CLIMATE SCIENCE

Future land-carbon loss

J. Clim. http://doi.org/k8m (2013)

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Human activities have altered around one-third to one-half of the world's land surface, with significant consequences for climate, particularly in the high latitudes. Climate model simulations suggest that future changes in land use could further alter regional climate over the coming century.

Victor Brovkin of the Max Planck Institute for Meteorology, Germany and colleagues assessed the effect of changes in land use and cover on climate over the twenty-first century, using six Earth system models. Projected changes in land use — taken from the fifth Coupled Model Intercomparison Project — had little impact on twenty-first century climate at the global scale. However, a small but statistically significant change in mean annual temperature was apparent in regions of intensive land-use change in three of the models. In these regions, temperature change was associated with a reduction in the flux of water from the surface to the atmosphere, along with an increase in surface reflectivity.

Common to all models was a reduction in the size of the land carbon sink in response to altered land management, particularly in the tropics, where future changes are expected to be concentrated. *AA*

PALAEOCEANOGRAPHY

Current variations

Paleoceanography http://doi.org/k8n (2013)

In the modern ocean, the Western Boundary Undercurrent transports deep water from the North Atlantic Ocean into the subtropics. Marine sediment analyses indicate millennial-scale variations in the structure and speed of this current during the transition from interglacial to glacial conditions 70,000 years ago.

David Thornalley of Cardiff University, UK, and colleagues examined the grain size of sediments collected from the Blake Outer Ridge, off the mid-Atlantic coast of North America, to assess the behaviour of the Western Boundary Undercurrent from about 90,000 to 50,000 years ago. According to their analysis, the velocity of the undercurrent varied in concert with several millennial-scale climate oscillations at the end of the last interglacial. Cool events were marked by increased current speeds below 4.5 km and above 3 km depth, whereas the warmer periods showed a flow pattern reminiscent of that seen in the modern ocean.

The transition from interglacial to glacial conditions, however, was marked by the onset of a completely different pattern of flow: currents were substantially weaker between depths of 2.5 and 3.5 km, but stronger above 2.5 km. The researchers attribute this shift in circulation to atmospheric and oceanographic changes associated with the growth of Northern Hemisphere ice sheets at this time. *AN*

GEODYNAMICS

Long-term storage

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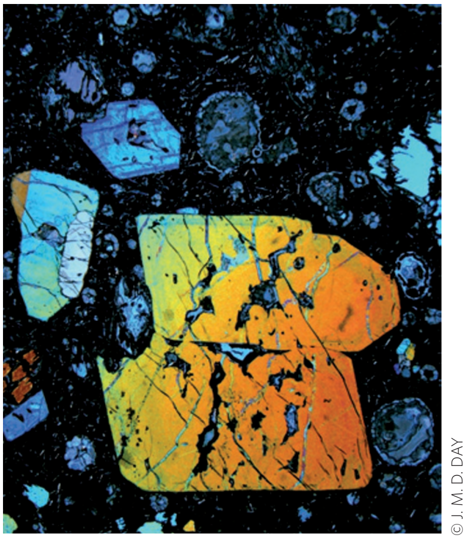

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Mantle plumes are thought to bring ancient, subducted crust back to Earth's surface. Geochemical analyses of lavas erupted above a mantle plume in the South Pacific Ocean suggest that such subducted crust can be stored in the mantle for billions of years.

Rita Cabral at Boston University, USA, and colleagues analysed the sulphur isotopic signature of lavas that erupted at Mangaia, in the Cook Islands, 20 million years ago. This volcano formed above a mantle plume upwelling beneath the South Pacific Ocean. They found a sulphur isotopic composition of the lavas that could only have come from photochemical reactions that occurred in the atmosphere and deposited sulphur in rocks forming at the surface. However, these atmospheric reactions haven't occurred on Earth for at least 2.45 billion years. The researchers therefore suggest that the mantle plume beneath the Cook Islands taps a slab of ancient crust that formed at Earth's surface several billions years ago and was subsequently subducted.

The data imply that ancient crust can survive in the Earth's mantle for billions of years before being brought to the surface by upwelling mantle plumes. *AW*

PLANETARY SCIENCE

Snow storms on Mars

Geophys. Res. Lett. http://dx.doi.org/10.1002/grl.50326 (2013)

During the martian winter, carbon dioxide in the planet's atmosphere condenses to form ice clouds and snow. Model simulations suggest that the formation of airborne ice is promoted by the passage of planetary waves.

Takeshi Kuroda of Tohoku University, Japan, and colleagues identified the mechanisms of ice cloud formation in the high northern latitudes of Mars, using a general circulation model. In the model, ice clouds formed north of 70° N, at altitudes of up to 40 km. Ice cloud formation coincided with the presence of eastward-travelling planetary waves, a dominant feature of winter-time atmospheric dynamics in the north. The passage of these waves lowered local air temperatures below the carbon dioxide condensation level, at which point ice emerges.

Ice particles generated below about 20 km altitude fell to the surface as snow, potentially contributing to polar ice cap formation. Deposition was greatest in regions impacted by planetary waves. Given the regularity of these waves, the authors argue that deposition to the surface can be reliably predicted. *AA*

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