

Drilling begins in search of molten energy

With visions of clean, abundant energy dancing in their heads, Energy Department investigators last week started drilling an ambitious hole into the heart of an active volcanic system in central California. The \$8 million exploratory well marks the initial phase in a plan to pull heat energy out of molten rock in volcanic regions.

"The potential energy resource locked up in magma, or molten rock, at temperatures above 650°C is really enormous," says project manager James C. Dunn from Sandia National Laboratories in Albuquerque, N.M., which directs the drilling.

Magma energy is the least developed form of geothermal energy, and the United States has explored the possibility of exploiting this source since the early 1970s. The Department of Energy picked Long Valley Caldera, near Yosemite National Park, for the first full-scale test because evidence suggests magma is pooling at a shallow depth below the crater, which formed in an eruption 720,000 years ago. Over the last decade, the caldera's center has bulged upward by 0.5 meter and swarms of earthquakes have rocked the region. Geophysical tests hint that the roof of the magma chamber lies at a depth of 5 to 7 kilometers.

The drilling project will not actually penetrate into magma, which can reach temperatures of 1,200°C. Rather, planners envision drilling until the well reaches either a depth of 6 km or a temperature of 500°C, a project that should take four years. Information gathered from that depth will help scientists plan subsequent stages of the program to extract magma energy.

Most important, the exploratory hole will reveal whether the caldera truly holds a magma chamber at a shallow, drillable depth. Dunn says this is the first time investigators have drilled to assess the accuracy of the geophysical surface tests.

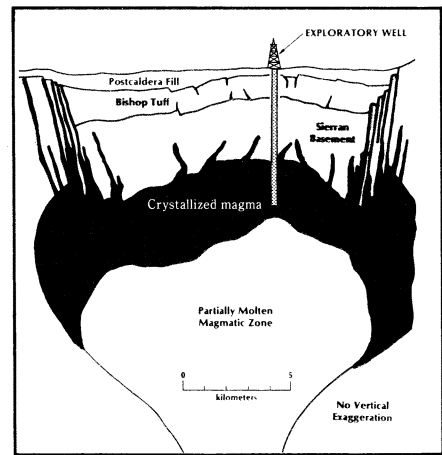
The drill hole will bypass some of the problems limiting the resolution of those tests. The Sierra Nevada mountains to the west cause near-surface groundwater to flow eastward across the caldera, carrying magma-generated heat away from the region. This effect skews the picture scientists derive from heat-flow measurements. In addition, layers of porous volcanic rock dampen the seismic waves that can indicate underground structures. By reaching below the porous layers into regions where groundwater flows much more slowly, scientists hope to gain a clearer view of the magma location.

Moreover, experiments in the bore hole will help define the size of the magma chamber and the chemistry of the rock — factors that determine how much energy can be extracted.

Aiming to pierce 500°C rock, the project will push drilling technology to its limit. The Energy Department plans to test new high-temperature equipment, including an insulated drill pipe designed to protect lubricating drilling fluids from damaging heat.

If studies do reveal a large magma body at a shallow depth, a follow-up project calls for drilling a well into the magma itself. In theory, molten rock around the well should harden and crack as a result of the drilling. A geothermal plant could then generate pressurized steam by pumping water down into the fractures of the hot rock.

Geoscientists say the exploratory hole will provide a unique opportunity for basic science experiments. But with funding for the drilling coming from the Department of Energy's geothermal technology office, science will receive second priority behind the project's main thrust, energy. While the federal government does plan to fund some basic research, scientists express concern that budgetary constraints will severely limit such work. Money problems last year curtailed the drilling of the nation's deepest scientific hole, located near the San



Project will drill directly above molten magma in California volcanic crater.

Andreas fault. Planned to reach a depth of 5 km, the hole bottoms out at 3.5 km (SN: 3/26/88, p.199).

Meanwhile, the Soviet Union plans to continue drilling its 12-km-deep hole on the Kola Peninsula. The deepest drill hole in the world, the Kola well is only one of 11 holes the Soviets are currently drilling to a planned depth greater than 8 km. West Germany has just finished a 5-km-deep pilot hole as a prelude to drilling a 10-km-deep hole for basic science research.

—R. Monastersky

Preventing pregnancy with the cervical cap

Near-perfect use of the cervical cap carries a first-year pregnancy risk of 6 percent — half the risk posed by typical use of the cap, say researchers who have completed the largest clinical trial to date of the recently introduced birth control device.

"This is one of the first studies to look at the relationship between the style and type of use of a [contraceptive] method and [its] effectiveness," says Gary A. Richwald of the School of Public Health at the University of California, Los Angeles. He and his colleagues studied 3,433 women fitted with a cervical cap — a rubber cup about 3.5 centimeters in diameter, held in place over the cervix by suction and carrying a film of spermicide. Their report appears in the August *OBSTETRICS AND GYNECOLOGY*.

The Food and Drug Administration approved marketing of the cervical cap in May 1988 after a National Institutes of Health study and other reports demonstrated its effectiveness in preventing pregnancy. The NIH study randomly assigned 1,529 women to a cervical cap or diaphragm, finding overall first-year failure rates of 17.4 percent for the cervical cap and 16.7 percent for the diaphragm. But these rates included statistics on typical users, who may occasionally forget to use the cap or spermicide. Richwald's study shows that near-perfect users — women who never

have sex without the device, use spermicide 100 percent of the time and wear the cervical cap no longer than 72 hours — have a much lower risk of unintended pregnancy than the overall average reported by NIH.

Richwald's team found no serious medical complications with the cervical cap, although more than 20 percent of the women in their study reported cap dislodgement during or after intercourse. Some women discontinued its use for this reason, although Richwald says dislodgement shouldn't contribute much to pregnancy risk because the cap works by delivering a spermicide dose near the cervix.

The cervical cap is an effective and convenient birth control method, comments Cynthia Pearson of the National Women's Health Network in Washington, D.C. But she adds that more research must determine whether the device boosts a woman's risk of cervical cancer. The NIH study hinted that cap users, compared with diaphragm users, may have a greater chance of developing cervical cancer, but Richwald's study found relatively few cap users with abnormal Pap smears indicating cervical cancer risk. Still, FDA advises cap users to get a Pap smear after the first three months of use, while an ongoing postmarketing study attempts to assess any potential cancer risk.

—K.A. Fackelmann