

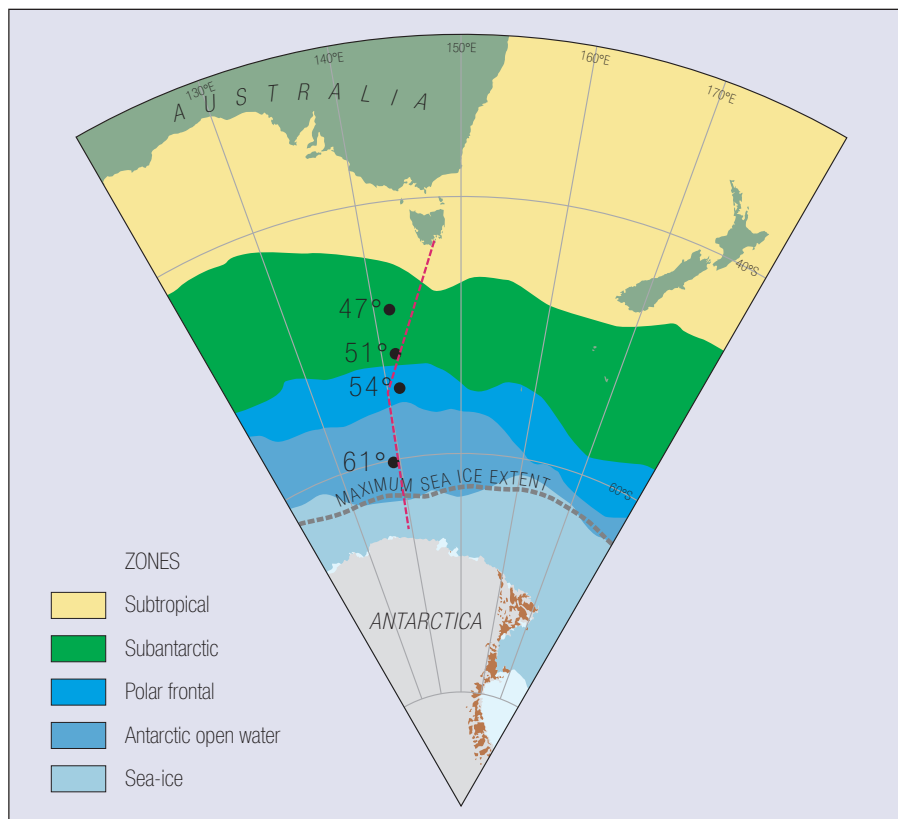
CLIVAR gathers evidence for global climate studies

The largest marine science cruise ever conducted by the Australian Antarctic program, over 45 days from late October to mid December 2001, involved a team of 70 researchers and technicians from 11 countries. The 'CLIVAR' cruise aboard the icebreaker *Aurora Australis* investigated how the Southern Ocean influences the Earth's climate and the global carbon cycle.

The Climate Variability and Predictability Program (CLIVAR) is a 15 year program initiated in 1995 by the World Climate Research Program (WCRP) to describe and better understand processes responsible for climate variability on seasonal to centennial time scales.

The cruise was one of a series in the Southern Ocean between Tasmania and Antarctica to investigate changes in oceanic circulation patterns and the consequences of these changes on marine life and the ability of the Southern Ocean to exchange heat and gases with the atmosphere. Three other, Japanese, research cruises in this area in early 2002 will provide a picture of the seasonal dynamics of the oceanic and biological processes in this part of the Southern Ocean.

The Southern Ocean is one of the primary regions where carbon dioxide is taken up and stored in the deep ocean. To be able to predict future atmospheric carbon dioxide concentration - and hence future climate -



The CLIVAR track between Tasmania and the Antarctic coast. Also shown are the major zones of the Southern Ocean and the location of sediment trap arrays

we need to determine how the ocean takes up carbon, and whether the amount of carbon taken up by the ocean is likely to change. Computer models suggest that the changes may be large in the Southern Ocean, but such predictions need to be tested by the sort of observations made on this cruise.

Phytoplankton (microscopic marine plants at the base of oceanic food webs) require carbon, nutrients and light to grow. Why the phytoplankton are not able to use all the nutrients available in surface waters of the Southern Ocean, as happens in most other parts of the global ocean, is still a mystery. A hypothesis that it is because they lack iron - a necessary trace element - was explored

on the voyage by adding iron to sea water. This confirmed that phytoplankton growth was limited by iron and that different groups of phytoplankton responded differently to iron addition - important from a carbon uptake and sinking perspective.

Formation of Antarctic bottom water - very dense water which sinks and carries oxygen and other gases to the deepest layers of the ocean - is a major process driving the vertical mixing of the oceans which, computer models suggest, will decrease with global warming with deleterious effects on ocean life. A special study was undertaken to investigate why a region of the Antarctic coast near Mertz Glacier is one of the few places around Antarctica where conditions are right to produce Antarctic bottom water.

Several experiments were conducted on board the ship to investigate biological responses to different light and the role of grazing of phytoplankton on biological production. Other investigations on the cruise included community structure of sea ice organisms, sea ice thickness and consistency and the distribution of planktonic animals and squid.

Harvey Marchant, Biology Program Leader, AAD



Instruments called sediment traps are used to determine what and how much of the biological production in surface waters is transported to the deep ocean. Here a sediment trap, one of an array of three, is about to be deployed. The array is anchored to the seafloor with the concrete weight (top left) and held upright in the water with floats - the yellow spheres (bottom right). This array will be recovered after collecting sedimenting material on a monthly basis for a year.