Water for faults

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Some small earthquakes in subduction zones are generated by the dehydration of minerals under high temperature and pressure. Experimental analyses indicate that seismic activity observed at intermediate depths in the subducting slab could result from the rapid release of fluids from deep minerals.

Isabelle Daniel at the Université de Lyon, France, and colleagues carried out dehydration experiments on samples of antigorite — a mineral found in the subducting oceanic mantle. The release of fluids from antigorite grains was not only much faster than the rate of collapse of the mineral itself, but also faster than the collapse of any other mineral in the subducting slab and surrounding mantle. Dehydration earthquakes are triggered only when the fluids escape the mineral through an open pore before the mineral collapses under pressure.

The authors conclude that the rapid dehydration of antigorite probably triggers seismicity in subducting plates.

Iceberg influence

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ISTOCKPHOTO.COM / MLENNY

Ocean surveys suggest that meltwater from free-floating icebergs can affect the chemistry and biology of the surrounding sea water as they pass through the ocean.

John Helly of the University of California, San Diego, and colleagues carried out surveys in the Southern Ocean in March and April 2009 to examine the impacts of a single, free-floating iceberg on the surrounding sea water. The iceberg broke off from the Ross Ice Shelf in 2002. They detected a plume of water with lower temperature and salinity than the surrounding sea water, which stretched up to 19 km away and was mixed to depths of 1,500 m. The plume persisted for up to ten days following the passage of the iceberg. In total, the researchers estimate that this single iceberg altered the chemical properties of 3,000 km^3 of water during its 23-day transit.

The researchers also observed variations in the partial pressure of carbon dioxide and seawater chlorophyll, suggesting the meltwater influenced the distribution of phytoplankton.

Moisture decline

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GARRY K. SMITH

Analyses of cave deposits indicate that changes in the North Atlantic meridional overturning circulation during the last glacial period affected the strength of the Australian–Indonesian summer monsoon.

Sophie Lewis of the Australian National University and colleagues reconstructed precipitation patterns over Flores, Indonesia, from 31,500 to 25,600 years ago from a fast-growing stalagmite in the Liang Luar cave. The evolution of oxygen isotope compositions of the stalagmite calcite suggests that precipitation decreased from 30,800 to 30,200 years ago. This was followed by a hiatus in deposition, indicative of even dryer conditions. The team attributes this to a southward shift in the rain belt associated with the intertropical convergence zone during this time.

The period of drying corresponds to a shutdown of meridional overturning in the North Atlantic Ocean and widespread cooling in the Northern Hemisphere. Model simulations have indicated that such cooling could have driven the southward migration of the intertropical convergence zone, which would have reduced precipitation in the regions affected by both the Australian–Indonesian and Asian summer monsoons.

Stirred mantle

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The thick and stable continental crust acts as a thermal lid that insulates the hot mantle and reduces the escape of heat from the Earth's interior. Numerical simulations show that continental cover should also facilitate efficient mixing of the mantle.

Henri Samuel of Universität Bayreuth, Germany, and colleagues assessed the influence of continents of varying size on mantle convection using numerical models. Beneath the continents, mantle temperatures were significantly warmer than those below the oceanic crust. As a result, the viscosity of the mantle is lower where covered by continents and causes it to convect more vigorously. When continents are similar in lateral extent to those on Earth today, they cause a three- to sixfold increase in mixing efficiency of the mantle, compared with an Earth with no continents.

How the large-scale heterogeneities that exist at depth in the Earth's mantle have survived for so long in such a well-stirred mantle remains unclear.

Black-carbon warming

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Aerosols that contain black carbon both reflect and absorb radiation, hindering estimates of their overall impact on climate. Model simulations and observational data suggest that black-carbon aerosols caused a significant but minimal warming of global near-surface temperatures in the twentieth century.

Gareth Jones, of the Met Office Hadley Centre, UK, and colleagues assessed the climatic impact of black-carbon aerosols over the past century using temperature records and numerical simulations. According to their model simulations, black-carbon aerosols from fossil fuel and biofuel sources warmed the Earth's surface by 0.14 K, compared with a greenhouse-gas-induced warming of 1.06 K. Their analysis of observational data confirmed that black-carbon aerosols had a detectable but small influence on temperatures in the latter half of the twentieth century.

However, the researchers note that changes in the reflectivity of snow caused by the deposition of black carbon on its surface — which were not considered in their analysis — could exacerbate the warming effect, at least on a local level.