Re-initiation of Subduction and Magmatic Responses in SW Japan during Neogene Time

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Southwestern (SW) Japan during Paleogene time was affected by subduction of the Kula and Pacific plates beneath the eastern margin of Eurasia, followed by a brief episode of transform faulting to allow the Shikoku Basin to open at 27-15 Ma. Subsequent opening of the Japan Sea backarc basin in middle Miocene time broke Japan away from Eurasia and SW Japan rotated clockwise about 45 degrees as it drifted south (17-15 Ma). Southward drift required subduction of the Philippine Sea Plate beneath SW Japan, leading to the formation of a magmatic arc. Subduction of the hot Shikoku Basin lithosphere and spreading ridge resulted in distinctive volcanism in the SW Japan forearc between 17 and 12 Ma. This volcanism included MORB-like intrusions and OIB-type alkali basalts, felsic plutons in the accretionary prism, and high-magnesium andesites along the Setouchi forearc basin. Mafic magmas in the outermost forearc originated from the subducted Shikoku Basin spreading ridge, whereas Setouchi high-magnesium andesites (HMA) may have resulted from the interaction of melts of the subducted Philippine Sea Plate with the overlying mantle. Felsic magmas in the forearc resulted from melting of Shimanto Belt sediments caused by intrusion of HMA magmas. Persistent rear-arc volcanism was caused by upwelling asthenosphere associated with opening of the Sea of Japan. Rear-arc volcanism began about 25 Ma as rift-fill low alkali tholeiite volcanism, and was replaced gradually after 12 Ma by alkali basalt volcanism. Upwelling-related alkali volcanism continues up to the present, whereas forearc volcanism ceased at 12 Ma. The volcanic arc narrowed with time as the Philippine Sea slab descended and slowly cooled. Adakitic dacites erupted after 1.7 Ma above the 100 km depth contour of the subducted Philippine Sea plate, suggesting that melting resulted from interaction of the slab with upwelling asthenosphere. Interactions between upwelled rear arc asthenosphere and subduction of the hot Philippine Sea slab appear to have been the main controls of magmatism for the Neogene SW Japan arc.