Kate Scharer

18/17 — * Wize Thoughts out Discussion

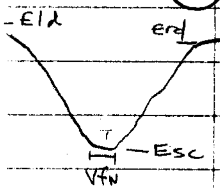
Task 2

Ⓑ $S = \frac{L_{mf}}{L_s} = \frac{47.5}{42} = 1.13$

$\boxed{\text{Active Front } S = 1.13, \; V_f = 0.16}$

Ⓓ $V_f = \frac{V_{fw}}{\left[\frac{(E_{ld} - E_{sc}) + (E_{rd} - E_{sc})}{2}\right]}$

$\boxed{V_f \text{ Average} = 0.16}$



Little Alvord Creek

$V_f = \frac{0.1\left(\frac{7000}{8.95}\right) \times 2}{[(6040-4900)+(6200-4900)]} = \frac{156.4}{2440} = 0.064$

Pike Creek

$V_f = \frac{0.15\left(\frac{7000}{8.95}\right) \times 2}{(5760-4760)+(5920-4760)} = \frac{234.6}{2160} = 0.11$

1564.24

Dry Creek

$V_f = \frac{0.05\left(\frac{7000}{8.95}\right) \times 2}{(5480-4840)+(5360-4840)} = \frac{78.2}{1160} = 0.067$

Indian Creek

ⓐ $V_f = \frac{0.05\left(\frac{7000}{8.95}\right) 2}{(5040-4400)+(4600-4400)} = \frac{78.2}{840} = 0.093$

ⓑ $V_f \quad \frac{0.05 \cdot \frac{7000}{8.95} \cdot 2}{(5840-5100)+(5900-5100)} \quad \frac{78.2}{1540} = 0.051$ (higher in mtn's.)

Tuffy Creek

$V_f = \frac{0.1\left(\frac{7000}{8.95}\right) 2}{(4480-4250)+(4360-4250)} = \frac{156.4}{340} = 0.46$

Summary Questions

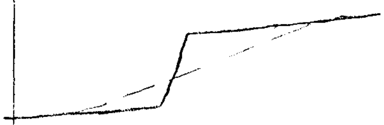
① The Steens Fault Zone exhibits normal faulting, suggesting that it may be an area of transtension between the right lateral Brothers Fault Zone (north) and Eugene-Denio fault zones (south). The southeast corner of Oregon is considered part of young Basin & Range province. ✓

Leaky??

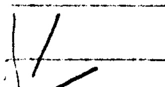
Based on a low S value (1.1) and a low average Vf value (0.16) in the study area, the Alvord Segment of the Steens FZ (Fig 3) would be considered tectonically active. Geomorphically, this can be seen in the narrow, steep canyons which suggest base level drop is barely matched by the erosive rates of the downcutting streams. (conversely, very low precip rates could give a similar signature!) → WHAT ABOUT LATE PLEIST. GLACIATION AT HIGHER ELEV.??

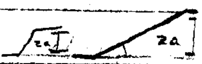
At a smaller scale, one may find offset geomorphic (young) features including alluvial fans, playa deposits or thermal deposits. The cross section on Figure 4 suggests ~800 m of alluvial deposits have accumulated; the total offset of the Steens Basalt is on the order of 2700 m!

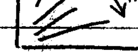
$\frac{2.7 \times 10^6 \text{ mm}}{9.3 \times 10^6 \text{ yrs}} = 0.29$ mm/yr vertical releif. Not shabby! ✓



② From graph: Scarp Slope vs. offset:

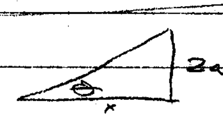


Higher slope gradients generally have lower offsets? 

This is interesting, because it implies there is a relationship between earthquake magnitude (as a proxy for offset ... aka Wells + Coppersmith relationships) and slope of scarp. I doubt this is true, but simply an artifact of the data set. Slope of young scarps (little erosion) is dependent on structural controls. I believe this graph is best used to compare change in slope with age of scarp: 

(see ~~***~~ caveat #3)

The graph suggests that with age, the scarp slope lowers, consistent with the observation of diffusive degradation of the surface.

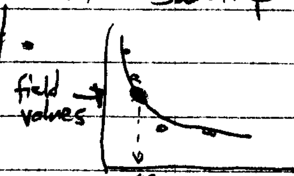


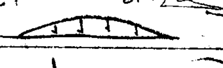
$\tan\theta = \frac{2a}{x}$ $\qquad \sin\theta = \frac{2a}{h}$

$x = \frac{2a}{\tan\theta}$ $\qquad h = \frac{2a}{\sin\theta}$

we graphed $\frac{1}{x}$

Graph 2 shows this relationship changes quickly at first, slowing degradation with time as wash controlled slope decline is dominant. Could be used empirically to find age since rupture if scarp morphometry were obtained in the field.



(3) Very poor R^2 values. The Oquirrh Mtns ($R^2 = 0.46$), Steens ($R^2 = 0.46$), and Drum Mtns ($R^2 = 0.71$) values do not represent good fits to the data. This suggests offset vs. scarp slope relationships within the fault data set may not be linear. In fact, offset variations along the fault strike ~~are~~ frequently have a bow shaped distribution [ or] that is not (necessarily) dependent on slope, but on the energy of the rupture changing as it moves thru the rocks.

- As discussed in Appx A, structural lows at the base of the scarp may be common – this would require filling before diffusive scarp profile would develop; the form is not always consistent w/ the error fxn shape.

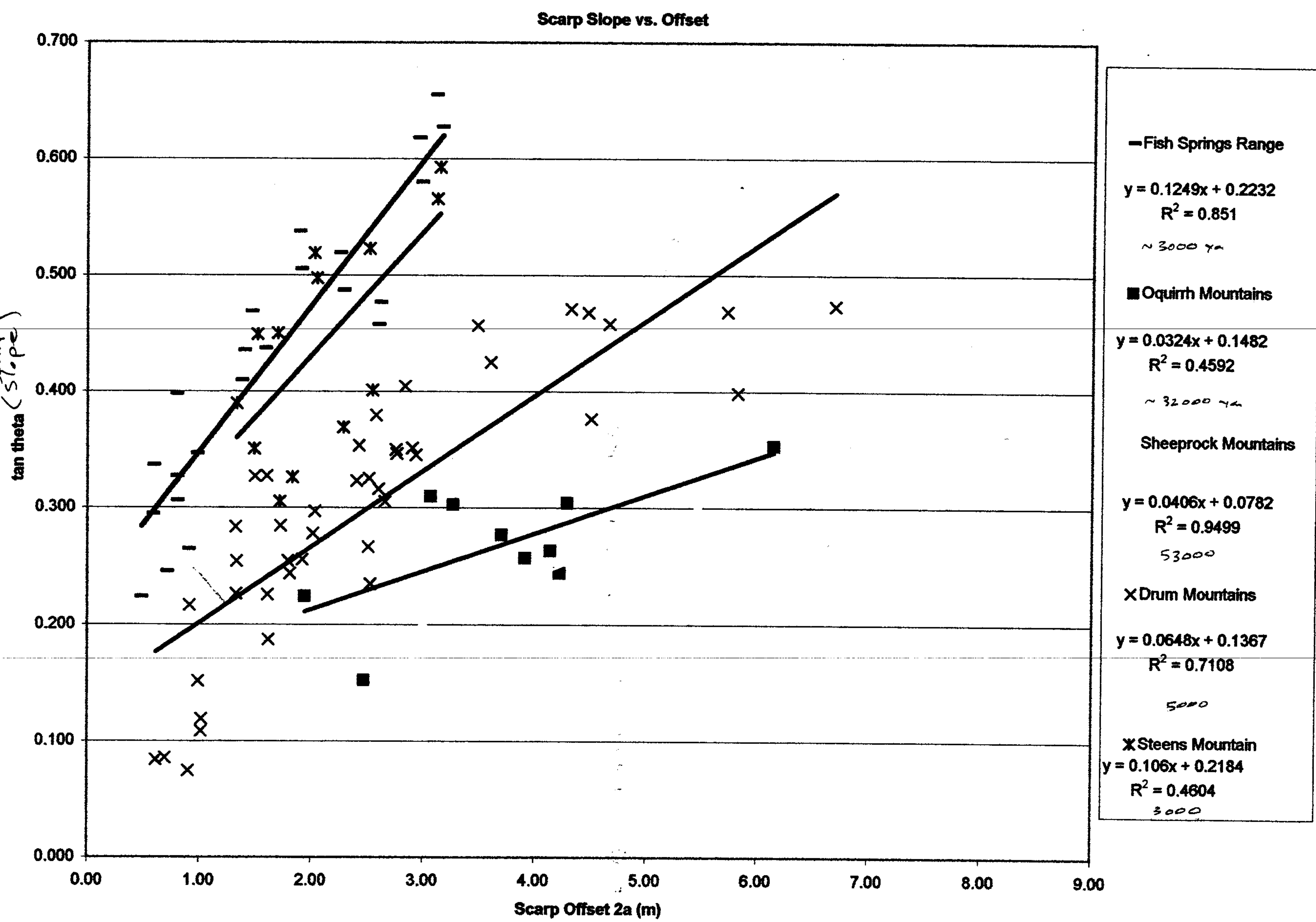
- Soil development on an originally low slope could retard diffusive mechanisms, again changing the modeled profile form.

- Assumes these offset values represent only one event. 7–8 meters is getting in the upper range, especially for normal faults.

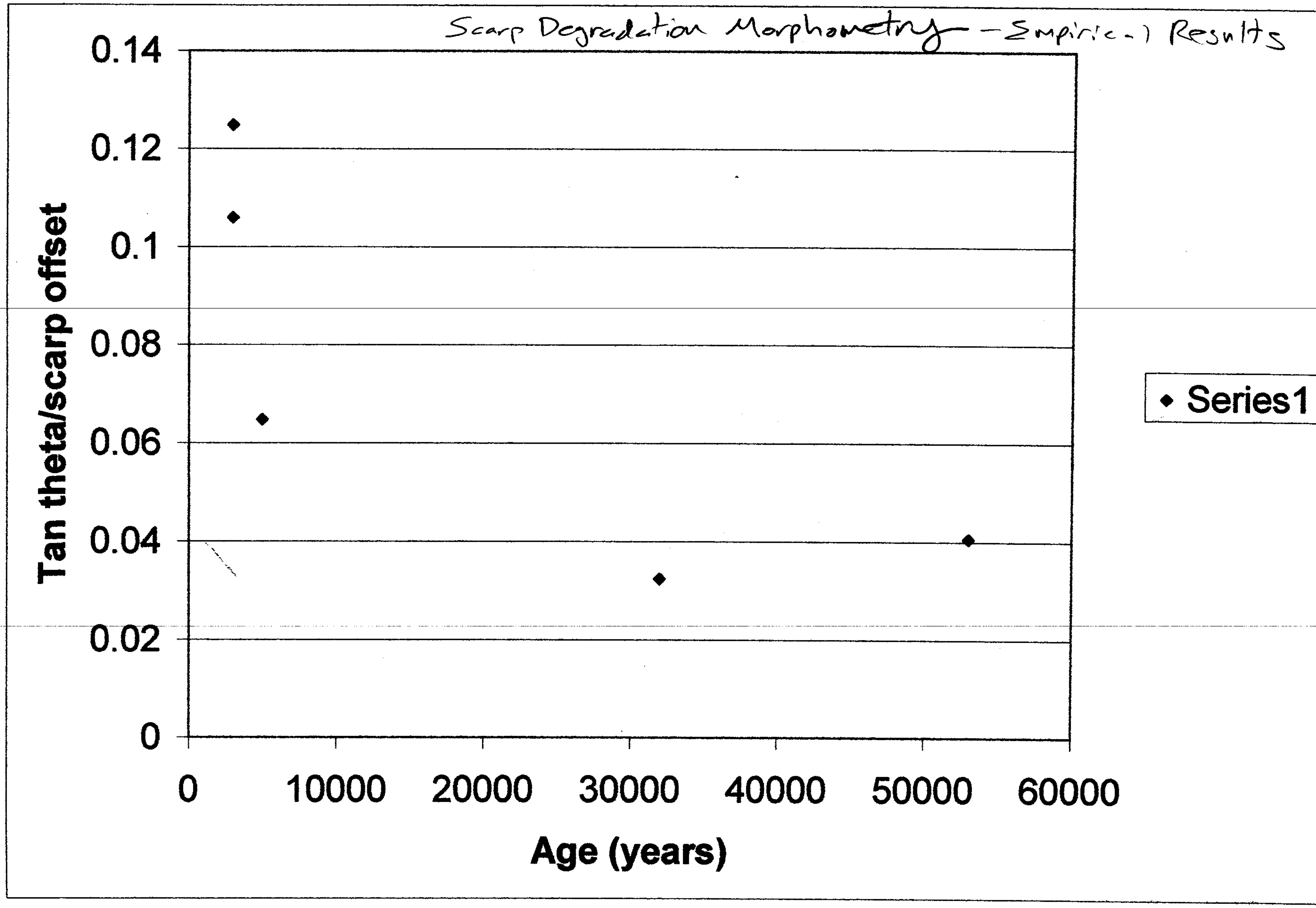
* Assumes that fault scarps are initially high angle: a young low angle fault may have a similar profile to an older (degraded) fault scarp; these results would not "fit" into the pattern observed in the second graph. (A good arguement for trenching!)

Also (!) as shown in Figure 7, degradation of a specific scarp does not cause slope decline — at first. It shows a change in slope at the head and toe (diffusion will be dominant where $\frac{dy}{dx}$ is variable). Field work should also evaluate stage of degradation based on total scarp morphology, not just averaged slope.

Graph 2 — If used for empirical relationships, need to show tectonic style + climate are reasonably similar to existant data.



Scarp Slope vs. Offset
tan theta (Scarp Slope)
Scarp Offset 2a (m)
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
Fish Springs Range
y = 0.1249x + 0.2232
R^2 = 0.851
~3000 ya
Oquirrh Mountains
y = 0.0324x + 0.1482
R^2 = 0.4592
~32000 ya
Sheeprock Mountains
y = 0.0406x + 0.0782
R^2 = 0.9499
53000
Drum Mountains
y = 0.0648x + 0.1367
R^2 = 0.7108
5000
Steens Mountain
y = 0.106x + 0.2184
R^2 = 0.4604
3000


Scarp Degradation Morphometry - Empirical Results
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Tan theta/scarp offset
0
10000
20000
30000
40000
50000
60000
Age (years)
Series1