



Australian Government

---



# Radioecology at ANSTO 2016 and into the future

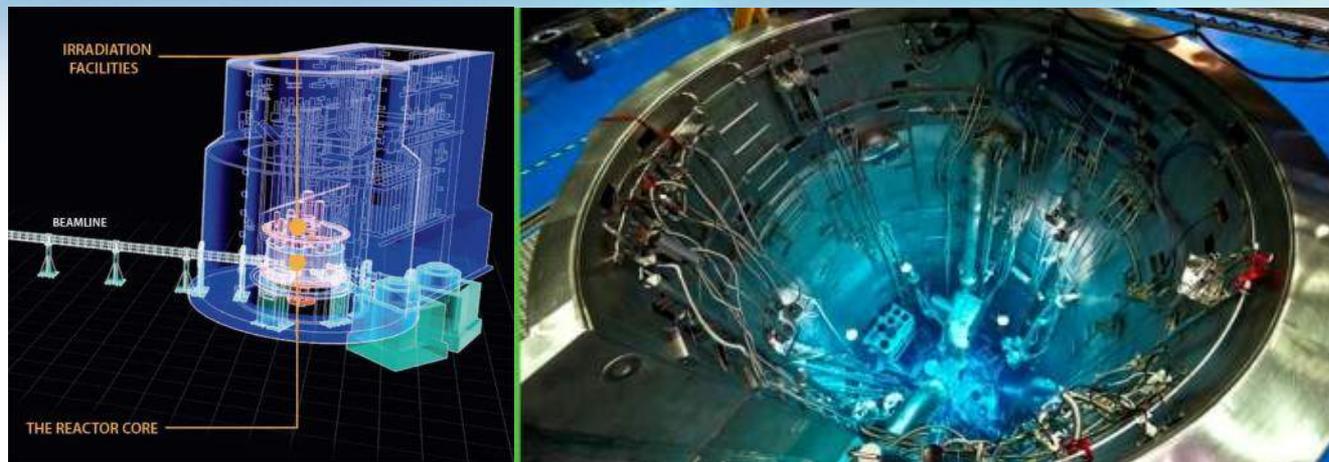
**Mathew Johansen and Tom Cresswell**

**ANSTO Environmental Research**

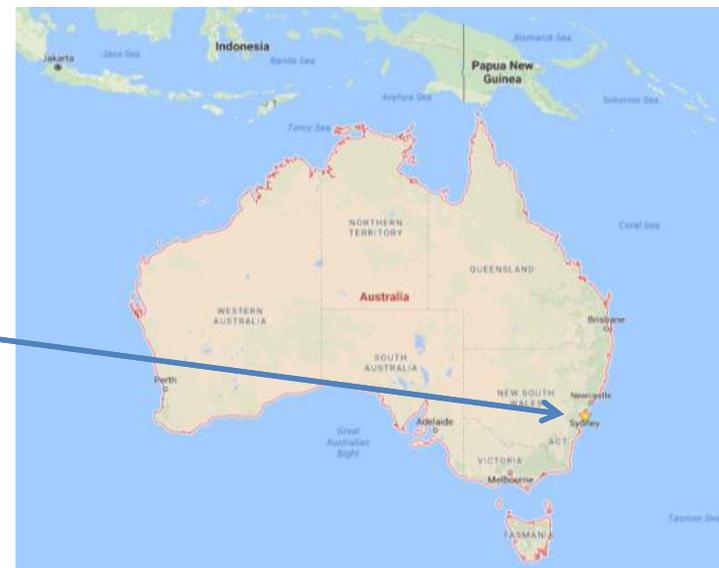
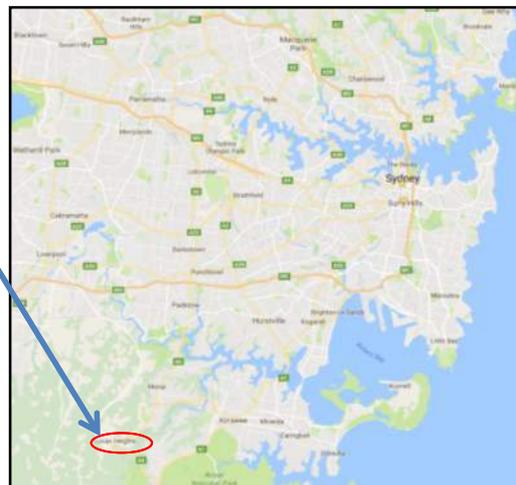
**[Tom.Cresswell@ansto.gov.au](mailto:Tom.Cresswell@ansto.gov.au)**

**[Mathew.Johansen@ansto.gov.au](mailto:Mathew.Johansen@ansto.gov.au)**

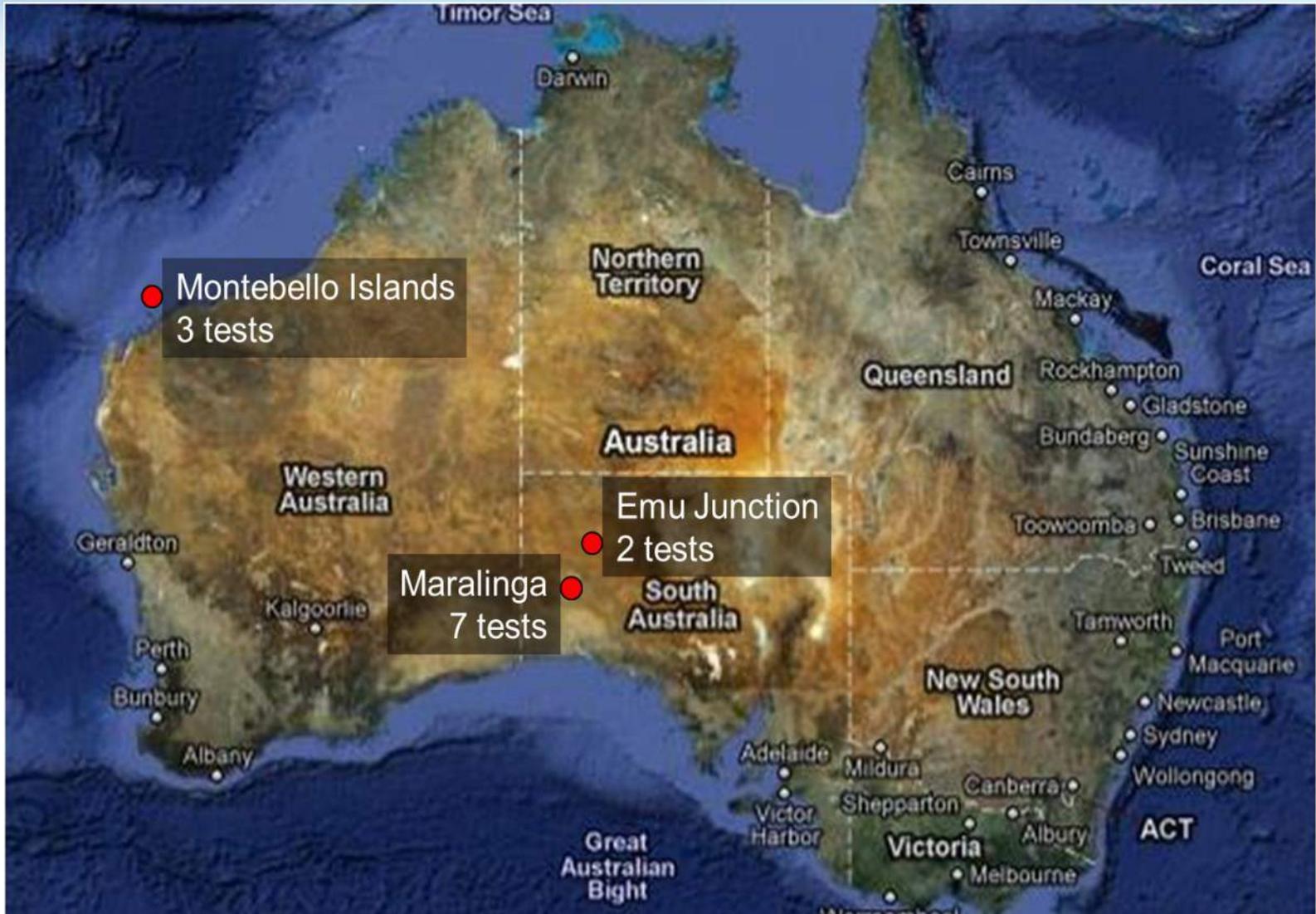
# Australian Nuclear Science and Technology Organisation (ANSTO)



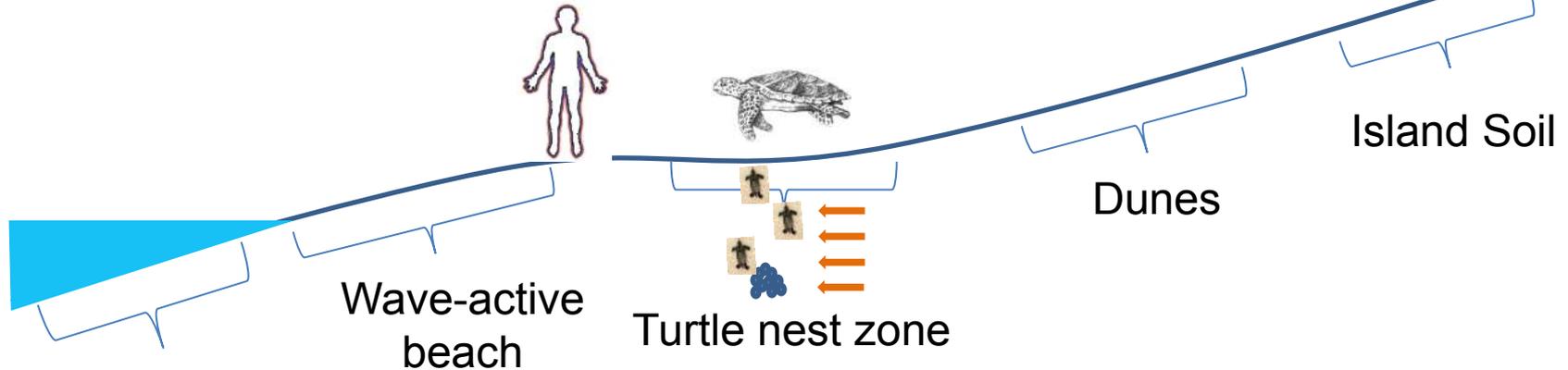
**OPAL Research Reactor** produces nuclear medicine and facilitates research into environment, human health and nuclear fuel cycle



# Environmental dose rates at the former British nuclear test sites in Australia



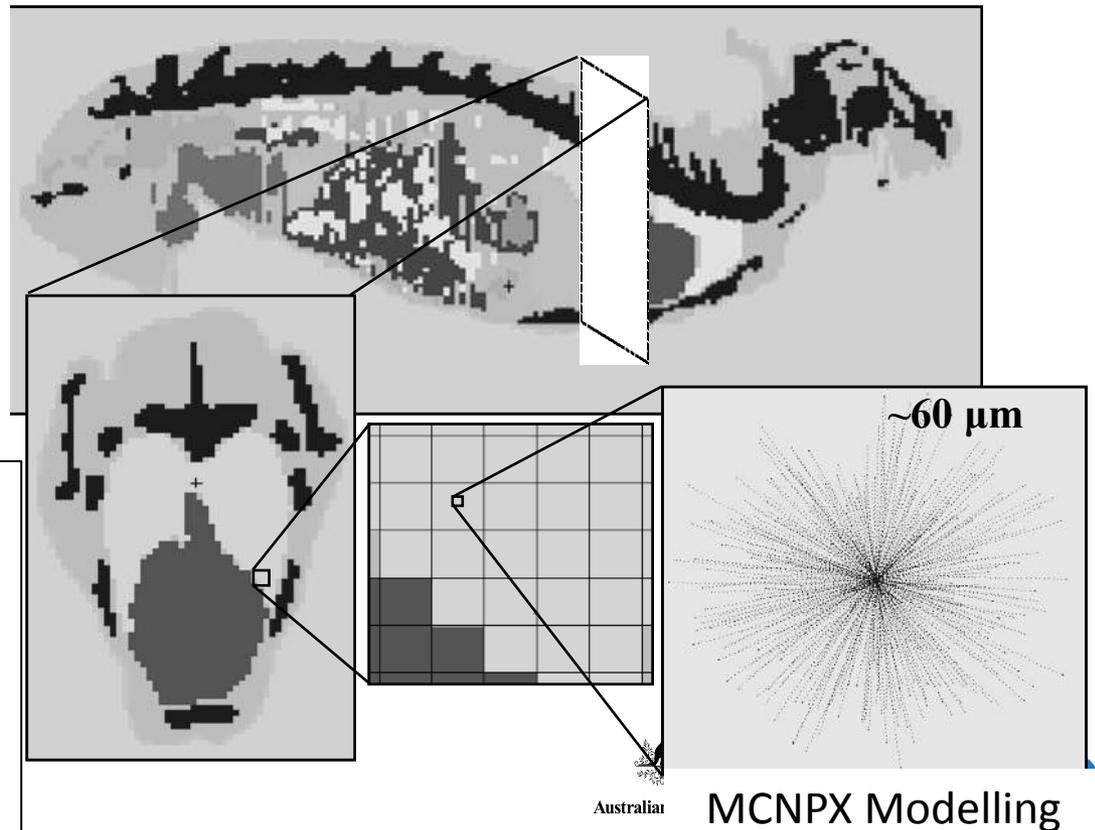
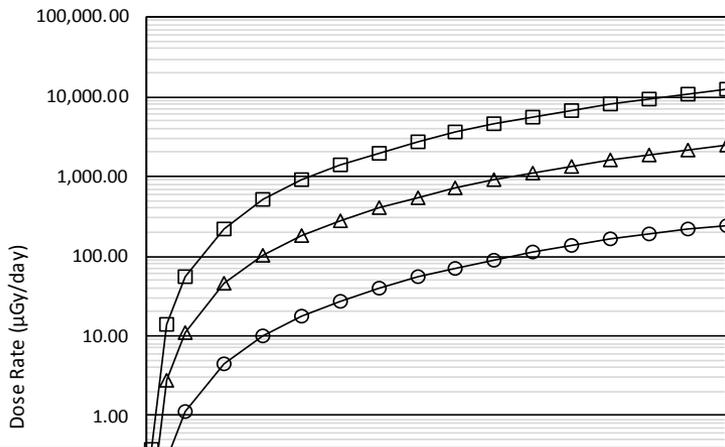
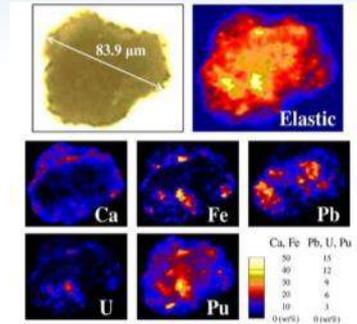
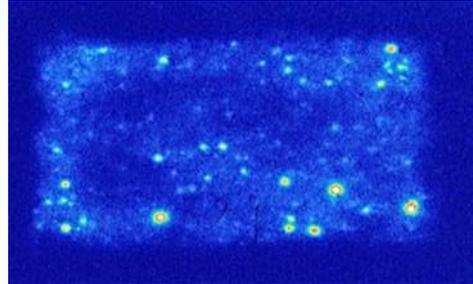
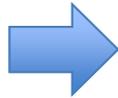
# Human and wildlife exposure along a lagoon-beach-inland transect



Sediment near detonation site

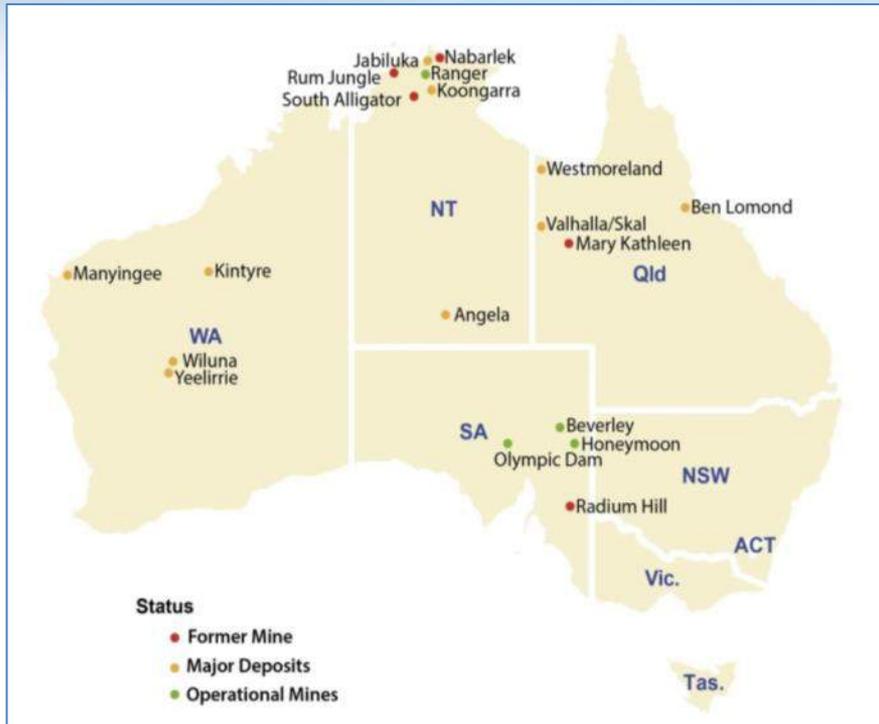


# Hot particle considerations in dose to living organisms using Synchrotron, AMS, PIXE, $\alpha, \beta, \gamma$ analyses, autoradiography

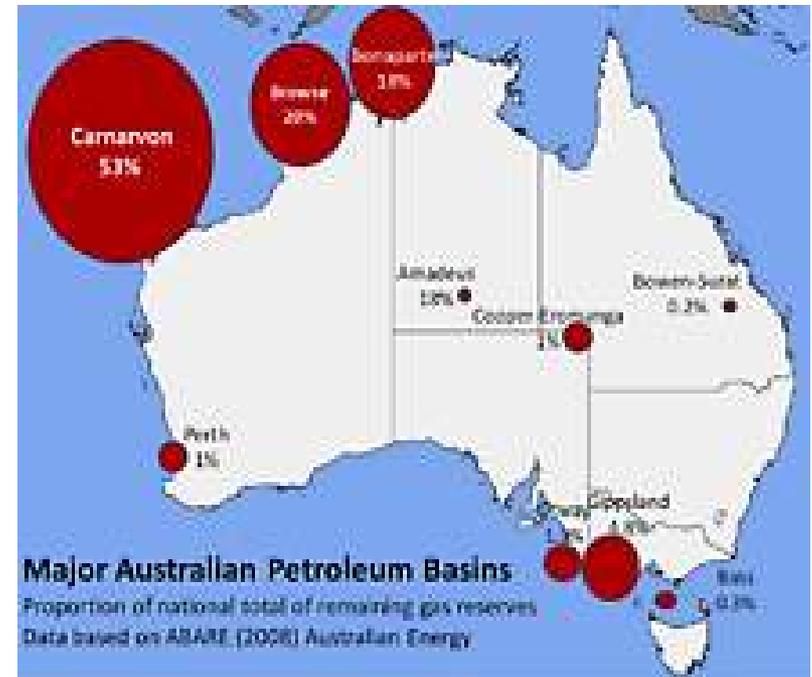


Partnering with:  
 Norwegian University of Life Sciences (NMBU),  
 University of Seville,  
 Lawrence Livermore National Laboratory,  
 IAEA CRP partners  
 COMET-RATE partners

# Evaluation of uranium, mineral sands, oil and gas production sites



ANSTO analysis and modelling capabilities are assisting ARPANSA, ERISS, and commercial companies in evaluating radiological contamination concerns and dose rates.

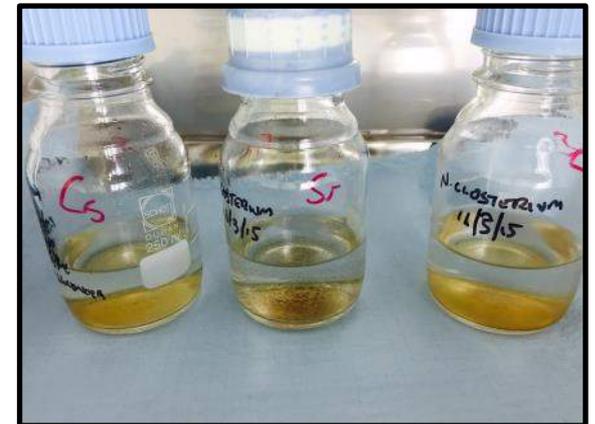


Improved parameters and tools needed for evaluating subsea NORM scale



# ANSTO Radioecology Facilities

*Aquatic Lab for stable and radiotracer studies*



# ANSTO Radioecology Facilities

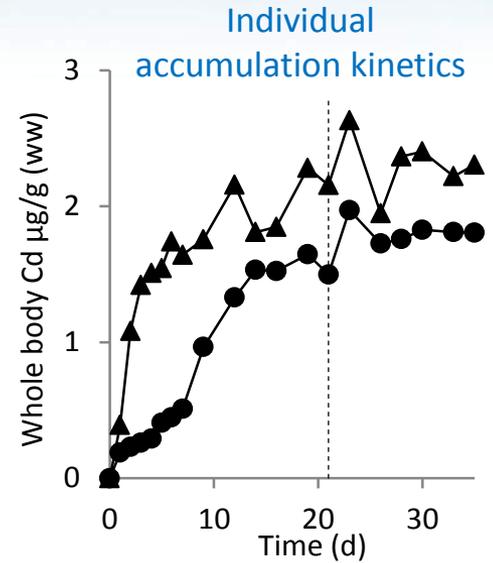
*Greenhouse for stable and radioisotope studies*



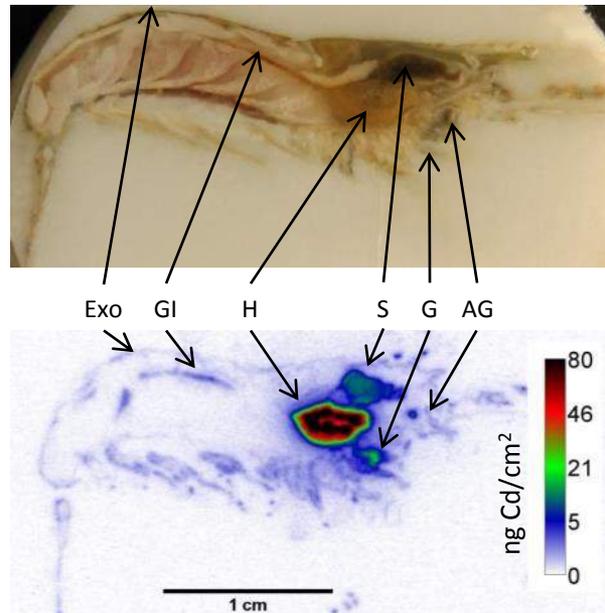
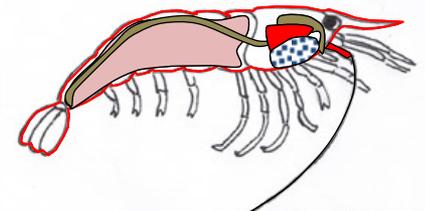
# Aquatic ecotoxicology research at ANSTO



'Tag' with radiotracer  
– add to water and diet



Quantify internal distribution of contaminant



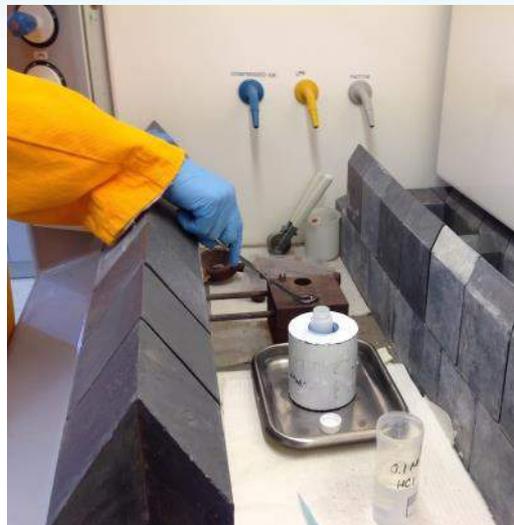
Increased understanding of organism response to contaminants

Improved management of aquatic ecosystems

# Production of radioisotopes at ANSTO's OPAL reactor



Neutron activation



De-canning and preparation of stock solution



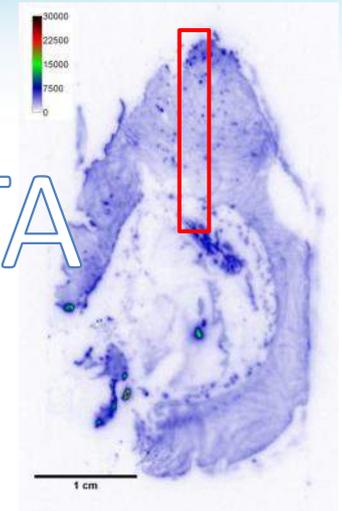
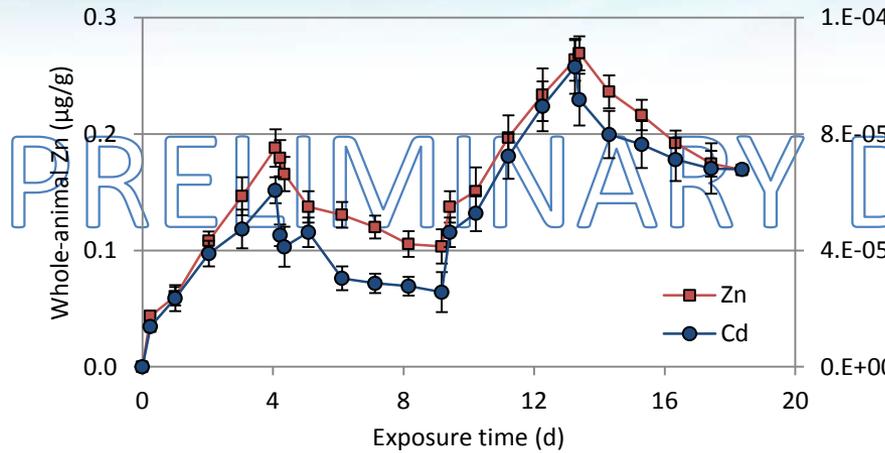
Addition of active solution to experiment

## Recent production of radioisotopes

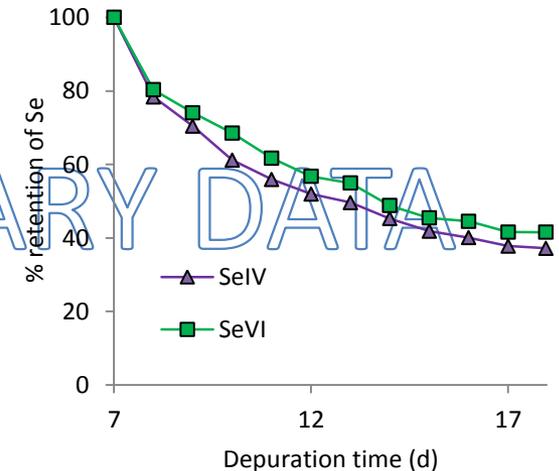
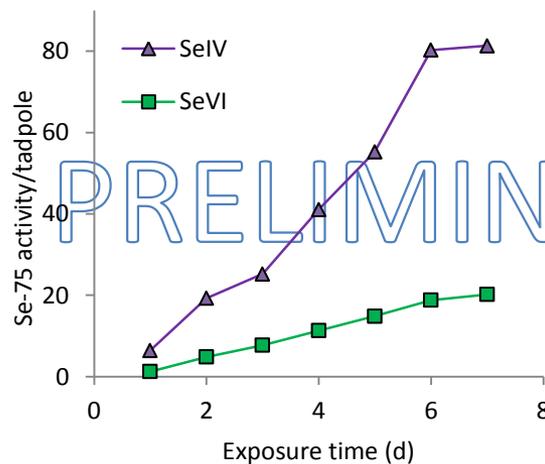
- $^{141}\text{Ce}$  (in nano and ionic forms)
- $^{134}\text{Cs}$
- $^{75}\text{Se}$  (as SeIV and SeVI)
- $^{65}\text{Zn}$

# Radioecology research at ANSTO: Aquatic ecosystems

Rebecca Hull – University of Melbourne; Metal bioaccumulation and internal distribution by ascidians



Chantal Lanctôt – Smart Water Research Centre; Coal mine derived metal bioaccumulation by striped marsh frogs

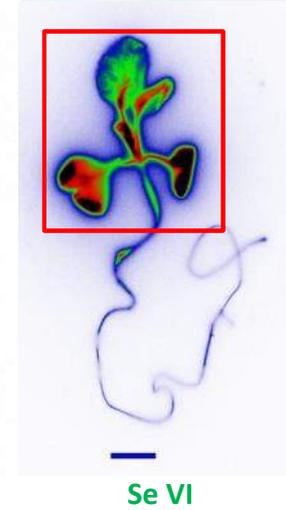
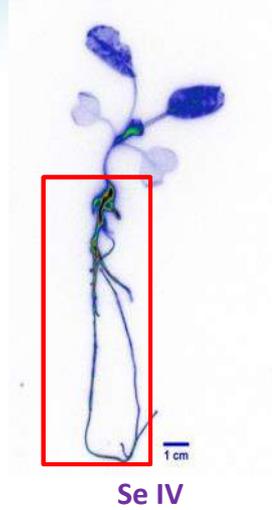


# Radioecology research at ANSTO: Terrestrial ecosystems

Divya Vinod – University of Technology Sydney; Assessing Se bioaccumulation and protein distribution by crop plants – Biofortification and phytoremediation



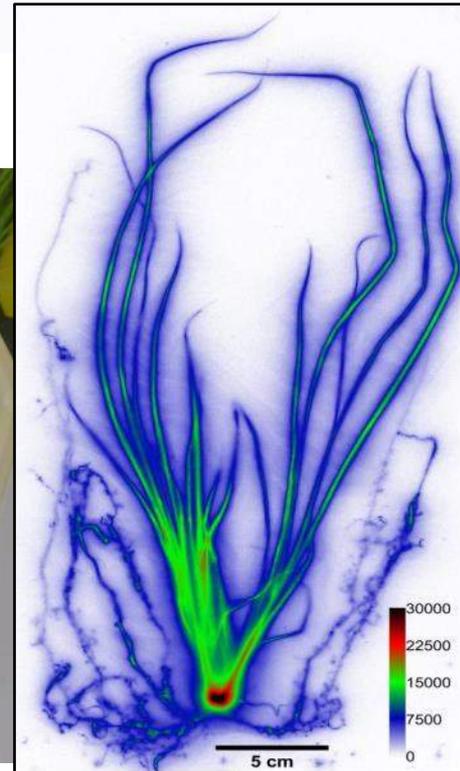
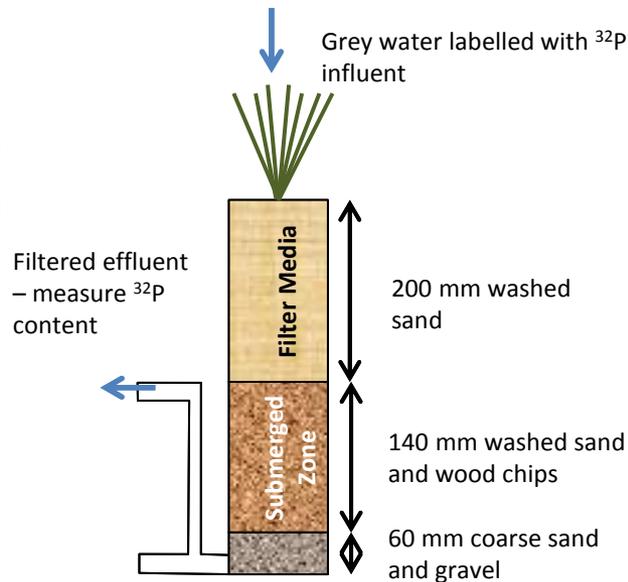
phytoremediation



Conversion to Organic Se/Protein. Majority in:

1. Glutelin
2. Albumin
3. Crude Starch

Harsha Fowdar – Monash University; Tracing nutrients (P) associated with grey water through biofilters (*Carex spp.*)



# Key International collaborations

- IAEA Monaco (Live animal radiotracing methods)
- IAEA MODARIA
- IAEA CRP on Hot Particles
- **BATAN Indonesia (visit by Wahyu Retno Prihatiningsih facilitated by IAEA)**
- IAEA RAS Marine Benchmark Study on the Possible impact of the Fukushima Radioactive Releases in the Asia-Pacific Region
- Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO)
- University of Salford (Live animal radiotracing methods)
- COMET-RATE
- University of Seville
- **Fukushima University (assessment of wild boar)**
- Oregon State University
- Lawrence Livermore National Laboratory
- Norwegian University of Life Sciences (NMBU)



# Research priorities and plans for future work

1. Combine live-animal radiotracing techniques to quantify real-time contaminant bioaccumulation with non-lethal measures of effect (e.g. behaviour, colour change, respiratory rate) – Live animal SPECT imaging
2. Wildlife dose assessments at nuclear and mining sites
3. Hot particles – improve understanding of long-term bioavailability
4. Continue providing data and ANSTO capability assistance to international partners

## *Future work:*

1. NORM scale in the ocean: radiological and ecotoxicological effects on benthic marine organisms (offshore oil and gas industry)
2. Radiosynthesis of  $^{35}\text{S}$ -labelled PFOS to better understand the hydrological and ecological transport and fate of the persistent organic pollutant
3. Studies into the impacts of metal mixtures on aquatic organisms and how these mixtures relate to current water quality guidelines
4. Use radiotracing techniques to understand the mechanisms of toxicity due to rates of accumulation and organ distribution of non-radiological contaminants