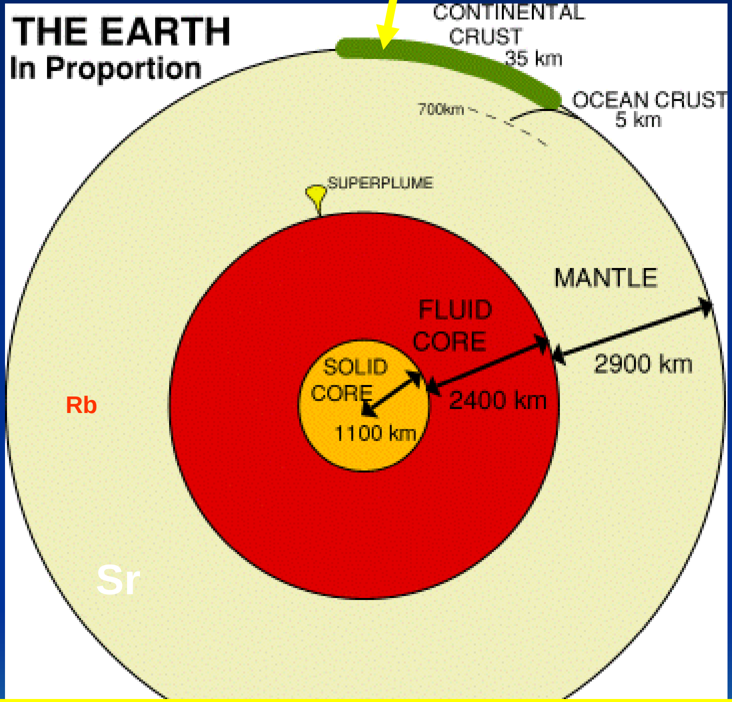
Isotope Geochemistry

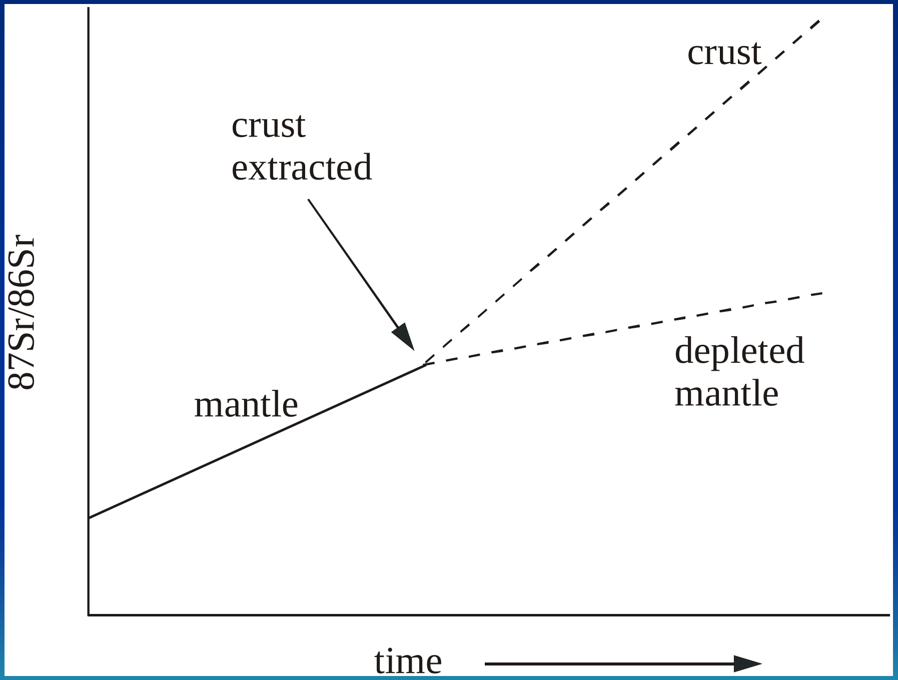
Sr isotopic evolution

Rb Sr

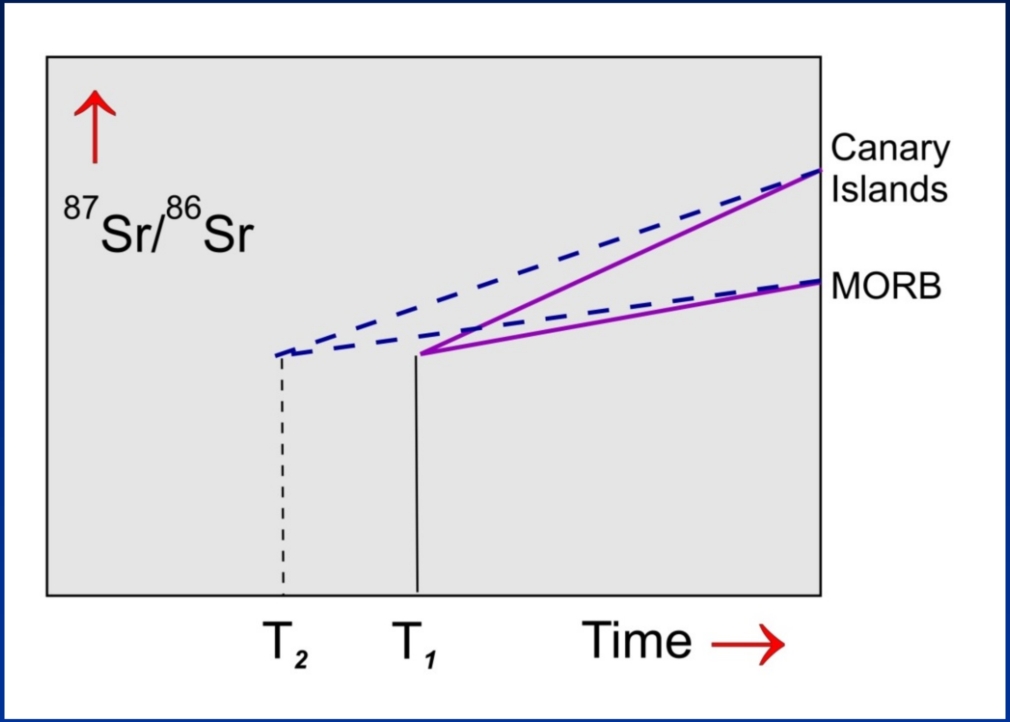


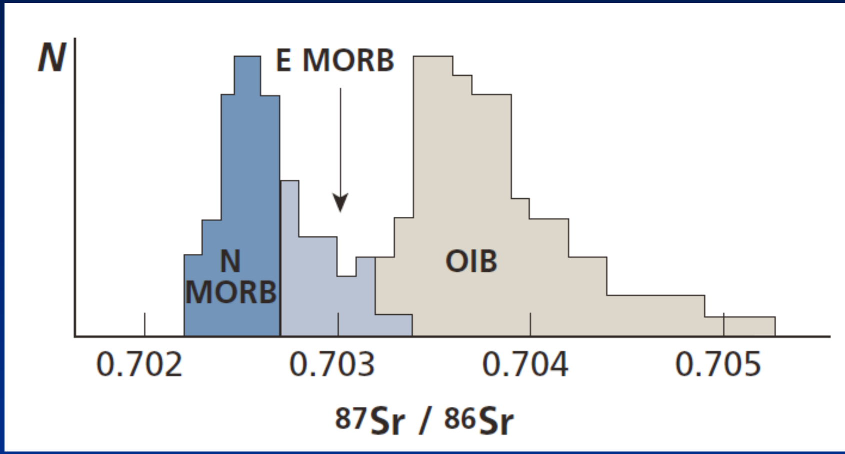
Continental crust: 32-78 ppm Rb, 260-333 ppm Sr
Depleted Mantle: 0.6 ppm Rb, 19.9 ppm Sr

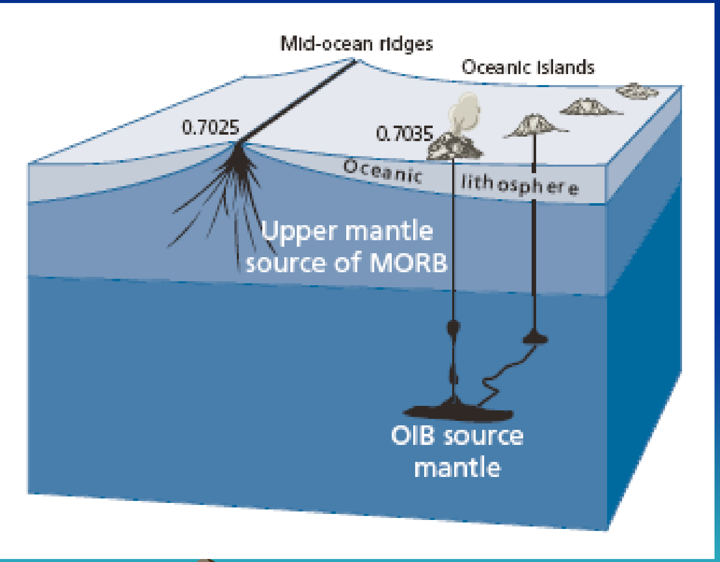
$^{87}Sr/^{86}Sr$ ratio of the crust higher than that of the mantle due to the preferential partitioning of Rb into the crust relative to Sr



“Prehistoric” evolution of MORB and OIB



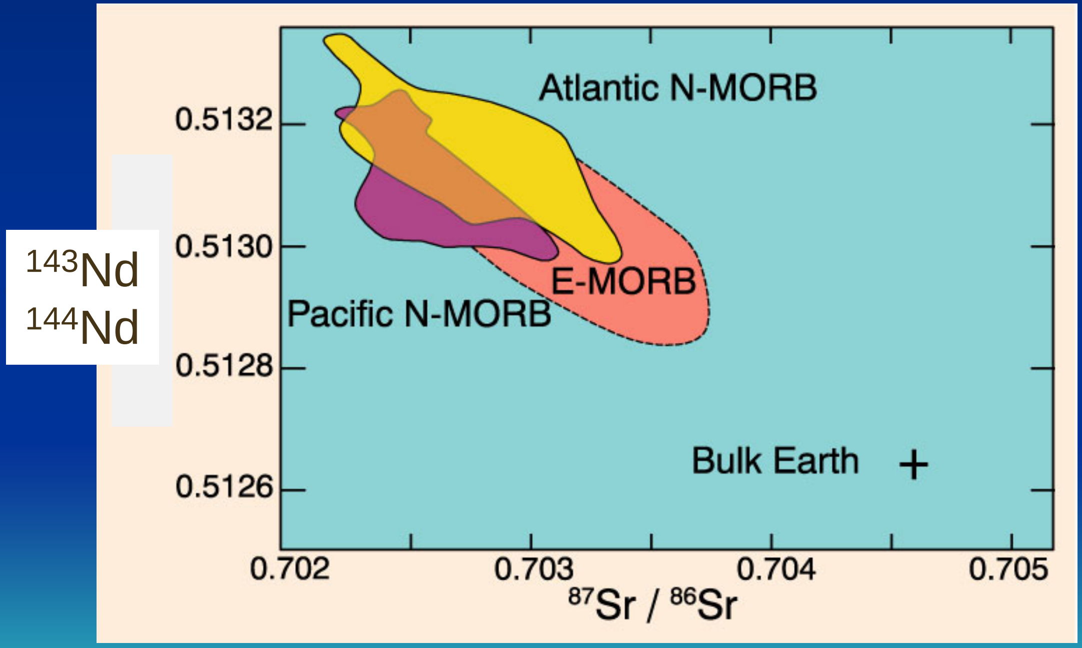




Allègre (2008)

Isotope Geochemistry

- N-MORBs: $^{87}Sr/^{86}Sr < 0.7035$ and $^{143}Nd/^{144}Nd > 0.5130$, → depleted mantle source
- E-MORBs extend to more enriched values



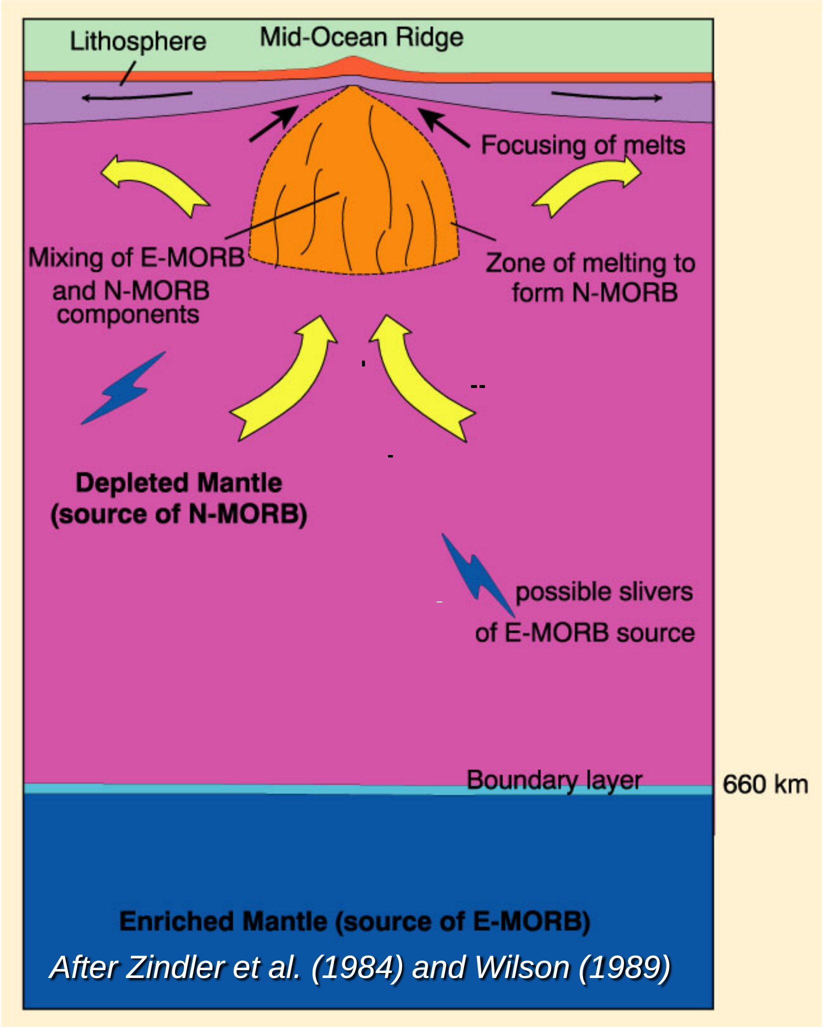
Data from Ito et al. (1987) and LeRoex et al. (1983)

MORB Petrogenesis

Generation

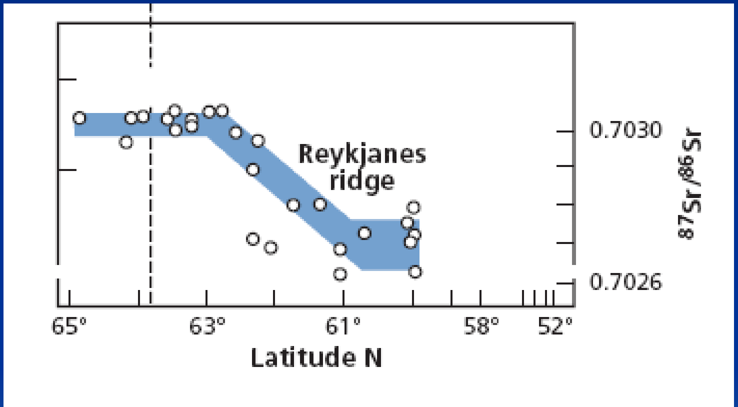
- Region of melting is probably ~ 100 km wide, but is focused into the 3-8 km wide zone beneath the ridges

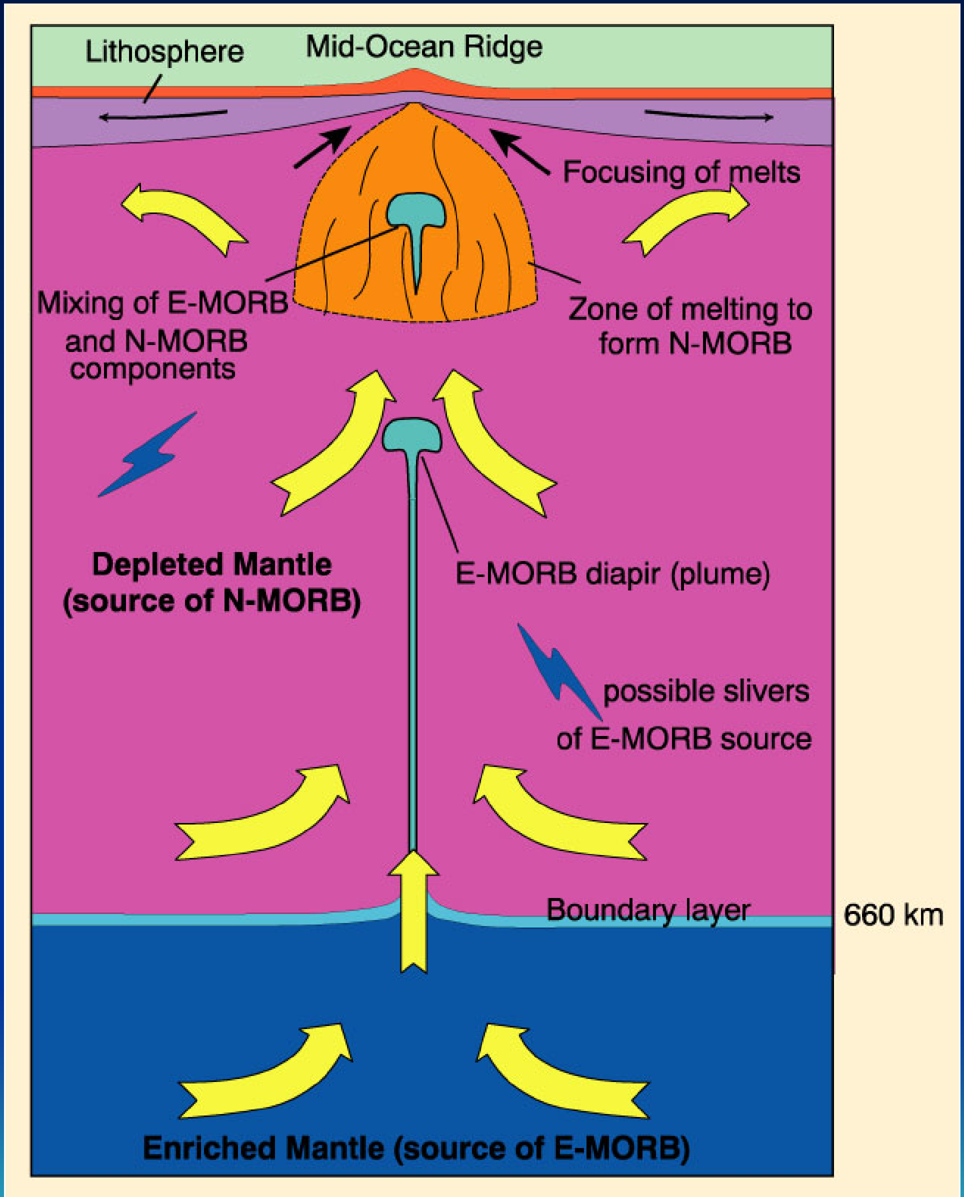
- Melt blobs separate at about 25-35 km



After Zindler et al. (1984) and Wilson (1989)

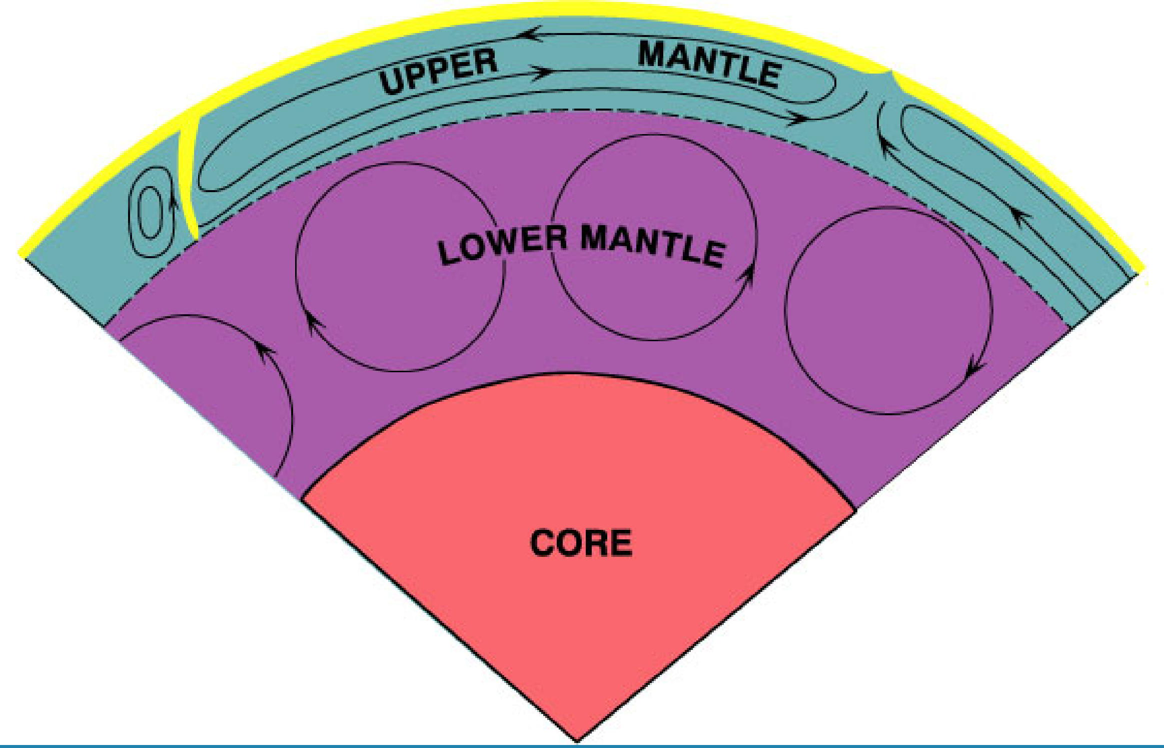
- Lower enriched mantle reservoir may also be drawn upward and an E-MORB plume initiated





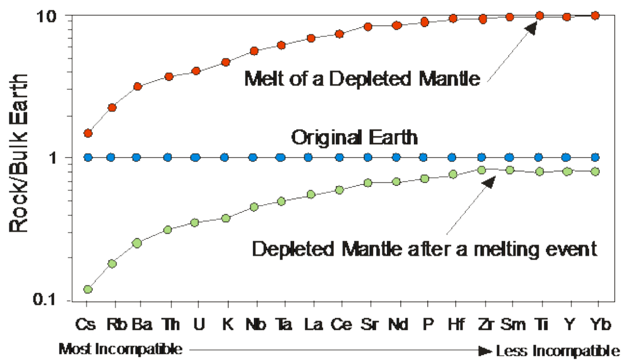
Mantle model

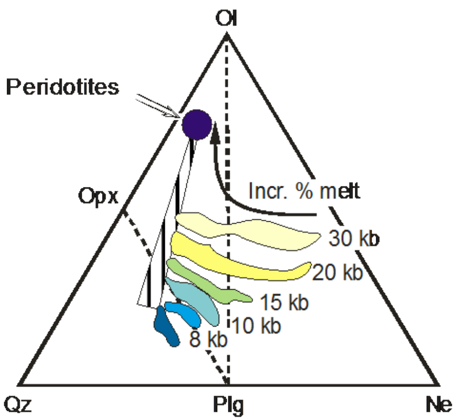
- Upper depleted mantle = N-MORB source
- Lower undepleted & enriched E-MORB (and OIB) source

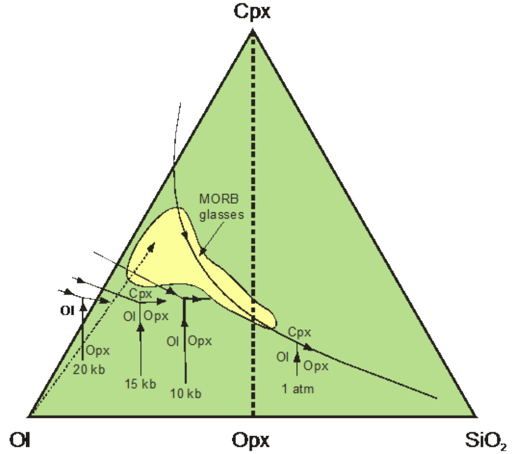


Conclusions about N-MORBs

- Melting is likely caused by decompression of the mantle peridotite (lherzolite) as it rises beneath the oceanic ridges as a result of convection.
- Flat HREE pattern of MORBs indicates derivation from the spinel-lherzolite field
- Primary MORB magmas appear to be produced by partial melting of the mantle over a range of pressures between ~15 and 20 kb.
- Most MORBs erupted are not primary melts of the mantle, but instead appear to have suffered olivine fractionation.
- The small range in composition of MORBs can be explained by crystal fractionation of Olivine + Plagioclase + Cpx at low pressures near the surface.
- Degree of melting is relatively high (>10%) (see phase diagrams and trace element spider diagrams)
- **N-MORBs appear to be the result of melting of an incompatible element depleted mantle, both in terms of their incompatible trace element compositions and isotopic ratios of Sr and Nd.**

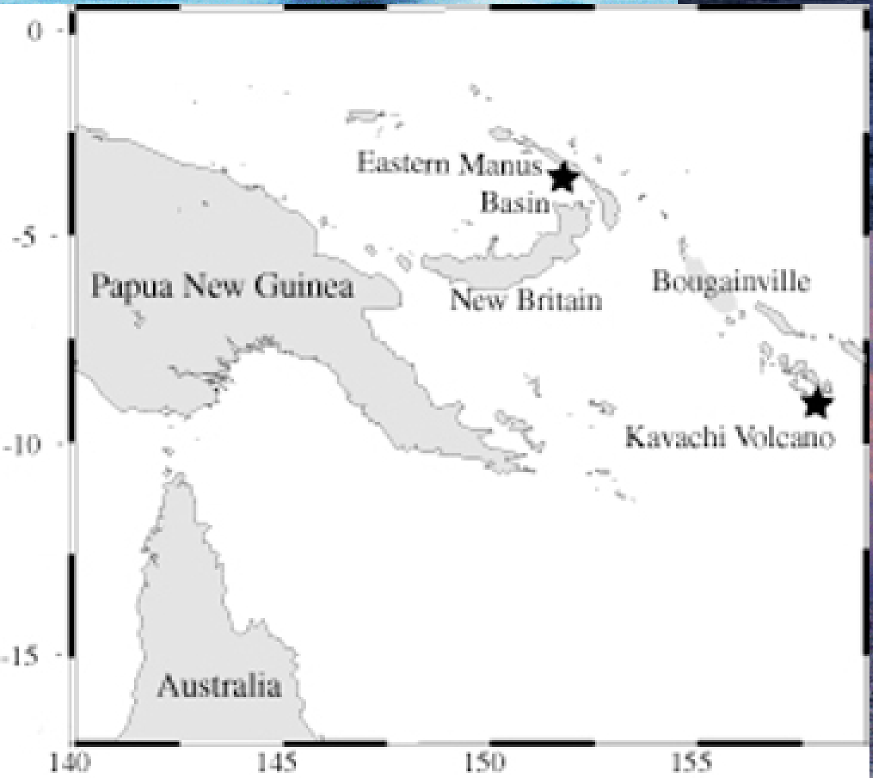


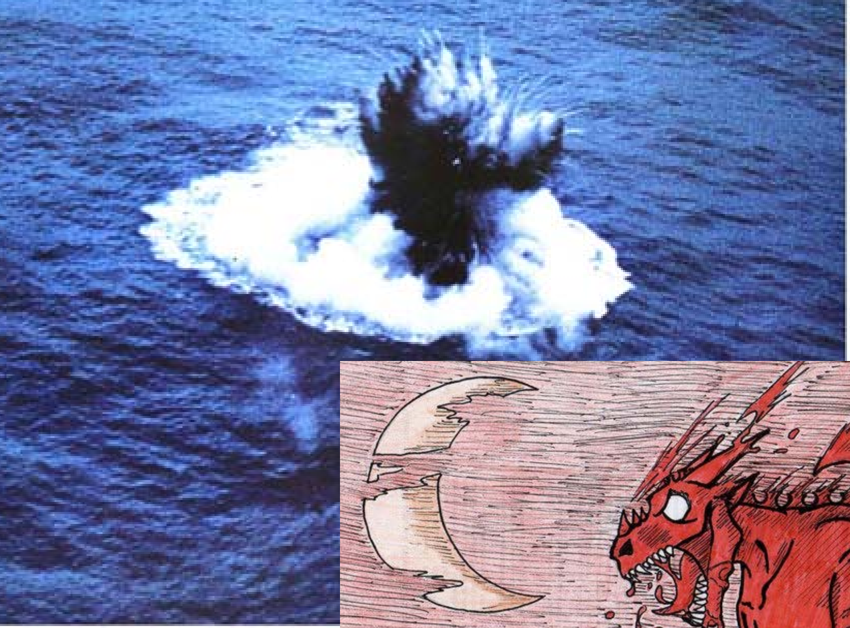
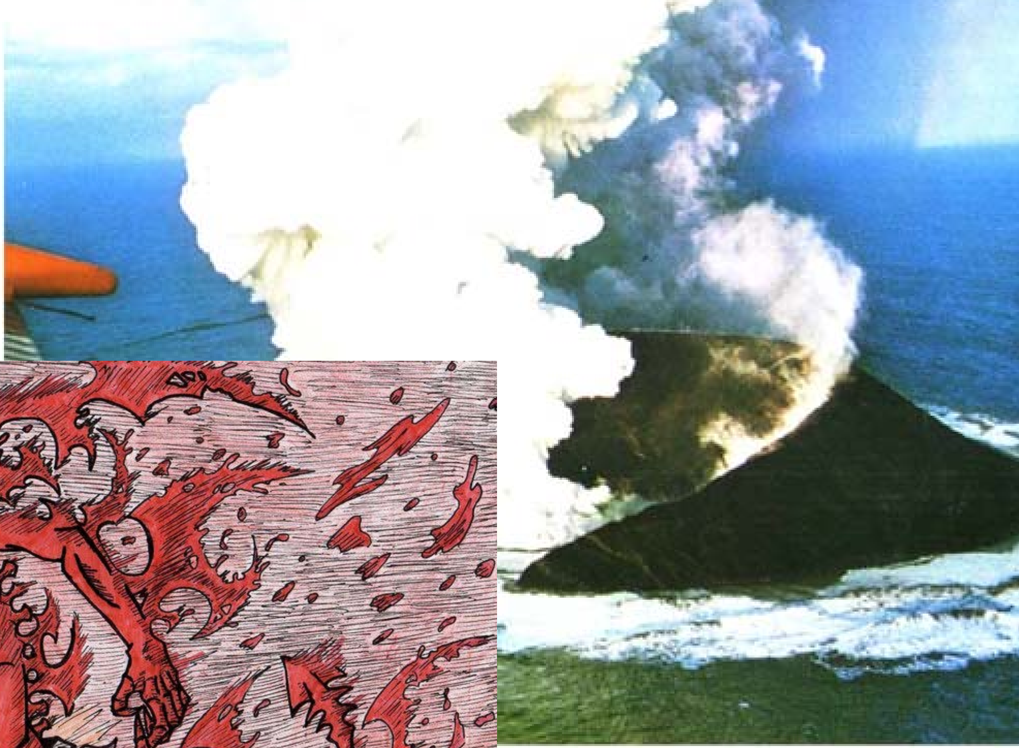




Ocean Intraplate Volcanism

Kavachi Seamount, May 2000



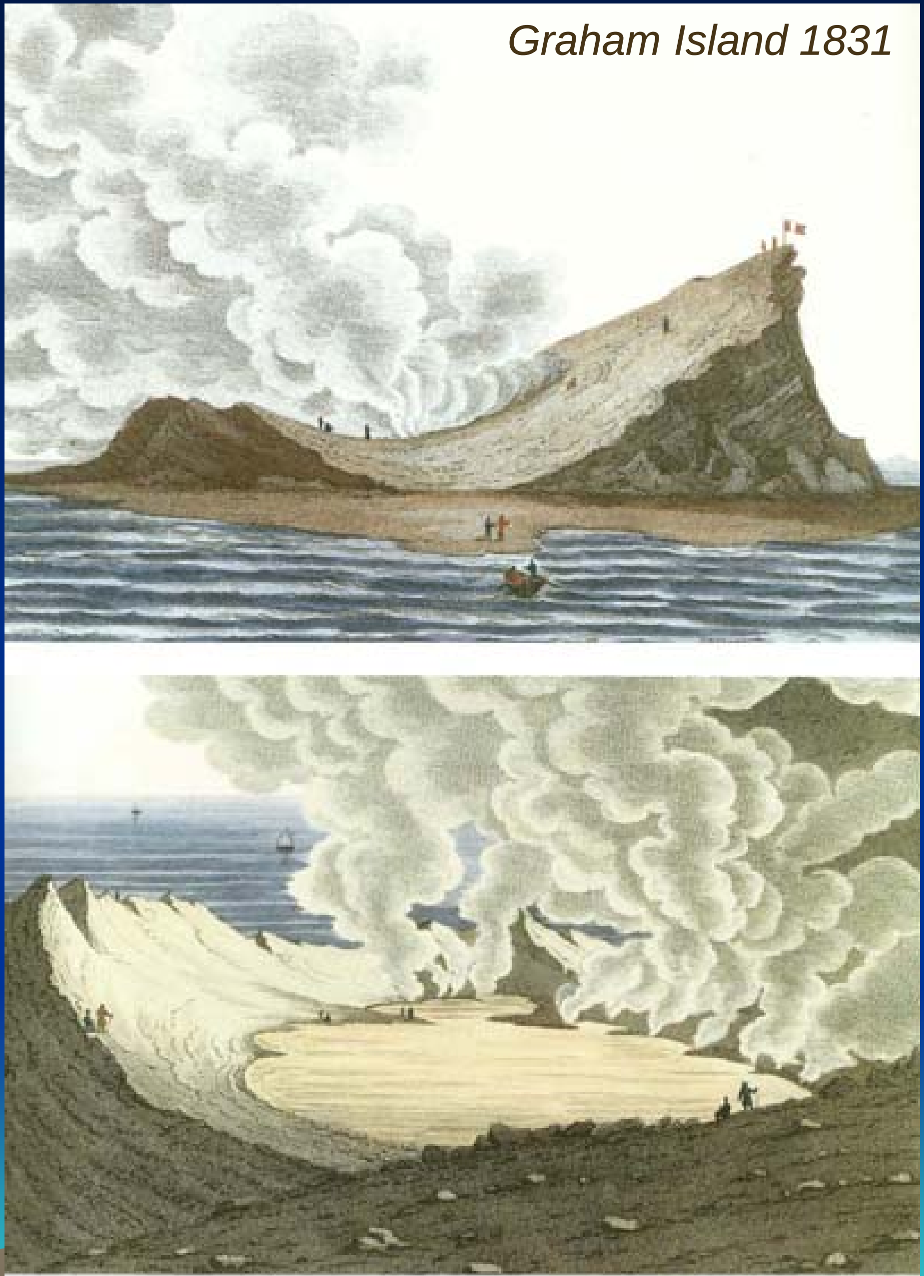




Surtsey 1963-64

Eruption of Capelinhos, Azores (1957). The hydro-volcanic (Surtseyan) eruption of Capelinhos occurred on the western extremity of Fayal Island. The eruption generated a new island that coalesced with the mainland, adding an additional square mile to Fayal Island. Foto: base surge due to collapse of the eruptive column.

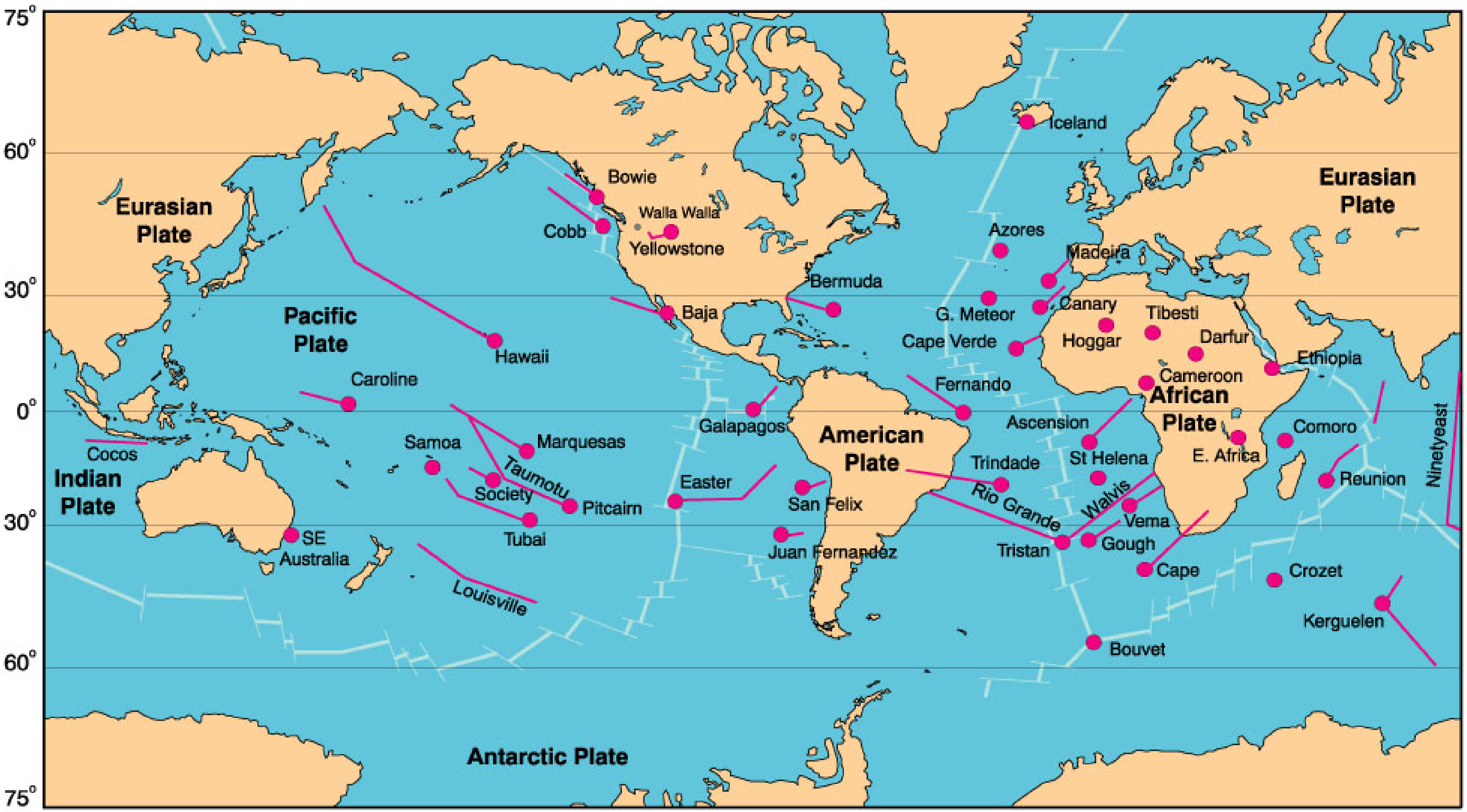
Graham Island 1831

Gouache Painting of the Eruption of Graham Island (1831)



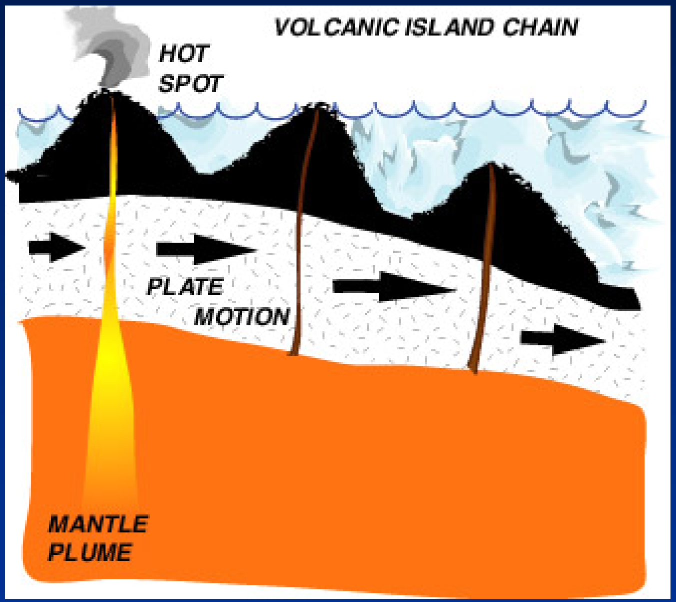
Graham Island, 1831 (alter Stich, aus Schmincke 2000

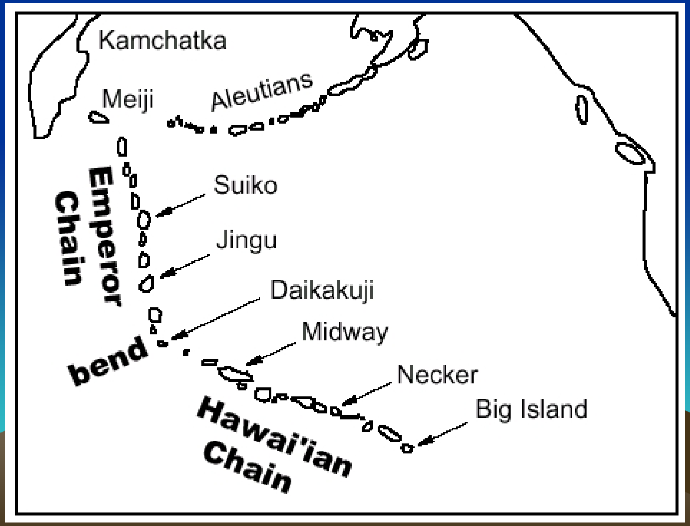
Ocean islands and seamounts

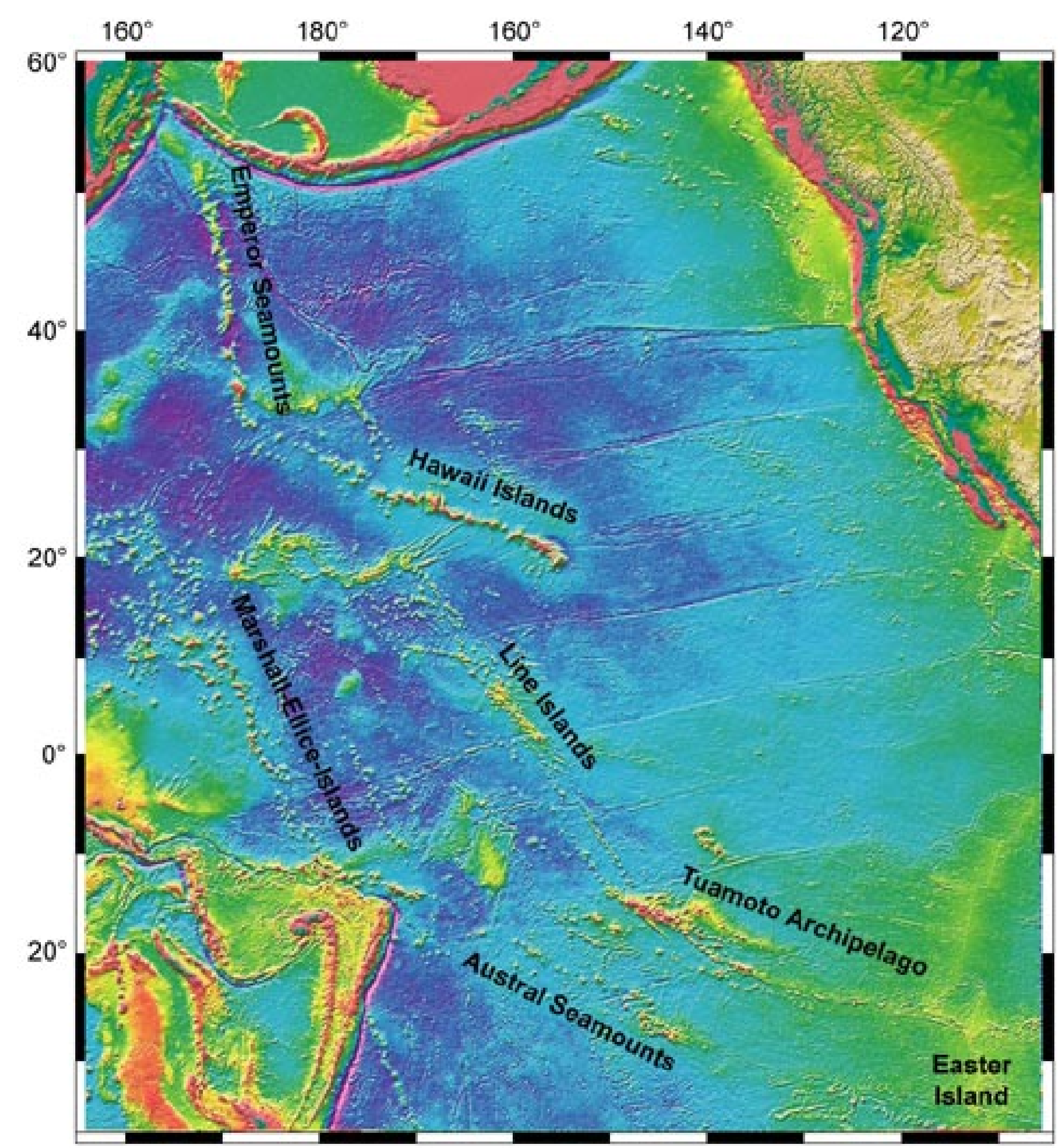


Crough (1983)

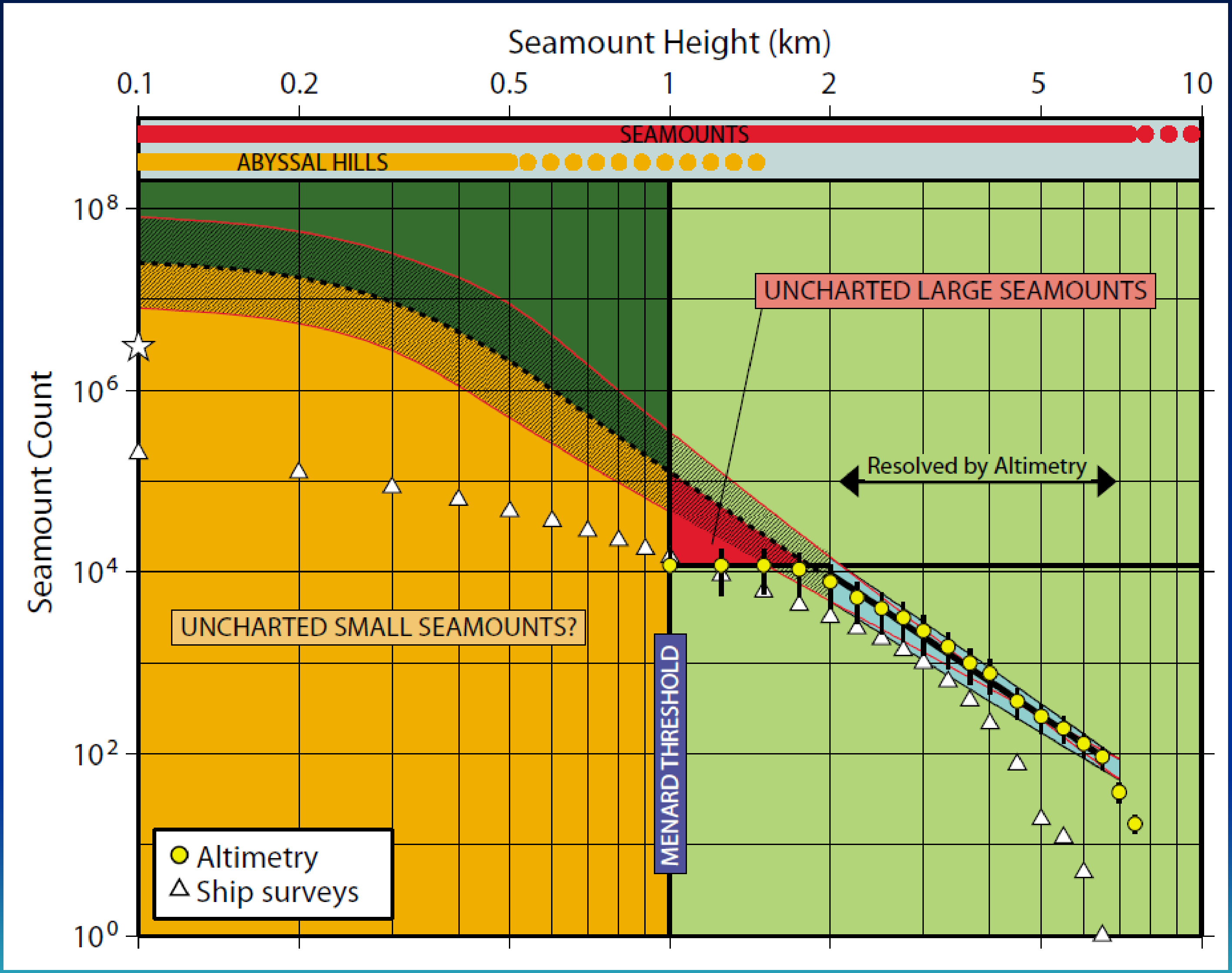
Hot spot tracks across the N'Pacific







“Global seamount census”



Wessel et al. (2010)
Oceanography 23

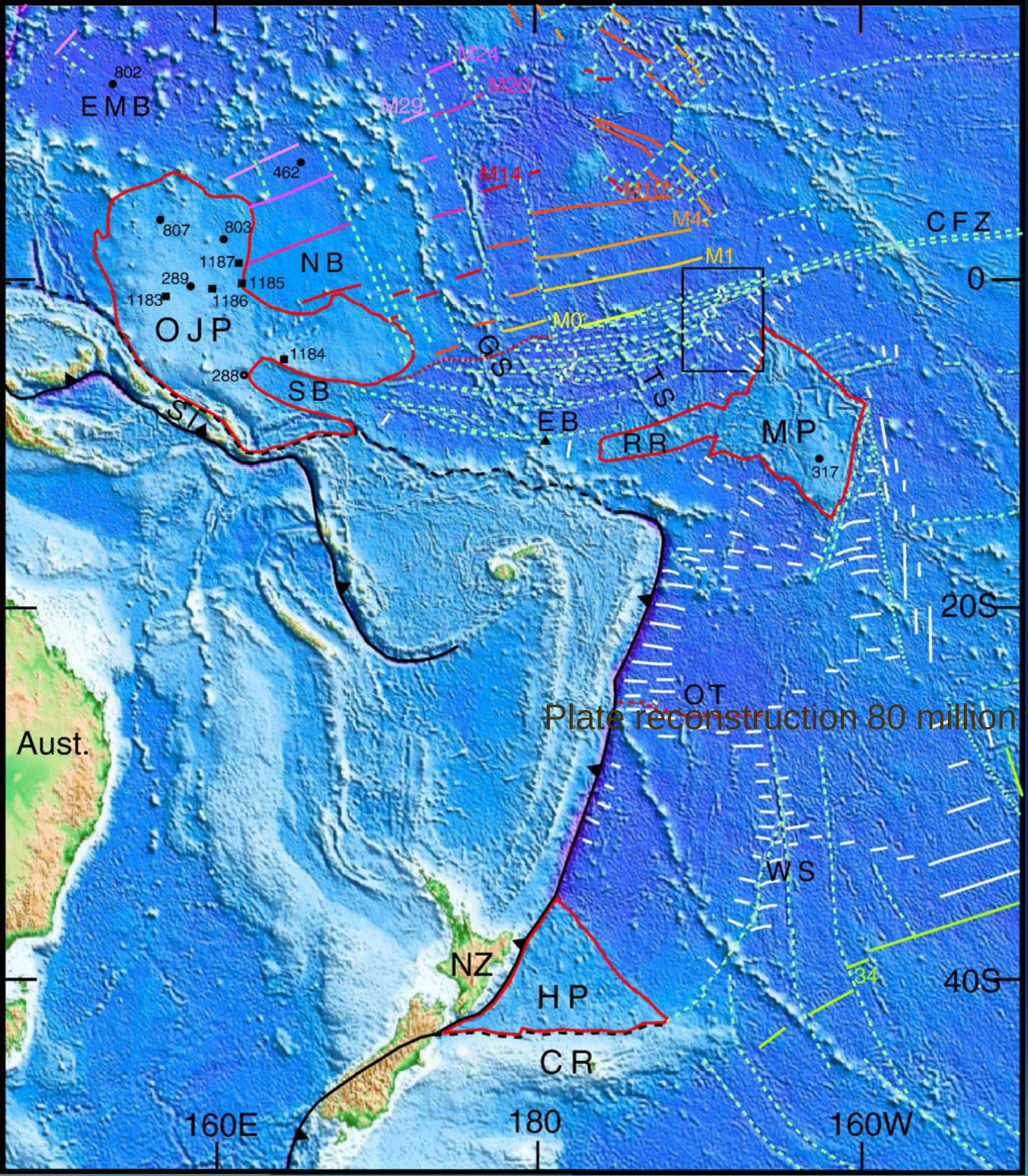
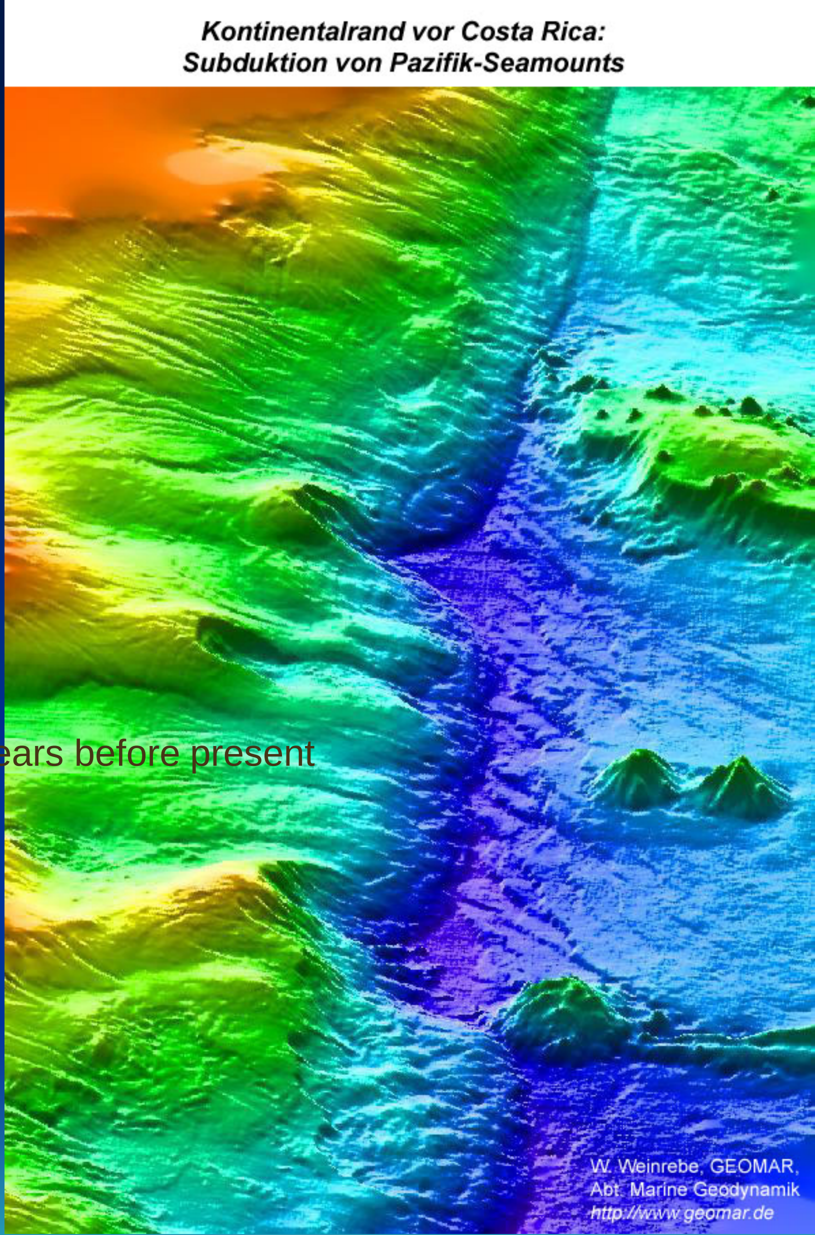
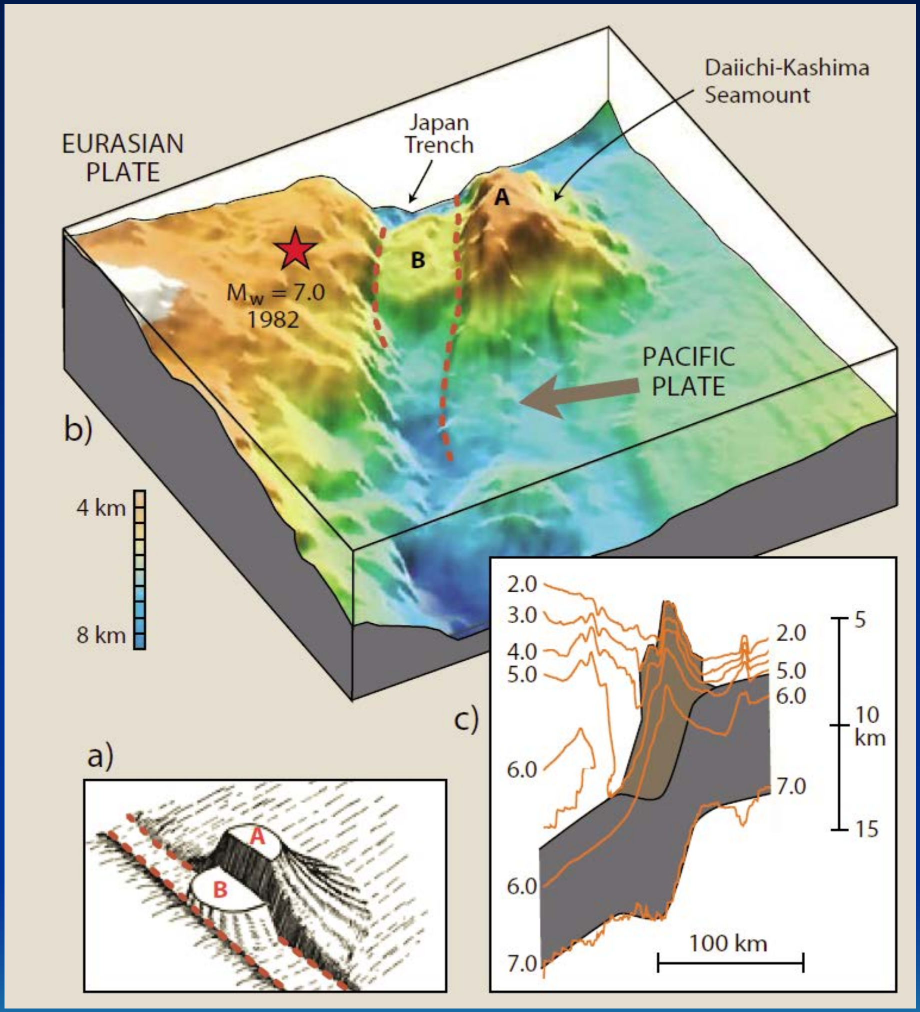
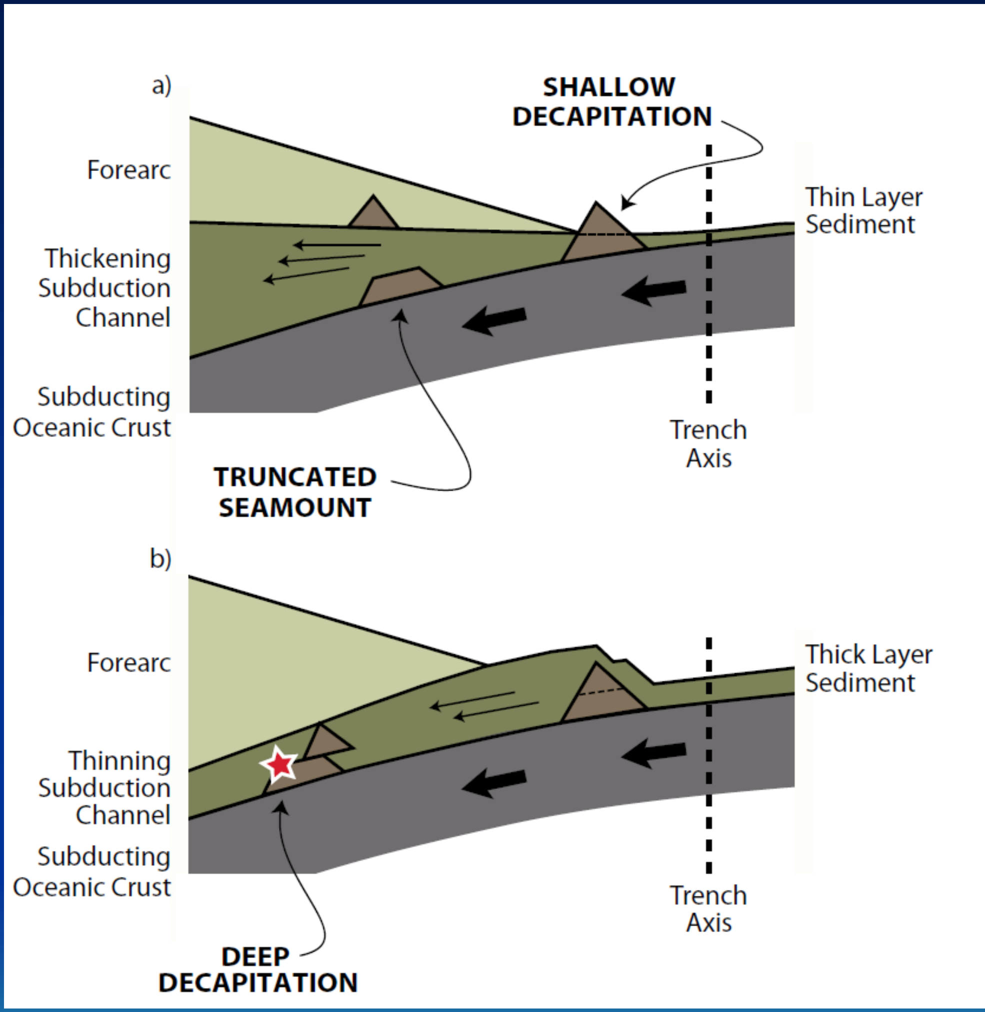


Plate reconstruction 80 million years before present



Seamount subduction model





Watts et al. (2010)
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