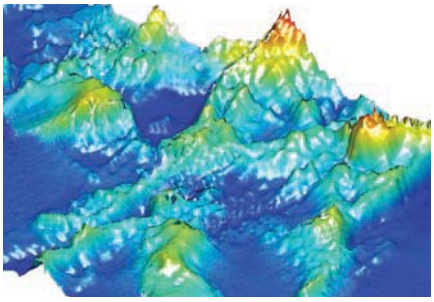
Mapping sea ice



Geophys. Res. Lett. **35**, L01501 (2008)

The differences between first-year and multi-year sea ice in roughness, ridge shape and under-ice topography are revealed in a new study showing a full three-dimensional digital terrain map of the underside of the ice.

Peter Wadhams and Martin Doble of the University of Cambridge, UK, deployed a specially designed small autonomous underwater vehicle equipped with a sonar system through a hole in the sea ice in the Arctic Ocean. Although fresh ice and ice that is several years old can be difficult to distinguish on the surface, the undersides revealed striking differences. Multi-year ice was generally rugged and marked by depressions and peaks with rounded edges, whereas first-year ice was generally flat but crossed by numerous cracks and faults. These cracks are the most likely starting points for new pressure ridges.

The features were confirmed by drilling 132 holes in the ice, but the sonar scans gave much more detailed results over a wider area in a much shorter time. The autonomous underwater vehicle thus offers a versatile method for the full three-dimensional mapping of Arctic sea ice.

A Pacific break-up

Earth Planet. Sci. Lett. **265**, 195–208 (2008)

The Pacific plate could break into two smaller plates in the geologic future, suggests a new modelling study. Volcanic activity in the south-central Pacific, at a distance from major plate boundaries and previously considered to be the surface manifestation of a mantle plume, may be the first sign of this impending break-up.

Using two-dimensional numerical models, Valerie Clouard and Muriel Gerbault of the University of Chile simulated the evolution of the Pacific plate over 10 million years. While the westward motion of the plate is relatively unimpeded in its northern parts, the rigid Australian plate blocks movement at the southern end. In the model, the resultant differential motion of the northern and southern parts of the Pacific plate leads to a band of internal deformation. This band, extending from the Samoan islands in the west to Easter Island in the east, corresponds well to the location of the volcanic activity, which is probably facilitated by upwelling of the underlying hotter and weaker mantle layer.

The simulations suggest that this weak zone could develop into a new plate boundary within a few tens of million years

Incision drives uplift

Geol. Soc. Amer. Bull. **120**, 142–155 (2008)

The mighty Yarlung Tsangpo-Brahmaputra River cuts a spectacular gorge through the Namche Barwa-Gyala Peri massif — a rapidly uplifting dome-shaped structure in the Himalayas of southeastern Tibet. A recent study suggests that incision by the river drives the sustained, localized uplift of this massif and that their close spatial association is hence not coincidental.

Noah Finnegan from the University of Washington and colleagues conducted detailed fieldwork in the Namche Barwa-Gyala Peri region and obtained satellite-derived information to estimate rates of river incision and regional elevation and rainfall patterns. Uplift rates for the massif over the past few million years were assessed from mineral cooling ages reported in previous work. An integration of these datasets reveals a close spatial association between a 'bull's-eye' pattern of high uplift of the massif and the region with most intense fluvial incision. The localized nature of the uplift appears to be strongly controlled by the spatial pattern of erosion, thus indicating a strong coupling between fluvial incision and rock uplift.

Had the sustained uplift of the massif not kept pace with fluvial incision, erosion proceeding rapidly upstream would have led to Tibet being deeply incised.

A coral tells all

Geology **36**, 11–14 (2008)

Whether the frequency and intensity of Atlantic hurricanes has increased over the last century is controversial. A recent study presents a coral proxy record for climatic changes over the last century that records a general increase in the intensity of Atlantic hurricanes.

Steffen Hetzinger of the Leibniz Institut für Meereswissenschaften in Kiel, Germany and his colleagues analysed a drill core from a brain coral retrieved from an archipelago off Venezuela, and obtained a monthly record of oxygen isotopic compositions from 1918 to 2004. These values are closely correlated with records of sea surface temperature as well as vertical wind shear over the region of the Atlantic where tropical cyclones develop. Both of these factors are thought to influence hurricane activity. Not surprisingly, the oxygen isotopic compositions also correlate with indices that measure hurricane activity and intensity.

Brain corals of the genus used in this study can live for up to several hundred years. Long-term climate records could hence be deciphered from their oxygen isotopic composition and used for understanding climate variability at various temporal scales.

Human impact on rivers

Nature **451**, 449–452 (2008)

A significant increase in the amount of bicarbonate exported by the Mississippi River is a direct result of changes in human land use and agricultural practices, according to a new study. The findings reveal that the higher discharge from agricultural land is not driven by an increase in precipitation, and anthropogenic forcing has outweighed climatic forcing in the last 50 years.

Peter A. Raymond from Yale University and colleagues, combine a 100-year record of bicarbonate fluxes from the Mississippi River with streamflow and precipitation data. They reveal that agricultural practices are responsible for half of the observed 40% increase in the flux of bicarbonate. The researchers suggest that practices such as liming, fertilizer use, till drainage, irrigation, changes in crop type and rotation all contribute to the increased bicarbonate flux. Large-scale changes to crop production to meet new demands for the ethanol biofuel industry may also continue to alter cropland water and carbon export.

The Mississippi is North America's largest river system and drains about 40% of the United States. The flux of bicarbonate from this river to the oceans constitutes an important aspect of the global carbon cycle.