EDITORS' CHOICE

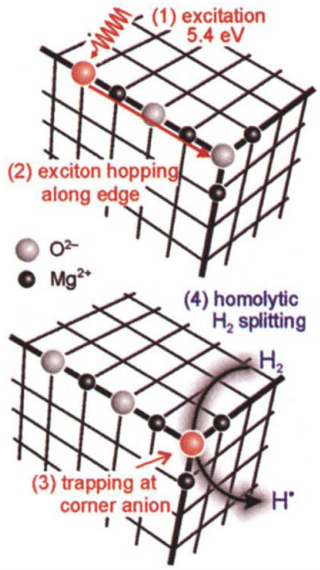
edited by Gilbert Chin

CHEMISTRY

Corner Shots

Oxide photocatalysts with wide band gaps, such as alkaline earth oxides, convert the energy of ultraviolet (UV) photons into electron-hole pairs. For nanoparticles of MgO, the energy needed to generate the hole state (which converts an O^{2-} anion to O^{-}) depends on the coordination of the O^{2-} anion: A three-coordinate corner site (O_{3C}^{2-}) requires less energy to form the radical (4.6 eV) than does a four-coordinate edge site (5.5 eV).

Sterrer *et al.* have used three techniques—electron paramagnetic resonance, infrared spectroscopy (IR), and diffuse UV reflectance spectroscopy—to study the optical excitations on clean MgO nanoparticles (with diameters of 5 to 8 nm). Photoexcitation of either site led to EPR signals corresponding only to O_{3C}^{-} sites. Exposure to hydrogen during 5.5-eV irradiation fully bleached the EPR signal, depleted the UV absorption associated with the O_{3C}^{2-} sites (but not the O_{4C}^{2-} sites), and led to the appearance of a single O–H stretching band in the IR spectrum. The authors conclude that the initially formed edge site exciton (or the oxygen radicals that form from it) migrates to the corner sites rather than reacts with the hydrogen donor species.



Migration of edge excitation.

Such studies should prove useful in understanding more complex reactions of these catalysts, such as the activation of C–H bonds. — PDS

J. Am. Chem. Soc. 10.1021/ja028059o (2002).

GEOLOGY

A Slump in Paleoseismology

Large earthquakes often spur mass sediment movements, such as the submarine slumps that generate tsunamis. Correlating in time and space precisely dated slump deposits should thus provide a chronology of prehistoric seismicity in intraplate settings such as central Europe, where the historical record of earthquakes is spotty.

Using a grid of high-resolution seismic profiles, Schnellmann *et al.* identified in the subsurface of Lake Lucerne 13 synchronous slump deposits that were associated with the magnitude 6.2 earthquake of 1601. Applying the subsurface "fingerprint" of that event to deeper stratigraphic horizons on the profiles and dating material from sediment cores, they then found four slump-rich zones ascribed to previously unknown earthquakes ranging in age from 2420 to 14,560 years before the present. Modeling indicated that the slump associated with one of these events was capable of producing a tsunami higher than 3 m, which suggests that earthquake-associated tsunamis can pose a risk in lakes as well as oceans. — SW

Geology **30**, 1131 (2002).

PALEOCLIMATE

Ancient Global Warming

The Paleocene-Eocene thermal maximum occurred at the close of the Paleocene Epoch about 55 million years ago. Within a few thousand years, sea surface temperatures warmed by 4° to 8°C, and deep ocean temperatures increased by 5°C. This episode, which lasted for approximately 210,000 years, induced a host of biotic responses and produced a large perturbation in the marine and terrestrial carbon isotopic records. It is believed that this event was caused by massive dissociation of marine sedimentary methane hydrates, but the sequence of processes that triggered it is still obscured by the difficulty of determining its timing and duration.

Thomas *et al.* present high-resolution stable isotope records based on analyses of single planktonic and benthic foraminiferal shells, demonstrating that the initial carbon isotope excursion was geologically instantaneous and was preceded by a brief period of gradual surface-water warming. Methane-derived carbon was mixed from the surface ocean downward, suggesting that a significant fraction of the initial dissociated methane hydrate reached the atmosphere before oxidation. This

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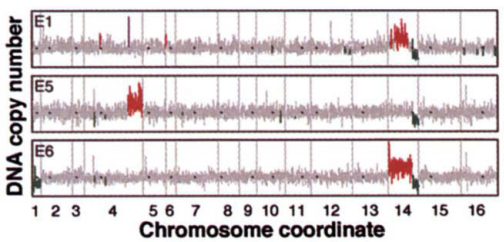
GENETICS

The Bases of Breakpoints

Microorganisms can restructure their genomes in response to environmental pressures. When glucose is scarce, budding yeast sequentially acquire mutations that enable "evolved" clones to assimilate glucose more rapidly than their ancestors. Further work has hinted that this capacity is enabled by gene amplification, but other mechanisms may come into play in other evolutionary contexts, such as speciation and tumor progression.



CGH analysis of three strains showing a common breakpoint on chromosome 14.

Dunham *et al.* used microarray-based comparative genomic hybridization (CGH) to screen nutritionally challenged yeast at single-gene resolution. They found that genome rearrangements occurred nonrandomly and were especially frequent near transposon-related sequences. Moreover, some of these rearrangements probably account for the observed increases in fitness. For example, three clones displayed an identical transposon-associated breakpoint adjacent to the gene encoding citrate synthase—the entry point into the tricarboxylic acid cycle—and three clones had amplifications in hexose transporters. Cha and Kleckner (Reports, 26 July, p. 602) have suggested that transposon sites are fragile in some way, and Dunham *et al.* contend that they provision yeast with adaptive resources and may relate to processes by which mammalian genomes evolve during tumorigenesis. — CA

Proc. Natl. Acad. Sci. U.S.A. 10.1073/pnas.242624799 (2002).

CREDITS: (TOP) STERRER *ET AL., J. AM. CHEM. SOC.* 10.1021/JA028059O (2002); (BOTTOM) DUNHAM *ET AL., PROC. NATL. ACAD. SCI. U.S.A.* 10.1073/PNAS.242624799 (2002)

supports the idea that the Paleocene-Eocene thermal maximum was triggered by a small surface ocean warming, followed by the injection into the atmosphere of large amounts of methane, a potent greenhouse gas, derived from marine sedimentary sources. — HJS

Geology **30**, 1067 (2002).

IMMUNOLOGY

Fatal Attraction

Type 1 diabetes is the outcome of an autoimmune T cell response that destroys the insulin-producing β cells within the pancreas. The early stage of the disease—known as insulitis—is marked by infiltration of pancreatic islets by T cells, and, in an ironic twist, Frigerio *et al.* suggest that β cells may themselves be partly responsible. Exposure of a β cell line to a mix of inflammatory cytokines (IFN-γ, IL1-β, and TNF-α) stimulated the production of chemokines, proteins that orchestrate the migration of leukocytes. The same assortment of chemokines was detected in islets from mice with an induced form of insulitis; in culture, these chemokines stimulated migration of T cells isolated from prediabetic mice. This chemotaxis depended most strongly on the CXCR3 receptor and corresponded with delayed induction of diabetes in CXCR3-deficient mice. — SJS

Nature Med. **8**, 1414 (2002).

BIOCHEMISTRY

Organization RINGleader

Eukaryotic cells contain a number of vaguely defined supramolecular structures—aptly termed dots, speckles, and bodies—whose functional roles are unclear. The individual proteins found within these structures perform diverse functions, but many possess a small zinc-binding motif called a RING domain. Kentsis *et al.* report that purified RING domains from several unrelated proteins, including the breast cancer susceptibility gene product 1 (BRCA1) and the promyelocytic leukemia protein (PML), can self-assemble in vitro into high-order structures that resemble those formed in cells. These RING bodies acted as structural scaffolds for multiple partner proteins, raising the possibility that the function of RING domain self-assembly in cells is to integrate biochemical reactions. — PAK

Proc. Natl. Acad. Sci. U.S.A. **99**, 15404 (2002).

CHEMISTRY

Explosive When Scratched

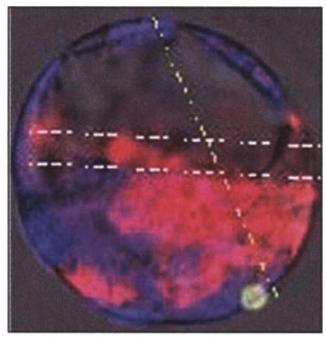
Cubane—a molecule consisting of eight carbon atoms at the corners of a cube with a hydrogen atom attached to each carbon—was first reported in 1964. Manini *et al.* have prepared an expanded cubane, in which C≡C–C≡C units connect each pair of adjacent corners. In their synthesis, two corners are joined to form an edge, two edges are linked to yield a face, and two faces are combined to produce a cube. The resulting structure contains 56 carbon atoms, and each corner is protected with a methoxy ($-OCH_3$) group. Although this expanded cubane is highly strained and explosive, the authors were able to characterize the molecule with nuclear magnetic resonance and to verify its cubic symmetry. Mass spectrometry indicates that, upon loss of the methoxy groups, the molecule is not stable in the cubane geometry and converts to a fullerene. — JFU

Angew. Chem. Int. Ed. **41**, 4339 (2002).

DEVELOPMENT

I See a Pattern

When a mammalian zygote divides, the two cells follow distinct fates. The first to undergo a second division contributes to the embryonic part of the blastocyst, whereas the other cell contributes to the abembryonic portion. Earlier, it was noted that the cleavage plane for the initial cell division event correlated with the location of the fertilization cone that formed after sperm entry into the oocyte. Piotrowska and Zernicka-Goetz have examined embryos that had never been fertilized and those from which cytoplasm at the site of sperm entry had been removed. In these embryos, the two blastomeres that formed in the initial cleavage event did not differ in their proportional contributions to the embryonic and abembryonic parts of the blastocyst. Hence, sperm is needed not only for its genetic content but also as a spatial cue for embryo patterning. — BAP



After removal of cytoplasm, the cleavage plane (yellow) no longer aligns with the boundary between the embryonic and abembryonic parts (white lines).

CREDIT: PIOTROWSKA AND ZERNICKA-GOETZ, *DEVELOPMENT* **129**, 5803 (2002)

Development **129**, 5803 (2002).