SPERA Newsletter July 2018

Call for participant presentations at SPERA 2018 workshop: Radionuclides as tracers of Environmental Processes (Peter Medley; peter.medley@health.gov.au)

The RACI Radiochemistry Division workshop is calling for abstract submissions from participants to present at the SPERA 2018 workshop to be held on 6th November 2018. The workshop is intended to be an open dialogue, allowing participants to present on-going work, challenges they are experiencing or ideas and projects they are trying to put together, with attendees directly participating in the workshop to generate ideas and provide scientific expertise.

Participants will be given a 15 minute presentation window with a recommended 10 minutes to present and explain the work with a further 5 minutes dedicated to discussion and comment by workshop participants.

The main theme of the workshop is how useful radioactive isotopes are as tracers of environmental processes, split into 2 topics, one with a focus on marine processes and the other on groundwater processes. It would be desirable that participant presentations have a focus on at least one of these topics. There will be 4 main presenters with significant experience in marine or groundwater research that will contribute to the discussion of participant presentations that could be of great benefit to participants involved.

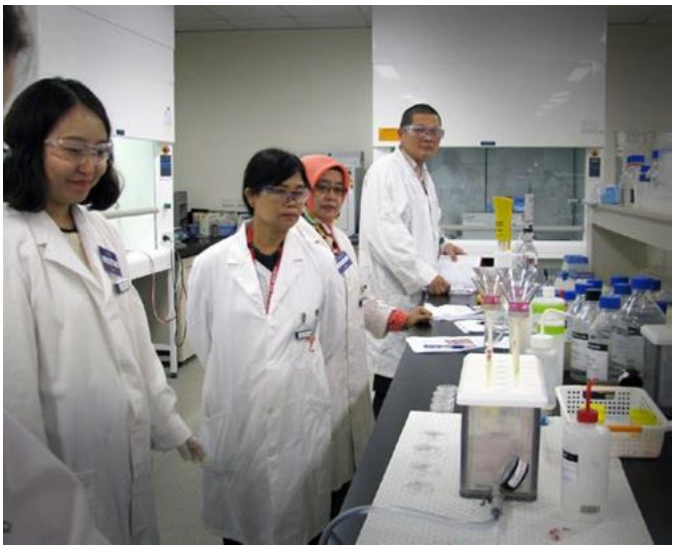
This is a great opportunity for students, early career researchers or people undertaking/developing projects in marine or groundwater research to discuss their work and get feedback in a more informal environment than at a standard scientific conference. The abstract should be submitted in the same format as conference abstracts. Abstracts can be submitted directly the RACI Workshop co-ordinator Peter Medley, via email at peter.medley@health.gov.au noting that it is intended for the 'RACI Radiochemistry Division workshop', and should describe the general topic of the presentation. Noting key areas for discussion by participants at the workshop is recommended.

ARPANSA (Stephen Long; Stephen.Long@arpansa.gov.au)

IAEA regional training course on radiochemical analysis of marine environmental samples

ARPANSA hosted a regional training course over two weeks in early June. The training course was organised in conjunction with the International Atomic Energy Agency (IAEA) and was presented by three SPERA experts: Sandra Sdraulig (ARPANSA), Pere Masque (Edith Cowan University) and Atun Zawadzki (ANSTO). The objective of the training course was to enhance participating country capability in radioanalytical techniques. The training course focused on the analysis of transuranic radionuclides (plutonium isotopes and americium-241) in seawater and lead−210 dating of sediments. Fifteen participants, from 12 different countries were funded by the IAEA to attend the course.

The course comprised a series of lectures plus laboratory work. Presentations were given on topics related to environmental sampling and sample preparation, for seawater and sediments and theory on lead-210 dating and the analysis of plutonium and americium. Additional lectures were provided on measurement techniques (alpha spectrometry and gamma spectrometry), determination of uncertainties, laboratory accreditation and a refresher on the sampling and analysis of radiocaesium. A large component of the course was the laboratory work, which enabled participants to have 'hands on' experience in the analysis of sediments for lead-210 and radium-226 plus the analysis of seawater for plutonium isotopes and amercium-241. Techniques used included sample preparation, measurement, and calculation of results and uncertainties.



New to the ARPANSA Team

SPERA member, Andrew Yule, joined ARPANSA in March. Andrew has previously worked at SGS, Olympic Dam and Global Medical Solutions. Andrew's primary focus will be ARPANSA's radon laboratory, which includes a radon chamber and a large array of instruments.

New publications/reports from group

Stephen Long was the drafting leader for the revision of the Australian Standard (AS/NZS 2243.4) for radiation protection in laboratories. This Standard sets out requirements for the protection of people, non-human biota and the environment from harmful effects of ionizing radiation used in or as a result of any use within or in connection with a laboratory. The new version of the standard became available on July 1.

ARPANSA recently published a technical report on *Assessment of radon progeny dose conversion factors from measurements in the underground uranium mine at Olympic Dam* (https://www.arpansa.gov.au/research-and-expertise/technical-reports). In ICRP Publication 115, published in 2010, the ICRP revised upwards its assessment of risk detriment for inhalation of radon decay products (RDP) and indicated its intention to replace the current dose conversion convention with a dose conversion coefficient derived from dosimetric modelling. There is very little published data on RDP aerosol characteristics in modern uranium mines. Given the potential regulatory and operational impacts for assessment of doses from inhaled radon decay products in Australian uranium mines, it was determined that a study of the RDP aerosol characteristics in current Australia mines should be undertaken. This report summarises the measurements conducted at the Olympic Dam uranium mine in December 2013 to characterise the RDP parameters.

ARPANSA has also recently published advise on the impact on workers and the public due to the ICRP doubling its estimate of risk from exposure to radon and the recent publication of new dose conversion factors for workers exposed to radon (https://www.arpansa.gov.au/understanding-radiation/sources-radiation/radon/new-dose-coefficients-radon-progeny-impact-workers).

ANSTO Aquatic Ecosystems Research (Tom Cresswell; Tom.Cresswell@ansto.gov.au)

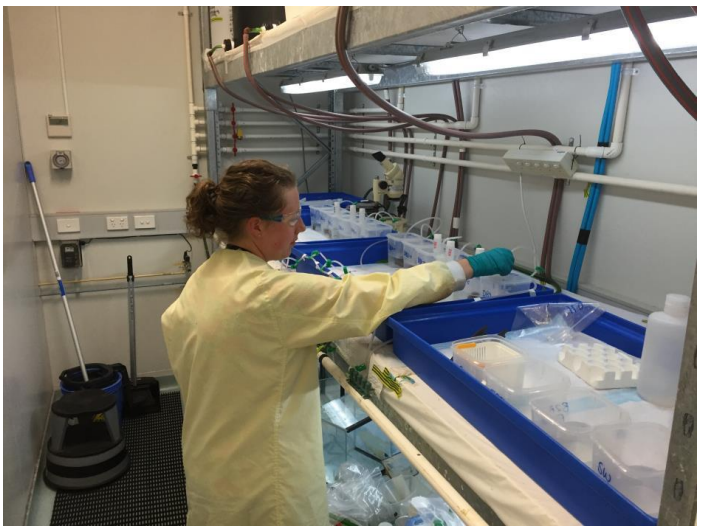
RMIT Honours student **Sigrid Wilkens** completed a visit to ANSTO during March and April 2018 to undertake studies into the bioavailability of nano Zn particles by the amphipod *Allorchestes compressa*. Nano ZnO and $ZnCl_2$ were neutron activated in the OPAL research reactor to produce the beta- gamma-isotope ^{65}Zn, which was exposed to amphipods over a period of 2 weeks, followed by a 2 week depuration period. The study confirmed the very soluble nature of ZnO nanoparticles at environmentally-relevant concentrations and suggested that the current ANZECC water quality guidelines for soluble Zn are sufficient to manage ZnO nanoparticles at the <50 µg/L concentration in seawater. Sigrid also completed a pilot study into the use of *A. compressa* for sub-lethal toxicity testing (reproduction) with Zn and the results look very promising.

Sigrid Wilkens preparing for Zn radiotracer exposures with amphipods

University of South Australia researchers **Thea Lund Read**, **Casey Doolette** and **Enzo Lombi** have been using the same neutron activated ^{65}Zn products to increase crop quality (through Zn biofortification) and crop yield by improving current agricultural practices. Active nano, micro and soluble Zn (as either Zn-EDTA or $ZnCl_2$) have been applied to leaves of wheat and the foliar dispersion kinetics of Zn to the rest of the plant will be determined by gamma spectrometry and imaging techniques. We have extended the study to full plant maturity so we can determine the concentration of added Zn that made its way to the grain. This will give us a full picture of the uptake, translocation and ultimately biofortification of the grain with Zn from the four treatments.

Thea Lund Read and Casey Doolette preparing nano and micro ^{65}Zn suspensions ready for foliar application to wheat within the ANSTO greenhouse

Australian Catholic University Hons. student **Danielle Hill** is conducting research at ANSTO to better understand the effects of moulting on contaminant bioaccumulation by decapod crustaceans. Several studies have determined that moulting (shedding the exoskeleton or shell) for decapods causes significant differences in the uptake or efflux kinetics of common inorganic contaminants and these differences can last for > 1 month. Danielle will be feeding the spotted shore crab, *Paragrapsus laevis*, with a diet supplemented by moult hormones (e.g. ecdysone) to synchronise moulting and will then be using radioisotope tracers to understand how moulting effects bioaccumulation kinetics in the crabs. Danielle is currently battling with the crabs to get them to eat numerous different food types in preparation for the study but the crabs are not cooperating!



Rebecca Hull setting up ascidian exposures to ^{109}Cd and ^{65}Zn in the ANSTO Aquatic Monitoring lab

University of Melbourne PhD student **Rebecca Hull** conducted research at ANSTO (January - February 2016) to better understand sea squirts' handling (uptake, loss, and internal distribution) of a non-essential (Cd) and an essential (Zn) trace metal when associated with food or dissolved in seawater. The sea squirt *Styela clava* was exposed to ^{65}Zn and ^{109}Cd singly or as a mixture for the dissolved exposure, and singly when associated with food – the microalga *Tetraselmis* sp. When exposed to trace metals via water, sea squirts accumulated and retained more Cd in the presence of Zn, whereas Zn was handled similarly when exposed singly and with Cd. When exposed to trace metals via diet, more Cd (cf. Zn) was lost and little remained internally after three days. Sea squirts accumulated Cd in the test – a body casing, unique to sea squirts – but only with dissolved exposure, and Zn in the branchial basket (analogous to gills) when exposed via water and food. Rebecca is currently writing her thesis and preparing this work for publication.

Griffith University PhD student **Kaitlyn O'Mara** conducted an estuarine food chain radiotracer experiment at ANSTO in April – June 2017. To better understand mechanisms for metal accumulation in estuarine food webs, organisms from three trophic levels (sand clams *Katelysia scalarina,* school prawns *Metapenaeus macleayi* and sand whiting *Sillago ciliata*) were exposed to seawater, suspended sediment and food labelled with ^{109}Cd, ^{54}Mn and ^{65}Zn radiotracers. While sand clams accumulated these metals from labelled seawater, suspended sediment and food (green and brown microalgae), school prawns and sand whiting only exhibited metal uptake from food (labelled pellets and prawns were fed to school prawns and sand whiting, respectively). This experiment demonstrated that filter feeders are sensitive to metal uptake from a variety of sources and may be an important link between environmental contamination and contamination in higher trophic level species such as prawns and fish. Low metal assimilation efficiencies in sand whiting (9-23%) compared to school prawns (53-65%) indicate that these fish have exclusion mechanisms that are favourable to allow them to survive in contaminated environments. Kaitlyn is currently writing up the results of this experiment in a research paper, while also analyzing field samples from Moreton Bay and the Gulf of Carpentaria for stable isotopes and trace metals to study catchment influences on estuarine food webs in natural and disturbed systems.

PhD student **Francesca Gissi** has been working with CSIRO, UOW, SCU and ANSTO to look at the uptake and distribution of metals in corals. Francesca has conducted experiments on coral sections using the ITRAX XRF core scanner, Laser Ablation ICP-MS and accellerater-based particle-induced X-ray emission (MicroPIXE) to determine the biodistribution of nickel in fragments. Experimental work is completed and Francesca is currently writing up results for her thesis and a publication.

Plans are still underway to create **microplastic radiotracers at ANSTO** in collaboration with the International Atomic Energy Agency (IAEA). We are working through the synthesis of metal-doped microplastics at ANSTO and we will then conduct pre- and post-neutron activation characterisation of particles before bioaccumulation studies with marine organisms are conducted.

A **PhD top up scholarship** ($7,500 cash per annum) is available at ANSTO in Sydney for a potential PhD student affiliated with a partner university to better understand the ecotoxicological and radiological **effects of NORM scale on aquatic organisms**. Naturally occurring radioactive materials (NORM) scale residues frequently accumulate on the interior surfaces of subsea oil and gas pipes and other structures, and may persist long after extraction operations have ceased. Within such scale materials are a range of metal contaminants, as well as NORM dominated by the U-238 and Th-232 decay series. The project will provide for a more valid assessment of the risk posed by sub sea oil and gas scale to aquatic organisms as compared with current methods which rely on default/reference parameters which may greatly misinterpret the risk. Please see the project outline for more details of the research. For further information, please contact **Dr. Tom Cresswell** (tom.cresswell@ansto.gov.au); (02) 9717 9412.

Two scenarios of pipeline assessment (routine operation left and degraded pipeline right) that will be undertaken in the research and an example of the build-up of (predominantly) barium sulphate NORM scale in pipelines

ESR New Zealand (Michelle Thomas; michelle.thomas@esr.cri.nz)

New Zealand's Institute pf Environmental Science and Research (ESR) is currently advertising for a scientist or senior scientist with a strong background in radiation science, especially nuclear and radiation physics, radiation detection instruments and analysis. Ideally, the candidate would have experience in working under ISO 17025 and also have a good understanding of statistics and propagation of uncertainties.

The link to the ad: https://careers.sciencenewzealand.org/jobdetails?ajid=3CqB8. Closing date is 15th July but if you are interested in the position after the closing date, please email ncrs.envrinmental@esr.cri.nz.

Improving Australian Uranium and Thorium Biological Uptake Parameters: A National Energy Resources Australia (NERA) Project led by Flinders University

(Rachel S. Popelka-Filcoff; rachel.popelkafilcoff@flinders.edu.au)

Project Description

Industry: Uranium

Knowledge Priority: Understand and unlock Australia's resources base or Optimise the regulatory framework or Build talent and enable effective collaboration and innovation

State: SA

This project aims to expand fundamental knowledge surrounding the radiological impacts of uranium mining which may be used for determining radiological impact to non-human species in Australian arid zone environments. The project will assess the radiological impacts of uranium mining projects at Olympic Dam and Beverly mines in South Australia, through analysing the radioactivity of flora, fauna and baseline soil data. The results will generate data towards a national database to understand radiation in Australia's arid environments, as well as to enable companies required to undertake environmental risk assessments to compare to baseline Australian soil values.

Development of Australian specific data for use in models will provide a better understanding and an improved environmental impact assessment processes. In addition, decision making by operators and regulatory authorities will be based on more relevant local information and inform more expedient decision making. The project will build radiation protection expertise, skills and knowledge for the workforce of the future, in the mining industry.

Project Funding

Total Project Cost: $417,000

- NERA: $208,500

  **Funding excludes GST*

Project Timeframe

Current Status: Contracts have been signed and project has commenced

Start: June 2018

End: December 2019

Project Members

- NERA (National Energy Resources Australia)
- Flinders University
- BHP
- Heathgate Resources
- Vimy Resources
- ARPANSA
- ANSTO
- JRHC Enterprises

Accelerator Mass Spectrometry Group/Department of Nuclear Physics, The Australian National University (Dr Michaela Froehlich; michaela.froehlich@anu.edu.au)

First Announcement

Heavy Ion Accelerator Symposium 2018

Applications of Accelerated Ions

On behalf of the HIAS 2018 Organising Committee and Department of Nuclear Physics at the Australian National University, I would like to invite you to join us at **HIAS 2018** and what will be the 6th edition of this conference series. The Symposium aims to provide a forum for experts from across the nation, and beyond, to build cross-institutional and interdisciplinary links in research areas exploiting the capabilities of heavy-ion accelerators and associated state-of-the-art instrumentation. Participants include, but are not limited to, national and international researchers, students, instrumentation and accelerator experts, and potential user communities.

The Symposium will be held on the **Australian National University campus, Canberra** on the **19th-21st November 2018**. The scientific program is intended to include overview presentations targeting a wide audience, with particular focus on:

- Accelerator applications in Materials Science
- Applications of nuclear isotopes in environmental processes
- Ionising radiation in Biology and Medical Science

There will be several invited speakers in addition to contributed abstracts, along with the opportunity to host dedicated 'break-out' sessions in topics of special interest to those attending.

The registration deadline is 14th October 2018. The registration fee is:

- Student – AUD$250
- Early bird – AUD$350 (until 1st October)
- General – AUD$450

For further details please see our conference webpage **http://hias.anu.edu.au/2018/** or contact us at **hias@physics.anu.edu.au**.

Environmental Radioactivity Laboratory (ERL) at Edith Cowan University (Pere Masqué, p.masque@ecu.edu.au)

The Environmental Radioactivity Laboratory (ERL) at Edith Cowan University in Perth began its operations in late 2015. This laboratory conducts research focused on the use of both natural and artificial radioactive isotopes (such as ^{7}Be, ^{90}Sr, ^{137}Cs, ^{210}Po, ^{210}Pb, ^{222}Rn, Ra, ^{234}Th, ^{230}Th, ^{231}Pa, Pu and U) as tracers of environmental processes, mostly in the oceans. The main research areas of interest of the group are:

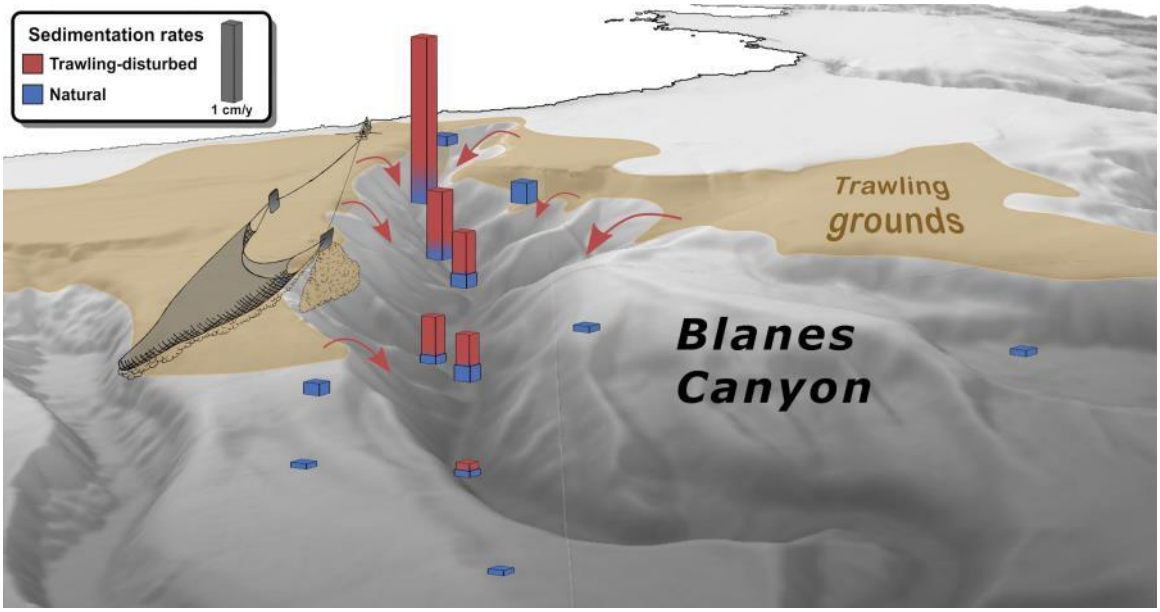
- The Ocean's role in global climate change as a source or sink of atmospheric CO_2
- The capacity of coastal ecosystems for storing carbon at different time scales and their significance to mitigate anthropogenic CO_2 emissions (Blue Carbon)
- The impact of submarine groundwater discharge (SGD) on nutrient and trace metal biogeochemistry of coastal and open ocean regimes.
- Radiological impacts of radioactive materials in the environment
- Reconstruction of the historical patterns of climate, pollution and other natural and anthropogenically-driven processes, using sediment records as archives

At present the team is composed by Prof. Masqué, Dr. Viena Puigcorbé (postdoc) Mrs Gloria Salgado (lab manager), and Ms Anna Lafratta (PhD student). The ECU-ERL operates in a quarantine certified radiochemical laboratory, equipped with 3 Canberra SAGe gamma detectors, 2 Canberra Alpha Analyst systems (with 24 detectors), 2 RISØ beta counters, 4 RaDeCC counters, and 2 RAD7 Radon detectors. Current working areas include the Atlantic, Pacific, Antarctic and Arctic Oceans, the Mediterranean Sea, Fukushima and vegetated coastal ecosystems around the world.

Recent field trips include two oceanographic expeditions in the Southern Ocean, one of them reaching the coasts of the Antarctic continent, to examine the capacity of those waters to export organic carbon to depth and thus work as potential atmospheric CO_2 sinks and a sampling trip in Madagascar to collect sediment cores from mangrove forests and seagrass meadows to quantify their capacity in sequestering carbon.


RV Aurora Australis sailing through the sea ice in the Southern Ocean (Jan 2017)

We welcome MSc and PhD students as well as recent graduates interested in joining the lab. At present we offer the possibility of a PhD project on the use of naturally occurring radioisotopes as traces of particle export in the open ocean. The candidate would apply to an ECU PhD fellowship or other grants. The successful candidate would work on the application of the radioactive pairs ^{234}Th:^{238}U and ^{210}Po:^{210}Pb as tracers for carbon and iron export in the ocean. It will require spending time at sea joining oceanographic expeditions for sample collection. This PhD project will be conducted in collaboration with national and international research centres and universities. For further information, please contact Prof. Masqué (p.masque@ecu.edu.au).



Impact of bottom trawling on sedimentation rates in a submarine canyon in the Northwestern Mediterranean Sea obtained using ^{210}Pb (from Paradis et al., *Progress in Oceanography*, 2018. https://doi.org/10.1016/j.pocean.2018.07.001).

Some recent publications from the group (see http://orcid.org/0000-0002-1789-320X):

- Krause-Jensen, D., Lavery, P., Serrano, O., Marbà, N., Masque, P. and Duarte, C.M. (2018). Sequestration of macroalgal carbon: The elephant in the Blue Carbon room. *Biology Letters*, 14: 20180236. http://dx.doi.org/10.1098/rsbl.2018.0236.
- Arias-Ortiz, A., Serrano, O., Masqué, P., Lavery, P.S., Mueller, U., Kendrick, G.A., Rozaimi, M., Esteban, A., Fourqurean, J.W., Marbà, N., Mateo, M.A., Murray, K., Rule, M. and Duarte, C.M. (2018). A marine heat wave drives massive losses from the world's largest seagrass carbon stocks. *Nature Climate Change*, 8, 338-344. https://doi.org/10.1038/s41558-018-0096-y.
- Carnell, P.E., Windecker, S.M., Brenker, M., Baldock, J., Masqué, P., Brunt, K. and Macreadie, P.I. (2018). Carbon stocks, sequestration and emissions in inland wetlands of south eastern Australia. *Global Change Biology*, https://doi.org/10.1111/gcb.14319.
- Vives i Batlle, J., Aoyama, M., Bradshaw, C., Brown' J., Buesseler, K.O., Casacuberta, N., Christl, M., K.O., Duffa' C., Impens, N., Iosjpe, M., Masqué, P. and Nishikawa, J. (2018). Marine radioecology after the Fukushima Dai-ichi nuclear accident: are we better positioned to assess the impact of radionuclides in marine ecosystems? *Science of the Total Environment*, 618, 80-92. https://doi.org/10.1016/j.scitotenv.2017.11.005.
- Puigcorbé, V., Roca-Martí, M., Masqué, P., Benitez-Nelson, C.R., Rutgers van der Loeff, M., Bracher, A. and Moreau, S. (2017). Latitudinal distributions of particulate carbon export across the North Western Atlantic Ocean. *Deep-Sea Research I*, 129, 116-130. https://doi.org/10.1016/j.dsr.2017.08.016.
- Casacuberta, N., Christl, M., Buesseler, K.O., Lau, Y., Vockenhuber, C., Castrillejo, M., Synal, H.-A. and Masqué, P. (2017). Potential releases of ^{129}I, ^{236}U and Pu isotopes from the Fukushima Dai-ichi nuclear power plant to the ocean during 2013 to 2015. *Environmental Science & Technology*, 51, 9826-9835. https://doi.org/10.1021/acs.est.7b03057.
- Paradis, S., Puig, P., Masqué, P. Juan-Díaz, X., Martín, J. and Palanques, A. (2017). Bottom-trawling along submarine canyons impacts deep sedimentary regimes. *Scientific Reports*, 7: 43332. https://doi.org/10.1038/srep43332.
- Buesseler, K.O., Dai, M., Aoyama, M., Benitez-Nelson, C., Charmasson, S., Higley, K., Maderich, V., Masque, P., Morris, P.J., Oughton, D. and Smith, J.N. (2017). Fukushima Daiichi-derived radionuclides in the Ocean: transport, fate, and impacts. *Annual Review of Marine Science*, 9, 173-203. https://doi.org/10.1146/annurev-marine-010816-060733.
- Puigcorbé, V., Roca-Martí, M., Masqué, P., Benitez-Nelson, C.R., Rutgers v. d. Loeff, M., Laglera, L.M., Bracher, A., Cheah, W., Strass, V., Hoppema, M., Santos-Echeandía, J. and Klaas, C. (2017). Particulate organic carbon

export across the Antarctic Circumpolar Current at 10ºE: Differences north and south of the Antarctic Polar Front. *Deep-Sea Research II*, 138, 86-101. https://doi.org/10.1016/j.dsr2.2016.05.016.

- Roca-Martí, M., Puigcorbé, V., Iversen, M.H., Rutgers van der Loeff, M., Klaas, C., Cheah, W., Bracher, A. and Masqué, P. (2017). Particulate organic carbon export during the decline of a vast diatom bloom in the Atlantic sector of the Southern Ocean. *Deep-Sea Research II*, 138, 102-115. https://doi.org/10.1016/j.dsr2.2015.12.007.