

**PLATE TECTONICS CONTROLS GLOBAL CLIMATE CHANGE BY DETERMINING THE FREQUENCY OF MAJOR EXPLOSIVE, SUBDUCTION-RELATED VOLCANIC ERUPTIONS CAUSING INCREMENTAL GLOBAL COOLING VERSUS THE EXTENT OF SUBAERIAL, RIFT-RELATED, EFFUSIVE, BASALTIC LAVA FLOWS CAUSING SUDDEN GLOBAL WARMING, OCEAN ACIDIFICATION, MASS EXTINCTIONS, AND OFTEN THE ENDS OF GEOLOGIC EONS, ERAS, PERIODS, ETC.**

Major explosive volcanic eruptions deplete the ozone layer causing 2°C warming in industrial areas during the first winter, but forming sulfuric acid aerosols in the lower stratosphere that grow large enough over months to reflect and scatter sunlight, causing global cooling of ~0.5°C for 2 to 4 years. Modelling shows this short-term cooling still affects ocean temperatures 100 years later and that several large eruptions per century can slowly increment the world into ice-age conditions over tens of thousands of years, as is well documented in ice cores over the last 130,000 years. Glaciation began in Antarctica ~34 Ma, for example, resulting from major volcanism in the Izu-Bonin-Mariana, Aleutians, southern Rocky Mountains, and Sierra Madre Occidental.

Major effusive basaltic lava flows, covering up to 11 million square kilometers of continental rift zones and subaerial oceanic rift zones, do not form significant cooling aerosols but do deplete the ozone layer causing rapid net warming. They also cause ocean acidification and mass extinctions. The extrusion of 84 km<sup>2</sup> of basaltic lava from Bárðarbunga in Iceland in 2014 appears to have made 2015-2016 the hottest years in the instrumental record. The extrusion of 800 km<sup>2</sup> from Eldgjá in Iceland initiated the Medieval Warm Period. Basalt flows in the Craters of the Moon area of Idaho appear to have caused the Roman Warm Period and other warm periods at 6840 and 7770 BP. Widespread eruption of basaltic volcanoes and fissures in Iceland warmed the world out of the last ice age ending the Pleistocene. Initial rifting between Greenland and Norway ended the Paleocene. The Deccan Traps ended the Mesozoic. The Central Atlantic Magmatic Province ended the Triassic. The Siberian Traps ended the Paleozoic.

The footprints of climate change in ice cores, sediments, and rocks show, when adequate resolution is available, rapid warming within years to decades followed by slow cooling over centuries to millennia in sequences averaging as little as 4000 years but are very erratic in timing. The largest basaltic flows are contemporaneous

with the largest warmings and occur at the end of most geologic eons, eras, periods, epochs, and even ages. Detailed mapping of climate change, like magnetic anomalies, may ultimately provide ways to date and cross-correlate geologic formations worldwide.