

SPERA Newsletter August 2019

Environmental Radioactivity Laboratory at Edith Cowan University (Pere Masque; p.masque@ecu.edu.au)

New paper on ^{210}Pb -derived sediment and carbon accumulation rates in vegetated coastal ecosystems

Vegetated coastal ecosystems, including tidal marshes, mangroves and seagrass meadows, are being increasingly assessed in terms of their potential for carbon dioxide sequestration worldwide. However, there is a paucity of studies that have effectively estimated the accumulation rates of sediment organic carbon (C_{org}), also termed blue carbon, beyond the mere quantification of C_{org} stocks. Here, we discuss the use of the ^{210}Pb dating technique to determine the rate of C_{org} accumulation in these habitats. We review the most widely used ^{210}Pb dating models to assess their limitations in these ecosystems, often composed of heterogeneous sediments with varying inputs of organic material, that are disturbed by natural and anthropogenic processes resulting in sediment mixing and changes in sedimentation rates or erosion. Through a range of simulations, we consider the most relevant processes that impact the ^{210}Pb records in vegetated coastal ecosystems and evaluate how anomalies in ^{210}Pb specific activity profiles affect sediment and C_{org} accumulation rates. Our results show that the discrepancy in sediment and derived C_{org} accumulation rates between anomalous and ideal ^{210}Pb profiles is within 20% if the process causing such anomalies is well understood. While these discrepancies might be acceptable for the determination of mean sediment and C_{org} accumulation rates over the last century, they may not always provide a reliable geochronology or historical reconstruction. Reliable estimates of C_{org} accumulation rates might be difficult at sites with slow sedimentation, intense mixing and/or that are affected by multiple sedimentary processes. Additional tracers or geochemical, ecological or historical data need to be used to validate the ^{210}Pb derived results. The framework provided in this study can be instrumental in reducing the uncertainties associated with estimates of C_{org} accumulation rates in vegetated coastal sediments.

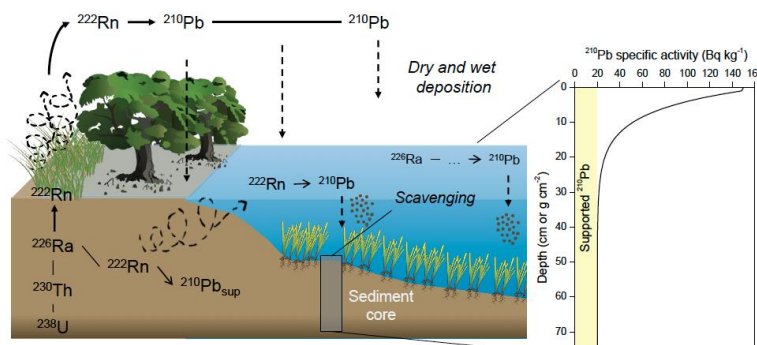


Figure 1. ^{210}Pb cycle and idealized ^{210}Pb specific activity profile in sediments. Images of vegetated coastal habitats: Tracey Saxby, Integration and Application Network, University of Maryland Center for Environmental Science (<http://ian.umces.edu/imagelibrary/>, last access: 6 September 2018).

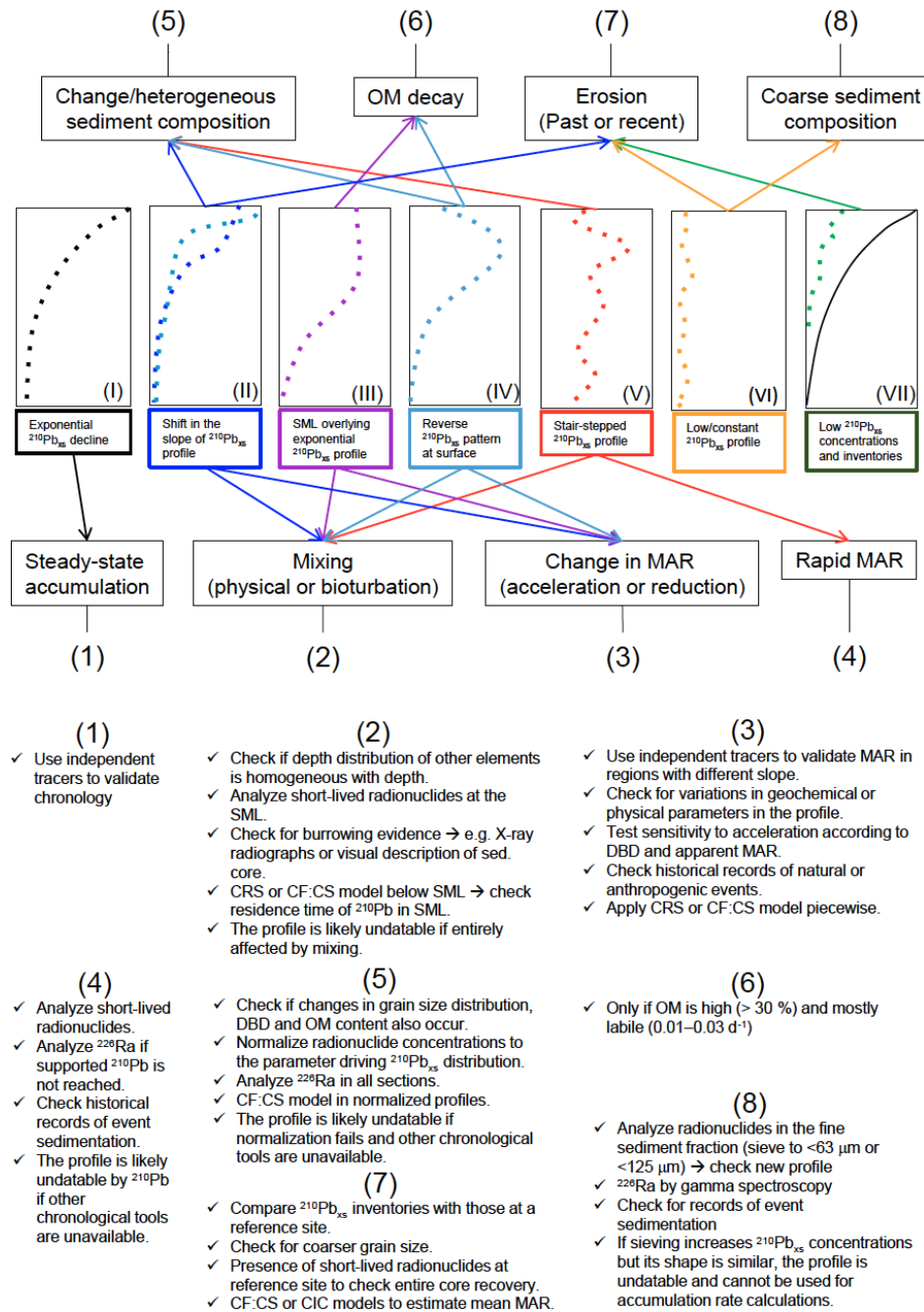


Figure 2. Diagnostic features for seven distinct types of $^{210}\text{Pb}_{\text{xs}}$ profiles in vegetated coastal sediments (based on the literature and results from simulations in this study) and recommended actions to interpret each profile type and the sedimentary processes most likely involved. Characteristics of each profile type are explained in Sect. 3.1. The solid line in type VII represents the $^{210}\text{Pb}_{\text{xs}}$ specific activity profile at a reference undisturbed site.

¹ Arias-Ortiz, A., Masqué, P., Garcia-Orellana, J., Serrano, O., Mazarrasa, I., Marbà, N., Lovelock, C., Lavery, P. and Duarte, C.M. (2018). Reviews and syntheses: ^{210}Pb -derived sediment and carbon accumulation rates in vegetated coastal ecosystems - setting the record straight. *Biogeosciences*, 15, 6791-6818. <https://doi.org/10.5194/bg-15-6791-2018>.

Marine Radioactivity Training Program – Applying Radioisotopes in the Study of Marine Processes (Pere Masque; <mailto:p.masque@ecu.edu.au>)

ECU are offering a 2-week course to provide participants with the fundamental concepts of working with radioactive tracers in the ocean. The course will be held in the Environmental Radioactivity Laboratory at Edith Cowan University from 18th-29th November 2019. Further details can be found in the attached flyer.

SETAC AU 2019 conference in Darwin, 7-11 July (Tom Cresswell; Tom.Cresswell@ansto.gov.au)

The 2019 Society of Environmental Toxicology and Chemistry (SETAC) Australasia conference was held in Darwin recently and hosted over 240 national and international delegates. The conference began with a day workshop titled *Prioritising Australia's Chemicals of Concern*. The workshop aimed to identify what the key environmental contaminants of concern were in Australia and to determine the best strategies for addressing these concerns. Not surprisingly, pesticides came out as the chemicals of most concern and while they currently have a strong regulatory system governing their production, sale and use in Australia, high concentrations are often found in sediments, urban areas and groundwaters, most likely due to off-label use of chemicals. It was identified that the SETAC and broader community of scientists can work with the regulator (APVMA) to determine gaps in current research to work toward increasing environmental protection.

The three day main conference was run over three concurrent sessions and featured presentations from all aspects of environmental toxicology and chemistry, both terrestrial and aquatic. The conference also featured a special session on Radiochemistry and Radioecology that was sponsored by RACI and SPERA. This session aimed to create strong collaborations between traditional environmental protection science and those of us that utilise nuclear techniques or methods to achieve the same goal. The session was opened by invited keynote presentation from Rachel Popelka-Filcoff from Flinders University who spoke about *Developing international radiological risk assessment tools and approaches for Australia's arid environments*. The first session also featured talks from ANSTO's Leena Hogan who described the development of radioisotope tracers for use in environmental research and University of Canterbury PhD student Sarah Guy, who presented on the *Source of spatial variability of ²¹⁰Po in NZ shellfish and dose assessment*. Sarah received SPERA's student travel award to attend the SETAC AU conference and will provide her own report below.

The second session of the Radiochemistry and Radioecology session featured talks from Peter Medley from Qld Health about *Baseline radiation levels and trace metals in Queensland prawn species, uptake properties and radiological dose* and from Scott McMaster from the Department of the Environment and Energy (ERISS) on *Bioaccumulation monitoring of radionuclides and stable metals in freshwater mussels from downstream of Ranger Uranium Mine*. The second session also had presentations from three students associated with ANSTO on their laboratory radiotracer research (see below). The final talk of the special session was from John Pfitzner (ERISS) who presented on *Back to first principles – the importance of understanding software algorithms and examples of critically assessing applications*.

The special session was very well attended with standing room only by the end of the session and it demonstrated that the research that SPERA and RACI Radiochemistry members conduct being very aligned to those members of SETAC. It is hoped that future SPERA, RACI and SETAC meetings will provide options for continued collaboration and cross-pollination.

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

A recent paper from Griffith University student **Kaitlyn O'Mara** has been published in [Science of the Total Environment](#) on her research at ANSTO in 2017 on the uptake and accumulation of cadmium, manganese and zinc by fisheries species: Trophic differences in sensitivity to environmental metal accumulation. Kaitlyn conducted this work using radioisotope tracers of Cd, Mn and Zn in the Aquatic Ecosystems lab.

The recent SETAC AU conference in Darwin featured a special session in Radiochemistry and Radioecology, sponsored by RACI Radiochemistry and SPERA, and showcased how nuclear techniques can be used in environmental assessments, both within the field and in the laboratory. PhD students **Kaitlyn O'Mara** and **Sarah**

McDonald and Hons. student **Danielle Hill** presented the outcomes of their respective live-animal radiotracing research at ANSTO, either as part of their broader research degrees or as their main subject areas. **Tom Cresswell** also gave a presentation for his ANSTO colleague, **Leena Hogan** on ANSTO's recent progress on creating novel radioisotopes for a variety of applications including human health, pharmaceutical and environmental research.

Conversations are currently underway with an Hons. student at the University of Tasmania and **Tom Cresswell** to engage the student in a PhD project into NORM scale assessments to inform offshore petroleum decommissioning strategies. The student will likely be enrolled at Macquarie University with **Dr. Katie Dafforn**.

University of South Australia PhD student, **Maja Arsic** from Prof. **Enzo Lombi**'s lab has recently received an AINSE Postgraduate Research Award for a joint study between UniSA and ANSTO on "Tracing foliar phosphate nanoparticle fertilizer uptake and translocation in wheat and barley" in which Maja will synthesise active phosphorous nanoparticles to apply to crops. Maja will largely be utilising ANSTO's PSL phosphor plate imaging techniques to visualise the distribution of phosphorous within the plants after certain application regimes and timings. Maja recently made use of ANSTO's licenced greenhouse to undertake radiotracer experiments in wheat and barley earlier this year.

Tom Cresswell is currently working with members of the Plastics Awareness Global Initiative (PAGI) workshop to prepare a perspectives paper on the fate of plastics currently in the global oceans. **Tom** is also the lead investigator on an IAEA Cooperative Research Program entitled "Developing Radioecological Tracers in Australia to Assess Coastal and Marine Ecosystem Health." The project is due to commence in early 2020 and run for 3 years.

Report from recipient of the SPERA Student Travel Award to attend the SETAC AU 2019 conference in Darwin (Sarah Guy; sarah.guy@pg.canterbury.ac.nz)

Recently, I had the great opportunity to attend the SETAC AU 2019 conference held in Darwin on 8-10th of July. The SETAC AU conference is a forum held by SETAC AU every 2 years. SETAC AU is a regional chapter of the Society of Environmental Toxicology and Chemistry (SETAC) Asia-Pacific geographic unit. The SETAC AU conference's objectives are to protect and improve the environment through collaboration, across disciplines and across borders. The SETAC AU 2019 conference program included 3 plenary and 3 keynote speakers, 3 workshops, more than 100 oral presentations, more than 20 posters, an exhibition of providers of scientific products and services and social events.

With this incredible number of presentations, held in 3 different rooms, it was sadly impossible to attend all of them. I attended the following sessions: Indigenous knowledge and values: Collaborating with Australian Sciences, Radiochemistry and radioecology, Anthropogenic debris – exposure and effect, Genomic for environmental monitoring and protection, Novel and rapid biomonitoring techniques and field sampling, Environmental concentrations and impacts of UV filters, Speciation and bioavailability of contaminants, Managing environmental quality for on-shore oil and gas operations.

Speakers were passionate about their topic and delivered fantastic presentations. Some presentations drew my attention more than others for different reasons: some were closely related to my research project, some made me think "this is brilliant; why have I not thought about that before?" and for others the speaker presented their research in such a fantastic way that it was impossible to switch off. Talks that drew my attention included (but not limited to!): Leisa-Maree Toms (Queensland University of Technology), Population trends of per- and poly-fluoroalkyl substances (PFAS) in Australia; Peter Medley (Queensland Health), Baseline radiation levels and trace metals in Queensland prawn species, uptake properties and radiological dose; Kaylah Del Simone (University of

Queensland), Using wild marsupials to identify the source of manganese contamination on Groote Eylandt, NT; and Will Grant (Illumina), Next generation tools for environmental research and monitoring.

I'm really thankful for attending the SETAC AU 2019 conference in Darwin. I had a great time; I learnt a lot; made friends; discovered new fields; progressed with my research project and was the Runner Up for the Best Student Oral Presentation in Environmental Chemistry!

I would like to thank SPERA and the University of Canterbury for their financial assistance as well as the SETAC AU Darwin organising committee for putting together an exceptional conference.

A very special thanks goes to my "buddy" Tom Cresswell for being a fantastic mentor during the conference and to Peter Medley for his priceless advice and for giving me a tour of Darwin.

I would like to acknowledge my supervisors Prof. Sally Gaw, Dr. Andrew Pearson, Oksana Golovko, Dr. Michael Lechermann and Dr. Sarah Beaven.