

Finding Petroleum

How Zohr changes the way geologists understand the region

A Zohr type discovery in Cyprus?

Potential in Israel

Independent Resources' experience in Egypt

Lebanon's upcoming license round

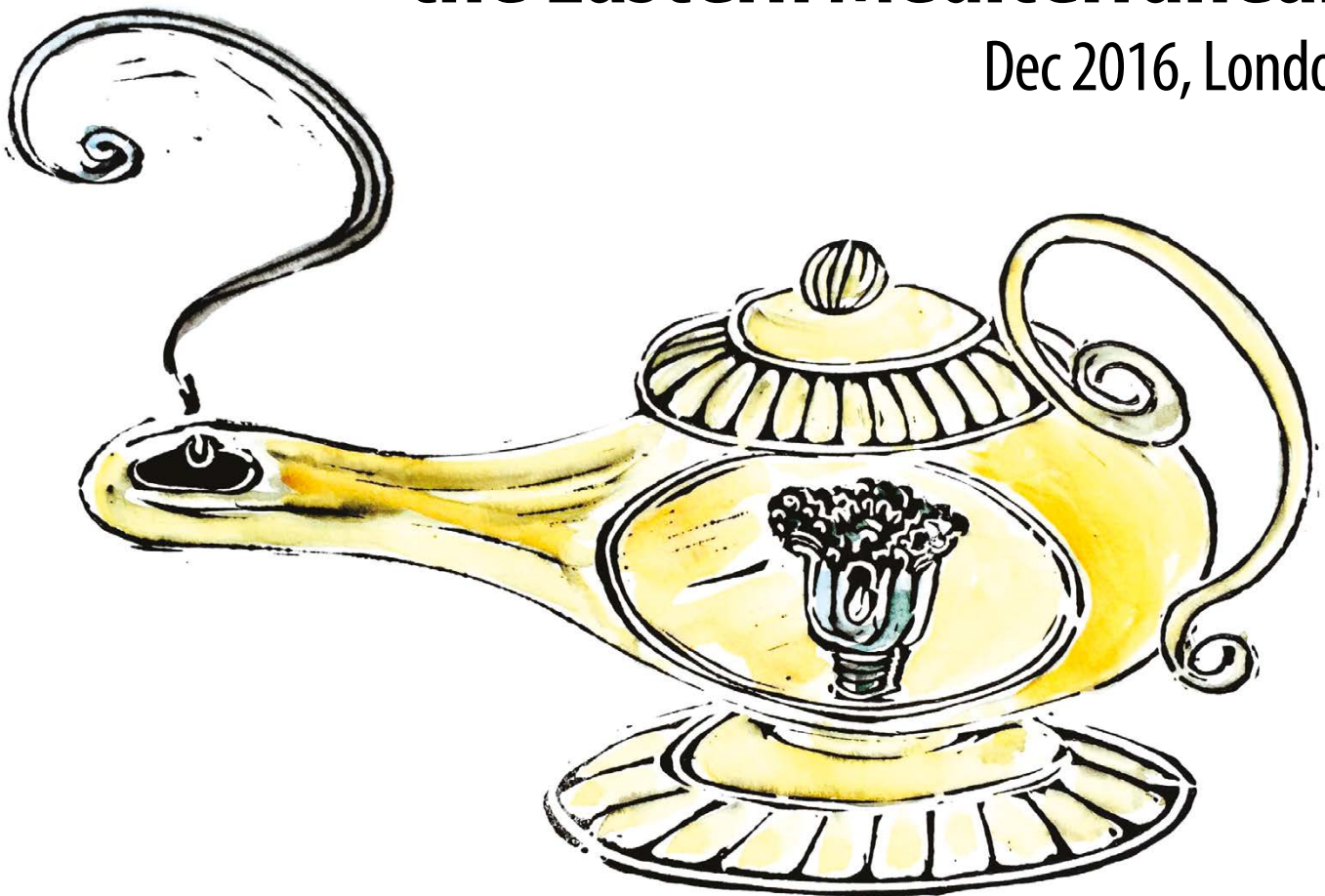
Egypt's "West Mediterranean"

Event Report, Finding Petroleum in North Africa and the Eastern Mediterranean, Dec, 2016, London

Special report

Finding Petroleum in North Africa and the Eastern Mediterranean

Dec 2016, London



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Finding Petroleum

Finding Petroleum in North Africa and the Eastern Mediterranean

This is a report from the Finding Petroleum conference "Finding Petroleum in North Africa and the Eastern Mediterranean" held in London, in December 2016

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Report written by Karl Jeffery, editor of Digital Energy Journal
jeffery@d-e-j.com
Tel 44 208 150 5292

Sales manager

Richard McIntyre
rmcintyre@d-e-j.com
Tel 44 208 150 5291

Conference chairman and producer:
David Bamford

Layout by Laura Jones, Very Vermilion Ltd

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Finding Petroleum's December 2016 London forum provided an update on oil and gas opportunities in North Africa and the Eastern Mediterranean, in the light of the massive Zohr discovery in Egypt and Sound Energy's gas discovery in Morocco



StrategicFit's Andrew Lodge

North Africa could be considered two different oil and gas provinces, the one which exists now and the one of the future, Andrew Lodge of StrategicFit, a former director of exploration with Premier Oil, and chairman of the session.

The big recent news is ENI's Zohr discovery offshore Egypt, close to the Egypt / Cyprus maritime border, discovered in 2015, and Sound Energy's Tendara discovery in North East Morocco, discovered in 2016.

Zohr is "one of the most significant gas discoveries in the region," Mr Lodge said. Zohr will be tied back to an existing gas infrastructure, with the gas to be liquefied and exported.

Sound Energy's August 2016 gas discovery in Morocco is "one of the most exciting news stories of the year," Mr Lodge said.

This discovery "came to me as a major surprise," he said. It could "turn Morocco into a major gas exporter at some point in the near future."

The discovery was made in one of the oldest known plays, in the North East of the country, and in a well test it flowed 17.5m SCF/day.

Morocco must find a way to get this gas to a market, probably an export market, he said.

It proves there are business opportunities for small companies. It may also encourage oil and gas majors to get involved in Morocco, so long as a market for the gas can be found, he said.

"It always surprises me how many and how often significant discoveries are made when many of the sage people think it is almost over for exploration - particularly for large resources," he said.

Mr Lodge went on to give a review of how he sees the opportunities in the region, country by country.

Cyprus

Mr Lodge was involved in a license round in 2012, as part of his former employment as exploration director of Premier Oil. At that time, Eni and Kogas was "most successful bid group in the round," he said.

All the talk at that time was about establishing LNG export facility on Cyprus with the gas provided from Cyprus' Aphrodite field, and future gas that would be discovered. "Well, that further gas has not been discovered yet," he said.

However, as a result of the Zohr discovery (which is in Egyptian waters, but close to Cypriot waters), the focus in Cyprus now shifts to the carbonate play extending into Cypriot waters.

Cyprus currently sees itself as a potential hub for gas development in the region, possible through pipelines, Mr Lodge said. The Cyprus domestic market for gas is "very limited," he said.

Israel

Israel has major offshore gas discoveries but their development has been inhibited by internal oil and gas policies, he said. Israel is now putting emphasis on getting that gas to market.

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“We should see progress,” he said.

Israel has a domestic market for gas, but not enough to take all the gas Israel has found – most of it will need to be exported.

There is a talk about a pipeline linking Israel to the European market. One possible way is through Cyprus, to Crete, and up to Europe.

The stumbling block for the pipelines is political instability, the need for different governments to talk to each other, and ultimately financing, he said. The money will probably need to come from Europe one way or another. StrategicFit estimates that a pipeline might be in place by 2025.

Lebanon

Mr Lodge is sceptical of the potential for Lebanon. “I suspect I could stand here in 10 years time, and the situation remains the same,” he said. “My personal bet is - it never will get exploited”.

Libya

Libya “has gone through hell and high water

in the last couple of years - it seems to be now light at the end of the tunnel,” he said. “The operators, I notice, are moving back in to onshore development.

Oil export should be heading towards its pre 2015 peaks by the end of 2017.”

Oil companies are starting to re-establish themselves with onshore operations. Libya has been exempted from OPEC’s supply cap.

Shell has been talking for many years about building an onshore LNG gas facility in Libya. “There has been gas found offshore,” he said. “Some point in the future that may happen. [Only] a brave man would invest in or attempt to build an LNG facility onshore Libya at the moment.”

“Libya could join such a pipeline export route via Cyprus at a future time once things have settled down,” he said.

Libya might have a domestic market for gas in some time in the future, but this is a long way off he said.

Algeria

Algeria is sending its gas to European mar-

kets. The National oil company Sonatrach “is expanding gas production, we should see 11 percent increase in gas over the next year,” he said.

Sonatrach is trying to encourage external investment. There is also some risk. “Attacks still occur on facilities deep in the deserts of Algeria,” he said.

Tunisia

In Tunisia, the production is declining, a problem made worse by industrial disputes delaying new production, he said.

Conclusion

In conclusion, the region is an established oil and gas province but as a result of the recent major gas discoveries in both the west and east of the region, the key to the future is gas export, he said.

The discussions about gas export in the past have been mainly on LNG, but now there is more and more interest in pipelines, provided stability can be achieved, government agreements reached and of course financing obtained.

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Greg Coleman - "need to drink a lot of tea" in Egypt

Egypt has a very established operating structure which has been successful for decades. Custom and practise has evolved over the decades. "It requires a lot of tea drinking with people to make sure you work your way through the system," said Greg Coleman, CEO of Independent Resources



Greg Coleman, CEO of Independent Resources.

The traditional operating areas of Egypt are mature and are excellent hunting grounds for new and smaller companies, said Greg Coleman, CEO of Independent Resources.

But, "it requires a lot of tea drinking with people to make sure you work your way through the system," he said.

Partners who are collaborating on a project will usually sign a 'joint operating agreement', but then it ends up sitting in a desk drawer and rarely read, and the operating practises end up running differently to how the author of the agreement intended.

"It causes a lot of challenges for those of us trying to squeeze every penny from every barrel of oil," he said.

There is a novel approach in establishing joint venture companies in Egypt, which ensures that Egyptians have a say in how the work programs are developed. But it can lead to duplication of effort, because each joint venture company also has an operator, and they can end up doing the same work. "It can lead to high operating costs if it's not managed properly," he said.

When doing business in Egypt, a relationship with the national oil companies is critical, since they are both regulators and occasionally owners,

The traditional NOC is EGPC (Egyptian General Petroleum Corporation), there is also EGAS (Egyptian Natural Gas Holding Company) and GANOPE (Ganoub El Wadi Petroleum Holding Company), which manages fields in Southern Egypt.

Another challenge in Egypt is safety, particularly road safety.

On the plus side, costs of operation "are low or can be low," there is an infrastructure of export and processing facilities, and

It is possible to obtain good equipment, and buy assets with good equipment. "This was one of our requirements - being able to buy assets which weren't at the end of their useful life - like some of the ones we've looked at," he said.

Independent Resources

Mr Coleman's company, Independent Resources, specialises in production and low risk exploration opportunities in the Mediterranean. It started in Italy, and has most recently been active in Tunisia and Egypt.

The company has a market capitalisation of £1.8m (January 2017) and so would be considered a 'microcap', he said.

In around late 2015, the company acquired a producing interest in an onshore producing asset in the Western desert of Egypt.

The area had been widely explored by two companies, TransGlobe Energy Corporation, which is listed in Canada, and Vegas Oil and gas. The companies spent \$100m on exploration, and discovered about 2m barrels of oil reserves, which is "not a very attractive prospect," he said.

They have a producing oilfield and a gas field.

"There are elements which, for our company, it is quite easy to see how we could make a lot of money with them. So [it is] interesting from that perspective, but relative to our size of course," he said.

History in Egypt

Egypt has a long history of oil and gas operations - Mr Coleman previously worked in the Gulf of Suez for oil company Amoco in the 1970s and 1980s.

Amoco was acquired by BP in 1998, and Mr Coleman rose to having responsibility for health, safety, security and environment for the whole BP group.

"In 1982, we were producing 900,000 bopd in Gulf of Suez, making the government of Egypt a pile of money, they were running oil sales through their treasury," he said.

At the time, the Western desert of Egypt was considered a 'non-entity' in the oil and gas industry, with production of 15,000 to 20,000 bopd.

"It was a place where we employed a lot of people to keep things moving along from an employment point of view," he said.

People talk about collaboration, but at the end of the day it comes down to financial alignment, and it is critical that your interests (as a company) are aligned with those of your investors.

Egypt today

There are not many tourists in Cairo these days, following recent events, and the country's best soldiers are patrolling the border with Libya, he said. The economy was very dependent on tourism.

There are continual problems in Northern Sinai, which borders Israel and the Gaza Strip, with bombings and terrorist activities. "I don't have the key to solving this particular dilemma, I don't think many people do," he said.

China is taking a much bigger interest in Egypt, following Chinese oil company Sinopec buying into Apache's operations in the Western desert.

Sinopec now has a large number of professionals working in Cairo for this joint venture project. In 2014, another Chinese company ZhenHuaOil acquired the Vegas Oil and Gas interest.

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US companies have been “pretty dominant” in Egypt since the 1970s. Now Russian companies are starting to arrive, with rumours that Rosneft is going to buy a share of the Zohr oil-field.

“Global politics is going to have a big part to play in Egypt,” he said.

You need to really understand and study the politics, he said, understand the local politics and the ambitions of China and Russia. “It all makes for a cocktail of complexity that most of us need to be very careful about.”

Oil companies in Egypt

The infrastructure of the oil and gas industry manages to continue despite all the complex politics, he said. “Wells get drilled, seismic gets run. I’m pretty optimistic that Egypt will become a strength in the North African region.”

Apache has been in Egypt since the 1980s, building up its portfolio gradually, including acquiring BP assets. Apache now produces 250,000 bopd from the Western desert, most of which the company exports itself, rather than giving it to the government to export.

Apache has between 5 and 20 rigs drilling at any one time, both on exploration and development. It is “a major success story for an American company,” he said.

Anadarko has done “pretty well” in Algeria, with “several hundred thousand barrels a day,” he said.

“They have fought through some interesting issues with Sonatrach which is a very dominant national oil company,” he said.

There are also Middle Eastern companies active, including Kuwait Energy who have increased production from zero to 25,000 bopd, and recently took EGPC into its joint venture in Iraq, “which had benefits for both parties. For EGPC this is their first venture outside their own country,” he said.

There are a number of private companies active, including PICO International Petroleum which is a locally owned (indigenous) company, IPR, which is partly American and partly indigenous, and L1 Energy, owned by Alfa Group, which recently acquired German operator DEA.

State companies active in the region include Kuwait Foreign Petroleum Exploration Company (KUFPEC) active in Egypt and Tunisia, CNOOC / CNPC of China, active in Algeria, SINOPEC of China active in Egypt. “When Rosneft arrives it’s going to get very complex,” he said.

Many companies in this part of the world are in financial difficulties, particularly with high levels of debt. There can also be challenges getting paid for your oil in Egypt and sometimes also in Libya.

“If you have a balance sheet that can afford to wait then fine But many companies can’t afford to wait, smaller companies in particular.”

“These companies are very dependent on relationships to be able to carry on and keep growing.”

There are many companies in the small end of the market, and those with high debt levels are really struggling, he said.

There are often complexities involved in acquisitions. “Our company had a long tail of issues in Italy it took us several years to clean up,” he said.

“There’s liabilities that an acquirer doesn’t want to be having to manage. These are obstacles to consolidation.”

There can be a big prize though, consider that Sound Energy’s market capitalisation has increased from £75m to £500m in 6 months.

Mr Coleman pays close attention to TransGlobe Energy Corporation. The company acquired a “very interesting” heavy oil portfolio in 2007-2008, although it has been marginal economically in recent years.

TransGlobe recently got agreement from EGPC to sell its own oil, which enabled the company to “remove their backlog of receivables which was really sinking them,” he said. Part of the reason for that is they spent 2 years to persuade EGPC this was a good way of earning US dollars for the treasury, which otherwise they wouldn’t be able to get.

Consolidation

Across North Africa, there are a number of companies who’ve been acquired or gone out of business over the past few years.

One is First Calgary Petroleum which was operating in Algeria up to a few years ago. “They really got the squeeze from Sonatrach because they weren’t developing their asset quickly enough,” he said. “They were a forced sale to ENI.”



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“This is typical of the kind of thing that goes on. National governments are pretty strong. And these are smart people, they’ve been working in the industry for 30-40 years, they’ve been negotiating with BP and Shell for a long time, they’ve seen the good and bad of industry.”

A company called Verenex Energy of Calgary developed a block in Libya and sold out. “As I recall they had a profit oil share of 5 per cent on their production, which is pretty difficult to make money on,” he said. “They did well to sell it.”

The block was bought by Medco Energi of Indonesia, which also bought Chinook Energy, a company listed in Toronto, which had interests in Tunisia.

Dana Petroleum acquired an interest in Egypt in 2007 from Devon Energy. The entire company was sold to KNOC (Kuwait National Oil Company) in 2010.

Petroceltic is an “interesting company I follow quite a bit,” he said. It has a “really strong position” in Egypt following its acquisition of Melrose Resources in 2012, with production of gas condensate in the Nile Delta. “But their debt got them in trouble, in this part of the world having high debt levels is a recipe for disaster.”

“Debt is a killer, anybody who thought the price of oil was going to stay at \$100 and took debt on that basis is really struggling today,” he said.

“Probably the company with the best campaign, if I can say that, is SDX. They are doing some exploration in the Nile Delta. They have some money in the bank.”

Also, “Rockhopper [Exploration] acquired some interests in Egypt last year (2015).”

“My message is – there’s a lot of companies here

Tunisia

Mr Coleman’s company Independent Resources also has a “little” exploration license in Southern Tunisia.

In Tunisia, the tourism industry is suffering due to recent attacks.

The unions are very strong. “Making sure the workforce gets paid properly and communities benefit from activities is an ongoing issue,” he said.

The oil and gas industry does not have a good reputation in Tunisia, due to the behaviour of companies in the past, and this has an impact on small companies showing up and trying to do business.

The “legacy” – long term reputation – of the oil industry is not very good in Tunisia, he said.

There is a lot of hostile activity in Southern Tunisia, as it is a pathway between Libya and Algeria. “About a year ago the Tunisians built a trench to the South Coast of the country and tried to fill it with water,” he said. “It stopped the smugglers for a about a week then they realised they could cross it if they put a temporary bridge across it.”

As a result of all of this, it has proven very hard for Mr Coleman’s company to farm out its block in Tunisia. “It has prospectivity, the terms are good, but it isn’t enough to attract someone entering the country for the first time.”

Israel

Israel has a gas pipeline to Egypt. It was originally built to supply Egyptian gas to Israel. While the gas was flowing to Israel, there was a great deal of argument between the two countries about it, over both price and throughput, he said.

Now Israel is looking to export the gas to Egypt, so Israel has “a different hand to play”, he said.

“There are so many people interfering in this relationship between two countries it’s difficult to see how it will turn into a hugely beneficial arrangement, he said.

People

When working in the region, the people you employ is a key factor in your success, he said. “Make sure your projects there can be managed by people who live there.”

Local people are talented and have been well trained, so they are able to run operations, he said. But when companies arrive from Canada,

the UK, Russia and China and want to “do it our way”, it creates a great deal of complexity.

Egyptians in particular insist on keeping control of the joint ventures through the structures they have in place. “I think that’s a good thing for them,” he said. “There is a sort of built in structure to make sure the Egyptians are participating and getting into the good jobs.”

A lot of resentment built up against Americans and Canadians over the past few decades for not providing enough jobs to local people, he said.

Sometimes Chinese companies appear to be employing mainly their own people rather than local people, he said, or keeping all the interesting work to Chinese people.

However the Chinese are also investing and lending money to the local government, which to some extent compensates for employing less local people. “Money talks,” he said. “The Chinese have arranged a \$2.6bn debt facility for Egyptian national bank, they’re building a free trade zone on the Red Sea.”

However, if Chinese companies do not work with local people, it will “eventually come back to haunt them, I suspect,” he said.

Managing your exports

One audience member asked whether the ultimate key to success in the region, for both small and large companies, was being able to manage your own exports.

Mr Coleman replied that this pathway worked for TransGlobe, which entered the Western desert on condition that it could manage its own export.

Some companies try to negotiate this after they have set up operations, so they have a weaker hand.

TransGlobe made the negotiation on the basis that it would mean the company would have more money to invest in its own developments, he said.

Independent Resources has the right to export its own oil, although in practise it is too small to be able to do it. “You need to be producing 15,000 bopd to get enough loadings every month to be able to justify it,” he said.

PGI – some countries safer than others

Arthur Snell, managing director of risk management consultancy PGI Intelligence, gave a round-up of how he sees security across the region and where the biggest risks are



Arthur Snell, managing director of PGI Intelligence

Arthur Snell, managing director of PGI Intelligence, gave a round-up of how he sees security across the region and where the biggest risks are.

Mr Snell had a previous career working with the UK Foreign Service, including in Iraq, Yemen, Nigeria and Zimbabwe, finally with a few years as British Ambassador to Trinidad and Tobago in 2011-2014.

Morocco

Mr Snell began with Morocco, which you can describe in security terms as “pretty stable,” he said, although not without challenges.

“Morocco probably has the best security forces of any country in this region, extremely effective, they are regularly arresting terror suspects, plots are being disrupted,” he said. “It’s not that there isn’t a [security] problem, but the government is very well placed to deal with it.”

Altogether, Morocco could count as a country with “cause for optimism”, he said. It is pretty autocratic, but has quite an inclusive economy, reasonable education standards and jobs to enable a growing middle class. “For a medium term it looks pretty good,” he said.

A tricky issue is the disputed territory of Western Sahara. Morocco has awarded licenses to a number of international oil companies to drill there, “but this remains debatable under the UN ruling,” he said. “There’s no easy pathway to seeing the whole Western Sahara dispute unravelling.”

Tunisia

Tunisia has a much bigger problem in security

terms, with some big attacks on tourists, and people considering investment have many concerns.

“Tunisia is the country with the highest per capita recruitment to Islamic State,” he said. “If you head out to Raqqa in the Syrian desert, you’ll find a surprising number of Tunisians,” he said.

“That’s not a new thing. When I was working in Iraq in the mid-2000s, Tunisians were very involved.”

There are also powerful trade unions which make it a difficult place to operate.

However, “in some respects, Tunisia is a country which has come through the Arab spring with a modicum of democracy and political stability,” he said.

Algeria

Algeria has a very different environment, an extremely mature oil and gas basin.

There could be a succession crisis coming up. The president has not been seen in public since 2014 and it is not clear if he is still alive.

The same political system has run the country since the end of Algeria’s war of independence from France in 1962. There is a jostling for power among generals who have run the country for decades. “None of them will be willing to cede power to a new generation very quickly,” he said.

Looking at the sorts of people likely to be taking charge, it doesn’t look likely there will be much reform of government.

The country also has economic challenges, having relied on a high oil price for many years. It plans to slash spending in 2017, but this will be hard since Algeria has tried to keep its population happy with a lot of state employment.

Security is still a big problem in Algeria, including with rocket attacks seen in the South. It is surrounded by militants, surrounded by

Libya, Mali, and Niger, a fairly lawless and geographically spacious environment.

Libya

In Libya, there is an ongoing civil war and many people trying to run the country. There are attempts to create a UN backed unity government, but this is weakened by efforts by Western powers to work together with one of the warlords, General Khalifa Haftar, to try to push IS out of Sirte.

“That’s an important development in security terms it has undermined the strength of the unity government,” he said.

International oil companies are seeing glimmers of hope for Libya, but “I think we’ve got a very long way to go before seeing anything like a single state controlling the territory,” he said.

“You’ve got a very high rhythm of security incidents ongoing.”

The British government is very cautious in getting involved with encouraging business in the region, after some bad experiences in Libya, he said.

The attack in Sousa, Libya, in 2013, could be the third worst attack targeting British nationals in history, he said.

Egypt

Egypt continues to see bombings. “Egypt is in a very difficult place,” he said. “You’ve got a strong man in [President Abdel Fattah] el-Sisi trying to recreate the magic of the Mubarak era but with an even tighter grip on the country.”

“The country has been riven with Islamist terrorism for decades - and that hasn’t gone away.”

There has been a recent growth in insurgency in the Sinai province.

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This may not affect the ability of oil and gas companies to operate, but it does undermine confidence, he said.

In terms of regulations, Egypt is probably moving in the right direction, with some reforms. Egypt does have financial arrears to international oil companies, and that is delaying future investment. “There is cause for very cautious optimism,” he said.

Eastern Mediterranean

Looking at the Eastern Mediterranean, there is quite a complicated map, with a disputed border between Israel and Lebanon, Cyprus, Gaza, leading to maritime border disputes.

Lebanon has a very high threat from terrorism in border areas and suffers from being in the front line of the Syria conflict, he said, as well as the Israel- Palestine issue. It also has a history of ineffective government.

Lebanon is trying to get an oil licensing round going. 46 international companies have been qualified for it, but it is being repeatedly delayed.

Israel is “clearly a different sort of country”. It will always face attempts to sabotage its oil and gas industry, both from operators within the country, like Hamas, or international terrorists. It also has some pretty complicated politics of its own.

“We’ve seen a lot of tension among lawmakers and the prime minister over manage-

ment of oil and gas sector, which has brought a lot of uncertainty,” he said. For example the High Court blocked a Petroleum Profits Taxation law in March 2016.

There is also potential for a relationship between Israel and Egypt – Egypt recognises the state of Israel.

Cyprus’ big advance is EU membership, which puts it in a different space. “We’re seeing quite a positive development there,” he said. The big challenge is the pipeline, getting gas out.

If Israel wants to export its gas, the obvious route is through Turkey, but that would mean going through Lebanon, which does not recognise Israel. The gas could be piped through Cypriot waters, but that is not straightforward due to the Cyprus-Turkey dispute.

It is possible that the Cyprus-Turkey dispute could be settled. “Of all the stalled global problems, this one has seen a bit of positive movement. I wouldn’t want to rule out some sort of a settlement,” he said.

Another possibility is a pipeline which did not go through any Turkish waters at all, he said. It is possible to imagine Cyprus and Israel working together.

Regional perspective

Taking a regional perspective on terrorism, the main theatre of activity is Libya with

Islamic State, and Islamic State in Syria and Iraq, he said. “In both cases it is not overoptimistic to say the Islamic State is on the back foot in military terms.”

A collapse of IS could mean that the quite large numbers of Tunisians, Moroccans and Egyptians who have joined will return to their own country.

This happened in the 1990s, when Afghan Arabs returned to the Middle East, and led to the formation of Al Qaeda.

“A victory over Islamic state whether in Syria or Iraq doesn’t necessarily mean an improvement in security in the [other] regions, he said.

There are also other terror organisations, such as Al Qaeda in the Islamic Maghreb (AQIM), which continues to operate, targeting hotels in West Africa, or with operations in the South of Algeria.

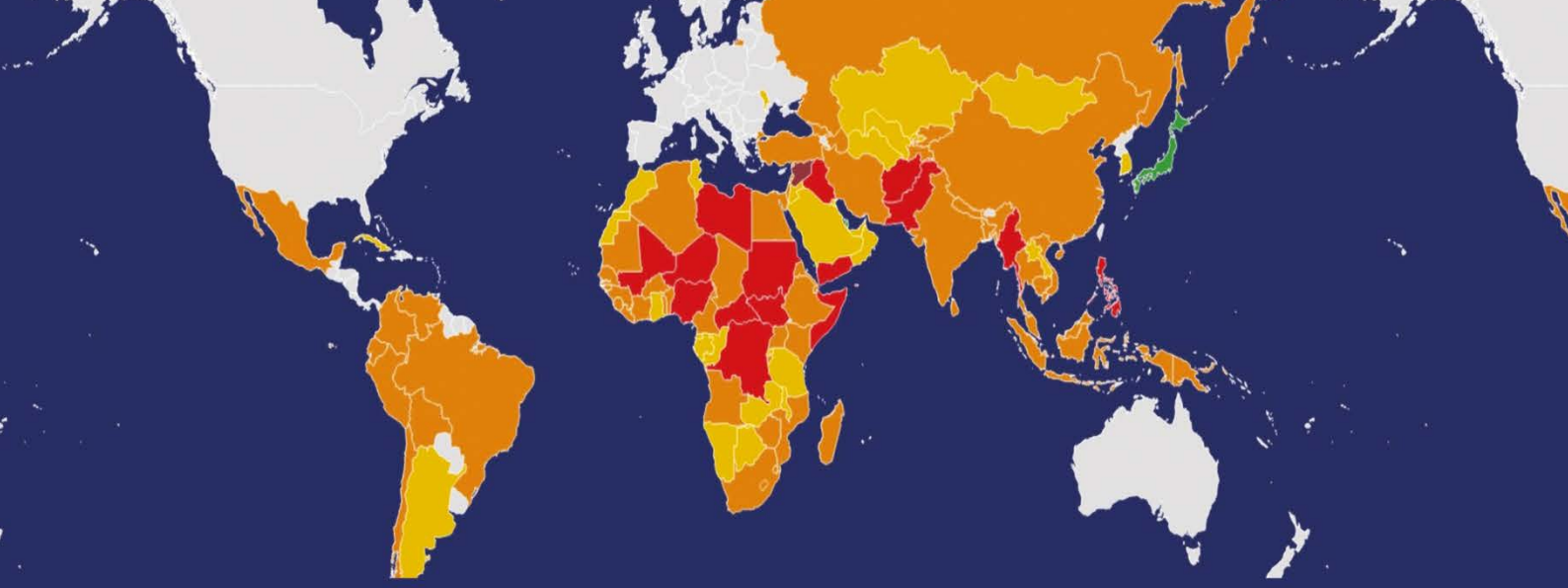
“That entity remains quite well embedded. Its financing depends on smuggling routes through Sahara. I don’t think we’ll see that go away.”

Egypt has many complex disputes – consider that the original members of Al Qaeda were largely Egyptian.

Egypt has over decades tried to deal with the problem of terrorism by having an extremely authoritarian government. History tells you that it’s not always the most successful way of dealing with this, he said.

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PGS – the Egyptian “West Mediterranean” opportunity

Seismic company PGS believes that there could be many interesting opportunities for exploration in Egypt’s western offshore waters, which it calls the “West Mediterranean Sea”



Øystein Lie, project manager multi-client for the Middle East and CIS with seismic company PGS

Egypt’s Western offshore waters, which Egypt names the “West Mediterranean Sea”, have not yet seen any oil and gas discoveries. But “Maybe in a few years’ time it will be different,” said Øystein Lie, project manager multi-client for the Middle East and CIS with seismic company PGS.

Egyptian state company EGAS is aiming to run a bid round for the area in mid-2017.

There have been many Egyptian discoveries in central Egyptian waters, where the River Nile enters the Mediterranean, north of there (Zohr) and further to the East (Levant Basin), but nothing yet to the west, he said.

The west Mediterranean region is over 80,000km², almost the same size as the Nile Delta.

PGS has survey data from 1999, 2005 and 2008, and the company is now re-processing this data. It acquired more data in April-May 2016, with 7000km of 2D data. This was funded by a number of oil companies. It has also acquired gravity and magnetic data.

By the end of the first quarter of 2017, PGS will have a full assessment of the area ready, he said.

Two exploration wells

There has been some drilling activity in Egypt’s west Mediterranean in the past, with two exploration wells, one on the continental shelf and one in the deep Herodotus basin. “These are both dry, but still giving valuable information about lithology that we will come back to,” he said.

The main target of the Kiwi well was the subsalt sands, which was not successful.

The Kiwi well, drilled with Statoil, was an exploration well drilled in a block sized 4,000 to 5,000km². The well location was chosen on the basis of time imaging, not depth imaging. “It is not trivial to understand the geometry of these fan lobes,” he said. There was probably also a bit of bad luck involved.

They found a high quality sandstone reservoir when they drilled deeper, indicating that the failure was either due to no migration into the reservoir, or nothing trapping the hydrocarbons into it.

Geological provinces

PGS has defined a number of geological ‘provinces’ in this frontier area- a shelf area (close to shore), the Matruh Canyon (in the middle of the region), and the Herodotus Basin, covering deeper waters.

The shelf area is an extension of the existing onshore petroleum systems, with faulted Cretaceous and Jurassic strata, and proven source rock from the Jurassic and Cretaceous. There are potential oil migration pathways, and traps defined.

The Matruh Canyon, is a failed rift with a thick sedimentary package.

The Herodotus Basin, has a region with Miocene-Oligocene turbidite sandstones beneath Messinian salt in the Herodotus basin.

There should be both a biogenic system and a thermogenic system, sealed by the Messinian salt, he said.

There are some carbonates in the region, which are structurally very similar to Zohr. The Zohr discovery was also sealed by Messinian salt.

There are possible direct hydrocarbon indicators within the survey area, which could indicate an extension of the Nile Delta play.

There are sand lobes within the Herodotus Basin, sourced from the Nile Delta.

“This is a very exciting area that we look forward to develop,” he said.

One audience member asked if the interpretation of carbonate build-ups was based on geometry or looking at the seismic velocities as well.

“It is based on geometry basically, and the seismic character, but we’re looking at seismic velocities too,” he replied.



The talk included a large amount of geologic description, which is difficult to report on in a written report, but you can see it yourself together with the slides on www.findingpetroleum.com/event/7959e.aspx



Spectrum – Zohr discovery changes everything in the Eastern Mediterranean

The Zohr discovery not only changes people's view of the hydrocarbon potential of the region – it prompted Neil Hodgson to change the way he interprets seismic – looking at the world now with “Zohr Eyes”.



Spectrum's Neil Hodgson

ENI's 30 TCF Zohr discovery, in Egyptian waters, has changed the way the gas market is going to work in the region, the geopolitics, and the enthusiasm the industry has for the region.

Just two years ago, when Mr Hodgson did a tour of oil companies in the Eastern Mediterranean, the general feeling was that the Nile Delta was “more or less played out”, work around offshore Israel had passed its peak, Lebanon was stuck in a license round it couldn't quite finish, and no-one had found much exploration potential offshore Cyprus. So the whole region was very quiet.

“That all changed with the Zohr discovery,” he said. “Because of Zohr, effectively, we've had license rounds in Cyprus. We are expecting a rejuvenation of the Lebanon license round perhaps by the end of this year. (note – post script; the Lebanon License round's missing decrees have since been adopted Jan 2017). The Israelis have also got a license round ongoing, the Egyptians too.”

ENI published the seismic line it used to find Zohr in 2012. The field has a distinctive atoll-reef structure. It sits on layers of carbonates, which started building up in the late cretaceous (145.5 million years ago [mya] to 65.5 mya).

The gas reservoir is actually early Miocene (23 mya to 5.3 mya). It is surrounded by biogenic shale rock, which provided biogenic gas charge. It is sealed above by Messinian salt (which is part of the Miocene, 7.2mya to 5.3 mya).

The gas column is 643m high, “astonishingly big,” he said.

ENI has published a ‘repeat formation tester’ (RFT) plot, measuring pressure at specific points on the borehole wall, and it is the “sharpest RFP plot I've ever seen,” he said.

It is interesting to see that ENI has mapped out the subsurface gas so it stops exactly at the maritime border between Egypt and Cyprus, he noted, in a half joke.

Zohr might have been formed from an atoll (a rig shaped coral reef around a lagoon) – on the seismic line you can see some reef on the West and East side of the gas reservoir.

On the seismic you can see very poor reflectivity (for the Western reef), very good reflectivity for the reservoir, and very poor on the Eastern reef).

Until Zohr was discovered, all interpreters could really see was areas with no reflectivity and areas with good reflectivity.

Analogues to Zohr

So when looking for analogues (similar reservoirs) to Zohr, the geologists are looking for something similar, he said.

The crucial issue for finding more fields like Zohr is likely to be looking for carbonate build ups with a covering of Messinian salt, he said.

These structures had been seen before Zohr was drilled, including by Spectrum, but people did not realise that they would have such good reservoir, he said.

Carbonate build-ups have been drilled many times on the Eastern side of the basin, but “they've almost never worked,” he said. “What's different about this one is it has a very thick salt layer on top of it.”

Spectrum has put its data through more sophisticated “broadband” seismic processing techniques, which makes it possible to see reflectivity in the carbonate build up.

Spectrum staff have been looking through the data for geological features similar to Zohr, with Messinian salt above, and a lagoon, with the reef shown up around it with poor quality reflectivity. “Immediately we found one in the North West [which is] 4 or 5 times bigger than Zohr,” he said.

If you look for these features, “you can just see one after another,” he said. “We're seeing build-up after build-up with thick salt on top.”

The salt had so much complexity in it that the seismic is hard to interpret, and this may have put people off in the past.

But now Zohr has been discovered, people are looking at the data differently, looking for salt, and something from below sticking up into it. “We see quite a lot of these things, we had quite a lot of fun mapping them out,” he said.

“You could take the view that Zohr was a freak. But if we can find another one of these carbonate build-ups, why wouldn't the others work?”

“You need to find the thick salt with carbonate build up sticking into the thick salt, surrounded by Miocene mudstones to provide the biogenic material for the methane. Why on earth wouldn't they work?”

There are a number of atolls which seem to be surrounding the Eratosthenes carbonate platform, he said.

The cretaceous period in the Mediterranean was “really boring,” with just “carbonate platform deposited on carbonate,” he said. “It grew and grew and the basin slowly subsided. Nothing happening apart from that.”

The famous Eratosthenes carbonate platform was formed in this way. It is very large. There is a deep basin next to it, with atolls forming on one side, and the other side is deep-water Lebanon.

“We can map out across the Eratosthenes platform lots of these little atolls, they all have the

Finding Petroleum in North Africa and the Eastern Mediterranean

same sort of play elements, Thick salt, carbonate building up into the salt surrounded by Miocene source rock,” he said.

Identified in this way, there is an analogous prospect in Northern Libya which looks similar to Zohr, but is ten times bigger, he said. This field sits over a Jurassic rift, so it probably has a Jurassic source rock beneath it, he said, which could mean it is filled with oil rather than gas. There could be “something with another 10bn barrels potential offshore Libya.”

Carbonate reservoirs are normally very hard to explore in. “You drill one well and find good porosity, drill another well 10 feet to the right and you find no porosity,” he said. But “That doesn’t seem to be happening on Zohr.”

Taking a seismic line running from near the Nile Delta (Egyptian coast) to the Eratosthenes Platform (near Cyprus), shows there’s very little salt to the South. It may have been originally deposited there, but then pushed out into the Mediterranean by the Nile waters.

Dynamic Topography theory

Researchers are exploring a new theory of the earth, where there is small scale (1000km) upswelling and downswelling from the mantle, pushing the crust up or letting it sink, due to convection currents in the mantle.

What is interesting is that the size of these convection cells could be much smaller than previously thought.

The study has produced a map, which is the “most profound life changing map I’ve seen in a long time,” Mr Hodgson said.

There was previously a theory that continental plates were being pushed around by convection in the mantle causing upswelling and downswelling, but that theory may need to be revised because the convection cells are much smaller than the oceanic plates. So the plate would be pulled in many directions at once.

“I’m pretty sure we’re going to have to kick plate tectonics, as we currently understand it, to one side,” he said.

Africa has been moving and rotating over geological time, moving over these convection cells, basically being pulled down and lifted up

as it is dragged over them. “It is quite a profound concept,” he said.

The Mediterranean Sea went from being supported by a swelling beneath it pushing up, and then it starts to subside very quickly.

So although the Cretaceous period (145.5 mya to 65.5m mya) not much was happening, in the Tertiary period (66mya to 2.6 mya) it all started to subside, changing the way the whole crust works.

As a result, the Nile River started flowing towards the North, bringing clastics (fragments of rock) in for the first time. The big carbonate platforms started subsiding quickly.

This could be how the atolls (rings of coral) were formed, he said, with coral growth trying to compensate for the seabed subsidence.

By the end of the Miocene (5.3mya), the reefs could not grow fast enough to keep out of the water, and became drowned, and the Eratosthenes platform was drowned at the same time.

There are other parts of the Mediterranean, including south of the toe of Italy, and North of Libya, where the Messinian salt has been

pushed into a big dome.

Biogenic

The Zohr field holds biogenic gas, which means it was formed from decomposing (rotting) organic matter, rather than thermogenic, formed by heating organic matter.

Reservoirs in the Nile Delta are about 50:50 biogenic and thermogenic gas, Mr Hodgson said

A significance of this, from an oilfield development point of view, is that biogenic gases do not come with any fluids, and so can be developed quickly using long subsea tieback pipelines.

Zohr should be on-stream within 3 years of discovery. “If you’ve got liquids you can’t do a long tie-back without asking for big trouble,” he said.

Biogenic fields do not need any separate source rock. But it is important that the reservoir did not get too hot, because high temperatures will kill off the microbes.

Finding Petroleum



TGS – Israel: Seeing Deeper with Clari-Fi broadband reprocessing

There is potential for undiscovered petroleum reserves within the Mesozoic sediments of the offshore Levant Basin, which are imaged with new broadband reprocessing of a vintage 2D seismic dataset undertaken by TGS.



Alex Birch-Hawkins, Interpretation Geophysicist with TGS.

TGS have completed a broadband reprocessing of a vintage 2D seismic survey in the Levant Basin, offshore Israel.

This has led to significant

improvements in the imaging of the proven Tertiary petroleum system, but importantly it has also improved our understanding of the deeper geology and petroleum potential of the Mesozoic sediments, said Alex Birch-Hawkins, Interpretation Geophysicist with TGS.

“Through better understanding of the Mesozoic geology and higher confidence in stratigraphic correlations, we can update our basin temperature models and begin to develop new play concepts,” he said.

TGS acquired 6831 km of 2D data in 2001, which is now publicly available and part of the data pack supplied to companies during bid rounds. These data were reprocessed using TGS’ latest Clari-Fi broadband reprocessing in 2016, which is available for licensing exclusively from TGS on a multi-client basis. The Pre-Stack Time Migration is complete and currently available, the depth based data will follow in the first quarter of 2017. In addition, TGS has a digital well log database of 52 wells available.

Exploration in the Levant Basin of Israel began in the 1980s and 1990s, with a number of wells drilled in the nearshore region targeting Mesozoic anticlines. “There was limited success... with some high grade oil shows within oolitic grainstones”, he said. “A good hint for a potential petroleum system but nothing too concrete.”

The attention then moved to the biogenic gas play in the Tertiary, which has had a number of successes including the

high-profile Tamar and Leviathan fields discovered in 2009 and 2011, which has led to much renewed interest in the region. In 2016 Israel announced a bid round of 24 offshore blocks, closing in April 2017.

Imaging new play concepts with Clari-Fi

In early 2016 Vasiliki Kosmidou from Imperial College, London completed an interpretation study on the TGS Levant Basin data, assessing the Mesozoic oil potential as part of her MSc thesis sponsored by TGS. Her work included modelling of temperature trends within the deeper sediments of the basin to assess source rock maturity and expulsion timing. “It is important to note that this study was undertaken using the vintage data only,” Mr Birch-Hawkins said.

According to Ms Kosmidou’s thermal modelling, a Middle Jurassic source rock would reach peak expulsion by the Early Cretaceous.

There were two phases of tectonic extension, followed by deposition of marine clastics, and two phases of contraction, which would have reactivated many of the faults and formed rollover anticlines, he said. Using the reprocessed data, you can see thick Messinian salt, and pre-salt Tertiary sequences below, allowing for development of play concepts within both the Mesozoic and the Cenozoic.

Four areas of improvement

TGS presented four examples demonstrating how pre-existing interpretation on the vintage data (using its “Clari-Fi” method) would change with the reprocessed data, and the impact this would have on geological understanding and petroleum system modelling for the basin. These include: impacts to basin temperature models, improvements in seismic facies identification for play fairway analysis,

better definition of traps in both proven and potential plays, and improvements in gather flatness and AVO recovery.

The improved imaging of the basement on the new data might lead to a different understanding of the temperature profiles and heat flow throughout the basin, which would in-turn impact the timing of expulsion from source rocks. This could lead to development of a deeper thermogenic play for the basin, which could potentially hold large volumes of undiscovered hydrocarbon reserves. The improved imaging of the Messinian salt reveals that there may be interbedded sediments or layered evaporates within the salt, “this too has a big impact on the basin temperature regime,” he said.

The broadband reprocessing also improves play fairway analysis. This is a powerful tool, applying a consistent geological model to a basin, and it is regularly undertaken by the Geoscientists at TGS as multi-client interpretation studies for various global basins, he said.

“Utilising seismic facies analysis, we can differentiate each interpreted stratigraphic sequence based on three criteria: seismic amplitude strength, reflector continuity, and reflector geometry. This can be done for each interpreted sequence, and then calibrated back to well data.

“Using the gross depositional environment and facies information from the well as a hard data point, we can extrapolate away from the well to build the geological interpretive model for the basin. It can then be used to predict source rock distribution and reservoir distribution.”

The two critical requirements for this type of study are “well data, with which to calibrate your seismic facies, and good quality consistent seismic data”, Mr Birch-Hawkins said. Without good quality, reliable seismic data, the facies might be mapped incorrectly, treating noise as genuine geological variation.

When comparing the vintage Israel seismic data to the reprocessed data, “we can see a lot of the variations are actually just issues with data quality on the vintage data”, he said. “In this example the reflectors on the broadband reprocessed data show much better continuity. That changes how we would map our seismic facies, how we would delineate our geological environments, and hence prediction of petroleum systems.”

Better data can also help improve our definition of traps, which allows for more confident development of leads and prospects.

“This applies to both the unproven Mesozoic play, where we see improved fault plane

definition around tilted fault blocks, and the proven Tertiary biogenic play, where we have identified large amplitude anomalies on the Clari-Fi data associated with a proven biogenic gas field that are not visible on the vintage data.”

“This type of uplift in data quality is vital for mapping undrilled analogous amplitude anomalies within the proven play. It also increases our confidence in the data as input to AVO forward modelling studies.”

“Ultimately, as geoscientists we can always do a lot of advanced geological interpretation and analysis, but we’re fundamentally always limited by the data available

to us. So where we can have higher confidence in our data, we can have higher confidence in our models and, hence, our results” he said.

The Clari-Fi broadband reprocessing of this 2D seismic survey is a great example of a reliable dataset that can be utilised in such studies.

Note: the talk included many examples showing the advantages of the reprocessed data over the vintage data, which can be seen in the online video. See www.findingpetroleum.com/event/7959e.aspx



PGS: Lebanon Licensing Round, a unique exploration opportunity

Lebanese waters could be described as having ‘moderate’ prospectivity – there are good reasons for reservoirs to exist, although none have been found yet, said Simon Baer of BGS

Lebanon

Mr Baer believes that the upcoming license round in Lebanon, expected in 2017, could be a good opportunity. So far, Lebanon is totally unexplored.

However no wells have yet been drilled, and no source rock has been found, so overall the potential could be described as ‘moderate’, he said.

On the plus side, Lebanese waters are next to Israeli waters, where there have been good gas discoveries.

“There’s high indications for the presence of sandstones or fan systems, [for a reservoir],” he said.

Offshore Lebanon could be split into two domains, one carbonate dominated and one clastic dominated.

There is a thick, constant, Messinian salt package, which is a ‘perfect seal’ for upper Miocene reservoirs.

The Northern Levant basin is much deeper than the Southern Levant basin, and this means there could be a thermogenic system there, perhaps oil generation.

The region has a complex tectonic history, including extension, inversion and transgression caused by interaction of several continental plates.

There is a question of whether the sediments are only arriving via the Nile, or if there are other sources of sediments. One image of the upper Miocene gives indications of a “huge fan system” coming from the north, which could indicate a river delta emptying there in the geological past.

There are structural and strategic traps in all intervals, and strike slip faulting.

Looking along the Levant margin, the seismic indicates the presence of carbonates of considerable size, and could therefore represent interesting potential reservoirs. There could be reservoirs on the margin, charged by a thermogenic source. The depth processed data shows several structural closures.

Cyprus

Cyprus has exploration potential in carbonate structures which are analogues to Zohr, he said. There are analogues to Zohr in blocks 10 and 11 for Cyprus, and partly in blocks 6 and 7.

There is also a lower Miocene inversion structure and Miocene fan sandstones which could be prospective.

These petroleum ‘aspects’ are proven in nearby analogue discoveries, he said.

Future 3D seismic acquisition will define the potential trapping structures, give more understanding of migration pathways, and a better understanding in general.

Eastern Med

Altogether, the Eastern Mediterranean could be described as a “very prolific, biogenic gas province,” Mr Baer said.

There is a very old passive margin and a very old oceanic crust. “That’s the key factor of all these biogenic gas discoveries,” he said.

Until Zohr, all of the discoveries had been in clastics, in four different regions - the Nile Delta, south of Cyprus, offshore Israel, and West of Egypt.



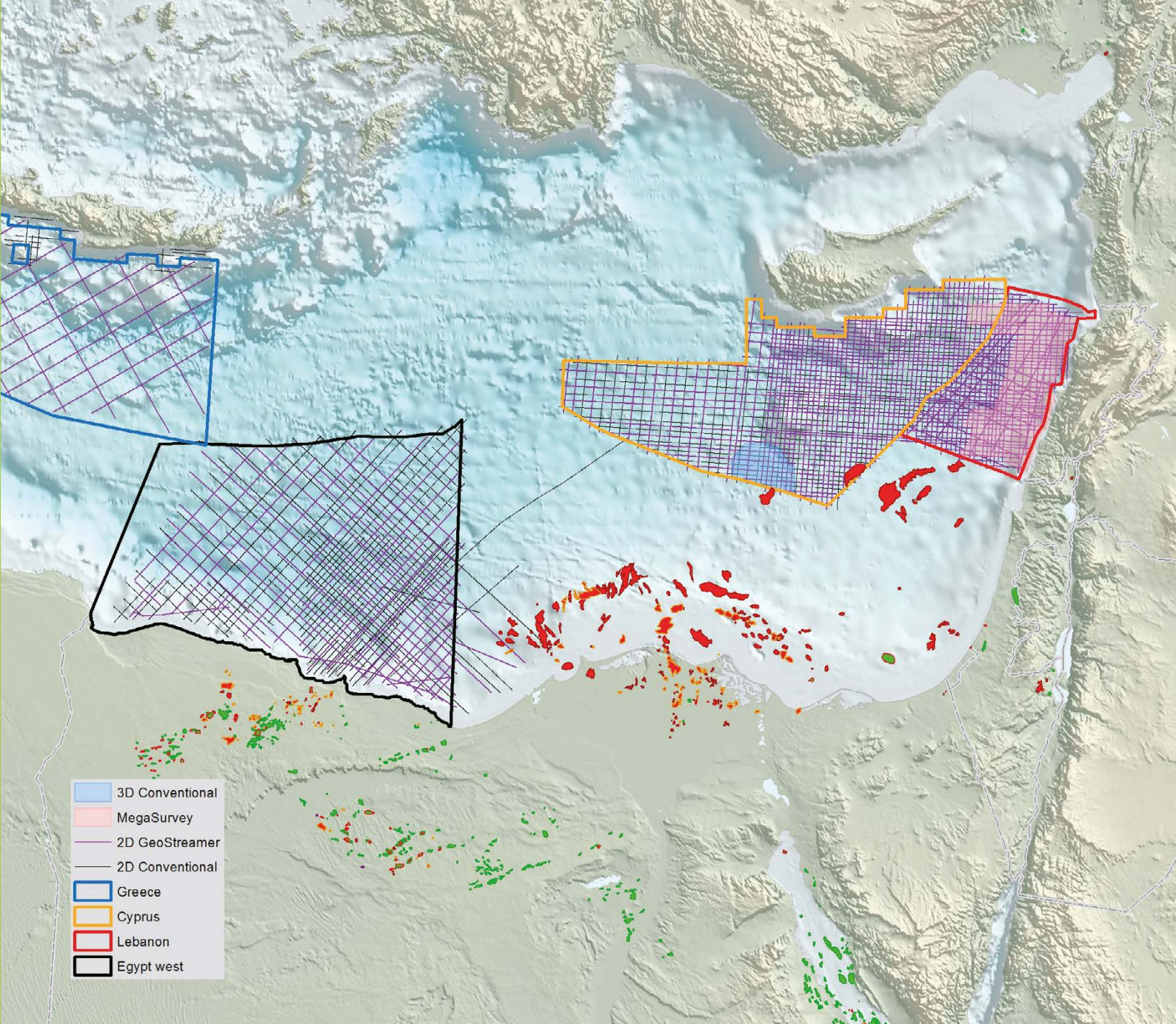
NOTE: The talk included a large amount of geologic description and images, which is difficult to describe in a written report, but it all available with the online video – see www.findingpetroleum.com/event/7959e.aspx

Finding Petroleum in North Africa and the Eastern Mediterranean The Geological Society, London, Dec 12 2016 Attendee list

Geoffrey Boyd, Field Development Consultant, Antium Frontfield	Mark Jones, Business Development Manager E&A, INTECSEA	Protection Group International
Sergey Drachev, Co-founder, ArcGeoLink Ltd.	Jonathan Brown, Geophysicist, JB Geosciences	Charlie Pembroke, Risk Consultant, Protection Group International
Somar Abdullatif, Priniciple Geoscientist, AYA Petroleum Limited	Mark Foster, Managing Director, JHKI Services Limited	Peter Elliott, Consultant, PVE Consulting Ltd
Andrew Gilmore, Head of Business Development - Oil & Gas, Babcock Energy & Marine Services	John Griffith, Upstream Advisor, JYG Consulting International Ltd	Krisztina Kovacs, Manager, PwC Deals Strategy - O&G, PWC
Sisila Pathirana, Geophysicist, Africa New Ventures, BP	Christopher Tiratsoo, Editor, Journal of Petroleum Geology	Robert Stevens, Richmond Energy Partners
Ahmed El Gazzar, Regional Geologist, Africa New Ventures & Regional Exploration, BP	Toni Gaudelli, Senior Account Manager, LandMark	Samira Melloul, Manager, RJ Energy / PEL
Bryn Austin, Director & Geological/Geophysical Consultant, Brynterpretation Ltd	Sigrún Stanton, Regional Geoscientist, Landmark Exploration Insights	Andrew Webb, Deputy General Manager, Robertson Limited
Oliver Whitfield, Buried Hill	David Peel, Technical Director, Lukoil	Norrie Stanley, Consultant, RPS Energy
John Glass, Consultant Geologist, Cloverfield Consulting Ltd	Chris Morgan, Managing Director, Lynx Information Systems Ltd	Martin Smith, Business Development Manager - Operations, RPS Energy
David Craig, Count Geophysics	Brian McCleery, Director, M2C Energy Advisers	Simon Casey, Marine Sales Manager, Shearwater GeoServices
Maria Mackey, Energy Sector, Cray UK	David Pilling, Head of Oil & Gas, Nedbank Capital	Simon Gozzard, Exploration Geoscientist, Shell
Tom Richards, Regional Manager, North Africa, Drillinginfo	Thomas Jewell, Neflex Champion - Middle East & North Africa, Neflex (Halliburton)	Andrew Pollock, Geologist - Global New Ventures, Shell
Chad Barnes, Upstream Analyst, Energy Industries Council	James Dodson, Business Development Director, NEOS	Pete Nolan, Exploration consultant, SHP
Tom Pepper, Energy Intelligence	James Andrew, Busines Development Mgr EAME, NEOS	Neil Carmichael, CEO, Siren
Mark Lonergan, Business Development, EPI Group	Fearghal Hayes, New Ventures Manager, Europe and North Atlantic Margin, NexenCNOOC	Neil Hodgson, EVP Mediterranean and Middle East Region, Spectrum Geo Ltd
Mark Stanley, Director Business Development, EPI Ltd	Mike King, Oil & Gas Manager, NPA Satellite Mapping	Jevon Hilder, Vice President, Mediterranean and Middle East, Spectrum Geo Ltd
Pete Rumelhart, Project Manager Africa New Opportunities, ExxonMobil	Graham Pazdzierski, Director, Oolithica	Nigel Flood, Multiclient Sales Manager, Spectrum Geo Ltd
Ivan Fabuel-Perez, Senior Exploration Geologist Africa New Opportunities, ExxonMobil	Alessandro Lanfranchi, Oolithica Geoscience Ltd	Jorgen Keyser, Statoil
Roger Bignell, Geological Consultant, Fairway Exploration	Jamie Main, Director, PGI	Per Christian Alsgaard, Statoil
Richard McIntyre, Sales Manager, Finding Petroleum	Ryan Turner, Political Risk Analyst, PGI	Andrew Lodge, Principal, Strategic Fit, Egdon Resources
Karl Jeffery, Editor, Finding Petroleum	Charles Brown, Business development director, PGI Ltd	Vibhusha Raj Sharma, StrategicFit
Avinga Pallangyo, Conference Producer, Finding Petroleum	Iain Brown, PGS	Joseph Pape, Exploration Advisor, Stratochem Services
Alexandra McKenzie, Artist, Finding Petroleum	Øystein Lie, Project Manager MC Middle East and CIS, PGS	Kieran Aust, Business Dev. Mgr., Suez Oil & Gas Systems
Alexandra Jackson, Analyst, Gas Strategies	Simon Baer, PGS	Jon Ford, Consultant, Tedstone Oil & Gas
Chris Boot, Business Development, Getech	Matt Tyrell, Principal Geoscientist, PGS	Ben Sayers, Project Developer, TGS
Waclaw Jakubowicz, Managing Director, Hampton Data Services	Matthew Pyett, PGS	Alex Birch-Hawkins, Geophysicist, TGS
Lawrence Jackson, Senior Account Executive, IHS	Thomas Hansen, Geoscientist, PGS	Hugh Ebbutt, Independent, Upstream Adviser
Sian Evans, Research Postgraduate, Imperial College London	Frederic Yeterian, Director, Philax International (UK) Ltd	Robert Hayes, Subsea Support Manager, Wood Group
Greg Coleman, CEO, Independent Resources Plc	David Contreras, Gegional Geoscience Manager, Polarcus	Helen Ricketts, Business Development Manager, Wood Group Kenny
	Arthur Snell, Managing Director, Intelligence,	Todd Jensen, Middle East and North Africa Data Analyst, Wood Mackenzie

What did you enjoy most about the event?

<p>“ I liked the Zohr talk. Very positive thinking!</p> <p>(TGS)</p>	<p>“ Networking and hearing more about the region.</p> <p>Helen Ricketts (Wood Group)</p>	<p>“ Learning from subsurface professionals.</p> <p>Frederic Yeterian (Philax Resources)</p>
<p>“ The optimism. Mark Jones</p> <p>(Intecsea)</p>	<p>“ The organisation was great, presentations were spread out well.</p>	<p>“ Combination of informative presentations</p>



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