Creation and recycling in Archean Antarctica

Principal Investigator: Dr Daniel J. Dunkley

The Antarctic continent is an amalgam of terranes assembled in stages over most of the Earth's history. The only part of the continent known to have developed in the Eoarchean Era (before 3.6 billion years ago) is found in the Napier Complex of east Antarctica, where recent work has revealed the possibility of widespread crust formed in the early Earth. Extremely scant data from the eastern part of the complex in Kemp Land (see map) indicate multistage crustal evolution from 3.8 billion years ago (Ga) to a major high to ultra-high temperature tectonometamorphic event at 2.5 Ga, which produced the final assembly of an Archean craton. From equally scant data, it has been suggested that the craton forms the basement to Proterozoic supracrustal rocks in the adjacent Rayner Complex, which was reworked by orogenic events at 1.6 and 1.0 Ga. These three key events, at 2.5, 1.6 and 1.0 Ga, are also recognised in the eastern/central Indian peninsula, which adjoined east Antarctica in the Gondwanan supercontinent at 0.5 Ga. However, this late configuration of cratons in Antarctica and India is unlikely to represent the original Archean assembly, due to the presence of younger suture-type orogenic belts between them. To recover original relationships between Archean continental fragments, a better characterisation is required of the associations between the Napier and Rayner Complexes in east Antarctica, and of cratons in India also assembled by the 2.5 Ga event.

This project aims to comprehensively examine for the first time, through a combination of geochronology, geochemistry and metamorphic petrology, a 30000 km^2 area of Kemp Land that incorporates the boundary between the Napier and Rayner Complexes (see map). Within this area, only four sites have been dated by analysis of zircon, a mineral that can preserve isotopic signatures of multiple geological events. Using an archive of geological materials collected by Australian National Antarctic Research Expeditions from the 1950's to 80's, a set of samples has been selected for investigation. Four isotopic systems will be employed to investigate zircon extracts: U-Pb for dating of rock formation; Lu-Hf for defining juvenile crustal growth versus crustal recycling; and O and Si for identifying the degree of interaction with the hydrosphere and atmosphere in the formation of continental crust. Additionally, zircon and monazite will be dated by microbeam techniques to define tectono-metamorphic events in Kemp Land. Complementary to this program of Antarctic research, field work and analysis will be conducted on the margins of similar cratons in the Indian peninsula, to search for shared geological histories and tectonic correlations at and before 2.5 Ga and to find correlations between their early geological histories.