CGG'S KEY ROLE
IN ADVANCING REGIONAL BUSINESS AND ENERGY TRANSITION OBJECTIVES

Exploring the Middle East's energy landscape in an exclusive chat with CGG's **Ramez Refaat**

By: **Pooja Kapoor**

Sercel's recently launched 528 land acquisition solution (Image courtesy of Sercel)

CGG is a leading global provider of technology and high-performance computing, offering a wide range of data, products, services, and solutions in the fields of Earth science, data science, sensing, and monitoring. In an exclusive interview, Ramez Refaat, Middle East Geoscience Manager, CGG speaks extensively about the organisation's projects and developments in the Middle East.

How has CGG's technology and expertise influenced the energy industry in the Middle East?

Seismic technology has played a key role in oil and gas exploration in the Middle East for decades and CGG has been closely involved in this story from the start. We deployed seismic acquisition crews there in the 1950's and our Sercel land seismic acquisition equipment has been deployed there since the 1960's. We then took the lead with high-productivity land super-crews in the region into the 2010's before we began our strategic transition and exited the acquisition services business in 2020.

Sercel is still the major solution supplier of the latest high-end equipment in the region and last summer was awarded multiple major equipment contracts, including the delivery of 54 Nomad vibrator trucks and 29,000 GPR300 seabed nodes, to acquire several major onshore and OBN seismic surveys.

The Middle East has some of the most challenging environments for seismic imaging, both onshore and offshore in the Nile Delta, Red Sea and Mediterranean Sea. As operators look for new fields to renew their reserves in complex areas, they need to de-risk prospects – from a technical, safety and carbon emissions standpoint. This is also true for optimising recovery of the remaining oil in mature fields, where the highest-quality data is needed to improve understanding of the reservoir. Both of these requirements call for specialised imaging skills, local knowledge and the latest cutting-edge technology, which includes the most advanced algorithms

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and HPC capability. CGG has all of these to deliver the highest-quality 3D images of the subsurface that can help operators better evaluate and prioritise opportunities.

In the UAE, we have had a seismic imaging operation for more than 20 years and opened a Regional Geoscience Centre in 2019 as a strategic technology hub for integrated services in the region. Offshore, our experts recently used our latest proprietary technology, including full-waveform inversion, and massive HPC resources to image the vast 26,000 sq km "mega-OBN" survey, the largest in the industry, to achieve step-change results. We believe very few in the industry could successfully deliver a project like this.

In Egypt, where we have been present for more than 35 years, we have an in-depth knowledge of the geology, both onshore and offshore, and significant local expertise in successfully applying our seismic imaging technologies to these challenging environments.

Offshore, CGG has recently conducted the seismic imaging of the OBN project to image the area around the Atoll and Atoll North fields, the first of its kind in the offshore Nile Delta. For this, we have applied our unique high-end OBS & full-waveform inversion (FWI) imaging technologies to deliver the highest-quality 3D seismic images of pre-Messinian targets for improved field development planning and near-field exploration.

We have worked with every national oil company and major in the region, and, as an outstanding example, our dedicated seismic imaging centre for PDO in Oman, our largest DPC worldwide, will be celebrating its 30th anniversary this year. This achievement is based on a highly collaborative and successful partnership that focuses on safety, integrity and innovation. As with its other centers, CGG is also very committed to its significant In-Country Value initiatives within Oman, which include promoting and developing local talent and supporting

Ramez Refaat, Middle East Geoscience Manager, CGG

educational initiatives and university outreach programs.

What are some challenging technologies that CGG's team is currently working on?
Onshore in the Western Desert, seismic imaging has been hampered by difficult near-surface conditions which scatter and disperse seismic waves and cause reverberations, obscuring the reservoirs below. A new generation of high-density seismic surveys are being complemented by algorithms like multi-wave inversion to provide accurate models of this complex shallow geology, and wave-equation deconvolution to remove the reverberations and provide clearer images of the reservoirs.

Offshore in the Nile Delta and Mediterranean, complex faulting and the highly variable Messinian evaporite layer mask deep reservoirs in complex channel
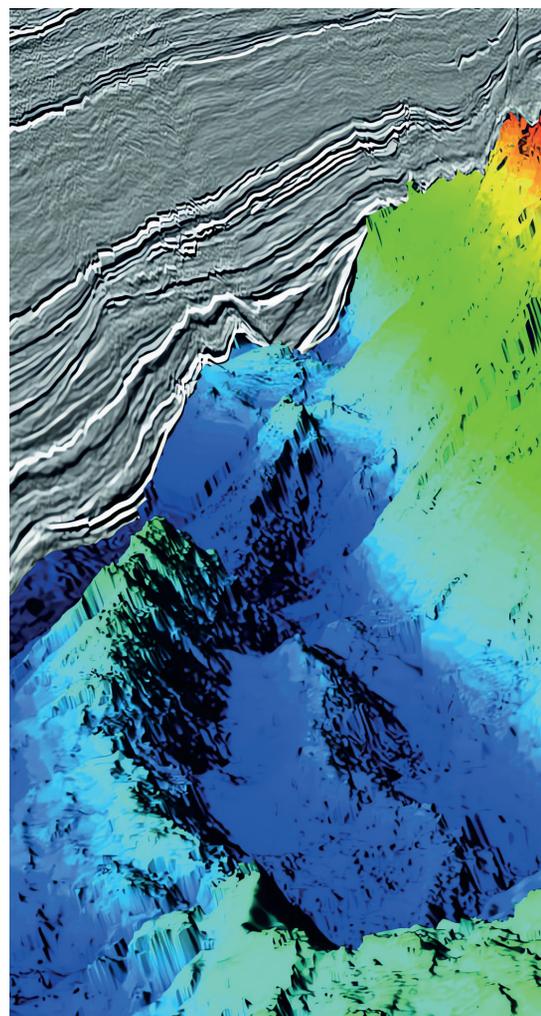
Seismic exploration

sand bodies. FWI is now a key technology for imaging in these complex geological settings. CGG's proprietary version of FWI, time-lag FWI, is particularly effective and has provided many industry-benchmark results. It is a technology we have used extensively in the Gulf of Mexico and the North Sea. It provides extremely detailed and accurate velocity models that enable a step-change in seismic image quality for drilling and reservoir delineation, which we have seen with projects in the region, including the OBN surveys offshore Abu Dhabi and the Nile Delta and various onshore projects. Elastic FWI (E-FWI) is a new development which takes into account the more complex elastic wavefield propagation that occurs in the presence of salt bodies and evaporite layers found in

"The Middle East will be a key future hub for large-scale CCS projects and therefore an important region for the future in the global context of scaling up carbon storage "
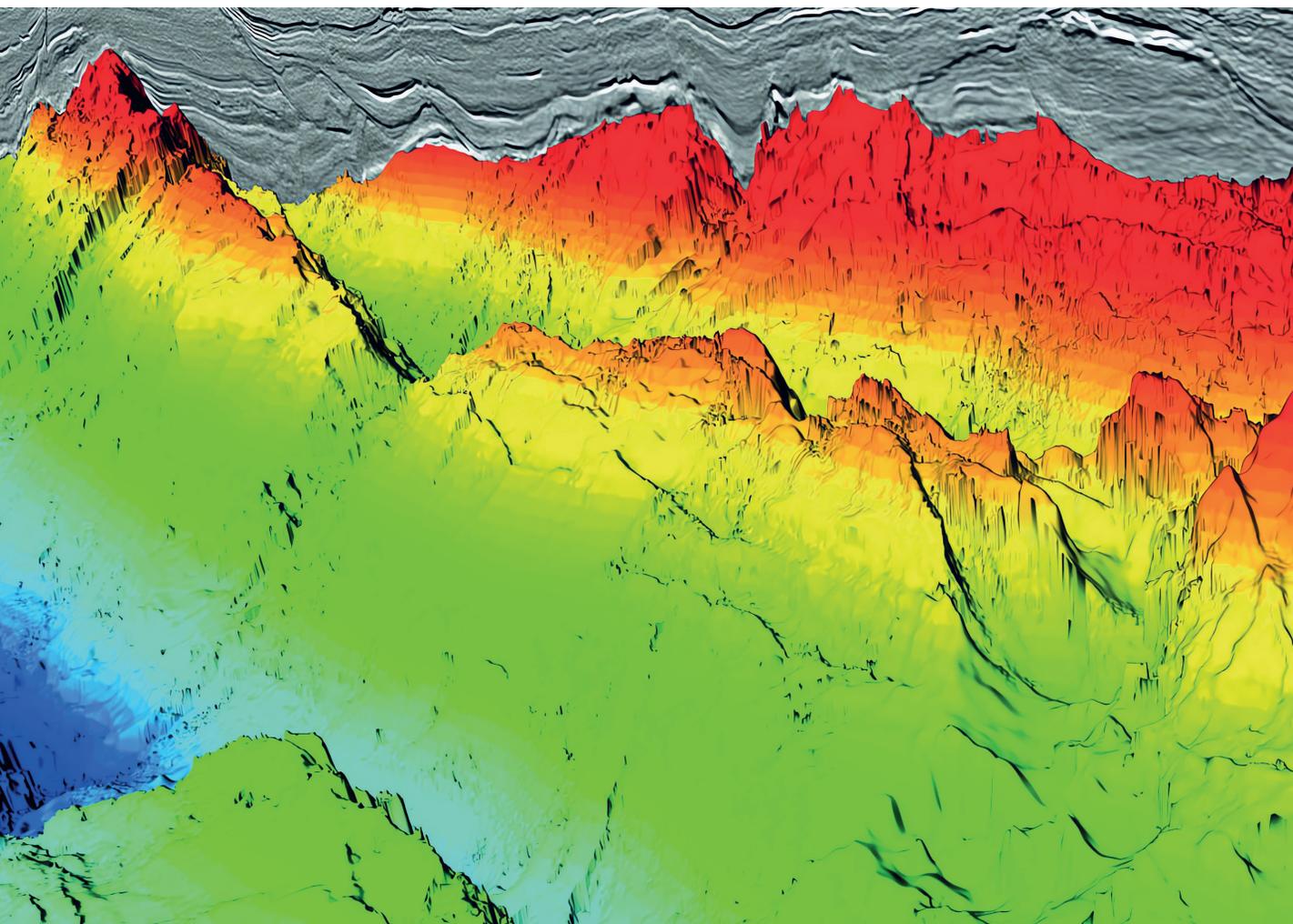
the Middle East. Again, CGG's proprietary E-FWI technology provides important uplifts in the accuracy of the seismic image which enable better drilling decisions to be made.

Ocean bottom seismic is recognised as the next step for marine seismic in complex areas. When OBN data is combined with the latest processing workflows and imaging technologies it provides remarkable images of previously obscured reservoirs. Again, this is something that CGG has worked on in key locations around the world, such as the Gulf of Mexico and the Caspian Sea, and we are excited to be working with bp for the seismic imaging of the first OBN survey ever conducted in the Nile delta covering the Atoll and Atoll North fields.

As a general trend, seismic surveys in the Middle East have become progressively larger and more complex over the years, with ambitious projects covering huge areas at a greater data density than ever before, setting new industry records, and creating huge datasets. These datasets represent a challenge for seismic imaging both in terms of both the compute power required and the hands-on data QC during processing. It would be impossible to deliver seismic imaging results for these datasets or interpret the geological detail in these results in a timely fashion without adopting and innovating machine learning technology to augment and accelerate traditional workflows. This is another core strength of CGG, with subject-matter experts in data science, AI and geophysics we are able to develop the machine

learning tools to help deliver these mega-projects on time.

How can CGG's technologies be used by clients to help the energy industry achieve net zero?
Our core businesses already support the efficient and responsible discovery and development of the oil and gas that is needed to ensure an equitable energy transition, and our high-quality 3D seismic images can help our clients to reduce their carbon footprints by giving them the subsurface insight they need to de-risk prospects and also optimise production from mature fields by optimally targeting reservoirs and selecting more accurate drilling locations to avoid hazards.

Our successful multi-client survey

Sercel Nomad 65 Neo vibrator trucks operating in the desert (courtesy of Sercel)

business model also provides cost and emissions efficiencies for the industry. It covers areas of interest with a single survey which can be acquired more efficiently than multiple smaller surveys, enabling local players to participate with lower costs upfront and government bodies to partner with CGG for joint market and block promotion globally through CGG's extensive commercial network. To improve sustainability, CGG is also giving priority to conducting seismic reprocessing programs of existing legacy data, avoiding the need for new data acquisition in some cases.

We believe geoscience has a vital role to play in helping to achieve net-zero goals and our aim is to apply our geoscience and data science expertise, along with our data and technology to support and accelerate the sustainable shift to net-zero and we are already supporting our clients across CCUS, mining (for critical minerals) and geothermal.

We have spent many years building our own library of data through our Earth Data group – including huge quantities of seismic, well, geological & satellite data, covering vast areas of the globe. The skills we have developed in data science and data management combined with the insights we can draw from all of this data are now being re-purposed with the energy transition in mind. We have recently started building an exciting suite of global and regional-scale GeoVerse™ screening products for carbon capture and storage (CCS), critical minerals and geothermal resources.

We have also released two GeoVerse global resource assessment studies, one to help operators evaluate geothermal energy potential and identify new sites and regions for future development, and the other to screen for lithium brine, to support the search for new sources of this critical energy transition element.

For critical minerals, we have been active in mining for decades, typically by applying our geological, seismic, earth monitoring and multiphysics expertise for exploration, and our satellite earth observation groups for mine site monitoring. To help find critical minerals, we can do regional scale screening for prospective resources or produce detailed studies to identify and quantify mineral potential for a specific customer. For example, CGG has been selected by the French government as a technical partner to support the LiMongolia
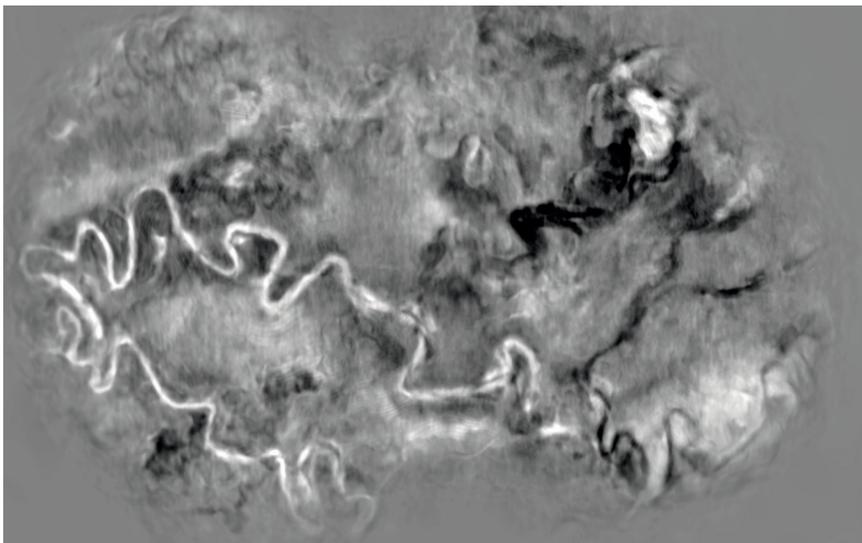
Stratal slice below Messinian Unconformity from 40Hz FWI image. Offshore Nile Delta, Egypt (courtesy of bp)

project, a joint initiative by the National Geological Survey of Mongolia (NGS) and the French geological survey, BRGM, to evaluate the regional prospectivity of Mongolia for critical minerals, particularly uranium and lithium.

What role does carbon storage play in the energy transition and how does CGG hope to contribute to it, especially in the Middle East? Are there any projects in the pipeline regarding the same?

Carbon storage is likely to play an important role in dealing with CO2 emissions that are hard to abate. This will include new projects coming in the Middle East, led by countries with leading oil and gas production positions who have significant emissions to manage. Examples include the UAE and Saudi Arabia, both of which are countries that host very large potential carbon storage capacities as well as significant infrastructure already in place today.

CGG already has a 15-year track record of delivering impactful results in carbon storage with expertise spanning the carbon storage project lifecycle including participation in landmark CCS projects around the world such as Sleipner, In Salah and Gorgon.

CGG can supply critical subsurface insights for carbon storage sites, from the initial site screening and 3D site characterisation to later site monitoring and closure. We aim to leverage our industry-leading position in subsurface imaging to achieve this, with pre-injection data transformation, periodic time-lapse data processing and integration as well as continuous data processing.

We continue to not only look at how current technology in the oil and gas space, such as 3D seismic imaging and 4D seismic monitoring, can be re-focused to be applied to carbon storage but also to continuously investigate what solutions are needed for

the future through a perpetual R&D effort.

CGG believes that the Middle East will be a key future hub for large-scale CCS projects and therefore an important region for the future in the global context of scaling up carbon storage.

CGG has been at the forefront of wellsite geological analysis in the region, what have been the challenges and what are CGG's most successful projects in this regard?

This region has some of the most complex geology, which has historically been a challenge for seismic and reservoir characterisation.

As regards, wellsite geological analysis, our first wellsite work in the region was undertaken in the late 1970's. We experienced massive growth since then in Oman, UAE, Qatar and Saudi Arabia and have been continuously present for over forty years. We have wellsite crew active in the region every day of the year.

Almost all our wellsite work in the Middle East provides well placement for carbonate reservoir development drilling. The challenges are understanding the reservoir at the micro-scale as well as at the seismic scale. CGG uses our integrated geology team and our best-practice laboratory techniques established over the last sixty years. We acquire valid, precise and accurate pre-drill data of the specific field under development. These field specific data are essential for wellsite decision-making while drilling.

Last year, our Abu Dhabi-based geology team used their extensive local knowledge to undertake a geological desk study which included a field outcrop mapping in the northern Emirates. The insight they provided in this complex structural area was a key factor in enabling our IOC and NOC partners to reduce risk and improve the chances of success in their exploration efforts. The findings were extremely valuable for follow-on drilling, when the CGG wellsite team followed the project into the subsurface, analysing rocks at the wellsite and delivering geology information for decision-making while drilling, saving costs and reducing risk. O
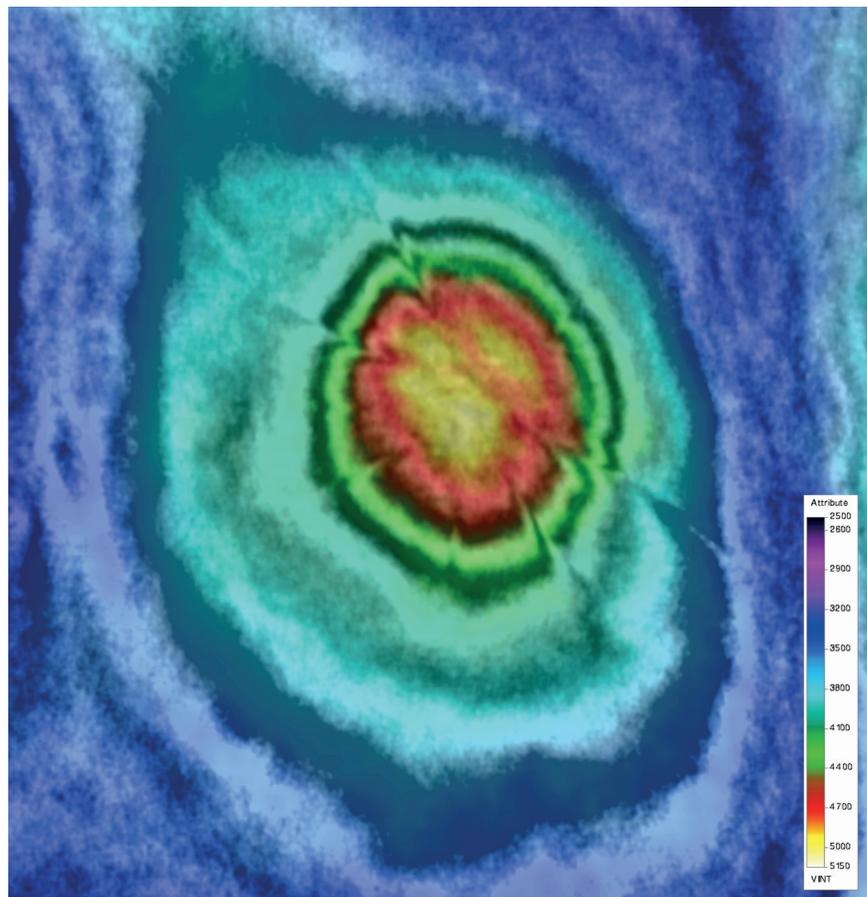
Seismic image depth slice from OBN data with 20Hz FWI velocity model color overlay, offshore Abu Dhabi