Survey Maps Philippine Sea Structures

Detailed structural images of two basins in the Philippine Sea and related data collected by the Japanese *Continental Shelf Surveys Project* are increasing our understanding of how back-arc basins evolve. The area surveyed covers the southeastern East China Sea, the northern Philippine Sea, and the westernmost Northwest Pacific Basin (Figure 1). One purpose of the survey is to gather information to help define Japan's legal continental shelf in the context of the *United Nations Convention on the Law of the Sea,* which became effective in 1994.

Data collected during the project were used to produce a series of maps, the Basic Maps of the Sea in Continental Shelf Areas, which are at a scale of 1/1,000,000 of bathymetry, submarine structure, total magnetic intensity anomaly, and free-air gravity anomaly. Three map sets encompassing major tectonic elements in the Philippine Sea and the Northwest Pacific Basin have been released. Since 1983, the project has acquired narrow multibeam echo sounder *SeaBeam* and *SeaBeam 210* swath bathymetry, single- and 24-channel seismic reflection, magnetic and gravity data, and dredged basement rocks from the survey vessel *Takuyo,* with ship tracks spaced at 9 to 11 km intervals.

The Shikoku and the Parece Vela (Okinotorishima Basin in Japanese charts) basins are inactive back-arc basins that formed to the west of the currently active Izu-Ogasawara/ Mariana arc (Figures 1 and 2a) and are characterized by clear bathymetric fabric that is closely related to spreading processes that formed them.

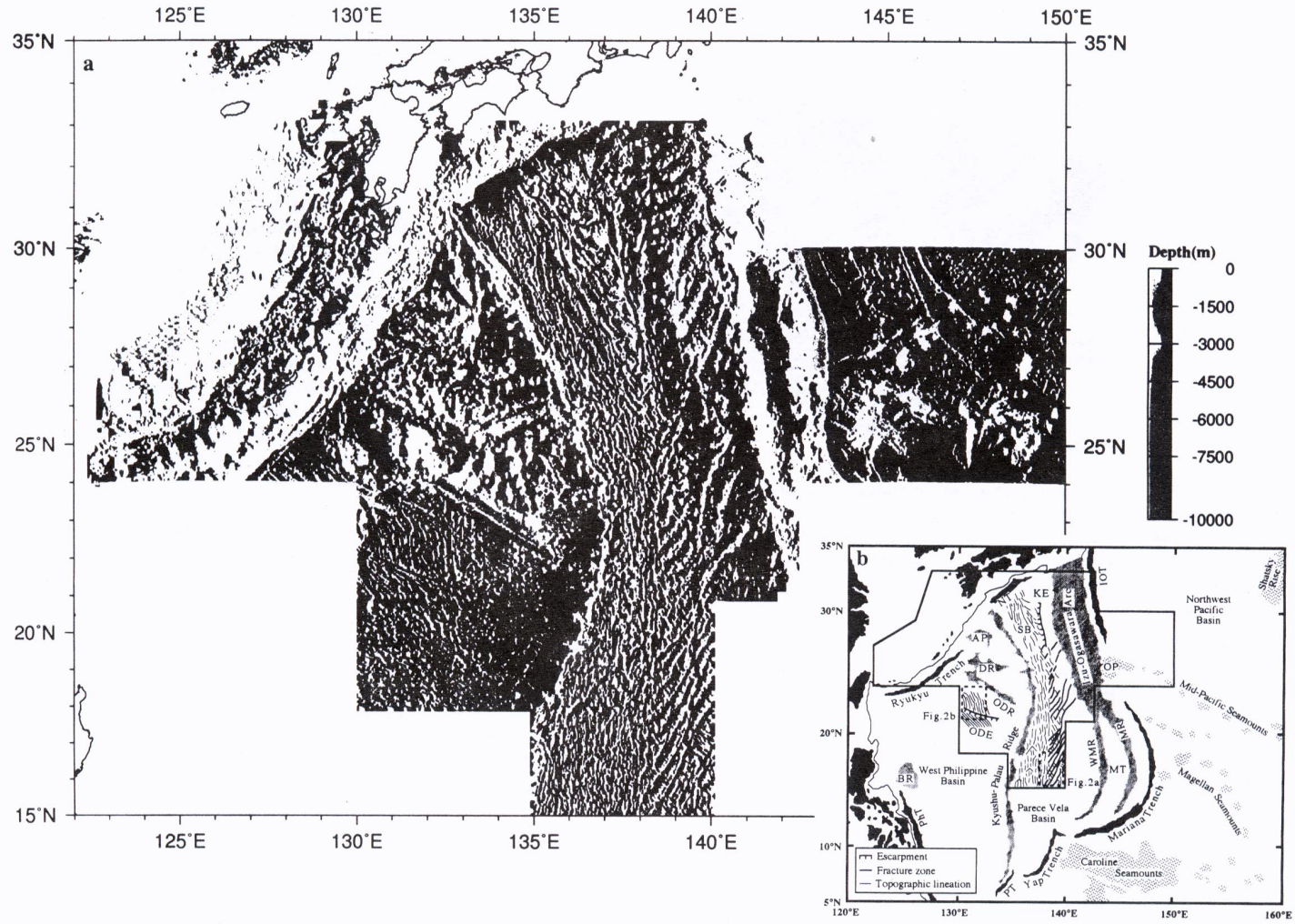

Fig. 1. a) Shaded image of bathymetry, which the Japanese Continental Shelf Surveys Project surveyed from 1983 to 1996. Note the north-south trending fabric in the western and the northeast-southwest trending en-echelon fracture zones in the central Shikoku/Parece Vela Basin (see Fig. 2a); b) Major bathymetric elements in the Western Pacific. The polygonal box shows the surveyed area of Fig. 1a. The smaller boxes indicated by dashed lines show the locations of Figs. 2a and 2b. The major structural domains in the Shikoku/Parece Vela Basin and the West Philippine Basin deduced from bathymetric imagery are shown. IOT=Izu-Ogasawara Trench, PT=Palau Trench, PhT=Philippine Trench, NT=Nankai Trough, AP=Amami Plateau, DR=Daito Ridge, ODR=Oki-Daito Ridge, BR=Benham Rise, WMR=West Mariana Ridge, MR=Mariana Ridge, OP=Ogasawara Plateau, SB=Shikoku Basin, MT=Mariana Trough, KE=Kinan Escarpment, ODE=Oki-Daito Escarpment.

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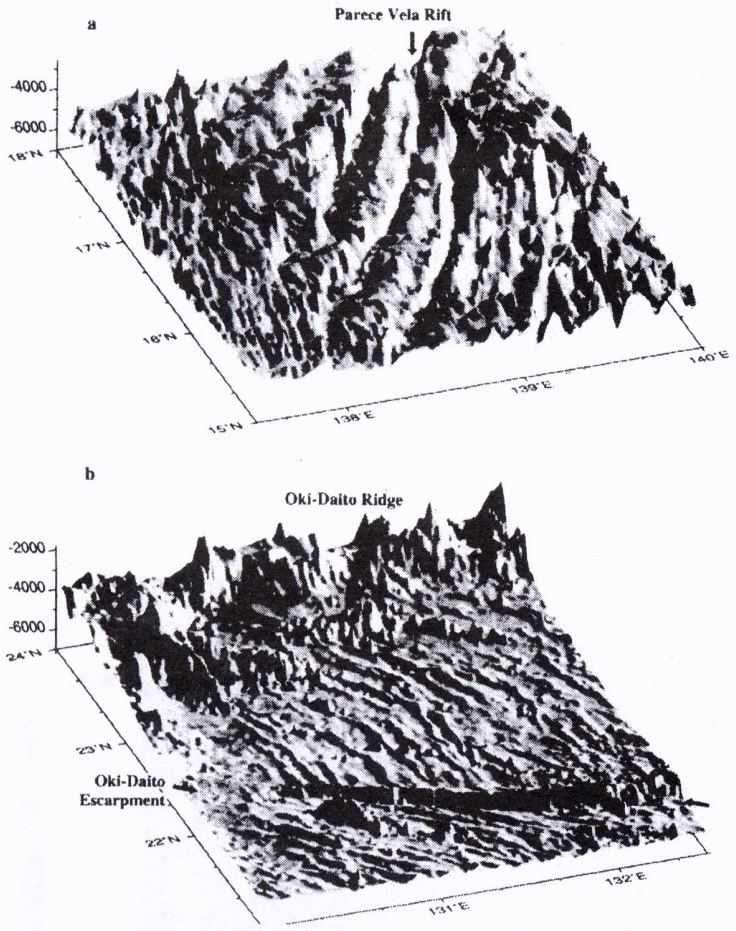

Fig. 2. a) Three-dimensional bathymetric image of the central Parece Vela Basin. North-south trending bathymetric fabric in the western part and northwest-southeast trending fabric gradually change direction counterclockwise toward the axis in the central Parece Vela Basin (see Fig. 1a); b) Three-dimensional bathymetric image of the vicinity of the Oki-Daito Escarpment. Note that the bathymetric fabric in the West Philippine Basin floor changes direction against the escarpment (see Fig. 1a).

The central Shikoku Basin features en-echelon spreading axes with S-shaped transform faults cutting magnetic lineations. The central Parece Vela Basin is characterized by a north-south trending chain of right-stepping en-echelon depressions (Figure 2a), which are diamond-shaped and bordered by steep, 1000 to 1500 m escarpments extending northeast-southwest from the depressions into the surrounding basin floor and then gradually fading out (Figures 1 and 2a).

We believe that these S-shaped escarpments and the depressions are the bathymetric expressions of S-shaped transform faults or fracture zones and extinct spreading axes, respectively. The spreading history of the Parece Vela Basin consisted of two stages, the first of which was east-west spreading with spreading axes trending north-south. The second stage involved counterclockwise rotation of spreading axes from north-south to northwest-southeast. The S-shaped escarpments of transform faults formed as the spreading axes rotated and became segmented. This spreading model of the Parece Vela Basin is quite similar to that of the Shikoku Basin.

Bathymetric fabric and magnetic lineations in both basins show a progressive asymmetric fanning, which characterizes a rotation of spreading axes, which became segmented in both basins and gradually rotated after spreading rates decreased in later phases of basin evolution.

Our data show that the eastern margin of the Shikoku Basin is marked by the steep 500 to 800 m Kinan Escarpment, which extends north-south for about 500 km along the eastern Shikoku Basin (Figure 1).

A large west-northwest–east-southeast trending escarpment, tentatively named the Oki-Daito Escarpment, roughly parallels the Oki-Daito Ridge in the northern West Philippine Basin (Philippine Basin in Japanese charts, Figures 1 and 2b). Maximum relief is about 1000 m. Bathymetric fabric in the basin changes abruptly against the escarpment; the trend is nearly north-south in the north and northwest-southeast in the south. The Kinan Escarpment could be a large normal fault formed by post-spreading deformation of Shikoku Basin lithosphere along the mechanical boundary between the active "buoyant" island arc (Izu-Ogasawara arc) and the inactive "isostatically sinking" back-arc basin (Shikoku Basin). The Oki-Daito Escarpment could have formed similarly.

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