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チャレンジャー海淵前弧における蛇紋岩湧水系の理解のカギは若い玄武岩の活動にある
Young basaltic volcanism as a key for understanding serpentinite-hosted vents in the Challenger Deep Forearc

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The Izu-Bonin-Mariana forearc is a typical nonaccretionary convergent plate margin; the inner trench slope exposes lithologies found in many ophiolites. In particular, serpentinized peridotite crops out and has been sampled from the inner trench wall along the southernmost Mariana forearc facing the Challenger Deep. Our studies there indicate that this is a region of forearc rifting unusually close to the trench axis, as manifested by the Southeast Mariana Forearc Rift [SEMFR; Ribeiro et al., 2013, G3]. Convergent margin igneous activity is generally limited to beyond 100-200 km from the trench, so the presence of SEMFR is an unusual characteristic of the southernmost Mariana forearc. We have also discovered more evidence of young basaltic volcanism from ˜100 km west of SEMFR. DSV Shinkai 6500 dives during YK13-08 cruise recovered volcaniclastics from 5.5 to 6 km deep in the inner wall of the Mariana Trench, ˜50 km northeast of the Challenger Deep [Stern et al., 2014, Island Arc]. The volcaniclastics include fresh basaltic glasses that are similar to basalts from SEMFR as well as to Mariana Trough backarc basin basalts and we conclude that they formed by recent eruptions on the inner trench wall. Earthquake foci also indicate that the Challenger Deep forearc is a region of strong extension, and bathymetric data indicate that multiple tectonic rifts dissect it, indicating that diffuse extension occurs in the forearc.

We have discovered and have been studying a serpentinite-hosted ecosystem, the Shinkai Seep Field [SSF; Ohara et al., 2012, PNAS] in the inner wall of the Mariana Trench, ˜80 km northeast of the Challenger Deep. SSF is a diffuse cold seep, serpentinite-hosted system that hosts ecosystem mainly consisted of vesicomyid clams. We have tried to find more SSF-type seeps along the southernmost Mariana forearc during YK13-08 and YK14-13 cruises, but no such seeps were found so far. The origin of the fluid of SSF may originate in the shallow subducting slab, unrelated to igneous activity. Another possibility, based on the fact that YK13-08 volcaniclastics are found ˜5 km west of SSF, is that SSF vent fluid originated from seawater circulated within the shallow crust driven by the heat of young magmatic intrusion, as is proposed for the Lost City hydrothermal field in the Mid-Atlantic Ridge. Our results suggest that identifying sites of recent forearc igneous activity may help locate other sites of seafloor venting on the inner trench wall of the Challenger Deep Forearc.

Keywords: Challenger Deep, forearc, serpentinite, young basalt