Limited Extension During Peak Tertiary Volcanism, Great Basin of Nevada and Utah

Best and Christianson, 1991

Synextensional vs Nonextensional

- 1. Extension is localized pre volcanism
- 2. Minor Extension during peak Volcanism
- 3. Poor time space relationship between extension and magmatism
- 4. Peak extension after peak volcanism



Stratigraphic Record



Tertiary Volcanism Review

- Until 31Ma: Diverse composition of magmatism -> andesite, dacite, and rhyolite
- 31Ma- 20Ma: Similar diversity, overshadowed by ignimbrite flare up volume -> rhyolite and ash flow deposits
- 3. 20Ma and after: lavas, increasingly alkalic
- 4. 8-6Ma: Bimodal magmatism
- 17Ma- Basin and range extension and faulting initiated
- 21Ma orogenic to anorogenic rhyolite



Stratigraphic Record

 Peak volcanism correlates with time throughout volcanic fields in the southwest



Synextensional Volcanism

Conditional Statement

If yes, then we would see:

- Angular unconformities
- Sedimentary deposits within volcanic sequences
- Fanning dips
- Variation in ash flow sheets

Generally: preserved accumulation of sediments moving from high to low topography

Nonextensional Volcanism

Fragmented, non continuous form of extension

- Pre tertiary faulting: Grant and southern Egan Ranges
- Lack of faulting during peak volcanism: Undisturbed units in sections, widely distributed ash flow sheets
- Resume faulting post peak volcanism to create Basin and Range



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Episodic Extension Evidence

- Yerington District has a complete stratigraphic record and represents deformation and timing in southeastern Nevada
- Low amount of epiclastic deposits/ lack of angular discordances indicates extensional quiescence during peak volcanism 30-20Ma; Extension recorded (>100%) from 17-11 Ma
- Data used to debunk papers supporting continuous extension *Gans et al., 1989, Zoback et al., 1981, and Wernicke et al., 1987* as all these data support two major episodes of extension before and after peak volcanism in the Miocene.



Extension and Volcanism in Time and Space

- Revised History: Extension occurred before 34-32Ma and after 22-15Ma
- Extension DNE Volcanism

VOLCANISM

10

20

AGE (Ma)

EXTENSION

30

Relative intensity

volume

Relative



Experiment

• Are there any fundamental differences between tertiary volcanism associated with major extension and tertiary volcanism not associated with extension?









Rhyolite

75

80

No compositional difference, only volume of erupted material is different



Shaded = E. Central Nevada

Tectonomagmatic Model

- Great Basin can be compared to the late Cenozoic evolution of the central Andes due to shallow subduction.
- Lava Dominated volcanism before and after peak volcanism is associated with extension and a lower mantle input



Tectonomagmatic Model

- Pre-Peak Volcanism Extensionrelaxation of gravitationally unstable crust. Magmas invaded crust as dikes, evolved magmas leaked to surface
- Peak Volcanism- stagnation of magma below south central great basin caused more magma input
- Post Peak Volcanism Extension-Reorientation of stress field
- Space Problem



Conclusion

- 1. Period of extensional quiescence during the late Oligocene early Miocene (previously unrecognized)
- 2. Maximum extension and maximum volcanism are not related in time and space
- 3. On first order changes in plate tectonics are reflected in the Great Basin Ex: subducting plate breaks off, sweep of magmatism stagnates and produces the ignimbrite flare up
- 4. Volcanism before and after the ignimbrite flare up is associated with extension



Brittle Ductile Transition in Plutons

- Brittle- West
 - Faulting, faulted grains
- Ductile- East
 - Sub solidus fabrics, folds, mylonitization







19SNV24A-Ultramylonite High Strain

19SNV24B-Protomylonite Moderate strain 19SNV24C-Protomylonite Low Strain 19SNV24D-Granite No Strain

Differential Strain in Ireteba - Z