41-5 Age constraints and depositional setting of the earliest Cenozoic sedimentary rocks exposed in several ranges throughout southern Nevada

Jens-Erik Lund Snee, Theresa M. Schwartz, and Joseph P. Colgan
jlundsnee@usgs.gov; U.S. Geological Survey Geosciences and Environmental Change Science Center, P.O. Box 25046, MS 980, Denver, CO 80225

Characterization of the first Cenozoic sedimentary rocks throughout southern Nevada, supported by U-Pb detrital zircon geochronology, reveal that most were deposited ≤10 Myr before the first local volcanism ca. 27.6 Ma. Most sections are ~100 m thick, but near the Spotted Range they may be as old as Eocene and exceed 1 km, suggesting a significant early–middle Cenozoic basin in the hinterland. Often (but with exceptions), the first deposits were derived from local sources, followed by addition of farther-traveled clasts, and capped by lacustrine limestones indicating damming.

Motivation

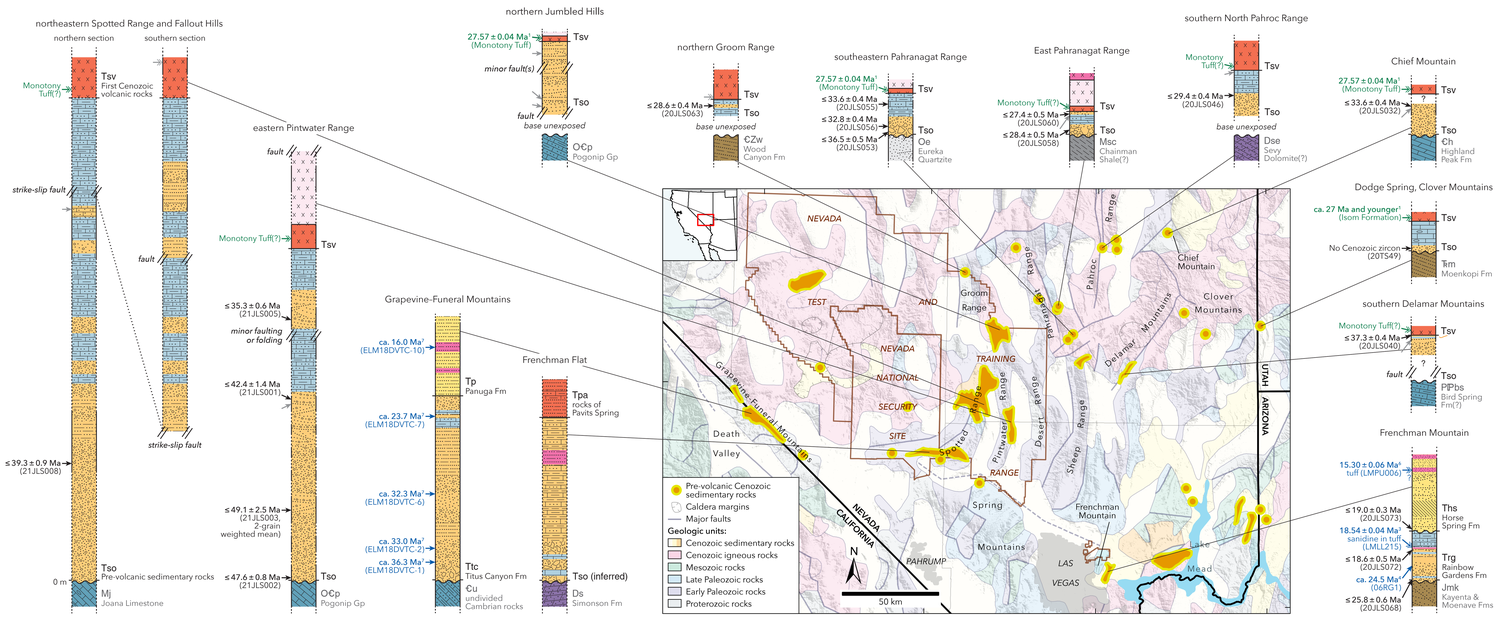
Key aspects of the transition from Mesozoic shortening to Cenozoic extension in the western U.S. Cordillera remain poorly understood, notably the length of time between the end of compression and the onset of extension, and the nature of the paleogeography that existed during that interval.

We present new stratigraphic characterization and depositional age constraints for sections of the earliest Cenozoic deposits throughout southern Nevada (Fig. 1). These strata are sparsely exposed but provide some of the only paleogeographic record between Paleozoic or Mesozoic time and the arrival of south-migrating "ignimbrite flare-up" volcanism in the middle Cenozoic.

Methods and data

We **measured a detailed section** in the southeastern Pahranagat Range, where this unit is well exposed, and we **constructed schematic sections** there and elsewhere (**Fig. 2**), with thicknesses determined in part from satellite imagery. The stratigraphic column from the Grapevine and Funeral Mountains is after Miller et al. (2022), and that from Frenchman Mountain is after Lamb et al. (2018).

We obtained U-Pb detrital zircon ages from 19 samples (Fig. 3) at the University of Arizona LaserChron Center. Nearly all samples yielded well-constrained maximum depositional ages (MDAs) based on weighted means (shown in **Fig. 4** and indicated on the left sides of the schematic stratigraphic columns in **Fig. 2**).



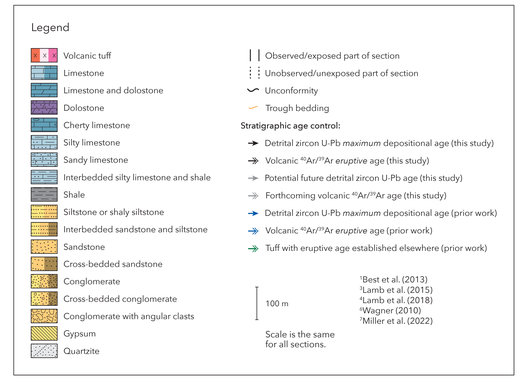


Fig. 1. (*center*) Generalized geologic map (after Garrity & Soller, 2009) highlighting pre-volcanic Cenozoic deposits in southern Nevada.

Fig. 2. (*surrounding*) Schematic stratigraphic columns with deposition-al age constraints.

Fig. 5. (*right*) Characteristic section for the thinner (~100 m) deposits.

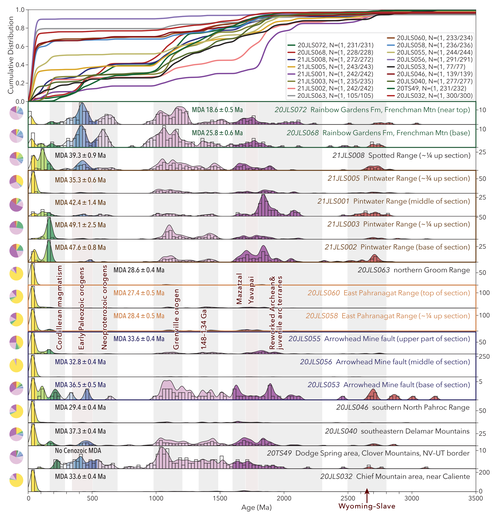


Fig. 3. (*left*) U-Pb detrital zircon ages. Population designations are from Gehrels & Pecha (2014). Unlike in Fig. 4, MDA uncertainties are 2σ and external errors are included.

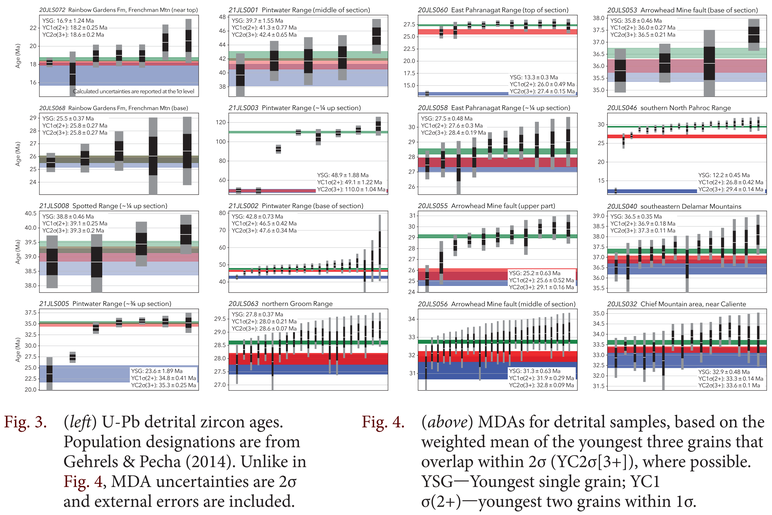


Fig. 4. (*above*) MDAs for detrital samples, based on the weighted mean of the youngest three grains that overlap within 2σ (YC2σ[3+]), where possible. YSG—Youngest single grain; YC1σ(2+)—youngest two grains within 1σ.

Conclusions

- Sediment was deposited and preserved throughout southern Nevada within, in many cases, only ~10 Myr before local deposition of the first Cenozoic volcanic rocks.
- The pre-volcanic rocks form scattered, usually thin (~100 m) exposures but are >1 km thick near the Spotted and Pintwater Ranges and the Fallout Hills.
- Thickness and facies patterns suggest that a sedimentary basin developed there potentially as early as Eocene time (47.6 Ma or younger). Deposition and preservation of the thinner (~100 m) deposits initiated later, after ca. 37 Ma.
- In most areas, deposition continued almost until eruption of the Monotony Tuff ca. 27.6 Ma.
- Many sections display the following facies pattern (**Fig. 5**), albeit with exceptions:
  - Lower strata consisting of angular and coarse-grained (cobbles to boulders) conglomerate dominated by Paleozoic lithologies exposed immediately below. This suggests primarily local derivation of sediment.
  - Transitioning upward to include more rounded clasts with lithologies that likely required transport from more distal sources than the local basin margin.
  - The upper part of many (but not all) sections is dominated by lacustrine carbonate rocks, indicating damming.

References

Best, M.G., Gromme, S., Deino, A.L., Christiansen, E.H., Hart, G.L., and Tingey, D.G. 2013. The 36–18 Ma Central Nevada ignimbrite field and calderas, Great Basin, USA: Multicyclic super-eruptions. Geosphere 9(6): 562-1636.

Garrity, C.P., and Soller, D.R. 2009. Database of the Geologic Map of North America: Adapted from the Map by J.C. Reed, Jr. and others (2005): U.S. Geological Survey Data Series 424, scale 1:5,000,000.

Gehrels, G. and Pecha, M. 2014. Detrital zircon U-Pb geochronology and Hf isotope geochemistry of Paleozoic and Triassic passive margin strata of western North America. Geosphere 10(1): 49-65.

Lamb, M.A., Beard, L.S., Dragos, M., Hanson, A.D., Hickson, T.A., Sitton, M., Umhoefer, P.J., Karlstrom, K.E., Dunbar, N., and McIntosh, W. 2018. Provenance and paleogeography of the 25–17 Ma Rainbow Gardens Formation: Evidence for tectonic activity at ca. 19 Ma and internal drainage rather than throughgoing paleorivers on the southwestern Colorado Plateau. Geosphere 14(4): 1592-1617.

Lamb, M., Beard, L.S., Hickson, T., Umhoefer, P., Dunbar, N., Schleicher, J., and McIntosh, W. 2015. Late Oligocene–early Miocene landscape evolution of the Lake Mead region during the transition from Sevier contraction to Basin and Range extension. GSA Bulletin, 127(7-8), p. 899-925.

Miller, E.L., Raftrey, M.E., and Lund Snee, J.-E., 2022, Downhill from Austin and Ely to Las Vegas: U-Pb detrital zircon suites from the Eocene–Oligocene Titus Canyon Formation and associated strata, Death Valley, California, in Craddock, J.P., Malone, D.H., Foreman, B.Z., and Konstantinou, A., eds., Tectonic Evolution of the Sevier-Laramide Hinterland, Thrust Belt, and Foreland, and Postorogenic Slab Rollback (180–20 Ma): GSA Special Paper 555: 1–20, doi:10.1130/2021.2555(14).

Wagner R.R., 2010, Miocene Fault and Basin Analysis, Northern Frenchman Mountain Block, Lake Mead Domain, Nevada [M.S. thesis]. Flagstaff, Arizona, Northern Arizona University, 229 p.

doi:10.1130/abs/2022CD-374310