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Water research

What is an isotope?

Atoms are everywhere. Everything we touch, see, taste and smell is made up of atoms. Likewise isotopes, which are simply atoms with a different number of neutrons, are also everywhere.

ANSTO's environmental researchers use a wide variety of isotopes, including some that are radioactive, to understand how environmental systems - water, earth, air, plants and animals - function and interact, and the impact that humans are having on the environment.

Our research enables industry and policy makers to make informed decisions about this important resource and ultimately improve our world.

With Australia being the world's driest inhabited continent and second driest continent after Antarctica, water research is essential for the prosperity of our country.

Using some of Australia's best and most sensitive scientific instruments, ANSTO scientists use isotopes to research:

Oceans, reefs and harbours

Rivers and wetlands

Rainfall and stalagmites

Glaciers and icesheets

Groundwater and aquifers

Environmental water solutions for industry

Nuclear research techniques are so sensitive, it's equivalent to being able to detect a single glass of red wine if it was dropped into Sydney Harbour.

Oceans, reefs and harbours

Plastics and their impact on the marine environment

Studies at ANSTO and the Australian Synchrotron on the feathers of several species of sea birds have revealed how the birds absorb trace metals from disintegrating plastic waste, a major pollutant that is increasingly affecting the world's marine ecosystems.

Migratory bird feathers carry the signature of the bird's diet and in turn, the state of the environment along its travelled route.

This study allowed for the whole feather to be scanned and analysed providing a better understanding of contaminant distribution along the full length of the feather.

The results of the study have paved the way for this technique to be used in future research to get a historical record of a bird's fertility and diet, and make predictions about its future health and lifespan.

A Flesh-footed Shearwater feather analysed at the Australian Synchrotron.

Glaciers and ice sheets

What will happen to Antarctic ice in a warming world?

The East Antarctic Ice Sheet holds enough water to raise the global sea level by around 60 metres and inundate coastal towns and cities around the world.

Therefore knowing how climate responded during past changes will help scientists understand what may happen if climates change again.

A team of researchers from Macquarie University, University of Otago, Victoria University and the University of Glasgow used ANSTO's accelerator mass spectrometry facilities and techniques developed at ANSTO to examine the rocks that had been expelled by the glaciers. These rocks are essentially the glacier's 'little black box' that can reveal when and how they were expelled from the glacier. Providing insights into past climates through measuring changes to the ice sheet over the millennia.

Rivers and wetlands

ANSTO work protects sensitive wetlands

Wetlands of international significance are protected by an international convention known as Ramsar – and ANSTO scientists are doing their bit to monitor and provide invaluable information about these sensitive sites.

One of the potentially most vulnerable sites is the Towra Point Nature Reserve located on the southern end of Botany Bay. Towra Point is Sydney's largest and most diverse wetlands environment, containing 60 per cent of the saltmarsh communities in the region and 40 per cent of the region's mangroves. More than 100 species of birds have been identified at the Nature Reserve including 34 species of migratory birds, some of which fly up to 12,000 km from places like Siberia, China and Japan.

Using world class facilities, researchers from ANSTO analyse core samples of sand taken from Towra Point Nature Reserve. By analysing the heavy metals in the sand, the researchers are able to compile a history of pollution and gain an understanding of how to best manage this important site.

ANSTO graduate Stephanie Kermode and environmental scientist Henk Heijnis.

Groundwater and aquifers

Rottnest Island's bore water: a sustainable resource?

ANSTO researchers are studying groundwater on Rottnest Island, Western Australia, to assess the isotopic composition of the water underlying the island. The groundwater is used during the summer months to supplement the island's other water supplies, and this study is looking into whether it can be sustainably used as a resource long term by determining how much groundwater there is and how quickly it is being replenished.

ANSTO's chemical analysis of the water includes measuring the naturally-occurring isotope tritium as an indicator of the water's age. This isotope is used as it gives added information on the history of the water.

As tritium (or hydrogen-3) has a half-life (time required for it to reduce to half its quantity) of 12 years, groundwater with none of the isotope present would be deemed to be a subterranean resource more than 50 years of age.

If the water contains any measurable tritium, it follows that it has been in contact with the atmosphere within the past 50 years. When the water molecule goes into the ground it undergoes radioactive decay and every 12 years its tritium activity will decrease by half.

Regular sampling and analysis will assist in planning the island's future water needs.

Graduate Eliza Wells (left) and environmental scientist Karina Meredith undertaking groundwater quality sampling at Rottnest Island, Western Australia.

Rainfall and stalagmites

Studying Western Australian caves to help us understand changes in climate

The availability of fresh water is a crucial issue for people in Perth, one of the world's most isolated cities. Rainfall has declined by 17 per cent on average in Australia's south-west since 1970, so gaining an understanding of rainfall patterns is of great importance to the city's planners.

Since conventional rainfall records are limited to around 110 years, researchers need to apply different climate research methods to gain longer term understanding of rainfall patterns. ANSTO researchers have turned to cave stalagmites to help provide the answers.

Cave stalagmites are a rock formation that rises from the floor of a cave due to the accumulation of material deposited on the floor from minerals dissolved in dripping water. Using nuclear techniques, scientists are unlocking thousands of years of rainfall-sensitive data, preserved in the crystallised calcium carbonate from Golgotha Cave in south-west Western Australia. This information is providing an invaluable archive of previously unavailable climate data.

Environmental water solutions for industry

Membrane bioreactor and sewage treatment technology

A ground-breaking water cleansing technology developed at ANSTO was successfully commercialised and the intellectual property sold to Sutherland Shire clean tech company, BioGill Environmental Pty Ltd.

The system has numerous industrial and environmental applications, including the treatment of grey water, sewage and wastewater from aquaculture, and food and beverage processing.

The technology is also considered to have great potential for cleaning water on ships, offshore platforms and remote islands where protecting sensitive environments is essential.

Image courtesy of BioGill.

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Discover more

Find out more about the important research being undertaken by ANSTO and its collaborators.

Take a tour

ANSTO's free Lucas Heights campus tours are suitable for novices to budding scientists, where you get to see our scientists at work.

School groups are welcome and there are several excursions available.

Bookings

02 9717 3090 tours@ansto.gov.au

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Locations

Lucas Heights | Camperdown | Clayton

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