Destined Doomsday: When A Supervolcano Erupts

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Among all the scenarios of the extinction of the human race, a supervolcano eruption is the most likely one.

A volcano is a crack in the crust of a planetary-mass object like Earth that allows hot lava, volcanic ash, and gases to escape from a magma chamber beneath the surface (Government of Canada, 2022). Volcanoes erupt in various ways, yet in the majority of eruptions, the material listed following will be ejected: 1. volcanic gases, a mixture primarily composed of steam, carbon dioxide, and a sulfur compound (depending on temperature, either sulfur dioxide or hydrogen sulfide); 2. lava, the term given to magma as it emerges and flows across the surface; 3. tephra, solid particles of various shapes and sizes ejected and thrown into the air (Chisholm, 1911).

A supervolcano is a volcano that has had an eruption with a Volcanic Explosivity Index of 8 (Government of Canada, 2022). A VEI 8 eruption indicates that the deposit volume exceeds 1,000 km^3 (United States Geological Survey, 2022). Once a super caldera erupts, it will trigger a chain reaction of disasters ranging from direct disasters like massive ash falls and massive lava flows to indirect disasters like extreme climate changes and crop destruction. These disasters will most possibly result in a rapid decrease in the human population and - more severely - the extinction of humanity. Throughout Earth's history, geologists have documented at least 47 super-eruptions (Mastin, 2014), and the most recent one occurred around 26,000 years ago in Lake Taupo, New Zealand (Plummer, 2014). Despite that authorities and some volcanic geologists have widely underestimated the likelihood of extinction-level eruptions as presented below, the supervolcano eruption remains the most likely existential threat to humans.

It is critical to define existential threats before supervolcano eruptions can be classified as such. In 2002, Nick Bostrom's Typology of Risk introduced three dimensions to describe the magnitude of a threat to humans: "Scope," "Intensity," and "Probability". "Scope" means the size of the group of people that are at risk, with three types of subcategories: "personal", "local", and "global". The possibility of a cliff falling is a personal risk; an earthquake occurs as an example of a local risk; and extreme weather events are an example of a global risk. "Intensity" refers to how badly each individual in the group is affected. It can be classified into two subcategories: endurable and terminal. An example for an endurable risk is having part of your asset stolen; a representative case for a terminal risk is death. "Probability" indicates the best current subjective estimate of the probability of the adverse outcome. Hence an existential risk, according to Bostrom's theory, is one that threatens humanity as a whole and meets the criteria of "global," "terminal," and "probable." As for supervolcanoes, the Yellowstone's eruption is a representative subject for such catastrophic simulation. To investigate the three aspects, it is necessary to first comprehend the effects of the Yellowstone effusion and what specifically will happen to the human species after the apocalyptic disaster.

Scale

The first disaster that occurs when a supervolcano erupts is the widespread lava flows. The magma chamber underneath Yellowstone is approximately 90 km long and 40 km wide (United States Geological Survey, 2022). Yellowstone's largest eruption ejected 2,450 km^3 of magma, which is 9800 times more than the well-known St. Helens eruption in 1980. Scientists predict that if Yellowstone undergoes a Super eruption, lava will burst through the crater and bury everything within 64 km of the volcano (Mastin, 2014). However, this is not as catastrophic as the widespread volcanic ash. Most of the United States, a large portion of Canada, and parts of

Mexico's territory will be covered by a significant amount of volcanic ash in a one-month Yellowstone supereruption. Tom Simkin and Lee Siebert (2011) stated that half of the world's volcanoes would have a two-month eruption period. Because Yellowstone is a Supervolcano with a large magma chamber underneath it, its eruption period may last longer than two months. As a result, the impact of volcanic ash could be much worse, burying more countries or continents under thick toxic ash.

Intensity

The intensity of the extensive lava flow is definitely terminal due to its extremely high temperature of 700 to 1,300 °C (Evers, 2022). Most substances in its path will be heated to destruction by the lava flow. Great ash fall appears to be less aggressive than lava flow, but it impacts the planet in another way. If Yellowstone erupts, one-third of the material emitted from the crater of approximately 330 km^3 will be released into the atmosphere. A large amount of volcanic ash has the potential to kill living beings as well as to crush buildings. A few centimeters of ash can destroy farms, clog roads, cause severe respiratory problems, block sewer lines, make transportation difficult, and short-circuit transformers (Plummer, 2014). In essence, transforming a large portion of North America permanently unsuitable for humans to live.

Nonetheless, the disasters described above may not be the worst consequences of the Yellowstone Super eruption. Based on a BBC report, volcanic ash from a major supervolcanic eruption could reduce global annual average temperatures by up to 10 ºC (2014). Furthermore, the Northern Hemisphere could cool by up to 12 ºC. Conforming to experts, colder temperatures could last for six to ten years. Crops such as rice (Krishnan, 2011), which requires an average temperature of above 20 °C to harvest, wheat (Global Precipitation Measurement Mission, 2011), which requires an average temperature of above 21 °C for a bountiful harvest, and maize

(Greaves, 1996), which germinates the best at 25 - 28 °C while being extremely sensitive to sub-optimal and supra-optimal temperatures, will almost certainly see a significant decrease in output. Scientists also predict that the Monsoon will fail due to greater temperature changes in the Southern Hemisphere, causing mass starvation in countries that rely on life-giving rains. (BBC, 2014). Crop failure would have a global impact on all farms and plantations. The devastation of staple food supply would almost certainly be a massive global starvation unprecedented in human history.

We humans will most likely become extinct if Yellowstone erupts. Dr. Jerzy Zaba (2019) of the University of Silesia in Katowice, Poland, confirmed previous predictions that the Yellowstone supervolcano's eruption would cause world-ending destruction. He said: "due to the effects of climate change, around five billion people would die from hunger." Nevertheless, this stunning conclusion is drawn without consideration of the number of death caused by lava flow, dreadful respiratory diseases generated by the supreme ash fall, and many other deadly primary disasters and secondary hazards. The total death toll from a Yellowstone super eruption is highly possible to exceed 5 billion (Vatican, 2019). Due to the preceding discussion, it is reasonable to regard the intensity of the direct and indirect crisis caused by the Yellowstone supervolcanic eruption as terminal.

Yellowstone supereruption’s intensity is vastly misjudged. Despite adequate evidence that the Yellowstone supereruption is capable of destroying humanity, global media outlets including The Express (Kettley, 2018) stated that only about 70,000 will be threatened by Yellowstone supereruption while The Daily Mail (Zolfagharifard, 2015) claimed only 90,000 people would be killed immediately. The outcome of the Yellowstone supereruption was also underestimated by governments. As pointed out by the Federal Emergency Management Agency,

the volcano would only cause 14 percent of the US GDP in damage (Hart, 2021). On contrary to such misleading information, the entire North American civilization and more continents, as conclusion drawn above, will indeed suffer greatly from the supereruption.

Probability

Aside from the lethal scale and intensity of the Yellowstone eruption, many geologists and scholars believe that the next supereruption will occur within the next 100,000 years. Recorded by the USGS, there is a chance that Yellowstone Supervolcano will erupt within the next 100,000 years because the estimated period of Yellowstone's eruption is approximately 725,000 years and over 640,000 years has passed without a major volcanic movement. Joel Mize emphasized that another massive explosion can be expected ("is likely") sometime within the next 100,000 years based on the periodicity of the previous explosions (2018). Aside from these hypotheses about eruption times, the Yellowstone supervolcano is subject to frequent geological movements such as earthquakes. The long-term average density of earthquakes is around 1,500 – 2,000 earthquakes per year (Yellowstone Volcano Observatory, 2020). From 2010 to 2019, the University of Utah Seismograph Stations documented 17,243 earthquakes in the Yellowstone region. This results in an average of 4.7 earthquakes per day, or one every 5.1 hours. The findings indicate that Yellowstone is always active and that a deadly eruption could occur at any time. Consequently, Yellowstone will not only erupt as a geologically valid event, but it will most likely occur sooner rather than later.

There have been publications demonstrating that the Yellowstone eruption is an improbable incident. The National Review, for example, stated that the Yellowstone supervolcano would probably not erupt (Butler, 2020) and National Geography also stated that Yellowstone is "unlikely to erupt" (Samson, 2022). Yet the predictions made as such are highly

irresponsible without taking a foreseeable future into consideration. The "unlikely to erupt" assumption is set in a contemporary society, meaning that the Yellowstone is unlikely to erupt today, this week, or this year. But the eruption of the Yellowstone is a definite incident within a larger time frame. The American Scientist also underestimated the Yellowstone's eruption possibility and ranked it as low as No. 21 in the volcanic threat assessment in 2005 (Hunter, 2019). Authorities have also significantly underestimated the possibility of a Super volcanic eruption. Those publications led to governments spending relatively little money to prevent, research, and forecast world-ending volcanic movements in comparison with funds used to prevent less severe disasters. The Federal Aviation Administration, for example, spends more than 7 billion USD per year on aviation safety – which may seem somewhat reasonable - and only about 22 million USD are spent on volcano hazard programs every year (Walsh, 2019). Many other scholars and administrators have downplayed the possibility of a super volcanic eruption, concluding that it is not something that humanity should be concerned about. So, it is clearly reasonable to say that the probability of Yellowstone eruption is seriously underestimated.

Conclusion

The Yellowstone volcano's eruption satisfies all three requirements of Bostrom's existential crisis criteria. It has a global impact, is capable of exterminating billions of people, and most importantly, is a definite incident. On the other hand, many mainstream scientific organizations, media outlets, and governments have not informed the public on this deadly incident, either deliberately or in confidence that it will not take place and cause the human extinction. It is not about being condescending and telling the people how to react to the destined supervolcano eruption, but rather empowering them and making them see the inevitable consequences if the society refuse to change their arrogant mindset and start to face the reality.

Though it is too soon to say that more of the global population will survive the eruption and the starvation if the public start to take precautions as Doomsday Preppers, human beings still got plenty of time to actually think about what can be done in order to preserve the fragile civilization.

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