

edited by Gilbert Chin

BIOCHEMISTRY

Micromanagement

Biological processes such as the handling of information and metabolic flux rely on macromolecules: large functionally diverse polymers of repeating units (nucleotides, amino acids). Regulatory mechanisms superimposed on these processes often rely on these very same kinds of macromolecules.

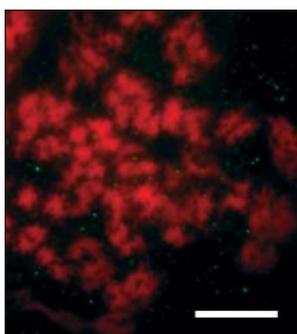
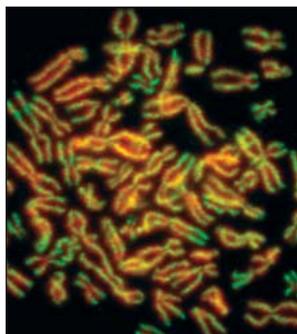
Nevertheless, recent studies have revealed a rich network of regulatory controls based on small molecules, and Grundy *et al.* now identify the L box, named for its involvement in lysine pathways. Lysine, in addition to being an essential amino acid, is used as a cross-linking building block (along with its precursor diamino-pimelic acid) for the bacterial cell wall. The L box is an approximately 200-nucleotide region of the upstream portions of RNAs encoding lysine biosynthetic enzymes; in the presence of millimolar concentrations of lysine, its secondary structure changes and stops synthesis of the RNAs. Even though there is little sequence similarity between the L box of different genes, unlike the S box (which responds to S-adenosyl methionine levels), these sensors are alike in being able to discriminate between closely related metabolites (in this case, lysine versus diaminopimelic acid). — GJC

Proc. Natl. Acad. Sci. U.S.A. **100**, 12057 (2003).

GEOCHEMISTRY

Weathering the Alps

Increases in atmospheric CO₂ are assumed to increase weathering, because silicate minerals react to form water-soluble carbonates: for instance, CaSiO₃ + CO₂ → CaCO₃ + SiO₂. This reaction draws down atmospheric CO₂ levels, and it has been suggested that mountain building contributes to global cooling. In turn, it is commonly assumed



Normal chromosomes (top) containing DNA (red) and condensin (green) appear distinct, but condensin-depleted chromosomes are disordered.

appear to make separate contributions to the generation and maintenance of condensed chromosome structure. — SMH

Cell **115**, 109 (2003).

that mountain building and mechanical erosion, by increasing the exposed surfaces of minerals, accelerate this chemical weathering. Quantifying these processes is important for inferring the interaction between climate change and topography on Earth, and for predicting past and future CO₂ levels. Jacobson and Blum worked to quantify these fluxes by examining stream chemistry in the Southern Alps of New Zealand. Here, the west side of the range is steep and wet (because of rapid uplift) as compared to the east side, despite the presence of similar types of rock. Although levels of dissolved Mg and Ca ions are much higher in the streams draining the western side of the Alps, most of this difference can be traced to the breakdown of carbonate miner-

CELL BIOLOGY

A Distinction with a Difference

In the transition from interphase to mitosis, chromosomal material changes from a fuzzy indistinct mass into compact and well-defined pairs of chromosomes. Condensin complexes contain proteins of the structural maintenance of chromosomes (SMC) family and function in the assembly and segregation of mitotic chromosomes. Ono *et al.* suggest that two types of condensin complexes are present in vertebrate cells. While sharing SMC subunits, condensin I and II differ in their other subunits. Depleting either or both of the condensin complexes disrupted the normal ordered structure of mitotic chromosomes in slightly different ways and obscured the demarcation of the two chromosomal chromatids. Furthermore, the two condensin complexes localized to different sites along the condensed chromosomes and hence

appear to make separate contributions to the generation and maintenance of condensed chromosome structure. — SMH

Cell **115**, 109 (2003).

als and not to silicate weathering related to CO₂ consumption. Overall, mountain building seems to increase atmospheric CO₂ consumption via weathering by only a factor of 2, less than previously thought. — BH

Geology **31**, 10 (2003).

MATERIALS SCIENCE

The Yttrium Solution

When metal alloys are cooled, they tend to form crystalline arrays, but for some it can be technologically advantageous to induce them to adopt an amorphous structure instead. These metallic glasses can be formed via extremely rapid cooling, but this method of fabrication only works for wires and ribbons, which have high surface-to-volume ratios.

Two groups, looking at differ-

ent alloys, have found that yttrium (Y) can enhance the formation of glasses significantly and thus make it feasible to fabricate components in bulk form. Guo *et al.* started with a group of rare earth alloys based on La-Al-Ni and La-Al-Cu and added Y as the base element (the majority component). The addition of an additional element raised the complexity of the alloy and hence its glass-forming ability, and the specific choice of Y worked well because its atomic size falls between those of La and Al, leading to an improvement in packing efficiency. Replacement of some of the yttrium with scandium, which has a similar atomic size, further enhanced the glass-forming ability, and fully amorphous rods could be produced by cooling in water. Lu *et al.* found that the addition of small amounts of Y vastly improved the glass-forming ability of iron-based metallic glasses. The Y not only scavenged free oxygen and thus stabilized the melt, but moved the processing conditions closer to the eutectic point and prevented the formation of secondary iron-based crystallites. — MSL

Appl. Phys. Lett. **83**, 2575; 2581 (2003).

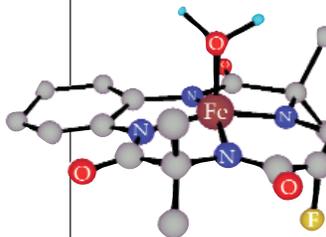
CHEMISTRY

An Iron Grip

The utility of enzymes such as horseradish peroxidase (HRP), which can be used to activate hydrogen peroxide for subsequent organic reactions such as bleaching, is often limited by the loss of activity at high or low pH. Recently, small molecules that exhibit the activity of these metalloporphyrin-containing enzymes have been developed. They carry a porphyrin mimic, a tetraamido macrocyclic ligand (TAML) for binding Fe^{III}, but do not need the surrounding protein shell for activity.

CONTINUED ON PAGE 361

The TAML catalyst:
gray, carbon; light
blue, hydrogen.



Unfortunately, these catalysts are perhaps too biomimetic, in that they also lose activity at pH < 4.

Ghosh *et al.* explored ways of stabilizing these TAML catalysts at low pH. They found that by placing electron-withdrawing substituents, such as fluorine, at the carbon that bridges the two carbonyl groups, they could increase the resistance against acid-induced hydrolysis, which demetalates the compound, by up to 11 orders of magnitude at low pH, presumably by inhibiting the protonation of the amide oxygens. These results not only expand the range of these catalysts, but may also provide a model system for studying demetalation of enzymes. — PDS

J. Am. Chem. Soc. 10.1021/ja0367344 (2003).

GEOPHYSICS

Plate Resolution

Unlike political boundaries, plate tectonic boundaries are determined by geologic, geodetic, and seismic data. These data can be difficult to interpret because the motion of one plate must be considered relative to the motions of other plates. One of the commonly used plate models is NUVEL-1, in which 11 or 14 moving plates are fitted like puzzle pieces around a fixed Pacific plate to create a protective skin over the convecting mantle. Surprisingly, some of the major plate boundaries are not unambiguous, and microplates sometimes are used to resolve discrepancies.

Geodetic poles from this work (blue) and NUVEL-1A (green), and the recent earthquake (red star).

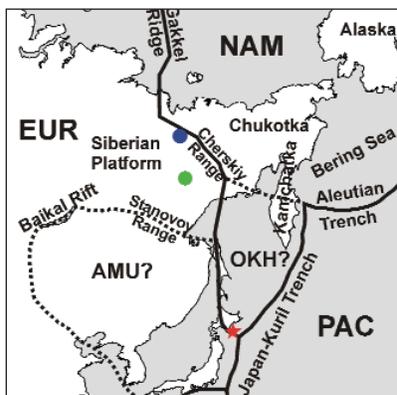
EDITORS' CHOICE

CONTINUED FROM 359

Steblov *et al.* combined geodetic data from eastern Siberia, the western Pacific, and the global network, collected between 1995 to 2002, to determine the boundary between the Eurasian and North American plates. Eastern Siberia, east of the Cherskiy Range, belongs to the North American plate, settling a 30-year debate. The geodetic pole of relative rotation for Eurasia–North America is shifted slightly north of the pole from the NUVEL-1A model; this difference may reflect plate motions recorded by the geodetic data from the past 7 years versus the longer-term motions (past 3 million years) estimated by the geologic data used in NUVEL-1A. Still to be determined is whether two proposed microplates, Okhotsk and Amurian, exist to the south of the Cherskiy Range in eastern Asia.

The 8.3 magnitude Hokkaido earthquake on 25 September 2003, which occurred offshore of the north island of Japan, is attributed to thrust faulting near the North American–Eurasian–Pacific plate triple junction, but if the microplates do indeed exist, then the earthquake occurred near the Okhotsk–Amurian–Pacific plate triple junction instead. — LR

Geophys. Res. Lett. 10.1029/2003GL017805 (2003).



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Targeting Prostate Cancer via G Proteins

Prostate cancer typically starts as an androgen-dependent tumor, but then can progress to androgen independence. Bookout *et al.* investigated the role of heterotrimeric guanine nucleotide-binding proteins (G proteins), specifically the $\beta\gamma$ subunits, in androgen-independent tumor growth in culture and in vivo. Androgen-independent PC3 human prostate cancer cells exhibited increased apoptosis when treated with recombinant adenovirus to induce expression of a G $\beta\gamma$ inhibitor, a peptide from the C terminus of G protein-coupled receptor kinase 2 (GRK2ct). Furthermore, injection of adenovirus carrying GRK2ct into PC3 tumors established in athymic mice slowed tumor growth and promoted apoptosis in the region adjacent to the injection site. Thus, inhibition of G protein signaling may represent another strategy for treatment of androgen-independent prostate cancer. — NG

J. Biol. Chem. 278, 37569 (2003).

CREDITS: (LEFT) GHOSH *ET AL.*, *J. AM. CHEM. SOC.* 10.1021/ja0367344 (2003); (RIGHT) STEBLOV *ET AL.*, *GEOPHYS. RES. LETT.* 10.1029/2003GL017805 (2003)