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Acquisition of ground reference of sidescan sonar 'Wadatsumi' imagery and magnetic anomaly in the central Mariana Basin

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The Mariana Basin is one of active back-arc basins in the world. It develops on the Philippine Sea Plate subducted by the Pacific Plate. The basin exhibits a remarkable bow-shaped and extremely asymmetry geometry. Spreading axes of the basin are distributed in the eastern part of the basin, near the Mariana volcanic arc, rather than in the center.
To elucidate an asymmetric seafloor spreading styles and a detail volcanic activity of the Mariana Basin, two research cruises, KR03-12 and YK08-08, are conducted. We carried a deep-towed sidescan sonar survey using "Wadatsumi system (Ocean Research Institute, Univ. of Tokyo)" in 2 003. Wadatsumi sidescan sonar system transmits ~100 kHz acoustic signal and receives it by two hydrophone arrays. The system detects fine-scale (~several meters resolution) backscattering strengths that image seafloor bathymetry and facies. A 10-km wide and 22-km long backscattering strength map of the northern half of the Seg-17 axial valley floor was obtained by the survey in 2003. In 2008, we conducted submersible Shinkai6500 dives in the Wadatsumi imaged area, and obtained rock samples, video images, and geomagnetic anomaly profiles.

The Wadatsumi observations exhibit that two directions of geological features (faults, fissures, and ridges) are developed on the Seg-17 axial valley floor. One group trends subparallel to the axial valley, and the other group trends ~15 degrees oblique to the valley. The obliquely trending group is distributed in the eastern part of the valley. To know detail volcanic activity and age-relationship between two differently trending groups, we set three Shinkai6500 dives over the following situations: (1) DIVE#1088: long transit from the volcanic ridge in the center of the axial valley to the western lava plain, (2) DIVE#1089: superimposed seamount on the eastern lava plain, and (3) DIVE#1090: layered lava plain. As a result of the dives, we founds following things:
1. We obtained good ground references of Wadatsumi sidescan sonar imagery.
2. We found a good correlation between relative thicknesses of sediments and sidescan sonar backscattering intensities.
3. We found small geological features which were not recognized by the sidescan sonar imagery: (i) we found several new lava flows, and (ii) obliquely trending fissures cut subparallel trending geological features.
4. Effective comparison between geological observations, sidescan sonar imagery, and geomagnetic anomaly profiles become possible. We have obtained the following observations: (iii) geomagnetic anomaly profile along DIVE#1088 shows a complicated pattern. Thus we consider that the site of "seafloor spreading" is not confined to a narrow zone in the axial floor but takes place at multiple sites, (iv) the seamount on the eastern lava plain (DIVE#1089) does not show a high anomaly, (v) superposed lava plain (DIVE#1090) does not show remarkable differences, and (vi) remarkable high anomalies did not observed along the three dive tracks.

Keywords: sidescan sonar, backarc basin, slow spreading, volcanism, trend of geological features