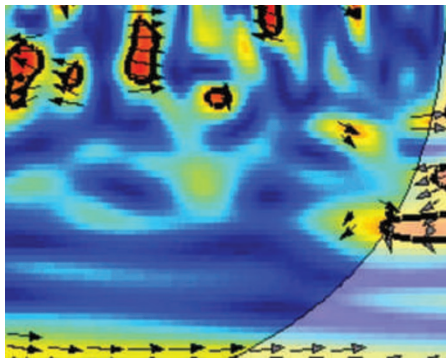


## Sudden warming source

*Geophys. Res. Lett.* doi:10.1029/2010GL045756 (in the press)



AGU

During sudden stratospheric warming events, the temperature of the atmosphere between about 10 and 50 km — the stratosphere — rises by several tens of Kelvins. Numerical simulations suggest that the frequency of these rapid warming events is controlled in part by Northern Hemisphere climate.

Semjon Schimanke of the Universität Berlin and colleagues assessed the factors responsible for variations in the frequency of sudden stratospheric warming events on multidecadal timescales using an ocean–atmosphere general circulation model that resolves the stratosphere. According to their simulations, the frequency of sudden stratospheric warming events peaks every 52 years. The episodic increase in frequency coincides with periods of increased heat flux from the North Atlantic Ocean to the atmosphere, enhanced snow cover over Eurasia, and an increase in tropospheric wave activity.

The researchers suggest that multidecadal variability in the frequency of sudden stratospheric warming events is generated within the ocean–troposphere–stratosphere system, and not by external factors such as solar variability as previously suggested.

## Hot Archaean ridge

*Geology* **38**, 1083–1086 (2010).

Geochemical modelling suggests that mid-ocean ridges may have played an important role in forming the Archaean continents. Continental rocks that are more than three billion years old are found today alongside equally ancient rocks that were created in an unusually buoyant mantle, leading to the suggestion they were formed at a mantle plume.

Using geochemical and mineralogical data, Hugh Rollinson at the University of Derby demonstrated that these buoyant

Archaean rocks could have instead formed at mid-ocean ridges, if the ridges were much hotter than those observed on Earth today. He argues that intense heat from the mid-ocean ridge would promote the formation of extremely thick and dense oceanic crust, leaving the underlying lithosphere unusually buoyant. As the dense oceanic rocks began to subduct and fall into the mantle, pockets of less-dense melt would escape from the oceanic crust, rising up through the already buoyant lithosphere to create the continents.

The formation of continents in the Archaean was therefore coupled to an unusually buoyant lithosphere, a feature not observed on Earth today.

## Submerged carbon

*J. Geophys. Res.* doi:10.1029/2010JC006446 (in the press)

The formation of intermediate water masses in the North Atlantic Ocean is associated with the sequestration of large quantities of carbon, though the source of the carbon is not well constrained. Almost all of the carbon entering the mode waters comes from sinking surface waters, according to a biophysical model.

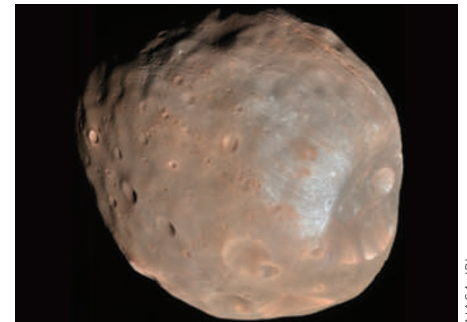
Marina Levy of LOCEAN-IPSL, France, and colleagues assessed the transport of carbon into the ocean interior during the formation of the intermediate-depth Northeast Atlantic mode waters using a biophysical model. The model integrated physical and biogeochemical data collected during four ocean cruises. According to the researchers' simulations, the sinking of phytoplankton and the subduction of water masses each represented half of the easily degradable organic carbon exported from the surface ocean.

However, the sinking of surface waters accounted for 98% of the total carbon exported below the surface mixed layer, mainly in the form of dissolved inorganic carbon and refractory dissolved organic matter. The researchers suggest that the

sinking of water masses in the North Atlantic is a key component of the region's carbon sink.

## Big bang for Mars

*Icarus* doi:10.1016/j.icarus.2010.10.023 (in the press)



NASA-JPL

The relatively tiny moons that orbit Mars — Phobos and Deimos — could have been formed by the same impact that revved up its rotation, holds a recently published hypothesis. Like the Earth, Mars has more angular momentum than expected from planetary coalescence alone, indicating a very large collision early in its history.

Robert Craddock of the Smithsonian Institution, Washington DC, used the measured discrepancy in the angular momentum of Mars to estimate the effects of the impact. He suggests that the velocity of the impacting object was greater than  $7 \text{ m s}^{-1}$ , enough to vaporize rock and send it into orbit around Mars. Once the dust settled into an accretionary disk, small, low-mass moons would begin to form. This could account for the orbits of the moons, which are incompatible with an origin as asteroids that were captured by martian gravity.

In this model of formation, Phobos and Deimos are composed of loosely aggregated material, which could explain the low densities reported for the martian moons.

## Core magnetism

*Nature* **468**, 952–954 (2010)

Measurements of the rocking and swaying of the Earth on its axis suggest that the strength of the magnetic field in the Earth's core is about 50 times greater than the field observed at the surface.

The gravity of the Sun and Moon create a well-known and predictable tidal influence on Earth that causes the planet to move about its axis as it rotates. However, flow in the liquid outer core of Earth generates electric currents that dampen these tidal motions. Bruce Buffett at the University of California, Berkeley, used a comparison between the observed and expected tidal motions to estimate variations in the electric currents in the core. The electric currents are related to the strength of the magnetic field in the outer core.

He suggests the magnetic field strength is 2.5 mT, which is at the lower end of estimates for the core's strength. The lower value rules out previous suggestions of anomalously high fluid viscosity in the outer core.