Woods Hole Oceanographic Institution in Massachusetts report that organic carbon caught in their sediment trap in the Canada Basin is "strikingly old", with an approximate age of 2,000 years. If the carbon in the trap came from particulate matter descending from the surface, as oceanographers would expect, its age should be indistinguishable from that of surface carbon.

The findings imply that organic carbon at a depth of 3,000 metres largely originates from the basin's surrounding margins. This sets the Canada Basin apart from other ocean basins studied and means that models generally used to describe ocean carbon cycling do not apply in the Arctic.

BIOCHEMISTRY

Cook the catalyst

J. Am. Chem. Soc. doi:10.1021/ja802404g (2008)

Microwaving enzymes that work best in hot environments can boost their activity at near-room temperature, find Alexander Deiters and his co-workers at North Carolina State University in Raleigh. They exposed several enzymes from hyperthermophilic organisms that function best at 90–110 °C to microwave radiation that warmed the enzyme–substrate mixture to around 40 °C.

Normally, the enzymes would have done little at 40 °C, but the microwaves multiplied their industriousness at this temperature, in one case more than fourfold. Deiters and his team attribute the effect to a loosening up of the enzymes' molecular structures, caused by interactions of the molecules and the microwaves' oscillating electric field.

MOLECULAR IMAGING

A gentler touch

Phys. Rev. Lett. **101,** 013001 (2008)

In order to watch chemical reactions as they happen, researchers need the constituent molecules lined up just right. Lasers can help to achieve this, but usually disturb the reaction process because they excite the molecules.

Hirofumi Sakai and his colleagues at the University of Tokyo now demonstrate a way to avoid this excitation with carbonyl sulphide molecules. First, they placed the molecules in a weak electrostatic field. Then they zapped the carbonyl suphide with a nanosecond laser pulse shaped like a cresting wave. The pulse's shape nudged the molecules into alignment, where they remained after it was turned off.

The team believes that this technique could be adapted for studies of reaction dynamics and molecular imaging.

TISSUE ENGINEERING

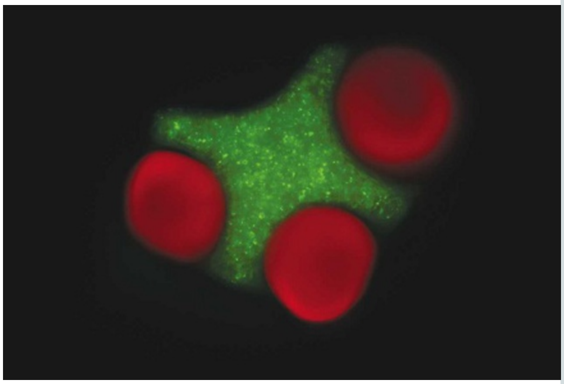
To rig with oil

Proc. Natl Acad. Sci. USA **150,** 9522–9527 (2008)

Three-dimensional artificial tissue structures can assemble themselves when shaken with a little oil, report Ali Khademhosseini at Harvard Medical School in Cambridge, Massachusetts, and his co-workers.

The researchers made use of the tendency of water and oil to repel one other to force water-loving microgels — polymers packed with cells — to form straight lines and other shapes (such as the cross attached to three rods, pictured below).

The hydrophilic microgels minimized their surfaces' contact with the oil by stacking closely together. The structures were later fixed in place by a cross-linking reaction.



A. KHADEMHOSSEINI

EVOLUTION

Sea skeletons

Nature Geosci. doi:10.1038/ngeo251 (2008)

Corals, sponges, bivalves and other calcifying marine creatures secrete their calcium carbonate shells and skeletons in the form of aragonite, calcite or both. The evolutionary successes of aragonitic and calcitic genera over the past 500 million years were influenced much more strongly by mass extinctions than by the chemical composition of the seas, researchers have found.

This is surprising because the oceanic ratio of magnesium to calcium has fluctuated throughout this period; a high ratio facilitates aragonite precipitation, a low one promotes calcite precipitation. But Wolfgang Kiessling of Humboldt University in Berlin, Germany, and his colleagues show that this cycling does not match the relative abundances of aragonite- and calcite-secretors in the fossil record. The mineralization changes correlate with mass extinctions, which seem to alter the fortunes of the two categories at random.

JOURNAL CLUB

Seth Putterman
University of California, Los Angeles

A physicist links magnetism, force and fatigue.

If a metal bar is repeatedly stretched and released it becomes fatigued and, eventually, ruptures. The latter can occur suddenly and unexpectedly: sometimes materials scientists can find no obvious thermodynamic hint that a steel rod is about to break. I am interested in fatigue because it parallels other phenomena that concentrate energy density, such as triboluminescence, whereby diffuse stress makes a crystal glow.

In both triboluminescence and fatigue, applied forces cause molecular rearrangements. But fatigue also involves nanometre-sized defects that accumulate during the useful life of a piece of metal and organize themselves into a soft spot. Recently, Sidney Guralnick and his colleagues at the Illinois Institute of Technology in Chicago measured how much work is needed to complete each 'stretch and release' cycle in rods of AISI 1018 steel, a common low-carbon steel that is used in vehicle parts such as gears (S. A. Guralnick *et al. J. Phys. D Appl. Phys.* **41,** 115006; 2008). This allowed them to follow changes in the material's response to force as it fatigued.

A shift occurred at merely 12.3% of the time to rupture. What is happening inside the steel at this point is mysterious, but the number holds true even when the useful life of identically manufactured rods varies by a factor of 200.

Further clues will no doubt come from steel's piezomagnetism — the fact that its magnetism varies with the degree of stretch it experiences. This relationship is complex: even when the metal is so slightly strained that it goes back to its original shape on release, its magnetic field does not return to the pre-stretched state. One day investigations into this property may uncover the organizing principle of the nanometre-sized defects that underlie metal rupture.

Discuss this paper at **http://blogs.nature.com/nature/journalclub**