

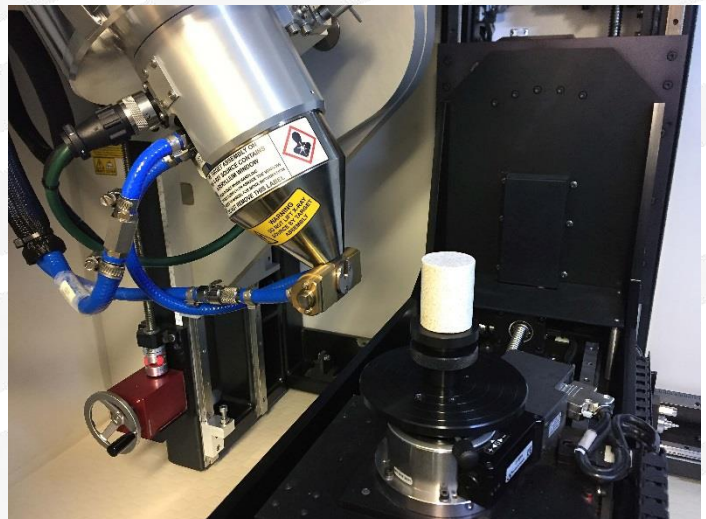
# Case Study

## CT scanning advances well bore analysis

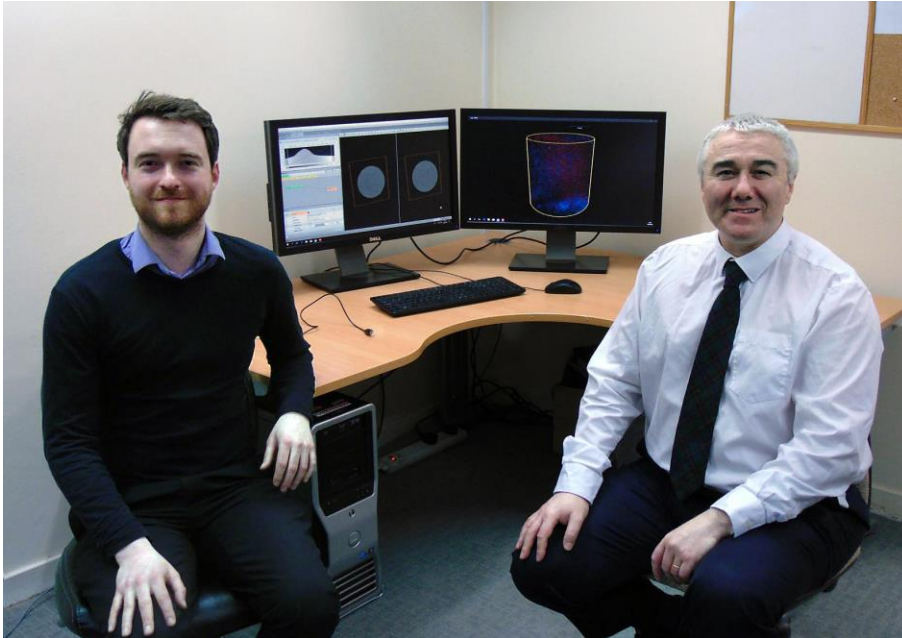
**Nikon Metrology's CT scans of rock core samples  
improve Scottish company's oil and gas flow predictions**

Drilling for oil or gas is an expensive business, whether offshore or on land, so it is essential for E&P (exploration and production) companies to minimise the risk that their planned drilling operations will fail or not meet target yield. Aberdeen-based Premier, COREX ([www.corex.co.uk](http://www.corex.co.uk)), part of the Premier Oilfield Group and a leading global provider of core analytical services to the oil and gas industry, is the preferred supplier of data for risk mitigation to operators worldwide. Customers are to be found worldwide, through Europe, North Africa and the Middle East to the USA and Australia.

The firm has been providing these services for more than 30 years but it is only within the last decade that it has augmented its rock core investigations by sending samples for analysis approximately every week to Nikon Metrology's ([www.nikonmetrology.com](http://www.nikonmetrology.com)) centre of excellence for microfocus computed tomography (micro-CT) in Tring, Hertfordshire. The systems and the X-ray sources that power them are manufactured on site in three factory units, with further areas devoted to service and support. The company also provides subcontract CT scanning services using its own equipment, which doubles as a demonstration facility.



### Solids migration analysis beats porosity testing



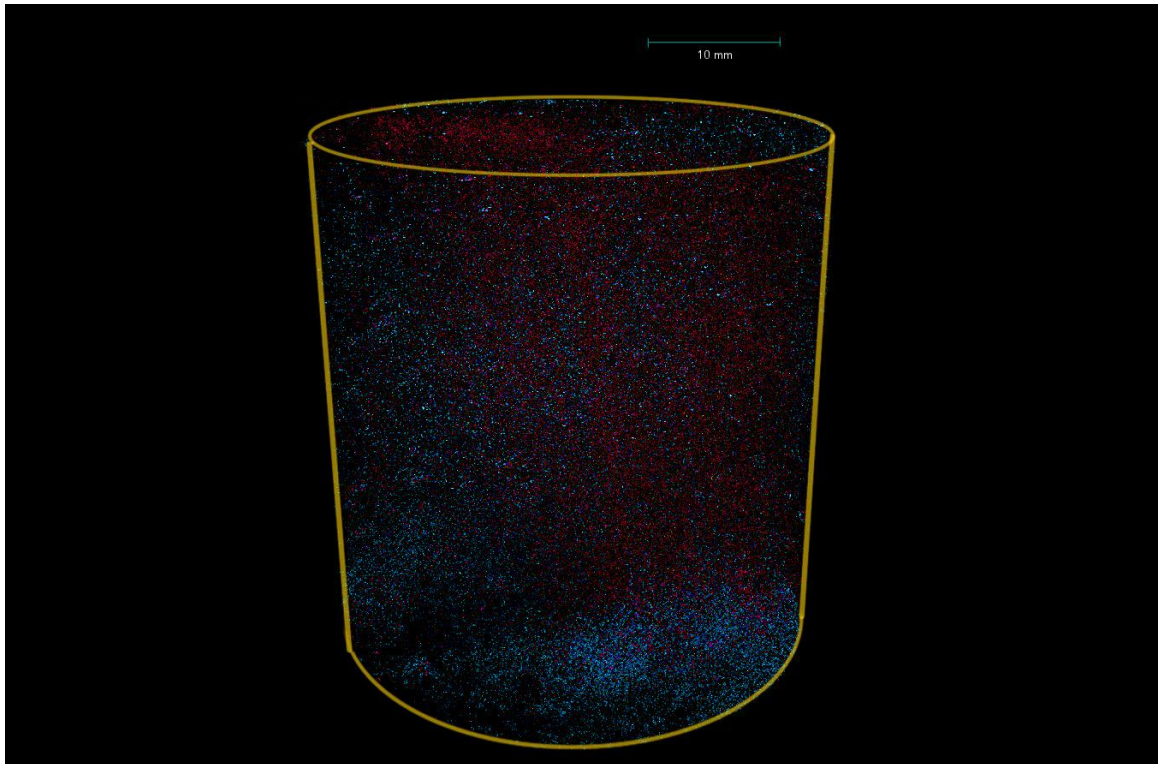
Ian Patey, (right) Manager Formation Damage and Stimulation Group at Premier, COREX explained, "Operational fluids are used to assist the drilling and completion of boreholes by providing hydrostatic pressure and preventing formation fluids from entering the well bore, as well as to cool and clean the drill bit and evacuate drill cuttings. We advise on the best operational fluids (eg drilling fluids) to use for a particular job to avoid formation damage.

"The fluids inevitably interact with the wellbore, changing the structure and porosity of the rock which can in turn restrict or increase the flow of gas or oil from the reservoir. In the former case, hydrocarbon recovery is compromised.

"One of our jobs, therefore, is to take representative core samples from various depths, particularly at critical intervals in the strata, to identify any alteration in the rock. We look in particular at the addition or removal of solids that could indicate accumulation or strippage from the framework and hence negative or positive changes to flowrate."

One member of staff in the Aberdeen laboratory closely involved with this work is formation damage geologist and project coordinator Leigh Wright. (Left in image) He commented, "Being able to simulate wellbore operations and reservoir conditions accurately, whether to pre-screen a proposed operation or troubleshoot an existing project, requires data from

rock samples taken using an array of different equipment for observation, measurement and chemical analysis.



"However, micro-CT scanning is the key technology, as it is central to providing a true picture to our clients. We have found that simple before-and-after permeability measurements on a sample can be a misleading metric to predicting oil or gas flow impairment.

"Much more accurate is being able to look at the deposition or removal of solids such as clay fines to see how they have migrated, which shows the physical alteration. A major advantage of CT is that it can separate materials based on their density characteristics. Three-dimensional change modelling from scan data using Avizo visualisation and analysis software is an excellent tool for seeing how the rock is actually altering over time."

#### Rapid subcontract scanning

Micro-CT scanning adds value to Premier, COREX's formation damage testing procedures by aiding interpretation and reducing risk to operators. Rock samples flown down from Aberdeen to Tring are typically 25 to 38 mm in diameter, 25 to 50 mm long. A team of Nikon Metrology applications engineers is on call and has at its disposal six of the company's machines to perform subcontract inspection. Turnaround time for Premier

COREX's receipt of results is two days, including flights.

Mr Patey added, "We carried out an internet search at the outset and identified Nikon as likely to be the best provider of contract CT services due to the company's size and the fact that it is a commercial organisation rather than a university or R&D centre. We also liked the reassurance of working with the manufacturer of the equipment. The service we receive is always professional and prompt and the imaging capability of their systems is excellent."

High-resolution micro-CT scanning is non-destructive and can reveal bedding features, fractures, cements and heterogeneities that are smaller than one micron. The images and data sets produced can show grain size and shape, pore size and network, cements and mineralogy and can potentially visualise fluids and saturation.

The resolution of a typical medical CT scanner would be sufficient to show coarse features but not individual grains, pores, micro-fractures, voids and fine features. Conventional testing techniques such as scanning electron microscopy and thin section are commonly used to understand what has happened within core samples and they provide valuable data. However, they are destructive testing procedures and unable to examine the entire volume of a core sample to show distribution of damage quickly or cost-efficiently, so there is potential to miss the mechanisms involved.

### Patents

Premier, COREX has a patent (GB (granted): GB2524810 and US (publication number): US2017108483) to take its rock core analytical services a step forward by using volumetrics to quantify the alteration to the sample over time. Micro-CT scanning will be pivotal to its successful application.

The idea is to segregate the damage mechanisms by simulating them in 3D using the virtual scan model, with the flexibility to anticipate how the rock structure will alter under the influence of a single change, a second change, or both. The technique is being developed to include the ability to overlay combinations of up to seven variables, providing a powerful analytical and predictive tool.

### 30 years' experience

Nikon Metrology has over 30 years' experience in X-ray and CT inspection and has been offering contract inspection services since 1997. Its facilities support one-off projects up to large batch inspections in many industries including aerospace, automotive, Formula 1, telecoms and pharmaceuticals. Samples examined range from the latest microchip to a 65 million-year-old dinosaur egg.

Results are supplied in short turnaround times as easy-to-understand, customer-tailored reports with still images or complete data sets. If required, interpretation of results can be carried out by Nikon Metrology's experts. Alternatively, training sessions are available enabling customers to operate X-ray or CT systems themselves in order to carry out their own inspections at centres around the UK.

The microfocus sources produced in Tring exclusively for Nikon Metrology's own CT systems reveal very fine detail. Exclusive, high-flux, rotating targets enable fast scanning times. The non-destructive technique preserves the item under examination, which can often be expensive, enabling material analysis, assembly evaluation and metrology CT. Accurate simultaneous measurement of internal and external dimensions is possible, plus comparison with CAD models and GD&T (geometric dimensioning and tolerancing).

The six micro-CT machine models in Tring available for contract inspection are XT V 160, XT H 180, XT H 225 ST, MCT 225, XT H 320, XT H 450, the number designating the power of the X-ray source in kVA. In summer 2018, a walk-in facility will be opened able to cope with components or samples as large as 2 metres high by 1.5 metres across. Further details are available from Nikon Metrology, Tring Business Centre, Icknield Way, Tring HP23 4JX. Contact: [sales@nikonmetrology.com](mailto:sales@nikonmetrology.com) / Tel: +44 1442 828700.

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**Three photographs attached:**

1. Right: Ian Patey, Manager Formation Damage and Stimulation Group, Premier, COREX.  
  
Left: Leigh Wright, Formation Damage Geologist and Project Coordinator, Premier, COREX.
2. A Premier, COREX rock core sample undergoing subcontract micro-CT analysis at Nikon Metrology's centre in Tring, Hertfordshire.

3. Premier, COREX has developed a more accurate method of predicting the flow of oil or gas from a well by monitoring in 3D the migration of solids in core samples using CT scan data from Nikon Metrology and Avizo software.

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