Detrital Zircon Geochronology of Bull Run and Copper Basins, NV

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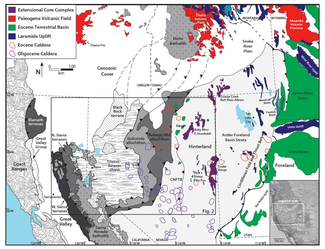
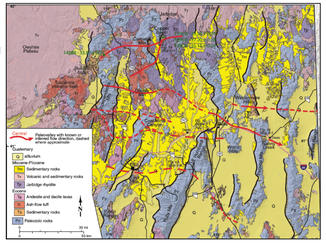
Introduction

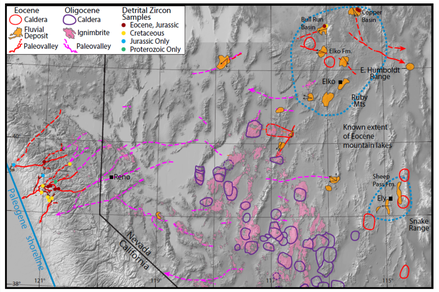
Sediment provenance data can be used to reconstruct paleodrainage patterns, relative paleotopography, and regions of active erosion and volcanism at the time of sediment deposition. Provenance data also provide constraints on the timing of basin formation, lake expansion, and periods of basin connectivity. Here we investigate the relationship between active deposition in the Bull Run and Copper Basins of northeastern Nevada and early extension in the Cordilleran hinterland as part of an orogen-scale study.



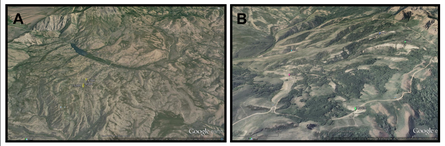


Top Right: Regional map of Cenozoic and basement geology from Cassel et al. (2012).
Right: Geologic map of NE Nevada with paleodrainages from Henry (2011).

Field Work



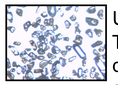
Above: Map of study area: Eocene strata locations in orange, with paleocurrent measurements indicated by black arrows. Detrital zircon sample locations from this study and from Cassel et al. (2012). Figure from Cassel et al. (*sub.*), calderas from Henry (2008).



Above: Sample locations for A) Bull Run Basin and B) Copper Basin. Images from Google Earth.

Field work was performed in August 2012. Samples were collected from measured stratigraphic sections in both basins. Strata consist of predominantly fluvial and thin lacustrine sedimentary rocks containing branch and seed fossils with thin interbedded tuffaceous units. Copper Basin strata predominantly consisted of thick primary ash fall tuffs and ignimbrites interbedded with tuffaceous fluvial and lacustrine packages. Rare horizontally-laminated strata contained flora, including the Axelrod flora collection (1966).

Detrital Zircon Work

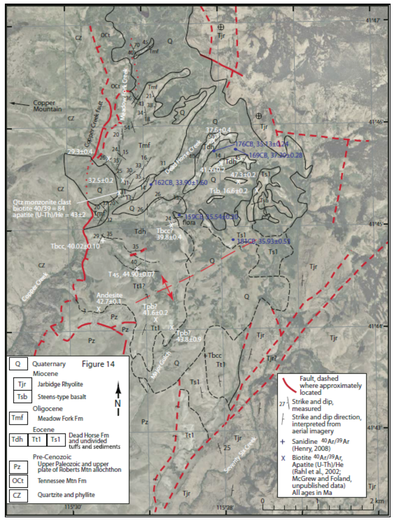


Zircons from Copper Basin

U-Pb ages on detrital zircon grains were obtained from several stratigraphic levels. The youngest population of three or more grains is interpreted as the maximum depositional (MD) age of the sample, which range from 33.9-37.2 Ma in Copper Basin strata and 30.5-36.4 Ma in Bull Run Basin strata. These ages are consistent with $^{40}Ar/^{39}Ar$ sanidine ages from Henry (2008), but are 2-5 Ma younger than $^{40}Ar/^{39}Ar$ biotite ages of McGrew and Foland (*unpublished*). A sample collected just below the Copper Basin flora described by Axelrod (1966) provides a new maximum depositional age of 35.5 Ma for the flora.

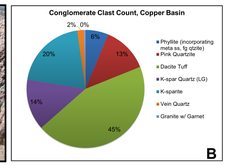
Left: Photos from Bull Run Basin of: A) uppermost conglomerate unit, B) tuffaceous sandstone from mid-section, and C) cross-bedded sandstone.

Right: Photos from Copper Basin of: A) location of Axelrod flora collection, B) primary tuff below flora beds, and C) tuffaceous sandstone with fossil.

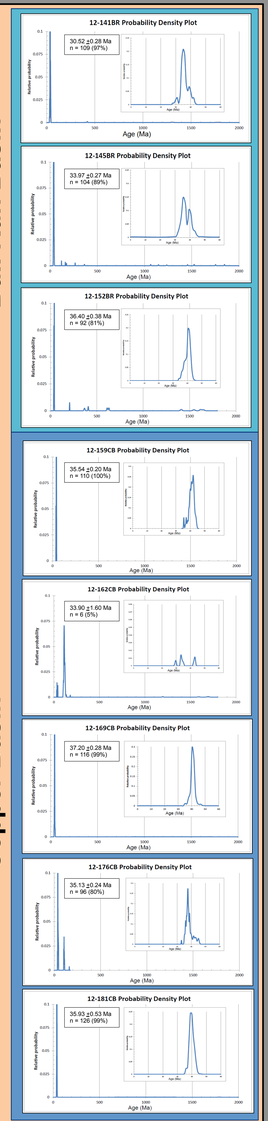


Above: Map of Copper Basin showing locations of prior dates (white) and new DZ MD ages obtained in this study (blue). Modified from Henry (2008).

Major grain age populations range from 32-44 Ma in Bull Run strata and 35-46 Ma in Copper Basin strata, and are dominated by volcanic material, primarily sourced from the northeastern Nevada volcanic field. Secondary 101-125 Ma grain age populations found in upper Copper Basin strata were likely sourced from intrusions related to the last pulse of Cordilleran arc magmatism. Bull Run strata also contain minor grain age populations of 120-360 Ma, 1080-1240 Ma, 1450-2390 Ma. Dominant grain age populations in Copper Basin sediments are similar to those in the middle Eocene strata in basins in northeastern Nevada, while Bull Run Basin grain age populations are similar to those in late Eocene central Nevada basin strata.



Above: A) Conglomerate of Nanny Creek, and B) clast composition count from Nanny Creek, south of Copper Basin.



Above: View of Copper Basin from the south.

Conclusions

Although strata in both basins are dominated by northeastern Nevada volcanic field zircon grain ages, the diversity of older grain age populations between the two basins and 2-3 Ma younger grain age populations in Bull Run strata shows that the two basins were not part of one continuous paleodrainage. Conglomerate clast counts and paleocurrent analysis support this interpretation. The new maximum depositional ages from Bull Run Basin show that the sedimentary sequence is as young as early Oligocene, much younger than previously thought. This provenance data suggests that either 1) basins formed via localized, small-scale upper crustal extension or 2) these basins were separated by the paleo-drainage divide of the Cordilleran hinterland.

Future Work

An NSF Collaborative research project (PI Cassel, Co-PI Stockli, in collaboration with UI, UW, and Sonoma State) is underway to continue work in the entire Elko Co. region, including fluvial and lacustrine stratigraphy, $^{40}Ar/^{39}Ar$ geochronology, multi-proxy stable isotope paleoaltimetry and combined single-grain detrital zircon (U-Th)/He and U-Pb dating.

References

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