

The last unknown pieces of the Proto-Philippine Sea Plate: Huatung Basin and Gagua Ridge

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Little is known about the Proto-Philippine Sea Plate (PSP), which existed as a counterpart to the Pacific Plate during subduction initiation of the Izu-Bonin-Mariana (IBM) Arc. IBM subduction is recently postulated to have occurred synchronously along the PSP margin at around 52 Ma (Ishizuka et al. 2011 EPSL).

To investigate the crustal structures of the PSP, we have conducted multiple research cruises since 2010 in the regions that were regarded as potential remnants of the PSP: Daito Ridges, Izu-Bonin forearc and Southern Kyushu-Palau Ridge. Submersible and ROV observations and rock sampling revealed that these regions expose deep crustal sections of continental rocks, spanning various volcanic, plutonic, metamorphic, and ultramafic rocks (e.g. Morishita et al. 2018 Am. Min.). Geochemistry and radiometric dating of these rocks clearly indicate that the PSP consists predominantly of Mesozoic arc rocks. Furthermore, amphibolite collected at the Southern Kyushu-Palau Ridge yielded Cambrian protolith zircons, suggesting that even older continental fragments may exist within the PSP. These findings and tectonic reconstruction of the PSP (Deschamps and Lallemand 2002 JGR) suggest that subduction of the Izu-Bonin Arc initiated at the continental margin of Southeast Asia, and later acquired its intra-oceanic-like setting through formation of the backarc basins since the Eocene.

However, there are unresolved questions regarding the crustal structure of the PSP at Huatung Basin and Gagua Ridge, located at the northwestern margin of the current Philippine Sea Plate. Deschamps et al. (2000) EPSL suggested that Huatung Basin was formed in the Early Cretaceous, based on modeling of magnetic anomalies and radiometric dating of MORB-like gabbro collected at the southern part of the basin. If so, Huatung Basin is the only known oceanic domain in the PSP, indicating that the PSP was a complex of continental and oceanic crusts. In contrast, Doo et al. (2014) MGR and Kuo et al. (2009) GJI indicated much younger post-Eocene spreading of the basin based on reinterpretation of the magnetic anomalies and thin lithosphere under the basin. If the basin is formed after the Eocene, it is most likely part of the IBM backarc basins. Gagua Ridge, comprising the western margin of the basin, was interpreted to be oceanic crust uplifted along a transform fault (Deschamps et al. 1998 MGR), but dredge sampling conducted in 1980 recovered andesite and metamorphic rocks, suggesting a more complex crustal structure.

To unravel the crustal structure of the Huatung Basin and Gagua Ridge, geological and geophysical surveys are planned by R/V Hakuohmaru in November–December, 2020. Here we will summarize our ongoing research in the PSP and introduce our scientific objectives for the upcoming cruise.

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