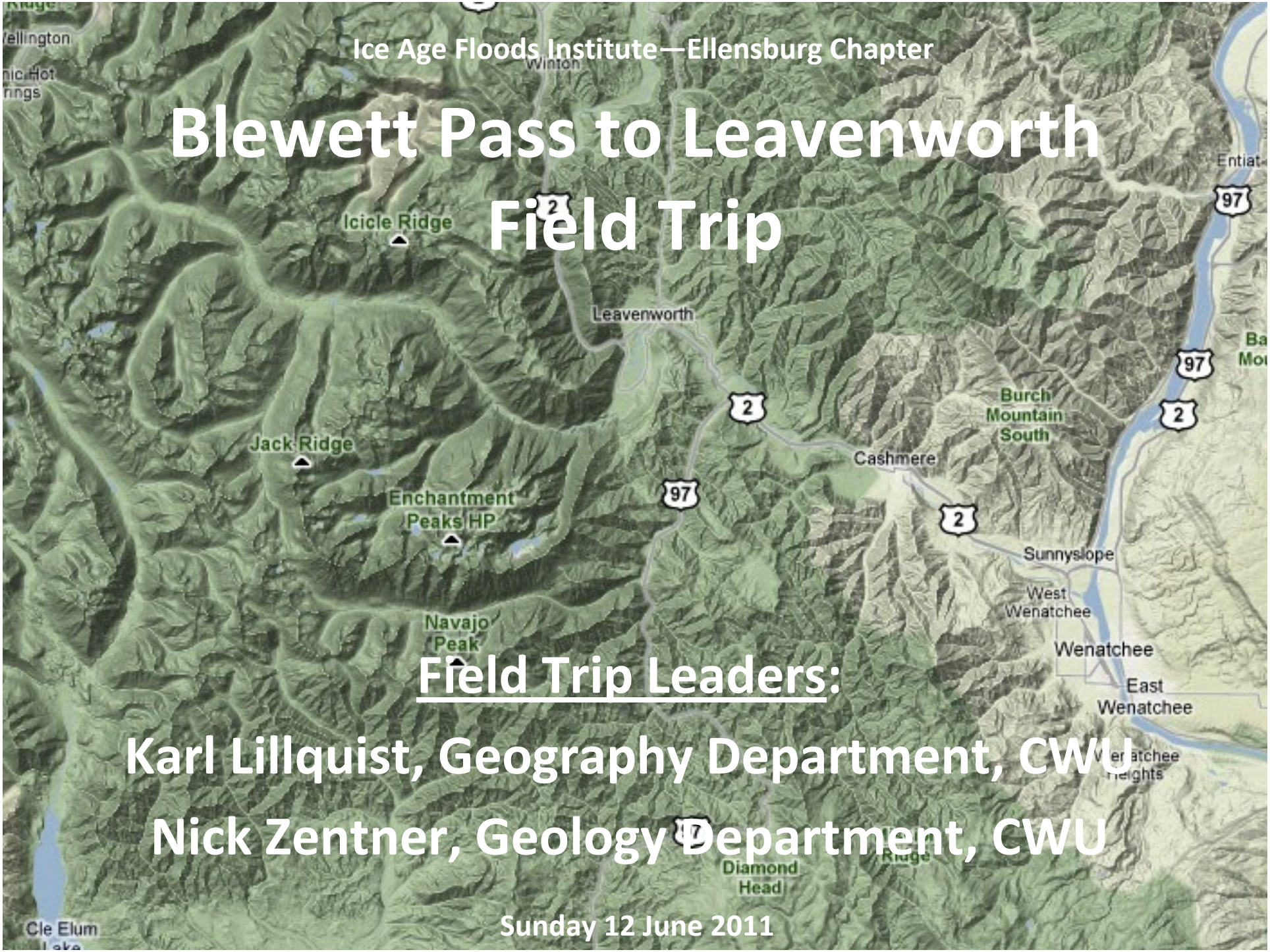
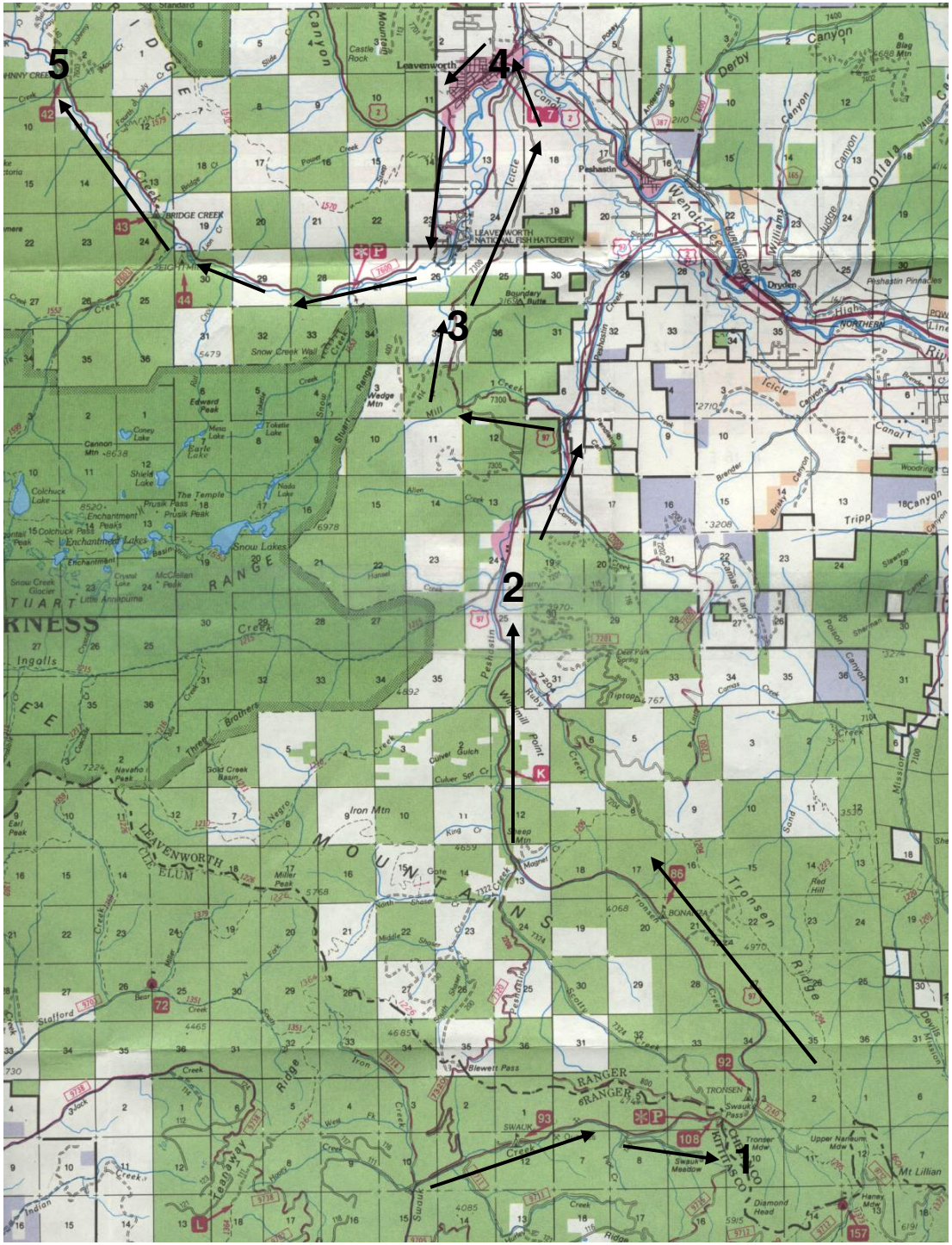

Ice Age Floods Institute—Ellensburg Chapter
Blewett Pass to Leavenworth
Field Trip
Icicle Ridge
Leavenworth
Jack Ridge
Enchantment
Peaks HP
Navajo
Peak
Burch
Mountain
South
Cashmere
Sunnyslope
West
Wenatchee
Wenatchee
East
Wenatchee
Diamond
Head
Cle Elum
Field Trip Leaders:
Karl Lillquist, Geography Department, CWU
Nick Zentner, Geology Department, CWU
Sunday 12 June 2011



Route & Itinerary

11:00 Depart from CWU's Hebeler Hall

12:00 Arrive Stop 1a—Blewett Pass

12:40 Depart for Stop 1b

12:45 Arrive Stop 1b—Discovery Trail (restroom)

1:00 Depart for Stop 2

1:15 Arrive Stop 2—Ingalls Creek-Peshastin Creek Junction

1:45 Depart for Stop 3

2:15 Arrive at Stop 3—Icicle Creek Valley Overlook

2:55 Depart for Stop 4

3:15 Arrive at Stop 4—Leavenworth Visitor Center (restrooms)

3:30 Depart for Stop 5

4:00 Arrive at Stop 5—Icicle Creek Valley

4:30 Depart for Ellensburg

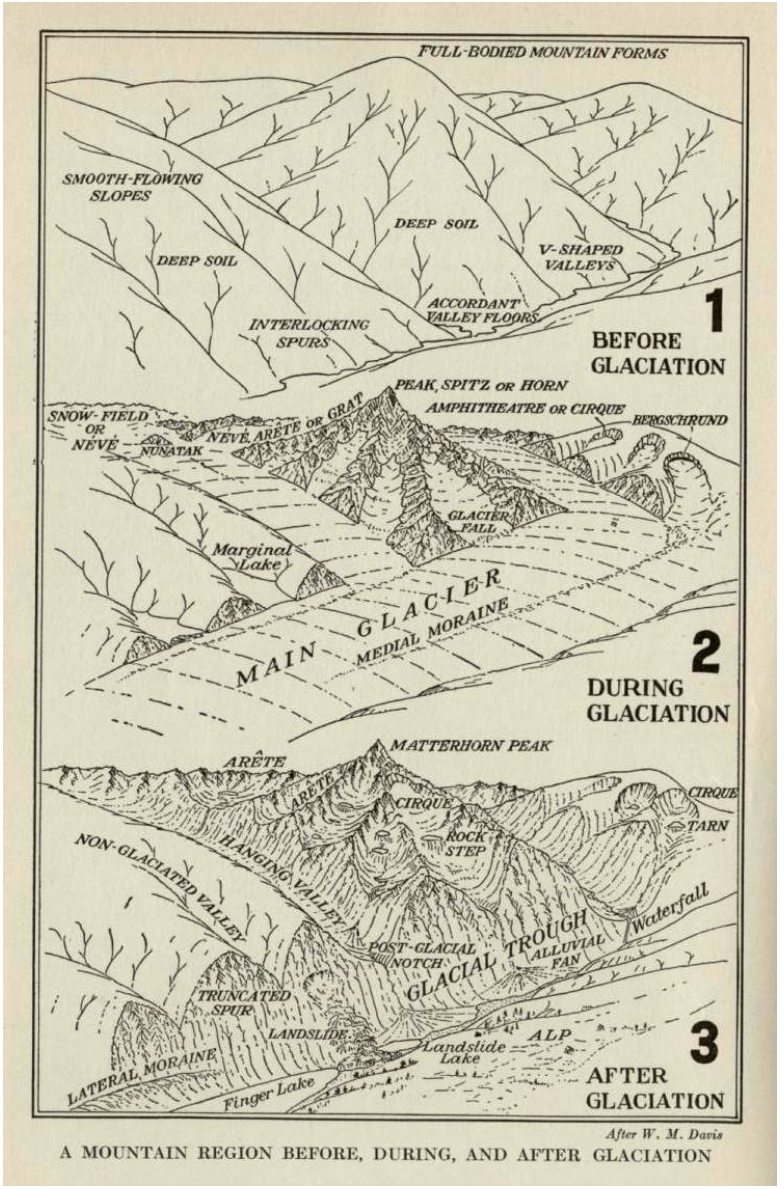
6:00 Arrive in Ellensburg

Enroute to Stop 1

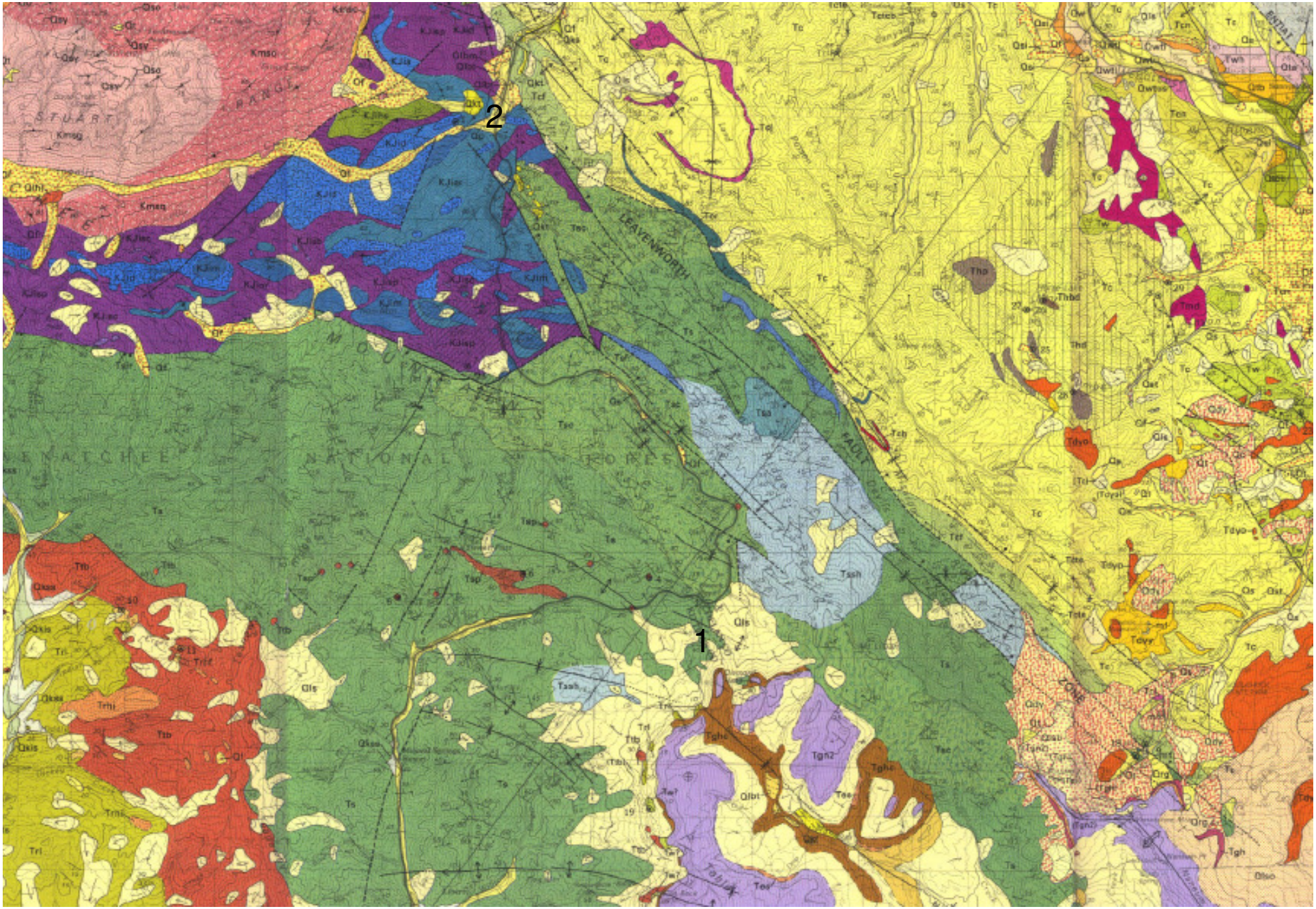
- In the Kittitas Basin, note the ridges of basin fill east & west of US 97. This fill has its origins from the mainstem Yakima River from the Cascades and sidestreams from the Wenatchee Range. Subsequent stream erosion planed off and dissected this fill to form a large *pediment* (see Tabor et al, 1982).
- At the high point on US 97 before joining WA 970, note the dark brown 15 million year old (myo) (Miocene) Columbia River Basalts (CRB's). Our route to Blewett Pass essentially parallels the northwestern margins of these *lava flows* (see Tabor et al, 1982).
- Around the Liberty Cafe, note the reddish brown Teanaway Basalts. These 47 myo (Eocene) volcanics originated just west of here as lava flows while in other places along our route they occur as *dikes*. Their reddish brown color tells you that they are well older than the CRB's (see Tabor et al, 1982).
- As we proceed toward Blewett Pass, note the bedded, light brown to blonde colored Swauk Formation. This ~50 myo (Eocene) continental sedimentary unit consists of sandstone, shale, and conglomerate (see Tabor et al, 1982).

Stop 1a—Blewett Pass Area

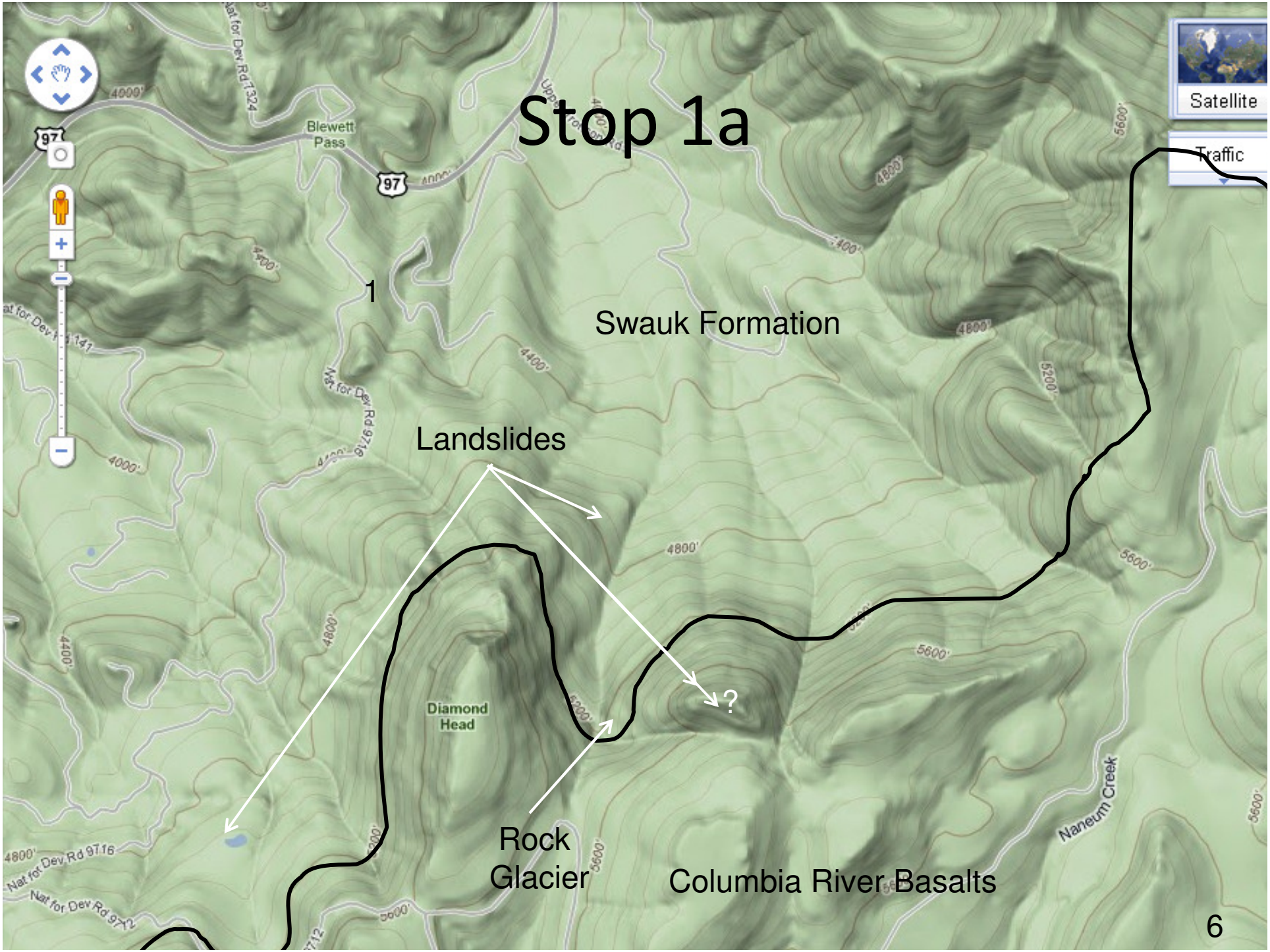
- Receding edge of Columbia River Basalts
- Expanding Swauk Formation
- Glaciers or landslides in this watershed?
  - Elevation & temperature
  - Continentality & precipitation
  - Aspect
  - Equilibrium Line Altitudes (ELA's)
  - Different glacial periods w/in Pleistocene

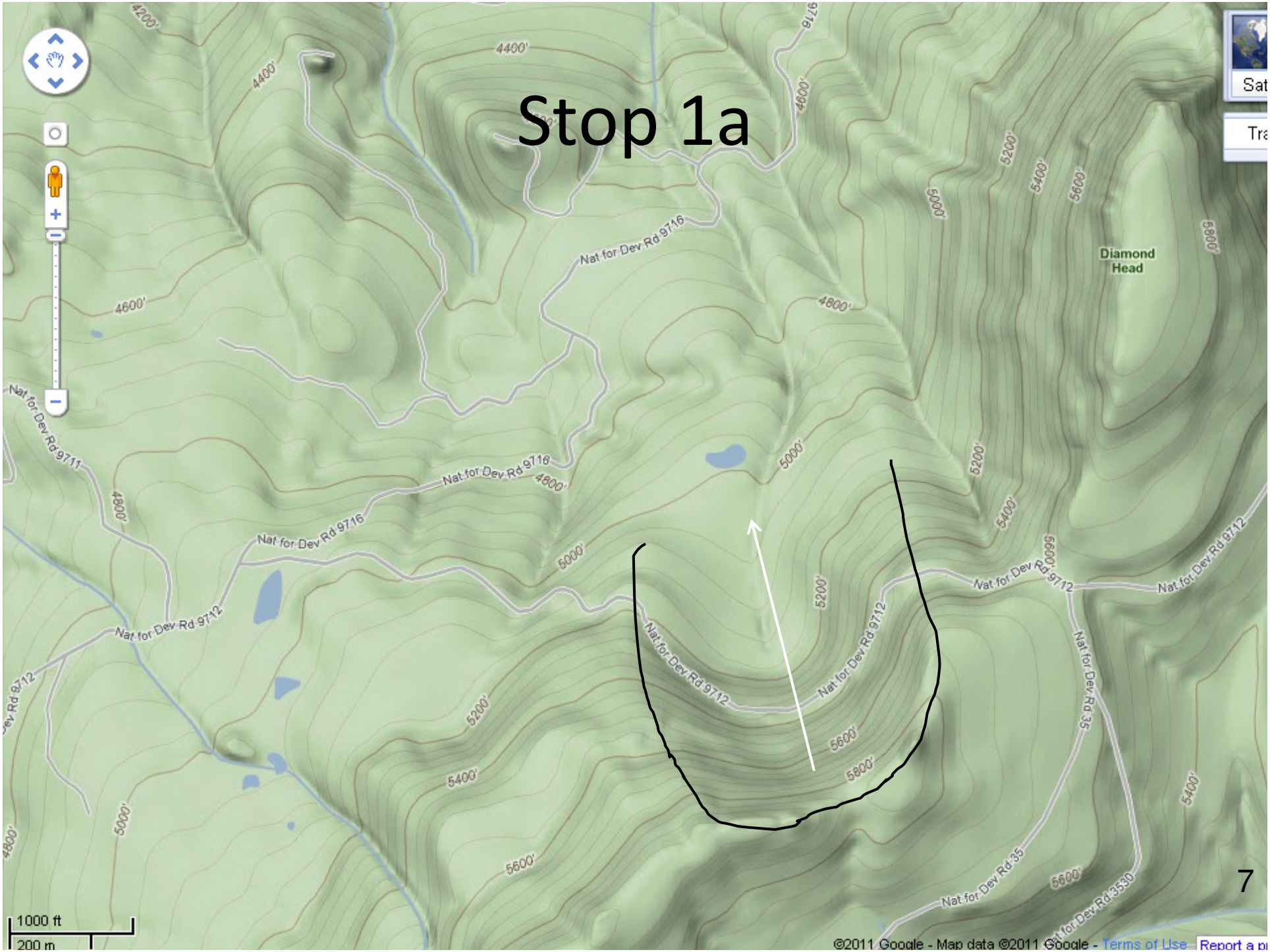


From Lobeck, 1939, p. 262)



Tabor and others (1982)


Stop 1a
1
Swauk Formation
Landslides
?
Rock
Glacier
Columbia River Basalts
Blewett
Pass
Diamond
Head
Nat for Dev Rd 9716
Nat for Dev Rd 9712
Nat for Dev Rd 1324
Nat for Dev Rd 9716
Naneum Creek
Satellite
Traffic
97
4000'
4400'
4800'
5200'
5600'


Stop 1a
Diamond Head
Nat for Dev Rd 9716
Nat for Dev Rd 9711
Nat for Dev Rd 9712
Nat for Dev Rd 35
Nat for Dev Rd 3530
4200'
4400'
4600'
4800'
5000'
5200'
5400'
5600'
5800'
1000 ft
200 m
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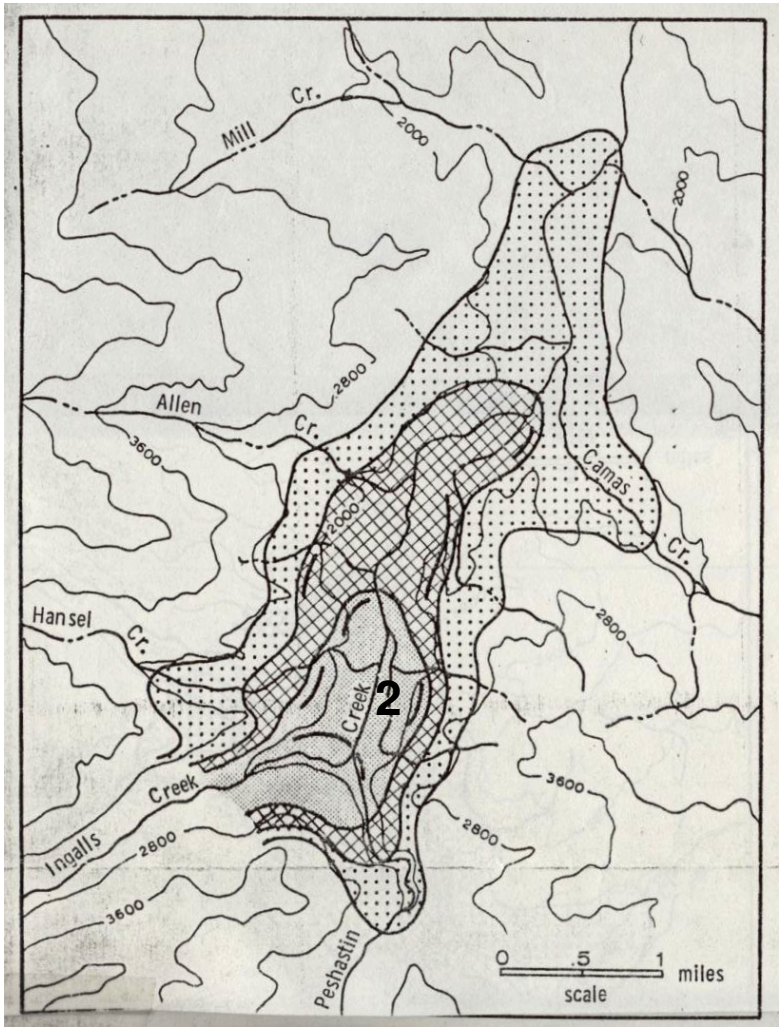
Enroute to Stop 2

- Note the generally narrow, winding nature of the Tronsen & Peshastin creek valleys in which US 97 follows from Blewett Pass to the mouth of Ingalls Creek valleys. This is not characteristic of a glacial valley.
- Note the shiny, green (on fresh surfaces) and red (on weathered surfaces) rock as we descend. These are ultramafic metamorphics, especially peridotite and serpentinite, of the Ingalls Complex. These units represent a late Jurassic (~150 myo) ocean floor materials (see Tabor et al., 1982).
- Note the fresh scars of at least four fresh landslides in the Ingalls Complex along US 97. One of these originated/reactivated in the Winter 1996 flooding and resulted in Blewett Pass being closed for weeks.

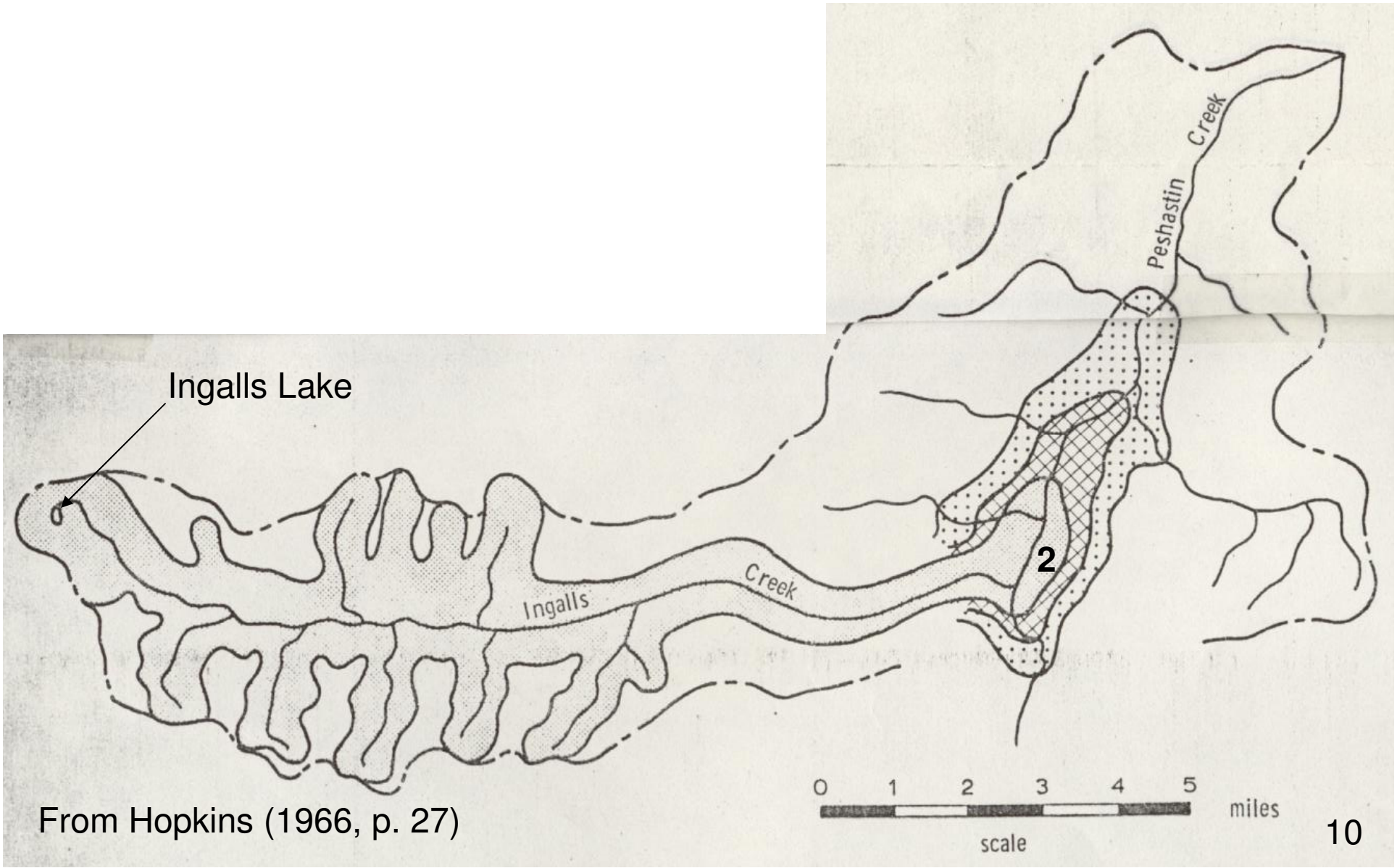
Stop 2—Ingalls-Peshastin Creek Junction

- Geology & source of Ingalls Creek drainage
- Ingalls Creek Valley as a glacial valley
  - Evidence?
- Spatial & temporal extent of glaciation
  - Granite weathering ratios
  - Surface boulder frequencies
  - Weathering profiles Evidence
- Impacts on drainages
- Widespread mid- to late Holocene alluviation & Mazama ash



Hopkins (1966, p. 27)

Stop 2



From Hopkins (1966, p. 27)


Stop 2
Peshastin
Right Lateral
Moraine
Leavenworth I
Right Lateral
Moraine
Allen Creek
Blewett Cutoff
Old Blewett Rd
Hansel Ln
Allen Ln
Ingalls Creek Rd
Hansel Creek
Ingalls Creek
Tip Top Rd
Canas Creek Rd
Satellite
Traffic
97
2

		GRANITE-WEATHERING RATIO (f:w)	BOULDER FREQUENCY	DEPTH OF OXIDATION (inches)	B HORIZON (inches)	DEGREE OF MODIFICATION OF MORAINES
YOUNGER DRIFT	III			24		Sharp and easily discernible
	II	87:13	101.0	36		
	I	81:19	88:6	45	~18	
INTERMEDIATE DRIFT		47:53	24.3	72	24	Subdued, but discernible
OLDER DRIFT		4.96	11.3	>120	40	Essentially no topographic expression

Mean values of time-dependent relative age parameters associated with the Ingalls Creek glacier (Hopkins, 1966, p. 61). Younger Drift = Leavenworth; Intermediate Drift = Peshastin

Enroute to Stop 3

- Approximately 3 miles north of the Stop 2, turn left off of US 97 onto Mountain Home Road. We will follow this good gravel road for approximately 5 miles to Stop 3.
- Once at the ridge top, note the lush, young vegetation interspersed with snags. This is evidence of a large wildfire that burned through the area in 1993. Note the fresh landslides in this burned area that may have occurred as roots of burned trees rotted therefore resulting in a loss of root strength to hold the slope together.

Stop 3—Icicle Creek Valley Overlook

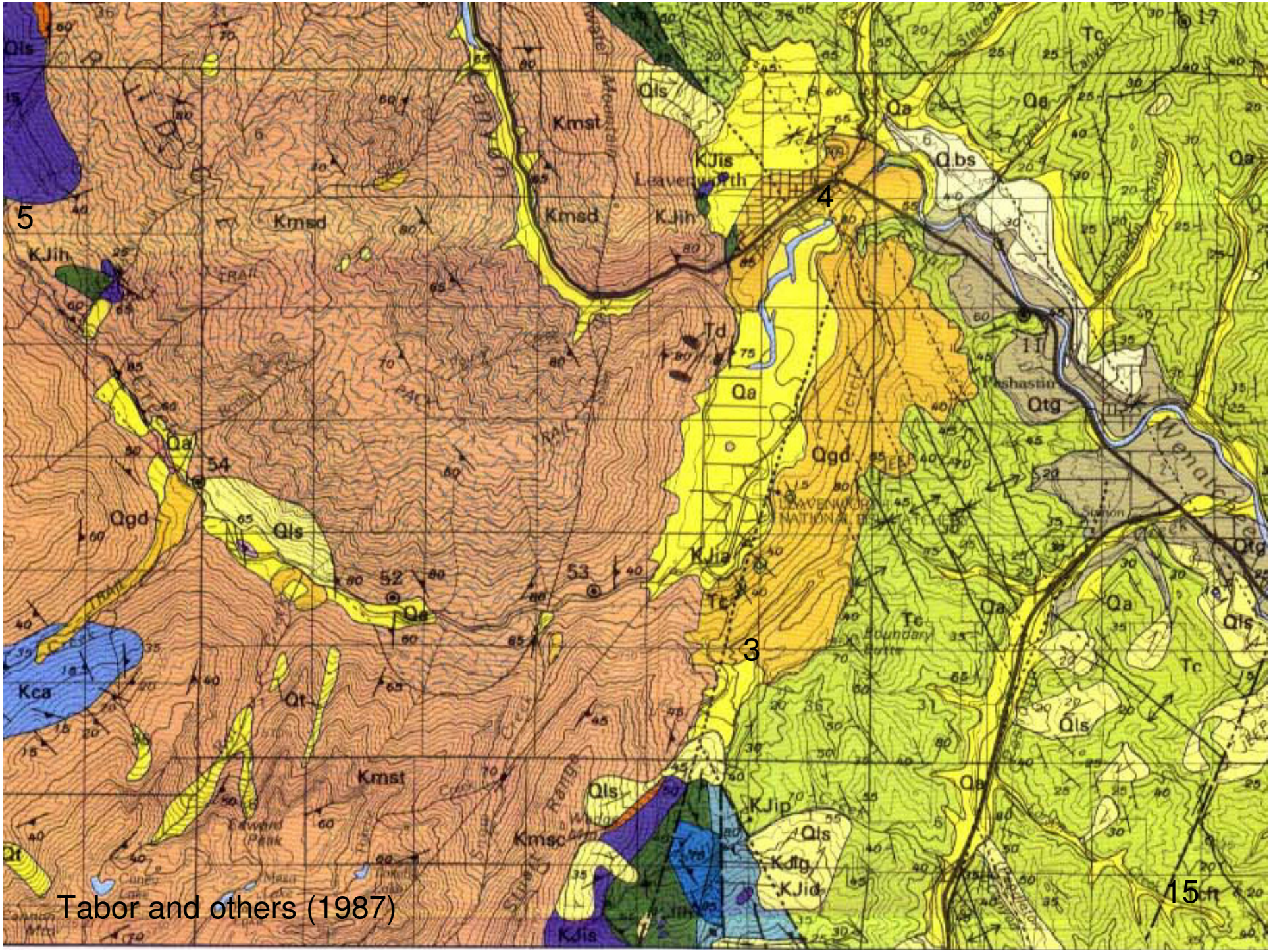
- Bedrock & structure of Icicle Creek Valley
- Morphostratigraphy of lateral moraines
- Glacial origins & history
  - ^{36}Cl dating
    - Based on ^{36}Cl quantity of boulders assumed to have been exposed at moraine surface since deposition…
    - Mean ages of all samples lying w/in one standard deviation of mean for all samples
    - Minimum ages
    - Problems w/ this method
      - Reworked boulders
      - Fire
- Drainage changes in Leavenworth area
- 1993 wildfire impacts

Mean Age of Boulder Population and Age of Oldest Boulder

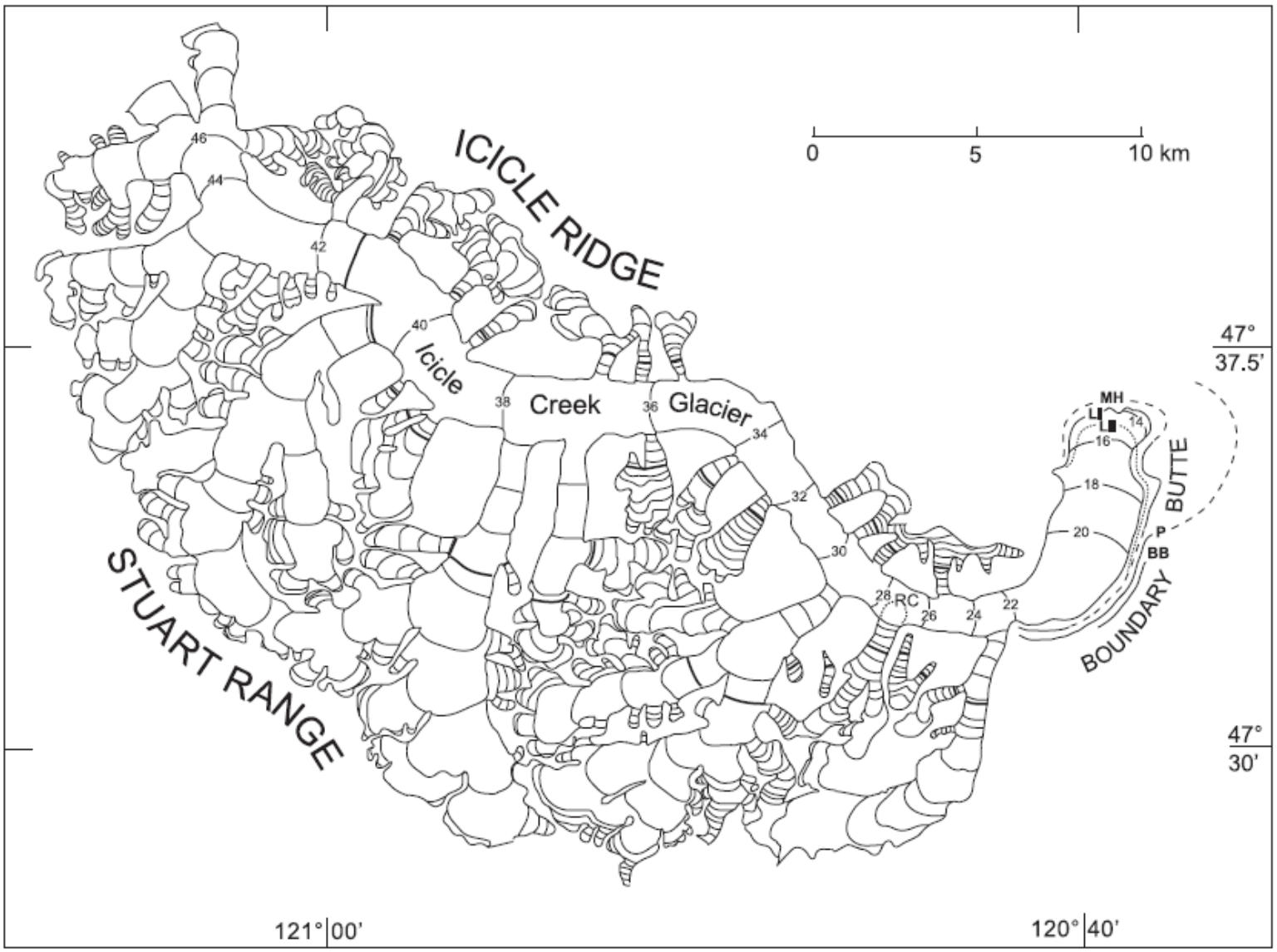
Moraine	Population Mean[a]	Oldest Date
Rat Creek II	12,500 ± 500 (n=9)	13,500 ± 600
Rat Creek I	13,300 ± 800 (n=6)	14,500 ± 500
Leavenworth II	16,100 ± 1100 (n=11)	17,000 ± 1000
Leavenworth I	19,100 ± 3000 (n=17)	24,700 ± 1100
Mountain Home	71,900 ± 1500 (n=5)	72,200 ± 1400
pre-Mountain Home	93,100 ± 2600 (n=3)	94,900 ± 3100
Peshastin	105,400 ± 2200 (n=8)	112,800 ± 1700

[a]Excludes outliers

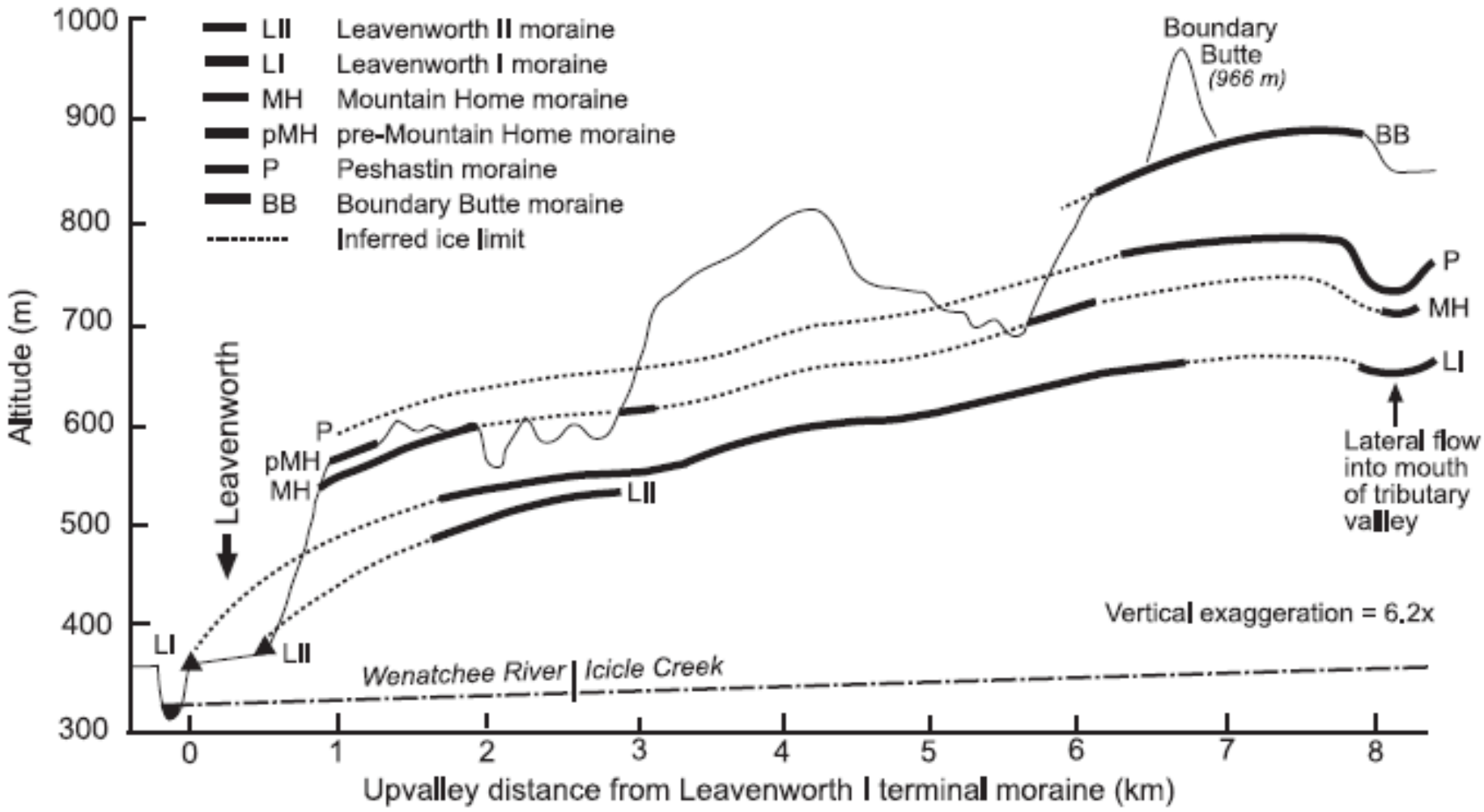
from Porter & Swanson (2008, p. 152)


Qls
Kmst
KJis
Kmsd
KJih
Td
Qa
Qbs
Tc
Qtg
Qgd
Kca
Qt
KJip
Kdlg
KJid
Kdis
5
4
3
15
Tabor and others (1987)


Stop 3
Moraine
3
Mountain View Cemetery
Icicle Rd
Dreabis St
Old Bridge Rd
Mountain Home Rd
Natl Forest Develop Road 7300 Rd
1000 ft



Topographic reconstruction of Icicle Creek glacier (contour interval in meters) at the time of the maximum Leavenworth I advance. Crests of major moraines in the lower reaches of the valley include Boundary Butte (BB), Peshastin (P), Mountain Home (MH), and Leavenworth I and II (LI and LII). The type Rat Creek Moraines (RC) lie at the mouth of Rat Creek, the second major southern tributary (Porter and Swanson, 2008, p. 134).



Transect along Boundary Butte Ridge in lower Icicle Creek-Wenatchee River valley showing positions of right lateral moraine crests (bold lines; dotted Where inferred) of Icicle Creek glacier. Triangles are LI and LII lateral moraines (Porter and Swanson, 2008, p. 149).

Enroute to Stop 4

- As we descend from Boundary Butte Ridge, note the lateral moraines we parallel and ultimately cross. These include the entire sequence from Peshastin to Leavenworth-aged moraines.
- When you reach the bottom of the Boundary Butte Ridge, work your way out to US 2. At US 2, turn left and drive into Leavenworth. We will gather at the Leavenworth Visitor's Center that is just before (east) of the 76 service station on the right (north) side of the US 2. The visitor center is across US 2 from a large old fruit warehouse. Restrooms are available in the 76 station.
- Note the low hills immediately north of us but still in the valley. These are Leavenworth I and Mountain Home moraine remnants. The Leavenworth II moraines are much-modified and pass through the center of town to our south.

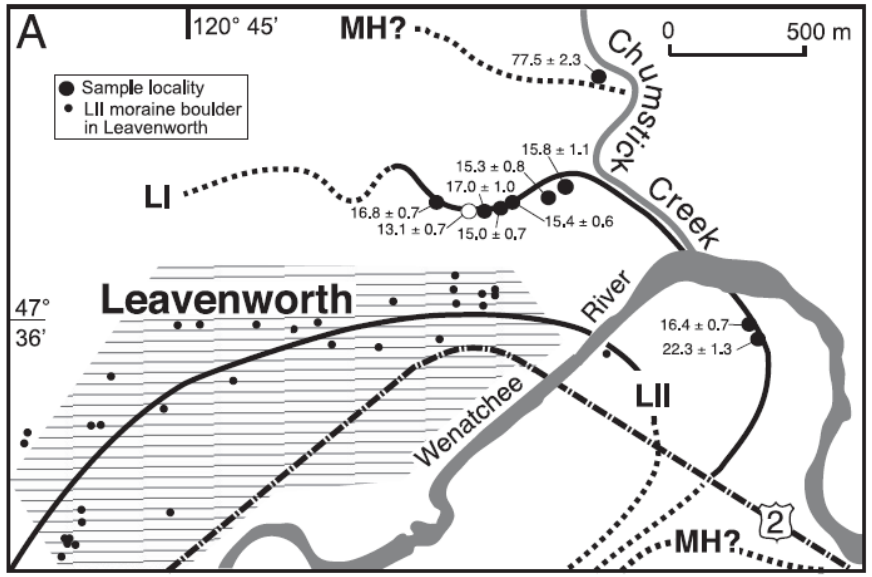
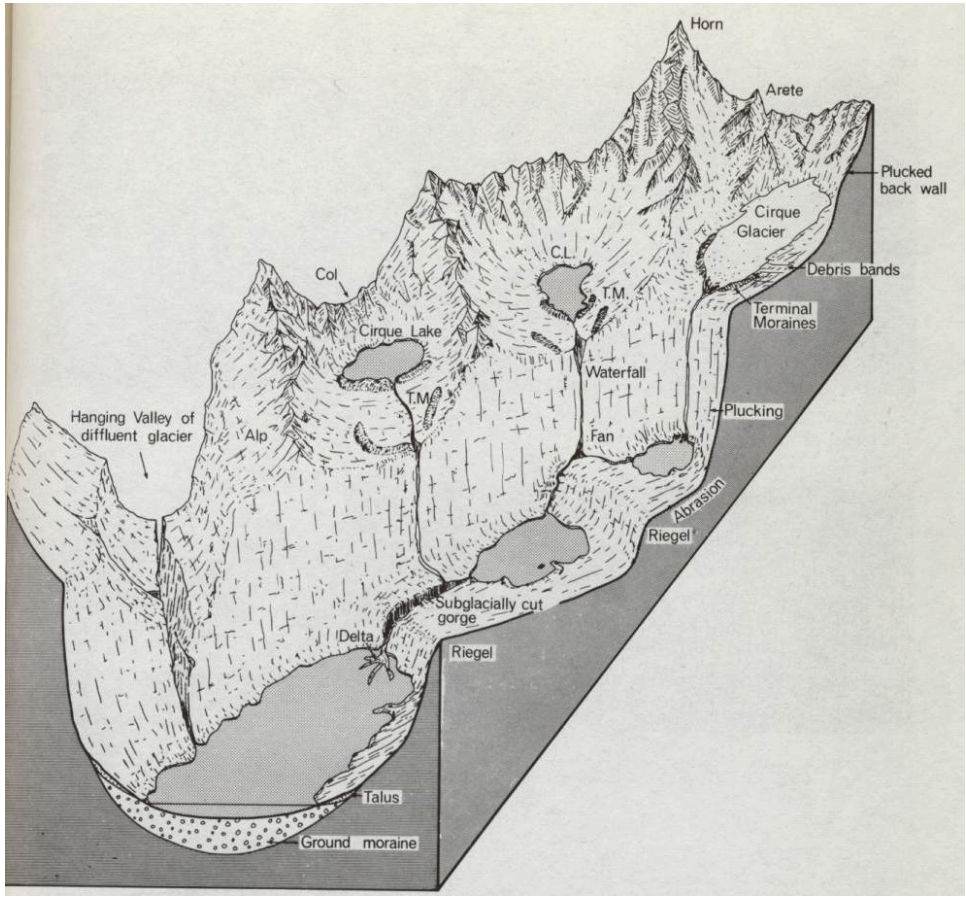


Fig. 12. Maps showing moraines of Icicle Creek glacier and ages of sampled boulders. Ages shown are in thousands of ^{36}Cl years. Open circles identify statistical outliers. (A) Leavenworth I and II terminal moraines in and near Leavenworth, and possible Mountain Home moraine remnant. Large granitic boulders within the city limits of Leavenworth, shown by small dots, form an arc that trends southwest toward the mouth of Tumwater Canyon (fig. 10). Inferred ice limits shown by dashed lines.

(from Porter & Swanson (2008, p. 150)

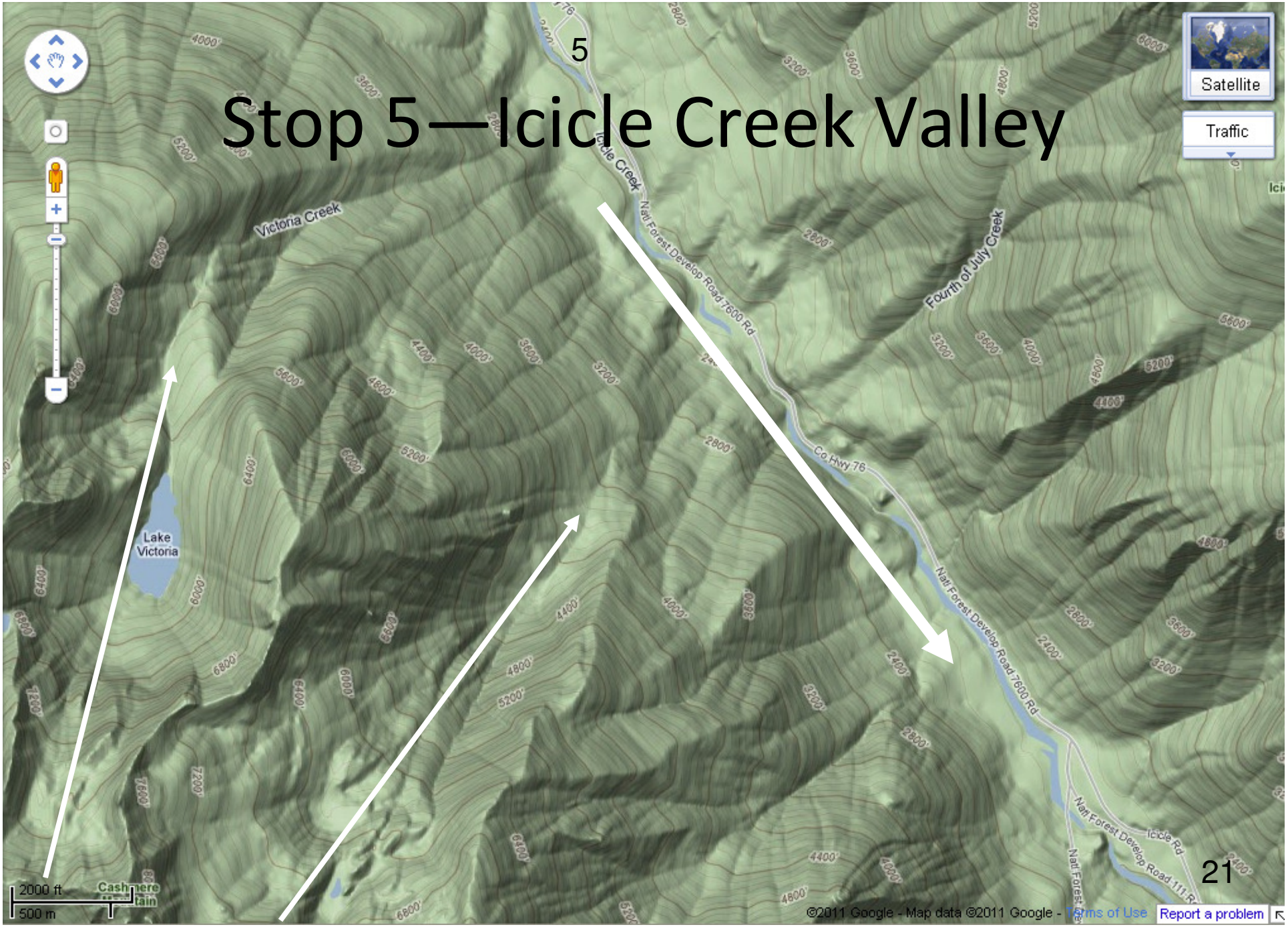
Stop 5

- Characteristics of glacial valleys
  - U-shapes
  - Truncated spurs
  - Association w/ other glacial features
    - Hanging valleys
    - Roche moutonees
    - Erratics
    - Lateral moraines?
- Post-glacial modification
  - Icicle Creek
  - Landslides



From Selby (1985, p. 439)

Stop 5—Icicle Creek Valley



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