SEEING THE UNSEEN
/ INDEX OF CONTENTS

01 INTRODUCTION
- OVERVIEW
- VALUE FOR BUSINESS
  - MAXIMISING PRODUCTIVITY
  - ENHANCING INTERPRETER PERFORMANCE
  - REDUCING INCIDENT POTENTIAL
- UNIQUE CAPABILITIES OF SHELL

02 INTEGRATION
- BASIN & PLAY ANALYSIS
  - PLAY BASED EXPLORATION
  - BASIN MODELLING
  - GEOCHEMISTRY KNOWLEDGE CAPTURE
- INTERACTIVE SEISMIC PROCESSING AND DIAGNOSTICS
- REGIONAL INTERPRETATION PLATFORM
  - DATA ACCESS, DATA MANAGEMENT AND GEODETIC INTEGRITY
  - MULTI-SCALE 2D/3D INTERPRETATION
  - SCALABLE VELOCITY MODEL BUILDING AND DEPTH CONVERSION

03 IN ACTION
- WIDE AZIMUTH SEISMIC SURVEYING
- NON-SEISMIC DATA INTERPRETATION
- STRATIGRAPHIC INTERPRETATION

04 DEPLOYMENT
- TECHNOLOGY LEVERAGED GLOBALLY
- SEAMLESS GLOBAL ROLLOUT
- DIRECT WORKFLOW SUPPORT
- COLLABORATION FOR OPTIMUM EFFICIENCY
GEOSIGNS* is highly advanced seismic imaging and interpretation technology: a suite of tools, integrated to a degree unique in the industry, developed to pursue more complex prospects in ever more challenging environments. Derived from a century of experience in the field, GEOSIGNS helps Shell and partners increase efficiency and make better business decisions, globally.

*GEOSIGNS is a trademark that is owned and used by companies of the Shell Group
OVERVIEW

GEOSIGNS is highly advanced seismic imaging and interpretation technology: a suite of tools, integrated to a degree unique in the industry, developed to pursue more complex prospects in ever more challenging environments. Derived from a century of experience in the field, GEOSIGNS helps Shell and partners increase efficiency and make better business decisions, globally.
VALUE FOR BUSINESS

GEOSIGNS has been instrumental in many recent exploration and development successes for Shell. Its advanced capabilities deliver tangible business benefits. They include basin modelling, seismic survey acquisition design, seismic processing quality control, regional interpretation, quantitative interpretation, volumetrics and production geosciences, and portfolio management.

MAXIMISING PRODUCTIVITY

GEOSIGNS co-visualisation capabilities bring greater efficiency to field development by providing better resolution of structural uncertainties, while quantitative interpretation supports hydrocarbon identification and potential quantity for planning, drilling, operations and field development budgeting.

A ‘modelling while interpreting’ tool offers specialists who are working with seismic and well data the ability to assess the implications of interpretations in terms of the structural and thermal evolution of the prospect, from basin modelling; conditioned by geological, geophysical and geochemical data.

ENHANCING INTERPRETER PERFORMANCE

Efficiency is increased by the combination of three factors: the integration of tools, automated technologies and a common interface for standard and specialised workflows. Flexibility is also a key feature, allowing users to interrogate data according to their particular workflow.

REDUCING INCIDENT POTENTIAL

Risk management in well planning is improved by: identifying seafloor and subsurface hazards, providing accurate formation depths and pore pressure predictions. In addition, GEOSIGNS can perform quality control on fault topology and seals.
UNIQUE CAPABILITIES OF SHELL

Shell was one of the first companies to develop its own interpretation and visualisation system. The integrity of GEOSIGNS is derived from decades of leadership in geological and geophysical exploration and development.

Watch this short film to find out more about GEOSIGNS.
The seamless integration of a unique breadth of data types is a defining aspect of GEOSIGNS, delivering added value by extending our understanding of basin and reservoir potential. This extensive suite incorporates dozens of proprietary technologies developed to help Shell and its partners build a comprehensive picture of the subsurface.
BASIN & PLAY ANALYSIS

A global interactive database designed to enable play based exploration, giving explorers access to a wide variety of subsurface data. This allows the identification of the best exploration growth opportunities, creatively and consistently, through better understanding and risking of the basins and petroleum systems in which they work and the geological plays that they contain.

PLAY BASED EXPLORATION

Understanding of the petroleum system of a basin, supporting the identification, mapping and quantification of hydrocarbons are key elements in play based exploration. They include common risk segment mapping and scenario analysis for fixed size and distribution predictions.

BASIN MODELLING

Examining the basin as a whole determines the fill, stratigraphic sequences and potential for generating and trapping hydrocarbons. Modelling covers the thermal and pressure evolution of basins as well as the generation and migration of hydrocarbons in the subsurface through geological time. This enables estimation of the impact of pressure and temperature on rock and fluid properties. In recent years, basin modelling has supported pre-drill pore pressure prediction, reservoir quality prediction, seismic velocity prediction and the rapid scanning and ranking of unconventional oil and gas opportunities.

GEOCHEMISTRY KNOWLEDGE CAPTURE

The synthesis of source rock data, including rock maturity and type enables the interpretation of source rock potential. This is done through analysis of hundreds of thousands of samples available in Shell's database of fluid properties and composition geochemistry.
INTERACTIVE SEISMIC PROCESSING AND DIAGNOSTICS

A toolkit for the interpreter to support additional processing of seismic data for better resolution of the smallest details. This system leverages the many years of seismic processing experience within Shell to reveal unique insights and properties in the subsurface.
REGIONAL INTERPRETATION PLATFORM

Performance capabilities extend far beyond comparable systems due to the integration of a number of fundamental tools which complement the applications used. A particular strength is the speed of converting time seismic data to the depth domain and vice versa, utilising simple or complex operations as required by the interpreter.

DATA ACCESS, DATA MANAGEMENT AND GEODETIC INTEGRITY

Interpreters have access to both proprietary and vendor data stores. Proprietary data stores can be used for increased data security. The combination of these data stores allows us to create extra multiple attributes for more accurate data positioning.

MULTI-SCALE 2D/3D INTERPRETATION

Bringing together multiple 3D projects and 2D seismic lines from a geographic area to share interpretation across all the various data vintages delivers a broad view of very large areas. It also supports the close scrutiny of target areas in detail.

SCALABLE VELOCITY MODEL BUILDING AND DEPTH CONVERSION

Enabling interactive domain conversion for regional to detailed velocity model construction. Multiple options include different time to depth techniques from complete velocity models to traditional V0-KZ velocity assumptions using well-derived time to depth conversions but adding physical properties such as compaction identities and interpreted horizon control.

Capabilities range from simple to relatively complex tasks. For example, using one velocity file to convert time or depth data 'on the fly' to the other domain or, for complicated geology, building Earth velocity models for a three-dimensional domain conversion solution.
INTERACTIVE QUANTITATIVE INTERPRETATION

A set of tools to model seismic signatures for oil, gas and water at a given location and then compare those signatures to actual stacked and pre-stack seismic data. Amplitude vs offset toolkits, in addition to other modelling suites, help interpreters control the risk in estimating reservoir quality and fluid content.
NON SEISMIC DATA

A ‘bottom-up’ view of deep basins to understand and predict pre-salt paleogeography and petroleum system distribution and timing, highlighting possible sweet spots for hydrocarbon exploration.
GLOBAL EXPLORATION MANAGEMENT SYSTEM & FASTRACK

Exploration geoscientists, portfolio managers and planners use GEMS/Fastrack extensively to assess the volumetric potential of subsurface resources and manage their portfolios to guide key business decisions.

EXPLORATION PROSPECT EVALUATION AND PORTFOLIO MANAGEMENT

Three modules enable creating prospects and managing them over their lifecycle. This includes evaluating their risked volumetric potential; creating notional wells; and calculating entitlement volumes using portfolio cases that serve as source for the reporting of udSFR and dSFR volumes in the annual reporting of petroleum resources, project initiation notes and/or investment proposals.
GEOSIGNS helps Shell and partners increase efficiency and make better business decisions, globally. Three examples illustrate its contribution to the creation of commercial value.
In some deepwater locations, salt layers can distort sound waves during seismic surveys, making it much harder to build an accurate picture. Shell has developed wide azimuth seismic surveying to overcome this challenge; the term describes the precise measurement of the angle in relation to the sea surface.

This new approach entails recording seismic signals from sensors on the seafloor, towed separately from the source boat, or on land using geophones. Wide azimuth recording images rock and salt layers from patterns up to 360° of azimuth for superior resolution and interpretation of the seismic data, often providing information on rock layers that was previously invisible. The higher costs of acquiring wide angle seismic data and the computing power needed for analysis limited the application of wide-angled surveys. Advances in interpretative technology have now made it an invaluable tool for the exploration of new fields.

Shell deployment of wide-angle seismic surveying in the Gulf of Mexico led to the discovery of four major fields, adding hundreds of millions of barrels of oil and gas to the region's resources in 2010.
NON-SEISMIC DATA INTERPRETATION

In frontier areas with sparse seismic data, considerable ambiguity regarding the nature of structural features can arise. Where is the basement...are volcanics present...could the structures be carbonates...where is the salt?

Sensitivity to rock properties means gravity, magnetic, radiometric and electromagnetic data offer insights into the composition of structural features otherwise unattainable from seismic measurements alone.

Magnetic analysis and gravity modelling visualised and integrated in multi-dimensional interpretation (nDI) with seismic data can rapidly discriminate between alternative hypotheses, giving the interpreter a better understanding of the basin as well as potential prospects.

In Colombia, analysis of the macro rock properties derived from gravity and magnetic modelling integrated with seismic data has led to a new play development. It removed ambiguities and yielded new insights into the extent of continental crust and rock properties of the Chinchorro Paleohigh, previously thought to be crystalline basement.
STRATIGRAPHIC INTERPRETATION

The Nelson Field in the UK Central North Sea is a stratigraphically complex, channelised reservoir in production since 1994 and now at the mid-mature stage of field life. The current management strategy is focused on identifying infill well locations with the aim of recovering bypassed oil.

Key to identifying such locations is an accurate reservoir model to highlight unswept areas through simulation. Recent insights into both the static and dynamic behaviour of the field have led to the building of a new model to understand production performance.

The static model was built around reinterpreted macrofacies within a new structural framework. The reinterpretation of macrofacies was undertaken using data sources including seismic sculpting images, seismic attribute analysis, core reinterpretation, well log analysis and production well characteristics. Once integrated, these delivered increased resolution both vertically and laterally.

A new structural model was interpreted to delineate new features. In addition, Waveform Classifier and Spectral Decomposition were used in combination with the new structural model to delineate channel margins. Characteristic signatures from gamma ray, neutron and density logs helped designation of macrofacies and, in particular, checking whether a specific well was in the correct macrofacies polygon.

The result was that existing macrofacies were interpreted with much greater spatial accuracy. Some evidence suggested it may be possible to subdivide the reservoir into a greater number of macrofacies than before, including channel fairway, channel margin, inter-channel, slumps, abandoned channels and fans.

A new static model suite has been built and carried forward into dynamic simulation. It shows a good history match on total fluid production, oil and water production and pressure. It has helped to evaluate a number of possible infill targets and to better manage the field performance.
Shell works to ensure all its interpreters leverage GEOSIGNS to the full extent. Comprehensive support includes established processes for speedy platform deployment. Technical consultancy drives capitalisation and local training underpins the technical fluency of the workforce. Shell leads the field in its commitment to supporting partners in this way.
TECHNOLOGY LEVERAGED GLOBALLY

GEOSIGNS is a standard global software platform with more than 1200 users within Shell. It delivers knowledge sharing, cost reduction and performance advantages in exploration and development. Applications share a common look and feel; all types of data are available through a data manager. GEOSIGNS runs on Win64 and Linux desktops, laptops and remote blades.

Shell operates High Performance Computing Centres of Expertise in Houston, Amsterdam, and Bangalore as well as with joint venture partners in Malaysia, Oman, and Nigeria. There are also research collaborations with selected universities such as the University of Texas and the University of California at San Diego.
SEAMLESS GLOBAL ROLLOUT

Shell ensures GEOSIGNS is implemented as quickly and efficiently as possible. The combination of a mature process, global infrastructure and dedicated IT teams ensures tools and technologies are deployed rapidly. Thereafter, the uptake of new functionality is prioritised to the same degree.
DIRECT WORKFLOW SUPPORT

Shell provides a complete global and regional consultancy service through dedicated experts. They have in-depth knowledge of Shell technology and business elements relevant to geoscientists. Working alongside subject matter experts and technical management, they devise bespoke training programmes to address capability gaps, update users on new features and address technical business challenges. Training is tailored to individual preference, whether one on one mentoring, class room workshops or audio and video online training.
COLLABORATION FOR OPTIMUM EFFICIENCY

Shell technology experts are part of a close feedback loop which engages Shell product development teams with partners’ technical business challenges, as they arise. Functional and operational insights are discussed to enable faster updates and quick localised deployment.