

## **What are Gas Hydrates?**

Sometimes called “Fire Ice”, gas hydrates are ice-like compounds composed of water and methane gas in very compact form. Immense quantities of gas hydrates exist in permafrost and offshore regions around the world.

### ***Gas Hydrates affect humans in three distinct ways:***

- As a potential energy source
- Worldwide, the total amount of carbon in hydrate form is believed to be twice that of all conventional reserves (coal, oil, and natural gas) combined. To put that into perspective, if methane hydrates were the only source of US. Energy, the mean estimate, if fully recoverable, could provide energy to the US at current consumption rates for 64,000 years!
- As a submarine geo-hazard
- Decomposition of gas hydrates produces large volumes of gas which can affect submarine slope stability. Gas hydrates may have been involved in triggering the Storegga slide off the west coast of Norway. This slide occurred 7000 years ago but produced a slide scar covering 34,000 km squared with a headwall 290 km long and run-out distances of up to 800 km – but the truly amazing aspect of this slide is that the original slope angle was only about 2 degrees
- As a factor in global climate change
- Methane gas is an important greenhouse gas with a global warming potential 3.7 times that of carbon dioxide. Up to 12 percent of greenhouse effects are the result of atmospheric methane therefore it is important to have an accurate inventory of the sources and stocks of methane.

## **Discovery of Methane Hydrates**

University of Victoria researchers discover canyon full of methane hydrates

Canada may have another energy resource, thanks to a discovery made by a University of Victoria ocean researcher.

University of Victoria geophysicist Dr. Ross Chapman and the crew of Canadian Coast Guard Ship John P. Tully travelled to Barkley Canyon, just off Uclulet, last month where they found the largest amount of methane hydrates ever discovered on the seafloor off Canada.

The finding has two major implications. First of all, methane hydrates are a potential alternative energy source. Secondly, scientists suspect its release from the ocean floor during earthquakes may add to greenhouse gas levels in the Earth’s atmosphere.

Methane gas has gained ground against other sources of energy such as coal, hydroelectric power and nuclear energy. It stands out as a readily available and cheap fuel, and its characteristics could make it the energy source of the future.

An untapped source of methane gas, hydrates are ice like formations formed on the ocean floor during subduction, when a plate of the earth's crust dives beneath another. This causes fluids, containing gas, to rush to the surface. When the gas is at greater depths it is warm, and as it moves vertically up the sediment column, it freezes as a hydrate. The result is a crystalline solid that consists of methane molecules, which are individually surrounded by a cage of water molecules.

Since methane hydrates form under conditions of high pressure and low temperature, they begin to decompose into gas and water as soon as they are removed from the ocean floor. Like a huge Bromo Seltzer, they bubble, fizz, and vaporize when exposed to surface-level air pressures.

Methane hydrates are estimated to be twice as numerous as the world's known oil, coal and natural gas deposits. Hundreds of deposit sites have been identified off the coasts of Japan, India and Costa Rica, among others, and countries such as Japan have invested millions of dollars researching extraction methods.

Chapman and his colleagues have been researching methane hydrates for 10 years and have been using the Canadian submersible ROPOS (Remotely Operated Platform for Ocean Science) to look for evidence on the seafloor. After some deep-sea fishermen pulled up some hydrates two years ago, Chapman suspected that he would find methane hydrates in the area. But until now he has never seen such huge mounds of hydrates in Canadian waters.

"We knew the methane hydrates existed because of seismic investigations offshore," says Chapman, "But when we sent our ROPOS down 850 metres to the seafloor we found masses of methane hydrant mounds. Most of them were three or four metres high and 10 metres wide – the size of a house.

Chapman estimates that the deposit takes up three or four square kilometres of the seafloor. "On our second day out we saw small oil slicks on the ocean's surface. At first we thought they were from the submersible, or the ship. But they were actually coming from the methane hydrates. When we tested the oil we discovered that it had come from deeper in the sediments and had the consistency of a highly refined gasoline."

While this discovery is exciting for the scientific community, commercial extraction remains a long-term proposition because the technology to tap the hydrates doesn't exist yet. Canadian US experts predict it could take decades to develop the technology.

As well, Chapman warns that a major earthquake could have a devastating effect by causing a rise in global warming. The hydrates could float to the ocean surface, resulting in a huge discharge of methane gas – a greenhouse gas 20 times more powerful than carbon dioxide.

On the plus side, researching methane hydrates may also provide valuable insight into the earth's past. Some organisms living on the ocean floor that use the hydrates for food resemble life forms that populated the earth billions of years ago.

The University of Victoria methane hydrate research team includes Chapman and his colleagues – Drs. George Spence, Michael Whiticar, Verena Tunnicliffe and their students. The Natural Sciences and Engineering Research Council (NSERC) funds their research and field studies.

Next year, Chapman will return to Barkley Canyon to obtain more samples of oil, gas and hydrates. He will also take heat flow measurements to determine fluid flow in the region and complete a detailed seismic survey to see if there are other sites nearby.