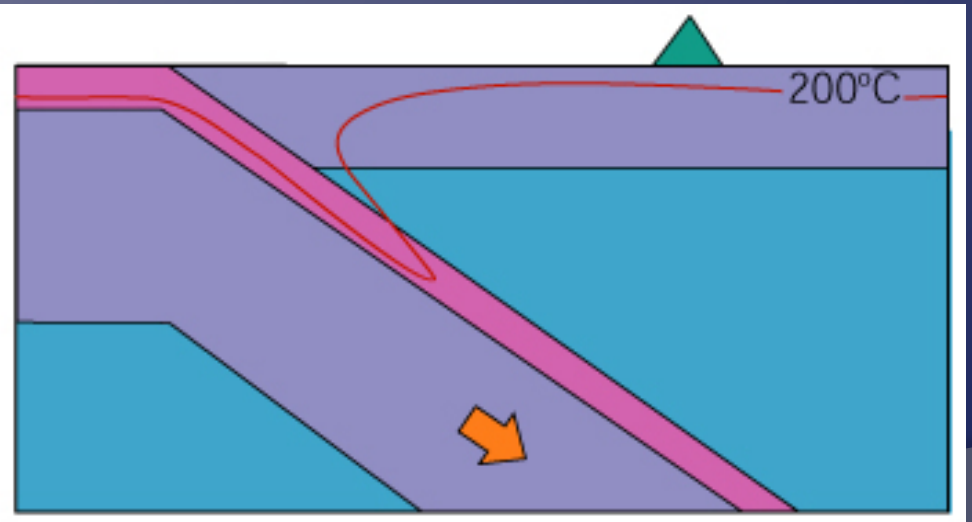
Sarah Lambart - 2016

LECTURE 19: SUBDUCTION MAGMATISM

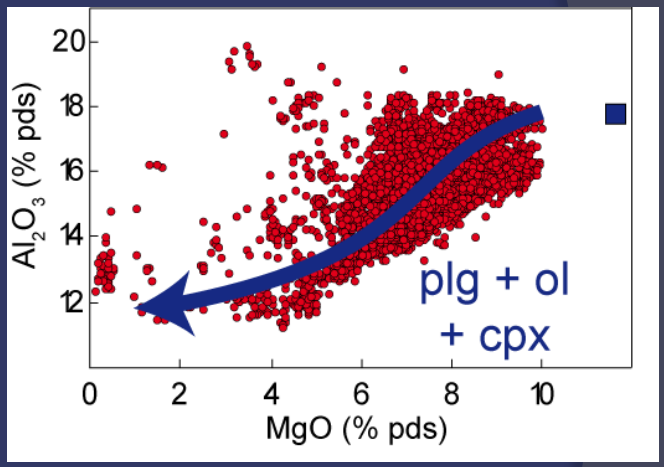


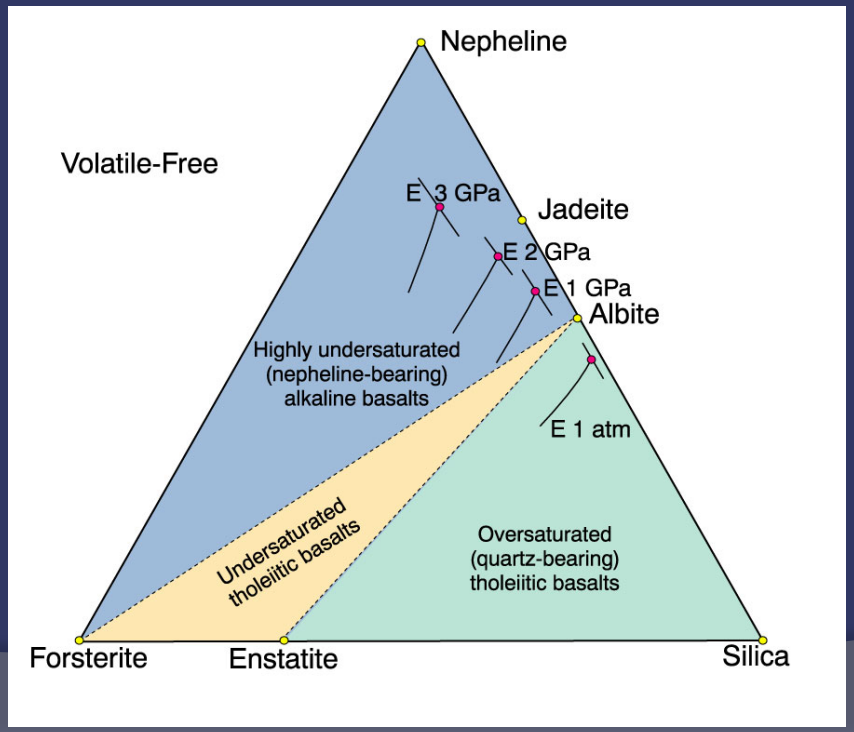
Recap Lecture 18: MORB

- Facts:
  - Oceanic floors: 60% of Earth's surface
  - Most of the rocks produced at ridges are MORB
  - Large compositional variability
    1) Magma differentiation/crystallization
    2) Melting conditions (Pressure, Temperature)
    3) Source composition
    (4) Melt segregation and transport)

Recap Lecture 18: MORB
1) low pressure crystallization

- Petrography: Mineral association: Ol (Mg-rich) ± Sp, Cpx, Plg
- Geochemistry

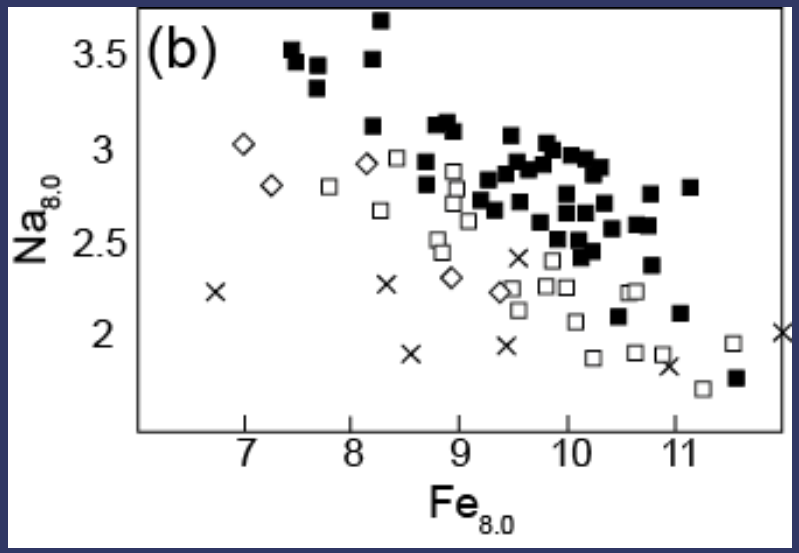


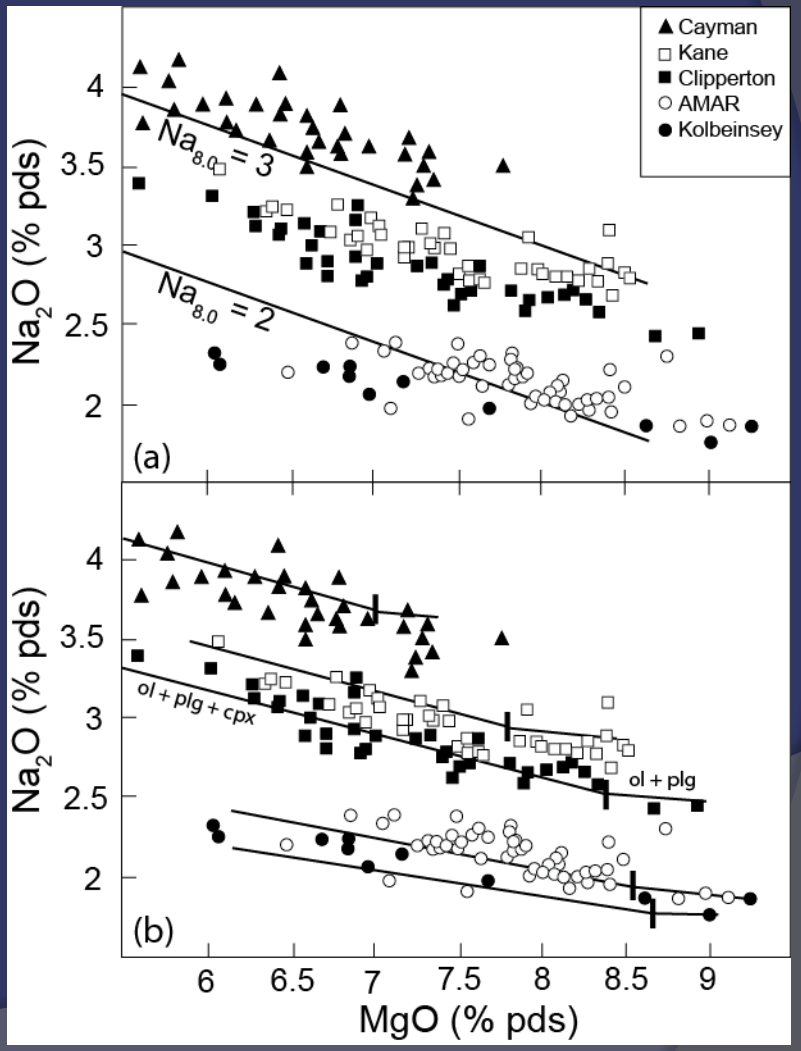


- Experimental petrology

Recap Lecture 18: MORB

1) Correction for low pressure crystallization

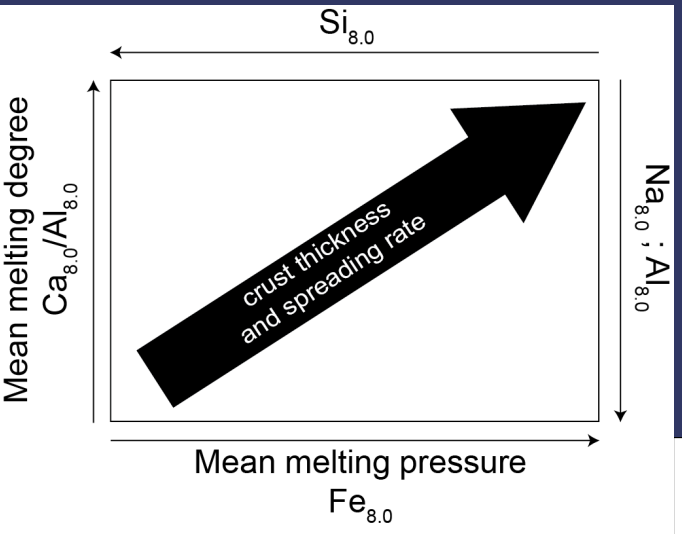




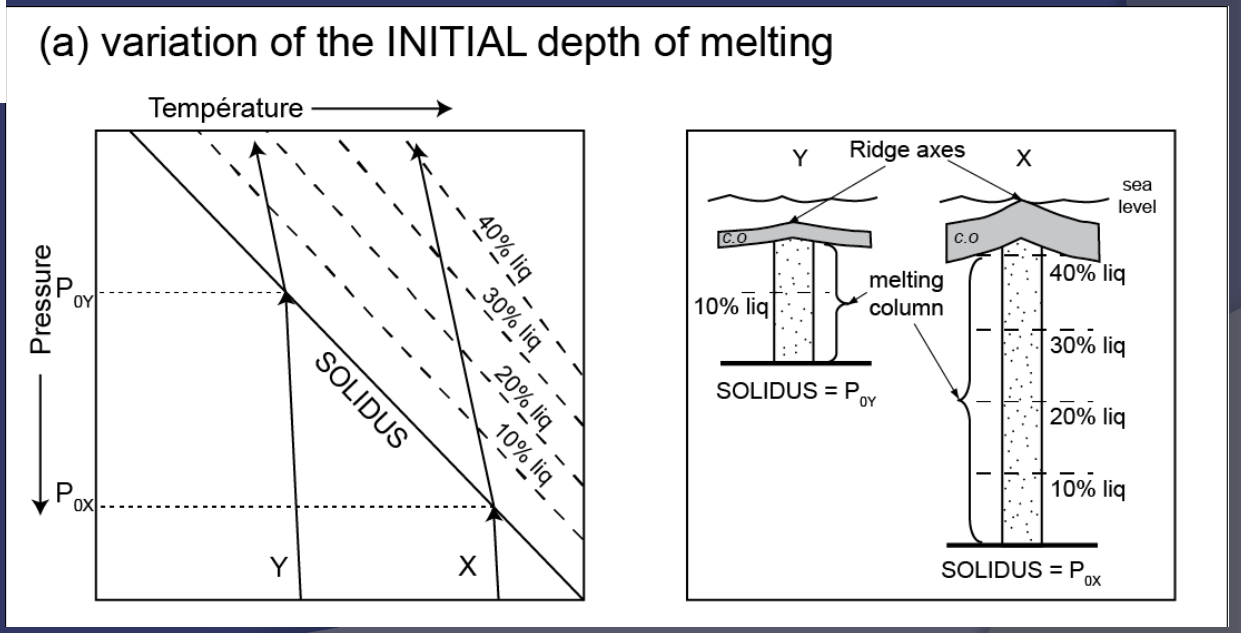
Modified from Langmuir et al., 1992

Recap Lecture 18: MORB

2) melting process



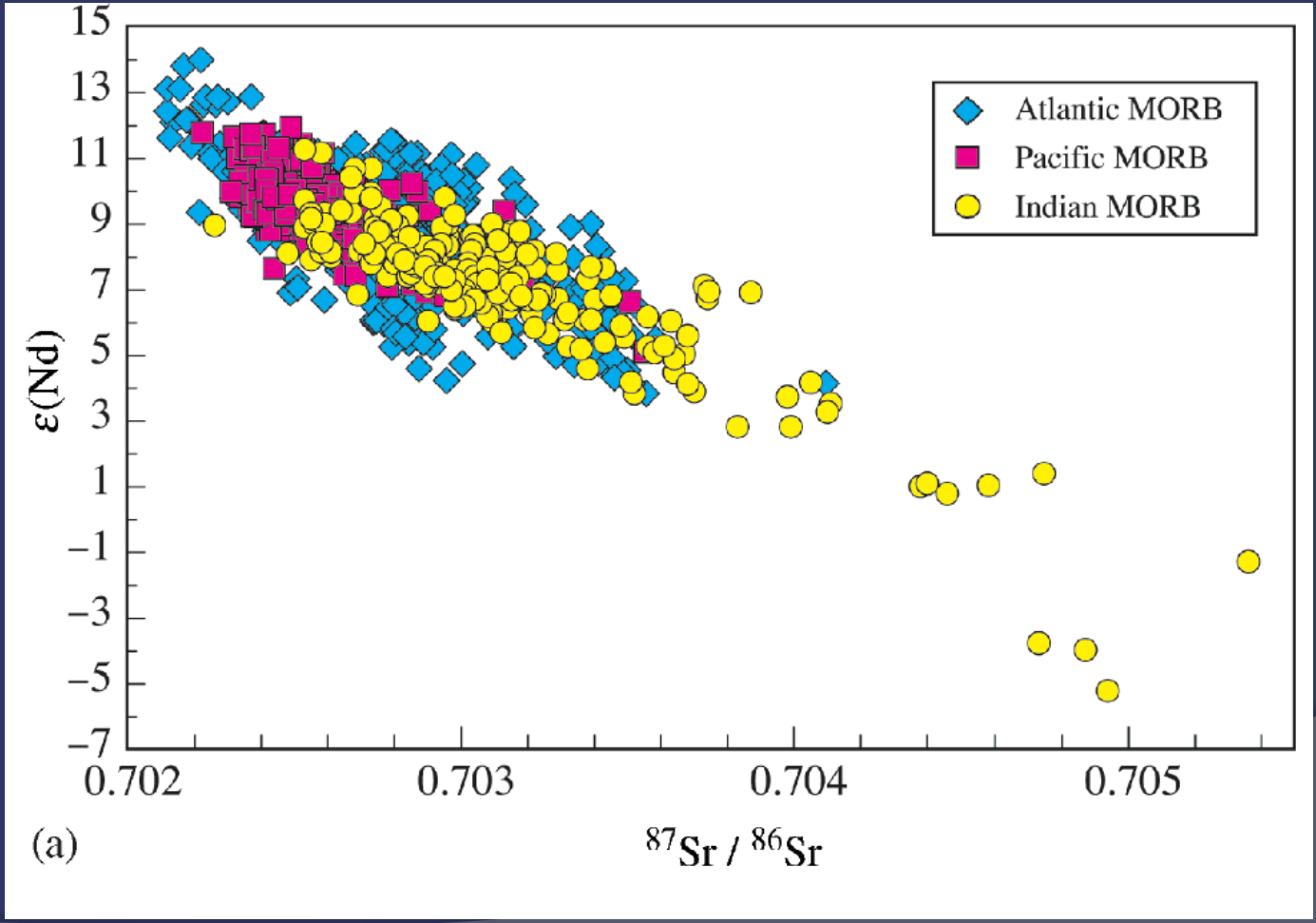
Major element variations of primary MORB: variations of F_{mean} and P_{mean}



From Klein and Langmuir, 1987

Recap Lecture 18: MORB

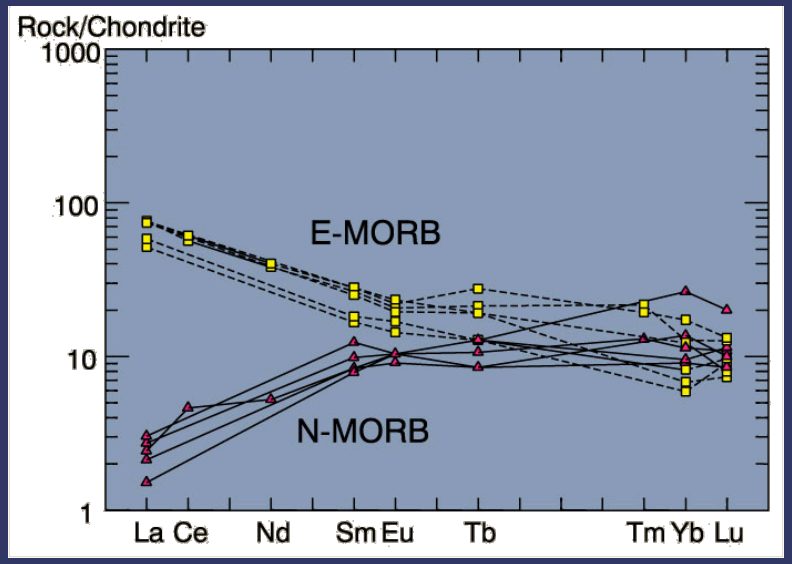
3) Source composition

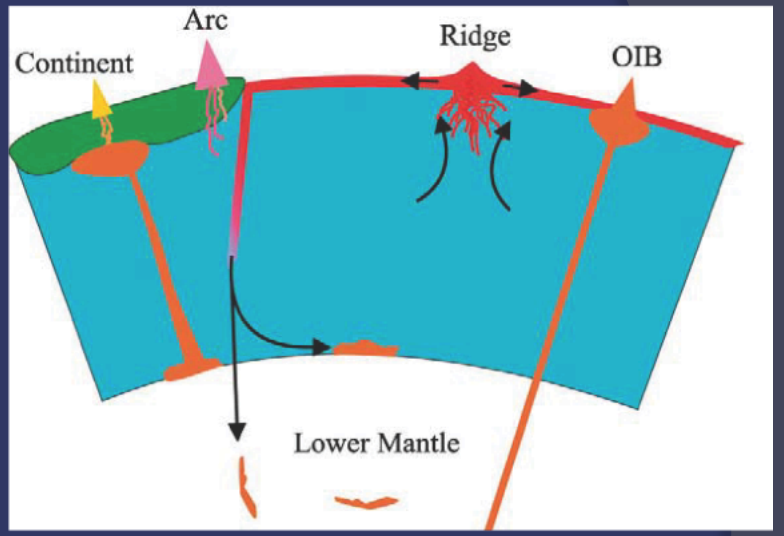


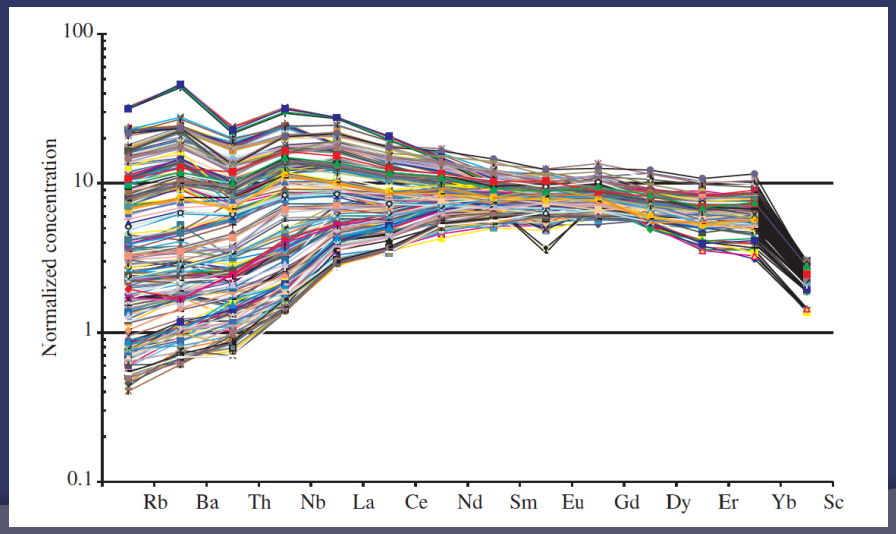
From Hofmann, 2003, Treatise on Geochemistry, Volume 2.

Recap Lecture 18: MORB

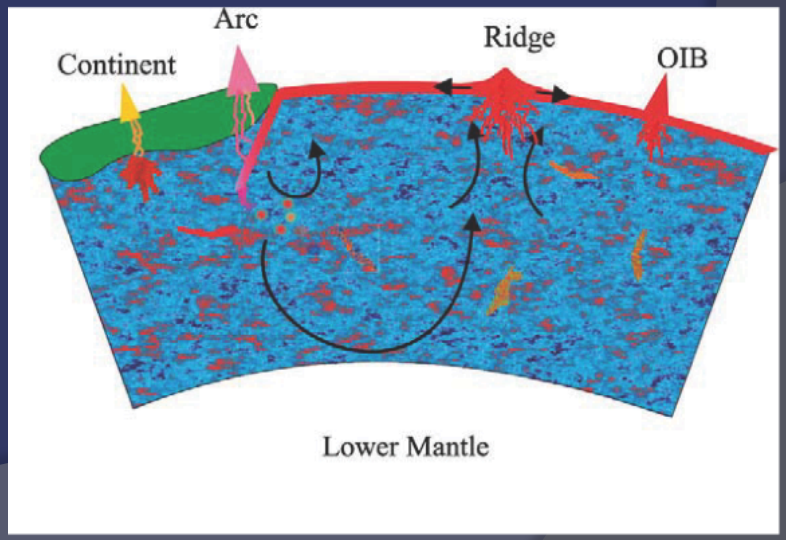
3) Source composition : 2 models







Hofmann, 2003, Treatise on Geochemistry, Vol. 2.



Meiborn and Anderson, 2003, EPSL 217

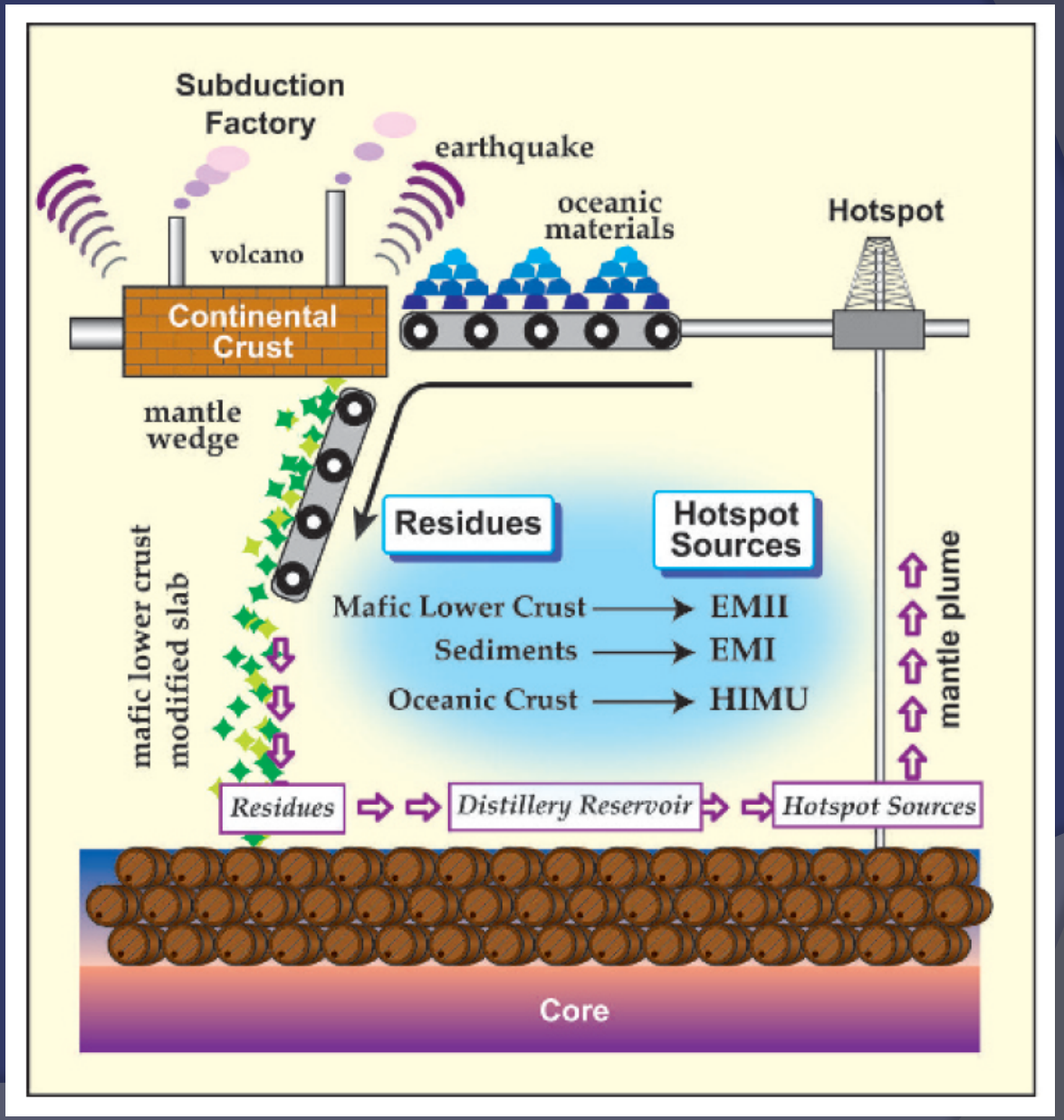
Recap Lecture 18: MORB

Summary

- Most of the variation in major element compositions: low pressure crystallization
- “Rest” of the variation in major element compositions: different thermal states of the mantle
- Variations of isotopic compositions and part of the variation in trace element compositions: source heterogeneity

The Subduction Factory

From Tatsumi, Y. (2005) The subduction factory: How it operates in the evolving Earth. GSA Today, **15**, 4-10.



Subduction Zones

Island arc: ocean.-ocean.

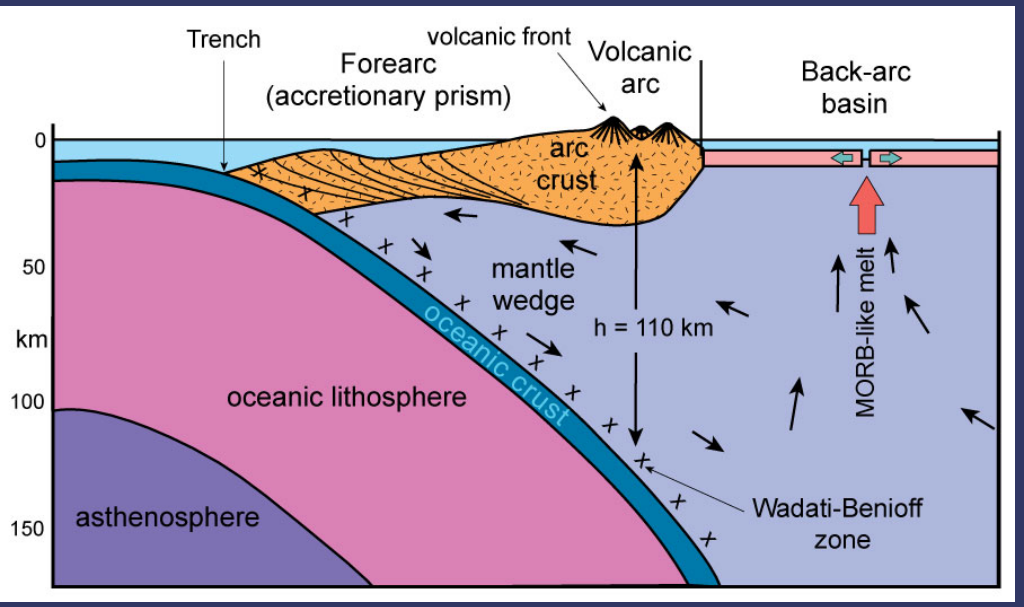


Fig. 16.2 in Winters

Continental arc: ocean.-cont.

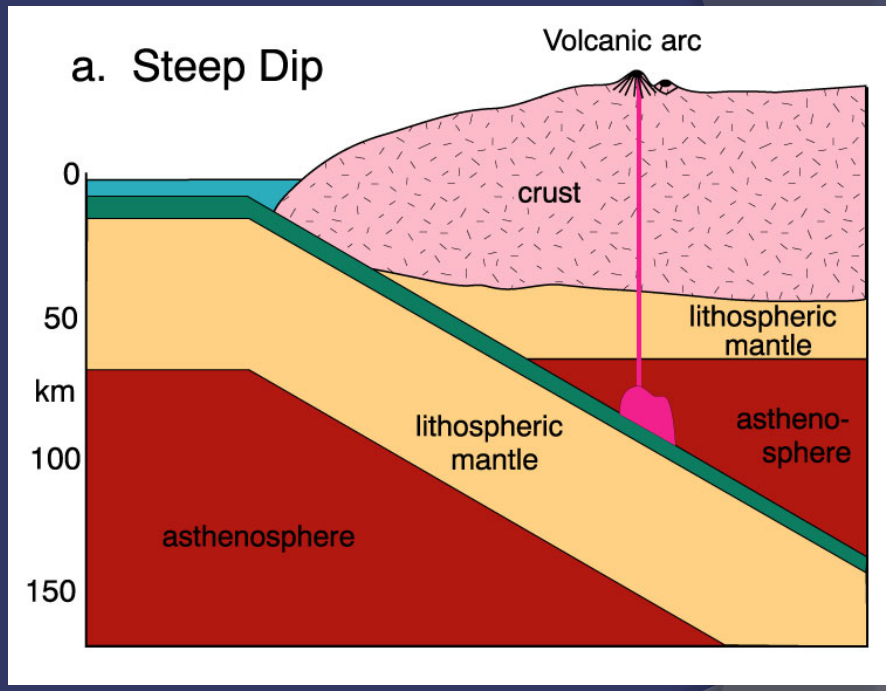
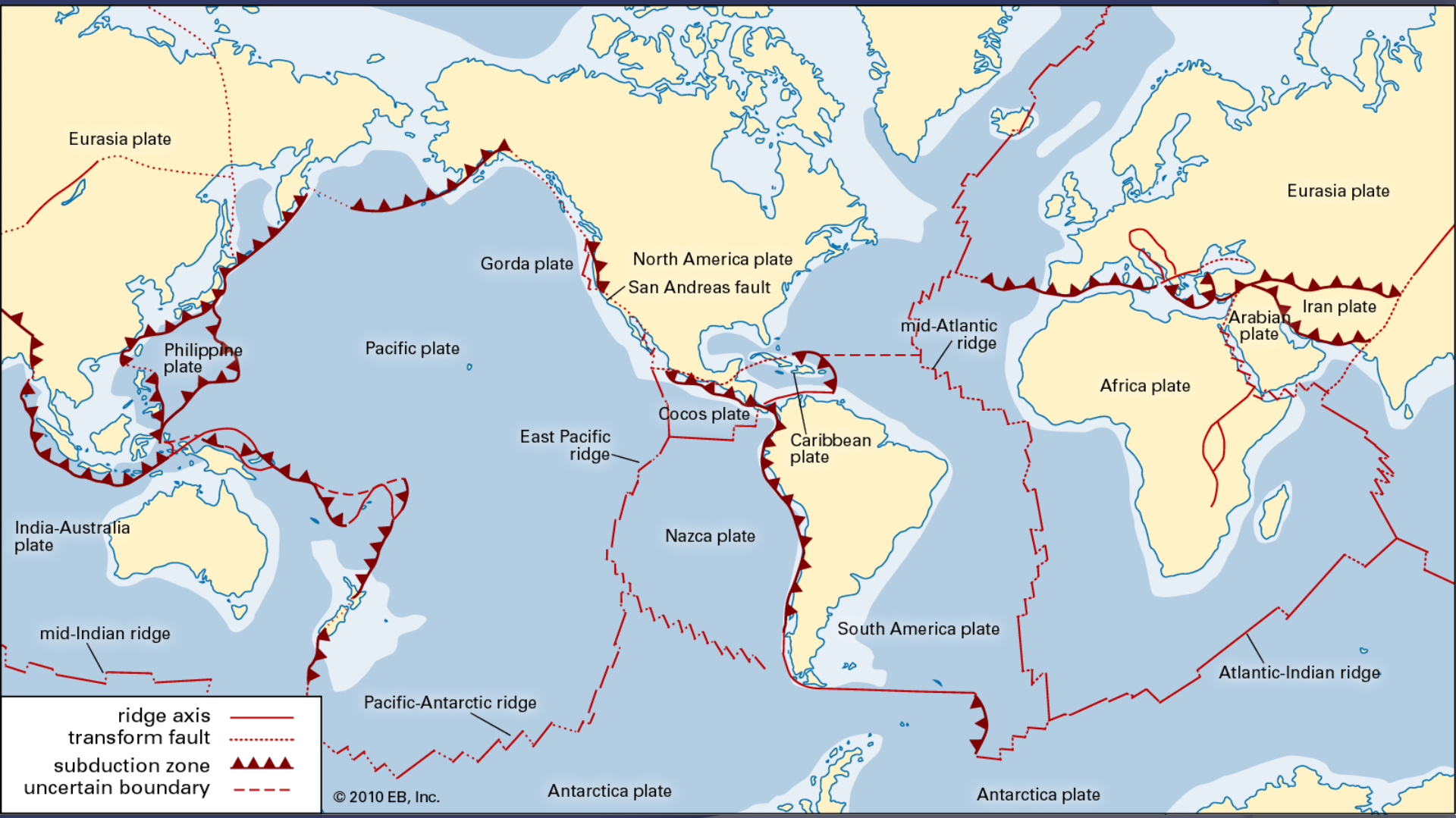


Fig. 17.2 in Winters

Subduction Zones



Magmatic series

- Much larger compositional diversity than oceanic magmatism
- Presence of 4 magmatic series:
  - Tholeiitique
  - Calc-alkaline
  - K-rich calco-alkaline
  - Shoshonitique (K-rich alkaline series)

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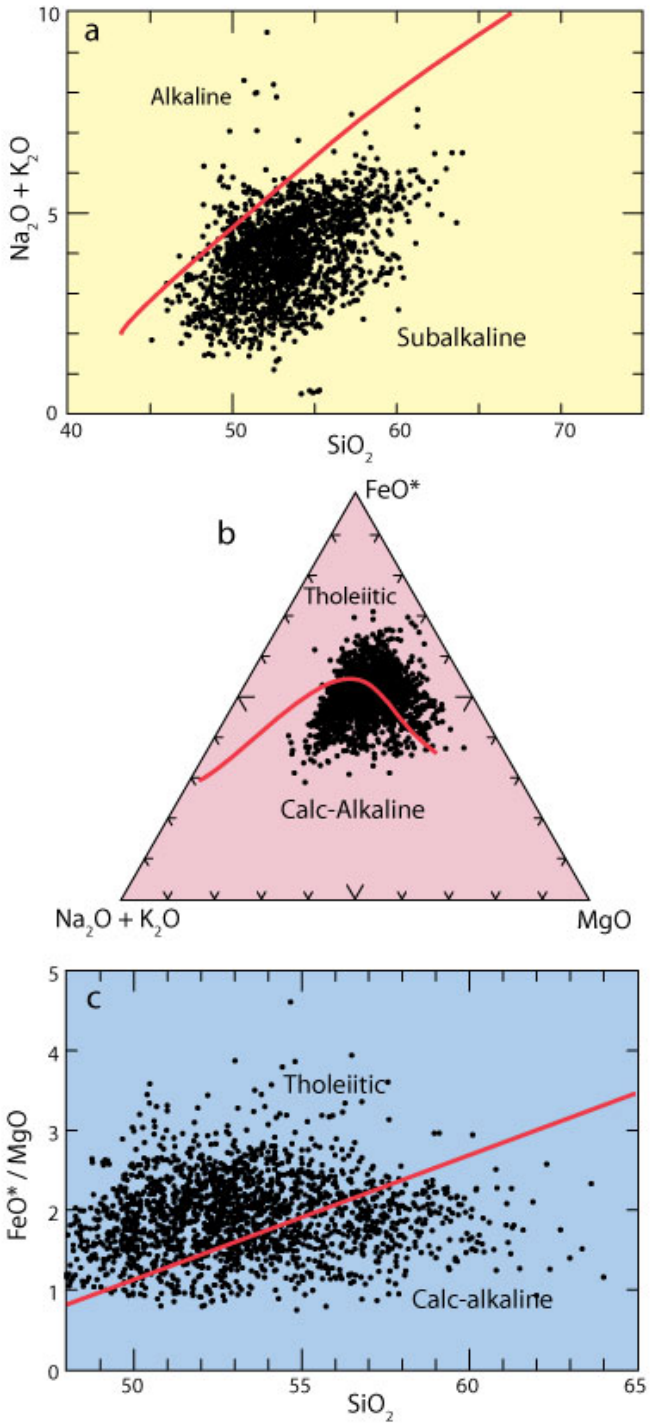


Fig. 16.3 in Winters

Island Arc

- Magmatic series:
  - Young arc: tholeiitic (mostly basalt)
  - Mature arc: tholeiitic and calc-alkaline (andesite)

  ⇒ temporal variation

- Japan arc: increase of the K_2O content with distance to the trench

  ⇒ Spatial variation

Island Arc

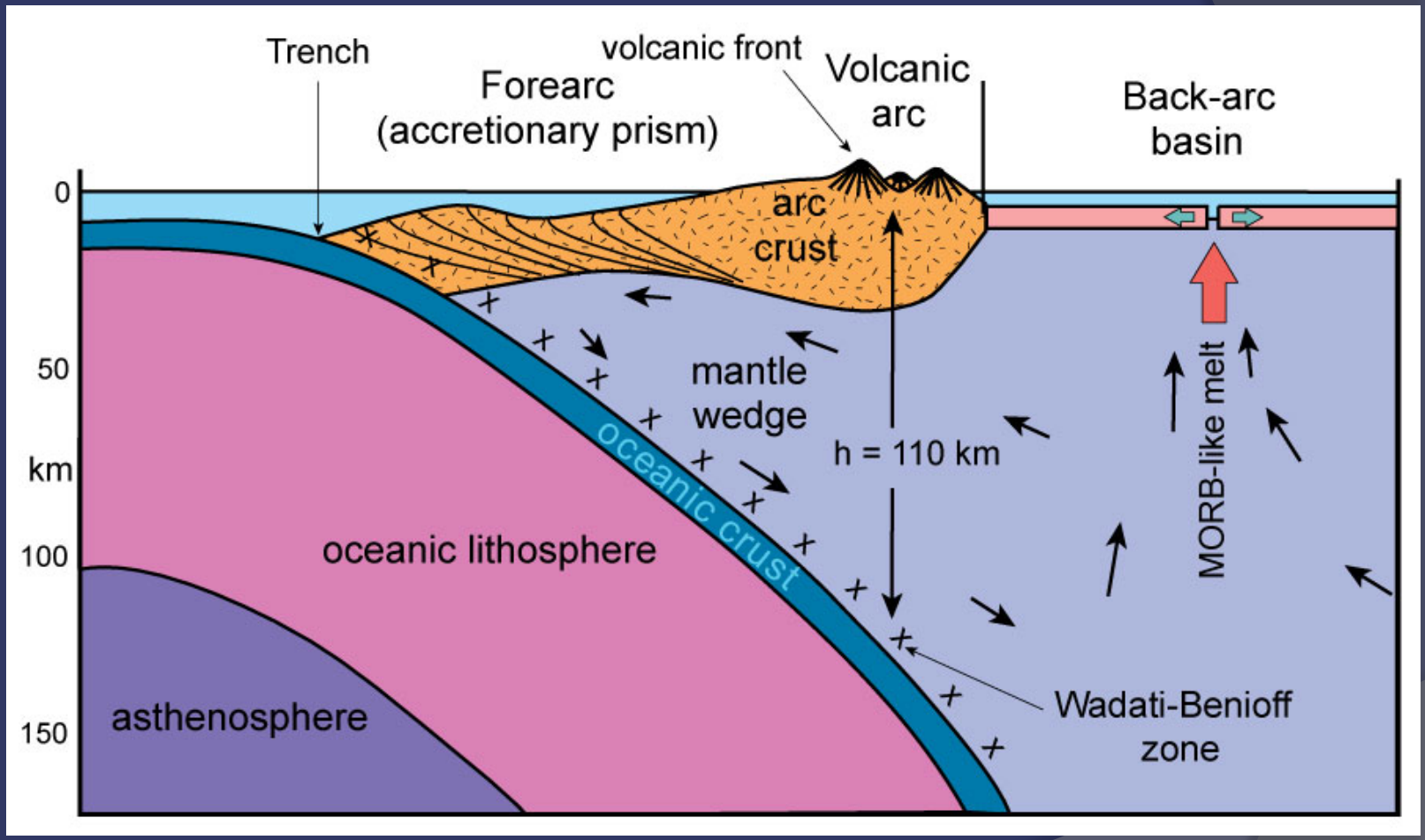


Fig. 16.2 in Winters

Island Arc

- Mineralogy:
  - Biotite
  - Plagioclase
  - Quartz
  - Olivine
  - Pyroxenes
  - Amphibole
  - Oxides: magnetite

Island Arc

- Geochemistry – major elements:

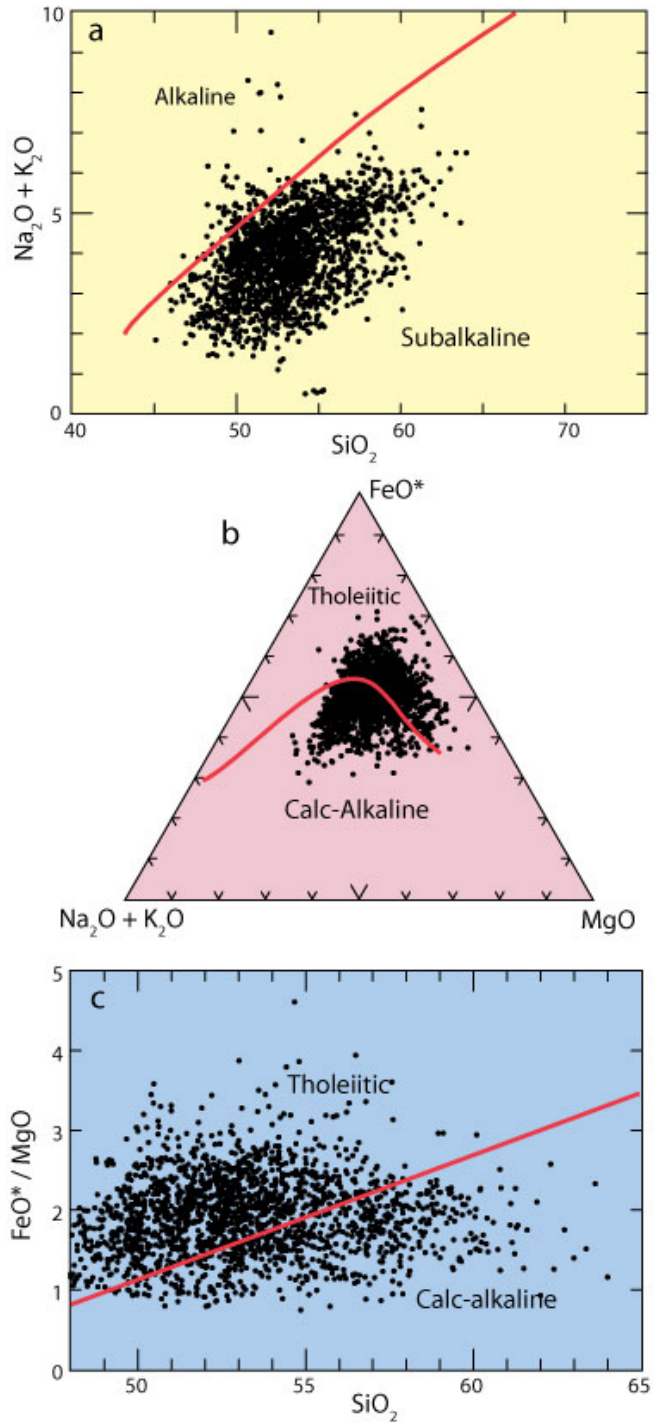
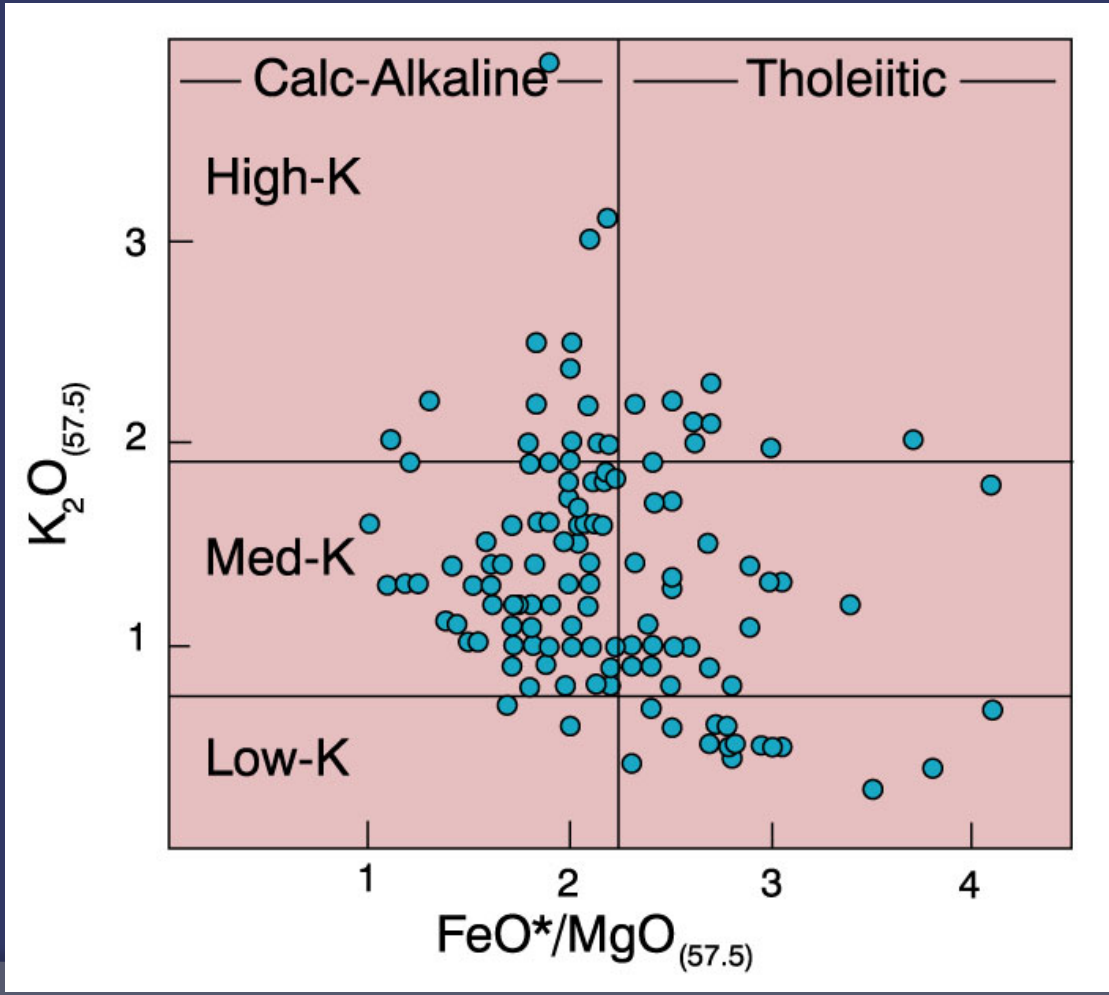


Fig. 16.3 in Winters

Island Arc

- Geochemistry – major elements:

Fig. 16.5 in Winters



Island Arc

- Geochemistry – trace elements:

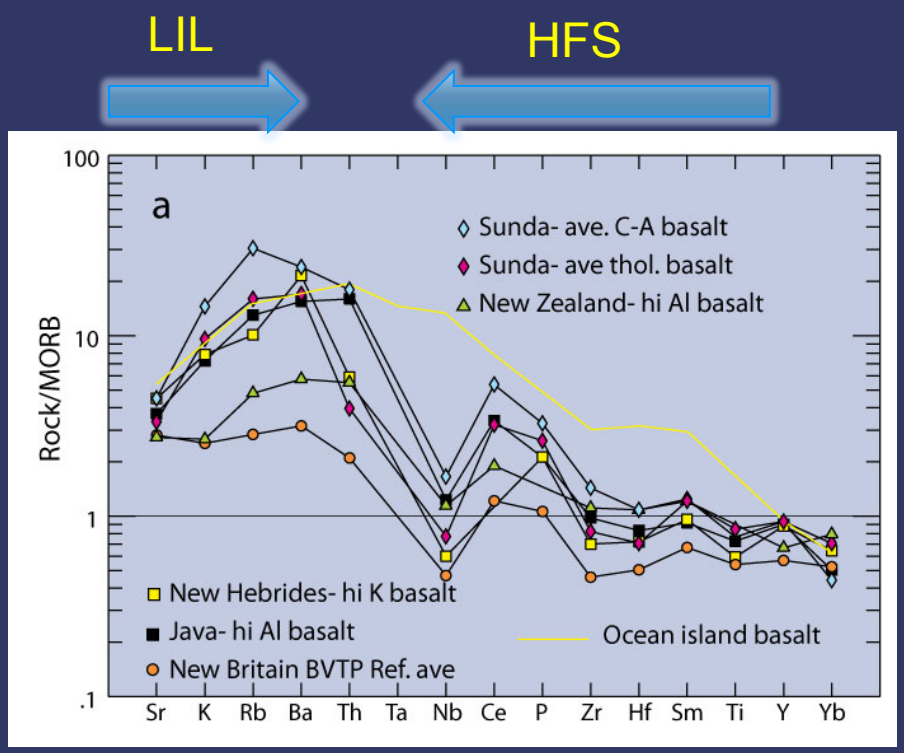
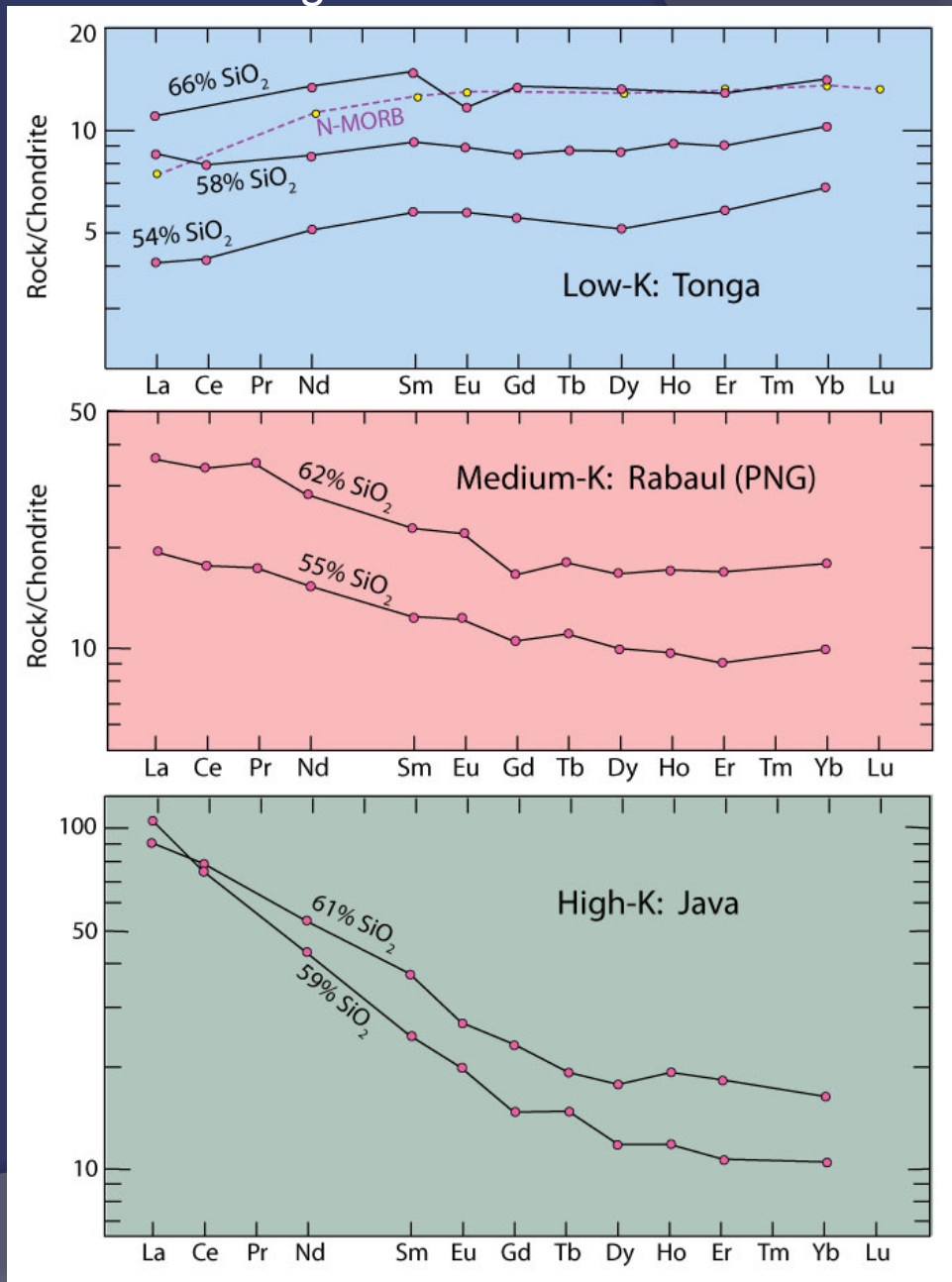


Fig. 16.11 in Winters

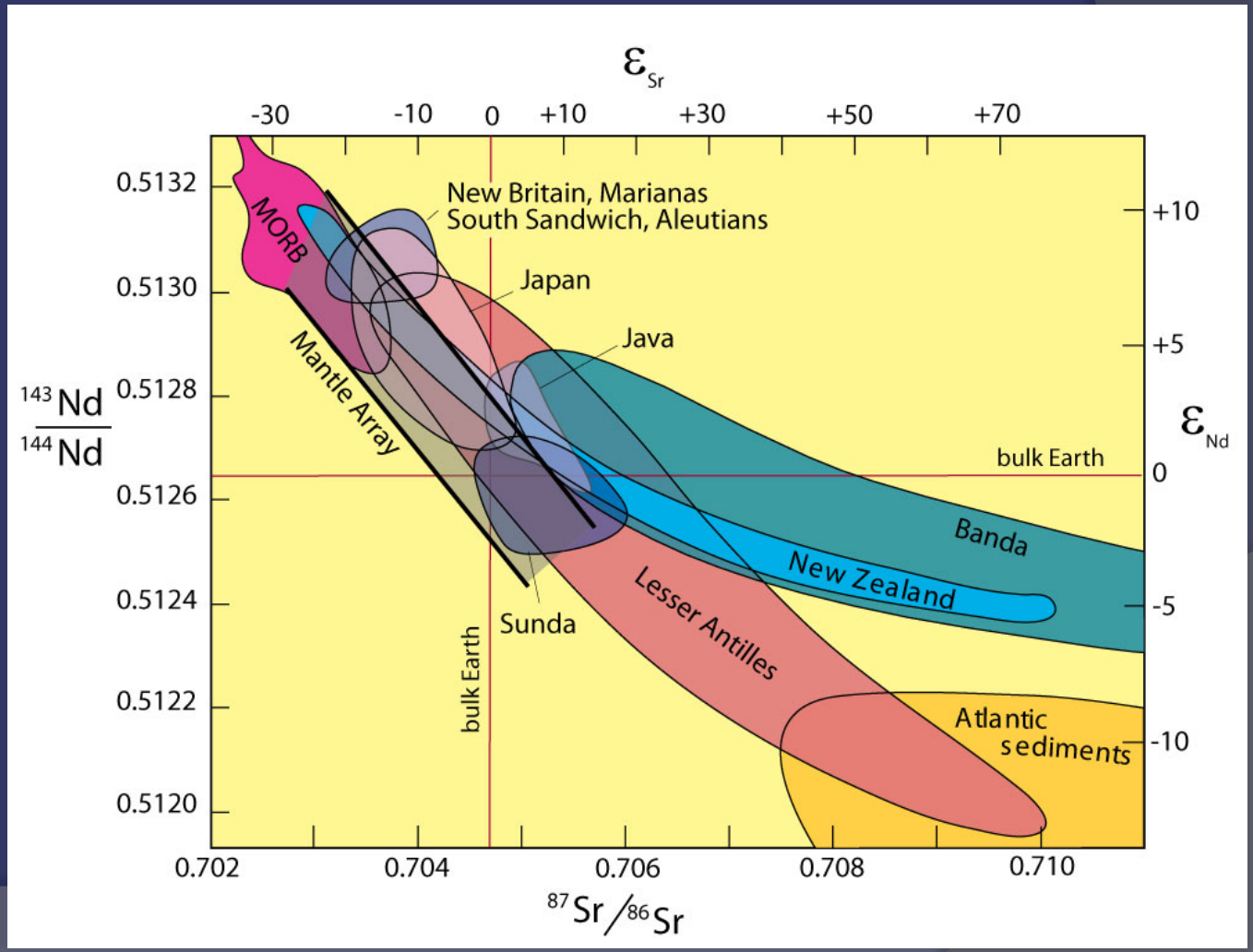
Fig. 16.19 in Winters



Island Arc

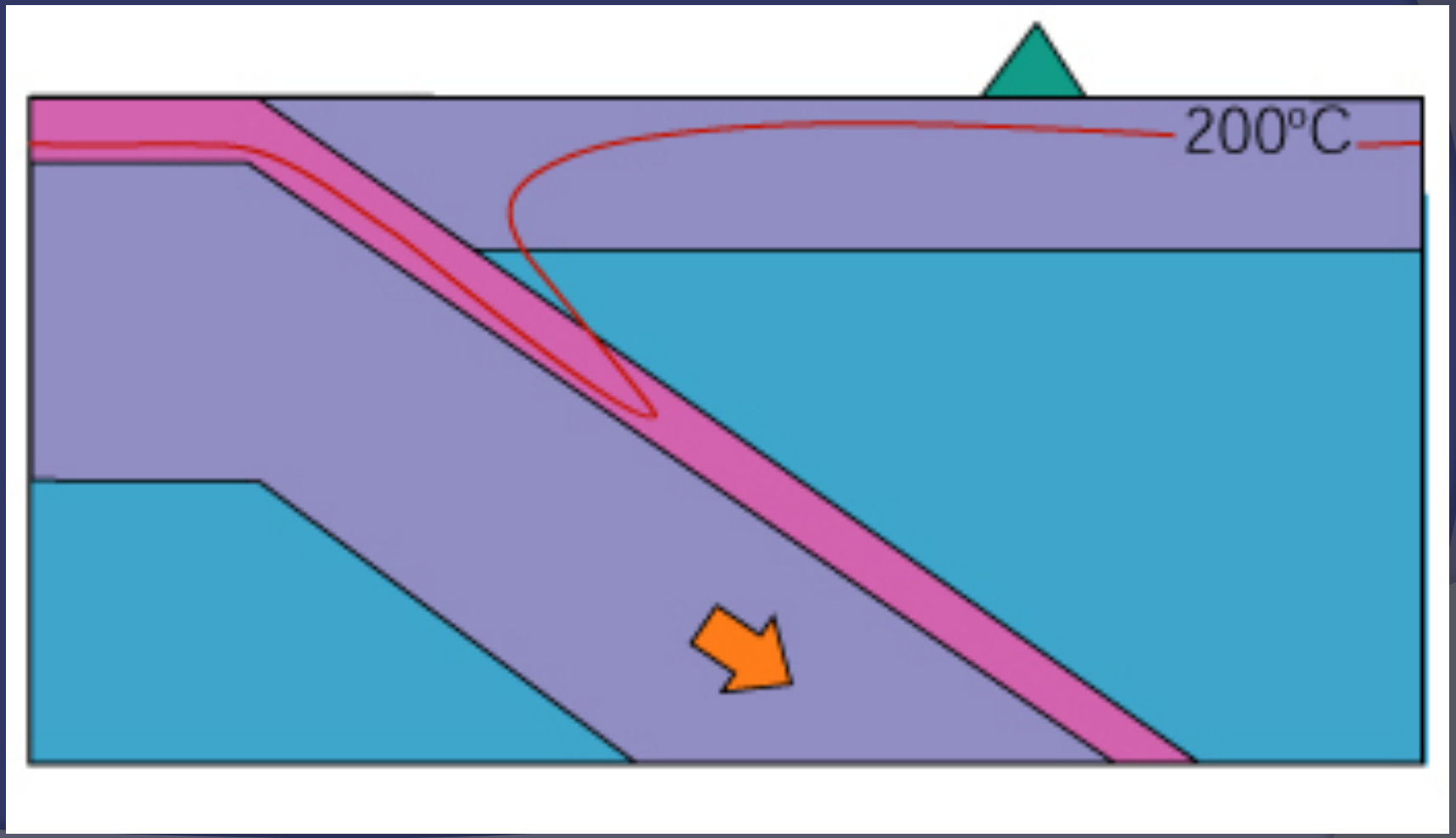
- Geochemistry – isotopes

Fig. 16.12 in Winters



Island Arc Petrogenesis

Paradox?



Island Arc Petrogenesis

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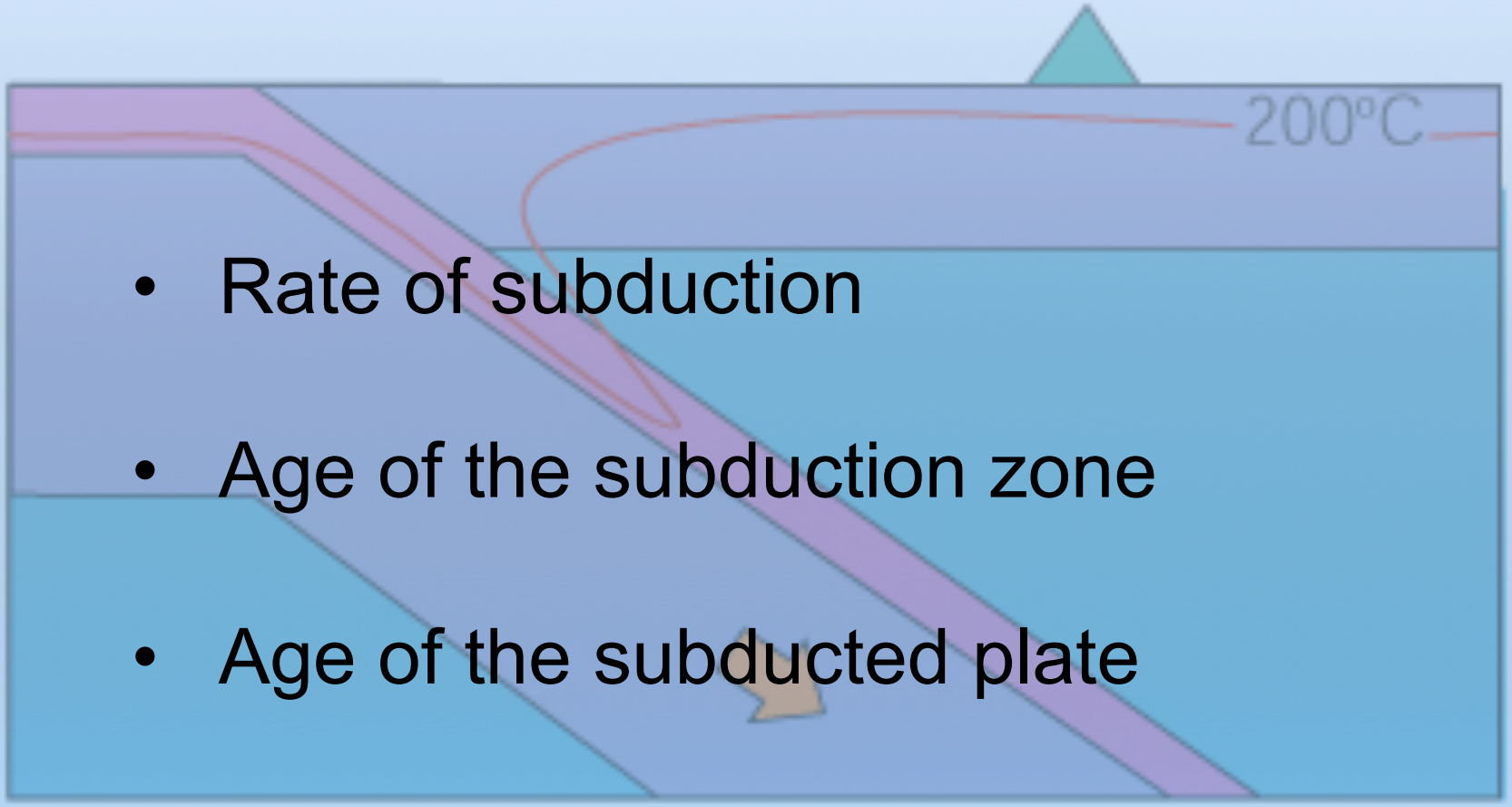

- Rate of subduction
- Age of the subduction zone
- Age of the subducted plate

Island Arc magma source

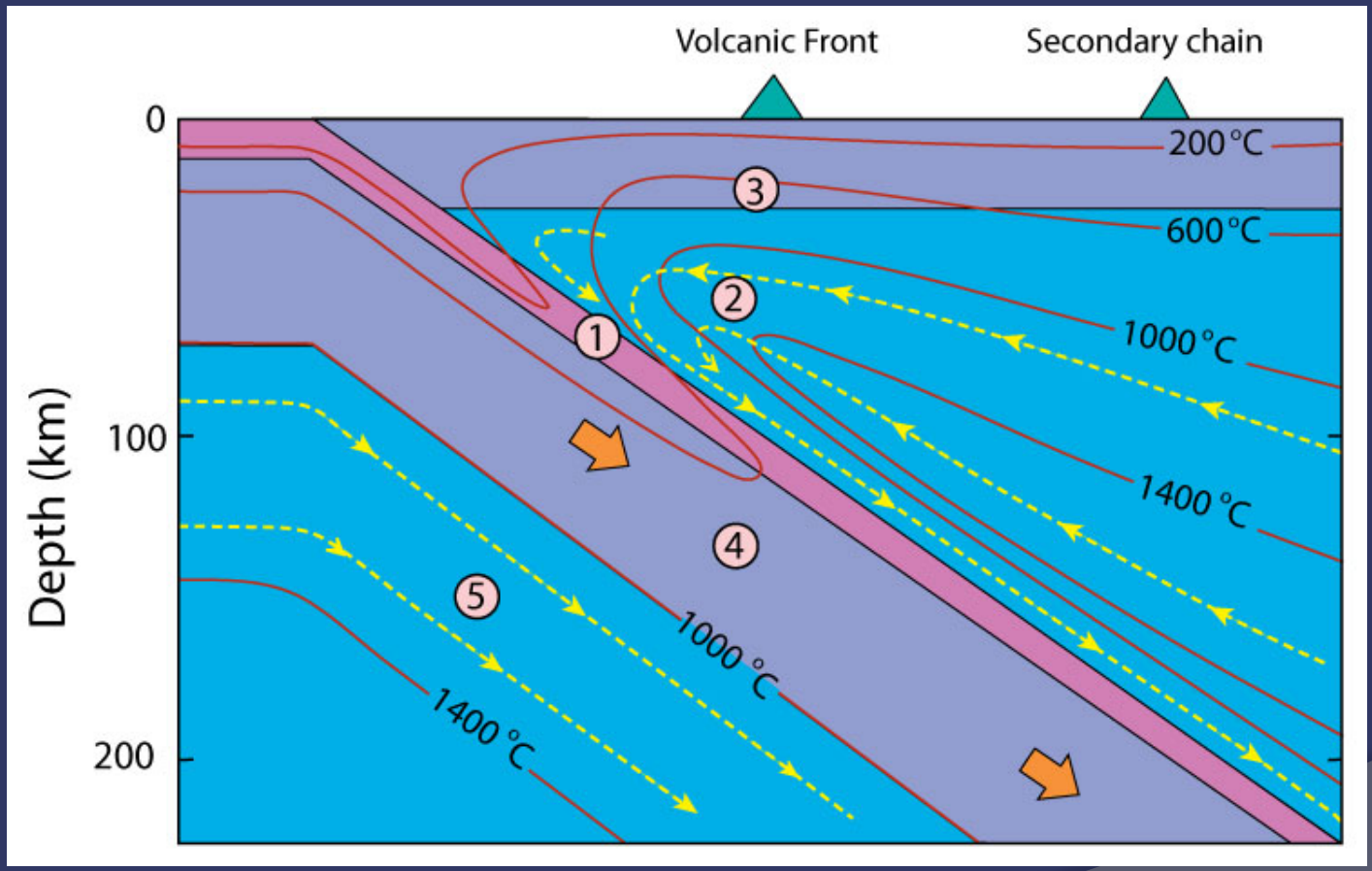

Fig. 16.15 in Winters

Island Arc magma source

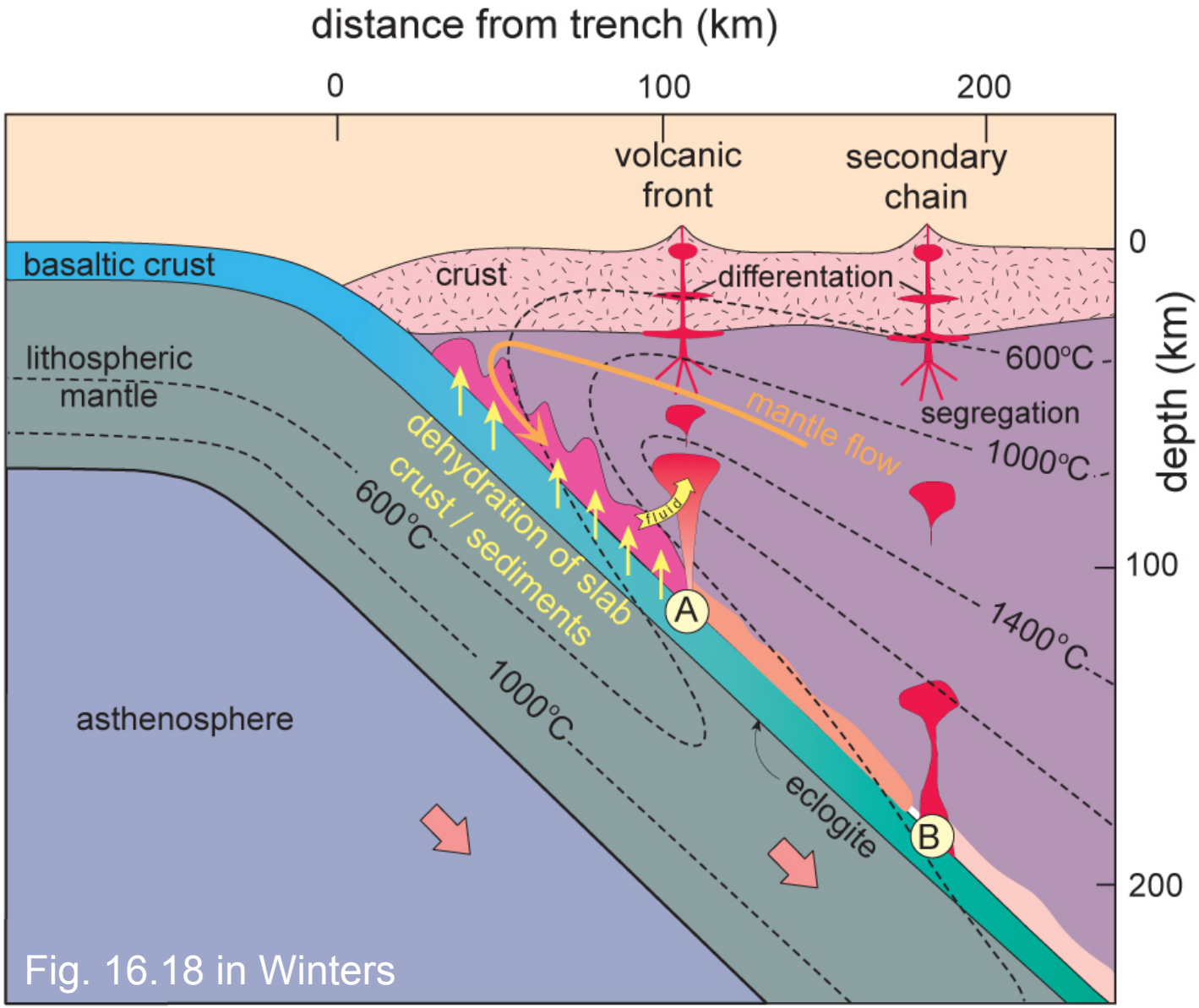

Fig. 16.18 in Winters

NEXT TIME

Review/Questions