Geological Expression –

The Future of Seismic Interpretation

Investment in innovation and new technologies is increasingly critical for economic success in hydrocarbon exploration and production. This is particularly the case in seismic interpretation where we are trying to obtain an understanding of the subsurface geology through analysis of complex remote sensing data. The importance of seismic data to both exploration and production is reflected in the almost USD 8 billion annual spend on seismic acquisition and processing. Globally, some 11 million square kilometres of licensed offshore acreage is now covered by seismic data.

illustration: ffA

BY JONATHAN HENDERSON

Seismic data contains an enormous quantity of information much of which is currently not being accessed due to lack of time, exacerbated by significant gaps in the interpreter's analysis toolkit. Therefore technologies that can make seismic interpretation more efficient and more effective can unlock enormous value through providing additional, highly detailed knowledge of hydrocarbon systems, exploration prospects and producing reservoirs.

The potential to add substantial value is as true in mature provinces, for example the UKCS, NCS and Gulf of Mexico, as it is in more frontier areas such as deep water and pre-salt environments.

3D Image Processing

There are a number of long established subsurface geoscience companies each commanding their own position in the subsurface geoscience arena. Many of these companies have developed technologies that have brought benefits to the global oil and gas industry. Amongst these companies, ffA is unique due to its heritage in

medical imaging and more than 15 years as an innovator in post stack seismic analysis.

By focussing on the use of 3D image processing as an aid to interpretation, ffA has always had a different perspective to the majority of geophysical software companies. This has resulted in ffA pioneering several technologies that are now part of most mainstream interpretation workflows. These include working with Shell to develop the first automated 3D seismic geobody delineation techniques and with Statoil on the use of volumetric colour blending in seismic interpretation.

Both these are examples of ffA's ability to adapt sophisticated image processing techniques into easy to use technology that can be applied to seismic data.

Seismic Attribute Analysis

The importance of improving seismic interpretation efficiency has been made more pressing by the advances in seismic acquisition and processing technologies that have been seen over the last five

years. These advances have improved the reliability of the seismic image and made it possible to image more subtle structures, but have also greatly increased the amount of seismic data that need to be analysed.

Whilst improving data quality is important, we must not forget that seismic data has little or no value unless it can be converted into a better understanding of the subsurface.

We must also remember that even the best quality seismic data does not provide a complete description of the geology and the harder we push the data the more we must rely on the skill and experience of the interpreter to achieve an accurate understanding of the subsurface.

Geological Expression

Seismic attributes have long been considered as having an important role in improving interpretation efficiency. Unfortunately, the way attribute analysis is used at present often results in information overload whilst intensifying data management issues. To address these

problems, ffA is delivering new technologies to help the interpreter directly translate the geophysical data into geological understanding. These technologies support a new paradigm in seismic interpretation, Geological Expression, which empowers the interpreter so that they can use their experience to best effect.

The Geological Expression approach brings interpretative knowledge and objective data analysis together in a unique data driven interpreter guided workflow. In this way, Geological Expression bridges the gap between seismic processing and standard interpretation workflows to give the power to make the most informed seismically driven decisions in days, not weeks.
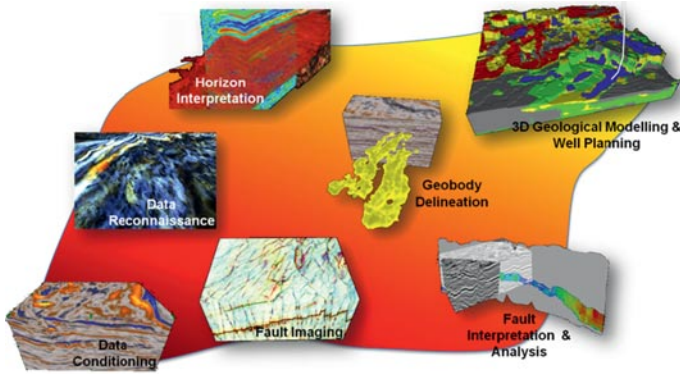
GeoTeric

ffA's Geological Expression software, GeoTeric, underpins a workflow that utilises 3D seismic analysis and sophisticated multi-spectral visualisation to reveal the geology which is expressed, but often hidden, in the data. At the heart of Geological Expression workflow is

an intuitive technique for extracting the 3D geometry of geological elements as individual objects that can be used as the building blocks of a 3D geological model.

This technology is called "Adaptive Geobodies" and its power and efficiency arise from two properties. Firstly, it can extract geological elements whose characteristics are highly variable because of its ability to adapt the criteria for defining a specific object much in the way that the human visual system does. In addition, it recognises that seismic data is an incomplete representation of the subsurface and allows the interpreter to step in and guide the delineation process when the data isn't enough on its own.

To counter balance the subjectivity introduced when a data driven process is overridden by manual intervention, objects defined in this

Geological Expression workflow utilises attribute analysis and sophisticated multi-spectral visualisation techniques to reveal the geology that is expressed in the data **(illustration: ffA)**

way are assigned a confidence value that indicates how well the surface position respects the underlying data. It is therefore very easy to see where the interpretation is data constrained and where it is defined by the expertise of the geologist or geophysicist.

Geological Expression Workflow

Achieving the optimal Geological

Expression workflow requires information to be delivered at the speed at which the interpreter works and thinks so that it can be assimilated and used to build an understanding of the subsurface most effectively. With the large amount of data within typical seismic volumes this has only now become possible due to the improvements in the desktop hardware available to most interpreters.

Even with the latest hardware a sophisticated approach to software design and implementation, which utilises the processing power available in both the workstations CPU and GPU, is required. This is what GeoTeric, is striving to achieve.
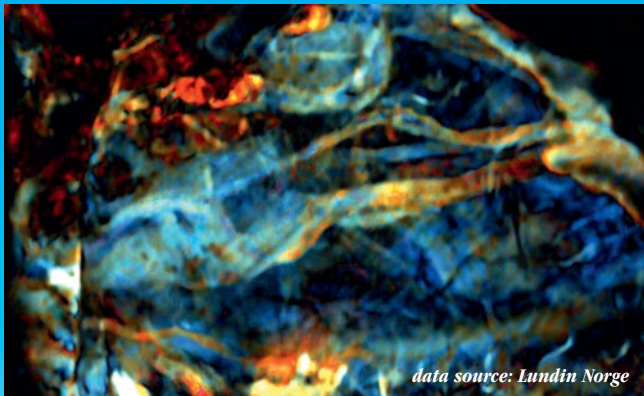
A New Paradigm

Geological Expression is a new paradigm for seismic interpretation that greatly increases the understanding of the subsurface that can be gained directly from seismic data. Only through examining the subsurface as thoroughly as can be achieved with the Geological Expression approach will we be able to maximise the returns on our investment in seismic data and fully exploit the hydrocarbon resources that remain accessible to us. ■

GeoTeric

Earlier this year, ffA reached a milestone in the Company's history with the launch of GeoTeric, the Geological Expression software. GeoTeric bridges the gap between processing and interpretation by directly translating geophysical data into geological information. With GeoTeric's patent pending data driven and user-guided approach, interpreters explore for new reserves and evaluate reservoirs with greater understanding than ever before, whilst removing weeks from the interpretation workflow. GeoTeric addresses challenges faced by interpreters working both onshore and offshore in clastic, carbonate and shale environments.

GeoTeric incorporates many of ffA's market leading technologies, including volumetric frequency decomposition and RGB colour blending as well as ffA's pioneering Adaptive Geobodies™ technology, which was developed in collaboration with Lundin Norge. The Adaptive Geobodies technology is at the heart of the data driven – interpreter guided approach embodied in the Geological Expression paradigm for seismic interpretation.

data source: Lundin Norge

With Adaptive Geobodies interpreters can generate 3D geobodies based on single or multiple attribute responses very intuitively and interactively. Sophisticated 3D manual manipulation tools and the ability to account for the interplay between different elements of the geology makes it possible to extract 3D geobodies in areas such as braided channel or karst systems where it would be impossible with all other commercially available techniques.

GeoTeric brings together the power of analysis and the knowledge and experience of interpreters in a new way. The result is much more efficient and effective interpretation workflows. GeoTeric makes it possible to unlock the full potential of seismic data giving interpreters the power to make the most informed, seismically driven decisions.

The Author:

Jonathan Henderson is a physicist with over 20 years of extensive experience in imaging and image analysis. His initial interests were in medical imaging, where he had worked on developing new methods for extracting and quantifying the information contained in X-rays and ultrasound scans. Since joining ffA in 2001, he has used his knowledge of medical image analysis to help the Company develop unique seismic image analysis technologies. Jonathan has been Managing Director of ffA for 6 years during which time the company, its global customer base and its software portfolio have all expanded substantially; the latest being the launch of GeoTeric, the Geological Expression software.