SLATE MOUNTAIN AND NORTHERN SAND SPRINGS RANGE, NEVADA GEOLOGIC MAPS CLARIFY KEY CROSS-CUTTING RELATIONS IN THE CORDILLERAN HINTERLAND

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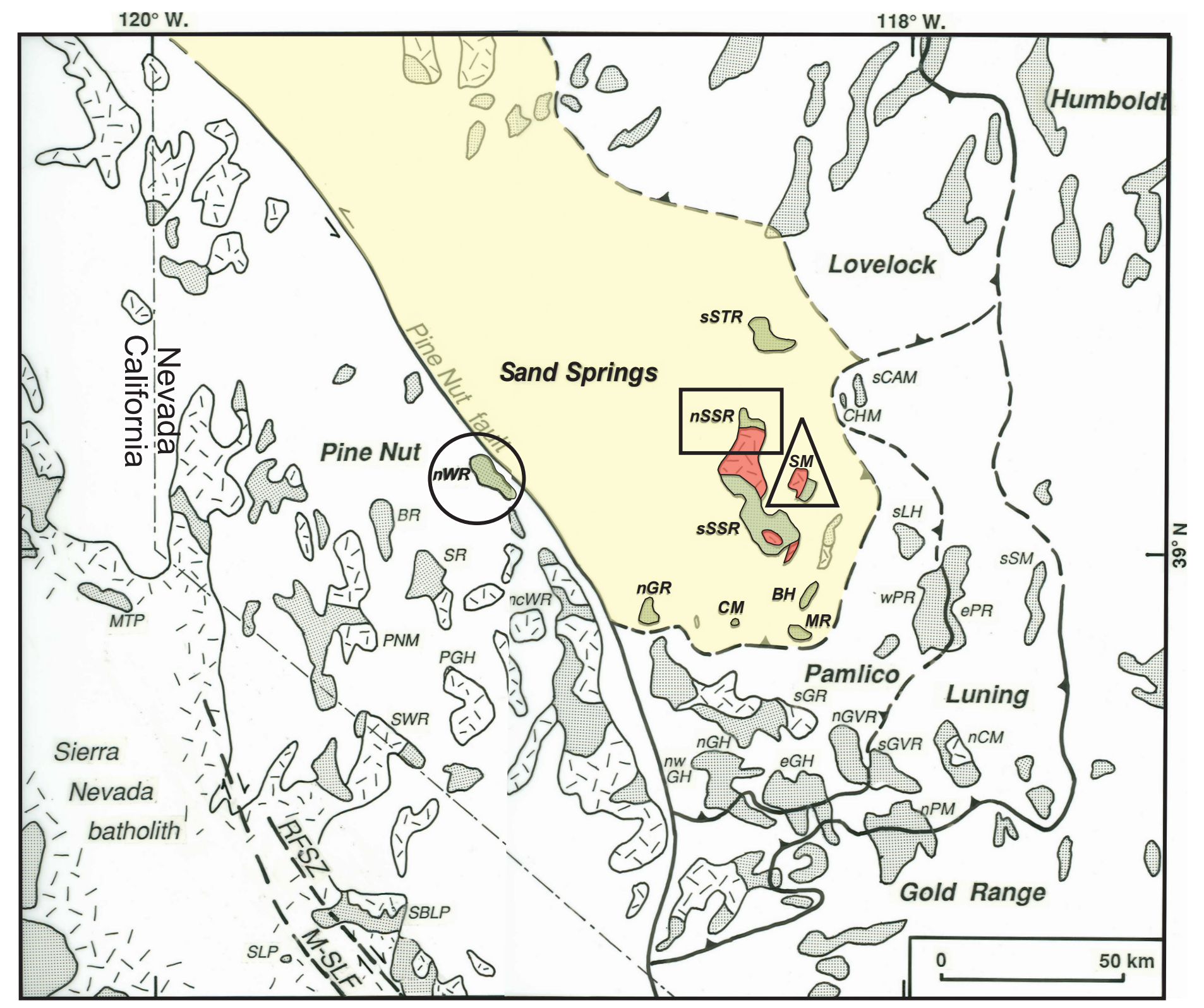
Objectives:

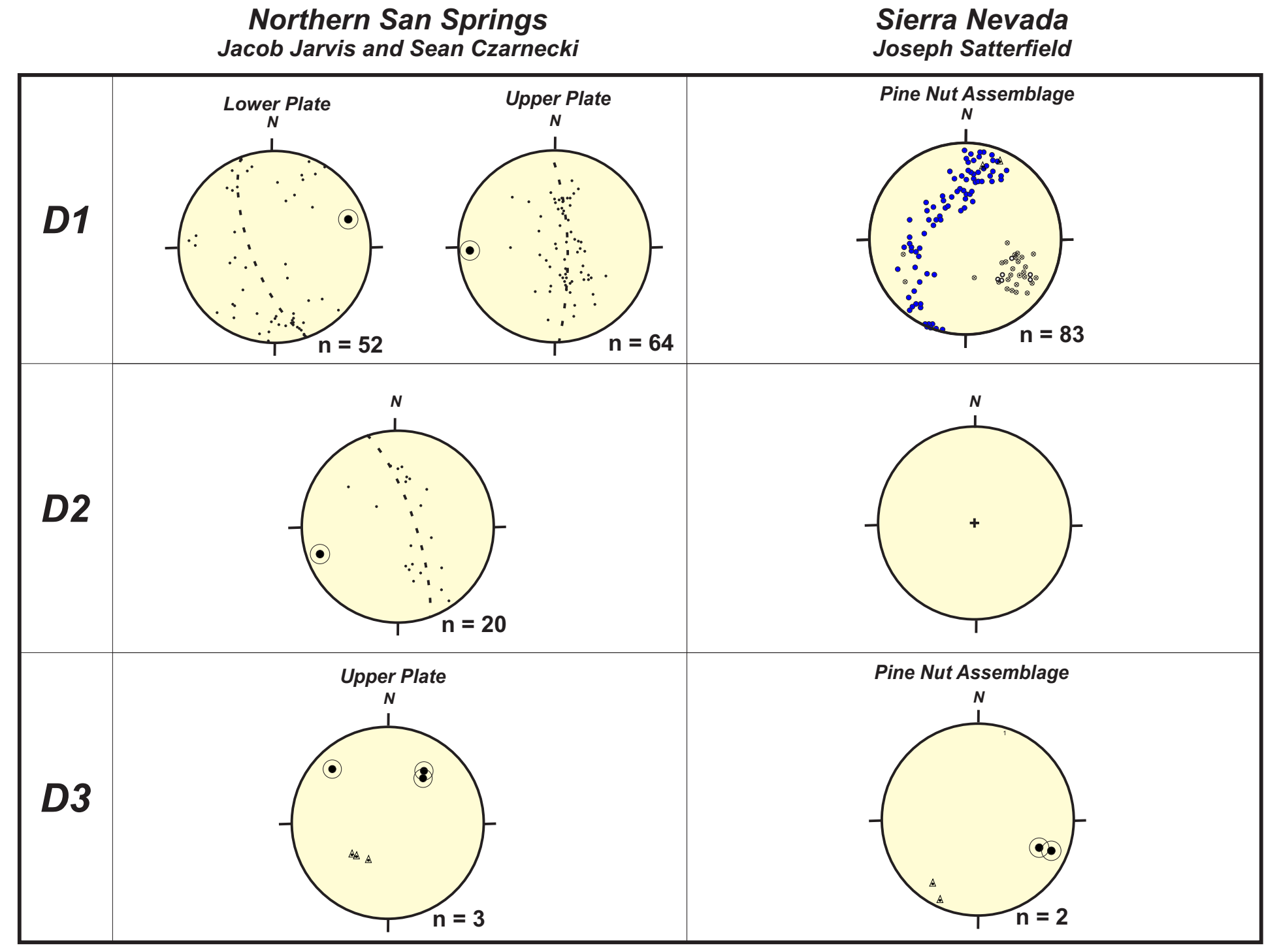
- To create detailed geologic maps of the northern Sand Springs Range (nSSR) and Slate Mountain (SM) of the Sand Springs assemblage at a 1:8000 scale.
- To collect fault kinematic data.
- To describe orientations of map-scale folds.
- To construct cross-sections for the two map areas including a tied grid of cross-sections for the nSSR in order to model the subsurface.
- To revise previously published sequences of events based on geologic mapping and to confirm sequence correlation between the two map areas.
- To correlate deformation events across the Sand Springs assemblage and into nearby assemblages.

Methods:

- Completed field mapping using handheld GPS and Brunton compasses over two field seasons (August 2015 and June 2016) totaling three weeks.
- Extrapolated mapped contacts using satellite imagery.
- Used field measurements to create cross-sections including a tied grid for the northern Sand Springs Range.
- Analyzed thin sections with petrographic microscopes to complete rock descriptions and correlate units in the two map areas.
- Constructed stereonets to show deformation phases and correlations with surrounding terranes.



Regional Map of west central Nevada showing the locations of the northern Sand Springs Range (nSSR, in rectangle), Slate Mountain (SM, in triangle), and northern Wassuk Range (nWR, in circle). Major lithotectonic assemblages and their bounding faults are also shown. The nSSR and SM are in the Sand Springs assemblage (in yellow) of the Luning-Fencemaker Fold and Thrust Belt (LFTB) and the nWR is in the Pine Nut assemblage. Modified from Oldow et al. (1993).



Stereonets show three deformation events in the northern Sand Springs Range and two correlative events in the Pine Nut assemblage. D1 is a pre-LFTB deformation event found in both assemblages. D2, LFTB first-phase folding and faulting, is present in the Sand Springs assemblage but not in the Pine Nut assemblage. Nothwest-trending D3 folds overprint earlier structures in both assemblages.

Geologic Map of the Northern Sand Springs Range, Churchill County, Nevada

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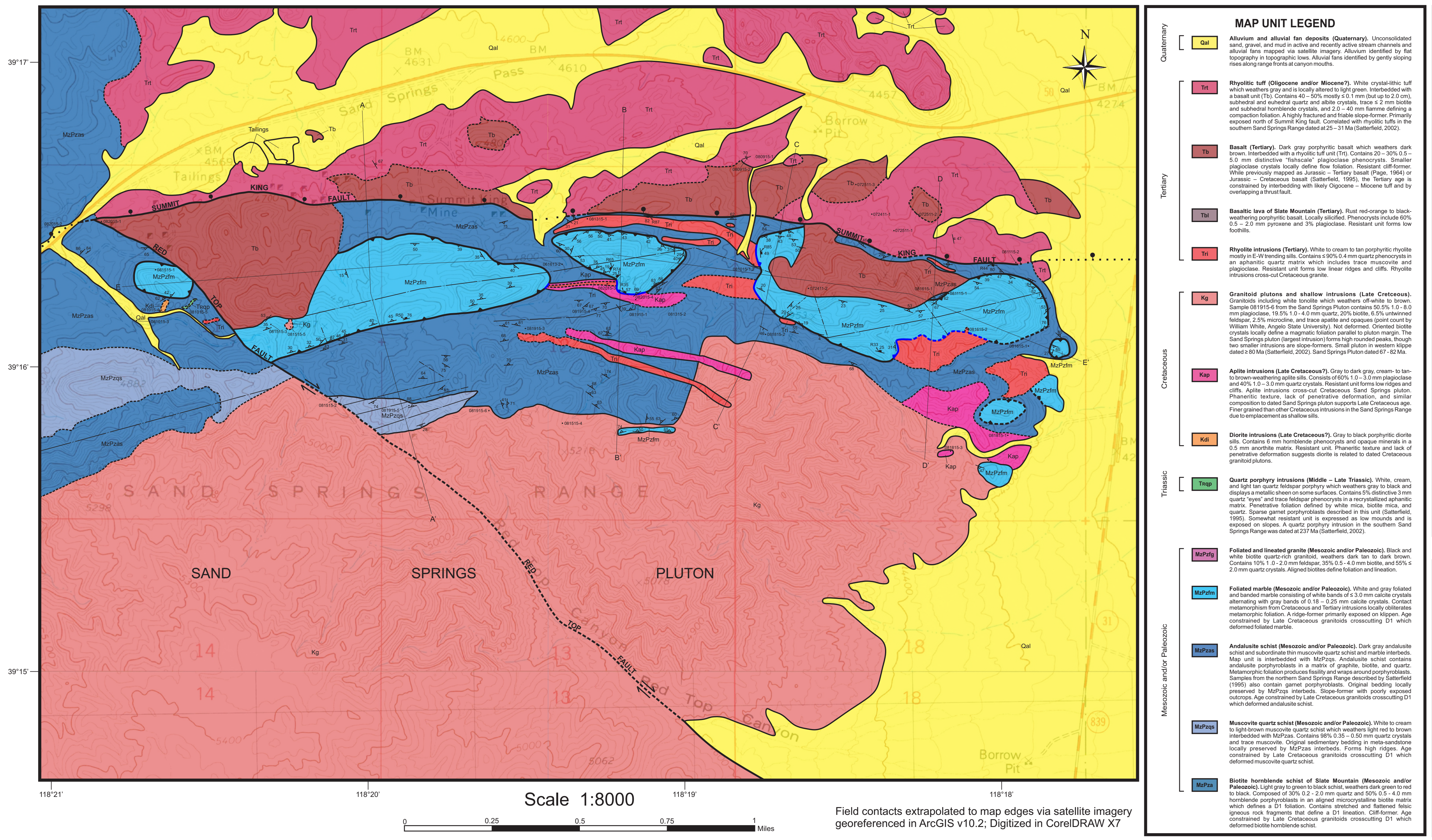
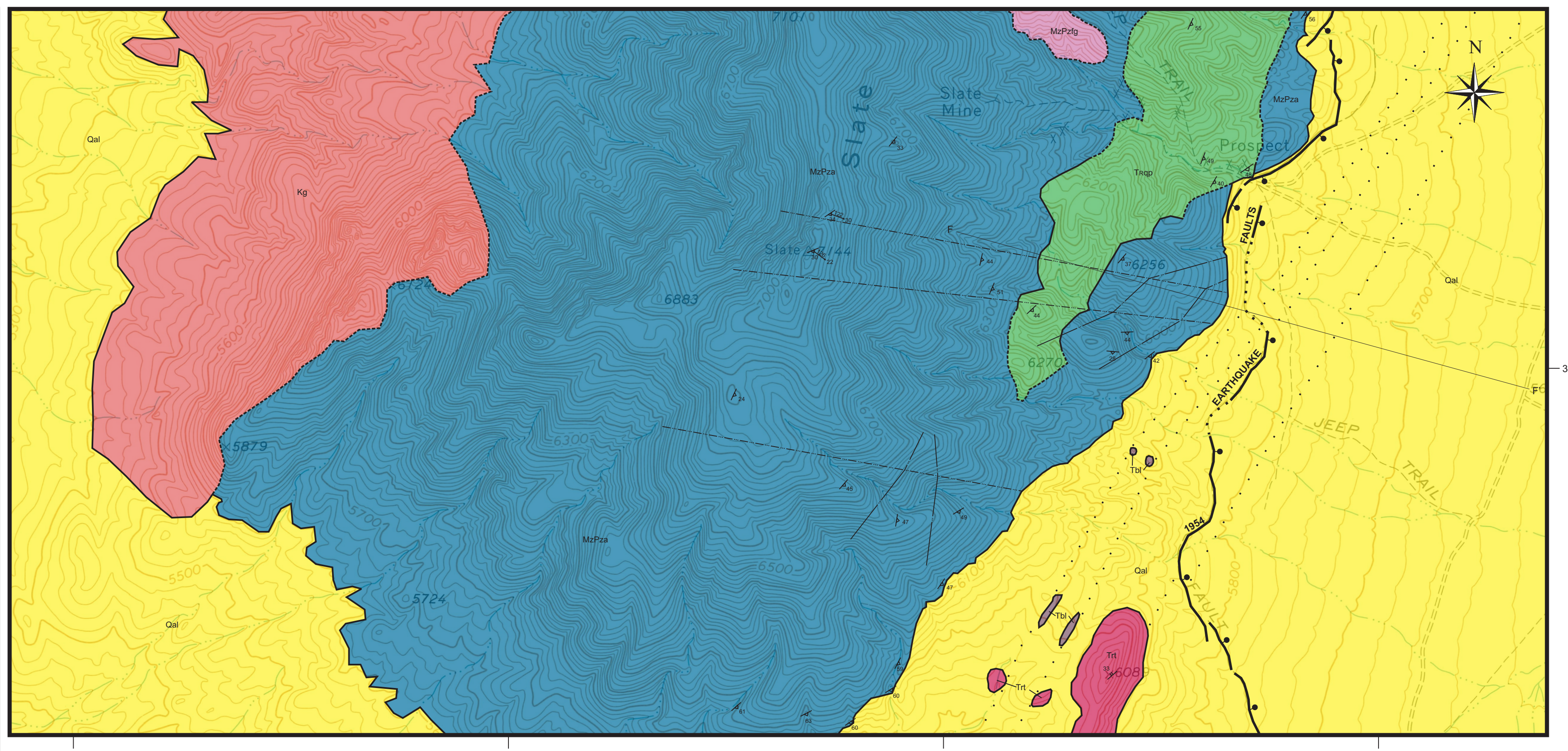
Department of Physics and Geosciences, Angelo State University, September 2016



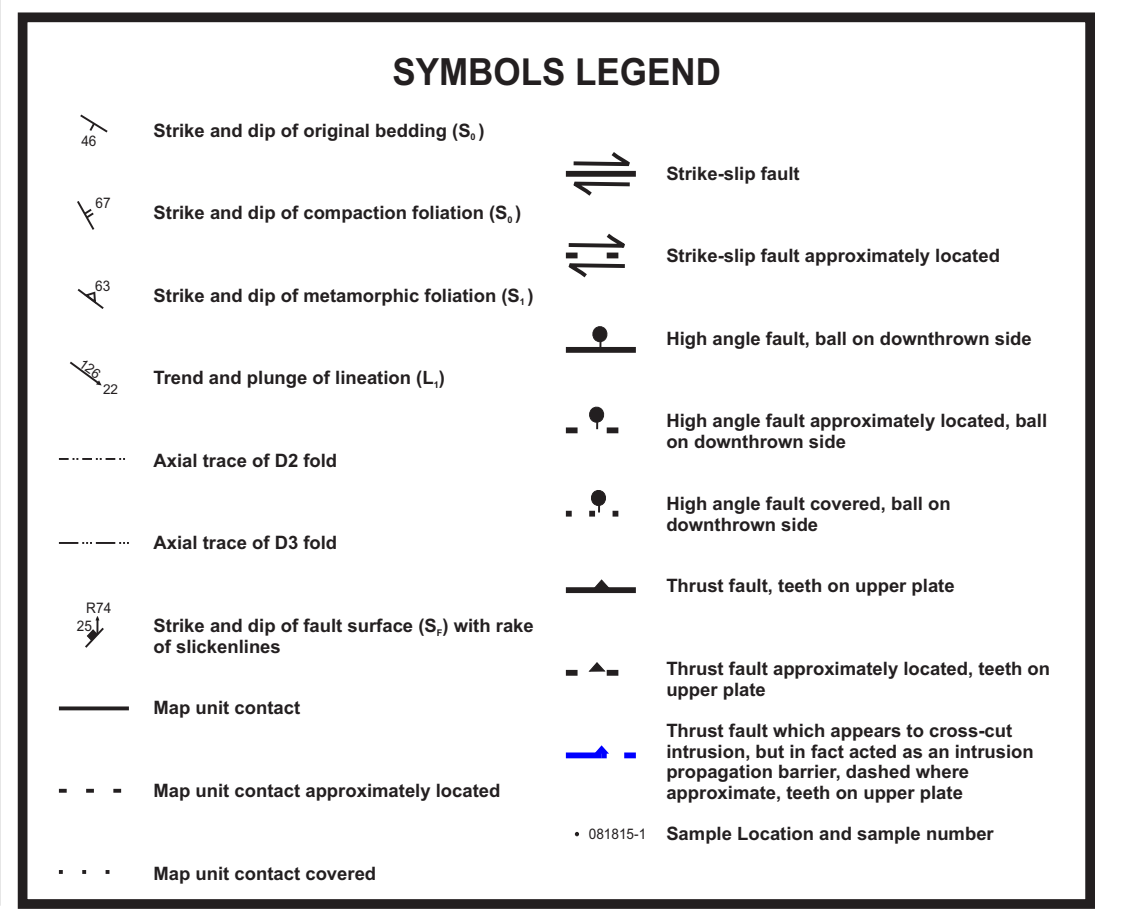
Field contacts extrapolated to map edges via satellite imagery georeferenced in ArcGIS v10.2; Digitized in CorelDRAW X7

Geologic Map of Slate Mountain, Churchill County, Nevada

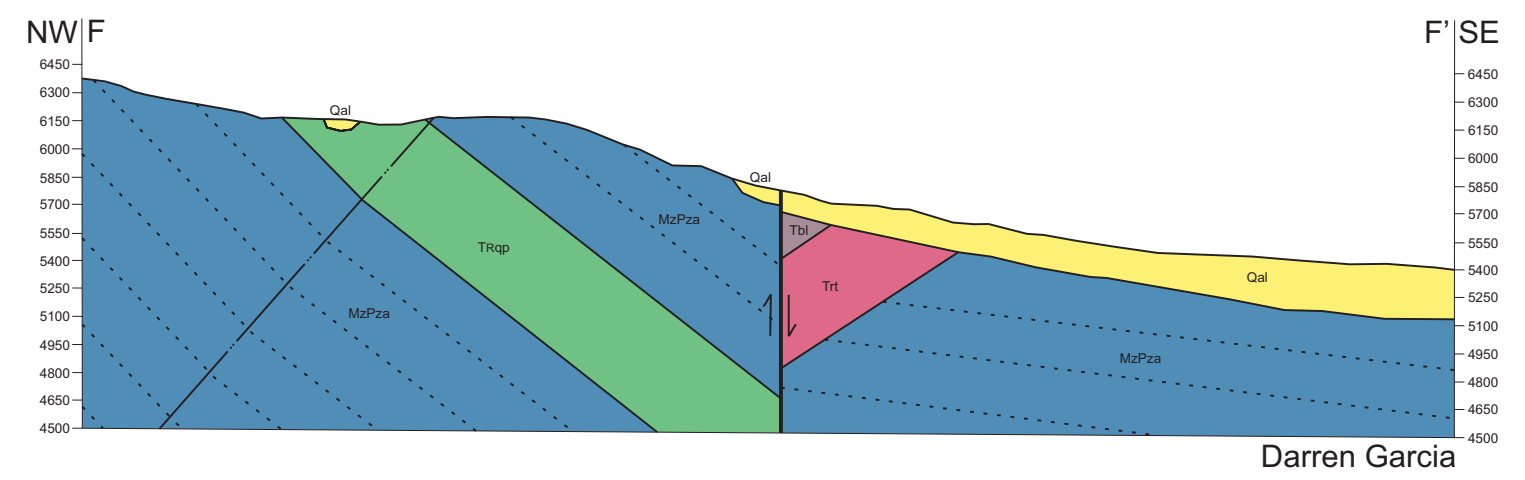
Darren Garcia and Sean Czarnecki
Department of Physics and Geosciences, Angelo State University, September 2016



Field contacts extrapolated to map edges via satellite imagery from Google Earth; Digitized in CorelDRAW X7



Cross-section of Slate Mountain



Darren Garcia

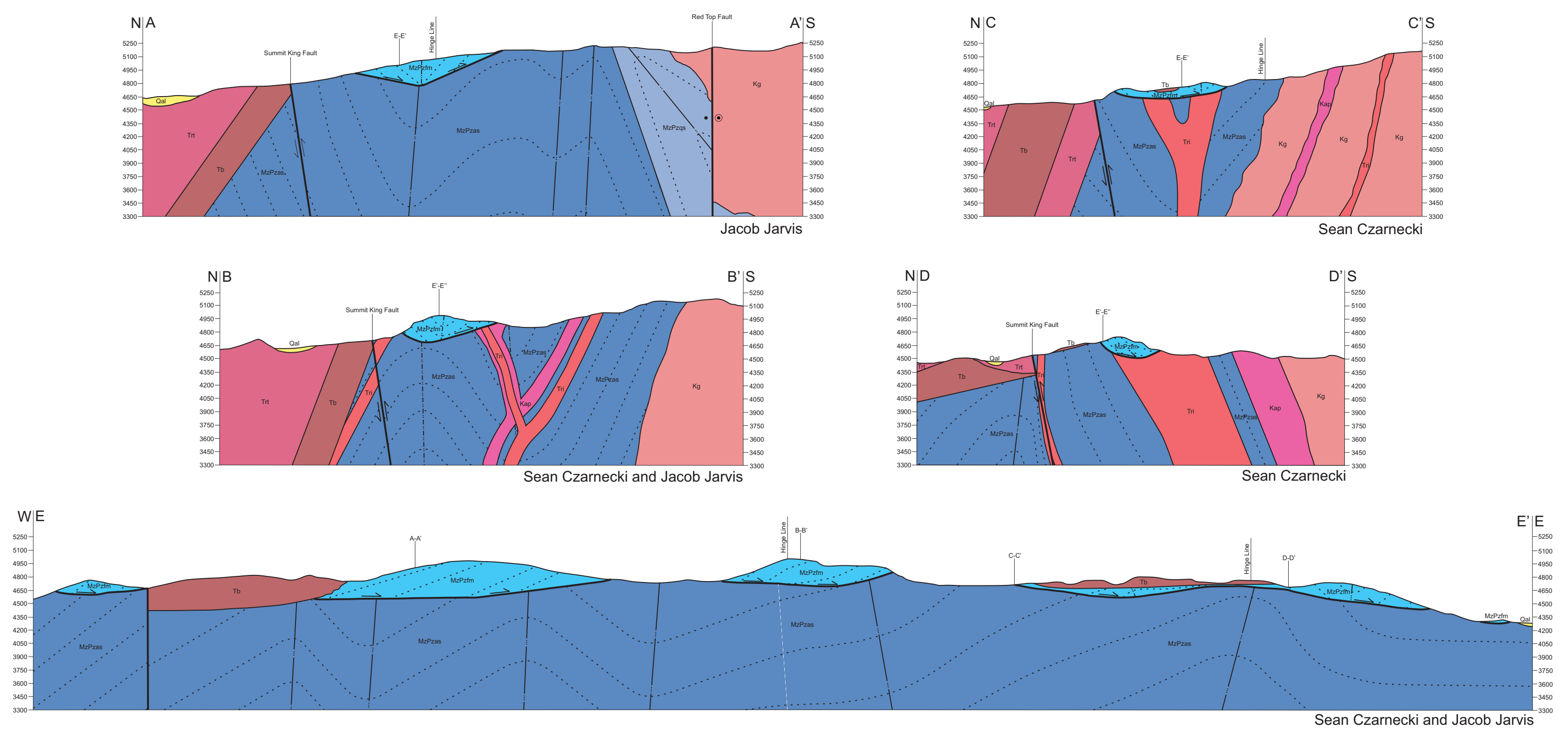
Cross-section at a 1:8000 scale (same as map scale). No vertical exaggeration. Dashed lines are metamorphic foliation form lines. View to the northeast that shows D2 folding of D1 foliation within MzPza. This section also shows the 1954 Earthquake fault cross-cutting the Quaternary fan deposits.

View of the eastern klippe to the east. The thrust fault is represented as a thick line and can be seen to be folded matching the NE orientation of D2. At least five light-colored Tri sills can be seen approaching but ultimately terminating just below the thrust at the base of the cliff-forming MzPzfm.

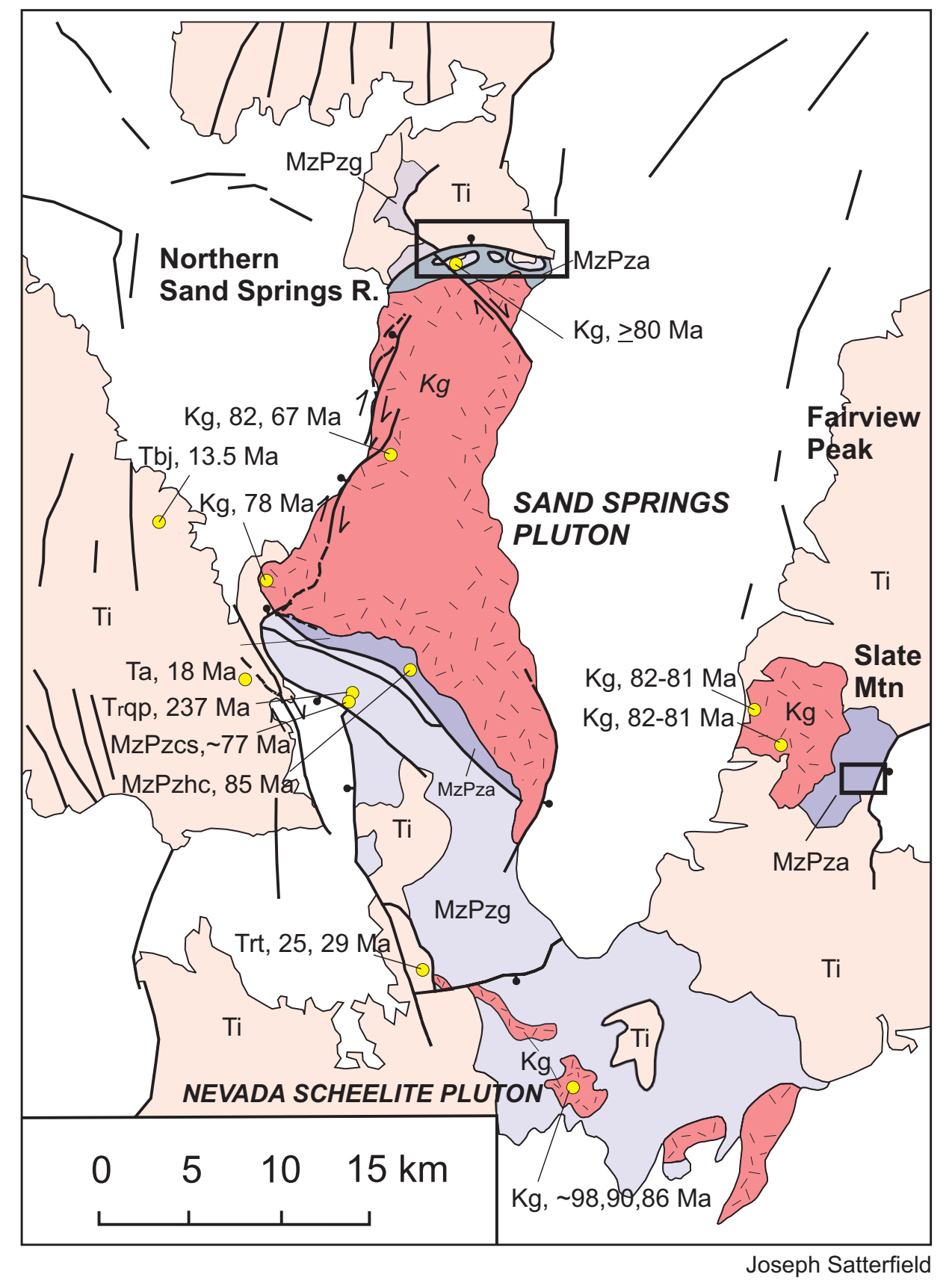
View of the western klippe to the northwest. The thrust fault is represented as a thick black line and can be seen to be broadly folded to match the NW orientation of map scale D3 folds.

View of the eastern klippe to the NE showing a light-colored Tri sill cutting across the thrust fault (thick black line, dashed where location inferred) at the base of the cliff forming MzPzfm.

Cross-sections of the Northern Sand Springs Range

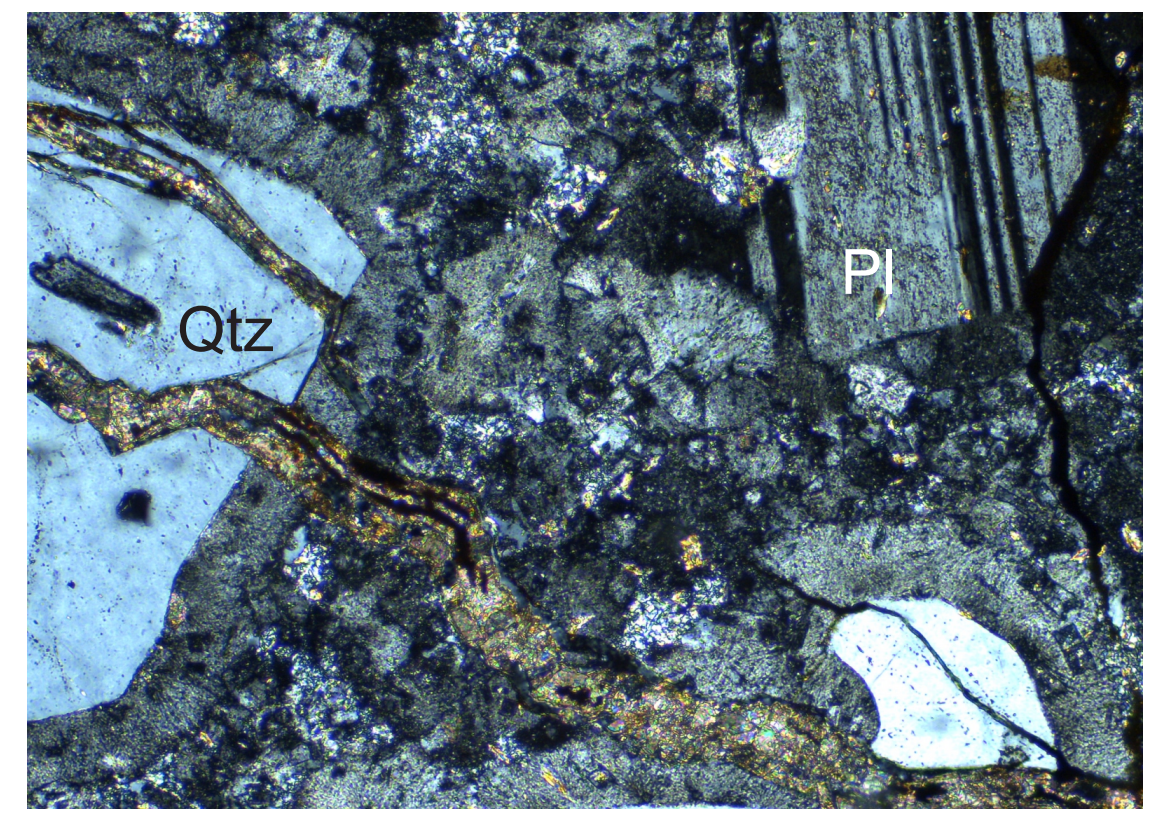


Tied grid of cross-sections at a 1:8000 scale (same as map scale). No vertical exaggeration. Dashed lines are metamorphic foliation (S1) form lines. A-A', B-B', C-C', and D-D' are views to the east and show the D2 folding of the thrust fault and D1 foliation within MzPzfm and MzPzas. These sections also show that sills intruded subparallel to foliation, that Kap pooled at the central klippe thrust, and that the Summit King fault cross-cuts the youngest units in the map area (Tb and Trt). E-E' is a view to the north showing the broad D3 folding of the thrust and of D1 foliation within MzPzfm and MzPzas as well as Tb overlapping the thrust fault.

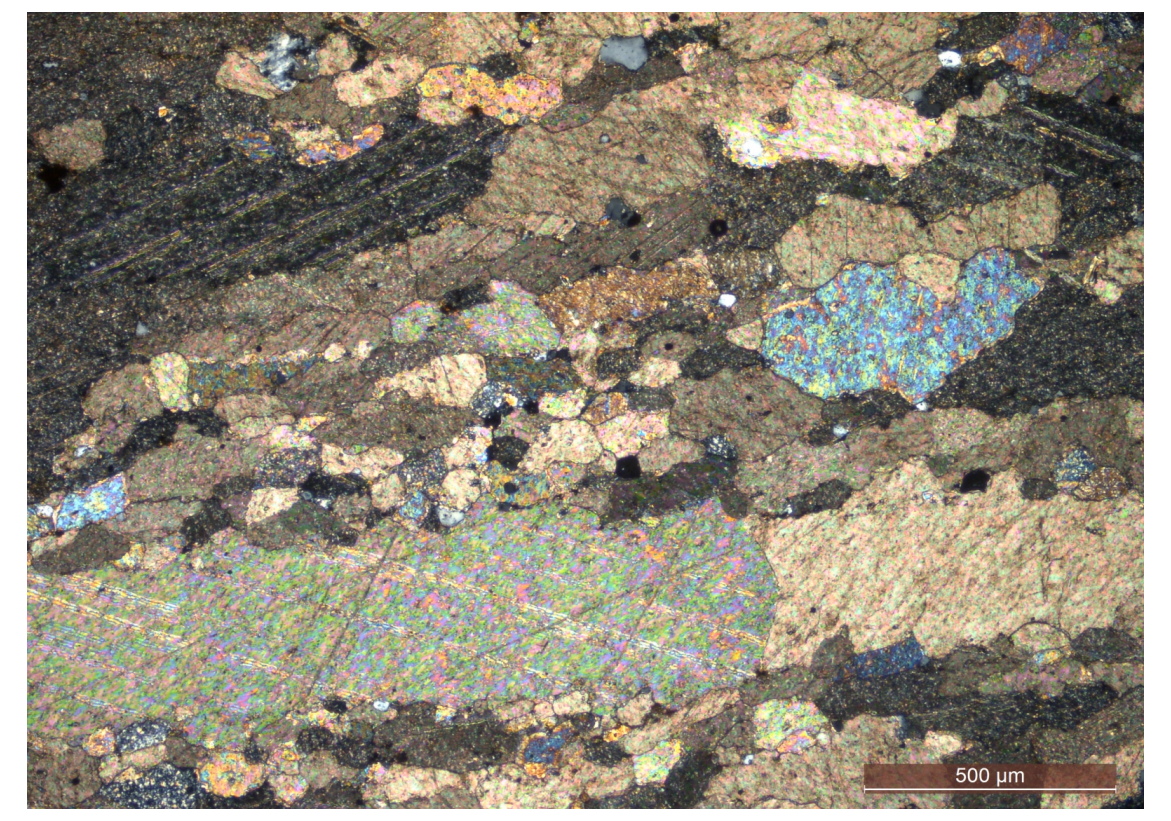


Joseph Satterfield

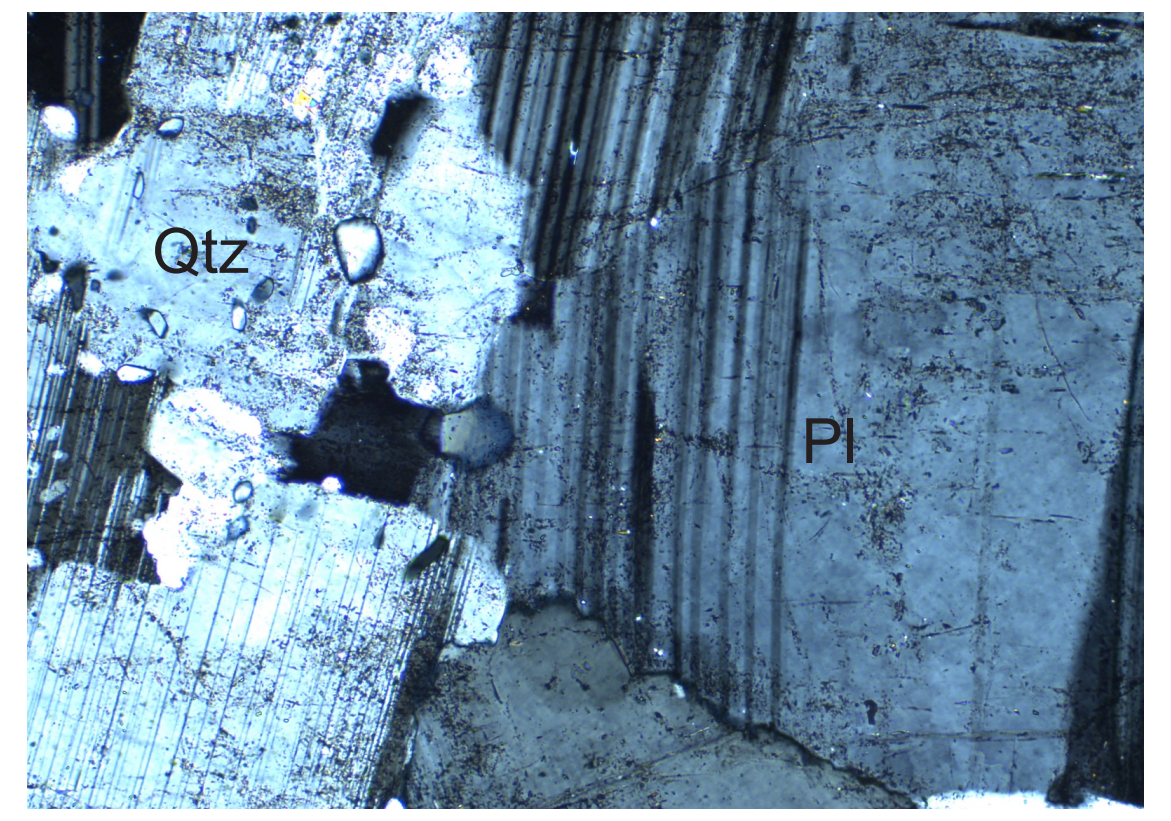
Simplified geologic map showing isotopic dates and Cenozoic faults of the Sand Springs Range and Slate Mountain area. Isotopic dates are identified by yellow dots. The two geologic map areas are outlined. Kg: Cretaceous granite, MzPza: Mesozoic and/or Paleozoic amphibolite facies, MzPzg: Mesozoic and/or Paleozoic greenschist facies, Ti: Tertiary igneous.



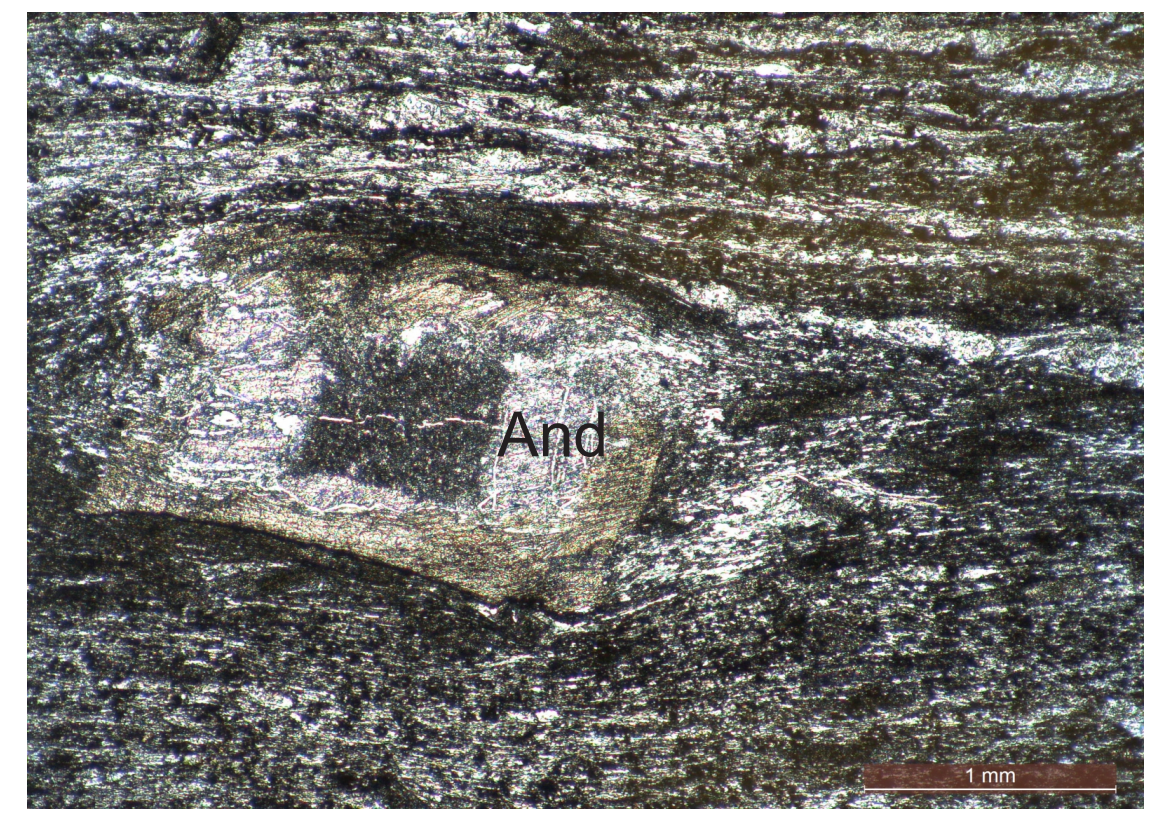
081015-2 Tri 100X: Typical Tertiary porphyritic rhyolite sill. Mostly quartz matrix with larger quartz and plagioclase crystals . The aphanitic texture of the matrix supports a Tertiary age interpretation.



081515-1 MzPzfm 50X: This section shows the elongation and size variation of calcite crystals that define foliation in the foliated marble. Larger crystals are white bands in hand sample, while smaller crystals are gray bands. Credit: William White, Angelo State University.



081815-1 Kap 100X: The 1.0 - 3.0 mm quartz and plagioclase crystals in this section and similar mineralogy suggest this and related aplite dikes are Cretaceous.



082015-2 MzPzas 25X: This image depicts the metamorphic mineral alignment that defines the foliation in the andalusite schist. Andalusite schist labeled. Credit: William White, Angelo State University.

Conclusions:

- Northern Sand Springs Range (nSSR) basalt (Tb) previously mapped as Jurassic-Cretaceous or Jurassic-Tertiary is interbedded with Tertiary tuff (Trt) and overlaps the thrust fault.
- Cretaceous and Tertiary sills in the nSSR stop at, pool beneath, or cross-cut the folded low-angle fault, indicating this fault is Cretaceous or older.
- Three generations of pre-Cenozoic deformation have been identified within the northern Sand Springs Range and Slate Mountain.
- D1 is a pre-Luning-Fencemaker Fold and Thrust Belt (LFTB) syntectonic amphibolite-grade deformation event that is related to NW-trending D1 folds within the northern Wassuk Range of the Pine Nut assemblage .
- D2 and D3 in the northern Sand Springs Range and Slate Mountain are deformation events correlated with the first two phases of LFTB deformation.

These findings lead to the following revised Sequence of Events for the Sand Springs assemblage:

1. Protoliths of meta-sedimentary and meta-volcanic units deposited before or during the Mesozoic.
2. Protolith of foliated granite of Slate Mountain intrudes meta-sedimentary protoliths before or during the Mesozoic.
3. Triassic plutons, protoliths of meta-rhyolites, intrude meta-sedimentary protoliths. Relative timing of foliated granite and meta-rhyolite uncertain.
4. Sierran deformation (D1) folds and metamorphoses protoliths to amphibolite-grade metamorphic tectonites, resulting in a foliation (S1), stretching lineation (L1), and mineral lineation (L1).
5. Early LFTB deformation (D2) begins to fold S1, then creates the thrust fault, then further folds S1 and the thrust fault with NE orientation.
6. Later Luning-Fencemaker deformation (D3) refolds S1 and thrust fault in broad map-scale folds oriented NW.
7. Cretaceous Sand Springs pluton and related granitoids passively intrude metamorphic tectonites.
8. Cretaceous sills intrude along foliation planes, pooling at thrust and cross-cutting Sand Springs pluton.
9. Tertiary sills intrude along foliation planes, cross-cut Cretaceous intrusions, and stop at or cross-cut the thrust fault.
10. All units uplifted and eroded.
11. Tertiary basalt lava flows and pyroclastic flows extruded. Basalt flows overlap thrusts.
12. Older Basin and Range and Walker Lane faulting.
13. Valleys eroded and Quaternary alluvium deposited.
14. Holocene Basin and Range and Walker Lane normal faults (Summit King fault and 1954 Earthquake faults) and right-lateral strike-slip fault (Red Top fault) begin cross-cutting units and older structures.

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