EDITORS' CHOICE

edited by Gilbert Chin

GEOLOGY

Mineral Composition in the Mantle

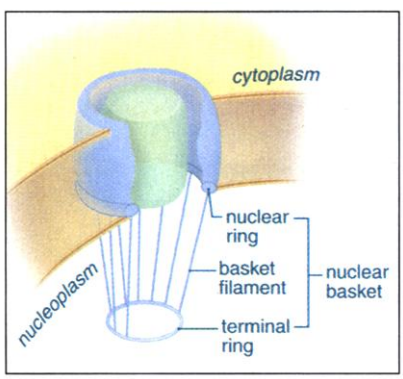
Earth's lower mantle—which makes up most of the Earth, from a depth of about 670 to 2700 km—is believed to be composed primarily of magnesium silicate ($MgSiO_3$) in the perovskite structure and magnesiowustite (Mg,Fe)O, and several less abundant phases. Knowing the proportions of these minerals is important for understanding Earth's dynamics, such as whether the lower mantle evolved separately from the upper mantle. Determining the mineralogy requires matching high-pressure experimental results, most of which have been on the end-member compositions, with seismic and other geophysical measurements. Recent work has shown that minor amounts of ferric iron (Fe), aluminum (Al), and calcium (Ca) greatly affect the match to geophysical parameters, as well as to the geochemistry of the mantle, because they are fractionated differently between perovskite and magnesiowustite.

Wood presents a series of experiments designed to evaluate further the effect of Ca, Al, and Fe in the reactions at the top of the lower mantle that produce Mg perovskite and magnesiowustite. The results show that formation of Mg-rich, Al-free perovskite at the top of the lower mantle can explain the sharp seismic signal; at deeper levels, the perovskite becomes more aluminum-rich as garnet breaks down. The data are consistent with a lower mantle that is about 80% Mg-rich perovskite containing Al and Fe, 15% magnesiowustite, and 5% Ca-perovskite. — BH

Earth Planet. Sci. Lett. **174**, 341 (2000).

CELL BIOLOGY

Nuclear Organization



Nuclear pore complex.

The transport of small molecules by passive diffusion and of proteins and RNAs by active transport into and out of the eukaryotic nucleus takes place through nuclear pore complexes (NPC). The yeast proteins Mlp1p and Mlp2p were identified in a screen for NPC-associated proteins and have been localized to filamentous structures that extend from the nuclear pore ring into the nucleoplasm. Galy *et al.* find that deletion of Mlp2 reduces DNA repair efficiency, similar to what is seen upon deletion of Yku70p, a protein that is known to bind to the ends of chromosomes—the telomeres—and has been localized to the periphery of the nucleoplasm. The perinuclear localization of telomeres and their associated proteins also appears to contribute to the repressive effect of telomeres on the transcription of nearby genes. Further analysis showed that deletion of Mlp2 disperses Yku70p throughout the nucleoplasm and that proper localization is mediated by a direct association of the two proteins. Another intriguing connection between the NPC and telomeres comes from the observation that truncating the nucleoporin Nup145p produces aberrant localization of the Mlp proteins and of Rap1p, another telomere-binding protein, and also a de-repression of a subtelomeric gene. How all of these results fit together is not yet clear, but the linkage between telomeric localization and function and the NPC warrants a closer look. — BAP

Nature **403**, 108 (2000).

ASTRONOMY

A Windy Day on Mars

The solar wind is a plasma with interplanetary magnetic field lines. Earth's intrinsic magnetic field largely shields us from the effects of the solar wind. Mars, however, has no permanent magnetic field; when the solar wind meets Mars, it creates a bow shock, and magnetic field lines compress between the bow shock and ionopause of Mars. This thin layer of plasma is called the magnetic pile-up boundary (MPB).

The Mars Global Surveyor (MGS) spacecraft passes through the MPB daily in its polar orbit. Crider *et al.* analyzed the electron flux data from one orbit as measured by the electron reflectometer aboard the MGS. They noticed a decrease in the electron flux in the MPB at energies between 40 to 150 electron volts, suggestive of electron impact ionization of neutral H, O, and CO_2 above the ionosphere. These data were used to construct a qualitative model incorporating the density of the neutral species, the velocity of the solar wind flow around the planet, and the magnetic field geometry of the interaction. Through electron impact ionization, the incoming solar wind ionizes the neutral species and sweeps them away, thus eroding the martian atmosphere. — LR

Geophys. Res. Lett. **27**, 45 (2000).

BIOCHEMISTRY

Unwinding Chromatin

In eukaryotic cells, DNA is packaged into a 10-nm filament of nucleosomes, which are particles containing two turns of DNA wrapped around a core of histone proteins, and the nucleosomes are condensed into a 30-nm chromatin fiber. Even higher-level organization enables cells to encapsulate a 5-cm chromosome into a 5-μm nucleus. Cui and Bustamante have begun to make measurements of the mechanical parameters by stretching single chromatin fibers using laser tweezers. From a model incorporating their force-extension data, they suggest that the attractive energy between nucleosomes may be about 3.4 k_BT and therefore that interconversion between the filament and fiber may necessitate only a gentle tweak of the dynamics. How the cell might regulate these internucleosomal interactions, and thus gain access to genes that need to be turned on, is through highly specific and reversible covalent modifications of the histone tails that protrude from the core particles, as summarized by Strahl and Allis. — GJC

Proc. Natl. Acad. Sci. U.S.A. **97**, 127 (2000); *Nature* **403**, 41 (2000).

APPLIED PHYSICS

True-Blue Laser Diodes

Laser diodes based on the wide gap III-V compounds of indium gallium nitride (InGaN) have been demonstrated to operate at room temperature for thousands of hours at wavelengths in the violet range (390 to 420 nm). For applications in full-color laser displays, laser operation in the blue (450 nm) is desirable, but the required reduction in effective band gap

CONTINUED ON PAGE 395

SOURCE: MODIFIED FROM OHNO *ET AL.*, NUCLEOCYTOPLASMIC TRANSPORT: THE LAST 200 NANOMETERS, *Cell* 92, 327–336.

obtained by increasing the amount of indium results in a prohibitive increase in the current density required to initiate and maintain lasing. These high currents result in catastrophic failure of a multiple quantum well device after only a few hours of operation. Nakamura *et al.* now show that by careful design of the laser cavity, and in particular the number of InGaN wells that make up the active region of the laser, they can reduce the threshold current and extend the lifetime of the devices to approximately 200 hours. The authors suggest that reverting to a single quantum well structure helps to preserve the integrity of a InGaN layer containing higher levels of indium. — ISO

Appl. Phys. Lett. **76**, 22 (2000).

PSYCHOLOGY

Speed Reading

Pronouncing English words is notoriously difficult because the same combination of letters (a grapheme) can be pronounced differently in different words and, sometimes, the same combination of graphemes can be pronounced differently in different contexts. Paulesu *et al.* show that the need to access lexical or semantic resources is correlated with slower reading times—as compared to pronouncing words in Italian, which offers an almost one-to-one mapping of graphemes onto sounds—and with distinct sets of brain regions activated during reading English versus Italian. These regions are consistent with proposals based on deficits in language skills observed in neurological patients and reveal the influence of culture on neural processing. — GJC

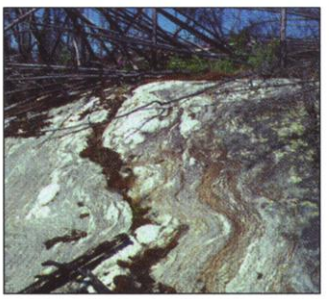
Nature Neurosci. **3**, 91 (2000)

GEOLOGY

Demarcating Old Rocks

Crust that is greater than 3.0 billion years old is distributed in the cores of cratons (stable areas of Earth's crust); these can be found in the interiors of several continents. Identifying and correlating these cores provides clues to the rate of formation of continental crust through time and to Earth's geochemical evolution, and also reveals whether some form of plate tectonics operated early in Earth's history.

Qiu *et al.* have identified 3.2 billion year old rocks in the Yangtze craton located in south China. Rocks of this age were thought to be restricted to the North China craton, which was joined with the Yangtze craton only 220 million years ago along a major orogenic belt (the Qinling-Dabie-Sulu suture). Separately, Böhm *et al.* have identified crust at least 3.5 billion years old (and perhaps from 3.8 billion years ago) along the ancient margin of the Superior Province located in Manitoba, Canada (the large craton core in eastern and central Canada). Both studies used uranium-lead dating of zircons to date directly the formation of igneous rocks and samarium-neodynium geochemical analysis of whole rocks to estimate the age of extraction of crust from the mantle. — BH



Ancient crust in Manitoba.

CREDIT: CHRISTIAN O. BOEHM

Geology **28**, 11 (2000); *Geology* **28**, 75 (2000).

Science's stke

Removing Receptors by Ubiquitination

The intracellular adaptor protein c-Cbl has been implicated in the ubiquitination and degradation of growth factor receptors. Levkowitz *et al.* and Lill *et al.* have determined that interaction between the src homology 2 (SH2) domain of c-Cbl and the cytoplasmic tail of the epidermal growth factor (EGF) receptor is essential for this effect. Binding of EGF to the receptor is known to activate the cytoplasmic tyrosine kinase domain; Levkowitz *et al.* showed that a phosphorylated tyrosine residue in the EGF receptor tail serves as the c-Cbl docking site and also that c-Cbl itself becomes phosphorylated on a tyrosine residue. Phosphorylation of c-Cbl was required for ubiquitination of activated EGF receptor, suggesting that the adaptor protein may act as a ubiquitin ligase. Furthermore, ubiquitination may contribute to diverting internalized growth factor receptors to the lysosomal degradation pathway because activated EGF receptors lacking the c-Cbl docking residue were neither ubiquitinated nor degraded. Instead, they were internalized and then recycled to the cell surface. Thus, ubiquitination of growth factor receptors may ensure receptor downregulation by recruiting both proteosomal and lysosomal degradation pathways. — LDC

Mol. Cell **4**, 1029 (1999); *J. Biol. Chem.* **275**, 367 (2000).