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Geotectonic Framework of Japanese Convergent Margin

A synthesis of recent marine geophysical and geologic investigations around Japan uses data obtained by the Ocean Research Institute of the University of Tokyo (including the Japan-France KAIKO Project), the Hydrographic Office and Geological Survey of Japan, and the Japan National Oil Company. This work reveals the contrasting characteristics of forearc and back-arc morphotectonics around Japanese subduction zones. From the north, the following features can be summarized.

The Kuril Trench off Hokkaido shows a pile of trench deposits as much as 2-sec two-way traveltime in thickness. Despite this thickness, there is little evidence of deformation related to the accretionary processes. We propose that subduction of the thick trench fill is occurring at this boundary.

The Japan Trench is characterized by massive slumping processes and debris accumulation at the toe of the overriding plate. The Dai-ichi Kashima seamount at the trench has been broken in half by normal faulting related to bending of the oceanic lithosphere into the subduction zone. Forearc subsidence is also evident on various profiles. We believe that the inner wall of the Japan Trench has been eroded tectonically at least from the Miocene to the Pliocene.

Three plates interacting at the trench triple junction (Japan, Sagami, and Ogasawara Trenches) created a complex framework of convergent margin tectonics, including highly oblique convergence, forearc sliver collision, and pull-apart basin.

The conspicuous features observed in the Izu-Bonin arc are forearc ophiolite (serpentinite diapir) and back-arc rifting close to the volcanic arc. As a result of intraplate shortening related to the Izu-Bonin arc collision against Honshu, the Shikoku basin oceanic crust was ruptured and uplifted, forming a high called the Zenisu Ridge. The Nankai Trough has been filled by turbidites transported through the Suruga Trough area from the Izu collision zone. The trench fill is being offscraped and accreted to the landward side. A series of forearc depressions developed along the Nankai Trough is the consequence of east-west contraction resulting from northeast and southwest Honshu collision at the Fossa Magna.

The Japan Sea is composed of three sedimentary basins that are underlain by oceanic crust and many topographic highs of continental fragments. A rapid rotation of the Japanese arc at 15 Ma created this back-arc basin, which probably is now being consumed at the northeast Japan margin with development of a new subduction boundary.

The Ryukyu Trench is morphologically similar to the Japan Trench. The forearc basin along the Ryukyu arc shows a contrasting style of development: normal compression to the north versus oblique convergence to the south divided by the Miyako depression. The back-arc basin of the Ryukyu arc, Okinawa Trough, is the rare example of ongoing back-arc continental rifting. The north-south extension has started since the late Miocene.