Environmental Effects of the Largest Volcanic Eruptions: From Mass Extinctions to Threats to Civilization

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Flood basalt eruptions have been suggested as a possible cause of mass extinctions in the history of life. Postulated climatic effects of these huge eruptions range from warming induced by release of carbon dioxide and sulfur dioxide gases, to cooling from tropospheric and stratospheric aerosols. Under certain conditions, such effects may be severe. The correlation or near-correlation among a number of well-dated continental flood basalt eruptions and mass extinctions suggests that they could be related.

The largest explosive volcanic eruptions (supereruptions) are capable of producing more than 1,000 cubic km of ejected material and greater than 1000 megatons of sub-micron atmospheric aerosols and dust. These eruptions may create global climatic disturbances sufficient to cause severe problems for world agriculture and modern civilization. The Toba supereruption of 74,000 years ago may have affected human evolution. Supereruptions are estimated to occur on average about every 50,000 years, which is about twice the frequency of impacts by comets and asteroids about 1 km in diameter predicted to cause similar climatic effects. Prediction, prevention, and mitigation of global volcanic climatic disasters may be potentially more difficult than planetary protection from the threat of large impacts, so that explosive volcanism might limit the longevity of technological civilizations.