next year's drilling, the company hopes to take the commercially significant step of classifying some of the hydrate resource as energy reserves, says Michael D. Max, a geologist with the Naval Research Laboratory in Washington, D.C. "What that means is [the resource] changes from a possibility to a certainty. That means they would be able to put some recovery numbers on it, and they can start looking at the commerciality and the costs," says Max.

Right now, the costs of producing methane hydrates remain a big question mark because nobody has tried to extract this resource, with the possible exception of the operators of a controversial well in Siberia. Solid hydrates won't come out of the ground as easily as oil and so-called conventional gas, which can flow through rock pores and then up through the drill pipe.

One way to pry hydrates loose would be to release some pressure on the deposit, which would cause the methane and water to split apart, or dissociate. The advantage of this technique is that it would be relatively cheap, says Collett. To relieve pressure, a drill crew could tap the methane gas that often accumulates underneath and pushes up on the deposit. Unfortunately, this process might work too slowly, he says. As hydrates dissociate, they cool down, which stabilizes them and prevents more hydrate from melting.

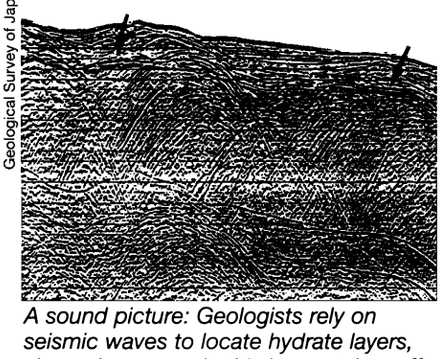
To speed up the process, crews could drill far below the methane hydrates and pump hot water upward into the deposit, thereby melting the hydrates. Or, they could inject antifreeze from the surface to spur dissociation. "But when you look at the total balance sheet of the issue," says Collett, "the minute you start looking at enhanced techniques, you're putting energy and money into the project, and gas is not a real expensive commodity. So, you end up with the problem that you're putting more money in than you're going to get out in the form of gas."

Even though hydrates remain uneconomical at present, U.S. policy makers see other reasons for researching these deposits. Oil-drilling operations in the Gulf of Mexico are now moving into water more than 1,000 m deep and are starting to drill through methane hydrate layers more frequently, raising safety concerns. A drill spinning through the hydrate can cause it to dissociate, and each liter of melted hydrate releases 160 liters of gas, says Robert S. Kripowicz, acting assistant secretary for fossil energy at the U.S. Department of Energy.

The freed gas can explode out of the hole, causing the drilling crews to lose control of the well, a costly problem to solve.

"Offshore operators are increasingly reporting problems of drilling through hydrates," Kripowicz told the House energy subcommittee.

Geological Survey of Japan



A sound picture: Geologists rely on seismic waves to locate hydrate layers, shown by arrows in this image taken off the coast of Japan.

Geological Survey of Japan

A map of Japan shows suspected fields of methane hydrates. Next year, the Japan National Oil Corp. will drill into region number 4.

Engineers are exploring whether unstable hydrate layers could give way beneath oil platforms or even play a role in triggering tsunamis (SN: 10/3/98, p. 221). Climate researchers have also grown concerned about hydrates because global warming could melt some shallow methane deposits, releasing millions of tons of this potent greenhouse gas into the air.

With so little known about methane hydrates, energy experts say that it is hard to predict whether society will ever tap into these deposits as a fuel source. Still, the Japanese initiative has spurred other oil companies to take an active interest. At a meeting last month in Chiba City, Japan, a group from Shell International Exploration and Production, B.V., discussed its analysis of exploiting methane hydrates. "Our consensus is there are no show stoppers. There is nothing that we cannot handle technically. If we encountered a good accumulation of natural gas hydrates, we could develop it with the existing technology," says Wim J. A. Swinkels, a member of Shell's gas hydrate team. The only issue standing in the way right now, he says, is economics.

Yet, the days of plentiful oil and gas are numbered, and countries will require new energy sources to keep the wheels of progress spinning. "We're enjoying a wonderful economy right now, largely because of the very low cost of energy," said Rep. Vernon J. Ehlers (R-Mich.) at the recent hearing on methane hydrates. "I'm very worried about what's going to happen when the cheap oil is gone, and we're not paying enough attention to it." □

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for self-importance through power. The young are especially vulnerable because adolescence is a period of wide vacillation between self and other—the stage in which we try each bias, testing our wings as independent decision makers. Their need for security can be intense.

M.M. Kramer
Wausau, Wis.

Although every anecdote of violence in the article "Incriminating Developments" quite appropriately describes the actions of boys, the article makes no mention of the possible role of gender in juvenile violence. It is a wonder that so many learned professionals can apparently ignore the fact that about 90 percent or more of all violent conduct is the conduct of boys and men. If we ever hope to understand these terrifying events, we must first ground our inquiry in reality by asking about the roots of aggression and violence in boys.

Judith A. Ferry
Kingston, N.Y.

Researchers have long noted the surplus of male violence, although the rate for females is now rising. —B. Bower

More experts on experts

The sooner we figure out how experts make decisions, the better. Gary Klein, a psychologist, calls the experts' process "naturalistic decision making" as opposed to whatever it is the rest of us rely on ("Seeing through Expert Eyes," SN: 7/18/98, p. 44). Patricia Benner, a nurse, proposed a similar concept about nurses' decision making (*From Novice to Expert*, 1984, Addison-Wesley).

Sandy Oestreich
North Redington Beach, Fla.

A colleague and I were both surprised that you could write such a long article without mentioning case-based reasoning once.

It was developed primarily by Janet Kolodner at Georgia Tech about 10 years ago and has been the basis for a wide range of expert systems that have been used to recognize situations and apply and tailor solutions to them. There are several commercial systems based on the technology.

An area for future research along these lines would be areas like sports officiating. Sports officials first have to learn the laws of their respective games and then learn how to recognize situations and react appropriately. Usually, events happen far too quickly to be able to reason out whether a foul has occurred. Very often, judgment enters into decisions when it is necessary to gauge the impact of an action. The World Cup presented many of these opportunities recently.

Ivan Mann
Birmingham, Ala.