RV *Investigator* Scientific Highlights

Voyage #:	IN2016_T01		
Voyage title:	Continuity of Australian terranes into Zealandia: towards a geological map of the east Gondwana margin		
Mobilisation:	Hobart, 25 April 2016		
Depart:	Lautoka, 1900, Friday, 30 June 2016		
Return:	Hobart, 0400, Thursday, 14 July 2016		
Demobilisation:	Hobart, 15 July 2016		
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Continuity of Australian terranes into Zealandia: towards a geological map of the east Gondwana margin

Introduction

A large gap in our knowledge of east Australian geology lies hidden beneath the seas off eastern Australia. Very little is known about the geological make-up of the submarine banks and ridges under the Tasman and Coral seas. In addition, the physical, chemical and biological properties of the ocean waters are poorly understood in this remote region.

The voyage consisted of several projects with the following objectives:

1. Map the seafloor fabric and geologic terranes that make up the northern reaches of Earth's largest submerged continent, Zealandia
2. Characterize bio-optical properties of the water column both during the voyage and through deployment of floats for long-term monitoring.
3. Collect oceanographic measurements to groundtruth global mapping of seawater properties based on satellite imagery
4. Analyse seawater samples to investigate the diversity and activity of marine microbes, their tolerance to temperature, and their role in the global cycle of Carbon, Nitrogen and Sulphur.
5. Investigate the properties of marine aerosol over the southern hemisphere, and quantify their contribution to Earth's climate.

Contribution to the nation

Lying beneath the seas east of Australia is the world's largest continental fragment, the Lord Howe Rise. The area comprises one of Australia's largest frontier hydrocarbon provinces, but has seen limited exploration investment because key geological information has remained unknown. Our voyage successfully recovered a suite of rocks (from ancient basement to recent sediments) which will fill a major gap in geological maps of the area used by industry and government. This investigation aligns with the goals of planned major scientific drilling expedition in the next few years lead by Geoscience Australia.

This voyage also gave us the opportunity to characterize bio-optical and biogeochemical properties of ocean waters east of Australia, and study marine microorganisms (phytoplankton, bacteria and archaea) forming the base of the food chain and impacting nutrient availability and local climate. We were able to map the function of these microbes along the ship's transit path, from tropical to high-latitude temperate waters, giving us a greater understanding of how the environment shapes microbial function, and therefore how this might change in future oceans.

As a result of this voyage

In addition to mapping a new plate boundary in the ocean between New Caledonia and Fiji, we recovered rocks from thousands of meters below sea level indicating land once exposed at the surface, an ancient river system and a string of submarine volcanoes.

1. We have a better understanding of the geological foundations of northern Zealandia, and how to make connections between the rock units of Australia and New Zealand.
2. We have found evidence for ancient river systems and a string of submarine volcanoes, which were once above sea level along the eastern margin of the Australian landmass.
3. We have mapped a new plate boundary in the ocean west of Fiji, a major submarine landslide structure along the margin of New Caledonia, and imaged volcanic edifices along the extinct ridge that forms the spine of the Tasman Sea.
4. We have commenced a program of laboratory analysis on our recovered rocks samples to determine their geochemistry, age of formation, and more clearly establish their origin within the breakup of Gondwana and the separation of Zealandia from Australia.
5. We have a greater understanding of the environmental factors driving microbial community structure, function and diversity in Australian waters, particularly with respect to the carbon, nitrogen and sulphur cycles, which underpin the marine food web.