STRATIGRAPHIC HISTORY AND PROVENANCE OF THE UPPER CRETACEOUS (CONIACIAN-SANTONIAN) LOWER PART OF THE CREVASSE CANYON FORMATION IN WEST-CENTRAL NEW MEXICO

Leo Kuyl (M.S. Candidate)

Monday, October 13th, 2025


Paleocene-Eocene Baca and Spears Formations
Cretaceous Crevasse Canyon Formation
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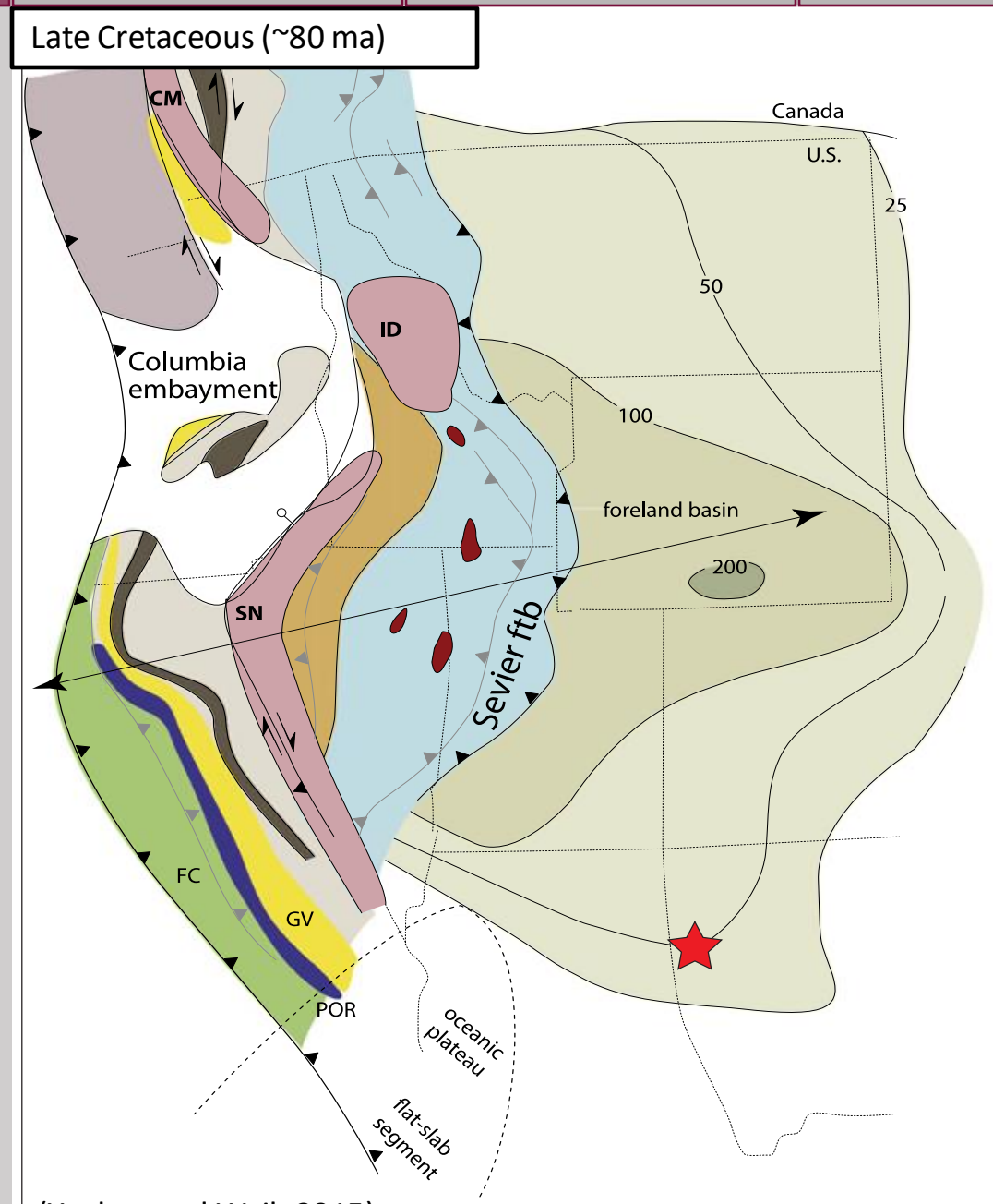
Outline

1. Research Goals
2. Geologic & Stratigraphic Background
3. Methods
4. Results and Interpretations
5. Conclusions

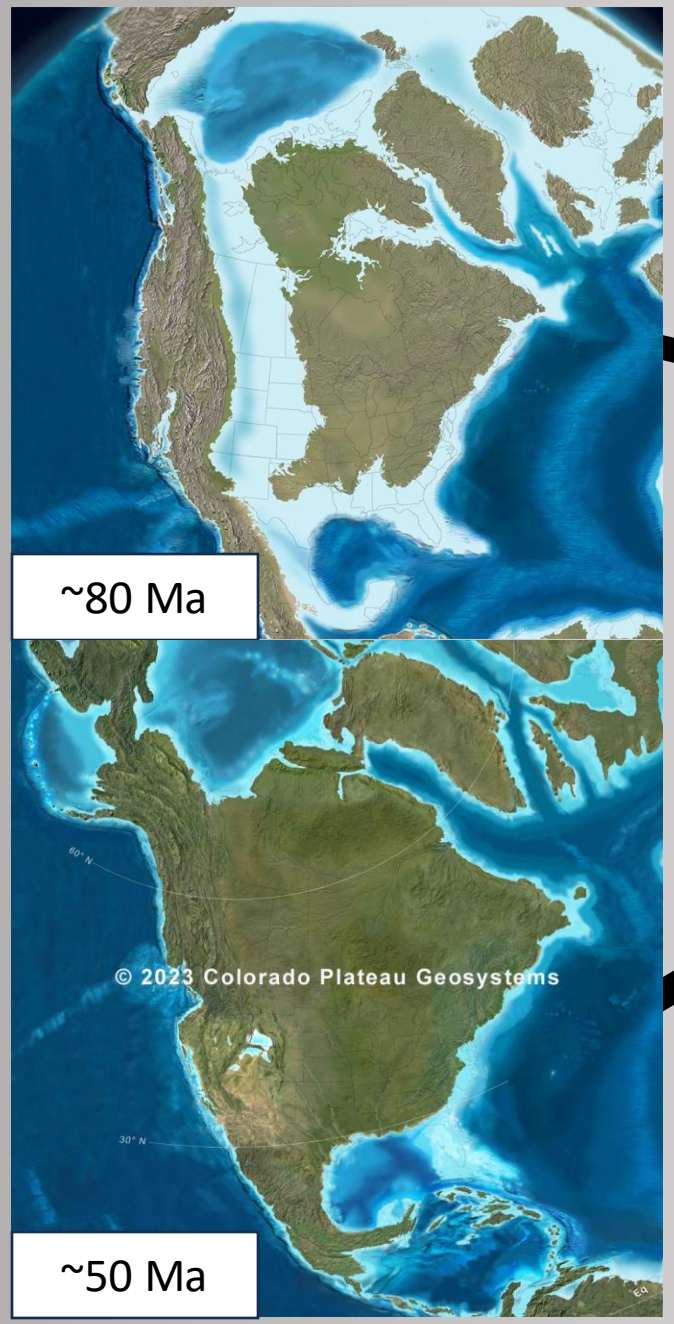
Research Goals

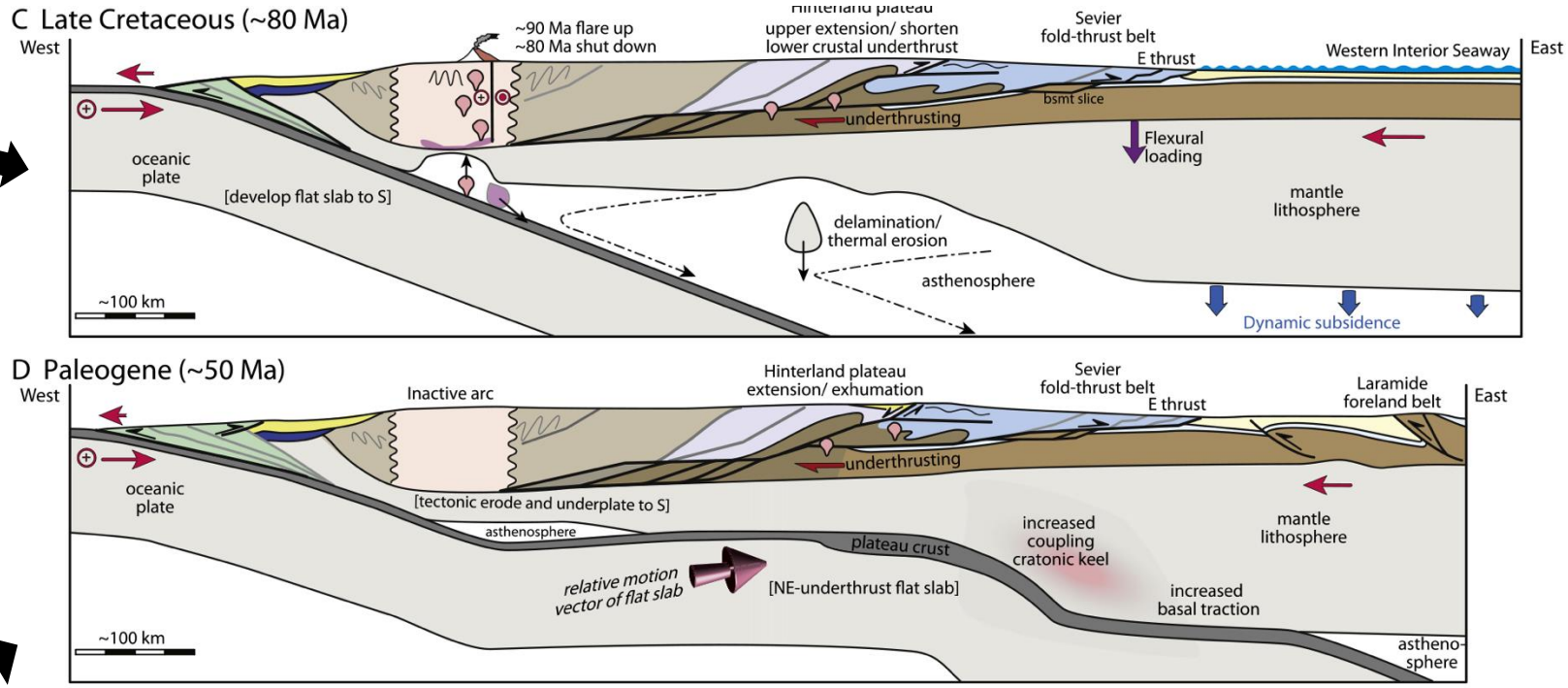
- Constraint the depositional environment for the Crevasse Canyon Formation in west-central New Mexico
- Provide provenance interpretations for detritus of the Crevasse Canyon Formation
- Develop new sediment dispersal models

- Late Jurassic-Late Cretaceous development of Andean style subduction
- Development of accretionary wedge, forearc basin, arc, foreland basin etc
- Buoyant oceanic plateau begins subducting on SW margin
- Study area = ★



(Yonkee and Weil, 2015)



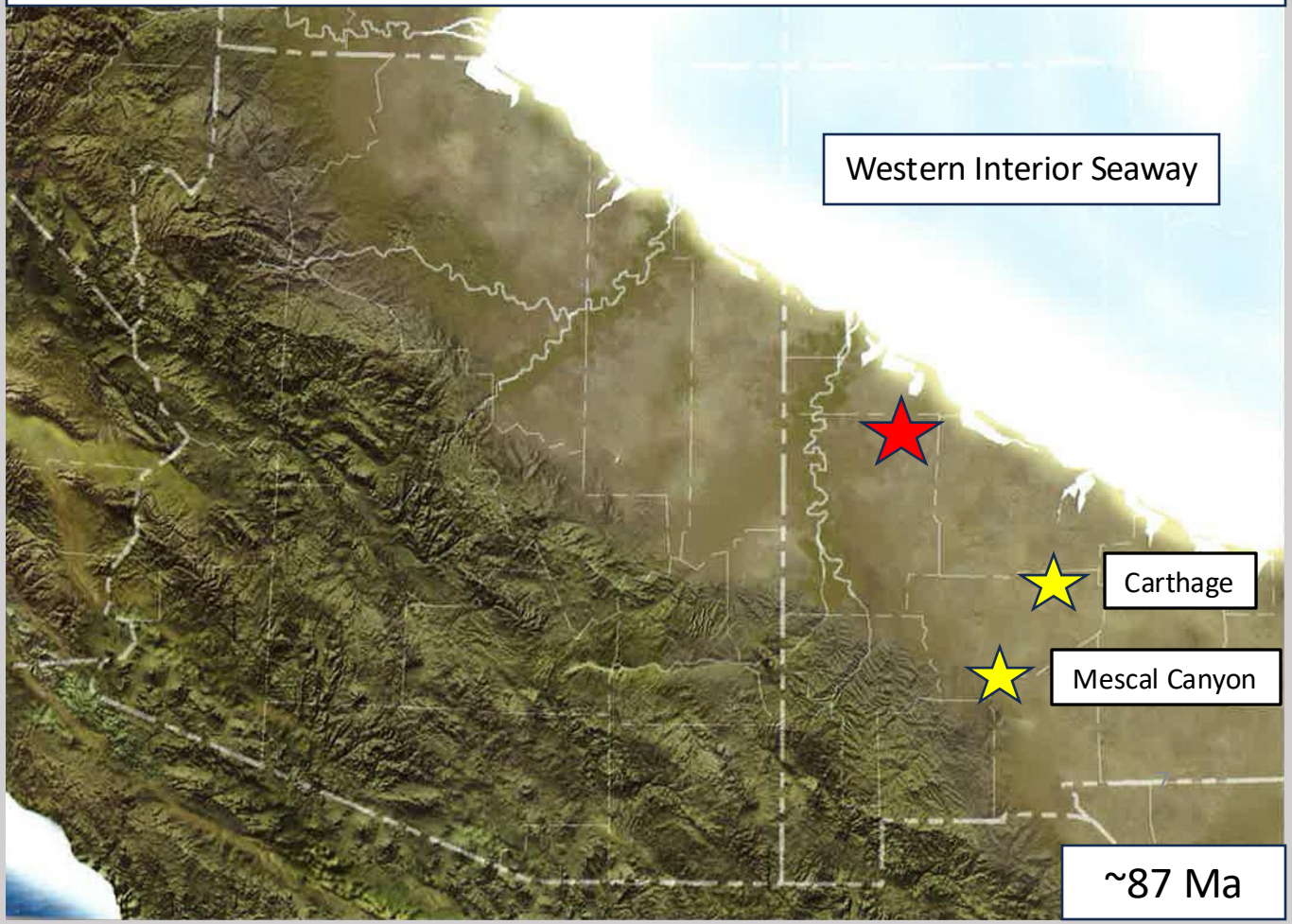


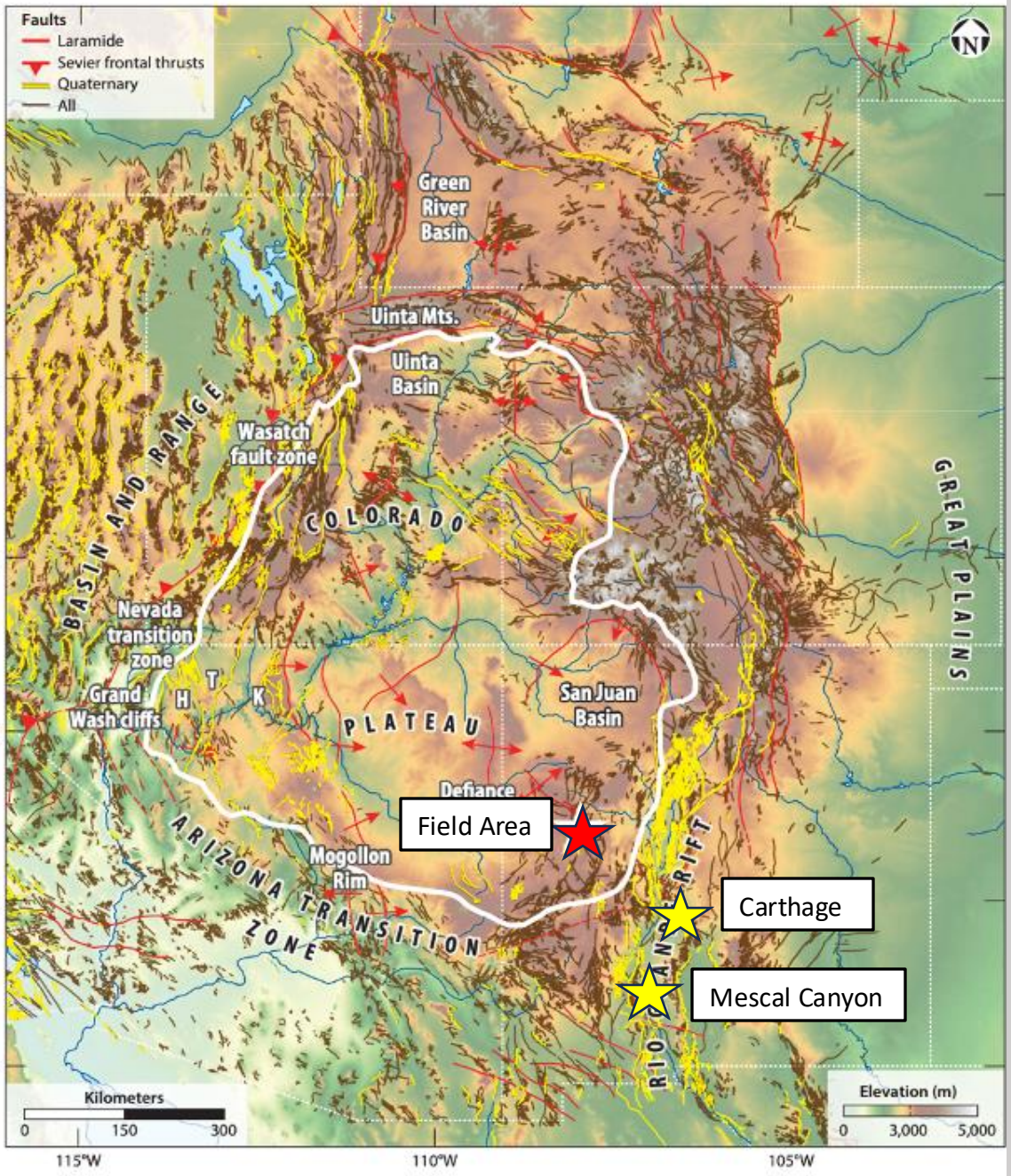
(Yonkee and Weil, 2015)

(Colorado Plateau Geosystems, 2023)

(Colorado Plateau Geosystems, 2023)

- New Mexico under marine and non-marine conditions from fluctuation in relative sea level
- Study area = ★ Previous study areas = ★

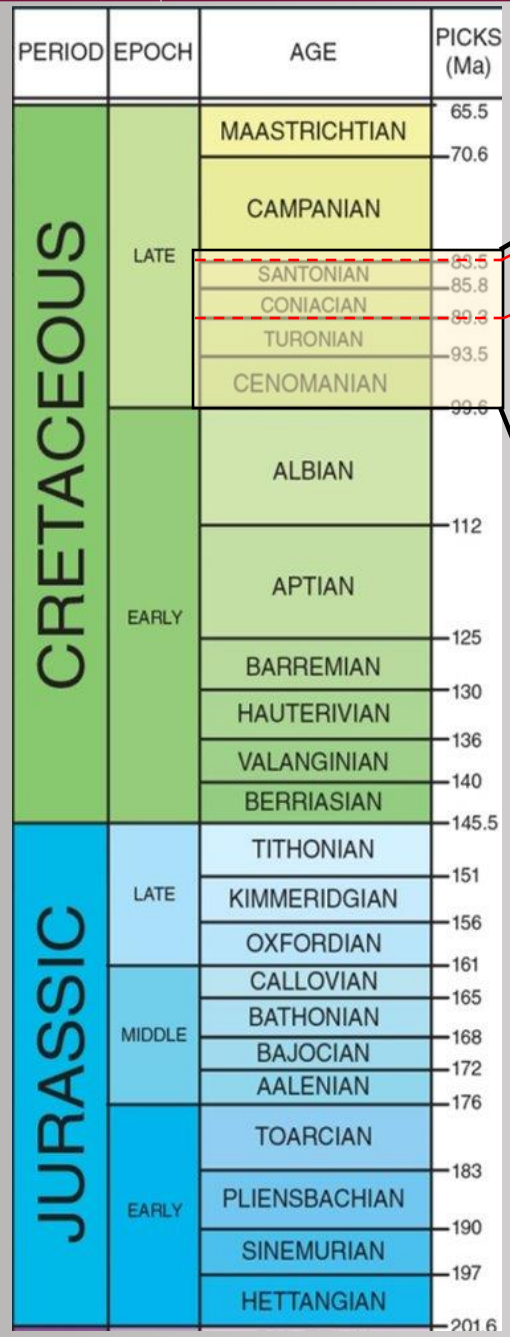


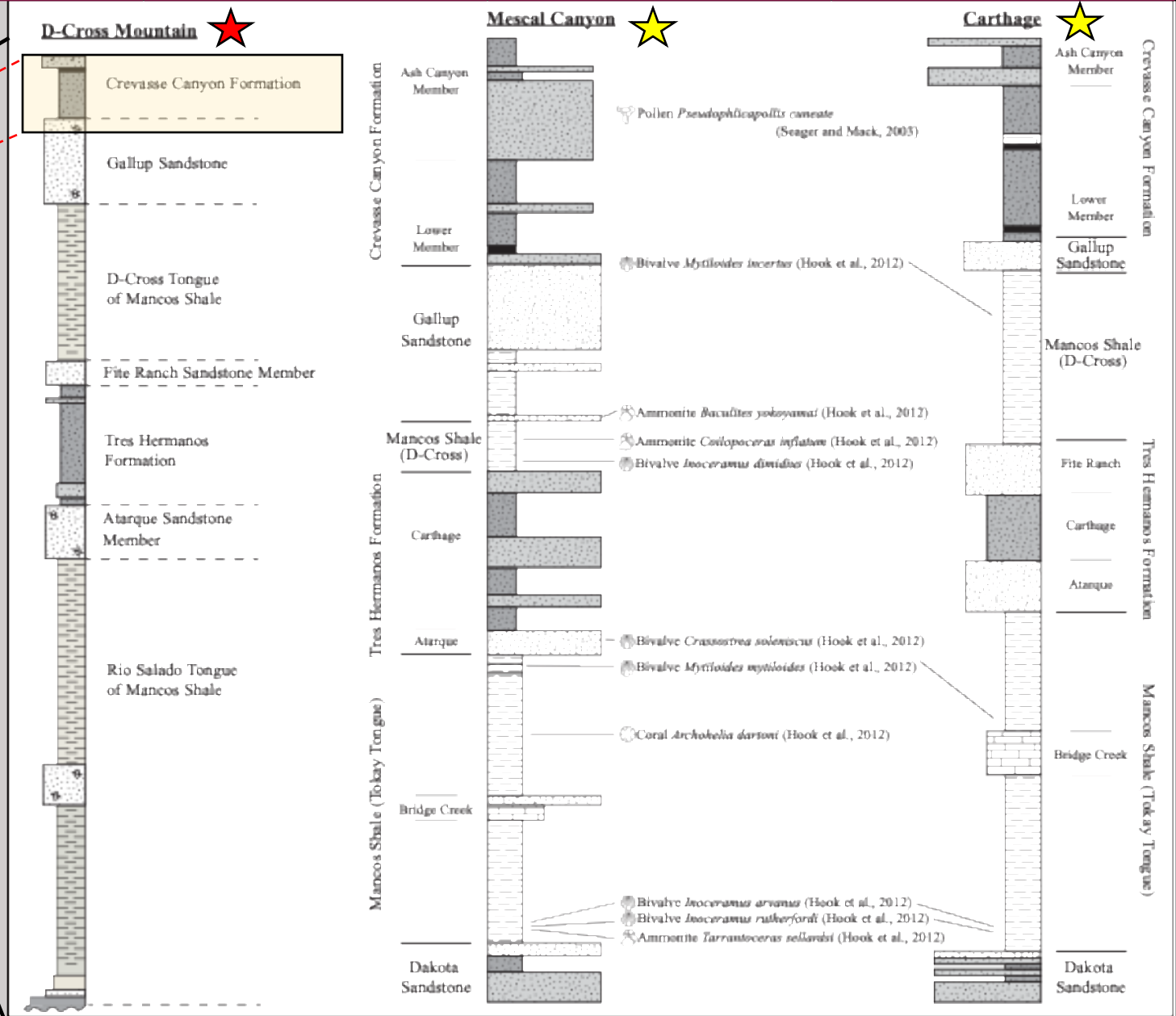


Field area Located on southeastern margin of the Colorado plateau (map highlights current extent of tectonic related deformation)

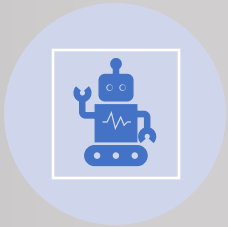
- Laramide deformation to east
- Rio Grande Rift related deformation to east
- Basin and Range extension to the west

(Karlstrom et al., 2022)





Modified from (Stopka, 2015)



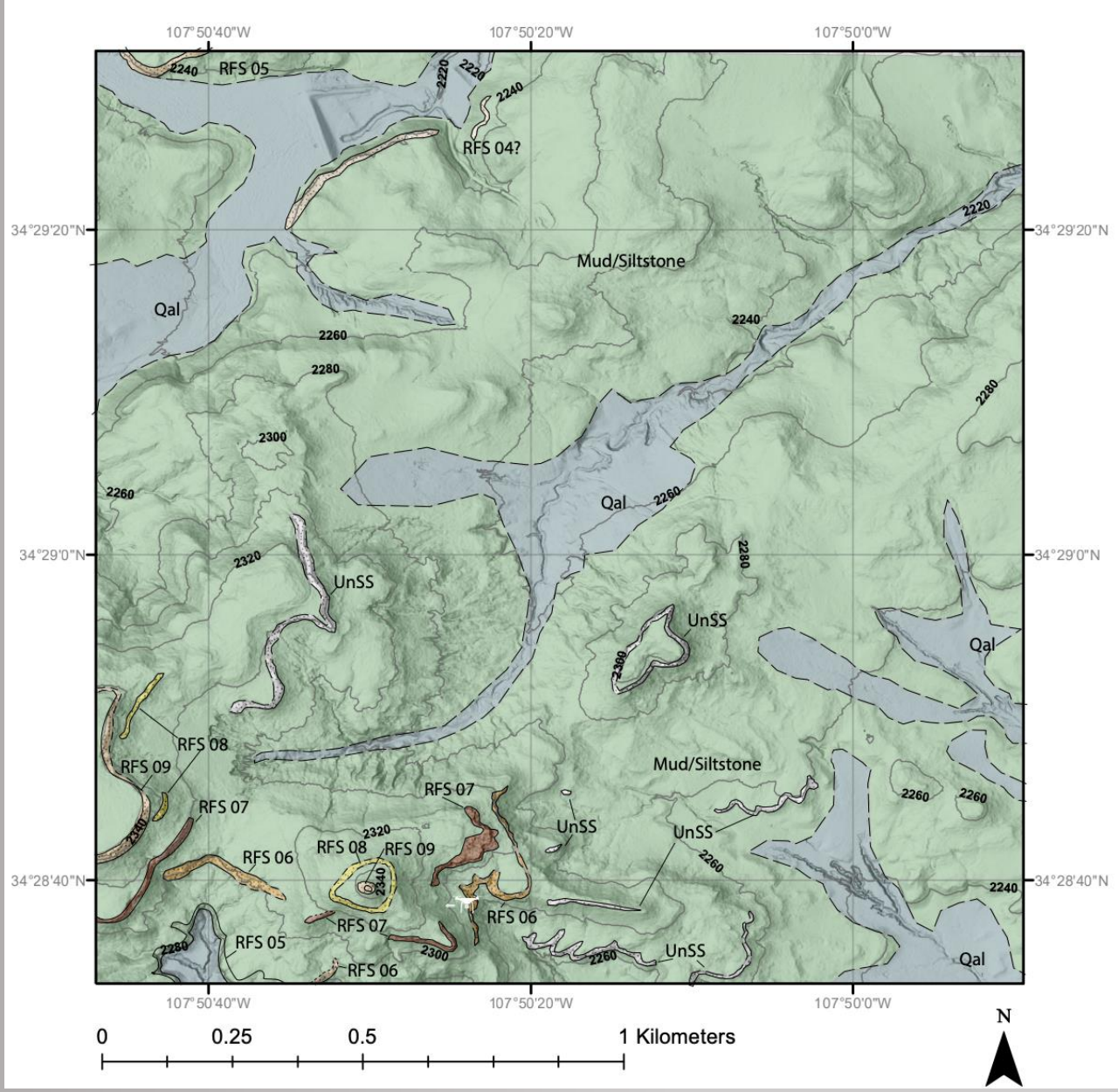
GIS & DRONE MAPPING OF SANDSTONE BODIES

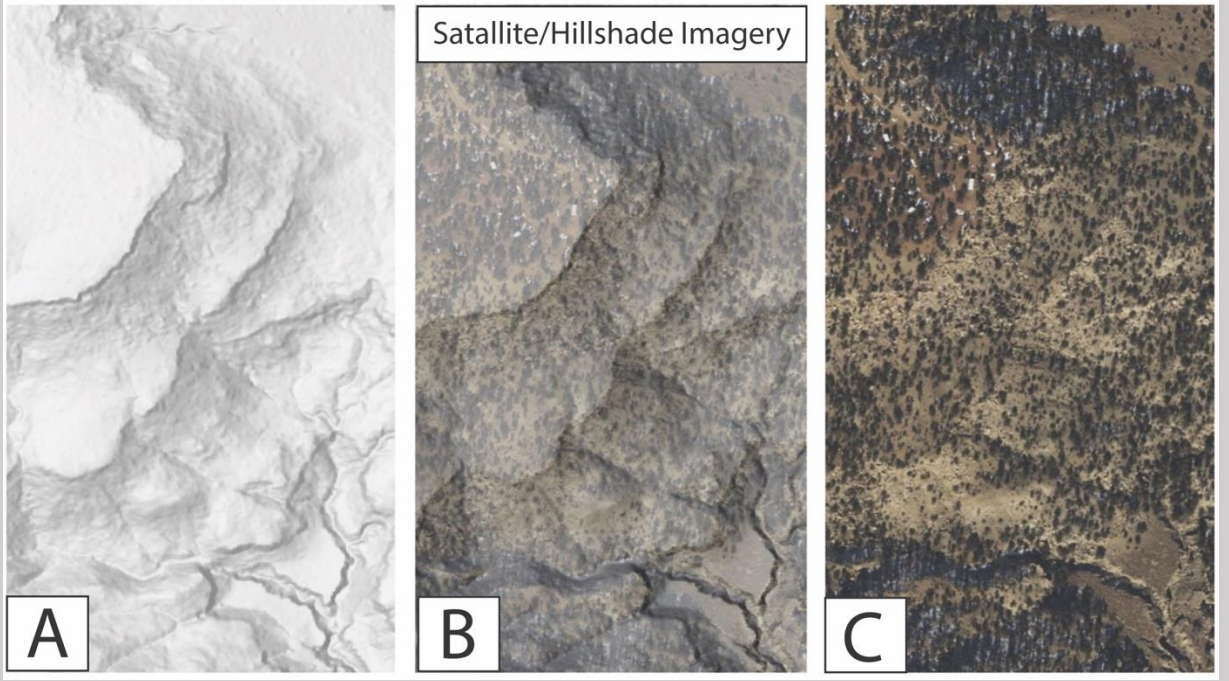
N=3 MEASURED STRATIGRAPHIC SECTIONS

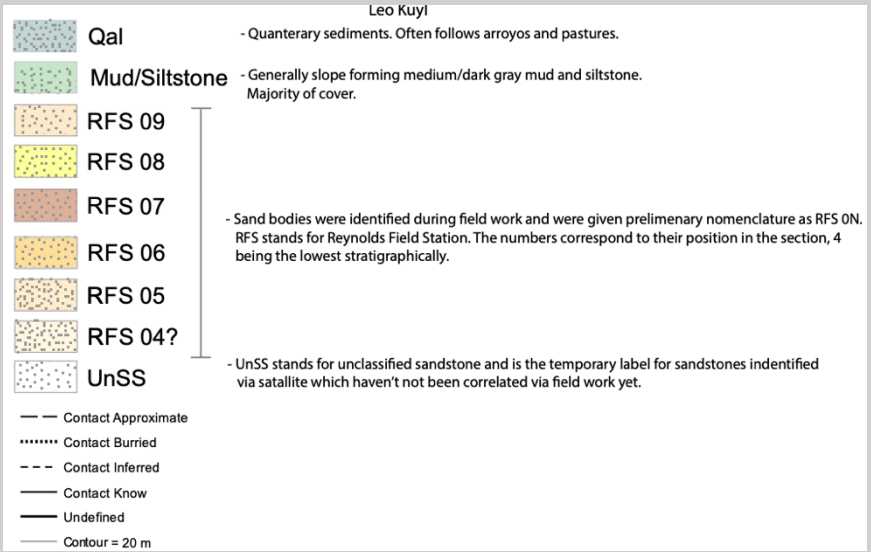
U-PB ANALYSES OF N=7 (n=1514) SAMPLES FOR DETRITAL ZIRCON GEOCHRONOLOGY

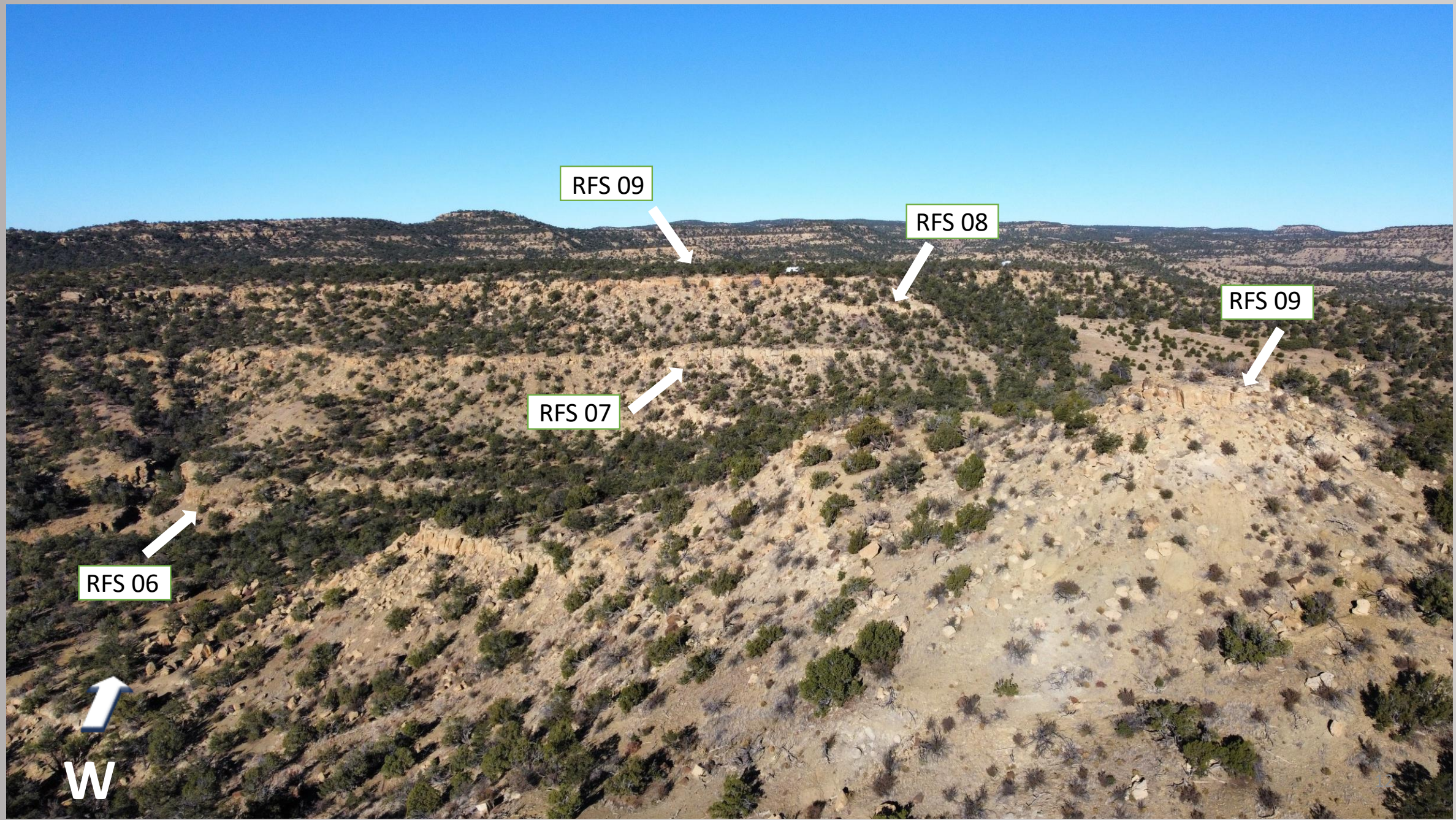
GAZZI-DICKINSON METHOD OF POINT-COUNTING OF N=14 (n=5600) SANDSTONE SAMPLES FOR MODAL COMPOSITION DETERMINATION

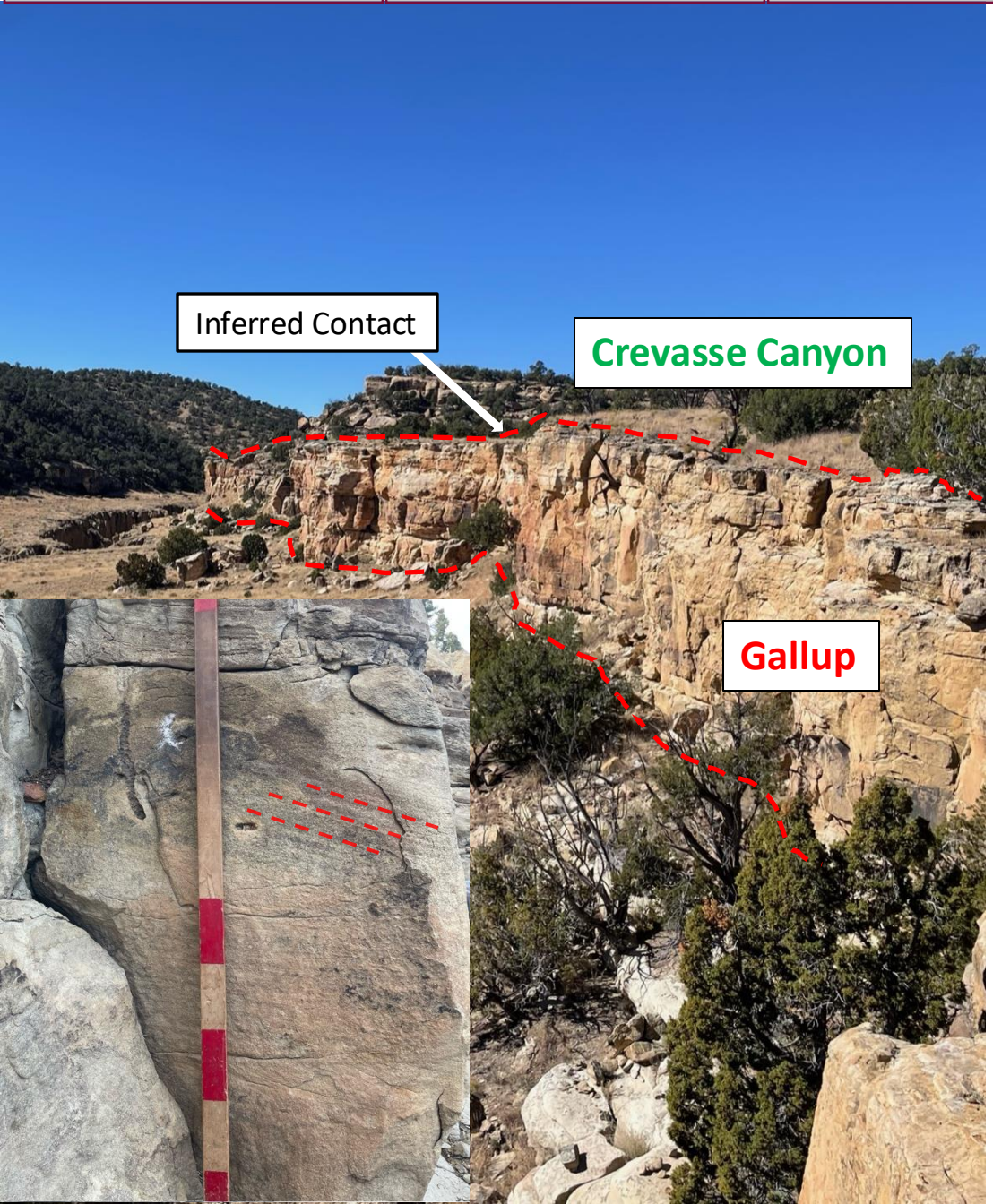
MEASUREMENT OF PALEOCURRENT INDICATORS TO DETERMINE PALEOFLOW

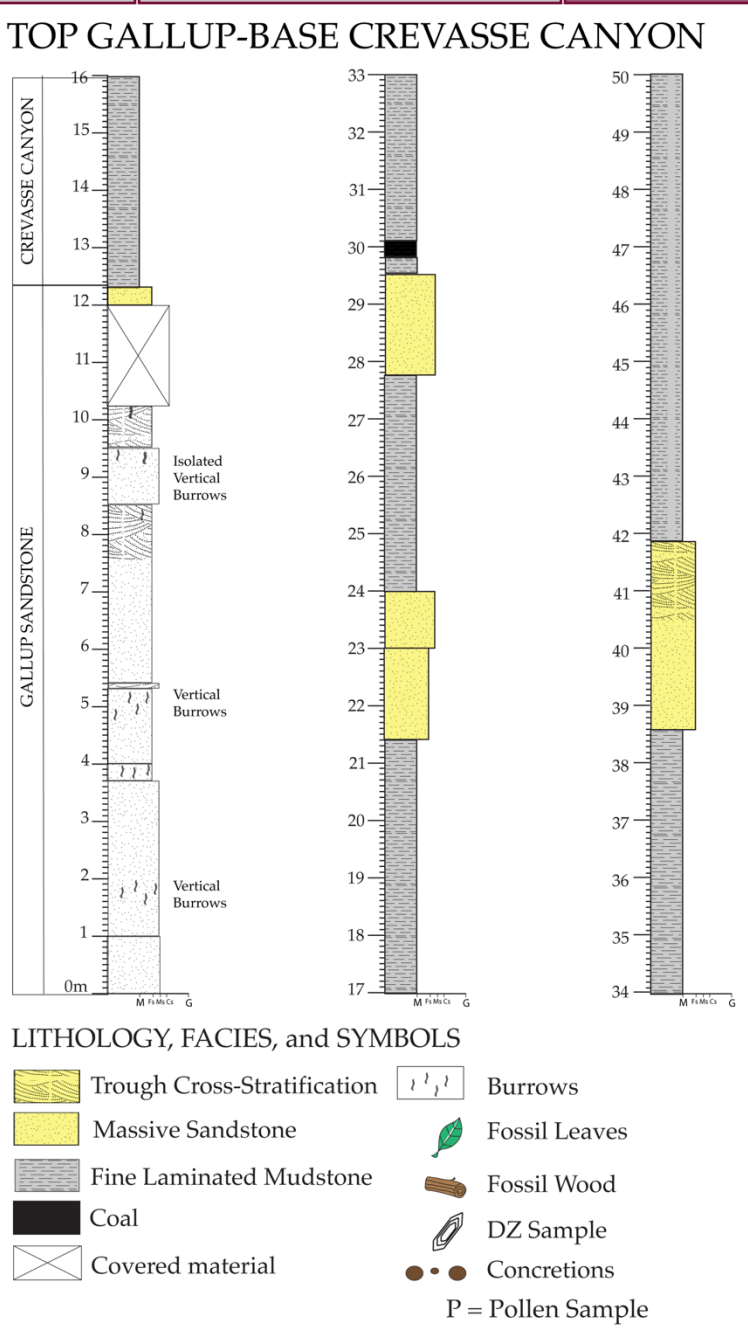

107°50'40"W
107°50'20"W
107°50'0"W
34°29'20"N
34°29'0"N
34°28'40"N
RFS 05
RFS 04?
Mud/Siltstone
Qal
UnSS
RFS 08
RFS 09
RFS 07
RFS 06
0
0.25
0.5
1 Kilometers
N


Satallite/Hillshade Imagery
A
B
C

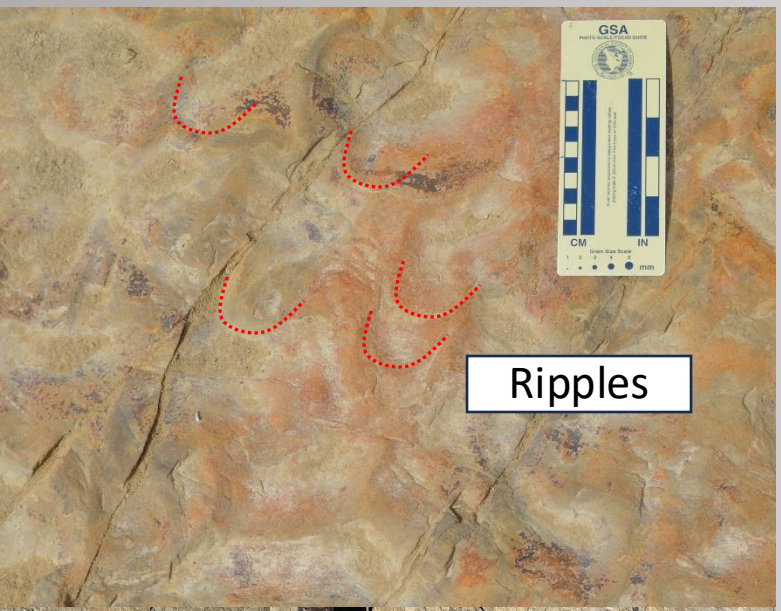

Leo Kuyl
Qal
- Quanterary sediments. Often follows arroyos and pastures.
Mud/Siltstone
- Generally slope forming medium/dark gray mud and siltstone. Majority of cover.
RFS 09
RFS 08
RFS 07
RFS 06
RFS 05
RFS 04?
- Sand bodies were identified during field work and were given prelimenary nomenclature as RFS 0N. RFS stands for Reynolds Field Station. The numbers correspond to their position in the section, 4 being the lowest stratigraphically.
UnSS
- UnSS stands for unclassified sandstone and is the temporary label for sandstones indentified via satallite which haven't not been correlated via field work yet.
Contact Approximate
Contact Buried
Contact Inferred
Contact Know
Undefined
Contour = 20 m

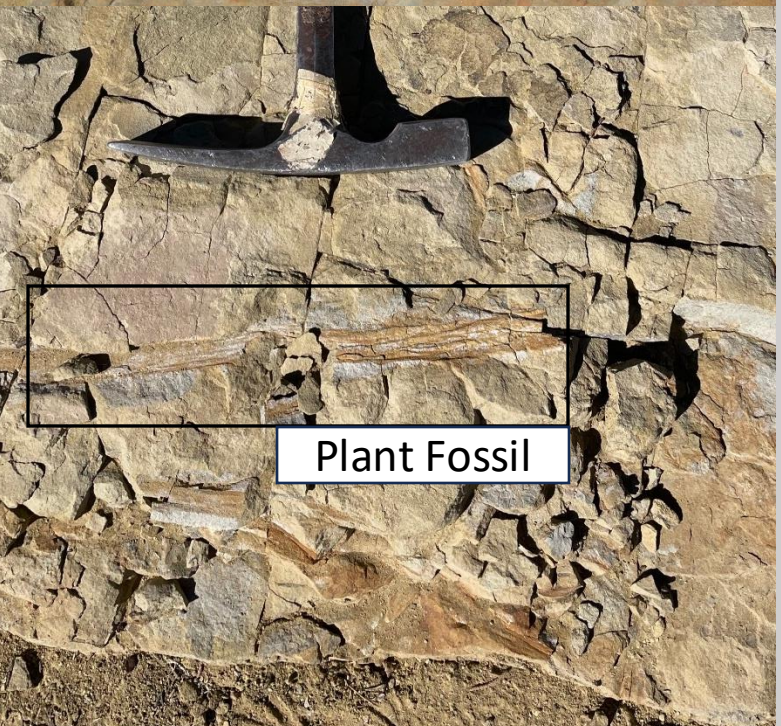

RFS 09
RFS 08
RFS 09
RFS 07
RFS 06
W

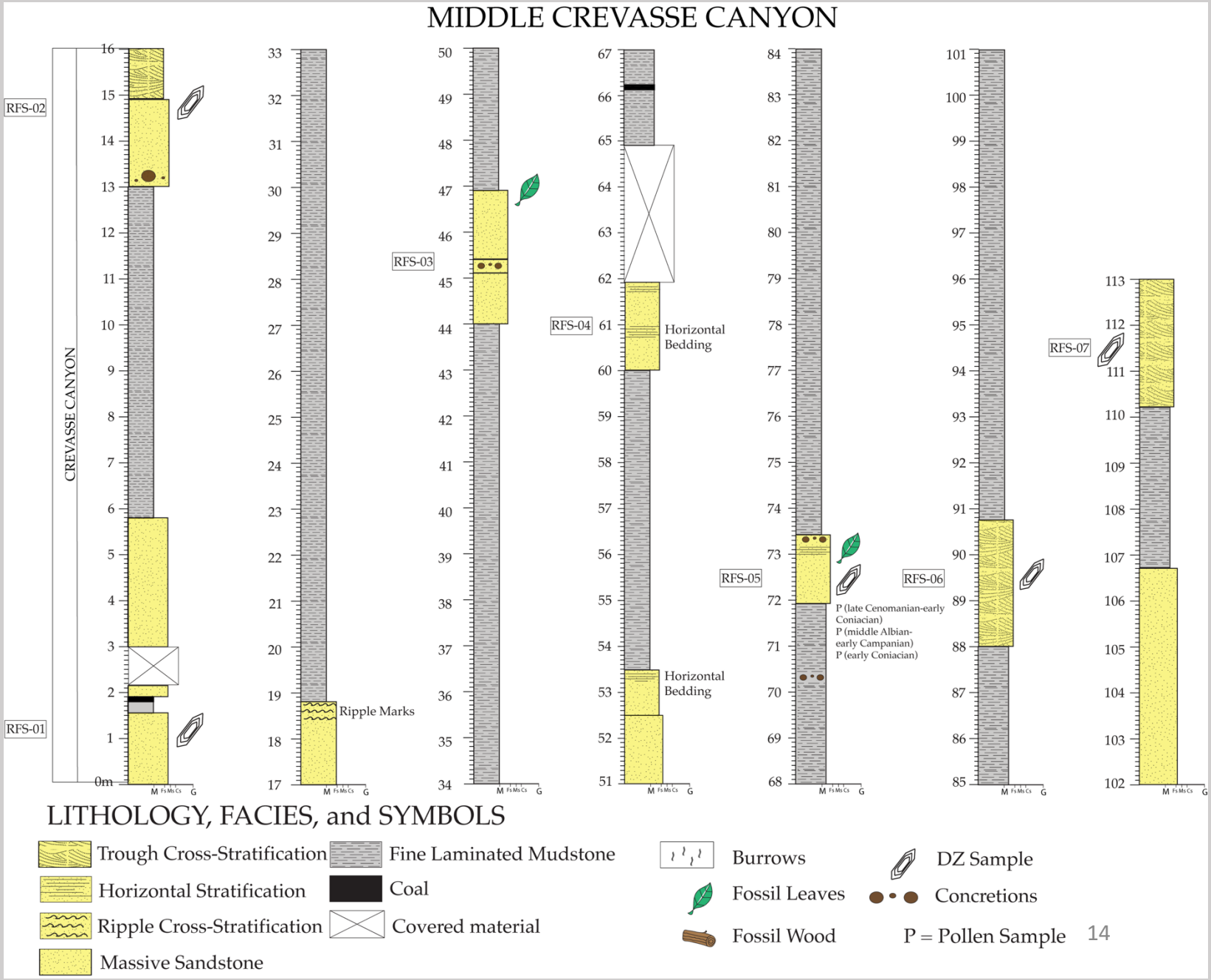


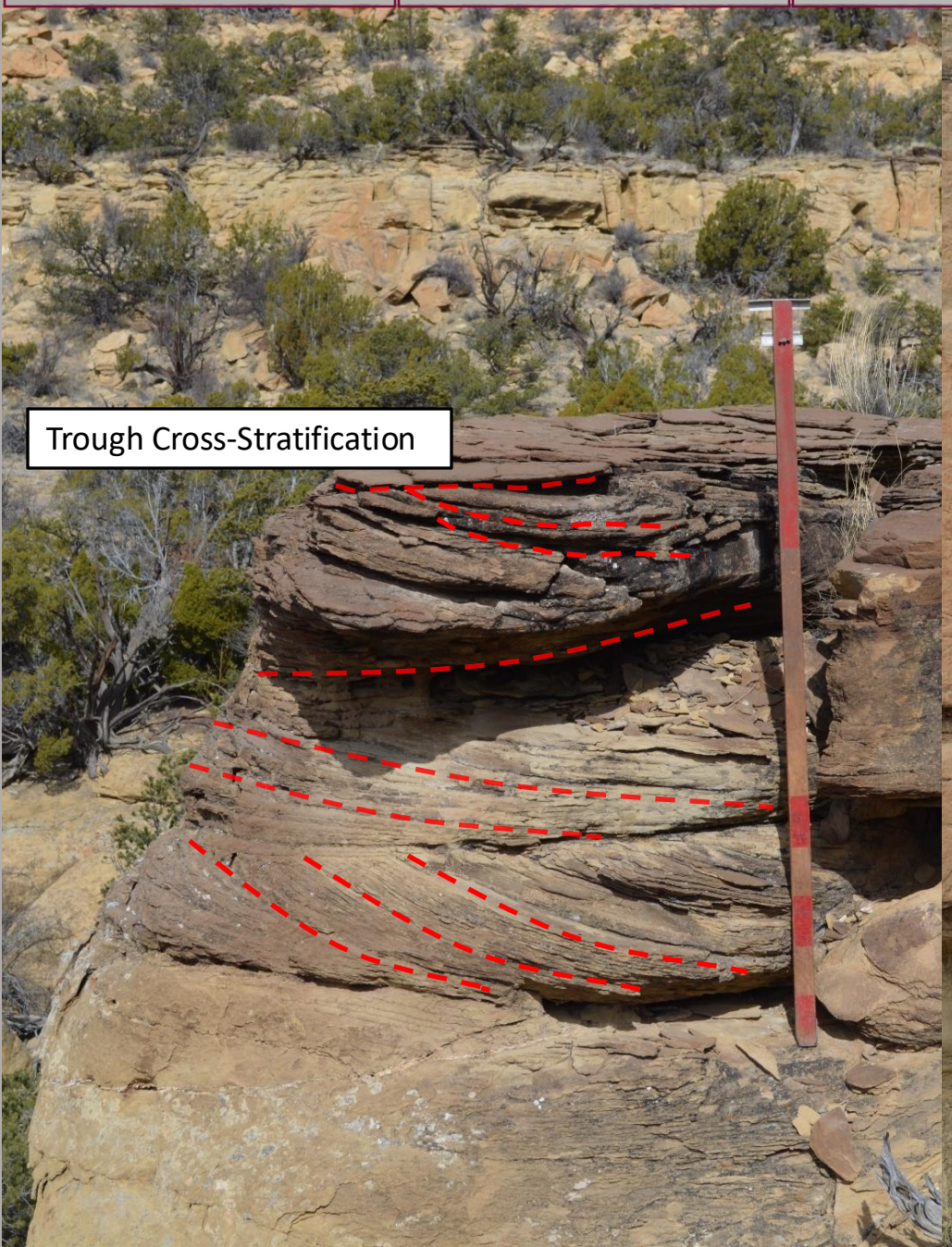


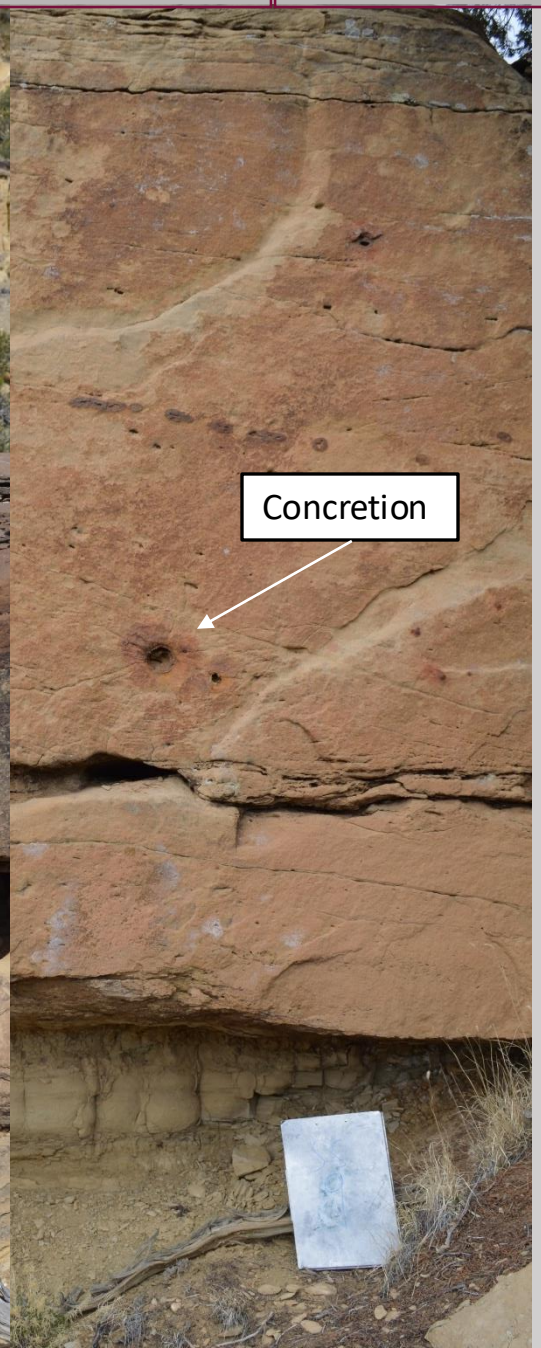
- Records transition from marginal marine Gallup Sandstone to non marine basal Crevasse Canyon Formation
- Bioturbation from Vertical and horizontal burrows in Gallup
- Characteristics of upper shoreface deposits

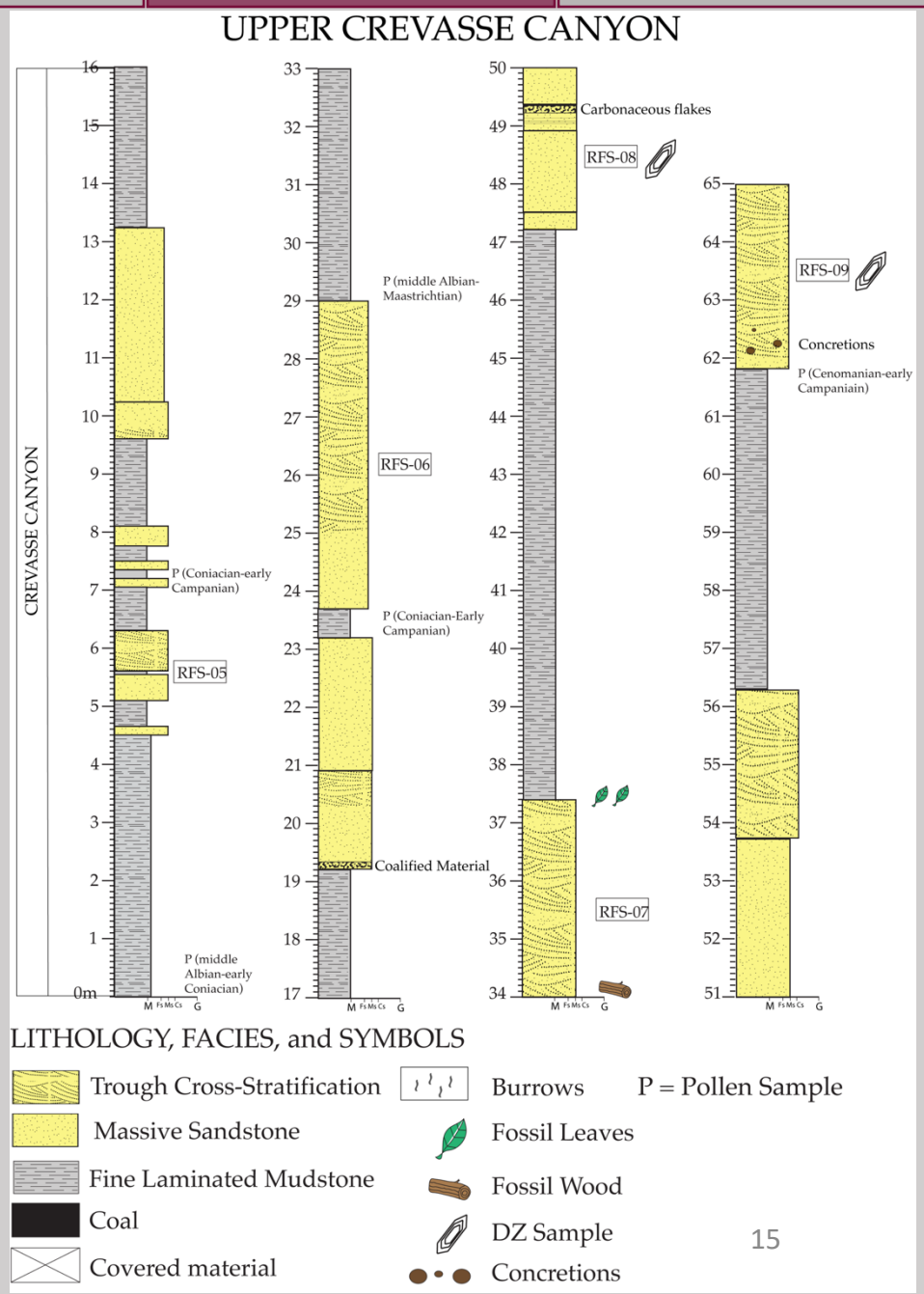

GSA
CM
IN
Ripples

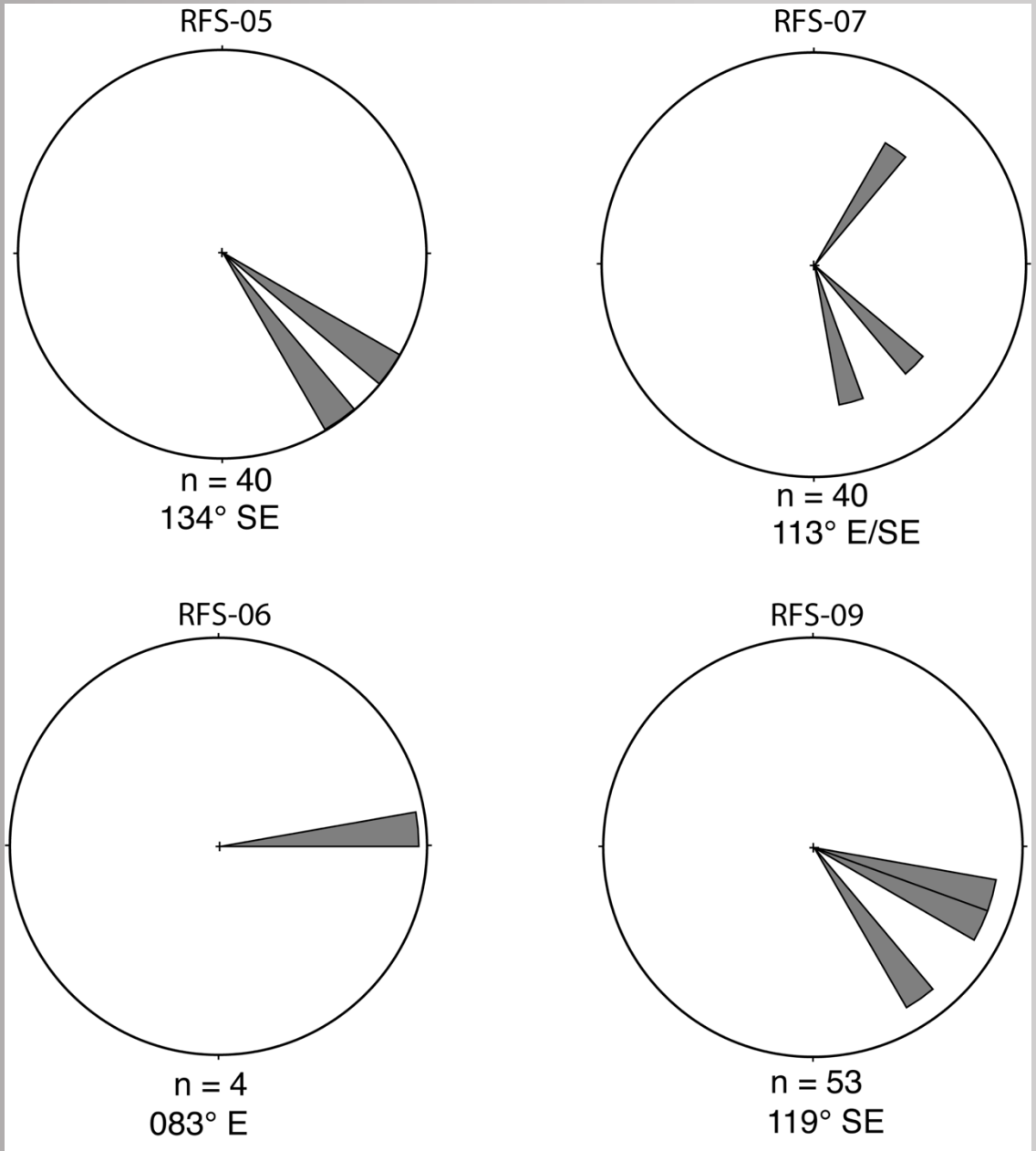

Plant Fossil


MIDDLE CREVASSE CANYON
CREVASSE CANYON
RFS-01
RFS-02
RFS-03
RFS-04
RFS-05
RFS-06
RFS-07
Ripple Marks
Horizontal Bedding
Horizontal Bedding
P (late Cenomanian-early Coniacian)
P (middle Albian-early Campanian)
P (early Coniacian)
M Fs Ms Cs G
LITHOLOGY, FACIES, and SYMBOLS
Trough Cross-Stratification
Horizontal Stratification
Ripple Cross-Stratification
Massive Sandstone
Fine Laminated Mudstone
Coal
Covered material
Burrows
Fossil Leaves
Fossil Wood
DZ Sample
Concretions
P = Pollen Sample

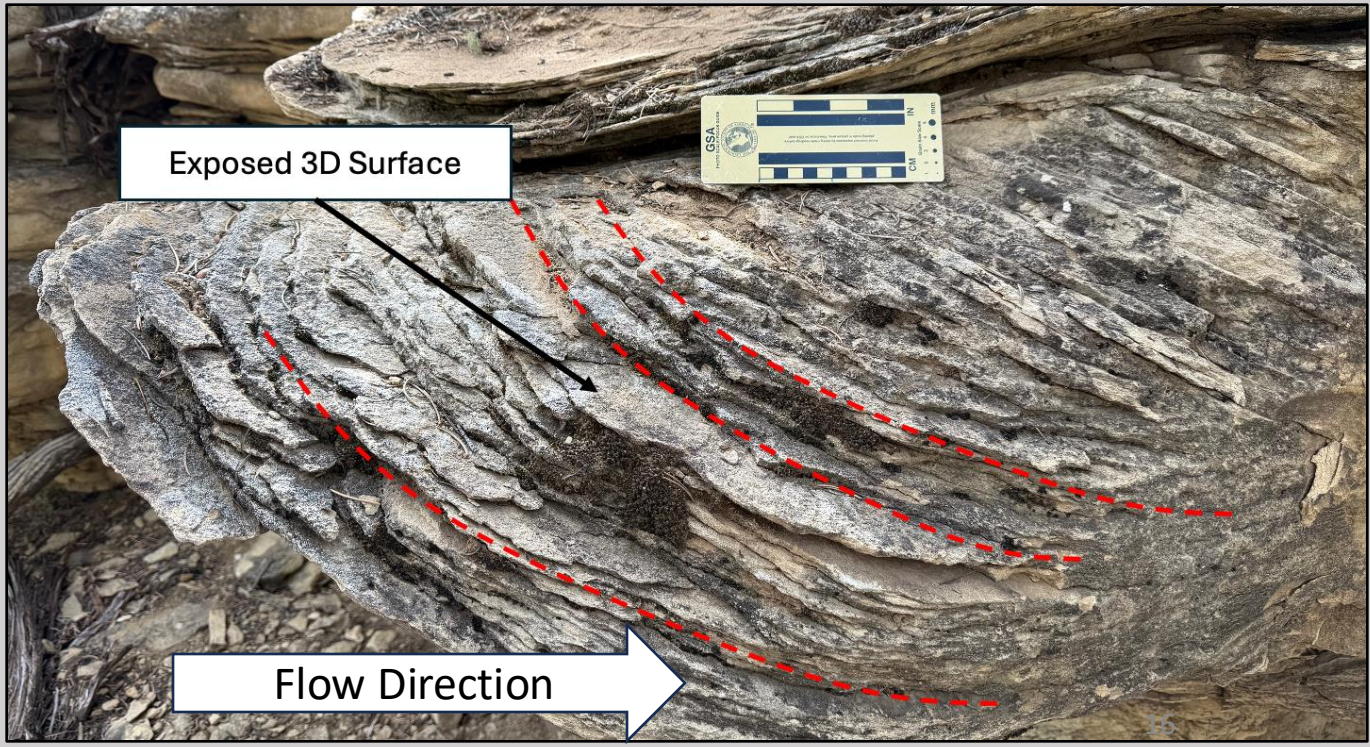

Trough Cross-Stratification


Concretion


UPPER CREVASSE CANYON
CREVASSE CANYON
RFS-05
RFS-06
RFS-07
RFS-08
RFS-09
P (Coniacian-early Campanian)
P (middle Albian-early Coniacian)
P (middle Albian-Maastrichtian)
P (Coniacian-Early Campanian)
P (Cenomanian-early Campaniain)
Carbonaceous flakes
Concretions
Coalified Material
LITHOLOGY, FACIES, and SYMBOLS
Trough Cross-Stratification
Massive Sandstone
Fine Laminated Mudstone
Coal
Covered material
Burrows
Fossil Leaves
Fossil Wood
DZ Sample
Concretions
P = Pollen Sample



- Measurements taken from planar and left/right limbs of trough cross-stratification
- Overall paleoflow trends from Crevasse Canyon in west-central New Mexico show flow to the east/southeast

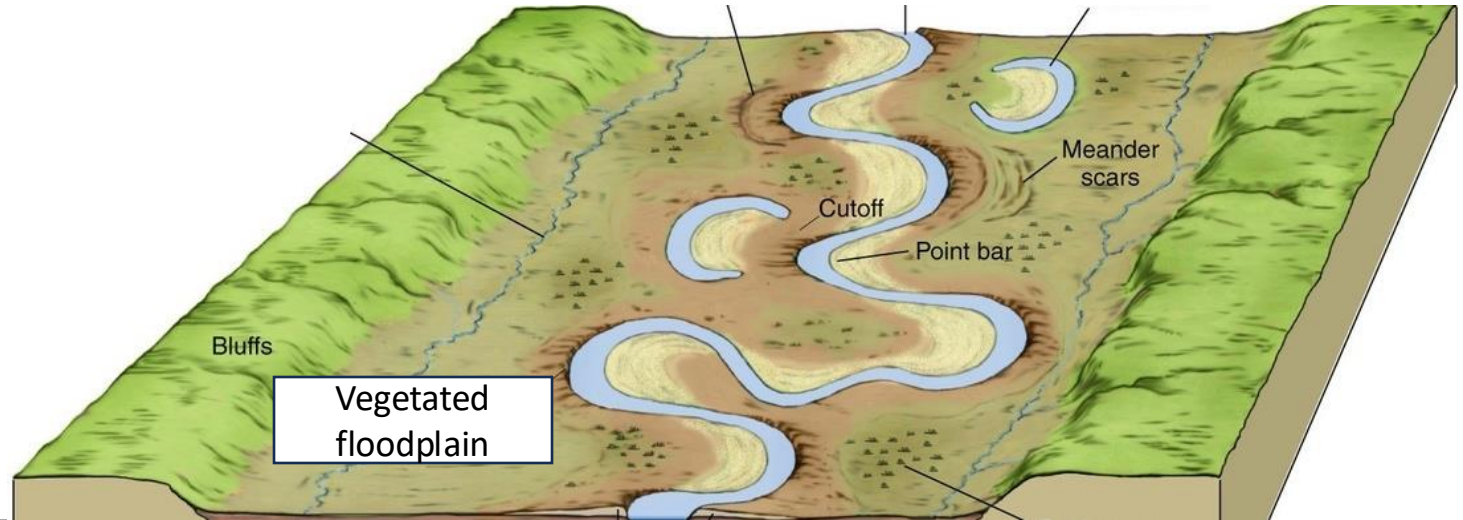


Environment of Deposition Interpretations

- Gallup to lower Crevasse Canyon records final transition from upper shoreface to fluvial EOD

- Crevasse Canyon interpreted as meandering fluvial channels encased in a well developed, highly vegetated, non-marine floodplain in flat lying foreland basin

- Concurrent studies show palynomorph (pollen) samples taken from mudstones at the RFS are non-marine

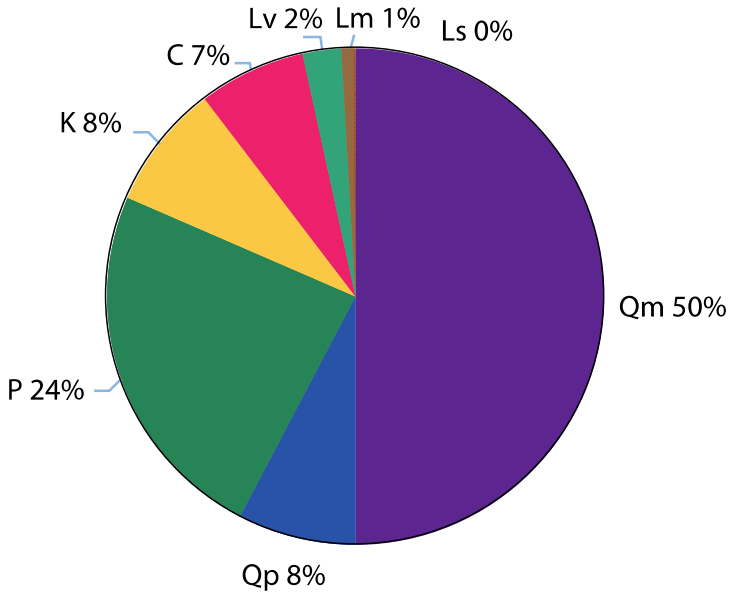


(Pearson Prentice Hall, 2005)

What is the modal composition of these sandstones?

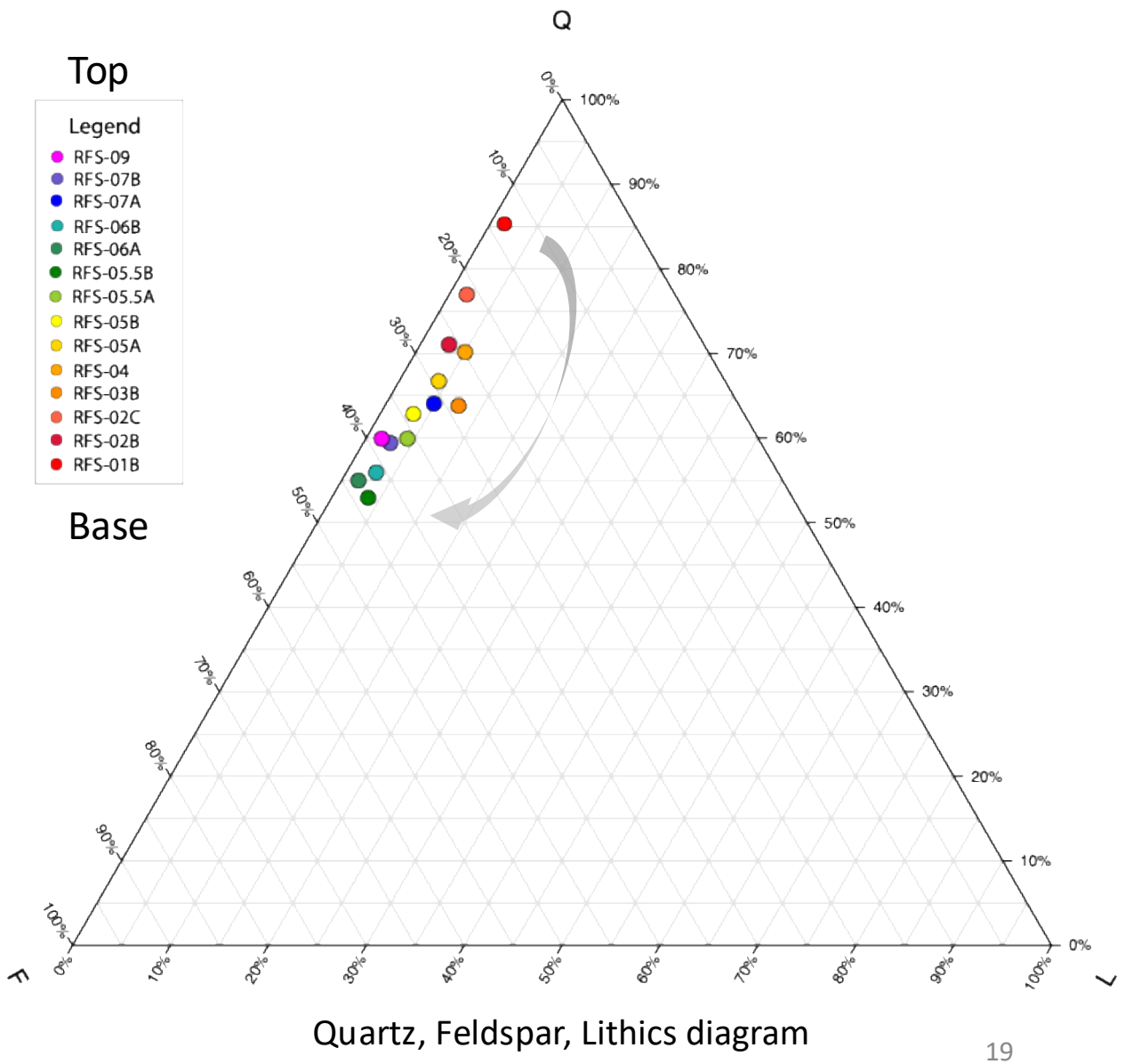
What detrital zircon ages are represented?

RFS Bulk Composition

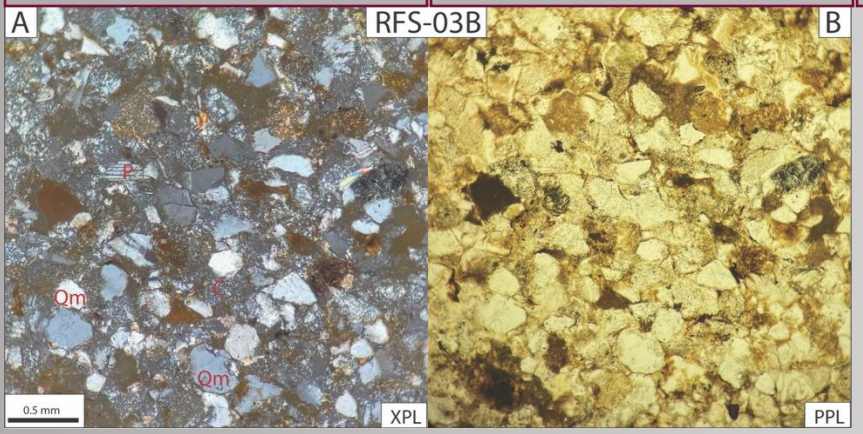


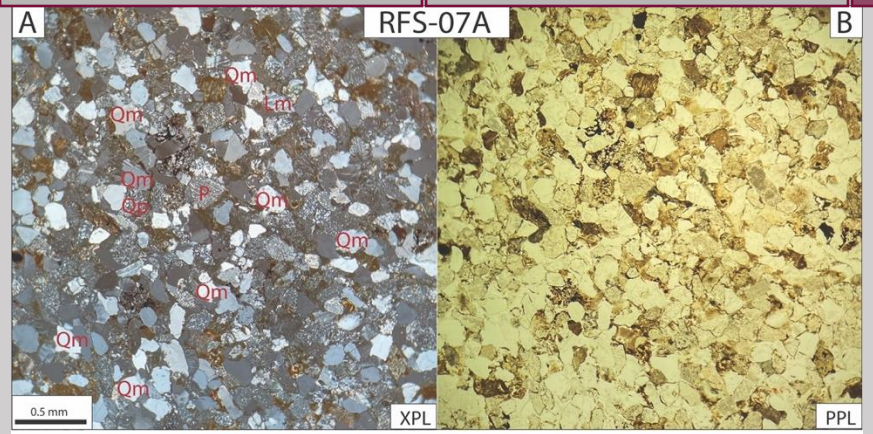
- Qm - Monocrystalline Quartz
- C - Chert
- Qp - Polycrystalline Quartz
- Lv - Lithic Volcanic
- P - Plagioclase Feldspar
- Lm - Lithic Metamorphic
- K - Potassium Feldspar
- Ls - Lithic Sedimentary

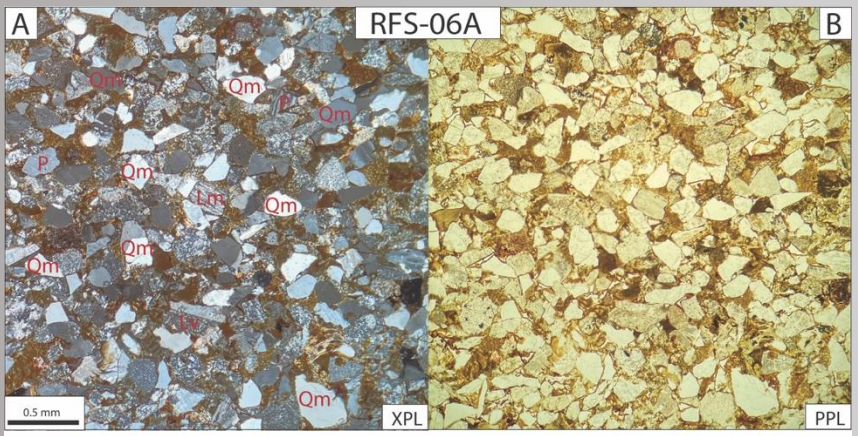
N = 14, n = 5600

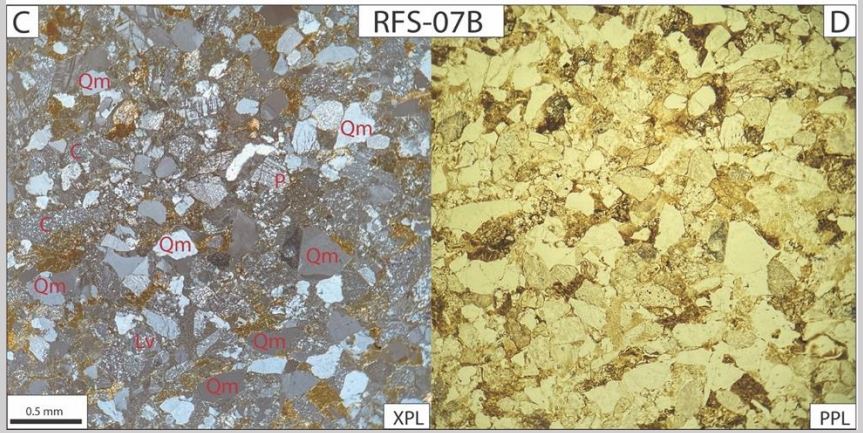


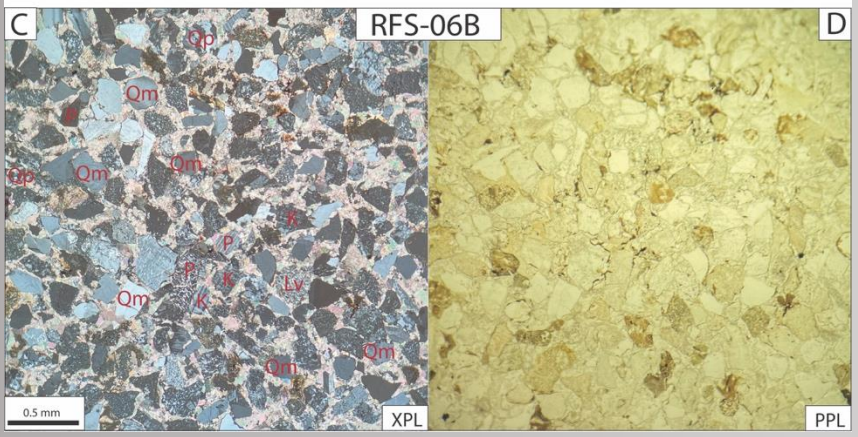
Quartz, Feldspar, Lithics diagram

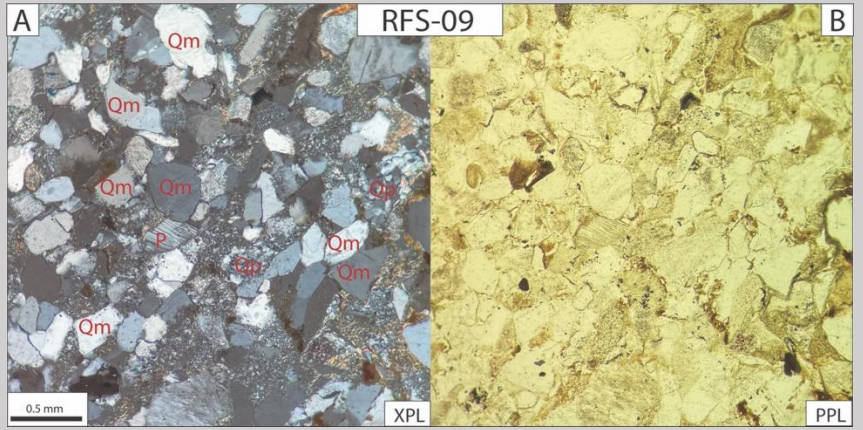




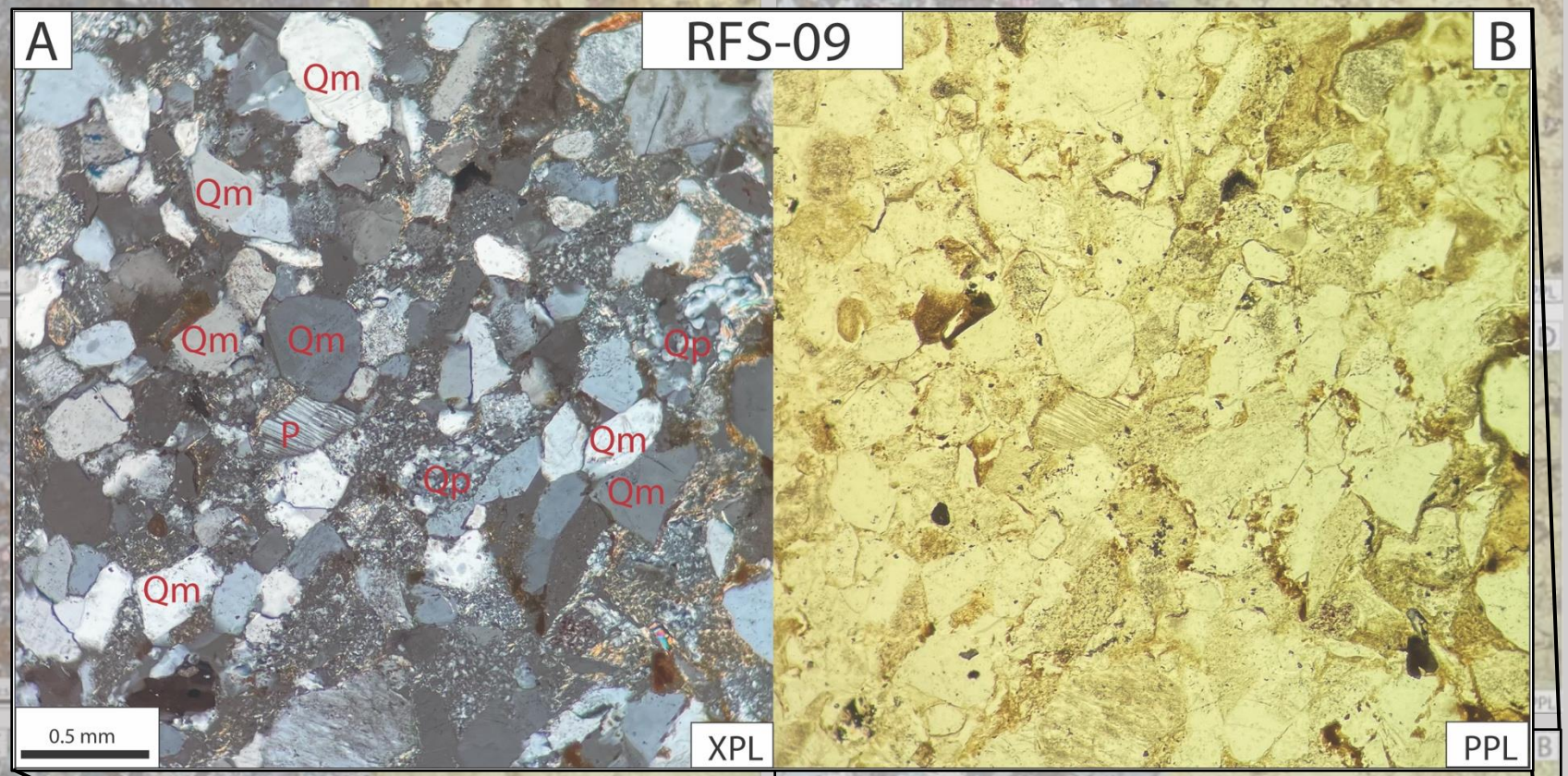






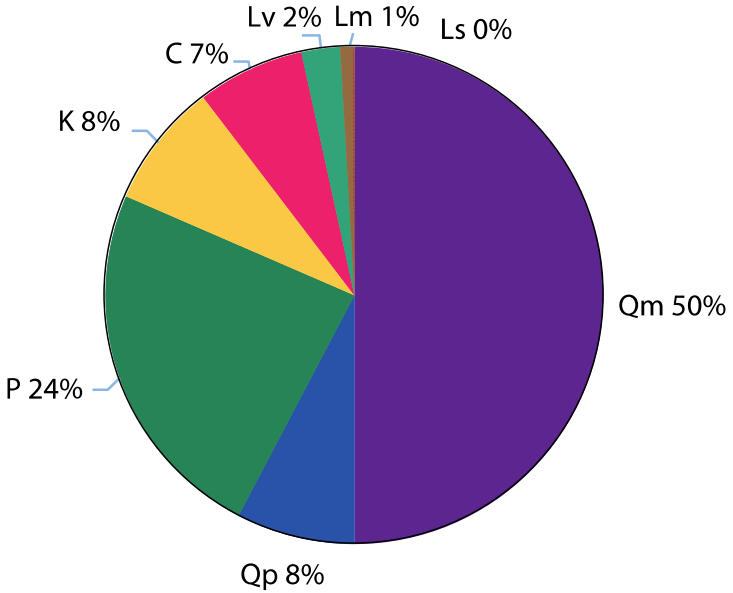


- Sandstones characterized by predominantly upper fine to medium grained sand
- Grains sub-angular to sub-rounded and well sorted
- At first glance, noticeable abundant and well-defined quartz grains and feldspars



- (Qm = monocrystalline quartz, Qp = polycrystalline quartz, P = Plagioclase feldspar)

RFS Bulk Composition



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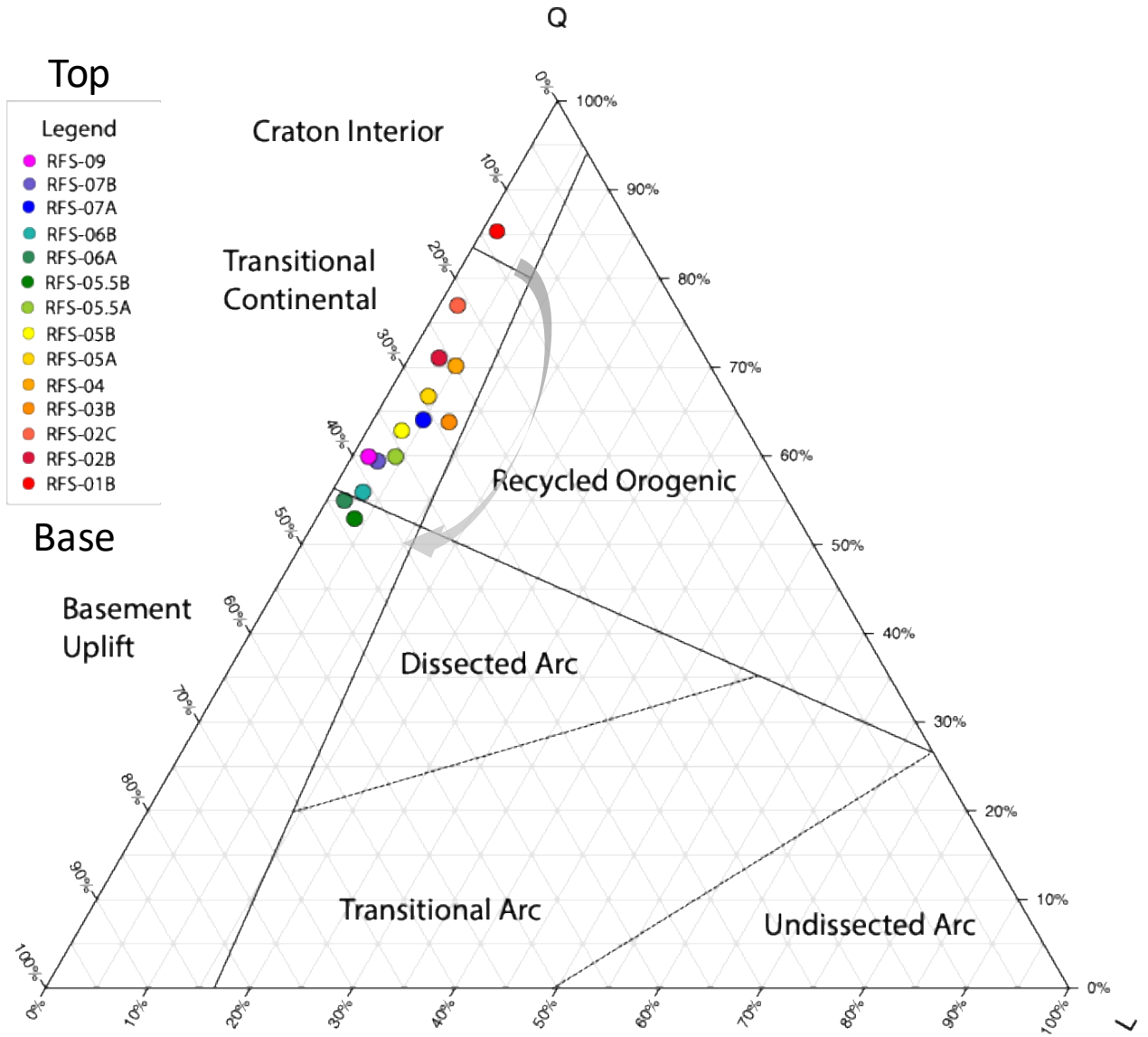
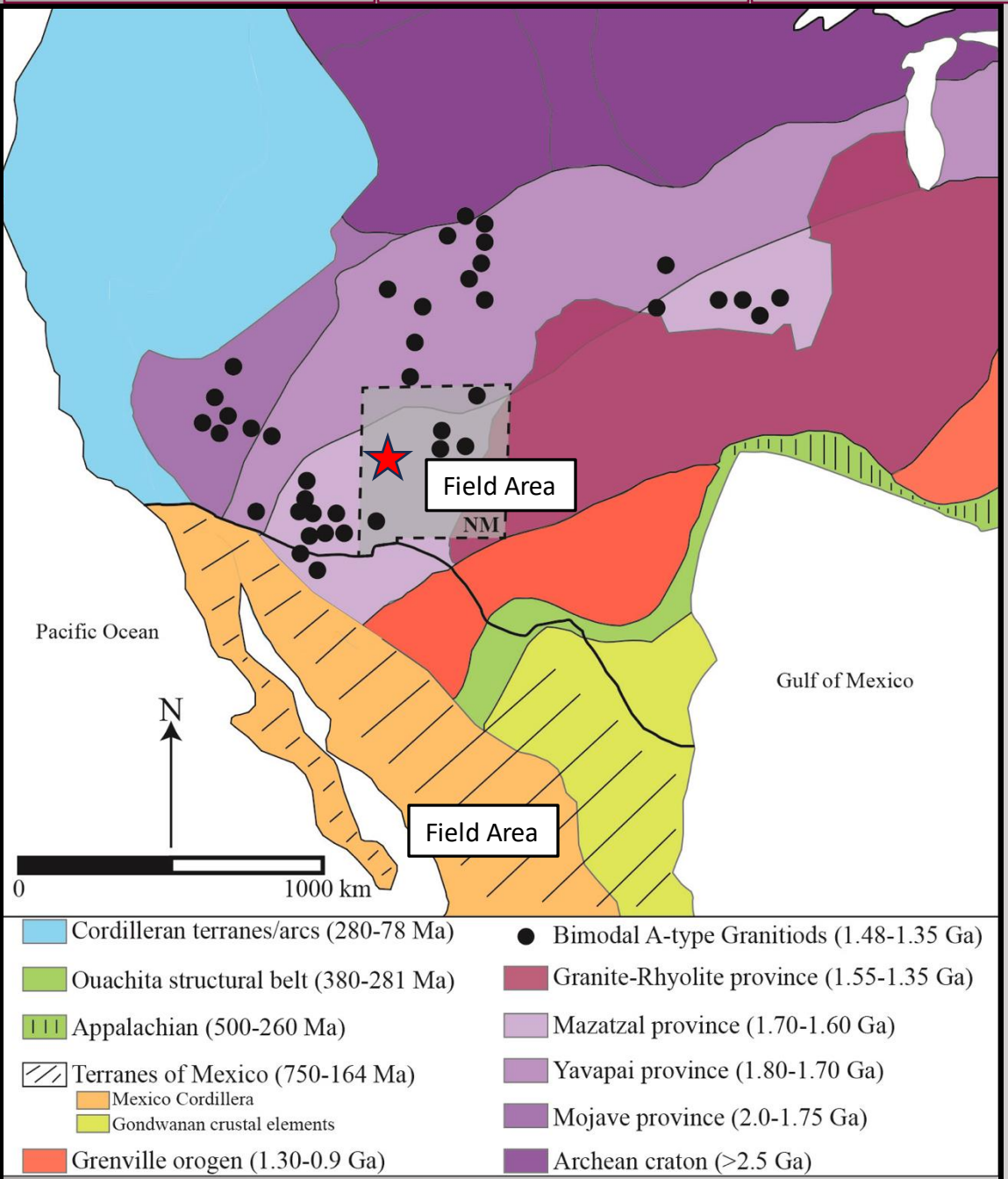
N = 14, n = 5600



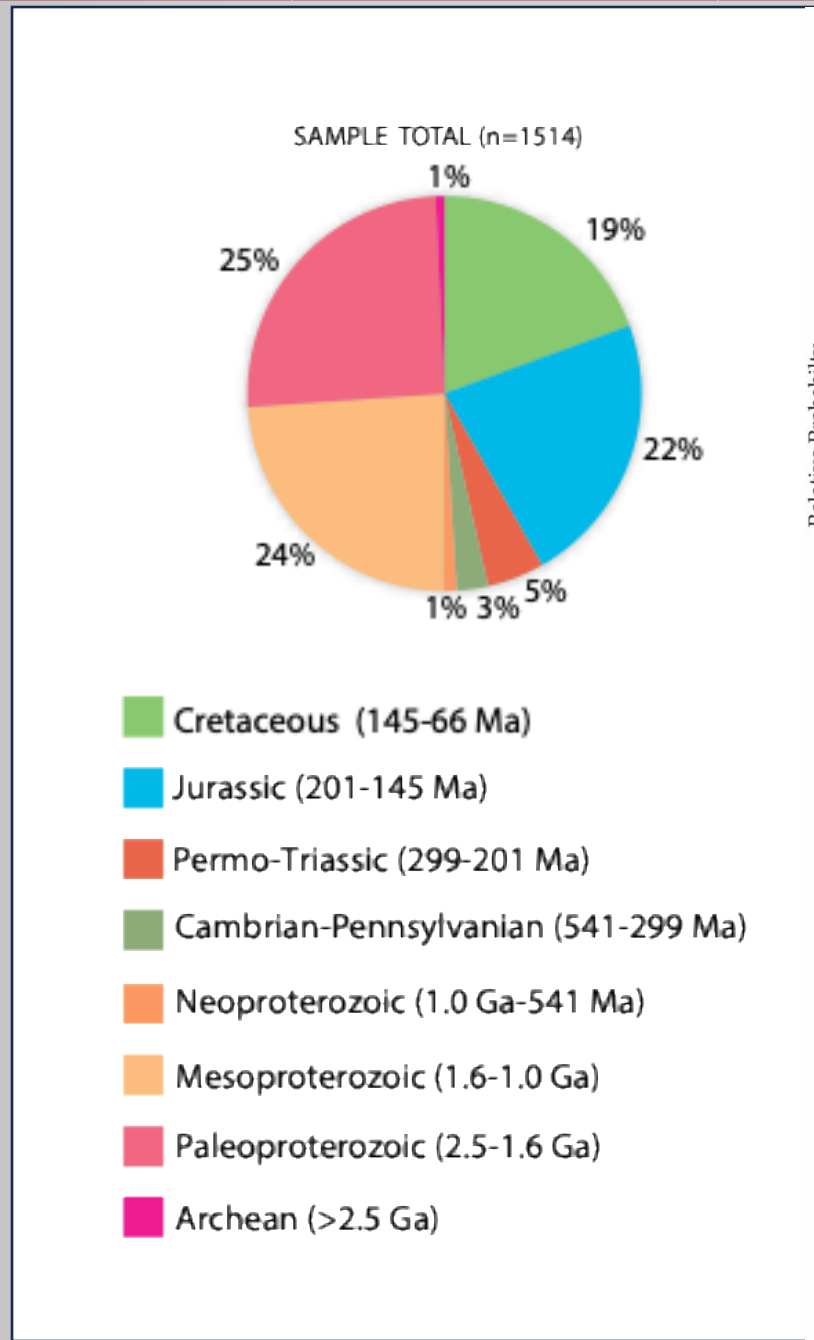
Discrimination Diagram (Dickinson et al, 1983)

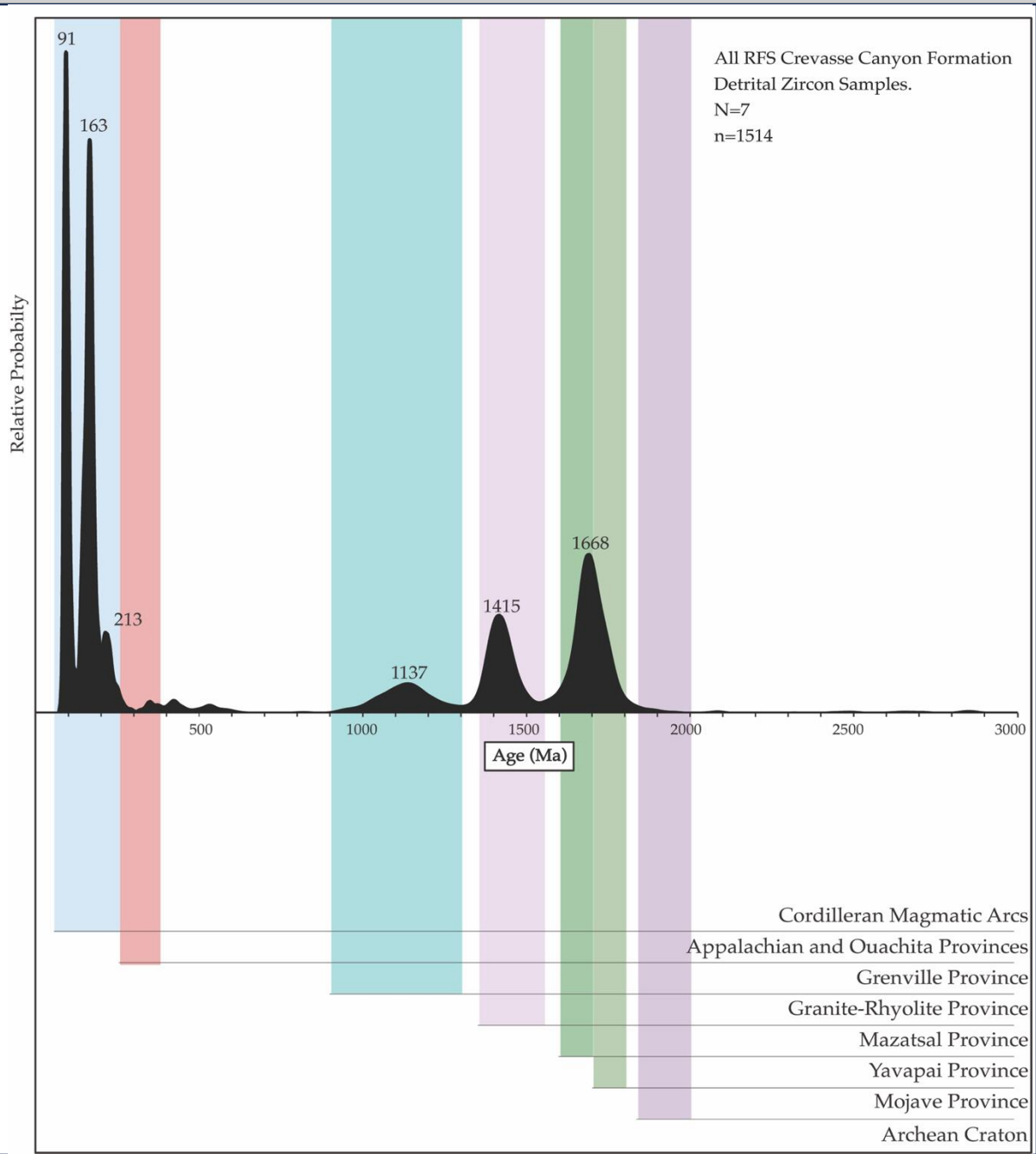


- Map shows continent scale provinces
- Detrital Zircon age data should fall within age ranges
- Provides Insight into sediment sourcing
- Note: Precambrian basement not exposed during Late Cretaceous in New Mexico

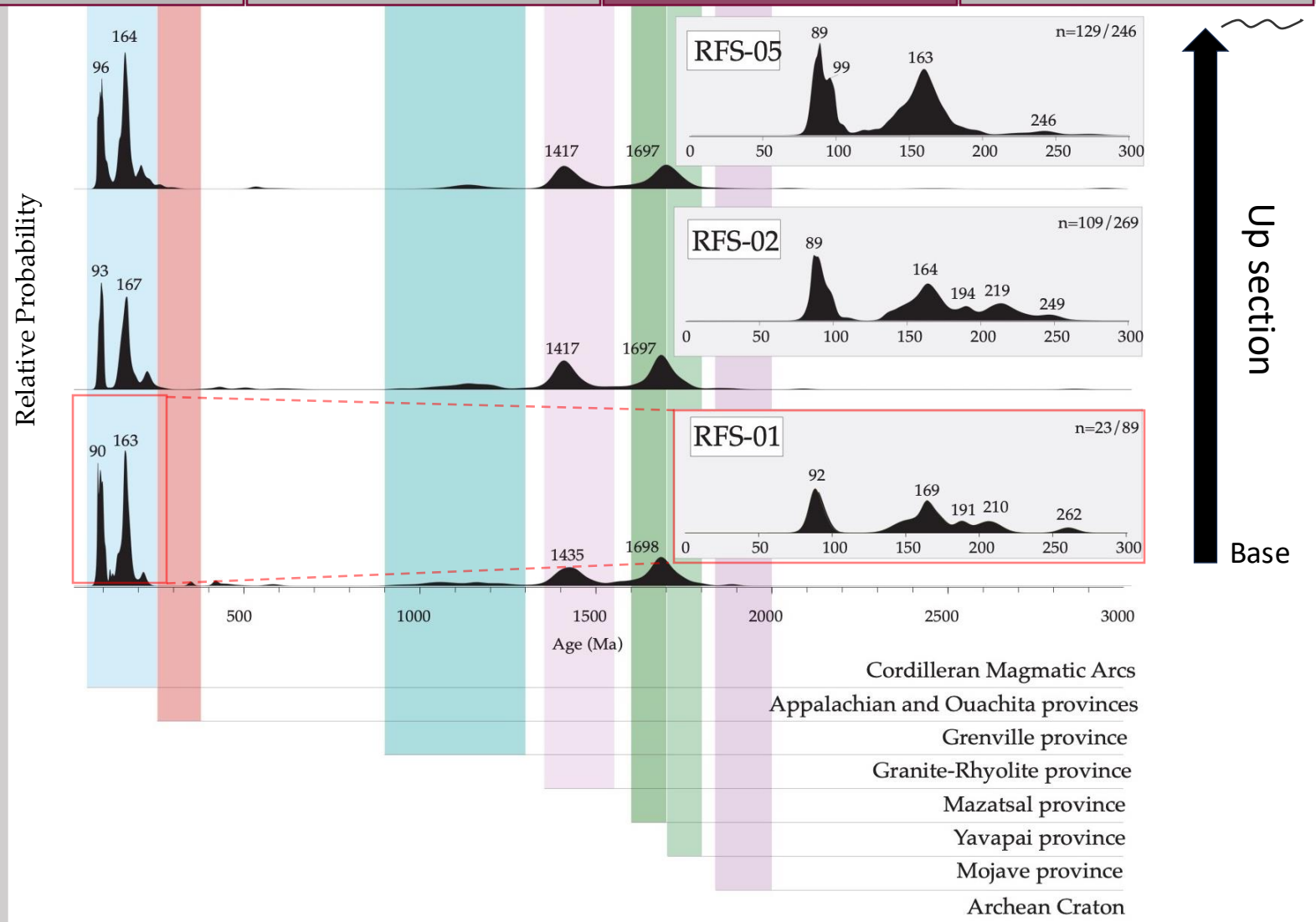
Modified from (Stopka, 2015)

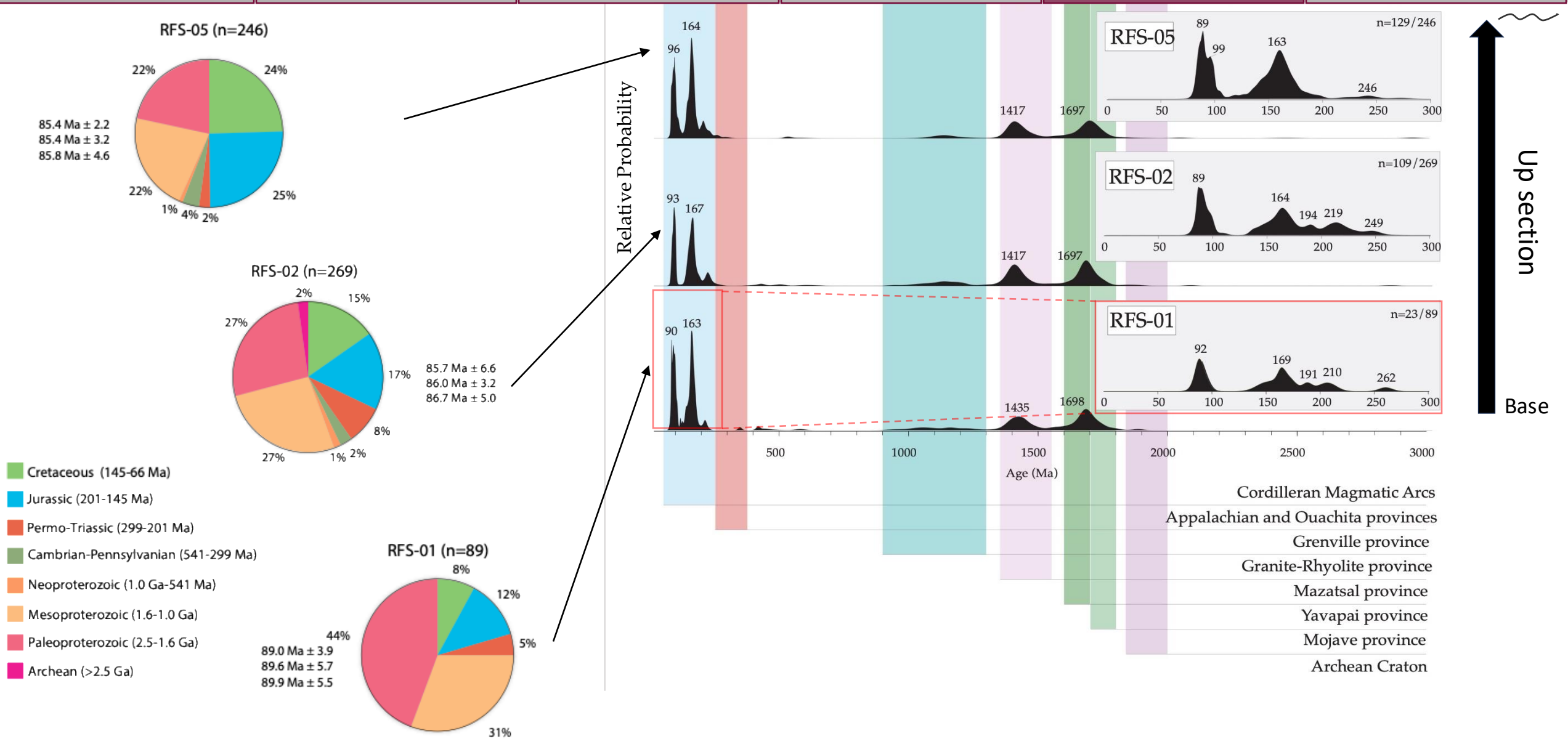
- Bulk zircon ages dominated by Paleoproterozoic grains
- Mesoproterozoic, Jurassic, and Cretaceous grains also abundant



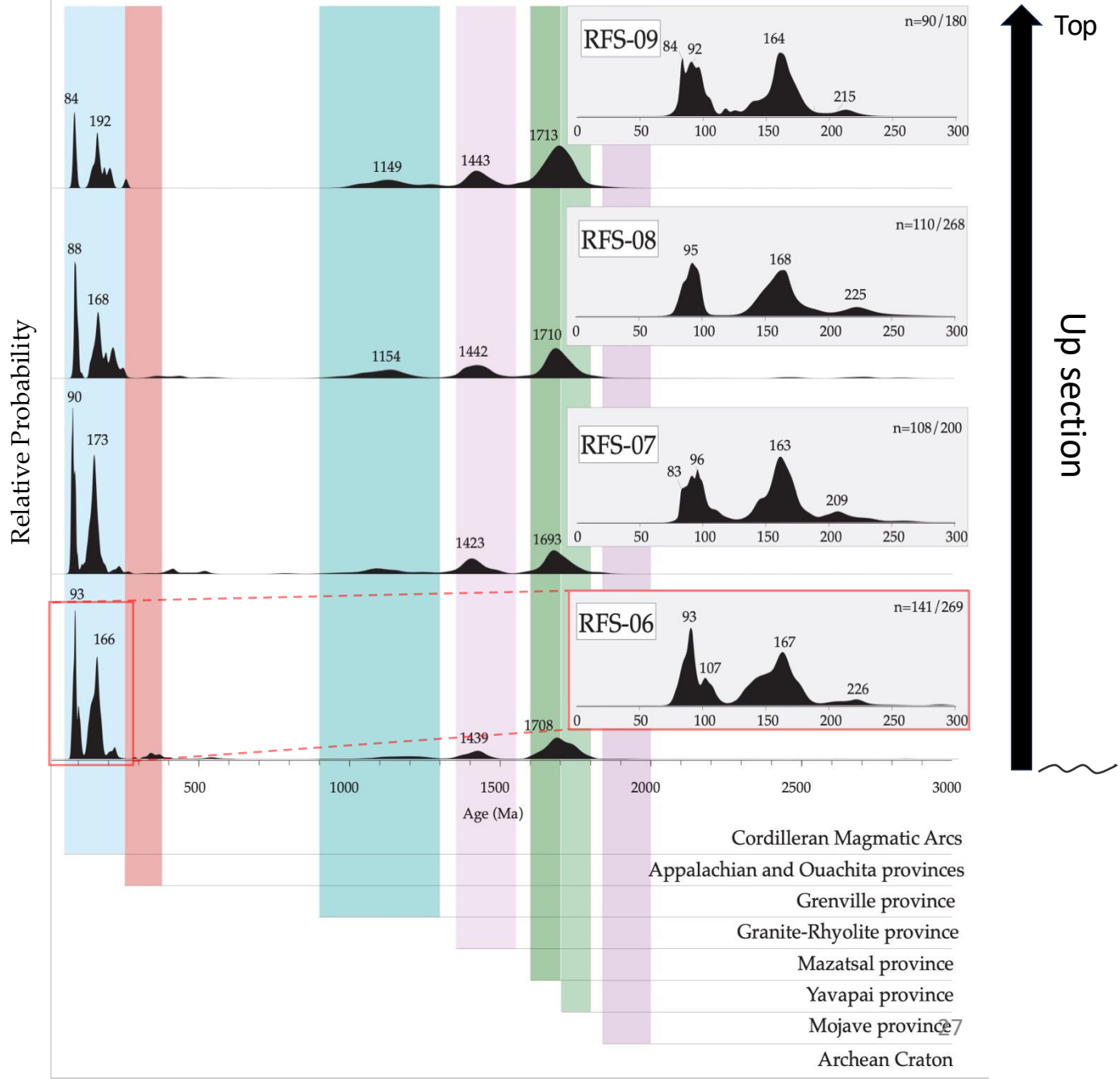


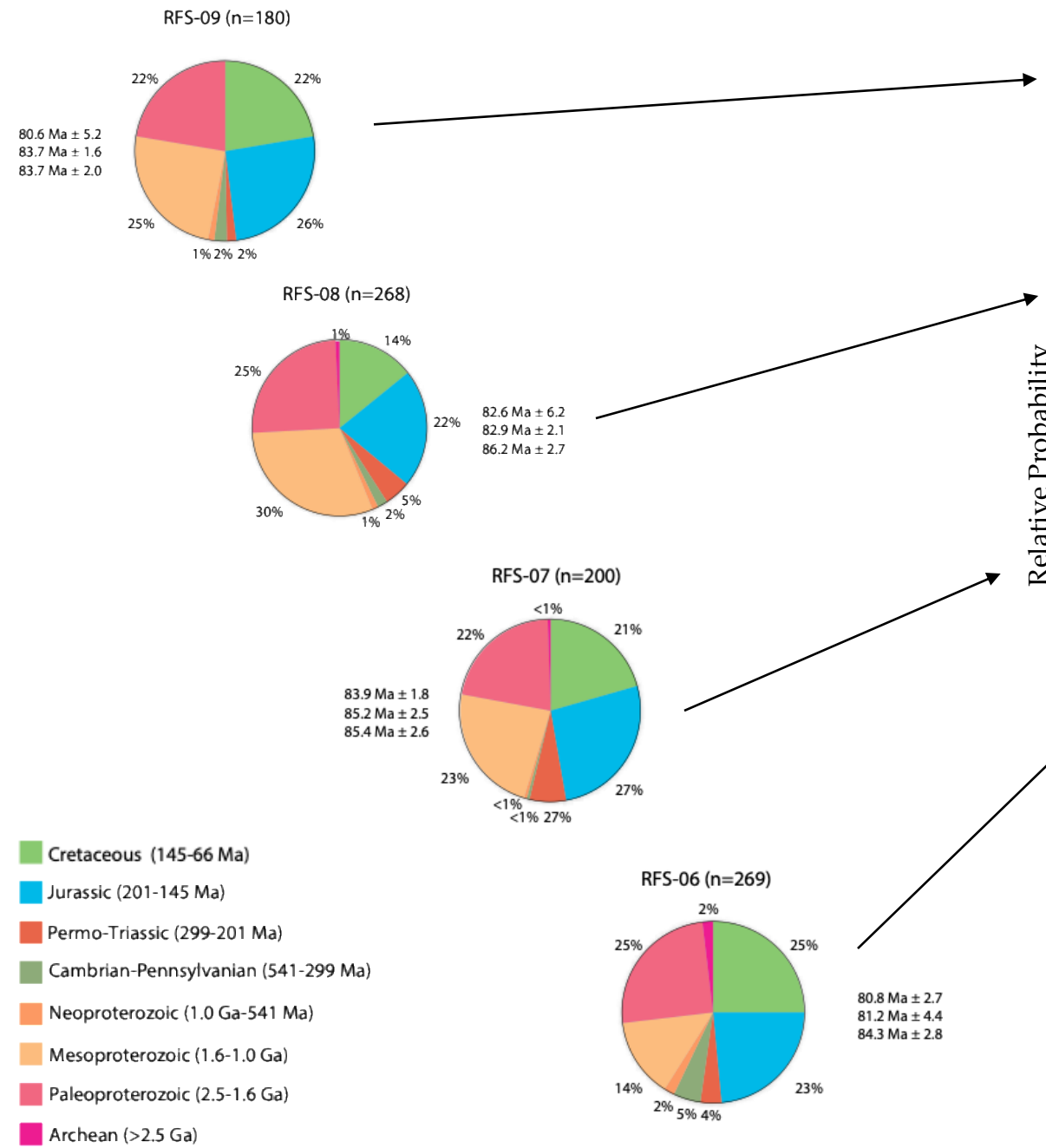
- Primary Peaks: 90-167 Ma
- Secondary Peak: 1417-1698 Ma
- Isolated occurrences at: 950-1300 Ma & 300-500 Ma

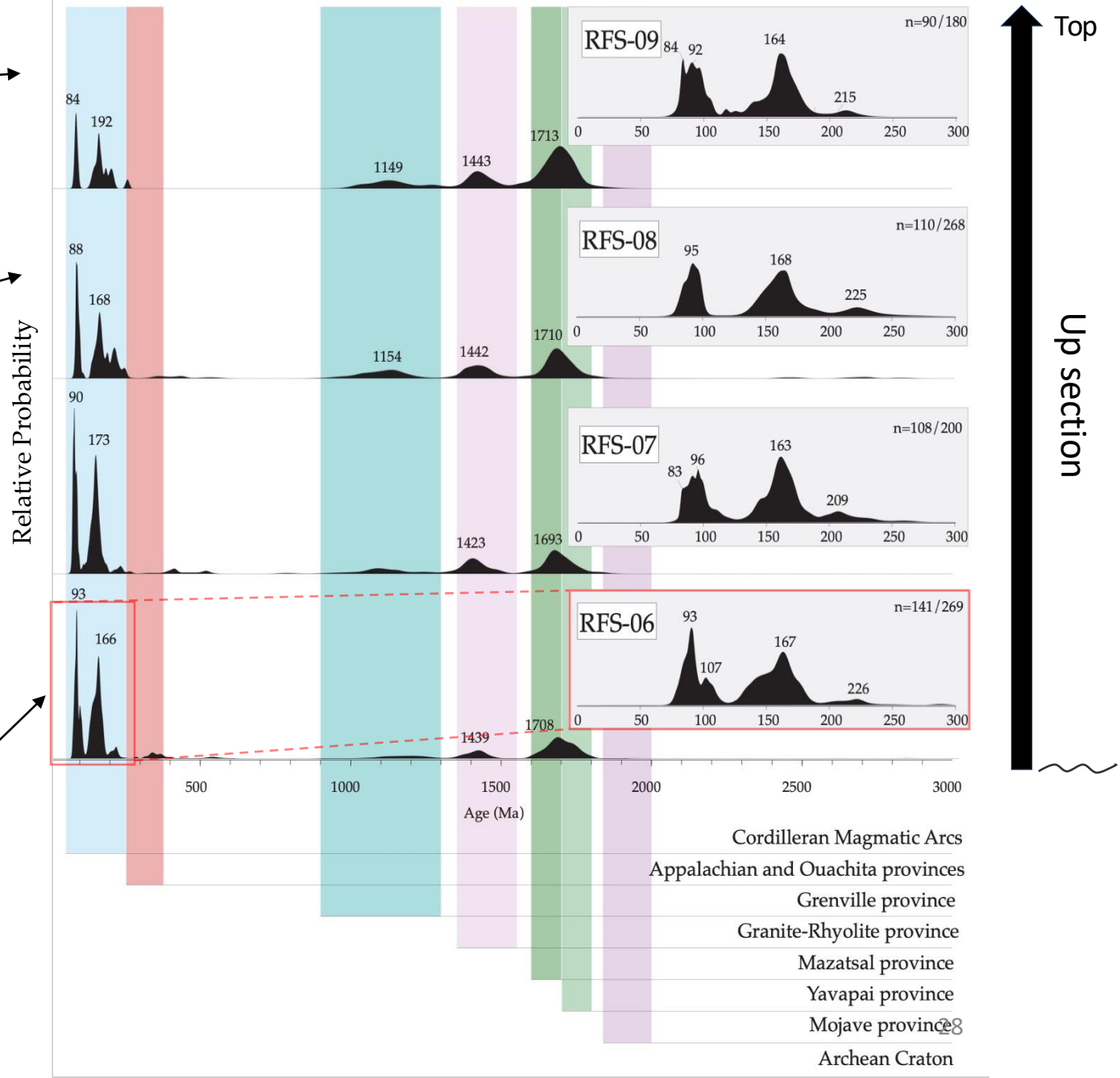



RFS-05 (n=246)
22%
24%
22%
25%
1%
4%
2%
85.4 Ma ± 2.2
85.4 Ma ± 3.2
85.8 Ma ± 4.6
RFS-02 (n=269)
2%
15%
27%
17%
8%
27%
1%
2%
85.7 Ma ± 6.6
86.0 Ma ± 3.2
86.7 Ma ± 5.0
RFS-01 (n=89)
8%
12%
44%
5%
31%
89.0 Ma ± 3.9
89.6 Ma ± 5.7
89.9 Ma ± 5.5
Cretaceous (145-66 Ma)
Jurassic (201-145 Ma)
Permo-Triassic (299-201 Ma)
Cambrian-Pennsylvanian (541-299 Ma)
Neoproterozoic (1.0 Ga-541 Ma)
Mesoproterozoic (1.6-1.0 Ga)
Paleoproterozoic (2.5-1.6 Ga)
Archean (>2.5 Ga)
Relative Probability
164
96
1417
1697
RFS-05
n=129/246
89
99
163
246
93
167
RFS-02
n=109/269
89
164
194
219
249
90
163
RFS-01
n=23/89
92
169
191
210
262
1435
1698
0
50
100
150
200
250
300
500
1000
1500
2000
2500
3000
Age (Ma)
Up section
Base
Cordilleran Magmatic Arcs
Appalachian and Ouachita provinces
Grenville province
Granite-Rhyolite province
Mazatsal province
Yavapai province
Mojave province
Archean Craton

- Primary Peaks: 90-167 Ma
- Secondary Peak: 1417-1698 Ma
- Isolated occurrences at: 950-1300 Ma & 300-500 Ma
- Slight decrease in probability for primary peaks




RFS-09 (n=180)
22%
22%
25%
26%
1% 2% 2%
80.6 Ma ± 5.2
83.7 Ma ± 1.6
83.7 Ma ± 2.0
RFS-08 (n=268)
1%
14%
25%
22%
30%
5%
1%
2%
82.6 Ma ± 6.2
82.9 Ma ± 2.1
86.2 Ma ± 2.7
RFS-07 (n=200)
<1%
22%
21%
23%
27%
<1%
<1% 27%
83.9 Ma ± 1.8
85.2 Ma ± 2.5
85.4 Ma ± 2.6
RFS-06 (n=269)
2%
25%
25%
14%
23%
2%
5% 4%
80.8 Ma ± 2.7
81.2 Ma ± 4.4
84.3 Ma ± 2.8
Cretaceous (145-66 Ma)
Jurassic (201-145 Ma)
Permo-Triassic (299-201 Ma)
Cambrian-Pennsylvanian (541-299 Ma)
Neoproterozoic (1.0 Ga-541 Ma)
Mesoproterozoic (1.6-1.0 Ga)
Paleoproterozoic (2.5-1.6 Ga)
Archean (>2.5 Ga)

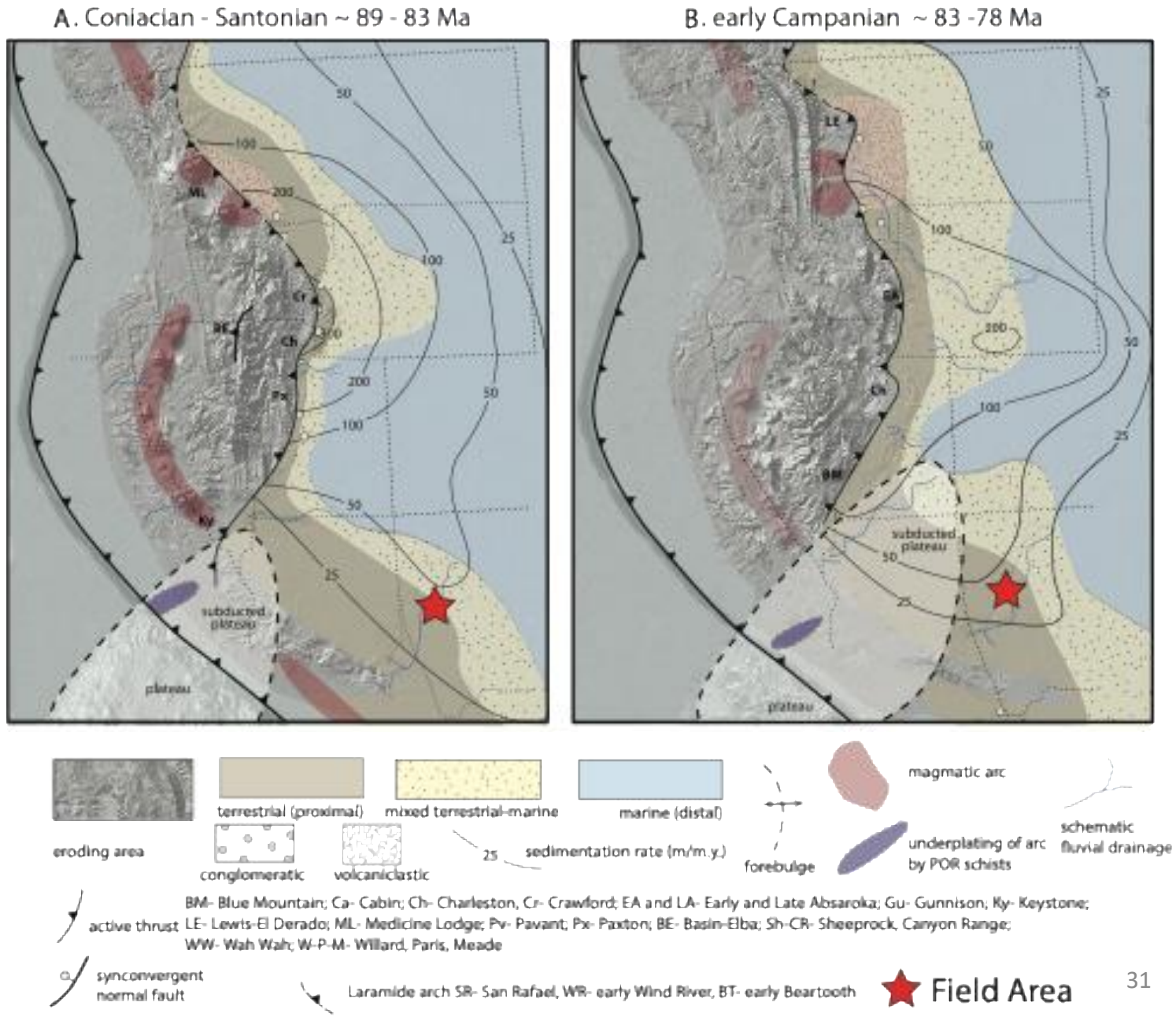

Relative Probability
RFS-09
n=90/180
84 92 164 215
84 192 1149 1443 1713
RFS-08
n=110/268
95 168 225
88 168 1154 1442 1710
RFS-07
n=108/200
83 96 163 209
90 173 1423 1693
RFS-06
n=141/269
93 107 167 226
93 166 1439 1708
0 50 100 150 200 250 300
500 1000 1500 2000 2500 3000
Age (Ma)
Top
Up section
Cordilleran Magmatic Arcs
Appalachian and Ouachita provinces
Grenville province
Granite-Rhyolite province
Mazatsal province
Yavapai province
Mojave province
Archean Craton

Key Modal Composition and DZ Interpretations

- Sandstone modal composition data biased towards transitional continental and basement uplift provenance fields
- Sandstones dominated by quartz, feldspar abundance increases upsection, lithic fragments make up very little of overall composition
- Youngest grains within Coniacian-Santonian range, with youngest single grain possibly Campanian in age, likely from reworked airfall/ash
- Detrital zircon data has both zircons that overlap with Cretaceous Cordilleran Arc signatures, as well as older Mesozoic to Precambrian age signatures

Effects of buoyant plateau subduction?

- Shatsky conjugate subducting underneath the continent to the east
- Deeper, plutonic roots exhumed and eroded



(Yonkee and Weil, 2015)

Coniacian-Santonian (89-83 Ma)

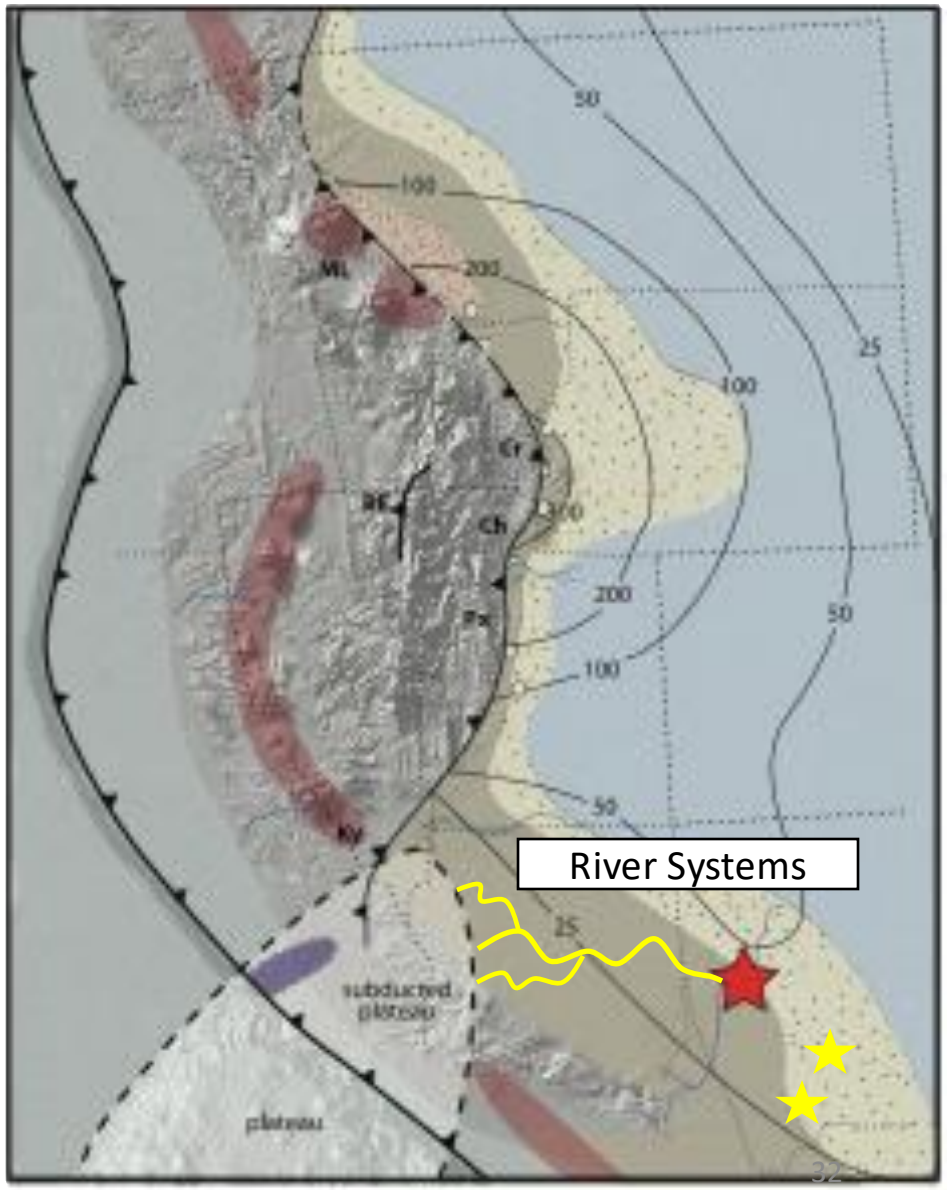
Western Interior Seaway

River Systems

This study

Previous studies

Coniacian-Santonian (89-83 Ma)



(Yonkee and Weil, 2015)

1. Based on sedimentary and palynology data, this section of Crevasse Canyon Formation represents **a distal, non-marine, meandering fluvial system in a flat lying, vegetated foreland basin**

2. The lower part of the Crevasse Canyon Formation is of Coniacian-Santonian age, but **could be as young as early Campanian**

3. Mesozoic to Precambrian DZ ages likely sourced from **recycled Mesozoic eolianites of the Colorado plateau region**

4. Provenance interpretations tell us **headwaters originated directly from Cordilleran arc to the west to deposit zircons of similar age as the formation**

5. DZ and modal composition indicates **exhumation of plutonic roots** despite modal composition plotting within transitional continental fields

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