Breaking Through Barriers

Martin Hovland, Statoil, Norway

Gas hydrates are crystallized gas and water that form under high pressure and low temperatures in the deep sea. These natural gas reserves could potentially contain as much energy as all other forms of fossil fuels combined, but are poorly understood.

ODP's extensive scientific and safety review process has allowed it to make discoveries in areas previously off limits to drilling — including areas with hydrates. An anomalous sub-seabed boundary known as the "Bottom Simulating Reflector" (BSR) was discovered about 30 years ago in deep water. It represents a barrier formed between sediments containing frozen gas hydrates located above sediments charged with free gases. Because the BSR was interpreted as a dangerous barrier to drill through, it was avoided in all drilling campaigns until the mid-1980s, when ODP Leg 112, off Peru, intentionally pierced through it without incident. Since then, BSRs have been penetrated on several other ODP legs, including Leg 146 on the Cascadia Accretionary Margin in the Pacific Ocean, and Leg 164 on the Blake Ridge off North Carolina in the Atlantic Ocean.

Breaking through the BSR has placed ODP at the forefront of gas hydrate research. The scientific results of these pioneering drilling campaigns have provided us with much needed basic knowledge on the dynamic fluid flow and gas hydrate formation mechanisms in deep ocean sediments important for possible future industrial drilling for hydrocarbon exploration and exploitation.

For example, a recent expedition, Leg 204, examined hydrates offshore Oregon in an area known as Hydrate Ridge. Among the most surprising findings of Leg 204 was that hydrate is forming very rapidly below the seafloor. Scientists also gained an understanding of the importance of sediment properties, such as composition and size of grains, in the distribution of hydrate within the sediments, which may provide clues to their locations.

The safe drilling shown in these difficult operations, where all possible cautionary action was implemented, has demonstrated the value of having panels of experts to overlook and review each and every hole to be drilled. In the case of the BSR-penetration, ODP's Pollution Prevention and Safety Panel, which reviews each drilling site, finally allowed and approved these campaigns.

Figure 1

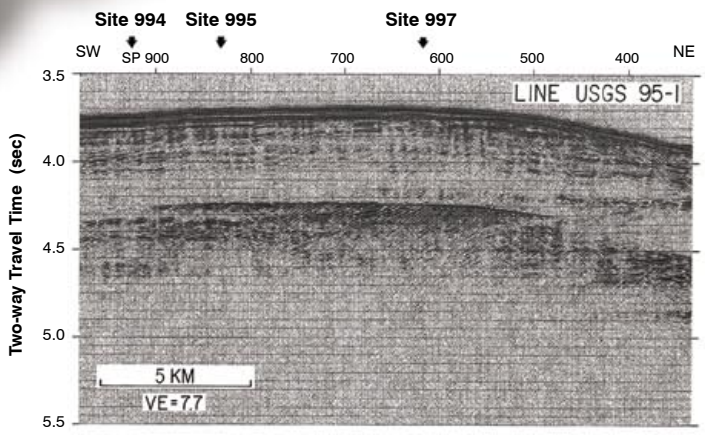

Figure 2

Figure 1. Hydrate sample collected on ODP Leg 204.
Figure 2. Seismic reflection profile (USGS 95-1) showing the BSR collected from Cape Hatteras during ODP Leg 164.