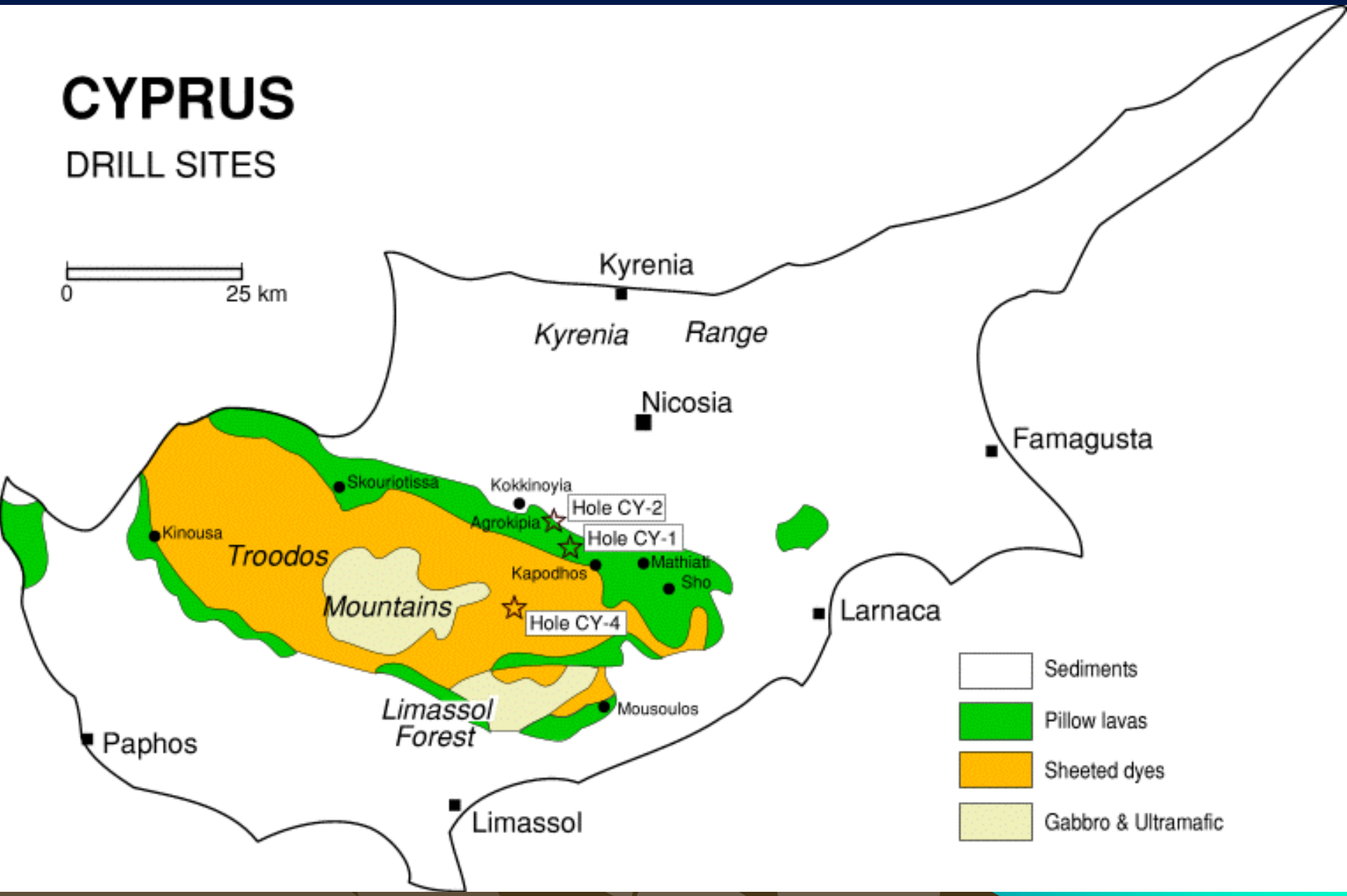
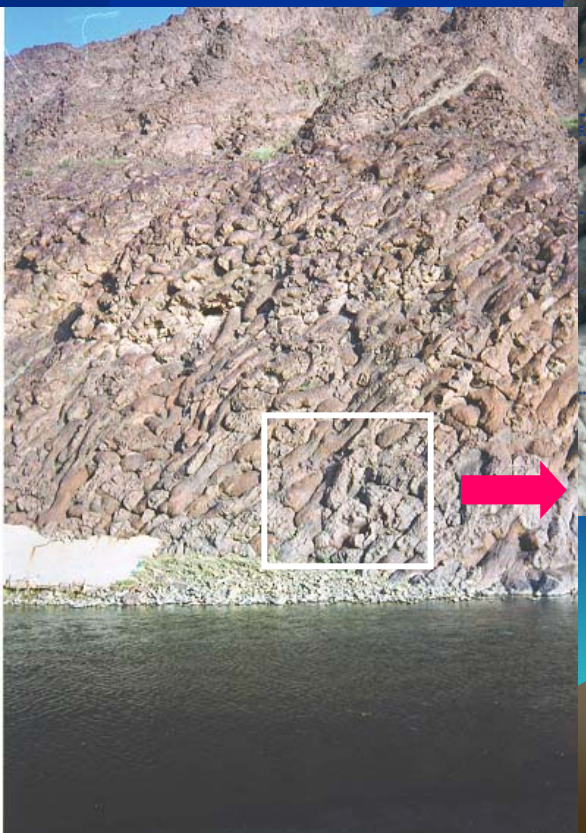

CYPRUS
DRILL SITES
0
25 km
Kyrenia
Kyrenia Range
Nicosia
Famagusta
Skouriotissa
Kokkinoyia
Hole CY-2
Agrokipia
Hole CY-1
Kinousa
Troodos
Mountains
Kapodhos
Mathiati
Sho
Hole CY-4
Larnaca
Limassol
Forest
Mousoulos
Paphos
Limassol
Sediments
Pillow lavas
Sheeted dyes
Gabbro & Ultramafic

Pillow-lava

Ocean floor pillow basalt (recent)

15 Ma old pillow basalts, Idaho. Top of the Columbia River Basalt formed in a water-filled canyon.

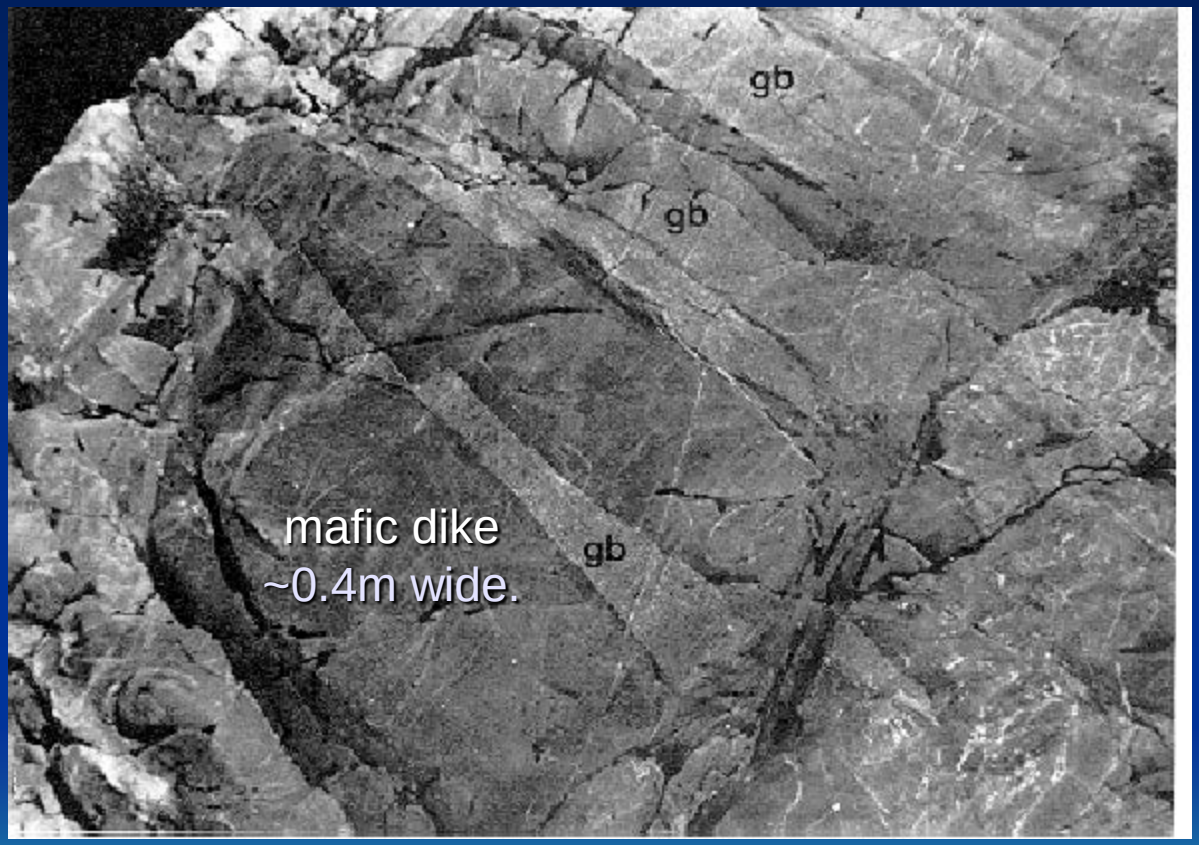
Pillow-lava



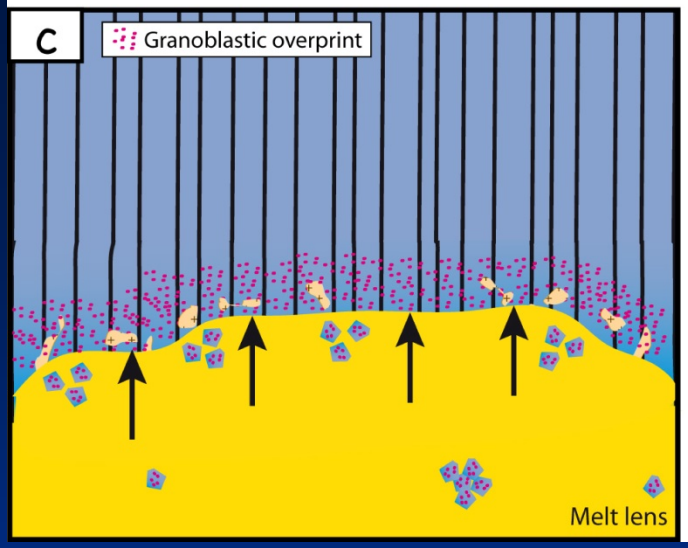
Pillow lavas in the
Semail ophiolite, Oman

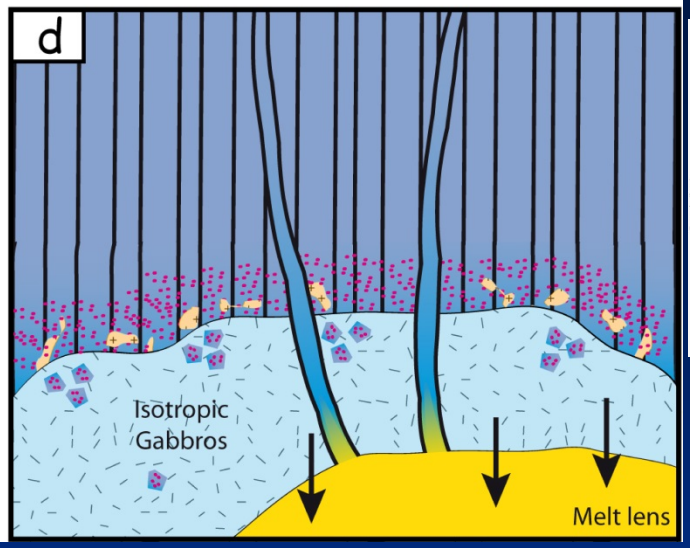
Dikes intruding pillows

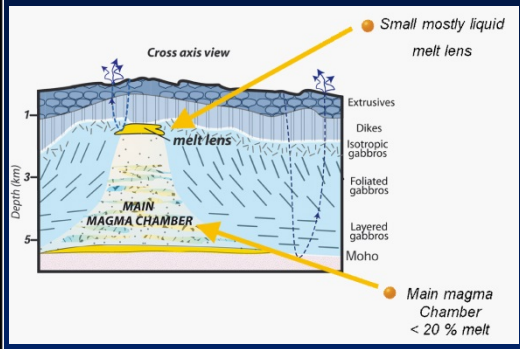
Sheeted dike complex



from Harper (1989)







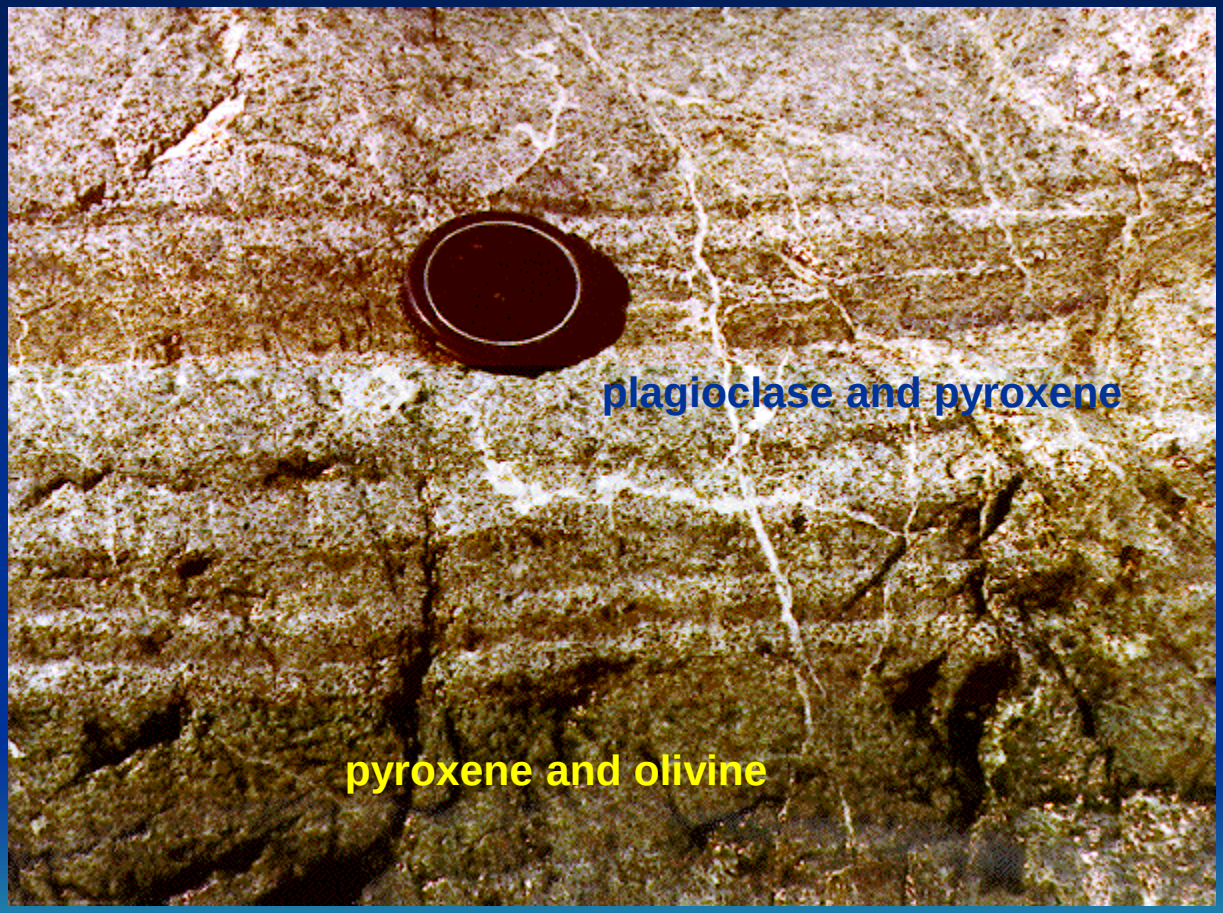
Upward migration of the melt lens causes:

- reheating and recrystallization of the base of the dikes (red dots) to granoblastic dikes
- assimilation of xenoliths in the melt lens

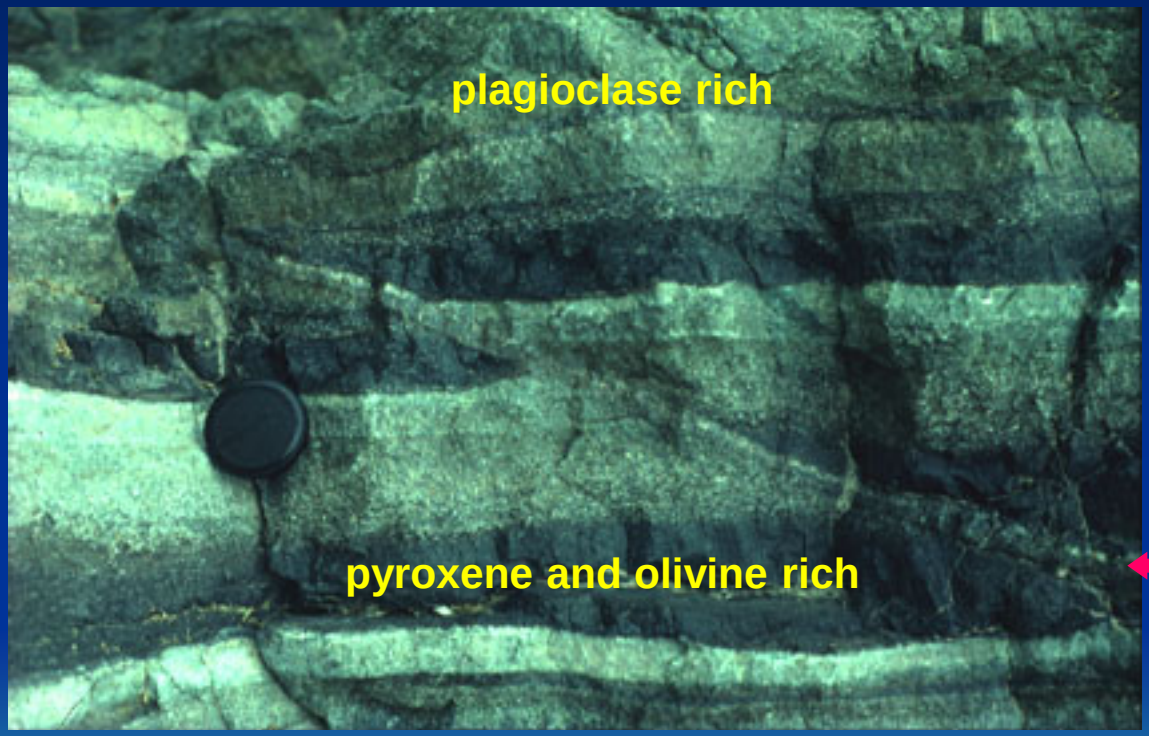
Downward migration of the top of the melt lens resulting in the crystallization of the isotropic ophitic gabbros → New dikes can be injected from below; they grade upward to "classical" dikes with chilled margins.

France et al. *Geochem. Geophys. Geosyst. (2009)*

Layered gabbro

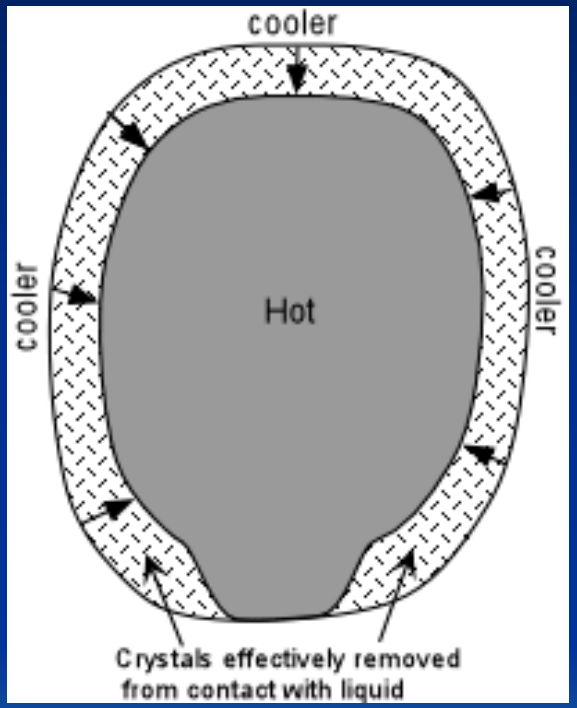


Layered gabbro

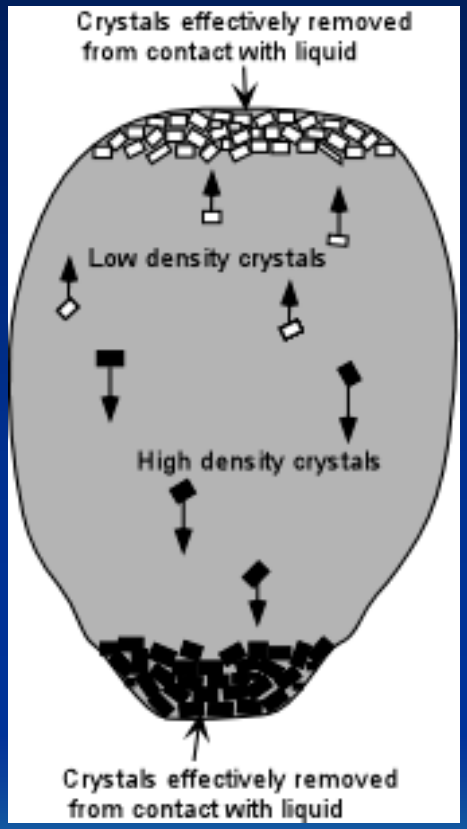


Formation of igneous layering

Inward Crystallization

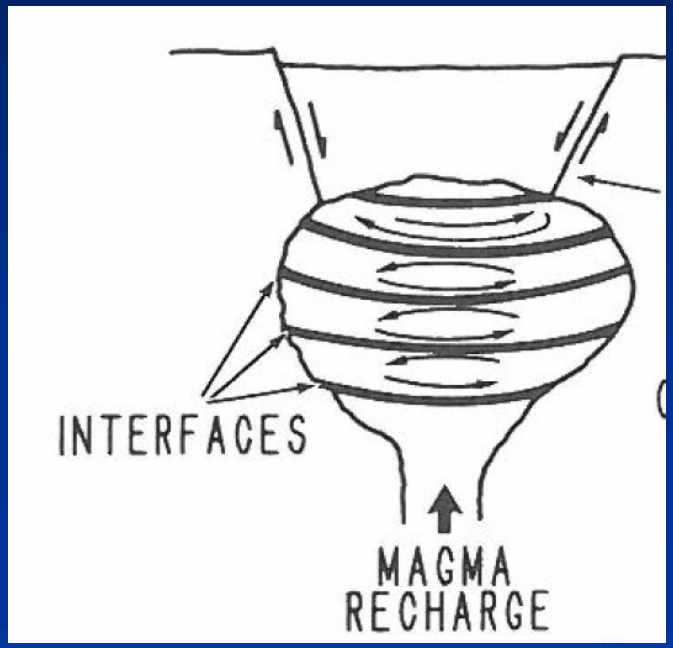


Crystal Settling/Floating



… or varying nucleation rates for different mineral phases

Double diffusive convection



a form of convection driven by two different density gradients

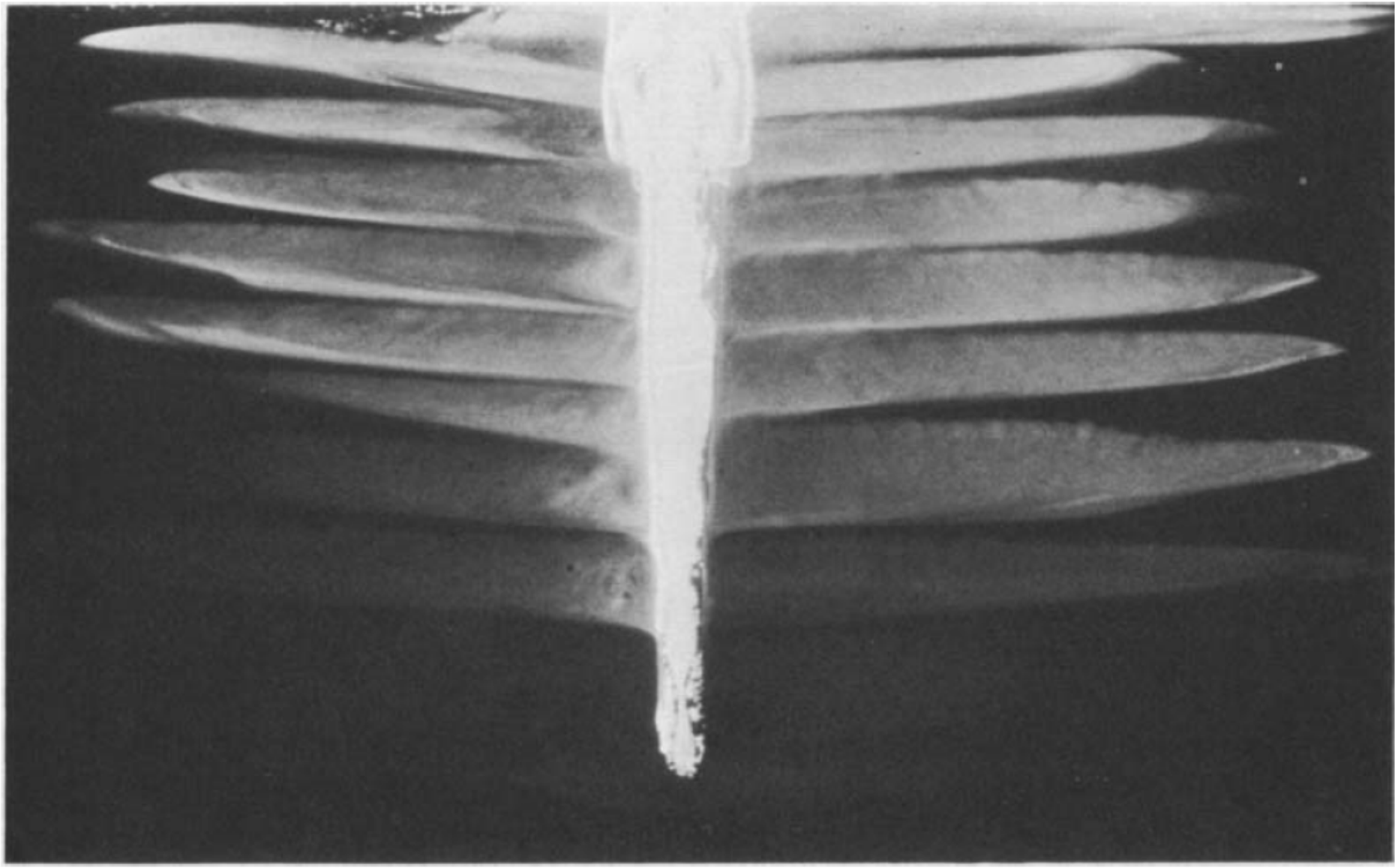


FIGURE 4. A series of layers formed by the melting of an ice block into a salinity gradient. Fluorescein dye, originally frozen into the ice, has been illuminated from the side to show the final distribution of the fresh water (from Huppert & Turner 1980).

Upper mantle composition

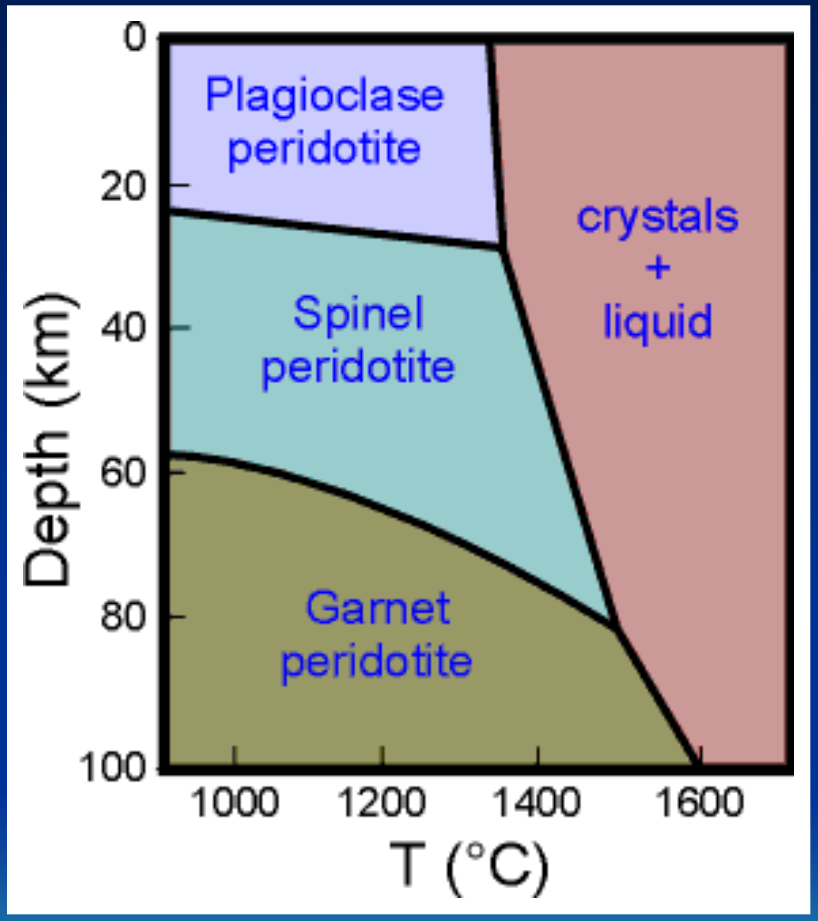
Peridotite (ultramafic)

Plagioclase-Peridotite → Spinel-Peridotite

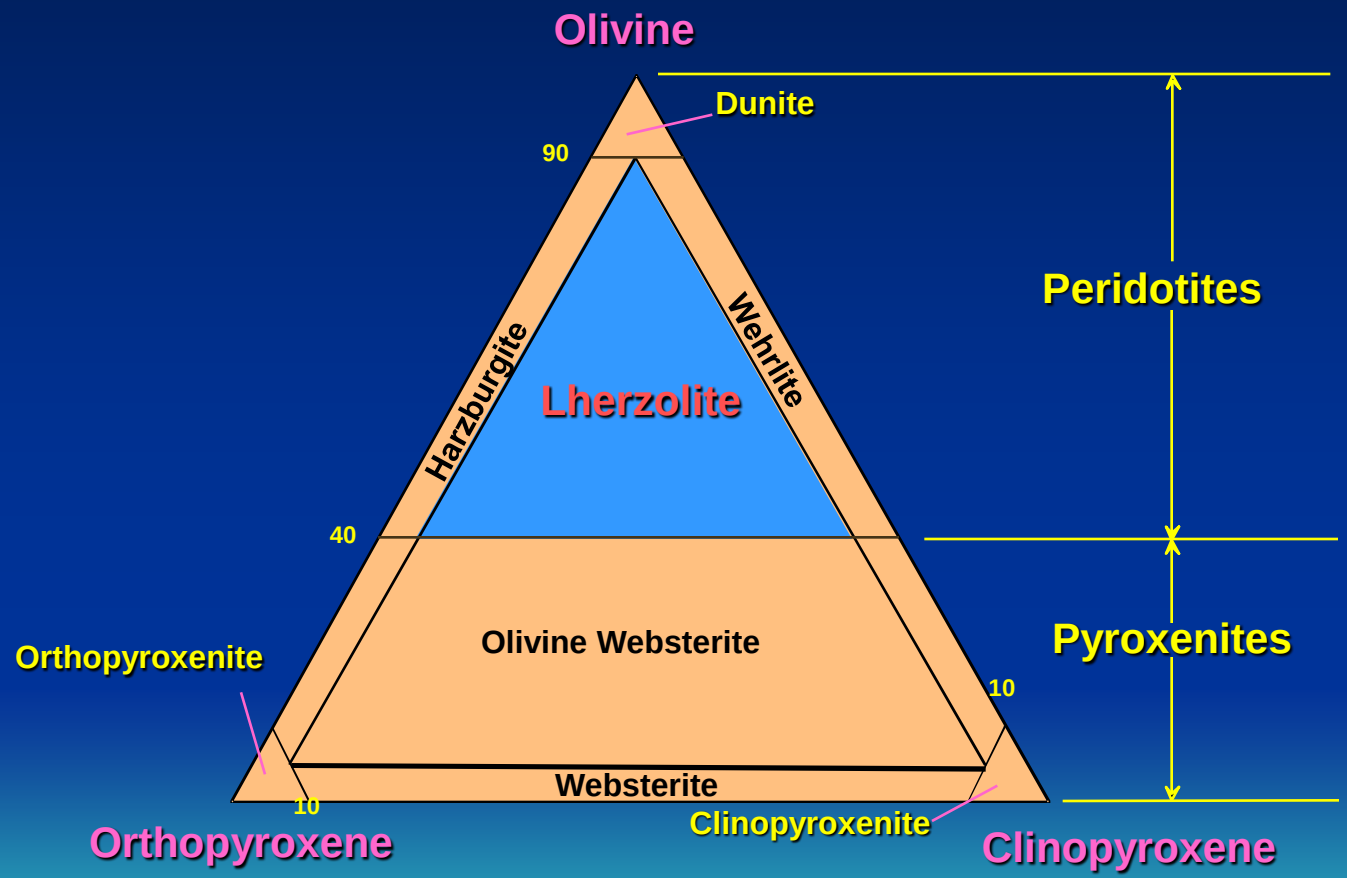
Plagioclase + Olivine =
Spinel + Cpx + Opx

Spinel-Peridotite → Garnet-Peridotite

Spinel + Cpx + Opx =
Garnet + Olivine



Lherzolite: A type of peridotite with olivine > Opx + Cpx



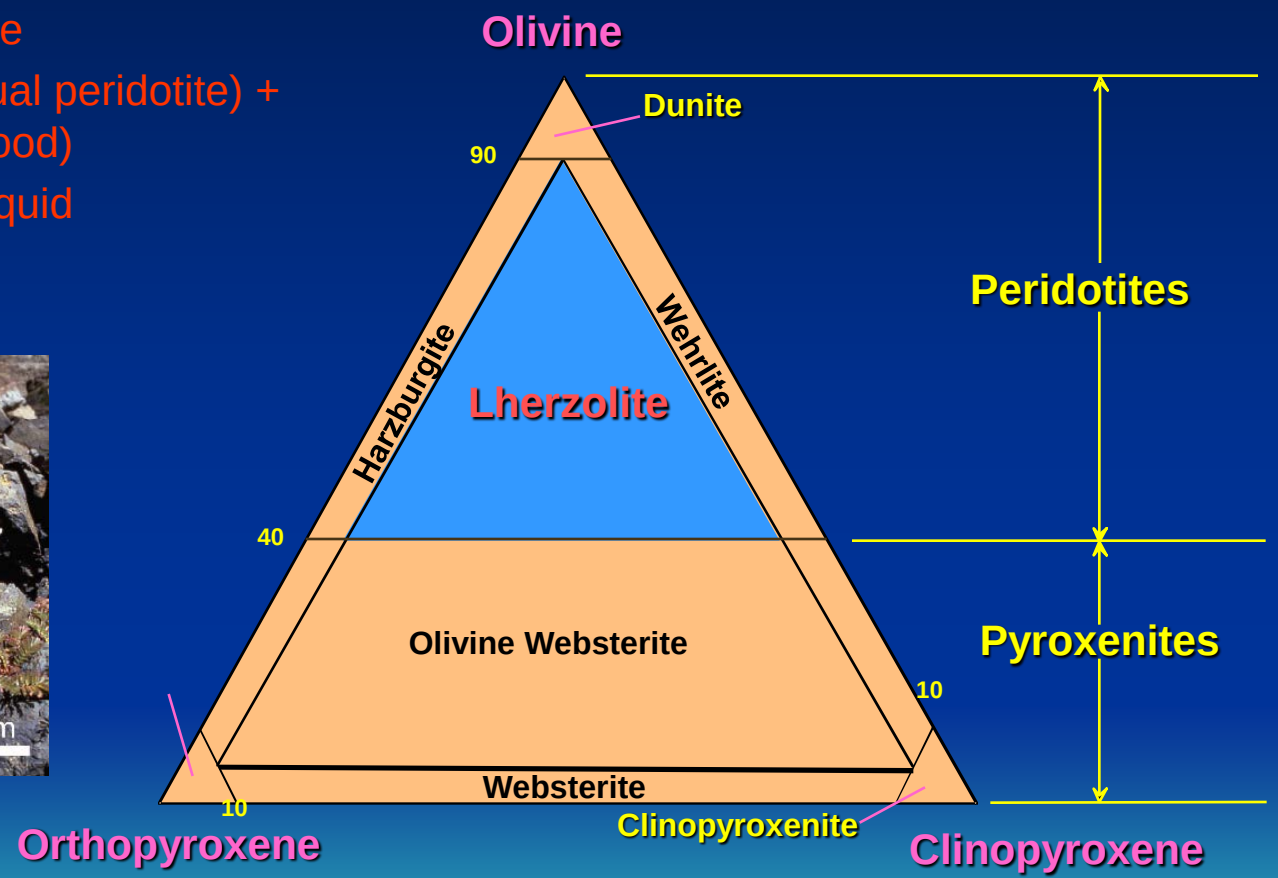
Lherzolite: type of peridotite with olivine > Opx + Cpx

Pyrolite = primitive fertile mantle

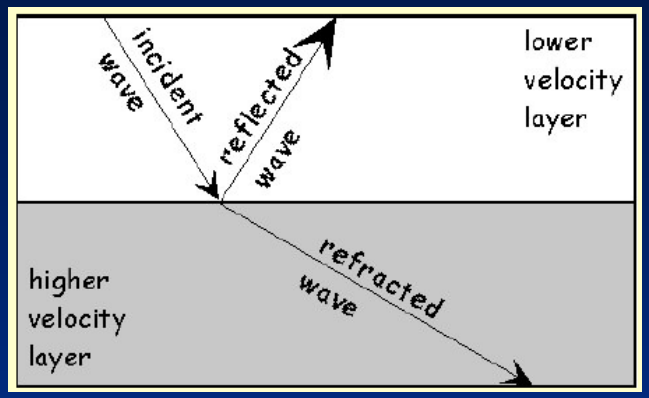
Pyrolite = 3 parts dunite (residual peridotite) + 1 part basalt (Ringwood)

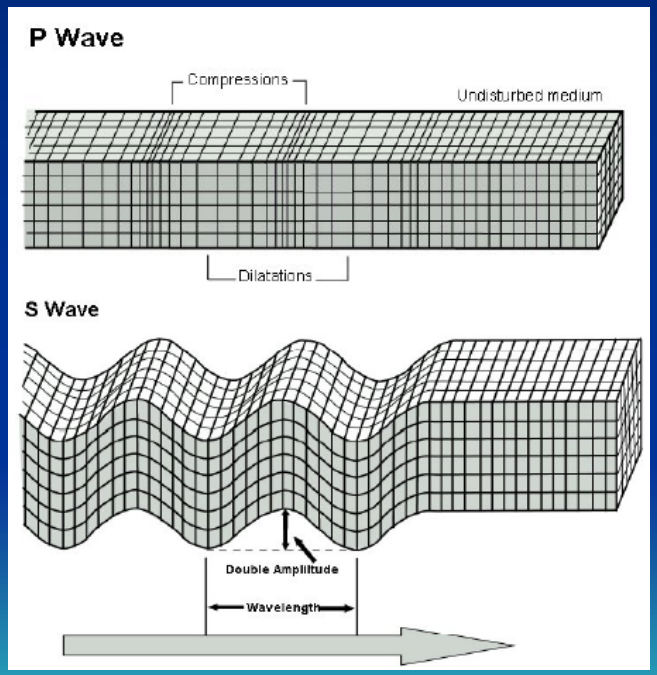
Melting of pyrolite → basaltic liquid

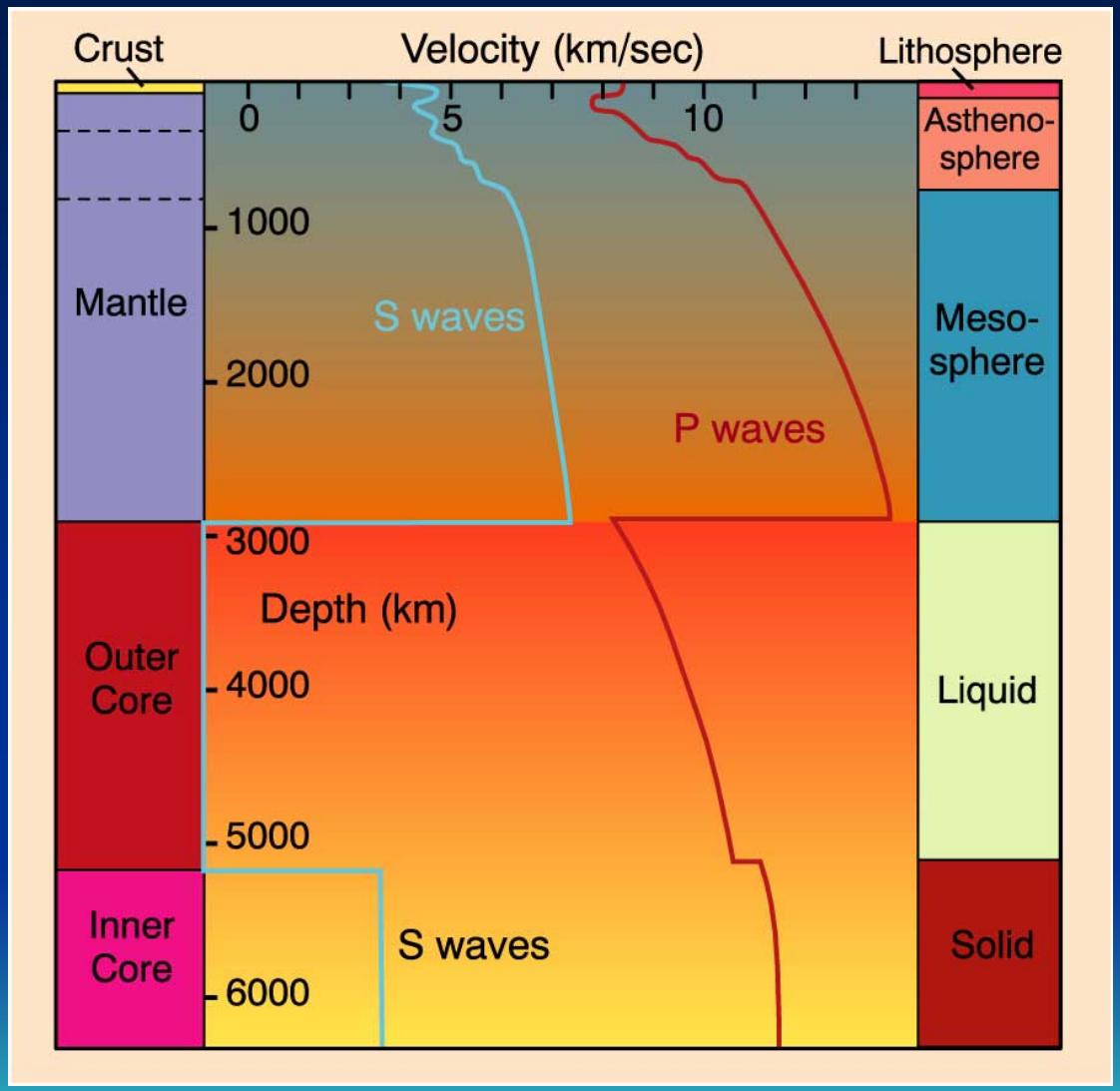
Residue = harzburgite



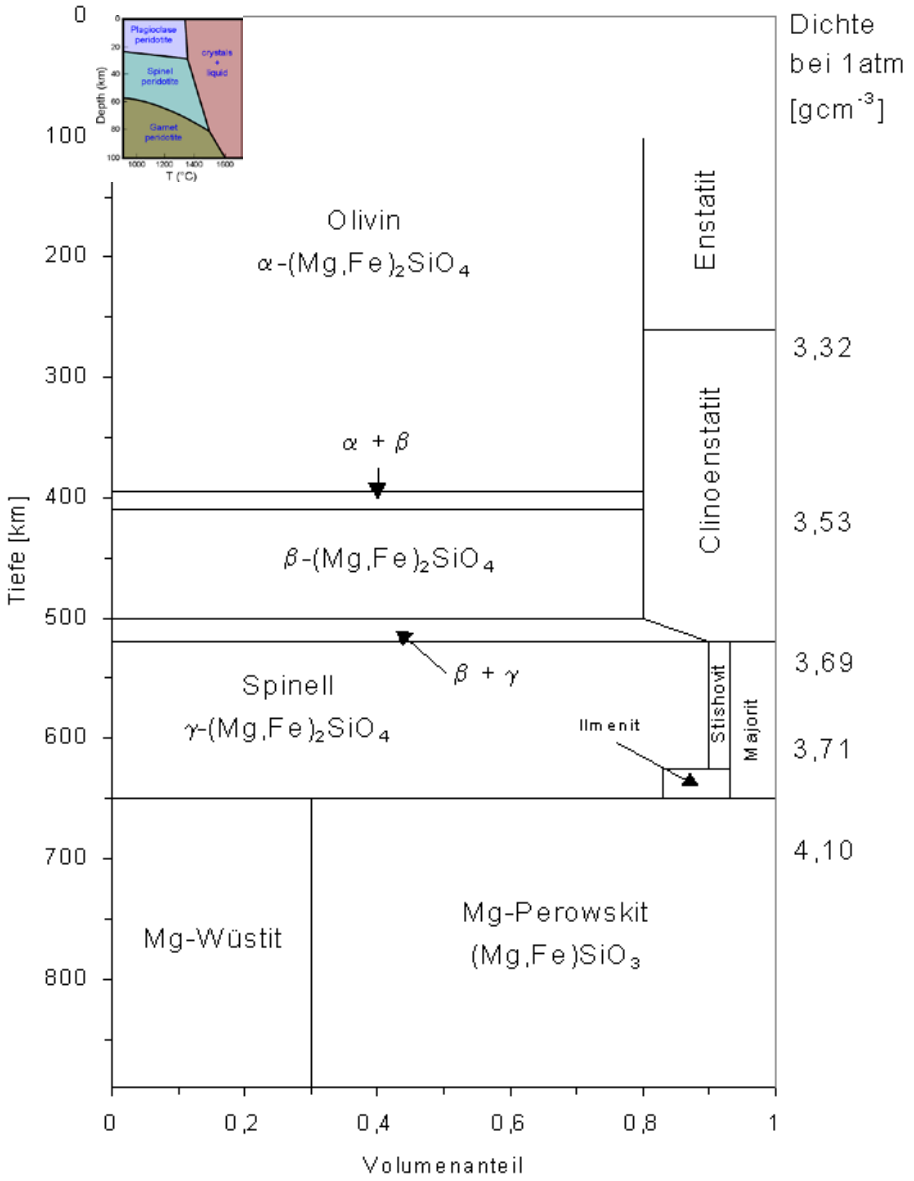
Variation in P and S wave velocity with depth







Mantle composition



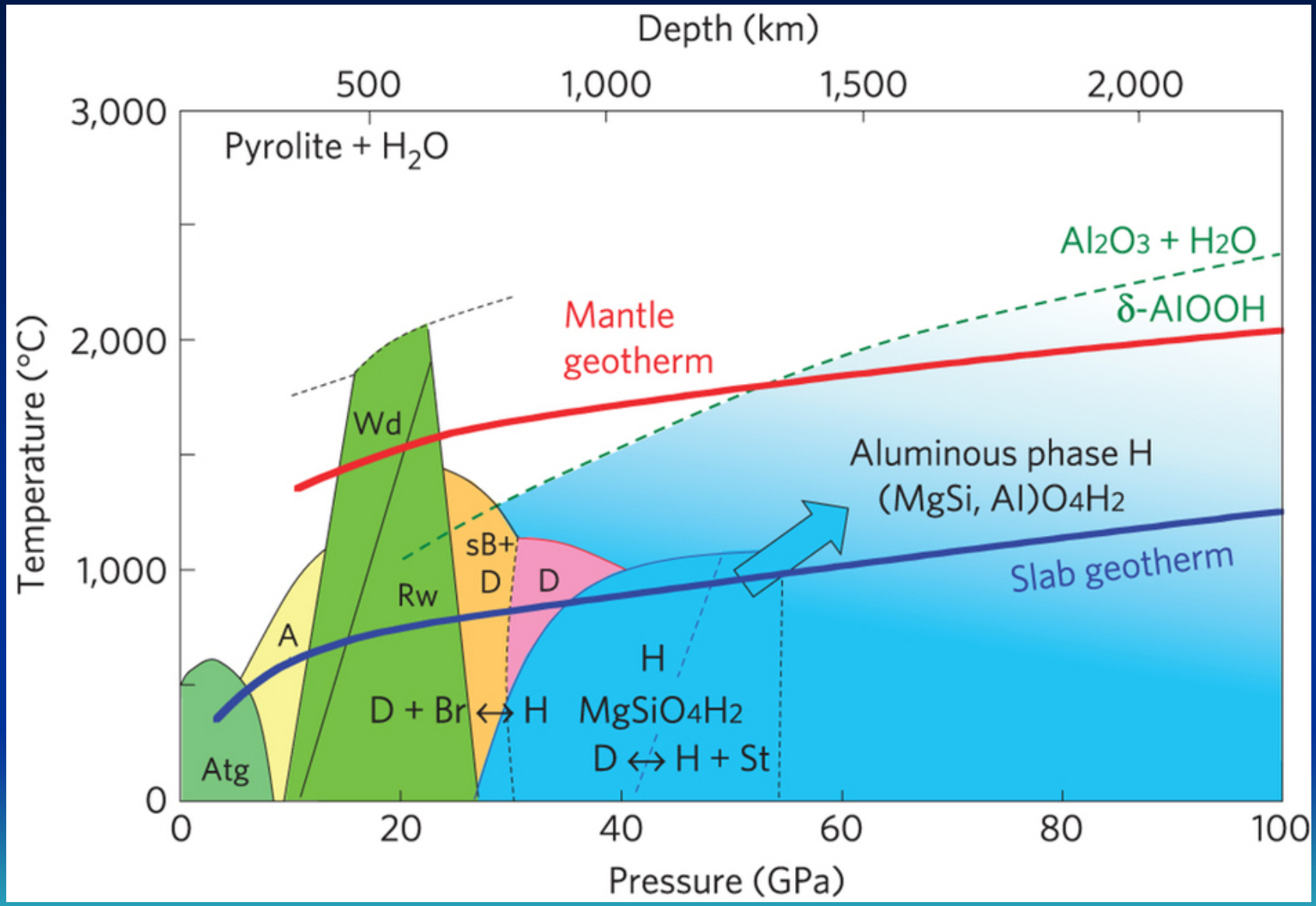
High pressure phase transitions:

~410 km: olivine → wadsleyite

~520 km: wadsleyite → ringwoodite

~660 km: ringwoodite → perovskite + wüstite (SiIV → SiVI)

Stability of hydrous silicate and water transport to the deep lower mantle



Nishi et al. (2014) Nature Geoscience 7, 224–227

The Earth's Interior

Mantle:

Peridotite

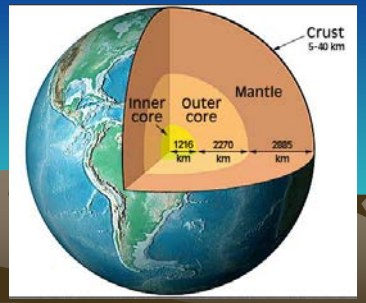
Upper to 410 km (olivine)

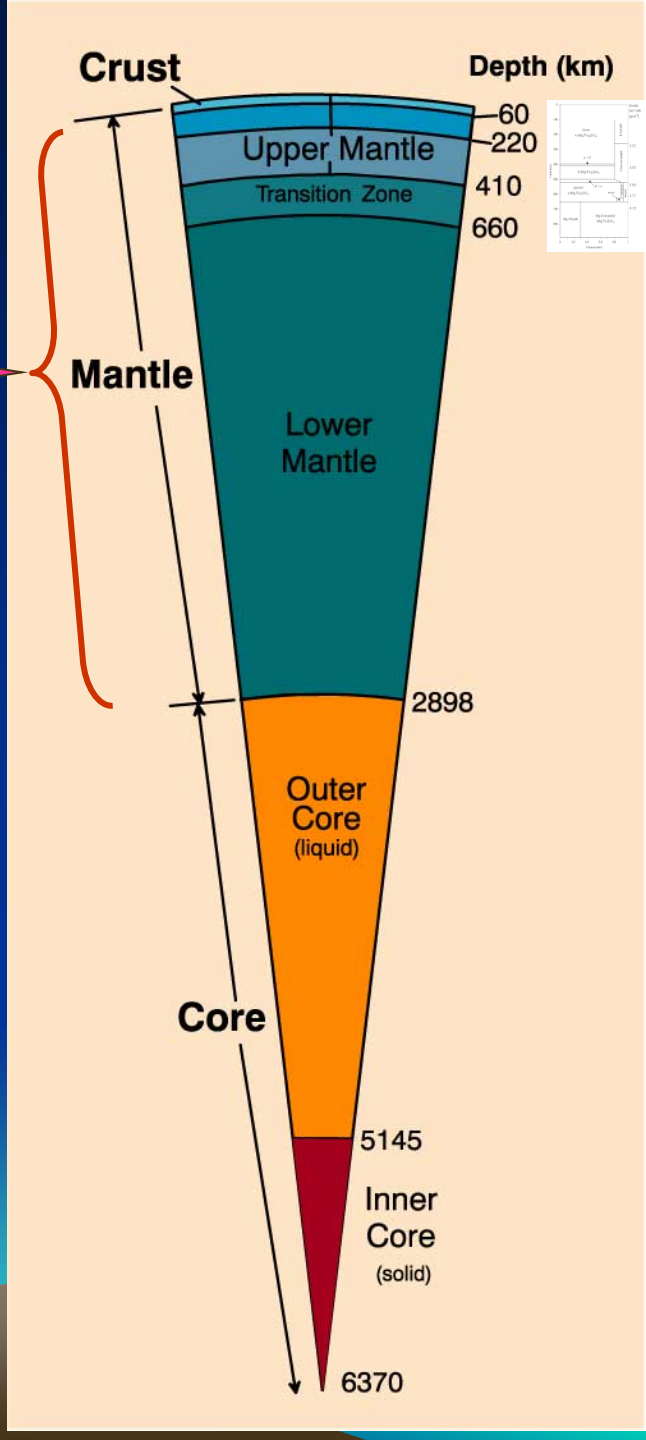
- Low Velocity Layer 60-220 km

Transition Zone as velocity increases ~ rapidly

- 660 km
  - γ-Olivin $\rightarrow$ Mg-Perowskit + Mg-Wüstit
  - Cpx + Gnt $\rightarrow$ Majorit

Lower Mantle has more gradual velocity increase

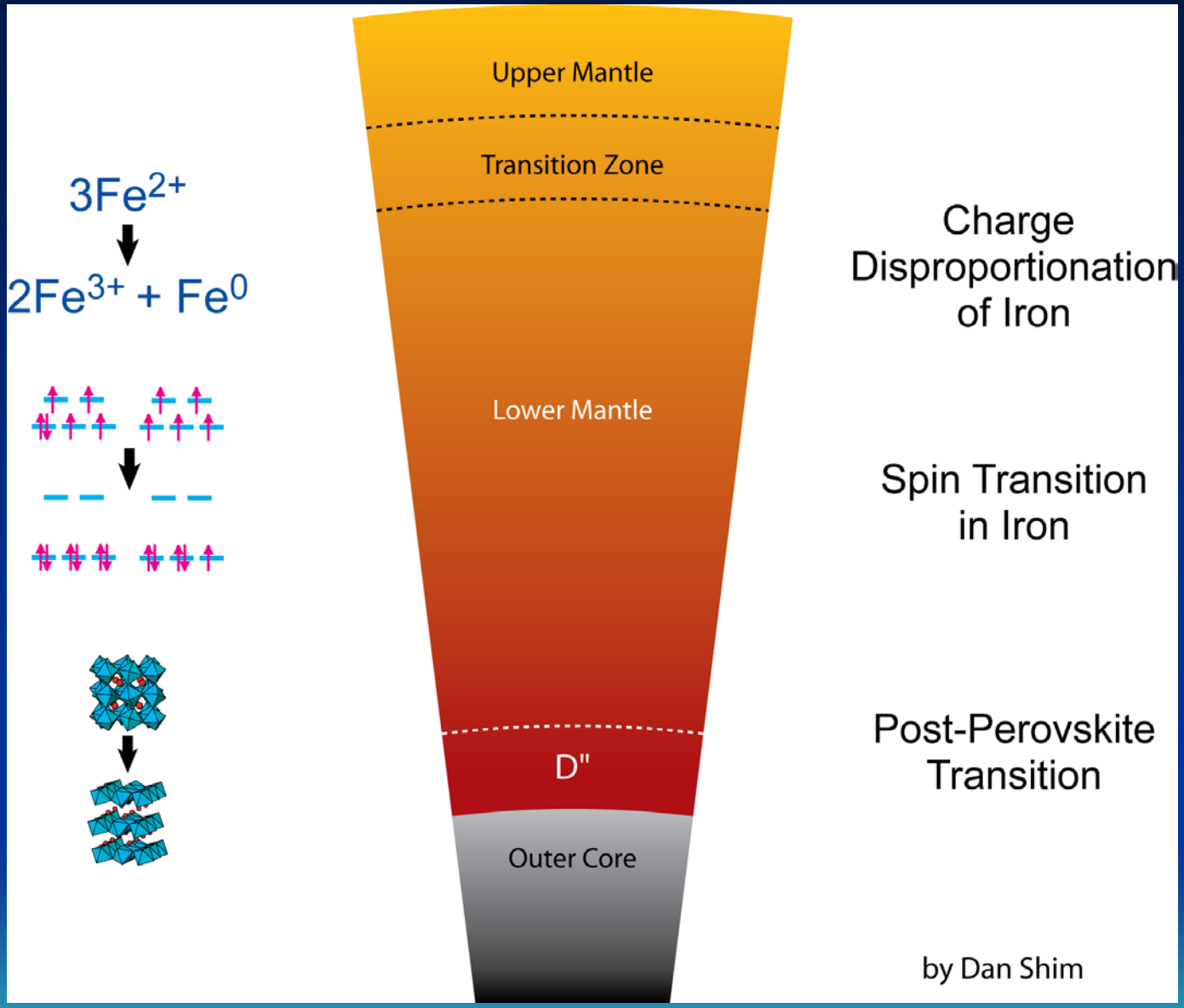




ferrous iron undergoes charge disproportionation to ferric iron, which still remains in perovskite, and metallic iron, which may precipitate out from perovskite.

iron undergoes changes in its electronic configuration.

silicate perovskite undergoes a transition to post-perovskite.



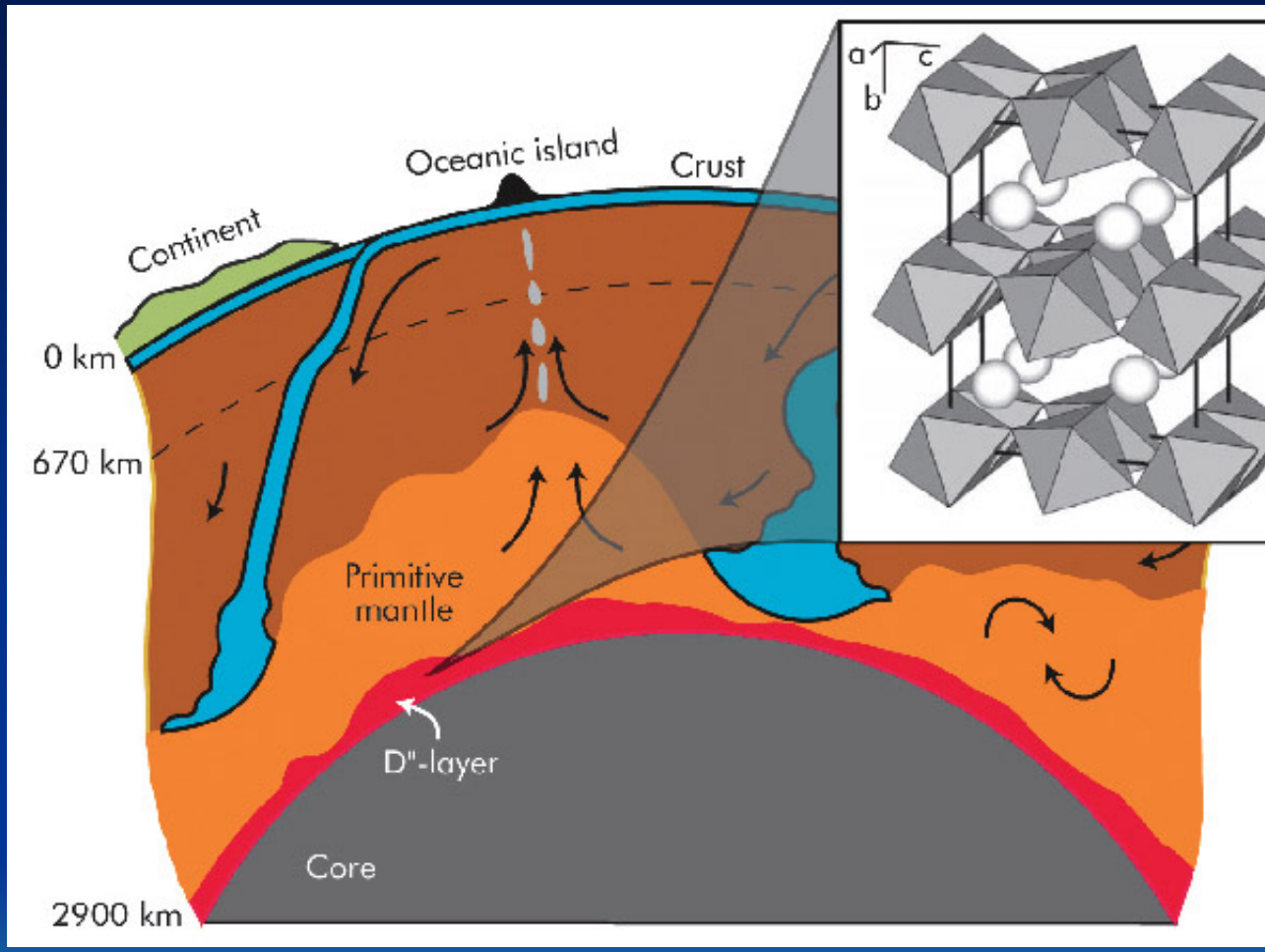
Shim (2008) Ann Rev Earth Planet Sci 36, 569-599

Perovskite to post-perovskite transition and the nature of D''

Near the base of the mantle $MgSiO_3$ perovskite transforms to a new high-pressure form with stacked SiO_6-octahedral sheet structure with an increase in density of 1.0 to 1.2%.

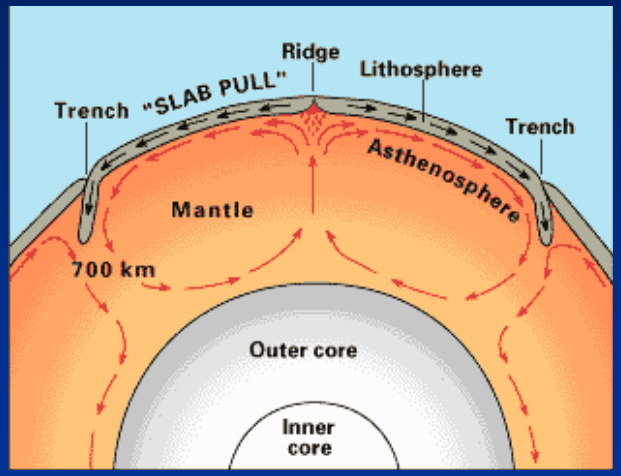
The origin of the D″ seismic discontinuity may be attributed to this post-perovskite phase transition.

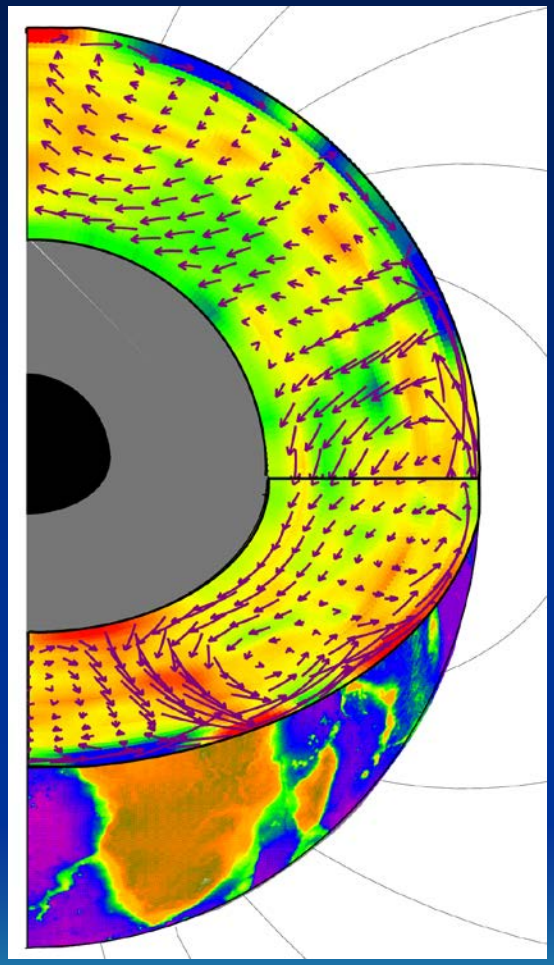
The new phase has preferred orientation with platy crystal shape that can cause the seismic anisotropy in the D″ layer.

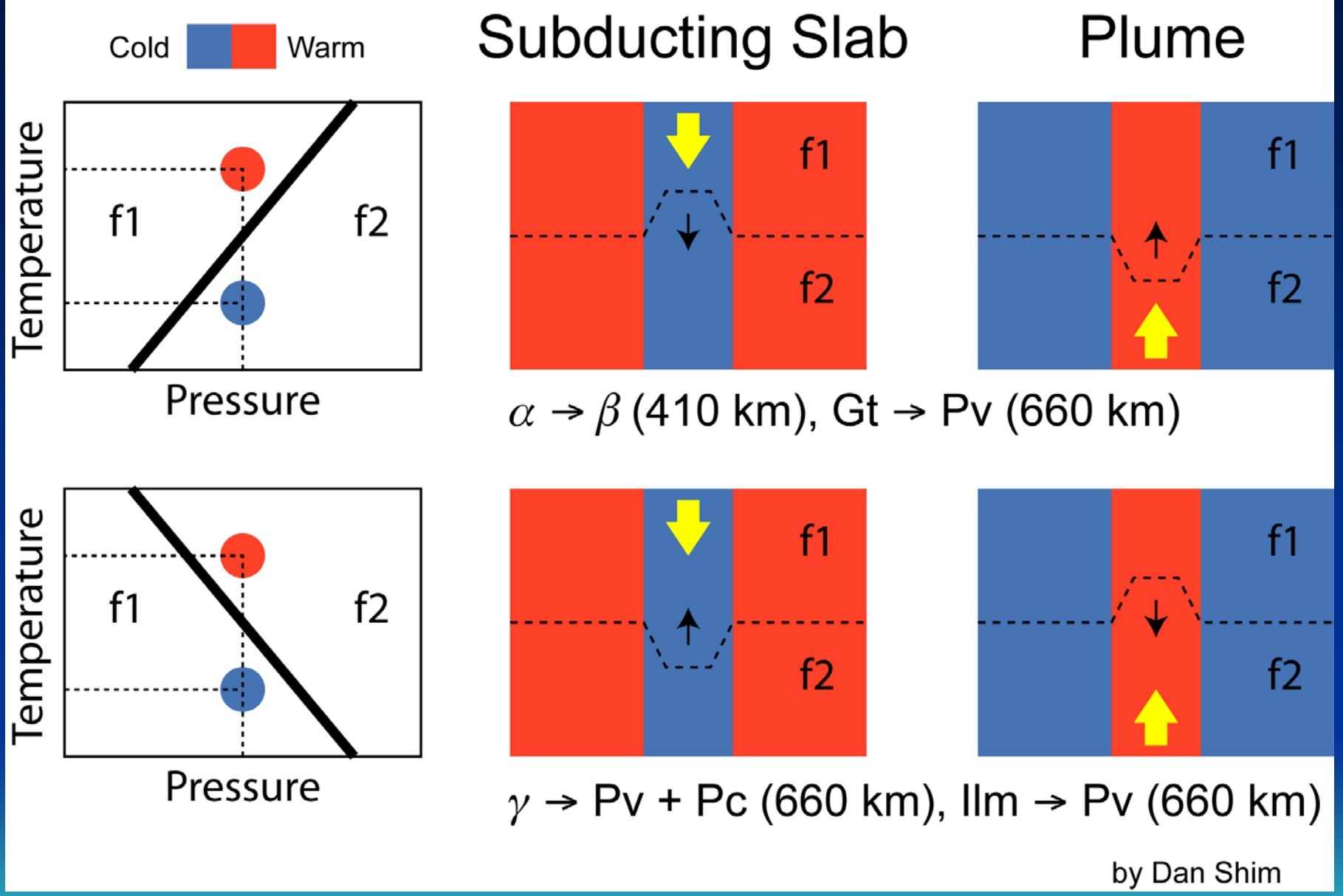


Murakami et al. (2004) Science 304, 855-858
Andrault et al. (2010) Earth Planet Sci Lett 293, 90-96

Mantle convection







Christensen (2001) Physics of the Earth and Planetary Interiors 127, 25–34