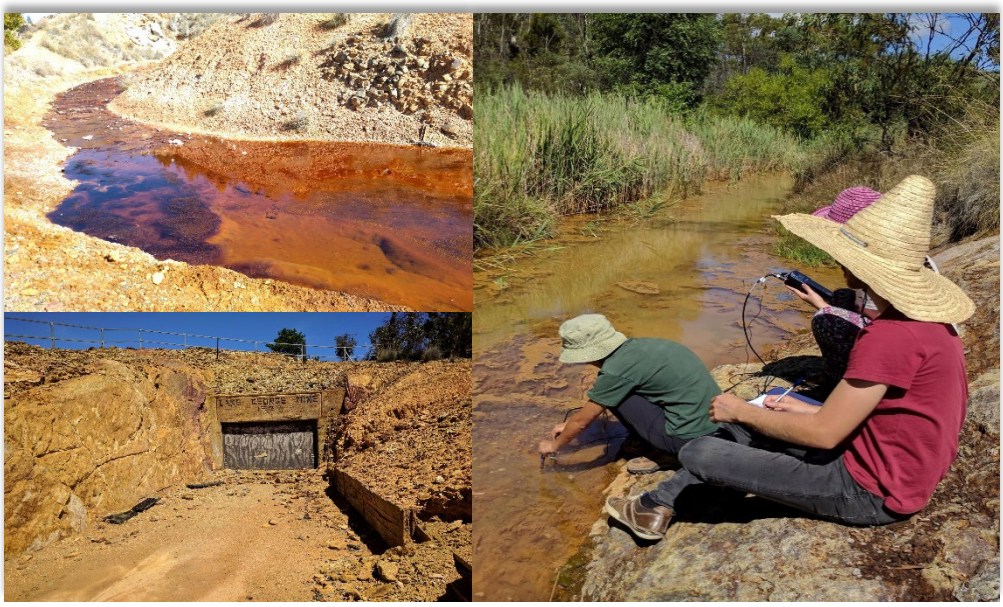
Australian National University



MERCURY AUSTRALIA SYMPOSIUM 2023:

AUSTRALIAN RESEARCH CONTRIBUTIONS TO UNDERSTANDING THE GLOBAL CYCLING OF MERCURY

Event Booklet

13 - 14 July, 2023

Coombs Building – School of Culture, History and Language

Australian National University Campus

ACKNOWLEDGEMENTS

ACKNOWLEDGEMENT OF COUNTRY

The workshop organisers acknowledge and celebrate the Ngunnawal and Ngambri people on whose land we meet. We pay respect to Elders past and present, and extend that respect to all First Australians attending our event.

SPONSORS

We would like to thank our sponsors for their contributions

The ANU School of Culture, History and Language has contributed to funding Jalene's work and the overall organisation of our symposium.

The Australian Institute of Nuclear Science and Engineering is contributing with the prize for best student presentation.

PS Analytical is contributing to the prize for best ECR presentation.

Methrohm Australia is contributing to the morning and afternoon teas.

MERCURY AUSTRALIA

Mercury Australia is a network of Australian university researchers investigating the historical and contemporary uses and impacts of mercury. The group conduct research in Australasia to identify potential adverse effects of mercury on the environment and human health, as well as ways in which to mitigate those risks.

Prior to Mercury Australia, research on mercury in the Australasian region had been being pursued separately in different universities and research centres. Our team has arisen to unite these research efforts, aiming to create new collaborations and, crucially, to translate the research results into publicly accessible information (through www.mercury-australia.com.au).

Mercury Australia is dedicated to providing independently verified research into the sources and impacts of the commercial uses of mercury without bias from vested interests or pressure groups. Our combined many years of experience in researching mercury and related topics in the Australasian region allows us to provide highly credible and reliable findings.

ANU SCHOOL OF CULTURE, HISTORY & LANGUAGE

The School of Culture, History and Language (CHL) is a community of researchers dedicated to investigating and learning with and about the people, languages, and lands of Asia and the Pacific. CHL remains the core of expert Australian knowledge on the Asia Pacific Region within the College of Asia and the Pacific at the Australian

National University. The College of Asia and the Pacific is unique at ANU in transdisciplinary and interregional foundation and the School exemplifies this outlook. Our research is organised around research themes of Culture, History, Language, and Environment which include the discipline areas of: Anthropology; Archaeology and Natural History; Gender, Media and Cultural Studies; Languages; Linguistics; and Pacific and Asian History.

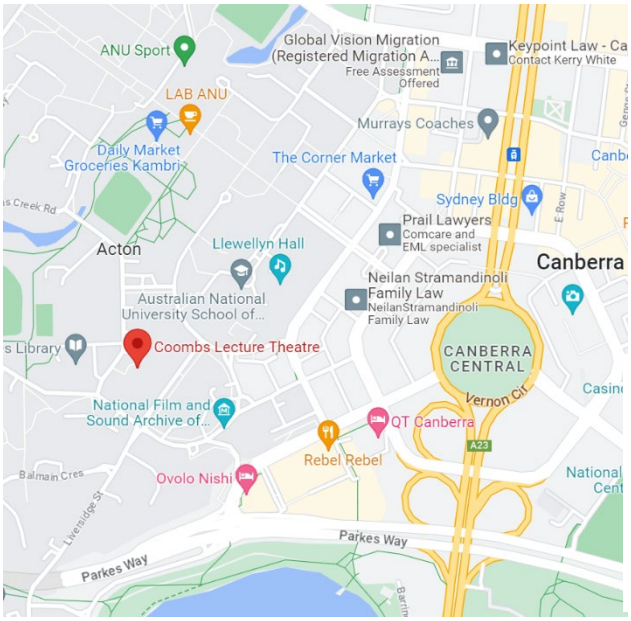
We create knowledge that is specialised, critical, engaged with current discourses and debates within the many disciplines incorporated into our structure. The School's structure is diverse and inclusive. We embrace and relish diversity as a core strength. From this diversity comes the complexity necessary to support a research environment which supports innovative and influential teaching and research.

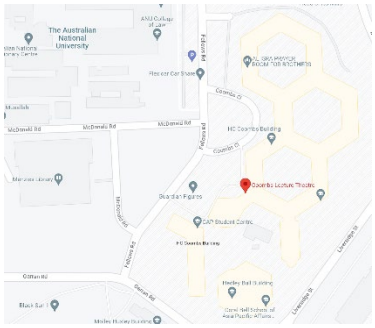
INFORMATION FOR GUESTS

SYMPOSIUM VENUE

The Mercury Australia Symposium 2023 will be held in Seminar Room G in HC Coombs Building 9, Fellows Rd, ANU, Acton ACT 2601.

Seminar Room G is room number **3.314**. Coombs can be difficult to navigate, so please keep in mind that the first number denotes which HEXAGON the room is in (Seminar Room G is in hexagon 3). The second number denotes which floor the room is in (Seminar Room G is on the 3rd floor). The last two numbers denote the room number (Seminar Room G is room 14).





HC Coombs Building 9, Fellows Rd

Seminar Room G 3.314

The HC Coombs Building is on the southern side of the ANU campus and is around a 10–15-minute walk from the main Kambri precinct, and around a 25-minute walk from Canberra's CBD. Transport options are provided below.

The J.G Crawford Building is around 7 – 10 minute walk to Canberra's New Acton precinct, with hotels, restaurants, bars and cafes in that area.

Parking around HC Coombs is limited – see transportation note below.

The closest cafe on campus to our symposium is The Gods Cafe in the Hedley Bull building (next to HC Coombs), La Baguette (about a 5 minute walk from Coombs in the Arts Building) or the café in the National Film and Sound Archive behind Coombs.

ACCOMMODATION

There are many accommodation options close to Canberra's city centre, the Australian National University and as well as restaurants and cafes. The prices are estimates for the July period.

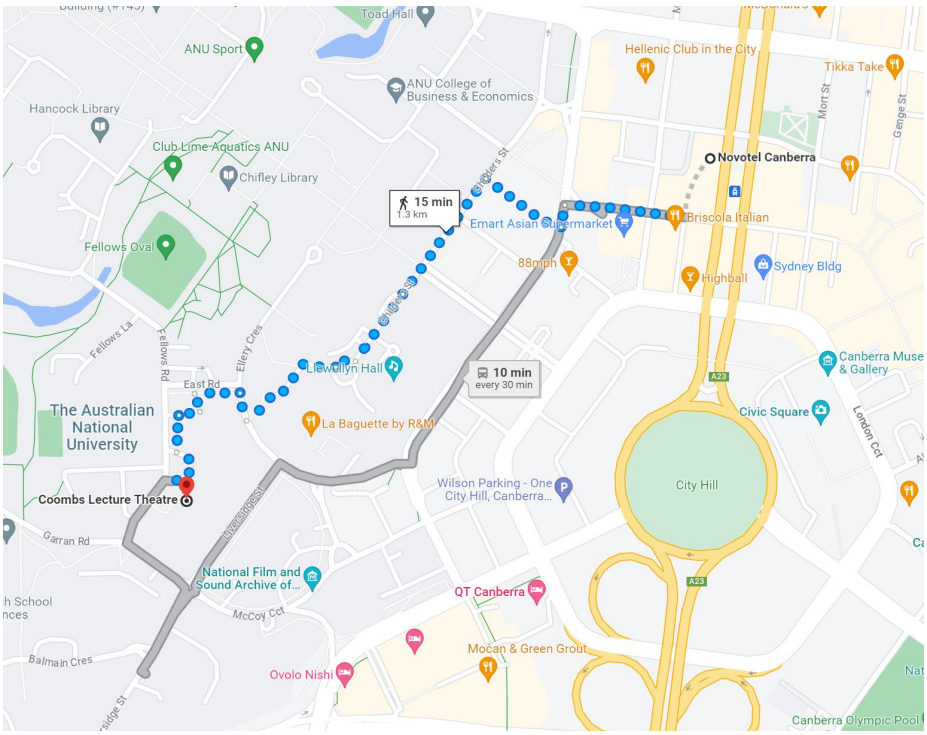
- The Novotel Canberra - $200 per night.
- *Ovolo Nishi - $230 - 290 per night (fully serviced hotel room, breakfast included)
- *Ovolo Nishi - $210 per night (apartment, self-contained, breakfast not included)
- Peppers Gallery Hotel Canberra - $200 per night (breakfast included)
- QT Canberra - $195 per night (breakfast not included)

*These prices are with the ANU discount (Normal price is $370 per night). If you are interested in booking with Ovolo, please let us know and we will arrange the discount code for you.

Alternatively, there are many other accommodation options around the Canberra CBD area, New Acton precinct near ANU, or Airbnb options throughout the city. Take a look at Booking.com, Agoda and Last Minute for more options.

TRANSPORTATION OPTIONS

Walking: It is approximately a 15-minute walk from The Novotel and the Canberra CBD across to the HC Coombs Building. Bring a coat, grab a coffee on your way and take in the crisp Canberra morning air!



Scooters: There is a network of Beam Mobility and Neuron Mobility e-scooters available in Canberra's CBD, with rental scooters readily available by The Novotel. More information available here.

Public Transport: Action Bus Route 53 departing from Alinga St near The Novotel will drop you behind the HC Coombs Building at the corner of Liversidge St and Ellery Crescent. Guests will need to purchase a MyWay travel card to use to tap on and off the bus before travel (these can be purchased and topped up at the convenience store just next to The Novotel. Top ups can also be made at other convenience stores and at any light rail stop). Alternatively single use tickets can be purchased from the bus interchange in the city.

Driving: Paid parking is available at ANU- for more information, please see ANU Parking. Our symposium will coincide with graduation ceremonies, so we do not recommend driving if possible.

INFORMATION FOR PRESENTERS

- Each presenter in the normal panel sessions will have a maximum of 15 minutes to deliver their presentation. The chair for each session will be time-keeping to ensure everyone has a chance to present.
- At the end of each session the chair will open the panel for a Q&A discussion for around 5 minutes.
- If you are presenting in person, please ensure you have sent your slides to Jalene or Larissa.
- Online presenters will use the 'share screen' function in Zoom to share their PowerPoint slides with the audience over Zoom. Please ensure your PowerPoint slides are prepared well in advance, and please send a copy of your slides to Jalene or Larissa at least 24 hours before your session. This is important to ensure that we are able to share your slides in the session in case the 'share screen' function does not work at your end.

FOR OUR ONLINE PARTICIPANTS

This symposium is being delivered in hybrid mode, and many people will be attending online from all corners of the globe over Zoom. Welcome!

There is a single Zoom Link for both days. All presentations will be accessible via the Zoom app or your browser. We will be using the waiting room function, so please bear with us when you sign in.

Please use the link below to join the meeting:
https://anu.zoom.us/j/89910829372?pwd=cTFjelVncDd5V2lmM0pPSVpJRlhWZz09

Meeting ID: 899 1082 9372

Passcode: 998607

If you have any issues connecting, please WhatsApp message:

- Jalene Nalbant: +61 430 354 056; or
- Larissa Schneider: +61 429 088 813

  and we can help you connect.

For our guests who are presenting online, please note the following:

i. Please prepare the presentation using PowerPoint or as a PDF file using a 16:9 (international standard) aspect ratio
ii. Your presentation time includes 5 minutes of questions
iii. Have your presentation loaded and be ready to share your screen
iv. Please ensure your font and diagram size are appropriate
v. Please test your slides, microphone and webcam in the speaker breakout room at least 10 minutes before your scheduled presentation
vi. Each presenter will have a maximum of 15 minutes to deliver their presentation
vii. There will be 5 minutes at the end of each presentation for Q&A

For further assistance regarding sharing a PowerPoint over Zoom, please click.

CATERING, COFFEE & SYMPOSIUM DINNER

Catering is provided for our symposium morning tea, lunch and afternoon tea each day. If you have any dietary requirements, please ensure that you have filled out the online form: https://docs.google.com/forms/d/e/1FAIpQLScjlTDe0P2LaJ6jBr6H5Kj8JYMRiw3lTTa1dzd_xJ7Uj_eW_g/viewform

If you're looking for a good coffee to kickstart your day, we recommend the following cafes around Canberra's CBD: Tonic; Harvest; Two Before Ten; The Cupping Room. And the best coffee on campus is at: Coffee Lab and Rex Espresso in the Kambri precinct, and The Gods Cafe in the Hedley Bull Building (NB: The Gods Cafe is the closest cafe to HC Coombs Building).

Our symposium dinner will be held on Thursday 13 July, 6:30pm (for a 7pm start), at nearby La Bicicletta Restaurant. This is approximately a 10 minute walk from our symposium venue, and a 5 - 10 minute walk back to The Novotel/ Canberra CBD. All the menu options at the dinner can be tailored to meet halal, vegan, vegetarian, gluten free and other dietary requirements. The dinner is $45 per person, to be paid by delegates. If you would like to join the dinner but have not yet filled in the online for to RSVP, please do so ASAP: https://docs.google.com/forms/d/e/1FAIpQLScjlTDe0P2LaJ6jBr6H5Kj8JYMRiw3lTTa1dzd_xJ7Uj_eW_g/viewform

STAYING COVID SAFE

We are committed to keeping all delegates COVID safe during the workshop, and will be following The ANU and ACT Health's latest COVID safety protocols. This includes the following advice for all guests.

Do not come to the workshop if you:

- Are feeling unwell with any COVID-19 symptoms, and/or
- Are feeling unwell in general

Reducing risk in indoor settings

- Participants are encouraged to wash/disinfect hands regularly during the day including on arrival and departure. Hand sanitiser will be available free of charge at the venue
- Practise cough etiquette (coughing or sneezing into your elbow or tissue)

Rapid Antigen Testing (RATs)

- RATs are readily available in chemists, convenience stores and supermarkets in the Canberra CBD and on campus. If you are feeling unwell at any stage throughout the workshop, we strongly encourage you to self administer a RAT test at your accommodation and wait for the results
- If you return a positive result, please let Jalene or Larissa know and make sure you follow ACT Health guidelines. Do not stay on campus.

For more information, please visit ACT Health's COVID-19 page, or The ANU's COVID-19 page for latest updates and information. If you have any accessibility requirements or COVID-specific concerns, please email: Jalene.Nalbant@anu.edu.au

EXPLORING CANBERRA

There is lots to see and do in Canberra outside The ANU! Some of our favourites include the nearby New Acton precinct; The National Gallery of Australia; The National Museum of Australia; The National Library of Australia; Drill Hall Gallery; The National Portrait Gallery; and the National Arboretum. If you're looking to stretch your legs, take in a stroll around Lake Burley Griffin, wander through the Botanic Gardens near ANU, or head up Mt Ainslie for sweeping Canberra views.

For more inspiration, see Visit Canberra, Atlas Obscura, and Broadsheet; or just ask us!

PROGRAM DAY 1, THURSDAY 13TH JULY 2023

Time	Title	Presenter
9:00 – 9:05	Acknowledgement of Country	Larissa Schneider
9:05 – 9:10	Welcome and Opening	Assa Doron
9:10 – 9:15	Housekeeping	Jalene Nalbant
Theme 1 – Microbiology/Pathology/Analytical		
9:15 – 9:30	Linking microbial community dynamics to methylmercury production	Caitlin Gionfriddo
9:30 – 9:45	Mercury in the Amazon	Charles Mckibbin
9:50 – 10:05	Mercury investigations and implications for endemic disease in seals and sea lions	Rachael Gray
10:10 – 10:20	Biokinetics and interaction of mercury and selenium in metamorphosing tadpoles	Danielle Hill
10:30 am Morning Tea (30 mins)		
11:00 – 11:10	Mercury bioremediation has legs!	Kate Tepper
Theme 2 – Mercury in Marine Environments/Analytical Research		
11:15 – 11:30	Characterising contaminants in subsea gas pipeline scale to in-form offshore decommissioning	Tom Cresswell
11:35 – 11:50	Preliminary investigations into the solubility of metacinnabar (HgS) under Australian marine conditions.	Francesca Gissi
11:55 – 12:05	Using radioisotope tracers to study mercury accumulation in marine crustaceans	Alexandra Boyd
12:10 – 12:20	Opportunities for mercury research with AIMS	Darren Koppel
12:30 pm LUNCH BREAK (40 mins)		
13:10 – 13:25	Trace and ultra-trace determinations of mercury &	Timothy Paul Williams

	methylmercury in environmental samples: some practical solutions	
13:30 – 13:45	Mercury concentrations in Australian Marine mammals: a review	Simon Apte
Theme 3 – Atmospheric Mercury/Natural Archives		
13:50 – 13:55	An update on monitoring mercury in air and rain	Melita Keywood
14:00 – 14:10	Preliminary finding on long-term monitoring of atmospheric from Kennaook/Cape Grim monitoring site, Australia	Bakhat Rawat
Theme 4 – Governance/Policy: Part One		
14:15 – 14:45	The Minamata Convention on Mercury – Australia's involvement in addressing global mercury pollution	Sarah Douglass and Olha Furman
KEY NOTE SPEAKER		
15:00 – 15:45	The role of the ocean and air-sea exchange of mercury on the global mercury cycle	Professor Robert Mason
Out of Theme Speakers – International Time Zones		
15:45 – 16:00	Physiology, growth and detoxification characterization of Hg detoxifying isolates and consortia.	Carla Pereira-García
16:05 – 16:10	Mercury export flux in the Southern Ocean estimated from $^{234}Th/^{238}U$ disequilibrium	Viena Puigcorbe Lacueva
Theme 5 – Artisanal Small-scale Gold Mining (ASGM)		
16:15 – 16:30	Environmental distribution of mercury from small scale gold mining Buru Island, Maluku Province, Indonesia.	Amanda Jean Reichelt-Brushett
16:35 – 16:45	Mercury and selenium concentration in stranded and deceased whales from New South Wales, Australia	Natalie Palmer
16:50 – 17:05	Mercury in ASGM telluric environment in Cote d'Ivoire	Dominique Bally

17:10 – 17:25	Ecotechnol/MDS membrane technology overview with case studies	Brant Tapley
19:00 – 22:00 Dinner at Bicicletta Restaurant* *Please bring $45 cash as they do not split bills		

PROGRAM DAY 2, FRIDAY 14TH JULY 2023

Time	Title	Presenter
9:00 – 9:05	Recap and housekeeping	Larissa Schneider and Jalene Nalbant
KEY NOTE SPEAKER		
9:05 – 9:50	Development of Canada's global mercury passive air sampling network	Dr Katrina McSween
Theme 6 – Governance/Policy: Part Two		
9:50 – 10:00	Knowledge-led regulation: Opportunities for responding to emerging mercury risks through a duties-based approach	Dru Marsh
Theme 7 – A Multidisciplinary Approach to Mercury		
10:05 – 10:20	A PhD Journey- Using Palaeoenvironmental Reconstructions to Examine Initial Anthropogenic-Environment Interactions on Palau and Yap	Jalene Nalbant
10:25 – 10:40	Tracing the Past, Shaping the Future: Studying Lake Sediments to Understand Long-Range Toxic Metal Pollution	Rodger (Rujia) Yan
10:45 am MORNING TEA (20 mins)		
Theme 8 – Anthropogenic Emissions		
11:10 – 11:25	Mercury emissions from the coal and non-ferrous sectors	Peter Nelson
11:30 – 11:45	Development of scenarios to assess future global mercury emissions from coal-fired power plants	Edward Archer

11:50– 12:05	Mercury emissions from mining and non-ferrous metal ores	Larissa Schneider
12:10 – 12:15	QCMs for Mercury sensing	Samira Almalki
12:20 – 12:30	The effect of prescribed wildfire on soil mercury concentrations in an Australian native Eucalyptus forest	James Taylor
12:30 pm LUNCH BREAK (40 mins)		
Theme 9 – Legacy of Mercury Contamination from Mining and Other Industries		
13:15 – 13:30	When the dust settles: cleaning up Latrobe Valley's toxic coal ash dumps	Chloe Badcock & Hayley Sestokas
13:35 – 13:45	Mercury analysis in the Finniss River food web, Northern Territory	Isabel Ely
Theme 10 – Synthesis of Hg Research in the Southern Hemisphere		
13:50 – 14:05	A synthesis of mercury research in the Southern Hemisphere, part 1: Natural processes	Larissa Schneider
14:10 – 14:25	A synthesis of mercury research in the Southern Hemisphere, part 2: Anthropogenic perturbations	Jenny Fisher
14:25 – 15:00 Discussion About MA-related Activities & Closing Remarks		

MEET THE HOSTS!



Associate Professor Larissa Schneider

Environmental Scientist

Associate Professor, ANU School of Culture, History and Language

Ms Jalene Nalbant

Environment and Archaeology

PhD Student, ANU School of Culture, History and Language

WELCOME!

On behalf of the Australian National University, the organising committee would like to extend a warm welcome to everyone attending the Mercury Australia Symposium 2023. We are fortunate to be able to organise a mixed event with face-to-face and virtual presentations.

It is our pleasure and delight to offer keynote presentations from Professor Robert Mason (University of Connecticut) and Dr Katrina McSween (Environment and Climate Change Canada).

We, the organising committee, would also like to thank our sponsors of this year's symposium, the School of Culture History and Language (ANU), Metrohm Australia, PS Analytical, and AINSE for offering morning tea, lunch, and prizes for best ECR and student presentations.

We kindly ask that you make yourself familiar with the contents of this handbook. It contains the code of conduct, symposium program, and information about the speakers. We have also included information about Mercury Australia and our facilities. We hope that you find the symposium engaging, thought-provoking, and a valuable resource for your future research.

Organising Committee

- Larissa Schneider
- Jalene Nalbant

For In-Person Guests:
Wifi Guest username: Mercury
Wifi Guest Password: 23Sympo23

Please also note that the dinner on Thursday 13th at La Bicicletta (https://www.bicicletta.com.au) will require cash ($45) to pay for food. Drinks can be paid for when ordered at the bar, however La Bicicletta does not split bills and we will need to pay for our dinner by cash. Thank you.

CODE OF CONDUCT

Recording, taking photos, or screenshots of the presentations is strictly prohibited unless explicit permission have been granted by the presenter(s).

All participants are expected to treat each other with curtesy and respect at all times. Personal attacks, harassment, intimidation, or discrimination directed towards other participants will not be tolerated. Disruption of presentations will also not be tolerated.

Unacceptable conduct includes, but is not limited to, verbal comments relating to gender, sexual orientation, disability, physical appearance, body size, race, religion, national origin, inappropriate use of nudity and/or sexual images in Zoom meetings or presentations, and threatening or stalking any participant.

Consequences for Violating the Code of Conduct: Anyone requested to cease unacceptable behaviour will be expected to comply immediately. Symposium organisers may take any action deemed necessary and appropriate, which includes removing an individual from the symposium. ANU Mercury Australia symposium organisers may also ban individuals for violating this code of conduct at any future meetings.

Reporting Violations of the Code of Conduct: If you are the subject of unacceptable behaviour or have witnessed any such behaviour, please immediately notify us via the Chat function on Zoom or by writing to mercury mercury.symp.2023@gmail.com

KEYNOTE SPEAKERS

PROFESSOR ROBERT MASON

Dr Mason's talk at the Symposium will focus on the role of the ocean and air-sea exchange of mercury on the global mercury cycle, and, in particular, on the cycling of mercury in the Southern Hemisphere. The talk will focus on recent measurements made during a US GEOTRACES cruise in the South Pacific/Southern Ocean in 2022/23, and contrast and compare these with other data from around Antarctica and elsewhere in the Southern Hemisphere. The talk will also highlight differences between the hemispheres, in terms of sources and cycling, the gaps in knowledge, and the need for further measurements.

Bio: Robert Mason is a professor in the Department of Marine Sciences, with a joint appointment in Chemistry, at the University of Connecticut. He has studied the environmental fate, transport and bioaccumulation of mercury and methylmercury in both the freshwater and marine environment throughout his career. His current research focuses on the air-sea exchange of mercury and the reactions and transformations of mercury in surface waters and the atmosphere, as well as the factors influencing the formation and bioaccumulation of methylmercury at the base of the marine food chain.



Affiliation: Department of Marine Sciences, University of Connecticut, USA

Contact: robert.mason@uconn.edu

DR KATRINA MCSWEEN

Dr MacSween's talk in the Symposium will give an overview of how the Canadian global program on mercury passive air sampling has been run, the insights gained by the research team and provide an update on Australia's contributions. The strong global picture of atmospheric mercury concentrations developed by this global program provides valuable information on atmospheric Hg patterns and helps to inform the progress of regulatory actions.

Bio: Dr Katrina MacSween completed her PhD at Macquarie University, where she studied mercury terrestrial air-surface exchange and the influence of meteorological and environmental factors. She is currently working as a post-doctoral researcher for Environment and Climate Change Canada, specialising in atmospheric mercury research. Her primary research involves the development of Canada's global mercury passive air sampling network and mercury in the Arctic. Using passive air samplers, Canada has created a network to increase global coverage of mercury monitoring, with a focus on monitoring in remote areas where access to established technologies at reasonable costs is limited. The intent of this study is to assess the feasibility of a globally implemented monitoring program using the Tekran MerPAS® to establish a baseline concentration in remote locations and help with evaluating regulatory measures outlined by the Minamata Convention. There is currently no ongoing program investigating atmospheric mercury on a truly global scale. As such, mercury researchers and policy makers rely on regional and multi-regional networks which leave large and significant gaps in in our global understanding.



Affiliation: Environment and Climate Change Canada, Government of Canada, CA

Contact: katrina.macsween@ec.gc.ca

LINKING MICROBIAL COMMUNITY DYNAMICS TO METHYLMERCURY PRODUCTION

Caitlin Gionfriddo[1]

[1] Department of Environment and Genetics, La Trobe University, Wodonga, VIC. Australia.

Microbes play a significant role in controlling the form and fate of mercury in the environment. In my research I utilize various molecular and meta-omic methods for linking microbial community dynamics and methylmercury production in aquatic ecosystems. In this talk, I will give a synopsis of my recent research linking microbial genetics to mercury biogeochemistry. I often use a combination of amplicon sequencing, meta-omics analyses, microcosm manipulation experiments, in-depth omics analyses, and empirical modelling to investigate how microbes cycle mercury. These methods enable the identification and quantification of mercury-methylating microbial groups, the assessment of genetic potential and activity of the microbial community, the study of how environmental factors impact microbial dynamics, and the development of predictive models for net methylmercury accumulation. By analysing the composition and activity of microbial communities, and their genetic potential for mercury transformations, my research contributes to our understanding of the environmental drivers of methylmercury production and its implications for ecosystem health.

Bio: Caitlin Gionfriddo is an environmental microbiologist and biogeochemist who studies how microbes control the form and fate of toxic metals in the environment. Her current research is primarily focused on mercury biogeochemistry in freshwater and estuarine ecosystems. Caitlin joined La Trobe University (Albury-Wodonga) in January 2023 as a Research Fellow in the Centre for Freshwater Ecosystems. Caitlin received her Ph.D. in 2017 from the University of Melbourne and has previously conducted research at Oak Ridge National Laboratory (Tennessee, USA) and at the Smithsonian Environmental Research Centre (Maryland, USA).

Affiliation: LaTrobe University

Contact: C.Gionfriddo@LaTrobe.edu.au

MERCURY IN THE AMAZON

Charles McKibbin[1]

[1] Metrohm Australia- Milestone - Charles.McKibbin@metrohm.com.au

The production of illegal cocaine in South America has led to a downstream effect of high-level Mercury in the immediate & surrounding area of the Madre de dios Region of Peru. By using the Milestone DMA-80 – (a direct mercury analysis method) Prof. Luis Fernandez & his team has shown mercury leeched into the soil & water system. This has led to a bioaccumulation of mercury in the local fish population & subsequently the local human population.

Bio: Charles McKibbin is the Product Manager for Milestone at Metrohm Australia, an analytical instrumentation company which supplies Mercury analyser & Microwave digestion/extraction/synthesis systems.

Affiliation: Milestone, Metrohm Australia

Contact: Charles.McKibbin@metrohm.com.au

MERCURY INVESTIGATIONS AND IMPLICATIONS FOR ENDEMIC DISEASE IN SEALS AND SEA LIONS

Rachael Gray[1]; Michael Terkildsen[2], Shannon Taylor[1]

[1] Sydney School of Veterinary Science, Faculty of Science, The University of Sydney, Camperdown, NSW. Australia.
[2] Sydney, NSW, 2006, Australia.

The endangered Australian sea lion, *Neophoca cinerea,* is Australia's only endemic pinniped species. An objective of the Australian sea lion Recovery Plan is to identify threats to the species' recovery, including the impact of disease and pollutants.

Endemic hookworm infection causes disease and mortality in *N. cinerea* pups. Given the impact of mercury (Hg) and other non-essential heavy metals on the host immune response, the concentrations of Hg and selenium (Se) were determined in the blood of *N. cinerea* pups sampled between 2017-2021 at Seal Bay Conservation Park, South Australia.

Significant seasonal and temporal (age-related) differences ($p<0.05$) were seen in Hg and Se concentrations and the molar ratio of Se:Hg. Median Hg concentrations were significantly higher in 2017/18 (357 µg/L) compared to concentrations in 2019 and 2020/21 (198 and 241 µg/L, respectively) with Hg concentrations above toxicological thresholds reported for marine mammals. The concentration of Se (1332, 647, 763 µg/L) and molar ratio of Se:Hg (9.47, 7.98 and 6.82) were low compared to other pinniped pups, indicating potential vulnerability of pups to the toxic effects of Hg. The importance of these findings, with respect to the role, if any, of elevated Hg concentrations in the severity of hookworm disease in *N. cinerea,* will be discussed.

Bio: Rachael Gray is an Associate Professor at the Sydney School of Veterinary Science, The University of Sydney. Dr Gray combines teaching Veterinary Pathology to Doctor of Veterinary Medicine students with her research on health, disease and toxicants in Australian sea lions and Australian and long-nosed fur seals.

Affiliation: University of Sydney

Contact: rachael.gray@sydney.edu.au

BIOKINETICS AND INTERACTION OF MERCURY AND SELENIUM IN METAMORPHOSING TADPOLES

Danielle Hill [1 2] , Tom Cresswell [3] , William Bennett [2 4] , Chantal Lanctot [1 2]

[1]Australian Rivers Institute, Griffith University, Southport, Queensland, Australia.
[2]School of Environment and Science, Griffith University, Southport, QLD, Australia
[3]ANSTO, Lucas Heights, QLD, Australia
[4]Coastal and Marine Research Centre, Griffith University, Southport, Queensland, Australia

Understanding interactions between trace elements is vital to determining potential effects of industrial waste on aquatic ecosystems. Interactions between mercury (Hg) and selenium (Se) are well known in aquatic organisms. However, understanding of the underlying mechanism of these interactions is still lacking. Amphibians may be more susceptible to changes in toxicity due to the complex nature of metamorphosis; with the remodelling and degeneration of tissues there is the potential for the redistribution of contaminants among organs. As such, we investigated the biokinetics and interaction of Hg and Se and determined changes in biodistribution during metamorphosis of *Limnodynastes peronii* tadpoles. Results from dietary exposure indicate there was no difference in Hg retention between treatments, whereas tadpoles exposed to Se alone had a greater retention rate of Se than those in the combined treatment. Biodistribution was also similar across treatments, with most Hg and Se in the liver, gut and muscle tissue.

Bio: Danielle Hill is a PhD student with the Australian Rivers Institute at Griffith University. Currently based at ANSTO in Sydney, she uses live animal radiotracing techniques to determine the biokinetics and biodistribution of metals in amphibians as they go through metamorphosis.

Affiliation: Griffith University

Contact: Danielle.Hill2@griffithuni.edu.au

MERCURY BIOREMEDIATION HAS LEGS!

Kate Tepper[1], Josh King[2], Chandran Pfitzner[1], Marco Morsch[3], Simon Apte[2], Maciej Maselko[1,4,5]

1. Applied BioSciences, Macquarie University, Sydney, NSW, Australia.
2. CSIRO Land and Water, Lucas Heights, NSW, Australia.
3. Macquarie Medical School, Faculty of Medicine and Health, and Human Sciences, Macquarie University, Sydney, NSW, Australia.
4. Biomolecular Discovery Research Centre, Macquarie University, Sydney, NSW, Australia. 5. CSIRO Health and Biosecurity, Canberra, ACT, Australia

Animals engineered with the microbial enzymes, organomercurial lyase (MerB) and mercuric reductase (MerA), may be able to redeem value to contaminated organic wastes and disrupt biomagnification of mercury in aquatic and terrestrial food chains. We demonstrate that this idea has legs using the animal genetic models *Drosophila melanogaster* and *Danio rerio* (zebrafish). *D. melanogaster* incubated with 0.2 ppm methylmercury in their diet showed that Fly/MerA+B adults had >98% more Hg^{2+} than wildtype at eclosion. After 48h on diet without methylmercury, eclosed Fly/MerA+B and wildtype adults respectively had 78% and 36% less total mercury than at eclosion. We will also test if zebrafish engineered with MerA+B can demonstrate whether mercury biomagnification can be disrupted within aquatic and terrestrial food chains. We are concurrently developing technical capabilities to engineer black soldier flies (BSF) as a platform to sustainably biomanufacture high-value industrial enzymes. Black soldier flies are already used industrially to valorise limited organic wastes into a small variety of low value products, such as insect protein/lipids for feed and organic waste fertiliser. We plan to engineer BSF with MerA and MerB and test whether BSF can redeem value to organic wastes contaminated by mercury, such as fisheries waste and municipal biosolids.

Bio: Kate Tepper is a PhD candidate in Applied BioSciences at Macquarie University, Sydney. Kate's research involves pioneering sustainable insect biomanufacturing and animal bioremediation.

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CHARACTERISING CONTAMINANTS IN SUBSEA GAS PIPELINE SCALE TO INFORM OFFSHORE DECOMMISSIONING

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Successful decommissioning of offshore oil and gas production pipelines requires an effective and safe approach of assessing and managing chemical and radiological residues, especially when in situ decommissioning options are considered as part of the closure planning. This study characterised the inorganic and radiological constituents of pipeline scale collected from a subsea welded-steel lean hydrocarbon (dry) gas pipeline. While pigging dust contained high concentrations of total mercury (approximately 1.7% dry mass), metacinnabar (β-HgS) was present as the major species. Organic mercury accounted for <0.01% of the total mercury. Mercury, nickel, manganese, cobalt and ^{210}Po from pigging dust demonstrated solubility in seawater above water quality guidelines. However, 28-day bioaccumulation tests using Australian benthic fauna suggested very limited bioavailability of all contaminants. These results are consistent with minimal short-term ecotoxicological risk from this pipe scale. Further studies are focussed on potential long-term changes to contaminant bioavailability from site-specific geochemical parameters.

Bio: Tom Cresswell is a Principal Research Scientist in ecotoxicology and radioecology at Australia's Nuclear Science and Technology Organisation (ANSTO). His research centres on the fate and effect of contaminants in aquatic environments, focussing on understanding contaminant bioavailability to both freshwater and marine organisms. He is currently working with the offshore petroleum industry operators and regulators to determine acceptability thresholds for managing contaminated subsea infrastructure.

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PRELIMINARY INVESTIGATIONS INTO THE SOLUBILITY OF METACINNABAR (HGS) UNDER AUSTRALIAN MARINE CONDITIONS.

Francesca Gissi[1], Alexandra Boyd[1], Darren Koppel[2], Tom Cresswell[1]

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Mercury is routinely detected in offshore gas production facilities and infrastructure. As these facilities are decommissioned, effective risk management is required to ensure there is no impact from mercury on the marine environment, especially where *in situ* decommissioning is considered. While concentrations of mercury were high in scale from an Australian offshore gas export pipeline (~ 1.7% dry mass), the dominant species (>99%) was metacinnabar (-HgS). The scientific literature generally reports HgS to be relatively low risk, i.e., limited solubility and bioavailability. However, few studies have investigated the fate and transport of HgS under Australian marine conditions. Using radioisotope tracers of mercury (^{203}Hg), we have synthesised metacinnabar and commenced investigations into its solubility and transformations in seawater under varying conditions of light, temperature and dissolved oxygen. The range of conditions reflect the offshore marine environment around Australia. Our studies contribute to assessing risk of metacinnabar from subsea gas pipelines.

Bio: Francesca Gissi is a Research Scientist in ecotoxicology and geochemistry at Australia's Nuclear Science and Technology Organisation (ANSTO). Francesca's research has focussed on investigating effects of metals on marine organisms and generating toxicity data to develop water quality guidelines. She is currently investigating the potential effects of mercury from subsea decommissioned oil and gas pipelines on the marine environment. This research supports a larger project at ANSTO aimed at providing best practice science to inform environmental management decisions around decommissioning offshore oil and gas infrastructure.

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USING RADIOISOTOPE TRACERS TO STUDY MERCURY ACCUMULATION IN MARINE CRUSTACEANS.

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Throughout the productive life of oil and gas infrastructure, contaminants such as mercury can build up on the internals of pipelines. Mercury is therefore an important consideration when it comes to decommissioning this infrastructure. Environmental risk assessment is a key part of decommissioning planning. This involves understanding any potential risks from mercury associated with infrastructure on the surrounding marine environment. Using radioisotope tracers of mercury (Hg^{203}), we radio-labelled sediment mixtures using a combination of silt and sand to replicate particle size and organic carbon content reported in sediments around offshore oil and gas infrastructure. In preliminary investigations, we exposed a model marine organism, the amphipod, *Melita plumolosa* to these sediments and measured bioaccumulation of Hg using live-animal radiotracing. Here, we will present the findings and observations of this trial. This work contributes to assessing the risk to aquatic environments when making decommissioning decisions for mercury-contaminated offshore infrastructure.

Bio: Alexandra Boyd is a Radioecologist at Australia's Nuclear Science and Technology Organisation (ANSTO) working primarily on the Offshore Infrastructure Decommissioning project. She started at ANSTO two years ago as a Graduate in the Human Health team, which was more closely related to her university degree in Pre-medicine, Health and Science. In the past 1.5 years, Alexandra has been developing a knowledge of ecotoxicology by investigating mercury as a contaminant.

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OPPORTUNITIES FOR MERCURY RESEARCH WITH AIMS

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The Australian Institute of Marine Science (AIMS) is Australia's tropical marine research agency with a mission to provide the research and knowledge to support growth in the sustainable use, management, and protection of our marine reserves. AIMS' recent mercury research has focused on supporting the predictive assessment of mercury impacts to marine environments from releases associated with offshore oil and gas decommissioning activities. This requires a multidisciplinary approach encompassing chemical, biological, and ecological techniques. AIMS is keen to partner with other researchers in these fields to leverage our unique capabilities for mercury research, including our SeaSim aquaria, marine organism husbandry, and field sampling of marine sediments and organisms.

Bio: Darren Koppel is a research scientist specialising in the ecological risk assessment of contaminants. His research career has focused on the assessment and management of legacy and emerging contamination issues from the Antarctic to the tropics using ecotoxicology and environmental chemistry techniques.

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TRACE AND ULTRA-TRACE DETERMINATIONS OF MERCURY & METHYLMERCURY IN ENVIRONMENTAL SAMPLES: SOME PRACTICAL SOLUTIONS

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PS Analytical has been in the business of sampling and determining mercury (Hg) and the hydride elements, from a variety of sample matrices, for over 40 years. The detection systems are based on Atomic Fluorescence Spectroscopy (AFS) which has some advantages in terms of sensitivity, wide working ranges and freedom from interferences. Important environmental application areas for us include; air monitoring (environmental and OH&S), seawater, fresh water, wastewater (e.g. mine run off), fish, shellfish and other biota.

Some of these matrices are analytically challenging and we discuss current sample handing approaches, including selective extraction speciation work and review associated analytical performance including coupled chromatography systems.

Bio: Tim Williams (PhD, MRSC, CChem) is currently GM for PS Analytical and has been involved the instrumental commercial development for many years. He has an academic/lecturing background in environmental analytical chemistry as well as chemical engineering.

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A REVIEW OF MERCURY CONCENTRATIONS IN AUSTRALIAN MARINE MAMMALS, BIRDS AND TURTLES

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A comprehensive review of the published data on mercury concentrations in Australian marine mammals, birds and turtles is presented. The majority of studies have relied on the utilisation of opportunistically collected samples, animal strandings, and bycatch. This has resulted in large gaps in geographical, temporal and species coverage data. For instance, published data is absent for pinnipeds in NSW and out of 14 endemic species of dolphins, data only exists for seven species. Mercury concentrations measured in various marine species and their tissue types are extremely variable with ranges typically spanning several orders of magnitude but are generally comparable with international data. Trends with contaminant concentrations with tissue type follow accepted patterns of behaviour for higher organisms with the highest mercury concentrations in liver tissue. Herbivores have lower mercury loadings than carnivores reflecting the importance of diet and there are identifiable age-related trends. The lack of supporting pathology on dead and stranded animals and data on specimens from uncontaminated locations restricts conclusions on organism health impacts. Recommendations for future investigations are made.

Bio: Simon Apte is a Senior Principal Research Scientist at CSIRO Environment, Lucas Heights Sydney. His laboratory specialises in the ultratrace analysis of inorganic contaminants in aquatic systems and the impacts on mining on these ecosystems.

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AN UPDATE ON MONITORING MERCURY IN AIR AND RAIN

Melita Keywood[1]; Jennifer Powell[1]; Jason Ward[1], James Harnwell[1], Erin Dunne[1], Nigel Somerville[2]; Isabel Ely[3]; Lindsay Hutley[3]; Jenny Fisher[4]; Peter Nelson[5]

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The Minamata Convention is a global treaty whereby signatory countries, including Australia, have committed to reducing anthropogenic emissions of mercury. The effectiveness of the convention includes evaluation of trends in levels of mercury in core media, including air. Long term observations of mercury in air at the Kennaook / Cape Grim Baseline Air Pollution Station and the Northern Territory Baseline Air Pollution Station will be used to contribute to this process. Both sites are impacted by both continental and marine airmasses and are among only a handful of sites in the Southern Hemisphere with observations for more than 5 years. In this presentation we will discuss the measurement program, characteristics of both sites and a recent expansion of the network to include passive sampling and wet deposition measurements.

Bio: Dr Melita Keywood is a Research Director in the Environment Business Unit of CSIRO and is a co-leader of the Aerosols, Reactive Gases and Multiphase Atmospheric program at the Kennaook Cape Grim Baseline Air Pollution Monitoring Station. Melita's research expertise lies in the microphysical properties of aerosol and multiphase atmospheric chemistry.

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PRELIMINARY FINDING ON LONG-TERM MONITORING OF ATMOSPHERIC FROM KENNAOOK/CAPE GRIM MONITORING SITE, AUSTRALIA

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Mercury (Hg) is a global pollutant that seriously threatens human health and the ecosystem due to its toxicity, persistence, and bio-accumulative nature. The northern hemisphere (NH) has many atmospheric Hg datasets due to long-term measurements started many years ago; however, atmospheric Hg is sparsely measured in the Southern Hemisphere (SH) with shorter records available. Therefore, long-term continuous monitoring of atmospheric Hg initiated in 2013 at the pristine environment of Kennaook/Cape Grim (Tasmania) is particularly valuable. Here, we present an analysis of atmospheric elemental mercury (Hg^0) measurements conducted at Kennaook/Cape Grim, along with measurements of meteorology and other pollutants (radon, carbon monoxide). Hg^0 has been measured continuously with 5-min resolution using a Tekran-2537X instrument since June 2017 (earlier measurements using a Tekran-2537B will not be discussed here but will contribute to future analysis). The average mean Hg^0 concentration was 1.06±0.01 ng m^{-3} with a range of 0.7-4.5 ng m^{-3} from 2017 to 2022. The average mean is lower than the NH background value (1.5 to 1.7 ng m^{-3}) but similar to previous estimates of the SH background (1.0-1.3 ng m^{-3}). The diurnal pattern shows that Hg^0 is higher in the daytime and lower at night, attributed to higher wind speed. There is no clear seasonality in Hg^0 concentrations observed at Cape Grim; however, values are somewhat higher in winter (Jun-Aug) compared to other seasons, reflecting that the data are not homogenous. There is evidence of high Hg^0 in the winter and spring as the wind speed increases from the south to west directions, indicating increased influence from oceanic sources.

Presenter: Bakhat Rawat

Bio: Bakhat Rawat is a Ph.D. student in the Centre for Atmospheric Chemistry at the University of Wollongong. His research interests include atmospheric Hg cycling, air pollution, atmospheric modelling, and environmental biogeochemistry.

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THE MINAMATA CONVENTION ON MERCURY – AUSTRALIA'S INVOLVEMENT IN ADDRESSING GLOBAL MERCURY POLLUTION

Sarah Douglass [1]; Olha Furman [1]

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The Minamata Convention on Mercury is an international treaty to protect human health and the environment from the harmful effects of mercury. The Convention addresses the lifecycle of mercury from its entry into the economy (via mining or international trade); to its uses in products; its releases and emissions from industrial processes; through to waste management and storage. Australia ratified the Minamata Convention in December 2021, making Australian Governments legally bound to the obligations contained within this important treaty.

In this presentation, Sarah Douglass from the Australian Government Department of Climate Change, Energy, the Environment and Water will provide an overview of Australia's implementation of the Minamata Convention and opportunities for strategic engagement leading up to the next meeting of the international decision-making body (Minamata COP5).

Dr Olha Furman, as Australia's regional representative on the Minamata Convention's scientific body, the Open-Ended Scientific Group, will introduce critical data collection and interpretation standards being developed by the Minamata Convention's scientific body that will underpin global reporting on mercury and inform future environmental and human health monitoring activities in Australia and across our region.

Bio: Sarah Douglass is the Australian Government's lead on the Minamata Convention on Mercury and on United Nations negotiations to establish a Science Policy Panel on Chemicals, Waste and Pollution Prevention. Through this role, Sarah is responsible for developing domestic and international policies and strategies.

Ms Douglass has a double Masters in Diplomacy, and Environmental Management and Development. She has enjoyed a varied career as a strategic policy officer and senior liaison officer across the Federal environment portfolio, as well as in the office of the Minister for Energy and Emissions Reduction. Previously, she has been the Australian Government's lead on international biodiversity policy, coordinated a strategic climate policy review, and driven national fuel quality reforms.

Bio: Dr. Olha Furman is the senior policy officer in the International Chemicals and Waste team, Department of Climate Change, Energy, the Environment and Water. Olha supports the effective implementation of Australia's obligations under the international agreements on chemicals. In her previous role Olha contributed to the development of the national standards to ensure more effective management of environmental risks from industrial chemicals in Australia, coordinated the Australian response on OECD test guidelines designed to test chemical effects on human health and environment, and provided evidence-based technical and policy advice on risk assessment of industrial chemicals. Olga's main scientific contributions have been in environmental chemistry and engineering (fate of toxins in complex environmental settings, application of advanced oxidation/reduction processes for water and soil treatment).

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PHYSIOLOGY, GROWTH AND DETOXIFICATION CHARACTERIZATION OF HG DETOXIFYING ISOLATES AND CONORTIA

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Marine sediments polluted due to anthropogenic activities can be major reservoirs of toxic mercury species, like inorganic mercury (Hg2+) and mono-methylmercury (MeHg). Some microorganisms inhabiting these ecosystems may play a key role in the biological detoxification of these toxic compounds, mediated by the mer operon. A large scale screening of a marine bacteria collection obtained from mercury impacted sediments was performed in order to find environmental bacteria or consortia able to detoxify Hg. Finally, a few candidates containing mer genes were selected for a further physiological characterization. We measured their specific growth and mercury detoxification rates in batch culture, and we selected the best candidates to assess the optimal growth rate conditions in continuous culture for achieving an optimized mercury detoxification. Three different dilution rates (0.2, 0.1 and 0.05 h-1) were tested until the cultures in the bioreactors reached steady state, and samples were taken and incubated at 4 µM HgCl2 plus 0,04 µM MeHg. After 24 h of incubation, the candidates were able to remove a high percentage of the total Hg when previously adapted in the bioreactor to the highest growth rates. These results highlight that some sediment bacteria show great capacity to detoxify mercury at high rates.

Bio: Carla Pereira-García is a PhD candidate at the Autonomous University of Barcelona. She is in her last year of PhD and hopes to defend her thesis by the end of the year. Her focus has been in the bacterial participation in the mercury cycle, biotically mediated methylation and demethylation as well as reduction. She has studied this group of bacteria from different perspectives, metagenomics and metatranscriptomics to understand the community as a whole and more in detail through culturing and physiological characterization.

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MERCURY EXPORT FLUX IN THE SOUTHERN OCEAN ESTIMATED FROM $^{234}TH/^{238}U$ DISEQUILIBRIUM

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The ocean is a key player in the biogeochemical cycle of mercury (Hg) and through the biological pump, a fraction of the Hg that reaches the ocean is removed from its surface and can be buried in the marine sediments, which are a long-term sink that can keep Hg stored away for long periods of time. Despite the importance of understanding the fate of Hg in the ocean, the downward Hg export flux and Hg burial rates in marine sediments are not well-constrained and estimates are usually indirect and based on balancing the inputs and outputs of Hg budgets. Testing those models with in-situ data and examining the export of particulate Hg in the ocean will help improve our predictive efforts on Hg models, thus constraining the global Hg budgets. In that line, here we estimated downward Hg export flux based on Hg concentrations in suspended particulate matter and using the radionuclide pair 234Th/238U, coupled to Hg/234Th ratios in particles in the Southern Ocean, south of Tasmania. Results were compared to estimates of Hg export derived from the MIT General Circulation Model (MITgcm) and preliminary data shows the results from both approaches are within reasonable agreement.

Bio: Viena Puigcorbé is a Postdoctoral Fellow at the Marine Microbial Ecology group at the Institut de Ciències del Mar-CSIC, in Barcelona. Her research focuses on the use of naturally occurring radionuclides to study marine processes, particularly to estimate export fluxes of particles in the upper ocean. She recently dived into the microbial ecology field, aiming to combine this new knowledge with her biogeochemistry background to better understand the ocean biological pump

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ENVIRONMENTAL DISTRIBUTION OF MERCURY FROM SMALL SCALE GOLD MINING BURU ISLAND, MALUKU PROVINCE, INDONESIA.

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Artisanal small-scale gold mining (ASGM) using mercury amalgamation has been occurring on Buru Island, Indonesia since early 2012, and has caused rapid accumulation of mercury in river, estuary and marine sediments. Mercury concentrations in sediments exceeded guidelines values at all sites across sampling areas in 2013 and were as high as 47 mg/Kg. At some trommel sites and in tailings ponds mercury concentrations were over 800 mg/Kg. Methylmercury was also was up to 0.12% of the total mercury measured at some sites, highlighting suitable conditions and relative short time frame for mercury methylation. Samples of seafood from local fish markets also exceeded food safety guidelines for some species. Recent interventions to ban the mining and ore processing have reduced the intensity of the mining, however, there are many thousands of legacy sites. Furthermore, within the same province cinnabar mining provides a steady supply of mercury to ASGM operators throughout the region.

Bio: Amanda Reichelt-Brushett is a Professor in the Faculty of Science and Engineering at Southern Cross University. Her research focuses on understanding the chemical behaviour and organism response to pollutants in aquatic systems. She is editor and co-author of a recently published text book titled: Marine Pollution -Monitoring, Management and Mitigation, published by Springer and available as open access:

https://link.springer.com/book/10.1007/978-3-031-10127-4

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MERCURY AND SELENIUM CONCENTRATION IN STRANDED AND DECEASED WHALES FROM NEW SOUTH WALES, AUSTRALIA

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The dietary accumulation and biomagnification of mercury (Hg) is typical in cetaceans, particularly in predatory Odontocetes species. Hg generally accumulates in cetacean liver tissue, and can be transferred both in vitro and to suckling young. Selenium (Se) can offer some protection against Hg toxicity in cetaceans, however if toxicity thresholds are surpassed, severe biological and reproductive dysfunction, neurological disorders and neoplasia can follow. Various tissues collected post-mortem from 18 cetaceans (16 Ziphiidae, one *Megaptera novaeangliae*, one *Kogia breviceps*) stranded on the NSW coast over ~15 years were investigated for Hg and Se, among other contaminants. Results are discussed in context with species, sex, age class, tissue type, and post-mortem findings. Hg concentrations exceeded reported toxicity thresholds in several individuals, as high as 363mg/kg (dw) in *Mesoplodon layardii* liver tissue. Molar Hg:Se (liver) ratios had an R^2 value of 0.9917, and were 1:1 for several individuals. Methylmercury was present in all samples selected for Hg speciation. This study provides important Hg baselines for cetaceans in NSW, and globally, including several rare Ziphiidae species.

Bio: Natalie Palmer is an Honours candidate and graduate Marine and Environmental Scientist at Southern Cross University, as well as a veterinary nurse with Byron Bay Wildlife Hospital. Her research focuses on contaminant analysis in stranded and deceased cetaceans.

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ECOTECHNOL/MDS MEMBRANE TECHNOLOGY OVERVIEW WITH CASE STUDIES

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The removal of mercury from contaminated waters with standard Reverse Osmosis membranes is known to be highly effective albeit with membrane fouling and concentrate treatment options concerns. Ecotechnol (Australia) and Membrane Development Specialists (USA) offer both modified Nanofiltration and high flux RO membranes which offer higher Mercury rejections at high permeate recoveries and when combined with upfront pretreatment via Ultrafiltration and periodic cleaning of the last elements have proven to improve operating and maintenance efficiency. Permeate concentrations of 1-2ppb are possible through modified RO/NF systems with the concentrate accounting for 5-20% of the feed flow containing >99.9% of the Hg. It is proposed that the concentrated volume reports to a small footprint and likely modular Carbon in Circuit (CIC) modular plant similar to gold heap leach circuits where mercury is known to effectively adsorb onto the granulated carbon. The mercury laden carbon can either be removed from site or thermally regenerated with a commonly available mercury retort installed.

Bio: Brant Tapley is a metallurgist with 20 years of industry experience in plant operation and optimisation, design, due diligence, feasibility and project development. His experience includes working in Australia, United States, Norway, Russia and West Africa. Brant has worked in Operations role in gold, base metals and magnetite and as a consultant through JT Metallurgical Services, providing advice to small scale developers through to large scale global producers. His professional interests are with identifying opportunities across all project levels to maximise throughput, improve geometallurgical understanding of the ore body, increase economic recovery and reduce costs to increase the economic return to Clients. He also values the mentoring and training Operators and Metallurgists and developing new technology to the benefit of production, environment, and safety which includes the implementation of membranes plants in process and environmental applications.

Brant is a Director of Ecotechnol, JT Metallurgical Services, Mintap Services and Oroya Laboratories and holds a Bachelor of Engineering (Minerals Engineering) and Bachelor of Science (Chemistry).

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KNOWLEDGE-LED REGULATION: OPPORTUNITIES FOR RESPONDING TO EMERGING MERCURY RISKS THROUGH A DUTIES-BASED APPROACH

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The introduction of a preventative, general environmental duty (GED) into Victoria in preference to post-harm pollution offences represents a significant opportunity to tackle a diverse range of cumulative environmental pollutants, including mercury. The GED makes it an offence to fail to minimise the risks of harm from pollution and waste where it is reasonably practicable to do so. What is considered 'reasonably practicable' is a question of degree and fact, not limit-setting or proof of *actual* harm. The approach embraces two opportunities for addressing mercury: firstly, 'harm' means an adverse effect of *any degree or duration,* including *cumulative* effects. Secondly, what is 'reasonably practicable' requires consideration of 'the state of knowledge' on a risk, enabling the GED to track advances in risk knowledge and technology and techniques to minimse risks without needing to update the law. Mercury-related research can strengthen protection under the GED by advancing knowledge on the risks and how to minimise them.

Bio: Dru Marsh is manager of internal review at EPA Victoria and adjunct lecturer at UNSW Canberra. His research interests include understanding duties-based regulation and its practical implementation in a range of contexts, including environment, workplace safety, conservation and intellectual disability. He is a practising solicitor in the community legal sector and also has a background in science and environmental consulting.

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A PHD JOURNEY - USING PALAEOENVIRONMENTAL RECONSTRUCTIONS TO EXAMINE INITIAL ANTHROPOGENIC-ENVIRONMENT INTERACTIONS ON PALAU AND YAP

The timing of human colonisation of the Palau and Yap Island groups is currently poorly defined. This issue is exacerbated by the darth of early archaeological sites identified to date and island subsidence (sinking) likely leaving the earliest sites underwater. In my PhD project I will use geochemical proxies, including Hg, to generate a palaeoenvironmental reconstruction from sediment cores. Palaeoenvironmental reconstructions offer a unique perspective in environmental archaeological studies. Understanding how the landscape has changed in response to climate variations and anthropogenic activities, and the dynamic relationship between these drivers, presents opportunity to examine human-environment interactions in areas with poor archaeological records, like Western Micronesia.

Presenter: Jalene Nalbant

Bio: Jalene is a PhD candidate at the Australian National University using palaeoenvironmental reconstructions to examine research questions in archaeology. Their research focuses on the relationship between lake-catchment dynamics and geochemical records preserved in lake sediments. They are passionate about accessible education and are eager to explore effective public engagement strategies.

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TRACING THE PAST, SHAPING THE FUTURE: STUDYING LAKE SEDIMENTS TO UNDERSTAND LONG-RANGE TOXIC METAL POLLUTION

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Mercury, with its long atmospheric life, possesses the capability to disperse widely from its source locations and contaminate vast areas. Due to the intensification and shifting patterns of the southern westerly wind, this pollutant now has the potential to traverse the Southern Ocean and reach Antarctica. Comprehending the dynamics of atmospheric mercury transport is pivotal for effective mercury governance. Lake sediments serve as remarkable repositories of historical mercury deposition. By combining samples from Australia, New Zealand, and Argentina, we investigate their potential in reconstructing past mercury deposition through a multidisciplinary approach spanning biogeochemistry, computation, and molecular biology techniques

Bio: Rodger (Rujia) Yan is a PhD student at the School of Culture, History, and Language at The Australian National University. With a background in evolutionary science, bioinformatics, and biotechnology, Rodger has taken a multidisciplinary approach to studying symbiosis in the marine environment. His PhD project aims to expand his knowledge from the biotic to the abiotic world and develop a holistic understanding of our environment under the overarching theme of climate change.

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MERCURY EMISSIONS FROM THE COAL AND NON-FERROUS SECTORS

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Large scale industrial sources are potentially large sources of mercury emissions to the atmosphere. The most recent Global Mercury Assessment (for 2015) estimates total emissions of approximately 1000 tonnes/year from the industrial sources included in the Minamata Convention (coal combustion, non-ferrous metal smelters, cement production and waste incineration) or 45% of total anthropogenic emissions. Hence successful implementation of the Convention requires substantial reductions in emissions from these sources. In this presentation we report on recent investigations funded by the UN Environment Program (UNEP) and the Global Environment Facility (GEF) to increase understanding of future emissions from the coal and non-ferrous sectors.

Bio: Peter Nelson is Professor Emeritus of Environmental Sciences in the School of Natural Sciences at Macquarie University in Sydney. Professor Nelson has more than 40 years' experience in research on the assessment and control of air pollution and on environmental issues associated with energy production and use. He has been Co-lead UN Environment Partnership on Mercury Control in Coal Combustion (2017-); Lead author, BAT/BEP Guidance for the Minamata Convention on Mercury, (2014 – 2017); and Member of the Expert Group for the UNEP Global Mercury Assessment (2012 – 2018).

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DEVELOPMENT OF SCENARIOS TO ASSESS FUTURE GLOBAL MERCURY EMISSIONS FROM COAL-FIRED POWER PLANTS

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This presentation highlights the ongoing work for a project funded by the UN Environment Program (UNEP) and the Global Environment Facility (GEF) aimed at assessing future global mercury emissions from coal-fired power plants. The project focuses on exploring reduction potentials in mercury emissions by developing scenarios that consider the diverse energy development plans and commitments made by different countries to the Paris Agreement and the Minamata Convention. Through a comprehensive analysis of information on energy development, policy frameworks, and technological advancements, the project is aimed to provide insights into future emissions trajectories and offer guidance on the best available technologies and environmental practices (BAT/BEP) for countries to fulfill their commitments under the various UN Conventions. The presentation will discuss the methodology employed, key findings, and policy implications derived from the developed scenarios. It aims to provide valuable guidance to stakeholders (e.g., policymakers, funding agencies, and government organizations) in formulating effective strategies to mitigate mercury emissions, towards the safeguarding of both human health and the natural environment.

Bio: Edward Archer brings extensive experience in multi-disciplinary environmental research, having collaborated with various global institutions on the evaluation of effluent quality from innovative water treatment technologies, profiling of emerging contaminants in freshwater ecosystems, and establishing wastewater-based epidemiology initiatives. His current role as a Research Fellow in the School of Natural Sciences at Macquarie University, Sydney, involves assessing the fate of global atmospheric emissions of mercury, greenhouse gas, and persistent organic pollutant coming from the coal combustion sector.

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MERCURY POLLUTION FROM NON-FERROUS MINING DURING THE BRITISH COLONIAL SETTLEMENT IN TASMANIA

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Metallurgical processes (smelting) of non-ferrous metals are one of the important anthropogenic sources of mercury. Copper, zinc, lead and mercury have affinity to sulfur, which leads to mercury being associated with these metals and in turn, its release during extraction of any of the aforesaid metals. We present the first record of Hg concentration and fluxes from sediments of four isolated lakes located next to the largest Copper mine of the 19th Century in the Southern Hemisphere. We used a multi-proxy approach to assess the response of Hg fluxes to the mining activities related to British colonisation in Australia. Mercury deposition fluxes in lake sediments dated at ~ 1942 AD have shown a 56 X increase from background value prior to British colonisation (3 vs. 167 µg/m^2/yr respectively). These values are similar to Spanish colonisation in South America, which increased Hg deposition fluxes in Peruvian lakes by 55 X background values.

Bio: Larissa Schneider is an Associate Professor at the School of Culture, History and Language of the Australian National University. Her research focuses on the geochemistry of freshwater lake sediments to reveal long-term interactions between humans, climate and metal contamination using the information stored in the bottom of lakes. She is the founder and convener of Mercury Australia (www.mercury-australia.com.au), a network of Australian university researchers investigating the historical and contemporary uses and impacts of mercury in Australia and the Pacific.

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NOVEL MATERIALS ON QCMS FOR ENHANCED MERCURY SENSING PERFORMANCE.

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The presence of mercury (Hg) in the environment causes threats to human health and ecosystems. Thus, this study aims to develop nanocomposites directly on quartz crystal microbalance (QCM) based sensor devices that enable high selectivity and sensitivity toward Hg^0 vapour while significantly improving recovery and response time performance compared to those reported in the literature. The approach is based on previously published findings from our group that thin layers of gold on silica support layers can significantly enhance sensitivity and sensor recovery relative to other support materials. Thus, the initial material in this work involves forming a silica sol-gel-based metal composite directly onto the QCM electrode surface. The sensors' performance is tested toward Hg^0 vapour sensing in the presence of common interfering gases, including humidity, which often co-exists with Hg vapour in the industry stack effluents. The results showed that the sensing for elemental mercury is achieved despite the presence of the interfering gases.

Bio: Samira Almalki is a 2nd year PhD student at the School of Applied Science, RMIT University. Her research focuses on mercury gas sensing using metal composites deposited on the electrodes of quartz crystal microbalance (QCM) sensors. She is an international student with a full scholarship provided by SACM.

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THE EFFECT OF PRESCRIBED WILDFIRE ON SOIL MERCURY CONCENTRATIONS IN AN AUSTRALIAN NATIVE EUCALYPTUS FOREST

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Australia is an especially fire-prone continent, where controlled burning is practiced as a preventative measure for reducing the impact of wildfires and has been undertaken culturally for over 60,000 years. Wildfires can burn at a high intensity, while controlled burns are typically of a low intensity. A knowledge gap exists regarding the behaviour of soil mercury in controlled burns in Australia. Mercury (Hg) is volatised and released to the atmosphere when soil is heated. In this study, we quantify the Hg and organic content of mineral and organic soils in native eucalyptus forest in Gippsland, Victoria. Mineral and organic soils were sampled from burnt and unburnt sites, unburnt organic soils were also collected around tree bases. Analyses revealed that organic content correlated with Hg content, and that Hg was higher in unburnt areas than burnt soils. Results also reflect the patchiness of low intensity fires and the steep soil thermal profile, with large Hg ranges in burnt organic soils and a smaller range in the mineral layer.

Bio: James Taylor is an undergraduate student, currently studying a double degree in environmental science and chemistry at the Australian National University. His research focusses on the behaviour and cycling of mercury in Australian soils and how this is impacted by fire activity.

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A SYNTHESIS OF MERCURY RESEARCH IN THE SOUTHERN HEMISPHERE, PART 1: NATURAL PROCESSES

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Recent studies demonstrate a short 3–6-month atmospheric lifetime for mercury (Hg). This implies Hg emissions are predominantly deposited within the same hemisphere in which they are emitted, thus placing increasing importance on considering Hg sources, sinks and impacts from a hemispheric perspective. In this paper, we centre the uniqueness of the SH in the context of natural biogeochemical Hg cycling, with focus on the mid-latitudes and tropics. We identify and describe five key natural differences between the hemispheres that affect the biogeochemical cycling of Hg: biome heterogeneity, vegetation type, ocean area, methylation hotspot zones and occurrence of volcanic activities. We review the current state of knowledge of SH Hg cycling within the context of each difference, as well as the key gaps that impede our understanding of natural Hg cycling in the SH. The differences demonstrate the limitations in using NH data to infer Hg processes and emissions in the SH.

Bio: Larissa Schneider is an Associate Professor at the School of Culture, History and Language of the Australian National University. Her research focuses on the geochemistry of freshwater lake sediments to reveal long-term interactions between humans, climate and metal contamination using the information stored in the bottom of lakes. She is the founder and convener of Mercury Australia (www.mercury-australia.com.au), a network of Australian university researchers investigating the historical and contemporary uses and impacts of mercury in Australia and the Pacific.

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A SYNTHESIS OF MERCURY RESEARCH IN THE SOUTHERN HEMISPHERE, PART 2: ANTHROPOGENIC PERTURBATIONS

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Environmental mercury (Hg) contamination is a global concern requiring action at national scales. Scientific understanding and regulatory policies are underpinned by global extrapolation of Northern Hemisphere Hg data, despite historical, political, and socioeconomic differences between the hemispheres that impact Hg sources and sinks. In this paper, we explore the primary anthropogenic perturbations to Hg emission and mobilization processes that differ between hemispheres and synthesize current understanding of the implications for Hg cycling. In the Southern Hemisphere (SH), lower historical production of Hg and other metals implies lower present-day legacy emissions, but the extent of the difference remains uncertain. More use of fire and higher deforestation rates drive re-mobilization of terrestrial Hg, while also removing vegetation that would otherwise provide a sink for atmospheric Hg. Prevalent Hg use in artisanal and small-scale gold mining is a dominant source of Hg inputs to the environment in tropical regions. Meanwhile, coal-fired power stations continue to be a significant Hg emission source and industrial production of non-ferrous metals is a large and growing contributor. Major uncertainties remain, hindering scientific understanding and effective policy formulation, and we argue for an urgent need to prioritize research activities in under-sampled regions of the SH.

Bio: Jenny A. Fisher is an Associate Professor in the Centre for Atmospheric Chemistry at the University of Wollongong, Australia. Her research interests include atmospheric chemistry and composition modelling, atmospheric mercury emissions and cycling, and atmospheric processing of greenhouse gases and air pollutants.

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