International Association of Geophysical Contractors

THE VOICE OF THE GEOPHYSICAL INDUSTRY SINCE 1971

Introduction to Marine Seismic Technologies

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Planet Earth. If you look closer, you'll see that a whole other world exists beneath the surface of land and sea. Layers of rock structures go deep into the Earth's crust for miles. Trapped within these structures, along with other liquids and solids, are deposits of oil and natural gas, the world's two most important sources of energy.

So, how do you find something that's completely hidden beneath the Earth's surface and underwater? For more than a half a century, the oil and gas industry has used seismic surveys as a reliable strategy for pinpointing where to drill.

Modern seismic imaging reduces risk by increasing the likelihood that exploratory wells will successfully tap hydrocarbons and decreasing the number of wells that need to be drilled in a given area. Surveys are conducted by sending acoustic waves into the various buried rock layers beneath the sea floor and then recording the time it takes for each wave to bounce back while measuring the various characteristics

A Challenge Under the Sea

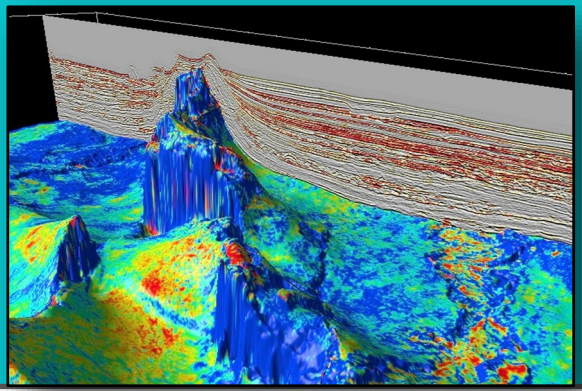
Because nearly a third of all oil produced today comes from offshore wells and most of the world's untapped oil reserves are in deepwater environments, the future of energy is intimately tied to seismic data acquisition and processing technology, which can help us both increase productivity and protect our environment.

To reduce risk and maximize production in challenging subsea environments, the oil and gas industry needs the most accurate possible graphic representation of the earth's subsurface geologic structure. Fortunately, today's hi-resolution images produced via seismic surveying are orders of magnitude more effective than traditional methods, such as exploratory drilling.

Environmental Management Tool

It's not all about wells either. Seismic surveys can be used in detailed pipeline corridor mapping, which provides the essential raw data to reduce the risks inherent in the design and installation of sub-sea oil and gas pipelines. Seismic surveys are also used to monitor reservoirs as they are emptied, which allows the operator to efficiently place additional wells for complete hydrocarbon removal. Such technology allows more efficient production from existing reservoirs, which may have been close to exhaustion using older technology.

Seismic surveys reduce safety and environmental risks and the overall footprint of exploration. For example, seismic surveys help identify unstable load-bearing substrate and the features that cause it, such as the presence of high pressure shallow gas or gas hydrate deposits. They also help manage well bore integrity and predict pore pressure, both of which enhance production management. They can be used to identify an area that's non-prospective, to delineate reservoir boundaries, and to optimize efficiency, so that extraction requires fewer wells, but produces greater volume.

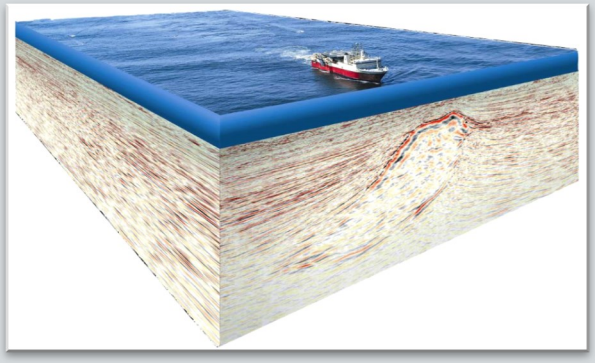


How Seismic Surveys Work

Seismic surveys are temporary and transitory and are the least intrusive and most cost-effective means to understanding where recoverable oil and gas resources likely exist. Modern seismic surveys are much like ultrasound technology—a non-invasive mapping technique built upon the simple sound wave. To carry out these surveys, marine vessels use acoustic arrays, such as a set of compressed air chambers, to create seismic pulses. The acoustic array is towed behind a seismic survey vessel and releases bursts of high pressure energy into the water. The pulses are bounced off the layers of rock beneath the ocean floor. The returning sound waves are detected and recorded by hydrophones that are spaced out along a series of cables that are dragged behind the survey ship or autonomous nodes placed on the seafloor by ROVs.

Seismologists then analyze the information, using computers, to visualize the features that make up the underground structure of the ocean floor. Both two dimensional and three dimensional surveys are used in the industry. Once the data is processed, geophysicists interpret it and integrate other geoscientific information to make assessments of where oil and gas reservoirs may be accumulated. The end product of all this work and technology is a graphic 2D or 3D representation of the earth's subsurface geologic structure. Based largely on this information, exploration companies will decide where (or if) to drill for oil and gas.

Environmental stewardship is an industry value and priority. We have demonstrated our ability to operate seismic exploration activities in a manner that protects marine life. Examples include the avoidance of important feeding and breeding areas, exclusion zones around seismic operations, soft starts (gradual ramping up of a seismic sound source) and physical and acoustic monitoring by professionally trained marine mammal observers (MMOs) and protected species observers (PSOs). More than three decades experience of worldwide seismic surveying and various research studies indicate that the risk of direct physical injury to marine mammals is extremely low, and currently there is no scientific evidence demonstrating biologically significant negative impacts on marine mammal populations.



Additional Resources on Introduction to Marine Seismic Technologies

1. Safety of Seismic: http://www.appea.com.au/2012/12/science-and-experience-show-seismic-is-safe/
2. An Overview of Marine Seismic Operations: http://www.ogp.org.uk/pubs/448.pdf
3. Seismic Surveys: http://www.seismicsurvey.com.au/
4. Seismic and the Marine Environment: http://www.appea.com.au/wp-content/uploads/2013/05/Seismic_and_the_Marine_Environment.pdf

Environmental Stewardship

The geophysical industry takes a great deal of care and consideration of potential impacts to the marine environment. In its efforts to operate in an environmentally responsible manner, the industry implements measures to ensure that marine mammals are further protected from direct or indirect harm from its operations. For more than 40 years, the industry has demonstrated its ability to operate seismic exploration activities in a manner that protects marine life. Various research studies indicate that the risk of direct physical injury to marine mammals is extremely low, and currently there is no scientific evidence demonstrating biologically significant negative impacts on marine mammal populations.

Find out more at www.iagc.org