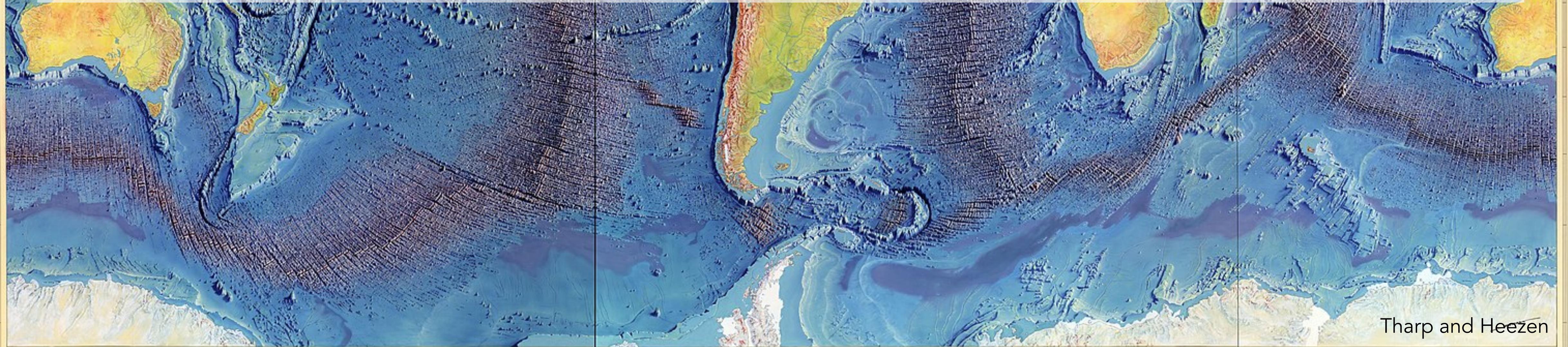


Global Correlations of Ocean Ridge Basalt Chemistry with Axial Depth and Crustal Thickness

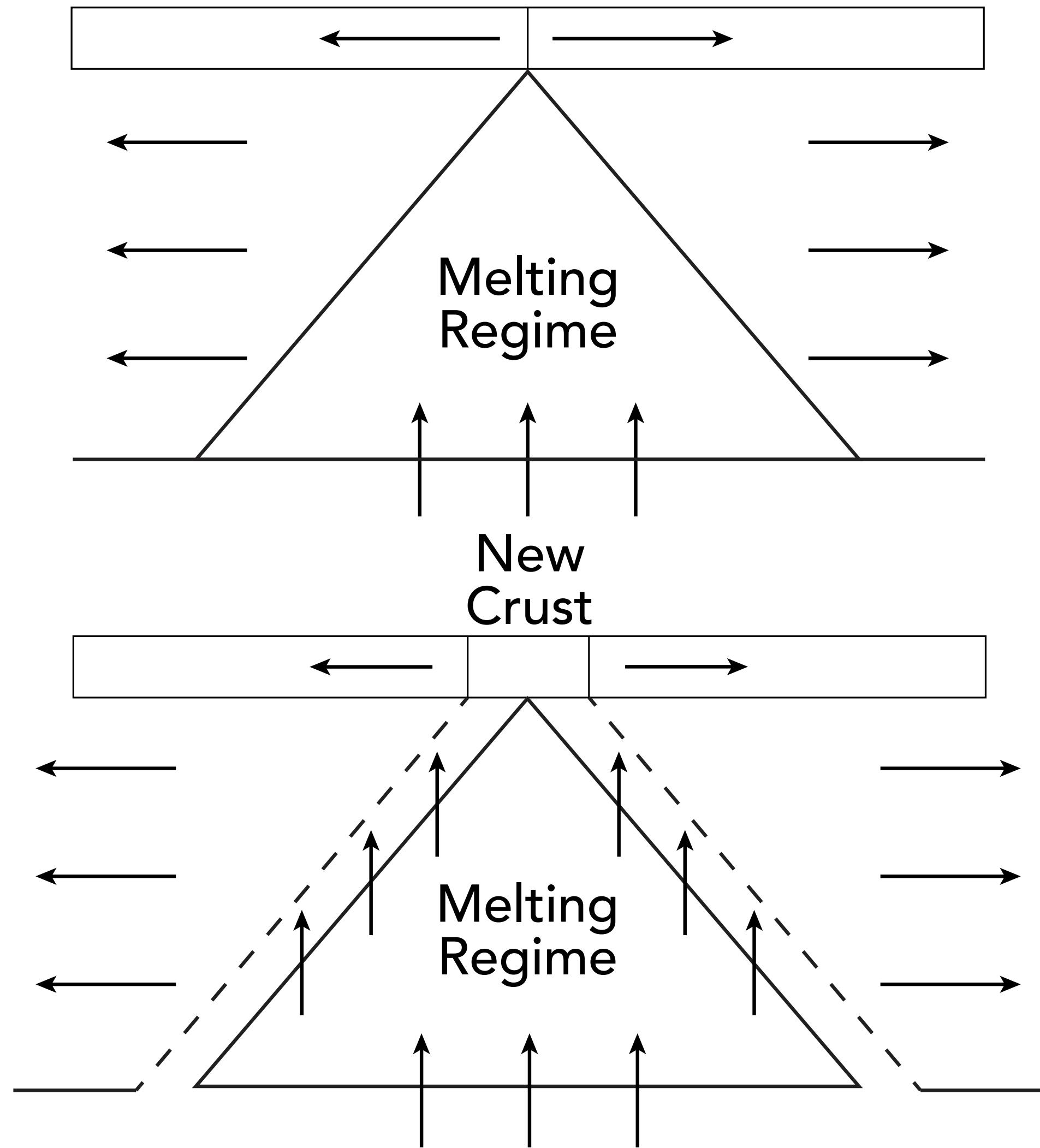
Emily Klein and Charlie Langmuir



Tharp and Heezen

How does mantle melting occur and why do we see volcanism at mid-ocean ridges?

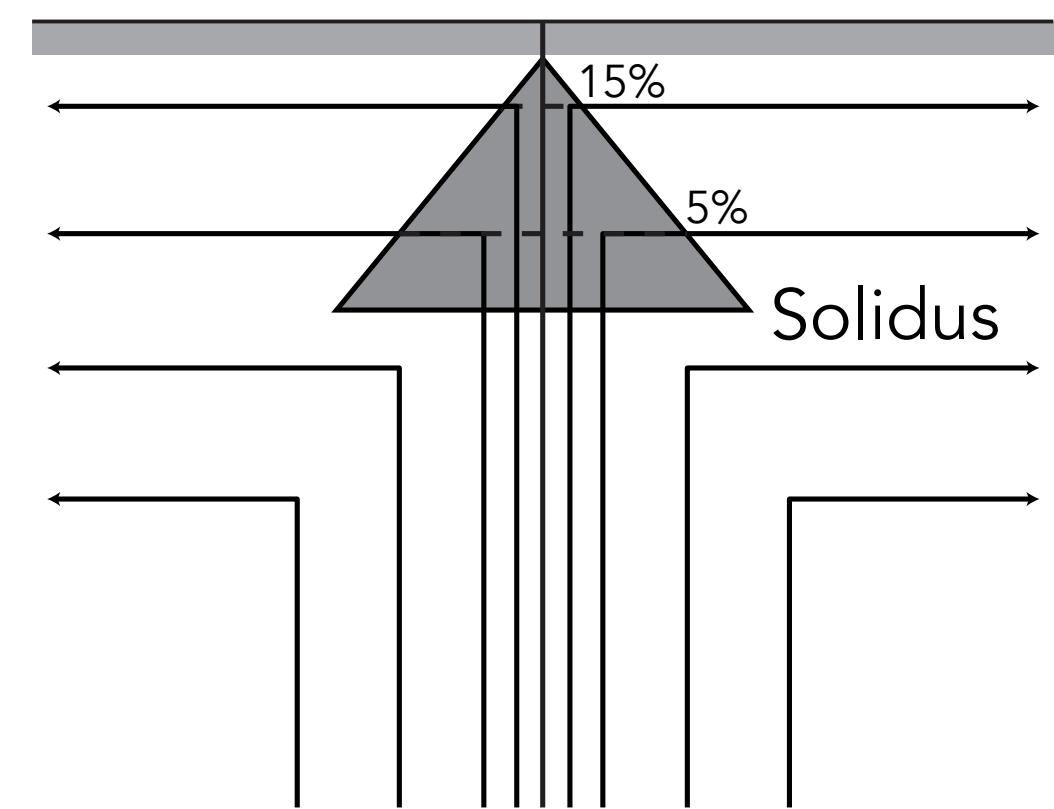
- At ridges, tectonic plates spread apart and the mantle rises to fill the gap given the reduction of pressure. Mantle melts form through *decompression melting*.
- Mantle melts ~1% per 3 km of upwelling - experimentally determined.



modified from Langmuir and Broecker,
How to Build a Habitable Planet

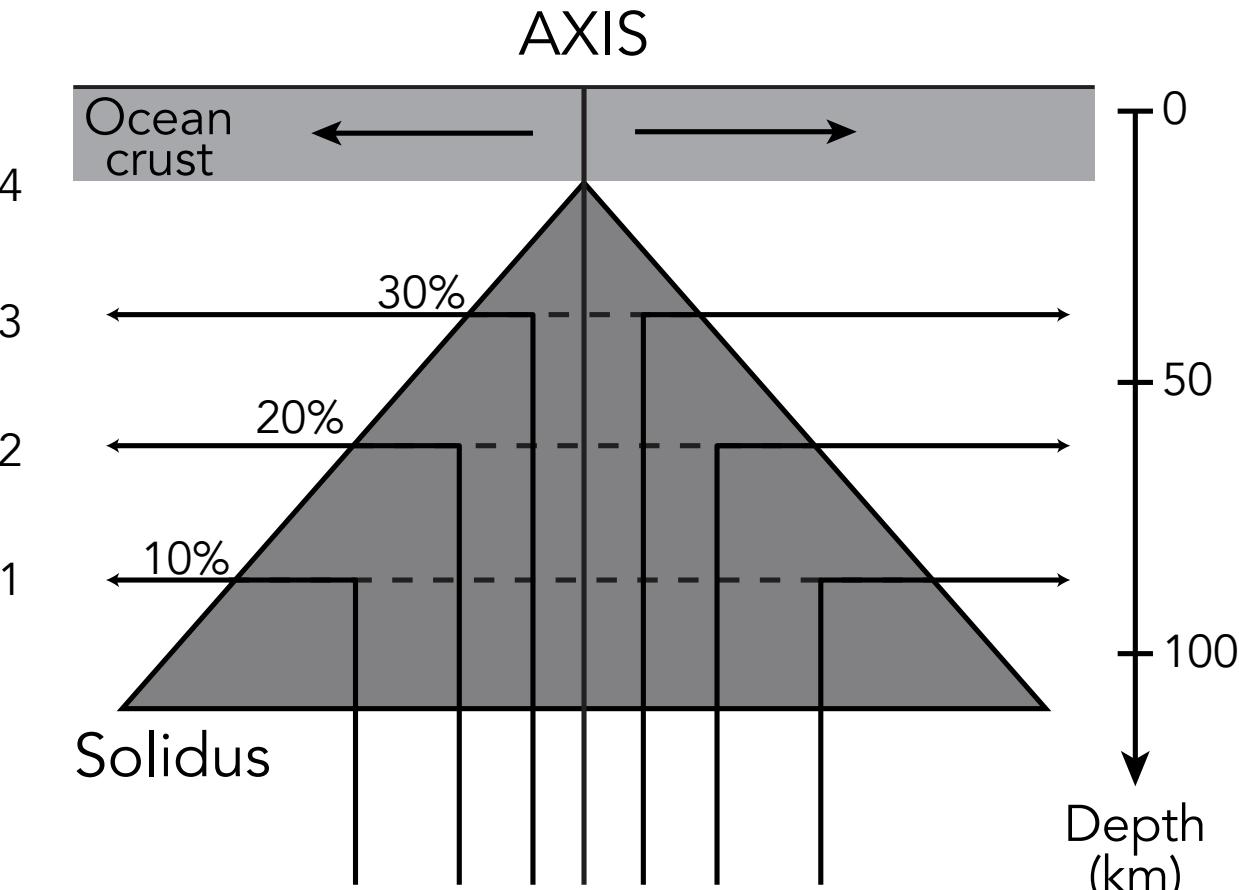
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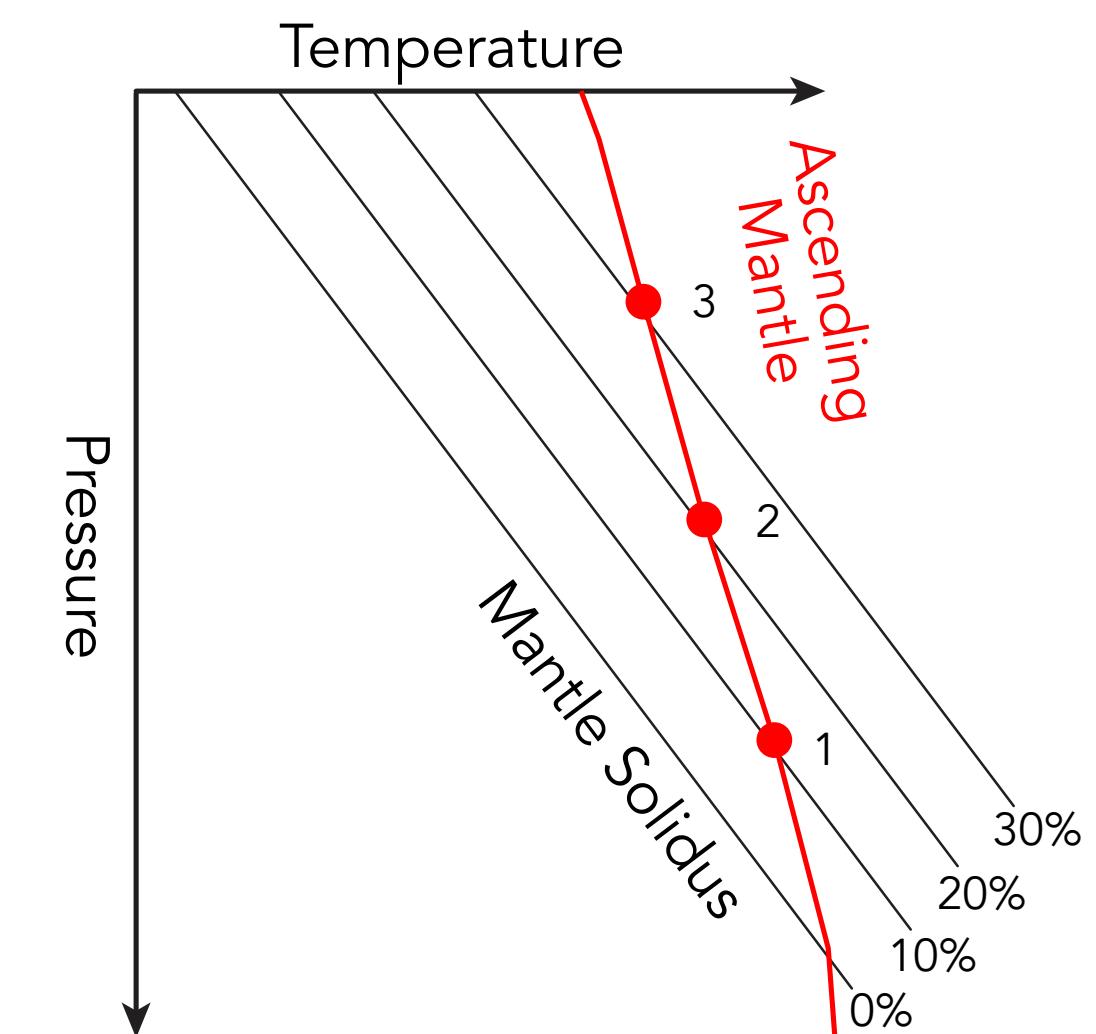
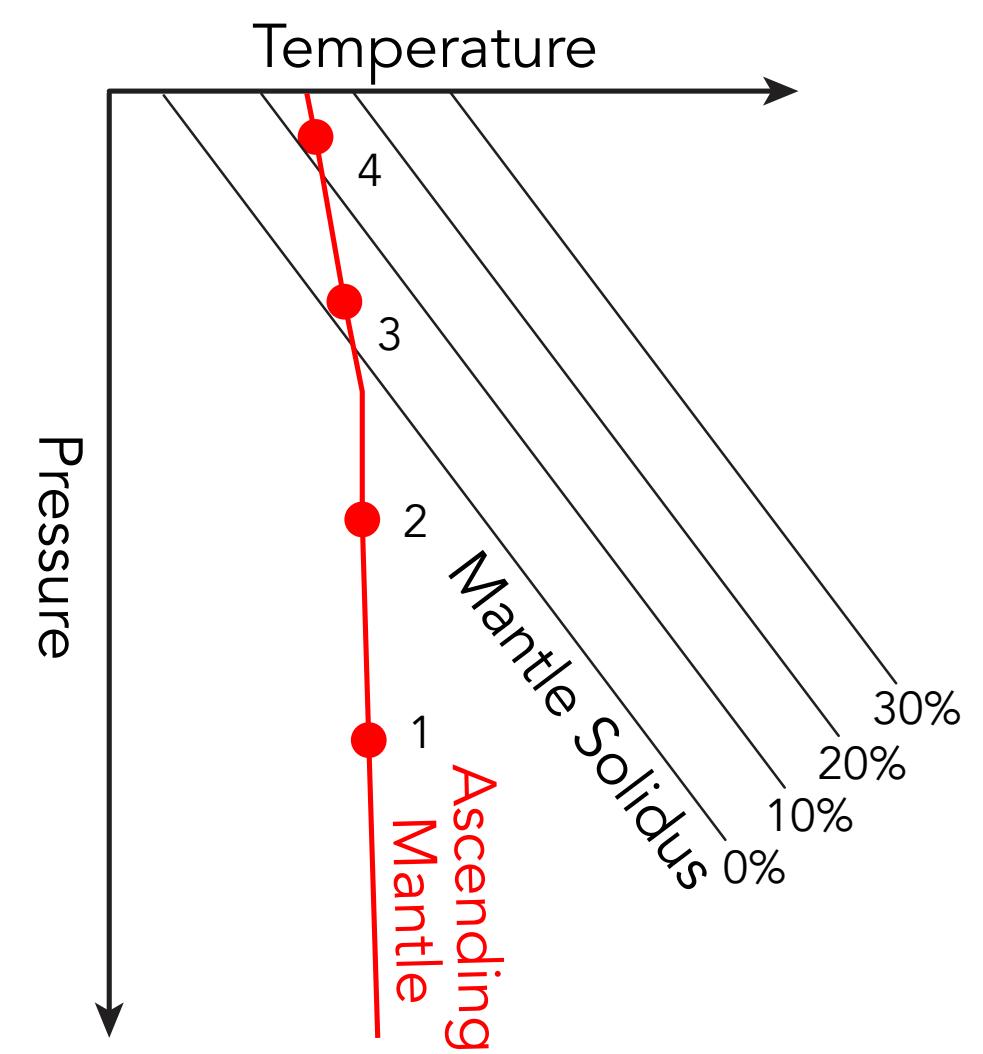
Cold Ascending Mantle

- Shallower melting
- Less decompression
- Less melting
- Thinner oceanic crust



Hot Ascending Mantle

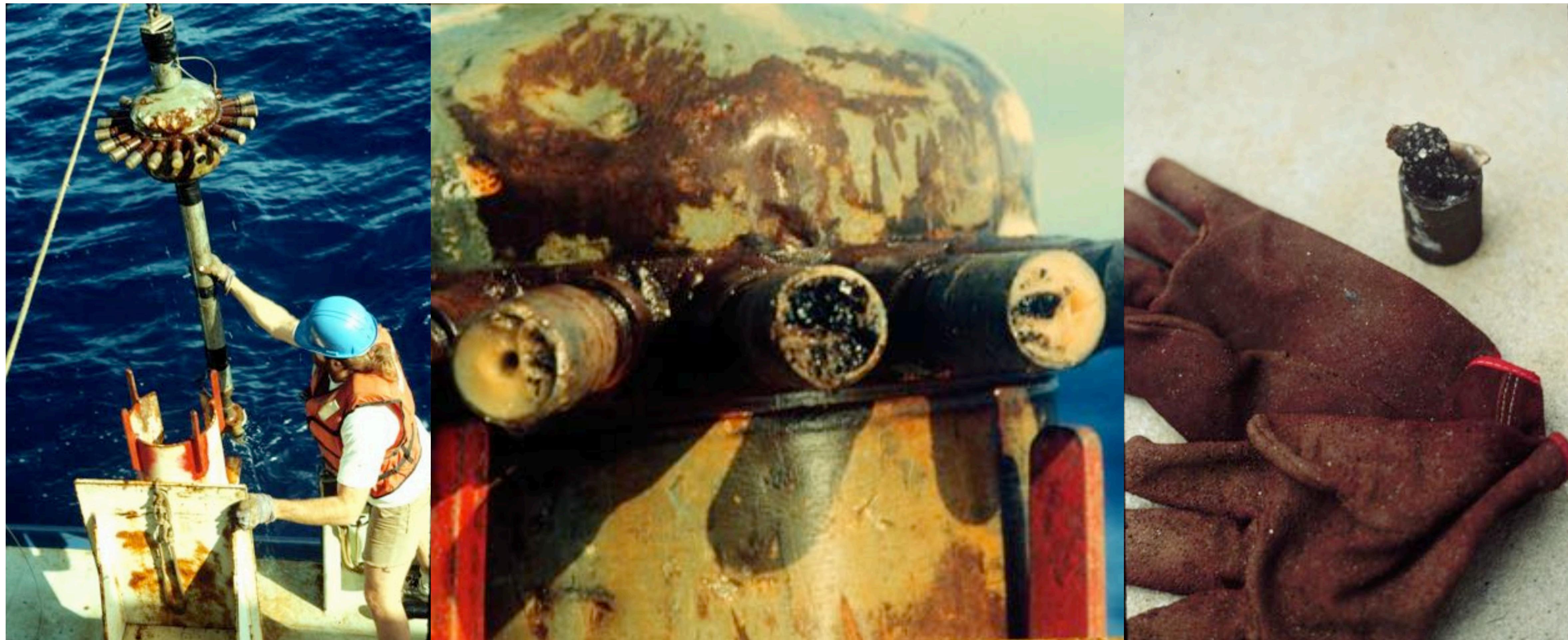
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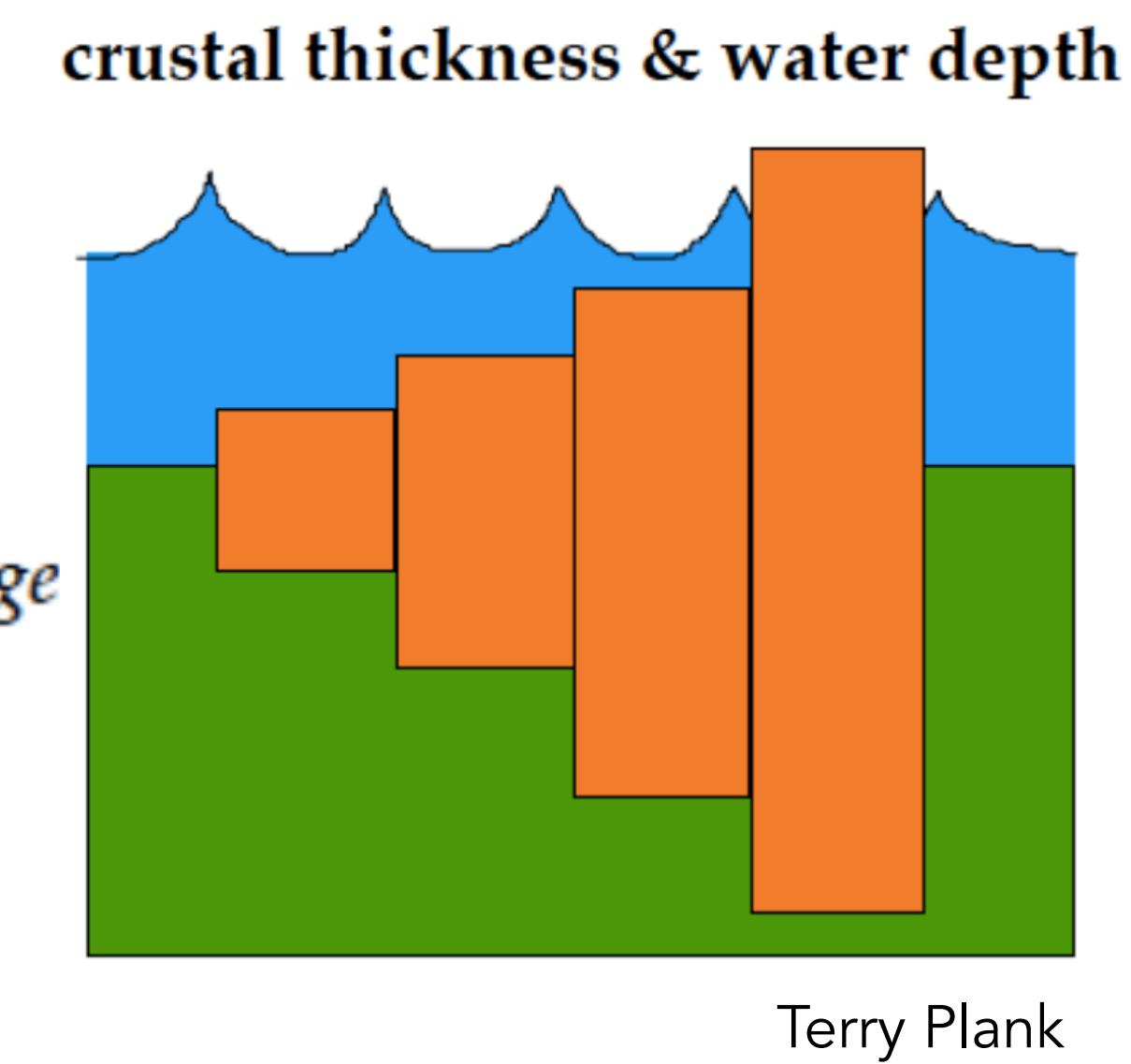
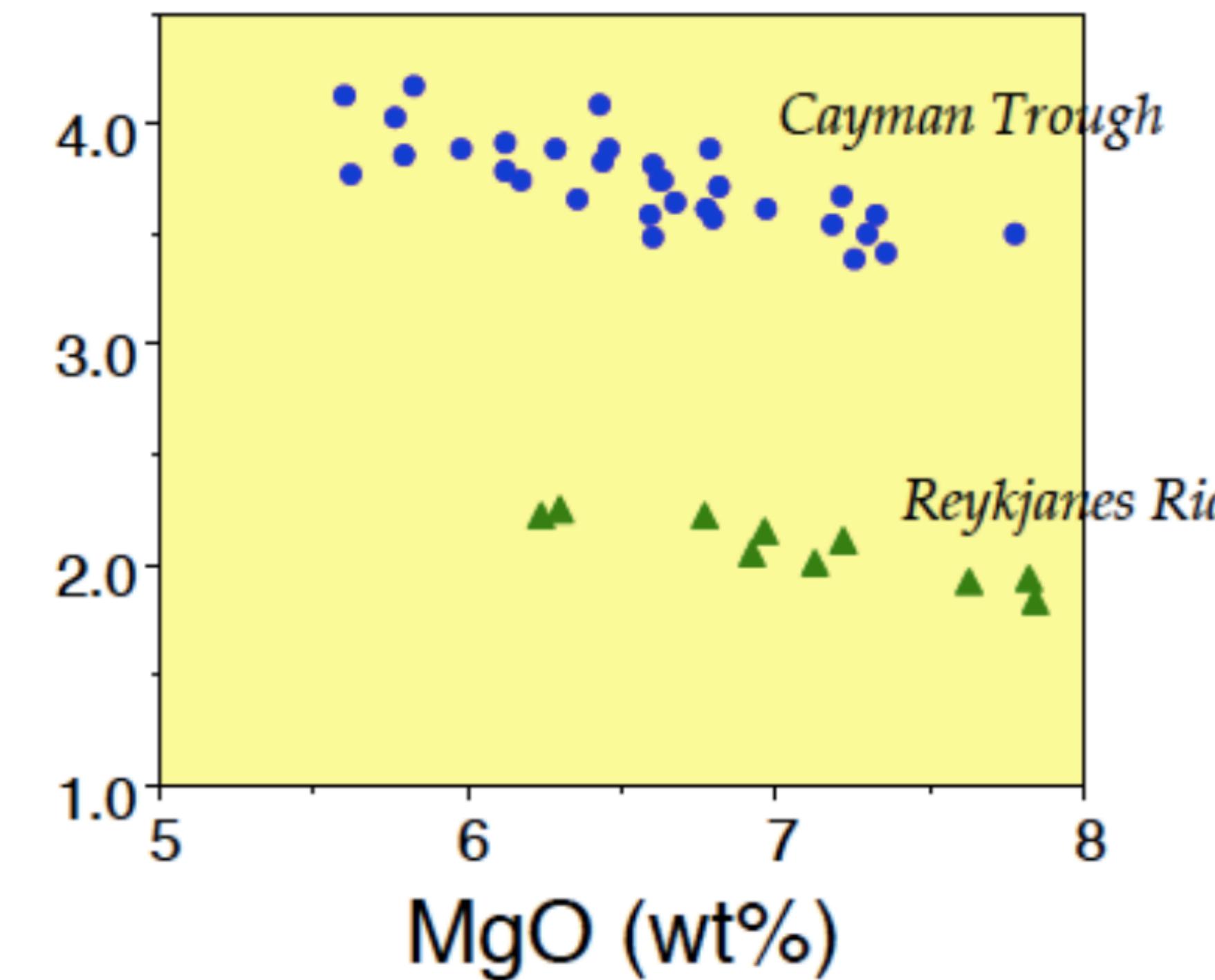
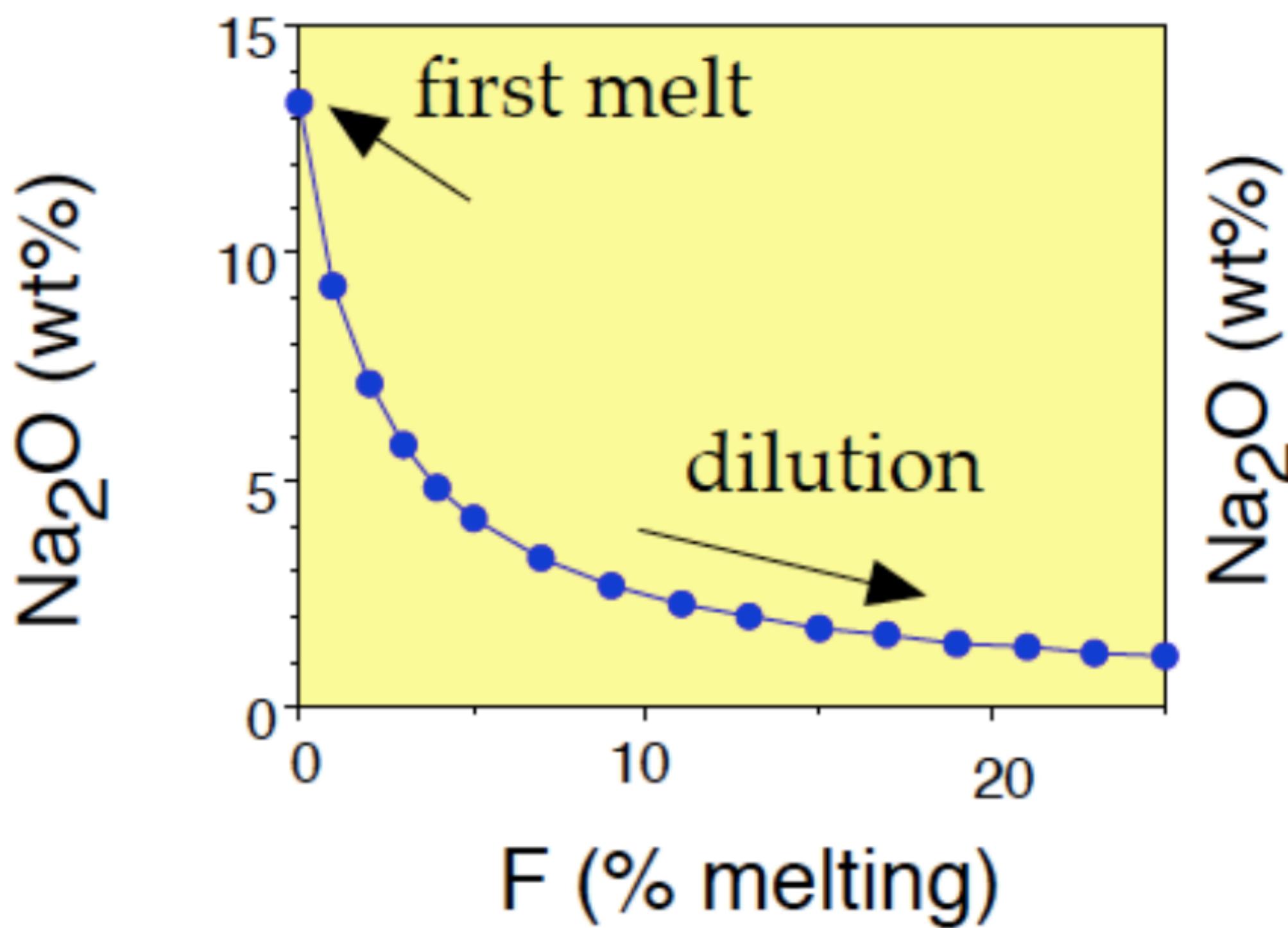
How can we use geochemistry to develop a first-order understanding of melting at mid-ocean ridges?

- Examine the chemistry of rocks erupted at mid-ocean ridges, termed *mid-ocean ridge basalts*



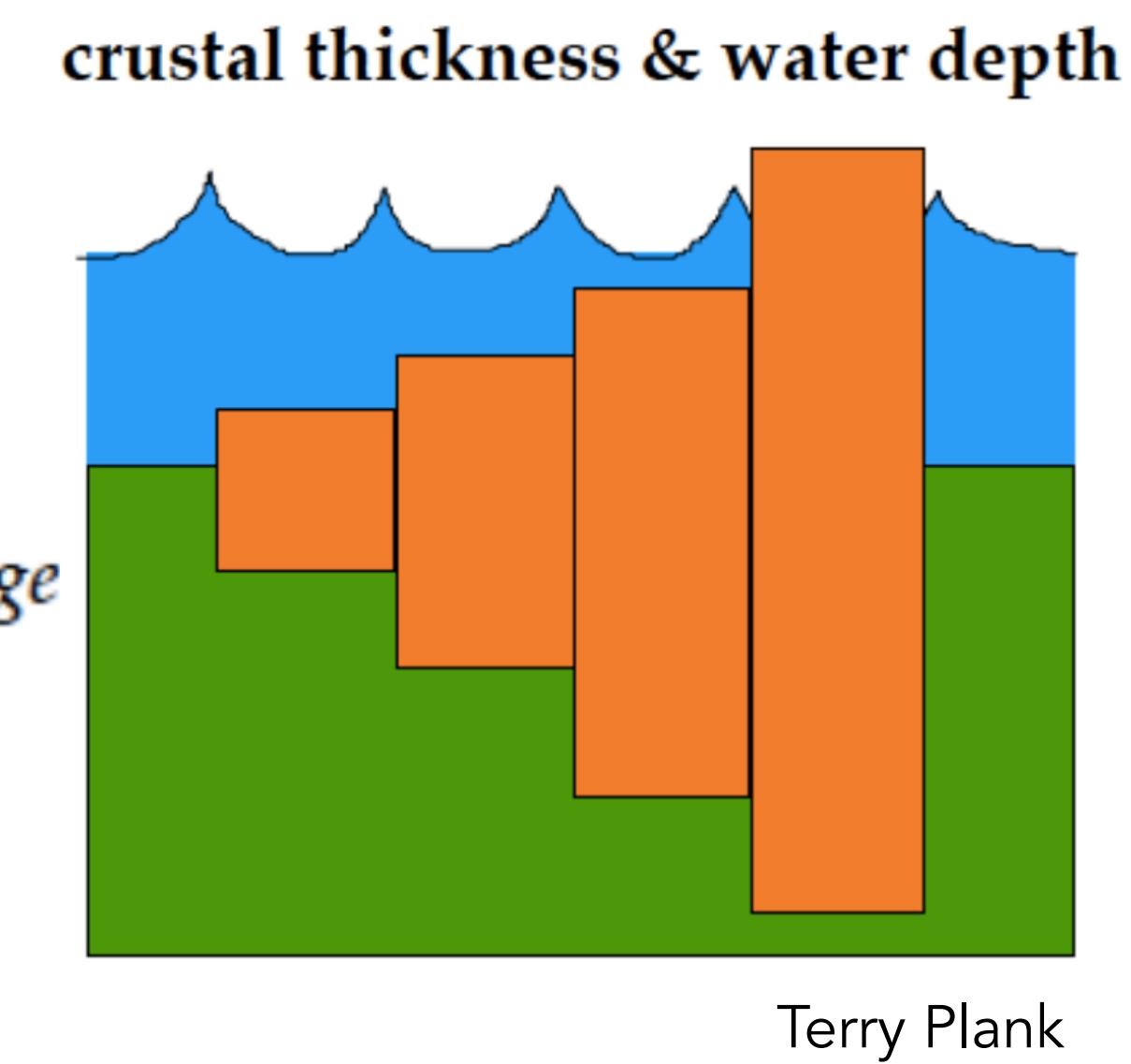
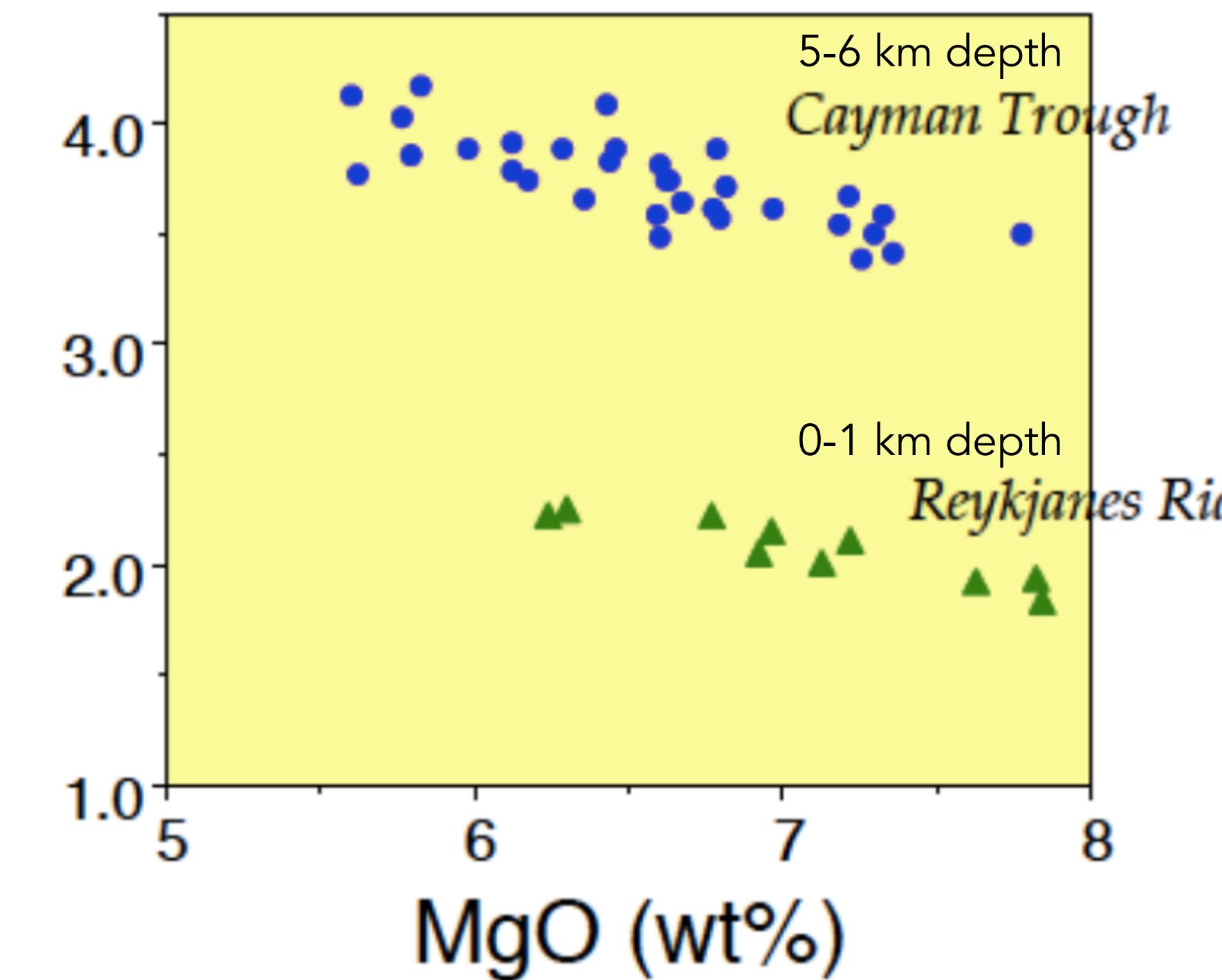
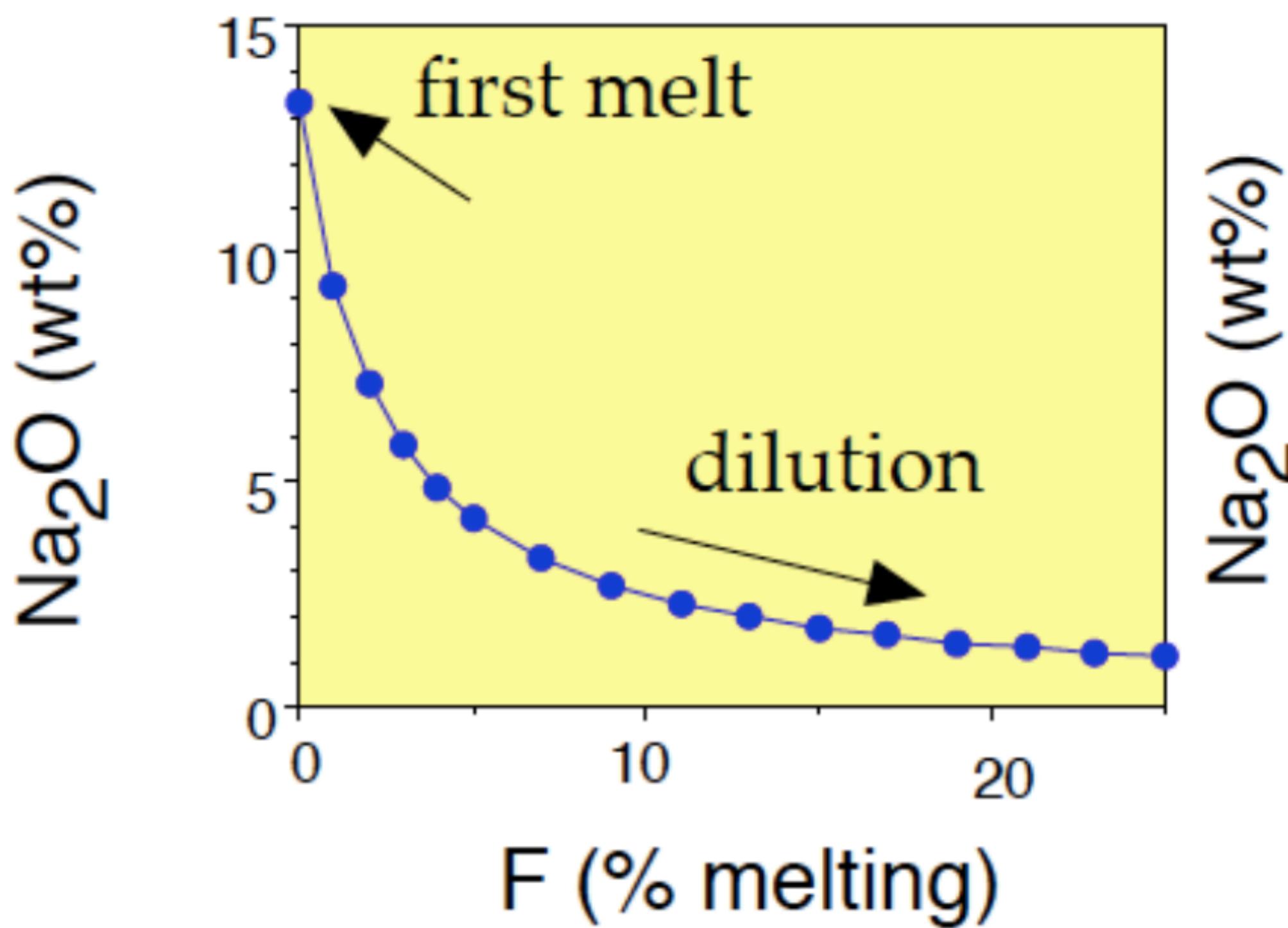
What do global MORB data tell us about mantle melting?

- Chemical variability in MORB relates to whether elements 'prefer' the liquid magma or solid minerals during crystallization
 - **Na likes melt** and will remain in melt, so is an *incompatible element (in minerals)*
 - **Mg likes minerals** and will be taken up by minerals, so is a *compatible element (in minerals)*

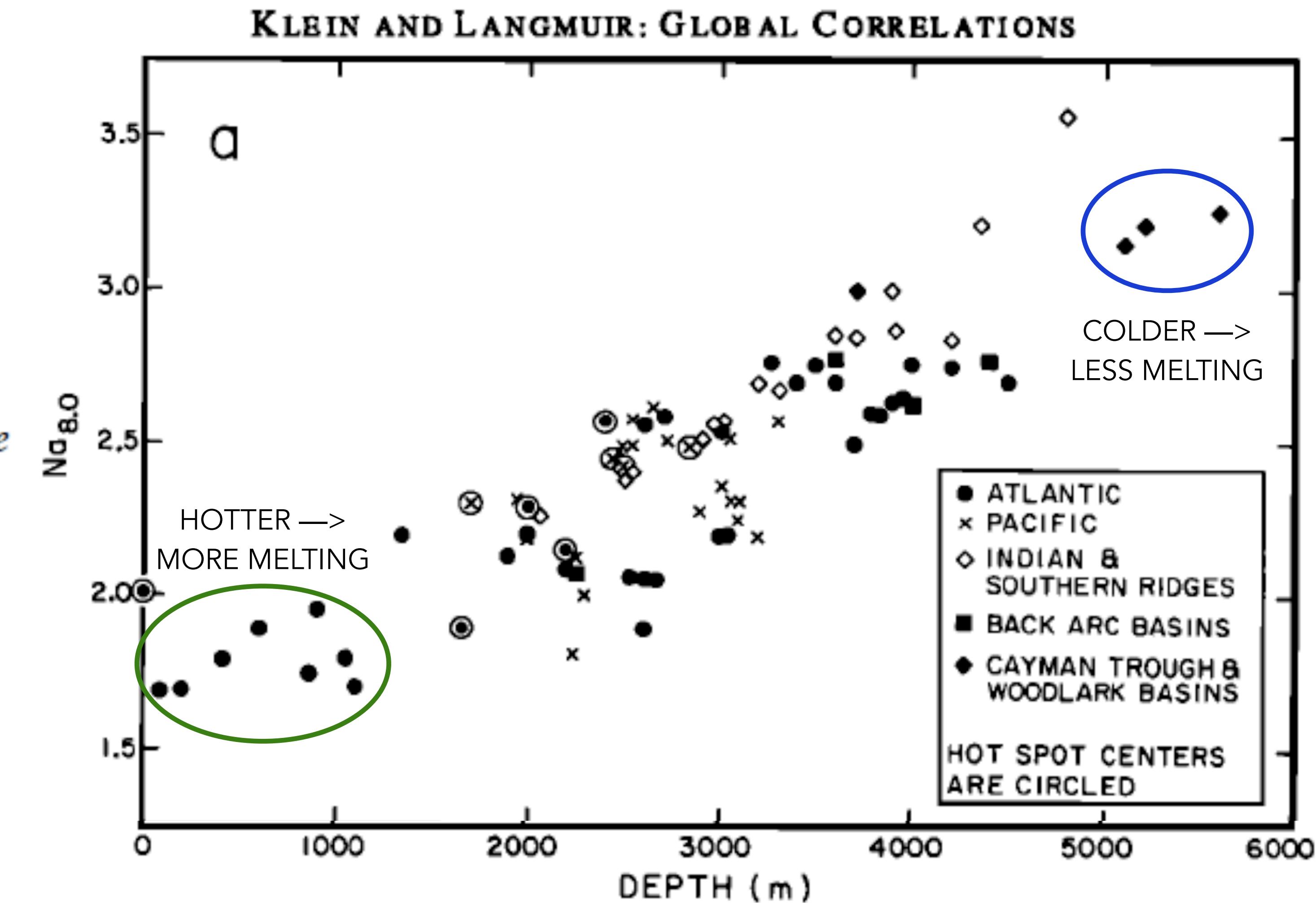
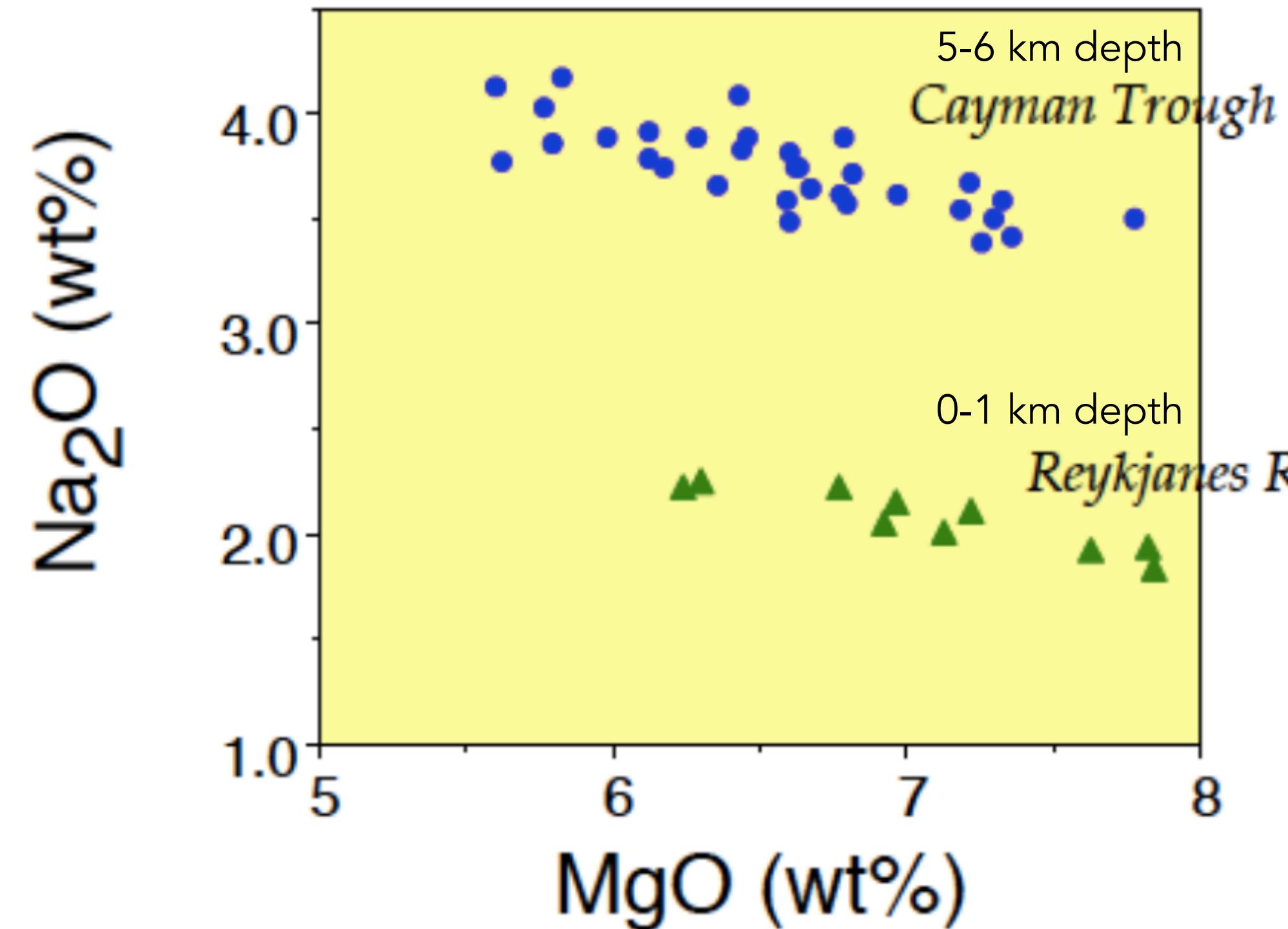


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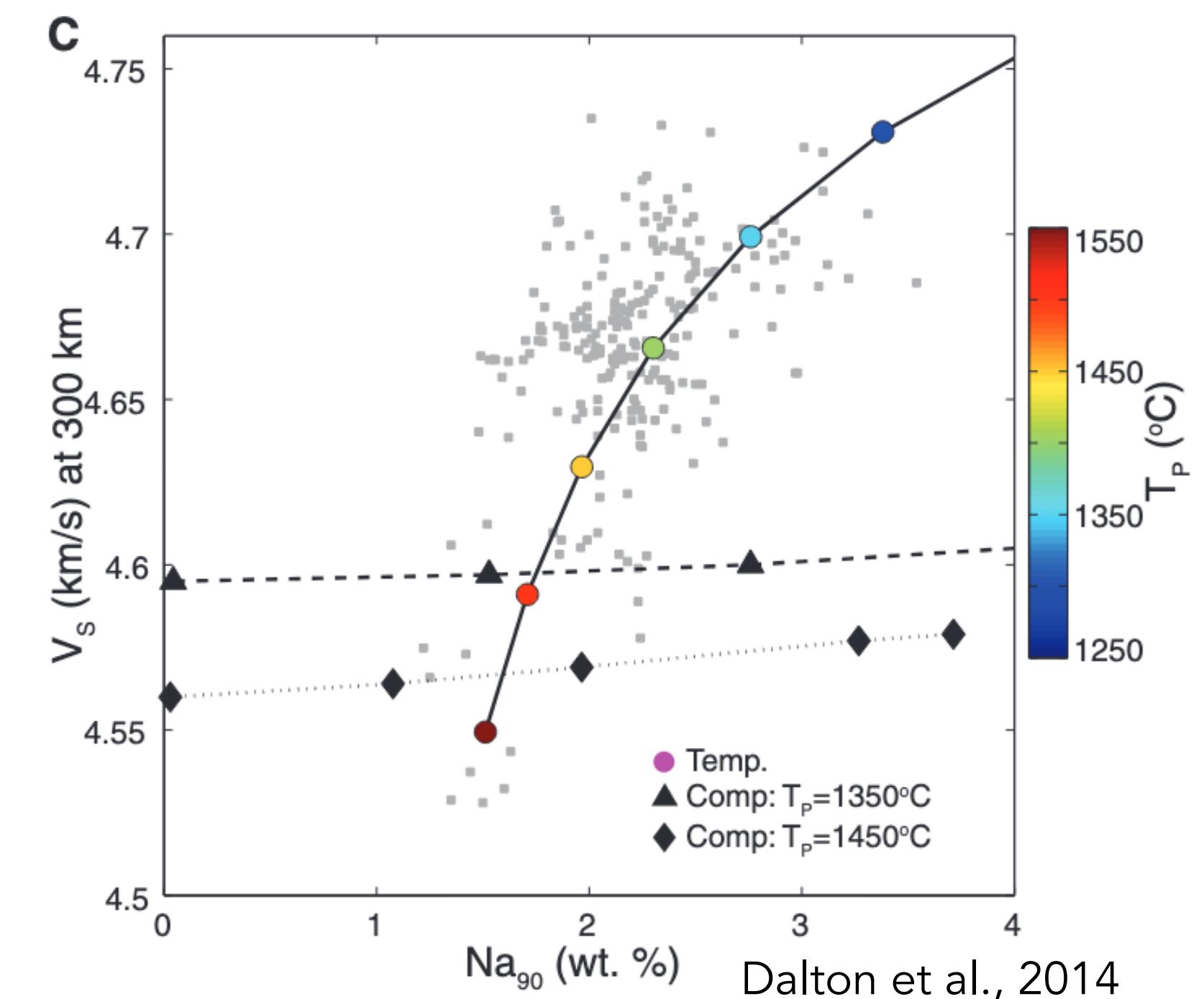
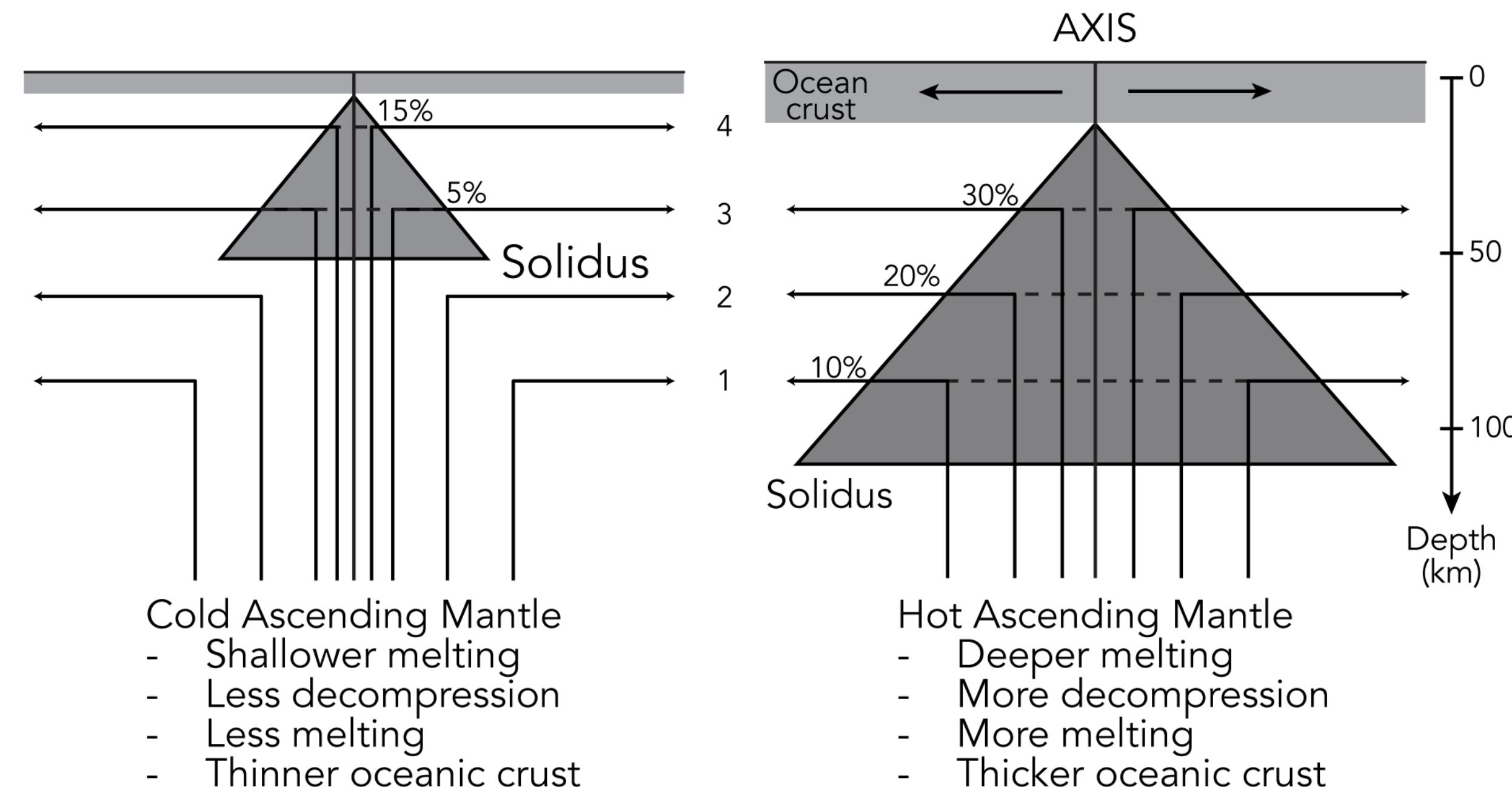
What do global MORB data tell us about mantle melting?



Klein and Langmuir, 1987 JFR

Conclusions

- MOR are a significant source of volcanism on our planet (80%!) as a kinematic manifestation plate tectonics and solid earth recirculation.
- Mantle temperature and extent of melting is the primary influence on the volume and composition of magmas producing MORB.
- Hotter mantle temperatures results in:
 - More decompression melting
 - Thicker oceanic crust, deeper melting
 - Lower sodium
 - Lower seismic velocities



Dalton et al., 2014