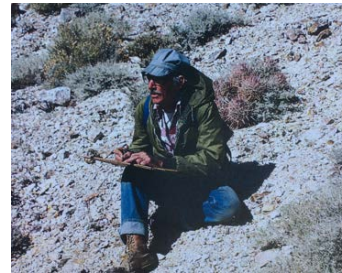


Amargosa Chaos: A Product of Multiphase Deformation

Sammy R. Castonguay,

Treasure Valley Community College
Four Rivers Community Sr. Prep School

T1: Death Valley Tectonics
Tribute to Lauren and Benny



DH

Marli B. Miller,

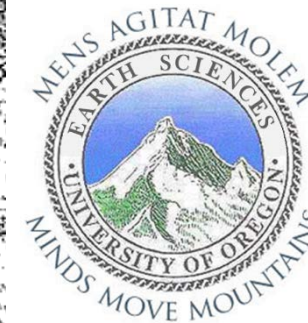
University of Oregon



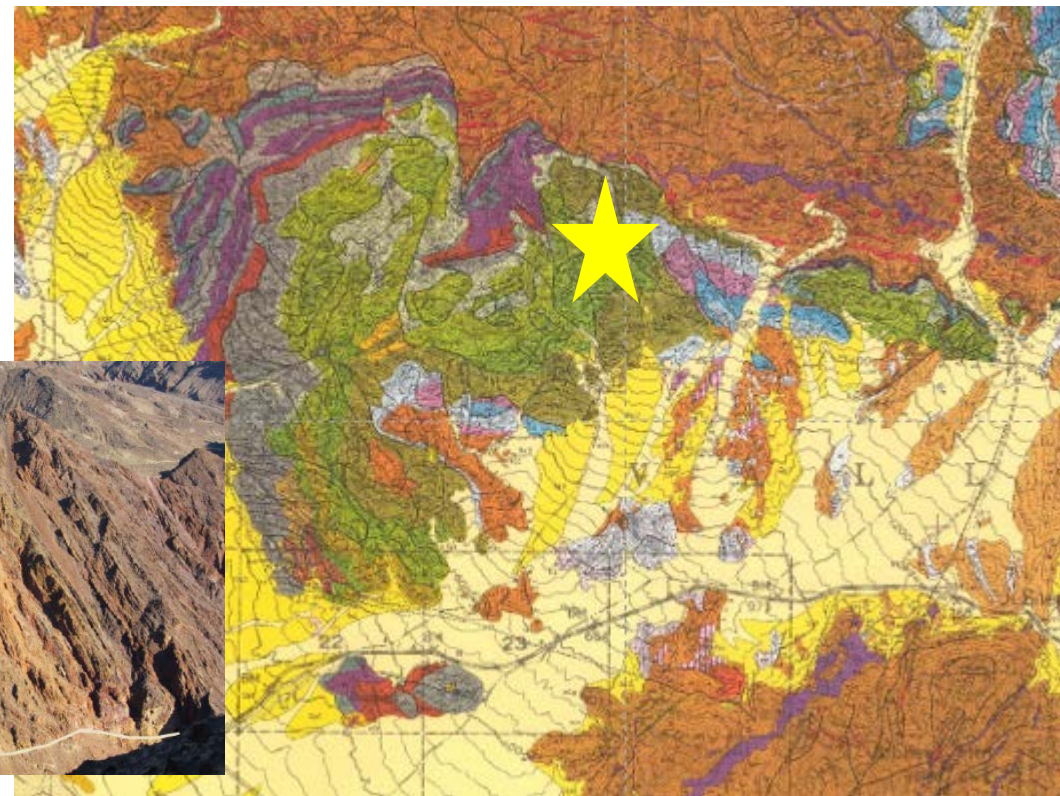
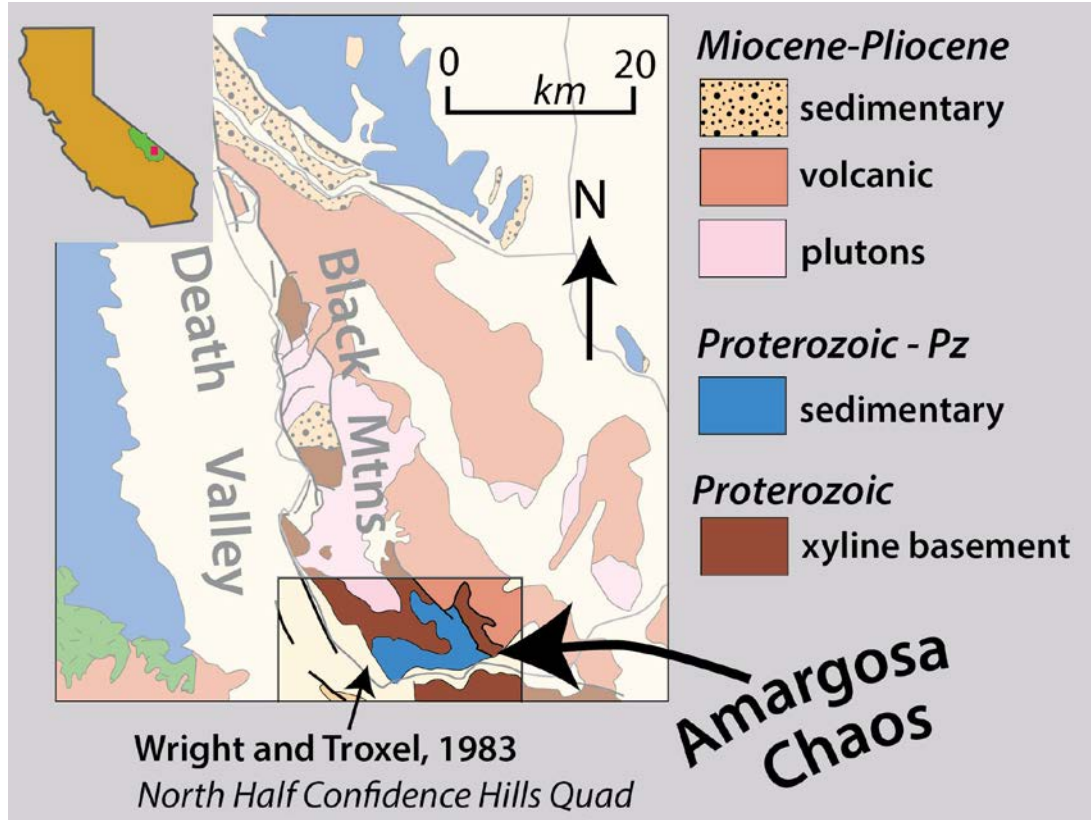
+



@



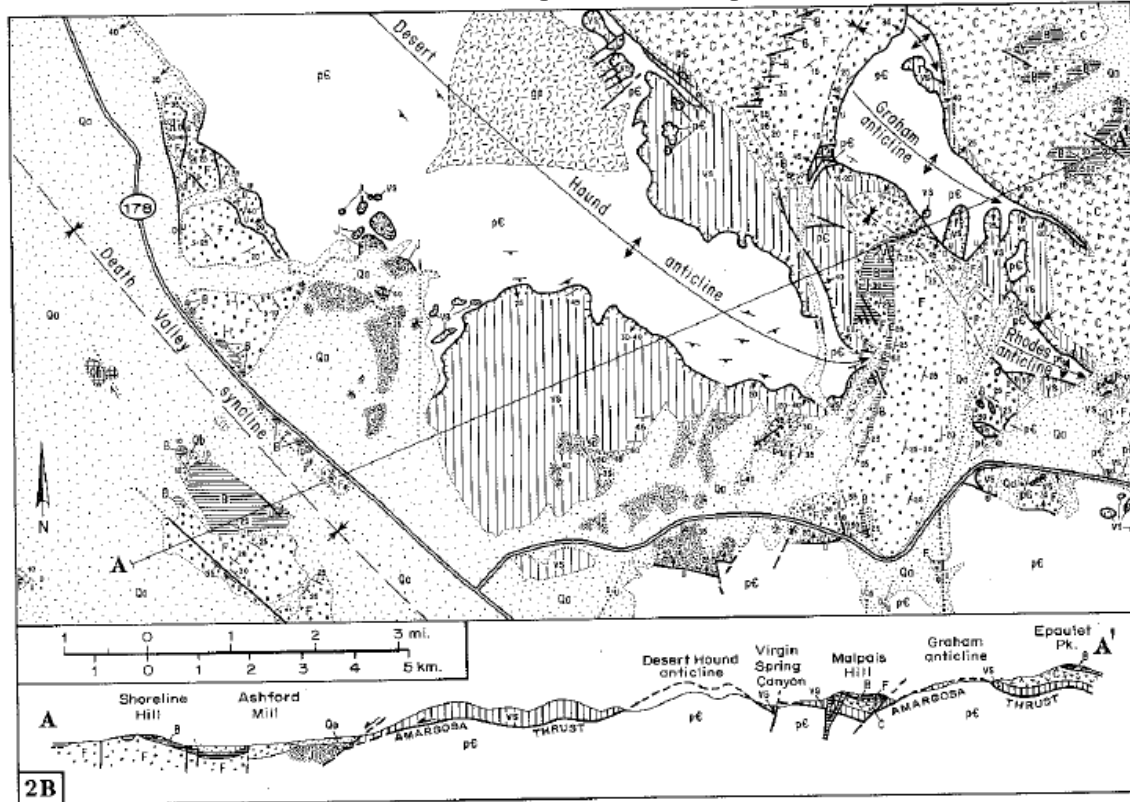
How did you walk into this problem?



***'This is a mess'!**

***'I don't know, it is your thesis!'**

Noble's Chaos (1941)



*Three Chaos “phases”

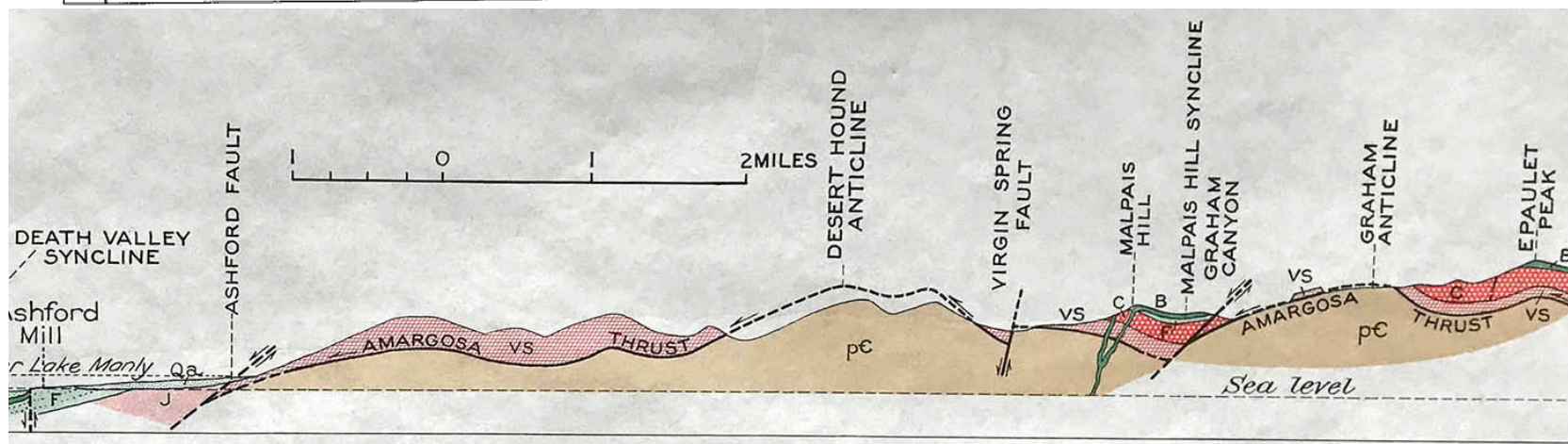
Calico Phase: Cenozoic Volcanics

Jubilee Phase: Landslide Breccias

Virgin Spring: Neoprot. Sed Rocks

*VS Chaos: “arrangement of the blocks is confused and disordered —chaotic”

*formed in upper plate of “enormous” thrust fault





Wright and Troxel's Chaos (1984)

*“Four deformational events”

Metamorphism of basement

Deposition of Pahrump (Super)group

Regional folding [Desert Hound Anticline]

Extensional chaos “largely or wholly movement on normal faults”

*“has consisted, in general, of a continuum featured by normal faulting.

*“not a regional surface of dislocation” acknowledged in previous talk from Miller

Castonguay's Chaos (2013)

- *Focus on geometry, mechanics, and the “continuum normal faulting” called for by Wright and Troxel (1984)**
- *find some order of Noble (1941) confused, “whale-shaped lozenges”**

**Wright and Troxel,
1984**

The overall geometry and the mechanics of the formation of the chaos, however, continue to puzzle us. Particularly perplexing is the manner by which a relatively large mass of chaos can be strongly extended while the immediately underlying block of the complex apparently is not. We have suggested (Wright and

Castonguay's Chaos (2013)

- *area provides review of textbook-like features!
- *sed rocks & struct.
- *intrus. and volcs.
- *gneiss and schist
- *fans, falls, dunes
- *folds and faults
- *breccia, gouge, slicken
- *contact and hydrothermal
- *mining



Castonguay's Chaos (2013)

***area provides review of textbook-like features!
...but it's a mess!**



Castonguay's Chaos (2013)

***Six deformational events *within* VS chaos**

D1:

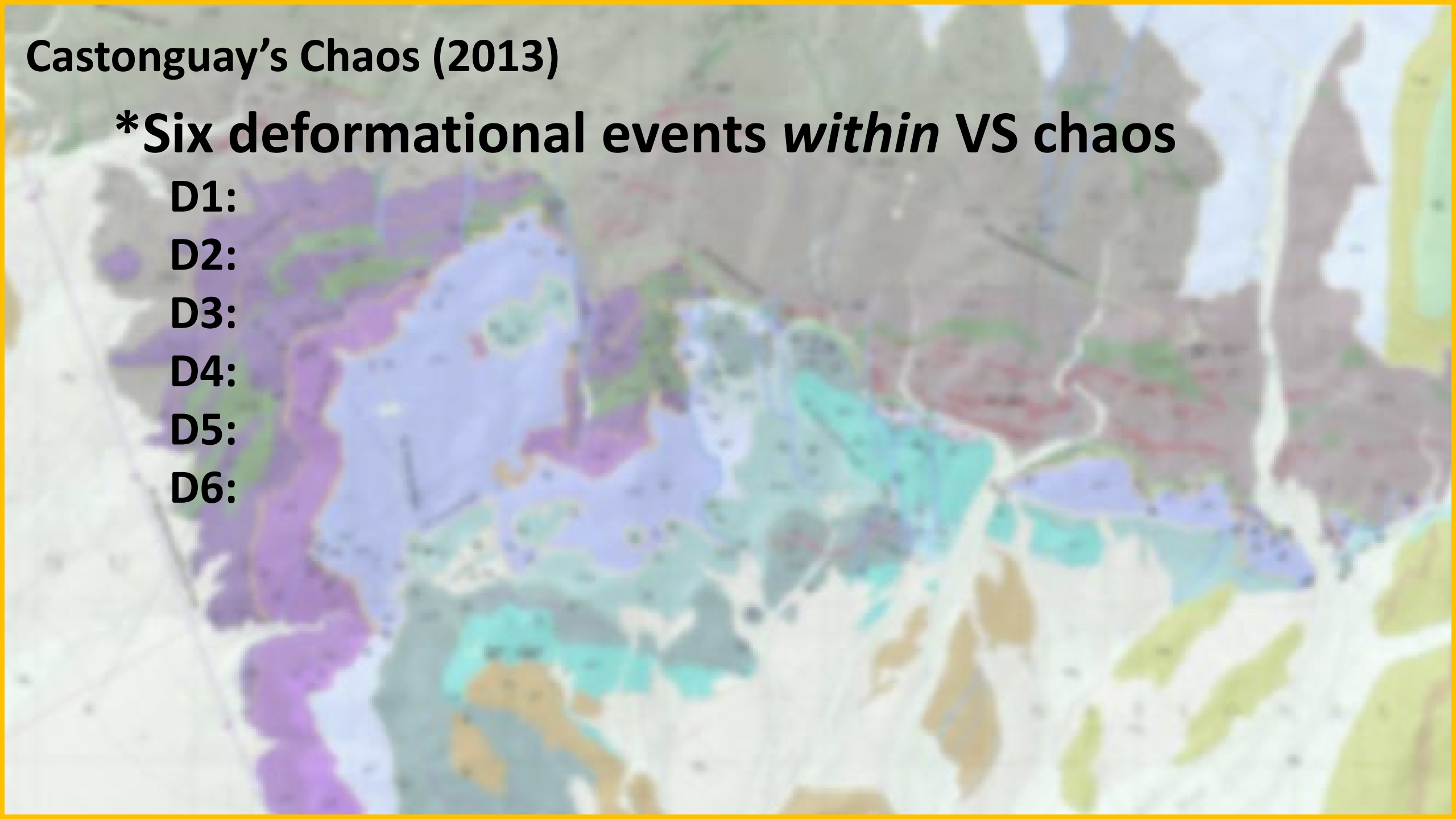
D2:

D3:

D4:

D5:

D6:



Castonguay's Chaos (2013)

*Six deformational events *within* VS chaos

D1: thrusts and folds (Castonguay, GSA 2012, Querétaro, MX)

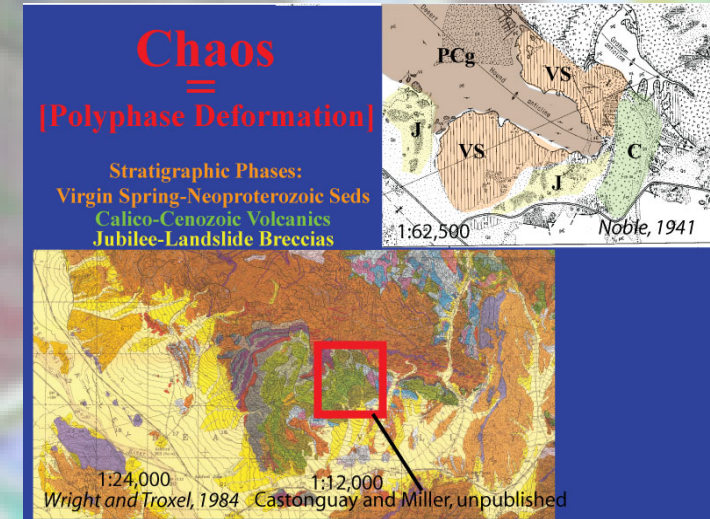
D2:

D3:

D4:

D5:

D6: active Black Mountain front (Bodin ?)



Castonguay's Chaos (2013)

*Six deformational events *within* VS chaos

D1: thrusts and folds (Castonguay, GSA 2012, Querétaro, MX)

D2:

D3:

D4:

D5: Domino faults (W&T #4 & Topping, next talk)

D6: active Black Mountain front (Bodin ?)



Topping, 1993

Castonguay's Chaos (2013)

***Six deformational events *within* VS chaos**

D1: thrusts and folds (Castonguay, GSA 2012, Querétaro, MX)

D2: presently low-angle normal faults

D3: regional folding (W&T #3; Turtlebacks)

D4: Amargosa 'surface' (Miller)

D5: Domino faults (W&T #4 & Topping, next talk)

D6: active Black Mountain front (Bodin ?)

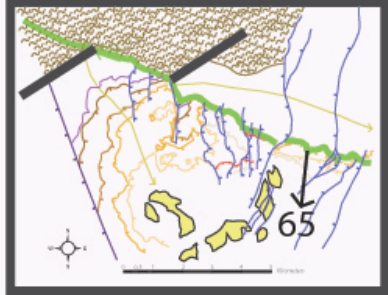
D4: Amargosa 'surface'

Miller (2018), previous talk

ble as a segment of his Amargosa thrust, extends beyond the most northwesternly exposures of the Pahrump Group and splays into the complex. There, too, southwest of the fault, the

Wright and Troxel (1984), regarding Noble (1941)

i introduction ii methods **iii results** iv conclusions

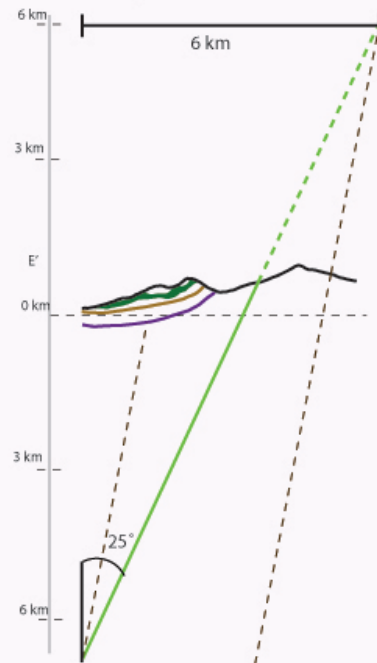


Scenario A)

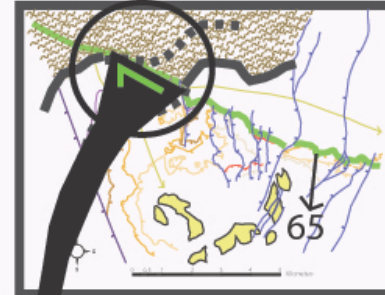
NO fold geometry

$$6 \text{ km} / \sin(25) = 14.2 \text{ km}$$

D4: Slip Assesment



i introduction ii methods **iii results** iv conclusions



D4: Slip Assesment

Scenario A) & B)

Pure Dip-slip

8-15 km

Scenario C)

Pure Right-lateral

~2.8 km

D3: Broad Folds Desert Hound Anticline

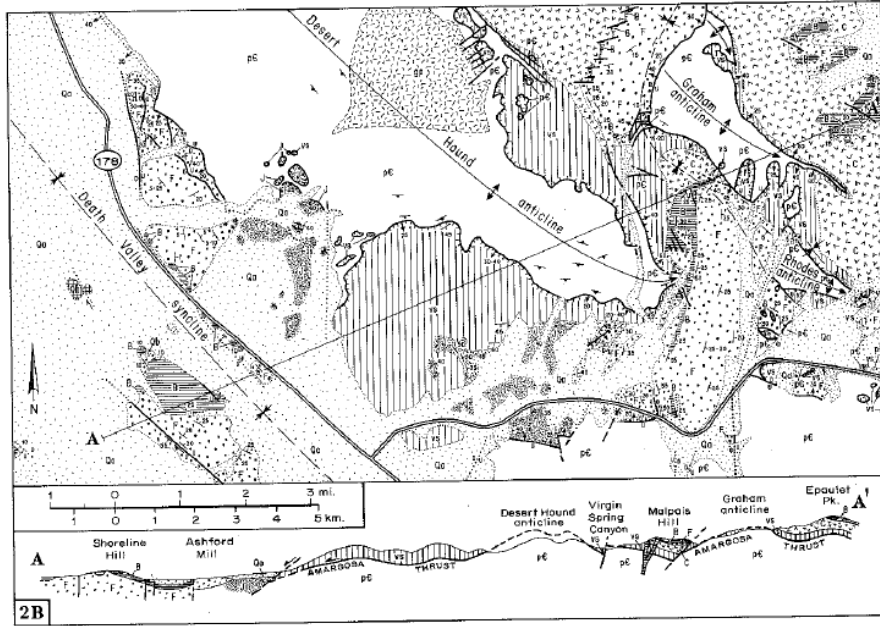
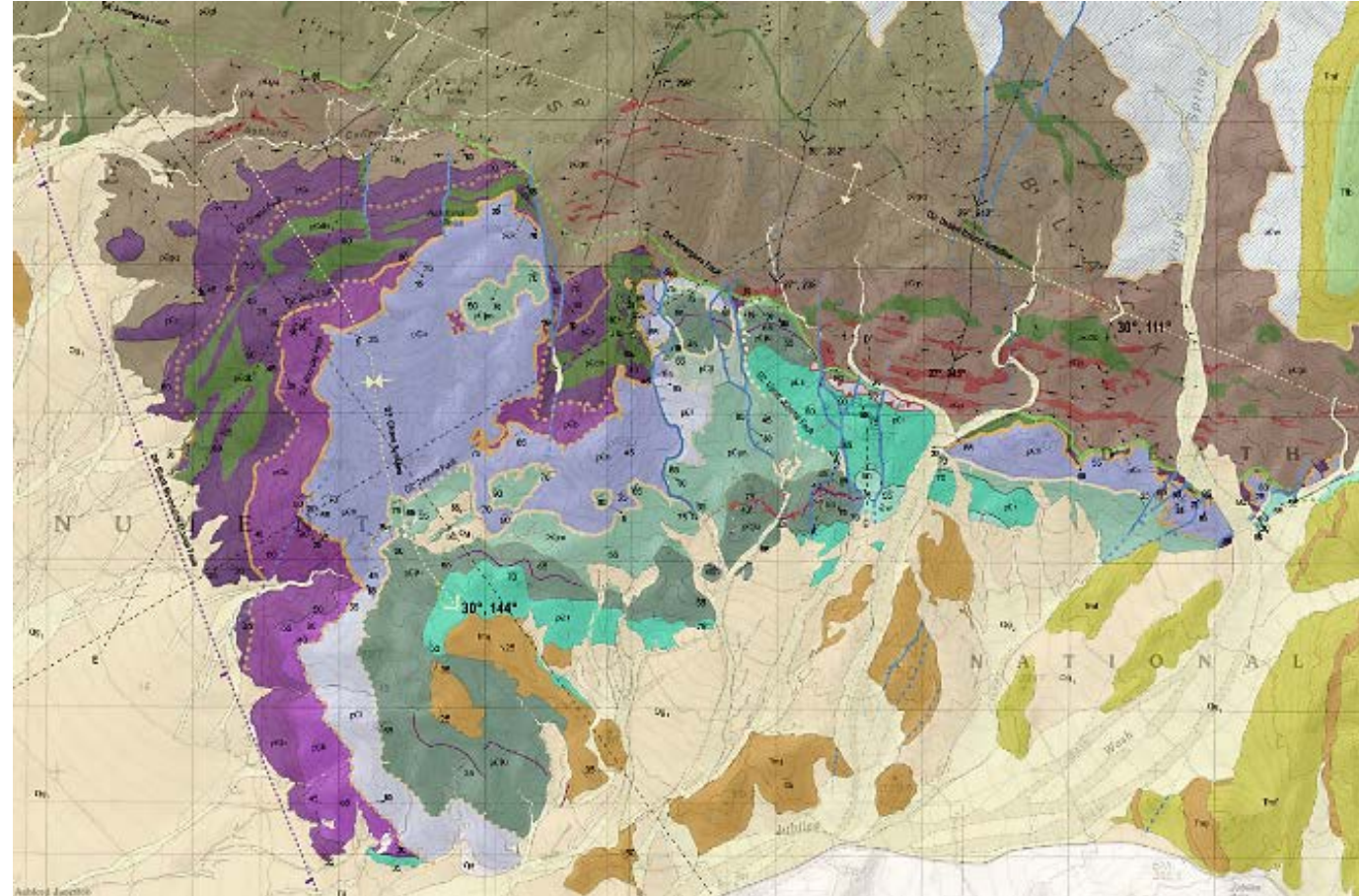
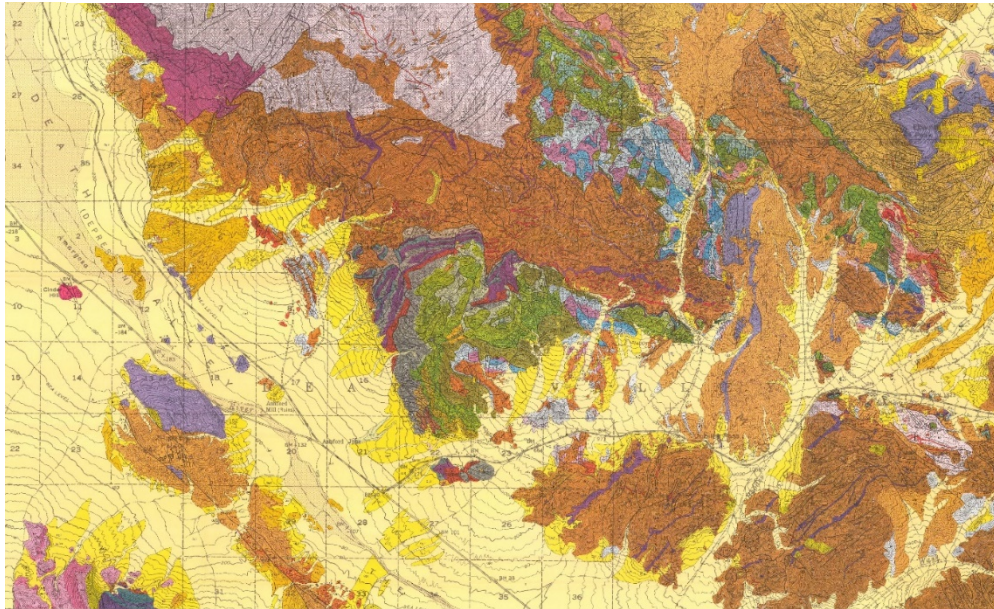


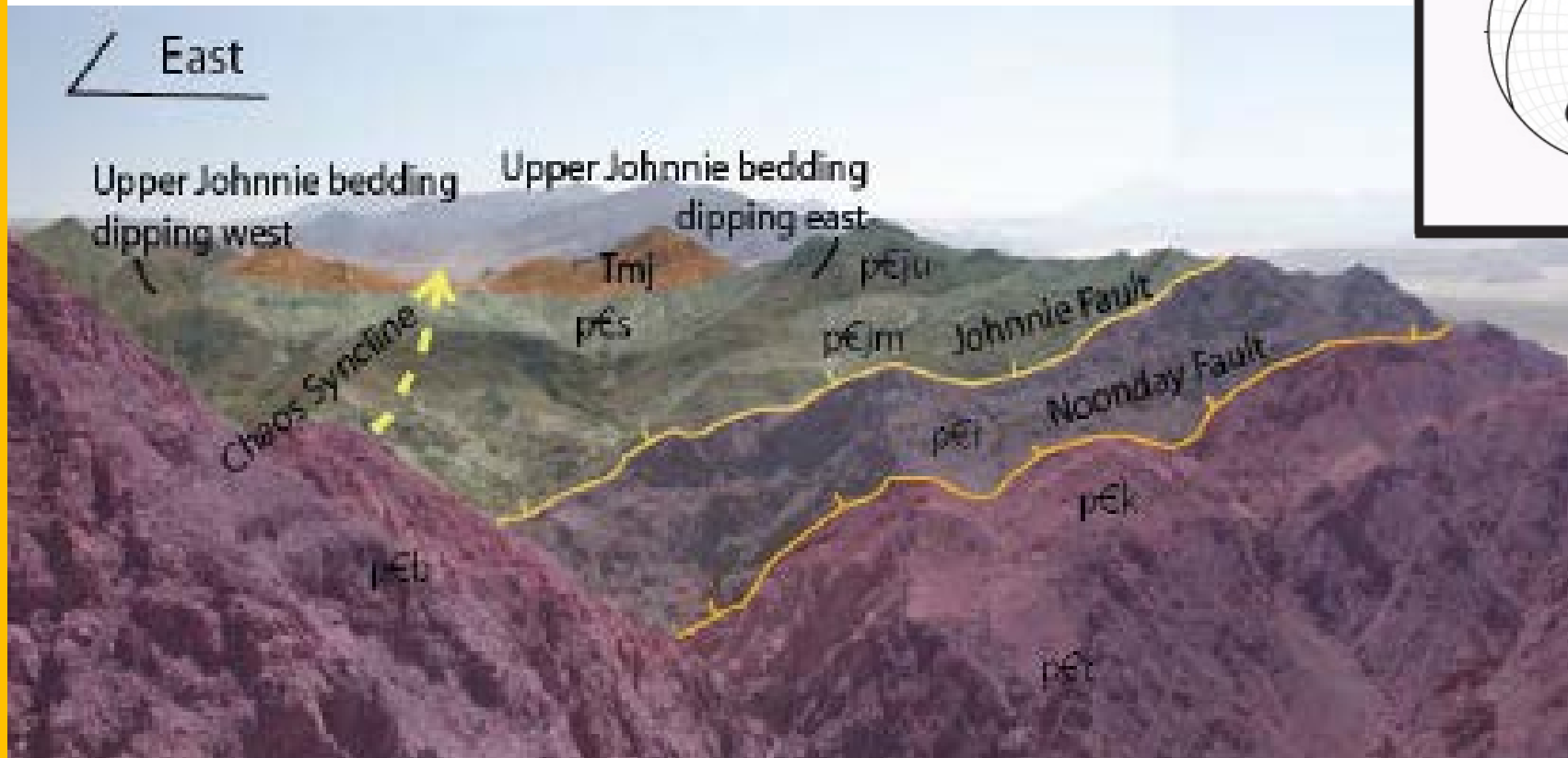
Figure 28. Noble's (1941) original map and cross section of the Virgin Spring area, redrafted and slightly modified for black and white reproduction.



D3: Broad Folds

Chaos (?) Syncline

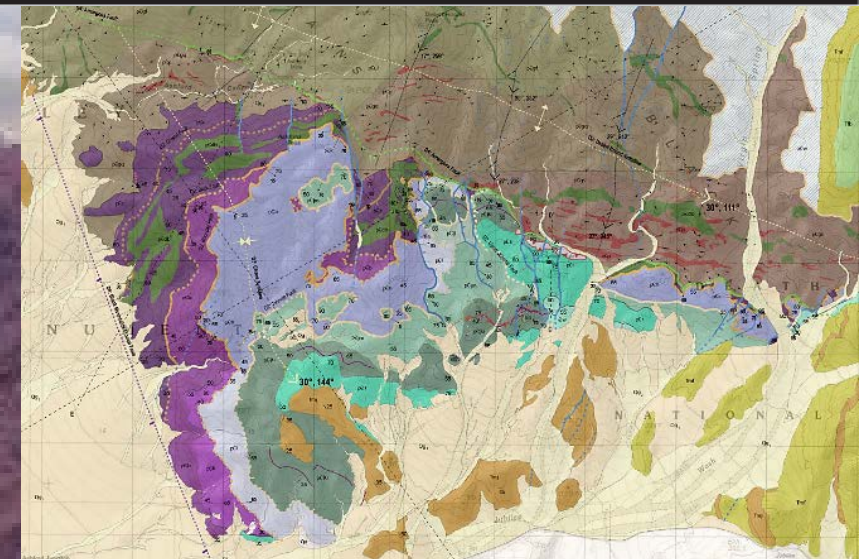
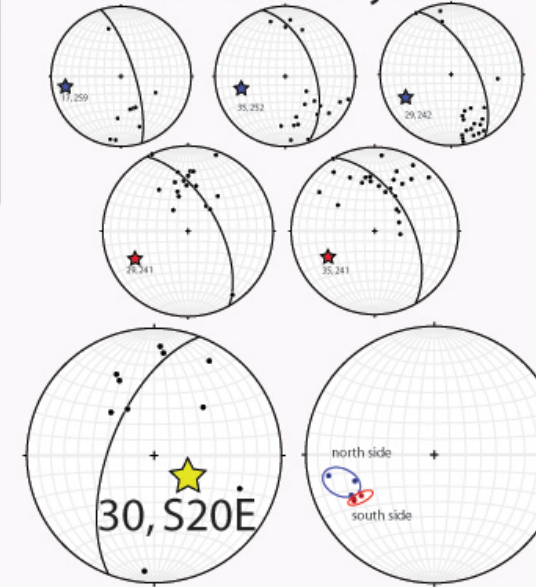
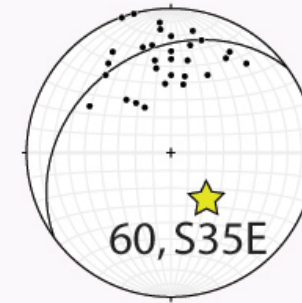
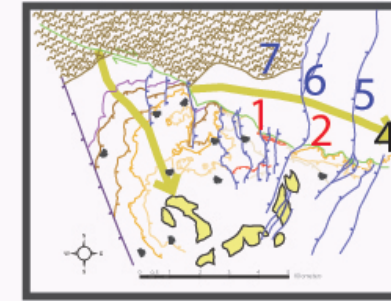
Scallywag Syncline



i introduction ii methods **iii results** iv conclusions

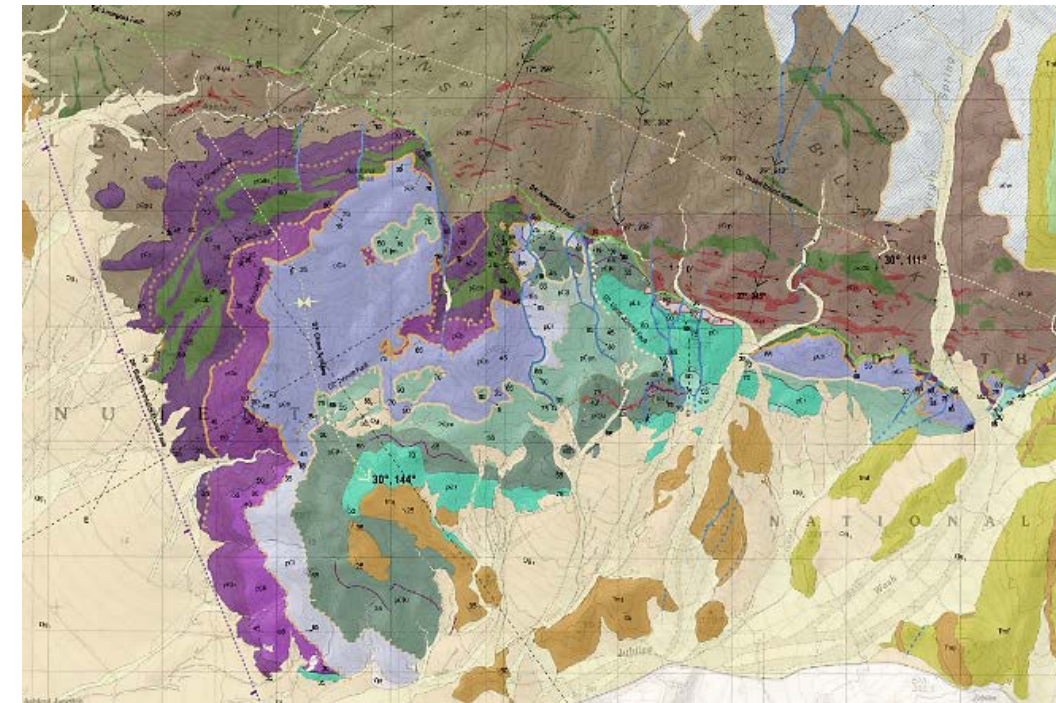
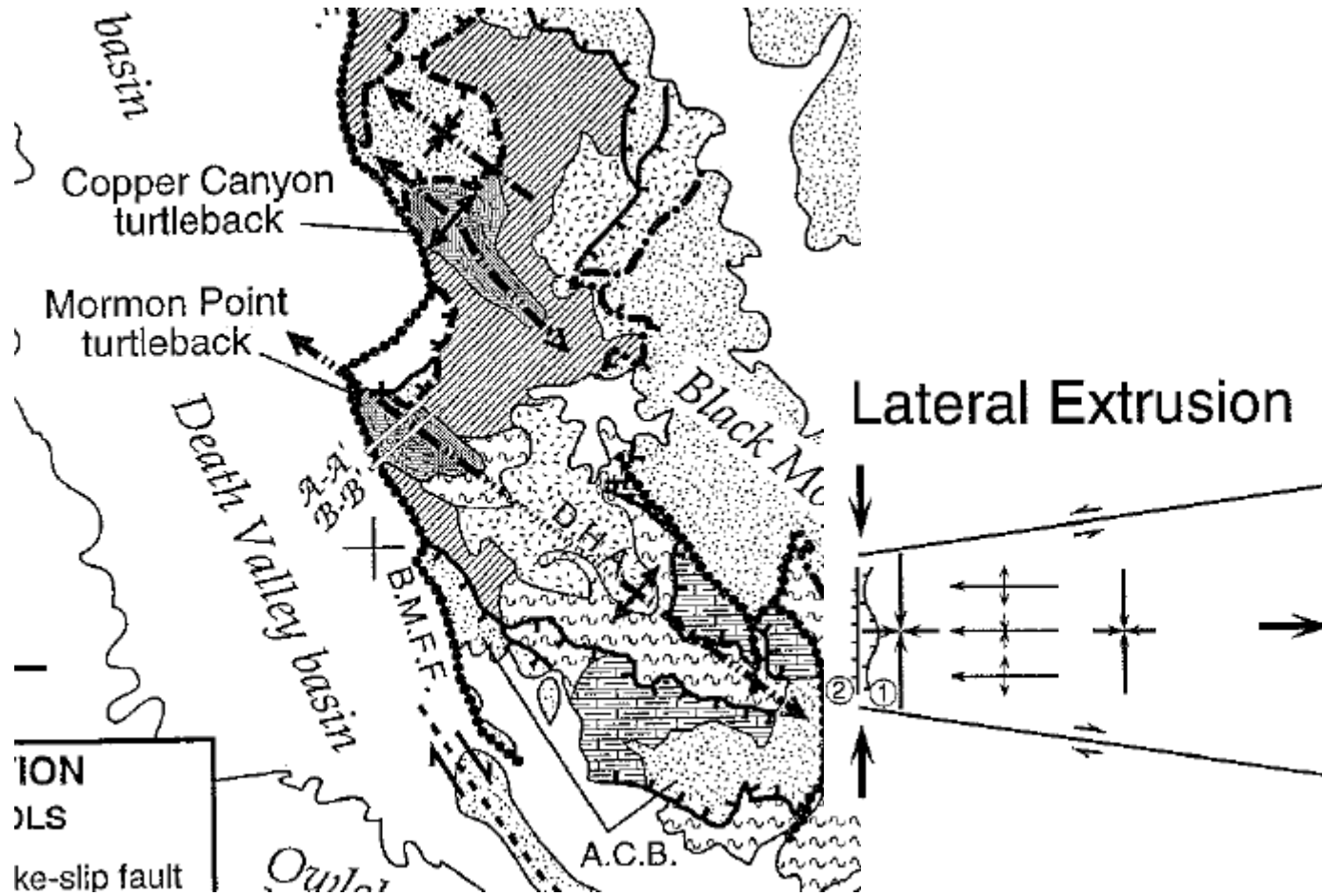
D3: Broad Folds

Stereonet Analysis:



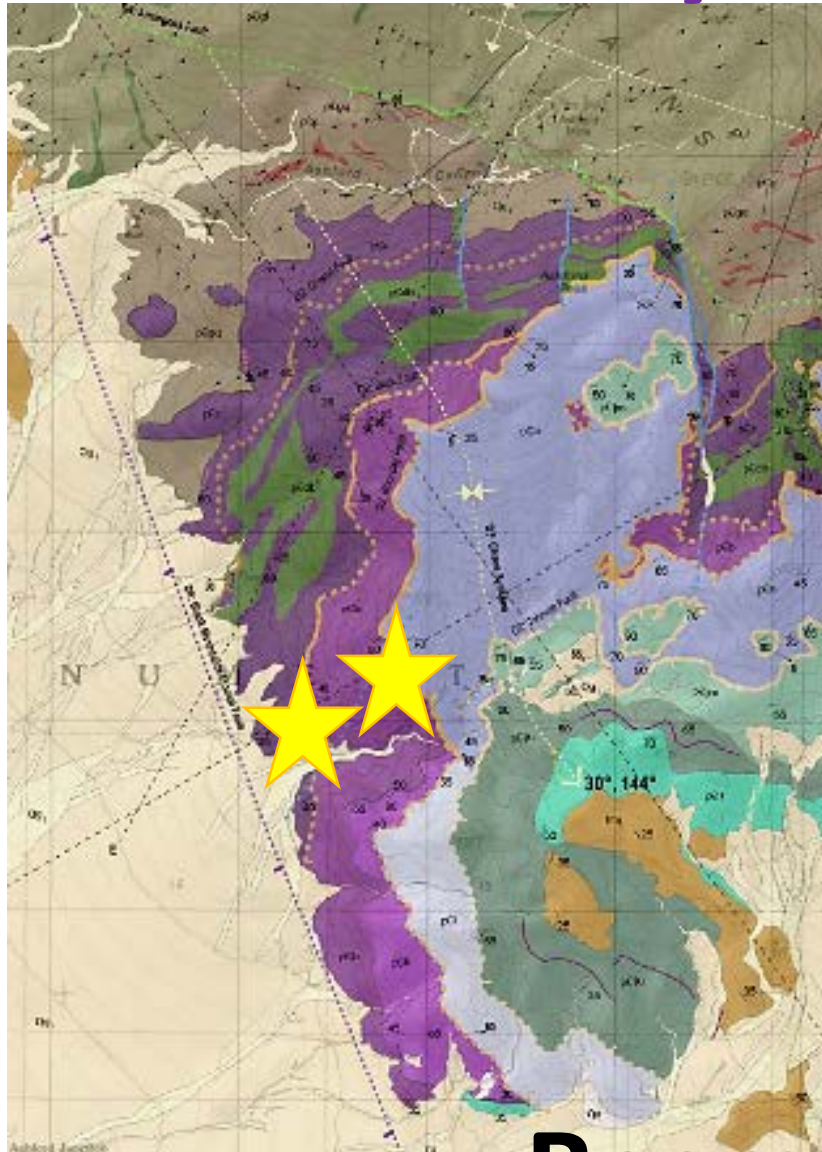
D3: Broad Folds

Desert Hound Anticline and Scallywag Syncline

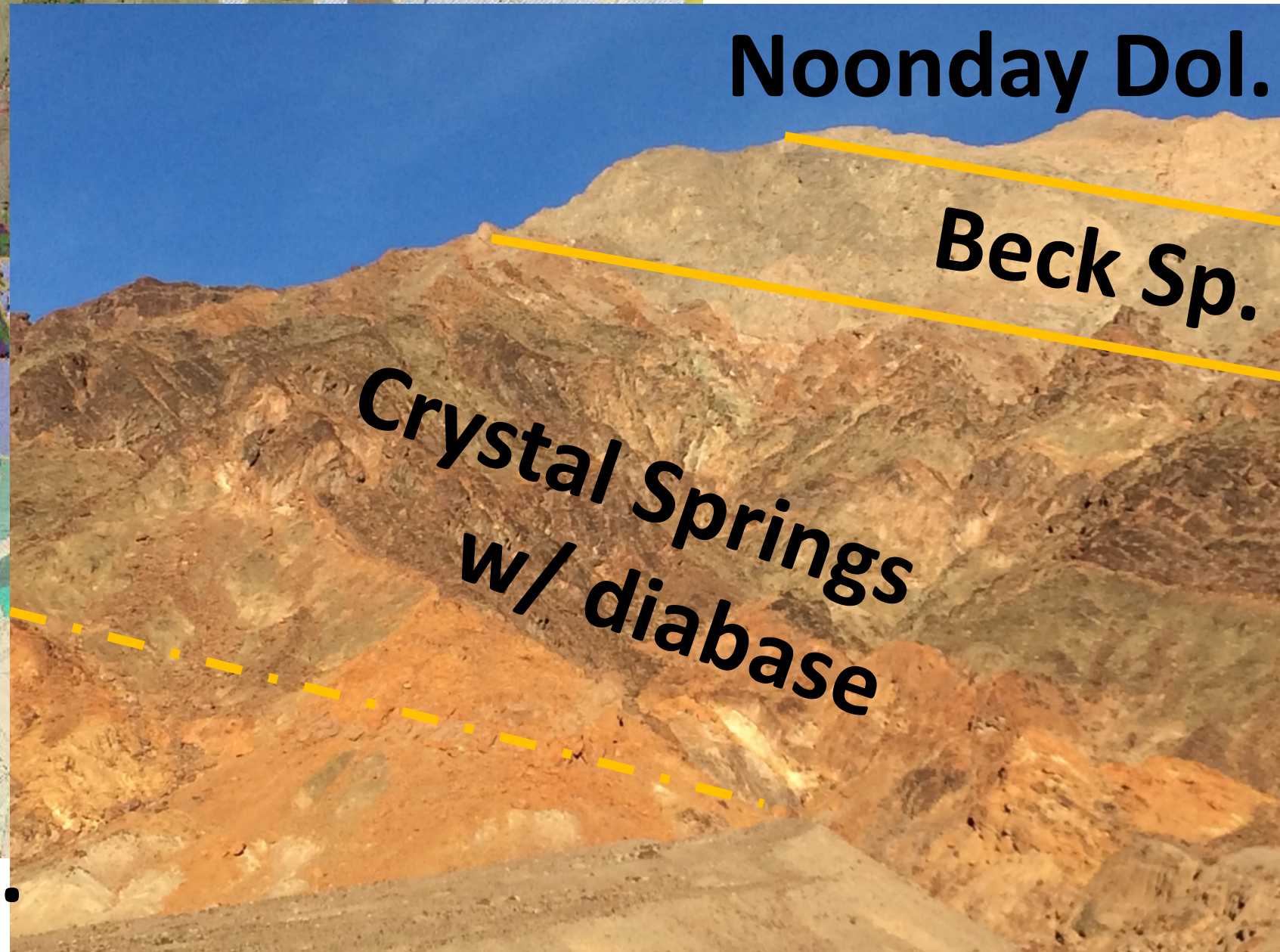


Mancktelow and Pavlis (1994)

D2: Presently Low-angle normal faults

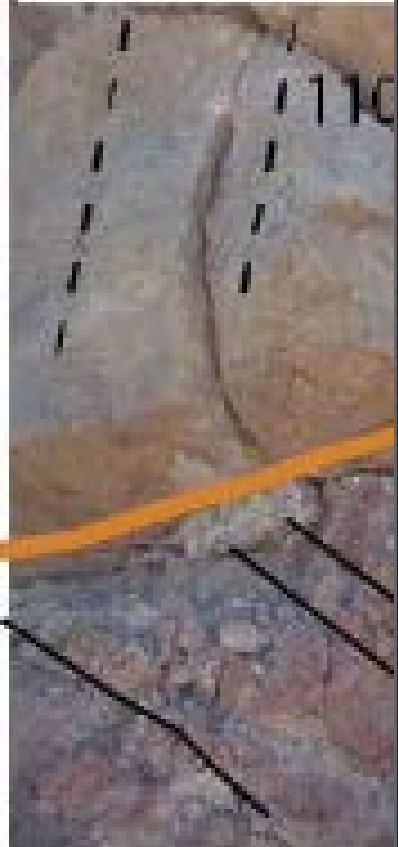


Basm.



D2: Pres

'Sallywag C



*courtesy of Marli Miller

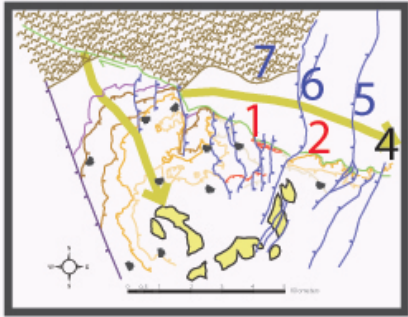
D2: Presently Low-angle normal faults



*courtesy of Marli Miller

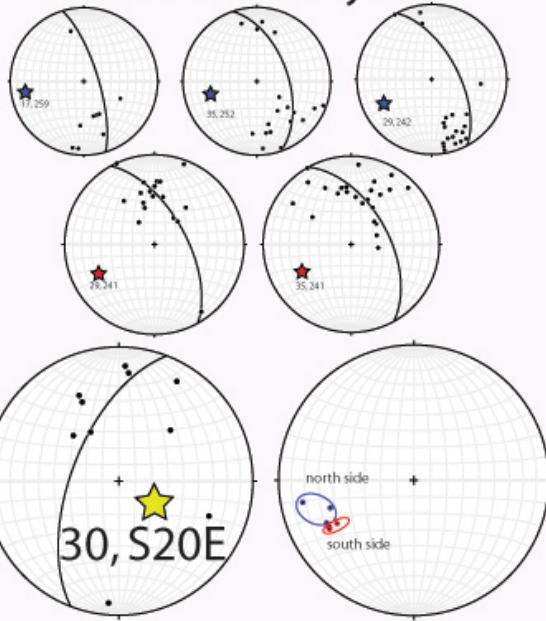
D2: Presently Low-angle normal faults, Which are folded...

i introduction ii methods **iii results** iv conclusions



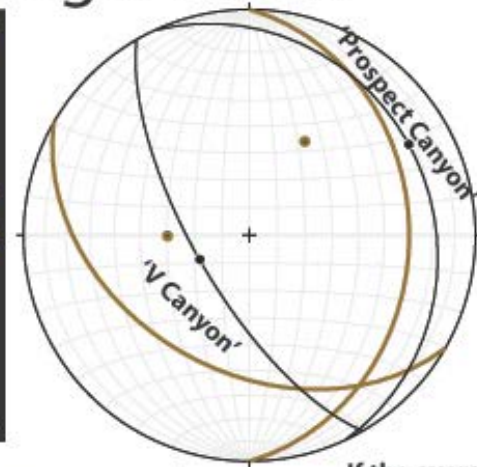
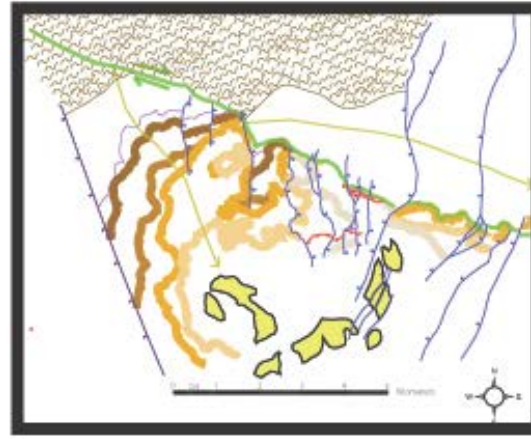
D3: Broad Folds

Stereonet Analysis:



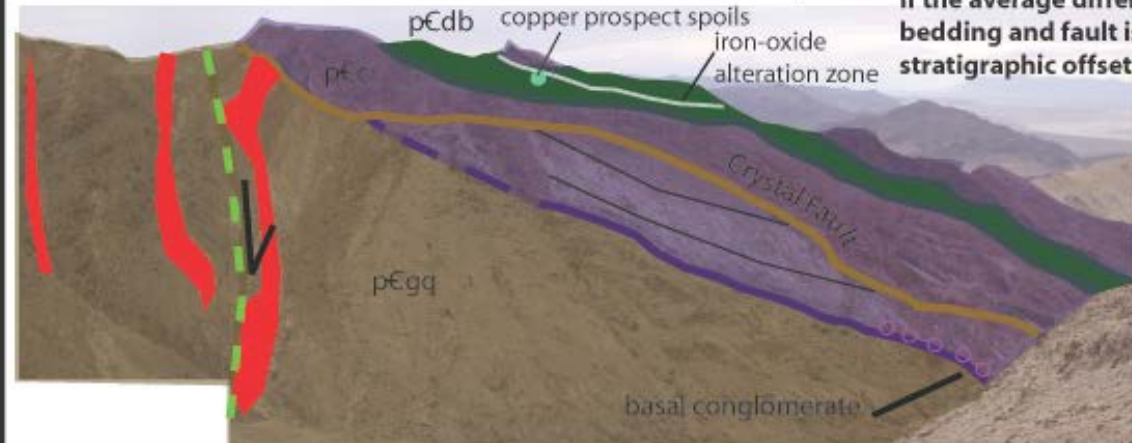
i introduction ii methods **iii results** iv conclusions

D2: 'Shingle Faults'



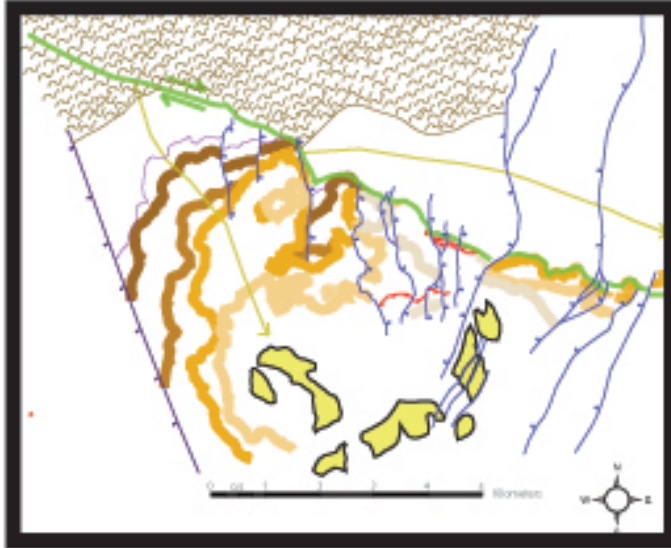
$$\frac{200\text{m}}{\sin(25^\circ)} = 473\text{ m}$$

If the average difference between bedding and fault is 25°, and the stratigraphic offset is ~200m, then:



i introduction ii methods **iii results** iv conclusions

D2: Slip Assessments



- Three Assumptions:
- 1) No previous deformation
 - 2) Constant fault dip at depth
 - 3) Generalized Stratigraphy

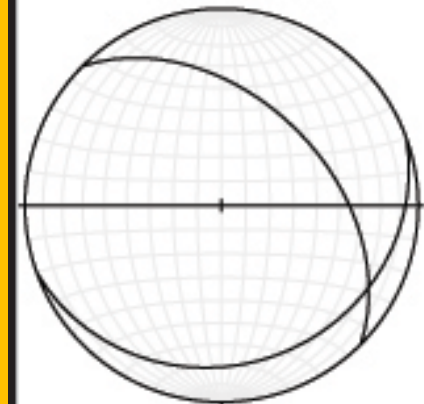
Crystal = 470 km

480m

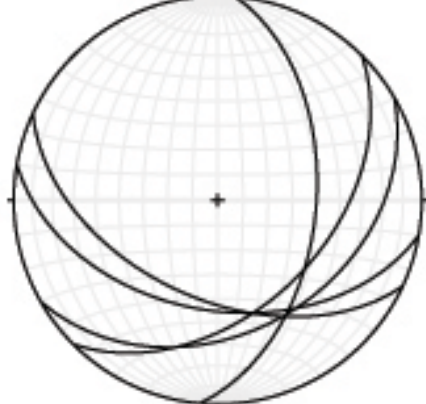
2555m

600m

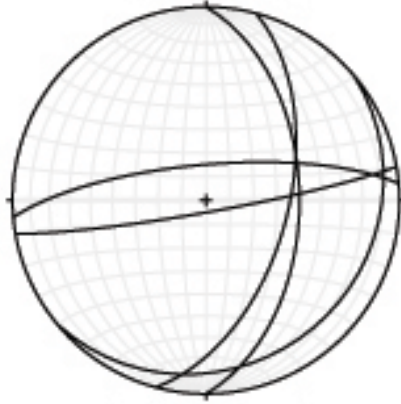
400m



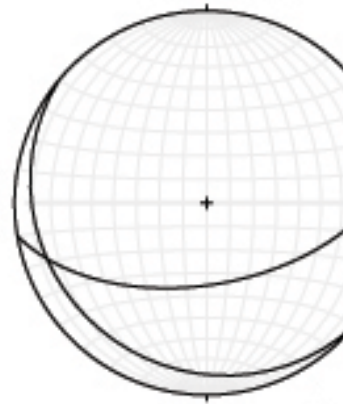
Beck



Noonday



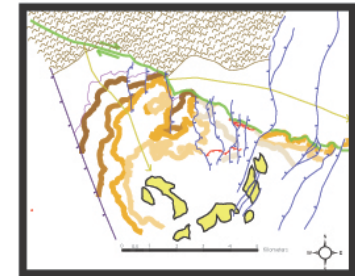
Johnnie



U. Johnnie

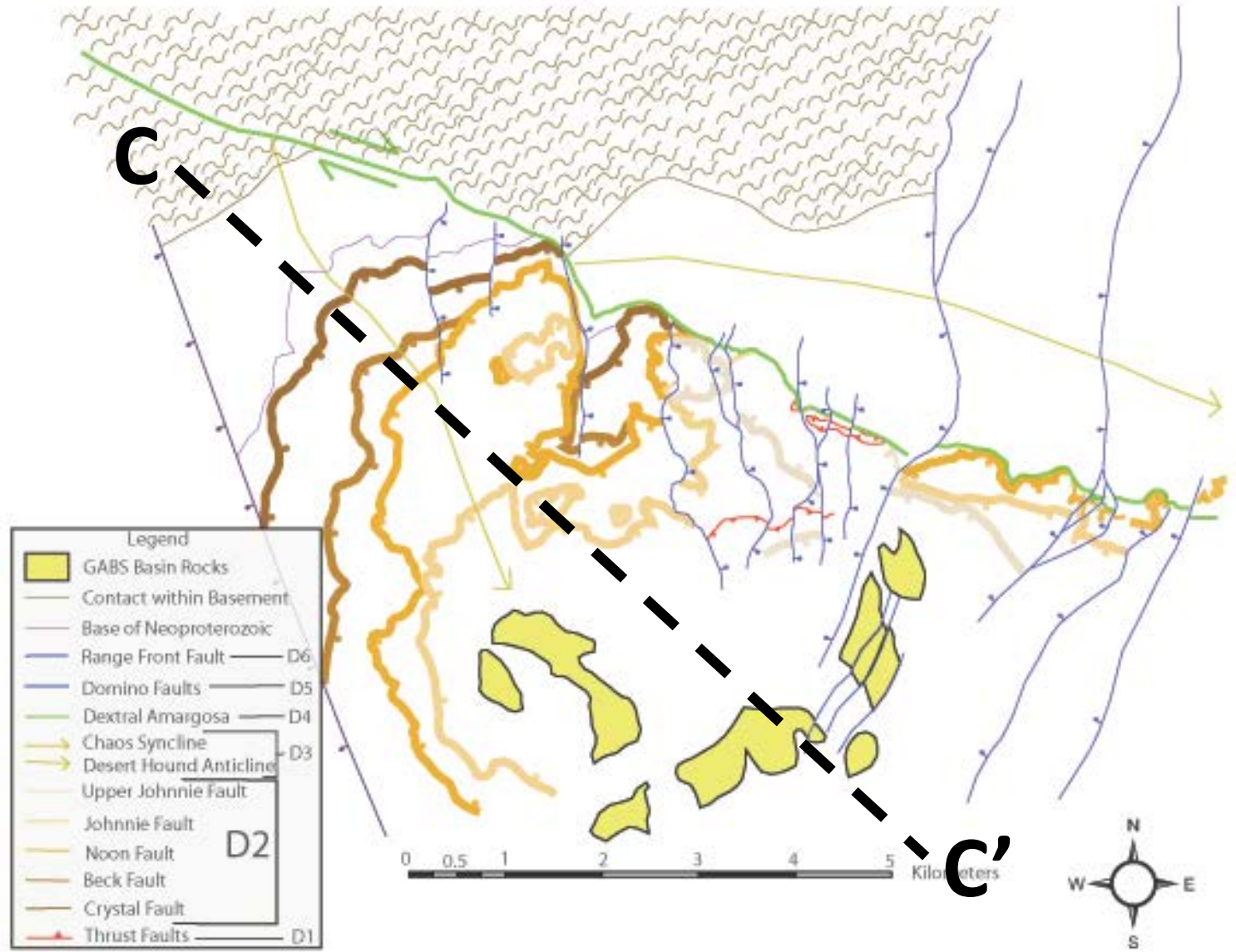
i introduction ii methods **iii results** iv conclusions

D2: Chaos Fault System

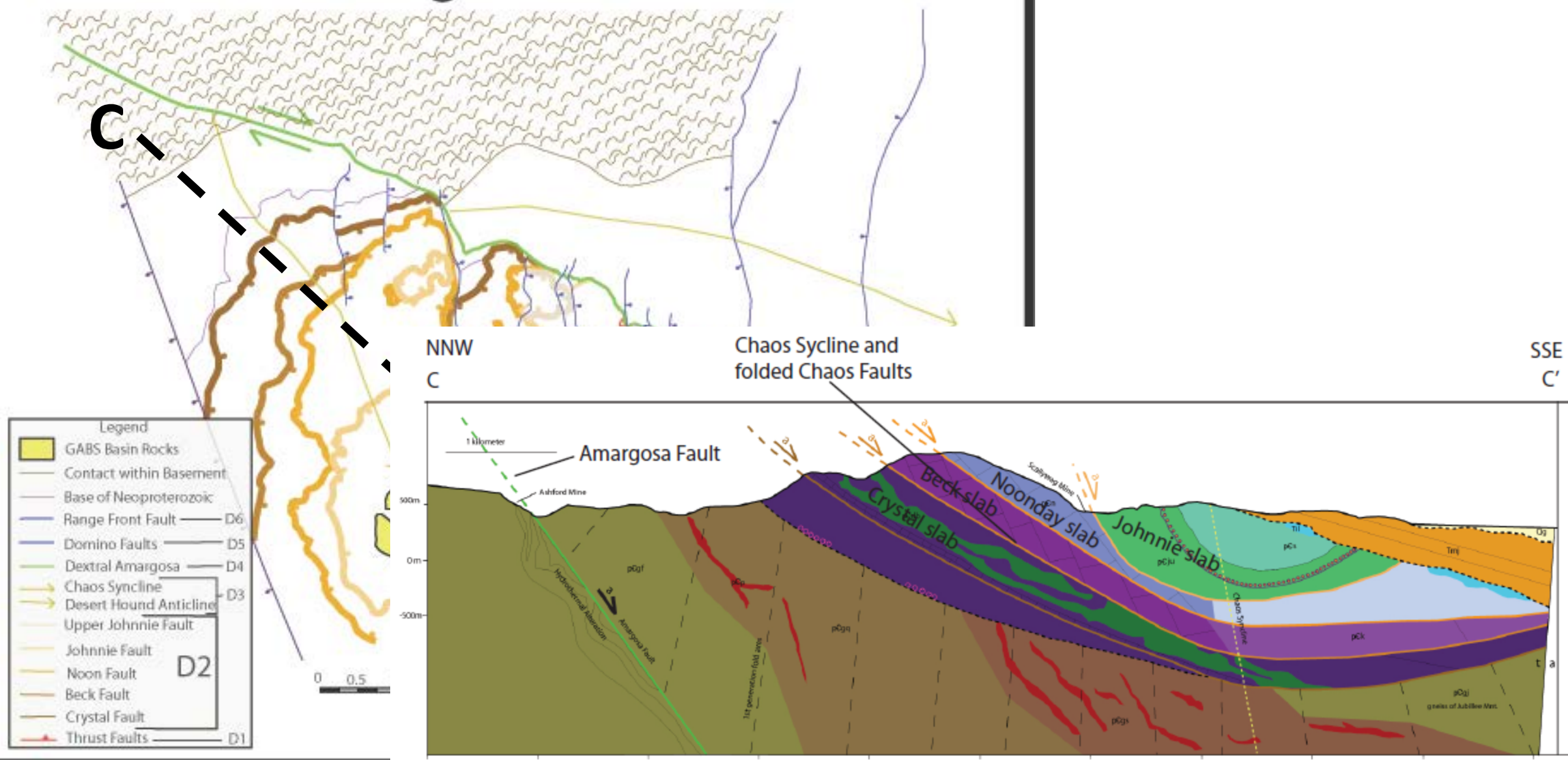


~4.5 km of slip

D2: 'Shingle Faults'



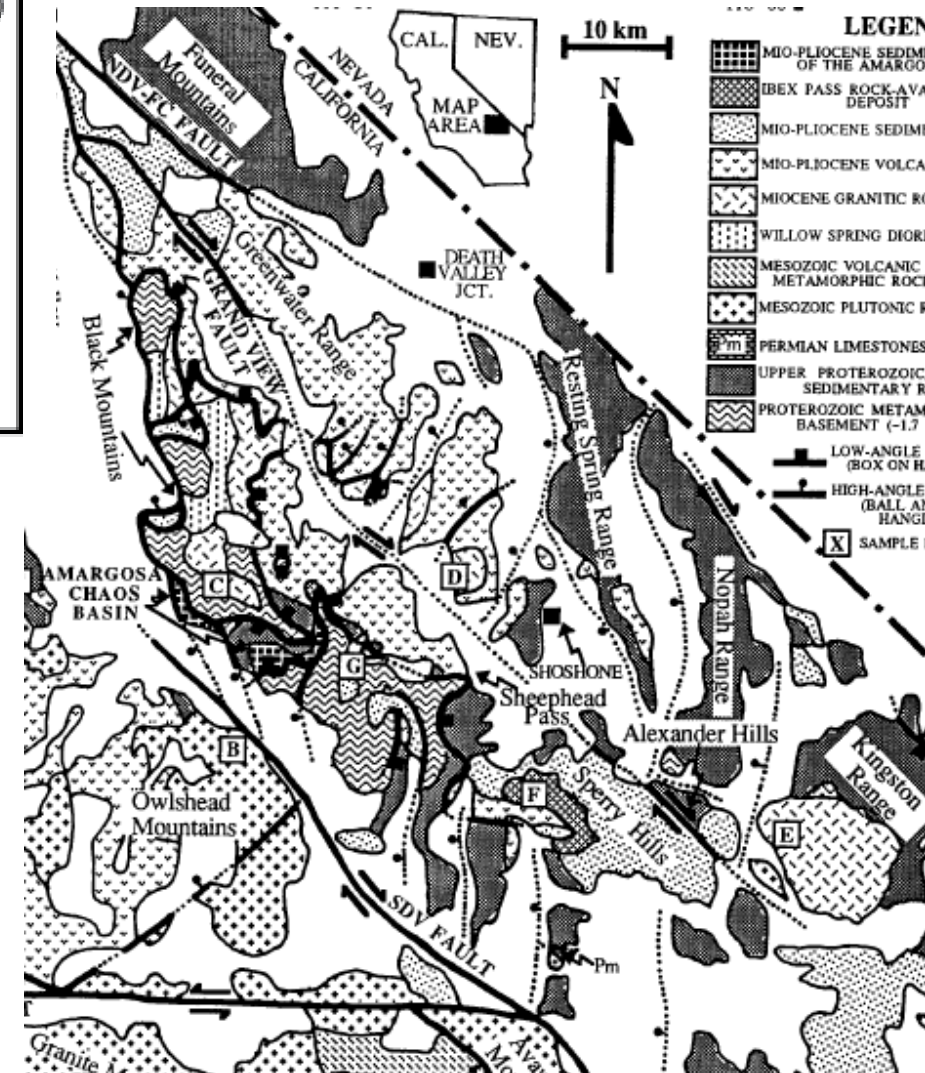
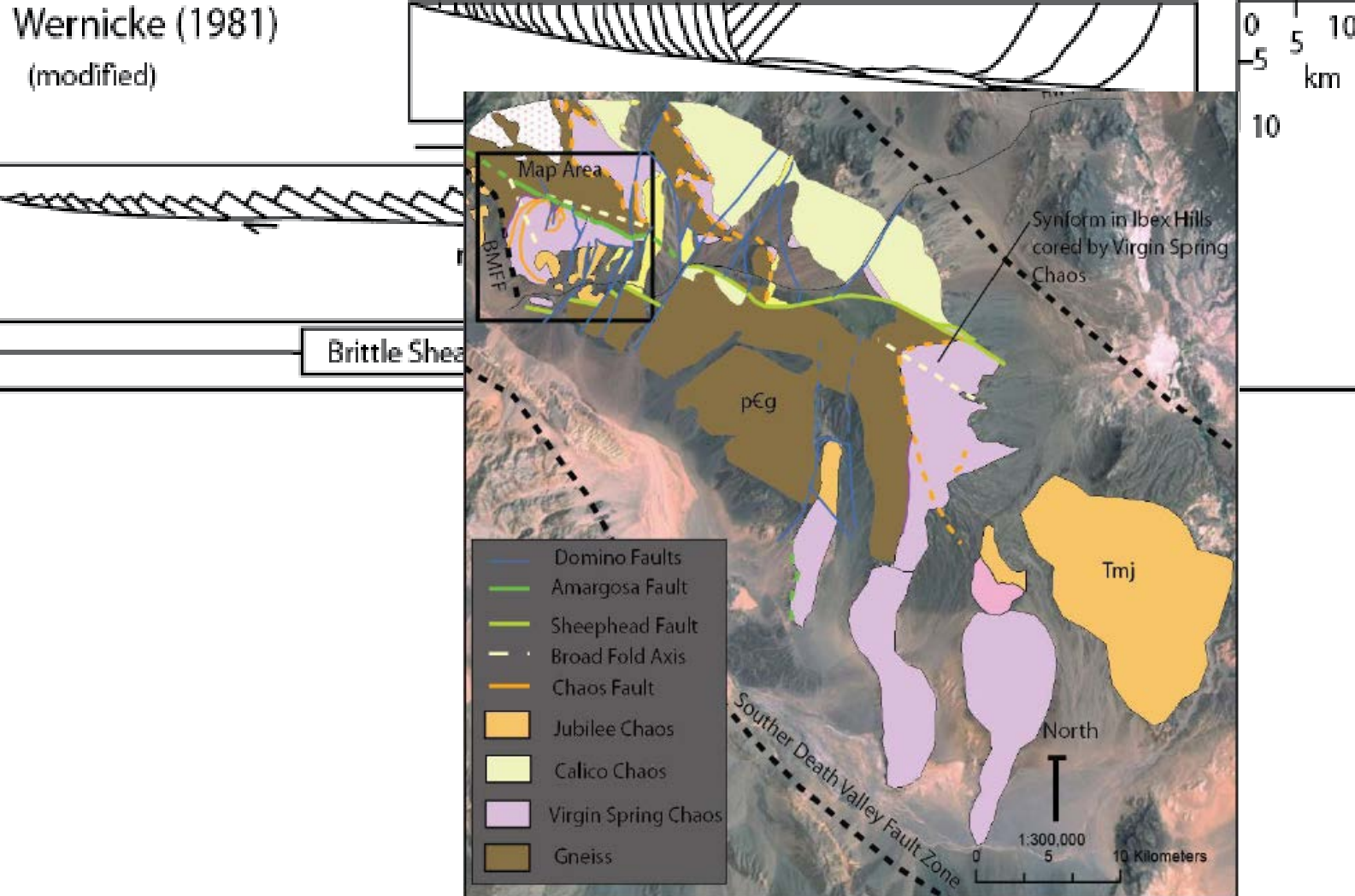
D2: 'Shingle Faults'



D2: Presently Low-angle normal faults

Extensional Nappes?

Wernicke (1981)
(modified)



Castonguay's Chaos (2013)

***Six deformational events *within* VS chaos**

D1: thrusts and folds (Castonguay, GSA 2012, Querétaro, MX)

D2: presently low-angle normal faults

D3: regional folding (W&T #3)

D4: Amargosa 'surface' (Miller)

D5: Domino faults (W&T #4 & next talk)

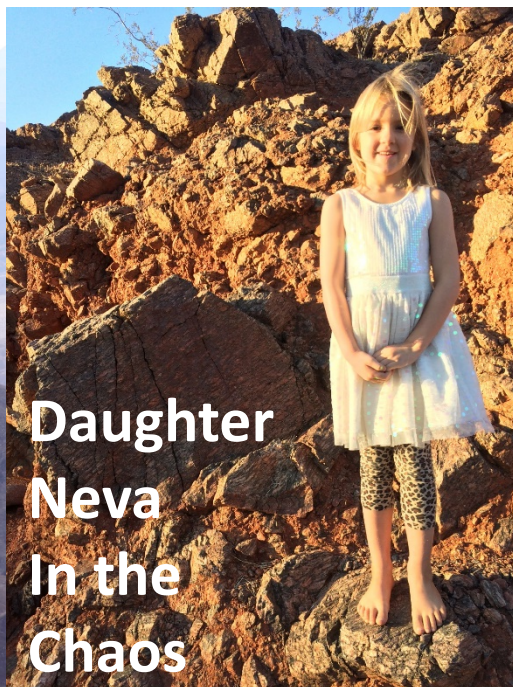
D6: active Black Mountain front (Bodin ?)

***modern arrangement depends on earlier deformation**

**Chaos: small differences in initial conditions within a
Dynamical system may lead to deterministic chaos.**



**Marli and Kris
2011**



**Daughter
Neva
In the
Chaos**



Benny and Sammy, 2011



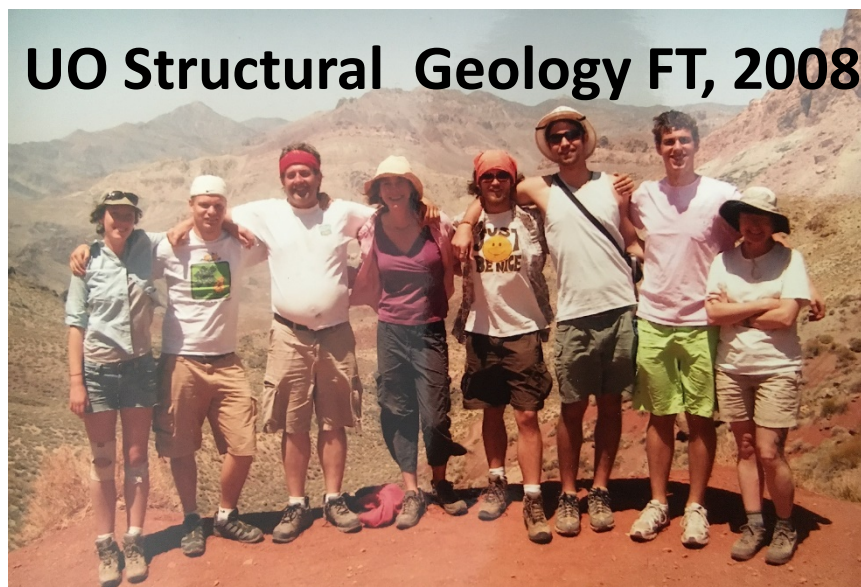
**Benny Memorial FT,
Sept. 2017**

Thank you!

Questions?



**Lauren Memorial FT,
2013**



UO Structural Geology FT, 2008



David and Sammy, 2011



BASS CAMP, GRAND CANYON

PHOTOGRAPHER: LEVI NOBLE

MEDIUM: NITRATE PHOTOGRAPH

CREATED: CA. 1920

GIFTED: 2000 BY DR. LAUREN WRIGHT

This is a photo of Dorothy Noble and John Walthenberg taken ~~was~~ by Levi Noble.

~~There~~ The three of them were en route to Bass Camp (there were two Bass Camps one on the rim and the other on the Colorado River)

where Levi camped during his field work on his Ph.D. thesis. See USGS Open File report no. ? by Wright and Troxel.