Similarities in asymmetrical, oceanic spreading: Iceland, South Atlantic, NE Gulf of Mexico, and Marianas backarc basin

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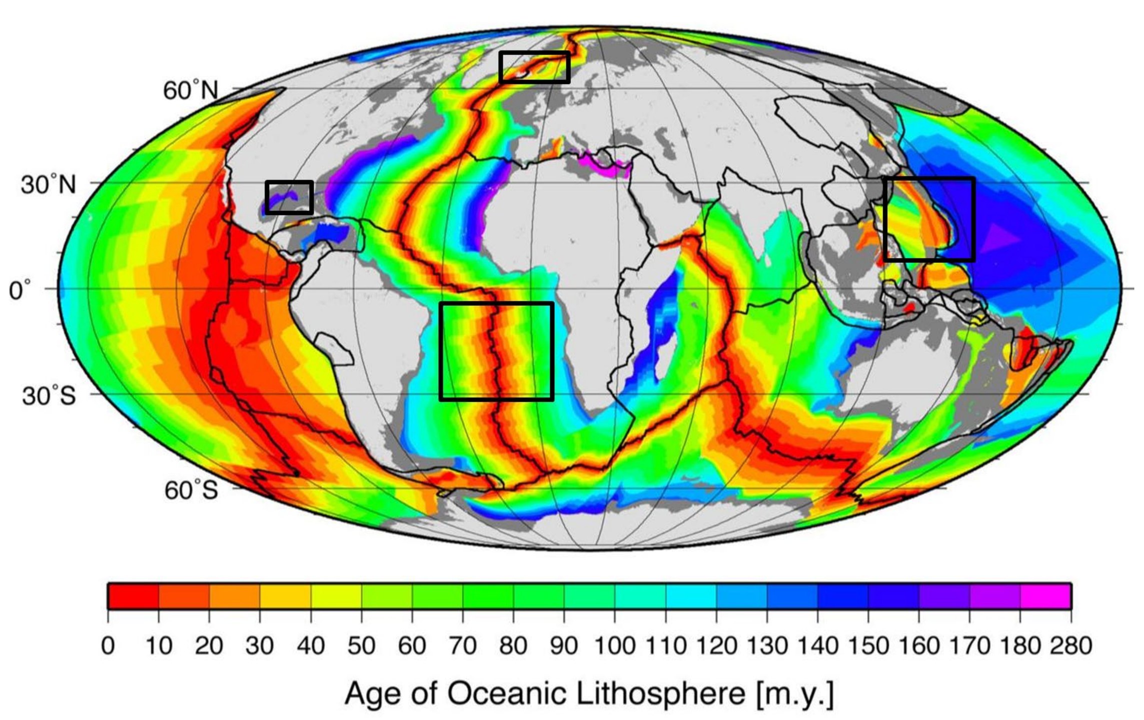
Abstract

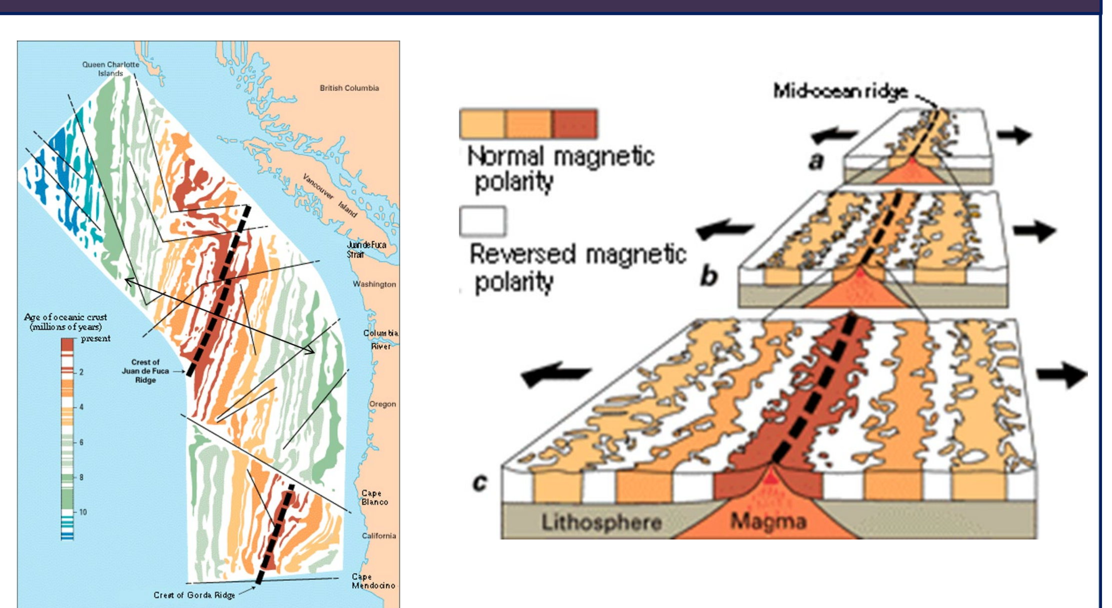
In the paradigm of plate tectonics, seafloor spreading is viewed as a perfectly symmetrical process - whereby equal areas of new oceanic crust are created on either side of a single, spreading ridge. Asymmetrical seafloor spreading - recorded by unequal areas of oceanic crust present in the North Atlantic, Gulf of Mexico, and South Atlantic- has been previously explained by three models: 1) the presence of multiple spreading ridges - formed by "ridge jumps" - would produce wider zones of oceanic crust on the side of the main spreading ridge with additional ridges; these earlier extinct ridges can be identified from maps of magnetic anomalies formed at the spreading ridges and from bathymetry; 2) the presence of hotspots are frequently associated with areas of asymmetrical spreading; where the wider zone of oceanic crust is found on the opposite side of the hotspot; and 3) for backarc basins one idea is that trenchward slab rollback provides a mechanism to explain asymmetry in a subduction setting. I use Gplates software to create reconstructions of the most asymmetrical areas of seafloor spreading in both continental breakup and subduction settings in order to better understand the role of nearby hotspots on the spreading ridge.

Areas of asymmetrical seafloor spreading



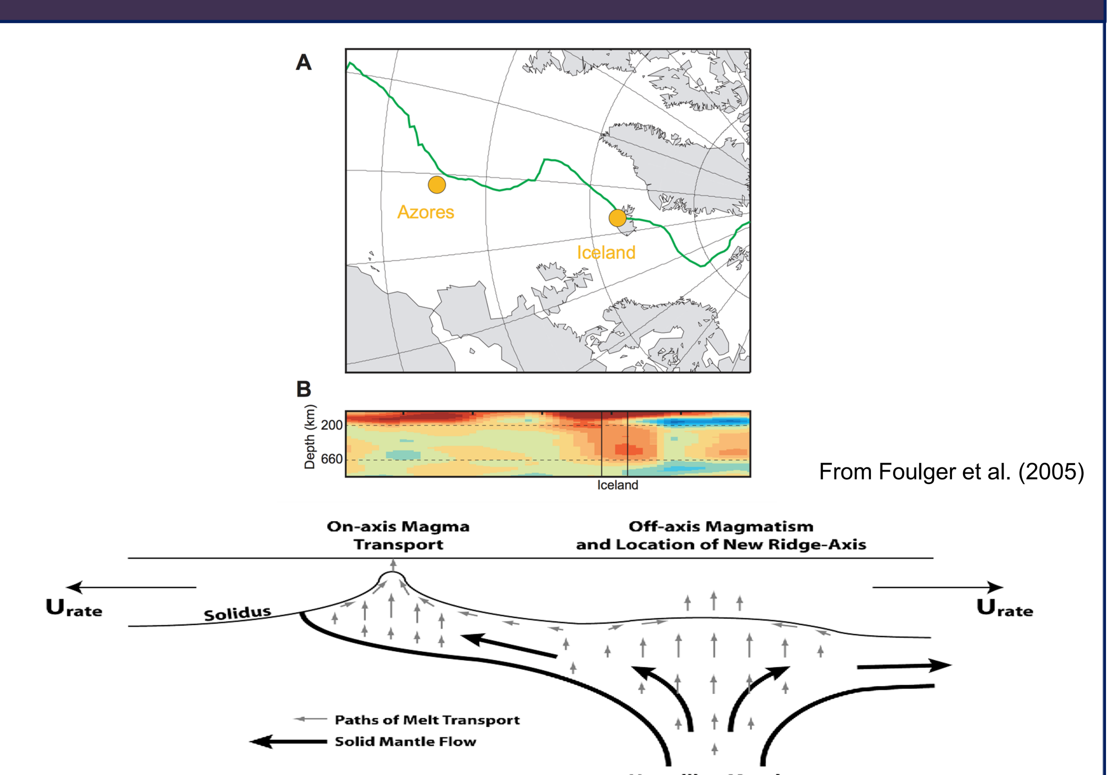
From Mueller et al. (2007)

Symmetrical spreading on the Juan de Fuca Ridge



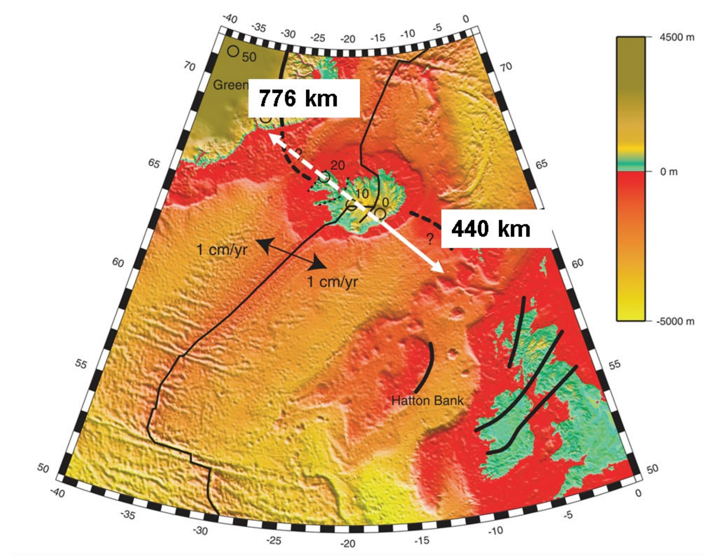
http://maps.unomaha.edu/Maher/plate/week2/seafloor.html

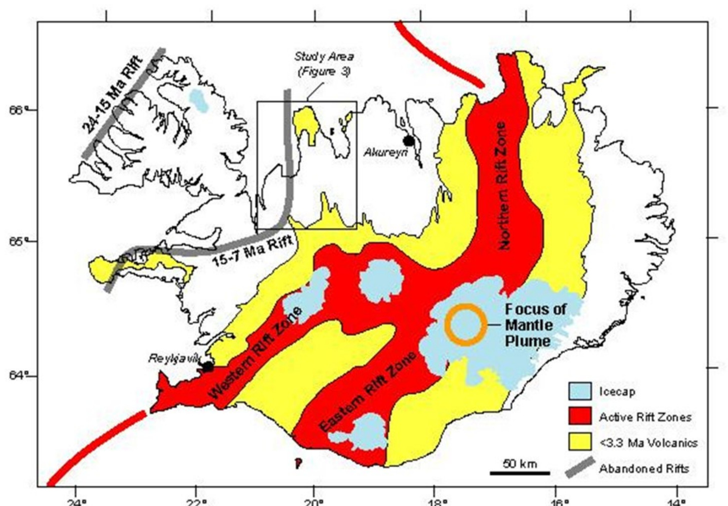
Hotspot model for asymmetrical spreading

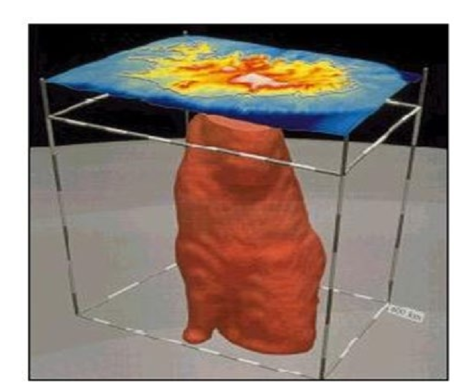


From Mittelstaedt et al. (2011)

Asymmetrical spreading related to the Iceland hotspot

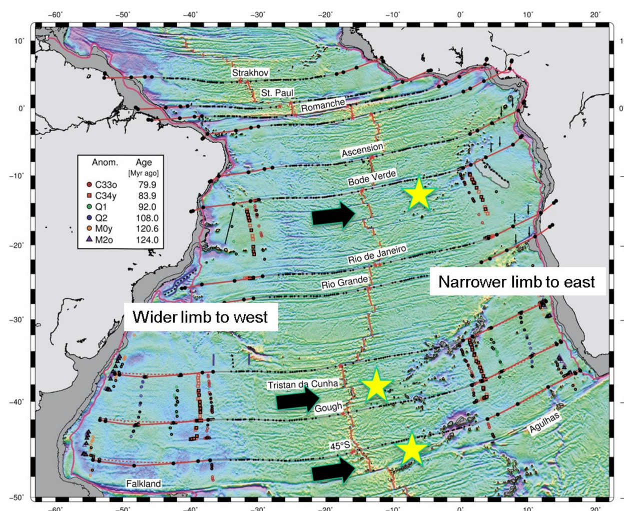




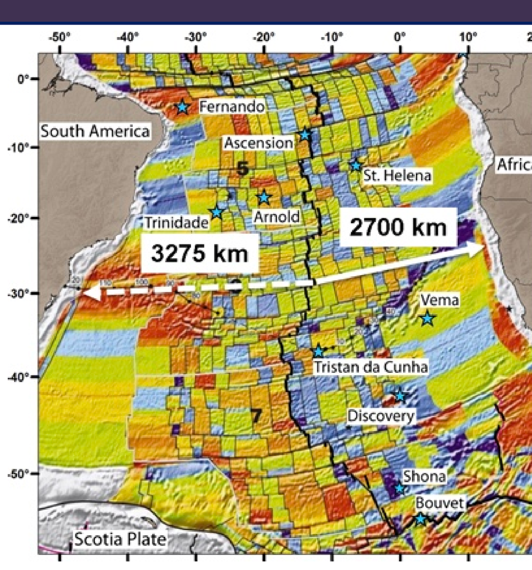


From Foulger et al. (2005)

Asymmetrical spreading in the South Atlantic

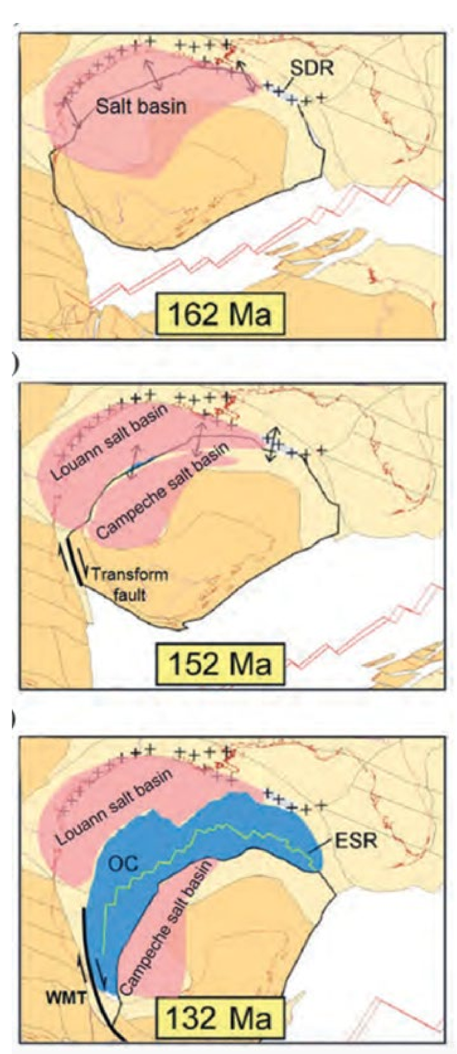


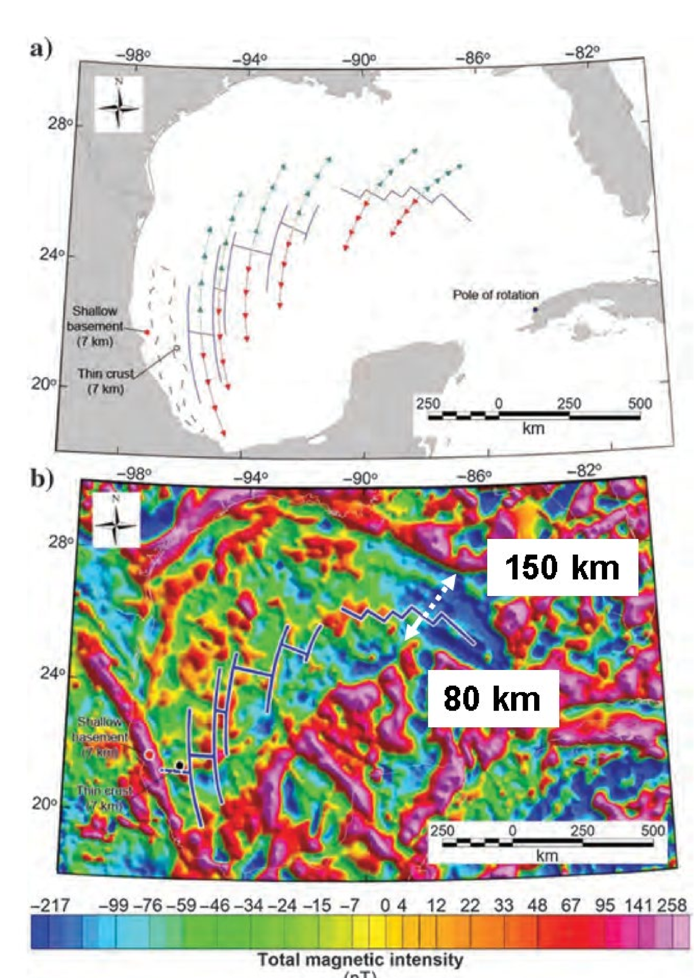
From Granot and Dyment (2015)



From Mueller et al. (1998)

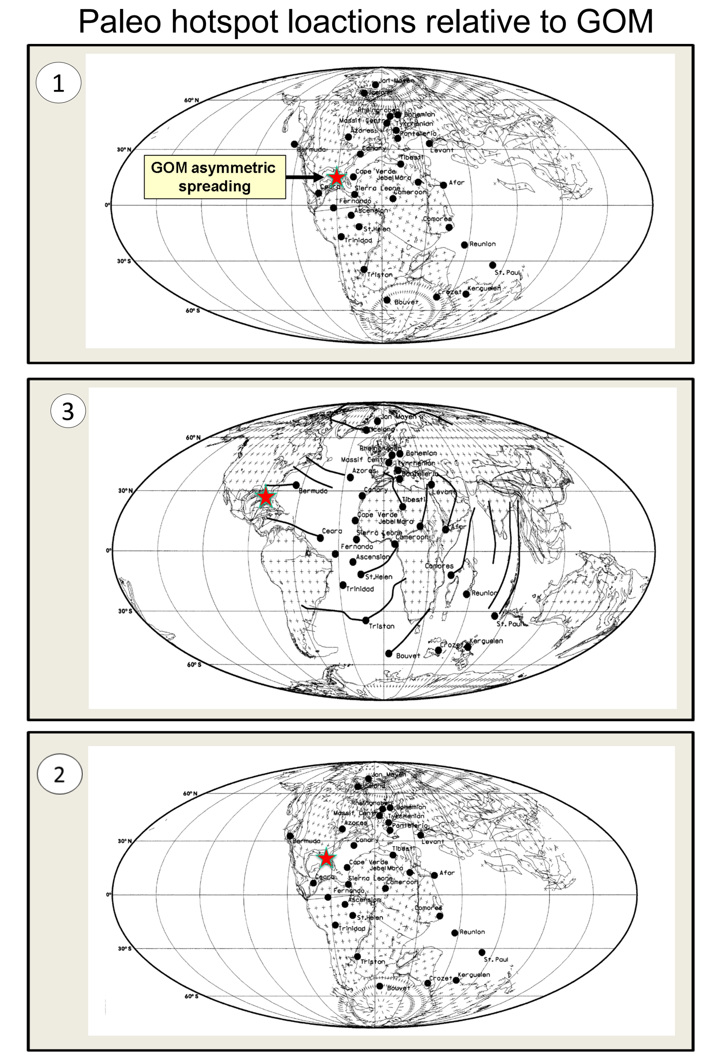
Asymmetrical spreading in the Gulf of Mexico region





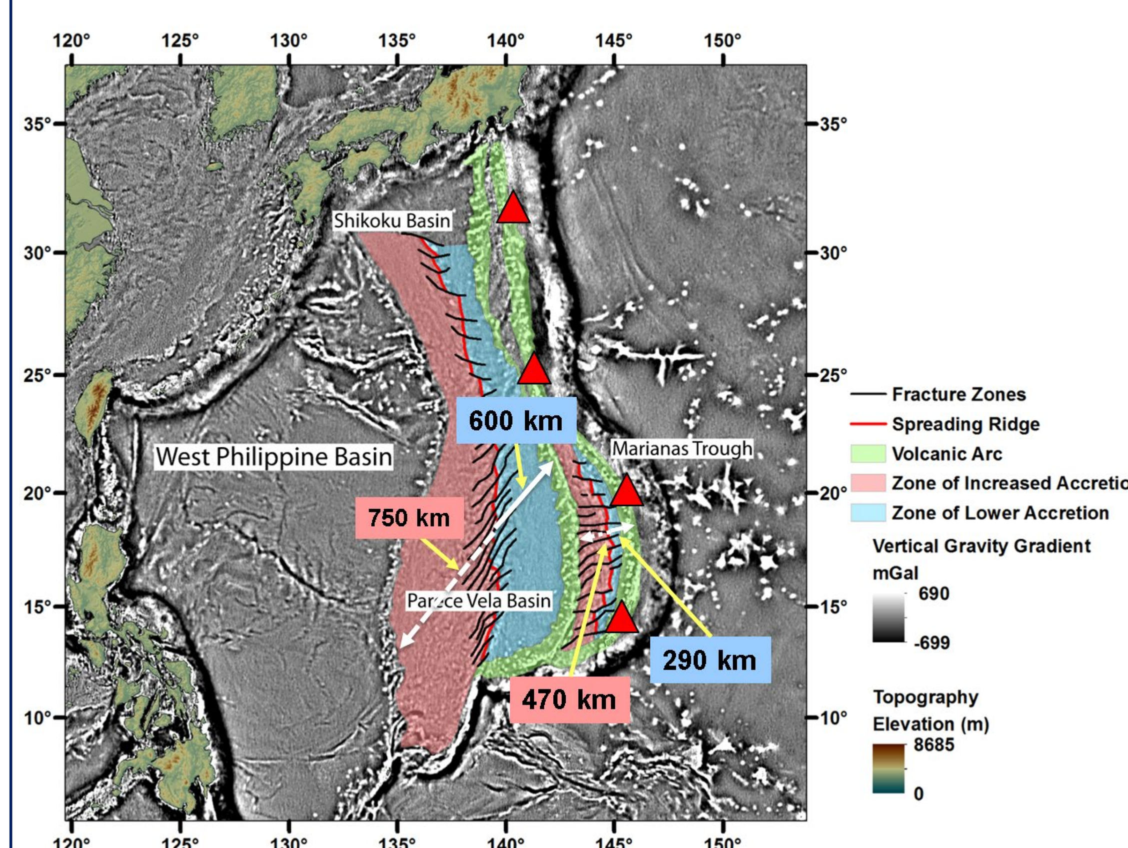
From Nguyen and Mann (2016)

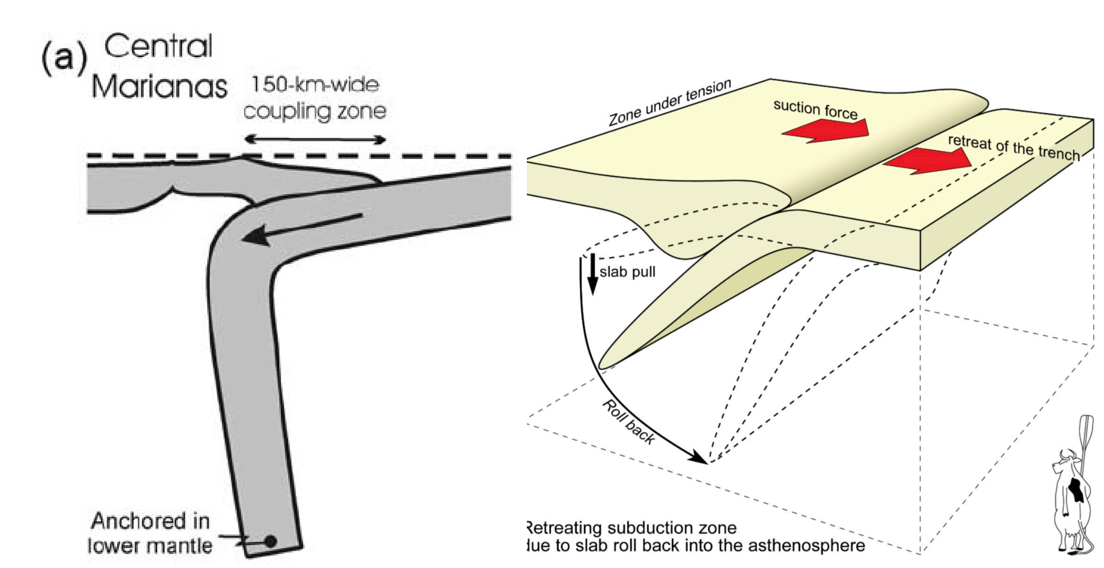
Paleo hotspot loactions relative to GOM



From Golonka and Bocharova (2000)

Asymmetric spreading in the Marianas backarc basin





From Givirtzman and Stern (2004)

Conclusion: Proximity of ridge to hotspot produces greater asymmetrical spreading