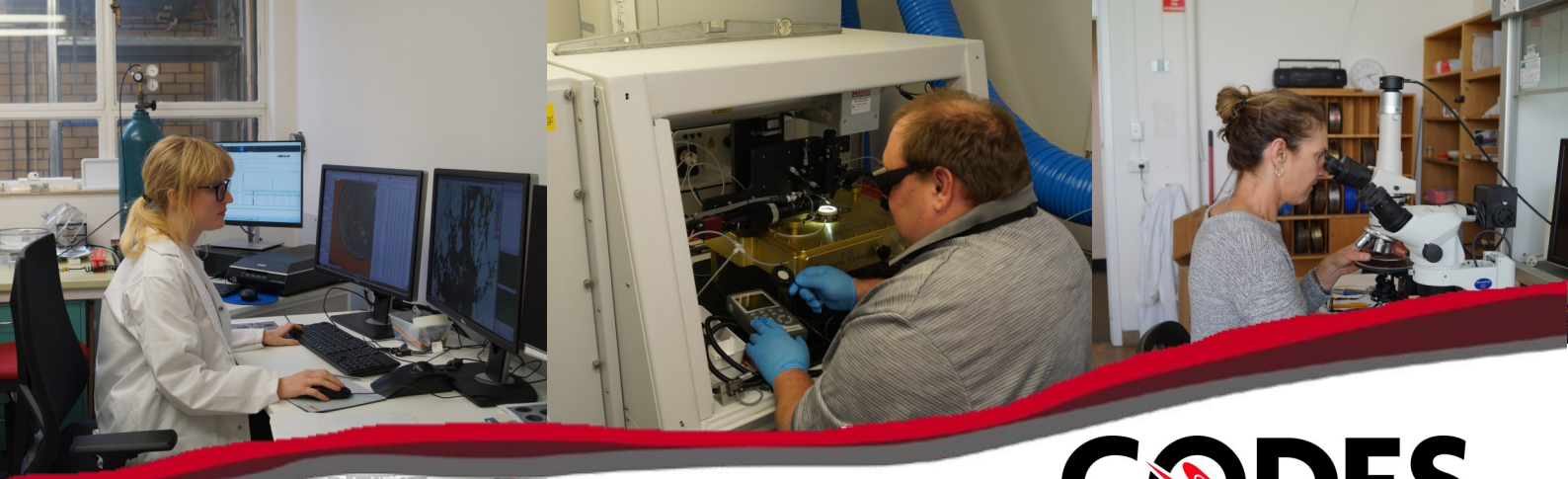




CODES Analytical Laboratories

offer a range of analytical services on a fee-for-service basis

Instrumentation and techniques available

- LA-ICP-MS trace element analyses and/or imaging of elemental distribution within minerals using quadrupole or time-of-flight mass spectrometers
- LA-ICP-MS U-Pb geochronology
- LA-ICP-QQQ-MS beta decay geochronology
- SEM-based quantitative mineralogy, mineral identification and liberation analysis *
- Whole rock geochemistry (XRF, ICP-MS)
- X-ray diffraction
- Specialist lapidary and petrographyservices including heavy mineral separation
- Optical mineralogy
- Electron microprobe analysis (EMPA) *
- Stable isotope mass spectrometry *
- Laser Raman *

* These techniques are provided in collaboration with the Central Science Laboratory at UTAS, leading to longer turnaround times

Examples of services and applications

Sample preparation

- Preparation of polished thin and thick sections
- Preparation of 25-, 30- and 40-mm round mounts for in-situ micro-analyses
- Sieving and mounting multi-mineral concentrates with grain sizes > 10 μ m
- Crushing and milling for heavy mineral separation and bulk chemical and mineralogical analyses
- Mineral separation and mounting of grains
- Lithium borate fused disks for XRF major element analysis
- Pressed powder pellets for XRF and LA-ICP-MS trace element analysis
- Drilling out of sulfide minerals for S isotopic analysis

Geochronology

U-Pb dating of zircon, monazite, rutile, sphene, apatite and hydrothermal minerals. Lu-Hf dating of garnet, apatite, fluorite and calcite. Rb-Sr dating of micas, feldspars, and other Rb-rich

minerals and Re-Os dating of sulfides coming soon (enquiries welcome).

- U-Pb dating by LA-ICP-MS of igneous samples (age reported)
- U-Pb dating by LA-ICP-MS of detrital samples (age range and probability distribution reported)
- U-Pb dating by LA-ICP-MS of hydrothermal minerals (epidote, garnet, apatite, monazite, calcite, rutile, titanite, cassiterite, wolframite, scheelite) (age reported)

A standard set of 30 isotopes is analysed and reported for zircon and monazite, including all rare earth elements; a standard set of 24 isotopes is analysed and reported for apatite, including all rare earth elements; other minerals are dated using specific U-Pb analytical methods.

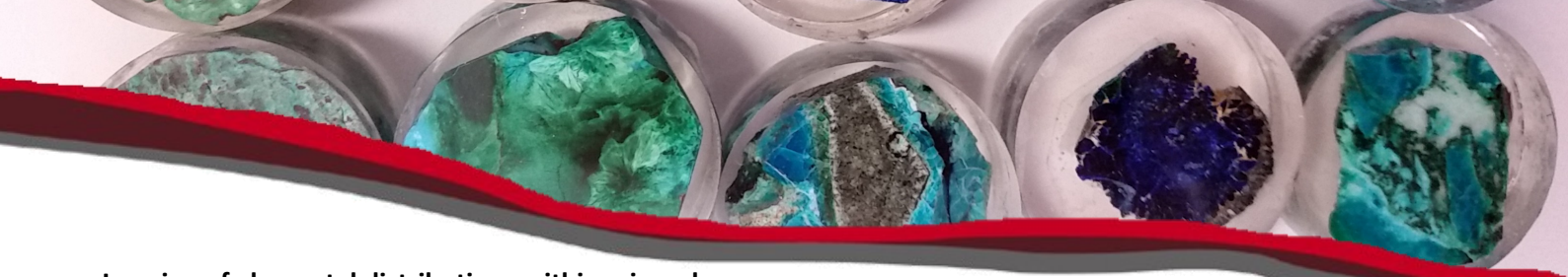
Charges for U-Pb geochronology sample preparation are applied regardless of whether minerals of interest have been found in the samples. Full charges will be applied when age determination could not have been performed due to large amounts of common Pb present or large extents of Pb loss. Dating of epidote and garnet is only performed after the mineral grains have been analysed for trace element contents (charged separately) and the date-ability of the sample has been assessed.

Chemical and isotopic analysis of minerals **

Oxides, sulfides and sulfosalts, carbonates, phosphates, silicates and some metals.

- Analysis of sulfide minerals for a wide range of chalcophile and siderophile elements
- Epidote, chlorite, quartz, calcite, alunite, tourmaline chemistry $\pm$ vectoring following Amira Footprints Project protocols
- Multi-mineral fertility assessments (zircon, rutile, apatite, titanite, magnetite, epidote, tourmaline)
- PGE analysis in sulfides and oxides
- General mineral trace element analysis
- Pb isotopic analysis of sulfides and K-feldspar
- Quantitative EPMA analysis of minerals

*** Charges for epidote, chlorite, quartz, calcite, alunite and fluorite only applied to analyses which have passed Amira Footprints Project rejection criteria (the minimum charges per sample apply). PGE analysis may attract higher charges.*



Imaging of elemental distributions within minerals

- Modal mineral analysis (MLA and similar techniques)
- LA-ICP-MS imaging of element distribution
- Mineral-specific and multi-mineral quantification of LA-ICP-MS images
- EPMA imaging of element distribution*
- CL and BSE imaging on SEM*

Gold, critical metal, and other metal deportment

- Concentrations of refractory and critical metals by LA-ICP-MS
- Identification of micro-inclusions in minerals by LA-ICP-MS
- LA-ICP-MS image of element distribution
- 3D modelling of elemental distribution and total concentration within minerals
- Full mineralogical characterisation using quantitative mineralogy on SEM, including full minerals liberation analysis*
- Modal mineralogy analysis on SEM*
- Sparse phase search on SEM*
- Mass-balance calculations of element deportment

Bulk analysis

- WDS XRF wholerock analysis
- Solution ICP-MS analysis
- Powder XRD
- Particle size distributions
- S isotope analysis of powdered sample (sulfide or sulfate minerals)
- Pb isotope analysis by Solution ICP-MS

Details of instrumentation

LA-ICP-MS

CODES Analytical Laboratories house four LA-ICP-MS units specialising in different applications. The equipment includes four state-of-the-art, high throughput RESOLUTION S-155 laser microprobes coupled to two Agilent 7900 quadrupole, two Agilent 8900 QQQ ICP-MS, and one TOFWERK ICP-TOF-MS.

XRF

The facility houses an Axios Advanced 4.0 kW X-ray fluorescence spectrometer by Panalytical. The instrument's automated sampling system enables fast throughput of samples for major and trace element analysis. The lab also houses two Olympus portable XRF instruments.

Solution ICP-MS and Clean Room

The facility houses a class 100 clean room for processing samples in an ultra-pure environment. It is equipped with a PicoTrace high-pressure digestion system, allowing for full dissolution of rock samples with resistant phases. Ultrapure

Seastar grade reagents are used to ensure low blank levels and high data quality.

Lapidary

The facility is equipped with state-of-the-art polishing and thin-section making equipment. It also includes numerous saws for cutting core, thin-sections, laser mounts and polished sections, allowing for rapid turnaround of sample submissions.

University of Tasmania Central Science Laboratory

CODES Analytical Laboratories have reciprocal arrangements with the UTAS Central Science Laboratory, which has an extensive suite of complementary equipment, particularly in the areas of electron microscopy, X-ray microanalysis, laser Raman spectroscopy, ICP-MS, and Mineral Liberation Analysis (MLA).

For more information visit www.utas.edu.au/research/central-science-laboratory

About CODES and CODES Analytical Laboratories

CODES, the Centre for Ore Deposit and Earth Sciences, is based alongside the Discipline of Earth Sciences at the University of Tasmania. Formed in 1989, the Centre has grown substantially over the years and is widely regarded as a global leader in ore deposit research and training across the mining value chain from exploration through mining and processing to waste characterisation and management. It is home to over 30 highly qualified research staff and over 135 postgraduate students. The Centre has developed an integrated, ore-systems-based research program that encompasses an array of disciplines, from district architecture and ore characterisation, through to geometallurgy and environmental geoscience, all underpinned by world-class analytical facilities.

CODES Analytical Laboratories play a dual role, being simultaneously a research unit within CODES and a service unit which allows CODES staff and students, our academic and industry partners and collaborators, and external users, to perform geochemical analyses using the methods developed through our R&D program. Laboratory staff participate in a range of R&D projects aimed at developing novel analytical methods and instrumentation. The Laboratories generate analytical data on a fee-for-service basis to external users. The Laboratories provide analytical services which are not currently available through commercial analytical laboratories.

CODES Analytical Laboratories' facilities and expertise are used extensively by other leading research organization and the minerals industry.

Contact details

For further information and pricing, please contact:

CODES.Labs@utas.edu.au

CODES

Centre for Ore Deposit and Earth Sciences
University of Tasmania, PO Box 807, Sandy Bay, Tasmania 7006, Australia
Tel: +61 3 6226 2472 | CODES.Info@utas.edu.au | utas.edu.au/codes

CRICOS Provider Code: 00586B