

Today's operators in Africa are facing a key challenge - the need to address the increasing geological complexity of many of Africa's fields against the need to adapt to the different operating contexts in each African country. By Paul de Groot, dGB Earth Sciences

# Increasing seismic interpretation skills in Africa

**G**EOLOGICAL CHALLENGES VARY from the deepwater Angolan sedimentary basins to the very limited seismic coverage in onshore regions of Egypt and Algeria (areas that are often characterised by poor seismic responses) and the challenges that the East African Rift System brings in East Africa. With the industry running out of classical structural traps (as is the case in Libya, for example), there has been a significant rise in complex structural and stratigraphic hydrocarbon plays.

Such complexity isn't limited to the traditional oil producing countries of Nigeria, Angola, Algeria, Egypt, and Libya, but new players as well. The country of Gabon is one such example, where pre-salt and post-salt areas are being targeted or Equatorial Guinea where a number of shallow water areas are the focus of exploration attention. So what does this mean for existing exploration technologies?

It means that there is increased pressure on seismic interpretation technologies to extract maximum value from multiple volumes of often complex seismic and geological data.

The detection of more subtle traps and reservoir fluid content also requires more sophisticated attribute analysis and a greater understanding of seismic stratigraphy and fluid migration in seismic interpretation today.

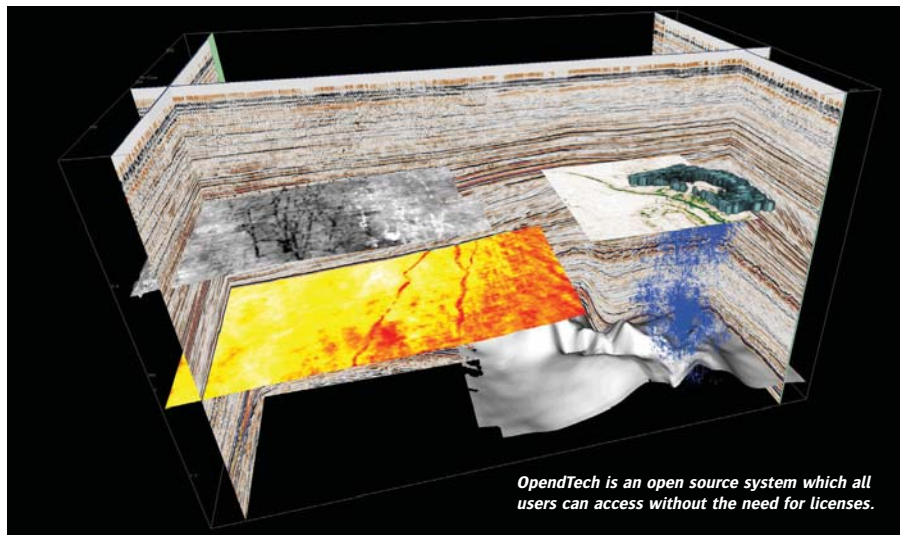
## The in-country challenges

Aligned with this geological complexity are the different operational contexts in which exploration is taking place. This can include environmental, security and cultural challenges and perhaps, most important of all, the shortage of local skills.

The shortage of graduates entering the oil & gas industry and a workforce reaching retirement age is starting to have a significant impact on exploration throughout the world and particularly in Africa.

A recent 2009 poll by management consultants, KPMG, of director-level executives across some of the world's leading national oil producers found all in agreement that a lack of skilled personnel was the biggest threat to their businesses going forward.

This short supply of key resources, such as engineers and geologists, can have a huge effect on existing operations leading to vast time and money being spent on training graduates up to capacity as well as potential bottlenecks in execution. In the words of a former Chief Petroleum Engineer at Shell: "all too often over the past 30 years, the core skills required to find and produce hydrocarbons have been treated as a cost and not as an investment of strategic importance."



*OpendTech is an open source system which all users can access without the need for licenses.*

In many African countries, there is also a shortage of graduates entering the industry. While such shortages tended to be covered up in the past by an influx of expatriates from regions where there was an excess of supply, such is the industry-wide shortage that this is no longer possible.

In order to develop the next generation of African graduates, it is essential that effective knowledge transfer is established between the commercial oil & gas sector and university students and graduates, with the adoption of seismic interpretation skills particularly important.

The growing focus African governments are placing on 'local content' in upstream oil & gas exploration and production is another key driver for this. In Nigeria, for example, the National Petroleum Investment Management Services (NAPIMS) is playing a key role in promoting the use of local resources in areas, such as seismic data processing, front end engineering and design work, and management positions.

Furthermore, each oil company must negotiate its expatriate workers allotment with NAPIMS and hire Nigerian workers unless they can demonstrate that particular positions require expertise not found in the local workforce. One area of expertise where such skills are lacking is seismic interpretation.

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## The growth of seismic interpretation

There's no doubt that operators' seismic interpretation capabilities have increased dramatically over the last few years.

The ability to develop geologically consistent 3D representations of the subsurface, collaborative workflows and the emergence of attribute analysis – so important in revealing geological information that may remain otherwise hidden – are just three examples of this.

However obstacles remain – in particular the lack of integration between the different software applications, and the lack of an open platform that supports multi-volume, interactive attribute analysis.

It was against this context that we, at dGB Earth Sciences, developed OpendTect. OpendTect is an open source system which all users can access without the need for licenses. It allows for the visualisation and interpretation of multi-volume seismic data using attributes, modern visualisation techniques, and a variety of sophisticated commercial plug-ins.

One such plug-in is the Sequence Stratigraphic Interpretation System (SSIS Plug-In) which helps operators better understand the depositional history of sedimentary sequences and can extract more information from the seismic data. This plug-in is particularly applicable to the new fields offshore Ghana and the Ivory Coast where the reservoirs are deltaic fans and where a good insight into the depositional environment for locating and analysing the reservoirs is essential.

Other OpendTect plug-ins include a Dip-Steering plug-in for calculating dip & azimuth maps and some of their unique attributes; a Neural Network plug-in which can detect geologically meaningful patterns (3D bodies or 2D horizon-based areas) through the visualization of patterns with similar seismic



**41 students from 20 different Universities in Niger are being trained up on OpendTect. The students include heads of departments, professors, lecturers and PhD students.**

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responses; and a Velocity Model Building plug-in for the building of accurate velocity models to better target hydrocarbon reserves.

As well as plug-ins developed by ourselves, users can also access plug-ins developed by our partners, such as the Seismic Spectral Blueing plug-in developed by ARK CLS and the Deterministic & Stochastic inversion plug-in developed by Earthworks & ARK CLS.

The result is a highly practical and sophisticated seismic interpretation tool which unifies many of today's seismic interpretation technologies, can be accessed by all members of the asset team, and through which the understanding and interpretation of structural geologies can be enhanced.

### **Introducing OpendTect to universities**

With the whole premise of OpendTect being based around openness and collaboration, it was important to us that we put the software in the hands of as many university PhD and MSc students as possible.

There were two twin goals to this – to bring graduates and future entrants into the oil & gas industry up to speed with the latest seismic interpretation techniques (as described in the previous section) and also use these students as a very broad test sample as we look to further refine OpendTect and introduce new commercial plug-ins.

To date, dGB has established relationships with over 180 universities worldwide dispensing over 1,000 free licenses. The list is truly global and includes 58 universities in Europe, 12 in the Middle East, 27 in Africa, 28 in Asia, 10 in the Asia Pacific region, and 43 in the Americas.

African universities include Ain Shams University and Al Azahar University in Cairo, Egypt; Al Neealin University and the University of Dongola in Sudan; the University of Boumerdes in Algeria; and the University of Ghana near Accra.

These universities have not only received the free OpendTect software and its open source platform but also all of its commercial plug-ins which include applications for dip steering, sequence stratigraphic interpretation, and neural networks.

In addition to this, we have also built up a database of seismic information for universities to work with. dGB's Open Seismic Repository contains seismic data, interpreted horizons and well data from a number of global locations, including Central Alaska, offshore Netherlands, and the North Atlantic Ocean, offshore Canada.

So what has the feedback been from the universities?

Here are just a few quotes:

"OpendTect is the most powerful software for

seismic interpretation I've ever used", according to David Gamez Ortiz from the Universidad Rey Juan Carlos in Madrid. "With an impressive 3D visualisation technique and its complete suite of additional functionalities, I sincerely recommend it to everybody interested in seismic exploration and interpretation."

In North America, the software is being used at Texas A&M where, according to Professor of Oceanography, Dr. William Bryant, "the faculty and graduate students within the Department of Oceanography deeply appreciate the use of such a valuable tool."

Isabel Restrepo from EAFIT University in Colombia found the attribute processing to be very useful saying that she was "very happy with some results that I found with attributes using OpendTect."

### **Building up local capacity in Nigeria**

As already mentioned, the African exploration sector and countries, such as Nigeria, are also facing a significant skills shortage driven by scarce talent, an ageing workforce, and the slow pace of technology and knowledge transfer.

Against this backdrop, a number of Nigerian Universities have also been recipients of dGB software. One such example is Obafemi Awolowo University in Osun State. Dr. Adepelumi Adekunle Abraham, Senior Lecturer in Geophysics, continues:

"We want to sincerely express our appreciation to dGB for donating OpendTect to our University. Since the installation of OpendTect in our University, the quality of our teaching and research has significantly improved. We now have several

students using one aspect or the other of the OpendTect for their projects (BSc, MSc and PhD)."

In June this year, dGB donated US\$4.8mn of software to 20 Nigerian universities. These included Ahmada Bello University in Zaria; Covenant University and Crawford University, both in Ogun State; the Federal Universities of Technology in Akura and Owerri; Kogi State University; Niger Delta University; the University of Lagos; and the Rivers State University of Science & Technology in Port Harcourt.

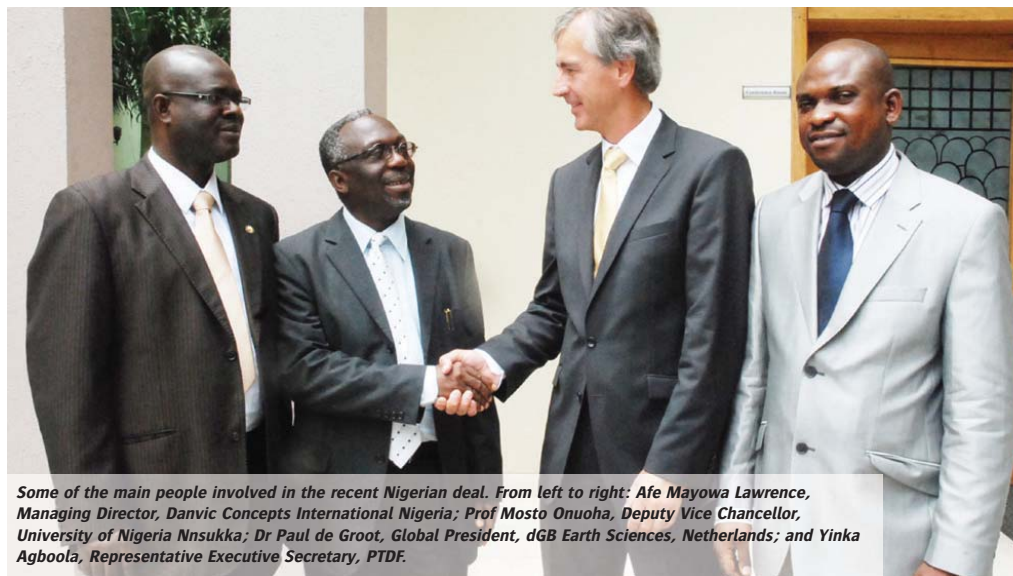
The announcement, made in partnership with local Nigerian oil & gas services provider, **Danvic Concepts International**, who will be co-ordinating the local roll-out, forms part of the Petroleum Technology Development Fund (PTDF), a Nigerian government initiative to enhance research and training within the country's oil & gas sector.

Partnering with the PTDF, dGB is helping to meet their stated vision of "serving not only as a vessel for the development of indigenous manpower and technology transfer/acquisition in the petroleum industry but to also make Nigeria a human resource centre for the West African sub-region."

It was a pleasure to visit Lagos recently and attend a forum to introduce this collaboration in the presence of the Executive Secretary of PTDF, and the Vice Chancellors from all 20 Universities.

As the demand for oil continues to rise and companies are forced to maximise exploration efforts on increasingly complex reserves, the demand for technical expertise is only likely to increase.

We hope that this model of technology transfer with Nigeria will be replicated throughout the continent as we continue to ensure the graduates of tomorrow are fully trained up with the seismic interpretation skills of today. ■



**Some of the main people involved in the recent Nigerian deal. From left to right: Afe Mayowa Lawrence, Managing Director, Danvic Concepts International Nigeria; Prof Mosto Onuoha, Deputy Vice Chancellor, University of Nigeria Nnsukka; Dr Paul de Groot, Global President, dGB Earth Sciences, Netherlands; and Yinka Agboola, Representative Executive Secretary, PTDF.**