Terrane

- A crustal block bounded by faults
- Preserves a geologic history that is distinct from adjacent terranes
- Accreted by tectonic processes

Siletzia Revisited

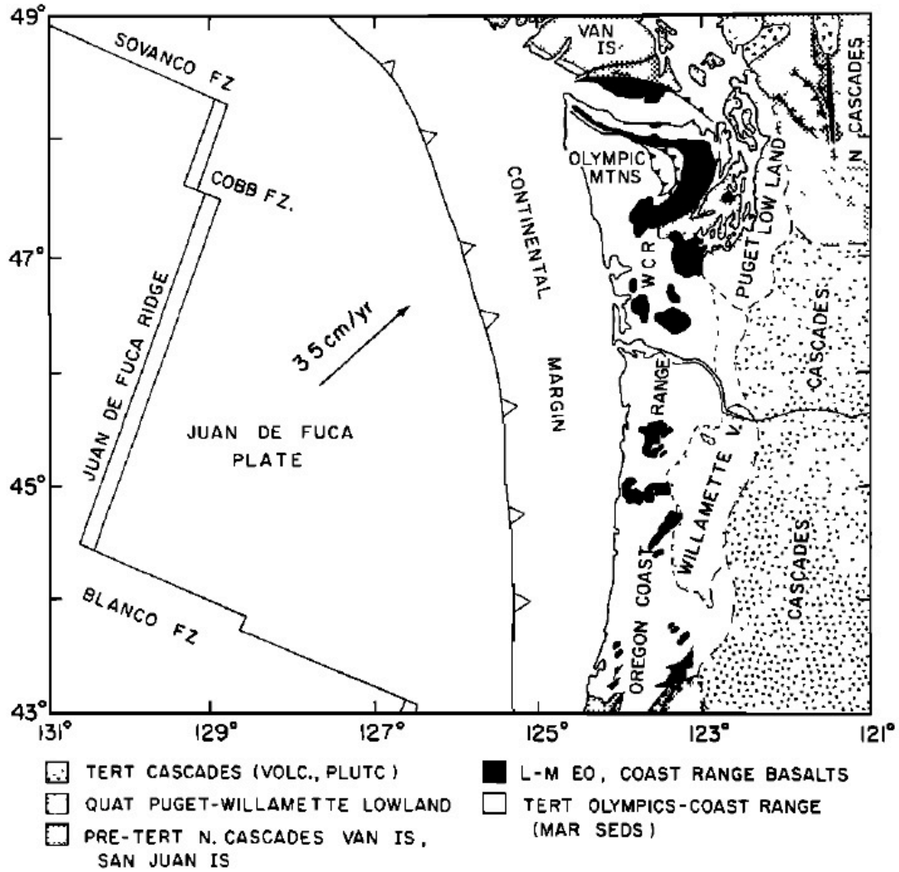


Fig. 1. Generalized geology and present plate boundaries in the Pacific Northwest. The basement rocks in the Coast Range (solid black) crop out in a north-south linear pattern from the southern tip of Vancouver Island to southern Oregon. These are tholeiitic submarine pillow lavas and subaerial alkalic basalts, which are thought to have been erupted as a line of islands at a segment of the early Tertiary Farallon-Kula plate spreading ridge.

R A Duncan 1982
A Captured Island Chain in the Coast Range of Oregon and Washington

JGR v 87, B13, 10827-10837

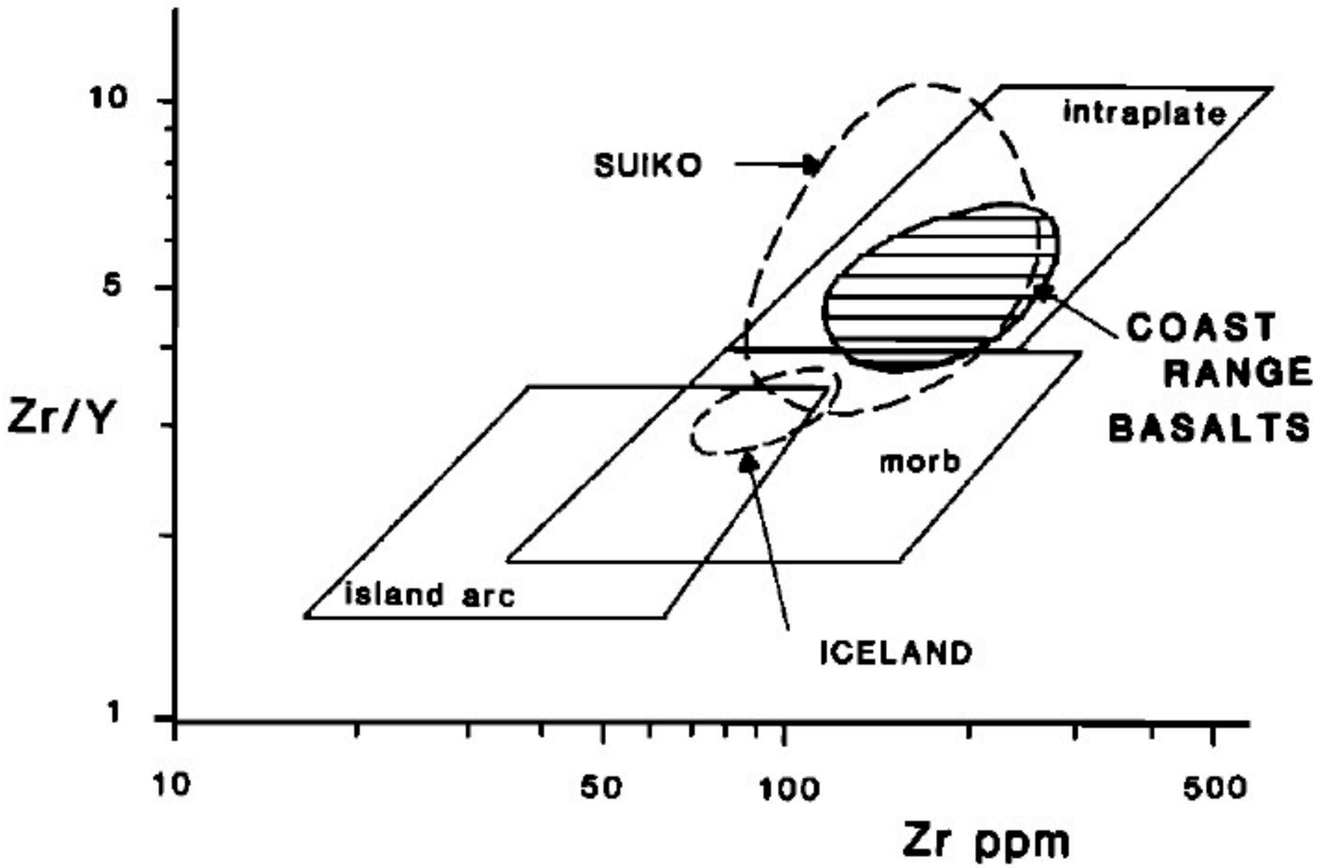


Fig. 5. Trace elements have been used to distinguish the tectonic environment of eruption of otherwise similar basalts. Here Zr and Y are used to characterize basalts from the Coast Range [Loeschke, 1979; Globerman, 1980] as intraplate to ocean floor origin. For comparison, analyses from Suiko Seamount [Kirkpatrick et al., 1981] and eastern Iceland [Wood, 1978] are illustrated.

Duncan 1982

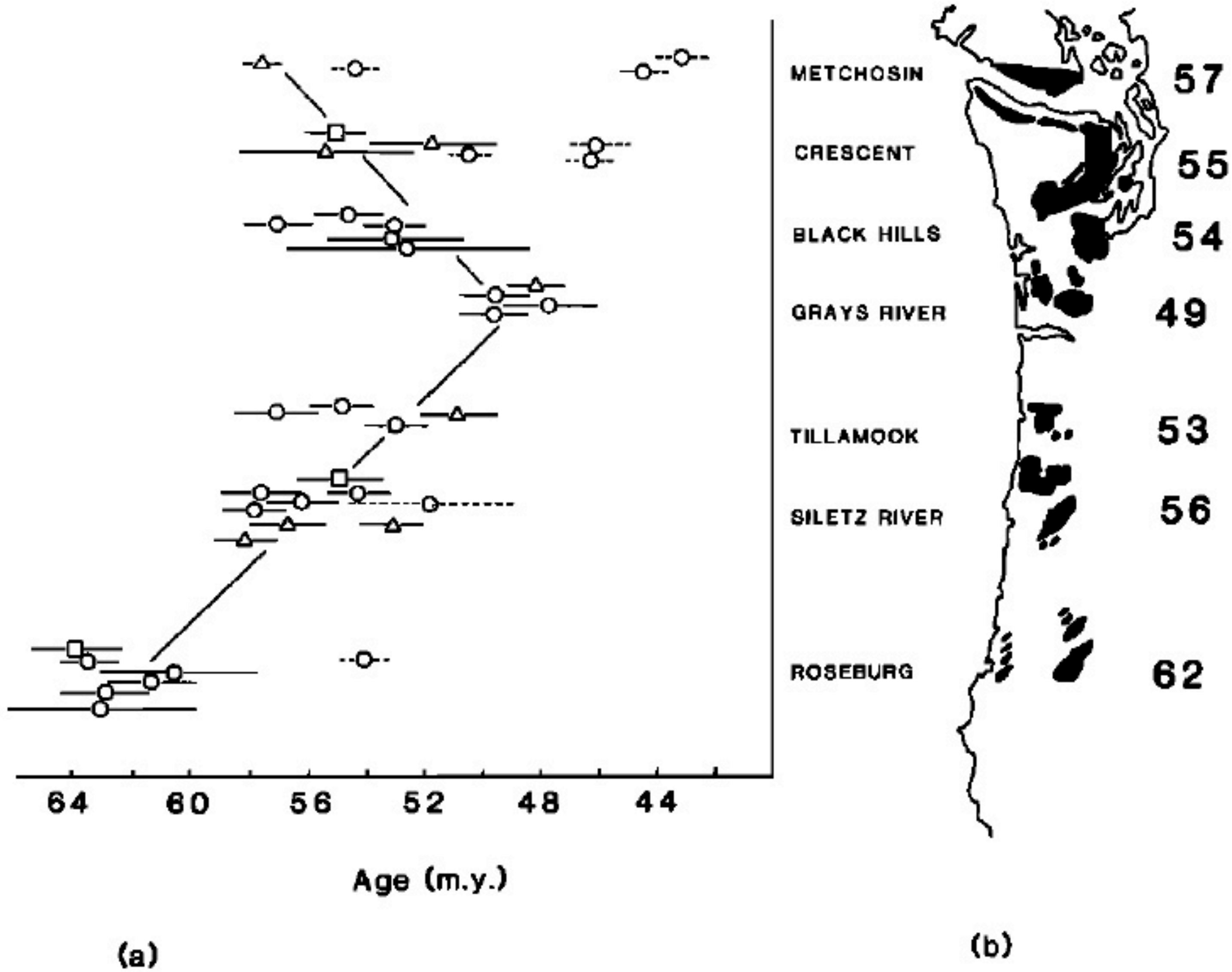


Fig. 2. (a)K-Ar and ^{40}Ar-^{39}Ar geochronology of basalts from the Coast Range, Oregon and Washington, reveals a V-shaped pattern when ages at various eruptive centers are plotted against distance. Open circles are conventional K-Ar

Duncan
1982

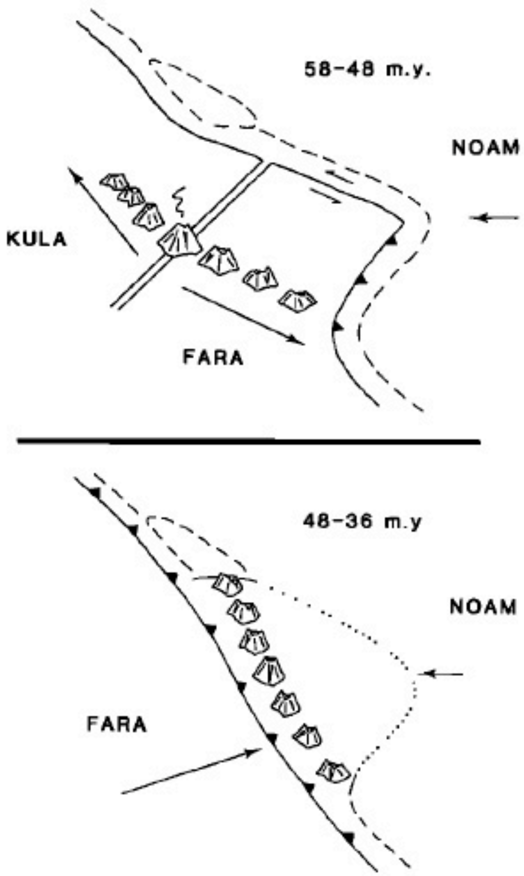


Fig. 4. (top) The distribution of ages within the early Tertiary eruptive centers favors an origin by hot spot volcanism underlying a spreading ridge segment. Seamounts and islands so generated would have been carried away from the hot spot in two directions, on the Kula (northern Coast Range) and Farallon (southern Coast Range) plates. Calculated absolute plate motions are shown as solid arrows. (bottom) As part of a major plate motion reorganization, this ridge segment stopped spreading, succeeded by Farallon-Pacific spreading farther north, by magnetic anomaly 21 (~48 m.y.) time. The subduction zone between the Farallon and North America plates then moved to the west, capturing this island lineament against North America.

Duncan 1982

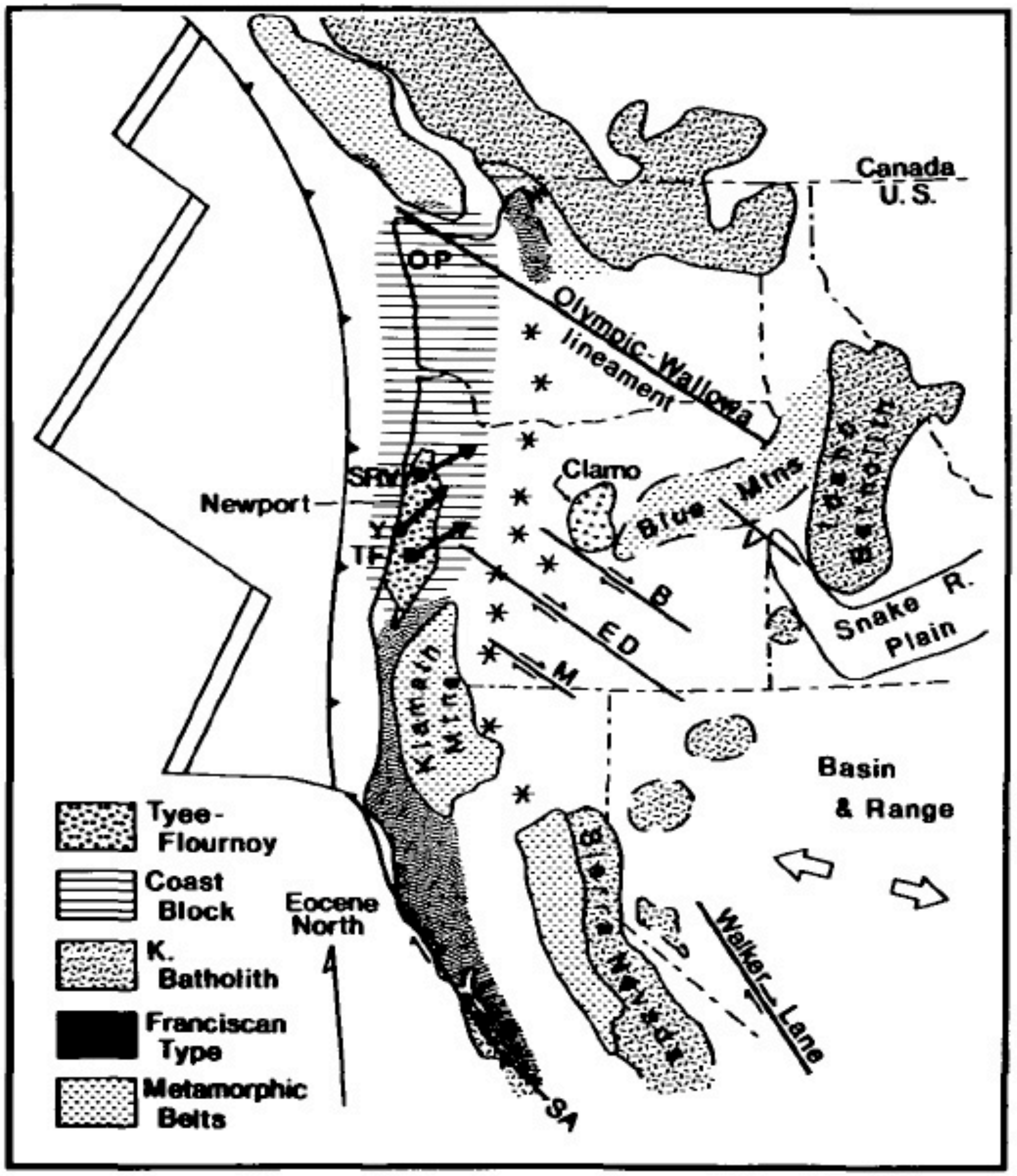


Figure 1. Generalized geologic and tectonic map of northwestern United States based in part on Hamilton (1969) and Lawrence (1976). SRV = Siletz River Volcanic Series, Y = Yachats basalt, TF = Tyee and Flournoy Formations, OP = Olympic Peninsula. Fault zones and lineaments: V = Vale, B = Brothers, ED = Eugene-Denio, M = McLoughlin, SA = San Andreas.

Simpson and Cox 1977 Paleomanetic evidence for tectonic rotation of the Oregon Coast Range *Geology* v 5, pp 585-589.

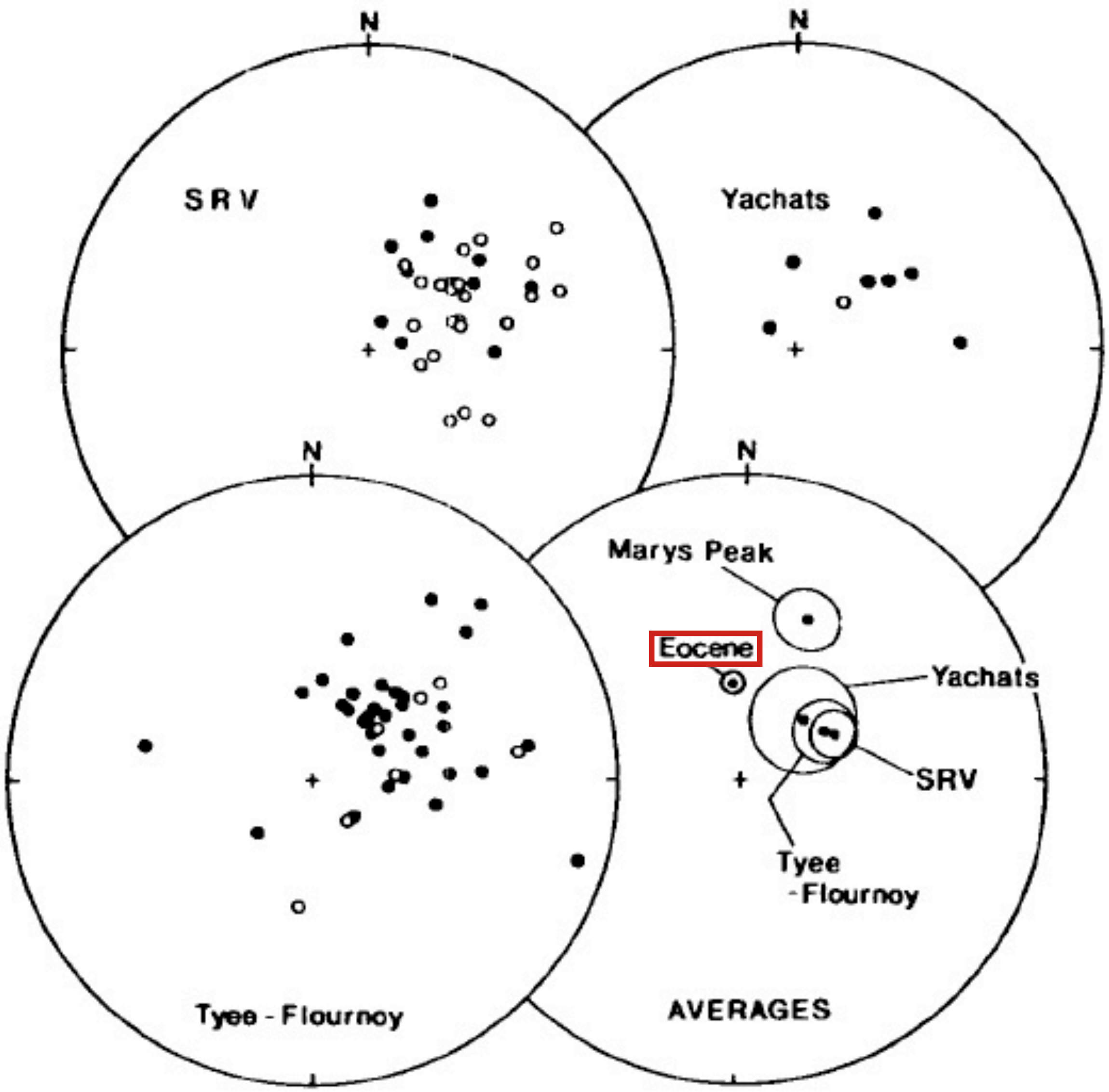


Figure 2. Site-mean magnetization directions for Siletz River Volcanic Series (SRV), Yachats basalt, Tyee and Flournoy Formations, and averages. Eocene field direction predicted from studies in stable parts of North America and result for Marys Peak sill (Clark, 1969) are also shown. Reversed polarities have been projected through origin onto lower hemisphere and are shown as open circles. Large ovals are circles of 95% confidence about the means.

Simpson and Cox 1977

TABLE 1. PALEOMAGNETIC DATA

	D (°)	I (°)	Field α_{95}	No. sites	Pole lat (°)	Pole long (°E)	Pole α_{95}	Rotation*
Expected field directions for Eocene rocks (from North American studies, see text)	355	64	4	4	87	169	6	. . .
Expected field directions for Eocene rocks (from North American, European, and Russian studies, see text)	345	68	3	19	78	187	5	. . .
Expected field directions for upper Tertiary rocks (Beck, 1976)	354	61	4	3	85	114	6	. . .
Siletz River Volcanic Series (Cox, 1957)	70	55	7	8	37	310	9	75 ± 12
Siletz River Volcanic Series (Cox, 1959, recalculated)	68	56	7	9	39	310	9	73 ± 12
Siletz River Volcanic Series (present study)	60	62	8	24	48	306	11	65 ± 17
Siletz River Volcanic Series (Cox, 1959, recalculated, and present study)	63	61	6	33	45	307	8	68 ± 12
Tyee-Flournoy Formations	59	63	8	40	49	305	11	64 ± 16
Yachats basalt	46	64	14	8	58	308	20	51 ± 33
Marys Peak sill (Clark, 1969)	22	42	8	26	63	8	8	28 ± 12
Miocene basalts from Oregon Coast	354	52	25	8	67	349	29	0 + 44

Note: D = declination, I = inclination.
* ± indicates 95% confidence limits.

Simpson & Cox 1977

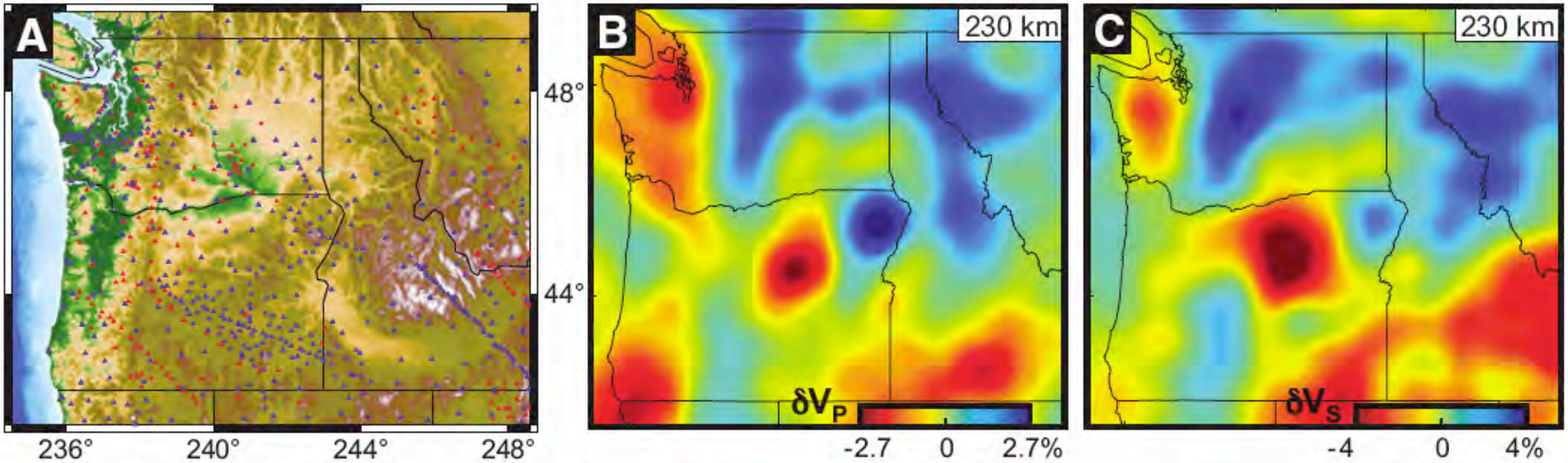


Figure 1. A: Regional topography and stations used in our study. Blue indicates stations used for P and S data; red indicates short-period stations used only for P data. Backarc area underlain by Siletzia is well approximated by low-lying Columbia basin (see Fig. 2). B: P-wave velocity variations. C: S-wave velocity variations.

Schmandt and Humphreys 2011 Seismically imaged relict slab from the 55 Ma Siletzia accretion to the northwest United States Geology v 39, p 175-178.

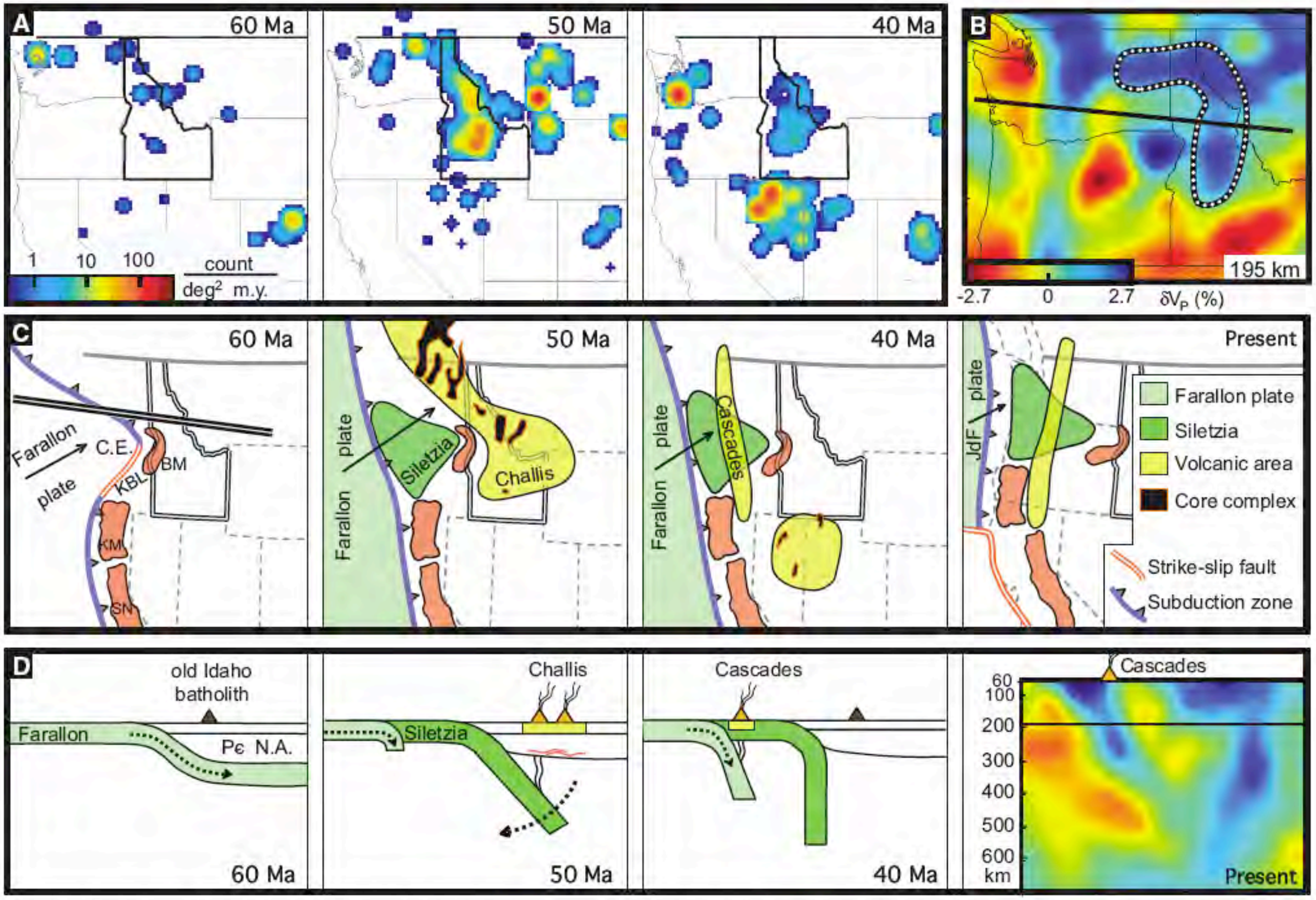


Figure 2. Maps and cross sections of northwestern United States at 60, 50, 40, and 0 Ma. Border of Idaho is highlighted. A: Maps showing density of reported dated igneous rocks from NAVDAT (North American volcanic and intrusive rock database; Walker et al., 2004). Data are binned in time and space (age data distributed equally over reported range, and age uncertainty >10 m.y. rejected). Results are smoothed over 50 km in space and 1 m.y. in time. Large dynamic range requires log scale and indicates variations between lulls and flare-ups. B: P-wave tomography, emphasizing correlation between imaged curtain and Challis magmatism. Dotted line—Siletzia curtain outline. Dark line—location of cross-section A–A′. C: Maps illustrating regional tectonic and magmatic evolution, modified after Dickinson (2006). Intact and coherent units defined by presence of Mesozoic to Cretaceous plutons and associated arc-related rocks are shown in pink; Klamath Mountains (KM), Blue Mountains (BM), and Sierra Nevada (SN). Prior to accretion, 60 Ma, Klamath–Blue Mountains lineament (KBL) is shown as transform boundary (Riddihough et al., 1986). At 60 Ma Farallon plate subducted to northeast in Columbia Embayment (C.E.). Siletzia accreted and subduction stepped west ca. 55–53 Ma, and by 50 Ma Challis magmatism was strong (JdF—Juan de Fuca). D: Cross sections (along B–B′ shown in C, left panel) show our interpretation of subduction history. At 60 Ma, Farallon slab subducts flat against Precambrian (Pє) North America (N.A.). Then, shortly after Siletzia accretion (50 Ma), Cascadia subduction initiates and abandoned, previously flat Farallon slab rolls back, exposing basal North America and Farallon crust to inflowing asthenosphere, causing melting. Event is over by 40 Ma, and little has changed to present, represented by tomography cross section, A–A′.

Schamdt and Humphreys 2011

Forearc migration in Cascadia and its neotectonic significance

Wells et al 1998

Geology pp 659-652.

“The Big Picture”

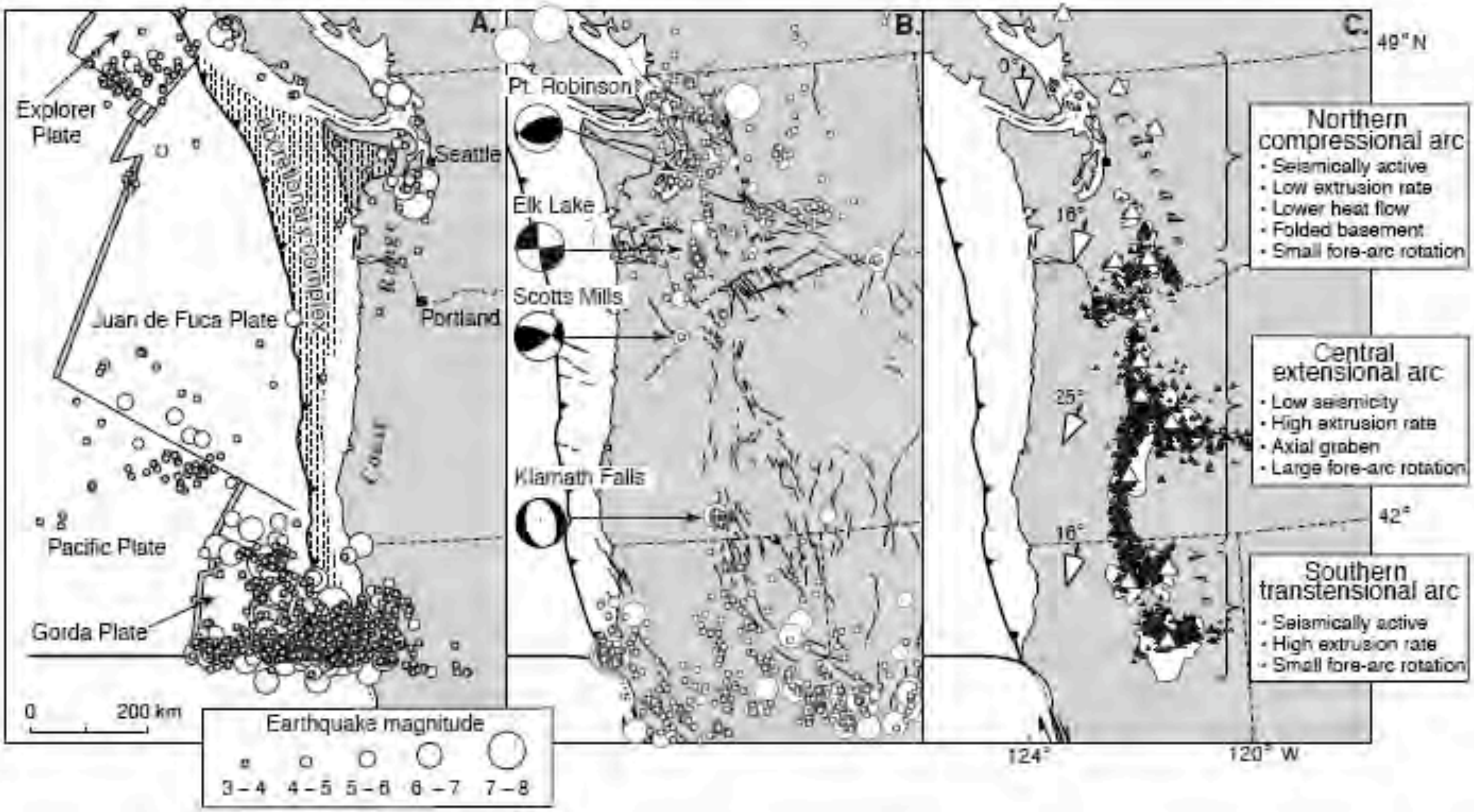


Figure 2. Cascadia earthquakes, faults, volcanoes, and fore-arc rotation (see text). A: Lower plate seismicity. B: Upper plate seismicity, recent focal mechanisms ($M_w > 5$), and late Cenozoic faults. C: Quaternary arc volcanism—white; major volcanoes—open triangles; post–5 Ma volcanic vents—filled triangles; fore-arc rotations with uncertainties—arrows (Pezzopane and Weldon, 1993; Sherrod and Smith, 1990; Guffanti and Weaver, 1988; Wells, 1990; Wiley et al., 1993; Madin et al., 1993).

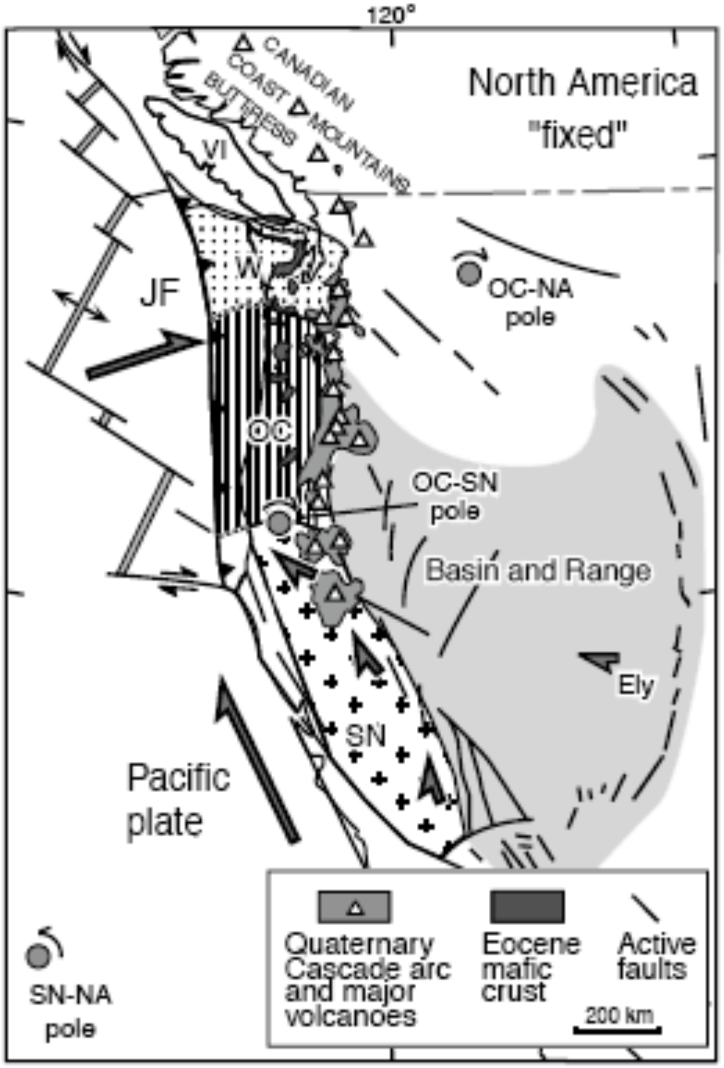
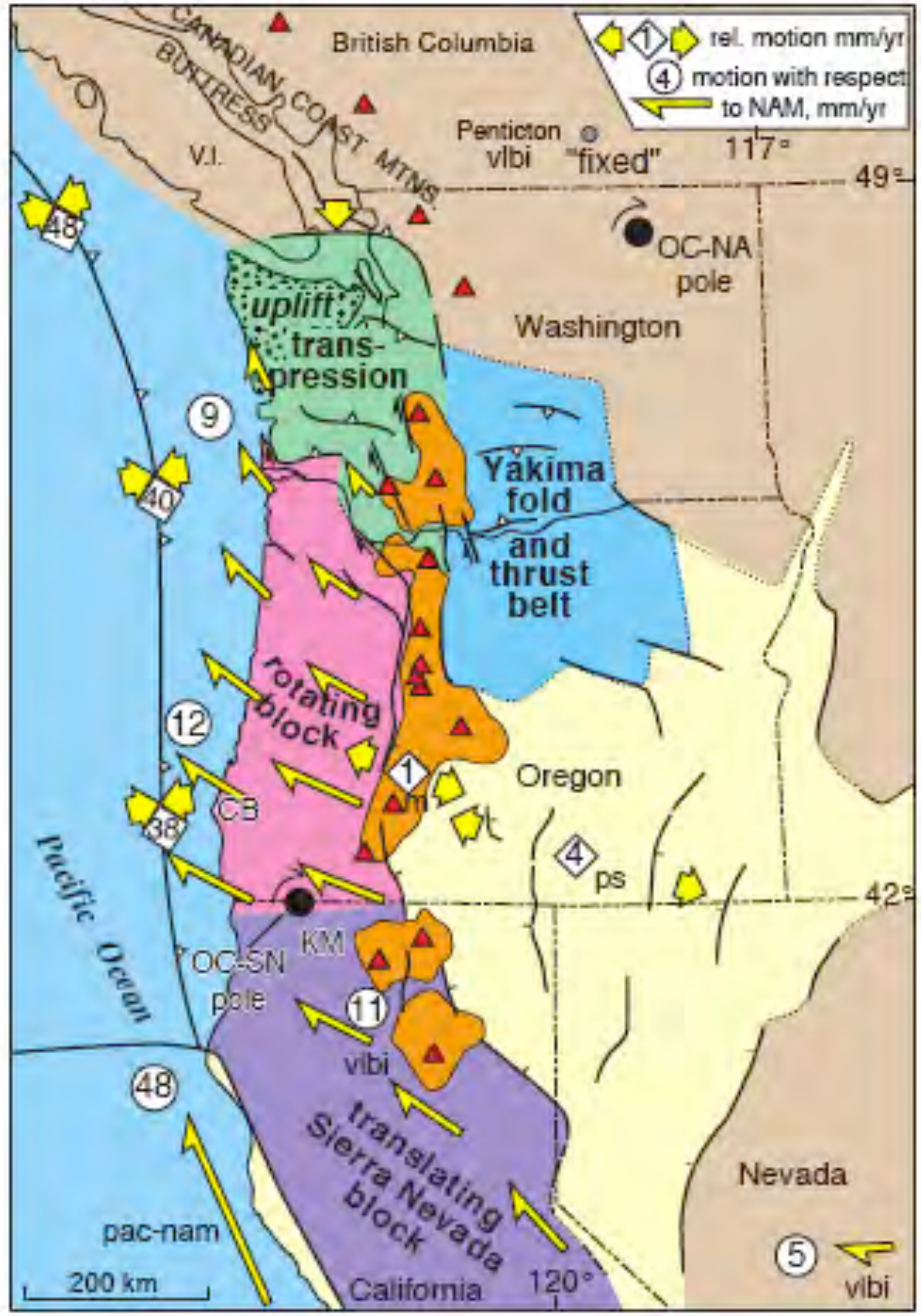


Figure 1. Tectonic setting of Cascadia. Juan de Fuca plate (JF) is subducting (barbed fault) beneath North America. Migrating Cascadia fore-arc terrane divided into Washington (W), Oregon Coastal (OC), and Sierra Nevada blocks (SN). "Instantaneous" Euler rotation poles shown for SN relative to North America (NA), OC-SN, and OC-NA. VI—Vancouver Island.



Terrane

- A crustal block bounded by faults
- Preserves a geologic history that is distinct from adjacent terranes
- Accreted by tectonic processes

The Klamath Mountains

But first a small diversion into obscure corners of petrography

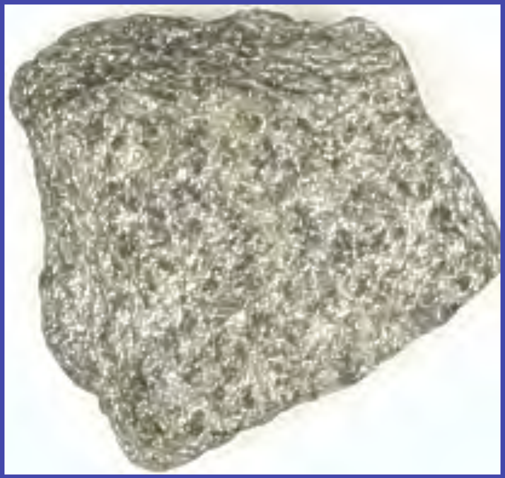
(the study of rocks)

Metamorphic Rock Textures

Claystone
(Unmetamorphosed)

Slate Low Grade

Phyllite Low Grade

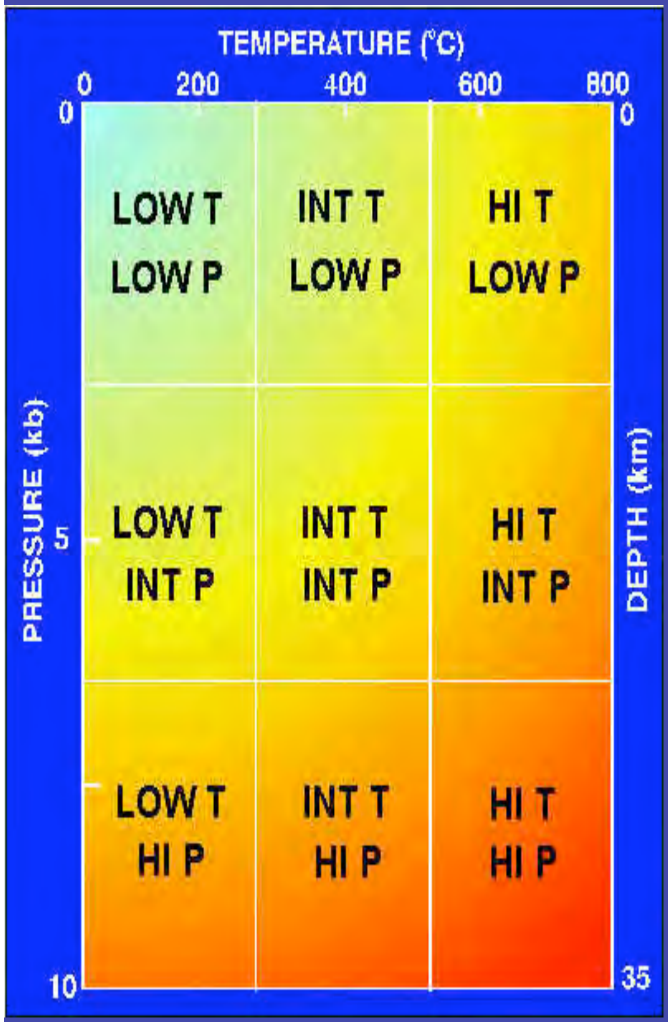


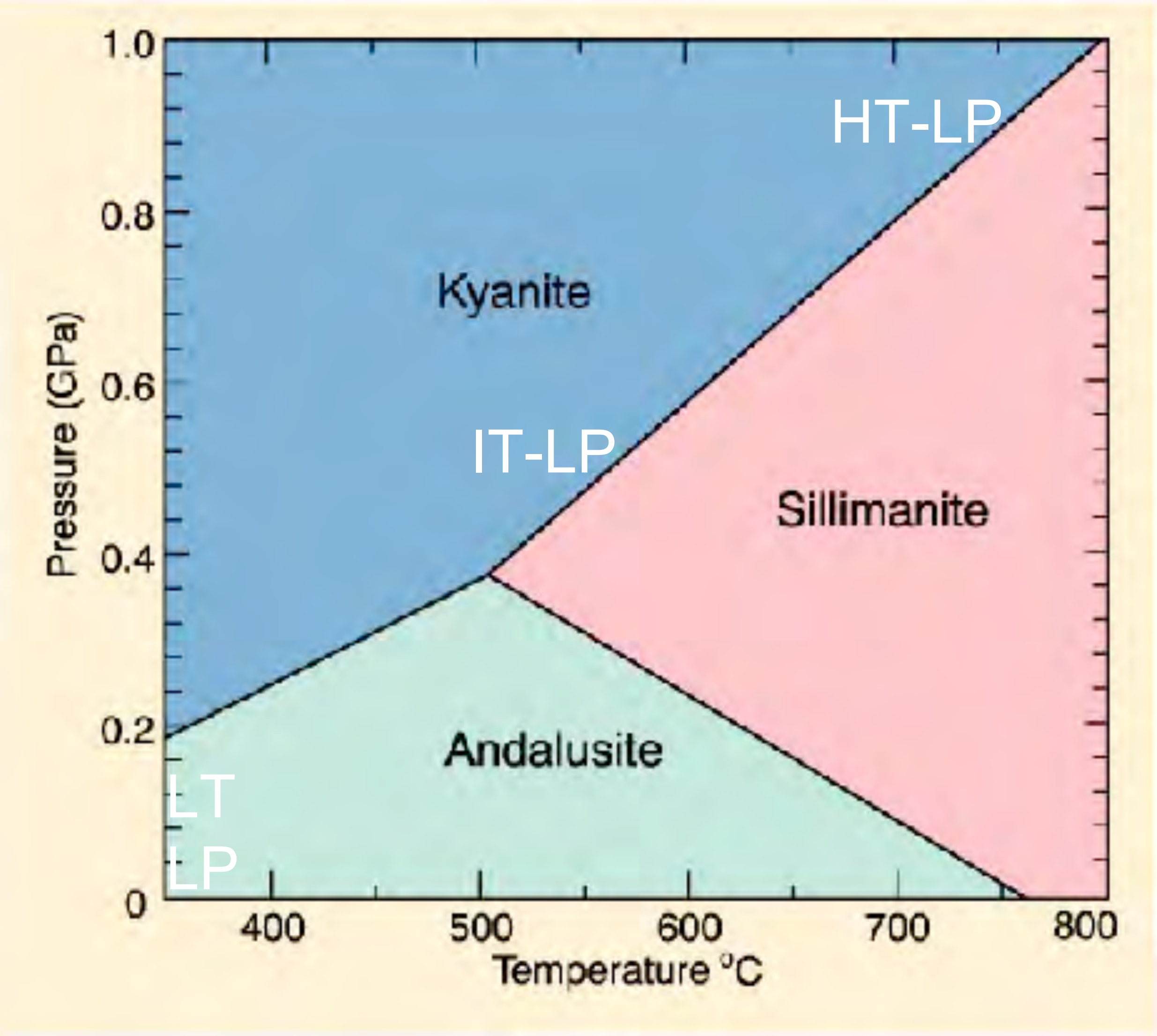
SchistMedium Grade

Gneiss: High Grade

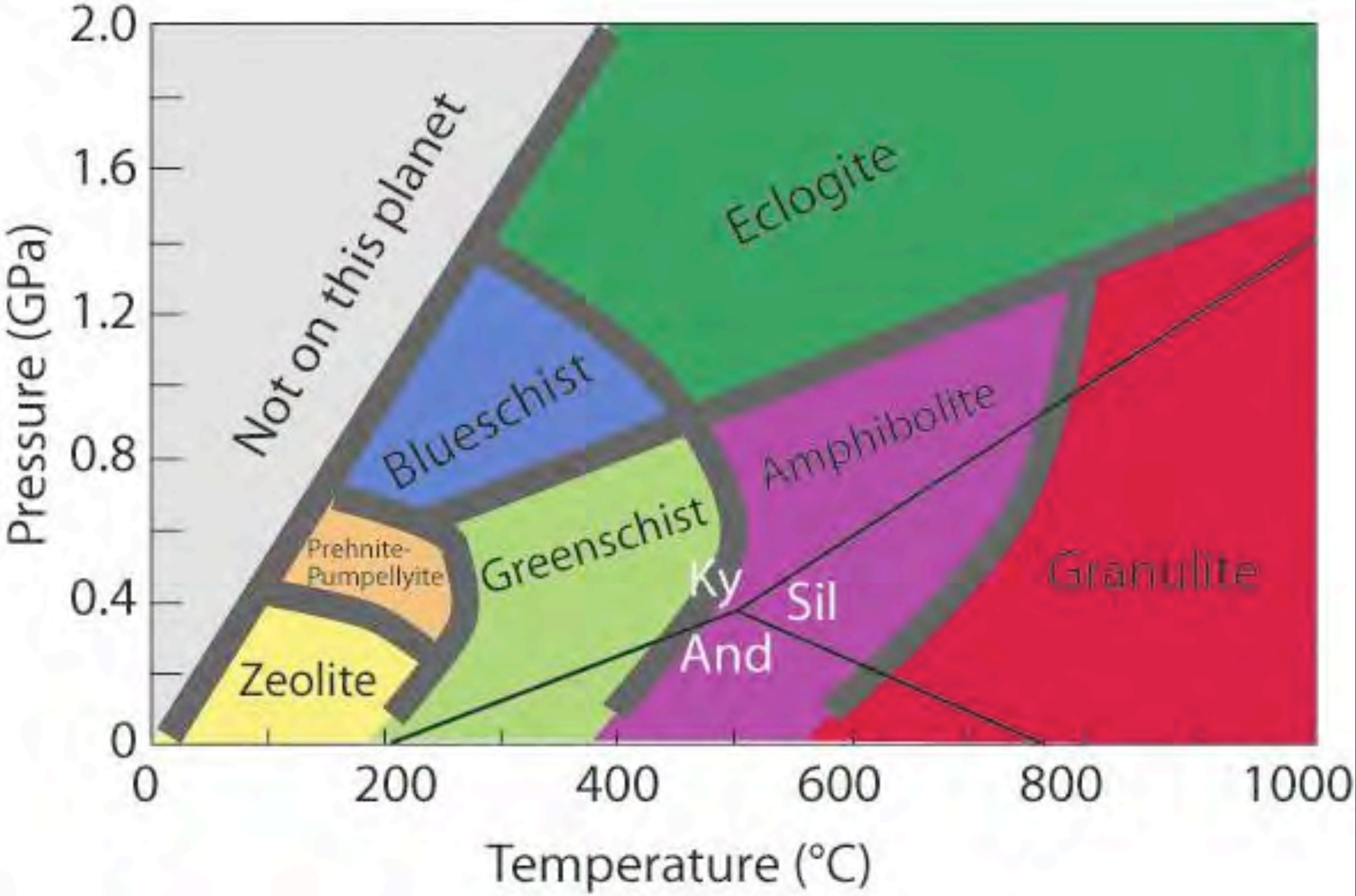
Temperature-Pressure-Grade

Grade Indicator Minerals Al2SiO5





Metamorphic Facies



End of digression.

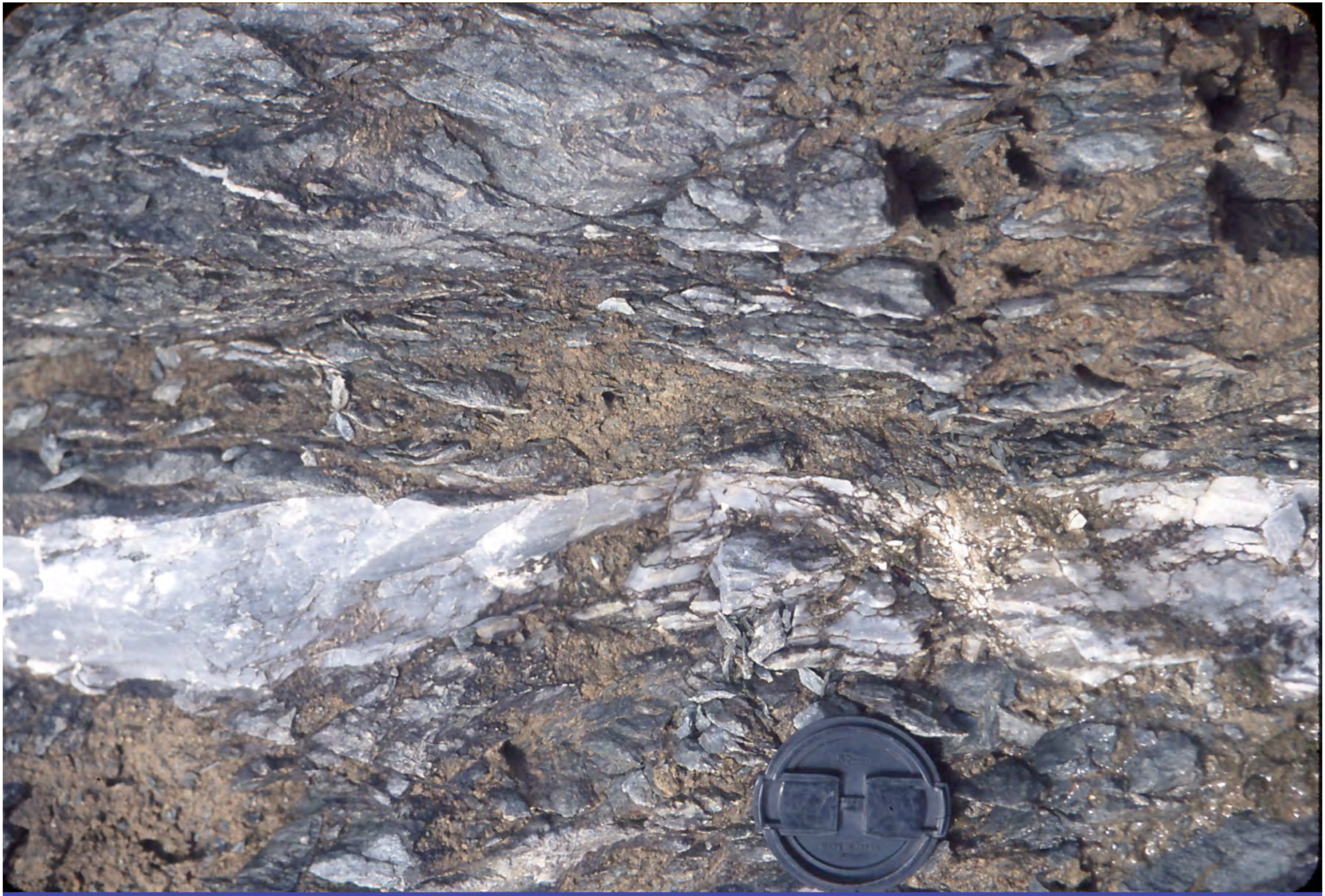
The Klamath Mountains

As seen

Along Interstate 5

Cow Creek Fm gneiss, near Sutherlin, OR

Cow Creek Fm Gniess detail



Cow Creek Fm, metabasalt outcrop

Cow Creek Fm Granite

Hanna Nickel Mine, Riddle, OR

Hanna Nickel Mine, Riddle OR

Serpentinite, I-5, near south of Roseburg, OR

Applegate Fm, near Applegate, OR

Cretaceous Hornbrook Fm, Siskiyou Summit

Klamath Mountains, Klamath & Shasta Lakes, Northern California

Josephine Ophiolite, Trinity Alps, near Yreka, CA

Trinity Alps, near Dunsmuire, CA

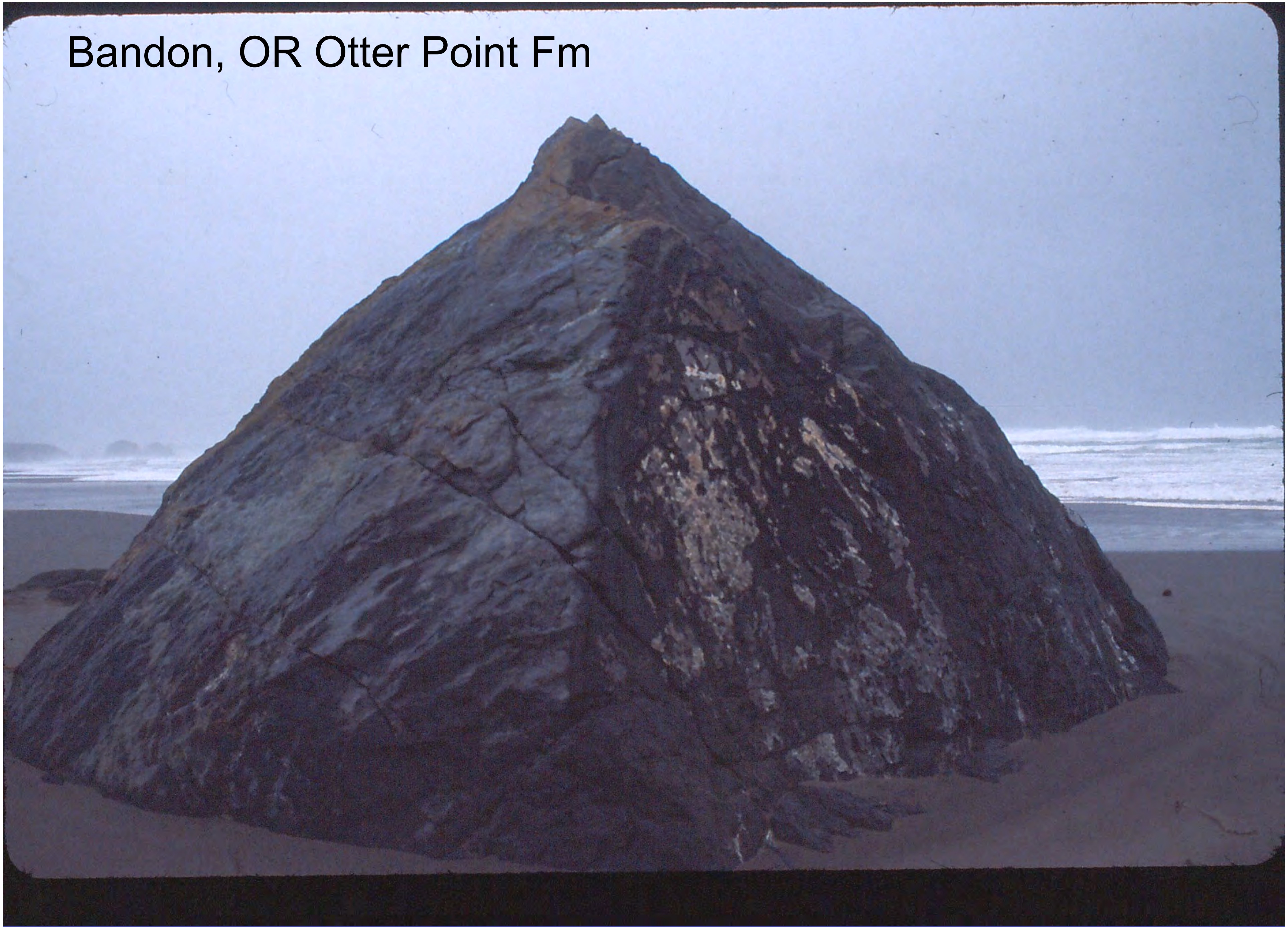
Klamath Mountains

As seen

Along Oregon Coast
And near
Oregon Caves NP

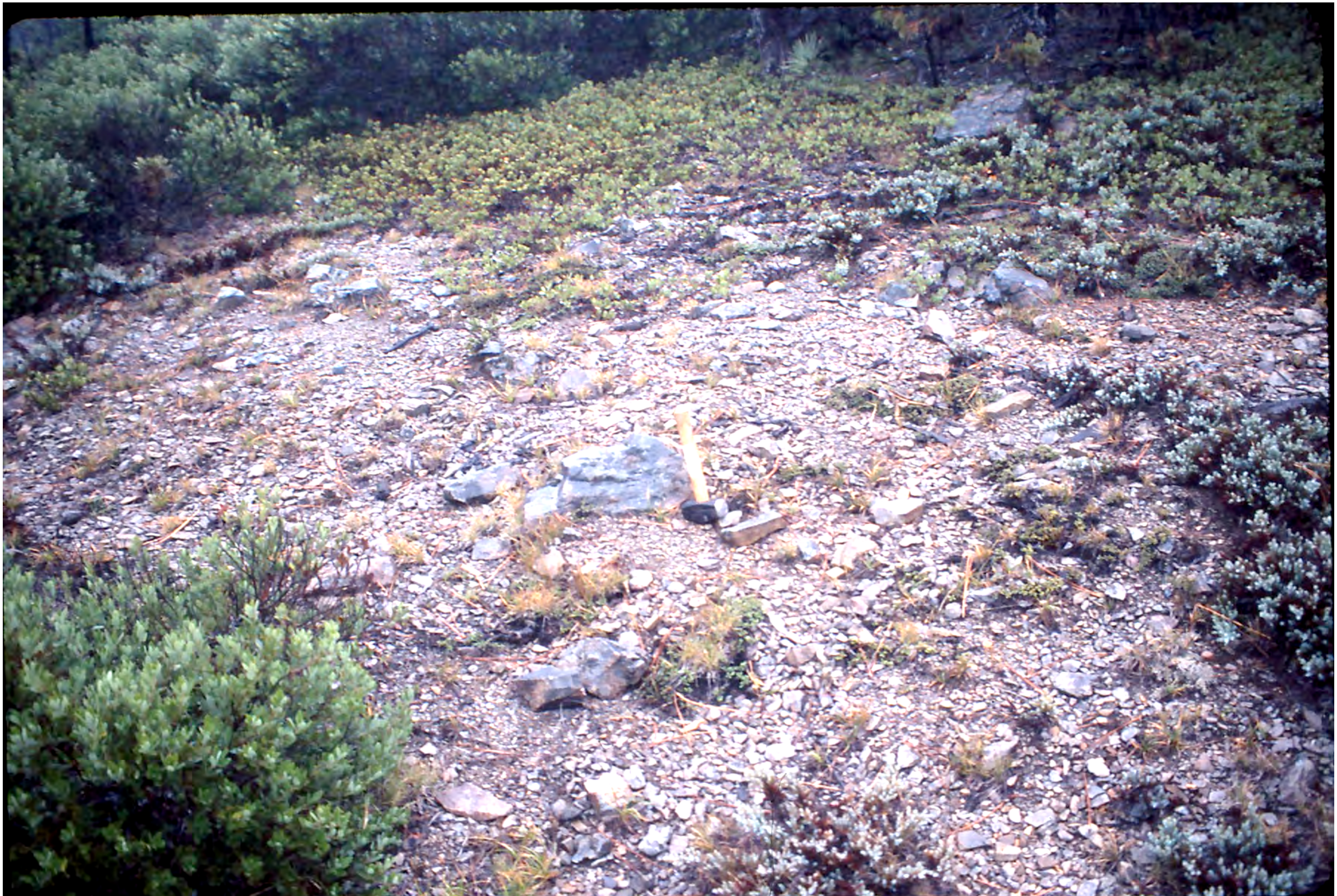

Late Cretaceous deep marine sediments
Cape Sebastian, OR

Otter Creek Fm, Buena Vista Point, OR US 101


Bandon, OR Otter Point Fm

Otter Point Fm meta-basalt, Bandon, OR

Cape Sebastian, Otter Point Fm meta-basalts



Josephine Ophiolite, near US 199, south of Cave Junction, OR

Near Oregon Caves National Park, Meta-sediments

Near Oregon Caves, Permian meta-sediments

Klamath Mountains

Near
Sawyer’s Bar
California


Trinity Alps Rd
ELK GULCH TRAIL 2
BRIDGE CAMP C.G. 3
STUART FK. TRAIL 3

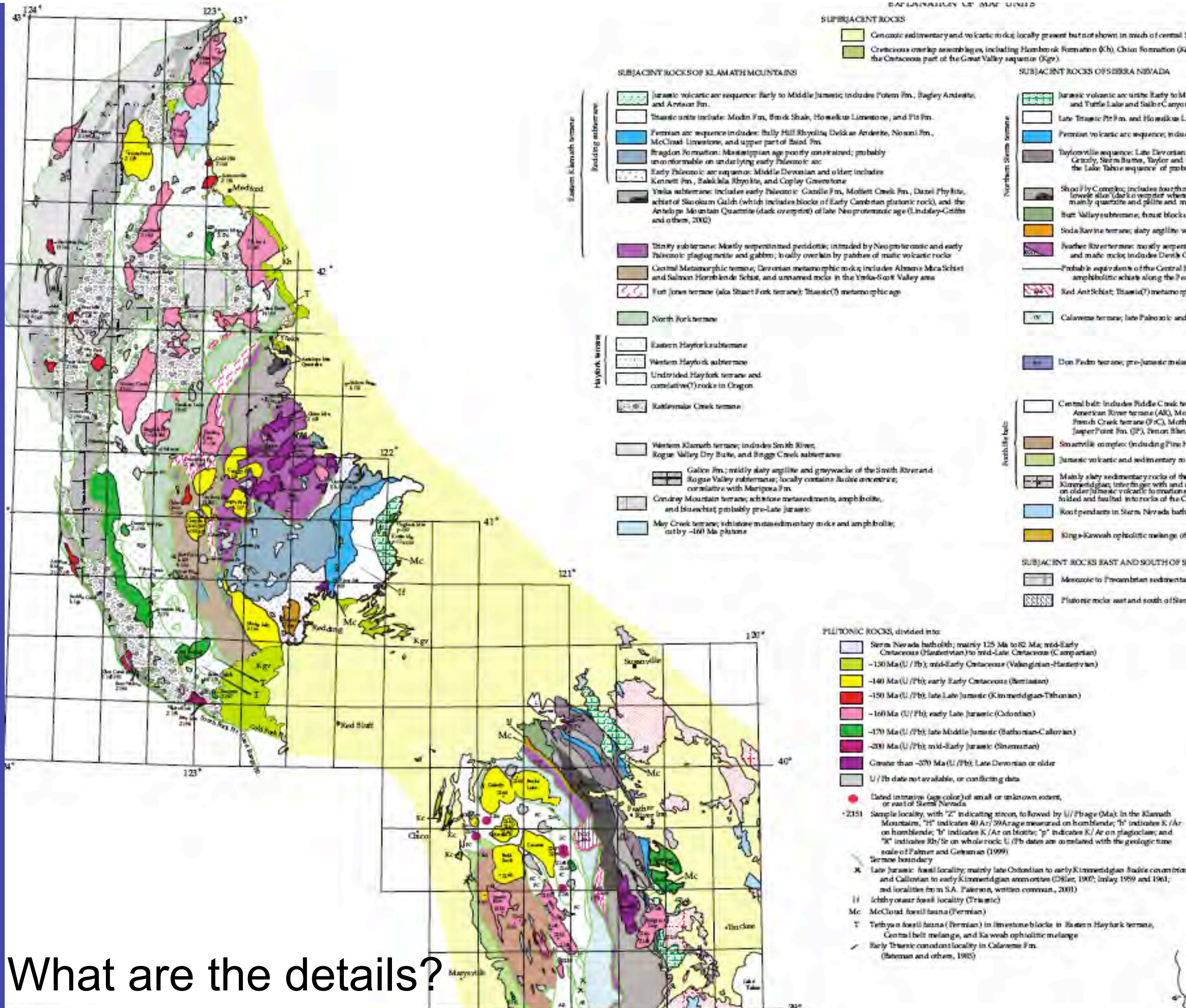

Thrust fault!


Gruss: Weathered Granite


Sawyer’s Bar, CA

Terrane

- A crustal block bounded by faults
- Preserves a geologic history that is distinct from adjacent terranes
- Accreted by tectonic processes



What are the details?

But why worry about this "terrane" concept?

Consider some cherts found here

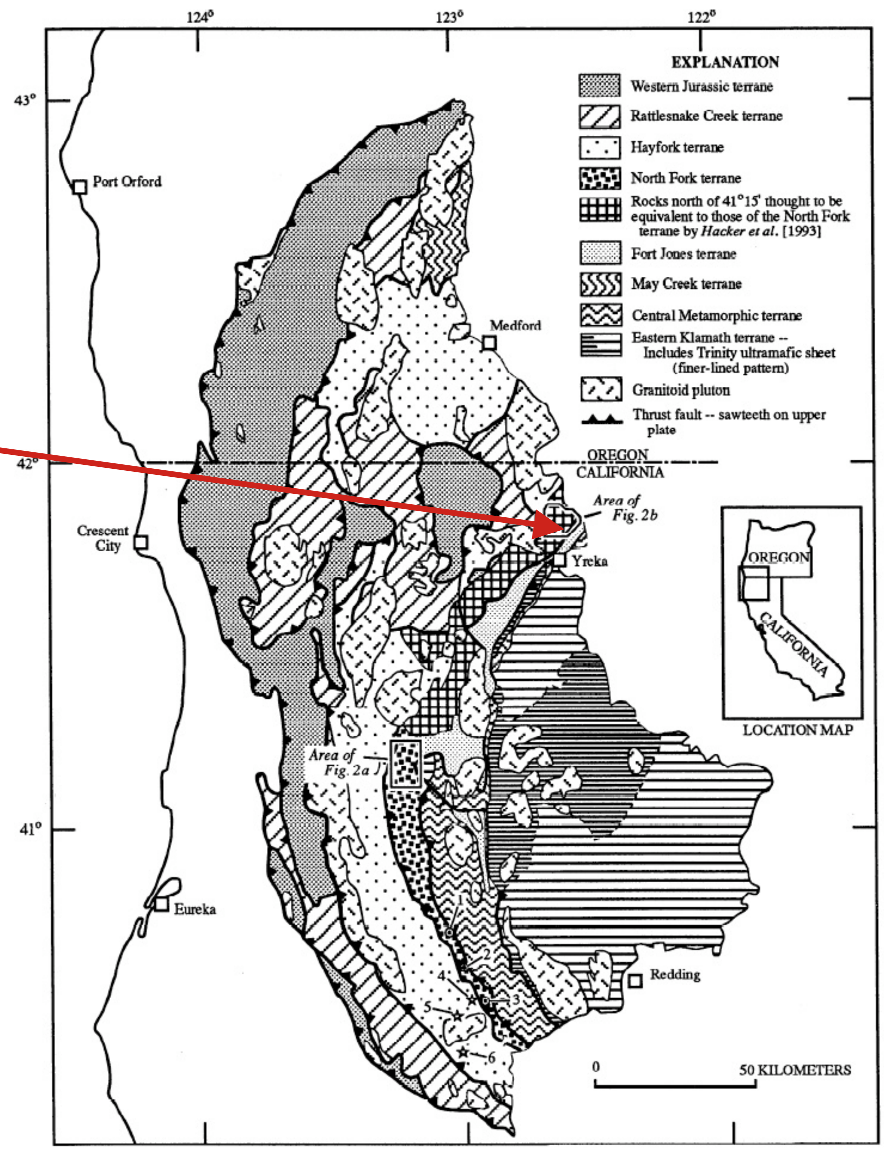
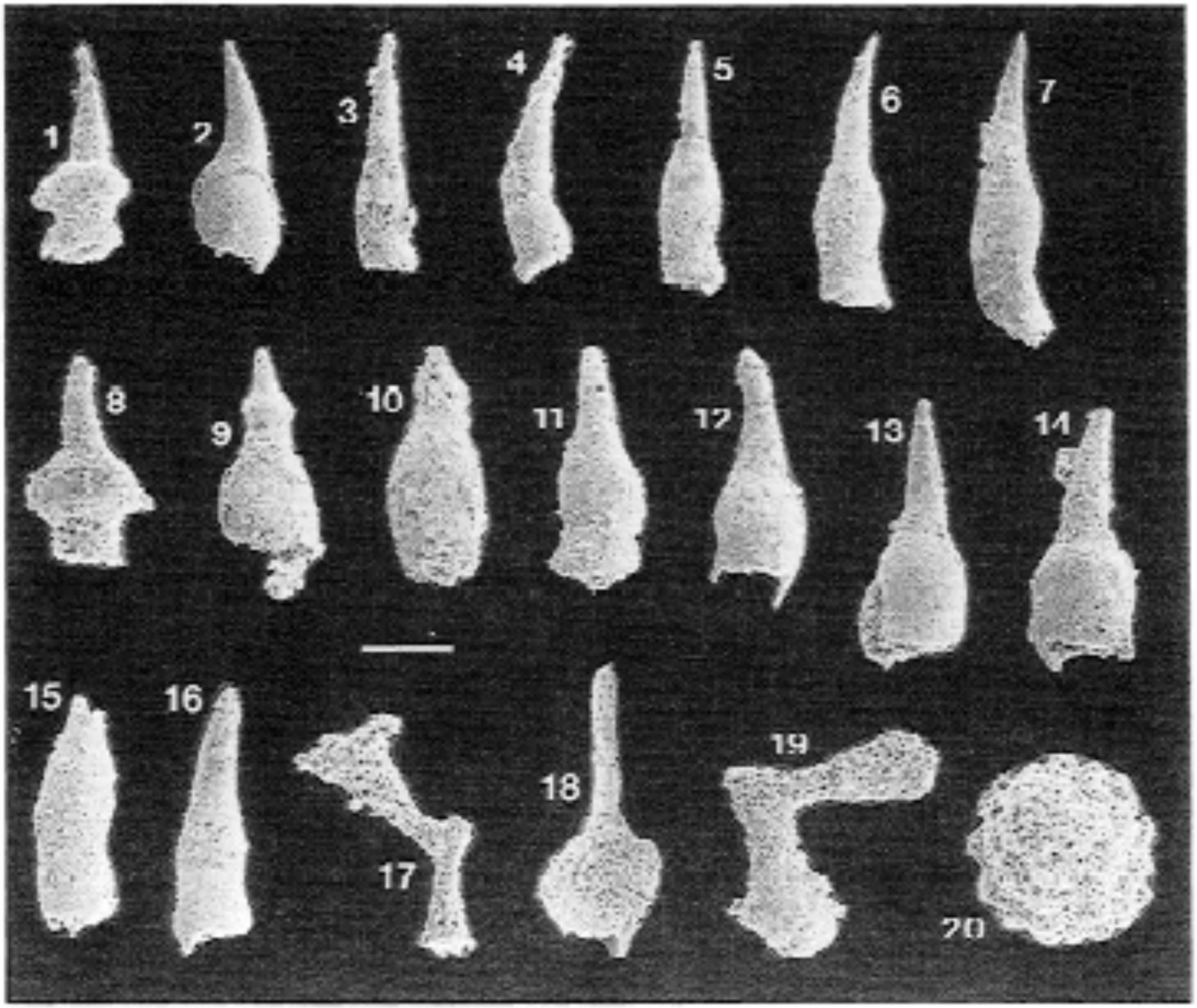


Figure 1. Sketch showing principal terranes of the Klamath Mountains province and areas sampled for paleomagnetism and paleontology. Dots are localities within the North Fork terrane with a schwagerinid fusulind fauna; stars are localities within the Eastern Hayfork terrane with a Tethyan foraminiferal fauna. Localities are 1, Mill Creek (40.71°N, 123.06°W) *Irwin* [1974] Location 1; R.C. Douglass (written communication 1972); 2, Hayfork Summit (40.61°N, 123.00°W) *Irwin* [1974] Location 4; *Luken* [1985] Location 5; 3, Brown's Creek (40.52°N, 122.94°W) R.C. Douglass, as given by *Irwin* [1972]; 4, East Fork Hayfork Creek (40.51°N, 122.98°W) *Luken* [1985] Location 12; 5, Potato Creek (40.47°N, 123.03°W) *Irwin et al.* [1985] Location 3; *Nestell et al.* [1981]; 6, Hall City Cave (40.41°N, 123.01°W) *Irwin et al.* [1985] Locations 7 and 9; *Luken* [1985] Location 24; *Nestell et al.* [1981]. Figure 1 is adapted from *Irwin* [1989] and *Hacker et al.* [1993].

Mankinen et al 1996



e 4. All figures are scanning electron photomicrographs of the radiolarians from site 2 near Willi
; fauna are assignable to the Late Permian *Follicucullus japonicus* Zone of *Ishiga* [1991]. Bar scal

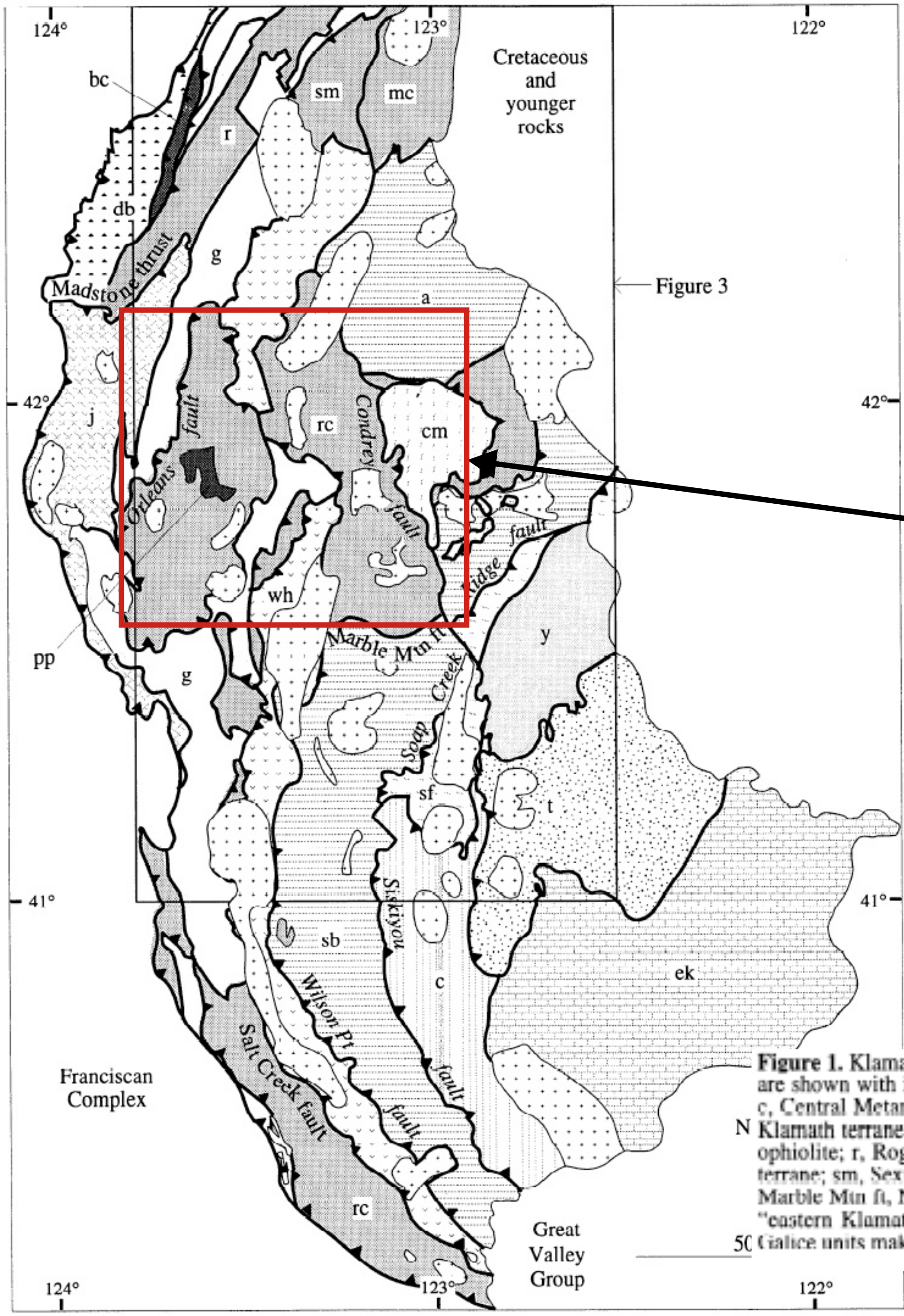
Mankinen et al 1996

These cherts were deposited 10° north of the equator, and then moved another 10° north relative to North America.

So perhaps they sit within a terrane that later accreted to North America.

Figure 12. Dashed line shows indicated paleolatitude for deposition of Permian chert of the North Fork terrane assuming the northern hemisphere option, and the shaded area is its 95% confidence interval. Star shows the present-day position of the Klamath Mountains province.

Mankinen et al 1996

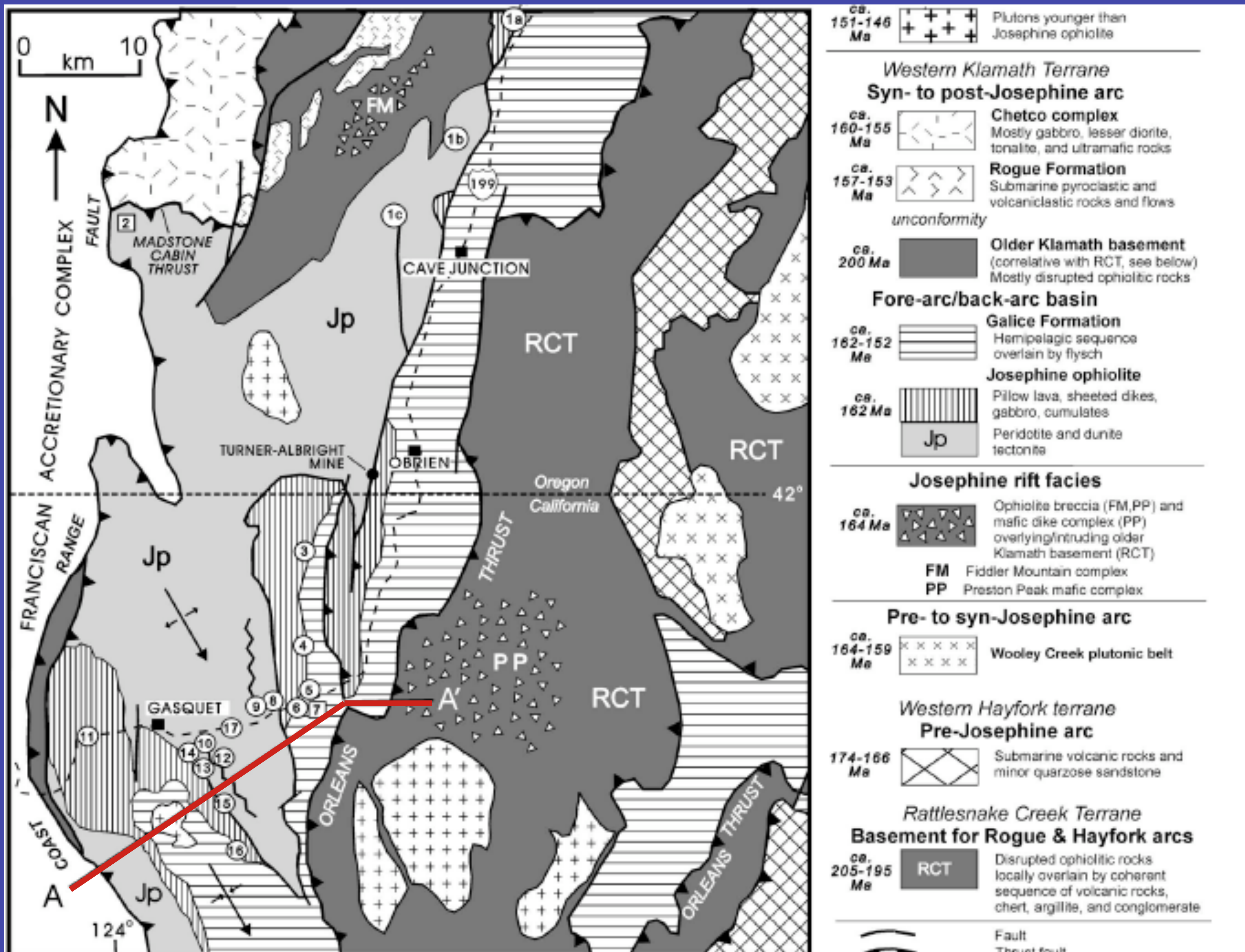


Here is a simplified map of the Klamaths. Thrust faults bound several terranes.

Consider the ophiolites either side of the Cal-Or border.

Figure 1. Klamath Mountains rock units [after *Hacker and Ernst*, 1993]. Potentially correlative terranes are shown with identical patterns. Abbreviations are a, Applegate terrane; bc, Briggs Creek subterrane; c, Central Metamorphic terrane; cm, Condrey Mountain terrane; db, Dry Butte subterrane; ek, Eastern Klamath terrane; g, Galice Formation; j, Josephine ophiolite; mc, May Creek terrane; pp, Preston Peak ophiolite; r, Rogue Formation, rc, Rattlesnake Creek terrane; sb, Sawyers Bar terrane; sf, Stuart Fork terrane; sm, Sexton Mountain terrane; t, Trinity terrane; wh, Western Hayfork terrane; y, Yreka terrane; Marble Mtn ft, Marble Mountains fault. The Yreka, Trinity, and Eastern Klamath terranes compose the "eastern Klamaths" referred to in the text, and the Dry Butte, Rogue, Briggs Creek, Josephine, and Galice units make up the western Klamath terrane.

Hacker et al 1995

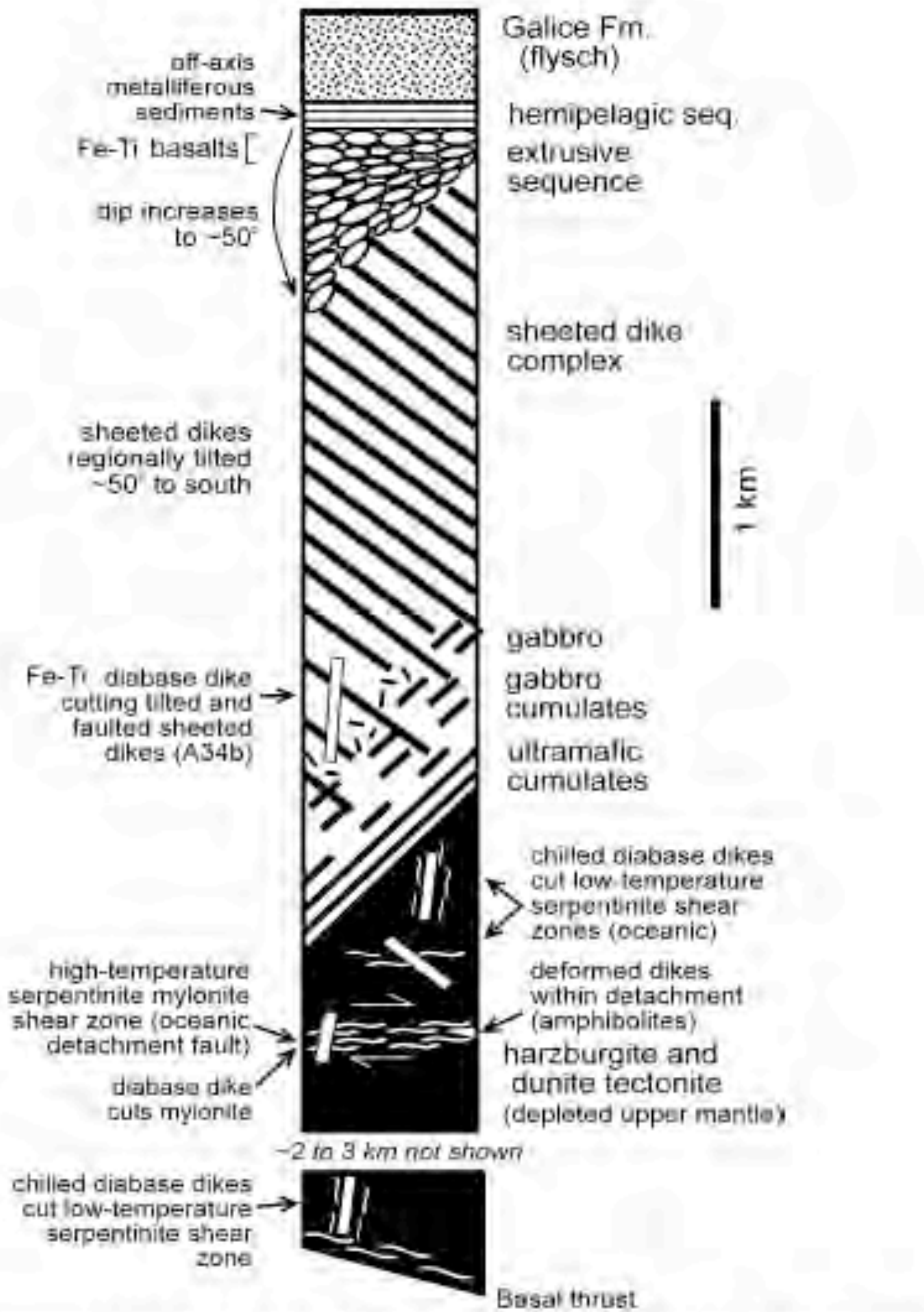


0 km 10
N
FRANCISCAN ACCRETIONARY COMPLEX
FAULT
RANGE
COAST
MADSTONE CABIN THRUST
FM
Jp
RCT
CAVE JUNCTION
199
TURNER-ALBRIGHT MINE
OBRIEN
Oregon
California
42°
THRUST
PP
A′
A
GASQUET
ORLEANS
ORLEANS THRUST
124°
ca. 151-146 Ma
Plutons younger than Josephine ophiolite
Western Klamath Terrane
Syn- to post-Josephine arc
ca. 160-155 Ma
Chetco complex
Mostly gabbro, lesser diorite, tonalite, and ultramafic rocks
ca. 157-153 Ma
Rogue Formation
Submarine pyroclastic and volcaniclastic rocks and flows
unconformity
ca. 200 Ma
Older Klamath basement
(correlative with RCT, see below)
Mostly disrupted ophiolitic rocks
Fore-arc/back-arc basin
ca. 162-152 Ma
Galice Formation
Hemipelagic sequence overlain by flysch
Josephine ophiolite
ca. 162 Ma
Pillow lava, sheeted dikes, gabbro, cumulates
Peridotite and dunite tectonite
Josephine rift facies
ca. 164 Ma
Ophiolite breccia (FM,PP) and mafic dike complex (PP) overlying/intruding older Klamath basement (RCT)
FM Fiddler Mountain complex
PP Preston Peak mafic complex
Pre- to syn-Josephine arc
ca. 164-159 Ma
Wooley Creek plutonic belt
Western Hayfork terrane
Pre-Josephine arc
174-166 Ma
Submarine volcanic rocks and minor quarzose sandstone
Rattlesnake Creek Terrane
Basement for Rogue & Hayfork arcs
ca. 205-195 Ma
Disrupted ophiolitic rocks locally overlain by coherent sequence of volcanic rocks, chert, argillite, and conglomerate
Fault
Thrust fault

Harper 2003

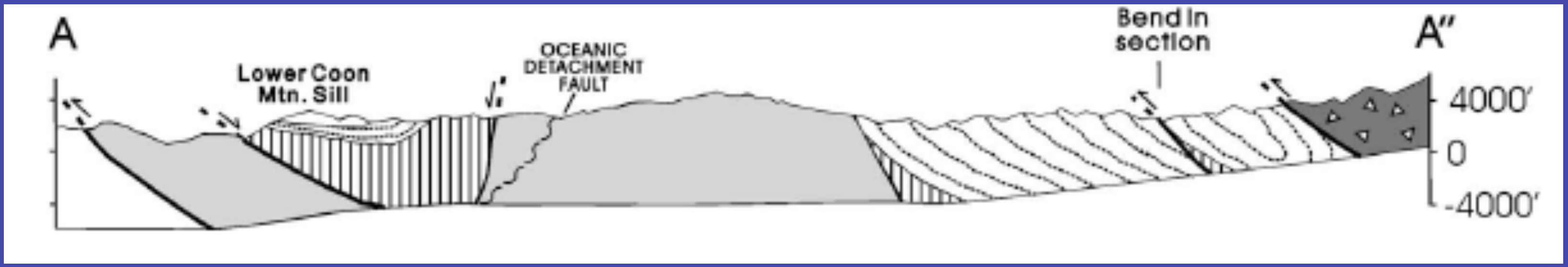
Ophiolite: a slice of ocean crust.

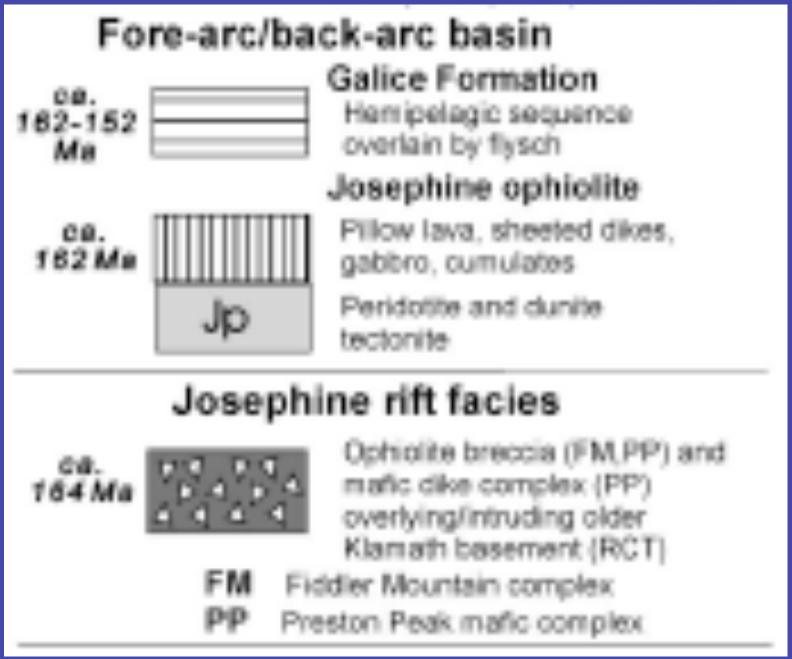
A very common sequence of rocks in the Klamaths.



2. Sequence of lithologies in the Josephine Ophiolite (modified from Harper, 1984,

Harper 2003


A
Lower Coon
Mtn. Sill
OCEANIC
DETACHMENT
FAULT
Bend in
section
A″
4000′
0
-4000′


Fore-arc/back-arc basin
ca.
162-152
Ma
Galice Formation
Hemipelagic sequence
overlain by flysch
Josephine ophiolite
ca.
162 Ma
Pillow lava, sheeted dikes,
gabbro, cumulates
Jp
Peridotite and dunite
tectonite
Josephine rift facies
ca.
164 Ma
Ophiolite breccia (FM,PP) and
mafic dike complex (PP)
overlying/intruding older
Klamath basement (RCT)
FM Fiddler Mountain complex
PP Preston Peak mafic complex

Harper 2003

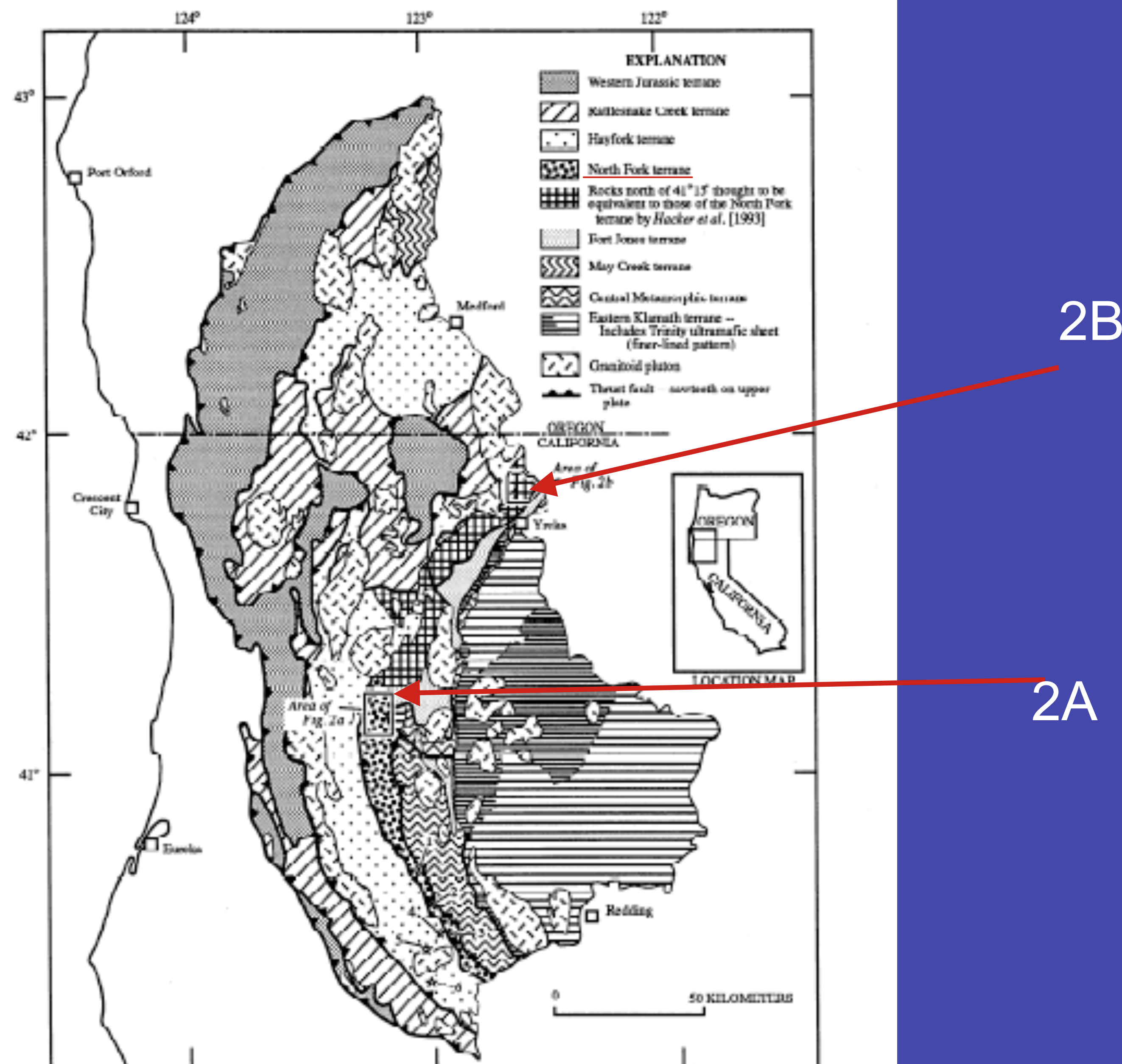
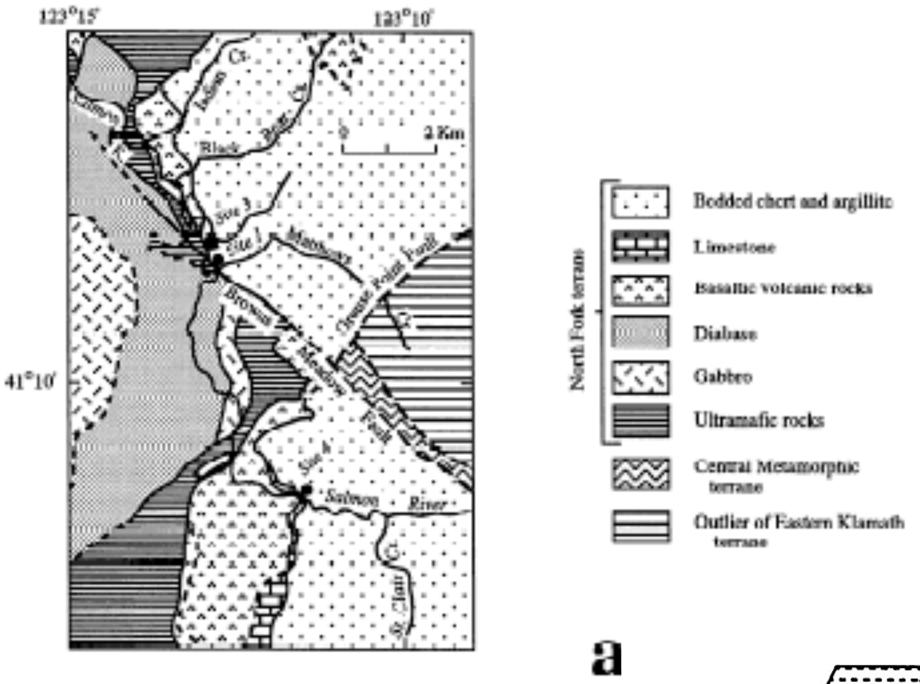


Figure 1. Sketch showing principal terranes of the Klamath Mountains province and areas sampled for paleomagnetism and paleontology. Dots are localities within the North Fork terrane with a schwagerinid fusulind fauna; stars are localities within the Eastern Hayfork terrane with a Tethyan foraminiferal fauna.

More ophiolite sequences



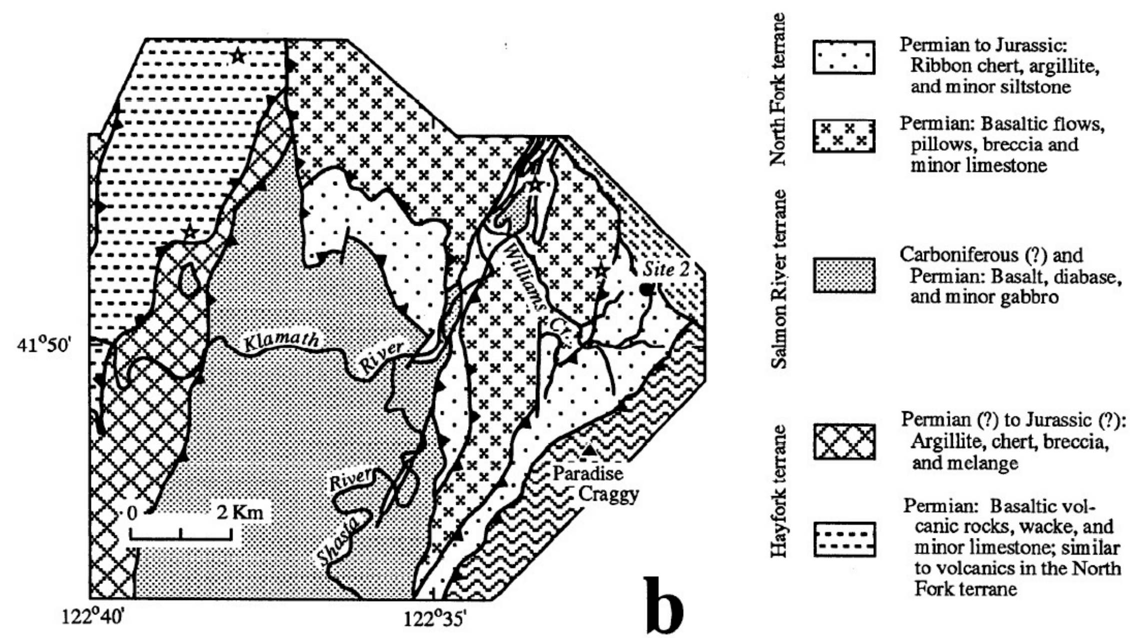


Figure 2. Maps showing areas outlined in Figure 1: (a) Salmon River area showing paleomagnetic sampling sites 1, 3, and 4; adapted from *Ando et al.* [1983] and *Davis* [1968]; (b) Klamath River area north of Yreka showing paleomagnetic sampling site 2. Stars denote locations of fossiliferous limestone discussed in text. Map and terrane assignments are adapted from *Mortimer* [1984].

Makinen 1995

Ernst 1999

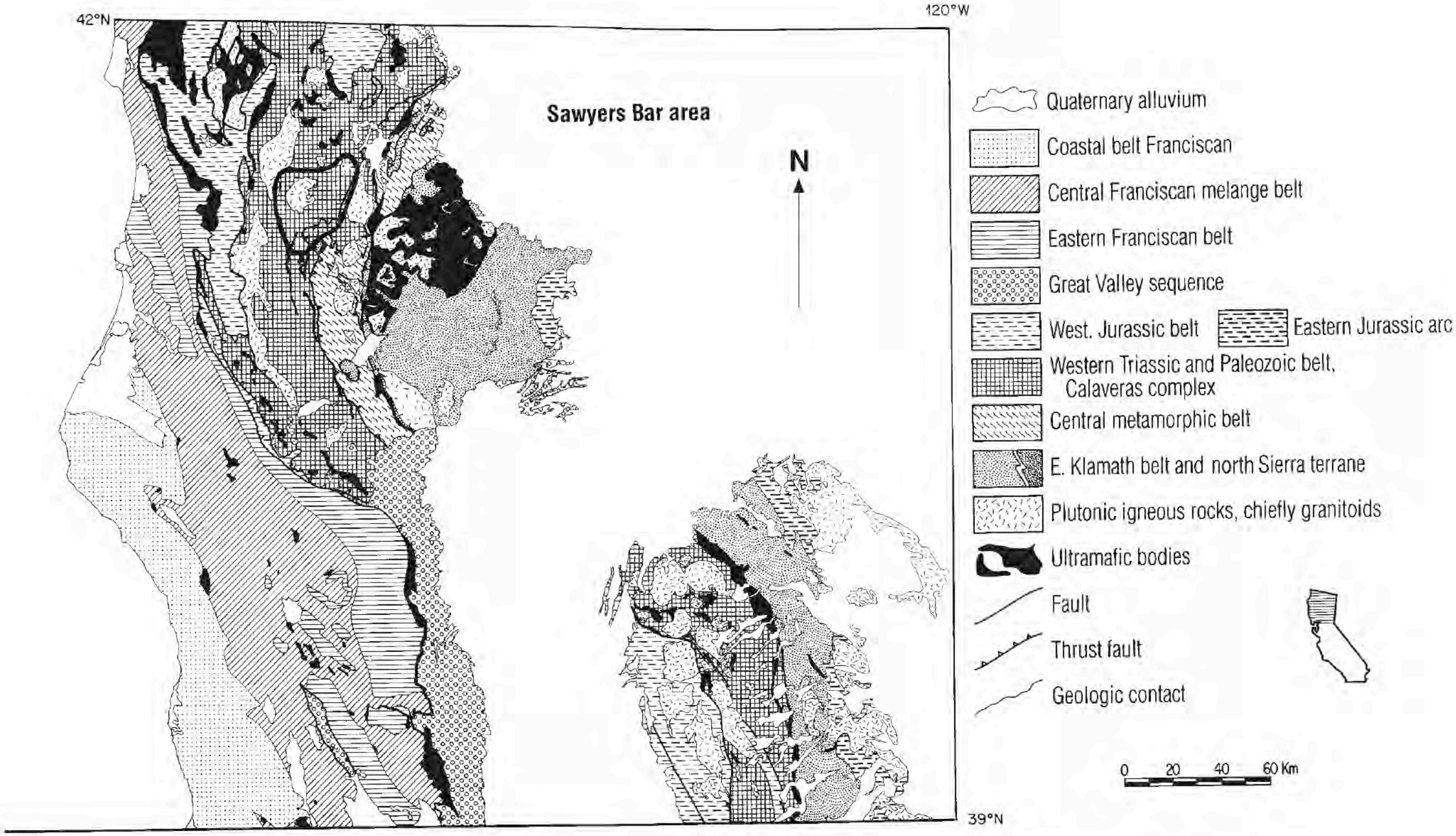
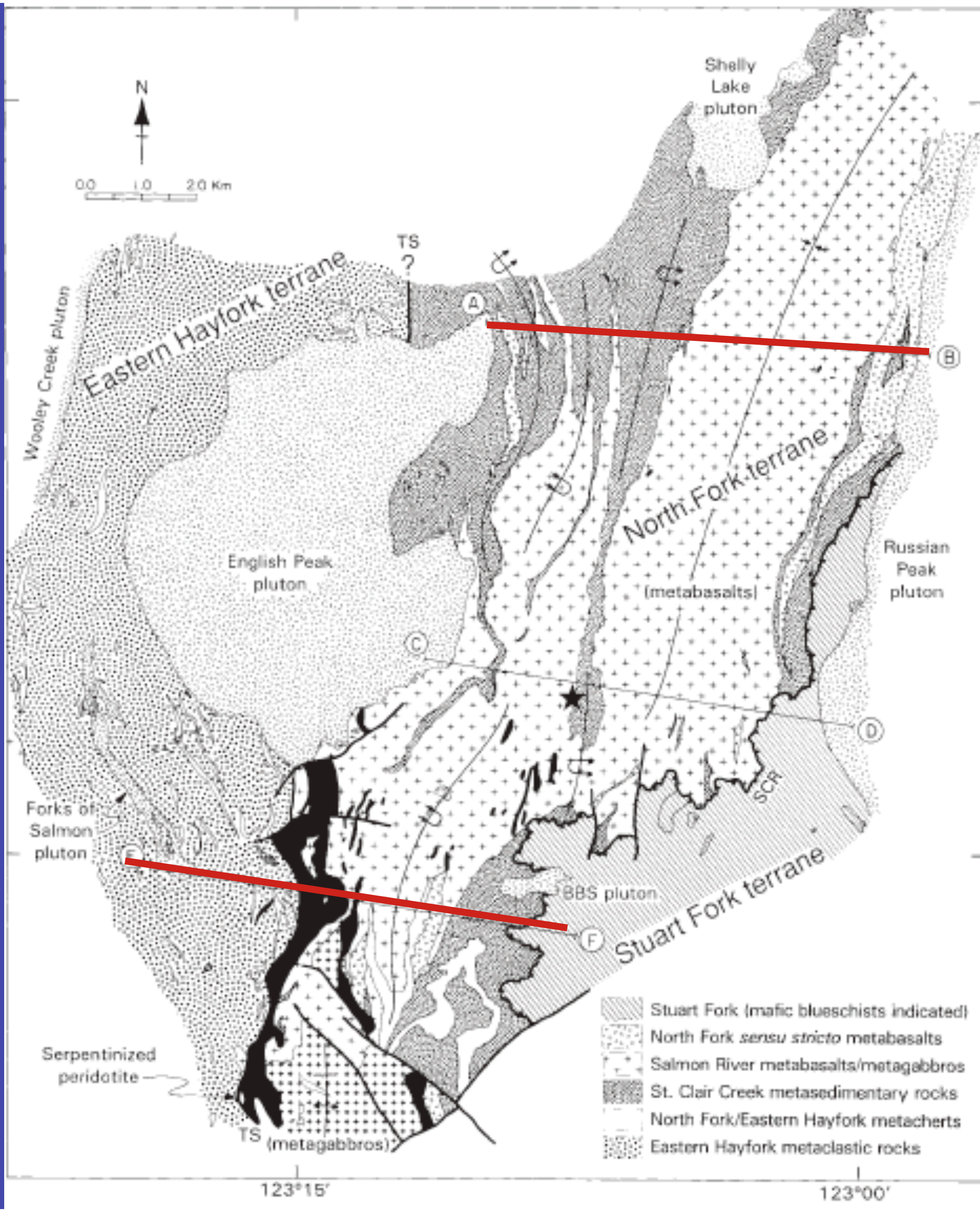
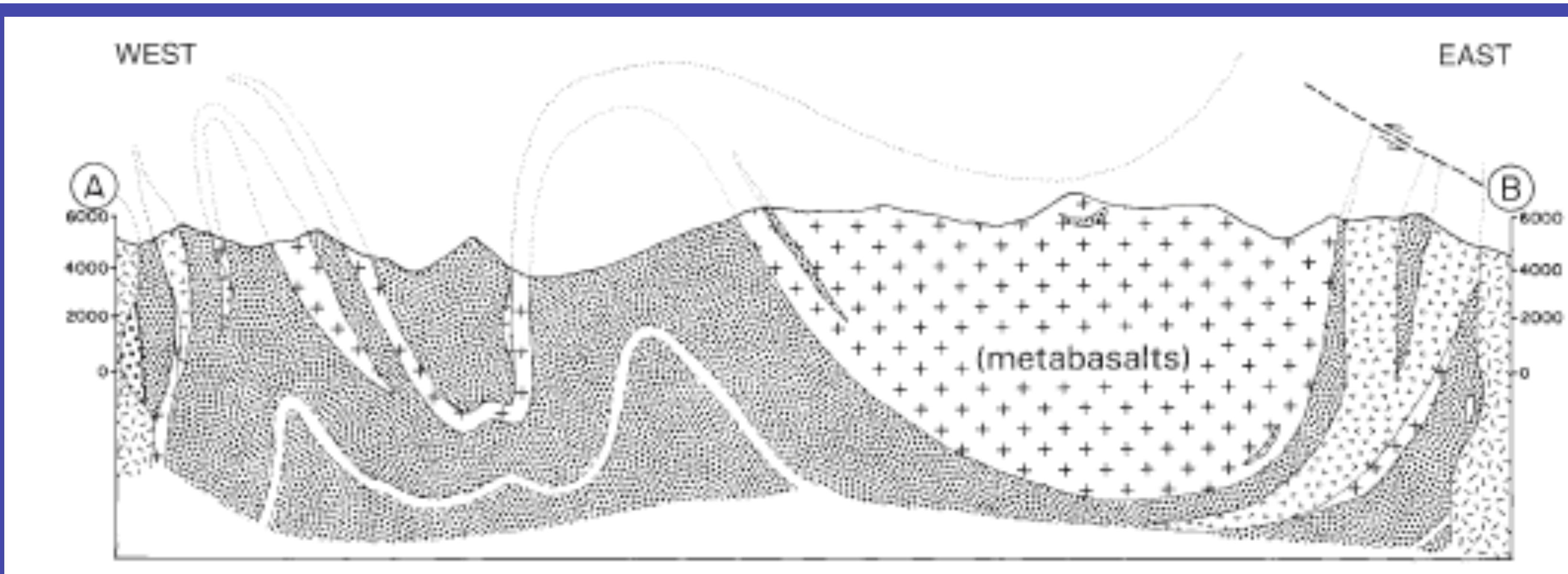


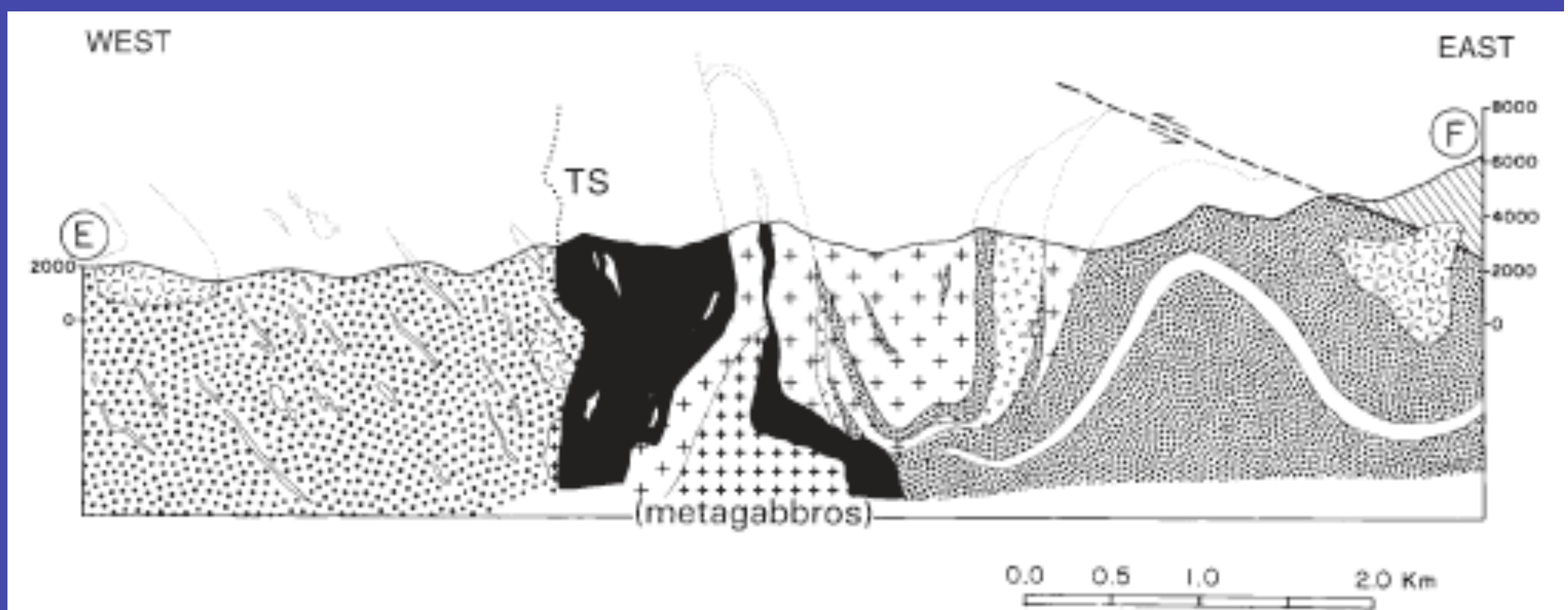
Figure 1. Geologic index map of northernmost California, after Jennings (1977) and Ernst (1983). The disposition of Sierran-Klamath-Franciscan lithotectonic belts reflects progressive seaward continental growth. For simplification in the Klamath Mountains, the Stuart Fork terrane and the Western Triassic and Paleozoic belt are combined.



N
0.0 1.0 2.0 Km
Shelly Lake pluton
41°30'
TS ?
Eastern Hayfork terrane
Wooley Creek pluton
A
B
North Fork terrane
English Peak pluton
(metabasalts)
Russian Peak pluton
C
D
SCR
Forks of Salmon pluton
E
41°15'
BBS pluton
F
Stuart Fork terrane
Serpentinized peridotite
TS (metagabbros)
123°15'
123°00'
Stuart Fork (mafic blueschists indicated)
North Fork sensu stricto metabasalts
Salmon River metabasalts/metagabbros
St. Clair Creek metasedimentary rocks
North Fork/Eastern Hayfork metacherts
Eastern Hayfork metaclastic rocks

Ernst 1999


WEST
EAST
A
B
6000
4000
2000
0
(metabasalts)


WEST
EAST
E
F
TS
8000
6000
4000
2000
0
(metagabbros)
0.0
0.5
1.0
2.0 Km

Ernst 1999

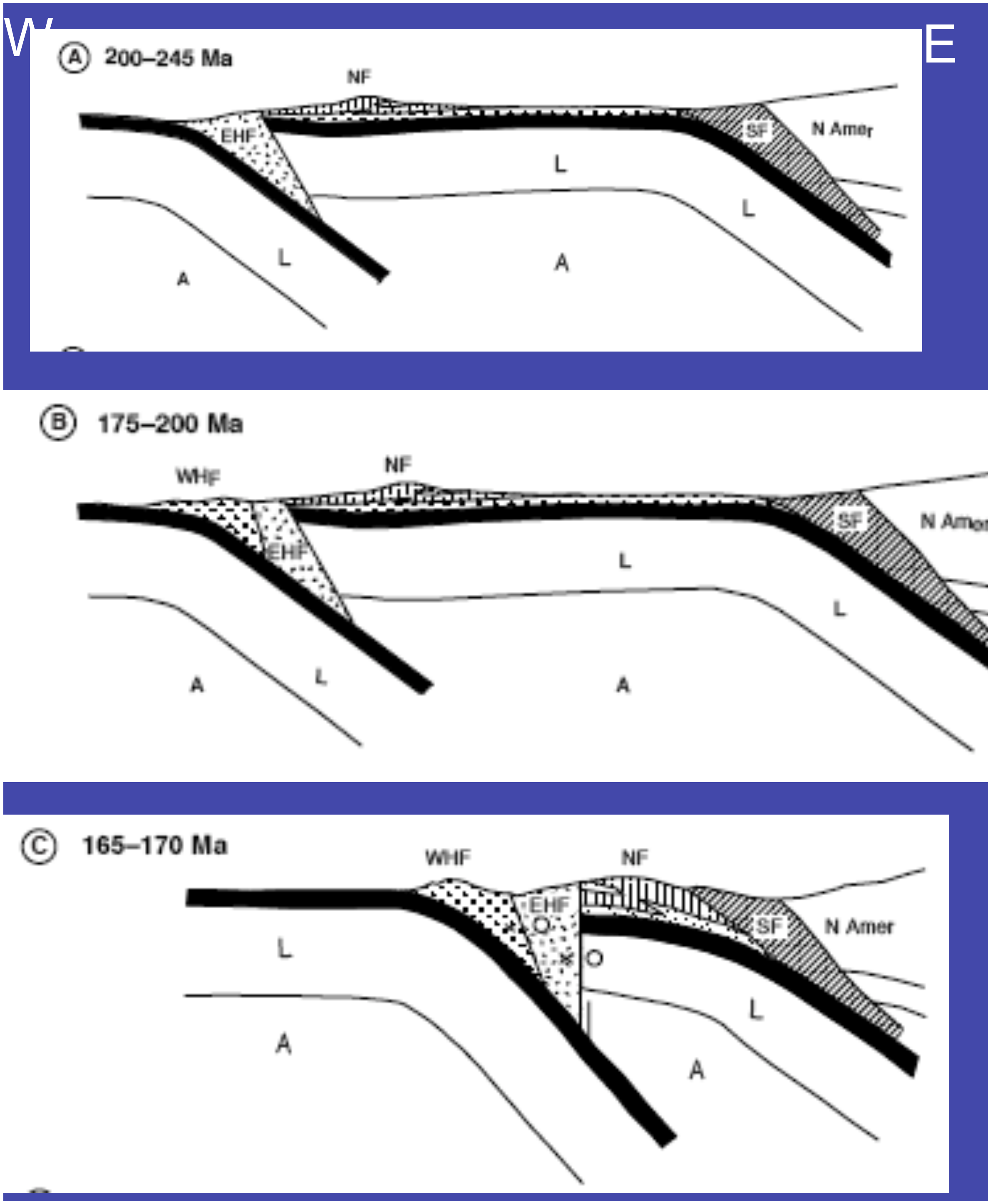


Figure 6. Speculative plate tectonic history of the central portion of the Western Paleozoic and Triassic belt, based on detailed mapping, petrotectonics, and geochemistry of the Sawyers Bar area. View is to the north. Abbreviations: A—asthenosphere; L—lithosphere; WHF—Western Hayfork terrane; EHF—Eastern Hayfork terrane; NF—North Fork terrane; and SF—Stuart Fork terrane. (A) Triassic-earliest Jurassic time; eastern subduction zone becomes inactive and Stuart Fork terrane is sequestered at midcrustal levels by ca. 227 Ma; (B) Early and Middle Jurassic time; Western Hayfork is juxtaposed against inboard Eastern Hayfork through consumption of intervening basin or due to transpression; (C) late Middle Jurassic time; outer subduction zone is still active (X indicates relative movement into the plane of section, i.e., northward; bull's eye indicates relative movement out of the plane of section, i.e., southward); and (D) early Late Jurassic time; local termination of convergence and thermal relaxation. See text for discussion.

Ernst 1999

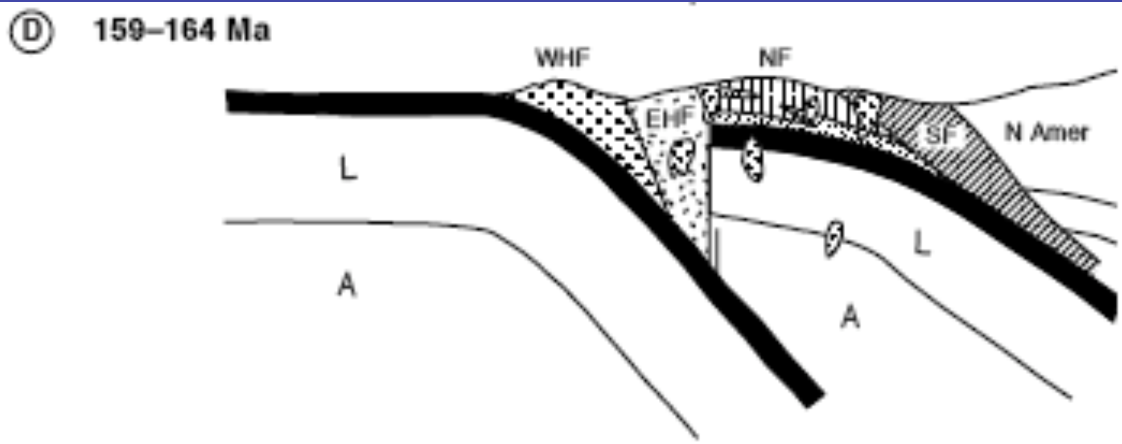


Figure 6. Speculative plate tectonic history of the central portion of the Western Paleozoic and Triassic belt, based on detailed mapping, petrotectonics, and geochemistry of the Sawyers Bar area. View is to the north. Abbreviations: A—asthenosphere; L—lithosphere; WHF—Western Hayfork terrane; EHF—Eastern Hayfork terrane; NF—North Fork terrane; and SF—Stuart Fork terrane. (A) Triassic-earliest Jurassic time; eastern subduction zone becomes inactive and Stuart Fork terrane is sequestered at midcrustal levels by ca. 227 Ma; (B) Early and Middle Jurassic time; Western Hayfork is juxtaposed against inboard Eastern Hayfork through consumption of intervening basin or due to transpression; (C) late Middle Jurassic time; outer subduction zone is still active (X indicates relative movement into the plane of section, i.e., northward; bull's eye indicates relative movement out of the plane of section, i.e., southward); and (D) early Late Jurassic time; local termination of convergence and thermal relaxation. See text for discussion.

Ernst 1999

Hacker et al 1995

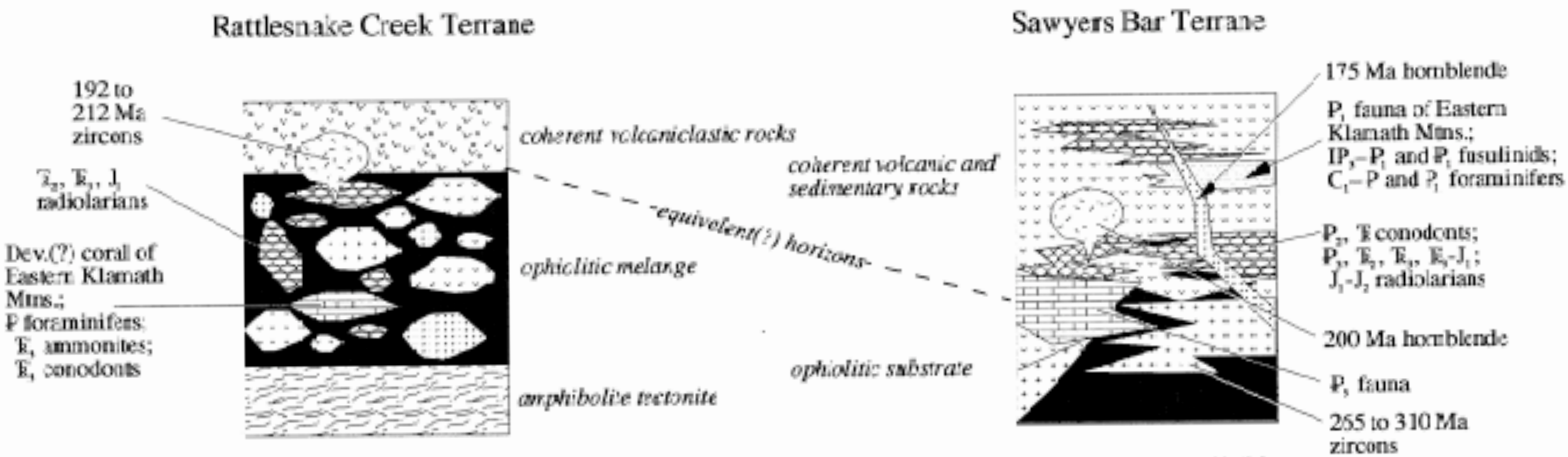


Figure 2. Comparison of Rattlesnake Creek and Sawyers Bar terranes. Both contain Paleozoic ophiolitic basement overlain by Early Jurassic(?) volcanoplutonic centers. Subscripts 1, 2, and 3 to period names refer to Early/Lower, Middle, and Late/Upper, respectively. See references in text.

Ophiolites in different parts of the Klamaths . . .

How do we assign ages to these cross sections?

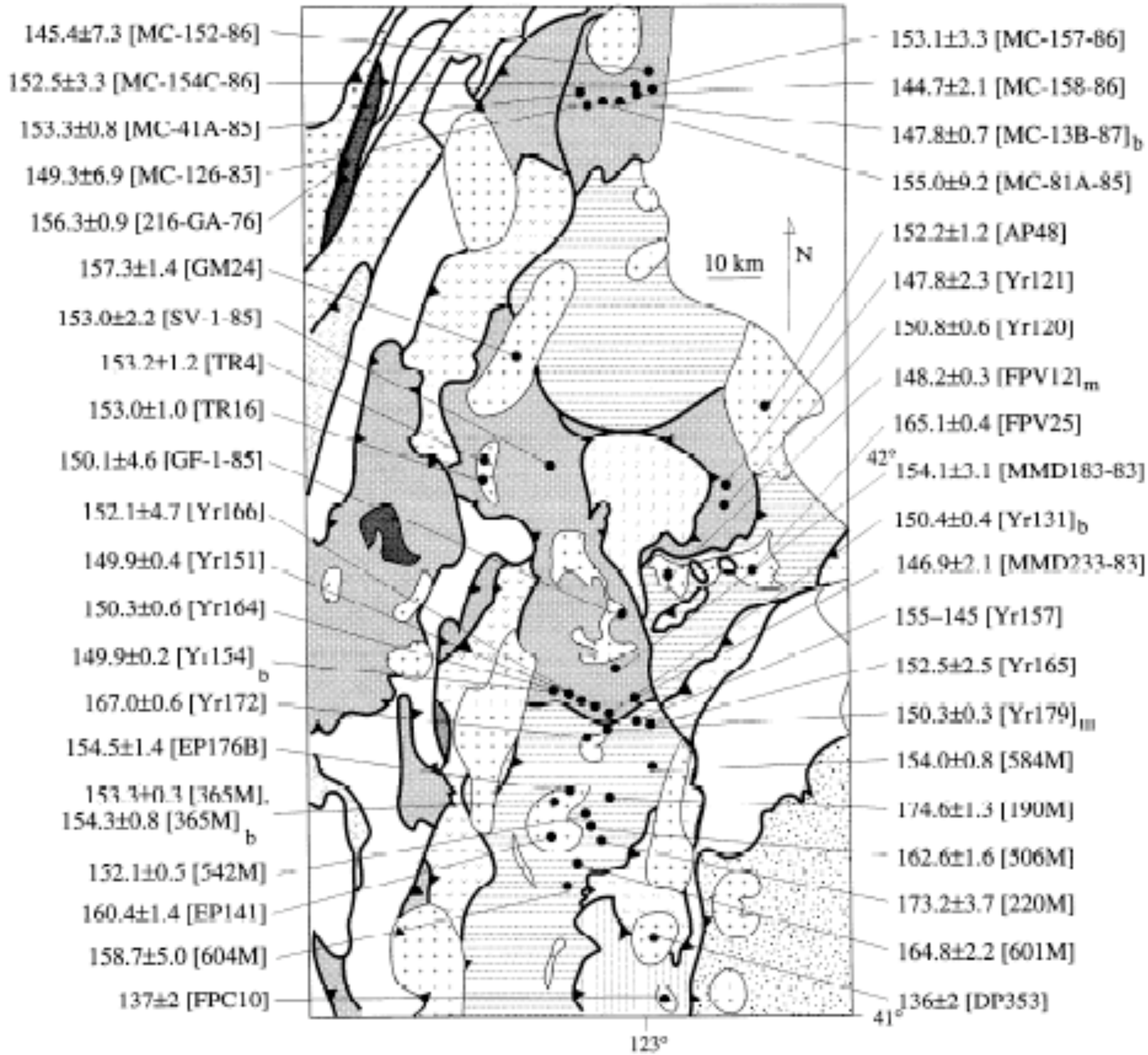


Figure 3. New $^{40}Ar/^{39}Ar$ ages; all are hornblende, except for biotite and muscovite ages labeled with b and m, respectively. See Figure 1 for location and unit names. For additional ages from this same general area, see *Hacker et al.* [1993].

Hacker et al 1995

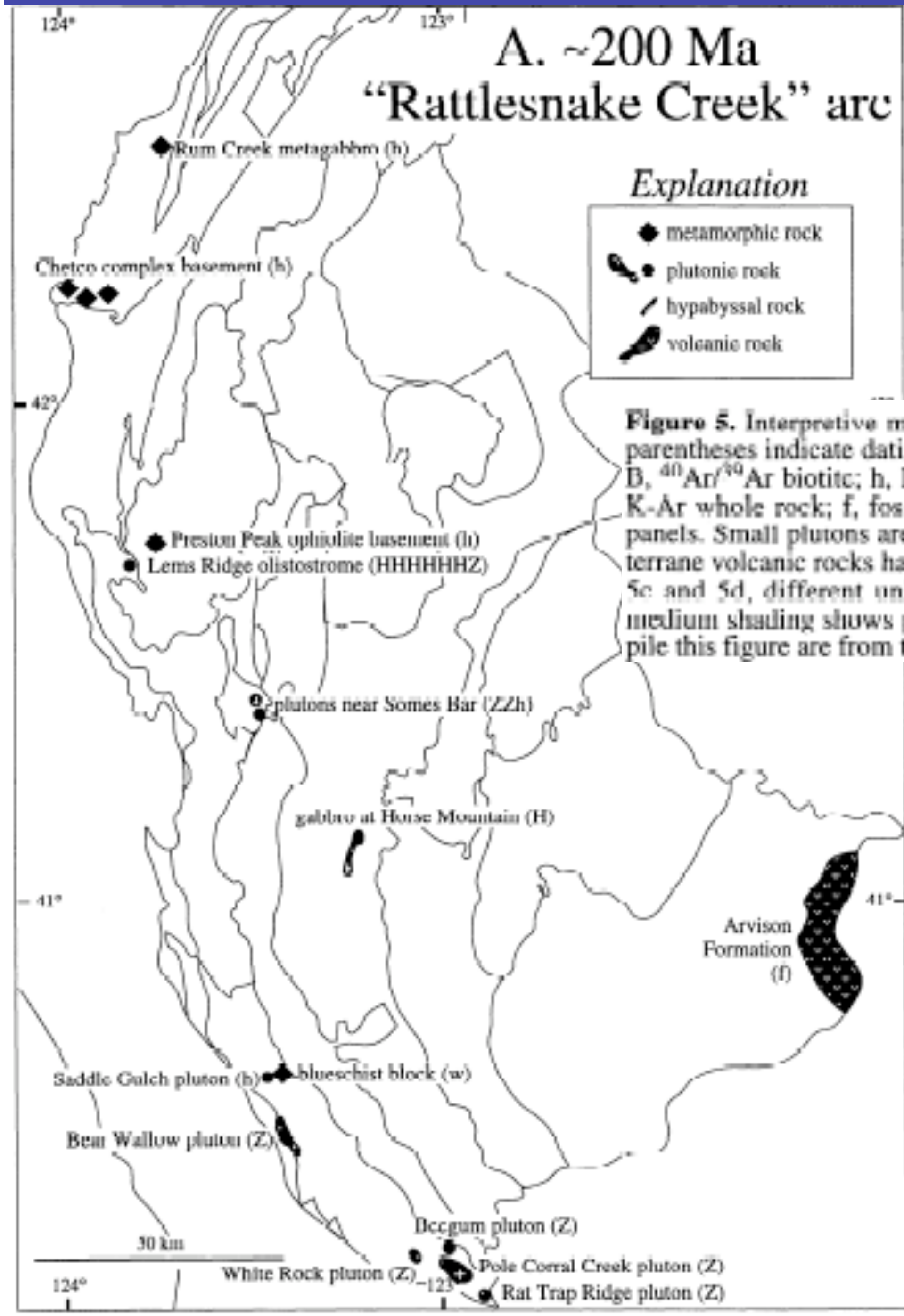
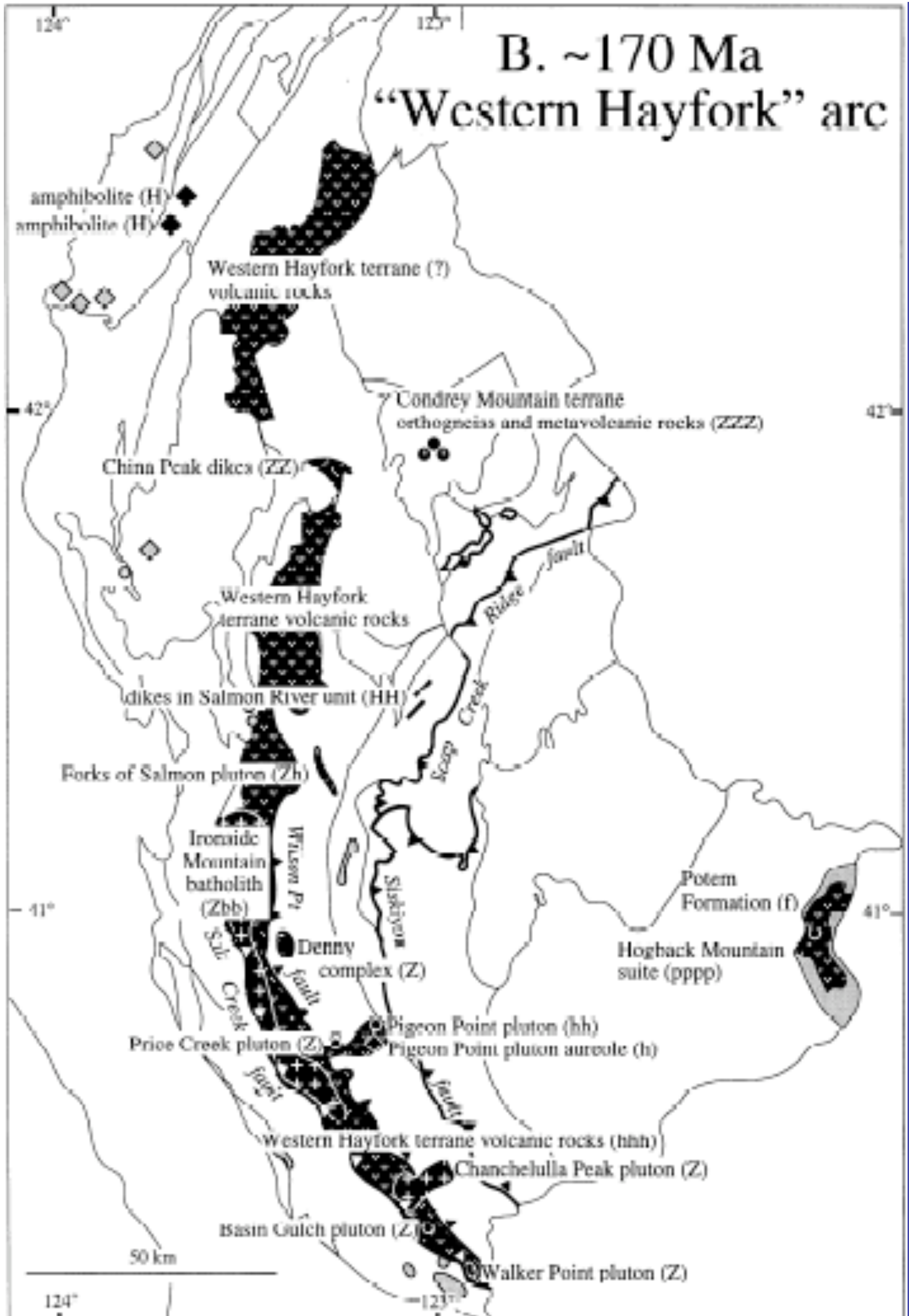
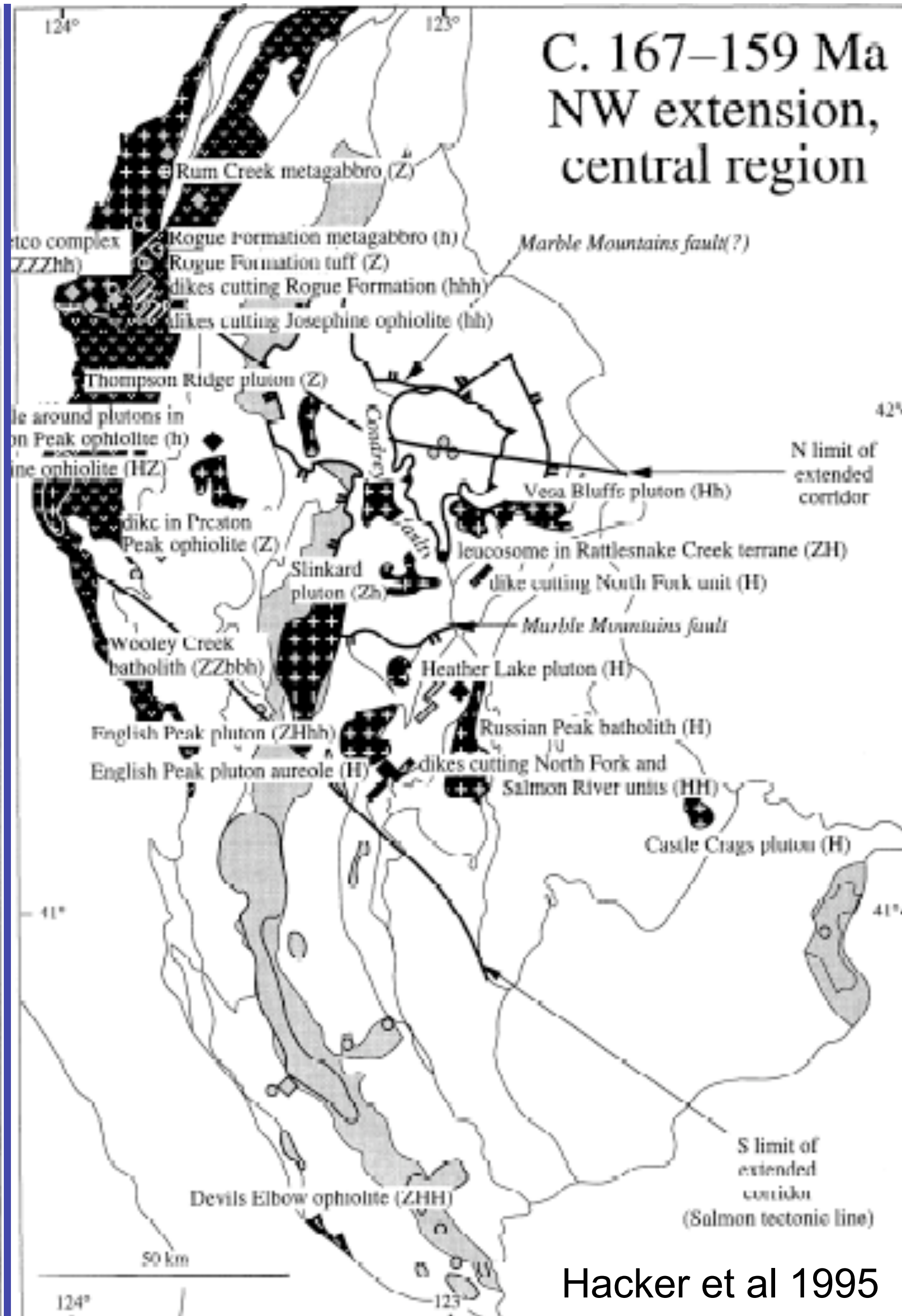


Figure 5. Interpretive maps showing intrusion, volcanism, and metamorphism in six stages. Letters in parentheses indicate dating method: Z, U/Pb zircon; H, $^{40}Ar/^{39}Ar$ hornblende; M, $^{40}Ar/^{39}Ar$ muscovite; B, $^{40}Ar/^{39}Ar$ biotite; h, K-Ar hornblende; m, K-Ar muscovite; b, K-Ar biotite; p, K-Ar plagioclase; w, K-Ar whole rock; f, fossil. After its initial appearance in black, each feature is shaded in subsequent panels. Small plutons are shown as circles. In Figure 5b, only the southern part of the Western Hayfork terrane volcanic rocks have been dated; the central and northern parts may be of different age. In Figures 5c and 5d, different units within the Rogue/Chetco arc have not been differentiated. In Figure 5e, medium shading shows plutons cooling through hornblende and mica closure to Ar. Data used to compile this figure are from this paper or summarized by *Hacker and Ernst* [1993].

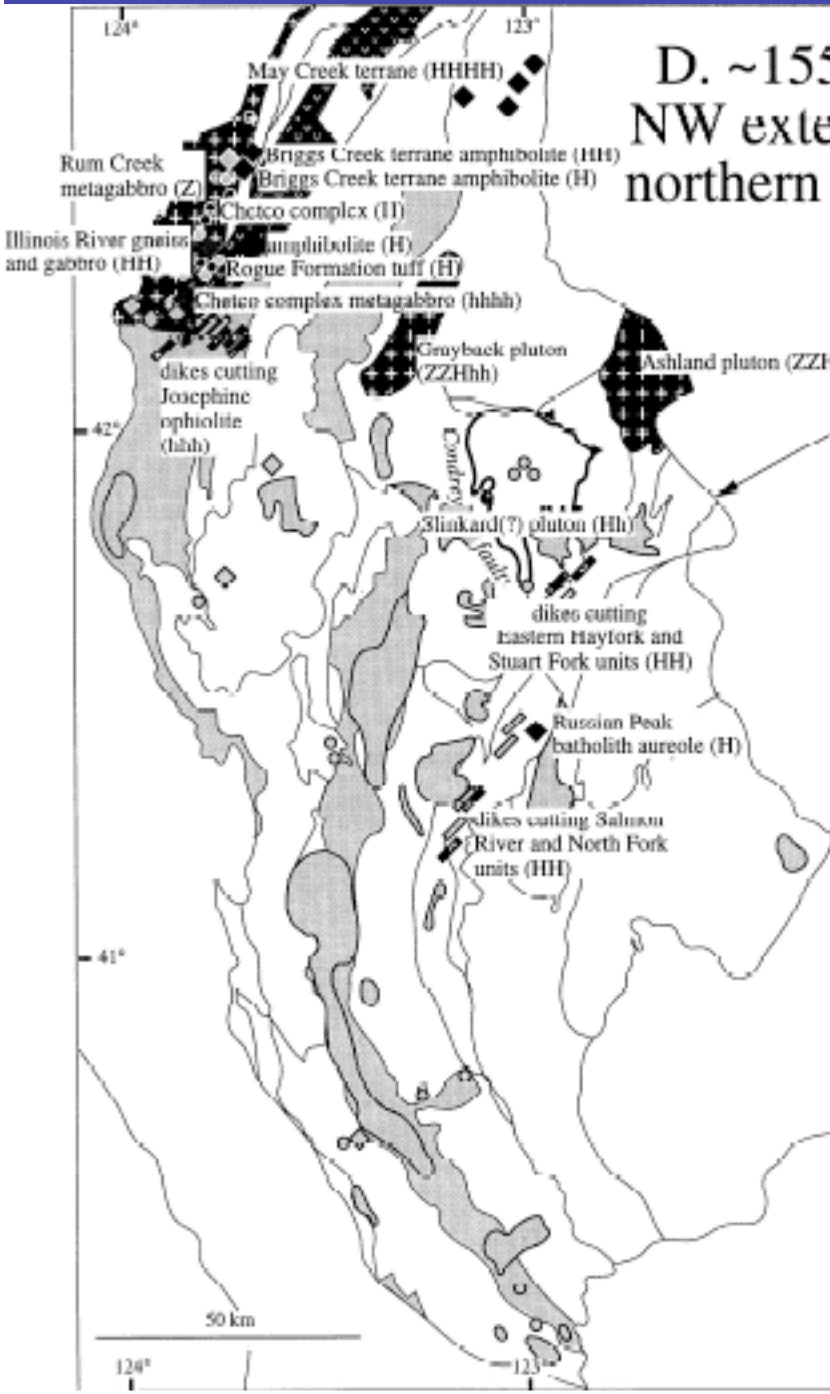
Using the age dates, we can assign ages to regional events, such as terrane collisions.

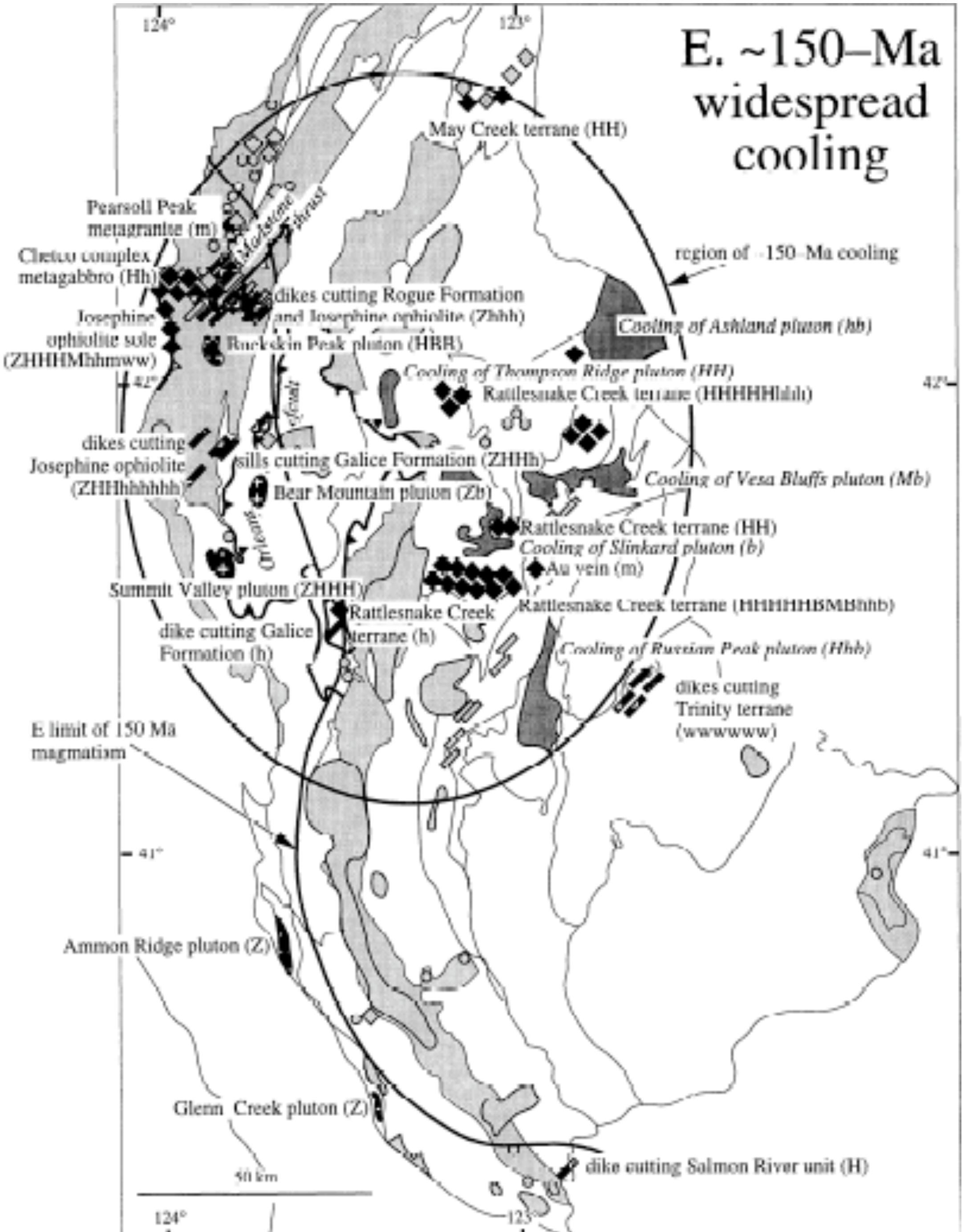
Hacker et al 1995





Hacker et al 1995





Hacker et al 1995

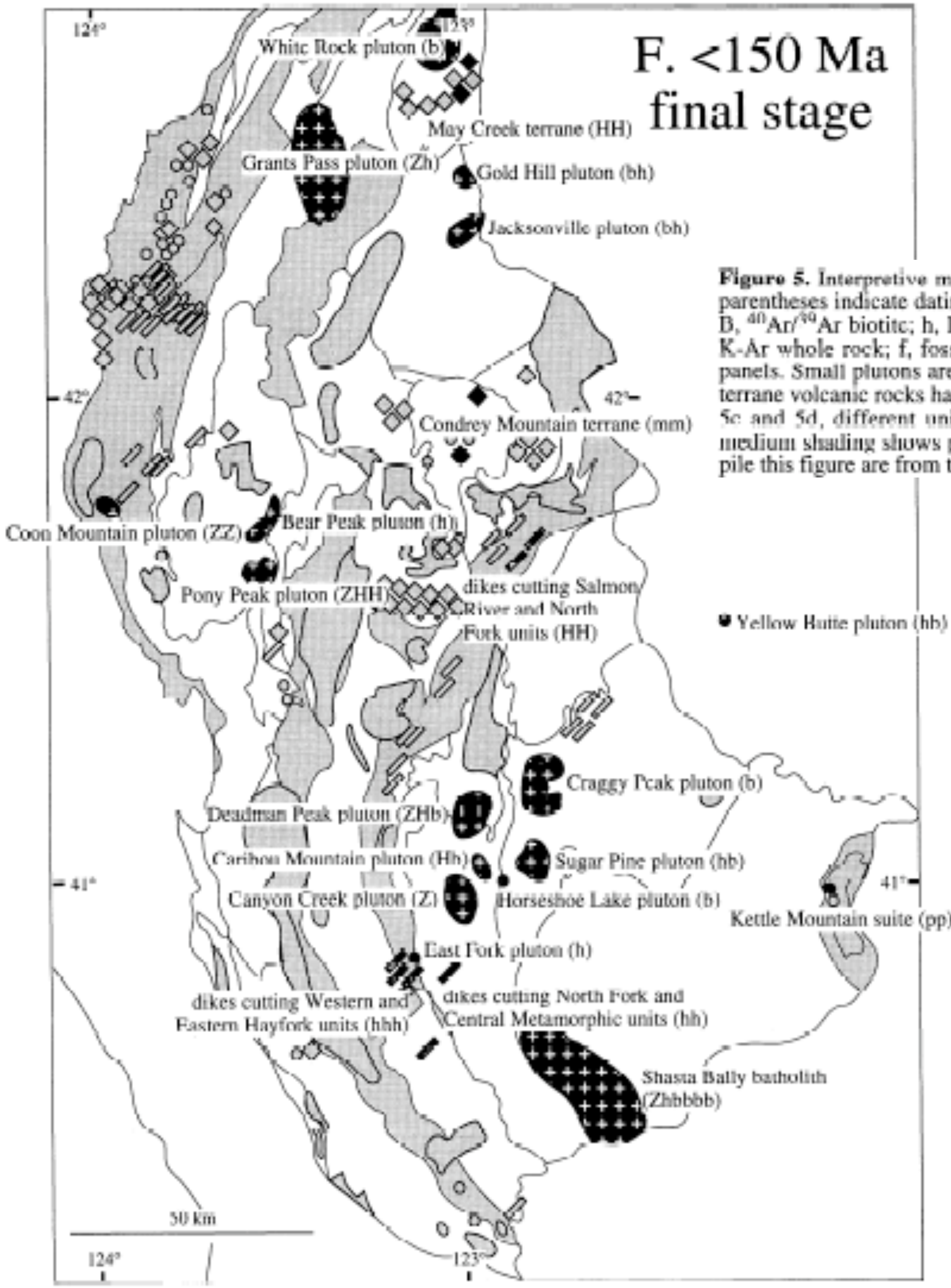


Figure 5. Interpretive maps showing intrusion, volcanism, and metamorphism in six stages. Letters in parentheses indicate dating method: Z, U/Pb zircon; H, $^{40}Ar/^{39}Ar$ hornblende; M, $^{40}Ar/^{39}Ar$ muscovite; B, $^{40}Ar/^{39}Ar$ biotite; h, K-Ar hornblende; m, K-Ar muscovite; b, K-Ar biotite; p, K-Ar plagioclase; w, K-Ar whole rock; f, fossil. After its initial appearance in black, each feature is shaded in subsequent panels. Small plutons are shown as circles. In Figure 5b, only the southern part of the Western Hayfork terrane volcanic rocks have been dated; the central and northern parts may be of different age. In Figures 5c and 5d, different units within the Rogue/Chetco are not been differentiated. In Figure 5e, medium shading shows plutons cooling through hornblende and mica closure to Ar. Data used to compile this figure are from this paper or summarized by *Hacker and Ernst* [1993].

Hacker et al 1995

USGS OF 99-374: a history of Klamath accretion

Figure 1
Central Metamorphic episode
Late Silurian(?) to Middle Devonian time
(>400 Ma—380 Ma)

Figure 2
Fort Jones Episode
Permian—Triassic time
(~260—~240Ma)

Figure 3
North Fork episode
Early Jurassic (Pliensbachian)
time (~198—193 Ma)

USGS OF 99-374

Figure 4
Eastern Hayfork episode
Early(?) Middle Jurassic (~Bajocian)
time (~180 Ma)

Figure 5
Western Hayfork episode
Late Middle Jurassic (Early Callovian)
time (~168 Ma)

Figure 6
Rattlesnake Creek episode
Late Middle to early Late Jurassic
(Callovian to Oxfordian) time (~164 Ma)

Figure 7
Western Klamath episode
Late Jurassic (Late Kimmeridgian or
Early Tithonian) time (~150-2 Ma)

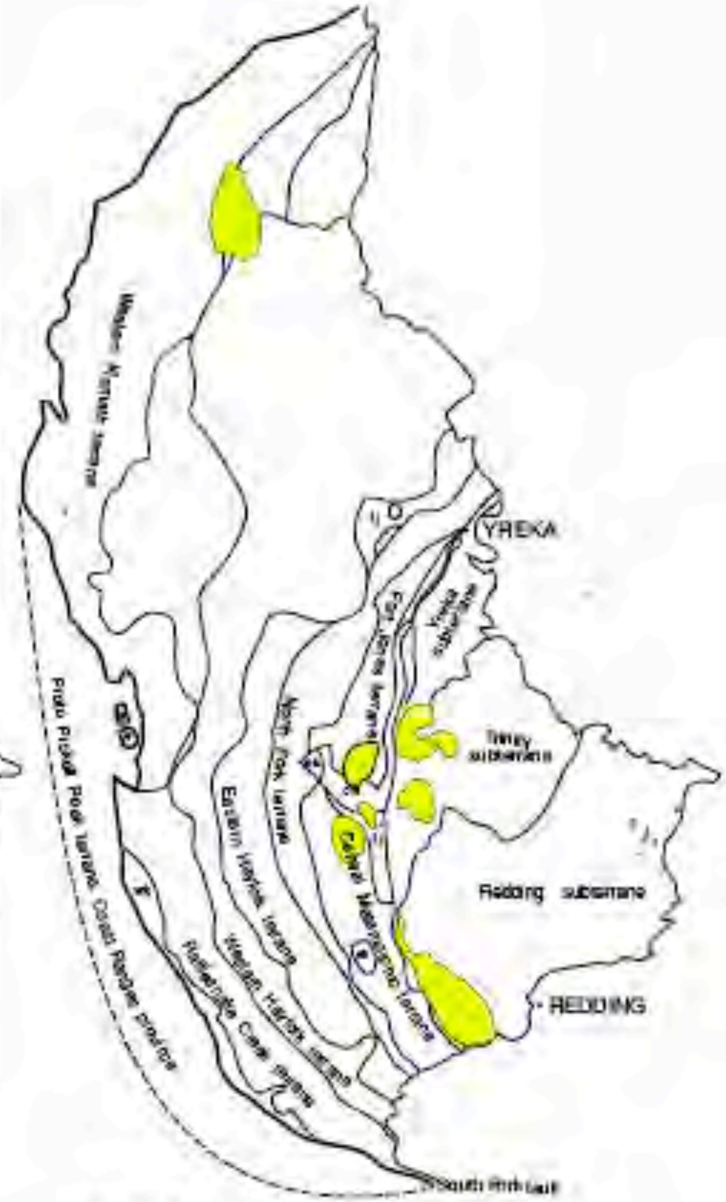


Figure 8
Pickett Peak episode
Early Cretaceous time
(~140-5 Ma)

USGS OF 99-374: note the use of granites to assign ages.

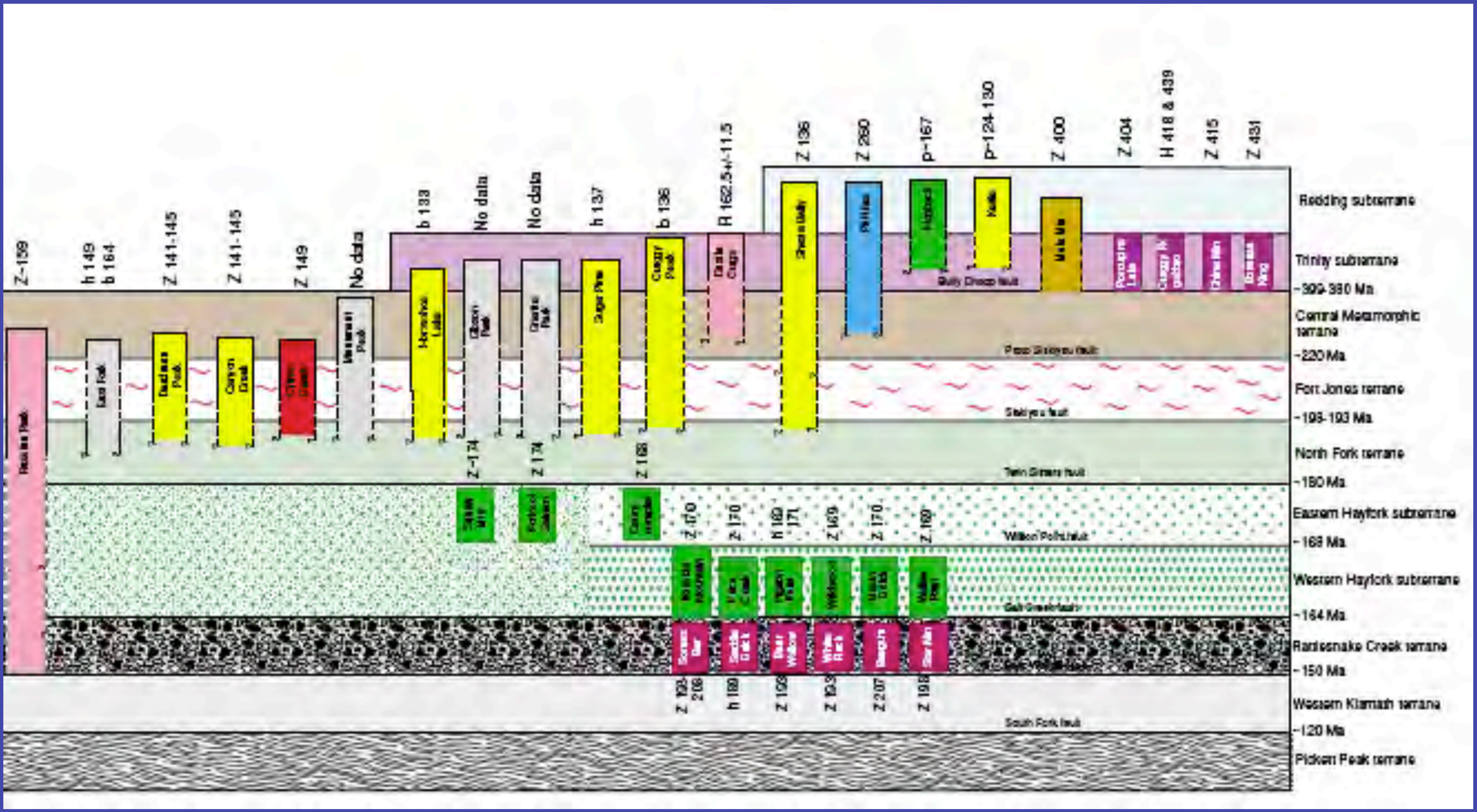
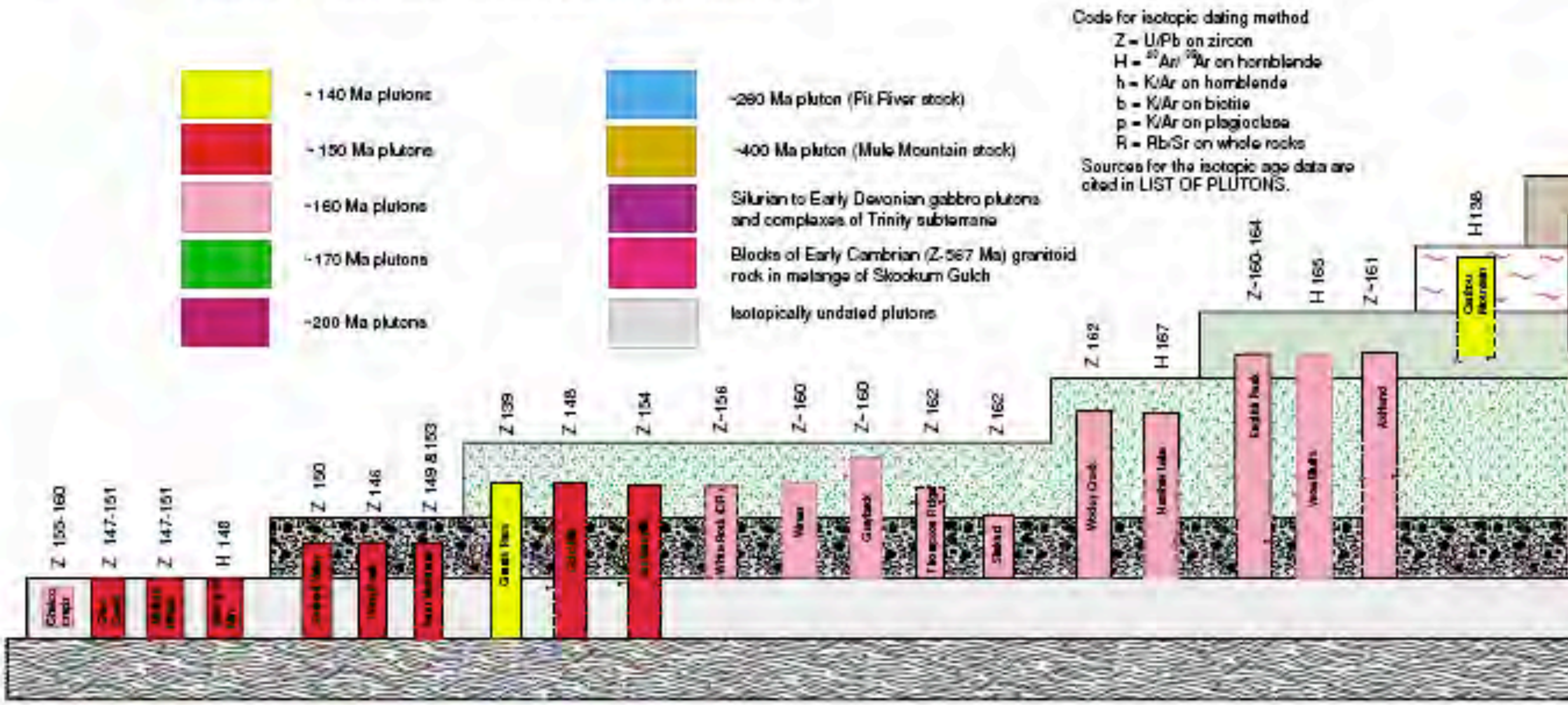


Figure 10. Schematic vertical section showing the stacked accreted terranes of the Klamath Mountains, and the intrusive relations of the plutons.



USGS
OF 99-374

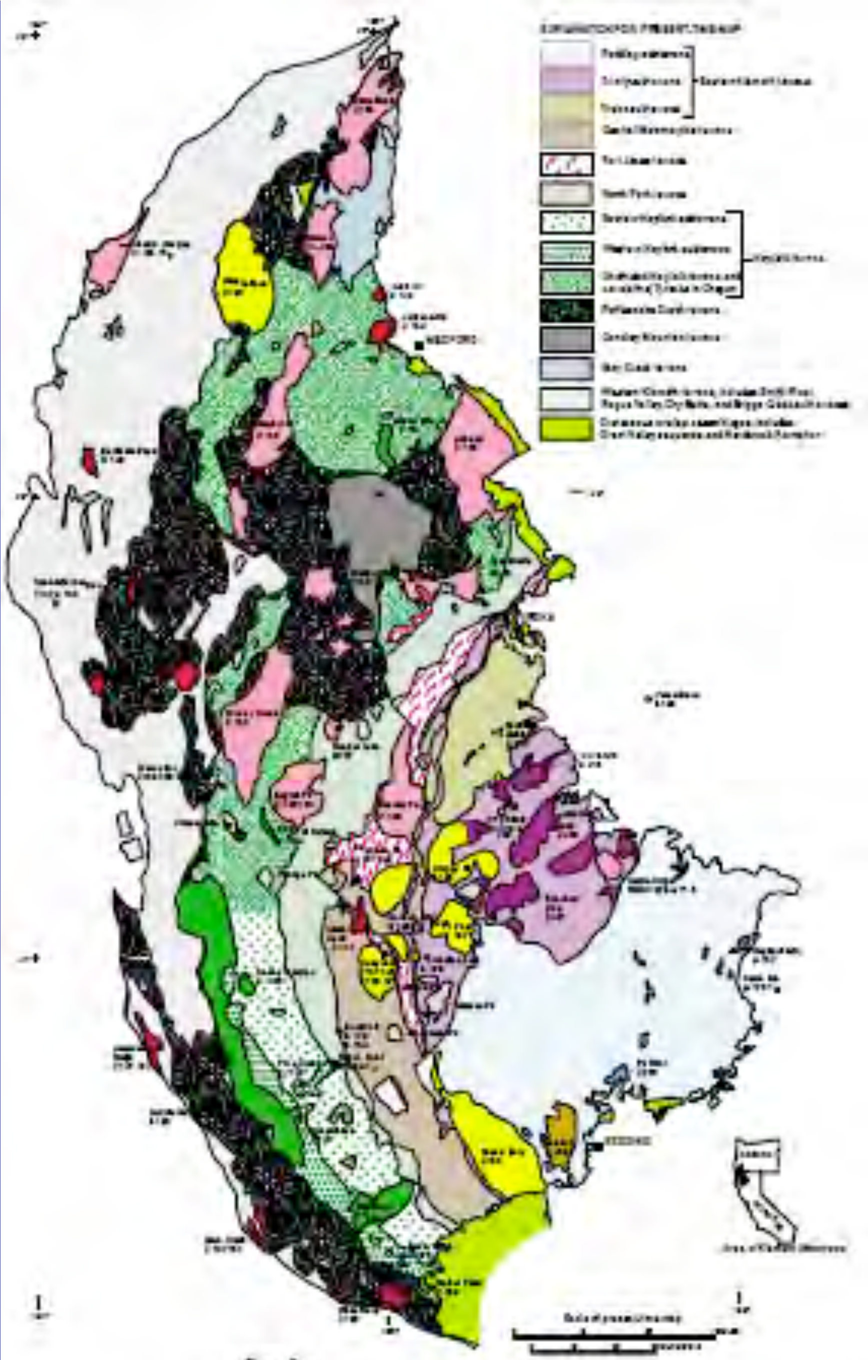
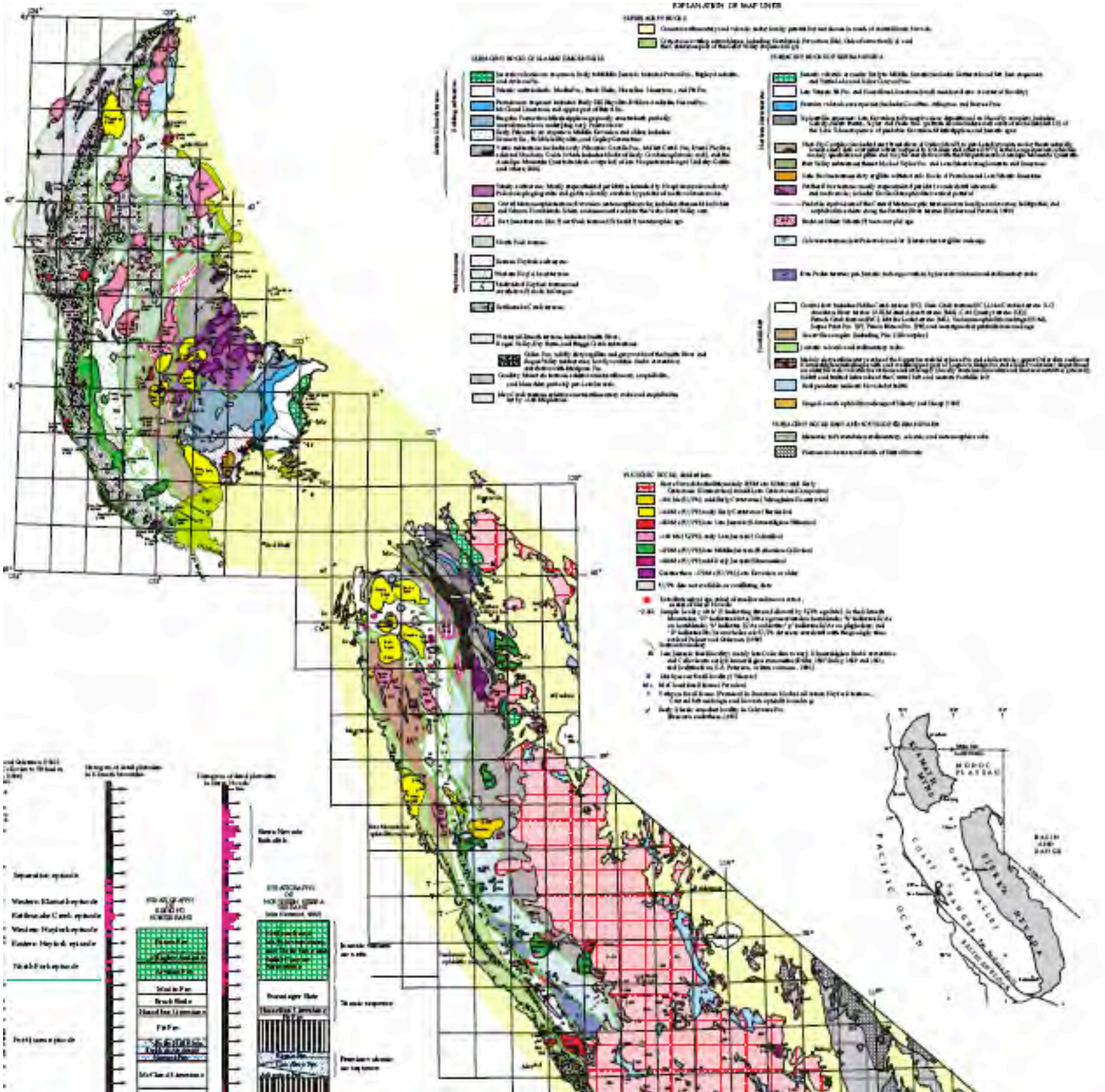


Figure 6
Present time
Geology modified from Irwin ([illegible])



The Klamaths

And

The Sierras

A Proposed Correlation

The Klamath Mountains

- A large scale domal region
- Four distinct thrust-bound major terranes
- Many sub-terranes
- Range from Permian to Cretaceous
- Evidence to infer multiple subduction zones
- A long-lived zone of continental growth
- Similar to the Sierra Nevada
- Related to Blue Mountains and other northern regions