The slow melt

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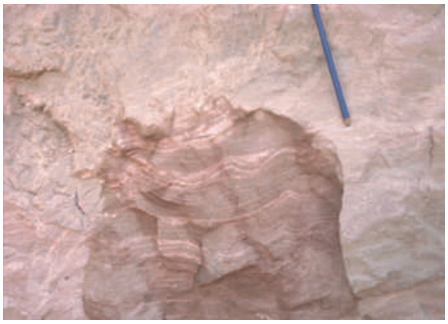

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The most recent snowball Earth glaciation, when continental ice sheets and glaciers spread into the tropics, ended about 635 million years ago. Analyses of the unusual rocks — known as cap carbonates — that formed when the ice receded suggest that, unlike the terminations of more recent glacial periods, the meltdown took tens to hundreds of thousands of years.

Eric Font, of the University of Lisbon, and colleagues collected palaeomagnetic data from the first 20 m of the cap carbonates — the cap dolostones — in Brazil, which revealed the presence of at least five magnetic reversals. Based on models of the Earth's magnetic field, the team suggests that the rocks must have taken between 600,000 and 800,000 years to form. Furthermore, estimates of rates of dolomite precipitation in modern environments imply that the rocks couldn't have formed in fewer than 10,000 years.

Although further refinement of this timing will be necessary, the formation of the cap dolostones, and hence the deglaciation of snowball Earth, took much longer than initially thought, indicating post-snowball climates may not have been as hot and humid as previously suggested.

Explosive eruptions

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Groups of volcanoes on Mars, called volcanic cones, are thought to have formed from explosive interactions between lava and underground water or ice. Numerical simulations of the eruptions now indicate they formed when water was stable at shallow depths below the martian surface, between 75 and 250 million years ago.

To determine where and when the volcanic eruptions were interacting with the underlying water table, Christopher Hamilton, at the University of Hawaii, and colleagues investigated the western Tartarus Colles region of Mars. They mapped individual lava flows using data from the Mars Reconnaissance Orbiter, and dated them by counting the number of craters on each one; older lava flows have more abundant impact craters. Simulations of the interactions between the lava flows and the subsurface water or ice show that the groups of volcanic cones formed when the water table was located less than 42 m below the surface.

The team concludes that lava–water interactions on Mars could have melted large volumes of ice and generated hydrothermal systems that persisted beneath the lava flows for up to 1,300 years.

Cross-polar transport

Atmos. Chem. Phys. **10,** 5065–5073 (2010)

The amount of black carbon in the atmosphere over the Canadian high Arctic is dominated by emissions from the former USSR and Europe, according to numerical simulations. Atmospheric black carbon is thought to be the second largest contributor to warming in the Arctic.

Sunling Gong, of Environment Canada, and colleagues constructed a linear regression model to assess atmospheric black-carbon loads during the cold season in the Canadian high Arctic between 1990 and 2005; regional emissions were calculated based on a United Nations study. The former USSR was the main source of black carbon — contributing 67% of the black-carbon load — over the 16-year period. The European Union and North America contributed 18% and 15% respectively.

Eurasian contributions declined substantially over the measurement period, which the authors attribute to a reduction in emissions. The North American contribution was more static, and interannual variations were driven by changes in both emissions and transport.

Where the ice was

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The climate-induced collapse of the Larsen ice shelves in the Antarctic Peninsula in 1995 and 2005 has altered sea-floor and open-ocean biodiversity, according to an ecological survey of the region. Floating ice shelves cover a third of the Antarctic continental shelf, hiding a widespread but poorly understood marine community.

Julian Gutt, of the Alfred Wegener Institute, Germany, and colleagues analysed species diversity in the coastal waters and sea floor surrounding the Antarctic Peninsula in the years following the collapse of the Larsen ice shelves. They found little deep-sea biodiversity in the formerly ice-covered regions, with a lower species number and abundance of macro and megabenthic taxa compared with ice-free areas. The authors suggest that this lack of fauna reflects a nutrient-poor, ice-covered past, in which primary production was restricted.

However, locally, the sea floor and open water were colonized by a few pioneer organisms, such as sea squirts. Antarctic minke whales and seals were also observed, indicating the presence of newly established krill and fish populations, and heralding the emergence of a productive Antarctic-shelf ecosystem.

Plume partitioned

Earth Planet. Sci. Lett. **295,** 231–240 (2010)

A numerical simulation of the Hawaiian hotspot shows that the mantle plume feeding volcanic activity at the surface is composed of long-lived columns of chemically distinct material. The chemistry of present-day Kilauea and 350,000-year-old Mauna Kea lavas is identical, yet different from the intervening flows.

Cinzia Farnetani, at the Institut de Physique du Globe de Paris, and Albrecht Hofmann, at the Max-Planck-Institut für Chemie in Mainz, used numerical models to link the observed variation in lava chemistry to the internal structure of the Hawaiian plume. They simulate an upwelling plume composed of several long, narrow columns of distinct mantle rock. Each of the columns is up to ~1,000 km long, with a radius of ~10 km, and acts to supply the surface volcanoes with rock derived from deep in the mantle.

Ancient volcanoes with lava flows that are identical to the present-day eruptions can only be reproduced in the model by individual columns that are at least 600 km long and are able to supply the surface volcanoes with lava for about 400,000 years.