Dating the influence of Deccan Traps eruptions

The Deccan Traps flood basalts in India represent over a million cubic kilometers of erupted lava. These massive eruptions occurred around the same time as the end-Cretaceous mass extinction some 65 million years ago, which famously wiped out all nonavian dinosaurs. Schoene et al. determined the precise timing and duration of the main phase of the eruptions, which lasted over 750,000 years and occurred just 250,000 years before the Cretaceous-Paleogene boundary. The relative contribution of these eruptions and of the Chicxulub impact in Mexico to the mass extinction remains unclear, but both provide potential kill mechanisms. — NW

Science, this issue p. 182

Going BATty to fight prostate cancer

Although many early cases of prostate cancer can be treated by blocking the activity of male hormones, the tumor often develops resistance and regrows. Standard hormone-based treatments, which all involve androgen deprivation, are ineffective at this stage of the disease. Now, Schweizer et al. describe an approach based on evidence that cancer cells adapted to low-androgen conditions may not tolerate high concentrations of testosterone. A clinical trial of BAT (bipolar androgen therapy), in which very high and very low concentrations of testosterone alternate in the patients’ blood, showed that the regimen was well tolerated. In addition to direct anticancer effects, intermittent testosterone treatment also restored the tumors’ sensitivity to anti-androgen agents, further expanding patients’ treatment options. — YN


Breaking the symmetry in an atomic gas

Cooling a physical system through a phase transition typically makes it less symmetrical. If the cooling is done very slowly, this symmetry change is uniform throughout the system. For a faster cooling process, the system breaks up into domains: The faster the cooling, the smaller the domains. Navon et al. studied this process in an ultracold gas of Rb atoms near its transition to a condensed state (see the Perspective by Ferrari). The authors found that the size of the domains froze in time in the vicinity of the
ULTRAFAST DYNAMICS

Traveling a long way past the junction

Diodes are central components of modern electronic circuits. They essentially consist of two semiconductors sandwiched together, with one deficient in electrons (p), the other enriched (n). Najafi et al. used ultrafast electron microscopy to study the dynamics in a silicon diode on a time scale of trillions of a second. They discovered that when light excites the diode’s charge carriers, those carriers migrate much farther past the p-n junction than standard models would imply. The authors explain the results using a ballistic transport model. — JSY

DNA REPAIR

A factor for repairing broken DNA

Unprogrammed DNA double-strand breaks are extremely dangerous for genomic stability. Nonhomologous end-joining (NHEJ) repair systems are present in all domains of life and help deal with these potentially lethal lesions. Ochi et al. have discovered a new factor involved in NHEJ by searching for proteins with structural similarities to known NHEJ proteins. Specifically, PAXX, a paralog of XRCC1 and XLF, interacts with a key repair pathway protein, Ku, and helps promote ligation of the broken DNA. — GR

GLIOLOGY

Losing traction at higher speeds

How, exactly, will glaciers and ice sheets respond to climate warming? We know that they will melt faster as temperatures rise, but the way they slide over the ground below also should be affected, and that could have a significant impact on how fast they fall apart at their margins. Zoet and Anderson conduct a laboratory study to investigate how drag between ice and the surface that supports it changes with increased sliding speed. They find that drag decreases with increased sliding speed if there exist the right kinds of gaps between the ice and the surface below, which means that weather or climate variability has the potential to cause even more rapid glacier motion, and thus faster sea-level rise. — HJS

CASPASES

For caspases, an escape from death

Caspase proteins are well known for their role in degrading proteins and causing programmed cell death, but researchers now show that they may have nonlethal jobs, too. While looking for proteins that partner with microRNAs (small noncoding RNAs that silence gene expression) to regulate how the nematode Caenorhabditis elegans develops, Weaver et al. found the caspase CED-3. Further experimentation revealed that CED-3 cleaved proteins that play important roles in the immune response, resulting in the dilation of cerebral arteries. — WW

IN OTHER JOURNALS

Edited by Kristen Mueller and Jesse Smith
RNA SPlicing

Predicting defects in RNA splicing

Most eukaryotic messenger RNAs (mRNAs) are spliced to remove introns. Splicing generates uninterrupted open reading frames that can be translated into proteins. Splicing is often highly regulated, generating alternative spliced forms that code for variant proteins in different tissues. RNA-binding proteins that bind specific sequences in the mRNA regulate splicing. Xiong et al. develop a computational model that predicts splicing regulation for any mRNA sequence (see the Perspective by Guigó and álarcel). They use this to analyze more than half a million mRNA splicing sequence variants in the human genome. They are able to identify thousands of known disease-causing mutations, as well as many new disease candidates, including 17 new autism-linked genes. — GR

Science, this issue p. 144; see also p. 124

Batteries

Watching the silver lining inside

Some types of batteries contain both a transition metal reducible metal, such as the cathode material Ag$_2$VP$_2$O$_7$. During operation, both Ag and V ions are reduced, and the Ag atoms can form wires to enhance the internal conductivity. Kirshenbaum et al. probe the discharge of a battery at different rates and track the formation of Ag atoms using in situ energy-dispersive x-ray diffraction (see the Perspective by Dudney and Li). They show how the discharge rate affects whether the Ag or V is preferentially reduced and also the distribution of the Ag atoms, and then correlate this to the loss of battery capacity at higher discharge rates. — MSL

Science, this issue p. 149; see also p. 131

Materials Science

Popping materials and devices from 2D into 3D

Curved, thin, flexible complex three-dimensional (3D) structures can be very hard to manufacture at small length scales. Xu et al. develop an ingenious design strategy for the microfabrication of complex geometric 3D mesostructures that derive from the out-of-plane buckling of an originally planar structural layout (see the Perspective by Ye and Tsukruk). Finite element analysis of the mechanics makes it possible to design the two 2D patterns, which is then attached to a previously strained substrate at a number of points. Relaxing of the substrate causes the patterned material to bend and buckle, leading to its 3D shape. — MSL

Science, this issue p. 154; see also p. 130

Biologias

Mechanically soft neural implants

When implanting a material into the body, not only does it need the right functional properties, but it also needs to have mechanical properties that match the native tissue or organ. If the material is too soft, it will be mechanically degraded, and if it is too hard it may get covered with scar tissue or it may damage the surrounding tissues. Starting with a transparent silicone substrate, Minev et al. patterned microfluidic channels to allow for drug delivery, and soft platinum/silicone electrodes and stretchable gold interconnects for transmitting electrical excitations and transferring electrophysiological signals. In tests of spinal cord implants, the soft neural implants showed biointegration and functionality within the central nervous system. — MSL

Science, this issue p. 159

Metabolism

Getting specific about amino acid sensing

The protein kinase complex mTORC1 regulates growth and metabolism, and its activity is controlled in response to the abundance of cellular amino acids. Jewell et al. report that control of mTORC1 in response to glutamine does not require the Rag guanosine triphosphatase (GTPase) implicated in the sensing of other amino acids such as leucine (see the Perspective by Abraham). For sensing of glutamine, another GTPase, Arf1, was required. Distinct mechanisms thus appear to couple various amino acids to signaling by the mTORC1 complex. — LBR

Science, this issue p. 178; see also p. 125

Metabolism

Sensing amino acids at the lysosome

The mTORC1 protein kinase is a complex of proteins that functions to regulate growth and metabolism. Activity of mTORC1 is sensitive to the abundance of amino acids, but how the sensing of amino acids is coupled to the control of mTORC1 has been unclear. Wang et al. searched for predicted membrane proteins that interacted with regulators of mTORC1. They identified a protein currently known only as SLC38A9. Interaction of SLC38A9 with mTORC1 regulators was sensitive to the presence of amino acids. SLC38A9 has sequence similarity to amino acid transporters. Effects of modulation of SLC38A9 in cultured human cells indicate that it may be the sensor that connects the abundance of arginine and leucine to mTORC1 activity. — LBR

Science, this issue p. 188