Meteor linked to rich ores at Sudbury

Take a nickel out of your pocket and chances are that the metal came from an unusual geologic structure in Ontario, Canada, called the Sudbury Igneous Complex. This 60-kilometer-long structure is made up of zones of different igneous (cooled from a molten state) rock types stacked like a series of elliptical-shaped bowls. Not only is it the world's largest single source of nickel, but it is also rich in copper and other elements.

In spite of a long history of mining, the geologic origin of the complex has remained in question for more than a century. Some scientists have argued that the complex formed when magma (molten rock) from the mantle moved up through the crust. But now three researchers present geochemical evidence in the Oct. 25 SCIENCE that fortifies another idea, originally suggested in 1964, in which the structure was formed when a meteorite slammed into the earth 2 billion years ago with enough energy to melt crustal rocks.

Asish R. Basu and Billy E. Faggart Jr. at the University of Rochester (N.Y.) and Mitsunobu Tatsumoto of the U.S. Geological Survey in Denver measured the concentrations of neodymium and samarium in 16 rock samples representing each rock type in the complex. The researchers chose to look at neodymium and samarium because these elements provide a powerful tool for differentiating between crustal rocks and material that comes from the mantle. For example, neodymium atoms are larger and somewhat lighter than samarium atoms, so they have a greater tendency to migrate into plumes of magma, which then rise to the crust, leaving proportionately more samarium in the mantle. And since samarium-147 radioactively decays into the isotope neodymium-143, one also expects to find a higher ratio of neodymium-143 relative to neodymium-144 in mantle-derived rocks than in crustal material.

Regardless of the rock type or the sample location, Basu's group could find no neodymium isotope ratios that reflected that mantle material. Instead, "we find a very strong signature of the upper crust," says Basu. "The only viable explanation is that the Sudbury Complex formed from the melting of crustal rocks by way of a meteoritic impact." The other main line of evidence pointing to an impact are previously discovered shatter cones — distinctively striated conical rocks that have been fractured in a way thought to result from shock waves.

While they have yet to work out the details, the researchers think the impact was responsible for the unusual abundances of ores at the complex. Basu suggests that the meteorite triggered the melting of very large amounts — much more than are typically associated with impacts — of both basaltic and granitic crustal rocks at Sudbury. When molten basalts and granite combine, he says, sulfur tends to separate out from the mixture just as oil and water separate after mixing. In so doing, the researchers think, the sulfur took with it nickel, copper and other elements from the melt to form the ore-rich, concentrated sulfide layer found at the bottom of the Sudbury Complex.

"That kind of process doesn't easily take place in ordinary volcanism in the crust," says Basu. Because the basaltic magma from the mantle cools constantly as it moves through and heats the crustal granites and sandstones, it doesn't have a chance to assimilate enough crustal rocks to produce the sulfide ores in such quantities, he says.

In addition to neodymium and samarium, Basu's group measured the concentrations of rare earth elements. They found that for light rare earth elements, the compositions of the Sudbury Complex rocks were essentially the same as those measured in the North American Shale Composite, an eroded sediment thought to represent the average upper continental crust.

The researchers also dated the Sudbury rocks using the samarium-neodymium radioactive clock to obtain an age of 1.8 billion years — in excellent agreement with previous dating using uranium and lead isotopes. These dates make the Sudbury Complex one of the earth's oldest known "astroblemes," or eroded impact craters. The group will present its findings at the upcoming Geological Society of America meeting in Orlando, Fla.

—*S. Weisburd*

Growth hormone okayed

The Food and Drug Administration last week approved the marketing of a bacterially manufactured human growth hormone. The hormone joins an insulin product as the only U.S.-approved human drugs made by recombinant DNA processes.

The approval is timely for the estimated 10,000 to 15,000 U.S. children whose pituitary glands do not produce enough of the growth-stimulating hormone. Last April the federal government halted distribution of a cadaver-derived version because three recipients had developed a rare, fatal viral disease.

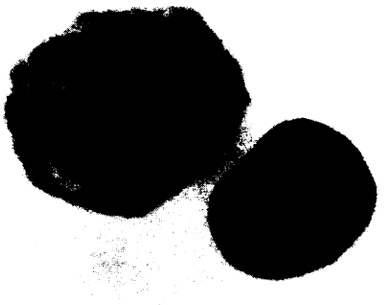
A spokesperson for Genentech, Inc., in South San Francisco, makers of the newly approved version, says that for ease of marketing and to prevent medically unsubstantiated uses, such as administering the drug to children with normal pituitaries and to athletes, the company is marketing the product only through hospital pharmacies in about 150 medical centers. □

Organ request law

The success of organ transplants gives hope to the very ill, but it also creates a waiting list of patients desperately seeking donor organs. Now lawmakers are attempting to increase the availability of scarce organs. As of Jan. 1, California will join New York and Oregon in requiring general acute-care hospitals to ask families for permission for organ donations whenever a patient dies.

The new rule also requires hospitals to notify organ procurement organizations when organs are donated, and to use "reasonable discretion and sensitivity" when contacting surviving family members. □

Daisy chains: Cyclosporine link



Journal of Cell Biology

The normally round nuclei of white blood cells known as helper T lymphocytes take on a daisy shape (above) after exposure to cyclosporine, an immune-suppressive drug. The morphological change suggests that cyclosporine alters the matrix supporting the chromosomes in the nucleus, says one of the phenomenon's discoverers, Allan Hess of Johns Hopkins University in Baltimore. And by doing so, he suggests, the drug halts genetic activity in the helper T cells, the orchestrators of the immune system.

The unusual shape change has also been reported in the nuclei of helper T lymphocytes infected by HTLV-I and -II, two leukemia-causing viruses related but not identical to the AIDS-associated virus, known variously as HTLV-III, LAV and ARV. But with the viral infection the change is irreversible, whereas two hours after cyclosporine exposure ends, the nuclei return to their round shape.

On the biochemical level, Hess and his colleagues have found that cyclosporine binds to calmodulin, a cell protein with many functions. The binding, they previously reported in the April 19 SCIENCE, *is a necessary step in the cell's activation and replication, and can be interrupted by cyclosporine. A report of the shape change is scheduled to appear in the January 1986* JOURNAL OF CELL BIOLOGY.