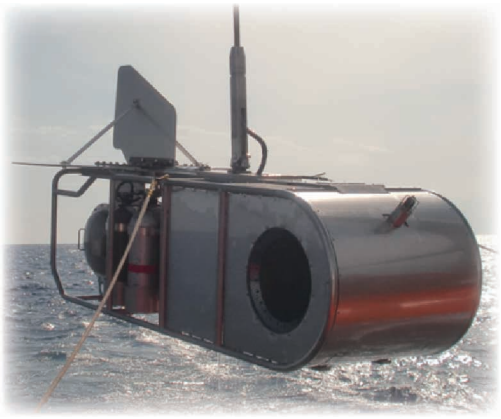
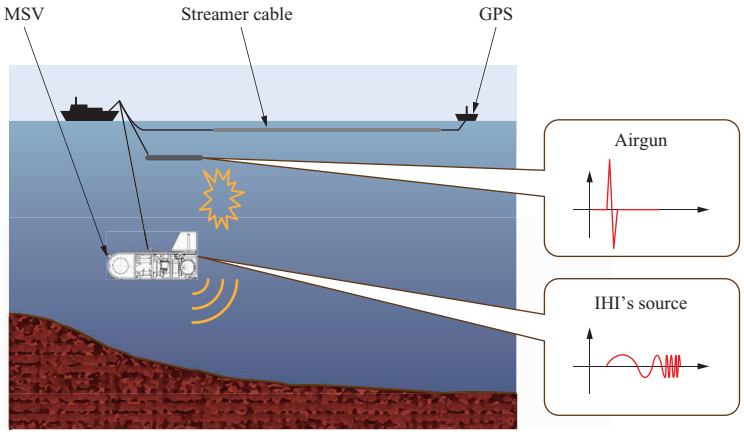
Searching for Offshore Resources with Environmentally-Friendly Sound

Offshore resources exploration system with IHI Marine Seismic Vibrator

Concern is growing over the harmful effect on marine mammals of heavy impact sounds from airguns used in exploration for offshore resources.
IHI has therefore mobilized its methodically cultivated technologies to produce a gentler sound for animals — offering a new solution.



IHI-MSV-250



Generated waveform

Exploration for offshore resources

The seabed holds oil, natural gas, methane hydrate, and other fuel resources, as well as minerals from seafloor hydrothermal deposits, and rare metals. Some of the microbial resources there are not found onshore. In order to find these resources, submarine topography and geology must be explored.

A widely used method for such exploration is seismic reflection survey, in which a sound generated by a sound source (technically known as a seismic source) is analyzed after reflecting off the seafloor.

One commonly used seismic source is the airgun, which shoots out elastic waves with impulse waveform for the survey. Some of these elastic waves reflect at the bottom of sea and the remaining part enters further into the seabed until being reflected on stratum boundaries with different acoustic impedance. The reflected acoustic signals are received by multiple hydrophones (i.e., underwater microphones) attached to a streamer cable. The signal is then analyzed to understand the geological structure in order to locate where resources are.

The airgun generates an impulse wave that sounds like an explosion by releasing compressed air in an extremely short period of time. This sound has broadband wave ranges from low frequency to high frequency and is emitted with a large amount of energy. A certain part of the frequency range within the zone of audibility of whales, dolphins, and other marine mammals, is raising concerns over possible harmful effects on them.

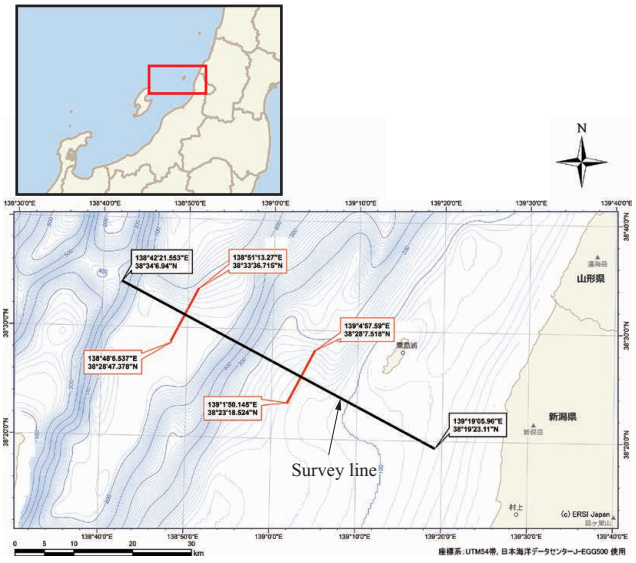
Seismic source by IHI

In the 1990s, IHI developed a seismic source that vibrates underwater to generate a sound for research conducted by the Defense Agency (currently the Ministry of Defense), which is now provided as standard equipment. This servo-controlled hydraulic-driven seismic source features the ability to freely set the output level, frequency, phase, and other parameters of the generated sound. Unlike airguns that shoot out waves only several meters below the sea surface, the source developed by IHI can shoot out waves during deep-tow operations.

The acoustic energy necessary for exploration of offshore resources can be produced by sweeping the frequency within a limited range for a certain period of time without relying on an impulse sound. In contrast to airguns that instantly generate a broadband sound with a large amount of energy, the source made by IHI generates a sound within a limited frequency range using a small amount of energy. This promising device offers an environmentally friendly solution with less harmful impacts on marine life.

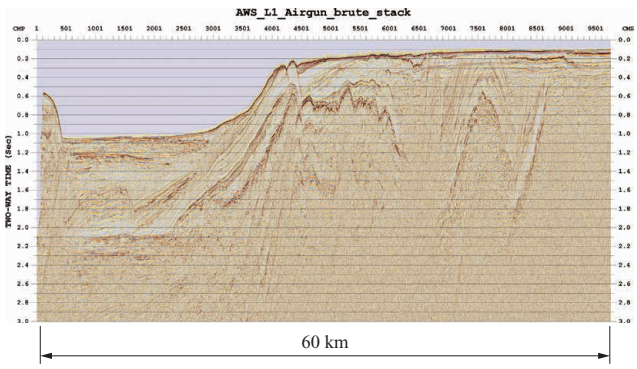
The Marine Seismic Vibrator (MSV) is a seismic source developed by IHI for a test survey. The compact body contains a control unit, a vibrator unit, and a hydraulic unit. The pressure inside the vibrator is regulated to match the surrounding seawater pressure to make it possible to generate a sound in the deep sea.

The source was employed in a test exploration survey conducted in July 2015. In the meantime, another test survey was conducted with an airgun that produces more than 100 times the sound pressure (as an indicator of the output level) coming from the MSV. The results from the two surveys were compared to validate that the MSV is as effective a tool as airguns. The exploration survey was conducted in the Sea of Japan off the coast of Awashima Island of Niigata Prefecture.

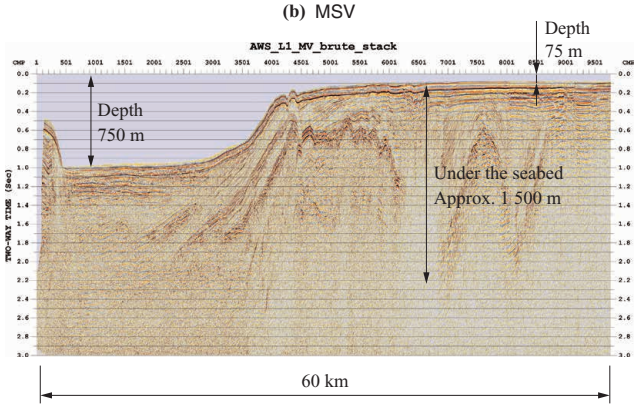


Survey area

(a) Airgun



(b) MSV



Seismic section images

The survey line extended for 60 km from southeast to northwest.

According to the comparison, almost identical images of geological layers were obtained from both surveys. This demonstrates that MSV makes it possible to conduct a survey comparable to that using an airgun.

Our future goals

IHI will build an advanced exploration system based on its original MSV technologies. Our horizon extends beyond mere provision of hardware and software, and is aiming toward the exploration service business.

We will join in the development of offshore resources as an innovator in marine acoustics to win a new position in the marine frontier while incorporating associated portfolios as our business grows to provide a total solution.

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