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12/9/16

Hildebrand Analysis: Topic 4

Hildebrand interprets much of the classic late pC-Paloezoic "Cordilleran miogeocline" as exotic to North America

Is there a break in the detrital zircons populations going west from stable North America out to the "Antler platform"?

U-Pb isotope data from zircons can provide information on the provenance of a rock. One would expect a rock with an exotic source relative to North America to look different than rocks native to North America. This question aims to see if areas that Hildebrand and classic interpretations of North American assembly disagree on have signals that correspond to known allocthonous terranes or to stable North America.

The Roberts Mountain allocthon is considered exotic by both classic and Hildebrand's interpretation of how North America assembled as it sits west of the Roberts Mountain thrust [Figure 1]. The zircon data seems to indicate two different types of rocks [Figure 2]. The Lower Vinini formation is believed to have central Laurentia roots, mainly due to the 1.4 Ga signal, whereas the other strata have western Laurentia roots (Linde et. al. 2016). The main signals we are interested in for the Lower Vinini are the 1.1, 1.4, 1.8 and 2.6 Ga peaks [Figure 3]. For strata that resemble the rest of the Roberts Mountain allocthon, peaks at 1.9, 2.1 and 2.7 Ga would be expected.

As we move east, over the Roberts Mountain Thrust, we enter the Antler Margin and Sevier Hinterland. This region of North America is believed to be stable in classic interpretations, but Hildebrand has identified this area as exotic and native to "Rubia" due to a 1.5 Ga signal located in Idaho (Hildebrand 2009, 2013). The two most western samples from Drushke et. al. (2011), Newark Canyon and Duckwater Mountain, should reside in the Antler Margin[Figure 4 and Figure]. Newark Canyon [Figure 5] has the exact same signals as noted in the Lower Vinini formation. The zircon data from Duckwater Mountain [Figure 6] however, has signals that are more consistent with the other strata from Roberts Mountain. It would appear that the Antler Margin has a consistent origin as the Roberts Mountain allocthon. As these samples are much younger than the ones taken from Roberts Mountain, the signals much younger than 1.1 Ga can be ignored for the purpose of our analysis.

Drushke et. al. also took measurements from the Sheeps Pass formation, which is located further east, but it is unclear if this is located in the Antler Shelf or Sevier Hinterland. The main signals in this data changes slightly as a 1.6 and 2.1 Ga signal start to emerge and the 1.4 Ga signal appears subdued [Figure 7].

This is interesting to note, but it is not consistent with samples that lie further east. As much of the zircons are still consistent with data from the Roberts Mountain allocthon, I don't believe this data indicates a shift from the Antler Margin to the Antler Shelf.

Linde et. al (2014) analyzed zircon samples across eastern Nevada and much of Utah. These samples mostly lie in the Sevier Hinterland and the Sevier Fold and Thrust Belt [Figure 8]. Figure 9 illustrates how similar these signals look as the same 1.1, 1.4, 1.8 and 2.6 Ga peaks exist throughout all the Cambrian samples. This effectively shuts down the idea of there being any west to east variation within Hildebrand's Rubia terrane that may have been suggested by the Sheep's Pass formation.

The Colorado Plateau is the first area that can be easily identified as stable North America in both western U.S. models. Zircon data from the Chinle Formation [Figure 11] in the Colorado Plateau has peaks at nearly the exact same times as the Lower Vinini formation (Dickinson and Gehrels 2009).

From the above zircon analysis, I make the following assertions. The Lower Vinini formation appears to be a non-exotic portion of the Roberts Mountain allocthon as it varies greatly from the other samples and the signals appear to exist deep into stable North America. The data across much of Nevada and Utah indicates little to no west to east variation in zircon populations. Some zircon samples east of the Roberts Mountain thrust appear to be allocthonous, like the Duckwater Canyon samples, but ultimately the vast majority of the data seems to indicate the contrary. This strongly disagrees with Hildebrand's interpretations while providing strong support to more classical interpretations of how the western U.S. and North America assembled.

Figures:

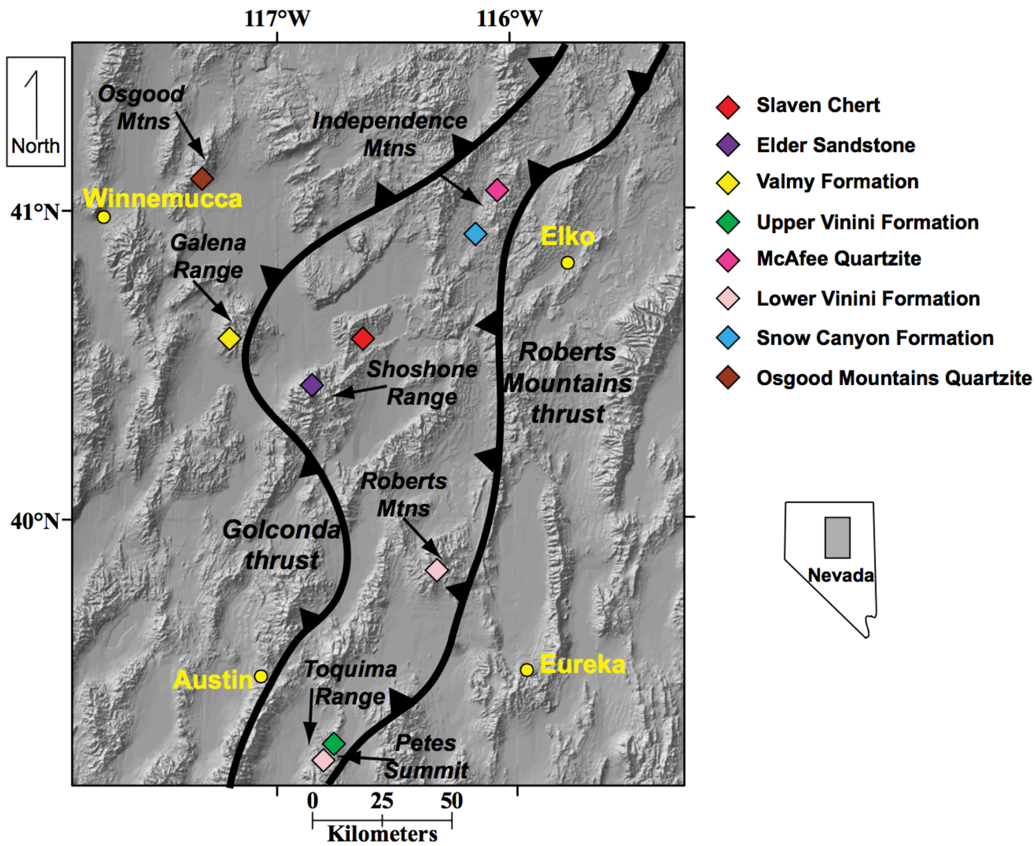

Figure 1: Map of north-central Nevada, showing sample locations (colored symbols) and the traces of the Roberts Mountains and Golconda thrusts.

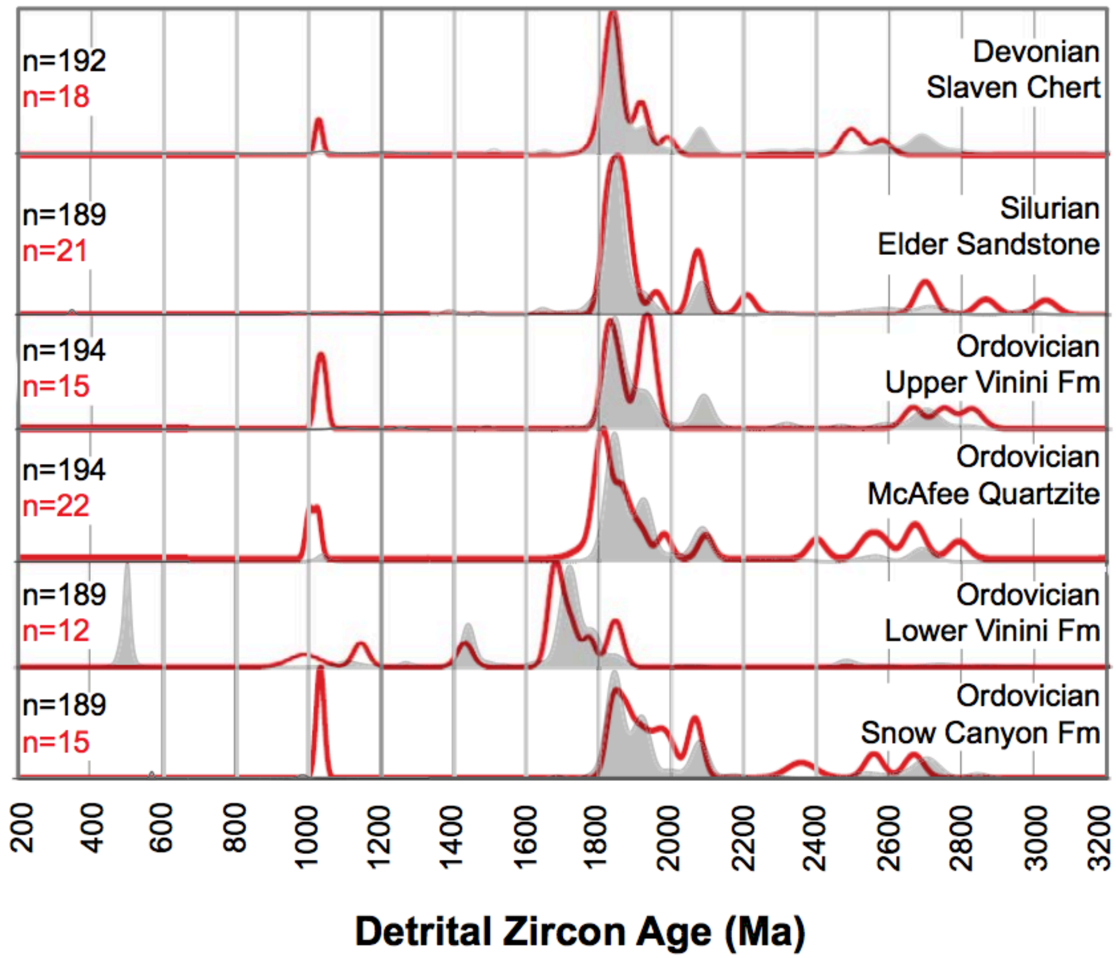

Figure 2: Normalized probability plots showing U-Pb ages of strata sampled. Red lines show the data from isotope-dilution thermal ionization mass spectrometry (Gehrels et al., 2000a); gray- filled curves are the data from laser-ablation inductively coupled plasma mass spectrometry (this study). Numbers of grains analyzed are shown (n =).

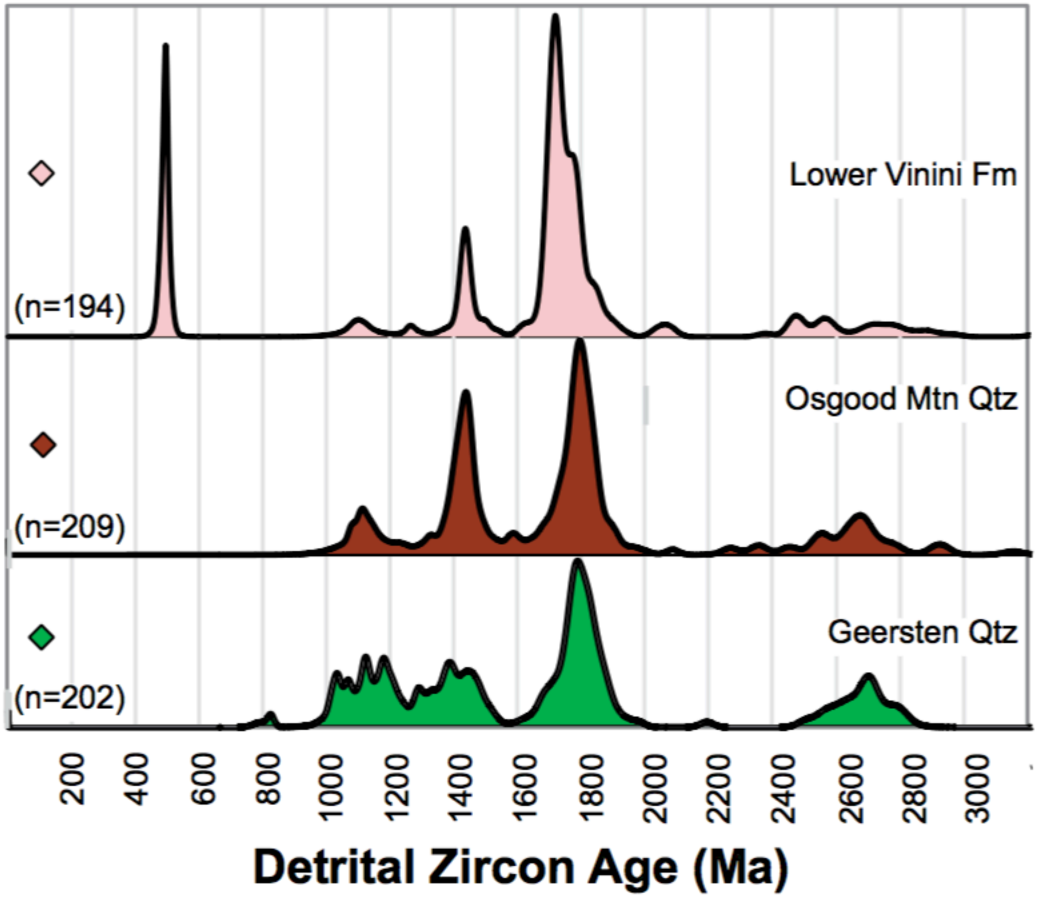

Figure 3: U-Pb ages data for Roberts Mountains allochthon (RMA) and select Laurentian passive margin strata. The data from the Osgood Mountains Quartzite and the Geersten Canyon Quartzite are from Gehrels and Pecha (2014).

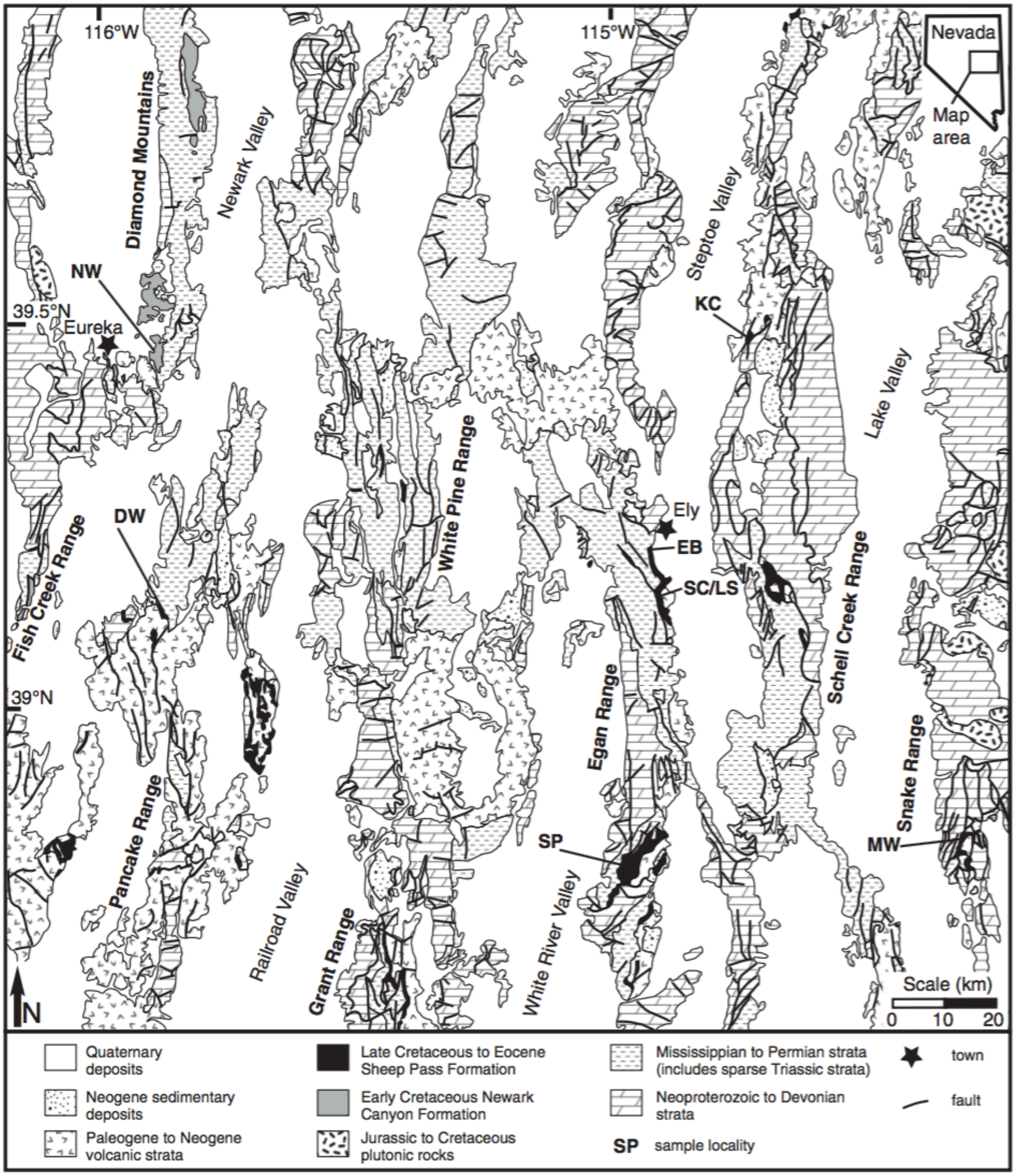

Figure 4: Figure 2. General geologic map of east-central Nevada, modi- fied from Stewart and Carlson (1977). NW—Newark Canyon type section of the Newark Can- yon Formation, DW—Duck- water Mountain section of the Sheep Pass Formation, SP— Sheep Pass Canyon type section of the Sheep Pass Formation, EB—Elderberry Canyon sec- tion of the Sheep Pass Forma- tion, SC/LS—Sawmill Canyon and Lowry Spring sections of the Sheep Pass Formation, KC—Kinsey Canyon type sec- tion of the Kinsey Canyon For- mation, MW—Murphy Wash section.

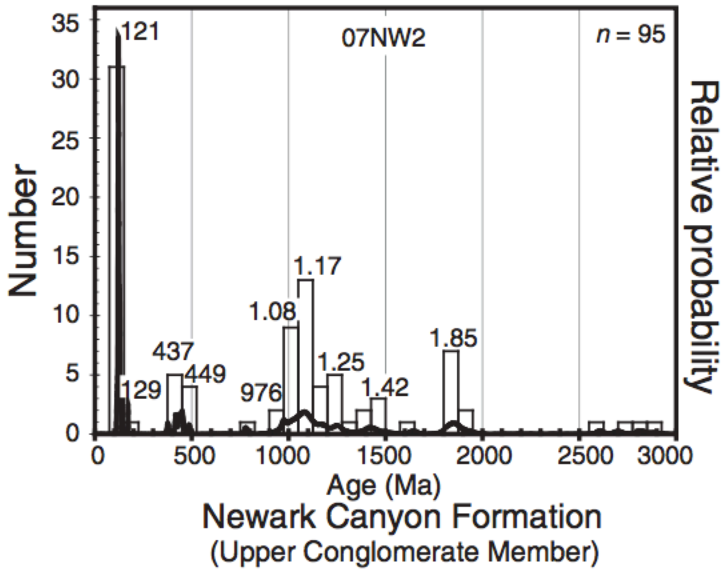

Figure 5: Probabilty density plot of U-Pb zircon data for the early Cretaceous Newark Canyon Formation

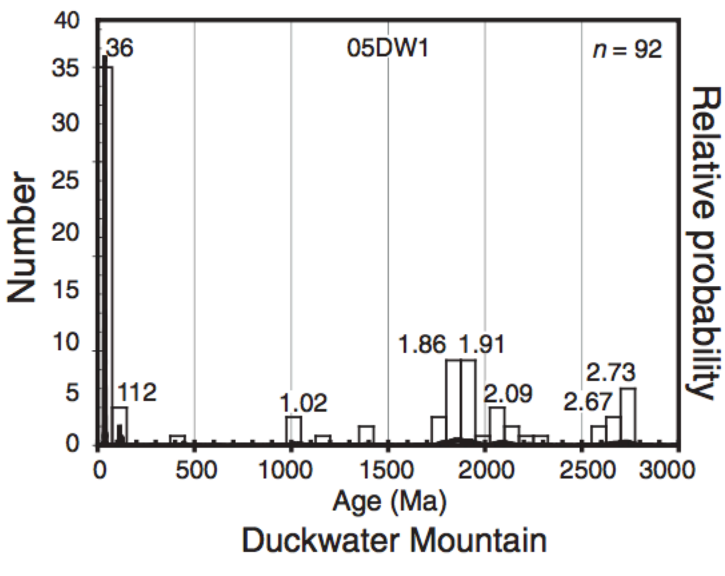

Figure 6: Probability density plot of U-Pb zircon data for Eocene rocks in DuckWater Mountain

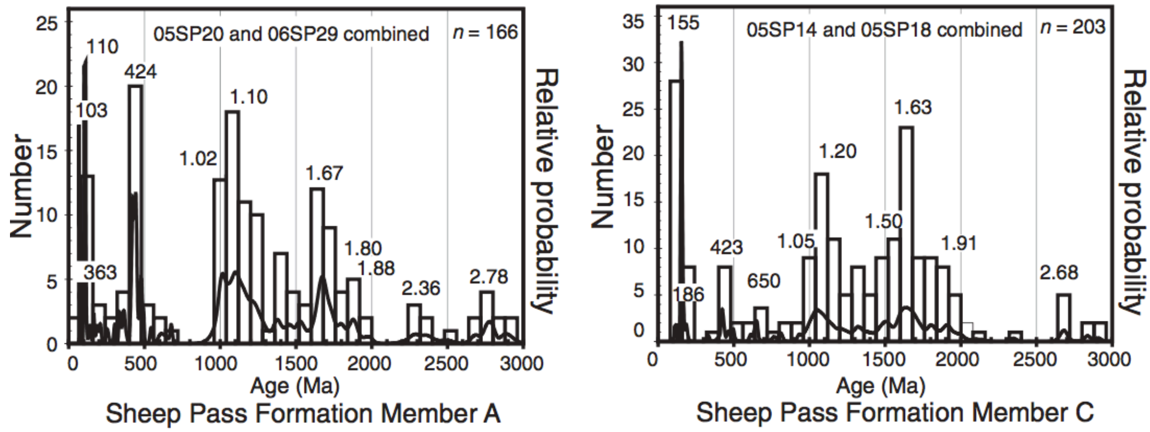

Figure 7: Probability density plots of U-Pb zircon data from Eocene rocks in the Sheep Pass Formation

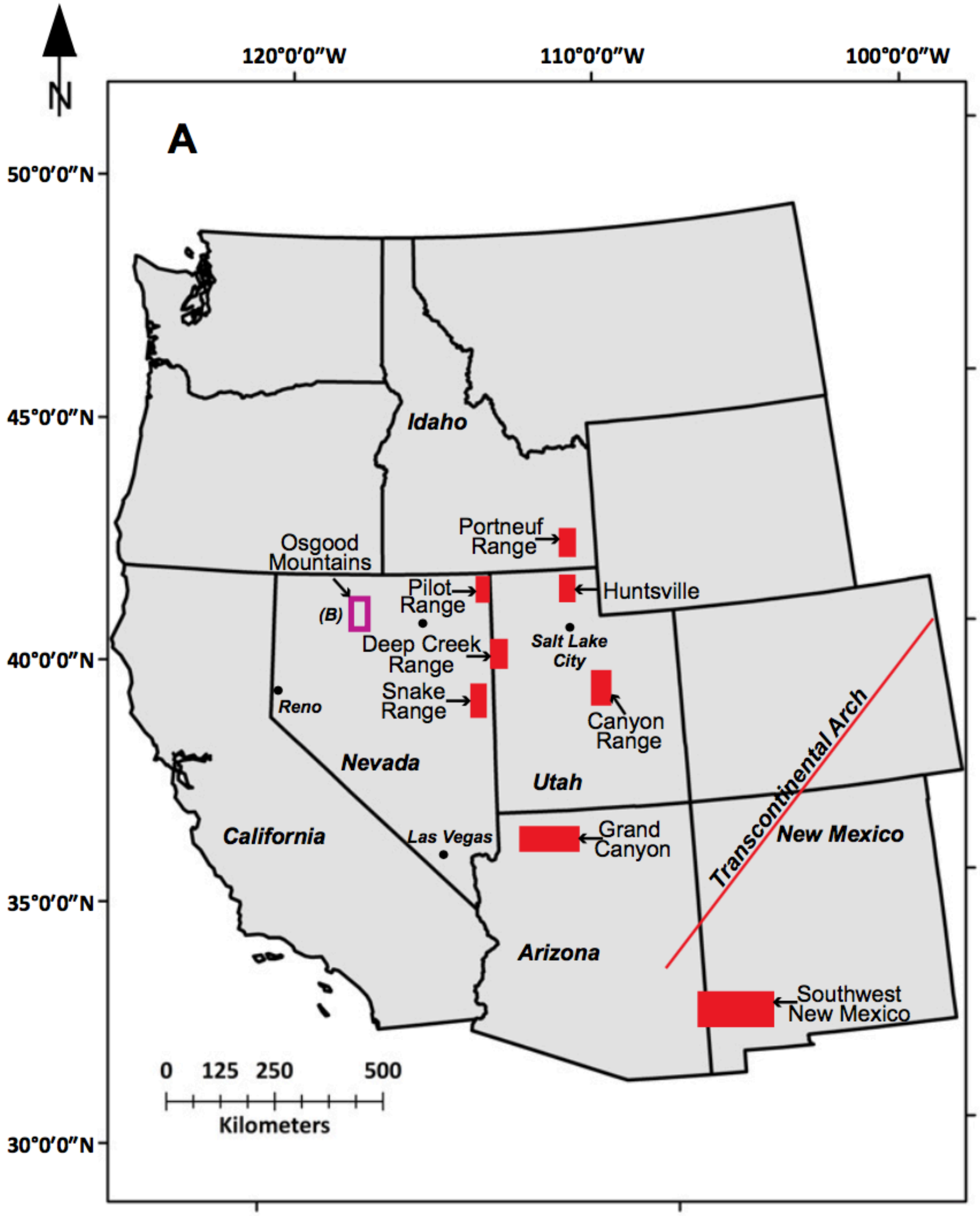

Figure 8: Locations of study areas in the vicinity of the Osgood Mountains and in the Great Basin region for Linde et. al. 2014.

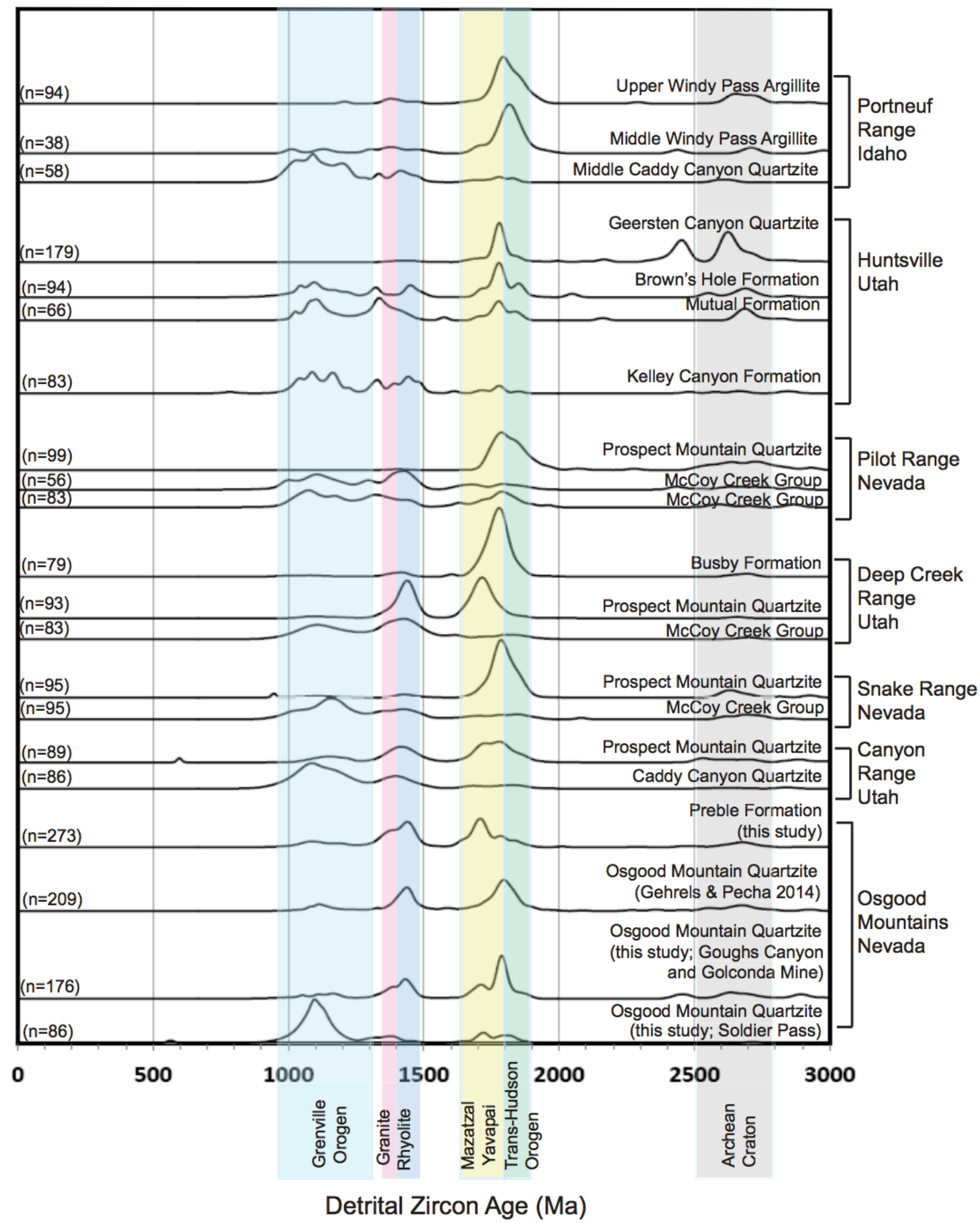

Figure 9: Plots of detrital zircon age of each Neoproterozoic–Cambrian unit organized by locality showing the distribution of detrital zircon ages. Curves are normalized probability plots. The number of detrital zircon grains composing each analysis is shown on the left. Within each location the older units are on the bottom. The vertical shaded bars show principal ages of zircons that would have been shed from potential source regions; please see Linde et. al 2014 for more information

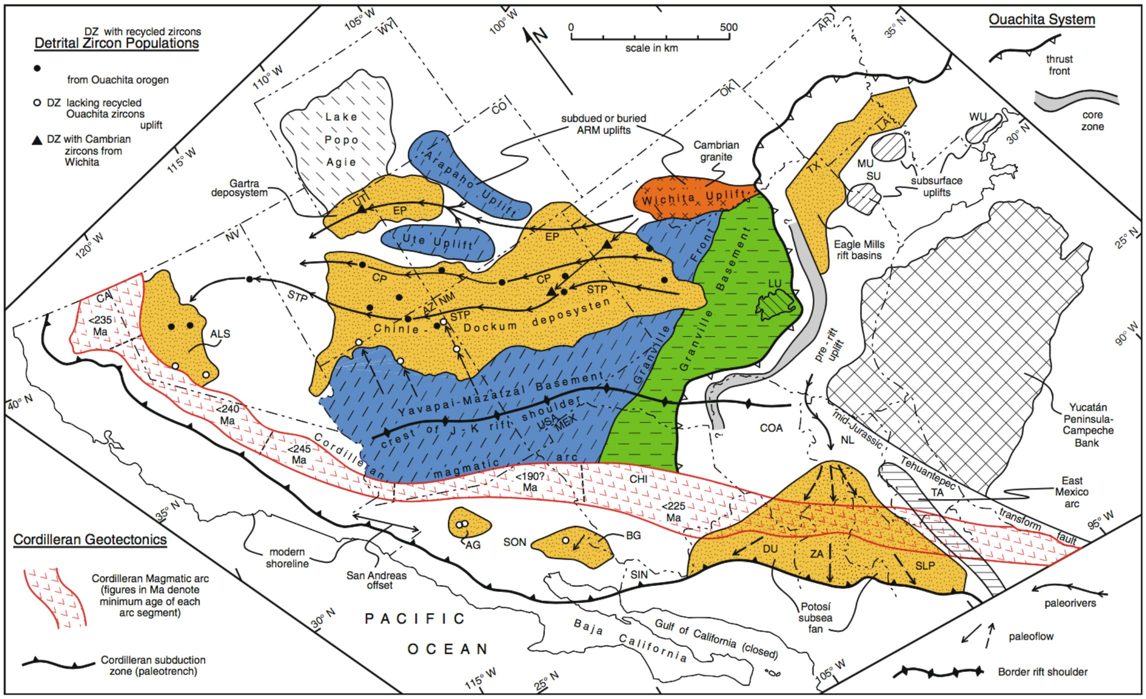

Figure 10: Map showing Geotectonic relations of Chinle-Dockum and associated Late Triassic depositional systems in southwestern Laurentia. Zircon samples are shown based on the legend in the upper left.

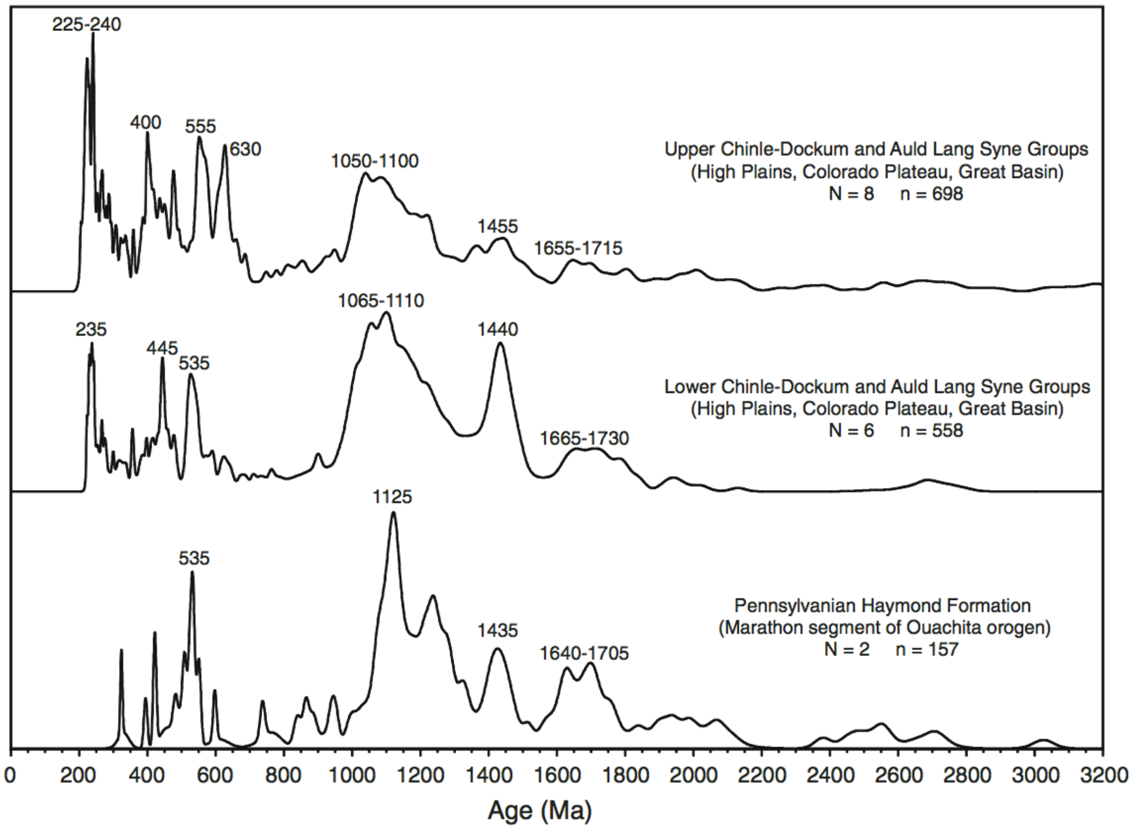

Figure 11: Age-distribution curves of composite DZ populations in Paleozoic sedimentary rocks of the Ouachita system (bottom after Gleason et al. 2007) and in the lower (middle) and upper (top) Chinle-Dockum and Auld Lang Syne depositional systems (Fig. 10) of Late Triassic age.

References:

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