TSUNAMI

Onshore shake-up

Geology **40,** 887–890 (2012)

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Layers of thick sediment typically deposited on land by a tsunami are thought to originate largely from the beach and shoreface. An analysis of the sediment deposited on the Sendai Plain, Japan, by the Tohoku-oki tsunami, however, reveals that much of the material consists of terrestrial sand and soil liberated by the preceding earthquake.

Kazuhisa Goto at the Chiba Institute of Technology, Japan, and colleagues used field surveys and satellite and digital elevation data to analyse changes in the topography of the Sendai Plain, before and after the Tohoku-oki earthquake and tsunami in March 2011. The Sendai Plain is a flat-lying coastal plain that hosts extensive rice paddies and is located immediately onshore from the earthquake's epicentre. The volume of sediment deposited on the plain by the tsunami was found to be four times greater than the amount eroded from the beaches. The tsunami deposits were particularly thick in the rice paddies, and a closer inspection of the sands revealed ripped-up clasts of soil. The researchers suggest that sand from beneath the rice paddies was liberated and expulsed by a process called liquefaction, whereby unconsolidated and saturated sediments are transformed into a liquid-like substance during ground shaking caused by an earthquake.

Some marine sediments are probably also transported onshore during tsunami events. However, the results imply that the terrestrial environment can contribute significantly to tsunami deposits. *AW*

PALAEOCLIMATE

Circulation shrinkage

Clim. Past **8,** 1323–1337 (2012)

A period of intense warmth 125 to 90 million years ago, known as the mid-Cretaceous super greenhouse, was marked by substantially different tropical and subtropical atmospheric circulation compared with earlier, cooler times, suggests an analysis of Cretaceous desert distribution.

Hitoshi Hasegawa of the University of Tokyo and colleagues tracked the location of Cretaceous-aged deserts in Asia as well as the prevailing wind direction indicated by the aeolian features preserved in the desert deposits. Today, deserts develop where dry air downwells in the subtropical limb of the Hadley circulation cell, around 30° N and 30° S. The authors' reconstruction of Cretaceous wind systems suggests that during the moderately warm climates of the early and late Cretaceous, the Hadley circulation expanded by about three to six degrees of latitude. However, during the extreme mid-Cretaceous heat, the circulation contracted dramatically, with the descending limb located at about 25° N. Such a contraction is supported by the contemporaneous appearance of arid environments in relatively low-latitude locations around the globe.

The Hadley cell has generally expanded in response to rising atmospheric CO_2 concentrations and global temperatures. The authors suggest that a climatic threshold may exist beyond which the cell will contract. *AN*

PLANETARY SCIENCE

Mars bedevilled

Icarus http://doi.org/jc6 (2012)

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Dust devils — swirling updrafts of air and dust — have been observed whirling across arid landscapes on Earth and Mars. Measurements of dust devils on Earth suggest that the paths and speeds of these whirlwinds are directed by the ambient winds at the site.

Matthew Balme at the Planetary Science Institute, USA, and colleagues used a stereo camera system to image more than a hundred dust devils in two study areas in southwestern USA. They combined their field measurements of the dust storms' positions through time with local meteorological data to calculate the horizontal velocity of the dust devils as a function of ambient wind velocity. They found that the dust devils move in the direction of the ambient winds, at the same speed as winds at 20–30 metres above the surface. The horizontal velocities of dust devils should therefore reflect the local wind conditions during periods of dust devil activity.

Because the paths of dust devils are frequently captured in spacecraft imaging of Mars, the researchers suggest that they can be used to assess local surface winds on the red planet. *TG*

BIOGEOCHEMISTRY

Arctic nitrogen fix

Glob. Biogeochem. Cycles **26,** GB3022 (2012)

Marine bacteria serve as a significant source of biologically available nitrogen to the global ocean. Many of these nitrogen fixers reside in tropical, subtropical and temperate waters, but measurements in the Arctic Ocean suggest that a substantial community of nitrogen fixers can also be found in the high-latitude waters of the Beaufort Sea.

Marjolaine Blais of Laval University, Canada, and colleagues assessed rates of biological nitrogen fixation — that is, the conversion of atmospheric nitrogen into a biologically usable form — at various locations in the Canadian Arctic. Rates of nitrogen fixation were greatest at the mouth of the Mackenzie River, a region highly influenced by freshwater runoff. Nitrogen fixation declined in waters less influenced by the Mackenzie River. According to a phylogenetic analysis, heterotrophic bacteria — and not the cyanobacteria that are typically implicated at lower latitudes — were probably responsible for nitrogen fixation in these river-influenced waters.

The researchers suggest that the Mackenzie River serves as a source of nitrogen-fixing heterotrophic bacteria to the Beaufort Sea. *AA*

Written by Anna Armstrong, Tamara Goldin, Alicia Newton and Amy Whitchurch