Extinct spreading center of the Parece Vela Basin - a result of deep-tow magnetic survey

Kyoko OKINO, Chiori TAMURA, and Kensaku TAMAKI
okino@ori.u-tokyo.ac.jp, Ocean Research Institute, University of Tokyo
Hiromi FUJIMOTO
Tohoku University

Abstract. The Parece Vela Rift, a north-south trending chain of deep depressions, is the remnant spreading center of the Parece Vela Basin in the Philippine Sea. The rift is deeper than 6000 m and is highly segmented by prominent fracture zones. The results of our deep-tow magnetic survey show the intermediate-rate spreading in average and a possibility of asymmetric spreading at the terminal phase of the basin formation.

Introduction

The Shikoku and Parece Vela Basins are the extinct backarc basins occupying eastern half of the Philippine Sea. They were formed during late Oligocene and Middle Miocene behind the proto Izu-Bonin-Mariana arc-trench system. Two basins were developed as one backarc system in the later stage of the spreading. We can see the clear spreading fabric, and a sea mount chain along the axis of the Shikoku Basin and a chain of depressions at the Parece Vela Basin. Magnetic lineation pattern also presents an evolutionary history of these basins as follows; the earlier east-west spreading from 26 Ma to 20/19 Ma, and the later northeast-southwest spreading. The spreading ceased at around 15 Ma in the Shikoku Basin. Detailed reconstruction was carried out in the Shikoku Basin, however the precise history of the Parece Vela Basin is still questionable, because of its weak and complicated magnetic anomaly and lack of age dating of basement rocks.

The Parece Vela Rift, the remnant spreading center of the Parece Vela Basin, shows very deep (>6000m) rift valley, which may indicate an amagmatic extension was dominant in the terminal phase of the basin formation (Fig. 1). The spreading axis is highly segmented and the off-axis basin floor is characterized by prominent fracture zones and the perpendicular spreading fabric. A unique corrugated seafloor like the mega-mullion structure in the MAR is observed near the axis (Ohara et al., in press). In order to obtain precise opening history and the phenomena in the terminal phase of the backarc spreading, two surveys were conducted by Japanese research ships. Our fist survey was across the Parece Vela Rift by using surface-tow proton magnetometer and SeaBeam (Fig. 1, thin line). Then, based on the results of this survey, we carried out the deep-tow magnetometer survey along two parts of the surface-tow survey line (Fig.1, thick lines).

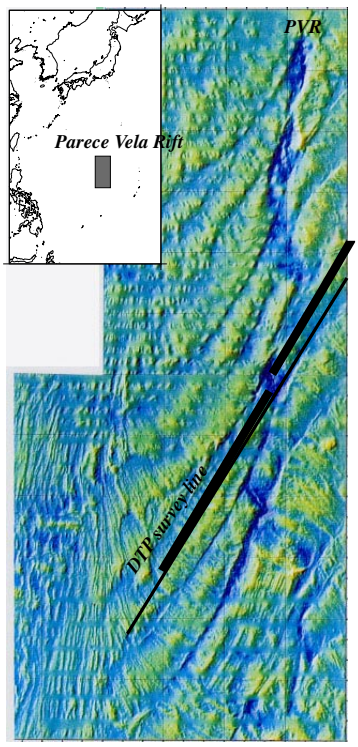

Figure 1 Bathymetry of the Parece Vela Rift (Modified Ohara et al., in press). Thick and Thin line indicate deep-tow and surface-tow magnetic survey lines, respectively.

Survey Results

The SeaBeam bathymetry shows clear normal spreading fabric, however there is a domed topographic high just west of the rift. And we can also recognize the corrugation not parallel to the spreading fabric on the top of the dome. It may be similar to the mullion structure, the exposed lower crust, reported in the Mid-Atlantic Ridge slow spreading center. We also obtained a long magnetic

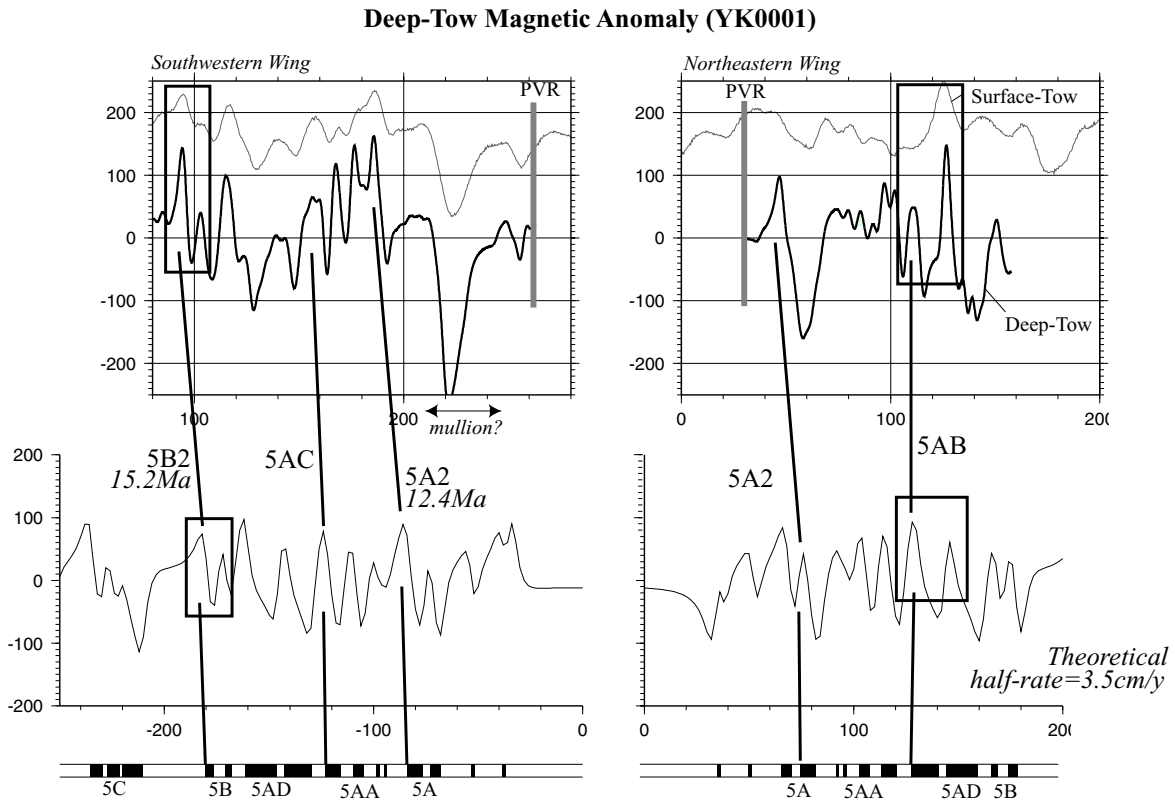

Figure 2 (Top) Results of deep and surface-tow magnetic anomaly survey and their interpretation. (Bottom) Theoretical magnetic anomaly pattern from at spreading rate of 3.5 cm/y (half-rate).

anomaly profile across the PVR. In the southwestern wing, we can tentatively identify the peaks as 5D to 5A, though we could not label these small peaks completely. On the other hand, the northeastern wing is not so clear partly due to the obliquity of the survey line.

In order to obtain perfect match of the small anomaly peaks for both wings, we conducted the deep-tow magnetic survey along almost the same line of the surface-tow survey line. The towing depth is not enough, but we can obtain larger amplitude profiles with shorter wavelength anomaly (Fig. 2). In southwestern wing, we can distinguish 5B1 from 5B2, which could not be recognized in the surface profile. And 5 peaks of Chron 5AD to 5A2 are confirmed. 5A1 is 12.4 Ma. In the same way, we identify Anomalies 5AD to 5A2 in the northeastern wing. Spreading half-rate 3.5 cm/y showed best fit. In the east, the youngest anomaly is 5A2; on the other hand, we observe a couple of peaks younger than 5A2 just west of the rift. The pattern of profile seems different from those in other part and it maybe due to the character of the magnetized body of the domed mullion like structure.

Discussion and Conclusion

Based on surface and deep-tow magnetometer measurements, geomagnetic polarity Chron 5D to 5A2 are identified in the central part of the Parece Vela Basin. It corresponds to 18.2 to 12.4 Ma (Cande and Kent, 1995). It is much younger than previously considered, for the spreading stopped at 14.8 Ma in the Shikoku Basin. And it may imply the different age of final shutdown of the Shikoku - Parece Vela spreading system. Spreading rate of the terminal phase after 15 Ma, is estimated as 7 cm/y, an intermediate-spreading rate. The asymmetry of anomaly pattern near the rift valley indicates that the southwestern wing continues extension after 12 Ma. It supports the idea of mullion structure, which is asymmetric extension of the rift. The mullion structure is interpreted as an exposure of the footwall along a large detachment fault in the slow-spreading center (Tucholke and Lin, 1994), however the mechanism of asymmetric opening at intermediate-rate spreading center has remained to be solved.