

Eocene rifting in the northern Ryukyu arc triggered by ridge subduction: Insights from the geology of the Amakusa region

Kentaro Ushimaru

The eastern margin of the Eurasian plate experienced extensive rifting during the early Paleogene. In this period, many grabens were filled with kilometers-thick Eocene formations in the East China Sea. The timing of the rift initiation is loosely constrained to be Early or early Middle Eocene, which coincided with the Izanagi--Pacific ridge subduction.

However, the temporal relationship between the rifting and the ridge subduction is unclear due to poor age constraints from basal deposits in the rift basins. Consequently, the two events have been discussed separately, despite their temporal and spatial proximity.

A clue to this problem is provided by the Eocene formations in the Amakusa region, northern Ryukyu arc. While a Paleogene graben has been found offshore west of the region, age constraints for this structure are weak. In contrast, the depositional ages of the Eocene formations onshore in the Amakusa region are well-constrained, thus the timing of rift initiation may be discernible. The large thickness of the Eocene ones requires syn-depositional tectonic subsidence, but no geologic structure related to the tectonics has been identified.

To reveal the Eocene tectonics in the Amakusa region, a geological map of northwestern Shimoshima Island was made in this study. As a result, the oldest structure observed in the Eocene formations was found to be normal faults. There were high- and low-angle normal faults affected by younger faulting and folding in the Miocene. Those normal faults commonly had N-S to NW-SE transport direction, with a maximum displacement of 1000 m. One of the low-angle normal faults was inferred to be older than folding because the estimated fault plane becomes a listric normal fault when unfolded.

This study presents a tectonic model in which the Eocene formations in the Amakusa region were deposited in a large half graben. This model is supported by the oldest normal faults cutting the Eocene formations, the SE-ward thickening trend of the formations, and the presence of an Eocene graben structure offshore west of the Amakusa region. The main basin margin fault with a NE-SW trend is inferred to lie southeast of the Amakusa region. This half graben can be regarded as a northeastern branch of the rift basins in the East China Sea.

The timing of rift initiation in the Amakusa region is 50 Ma, which coincides with the Izanagi--Pacific ridge subduction. Subduction of a spreading ridge which is parallel to the trench causes a rapid decrease in the convergence rate of plates. As a result, the horizontal compression on the overriding plate weakened enough to trigger the rifting in the eastern Eurasian margin.