ANALYSED

1 1.0079 **A** APPLICATION	**14** 92.906 **N** NORMALISATION
1 1.0079 **A** AQUSITION	**12** 24.305 **L** LOCATION

23 50.942 **Y** YIELDISATION	**19** 39.098 **S** SIMULATION
5 10.811 **E** EVALUATION	**4** 9.0122 **D** DIFFRACTION

ADVANCED RESERVOIR QUALITY SERVICES - **ANALYSIS FOR THE OIL & GAS INDUSTRY**

SGS
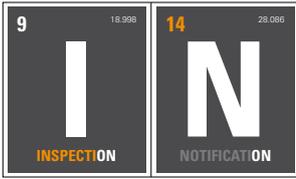
IN-DEPTH ANALYSIS
FOR RESERVOIR OPTIMISATION
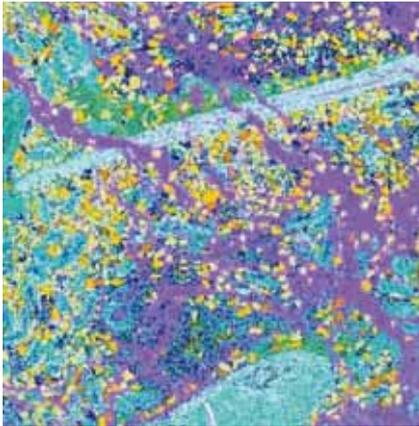
WHAT ARE ADVANCED RESERVOIR QUALITY SERVICES?

Advanced Reservoir Quality (ARQ) Services combine advanced mineral analysis technology developed by the Australian Commonwealth Scientific and Research Organisation (CSIRO) with other analytical techniques developed by SGS. ARQ Services, previously known as QEMSCAN® Services, combine features found in other instruments such as X-ray diffraction (XRD), Scanning Electron Microscope (SEM) and Electron Probe Micro Analyser (EPMA) into the next generation of analysis of minerals, rocks and materials.

To date, ARQ Services have been used successfully for commodities such as mineral sands, precious and base metals and industrial minerals. Now, SGS is applying the technology to the oil and gas sector where ARQ Services can be used to improve the understanding of production potential of hydrocarbon discoveries in both the exploration and development phase.

THE TECHNOLOGY

ARQ Services integrate eBeam technology from Carl Zeiss SMT with state of the art Nitrogen-free Energy Dispersive Spectrometers (EDS) using software to provide a comprehensive solution capable of identifying most rock forming minerals in milliseconds.

Together with quality assured, specifically designed sample preparation, SGS's ARQ Services are unique in their ability to handle a wide range of sample types, from thin sections to loose cuttings, through to rough rock samples and other materials. We can analyse almost everything from core samples to dust to produce consistent, reliable quantitative measurements.
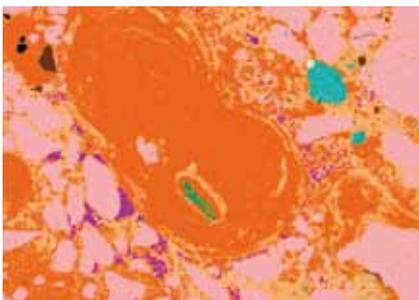
THE VALUE OF ADVANCED RESERVOIR QUALITY SERVICES TO THE OIL & GAS INDUSTRY

As the location and extraction of new hydrocarbon reserves becomes increasingly difficult, targeting complex geological environments characterised by low porosity and permeability, the application of technologies like ARQ Services will help our customers extract maximum value from data acquisition programmes in exploration and development wells.

ARQ Services can be used standalone to describe the mineralogy and texture of drilled intervals on the basis of cuttings or it can be used as a complementary data source to calibrate and improve sedimentological models and petrophysical analysis

QEMSCAN BULK MINERALOGY (WITH ADDITIVES) NORMALISED - CORE & CUTTINGS	QEMSCAN BULK MINERALOGY (WITHOUT ADDITIVES) NORMALISED - CORE & CUTTINGS	QEMSCAN CLAY MINERALOGY NORMALISED - CORE & CUTTINGS	XRD CLAY FRACTION NORMALISED	QEMSCAN DETAILED LITHOTYPES (WITHOUT ADDITIVES) NORMALISED	QEMSCAN BULK DENSITY V. DENSITY (1.95 - 2.95 G/CM3)	QEMSCAN GRAIN SIZE (0-100µM) V. GR	EXAMPLE SAMPLE IMAGES

of logged and/or cored sections. Using consistent and statistically sound measurements on a variety of rock material enables end users to gain a unique insight into rock mineralogy, type and texture in an objective manner. These include:

- Mineralogy – all rock forming minerals can be identified and their abundance quantified which can be used to calibrate neutron-induced capture gamma ray spectroscopy from wireline log data to provide reliable mineralogical records over logged intervals;

- Clay minerals can be identified and subdivided based on their elemental chemistry as well as their optical and morphological characteristics;

- Distribution of authigenic and detrital mineral phases can be mapped for each sample or sample particle;

- Matrix density values calculated from actual mineralogy for e-log calibration and more accurate porosity calculation;

- Porosity measurement including pore size distributions which can be used to help predict capillary and flow behaviour;

- Lithological classification and subdivision of mixed lithology samples based on mineral composition and texture, which can be integrated with core description data to improve the stratigraphical subdivision and assist with well correlation

- Textural data such as grain size distribution, sorting and roundness, provide unique information about vertical and lateral depositional trends, sedimentary processes and environment of deposition;

- Quantitative lithology for calibration against multi-mineral models from petrophysical analysis;

- Identification of subtle, mineralogically distinct horizons for well-to-well correlation (e.g. tuffs); and

- Enhanced completion and drilling fluid analysis and, recommendations based on clay mineralogy and carbonate content.

At SGS, we aim to deliver results to our customers in a timely manner and fit for purpose, irrespective of sample type. Final deliverables can range from tabulated data and digital false colour images, to fully integrated projects where wireline log and core analysis data are combined in comprehensive 3D reservoir modelling of facies, porosity and hydrocarbon saturation, and assessment of production potential (permeability distribution).

ARQ data can be provided in most common industry formats for integration in subsurface modelling workflow (e.g., in Petrel project format, LAS or Excel). The integration of ARQ Services with wireline or core data is done with the support of the technical expertise of SGS Horizon's integrated subsurface consultancy. SGS Horizon's has in depth knowledge and experience, of a wide range of oil and gas regions, settings and environments. This offers significant potential for SGS to further improve and enhance the services they provide to clients.
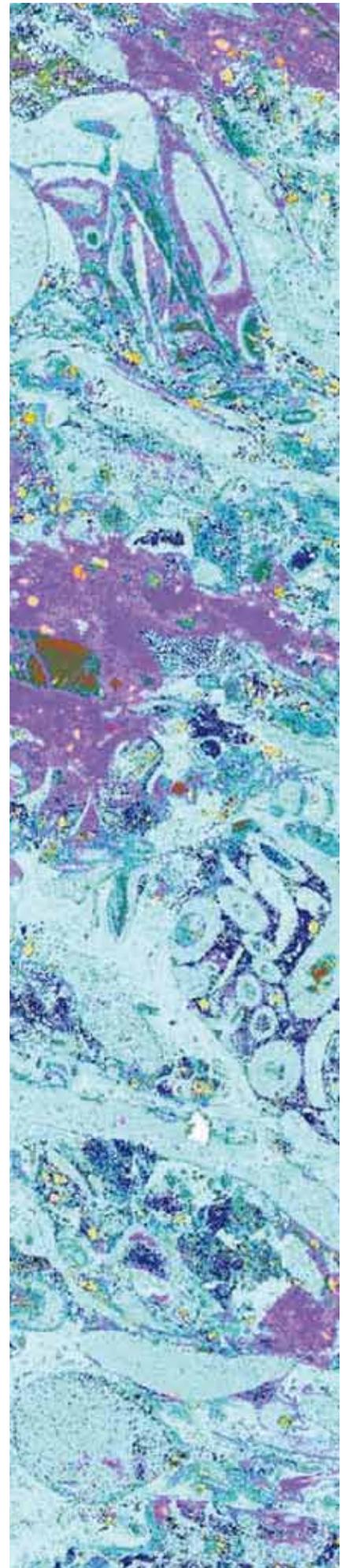
WHY SGS?

SGS is the world's leading inspection, verification, testing and certification company. Recognised as the global benchmark for quality and integrity, we employ over 64 000 people and operate a network of more than 1 250 offices and laboratories around the world.

SGS has invested heavily in the development and application of QEMSCAN® technology, for the minerals and mining industry over the last ten years. We are the world's largest commercial operator of the technology with a decade of experience and ten machines worldwide, and are now expanding into the Oil & Gas sector with this technology. Our customers include exploration and production companies, global mining giants, university geoscience departments, metallurgical and materials laboratories and research institutions.

We provide innovative services and solutions for every part of the oil, gas and chemicals industry. Our global network of offices and laboratories and our dedicated team allow us to respond to your needs, when and where they occur. Our reputation for independence, excellence and innovation have established us as the market leaders in providing services that improve efficiency, reduce risk and deliver competitive advantage for you.

FOR MORE INFORMATION ABOUT ADVANCED RESERVOIR QUALITY SERVICES, CONTACT OGC@SGS.COM, OR VISIT WWW.SGS.COM/OGC

WWW.SGS.COM

WHEN YOU NEED TO BE SURE

SGS