Serpentinites act as sponges for fluid-mobile elements from abyssal to subduction zone environments

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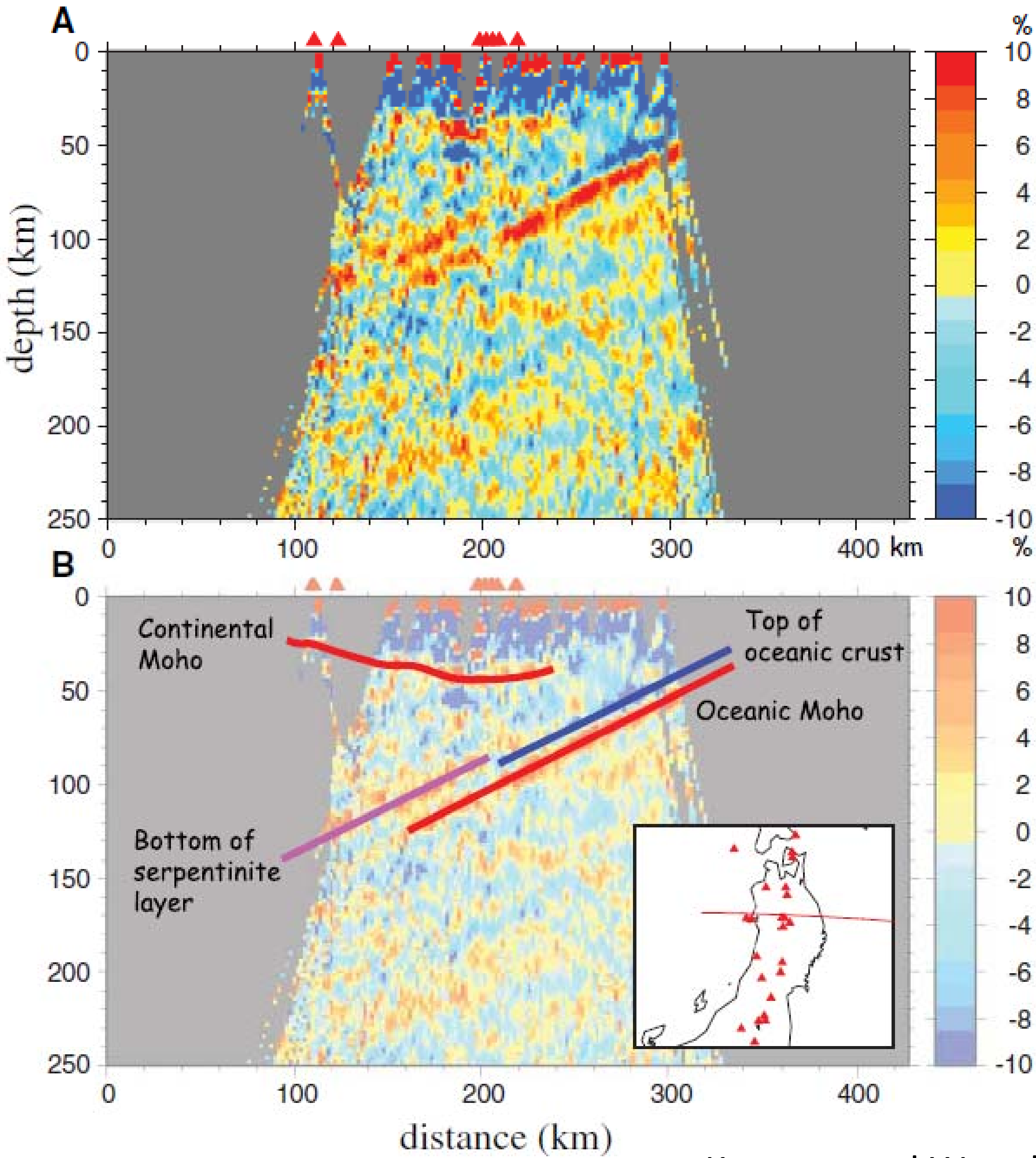
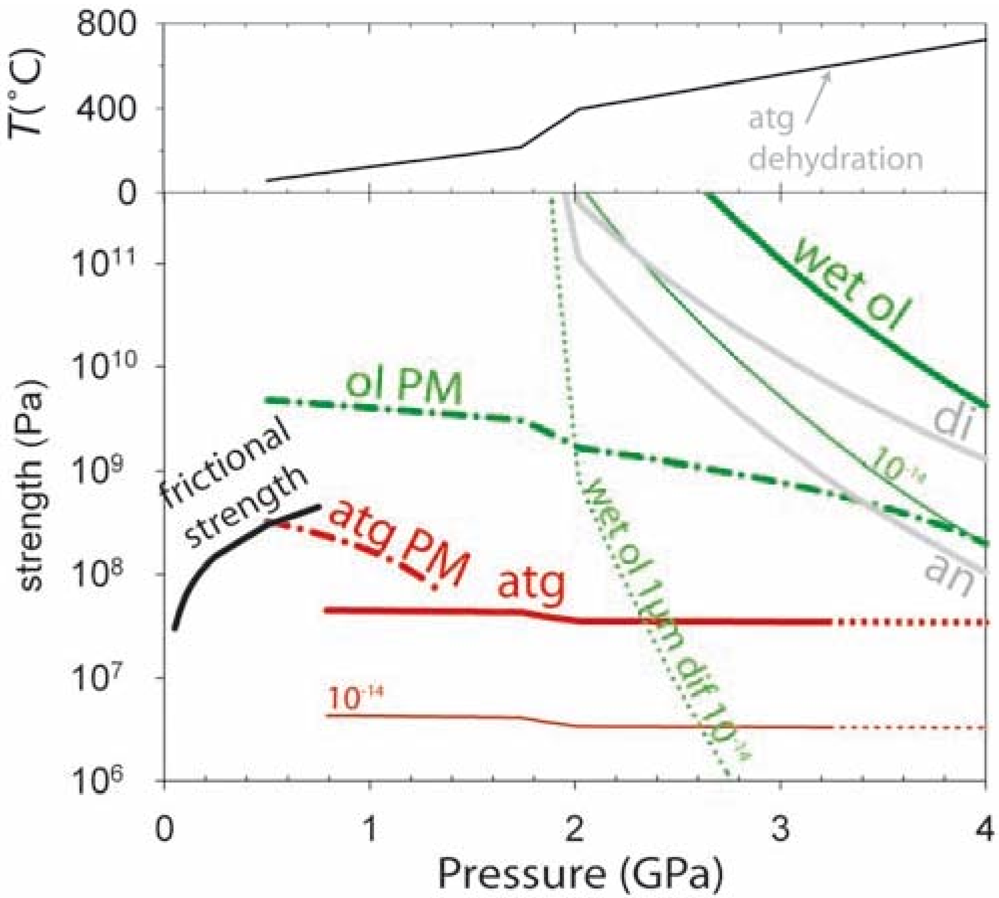
Receiver Function



Kawatsu and Watada, Science, 2007

Serpentinites : a good candidate to facilitate exhumation of HP to UHP rocks

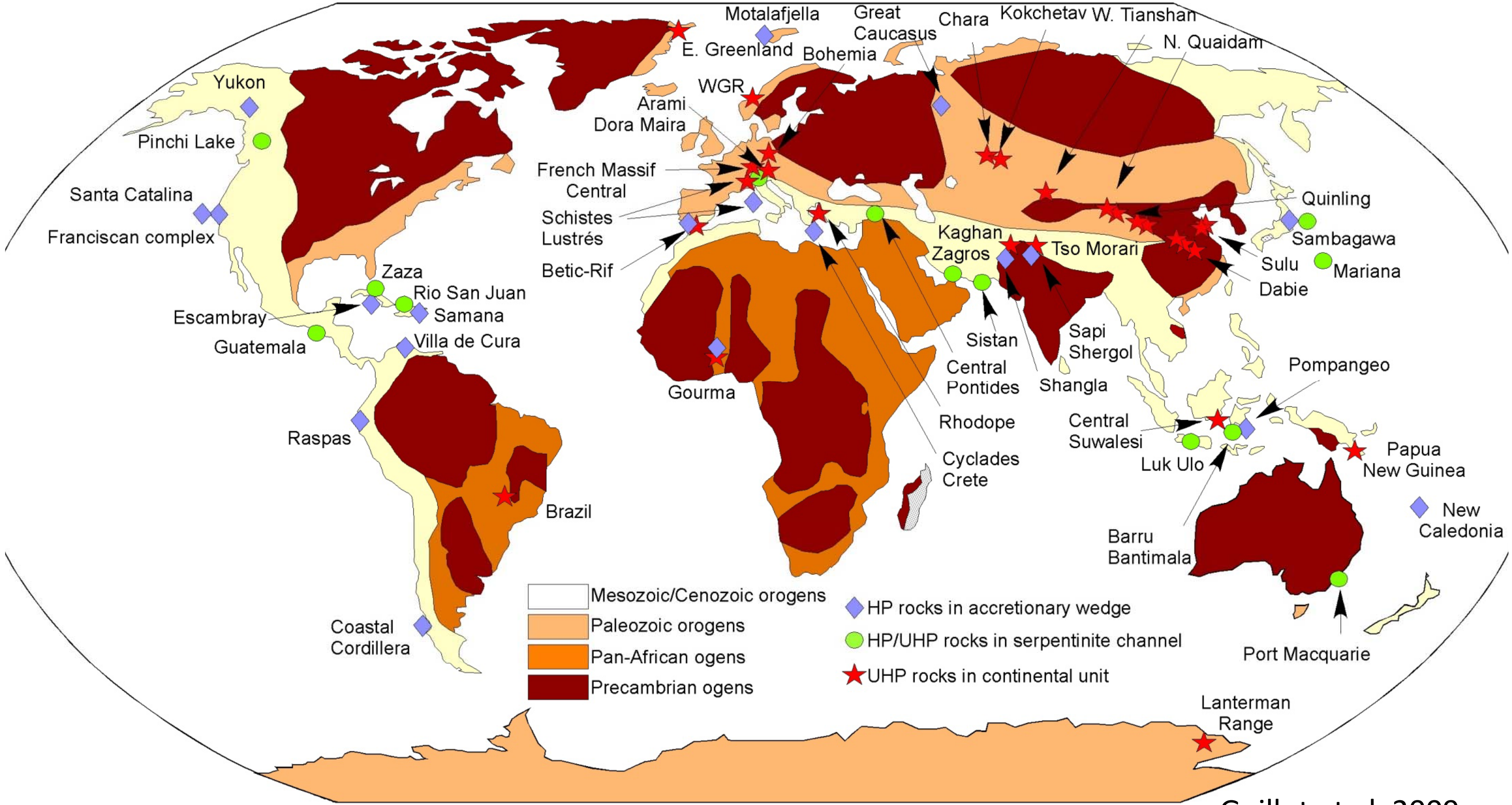


Antigorite : low strength compare to olivine

Effective viscosity :< 10^{19} Pa.s

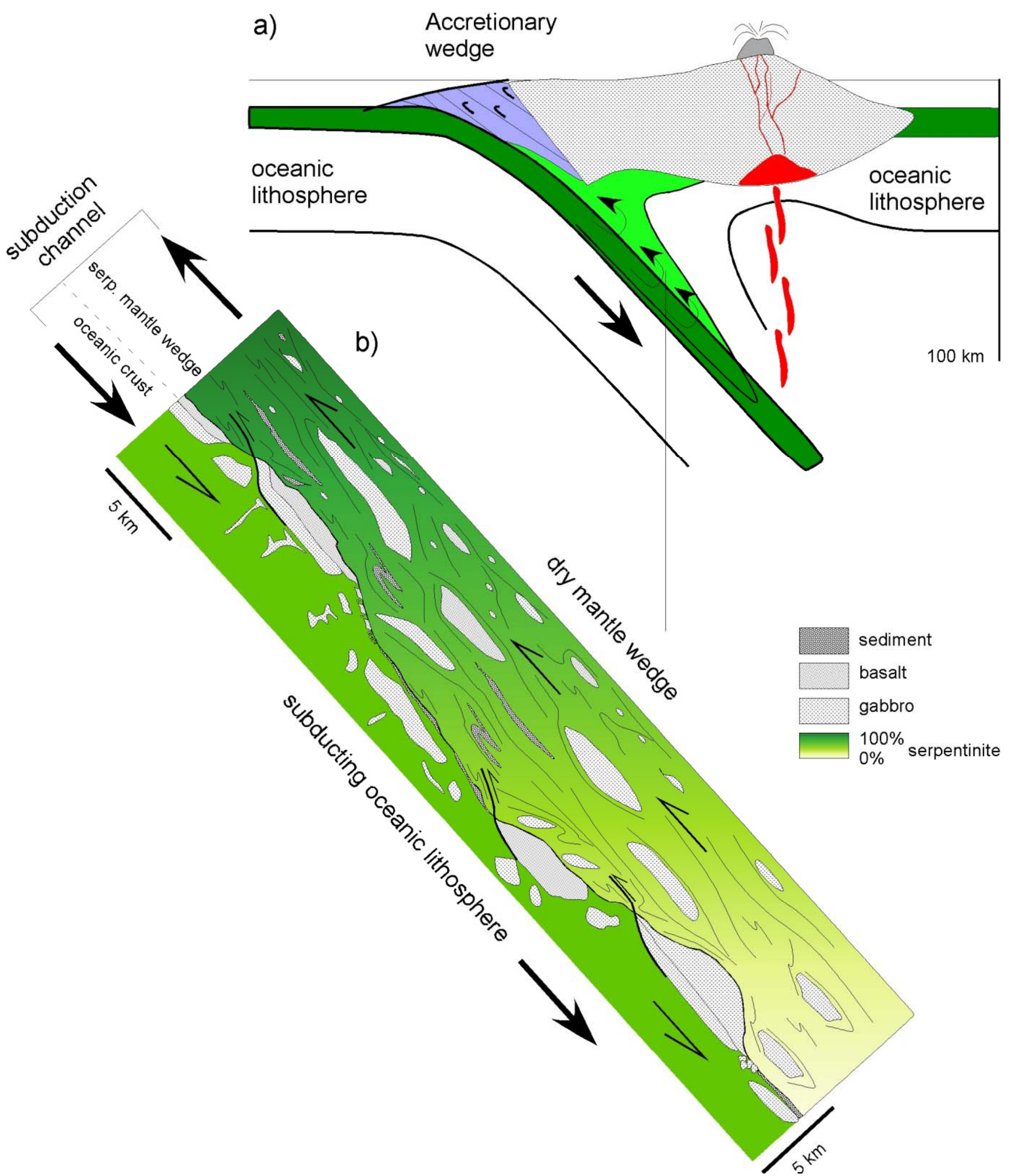
Hilairet et al., Science, 2007

61 occurrences of Phanerozoic HP to UHP units

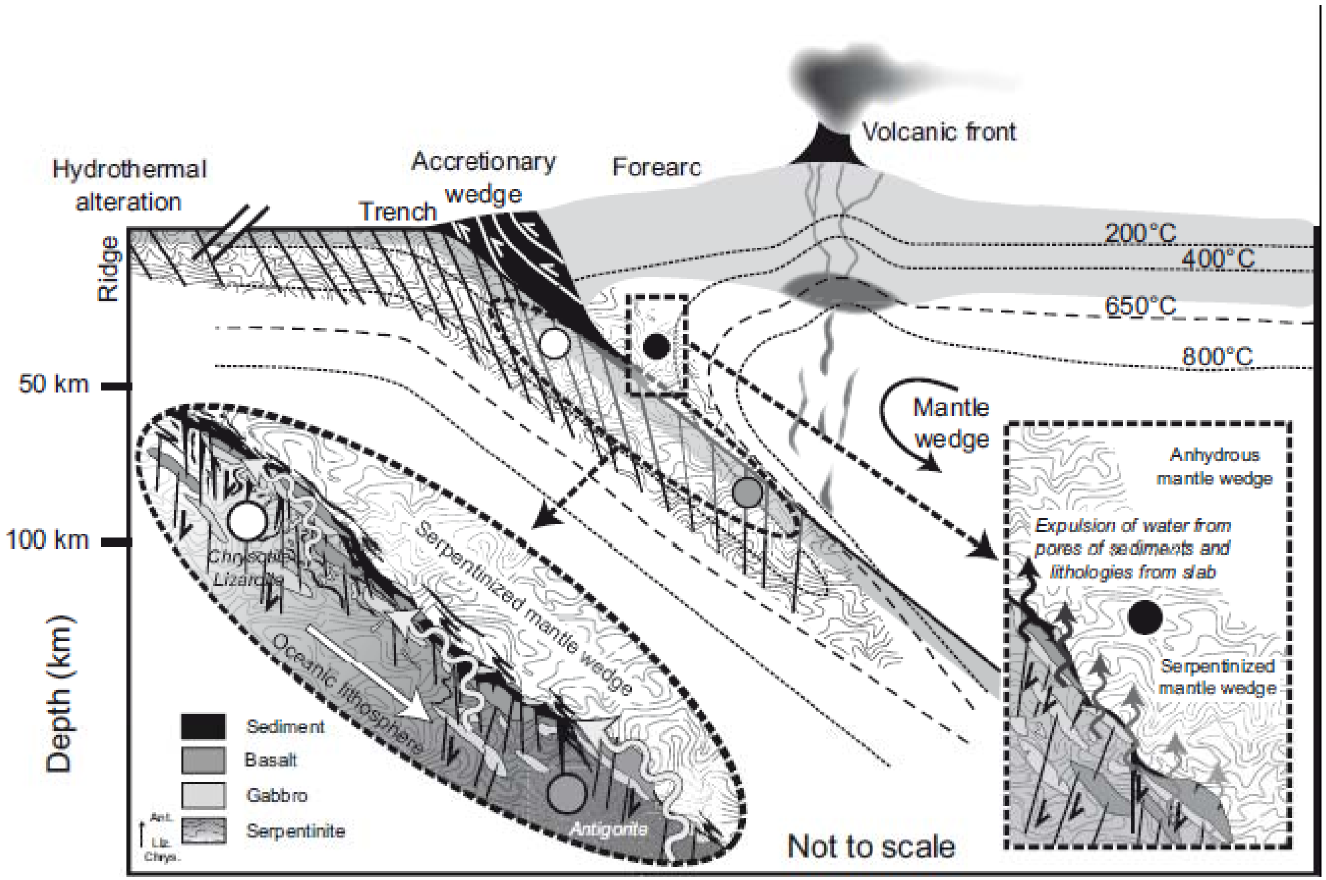


Guillot et al. 2009

Almost 25% of HP to UHP are exhumed within a serpentinite subduction channel



Guillot et al., 2009



Deschamps et al., submitted

Serpentinites are stable at mantle depths

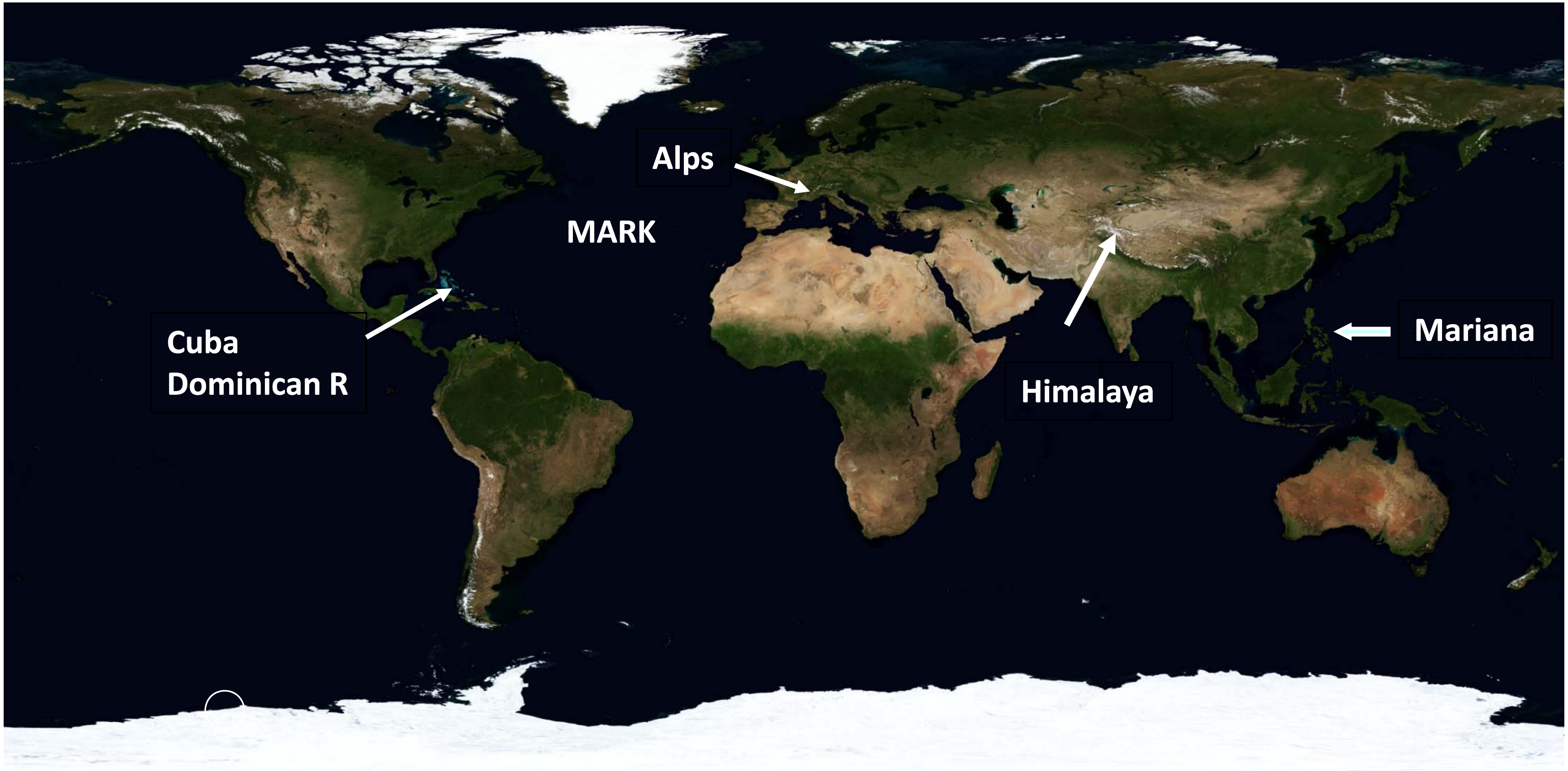
They host water & FME in the mantle.

Recylcing of FME elements in subduction zones

Identification of protoliths of serpentinites

Sources of waters for hydration

Sources of FME

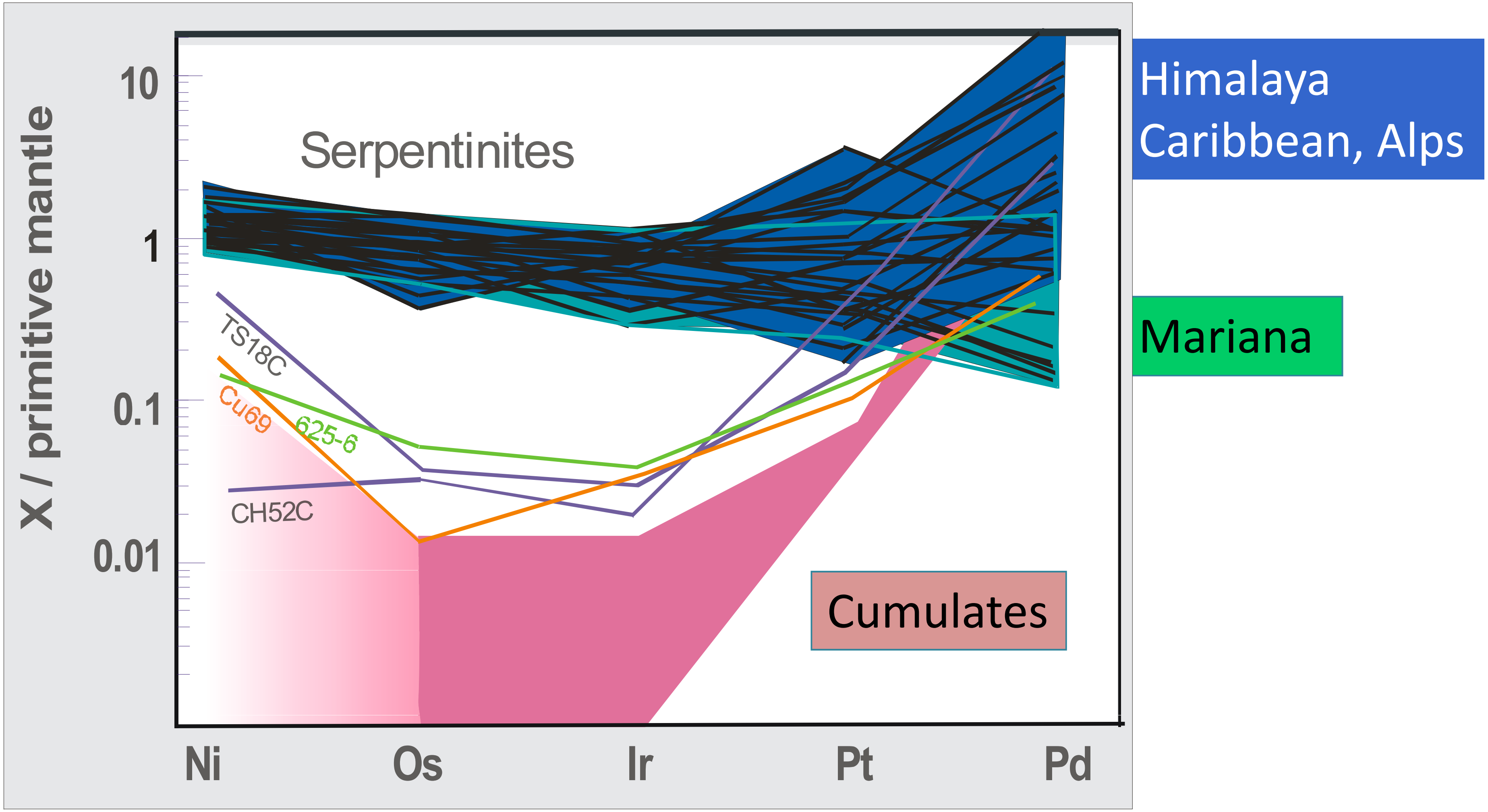


Serpentinites coming from Himalaya, Alps, Cuba-Dominican Republic:

Upper Cretaceous-Eocene subduction zones

Serpentinites are exhumed with HP to UHP rocks from 40 to 120 km depth

Protoliths of serpentinites Platinum group elements



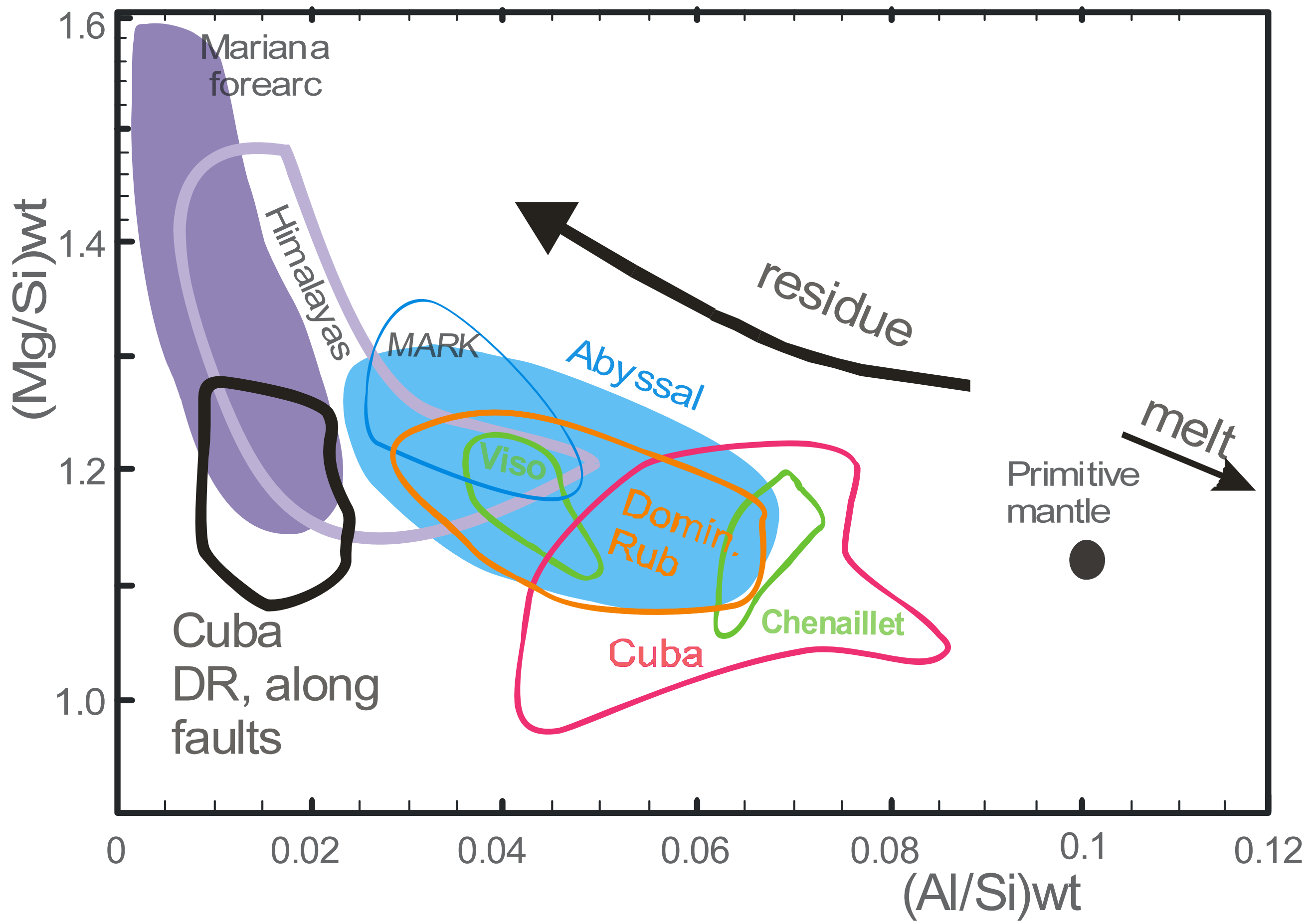
Hattori and Guillot, 2007

Major elements, comparison

Himalaya and major Cuba faults are refractory and similar to Mariana forearc : Mantle wedge

Alps, Cuba, DR: a less refractory and similar to abyssal peridotites

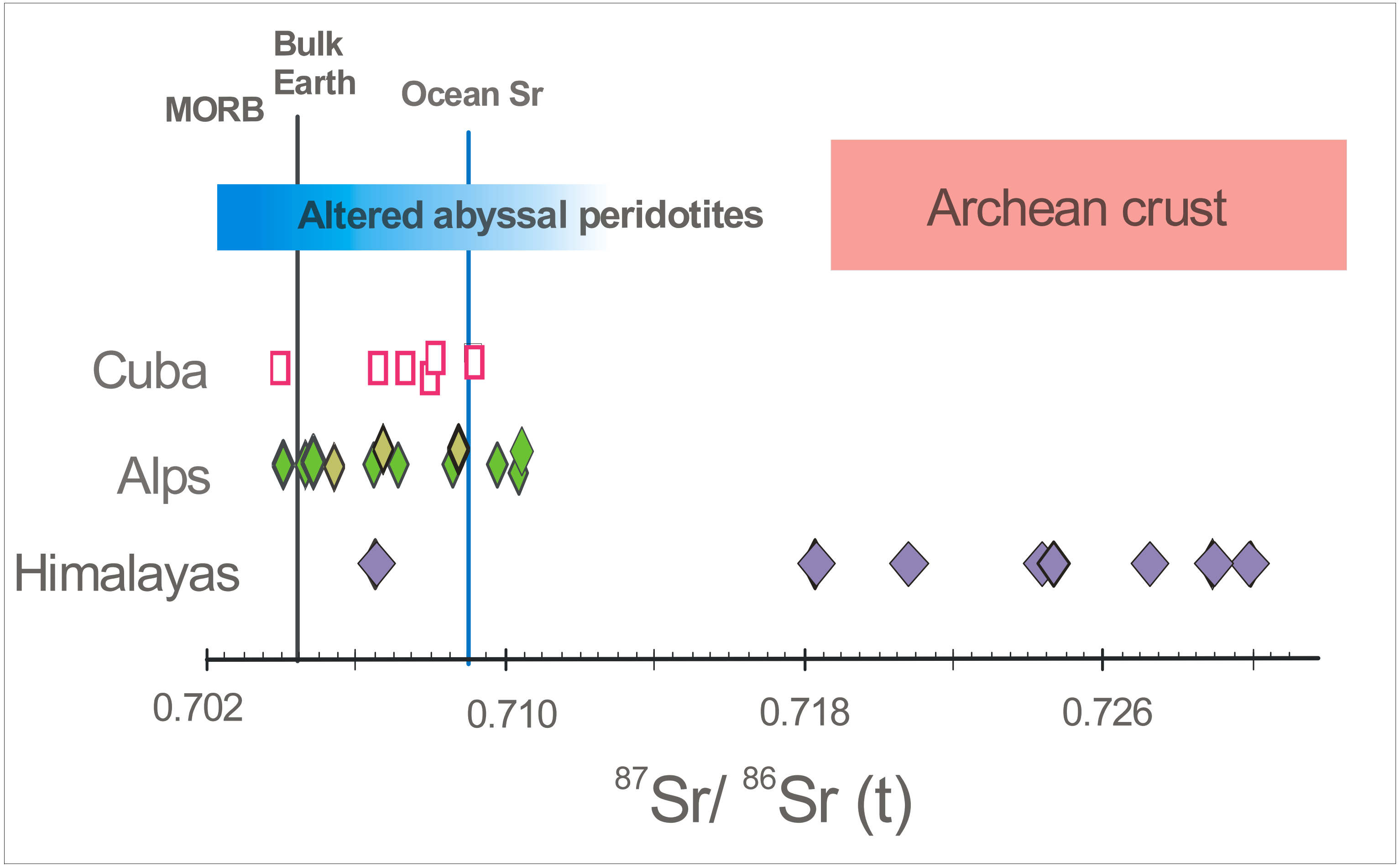
District-scale variations: Viso samples are more refractory than Chenaillet.



Hattori and Guillot, 2007

Fluid origin : Sr-isotopes

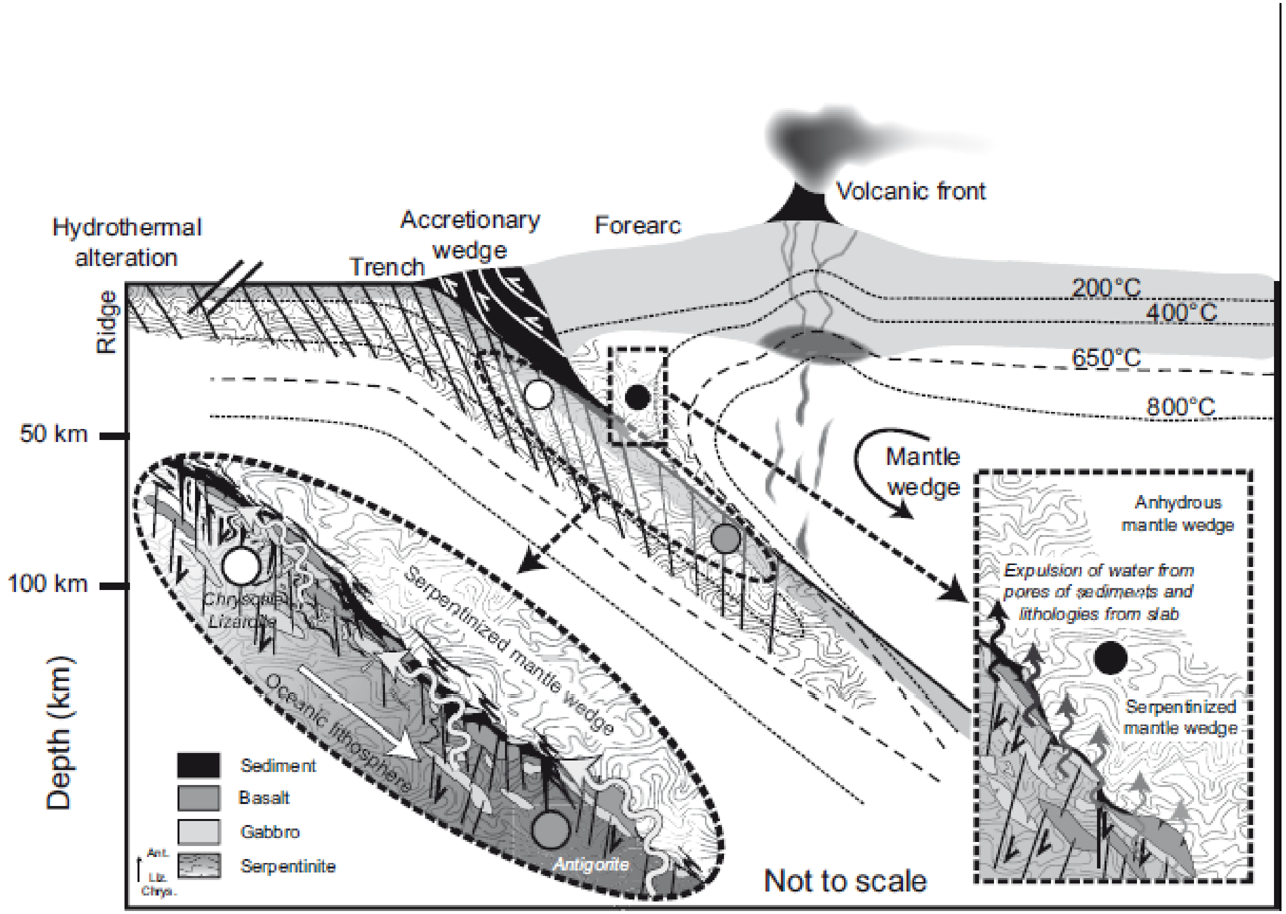
Subducted oceanic serpentinites; contribution of marine Sr
Mantle wedge serpentinites received Sr from subducted continent



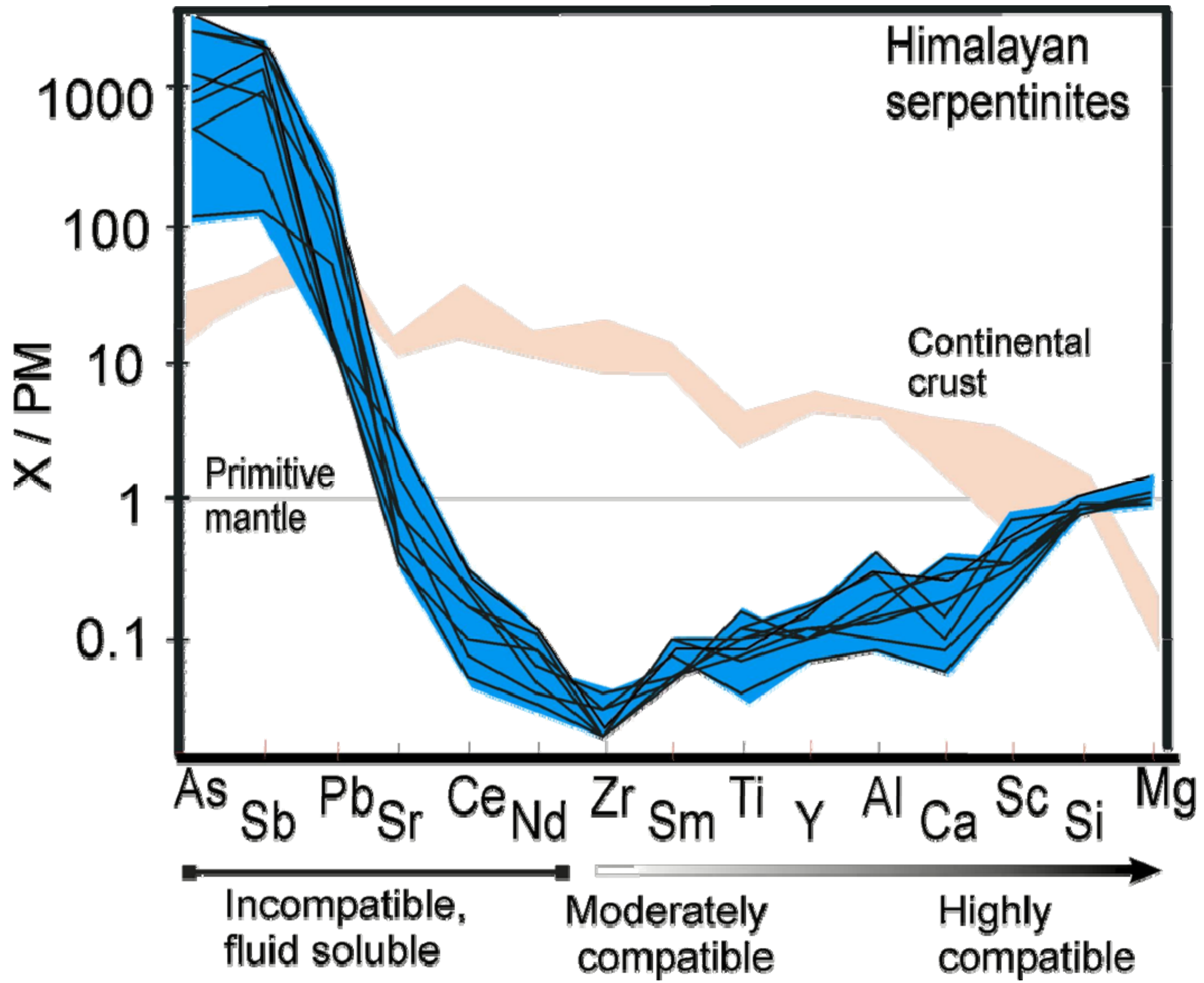
(Hattori & Guillot, G-cubed, 2007)

Fluid-mobile elements (FME)

As, B, Sb, Li, Pb, U



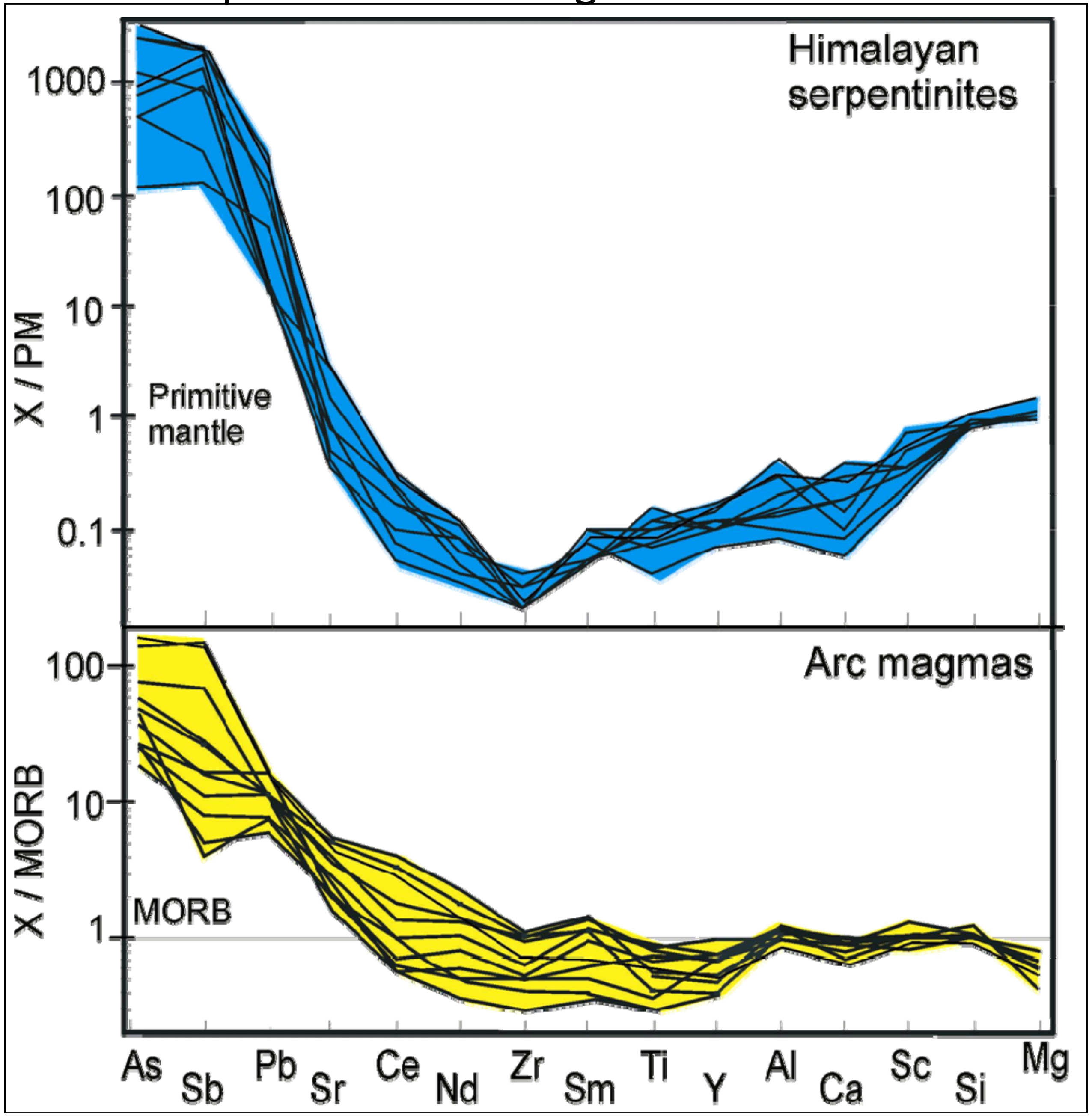
Profound enrichment of fluid-mobile elements in mantle wedge serpentinites



Hattori & Guillot, 2003

The enrichment pattern of serpentinites.
Similar to the enrichment pattern of arc magmas at vol. fronts

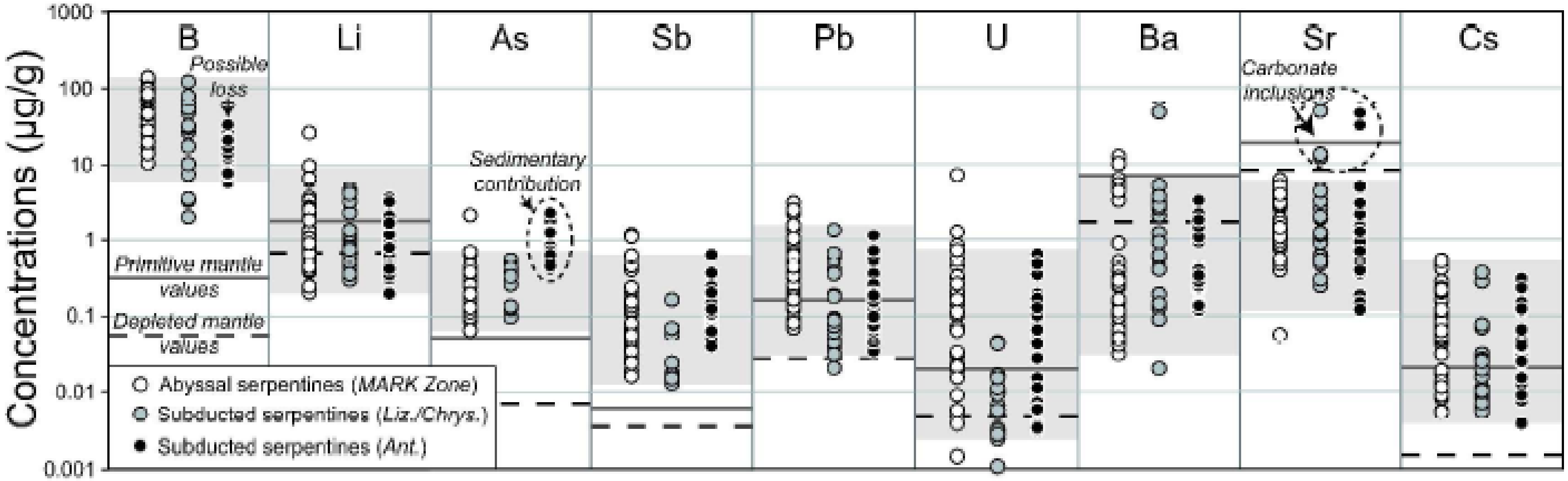
FME in arc magmas derived from serpentinites



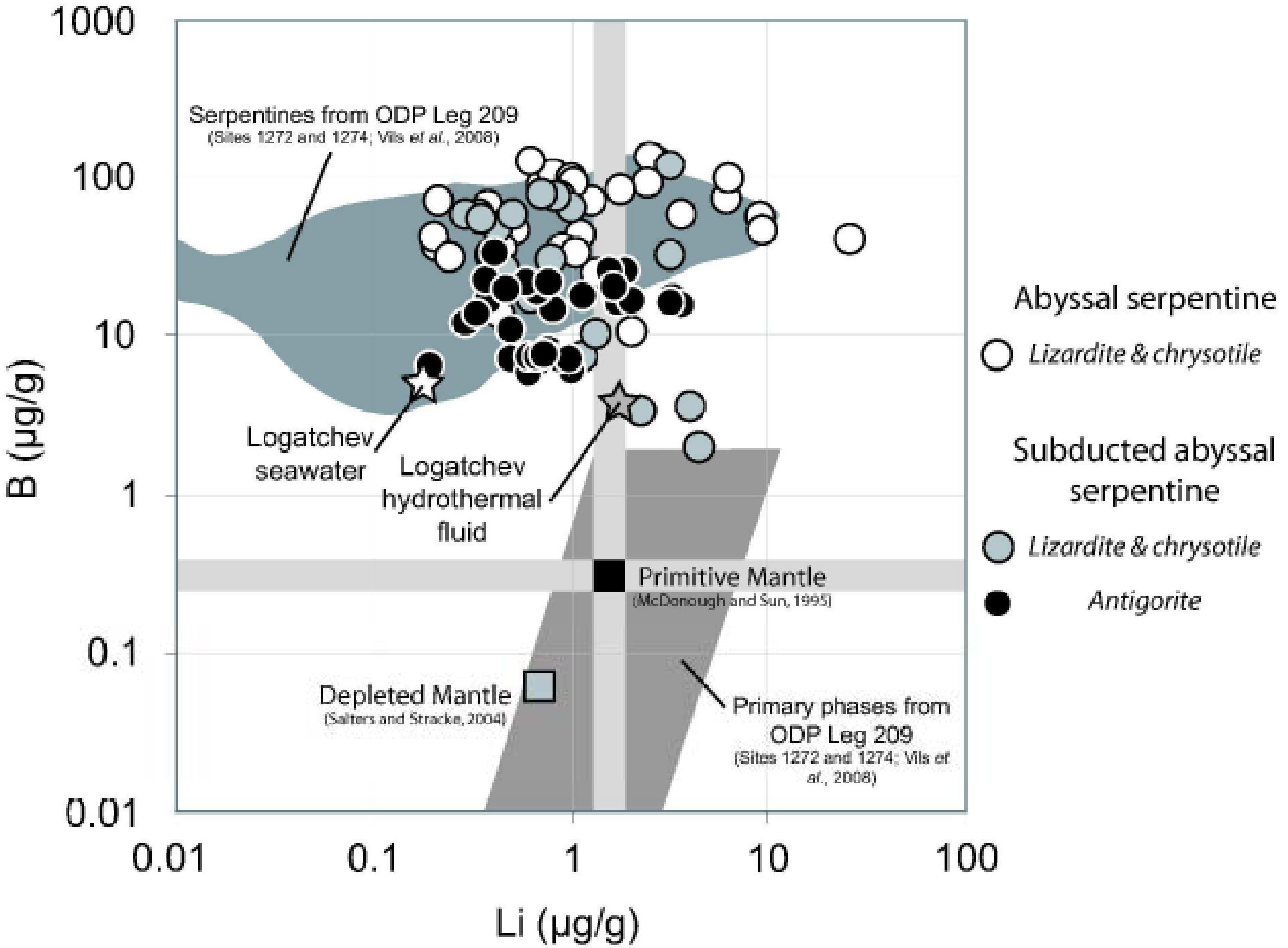
Hattori & Guillot, 2003

FME in subducted oceanic serpentinites

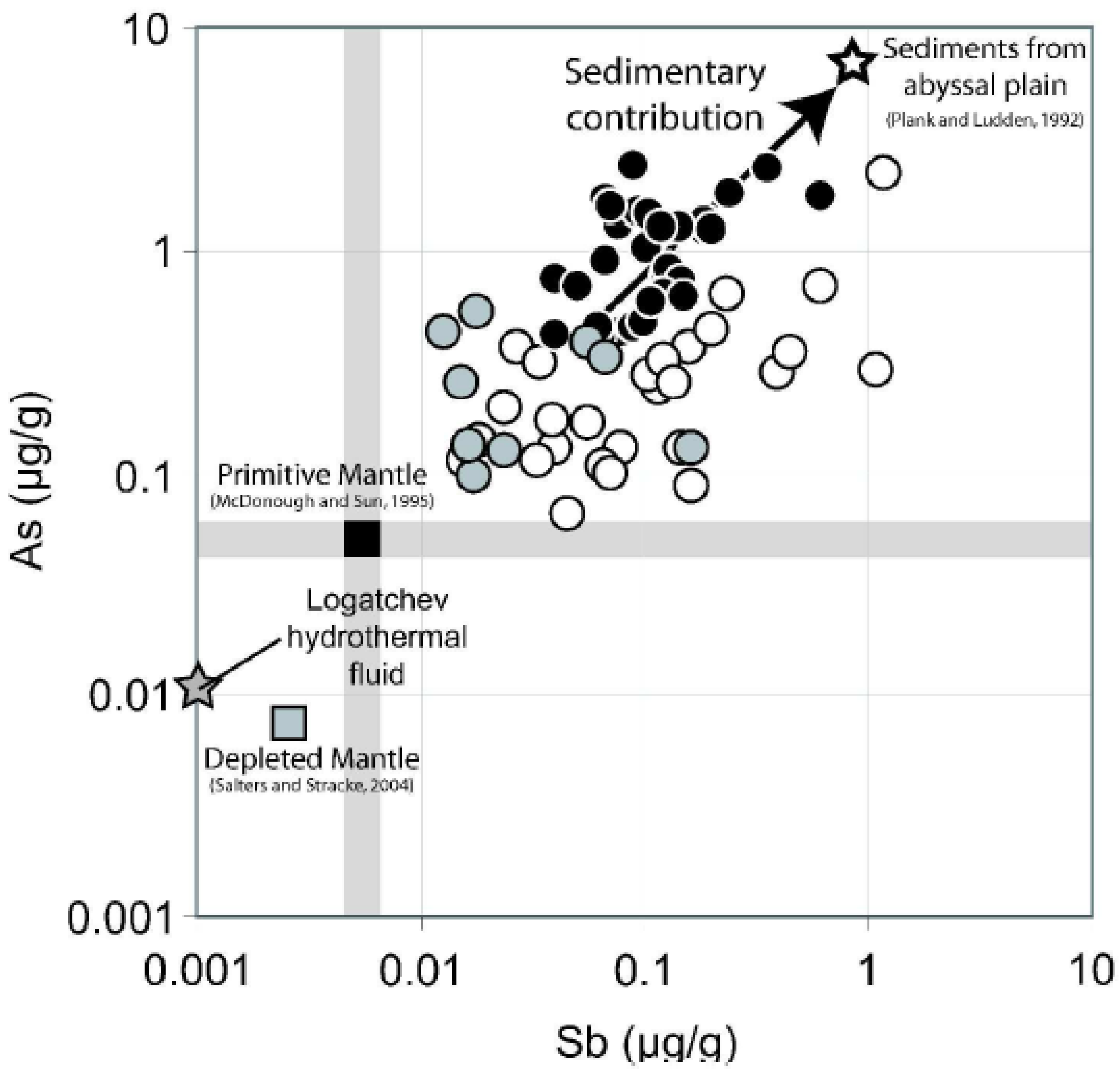
Caribbean example



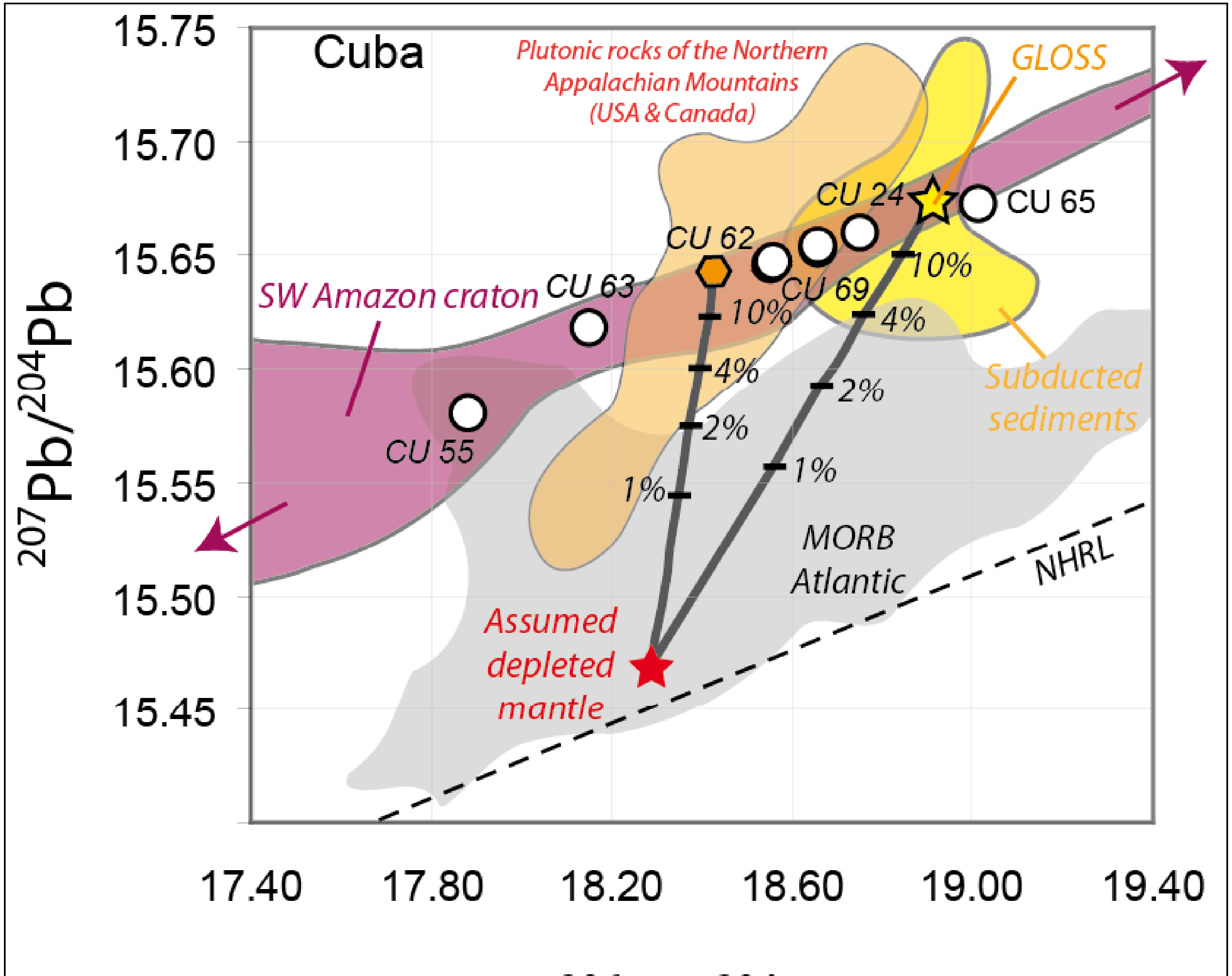
Deschamps et al., 2011



Deschamps et al., 2011



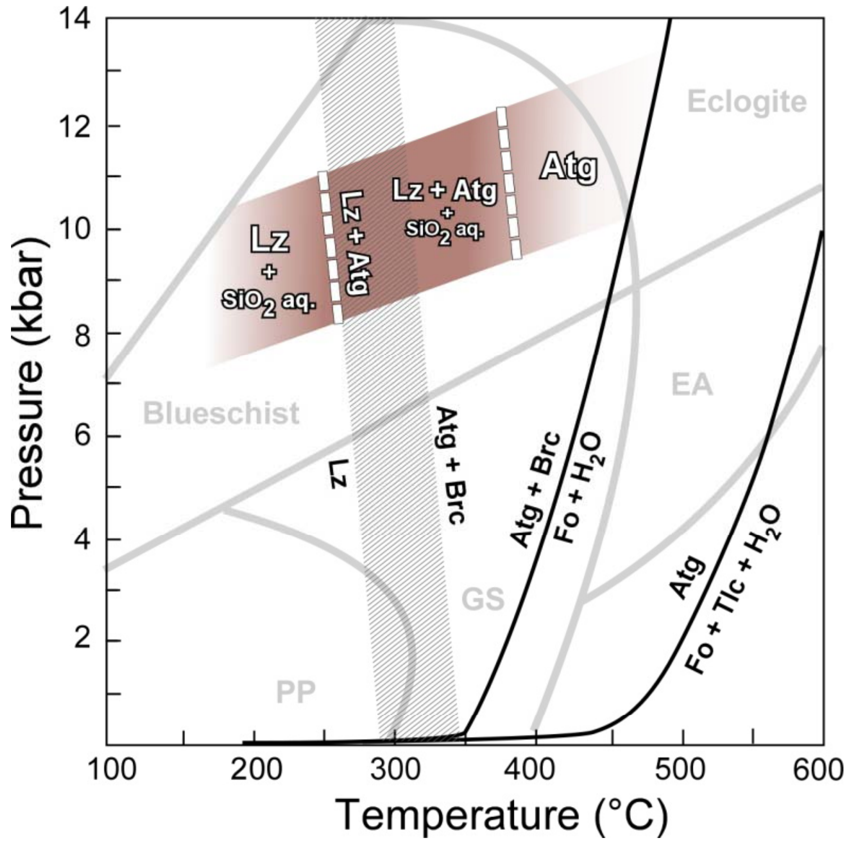
Deschamps et al., 2011

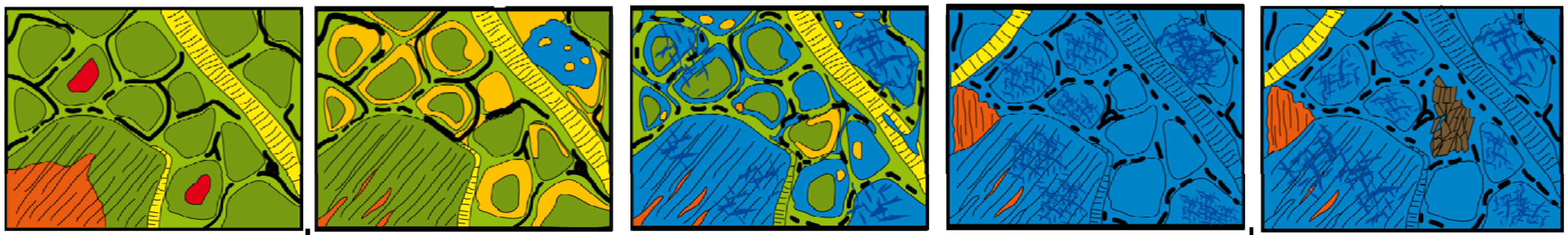


Deschamps *et al.*, submitted.

Pb isotopes show that oceanic serpentinites incorporated 10% of fluids derived From subducted sediments

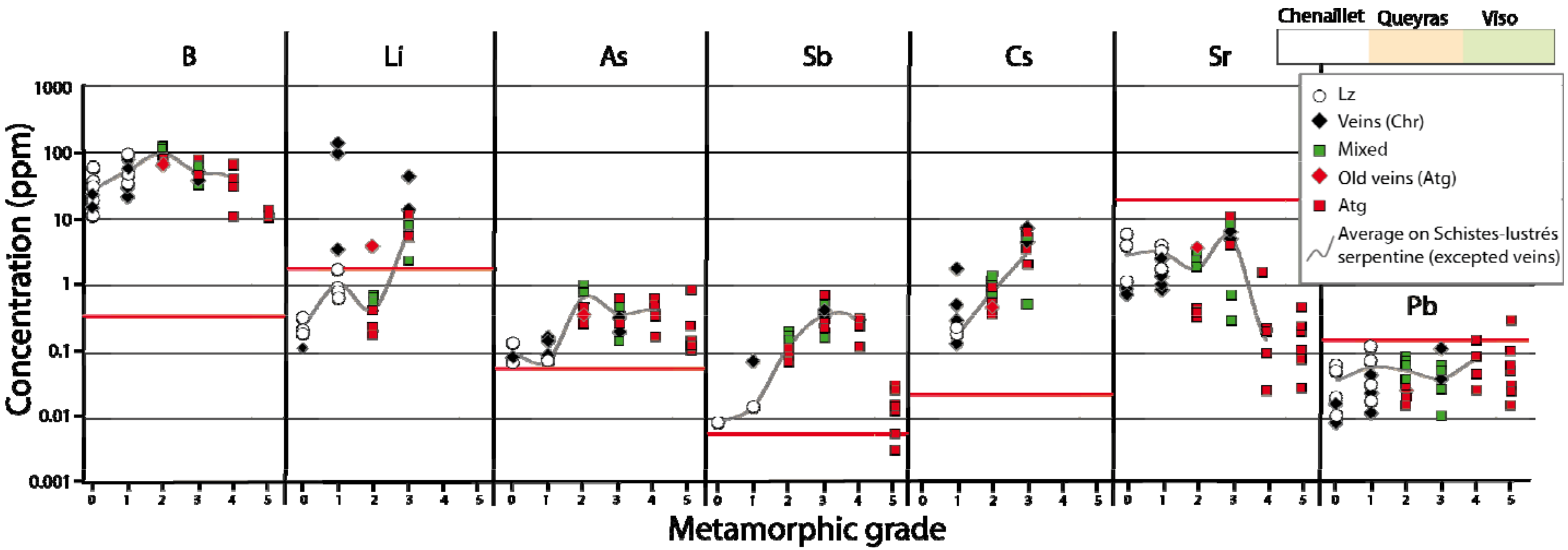
Progressive antigoritisation along a HP-LT metamorphic gradient : Alpine example





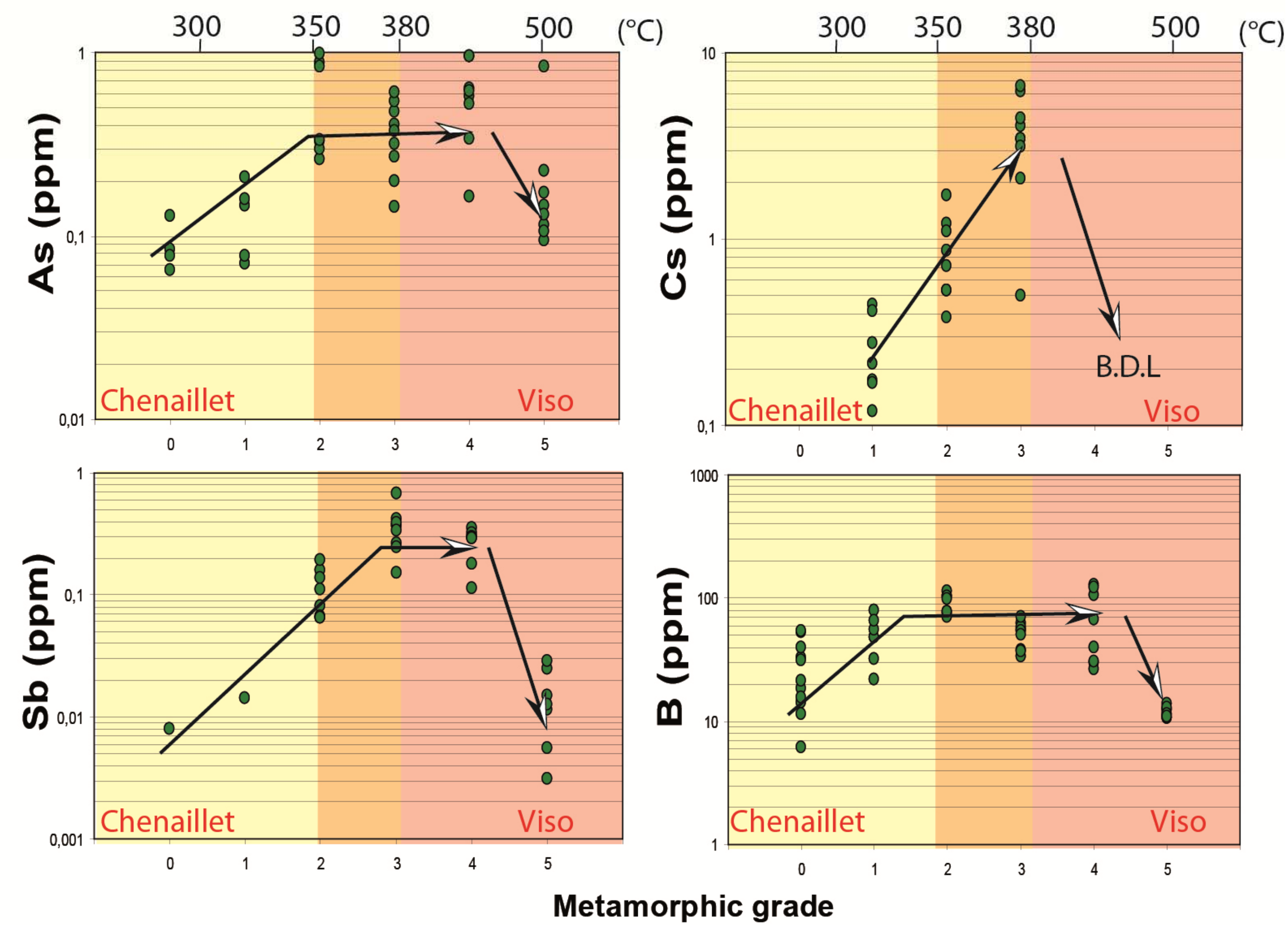
Lafay et al., in prep.

FME in subducted oceanic serpentinites : Alpine example



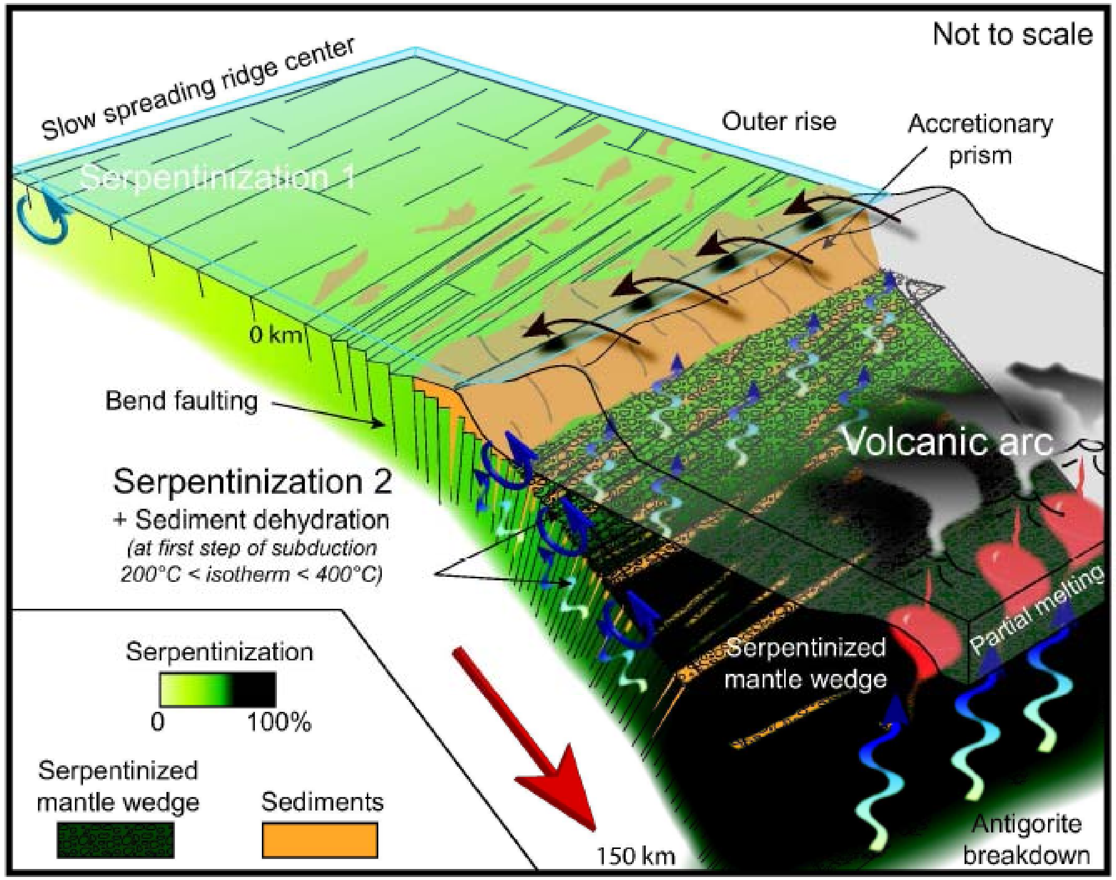
Lafay et al., in prep.

SERPENTINITES



Volatil enrichment up to 450°C coming from surrounding metasediments followed by devolatization at ca. 500°C

Lafay et al., in prep.

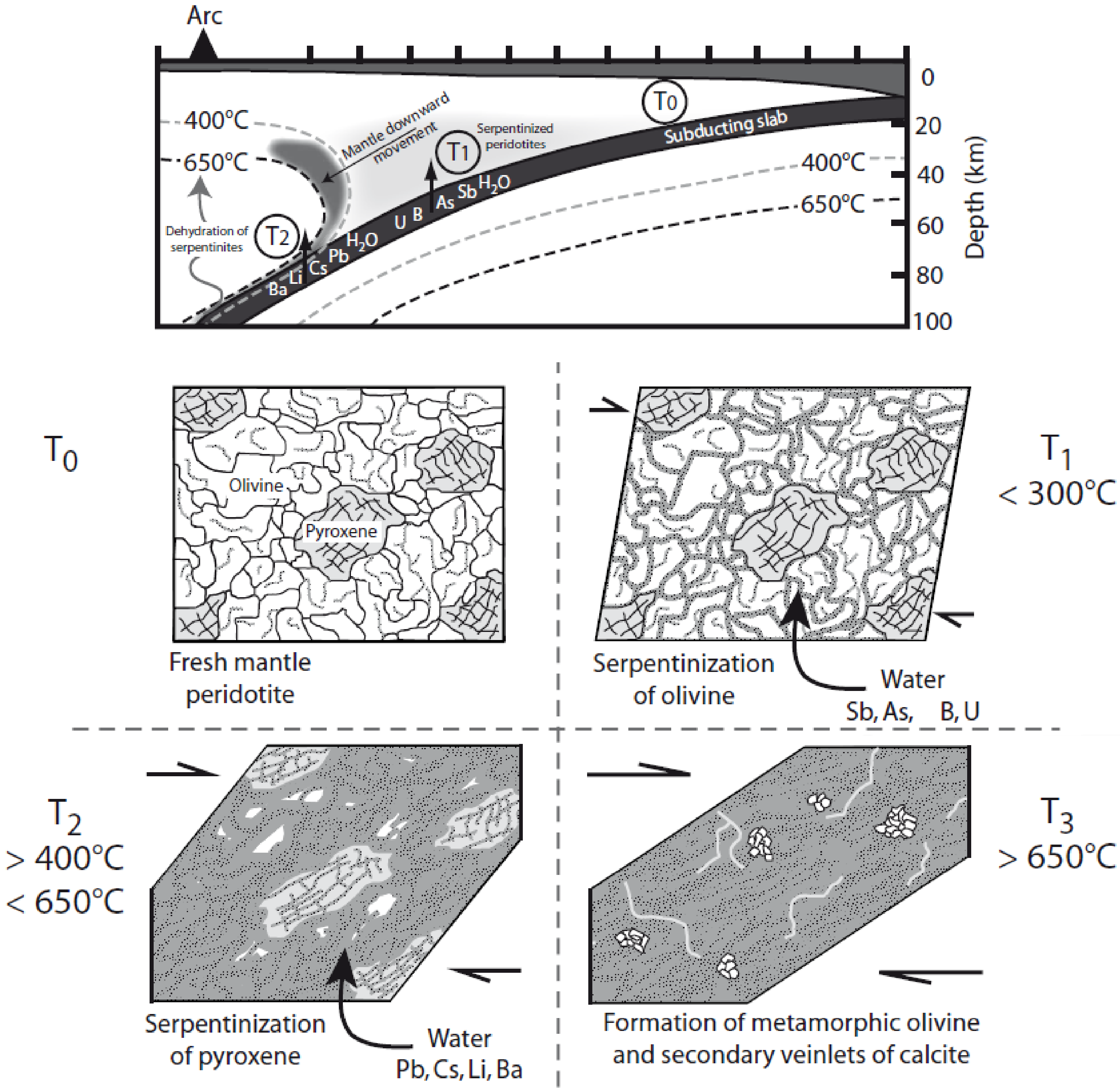


Deschamps et al., 2011

Mantle wedge serpentinites are highly enriched in fluid-mobile elements coming from the progressive dehydration of the subducted sediments at shallow level within the mantle wedge

Subducted oceanic serpentinites are also enriched in fluid-mobile elements,
first by hydrothermal fluid circulation in oceanic environment
second by sediment dehydration at the onset of subduction

Both serpentinitites lost volatils after 500°C and participate to FME enrichment in arc magmas



Arc
0
20
40
60
80
100
Depth (km)
400°C
650°C
Mantle downward movement
Serpentinized peridotites
T0
T1
T2
Subducting slab
400°C
650°C
Dehydration of serpentinites
Ba Li Cs Pb H2O U B As Sb H2O
T0
Olivine
Pyroxene
Fresh mantle peridotite
T1
< 300°C
Serpentinization of olivine
Water
Sb, As, B, U
T2
> 400°C
< 650°C
Serpentinization of pyroxene
Water
Pb, Cs, Li, Ba
T3
> 650°C
Formation of metamorphic olivine and secondary veinlets of calcite