New insight on structure and processes of subseafloor hydrothermal vent systems from deep-tow and rock magnetic studies

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Abstract : The PACMANUS hydrothermal vent field in the Eastern Manus back-arc basin, Papua New Guinea, is considered as a modern-day analog of massive volcanogenic sulfide deposits within felsic volcanic sequence. This active vent field was drilling in November-December 2003 by Ocean Drilling Program Leg 193. The recovery was generally low with less than 15\% due to fragility of rocks. Paleomagnetic measurements and scanning electron microscope observations were performed on samples from three major sites (Sites 1188, 1189 and 1191). Site 1188, a low-temperature diffused venting region, was drilled to 370 mbsf. Site 1189, a black smoker region, was drilled to a depth of 200 mbsf using RCB. The recovered rock samples have inclination close to the present-day Earth field (-7º), but those near the seafloor have much steeper inclination of up to - 25º. The upper 35 m of the sites consists of fresh to moderately altered dacite-rhyodacite, which exhibits moderately high natural remanent magnetization (< 6 A/m). The region below this extrusive layer largely comprises of pervasively altered rocks with little evidence of sulfide deposit and as a whole exhibits a low magnetization intensity. However, two intervals with extremely high remanent magnetization were discovered below the upper extrusive layer at Site 1188 (135-211 mbsf and 280-370 mbsf) and one interval at Site 1189 (137-190 mbsf). In particular, the samples between 135-211-mbsf interval at Site 1188 have extremely high remanence with intensities ranging up to 300-500 A/m. Although pockets of magnetite are not uncommon in the ancient hydrothermal ore bodies, they have seldom been documented in modern-day system, and little is known about the physical and chemical condition that allows the magnetite to form in hydrothermal vent systems. Two possibilities of magnetite formation are explored: one that these magnetites precipitated from magnetite-rich fluid as it cooled from above the Curie temperature (TRM) and the other that magnetization was acquired by the growth of magnetite grains below the Curie temperature (CRM). We also show the results of near-seafloor deep-tow magnetic field measurements made after the drilling in order to define the dimensions of demagnetized zones. Our results demonstrate that two hydrothermal vent site (1188 and 1189) are different in terms of degree of demagnetization and suggest that Site 1188 has experienced a greater degree of alteration than Site 1189.