

## Cruise Summary

NT09-02 Leg-1

R/V Natsushima

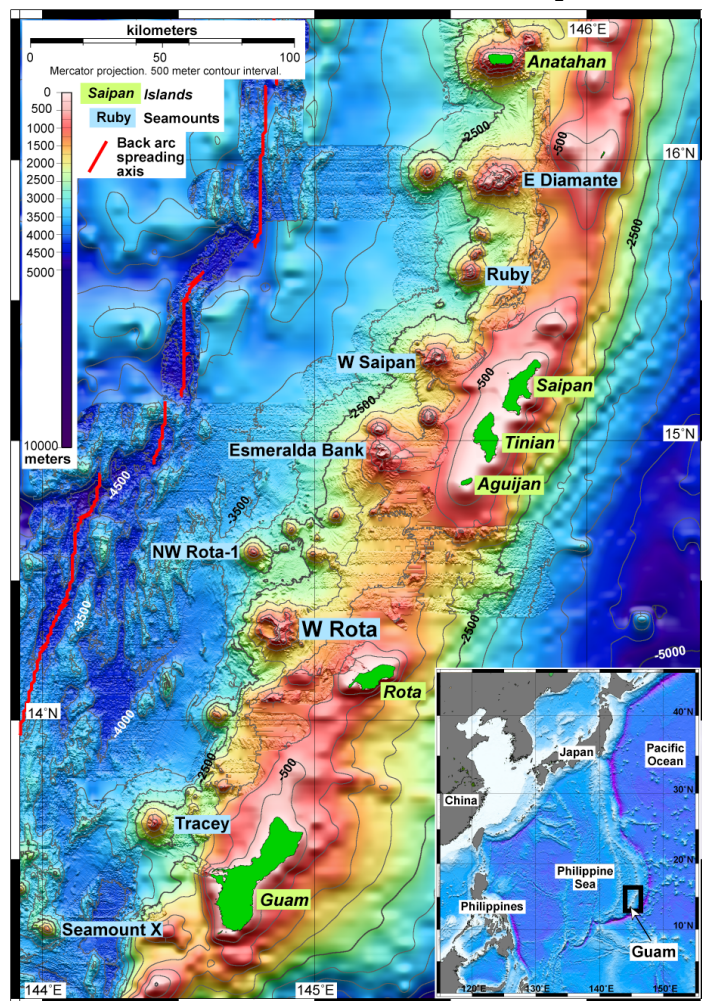
Yoshihiko Tamura (IFREE, JAMSTEC)

Studies of rear-arc volcanism and crustal structure in the northern Izu Arc

February 2 to February 7, 2009

(Guam to Saipan)

Southern Mariana submarine volcano province



*Submarine volcanoes of interest to this study (Tracey, W Rota and NW Rota-1).*

### Overview of Observation

During this cruise, a Japan-US team of scientists studied volcanism near the southern end of the active Izu-Bonin-Mariana arc (Stern et al., 2003) using JAMSTEC's R/V Natsushima and ROV Hyper-Dolphin and. We focused on the Southern Seamount Province of the active Mariana Arc between 13°30'N and 14°40'N. The targets lie just west of the Mariana frontal arc islands, especially Guam and Rota. The cruise completed additional multi-beam maps of the seafloor, completed four dives of Hyper-Dolphin, and recovered 56 rock samples and 8 core samples. Two monitoring instruments were deployed at NW Rota-1.

Tracey Seamount: Dive 949 landed near the base of the western slope of a ~100m

tall conical feature developed within a west-facing sector collapse pit near and west of the summit of Tracey Seamount, at a depth of 1338m. Samples R01-R07 were collected from this conical feature, which is thought to be the last magmatic event in the development of Tracey seamount. The conical feature appears to be a dacite dome, as demonstrated by dikes and other steeply dipping flow features that indicate the viscous dacitic magma mostly flowed up and out of the vent. After reaching the summit of the resurgent dome at 1191m, the HD flew eastward ~1km and dropped down to 1300m to traverse the ~500m tall west facing scarp defining the eastern margin of the sector collapse. Samples R08-R15 and push cores C01, C02 were collected during this traverse. The section consisted of apparently interlayered ol-cpx-pl basaltic andesite and pumiceous sandstone, with the proportion of sandy layers and pumice increasing upwards, suggesting that the volcano evolved to erupt increasing proportions of felsic material prior to the final events, which appear to have been sector collapse and emplacement of the resurgent dacite dome.

W. Rota Volcano: Dive 950 consists of two short transects, designed to study the altered and mineralized section, and one long transect to study the volcanic stratigraphy of the north wall. The first transect began at an outcrop of pervasively altered pale-gray volcanic rock with sets of cross fractures, some black and reddish staining, and moderate sediment cover. Sampling recovered a boulder of pervasively altered white to pale-gray volcanic rock with abundant disseminated sulfide and minor sulfide-lined vugs and veins. Much of the outcrop seen in the dive showed a well-developed fracture system with one set oriented sub-vertical and the other sub-horizontal. Pervasively altered rocks occur in outcrop and as talus between sections covered by sediments through most of the dive.

The second traverse was a short distance north of the first and was designed to see how far the pervasive zone of alteration might extend. However, much of the section traversed here was covered by sediment. Layers at the beginning of the line were rust-red below a thin blanket of white-gray sediment. The extensive red layer may represent a buried bacterial mat that lived at the sediment surface above a diffuse-flow hydrothermal system. Pervasively altered rocks were not found in this transect. Fresh andesite was collected at 1118 m and fresh basalt at 1071 m.

The final transect was along a more northerly portion of the caldera wall to look for layered pyroclastics marking the caldera scarp. The dive began among piles of black to dark-gray andesite-dacite cobbles and boulders. Andesite and dacite were the dominant rock types collected throughout the section from 1220 to 560 m, with andesite more commonly encountered at the base and dacitic pumice becoming increasingly common up section. A broad bench between ~980 and 850m was covered with loose sediment that commonly showed ripple marks. Above this it appears that the traverse approached an important eruptive center positioned on the shallowest part of the ridge. This part of the traverse crossed igneous rocks that were very coarse and quite fresh. A composite dike of andesitic (plag-pyroxene andesite) and felsic (pyroxene dacite) magmatic material was observed near the top of the section.

Andesite Knoll: Andesite Knoll is a small volcanic cone ENE of NW Rota-1. It was sampled by D12 during the COOK cruise, recovering mostly andesitic lavas. Dive 951 was conducted here because the US

Coast Guard planned to work on the summit of NW Rota-1 on the morning of February 6<sup>th</sup>. This small seamount was first mapped and sampled by Leg 7 of the Cook Expedition (2001). The andesitic composition of the D12 lava stands in contrast to the basaltic material erupted recently from NW-Rota to the west and picrites erupted from Chaife Seamount to the east. Because of the limited amount of material recovered in 2001 and the unusual magmatism in the region, more detailed examination and sampling was needed.

Dive 951 reached bottom at a depth of 2319 meters on the NE flank of the volcano. The immediate landing location was a terrace or shallowly dipping slope covered with gray-white sediment. Numerous centimeter scale rock clasts were observed in the sediment. *Hyper Dolphin* climbed towards the summit from this point, and encountered steep slopes of blocky lava flows and ledges alternating with gentler slopes covered with sediment. The steep slopes were not continuous and consisted of projecting outcrops that were likely flows. The outcrops varied in morphology, most were blocky due to strong jointing, but pillow morphologies were observed. Some outcrop formed overhanging ledges. Outcrop on the upper slopes had thin (2-5 cm) sheet flow layering. Fourteen rock samples were recovered. All the samples are dark gray, porphyritic plagioclase phyrlic basalt or basaltic-andesite.

NW Rota-1 volcano: Dive 452 examined the summit region of NW Rota-1, around Brimstone Pit. The volcano, which was first observed to be active in 2004, remains active, with a vigorous plume emanating from the vent. There was significant sulfur being ejected in the plume, abundant release of carbon dioxide, and occasional bursts of tephra. No evidence of lava was observed. The shoal edge of the rim is now at about 519 m. When activity here was first observed, the depth of the pit rim was about 540 m. It appears there has been significant growth of the vent area in the nearly five years of activity here.

There were abundant sulfur coatings and rims on many rocks and very abundant microbial mats in some places. Shimmering water can be identified near some of the microbial mats. Shrimp and crabs are common as well.

There are steep fissures observed in places, and near the summit large columns or spires of volcanic material that appear to be constructed by the volcanic activity. Six rock samples and four core samples were recovered. Two temperature-redox meters were placed near the rim of the vent (by K. Nakamura of the Geological Survey of Japan).