EDITORS' CHOICE

edited by Stella Hurtley

ECOLOGY

Nutrient Dynamics in Peat Bogs

Swedish *Sphagnum* peatland.

Peat bogs dominated by *Sphagnum* moss store up to one-third of the carbon sequestered in soils globally. Hence, the productivity and rates of decay in these ecosystems can influence the global carbon (C) cycle and climate change. Productivity and decay are affected by the input of nitrogen (N) from the atmosphere, and the rates of N deposition have increased in recent years because of human activities. Aerts *et al*. carried out an experiment over 4 years on Swedish *Sphagnum* peatlands, in which they manipulated N and phosphorus (P) input. They found no significant direct effects on productivity or decay. However, litter chemistry was significantly altered in several key respects (such as ratios of C:N, C:P, and N:P) that lead to higher potential decay rates. This could in turn lead to greater C losses to the atmosphere. They also found that potential decay was exacerbated by a drought that occurred during the experiment, adding to evidence that extreme climatic events can have significant longer term effects. — AMS

J. Ecol. **89**, 292 (2001).

GEOPHYSICS

Modeling Magma Explosions

During a volcanic eruption, magma rises through a conduit toward the surface, decompressing as it rises, and the volatile components start to form bubbles. The magma will fragment and erupt explosively if the pressure from the growing bubbles exceeds the strength of the magma. Lensky *et al*. estimated when a rising magma could become explosive by modeling the radial viscosity profile in a spherical shell of melt that develops around a bubble. In their model, the magma contains a close-packed lattice of bubbles, and each bubble has a shell of melt that is oversaturated in water. As the magma rises, the melt becomes dehydrated as water vapor is transferred to the growing bubble. This process creates a radial gradient of the viscosity in the melt layer such that the inner edge of the shell has a higher viscosity. The higher viscosity allows the bubble to build up additional pressure that leads to magma fragmentation and explosive degassing. Although the bulk viscosity of the magma is not sufficient to create an explosive eruption, the higher effective viscosity of the melt around each bubble is. — LR

Earth Planet. Sci. Lett. **186**, 1 (2001).

MATERIALS SCIENCE

A Light Approach to Failure

Certain crystalline materials (including table sugar) emit light when then are fractured. This property, triboluminescence, can be exploited to make sensors to detect structural damage, such as in composite materials, where internal damage is often not accompanied by external indications of failure. One factor that has limited the use of these systems is getting the light from the fracture source to a detector. The light may have to travel relatively long distances (as in the case of an aircraft component) or through strongly absorbing materials (as in the case of a carbon fiber–reinforced plastic). In a typical setup, the triboluminescent material is coupled to a silica optical fiber that is used to transmit the emission, but the signal-to-noise (S/N) ratio for this system is poor. Sage *et al*. have designed two systems, one polymeric and one silica based, in which the sensor material is coupled to a photoluminescent fiber that captures the initial emission and then reemits at a frequency that matches the waveguide modes of the fiber. For these new detectors, a significantly improved S/N ratio was observed, and for glass fiber composites, the detectors acted as global sensors—only a few detectors were needed to detect damage throughout the entire specimen. — MSL

Smart Mater. Struct. **10**, 332 (2001).

BOTANY

Irn Bru

Plant crop productivity is limited by the availability of iron in the soil, which is governed by the physicochemical characteristics of the soil type. Despite its abundance in alkaline soils, iron is poorly soluble and little is available for plant uptake under such conditions. Rice is especially vulnerable to iron limitation, because its roots produce relatively little of the iron-solubilizing proteins known as mugineic acid family phytosiderophores (MAs). Now Takahashi *et al*. have shown that this weakness can be compensated for by introducing the genes encoding the key MAs—nicotianamine synthase and nicotianamine aminotransferase—from barley. Transgenic rice plants express the genes, secrete MAs, and stay green and healthy when iron is in short supply, and show fourfold greater productivity than normal rice. — CA

Nature Biotechnol. **19**, 466 (2001).

GEOCHEMISTRY

Mantle-Derived Magmas High in Silica

Most rock samples are derived from Earth's crust. Information about the rest of the solid Earth is limited to the less abundant macrocrystalline rocks called peridotites, which are derived more directly from the mantle and are rich in olivine and pryoxene. Pin *et al*. have found samples of a chemically unusual mantle-derived rock in the Pyrenee Mountains of France. The rock occurs as silicon-, aluminum-, and sodium-rich dikes intruded into a peridotite massif in the Cretaceous composed of lherzolite. The dikes are also enriched in strontium, barium, niobium, tantalum, and the light rare earth elements. Their chemical characteristics indicate that they evolved from small degrees of partial melting of a peridotite rich in harzburgite in the uppermost mantle to produce magmas enriched in silica. The high sodium content and enrichments in some other trace elements suggest that the melts were infiltrated by carbon dioxide and water-rich fluids

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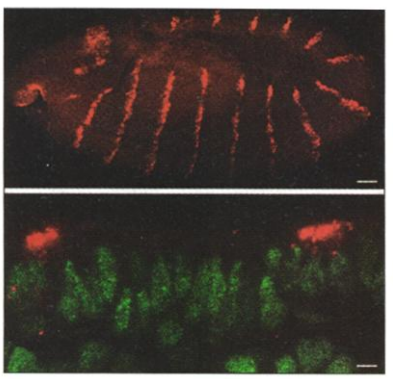
brought in by carbon-rich magmas. The fluids reduced the viscosity of the melts and allowed them to aggregate into the larger dikes. The dikes are a distinctive example of silica-rich melts derived by low degrees of partial melting in the mantle; previously such melts were only produced in laboratory experiments or found as small glassy inclusions in rocks. — LR

Geology **29**, 451 (2001).

APPLIED PHYSICS

Crowding of Electrons Breaks the Links

Although the voltages applied to thin metal wires that connect integrated circuits in chips are small, the voltage drops across short distances can lead to high electric fields. These applied fields can cause electromigration of metal atoms, which can ultimately thin and break the wire. This problem is likely to be exacerbated as circuit dimensions continue to shrink. Localized crowding of current around the defective regions in the wire has been thought to accelerate deterioration, but this cause has so far lacked strong experimental evidence. Yongsunthon *et al.* used a magnetic field microscope to probe the current density along a 10-μm-wide gold wire decorated with small notches along its length. About 70% of the current was concentrated within a very short region (about 1 μm) in the vicinity of the notch edges. Although it is not clear from this work whether electromigration can be prevented, the results may provide clues for controlling its extent. — ISO



Apical localization of wg transcripts (red). Top shows surface of Drosophila embryo, bottom shows cross section through embryo (nuclei, green).

Appl. Phys. Lett. **78**, 2661 (2001).

NEUROSCIENCE

Brain Repair

Damaged neuronal projections may sometimes show limited abilities to regenerate. However, such regeneration is rarely seen in the central nervous system, where regenerating axons are unable to make their way through scar tissue within the lesion. Moon *et al.* have now shown that the proteoglycans of scar tissue may be responsible for inhibiting axonal regeneration. Damage was experimentally induced in the nigrostriatal tract of adult rats. Without further intervention, all of the severed axons would die within about 10 weeks. However, when the rats were treated at the lesion site with an enzyme that degrades the chondroitin sulfate modifications on proteoglycans, they consistently showed improved regeneration of axons through the lesion. Repair in the nigrostriatal tract is of particular interest because of its involvement in Parkinson's disease in humans. In addition, the influence of scar tissue on the ability of neurons to regenerate may be important throughout the central nervous system. — PJH

Nature Neurosci. **4**, 465 (2001).

DEVELOPMENT

Messages on the Move

Correctly polarized epithelial cells are essential in developing tissues. Polarity is established by the asymmetric distribution of molecules to the apical and basolateral cell surfaces, enabling each to perform distinct functions. In many cases, cell polarity is achieved through differential protein trafficking. However, asymmetry can also be generated by the differential trafficking of messenger RNAs (mRNAs).

Two recent reports indicate that the distribution of Wingless (WG), a secreted glycoprotein implicated in developmental signaling events, is controlled via its mRNA. Using high-resolution in situ hybridization in fruit fly embryos, Simmonds *et al.* found that the apical cytoplasm of most epithelial cells is enriched in *Wg* mRNA and that this localization is critical for optimal signaling activity of the WG protein. Independently, Wilkie and Davis used time-lapse imaging to explore the mechanism by which *Wg* mRNA and other apically localized mRNAs reach their subcellular destination. The mRNAs are exported from the nucleus in all directions but then assemble into particles that are transported along microtubules to the apical cytoplasm. The transport is mediated by the motor protein dynein in association with dynactin. Such dynein-mediated transport may be a common mechanism for mRNA localization. — PAK

Cell **105**, 197; 209 (2001).

CREDITS: SIMMONDS *ET AL.*, *CELL* **105**, 197, 209 (2001).