Yucca site: A conclusion and controversy

Geoscientists reported evidence this week that bolsters federal plans to store the United States' most dangerous nuclear wastes inside a Nevada ridge called Yucca Mountain. But even as they tried to lay to rest one subject of debate, they disclosed intriguing findings that will likely raise new questions about the long-term safety of the repository site.

The latest results counter a theory that has attracted considerable attention over the last year and has threatened the repository plan. That theory, put forth by geologist Jerry Szymanski of the Department of Energy, holds that earthquakes in the recent geologic past have caused the normally deep groundwater beneath Yucca Mountain to surge hundreds of meters toward the surface.

Such an event would spell disaster for the underground repository, which must remain extremely dry for the 10,000 years it will take waste from nuclear reactors to decay to safe levels. If groundwater flooded the repository during that time, it would carry away dangerous isotopes, spreading them into the environment.

Szymanski developed his groundwater theory to explain prominent subsurface mineral deposits found at a nearby site called Trench 14. According to the theory, the trench's calcite and opal deposits formed when upwelling warm waters carried deep minerals toward the surface along fractures in the rock.

A federal research team now reports it has ruled out that theory.

"What we have shown in the past year is that there is just no way for water to have come up to form those deposits in the last 500,000 years," says geochemist John S. Stuckless of the U.S. Geological Survey (USGS) in Denver.

At a meeting of the Geological Society of America in San Diego this week and in a paper in the Oct. 25 SCIENCE, Stuckless and his colleagues described numerous test results indicating the Trench 14 deposits formed from rainwater percolating down through the soil, rather than from floods of upwelling fluids.

The scientists "fingerprinted" the Trench 14 deposits by measuring five sets of isotope ratios for strontium, uranium, oxygen, carbon and lead. All of these elements come in several different forms, or isotopes, and the ratio of one isotope to another provides information about how a mineral deposit formed.

The isotope evidence has persuaded the Department of Energy, which runs efforts to evaluate the suitability of the Nevada site. "The evidence is overwhelming in favor of their results [contradicting the upwelling theory]," says Deputy Project Manager Maxwell B. Blanchard.

The Energy Department still awaits the conclusions of a National Academy of Sciences panel convened principally to resolve the Trench 14 issue. Although the panel will not present its final report until early next year, Stuckless says members have told him they find the isotope evidence "very compelling."

Panel chairman Barry Raleigh of the University of Hawaii told SCIENCE NEWS he could not discuss his group's conclusions, but he did say that "isotope methods are extremely powerful tools for determining where groundwater deposition in the Yucca Mountain area might have happened."

Szymanski, however, refuses to concede. "The fundamentals of their conception are just like people who thought that the Earth is flat," he says.

While the USGS scientists believe the isotope data settle the Trench 14 issue, a different set of deposits found in the mountain has raised new concerns. Carbon isotope ratios in almost all drill cores from the area reveal that calcite deposits above the present water table are depleted in the carbon-13 isotope — an indication that the water table has not changed much since the deposits formed. But one drill core, from Hole USW-G4, shows carbon-13-enriched deposits from 500 meters above the current water table.

On its own, this one piece of data would indicate that at some point in the past, the water table sat high enough to flood the planned repository, says Joseph F. Whelan of the USGS in Denver, who presented these preliminary findings at the meeting. But he and his colleagues say they are confused because nearby drill holes show no evidence of such high water levels.

Szymanski takes the new data as proof that Yucca Mountain should not serve as a nuclear waste repository. Stuckless counters that the unsolved puzzle need not threaten the repository plan because these deposits may be millions of years old — so ancient that they would have little bearing on modern geologic activity at the site. — *R. Monastersky*

USGS

Scientists standing in Trench 14 examine white veins of calcite and opal deposited in a fracture near Nevada's Yucca Mountain. The mineral veins lie at the heart of a scientific controversy about the safety of building a repository inside the mountain to hold spent fuel rods from the nation's nuclear power plants.

Bone savers: Rating lifestyle and drugs

Osteoporosis, an embrittling bone loss common among postmenopausal women, causes roughly 1.3 million fractures in the United States each year. A new Australian study — the first to pit the three most common preventive regimens head to head — confirms what other studies have suggested: Estrogen-replacement therapy offers the best protection against osteoporotic bone fractures. However, the same study shows that in the absence of hormone supplements, a combination of regular exercise and calcium-rich diet can significantly slow osteoporosis.

"I was surprised that this lifestyle approach was as successful as it was," says study director Richard L. Prince of the University of Western Australia in Perth.

He and his co-workers recruited 120 nonsmoking women, aged 52 to 60, and assayed their bone density at three forearm sites every three months for two years. Densities initially hovered in the lower 40 percent of those seen in women the researchers had studied previously, indicating a high risk of eventual fractures.

The researchers encouraged the women to take at least one hour-long, low-impact aerobics class and two brisk, 30-minute walks a week. In addition, they gave all 120 women identical-looking sets of pills. One-third received daily placebo pills, another third took 1 gram of calcium per day, and the rest received estro-