

Applications In Action

LAND IMAGING SYSTEMS



Full-wave Imaging for Heavy Oil

ION Systems Drive Strategic Drilling Decisions

SEGMENT: Land Seismic Acquisition

REGION: Axe Lake Field, Saskatchewan Canada

TECHNOLOGIES: Scorpion® Land Acquisition System with VectorSeis® Digital Receivers

The Challenge

Heavy oil reservoirs are difficult to characterize and develop without high quality subsurface imaging and in-depth knowledge of the reservoir. High resolution seismic data is key to operational success.

In November 2007, Oilsands Quest, an aggressive oil sands explorer, recognized the need to better characterize its Axe Lake discovery in northwest Saskatchewan and northeast Alberta. As a technology leader, Oilsands Quest actively pursued techniques to define the eastern extent of the Athabasca Basin through the adoption of cutting-edge technology. With an estimated 1.547 billion barrels of discovered bitumen in place underlying the Axe Lake field, Oilsands Quest sought an application that could produce the highest quality subsurface imaging to help drive strategic operating initiatives.

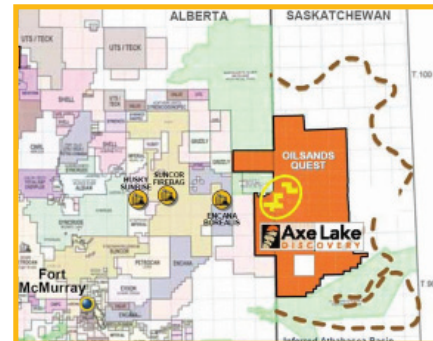
In-situ production typically requires drilling horizontal wells in pairs, one to pump steam in and one to extract bitumen, to a reservoir that may be less than 200 meters deep. Optimal placement of these horizontal well pairs in the heavy oil reservoirs requires superior image resolution, which is achievable with high-density, multi-component 3D seismic surveying. Most surveys must be completed during the Canadian winter season when the ground is frozen, making time and productivity crucial factors to program success.

The Solution

A high-density, high quality full-wave seismic acquisition program utilizing a Scorpion cable-based land acquisition system and VectorSeis digital multi-component receivers.

To accurately characterize heavy oil reservoirs, combinations of advanced survey design methods, acquisition technologies, and processing techniques are necessary. Oilsands Quest utilized Geokinetics, a leading geophysical services company, to develop an efficient acquisition program utilizing the latest technology to provide high quality, high-density seismic imaging for all three surveys.

The application of the full-wave solution in this case involved Oilsands Quest as the E&P operator, ION as the technology and imaging equipment manufacturer, and Geokinetics as the owner of the full-wave equipment and provider of field acquisition services. The three, 3D seis-



Oilsands Quest recently commissioned three 3D full-wave, high-density seismic surveys comprising approximately 14 square miles of land (shown in yellow).

“Obtaining the best possible image of the reservoir is of paramount importance to our business objectives of quantifying our commercial bitumen deposits and delineating the resource.”

Errin Kimball
Vice President, Exploration
Oilsands Quest Inc.



VectorSeis receivers being prepared for deployment.

VectorSeis is the industry's most widely used digital, multi-component receiver for recording P-wave and S-wave seismic data. With three patented MEMS accelerometers to record X, Y and Z data, VectorSeis allows geophysicists to measure true 3D ground motion and record the full seismic wavefield with unsurpassed vector fidelity.

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LAND IMAGING SYSTEMS

mic programs were completed in 100 days, utilizing Scorpion, ION's cable-based land acquisition system with 6,500 VectorSeis digital full-wave receivers. The seismic acquisition platform utilized a live spread of 2,400 stations per shot (7,200 channels) configured for full-wave recording using 3C VectorSeis receivers at a 10 meter spacing interval.

Geokinetics' program gathered full-wave seismic data from approximately 90,000 receiver points utilizing an estimated 100,000 dynamite shots at an average of 1,000 shots per day. The program represents one of the largest high-density, full-wave shoots in the oil sands industry covering more than 14-square miles of marshy land. The acquisition method was both highly productive, yielding a record day of 2,236 shots recorded, and extremely successful in terms of seismic image quality for further processing and interpretation of the Axe Lake discovery area.

The Results

Improved subsurface images help optimize strategic drilling programs.

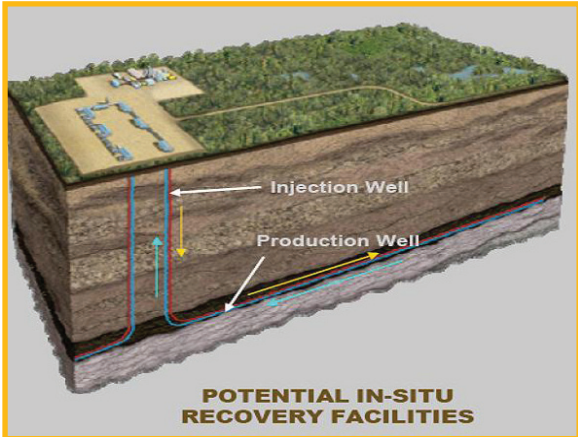
Utilizing full-wave, multi-component VectorSeis receivers, Geokinetics was able to offer Oil-sands Quest high-frequency seismic data in the range of 150Hz to 200Hz. Conventional 2D geophone arrays typically capture between 70Hz to 80Hz, and require additional personnel and valuable time to deploy.

The high resolution 3C seismic data provides the oil company with an opportunity to better plan and implement drilling programs by clearly identifying and mapping reservoir quality from top to bottom. With superior image resolution, the oil company has the potential to more accurately place horizontal well-pairs. Superior imaging can also reduce the number of vertical stratigraphic cored wells, wells drilled for informational purposes only.

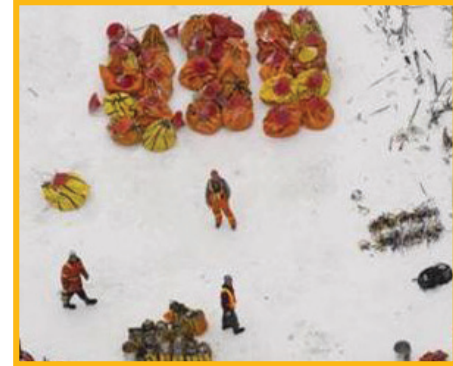
In addition, multi-component seismic data can be leveraged during production to monitor the movement of injected steam into and around the reservoir. Because heavy oil extraction requires steam injections to heat the bitumen, it is imperative to drill steam wells with minimal obstructions for the highest quality production results. Full-wave

imaging is a viable resource, lending valuable insight for program planning and drilling strategy.

Time-lapse 4D seismic analysis would further enhance production optimization through steam monitoring over the complete injection and production lifecycle. The practical use of 4D seismic for steam monitoring allows operations management to have intimate knowledge of reservoir dynamics, offering early detection of injection inefficiencies.



Full-wave seismic imaging can not only assist in well planning and drilling program efficiency, but can further optimize heavy oil productivity by identifying and mitigating risks associated with ineffective steam injection sites.



The seismic crew is staging the Scorpion system equipment after it was delivered by helicopter.

"Maximizing field productivity is a crucial factor to successful surveying. Our team worked diligently to meet and exceed the requirements for the high density shoot, and we are extremely pleased with the field performance of the acquisition system."

Jason Nelson
General Manager, Canada
Geokinetics, Inc.

We would like to thank Oilsands Quest and Geokinetics for permission to show the above referenced results.

For more information contact:
Vince Rodych
vince.rodych@iongeo.com