Cruise Summary

1. Cruise Information

● Cruise ID

MR16−09

● Name of vessel

Mirai

● Title of the cruise

Trans South Pacific Project

● Chief scientist

Akihiko Murata (JAMSTEC) for legs 1 and 4

Naomi Harada (JAMSTEC) for leg 2

Hiroshi Uchida (JAMSTEC) for leg 3

● Representative of the Science Party (affiliation)

(1) Naomi Harada, Akihiko Murata and Natsue Abe: (JAMSTEC).

(2) Fumikazu Taketani (JAMSTEC).

(3) Shuhei Masuda (JAMSTEC).

(4) Taichi Yokokawa (JAMSTEC).

(5) Toshiya Fujiwara (JAMSTEC).

(6) Masaki Katsumata (JAMSTEC).

(7) Chisato Yoshikawa (JAMSTEC).

(8) Kazuma Aoki (Toyama University).

(9) Takeshi Matsumoto (University of the Ryukyus).

● Cruise period

Leg 1 (22 days): Suva (27th Dec., 2016) to Puerto Montt (17th Jan., 2017)

Leg 2 (17 days): Puerto Montt (20th Jan., 2017) to Punta Arenas (5th Feb., 2017)

Leg 3 (26 days): Punta Arenas (8th Feb., 2017) to Auckland (5th Mar., 2017)

Leg 4 (21 days): Auckland (8th Mar., 2017) to Sekinehama (28th Mar., 2017)

● Research area

South Pacific, Chilean coast, Southern Ocean, and western North Pacific

２. Overview of the Observation

The Southern Ocean is a mirror, which reflects global-scale environmental changes. In fact, it is reported that salinity and oxygen decreases in intermediate and upper deep waters over the south of Australia, located in the western part of the observation area. Furthermore, distinct warming from intermediate to deep layers is also observed in the Drake Passage, located to the east of the observation area. In addition, the observation area corresponds to where sea ice retreat and ice sheet melting on the continent are progressed most largely. As a cause of ice changes, a temperature rise in Upper Circumpolar Deep Water is assumed to occur.

The Pacific sector of the Southern Ocean is important again, because it stores a large amount of anthropogenic CO_2, which is a main cause of ocean acidification. The marginal sea of Chile is a source for atmospheric CO_2 because of active coastal upwelling. Decrease of pH is said to cause reduction of productivity of diatom, while it is said to cause higher productivity of diatom due to higher concentration of iron available to diatom. For calcareous biology, decrease of pH is threatened to promote dissolution of skeleton and shell. Nevertheless, it is also reported that thicker shells are formed in response to decrease of pH. Like these, responses of primary producers against ocean acidification are not constant, being able to be positive or negative. In addition, there are hypotheses with respect to positive or negative impacts of ocean acidification on ecosystem in intermediate and deep layers, where marine snow is fed and on influences on material cycles in sea floor. These hypotheses are examined by observing chemical characteristics (temperature, salinity, carbonate system, nutrients, etc.) and by collecting biological samples.

For research into the interior of the earth, there is a hypothesis that a boundary exists at latitudes 41° – 43°S, which distinguishes chemical composition of mantle in the western hemisphere with the composition in the eastern hemisphere and that the existence of the boundary affects material cycles in the interior of the earth. Recently, a tight relationship is pointed out between changes in sea level and crust formation rate in mid-oceanic ridge. To test these hypotheses, periods of igneous activities in the Chile Ridge and the fracture zone are determined, and the structure in oceanic crust and geochemical characteristics in rocks around the region are clarified. Furthermore, changes in sea level and structure of deep-ground are exhibited, and mechanism acting among ridge subduction, great earthquake and accompanied volcanic activities is illustrated.

The projects conducted in MR16−09 are as follows:

(1) Trans Pacific Project: Ocean Acidification, Marine Biodiversity, Pacific Meridional Overturning Circulation, Crustal Evolution;

(2) Ship-borne measurements of aerosols in the marine atmosphere: Investigation of potential influence of marine aerosol particles on the climate;

(3) The monitoring of ocean climate change from surface to deep layer in the Southern Ocean by using Argo-type floats;
(4) Geochemical and microbiological processes throughout water column of the Southern Ocean in the eastern Pacific sector;
(5) Regional distribution of seafloor displacement caused by the 2011 Tohoku-oki earthquake: What happened in the northern Japan Trench?
(6) Cumulus-scale air-sea interaction study by shipboard in-situ observations;
(7) Geochemical and microbiological investigation for sea surface to sea bottom along Chile margin;
(8) Aerosol optical characteristics measured by Ship-borne Sky radiometer;
(9) Cessation of active spreading axes at trenches.

The above numbers correspond to those attached to representatives of science parties.