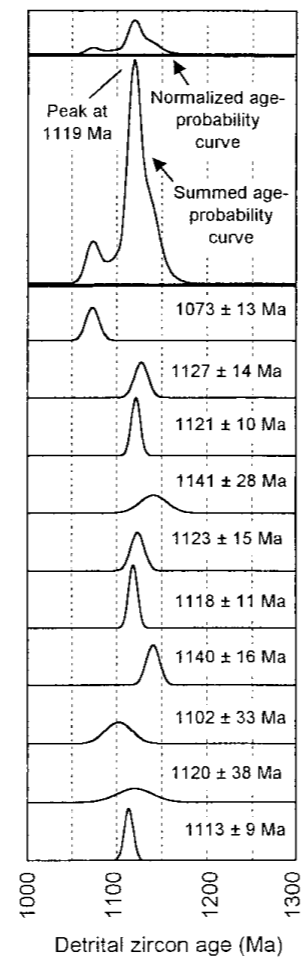


Burchfiel et al., DNAG





Use of Detrital Zircons

Many workers now combine individual zircons as illustrated at left, summing probability density functions

Stewart et al., GSA Bull 2001

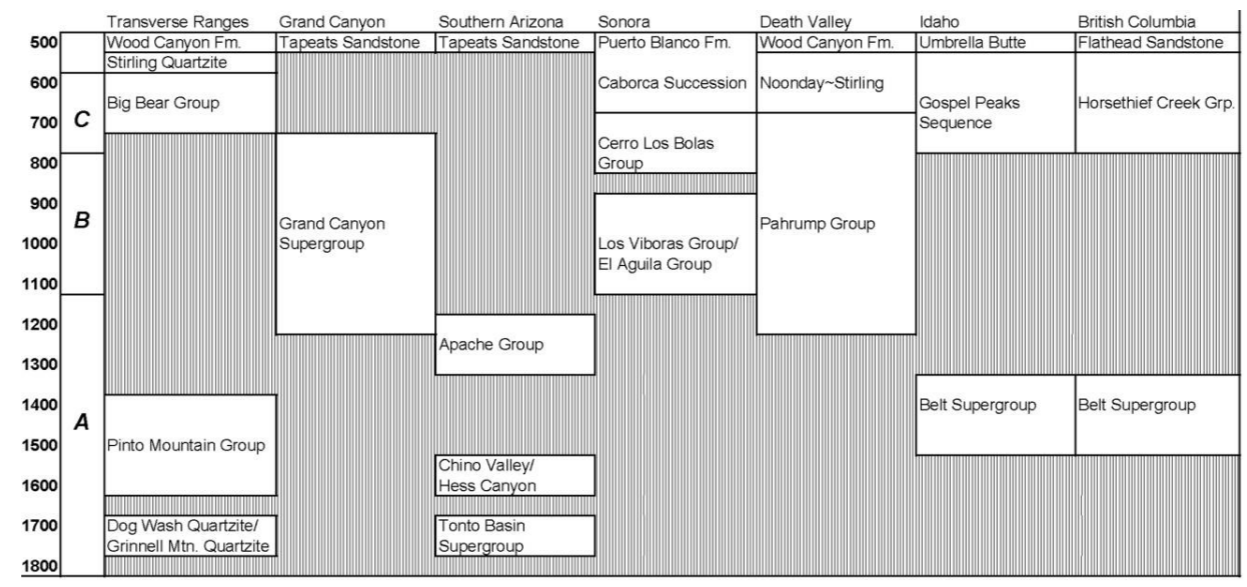
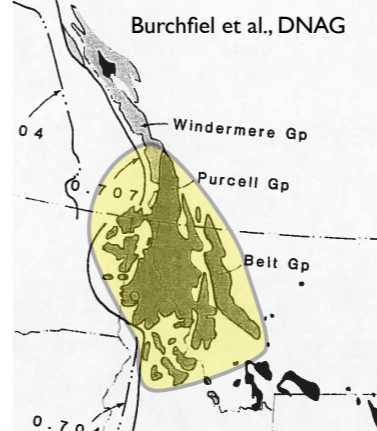
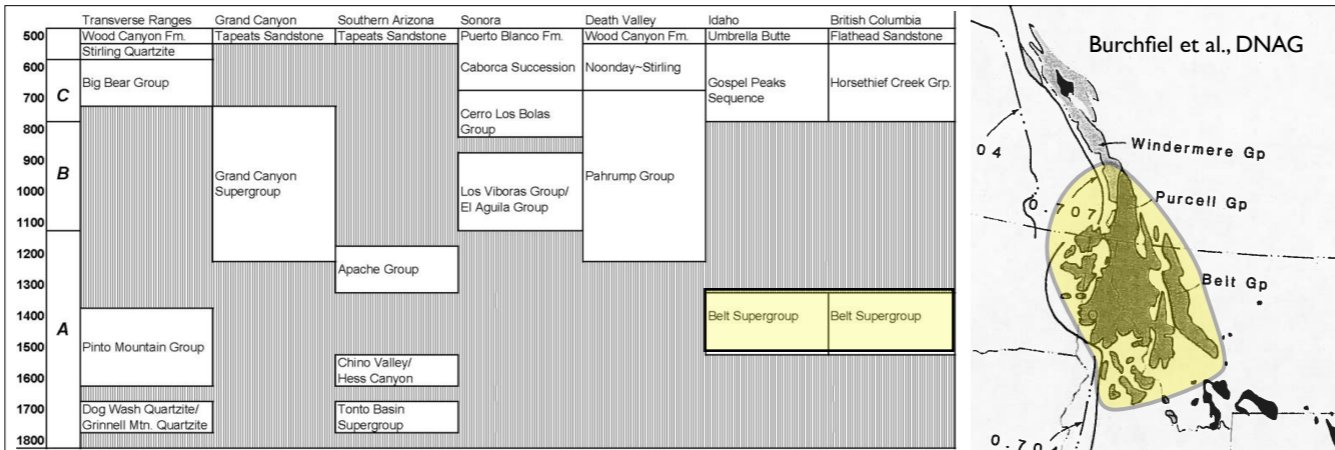
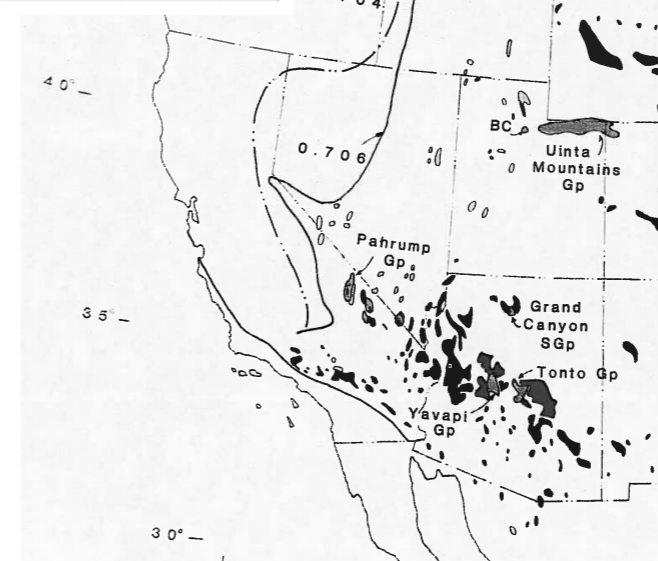


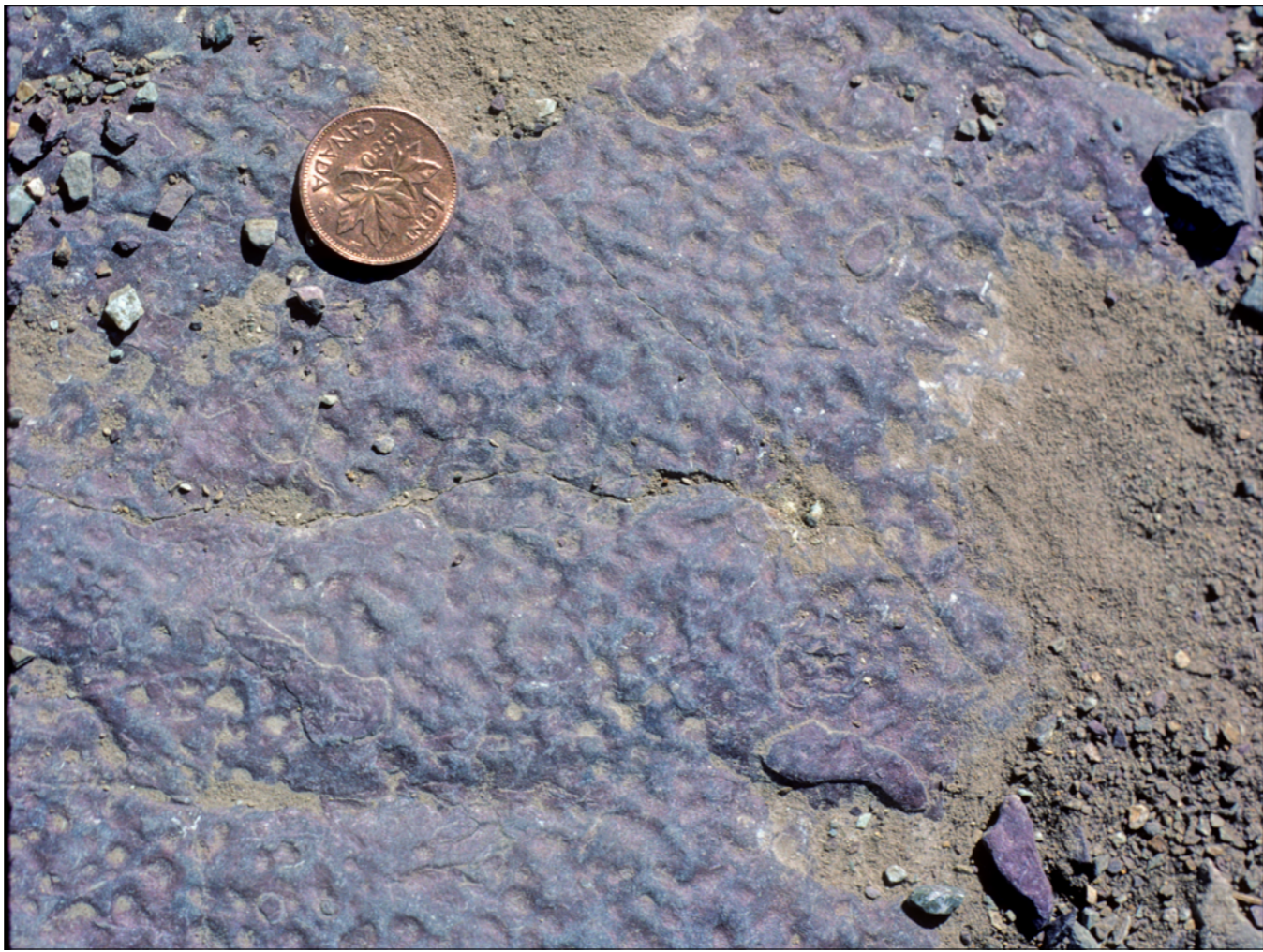
Figure 13. Regional stratigraphic correlation chart for Proterozoic sedimentary rocks in the southwestern Cordillera, illustrating the inferred correlation of quartzite sequences in this study (adapted from Link et al. 1993; additional data from Timmons et al. 2001; Cox et al. 2002; Stewart et al. 2002; Lund et al. 2003). Grinnell Mountain and Dog Wash quartzites are components of the Paleoproterozoic basement and are not representative of a regionally widespread Joshua Tree terrane. Pinto Mountain Group is correlated with Cordilleran Proterozoic succession A and is therefore similar in age or slightly younger than quartzites of the Mazatzal Group of the Tonto Basin Supergroup. Big Bear Group is pre-Stirling Quartzite in age and correlated with the early part of succession C deposited in the earliest stages of Neoproterozoic Cordilleran rifting.

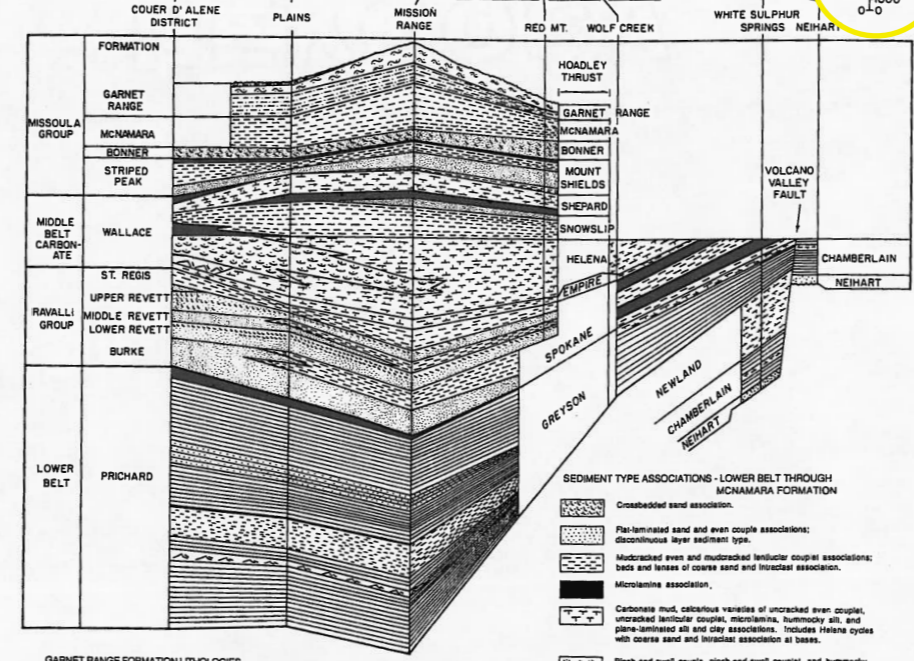
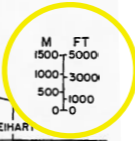
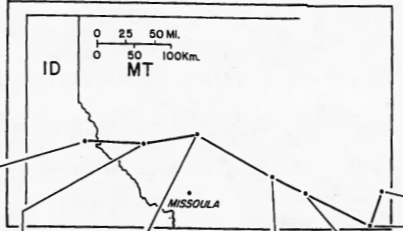


Belt Supergroup







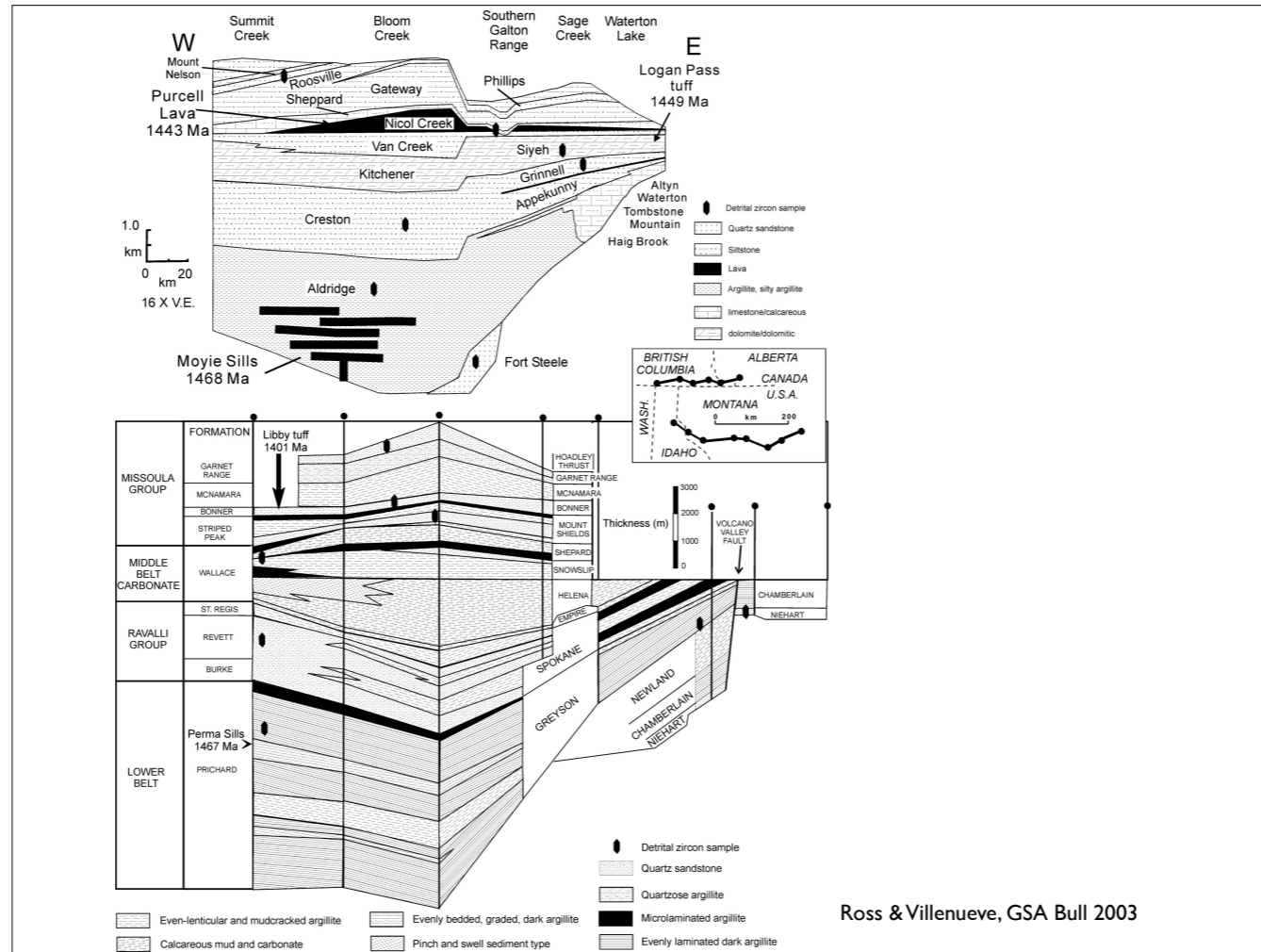


GARNET RANGE FORMATION LITHOLOGIES

Dark greenish gray, micaceous, lenticular and tabular quartzite with argillite interbeds.
 Dark greenish gray, micaceous, hummocky cross-stratified quartzite.

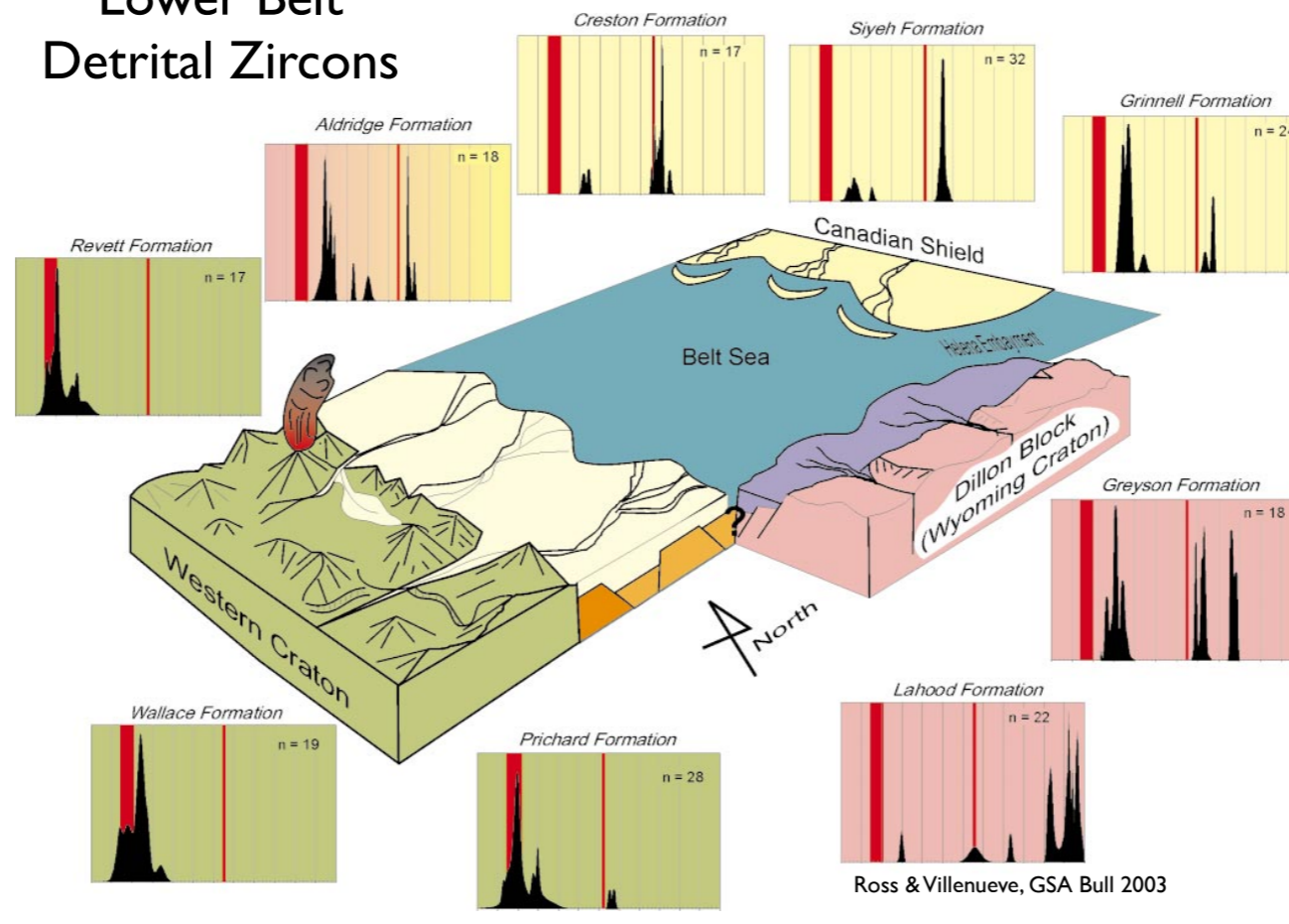
- SEDIMENT TYPE ASSOCIATIONS - LOWER BELT THROUGH MCNAMARA FORMATION**
- Crossbedded sand association.
 - Flat-laminated sand and even couplet associations; discontinuous layer sediment type.
 - Mudcracked even and mudcracked lenticular couplet associations; beds and lenses of coarse sand and intraclast association.
 - Microlamina association.
 - Carbonaceous mud, calcareous varieties of uncracked even couplet, uncracked lenticular couplet, microlamina, hummocky silt, and plane-laminated silt and clay associations. Includes Helena cycles with coarse sand and intraclast association at bases.
 - Pinch-and-swell couplet, pinch-and-swell couplet, and hummocky silt associations.
 - Plane-laminated silt and clay, uncracked even couplet, and hummocky silt associations.
 - Muddy graded sand association.
 - Hummocky silt association.

Link et al., DNAG



Ross & Villeneuve, GSA Bull 2003

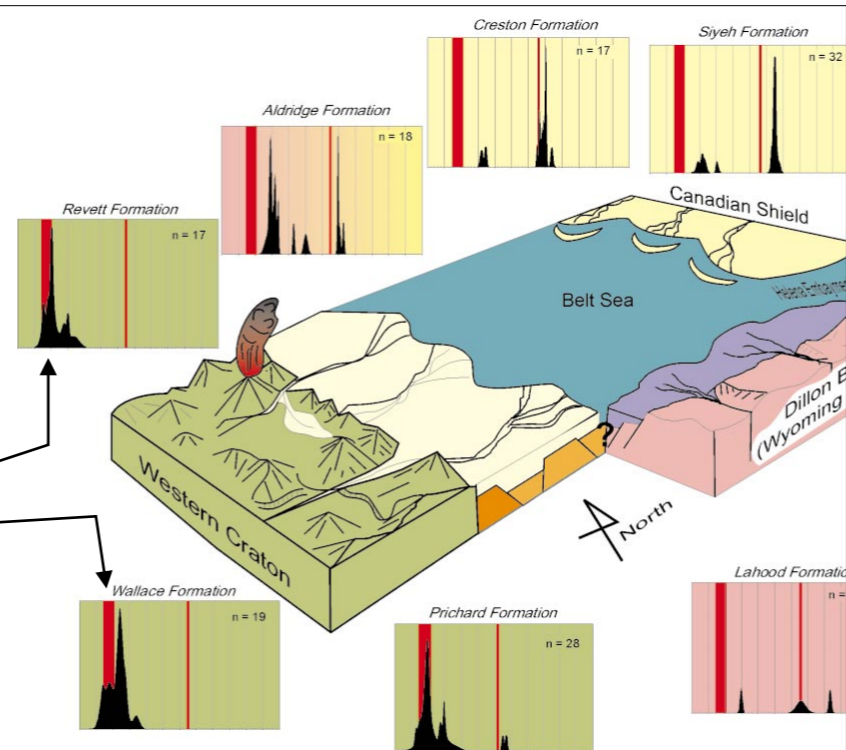
Lower Belt Detrital Zircons



Red thick bar is hiatus in NAm igneous and thin is Archean-Proterozoic bdry. Paper says these ages abundant in Australia and Baltica (another paper points out they are found in Amazonia, too).

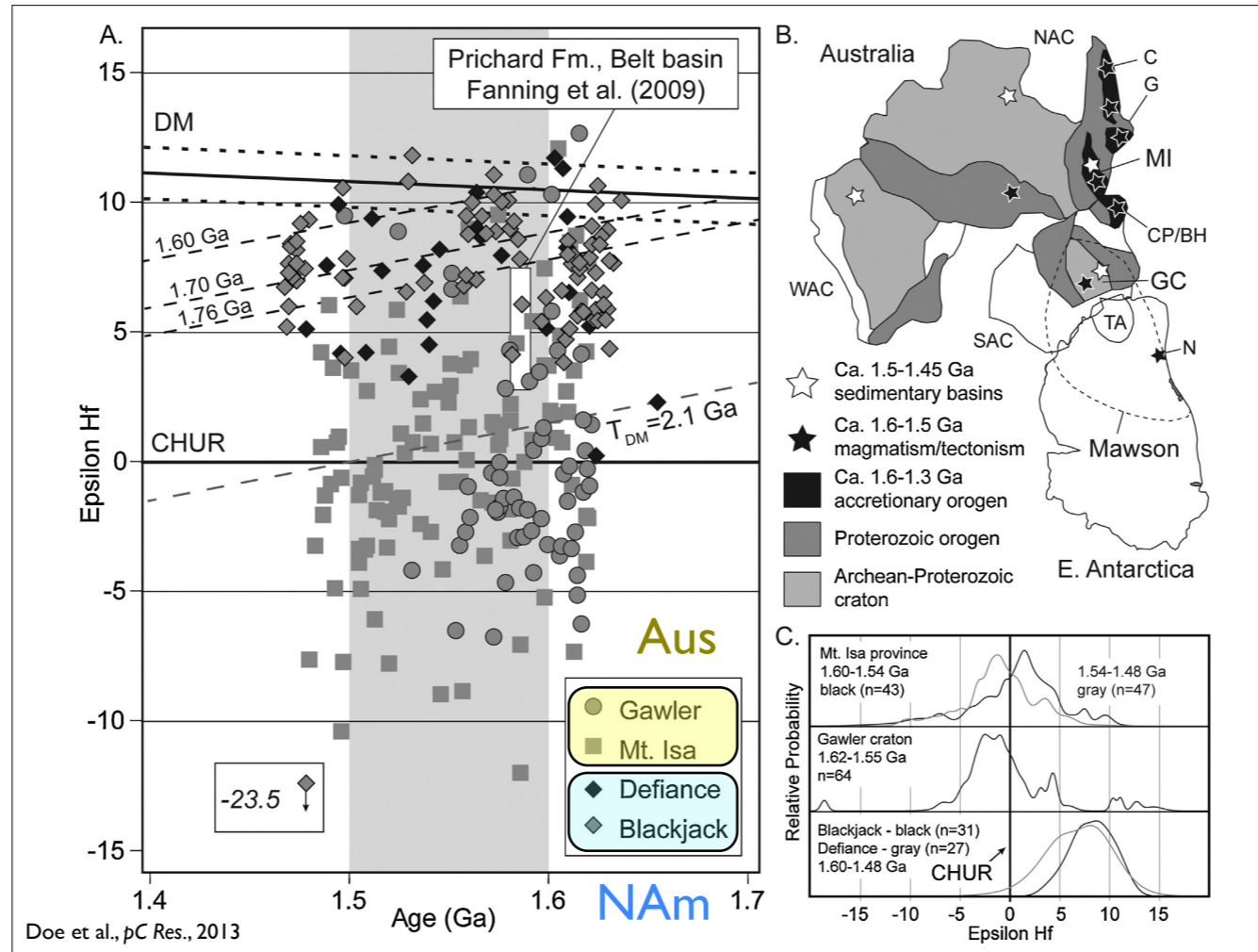
Lower Belt Detrital Zircons

These ~1.5 Ga
zircons
uncharacteristic of
NAM, but common in
Australia, Baltica (and
Amazonia)

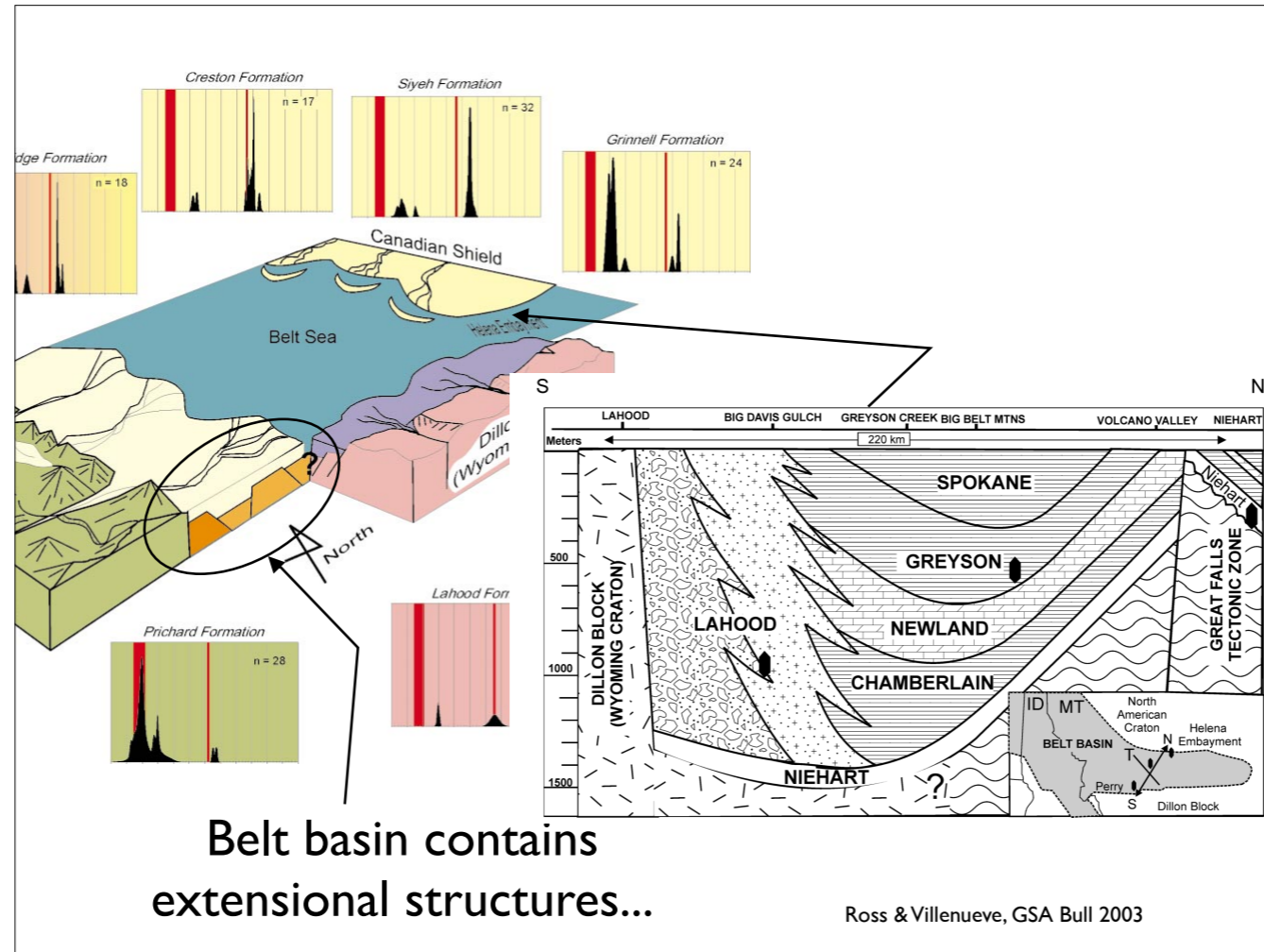


Ross & Villeneuve, GSA Bull 2003

Red thick bar is hiatus in NAM igneous and thin is Archean-Proterozoic bdy. Paper says these ages abundant in Australia and Baltica (another paper points out they are found in Amazonia, too).

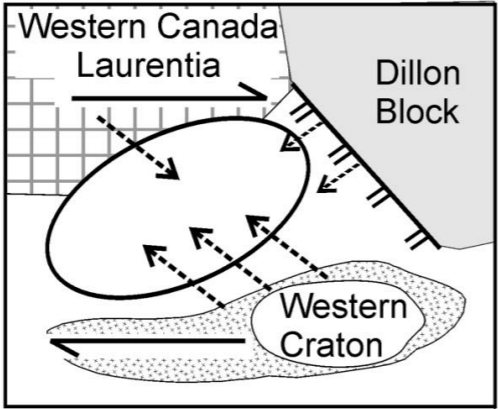


This seems to support an Australian source to the west of the WUS c. 1500 Ma (but how??-plot in lower right seems to make this unlikely). — same time as constraints used to put Siberia there! This is from newly recognized 1.48 Ga quartzites in NE AZ. Absence of these zircons later thought to mean that these terranes moved during shift from Nuna/Columbia supercontinent to Rodinia. Fig. 7. A) Initial ϵ_{Hf} values for 1.62–1.48 Ga detrital zircon from the Defiance uplift and Blackjack Formation, Arizona, plotted with the range of ϵ_{Hf} values for 1.59 Ga detrital zircon from the Lower Belt Group (Fanning et al., 2009) and detrital zircon from river sediment derived from the Gawler craton (Belousova et al., 2009) and Mt. Isa region (Griffin et al., 2006). The lower black dashed line represents a 2.1 Ga peak in TDM ages of the Gawler data (Belousova et al., 2009). B) Generalized reconstruction of Australia (Giles et al., 2004; Cawood and Korsch, 2008) and East Antarctica (Payne et al., 2009) during the Proterozoic showing the distribution of potential 1.6–1.5 Ga igneous sources and 1.5–1.45 Ga sedimentary basins. The approximate outline of the Mawson continent is shown by the dashed line. NAC—North Australia craton; C—Coen region; G—Georgetown region; MI—Mt. Isa region; CP/BH—Curnamona province and Broken Hill region; GC—Gawler craton; TA—Terra Adelie; SAC—South Australia craton; WAC—West Australia craton; N—Nimrod Group. C) Probability density plots showing the distribution of initial ϵ_{Hf} values for age populations of 1.60–1.54 Ga and 1.54–1.48 Ga for the Mt. Isa region (Griffin et al., 2006), a 1590 ± 40 Ma age population from the Gawler craton (Belousova et al., 2009), and the entire range of overlapping ages from the Blackjack Formation and Defiance uplift.

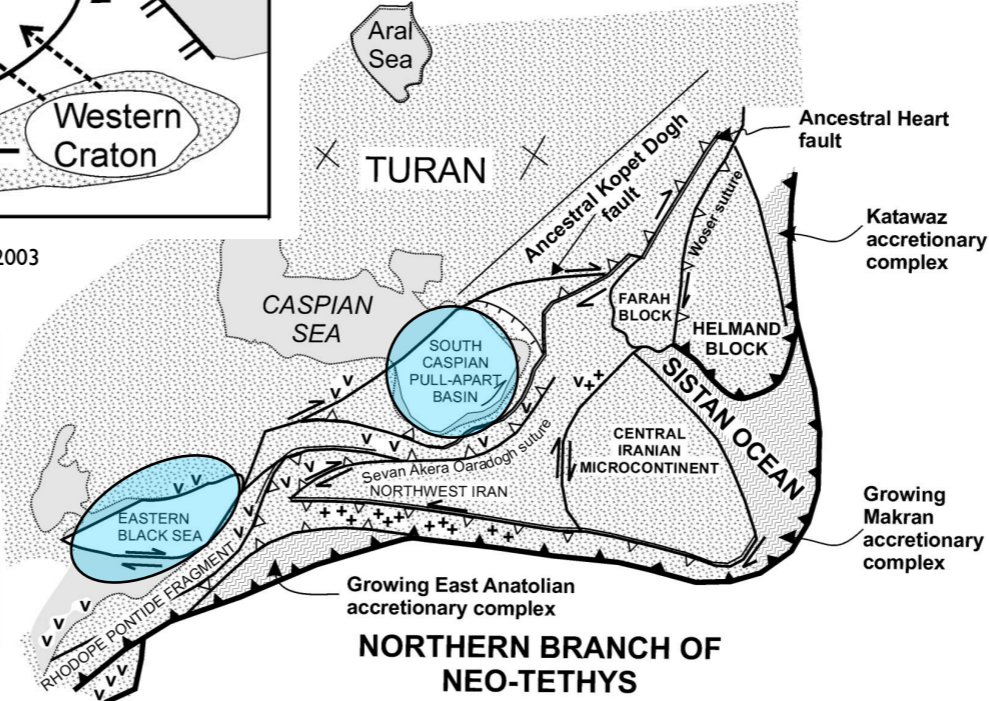


Red thick bar is hiatus in NAm igneous and thin is Archean-Proterozoic bdry. Paper says these ages abundant in Australia and Baltica (another paper points out they are found in Amazonia, too).

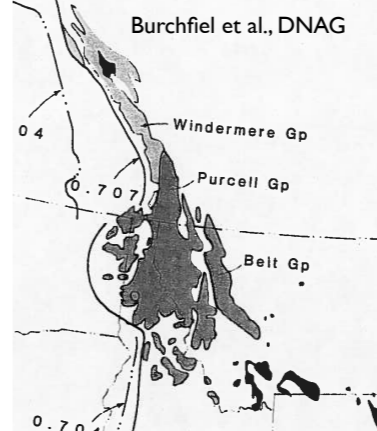
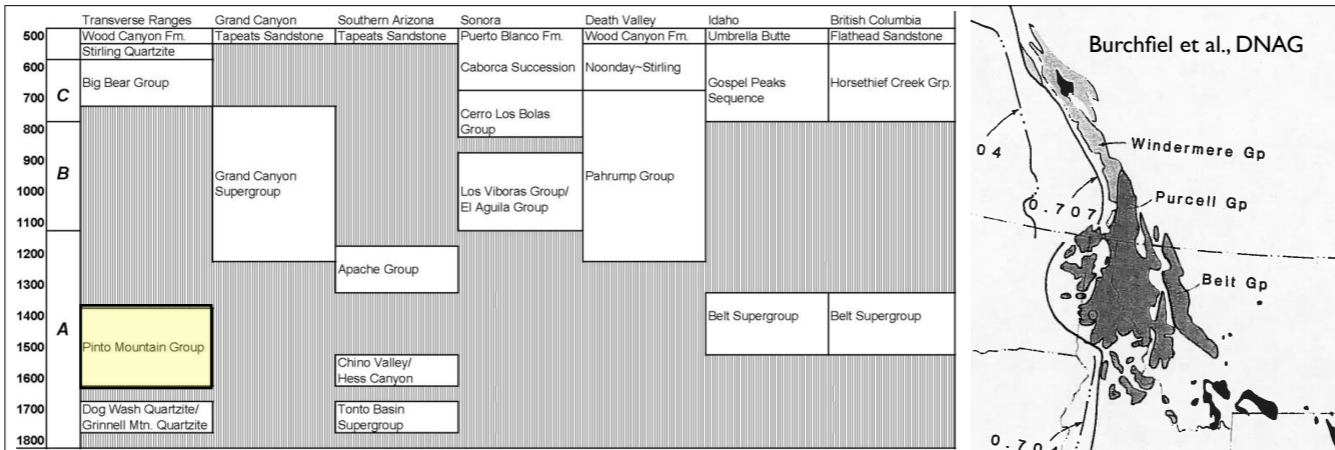
...maybe oblique pull-apart?
Analogy to K SW Asia



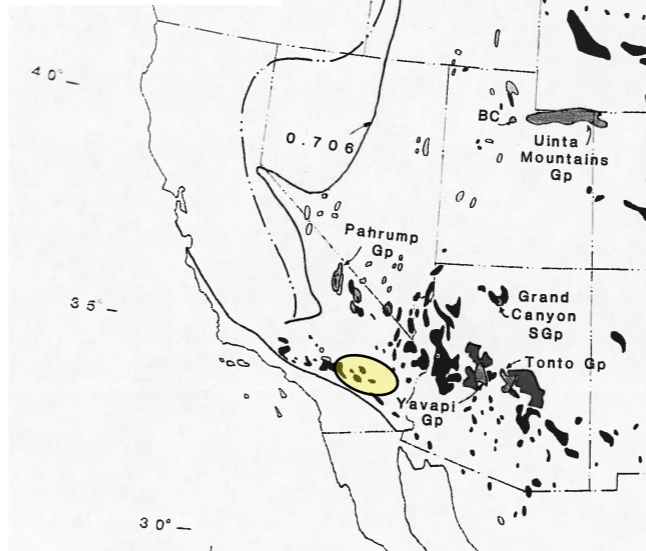
Ross & Villeneuve, GSA Bull 2003

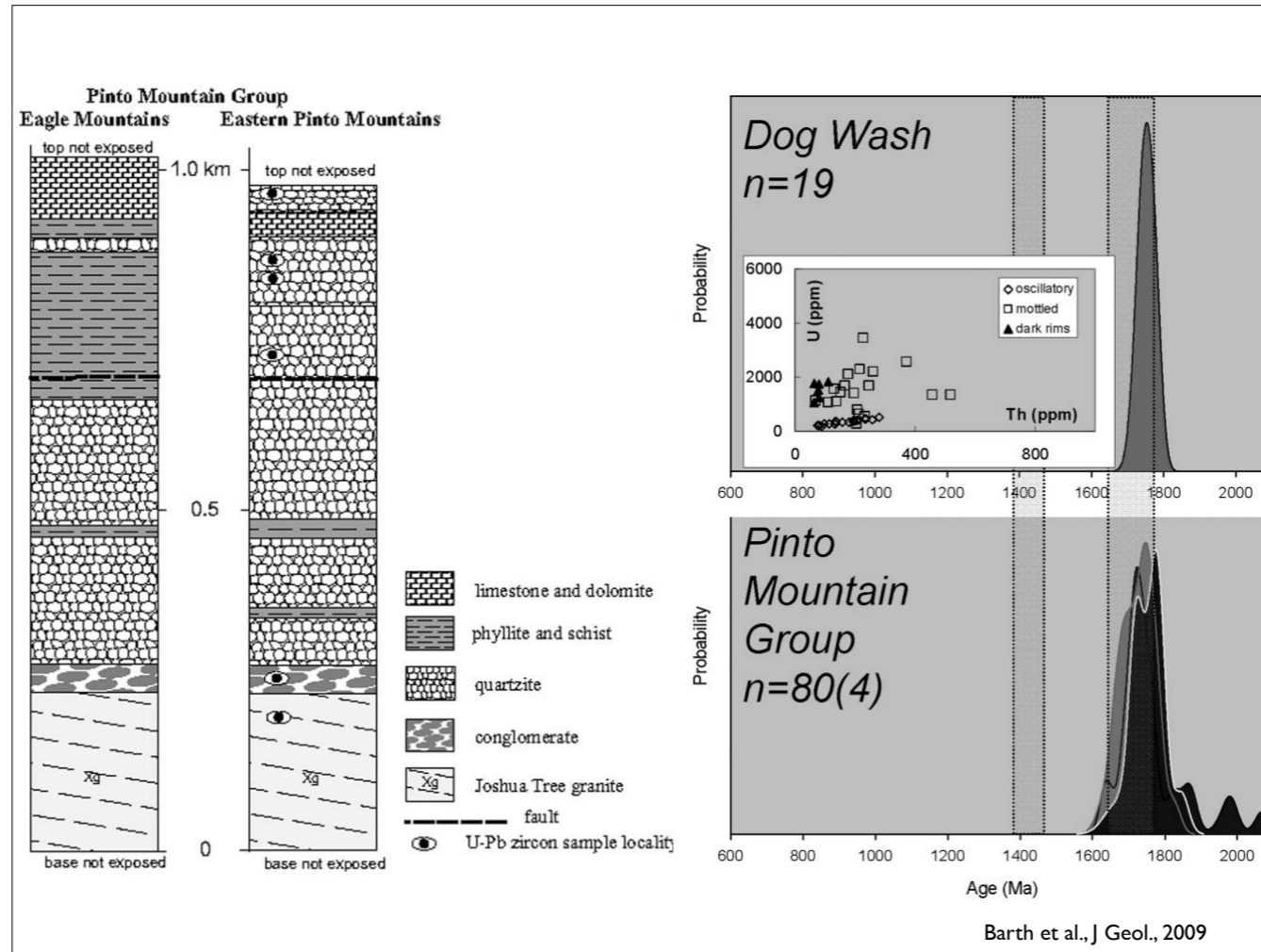


While an interesting idea, seems to run into issues with plutonism being all to SE...



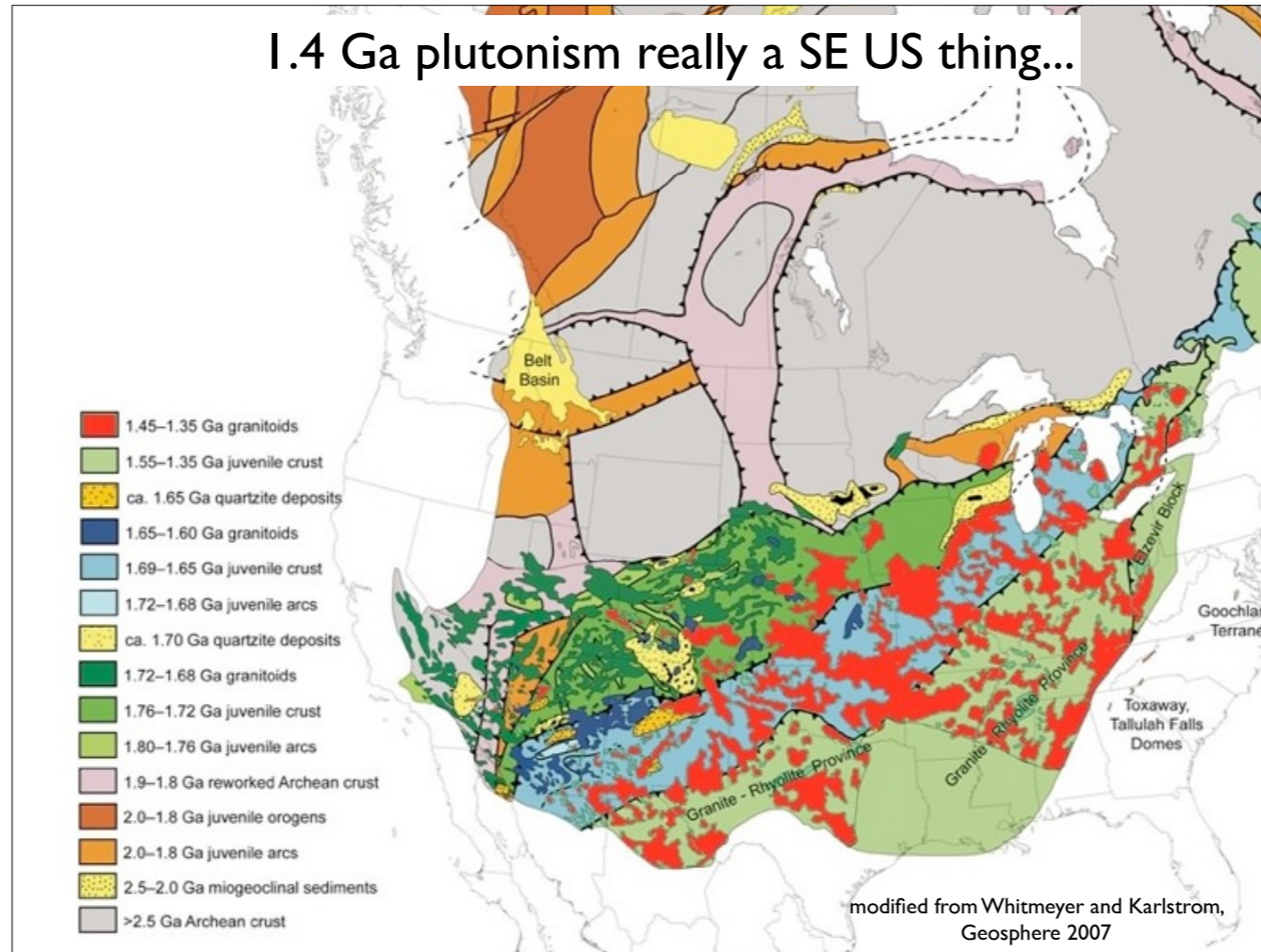
Pinto Mountain Group



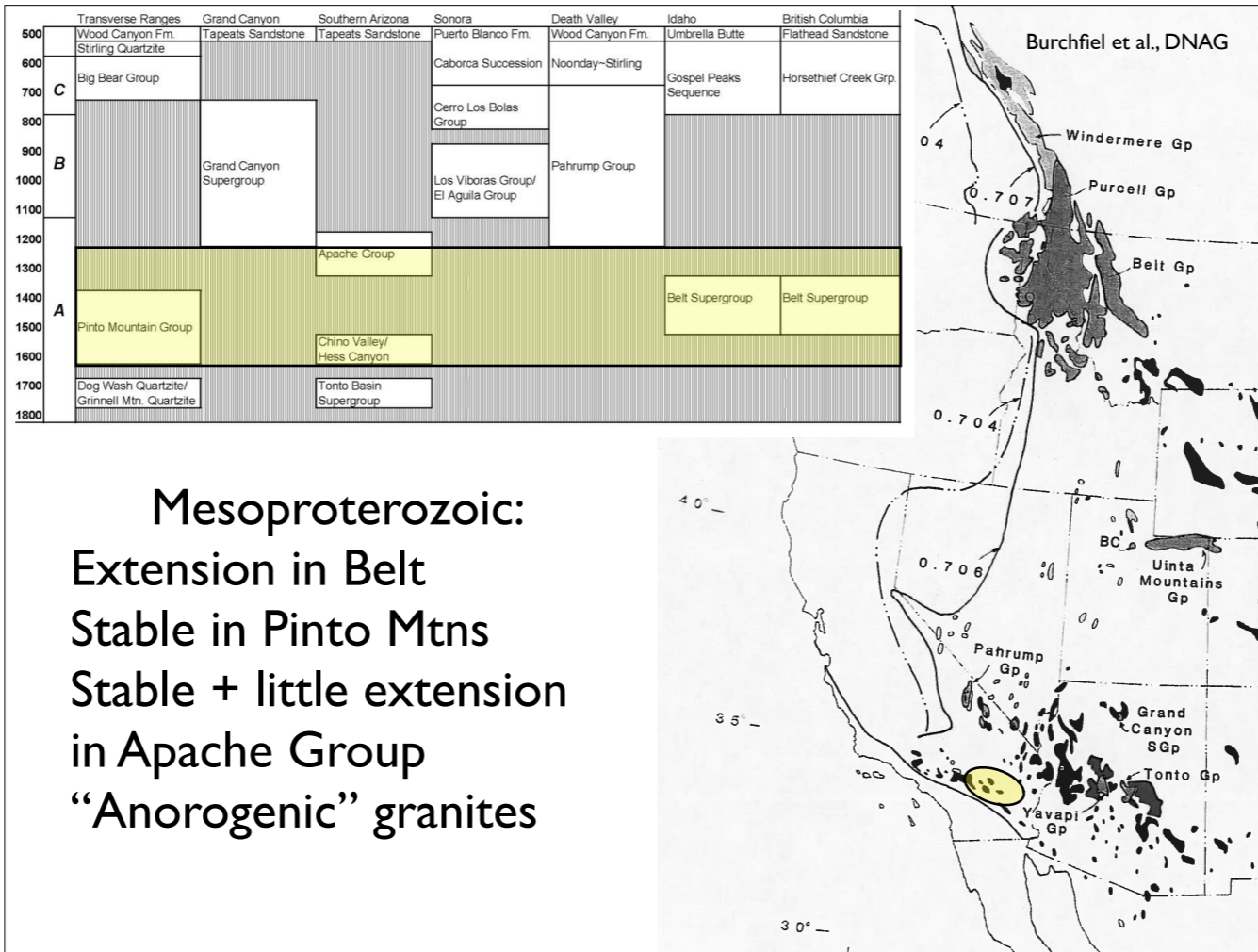


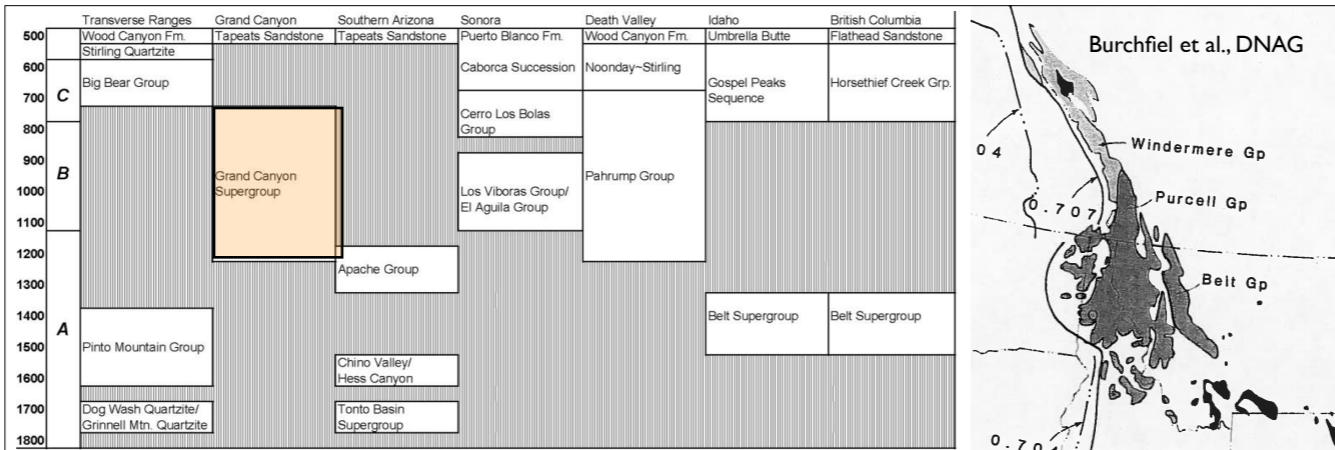
Two notes: No c. 1400 Ma zircons, so probably not that young. And no unusual zircons--exotic terrane not required (but not impossible, either).

1.4 Ga plutonism really a SE US thing...

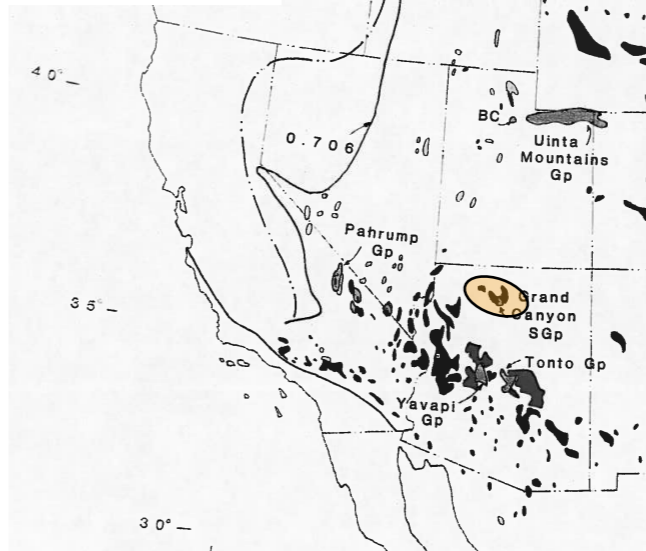


...though note that the Holland et al. paper identified some in SoCal not evident on this map. Also note this is during Belt deposition.

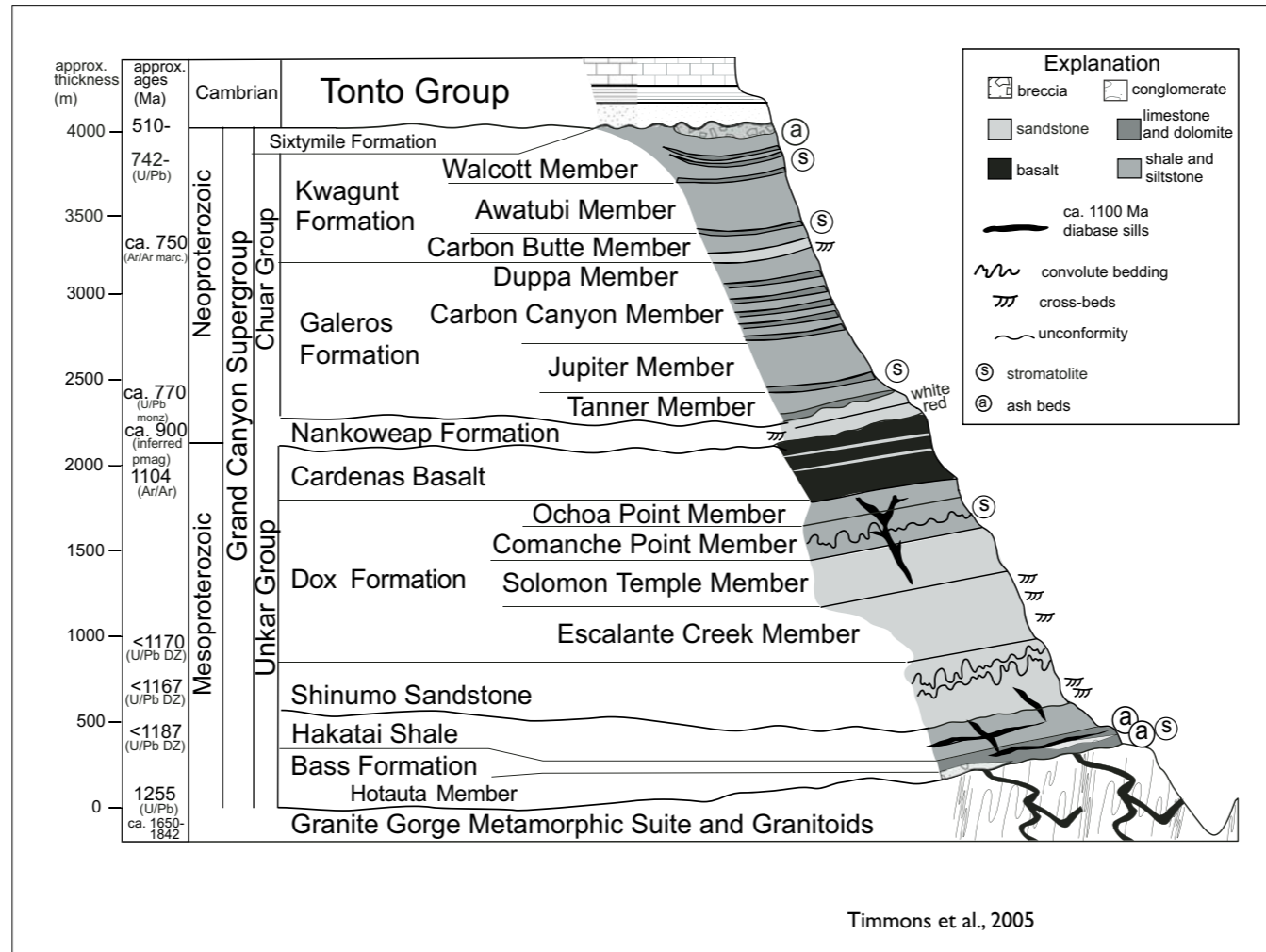




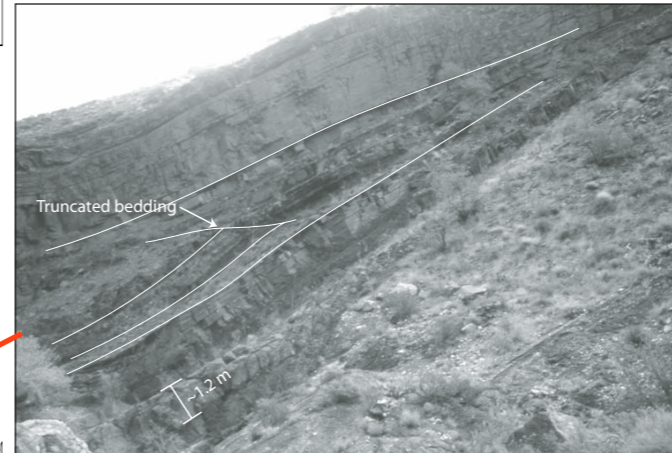
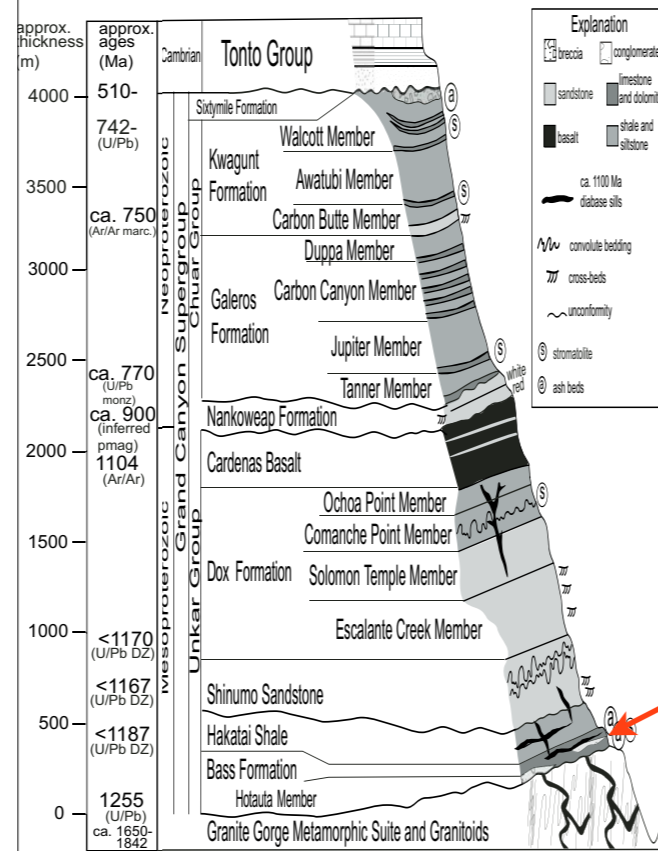
Grand Canyon
Supergroup
(Chaur Group over
Unkar group)





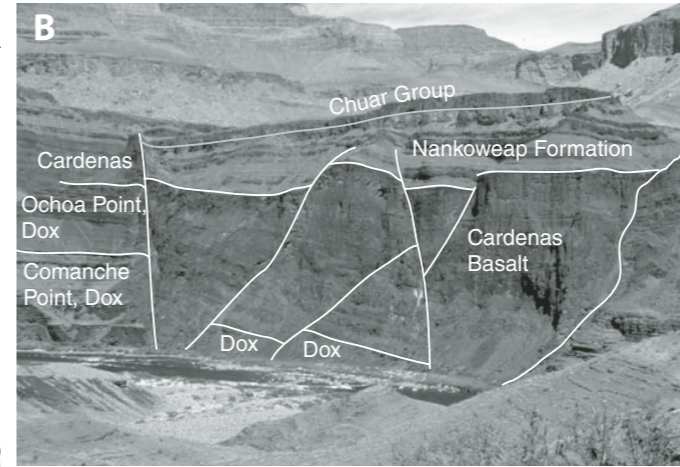
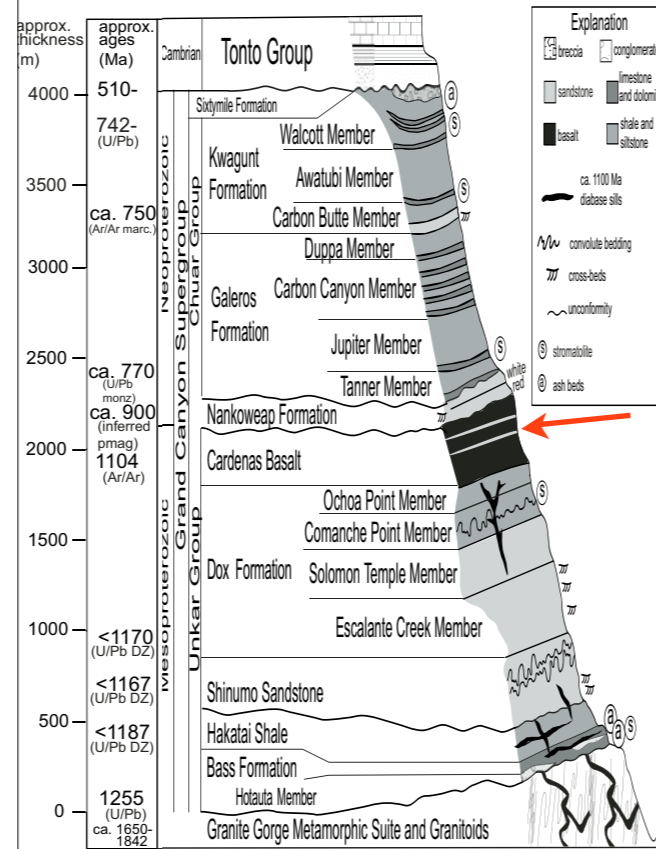


Mild 1.2 Ga NE-trending monocline

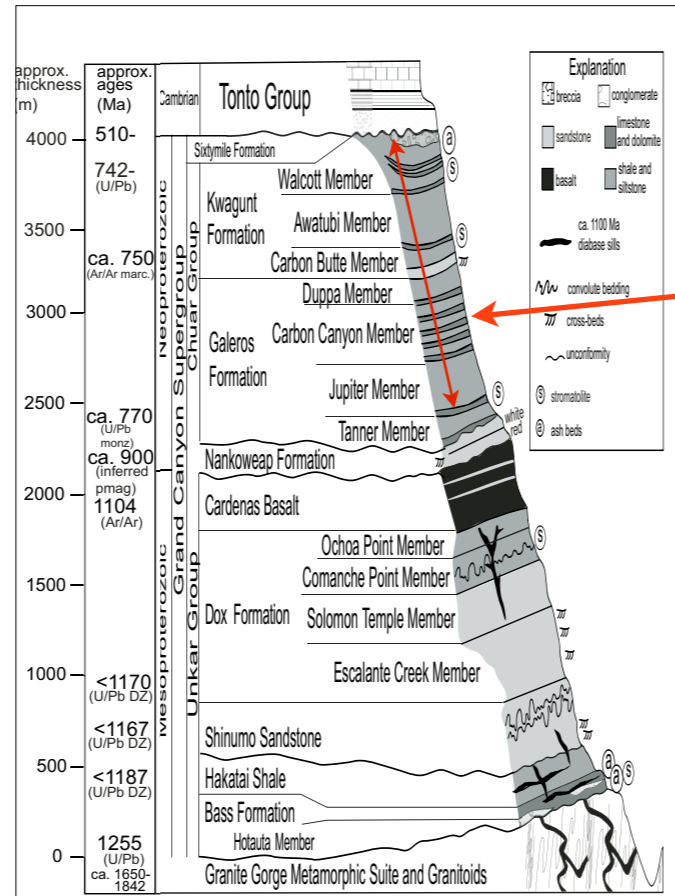


Timmons et al., 2005

I.I Ga grabens



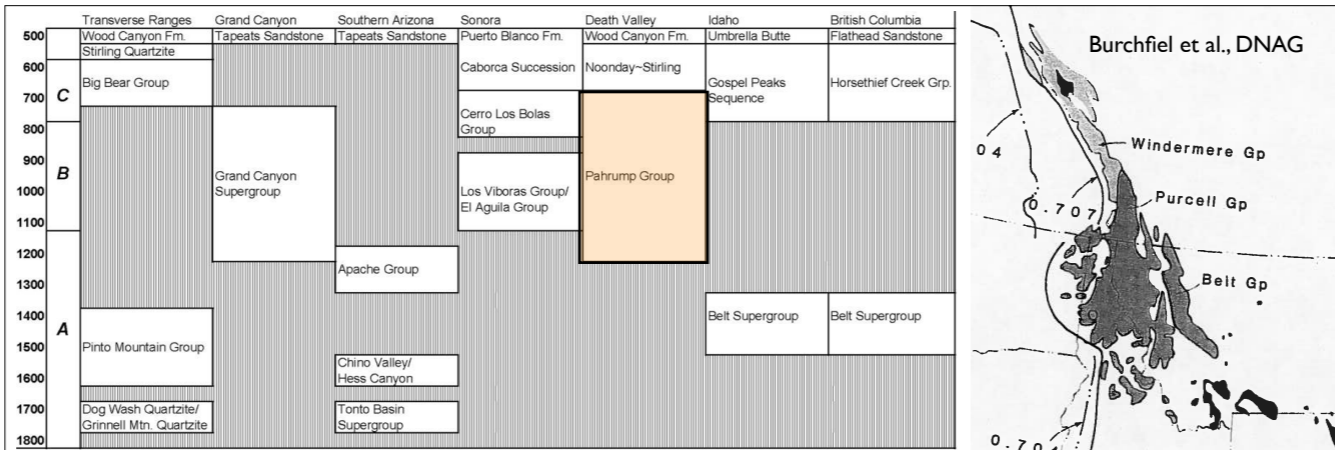
Timmons et al., 2005



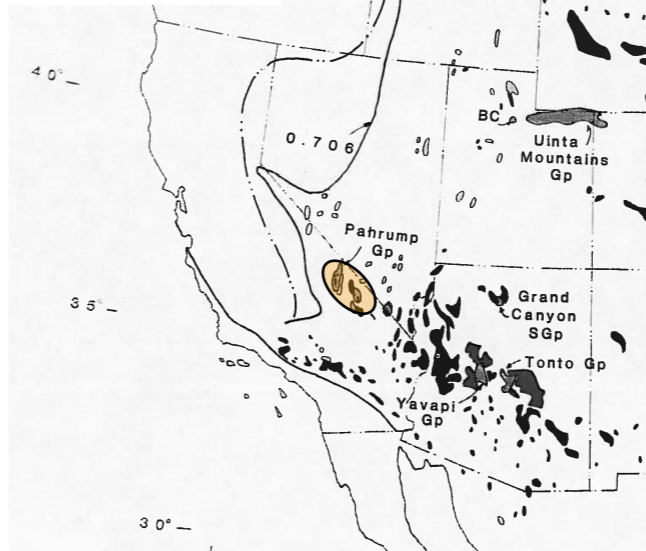
0.76 Ga extension (e.g., 700m slip on Butte Fault)



Timmons et al., GSA Bull., 2001



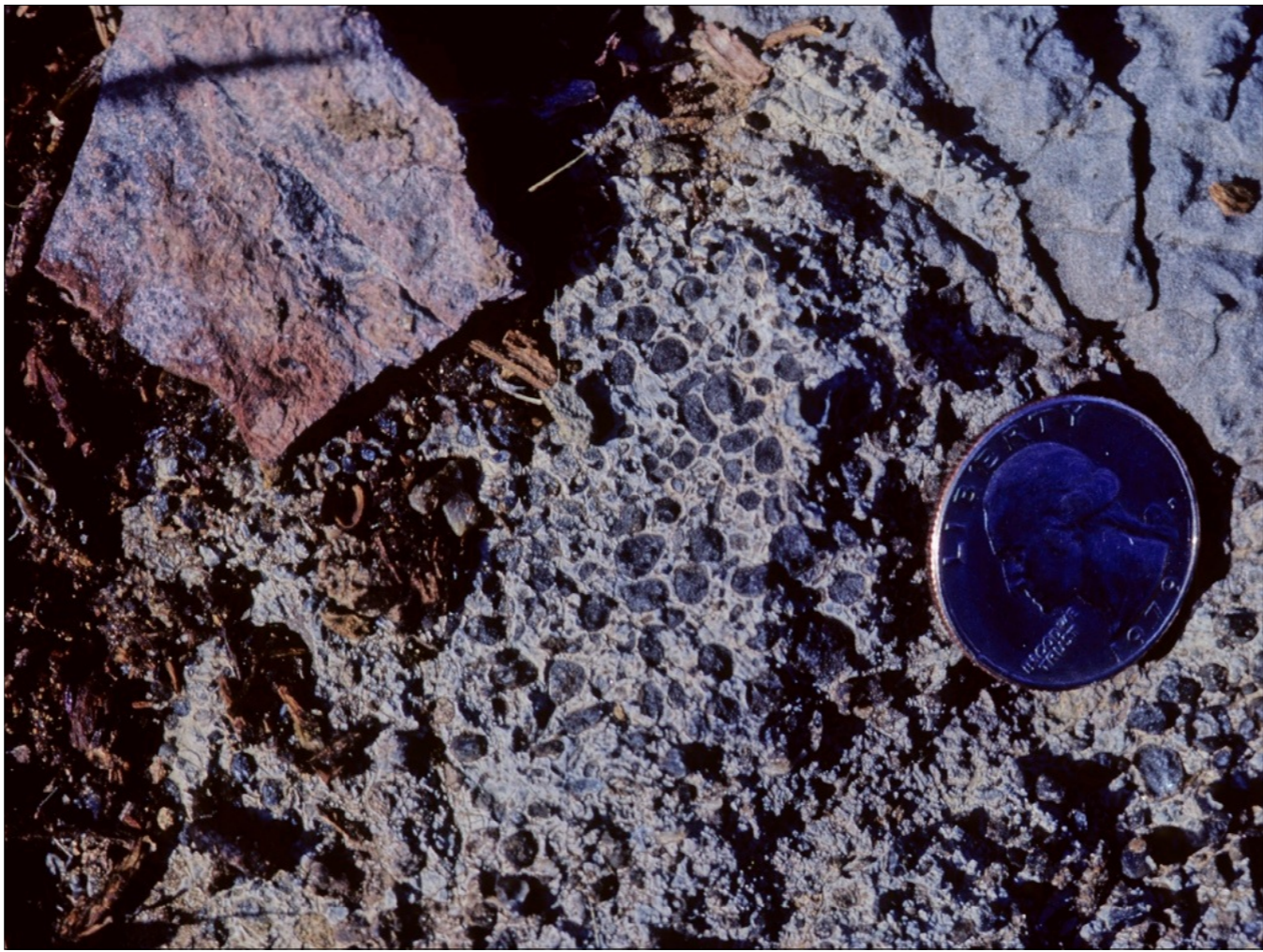
Pahrump Group
 (Kingston Peak over
 Beck Spring Dolomite over
 Crystal Spring Fm)

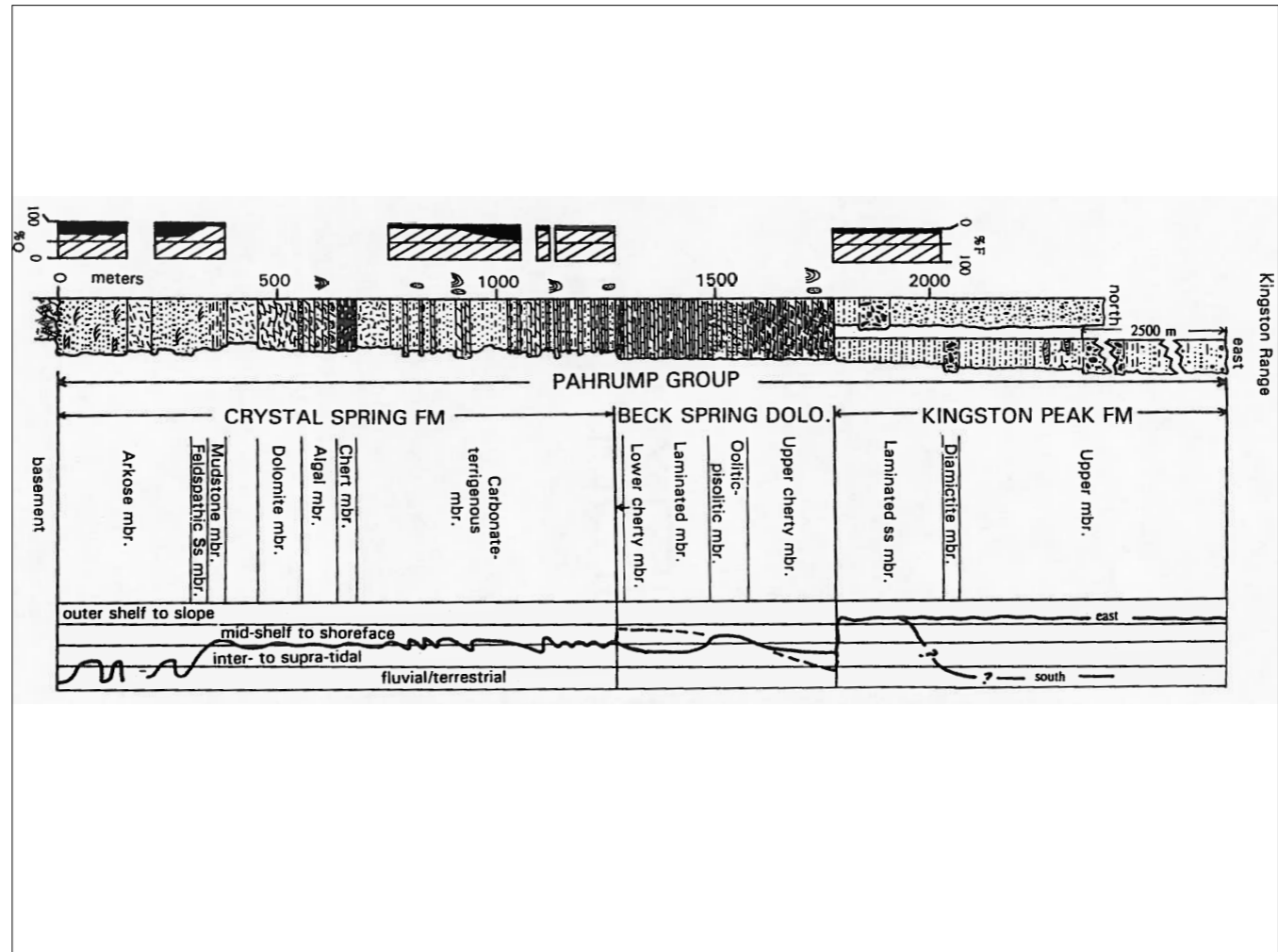


Crystal Spring below Beck Spring

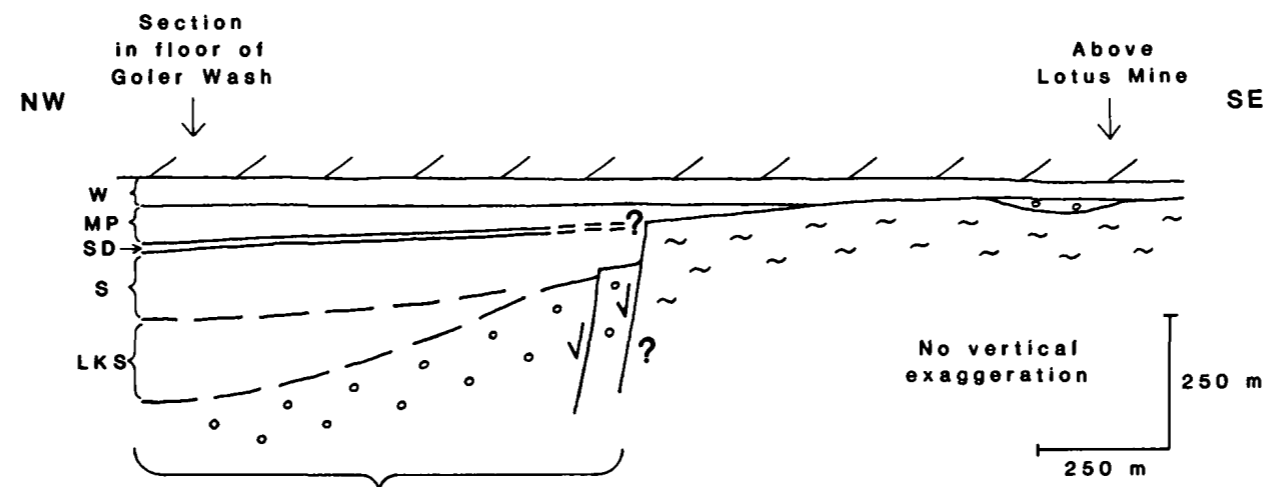




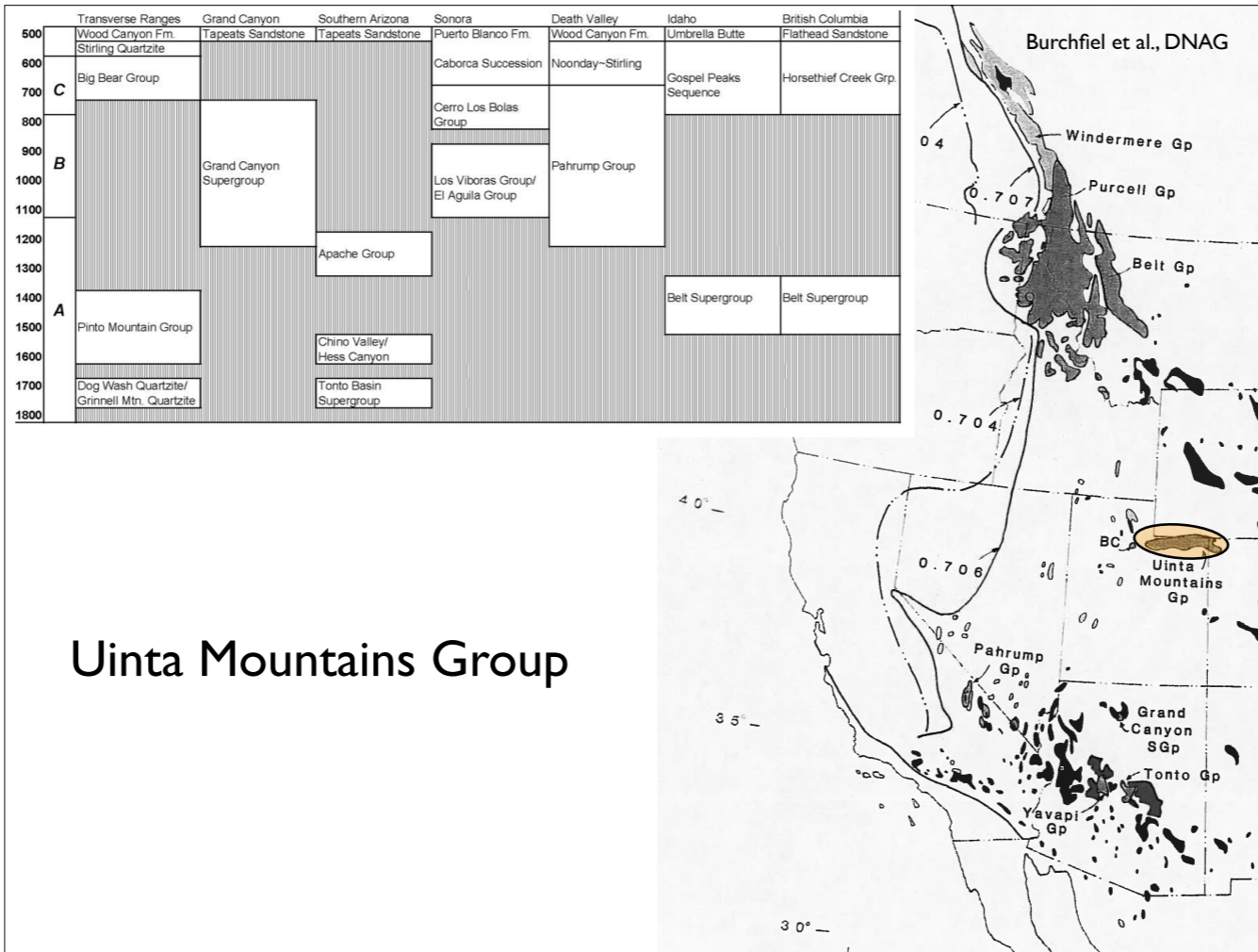




Now appears there is a big break in the lower Crystal Spring



Substrate is : Crystal Spring Formation south of Goler Wash, lower Proterozoic metamorphic rocks in Goler Wash and Coyote Canyon.



Uinta Mountains Group

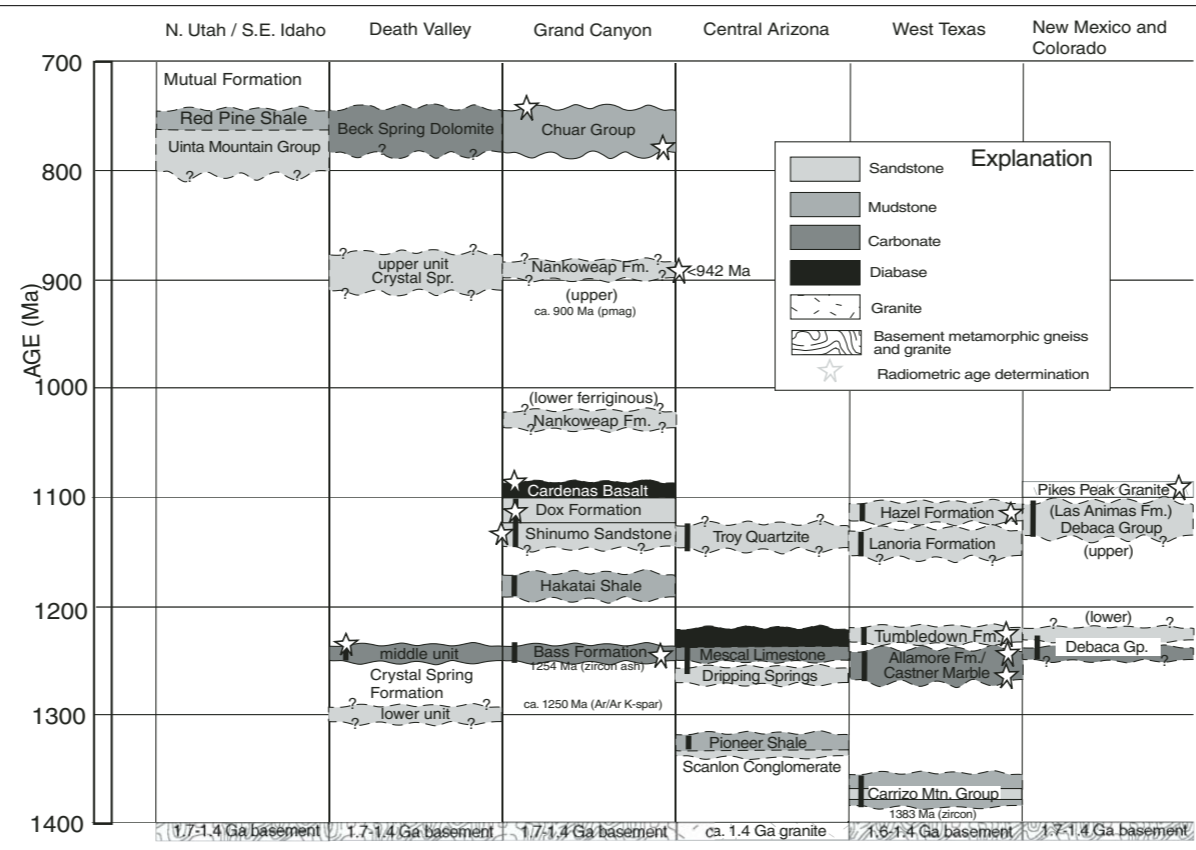
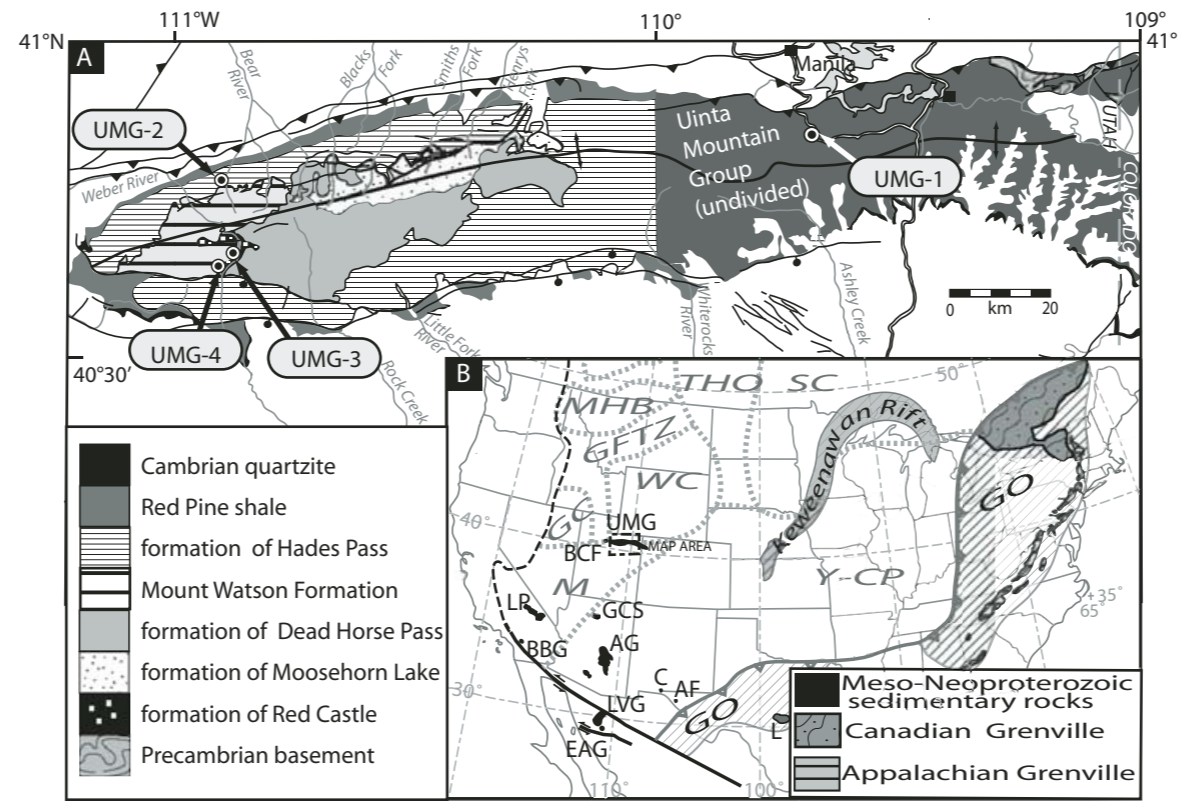
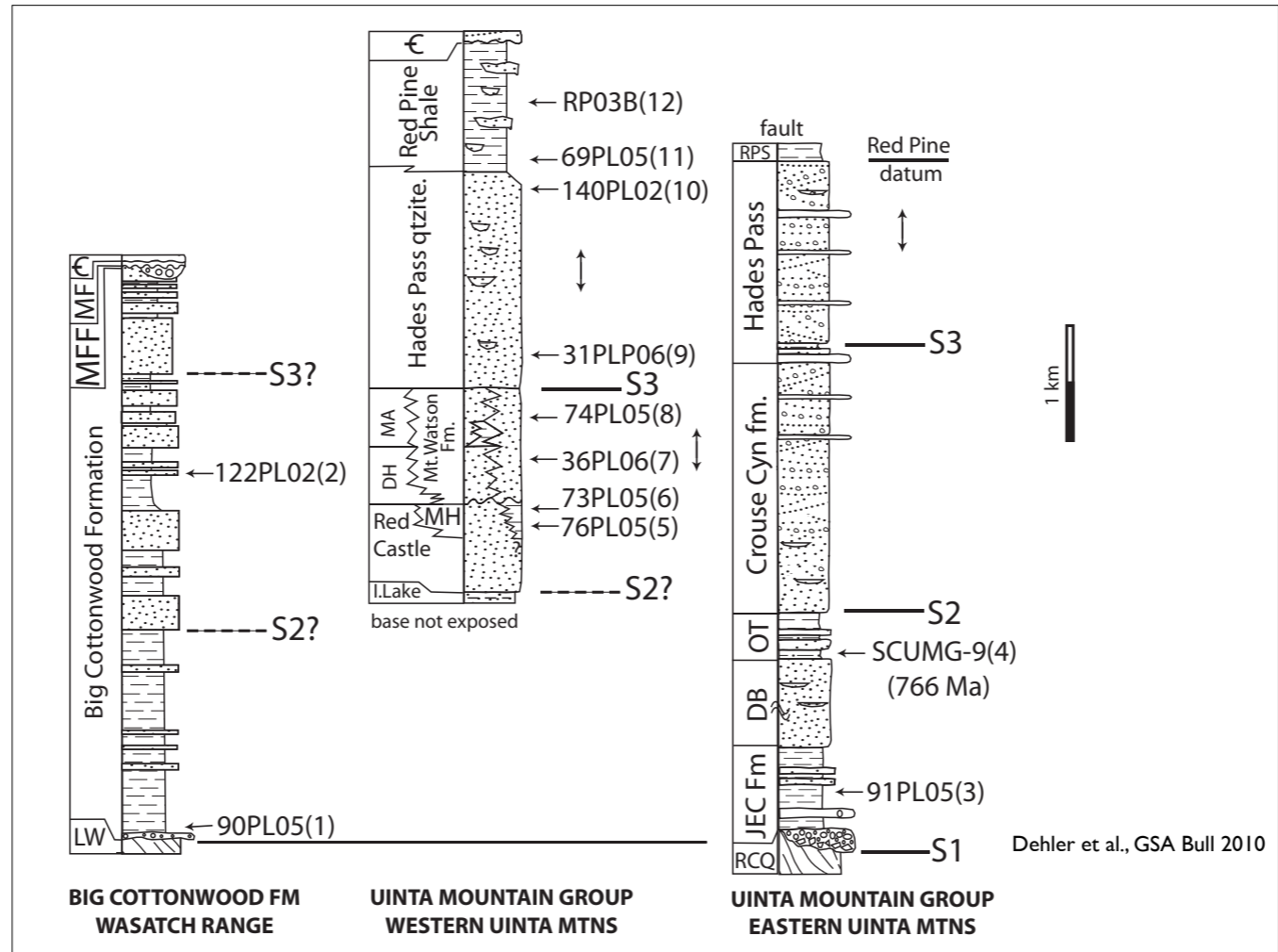


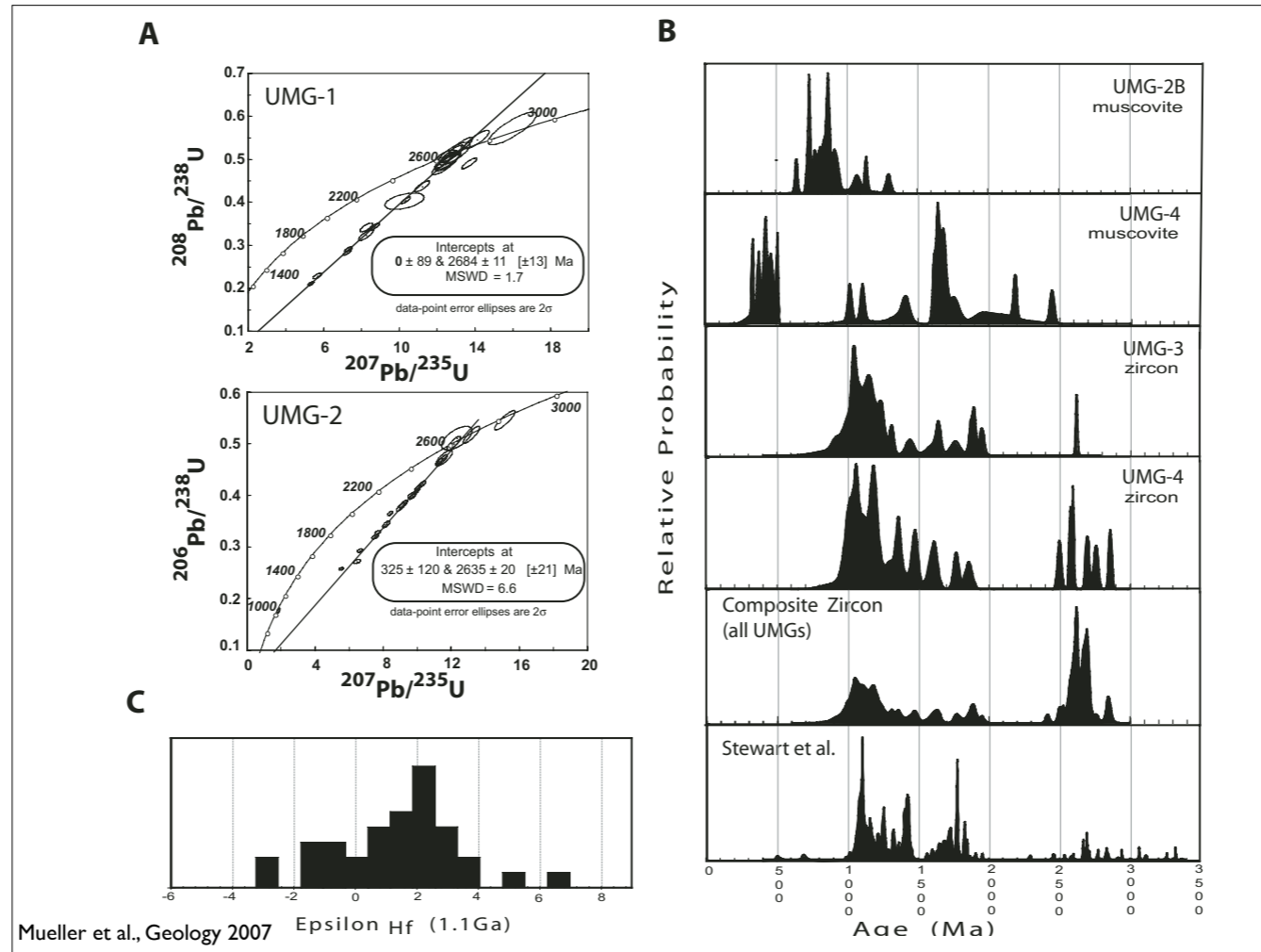
Figure 16. Correlation of lower Mesoproterozoic and Neoproterozoic successions in the southwestern United States, showing three main tectono-stratigraphic packages and unconformities: (1) 1350–1250 Ma intracratonic successions; (2) 1250–1100 Ma syntectonic intracratonic deposition; (3) ca. 900 Ma unconformity bounded sedimentary rocks; and (4) ca. 800–700 Ma synrift deposits (Dehler et al., 2001). Radiometric ages are cited in the text (figure modified after Link et al., 1993).

Timmons et al., 2005



Mueller et al., Geology 2007

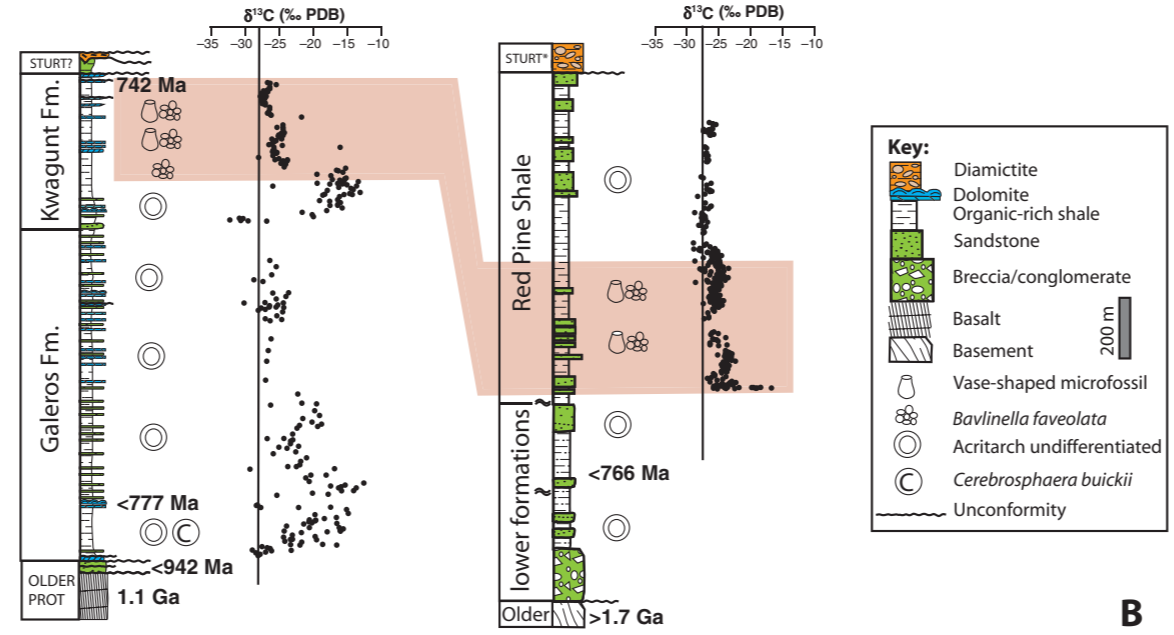




caption in paper is scrambled. Muscovite probabilities are apparently Ar-Ar dates

CHUAR GROUP

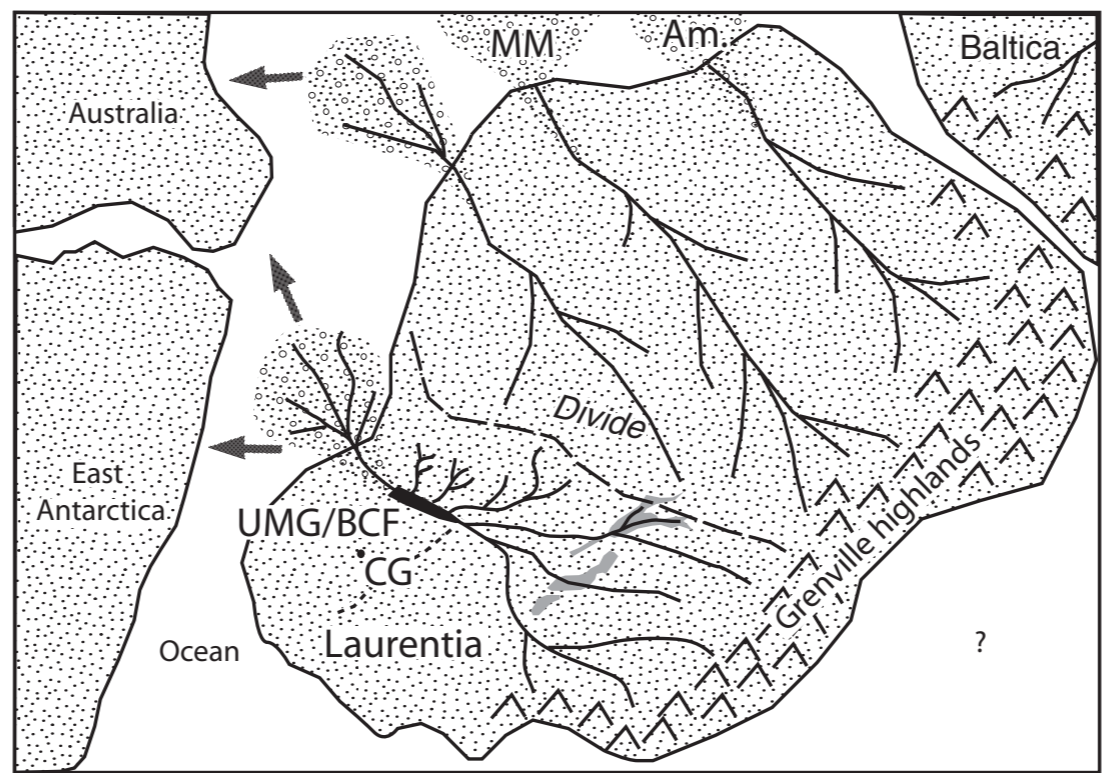
UINTA MOUNTAIN GROUP



B

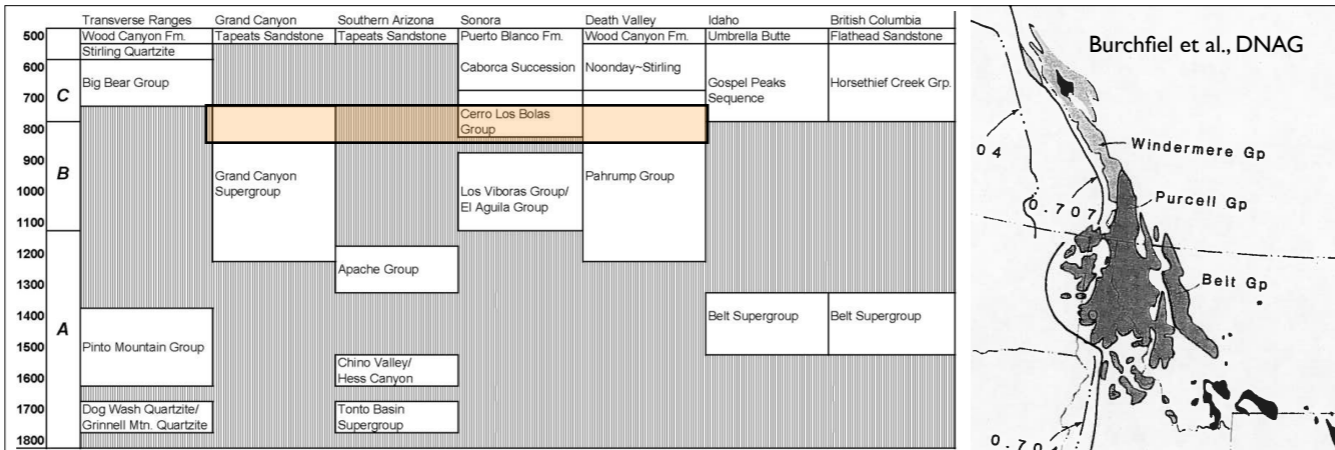
Dehler et al., GSA Bull 2010

c. 750 Ma

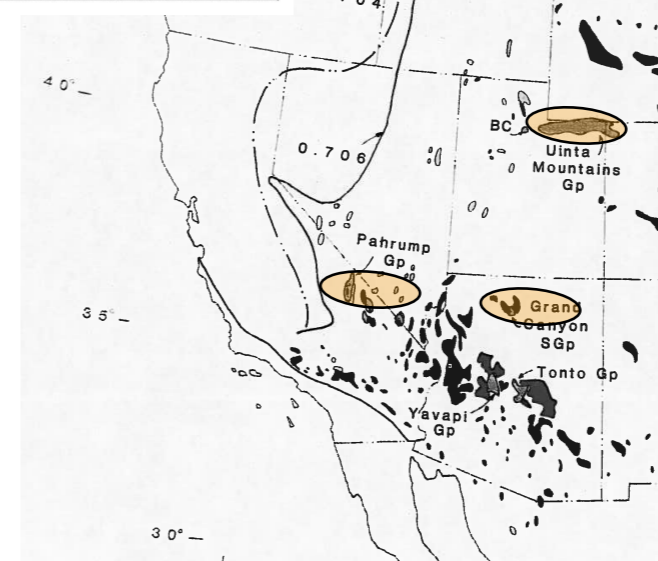


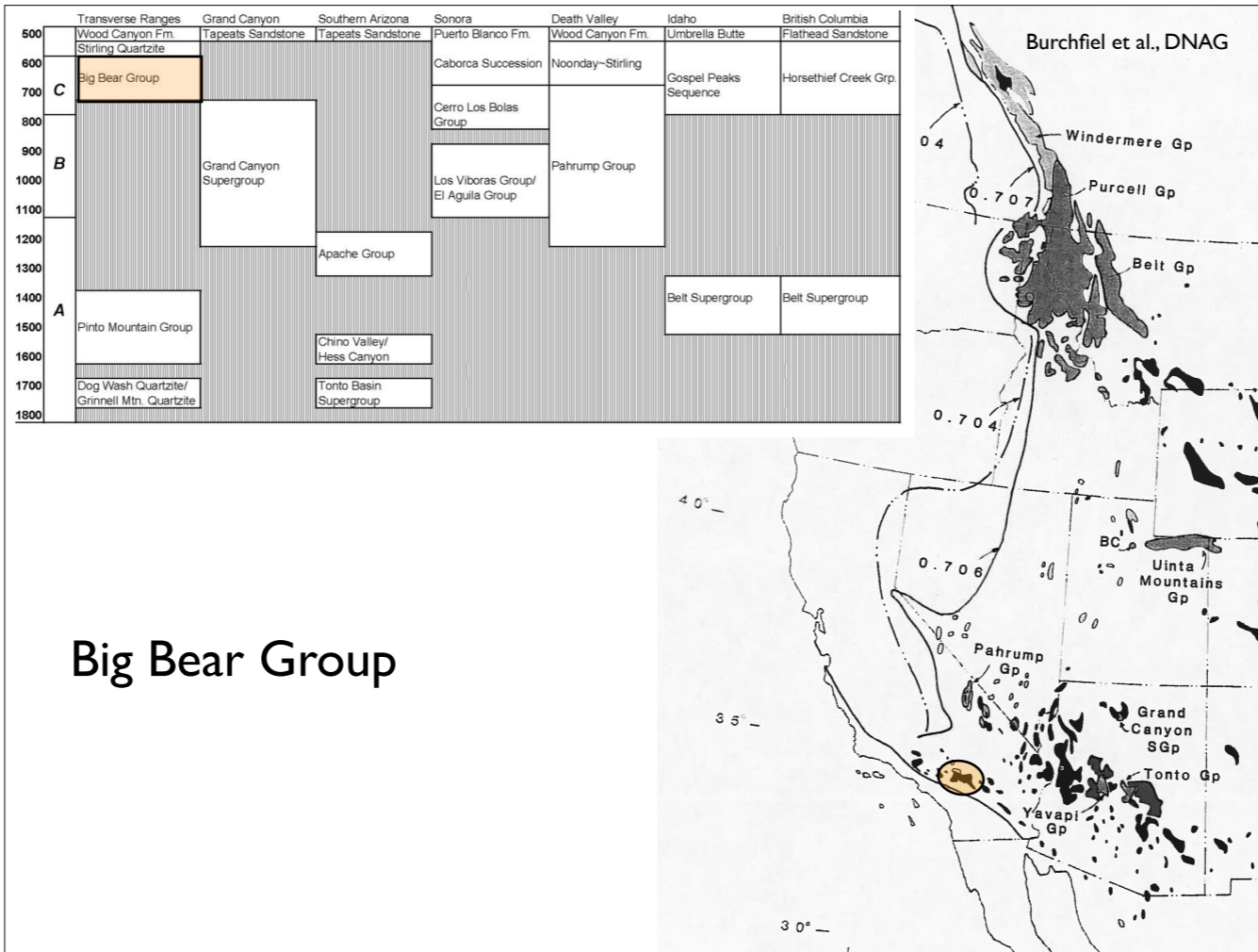
Dehler et al., GSA Bull 2010

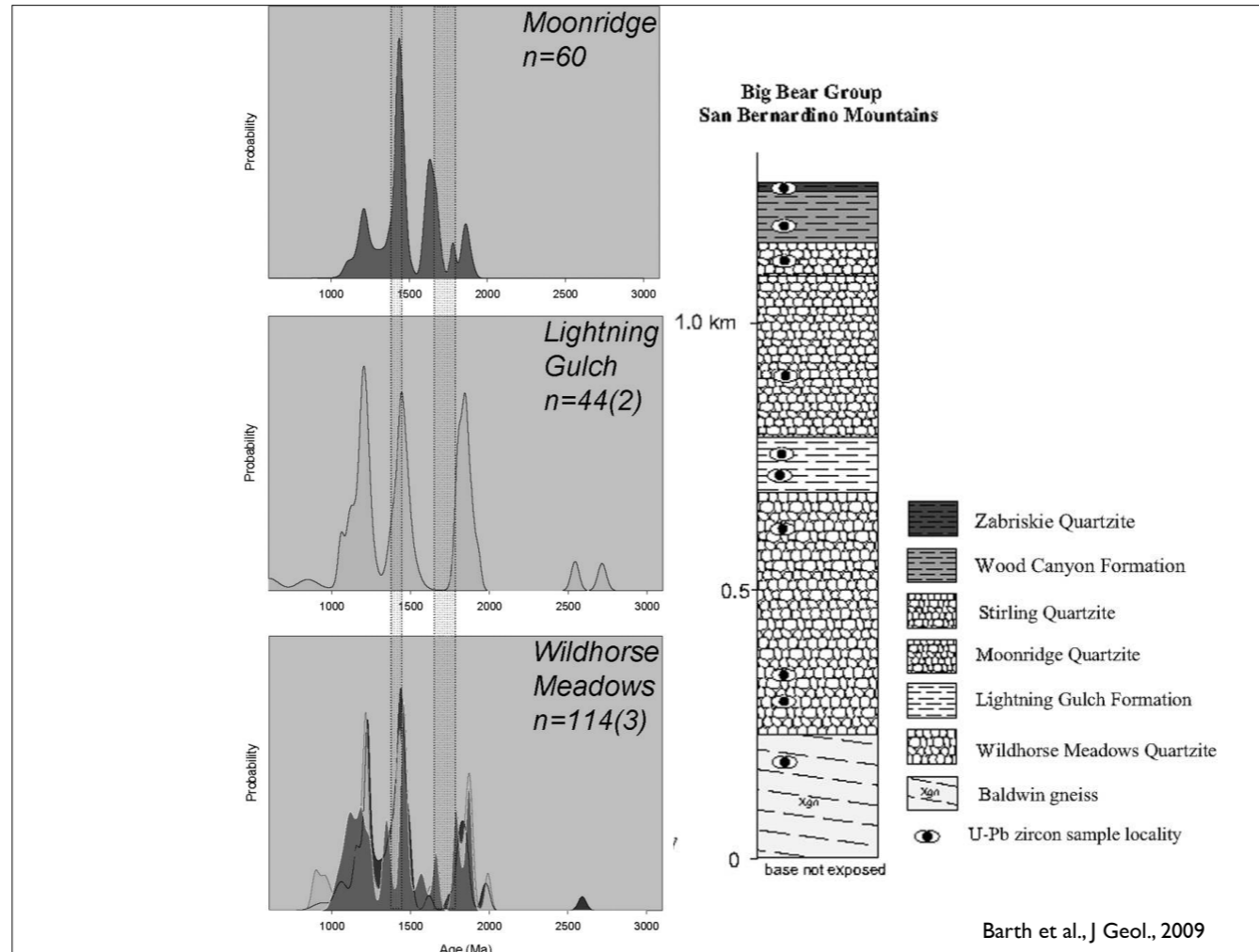
Detrital zircons from Grenville in Aust and Ant need source like this.



Late pC
 Extension everywhere...
 no igneous activity
 but still connected?



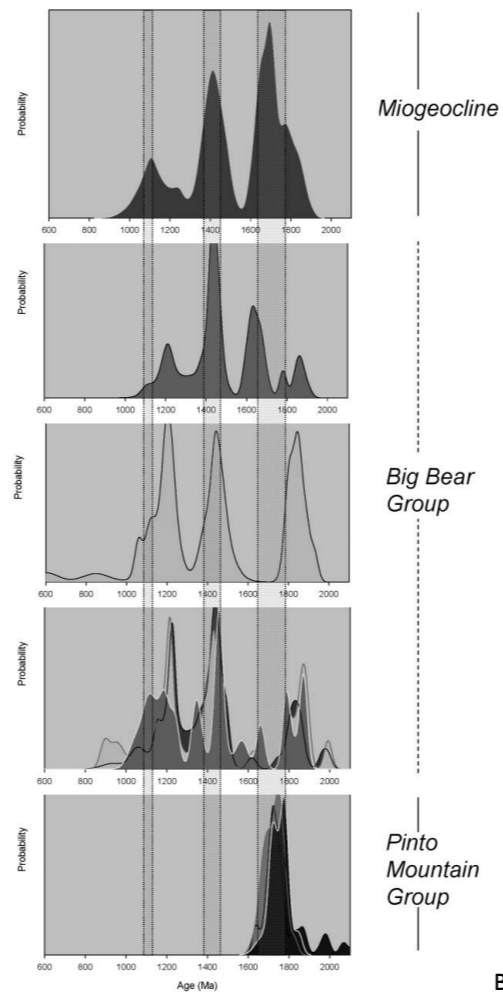




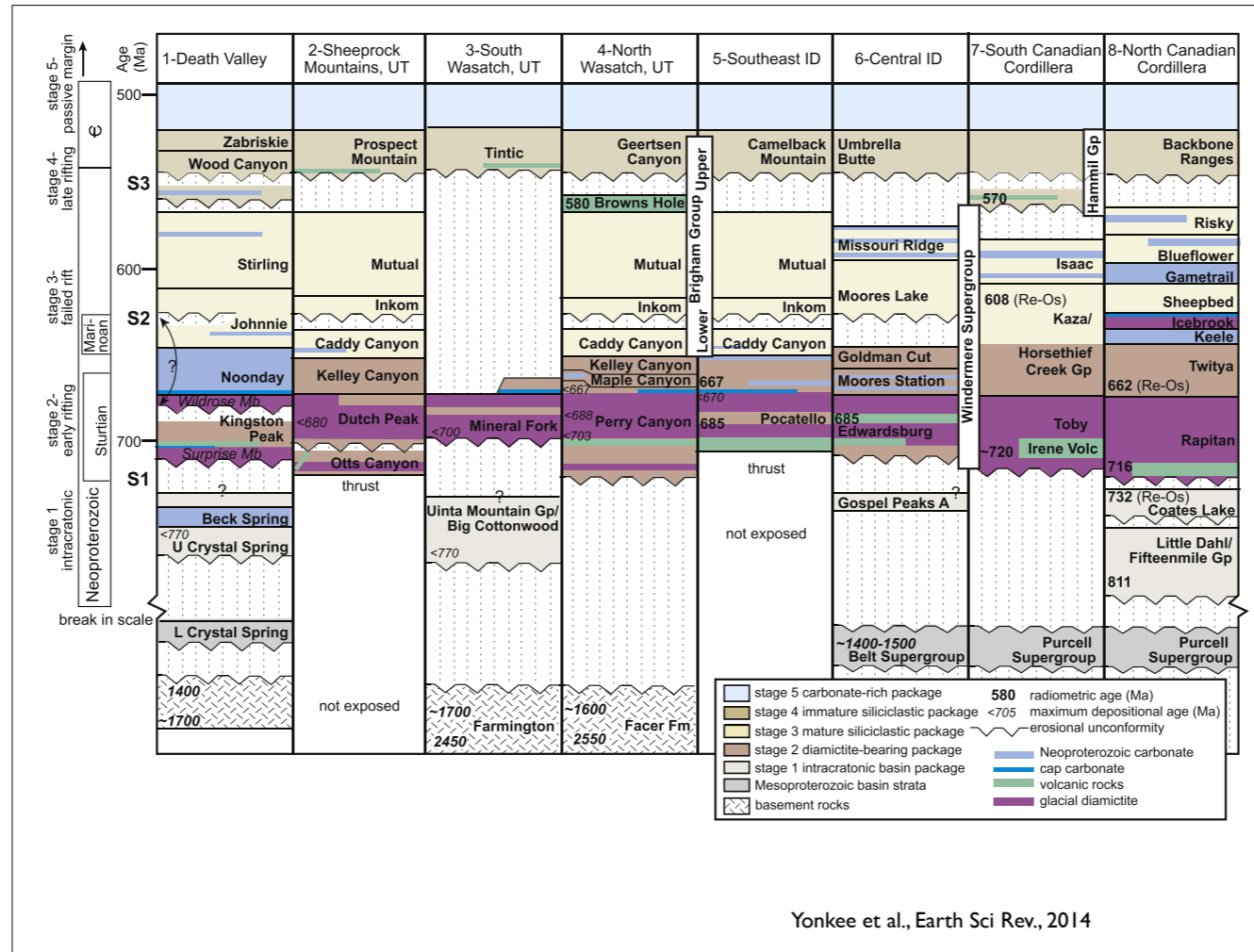
Big Bear group is clearly younger, but zircons don't look NAM and the sedimentary structures suggest a source to SW--is this last record of adjacent material?

Note miogeocline peaks don't match Big Bear Group, which shows transport from southwest...

so something was still attached to North America at this time but maybe rifting off

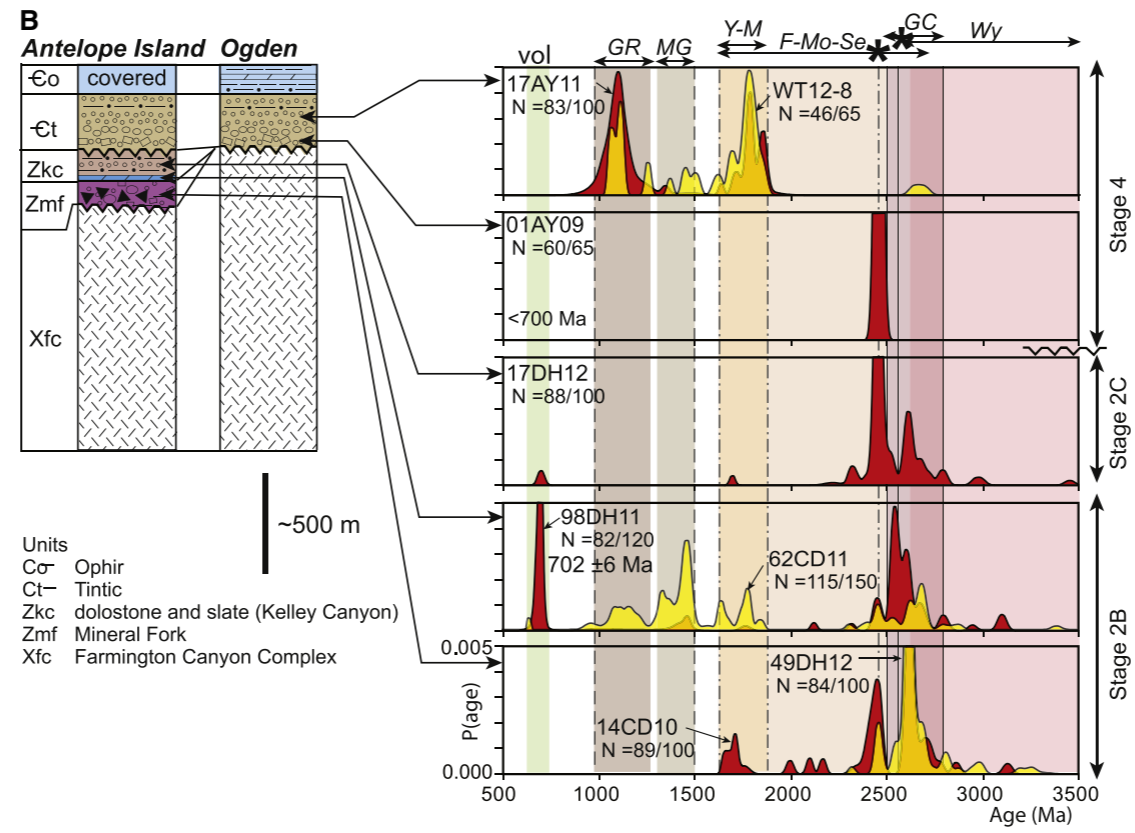


Barth et al., J Geol., 2009

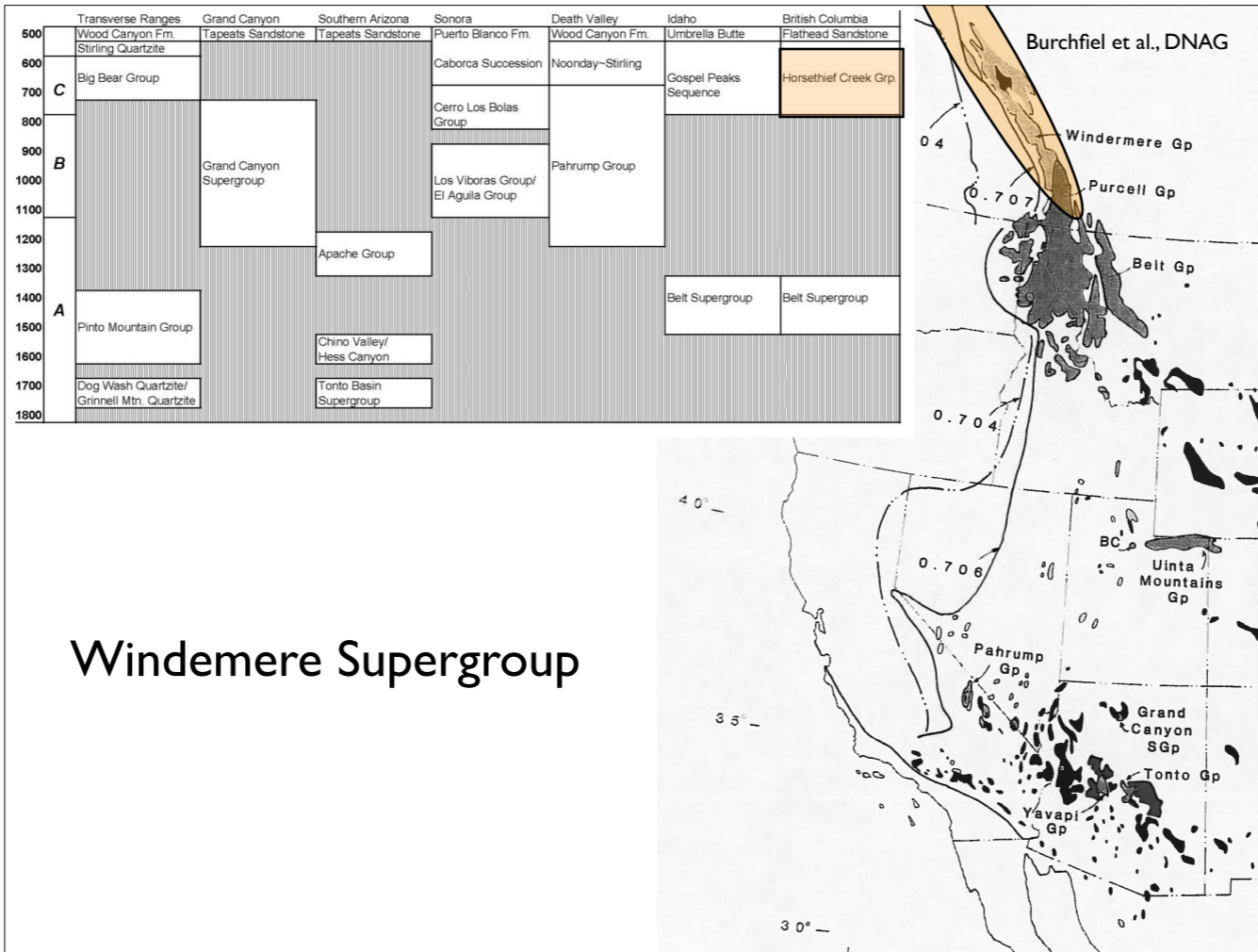


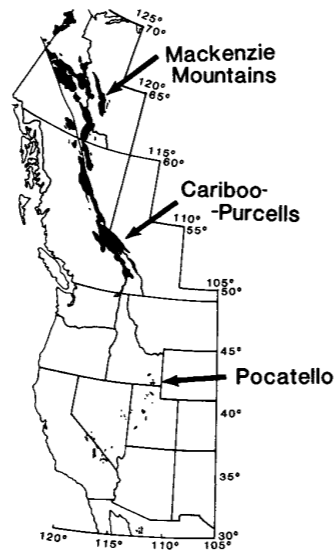
Yonkee et al., Earth Sci Rev., 2014

Late Proterozoic correlations now made with use of detrital zircons and presuming some glacial correlations.

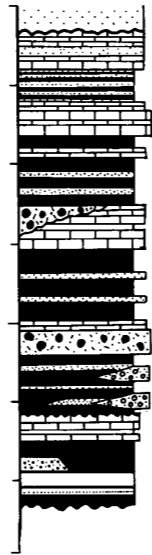


An example of how detrital zircons can be misleading—look at 01AY09

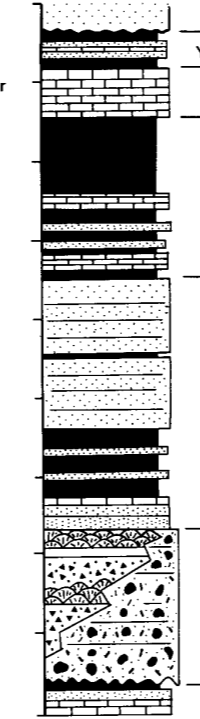




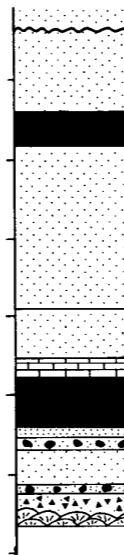
Mackenzie Mountains



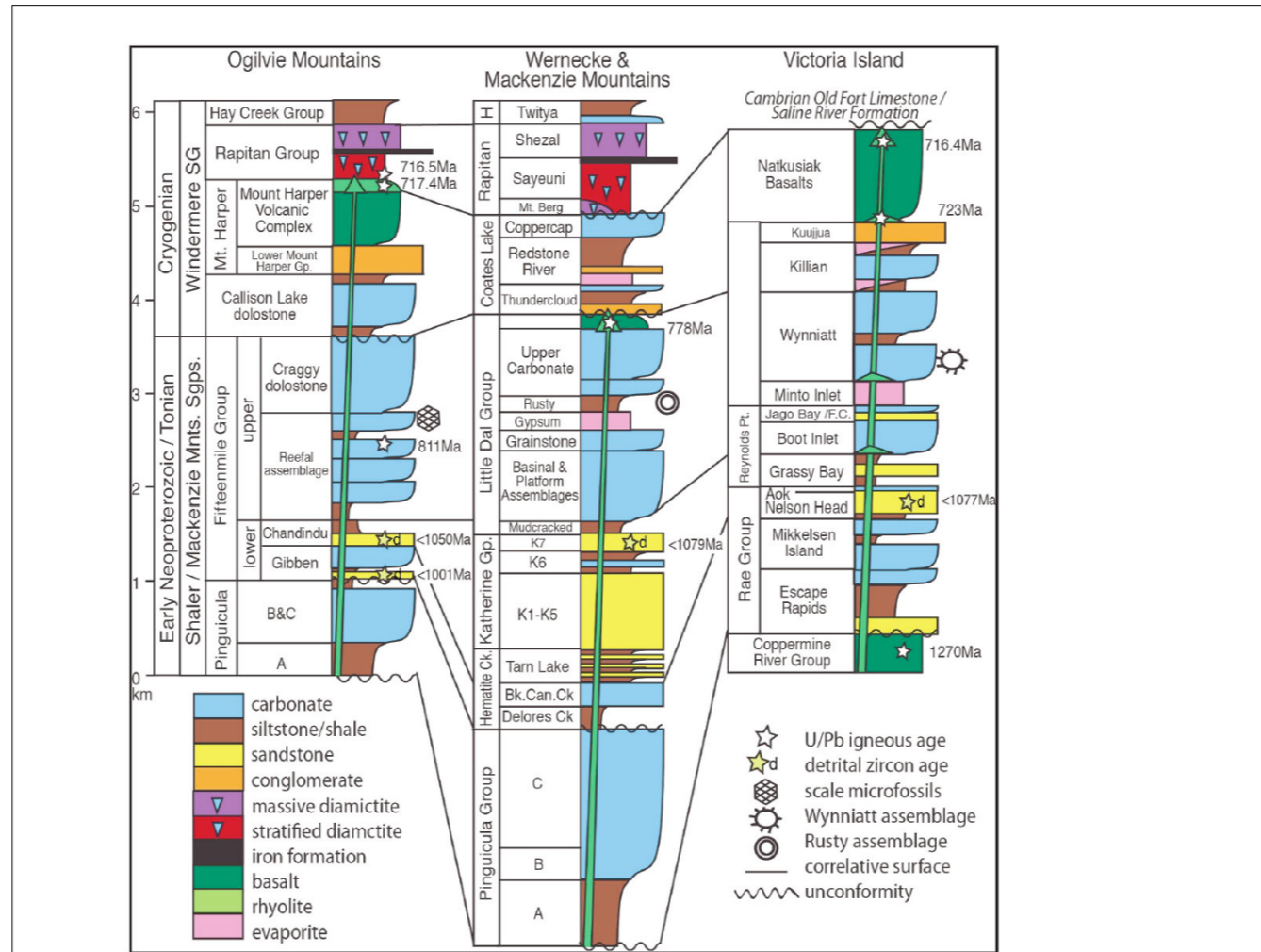
Cariboo-Purcells



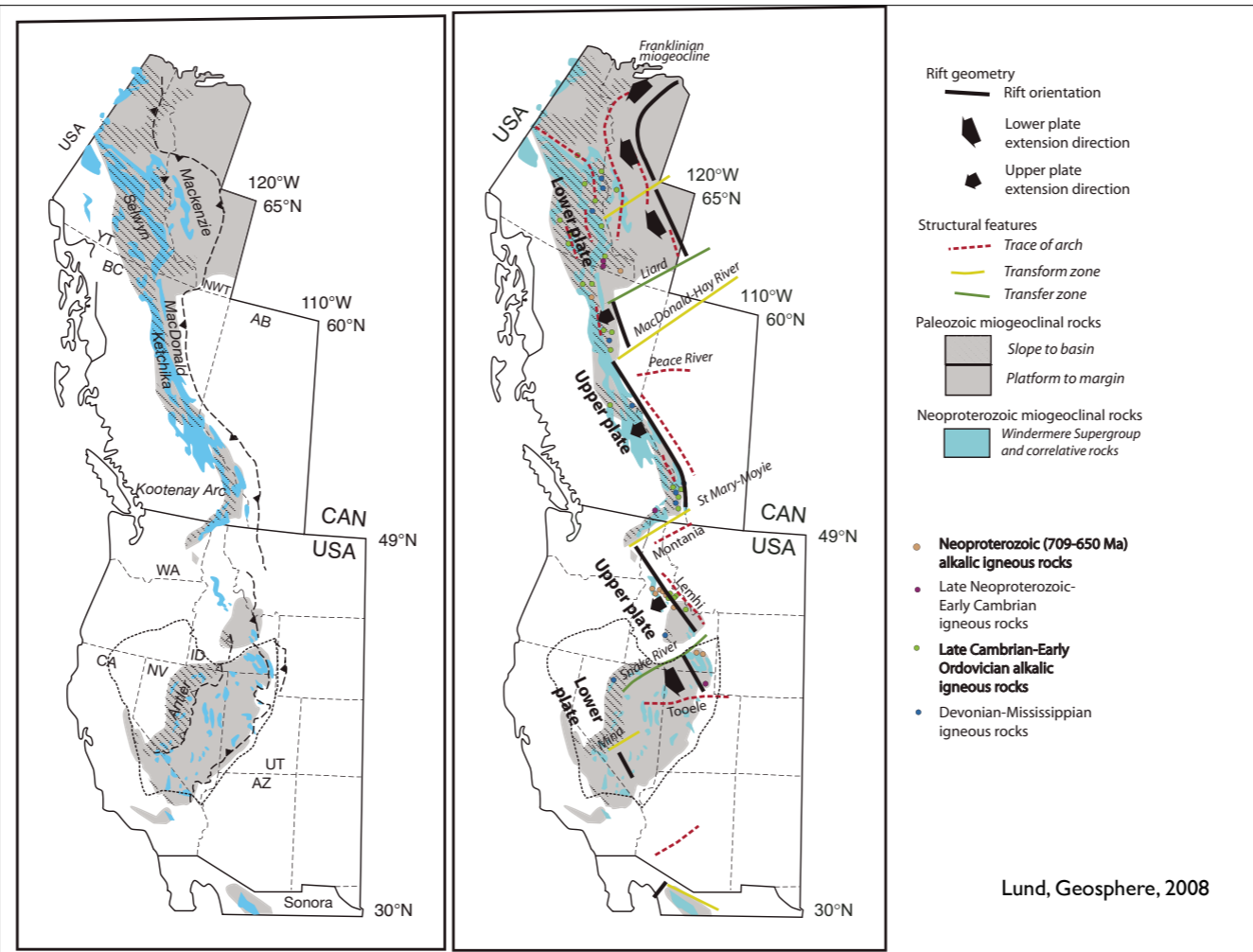
Pocatello

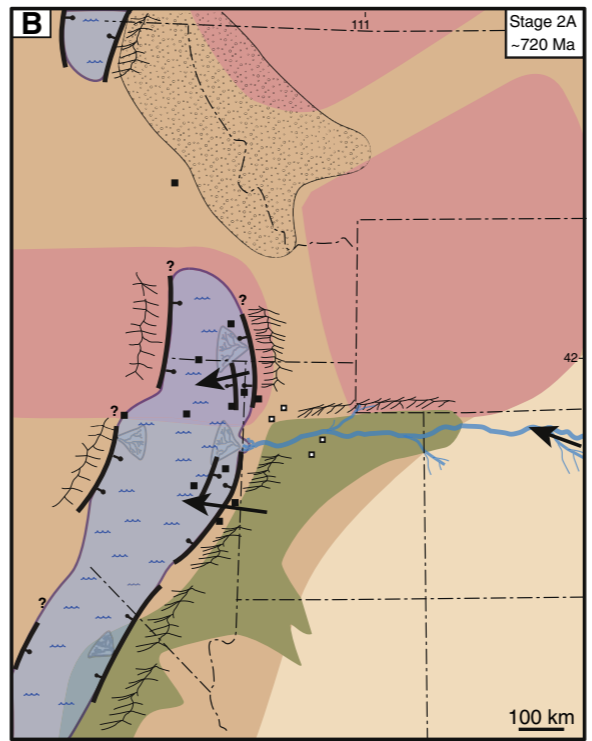
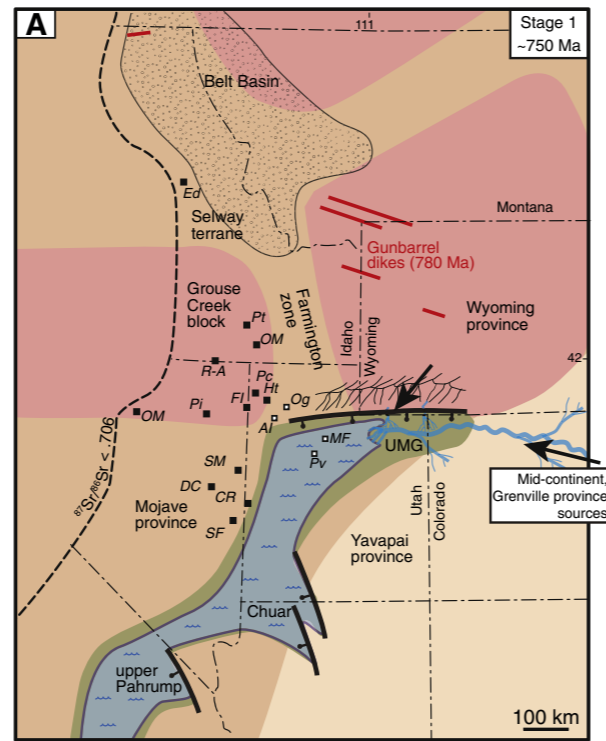











Ross, Geology 1991









Note magmatism in here

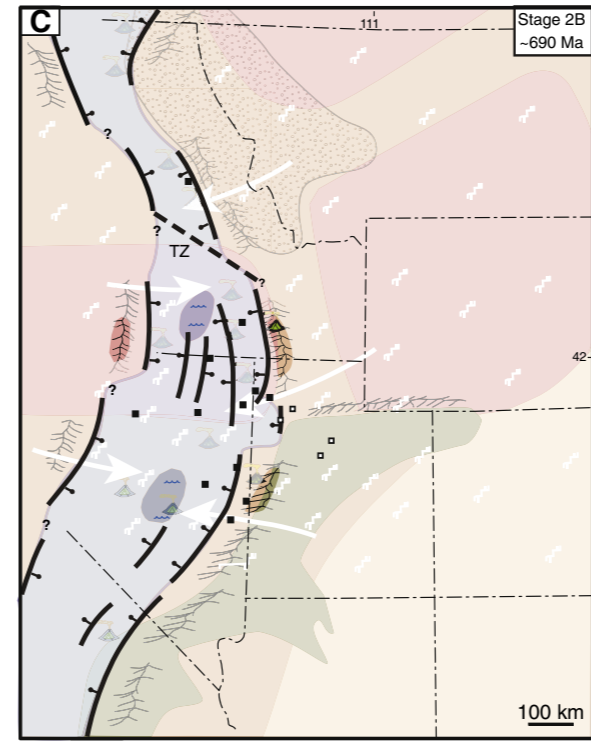
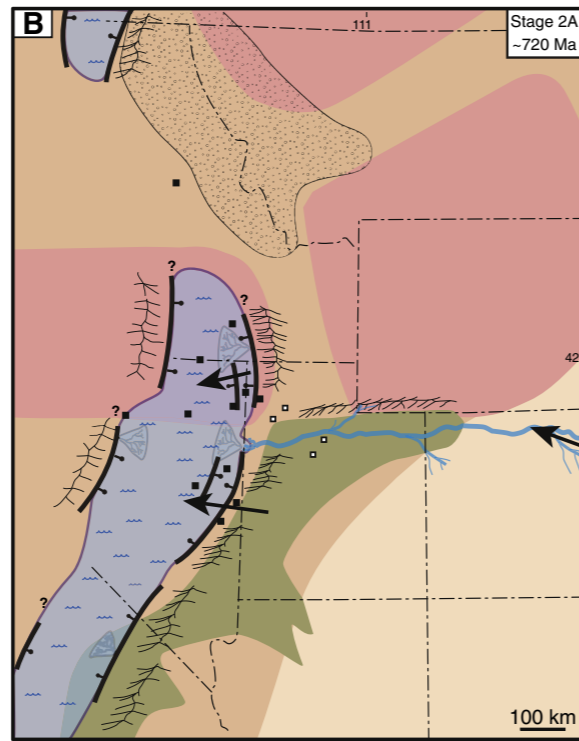



















-  mountains/uplift
-  marine water
-  submarine fan
-  fault
-  volcanic source
-  glacial ice
-  fluvial system
-  paleocurrent
-  sediment source

-  Belt Basin
-  Grenville-Llano basamer
-  Midcontinent granitic basement
-  Paleoproterozoic juvenile basement
-  Paleoproterozoic mixed basement
-  Archean basement

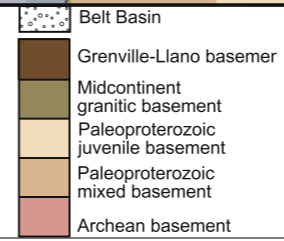
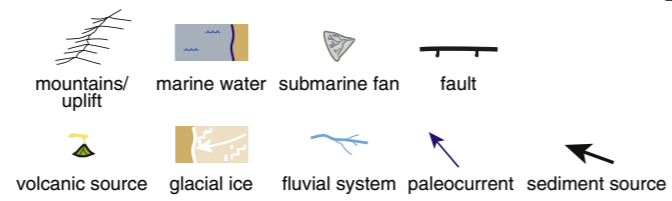
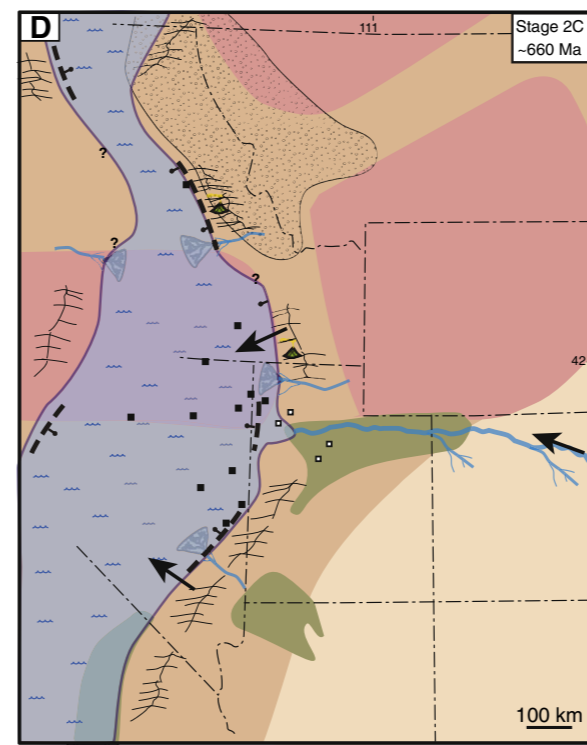
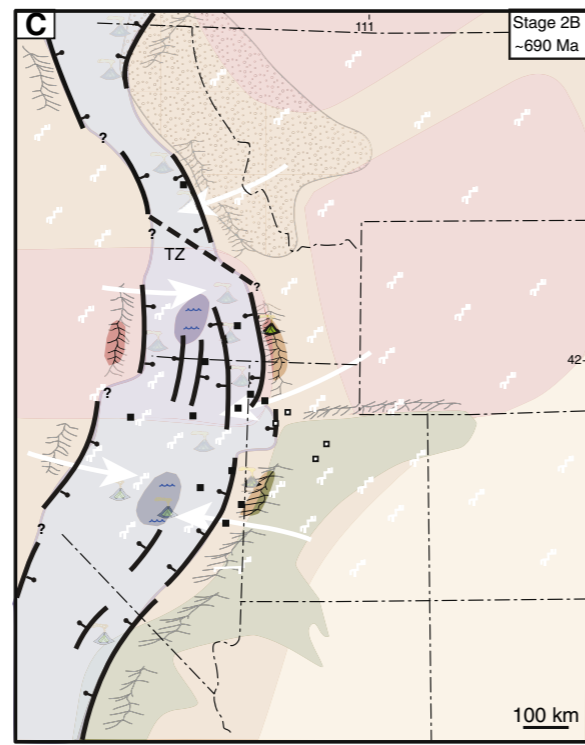
Yonkee et al., Earth Sci Rev, 2014



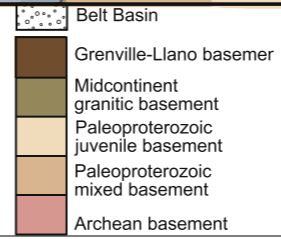
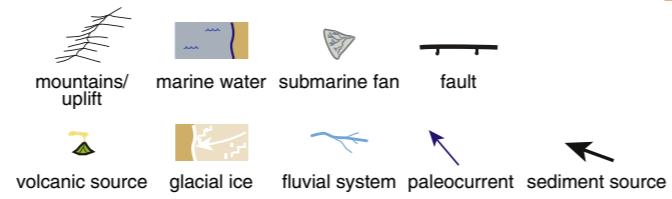
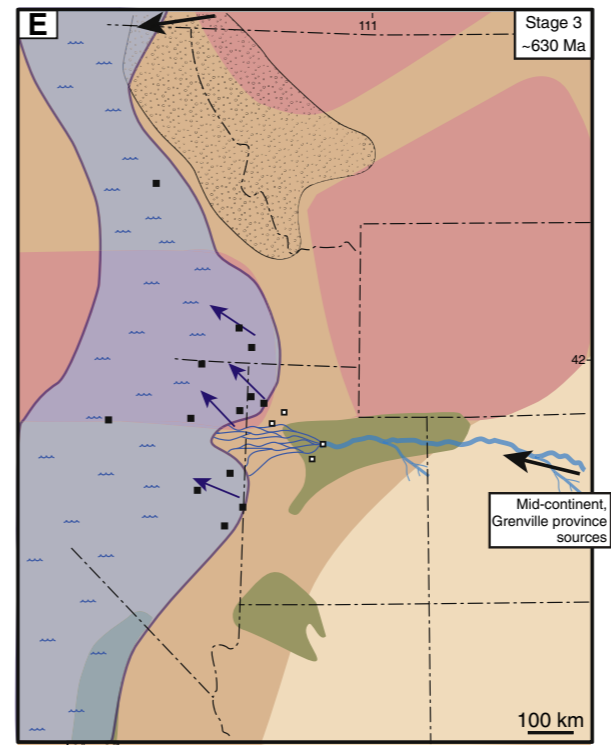
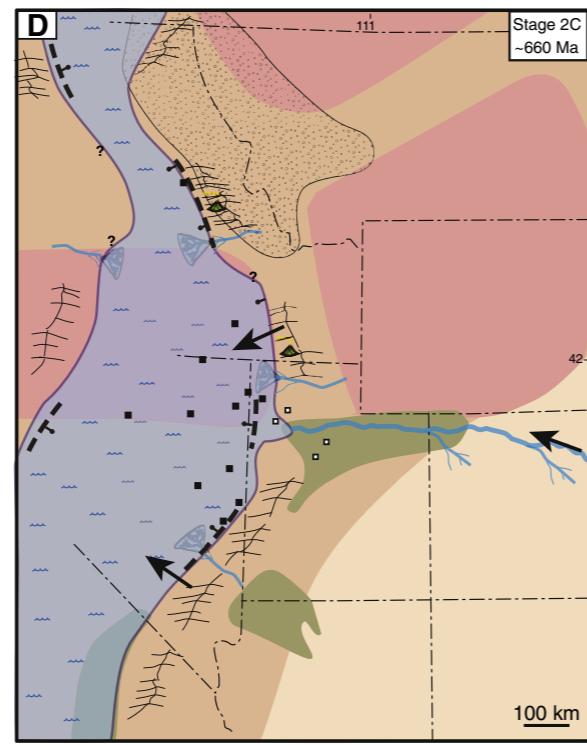
-  mountains/uplift
-  marine water
-  submarine fan
-  fault
-  volcanic source
-  glacial ice
-  fluvial system
-  paleocurrent
-  sediment source

-  Belt Basin
-  Grenville-Llano basamer
-  Midcontinent granitic basement
-  Paleoproterozoic juvenile basement
-  Paleoproterozoic mixed basement
-  Archean basement

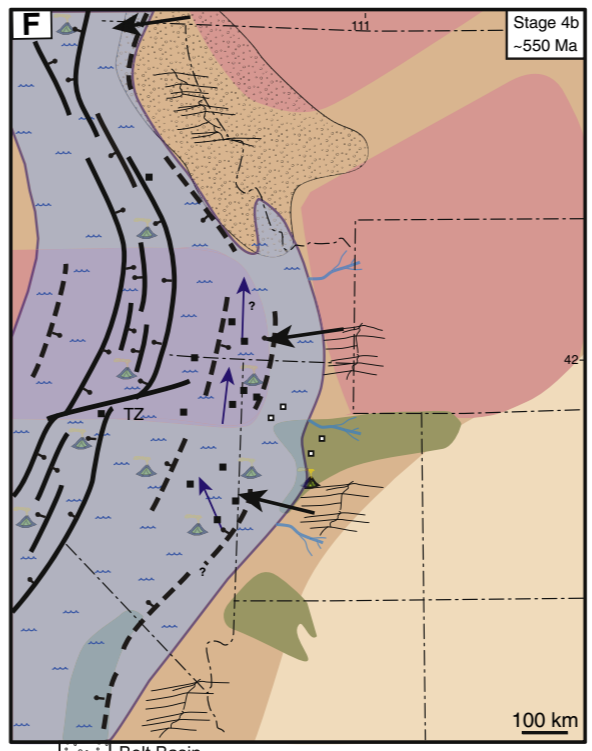
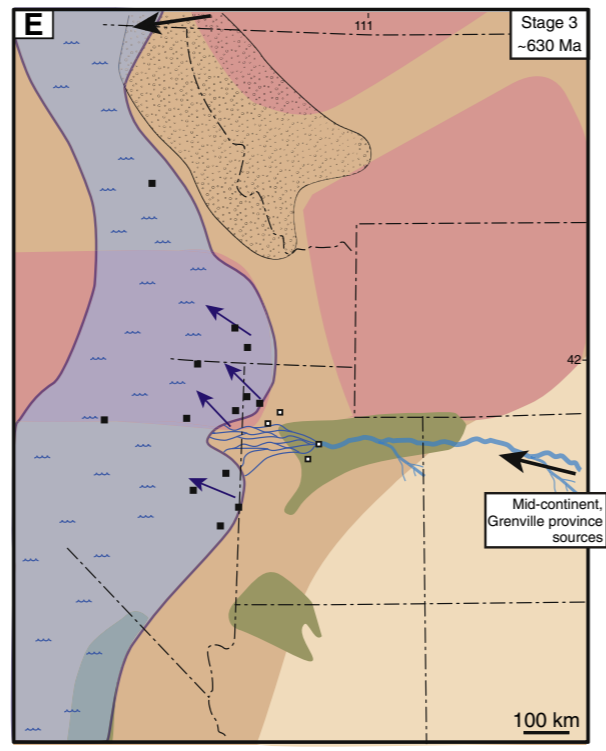
Yonkee et al., Earth Sci Rev, 2014

















Yonkee et al., Earth Sci Rev, 2014



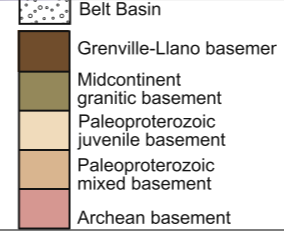
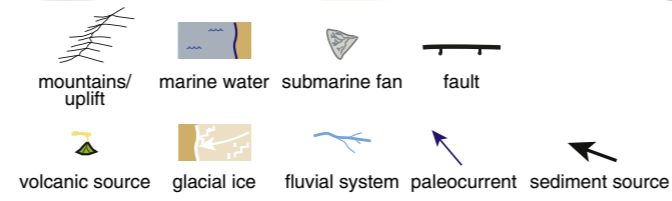
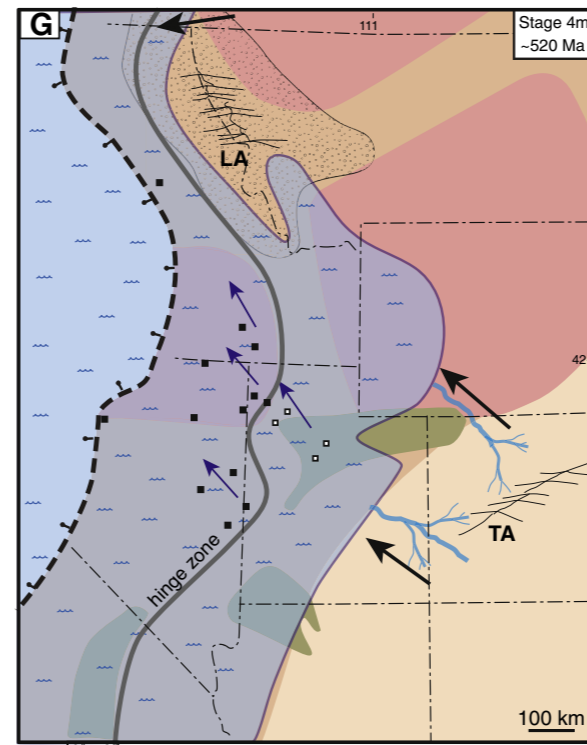
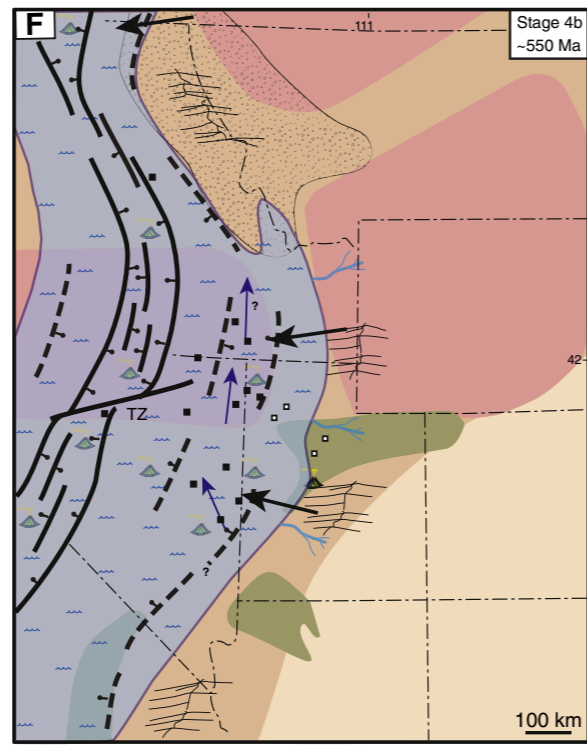
Yonkee et al., Earth Sci Rev, 2014



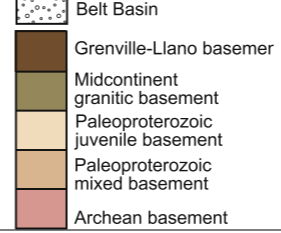
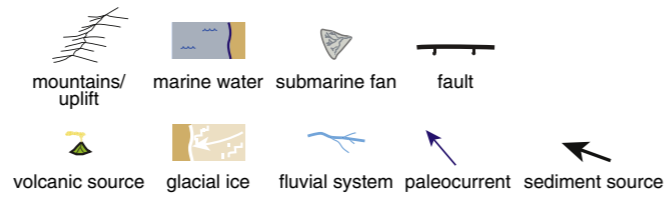
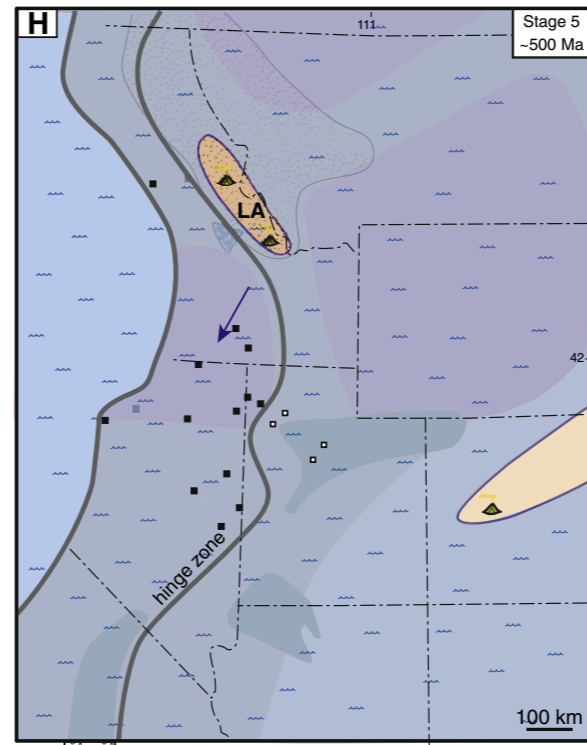
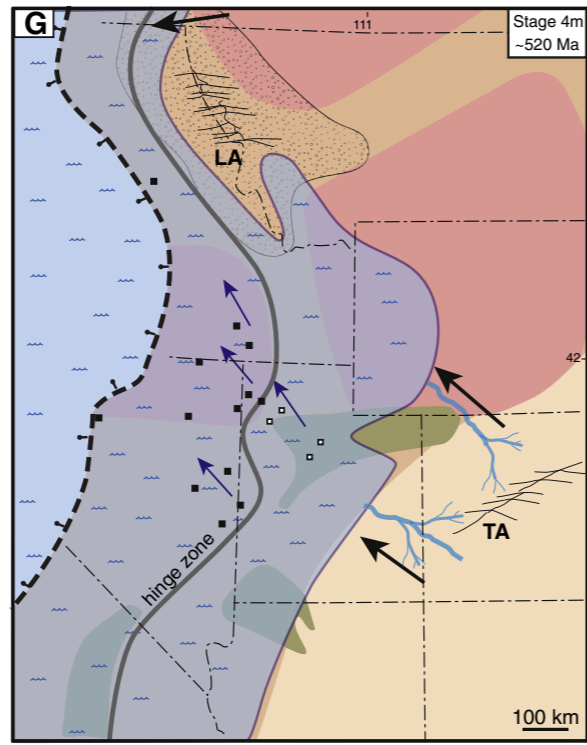
-  mountains/uplift
-  marine water
-  submarine fan
-  fault
-  volcanic source
-  glacial ice
-  fluvial system
-  paleocurrent
-  sediment source

-  Belt Basin
-  Grenville-Llano basamer
-  Midcontinent granitic basement
-  Paleoproterozoic juvenile basement
-  Paleoproterozoic mixed basement
-  Archean basement

Yonkee et al., Earth Sci Rev, 2014



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