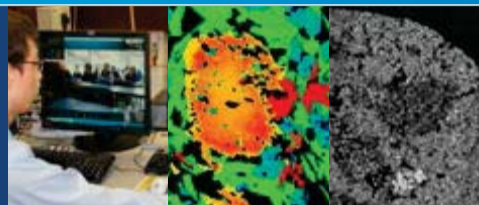




How to build an artificial nose
ARC Funding to expand our capability
Emeritus Prof. George Rogers FAA



Adelaide outreach – Science Week
Electron probe microanalysis workshop
Art conservation research award

RESEARCH

Coral keeps us cool



UWA In this time of significant climate change, understanding the natural regulators of climate is crucial. A/Prof. Peta Clode from the AMMRF at the University of Western Australia is part of a team led by researchers from the Australian Institute of Marine Science, whose research on coral and climate was published recently in the prestigious journal *Nature*.

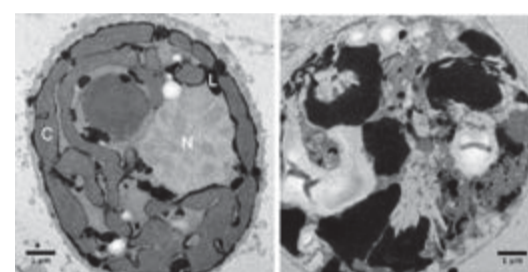
The researchers discovered that coral produces an important sulphur molecule,

called dimethylsulphoniopropionate (DMSP) and that its production increases when corals are subjected to water temperatures that cause them thermal stress. This molecule has significant properties ranging from cellular protection in times of temperature stress, to local climate-cooling through the formation of clouds in the sky above the ocean.

Previously it was assumed that the large concentrations of DMSP emitted from coral reefs came from the symbiotic algae that

are intimately associated with corals. However, the team found that this is not the full story and that the coral cells themselves produce much of the DMSP. This is the first example of DMSP being produced by an animal of any kind. A/Prof. Clode used transmission electron microscopy in the AMMRF at UWA to help to demonstrate this. Compared with algae in normal temperatures, heat-stressed symbiotic algal cells in coral tissue show massive deterioration of their cellular components and are not capable of producing the large amounts of DMSP that were detected. From these observations, combined with additional analytical and molecular data from both adult and algae-free juvenile corals, the authors were able to show that the DMSP was coming from the coral host cells.

This molecule and its breakdown products act as antioxidants that protect coral from environmental stresses, including the high solar radiation that they experience. It also contributes to the cooling of local climate by providing nuclei for the formation of water droplets in the atmosphere above the ocean



TEMs of algal cells: normal (left) and heat stressed (right).

– helping to create clouds that reflect heat, thereby reducing the heating effect of the sun's rays.

Australia's Great Barrier Reef is a major emitter of sulphur aerosol particles. This reef is the largest biological structure on the planet and the release of these particles along its 2600 km length could constitute a major source of cloud condensation nuclei. If coral numbers continue to decline, as is the current trend, cloud formation could be impeded, less heat will be reflected and sea surface temperatures will rise.

Human activities that cause a decline in coral cover may therefore further destabilise climate regulation creating a vicious circle of ocean warming. ■

New bioinsecticides from bacteria

UQ In their quest to understand the structure of a new bacterial insecticide, researchers have found a previously undiscovered mechanism by which cells produce and store toxins to prevent them from harming unintended targets.

The bacteria, *Yersinia entomophaga* was originally found in the native New Zealand grass grub by Dr Mark Hurst from AgResearch in NZ. The bacteria kill the grubs by secreting an insecticidal protein. The discovery that the bacteria also infect and kill agricultural pests such as the diamondback moth, that damages crops worldwide, piqued the team's interest.

Dr Michael Landsberg from the University of Queensland's (UQ) Institute for Molecular Bioscience worked with Dr Hurst and had previously determined the overall structure of the insecticidal protein by using the flagship cryo transmission electron microscope

in the AMMRF at UQ. An image of this model features in our touring exhibition, Incredible Inner Space.

In an extension to this research, the team, led by Dr Hurst and Dr Shaun Lott from AgResearch and the University of Auckland, used the AMMRF at UQ and the Australian Synchrotron to build a complete molecular map of this complex protein using the previously elucidated model as a template. Dr Landsberg explained, "We showed that the bacteria manufactures a giant, hollow protein shell that encapsulates the toxin, much like a protective canister that is only opened when specific environmental conditions are encountered." These important results were recognised by publication in the journal, *Nature*.

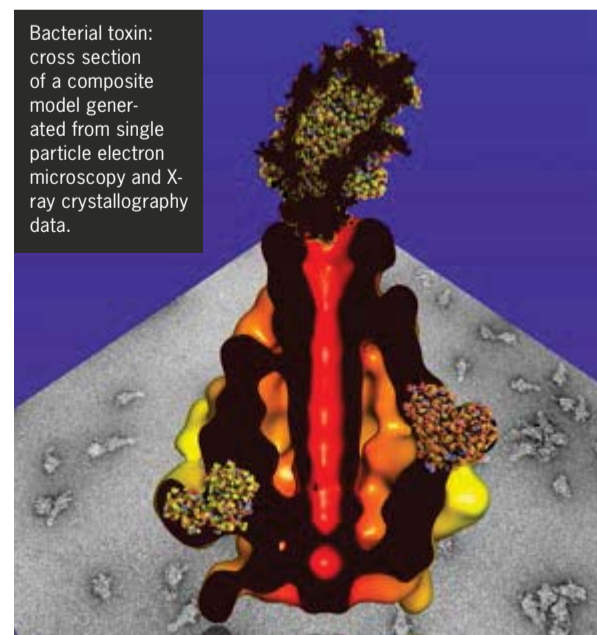
"The research explains how the bacteria can produce toxins without harming themselves – the toxins are secured in the protein

shell and released when they are needed to kill the insect." Dr Landsberg said that the bacteria's 'blueprint' for producing this canister uses a repeating protein sequence that is found abundantly in other bacteria and animals. "While the sequence encoding the shell is conserved across species, the toxins, or other encapsulated molecules, can be quite different," he said.

"Our studies suggest we may have found a molecular assembly manual that bacterial and animal cells alike use to manufacture a generic canister for the protection of toxic or sensitive molecules.

These discoveries have implications for research into human

disease as well as for the development of this new class of pesticide. ■



Bacterial toxin: cross section of a composite model generated from single particle electron microscopy and X-ray crystallography data.