lake is formed by a resurgent dome .

The exact year of the eruption is unknown , but the pattern of ash deposits suggests that it occurred during the northern summer because only the summer monsoon could have deposited Toba ashfall in the South China Sea . The eruption lasted perhaps two weeks , and the ensuing " volcanic winter " resulted in a decrease in average global temperatures by 3 @.@ 0 to 3 @.@ 5 ° C (5 to 6 ° F) for several years . Greenland ice cores record a pulse of starkly reduced levels of organic carbon sequestration . Very few plants or animals in southeast Asia would have survived , and it is possible that the eruption caused a planet @-@ wide die @-@ off . However , the global cooling has been discussed by Rampino and Self . Their conclusion is that the cooling had already started before Toba 's eruption . This conclusion was supported by Lane and Zielinski who studied the lake @-@ core from Africa and GISP2 . They concluded that there was no volcanic winter after Toba eruption and that high H2SO4 deposits do not cause long @-@ term effects .

Evidence from studies of mitochondrial DNA suggests that humans may have passed through a genetic bottleneck around this time that reduced genetic diversity below what would be expected given the age of the species . According to the Toba catastrophe theory , proposed by Stanley H. Ambrose of the University of Illinois at Urbana @-@ Champaign in 1998 , the effects of the Toba eruption may have decreased the size of human populations to only a few tens of thousands of individuals . However , this hypothesis is not widely accepted because similar effects on other animal species have not been observed , and paleoanthropology suggests there was no population bottleneck .

= = = More recent activity = = =

Since the major eruption ~ 70 @,@ 000 years ago , eruptions of smaller magnitude have also occurred at Toba . The small cone of Pusukbukit formed on the southwestern margin of the caldera and lava domes . The most recent eruption may have been at Tandukbenua on the northwestern caldera edge , suggested by a lack of vegetation that could be due to an eruption within the last few hundred years .

Some parts of the caldera have shown uplift due to partial refilling of the magma chamber , for example , pushing Samosir Island and the Uluan Peninsula above the surface of the lake . The lake sediments on Samosir Island show that it has risen by at least 450 m (1 @,@ 476 ft) since the cataclysmic eruption . Such uplifts are common in very large calderas , apparently due to the upward pressure of below @-@ ground magma . Toba is probably the largest resurgent caldera on Earth . Large earthquakes have recently occurred in the vicinity of the volcano , notably in 1987 along the southern shore of the lake at a depth of 11 km (6 @.@ 8 mi) . Such earthquakes have also been recorded in 1892 , 1916 , and 1920 ? 1922 .

Lake Toba lies near the Great Sumatran fault , which runs along the centre of Sumatra in the Sumatra Fracture Zone . The volcanoes of Sumatra and Java are part of the Sunda Arc , a result of the northeasterly movement of the Indo @-@ Australian Plate , which is sliding under the eastward @-@ moving Eurasian Plate . The subduction zone in this area is very active : the seabed near the west coast of Sumatra has had several major earthquakes since 1995 , including the 9 @.@ 1 2004 Indian Ocean earthquake and the 8 @.@ 7 2005 Nias ? Simeulue earthquake , the epicenters of which were around 300 km (190 mi) from Toba .

= = People = =

Most of the people who live around Lake Toba are ethnically Bataks . Traditional Batak houses are noted for their distinctive roofs (which curve upwards at each end , as a boat 's hull does) and their colorful decor .

= = Flora and fauna = =

The flora of the lake includes various types of phytoplankton , emerged macrophytes , floating macrophytes , and submerged macrophytes , while the surrounding countryside is rainforest including areas of Sumatran tropical pine forests on the higher mountainsides .

The fauna includes several species of zooplankton and benthic animals . Since the lake is oligotrophic (nutrient @-@ poor) , the native fish fauna is relatively scarce , and the only endemics are Rasbora tobana (strictly speaking near @-@ endemic , since also found in some tributary rivers that run into the lake) and Neolissochilus thienemanni , locally known as the Batak fish . The latter species is threatened by deforestation (causing siltation) , pollution , changes in water level and the numerous fish species that have been introduced to the lake . Other native fishes include species such as Aplocheilus panchax , Nemacheilus pfeifferae , Homaloptera gymnogaster , Channa gachua , Channa striata , Clarias batrachus , Barbonymus gonionotus , Barbonymus schwanenfeldii , Danio albolineatus , Osteochilus vittatus , Puntius binotatus , Rasbora jacobsoni , Tor tambra , Betta imbellis , Betta taeniata and Monopterus albus . Among the many introduced species are Anabas testudineus , Oreochromis mossambicus , Oreochromis niloticus , Ctenopharyngodon idella , Cyprinus carpio , Osphronemus goramy , Trichogaster pectoralis , Trichopodus trichopterus , Poecilia reticulata and Xiphophorus hellerii .

= = Gallery = =

= = Additional reading = =

Rampino , Michael R. and Stephen Self (1993) . " Climate @-@ volcanism feedback and the Toba eruption of 74 @,@ 000 Years Ago " . Quaternary Research 40 (3) : 269 ? 280 . Bibcode : 1993QuRes .. 40 .. 269R. doi : 10 @.@ 1006 / qres.1993.1081.

Vazquez , Jorge A. and Mary R. Reid (2004) . " Probing the accumulation history of the voluminous Toba Magma " . Science 305 (5686) : 991 ? 994 . Bibcode : 2004Sci ... 305 .. 991V. doi : 10 @.@ 1126 / science.1096994. PMID 15310899 .

Petraglia , M. ; et al . (2007) . " Middle Paleolithic Assemblages from the Indian Subcontinent Before and After the Toba Super @-@ Eruption " . Science 317 (5834) : 114 ? 116 . Bibcode : 2007Sci ... 317 .. 114P. doi : 10 @.@ 1126 / science.1141564. PMID 17615356 .