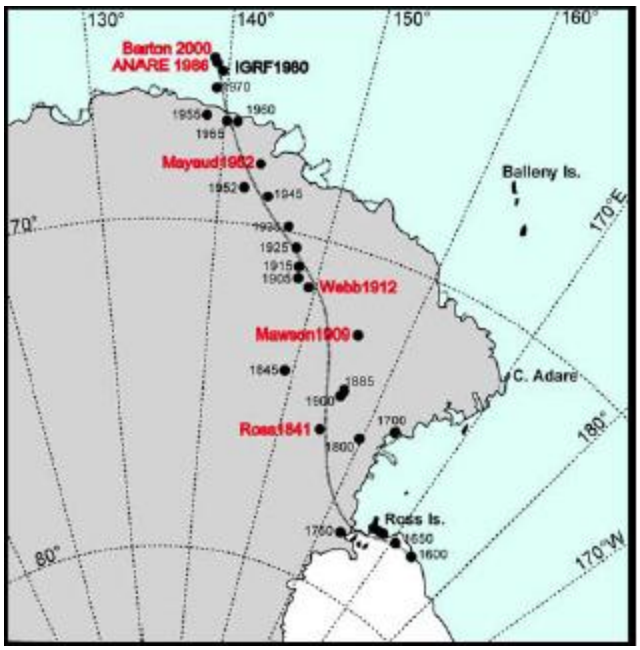
Global significance of the Antarctic

Professor Patrick Quilty AM

Pat commenced his talk by illustrating how much Antarctica influences life in Australia – a weather map focused on the Antarctica-Australia connection showed how circulation patterns around Antarctica, such as cold fronts, impinge upon and affect Australian weather. Pat then presented some information on Antarctica to provide a context and background: Antarctica's continent area is 13.9 x 106 km2, its permanent ice shelves are 3-4 x 106 km2, its annual sea ice is 17 x 106 km2, its volume of ice is 30 x 106 km3, the thickest amount of ice is almost 4800 m, its sea level effect is 70 m, and its lowest temperature is -89.6ooC. Rock outcrop in Antarctica is ~ 1%. The population of all non-indigenous peoples in summer is ~ 4000, and in winter ~ 1200.

Pat emphasised that the Earth is "One World", essentially that the Earth is a closed system, and that northern hemisphere effects have impact on Antarctica, and vice versa. The spring-time depletion of the ozone layer over Antarctica caused by northern hemisphere use of CFCs is an example of the connection.

The history of Science in Antarctica is marked by many prominent personalities and excursions over more than a century: three generations of the Enderbys, Henry Foster in 1829, James Eights, Dumont d'Urville in 1839/40, Charles Wilkes in 1839/40, James Clark Ross in 1840/41, the H.M.S. Challenger in 1874, the International Polar Year in 1882/83, Shackleton's South Magnetic Pole Party, and Georg von Neumayer. One of the outcomes of the scientific expeditions was the mapping of the south magnetic pole that had moved from the 1600s near Ross Island northward.



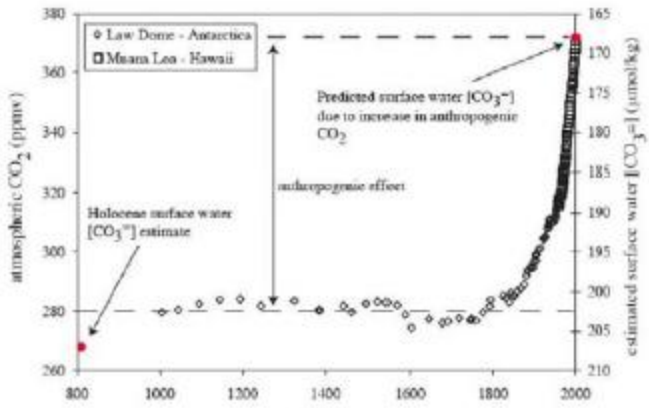
Migration of the south magnetic pole from 1600s to 1986

Pat then moved on to discuss the global circulation effected by Antarctica. He showed the effect of the katabatic wind, the freezing of surface water to develop high salinity high density water that migrates as a plume across the continental shelf and descends to abyssal depth to migrate as a basal current to as far north as the Equator. Pat considered this to be the most critical phenomenon on the Earth's surface today.

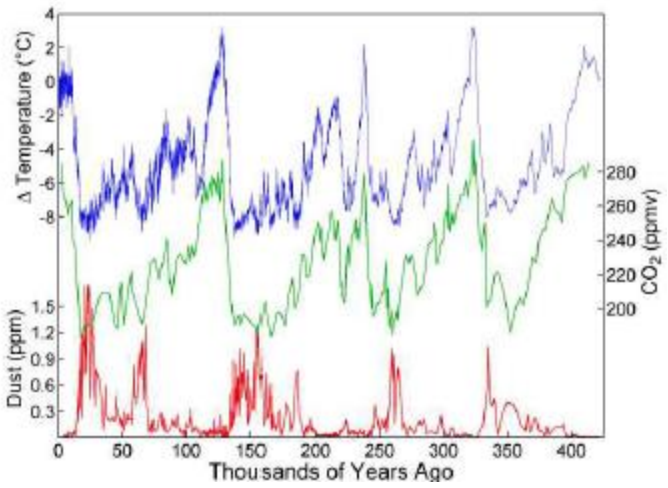
The story of the evolution of the Earth's surface environment is locked in Antarctica, and is a story of ice. Annual layering of ice holds ice stratigraphic information, and with use of 1100 m of drilling into the ice to extract cores, and thin sections of ice, and elemental and isotopic studies, the history of the Earth's environment has unfolded. Of particular use has been the trapped bubbles of gas (air) in the ice

Layering in Antarctica ice

Pat showed the reconstruction of the historical content of CO2 in the atmosphere over the past 1200 years from the Law Dome ice ore and, to put the CO2 content into a longer term perspective, the history of CO2, temperature and dust content over the past 400,000 years obtained from the Vostok ice core, and in a longer term perspective (from the Pliocene, i.e., 5.5 million years ago, to the present), by looking at the temperature signature provided by foraminifera and their oxygen isotopes, showing that there have been major fluctuations in temperature.



CO_2 in the atmosphere over the past 1200 years from the Law Dome ice core

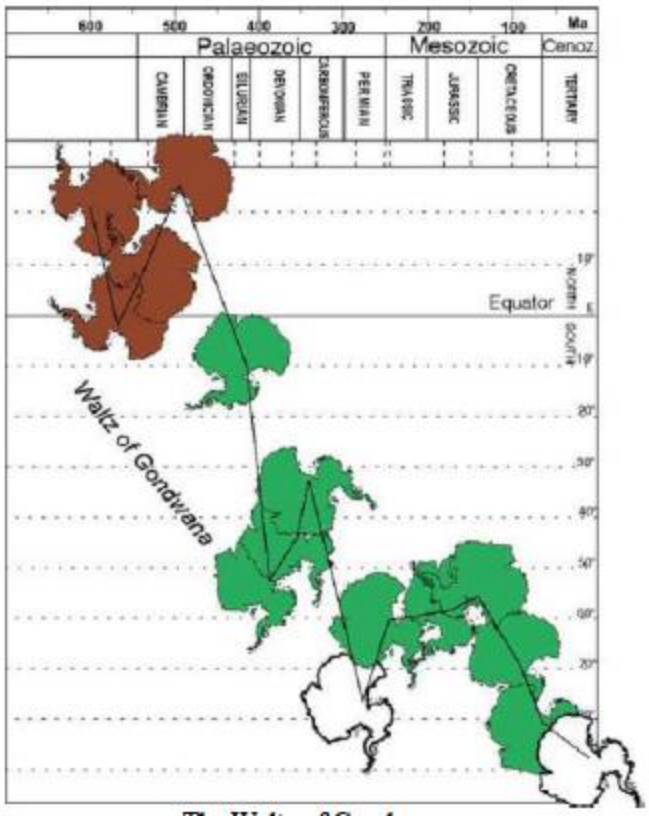


CO_2 temperature and dust over the past 400,000 yeas (Vostok ice core)

The next topic was geology. Pat showed that the geological evolution of Antarctica was linked to Australia's. With the assembly and dispersal of supercontinents such as Rodinia, Pangea, and Gondwana, Antarctica and Australia have remained firmly linked. Break-up of Australia from Antarctica began incipiently 120 million years, ago, with a seaway developed by 80-60 million years ago, with a gateway from the Indian Ocean to Antarctica by ~ 34 million years ago, and Australia definitely distant and moving north from Antarctica by 20 million years ago. Pat then showed the migration of Antarctica (known as the Waltz of Gondwana), using magnetic data, and Antarctica moved from latitudes north of the Equator in the late Precambrian to its present position over a period of 600 million years.

The evolution of Antarctica's fauna and flora and its links with Australia was the next focus of attention. While the modern flora and fauna of Antarctica are clearly different from Australia, with only two flowering plants in Antarctica and penguins and seals unique to Antarctica, there was greater resemblance in the past. Nothafagus beardmorensis, 2-3 millions old (with beech-like leaves) is found as a fossil located at 86° S at 1800 m above sea level. In Tasmania, there is a Nothafagus gunnii, located at 42° S.

Pat took the audience in an unusual direction with the next topic – that of the use of Antarctica as a model for human communities, i.e., the effects of isolation, and physiological responses- for instance, the study of antibody responses to bacteriophage φX-174 in humans exposed to the Antarctic winter-over as a model for space flight.



The Waltz of Gondwana