Making Canada's Offshore Safer Through Geoscience

Oil and gas deposits are found beneath Canada's continental shelf and slope, but severe weather and geological conditions make these remote resources among the most challenging in the world to extract. Some of these energy resources will remain untouched unless they can be produced safely and cost-effectively. Natural Resources Canada (NRCan) conducts geoscience research to ensure that geological risks and hazards are properly understood and predicted prior to designing or approving plans to develop and extract offshore energy resources.

Studying Seabed Stability

The stability of the seabed over petroleum basins has environmental and safety consequences for drill rigs, wells, and pipelines on the seafloor. Since offshore development projects can cost billions of dollars and can severely harm the environment if facilities are damaged, it is critical that they be safely designed and built with a full understanding of the seafloor geology and its stability.

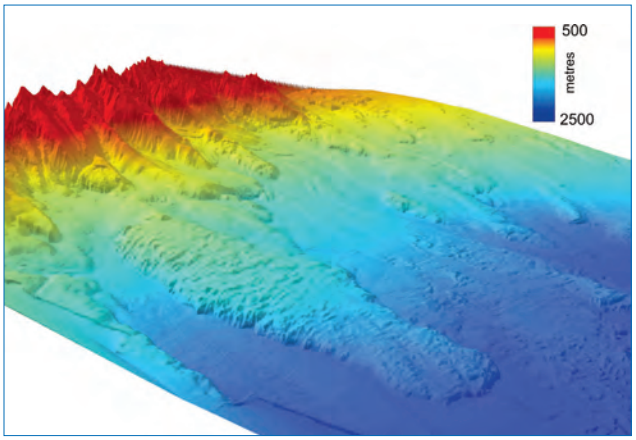

Figure 1. Submarine landslide (foreground) on the seabed in more than 1500 m water depth (imaged from EnCana Corporation seismic data).

The seafloor can be disrupted by modern geological processes, therefore specific areas of concern must be studied before plans for oil and gas extraction can be approved. Areas of concern include:

- the frequency of large submarine landslides (Figure 1);
- the risk of triggering a seafloor collapse when drilling wells;
- the occurrence of seabed scouring, which is caused by sea ice and icebergs so large that their keels (bottoms) scrape the seabed and create trenches and pits;
- the movement of seabed sediment during storms; and
- the ongoing release of shallow gas to the seafloor.

Methods and Techniques

NRCan's Geological Survey of Canada (GSC) carries out field studies in the Atlantic, Pacific, and Arctic oceans to identify the types of sediment on the seafloor and their stability (which indicates the potential for the occurrence of submarine landslides). The GSC also studies sediment transport patterns and the frequency and effects of seabed scouring by icebergs and sea ice. Research methods include:

- using sound energy to investigate and image seabed and subsurface sediments;
- collecting sediment cores with the help of research vessels to discover more about the properties and distribution of sediment types immediately below the seabed; and
- deploying instrumented platforms on the seabed to record the effects of seabed tidal and storm wave currents which erode and transport seabed sediments.

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Key Findings

1. The large seafloor canyons off of the eastern Canadian continental shelf are occasionally disrupted by landslides and sediment flows.
2. Iceberg scouring on the Grand Banks of Newfoundland has been infrequent over the last few decades, but it remains a risk to any structure erected on the seabed. Present rates are less than one scour per square kilometer every 25 000 years. On the Labrador Shelf, the risk appears to be about ten times higher.
3. Over 350 mud volcanoes (some of which are actively venting gas into the atmosphere) have been mapped on the Beaufort Shelf.
4. NRCan research indicates that in any particular area offshore eastern Canada, there is risk of a major landslide every 20 000 years and a minor one every few thousand years. Most of the large failures on the seabed date back more than 10 000 years, when glaciers advanced across the shelf and dumped sediment directly onto the slope. The 1929 Grand Banks earthquake, landslide and tsunami remind us that these events, although perhaps infrequent, can seriously impact modern society.

Making a Difference

NRCan researchers provide their geoscience knowledge and advice to regulators, industry representatives, environmental emergency responders, and others responsible for the creation of safe and sustainable strategies for the management of Canada's ocean resources. With this knowledge, risks and adverse environmental effects can be minimized in the offshore oil and gas development process. NRCan data on foundation conditions, sediment transport, and ice scouring has been used for the design and approval of seabed facilities for all offshore developments in Newfoundland and Labrador and Nova Scotia, as well as all drilling activities in the Beaufort Sea. As demand for energy pushes exploration into even more remote and northern locations, NRCan must continually strive to deliver current and relevant geoscience research to advise and influence design and development plans. That demand is pushing NRCan to develop new techniques and acquire new information in the deep waters of the Beaufort Sea, northeastern Canada, and the high Arctic.

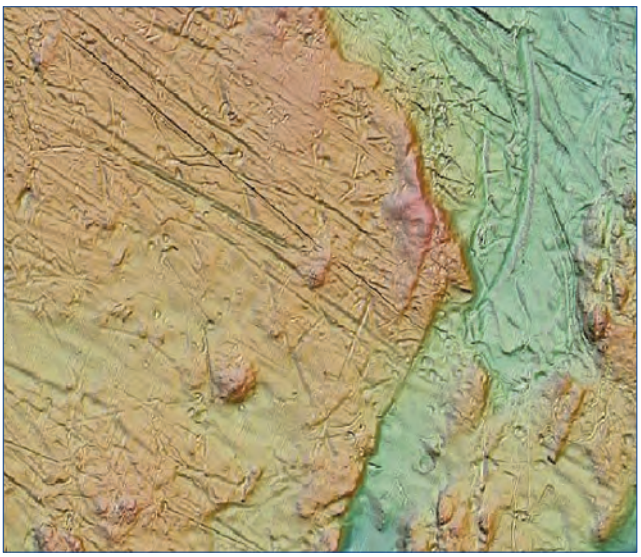

Figure 2. Seabed disturbance by iceberg scours offshore Labrador in water depth of more than 100 metres.

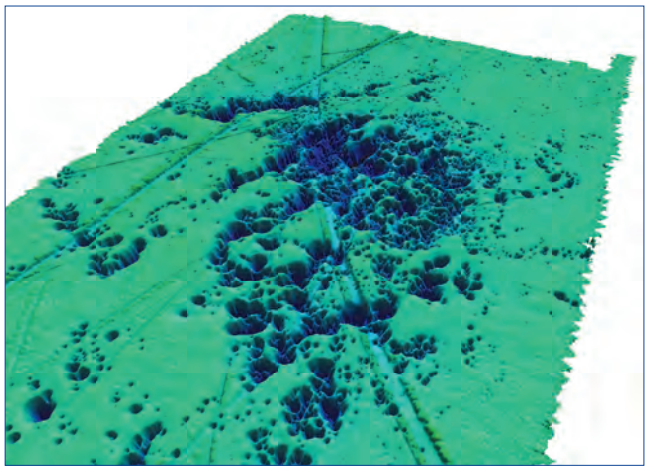

Figure 3. The Beaufort Sea seabed is heavily disturbed by dragging ice keels and can be further disrupted by active venting shallow gas.

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