CHEMISTRY

Mopping up plutonium — specifically

Production of plutonium is one of the major hazards associated with nuclear power plants. The toxic and radioactive material is a problem for people working with it and also contributes much of the radiation associated with long-term storage of nuclear plant waste. To help alleviate those problems, scientists at the Lawrence Berkeley Laboratory are designing molecules that bind plutonium and related elements (called actinides). The researchers are looking for substances that can remove plutonium from the body without sequestering essential elements and that can pull actinides from waste before it goes into long-term storage. Ken Raymond and Fred Weitl are successfully binding plutonium with the same type of chemical structures that nature uses to bind iron. However, they modify the molecules with such groups as sulfonic acid that are not found in natural chelators. The modifications make the compounds more soluble, less toxic and more resistant to air oxidation, Raymond says. The researchers have had to develop original synthetic schemes to make each new chelating agent.

To test the biological properties of a new agent, LBL physiologist Patricia Durbin gives a mouse an injection of plutonium followed by an injection of the chelating agent. She measures the amount of radioactivity in urine samples and, eventually, in the various mouse tissues. The best chelating agent synthesized so far is a sulfonated linear catechol amide. At one-tenth the concentration it removes plutonium as effectively as drugs now in use for treating plutonium poisoning, Raymond says. The new agent, in addition, does not complex iron, zinc and calcium as the current drugs do. Raymond described their research at the recent meeting of the American Chemical Society in Washington.

Smart drugs inhibit hormone action

Targeting drugs to the site of their desired action is a continuing challenge to medicinal chemists. Keith R. Latham and colleagues at the Uniformed Services University of the Health Sciences in Bethesda, Md., report that disguising an inhibitory substance as a hormone can create a highly directed drug. Latham reported to the meeting of the American Chemical Society that thyroid hormones coupled to mercury still bind specifically to the hormone receptors. The hormone can thus deliver mercury to hormone binding sites, where it inhibits the enzymes that metabolize the hormones and blocks the site, thus inhibiting hormone action. Latham says that mercury can be attached to almost any hormone by the methods his team has developed, so "smart" drugs may be in the offing for a variety of diseases, such as Parkinson's disease, Graves disease and hormone dependent tumors.

Natural defense against kidney stones

Urine contains small amounts of material that helps dissolve calcium oxalate, a major constituent of kidney stones, and thereby prevents kidney stone formation. Henry C. Margolis of Michael Reese Hospital in Chicago reports that he has isolated large enough amounts of that material for chemical studies. Because normal urine contains only small amounts of the inhibitors, Margolis made his isolation from an artificial system of growing kidney cells, he told the meeting of the American Chemical Society. He says that there is evidence that people who have a tendency to form kidney stones have less potent inhibitors or less than normal amounts present in their urine. Margolis is now working to determine the specific structure and properties of the inhibitors, which are glycoproteins. That information should be helpful in finding new drugs for prevention of kidney stones.

EARTH SCIENCES

Record-breaking icebreaker

Though a Soviet nuclear icebreaker was the first ship to reach the North Pole (SN: 8/27/77, p. 135), no U.S. ship has come close. Now, a Milwaukee-based Coast Guard icebreaker — the *Westwind* — has plowed farther into the Arctic icecap than any other U.S. ship, coming within 375 miles of the North Pole. The *Westwind* reached its record-breaking position of 85 degrees 45 minutes north latitude, which is 6 miles north of Cape Morris Jessup, the world's northernmost land mass on the tip of Greenland, on August 29, during a seven-week research cruise that originated July 1 in the ship's home port. The previous U.S. record was held by the Coast Guard icebreaker *Southwind,* which reached 83 degrees 01 minute on Aug. 15, 1970, in the Barents Sea, north of the Soviet Union. The six scientists on board the *Westwind* hope, among other things, to map the ocean bottom close inshore to eastern Greenland.

DSDP gets the hole story

The scientists of the Deep Sea Drilling Project gave the *Glomar Challenger* a little diversion last July from its normally months-long tours by conducting two weeks' worth of extensive, and in some cases previously unattempted, downhole experiments.

Unlike previous voyages of the DSDP in which several holes are drilled and studied, the researchers — led by Joe Cann of the University of Newcastle-upon-Tyne, England, and Stan M. White of Scripps Institution of Oceanography — concentrated on a single, 1,100-foot hole in the ocean floor between Ecuador and the Galapagos Islands. The purpose of their all-out assault was to study the effects of naturally circulating, subcrustal, superheated water on the development of the ocean crust.

Among the firsts claimed on the mini-leg is a literal picture of the inside of a drill hole. An ultrasonic beam, scanning the interior circumference of the drill hole every third of a second and moving nearly the entire length of the hole, produced a 9-foot mosaic portrait of the hole's interior wall. Clearly evident, according to the scientists, were the horizontal layering of the sediments, the cracks and fissures probably caused by circulating hot water and the "pillow" lavas formed when lava erupts onto the open sea floor. The instrument, recently developed for oil well inspection, had never before been used on ocean crust.

A Soviet magnetometer, which also scanned the entire length of the hole, produced the first magnetic portrait of a drill hole. As expected, the lava flow at the bottom of the hole had been erupted when the magnetic field of the earth was reversed, about 5.5 million years ago. The lava flow immediately above it, however, had a normal — or present day — polarity, indicating it may have erupted later. More surprising, however, was a strongly magnetic object detected in the sediments. According to the scientists, the object may be magnetite — a highly magnetic mineral — deposited by water when the sea floor formed.

Central to understanding the effects of circulating hot water on the crust is the permeability of the rock. In order to determine the rock's permeability, the researchers sealed off the lowest 100 feet of the drill hole and forced water into that section in order to create pressure. The rate at which the pressure drops indicates the permeability of the rock. The water pressure at the bottom of the hole — through 870 feet of sediment and 241 feet of volcanic rock — was 5,600 pounds per square inch. Under an additional 1,400 psi, the water dispersed very quickly, indicating high permeability.

Other measurements included recording gamma-ray radiation, which indicates the presence of volcanic ash, taking density and porosity measurements and analyzing a sample of the water believed to have percolated through the rock.