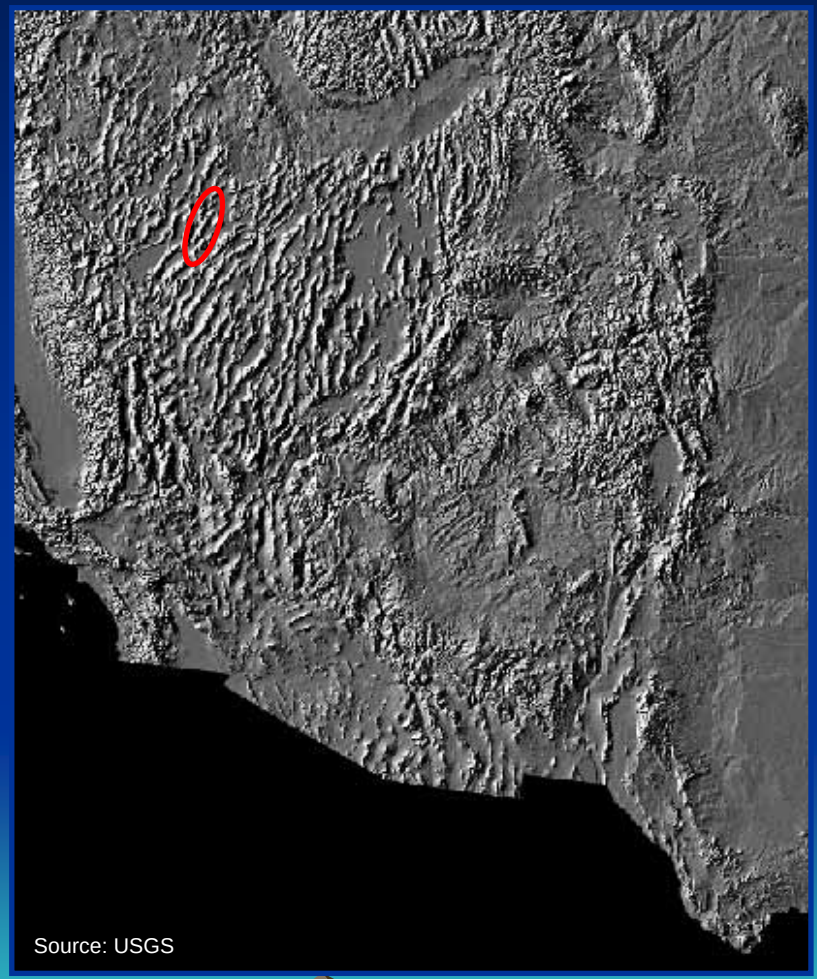
Fault-bounded Mountains and Morphometric Properties

- Type of exercise: Classroom exercise that accompanies lectures on and discussions of Tectonic Geomorphology.
- Content/concept goals: Students who complete this exercise,…
  - should develop an appreciation for the utility of simple morphometric properties.
  - should understand that they can develop and test their own morphometric properties; i.e., they are not restricted to those used by other geologists.

Black Mountains of Death Valley, Copyright © Marli Miller, University of Oregon

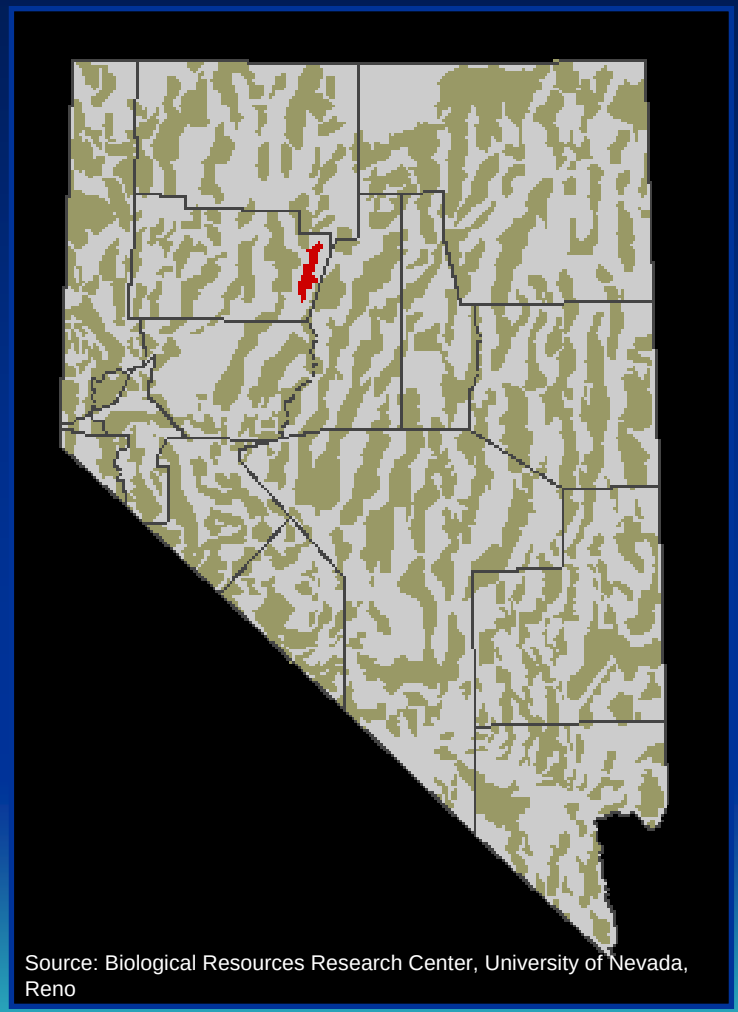
Fault-bounded Mountains and Morphometric Properties

- Higher Order Thinking Skills and other Skills Goals: Students who complete this exercise,…
  - synthesize topographic and structural data using topographic maps
  - formulate hypotheses regarding potentially useful morphometric properties
  - gain experience in working in groups and with topographic maps
- General Background:
  - Included as part of a chapter on endogenic forces
  - Follows an introduction of epeirogenic and orogenic processes.
  - Landforms and settings that are particularly useful in neotectonics
    - Fault-bounded mountains and piedmonts
    - Fault scarps
    - Plate margins
    - Geomorphic surfaces



Tobin Range

- Tobin Range exercise:
  - Bull, W.B., 1984, Tectonic Geomorphology: Journal of Geological Education 32, pp.310-324
- Requires a basic understanding of,…
  - Major physiographic provinces (i.e., the Basin and Range province)
  - Common types of faults (i.e., dip slip, strike slip)
  - Topographic maps
- Equipment:
  - Digital seamless topographic maps
  - 7.5 minute quad.s: Home Station Ranch , Jersey Summit , Kennedy Canyon, Mount Tobin , Needle Peak
  - 15-minute quad.s: Mount Tobin, Buffalo Springs, Cain Mountain
  - Rulers, map measurers
- Time:
  - One 50-minute class period (includes ~10 minutes of introduction/10-15 minutes exercise/15-20 minute discussion/5-10 minutes of follow-up)



Source: Biological Resources Research Center, University of Nevada, Reno

Bull, W.B., 1984, Tectonic Geomorphology: Journal of Geological Education 32, pp.310-324.

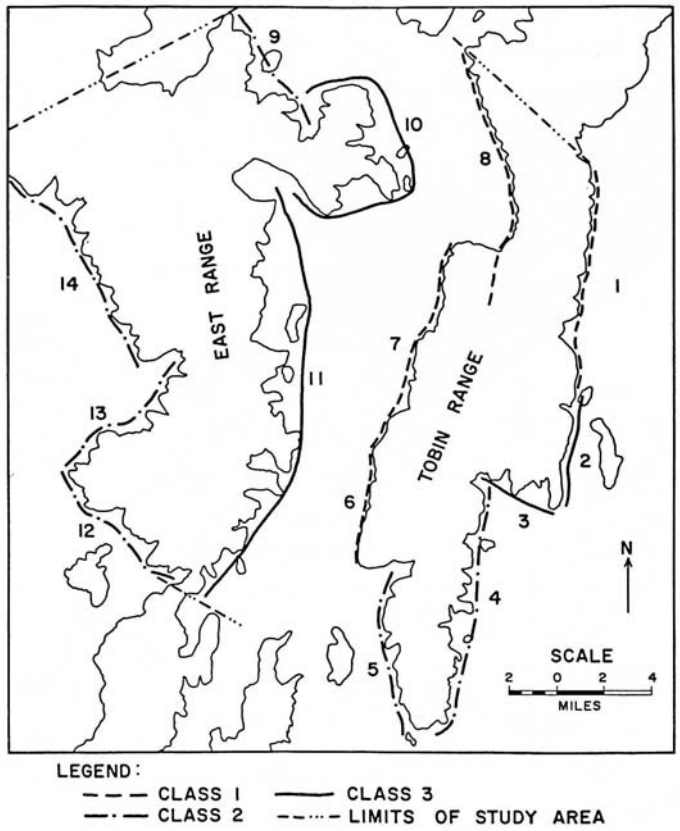


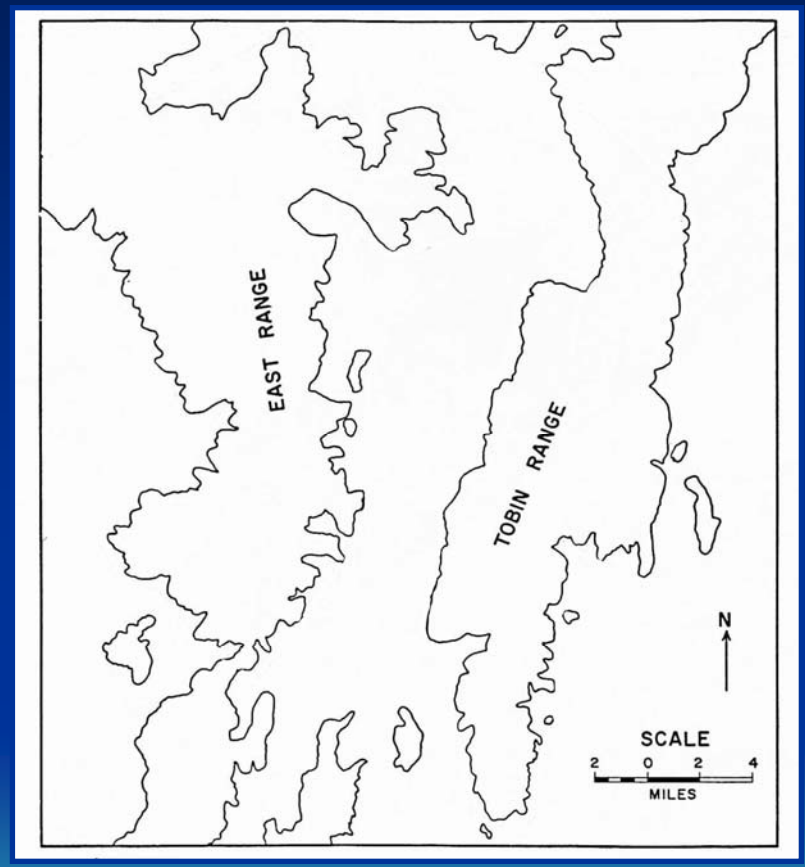
Figure 3. Three classes of late-Quaternary relative uplift of mountain fronts in part of north-central Nevada. See Table 2 for data set. From topographic map analysis made by John Partridge, University of Arizona.

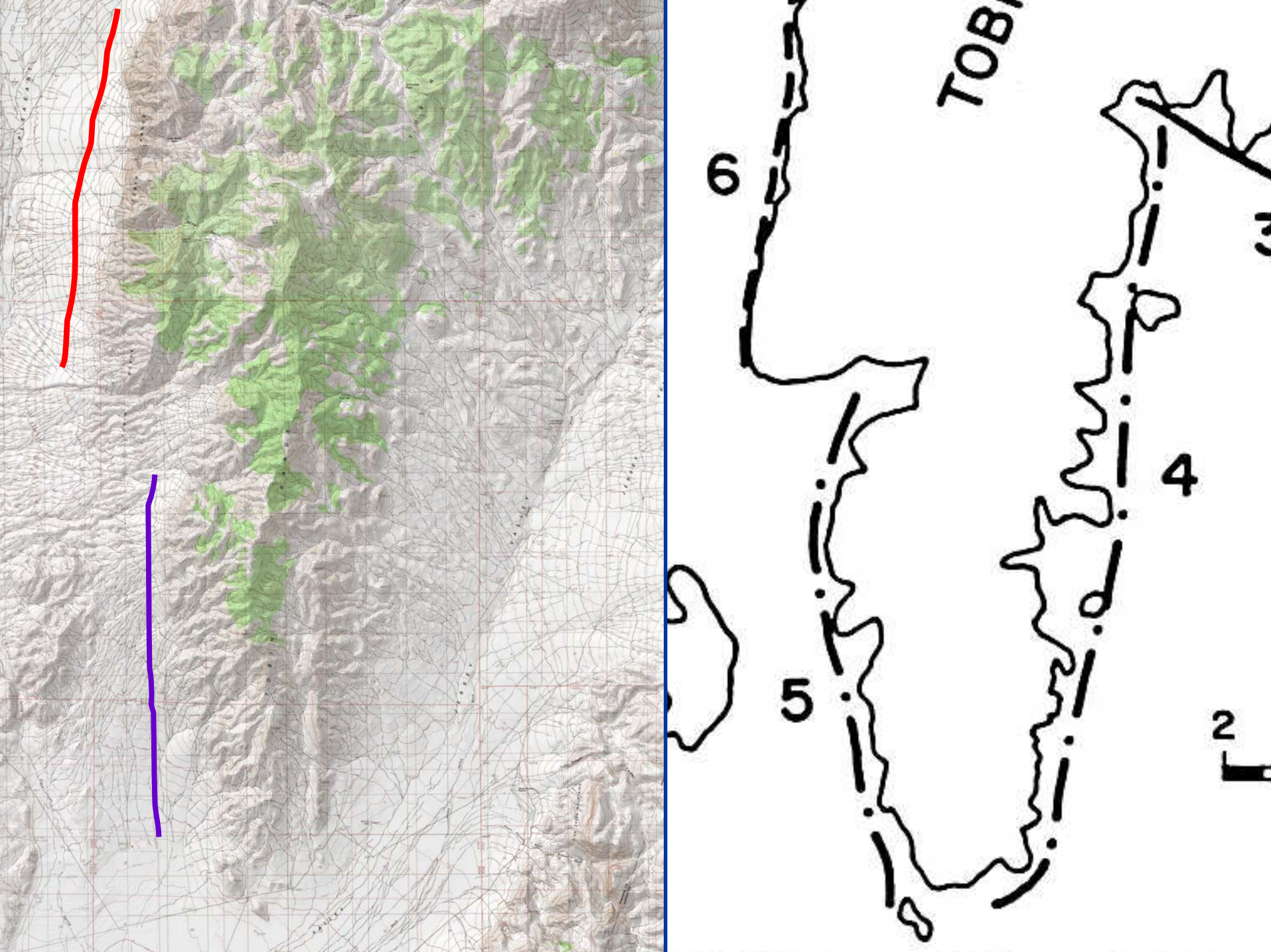
FRONT NO	LOCATION	SINUOSITY	MEAN V_f	V_f RANGE RATIO	FACET STAGES
CLASS 1 — ACTIVE MTN FRONT					
1	E. Tobin	1.28	0.16	0.08 - 0.51	1-5
6	W. Tobin	1.16	0.13	0.11 - 0.16	1-5
7	W. Tobin	1.22	0.13	0.06 - 0.53	2-5
8	W. Tobin	1.20	0.17	0.07 - 0.25	2-5
CLASS 2 RELATIVELY ACTIVE					
4	E. Tobin	2.16	1.31	0.36 - 3.53	2-5
5	W. Tobin	1.62	1.19	0.23 - 2.59	2-4
9	N. East Rng	2.11	1.96	1.25 - 2.50	6
12	W. East Rng	2.28	1.23	0.18 - 3.75	3,5
13	W. East Rng	2.18	1.00	0.15 - 2.25	3,4
14	W. East Rng	2.04	2.3	0.71 - 7.86	3-6
CLASS 3 INACTIVE MTN FRONT					
2	E. Tobin	4.04	1.72	0.43 - 3.33	-
3	E. Tobin	3.5	2.54	1.38 - 3.83	-
10	E. East Rng	2 63	7.85	1.33 - 16.3	4-6
11	E. East Rng	3.16	7.02	0.91 - 39.41	3-5

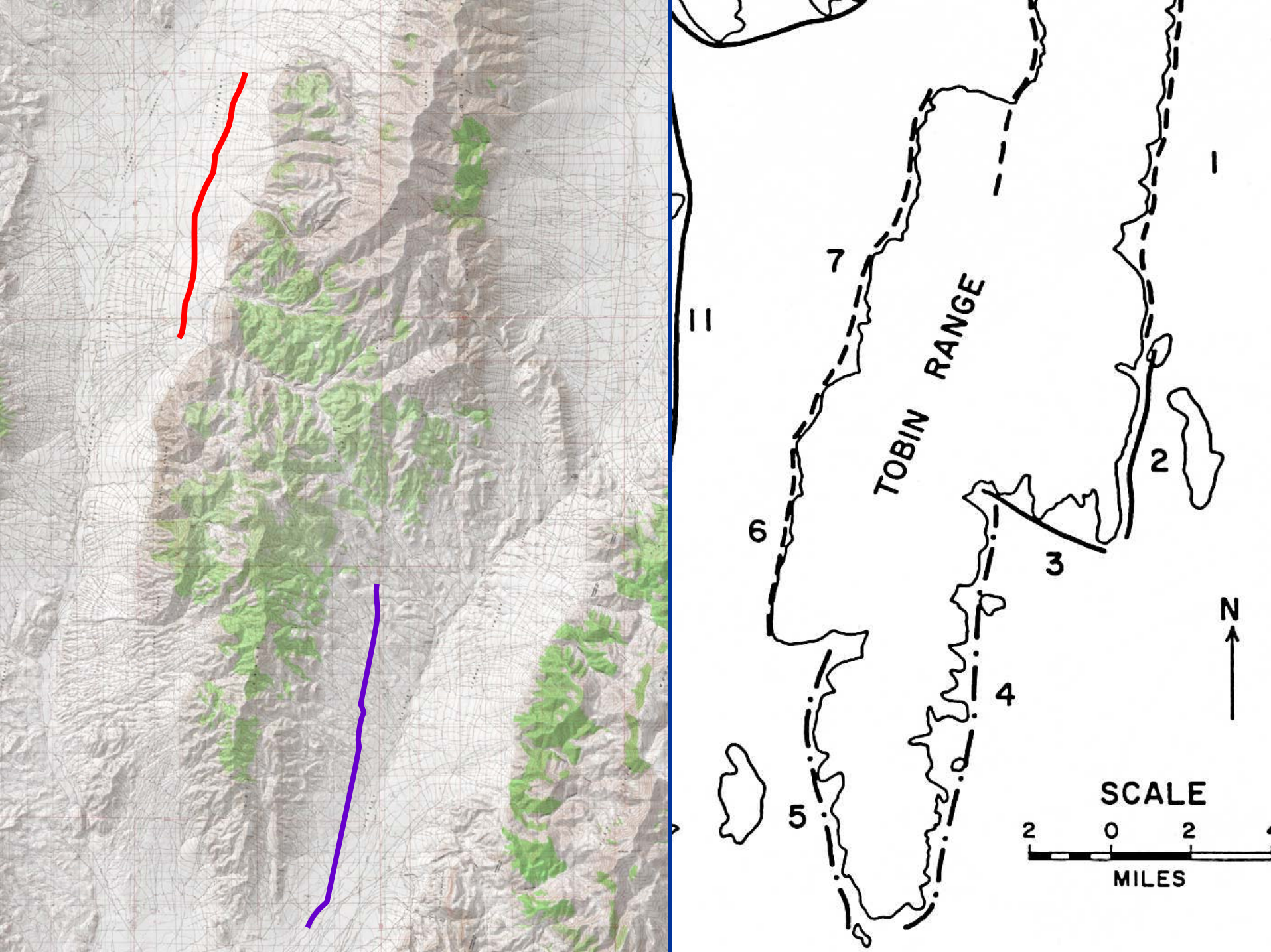
Table 2. Data set for three classes of relative uplift of mountain fronts in part of north-central Nevada. See Figure 3 for map. Sinuosity is the ratio of the length of the mountain-piedmont junction divided by the overall length of the front. The V_f ratio is the valley-floor width divided by the mean height of the adjacent watershed divides. Increasing dissection of triangular facets is indicated by increasing numbers. From topographic map analysis made by John Partridge, University of Arizona.

Tobin Range

- Discussion:
  - Introduce concept of morphometric properties
  - Review dip slip faults, fault scarps, and triangular facets
  - Introduce the Tobin Range as a typical example of a fault-bounded range
- Group Work:
  - Students work in groups of 2 or 3
  - Each group is given a set of topographic maps and some basic equipment
  - Each group has a map set showing a slightly different region, but all map sets have a red fault scarp and a purple fault scarp marked




6
4
5
2


TOBIN RANGE
1
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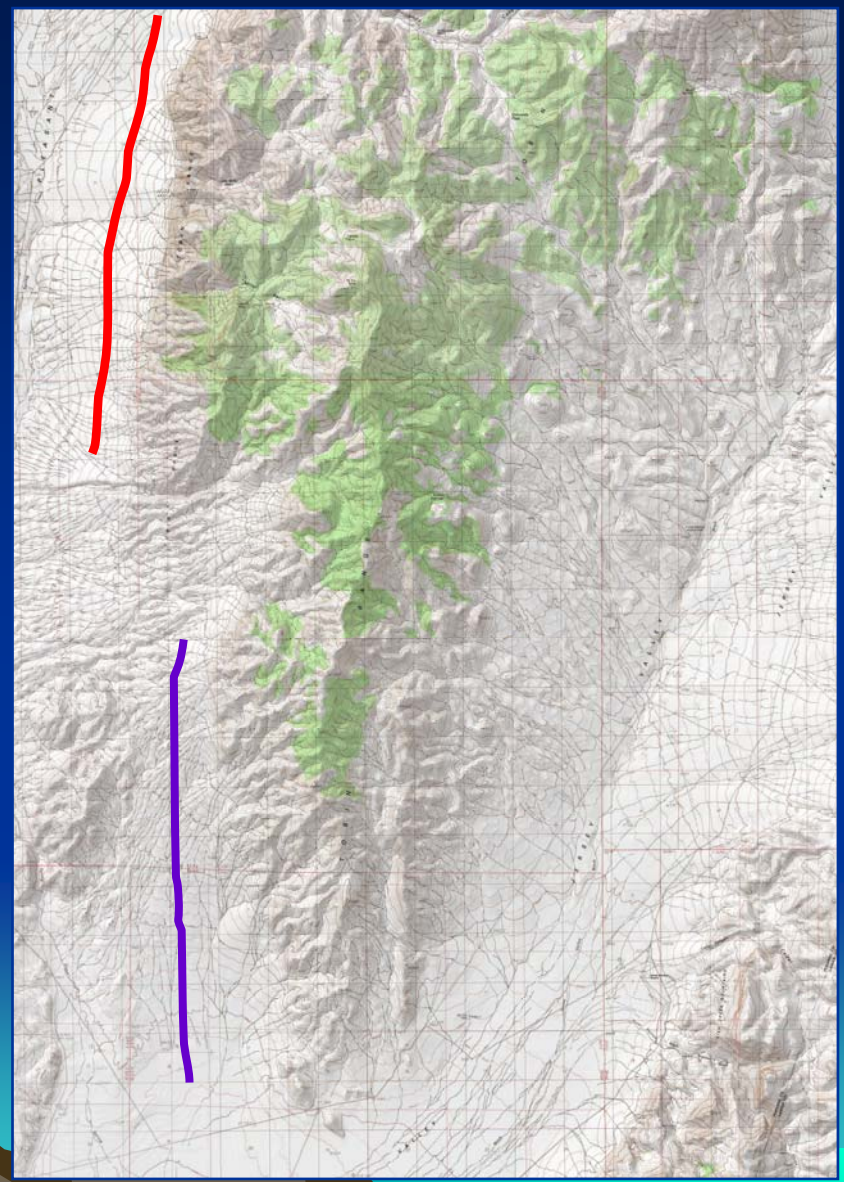
MILES

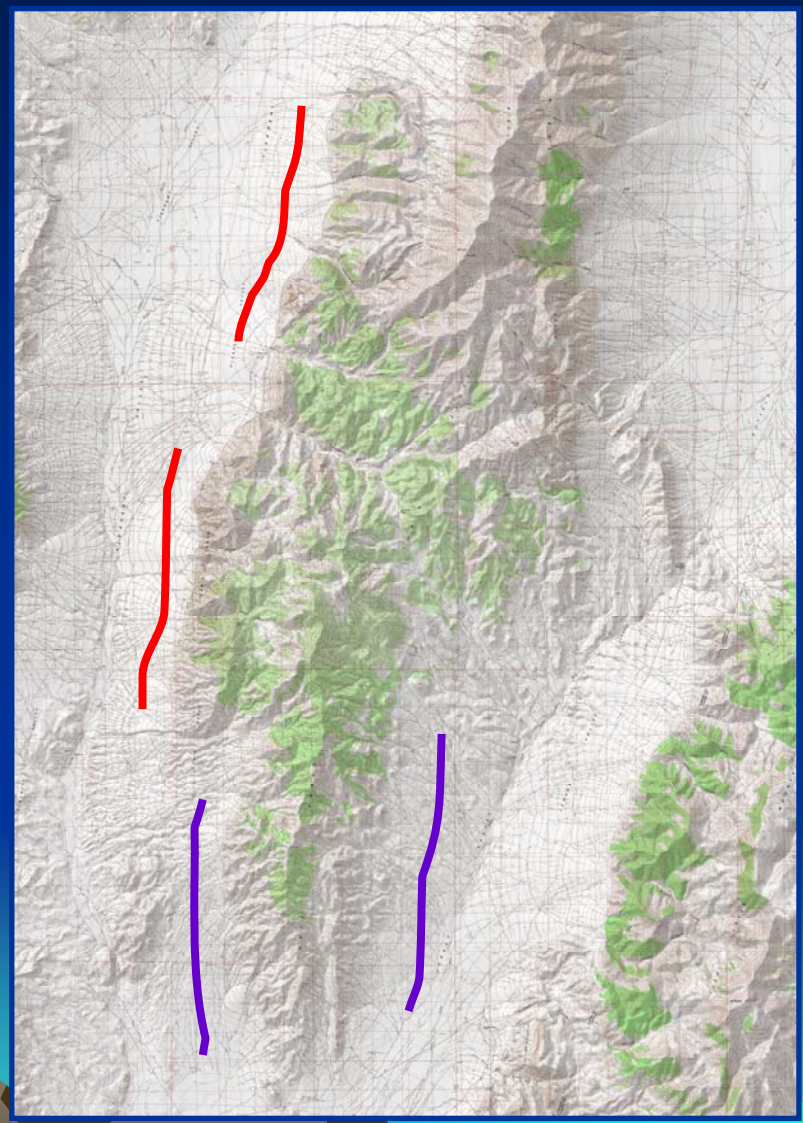
Tobin Range

- Each group is asked to do the following:
  - List physical characteristics of each of the two fault-bounded mountains/piedmonts that are marked on your maps with different colors.
  - Decide which fault-bounded mountains/piedmont has experienced more recent displacement.
  - Suggest morphometric properties that could be used to differentiate between the more recent and less recent displacement.
  - Explain why each of your properties makes sense.
  - *Morphometric properties must be measurable from the topographic maps.*



Tobin Range

- Group Discussion (after roughly 10 minutes):
  - Project an image of the entire range with all colored lines
  - Go through the first two questions as a class
  - Each group presents at least one morphometric property and explains their reasoning
  - Compile a list of properties that the class agrees on
  - Project Bull's table and we discuss as a class the properties that he used in his research of the Tobin Range
    - Sinuosity
    - Ratio between the valley floor width and the total valley height
    - Development of triangular facets



Tobin Range

- Evaluation:
  - No formal evaluation
  - Expectation for class participation
- Other topics/concepts that are addressed:
  - Effects of spatial variations in lithology
  - Effects of temporal changes in climate
  - Drainage basins and divides
  - Alluvial fan or terrace development
  - Relative vs. Absolute time
  - Quantitative vs. qualitative properties
- Adaptations:
  - Exercise is applicable to other fault-bounded mountains
  - Overall concept is applicable to other geomorphic processes