

Western Pacific carbonate platforms: Sunken atolls vs. carbonate banks

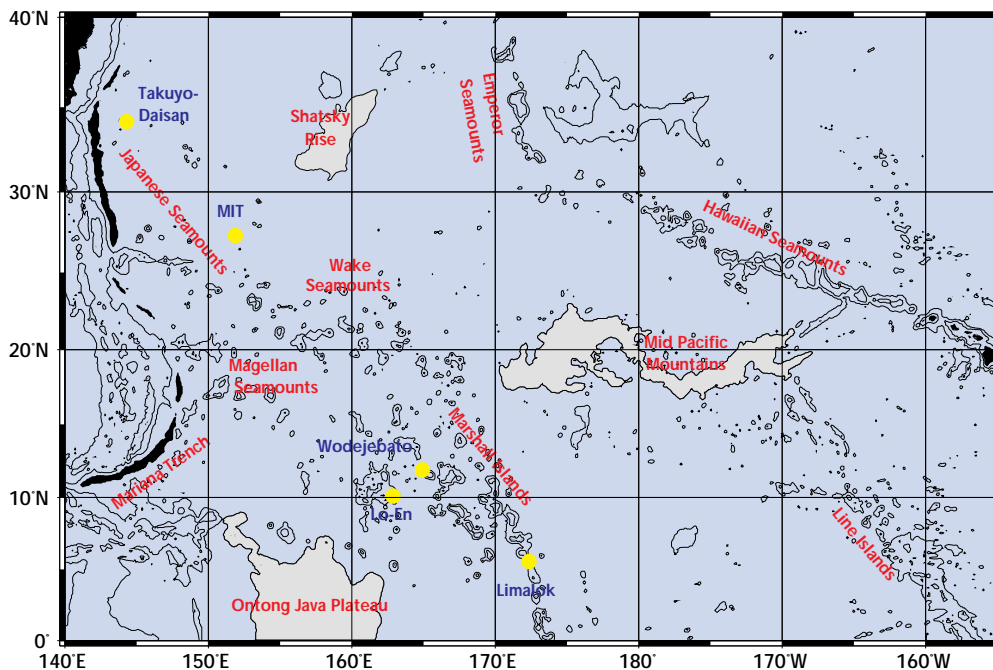
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Darwin's voyage on the *Beagle* led him to propose Pacific atoll formation as a sequence of steps initiated with a tropical volcanic island. Since the 1950's, bathymetric surveying and dredging of limestone from some of the Pacific flat-topped seamounts, called guyots, suggested that these sunken carbonate platforms are former atolls.

ODP Leg 144 drilled five guyots along a transect from the Marshall Islands to the Japanese Seamount Province (see figure). Paleomagnetic results indicate that the volcanic edifices were constructed in the tropics, between 30°S and 10°S. A pulse of volcanism during Barremian-Albian time constructed MIT and Takuyo-Daisan edifices and the pedestals of Lo-En and Wodejebato guyots, and was widespread in abyssal locations. A second pulse of volcanism, during the Santonian-Campanian, created emergent islands in the northern Marshall Islands and the Line Islands. Eruptions during the younger portion of this second episode formed some of the southern Marshall Islands chain, including Limalok Guyot. Independent of the age of formation, these volcanic islands typically became vegetated, developed soils, forests, and a shallow-water carbonate community. Two to seven million years after island formation, the edifice was flooded and a carbonate platform began.

Shoals were abundant; some guyots had periplatform ridges built from shoals and thin bioherms, composed of Cretaceous rudist-algal-coral boundstones. Platform communities terminated either in the Albian, late Maastrichtian, or middle Eocene. Northward motion of the Pacific plate carried these platforms into the zone of equatorial upwelling, possibly inhibiting carbonate production and enhancing bioerosion, resulting in the demise of the platform.

The carbonate platforms drilled during ODP Leg 144, lacked facies resembling a coral-algal reef framework surrounding a lagoon, typical of modern atolls. Instead, these ancient platforms had abundant loose carbonate sediment in shoals. Modern Pacific atolls are an inadequate analog for these ancient Pacific platforms; these Cretaceous and Eocene platforms are more similar to the modern Bahamian banks. Gross morphology does not always indicate genesis. Multiple depositional models can explain carbonate platform morphology. Although these ancient Pacific platforms have gross morphologies and geologic histories similar to the classic Darwin model of atoll growth and subsidence, they were constructed by organisms that produced depositional facies that built banks rather than atolls.



Location of guyots drilled during ODP Leg 144.