g24 Aulacogens < triple junctions, hotspots >

A rift valley is the most characteristic topographic feature of the boundary between divergent lithospheric plates. Tension in a direction at right angles to the incipient rift can result from plate pull or push, or both, and also from crustal up-arching. The deformation and fracture that results forms and drops a keystone, the upper surface of which is the floor of a rift valley.

Divergent plate boundaries occur as rifts within oceanic areas or traverse the land (for example, the Central Rift valley in Iceland, and the Great Rift Valley of Africa).

Volcanism associated with oceanic ridges is fissure eruption of plateau basalts. In the plate tectonics model, these lavas originate from decompression partial-melting of the asthenosphere that rises isostatically to fill between diverging lithospheric plates.

Figure g24.1 [1] The Ethiopian aulacogen formed during the Miocene splitting of African-Arabia supercontinent.

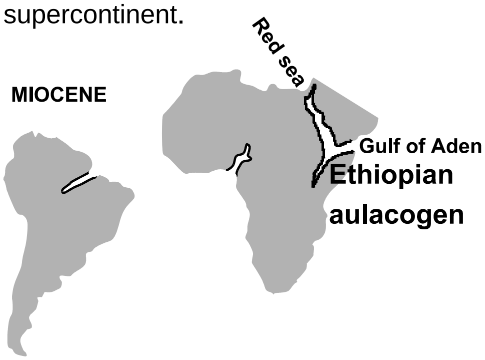
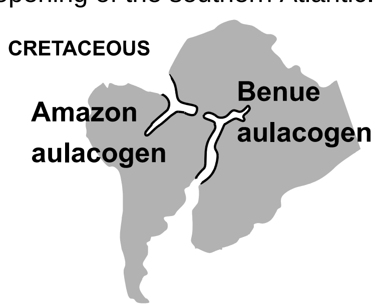


Figure g24.2 [1] The Amazon aulacogen and the Benue aulacogen formed during the Cretaceous opening of the southern Atlantic.



In some places, three plates diverge from a common point. This results in three rift valleys that radiate from a common point (a triple junction). Oceanic triple junctions are: Galápagos, Bouvet, Azores, and Rodriguez. Sometimes, in continental rifting, one branch of a triple junction deepens as a graben but does not separate enough to open a deep ocean. Such a “failed” third arm is called an *aulacogen* (originally described by Nikolaj Sergeevic Satskij (Schatsky) in 1945 as a “dead” branch of a paleooceanic rift system prograded into a craton that survives there as an intracontinental paleorift whereas a paleorift in young platforms is called a *taphrogen*).[2] By modern thought (*see* Topic *d9*), an aulacogen is a sediment-filled inactive rift of a triple junction that formed above a rising mantle plume (hotspot).[3]

An example of an existing, tectonically active, triple junction is one that centers on the Afar triangle (***Figure g24.1***). Two of its rift branches are the Gulf of Aden and the Red Sea each of which is opening as a deep ocean whereas its third branch through Jibuti (Djibouti), and which continues as the Great Rift Valley of Africa to the Lubombo flats in Swaziland, has not become oceanic.

Mantle plumes that led to the break-up of the Jurassic Gondwanaland continent are described by L. A. Lawver, L. M. Gahagan, and I. W. D. Dalziel. Still active is the Reunion hotspot that at 64 Ma split the Mascarene Plateau from India. The Marion plume at 88 Ma split Madagascar and India.[4]

Triple junctions that were associated with the beginning of the opening of the Atlantic ocean, could account for the Amazon Valley and the Benue Valley troughs (***Figure g24.2***). Those graben can be interpreted as aulacogens that had the potential to open further but failed to do so when the other branches widened to become the South Atlantic ocean. The Paraná-Etendeka plume at 132 Ma is implicated in this separation of South America and Africa.

The first of present-day continents to separate out of the Late Jurassic Gondwanaland continent (ending its existence) was Antarctica. The Karoo-Ferrar plume is implicate in the Early Cretaceous opening of the east coast of the Indian Ocean. Prior associated rifting had begun in the Early Jurassic 182 Ma as Laurasia and Gondwanaland continents came to be when the southern North Atlantic opened and linked transcurrent faulting split Pangea (ending its existence). Prior associated rifting had begun in Pangea in the late-Triassic. ❑