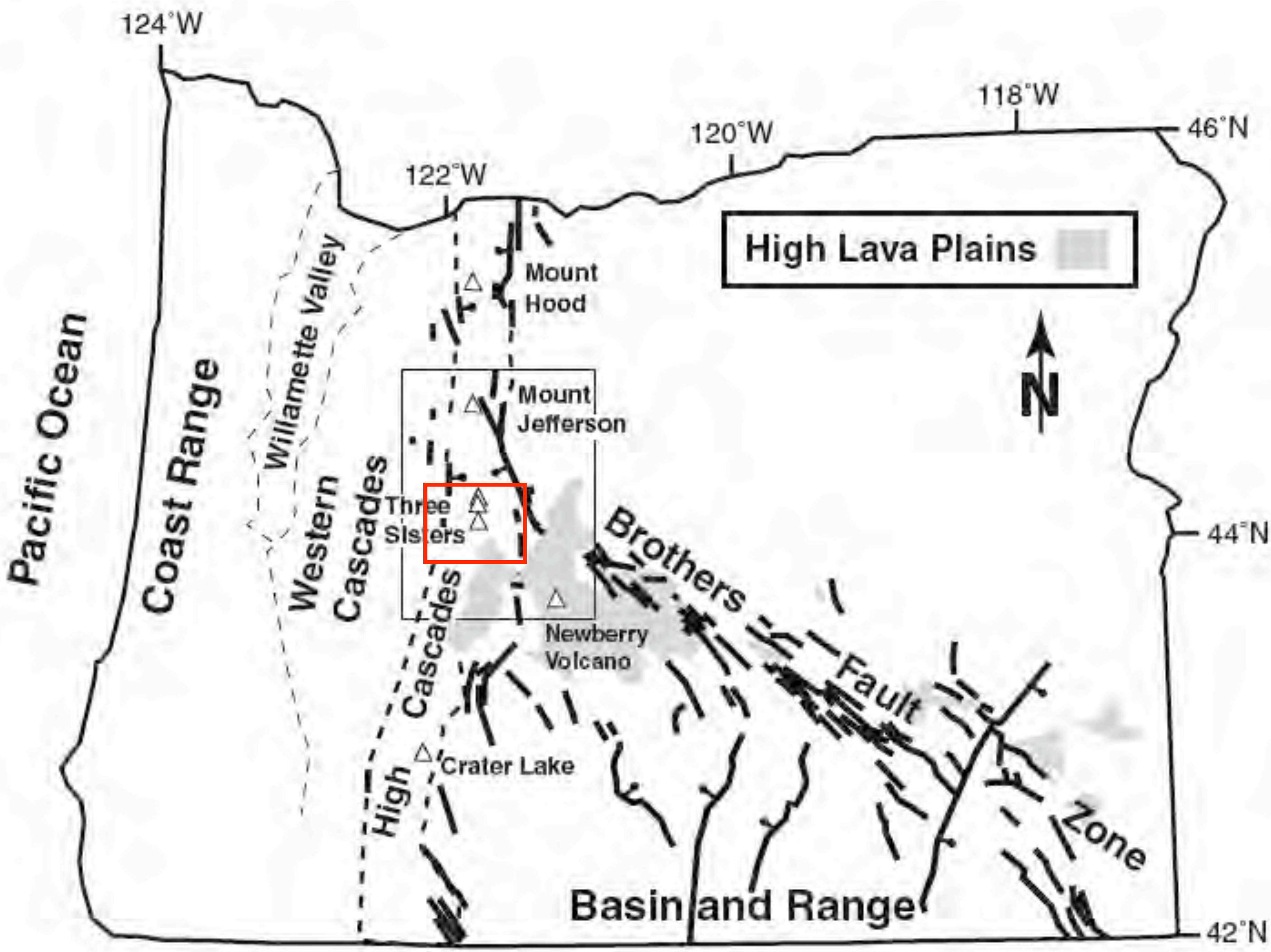


124°W
122°W
120°W
118°W
46°N
44°N
42°N
High Lava Plains
N
Pacific Ocean
Coast Range
Willamette Valley
Western Cascades
High Cascades
Mount Hood
Mount Jefferson
Three Sisters
Newberry Volcano
Crater Lake
Brothers Fault Zone
Basin and Range

South Sister, southwest face

Rock Mesa dacite flow, South Sister, west side

Devil’s Lake obsidian flow, above Sparks Lake, Sisters Wilderness

Broken Top, Sisters Wilderness

Broken Top summit area

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

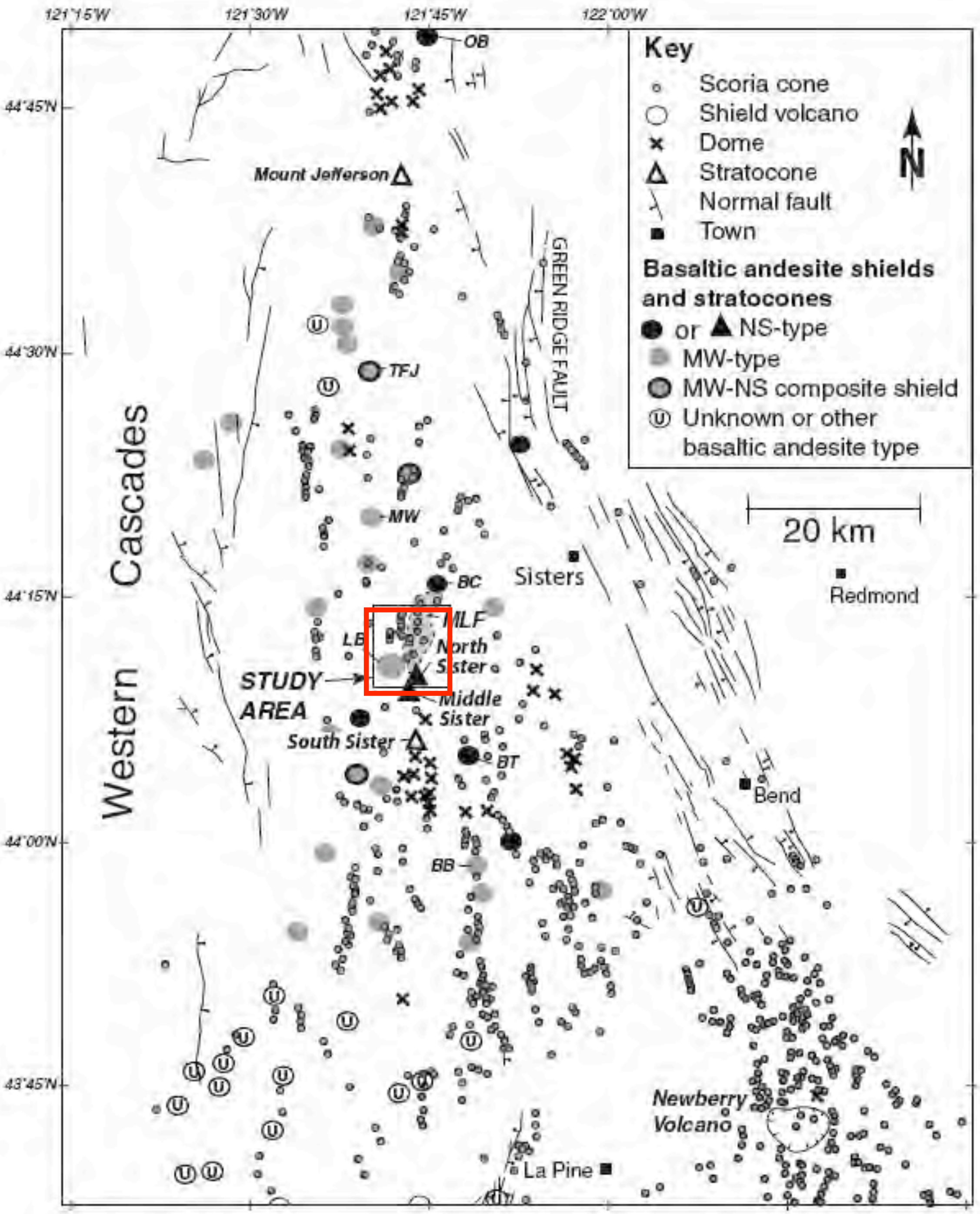
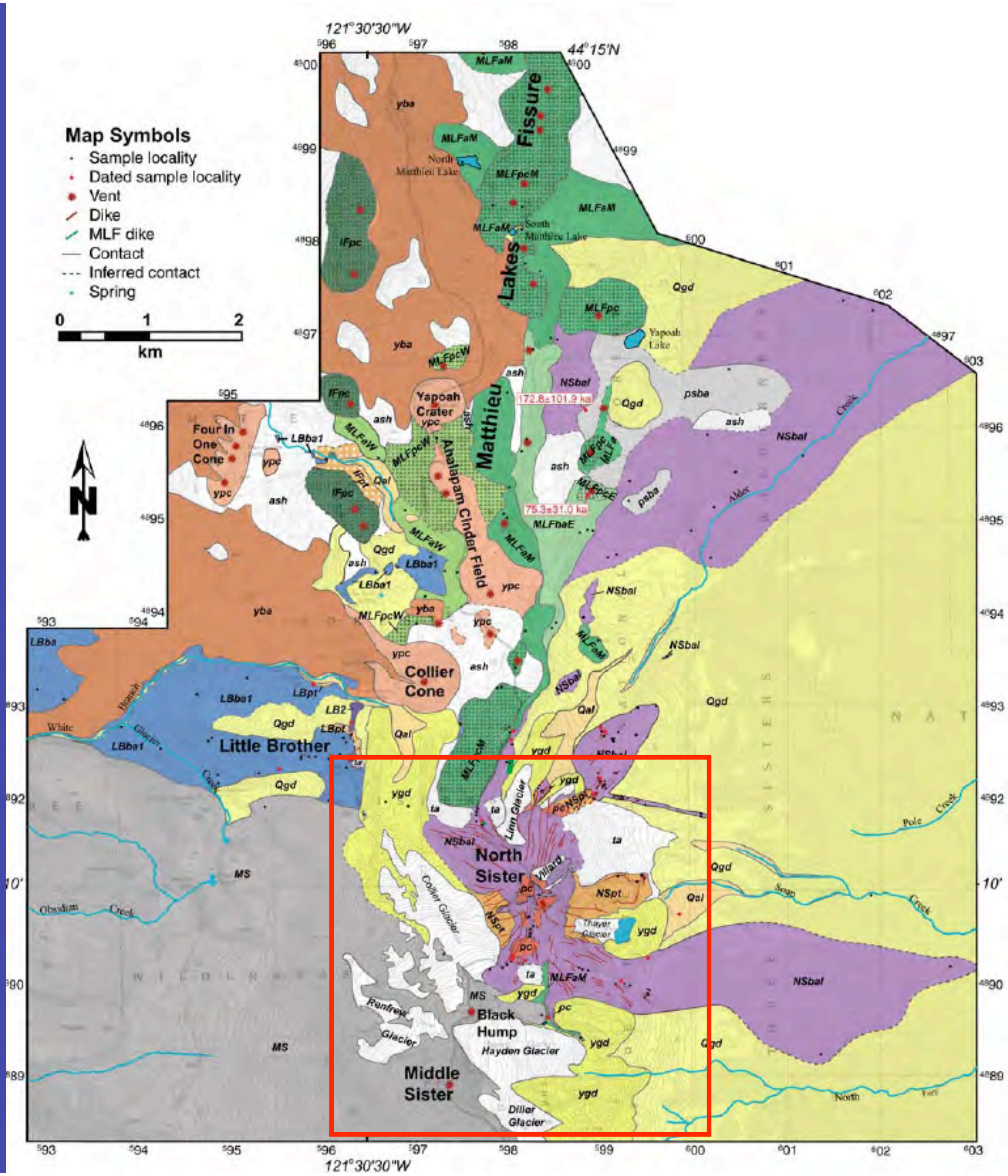


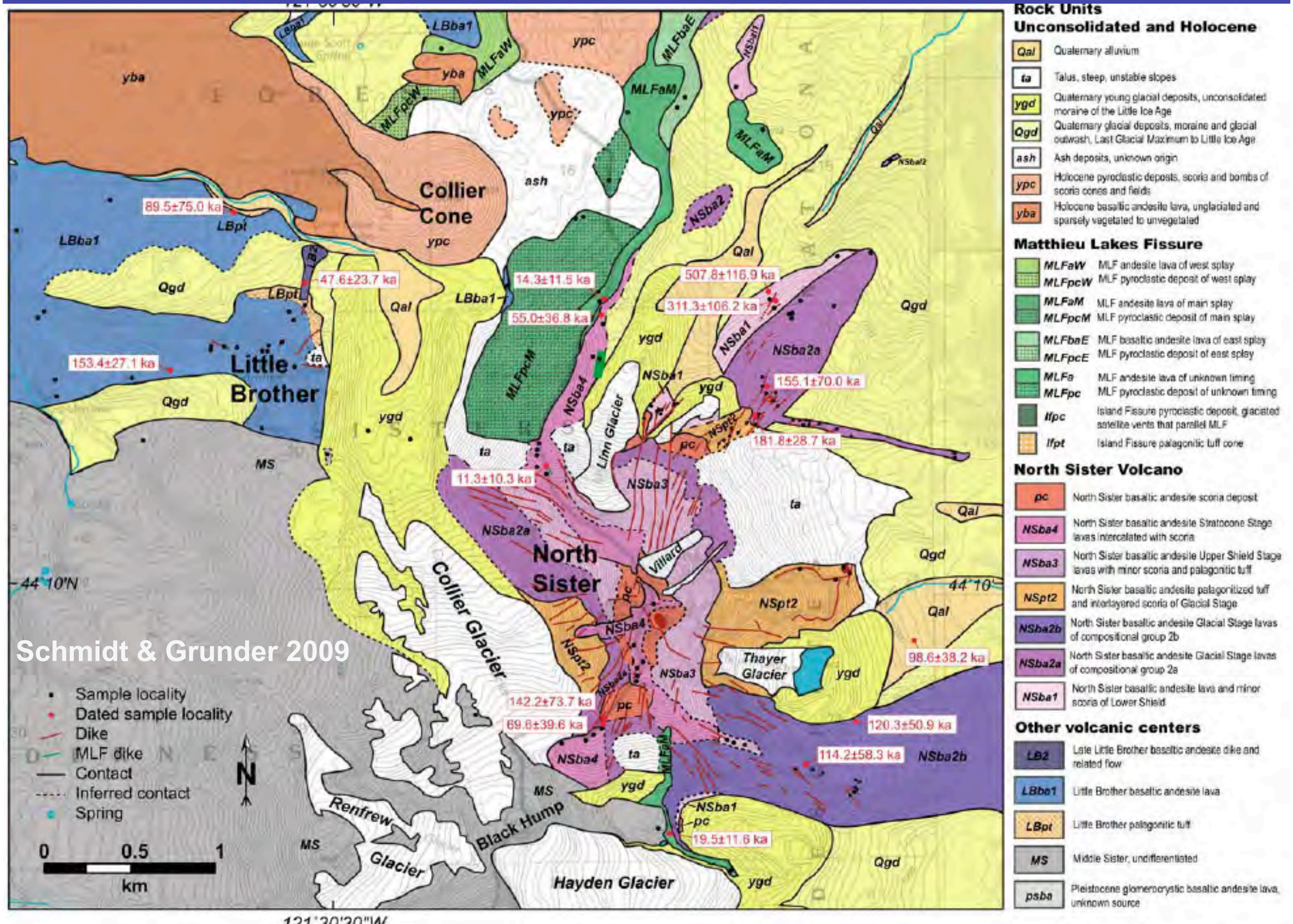
Figure 2. The distribution of volcanic vents, faults, and basaltic andesite types in the central Oregon Cascade Range. Monogenetic mafic vents tend to be found along lineaments that mimic exposed faults both in length and in orientation. The distribution of the two main types of basaltic andesite—North 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

Geologic Map
McKenzie Pass
North Sister
Middle Sister



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
MLFbaE 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
Ifpc Island Fissure pyroclastic deposit, glaciated satellite vents that parallel MLF
Ifpt Island Fissure palagonitic tuff cone
North Sister Volcano
pc North Sister basaltic andesite scoria deposit
NSba4 North Sister basaltic andesite Stratocone 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
Sample locality
Dated sample locality
Dike
MLF dike
Contact
Inferred contact
Spring
N
0
0.5
1
km
44°10'N
44°10'
121°30'30"W
Collier Cone
Little Brother
North Sister
Collier Glacier
Linn Glacier
Villard
Thayer Glacier
Renfrew Glacier
Black Hump
Hayden Glacier
89.5±75.0 ka
47.6±23.7 ka
153.4±27.1 ka
14.3±11.5 ka
55.0±36.8 ka
507.8±116.9 ka
311.3±106.2 ka
155.1±70.0 ka
181.8±28.7 ka
11.3±10.3 ka
98.6±38.2 ka
142.2±73.7 ka
69.6±39.6 ka
120.3±50.9 ka
114.2±58.3 ka
19.5±11.6 ka

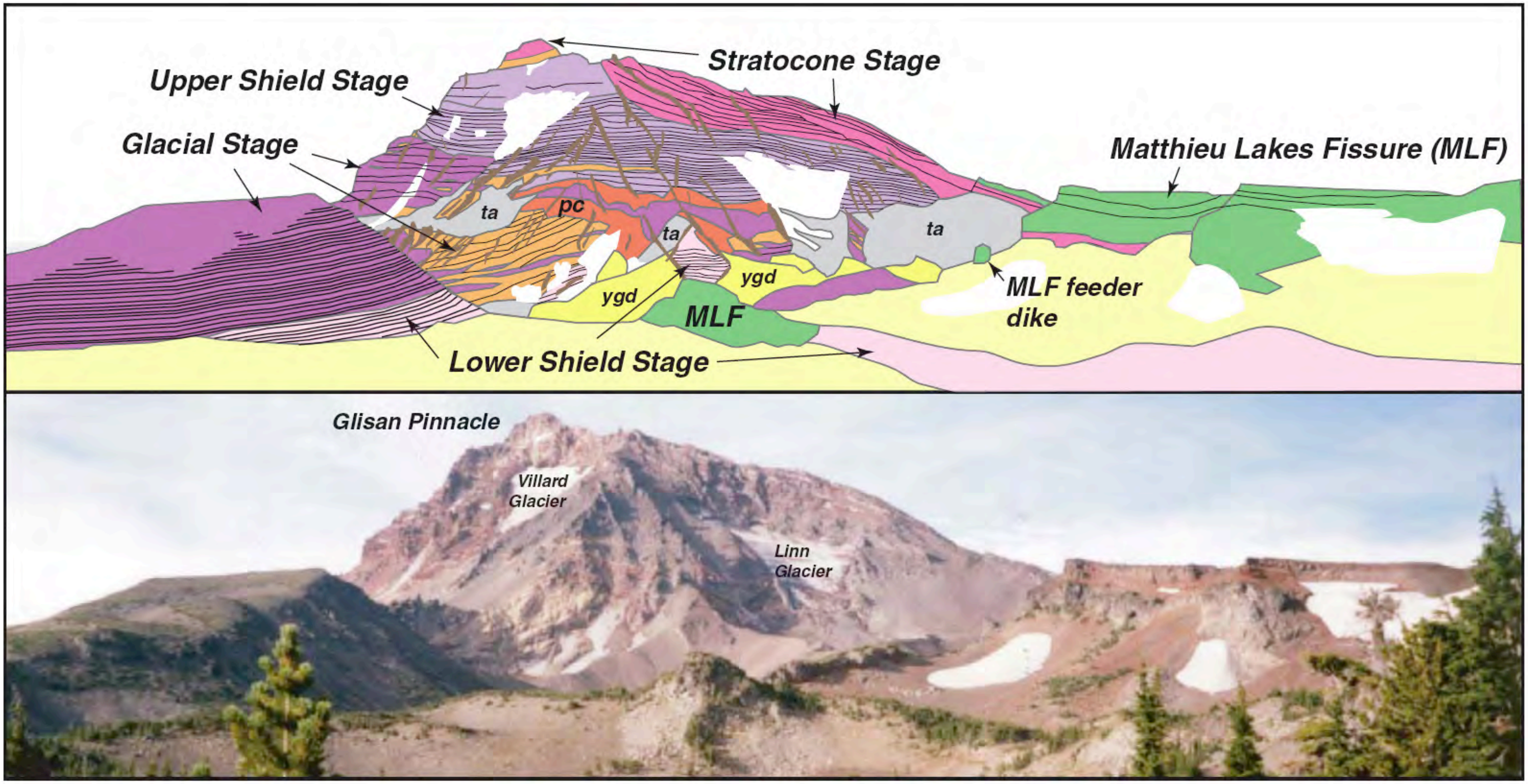


Figure 6. (A) Perspective view of North Sister Volcano with eruptive stages based on (B) photo of North Sister from the north. Note interfingering of Glacial Stage lavas and palagonitic tuffs on lower northeast flank (left) of North Sister.

Schmidt & Grunder 2009

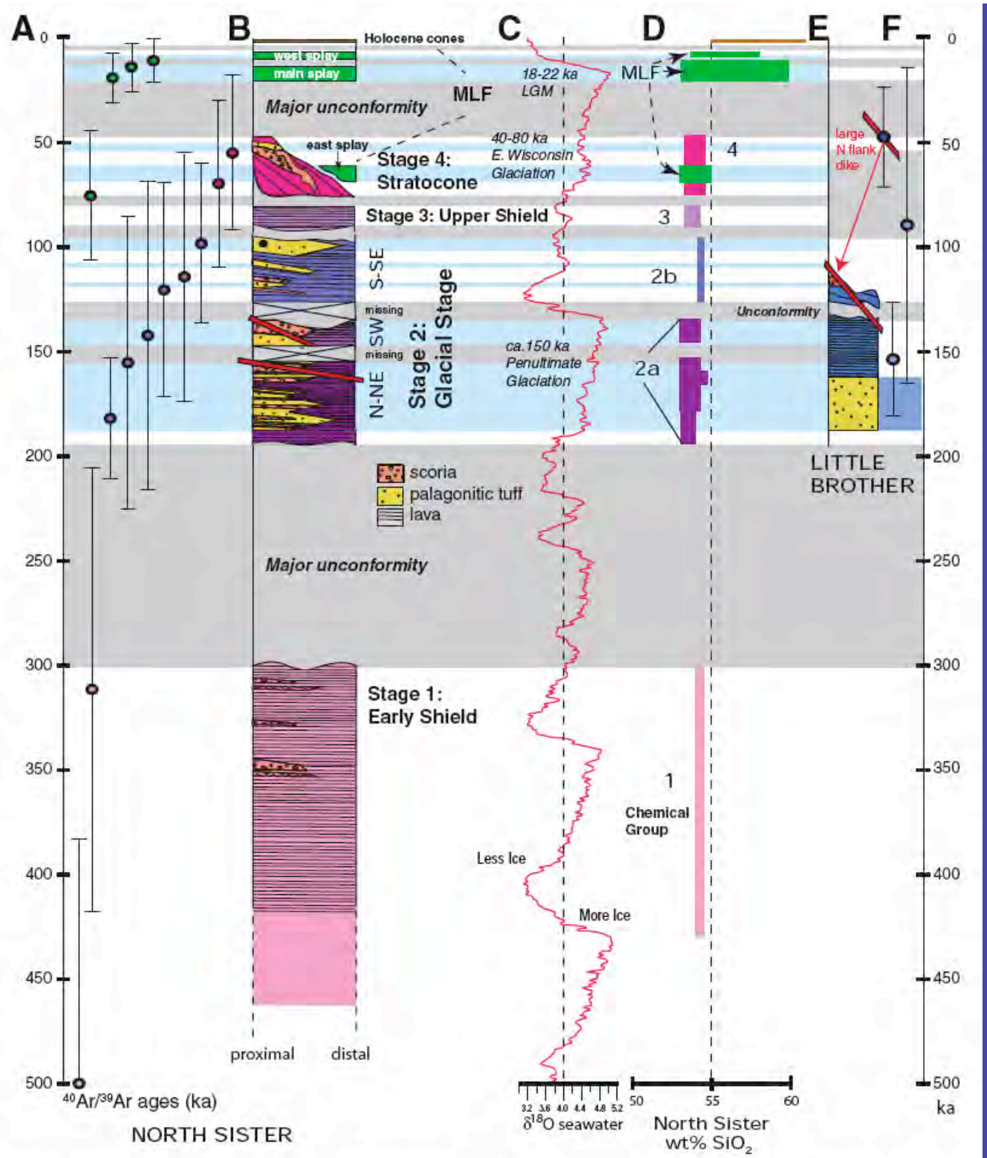
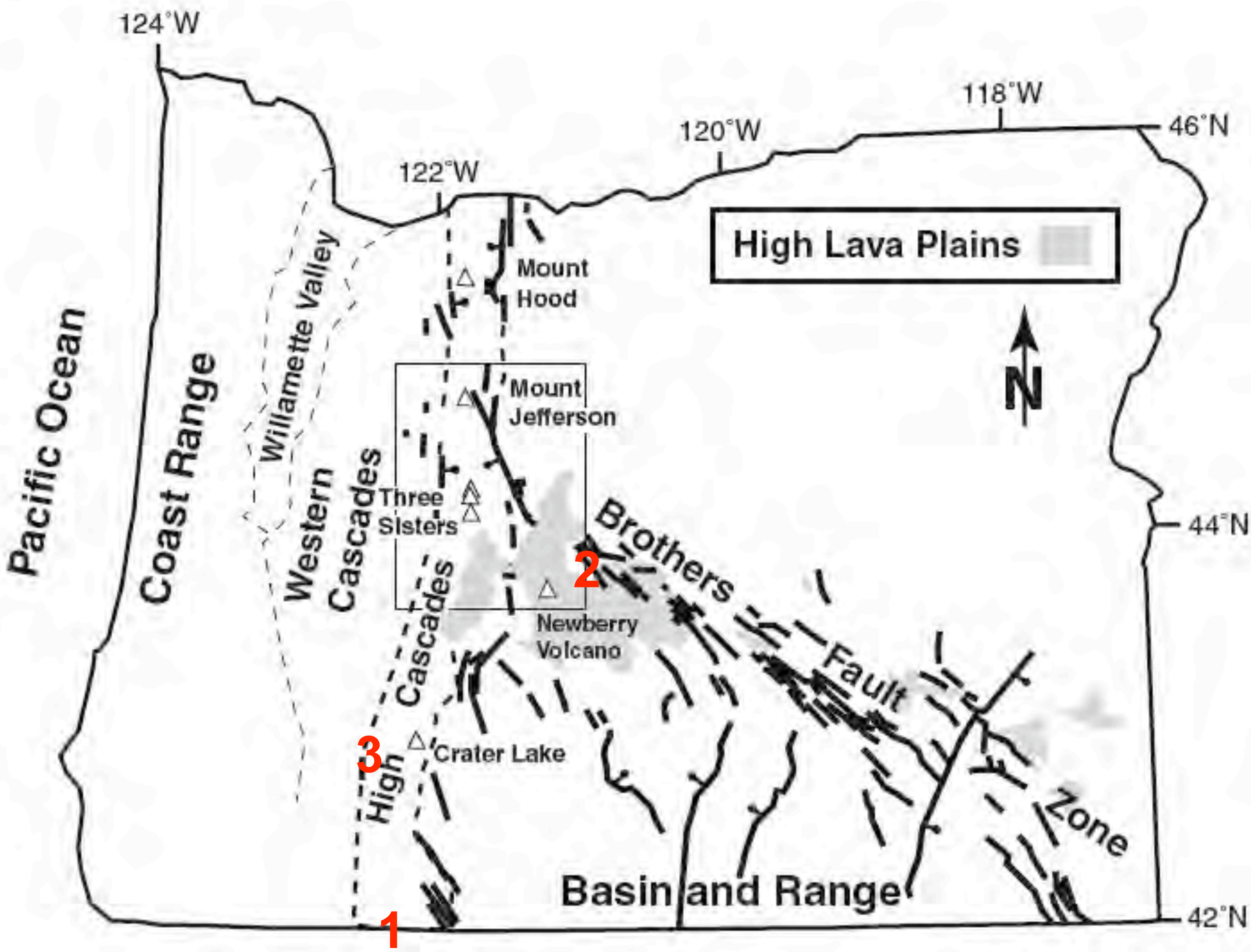


Figure 7. Summary of field and chemical data presented in this paper as a schematic stratigraphic section for North Sister and Little Brother. (A) $^{40}Ar/^{39}Ar$ dates with 2σ error for North Sister Volcano. Colors as in Figures 3 and 4. (B) Stratigraphic section for North Sister eruptive stages: 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 $\delta^{18}O$ of seawater record (Lisiecki and Raymo, 2005). Higher $\delta^{18}O$ values indicate times of more ice, and lower $\delta^{18}O$ 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 $^{40}Ar/^{39}Ar$ dates with 2σ error. An arrow connects a young date with a large, N10°E-trending Little Brother dike found on its north flank.

Schmidt & Grunder 2009



124°W
122°W
120°W
118°W
46°N
44°N
42°N
High Lava Plains
N
Pacific Ocean
Coast Range
Willamette Valley
Western Cascades
High Cascades
Mount Hood
Mount Jefferson
Three Sisters
Newberry Volcano
Crater Lake
Brothers Fault Zone
Basin and Range
1
2
3

North face Mt Shasta and Shastina from Weed CA airport

Weed Airport-hummocky landscape north of Mt Shasta

Newberry Volcano-Caldera with obsidian flow & maar volcano

Rhyolite Obsidian flow, Newberry volcano

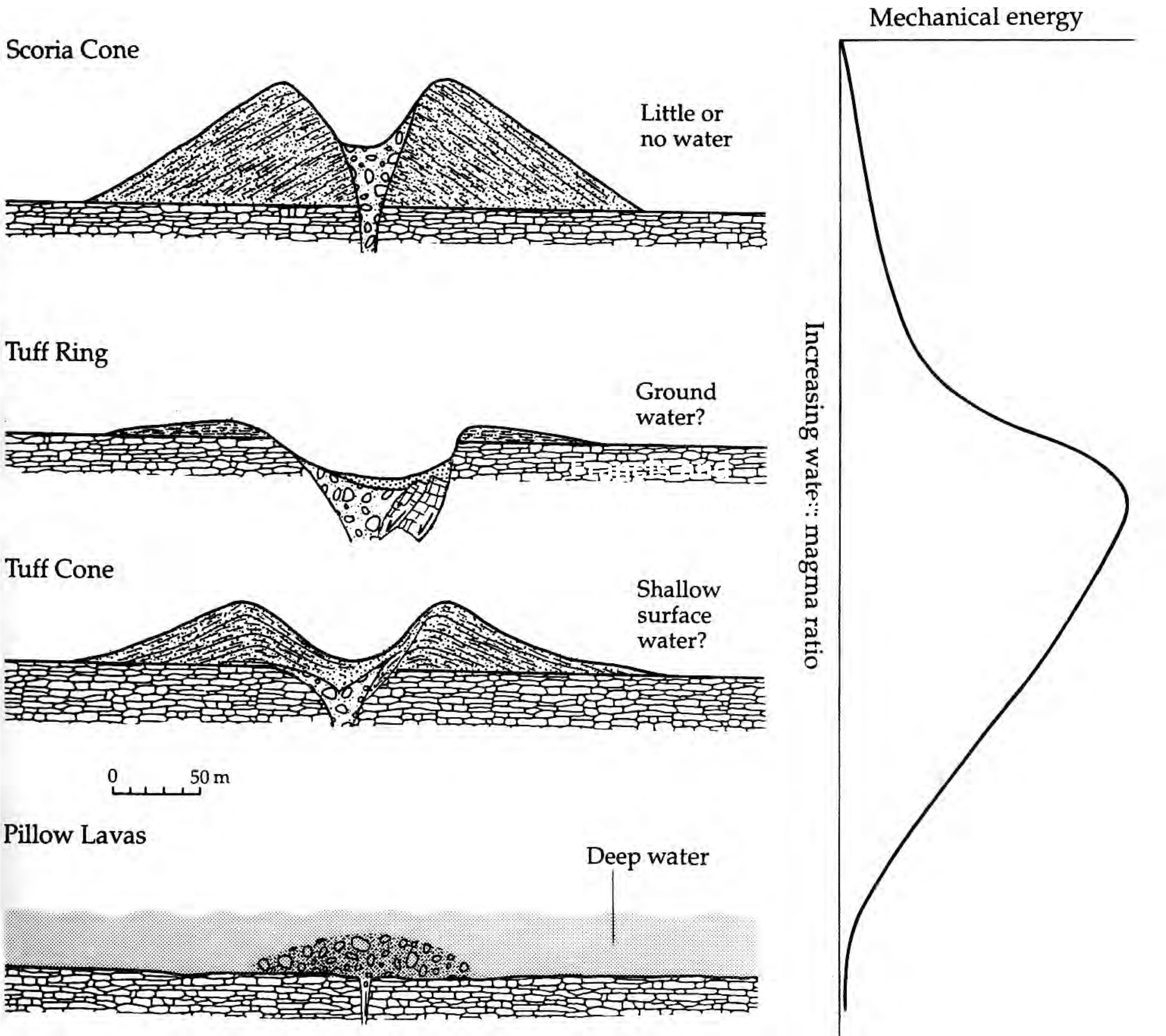
Flow banding in Newberry rhyolite obsidian flow

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/Imgs/Jpg/Newberry/Images/Newberry87_aerial_big_obsidian_flow_10-87.jpg


East Lake
Central Pumice Cone
Paulina Lake
http://earth-of-fire.over-blog.com/article-le-volcanisme-de-l-oregon-usa-62058434.html



Francis and Oppenheimer 2004)

Impact of water on small basaltic eruptions

Crater Lake 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

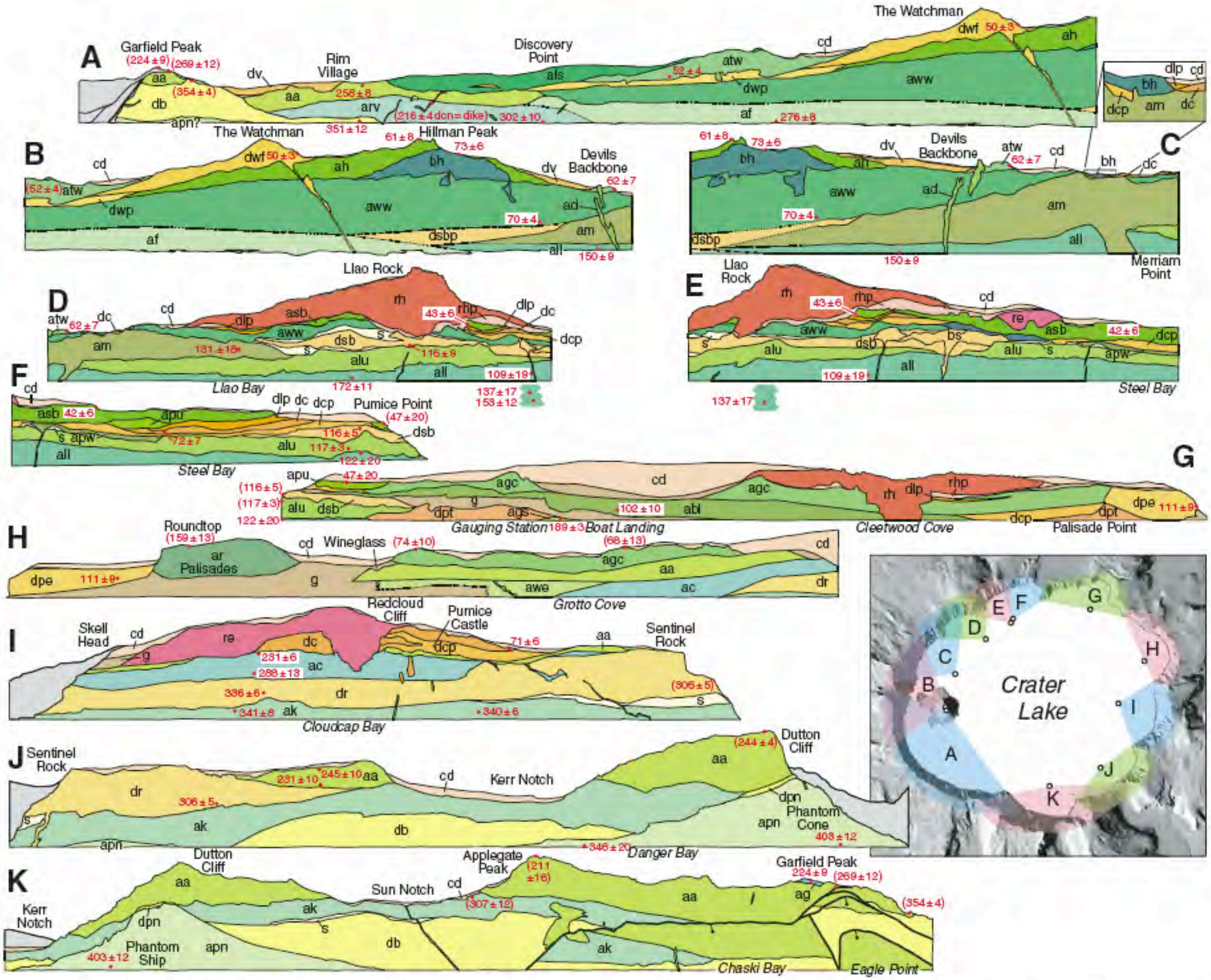


Figure 4. Geologic panoramas of the caldera walls, adapted from Bacon (2006) by inferring extent of map units beneath talus and vegetation. Unit cd represents climactic pumice fall, Wineglass Welded Tuff, lithic breccia, and ignimbrite of the climactic eruption. Explanation of units, etc., is as in Figure 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.

Baron & Lamphere 2006

Baron & Lamphere 2006

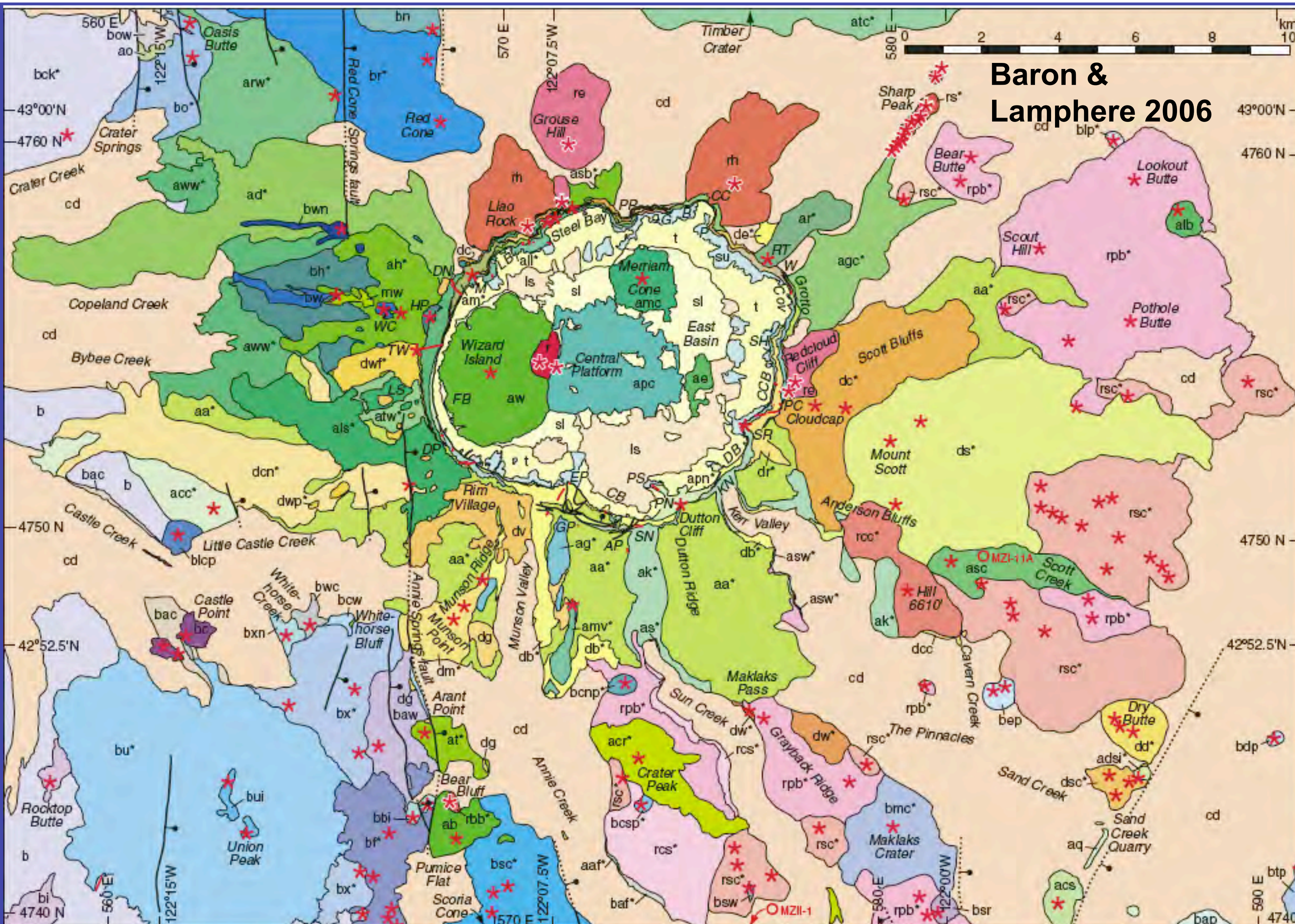


Figure 2 (*on this and following page*). Geologic map of Mount Mazama and surrounding region, adapted from interpretive bedrock map (Bacon, 2007) in which glacial and thin pyroclastic deposits are not shown. See Figure 3 caption for explanation of place names. Asterisks by unit labels in explanation indicate units dated by K-Ar or $^{40}Ar/^{39}Ar$. 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

- Sediment gravity-flow deposits (Hol.)
- Talus (Hol. and Pleist.)
- Landslide deposits (Hol.)
- Glacial deposits, undivided (Pleist.)
- Sedimentary deposits, undivided (l. and m. Pleist.)

VOLCANIC ROCKS

Mount Mazama

- Rhyodacite of the postcaldera dome (Hol.)
- Andesite of Wizard Island (Hol.)
- Andesite of Merriam Cone (Hol.)
- Andesite of the central platform (Hol.)
- Andesite of the E basin (Hol.)
- Deposits of the climactic eruption (Hol.)
- Hol. preclimactic rhyodacite (Hol.)
  - Lava
  - Pyroclastic
- Rhyodacite of Sharp Peak (l. Pleist.)
- Andesite S of Bear Bluff (l. Pleist.)
- Rhyodacite of Bear Bluff (l. Pleist.)
- Evolved Pleist. preclimactic rhyodacite (l. Pleist.)
- Mingled lava of Williams Crater (l. Pleist.)
- Dacite of Munson Valley (l. Pleist.)
- Andesite of Lightning Spring (l. Pleist.)
- Andesite of Steel Bay (l. Pleist.)
- Andesite of Pumice Point (l. Pleist.)
- Andesite of Devils Backbone (l. Pleist.)
- Andesite S of The Watchman (l. Pleist.)
- Dacite of The Watchman (l. Pleist.)
  - Lava
  - Pyroclastic-flow deposits
- Andesite of Hillman Peak (l. Pleist.)
- Dacite below Llao Rock (l. Pleist.)
- Andesite of Grotto Cove (l. Pleist.)
- Basaltic andesite of Hillman Peak (l. Pleist.)
- Dacite of Pumice Castle (l. Pleist.)
  - Lava
  - Pyroclastic
- Basaltic andesite of Steel Bay (l. Pleist.)
- Andesite W of Pumice Point (l. Pleist.)
- Andesite of the W wall (l. Pleist.)
- Andesite W of Red Cone (l. Pleist.)
- Submerged caldera wall outcrops, undiv. (Pleist.)
- Andesite of the Boat Landing (l. Pleist.)
- Dacite E of Palisade Point (l. Pleist.)
- Dacite of Steel Bay (l. Pleist.)
  - Lava
  - Pyroclastic
- Andesite of Merriam Point (l. Pleist.)
- Andesite of Llao Bay, upper unit (l. Pleist.)
- Dacite of Palisade Point (l. or m. Pleist.)
- Andesite of Llao Bay, lower unit (m. Pleist.)
- Andesite of Roundtop (m. Pleist.)
- Andesite E of Munson Valley (m. Pleist.)
- Andesite of the gauging station (m. Pleist.)
- Dacite N of Castle Creek (m. Pleist.)
- Andesite of Garfield Peak (m. Pleist.)
- Dacite S of Garfield Peak (m. Pleist.)
- Andesite of Applegate Peak (m. Pleist.)
- Andesite E of Wineglass (m. Pleist.)
- Andesite of Cloudcap Bay (m. Pleist.)
- Dacite of Munson Ridge (m. Pleist.)
- Andesite W of Fumarole Bay (m. Pleist.)
- Andesite below Rim Village (m. Pleist.)
- Dacite of Sentinel Rock (m. Pleist.)
- Andesite of Kerr Notch (m. Pleist.)
- Dacite of Chaski Bay (m. Pleist.)
- Dacite of Phantom Cone (m. Pleist.)
- Dacite of Mount Scott (m. Pleist.)
- Dacite of Cavern Creek (m.? Pleist.)
- Andesite of Phantom Cone (m. Pleist.)

Regional Volcanism, East

- Andesite of Scott Creek (l. Pleist.)
- Andesite of Crater Peak (l. Pleist.)
- Basaltic andesite S of Crater Peak (l. Pleist.)
- Basaltic andesite N of Crater Peak (m.? Pleist.)
- Andesite S of Lookout Butte (m. Pleist.)
- Basalt W of Sun Creek (m. Pleist.)
- Basaltic andesite of Maklaks Crater (m. Pleist.)
- Basalt of Sand Ridge (m. Pleist.)
- Basaltic andesite NE of Boundary Butte (m. Pleist.?)
- Rhyodacite of Pothole Butte (m. Pleist.)
- Rhyodacite S of Crater Peak (m. Pleist.)
- Rhyodacite of Scott Creek (m. Pleist.)
- Andesite of Sand Creek quarry (m.? Pleist.)
- Andesite NE of Annie Falls (m. Pleist.)
- Basaltic andesite E of Cavern Creek (m.? Pleist.)
- Andesite S of Sand Creek (m.? Pleist.)
- Basaltic andesite E of Dry Butte (m.? Pleist.)
- Basaltic andesite of Boundary Butte (m.? Pleist.)
- Andesite of Sun Creek (m. Pleist.)
- Dacite W of The Pinnacles (m. Pleist.)
- Basaltic andesite N of Lookout Butte (m. Pleist.)
- Andesite W of Sand Creek (m. Pleist.)
- Basaltic andesite E of Annie Falls (m. Pleist.)
- Rhyodacite W of Cavern Creek (m. Pleist.)
- Dacite of Sand Creek (e. Pleist.)
- Andesite S of Dry Butte (e. Pleist.)
- Dacite of Dry Butte (e. Pleist.)

Regional Volcanism, Northwest

- Basaltic andesite NW of Williams Crater (l. Pleist.)
- Basaltic andesite of Williams Crater (l. Pleist.)
- Basaltic andesite of Red Cone (l. Pleist.)
- Andesite of Timber Crater (l. or m. Pleist.)
- Basaltic andesite of Oasis Butte (m. Pleist.)
- Basaltic andesite N of Red Cone (m.? Pleist.)
- Andesite SW of Oasis Butte (m. Pleist.)
- Basaltic andesite W of Oasis Butte (m.? Pleist.)
- Basaltic andesite N of Crater Creek (e. Pleist.)

Regional Volcanism, Southwest

- Basalt of Castle Point (e. Hol.)
- Basaltic andesite N of Little Castle Creek (l. Pleist.)
- Basaltic andesite of Scoria Cone (l. Pleist.)
- Basaltic andesite NW of Pumice Flat (l. Pleist.)
- Basaltic andesite of Union Peak (m. Pleist.)
  - Lava
  - Intrusive
- Basaltic andesite of Whitehorse Bluff (m. Pleist.)
- Andesite of Arant Point (m. Pleist.)
- Basalt NW of Whitehorse Bluff (m.? Pleist.)
- Basaltic andesite W of Arant Point (m. Pleist.)
- Basaltic andesite W of Bear Bluff (m.? Pleist.)
- Basaltic andesite W of Mazama Campgr. (m.? Pleist.)
- Basaltic andesite of Whitehorse Creek (m.? Pleist.)
- Andesite N of Castle Creek (m. Pleist.)
- Basaltic andesite, undivided (Pleist. or Plio.)
  - Lava
  - Intrusive
- Basaltic andesite of Castle Point (e.? 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 $^{40}Ar/^{39}Ar$ methods
- MZI-11A **Geothermal exploration well**

Baron & Lamphere 2006

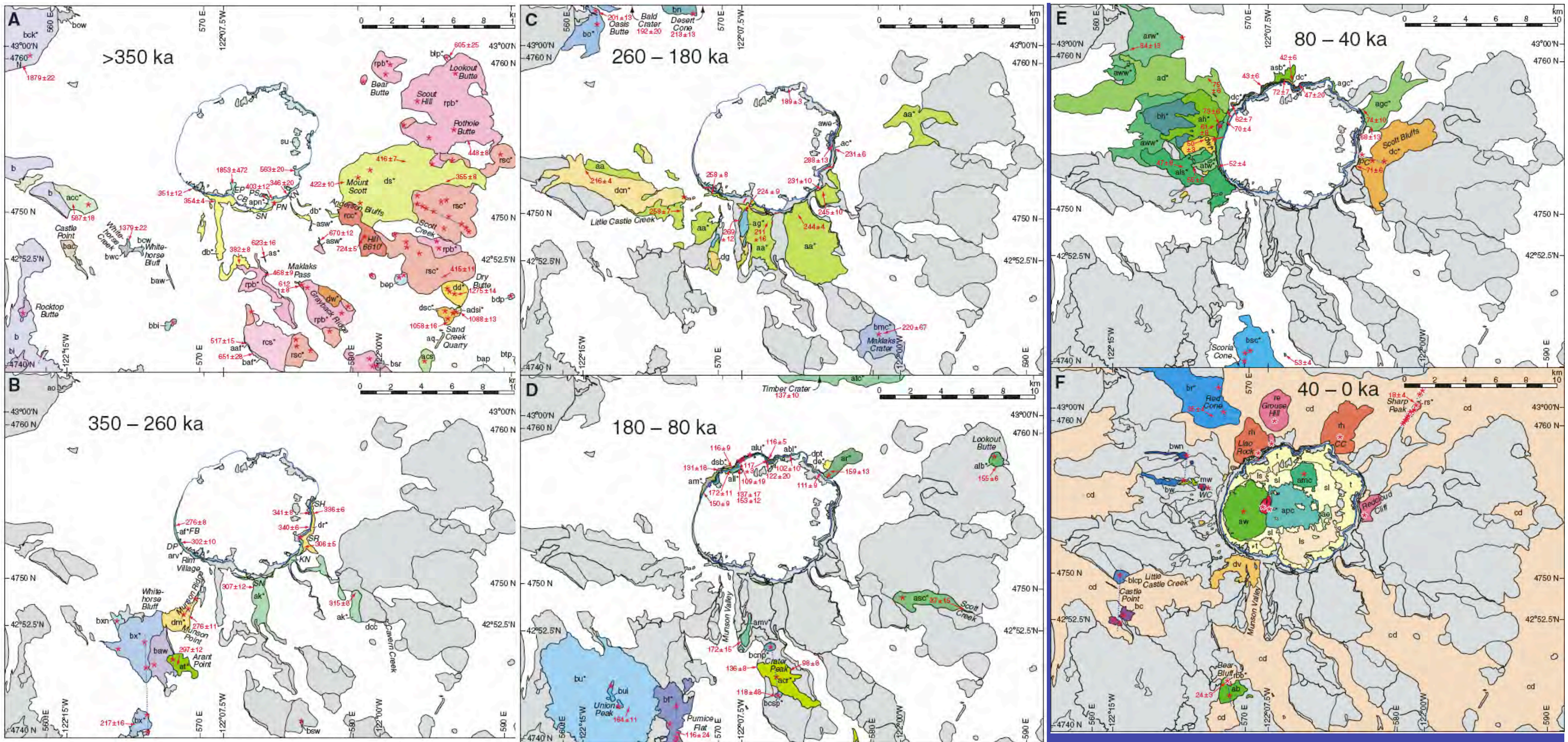
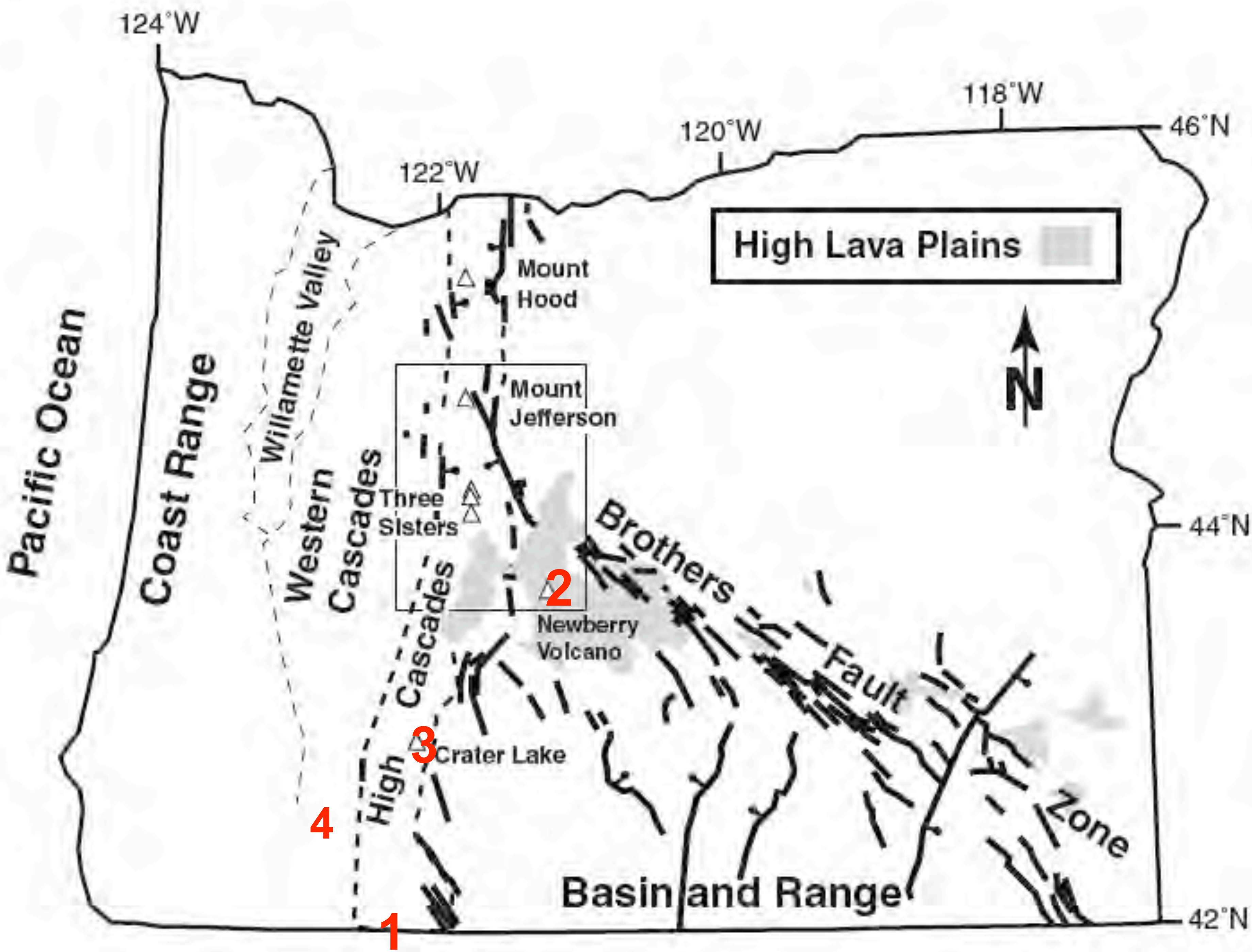


Figure 5 (*on following three pages*). Geologic maps showing assembly of map in Figure 2 in six time increments. Areas of units have not been reconstructed; faults are omitted. Gray areas in panels B–F depict units emplaced in earlier time increments. Explanation of units, etc., is as in Figure 2. Present 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).

Baron & Lamphere 2006


124°W
122°W
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High Lava Plains
N
Pacific Ocean
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Willamette Valley
Western Cascades
High Cascades
Mount Hood
Mount Jefferson
Three Sisters
Newberry Volcano
Crater Lake
Brothers Fault Zone
Basin and Range
1
2
3
4

Inverted topography: High Cascade lavas near Medford, OR

A Simplified Volcanic Activity Classification

- Diffuse degassing and fumaroles
- Hawaiian eruptions
- Lava lakes
- Strombolian eruptions
- Vulcanian eruptions
- Visuvian or sub-plinian eruptions (M‹4)
- Plinian eruptions (M=4+)
- Pelean eruptions
- Hydrovolcanic eruptions

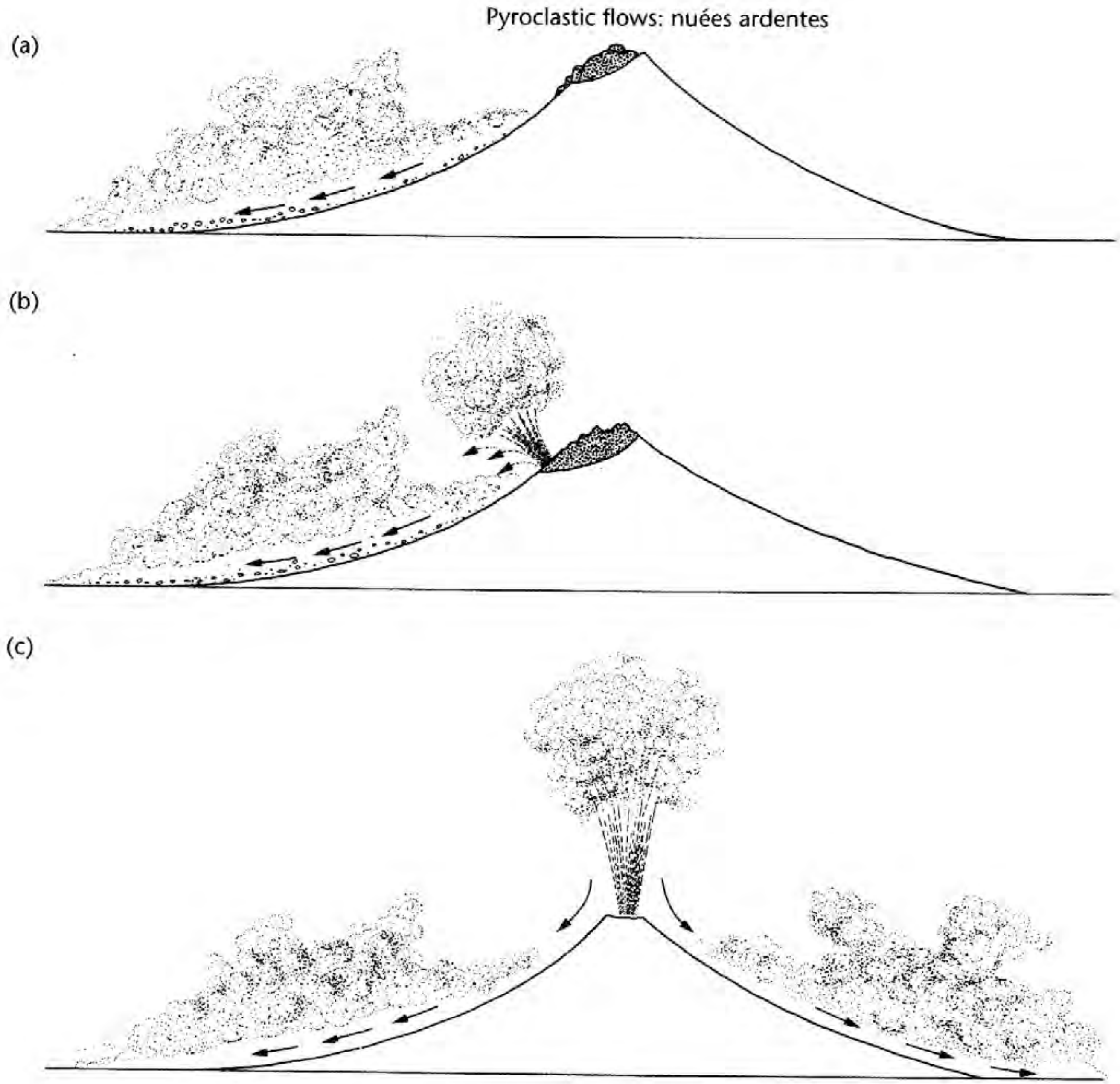


Fig. 9.7 Three common mechanisms for generating PDCs. (a) Simple gravitational collapse of a growing lava dome or flow on a volcano (merapi type). (b) Explosive disruption of growing lava dome (peléean type). (c) Collapse from eruption column (soufrière type).

Francis and Oppenheimer 2004)

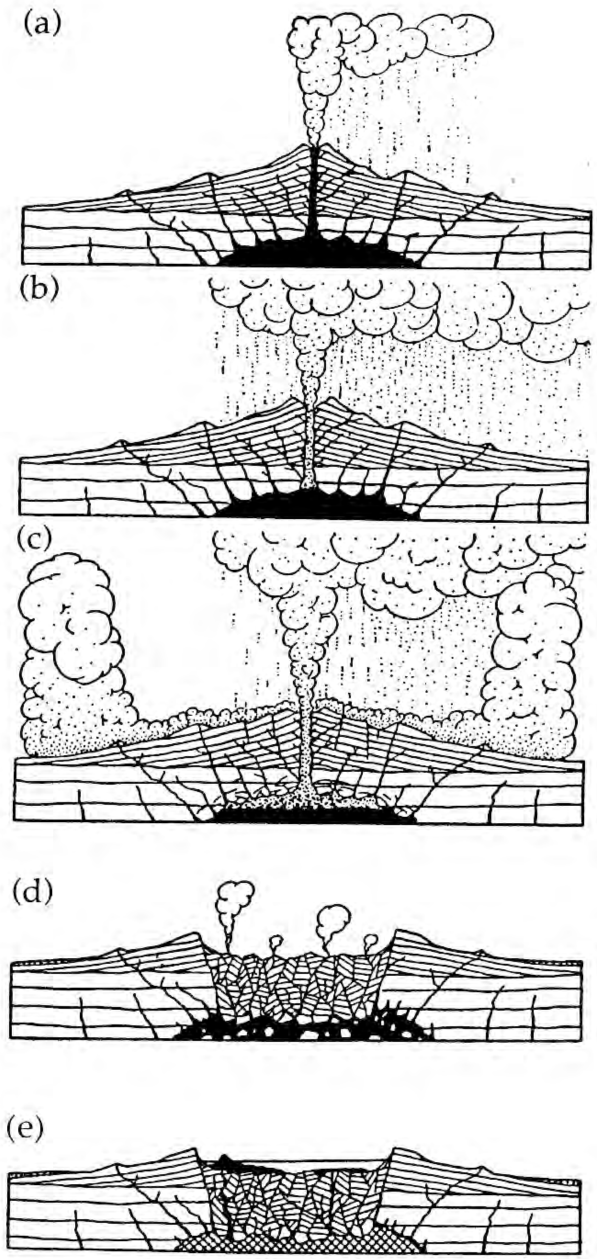
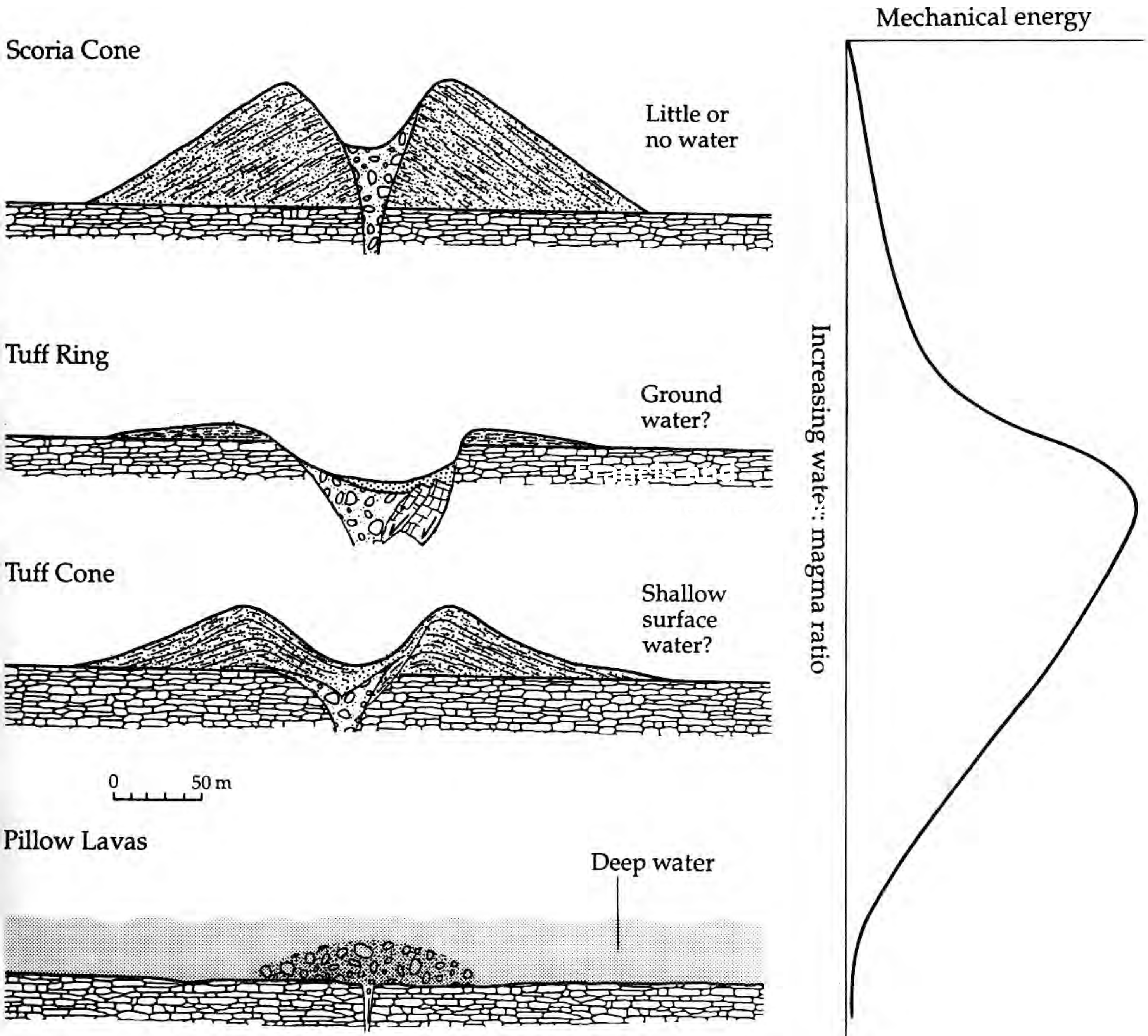


Fig. 11.5 Howel Williams's classic diagrams illustrating the formation of Crater Lake caldera Oregon [13]. His original

Formation of Crater Lake Howell Williams (1941)

(reproduced in Francis and Oppenheimer 2004)



Francis and Oppenheimer 2004)

Impact of water on small basaltic eruptions

Volcanic Magnitude

$$M = \log_{10} m - 7$$

M = magnitude

M = mass of tephra or lava

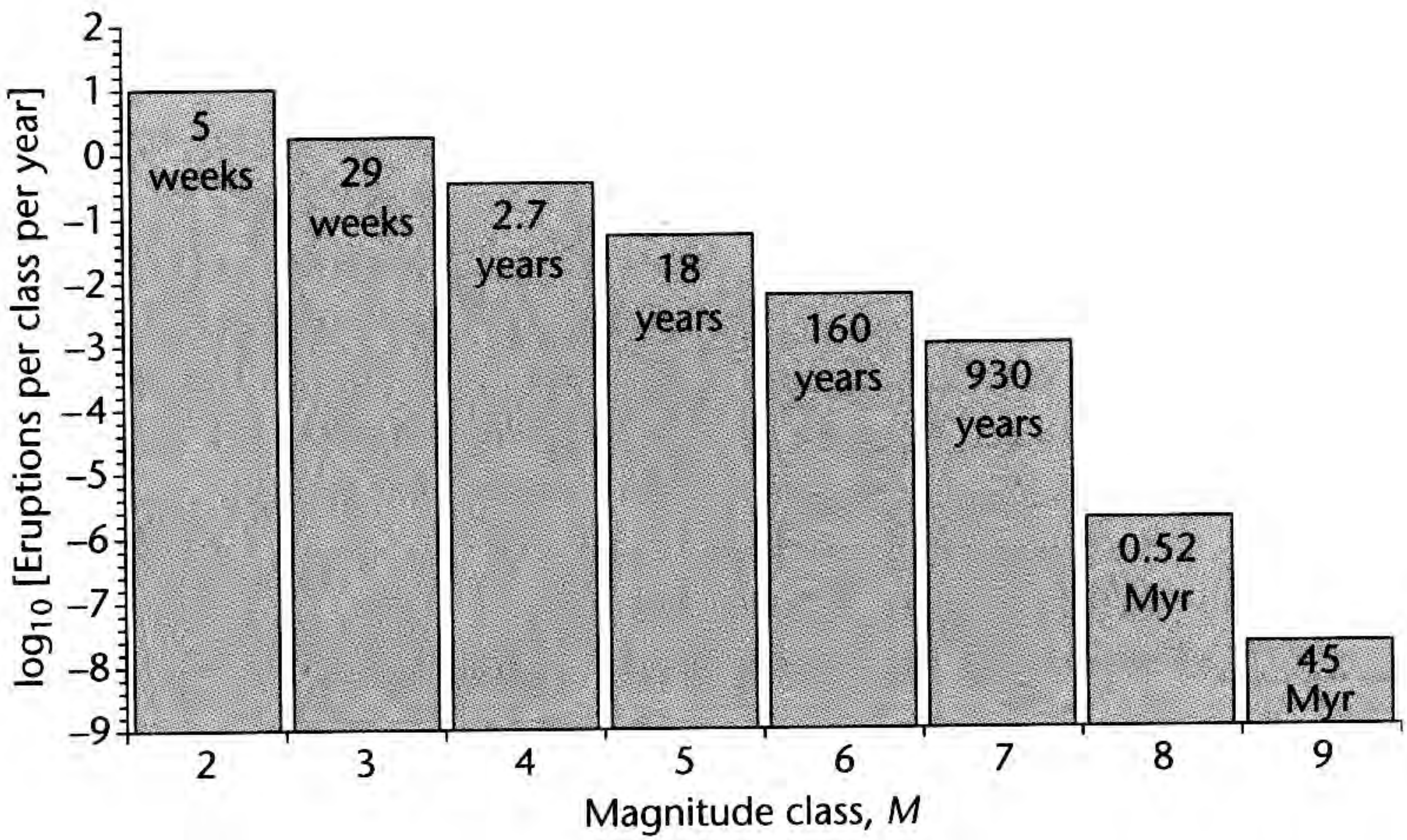


Fig. 5.5 Magnitude–frequency plot for subaerial volcanic eruptions based on records for last 300 yr for $2 \leq M < 6$; last 2 kyr for $6 \leq M < 8$; and for all known 'super-eruptions' of the past 45 Myr for $M \geq 8$. Note that extrapolation of the more or less reliable record for the past 300 years or even the last 2 kyr, to estimate the frequency of very large eruptions ($M \geq 8$), would result in a significant over-estimation of the their recurrence. The only $M = 9$ eruption in this compilation is the Fish Canyon Tuff eruption associated with La Garita caldera in the United States (Section 11.7), the implied frequency of magnitude 9 events should therefore be regarded very cautiously. Data from D. Pyle and B. Mason.

Pinatubu 7.1
Krakatoa 6.5
Mt St Helens 4.9

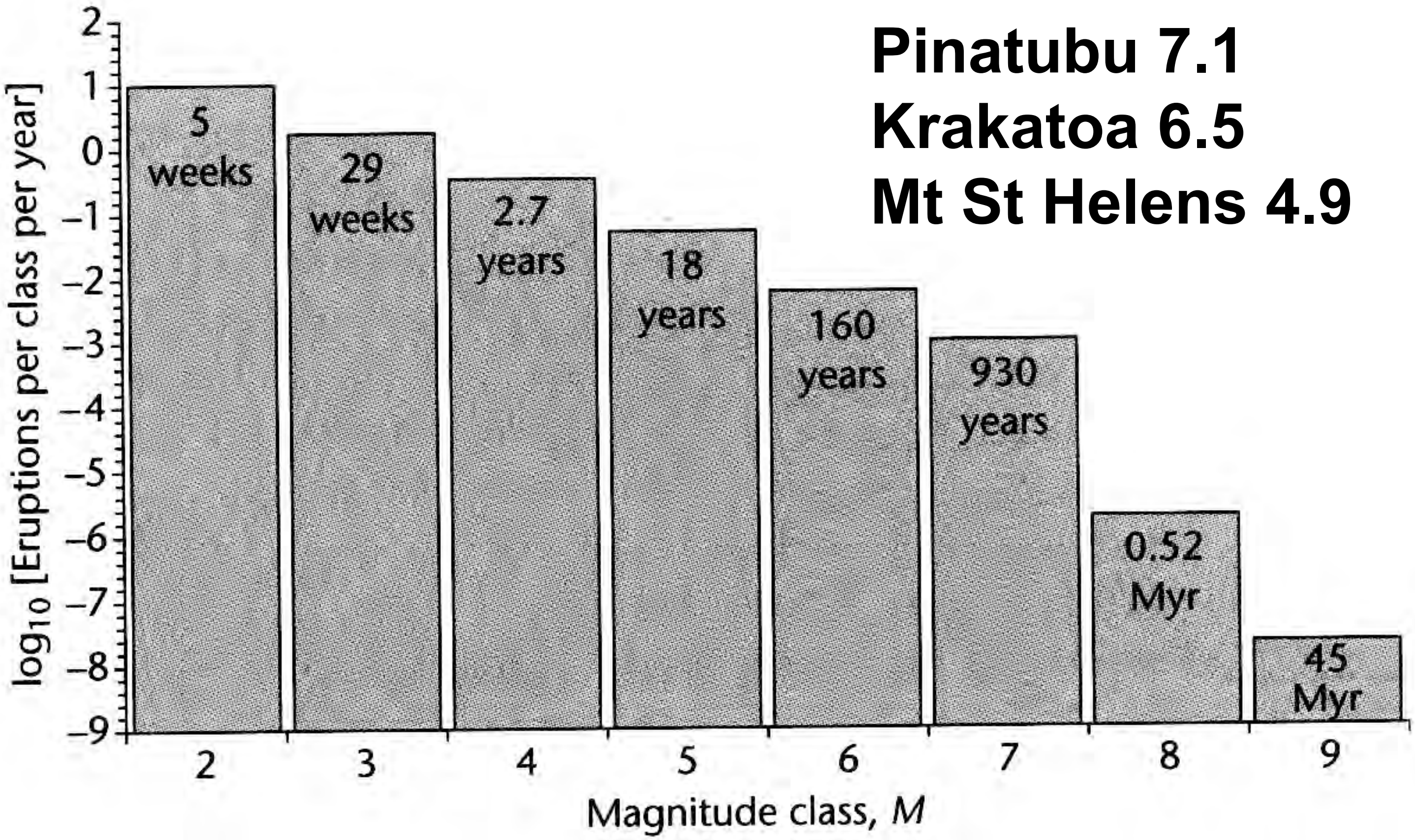


Fig. 5.5 Magnitude–frequency plot for subaerial volcanic eruptions based on records for last 300 yr for $2 \leq M < 6$; last 2 kyr for $6 \leq M < 8$; and for all known 'super-eruptions' of the past 45 Myr for $M \geq 8$. Note that extrapolation of the more or less reliable record for the past 300 years or even the last 2 kyr, to estimate the frequency of very large eruptions ($M \geq 8$), would result in a significant over-estimation of the their recurrence. The only $M = 9$ eruption in this compilation is the Fish Canyon Tuff eruption associated with La Garita caldera in the United States (Section 11.7), the implied frequency of magnitude 9 events should therefore be regarded very cautiously. Data from D. Pyle and B. Mason.

Tom Dick Mountain-view from above Timberline Lodge


Eagle Creek Fm
Bonneville Dam
Landslide on Eagle Creek Fm

Eagle Creek Fm

Eagle Creek Formation

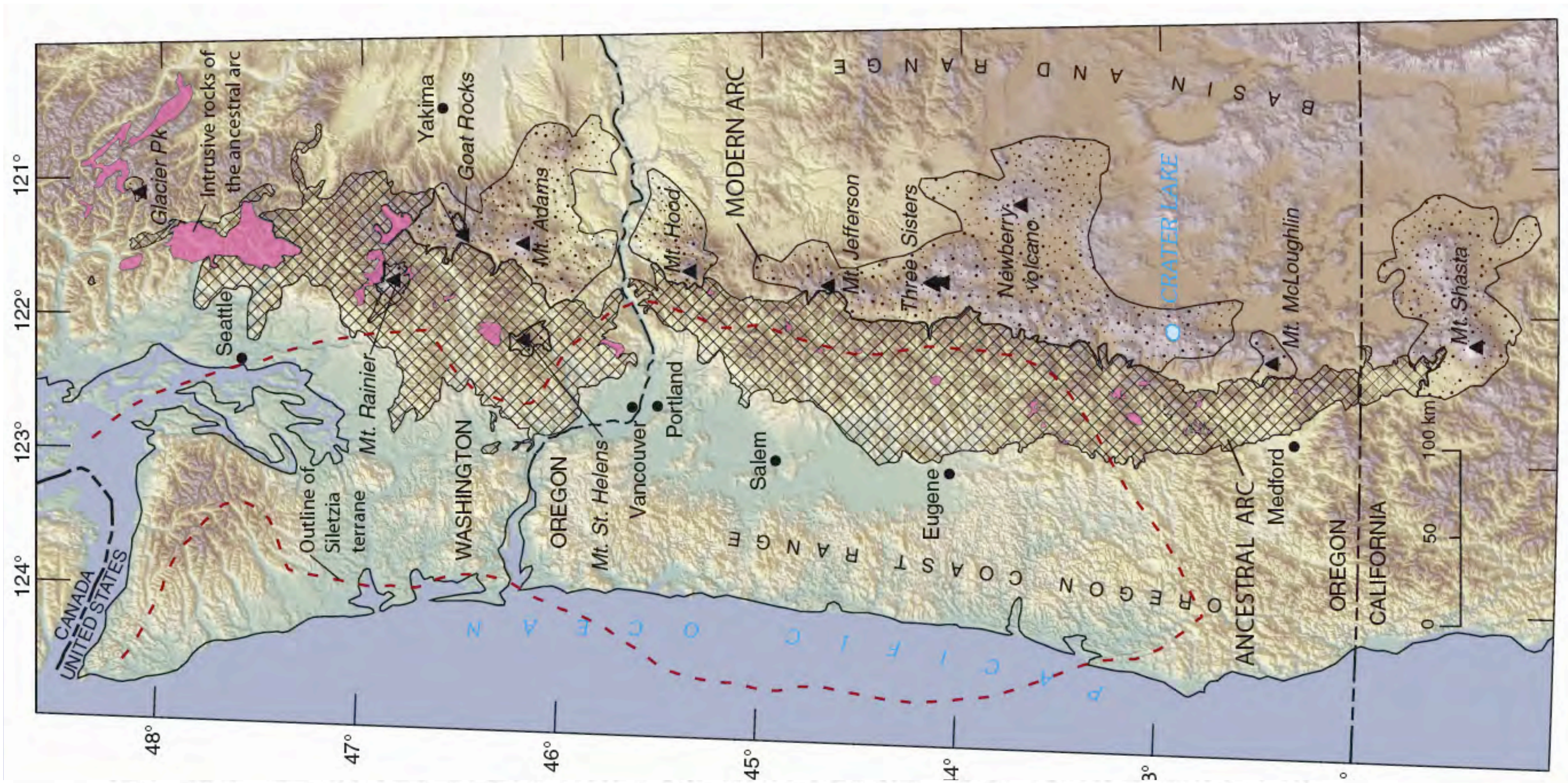
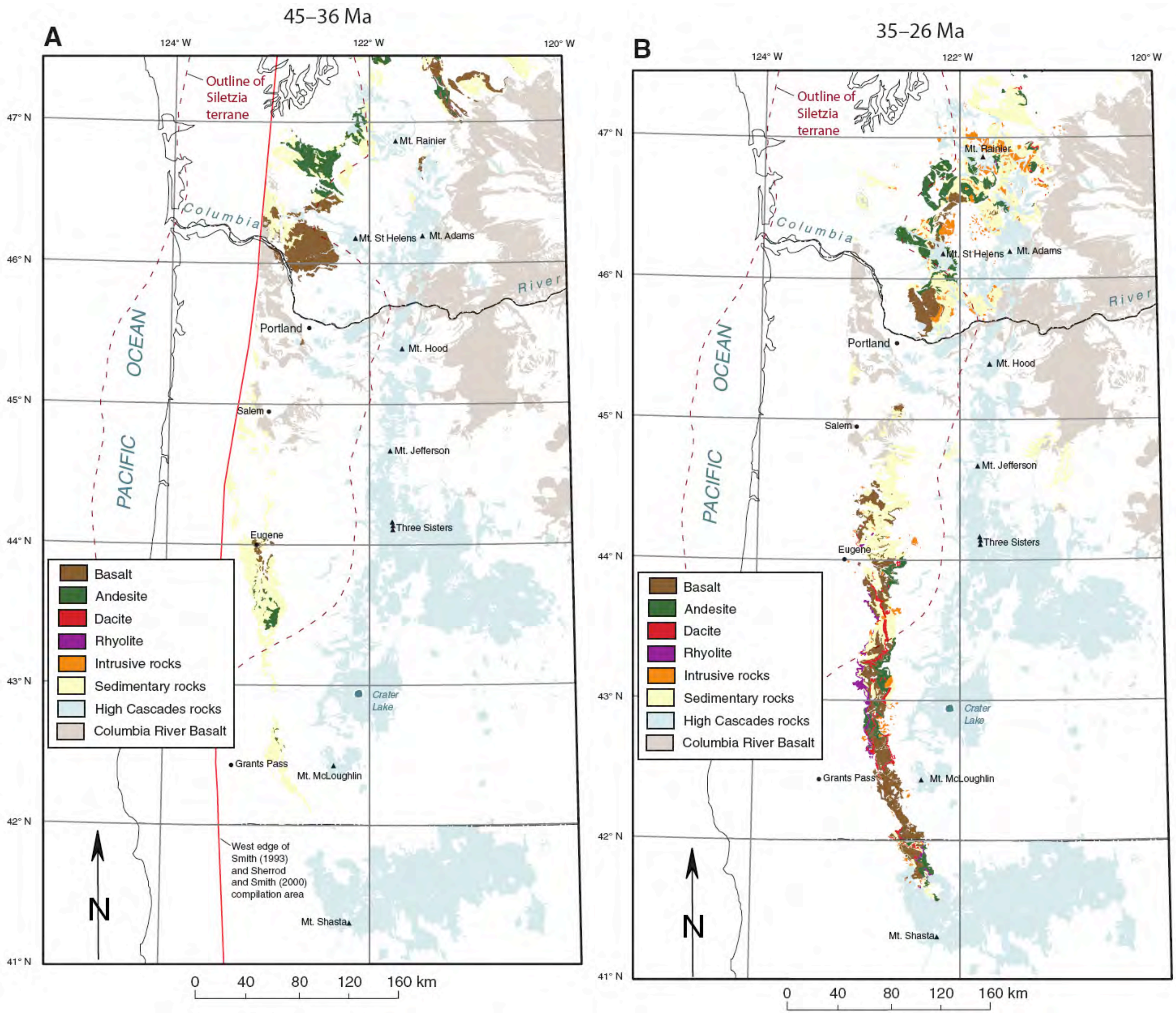


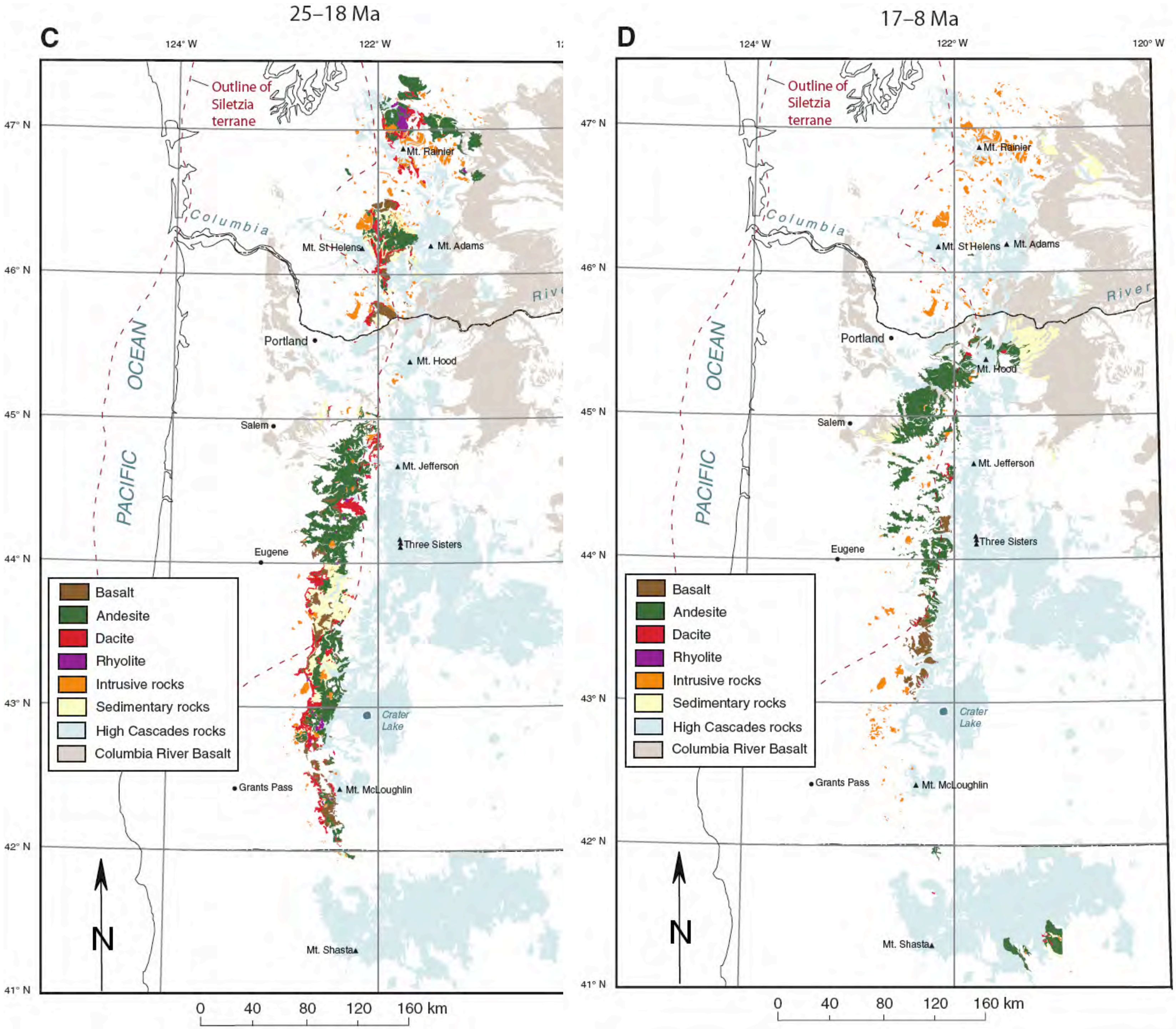
TABLE 1. GENERALIZED CHARACTERISTICS OF THE ANCESTRAL CASCADES ARC, WASHINGTON, OREGON, AND NORTHERNMOST CALIFORNIA

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

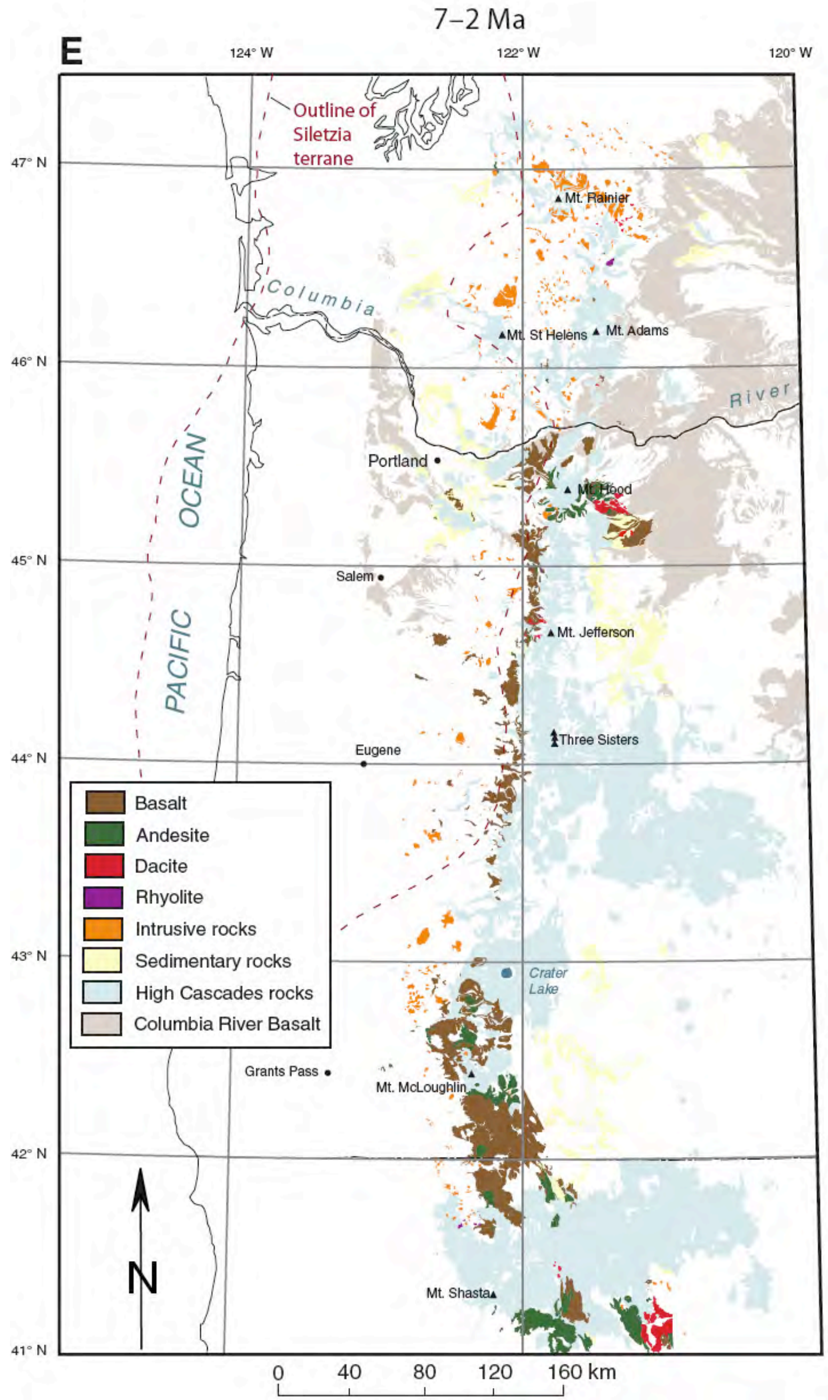
DuBray & Johnson 2011

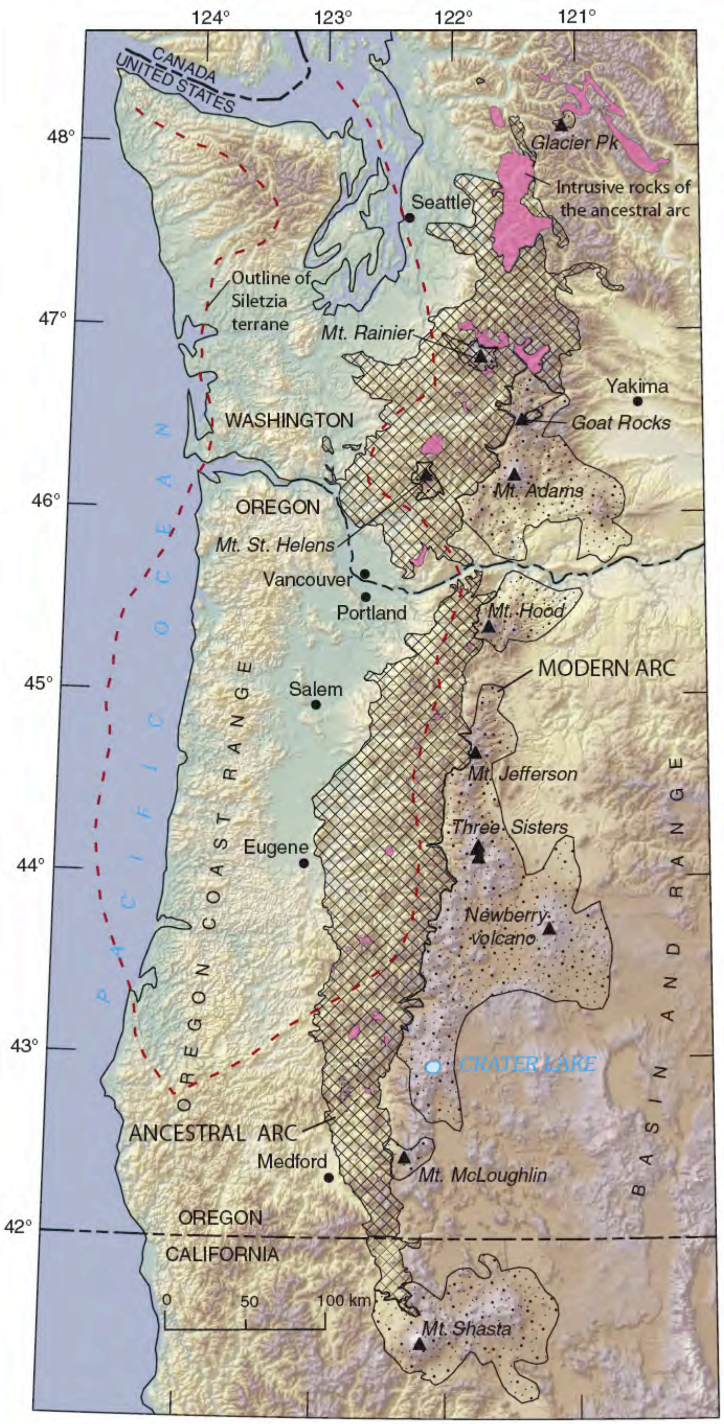


DuBray & Johnson 2011



DuBray & Johnson 2011





DuBray & Johnson 2011

DuBray & Johnson 2011

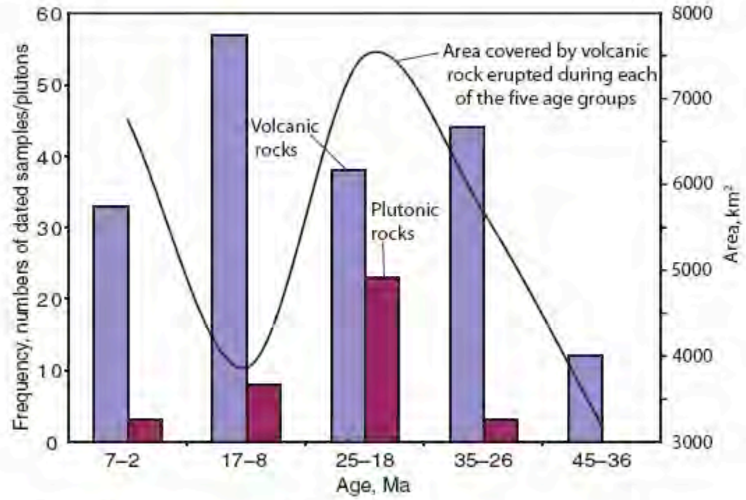


Figure 2. Age-frequency distribution and area-covered diagram for the northern segment of the ancestral Cascades arc. The age-frequency histogram shows the number of volcanic samples and plutons with ages in each of the five ancestral arc age groups. The area-covered curve shows the areal distribution 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.).

DuBray & Johnson 2011

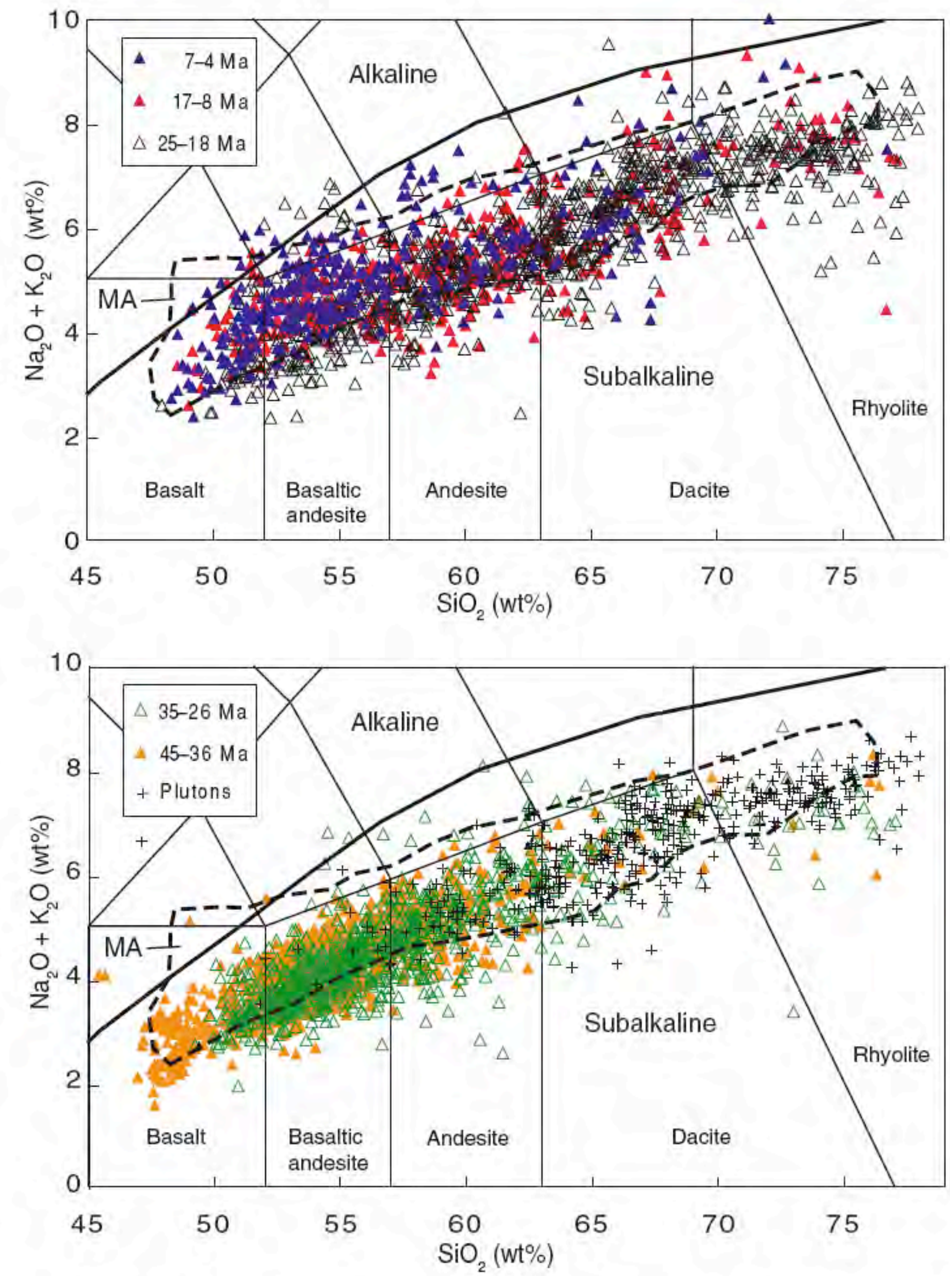


Figure 4. Total alkali-silica variation diagram showing compositions of ancestral Cascades rocks. Field boundaries are from Le Bas et al. (1986). Dashed line delineates the composition field of modern arc (MA) rocks of the High Cascades (data from GEOROC, 2010). Alkaline-subalkaline boundary is from Irvine and Baragar (1971).

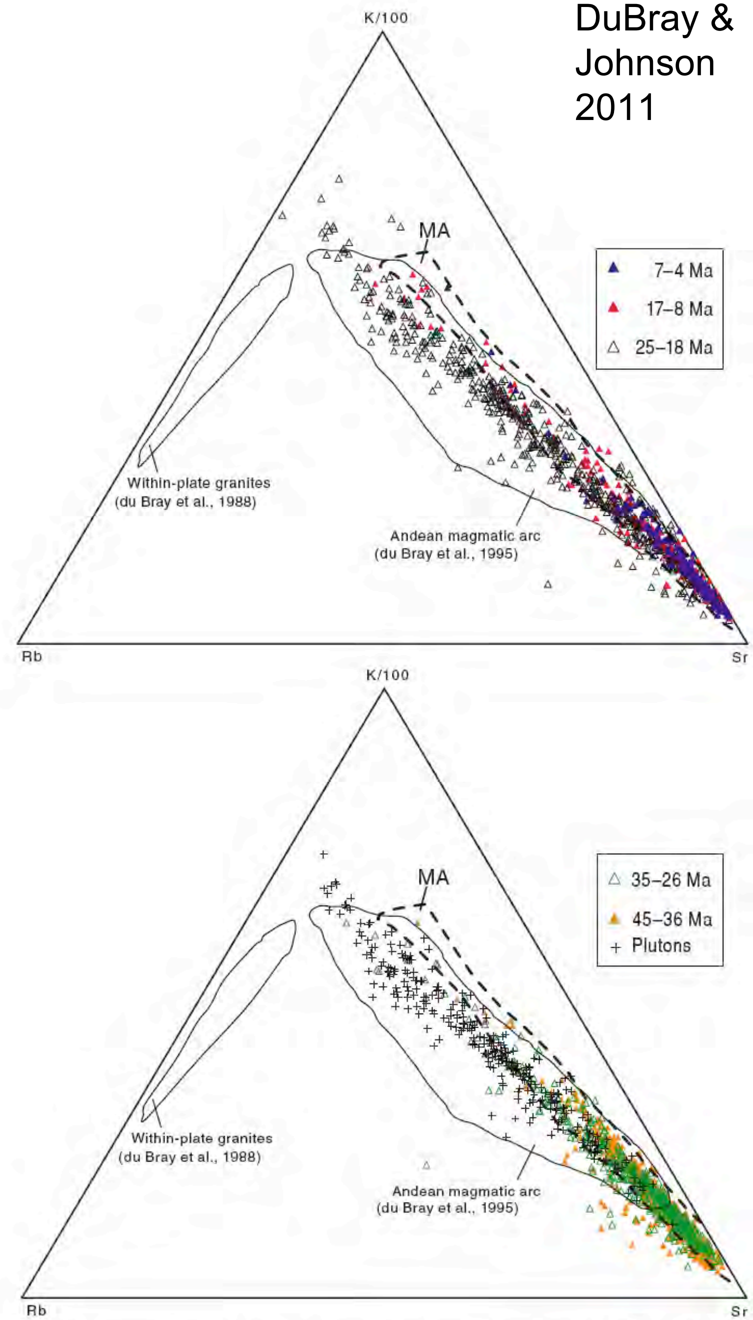
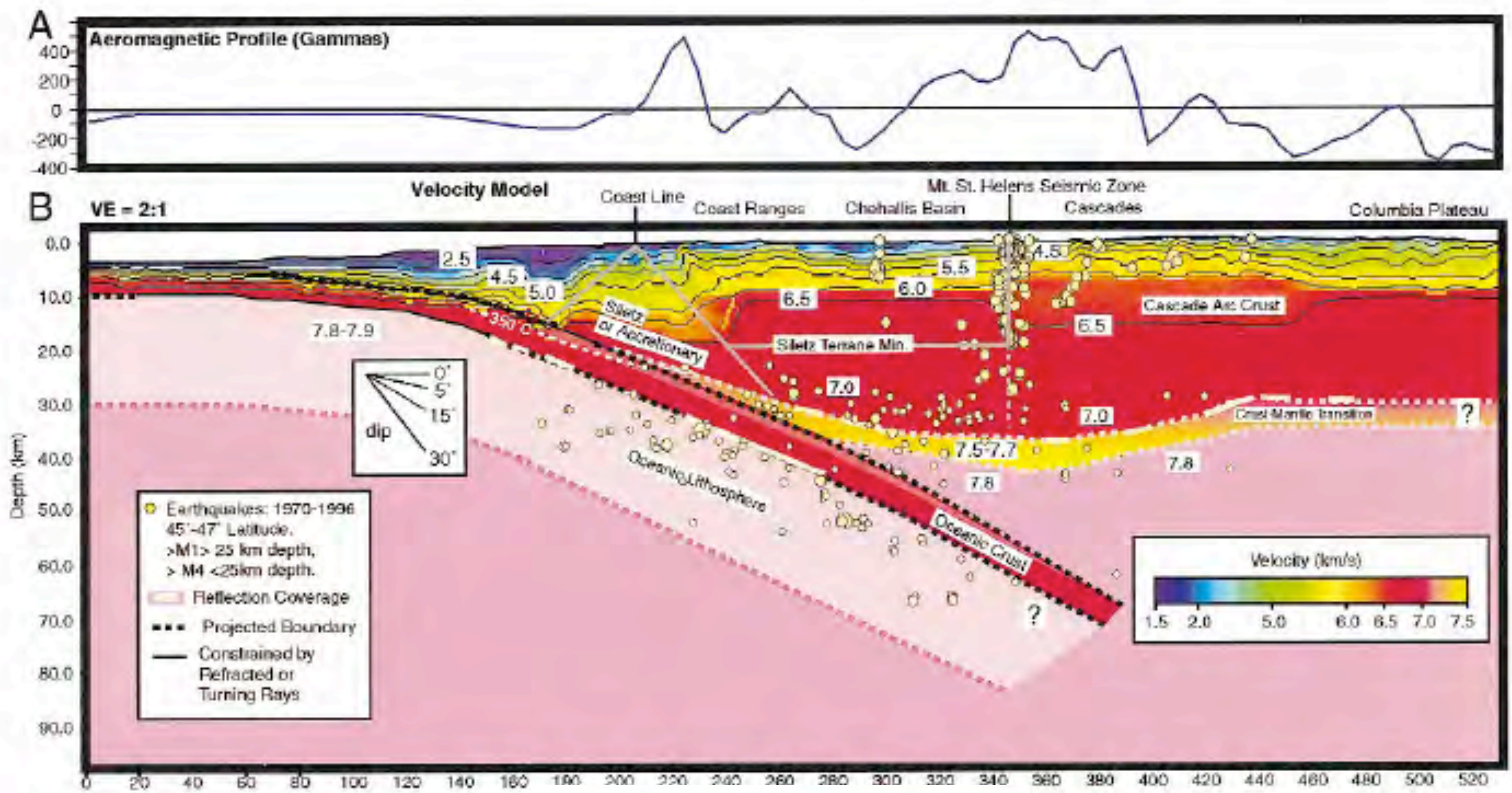


Figure 9. Ternary variation diagram showing the relative proportions of Rb, K, and Sr in samples of ancestral Cascades arc rocks. Dashed line delineates the composition field of modern arc (MA) rocks of the High Cascades (data from GEOROC, 2010).


A
Aeromagnetic Profile (Gammas)
400
200
0
-200
-400
B
Velocity Model
VE = 2:1
Coast Line
Coast Ranges
Chehalis Basin
Mt. St. Helens Seismic Zone
Cascades
Columbia Plateau
Depth (km)
2.5
4.5
5.0
5.5
6.0
6.5
4.5
Cascade Arc Crust
6.5
Siletz or Accretionary
350°C
7.8-7.9
Siletz Terrane Min.
7.0
7.0
Crust-Mantle Transition
?
7.5-7.7
7.8
7.8
dip
0°
5°
15°
30°
Oceanic Lithosphere
Oceanic Crust
?
Earthquakes: 1970-1996
45°-47° Latitude.
>M1> 25 km depth,
> M4 <25km depth.
Reflection Coverage
Projected Boundary
Constrained by
Refracted or
Turning Rays
Velocity (km/s)
1.5 2.0 5.0 6.0 6.5 7.0 7.5
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480 500 520


Olympic Mts accretionary complex
Seattle
Cascade Arc
Mt. Rainier
Columbia Plateau
Willapa Bay
Mt. Adams
Mt. St Helens
Portland
Columbia River
deformation front

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 youre cat please call Tyler ASAP @ 690-5801

TYLER 690 5801