his colleagues remeasured that site, they found the tundra releasing CO_2.

Temperatures in northern Alaska have risen in recent decades and may have precipitated the change measured by Oechel by drying the tundra and stimulating microbes in the peat. "I personally feel we're seeing the first effects of greenhouse warming," he says. "But even if that's not the case, it gives us indications of how ecosystems will perform when and if that warming occurs."

If tundra across the Arctic were releasing as much CO_2 as Oechel measured in northern Alaska, it would produce roughly 5 percent of the amount that humans emit through burning coal, gas, and oil. Oechel plans to make measurements this summer in Russia.

Jonathan T. Overpeck of the National Oceanic and Atmospheric Administration in Boulder, Colo., calls the pair of new studies a one-two punch: "Anyone who is going to say you can't believe the modeling stuff because it's so oversimplified better wake up when they see the numbers coming from the tundra."

Yet some tundra scientists remain unconvinced that the tundra has stopped storing CO_2. "I wouldn't put any significant money of my own down to say that it has changed much," says Donald Schell of the University of Alaska in Fairbanks.

—R. Monastersky

First direct measure of volcano's blast

Since Japan's Unzen volcano awoke in 1990 from a 200-year repose, lava has oozed from a vent on its eastern slope, forming an unstable dome that looms menacingly over towns below. Periodically, part of the dome shears off or collapses, releasing a cascade of debris with explosive force.

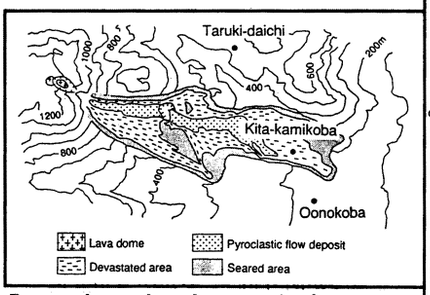
Volcanologists yearn to measure directly the energy released during such volcanic events. But such close-up, detailed observations pose extreme danger, and the fury unleashed by a dome collapse can turn expensive instruments into scorched, shattered hulks.

Now, using a simple, rugged device designed to gauge military munitions and other explosives, Japanese scientists have achieved the first direct measurement of the energy released during a volcanic blowout. Volcanologist Hiromitsu Taniguchi of the Science Education Institute in Osaka and geologist Keiko Suzuki-Kamata of Kobe University report their findings in the Jan. 22 GEOPHYSICAL RESEARCH LETTERS.

The researchers measured the shock wave created by a dome collapse on June 8, 1991, and then calculated the pent-up energy required to generate it — the equivalent of about 12,000 tons of TNT. Previously, volcanologists relied on more approximate measurements. In one widely used method, researchers locate a chunk of debris and calculate the energy required to hurl it from the volcano to its landing place.

To make their measurements, Taniguchi and Suzuki-Kamata set up three meters within the volcano's destructive range. The pressure-sensitive part of the meter consists of a hollow chamber about two inches wide, covered with a thin lead plate. The sensor is mounted on a sturdy pole driven into the ground.

The researchers calculated the June 8 shock wave at 75 meters per second at the source on the basis of how severely the wave deformed the lead plate as it passed the meter at Taruki-daichi, a town



Taniguchi and Suzuki-Kamata

Researchers placed meters in three towns near the eastern slope of Unzen to measure directly the energy released by a lava dome collapse.

2,700 meters northeast of the lava dome. That's powerful enough to knock over a person standing in Taruki-daichi, they report.

The new method of measuring may reduce inaccuracies, says Richard B. Waitt, a volcanologist at the U.S. Geological Survey's Cascades Volcano Observatory in Vancouver, Wash. "It's a far more direct means of [making measurements]," he says. "This allows some calculations as to what the volcano is capable of."

Unzen has proved capable of quite a lot. The blast that the Japanese researchers measured came just five days after a massive flow of hot ash and debris from a dome collapse killed 43 people in Kita-kamikoba, a town directly in the firing line of the volcano's east-facing vent.

Direct measurements of volcanic blasts may provide a means of checking the theoretical models some volcanologists have created to explore the physics of crumbling lava domes, says volcanologist Jonathan H. Fink of Arizona State University in Tempe, who helped develop such a mathematical tool.

"It's interesting that the number these [researchers] came up with — 75 meters per second as the maximum velocity — is well within the range that we would calculate based on the model," Fink comments.

—D. Pendick

Suicide signs loom in pair of surveys

Two new studies provide behavioral clues to the likelihood of attempting or completing suicide among members of two disparate groups: predominantly white, middle-aged nurses and teenagers of both sexes and varied ethnic backgrounds.

Among nurses tracked for 12 years, suicides rose markedly as cigarette smoking increased. And in a large sample of students in public high school, a particularly strong association emerged between thinking about or attempting suicide and committing aggressive acts such as carrying weapons and fighting.

Both studies, and a comment on the findings by psychiatrist David Shaffer of the New York State Psychiatric Institute in New York City, appear in the February AMERICAN JOURNAL OF PUBLIC HEALTH.

No decisive explanation exists for the connection between cigarette smoking and suicide, concludes a scientific team headed by David Hemenway, an epidemiologist at the Harvard School of Public Health in Boston. The researchers consider it unlikely that smoking causes suicide in any direct way. However, they note that smokers suffer increased rates of alcoholism and cancer, both of which boost the risk of carrying out a suicide, according to previous studies.

Independent data indicate that common genetic factors may predispose some people to both cigarette smoking and severe depression; the latter poses a major risk of suicide (SN: 1/30/93, p.71).

Hemenway and his co-workers studied more than 100,000 female registered nurses, age 30 to 55, living in 11 states. Participants completed questionnaires mailed every two years from 1976 to 1988. The researchers obtained death certificates for volunteers who died during the study; these documents provide a conservative estimate of the number who killed themselves.

Compared with those who had never smoked, women who smoked one to 24 cigarettes daily displayed twice the likelihood of committing suicide, and those smoking 25 or more cigarettes daily exhibited four times the likelihood of committing suicide, Hemenway's team contends.

The analysis did not consider other factors linked to suicide, such as alcoholism and depression, but it stands as a rare long-term study of the relation between a specific behavior and subsequent suicide, Shaffer asserts.

The second study, directed by epidemiologist Carol Z. Garrison of the University of South Carolina in Columbia, relied on questionnaires completed by 3,764 students in grades 9 through 12 regarding their behavior in the year prior to the survey. Youngsters attended public

schools throughout the state.

Three-quarters of the sample reported no thoughts of or attempts at suicide. About 11 percent cited serious suicidal thoughts, more than 6 percent acknowledged making a specific plan to kill themselves, and 7.5 percent reported making a suicide attempt.

Most suicide attempters reported formulating a plan to kill themselves rather than acting impulsively, the researchers say.

Cigarette smoking and use of alcohol and illicit drugs increased among those reporting suicide thoughts or attempts, the team reports. But teens who cited the most aggressive behavior stood the greatest chance of thinking about, planning for, or attempting suicide. This link remained after statistically controlling for alcohol and illicit drug use, race, and gender.

Aggressive teenagers may prove more likely to act on suicidal thoughts and plans when depressed, frustrated, or scared, Garrison's team suggests. However, they lack data on symptoms of depression among the students.

The South Carolina findings suggest that suicide prevention efforts should concentrate not only on depressed teens, but on highly aggressive and alcohol-abusing adolescents, Shaffer argues.

—B. Bower

Detecting an electromagnetic vacuum force

The electromagnetic force, which binds electrons to atomic nuclei, can have such distinctive effects in different situations that physicists have often given these effects special labels. Manifestations of the electromagnetic force range from the van der Waals forces of attraction between molecules and atoms to the postulated Casimir-Polder interaction between a neutral atom and an electrically conducting plate.

Now, researchers have for the first time obtained experimental evidence clearly demonstrating the existence of the elusive Casimir-Polder force. Edward A. Hinds and his co-workers at Yale University report their findings in the Feb. 1 PHYSICAL REVIEW LETTERS.

The Casimir-Polder interaction arises out of a quantum effect associated with fluctuations of electromagnetic fields in a vacuum. In 1948, H.B. Casimir and D. Polder proposed that such vacuum fluctuations would cause an observable attraction between an isolated, neutral atom and a flat, conductive plate.

Though extremely small, this attractive force would be the dominant influence when plate and atom are separated by distances much greater than an atomic diameter. At such distances, the time it takes for an electromagnetic field (or photon) to travel back and forth between atom and plate becomes significant. Known as retardation, this phenomenon affects how atom and plate interact with each other.

To detect the Casimir-Polder force, Hinds and his colleagues studied the deflection of sodium atoms traveling down the gap between two nearly parallel plates coated with gold. In the absence of other interactions, the sodium atoms would experience a Casimir-Polder force that pushes them sideways toward the plates as they move along the gap.

To detect such a minuscule effect, the researchers had to be particularly careful to avoid contamination of the gold film, which could give rise to stray electrical fields. Such fields would cause effects obscuring any attraction that could be attributed to the Casimir-Polder force.

The experiment "was a lot harder to do than it looks," says graduate student Charles I. Sukenik, a member of the Yale team.

The measurements reveal the presence of an atom-plate interaction that clearly fits a Casimir-Polder force much better than it does a van der Waals force. "Our results confirm the magnitude of the [Casimir-Polder] force and the distance dependence predicted by quantum electrodynamics," the researchers conclude.

"It's a really elegant experiment, beautifully carried out," comments Stephen R. Lundeen of the University of Notre Dame (Ind.).

Lundeen and his co-workers have attempted to detect the Casimir-Polder interaction in a different type of experiment. They studied transitions from one energy level to another in a helium atom in which one electron has been excited so that it tends to remain much farther from the helium nucleus than it would in its ground state. "We wanted to do a high-precision test on a microscopic scale," Lundeen says.

These experiments yielded the most precise measurements yet of energy levels to which the Casimir-Polder force makes a discernible contribution. However, the researchers found a minute but significant and puzzling discrepancy between their experimental results and theoretical calculations—based on quantum electrodynamics — of what those energy levels should be.

"We're seeing a vast difference from the energy levels that would exist in the helium atom if there were no retardation," Lundeen says. "But we have a clean experimental result that is in rather dramatic disagreement with the best available calculations."

Whether the Casimir-Polder force plays any role in this discrepancy remains unsettled. "It'll be interesting to see how this matter gets resolved," Lundeen says.

—I. Peterson

Valdez spill leaves lasting oil impacts

On March 24, 1989, the *Exxon Valdez* supertanker ran aground in Alaska's Prince William Sound. Ruptured holds released a fifth of the vessel's oil — some 10.8 million gallons of Prudhoe Bay crude. Over three years, Exxon, the state, and the federal government coordinated a $2.5 billion cleanup—sometimes involving 10,000 workers.

At an oil-spill symposium in Anchorage, Alaska, last week, scientists reported that both the pollution and its cleanup took a heavy toll on south central Alaska's marine ecosystems. And though many plants and animals are recovering, notable exceptions exist. The meeting marked the first general release of government-funded research on effects of the *Valdez* spill, observes Bruce A. Wright of the National Marine Fisheries Service in Auke Bay, Alaska, a coordinator of spill-damage assessment research.

Federal law requires that state and federal agencies name "trustees" to establish public claims against firms that damage natural resources. Trustees managing the case against Exxon prohibited their researchers from discussing spill effects prior to court approval, on Oct. 1, 1991, of a $900 million settlement from the Irving, Texas-based Exxon Co. USA. Planning for this meeting began just after that, Wright says.

No one knows exactly how much *Exxon Valdez* oil ended where. The National Oceanic and Atmospheric Administration (NOAA) is attempting to "reconstruct" the oil's trajectory and estimate its removal by plugging both weather data and observations from spill sites into sophisticated computer models.

Preliminary analyses indicate that 20 percent of the oil evaporated — 8 percent on day one alone, according to Douglas A. Wolfe, chief scientist of NOAA's ocean assessments division in Rockville, Md. He says another 50 percent probably degraded on beaches, in the water, and within tidal sediments; an estimated 12 percent now lies in deep (nonbeach) sediments, and some 3 percent remains on intertidal shores, usually as tarry deposits.

Mechanical water skimmers removed some 8 percent of the oil. Wolfe estimates that cleanup crews recovered 6 percent more from sand and sediment or dispersed this oil into the water, where less than 1 percent remains.

"Skimming was operation heartbreak . . . [because] not a lot of oil was picked up," recalls Coast Guard Vice Admiral Clyde E. Robbins, who served as the cleanup's initial, federal on-scene coordinator. Cleaning heavily oiled shorelines proved a more visible success, he says. Hot-water washing and treat-