Age of Oceanic Lithosphere (m.y.)

Data source:
Physiography of Cascadia
Ralph Haugerud, 2004
Quaternary Cascade arc

18 major centers
3416 Quaternary vents (Hildreth 2007)

segmentation after Guffanti and Weaver (1988)
Near orthogonal convergence
Most calcalkaline basalt

Siletzia basement
Most diffuse vents
Most HFSE basalt

Arc rift and abundant low-K basalt

Most variable composition
Gorda Plate and plate edge
Schmidt et al., (2007)
Modern arc has segmentation

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

E. Paleogene oceanic plateau

Paleozoic to Mesozoic Marine rocks

Paleozoic to Mesozoic Marine arc-related rocks

Schmidt et al., 2007
(duBray and John, 2011)
A long convergent and transform history
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
Western Cascades and John Day Fm

From Christiansen, 2005, after Christiansen and Yeats, 1992
Onset of flood basalts dikes and large calderas

From Christiansen, 2005, after Christiansen and Yeats, 1992
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Central Oregon Cascades

Eruption productivity

Onset of Cascade magmatism

Basalt and basaltic andesite and andesite

Dacite and rhyolite

Flood basalts, LKT basalt, arc-rift onset, Pacific vector

B&R shift to bimodal

(Verplanck and Duncan, 1987)
Narrowing of the arc with time
Central Oregon (Priest, 1990)

Consistent with slab steepening in time

35-17 Ma  17-7.4 Ma  7.4- 4 Ma  4- 0 Ma

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

(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

40-15 Ma

15-8 Ma

Intra-arc rift, 8-4 Ma

Quaternary

Courtesy of Martin Streck, from Oregon Western Cascades compilation of Rick Conrey
general increase in Ba/Nb with age of the arc

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

To assess changes in mantle and crustal contributions and compositions in time, need systematic time and space transects
Why ancestral Cascades?

Changes in arc through time
• type of mantle, degree of melt in past
• subduction effects on mantle and magma through time
• development of continental crust
• segmentation through time