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New insights into the Philippine Sea evolution: results from the recent Godzilla Megamullion study

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The Godzilla Megamullion is the largest known oceanic core complex, located in the Parece Vela Basin, an extinct backarc basin in the Philippine Sea. The previous studies, primarily based on poorly-constrained magnetics data, argued that the basin was active from 26 to 12 Ma at an intermediate-spreading rate of 8.8-7.0 cm/year full-rate, although the basin shows the characteristics typical for slower-rate spreading ridges. The most remarkable characteristic is found in peridotite petrology; most peridotites in the Parece Vela Basin are much less depleted than those exposed at comparable spreading rates on other mid-ocean ridge systems. The tectono-magmatic characteristics of the Parece Vela Basin were thus thought unusual and paradoxical.

However, the recent studies, based on the high-density samplings on the Godzilla Megamullion (total 42 sampling locations), show the evidences that the basin became slow to ultraslow environment in its terminal phase. Zircon U-Pb dating of gabbroic rocks from the Godzilla Megamullion reveals that the estimated slip rate of the Godzilla Megamullion detachment fault was approximately 2.5 cm/y; significantly slower than the previous estimate. The morphology and geology of the termination area are similar to those observed in ultraslow-spreading ridges; peridotite exposure along the two major parallel ridges bounded by steeply dipping normal faults, showing that mantle uplift occurred symmetrically along the these normal faults. Decreasing degree of partial melting of the peridotites as well as increased amount of plagioclase-bearing peridotites (showing melt stagnation in the shallow lithospheric mantle) are observed towards the termination of the Godzilla Megamullion.

Presence of axial alkaline volcanic chain is known in some backarc basins (e.g., Shikoku Basin, Japan Basin, South China Basin). It is known that these axial volcanoes were active after the cessation of spreading of the basins; hence these activities are called *post-spreading volcanism*. A 4.2 Ma alkaline volcanism is also known in the Parece Vela Basin, within the segment of the Godzilla Megamullion. However, based on the recent observations at the Godzilla Megamullion, we would hypothesize that the terminal phase of a backarc basin evolution will go through an ultraslow-spreading environment, inevitably erupting alkaline basalts. If this is the case, it would not be necessary to assume post-spreading volcanism. Furthermore, a hiatus period is normally assumed between the cessation of a backarc basin and the opening of a succeeding backarc basin. If our hypothesis is true, then there will be an overlap period of the terminal alkaline basalt volcanism and the rifting of a succeeding backarc basin, no hiatus period is necessary. This hypothesis may revolutionize our general understanding of the dynamics of backarc basin asthenospheric structure.

Keywords: Godzilla Megamullion, Philippine Sea, backarc basin, evolution