Mapping it out: Tracer technology and the search for oil

By Joe Rollwagen

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— Tor Bjørnstad, Chief Scientist, Institute for Energy Technology, Kjeller, Norway

A typical oil rig in the North Sea where radiotracers may be used to map the sea bed.
(Photo: M. Bengtsson/wikimedia.org/CC BY 3.0)

Ever since oil was first found off the shores of Norway in the 1970s, the country's economy has seen tremendous growth. To maintain the efficiency of production for the long term, Norway has made extensive use of nuclear techniques.

Nuclear tracers are used to help optimize oil production by mapping underwater oil fields. According to Tor Bjørnstad, Chief Scientist at the Institute for Energy Technology in Kjeller, Norway before the use of nuclear tracers scientists relied on seismic mapping, which delivered less precise data.

"A tracer tells you exactly what it sees, thereby optimizing the process," Bjørnstad said.

At present, the institute employs tracer technology in more than 30 different wells, while collecting samples from hundreds more.

Understanding the oil fields

Small quantities of radioactive material are mixed into the water or gas that is pumped down oil wells — around 5 ml for water-based tracers. Soil samples are then gathered from wells in the area, and if the tracer is picked up in multiple samples, it indicates that the wells are connected, drawing oil from the same reservoir (see box). Wells in which no radiotracer is found are separated by fault lines under the seabed. Understanding the extent of various oil fields is crucial in determining how to extract oil more economically.

Constructing a well costs upwards of 500 million kroner (US $62.5 million). Therefore, it has been a tremendous advantage to employ tracer technology, which is precise and causes minimal environmental impact, Bjørnstad explained.

Minimizing environmental impact

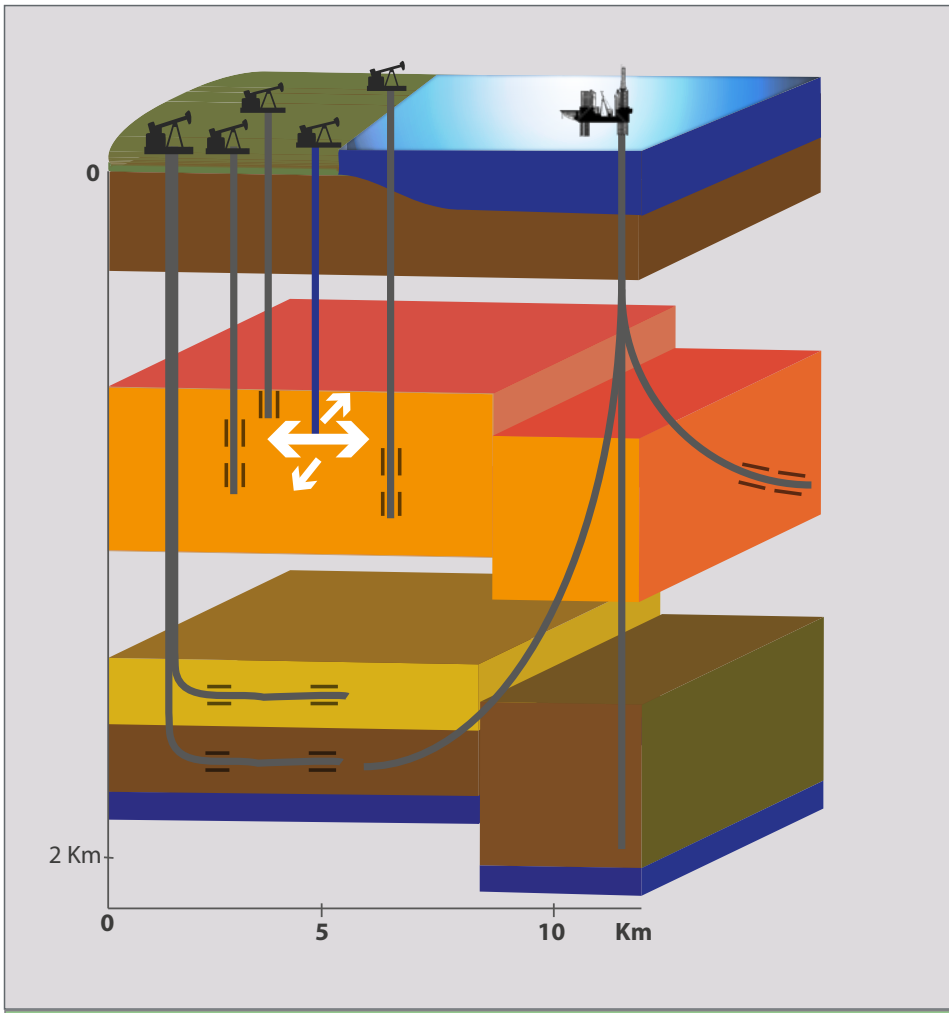
Meeting regulations and national safety standards, as well as international environmental standards, is a constant goal of the Institute for Energy Technology, Bjørnstad said. The sheer size of the oceans in comparison with the tiny amount of radioactive material used within tracers

ensures that there is a negligible threat to the natural environment.

The Institute has helped many emerging oil producers to employ this method. The IAEA has also facilitated technology sharing both independently and alongside the Institute. The IAEA and the Institute help other countries obtain the necessary equipment to use the technique, and also set up courses, meetings and coordinated research projects that provide learning opportunities to Member States.

In Viet Nam, for instance, the IAEA has helped to build the local knowhow needed to employ tracer technologies in oil exploration. "Before the projects [with the IAEA], tracer technologies for oil fields were not available in Viet Nam. The oil producer companies had to call in services from other countries," said Quang Nguyen Huu, Director of the Centre for Applications of Nuclear Techniques in Industry.

Viet Nam has a fractured basement oil field off its coast, where cracks and breaks occur on the seafloor due to the shifting of tectonic plates. This complex geology requires a tailored approach. With the help of IAEA-led training sessions, Viet Nam has been able to modify the tracer technology to suit the seabed's complex geology, Nguyen Huu said. Furthermore, Viet Nam has been able to export its services to countries such as Kuwait, Angola and Malaysia, he added.



Principle of tracer injection method for interwell communications

(Source: Application of Radiotracer Techniques for Interwell Studies, IAEA, 2012)

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Interwell tracer testing

Tracer applications can be found in almost any phase of oil field development. Interwell tracer technology is an important reservoir engineering tool for the recovery of oil.

This type of testing is also used in geothermal reservoirs to gain a better understanding of reservoir geology and to optimize production and reinjection programmes. The main purpose of conducting interwell tracer tests in oil and geothermal reservoirs is to monitor the quality and quantity of the injected fluid connections between injection and production wells, as well as to monitor the similarities and differences between wells and reservoirs.

The tracer is added into injection fluid via an injection well and observed in the surrounding production wells (see figure above). How the tracer responds helps to chart the flow pattern to provide a better understanding of the reservoir. This knowledge is important in optimizing oil recovery. Most of the information given by the tracer cannot be obtained through other techniques.