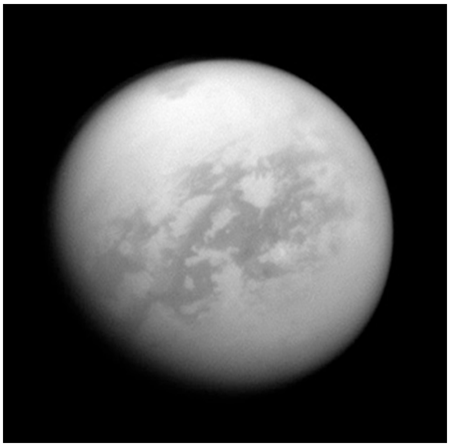
research highlights

PLANETARY SURFACES

Titan renewed

J. Geophys. Res. http://doi.org/h3r (2012)



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The surface of Saturn's moon Titan is less than 1 billion years old, with mechanisms ranging from ice volcanism to widespread erosion invoked to explain its resurfacing. An analysis of Cassini radar imagery, however, indicates little surface modification by fluvial erosion in some regions.

Because topographic data on Titan are currently limited, Benjamin Black at the Massachusetts Institute of Technology and colleagues devised a method to estimate erosional modification of a surface by quantifying the shapes of drainage networks. They calibrated the method with a numerical landscape evolution model, and then validated their approach by comparisons with terrestrial fluvial networks where the exhumation history is known. Applying their technique to four regions with prominent drainage networks on Titan, they estimate that regionally averaged fluvial erosion in these regions reflects only 0.5–9% of the initial topographic relief.

Assuming surface ages from crater counts, this implies that long-term rates of fluvial erosion are much slower than on Earth. Unless some regions on Titan have been resurfaced more recently than the global average, other mechanisms are required to explain Titan's resurfacing. *TG*

TECTONICS

Ancient channel flow

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During periods of mountain building, parts of Earth's deep crust are thought to become so weak that they begin to flow, a process currently suspected to be occurring under the Himalaya. Seismic data from North America suggest that a channel of flowing crust may also have formed 1.8 billion years ago under the Trans-Hudson orogen, a mountain range that ran through the core of North America.

David Eaton at the University of Calgary and colleagues used measurements of Earth's microseismic background vibrations to analyse the structure of the rocks that once formed this ancient mountain range. The mountains have since subsided and now lie beneath Hudson Bay. The seismic data show that the rocks in the shallow parts of the crust retain the patterns of deformation imparted in them when they were thrust upwards to form high mountains. In contrast, a similar pattern of deformation cannot be identified in rocks from the deeper crust. The researchers suggest that the original pattern was overprinted in the later stages of mountain building, when the deeper rocks became so weak that they began to flow.

The patterns of deformation preserved in the rocks beneath Hudson Bay are remarkably similar to those found in the present day Himalayan mountains, suggesting that the same processes operated in both cases. *AW*

PALAEOCLIMATE

Minimal ice growth

Earth Planet. Sci. Lett. **337–338,** 243–251 (2012)

The elevation of the interior of the ice sheet covering West Antarctica has not risen substantially over the past five million years, according to exposure ages collected near the ice sheet's divide.

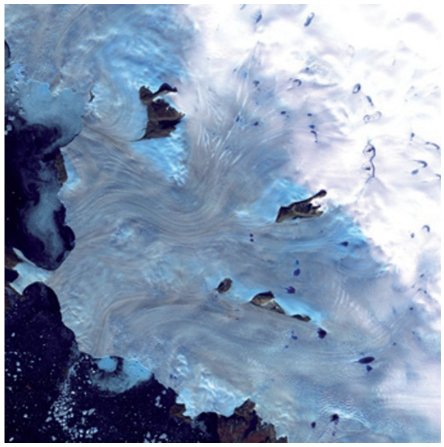
Sujoy Mukhopadhyay of Harvard University and colleagues measured the accumulation of cosmogenic nuclides on bedrock surfaces along the escarpment that divides the West Antarctic ice sheet from the East Antarctic ice sheet. The exposure ages, along with the team's subsequent ice-sheet simulations, suggest that the ice there has been at or below its present elevation for much of the past five million years, with only brief highstands of less than 200 metres. The largest of such highstands occurred 11,000 years ago, with a maximum elevation gain of 110 metres. Intriguingly, during periods of warming over Antarctica, when precipitation and snow accumulation rates were higher, the elevation of the West Antarctic ice sheet was very similar to, or lower than, its present-day height.

The modelling suggests that higher accumulation was balanced by more pronounced melting of the ice-sheet's marine-based edges, which led to the thinning and collapse of these sectors. *AN*

CRYOSPHERE

Microbes on the edge

Biogeosciences **9,** 2431–2442 (2012)



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Microbial communities reside on the surface of the ice sheet that covers most of Greenland, but the contribution of these communities to regional biogeochemical cycling is unclear. Measurements of nitrogen chemistry in natural surface holes indicate that microbes at the edge of the ice sheet fix nitrogen — they capture atmospheric nitrogen and convert it into a form that can be readily used by other organisms.

In the summer of 2010, Jon Telling of the University of Bristol and colleagues examined nitrogen dynamics in a series of small holes in the surface of the Greenland ice sheet along a 79-km-long transect, running from the terminus of the Leverett Glacier into the ice sheet interior. They identified acetylene reduction, a measure of nitrogen fixation, in debris-rich ice sampled from the glacier terminus, as well as in sediment and water collected from the edge of the ice sheet. The capacity for nitrogen fixation disappeared, however, around 7.5 km from the ice sheet's edge.

Nitrogen fixation by microbes could provide a source of bioavailable nitrogen to the periphery of the Greenland Ice Sheet, potentially aiding the colonization of ice sheet sediments by other microorganisms and plants. *AA*

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