VOLCANOLOGY

Shaky caldera

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In 2010, the Yellowstone caldera underwent a period of substantial seismic activity, followed by a period of subsidence. An analysis of the seismicity attributes the subsidence to the release of high-pressure, aqueous fluids.

David Shelly of the US Geological Survey and colleagues reanalysed data collected by the Yellowstone Seismograph Network during the 2010 Madison Plateau swarm. They identified a total of 8,710 earthquakes associated with the three-week-long event. The first burst of activity occurred in a localized area at depths between 8.5 and 11 km. The swarm then migrated along a plane, at a rate of roughly 750 m per day. The observed faulting generally indicated the weakening of existing fault surfaces, such as would occur when pore fluid pressures are suddenly elevated.

The researchers suggest that the initial deep rupturing was associated with the migration of high-pressure fluids from depth. The migration of these fluids into the surrounding rock generated the subsequent earthquake swarm, and the propagation of this swarm is consistent with the expected path of fluid diffusion. The release of these fluids could have reduced pressure in the caldera, promoting the subsidence of the surface. *AN*

PLANETARY SCIENCE

Cloudy Mars

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The martian atmosphere has clouds composed of both water and carbon dioxide ice, but the processes by which these clouds form seem to be different to those on Earth. Cloud nucleation experiments suggest that, like on Earth, water ice nucleates on dust particles in the martian atmosphere, but with a temperature dependency not seen in analogous water ice clouds high in Earth's troposphere.

Daniel Cziczo at the Massachusetts Institute of Technology and colleagues used an experimental cloud chamber adapted to mimic martian environmental conditions to study the formation of clouds made solely of water ice. They found that, in a low-pressure and chemically inert atmosphere similar to that of Mars, water ice clouds can form due to nucleation around dust particles of a similar size to those found on Mars. However, the concentration of dust particles required for ice to nucleate is dependent on temperature, with higher concentrations of particles required for nucleation at lower temperatures.

This unusual temperature dependence could explain why previous cloud nucleation experiments have failed to simulate the observed cloud cover on Mars. *TG*

CHEMICAL OCEANOGRAPHY

Physical flux

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Physical processes, such as the advection of surface waters to depth, draw carbon into the ocean interior. Model simulations suggest that the physically induced flux of carbon across the upper ocean exceeds that of other fluxes, such as the sedimentation of organic matter, by an order of magnitude.

Marina Levy, of LOCEAN-IPSL, France, and colleagues used a global sea-ice ocean-circulation model to quantify the physically induced flux of carbon into and out of the mixed layer of the upper ocean in pre-industrial times. According to their simulations, vertical advection led to the net subduction of dissolved inorganic carbon to depth in temperate, mid-latitude waters, whereas horizontal advection resulted in the net enrichment of mixed-layer waters with dissolved inorganic carbon in the tropics. Overall, physical processes led to an annual export of 264.5 Pg of dissolved inorganic carbon out of the mixed layer, and the annual injection of 275.5 Pg into the mixed layer, globally. Furthermore, 2.1 Pg of organic carbon was exported out of the mixed layer due to physical processes, equivalent to 20% of the total flux of organic matter to depth.

Although the ultimate fate of the carbon exported to the oceanic interior remains uncertain, the findings suggest that the physical transfer of carbon is a key component of the marine carbon cycle. *AA*

PALAEOECOLOGY

Nutrients in the wind

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A shift in atmospheric circulation 2,800 years ago curtailed the supply of the nutrient phosphorus to the Florida Everglades, sediment analyses suggest. The loss of this nutrient — combined with a shift to less humid conditions — dramatically altered the composition of vegetation in this region.

Paul Glaser of the University of Minnesota, Minneapolis, and colleagues assessed mineral composition and pollen content in a sediment core taken from the Northeast Shark River Slough, in the southern reaches of the Everglades. There were four distinct phases in the 4,500 year-long record. The first two phases record a rise in water levels and the development of extensive wetlands. The start of the third phase 2,800 years ago, however, saw a shift to vegetation associated with lower water levels and an abrupt drop in nutrient content, particularly phosphorus. Sediments from this period show a lower accumulation of Saharan dust particles as well, suggesting that dust was previously a key source of phosphorus. Water levels continued to decline throughout the final phase.

The team suggests the loss of this dust subsidy — linked to a southward shift of the storm track roughly 3,000 years ago — may have initiated a series of feedbacks that created the pattern of ridges, sloughs and tree islands that define the modern-day Everglades. *AN*

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