

Geologic and geochronological constraints on the Philippines Sea tectonics around 50 Ma

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Recent geological and geophysical survey cruises as well as IODP drilling expeditions in the Philippine Sea are providing new geologic and geochronological information useful for tectonic reconstruction of the Philippine Sea plate. Especially, tectonic reconstruction around 50 - 55 Ma, i.e., the period immediately before and after the subduction initiation to form Izu-Bonin-Mariana (IBM) arc is of particular interest, because it is critical for understanding the possible tectonic processes to enable subduction initiation.

In this contribution, the following three sets of data recently published or obtained from this region will be introduced, and possible tectonic models which could consistently explain the new data will be discussed.

1) OIB-like magmatism in the Philippine Sea: ⁴⁰Ar/³⁹Ar ages from a 1000km NW-SE line of oceanic plateaus in and around the West Philippine Basin (WPB) demonstrates that they formed as a time-progressive volcanic chain mirrored either side of the WPB backarc spreading center (Ishizuka et al., 2013). In the north this chain is bounded by a Mesozoic remnant arc (i.e., Daito Ridge group). Geochemically these oceanic plateaus have an EM-2 ocean island basalt (OIB) signature matching the older 45-51 Ma volcanic edifices discovered overlapping the remnant arc and intervening basins. The wide distribution of these edifices could mark the first arrival of upwelling mantle. These features are consistent with the extension and splitting of the Mesozoic arc terrane, driven by regional upwelling centered on the impact of the mantle plume at c. 51 Ma.

2) YK10-14 and YK13-08 cruises by R/V Yokosuka investigated Palau Basin (southernmost part of the Philippine Sea plate) and southern part of WPB obtained some crucial geological and geophysical data (Sasaki et al., 2014) for reconstruction of the Philippine Sea Plate. ⁴⁰Ar/³⁹Ar dating of dolerite sample from the Palau Basin crust exposed at the Mindanao Fracture Zone gave a plateau age of 40.4 Ma. This result indicates that the spreading of the Palau Basin was still going on at 40.4 Ma. This age is within an age range of active spreading of the WPB (e.g., Okino and Fujioka, 2002). This strongly implies that contrary to the previous hypotheses, the Palau Basin formed while the WPB was still opening, and the Palau Basin is not the oldest part of the WPB.

3) IODP Exp.351, targeted evidence for the earliest evolution of the Izu-Bonin-Mariana arc following inception, was conducted in Amami Sankaku Basin (ASB), west of the Kyushu-Palau Ridge (KPR), i.e., paleo-IBM arc. Igneous basement of this site, which presumably corresponds to the basement of the IBM arc, was successfully recovered. On-board preliminary data suggests that basaltic basement is early-middle Eocene (or older) and geochemically similar to forearc basalts from IBM forearc. This implies that the area of initial seafloor spreading associated with subduction initiation covers an area from forearc to reararc of future IBM arc.

Keywords: Philippines Sea plate, Izu-Bonin-Mariana arc, OIB, West Philippine Basin