國立中央大學
應用地質研究所
National Central University
Graduate Institute of Applied Geology

國立中央大學
National Central University

Analysis of deformation bands associated with the Trachyte Mesa intrusion, Henry Mountains, Utah: implications for reservoir connectivity and fluid flow around sill intrusions

Wilson, P. I. R., Wilson, R. W., Sanderson, D. J., Jarvis, I., and McCaffrey, K. J. W, Solid Earth 12 (2021), 95-117

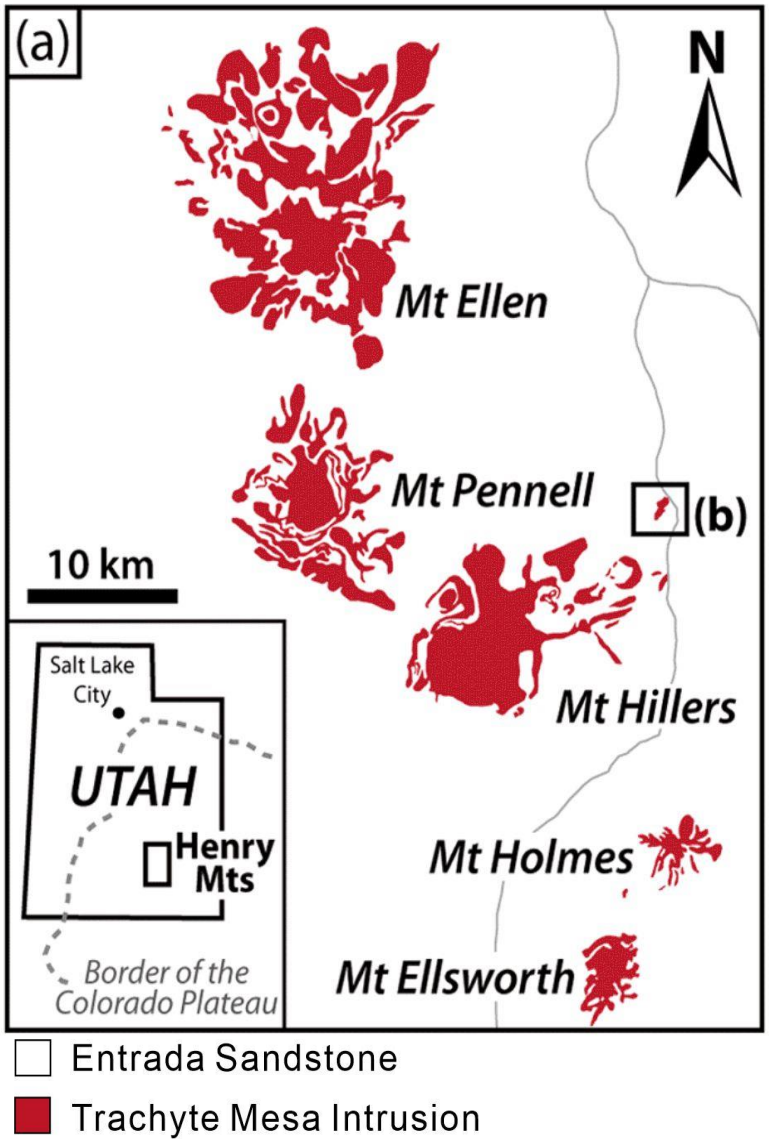
Presenter : Mu Kuo
Advisor : Wen-Jeng Owen Huang
Date : 2024/12/13

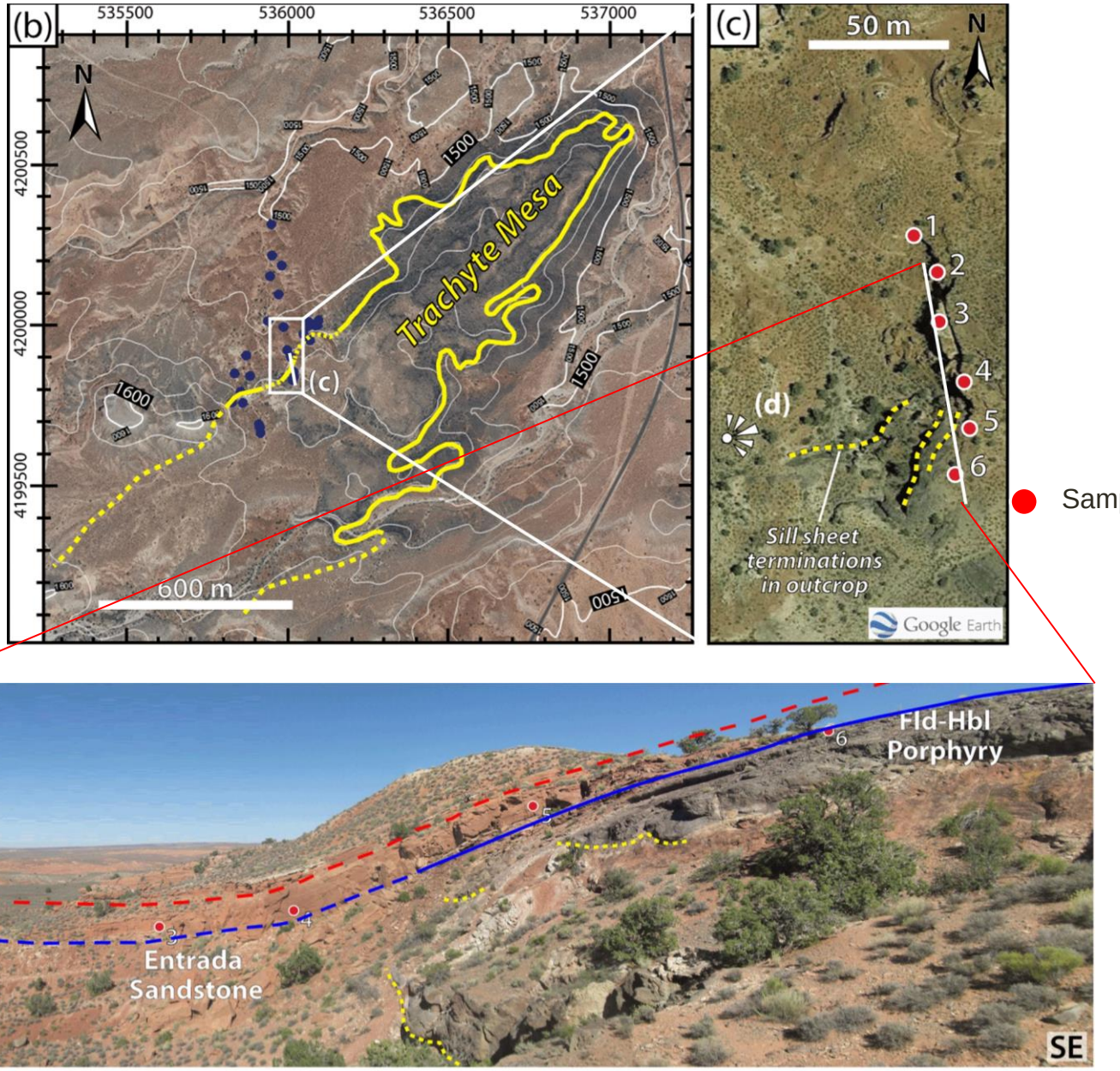
Geological setting

Entrada Sandstone
Age: Jurassic
Rock type: Aeolian Sandstone

Trachyte Mesa intrusion
Age: Oligocene
Rock type: Trachyte

The intrusion was formed by the amalgamation and stacking of multiple thin (1–5m thick) sill sheets (Johnson and Pollard, 1973; Menand, 2008; Morgan et al., 2008; Wilson et al., 2016).

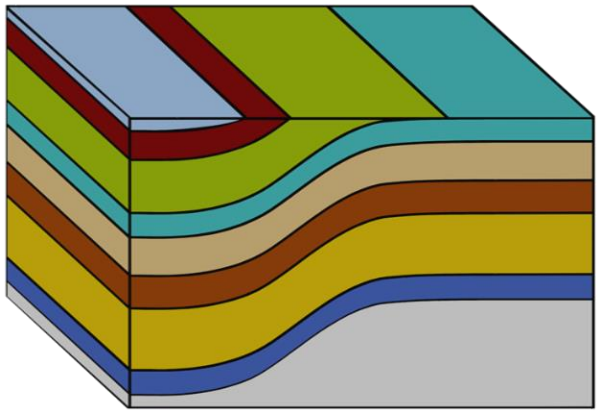


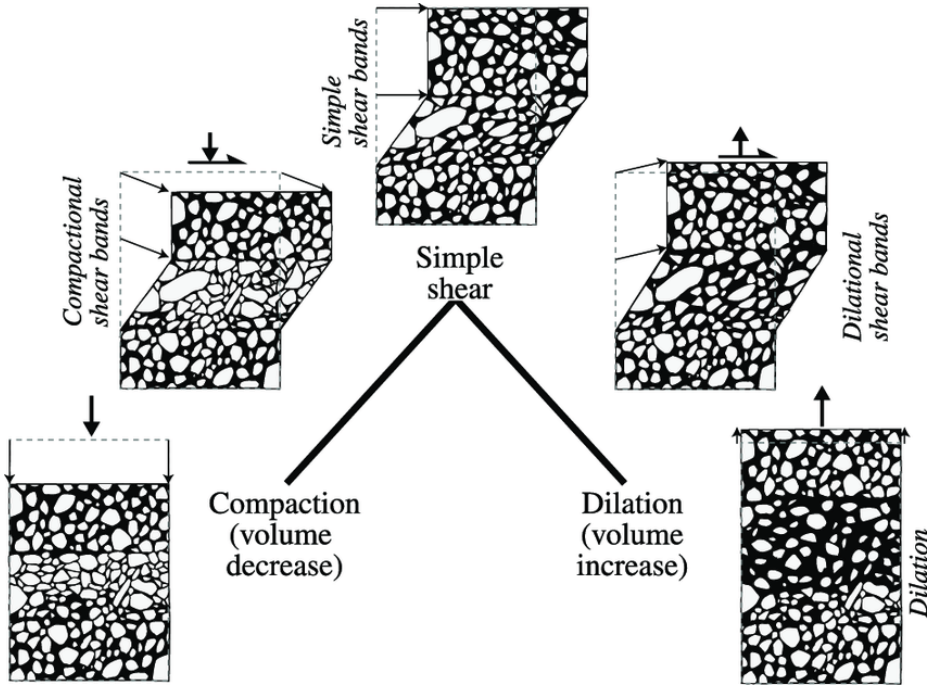

(b)
535500
536000
536500
537000
N
4200500
4200000
4199500
1500
1600
Trachyte Mesa
(c)
600 m
(c)
50 m
N
1
2
3
4
5
6
(d)
Sill sheet terminations in outcrop
Google Earth
Sampling location
Fld-Hbl Porphyry
Entrada Sandstone
NW
SE

Research purpose

1. The causes of the formation of monocline folding.
2. The formation and properties of deformation bands.
3. The influence of deformation bands on fluid flow.

Monocline Fold





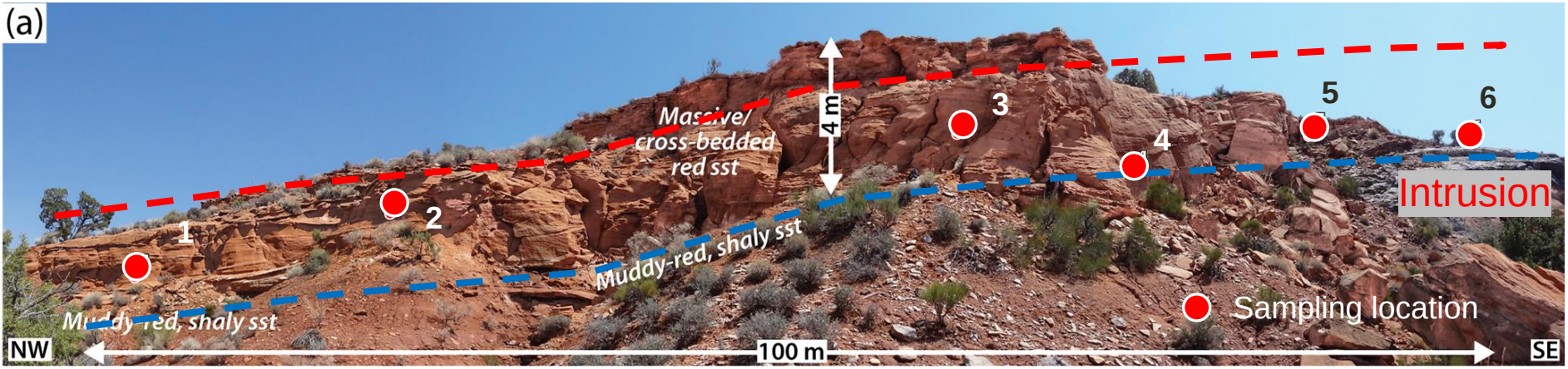
(Fossen et al., 2007)

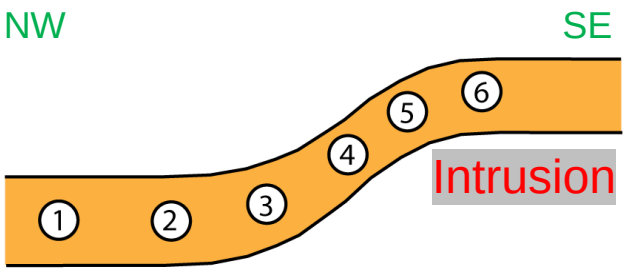
- Field work
  - Outcrop transverse (Measuring Lengths and Quantities)
  - Fracture Network Map – preparing for Node Counting & Fracture Analysis
  - Sampling for thin section

- Laboratory work
  - Node Counting & Fracture Analysis
  - Porosity Analysis under Microscope

Field work - Outcrop traverse

Measuring the scale and recording the pattern of the outcrop in each station.





Upper boundary of sandstone(speculate)

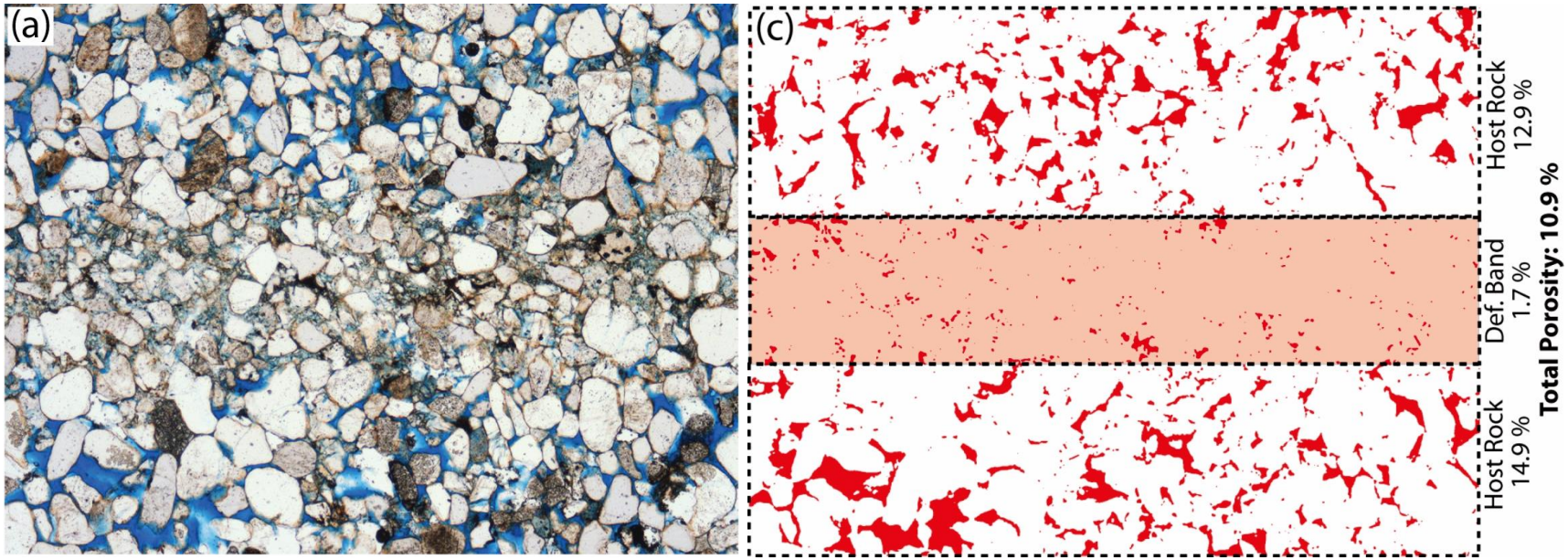
Lower boundary of sandstone(speculate)

sandstone

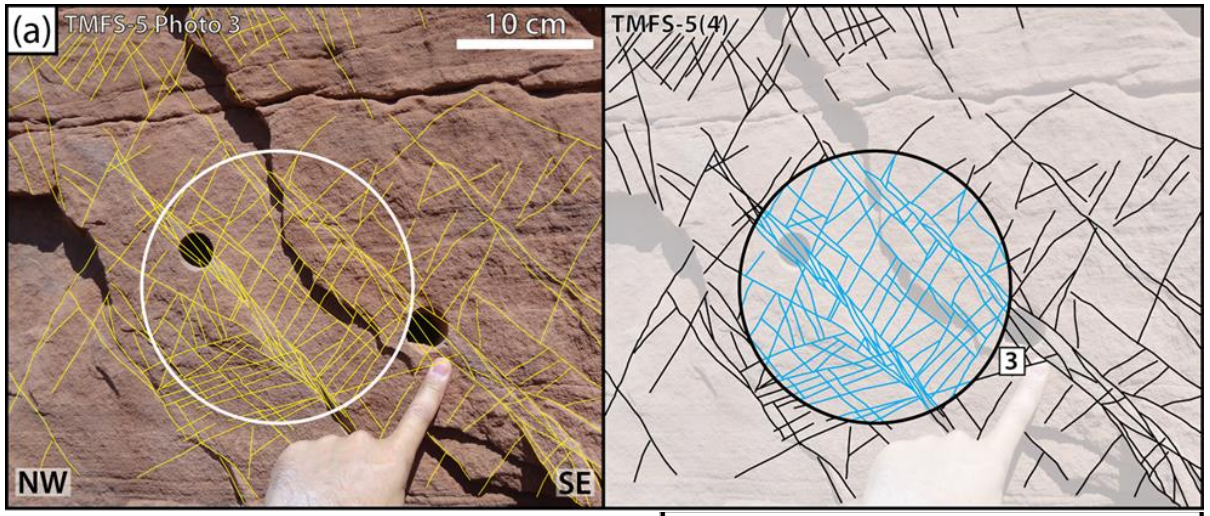
Laboratory work - Porosity Analysis

1. Make the thin section (Fill the dye into the pore)
2. Input the image into computer

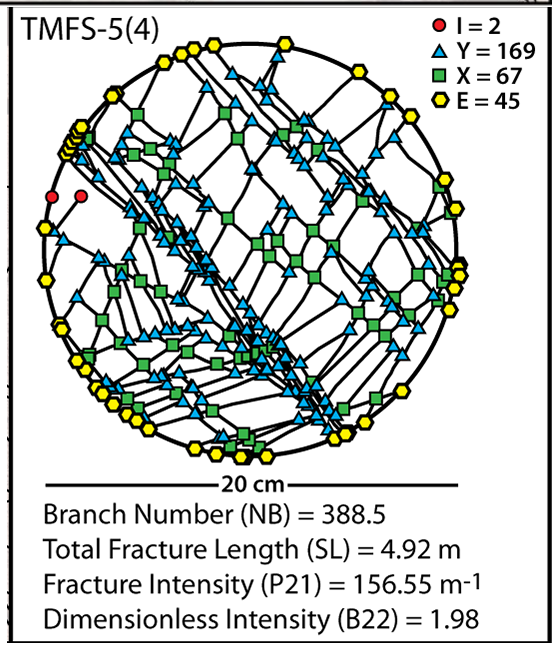
In the middle of the thin section, pore decrease significantly(reduce permeability).



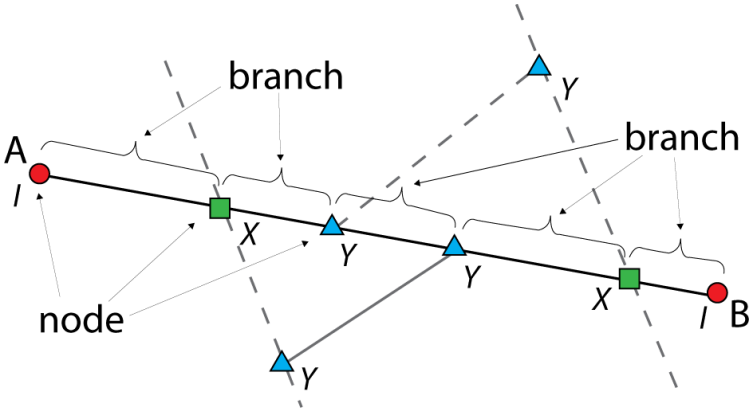
Laboratory work - Fracture analysis



1. Sketch the pattern of fractures or kink bands
2. Plot and count the number of nodes.
3. Nodes can be classified into 3 types: I-, Y- and X-nodes.

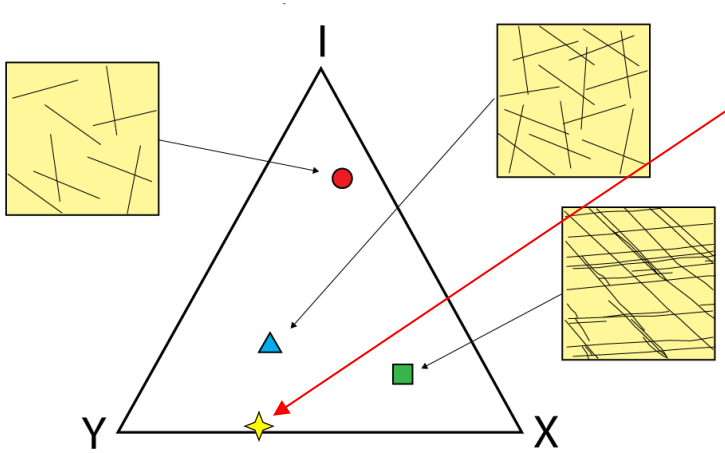


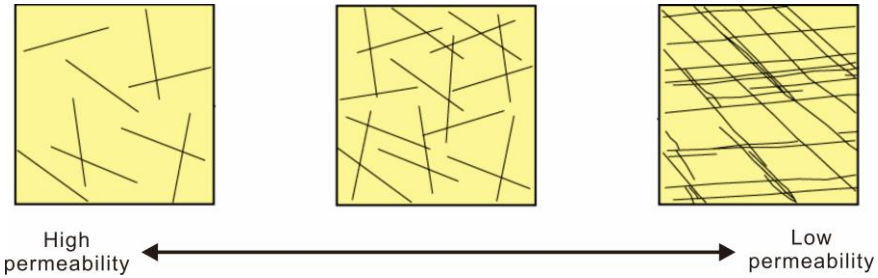
Fracture analysis

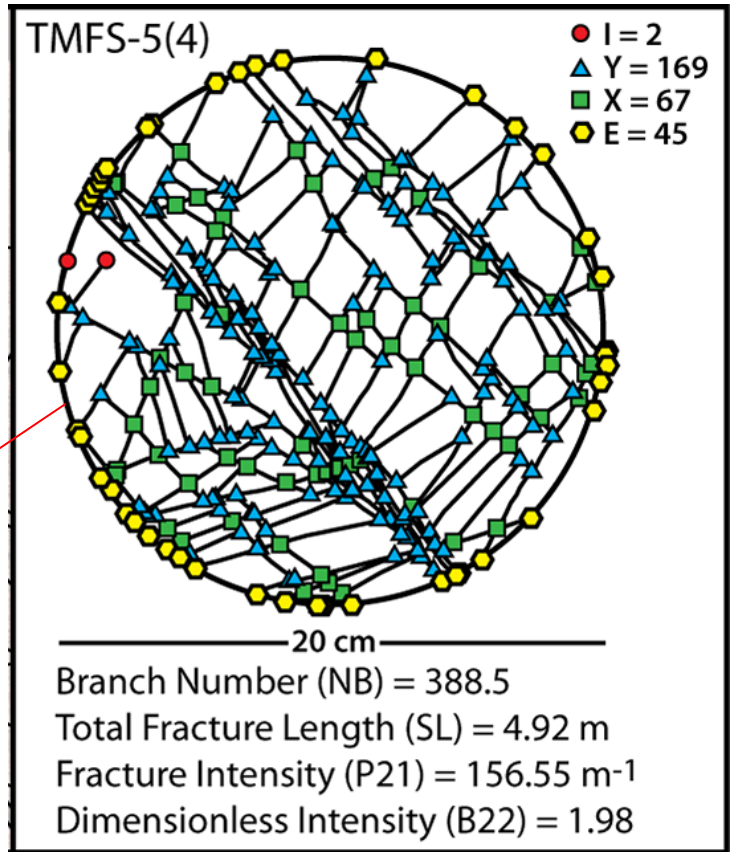


Main deformation band

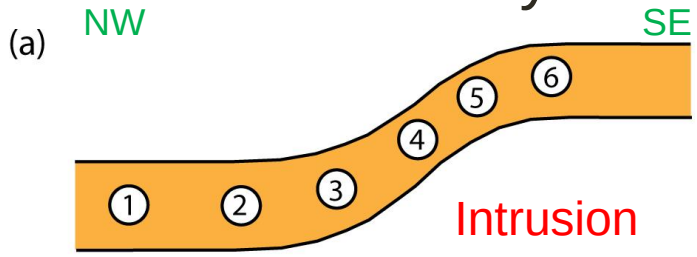
Branch deformation band

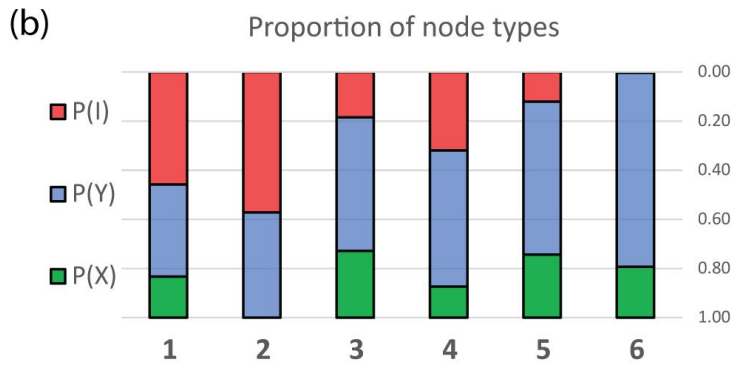


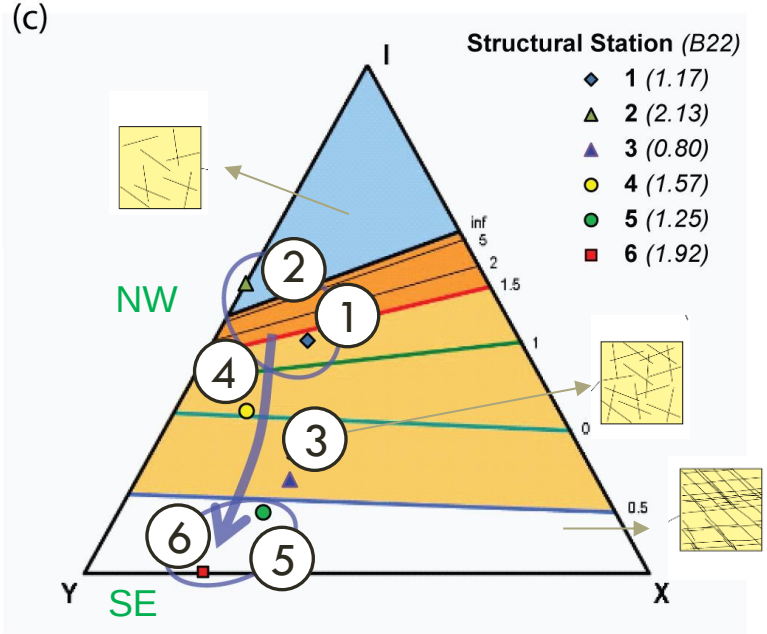




Fracture network analysis in each locality





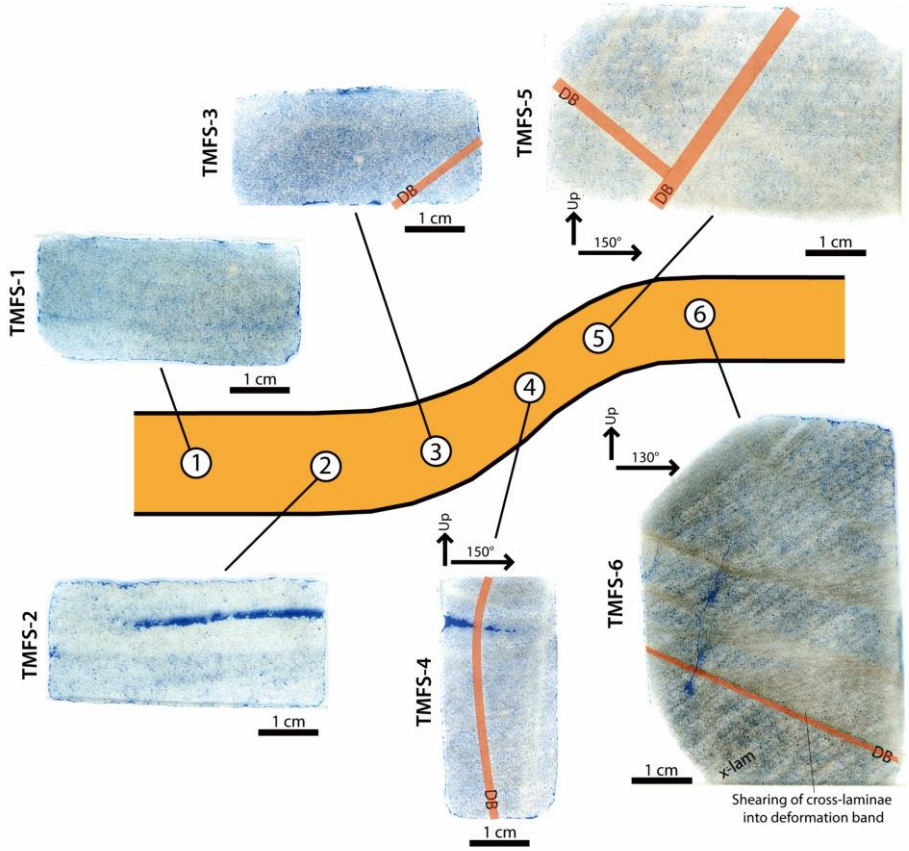


Topology								
	# Branches	$\|B\|$	27	6.5	117.5	186.5	1277	881.5
	# Lines	$\|L\|$	10	3.5	29.5	65.5	315	218.5
	Average degree	$\langle d \rangle$	2.25	1.86	2.90	2.49	3.02	3.20
	Proportion (Y + X)	$P(x+y)$	0.70	0.43	0.82	0.70	0.91	1.00

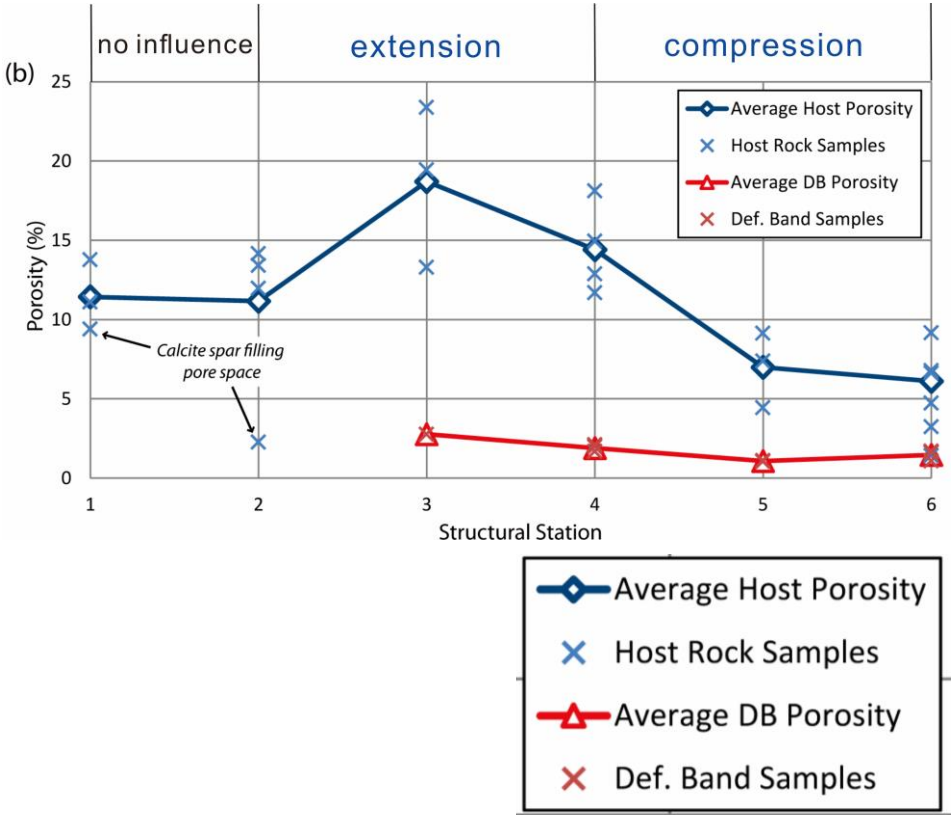
Deformation bands increase in intensity and frequency near the NW margin of the intrusion.

These bands exhibit a clear topological shift, with more Y- and X-nodes closer to the intrusion, indicating enhanced network connectivity but reduced permeability.

Each locality's attitude and porosity



Whole thin-section photographs (flatbed scans) for each structural station.



Variability in porosity observed in this study for each station.

How igneous intrusion effects country rock?

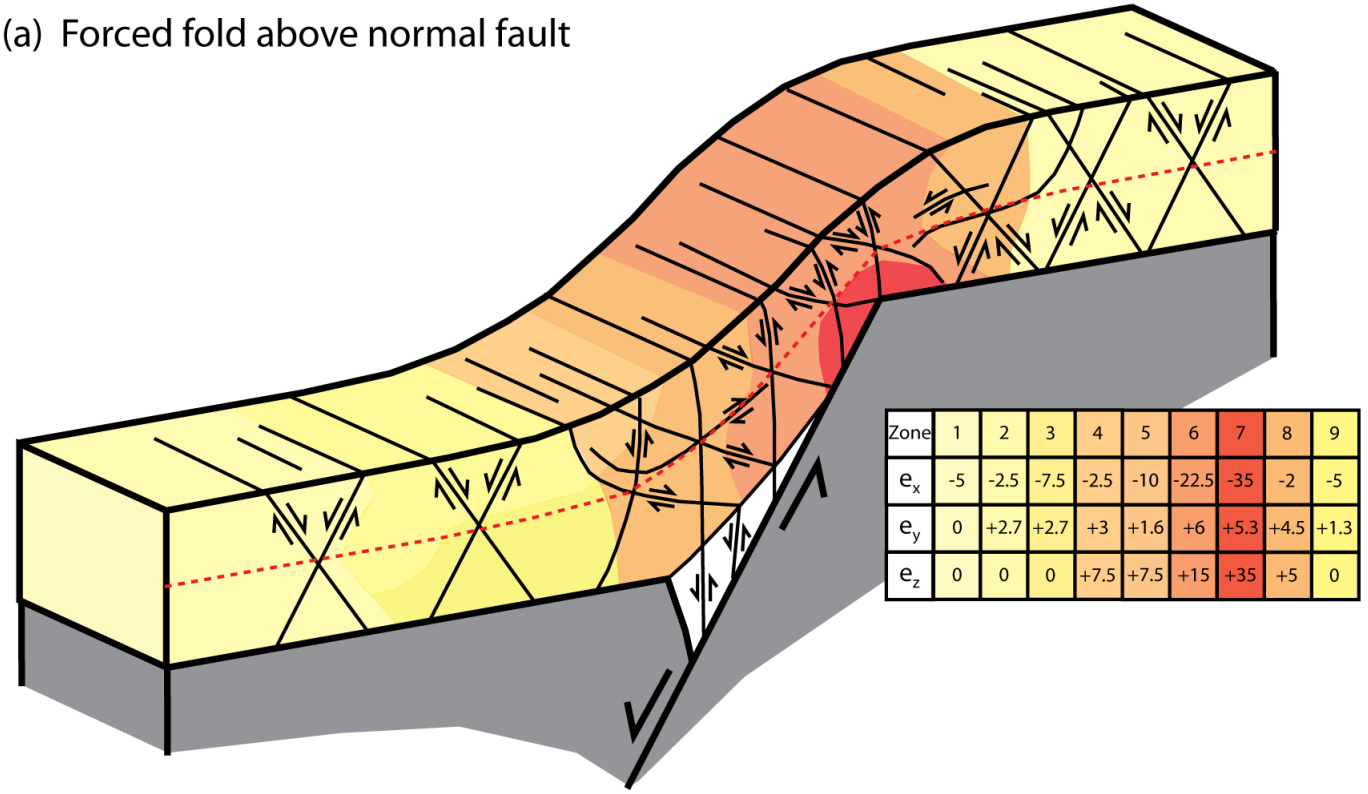
1. How igneous intrusion caused the monocline and visible deformation bands?

2. How many deformation bands (and nodes) caused by igneous intrusion in each locality?

How igneous intrusion caused the monocline and visible deformation band?

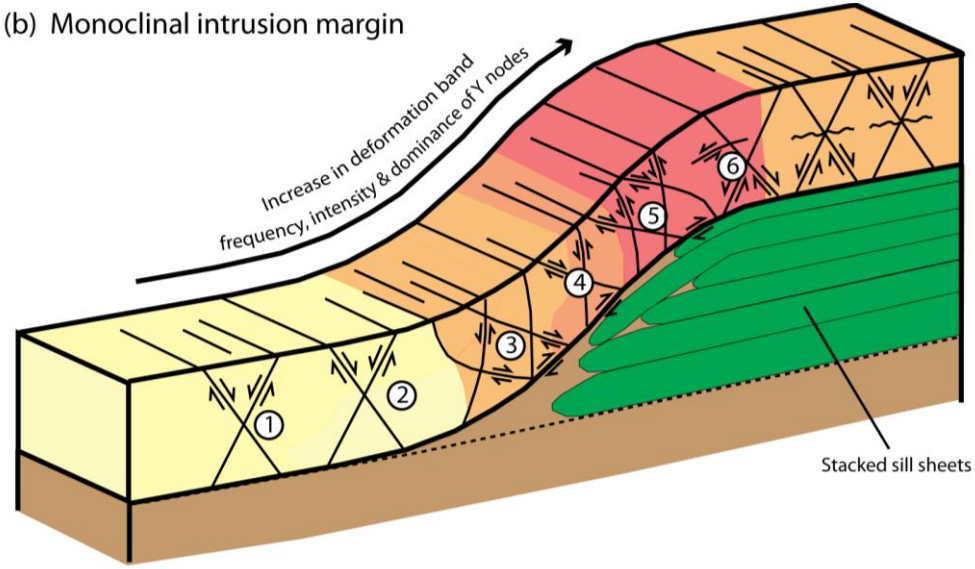
Possible reasons that might cause monocline:

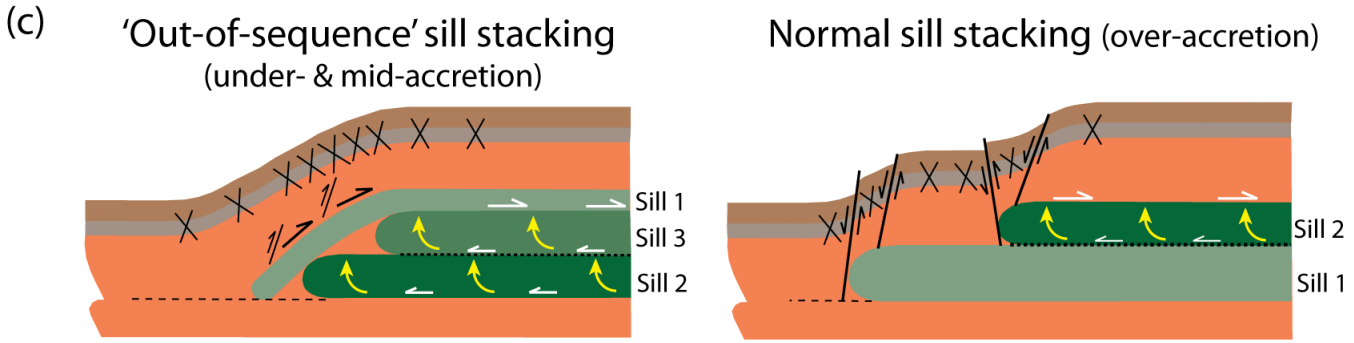
(a) Forced fold above normal fault

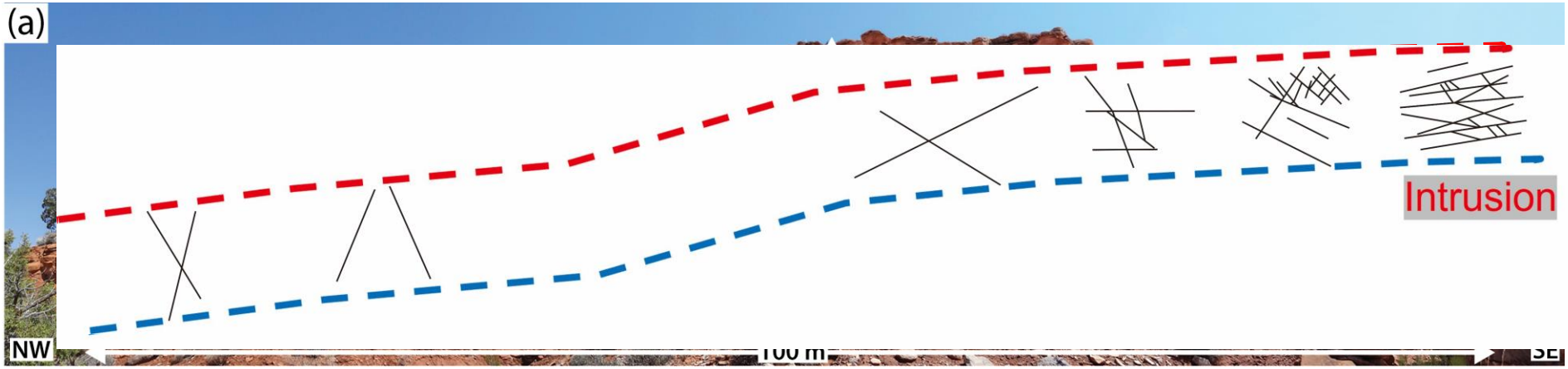


Zone	1	2	3	4	5	6	7	8	9
e_x	-5	-2.5	-7.5	-2.5	-10	-22.5	-35	-2	-5
e_y	0	+2.7	+2.7	+3	+1.6	+6	+5.3	+4.5	+1.3
e_z	0	0	0	+7.5	+7.5	+15	+35	+5	0

How igneous intrusion caused the monocline and visible deformation band?



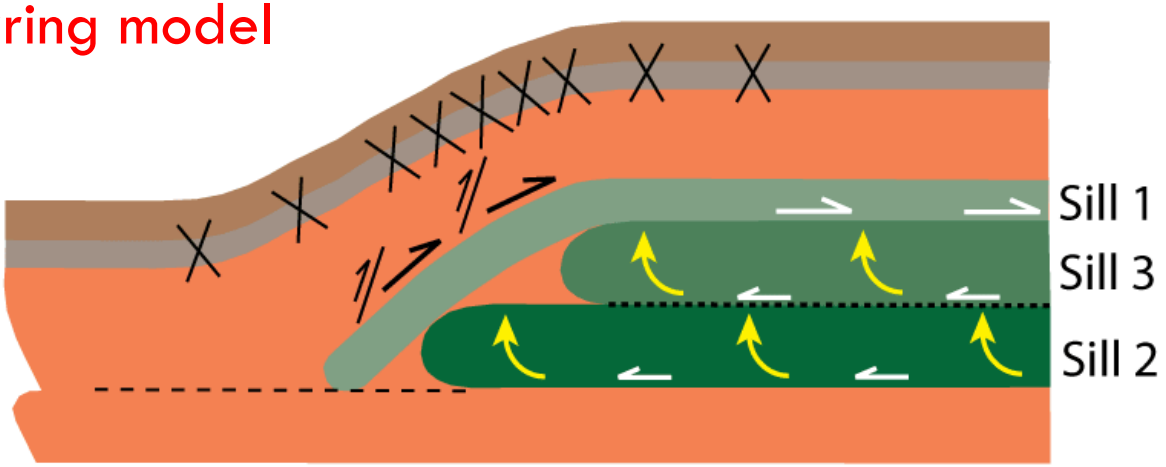




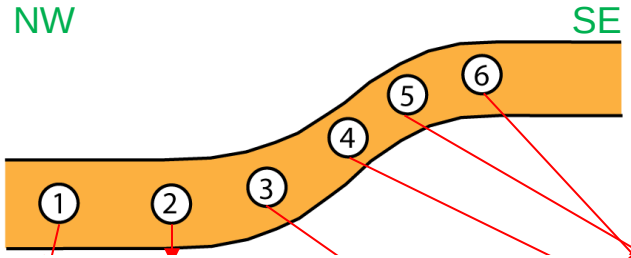
NW SE

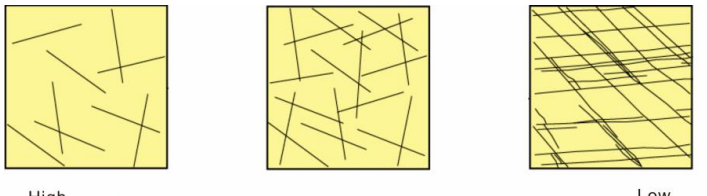
(c) 'Out-of-sequence' sill stacking
(under- & mid-accretion)

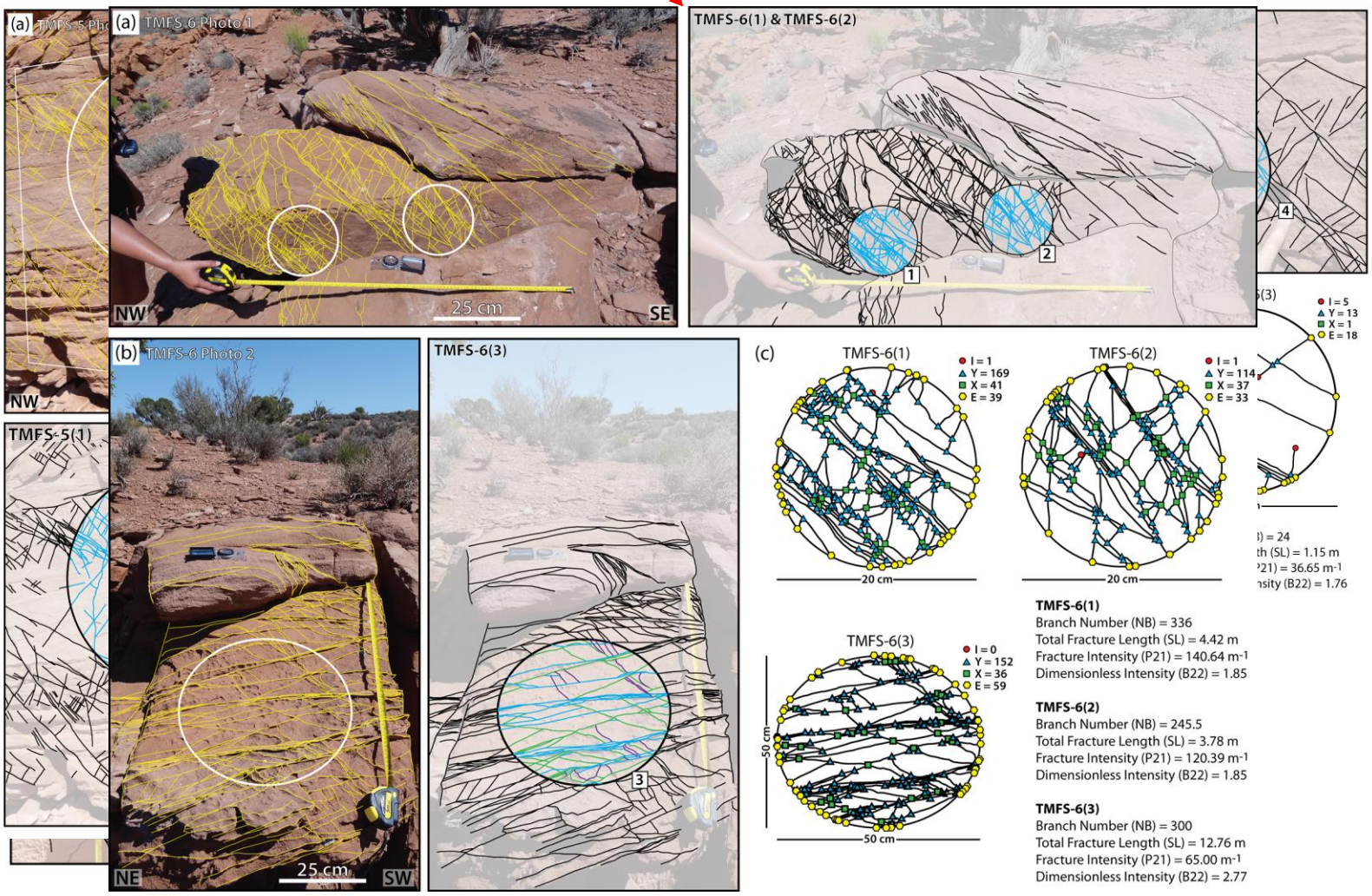
preferring model



How m … s (a
by igne … oca







1. These deformation bands and monocline developed in response to emplacement of the intrusion.
2. Deformation bands increase in abundance and intensity across the NW margin of the Trachyte Mesa intrusion(Localities 5 & 6).
3. The increase in Y- and X-nodes with proximity to the intrusion likely creates a barrier to flow perpendicular to the intrusion margin.

Thank you for your attention.