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Tectonics of the Western Indian Ocean

The tectonic province of the Western Indian Ocean is defined by the East Africa Rift Zone to the west and by the Ninety-East Ridge to the east. The northern boundary is the Arabian Peninsula and the southern limit is represented by the southern Indian Ocean spread center. The topography-bathymetry is dominated by the triple-junction Indian Ocean spread center and the mantle plume extrusions forming the Laccadives-Maldives-Chagos and Mascarene Plateau-Mauritius-Reunion chains of volcanic archipelagos and islands, and the mantle plume extrusion of the Ninety-East Ridge.

Initial breakup of ancestral Gondwana, sea floor spreading and appearance of oceanic crust was preceded by continental sag and development of the Late Carboniferous-Early Jurassic Karoo basins. The first oceanic crust appeared in the Middle Jurassic as the Africa-Arabia plate moved northward relative to the India-Seychelles-Madagascar-Australia-Antarctica plate. The north-south separation continued through the Neocomian.

A major jump in the spread center occurred in earliest Barremian with Antarctica-Australia separating from India-Seychelles-Madagascar. Madagascar began to move away from India-Seychelles via a transform fault along Madagascar's east coast. The trans-tensional transform evolved into a spread center during the Middle Cretaceous Barremian-Aptian-Albian as oceanic crust appeared. The mantle plume Rajmahal Traps first appeared in eastern India during the Aptian-Albian, and as the Indian plate continued to migrate northward, evolved into the Ninety-East Ridge.

The mantle plume-derived volcanic rocks of the Deccan Traps first appeared in western India near the Cretaceous-Tertiary boundary. The Seychelles began to separate from India in the early Paleocene. By the close of the Paleocene, a broad expanse of oceanic crust separated the Seychelles and western India. The mantle plume formed an extensive oceanic ridge that would become the Laccadives-Maldives-Mascarene Plateau. The ongoing spread center broke apart the oceanic ridge, beginning in the Eocene and continuing through the Oligocene. North of the spread center, mantle activity extended the Laccadives-Maldives to include the Oligocene-age Chagos Archipelago, while south of the spread center, the Mascarene Plateau basalts continued as the Saya de Malha and Nazareth Banks. Mantle plume extrusion continued to the south as the plate moved northward, creating Mauritius Island during the Miocene and Reunion Island during Pliocene-Recent.

In the northwest, Red Sea separation of Egypt from Arabia had begun during the Oligocene. Extension of the Indian Ocean spread center into the Gulf of Aden between Somalia and Yemen-Oman did not occur until the Miocene.

The East Africa Rift Zone began in the north in Ethiopia-Eritrea during the Early Miocene and has since extended southward through Uganda-Kenya-Tanzania-Mozambique into the southern Indian Ocean.