ANNUAL REPORT 2017

AINSE

THE AUSTRALIAN INSTITUTE OF NUCLEAR SCIENCE AND ENGINEERING

Playing a leading role in nuclear **Education** and training

Stimulating and supporting students and early career researchers in pursuing a career in nuclear science and engineering

Facilitating **Collaborations** with researchers at ANSTO's landmark infrastructure

Providing an effective **Network** between all stakeholders of nuclear science and engineering

Engaging with **Members** to enhance funding opportunities and ensure relevance of nuclear education and training

AINSE THE AUSTRALIAN INSTITUTE OF NUCLEAR SCIENCE AND ENGINEERING

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AINSE 2017 ANNUAL REPORT

From the President and the Managing Director

2017 has been an exciting year for AINSE. In addition to our traditional programs of honours and postgraduate student support, AINSE staff developed a number of new programs aimed at educating, training and linking stakeholders of nuclear science and engineering in Australia and internationally. These new programs meet AINSE's strategic priorities to seize new opportunities for funding beyond AINSE's traditional sources.

The year commenced with the signing of a memorandum of understanding with the French Embassy and ANSTO for an internship program between Australia and France. This resulted in a new program called 'Scholarship AINSE ANSTO French Embassy' (SAAFE) and allows AINSE to expand collaborations in nuclear science and engineering between Australia and France. One student from the University of Melbourne was fortunate to participate in this program in 2017. We are working towards extending this program to other countries in the future.

A further three other new activities were implemented throughout the year: a Residential Student Scholarship for PhD students supported by the New Fund commitment from ANSTO, an AINSE Study Tour to particle therapy centres in Japan, and the Women in STEM and Entrepreneurship School for undergraduates (AINSE WISE School).

Six PhD students were awarded scholarships in the first round of Residential Student Scholarships. These are specifically aimed at supporting students that are undertaking long term strategic projects at ANSTO facilities. This will enable the successful students at least six months on-site in support of their projects. These students will commence work on projects closely aligned with ANSTO's research programs: Environment, Human Health and Nuclear Fuel Cycle.

In September AINSE conducted a study tour in Japan to investigate particle therapy. Delegates were able to discover how Japan has developed particle therapy from the early experimental stages through to patient treatments in a hospital setting. With assistance from ANSTO, AINSE hosted this educational tour and made a small profit to return to AINSE programs.

In December AINSE held its first Women in STEM and Entrepreneurship school (AINSE WISE School). This was supported by ANSTO and funded by the Australian Government under the National Science and Innovation Agenda program called Women in STEM and Entrepreneurship. AINSE was one of twenty-four organisations that received funding in the first round of this program. Forty-three female students attended from thirty-five Universities. This meets with AINSE's strategic goal to engage with the next generation of researchers with an interest in nuclear science as AINSE provides leadership in the education of this next generation.

Twenty students from fourteen different Universities received a $5,000 stipend to support them through the honours year. An additional thirty-one students from fifteen Universities were awarded Post Graduate Research Awards (PGRA) in support of their PhD studies. This bought the current cohort of PhD students for 2017 to seventy-eight students. The new students were also invited to attend a PGRA Orientation week in October to meet their colleagues and learn about the collaborative potentials across ANSTO facilities. At the orientation the students participated in celebrations of Nuclear Science Week that is a global celebration organised annually by the National Museum of Nuclear Science and History in Albuquerque. The new AINSE cohort of PhDs were able to attend this event organised by AINSE with assistance from the Australian Young Generation in Nuclear (AusYGN).

The 21st Annual AINSE Winter School was held in July 2017 and this year the school was expanded to offer more places with the capacity increasing from forty-six students in 2016 to sixty students from forty Universities in 2017. Our new industry member Theranostics Australia also had the opportunity to send a student to the school which was filled by a student from the University of Western Australia. This was an opportunity to form links with a new industry stakeholder as we diversify AINSE's membership and stakeholder base.

In November AINSE members had the opportunity to attend a presentation regarding the ANSTO Innovation Precinct. This is the expansion of the Lucas Heights campus to have a Graduate Institute, Innovation Incubator and Technology Park. AINSE has a place on this steering committee and has had the good fortune to attend a number of events in 2017 to provide input into this plan. Professor Andrew Peele presented information about the Graduate Institute to all members on the day prior to the AINSE general meeting.

We extend congratulations to Professor Allan Chivas and Emeritus Professor Robert Burford for being awarded the title of Honorary Fellow of AINSE Ltd in recognition of their extensive service to AINSE. We also congratulate Ms Katie Coleborn the AINSE PGRA for being selected as the John Ferris Memorial Scholar for 2017.

In 2017 AINSE finished the year with a $299,193 surplus largely due to underspent travel in the PhD program and reduced staff costs. This followed a deficit year in 2016 and we are pleased to bring the business into a surplus with the goal of returning funds via the membership benefits of AINSE. At the end of 2017 AINSE finished with high financial reserves and we look forward to consulting the members in regards to this strong financial position. We will continue to communicate AINSE's purpose to different stakeholders, demonstrate leadership in the education of Australia's next generation by linking with the capabilities related to nuclear science and education, seize opportunities for funding outside of our traditional sources and further diversify the membership and stakeholder base.

Professor Ian Smith and Emeritus Professor Robert Burford both retired from the board in 2017 and we thank them for their contribution and stewardship of AINSE during their tenure. They both provided great stability to the business during times of change. Dr Rachel Caldwell left AINSE in 2017 and we thank her for her efforts as the Business Manager and Scientific Coordinator and wish her well in her career. We also thank Mrs Sandra O'Connor and Mrs Nerissa Phillips for taking on extra work to run the AINSE Winter School whilst we undertook recruitment to fill vacant positions. We welcome our new staff that commenced in 2017: Mr Paul Graydon our Business Manager, Ms Elizabeth Geyer our Communications and Event Coordinator and Mr Joshua Keegan, Casual Administration.

Once again, we thank Dr Adi Paterson for allowing us to promote and utilise the expertise of the staff and facilities at ANSTO. The ANSTO staff have assisted us with supervising students, running schools, providing expertise and many other activities. We also thank our Councillors and all of our members from our three categories: institutional, industry and individual for their support of AINSE through 2017 and we look forward to working with all members in 2018 as we celebrate the 60th anniversary of AINSE.

Professor Claire Lenehan - President

Ms Michelle Durant - Managing Director

AINSE BOARD 2017

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Our Vision

Enhancing Australia's capability in nuclear science and engineering by facilitating world-class research and education

Our Mission

AINSE will reach its vision through:

Playing a leading role in nuclear education and training

Playing an advocacy role for the Australasian nuclear community

Being an effective link between all stakeholders of nuclear science and engineering

Facilitating the development of multilateral and multidisciplinary strategic research initiatives

Utilising new streams of funding to increase impact

Our Strategic Priorities

Diversify AINSE's membership and stakeholder base

Seize new opportunities for funding beyond AINSE's traditional sources

Provide an effective and efficient link between different capabilities related to nuclear science and engineering

Develop AINSE's role as a credible advocate for the Australasian nuclear science and engineering community

Demonstrate leadership in the education of Australasia's next generation of scientists with an interest in nuclear science and engineering

Create an appropriate balance between funding project-based research and funding/facilitating multilateral and multidisciplinary collaboration

Effectively communicate AINSE's purpose to a wide range of different stakeholders

Numanodaira, Daisetsuzan Nataional Park, Hokkaido, Japan. Image Courtesy James Hooper (PGRA recipient)

RESEARCH HIGHLIGHTS

CORRELATION OF A WIDESPREAD 13TH CENTURY VOLCANIC ASH LAYER ACROSS CENTRAL INDONESIA AND ASCERTAINING ITS REGIONAL AND GLOBAL EFFECTS

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Globally, there are few examples where exceptionally large-magnitude eruptions have catastrophically impacted upon early historical human populations. The obvious examples are the eruption of Santorini (Thera) that extinguished the Cycladian Maritime culture in the eastern Mediterranean during the late Bronze Age (between c. 1662 and c. 1599 B.C.), the 79 A.D. eruption of Vesuvius that destroyed the Roman towns of Herculaneum and Pompeii, the Terra Blanca Joven (TBJ) eruption of Volcán Ilopango in El Salvador between 440 and 550 A.D. that may explain an episode in Mayan history known as the Classic Period Hiatus and the closely spaced eruptions of Tambora and Krakatoa in Indonesia whose direct and indirect effects resulted in widespread loss of life in 1815 and 1883 A.D., respectively.

In our research recently published in the Journal of Quaternary Science (Alloway *et al.*, 2017a) we report upon the 1257 A.D. Samalas eruption sourced from the island of Lombok, whose ash products are widely distributed across the central Indonesian archipelago. Pivotal to this study was systematic stratigraphic descriptions, geochemical finger-printing of the ash particles and acquisition of associated radiocarbon ages which were obtained from the ANSTO AMS Facility, (funded via AINSE Grant 16/001). Collectively, these parameters confirmed the identification of this widespread volcanic ash layer and its correlation to equivalent-aged records elsewhere.

Based on historical accounts from the Tambora 1815 A.D. eruption, there can be no doubt that the Samalas 1257 A.D. eruption was an equally, if not more, devastating event resulting in widespread loss of life and livelihood throughout large areas of central Indonesia during the mid-13th century. Its immense eruptive scale is registered by high volumes of Antarctic-wide sulphate deposition (Sigl *et al.*, 2014) – almost 1.6 times that of the Tambora 1815 A.D. event (see Fig. 2). This exceptionally large Samalas eruption can also be registered through anomalous meteorological events chronicled throughout Europe and Middle East in 1258 that resulted in agricultural collapse, famine, disease and the emergence of unusual social phenomena (Stothers, 2000). Heightened warfare at this time also resulted in considerable socio-political upheaval and dramatic demographic changes. It therefore becomes a difficult exercise to disentangle adverse effects from conflict-driven societal disruption from that indirectly caused by the far-flung consequences of the Samalas 1257 A.D. eruption that occurred at about the same time. Certainly, it can be predicted that sudden and relatively short-lived eruption-induced meteorological changes affecting subsistence agriculture most likely exacerbated societal unrest and led to further conflict.

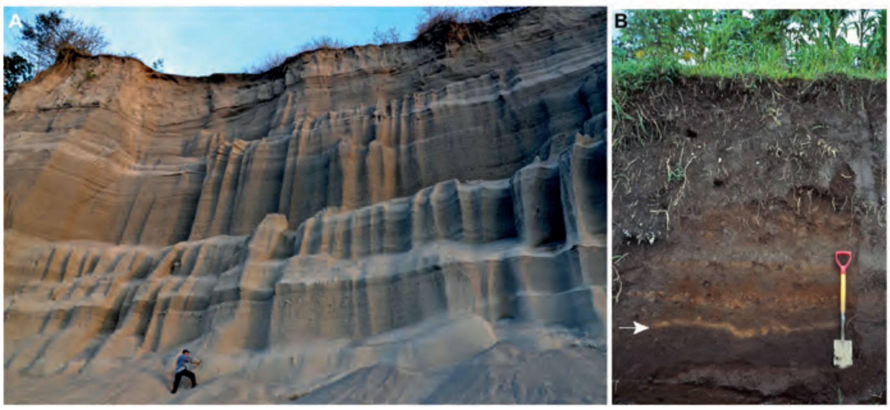

Figure 1: A. Proximal Samalas eruptive deposits (i.e. multiple, interbedded metre-thick surge and associated elutriated (co-PDC) ash deposits) exposed on the northwestern lower flanks of Rinjani Volcano, Lombok Island, Indonesia. **B.** Distal Samalas tephra exposed at ~2 m depth near Muntilan in central Java (~660 km westward from eruptive source).

In addition to climatic and related information from the medieval European chronicles, the Samalas 1257 A.D. eruption appears to have enhanced an El Niño-like event in its immediate aftermath. This volcanic forcing producing such an El Niño-like event can be affirmed from both modelling (i.e. Emile-Geay *et al.*, 2008; Mann *et al.*, 2009) and examining proxy evidence derived from a variety of equivalent-aged, high-resolution records in Asia (Li *et al.*, 2011) and from a wide latitudinal spread in the Americas (see Fig. 3 and associated ref's).

At the time of the Samalas eruption several socially advanced kingdoms with written records dominated large areas of the central Indonesian archipelago (i.e. Munoz, 2006). The almost ubiquitous occurrence of archaeological sites across this region with stone inscriptions and iconography provide ample opportunities for recorded events of that time to be implicated, either directly or indirectly, in the expected effects of this widespread eruption. Unfortunately, there is a distinct lack of archaeological references that might otherwise associate the expected effects of the largest tropical eruption of the last two millennia to socio-political events of that time. However, this lack of reference may in itself be indicating that through their highly developed inter- and intra-regional trade and commerce networks these sophisticated societies were somewhat resilient to eruption effects and able to respond and adapt relatively effectively to these kinds of environmental challenges - though this has yet to be proven. Ultimately, the connection between this exceptional mid-13th century eruption and contemporary societal accounts from central Indonesia should eventually emerge from future archaeological findings.

ACKNOWLEDGEMENTS

Dr's Wimpy Tjetjep, R. Sukhyar, M.A. Purbawinata, and A. Ratdomorpurbo, are all thanked for their contributions to, and support of, this research in the late 90's. The more recent continuation of this research has been generously supported by Dr R. Edy Prasodjo, Head of the Centre for Volcanology and Geological Hazard Mitigation (CVGHM), Dr Agung Pribadi, former Head of the Geological Survey of Indonesia (VSI), and Dr Gert van den Bergh (CAS, University of Wollongong). We gratefully acknowledge the funding from The Australian Institute of Nuclear Science and Engineering Ltd for AMS ^{14}C (OZ) analysis (AINSE grant 16/001).

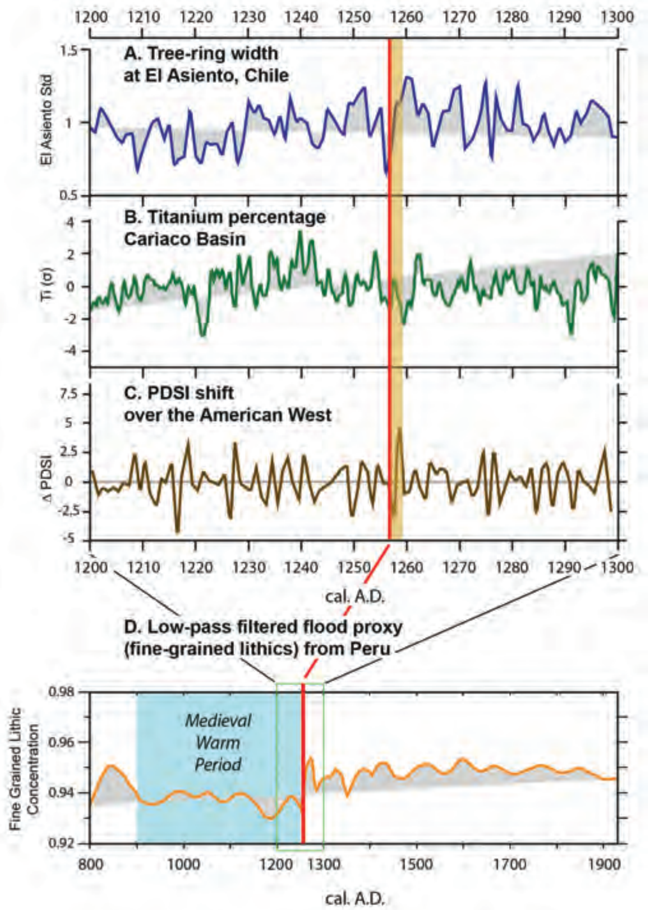

Figure 3: Multiproxy evidence from the Americas of a volcanic-forced El Nino event closely coinciding with the Samalas eruption (indicated by the pink line at 1257 A.D.): A. Standardised tree-ring width at El Asiento, Chile (Luckman and Villalba, 2001); B. Titanium concentration in core 1002 from the Cariaco Basin (Haug et al., 2001); C. PDSI shifts over the American West (Cook and Krusic, 2004); D. Concentration of lithic grains occurring in sediments off the coast of Peru as a proxy of continental run-off after flood (El Niño) events (Rein et al., 2004). Data is represented as a low-pass filtered (orange) curve. The Medieval Warm Period (c. 900 to 1250 A.D., Mann et al., 2009) is shaded in blue.

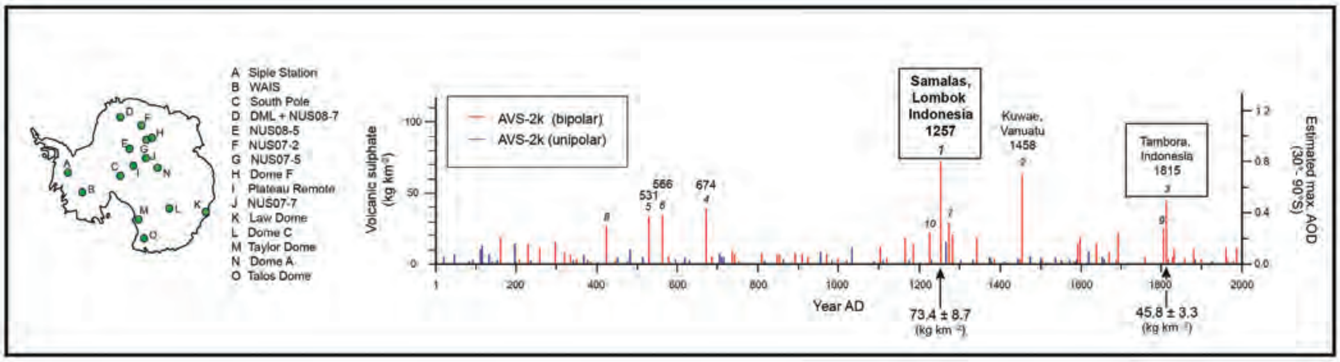

Figure 2: The relative scale of Samalas 1257 A.D. and Tambora 1815 A.D. eruptions interpreted from a composite (AVS-2k) ice-core record of volcanic sulphate deposition over Antarctica (Sigl et al., 2014). Red and blue bars indicate bipolar (suggesting a tropical source) and unipolar sulphate deposition respectively, based on synchronous sulphate signals in Greenland ice cores. The ten largest sulphate events and their relative rankings are each indicated by numeric labels. The locations of Antarctic ice core sites used to develop this composite AVS-2k record over the last two millennia are also indicated.

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COMPARATIVE RADIOCARBON DATING OF MACROFOSSIL AND SOLVENT EXTRACTED ORGANIC MATTER IN LAKE CHITTERING, WESTERN AUSTRALIA

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The southwestern "toe" of Australia is a global biodiversity hotspot, containing unique species, including iconic old growth forests of Tingle and Karri eucalypts. However, these precious environments are under pressure from a drier climate, with autumn and winter rainfall consistently decreasing over the last 40 years (Bates et al., 2008; Delworth & Zeng 2014). To understand how future climatic changes may affect this area, we need to understand how the system has changed in the past.

Lake sediments are ideal archives for past environments, and multiple swamps and lakes exist across the southwest Australian region. However, the area is understudied, and the parameters controlling the ages and preservation of organic matter in lakes vary across systems. Before undertaking palaeoenvironmental reconstruction, we needed to investigate the best way to date our site. In lakes, macrofossils from land plants are usually the best material for dating, as land plants are in equilibrium with atmospheric ^{14}C, and so there is no distortion of the starting point of their radiocarbon "clock". In contrast organic carbon from aquatic sources is often subject to a reservoir effect, as the lake water contains carbon that is older than the date of deposition. However, plant macrofossils or charcoal may not be present throughout all lake cores, and so dating may necessarily be based on other organic matter. This work tested the comparative radiocarbon dates in macrofossils, and solvent extractable organic matter within a sediment core from SW Australia, to establish how a reliable dating framework could best be created.

The site investigated in this project was Lake Chittering (Figure 1), a shallow lake lying north east of Perth. A sediment core was collected in 2014, and sediment samples were taken at intervals matching the location of likely macrofossil samples. Solvent extractable organic matter was recovered, and split into polar and apolar classes.

Figure 1: Lake Chittering in Summer

When we evaluated the calibrated age data through the core, categorized by organic matter type, we found that the solvent extracted organic matter did lag the plant macrofossil, which is consistent with a reservoir effect and input to the solvent extractable material by aquatic plants or microbes. Chittering sediments have a significant input from microbial mats, which are visible in the shallow waters during summer (Figure 2). Nonetheless, a clear age / depth trend is still apparent, especially in the polar fractions. This suggests that even allowing for the reservoir effect, simple organic matter extracts have potential for building dating frameworks in sediments where plant macrofossils are not available. Our work will now move to building a full age model for the Lake Chittering sediments, and developing compound specific radiocarbon records, which will allow us to date molecules directly derived from plants or microbes, and so make the records from non-macrofossil sources more robust.

ACKNOWLEDGEMENTS

The work in this project was supported by AINSE research grant ALNGRA14502, and undertaken by Jon Lai, as part of an Honours project in the Department of Chemistry, Curtin University. The project was supervised by AINSE Research Fellow Dr Alison Blyth at Curtin, and Dr Quan Hua at ANSTO.

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Figure 2: Lake Chittering microbial mat

MILLENNIAL-SCALE VARIABILITY IN SOUTH-EAST AUSTRALASIAN HYDROCLIMATE BETWEEN 30,000 AND 10,000 YEARS AGO

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Global climate variability during the late Quaternary is commonly framed in terms of the 'bipolar seesaw' pattern of asynchronous temperature variations in the northern and southern polar latitudes (Broecker, 1998). However, the hydrological response to this pattern in the Southern Hemisphere (SH) mid-latitudes is not fully understood, as continuous, well-dated proxy records for the hydrological cycle in the region are sparse (Vandergoes et al., 2005).

We have produced a new well-dated, highly resolved record of moisture balance spanning 30,000 – 10,000 calendar years before present (30 – 10 ka BP), based on x-ray fluorescence (XRF) and organic carbon isotope ($\delta^{13}C_{OM}$) measurements of a sedimentary sequence from Lake Surprise in south-eastern Australia. The data provide a locally coherent record of the hydrological cycle, and are supported by existing low-resolution palaeoecological data (Builth et al., 2008) (Fig. 1).

This record is supported by a highly resolved age-depth model, derived from a total of 32 AMS ^{14}C dates. A common approach to dating lake sediment is to analyse bulk sediment for ^{14}C content. However, this approach is associated with high uncertainty at Lake Surprise, due to the possibility of contamination from very fine-grained autochthonous carbonate, and younger humic acids. Plant macrofossils have not been identified in the 30 – 10 ka BP section of the core, and we therefore chose to obtain all new AMS ^{14}C date from concentrated pollen samples (Fig. 2). Prior to our work, 16 radiocarbon dates existed for Lake Surprise, also obtained from concentrated pollen samples (Builth et al., 2008). I prepared and analysed a further 16, all within the 30 – 10 ka BP period of interest. The Bayesian age modelling

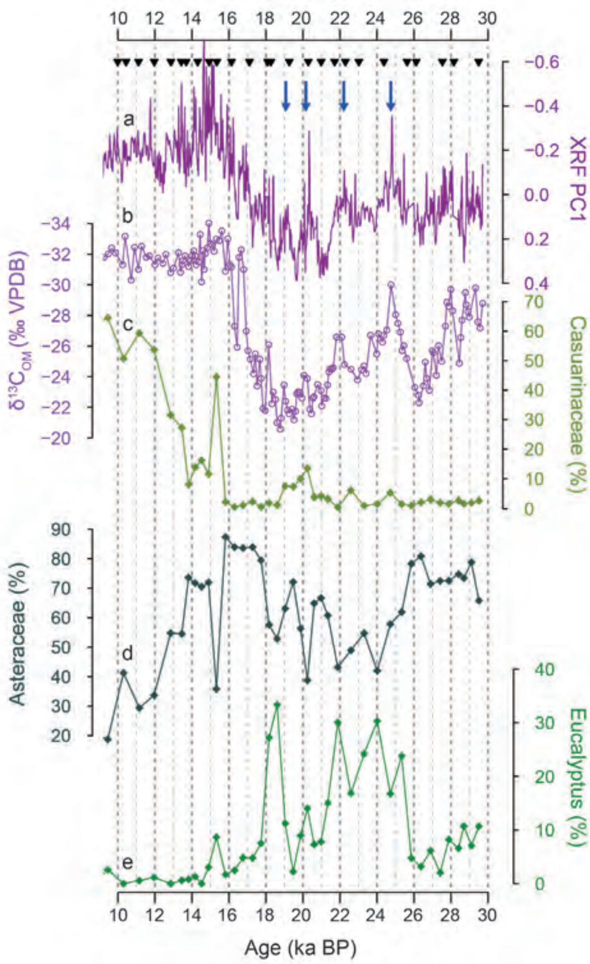

Figure 1: Selected data from the 30-10 ka BP geochemical record from Lake Surprise, in comparison with percentages of key pollen taxa (Builth et al., 2008): **a)** First principal component (PC1) of the calibrated scanning XRF dataset, interpreted to reflect aeolian deposition of Si in the lake; **b)** Bulk sediment carbon isotope ratios ($\delta^{13}C_{OM}$), interpreted to reflect plant moisture stress; **c-e)** Percentage of Casuarinaceae, Asteraceae, and Eucalyptus pollen, where increases in Casuarinaceae and/or Eucalyptus as the expense of Asteraceae have been interpreted to represent a regional increase in effective precipitation. Blue arrows indicate periods of increased effective moisture within the relatively arid LGM. Filled triangles denote 14C age control points.

software 'Bacon' in R (Blaauw and Christen, 2011) was used to construct an age-depth model combining the new and existing ages (Fig. 3). The model has a resolution of approximately one date per 800 years during the 30 – 10 ka BP period, making it one of the most highly-resolved lake sediment records for Australia during this interval.

Elevated Si (reflecting windblown quartz and clays), and relatively high $\delta^{13}C_{OM}$, indicate an extended period of relative aridity between 28 – 18.5 ka BP, interrupted by millennial-scale episodes of decreased Si and $\delta^{13}C_{OM}$¬, suggesting increased moisture balance. This was followed by a rapid deglacial shift to low Si and $\delta^{13}C_{OM}$ at 18.5 ka BP, indicative of wetter conditions.

The high-resolution record, supported by a secure chronology, allows us to compare the Lake Surprise record with other high-resolution records from south-eastern Australasia, and to explore the regional significance of the pattern of climate change identified at Lake Surprise. We also investigate potential drivers of hydroclimate change in south-eastern Australasia, and find that these drivers have varied over multi-millennial time scales (Falster et al., submitted).

ACKNOWLEDGEMENTS

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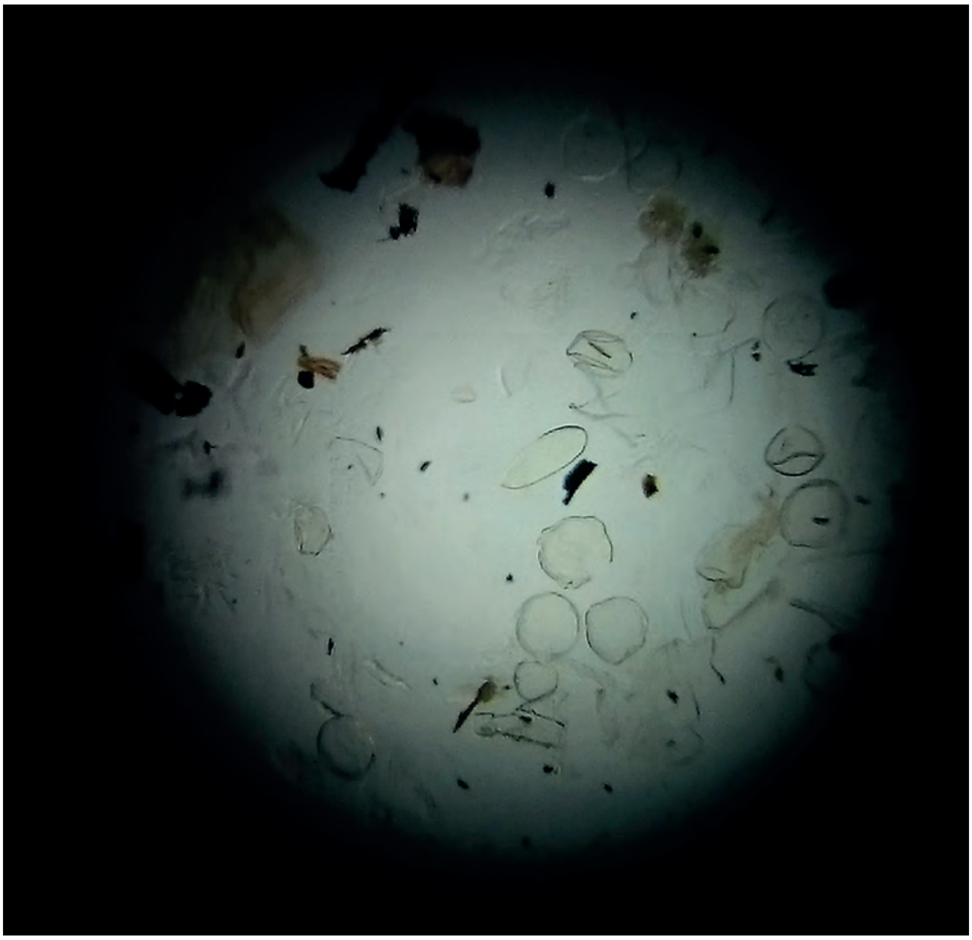

Figure 2: Example of a concentrated pollen sample, prior to drying and graphitisation for AMS ^{14}C analysis. Clear, rounded grains are pollen, and black, angular grains are charcoal fragments.

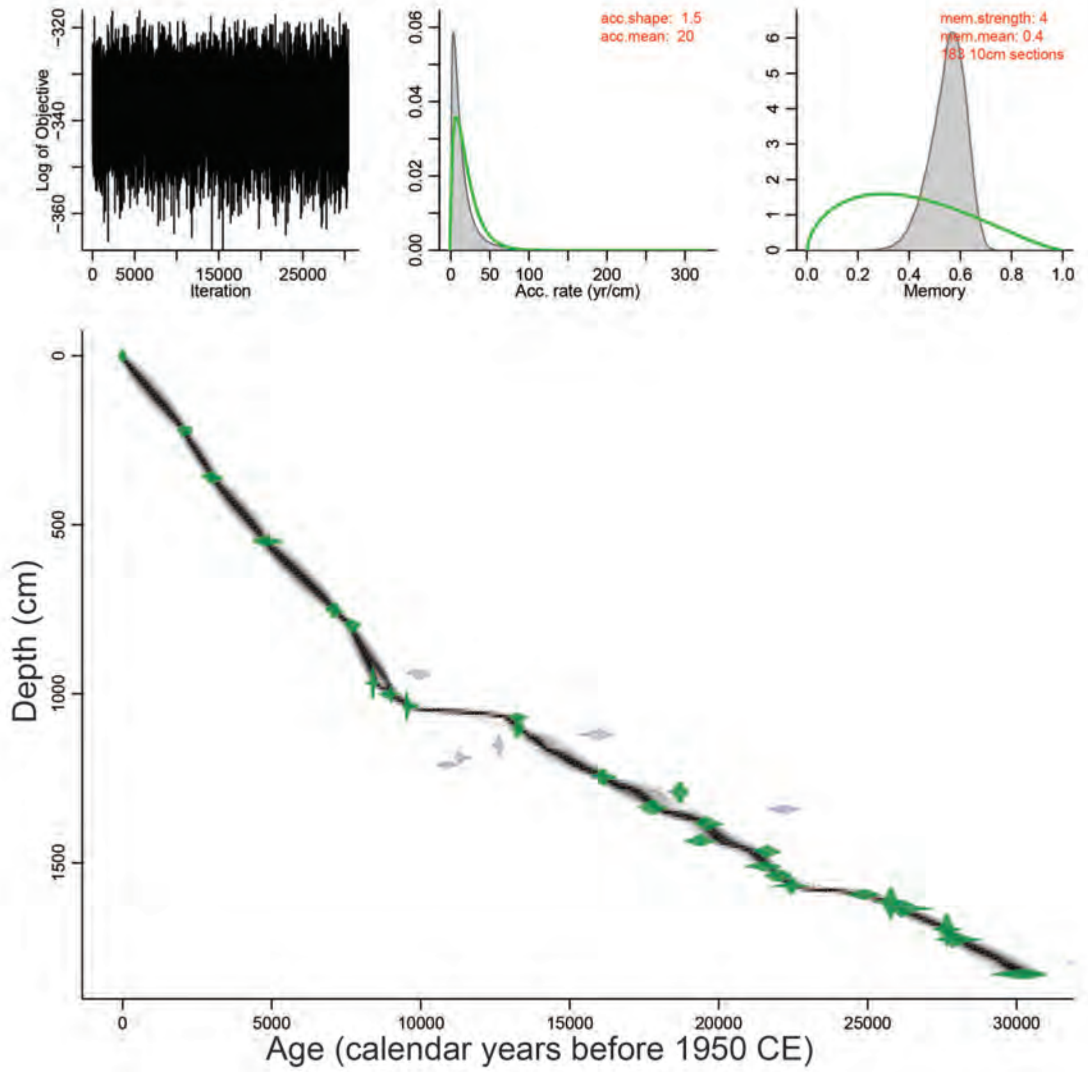

Figure 3: Age-depth model for Lake Surprise, created in the 'Bacon' software in R (Blaauw and Christen, 2011), using 32 radiocarbon (^{14}C) analyses of concentrated pollen samples. The model was derived from ^{14}C analyses coloured in green; the remained were identified as outliers, and excluded from the model. All ^{14}C dates were calibrated to SHCal13 (Hogg et al., 2013).

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NEUTRONS FOR NEW ANTIBIOTICS

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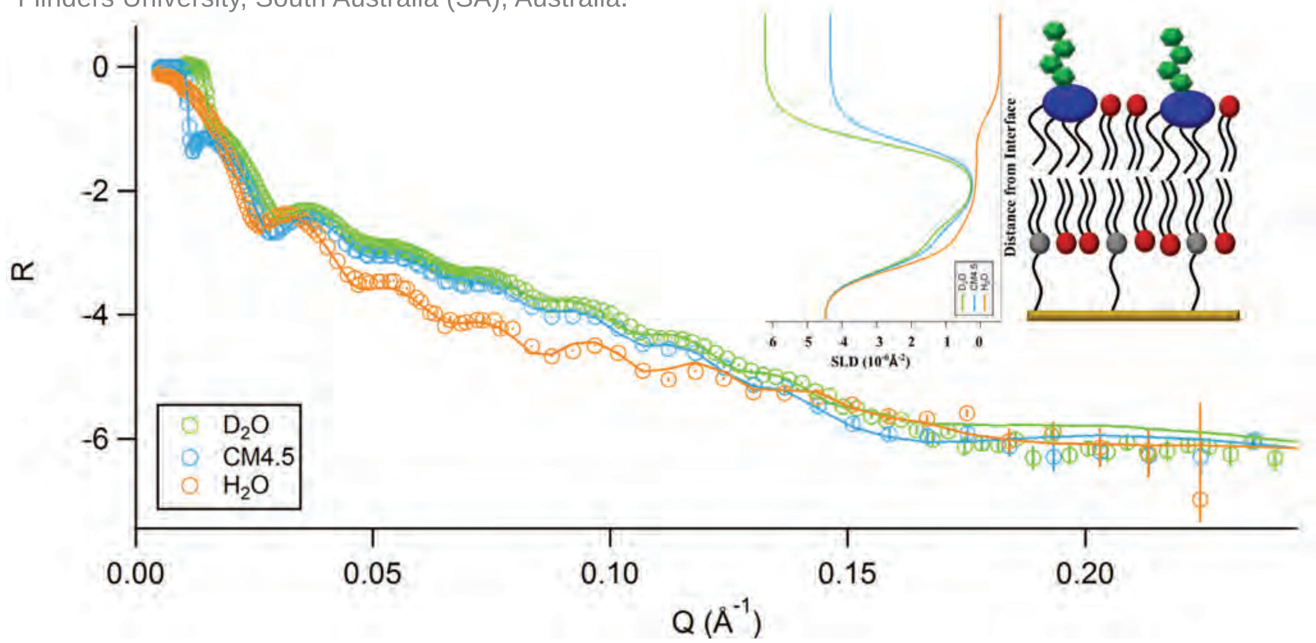

Figure 1: Schematic of the model membrane developed in this project. Neutrons were a vital part of the development as they enable the study of the assembled lipid bilayer in its natural state, showing its chemical composition in the vertical axis with sub-nanometer resolution

The World Health Organisation has issued an urgent call to action for the development of new antibiotics.[1] Resistance is beginning to develop against commonly used antibiotics and infections that were once easily cured can now be life threatening. There is an urgent need for the development of new antibiotics, but progress has thus far been very limited. Gram-negative bacteria (GNB) are of particular concern, as they can develop antibiotic resistance faster than Gram-positive organisms. This is a result of the unique structure of their cellular membrane.[2] The outer membrane of GNB is comprised of a mixture of phospholipids and lipopolysaccharides (LPS) [3], covering up to 75% of the bacterial surface[4]. The presence of LPS in the outer membrane presents a strong barrier to the entry of antibiotics into the cellular interior, thus enabling GNB to tolerate very high doses of antibiotics.

The outer membrane is therefore a crucial factor to consider when designing new antibiotics, as they must pass through the membrane to have an effect. The development of drug resistance can be reduced when directly damaging the cellular membrane, for example with cationic nanoparticles.[5] Improved knowledge of the means by which the outer membrane of GNB can be damaged will enable us to develop more effective strategies to target and destroy it with new antibacterial treatments. However, studying the outer membrane is challenging; it is a highly complex architecture containing a vast number of different lipids, proteins, carbohydrates and receptors. Furthermore, only very few tools can be used when studying the membrane of a bacterial cell.

We have developed the first self-assembled model of the outer membrane of GNB, shown in Figure 1. This membrane closely resembles the natural structure of the outer membrane of Gram-negative bacteria and can be studied using a wide range of tools. We have used a combination of neutron scattering and electrochemical impedance spectroscopy to demonstrate that this membrane is susceptible to the effects of Colistin sulfate. The model membrane is therefore a useful model to study the effect of antibiotics on the lipid membrane. It can now be used to develop new strategies to damage the outer membrane of GNB in a controlled environment, and the effect of the antibiotics on the structure and properties on the bilayer can be studied with an unprecedented number of analytical tools.

This project was carried out by Jakob Andersson and supervised by Associate Professor Ingo Köper at the Flinders University of South Australia. It was co-supervised by Dr Stephen Holt at the Australian Nuclear Science and Technology Organisation. Professor Köper has many years of experience developing model membrane platforms for use in biophysical studies of membrane proteins, drug-membrane interactions and biosensing. Dr Stephen Holt has significant experience studying lipid membranes via neutron scattering and his expertise in the area was crucial for the success of this project. Jakob Andersson has recently completed his PhD in biophysics and electrochemistry at Flinders University. The core of his doctoral work was the development of the membrane platform presented here.

ACKNOWLEDGEMENTS

This work was performed in part at the South Australian node of the Australian National Fabrication Facility under the National Collaborative Research Infrastructure Strategy. Instrument costs and travel funding was provided by the Australian Nuclear Science and Technology Organisaion for beam time proposals P5879, P5828, P5251 and P5239. Deuterated DPhyPC was provided by the National Deuteration Facility under proposal NDF5829. Jakob Andersson acknowledges supported through the Australian Institute of Nuclear Science and Engineering (AINSE) and the Research Training Scheme of the Australian federal government.

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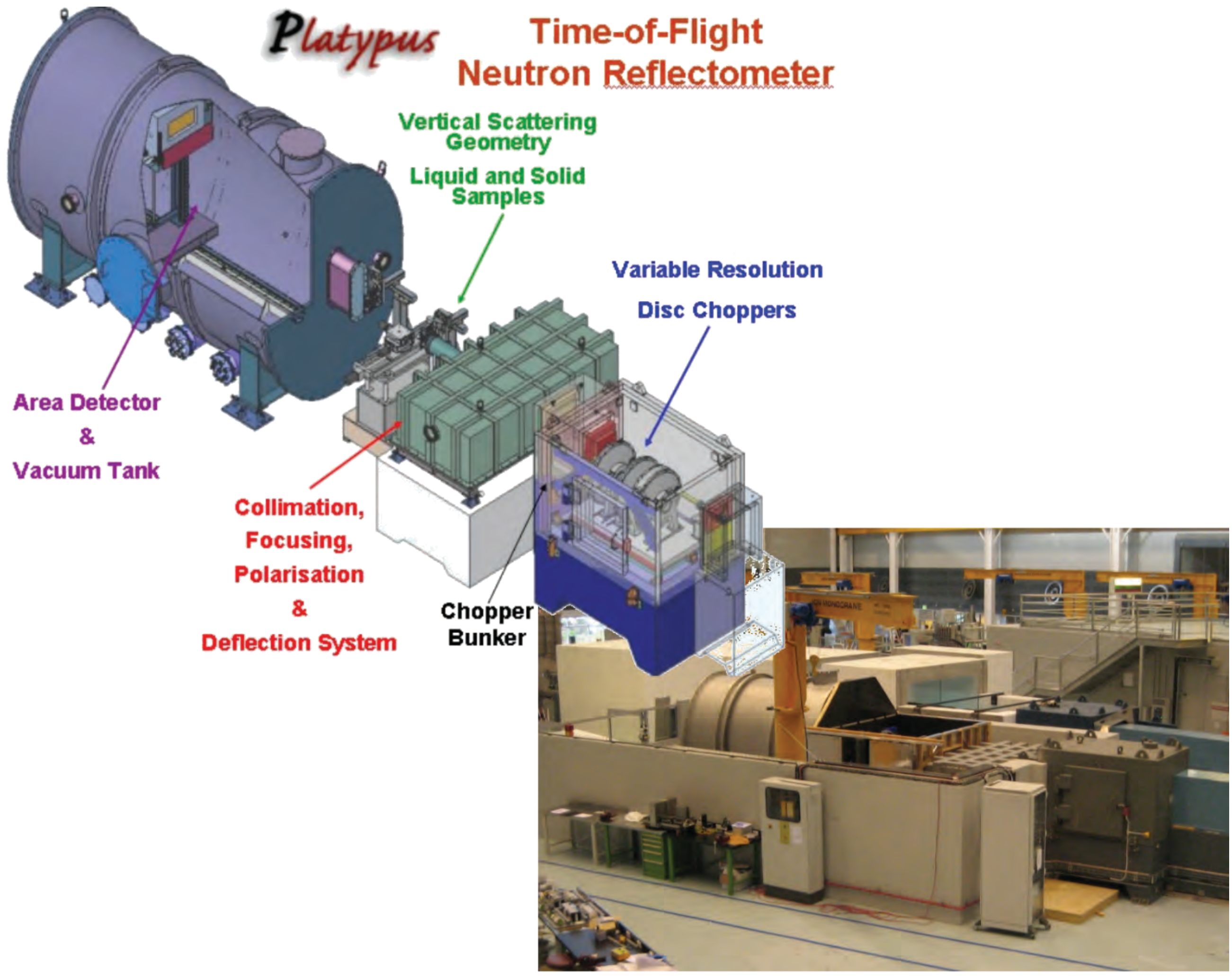
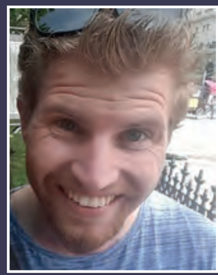


Schematic of Platypus reflectometer and photograph of instrument

THE DISCOVERY OF RANASPR – A NEW METHOD FOR INVENTING NUCLEAR MEDICINES



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At the conception of this project there was a singular goal – to produce a multimodal agent. An agent which, upon binding to a biological vector, could hypothetically detect tumours externally via positron emission tomography (PET) medical imaging by incorporation of a fluorine-18 radioisotope; then furthermore, enable these cancerous cells to luminesce via excitation of a rhenium centre, thus providing a surgical guide during excision of tumour masses. To our delight the project proved successful – the molecule was created by complexing a phenanthroline analogue ligand to rhenium, the rhenium emitted visible light, and fluorine-18 was able to be incorporated in high radiochemical yield (RCY).[1]

However, along the way we stumbled upon a much more exciting discovery. Through investigation of an instrumental error (see figure 1 for details), it was found that semi-aqueous conditions massively improved the amount of fluorine-18 that could be added to the phenanthroline molecule when, and only when, rhenium was included in the molecular structure. This was significant, because most fluorine-18 reactions do not work when any water is present in the reaction, requiring great efforts to distil the reaction media. Indeed we confirmed that, without rhenium, the reaction would not work at all.[2]

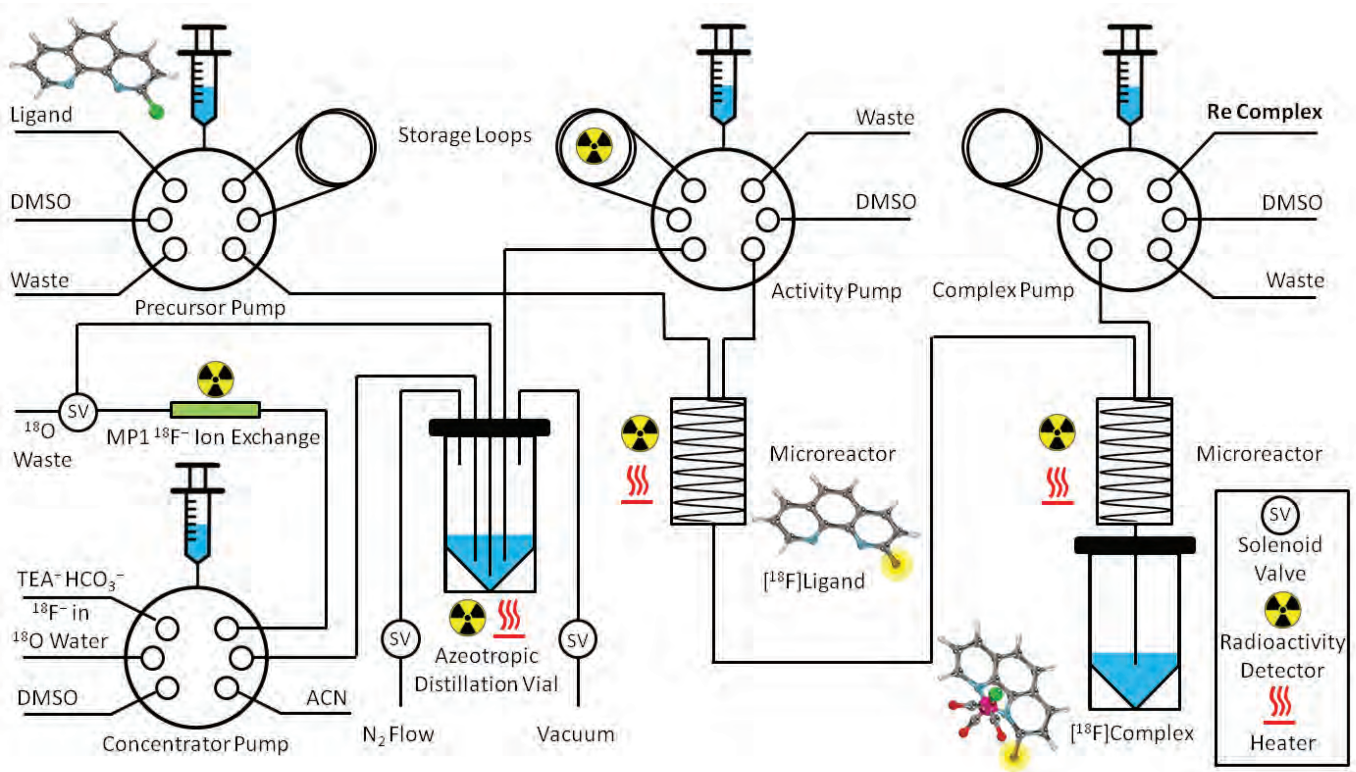

Figure 1: Automated synthesis module constructed from microfluidic technology for the purpose of the project. The instrumental error arose from lack of nitrogen gas and vacuum flow in the azeotropic distillation vial, which lead to semi-aqueous environment in the microreactors.

Following this early success we began to investigate other pyridinyl ligands similar to phenanthroline, beginning with bipyridine. We synthesised a suite of different chlorine substituted bipyridine ligands to radiolabel with, and without, rhenium attached. To our astonishment, none of the chlorine substituted bipyridines were able to be radiolabeled with fluorine-18. However, upon coordinating the bipyridines to rhenium we discovered yet again another exciting trend. At low temperatures the rhenium complex enables fluorine-18 incorporation, thus radiolabeling the complex (red line), peaking at 130°C for an example shown in figure 2. However, at temperatures greater than 130°C, the rhenium complex begins to fall apart, thus liberating the radiolabelled bipyridine ligand (blue line). This is indeed a novel method for radiolabelling previously unattainable, pyrindyl-bearing nuclear medicines which we refer to as RANASPR (Rhenium Activated Nucleophilic Aromatic Substitution for Pyridinyl Radiofluorination).

The discovery of RANASPR has opened a realm of unexplored experiments, begging questions as to the scope of ligands RANASPR can be applied to, and whether this phenomenon is intrinsic to rhenium.

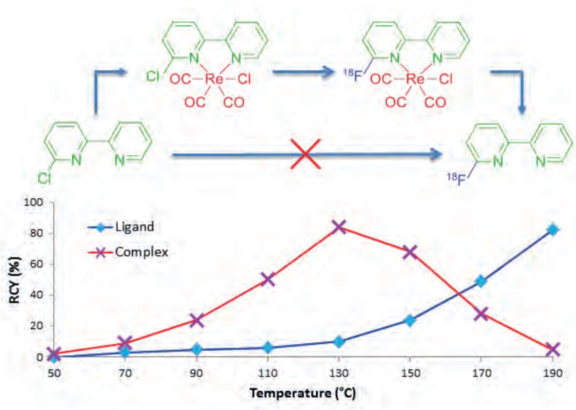

Figure 2: Applying RANASPR to form the fluorine-18 labelled rhenium complex (red line), which simultaneously dissociates under higher temperatures to liberate the fluorine-18 labelled ligand (blue), thus producing nuclear medicine that could not be made hitherto.

However, our current motivation is towards applying RANASPR to improve the radiosynthesis of the Alzheimer's disease nuclear medicine known as CABS13, alongside using RANASPR to create former Alzheimer's imaging agents which are believed to work more efficiently, but were never able to be radiolabelled in former studies.

The discovery of RANASPR is indeed an exciting time for us as researchers, but could not have been made possible without the hard work, expertise and collaboration of others. Foremost is the intellectual support and supervision provided from Dr. Giancarlo Pascali, Dr. Max Massi and Dr. Benjamin Fraser. Our appreciation extends also to Dr. Helen Maynard-Casely and Jack Clegg, for their collaboration at the Australian Synchrotron (refer to crystal structure in figure 3). Finally, we express our immense gratitude towards AINSE, not only for the funding of this project, though also for their compassionate support along the way.

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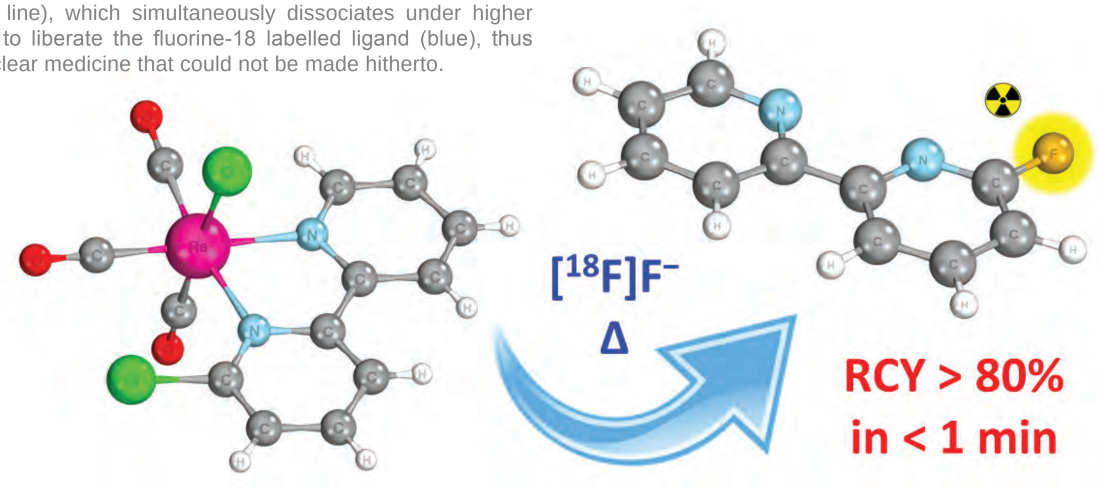

Figure 3: Crystal structure of one of the rhenium complexes (obtained from the Australian Synchrotron), which enables the formation of nuclear medicines using RANASPR in high RCY and extremely time efficient syntheses. Single crystal data was collected at MX1 on the Australian Synchrotron via Collaborative Access Program 12368, PI Jack Clegg (UQ).

LATE HOLOCENE HYDROCLIMATE VARIABILITY AT KANGAROO ISLAND, SOUTH AUSTRALIA

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Figure 1: Speleothem KHS3 collected from Kelly Hill Cave, Kangaroo Island, South Australia. The sampling track along the central growth axis is highlighted in blue.

Southern Australia has experienced severe droughts and overall decreases in seasonal rainfall in recent decades, which has resulted in negative agricultural impacts, uncertainty in water resource security, and increased bushfire risk. The context and drivers of these rainfall anomalies are not fully understood on decadal - centennial time scales due to the limited temporal coverage of instrumental climate data in the region. Longer baseline data for Australian rainfall variability can be extracted from natural archives, such as stalagmites in caves (speleothems), through the analysis of palaeoclimate proxy data.

This project will compile a new speleothem-based palaeorainfall record for southern Australia, which will extend knowledge of rainfall variability beyond the period covered by instrumental records. Kangaroo Island, South Australia, is an ideal location for the development of a palaeoclimate record because the site is predicted to act as a 'gateway location' for climate patterns affecting Australian population and agricultural centres. Analysis of modern rainfall samples has provided possible interpretations of geochemical variability within Kangaroo Island speleothems. Modern oxygen isotopes in precipitation are controlled by both rainfall amount and the origin of the rainfall (i.e. Southern Ocean or tropical Indian Ocean) across multiple time scales. This suggests that stalagmite oxygen isotopes likely record changes in rainfall amount and the dominant synoptic conditions responsible for bringing moisture to southern Australia.

Stable isotope and trace element results both high- and low-frequency variability, thought to be driven by fluctuations in climate. Agreement in the low-frequency trends between trace elements, stable isotopes, and instrumental rainfall data suggests that speleothem proxies have recorded an observed decrease in precipitation at Kelly Hill Cave in the upper section of the main stalagmite being analysed. High-frequency trace-element cycles are assumed to be annual in nature, and are proxies for rainfall and possible atmospheric contaminants transported to Kangaroo Island.

The current results of this study suggest that Kangaroo Island is a unique location in southern Australia that has the potential to record rainfall variability, as well as to examine the interaction of rain-bearing tropical versus mid-latitude weather systems on longer timescales. Speleothems from Kelly Hill Cave contain multiple proxies that collectively suggest a decrease in rainfall amount as well as decreased variability in recent decades. Extension of this record further back in time will provide greater understanding of the characteristics and drivers of droughts in southern Australia.

ACKNOWLEDGEMENTS

This project was supported by AINSE (PGRA) and ANSTO. We wish to thank Dr. Quan Hua for his assistance in radiocarbon dating, where bomb pulse dating is vital for establishing the age depth model for KI speleothems. We also thank Dr. Ian Goodwin for his assistance in synoptic typing of modern rainfall, Dr. Pauline Treble for vital discussion, and the team of volunteers at Kelly Hill Cave who collect rainfall samples, drip count data, and dripwater samples.

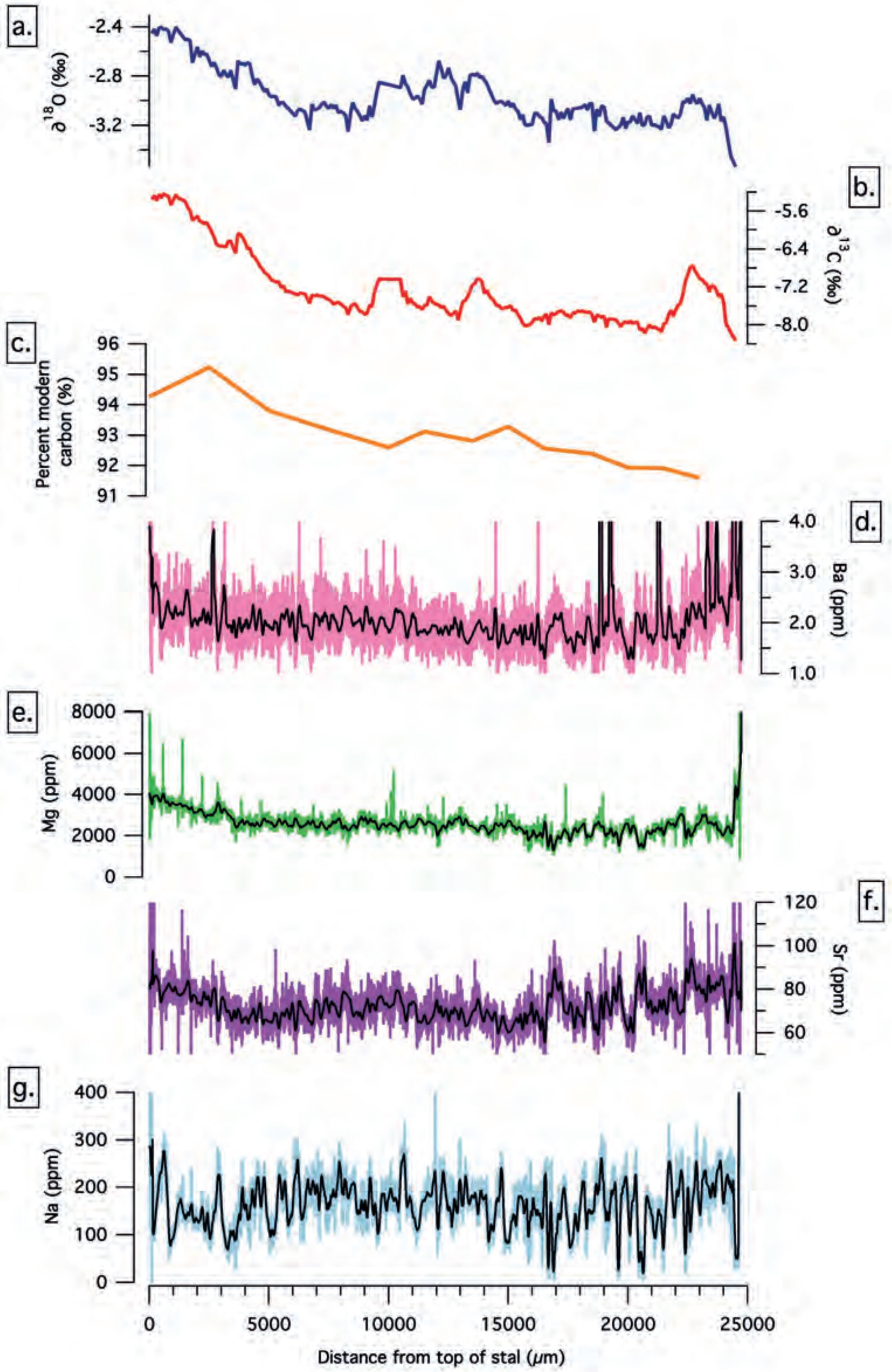

Figure 2: Summary of geochemical data from speleothem KHS3. KHS3 has been analysed for (a.) Oxygen and (b.) carbon isotopic values, (c.) percent modern carbon values, and hydroclimatically sensitive (d.) barium, (e.) magnesium, (f.) strontium, and (g.) sodium trace element concentrations.

UNLOCKING THE KIMBERLEY'S PAST: THE APPLICABILITY OF ORGANIC SPRING DEPOSITS FOR RECONSTRUCTING LATE QUATERNARY CLIMATIC AND ENVIRONMENTAL CHANGE

Emily Field[1], Hamish McGowan[1], Patrick Moss[1]

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The monsoon-affected Kimberley region of northwest Australia has a long history of human occupation for at least ~44,000 years (e.g. Hiscock et al., 2016), and is renowned for its rich archaeological legacy and rock art. However, knowledge of climate and environmental change in this region for the time period spanning human occupation is limited. As a result there is also a lack of understanding regarding long-term dynamics of the Indonesian-Australian Summer Monsoon (IASM). We therefore developed new, high-resolution records of climate and environmental change from the Kimberley spanning the last ~15,000 years since the Last Glacial-Interglacial Transition (LGIT), which is arguably the most significant transition in global climate during the late Quaternary (Reeves et al., 2013).

However, developing high-resolution records from tropical northern Australia is challenging due to its monsoonal climate. This limits the number of perennial water bodies found which are typically used for palaeoenvironmental research. We therefore targeted groundwater-fed springs with peaty deposits which can also provide high-resolution palaeoenvironmental records.

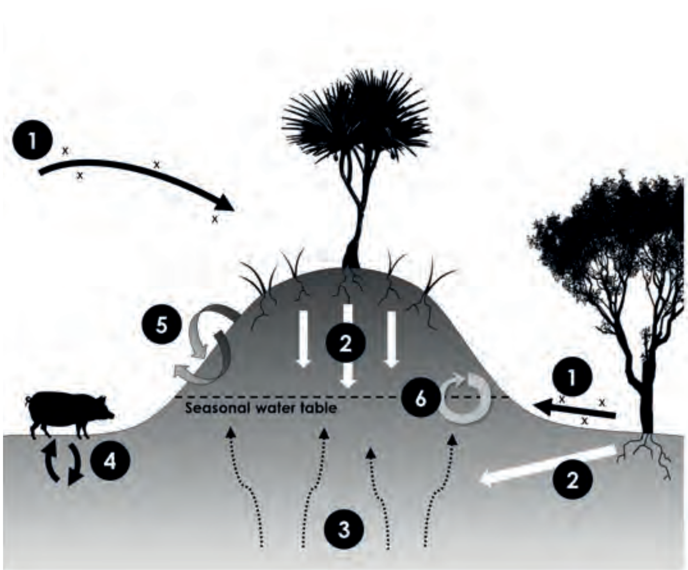

Figure 1: Potential sources of geochronological complexity in organic springs via (1) aeolian and alluvial input, (2) root growth and washdown of organic substances and sediment, (3) upwelling groundwater, (4) bioturbation, (5) self-mulching, slumping, and (6) weathering

We extracted three sediment cores (BSP02, FRN02, ELZ01) from organic springs in the northwest Kimberley's interior, although when initially dating bulk sediment, macro-charcoal and pollen concentrate found that our radiocarbon (^{14}C) and lead-210 (^{210}Pb) results were confusing. Subsequent analysis demonstrated that organic spring deposits in a variety of global locations also suffered similar chronological issues. We hypothesised that these were primarily due to complications from root growth and groundwater fluctuations (Figure 1).

We therefore applied a relatively novel pre-treatment for radiocarbon dating (hydrogen pyrolysis) to isolate stable polycyclic aromatic carbon (SPAC), since SPAC represents the carbon fixed by pyrolysis at the time of the burning event (Ascough et al., 2009) and is an "indigenous" component of the original charcoal therefore likely to produce a reliable ^{14}C date (Bird et al., 2014). Our results confirmed that SPAC is likely to give reliable ^{14}C dates in the deposits of well-developed organic springs. However, our ^{210}Pb and Plutonium-239+240 ($^{239+240}Pu$) results revealed that providing age control for recent spring sediments may prove more difficult due to post-burial uranium enrichment of spring deposits via groundwater.

This research not only provided viable chronologies for the three Kimberley sediment cores, but delivered a methodology for working with organic spring deposits in all global locations. This is particularly important for researchers working in arid and semi-arid environments where there are few other archives of high-resolution palaeoenvironmental change.

With these chronologies for BSP02, FRN02 and ELZ01 (Figure 2) we were able to undertake multi-proxy analysis to reconstruct climate and environmental change for the Kimberley over the last 15,000 years. Interpretations of elemental geochemistry, pollen, humification, non-pollen palynomorph, LOI and micro-charcoal datasets revealed the following key changes in northwest Australian climate and the IASM since the LGIT: (1) monsoonal precipitation increased from ~15ka, before intensifying at ~12.9ka; (2) monsoon activity was greatest in the early Holocene until ~7.5ka; (3) monsoonal precipitation gradually declined from 7.5ka, with a short-lived return to more active conditions centred at 4.2ka; (4) the monsoon weakened in the late-Holocene, with peak aridity between 2.6 – 1ka; and (5) conditions ameliorated somewhat within the last 1ka.

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We would like to acknowledge AINSE for granting the first author a PGRA which supported this research, and the assistance of Geraldine Jacobsen, Henk Heijnis, Atun Zawadzki, Patricia Gadd, David Child, Michael Hotchkis, Fiona Bertuch, Brodie Cutmore, Daniela Fierro and Jack Goralewski at ANSTO in obtaining the ^{14}C, ^{210}Pb, ^{210}Po, ^{226}Ra, $^{239+240}$Pu and ITRAX data used in this research.

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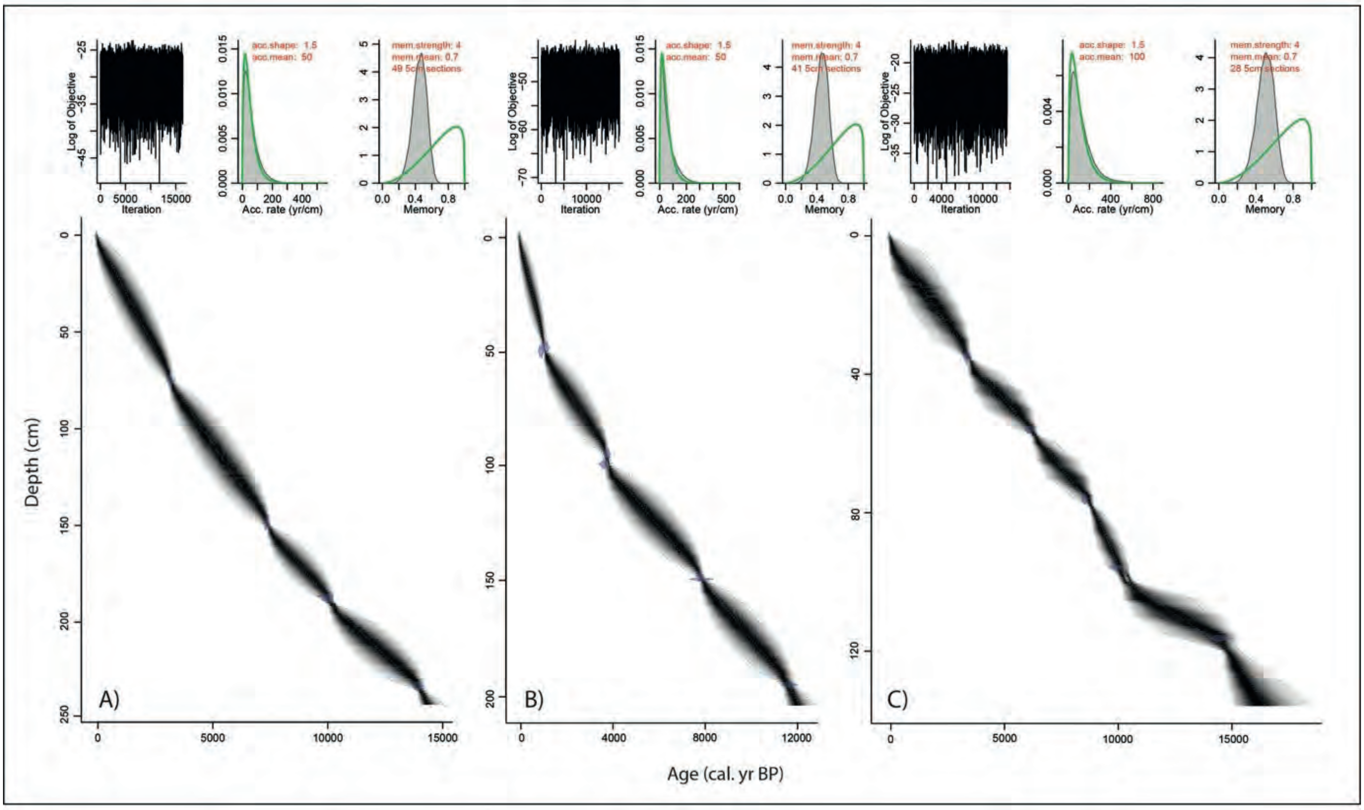

Figure 2: Bayesian age-depth models generated for cores (A) BSP02, (B) FRN02 and (C) ELZ01 using Bacon 2.2 (Blaauw and Christen, 2011). The upper panels indicate the number of iterations performed, accumulation rates and memory used in the generation of each model

USING RADIOISOTOPE TRACERS TO STUDY THE ACCUMULATION AND LOSS OF TRACE METALS IN A MARINE INVERTEBRATE

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Organisms inevitably encounter metals. Some metals enter the environment episodically, thus organisms may be exposed for short, repeated periods. With exposure, trace metals are accumulated (via water, food, etc.) and may be later eliminated ('depurated'). While some trace metals are necessary for metabolism ('essential' metals, e.g. zinc (Zn)), others are harmful unless expelled ('non-essential' metals, e.g. cadmium (Cd)). Consequently, organisms may handle metals differently with (1) each short-term exposure, and (2) the essential or non-essential nature of the metal.

A common marine invertebrate (the sea squirt or ascidian Styela plicata) was exposed to dissolved radioisotope tracers (^{65}Zn, ^{109}Cd) in the laboratory. Ascidians encountered radioisotopes separately or as a mixture for four days (the first exposure), followed by a five day period of no exposure (the first depuration). Ascidians were exposed again for four days (the second exposure), and depurated for five days (the second depuration). The whole-body accumulation of metals was quantified using gamma spectrometry on multiple days, and the internal distribution of metals was assessed using autoradiography post mortem.

Accumulation of the essential metal Zn was similar for the first and second exposures, regardless of the co-occurring Cd (Figure 1A). Conversely, the accumulation of the non-essential metal Cd was greater in the presence of Zn, and greatest following the second exposure (Figure 1B). Following the first depuration, the internal concentration of metal (Cd or Zn) was no different for ascidians exposed to one or two metals. Organisms exposed to Cd or Zn alone, however, retained more metal following the second depuration.

The internal distribution of metals also differed for each metal. Following both exposures, Zn accumulated within the branchial basket (analogous to gills), where Zn was likely removed from water for circulation around the body (Figure 2A). Following the second exposure, Zn also accumulated in the stomach; Zn is regulated but toxic at higher concentrations and may explain this different handling. For both exposure periods, Cd accumulated in the stomach – a potential strategy to minimise damage elsewhere in the body – and in the test – a body casing, unique to ascidians – likely via absorption from water (Figure 2B). After the second depuration, the distribution of metals was unchanged.

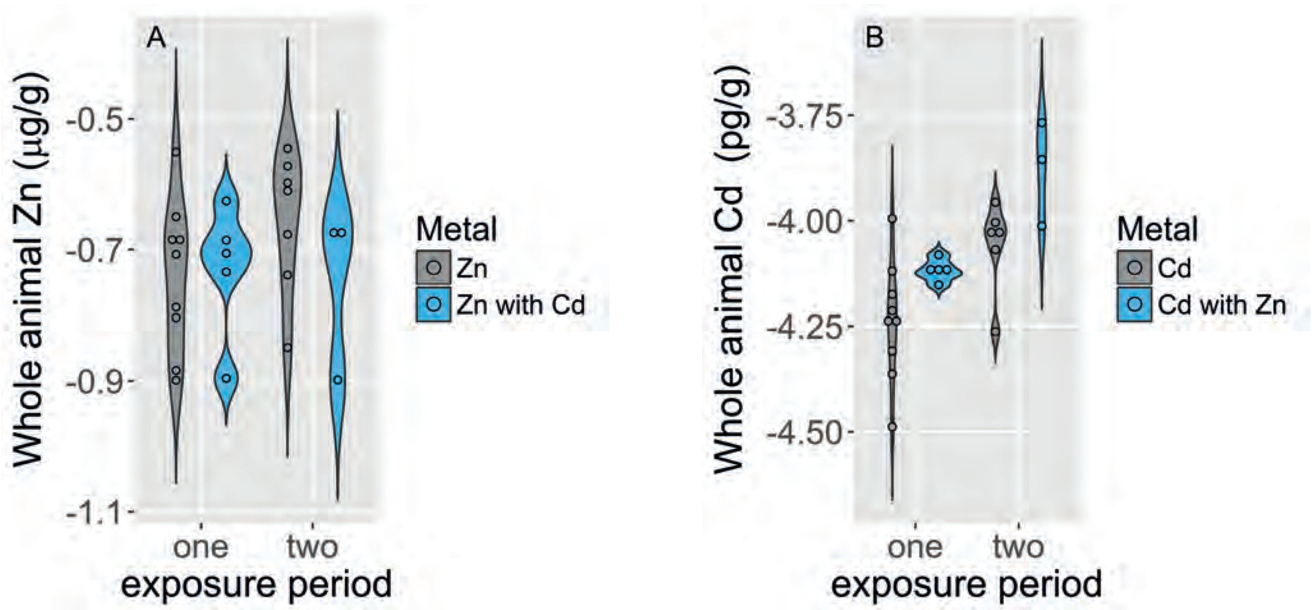

Figure 1: Internal concentration of Zn (A) and Cd (B) following one or two exposure periods. The ascidian Styela clava was exposed to the radioisotopes ^{65}Zn and ^{109}Cd singly (denoted 'Zn' or 'Cd', respectively) or dually (denoted 'Zn with Cd' and 'Cd with Zn', respectively). Each exposure period lasted 4 days. The density of whole body concentrations is shown by the violin plot and each circle represents the whole body concentration of one ascidian. Data are log_{10} transformed.

A trace metal's accumulation differed with its nature and the frequency of exposure. The internal concentration of a non-essential metal (Cd) was greatest (1) in the presence of an essential metal (Zn) and (2) following a second exposure. Furthermore, this non-essential metal was distributed differently within the body, suggesting the use of specific physiological mechanisms.

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This project was supported by an AINSE PGRA and through collaborative links between the ANSTO Environmental Research (Tom Cresswell), ANSTO Human Health Research (Paul Callaghan), ANSTO Radiobiology and Bioimaging (An Nguyen and Zoe Williams) and CSIRO Land and Water (Merrin Adams).

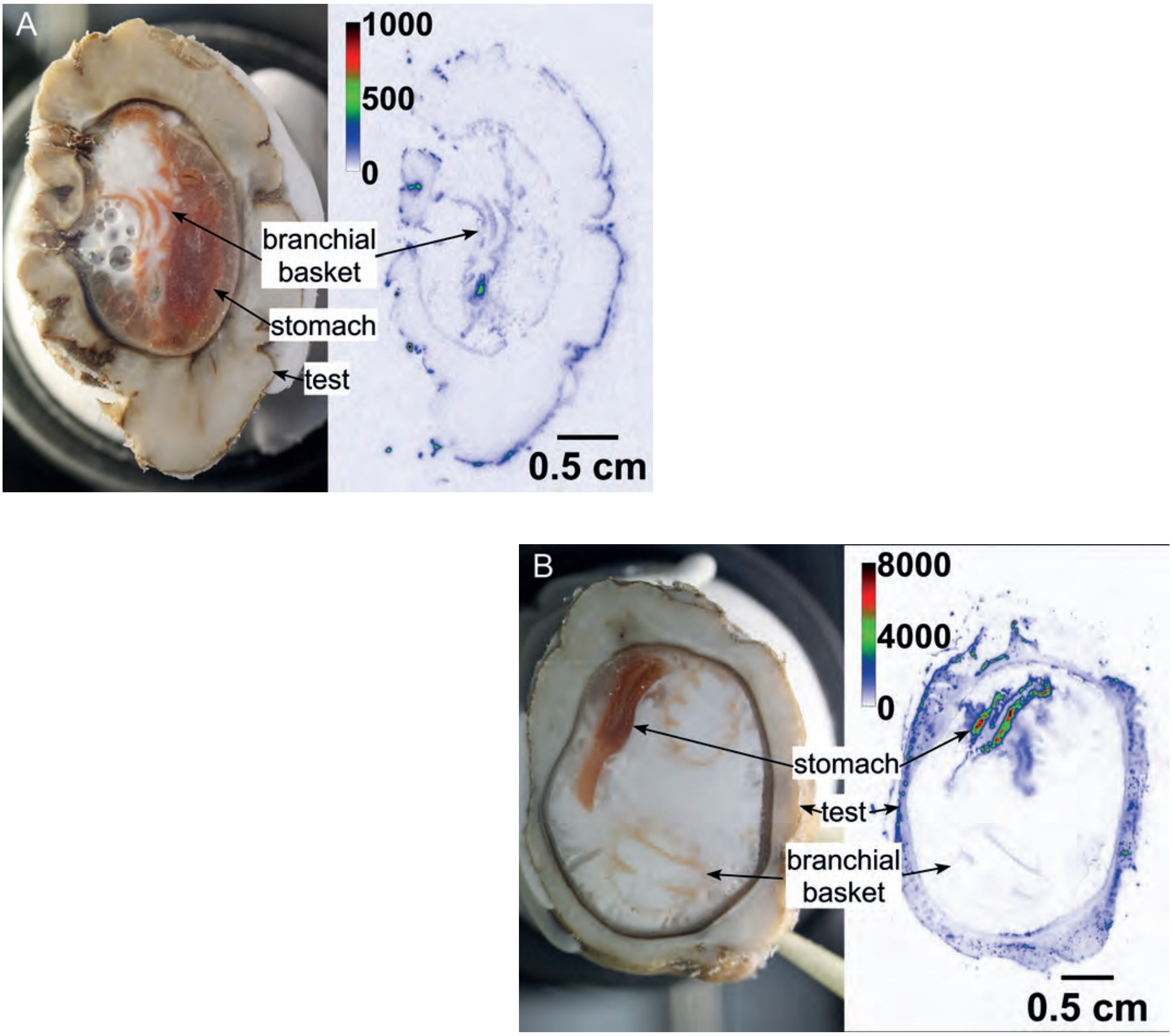


Figure 2: Internal distribution of ^{65}Zn (A) and ^{109}Cd (B) in the ascidian Styela plicata following the first exposure to dissolved radioisotopes. Colour bars on autoradiographs represent intensity of ^{65}Zn and ^{109}Cd per cm^2.

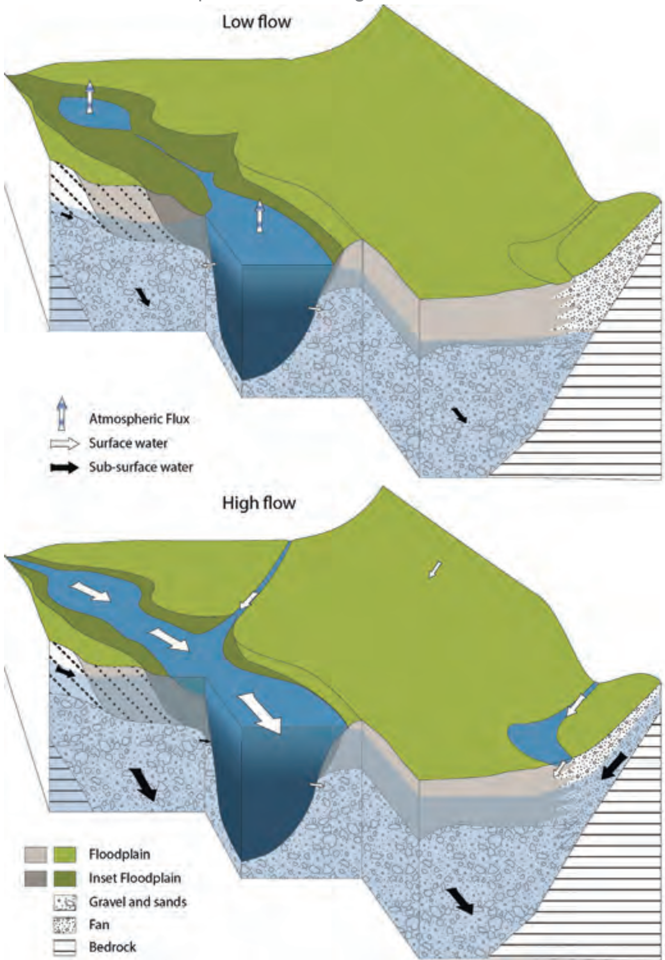
THE STRUCTURE, FUNCTION AND EVOLUTION OF CHAIN-OF-PONDS RIVERS: DEVELOPING A GEOMORPHIC FRAMEWORK FOR CONSERVATION AND REHABILITATION

Rory Williams[1], A/Prof Kirstie Fryirs[1], A/Prof Grant Hose[2]

[1]Department of Environmental Sciences, Macquarie University
[2]Department of Biological Sciences, Macquarie University

Figure 1(Above): Images of the Mulwaree River showing the same locations during no-flow and high-flow. Photos (left) E. Lisenby, (right) T. Ralph

Figure 2: No-flow and high-flow conceptual models for surface (white arrows) and sub-surface (black arrows) flows of the Mulwaree River. Semi-transparent blue layer over the cross-section is the sub-surface water level. Size of the arrow represents the magnitude of flow



Fluvial ecosystems function on a physical template created through hydro-geomorphic processes. Understanding the geomorphic structure, function and evolution of river systems provides vital information for appropriate management and identification and recognition of river diversity for conservation and rehabilitation. Chains-of-ponds are a form of discontinuous watercourse consisting of steep-sided ponds separated by densely vegetated alluvial valley fill sediments that contain shallow ephemeral channels or preferential flow paths. They are naturally resilient landforms and were prevalent across many of the low-slope tableland headwater areas of south-eastern Australia prior to European settlement. However, many have been lost due to landuse changes over the past 200 years and further changes to landuse and climate are predicted to enhance the risk of losing more of these important and iconic landscape features. Of particular interest is the Mulwaree Ponds system near Goulburn, NSW, one of the last remaining, large-scale chain-of-ponds in the country (Figure 1).

In this PhD project, Optically-stimulated luminescence dating (OSL), along with stratigraphic interpretation undertaken during an extensive coring program has been used to establish the long term evolution of the Mulwaree River. Large changes to the geomorphic structure have occurred over the last 100ka, from a high-energy sand and gravel bed river to a fine-grained suspended-load discontinuous watercourse. The current morphology of the chain-of-ponds was likely established in the mid-Holocene. These adjustments are synchronous with climatic changes associated with the decline in fluvial activity see across SE Australia in other river systems. However, here the manifestation of this adjustment has resulted in the formation of a discontinuous watercourse characterised by a chain-of-ponds. This transition has not been recorded elsewhere. The antecedent control of pool location during the Mulwaree River's higher energy phase has guided the establishment and persistence of exceptionally deep ponds that are beyond the capacity of the present river to create (or recreate in the event of their loss through incision or infilling).

The contemporary function of Mulwaree Ponds is characterised by dichotomous surface flow states of high-flow and no-flow (Figure 2). The hydrological function, and surface-subsurface water interactions in this system were assessed using ^{222}Rn and δ^2H and $\delta^{18}O$ stable isotopes. During high-flow or flood events, the Mulwaree Ponds is dominated by flow along the connecting channels and preferential flow paths between ponds. At this stage, flow is continuous through the system. The stable isotope ($\delta^{18}O$ and δ^2H) values of the pond water during high-flow periods were close to the local meteoric water line and were more depleted than any floodplain groundwater samples. This suggests that the pond water is dominated by inflow from overland flow sources at this flow stage (Figure 3). During no-flow periods the ponds are not recharged from the groundwater in a sufficient volume to alter the stable isotope composition or radon levels. Instead water levels are maintained by a hydraulic gradient from the surrounding (extensive) floodplain aquifer, which is itself fed by rainwater. The loss of water from the ponds during dry periods is predominately through evaporation. The functionality of the system changes between states but, on average, water levels between the ponds and the floodplain aquifer remain equivalent. The findings suggest that the hydrology of these systems could be highly sensitive to local-scale water extraction, shallow groundwater aquifer interference and declines in recharge from lower runoff and higher evaporation due to climate change.

ACKNOWLEDGEMENTS

This project was funded by an AINSE Postgraduate award and stipend (grant number 9201401114). This supported the gamma spectrometry analysis for OSL dating and the stable isotope and radon analysis of waters. Dr Suzanne Hollins, Dr Cath Hughes, Barbora Gallagher, Robert Chisari and Daniela Fierro were integral to these analyses at ANSTO. I hold an Australian Postgraduate Award (APA) and have received Macquarie University Higher Degree Research support. The remainder of this PhD project is funded by an ARC Linkage Project (LP 130100120) awarded to my supervisors A/Prof Kirstie Fryirs and A/Prof Grant Hose at Macquarie University. The ARC project partners are the Greater Sydney Local Land Services. I also wish to acknowledge the support of Randolph Griffiths and Amanda Carter on the property 'Kelburn'.

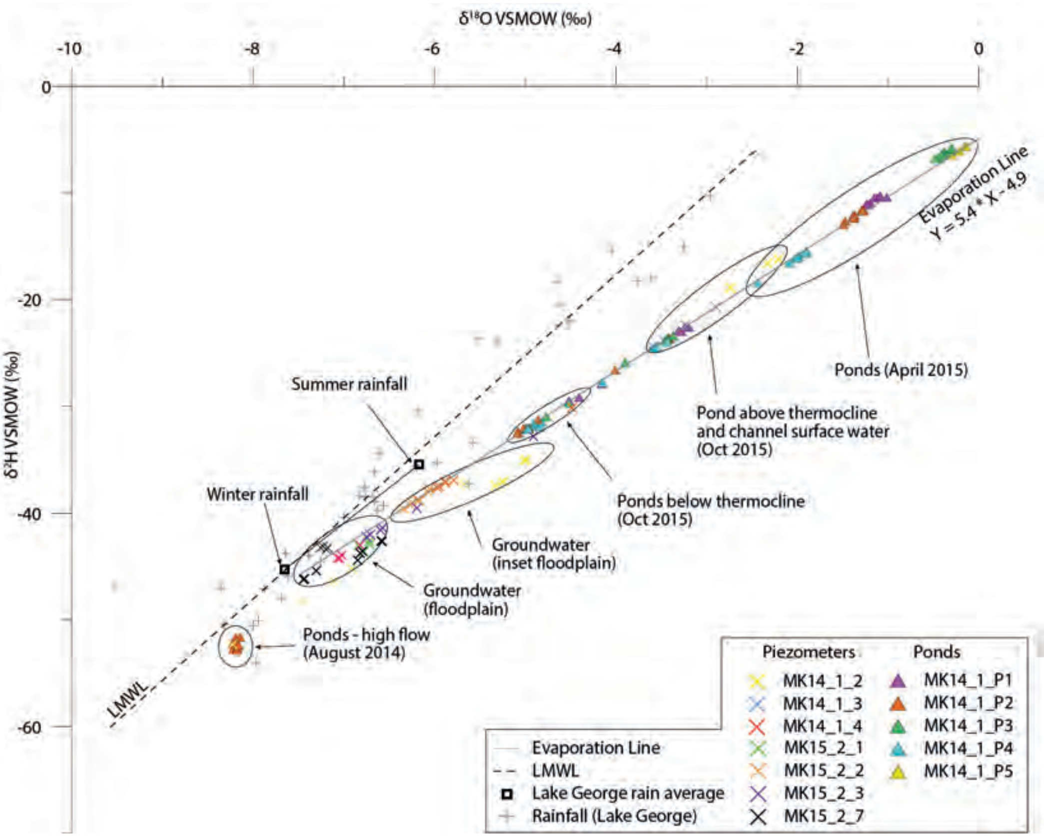


Figure 3: Stable isotopes ($\delta^{18}O$ and δ^2H) results relative to VSMOW for pond (Δ) and piezometer (□) samples. Evaporation line calculated from April and October 2015 pond no-flow samples. Groundwater samples are grouped (black ellipses) into two sets; floodplain and inset floodplain. Pond and connecting channel waters are grouped into four sets; August 2014 high-flow, April 2015 no-flow (where there was no thermocline), and October 2015 below and above the thermocline

AUSTRALIAN CONTINENTAL DUST FLUX: WHERE DOES THE DUST COME FROM AND WHERE DOES IT GO?

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Significant amounts of dust are transported both within Australia and offshore to the oceans. Dust, or fine particle aerosols, can have a serious impact on human health and the environment, reducing visibility and disrupting air travel. Many will remember the intense dust storm event on 23 September 2009 which affected much of the east coast of Australia, named in the local media as the "Red Dawn" dust event, and even deposited dust on the New Zealand ski fields two days later. Dust storms usually occur during periods of strong winds, low soil moisture and limited vegetation cover in source areas. For inland areas of Australia, the deposition of dust is a significant source of nutrients for the relatively infertile soils. Conversely, large dust storms can also result in substantial losses of topsoil and export of nutrients. Offshore deposition of transported dust can also increase nutrient concentrations in marine ecosystems.

This study analysed dust samples from four time periods at four long-term aerosol monitoring sites, located in important dust transport pathways of Broome (28 July 2010 – 29 December 2013), Heron Island (2 July 2008 – 23 June 2013), Fowlers Gap (2 July 2008 – 30 June 2010) and Mount Stromlo (9 July 2008 – 19 February 2012). Analysis of these samples allowed us to identify dominant dust pathways and sources, rather than just the effect from a single event.

We used a combination of Ion Beam Analysis to quantify the elemental concentrations to provide a geochemical "fingerprint" of the samples and HYSPLIT back trajectory modelling to identify transport pathways and source regions. Standard geochemical fingerprints can be used to identify samples which are sourced or dominated by regolith, oceanic salt, smoke, organic matter or other

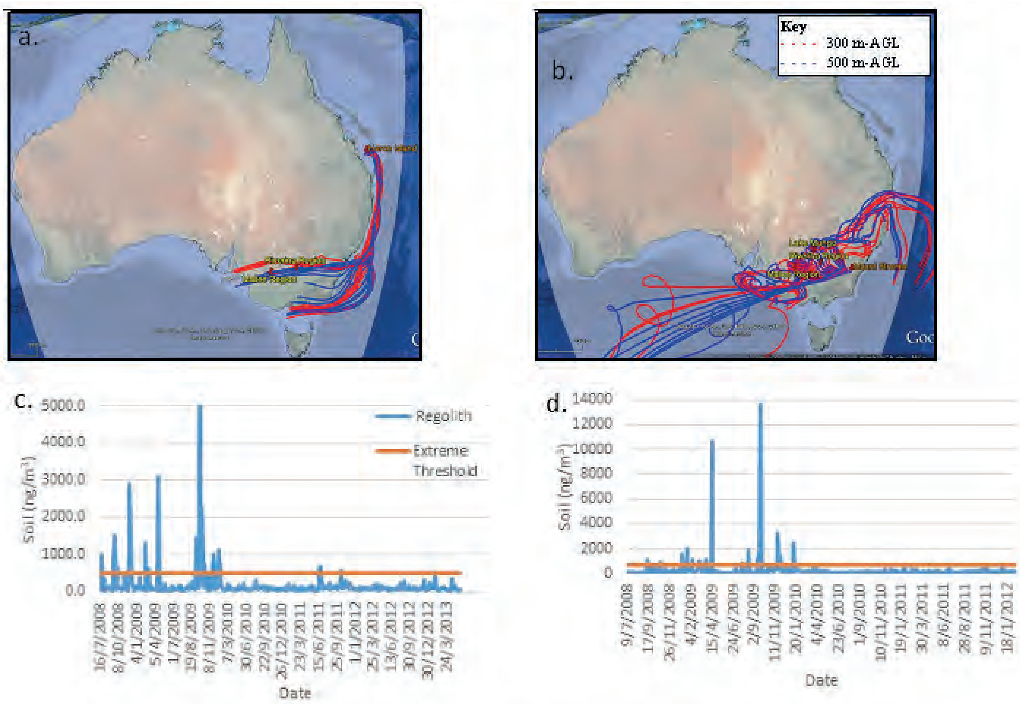


Figure 1. Seven-day hourly back trajectories at heights 300 m-AGL and 500 m-AGL (above ground level) from a) Heron Island on 19 April 2009, and b) Mount Stromlo on 15 April 2009 and source locations, and PM2.5 soil concentrations and the extreme threshold measured at the 95th percentile at c) Heron Island between July 2008 and June 2013 and d) Mount Stromlo between July 2008 and February 2012

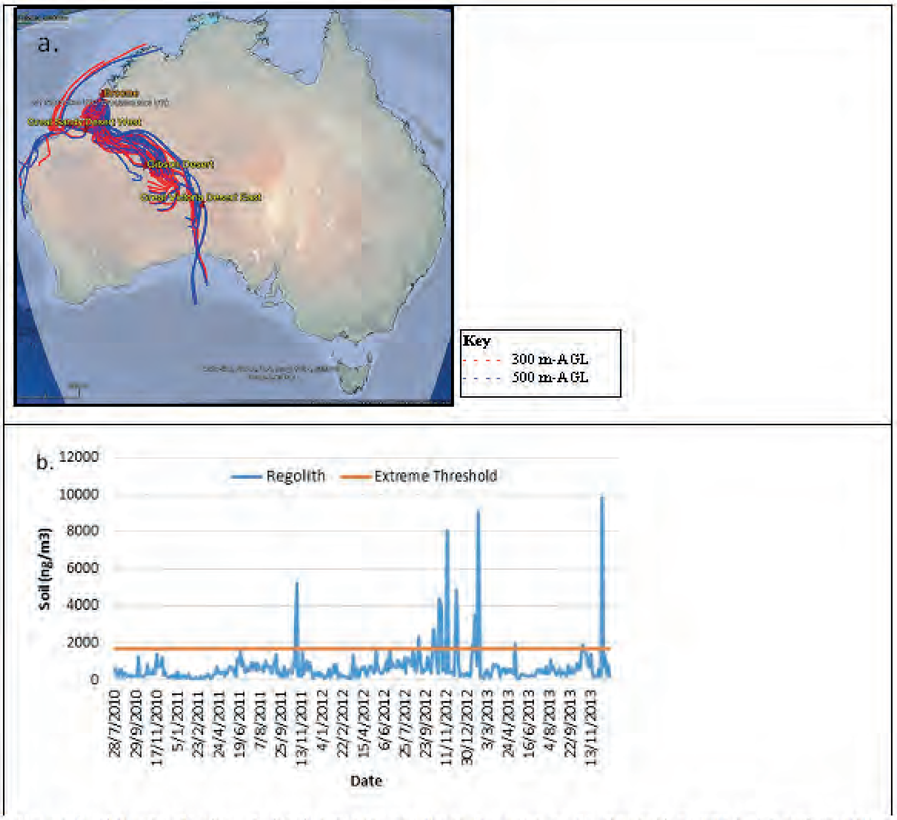


Figure 2. a) Seven day hourly back trajectories from Broome on 11 December 2013 at heights 300 m-AGL (above ground level) and 500 m-AGL and source locations, and b) PM2.5 soil concentrations at Broome between July 2008 and December 2013 and the extreme threshold measured at the 95th percentile

combinations which can identify specific environments.

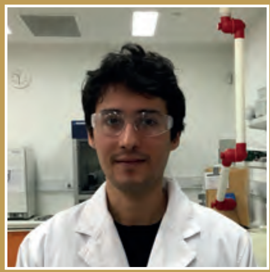
We found that for eastern Australia, a significant amount of dust is sourced from agricultural areas such as the Mallee and Riverina regions (Figures 1a-d), and is transported in a north-easterly direction. Dry lakes in these regions, such as Lake Eyre and Lake Windaunka, are also sources of salt that are transported along these same pathways. Similarly, at Fowlers Gap, dust is dominated by regolith and sourced from the southern Flinders Ranges and also transported in a north-easterly direction. In Western Australia, dust is also dominated by material sourced from the Great Sandy Desert and transported in a north-westerly direction (Figure 2a and b).

This study confirms that dry lakes, especially their fringe areas, the arid zone and dryland agricultural areas can be significant sources of dust, which are transported along known pathways, eventually to an oceanic sink. Further research can quantify the volume of 'topsoil' and quantity of nutrients that are being lost, particularly from agricultural areas, which is likely to be significant.

ACKNOWLEDGEMENTS

This project was supported by the Australian Institute of Nuclear Science and Engineering (ALNGRA14541). We would like to thank David Cohen and Eduard Stelcer from ANSTO for their input and assistance in the analysis of the samples.

REAL-TIME ANALYSIS OF STRUCTURAL CHANGES IN ION-EXCHANGE MEMBRANES DURING ELECTRO-DIALYSIS EXPERIMENTS IN MIXED SOLVENT ENVIRONMENTS



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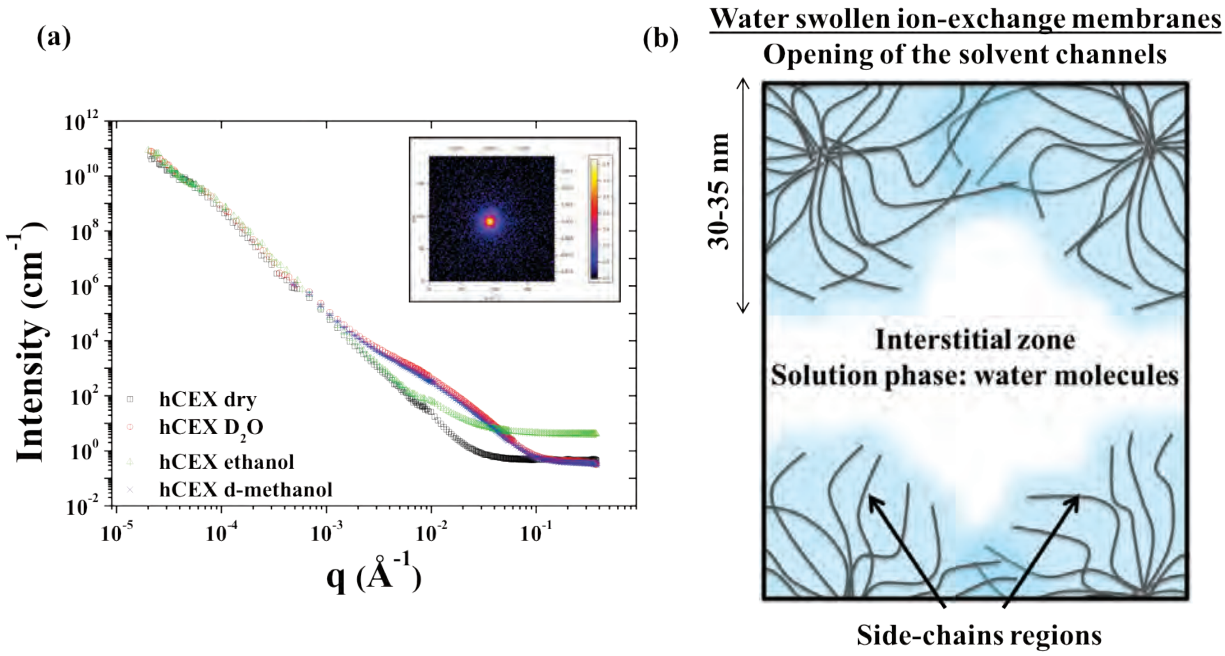

Figure 1: (a): Combined USANS/SANS data curves of the hybrid cation-exchange membrane (hCEX) with the inset representing a raw isotropic SANS scattering pattern at 20 m sample-to-detector distance. **(b)**: Cross-sectional illustration of the microstructure of the ion-exchange membranes when equilibrated in water.

Electro-membrane processes are mature separation technologies with a multitude of industrial applications. Electro-dialysis is one of the most representative electro-membrane processes and is primarily applied for seawater and inland brackish water desalination. During electro-dialysis operation, ionic and salt species are selectively transported across ion-exchange membranes and removed from the feed solution under the influence of an electrical current generated between two electrode plates. To date, all major industrial applications of electro-dialysis have been primarily limited to aqueous environments due to the loss of electrical and ionic conductivity of the ion-exchange membranes in non-aqueous environments.

Ion-exchange membranes are composite materials typically processed as thin sheets (150 to 300 μm) formed by shaping high-molecular weight polymeric ion-exchange materials. A flexible, macroporous and chemically inert polymer structure is usually used as a mechanical support. The free volume across the membrane and the material chemistry dictate the selective transport of ionic species across an interconnected network of charged clusters and channels. A key challenge to overcome in the separation of ionic species in pure or mixed organic solvents is therefore the control of the swelling of the different components of the membrane materials.

The first aim of this project was to determine and understand the organisation of the membrane structure when equilibrated in single and mixed solvents and its effect on the ionic transport. The interface between the ion-exchange material and the mechanical support was evaluated in the ultra-low-q region using Kookaburra, the ultra-small-angle neutron scattering instrument (USANS), while a broad solvent-dependent peak at the mid-q region was revealed by Quokka, a small-angle neutron scattering instrument (SANS), which was correlated to the microstructural properties of the materials on the nanoscale (Figure 1a). The USANS/SANS findings, supported by the extensive physico-chemical characterisation, allowed us to develop a model of the macro and microstructural changes of the ion-exchange membranes in mixed solvents environments as illustrated in Figure 1b.[1]

The second aim of the project was to investigate, in real-time, the effect of the electrical field on the membrane structure during electro-dialysis process. A SANS cell was specially designed to acquire SANS measurements of ion-exchange membranes during the in-situ electro-dialysis process as seen in Figure 2. Multiple identical cells were made using a stereolithography (SLA) 3D printer in order to limit the downtime during experiments to a minimum (due to the activation of the aluminium windows in the neutron beam). The electrodes/windows of the cells were made out of 0.3 mm thick aluminium foils in order to provide good electrical conductivity, transparency toward the neutron beam and sufficient mechanical strength. In addition, the 4 cm^3 electro-diffusion cell design allowed for the use of deuterated solvents. The cell voltage was maintained between 0 and 1.5 V during the experiments. The data analysis revealed that in the pure diffusion regime, U = 0 V, the SANS measurements were found to be consistent for the duration of experiment (Figure 3). However, for an applied potential of U = 0.5 V, clear variations of free volume and Guinier knees appeared for the cation-exchange materials at q ~ 0.01 $Å^{-1}$ suggesting consequent reshaping of the ionic clusters across the membrane material due to the electrical field, or electro-migration of ions under the experimental conditions. No further variations were noticed during the following experiments at U = 1 and 1.5 V which reveal that the structural changes induced at U = 0.5 V were persistent.

The combined USANS/SANS data allowed for the characterisation of micrometer to sub-nanometer sized features across the ion-exchange membranes while the in-situ SANS acquisition revealed the kinetic behaviours of the material during electro-dialysis. Data acquisition and modelling were performed with the kind assistance of Dr. Chris Garvey and Dr. Christine Rehm and the SANS in-situ electro-dialysis experiments were made possible with the help and support of the Sample Environment team at the Australian Centre for Neutron Scattering.

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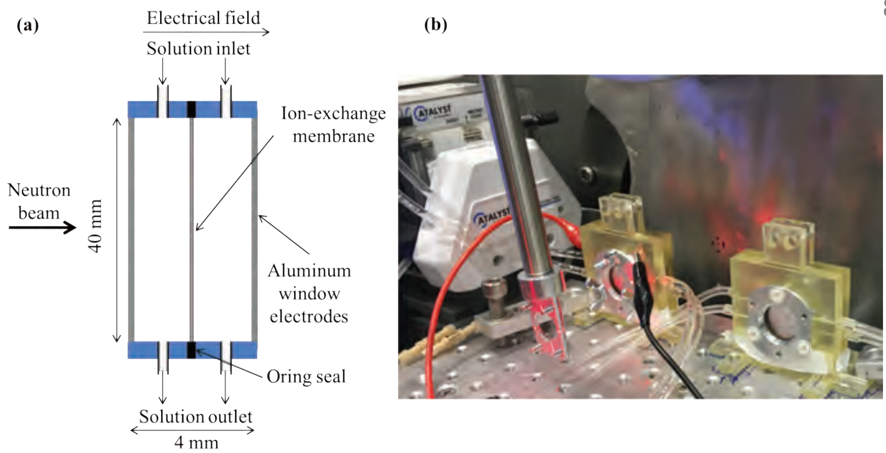

Figure 2: (a): Cross-sectional view of the electro-diffusion cells developed for the in-situ SANS measurements. **(b):** Picture of the electro-dialysis cells with a polypropylene-like (FullCure720®) resin frame fabricated on a stereolithography 3D printer.

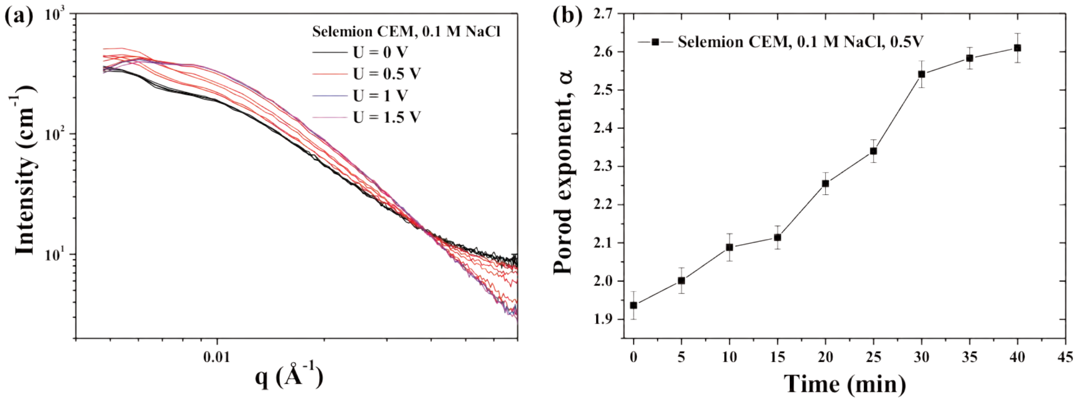

Figure 3: (a): Reduced SANS spectra of the Selemion® cation-exchange membrane (CEM) during electro-dialysis tests in 0.01 M NaCl and D2O. Data were measured for 40 min and post-binned with 10 min intervals. **(b):** Porod exponents as a function of the ED time for U= 0.5 V.

NEW APPROACHES FOR PROBING STRUCTURE-STIMULUS RELATIONS IN RESPONSIVE POLYMER BRUSHES

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[3] ACNS
[4] UNSW Sydney

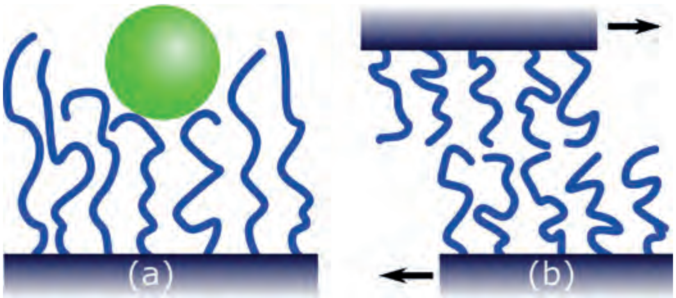

Figure 1: Polymer brush coated surfaces imparting (a) antifouling and (b) lubricating properties

Microscopic interfacial interactions have a macroscopic impact on a wide range of processes including lubrication, particle stability, self-cleaning and biofouling. A versatile method for controlling these interactions is the formation of polymer brushes through the dense end-grafting of polymer chains from the surface (Figure 1). Advances in controlled radical polymerisation techniques allow brushes to be formed on surfaces ranging from planar substrates, spherical nanoparticles, fibres and porous membranes. Incorporating monomers whose properties respond to external stimuli allows applications such as switchable lubricants, chromatography supports, cell-culture substrates and bio-sensors. Lab scale techniques including atomic force microscopy, contact angle, ellipsometry and quart-crystal microbalance allow the responsive nature of the surface to be characterised. However, the stimuli-response is dependent on the structure of the polymer at the interface and this can only be efficiently probed using neutron reflectometry (NR).

A significant focus of my work is understanding specific ion effects on polymer brushes. Specific ion effects are any phenomenon that is dependent on the identity of salt, not just its concentration. Seminal theories of weak polyelectrolyte brushes show that they are responsive to both pH and ionic strength but do not consider electrolyte identity. However, we have shown experimentally that the identity of added salt in the system can dramatically alter the response to ionic strength. NR measurements on a poly(2-diisopropylamino)ethyl methacrylate (PDPA) brush revealed that a collapsed conformation is favoured

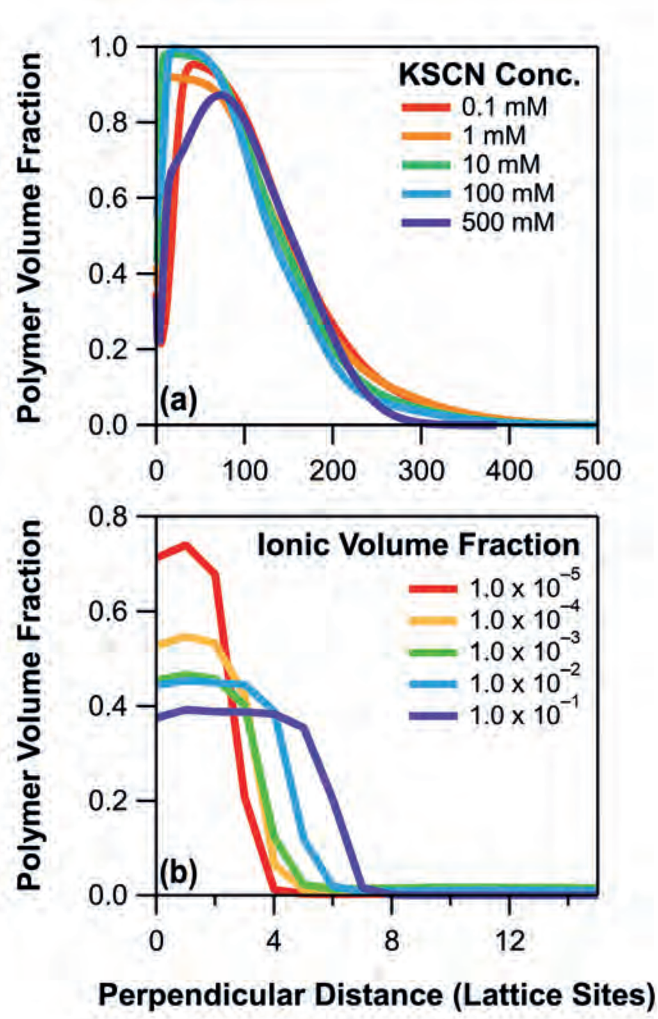

Figure 2: Relatively collapsed volume fraction profiles of (a) a PDPA brush as a function of chaotropic KSCN concentration determined by neutron reflectometry (NR) and (b) a hydrophobic polyelectrolyte brush as a function of volume fraction of hydrophobic anions determined by numerical self-consistent field theory (nSCF). Similar NR measurements in kosmotropic KCH_3COO and nSCF calculations with hydrophilic anions produce relatively extended volume fraction profiles (not shown). This supports the conclusion that anion hydration can account for the experimentally observed profiles. NB - Ionic volume fraction range corresponds to ~0.5 – 5000 mM

in potassium thiocyanate (Figure 2a), while the brush extends in potassium acetate. These data allowed us to develop and validate an extended numerical self-consistent field theory that showed that the degree of anion hydration can account for the observed effects (Figure 2b).[1]

The nature of ions also affects the structure of thermoresponsive brushes. Experiments on the archetypal thermoresponsive bush, poly(N-isopropylacrylamide) (PNIPAM), show that the brush phase separates into a dehydrated layer near the substrate followed by a swollen tail at temperatures between its fully collapsed and swollen states.[2] This phase separated structure accounts for the mismatch between measurements from surface and bulk sensitive techniques. In contrast to PDPA, addition of thiocyanate leads to more expanded brushes for a given temperature (Figure 3a). We have also studied an emerging family of biocompatible thermoresponsive polymer brushes known as the poly oligo(ethylene glycol methacrylates) (POEGMAs.) POEGMA copolymer brushes allow composition dependent tuning of the brush collapse temperature. NR measurements show that these brushes are significantly more sensitive to the addition of thiocyanate than PNIPAM and do not phase separate (Figure 3b).[3] Key to this analysis is the ongoing development of new software in close collaboration with Dr Andrew Nelson at the ACNS. Our most recent work involved the commissioning of a cell for Platypus which allows the structure of brushes to be studied under mechanical confinement. This brings us closer to observing inter-surface structures found in lubrication, antifouling and particle stabilisation applications. Preliminary work has showed that thermoresponsive brushes collapse at lower temperatures when confined by 1 bar of pressure.

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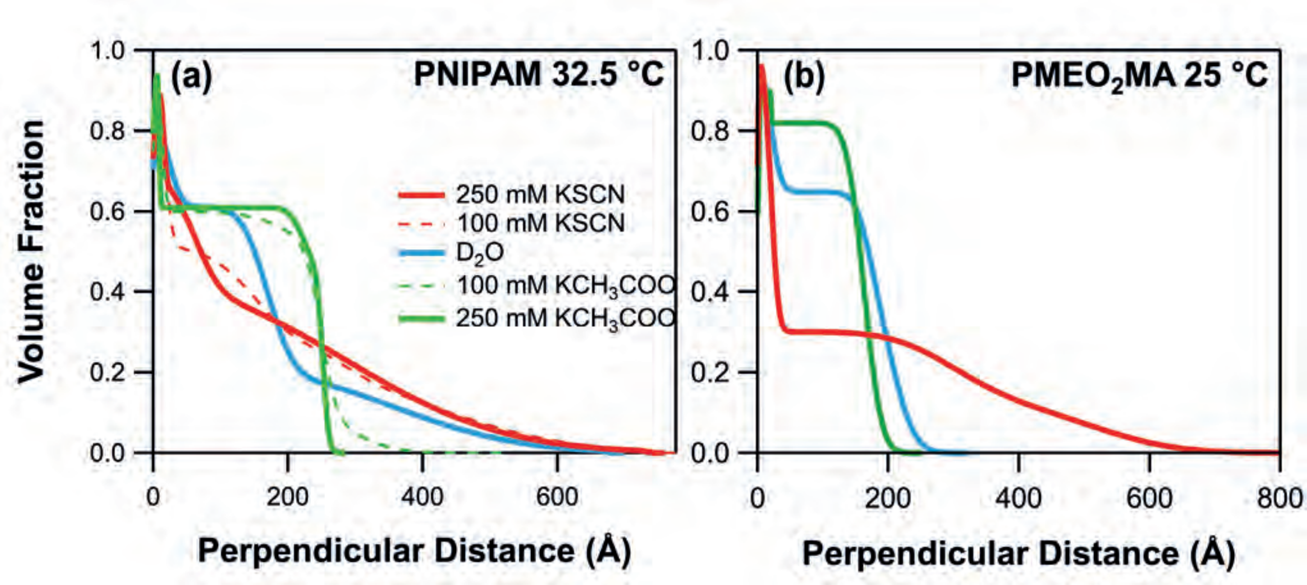

Figure 3: Volume fraction profiles as a function of salt concentration and identity of an (a) PNIPAM and (b) $PMEO_2MA$ brush determined by neutron reflectometry. Chosen temperature corresponds to the middle of the swelling transition in D_2O

MULTISCALE CHARACTERIZATION OF REDUCED GRAPHENE OXIDE ASSEMBLIES

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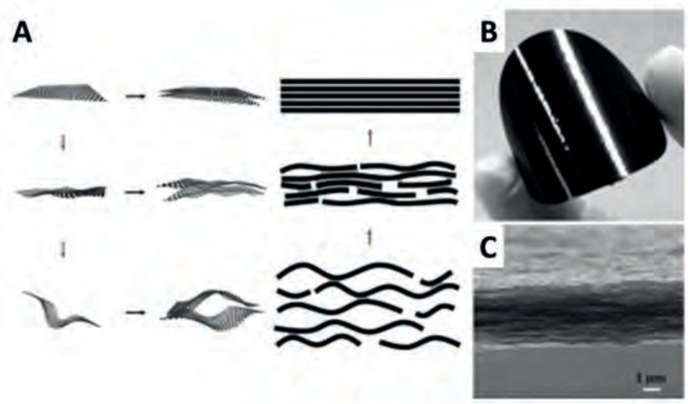

Figure 1: Illustration of the process to produce layered rGO assemblies from aqueous dispersions where the corrugation of the sheets can be influenced by hydrothermal treatment, drying method, and/or degree of oxidation to produce a different pore structure in the bulk (A). The rGO assemblies can be kept hydrated as free-standing hydrogels (B) or dried to form rGO paper (C). Reproduced from [3].

This work investigates the structure of reduced graphene oxide (rGO) assemblies from the sub-nm to macro-scale, relating the physical morphology to the material performance in these distinctive layered carbons. The wet processing of rGO sheets [1, 2] allows the chemistry to be specifically tailored, and further modification to the anisotropic pore structure of layered assemblies can be achieved through controlled hydration, resulting in a very distinctive type of porous carbon, as indicated in Figure 1 [3]. Many different processing conditions have been examined in this work, with a specific focus on the influence of oxidation and drying. Because the structure of these porous rGO assemblies is rather disordered and varies across a very broad range of length scales, X-ray and neutron diffraction and scattering techniques are able to provide insight on the total surface area of the pore network and structure of the carbon matrix – if the data is collected across a large q-range and with specific geometric considerations, as shown in Figure 2.

For this project, a microscale model based on the structure and chemical composition of the rGO sheets was developed. Then, the specific features of this model were used to describe and quantify the clustered structural units making up the carbon matrix and resulting pore network, as depicted in Figure 3. The basic structural unit (BSU) was found to be a turbostratic cluster consisting of approximately seven rGO layers with an (hk) coherence length extending across 6 nm with smaller, 1 nm, aromatic domains. The BSU was then used to evaluate rGO assemblies at the meso- and macroscale, and results show that while the size of these BSUs remains relatively constant, processing conditions will impact the disorder and the resultant stacking density, which is directly linked to the accessible surface area and ensuing pore network within the bulk. At the mesoscale, small and wide angle scattering (SANS, SAXS, WAXS) proved to be ideally suited for characterizing the pore network in both dried and hydrated rGO assemblies, offering the

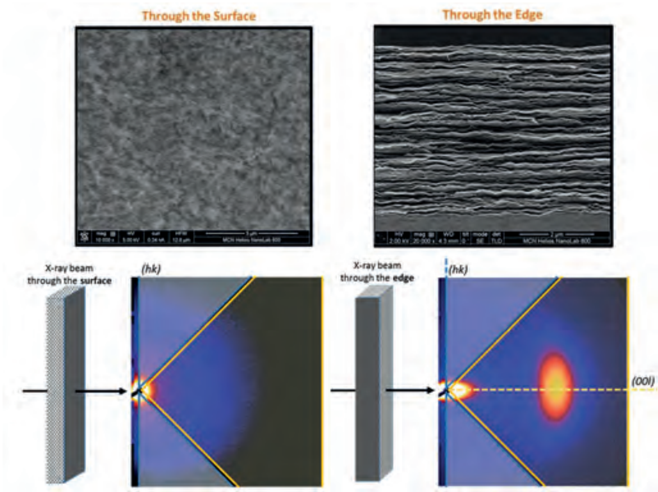

Figure 2: General description of how the alignment of specific structural elements in the rGO assemblies will influence the scattering pattern, depending on if the scattering measurements are taken through the surface or through the edge of the assembly. The SEM images (top) and schematic of the scattering geometry indicate how the rGO layers are oriented with respect to the incoming beam to produce the 2D scattering results. The scattering features detected at low-q (small angles) are representative of the pore network and carbon matrix, while the diffraction peaks for the (00l) and (hk) planes are only detected at very high-q (wide angles).

additional advantage of operating in ambient conditions and extending across a wide size range, as indicated in Figure 3.

Ashley Roberts has a research background in advanced electron microscopy characterization methods, and the AINSE PGRA award allowed her to expand her skillset to small angle scattering techniques in order to more fully characterize bulk materials such as porous carbons and nanocomposites. Professor Dan Li's current research interests are centered on synthesis and multi-scale characterization of graphene-based soft materials and their applications in energy storage and conversion, nanofluidics, bionics and environmental protection. He is well-known for his work with rGO materials, with two of his articles listed in the top 12 most cited papers in the field of Materials Science for 2004–14 (Thomson Reuters' Essential Science Indicators). Professor George Simon specializes in polymer blends, functional carbon nanoparticles, and polymer nanocomposites for specialized engineering applications and self-healing materials. Dr. Chris Garvey is an expert in small angle scattering techniques, with a particular focus on molecular ensembles at the interface between biology and materials science.

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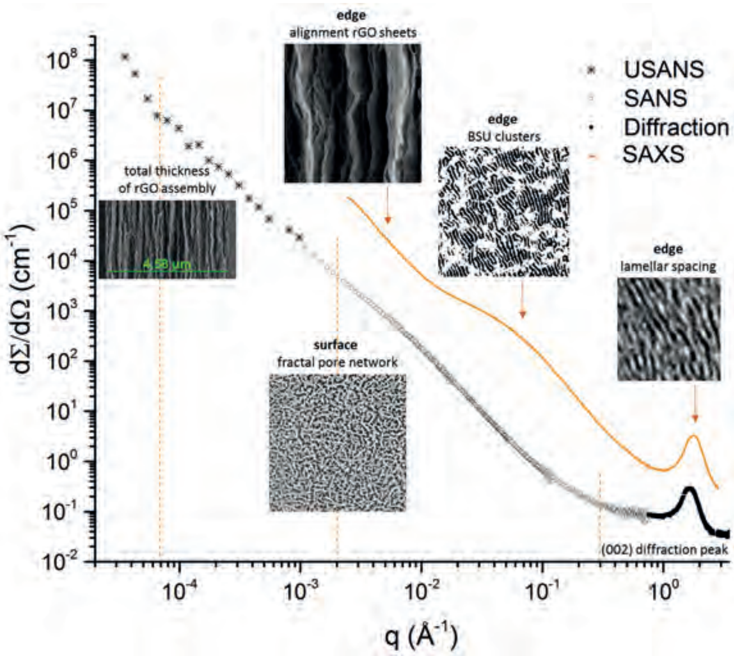

Figure 2: Depiction of the individual structural elements making up the X-ray (through-the-edge) and neutron (through-the-surface) scattering curves for rGO assemblies. This figure highlights the findings of this work, showing the influence of orientation and scale on the particular structural elements within the rGO assembly. The through-the-surface fractal network is consistent throughout the bulk, while the through-the-edge lamellar structure is composed of various structural entities that are only distinguishable with the high-intensity, small beam size available with X-rays. From right to left: the Bragg peak at high-q measuring the interlayer distance between the stacked aromatic domains; the broad feature at mid-q relating to the size of the turbostratic BSU clusters; the Porod region at low-q arising from the surface roughness of aligned and elongated rGO sheets; USANS extends the range to show that the fractal pore network continues uniformly across the entire 4.5 μm thickness of the rGO assembly.

SYNTHESIS AND STABILITIES OF HEAVY MAIN GROUP METAL HYDRIDES

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Metal hydrides (compounds containing M-H bonds) have a rich history and play key roles in catalysis, synthesis and more recently as hydrogen storage materials. The nature of metal-hydride bonding interactions is therefore of both fundamental and industrial importance. However, hydrids of the heavy main group metals (those with valence electrons in the 5s/6s and 5p/6p orbitals) are rare and in many cases, non-existent, due to their low thermal stability.[1] Until recently, analysis of this class of compound was limited to Infra-Red (IR) spectroscopy at very low temperatures (2-10 K). Within the past 20 years, room temperature stable species containing M-H (M = heavy main group metal) bonds have been reported using large ligands to prevent decomposition, allowing the determination of the bond connectivity using spectroscopy and X-ray crystallography. However, neutron crystallography is the only definitive method for determining the position of a hydrogen atom, and although this technique has been used extensively in the characterisation of transition metal hydride complexes, only two neutron structures of heavy main group hydrides have been reported in the literature.[2,3]

The aim of this research is to explore the nature of the metal-hydride interaction in a series of heavy main group metal hydride species. Although single crystal neutron diffraction is the only conclusive method for accurately determining the atomic position of hydrogen atom(s), classical neutron diffraction techniques require long collection times and large single crystals (>1 mm^3). In contrast, the Laue method used by the KOALA instrument at the Australian Centre for Nuclear Science (ACNS) allows the collection of neutron diffraction data using significantly smaller samples (>0.1 mm3) (Figure 1). With the help of Dr. Alison Edwards (ANSTO), we have used neutron diffraction to probe the structure of two indium hydride species stabilised by large ancillary ligands and have determined the first metric parameters for an In-H bond (Figure 2, 1 and 2).

The neutron crystal structure shows that in both cases, the hydride ligands are terminal and bound to a formally

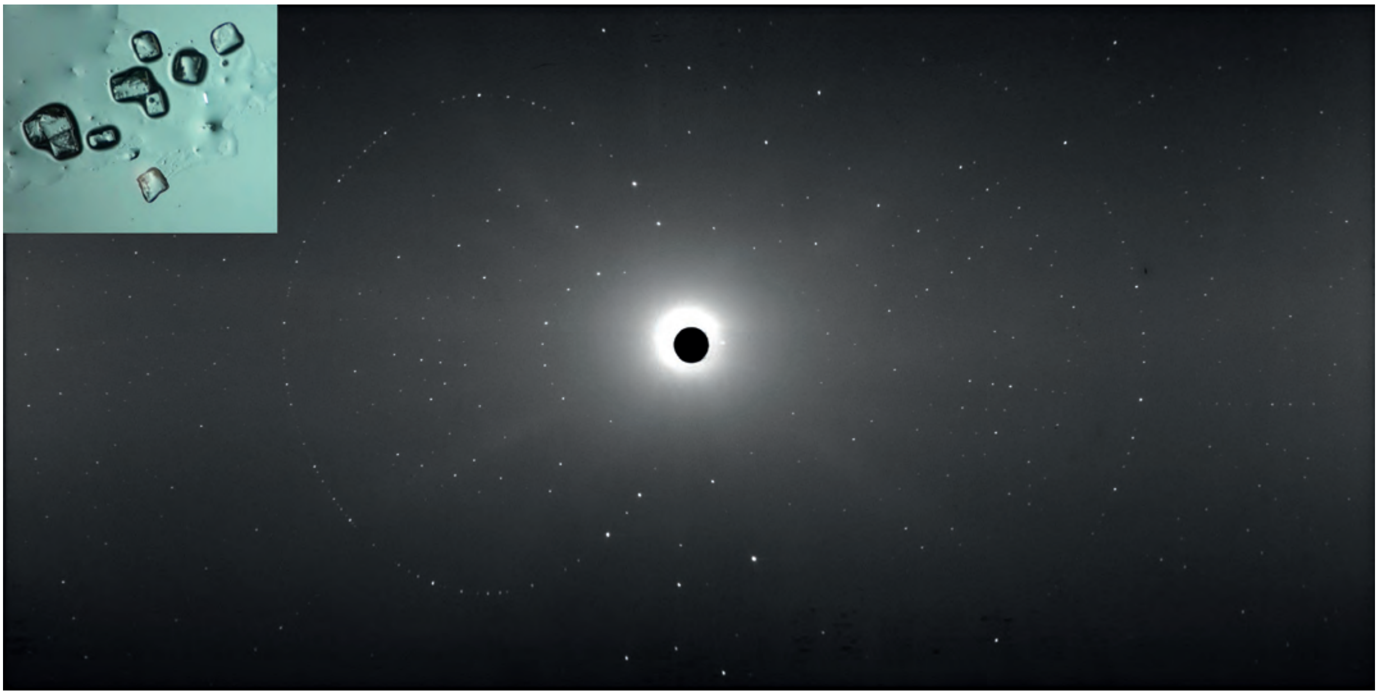

Figure 1: Crystalline samples analysed by neutron diffraction (top left) and neutron diffraction pattern obtained from the KOALA instrument.

negatively charged indium metal. The In-H bond distances (1, 1.751(3) and 1.723(3); 2, 1.746(3) and 1.722(3) Å) are in good agreement with the sum of covalent radii (Σ_{InH} = 1.73(10) Å), and show asymmetric bonding of the hydrides with one elongated In-H bond and one short In-H bond. Following from this investigation, our current efforts seek to exploit these and other bulky ligands in the stabilisation of other heavy main group hydrides (Sb and Bi), allowing characterisation by neutron diffraction, and the investigation of their potential applications as catalysts.

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The authors would like to acknowledge the Australian Institute of Nuclear Science and Engineering Postgraduate Research Award (AINSE-PGRA) and Victoria University of Wellington Doctoral Scholarship for their financial support, without which this research would not have been possible.

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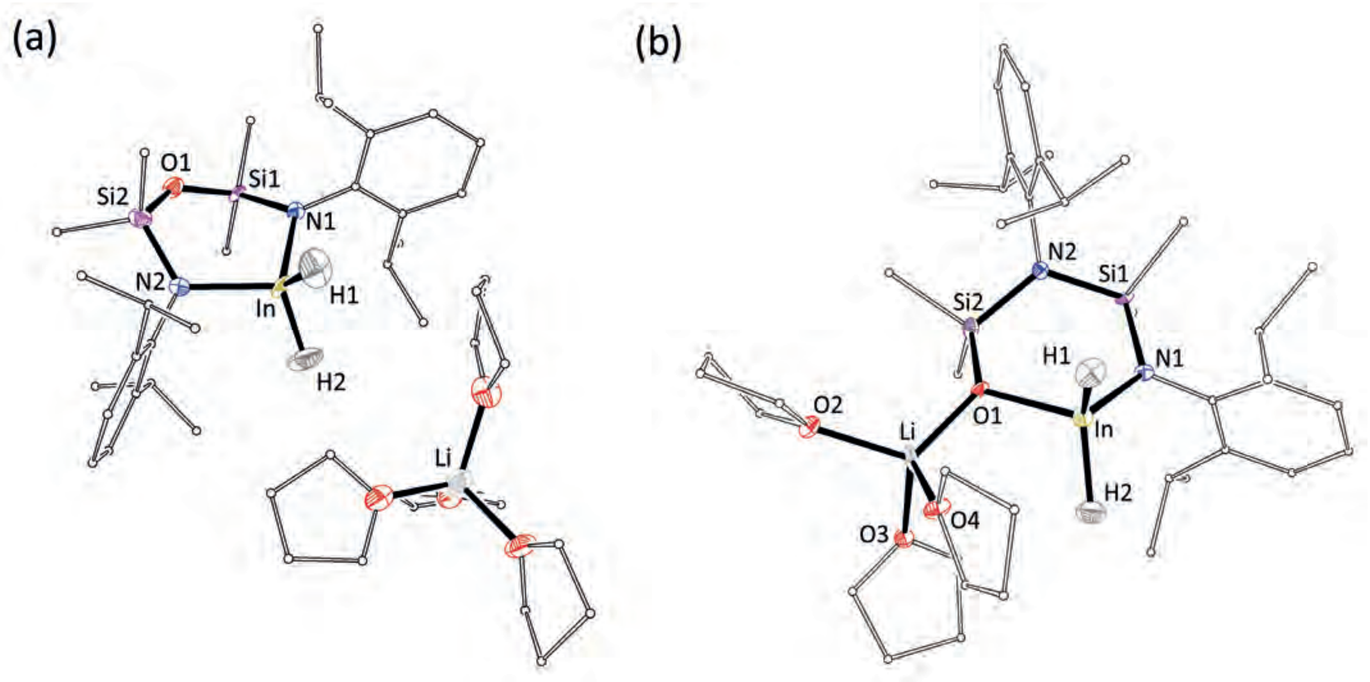

Figure 2: ORTEP representations of neutron structures of **1** (a) and **2** (b). Selected hydrogen atoms omitted and carbon atoms reduced for clarity.

USING SANS TO DETERMINE THE LOCATION AND CONFORMATION OF ENCAPSULATED PEPTIDES AND OTHER BIOMOLECULES WITHIN BICONTINUOUS CUBIC LIPIDIC MESOPHASES

Leonie van 't Hag,[1,2,3] Liliana de Campo,[4] Christopher J. Garvey,[4] Anna Sokolova[4] , George C. Feast,[3] Anna E. Leung,[5] Nageshwar Rao Yepuri,[5] Tamim Darwish[5] , Robert Knott,[4] Tamar L. Greaves,[6] Nhiem Tran,[6] Sally L. Gras,[1,2,7] Calum J. Drummond,[3,6] and Charlotte E. Conn[6]

[1]Department of Chemical and Biomolecular Engineering and [2]Bio21 Molecular Science and Biotechnology Institute, The University of Melbourne, Parkville, Victoria 3010, Australia
[3]CSIRO Manufacturing, Clayton, Victoria 3168, Australia
4 Australian Centre for Neutron Scattering and [5]National Deuteration Facility, Australian Nuclear Science and Technology Organisation (ANSTO), Lucas Heights, New South Wales 2234, Australia
[6]School of Science, College of Science, Engineering and Health, RMIT University, Melbourne, Victoria 3001, Australia
[7]The ARC Dairy Innovation Hub, The University of Melbourne, Parkville, Victoria 3010, Australia

Transmembrane peptides and proteins are located within the lipid bilayer environment of the cell membrane that surrounds the cells in most organisms. These peptides and proteins play an important role in solute transport, signal transduction and energy conversion in eukaryotic and prokaryotic cells. For this reason, they are important drug targets with more than half of all pharmaceutical compounds on the market targeting membrane proteins. The bicontinuous cubic phases are lipid bilayer structures that mimic the native environment of these membrane proteins and peptides. This research investigates whether transmembrane peptides preferentially partition to specific locations based on lipid bilayer curvature. As well as offering fundamental insight into the interaction between the peptide and the lipid bilayer, this research can advance a range of applications of hybrid protein-lipid materials including drug and vaccine delivery, crystallisation of membrane proteins, biosensors and biofuel cells.

Small-angle neutron scattering (SANS) experiments using QUOKKA showed that cubic membranes formed by the lipid phytanoyl monoethanolamide (PE) can be perfectly contrast-matched in D_2O. The contrast refers to the difference in scattering length density between different components in the sample. Here we have a three-component system of the transmembrane peptide, lipid and the solvent (D_2O). By mixing 87% w/w fully deuterated PE with 13% w/w fully hydrogenated PE we can match the scattering length density of the lipid bilayer to D_2O, resulting in the complete absence of Bragg peaks. Upon encapsulation of the hydrogenated transmembrane peptide WALP21 in the lipid bilayer (Figure 1(A)) we again have a difference in scattering length density and Bragg peaks (now resulting from the peptide) reappear, Figure 2. The intensity ratio of the Bragg peaks, particularly the √2 and √3 reflections of the diamond cubic Q_{II}^D phase, provides information on any enrichment of the peptide at either the locally flat or most negatively curved points, Figure 1(B). For the WALP21 peptide such enrichment was not observed, in contrast to what was suggested in several modelling studies.[1]

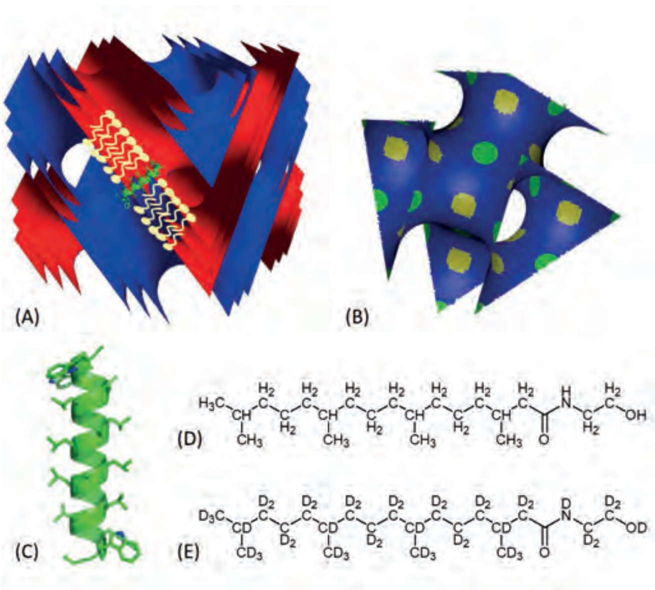

Figure 1: (A, B) Diamond cubic Q_{II}^D phase with the lipid bilayer indicated in (A) and the areas of varying Gaussian curvature indicated in (B). The local flat points are indicated with the green spheres and the points of highest negative curvature are indicated with the yellow spheres. In (C) the secondary structure prediction of WALP21 is shown. (D) Shows the chemical structures of fully hydrogenated (H)-PE and (E) of fully deuterated (D)-PE.

The results shown in Figure 3 are from the diamond cubic Q_{II}^{D} phase of phytantriol as an example for using time-of-flight SANS on BILBY. It can be seen that very good peak separation was obtained due to the improved wavelength resolution using the choppers (~5%). Currently the research described here is extended using different lipids and peptides t–o gain an improved understanding on drug delivery and in meso crystallisation.

This project is possible due to the collaboration between a large number of people and institutes. Particularly, the beamline scientists at the QUOKKA, BILBY and SAXS beamlines at ANSTO: Chris Garvey, Liliana de Campo, Robert Knott and Anna Sokolova, the team at the National Deuteration Facility lead by Tamim Darwish, the Molecular Assembly Lab at RMIT University lead by Charlotte Conn and Calum Drummond, Sally Gras at the University of Melbourne and Raffaele Mezzenga at ETH Zurich.

ACKNOWLEDGEMENTS

We acknowledge support of the Australian Centre for Neutron Scattering, Australian Nuclear Science and Technology Organisation in providing neutron research facilities and the Australian National Deuteration Facility (partly supported by the National Collaborative Research Infrastructure Strategy (NCRIS) – an initiative of the Australian Government) for providing the chemical deuteration facilities used in this work. We thank AINSE, Ltd for providing financial assistance (Award – PGRA) to L.v.H. to enable work at the Bragg Institute. S.L.G. is supported by the ARC Dairy Innovation Hub IH 120100005.C.E.C. is the recipient of an ARC DECRA Fellowship (DE160101281).

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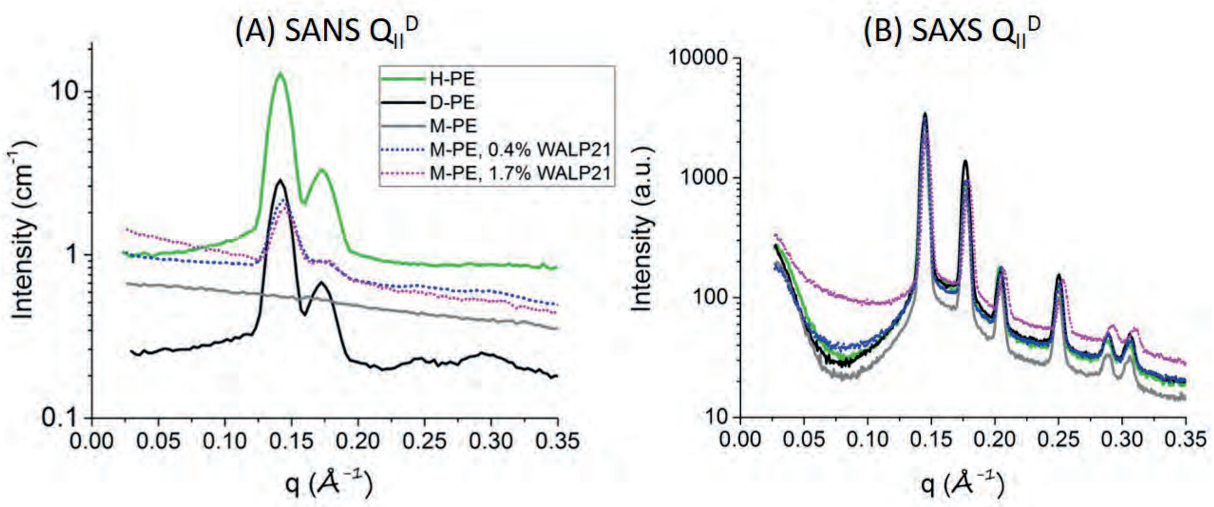


Figure 2: (A) SANS data on absolute intensity scale and (B) corresponding SAXS curves on a relative intensity scale. Results are shown for the diamond cubic Q_{II}^{D} phase of hydrogenated (H), deuterated (D) and contrast-matched (M) phytanoyl monoethanolamide (PE) in excess D_2O at 25ºC. Percentages of WALP21 are indicated in mol %.

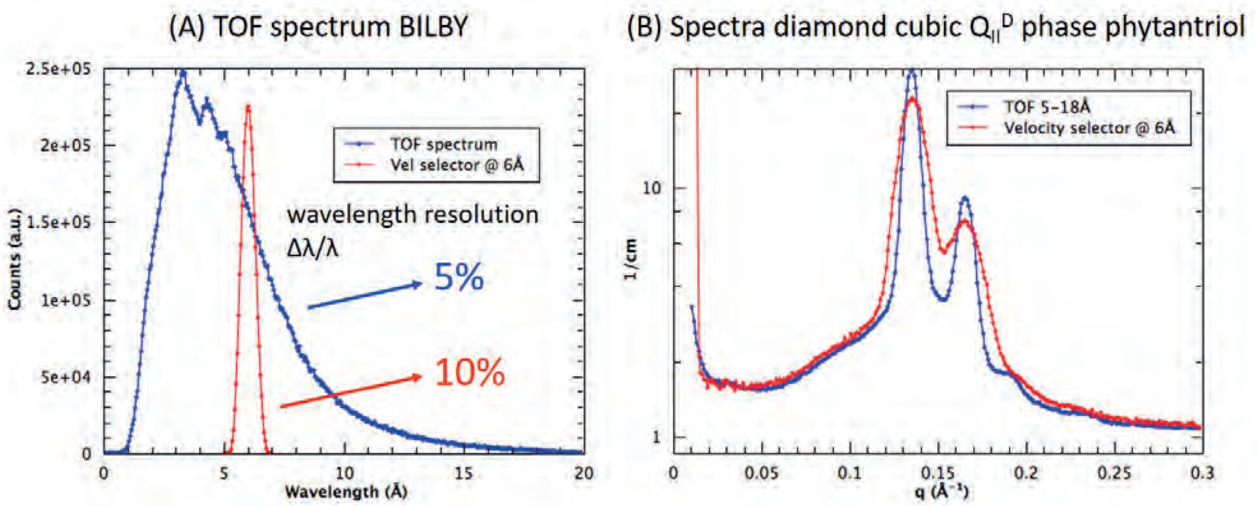
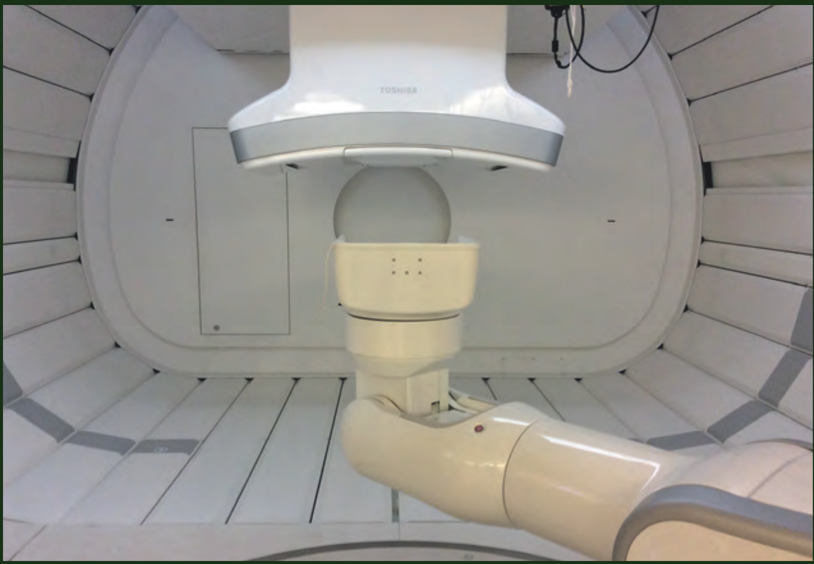


Figure 3: (A) Typical time-of-flight (TOF) spectrum on BILBY in comparison to the wavelength spread of neutrons with the velocity (vel) selector set to 6 Å. (B) SANS spectra of the diamond cubic Q_{II}^{D} phase of hydrogenated phytantriol in excess D_2O at 25ºC as obtained using TOF mode and using the velocity selector. Note that the flux is not displayed correctly in (A).



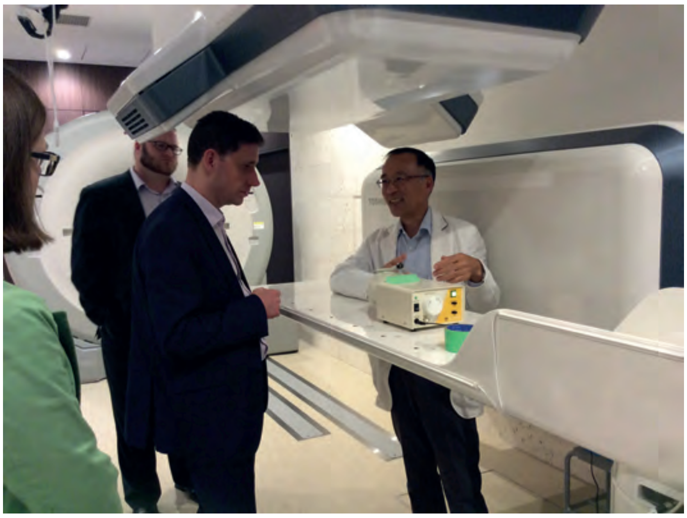
JAPAN STUDY TOUR

JAPAN STUDY TOUR - INVESTIGATING THE BENEFITS OF PARTICLE THERAPY

The Australian Institute of Nuclear Science and Engineering (AINSE) with assistance from The Australian Nuclear Science and Technology Organisation (ANSTO) conducted a study tour of Japan to investigate particle therapy. AINSE Managing Director, Michelle Durant and Dr Dale Prokopovich, ANSTO Physicist hosted the tour. Delegates attended from the medical and tertiary education sectors to discover how Japan has developed particle therapy from the early experimental stages through to patient treatments in the hospital setting.

The first site visit was the National Institute of Radiological Sciences (NIRS) in Chiba, where major advances in therapeutic application, experimental research and new technology development have occurred in particle therapy. Participants were able to have an in depth technical tour of the Heavy Ion Medical Accelerator in Chiba (HIMAC) and an opportunity to gain insights into the use of the facility for research and therapy from experts in the field, including the newly commissioned carbon ion superconducting gantry.

The next visit was the ion-beam Radiation Oncology Center in Kanagawa (i-ROCK) where delegates were guided in the advanced application of particle therapy from a technical and therapeutic standpoint. The delegates were able to learn about the respiratory gated hypofractionated carbon ion treatment delivery to a patient and how the treatment process is followed. The delegates were also able to visit the accelerator in order to observe how a heavy ion particle therapy facility could be physically incorporated into a hospital setting.



One of four treatment rooms at i-ROCK facility

(Left to Right) Professor Rick Franich, Ms Michelle Durant, Associate Professor Verity Ahern, Dr Shinichi Minohara of i-ROCK, Dr Jonathan Sykes, Adjunct Professor Liz Kenny, Associate Research Professor Ivan Kempson and Dr Dale Prokopovich

The final visit was to a new particle therapy facility in the center of Osaka in the final stages of construction. The participants were able to interact with the new facility operators and ask questions relevant to the construction phase of a new facility and how this might transfer to an Australian context.

Delegates gained an awareness of the most recent developments and proven track record in particle therapy by talking to leading specialists involved in the development of particle therapy as well as the subsequent implementation and treatment. At each location participants had the opportunity to experience in-depth tours with these particle therapy experts. The tour provided a unique perspective of particle therapy and the flow of the technology from a research tool to an operational hospital environment. The Study Tour significantly broadened the individual networking with people interested in these facilities.

OUTREACH ACTIVITIES

January 2017 | Meeting With University of Otago, Deputy Vice Chancellor Research and Enterprise
Michelle Durant met with the DVC (Research and Enterprise) of University of Otago who visited the AINSE Office and went on the ANSTO Tour

February 2017 | Meeting with French Embassy, Canberra
Michelle Durant and Nerissa Phillips visited the French Embassy to sign the MOU for the SAAFE scholarship Program

March 2017 | Science Meets Parliament, Canberra
Michelle Durant, Rachel Caldwell and PGRA Student Sharon Gray (from the Australian National University) attended this event on behalf of AINSE. This event was organised by Science and Technology Australia

July 2017 | Presentation at the University of South Australia, Future Industries Insitute
Michelle Durant gave a presentation to approximately 100 students

July 2017 | Presentation at Charles Darwin University
Michelle Durant met with A/Professor Krishnan Kannoorpatti and senior staff, and gave a seminar to approximately 30 students

August 2017 | Science Meets Policy Makers, Canberra
Michelle Durant attended this event on behalf of AINSE. This event was organised by Science and Technology Australia

September 2017 | Presentation at Western Sydney University Advanced Science Research Day
Michelle Durant was a guest speaker to promote AINSE, ANSTO and STEM careers

November 2017 | Presentation to Department of Industry, Innovation and Science Graduates
Michelle Durant was a guest speaker to promote AINSE

November 2017 | Science Meets Business, Sydney
Michelle Durant and Claire Lenehan attended this event on behalf of AINSE. This event was organised by Science and Technology Australia

November 2017 | Inaugural College of Science and Engineering HDR Conference, Flinders University
Michelle Durant gave a presentation to more than 100 students

CONFERENCES THROUGHOUT THE YEAR

There was a strong AINSE presence in booths/presentations at the following Conferences:

February	Australasian Soft Matter scattering Workshop
March	Higher Education Conference (Universities Australia)
March	ANU Science Fair
May	ACE 2017 Conference
May	ACE Italian Science Forum
May	Particle Therapy Forum
May - June	The 1st Asia Oceania Forum (AOF) Synchrotron Radiation School
July	Royal Australian Chemical Institute (RACI) Conference
August	UOW STEM Careers Expo
September	Society of Environmental Toxicology and Chemistry (SETAC) Conference
October	Australian Nuclear Association Conference (ANA2017)
October	9th Australasian Congress on Applied Mechanics (ACAM 9)
November	ANSTO User Meeting

VISITS THROUGHOUT THE YEAR

Michelle Durant attended several meetings and discussions throughout the year for networking and promotion of AINSE:

- University of Canberra
- The Australian National University
- Edith Cowan University
- Curtin University of Technology
- Murdoch University
- The University of Western Australia
- Victoria University
- French National Day Celebrations at the French Embassy, Canberra
- Opening of the Sydney School of Entrepreneurship (SSE)
- The University of Queensland
- Queensland University of Technology
- National Particle Therapy Symposium, Adelaide
- ANSTO Awards
- University of South Australia
- University of Adelaide
- Charles Darwin University
- Western Sydney University

AINSE DINNERS THROUGHOUT THE YEAR

AINSE had four Board dinners and two Council dinners. In 2017 Melbourne and Sydney hosted the dinner events.

Bruce Hudson Photography

MEETINGS AND COMMITTEES

AINSE COUNCIL

MEMBER ORGANISATIONS AND REPRESENTATIVE AT COUNCIL

Two Meetings of Council were held in 2017. There was an Annual General Meeting on 24 May and a General Meeting held on 30 November.

(o) denotes observer
(b) denotes AINSE Board Member

MEMBER CODE	ORGANISATION	MEMBERSHIP COMMENCED	COUNCILLOR	MEETINGS ATTENDED
ACU	Australian Catholic University	2001	Dr Duncan Cook	0
ADE	The University of Adelaide	1958	E/Professor Richard Keene	2
AKL	The University of Auckland	1995	Professor Jadranka Travas-Sejdic	1
ANS	ANSTO	1958	Dr Richard Garrett (b)	2
ANS	ANSTO	1958	Mrs Roslyn Hatton (b)	2
ANS	ANSTO	1958	Professor Lyndon Edwards (b)	2
ANU	The Australian National University	1958	Dr Anton Wallner	2
CAN	University of Canterbury	2005	A/Professor Greg Russell	2
CBR	University of Canberra	1996	Professor Bill Maher	0
CDU	Charles Darwin University	1995	A/Professor Krishnan Kannoorpatti	2
CQU	CQ University	1991	Professor Owen Nevin	2
CSI	CSIRO	2010	Dr Patrick Hartley	1
CSI	CSIRO		Dr Nathan Webster	1
CSU	Charles Sturt University	1995	Dr Julia Howitt	2
CUR	Curtin University of Technology	1989	Professor Craig Buckley	1
DEA	Deakin University	1997	Professor Peter Hodgson	0
DEA	Deakin University		Professor Aaron Russell	1
DST	Defence Science & Technology Group	2016	Dr Mark Petrusma	0
DST	Defence Science & Technology Group		Dr Ian Dagley	0
ECU	Edith Cowan University	1996	A/Professor Stephen Hinckley	1
FED	Federation University Australia	1997	A/Professor Kim Dowling	1
FLI	Flinders University	1966	Professor Claire Lenehan (President)	2
GRI	Griffith University	1975	Professor Evan Gray	2
JAM	James Cook University	1970	A/Professor Scott Smithers	1
LAT	La Trobe University	1966	Dr Andy Herries	0
MAC	Macquarie University	1966	Professor Barbara Messerle	0
MAS	Massey University	2014	Professor Richard Haverkamp	2
MEL	The University of Melbourne	1958	Professor Colette Boskovic	2
MON	Monash University	1961	Professor Ian Smith (b)	0
MUR	Murdoch University	1985-1997 - rejoined 1998	Dr Aleks Nikoloski	2
NCT	The University of Newcastle	1965	Professor Erich Kisi	0
NCT	The University of Newcastle		Dr Grant Webber	1
NSW	The University of New South Wales	1958	A/Professor John Stride	2
OTA	University of Otago	2007	Professor Gary Wilson	0
QLD	The University of Queensland	1958	Professor Ian Gentle (b)	2
QUT	Queensland University of Technology	1992	Professor Godwin Ayoko	2
RMI	RMIT University	1988	Professor Gary Bryant	1
SCU	Southern Cross University	1994	Professor Bill Boyd	1

MEMBER CODE	ORGANISATION	MEMBERSHIP COMMENCED	COUNCILLOR	MEETINGS ATTENDED
SWI	Swinburne University of Technology	1991	Professor Elena Ivanova	2
SYD	The University of Sydney	1958 - rejoined 2016	Professor Laurent Rivory	0
TAS	University of Tasmania	1958	Professor Andrew McMinn	1
THE	Theranostics Australia	2017	Dr Jerome Barley	1
UNE	The University of New England	1958	Dr Chris Fellows	1
USA	University of South Australia	1991	Professor Enzo Lombi	1
USC	University of the Sunshine Coast	2010	Professor John Bartlett	0
UTS	University of Technology Sydney	1988	Professor Michael Cortie	1
UWA	The University of Western Australia	1958	A/Professor Pauline Grierson	1
UWS	Western Sydney University	1993	A/Professor Gary Dennis	1
VAC	Vacuum Society of Australia	2017 - approved Nov	Dr Anton Stampfl	-
VUW	Victoria University of Wellington	2010	Professor Mike Wilson	2
WAI	The University of Waikato	2011	A/Professor Graham Saunders	2
WOL	University of Wollongong	1975 - rejoined 2016	Professor Will Price	2
	AINSE		Michelle Durant, Managing Director	2
	Independent Director		E/Professor Robert Burford (b)	2
	Independent Director		Dr Peter Coldrey (b)	1

ALTERNATE REPRESENTATIVES AND OTHER ATTENDEES AT COUNCIL

MEMBER CODE	ORGANISATION	REPRESENTATIVE	MEETINGS ATTENDED
ACU	Australian Catholic University	Dr Cliff Seery	1
ADE	The University of Adelaide	Professor Chris Sumby (o)	1
AKL	The University of Auckland	Professor Paul Augustinus	1
CAN	University of Canterbury	Dr Vladimir Golovko (o)	1
CSI	CSIRO	Dr Nathan Webster (o)	1
CUR	Curtin University of Technology	Dr Alison Blyth	1
LAT	La Trobe University	Dr Matthew Meredith-Williams	1
LAT	La Trobe University	Dr Colin Smith	1
MAC	Macquarie University	Professor Robert Willows	1
MON	Monash University	Ms Julie Rothacker	2
NCT	The University of Newcastle	A/Professor Grant Webber	1
RMI	RMIT University	Dr Charlotte Conn	1
SCU	Southern Cross University	A/Professor Malcolm Clark	1
SYD	The University of Sydney	Professor Steven Meikle	2
UNE	The University of New England	Dr Brendan Wilkinson	1
USA	University of South Australia	A/Professor Ivan Kempson	1
UWA	The University of Western Australia	Dr Grzegorz Skrzypek	1

OTHER ATTENDEES

	AINSE	Mr Paul Graydon (o)	1
	Escott Aston Chartered Accountants	Mr David Aston (AINSE Auditor)	1

Six Private Members were invited to attend

AINSE BOARD MEETINGS

Five Board Meetings were held in 2017.

EXECUTIVE MEMBER	OFFICE/POSITION	ORGANISATION	MEETINGS ATTENDED
Professor Claire Lenehan	President, University Representative	Flinders University	5
Ms Michelle Durant	Managing Director	AINSE	5
E/Professor Robert Burford	Independent Director	Independent	5
Dr Peter Coldrey	Independent Director	Independent	5
Ms Roslyn Hatton	ANSTO Representative	ANSTO	4
Professor Lyndon Edwards	ANSTO Representative	ANSTO	4
Dr Richard Garrett	ANSTO Representative	ANSTO	3
Professor Ian Gentle	University Representative	The University of Queensland	4
Professor Ian Smith	University Representative	Monash University	3

AINSE WINTER SCHOOL COMMITTEE

Ms Connie Banos	ANSTO
Mr Samuel Batty	ANSTO
Dr John Bennett	ANSTO
Dr Paul Callaghan	ANSTO
Ms Natasha Callan	ANSTO
Dr Tom Cresswell	ANSTO
Mrs Kelly Cubbin	ANSTO
Mr Rod Dowler	ANSTO
Ms Michelle Durant	AINSE
Dr Benjamin Fraser	ANSTO
Mrs Patricia Gadd	ANSTO
Mr Paul Graydon	AINSE
Dr Tracey Hanley	ANSTO
Prof Henk Heijnis	ANSTO
Dr Geraldine Jacobsen	ANSTO
Prof Thomas Millar	Western Sydney University
Mr Mitchell Klenner	AINSE PGRA
Mrs Sandy O’Connor	AINSE
Mrs Nerissa Phillips	AINSE
Mr Andrew Popp	ANSTO
Dr Krystyna Saunders	ANSTO
Dr Jamie Schulz	ANSTO
Mr Ken Short	ANSTO
Dr Craig Woodward	ANSTO
Ms Atun Zawadzki	ANSTO

AINSE STAFF

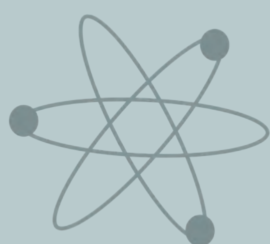
MANAGING DIRECTOR
Ms Michelle Durant, BSc, BFinAdmin

SECRETARIAT
Dr Rachel Caldwell, BMarSc, PhD
Concluded June 2017
Mrs Dianne Keegan
Commenced February 2017, Concluded May 2017
Mr Paul Graydon, BEc, CPA
Commenced June 2017
Ms Elizabeth Geyer, Cert. Comm (ASCA), BA, BArtTh(Hons),MArtAdmin
Commenced August 2017
Mrs Sandra O’Connor (part-time)
Mrs Nerissa Phillips (part-time)
Mr Joshua Keegan (casual)
Commenced July 2017

HONORARY FELLOWS

At the AINSE general meeting in November 2017 members voted to accept Professor Allan Chivas and Emeritus Professor Robert Burford both as Honorary Fellows of AINSE Ltd.

AINSE Honorary Fellowships are awarded by the AINSE Council to individuals for distinguished and dedicated services to the Institute.



AINSE SPECIALIST COMMITTEES

The Managing Director, AINSE, is an ex-officio (non-voting) member of all Committees. Committees met in May and in October. (a) indicates ‘alternate’ (b) indicated AINSE ‘Board Member’ (c) indicates AINSE ‘Councillor’

ARCHAEOLOGY AND GEOSCIENCES COMMITTEE (AGS)

A/Professor Patrick Moss (Convenor)	The University of Queensland
Dr Michael-Shawn Fletcher	The University of Melbourne
Dr Quan Hua	ANSTO
Dr Craig Sloss	Queensland University of Technology

BIOTECHNOLOGY AND BIOMEDICAL SCIENCES COMMITTEE (BBS)

Professor Damian Myers (Convenor)	Victoria University / The University of Melbourne
Professor Pam Sykes	Flinders University
Dr Ben Fraser	ANSTO
Dr Guo Jun Liu	ANSTO
Professor Elena Ivanova (a) (c)	Swinburne University of Technology
Professor Roger Price	The University of Western Australia

ENVIRONMENTAL SCIENCES COMMITTEE (ENV)

Dr Greg Skrzypek (Convenor)	The University of Western Australia
A/Professor Paul Augustinus	The University of Auckland
Dr Dioni Cendon Sevilla	ANSTO
Professor Isaac Santos	Southern Cross University
Professor Andrew McMinn (c)	University of Tasmania
Dr Henk Heijnis	ANSTO
Dr Krystyna Saunders (a)	ANSTO
Professor James Goff	The University of New South Wales

MATERIALS SCIENCE AND ENGINEERING COMMITTEE (MSE)

Prof Gary Bryant (Convenor) (c)	RMIT University
Dr Aleks Nikoloski (c)	Murdoch University
Dr Victor Streltsov	The University of Melbourne
Dr Stephen Holt	ANSTO
Dr Garry McIntyre	ANSTO
Professor Mihail Ionescu (a)	ANSTO
Dr Leigh Sheppard	Western Sydney University
Dr David Cohen	ANSTO
Professor Lyndon Edwards (b) (c)	ANSTO
Dr Ludovic Dumee	Deakin University

FINANCES

The Australian Institute of Nuclear Science and Engineering
AINSE Limited
ABN 18 133 225 331
Financial Statements
For the Financial Year Ended 31 December 2017

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ABN 18 133 225 331
Director's Report
For the Financial Year Ended 31 December 2017

Your Directors present their report on AINSE for the financial year ended 31 December 2017.

Directors

The names of Directors in office at any time during or since the end of the year are:

Emeritus Professor Robert Burford (cessation date 31 December 2017)
Ms Michelle Durant
Professor Lyndon Edwards
Professor Ian Smith (cessation date 9 November 2017)
Professor Ian Gentle
Dr Peter Coldrey
Ms Roslyn Hatton
Professor Claire Lenehan
Dr Richard Garrett (cessation date 20 January 2018)
Ms Helen Liossis (commencement date 1 January 2018)
Professor Andrew Peele (commencement date 9 February 2018)

Directors have been in office since the start of the financial year to the date of this report unless otherwise stated.

Principal Activities

The principal activities of AINSE during the financial year was to advance research, education and training in the field of nuclear science and engineering and related fields within Australasia by being, in particular, the key link between universities, ANSTO, other member organisations and major nuclear science and associated facilities.

AINSE's short-term objectives are to:

- Offer Postgraduate top up Scholarships, and Honours Scholarships to students from 41 University members for the conduct of research principally at ANSTO
- Organise educational schools and workshops in nuclear science and engineering for AINSE members
- Organise conferences in specific areas relating to nuclear science and engineering and in related fields that utilise nuclear techniques and analysis
- Support travel and accommodation for students and academics to present their AINSE supported research at conferences both within Australia and overseas

AINSE's long-term objectives are to:

- Be an effective link between all stakeholders of nuclear science and engineering
- Play an advocacy role for the Australasian nuclear community
- Play a leading role in nuclear education and training
- Facilitate the development of multilateral and multidisciplinary strategic research initiatives
- Utilise new streams of funding

The Australian Institute of Nuclear Science and Engineering
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For the Financial Year Ended 31 December 2017

STRATEGIC PLAN

Our Vision

Enhancing Australia's capability in nuclear science and engineering by facilitating world-class research and education.

Our Mission

AINSE will reach its vision through:

- Being an effective link between all stakeholders of nuclear science and engineering
- Playing an advocacy role for the Australasian nuclear community
- Playing a leading role in nuclear education and training
- Facilitating the development of multilateral and multidisciplinary strategic research initiatives
- Utilising new streams of funding

Strategic Context

AINSE has identified the following key trends and uncertainties influencing the future environment in which AINSE will operate:

Trends

- Integration of technologies at discipline boundaries
- Increasing role of science and technology in addressing grand societal challenges
- Ever-increasing flood of big data
- Increasing importance of large-scale strategic research
- Increasing importance of metric-driven funding
- Declining international competitiveness of the Australian manufacturing industry
- Increasing risks related to capex investments
- Declining industry Research and Development
- New innovation objectives in some Australian companies
- Evolution of the Cooperative Research Centres (CRC) system as a funding model

Uncertainties

- Ongoing funding for established infrastructure (both ANSTO and Universities)
- Ongoing debate about nuclear energy
- Industry appetite for nuclear research
- State of the Australian Research Council (ARC)
- Research environment in nuclear areas in Asia
- Changes in geopolitical priorities
- AINSE/ANSTO relationship
- Rate of employment
- Stability of financial markets (domestic and international)
- Incentives for researchers to engage with industry

The Australian Institute of Nuclear Science and Engineering
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STRATEGIC PRIORITIES

AINSE has defined the following seven strategic priorities for its Strategic Plan. These will drive our focus, resource allocation and how we monitor our success over the life of the Strategic Plan.

1. Effectively communicate AINSE's purpose to a wide range of different stakeholders

- Clearly enunciate AINSE's value proposition and align it with the priorities of Government, ANSTO and the Universities.
- Enhance AINSE's outreach activities to reach a wider audience beyond nuclear scientists and engineers.
- Work with outcome-focused advocacy groups to enhance the impact of nuclear technology.
- Re-evaluate the metrics AINSE uses to measure and demonstrate its performance.
- Constantly review how we best serve our stakeholders.

2. Create an appropriate balance between funding project-based research and funding/facilitating multilateral and multidisciplinary collaboration

- Explore future opportunities for funded collaborative projects through workshops related to thematic areas.
- Ensure continued relevance of AINSE programs.
- Consider focused program style grants in strategic areas.
- Maintain small grants opportunities.
- Encourage a broad engagement within member organisations.

3. Demonstrate leadership in the education of Australasia's next generation of scientists with an interest in nuclear science and engineering

- Expand AINSE's role in engaging the next generation of researchers with an interest in nuclear science.
- Engage with Universities at the executive level to be aware of, and align with, Universities' strategic priorities.
- Consider University accreditation for some AINSE activities (e.g. short/intensive courses).

4. Develop AINSE's role as a credible advocate for the Australasian nuclear science and engineering community

- Maintain and strengthen AINSE's independence while providing value to ANSTO.
- Speak with a coherent voice representing universities on nuclear science and engineering.
- Become a facilitator of increasing industry awareness (e.g. promotions, training courses, education, and professional development).
- Maintain and further develop a network of experts to communicate the state of the art in nuclear science and technology.
- Draw on AINSE alumni as a resource of support and expertise.
- Develop and maintain a catalogue of key messages for decision makers.
- Provide leadership in the development of a decadal plan for nuclear infrastructure investment.

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Director's Report
For the Financial Year Ended 31 December 2017

5. **Provide an effective and efficient link between different capabilities related to nuclear science and engineering**

- Support the user base across the facilities at ANSTO and other AINSE-supported facilities.
- Become a facilitator for collaboration and complementary use of scientific infrastructure.
- Effectively access the expertise within AINSE to facilitate optimum use of capabilities.
- Make effective use of the expertise and enthusiasm of ANSTO staff.
- Re-establish AINSE's reputation with the ARC and National Health and Medical Research Council (NHMRC) as credible lead organisation for funding proposals (e.g. Linkage Infrastructure Equipment and Facilities (LIEF), Centres of Excellence).

6. **Seize new opportunities for funding beyond AINSE's traditional sources**

- Be prepared to take advantage if/when new funding opportunities arise.
- Develop links with the philanthropy community through the AINSE Trust.
- Exploit our developed authority to leverage joint industry/government funding for innovation initiatives.
- Use our wide membership base and coherence as a credible argument to demonstrate an effective and efficient return on government/industry investment.

7. **Diversify AINSE's membership and stakeholder base**

- Increase the range of opportunities for existing members through flexible membership arrangements and new services.
- Review our membership fee calculation.
- Explore how to expand our stakeholder base, e.g. medical research organisations, international and environmental organisations, industry.

The Australian Institute of Nuclear Science and Engineering
AINSE Limited
ABN 18 133 225 331
Director's Report
For the Financial Year Ended 31 December 2017

Information on Directors

The Directors in office at the date of this report are listed below with particulars of qualifications, experience and special responsibilities (if any).

Claire Lenehan – Board Member.
Board Member since March 2014.
19 years' experience in scientific research.
BSc (Hons), PhD, MRACI.

Michelle Durant – Managing Director.
Board Member since April 2016.
27 years' experience in scientific and business administration and management.
BSc, BFinAdmin.

Lyndon Edwards – Board Member.
Board Member since 2008.
34 years' experience in academia and scientific research in Australia and UK.
MA, DPhil(Oxon), FIMMM, CEng.

Roslyn Hatton – Board Member.
Board Member representing ANSTO since December 2014.
Independent Board Member from August 2012 until September 2014.
26 years in public (ANAO) and private (Ernst & Young) sector audit and 8 years at the Commonwealth Bank in a financial accounting role.
Currently the Deputy Chief Financial Officer at ANSTO.
BComm (Accounting, finance and information systems) UNSW FCA.

Peter Coldrey – Board Member.
Board Member since August 2012.
41 years' industrial research experience in the chemical and ophthalmic lens industries.
FTSE, BE,PhD, BCom.

Ian Gentle – Board Member.
Board Member since August 2014.
35 years' experience in academia and scientific research and research management.
BSc (Hons), PhD.

Helen Liossis – Board Member.
Board member since January 2018.
30 years' experience in finance roles (including Chief Operating Officer, Head of Investor Relations and other senior executive roles).
Currently the Head of Corporate Strategy and Business Planning at Sydney Water.
BBus (Accounting and Economics), MBA, CPA, GAICD.

The Australian Institute of Nuclear Science and Engineering
AINSE Limited
ABN 18 133 225 331
Director's Report
For the Financial Year Ended 31 December 2017

Information on Directors continued

Andrew Peele – Board member.
Board member since February 2018.
25 years' experience in academia, scientific research and science management in Australia and USA.
Previous legal experience as a practicing solicitor in Victoria.
BSc (hons), PhD, LLB, Grad Dip (Intellectual Property), MAIP.

The Australian Institute of Nuclear Science and Engineering
AINSE Limited
ABN 18 133 225 331
Director's Report
For the Financial Year Ended 31 December 2017

Meetings of Directors

During the financial year, 5 meetings of directors were held. Attendances by each director were as follows:

	Number eligible to attend	Number attended
Emeritus Professor Robert Burford	5	5
Professor Claire Lenehan	5	5
Ms Michelle Durant	5	5
Professor Lyndon Edwards	5	4
Professor Ian Smith	5	3
Professor Ian Gentle	5	4
Dr Peter Coldrey	5	5
Ms Roslyn Hatton	5	4
Dr Richard Garrett	5	3
Ms Helen Liossis	0	0
Professor Andrew Peele	0	0

AINSE is incorporated under the *Corporations Act 2001* and is a company limited by guarantee. If AINSE is wound up, the constitution states that each member is required to contribute a maximum of $10 each towards meeting any outstanding obligations of AINSE. At 31 December 2017, the total amount that members of AINSE are liable to contribute if AINSE is wound up is $520 (2016: $440).

Auditors Independence Declaration

The lead auditor's independence declaration for the year ended 31 December 2017 has been received and can be found on page 57 of the report.

Signed in accordance with a resolution of the Board of Directors.

Director
Lyndon Edwards

Director
Michelle Durant

Dated this 27th day of March 2018

The Australian Institute of Nuclear Science and Engineering
AINSE Limited
ABN 18 133 225 331
Auditor's Independence Declaration to the Directors
For the Financial Year Ended 31 December 2017

In accordance with the requirements of section 60-40 of the *Australian Charities and Not-for-profits Commission Act 2012*, I declare that, to the best of my knowledge and belief, during the year ended 31 December 2017 there have been no contraventions of:

i. The auditor independence requirements as set out in the *Australian Charities and Not-for-profits Commission Act 2012* in relation to the audit; and

ii. Any applicable code of professional conduct in relation to the audit.

Delante Accountants and Business Advisers Pty Ltd
Chartered Accountants

David G Aston
Director

TAREN POINT NSW 2229

Dated 27th March 2018

The Australian Institute of Nuclear Science and Engineering
AINSE Limited
ABN 18 133 225 331
Statement of Comprehensive Income – By Nature
For the Financial Year Ended 31 December 2017

	Note	2017 $	2016 $
Revenue	2	1,670,370	2,260,653
External grants	2	96,824	-
Other income	2	104,564	86,850
Total income		1,871,758	2,347,503
Employee benefits expense		(457,724)	(467,355)
Depreciation expense	3	(11,385)	(12,815)
Audit, legal and consultancy expense		(32,124)	(61,970)
AINSE Awards		(734,916)	(1,586,882)
Other expenses		(336,416)	(284,080)
Surplus/(deficit) before income tax		**299,193**	**(65,599)**
Income tax expense		-	-
Surplus/(deficit) for the year		**299,193**	**(65,599)**

The accompanying notes form part of these financial statements

The Australian Institute of Nuclear Science and Engineering
AINSE Limited
ABN 18 133 225 331
Statement of Financial Position
As At 31 December 2017

	Note	2017 $	2016 $
ASSETS			
CURRENT ASSETS			
Cash and cash equivalents	4	3,084,641	2,734,982
Trade and other receivables	5	150,055	124,736
Other	6	15,940	13,225
TOTAL CURRENT ASSETS		3,250,636	2,872,943
NON-CURRENT ASSETS			
Property, plant & equipment	7	15,411	21,327
TOTAL NON-CURRENT ASSETS		15,411	21,327
TOTAL ASSETS		3,266,047	2,894,270
LIABILITIES			
CURRENT LIABILITIES			
Trade and other payables	8	103,475	22,152
Employees provisions	9	104,592	101,230
TOTAL CURRENT LIABILITIES		208,067	123,382
NON-CURRENT LIABILITIES			
Employees provisions	9	8,930	21,031
TOTAL NON-CURRENT LIABILITIES		8,930	21,031
TOTAL LIABILITIES		216,997	144,413
NET ASSETS		3,049,050	2,749,857
EQUITY			
Awards reserve	12	716,676	875,887
Accumulated surplus		2,332,374	1,873,970
TOTAL EQUITY		3,049,050	2,749,857

The accompanying notes form part of these financial statements

The Australian Institute of Nuclear Science and Engineering
AINSE Limited
ABN 18 133 225 331
Statement of Changes in Equity
For the Financial Year Ended 31 December 2017

	Awards Reserve $	Accumulated Surplus $	Total $
Balance at 1 January 2016	723,887	2,091,569	2,815,456
Net surplus/(deficit) attributable to AINSE	-	(65,599)	(65,599)
Transfers to and from awards reserve	152,000	(152,000)	-
Balance at 31 December 2016	875,887	1,873,970	2,749,857
Net surplus/(deficit) attributable to AINSE	-	299,193	299,193
Transfers to and from awards reserve	(159,211)	159,211	-
Balance at 31 December 2017	716,676	2,332,374	3,049,050

The Australian Institute of Nuclear Science and Engineering
AINSE Limited
ABN 18 133 225 331
Cash Flow Statement
For the Financial Year Ended 31 December 2017

	Note	2017 $	2016 $
CASH FLOWS FROM OPERATING ACTIVITIES			
Receipts from operations		1,674,186	1,886,413
Receipts from grants		175,182	-
Interest received		67,810	65,013
Award related payments		(826,976)	(1,219,637)
Payments to suppliers and employees		(735,074)	(943,555)
Net cash generated from operating activities		**355,128**	**(211,766)**
CASH FLOWS FROM INVESTING ACTIVITIES			
Payment for property, plant and equipment		(5,469)	-
Net cash used in investing activities		**(5,469)**	**-**
Net increase / decrease in cash held		**349,659**	**(211,766)**
Cash and cash equivalents at beginning of financial year		2,734,982	2,946,748
Cash and cash equivalents at end of financial year		**3,084,641**	**2,734,982**

The accompanying notes form part of these financial statements

The Australian Institute of Nuclear Science and Engineering
AINSE Limited
ABN 18 133 225 331
Notes to and Forming Part of the Financial Statements
For the Financial Year Ended 31 December 2017

Note 1 – Statement of Significant Accounting Policies

The financial statements cover The Australian Institute of Nuclear Science and Engineering (AINSE) as an individual entity. The Australian Institute of Nuclear Science and Engineering is a Company limited by guarantee, incorporated and domiciled in Australia.

Basis of Preparation

AINSE applies the Australian Accounting Standards – Reduced Disclosure Requirements as set out in AASB 1053: Application of Tiers of Australian Accounting Standards and AASB 2010-2: Amendments to Australian Accounting Standards arising from Reduced Disclosure.

The financial statements are general purpose financial statements that have been prepared in accordance with Australian Accounting Standards – Reduced Disclosure Requirements of the Australian Accounting Standards Board and the *Australian Charities and Not-for-profits Commission Act 2012.* AINSE is a not-for-profit entity for financial reporting purposes under Australian Accounting Standards.

Australian Accounting Standards set out accounting policies that the AASB has concluded would result in financial statements containing relevant and reliable information about transactions, events and conditions. Material accounting policies adopted in the preparation of these financial statements are presented below and have been consistently applied unless stated otherwise.

The financial statements, except for the cash flow information, have been prepared on an accruals basis and are based on historical costs, modified, where applicable, by the measurement at fair value of selected non-current assets, financial assets and financial liabilities. The amounts presented in the financial statements have been rounded to the nearest dollar.

The financial statements were authorised for issue on 26 March 2018 by the directors of AINSE.

The Australian Institute of Nuclear Science and Engineering
AINSE Limited
ABN 18 133 225 331
Notes to and Forming Part of the Financial Statements
For the Financial Year Ended 31 December 2017

Significant Accounting Policies

Revenue and Other Income

Grant revenue is recognised in the statement of comprehensive income when AINSE obtains control of the grant, it is probable that the economic benefits gained from the grant will flow to AINSE and the amount of the grant can be measured reliably.

If conditions are attached to the grant which must be satisfied before it is eligible to receive the contribution, the recognition of the grant as revenue will be deferred until those conditions are satisfied.

When grant revenue is received whereby AINSE incurs an obligation to deliver economic value directly back to the contributor, this is considered a reciprocal transaction and the grant revenue is recognised in the statement of financial position as a liability until the service has been delivered to the contributor, otherwise the grant is recognised as income on receipt.

Donations and bequests are recognised as revenue when received.

Interest revenue is recognised using the effective interest method, which for floating rate financial assets is the rate inherent in the instrument.

Revenue from the rendering of a service is recognised upon the delivery of the service to the customers.

All revenue is stated net of the amount of goods and services tax.

Property, Plant and Equipment

Each class of property, plant and equipment is carried at cost or fair value as indicated less, where applicable, any accumulated depreciation and impairment losses.

Plant and Equipment

Plant and equipment are measured on the cost basis and are therefore carried at cost less accumulated depreciation and any accumulated impairment losses. In the event the carrying amount of plant and equipment is greater than its estimated recoverable amount, the carrying amount is written down immediately to its estimated recoverable amount and impairment losses are recognised either in profit or loss or as a revaluation decrease if the impairment losses relate to a revalued asset. A formal assessment of recoverable amount is made when impairment indicators are present.

Plant and equipment that have been contributed at no cost, or for nominal cost, are valued and recognised at the fair value of the asset at the date it is acquired.

Depreciation

The depreciable amount of all fixed assets including buildings and capitalised leased assets, but excluding freehold lands, are depreciated on a straight line or diminishing value basis over their useful lives to AINSE commencing from the time the asset is held ready for use. Leasehold improvements are depreciated over the shorter of either the unexpired period of the lease or the estimated useful life of the improvement.

The Australian Institute of Nuclear Science and Engineering
AINSE Limited
ABN 18 133 225 331
Notes to and Forming Part of the Financial Statements
For the Financial Year Ended 31 December 2017

The depreciation rates used for each class of depreciable asset are:

Plant & equipment	15-35%
Motor vehicles	25%
Furniture and fittings	10-25%

The asset's residual values and useful lives are reviewed, and adjusted if appropriate, at the end of each reporting period.

Gains and losses on disposals are determined by comparing proceeds with the carrying amount. These gains or losses are included in the statement of comprehensive income. When revalued assets are sold, amounts included in the revaluation reserve relating to that asset are transferred to retained earnings.

Financial Instruments

AINSE's financial instruments consist mainly of deposits with banks, local money market instruments, short-term investments and accounts receivable and payable.

Initial Recognition & Measurement
Financial assets and financial liabilities are recognised when AINSE becomes a party to the contractual provisions to the instrument. Financial Instruments are initially measured at fair value plus transaction costs, except where the instrument is classified "at fair value through profit or loss" in which case transaction costs are recognized immediately as expenses in profit or loss. Subsequent to initial recognition these instruments are measured as set out below.

Classification and Subsequent Measurement
Financial instruments are subsequently measured at either fair value, amortised cost using the effective interest method, or cost. Where available, quoted prices in an active market are used to determine fair value. In other circumstances, valuation techniques are adopted.

Amortised cost is calculated as the amount at which the financial asset or financial liability is measured at initial recognition less principal payments and any reduction for impairment and adjusted for any cumulative amortisation of the difference between that initial amount and the maturity amount calculated using the effective interest method.

Fair Value
Fair value is determined based on current bid prices for all quoted investments. Valuation techniques are applied to determine the fair value for all unlisted securities, including recent arm's length transactions, reference to similar instruments and option pricing models.

Loans and Receivables
Loans and receivables are non-derivative financial assets with fixed or determinable payments that are not quoted in an active market and are subsequently measured at amortised cost. Gains or losses are recognized in profit or loss through the amortization process and when the financial asset is derecognized.

The Australian Institute of Nuclear Science and Engineering
AINSE Limited
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Notes to and Forming Part of the Financial Statements
For the Financial Year Ended 31 December 2017

Held-to-Maturity Investments

Held-to-maturity investments are non-derivative financial assets that have fixed maturities and fixed or determinable payments, and it is the entity's intention to hold these investments to maturity. They are subsequently measured at cost. Gains and losses are recognised in profit and loss through the amortisation process and when the financial asset is derecognized.

Financial Liabilities

Non-derivative financial liabilities (excluding financial guarantees) are subsequently measured at amortised cost. Gains or losses are recognised in profit or loss through the amortization process and when the financial liability is derecognized.

Impairment of Assets

At the end of each reporting period, AINSE assesses whether there is objective evidence that a financial asset has been impaired. A financial asset (or a group of financial assets) is deemed to be impaired if, and only if, there is objective evidence of impairment as a result of one or more events (a "loss event") having occurred, which has an impact on the estimated future cash flows of the financial asset(s).

In the case of financial assets carried at amortised cost, loss events may include: indications that the debtors or a group of debtors are experiencing significant financial difficulty, default or delinquency in interest or principal payments; indications that they will enter bankruptcy or other financial reogranisation; and changes in arrears or economic conditions that correlate with defaults.

For financial assets carried at amortised cost (including loans and receivables), a separate allowance account is used to reduce the carrying amount of financial assets impaired by credit losses. After having taken all possible measures of recovery, if management establishes that the carrying amount cannot be recovered by any means, at that point the written off amounts are charged to the allowance account or the carrying amount of impaired financial assets is reduced directly if no impairment amount was previously recognized in the allowance account.

When the terms of financial assets that would otherwise have been past due or impaired have been renegotiated, AINSE recognises the impairment for such financial assets by taking into account the original terms as if the terms have not been renegotiated so that the loss events that have occurred are duly considered.

Employee Benefits

Provision is made for AINSE's liability for employee benefits arising from services rendered by employees at the end of the reporting period. Employee benefits that are expected to be settled within one year have been measured at the amounts expected to be paid when the liability is settled. Other employee benefits payable later than one year have been measured at the present value of the estimated future cash outflows to be made for those benefits.

Cash and Cash Equivalents

Cash and cash equivalents include cash on hand, deposits held at-call with banks, other short-term highly liquid investments with original maturities of three months or less, and bank overdrafts. Bank overdrafts are shown within short term short term borrowings in current liabilities on the statement of financial position.

The Australian Institute of Nuclear Science and Engineering
AINSE Limited
ABN 18 133 225 331
Notes to and Forming Part of the Financial Statements
For the Financial Year Ended 31 December 2017

Goods and Services Tax (GST)

Revenues, expenses and assets are recognised net of the amount of GST, except where the amount of GST incurred is not recoverable from the Australian Taxation Office (ATO).

Receivables and payables are stated inclusive of the amount of GST receivable or payable. The net amount of GST recoverable from, or payable to, the ATO is included with other receivables or payables in the statement of financial position.

Cash flows are presented on a gross basis. The GST components of cash flows arising from investing or financing activities which are recoverable from, or payable to, the ATO are presented as operating cash flows included in receipts from customers or payments to suppliers.

Income Tax

AINSE Limited is exempt from income tax under section 50-5 of the *Income Tax Assessment Act 1997 as AINSE is established for the purpose of enabling scientific research to be conducted in Australia*.

Trade and Other Payables

Trade and other payables represent the liabilities for goods and services received by AINSE during the reporting period that remain unpaid at the end of the reporting period. The balance is recognised as a current liability with the amounts normally paid within 30 days of recognition of the liability.

Description of Awards Reserve

The awards reserve represents the future commitments for funding to scientists for research in two categories: AINSE supported facility awards and Postgraduate Research Awards. AINSE supported facility awards provide opportunities for researchers to access equipment that complements the facilities at ANSTO and are available for a period of 12 months. Postgraduate Research Awards provide support to post graduate students at an entry point in their qualification and last for the duration of their underlying primary scholarship.

Comparative Figures

When required by Accounting Standards, comparative figures have been adjusted to conform to changes in presentation for the current financial year.

The Australian Institute of Nuclear Science and Engineering
AINSE Limited
ABN 18 133 225 331
Notes to and Forming Part of the Financial Statements
For the Financial Year Ended 31 December 2017

	Note	2017 $	2016 $
Note 2 – Revenue and Other Income			
Revenue			
Payments from members		1,234,370	1,843,153
ANSTO promotion fee		436,000	417,500
		1,670,370	2,260,653
External grants	13	96,824	-
		1,767,194	2,260,653
Other income			
Conference registrations		22,734	16,655
Sponsorships		-	3,000
Interest received		68,980	67,191
Other income		12,850	4
		104,564	86,850
Total revenue and other income		1,871,758	2,347,503

Note 3 – Surplus for the Year

The surplus for the year has been determined after charging as expenses:

	2017 $	2016 $
Depreciation of property, plant and equipment	11,385	12,815
Bad and doubtful debts	-	-

Note 4 – Cash and Cash Equivalents

	2017 $	2016 $
Cash at bank	3,083,641	2,733,982
Cash on hand	1,000	1,000
Total cash and cash equivalents	3,084,641	2,734,982

Note 5 – Trade and Other Receivables

	2017 $	2016 $
Trade receivables	15,079	6,486
Less: Provision for impairment	-	-
	15,079	6,486
Other receivables	134,976	118,250
Total trade and other receivables	150,055	124,736

Note 6 – Other Current Assets

	2017 $	2016 $
Accrued interest	14,395	13,225
Prepayments	1,545	-
Total other current assets	15,940	13,225

The Australian Institute of Nuclear Science and Engineering
AINSE Limited
ABN 18 133 225 331
Notes to and Forming Part of the Financial Statements
For the Financial Year Ended 31 December 2017

	Note	2017 $	2016 $
Note 7 – Property, Plant and Equipment			
Plant and equipment – cost		17,300	11,831
Less: Accumulated depreciation		(6,083)	(4,397)
		11,217	7,434
Furniture and fittings – cost		10,485	10,485
Less: Accumulated depreciation		(6,291)	(4,194)
		4,194	6,291
Motor vehicles – cost		45,613	45,613
Less: Accumulated depreciation		(45,613)	(38,011)
		-	7,602
Total property, plant and equipment		15,411	21,327

a. Movements in Carrying Amounts

Movements in the carrying amounts for each class or property, plant and equipment between the beginning and the end of the current financial year.

	Plant & Equipment $	Furniture & Fittings $	Motor Vehicles $	Total $
Balance at 1 January 2017	7,434	6,291	7,602	21,327
Additions	5,469	-	-	5,469
Disposals	-	-	-	-
Depreciation	(1,686)	(2,097)	(7,602)	(11,385)
Balance at 31 December 2017	11,217	4,194	-	15,411

	2017 $	2016 $
Note 8 – Trade and Other Payables		
Trade and other payables	21,959	20,176
Grants received – in advance	78,358	-
Employees – accrued salary and wages	3,158	1,976
Total trade and other payables	103,475	22,152

The Australian Institute of Nuclear Science and Engineering
AINSE Limited
ABN 18 133 225 331
Notes to and Forming Part of the Financial Statements
For the Financial Year Ended 31 December 2017

	Note	2017 $	2016 $
Note 9 – Employee Provisions			
CURRENT			
Annual leave		57,708	58,806
Long service leave		46,884	42,424
		104,592	101,230
NON-CURRENT			
Long service leave		8,930	21,031
		8,930	21,031
Total employee provisions		113,522	122,261

Note 10 – Key Management Personnel Compensation

Any person(s) having authority and responsibility for planning, directing and controlling the activities of the entity, directly or indirectly, including any director (whether executive or otherwise) of that entity is considered key management personnel.

The totals of remuneration paid to key management personnel (KMP) of AINSE during the years are as follows:

	2017	2016
Key management personnel compensation	216,307	224,588

Compensation includes salary and wages, superannuation and fringe benefits.

Key management personnel compensation includes a rate of $1,000 per meeting provided to Independent Board Members.

Note 11 – Other Related Party Transactions

There were no related party transactions during the financial year.

Note 12 – Awards Reserve

	2017	2016
Opening balance at 1 January	875,887	723,887
Transfer to other comprehensive income	(159,211)	152,000
Balance as at 31 December	716,676	875,887

The Australian Institute of Nuclear Science and Engineering
AINSE Limited
ABN 18 133 225 331
Notes to and Forming Part of the Financial Statements
For the Financial Year Ended 31 December 2017

	Note	2017 $	2016 $
Note 13 – External Grants			
GRANTS REVENUE			
New Fund		55,750	-
Women in STEM and Entrepreneurship (WISE)		35,000	-
Scholarship AINSE ANSTO French Embassy (SAAFE)		6,074	-
		96,824	-
Details of External Grants			
New Fund			
Cash Contribution			
ANSTO		102,000	-
Less:			
Stipends and administration		55,750	-
Grants received – in advance		46,250	-
WISE			
Cash Contribution			
Department of Industry, Innovation and Science		35,000	-
Less:			
Program costs		35,000	-
Grants received – in advance		-	-
SAAFE			
Cash Contribution			
ANSTO		20,000	-
The Embassy of France in Australia		18,182	-
		38,182	-
In Kind Contribution			
AINSE		3,037	-
		41,219	-
Less:			
Flights and allowances		9,111	-
Grants received – in advance		32,108	-

The Australian Institute of Nuclear Science and Engineering
AINSE Limited
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Notes to and Forming Part of the Financial Statements
For the Financial Year Ended 31 December 2017

Note 14 – Financial Risk Management

AINSE's financial instruments consist mainly of deposits with banks, local money market Instruments, short-term investments, accounts receivable and payable, and leases.

The carrying amounts of each category of financial instruments, measured in accordance with AASB 139 as detailed in the accounting policies to these financial statements, are as follows:

	Note	2017 $	2016 $
Financial Assets			
Cash and cash equivalents		3,084,641	2,734,982
Trade and other receivables		150,055	124,736
Total financial assets		3,234,696	2,859,718
Financial Liabilities			
Trade & other payables		103,476	22,152
Total financial liabilities		103,476	22,152

Note 15 – Events after the Reporting Date

The Directors are not aware of any significant events since the end of the reporting period.

Note 16 – Company Details

AINSE's principal place of business is:

The Australian Institute of Nuclear Science and Engineering
AINSE Limited
New Illawarra Road
LUCAS HEIGHTS NSW

The Australian Institute of Nuclear Science and Engineering
AINSE Limited
ABN 18 133 225 331
Directors' Declaration
For the Financial Year Ended 31 December 2017

The Directors of AINSE declare that:

1. The financial statements and notes, as set out on pages 58 to 71 satisfy the requirements of the *Australian Charities and Not-for-profits Commission Act 2012* and *Not-for-profits Commission Regulation 2013*, and;

   (a) comply with Australian Accounting Standards – Reduced Disclosure Requirements, and

   (b) give a true and fair view of the financial position as at 31 December 2017 and of its performance for the year ended on that date.

2. In the directors' opinion there are reasonable grounds to believe that AINSE will be able to pay its debts as and when they become due and payable

This declaration is made in accordance with a resolution of the Board of Directors.

....	....
Director	Director
Lyndon Edwards	Michelle Durant

Dated this 27th day of March 2018

The Australian Institute of Nuclear Science and Engineering
AINSE Limited
ABN 18 133 225 331
Independent Auditor's Report to the Members of
The Australian Institute of Nuclear Science and Engineering
For the Financial Year Ended 31 December 2017

Audit Opinion

Opinion

We have audited the financial report of The Australian Institute of Nuclear Science and Engineering (AINSE), which comprises the statement of financial position as at 31 December 2017, and the statement of comprehensive income, statement of changes in equity and cash flow statement for the year then ended, and notes to the financial statements, including a summary of significant accounting policies, and the declaration by those charged with governance.

In our opinion, the accompanying financial report of AINSE is prepared, in all material respects, in accordance with *the Australian Charities and Not-for-profits Commission Act 2012, the Not-for-profits Commission Regulation 2013*.

Basis for Opinion

We conducted our audit in accordance with Australian Auditing Standards. Our responsibilities under those standards are further described in the *Auditor's Responsibilities for the Audit of the Financial Report* section of our report. We are independent of AINSE in accordance with the ethical requirements of the Accounting Professional and Ethical Standards Board's APES 110 *Code of Ethics for Professional Accountants* (the Code) that are relevant to our audit of the financial report in Australia. We have also fulfilled our other responsibilities in accordance with the Code. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

Information Other than the Financial Report and Auditor's Report Thereon

Those charged with governance are responsible for the other information. The other information comprises the information included in AINSE's annual report for the year ended 31 December 2017 but does not include the financial report and our auditor's report thereon.

Our opinion on the financial report does not cover the other information and accordingly we do not express any form of assurance conclusion thereon.

In connection with our audit of the financial report, our responsibility is to read the other information and, in doing so, consider whether the other information is materially inconsistent with the financial report or our knowledge obtained in the audit or otherwise appears to be materially misstated.

If, based on the work we have performed, we conclude that there is a material misstatement of this other information; we are required to report that fact. We have nothing to report in this regard.

The Australian Institute of Nuclear Science and Engineering
AINSE Limited
ABN 18 133 225 331
Independent Auditor's Report to the Members of
The Australian Institute of Nuclear Science and Engineering
For the Financial Year Ended 31 December 2017

Responsibilities of Management and Those Charged with Governance for the Financial Report

Management is responsible for the preparation of the financial report in accordance with *the Australian Charities and Not-for-profits Commission Act 2012, the Not-for-profits Commission Regulation 2013*, and for such internal control as management determines is necessary to enable the preparation of the financial report that is free from material misstatement, whether due to fraud or error.

In preparing the financial report, management is responsible for assessing AINSE's ability to continue as a going concern, disclosing, as applicable, matters related to going concern and using the going concern basis of accounting unless management either intends to liquidate AINSE or to cease operations, or has no realistic alternative but to do so.

Those charged with governance are responsible for overseeing AINSE's financial reporting process.

Auditor's Responsibilities for the Audit of the Financial Report

Our objectives are to obtain reasonable assurance about whether the financial report as a whole is free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion. Reasonable assurance is a high level of assurance but is not a guarantee that an audit conducted in accordance with Australian Auditing Standards will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of the financial report.

A further description of our responsibilities for the audit of the financial report is detailed in Appendix A to the Auditor's Report.

Delante Accountants and Business Advisers Pty Ltd
Chartered Accountants

David G Aston
Director

TAREN POINT NSW 2229

Dated 27th March 2018

The Australian Institute of Nuclear Science and Engineering
AINSE Limited
ABN 18 133 225 331
Independent Auditor's Report to the Members of
The Australian Institute of Nuclear Science and Engineering
For the Financial Year Ended 31 December 2017

APPENDIX A to the Auditor's Report

As part of an audit in accordance with Australian Auditing Standards, we exercise professional judgement and maintain professional scepticism throughout the audit. We also:

- Identify and assess the risks of material misstatement of the financial report, whether due to fraud or error, design and perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for our opinion. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control.

- Obtain an understanding of internal control relevant to the audit in order to design procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of AINSE's internal control.

- Evaluate the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures made by management.

- Conclude on the appropriateness of management's use of the going concern basis of accounting and, based on the audit evidence obtained, whether a material uncertainty exists related to events or conditions that may cast significant doubt on AINSE's ability to continue as a going concern. If we conclude that a material uncertainty exists, we are required to draw attention in our auditor's report to the related disclosures in the financial report or, if such disclosures are inadequate, to modify our opinion. Our conclusions are based on the audit evidence obtained up to the date of our auditor's report. However, future events or conditions may cause AINSE to cease to continue as a going concern.

We communicate with those charged with governance regarding, among other matters, the planned scope and timing of the audit and significant audit findings, including any significant deficiencies in internal control that we identify during our audit.

The Australian Institute of Nuclear Science and Engineering
AINSE Limited
ABN 18 133 225 331
Auditor's Disclaimer
For the Financial Year Ended 31 December 2017

The additional data presented in the Detailed Profit & Loss Statement is in accordance with the books and records of The Australian Institute of Nuclear Science and Engineering, which have been subjected to the auditing procedures applied in the statutory audit of AINSE for the year ended 31 December 2017.

It will be appreciated that the statutory audit did not cover all details of the financial data and no warranty of accuracy or reliability is given. Neither the firm nor any member or employee of the firm undertakes responsibility in any way whatsoever to any person (other than AINSE) in respect of such data, including any errors or omissions therein however caused.

Delante Accountants and Business Advisers Pty Ltd
Chartered Accountants

David G Aston
Director

TAREN POINT NSW 2229

Dated 27th March 2018.

The Australian Institute of Nuclear Science and Engineering
AINSE Limited
ABN 18 133 225 331
Detailed Profit & Loss Statement
For the Financial Year Ended 31 December 2017

		2017 $		2016 $
Operating Revenue				
Payments from Members		1,234,370		1,843,153
ANSTO Promotion Fee		436,000		417,500
External Grants		96,824		-
Interest Received		68,980		67,191
Sponsorships				
AANSS	-		3,000	
Conference Registrations		22,734		16,655
Other Income		12,850		4
Total Operating Revenue		1,871,758		2,347,503
Operating Expenses				
Wages & Salaries		397,896		420,106
Superannuation		59,828		47,249
AINSE Awards				
Postgraduate Awards				
ANSTO Facility Costs	-		82,500	
Travel & Accommodation	84,101		96,925	
Stipends	638,157		587,669	
		722,258		767,094
Winter School		10,658		4,333
Research Fellowships		-		102,119
Research Awards				
ANSTO Facility Costs	-		679,965	
Minor Equipment & Materials	-		2,559	
Travel Accommodation	-		35,412	
Other Costs	2,000		(4,600)	
		2,000		713,336
Conference Subsidies		92,060		92,031
Conference Management		68,178		19,387
Publication & Promotions		28,283		21,035
Meetings & Committees		81,519		84,673
AINSE Secretariat				
Audit Fees	21,397		20,475	
Bank Charges	748		611	
Depreciation	11,385		12,815	
Office Supplies	3,058		3,520	
Postage & Telephone	1,097		878	
Insurance	11,075		11,731	
Entertaining	213		375	
Books & Software	4,008		2,844	

The Australian Institute of Nuclear Science and Engineering
AINSE Limited
ABN 18 133 225 331
Detailed Profit & Loss Statement
For the Financial Year Ended 31 December 2017

		2017 $		2016 $
Administration & Staff Training	9,974		9,425	
Travel & Accommodation	9,498		9,200	
Vehicle Expenses	8,352		8,692	
Consultancy Fees	6,452		4,793	
Staff Recruitment	790		1,162	
FBT Expense & Payments	4,954		5,907	
Credit Card Expense	15		192	
Legal Expenses	4,275		36,702	
Miscellaneous	12,594		12,417	
		109,885		141,739
Total Operating Expenses		1,572,565		2,413,102
Surplus for the Year		299,193		(65,599)

WOMEN IN STEM AND ENTREPRENEURSHIP (WISE) SCHOOL

AINSE received grant funding from the Australian Government's Women in STEM and Entrepreneurship program, under the National Innovation and Science Agenda, to hold a school specifically for women at ANSTO. The Women in STEM and Entrepreneurship (WISE) School was targeted at first year university students with an emphasis on women in STEM and their career opportunities in nuclear science and engineering. The intensive three-day residential workshop featured a number of high-profile role models who gave presentations, engaged in panel sessions, tours and workshops to help inspire women into senior leadership roles in STEM.

AINSE invited a female student from each of its thirty-five Australian and six New Zealand university members to attend the school, and a lottery of reserve students was run to fill the vacant spaces. A total of forty-three students from thirty-five universities and two carers attended the inaugural WISE School from 4 December – 6 December. Students were able to meet and network with peers, as well as various high profile and successful men and women in STEM, while learning about the opportunities available to them in future careers in the STEM environment and how AINSE supports STEM students at levels of their student pathways.

The WISE school was opened by the Managing Director and President of AINSE with an overview of AINSE and the opportunities provided to students. ANSTO CEO Dr. Adi Paterson gave a poignant presentation, sharing personal accounts of female trailblazers in his family as well presenting the goals and programs ANSTO has developed to ensure a diverse and inclusive work environment.

Through a science communication workshop and a networking panel, students gained valuable techniques and strategies for use throughout their career to become future leaders and role models within the STEM environment. Students were also provided with a tour of the ANSTO site as well as facility-specific sessions within the different sectors of science and engineering and their involvement with Nuclear Science and Engineering. The students were also fortunate enough to be taken up to the control room on level 13 of the reactor.

A large and ongoing component of the WISE School was the establishment of a mentorship program between the students and ANSTO/AINSE staff members. Through a networking dinner, students were able to interact with their mentors and gain a greater understanding of the STEM careers and the opportunities through the nuclear science and engineering field. Zoom conferences have been arranged in 2018 to assist the students in developing professional networks.

The response to the WISE school was positive, with students stating that the program caused them to consider research and further academic study, as well as nuclear science and engineering career opportunities in the future. Feedback from the students also included a number of intangible benefits, such as increased self-belief and confidence.

AINSE would like to thank all who contributed to the success of the WISE school, without the efforts of the guest speakers and all organisations involved, the program would not have been the success that it was. AINSE would like to especially thank the Australian Government for providing funding for the WISE school. AINSE is exploring opportunities to install the WISE School as a permanent fixture on the annual events calendar.

"The best experience any female starting in STEM could ever hope for!"

"The best and most worthwhile experience so far in my university degree"

"The school was the most insightful, inspiring and rewarding experience I have ever had the honour of partaking."

"It was great to meet fantastic, positive people and be in such a supportive environment."

"It has given me direction in my studies and has opened a world of possibilities"

"It was a fantastic experience that has defined what I want to do in the future"

Guest Speakers

Sarah Ballantyne (ANSTO) ● Krystal Barter (Pink Hope) ● Dr Timothy Boyle (ANSTO) ● Lillian Caruana ● Dr Cathy Foley (CSIRO) ● Prof Marie-Claude Gregoire (ANSTO) ● Dr Merryn McKinnon (ANU) ● Scott Olsen (ANSTO) ● Dr Adi Paterson (ANSTO) ● Prof Judith Smith (UTS) ● Erica Smyth (ANSTO) ● Katrina Van De Ven (ANSTO) ● Kylie Walker (Science and Technology Australia) ● Prof Tim Wess (CSU)

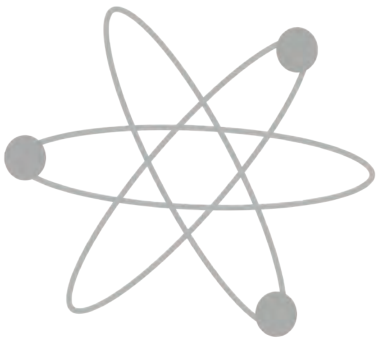
WISE SCHOOL 2017 STUDENTS

Maryna Bilokur	UTS
Ellena Black	AKL
Holly Blakely	CAN
Ashley Brooke Carey	FLI
Alena Chizhova	ADE
Natalie Ciavarella	SWI
Rebecca Craigie	MUR
Natalie Cross	UNE
Cintya Dharmayanti	USA
Candy Duff	CSU
Kirsten Fabian	QUT
Sophie Fontaine	MON
Mao Lin (Thomasina) Foo	UWA
Kate Gibbins	ANU
Rebecca Green	TAS
Emily Harvey	SCU
Skye Jenkins	RMI
Suzannah Keene	SYD
Denika Kelsall	CUR
Yie Chang Lin	ANU
Josephine Marjorie Longuet-Higgins	MAS
Charlotte Lyons	JAM
Britt Ann McDonald	CBR
Sarah McInnes	NSW
Emma Mederic	DEA
Natasha Mehl	UWA
Shay Morrison	USC
Abby Muldoon	SCU
Hinal Patel	DEA
Katie Plaisted	RMI
Catherine Pot	VUW
Tarin Ritchie	ADE
Zahra Sadat Naseri	WOL
Zahra Safdari	MAC
Dilys Sepe	CQU
Juliet Smith	UWS
Victoria Stojic	ACU
Edie Rose Thomas	WAI
Tayla Maree Thorogood	ECU
Smina Tribolet-Christensen	QUT
Laura Wait	QLD
Hannah Louise Walley	ECU
Sabrina Wilson	MEL

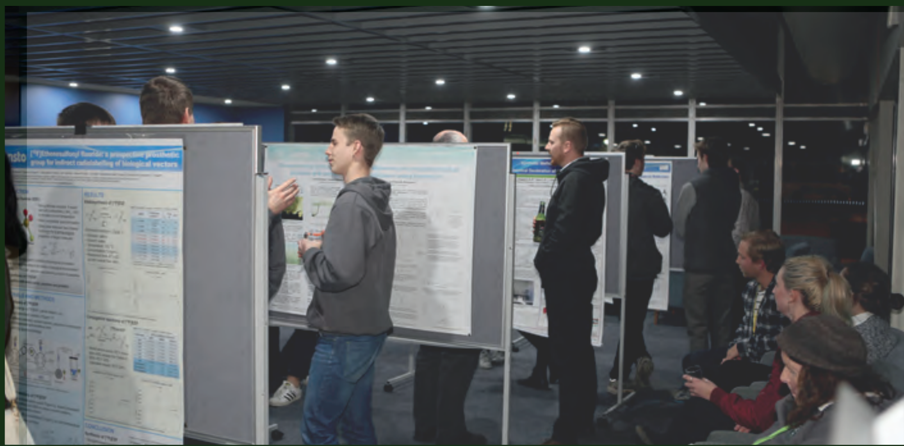
DISCIPLINES / AREA OF STUDY

Students came from a large background of disciplines:

Applied and Computational Mathematics/Earth Sciences
Biochemistry and Microbiology
Biology / Chemistry
Biomedical Science / Pharmacy
Biomedical Science, Human Health
Biomedical Sciences and Engineering
Chemical and Metallurgical Engineering
Chemical Engineering
Chemistry
Chemistry / Environment / Teaching
Chemistry and Mathematics
Chemistry / Politics
Chemistry + Physics
Earth/Environmental Science
Electrical Engineering
Engineering
Engineering (Civil) + Chemistry
Engineering (Mechatronics) / Technology (Motorsports)
Environmental Science
Environmental Science (Marine biology)
Materials Engineering
Maths and Engineering
Medical Science
Nuclear Physics
Pharmaceutical Science
Physics
Physics and Mathematics
Science (Biomedical) (Advanced)
Science - Chemistry
Science - Physics/Maths
Science (Chemistry/Biochemistry)
Science (Physics)
Secondary Education - Chemistry Major



Images courtesy Bruce Hudson Photography



WINTER SCHOOL

The Winter School is a week-long event held in July every year. It aims to provide a bridge for undergraduate students to learn about nuclear science and engineering within their respective fields, as well as to create a network between students of different universities that will continue throughout their future studies and careers.

For twenty-one years the Winter School has successfully connected nuclear science and engineering with the broader scientific and engineering community, introduced undergraduate students to the notion of further academic research through ANSTO and AINSE, and established a basis for students to become future leaders in the field of nuclear engineering and science.

“It allows the opportunity to see a different side of science I wouldn’t normally see”

This year, AINSE increased the capacity of Winter School, with attendance increasing from forty-six students in 2016 to sixty students in 2017.

Fifty-nine undergraduate students and one postgraduate student from forty member universities and organisations attended the Winter School from 17 July to 21 July. The Winter School theme for 2017 was ‘Marine Adventures’, and as such the goal of the school was to show the relationship between nuclear science and engineering in the marine environment.

The school opened with a presentation from the Managing Director before a range of high profile guest speakers explained their journey through undergraduate and postgraduate studies, and the importance of nuclear stewardship in today’s age. AINSE was fortunate to have Mr Sam Cleland from the Bureau of Meteorology give an inspiring and informative presentation on his work.

Students were treated to an overview of the work done at the Lucas Heights ANSTO facilities and the relationship between all fields of science and engineering. They also learnt about the research completed at ANSTO through tours as well as facility specific, hands on, sessions through the Lucas Heights site.

ANSTO CEO Dr Adi Paterson closed the Winter School with a presentation on his journey through undergraduate and postgraduate studies and the important role ANSTO plays in the advancement of nuclear science and engineering.

“It gave us the opportunity to be introduced to the facilities available and an overview of the work done”

In keeping with the previous year’s Winter Schools, there was an active social program to ensure students were able to interact in a fun environment. Students were given the opportunity to network with one another as well as various members of ANSTO and AINSE staff through a dinner in the city of Sydney, allowing them to establish connections throughout the program and beyond.

Students were provided with a project booklet and encouraged to discuss prospective projects with researchers during social events, the poster night and research roundup dinner. Students were also informed of the numerous opportunities AINSE offers to students at different stages of their student life.

“Meeting like-minded students and the AINSE/ANSTO staff was wonderful and the students from our city plan on keeping in touch”

The Winter School was a success with the feedback being overwhelmingly positive and many students expressing that it had made them consider a career in nuclear science and engineering. Highlights included the opportunities for students to connect with each other, AINSE and ANSTO staff, as well as gain access to the facilities on site.

The AINSE Winter School 2017 would not have been possible without the efforts of all of the guest speakers and organisations involved. AINSE would like to thank all who contributed to the success of the program. AINSE is committed to advancing its mission of enhancing Australia’s capability in nuclear science and engineering by facilitating world-class research and education through events such as the AINSE Winter School.

“Overall this week has been an incredible, invaluable experience and I feel like I might pursue nuclear-related study/work in the future. Thank you for this opportunity!!”

Has the Winter School given you an interest in research involving nuclear techniques?

YES 80%

WINTER SCHOOL 2017 STUDENTS

Rakesh Arul	AKL
Ryan Begley	THE / UWA
Marie Bosquet	MON
Corey Bridger	ADE
Zachary Brittain	SYD
Rikki Bruce	CDU
Harrison Caddy	UWA
Liam Carroll	CAN
Richard Curtis	LAT
Matthew Dale	QLD
Crystal Dao	MON
Sabrina Davies	UWA
Julie Donehue	TAS
Laura Easton	ADE
Matthew Elsley	UNE
Simon Eltoft	ECU
Lachlan Emerson	NSW
Kirsten Emory	MUR
Sean Foster	JAM
Georgia Free	UWS
Stephanie Gunn	MAS
Hai Phuong Ha	UTS
Danielle Hill	ACU
Emily-Rose Jones	QUT
Hana Kashkari	VUW
Ana Klisuric	USA
Dean Krak	QLD
Guy Leckenby	ANU
Ingrid Lindeman	WAI
Aaron Lloyd-Jones	NSW
Rachel Mackie	QLD
Neeraj Mall	FED
Katie Marshall	CUR
Sarah Alexandra McDonald	ADE
Jack McDonald	WOL
Shurui Miao	SYD
Scott Micke	UWA
Gabriel Nakhl	CSU
Keira Nesdale	MAS
Stephanie Owen	SWI
Anais Pages	CSI
Liam Parke	OTA
Ryan Parker	MEL
Andrew Pemberton	MEL
Tien Pham	DEA
Joshua Pheeney	CBR
Sophie-Wei Qi	NCT
Tamika Scheerlinck	MEL
Edward Smith-Roberts	ANU
Petra Sorensen	MAC
Daniel Stoker	QUT
Jeanette Tan	USA
Kelly Thompson	CQU
Sophie Tran	USC
James Tsoukalas	FLI
Sigrid Wilkens	RMI
Yunxin Xiao	MON
Timothy Zurrer	NSW
Mitch Klenner	CUR / Postgrad Helper
Francesca Gissi	CSI / WOL / Postgrad Helper

DISCIPLINES / AREA OF STUDY

Students came from a large background of disciplines:

Antarctic Science & Chemistry
Applied Chemistry
Archaeology
Biochemistry
Biotechnology
Chemical and Materials Engineering
Chemical Engineering
Chemical Physics
Chemistry
Chemistry and Maths
Chemistry Physical and Material Science
Chemistry/Biology
Chemistry/Physics
Electrical Engineering
Electrical Engineering and Physics
Engineering/Physics
Environmental Science
Environmental Science and Engineering
Environmental Science/Geology
Forensic Science (Chemistry)
Genetics/Chemistry
Geology
Mechanical Engineering
Medical Science and Pharmacy
Nuclear Astrophysics
Pharmaceutical Science
Physics
Physics & Maths
Physics & Neuroscience/Nuclear Medicine Physics
Physiology/Chemistry
Process Engineering
Science
Science, Microbiology, Developmental Biology

Preparing PSL autoradiography slides at ANSTO with Mathew Johansen and Nick Howell. Image courtesy Madison Hoffman (Honours Scholarship recipient)

HONOURS SCHOLARSHIPS

In 2017 AINSE continued the Honours program which first commenced in 2011. This program provides Honours Scholarships to a small number of excellent students who have a project which utilises the research facilities at ANSTO. The scholarships provide a stipend of $5,000AUD. The purpose of the scholarships are to provide a link between the Winter School and the other AINSE programs.

AINSE wishes to congratulate the twenty successful students representing fourteen universities. The students and their projects are:

Simon Collett, RMIT University
Structural and functional analysis of key parasite vaccine candidate proteins

Andrew Curtain, University of Wollongong
Investigation of Material Oxide Interfaces for Electronic Applications using Magnetometry and Polarised Neutron Reflectometry

Eleanor Denson, The University of Melbourne
Investigation into the reproducibility and temperature dependence of magnesium-calcium ratios in a cave pool speleothem

Christopher Freestone, The University of Newcastle
Sub-glacial Carbonates as an archive of basal conditions in the Italian Alps (Dolomites)

Luke Giles, Monash University
Synthesis of metal-organic frameworks inside confined soft matter templates

Bradley Graves, Macquarie University
Palaeo-fire and environmental history in floodplain wetlands of the Macquarie Marshes, NSW, Australia

Madison Hoffman, The University of Queensland
Characterising plutonium in the marine sediments at Australia's first nuclear detonation site: quantifying hot-particle vs. chemically-bound Pu

David Jorritsma, Curtin University of Technology
Electrosynthesis and nanocharacterisation of 2D materials for applications in catalysis

Veena Kelleppan, Monash University
Novel betaine surfactants

Scarlet Kong, The University of New South Wales
Dynamics at the morphotropic phase boundary of lead-free ferroelectrics

Chelsea Long, University of Tasmania
Do volcanic sulfate emissions increase the flux of cosmogenic beryllium to Antarctica?

Olivia McRae, The University of Sydney
Structured polymer hybrids for better batteries and photovoltaics

Theresa Orr, James Cook University
Improving the performance of hydrogen pyrolysis as a pretreatment for old samples

Stephen Piva, Monash University
Polar palaeoclimates during the warmest interval in Earth's history: the mid-Cretaceous hothouse

Michaela Ripper, The Australian National University
Determining the radiative width of the Hoyle state through pair conversion, gamma-ray and particle spectroscopy

Harley Rutherford, University of Wollongong
Dose quantification from in-beam positron emission tomography in Heavy Ion Therapy

Julia Short, The University of Adelaide
Tourism and it's the effect on Fraser Island's globally unique perched lakes

Sunny Wang, The University of New South Wales
Characterisation of negative thermal expansion materials and approaches towards zero thermal expansion materials via Li/Na/K batteries

Yunxin Xiao, Monash University
Investigation of targeted delivery of drug nanocrystal loaded liposomes by azide-cyclooctyne functionalisation

Timothy Zurrer, The University of New South Wales
Probing stabilisation structure of nanoparticle reference materials


Drilling a permafrost core at 1,900 meters on Table Mountain, Antarctica. Image Courtesy Jacob Anderson (PGRA recipient)

POSTGRADUATE RESEARCH AWARD (PGRA) SCHOLARSHIPS

An AINSE Postgraduate Research Award (PGRA) is a top-up scholarship. To be eligible for one of these awards, an applicant must hold an Australian Postgraduate Award (APA) or equivalent scholarship. The PGRA may be held until the expiry of the primary scholarship.

In addition to providing a student with a stipend of $7,500 pa, the award provides access to ANSTO's world-class facilities and expertise. An allowance for travel expenses for two visits and a total of one month's accommodation to Lucas Heights per annum is also awarded.

Thirty-one new AINSE postgraduate research projects were supported by a PGRA in 2017. The total number of scholars supported in 2017 were seventy-eight. AINSE received twenty-one theses and has now helped train four hundred and four students through its PGRA program, in aspects of nuclear science and associated techniques of analysis. Many more students have been assisted with their research by gaining access to Lucas Heights facilities through AINSE Awards made to their supervisors. The Council believes that one of the most valuable roles fulfilled by AINSE is the provision of these scholarships.

PhD THESES OF POSTGRADUATE SCHOLARS RECEIVED DURING 2017

Compartmentalisation and membrane activity in protic ionic liquids and deep eutectic solvents
Saffron Bryant, Chemistry, The University of Sydney
Commenced 1/7/2014

Search for novel multifunctional materials: A comprehensive neutron and Synchrotron diffraction study on cobaltates and spinels
Fenfen Chang, Physics, The University of New South Wales
Commenced 1/7/2014

Development of efficient low-cost semiconductor photocatalysts for solar H_2 production
Wan-Ting, Chen, Chemistry, The University of Auckland
Commenced 1/7/2015

Alignment and characterisation of hexagonal lyotropic liquid crystalline nanostructure for membrane synthesis
Weiwei Cong, Institute for Frontier Materials, Deakin University
Commenced 1/7/2012

Interpreting the feeding ecology of Southern Hemisphere Humpback whales through biochemical assessment
Pascale Eisenmann, SOPOPP, Griffith University
Commenced 1/7/2014

Physical processes and morphodynamics of coral reefs
Daniel Harris, School of Geosciences, The University of Sydney
Commenced 1/7/2010

A study of the spontaneous membrane insertion of chloride intracellular ion channel protein CLIC1 into model lipid membranes
Khondker Rufaka Hossain, Medical & Molecular Biosciences, University of Technology Sydney
Commenced 1/7/2013

Phase transitions in strain-tuned $SrCoO_3$-delta(0<delta≤0.5) thin films
Songbai Hu, Materials Science and Engineering, The University of New South Wales
Commenced 1/7/2014

Carbon storage in tidal wetlands of Southeast Australia
Jeffrey Kelleway, Plant Functional Biology and Climate Change Cluster, University of Technology Sydney
Commenced 1/7/2015

Investigating the physiochemical poperties and proton conduction mechanism of a new proton exchange membrane, based on novel heteropoly acid functionalised mesoporous silica nanocomposties
Krystina Lamb, Faculty of Science, Health, Education & Engineering, University of the Sunshine Coast
Commenced 1/7/2013

Radial heterogeneity evolution in polyacrylonitrile-based carbon fiber precursor during thermal stabilization
Srinivas Nunna, Institute of Frontier Materials, Deakin University
Commenced 1/7/2014

Coordination frameworks: Host-guest chemistry and structural dynamics
Stephen Ogilvie, Chemistry, The University of Sydney
Commenced 1/7/2013

Ross Sea deglaciation and holocene paleoenvironments
Rebecca Parker, Geology, University of Otago
Commenced 1/7/2016

Fluid descriptions of externally heated tokamak plasmas
Zhisong Qu, Plasma Research Laboratory, The Australian National University
Commenced 1/7/2014

Structure-property relationships of uranium and technetium-containing oxides
Emily Reynolds, Chemistry, The University of Sydney
Commenced 1/7/2013

Dynamics of carbon storage in subtropical seagrass meadows
Jimena Samper-Villarreal, Marine Spatial Ecology Lab, The University of Queensland
Commenced 1/7/2012

In-situ characterization of the early stages of bio-mimetic calcium phosphate and calcium carbonate mineralisation
Rayomand Shahlori, School of Chemical Sciences, The University of Auckland
Commenced 1/7/2014

Development of imaging agents to target tumour hypoxia
Deborah Sneddon, Eskitis Institute for Drug Discovery, Griffith University
Commenced 1/7/2015

Improving success rates for in meso crystallization using integral membrane proteins and membrane protein mimetics in the bicontinuous cubic phase
Leonie van 't Hag, Manufacturing Flagship, CSIRO/The University of Melbourne
Commenced 1/7/2015

Toward an advanced monolithic precursor templeted from hexagonal lyotropic liquid crystals
Guang Wang, Institute for Frontier Materials, Deakin University
Commenced 1/7/2015

The what and where of ultraviolet protective mechanisms in Antarctic mosses
Melinda Waterman, Biological Sciences, University of Wollongong
Commenced 1/7/2010

POSTGRADUATE SCHOLARS, AND THEIR PROJECTS, WHO WERE SUPPORTED DURING 2017

High-resolution dating of young, low uranium stalagmites: combining AMS ^{14}C analysis and SR-micro-XRF
Ebony Anderson, Earth Sciences, The University of Newcastle
Commenced 1/7/2017

When was the Antarctic landscape last unfrozen?
Jacob Anderson, Marine Science, University of Otago
Commenced 1/7/2017

Development of a platform for rapid antibiotic viability testing
Jakob Andersson, Chemical & Physical Sciences, Flinders University
Commenced 1/7/2015

Calibration of advanced hydrologic and isotopic palaeoclimate models with lake monitoring
Martin Ankor, School of Physical Sciences, The University of Adelaide
Commenced 1/7/2016

Far and mid-infrared spectroscopy of astrochemical species and aerosols
Rebecca Auchettl, Chemistry and Physics, La Trobe University
Commenced 1/7/2017

Morphology effect of novel poly(p-phenylene vinylene) brush thin films on their photoluminescence in solid-state
Paul Baek, School of Chemical Science, The University of Auckland
Commenced 1/7/2014

The impact of ionizing radiation on the central nervous system
Calina Betlazar-Maseh, Faculty of Health Sciences, The University of Sydney
Commenced 1/7/2017

Characterisation and evolution of Rottnest Island salt lake microbialites, Western Australia
Karl Bischoff, Earth Sciences, The University of Western Australia
Commenced 1/7/2017

The use of BiNSAIDs as novel chemopreventive agents for colorectal cancer
Tara Brown, School of Chemistry, University of Wollongong
Commenced 1/7/2017

Exploring magnetoelectric coupling in ferroics; neutron scattering experiments probing the magnetic phases of BiFeO3
Stuart Burns, School of Materials Science and Engineering, The University of New South Wales
Commenced 1/7/2016

The Last Interglacial: an analogue for future climate change?
Micheline Campbell, School of Earth and Environment, The University of Western Australia
Commenced 1/7/2015

Characterisation of pregnancy zone protein-cytokine interactions by autoradiography
Jordan Cater, Biological Sciences, University of Wollongong
Commenced 1/7/2017

Functional Magnetic Interface Phenomena in Nano-Architectures Studied by Polarised Neutron Reflectometry
Grace Causer, Institute for Superconducting and Electronic Materials, University of Wollongong
Commenced 1/7/2016

Landscape evolution of the Kimberley region and rock art dating using cosmogenic ^{10}Be and ^{26}Al
Gael Cazes, School of Earth and Environmental Sciences, University of Wollongong
Commenced 1/7/2016

Novel Oxynitride Photocatalysts for Solar Hydrogen Production
Andrew Chan, School of Chemical Sciences, The University of Auckland
Commenced 1/7/2015

Diffusion in Solid Ionic Conductors for Sodium-ion Battery Applications: Structure and Dynamics
Emily Cheung, School of Chemistry, The University of New South Wales
Commenced 1/7/2017

Materials for New Generation of Batteries
James Christian, Chemistry, The University of New South Wales
Commenced 1/7/2015

Sulphur: a new proxy for wildfire in speleothem records
Katie Coleborn, Biological, Earth and Environmental Sciences, The University of New South Wales
Commenced 1/7/2017 *John Ferris Memorial PGRA*

The Interfacial Structure and Composition of an Ionic Liquid Lubricant Additive
Peter Cooper, Engineering, The University of Western Australia
Commenced 1/7/2017

Examining the structure and function of Mixed Lineage Kinase-domain Like protein: the final executioner of necroptosis
Katherine Davies, Medical Biology, The University of Melbourne
Commenced 1/7/2017

The development of “first-in-class” multi-modal PET diagnostics/near-IR surgery guidance tools and radio-therapeutics
Jeremy Dobrowolski, Chemistry, The University of New South Wales
Commenced 1/7/2017

Uncovering the mechanisms of corrosion-resistant materials: towards developments of novel corrosion inhibition measures
Deepak Dwivedi, Chemical Engineering, Curtin University of Technology
Commenced 1/7/2017

Holocene drivers of environmental change from high-resolution lake sediment sequences in northern New Zealand
Gianna Evans, School of Environment, The University of Auckland
Commenced 1/7/2015

A Late Quaternary Climate and Environmental Reconstruction from Sub-Tropical Queensland
Michael Evans, Geography, Planning & Environmental Management, The University of Queensland
Commenced 1/7/2016

Assessing terrestrial climate variability over the last glacial-interglacial transition: a new quantitative, high-resolution, multi-proxy record from south-eastern Australia
Georgina Falster, Earth Sciences, The University of Adelaide
Commenced 1/7/2015

Radiocarbon age of dissolved organic carbon under contrasting land uses in NSW Australia
Rubeca Fancy, School of Environmental & Rural Science, The University of New England
Commenced 1/7/2016

Skyrmion system in a chiral multiferroelectric thin film of Cu_2OSeO_3
Nastaran Faraji Ouch Hesar, School of Materials Science and Engineering, The University of New South Wales
Commenced 1/7/2016

Unlocking the Kimberley’s Environmental Past: Late Quaternary Multi-Proxy Analysis of Tropical Mound Spring Peat Cores
Emily Field, Geography, Planning and Environmental Management, The University of Queensland
Commenced 1/7/2015

Radiocarbon dating of Kimberley rock art
Damien Finch, School of Earth Sciences, The University of Melbourne
Commenced 1/7/2016

Stable carbon isotope analysis of Pandanus sp. drupes: A proxy for ancient foraging practices at Madjedbebe (Malakunanja II)
Stephanie Florin, Social Sciences, The University of Queensland
Commenced 1/7/2015

A Breath of Fresh Air for Cystic Fibrosis
Melanie Fuller, School of Chemical and Physical Sciences, Flinders University
Commenced 1/7/2016

Reconstructing the post-glacial history of the subantarctic Auckland Islands from marine sediment cores using ITRAX XRF and AMS Radiocarbon
Greer Gilmer, Geological Sciences, University of Otago
Commenced 1/7/2015

Unravelling the complex relationship of the coral holobiont and its responses to metal contaminants
Francesca Gissi, School of Chemistry, CSIRO/University of Wollongong
Commenced 1/7/2016

Understanding the mode of action of analgesic conotoxin Vc1.1 and other analgesic conotoxins
Ellen Gleeson, Chemistry, Monash University
Commenced 1/7/2014

Interactions between meteoric, surface and ground water in fractured rock: Upper Murrumbidgee catchment
Sharon Gray, Research School of Earth Sciences, The Australian National University
Commenced 1/7/2016

Experimental Demonstration of Bragg-Edge Neutron Strain Tomography
Alexander Gregg, School of Engineering, The University of Newcastle
Commenced 1/7/2017

Toward Smarter Surfaces: Exploring the Selectivity and Stimuli-Response Available through Polymer Brushes
Isaac Gresham, Chemical Sciences, The University of New South Wales
Commenced 1/7/2017

Deciphering the mechanisms of antibacterial activity and resistance of polymyxins in Gram-negative bacteria
Meiling Han, Monash Institute of Phamaceutical Sciences, Monash University
Commenced 1/7/2016

Quantifying Anthropogenic Impacts on Dust Flux and its Interaction with Recipient Ecosystems
James Hooper, School of Earth & Environmental Sciences, University of Wollongong
Commenced 1/7/2016

Confinement effects on the stimulus response of polymer brushes
Ben Humphreys, Chemistry, The University of Newcastle
Commenced 1/7/2016

Interdecadal ENSO variability in the past millennium: the role of coupled air-sea interactions in the central Pacific
Jasmine Hunter, School of Earth Sciences & Environmental Sciences, University of Wollongong
Commenced 1/7/2017

Using atmospheric and plant-based sampling of C-14 to constrain local and regional fossil fuel emissions
Wenwen Huo, School of Earth Sciences, The University of Melbourne
Commenced 1/7/2016

Synthesis and characterisation of multi-stimuli responsive polymer brushes
Edwin Johnson, Chemistry, The University of Newcastle
Commenced 1/7/2017

Mineral controls on soil carbon stability along the subtropical giant podzol Cooloola chronosequence
Andrew Jones, School of Agriculture and Food Science, The University of Queensland
Commenced 1/7/2015

Search for novel multiferroic materials: A comprehensive Synchrotron and Neutron Diffraction Study on Magnetite (Fe3O4)
Yousef Kareri, Physics, The University of New South Wales
Commenced 1/7/2017

Hydrogen Depth Profiling of High Strength Steels
Oluwole Kazum, Chemical Engineering, James Cook University
Commenced 1/7/2015

Tomographic imaging of residual elastic strain fields in whole components via Strain Tomography
Henry Kirkwood, Chemistry and Physics, La Trobe University
Commenced 1/7/2015

Synthesis and Photophysics of Metal-Fluorine(18) Radiopharmaceutical Complexes as Optical-Positron Emission Multimodal Diagnostic Agents
Mitchell Klenner, Chemistry, Curtin University of Technology
Commenced 1/7/2015

Developing a spatio-temporal model for mass flow hazards at stratovolcanoes, Mt. Taranaki, New Zealand
Geoffrey Lerner, School of Environment, The University of Auckland
Commenced 1/7/2016

Structural investigation of the Munc18:SNARE protein complexes required for neurotransmission and blood glucose control
Emma Livingstone, Institute for Molecular Bioscience, The University of Queensland
Commenced 1/7/2016

Inorganic nanoparticles/metal organic frameworks hybrid membrane reactors for simultaneous separation and conversion of CO_2
James Maina, Institute for Frontier Materials, Deakin University
Commenced 1/7/2016

Using nuclear techniques to reconstruct fire-driven environmental changes in Western Tasmania
Michela Mariani, School of Geography, The University of Melbourne
Commenced 1/7/2016

Investigation and development of molten salt reactor designs
Lance Maul, Mechanical & Manufacturing Engineering, The University of New South Wales
Commenced 1/7/2014

Controlling interfacial properties and dispersion of graphene analogues
Thomas McCoy, School of Chemistry, Monash University
Commenced 1/7/2016

Evolution and sedimentary architecture of Halimeda bioherms in the Great Barrier reef: Understanding origin, development, morphology, and palaeo-environment
Mardi McNeil, School of Earth, Environmental and Biological Science, Queensland University of Technology
Commenced 1/7/2017

Understanding the co-precipitation mechanisms of Al_3(Sc,Zr) with Li-containing phases in Al-Cu-Li model alloys
Anne Mester, Institute for Frontier Materials, Deakin University
Commenced 1/7/2017

Structure-stimulus relations in responsive polymer brushes
Timothy Murdoch, Chemical Engineering, The University of Newcastle
Commenced 1/7/2015

A Fundamental and Systematic Investigation of Actinide (Uranium and Thorium) Containing Materials Related to the Nuclear Fuel Cycle
Gabriel Murphy, Chemistry, The University of Sydney
Commenced 1/7/2017

Investigating transfer and accumulation of trace metals up the food chain; using radiotracers to observe the uptake of contaminants in prawns and fish from seawater and dietary ingestion
Kaitlyn O'Mara, Australian Rivers Institute, Griffith University
Commenced 1/7/2016

Interfacial magnetism effects and multiferroic thin films for device applications
Oliver Paull, Institute of Superconduction & Electronic Materials, University of Wollongong
Commenced 1/7/2017

Chronology development of Auckland Maar Lake Sediment Records
Leonie Peti, School of Environment, The University of Auckland
Commenced 1/7/2017

Exploring the potential of Mg/Ca ratios in sub-aqueous speleothems to reconstruct surface temperatures over multiple glacial-interglacial cycles
Timothy Pollard, School of Geography, The University of Melbourne
Commenced 1/7/2017

Fire and Environmental Change in Northern Australia during the Late Holocene
Emma Rehn, Science and Engineering, James Cook University
Commenced 1/7/2017

Elucidating carbon sources in groundwater ecosystems via radiocarbon and stable isotope analysis
Mattia Sacco, Applied Geology, Curtin University of Technology
Commenced 1/7/2017

Synthesis and Stabilities of Heavy Main Group Metal Hydrides
Ryan Schwamm, SCPS, Victoria University of Wellington
Commenced 1/7/2015

Using C-14 to resolve mangrove carbon cycling
James Sippo, Centre of Coastal Biogeochemistry, Southern Cross University
Commenced 1/7/2016

An archaeological and palaeoenvironmental investigation into prehistoric occupation of the Namadgi Ranges in the southeast Australian uplands
Fenja Theden-Ringl, Archaeology and Natural History, The Australian National University
Commenced 1/7/2013

Sourcing historical contamination in the Gippsland Lakes, Victoria
Adam Trewarn, Applied and Biomedical Science, Federation University Australia
Commenced 1/7/2015

Investigating the architecture of rice starch at the nanoscale using complementary scattering methods to predict digestibility
Matthew Van Leeuwen, School of Science and Health, Western Sydney University
Commenced 1/7/2017

Neutron tomography and scattering in speleothems: the influence of porosity and texture on the accuracy of palaeoclimate interpretations
Valentina Vanghi, School of Environmental & Life Sciences, The University of Newcastle
Commenced 1/7/2016

Using ITRAX XRF, multi-dimensional isotope analysis and silica microfossils to study the palaeo-ecology of sclerophyll sites in the Atherton Tablelands, northeastern Australia
Loraine Watson-Fox, Geography, Planning & Environmental Management, The University of Queensland
Commenced 1/7/2016

Novel fluorinated radioligands of the tyrosine kinase, MERTK, for imaging and diagnosis in multiple sclerosis
Siu Wai Wong, Monash Institute of Pharmaceutical Sciences, Monash University
Commenced 1/7/2016

Operando X-ray Absorption Spectroscopy Study of Sodium Storage Mechanism of $ZnXP_2$ (X=Sn, Ge or Si) Anodes
Zhibin Wu, Institute of Superconduction & Electronic Materials, University of Wollongong
Commenced 1/7/2017

Developing isotopic techniques to investigate mangrove blue carbon in coastal landscapes
Campbell Young, School of Earth & Environmental Sciences, University of Wollongong
Commenced 1/7/2017

Detailed investigation of factors affecting the formation of intermediate phase during dehydroxylation of serpentine minerals
Sana Zahid, School of Engineering, Murdoch University
Commenced 1/7/2017

Variable Temperature Studies on Spin Crossover Materials to Model Guest Rearrangement and Molecular Rotations
Katrina Zenere, Chemistry, The University of Sydney
Commenced 1/7/2017

Synthesis, radiolabelling and bio-conjugation studies of [^{18}F]ethenesulfonyl fluoride (ESF) - a new innovative tool for radiopharmaceutical development
Bo Zhang, School of Chemistry, Monash University
Commenced 1/7/2016

Electrostatic effects on chemical reactivity; oriented double layer effects on chemical bonding kinetics and thermodynamic
Long Zhang, Intelligent Polymer Research Institute, University of Wollongong
Commenced 1/7/2016

PGRA ORIENTATION 'O' WEEK

AINSE awarded thirty-one new Postgraduate Research Awards to students across Australia and New Zealand in 2017. In order to provide students with additional support in their goal in achieving a postgraduate qualification, AINSE coordinates an Orientation Week (or 'O-Week') run in mid-October. The program began in 2015 with the objective to encourage and support young nuclear science and engineering students, as well as facilitate further educational and leadership development throughout students' postgraduate journeys.

Twenty students from the 2017 PGRA cohort attended O-Week, held from 16 October to 18 October. O-Week officially opened with a presentation from the AINSE Managing Director, followed by presentations from a number of AINSE staff members, outlining the support available to the students. ANSTO CEO Dr. Adi Paterson also welcomed the students on the first day, sharing his own postgraduate research journey and practical advice with the students over lunch.

Students gave a five minute presentation on their research projects to the group, as well as to ANSTO co-supervisors, giving everyone a great summary of the current research being conducted across Australia and new Zealand. Thanks to numerous guest speakers, students were given overviews of the facilities at Lucas Heights and Clayton, and how they relate to their research projects. The broad range of science communication strategies as well as professional research project insights from varied members of ANSTO staff were true highlights throughout the program.

The Nuclear Science and Technology Landmark Infrastructure (NSTLI) team put forward stimulating presentations on the new themes and platforms of their organisation as well as the importance of the work done at ANSTO and the nature of nuclear science and engineering. Students received practical advice and encouragement from several high profile speakers in regards to their Ph.D. journeys.

Students had the opportunity to go on a site tour of Lucas Heights, including the control room on level 13 of the OPAL reactor, as well as spend time with their ANSTO co-supervisor and go on a site specific tour to familiarise themselves with their research equipment.

"It gave us the opportunity to be introduced to the facilities available and an overview of the work done"

"I learned a lot about other research areas, scientific theories/concepts and connected with a number of scientists. A great opportunity to expand your mind and grow your network!"

O-Week also coincided with Nuclear Science Week – an international celebration on all aspects of nuclear science – and the Managing Director of AINSE was in close consultation with the Nuclear Science committee in the United States as well as the Australian Young Generation in Nuclear (AusYGN) to ensure that the two events coincided and were celebrated jointly.

AusYGN gave a presentation and assisted with a relaxed networking event and a trivia night, which included a special nuclear science week trivia round. The evening gave students the opportunity to work on their professional networking abilities and establish lasting connections with one another.

"It was great to get familiarised with the site, and to meet and mix with other PGRA's"

The feedback for the event was extremely positive, many saying the ability to interact with fellow PGRA students and form a connection with ANSTO and AINSE staff being the highlights of the week, with several students stating they would remain in contact with one another.

AINSE would like to thank all who contributed to the success of O-Week as it would not have succeeded without the efforts of the guest speakers and organisations involved. Thanks to those involved, O-Week was a resounding success and fulfilled its objectives in providing and establishing support networks to encourage young nuclear science and engineering students throughout their postgraduate studies.

RESIDENTIAL STUDENT SCHOLARSHIP (RSS)

The AINSE Residential Student Scholarship (RSS) is a new ‘top-up’ residential postgraduate scholarship to high quality students who are enrolled in a PhD at an AINSE Member University. The Scholarship differs from a Postgraduate Research Award (PGRA) in that a RSS student must be onsite at an ANSTO facility (at Lucas Heights, Camperdown and/or Clayton) for six months per year which can be a block of time or separate visitations. The award was developed as AINSE recognised an opportunity to support students whose project topics closely align with ANSTO’s research programs; The Environment, Human Health, Nuclear Fuel Cycle, Defence Industry and Fusion.

AINSE wishes to congratulate the successful RSS applicants approved in 2017 (listed below) who have secured up to $7,500 stipend, with up to $5,000 travel and accommodation allowance.

STUDENT	UNIVERSITY	TITLE
Jeremy Dobrowolski	The University of New South Wales	The development of first in class multi-model PET diagnostics / near-IR surgery guidance tools and radio-therapeutics
Stephen Harris	The University of New South Wales	Quantifying the nutrient cycle using stable isotope tracers from farm gate to catchments groundwater and atmosphere
Chandima Madubhashi Nilanthika Nikagolla	Queensland University of Technology	Hydrochemical assessment of groundwaters in CKDu affected regions of Sri Lanka
Lara Parata	The University of New South Wales	Using microbial and nuclear based strategies to improve fish quality and reduce the costs of farming tilapia in PNG
Glen Surjadinata	The University of New South Wales	The pentafluorosulfanyl (SF5) group: a new functionality for diagnosis and therapy
Fuyuan Zhang	Macquarie University	Role of cytokines in low dose radiation impact on central nervous system

SCHOLARSHIP AINSE/ANSTO FRENCH EMBASSY (SAAFE)

As a result of the MOU signed between AINSE, ANSTO and the Embassy of France in Australia one PhD student Liam Koehn from The University of Melbourne had the opportunity to participate in an internship in France in 2017. Another student Gabriel Murphy from the University of Sydney was selected as well and will be travelling to France in early 2018.

The SAAFE Program objective is to facilitate and enhance bilateral collaborative research in nuclear science and engineering between Australia and France. The program supports early career researchers at PhD level to expand research and innovation activities within Human Health, Environment and Nuclear Fuel Cycle, to initiate sustainable research networks and linkages to support Australia and France research and innovation. AINSE is very thankful of the support offered by the The Embassy of France and ANSTO to support this wonderful internship opportunity overseas.

SAAFE REPORT FROM LIAM KOEHN

Pregnant mothers and prematurely born infants who suffer from conditions such as epilepsy, cardiac disorders and cancer require medication that cannot be withheld. In order to understand which of these compounds are likely to access the developing brain, the biology of the mechanisms that exclude drug entry must be understood. The Saunders' laboratory at the University of Melbourne is undertaking a project to investigate the protective properties of the barriers between the blood and the brain at different stages of life.

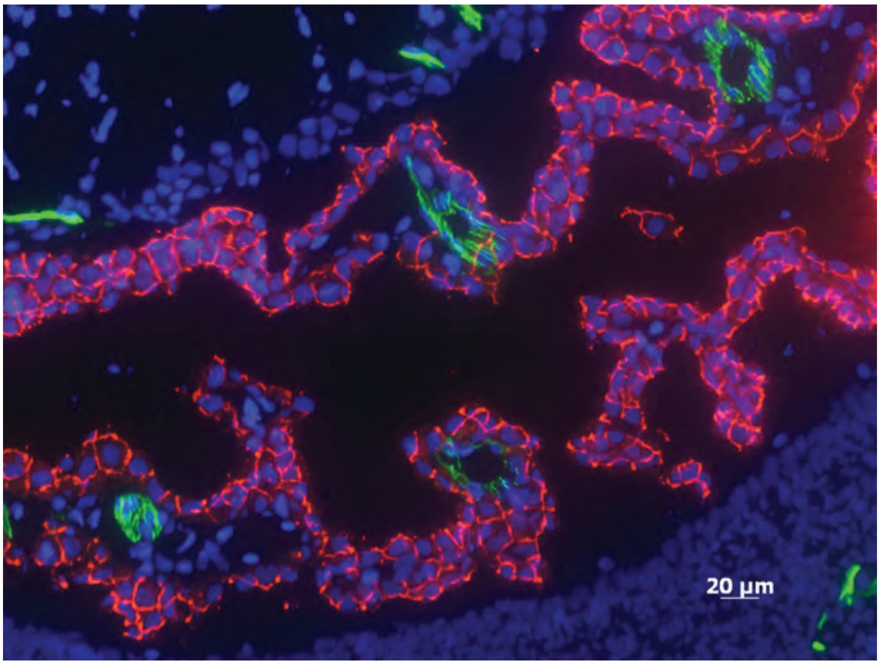
In September of 2017 Melbourne University PhD student and Saunders' laboratory member Liam Koehn was awarded the 2017 Scholarship AINSE ANSTO French Embassy (SAAFE) Research Internship. He travelled to Lyon in France to undertake a period of scientific research with Dr. Jean-Francois Ghersi-Egea and his team at the Lyon Neuroscience Research Center. Drs. Ghersi-Egea and Nathalie Strazielle are world-renowned experts in developmental neuroscience with particular expertise in studies of the choroid plexus, which is an epithelial tissue that acts as a barrier between the blood and cerebrospinal fluid that bathes the brain.

The project aimed at investigating the differences in the transfer of compounds from the blood to the brain early in development compared to later in life. An integral component of barrier defense are conjugating enzymes that tag drugs for removal and efflux transporters that grab the tagged drugs and push them back into the blood. Previous research has shown that when drugs are trying to cross from the blood to the adult brain the barriers can increase the amount of conjugating enzymes and efflux transporters present, providing increased protection. Whether brains early in development are able to respond to drug exposure in the same way has not yet been investigated. As medications prescribed to pregnant mothers and prematurely born infants are taken over a number of days, their entry into the brain will greatly depend on whether blood-brain barriers are able to regulate their defense levels.

The research design included both in vitro cell cultures and in vivo animal models investigating barrier responses to drug exposure. Spectrofluorimetry was used to measure the activity of conjugating enzymes while quantitative polymerase-chain reaction was used to measure the level of efflux transporters present. Results identified some developmental differences in the physiological response of the choroid plexuses to drug exposure. It appears that early in development the choroid plexus may be able to alter the expression of efflux transporters on the blood/cerebrospinal fluid barrier. In contrast, no differences were observed later in development or for conjugating enzymes at any age implying differential molecular control at the barrier.

These results may have large implications for what we understand about the biology of brain barriers over development. Understanding what drugs might be less likely to transfer to the brain due to barriers regulating defenses and what ages that applies to will assist doctors in deciding when it is safe to prescribe medications. These findings will also assist in future drug design to target medications to certain age-groups or stages of pregnancy. Further experiments are currently being set up to expand this collaborative project between the Ghersi-Egea laboratory in France and the Saunders laboratory in Australia.

The results from this study are currently being expanded in a project between Prof. Richard Banati at ANSTO and the Saunders laboratory, attempting to measure and image the transfer of medications into the developing brain. Any future results obtained at the French, Melbourne and ANSTO laboratories will be used in tandem to address integral scientific questions about developmental neurobiology and medicine.



An immunohistological staining of a choroid plexus. Image Courtesy of Liam Koehn

Lyon, France. Image Courtesy of Liam Koehn

RESEARCH FELLOWS

In 2006 AINSE, in conjunction with ANSTO established a Fellowship Scheme to add impetus to member Universities' growing stature in nuclear science and engineering and in related fields. Fellowships were for a three-year appointment in the first instance with the possibility of an extension to five years where subsequent continuing appointment at the university is foreseen. The AINSE Research Fellows Program concluded in December 2017.

AINSE wishes to congratulate Alison Blyth, whom AINSE awarded the AINSE Research Fellowship in 2011 and concluded in 2017:

2011 Alison Blyth, Curtin University of Technology
Molecular, stable isotopic and radiocarbon analyses of organic matter preserved in terrestrial records
Concluded December 2017

AINSE awarded the following Fellowships throughout the scheme:

2006 Darren Goossens, The Australian National University
Study of the nature and role of nanoscale order in complex materials
Concluded November 2011

2006 Daniel Riley, The University of Melbourne
Use of ultra-fast in-situ diffraction in the development of advanced materials
Concluded June 2010

2007 Duncan McGillivray, The University of Auckland
Probing the mechanisms of biomembrane interactions
Concluded December 2010

2007 Moeava Tehei, University of Wollongong
Study of relationships between function, structure and dynamics of biological molecules by neutron scattering
Concluded March 2013

2008 Lizhong He, The University of Queensland
The physical states of pharmaceutical proteins and self-assembled proteins
Concluded December 2011

2008 Helen McGregor, University of Wollongong
El Niño in context: reading the coral record of past climate extremes
Concluded October 2013

2009 David Turner, Monash University
Structural studies of metal organic materials for gas storage and anion exchange
Concluded December 2012

2009 John Daniels, The University of New South Wales
Application of advanced diffraction techniques for component and material design in functional, biological and structural applications
Concluded February 2015

2010 Rachel Popelka-Filcoff, Flinders University
Geochemical characterisation of Australian ochre by k0-neutron activation analysis for characterisation and sourcing of Aboriginal Australian mines and artefacts
Concluded June 2016

2010 Roman Dronov, Flinders University
Design of advanced optical biosensors through neutron based surface analysis
Concluded 2013

2012 Dr Neeraj Sharma, The University of New South Wales
Developing improved materials for energy generation and storage
Concluded December 2015

CONFERENCES AND WORKSHOPS

AINSE conferences play a major role in the information exchange process for scientific and technological information, providing a forum for debate and an opportunity for young researchers to present their work. In 2017 AINSE supported the following conferences, which included assisting with travel and accommodation to attend AINSE supported conferences. AINSE was also invited to sponsor several events throughout 2017. As part of the sponsorship, AINSE presented at the events promoting AINSE programs and networked with the delegates.

NAME OF EVENT	CONFERENCE TYPE	DATE	VENUE	STUDENTS SUPPORTED	STUDENT UNIVERSITIES / ORGANISATIONS
Australasian Workshop and School, Scattering for Soft Matter	Workshop	6 February - 9 February	ANSTO	6	The University of Adelaide The University of Auckland Deakin University Monash University University of South Australia
Universities Australia Higher Education Conference	Conference	1 March - 3 March	National Convention Centre, Canberra	-	Event Sponsorship
Berlin Neutron School	School	2 March - 10 March	Helmholtz Center Berlin for Materials and Energy, Germany	2	The Australian National University Flinders University
The 1st Asia Oceania Forum (AOF) Synchrotron Radiation School	School	28 May - 3 June	Australian Synchrotron, Clayton	6	Curtin University of Technology Griffith University Macquarie University The University of Newcastle University of Wollongong
International Conference on Neutron Scattering (ICNS)	Conference	9 July - 13 July	Deajeon Conference Center, Republic of Korea	2	The University of Auckland The University of Sydney
Royal Australian Chemical Institute Centenary Congress (RACI 2017)	Conference	23 July - 28 July	Melbourne Exhibition and Convention Centre	-	Event Sponsorship
Australasian Radiation Protection Society Conference (ARPS 2017)	Conference	6 August - 9 August	Novotel, Northbeach, Wollongong	-	Event Sponsorship
Society for Environmental Toxicology and Chemistry Australasia Conference (SETAC)	Conference	4 September - 6 September	Sofitel Gold Coast Broadbeach Hotel	-	Event Sponsorship
9th Asia-Oceania Neutron Scattering Association (AONSA) Neutron School	School	16 November - 20 November	J-PARC, Tokai, Ibaraki, Japan	5 ($500 per student)	Macquarie University The University of New South Wales The University of Sydney
ANSTO User Meeting	Conference	22 November - 24 November	Australian Synchrotron, Clayton	10	CSIRO The University of New South Wales University of South Australia The University of Sydney University of Wollongong
The 9th Australasian Congress on Applied Mechanics (ACAM 9)	Conference	27 November - 29 November	The University of New South Wales, Sydney	2	Monash University
Inaugural Australasian Community for Advanced Organic Semiconductors (AUCAOS) Symposium	Conference	4 December - 6 December	Peppers Salt Resort & Spa, Kingscliff	6	Charles Darwin University James Cook University Monash University Victoria University of Wellington

INTERNATIONAL TRAVEL SCHOLARSHIPS

Throughout the year, students from AINSE member organisations that are presenting their research with an ANSTO co-author are invited to apply for travel support to attend international conferences. AINSE international travel scholarships encourage students to attend and participate with conferences to exchange ideas and network with the nuclear science and engineering community. The international travel scholarship offers up to $1,000 towards travel. AINSE awarded seventeen scholarships to students to present and attend several high profile international conferences in 2017.

STUDENT	MEMBER CODE	CONFERENCE ATTENDED	LOCATION
Francois-Marie Allioux	DEA	2017 International Congress on Membranes and Membrane Processes	San Francisco, USA
Jakob Andersson	FLI	TethMem 2017	Vienna, Austria
Grace Causer	WOL	International Conference on Neutron Scattering 2017 & Satellite Meeting	Daejeon, Korea
Gael Cazes	WOL	European Geosciences Union (EGU) General Assembly 2017	Vienna, Austria
Tessa Charles	MON	International Particle Accelerator Conference (IPAC17)	Copenhagen, Denmark
Georgina Falster	ADE	Past Global Changes (PAGES) Open Science Meeting & associated Young Scientists Meeting	Zaragoza, Spain
Karthik Gopi	NSW	Asian-Pacific Aquaculture 2017	Kuala Lumpur, Malaysia
James Hooper	WOL	International Conference on High Latitude Dust	University of Iceland, Reykjavik, Iceland
Mitchell Klenner	CUR	22nd International Symposium on Radiopharmaceutical Sciences	Dresden, Germany
Chee Wah Loy	SYD	6th International Conference on Solid State Science and Technology 2017	Penang, Malaysia
James Maina	DEA	2017 International Congress on Membranes and Membrane Processes	San Francisco, USA
Michela Mariani	MEL	ALSO 2017 Mountains to the Sea	Honolulu, USA
Gabriel Murphy	SYD	Actinides2017	Sendai, Japan
Leonie van't Hag	MEL / CSI	International Conference on Neutron Scattering 2017 & Satellite Meeting	Daejeon, Korea
Julia Wind	SYD	16th European Conference on Solid State Chemistry (ECSSC16)	University of Strathclyde, Glasgow, Scotland
Bo Zhang	MON	International Symposium on Radiopharmaceutical Sciences 2017	Dresden, Germany

TRAVEL AND ACCOMMODATION SUPPORT

ANSTO FUNDED TRAVEL AND ACCOMMODATION SUPPORT FOR AINSE MEMBERS

Support for travel and accommodation is provided by ANSTO to AINSE members that are awarded access through the ANSTO portal. The following AINSE members received support in 2017:

ADE	The University of Adelaide
AKL	The University of Auckland
ANU	The Australian National University
CAN	University of Cantebury
CSI	CSIRO
CUR	Curtin University of Technology
DEA	Deakin University
FLI	Flinders University
GRI	Griffith University
MAS	Massey University
MEL	The University of Melbourne
MON	Monash University
MUR	Murdoch University
NCT	The University of Newcastle
NSW	The University of New South Wales
OTA	University of Otago
QLD	The University of Queensland
QUT	Queensland University of Technology
RMI	RMIT University
SCU	Southern Cross University
SYD	The University of Sydney
SWI	Swinburne University of Technology
TAS	University of Tasmania
UNE	The University of New England
USA	University of South Australia
UWA	The University of Western Australia
WOL	University of Wollongong

AINSE SUPPORTED FACILITY (ASF) FUNDING - 2017

One application was received and one member organisation was awarded funding.

The University of Melbourne	
Nuti Francesco	$2,500
Quenching factor measurements for the SABRE dark matter detector	
Heavy Ion Accelerator Facility (HIAF), ANU	
THE UNIVERSITY OF MELBOURNE TOTAL	$2,500
TOTAL AINSE ASF FUNDING APPROVED IN 2017	$2,500

AINSE SUPPORTED FACILITIES

The Australian Plasma Fusion Research Facility (APFRF), Australian National University

The Australian Positron Beamline Facility (APBF), Australian National University

Linear Accelerator / Pulse Radiolysis Facility, University of Auckland

Positron Facilities, University of Western Australia

Heavy-Ion Accelerator Facility (HIAF), Australian National University

SUPPORTED PUBLICATIONS

THE UNIVERSITY OF ADELAIDE

Alsharifi, Mohammed
David, S. C., J. Lau, E. V. Singleton, R. Babb, J. Davies, T. R. Hirst, S. R. McColl, J. C. Paton and M. Alsharifi (2017). "The effect of gamma-irradiation conditions on the immunogenicity of whole-inactivated Influenza A virus vaccine" Vaccine **35**: 1071-1079, 10.1016/j.vaccine.2016.12.044

Ankor, Martin
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