Post-Grenvillian tectonomagmatic evolution of the southwestern Laurentian front

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Methods

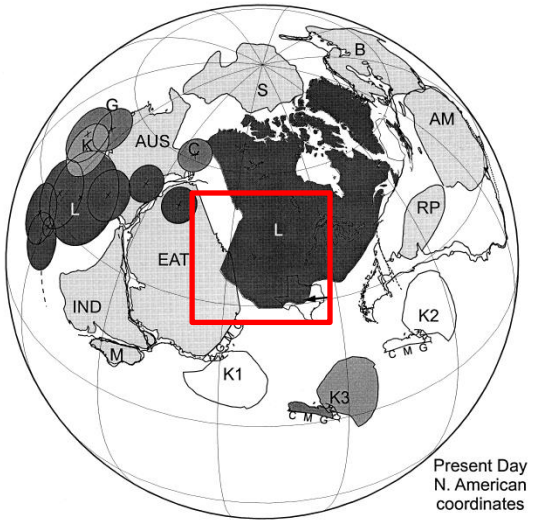
Zircon U-Pb dating of West Texas granites and associated Basalt dikes.

Zircon Hf isotopes composition

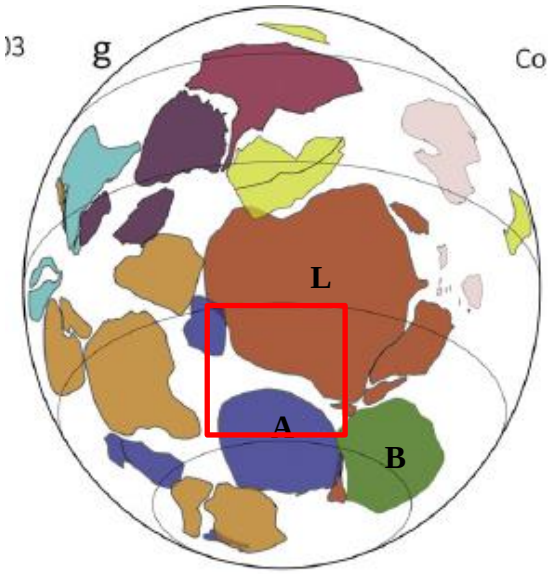
Whole-rock geochemistry

Integrating geochronological and geochemical data with spatially and temporally related magmatic rocks.

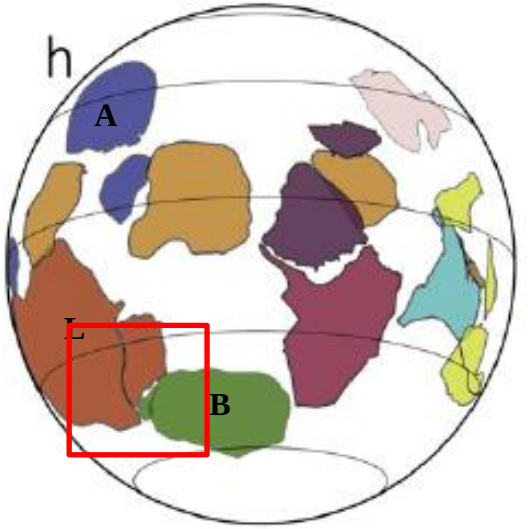
Orientation of Laurentia with respect to western and southern continents at ~1.1 Ga



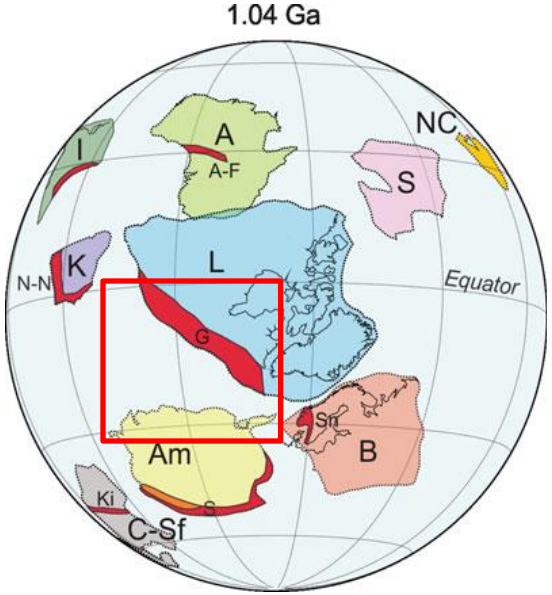
Dalziel et al., 2000



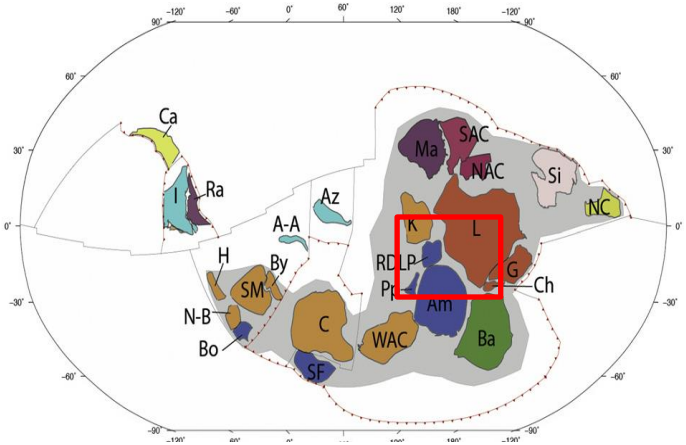
Li et al., 2008



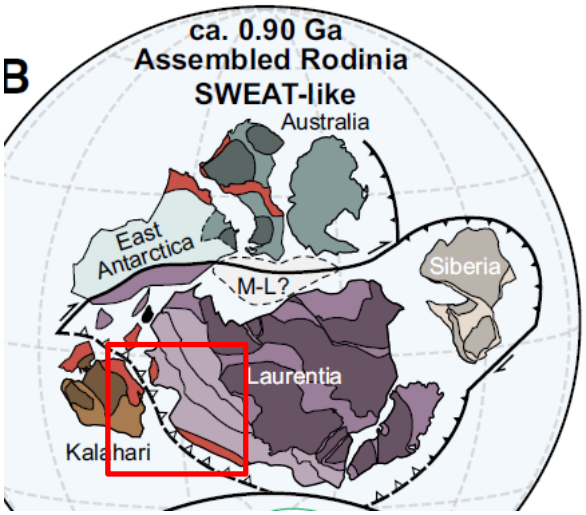
Evan, 2009



Mertanen and Pesonen, 2012

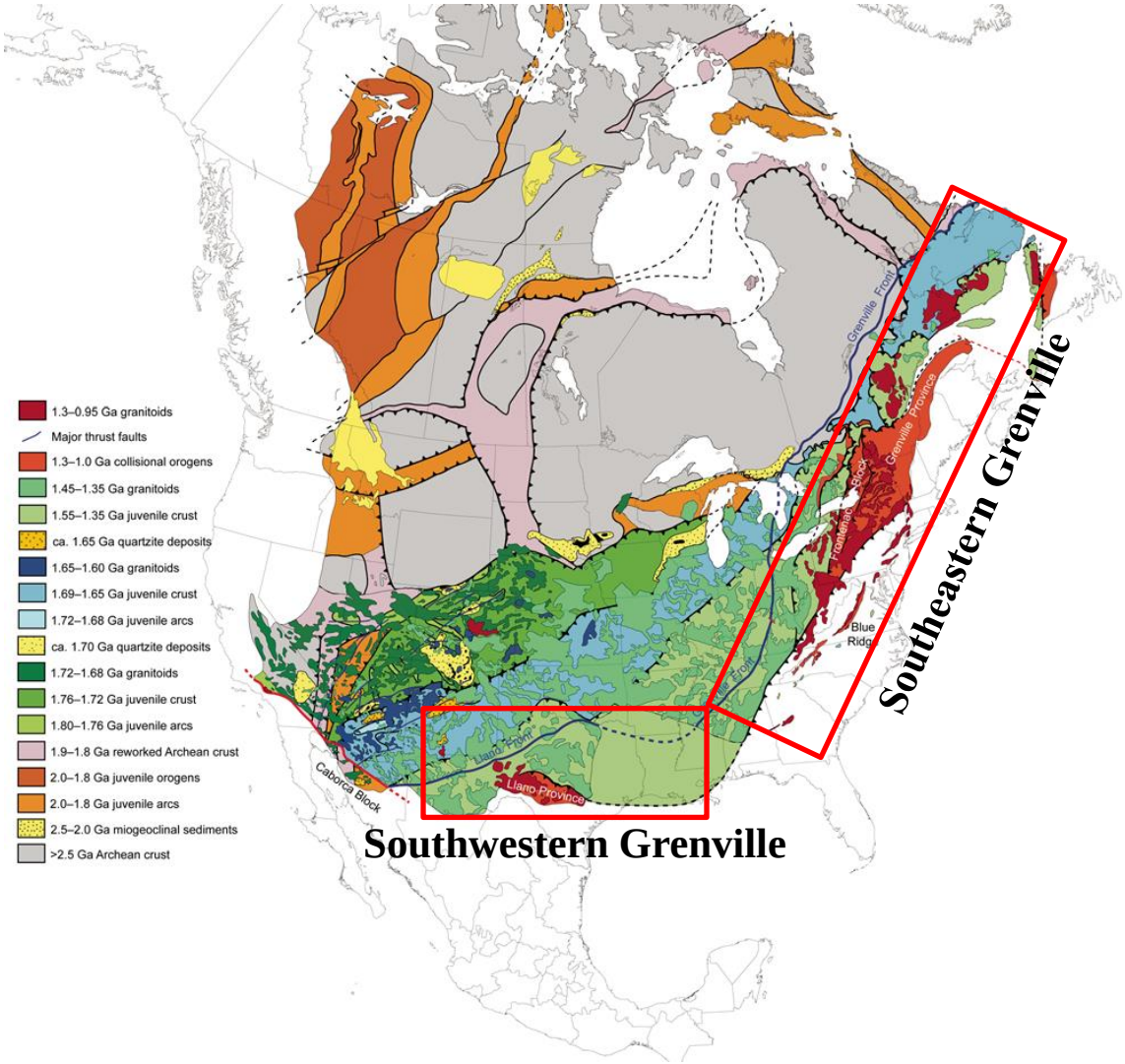


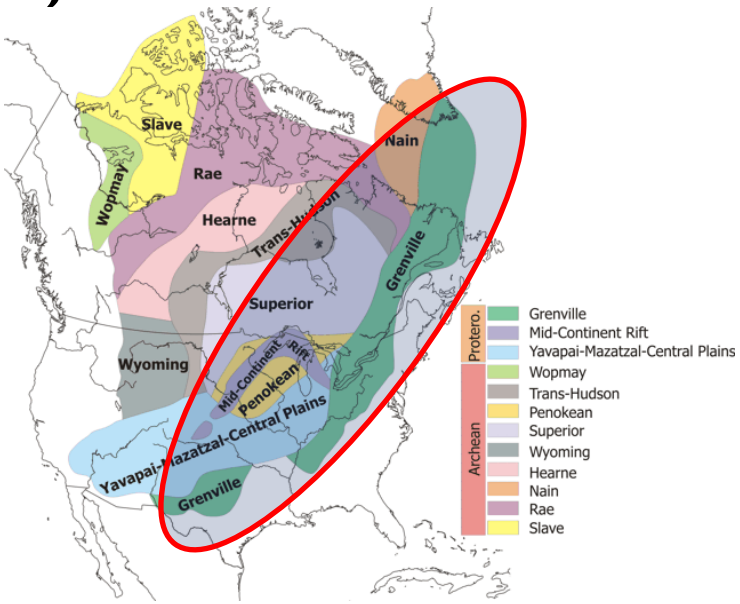
Merdit et al., 2017



Mulder et al., 2018

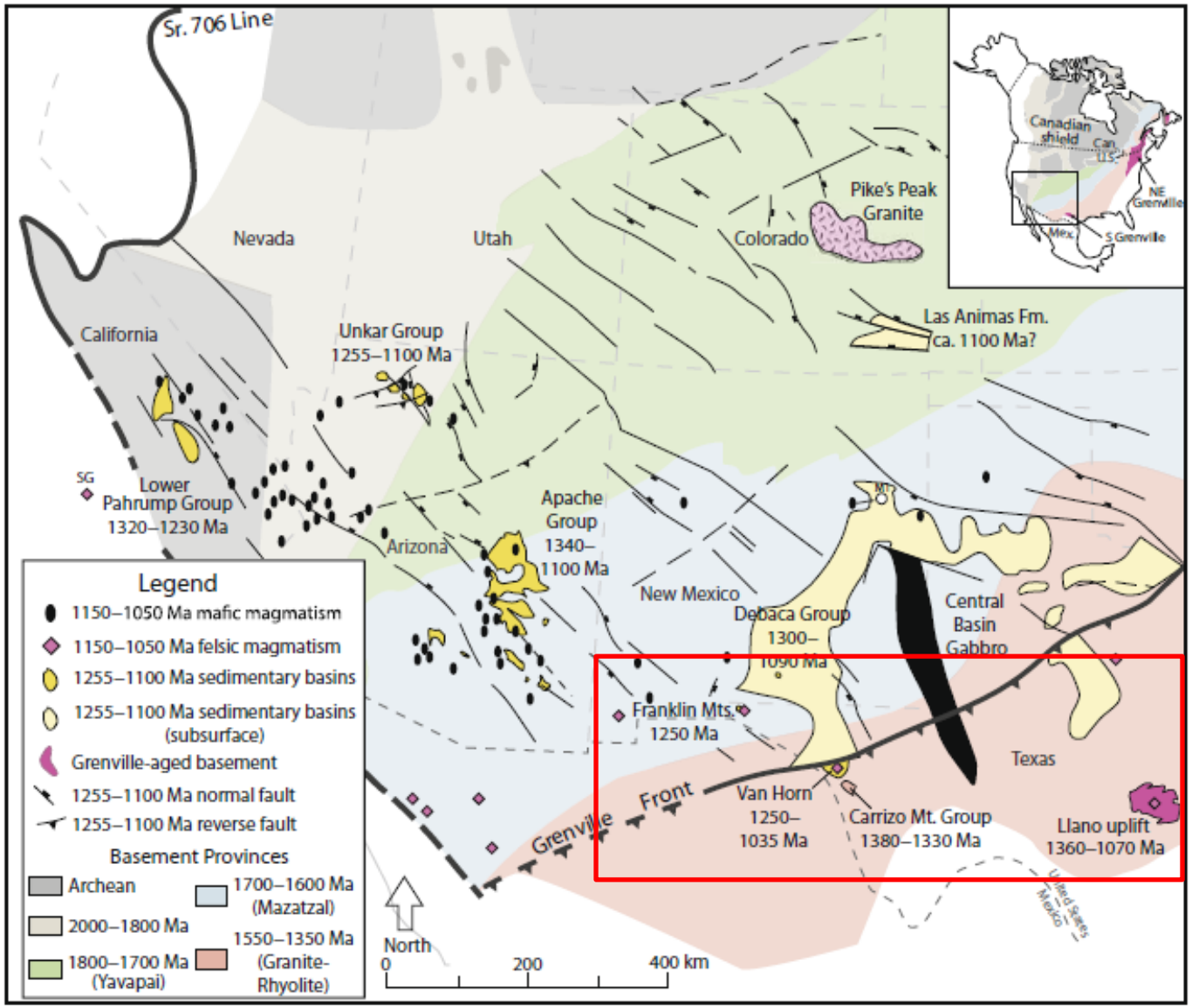
Southwestern and South eastern Laurentia and Grenvillian orogeny (1.3-1.1Ga)





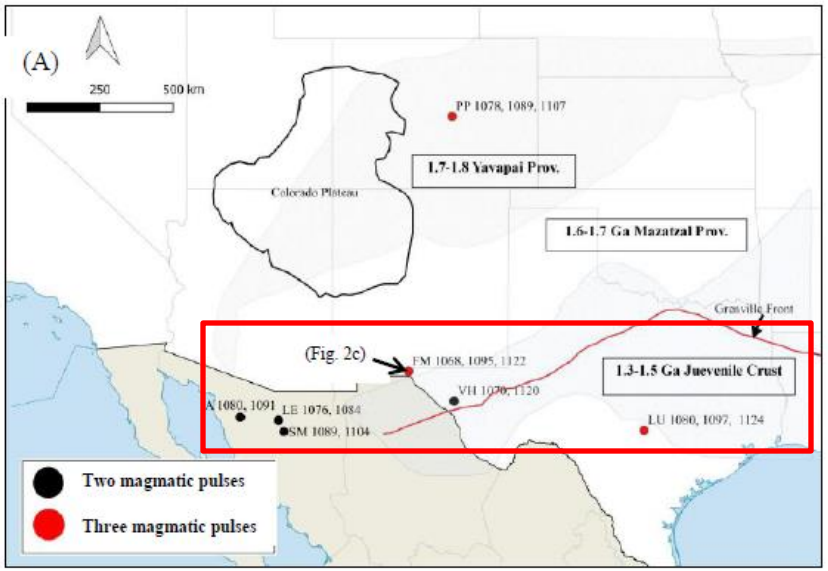
Whitmer and Karlstrom, 2007

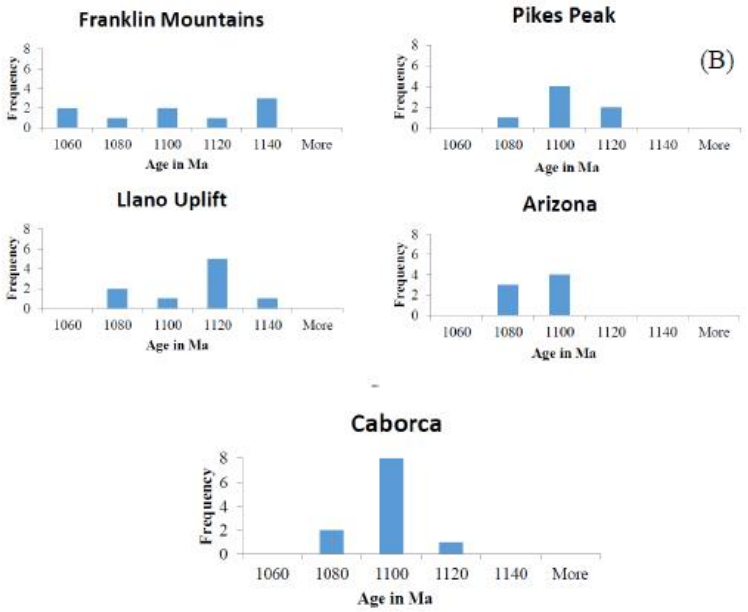
Lithotectonic units and Pre Neoproterozoic Geology of Southwestern Laurentia

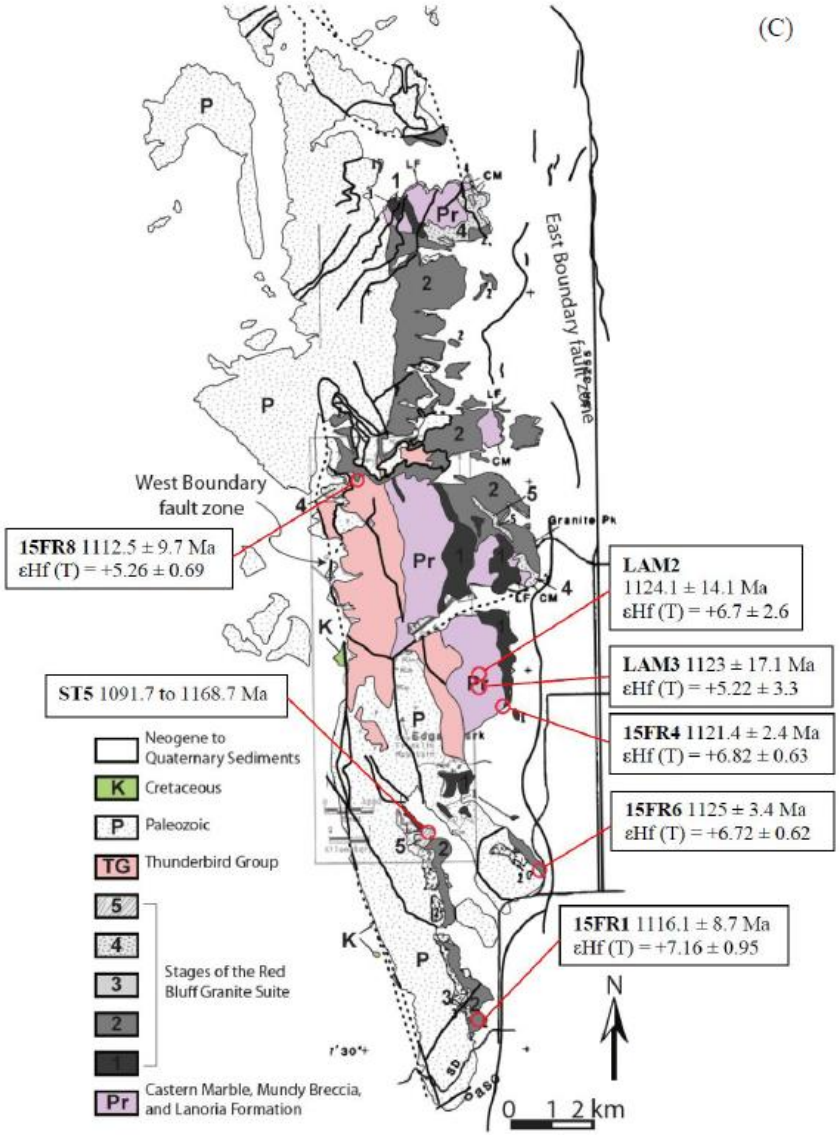


Mulder et al., 2017

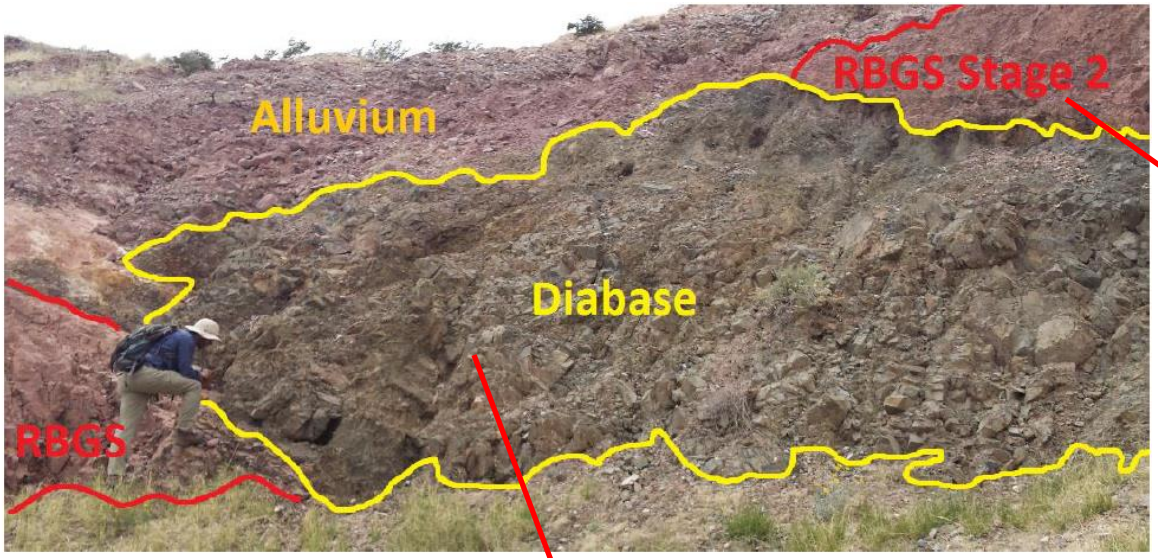
1.1 Ga magmatism in southwestern Laurentia and Franklin Mountain

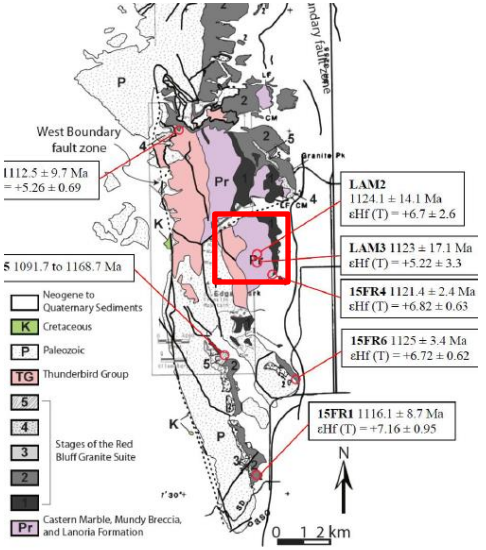




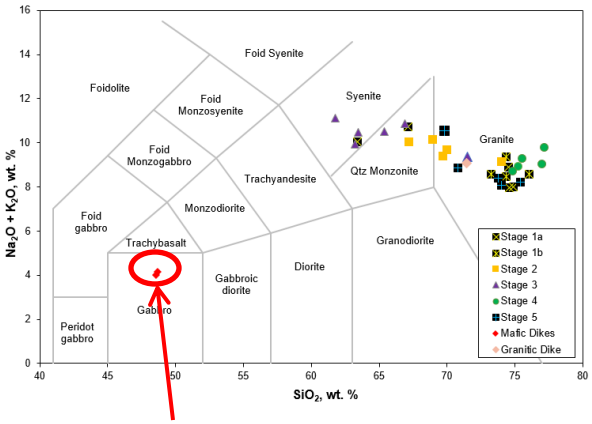


Red Bluff granite and diabase dikes

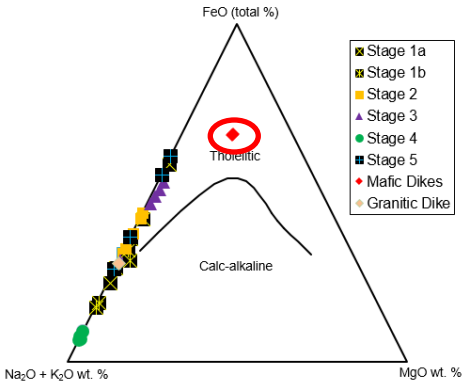


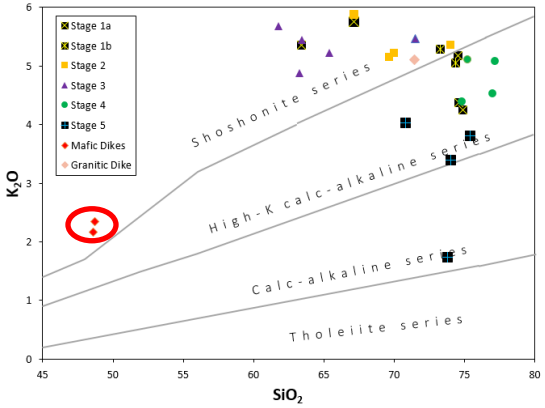


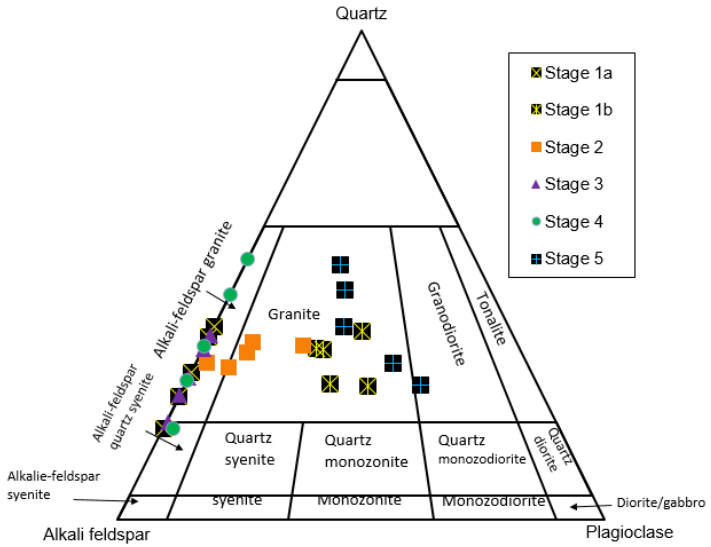
Geochemistry Red Bluff granite and mafic dikes

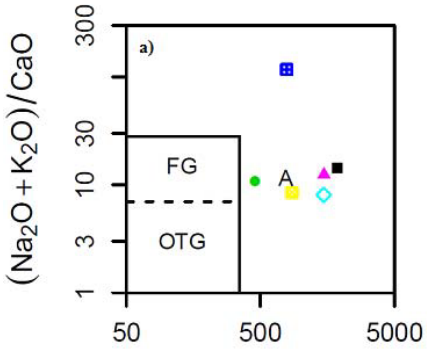


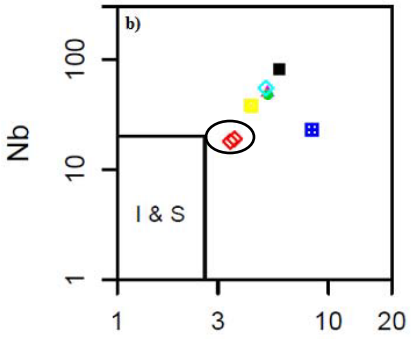
Diabase dikes

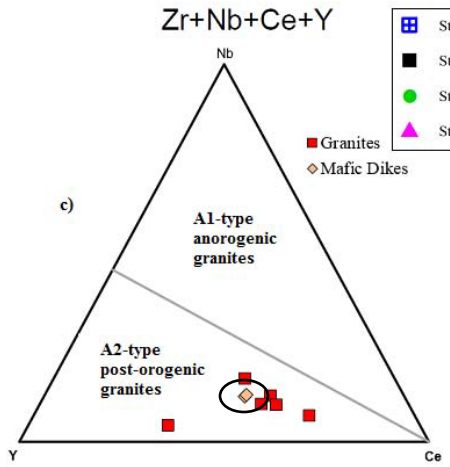


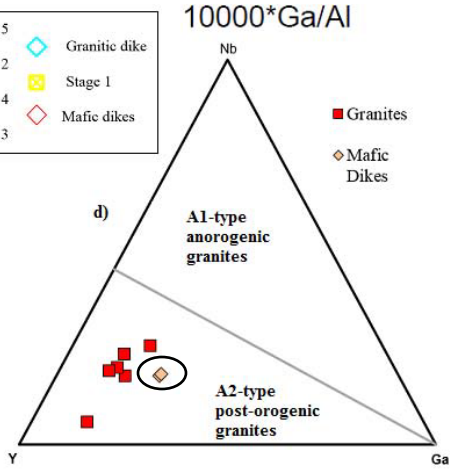




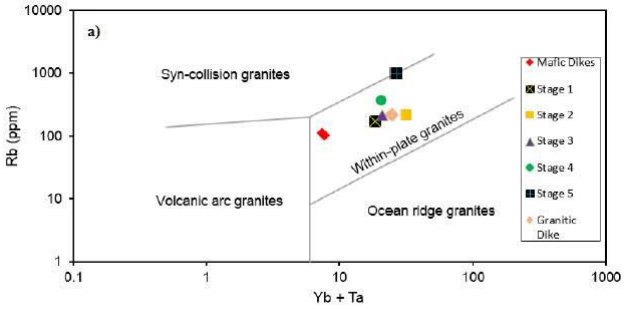


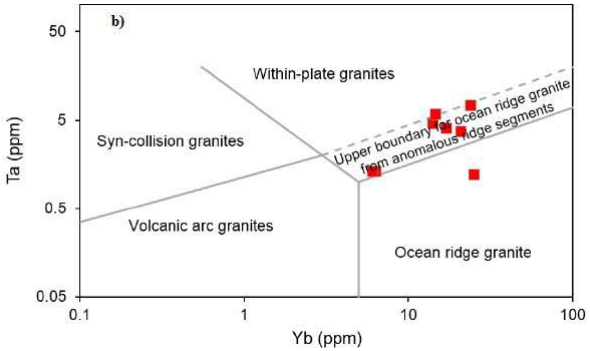


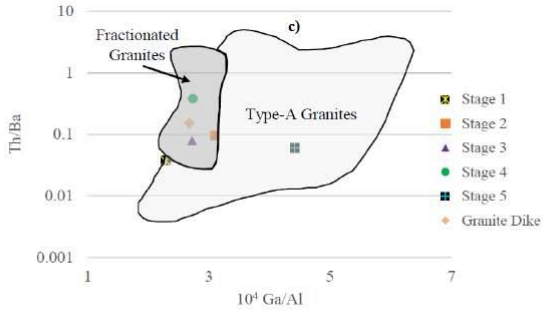


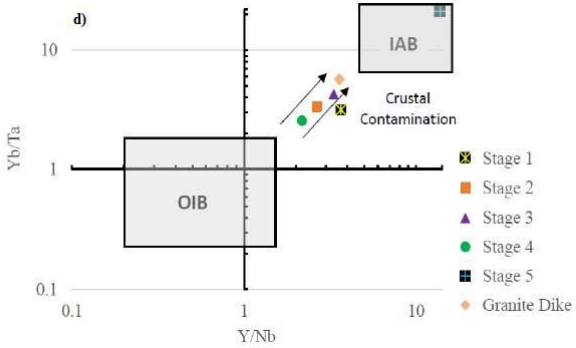


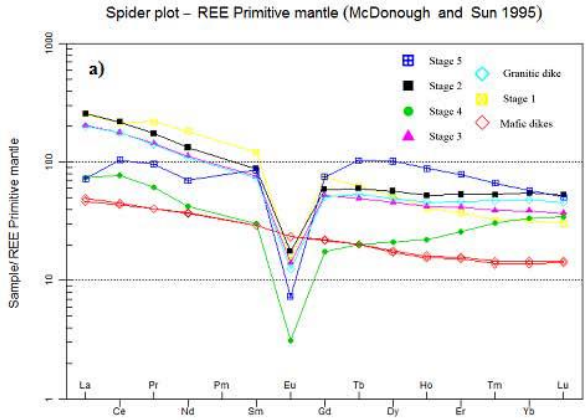
Geochemistry of Red Bluff granite and mafic dikes

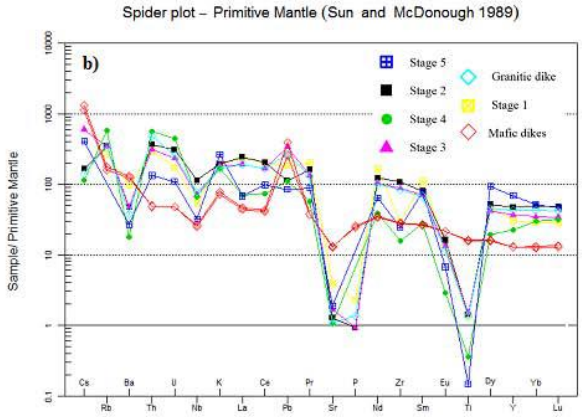




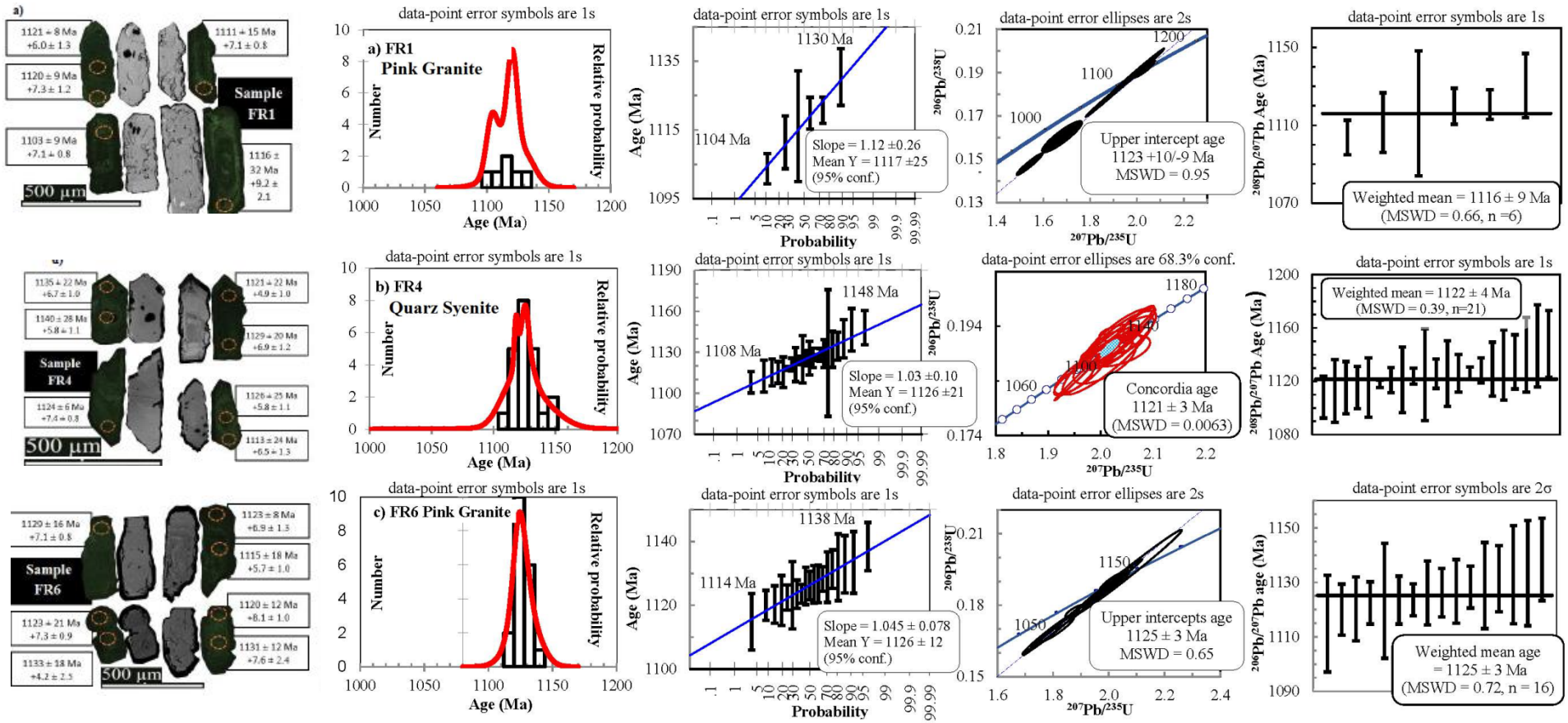








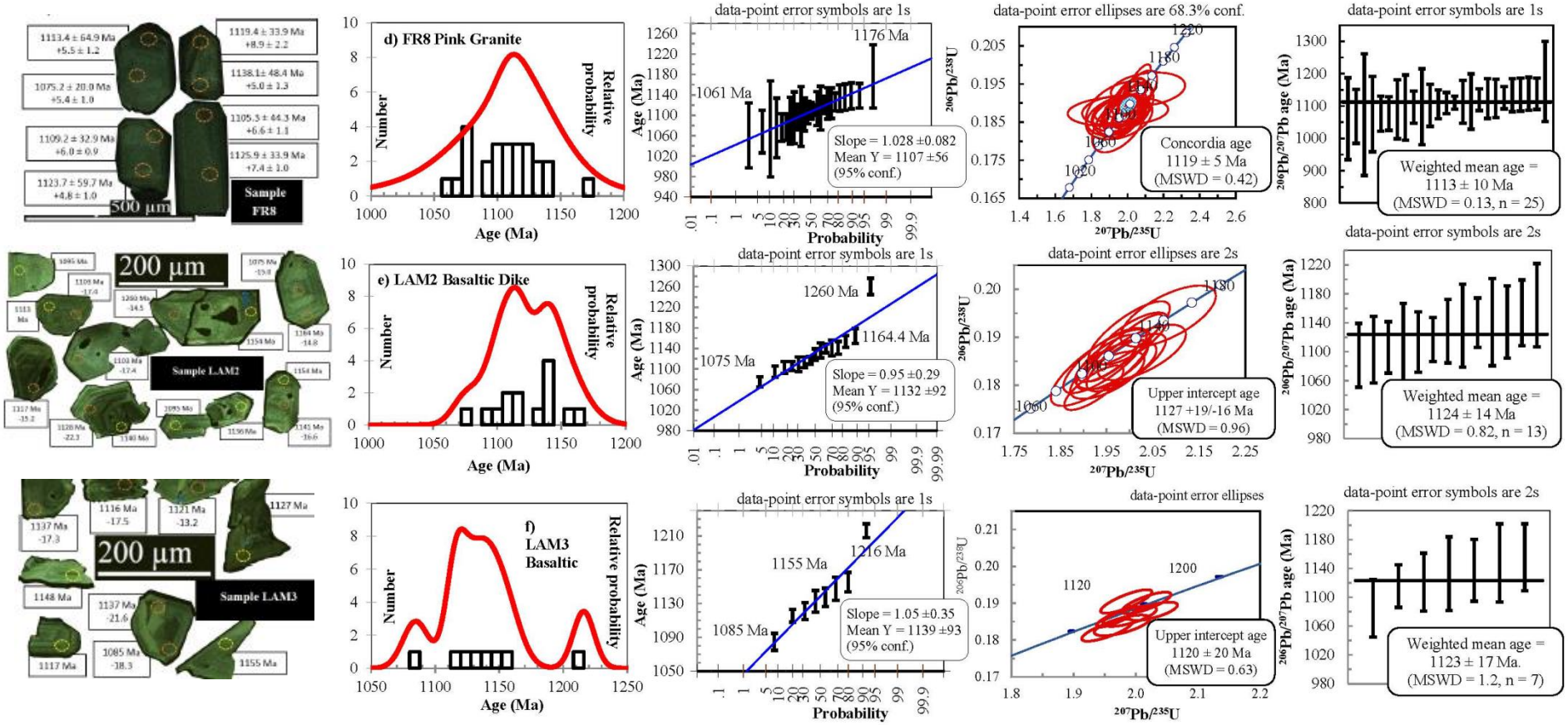
Zircon U-Pb geochronology of granites and diabase dikes



Oldest individual dates in granites ========== 1176-1138 Ma

No inheritance from Paleo-Mesoproterozoic crust.

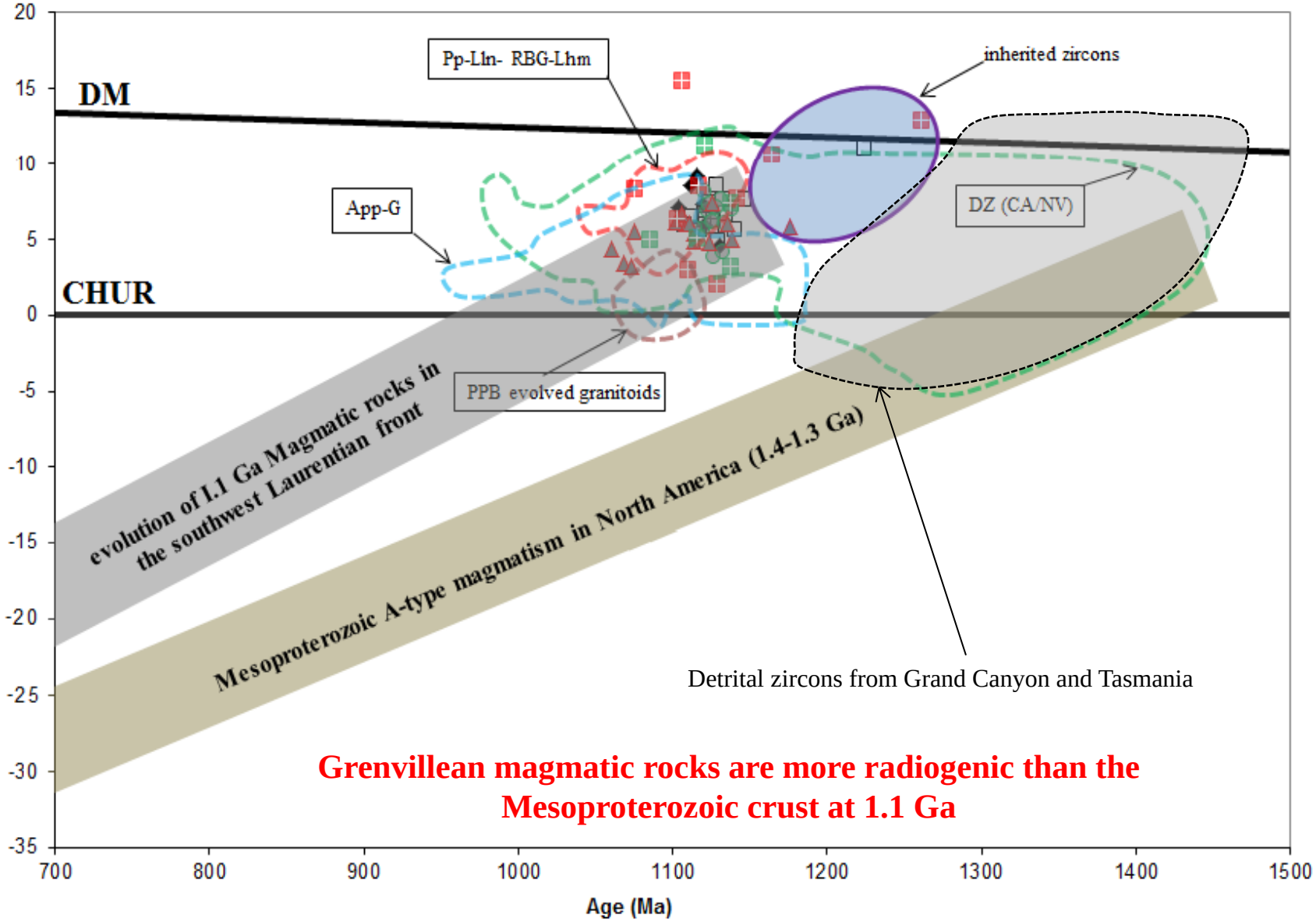
Zircon U-Pb Geochronology of granites and diabase dikes



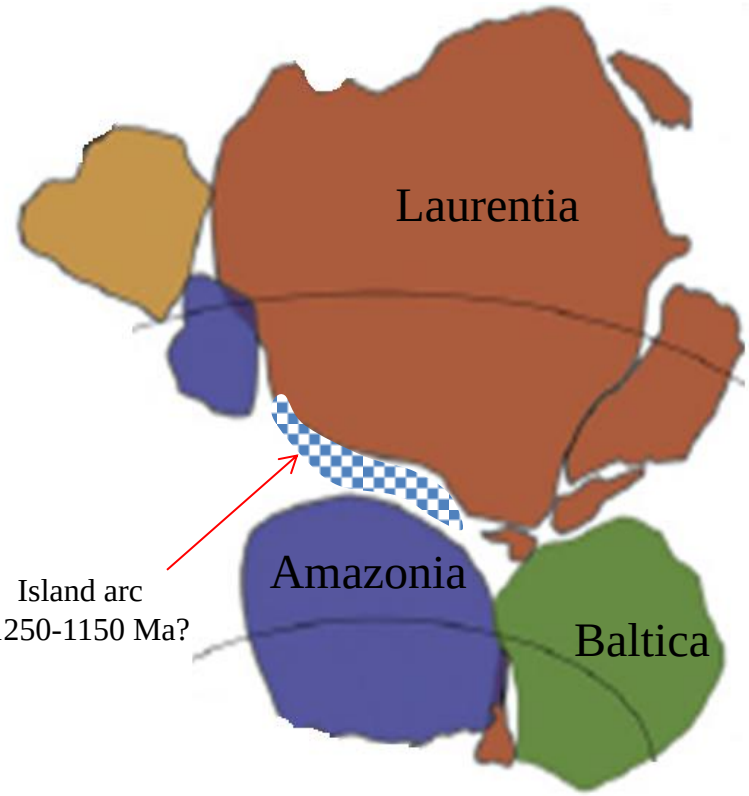
Oldest individual dates in diabase dikes ========== 1260-1155 Ma

No inheritance from Paleo-Mesoproterozoic crust.

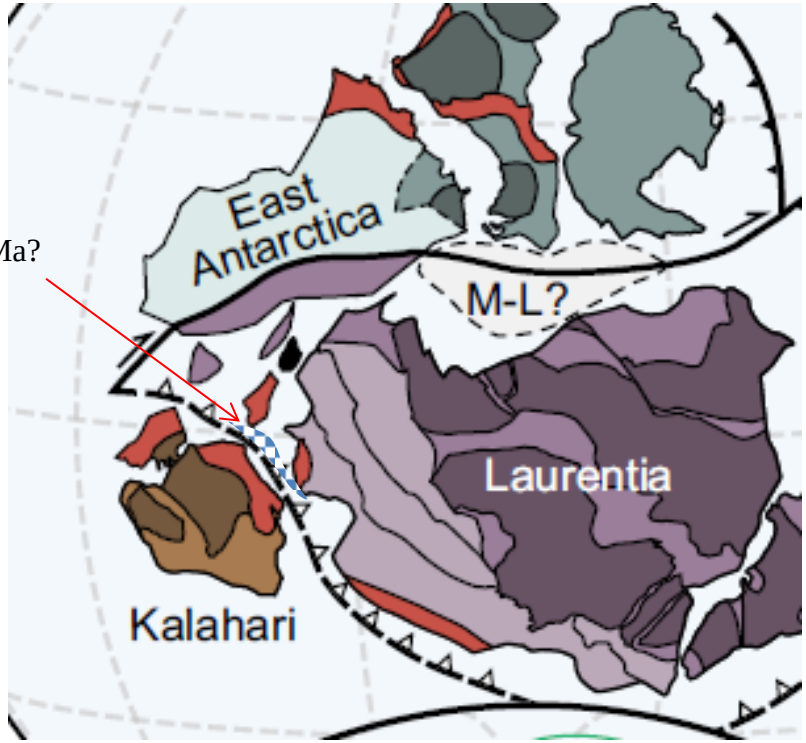
Zircon Hf isotopic evolution of West Texas and other 1.1 magmatic rocks in southwestern Laurentia



Formation of Continent-Arc type Southwestern Laurentia

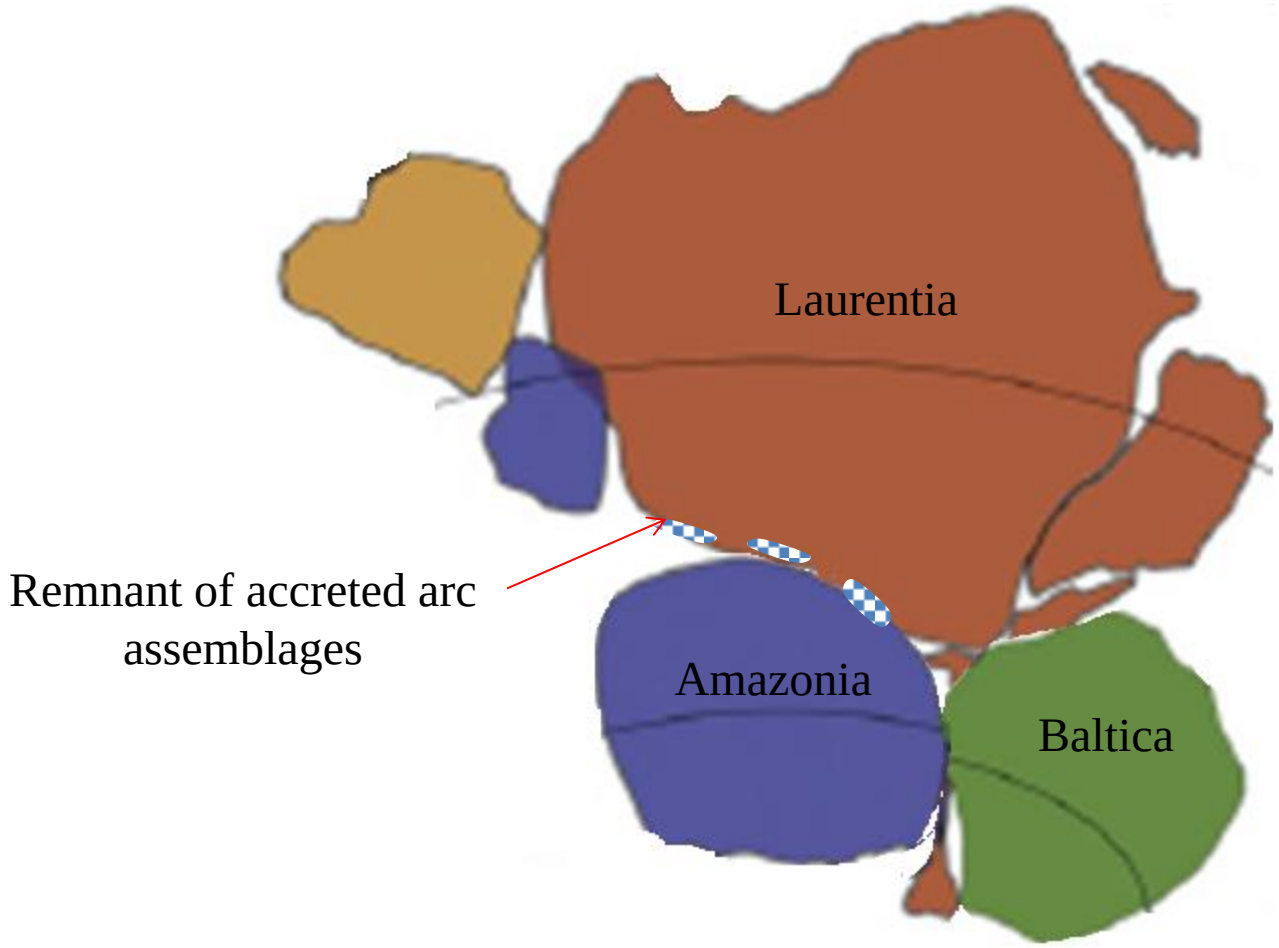


Modified after Li et al., 2008

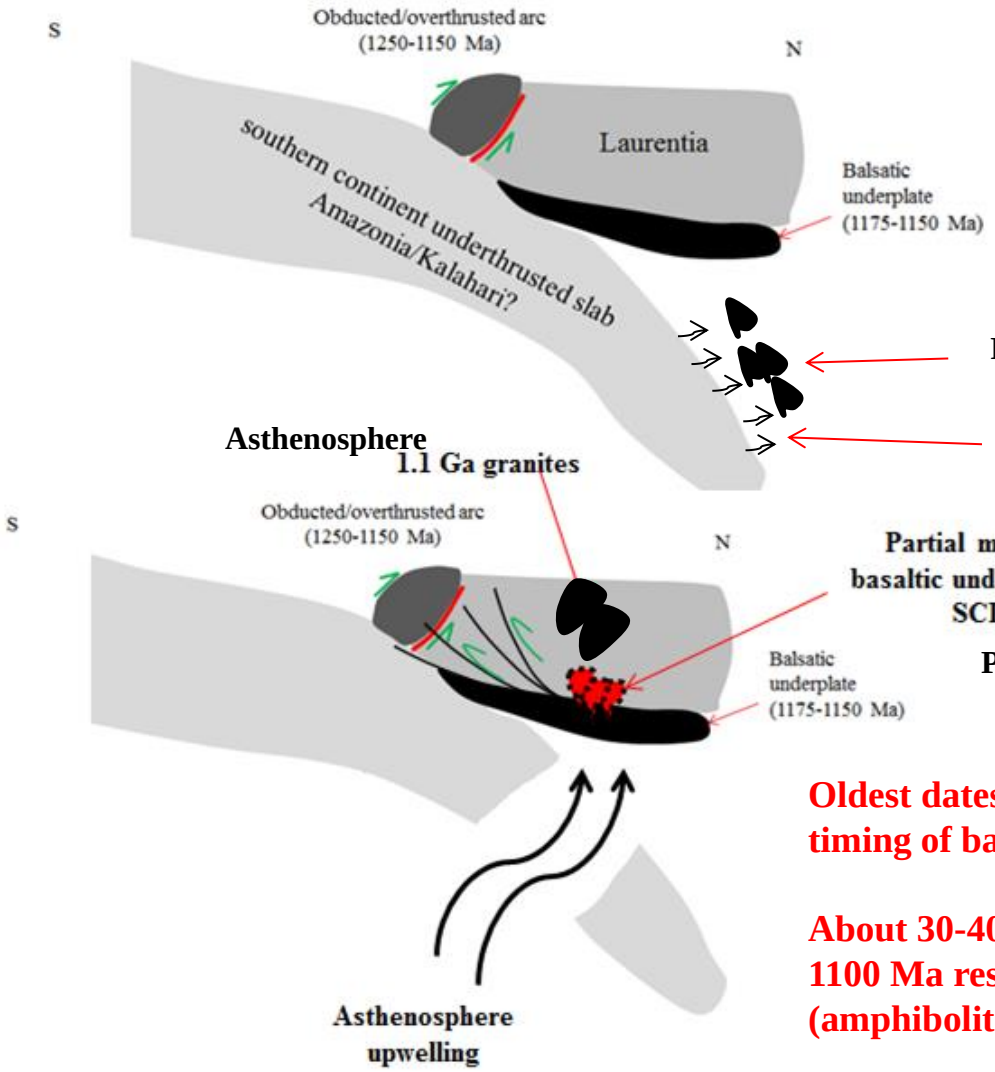


Mulder et al., 2018

Collision of Laurentia with a southern continent at ~ 1200-1150 Ma



Tectonomagmatic model for alkaline magmatism, deformation, leucogranites and migmatization in the west Texas and Llano 1.1 Ga



Continent-Continent collision and basaltic under plating 1250-1150 Ma

Partial melting of SCLM wedge

Dehydrated slab

Post-collision orogenic collapse resulted by a slab breakoff 1130-1100 Ma

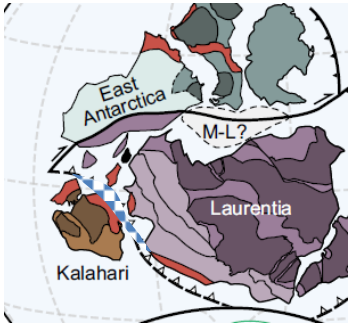
Oldest dates in granites and diabase dikes represent the timing of basaltic underplating i.e., 1175-1150 Ma

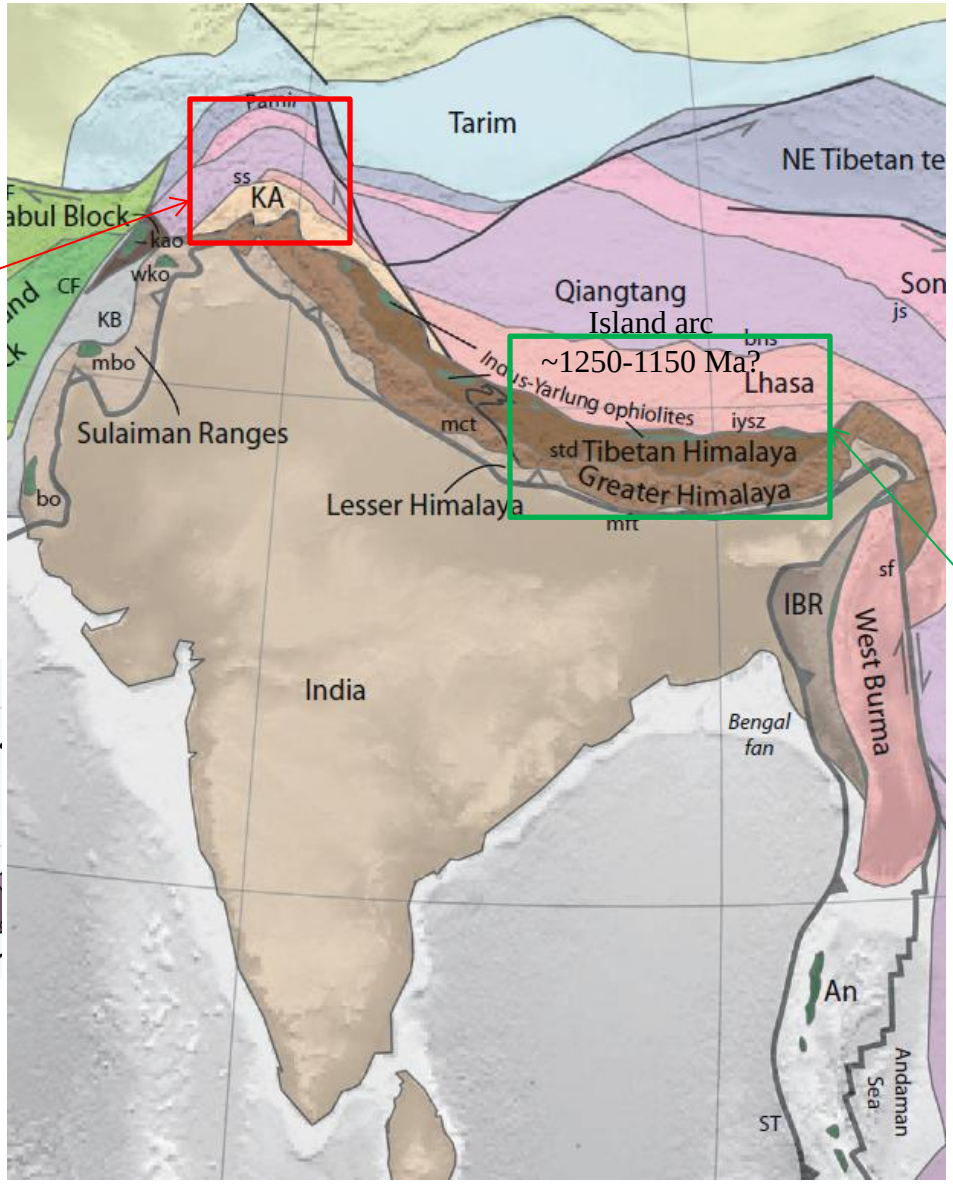
About 30-40 Ma later, slab breakoff and orogenic collapse at 1100 Ma resulting remelting of recently underplated basalt (amphibolites) and emplacement of granites

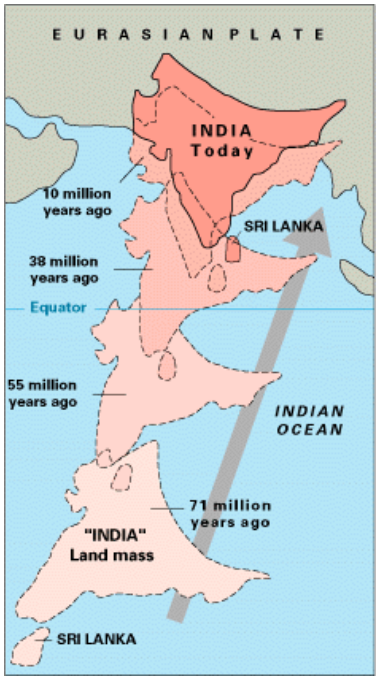
Is Grenvillean orogeny an older analogue to the Himalayan collision zone

Not a new idea though

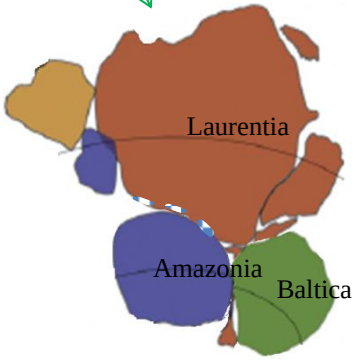
Or oblique collision at the indenting corner?





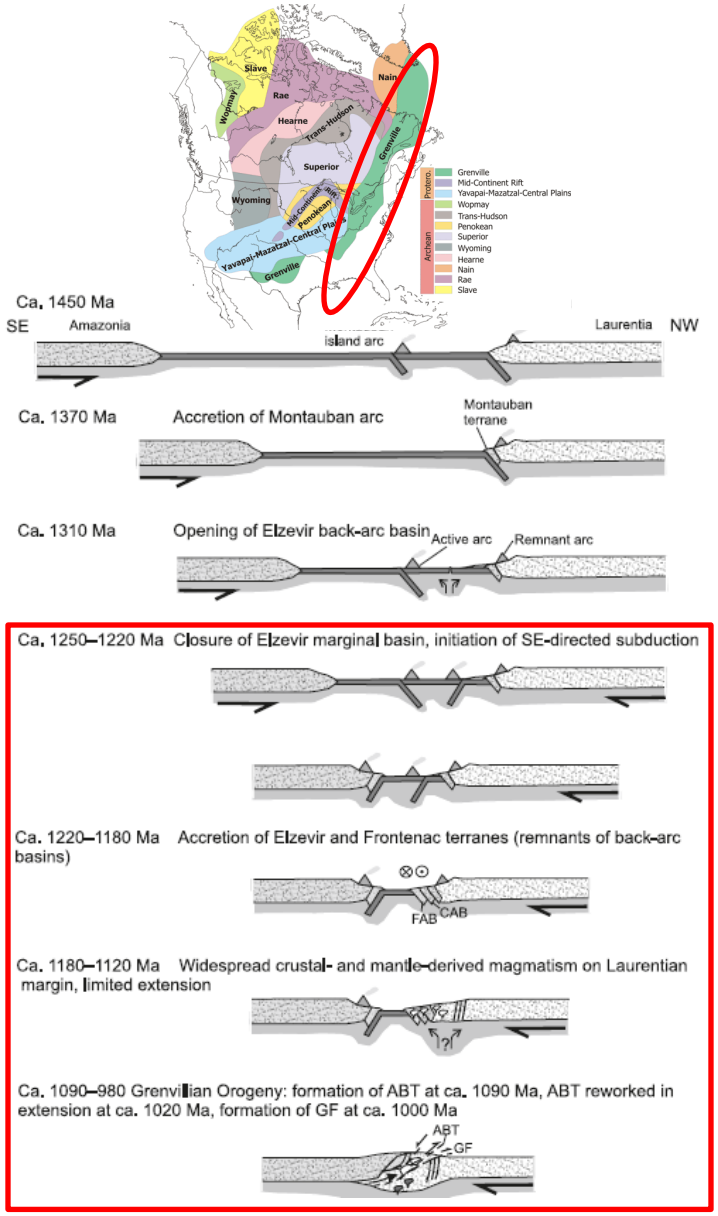


Head to head collision?

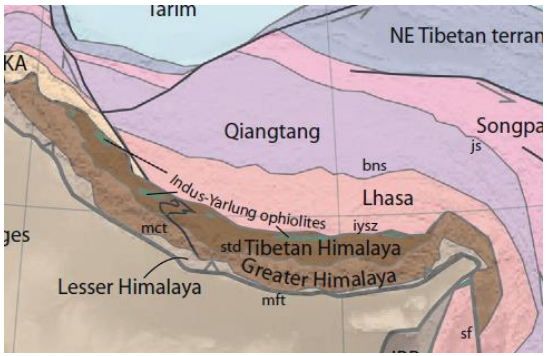


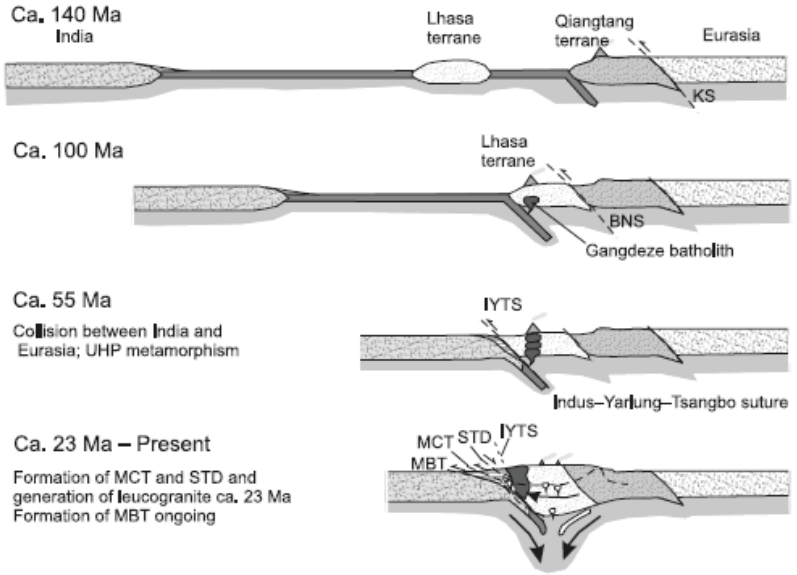
South Eastern Grenville comparison to India-Asia head to head collision

Collision of Amazonia and Southeast Laurentia

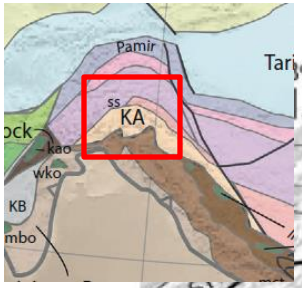


Head to head India-Asia ollision





India-Asia collision at northwestern indenting corner



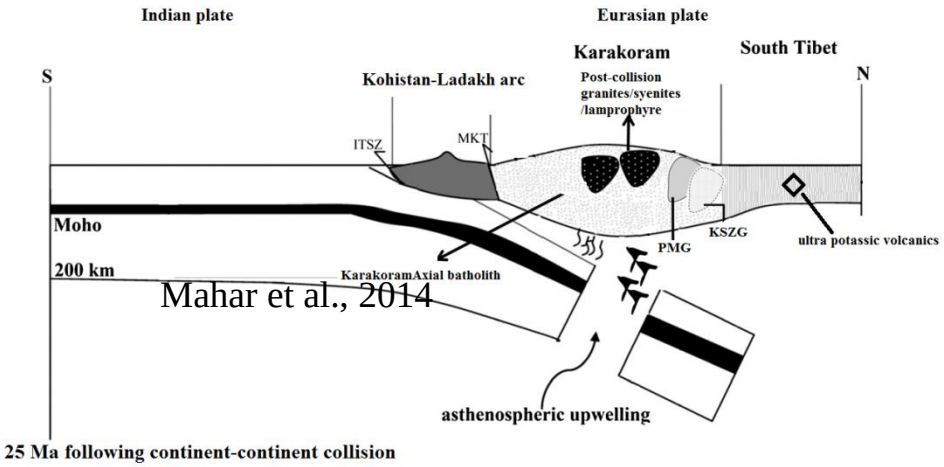
75°E
77°E
79°E
KARAKORAM BATHOLITH
SUTURE ZONE
MKT
Island Arc
KOHISTAN ARC
HUNZA (KMC)
Asian Plate
KARAKORAM FAULT
BALTORO GRANITES
BALTORO (KMC)
K2
alkaline granites, syenites and lamprophyre (30- 13 Ma)
ALTYN TAGH FAULT
South Tibet
TIBET
KARAKORAM METAMORPHIC COMPLEX
MMT
NANGA PARBAT SYNTAXIS
Island Arc
MKT
Karakoram/arc Collision
SHYOK SUTURE
NUBRA-SIACHEN GRANITES
LADAKH BATHOLITH
PANGONG METAMORPHIC COMPLEX
Indian Plate
MMT
Arc/Indian plate Collision
INDUS SUTURE ZONE
PANGONG TRANSPRESSIONAL ZONE
T
P
MBT
MBT
50 KM
ZANSKAR HIMALAYA
MMT
P
T

KARAKORAM FAULT:
P: Pangong Strand
T: Tangtse Strand

MBT:Main Boundary Thrust
MMT:Main Mantle Thrust
MKT: Main Karakoram Thrust

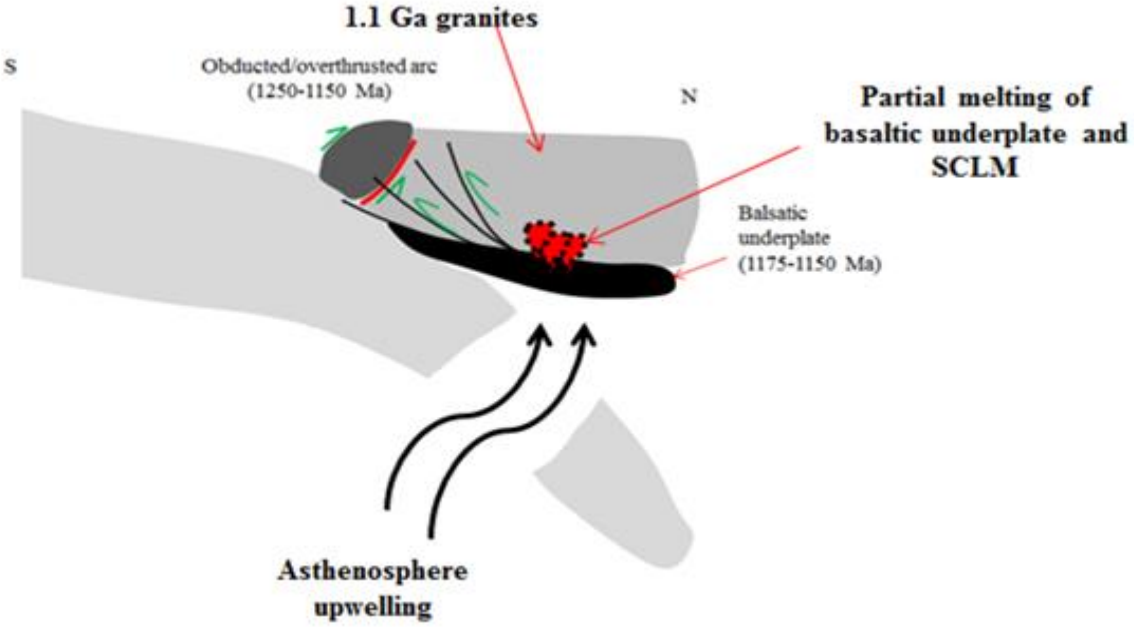
Post orogenic slab break off and magmatism ~30 Ma following continent-continent collision

Northwestern Himalaya



Mahar et al., 2014

Southwestern Laurentia



- Southern most Laurentia is similar to the southern margin of Asian plate in northwestern Himalaya.
- break off of descending slab under both plates.
- Deformation, uplifting, and HT metamorphism
- A sandwiched arc in both zones
- Alkaline magmatism ~30 Ma fllowing continent-continent collision

Conclusion

- **Granites and associated basaltic dikes yielded overlapping ages (~1.1 Ga) and Hf isotopes composition.**

- **Mafic dikes are possibly related to the basaltic underplate resulted by partial melting of SCLM which remelted by decompressing asthenosphere during a slab breakoff event.**
- **Absence of zircon inheritance and Hf isotope composition suggest minimal input from older Mesoproterozoic crust, perhaps southern margin of Laurentia is dominantly underlain by juvenile crust.**

- **For the origin of granites partial melting of basaltic under plate (amphibolites) is suggested.**

- **Southwestern Laurentia is similar to the southern margin of Asian plate in northwestern Himalaya both have recorded alkaline magmatism, migmatization, deformation and uplifting ~30 Ma following continent-continent collision.**