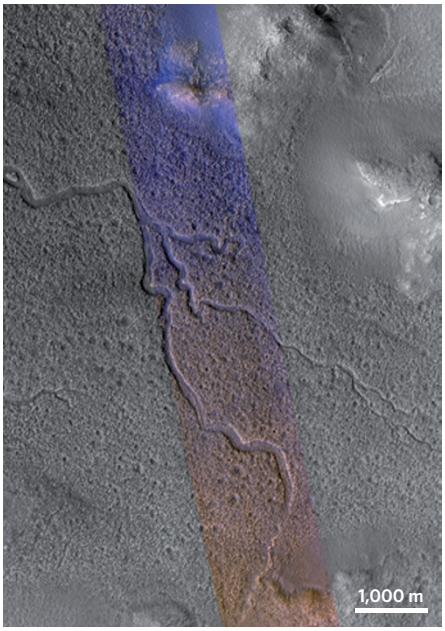
PLANETARY SCIENCE

Uphill flow

J. Geophys. Res. http://doi.org/q2g (2014)



The incision of shallow valleys, presumably by liquid water, at the martian mid-latitudes at a time when the climate is thought to have been cold and dry is enigmatic. Analysis of spacecraft imagery suggests that the valleys were carved by short-lived hydrological systems that developed beneath ice over 100 million years ago.

Daniel Hobley at the University of Virginia, USA, and colleagues analysed the geomorphology of two networks of valleys at the martian mid-latitudes, using images and data collected by the Mars Reconnaissance Orbiter, Mars Express and Mars Global Surveyor spacecraft. They found that the valleys are morphologically similar in the two regions and that both networks formed about 100 million years ago. Curiously, many of the valleys seem to have been formed by water flowing uphill. The researchers propose that the valleys were carved by water flowing beneath regionally extensive ice cover that was at least tens of metres thick. Such a scenario would permit the pressurized flow of water against the topographic gradient, similarly to water in a pipe.

The valleys may have formed rapidly during a single episode of ice melt, consistent with a short-lived period of climate warming. *TG*

GEODYNAMICS

Deep-rooted coupling

Earth Planet. Sci. Lett. http://doi.org/q2h (2014)

Geographical variations in the coupling between the tectonic plates and the underlying mantle are poorly constrained. Seismic data from the American Midwest now show that mantle flow is strongly coupled to the plate beneath Minnesota and Iowa, where the continent has a deep root.

Ken Dueker at the University of Wyoming, USA, and colleagues seismically imaged the structure of the rigid plate in the midwestern United States along with the underlying, flowing asthenospheric mantle. The North American Plate is thicker in the east, and has a deep root. The images show that where the plate thickens, passing seismic waves travel faster in one direction than perpendicular to it. The researchers explain this directional preference as a result of the acceleration of the flowing mantle as it is forced to move beneath the thick continental root, in the same way that air accelerates as it flows around the curved wing of an aeroplane. The acceleration of flow induces strain in the mantle rocks, causing minerals to align with the direction of flow and generating the observed fast seismic wave speeds.

Seismic investigations of mineral alignment could then help constrain the degree of coupling between the tectonic plates and underlying mantle flow elsewhere, too. *AW*

BIOGEOCHEMISTRY

Agricultural underproduction

Geophys. Res. Lett. http://doi.org/q2j (2013)

Agricultural production is expected to double by the year 2050, fuelled by an increase in the area and productivity of croplands. A comparison of plant growth in agricultural and non-agricultural areas suggests that the continued expansion of croplands could diminish carbon storage in terrestrial ecosystems.

W. Kolby Smith of the University of Montana, USA, and colleagues assessed the effect of converting natural ecosystems to agricultural land on global vegetation growth, as measured by net primary production, using crop yield and satellite data. According to their calculations, the total conversion of unmanaged land to agricultural land has reduced net primary production by 7% globally. Reductions in net primary production are apparent in 88% of agricultural areas, with the greatest declines in regions that were formerly tropical forests and savannahs. Only in intensively managed regions of Asia and the industrialized West, primarily Europe and North America, has the conversion to cropland stimulated vegetation growth.

The researchers argue that significant reductions in ecosystem carbon uptake are to be expected unless future agricultural policies take into account the adverse effects of agriculture on ecosystem productivity. *AA*

PALAEOCLIMATE

Saharan lake

Geology http://doi.org/q2k (2014)

The eastern Sahara Desert once hosted a large freshwater lake. Cosmogenic nuclide exposure dating and an analysis of ancient shorelines reveal that such a lake probably formed during the last interglacial period, more than 100,000 years ago, and was broadly similar in surface area to today's largest freshwater lakes.

Timothy Barrows at the University of Exeter, UK, and colleagues measured the amount of the isotope beryllium-10 in palaeolake shoreline deposits preserved in Sudan, eastern Sahara. Beryllium-10 accumulates in rocks when they are hit by cosmic radiation, so its abundance can be used to calculate the amount of time rocks or sediments have been exposed at the surface of the Earth. With the help of this method, the researchers date the palaeo-shoreline sediments to an age of about 109,000 years. Using a high-resolution digital elevation model to assess the regional topography today, and assuming that the topography at the time was not too dissimilar from now, they show that the lake could have covered an area of more than 45,000 km^2.

The lake could have formed when the White Nile River overflowed during seasonal floods under monsoon conditions that were more intense than those of today. *AW*

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