

Finding Petroleum

Using geochemistry to understand East Africa source rocks

The story of Senegal oil and gas operator Fortesa

Distance oil and gas learning in Uganda

Looking for oil in Mozambique Channel

Oil in Somaliland

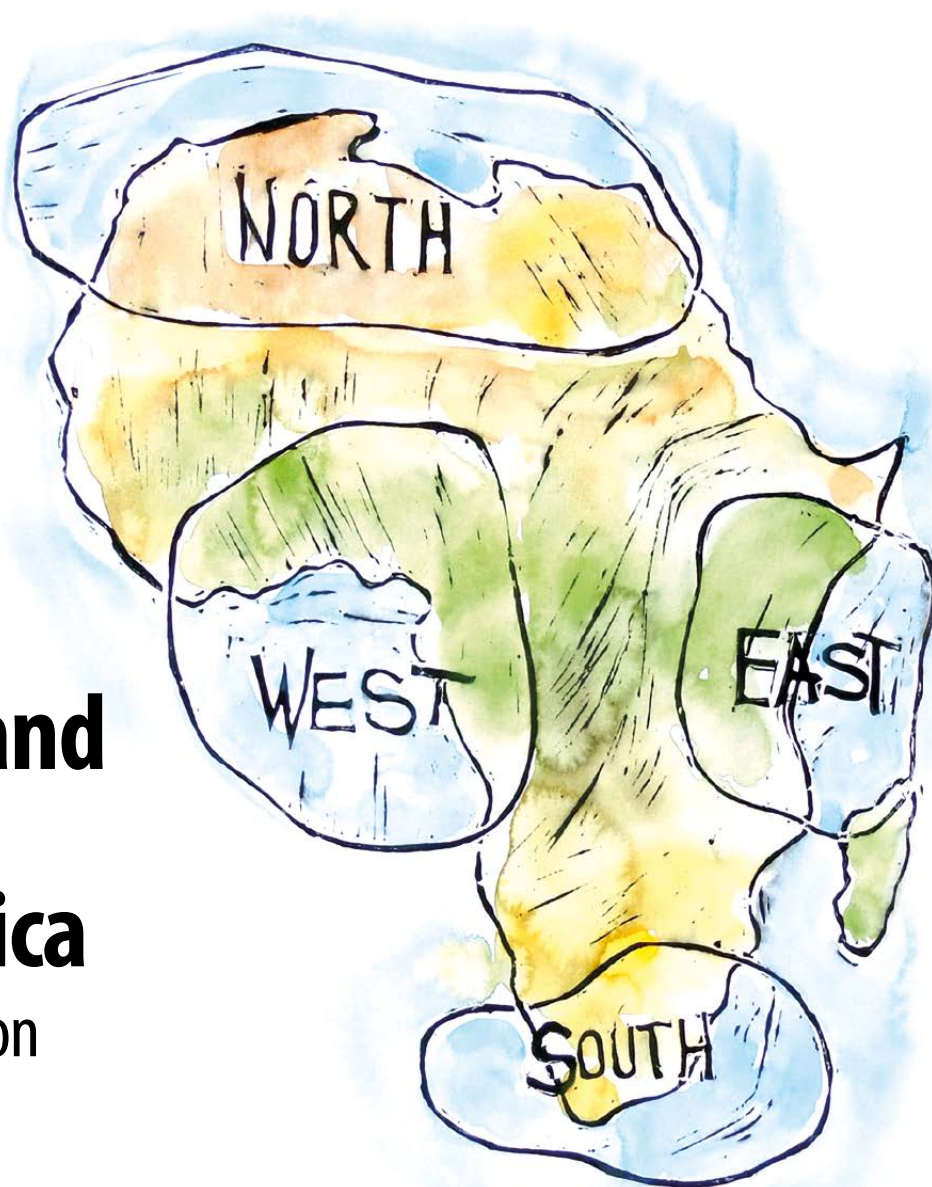
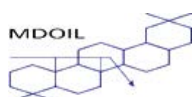
Finding Petroleum: Finding Oil and Gas in Sub Saharan Africa, London, June 25, 2018

Special report

Finding Oil and Gas in Sub Saharan Africa

June 25 2018, London

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Finding Petroleum

This is a report from the Finding Oil and Gas in Sub-Saharan Africa event, June 25, 2018, London

Event website

<http://www.findingpetroleum.com/event/210a5.aspx>

Many of the videos and slides from the event can be downloaded from the event agenda page.

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Finding Oil and Gas in Sub-Saharan Africa

Finding Petroleum's June 25 London forum "Finding Oil and Gas in Sub-Saharan Africa", looked at Fortesa's oil and gas activities in Senegal, new exploration techniques for East Africa, the challenges of local capability requirements, and possibilities of prospectivity offshore Mozambique and in Somaliland

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David Bamford of Petromall, event chairman, said he is seeing something of a shift in industry thinking about Africa compared to a few years ago. Before, companies were looking mainly at deepwater successes following Kosmos and Tullow in West Af-

rica. Now, companies are more interested in whether there might be oil to find, close to the recent gas discoveries off Mauritania and Senegal, and offshore Mozambique and Tanzania.

In North West Africa and the Mauritania / Senegal / Guinea basin, a few unsuccessful wells have been drilled looking for oil. In East Africa, "no-one has really discovered a significant oil province other than the Lake Albert Basin (Albertine Graben) in Uganda and Kenya."

Companies are also thinking harder about how they find local skilled workers to meet their 'local content' requirements to employ local workers. There is a big shortage of skilled technicians such as welders and electricians, particularly in East Africa, and a shortage of technical and commercial managers to drive the business. According to one estimate Uganda only has 40 oil and gas professionals.

The UK's Department for International Trade (DIT) is trying to help British companies take more of a role training skilled workers, Mr Bamford said.



David Bamford of Petromall



Finding Petroleum

Using oil geochemistry to better understand the source rocks of East Africa oil

Chris Matchette-Downes, founder of MDOIL and co-founder of the East Africa Oil Group, EAX and Adamantine Energy has spent some 15 years building an oils database to try to better understand the petroleum geology of East Africa in order to better understand the likelihood and location of commercial oil.

Chris Matchette-Downes, founder of MDOIL and co-founder of the East Africa Oil Group, EAX and Adamantine Energy has spent some 15 years building an oils database to try to better understand the petroleum geology of East Africa in order to better understand the likelihood and location of commercial oil.

He has teamed up with a group of 5 professionals, calling themselves “East African Oil Group”, including, David Boote, Andrew Long (a specialist in potential fields), Nick Cameron (geologist), Mike Rego (explorationist) together having geology, geochemical and gravity expertise. “We meet regularly and have debates about what is controlling the oil distribution, why oil hasn’t shown itself more readily,” he said.



Chris Matchette-Downes, founder of MDOIL

Drilling for oil has been relatively unsuccessful in coastal East Africa thus far, and perhaps part of that can be attributed to the poor data availability, he said. Explorers have been more interested in West Africa until now. But also, perhaps there have been errors made by explorers as to the age of source rocks, which has put exploration on the wrong path, leading people to “look for source rocks that don’t exist, trying to make things fit when they don’t.”

Mr Matchette-Downes emphasises that companies should start by using the evi-

dence to build basin models, rather than using seismic in isolation or be driven by models. “There’s a lot of data out there simply ignored,” he said.

Mr Matchette-Downes’ group are very keen to find a source of funding which will help them develop their theme further, do more basin modelling, and build their database of oils.

Complex margin

East Africa is quite a complex margin, more complex than the breakup of Africa and South America, he said. There is a complex strike slip regime, lots of pieces and remnant fragments.

East Africa started to break apart in the Carboniferous era (360 to 300 million years ago), initially in the Zambezi basin area onshore, with successful rifting commencing in the lower Jurassic with Madagascar-Seychelles-India breaking away and finally Seychelles in NW Indian parting as the Carlsbad Ridge opened. In the early phases there would be very narrow basins, ideal for accumulating organic material and source rock development. Post early mid-Jurassic the open seaway would have ended the possibility of source rock development for much of the region.

There are numerous ‘shows’ of oil, including oil seeps onshore, oil slicks offshore, and some condensate and of course gas production and vast gas discoveries. These can be seen on the western margin from the Cambay Basin with oil its production in the North all the way to the Outeniqua basin off South Africa to the South.

On the eastern flank of the breakaway margin, now fragmented, and in parts attenuated there are oil shows in Seychelles wells, tars washed up on the islands and produced oil in the Bombay High field (offshore Mumbai); oil and gas shows and accumulations throughout Madagascar and tars on the beaches of Comoros. Together

the West and Eastern breakup margins occupy a vast area.

These oil shows can be analysed to determine both the age and maturity of the precursor source rocks, and thereby through interpretation of the biomarker and isotope data type the discreet oil families.

The research group has also gathered data from published papers and other literature, adding to the knowledge gained from its own oil samples.

You can look for patterns in the sample data (isotopes, metals, biomarkers and other chemical signatures) and use that to get a sense of how the basins were set up and where they might be. So tying back the oil sample to the geology, he said, is the way to understand the petroleum potential.

For example, some oils in Western Madagascar wells which is very similar to oils found in offshore Kenya wells (Lamu area).

Source rocks

Mr Matchette-Downes showed a large slide with all the different potential source units determined from analysing oil samples found on beaches in wells and in seeps along the East African coastline. The analysis has shown that source rocks with “a complete spread [by age] from the tertiary in the North all the way through to the infra Cambrian in Oman” he said.

You can cross plot the different carbon isotope abundance ratios, oil molecule types, chain lengths, isomers, aromaticity and so on to allow such interpretation.

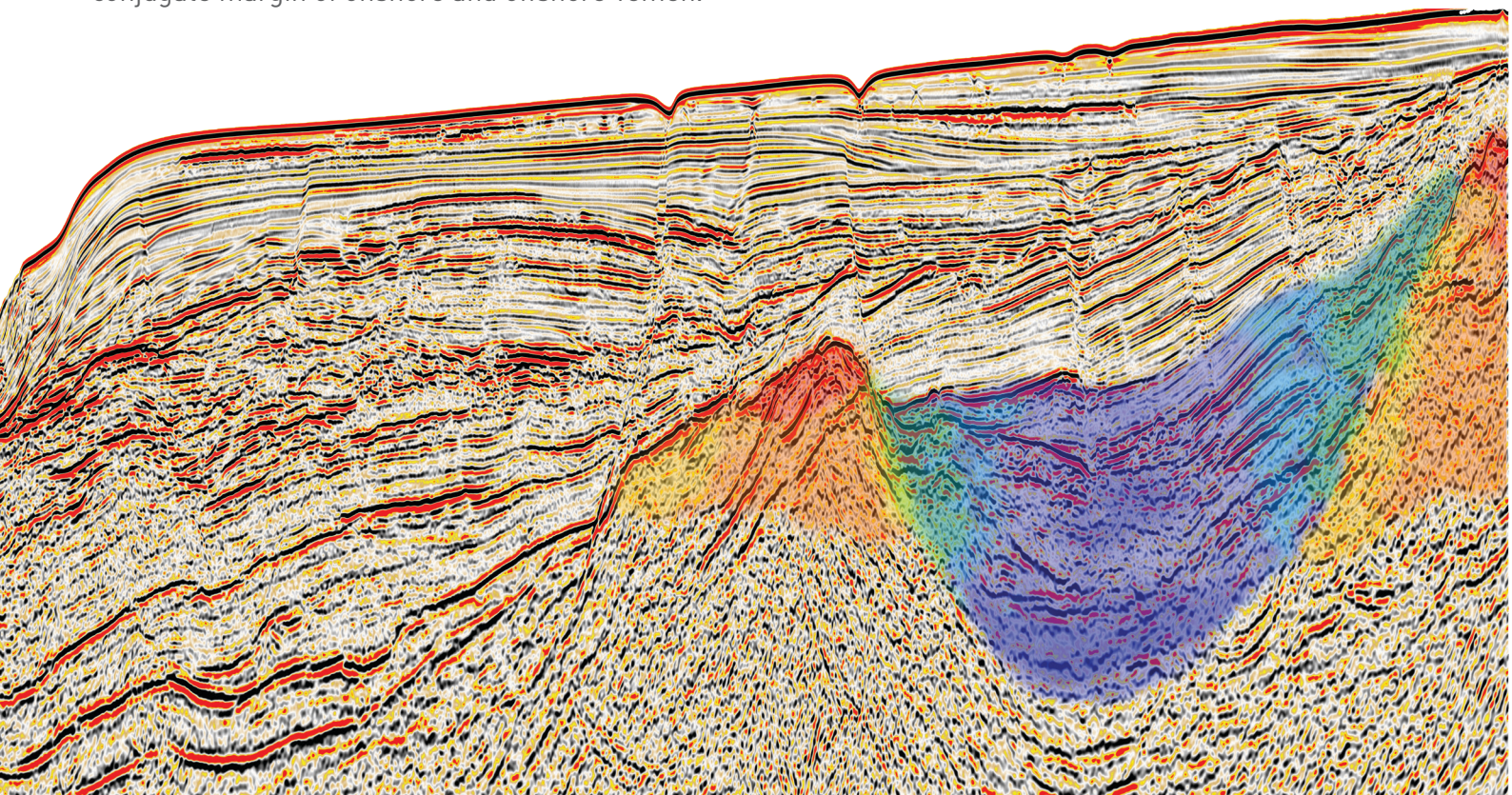
“Where the oils are not too biodegraded (most of them are) you can actually work out roughly the age of the precursor source rock,” he said.

From work done “decades ago” in the Seychelles, you can see 2 very clear oil types, one algal rich, the other from plant

Somaliland

Seismic and aeromagnetic data

TGS' recent acquisition completed in the Red Sea has regenerated our interest in reviewing the potential of other underexplored basins in the region. A stand-out area is offshore Somaliland: a recent review of more than 5,000 km of vintage 2D TGS multi-client data demonstrates exciting structures and plays in this unique rift environment. The hydrocarbon potential of this rift basin has been overlooked in the past, as indicated by the seismic. TGS' onshore multi-client aeromagnetics in Somaliland (34,693 km) showcases several structural domains that correlate with rift related oil fields on the conjugate margin of onshore and offshore Yemen.



See the energy at [TGS.com](https://www.tgs.com)



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debris. Both of them are very waxy so initially look quite similar. One family has affinities with the Lower Mesozoic of East Africa and the other more like the Tertiary oils of Northwest India.

Mr Matchette-Downes was able to match some of the oil samples from an oil well core with the tarballs watched up on the beach. "That oil in the Seychelles is pretty similar if not identical to oils we looked at in Tanzania," he said.

Cretaceous

There was a theory among some researchers that any source rock for East African oil would need to be Cretaceous or younger, because "anything older would be too mature, be cracked to gas, and so not of interest," he said.

But there is no evidence yet of any Cretaceous source rock. "It is a bit of a wild goose chase. When the Cretaceous became default source rock for East Africa, a lot of expensive wells were drilled on that basis."

There is known to be Triassic and Jurassic source rock along coastal regions, which are deeply buried under Tertiary and

Cretaceous deltas, thus increasing the burial temperature and driving the formation of gas.

But there could be potential for older source rocks in areas where there is attenuated continental crust further offshore where there are no thick Tertiary and Cretaceous sedimentary accumulations. These areas can be located from careful study of potential fields data, he said.

One example of a false trail involves the oil seep on Pemba Island, with a characteristic sterane distribution. Steranes are a complex carbon based compound group found in oils and their precursor source rocks. On close inspection, the oil character did not match that of the Cretaceous shale. Secondly, the Cretaceous shale it was being compared to had no source character, he explained.

Tertiary

Regarding the Tertiary as a source rock contender, BG drilled Sunbird 1 (June 2014) has been touted as having Tertiary derived oil. No evidence has been made available to support that. The immediately adjacent Cities Services wells both are immature even in the Cretaceous and contain oil shows that are super mature.

Looking further south in Mozambique, one can follow a gas wetness trend from the Buzi field which becomes slightly less dry, eventually within a field named Inhassoro which produces over 2000 barrels of condensate a day.

Again a Tertiary source is attributed despite the Sterane, maturity and other data suggesting a lower Mesozoic or older source, despite the Domo shales having low TOC, being relatively immature, having no potential generate oil or condensate and the basin being separated by a coast parallel graben from the presumed source kitchen.

So, the lower Jurassic and Upper Triassic hold the greatest potential source for oil, Mr Matchette-Downes concludes. "A lot of mistakes were made and expensive wells drilled trying to find things that didn't fit the facts," he said.

"Things like that which should be looked at rather than wanting something that might seem more amendable such as a young Cretaceous or Tertiary source rock, otherwise it will steer the exploration in the wrong direction," he said.

"There's a start to where you might want to look for oil," he concluded.

Finding
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Senegal, oil and the story of Fortesa

Senegal oil and gas company Fortesa International has 168 employees, all local, doing every single task of an oil company, including exploration, drilling, production operations, even building its own pipeline. Executive chairman Rogers Beall told the story

Fortesa, an oil and gas company has 168 employees in Senegal. It is a "completely vertical company" doing everything from exploration, drilling to operations, with 100 per cent "local content" (local staff). It has 2 of its own drilling rigs, an entire exploration and production department, and has installed and operated its own pipeline. All of this is managed from Dakar, the capital of Senegal.

The Senegal oil and gas history goes back to 1975, when Shell drilled the first well, and then state oil company Petrosen drilled the Gadiaga well in 1976, Mr Beall said.

Rogers Beall's first company, First Exchange, founded in 1990 in London, worked together with Senegal's national oil company Petrosen from 1991 to bring

in experts to understand the basin (geophysics, geology and geochemistry). It organised data packages and promotions with Petrosen as a "kind of outside mouthpiece".

Petrosen rented a drilling rig from a company in Morocco, and used it to drill 4 wells. 3 were dry wells, but the fourth was a big gas discovery. Then Petrosen bought a rig and drilled Gadiaga 2.

First Exchange spent a year travelling with Petrosen around the world trying to find a company which would help develop the field, but the efforts were unsuccessful. So it was suggested that Mr Beall should set up his own operator company, perhaps as a pathway to bringing in other companies. This led to the founding of Fortesa in 1999.

The first employee was a Senegalese national who had been trained in Paris by the French Institute of Petroleum (IFP), then joined Petrosen.

Fortesa spent about \$34m drilling wells, and produced about \$85m of gas.

Mr Beall tells a story that he had an office for his company First Exchange in Baku (Azerbaijan), and was sharing a taxi with some employees of American oil company Amerada Hess, and told them he was working in Senegal and developing gas. One of the Amerada Hess employees, a Greek national based in the UK, said he knew there was oil there, as he had been a well site geologist on an earlier Senegal project, and he knew it was a supergiant petroleum system.



Roger Beall, Executive Chairman, Fortsea International

Mr Beall immediately called a colleague to say “I’m riding in this taxi cab in Baku with a Greek guy from England, and he’s telling me we have oil.”

So Fortesa reprocessed some of the Shell seismic data (“12 fold, 21 track”) and took it to Occidental Petroleum in California. But just having the seismic proved not to be a strong enough argument to get Occidental Petroleum involved. There needed to be a geological story.

So Mr Beall put a team together, including Nick Cameron (who has worked as a consultant to Fortesa ever since) to “put together the regional geology correctly.”

No more wells were drilled for another 9 years, but a number of different companies took an interest. Eventually Cairn and Conoco hit success in 2014, drilling 2 wells, discovering a supergiant field which became SNE. The reserves in the two fields look to be 640m barrels of net recoverable oil, he said.

Then in the 2010s, Kosmos Energy made the Teranga, Tortue and Yakaar gas discoveries, estimated total reserves 60 TCF.

The main factor, which has led to success in recent years for First Exchange, Kosmos and Cairn, after 50-70 years of trying, is understanding the complete geologic story.

That’s what gets from ‘you have some pretty seismic but you don’t know what it is’ to what Kosmos and Cairn achieved, he said.

“What I’m talking about is not compiling the data, but understanding the data, building it into a correct model,” he said.

One oil major said that understanding the

petroleum system was similar to looking at a glass carriage clock, where you can see all the moving parts which lead to the end results – the opposite of a ‘black box’ where you see the results but not how it was created. It means “integrating the geochemistry, geology, the system and the story.”

So the whole process of getting the field into production had taken from 1991 to 2014, some 23 years, going from a time in the 1960s and 1970s with wells drilled without any modern data and understanding of petroleum systems, to now, where North West Africa is recognised as a “supergiant petroleum system”.

Today, Fortesa is looking for oil onshore, and has drilled 22 wells onshore so far. The data has been used to compile reports (published by First Exchange), covering the area from border of Mauritania to the Northern border of Sierra Leone.

I’m the only [onshore] producer for 2400km radius for Senegal. There is no other production until you get to Morocco or you get into Niger.”

Drilling the interslope

With the benefit of greater understanding from today’s seismic methods, it was possible to see that almost every offshore well in Senegal (before SNE) had been drilled in an interslope, where the rock layers have a high angle of incidence to horizontal.

This means that no sand stayed – it all went to the basin floor. There are some little strings of sands but no ‘sheet’ sands, so no possibility of a big discovery, Mr Beall said.

One exception was a well drilled by a French predecessor company to Total in 1955, Tienaba (Ti-1). Senegal was a French colony until 1960. It had been declared a dry hole. But Mr Beall’s colleague Nick Cameron saw it had drilled through a reservoir of 35 per cent porosity in the early Albian, far away from where everybody else had drilled.

This French company had drilled all the synclines, looking for basins. They found sands, seals, traps and shows, and then left the country in 1956.

Cairn drilled its “SNE North-1” well on top of a Jurassic platform. “It is absolutely

the correct place,” he said. Fortesa has analysed the geochemistry, which says “it’s much bigger”, he said. “This trend right here is something Cairn doesn’t have or hasn’t found yet. We’re real excited about this onlapping play.”

Mr Beall plans to drill some of the wells to greater depth (a little beyond 2000m), where it expects to find reservoir sands, which can be seen on seismic and gravity magnetics.

We think a lot of the gas we’ve been producing is oil “post mature,” he said. “That’s why I want to drill deeper.”

Fortesa is working with hard data, and “we’re able to predict an early Jurassic marine source rock in the whole littoral [coastline] of this huge basin.”

“I wanted to tie these super giant supergiant source rocks into these reservoirs, trying to put this system together”.

Jubilee slope fans

Mr Beall was asked how he fits in the idea of Jubilee field type slope fans (as seen in Tullow’s Jubilee field offshore Ghana).

“For explorationists, Jubilee has been a huge disappointment because no-one found another one,” he said. “I think Jubilee has something that the other fans didn’t have. The other fans that everyone has drilled up and down the coast don’t have a fault seal that jubilee has.”

“My opinion, as businessman, is that Jubilee works because it is fault sealed to the closure. There may not be another ‘Jubilee’ if you don’t have a 4 way closure. You have fans, you have sands but you don’t have a trap. I think Jubilee is unique. I’m not looking for Jubilee myself,” he said.

Fortesa is looking at prospects up dip and on the same trend as Kosmos, on and on the same play fairway as Cairn. “I’m just going to look to drill de-risked sands in the same environment,” he said.

Local content and local capability

Mr Beall has strong views about local content rules, where foreign companies are required to hire a certain number of locals.

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Local content rules are “stupid, wrong, it will fail, it will get people killed. We want local capability – people coming up through the ranks, as you all did [addressing Finding Petroleum’s London audience]. The quality and the competency is what’s required, not the rules.”

The problem is that once the people have been hired, there is little incentive for oil companies (and the individuals) for them to be useful.

“I’ve drilled 3 wells in Cameroon when we had forced local content. The operators that I drilled the wells for required us to hire Cameroonians. They had wonderful resumes. But they had absolutely no responsibility. They were observers on the rig on our system.”

“It’s a total bad way to treat people, to be forced to hire someone because they’re a citizen, as opposed to wanting to hire them because they are competent,” he said.

Mr Beall has advised governments not to “put in bad laws to force local content,” he said. Instead, “You should embrace and develop local capability. That is everything, and that’s what Fortesa has done.”

Fortesa hires Senegalese nationals to work initially in junior positions, then they develop the understanding and skills to be able to take on more senior roles. You can’t take inexperienced people and give them responsibility driving drilling rigs. “The only way to do it is one step at a time.

“With a new oil academy in Senegal, I have an arrangement with energy minister,

where we take 2 or 3 bachelors or masters students as interns at all times.” They can be working on drilling rigs, pipelines, production departments, exploration departments, admin on HSE.

Fortesa works with experienced drills and pipeline designers from the UK and the US, but they don’t do the work themselves, they watch over what the Senegalese people are doing and occasionally tell them they should do it in a different way. “That’s what we intend to have Senegal do,” he said.

Describing the basin

Mr Beall’s talk included a geological description of the basin (which is outside the scope of this report, but can be viewed free of charge online).



Distance oil and gas learning in Uganda

The Virtual University of Uganda (soon to be renamed Nexus International University) is a distance learning university based in Kampala, providing a range of postgraduate management and oil and gas courses, some with tutors from Europe – aiming to make it easier to develop local skills

The Virtual University of Uganda (soon to be renamed Nexus International University) is a distance learning university based in Kampala, providing a range of management and oil and gas courses some with tutors from Europe, aiming to make it easier to develop local skills.

All of the courses from the university are delivered online. The university was set up in 2010, and has a physical building in Kampala, Uganda. Petromall advises the University about opportunities to attract lecturers and sponsors and supports their efforts to develop relevant courses. Petromall is a partner company of Finding Petroleum.

The university provides post graduate programs in public health, international development, business administration, ICT for development, oil and gas management MBA, and a number of programs for people already working, in the ‘corporate academy’. The oil and gas management MBA is designed to develop students to manage oil and gas activity.

The local industry is about to massively expand, with Total and CNOOC expecting final development decisions on oil developments later in 2018, and expecting first oil

in 2021. There are several billion barrels of oil reserves to be developed along Uganda’s Lake Albert trend, and a plan to build a pipeline from Western Uganda to the coast via Tanzania.

Uganda is expecting to have 25,000 workers employed in the peak of the development of the oilfields, and there is a similar picture in the rest of East Africa. There’s also a huge amount of gas to be developed, said Greg Coleman, who is on the governing council of the university.

If there are to be 25,000 oil and gas workers, there would probably need to be between 1000 and 2000 middle and higher level managers to provide oversight. Good oversight of the work is critical, if the infrastructure being built is going to last for decades and provide many years of economic gain, he said.

And it would be better for the country, and probably the long term health of the industry in general, if more of them were local. But by one estimate, there are only about 40 oil and gas professionals in Uganda, he said.

The university’s goal is to “train and develop talent across Africa,” for the people

who will provide management and oversight of these developments, Mr Coleman said.

Mr Coleman noted that Senegal took something like 40 years to get a local oil and gas industry running (as Rogers Beall said in his preceding talk). But East African countries cannot afford to take 40 years to develop an oil and gas industry. And developing local talent is an important component of this development.

The government of Uganda has a Ministry of Energy and Mineral Resources, and a regulatory system (Petroleum Authority) for a future oil and gas industry. They have a national oil company starting to finance its share of development, both in oilfields and in refinery / distribution. It also has a National Council for Higher Education.

The oil and gas projects will also have impact on communities and the environment, with some communities completely transformed by it. This community change will also need careful and competent management, Mr Coleman said.

Meeting the students personally “gives me renewed energy every time,” he said. “These people are amazing – they are am-

bitious, working already on their own jobs—doing courses at night. Several students are working mothers doing courses at night.”

“You meet them and think, Africa has so much potential, if these people could be properly trained and equipped with the tools that we have, what a great job they could do, and how much better Africa could be.”

Furthermore, Uganda has 40m people, with over half the population under 14 years of age. “You realise what a challenge these countries and governments have to educate their people,” he said. Meanwhile there are plenty of obstacles with face-to-face education, not least that it is very difficult to travel around the country. So online education has good potential.

East Africa is already a high-tech society in some ways. There are 184m internet users in East Africa, and that is growing 20 per cent a year, so could rise to 450m in 5 years. There is widespread use of cashless payments, including paying bills using mobile phones. Some students are even taking the master’s program via their smartphones, Mr Coleman said.

University marketing

Mikki Hall, marketing consultant with VUU, said that in a survey of past graduates, 52 per cent said they thought the reputation of the university was “excellent”

and 48 per cent said they thought it was “good”, Ms Hall said.

But there are some negatives which are stopping people signing up more students, including the name ‘Virtual University of Uganda’. The word ‘Virtual’ meant it was perceived as fake and the word ‘Uganda’ didn’t have strong appeal in international circles, Ms Hall said. The university is currently planning to change its name.

Many East African students have been looking for international education, looking for online courses in Europe, the US, even in Australia. The University does have international tutors (although it is an East African university), and that is a unique selling point, she said.

The distance learning aspect of the education is also a key selling point, enabling people to study around other commitments, such as their existing jobs, or family commitments, and no need to spend time sitting in Kampala traffic going to university.

The next intake for the oil and gas management MBA will be in August. There will be additional MBAs on petroleum engineering and upstream management. The programmes are made up of 10 courses in total, each lasting about 8 weeks and each costing \$550, with a research project at the end, so a 2.5 year course in total. This is “really affordable when compared to other universities,” she said.



Mikki Hall, marketing consultant with VUU

The corporate academy has 3 short courses currently, in “Security in the Oil and Gas World”, Environment Impact Assessments” and “International oil and gas management.” These courses can be delivered face to face at the university at Kampala or online. Courses on tourism and environmental management are coming shortly.

VUU is looking for people and organisations who might be interested in sponsoring students so they can complete courses, or might be interested in lecturing on one of the online courses, or helping to develop courses, Ms Hall said.

As the university grows, the biggest markets are expected to be Tanzania, Kenya and Nigeria.

Finding
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Spectrum – looking for oil in Mozambique Channel (Angoche Basin)

Seismic company Spectrum believes that there could be a new prospective oil province beneath the Davie Ridge, which runs between Mozambique and Madagascar, based on understanding the geology as an “incipient subduction zone”

Seismic company Spectrum believes that there could be a new prospective oil province beneath the Davie Ridge, which runs between Mozambique and Madagascar, based on understanding the Davie Ridge as an “incipient subduction zone, with the African plate moving underneath the Madagascar –Seychelles –Mascarene microplate.

The Davie Ridge has been widely used as a plate boundary and a fracture zone to accommodate the southward movement of the Madagascar-India from the West Somali Basin in most of the plate reconstructions. Anongporn has also presented another recent idea by the German institution BGR proposing that the Davie Ridge is linked to the Gunnerus Ridge in the Larsen Sea in the Antarctica, and the Mozambique Basin is a conjugate margin to the Larsen Sea.



Anongporn Intawong, Geoscientist team leader with Spectrum

Spectrum’s analysis started with 3 regional seismic lines running south to north in the Mozambique Channel. The 2D seismic data shows typical passive margin features along the

Mozambique margin, up to the point when it

meets the Davie Ridge, the subsurface geology dramatically changed, said Anongporn Intawong, geoscientist team leader with Spectrum. No typical syn-rift features have been seen within the Mozambique dataset. In the southern part of the Mozambique Channel, the continental crust can be seen in the very inboard area, and then SDR zone, and then two types of oceanic crusts in the further outboard. These four crustal types have been mapped over the dataset area. Anongporn has also presented contourite depositional system identified within Spectrum’s dataset, and it has been first recognised within the Late Cretaceous to Early Tertiary, and then there was an influx of coarse clastics, mixed turbidite and contourite system, in to the basin from Oligocene onwards.

Moving up towards the central and northern parts of the dataset, the thickness of the sediments on the shelf can be seen much thinner on seismic sections comparing to the southern area, suggesting the area has been uplifted. When you get to the Davie Ridge, the basement morphology gets narrower, and you can see distorted continental crust all the way along the Davie Ridge, Anongporn said. Two regional Mozambique Channel transect lines across the Davie Ridge from the Mozambique margin to the Marondava basin offshore Madagascar were used to support for evidence of the oceanic crust of the African plate subducting underneath the Madagascan microplate.

Anongporn also presented a reservoir analogue, a mixed turbidites and contourites system, from the Ruvuma. This is comparable to what Spectrum has identified on their seismic sections.

The Davie Ridge runs between southern corner of Madagascar and north Mozambique coast. It can be seen quite easily on the seafloor morphology and it shows up on Bouguer gravity data, with a north-south direction. There is a thick sedimentary package under the Davie Ridge. Anongporn has also presented more interpreted seismic sections supporting Davie Ridge as the incipient subduction zone, including accretionary wedge and distorted continental crust.

There have been numerous sea surface oil slicks identified on optical satellite images in the Mozambique Channel, particularly in the Davie incipient subduction zone; these oil slicks are classified as “high confidence slicks” as all the pollution occurring oil slicks have been discarded from the dataset.

The sea slicks seen on the seismic data found within the Davie subduction zone are also associated with geological features and other Direct Hydrocarbon Indicators (DHIs) e.g. seabed channels and pock marks. This all points to a new prospective oil province offshore Mozambique, said Ms Intawong.

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Oil in Somaliland

Multiclient seismic company TGS believes that the building blocks of a working petroleum system are in place in Somaliland

Felicia Winter, interpretation geophysicist and potential field analyst with TGS, said “after careful evaluation it is evident that the building blocks of a petroleum system” are present in Somaliland, based on an interpretation study done by TGS.



Felicia Winter, Interpretation Geophysicist and Potential Field Analyst with TGS

The new government in Somaliland is keen to kick-start exploration in the country again, especially offshore, she said. This has resulted in plans by RakGas and BGP to undertake seismic acquisition offshore and oil company Genel to drill an exploration well onshore. The offshore is still very much untested on the western shelf and will benefit from more seismic data. The Genel onshore well has been proposed for early 2019.

The history of Somaliland oil and gas exploration goes back to 1910, with an oil seep in Dagah Shabel on the Western Coast. In the 1950s a large amount of wells were drilled for structural research reasons, with several of them also encountering oil. There were additional hydrocarbon shows during drilling in the 1980s, offshore and further to the east onshore, both oil and gas. The most recent well was drilled in 2012, which also showed oil and gas, recovered from Cretaceous, Jurassic and Triassic layers.

A number of wells distributed across the country have been declared dry, mainly due to poorly defined traps (either the seal or the reservoir not present), or the reservoir

being very thin. In part due to several of the wells in the 50s having the objective of structural intelligence, Somaliland is still relatively unexplored, particularly further east.

Geological analysis

TGS presented an assessment of the offshore prospectivity and the implication of that for the onshore potential of Somaliland. The evaluation was based on more than 5000km of 2D offshore seismic and 34,000km of onshore aeromagnetic data.

The coastal basins show structural traps from the Jurassic, Cretaceous and Tertiary ages. These traps, the surrounding structures and possible source rocks have been tested by TGS for the thermal regime, maturation and possible migration paths. Although the evaluation is a regional first pass assessment on the prospectivity, all necessary building blocks needed for a working petroleum system have been identified, according to TGS. “It is just a question of piecing it together and targeting more confidently”, Ms Winter said.

With no seismic onshore, the assessment of the exploration potential was mainly based on airborne magnetic surveys from TGS. Ms Winter could emphasize the interpretational value of the magnetic dataset regarding geology and structure by pointing out that the 25km line spacing of the magnetic survey allows a resolution of basin depths down to 5km, whereas the 2.5km line spacing of the infill survey resolves small scale structures of under 1.5km width.

Through seismic interpretation of the offshore, potential Jurassic and Cretaceous source rocks were identified as well as Mesozoic reservoirs. There is also a Tertiary petroleum system as indicated by seismic facies analysis and the structural and stratigraphic traps identified in the Eocene and Miocene. Modelling of public domain geochemical data at pseudowell locations allowed TGS to identify that both the Mesozoic and Tertiary petroleum systems have shown viable thermal regimes for maturity and expulsion.

Ms Winter identified traps offshore, including tilted fault blocks from rifting, flower structures from a transpressional setting, horst and graben systems and compressional anticlines with onlap. The Cretaceous rotated fault blocks originate from rifting between Somalia and Yemen.

The compressional and transpressional traps can be related to the tectonic phase of the opening of the Gulf of Aden, since the oceanic spreading occurs oblique to both margins and the resulting transform faults enable interesting structural strain.

Onshore, the exercise was to identify structural domains of interest, without available seismic, and correlate these to geological events. In the northwest there is a high amplitude, high frequency pattern in the aeromagnetics, which “we think might be related to Miocene volcanism, and probably disguises the underlying basin structures,” she said.

In the south there is another domain of interest with a variable amplitude, high/medium frequency pattern. This area is structurally complex due to W-E trending basin features, possibly connected to the Nogal graben system just east of the survey area, and interspersed strike-slip faulting that was induced by the later SW-NE rifting as a result of the break up offshore.

During the Q&A session of the talk she mentioned that in the past, geologists studying the region largely believed that the regional seal must have been breached by late stage uplift and tectonic events, causing any hydrocarbons to escape. She was able to show that the contrary is the case as “on the seismic offshore Somaliland we can see that this is not the case. There are no faults that penetrate the reservoir and seal, which also breach the entire overburden”.

Note: the talk involved a large amount of geological description, which cannot easily be included in a written report, but the video with low resolution slides is free to view on the Finding Petroleum website. See www.findingpetroleum.com/event/1537e.aspx

What did you enjoy most about the event?

“ The keen atmosphere during the talks, the casual networking in the breaks and at lunch.

“ The Senegal Fortesa talk.

“ The University presentation.

“ Update on Senegal and Somalia was excellent and the context setting was great.
Henry Lang (Ensure Environmental Consulting Ltd)

“ It's not too busy, so you can actually focus your networking on individuals rather than rushing around.
Susanne Lehnendorfer (PGS)

“ Networking, presentation of new ideas and original thinking, with chance to talk to presenters over coffee/lunch.
Mike Rego (PetroMall Ltd)

“ Entertaining talk by Rogers Beall on Fortesa's history in the MSGBC basin and good to see some new seismic from Somaliland and Mozambique.
Richard Walker (Consultant Geophysicist)

“ Spectrum talk remarkably insightful, totally novel, repercussions immense.
Nick Cameron (Geolnsight Limited)

“ New seismic imagery from the Mz Channel.
(MDOIL LIMITED)

“ Good networking, some learning.



Finding Oil and Gas in Sub-Saharan Africa London, June 25, 2018

Hugh Ebbutt, Director, A T Kearney	Henry Lang, Director UK and Africa, Ensure Environmental Consulting Ltd	Frederic Yeterian, Director, Philax International (UK) Ltd
Rogers Beall, Executive Chairman, Africa Fortesa Corporation	Martin Riddle, Technical Manager, Envoi	John Clure, Managing Director, Phoenix Hydrocarbon Resources Ltd
Geoffrey Boyd, Field Development Consultant, Antium FRONTFIELD	Karl Jeffery, Editor, Finding Petroleum	David Contreras, Regional Geoscience Manager, Polarcus
Muktadir Ur Rahman, Director, Apex Consulting Ltd	Avinga Pallangyo, Events Manager, Finding Petroleum	John Scotchmer, Principal Geological Advisor - Petroleum Systems, Premier Oil
Julian Moore, Technical Director, APT UK	Jeremy Berry, BD Director, GCA	Colin More, Prospect Geoscience
David Craik, Consultant, Atlaslocal	Nick Cameron, Geological Advisor, GeoInsight Limited	Tim Archer, Director, Reid Geophysics Limited
Paul Mullarkey, Managing Director, Auriga Energy	Bryan Moseley, Geologist	Robert Snashall, Consultant, RGSConsult
Alan Edwards, Beagle Geoscience Limited	Neil Mundell, Consultant Geophysicist, Geoseismix Ltd	Mike Larsen, Business Development Director, EAME, RPS Energy
David Sendra, Associate Consultant, BlackRockQI	Norman Hempstead, Director, Hempstead Geophysical Svcs	Martin Smith, Business Development Manager - Operations, RPS Energy
Joe M Boztas, Director/Interpreter, Boz Seismic Services	Phil Carpenter, Business Development Manager, Ikon Science	Terry Devine, Asset Development Manager, Schlumberger
Ken Agu, Executive Director, Bresson Energy Limited	Abbey Hunt, Geoscientist, Impact Oil and Gas	David Jackson, Principal Geologist, Shearwater Geoservices
Chris Matchette-Downes, MD & Owner, CaribX and MDOIL Limited	Neil Simons, Consultant, Independent	Phil Thompson, Shell
Andrew Webb, Manager, Petroleum Reservoir and Economics, CGG	Mike Hibbert, Independent Consultant	Rageh Omaar, Somops
James Andrew, Business Development Mgr EAME, CGG	Greg Coleman, CEO, Independent Resources Plc	Karyna Rodriguez, Director of Geoscience, Spectrum
John Glass, MD, Cloverfield Consulting Ltd	John Ciccarelli, Senior Reservoir Consultant, io oil & gas consulting	Anongporn Intawong, Team Leader Geoscientist, Spectrum Geo
Micky Allen, Consultant	John Griffith, Upstream Advisor, JJG Consulting International Ltd	Ian Setterfield, VP Sales, Spectrum Geo
Peter Allen, Consultant	Christian Bukovics, Independent Director, JKX Oil&Gas Plc	Andy Harris, SpectrumGeo
Peter Farrington, Geophysicist, Consultant Geophysicist	Neville Brookes, Principal Commercial Geoscientist, Lloyd's Register	Rob MacDonald, GIS Analyst, SpectrumGeo
Richard Walker, Consultant Geophysicist	Rupert Simcox, Data Analyst, Lynx Information Systems	Jorgen Keyser, Statoil
Graham Cleveatt, Managing Director, Cornhill Economics Ltd	Paul Spencer, Senior Production & Seismic Data Manager, Lynx Information Systems Ltd	Richard Brink, SVL
Ian Newth, Director, Count Geophysics	Mark Ashford, Managing Director, MACOM Consulting Ltd	Lisa Warsame, Business development executive - energy, Tessella
Dan Kunkle, Director, Count Geophysics	David Bamford, Director, New Eyes Exploration Ltd	Chris Anderson, Sales Director, TGS
David Boote, DBconsulting Ltd	Mike King, Oil & Gas Manager, NPA Satellite Mapping	Ben Sayers, Project Developer, TGS
Stephen Norman, Business Development Manager, DNV GL	Mike Rego, Independent Consultant, PetroMall Ltd	Felicia Winter, Interpretation Geophysicist/, TGS
Brian Donnelly, Consultant Geophysicist, Donnelly	Henry Dodwell, Consultant, PetroVannin	James Dodson, Account Manager, TGS
Emma Woodward, Regional Manager, West Africa, DrillingInfo	Matt Tyrrell, Principal Geoscientist, PGS	Diveena Danabalan, Upstream Energy Analyst- Oil and Gas, The EIC
Jimmy Boulter, E&P Data Analyst, Drillinginfo	Susanne Lehdorfer, Operations Geophysicist, PGS	Mikki Hall, Chief Marketing Officer, Virtual University of Uganda
Nnamdi Anyadike, Freelance writer analyst		Andrew O'Connell, Senior Geologist, Xodus Group

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Chris Matchette-Downes – MDOIL Limited
Mike Pereira-Rego – REGO Exploration Limited
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