Avulsion in action

Geomorphology
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Land reclaimed from the River Rhine and inhabited during medieval times was inundated with unusual frequency during several North Sea storm surges and Rhine flood events between AD 1421 and 1424. A modern reconstruction shows that, as a result of the inundation, the river diverted, and delta deposits began to accumulate in an inland tidal basin.

Maarten Kleinhans and his team, at Utrecht University in The Netherlands, collected detailed historical and geological data on this medieval case of river diversion and used them to constrain numerical models of channel development and sedimentation rate within a deltaic splay. The data showed that the inundation led to abandonment of the river channel — a process known as avulsion. The newly formed river channel then carried sediments to a nascent delta over the centuries following inundation.

The simulations indicated that these events led to higher floodwaters upstream of the diversion for two centuries, highlighting the potential risks and knock-on effects associated with both natural and human-induced river diversion.

Bumpy boundary

Earth Planet. Sci. Lett. **15,** 232–241 (2010)

Numerical modelling now provides the means to test hypotheses for the origins of large, low-seismic-velocity provinces in the lower mantle beneath the Central Pacific Ocean and Africa.

Two regions of unusually low seismic velocities have been consistently identified in seismic profiles, and attributed to either hot temperatures associated with clustering of mantle plumes or masses of chemically distinct material known as thermochemical piles. Teresa Lassak of Arizona State University and colleagues used numerical models to identify the core–mantle boundary topography that would arise from these two mechanisms. Plume clusters would produce an upward, domed curvature of the core–mantle boundary beneath the zones of low velocity, whereas thermochemical piles should be associated with a plateau-like core–mantle boundary with distinctive raised ridges along its edges.

Although existing seismic data are too coarsely resolved to distinguish between these unique topographic signatures, the simulations provide clear markers to identify the origins of these low-velocity provinces as more highly resolved measurements become possible.

South American seas

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Coastal waters in South America show signs of eutrophication due to excessive nutrient inputs. However, it has been difficult to predict future algal bloom events owing to a scarcity of observations. Model simulations that incorporate changes in riverine nutrient export suggest that the situation is set to worsen.

Luiz Felipe Van der Struijk and Carolien Kroeze, of Wageningen University in The Netherlands, used a global riverine nutrient export model to examine future trends in nutrients released to coastal waters in South America under different socio-economic scenarios. Under scenarios of either intense global trade or a more regionalized economy, export of dissolved inorganic nitrogen and phosphorus is projected to increase by 2050. Export is greater in the highly globalized scenario, however, owing to an increase in the number of people connected to sewage systems and more intense fertilizer use.

The researchers conclude that eutrophication is likely to increase in the coastal waters of South America this century.

Peatland push

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DON BECKER / USGS

About 5,000 years ago, atmospheric methane concentrations began to climb. Dating of Northern Hemisphere peats indicates that much of the rise can be attributed to methane produced during the expansion of high-latitude peatlands.

Atte Korhola and colleagues at the University of Helsinki used radiocarbon dating to track the expansion of peat-producing wetlands in the mid- to high-northern latitudes since the termination of the last glacial period. They found an initial pulse of wetland growth associated with the onset of interglacial conditions about 10,000 years ago. However, the greatest expansion of northern peatlands occurred after 6,000 years ago, coincident with rising atmospheric methane levels. The high-latitude wetland expansion was presumably caused by falling Northern Hemisphere temperatures, which decreased evaporation and promoted wetland growth.

Unlike their lower latitude counterparts, whose methane emissions tend to fall with time, high-latitude wetlands continue to emit large amounts of methane long after their initial formation. The authors therefore suggest that these peatlands could have contributed to much of the preindustrial atmospheric methane rise.

Close encounters

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Asteroids tend to develop a rusty colour as a result of long-term exposure to the conditions in space, but planetary scientists have long noted that some asteroids don't seem to have developed this space-weathered hue. A new analysis concludes that the unusual colour of these asteroids may arise from interactions with Earth's gravity.

Richard Binzel of the Massachusetts Institute of Technology and colleagues estimated the probable paths of a number of asteroids that pass by Mars and Earth. They found that the subset of asteroids with the unaltered, dark-grey colour was also the group most likely to have passed close to Earth sometime within the past 100,000 years.

During their Earth encounter, the asteroids experienced tidal stress from the pull of the Earth's gravity. The researchers speculate that the tides disturbed the surface grains on the asteroids, causing tiny landslides and exposing fresh grey rock.