Earth Science

Diamonds: A babe of 628 million years

While diamond lovers covet the clearest possible gems, geologists search the world over for stones marred by imperfections, because the impurities pack secrets about how diamonds form. A novel study of minerals trapped within one gem has now revealed the youngest known diamond, report Peter D. Kinny of the Curtin University of Technology in Perth, Australia, and Henry O.A. Meyer of Purdue University in West Lafayette, Ind.

The diamond, from Mbuji Mayi, Zaire, has an age of 628 million years, far younger than all previously dated diamonds, which range in age from 3.2 to 2.4 billion years.

"This suggests that diamonds have formed throughout geologic time and it wasn't just [early] periods when diamonds formed," says Meyer, who adds that diamonds are most likely still forming in Earth's mantle. He and Kinny discuss their research in the July JOURNAL of GEOLOGY.

In the past, geologists have dated diamonds by analyzing an aggregate of several mineral inclusions taken from different gems found in the same location. Kinny and Meyer analyzed only a single inclusion from one diamond, using a unique machine called the secondary high-resolution ion microprobe, or SHRIMP. Housed at the Australian National University in Canberra, SHRIMP sends a beam of ions that vaporizes a sample, which then passes through a high-resolution mass spectrometer. By measuring the amounts of uranium and lead isotopes, the scientists can use the radioactive decay of uranium as a clock to date the diamond.

Diamonds develop at depths of 200 kilometers under stable continental regions, where temperature and pressure conditions combine to force carbon into its extremely dense form. After resting there for millions or billions of years, the gems are brought to the surface by extremely fast volcanic blasts called kimberlite eruptions.

Megabergs left scars in Arctic

Oceanographers have discovered in the Arctic seafloor long grooves carved by ancient, giant icebergs far larger than any seen today. The evidence of these megabergs challenges previous ideas about what kind of ice covered the Arctic during the last ice age.

Peter R. Vogt and Kathleen Crane of the Naval Research Laboratory in Washington, D.C., and Eirik Sundvor of the University of Bergen in Norway detected the iceberg plow marks while mapping the seafloor northwest of Spitsbergen using a side-scan sonar on the Norwegian ship R/V *Håkon Mosby*. The depth of these scars indicates that some bergs extended 700 meters below the ocean surface.

"These are, to our knowledge, the first iceberg plow marks mapped in the Arctic Ocean proper and perhaps include the deepest iceberg drafts so far documented anywhere," the researchers write in the May GEOLOGY. Only the Antarctic today produces icebergs even approaching this size. The deepest iceberg keels ever measured reached 330 m below waterline, although researchers have hypothesized that some Antarctic icebergs today have keels 400 m deep.

Vogt and his coworkers discovered the plow marks along the flanks of a submerged feature called the Yermak Plateau. Because the top of the plateau shows few gouges, the oceanographers propose that it was beveled smooth by a thick ice shelf during the most recent ice age.

Climate researchers have long thought that the Arctic held only thin sea ice during the last glacial epoch. But the new results raise the possibility that a floating ice sheet some 400 to 600 m thick could have covered much of the ocean, say the researchers. If so, it may have connected the great glacial sheets covering North America and northern Europe.

Technology

A diode of many colors

At a typical intersection, cars take cues from a traffic light, whose colors turn from green to yellow to red.

Mimicking such color-changing sequences in light-emitting diodes (LEDs), commonly used to display information on electronic devices, offers practical advantages. Though LEDs already come in a range of colors, each hue requires a different kind of LED. So scientists have eagerly sought a LED that can produce a wide spectrum.

In the Aug. 4 NATURE, Vicki L. Colvin, a chemist at the University of California, Berkeley, and her colleagues report making a new kind of variable-color LED by blending cadmium-selenide nanocrystals with the semiconducting polymer *p*-paraphenylene vinylene.

By adjusting the size of the nanocrystals, the researchers can prompt the LED to shine yellow, orange, and red. By changing the voltage, they can get it to shine green.

"A traffic sequence," says Michael C. Schlamp, a chemist at Berkeley and a coauthor. "In theory, we should be able to get other colors too. We just haven't made the other nanocrystal clusters yet. But we will."

This LED has two unique features, says Schlamp. It represents the first use of nanocrystals in an electroluminescent device. And its color "can be adjusted without changing the method of material synthesis, just the size of the nanocrystals. One technique makes all the crystals. Their size varies based on how long they're brewed."

"That ability to tune the color of the electroluminescence by varying the nanocrystals' size is something that can't be done with polymers. To get a different color from a polymer electroluminescing device, you have to change the synthesis and make a different material," says Schlamp. "This is a big advantage for this kind of hybrid device."

Data holograms

Faced with a deluge of data – the ever-growing mountain of information brought on by the ubiquitous computer – researchers keep searching for ways to store lots of information in small spaces.

One route involves turning data into holograms.

Three Stanford University faculty members – physicist John F. Heanue and electrical engineers Matthew C. Bashaw and Lambertus Hesselink – have devised an information storage and retrieval system that records digital data holographically. Their report appears in the Aug. 5 SCIENCE.

The researchers achieve holographic storage by merging a laser beam carrying a picture with a so-called reference laser beam. The combination causes an interference pattern.

As the intensity of the interference pattern varies, a photosensitive recording material captures the signal. Once charged, the recording material's ability to refract light changes. "When the medium is exposed to a reference beam identical to the one used in recording, the light will diffract in such a way as to reproduce the original image," they explain.

A device called a spatial light modulator converts data into an optical signal for storage, they add. A hologram corresponding to one "data page" is then recorded in a special photorefractive crystal. By changing the angle at which the image is "written," or recorded, the system can store multiple holographic images.

To read the data, the reference beam illuminates the crystal, which reflects an image onto an array of charged coupled devices that converts the picture into an electronic signal.

The system works for both color pictures and video images, the researchers explain. In one case, they viewed, recorded, and accurately retrieved a holographic image of Leonardo da Vinci's "Mona Lisa."