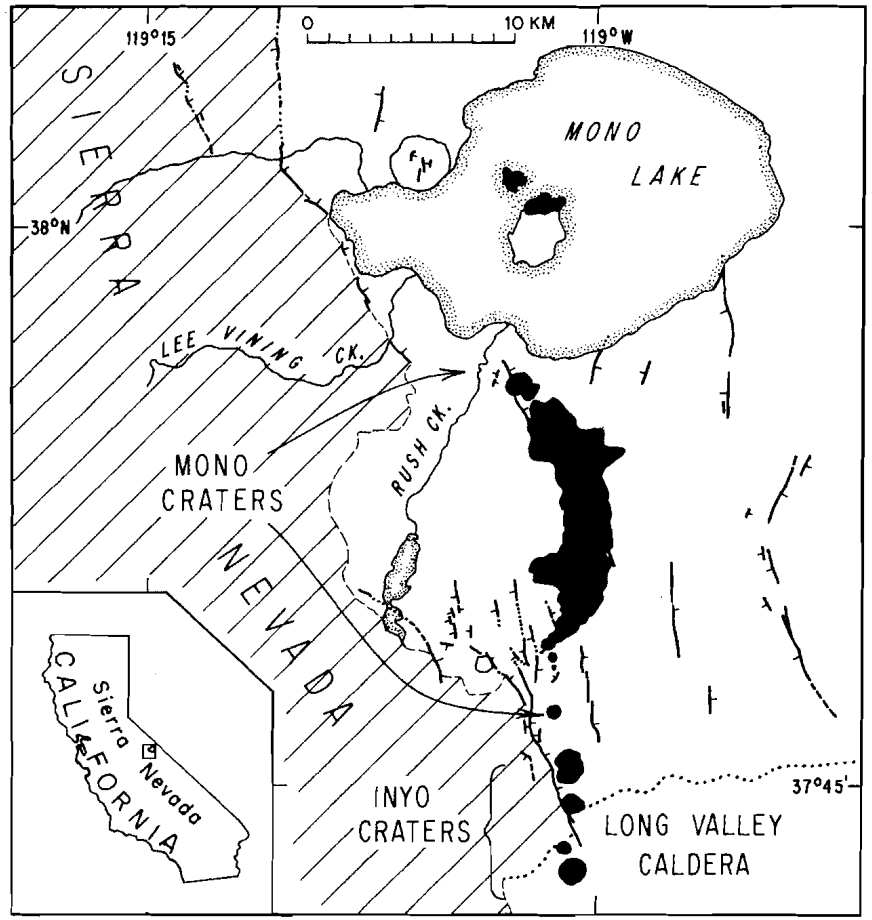
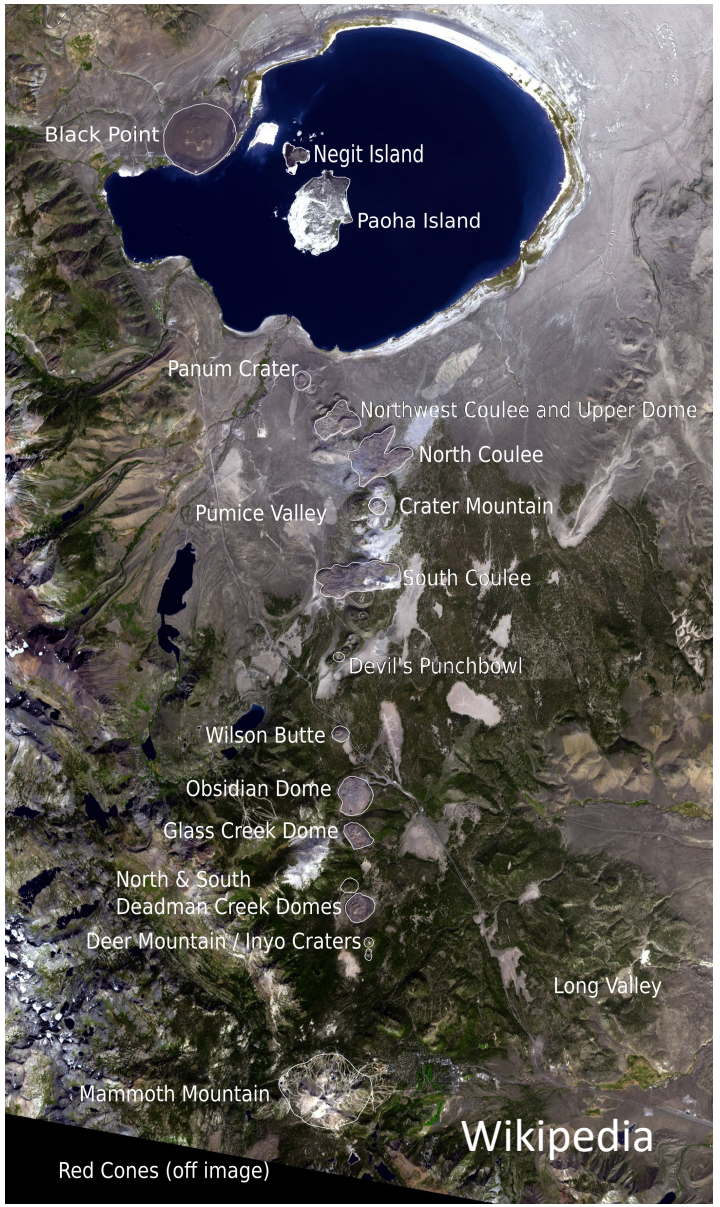
Most Recent Eruption of the Mono Craters, eastern central California

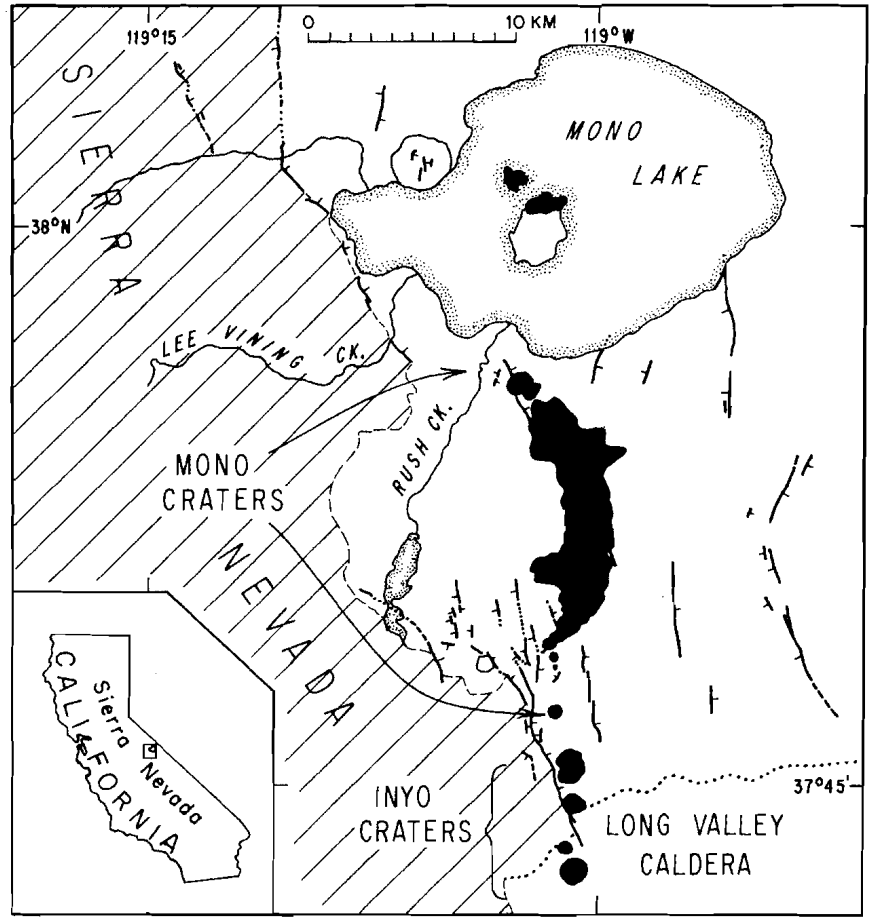
M. Bursik., & K. Sieh., 1986





Motivation and Overview

- East flank of the Sierra Nevada has had a young, violent, and exciting history
- Largest eruption in the area produced the collapse of the Long Valley Caldera (~0.7My)
  - Seismic data since 1978 has been related to the movement of magma beneath the caldera
- Specifically we'll be looking at one of the latest eruptions in Mono Craters (<0.7My) that produced a chain of craters that extends northward from Long Valley Caldera

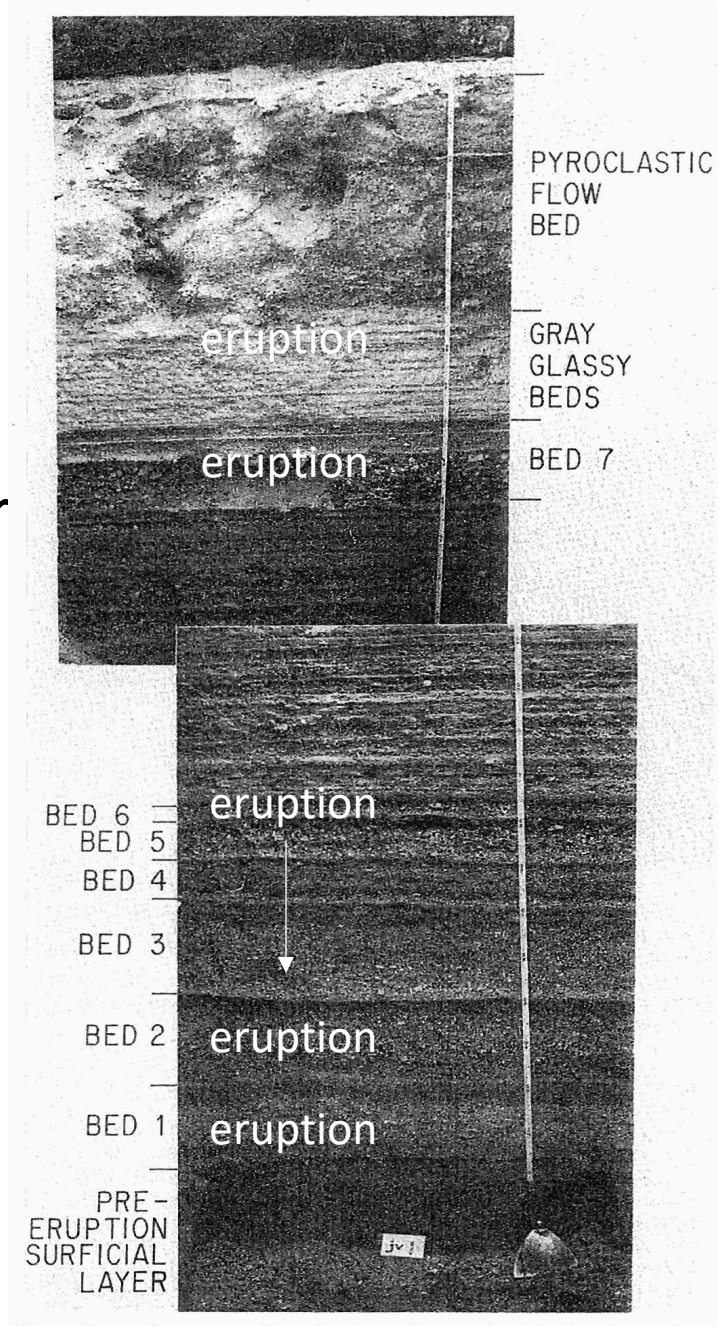


Phases and Products of Eruptions

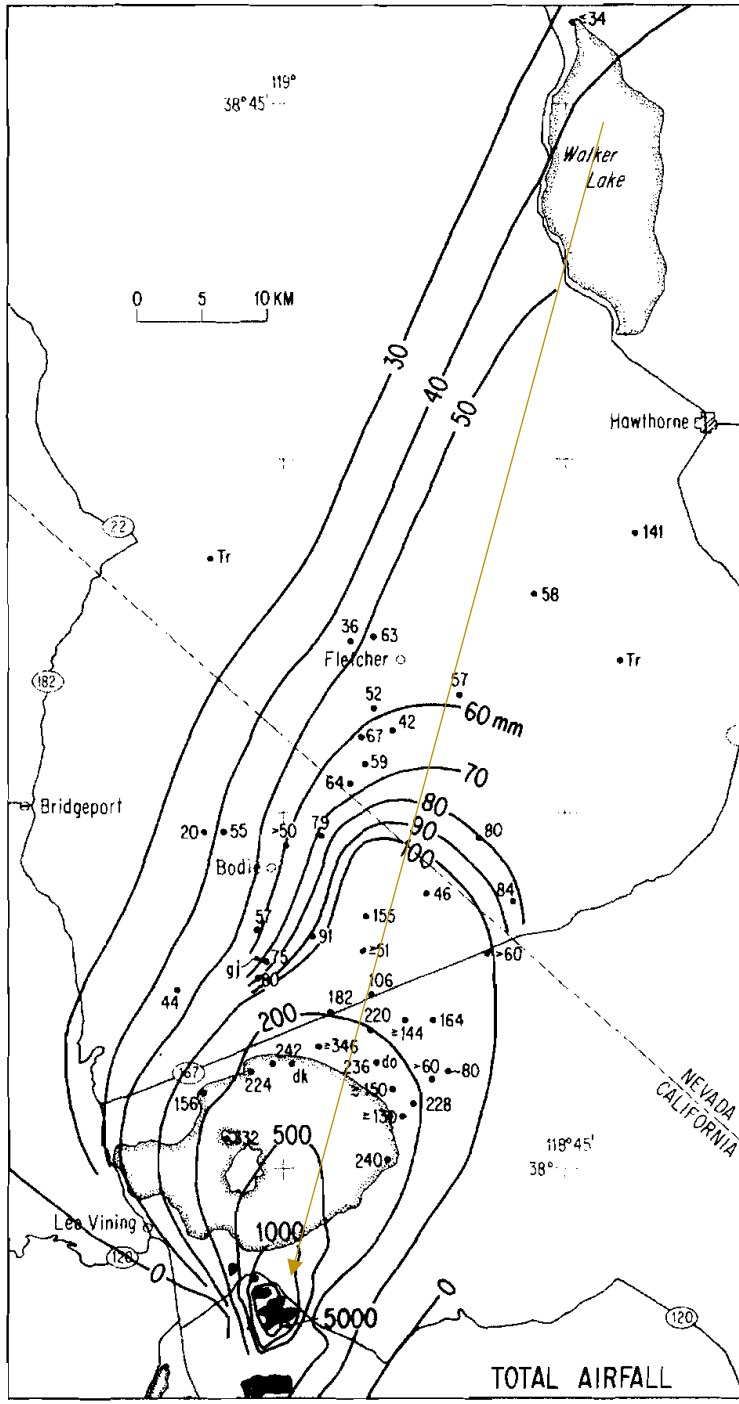
- The most recent eruptions produced dominantly silicic eruptions
- Phase 1: Most explosive- air fall beds 8000 km^2
- Phase 2: Pyroclastic flows and surges- 100 km^2
- Phase 3: Extrusion of block encrusted lava domes and flows- 6 km^2

Air Fall Beds

- Beds correlated throughout the region by tracing marker beds
- Isopach map contours thickest part of air fall deposit. Thickest part is the vent
- Asymmetric distribution from prevailing winds at the time

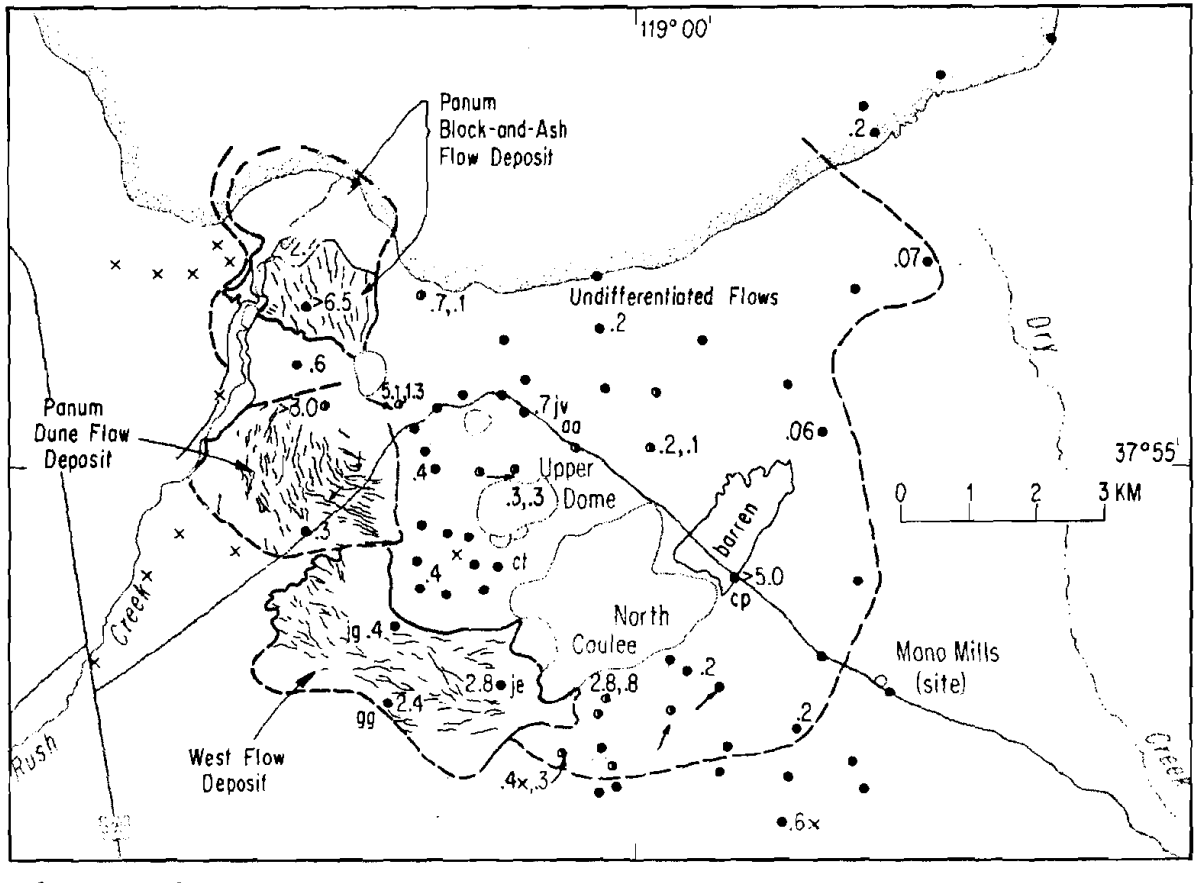


Total thickness – 2.5 m



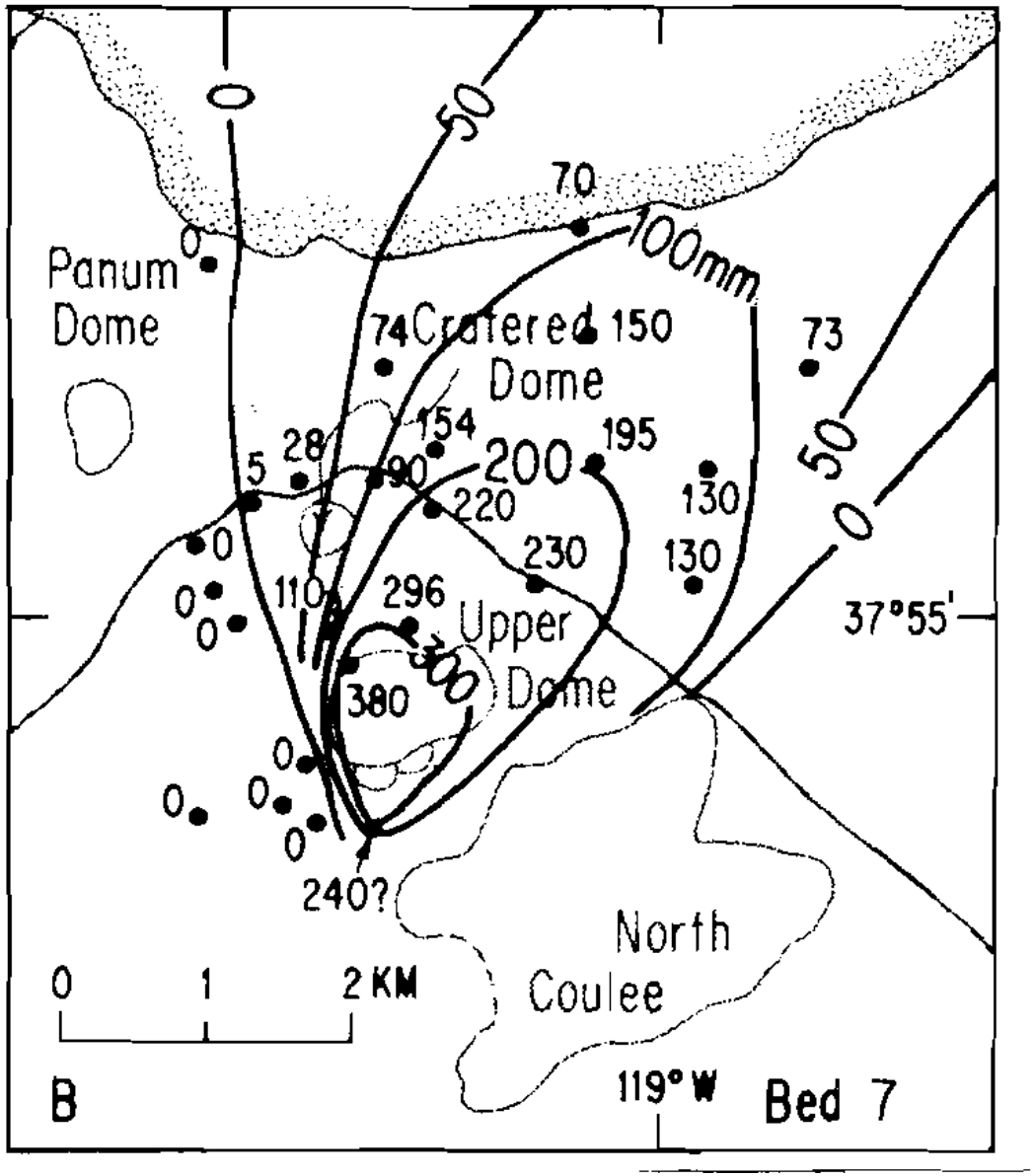
Pyroclastic Flows and Surge Deposits

- Flows associated spatially with vents
- Flows vary temporally:
- Group 1: emplaced between the eruption of beds 6,7
- Group 2: Associated with gray glassy beads
- Group 3: Erupted from Panum Crater



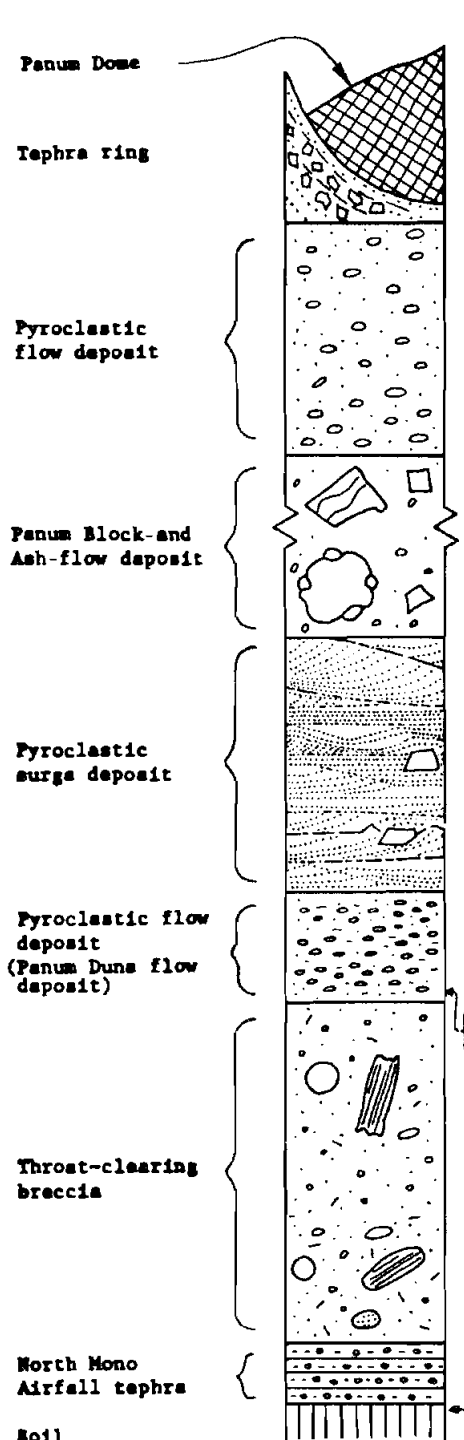
Domes and Coulees

- Mapped and identified five separate domes and coulees and four tephra rings and ridges
- From North to South:
  - Panum Dome
  - Cratered Dome
  - Upper Dome
  - Unnamed Satellite of Upper Dome
  - Northern Coulee



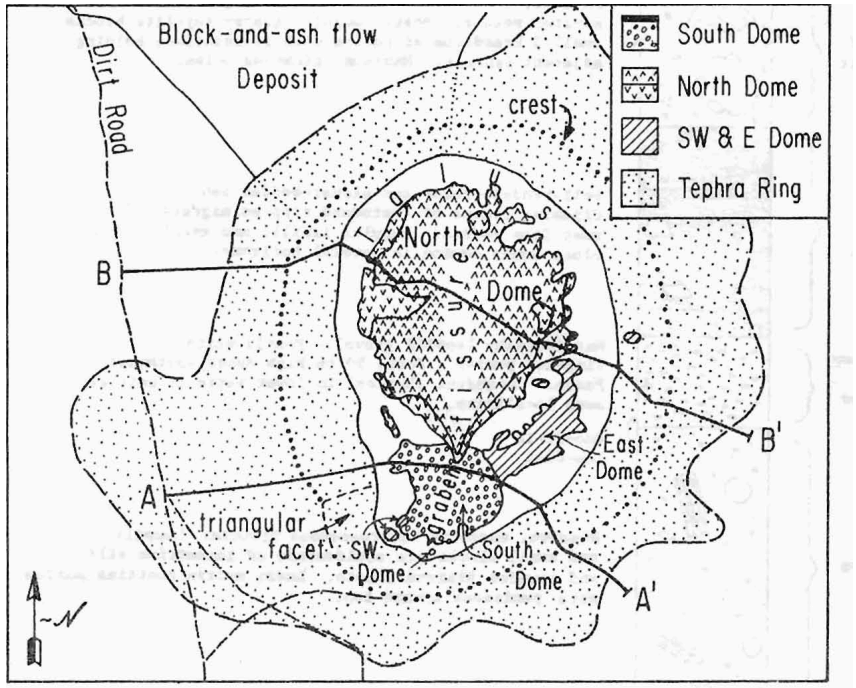
Panum Crater

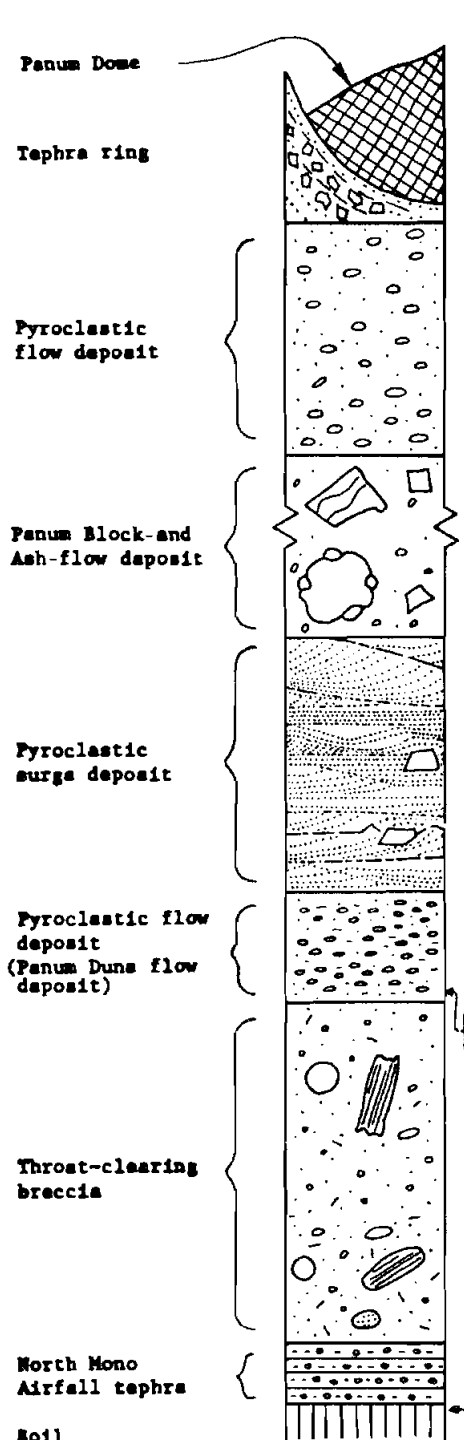
- Textbook rhyolitic lava dome
- Formation:
- Phase 1: Breccia
  - Evidence for rapid construction of a crater, from rising magma flashing to steam as it interacted with water above
- Phase 2: Flow Deposit
  - Breccia capped by pyroclastic flow, source is the Panum Crater, flow field is a mystery
- Phase 3: Surge Beds
  - Horizons in surge beds are marked by rhyolite bombs that indicate magma x water interaction



Panum Crater

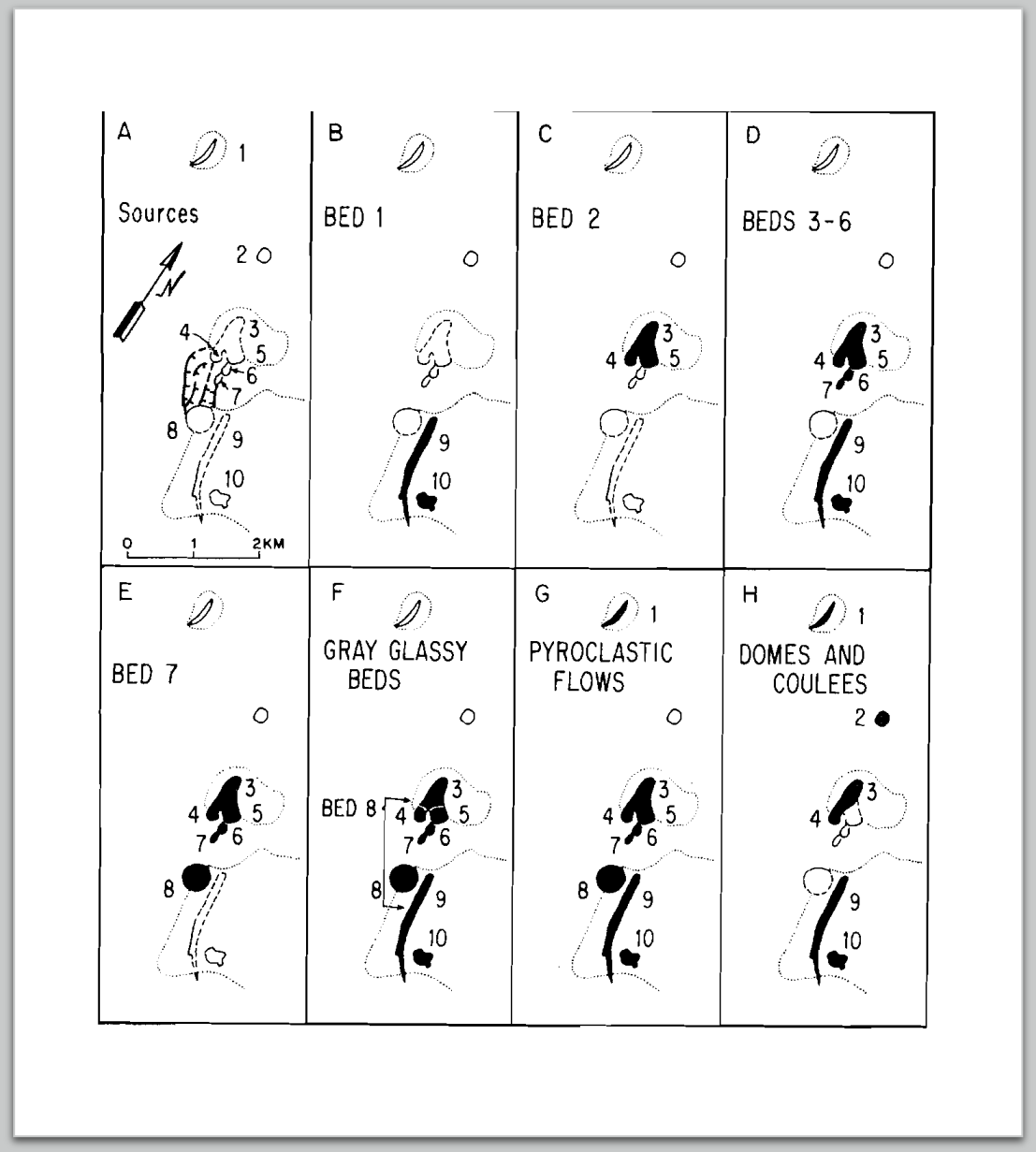
- Phase 4: Block and Ash Flow
  - From dome collapse
- Phase 5: Tephra Ring
  - Last major pyroclastic event in the Panum Crater
- Phase 6: Panum Dome
  - Final erupted product from the Panum Crater





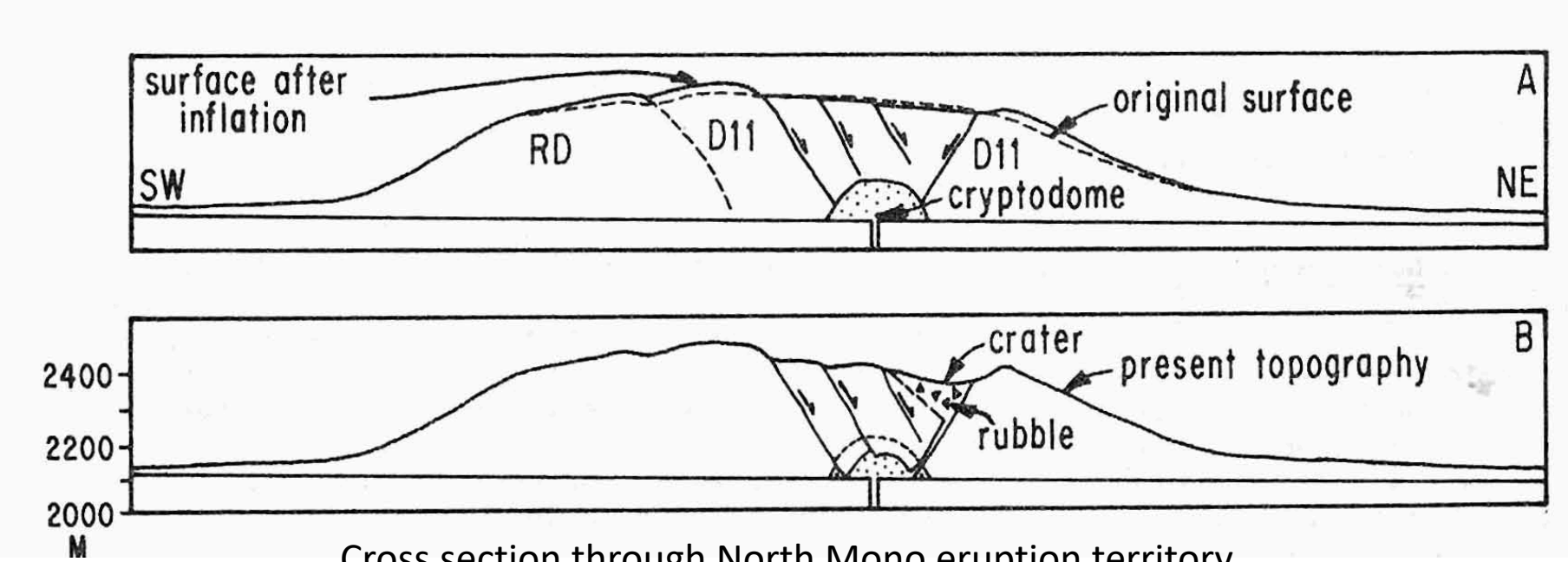
Source Regions

- Nature of latest eruption in Mono Craters is multi sourced
  - At least 10 different vents contributed to the eruption
  - Sources of different beds representing eruptions are as follows



Source Region Features

- 600 m Graben that accommodates northeast – southwest shallow extension
- Mechanism: North south trending sill or cryptodome causes inflation and evacuation of dome causes slip on graben faults



Cross section through North Mono eruption territory

Dike Intrusion during the North Mono Eruption

- Eruption catalyst was the shallow intrusion of a rhyolitic dike or dikes.
- Based on eyewitness accounts of previous eruptions (Krakatau), and the geologic record the eruption of silicic magma from aligned vents is not uncommon.
- Alignment is likely from a magma filled dike or several diapirs rising from a dike.

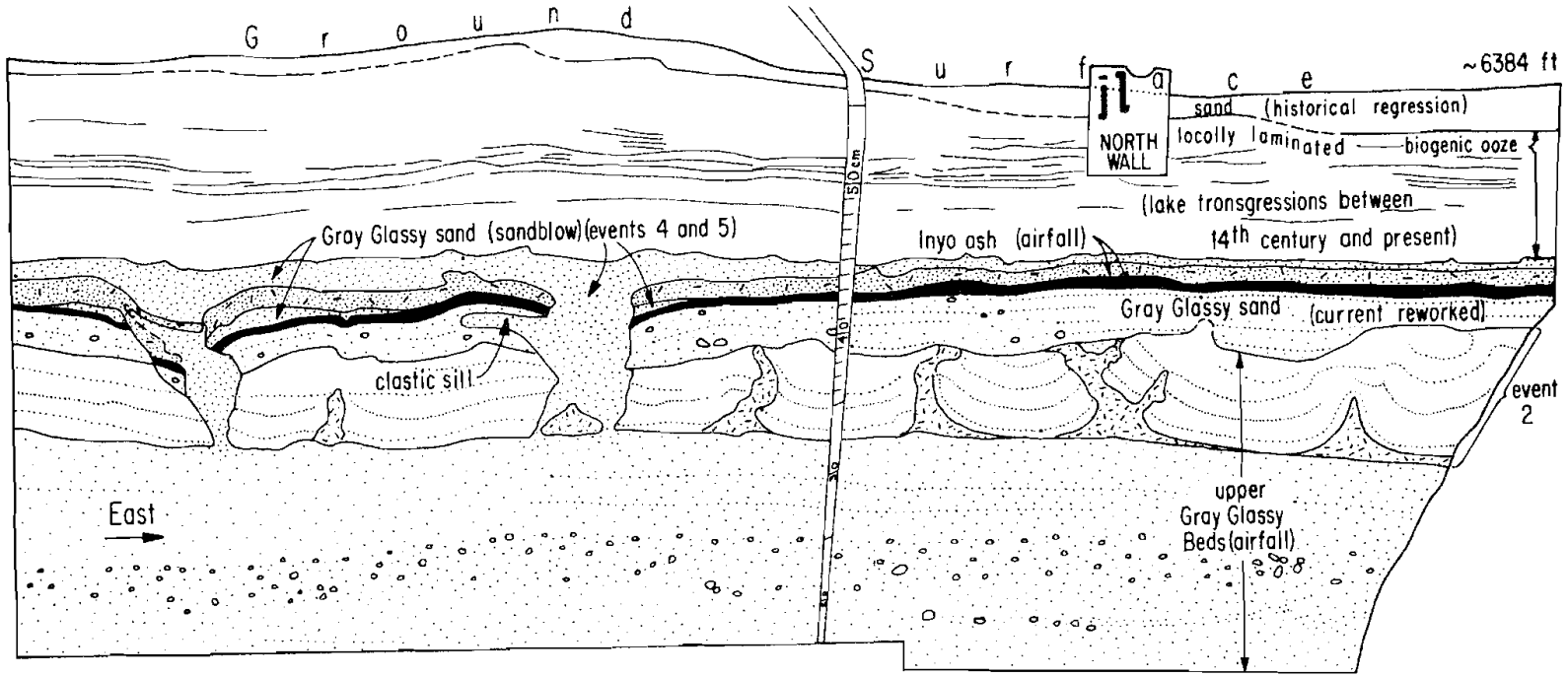
Dating and Duration

- Geologist Miller (1985), and Dendrochronologist D. Yamaguchi constrained the beginning age of the eruption by dating Jeffrey pines on early eruption products to ~1369 A.D (Holocene)
- Duration of pyroclastic phases: A few days to months
  - Based on radiocarbon constraints (~40 years max)
- Duration of extrusion of domes and coulees: A few years

Wikipedia

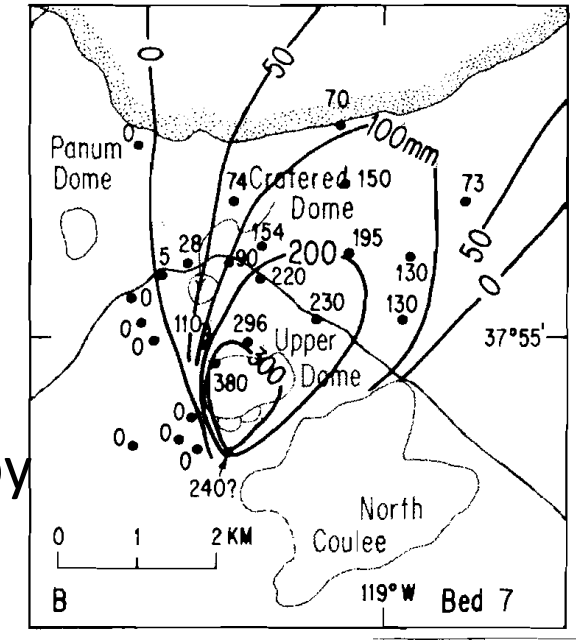
Seismicity

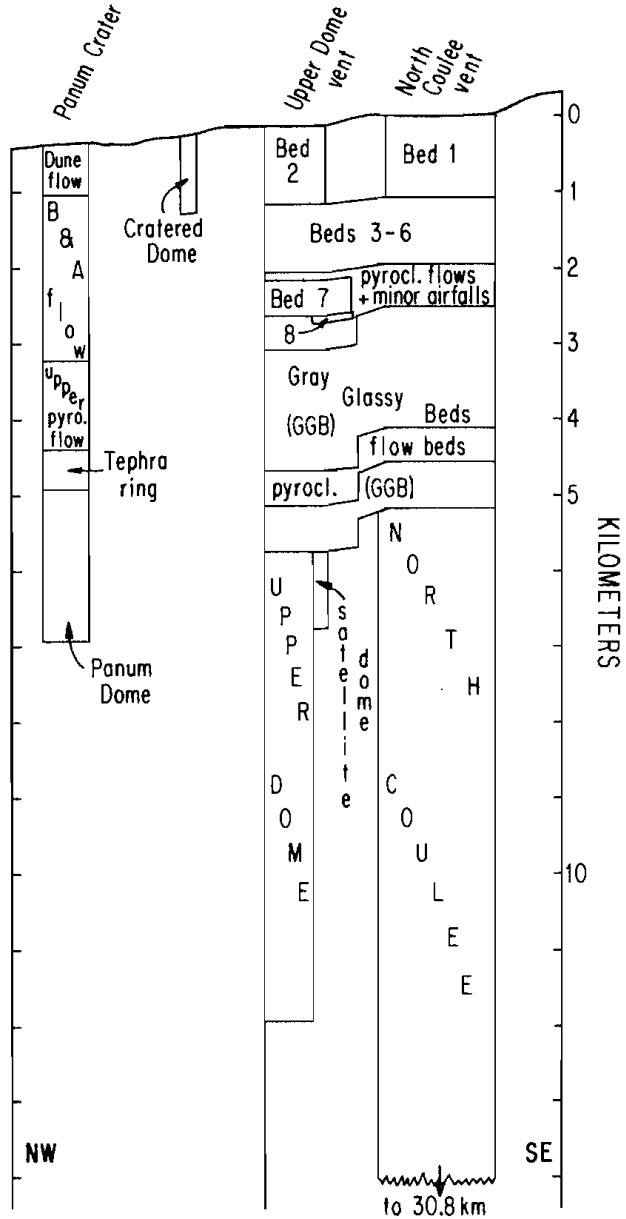
- There are 5 known liquefaction events that took place in the sediments of mono lake during the eruption of the North Mono tephras.
  - Liquefaction phenomena include: Bedding plane faults, load casts, and sand-blows



Implications of Eruption

- The North Mono dike intrusion relieved accumulated tectonic extensional strain by elastic rebound
- Magma pressure must have been high because dike walls are even further apart than expected from just elastic rebound alone
- Pulsating nature of the eruption is from the incremental release of the water rich rising magma dikes
- The gradually diminishing explosiveness of the eruption is due to the vertical stratification of water in the the magma dike.





Summary

- North Mono eruption released pyroclastic debris and lava from aligned vents in the northern crest of the volcanic chain during the Holocene.
- Pyroclastic phase- 40 years, Explosive phase- several moths
- Current geometry of vents indicates that the eruption was from the intrusion of a North south trending dike into shallow crust.
- Progression of eruption from Plinian to pyroclastic to extrusive is from varying degrees of stratification of water content in the magma dike
- Finally, the north mono eruption precedes the Inyo eruption (stratigraphic evidence)

Conclusion

- Variety of Cenozoic volcanism across Nevada
- In the Eastern Sierras dike intrusions seem to be replacing normal faulting as the dominant mechanism for crustal extension.

References

- Wikipedia- Mono Lake, Krakatoa volcano