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The West Philippine Basin: An Eocene to early Oligocene back arc basin opened between two opposed subduction zones

Anne Deschamps
Deep Sea Research Department, Japan Marine Science and Technology Center, Yokosuka, Japan

Serge Lallemand
Laboratoire Geophysique, Tectonique, and Sedimentologie, Université Montpellier II, Montpellier, France

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[1] Based on geological and geophysical data collected from the West Philippine Basin and its boundaries, we propose a comprehensive Cenozoic history of the basin. Our model shows that it is a back arc basin that developed between two opposed subduction zones. Rifting started around 55 Ma and spreading ended at 33/30 Ma. The initial spreading axis was parallel to the paleo-Philippine Arc but became inactive when a new spreading ridge propagated from the eastern part of the basin, reaching the former one at an R-R-R triple junction. Spreading occurred mainly from this second axis, with a quasi-continuous counter-clockwise rotation of the spreading direction. The Gagua and Palau-Kyushu ridges acted as transform margins accommodating the opening. Arc volcanism occurred along the Palau-Kyushu Ridge (eastern margin) during the whole opening of the basin, whereas the paleo-Philippine Arc decreased its activity between 43 and 36 Ma. The western margin underwent a compressive event in late Eocene-early Oligocene time, leading to the rising of the Gagua Ridge and to a short subduction episode along Eastern Luzon. In the western part of the basin, the spreading system was highly disorganized due to the presence of a mantle plume. Overlapping spreading centers and ridge jumps occurred toward the hot region and a microplate developed. Shortly after the end of the spreading, a late stage of amagmatic extension occurred between 30 and 26 Ma in the central part of the basin, being responsible for the deep rift valley that cut across the older spreading fabric. *INDEX TERMS:* 3040 Marine Geology and Geophysics: Plate tectonics (8150, 8155, 8157, 8158); 3035 Marine Geology and Geophysics: Midocean ridge processes; 8157 Tectonophysics: Evolution of the Earth: Plate motions—past (3040); 9320 Information Related to Geographic Region: Asia; *KEYWORDS:* Philippine, back arc, Southeast, Asia, geodynamic, model

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1. Introduction

[2] The West Philippine Basin (WPB) is a wide oceanic basin covering most of the western part of the Philippine Sea Plate (PSP). Despite its unusually great size, it has not been intensively studied, and its Cenozoic history is still controversial. Several models have been proposed for the kinematic evolution of Southeast Asia during the Tertiary, each of them integrating the formation of the WPB in various ways. We classify the published models into two groups, one considering the WPB as a trapped piece of a larger oceanic plate, and the other regarding it as a back arc basin.

[3] The first "entrapment model" was proposed by *Uyeda and Ben Avraham* [1972], and was modified by *Uyeda and McCabe* [1983]. According to them, the WPB resulted from the entrapment of a segment of the Kula-Pacific Ridge in the Middle Eocene time behind the newly formed Palau-Kyushu Ridge, during a plate reorganization. This model was adopted by *Hilde and Lee* [1984]. Later, *Jolivet et al.* [1989] proposed a variant of this model, in which the WPB was formed by trapping of a piece of the North New Guinea/Pacific Ridge, during the Middle Eocene. The main argument supporting this entrapment origin is the high angle between the fossil spreading axis and the paleo-volcanic arc (the Palau-Kyushu Ridge) [*Mrozowski et al.*, 1982; *Hilde and Lee*, 1984].

[4] On the other hand, *Lewis et al.* [1982] first proposed a back arc origin for the formation of the WPB. These authors suggested that the basin opened behind a subduction zone located along the East Mindanao-Samar Arc. *Seno and Maruyama* [1984], *Rangin et al.* [1990], and *Lee and Lawver* [1995] also suggested that the WPB is a back arc basin. However, in Seno's model, the basin would have opened behind a subduction zone located along the Palau-

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