

Rift Initiation and Evolution Recorded in the Oblique Tusas–Abiquiu Segment of the Rio Grande Rift, New Mexico

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Jolante van Wijk ^{1,2}

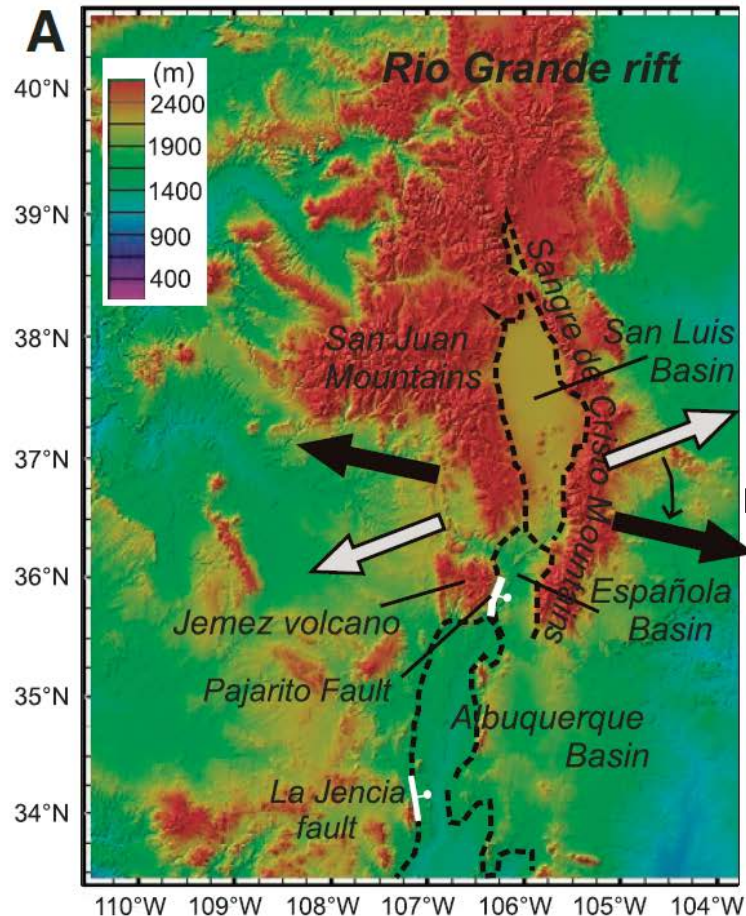
Ross A. Andrea ¹

1 University of Houston

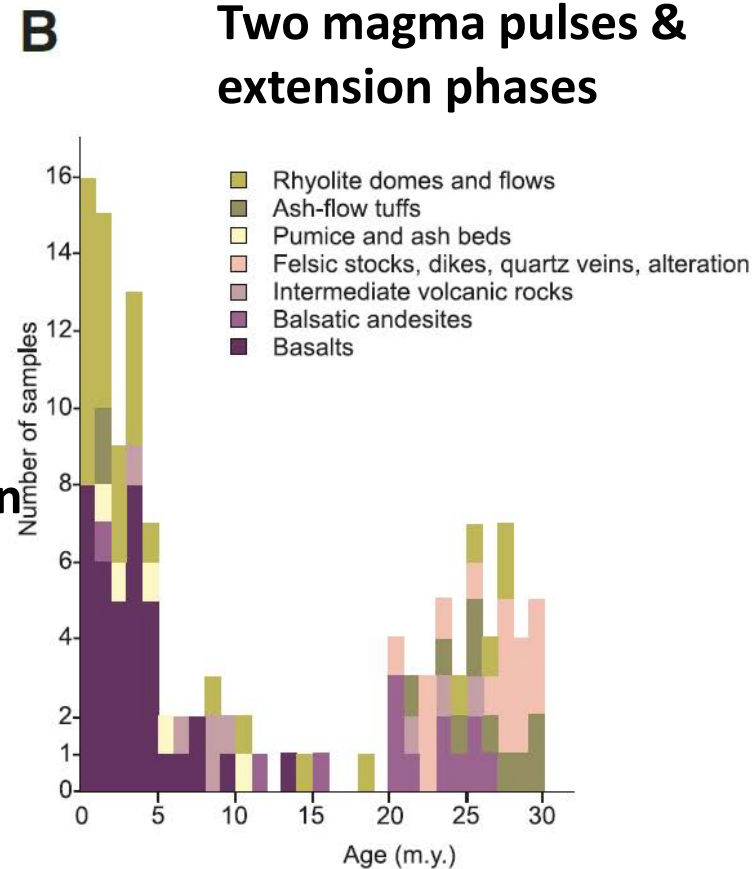
2 New Mexico Tech



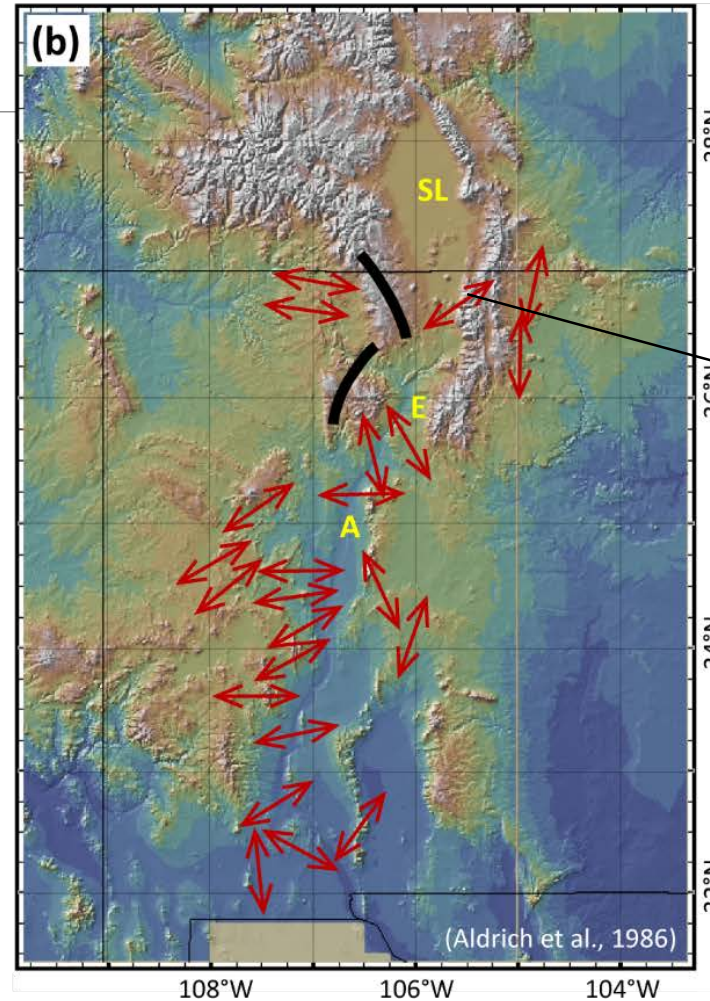
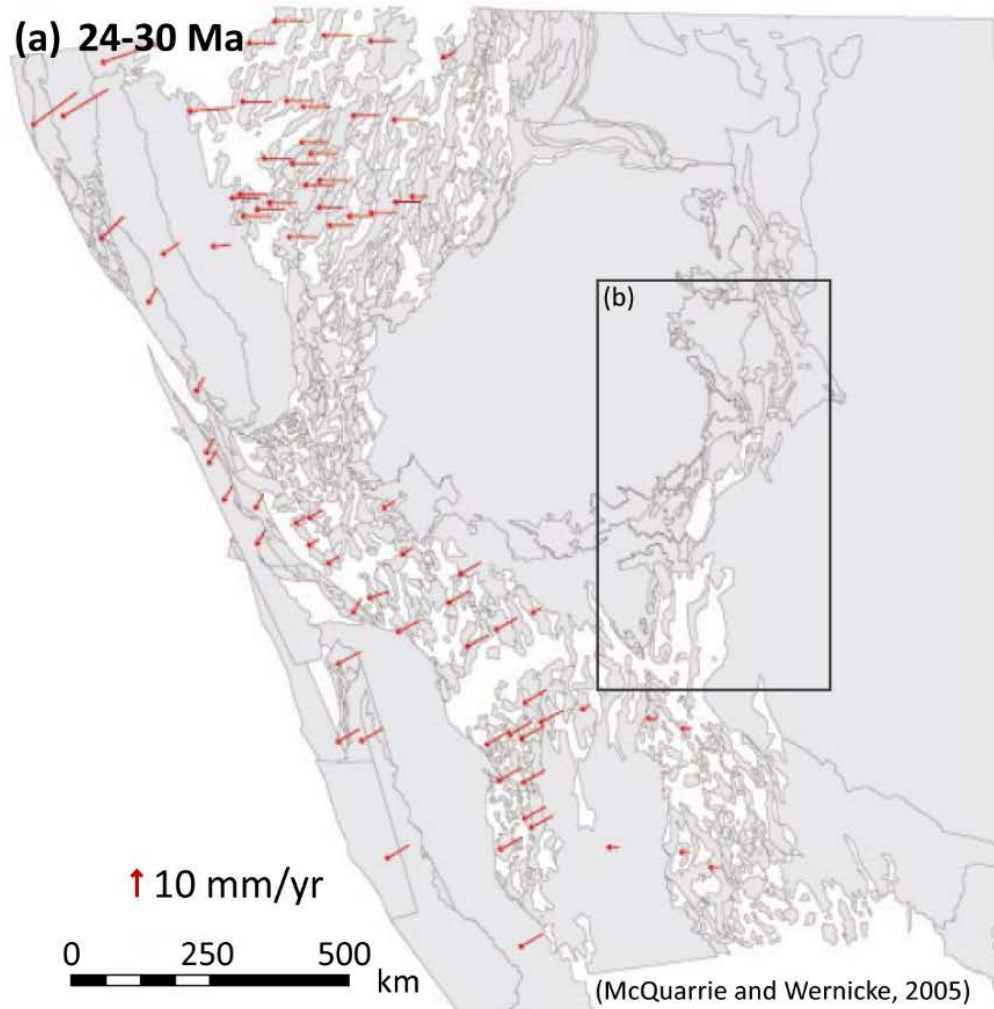
Rio Grande rifting: multiphase and multi-directional



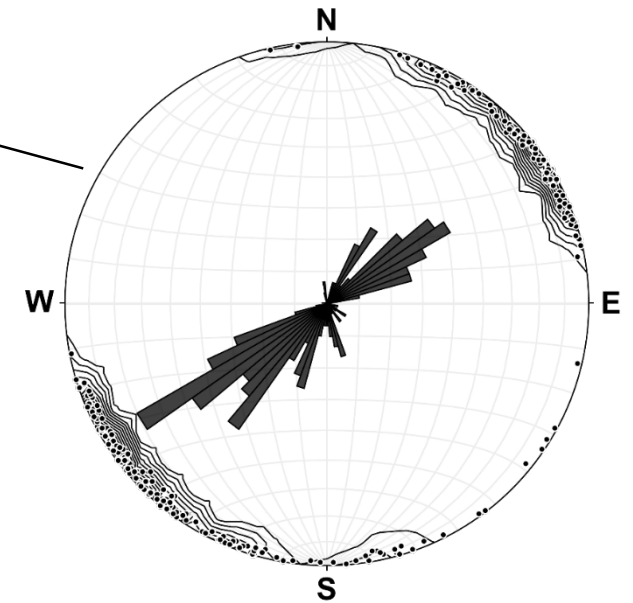
45° cw
rotation



Oligocene Extension: Basin & Range, S RGR, and N RGR



23-26 Ma Questa dikes



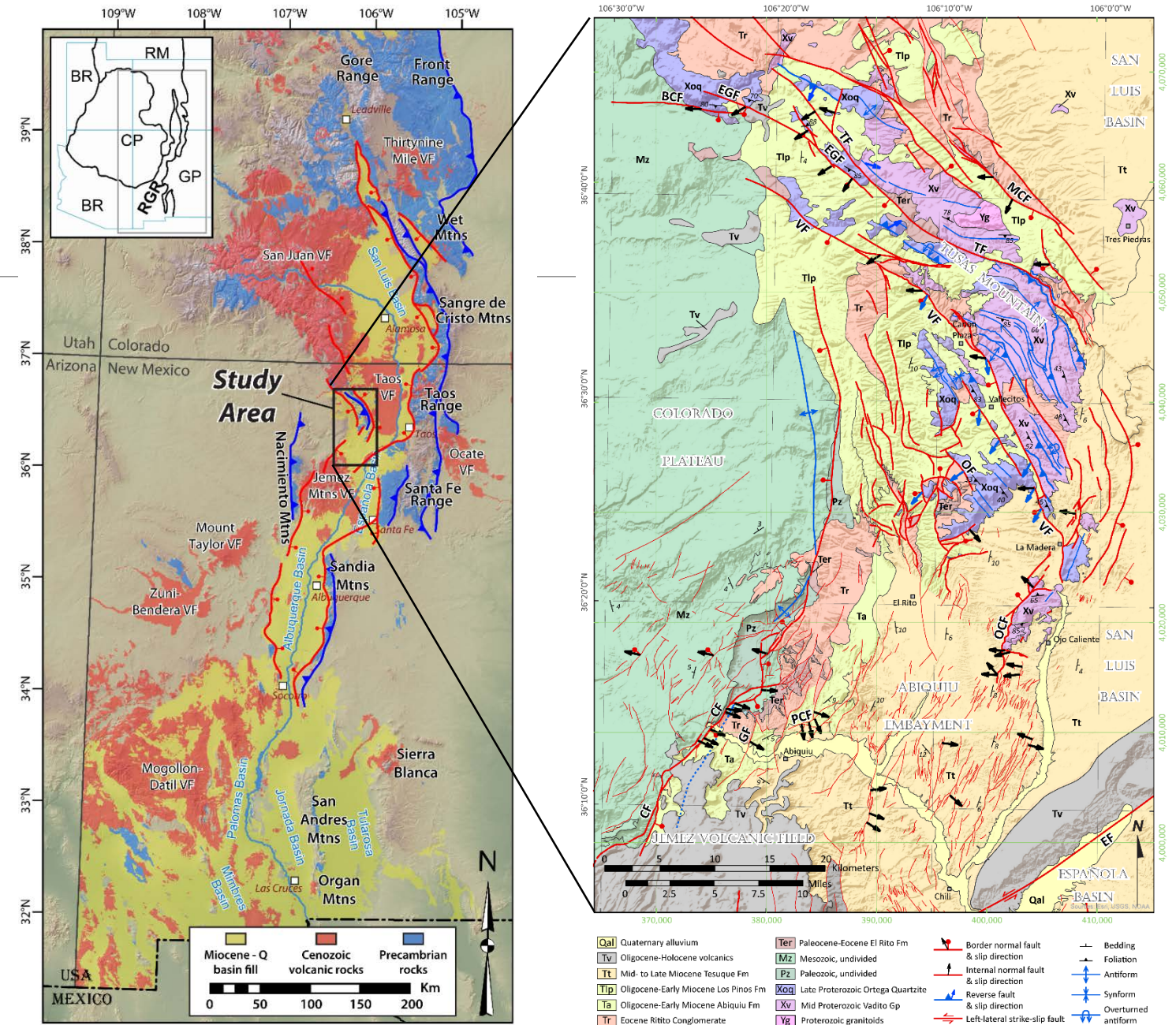
Poles, n=239

(data from Lipman & Reed, 1989)

Dike is not really a good indicator for the extension orientation in the N RGR...

Motivations

- (1) A *kinematic* test of *kinematic* models of the RGR
 - Rather than inferring from dike trend & basin geometry
- (2) A comparison with other rifts and rifting models



(modified from Ricketts et al., 2016, GSA Bull)

Conclusions

Kinematics

Mechanism

EPOCH	AGE	PICKS (Ma)
HOLOCENE		0.01
PLEISTOCENE*	CALABRIAN	1.8
	GELASIAN	2.6
PLIOCENE	PIACENZIAN	3.6
	ZANCLEAN	5.3
MIOCENE	MESSINIAN	7.2
	TORTONIAN	11.6
	SERRAVALLIAN	13.8
	LANGHIAN	16.0
	BURDIGALIAN	20.4
	AQUITANIAN	23.0
OLIGOCENE	CHATTIAN	28.1
	RUPELIAN	33.0



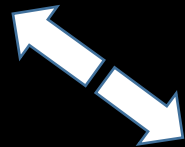
Near E-W extension

Small-scale convection



Local N-S “extension”

Loading of the Jemez VF



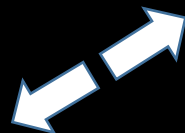
Oblique extension in Abqiuu
& Tusas;
fault growth & linkage

Pacific-North America
oblique motion

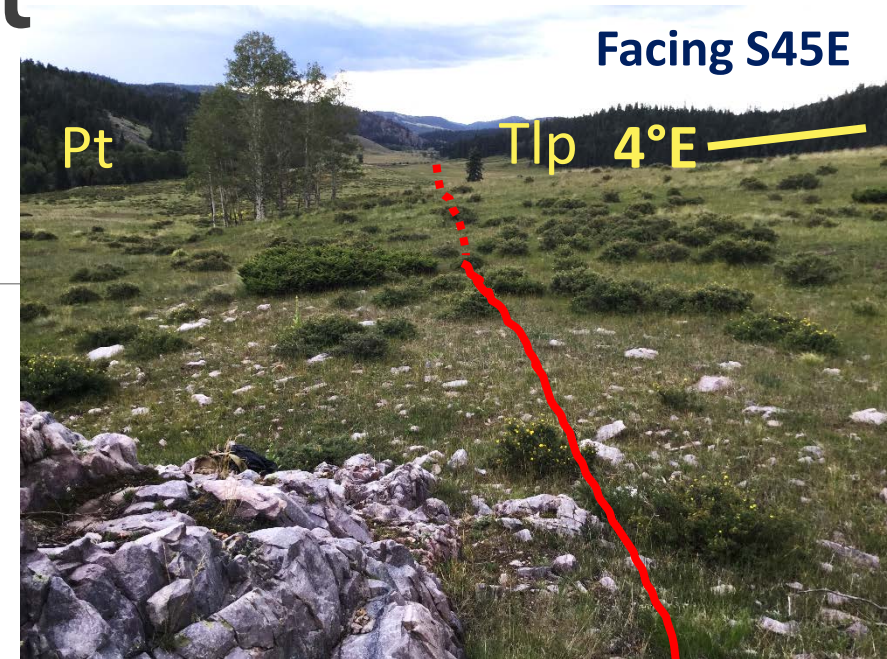
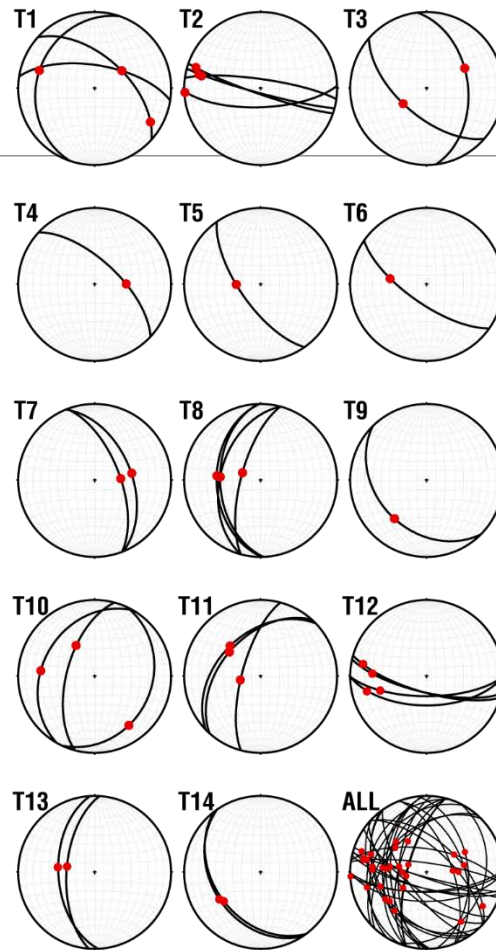
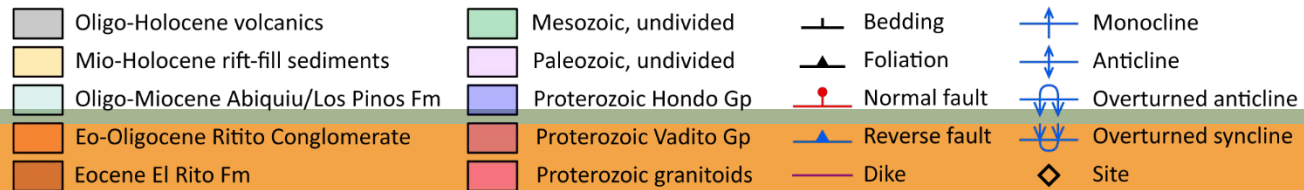
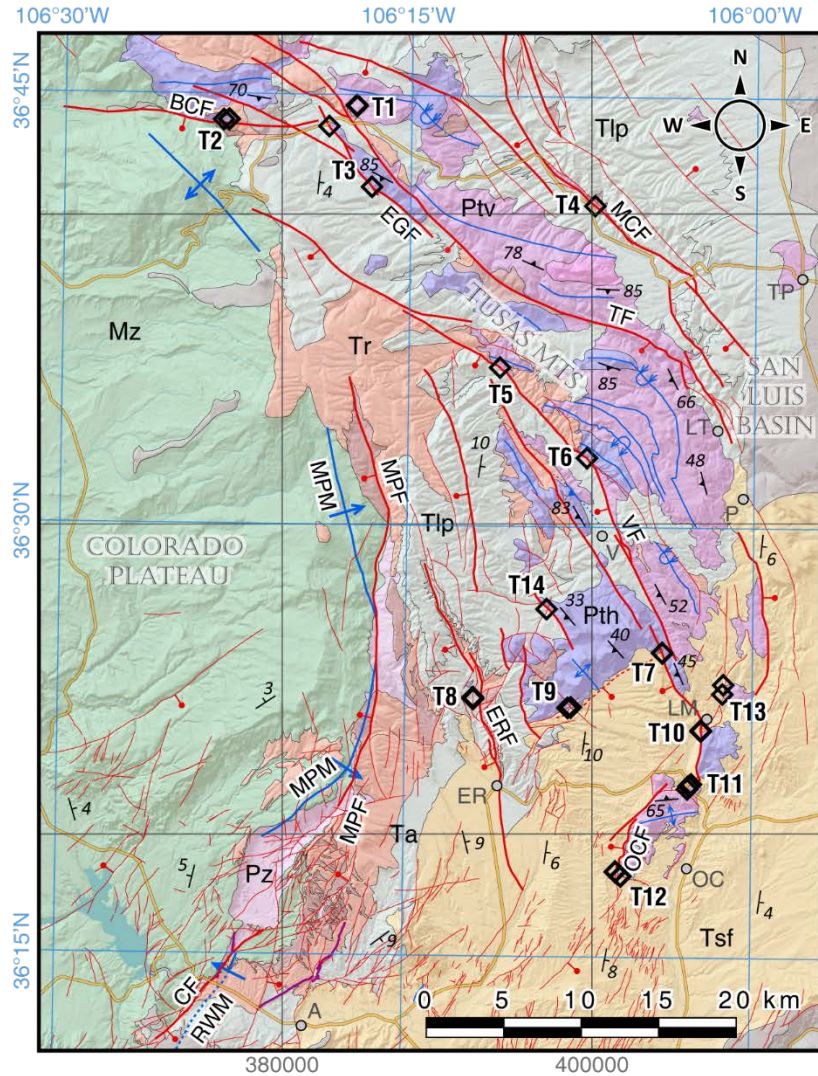


Orthogonal extension in Tusas;
reactivation

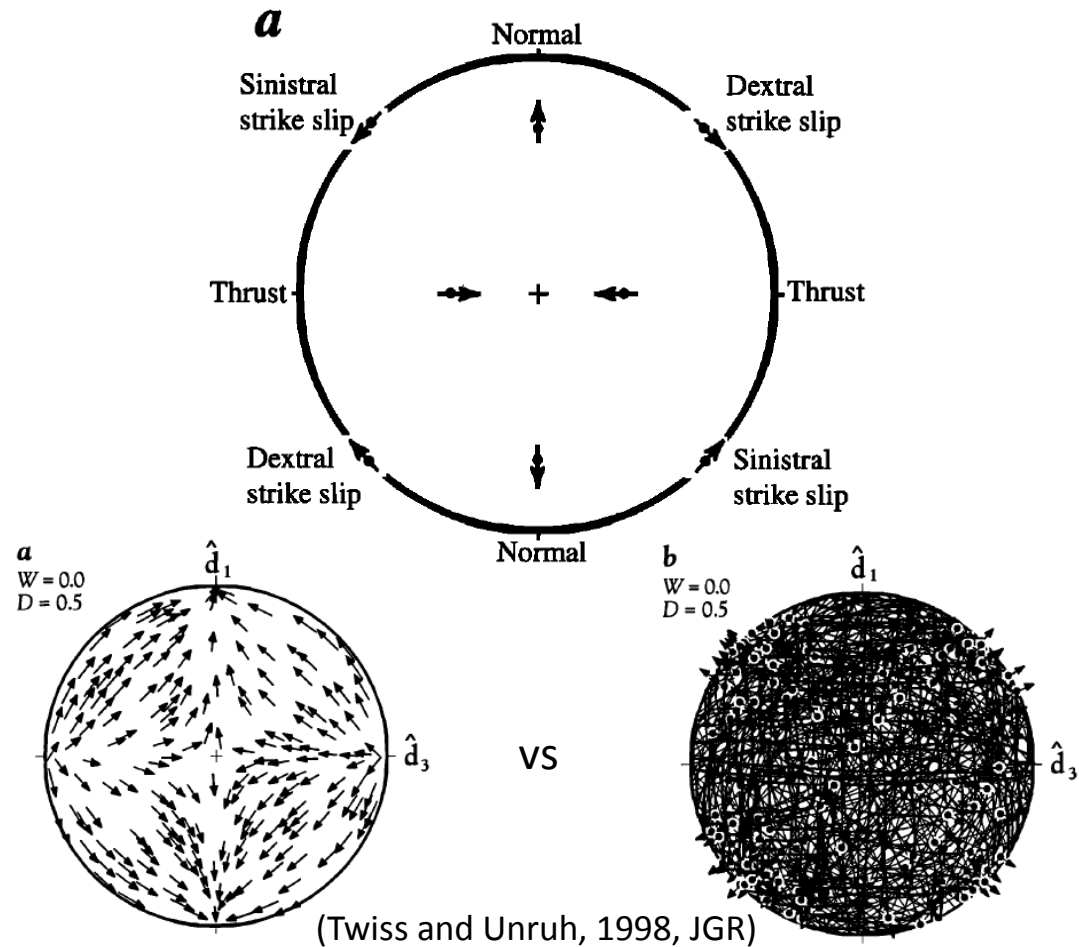
Farallon slab removal



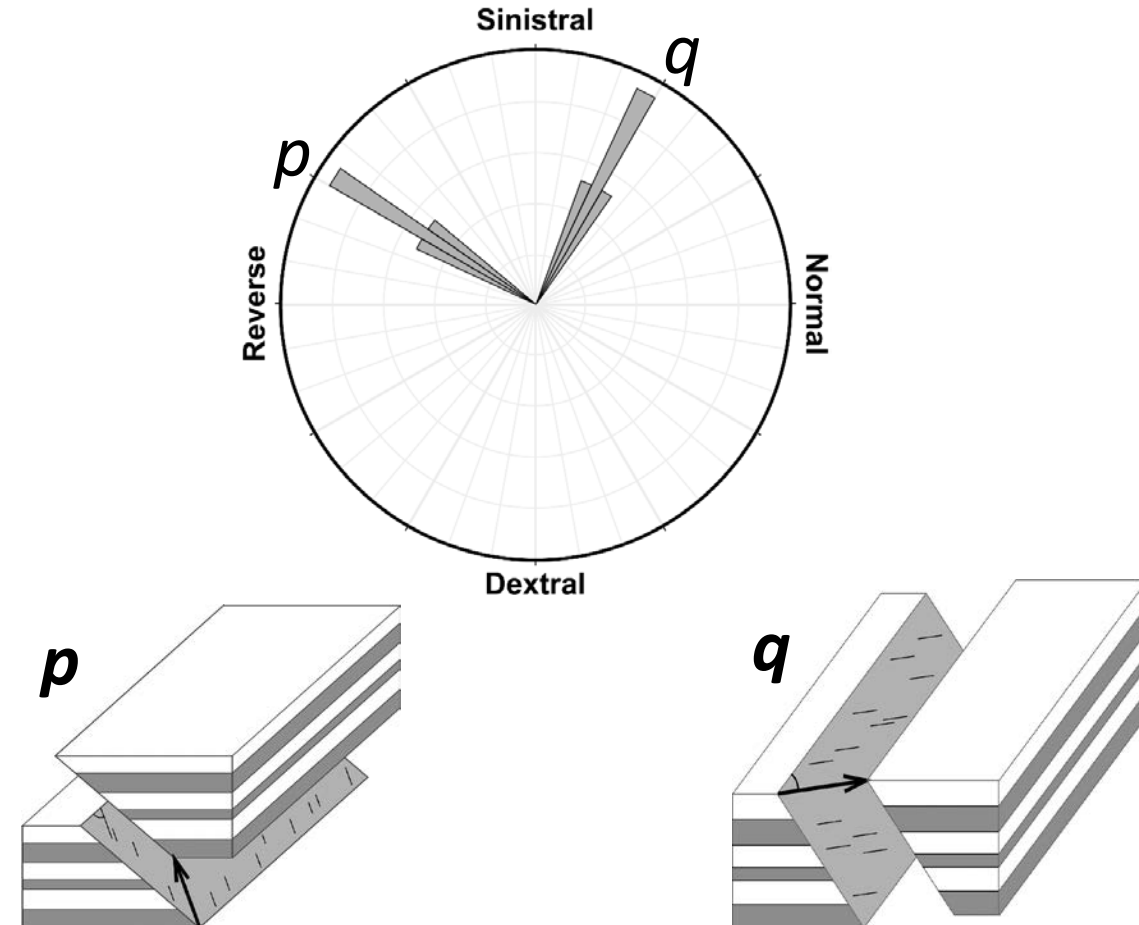
Tusas segment

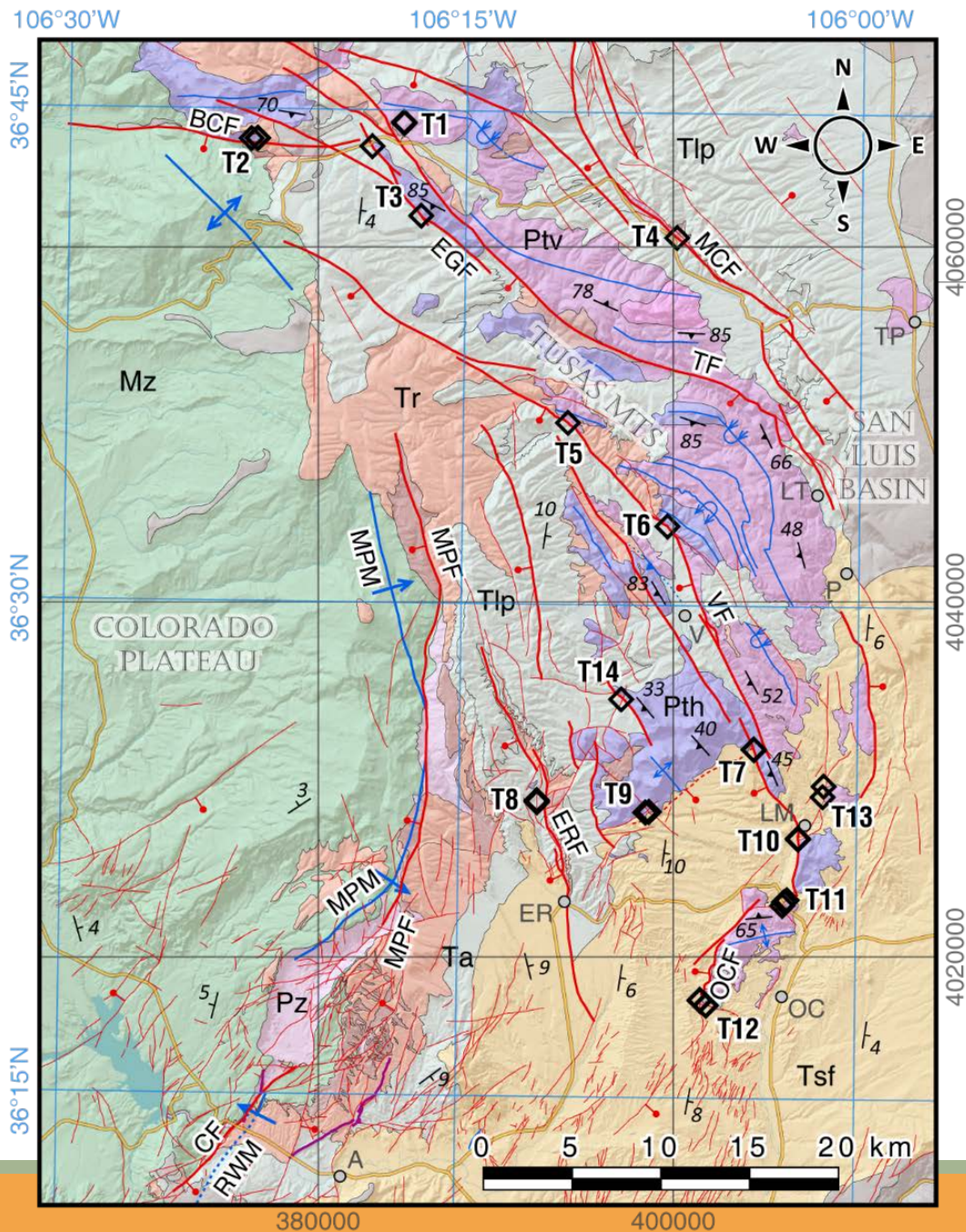


Tangent-Lineation Diagram

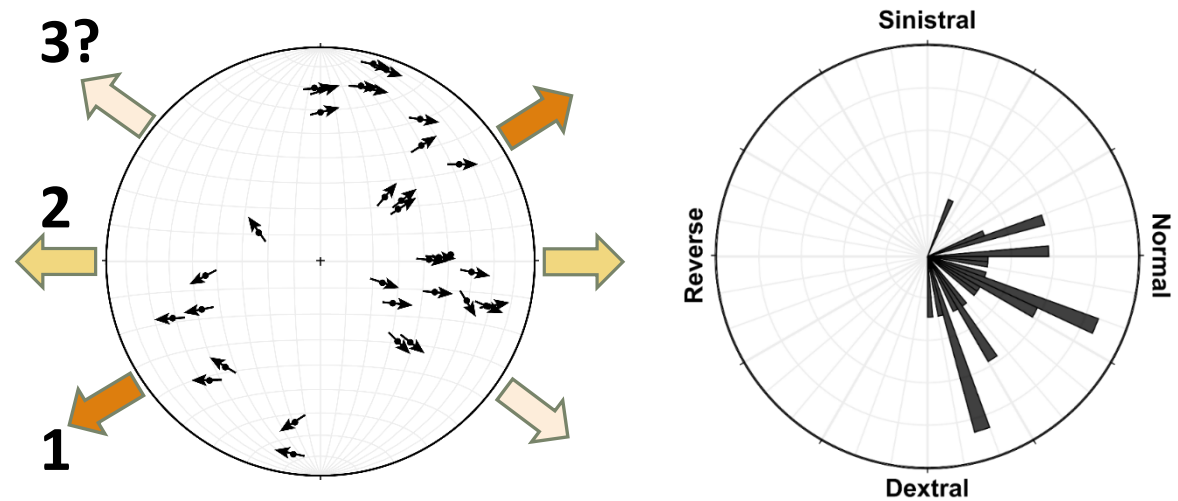


Rake Rose Diagram





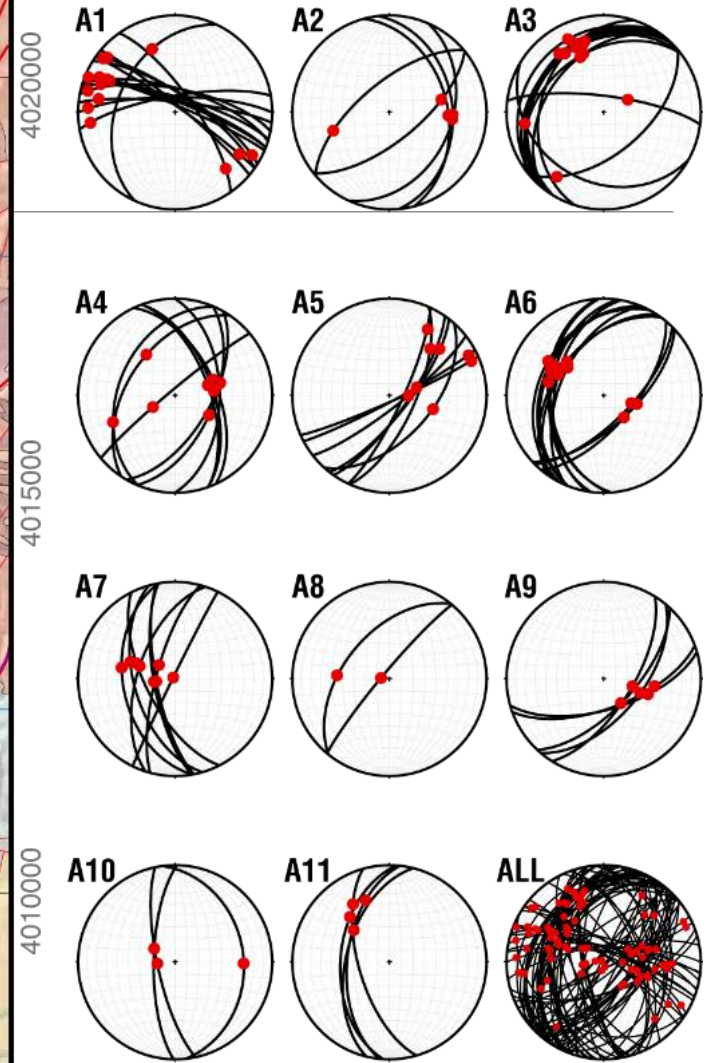
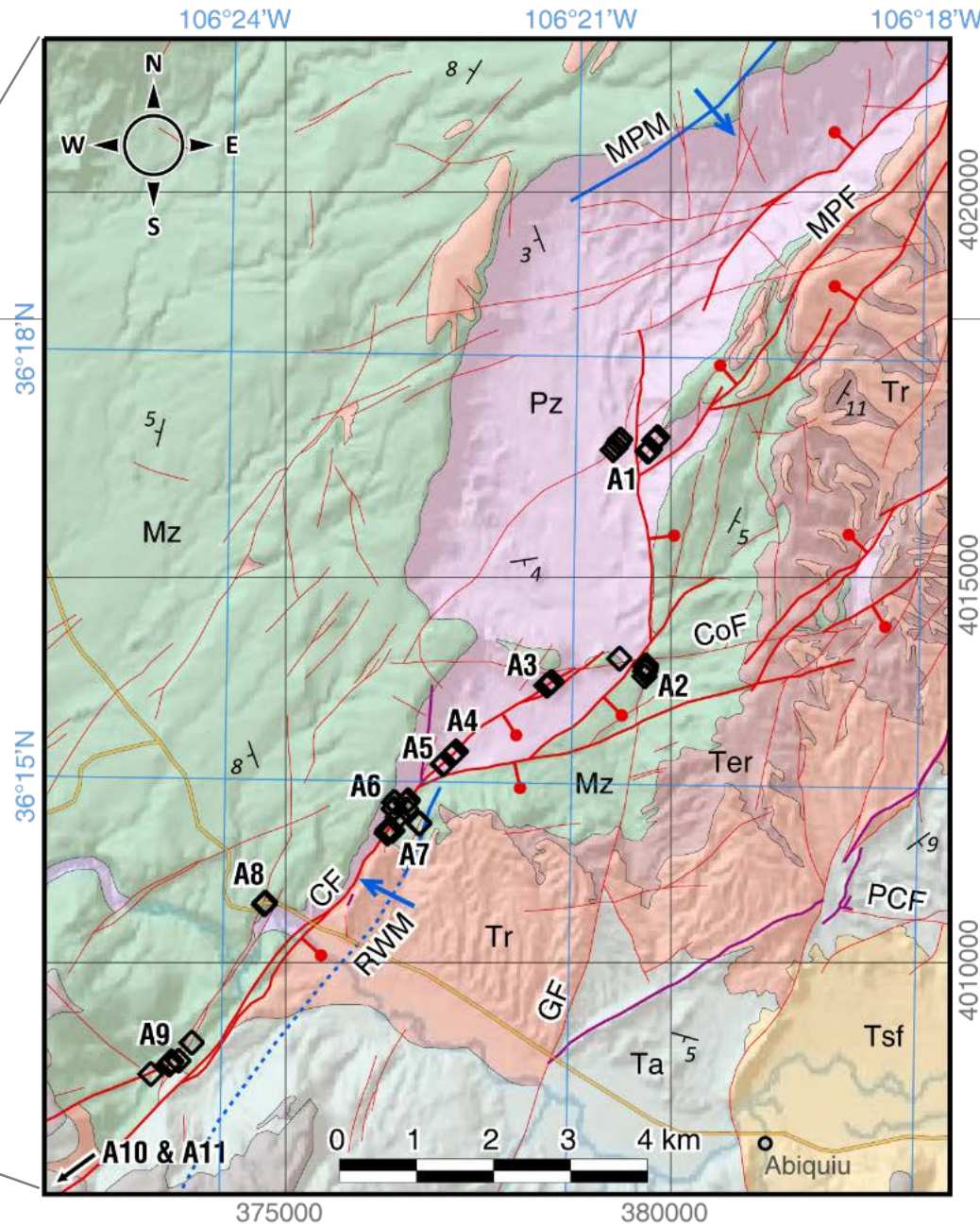
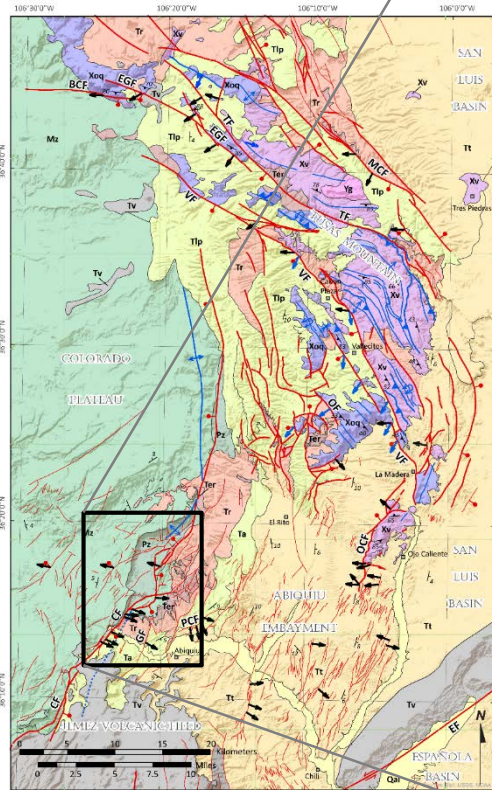
Tusas segment

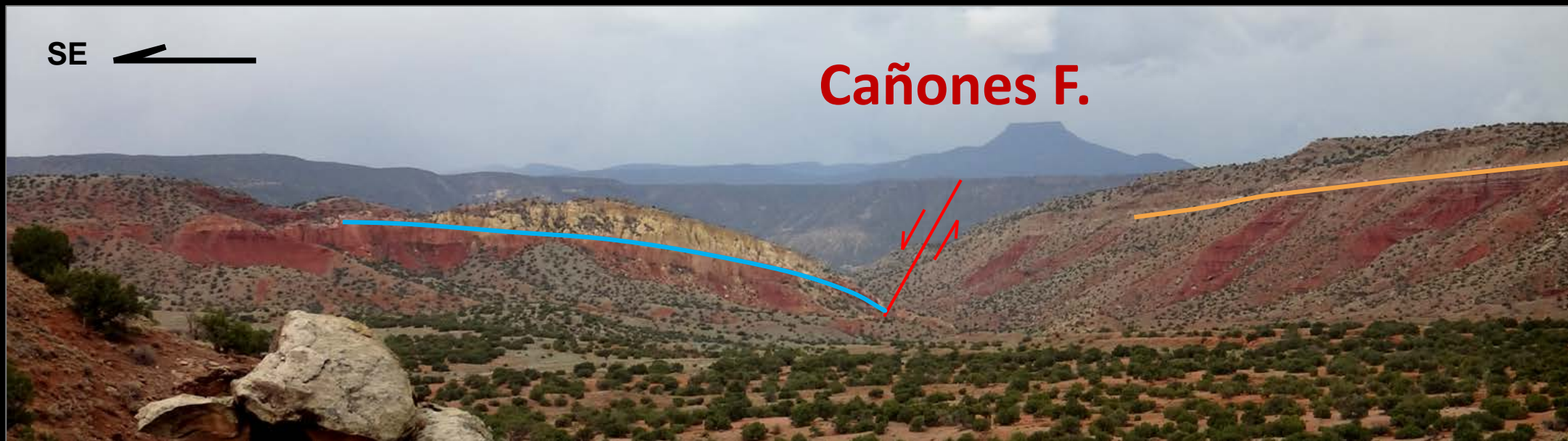


Multi-direction extension:
 1, S55°W, near orthogonal rifting
 2, near E-W, oblique (dextral-normal)
 3, N50°W (?)

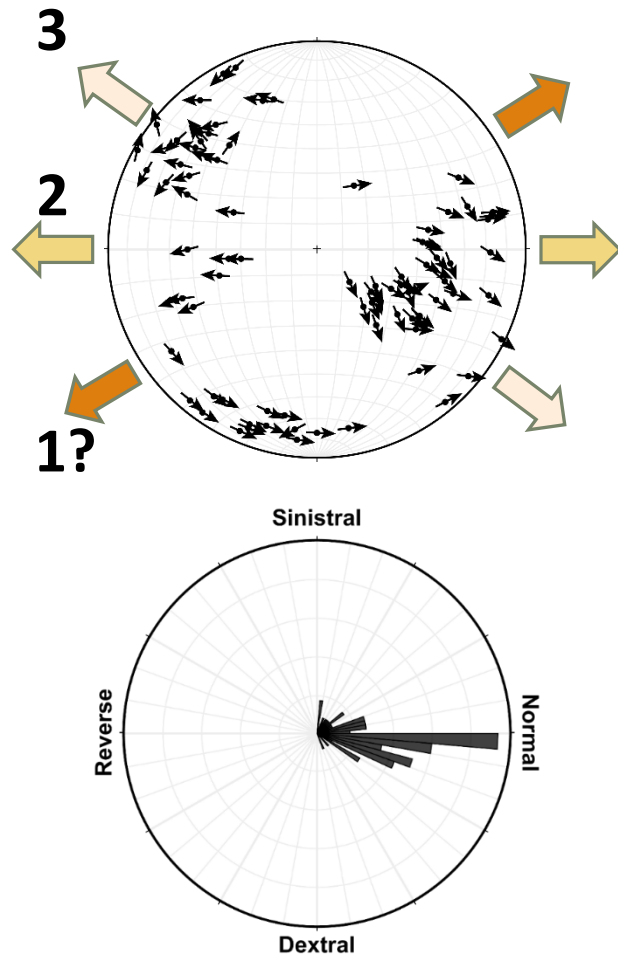
75° clockwise rotation of the extension orientation

Abiquiu segment

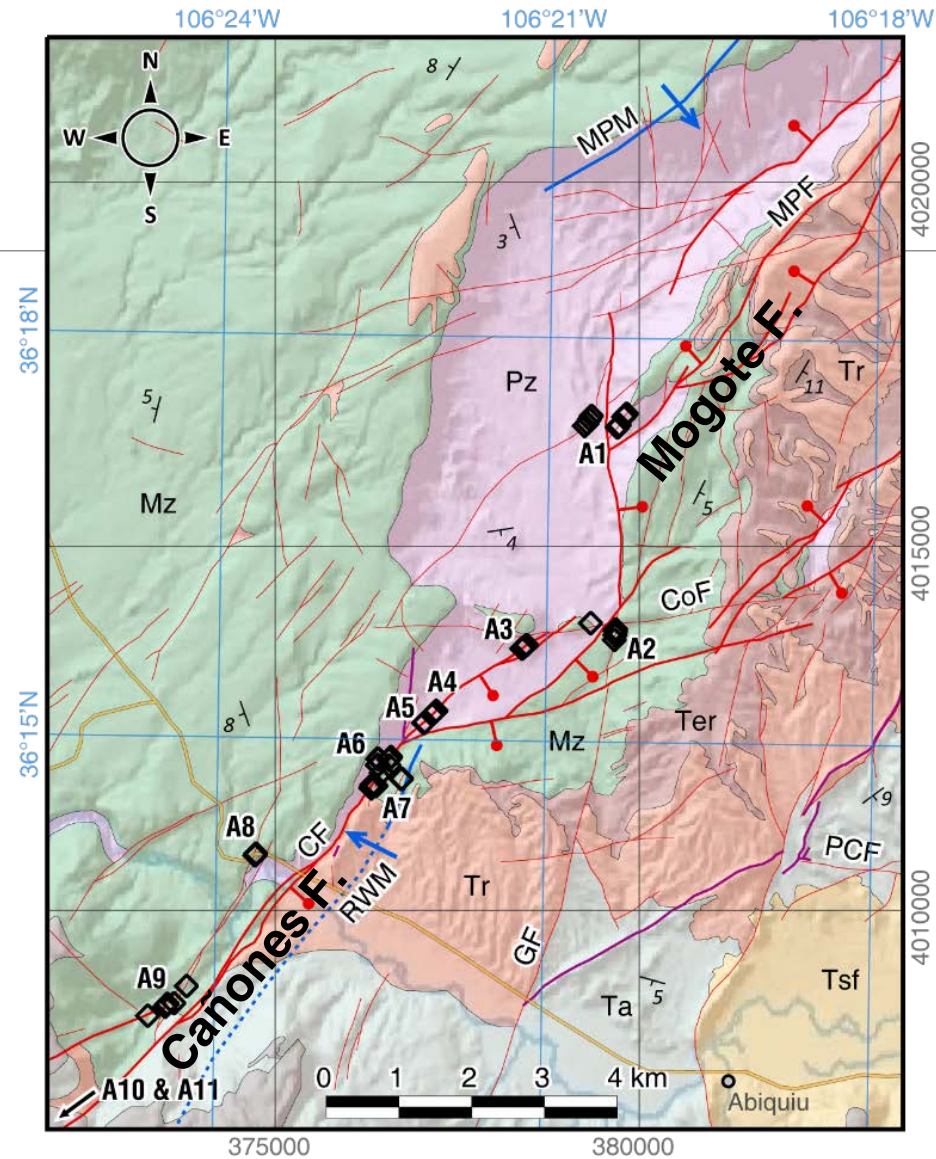




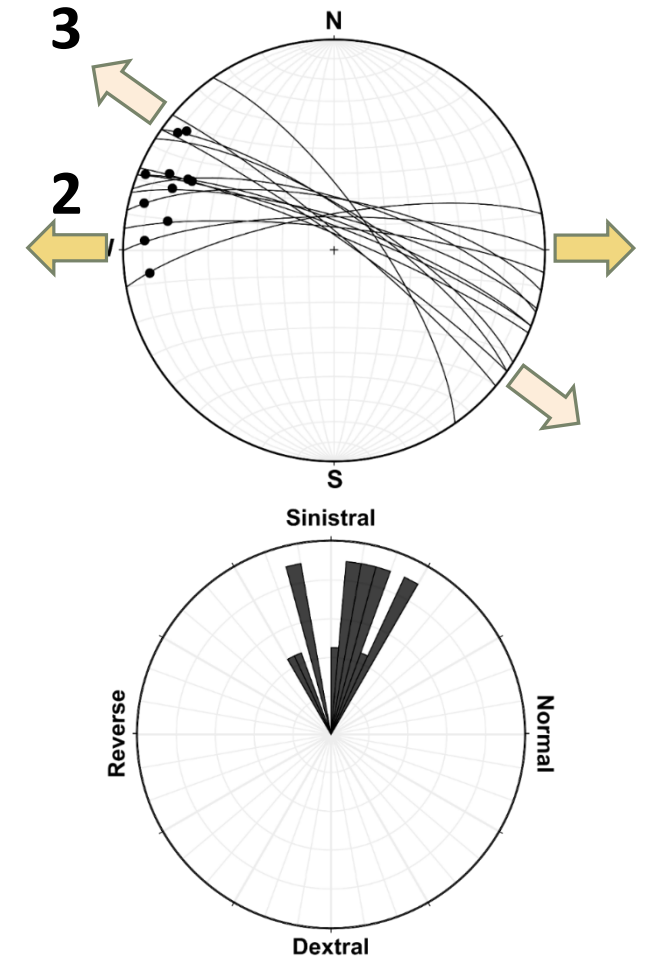
Abiquiu segment



N = 62, n = 266

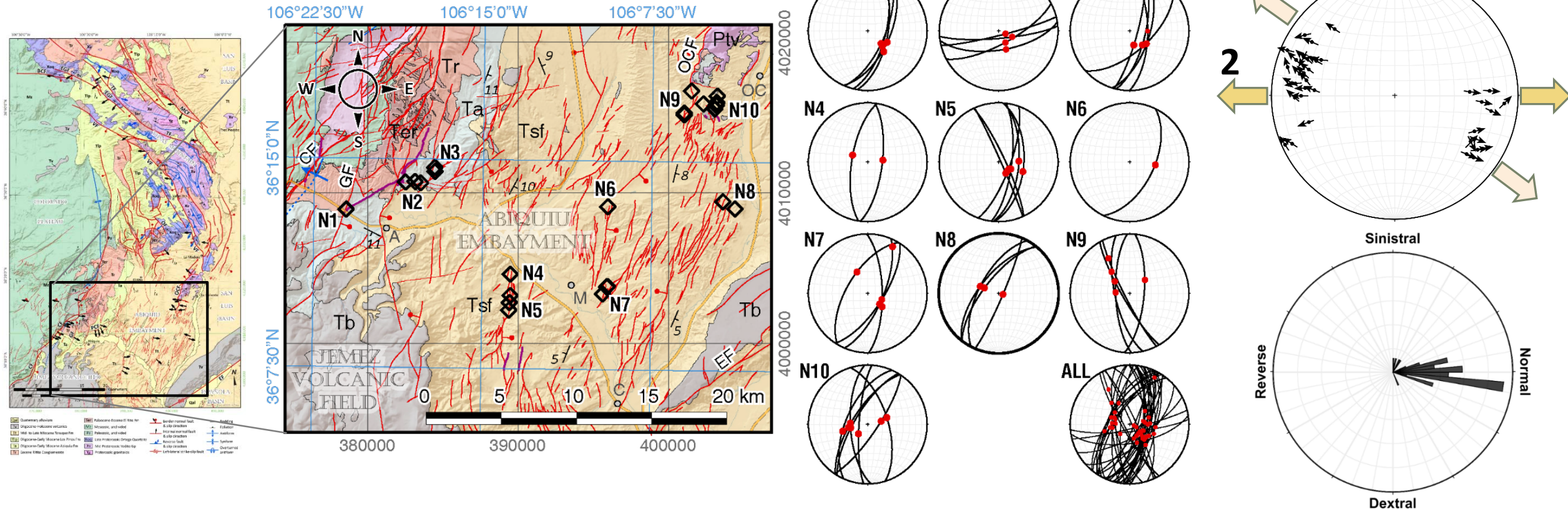


Mogote



N = 14, n = 33

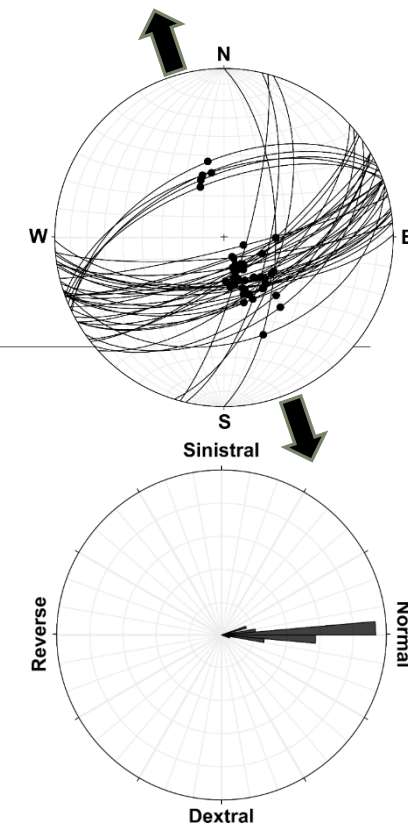
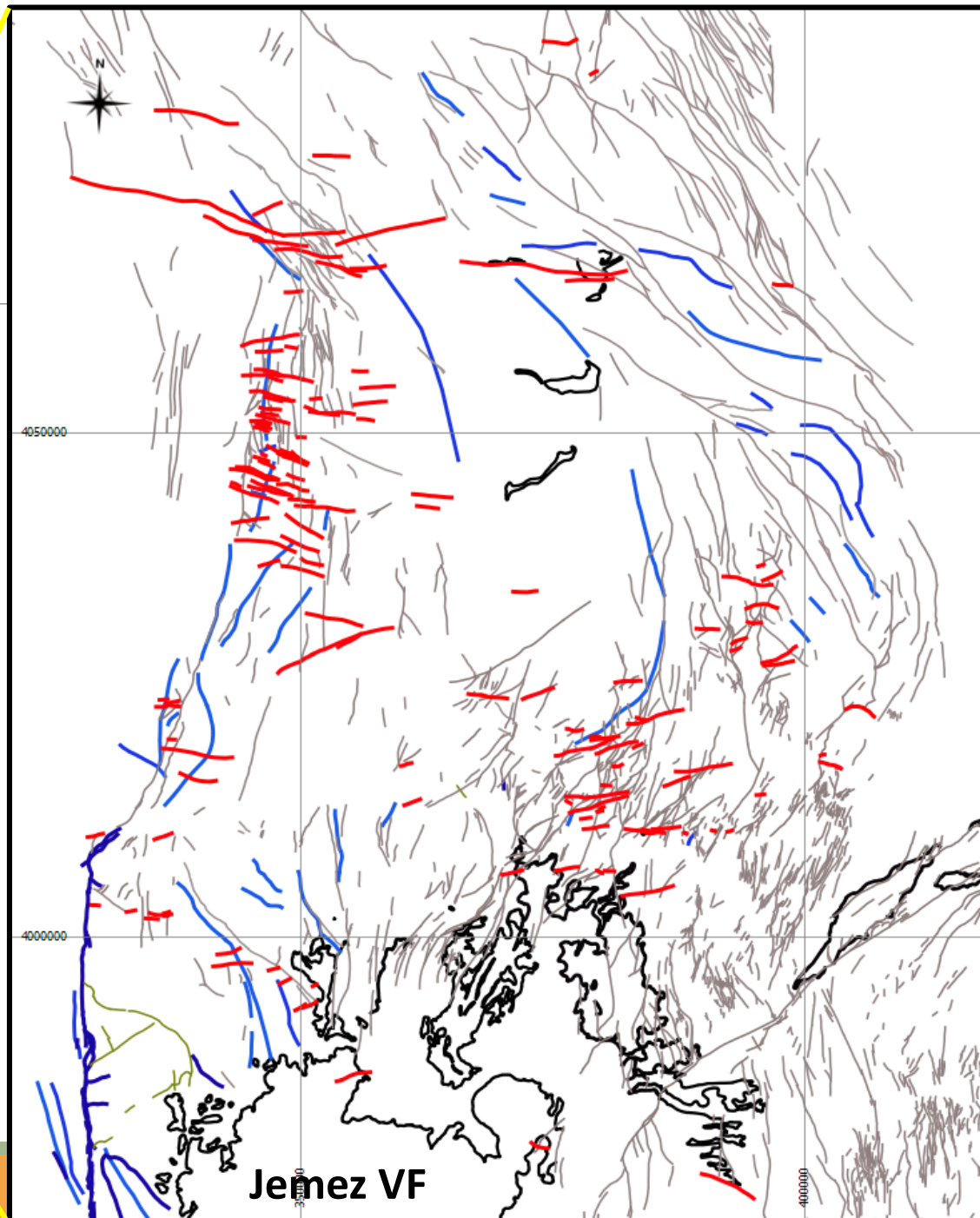
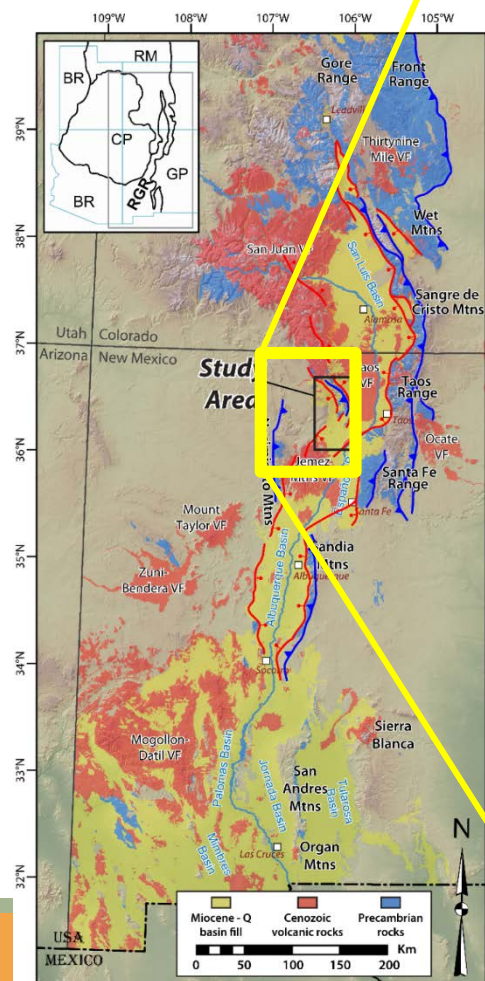
Internal faults in the Abiquiu embayment



N = 42, n = 250



E-striking normal faults

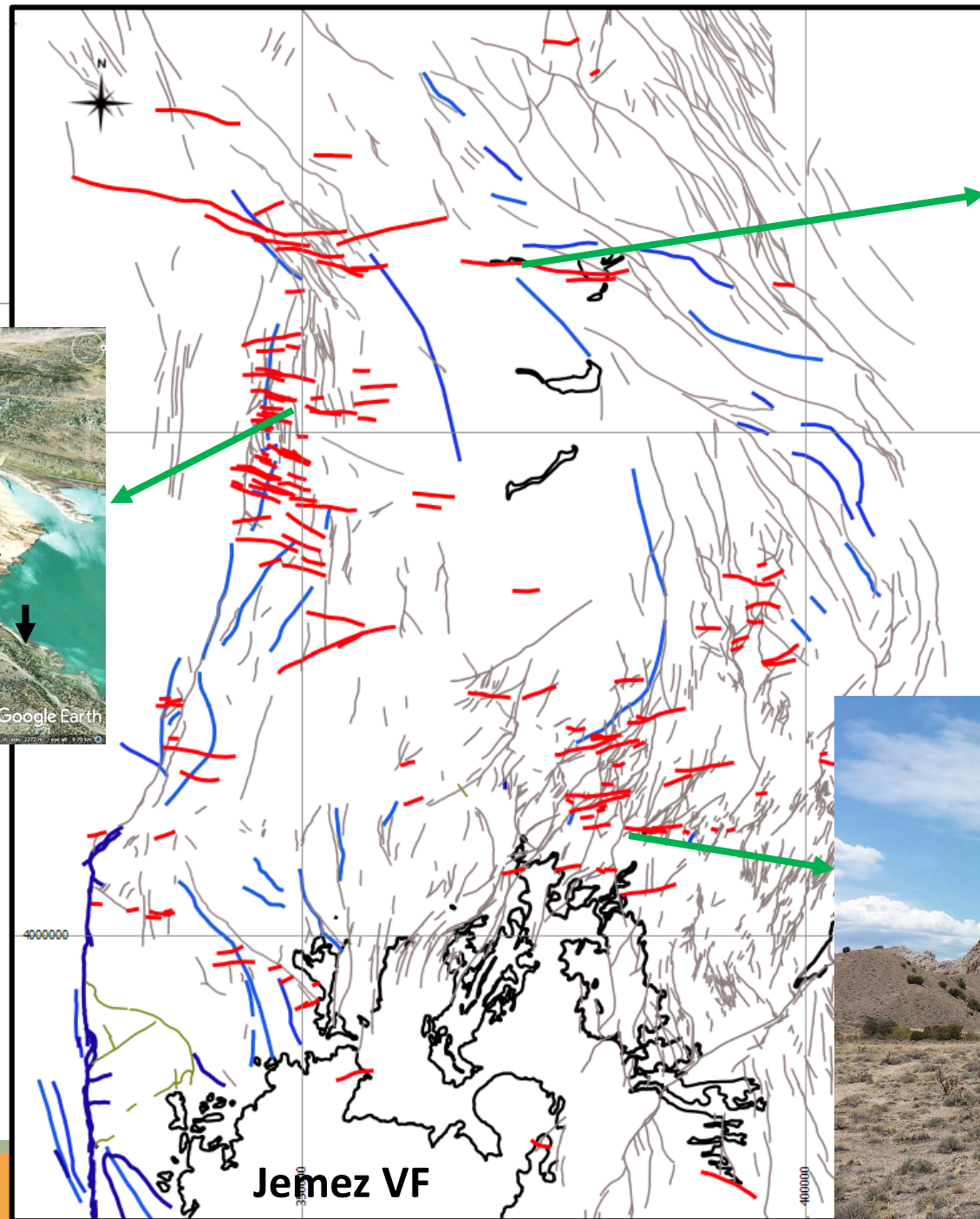
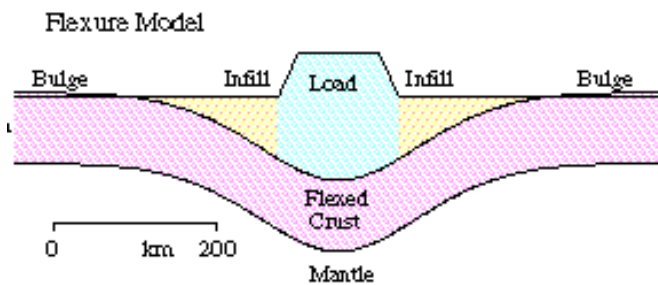
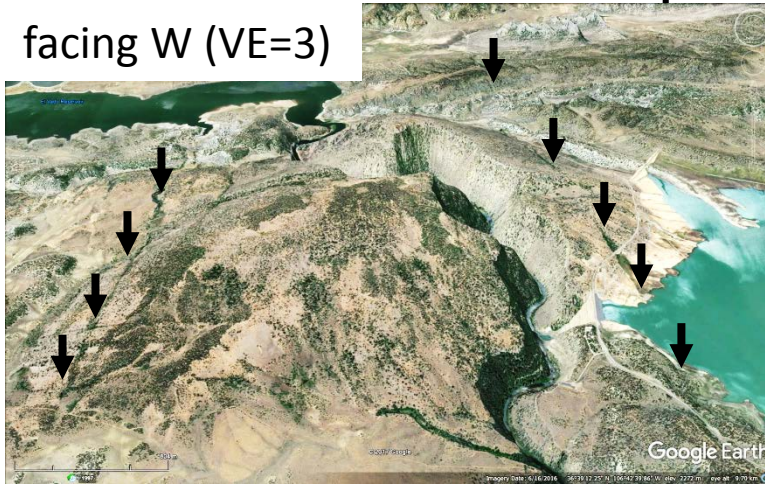


N = 43
n = 224

- Short & distributed
- Small displacement
- Cut previous structures
- Fault scarps detectable
- Present in both RGR & CP

E-striking normal faults

facing W (VE=3)



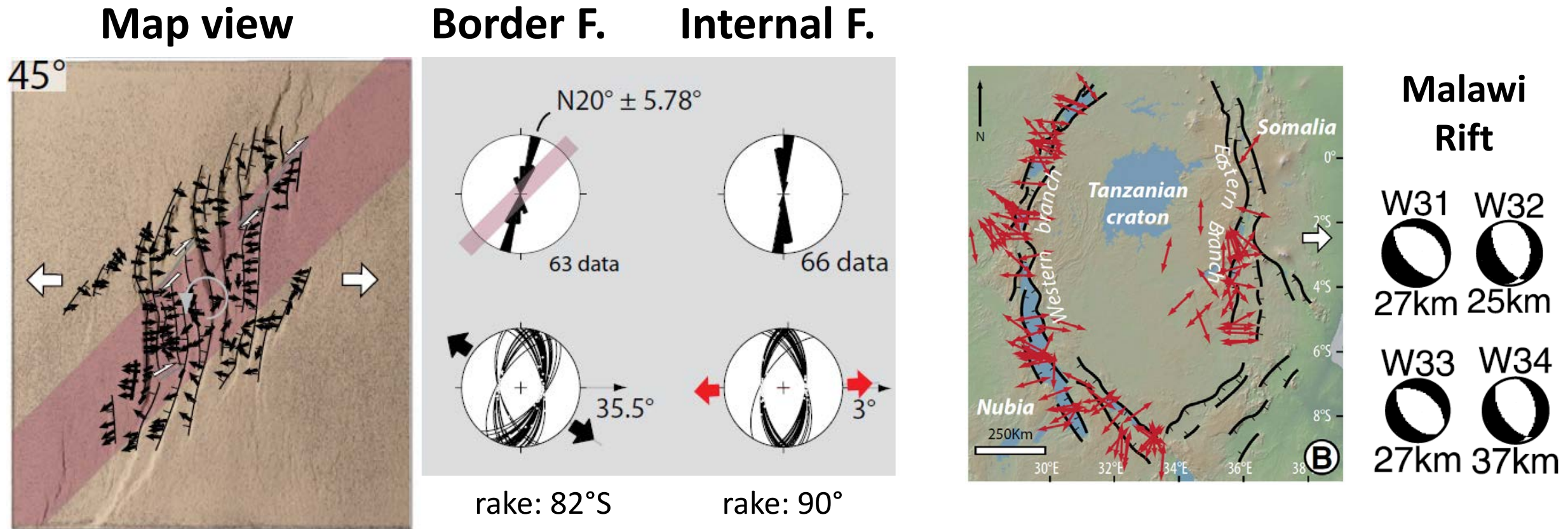
Brazos Cliff fault, facing W



Plaza Colorado fault, facing W



“Slip re-orientation” in oblique rifts under the influence of a crustal-scale weak zone



Slip re-orientation model vs. observation

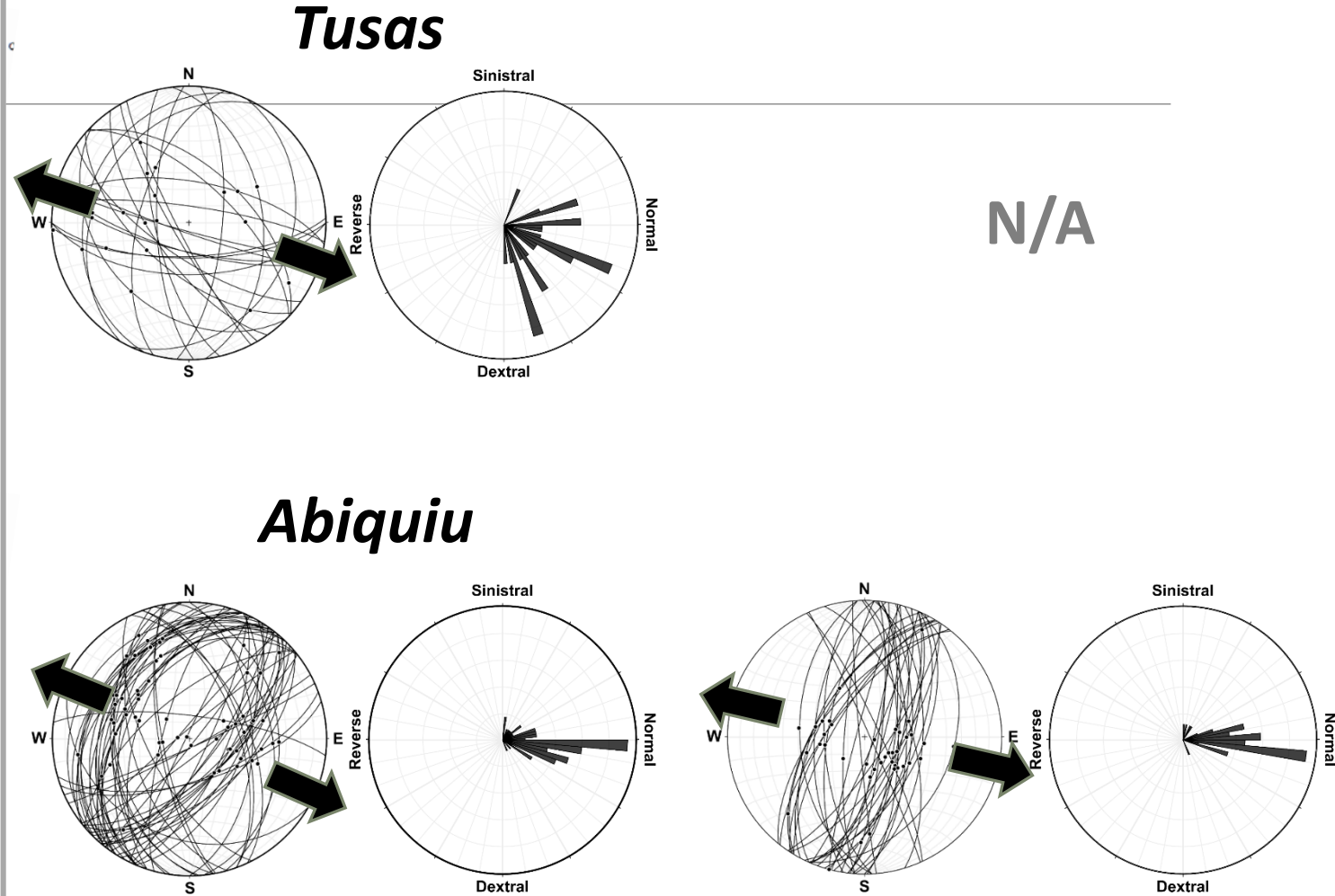
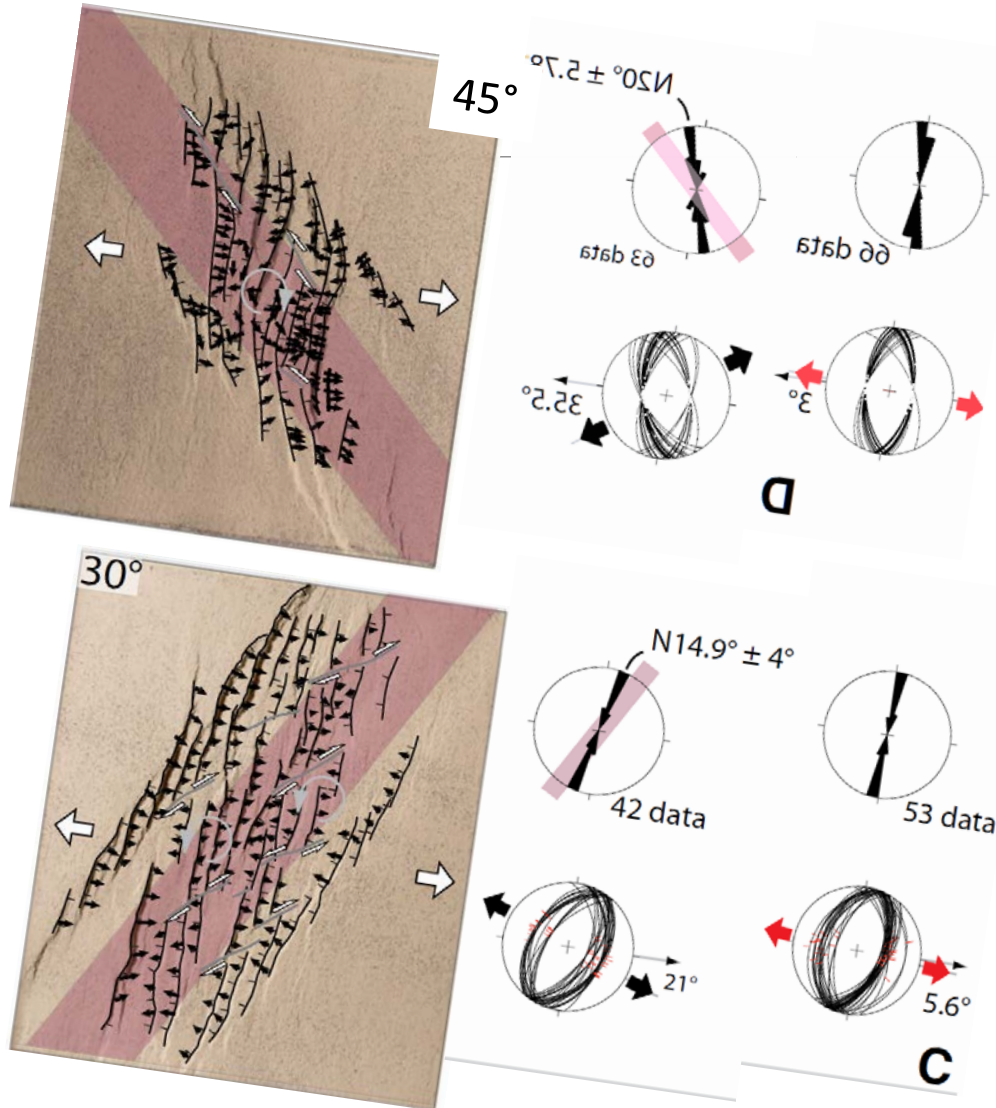
Map

Border

Internal

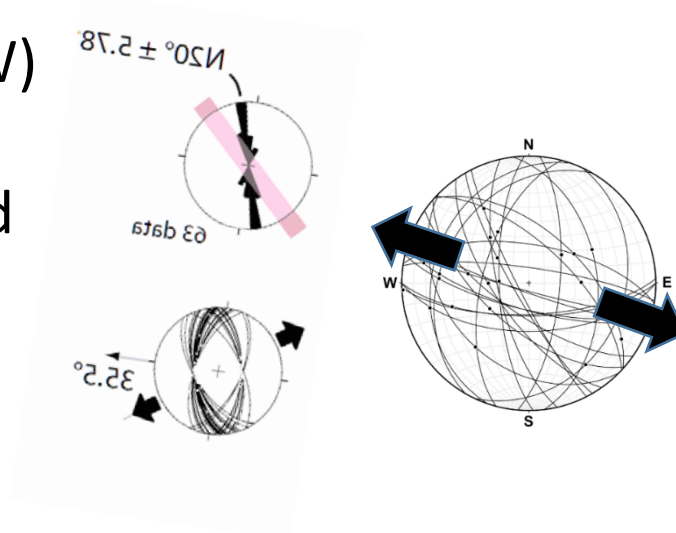
Border

Internal



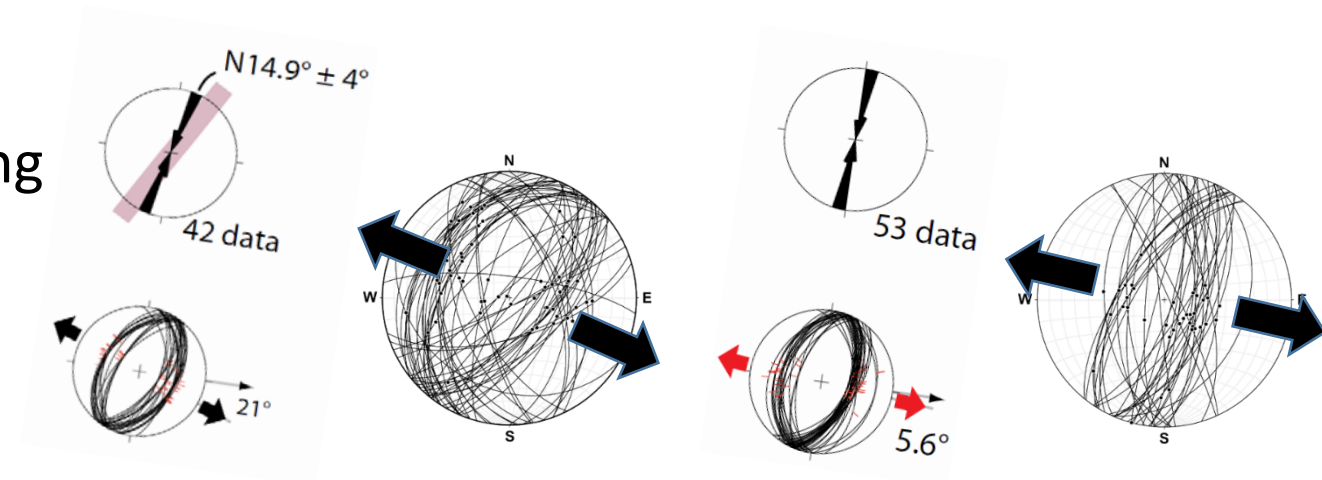
Tusas segment

- no slip re-orientation during oblique (WNW) extension
 - re-oriented strain paths not yet exposed
 - higher friction (magma-poor?)
- strike of reactivated fault not indicative of extension orientation



Abiquiu segment

- slip re-orientation may have occurred during WNW extension
 - weak crust underneath
 - elevated pore fluid pressure
 - more evolved stage?



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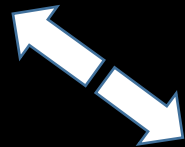
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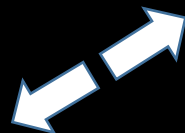
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fault growth & linkage

Pacific-North America
oblique motion



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Farallon slab removal



A scenic landscape photograph taken from a campsite. In the foreground, the corner of a green tent with a dark brown trim is visible on the right side. The ground is covered in dry grass and some low-lying plants. A wire fence with wooden posts runs across the middle ground. In the background, a large, prominent rock formation with a flat top and steep, rocky sides is illuminated by warm, golden light, likely from the setting or rising sun. The sky is filled with soft, white and grey clouds, and the overall atmosphere is peaceful and natural.

Thank you!