

2014 AGU Session: The Role of Volcanism in Atmospheric Phenomena

Climate Throughout Geologic Time Has Been Controlled Primarily by the Balance Between Cooling Caused by Major Explosive Eruptions of Evolved Magmas Typical of Island Arcs and Warming Caused by Voluminous Effusive Eruptions of Basaltic Magma Typical of Subaerial Ocean Ridges and Island Chains

Most volcanic eruptions deplete ozone ~6% for a few years, allowing more high-energy, ultraviolet-B radiation to warm earth. Record low levels of total column ozone followed the 1991 explosive eruption of Pinatubo. Yet 6% depletion also followed the smaller and more effusive eruptions of Eyjafjallajökull (2010) and Grímsvötn (2011) in Iceland. Explosive volcanoes also eject 10-20 megatons of sulfur dioxide into the lower stratosphere, forming sulfuric-acid aerosols that reflect and diffuse sunlight causing a net cooling of ~0.5°C for 3 years. High rates of explosive volcanos cool earth into ice ages while high rates of effusive basaltic volcanism in Iceland between 11,500 and 9,500 years ago clearly warmed Earth out of the last ice age depositing sulfate recorded in ice cores in Greenland. Basalts from these eruptions are observed as tuyas in Iceland dated during this period. The 25 Dansgaard-Oeschger abrupt warmings are contemporaneous with increased sulfate in Greenland and with the few older dates available for tuyas in Iceland. Extensive flood basalts were formed during the Paleocene Eocene Thermal Maximum and during times of most major mass extinctions when global temperatures rose substantially, with fossil evidence for ozone depletion.

Greenhouse-gas theory assumes electromagnetic radiation travels through space as waves and therefore thermal energy reaching earth is proportional to the square of wave amplitude. Thus the change in energy reaching Earth due to ozone depletion is considered small compared to infrared energy absorbed by greenhouse gases. But waves travel in matter and there is no matter in space. Electromagnetic energy is transmitted as frequency, as shown by radio signals, where energy equals frequency times the Planck constant. Thus thermal energy reaching earth when ozone is depleted is 50 times thermal energy involved in greenhouse gases. Global warming from 1970 to 1998 was caused primarily by 3% ozone depletion due to anthropogenic CFCs.