



South Sister, Middle Sister, North Sister from north side Broken Top

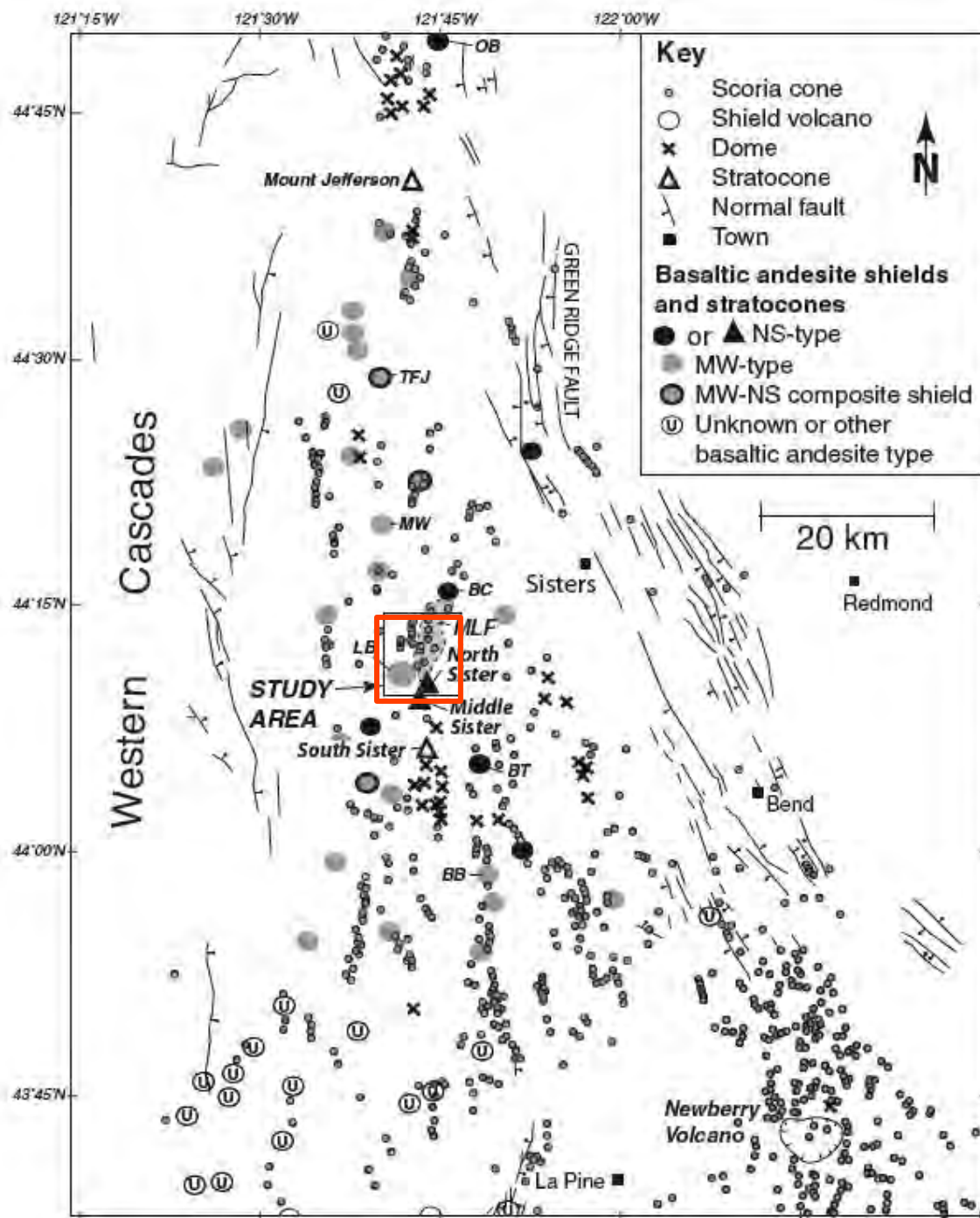
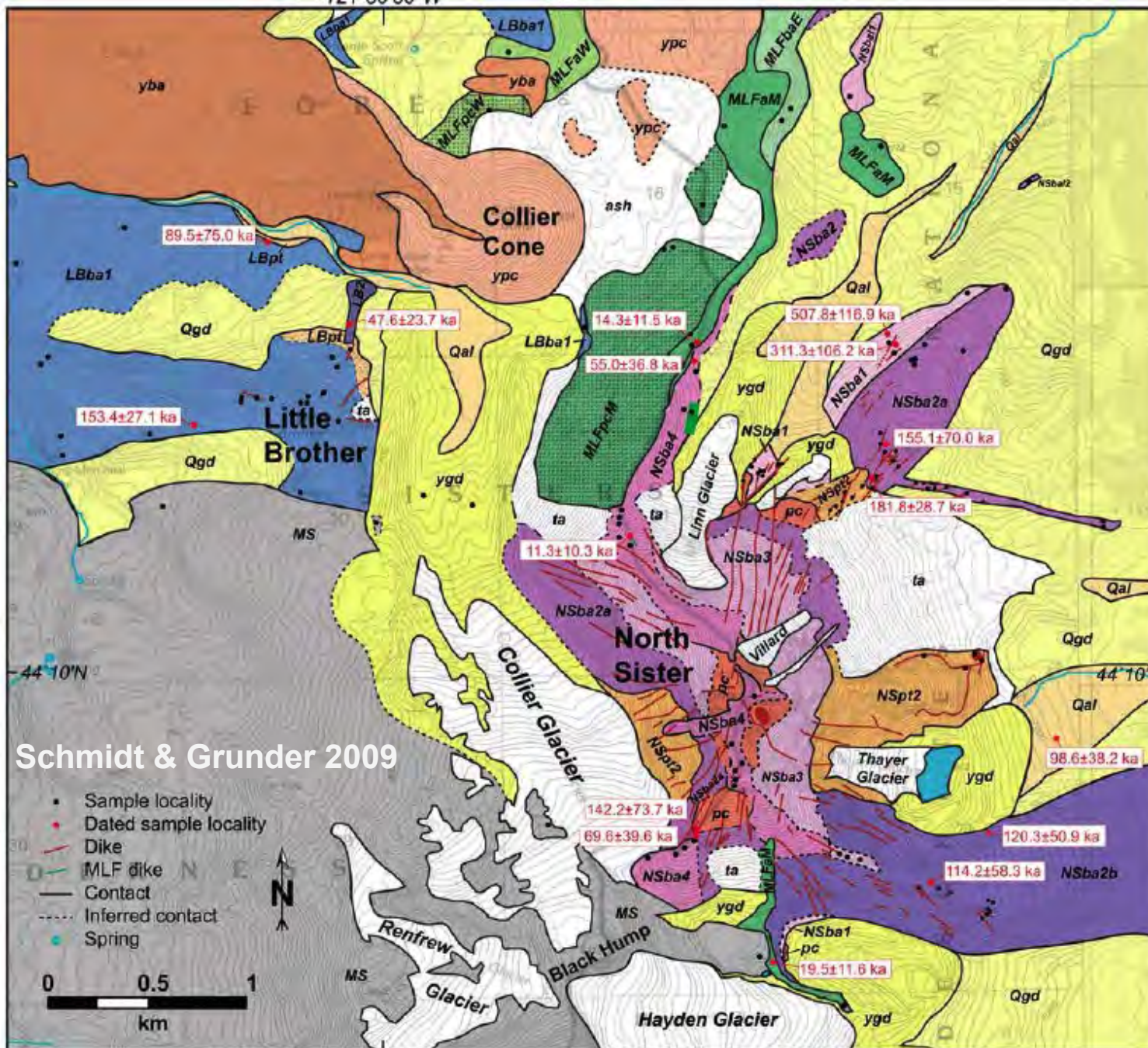


Figure 2. The distribution of volcanic vents, faults, and basaltic andesite types in the central Oregon Cascade Range. Monogenic mafic vents tend to be found along lineaments that mimic exposed faults both in length and in orientation. The distribution of the two main types of basaltic andesite—North Sister (NS)-type and Mount Washington (MW)-type—at shield and stratocone volcanoes is shown (Conrey et al., 2004). Abbreviations: OB—Ollalie Butte; TJF—Three-Fingered Jack; MW—Mount Washington; LB—Little Brother; MLF—Matthieu Lakes Fissure; BC—Black Crater; BT—Broken Top; BB—Bachelor Butte. Map was compiled from Sherrod et al. (2004) and Conrey et al. (2004).

Schmidt & Grunder
2009



Schmidt & Grunder 2009

Rock Units

Unconsolidated and Holocene

- Qal** Quaternary alluvium
- ta** Talus, steep, unstable slopes
- ygd** Quaternary young glacial deposits, unconsolidated moraine of the Little Ice Age
- Qgd** Quaternary glacial deposits, moraine and glacial outwash, Last Glacial Maximum to Little Ice Age
- ash** Ash deposits, unknown origin
- ypc** Holocene pyroclastic deposits, scoria and bombs of scoria cones and fields
- yba** Holocene basaltic andesite lava, unglaciated and sparsely vegetated to unvegetated

Matthieu Lakes Fissure

- MLFaW** MLF andesite lava of west splay
- MLFpcW** MLF pyroclastic deposit of west splay
- MLFaM** MLF andesite lava of main splay
- MLFpcM** MLF pyroclastic deposit of main splay
- MLFaE** MLF basaltic andesite lava of east splay
- MLFpcE** MLF pyroclastic deposit of east splay
- MLFa** MLF andesite lava of unknown timing
- MLFpc** MLF pyroclastic deposit of unknown timing
- lfpc** Island Fissure pyroclastic deposit, glaciated andesite vents that parallel MLF
- lfpt** Island Fissure palagonitic tuff cone

North Sister Volcano

- pc** North Sister basaltic andesite scoria deposit
- NSba4** North Sister basaltic andesite Stratocene Stage lavas intercalated with scoria
- NSba3** North Sister basaltic andesite Upper Shield Stage lavas with minor scoria and palagonitic tuff
- NSpt2** North Sister basaltic andesite palagonitized tuff and interlayered scoria of Glacial Stage
- NSba2b** North Sister basaltic andesite Glacial Stage lavas of compositional group 2b
- NSba2a** North Sister basaltic andesite Glacial Stage lavas of compositional group 2a
- NSba1** North Sister basaltic andesite lava and minor scoria of Lower Shield

Other volcanic centers

- LB2** Late Little Brother basaltic andesite dike and related flow
- LBba1** Little Brother basaltic andesite lava
- LBpt** Little Brother palagonitic tuff
- MS** Middle Sister, undifferentiated
- psba** Pleistocene glomerocrystic basaltic andesite lava, unknown source

121°30'30"W

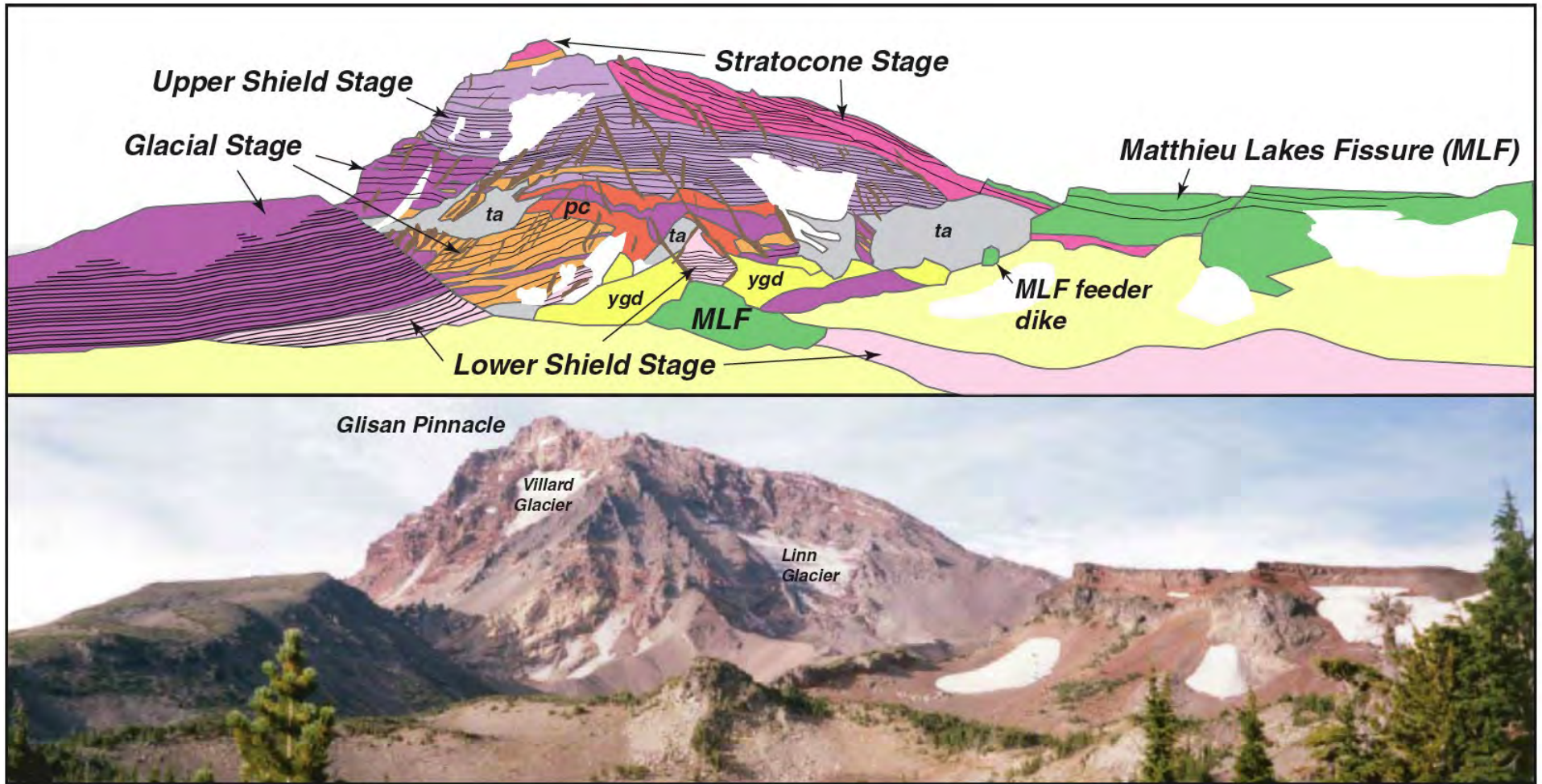


Figure 6. (A) Perspective view of North Sister Volcano with eruptive stages based on (B) photo of North Sister from the north. Note interfingering of Glacial Stage lavas and palagonitic tuffs on lower northeast flank (left) of North Sister.

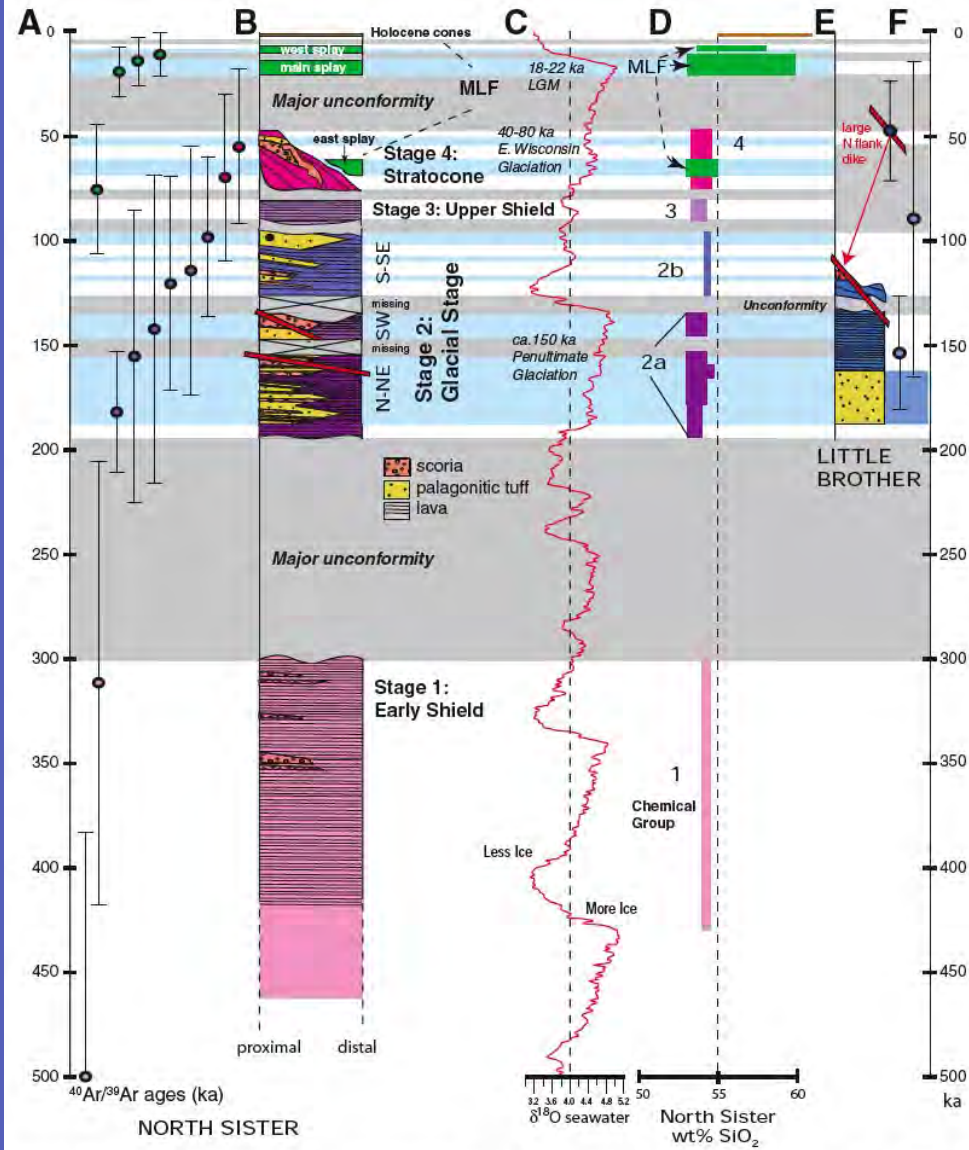
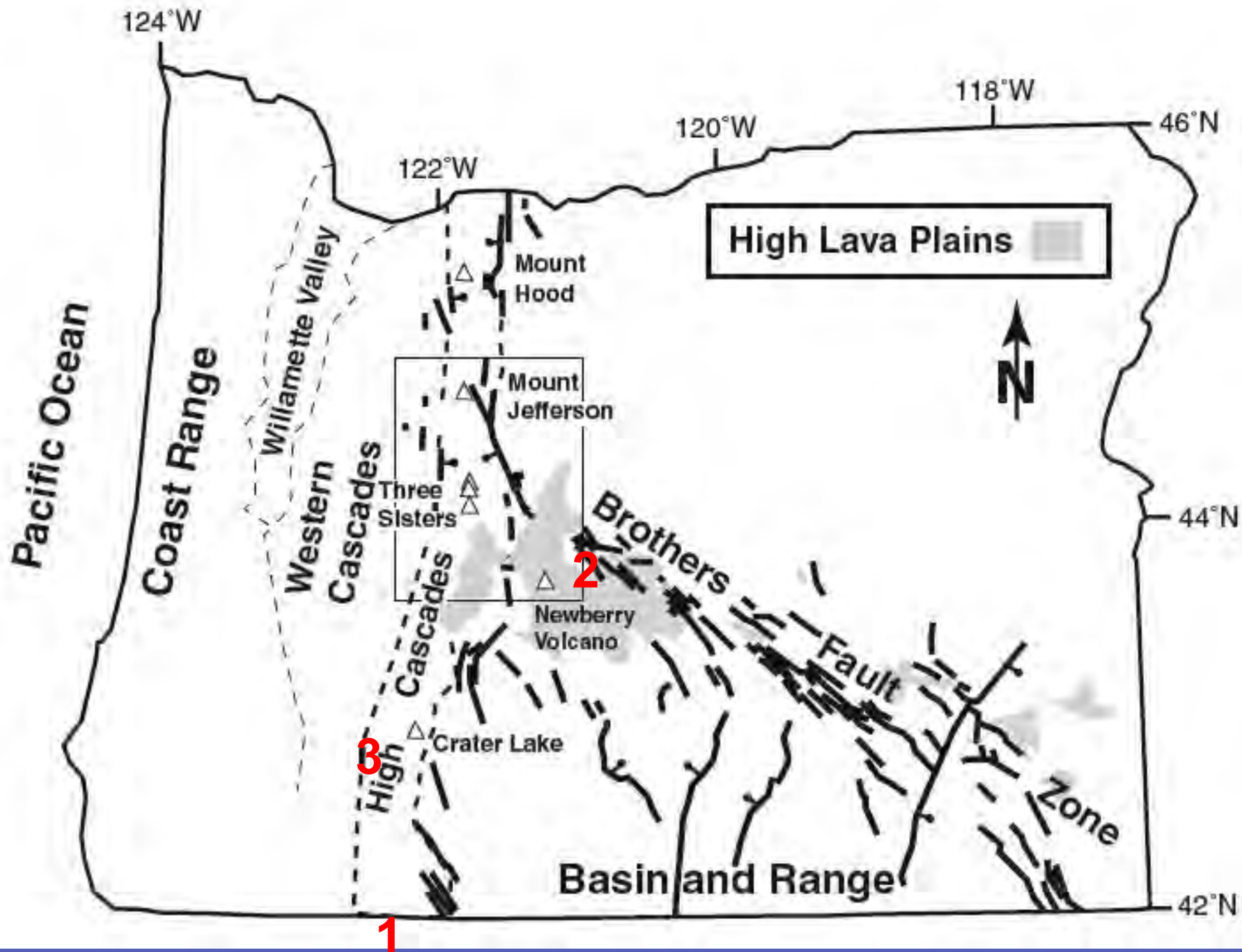


Figure 7. Summary of field and chemical data presented in this paper as a schematic stratigraphic section for North Sister and Little Brother. (A) $^{40}\text{Ar}/^{39}\text{Ar}$ dates with 2 σ error for North Sister Volcano. Colors as in Figures 3 and 4. (B) Stratigraphic section for North Sister eruptive stages: the Lower Shield Stage, the Glacial Stage, the Upper Shield Stage, the Stratocone Stage, and Matthieu Lakes Fissure (MLF). Subglacial eruptive sequences of palagonitic central volcano and thick Matthieu Lakes Fissure lavas are indicated in light blue. Unconformities are shown in light gray to (C) the global $\delta^{18}\text{O}$ of seawater record (Lisiecki and Raymo, 2005). Higher $\delta^{18}\text{O}$ values indicate times of more ice, and lower $\delta^{18}\text{O}$ values indicate less ice worldwide. Major glaciations of the Oregon Cascades, defined by Scott (1977), correlate with subglacial eruptions and unconformities. (D) SiO_2 concentrations through time. Variations within the 2a group are based on stratigraphy within the N-NE ridge. See Figure 8 and text for further description of compositional groups. (E) Schematic stratigraphic section of Little Brother. (F) Little Brother $^{40}\text{Ar}/^{39}\text{Ar}$ dates with 2 σ error. An arrow connects a young date with a large, N10°E-trending Little Brother dike found on its north flank.



1

2

3

Caldera: Newberry Caldera



1994

Imagery Date: 7/6/2014 43°43'02.60" N 121°13'56.99" W elev 6609 ft eye alt 41319 ft



Newberry Volcano-Caldera with obsidian flow & maar volcano



Rhyolite Obsidian flow, Newberry volcano

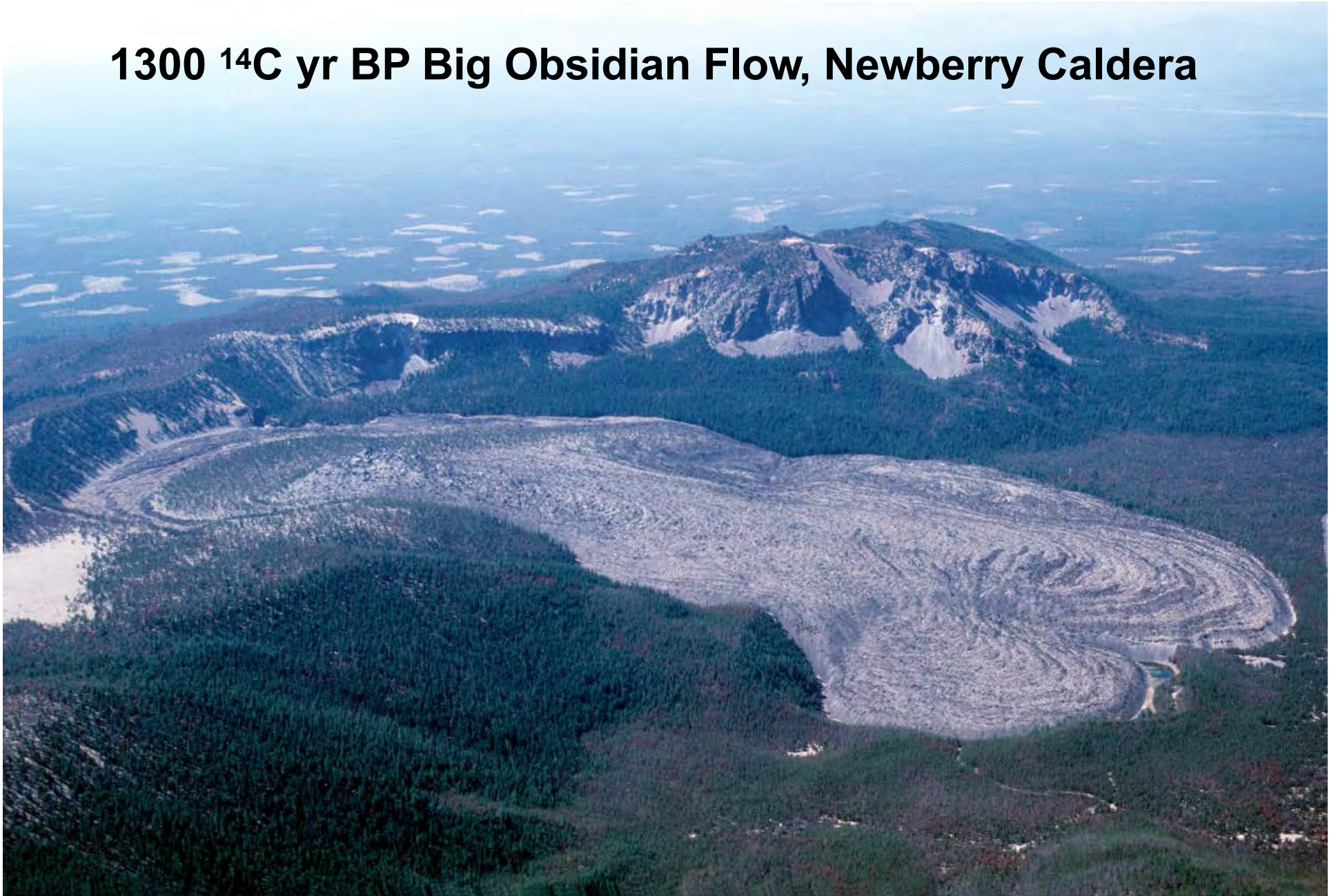


Flow banding in Newberry rhyolite obsidian flow



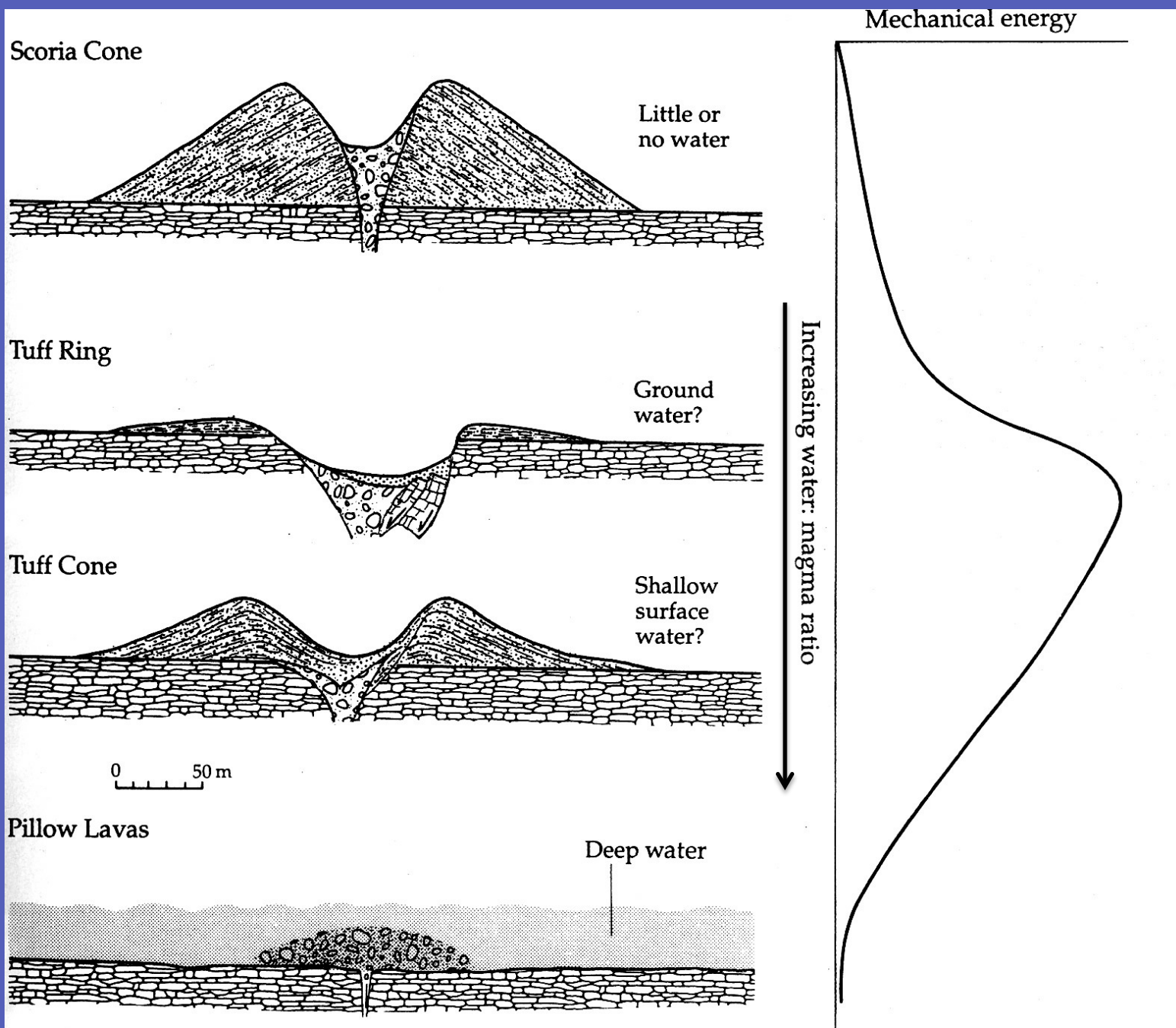
Gas bubble in Newberry obsidian flow. Jack Meyer for scale

1300 ^{14}C yr BP Big Obsidian Flow, Newberry Caldera



http://vulcan.wr.usgs.gov/Images/Jpg/Newberry/Images/Newberry87_aerial_big_obsidian_flow_10-87.jpg

Impact of water on small basaltic eruptions



Francis and Oppenheimer 2004



Paulina Lake

**Central Pumice
Cone**

East Lake

Maar Volcano: Fort Rock



Crater Lake Caldera Volcano with Wizard Island cinder cone





Phantom Ship-plumbing to vent, Mt Mazama



Crater Lake: Lalo Rock intra-canyon lava flow



Pinnacles in pyroclastic flow-cooling vents

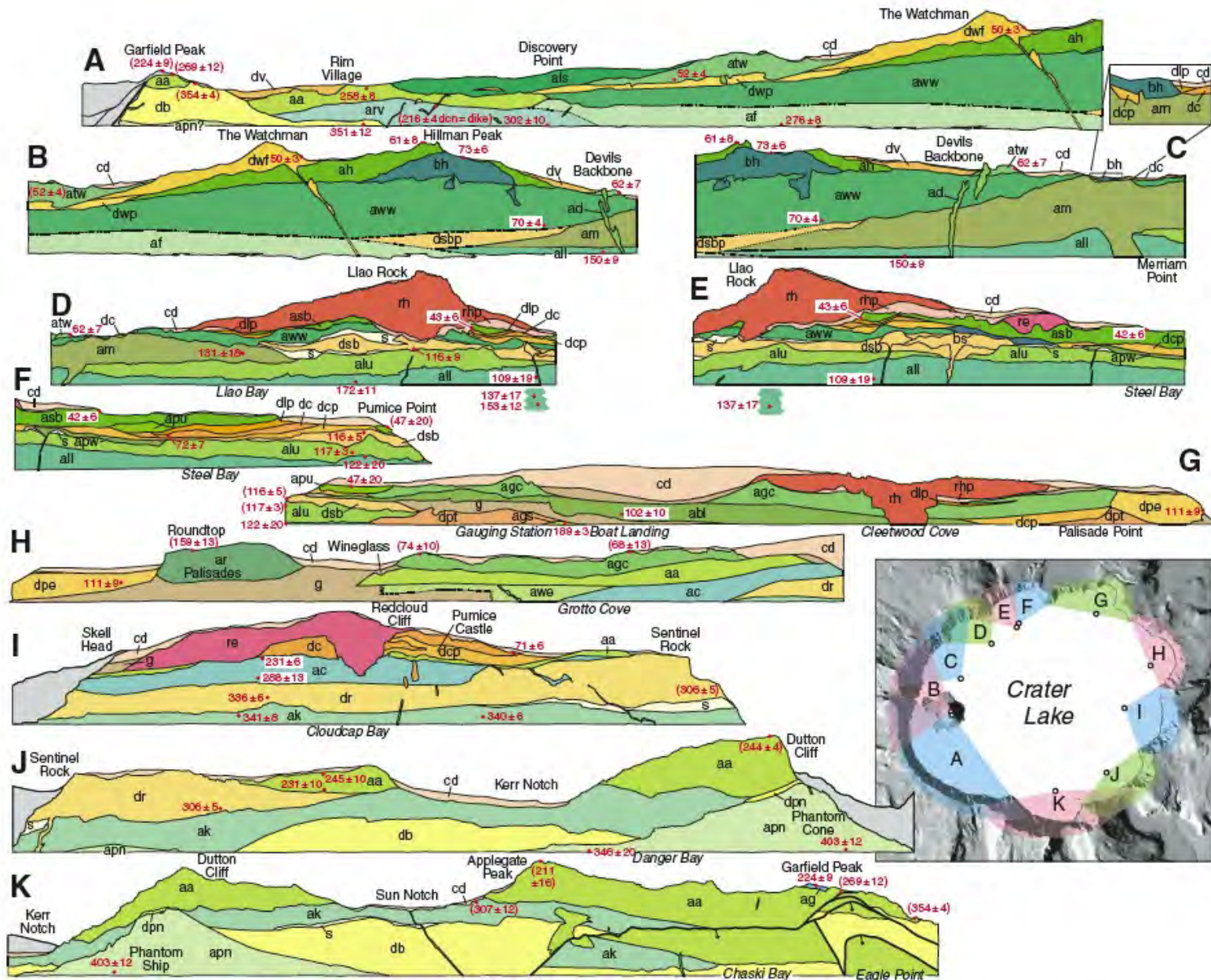


Figure 4. Geologic panoramas of the caldera walls, adapted from Bacon (2006) by inferring extent of map units beneath talus and vegetation. Unit cd represents climactic pumice fall, Wineglass Welded Tuff, lithic breccia, and ignimbrite of the climactic eruption. Explanation of units, etc., is as in Figure 2. Inset shows view points for each panorama. Scale varies because panoramas were plotted on photo mosaics. Note enlarged view of top of caldera wall in panorama C.

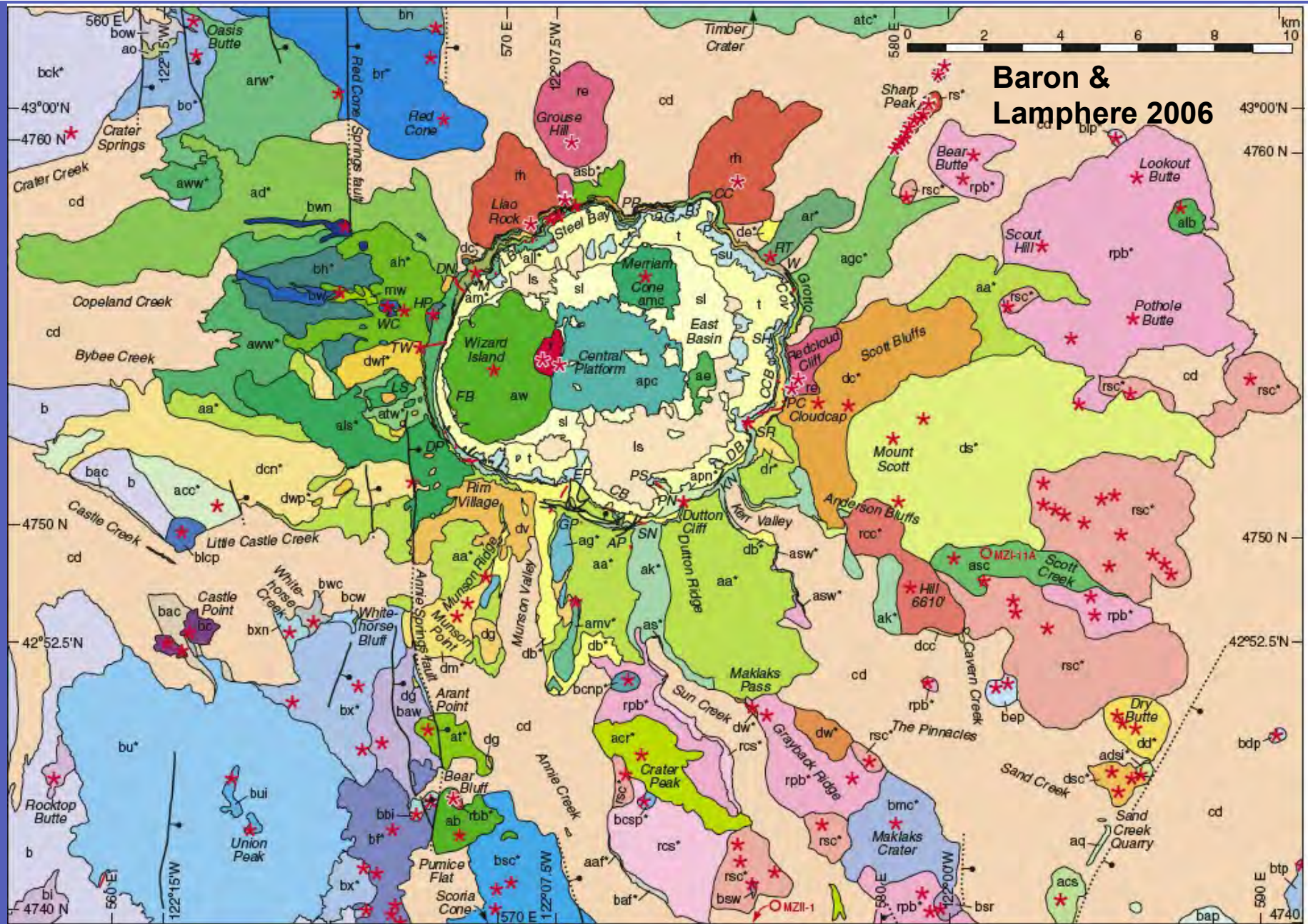


Figure 2 (on this and following page). Geologic map of Mount Mazama and surrounding region, adapted from interpretive bedrock map (Bacon, 2007) in which glacial and thin pyroclastic deposits are not shown. See Figure 3 caption for explanation of place names. Asterisks by unit labels in explanation indicate units dated by K-Ar or $^{40}\text{Ar}/^{39}\text{Ar}$. First letters of volcanic unit labels indicate composition: b—basalt or basaltic andesite; a—andesite; d—dacite; r—rhyodacite. Tick marks at edge of map are latitude, longitude, and UTM Zone 10 Eastings and Northings (km).

LIST OF MAP UNITS

[Units shown on maps and (or) panoramas]

SURFICIAL DEPOSITS

sl	Sediment gravity-flow deposits (Hol.)
t	Talus (Hol. and Pleist.)
ls	Landslide deposits (Hol.)
g	Glacial deposits, undivided (Pleist.)
s	Sedimentary deposits, undivided (l. and m. Pleist.)

VOLCANIC ROCKS Mount Mazama

rh	Rhyodacite of the postcaldera dome (Hol.)
aw	Andesite of Wizard Island (Hol.)
mmc	Andesite of Merriam Cone (Hol.)
apc	Andesite of the central platform (Hol.)
ae	Andesite of the E basin (Hol.)
cd	Deposits of the climactic eruption (Hol.)
rl	Lava
rhp	Pyroclastic
rs	Rhyodacite of Sharp Peak (l. Pleist.)
ab	Andesite S of Bear Bluff (l. Pleist.)
rb	Rhyodacite of Bear Bluff (l. Pleist.)
re	Evolved Pleist. preclimactic rhyodacite (l. Pleist.)
mw	Mingled lava of Williams Crater (l. Pleist.)
dv	Dacite of Munson Valley (l. Pleist.)
la	Andesite of Lightning Spring (l. Pleist.)
asb	Andesite of Steel Bay (l. Pleist.)
apv	Andesite of Pumice Point (l. Pleist.)
ad	Andesite of Devils Backbone (l. Pleist.)
aw	Andesite S of The Watchman (l. Pleist.)
dw	Dacite of The Watchman (l. Pleist.)
dl	Lava
dwp	Pyroclastic-flow deposits
ah	Andesite of Hillman Peak (l. Pleist.)
dlp	Dacite below Liao Rock (l. Pleist.)
agc	Andesite of Grotto Cove (l. Pleist.)
hn	Basaltic andesite of Hillman Peak (l. Pleist.)
dc	Dacite of Pumice Castle (l. Pleist.)
dl	Lava
dcp	Pyroclastic
bs	Basaltic andesite of Steel Bay (l. Pleist.)
apw	Andesite W of Pumice Point (l. Pleist.)
aww	Andesite of the W wall (l. Pleist.)
aw	Andesite W of Red Cone (l. Pleist.)
su	Submerged caldera wall outcrops, undiv. (Pleist.)
sl	Andesite of the Boat Landing (l. Pleist.)
dpe	Dacite E of Falisade Point (l. Pleist.)

dsb	Dacite of Steel Bay (l. Pleist.)
dl	Lava
dshp	Pyroclastic
am	Andesite of Merriam Point (l. Pleist.)
alu	Andesite of Liao Bay, upper unit (l. Pleist.)
dpl	Dacite of Palisade Point (l. or m. Pleist.)
al	Andesite of Liao Bay, lower unit (m. Pleist.)
ar	Andesite of Roundtop (m. Pleist.)
amv	Andesite E of Munson Valley (m. Pleist.)
age	Andesite of the gauging station (m. Pleist.)
dcr	Dacite N of Castle Creek (m. Pleist.)
ag	Andesite of Garfield Peak (m. Pleist.)
dg	Dacite S of Garfield Peak (m. Pleist.)
aa	Andesite of Applegate Peak (m. Pleist.)
awa	Andesite E of Wineglass (m. Pleist.)
ac	Andesite of Cloudcap Bay (m. Pleist.)
dnr	Dacite of Munson Ridge (m. Pleist.)
ef	Andesite W of Fumarole Bay (m. Pleist.)
arv	Andesite below Rim Village (m. Pleist.)
dr	Dacite of Sentinel Rock (m. Pleist.)
ak	Andesite of Kerr Notch (m. Pleist.)
db	Dacite of Chaski Bay (m. Pleist.)
dpr	Dacite of Phantom Cone (m. Pleist.)
ds	Dacite of Mount Scott (m. Pleist.)
dcc	Dacite of Cavern Creek (m.? Pleist.)
apn	Andesite of Phantom Cone (m. Pleist.)

Regional Volcanism, East

asc	Andesite of Scott Creek (l. Pleist.)
scr	Andesite of Crater Peak (l. Pleist.)
bosp	Basaltic andesite S of Crater Peak (l. Pleist.)
bomp	Basaltic andesite N of Crater Peak (m.? Pleist.)
ab	Andesite S of Lookout Butte (m. Pleist.)
bw	Basalt W of Sun Creek (m. Pleist.)
brn	Basaltic andesite of Maklaks Crater (m. Pleist.)
br	Basalt of Sand Ridge (m. Pleist.)
brp	Basaltic andesite NE of Boundary Butte (m. Pleist.?)
rb	Rhyodacite of Pothole Butte (m. Pleist.)
rs	Rhyodacite S of Crater Peak (m. Pleist.)
rac	Rhyodacite of Scott Creek (m. Pleist.)
aq	Andesite of Sand Creek quarry (m.? Pleist.)
ae	Andesite NE of Annie Falls (m. Pleist.)
be	Basaltic andesite E of Cavern Creek (m.? Pleist.)
acs	Andesite S of Sand Creek (m.? Pleist.)
bdp	Basaltic andesite E of Dry Butte (m.? Pleist.)
bap	Basaltic andesite of Boundary Butte (m.? Pleist.)
as	Andesite of Sun Creek (m. Pleist.)

dw	Dacite W of The Pinnacles (m. Pleist.)
blp	Basaltic andesite N of Lookout Butte (m. Pleist.)
aw	Andesite W of Sand Creek (m. Pleist.)
bal	Basaltic andesite E of Annie Falls (m. Pleist.)
roc	Rhyodacite W of Cavern Creek (m. Pleist.)
dc	Dacite of Sand Creek (c. Pleist.)
ads	Andesite S of Dry Butte (c. Pleist.)
dd	Dacite of Dry Butte (c. Pleist.)

Regional Volcanism, Northwest

bnw	Basaltic andesite NW of Williams Crater (l. Pleist.)
bw	Basaltic andesite of Williams Crater (l. Pleist.)
br	Basaltic andesite of Red Cone (l. Pleist.)
alc	Andesite of Timber Crater (l. or m. Pleist.)
bc	Basaltic andesite of Oasis Butte (m. Pleist.)
brn	Basaltic andesite N of Red Cone (m.? Pleist.)
ac	Andesite SW of Oasis Butte (m. Pleist.)
bow	Basaltic andesite W of Oasis Butte (m.? Pleist.)
bc	Basaltic andesite N of Crater Creek (c. Pleist.)

Regional Volcanism, Southwest

bc	Basalt of Castle Point (c. Hol.)
bcp	Basaltic andesite N of Little Castle Creek (l. Pleist.)
bc	Basaltic andesite of Scoria Cone (l. Pleist.)
bf	Basaltic andesite NW of Pumice Flat (l. Pleist.)
	Basaltic andesite of Union Peak (m. Pleist.)
bu	Lava
bu	Intrusive
bw	Basaltic andesite of Whitehorse Bluff (m. Pleist.)
af	Andesite of Arant Point (m. Pleist.)
bn	Basalt NW of Whitehorse Bluff (m.? Pleist.)
bw	Basaltic andesite W of Arant Point (m. Pleist.)
bb	Basaltic andesite W of Bear Bluff (m.? Pleist.)
bcw	Basaltic andesite W of Mazama Campgr. (m.? Pleist.)
bwc	Basaltic andesite of Whitehorse Creek (m.? Pleist.)
ac	Andesite N of Castle Creek (m. Pleist.)
	Basaltic andesite, undivided (Pleist. or Plio.)
b	Lava
bi	Intrusive
bac	Basaltic andesite of Castle Point (c.? Pleist.)

- Contact
- Dike
- Fault — Dotted where concealed; bar and ball on downthrown side
- * Volcanic vent — Does not include dikes feeding lava flows
- ← 244 ± 4 Dated sample — Location and age (ka) of sample dated by K-Ar or ⁴⁰Ar/³⁹Ar methods
- M21-11A Geothermal exploration well

Baron &
Lamphere
2006

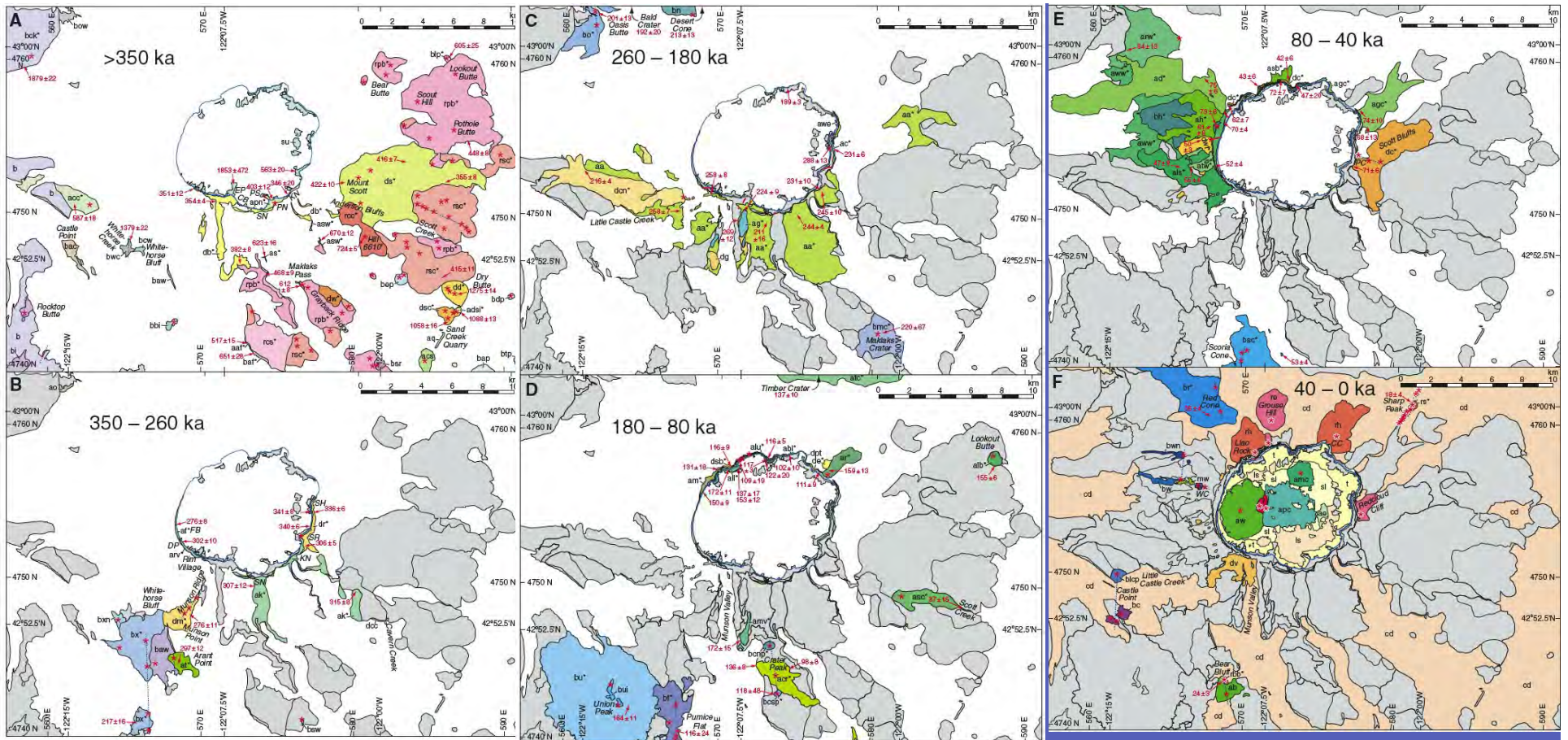


Figure 5 (on following three pages). Geologic maps showing assembly of map in Figure 2 in six time increments. Areas of units have not been reconstructed; faults are omitted. Gray areas in panels B–F depict units employed in earlier time increments. Explanation of units, etc., is as in Figure 2. Present lake shoreline for reference is shown in blue. Dotted blue lines indicate vent alignments. (A) Units older than 350 ka. (B) 350–260 ka. (C) 260–180 ka. (D) 180–80 ka. (E) 80–40 ka. (F) 40–0 ka. Here unit cd represents thick climactic ring-vent-phase ignimbrite only. See Figure 3 for complete set of place names. Tick marks at edges of maps are latitude, longitude, and UTM Zone 10 Eastings and Northings (km).

Formation of Crater Lake Howell Williams (1941)

(reproduced in Francis and Oppenheimer 2004)

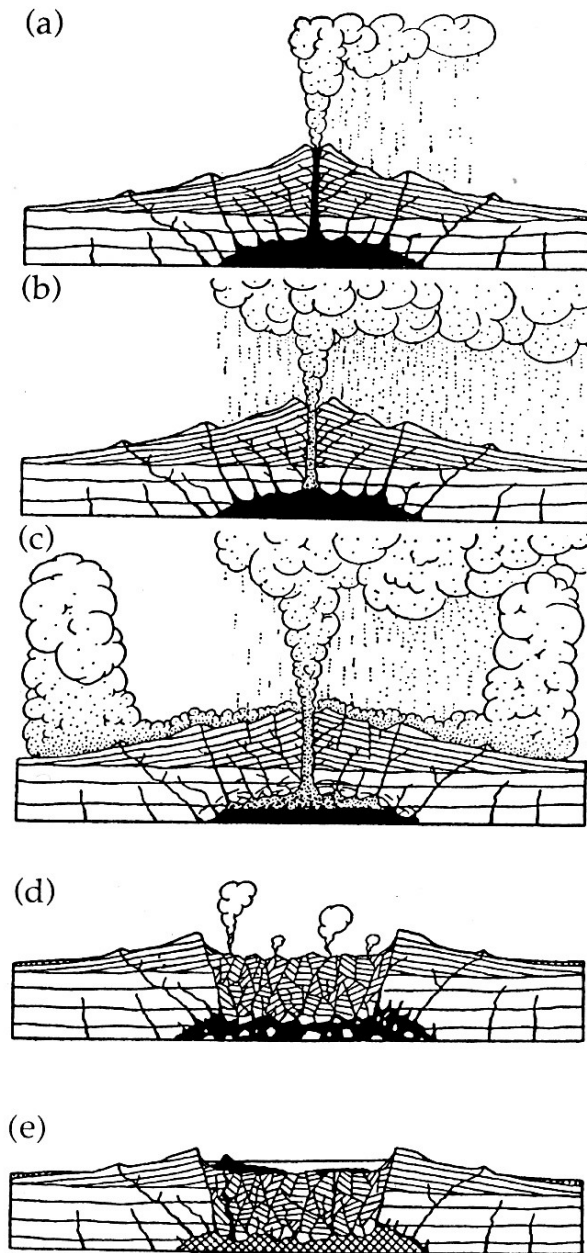
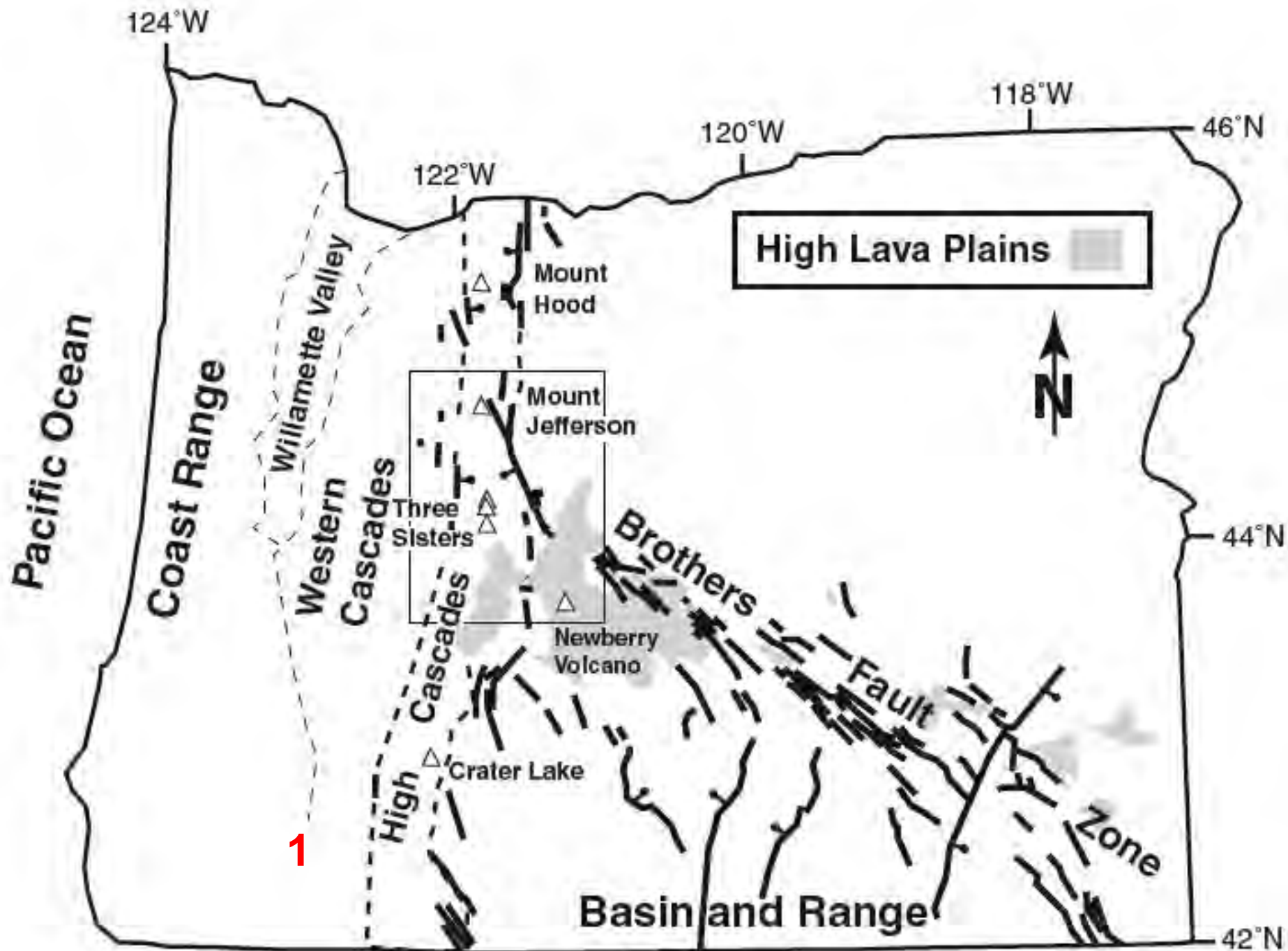


Fig. 11.5 Howel Williams's classic diagrams illustrating the formation of Crater Lake caldera Oregon [13]. His original



1

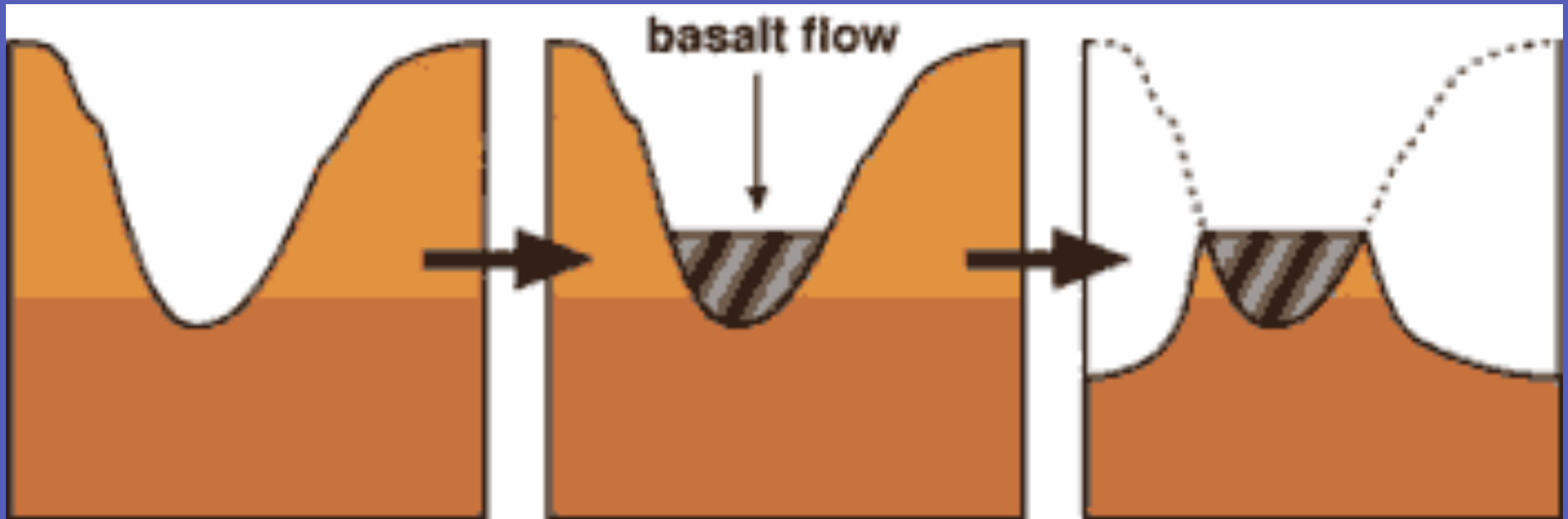
2 Mt Shasta ↓

1



Inverted topography: High Cascade lavas near Medford, OR

How to Make Inverted Topography

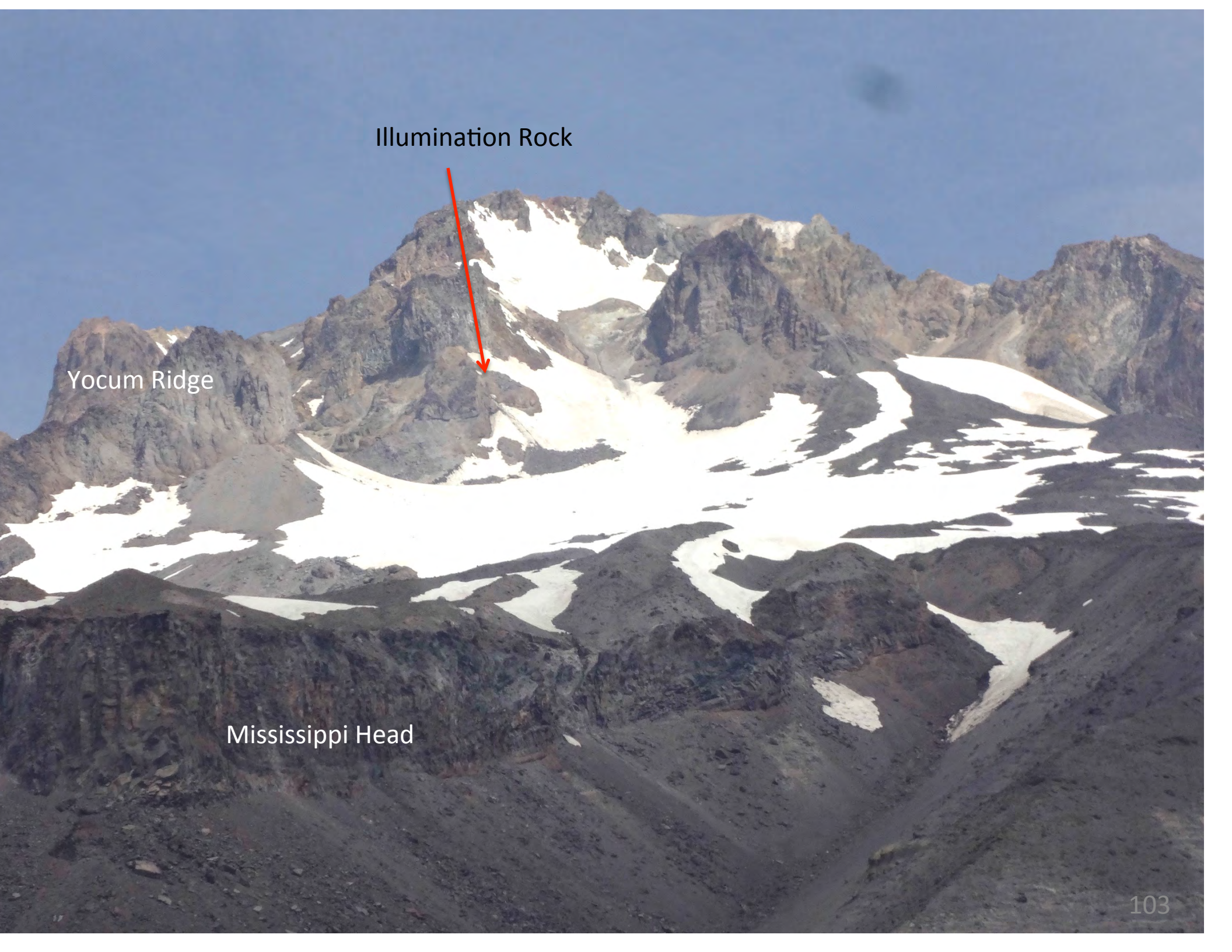




Inverted topography: High Cascade lavas near Medford, OR



Inverted topography: High Cascade lavas near Medford, OR



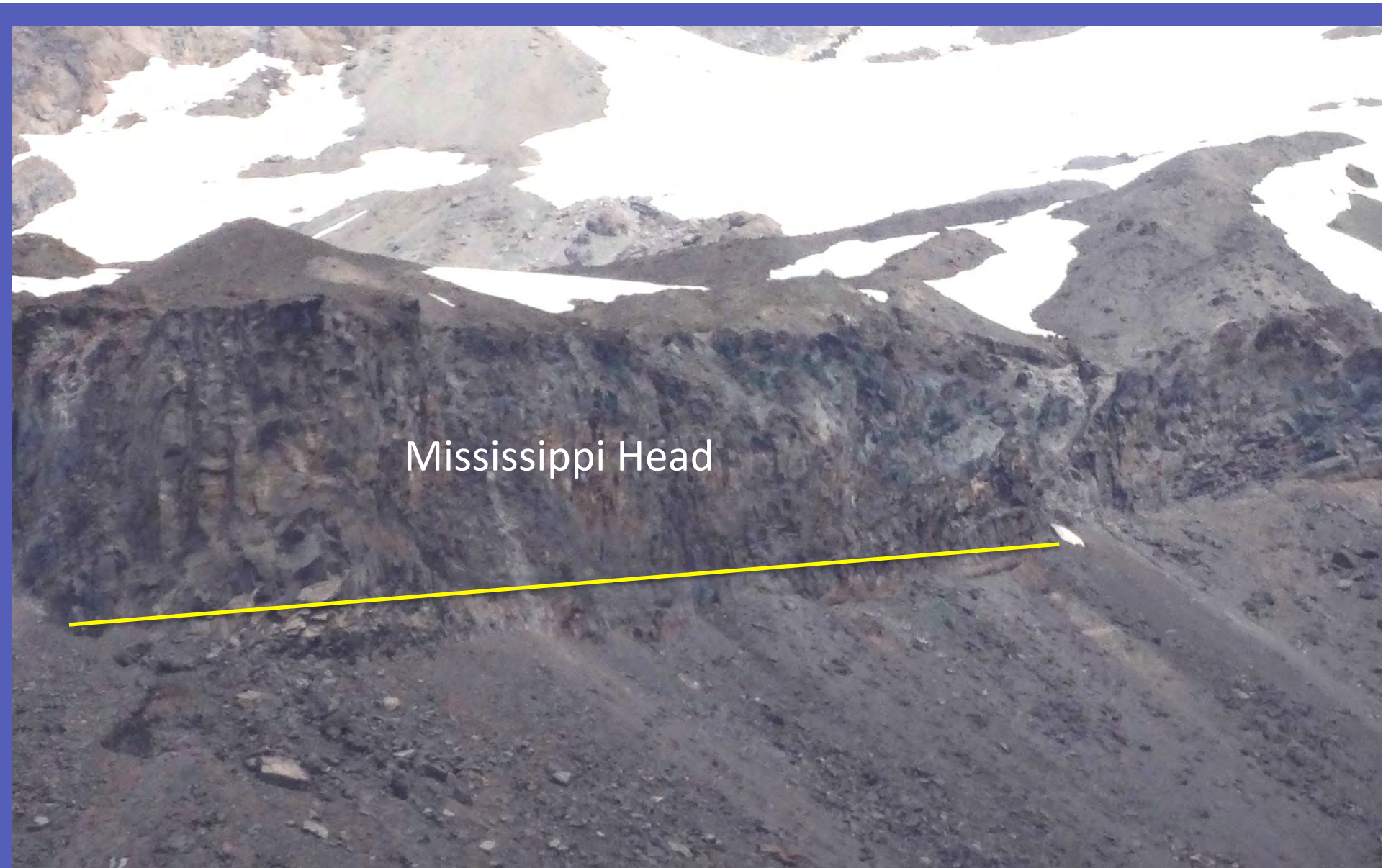
Illumination Rock

Yocum Ridge

Mississippi Head



Inverted Topography on Mt Hood



Mississippi Head

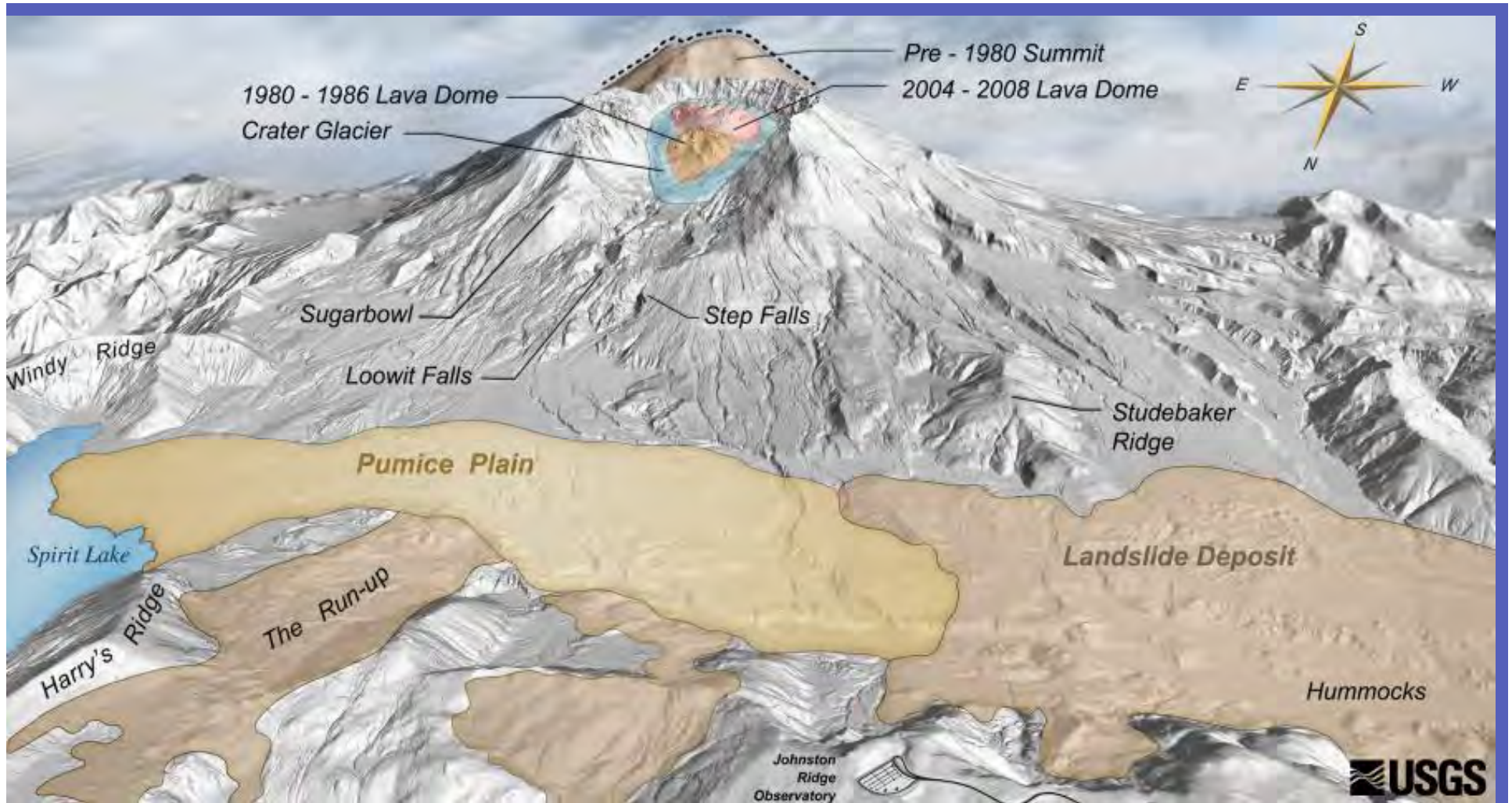
Inverted Topography on Mt Hood

2. Volcanic Landslides: Mt St Helens as a model for ancient Mt Shasta

Mt St Helens, May 1982







Mt Shasta viewed from the north



Figure 2. View southward from top of Gregory Mountain toward hills and flat areas formed by Shasta Valley debris avalanche.

144

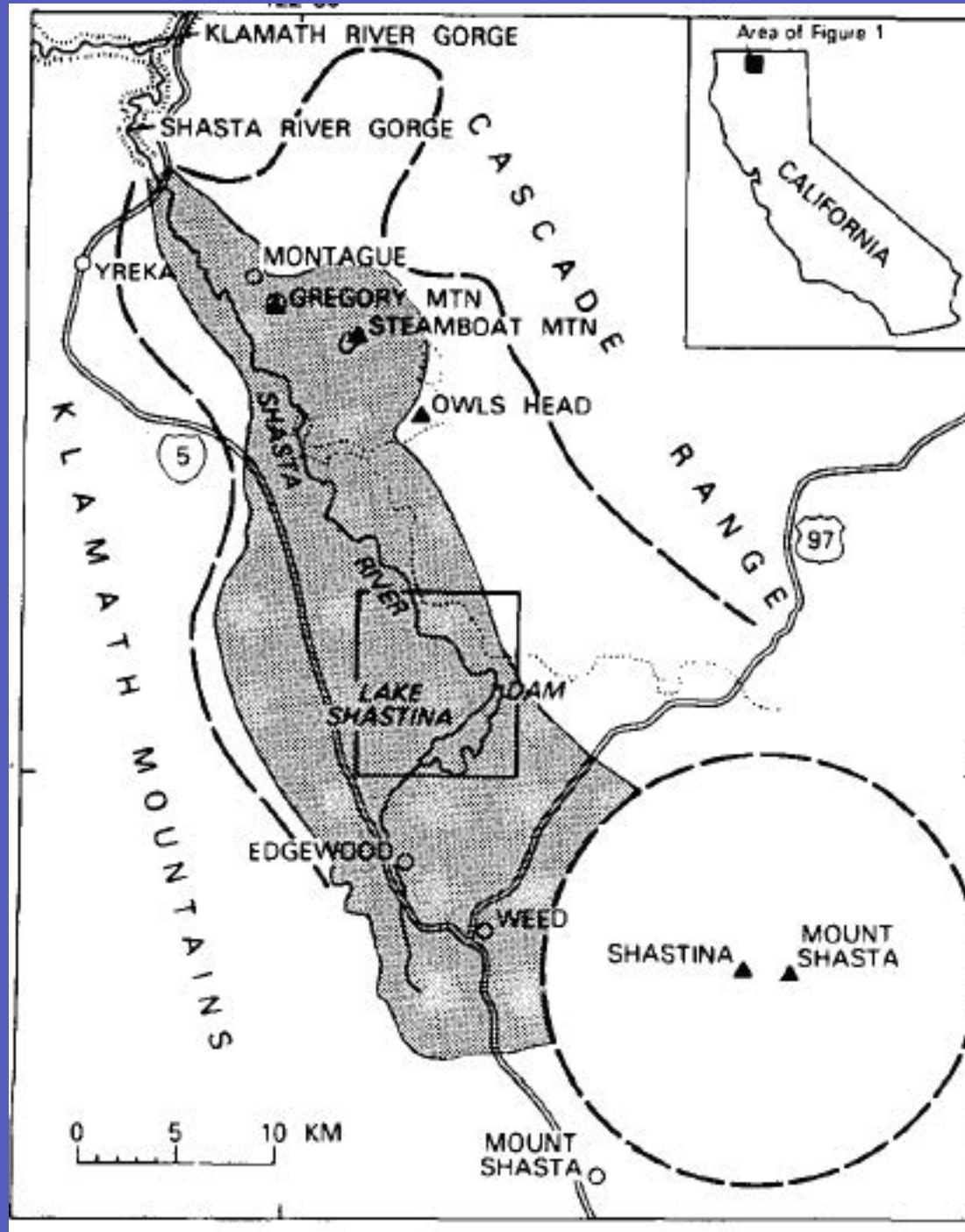
GEOLOGY, March 1984



North face Mt Shasta and Shastina from Weed CA airport



Weed Airport-hummocky landscape north of Mt Shasta
(Medicine Lake shield volcano on the horizon)



Crandell et al 1984

The Western Cascades



Tom Dick Mountain-view from above Timberline Lodge



Eagle Creek Fm

Bonneville Dam

**Landslide on
Eagle Creek Fm**



Eagle Creek Fm

Eagle Creek Formation



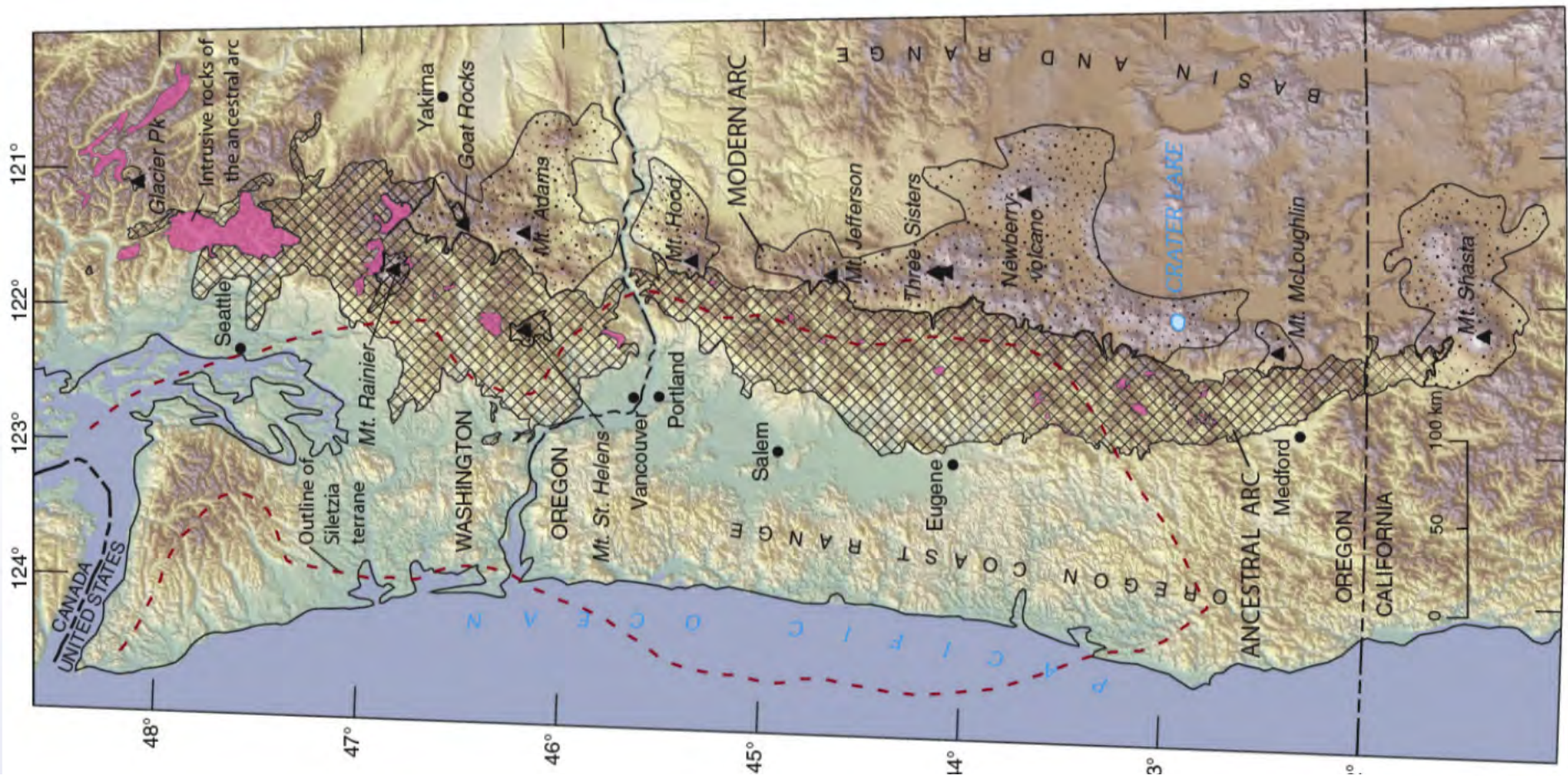
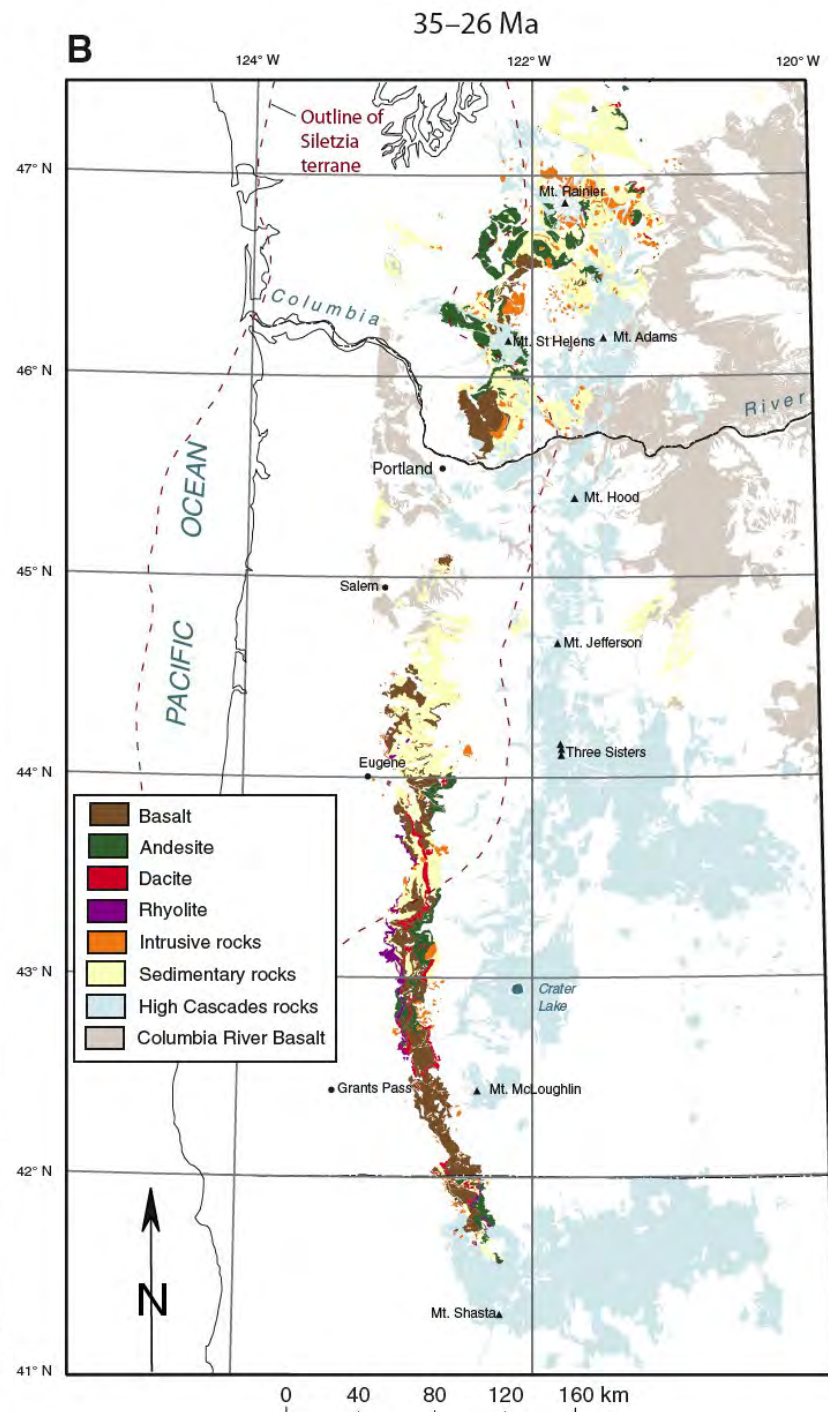
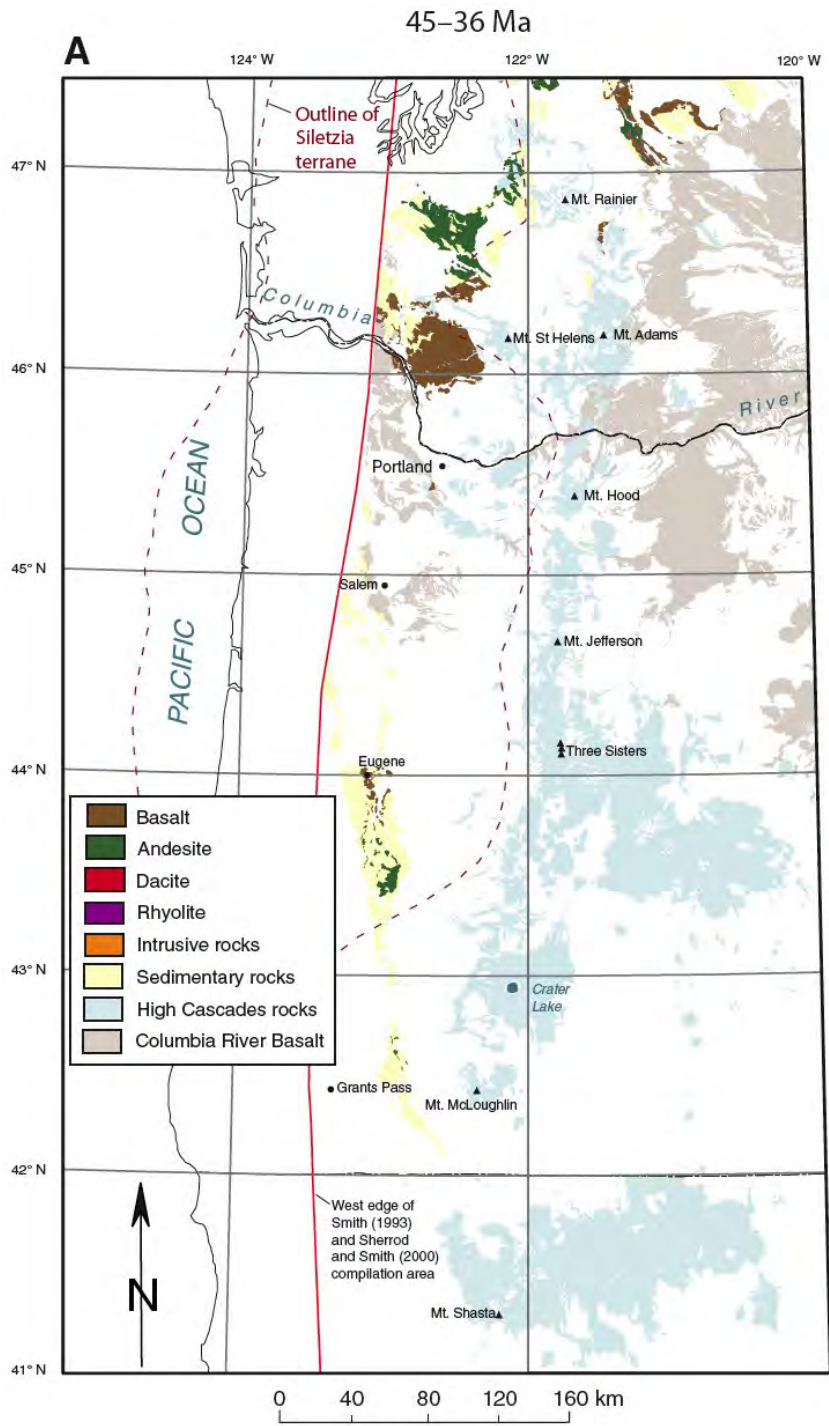
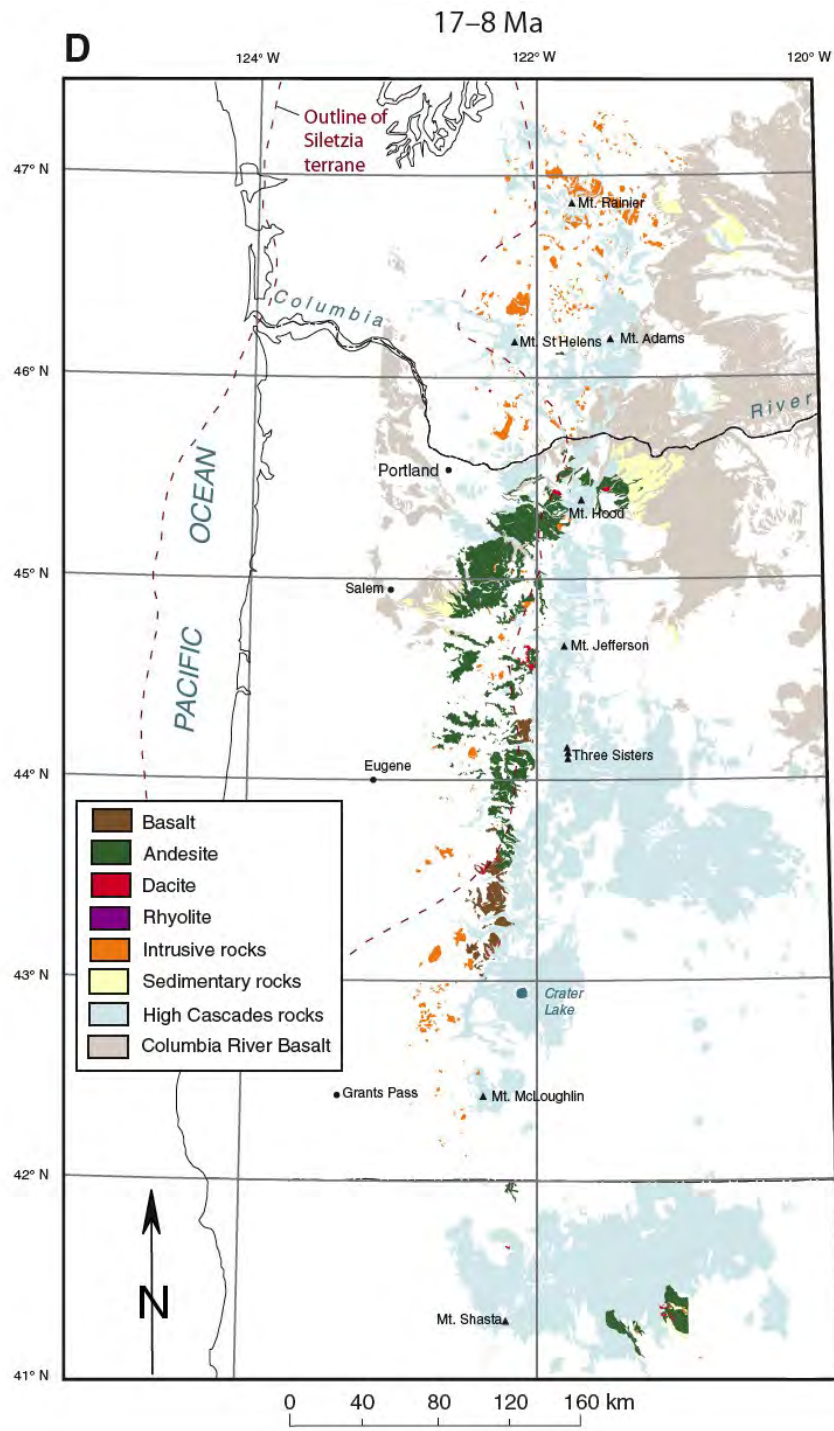
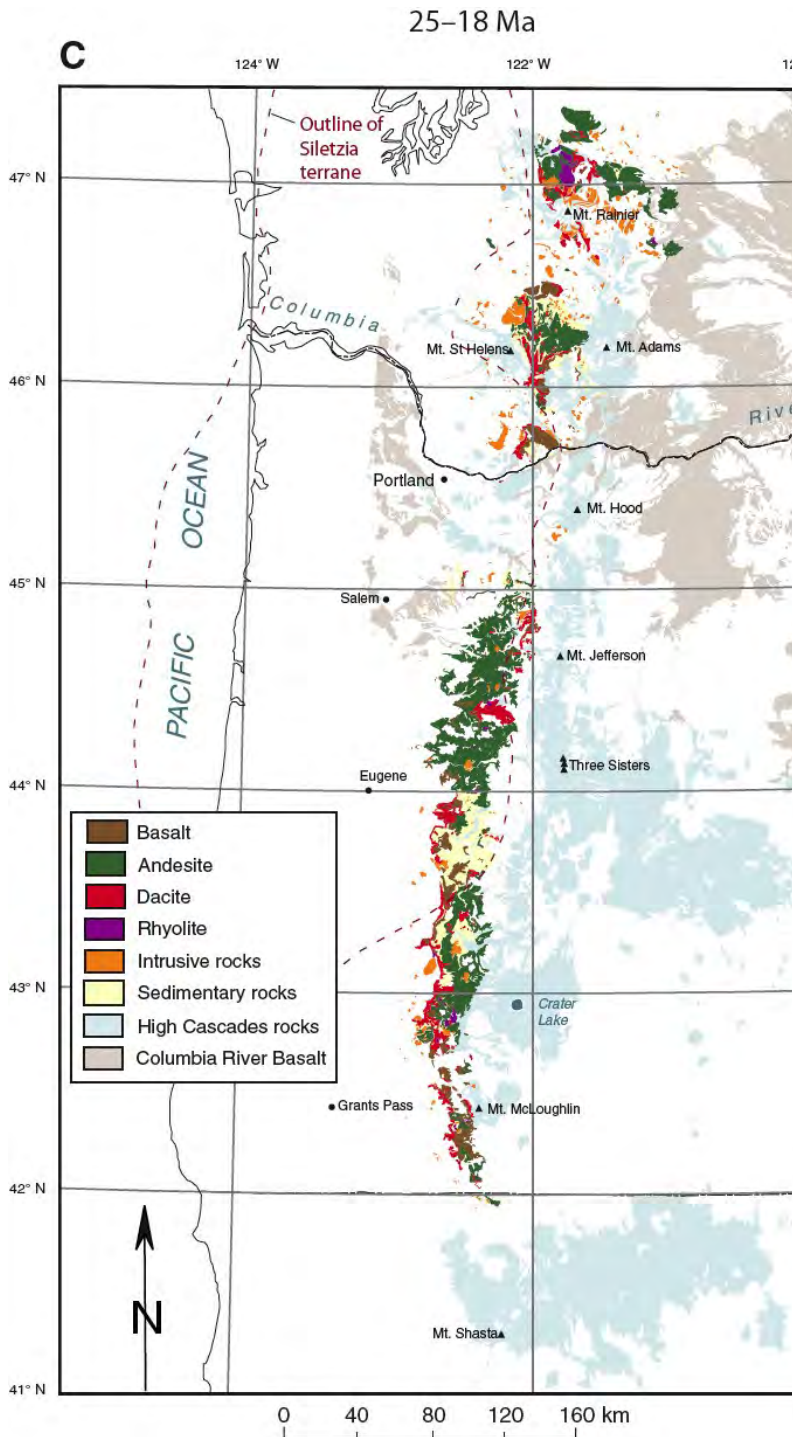
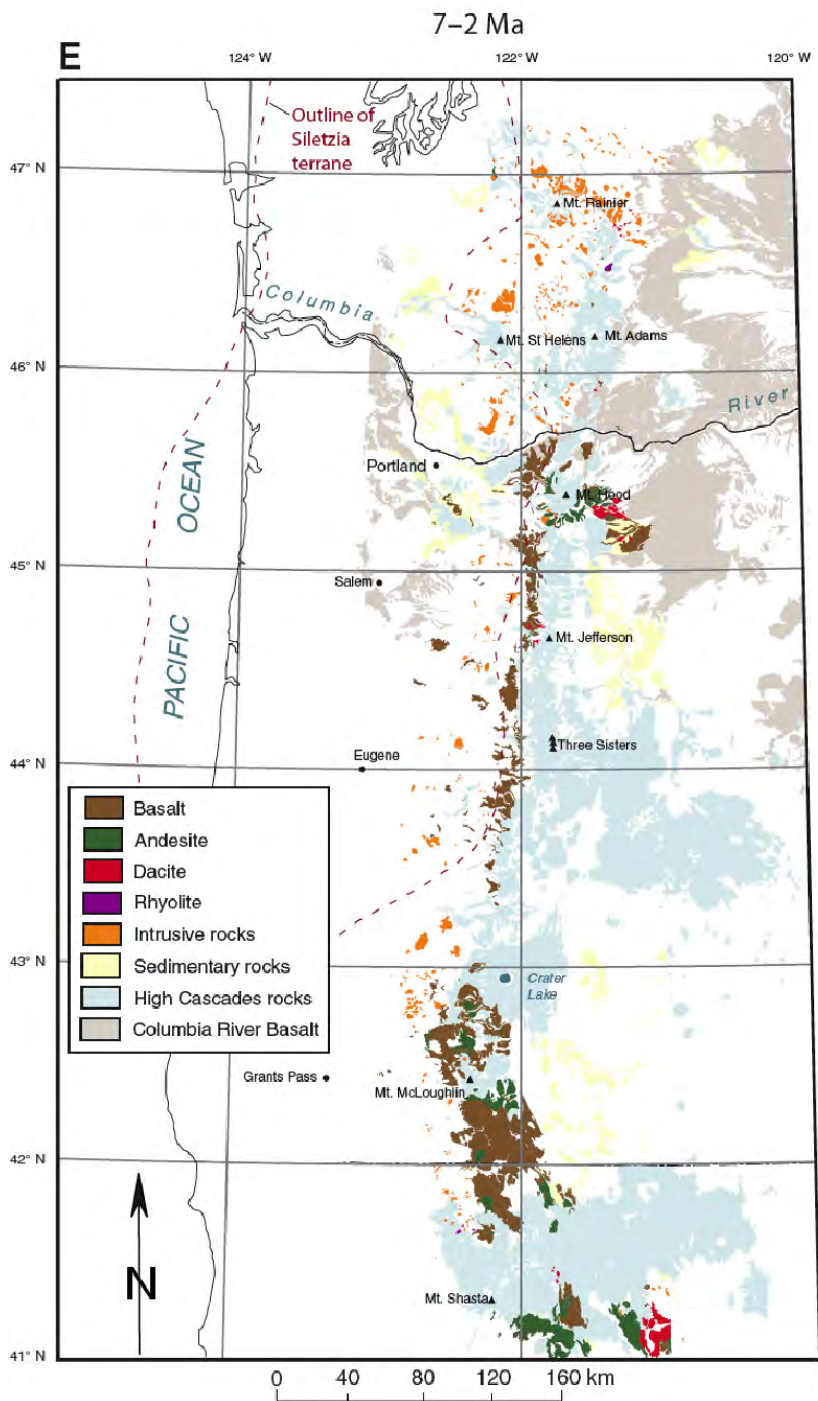


TABLE 1. GENERALIZED CHARACTERISTICS OF THE ANCESTRAL CASCADES ARC, WASHINGTON, OREGON, AND NORTHERNMOST CALIFORNIA

Time period (Ma)	Distribution	Relative volume	Dominant compositions	Dominant magma series	Tectonic setting	Pluton abundance	Mineral deposits
45–36	Mostly southwest Washington	Small	Basalt, basaltic andesite, andesite	Tholeiitic to calc-alkaline	Subduction, compression, slab window	Rare	Rare Cu breccia pipe deposits
35–26	Entire arc, except Mount Hood area	Moderate	Basalt, basaltic andesite, andesite	Tholeiitic to calc-alkaline	Subduction, compression	Sparse	Rare Cu breccia pipe deposits
25–18	Entire arc, except Mount Hood area and northern California; slight eastward axis shift	Large	Basaltic andesite, andesite, dacite, rhyolite	Tholeiitic to calc-alkaline	Subduction, compression north of Columbia River and extension to the south	Common	Common porphyry Cu and related deposits; rare epithermal Au-Ag deposits
17–8	Oregon arc segment	Small	Basaltic andesite, andesite	Calc-alkaline	Subduction, compression north of Columbia River and extension to the south	Rare	Rare porphyry Cu and related deposits
7–4	Oregon–northern California arc segment; additional eastward axis shift	Moderate	Basalt, basaltic andesite	Calc-alkaline	Subduction, compression north of Columbia River and extension to the south	None	Rare porphyry Cu-Mo deposits







DuBray & Johnson
2011

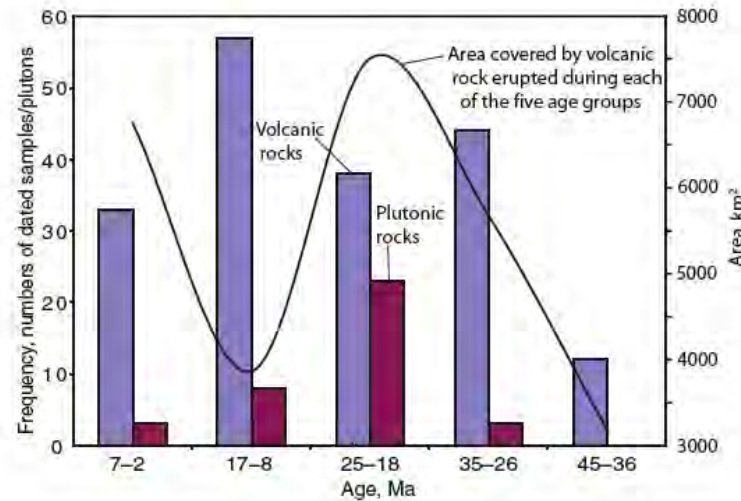


Figure 2. Age-frequency distribution and area-covered diagram for the northern segment of the ancestral Cascades arc. The age-frequency histogram shows the number of volcanic samples and plutons with ages in each of the five ancestral arc age groups. The area-covered curve shows the areal distribution of ancestral arc volcanic rocks in each of the five ancestral arc age groups (computed [Table 2] from the digital geologic map data of Smith [1993 and written commun., 2002] and Sherrod and Smith [2000]).

TABLE 2. AREA COVERED BY ANCESTRAL ARC VOLCANIC ROCK OF THE INDICATED COMPOSITION AS A FUNCTION OF AGE

Age group (Ma)	Basalt and basaltic andesite (km ²)	Andesite (km ²)	Dacite (km ²)	Rhyolite (km ²)	Total area (km ²)
45-36	1903	1174	0	89	3166
35-26	3004	2038	385	235	5662
25-18	1072	4851	1398	177	7498
17-8	530	3257	73	0	3860
7-2	4930	1471	310	38	6749
Total	11439	12791	2166	539	26935

Note: Areas computed from the digital geologic map data of Smith (1993), Sherrod and Smith (2000), and J.G. Smith (2002, written commun.).

CAT FOUND!

- Black and tan w/ gray
- No collar
- Male
- Not friendly!!** I think he might be scared!
- Not house broken!!
- Found @ 27th & holgate by dumpster



If this is your cat please call Tyler ASAP @ 690-5801

TYLER

690 5801