## Ice on acid

*J. Geophys. Res.*
doi:10.1029/2010JD014254 (2010)

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In laboratory experiments, acid coverings diminish the ability of dust particles to acquire coatings of ice. Mineral dust particles often serve as nuclei for ice crystals in the atmosphere, facilitating the formation of ice clouds.

Donna Chernoff and Allan Bertram of the University of British Columbia incubated both mineral dust and biological particles with sulphuric acid. Acid coatings increased the relative humidity required for ice to form on clay minerals and quartz grains by 20–30%. Ammonium bisulphate — a covering formed from sulphuric acid — had a similar effect. However, the presence of acid coatings did not affect the formation of ice on biological particles.

Sulphate and ammonia are common emissions from human activities, and thus could reduce the potential for ice formation on mineral dust particles in the atmosphere.

## Simple field

*Phys. Earth Planet. In.*
doi:10.1016/j.pepi.2010.06.011 (2010)

The Earth's present magnetic field is a dipole, but it has been suggested that the field has exhibited more complex behaviour during some periods in the past. Numerical modelling now suggests that the magnetic field that formed in young terrestrial planets, such as Earth and Mars, probably also began with simple north and south poles.

Kumiko Hori and colleagues at the Max Planck Institute for Solar System Research, Germany, simulated the effect of different thermal conditions on the formation of a magnetic field in the fluid core of a planet. If the temperature at the outer boundary of the planet's core was kept constant, then a magnetic field with several poles was formed. If, instead of temperature, the flux of heat at the boundary of the planet's core was constant, a magnetic field with just two poles — north and south — was formed.

Because the mantle of terrestrial planets is thought to impose a constant flux of heat rather than a fixed temperature on the planet's core, the researchers conclude that the early magnetic field of planets such as Earth and Mars was probably dipolar.

## Temperature sensitivity

*Science* doi:10.1126/science.1189587 (2010)

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Soil and plant respiration releases significant quantities of carbon dioxide into the atmosphere. Carbon dioxide flux measurements indicate that the overall temperature sensitivity of ecosystem respiration is uniform across biomes and climate zones.

Using a global dataset of carbon dioxide flux measurements, Miguel Mahecha of the Max Planck Institute for Biogeochemistry, Germany, and colleagues found marked differences in the long-term fate of carbon taken up through photosynthesis, as well as in the availability of this carbon for respiration, across the sites. The sensitivity of respiration to changes in temperature, however, fell within a narrow range, and proved to be independent of the mean annual temperature and biome. The global mean temperature sensitivity was also significantly lower than previous estimates. The authors attribute the difference to the exclusion of confounding processes in their analysis, such as the seasonal variability of biological activity.

This finding could help to explain recent observations of feedbacks between climate and the carbon cycle that are weaker than those suggested by numerical models.

## Not so tropical

*Earth Planet. Sci. Lett.*
doi:10.1016/j.epsl.2010.04.052 (2010)

Palaeomagnetic data suggest that the apparent rapid migration of the African and Eurasian plates towards the Equator 160 million years ago could be explained by the movement of the Earth's crust and mantle, rather than plate tectonics.

Maud Meijers of Utrecht University and colleagues used signatures of the magnetic field preserved in rocks in the Black Sea region to reconstruct the latitude of Eurasia from about 160 to 142 million years ago. Their measurements closely match palaeolatitudes obtained from the African plate, and suggest that Eurasia and Africa moved about 1,500 km closer to the Equator during this time.

This would be unusually rapid tectonic motion, especially as the plates were bounded by subduction zones, which tend to anchor plates to the mantle. Instead, the team concludes that the observed palaeolatitudes can be explained by true polar wander — the movement of the Earth's entire mantle and crust relative to the core, and thus magnetic north.

## Earthquakes by erosion

*Nature* **466,** 608–611 (2010)

Erosion by the Mississippi River may have triggered earthquake activity in the New Madrid seismic zone over the past 10,000 years, according to simulations. The zone occupies the eastern part of the upper Mississippi River embayment, which was incised during the rapid outpouring of glacial meltwater from the North American ice sheets from 16,000 to 10,000 years ago.

Eric Calais at Purdue University and colleagues numerically modelled the effects of the resulting sediment loss on the underlying crust. Their calculations showed that the removal of sediment unloaded the crust and caused it to flex upwards. The unloading reduced stress in the crust, and may have been sufficient to unclamp pre-existing faults that were already close to failure, initiating an earthquake sequence.

The group suggests that faults in the New Madrid seismic zone that have already ruptured are unlikely to produce more large earthquakes anytime soon, but that the continuing removal of sediments could bring others to failure in the future.