Gemini™ Extended Frequency Source

Challenge
Geologies with complex, rough or high contrast sediments such as salt bodies or chalks are often difficult to image due to poor seismic signal penetration. In addition, poor signal to noise ratios often cause the latest model building algorithms such as Full Waveform Inversion (FWI) to perform inefficiently and less effectively in a phenomena commonly referred to as cycle skipping. As a result, velocity models and their resulting seismic images do not often paint as accurate a representation of the subsurface as necessary to identify prospects, derisk and prioritize them or optimize well placement.

However, extensive research using synthetic data has proven that highly accurate velocity models may be achieved for complex geologies simply by using the inputs from the lowest frequencies, <4Hz. Algorithms such as FWI, may also insert structures such as salt bodies, automatically into smooth a—priori models. This is because lower frequencies are able to penetrate rough or high contract boundaries more effectively, thereby improving the signal to noise ratio in the data. The challenge to date has been that there has not been a commercial source solution capable of generating the desired <4Hz frequencies.

Product Description
ION’s new Gemini™ Extended Frequency Source (EFS) technology is a broadband seismic source technology that is able to generate the <4Hz frequencies required to image in complex geologies where penetration of low frequencies is key. The Gemini source is unique as it emits a broader spectrum of frequencies (2 – 80 Hz or higher) than conventional seismic sources or other purpose built low frequency sources. These characteristics allow it to offer an alternative to conventional sources for more efficient seismic acquisition. In addition, as seen by the limited emission of high frequency energy shown in the figures below, the Gemini source offers a more environmentally friendly source solution that reduces the impact to marine life.

The Gemini source’s patent pending design utilizes a pneumatic, air gun based, seismic source technology that is compatible with existing vessel configurations. It functions as a single point source and not an array; as such, its compact profile allows for easier deployment and operations than a typical multi-gun array. The Gemini source is available in two sizes to accommodate different survey designs:

- 4000 in³: best for conventional shot and receiver spacings
- 8000 in³: best for velocity surveys with sparse shot and receiver spacings

Figure 1: Spectrum comparing the results from a conventional OBS 5110in³ array (red) to the Gemini 4,000in³ source (green)
Imaging Benefits:

- Enhanced spectral content generated, specifically at low frequencies
- Higher S/N at low frequencies allows for more efficient velocity model building
- Low frequencies enhance the ability to image across hard, rough or sharp velocity contrasts
- Higher resolution velocity models to better identify and/or derisk prospects and improve well placement

Operational Benefits:

- Energy output is more environmentally friendly than conventional source arrays due to lower emission of high frequency energy
- Works with existing seismic source vessel equipment and configurations
- Air gun-based technology
- Single string configuration is simpler and less costly to deploy and operate
  - Reduced number of source elements, power, communications and high pressure air supply lines
  - Less in water gear reduces the overall number of maintenance service routines, intervals and downtime
- Primary source plus backup configuration ensures less downtime
  - 100% redundancy in the water
  - Redundancy of umbilical communication and power lines
- Flexible source solution that may be applied to ocean bottom seismic or stream seismic surveys
- Leverages leading edge and field proven seismic source technologies
- Modular and fully containerized delivery for expedient rigging and derigging along with a full set of spares
- Real time monitoring of near-field hydrophone, pressure and depth data for enhanced quality control
- Reduced HSE risks:
  - Simplicity of array deployment and retrieval operations
  - Reduced deployment and retrieval times
  - Reduced in water, weight and back deck towing and handling equipment
  - Asset Integrity and Business Management System developed to support execution

Figure 2: Spectrum comparing the results from a conventional OBS 5110in³ array (red) to the Gemini 8,000in³ source (green)