

Volcano-Tectonic Evolution of Basin and Range

References:

Christiansen and McGee (1978), GSA Memoir 152, Ch. 13

Smith, 1978, GSA Memoir 152, Ch. 6

Gans et al., 1989, GSA Special Paper 133

Condie, 1997, *Plate tectonics and crustal evolution*, ISBN: 0-7506-3386-7.

Central Cordillera ~70Ma

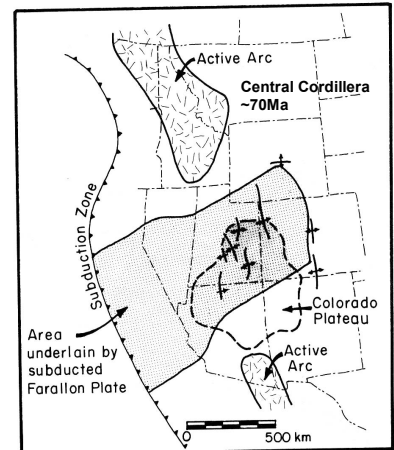
Young hot oceanic crust

Softens lithosphere

Causes general uplift

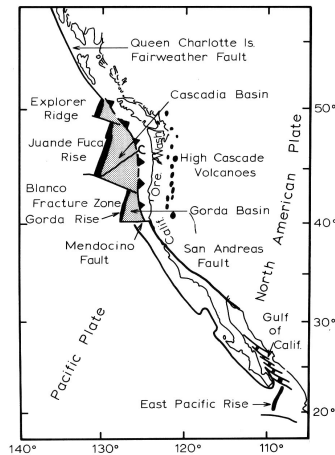
Source for basaltic magmas

Condie, 1993 Fig. 8.13



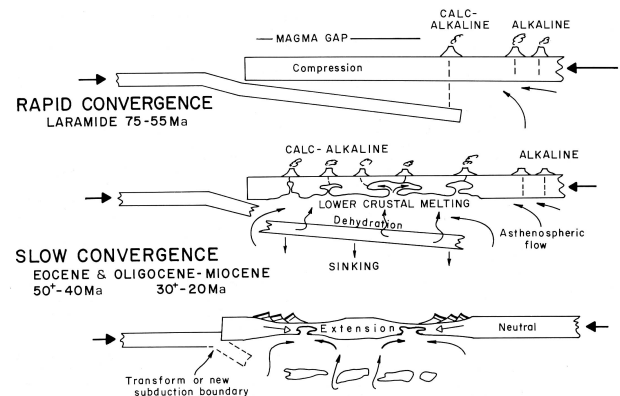
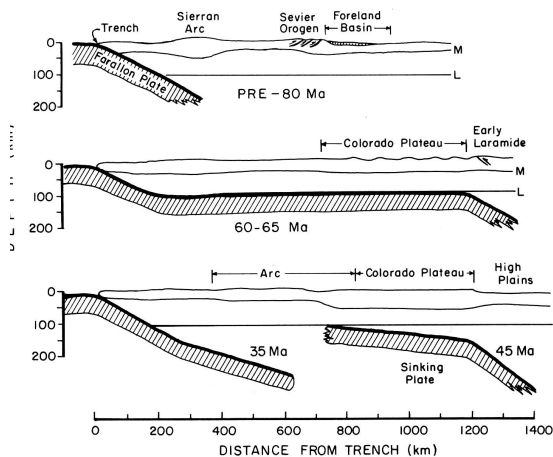
Present Conditions

- Limited subduction
- Cascade volcanism
- Transform systems
- Baja suspect terrane



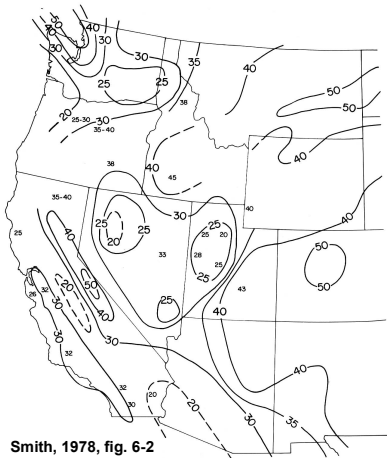
Volcano-Tectonic Evolution

- At 17 Ma the subduction zone was bounded at both ends by a transform system
- Broad stress field developed from NA-Pacific plate interactions
- Extension on a perpendicular axis opened the Snake River rift zone
- This zone changes into a transform system in Oregon



Crustal Thickness

- Reflects moho
- Thin crust in B&R
- Thick crust under batholiths



Synextensional Magmatism

- Highly extended eastern Great Basin
- 40-35 Ma andesite-rhyolite lava flows and rhyolite tuffs
- 35 Ma Kalamazoo Tuff and K-rich dacite tuff

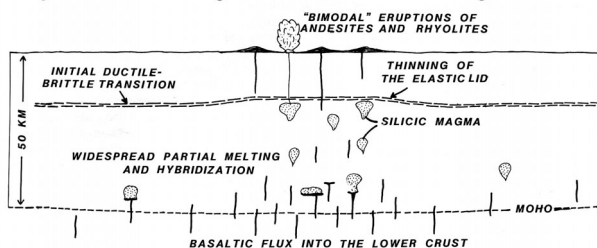
Petrologic Data

- High-K andesite evolve to rhyolite sequences
- Extensive contamination of mantle-derived basalts by crustal partial melts
- The major rock type (hornblende dacite) consist of 30-50% mantle material

Tectonic Model

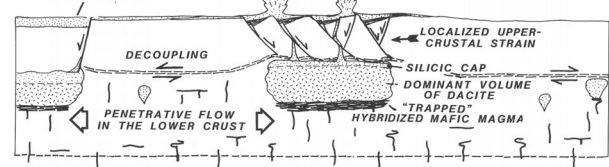
- Active rifting introduces basalt magma
- Mixing produces intermediate compositions
- Magmatically induced thermal weakening culminates with brittle fracture of the crust and ductile flow at depth

Stage I: Precursor magmatism - Thermal weakening of the crust

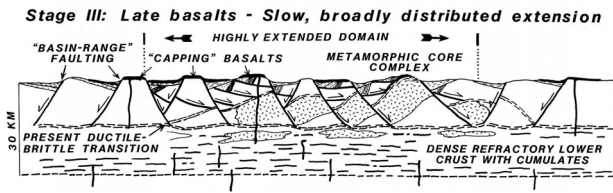


Gans et al., 1989, Fig. 20

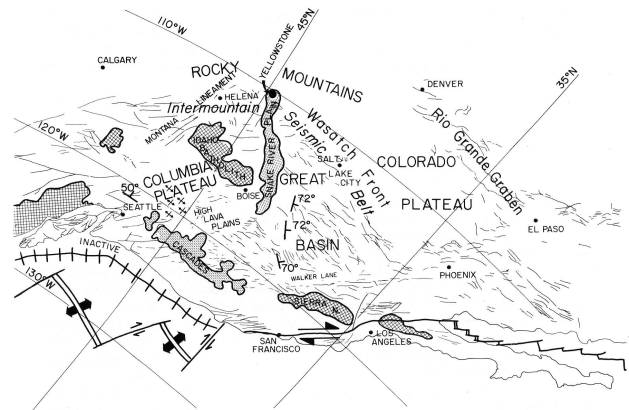
Stage II: Culminating eruptions - Onset of rapid extension



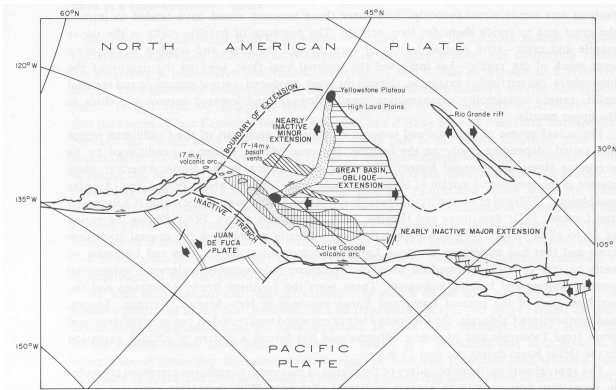
Gans et al., 1989, Fig. 20



Gans et al., 1989, Fig. 20



Smith, 1978, fig. 6-1



Smith, 1978, fig. 6-1

Later Tertiary

- Tectonic extension spread through the Great Basin
- Regional melting softened the lithosphere
- The crust thinned as it stretched
- Regional uplift spread laterally
- Basaltic volcanism occurred in thin brittle crust at the margins of the spreading zone
- Earthquakes and volcanism occur together

Summary

- Late Cenozoic motions of three plates formed two transform systems at the NA plate margin
- At 17 Ma the transform systems became partially coupled as the East Pacific ridge approached the NA craton

Final stage

- By 14 Ma oblique extension along old structural boundaries guided the transform in the north Great Basin
- Stress relief caused partial melting of the mantle and abundant basaltic volcanism
- This caused increased regional heat flow
- The consequence was a concentration of normal faulting