

RESEARCH HIGHLIGHTS

Tree-ring tales

Geology 36, 99–102 (2008)

Tree rings from the 'fossil forest' of Axel Heiberg Island in the far north of Canada are shedding light on the polar seasons of around 45 million years ago.

Hope Jahren, of Johns Hopkins University in Baltimore, Maryland, and Leonel Sternberg of the University of Miami in Coral Gables, Florida, studied carbon, oxygen and hydrogen isotopes within the well-preserved rings. They found unprecedented detail of month-to-month changes in the environment, such as a sharp increase in humidity during the growing season.

It is a rare look at the seasonal details of how forests grew in the unusually warm polar environment of the Eocene period.



P. CLEMENT/NATUREL.COM

PHYSIOLOGY

Acid test

PLoS Biol. 6, e13 (2008)

African naked mole-rats (*Heterocephalus glaber*, pictured below) do not feel pain from acid or capsaicin, the compound that makes chilli peppers hot; nor does their skin become more sensitive to temperature when it is inflamed, according to new work. On the other hand, they hate being pinched.

Thomas Park of the University of Illinois, Chicago, Gary Lewin of the Max-Delbruck Center for Molecular Medicine in Berlin and their colleagues explained the mole-rat's selective pain responses by comparing them with laboratory mice. The team uncovered unusual connections between the mole-rat's capsaicin-sensitive receptors and nerve cells called deep dorsal horn neurons. This is in addition to a lack of the neurotransmitter substance P,



R. AUSTING/FLPA

which the researchers had reported earlier.

Inducing the synthesis of substance P in mole-rats' hind legs gave the animals the ability to sense the burning of chilli applied to their hind feet, shown by the mole rats fretfully licking their feet.

GEOLOGY

Pipe dream find

J. Volcanol. Geotherm. Res. doi:10.1016/j.jvolgeores.2007.12.034 (2008)

Diamonds are found mostly in kimberlite pipes — vertical, often cone-shaped columns of rock formed by eruptions within Earth's mantle. During an eruption, churning by volcanic gases is likely to keep diamonds from settling in certain parts of the pipes, according to models made by Thomas Gernon and his colleagues at the University of Bristol, UK.

The researchers pumped gas through simulated volcanic particles confined in a rigid box to mimic the violent mixing that geologists think occurs when kimberlite forms. When the box walls were angled outwards at their top end, the team found that layered regions on the periphery often slipped into the churning core.

This rough heterogeneity suggests that diamond seekers shouldn't limit mining to just one part of the pipe, Gernon says.

CHEMISTRY

Reaction mapping

Science 319, 442–445 (2008)

The intricacies of the reactions at the interface of a gas and a solid catalyst have been probed with a

technique that is normally the preserve of clinicians — magnetic resonance imaging (MRI).

Louis-S. Bouchard at the University of California in Berkeley and his colleagues used MRI to follow parahydrogen — a version of hydrogen in which the nuclear spins of two linked atoms go in opposite directions, cancelling each other out magnetically — as it passed over a solid rhodium catalyst.

During the reaction under scrutiny — hydrogenation of propylene to propane — the parahydrogen splits up, and each half suddenly has its own magnetic charge, which is picked up by the MRI.

The ability to follow the reaction in a microreactor will help engineers and chemists design better lab-on-a-chip devices, which are increasingly used in pharmaceutical synthesis and industrial catalytic reactions, the authors say.

PRIMATOLOGY

Death by research

Curr. Biol. doi:10.1016/j.cub.2008.01.012 (2008)

For the chimpanzees of Côte d'Ivoire's Taï research project, humans are a blessing and a curse. Researchers protect the chimps from poachers, but can also make them sick, say Fabian Leendertz from the Robert Koch Institute in Berlin and his co-workers. They are the first to document transmission of viruses from humans to wild chimps.

After three outbreaks of respiratory disease in the Taï chimps, tissue samples from seven chimps that had died revealed that they had two common human paramyxoviruses. These two viruses often cause respiratory infections in humans, and can kill human

infants. The researchers say that many fatal transmissions from researchers and tourists to wild apes have probably already occurred, and call for strict hygiene, including face masks, when humans interact with apes.

MINERALOGY

Directional diamond

Earth Planet Sci. Lett. doi:10.1016/j.epsl.2007.11.052 (2007)

The mineral pyrrhotite, commonly found inside diamonds, acts as an ancient compass needle, recording where magnetic North was when the diamond formed.

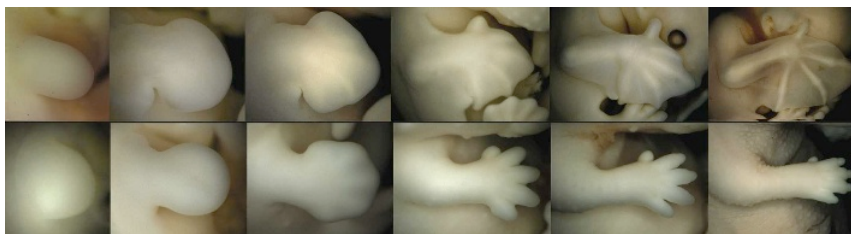
It is not the only mineral that does so. Earth's magnetic field has oscillated between North and South throughout history and a few magnetic minerals, such as magnetite, are well known to record accurately the field's direction when the mineral formed. These minerals provide a record for geologists interpreting the positions of the continents through time. But according to Bradford Clement at Florida International University in Miami and his team, pyrrhotite could prove extremely useful to researchers studying the Cretaceous period, when diamonds were formed, because quality magnetic minerals from that period have been consistently hard to find.

DEVELOPMENTAL BIOLOGY

Batmouse

Genes Dev. 22, 141–151 (2008)

Researchers have generated mice with longer forelimbs by inserting into their genomes a piece of DNA that regulates wing development in the short-tailed fruit bat, *Carollia perspicillata*. The result highlights the importance of regulatory DNA sequences in the evolution of diverse limb shapes.



The DNA fragment contained a sequence that enhances the expression of a gene called *Prx1*. *Prx1* governs limb development in mice and wing development in bats (pictured above), but when, where and how much it is expressed differs between the two animals.

Richard Behringer of the University of Texas at Houston and his co-workers switched a mouse *Prx1* regulatory sequence with that of a bat. Forelimbs in developing mouse embryos that carried the bat sequence were 6% longer than normal, but retained the shape of a normal mouse limb.

SUPRAMOLECULAR CHEMISTRY

Embrace the base

J. Am. Chem. Soc. 130, 818–820 (2008)

DNA synthesis, the basic process of biological replication, has been followed one step at a time using a new molecular device created by Reza Ghadiri and his team at the Scripps Research Institute in La Jolla, California.

The enzyme DNA polymerase adds new bases one by one to a 'primer' DNA strand growing on a template strand that has a complementary sequence. To monitor this process, the researchers attached a polymer tether to one end of the template strand and threaded this through the narrow neck of the pore-forming protein α -haemolysin, which is inserted in a lipid membrane. With an end cap that prevents unthreading, the composite

strand can be pulled into the neck of the pore and released again using an electric field. When lodged in the neck, the DNA affects the flow of ions through the channel, and the resultant change in ion current alters each time the primer strand is elongated by the addition of a new base.

BIOPHYSICS

Come together

J. Biol. Chem. doi:10.1074/jbc.M708898200 (2008)

When cells run short of calcium, they import more through 'store-operated' channels, which are ancient, ubiquitous and essential to many cell functions. Christoph Romanin at the University of Linz in Austria and his team have revealed details of how two proteins — ORAI1, which sits in the cell membrane, and STIM1 — come together to allow this import.

The authors used a technique called fluorescence resonance energy transfer microscopy, in which the energy needed to emit light passes from one molecular label to another only if they are within a few nanometres of each other. This showed that STIM1 can induce ORAI1's calcium-passing pore to open even when the two proteins do not form lasting clusters. The interaction is thought to involve a 'coiled-coil' domain — a structure that sticks out of the membrane into the body of the cell — on ORAI1.

JOURNAL CLUB

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A geneticist wonders what it takes to prove causality.

In the post-genomic era, we are increasingly confronted by a torrent of variation data, originating from gene sequence, copy number and methylation patterns. To complicate matters further, I anticipate that a notable fraction of variation among individuals will be found to be relatively rare events.

This would severely hamper our ability to implement statistical methods to associate variants with disease pathogenesis.

A recent paper by Carpten *et al.* (*Nature* 448, 439–445; 2007) highlights just how difficult solving this problem can be. The authors found a somatic missense mutation in *AKT1* in a small number (2–6%) of breast, colon and ovarian cancers, and expended considerable effort establishing its link to tumour development. Experiments included solving the *AKT1* protein's crystal structure; calculating the predicted effect

of the missense change on the protein's conformation and binding abilities; gauging phosphorylation rates of the protein; identifying cellular localization; measuring transformational competency of the mutant versus wild-type allele; and checking the mutant protein's ability to induce cancer in a mouse model.

In light of recent efforts to understand the total mutational load in cancer (for some examples see F. Dahl *et al. Proc. Natl Acad. Sci. USA* 104, 9387–9392; 2007; C. Greenman *et al. Nature* 446, 153–158; 2007; T. Sjöblom *et al.*

Science 314, 268–274; 2006), these data are both exciting and sobering, because the idea of performing such an exhaustive analysis on a large allelic series is not tenable. The challenge, therefore, is to solve this problem by developing functional assays that are physiologically relevant; amenable to at least medium throughput; and applicable to a range of mechanistic questions (not just neoplasia, for example).

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