

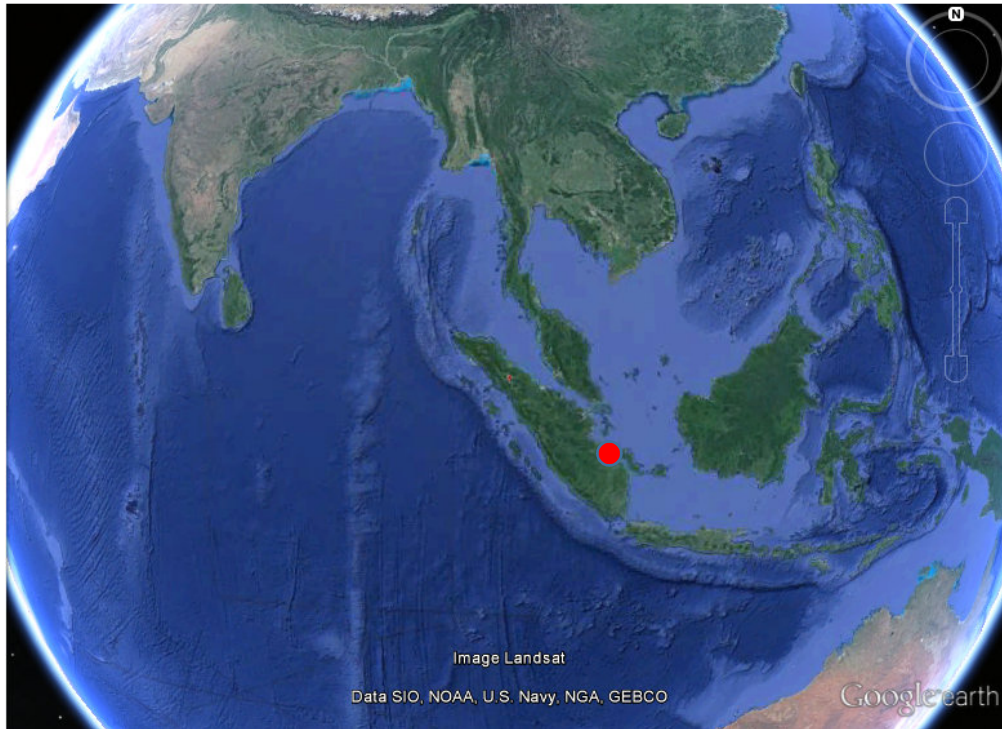
Supervolcanoes

The Eruption of Toba and its Possible Impact on Humans

Background Information

Super volcano: - a volcano capable of producing a volcanic eruption with an ejecta mass greater than 10^{15} kg

Toba, Sumatra erupted around 74,000 years ago



The Eruption

It was the largest explosive event of the past 100,000 years.

Roughly 2,800km³ of material was emitted which covered India and part of south-east Asia in over 15cm of ash.

The Climate Impacts

- The material emitted by the volcano would cause a large reduction in light, precipitation and temperature. Volcanic sulphates from the eruption have been found in the Greenland icecap for up to 6 years after the eruption.
- Although there is no actual evidence of annual to decadal response to the eruption – it could (should) have been very large (10°C or more) for up to a decade. This ‘volcanic winter’ would have put severe stresses on global ecosystems:
- Much of the vegetation on Earth would have died, which in most places would increase the albedo of the Earth - more of the Sun’s light would be reflected instead of warming the ground, and the planet would cool further.
- There is evidence of a 1000 year cooling after the eruption, but whether or not the cooling was caused by the eruption is not known. It may have been that the Earth was on the verge of a cooling event (stadial or glacial) anyway, being pushed by the Milankovitch cycles. The eruption may have been what was needed to tip it into a glacial period. For this, feedback mechanisms including the advance of polar snow and ice would be necessary. As the planet became ‘whiter’, more of the Sun’s light would be reflected instead of warming the ground, and the planet would cool further.
- If Toba (or a similar volcano) erupted now, it would cause the same short term (1-10 year) impacts, but would not tip the Earth into a glacial period.

The Genetic Bottleneck

The human population narrowly passed through a bottle neck at about the time of the Toba eruption. The sudden dark and cold conditions caused by the eruption, rather than the relatively slow move into a glacial period, would have largely destroyed human food supplies without giving time for population migration.

The eruption happened at a time when humans were beginning to move out of Africa and the Middle East in to the rest of the world.

A number of human species (such as Homo erectus and the Neanderthals) lived at the time of the eruption. Genetic evidence suggests that the numbers of Homo sapiens, our ancestors, fell to just a few thousand at about this time.

Exactly how the eruption affected our ancestors and related species is an area of active research.

Sources of Information

Volcanic winter and accelerated glaciation following the Toba super-eruption, M. Rampiro and S. Self, Nature, 1992

Did the Toba volcanic eruption of 74 ka B.P. produce widespread glaciation?, Robock et al, Journal of Geophysical Research, 2009

https://en.wikipedia.org/wiki/Toba_catastrophe_theory

<http://toba.arch.ox.ac.uk/edu.htm> (careful - this site confuses Ice Ages and Glacials)

Teaching Idea

Use <http://www.geoworld.co.uk/mys.htm> the 'mystery' approach to ask students to investigate the eruption of Toba, changes in climate and changes in the number of humanoids on the Earth.

Statements could include:

Approximately 70,000 years ago, the Earth went into a 1000 year cold period.

Sometime between 50,000 -100, 000 years ago, the number of humans fell to just a few 1000 individuals.

Explosive volcanoes blast sulphate aerosol and other particles into the stratosphere.

Much of the vegetation on Earth would have died.

The snowline would have been 3000m lower.

The Milankovitch cycles push the Earth in and out of colder and warmer periods.

If there is less vegetation, the Earth would reflect less of the Sun's light.

If there is more snow and ice, the Earth would reflect less of the Sun's light.

The eruption of Toba, around 74,000 years ago, was the biggest volcanic eruption since the emergence of modern humans.

Ash covered much of India and South-east Asia.

A volcanic winter caused temperatures to fall by over 10°C for a decade.