EDITORS' CHOICE

edited by Gilbert Chin

GEOLOGY

Fast Track to the Top

Minerals that require formation at very high pressures, including diamond, recently have been identified in crustal rocks from ancient orogenic belts associated with continental collision. The presence of these minerals implies that these rocks were subducted to depths of 100 to 200 kilometers (or perhaps even deeper), and then exhumed rapidly and brought near the surface. Two recent studies may imply an even faster exhumation than has been appreciated.

O'Brien *et al.* have discovered coesite, a high-pressure phase of silica (quartz is the stable phase at Earth's surface), in rocks from the Himalayan orogen in Pakistan. The presence of coesite and other minerals in fairly young rocks from the Himalayas implies rapid movement (approaching 1 centimeter per year) from depths close to 100 kilometers. This finding may force changes in models of the evolution of this part of the Himalayas. Stöckhert *et al.* examined metamorphic microdiamonds (stable at depths exceeding about 130 kilometers) discovered in central Europe. They argue that the diamonds crystallized from trapped fluids in minerals as the rocks cooled at high pressure within the diamond stability field and were then rapidly transported to regions of lower pressures. — BH

Geology **29**, 435; 391 (2001).

CELL BIOLOGY

Assembling the Assemblers

Within eukaryotic cells, the mitochondria are semiautonomous organelles that are bounded by a pair of membranes and that generate chemical energy for the cell in the form of ATP. Mitochondria do contain their own genome, which is essential for their maintenance, but most of their proteins are encoded by nuclear genes and need to be imported from the cytoplasm into the organelle.

Model *et al.* have examined how the protein import channel, which resides in the mitochondrial outer membrane, is itself put in place. The core protein of the import machinery is TOM (translocase of the outer membrane) 40, which forms a passageway across the outer membrane. In combination with TOM20 (a receptor for newly synthesized mitochondrial proteins) and three smaller components (TOM5, TOM6, and TOM7), TOM40 assembles into a 400-kilodalton complex in the outer membrane. Surprisingly, during its own import, TOM40 passes right across the outer membrane into the intermembrane space where it first associates with TOM5, then reinserts into the outer membrane where other components are added to create the mature import complex. One explanation of this peculiar behavior is that the intramembraneous portion of the import complex adopts an inflexible β-barrel tertiary structure, which cannot open sideways to allow a TOM40 protein to exit while in transit. — SMH

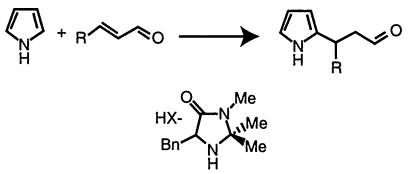
Naure Struct. Biol. **8**, 361 (2001).

CHEMISTRY

Giving Friedel-Crafts a Hand

One of the most versatile methods for adding a carbon-carbon bond to an aromatic ring is Friedel-Crafts alkylation, in which a Lewis acid (such as $AlCl_3$) catalyzes the addition of an electron-deficient s- or p-bonded compound. However, most variants of this venerable reaction are not stereoselective when adding more complex unsaturated species, such as a,b-unsaturated aldehydes.

Paras and MacMillan now show that reaction of pyrroles



with a,b-unsaturated aldehydes in the presence of a chiral amine (a benzyl imidazolidinone) and acid co-catalysts leads to stereospecific addition (typically 90% enantiomeric excess) to the C=C bond. This pathway is favored over the conventional acid-catalyzed pathway that would add to the C=O bond, and the benzyl group helps direct the pyrrole to adding to the *si*-face. The reaction is quite tolerant of substituents on the pyrrole ring as well as the *N*-alkyl group, and of various terminal groups on the aldehyde. — PDS

J. Am. Chem. Soc., in press.

POLYMER SCIENCE

Rapid Large-Scale Patterning

Block copolymers readily phase-separate to form microdomains, a process used to create templates for nanolithography, for instance. Getting neighboring domains to coalign is a difficult but necessary step for the formation of large templates. A number of tricks have been used to overcome this problem, but the methods used to date tend to be slow or limited to thin films.

Park *et al.* have devised a new approach that allows for the rapid production of aligned lamellar and cylindrical microdomains of amorphous diblock copolymers. A thin diblock polymer film was placed

CONTINUED ON PAGE 605

ECOLOGY/EVOLUTION

At Length Did Cross an Albatross

Diomedea exulans.

In many bird species, the sexes are morphologically distinct. Often this dimorphism is the result of sexual selection, but in some cases natural selection has acted to reduce competition between the sexes for food or broaden the foraging range of the species or both. Shaffer *et al.* investigate the biomechanics of sexual dimorphism in the wandering albatross from the Crozet archipelago in the southern Indian Ocean. In this species, females and males forage in different oceanic zones; females prefer subtropical and tropical waters, and males prefer the sub-Antarctic and Antarctic zones. Males were 20% heavier than females but possessed only 7% more wing area. Hence, wing loading in males is greater. These differences may reflect adaptation to the different wind regimes in the two zones, with greater wing loading being more advantageous in the windier Antarctic conditions. — AMS

Funct. Ecol. **15**, 203 (2001).

SOURCE: (TOP) PARAS AND MACMILLAN, J. AM. CHEM. SOC., IN PRESS; (BOTTOM) DR. SCOTT SHAFFER, UCSC

on a carbon-coated glass slide, and a solvent (either benzoic acid or anthracene) was placed underneath and sandwiched with a second glass slide. The sample was heated, which caused the polymer to dissolve into the organic solvent. As the sample was cooled directionally, the solvent crystallized in one particular crystal growth direction, and above it the polymer microdomains aligned in the same direction. The solvent was then washed away, leaving the domain structure of the diblock copolymer intact. Growth rates on the order of 2 millimeters per second were achieved, and well-aligned parallel lamellae were observed to extend over regions larger than 50 square microns. — MSL

Macromolecules **34**, 2602 (2001).

BIOMEDICINE

Refining a Drug

Taxol is an antitumor drug that binds to and stabilizes microtubules. Its binding site has been located on the β-subunit of the αβ tubulin dimer by electron crystallography; however, its precise conformation could not be resolved.

Snyder *et al.* have docked many different taxol conformers, derived from various structural studies, into the β-tubulin structure; three similar conformers gave reasonable fits, and one of these was refined to give a T-shaped taxol molecule. Whereas previous models have predicted that the hydrophobic moieties of taxol would associate with each other, in this model these groups interact with hydrophobic parts of the protein. Taxol binding converts a hydrophobic cleft in β-tubulin into a hydrophilic surface, and as such is functionally reminiscent of a peptide loop seen in α-tubulin. The lateral packing of these surfaces in the tubulin dimer may explain how taxol increases microtubule stability. The model rationalizes the taxol resistance conferred by some tubulin mutations and also is consistent with photoaffinity labeling studies and with structure-activity data obtained using synthetically substituted taxols. — VV

Proc. Natl. Acad. Sci. U.S.A. **98**, 5312 (2001).

BIOCHEMISTRY

Making a C-F Bond

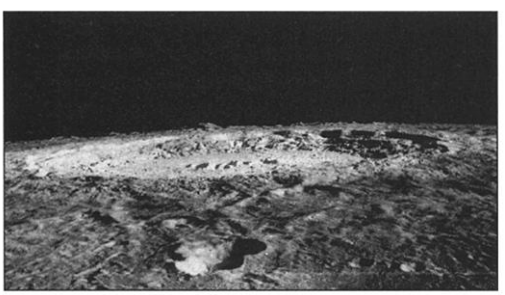
Naturally fluorinated biomolecules are rare. Although enzymatic reactions in which other halogens are manipulated either in their cationic or radical forms are known, the stability of the fluoride anion and its ready propensity as a leaving group may preclude its incorporation into metabolites. (Its leaving group character has, in fact, been the basis for the design of suicide inhibitors.) Now, Zechel *et al.* describe the detection by ^{19}F nuclear magnetic resonance of fluorinated glycosides as intermediates generated by two selectively mutated retaining glycosidases. Removal of one of the active site carboxylates enables fluorine to carry out the nucleophilic attack in the first or second step of the double displacement reaction. — GJC

J. Am Chem. Soc., in press.

PLANETARY SCIENCE

Lunar Cratering

Life in the early solar system was probably like a food fight at the end of a long week at summer camp—all of the leftovers were thrown around and produced a large number of craterlike impact features. The moon carries a signature of these events, technically referred to as the Late Heavy Bombardment (LHB), in the form of well-preserved impact craters that have not been wiped clean by later tectonic activity. Because it is difficult to date lunar surface features accurately, debate on when the LHB occurred continues. It may have lasted from 4.4 to 3.6 billion years ago, with an exponential decline in the number of impactors, but there is evidence of a sharp increase during the period from 4.0 to 3.8 billion years ago (called the lunar cataclysm).



The Copernicus Impact Center.

Morbidelli *et al.* estimate the supply rate of impactors to the Moon using orbital dynamic simulations, which they start just after the terrestrial planets have formed and before all of the planetesimals have been destroyed. They find that a small percentage of these planetesimals survive in highly inclined orbits. These survivors are then used to simulate a LHB of the Moon. The leftover planetesimals hit the Moon with an exponentially decaying rate consistent with a slow and steadily decreasing LHB. Thus, another mechanism may be required to account for the lunar cataclysm. — LR

Meteorit. Planet. Sci. **36**, 371 (2001).

CREDIT: NASA