

GO BEYOND BOUNDARIES



Research Facilities and Equipment

School of Geosciences

in partnership with James Hutton Limited

About Us

The School of Geosciences at the University of Aberdeen in partnership with James Hutton Limited have teamed up to provide an integrated analytical service. This synergy enables us to deliver a combined suite of complementary analyses and combine our interpretative expertise, enabling us to add depth to the unified services that we can provide.

The School of Geosciences at the University of Aberdeen has a global reputation for high-quality scientific investigations that tackle geological, geographical and archaeological challenges. We have a track record of working with industry to help solve societal challenges in areas including energy, climate change and access to clean water. University of Aberdeen laboratories are well-equipped for studies of rocks, sediments, soils and fluids.

This includes facilities for:

- Organic geochemistry (GCMS, TOC)
- Particle size analysis
- Elemental geochemistry
- Petrophysics
- Palynology
- Water chemistry

Our staff have technical expertise who can assist with the interpretation of your data.

The James Hutton Institute is a world-leading independent scientific research organisation based in Scotland, working in collaboration across the globe.

James Hutton Institute science addresses the challenges posed by the climate and nature crises on the sustainability and resilience of our crops, land, natural resources and communities through the development of transformative tools, interventions, products and land management practices. James Hutton Institute research is tested in their labs and at landscape-scale on their farms, combining natural and socio-economic sciences and considering the connections between crops, resources and people.

As the wholly owned commercial subsidiary of the Institute,

James Hutton Limited (JHL) extends our expertise through plant breeding, scientific research, consultancy, and specialised analytical services. With ISO17025, GMP and ISO 9001, JHL's laboratories ensure the highest standards of quality assurance, catering to a diverse clientele spanning industries such as aquaculture, crop science, extractive industries, food and drink and the environment.

JHL offers a wide variety of services including:

- Bacterial testing
- Bioinformatics
- BioSS (Biomathematics and statistics Scotland)
- Cannabinoids
- Chemical analysis
- Contract research
- Crop trials
- Environmental Technology Verification (ISO 14034 certification)
- Fourier Transform Infrared Spectroscopy (FTIR)
- Inorganic analyses, ICP-MS, ICP-OES, Ion Chromatography and colourimetric
- Isotope analysis
- Lipid analysis
- Marine sediment analysis
- Molecular diagnostics
- Organic analyses, GC-MS, GC-FID, HPLc and LC-QQQ-MS/MS
- Plant varieties, breeding and licencing
- Soil analysis
- Soil forensics
- X-ray Powder Diffraction (XRPD)

In this brochure you will find examples of the facilities we have and contact details that will enable you to access our services. Please get in touch if we can help you with your challenges.

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X-Ray Diffraction (XRD)

X-Ray Diffraction (XRD) is a versatile technique that can be used to identify any crystalline substance such as most minerals. It can also be used to quantify the proportions of different minerals or indeed many other substances when they are present in a mixture. Most samples are analysed in powder form, but it is also possible with some samples to analyse surface deposits without removing them from the object. XRD can also be used for proportional quantification, a specialty for which we are world renowned.

We are an extremely well equipped and staffed group, routinely undertaking mineralogical investigations for a wide variety of clients, including oil and gas, industrial minerals, ceramics, environmental, and research.



FEATURES

- The lab has 3 XRD instruments – 2 x Bruker D8 Advance, 1 x Panalytical Xpert Pro
 - All have position sensitive detectors, including the latest Lynxeye XE-T on our latest Bruker D8 Advance instrument, and optics featuring motorised divergence slits.
 - The Xpert Pro has recently upgraded optics and interchangeable stages including an Anton Par XRK 900 reaction chamber which is used for controlled humidity experiments and non-ambient diffraction at temperatures up to 900°C.
- Once collected diffraction data is processed and analysed using a variety of software, including Bruker's Diffrac.Eva, Profex and PowDR. In addition, we have the latest versions of the International Centre for Diffraction Data (ICDD) databases (www.icdd.com), that are used for identification of unknowns.
- Sample preparation is probably the most important step for a successful analysis, and we place great emphasis on careful and appropriate sample preparation for all of our methods.
 - For example, whole rock / bulk samples are routinely spray dried to produce truly random powders.
 - Essentially, samples are prepared as an aqueous slurry and sprayed into a heated chamber. In the chamber the spherical spray droplets dry, forming spherical granules, which are collected on a sheet of sample paper. For more information visit www.claysandminerals.com/spraydrykit.
- The XRD team also offer complementary analyses to further characterise your samples. This includes:
 - Determination of cation exchange capacity using the cobalt hexamine method.
 - Surface area and porosity determination.
- Reynolds Cup Winners
 - The Reynolds Cup is an international competition which utilises mixtures of pure mineral standards that represent realistic rock compositions, that must be identified and quantified.
 - Mineral phases include clay minerals and X-ray amorphous components.
 - The Hutton XRD team is the only lab in the world to be placed in the top three ranking positions each time since the competition's inception in 2000, highlighting the quality and accuracy of the work we do.
 - For more information visit www.clays.org/reynolds/

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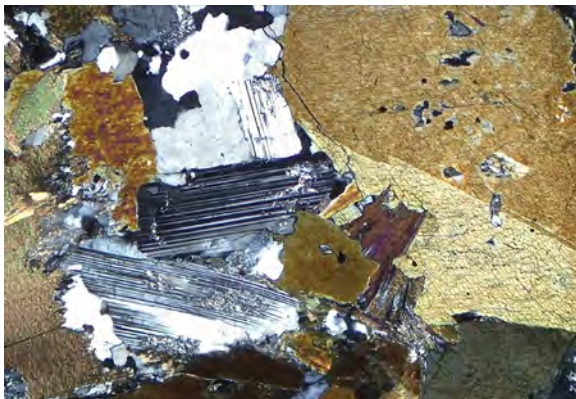


Scientific Services

Rock Preparation and Thin Sections

We offer comprehensive facilities for preparing rock samples to meet your specific requirements. Our equipment includes precision diamond saws, core drills, and crushing and milling apparatus.

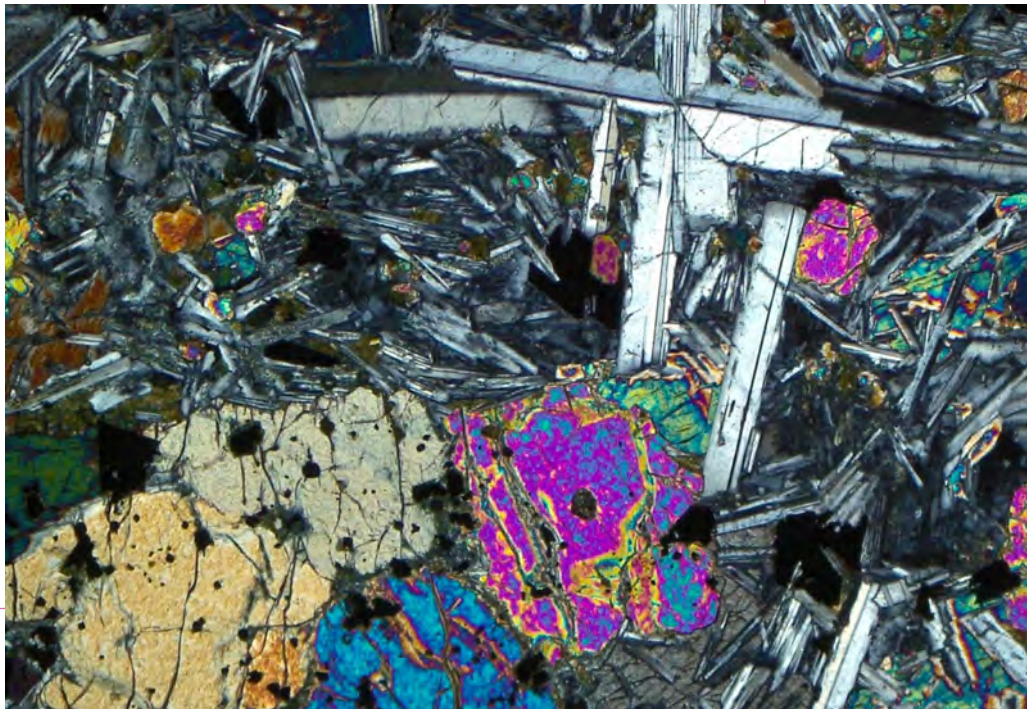
Delve deeper into geological research with our Thin Section Services. Our process begins with the precise cutting of samples, followed by slide mounting utilizing our Buehler PetroThin. Our skilled technicians then grind and polish the samples until ready for detailed microscopic examination. Whether your research focuses on mineral composition, sedimentary structures, or fossil content, our high-quality thin sections are an indispensable resource for your research.



FEATURES

Rock Preparation Equipment

- Core drill equipped with DiagrIt Stainless Steel Water Chuck capable of taking many sizes of core bits, allowing us to drill a large range of core diameters
- Our surface grinding machine is used to take cores to a precise length
- 24" saw for cutting larger slabs of rock
- 10" diamond bladed saw used for cutting hand specimens
- 4" saw allowing for accurate cutting of small samples
- Fly Press to crush samples into small fragments
- TEMA Mill to grind rock fragments into fine powders, as small as 60µm
- Sieve stacks to separate powders into size fractions



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Optical Microscopy

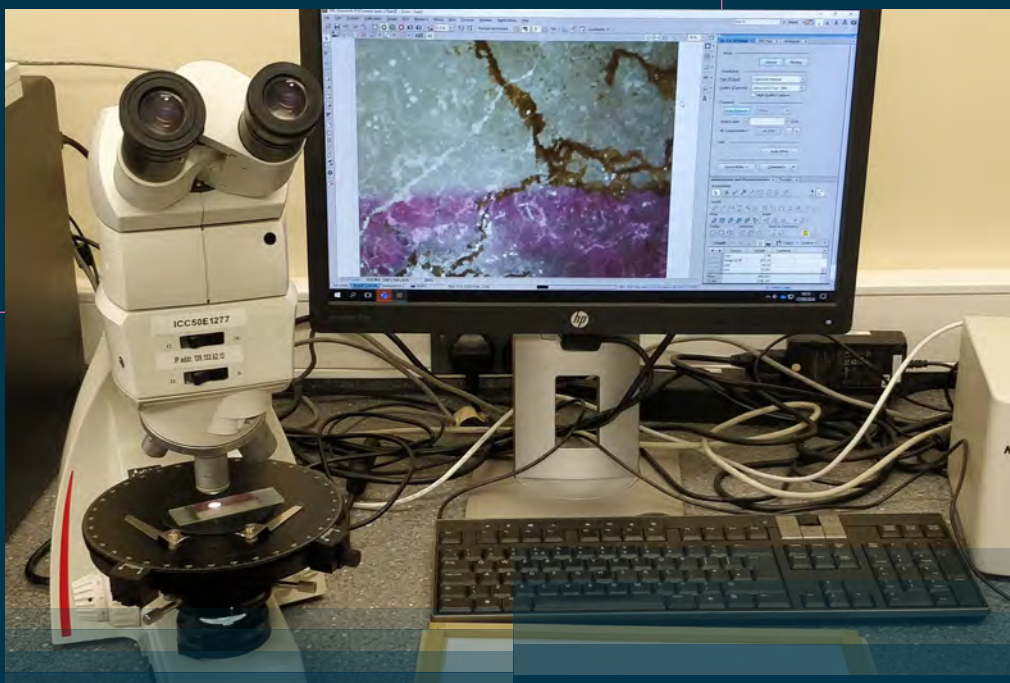
Optical microscopy of hand-specimens, thin-sections and slides can provide a wealth of information on the conditions in which rocks formed, and the subsequent processes that have affected them.

Stereomicroscopy requires little or no sample preparation and is the best approach on specimens with 3-dimensional topography. Compound microscopy requires microscope slides or thin sections but can provide higher resolution images.

We have a suite of high-quality microscopes with cameras, and expertise in petrographic interpretation.

FEATURES

- Nikon SMZ25 Zoom Stereomicroscope, with 25:1 zoom ratio, transmitted and reflected light, equipped with DS-Fi2 camera and Nikon Elements D software
- 2 Nikon LV100 compound microscopes with transmitted light (brightfield and darkfield) and UV reflected light, with 5x, 10x, 20x, 50x and 100x objectives
- 5 Leica DM750P compound petrographic microscopes (for thin-sections) with 4x, 10x, 20x, and 40x objectives, with ICCW50 cameras and Leica LAS EZ software
- 100 CarlZeiss Primotech petrographic microscopes with 2x, 5x, 10x, 20x and 60x objectives, with Axiocam 208 Colour cameras and Labscope software (useful for teaching as well as analysis)



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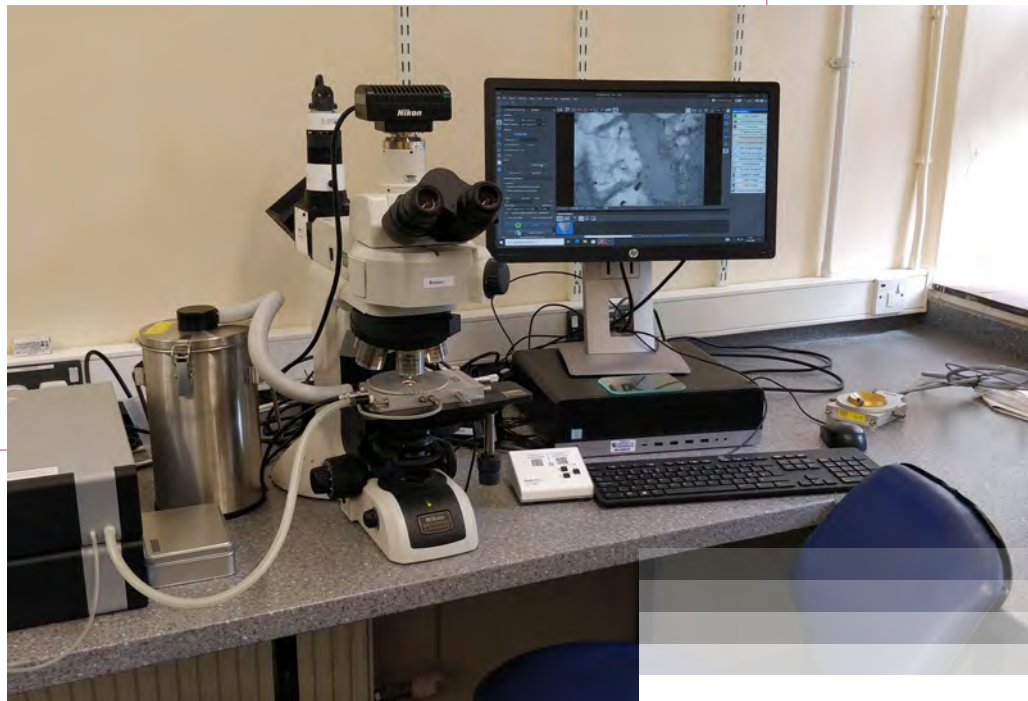
Fluid Inclusion Microthermometry

Fluid inclusion microthermometry involves deduction of the temperatures at which minerals were formed and can also yield information on the compositions and salinities of fluids that have passed through a rock, and the pathways that the fluids have followed.

Polished wafers are mounted in a special stage, and progressively heated or cooled until phase changes are observed and recorded.

FEATURES

- Two Nikon LV 100 Pol microscopes, each with 5x, 10x, 20x, 50x and 100x objectives
- Nikon Elements D software and DS-Fi3 cameras
- Transmitted and reflected light
- UV light for identification of organic carbon inclusions
- Linkam THMS 600 stage, enabling temperature changes from -195 (liquid N cooled) to +600°C
- Linkam TS 1500 stage, enabling temperature changes from ambient to +1500°C (rock melting temperatures)



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Particle Size Analysis

The analysis of particle size is used widely across both industry and research – including pharmaceuticals, manufacturing, the food industry and earth sciences.

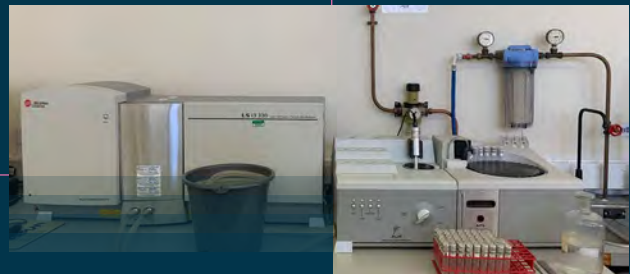
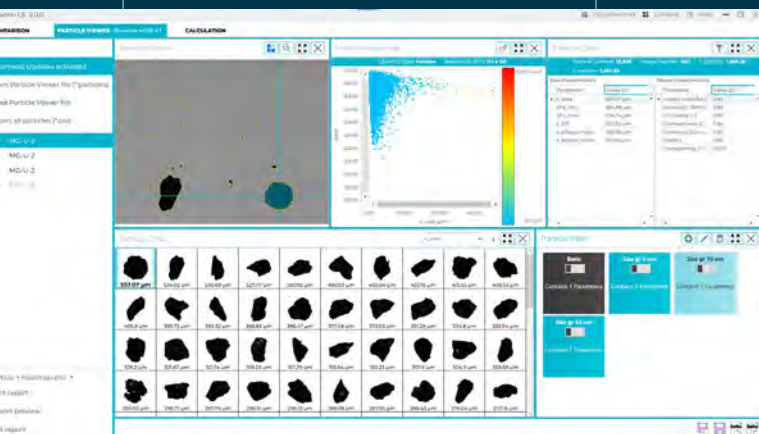
We run three wet dispersion particle size analysis machines. These machines produce accurate and repeatable analyses down to the nano-micron (nm) scale. The laser diffraction only Beckman-Coulter provides particle size analysis that is fast and affordable. The Microtrac Sync uses laser diffraction and dynamic image analysis giving it the ability to run morphometric analyses of the images it captures. A single analysis will take hundreds of images from which it will identify and analyse the shape for thousands of individual grains, allowing for precise measurement of particle size and shape, even for fine particles and aggregates.



FEATURES

Verder Microtrac Sync

- Particle size analyser using both laser diffraction and dynamic imaging
- 0.01um – 1000um particle size analysis
- Images from a 5.2megapixel, 22fps high resolution camera
- Less than 1g of sample required
- One run yields data with more than 30 size and shape parameters including: actual area, length, width, sphericity and roundness of each particle
- Beckman Coulter LS13320
- Laser diffraction particle size analyser
- 0.04um – 2000um particle size analysis
- The LS13320 offers a wide dynamic measurement range, allowing for the analysis of particles spanning multiple size fractions within a single sample
- Equipped with an autosampler which creates a quick turnaround time
- Affordability of large data set analysis for research supplementation
- Mastersizer 3000 with Hydro LV dispersion tank
- 0.01um – 2000um particle size analysis (typical usage – maximum 3,500 um)
- Data reported as required. For example, clay (<2 um), sand & silt (sizes as appropriate), D0.1, D0.5, D0.9 etc.
- Samples sieved to pass 2 mm aperture prior to dispersion within an aqueous matrix using sodium hexametaphosphate on an end-over-end shaker. Further dispersion external to instrument using ultrasonic bath.



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Scientific Services

Porosity and Permeability Analysis

The estimation of the porosity and permeability of materials is used in engineering, materials science and earth sciences.

We run a Mercury porosimeter to measure the porosity and pore size distribution of materials. Mercury has a high surface tension and is nonwetting to most materials, therefore its angle of contact and radius of curvature can be used to calculate the pore diameter into which it intrudes at a given pressure.

We also run a Jones Porosimeter and Permeameter. This combination instrument has both a Coberly-Stevens Boyle's Law porosimeter (He) and a gas permeameter (N₂). The instruments operate independently and are built to accommodate core plugs up to 3" long. It can measure permeabilities from 0.1 microdarcy to 10,000 millidarcy.



FEATURES

Micrometrics AutoPore IV 9500 - Mercury porosimeter

- Operates up to 33,000 psi (228 Mpa)
- Two low pressure ports and one high pressure port
- Measures the porosity and pore size distribution of materials.
- Can calculate inferred permeability
- Samples sizes of 1cm² to 2cm²
- Samples can be in solid or powder form
- A mercury storage and preparation area is located adjacent to the machine and is encased in a fume-hood with mercury filter

Jones Porosimeter and Permeameter

- This instrument measures both porosity and permeability of core plugs
- The porosimeter uses Helium at 100psi and is built to accommodate a range of core plug sizes
- The permeameter uses Nitrogen with a confining pressure of 400psi and is built to accommodate samples 1" and 1.5" diameter samples up to 3" long
- It can measure permeabilities from 0.1 microdarcy to 10,000 millidarcy



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Fourier Transform Infrared Spectroscopy

Fourier Transform Infrared (FTIR) spectroscopy is a versatile analytical technique capable of providing a chemical fingerprint for a wide range of organic and inorganic samples from simple homogenous materials to highly complex matrices and mixtures. A large variety of sample types from biological to clay minerals can be characterised as well as identifying unknowns or contaminants. This technique excels at tackling “problem samples” or confirming identification based on reference material.

Typical applications include:

- Blockages in pipelines e.g. sludges and naphthenates
- Scale deposits and corrosion products
- Failed or degraded O-rings and seals
- Internal deposits in engines
- Identification of polymers e.g. paints, plastics and coatings
- Produced water deposits

We deliver comprehensive reports with expert interpretation of FTIR spectra and is accredited to ISO 17025.

FEATURES

- Bruker Vertex 70 Spectrometer
- Analyse many sample types
- Minimal sample preparation
- Small volume or amount of sample
- Different duradisc accessories available depending on sample types.
- Non destructive
- Diamond crystal so not damaged by hard materials



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www.huttonltd.com/services/fourier-transform-infrared-spectroscopy-ftir



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Scientific Services

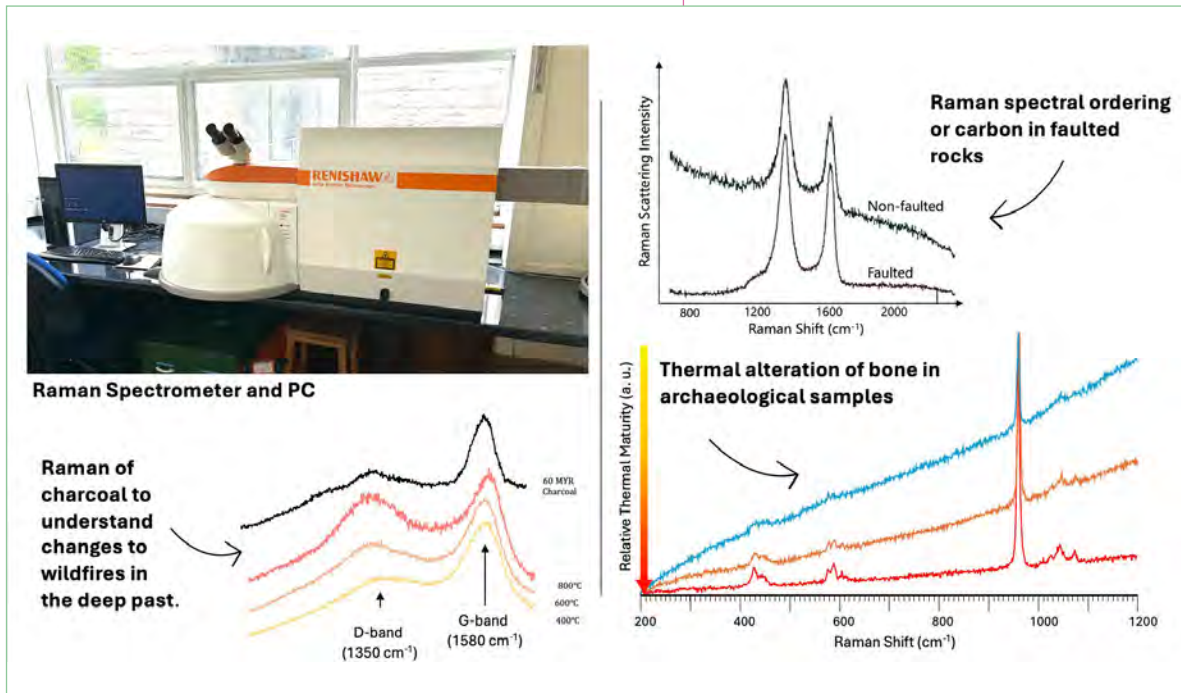
Raman Spectroscopy

Raman spectroscopy is a non-destructive technique utilising different laser wavelengths to provide detailed chemical and structural characterisation of materials. This technique is commonly used in the geosciences across a range of settings, such as:

- Carbon characterisation for burial temperature
- Mineral identification
- Thermometry of carbon
- Mapping of mineralogies
- Bone characterisation

FEATURES

- Renishaw inVia Raman microSpectrometer
 - 514nm laser
 - 785nm laser
- WiRE deconvolution software as standard, with peak identification, curve fitting and mapping protocols



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Inductively Coupled Plasma Mass Spectroscopy (ICP-MS) and Other Techniques

ICP-MS is a highly sensitive technique which can analyse a wide variety of sample types such as produced and natural waters, soils and sediments, biota, food products, plant material, cosmetics, seaweed, rock, chemical products.

As long as sample can be extracted or digested into solution then this can be analysed by ICP for most metals and some non-metal elements from trace to macro concentrations.

We can carry out all analyses from sample preparation including freeze drying, milling, extraction and digestion. We have many extraction techniques available such as nitric acid or aqua regia digest, fusion and microwave digest.

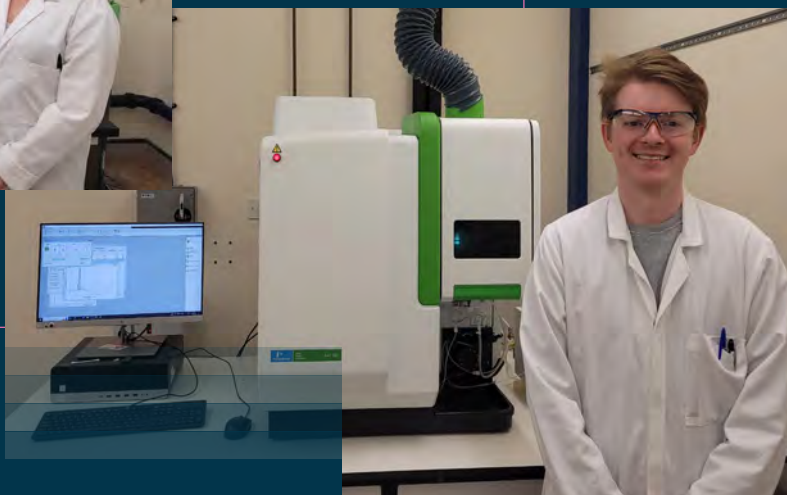
Typical applications:

- Water (natural and produced)
- Soils and sediments
- Effluents
- Chemical product

FEATURES

- Elemental analysis by ICP-MS covering a wide range of metals and non-metals from trace to macro levels. We also have Inductively Coupled Plasma-Optical Emission Spectroscopy (ICP-OES) for more complex matrices
- Total Organic Carbon and Total Nitrogen
- Chloride, Fluoride, Bromide, Sulphate and Nitrate analysis of waters by Ion Chromatography
- Phosphate, Nitrate, Ammonia and Alkalinity by Discrete Analyser
- CrVI analysis
- COD, BOD and Cyanide by HACH
- Digestion methods including acid reflux, microwave and fusion for geological samples
- Other techniques include Ion Chromatography for anions, colourimetric techniques by discrete analyser, COD and BOD by HACH spectrophotometer

Please get in touch to discuss your specific analytical needs.



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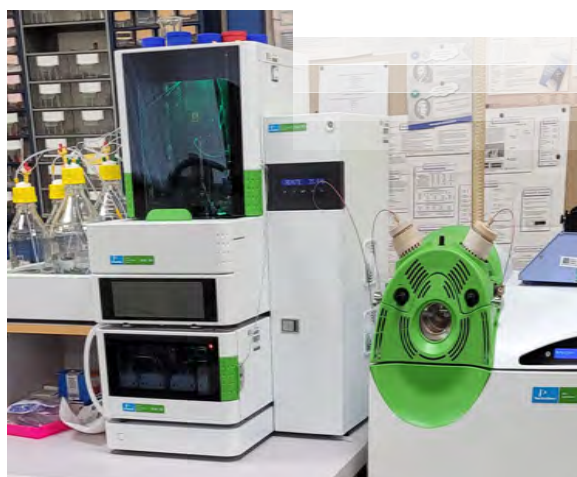
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Scientific Services

LC-QQQ-MS/MS

The LC-QQQ-MS/MS facility provides sensitive analysis (detection and quantification) of emerging organic contaminants (EOCs). This is a targeted approach covering different classes of EOCs including pharmaceuticals and personal care products, pesticides, endocrine disruptors and per- and polyfluoroalkyl substances (PFAS).

Emamectin benzoate, commonly known as SLICE, is a chemical used to control fish lice in salmon. SEPA issued a position statement in July 2022 with an interim environmental standard limiting operators to discharge of concentrations no greater than 131 ng per kg. To enable confidence in making a reading at that level, the required limit of detection was 13.1 ng per kg. Despite concentrating the sample during preparation, the only technique capable of detecting the chemical at these levels is LC-QQQ-MS-MS.



FEATURES

- Quantification of pharmaceuticals in water samples method: sample clean-up and LC-MS/MS analysis of a suite of 25 pharmaceuticals including analgesics and anti-inflammatory drugs, lipid regulators and cholesterol lowering statin drugs, anti-epileptics and antibiotics.
- Quantification of antibiotics in soil samples.
- Quantification of pesticides in water samples method: sample clean-up and LC-MS/MS analysis of 16 pesticides including neonicotinoid pesticides and non-neonicotinoids.
- Quantification of endocrine disrupting compounds in water method: sample clean-up and LC-MS/MS analysis of Bisphenol-A, Estrone (E1), Estradiol (E2), Estriol (E3) and 17-a-Ethylestradiol.
- Quantification of per- and polyfluoroalkyl substances method: sample clean-up and LC-MS/MS analysis of 18 PFAS, including PFOS and PFOA, in water, fish and meat samples.

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Scientific Services

GC-MS and GC-FID

This facility provides comprehensive analysis and method development services tailored to various organic compounds, encompassing a wide spectrum from polar to non-polar, small to large molecules, across diverse matrices such as Soils/Sediments, waters, food, and biota. Additionally, we offer qualitative/semi-quantitative analysis to identify potential contaminants, addressing clients' specific issues with a problem-solving approach.

We also offer consultancy services to advise on the most suitable extraction methods and techniques tailored to meet the specific needs of each client. Our recommendations are based on the availability of techniques and aim to provide optimal value-for-money solutions.



FEATURES

Applications include but not restricted to:

- Headspace GC-MS for volatile compounds analysis:
 - Residual Solvents (Such as: Acetone, Ethanol, methanol, iso propyl alcohol, Dioxane, Ethylene oxide, Hexane, Chloroform, Ethyl acetate)
 - Chlorofluorocarbons
 - Benzene, Toluene, Ethylbenzene, Toluene (BTEX)
 - Trihalomethanes
- GC-MS:
 - Alkanes (plants) Polyaromatic hydrocarbons (PAHs), Polychlorinated biphenyls (PCBs), Polybrominated diphenyl ethers (PBDEs), Tributyl tin (TBT) Carbon number distribution, Phthalates
- GC-FID:
 - Glycols (Monoethylene glycol, Diethylene glycol, Triethylene glycol), butanetriols, Bicine (N,N-Bis(2-hydroxyethyl) glycine), Furfuryl alcohol, Total Petroleum hydrocarbons
- Derivatisation methods (for polar compounds):
 - Volatile Fatty Acids (VFAs), Lactic acid, 3-Monochloropropane diols (3-MCPD), Glycidyl esters
- Other analysis using HPLC:
 - Organic acids (Oxalic, citric) 4-Hexyl resorcinol, 4-Methyl imidazole, Irgarol, Diuron (Booster biocides), Thymine, Thymidine

Method development and Consultancy Services for organic analysis are also provided.

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Scientific Services

Organic Geochemistry Laboratory

An organic geochemical facility equipped with Gas Chromatography-Mass Spectrometry equipment for liquid and gas analysis (GC-MS). We also have a Leco for carbon and sulphur analysis.

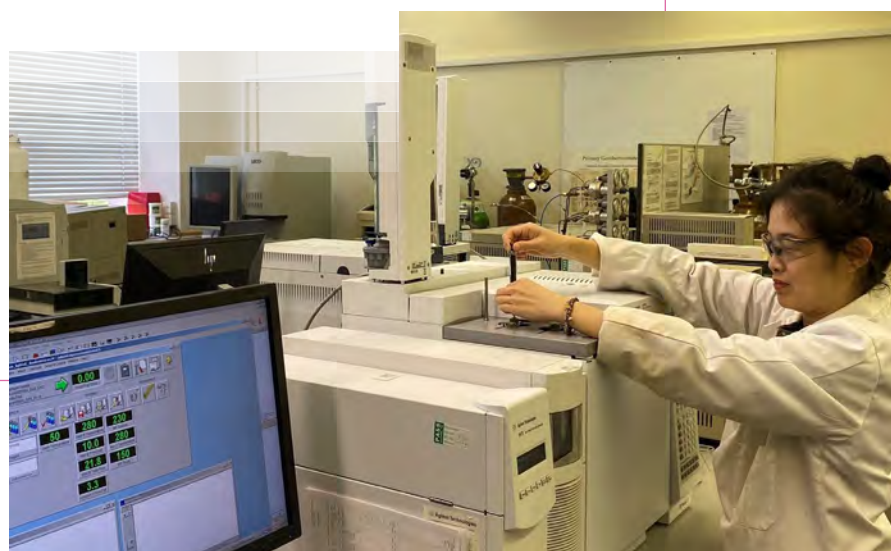
We provide specialized analytical services focusing on oil, gas and lipids but we also provide other characterizations for complex organic mixtures including molecular compositions (biomarkers and molecular markers), that can be used to understand geochemical processes.

We have equipment to process and extract from a range of sample matrices including sediments, rocks and other mixtures. We also offer SARA, TAN, Wax and Asphaltene determination and can develop methods and assays for specific circumstances and situations. Previous examples of this include ultra-trace detection of asphaltene, intracrystalline fats and lipids and nanoparticles in effluents and residues.



FEATURES

- Agilent 8890 GC connected to a 5977MS. Fitted with a 30 m HP5/DB5 or equivalent phase column. Used for analysing oils, petroleum, PAH, biomarker analysis.
- Agilent 6890 GC connected to a 5974MS. Fitted with a 30 m GAS-Pro or equivalent column. Used for gas, vapour, volatile and head space analysis. Applied to situations where it is necessary to determine what is present as well as how much of it.
- HP890-5972 GC connected to 5972 MS. This instrument is currently set up for Hydrocarbon Gas Analysis, but is reconfigured for different applications including Py-GC-MS.
- The LECO Carbon and Sulphur analyser is an instrument used to determine the weight percentage of Carbon and Sulphur in rock samples. The sample is combusted in a high frequency induction furnace in an oxygen rich atmosphere.
- Facilities for surface enhanced Raman scattering and UV-Vis spectrometry. This includes microfluidic and fluidic formats. This equipment is used for customised and bespoke analysis applications, as well as simple proximal characterisations.
- We have both automated solvent extraction, banks of soxhlets, acid digestion and cutting coring and grinding equipment for working with all rock and sediment types.



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Isotope Analysis Services

Isotope data from geological material such as mineral separates, whole rocks, residual salts in cores and formation waters have a wide range of reservoir geology applications in exploration, development and production. We at the Hutton have decades of experience producing both 'light' and 'heavy' stable isotope data for clients to a very high standard – ISO17025:2015.

We have an Isotopix Phoenix Thermal Ionisation Mass Spectrometer, TIMS, which is capable of analysing stable isotopes from Potassium to Uranium and have a particular focus on Strontium and Samarium-Neodymium. We also have a range of Isotope-Ratio-Mass-Spectrometers, IRMS, which are capable of performing both bulk and compound specific isotope analysis on the lighter isotopes such as Hydrogen, Carbon, Nitrogen and Oxygen.



FEATURES

Key services provided:

- Understanding reservoir compartmentalisation by Strontium Residual Salt Analysis – SrRSA
- Monitoring produced waters and investigating water allocation and connectivity
- Age dating marine sediments - Sr isotope stratigraphy.
 - Core, sidewall or cuttings.
 - Carbonate and sulphate minerals.
- Provenance and layering of biostratigraphically barren clastic sequences – Samarium - Neodymium.
- Hydrogen $\delta^2\text{H}$ on waters
- Carbon $\delta^{13}\text{C}$ on solids, waters (DIC & DOC), gases, neutral and phospholipid fatty acids, alkanes & amino acids
- Nitrogen $\delta^{15}\text{N}$ on solids
- Oxygen $\delta^{18}\text{O}$ on solids, waters & gases

Analytical Instrumentation:

- Thermal Ionisation Mass Spectrometer, TIMS
- Gas Chromatography Combustion Isotope Ratio Mass Spectrometer, GC-C-IRMS
- Elemental Analyser Isotope Ratio Mass Spectrometer, EA-IRMS
- Gas Bench Isotope Ratio Mass Spectrometer, GB-IRMS
- High Temperature Conversion Elemental Analyzer Isotope Ratio Mass Spectrometer, TC/EA-IRMS
- LGR water isotope analyser



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Scientific Services

Palynology Processing Laboratory

The palynology laboratory is a modern facility equipped to undertake acid digestion of rock samples for paleopalynology and kerogen analysis. Processing of rock samples includes the use of hydrofluoric, hydrochloric and nitric acids. Work is undertaken in high specification fume cupboards. Waste produced during the processing of rock materials is handled by a specifically designed neutralisation and scrubbing system.

Post acid digestion, the lab has facilities to remove mineral content by centrifuge and enhance recovery using additional oxidation and concentration techniques. Organic residues can be mounted in a variety of media or kept suspended in water.



FEATURES

- Modern laboratory
- Scrubber fume hood to undertake work with fuming acids
- Hydrofluoric Acid digestion removes silicates, leaving solid, insoluble organic matter (kerogen)
- Final product can be kept in residue or mounted on a microscope slide

Palynology and kerogen analysis allows you to:

- Correlate deposits and assigning dates
- Study climatic change
- Study evolution and extinction of plants
- Determine coal-bearing strata
- Define ancient shorelines



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Aberdeen University Geophysical Equipment Repository (AUGER)

AUGER is a suite of geophysical equipment available for research or commercial projects. It currently contains:

- 1 x Leica dGPS system
- Geoscanners bistatic 80MHz and dual 200/400 MHz ground penetrating radar
- 2 x Geometrics G-857 magnetometers
- 48-channel Geode seismic reflection/refraction equipment with hammer source
- 72-electrode IRIS Syscal resistivity tomography kit
- 10 x Güralp 6TD 30 s-100 Hz and 6 x Güralp Certimus 120 s-100 Hz seismometers.

We also have access to GPR (Geoscanners), resistivity (RES2DINV), seismic refraction (Geometrics), seismic reflection (Halliburton SeisSpace/ProMAX), dGPS (Leica), gravity & magnetic (Oasis Montaj/Geosoft) processing software.

More information is available in this video:



Please contact Dr David Cornwell if you are interested in using any the geophysical equipment for academic or commercial projects.



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