EDITORS' CHOICE

edited by Gilbert Chin

ASTRONOMY

Noble Gases and Martian Water

Nakhlites, one of the three classes of meteorites that originated from Mars, have a distinctive noble gas signature that may be related to isotopic fractionation that occurred during water-rock interactions on the martian surface. Studies of these meteorites may provide important clues concerning Mars paleoenvironment.

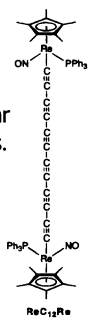
Swindle *et al.* analyzed argon, krypton, and xenon concentrations in the nakhlite Lafayette, which contains the highest concentration of hydrous mineral phases of any martian meteorite, and focused primarily on iddingsite, which is a mixture of clay minerals, iron oxides, and ferrihydrides. The Kr and Xe are enriched in the iddingsite relative to the other mineral phases in the sample, suggesting that the iddingsite is a potentially important carrier of the noble gas signature of the martian hydrosphere or atmosphere or both. The Xe fraction is isotopically distinct from terrestrial Xe and therefore martian in origin, and may represent trapped martian atmosphere from a shock process, Xe trapped in the polar ice in clathrates, or a time-varying Xe component of the atmosphere. The authors derived an upper limit of 670 ± 91 million years for the age of the formation of the iddingsite from K-Ar isotopic systematics. This finding suggests that liquid water may have been available on Mars more recently than suggested by martian surface morphology. — LR

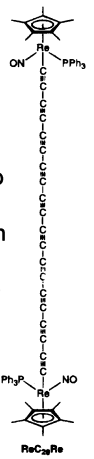
Meteorit. Planet. Sci. **35**, 107 (2000).

CHEMISTRY

Carbon Chain Gangs

Polymeric carbon chains consisting of sp-hybridized carbon—called carbynes or polyynes—have attracted the attention of researchers because of their unusual physical and chemical properties and their potential applications in molecular electronics and catalysis. However, these compounds are often unstable or even explosive and can be difficult to isolate. Dembinski *et al.* have performed a systematic study of the synthesis and physical characteristics of a series of polyynes with chains of 6 to 20 carbon atoms. The chains are sandwiched between two rhenium complexes, in contrast to earlier work in which the end groups on the chains contained carbon or silicon. The compounds constitute an unprecedented series of organo-transition metal complexes linked by the simplest pure-carbon connecting unit. The use of bulky electropositive end groups, which complement the somewhat electronegative sp carbon terminus, likely contribute to the relative stability of the compounds. — JU





J. Am. Chem. Soc. **122**, 810 (2000).

GEOLOGY

A Stronger Fault

The San Andreas fault is perhaps the most thoroughly studied fault in the world, in part because it fails in large earthquake events. Such release of stress in large earthquakes suggests that the crust should be strong. Nonetheless, the San Andreas has been thought to be an anomalously weak fault, in part because several studies failed to find any excess heat released along the fault, as might be expected if the fault zone were strong such that friction would be high during faulting. Also, the main tectonic stresses were inferred to be close to perpendicular to the fault, which imply that the fault slipped at low stress.

Scholz has now assembled a variety of arguments that the fault is actually strong, as would be consistent with most laboratory measurements of rock failure and other known faults. He argues that stresses near the fault are rotated toward low angles and thus high along the fault and that ground water flow, driven by the high topography along the fault, is redistributing the heat produced by high friction so broadly that there is no sharp heat flow anomaly. This model would imply that the permeability of the upper crust along the fault is higher than inferred in the original heat flow models, but consistent with values predicted or measured elsewhere. — BH

Geology **28**, 163 (2000).

EVOLUTION

Population Genetics of Frozen Bears

It is generally assumed that genetic differences between geographically isolated populations of a species are a direct consequence of their separation, which reduces the chance that genetic exchange will counteract divergence. Indeed, the degree of genetic divergence can be an indication of the endurance of isolation.

The present-day brown bear.

Leonard *et al.* have analyzed mitochondrial DNA sequences from samples of brown bears preserved for 15,000 years in Alaskan permafrost. The isolated populations of brown bears in present-day North America vary in their sequences of these regions of mitochondrial DNA; surprisingly, the sequences within a single population of Ice Age bears showed a similar range of variation. If this variation existed before the populations became geographically subdivided, then the current divergence is not the result of post-isolation genetic drift; rather, it must have arisen by a 'sampling effect', as the original population became fragmented and dispersed (see also Willis and Whittaker, Perspective, this issue, p. 1406).

The analysis of ancestral populations is a rare bonus for the population geneticist, and the exceptional preservation of the Ice Age brown bears is unlikely to be repeated in many organisms. But reconstructions of past population history by phylogenetic inference from extant populations now have an added twist. — AMS

Proc. Natl. Acad. Sci. U.S.A. **97**, 1651 (2000).

BIOCHEMISTRY

Assembling a Protein Jigsaw Puzzle

Scientists have reasoned that, like pieces of a jigsaw puzzle, if two proteins fit together, then this interaction is likely to contribute to in vivo function. Uetz *et al.* compare microarray and library variations of the yeast two-hybrid system as a step toward identifying the complete set of interactions that occur among the ~6000 yeast proteins. In the first approach, 6000 yeast colonies, each containing the activation domain of Gal4 fused to a different open reading frame

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SOURCE: R. DEMBINSKI *ET AL. J. AM. CHEM. SOC.* **122**, 810 (2000); PHOTO CREDIT: MICHEL ROGGO

(ORF), were mated to a separate set of hybrids containing the Gal4 DNA-binding domain fused to one of 192 ORFs. In the second approach, the 6000 ORF-containing varieties were pooled into a library, mated against DNA-binding domain—containing counterparts, and then analyzed in a semi-automated screen.

The microarray approach, although requiring significantly more work and time, provided more positive results per protein than the library approach. Furthermore, the pooling that occurs in the library approach may select against cells that are growing more slowly or mate less efficiently. A total of 957 possible interactions were identified by these approaches, many of which may help to classify proteins of known function but of unknown pathway. — BJ

Nature **403**, 623 (2000).

CELL BIOLOGY

Tale of Comet Tails

The intracellular pathogen, Listeria monocytogenes, travels through cells by nucleating the assembly of actin tails; these invading bacteria usurp existing cellular machinery to generate these spectacular comet-like structures. Intracellular organelle movements, however, are generally thought to occur along well-organized microtubule tracks.

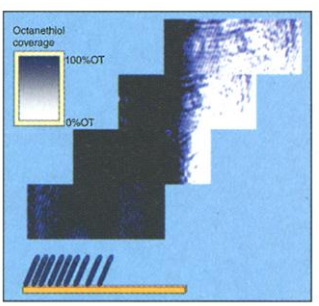
Taunton *et al.* were studying the behavior of actin in living *Xenopus* eggs and observed the formation of actin tails on certain cytoplasmic vesicles soon after the eggs had been 'activated'—the cellular equivalent of fertilization. The tail-forming activity was reconstituted in a cell-free system and involved the same set of proteins known to be involved in the formation of tails on invading pathogens—a process that previously had been reconstituted from purified components by Loisel *et al.* Subsequent analysis suggested that the cytoplasmic vesicles were multivesicular endosomes, and when mammalian endosomes and lysosomes were added to the frog system, they recruited the actin tail machinery and moved about. Merrifield *et al.* also have observed actin tails on pinocytic vesicles in cultured mast cells. — SMH

J. Cell Biol. **148**, 519 (2000); *Nature* **401**, 613 (1999); *Nature Cell Biol.* **1**, 72 (1999).

CHEMISTRY

Adsorbed Molecules on the March

An electrode placed into solution is supposed to be the same potential everywhere along its surface. Terrill *et al.* deliberately break this rule by using thin (and hence resistive) gold films (5 to 80 nanometers thick) on glass microscope slides as electrodes. By passing current through the film, they established voltage gradients of tens of millivolts per millimeter, which they then used to create gradients in the coverage of octanethiol monolayers electrodeposited from solution. Coadsorption of 3-mercaptopropionic acid on the remaining bare surface created a gradient in surface energy. The voltage gradient itself could be shifted with a potentiostat along the gold electrode, and thus the thiol film gradient could be shifted on the film while it remained in solution (as verified by surface plasmon resonance imaging). Applications might include transporting larger supramolecular objects attached to the thiols or exploiting surface tension gradients for fluid pumping. — PDS



Surface coverages of octanethiol (OT).

J. Am. Chem. Soc. **122**, 988 (2000).

Science's stke

Death Signal Cascade in Bacteria

The bacterial cell wall is the target for many antibiotics, which disturb the balance between extracellular autolytic enzymes and the cell wall biosynthesis necessary for growth. Novak *et al.* screened a library of loss-of-function mutants for penicillin tolerance in order to pinpoint genes that are responsible for regulating bacterial autolysis. A two-component signaling system, VncR-VncS, was identified along with a 27-amino acid peptide (Pep^{27}) and a membrane transporter, Vex. Secretion of endogenous Pep^{27} and detection by the VncR/S system was important for antibiotic-mediated cell death. Cells with disrupted *pep*^{27} and *vex* genes or disrupted *vncS* were tolerant to a broad range of antibiotics. — NG

Mol. Cell **5**, 49 (2000).

CREDITS: KARIN BALSS