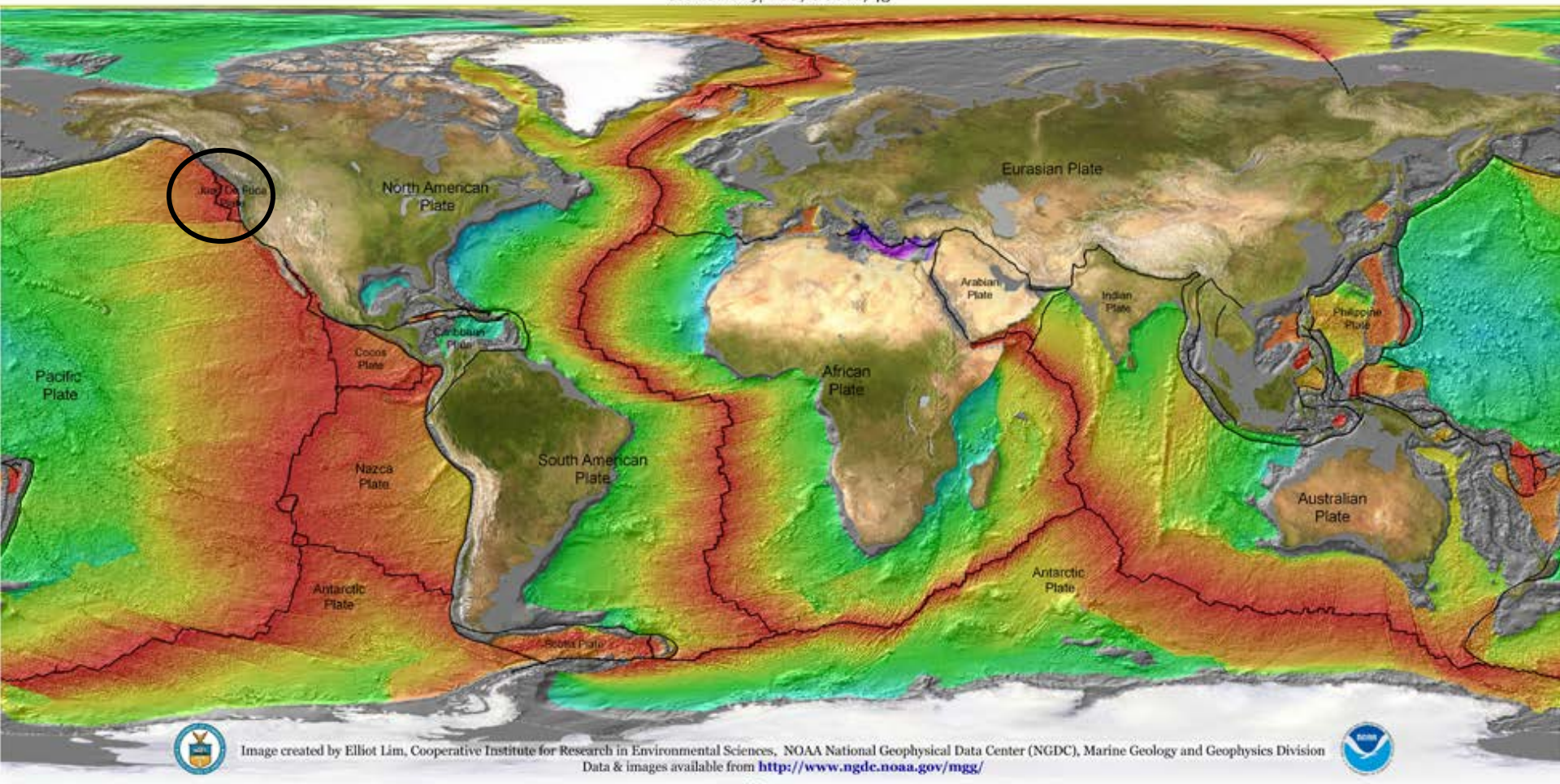
Age of Oceanic Lithosphere (m.y.)

young, hot

Data source:

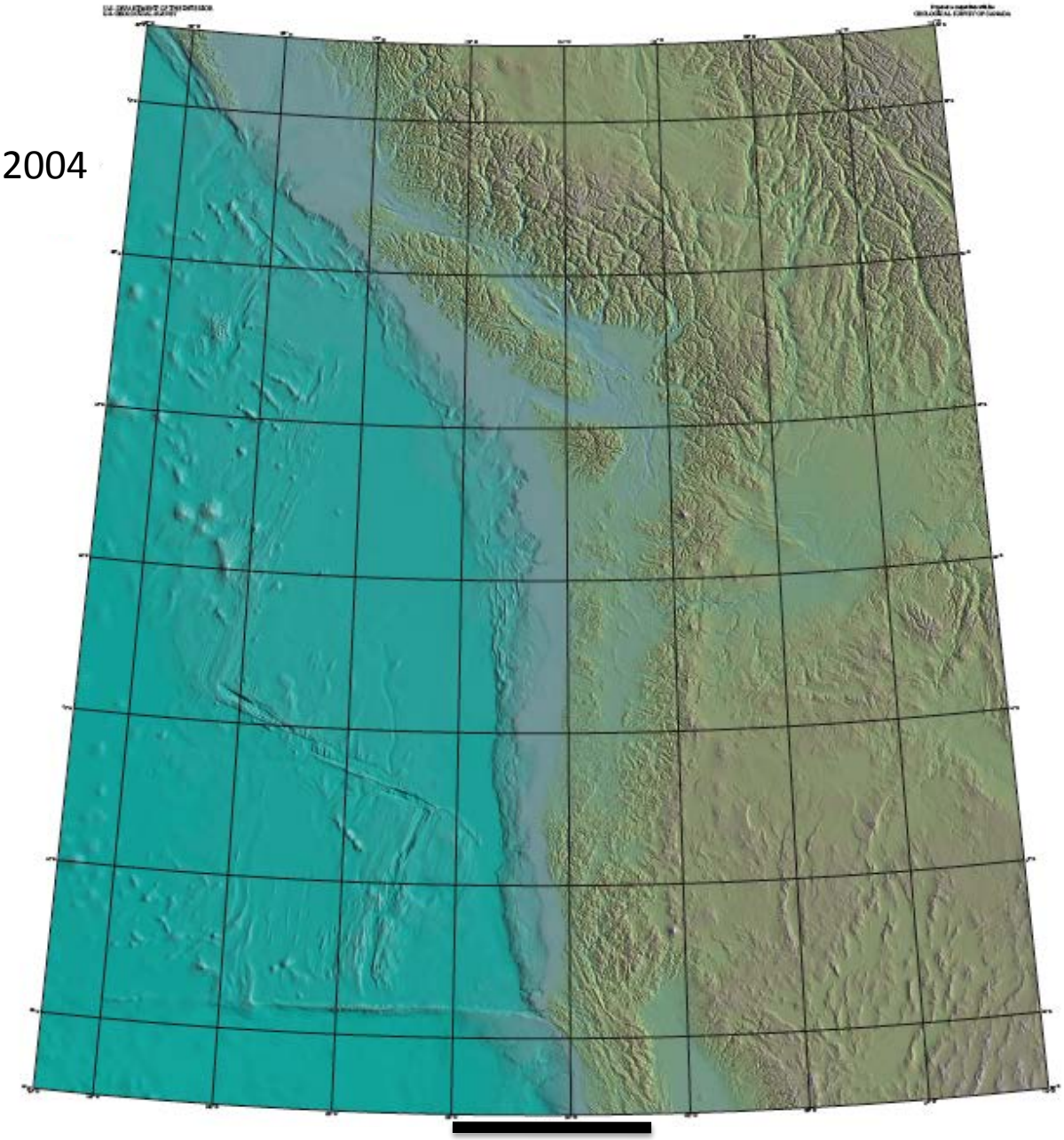
Muller, R.D., M. Sdrolias, C. Gaina, and W.R. Roest 2008. Age, spreading rates and spreading symmetry of the world's ocean crust,Geochem. Geophys. Geosyst., 9, Q04006, doi:10.1029/2007GC001743.

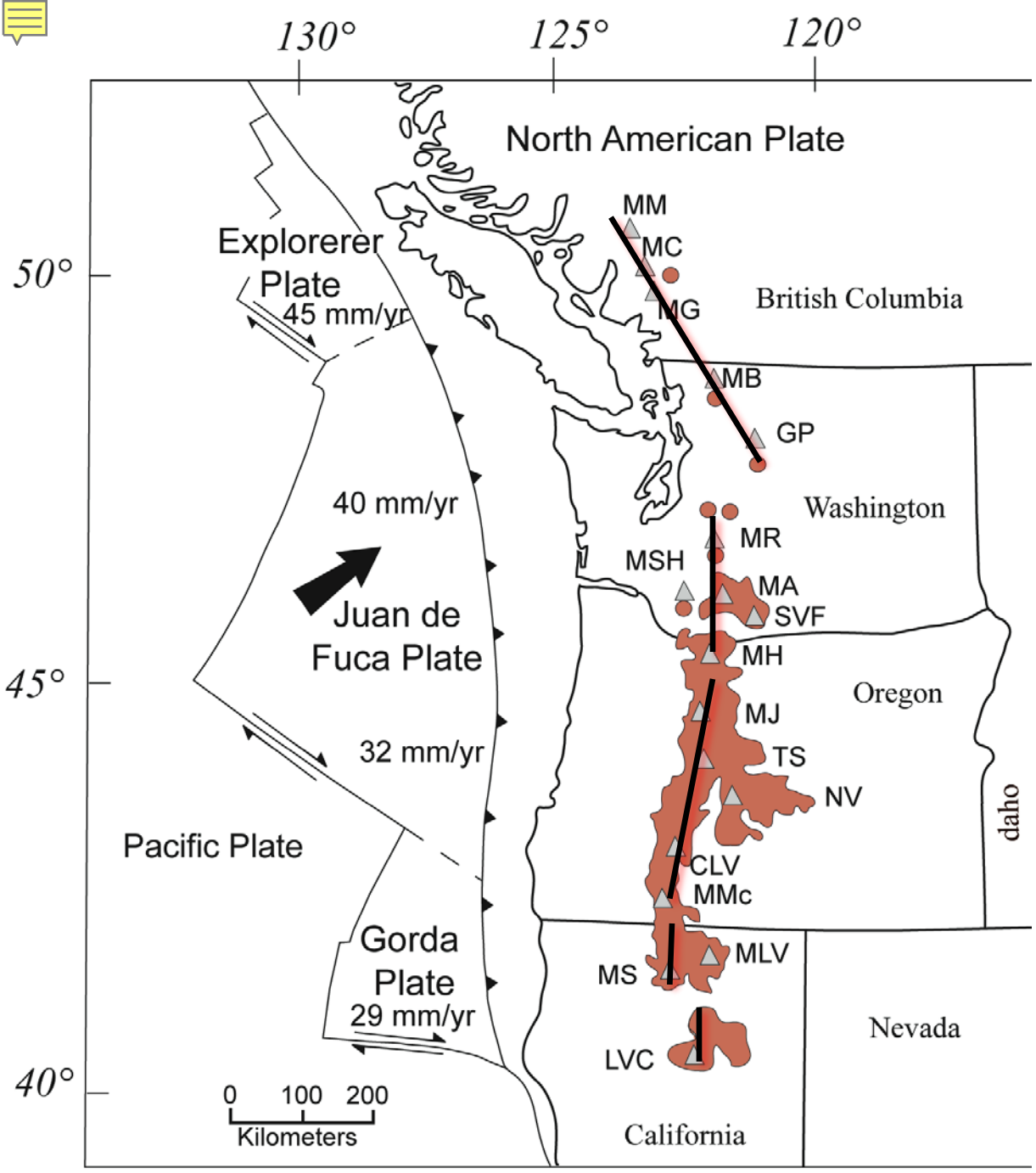


million years

0 20 40 60 80 100 120 140 160 180 200 220 240 260 280

Physiography
of Cascadia
Ralph Haugerud, 2004

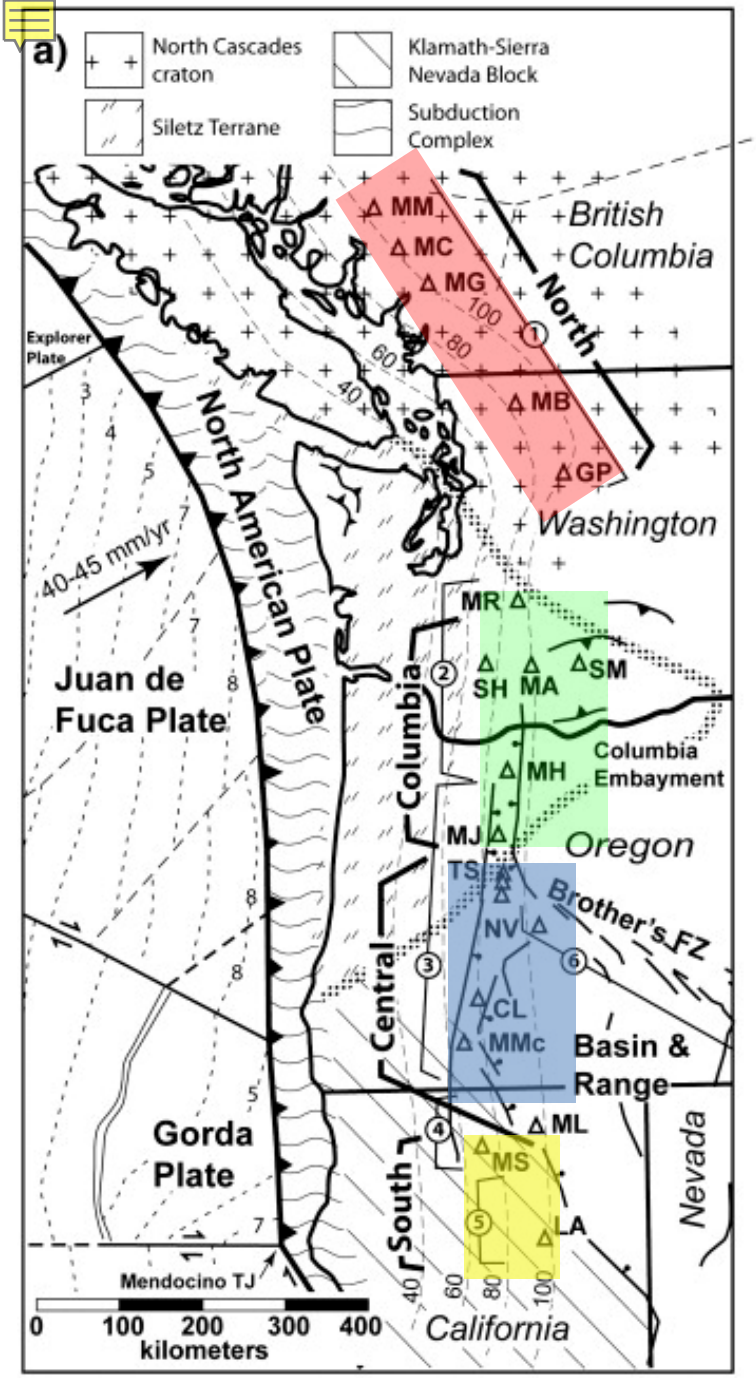




Quaternary Cascade arc

18 major centers
3416 Quaternary vents
(*Hildreth 2007*)

segmentation after *Guffanti and Weaver (1988)*



Schmidt et al., (2007)

b)

North

Near orthogonal convergence
Most calcalkaline basalt

Columbia

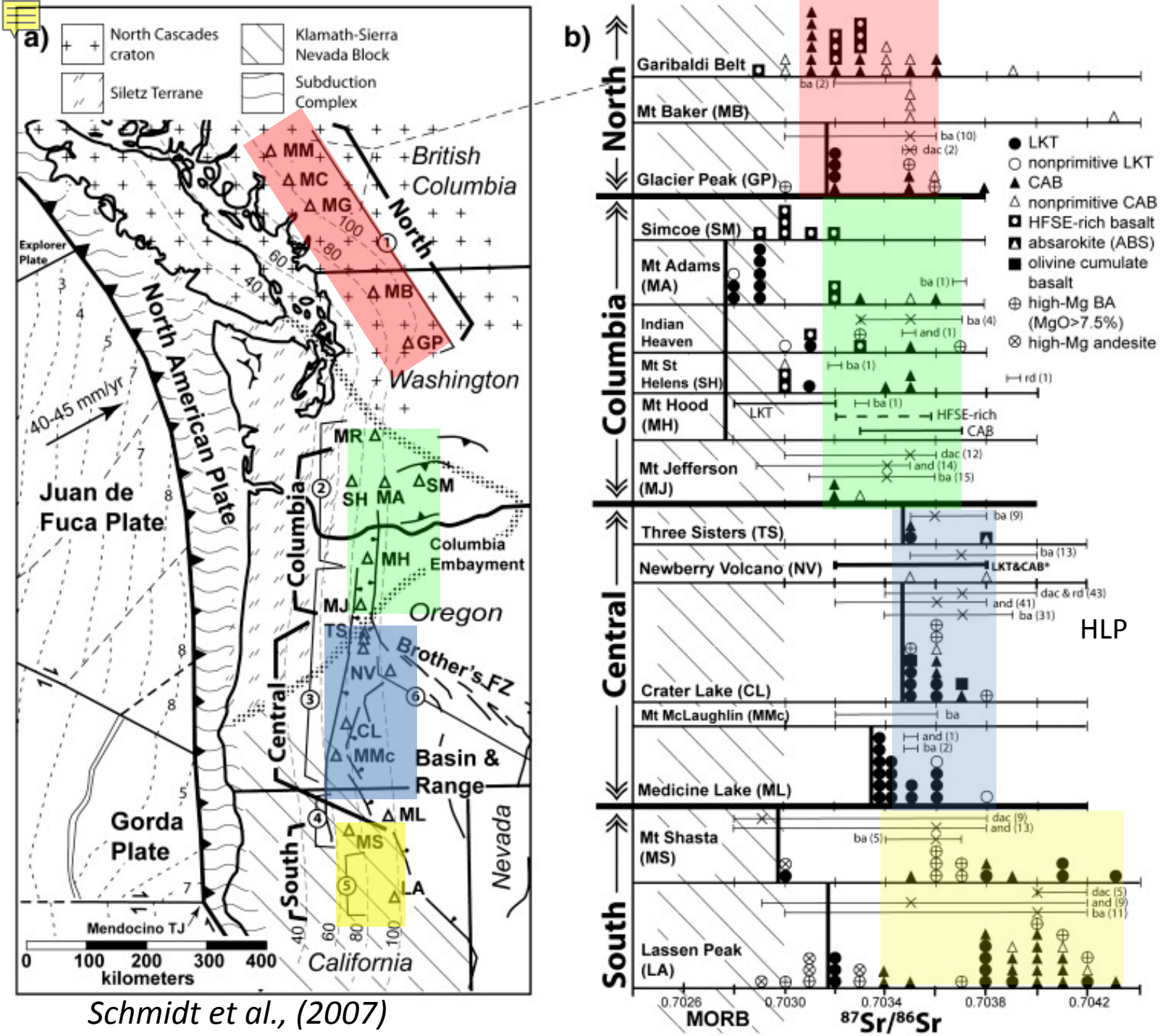
Siletzia basement
Most diffuse vents
Most HFSE basalt

Central

Arc rift and abundant low-K basalt

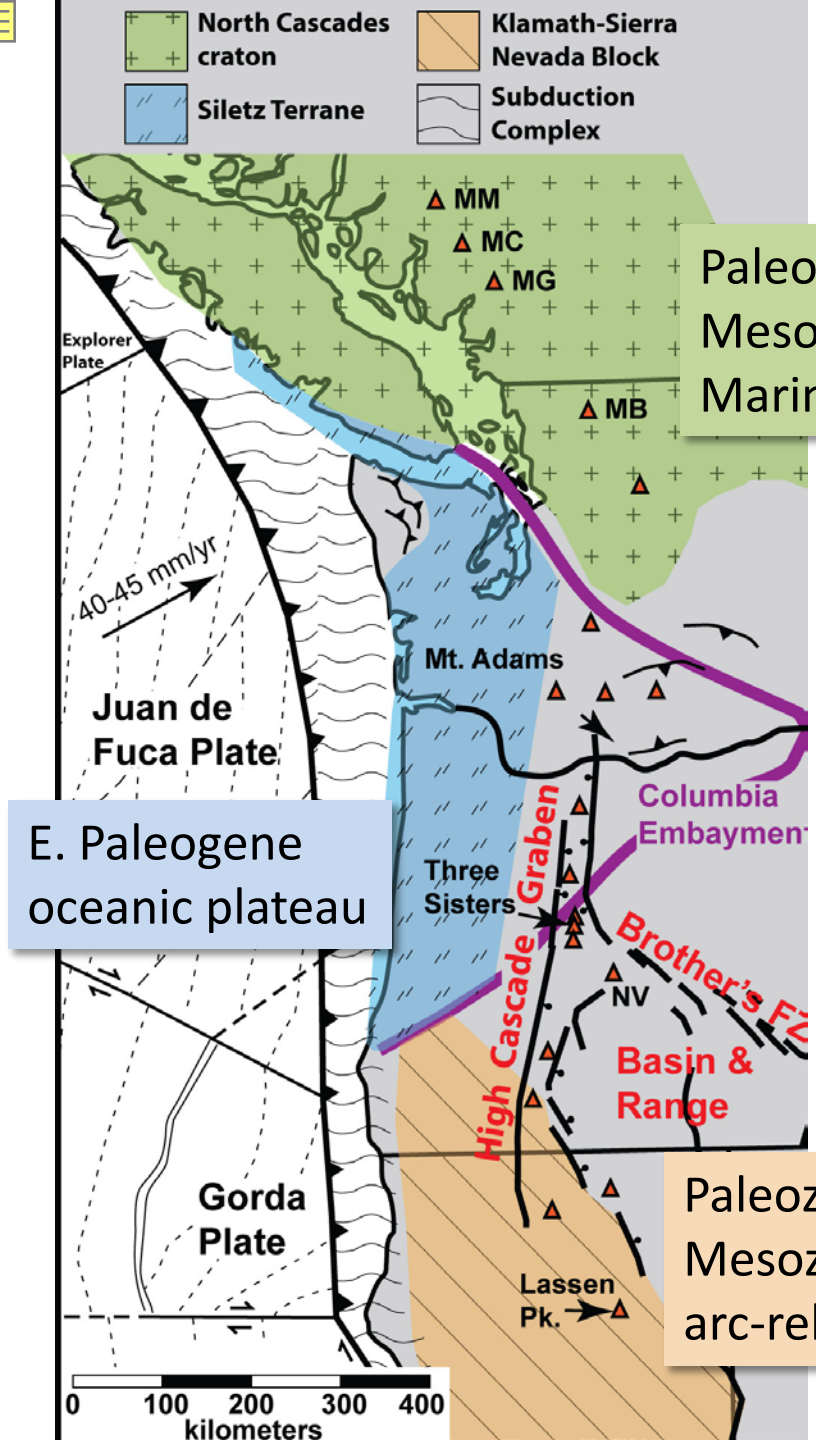
South

Most variable composition
Gorda Plate and plate edge



Calcalkaline basalt

Schmidt et al., (2007)



Paleozoic to Mesozoic Marine rocks

E. Paleogene oceanic plateau

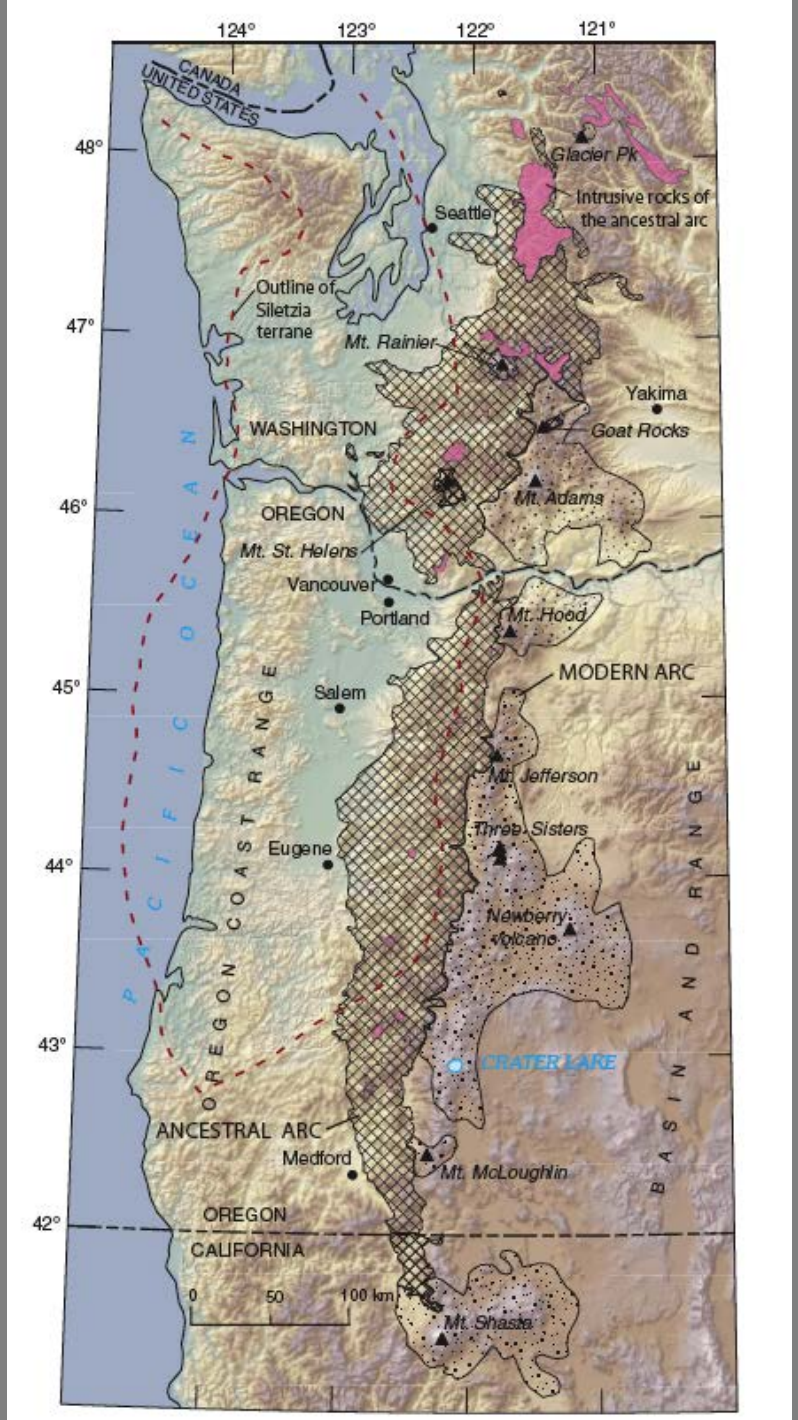
Paleozoic to Mesozoic Marine arc-related rocks

Modern arc has segmentation

- Vent distributions
  - Magma compositions
    - Mafic :silicic
    - Primitive magmas types
    - Isotopic composition
  - Continental Crust
  - Subducting Plate
  - Local tectonic regime
  - Slab seismicity

Schmidt et al., 2007

Photo by permission of Long Bach Nguyen



(*duBray and John, 2011*)

Photo by Chuck Hawks

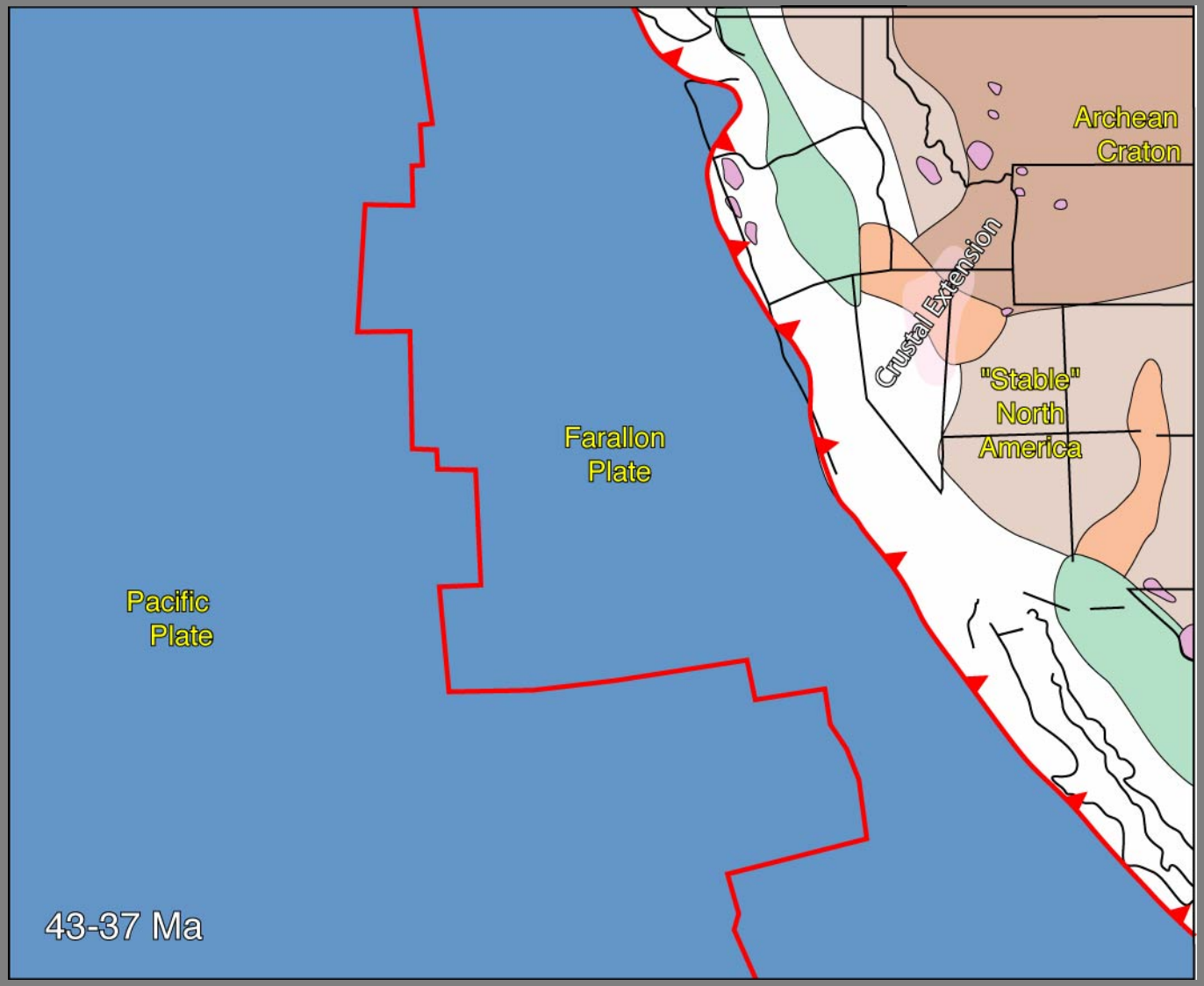
A long convergent and transform history

http://pubs.usgs.gov/gip/dynamic/Pangaea.html

3-0 Ma

From Christiansen, 2005, after Christiansen and Yeats, 1992

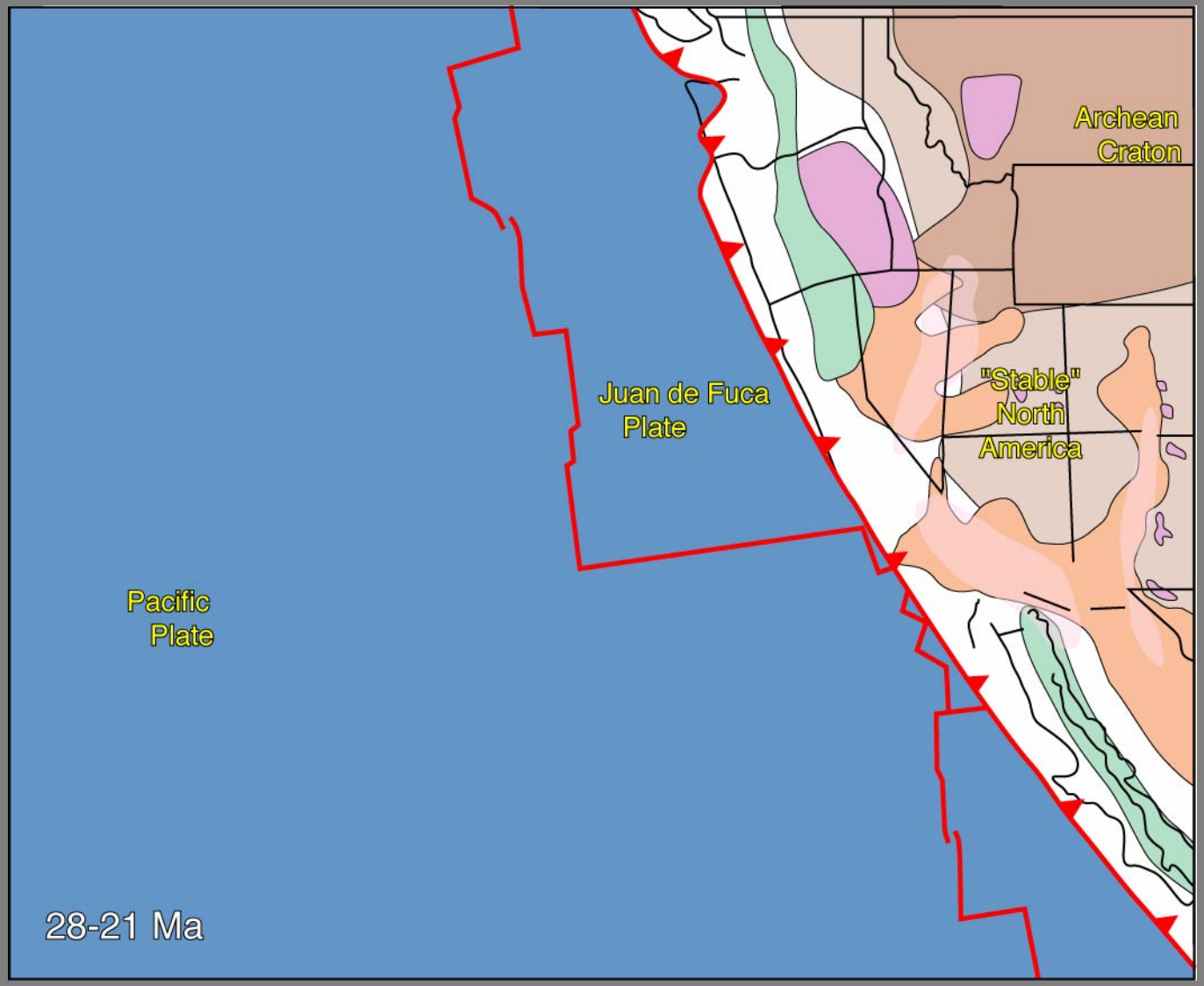
Onset of Cascades magmatism-
Western Cascades- Clarno Fm



Challis,
Absaroka,
forearc

43-37 Ma

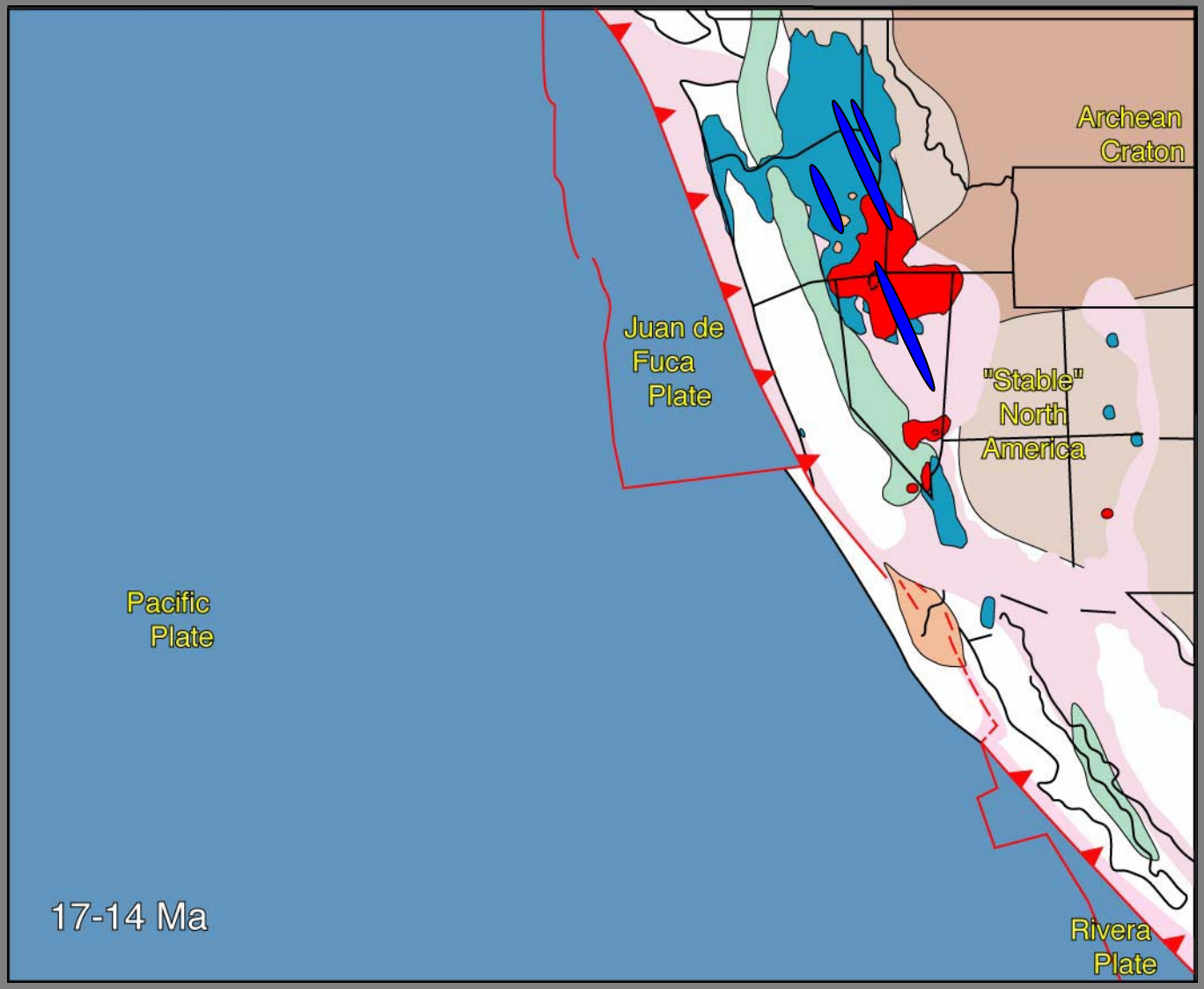
From Christiansen, 2005, after Christiansen and Yeats, 1992



28-21 Ma

From Christiansen, 2005, after Christiansen and Yeats, 1992

Onset of flood basalts dikes and large calderas

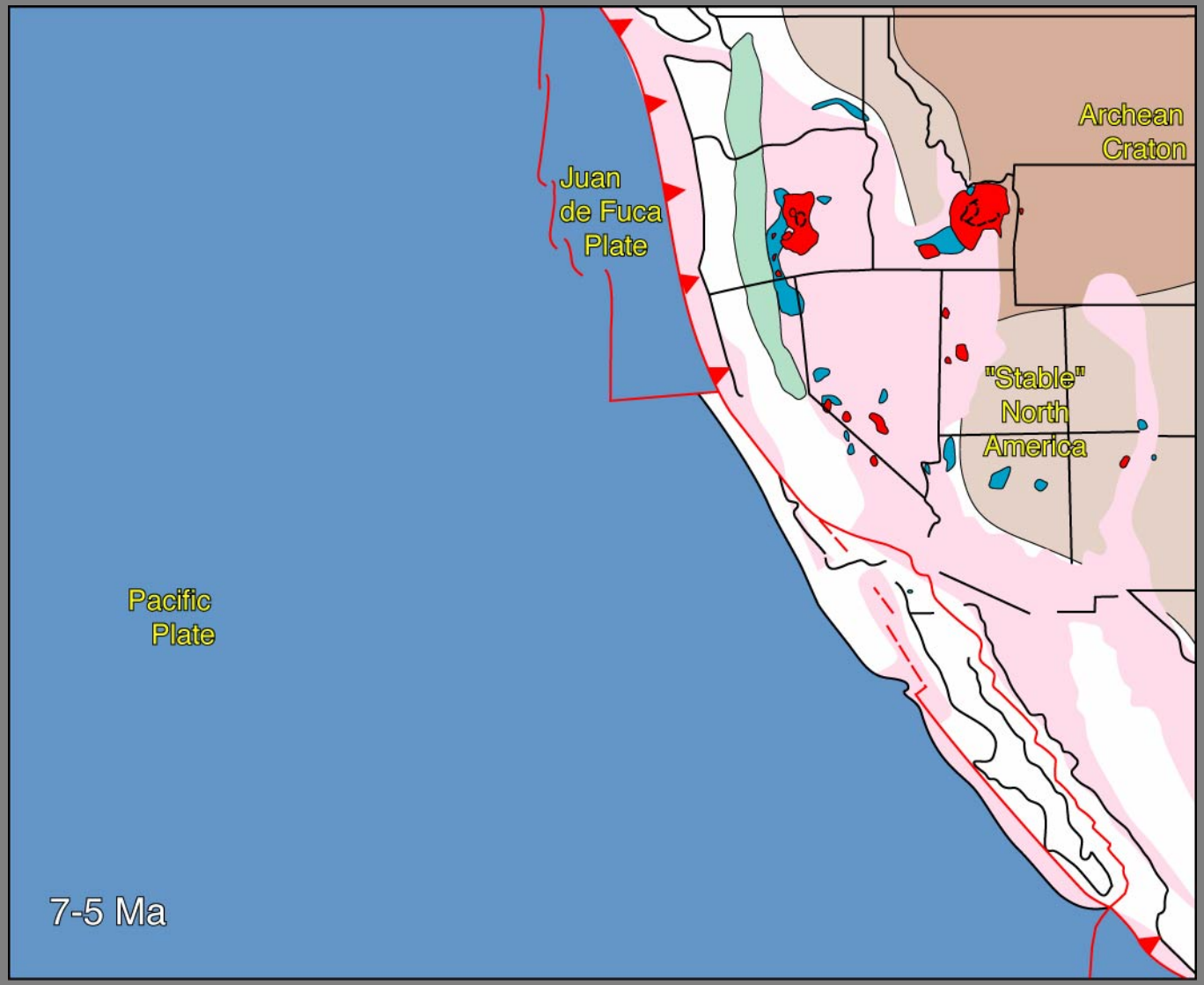


17-14 Ma

From Christiansen, 2005, after Christiansen and Yeats, 1992

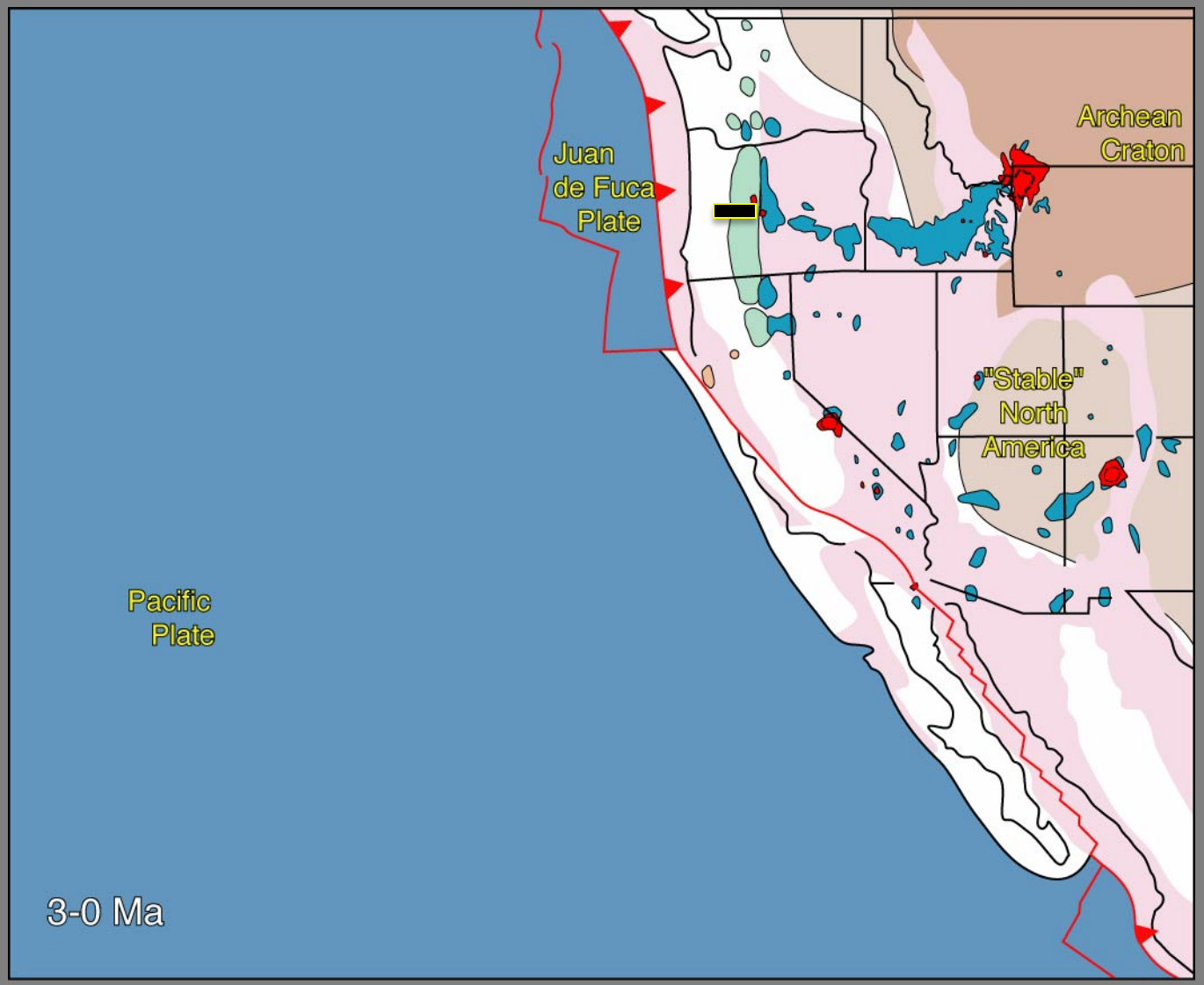
11-9 Ma

From Christiansen, 2005, after Christiansen and Yeats, 1992



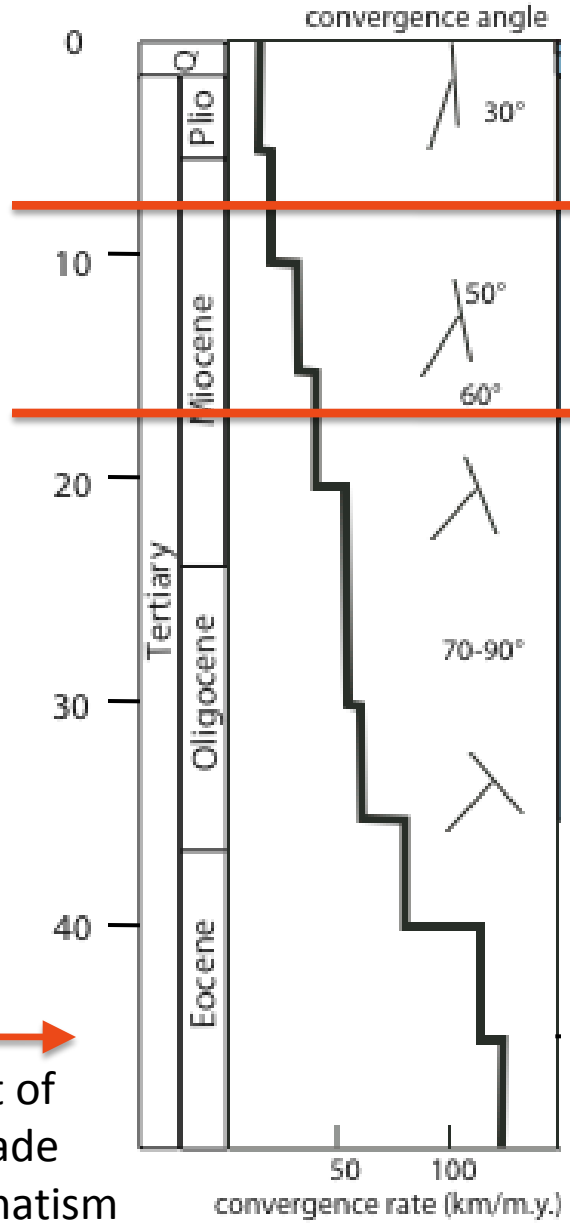
7-5 Ma

From Christiansen, 2005, after Christiansen and Yeats, 1992



3-0 Ma

From Christiansen, 2005, after Christiansen and Yeats, 1992



LKT basalt, arc-rift onset, Pacific vector

Flood basalts, B&R shift to bimodal

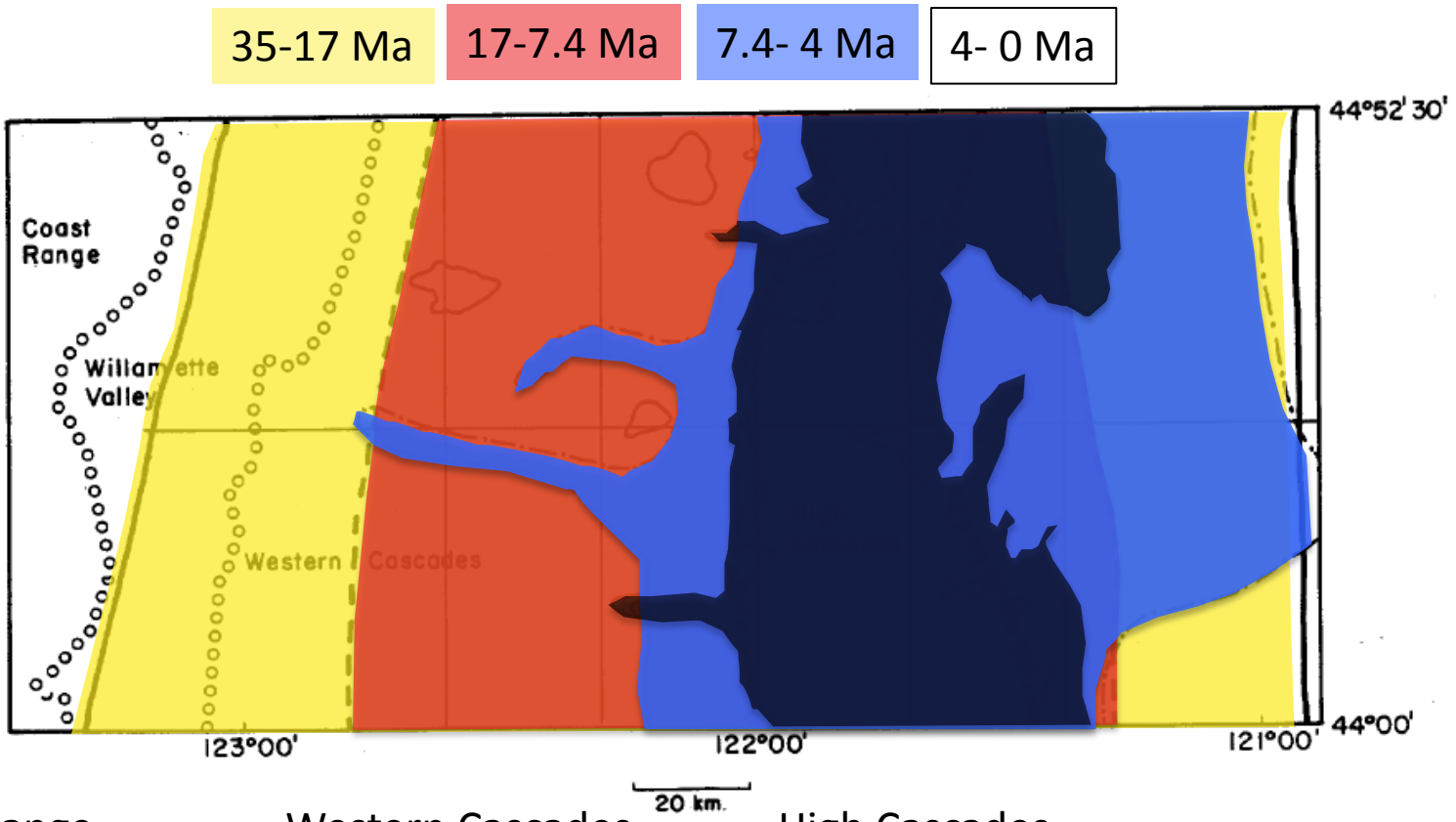
Onset of Cascade magmatism

(Verplanck and Duncan, 1987)

Narrowing of the arc with time

Central Oregon (*Priest, 1990*)

Consistent with slab steepening in time



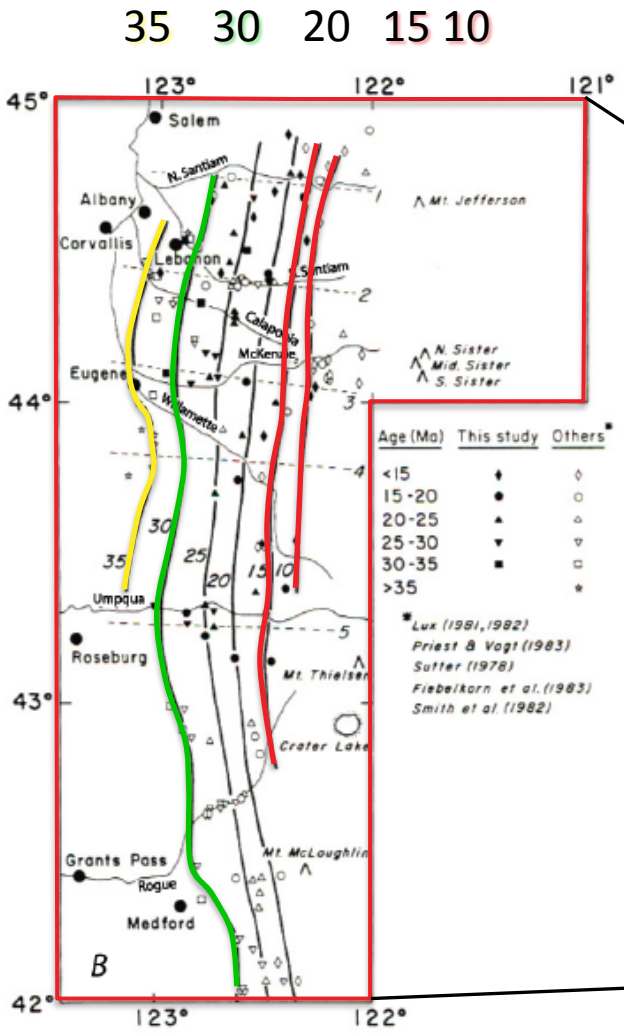
Coast Range

Willamette Valley

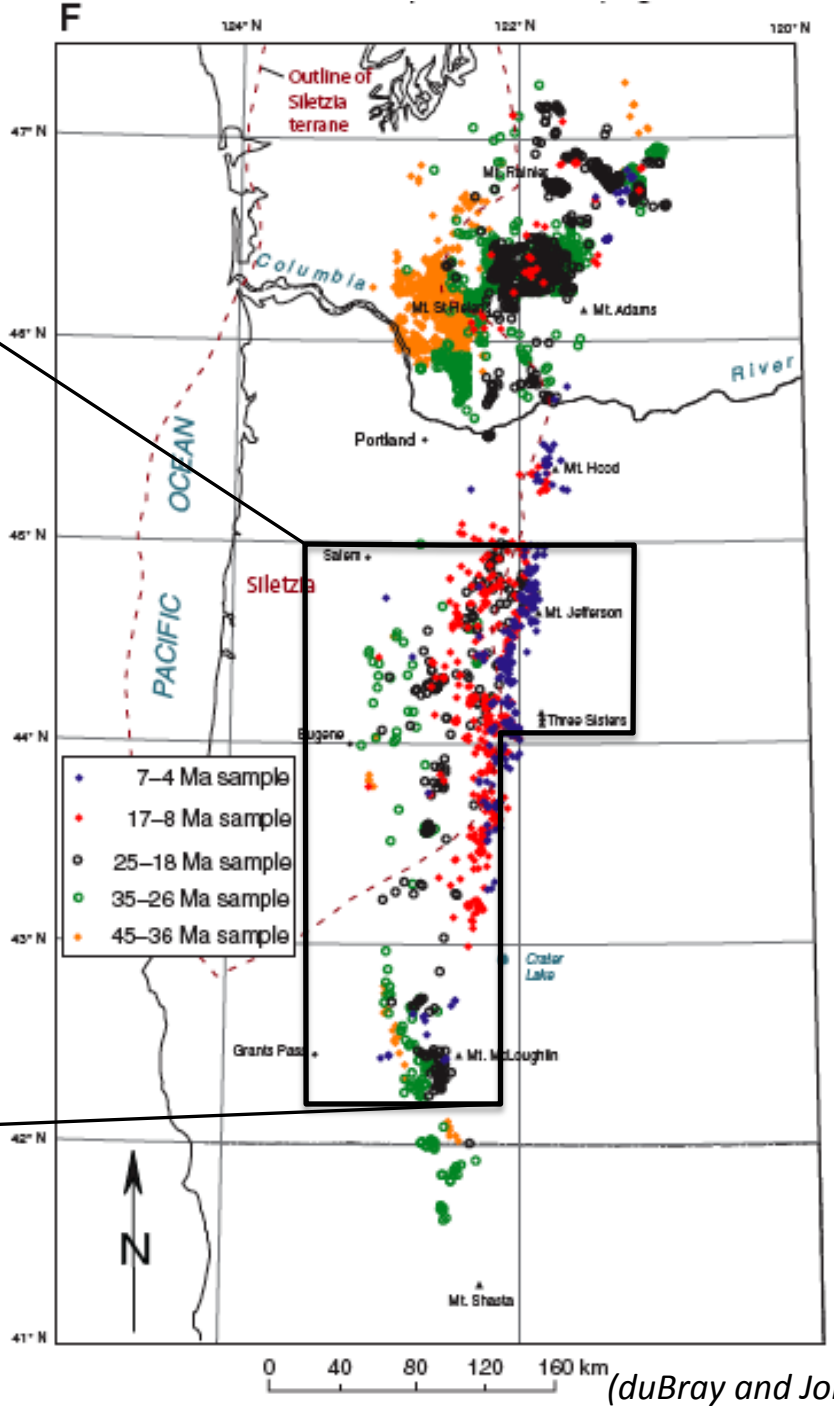
Western Cascades

High Cascades Graben

Eastward migration of the arc with time

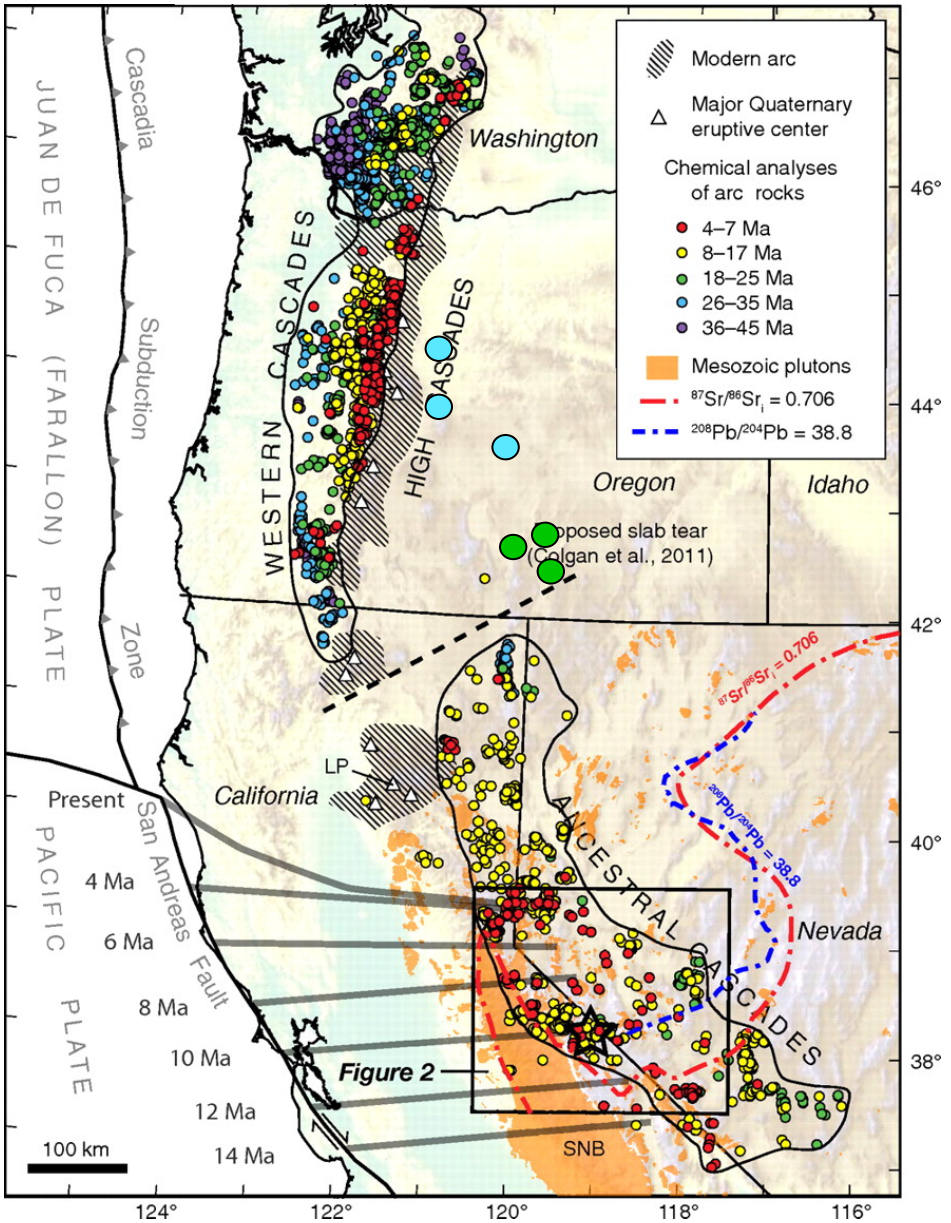


(Verplank and Duncan, 1987)



(duBray and John, 2011)

Inferred extent of ancestral and modern Cascades magmatic arc in western US

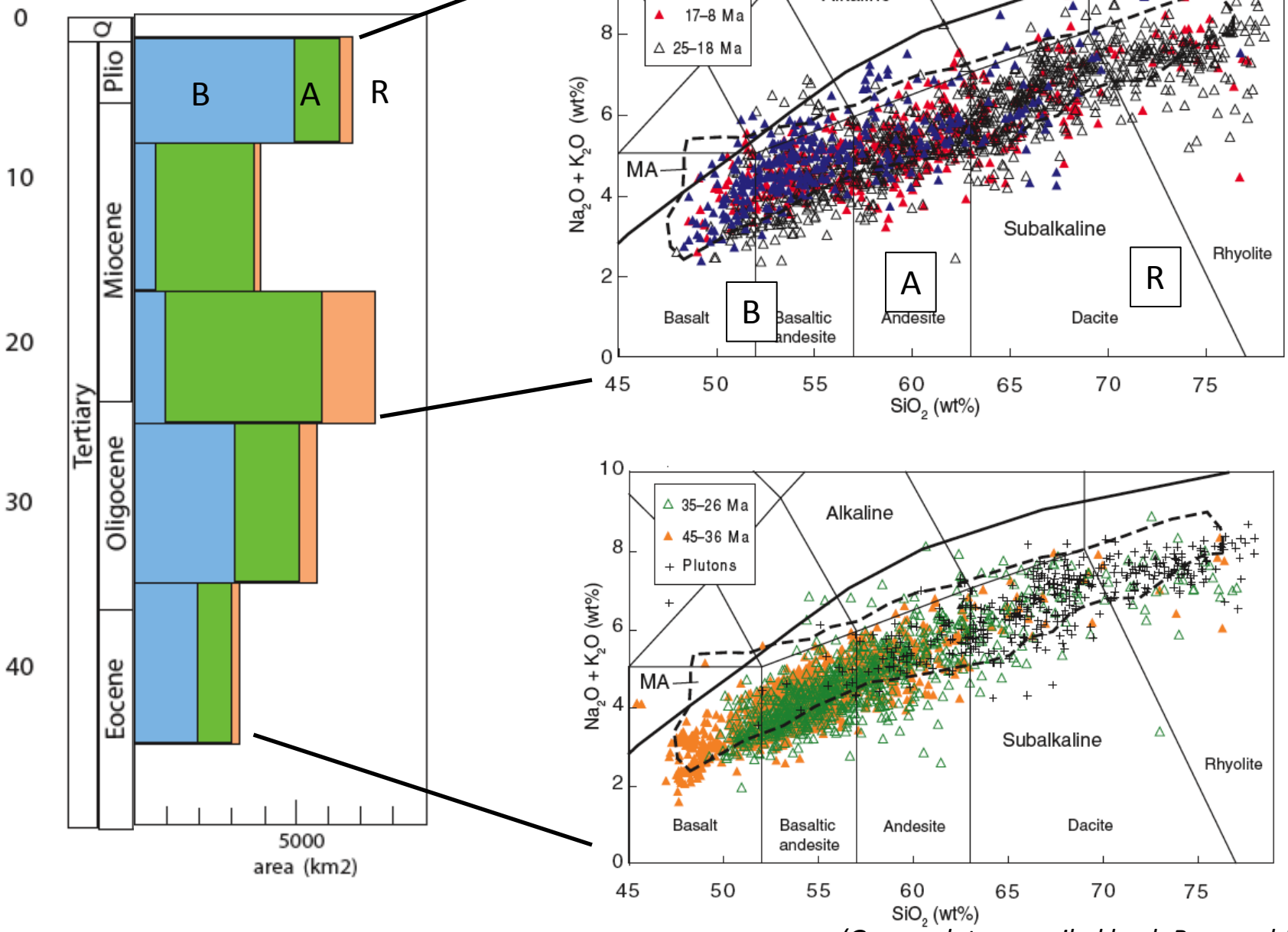


Eastward migration

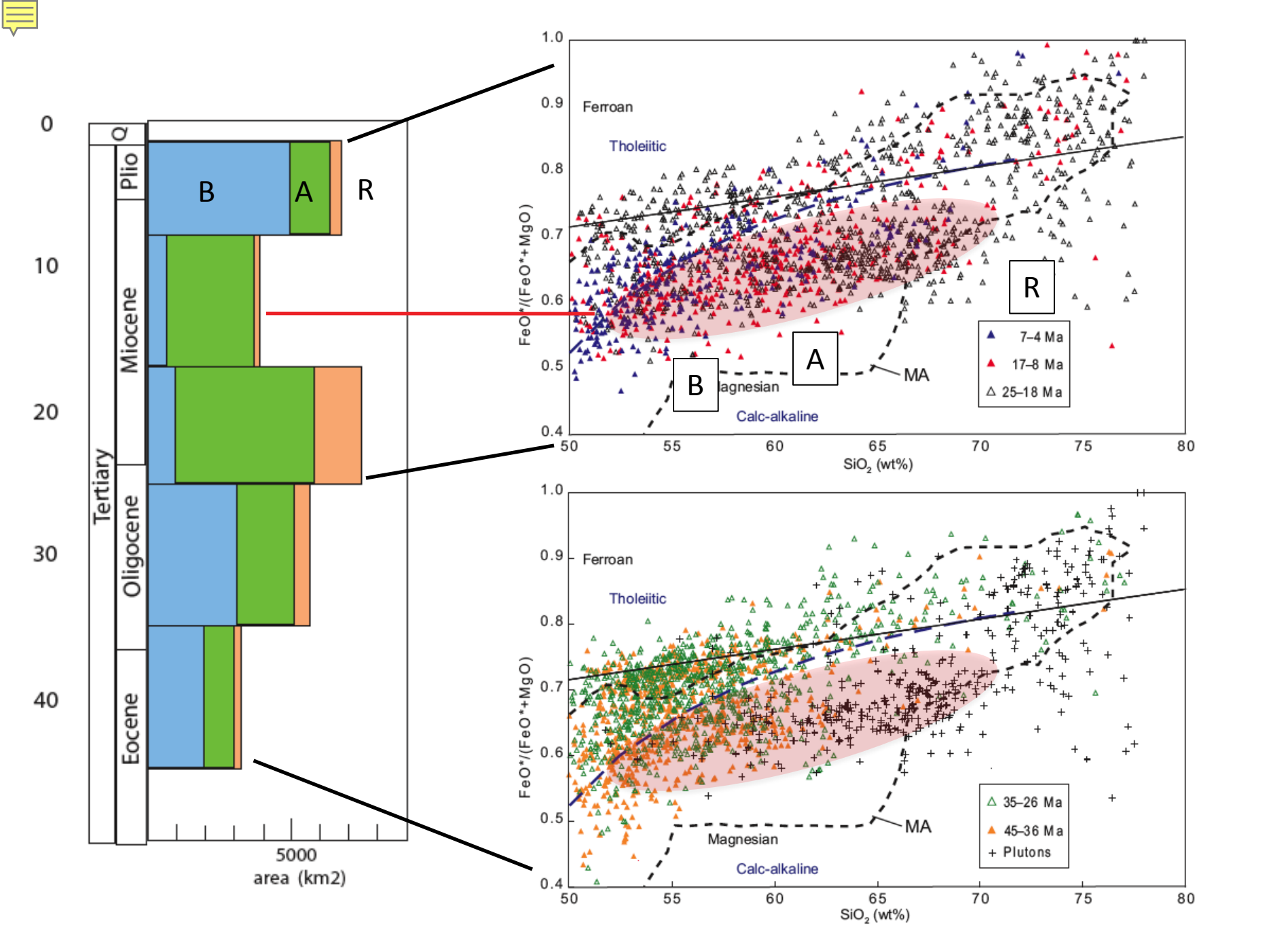
proposed slab tear

Maybe Westward migration

(modified by John et al., 2012 from du Bray et al., 2009; Colgan et al., 2011)

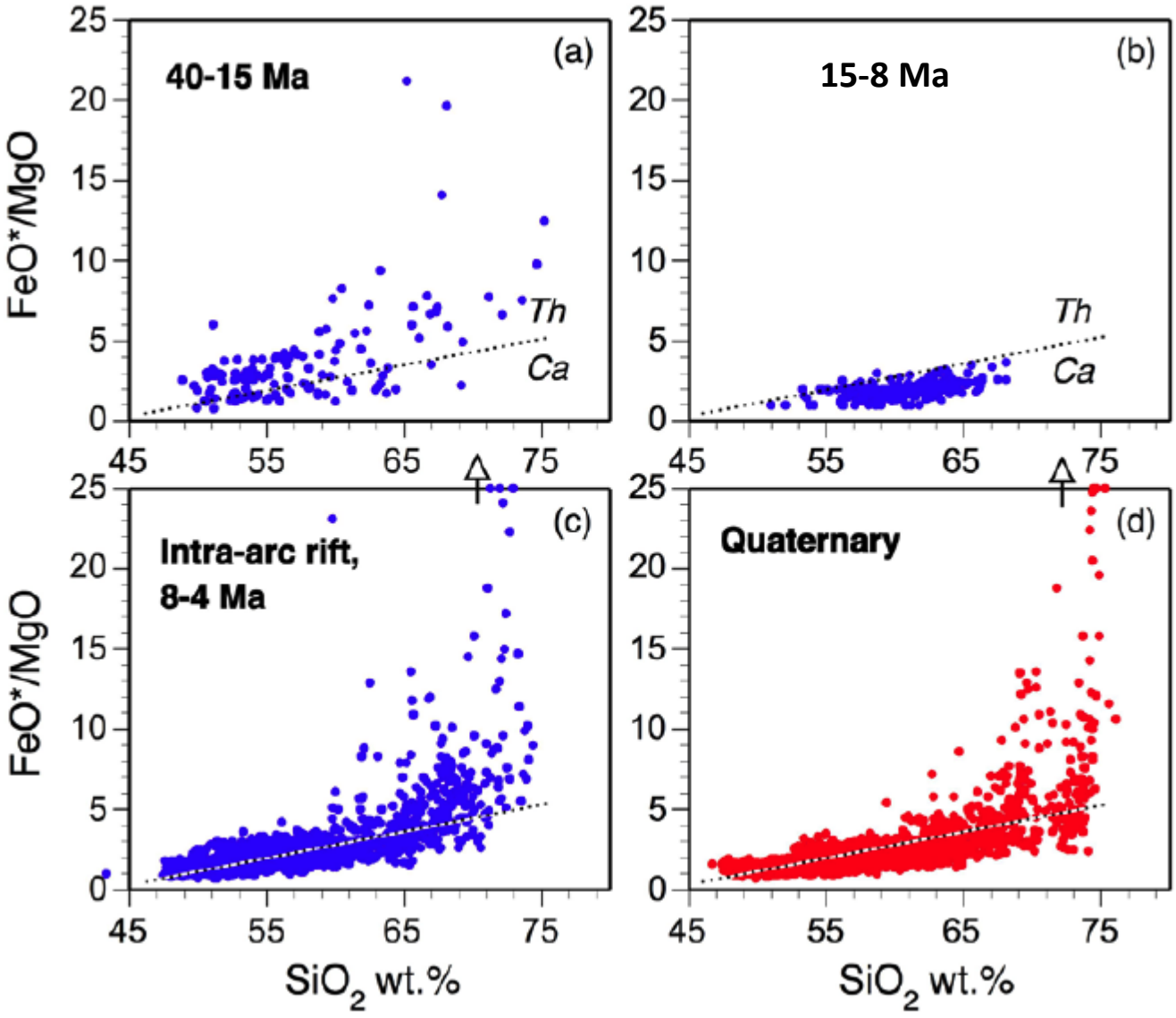


(Georoc data compiled by duBray and John, 2011)



(Georoc data compiled by duBray and John, 2011)

Temporal change in range and in compositional type



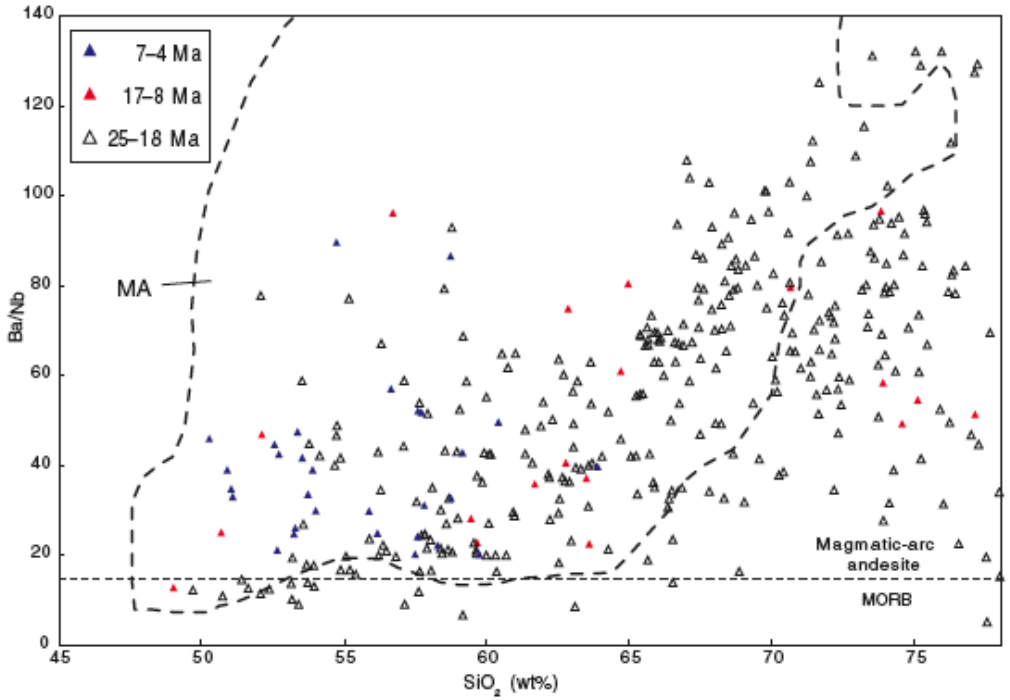
Courtesy of Martin Streck, from Oregon Western Cascades compilation of Rick Conrey

Ba/Nb

7-4

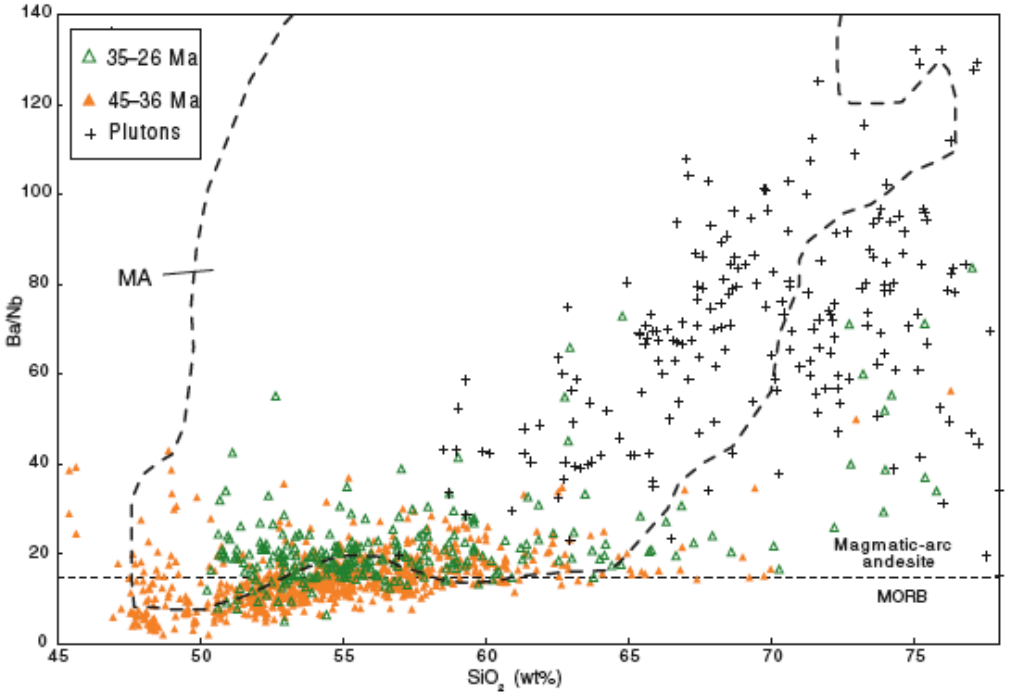
17-8

25-18



general increase in Ba/Nb with age of the arc

Most mafic and most mafic variability at onset and in modern arc



35-26

45-35

To assess changes in mantle and crustal contributions and compositions in time, need systematic time and space transects

Why ancestral Cascades?

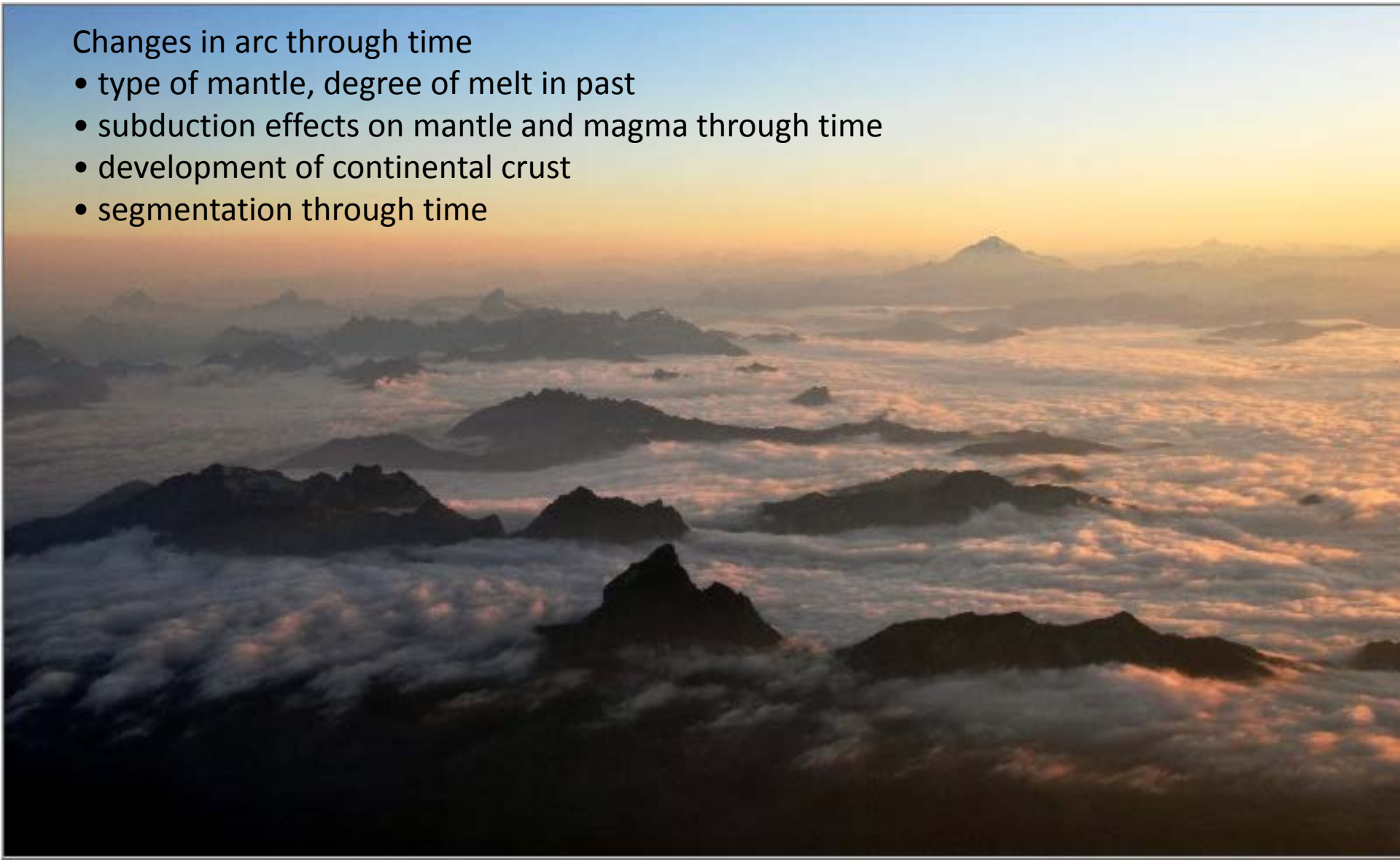


Photo by permission of Long Bach Nguyen