

MASTER OF ECONOMIC GEOLOGY UNIT

*via blended delivery*

# Ore Deposit Geochemistry, Hydrology and Geochronology

Week 1: May 29—June 3, 2023 (blended mode—in-person and online)

Week 2: July 3—7, 2023 (online only)

(Online content will be delivered via Zoom between 9am and 6pm AEST (UTC+10))



CODES, Centre for Ore Deposit and Earth Sciences, University of Tasmania

CRICOS Provider Code 00586B

*CODES' Master of Economic Geology unit on Ore Deposit Geochemistry, Hydrology and Geochronology, is presented by a range of CODES and invited experts. It provides an up-to-date review of the theory and practice of geochemistry, hydrology and geochronology as applied to studies of mineral exploration and ore deposit genesis. The first week covers basic principles of ore fluid chemistry, the use of magmatic minerals and whole rock geochemistry in exploration, geochronology, granite metallogeny, advanced geochemical exploration techniques and the uses of pyrite in mineral exploration (using samples provided by short course participants). The second week covers fluid-rock interaction and the physical hydrology of fracture-controlled hydrothermal systems, mass balance calculations from litho-geochemical data, stable isotope and fluid inclusions applications for exploration, and alteration mineral chemistry vectoring in porphyry and epithermal environments.*

## PRESENTERS

### INVITED SPEAKERS

**Phil Blevin** is Leader of Mineral Systems at the Geological Survey of NSW. He has extensive expertise in the relationships between igneous geochemistry and metallogenesis in eastern Australia.

**Scott Halley** is an independent consultant specializing in exploration geochemistry, and the application of multi-element ICP geochemistry and SWIR analysis to mapping alteration mineral zonation patterns around hydrothermal systems. Over the past 10 years, he has consulted to more than 130 mining and exploration companies in more than 25 countries.

**Nick Oliver** is Principal and Consultant HCOV Global. He specializes in combining structural and geochemical approaches to understanding ore deposits and their associated hydrothermal systems. Nick was previously director of EGRU and Professor of Economic Geology at JCU.

**John Walshe** is an Honorary Research Fellow, CSIRO Mineral Resources. He has contributed to development of mineral systems concepts and application to mineral exploration. John is particularly interested in "deep-Earth" degassing processes as a fundamental driver of metallogenesis, particularly with respect to late Archean Au systems.

**Lesley Wyborn** is an Honorary Professor the Research School of Earth Sciences and the National Computational Infrastructure Facility at ANU. She is a specialist in Proterozoic granite geochemistry and in detecting regional footprints of granite-related mineral systems using online information systems and processing, including HPC.

### CODES PRESENTERS

**Sheree Armistead** is a Postdoctoral Research Fellow at CODES. Her research focuses on the links between plate tectonics and mineral systems, and the cyclical and secular changes of these throughout Earth's history. Sheree primarily uses isotope geochemistry, data science, GIS and plate reconstructions in her research.

**Mike Baker** is a Senior Research Fellow in Economic Geology at CODES, University of Tasmania. He has extensive research expertise in mineral chemistry and its applications to exploration for porphyry and epithermal deposits.

**David Cooke** is the Director of CODES, the Centre for Ore Deposit and Earth Sciences. He has developed a global reputation for high quality research on porphyry copper and epithermal gold deposits and ore deposit geochemistry.

**Matthew Cracknell** is a Lecturer in Geodata Analytics for the Discipline of Earth Sciences and the Centre for Ore Deposit and Earth Sciences (CODES).

**Alex Farrar** is a Ph.D. candidate at CODES, whose research focuses on the link between structure, tectonics, and giant porphyry copper formation, using data analytics. Alex previously worked with First Quantum Minerals, conducting greenfield porphyry copper exploration in the Andes and sediment hosted copper exploration and mining in the African Copperbelt.

**Wei Hong** is a Researcher Fellow in Critical Minerals Characterisation at CODES. He was awarded a PhD degree in 2017 at CODES and continued to work here as a postdoctoral researcher until September 2019. Wei was appointed as an embedded MinEx CRC researcher at the University of Adelaide and a visiting researcher at the Geological Survey of South Australia between 2019 and 2022, before returning to CODES and taking his current position. His research interest includes application of geochronology, mineral chemistry, and isotopes to the genesis and exploration of magmatic-hydrothermal ore deposits.

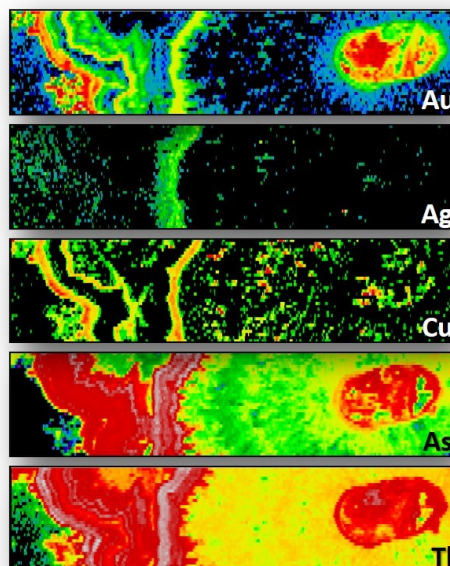
**Sebastien Meffre** is Professor at the University of Tasmania. He is the head of Earth Sciences and also works within the Centre for Ore Deposit and Earth Sciences (CODES). His current research interests include improving techniques for dating rocks using the U-Pb isotopic system.

**Jeff Oalman** is a Laboratory Analyst in LA-ICPMS.

**Robert Scott** is the Coordinator of the Master of Economic Geology program at CODES, and lecturer in Structural Geology in the Discipline of Earth Sciences at the University of Tasmania.

**Jeff Steadman** is a Postdoctoral Research Fellow in Geochemistry at CODES, specialising in mineral chemistry as a vector towards concealed gold, silver, and copper ore bodies.

**Lejun Zhang** is a Senior Lecturer at CODES and Earth Sciences, University of Tasmania specialising in the application of alteration mineral chemistry for enhancing exploration in green rock and lithocap environments, and vectoring using SWIR and whole-rock geochemical data.



***Ore Deposit Geochemistry, Hydrology and Geochronology***  
*is offered as a unit in the national Minerals Geoscience Masters program.*

## MASTER OF ECONOMIC GEOLOGY

### THE MOST COMPREHENSIVE MASTER DEGREE IN MINERAL EXPLORATION AND MINING GEOLOGY ANYWHERE IN THE WORLD

This course work-based Masters program is aimed at geoscientists who want to gain a thorough up-date on advances across the spectrum of economic geology applied to mineral exploration. The Master of Economic Geology at UTAS is part of the national Minerals Geoscience Masters program, jointly offered by the University of Tasmania and the University of Western Australia, in conjunction with Curtin Business School at Curtin University.

#### Course structure

The Masters course can be completed in either of two ways:

*Option 1 (research pathway):* requires the completion of six coursework units (worth 75% of total credit points) and a minor research thesis (worth 25%). Five of the units must be completed at CODES including thesis units KEA724 and KEA725, core units KEA712, KEA716 and at least one field-based unit, while the remainder may be completed at other participating universities. Duration: 18–24 months full-time; up to 36 months part-time (flexible in recognition of industry participants).

*Option 2 (professional pathway):* requires the completion of eight units of coursework, at least five of which must be undertaken at CODES including core units KEA712, KEA716 and at least one field-based unit. Duration: up to 36 months part-time (flexible in recognition of constraints on industry participants).

Participating universities offer up to seven units annually or in rotation over a two-year period. Most units are of two weeks duration.

#### Fees

UTAS tuition fees are approximately \$2,075 per unit (8 in total) for domestic students (2023 rate for Commonwealth Supported Places) and \$9,238 (AUD) per unit for full-fee paying overseas students (FFPOS) (2023 rate). Field-based courses have additional costs. Costs will vary for units taught by other MGM partner institutions.

#### Entry Requirements

BSc (Hons), or a BSc (majoring in geoscience) with at least two years industry experience. International students should be aware that English language proficiency requirements also apply.

#### Masters units offered by CODES

- 17 – 22 April & 8 – 12 May 2023:  
KEA716 Fundamentals of Economic Geology \*
- 29 May – 3 June & 3 – 7 July 2023:  
KEA709 Ore Deposit Geochemistry, Hydrology and Geochronology #
- 7 August – 15 October 2023 (Intensive Part 2: 18 – 22 September):  
KEA713 Geodata Analytics \*
- 16 – 27 October 2023:  
KEA711 Geometallurgy ^
- 25 October – 11 November 2023:  
KEA707 Ores in Magmatic Arcs (South America) ^
- February 2024:  
KEA718 Advanced Field Skills in Economic Geology ^
- March 2024:  
KEA708 Volcanology and Mineralisation in Volcanic Terrains (New Zealand, western Tasmania) ^
- April – May 2024:  
KEA716 Fundamentals of Economic Geology \*
- June – July 2024:  
KEA712 Ore Deposit Models and Exploration Strategies #
- October – November 2024:  
KEA710 Exploration in Brownfield Terrains \*

**NB** COVID-19 travel restrictions may impact the running of units with face to face delivery

\* online delivery

# blended delivery (week 1 face to face/online; week 2 online)

^ face to face delivery

- Diagenetic pyrite can also be enriched in a variety of trace elements. Although in most cases these will not be ore-related, diagenetic pyrite can preserve complex growth histories and may be suitable for this exercise.
- Ideally, samples should be between 50 and 500 g, and contain pyrite grains 0.05 – 2 mm in size. Please avoid samples containing very coarse grained or abundant arsenopyrite (or other arsenic-rich minerals).

Samples should be delivered to CODES as soon as possible, and no later than 4 weeks before to the start of the unit.

Send pyrite samples to:

Dr Robert Scott  
CODES, University of Tasmania  
Clark Rd, Sandy Bay, Tasmania, Australia 7005

#### We want your pyrite!

Masters students and fee-paying participants for Day 6 (Application of pyrite trace element chemistry to studies of ore deposit genesis) are invited to provide a small pyritic rock sample for study during the unit. The trace element composition of pyrite in the sample will be mapped by LA-ICPMS in CODES' analytical facility prior to the unit. During the unit, participants will analyse the data from their sample, and make predictions about deposit type, proximity and fluid chemistry based on the observed patterns of trace element enrichment.

Pyritic samples from any deposit type will do, but general guidelines are:

- Pyrite formed below ~350°C is generally most informative. Pyrite from deposits with protracted mineralization histories is ideal.
- Pyrite from deposits formed at temperatures >400 degrees C (e.g. porphyry Cu deposits) or from highly metamorphosed deposits generally contains fewer trace elements and is less suitable for this exercise. If used, choose fresh samples from shallower areas or the fringes of porphyry deposits.

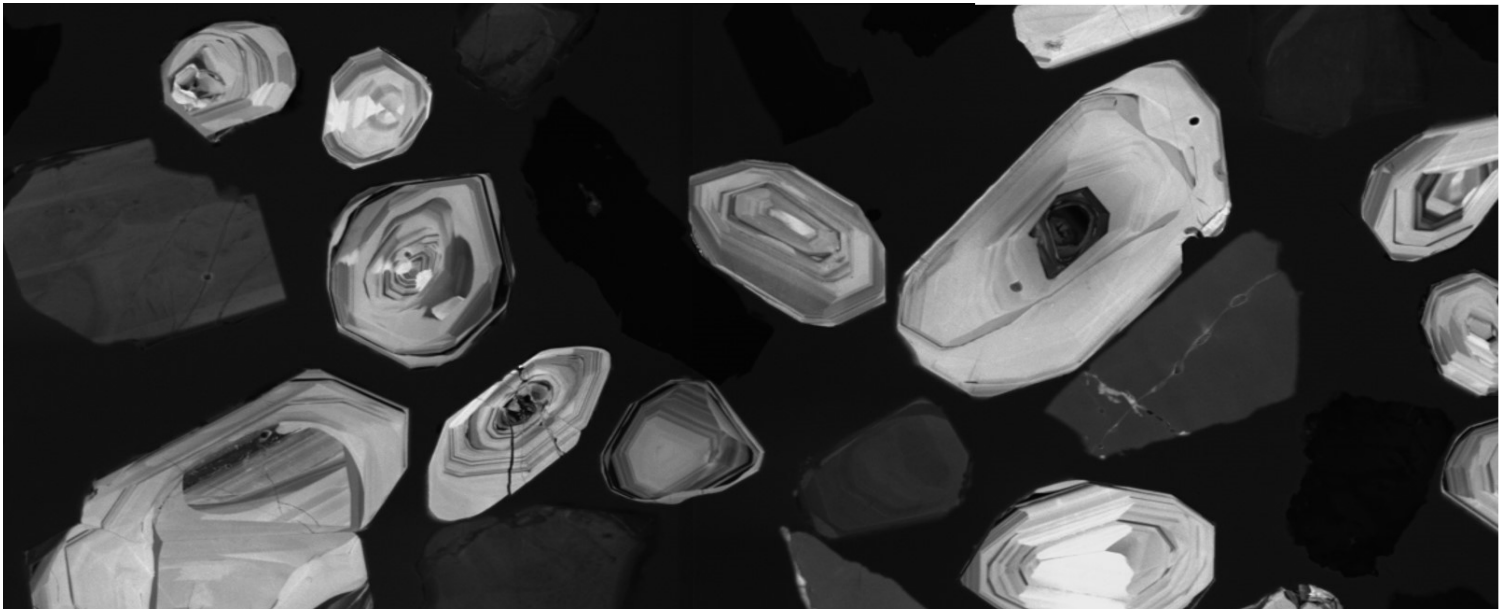
#### For further information contact:

Dr Robert Scott  
Masters Coordinator, CODES  
Private Bag 79, Hobart 7001, Australia  
Tel: +61 3 6226 2786  
Email: CODES.info@utas.edu.au  
Robert.Scott@utas.edu.au  
Web: utas.edu.au/codes/masters-short-courses

## PROVISIONAL PROGRAM

### WEEK 1: May 29—June 3

<b>Monday May 29</b>	Metal transport and ore-forming processes in hydrothermal systems—implications for ore genesis and exploration	<b>PRESENTER:</b> David Cooke
<b>Tuesday May 30</b>	Practical aspects of fluid flow and mineralization location in hydrothermal systems	<b>PRESENTER:</b> Nick Oliver
<b>Wednesday May 31</b>	Granites and granite metallogeny	<b>PRESENTERS:</b> Phil Blevin, Lesley Wyborn
<b>Thursday June 1</b>	Igneous geochemistry and magmatic mineral chemistry for exploration	<b>PRESENTER:</b> Mike Baker
<b>Friday June 2</b>	Enhanced geochemical exploration; introduction to the Ore Halo assignment	<b>PRESENTERS:</b> Scott Halley, Robert Scott
<b>Saturday June 3</b>	Application of pyrite trace element chemistry to studies of ore deposit genesis	<b>PRESENTERS:</b> Robert Scott, Jeff Steadman



### WEEK 2: July 3—7

<b>Monday July 3</b>	Radiometric dating techniques for exploration	<b>PRESENTERS:</b> Sebastien Meffre, Jeff Oalmann
<b>Tuesday July 4</b>	<b>AM:</b> Radiogenic isotopes, metallogeny & Earth Evolution <b>PM:</b> Mass balance calculations from whole rock geochemical data	<b>PRESENTERS (AM):</b> Sheree Armistead, Sebastien Meffre <b>PRESENTER (PM):</b> Robert Scott
<b>Wednesday July 5</b>	Mineral chemistry vectoring in porphyry and epithermal environments	<b>PRESENTERS:</b> Mike Baker, David Cooke, Matthew Cracknell, Lejun Zhang
<b>Thursday July 6</b>	<b>AM:</b> Stable isotopes—applications to ore genesis and exploration; Tourmaline—mineral chemistry and stable isotopes case study <b>PM:</b> Unconventional thinking applied to minerals systems (panel forum)	<b>PRESENTERS (AM):</b> David Cooke, Wei Hong <b>PRESENTERS (PM):</b> Scott Halley, Alex Farrar, John Walshe
<b>Friday July 7</b>	Minerals Geoscience Masters (MGM) Student presentations and wrap-up	<b>PRESENTERS:</b> Students

# REGISTRATION FORM

## Ore Deposit Geochemistry, Hydrology and Geochronology

Week 1: 29 May–3 June, 2023

Week 2: 3–7 July, 2023

Please complete and return to:

CODES

University of Tasmania, Private Bag 79  
Hobart, Tasmania, Australia 7001

Ph: +61 3 6226 2472

Email: CODES.Info@utas.edu.au

### PERSONAL DETAILS

Title—Please highlight ( Prof / Dr / Mr / Mrs / Ms / Miss )

First Name: ..... Last Name: (surname / family name): .....

Preferred Name: .....

Position: .....

Company / University: .....

Address: .....

City: ..... State: ..... Postcode: ..... Country: .....

Email: ..... Phone (mobile / cell): .....

Dial-in Location (ie City): ..... Dial-in Timezone (e.g. UTC +10): .....

Dietary requirements / allergies / other health issues (for in-person attendance only): .....

### REGISTRATION FEES

All fees are in Australian dollars (AUD) and include GST. Fees do not include tuition costs for enrolled students, nor the cost of travel and accommodation to attend in-person sessions in Hobart.

Please indicate

#### Minerals Geoscience Masters Program (MGM) Students:

Full unit (free) - University of Tasmania enrolled

Full unit (free) - University of Western Australia enrolled

#### Industry Participants:

Full training unit (\$3,600)- in person for week 1, online for week 2

Full training unit (\$3,300)- online only option

\_\_\_ days at \$600/day (maximum charge 6 days, indicate days below)

#### CODES Staff/Students:

Unit classes (free, indicate days below)

#### Other Full-time Students:

A limited number of online only discount places may be available for full-time students from other institutions. Please contact [CODES.Info@utas.edu.au](mailto:CODES.Info@utas.edu.au) to inquire about availability, together with proof of current full-time enrolment at your home institution.

PLEASE NOTE: Participants *NOT* attending entire training unit, please circle selected days

Week 1: 29 30 31 1 2 3 May-June

Week 2: 3 4 5 6 7 July

Please retain a copy of this form for your records and email to [CODES.Info@utas.edu.au](mailto:CODES.Info@utas.edu.au).

### PAYMENT

Registrations are due by 7<sup>th</sup> of May, 2023. Full payment must be received by 17<sup>th</sup> of May, 2023.

Preferred payment method. Please indicate

Credit Card

Upon receipt of your registration form and confirmation of your place, you will be provided with a payment reference number and web address for online payments. Please note: Credit card details *cannot* be accepted by email.

Invoice (payment can be made by credit card or bank transfer)

Invoice to (name/company): .....

Attention to (optional): .....

Reference (e.g. order number (optional)): .....

Address: .....

Email address: .....

**MGM STUDENTS: THIS FORM DOES NOT CONSTITUTE AN OFFICIAL UNIVERSITY ENROLMENT—YOU MUST ALSO ENROL VIA ESTUDENT BY THE INTERNAL DEADLINE (this may differ from the date above)**