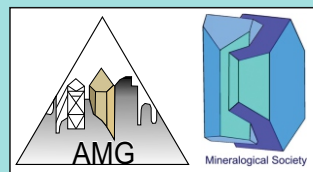


# Applied Mineralogist

The bulletin of the Applied Mineralogy Group



Edited by: George Guice  
Andrew Dobrzanski

Web: <http://www.minersoc.org/amg.html>  
Twitter: @amg\_min  
Email: [amgminsoc@gmail.com](mailto:amgminsoc@gmail.com)

September 2016  
Volume 1, Number 2

## From the AMG committee

Welcome to the second edition of Applied Mineralogist - the bulletin of the Applied Mineralogy Group! We would like to take this opportunity to introduce our committee:

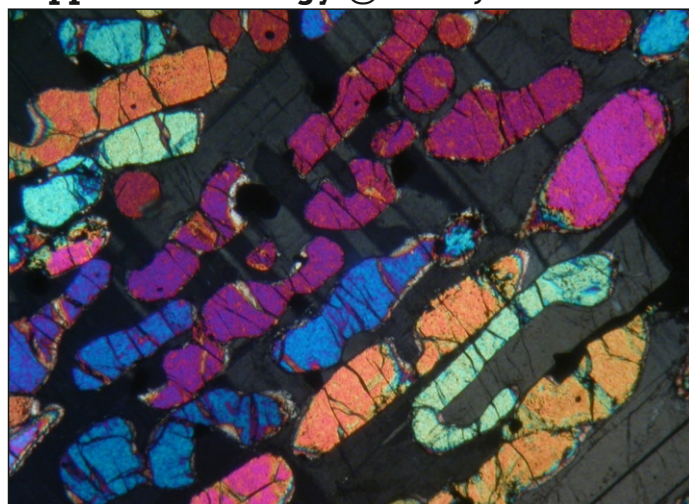
- **Hannah Hughes (chair)** is a postdoctoral fellow at the University of the Witwatersrand and will start a lectureship at Camborne School of Mines (CSM) in January. Hannah's research focuses on the precious and critical metal budget of the mantle and its evolution through time.
- **Eimear Deady (secretary)** is a mineral resources geologist at BGS with expertise in critical metals. Previously having worked as an exploration geologist, Eimear is also studying for her PhD with CSM and is involved in a number of EU-funded projects, including EURARE and HiTech AlkCarb.
- **John Bowles (treasurer)** has been involved with the AMG since 1973, having been both chairman and treasurer several times. Interested in oxide minerals and metal-bearing minerals, John's current research focuses on Pt exploration conducted in Sierra Leone.
- **Alicja Lacinska** is a mineralogist/petrographer at BGS with expertise in material characterisation using electron beam instruments. Alicja specialises in natural and experimental fluid-mineral/rock interaction systems and induced mineralogical and textural transformations and is involved with a number of UK/EU-funded projects.
- **John MacDonald** is a lecturer in Geology at the University of Glasgow. John specialises in clumped isotope analysis of carbonates and previously worked in high-grade gneiss terranes.
- **Dave Alderton** is a lecturer in Geology at Royal Holloway, whose research interests include characteristics and genesis of mineralisation associated with acid magmatism and mine waste characterisation.
- **Gavyn Rollinson** manages the Chemical, Imaging & Mineralogical Facility (CIMF) at CSM. Specialising in mineralogy, Gavyn's main expertise is the QEMSCAN® - an advanced automated scanning electron microscope - and has vast experience with a variety of sample types.
- **Jon Naden** has been an economic geologist at BGS since 2003 and is team leader for the British University Funding Initiative, which aims to fund PhD research.
- **Thomas Edwards** is a senior exploration geologist at the ICL Boulby potash mine in Yorkshire.
- **Will Brownscombe** is an economic geologist at the Natural History Museum, where he develops software for the rapid processing of LA-ICP-MS data. Will has worked on Au, U and Ni-Cu-PGE mineralisation, and is a keen field geologist.
- **Simon Dominy** holds executive technical and corporate roles with Exchange Minerals Ltd and MG Gold Ltd. With experience in academia, mine operations and consulting, Simon's background across mining geology and engineering underpins an interest in holistic metallurgical practice.

## In this issue:

- From the AMG committee
  - #AppliedMineralogy
  - **Special feature: C capture by mineralisation**
  - EMC 'critical metals' session preview
  - Coffee room small-talk: mineral application facts
  - Student bursaries
  - Calendar
  - About us
- **Mark Tyrer** is an independent geochemist working with several UK universities and a range of industrial partners. Mark's interests include: geomaterial use in environmental protection and resource-efficient material use.
  - **George Guice** is a PhD student at Cardiff University researching Archaean ultramafic complexes in the North Atlantic and Kaapvaal cratons. An economic geologist, George has also researched PGE mineralisation in Finland with the Geological Survey of Finland, during his CSM MSc.
  - **Andrew Dobrzanski** is a PhD student at University of Edinburgh studying REE processes within the Norra Kärr peralkaline intrusion (Sweden). Andrew's background is in ore geology and applied mineral carbon sequestration.

We are extremely keen to discuss applied mineralogy projects of all types and strongly encourage you to engage with our committee through the group's email address. We look forward to hearing from you!

## #AppliedMineralogy @FaithfullJohn



#ThinSectionThursday here's an old pic from the files: yet another superb olivine cumulate from Rum.

## EMC preview John Bowles

*Session 23: The future of critical metals: mineralogy, metallogenesis and geomaterials.*

*Tuesday 13th Sept. (9.30 - 15.15), Borgo Room*

This session, convened by the AMG and COM (Commission on ore mineralogy), concerns the future of the critical metals: their mineralogy, metallogenesis

**Introduction**

Carbon capture and storage by mineralisation (CCSM) is a method proposed to alleviate CO<sub>2</sub> emissions by sequestering it permanently in carbonate minerals. In practice, CCSM involves the chemical reaction between CO<sub>2</sub> and divalent metal cations (e.g. Mg from serpentine minerals) to form a new crystalline carbonate, either deep underground – *in situ* CCSM or above the surface – *ex situ* CCSM. During my PhD, I investigated the efficiency of Mg extraction from a selection of serpentine minerals as a proxy for their suitability to the *ex situ* CCSM. The serpentines, despite similar chemical composition [(Mg, Fe)<sub>3</sub>(Si, Al)<sub>2</sub>O<sub>5</sub>(OH)<sub>4</sub>] exhibit structural diversity that affects the degree of cation release prior to reaction with CO<sub>2</sub>, and thus impacts directly on the efficiency of sequestration.

**Methods**

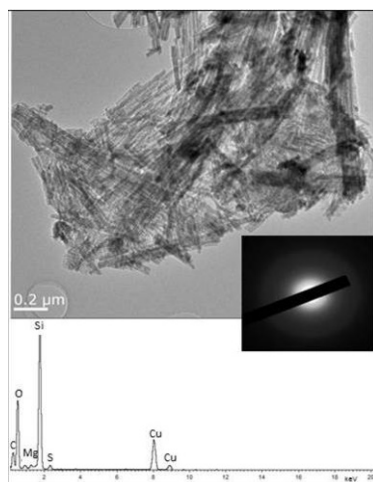
Nine structurally different serpentine minerals, including two antigorites, two trigonal lizardites 1T, two hexagonal lizardites 2H<sub>1</sub>, two chrysotile-rich samples and one polygonal serpentine in a proto-serpentine matrix were treated with acid for 30, 60, 120 and 180 minutes. Various techniques, including Fourier Transform Infrared Spectroscopy (FTIR), Transmission Electron Microscopy (TEM) and X-ray Fluorescence (XRF) were used to appraise the progressive structural and

chemical changes in the serpentine minerals upon the exposure to acid.

**Results and implications**

Compelling evidence for the non-uniformity of serpentine's performance was revealed, with nano-tubular chrysotile exhibiting the highest Mg extraction efficiency of 85% after 180 minutes of leaching, making it a good starting material for the *ex situ* CCSM.

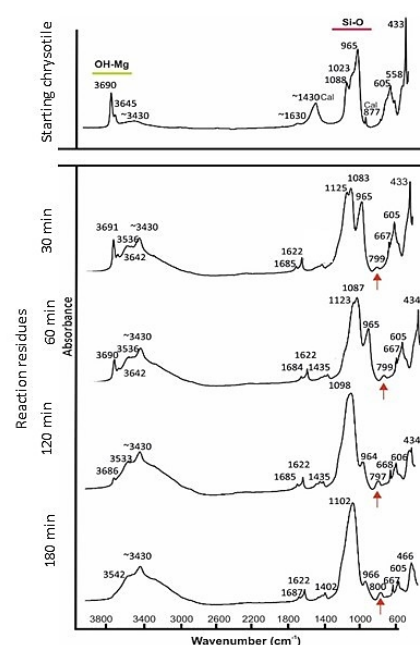
The acid leaching resulted in a significant modification to the crystal structure of the affected serpentines, as exemplified by chrysotile in Figures 1 and 2. During Mg extraction, the crystalline chrysotile transformed progressively into amorphous siliceous residuum,



**Figure 1:** TEM image of a bundle of acid-leached chrysotile fibres (180 min) and corresponding EDS spectrum and SAED, indicating that the leaching residuum is silica-dominated and amorphous. Trace amounts of Mg and S originated from the mineral and solution, respectively; whilst the prominent Cu and C peaks in the EDS spectrum are from Cu grid and C-based film, holding the sample.

This work was recently published in *Chemical Geology* (Lacinska *et al.*, *Chem. Geol.* 437, 153- 169) - [doi:10.1016/j.chemgeo.2016.05.015](https://doi.org/10.1016/j.chemgeo.2016.05.015) and will be presented in session 10 at EMC (12th Sept.)

manifested by diffused rings on the selected area electron diffraction pattern (SAED) and significant modification of the IR bands in the Si-O (965 cm<sup>-1</sup> to 1088 cm<sup>-1</sup>) and OH-Mg (3690 cm<sup>-1</sup>) spectral regions. The nearly pure amorphous silica is potentially a useful by-product that may be utilized in a wide range of industry. Collectively, these experimental and analytical techniques allowed assessment of the applicability of various polymorphs and polytypes of serpentine minerals to CCSM, and provided information that is essential to model and engineer the processes on an industrial scale.



**Figure 2:** FTIR spectra of chrysotile and associated reaction residues; reflecting the time dependent structural modifications in Si-O and OH-Mg regions that occurred during acid leaching. The progressive merging and broadening of Si-O bands and the new peak at ~800 cm<sup>-1</sup> (red arrows) indicate amorphous silica. The starting sample contained a trace amount of calcite.

Interested in writing a 'special feature' in a future edition? Please contact George Guice (GuiceG@cardiff.ac.uk).

and geomaterials. It is convened by John Bowles and Hannah Hughes on behalf of the AMG and Nigel Cook (COM Chair) on behalf of the COM of the IMA.

We have 14 oral presentations and 17 poster presentations.

Advanced technologies and the accelerating move

away from carbon-based fuels following COP21 in 2015 have highlighted the need for secure supplies of the metals required. Often these metals have a high value and are in short supply due to the rarity of their occurrence and bottlenecks in their value chain. Strategically, it is preferable to avoid a monopoly by country, region or enterprise and the overall criticality is a combination of supply, demand, geographic concentration and perceived political risk. Although recycling of some of these elements is greater than 50%, for many recycling is below 1%. This session will examine the properties of minerals that may offer a resource of Ga, Te, Ge, In, Hf, the platinum-group and the rare-earth elements as well as Co, Ta, Nb, V, Sn and Cr. The keynote talk for this session will be 'Indium and selenium in the Neves-Corvo VHMS deposit' by João Carvalho (et al.) from the University of Lisbon.

Other oral presentations will cover In-Se-Ge-bearing deposits in Argentina and developments in nanoscale characterisation of elements within zoned sphalerite. We will hear about economic assessment using trace element mapping, gold mineralisation at Neves-Corvo in Portugal and the relationship of magnetite to Cu-mineralisation in Namibia and well as descriptions of Ta and Nb in the Tapenouta deposit in Spain, REE in feldspars in IOCG systems, PGE assessment in oxide and laterite deposits and the use of automated mineralogy to the aid REE recovery in Malawi.

The posters will focus on: Sn-In in Bolivia; Te-Se in Cyprus; In- Sn in German skarns; Sn minerals in Portugal; PGM in Italy; Sb in SW England; Au-Te in the Urals; Au-Bi from Yakutia, as well as supergene Au in Spain; REE in Africa; Nb-Ta in Brazil; Co in oxide deposits; Ni-Co in Italy; Cu-As-Pb contamination of semi-arid soils in Namibia; W-Co-Mo in Portugal; and U in Hungary.

*EMC also includes the following sessions of interest to 'Applied Mineralogist' readers:*

- Inclusions in minerals as record of geological processes: new analysis methods and application (session 9).
- Clays, zeolites and nanostructures minerals: from mineralogy to applications in industry and environment (session 12).
- Ores, minerals and geomaterials in industrial processes and human activities (session 13).

Details of all sessions, including the critical metals session, are available at:

<http://emc2016.socminpet.it/programme/session-s-list.html>

### Coffee break small-talk: mineral application facts

- 40 litres of acid mine water from Parys Mountain on Anglesea contains enough copper to make a domestic electrical plug.
- Not only is Yttrium Aluminium Garnet (YAG) used as the host components of Lanthanoids in high power laser systems, it is also used to imitate diamond within pieces of jewellery.
- It would cost £590,000 to buy the weight of an adult Badger (*Meles meles*) in gold. (\$1220 gold price / 1.30 GDP to USD - correct on 11/08/2016).

### Student bursaries:

Are you attending a conference soon? Our bursaries are designed to support conference attendance for students and we encourage applications. We have extended the autumn deadline to Friday 30th September. Please go to <http://www.minersoc.org/amg.html#bursaries> for details. We look forward to your application!

### Calendar

*27th August - 4th September 2016*

35<sup>th</sup> International Geological Congress, Cape Town, South Africa. See: <http://www.35igc.org/>.

*5th - 6th September 2016*

Royal Society: Nucleation conference, Newport Pagnell, UK. See <http://www.geolsoc.org.uk/RS-Nucleation-past-and-future>.

*6th - 10th September*

Extractive Industry Geology (EIG) conference, Birmingham, UK. See: [www.eigconferences.com](http://www.eigconferences.com).

*11th - 15th September 2016*

European Mineralogical Conference (EMC), Rimini, Italy. Registration at: <http://emc2016.fr/en/>.

*19th - 21st December 2016*

40th Mineral Deposit Studies Group conference, Bristol, UK. Registration and abstract submission will be available in October.

*28th - 31st May 2017*

ERES 2017, Santorini, Greece. See: <http://eres2017.eresconference.eu/>

### About Us

Founded in 1963 by Norman F.M. Henry, the Applied Mineralogy Group (AMG) is a special interest group of the Mineralogical Society of Great Britain and Ireland. We encourage and promote the study and research of mineralogy applied to ores and related industrial mineral materials. This encompasses: ore microscopy, fluid inclusions in ores, nuclear minerals, coals, refractories, slags, ceramics, concretes and other building materials, mineralogical aspects of nuclear waste disposal, and mineral-related health hazards.



Interested in joining the Mineralogical Society and Applied Mineralogy Group? Go to: <http://www.minersoc.org/> for membership details.

