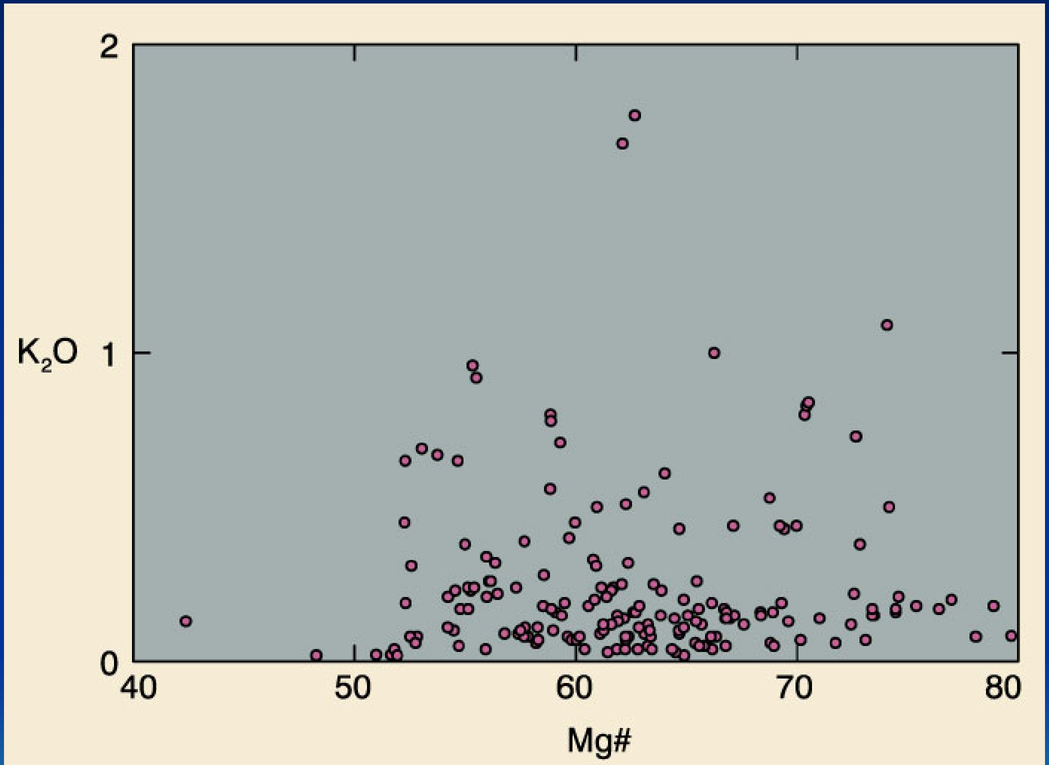
Geochemistry of MORBs

For constant Mg# considerable variation in K_2O

K: incompatible element

K concentration not affected greatly by <50% fractional crystallization

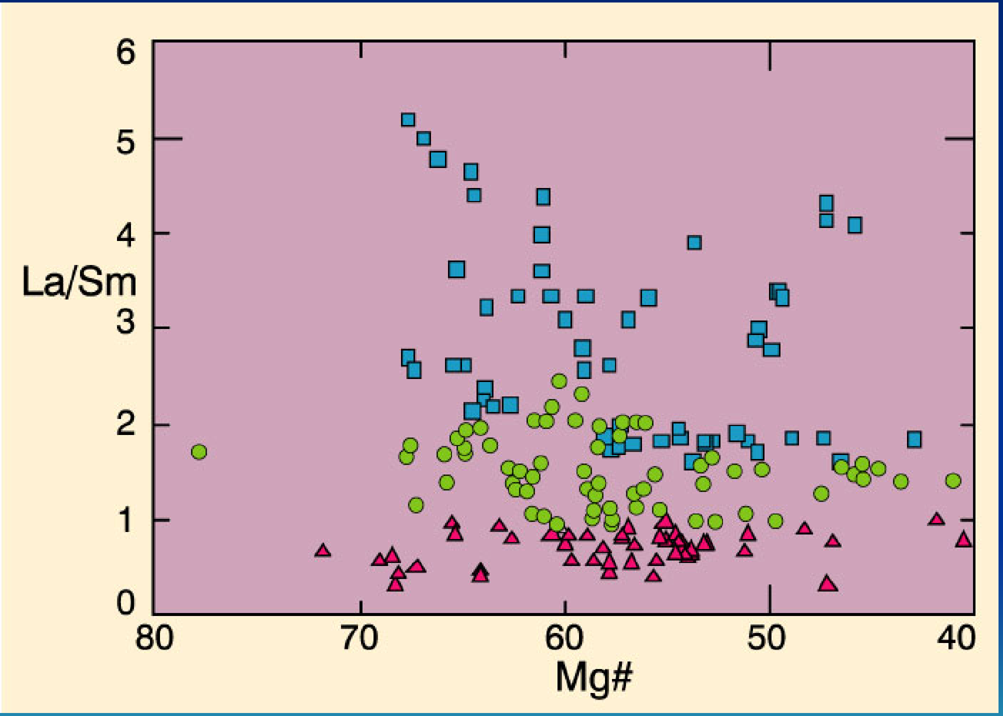
→ K variation reflects characteristics inherited from the mantle source



Data from Schilling et al. (1983)

Trace Elements

E-MORBs (squares) enriched over N- MORBs (red triangles) and T-MORBs (green dots) regardless of Mg#



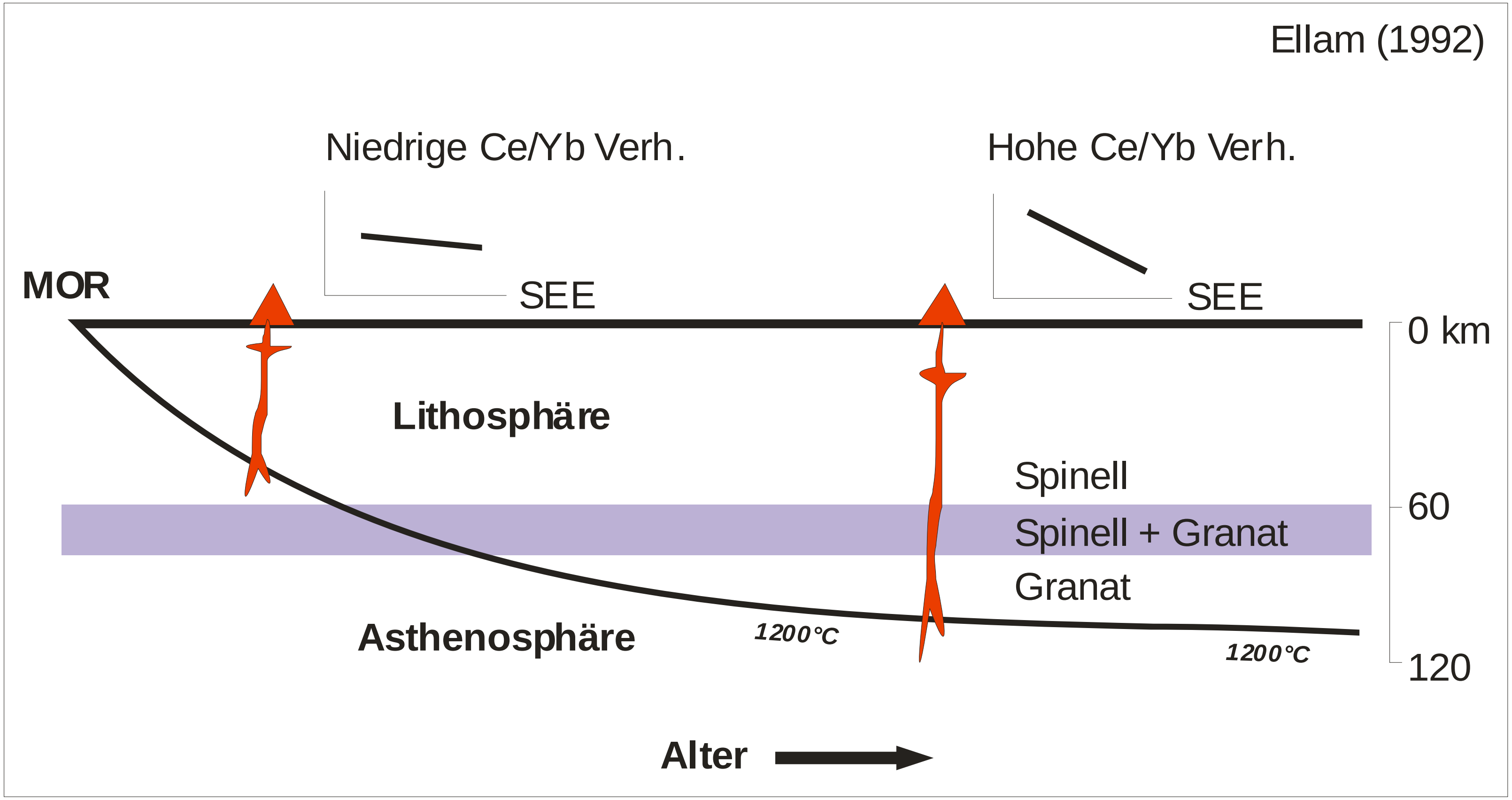
Data from Schilling et al. (1983)

E-MORBs La/Sm > 1.8

N-MORBs La/Sm < 0.7

T-MORBs (transitional) intermediate values

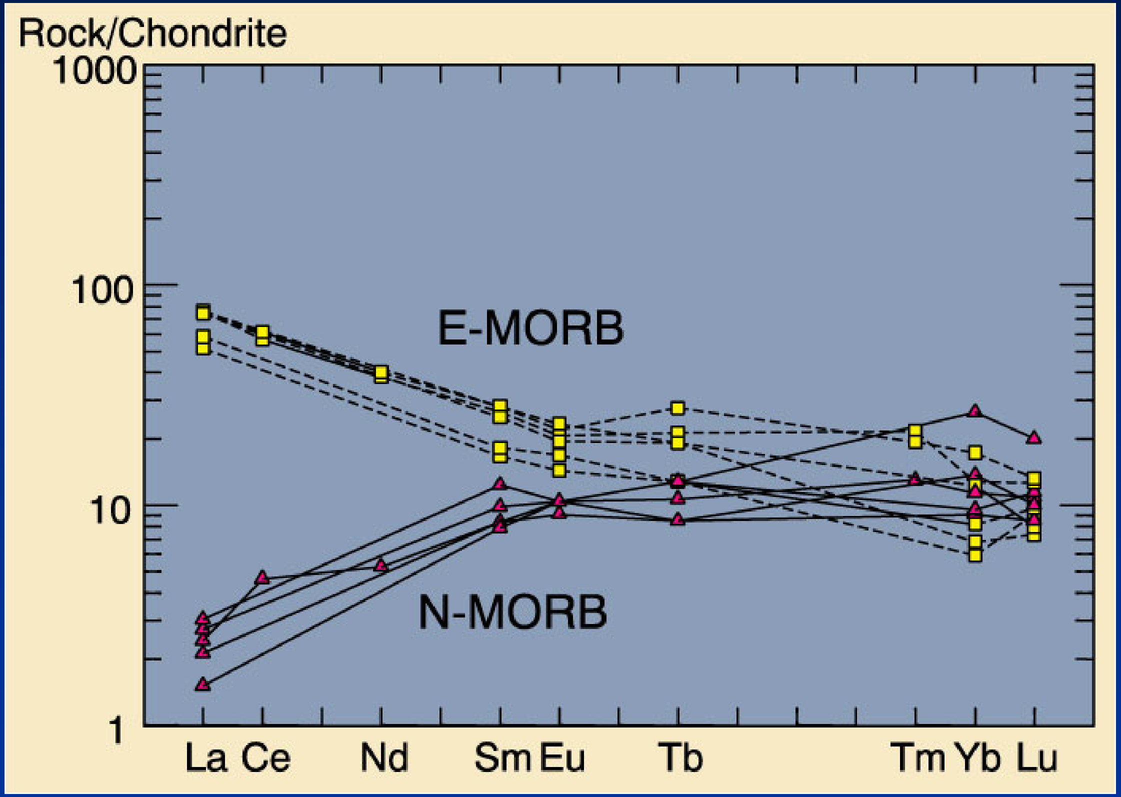
Trace element ratios and depth of melt generation



HREE depletion expected if garnet was a residual phase in the garnet-lherzolite field
Eu-anomaly expected if plagioclase was residual in the plagioclase-lherzolite field

Trace elements "Schilling-effect"

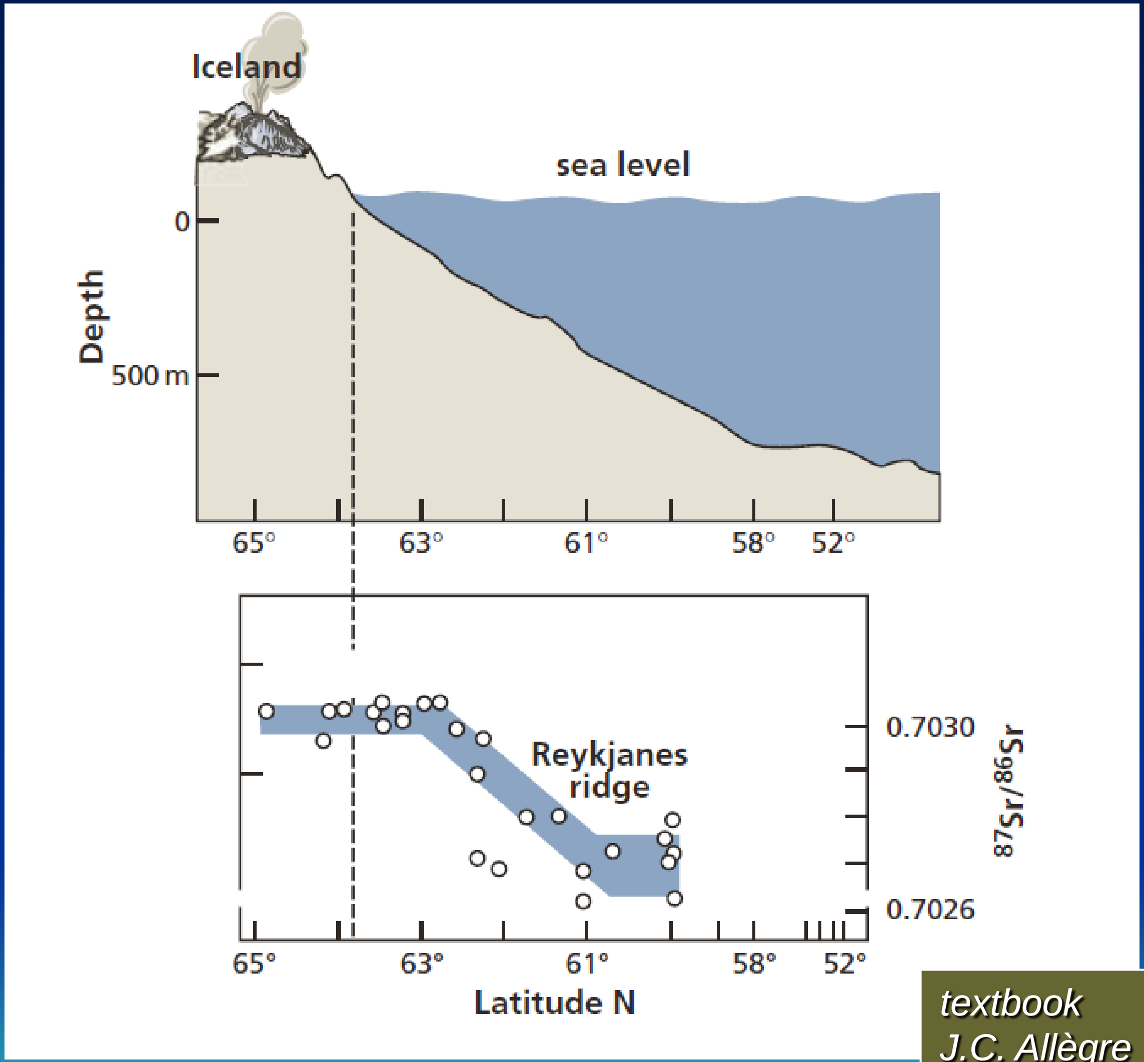
REE diagram for MORBs



Data from Schilling et al. (1983)

Origin of MORB in the **Spinel lherzolite field** is compatible with the REEs.

E-MORB or "Schilling-effect"



textbook
J.C. Allègre

Incompatible-rich and incompatible-poor mantle source regions for MORB magmas

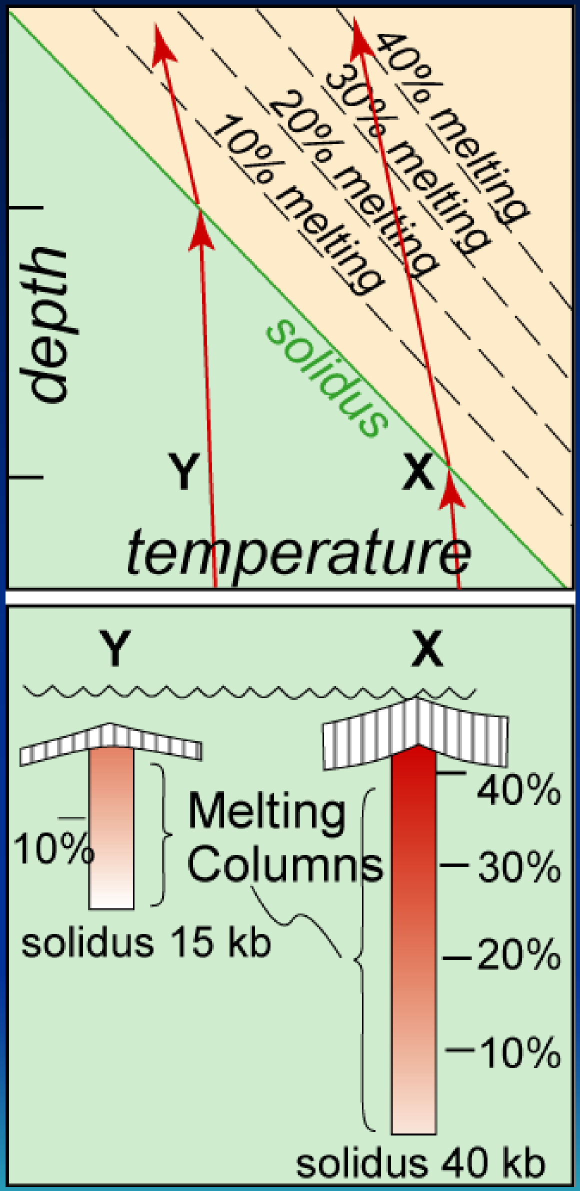
Conclusions about MORBs, and the processes beneath mid-ocean ridges

The mantle beneath the ocean basins is not homogeneous

- N-MORBs tap an upper, depleted mantle
- E-MORBs tap a deeper enriched source
- T-MORBs = mixing of N- and E- magmas during ascent and/or in shallow chambers

Mantle melting in reality

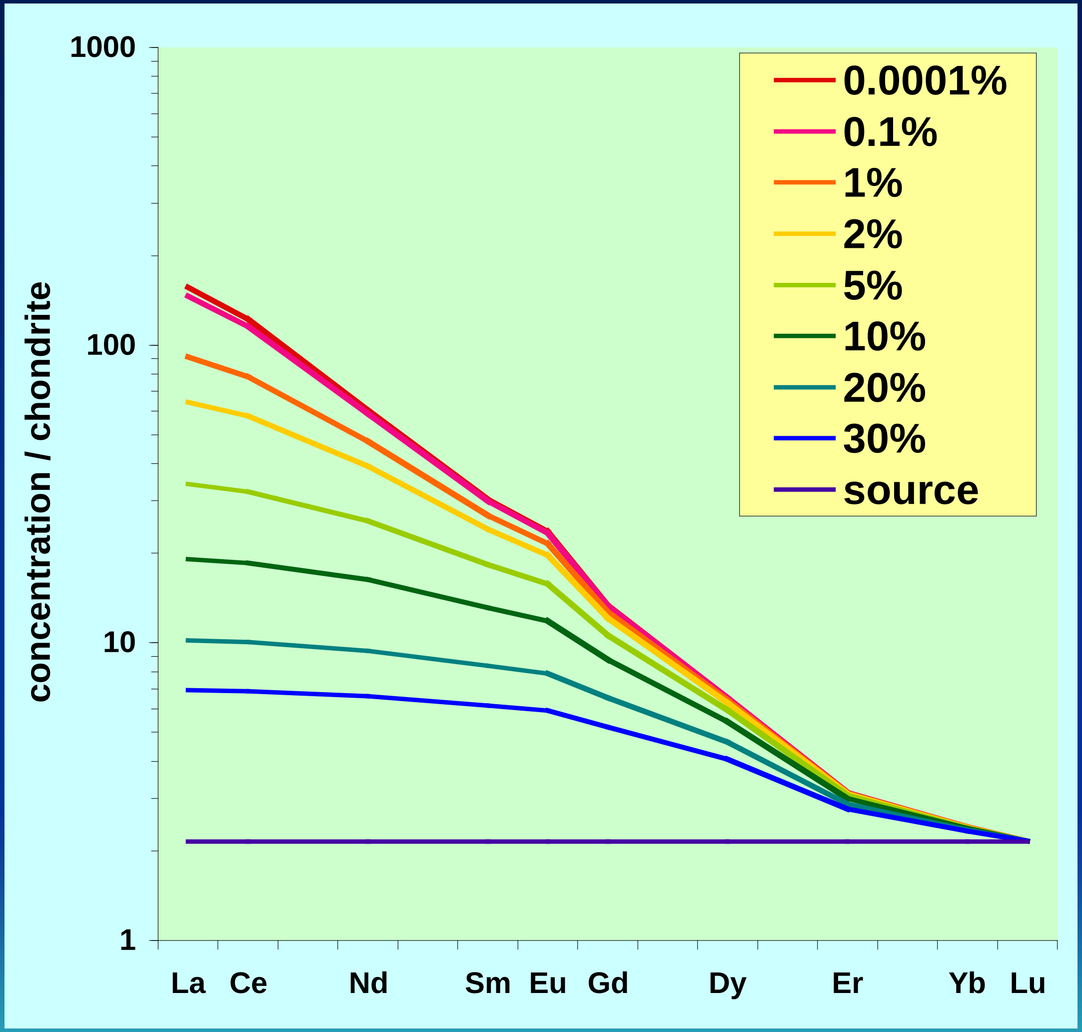
1. Melting is polybaric,
   i.e. occurs at a range of depths.
2. Melt can react with residual solid during transport
3. K_D's may vary with depth due to changes in P, T, and composition of residual phases.
4. Phases can become exhausted during progressive melting

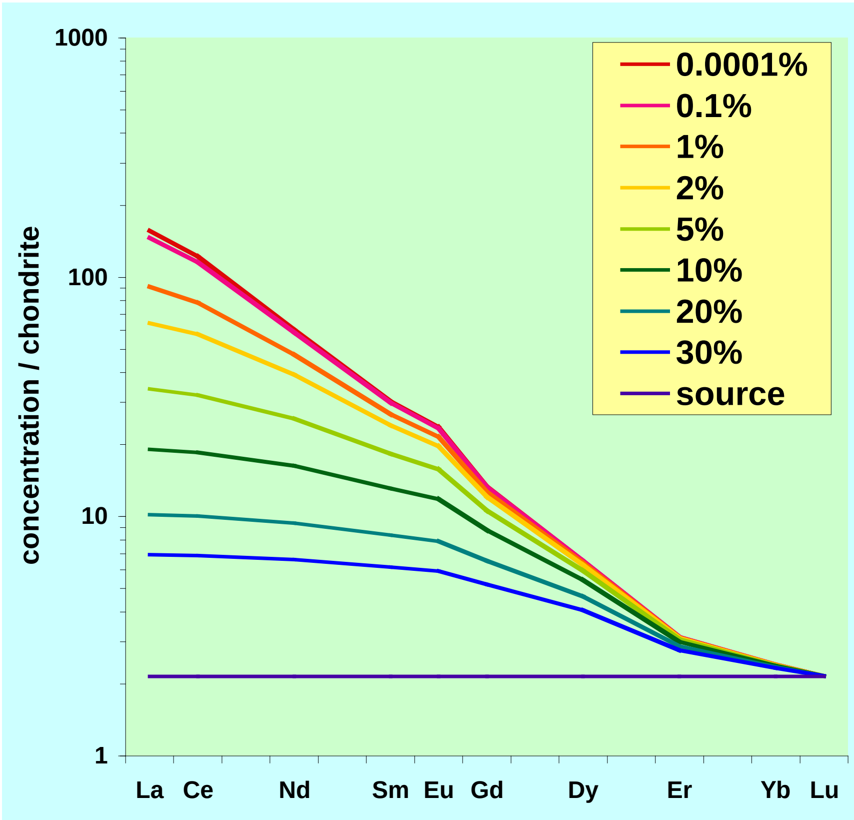


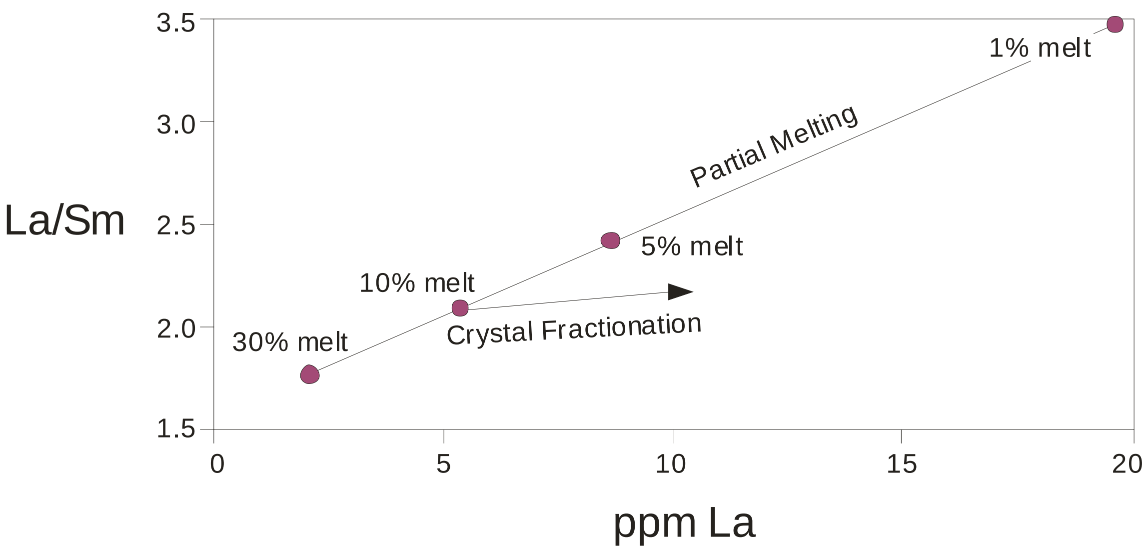
REE variations during melting

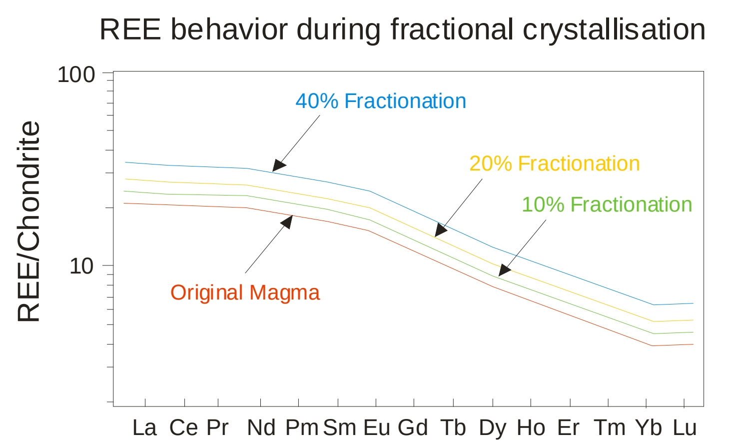
Modeled REE variations during different degrees of melting of a garnet peridotite mantle source

	wt%
olivine	60
opx	20
cpx	10
garnet	12
total	100




1000
100
10
1
concentration / chondrite
0.0001%
0.1%
1%
2%
5%
10%
20%
30%
source
La
Ce
Nd
Sm
Eu
Gd
Dy
Er
Yb
Lu


La/Sm
3.5
3.0
2.5
2.0
1.5
0
5
10
15
20
ppm La
1% melt
Partial Melting
5% melt
10% melt
30% melt
Crystal Fractionation


REE behavior during fractional crystallisation
100
10
REE/Chondrite
40% Fractionation
20% Fractionation
10% Fractionation
Original Magma
La
Ce
Pr
Nd
Pm
Sm
Eu
Gd
Tb
Dy
Ho
Er
Tm
Yb
Lu