# Detrital zircon age populations and geochemistry of selected late Jurassic sedimentary basins in the North American Cordillera: links between the Klamath and Cascade Mountains

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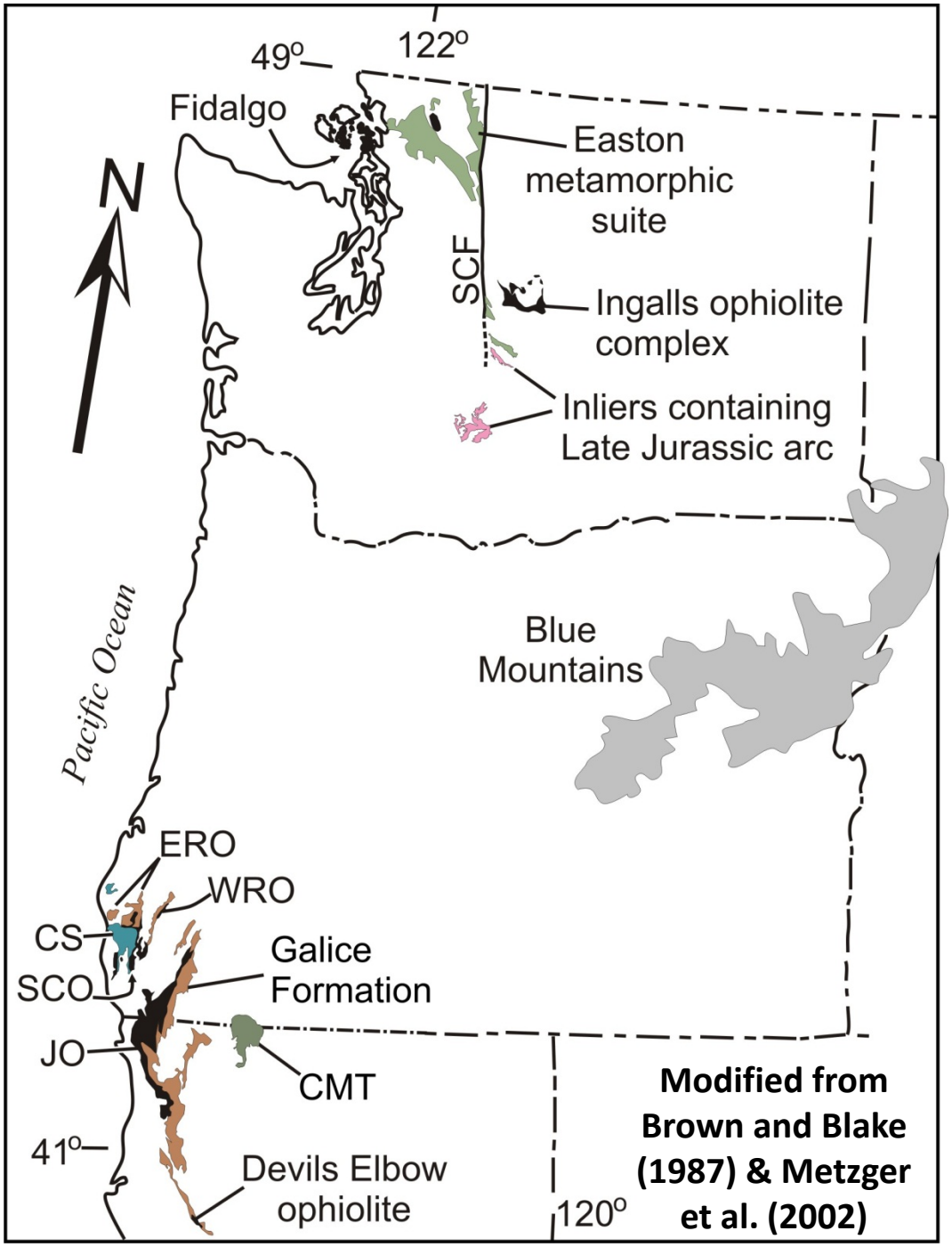
FLORIDA GULF COAST UNIVERSITY GEOLOGY

SJSU GEOLOGY

WASHINGTON STATE DEPARTMENT OF Natural Resources




Geologic sketch map displaying the location of Washington's Mesozoic units with respect to the Blue Mountains and Klamath Mountains.

CMT = Condrey Mountain terrane

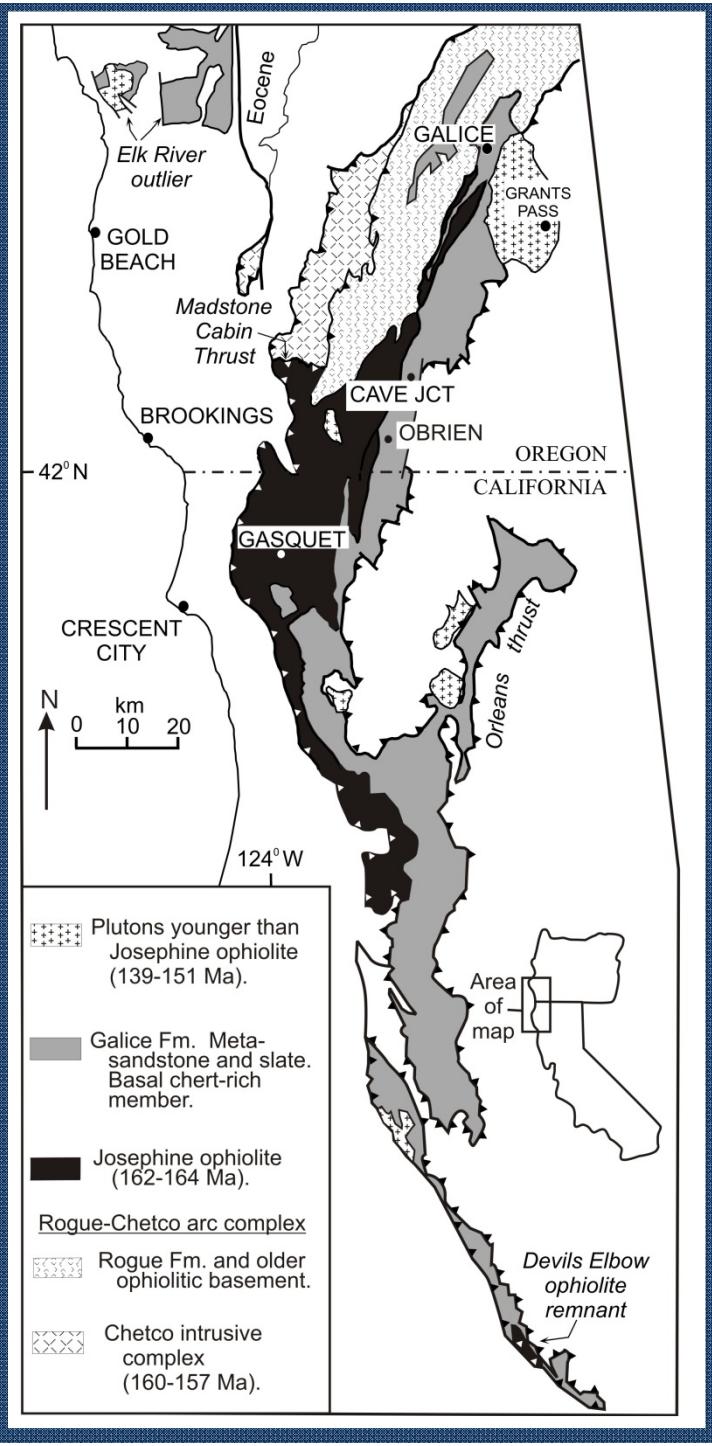
CS = Colebrooke schist

ERO = Elk River outlier

JO = Josephine ophiolite

SCO = Snowcamp ophiolite

WRO = Wild Rogue Wilderness ophioltie

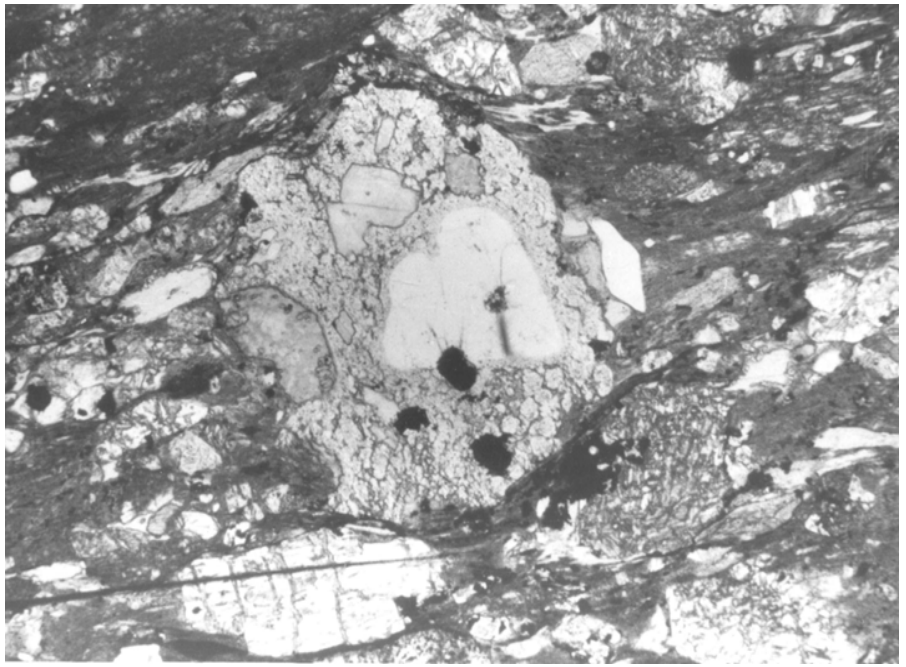



Generalized geologic map of western Klamath terrane, including Galice Formation.

The Galice Formation sits conformably on the Josephine ophiolite and its rift-edge facies; and, is gradational with the Rouge Formation.

Callovian- Kimmeridgian age radiolarians; Oxfordian-Kimmeridgian age *Buchia concentrica*

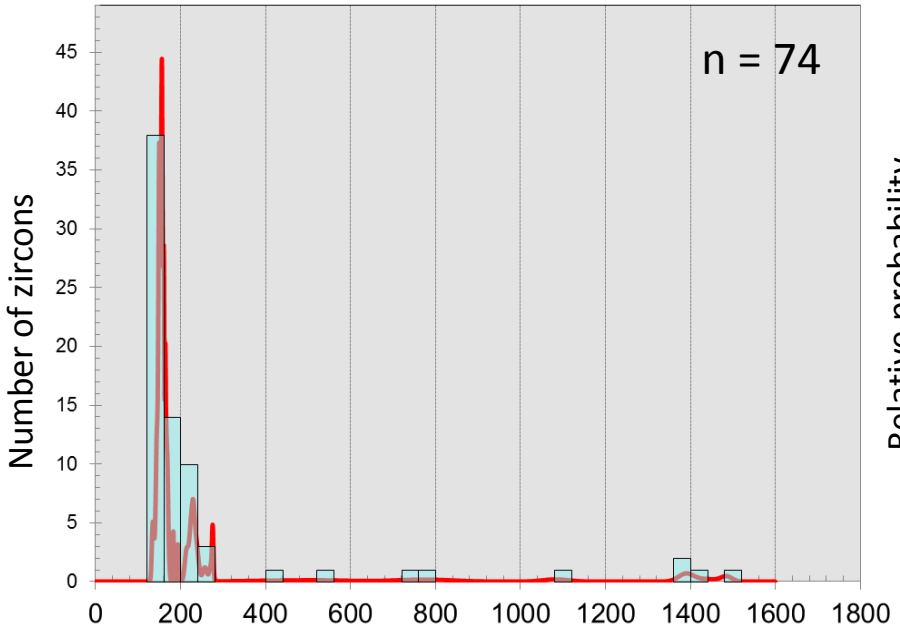
Modified from Wyld and Wright (1988), Miller and Saleeby (1995), Giaramita and Harper (2006).

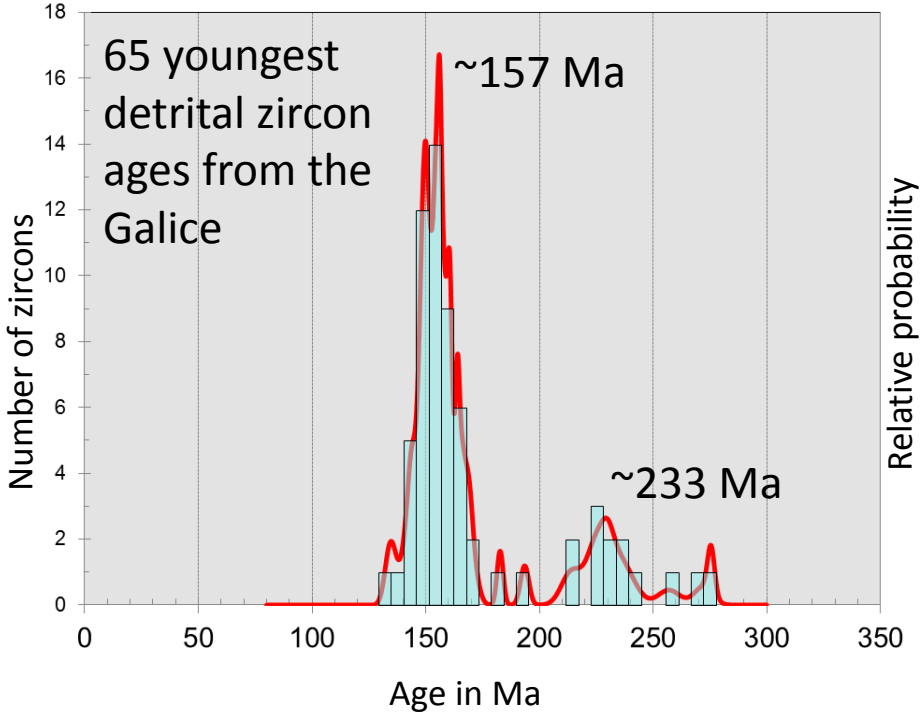


*Width of photo is approximately 1.5 mm.*

Galice Formation consists of a siliceous hemipelagic sequence, which grades upward into a thick turbidite sequence. Sandstones are volcaniclastic.

Fe-Mn-rich metalliferous sediments are located just above the contact between the Josephine ophiolite and the Galice Formation (Pinto-Auso and Harper, 1985)



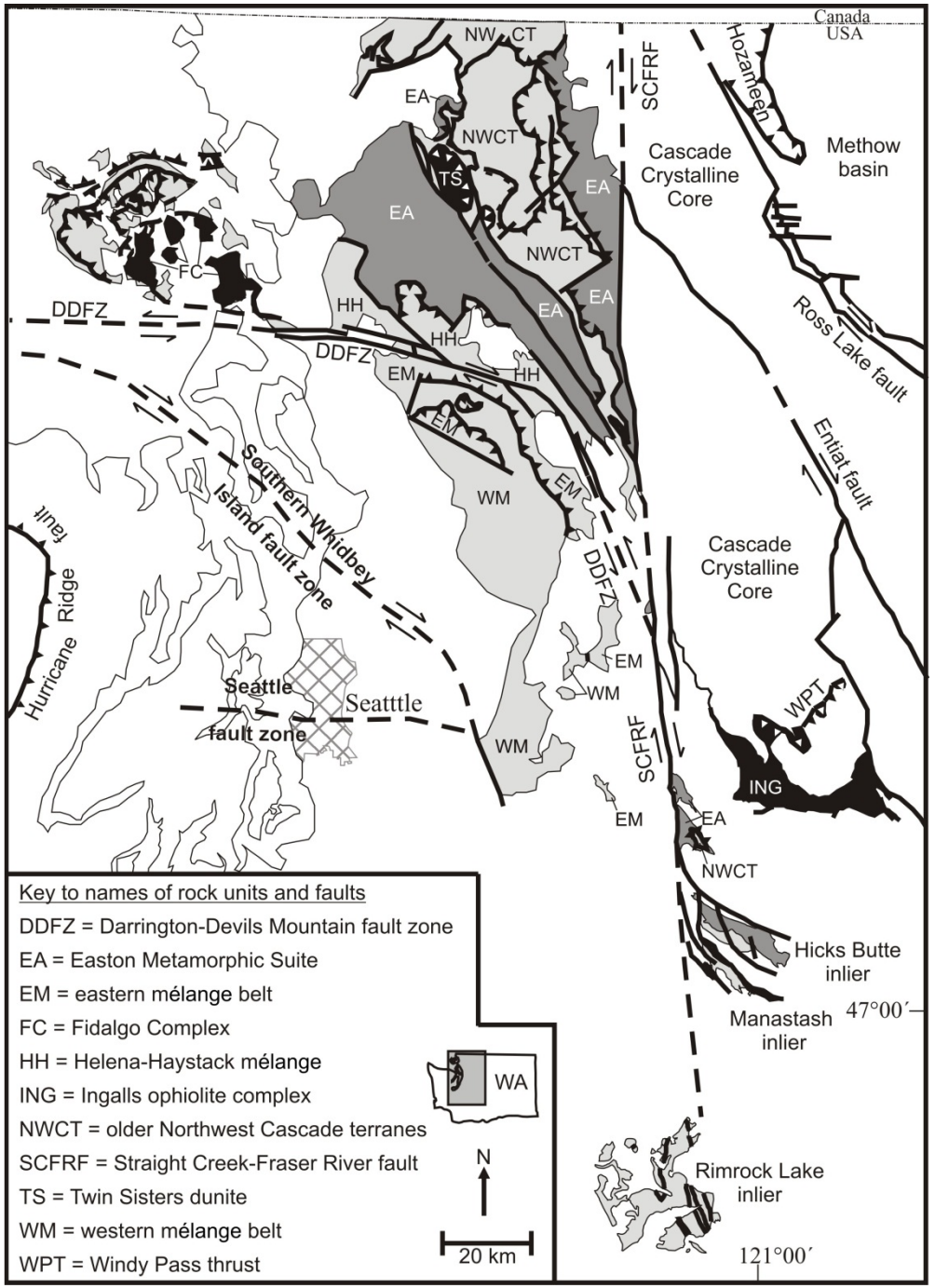




74 detrital zircons from a Galice Formation volcaniclastic sandstone were analyzed using the SHRIMP-RG at Stanford University.

Late Jurassic and Middle Triassic zircons dominate; 413 Ma, 537 Ma, 747 Ma, 790 Ma, 1083 Ma, 1381 Ma, 1396 Ma, 1435 Ma, & 1485 Ma zircons were identified.

Miller and Saleeby (1995) & Izsak et al. (2007) also identified PreCambrian detrital zircons in the Galice Formation.

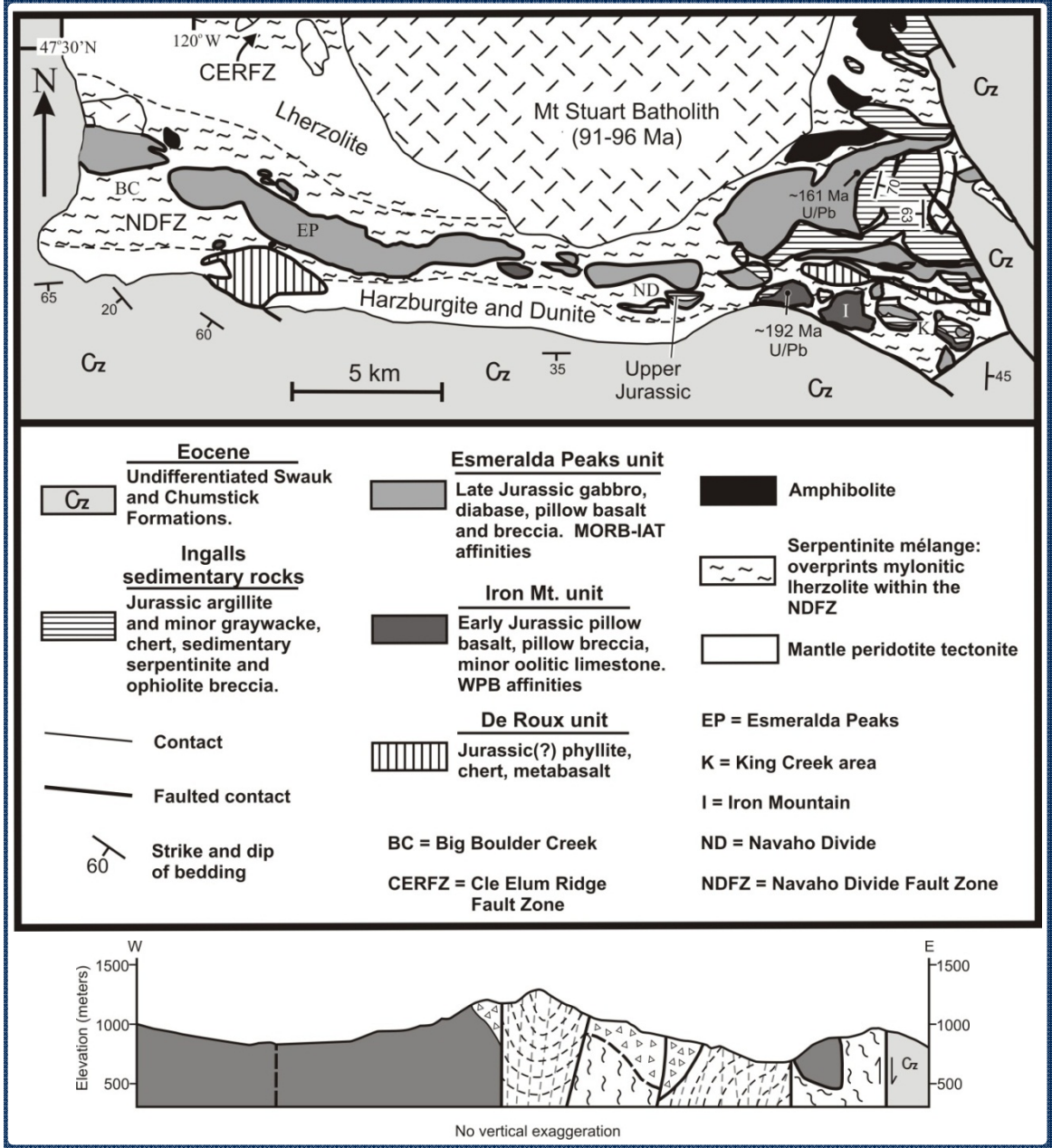
Younger zircons are $^{207}Pb$ corrected $^{206}Pb/^{238}U$ ages. Older zircons are $^{204}Pb$ corrected $^{207}Pb/^{206}Pb$ ages.




Simplified geologic map displaying pre-Cenozoic tectonic elements of the central and northwest Cascades.

Terranes east of the Straight Creek-Fraser River fault (SCFRF) have been dextrally displaced to the south.

Modified from Misch (1966), Miller et al. (1993), Tabor (1994), and Brown and Dragovich (2003) .

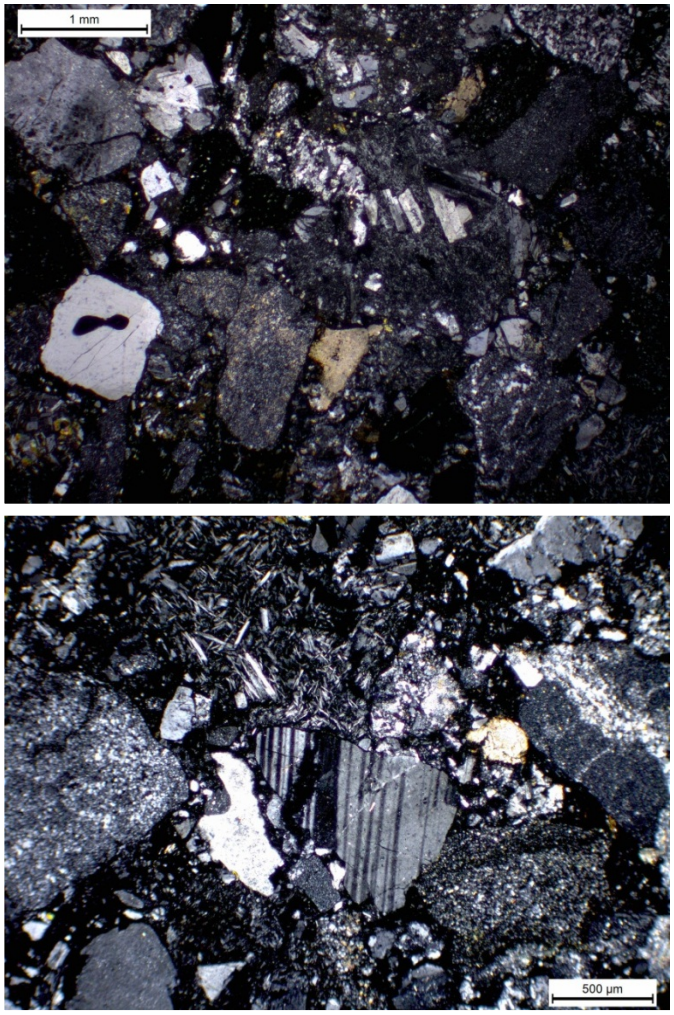



Generalized cross section through the eastern Ingalls

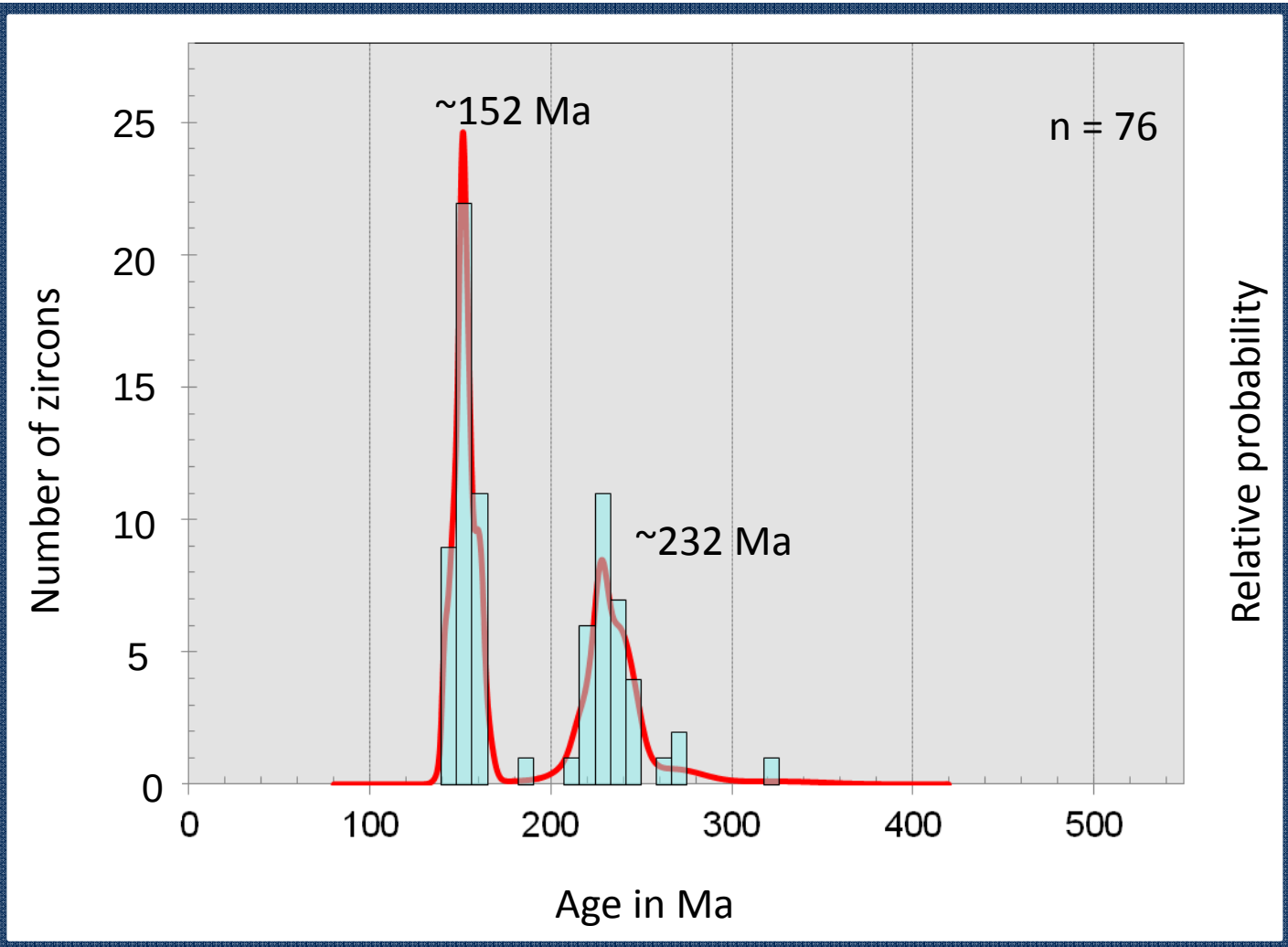
Generalized geologic map of the Ingalls ophiolite complex.

The Peshastin Formation sits conformably on the Esmeralda Peaks and Iron Mountain units of the Ingalls.

Callovian- Kimmeridgian age radiolarian assemblage in the Peshastin is identical to the Galice assemblage (E. Pessagno, 2004, written comm.).




Peshastin Formation consists predominantly of argillites with lesser chert, volcaniclastic sandstone, and breccia.




76 detrital zircons from a Peshastin Formation volcaniclastic sandstone were analyzed using the SHRIMP-RG at Stanford University.

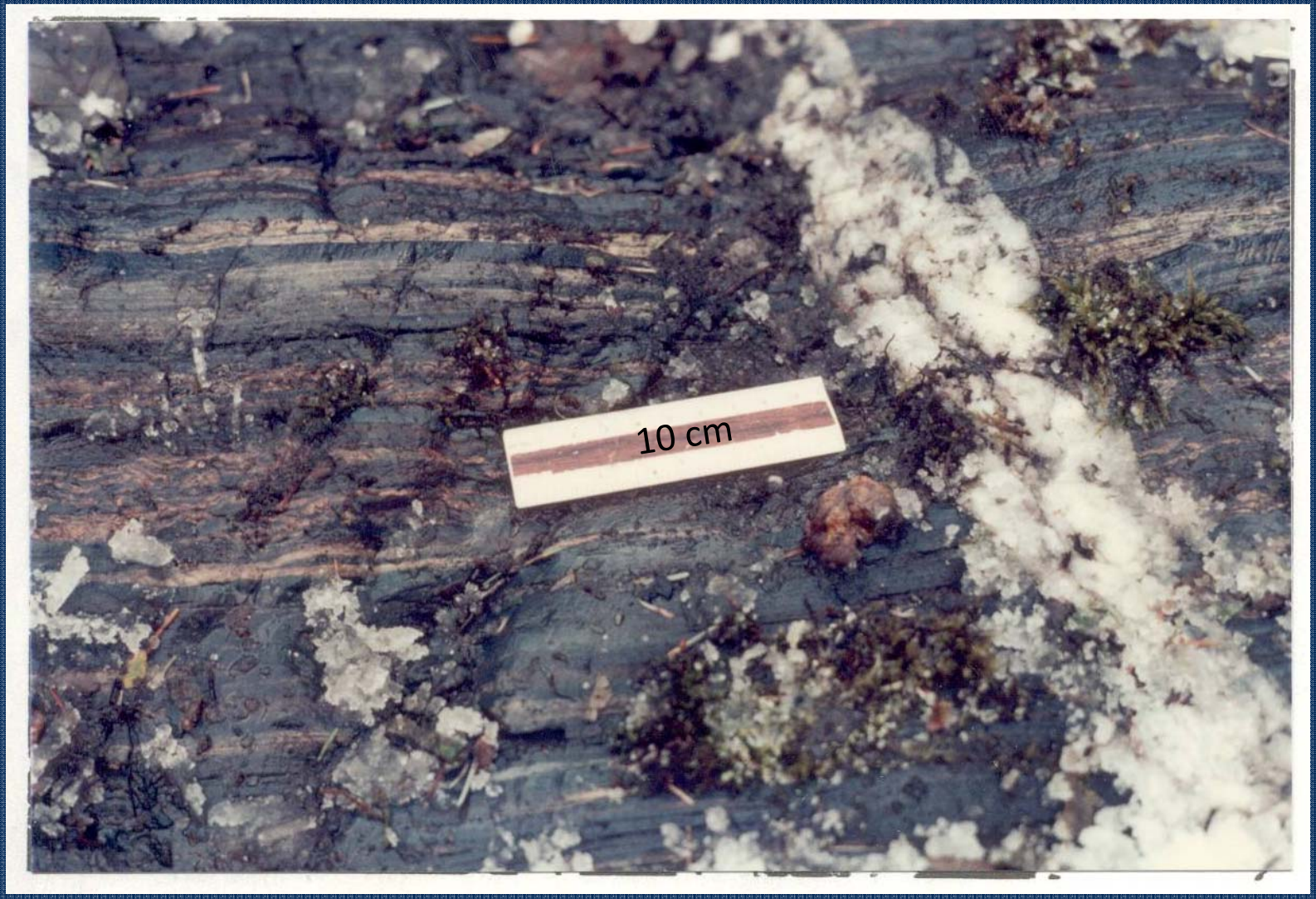
Late Jurassic and Middle Triassic zircon age populations were identified.

Zircons are $^{207}Pb$ corrected $^{206}Pb/^{238}U$ ages.

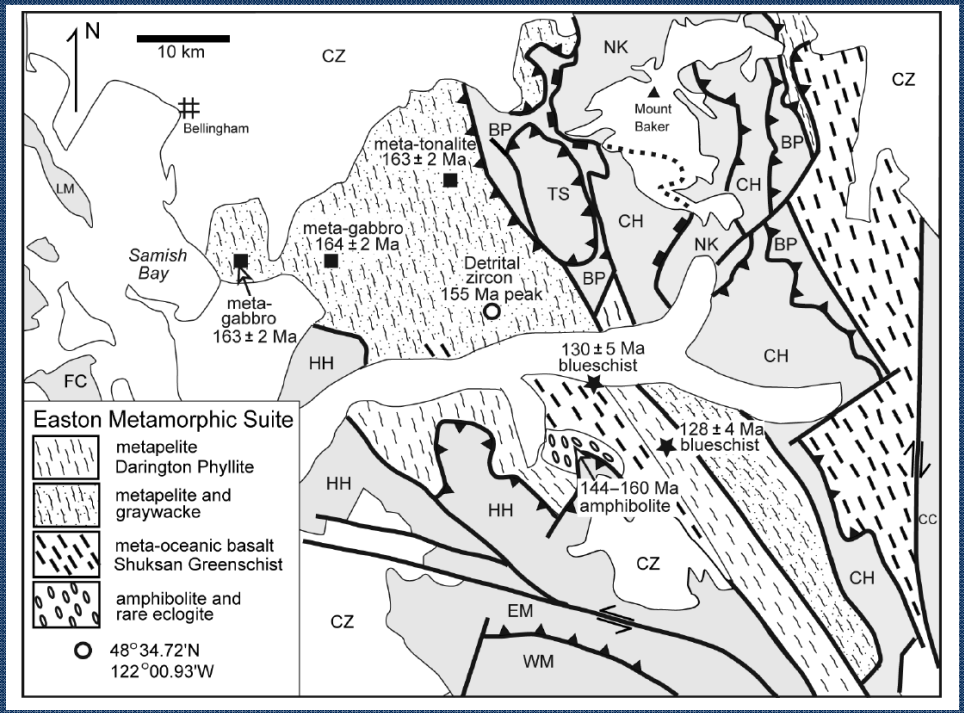

Easton Metamorphic Suite underwent regional epidote-blueschist facies metamorphism (120-130 Ma) (Brown et al., 1982; Armstrong and Misch, 1987) and consists of the Darrington Phyllite and the Shuksan Greenschist

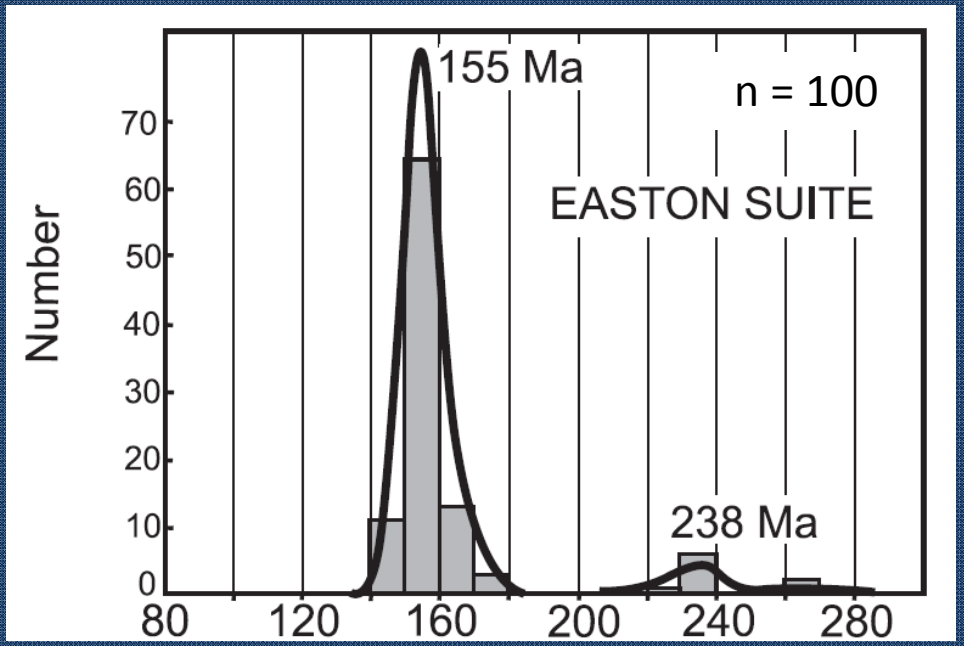
The Darrington Phyllite consists of siliceous carbonaceous phyllites with lesser metagraywacke and metatuffs.

The Darrington is inferred to have conformably overlain the Shuksan Greenschist.




Fe-Mn-rich metasediment from the Darrington Phyllite occur along the contact with the underlying Shuksan Greenschist (Gallagher, 1986)

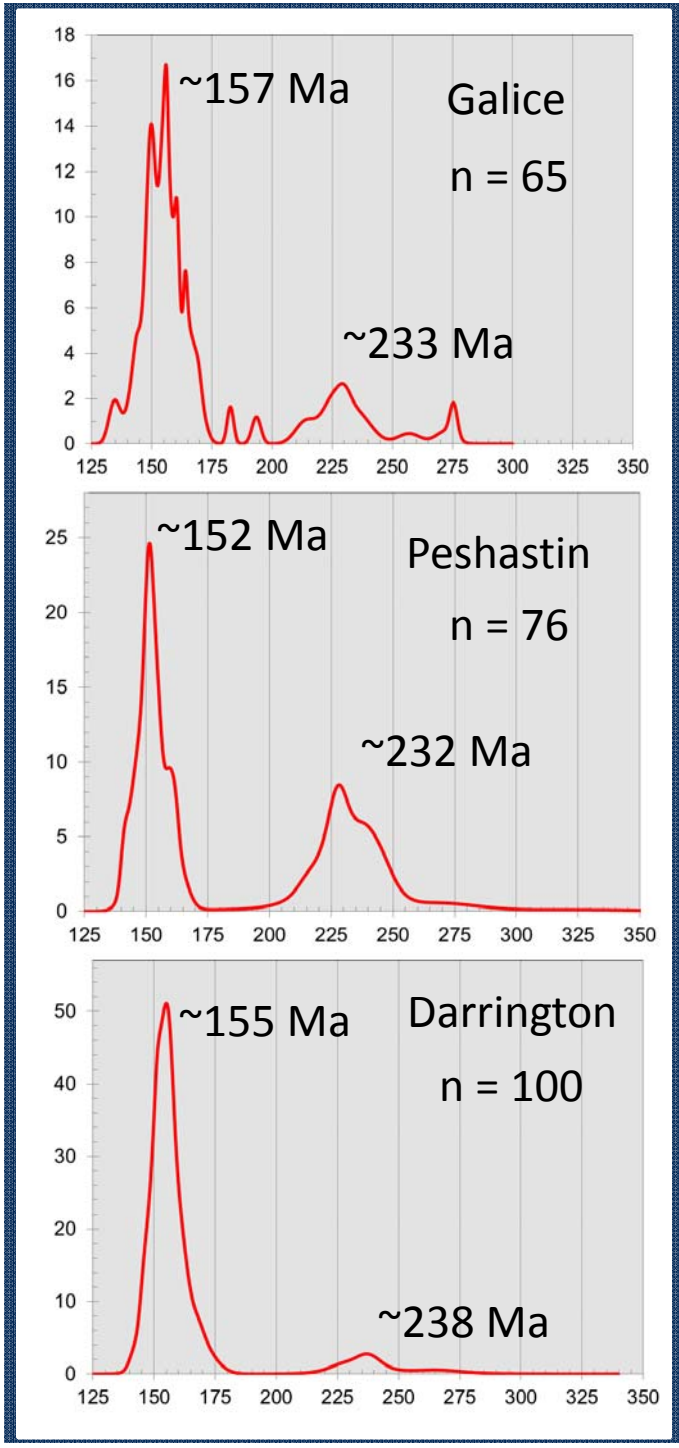



Brown and Gehrels (2007) analyzed 100 detrital zircons from a Darrington metasandstone of the Easton Metamorphic Suite using the LA-ICP-MS at Unv. Of Az.

Late Jurassic and Middle Triassic zircon age populations were identified.

A discordant zircon multiple grain fraction $^{207}Pb$ / $^{206}Pb$ age indicates the Darrington also contains Precambrian detrital zircons (Tabor et al., 1993)




Comparison of the detrital zircon ages for:

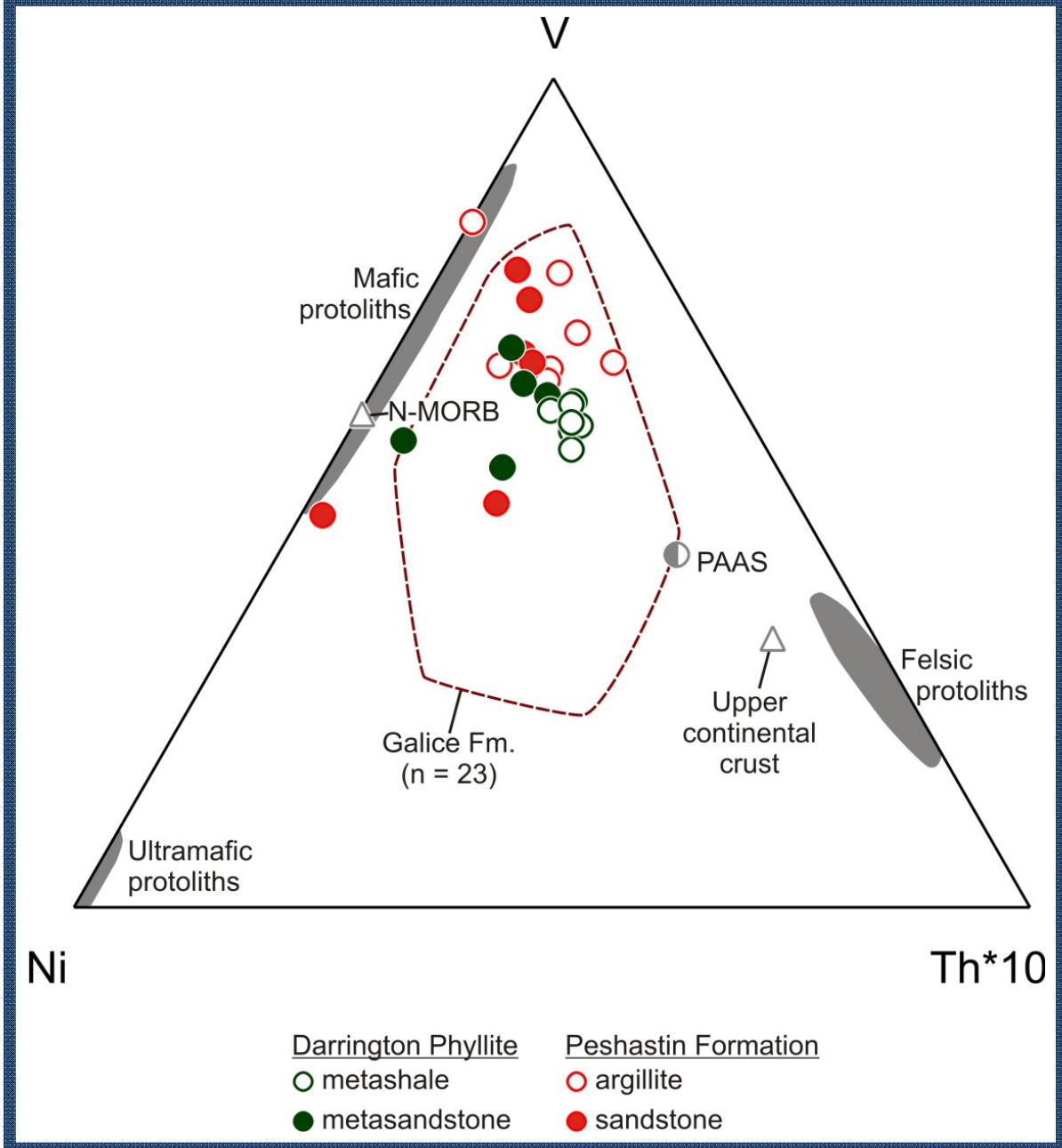
1) The 65 youngest age zircons from the Galice Formation;

2) The detrital zircons from the Peshastin Formation; and,

3) The published detrital zircon ages from the Darrington Phyllite (Brown and Gehrels, 2007).

All three have a dominant Late Jurassic age population with a lesser Middle Triassic age population.

The Galice and, to a lesser extent, the Darrington also contain Precambrian detrital zircons.

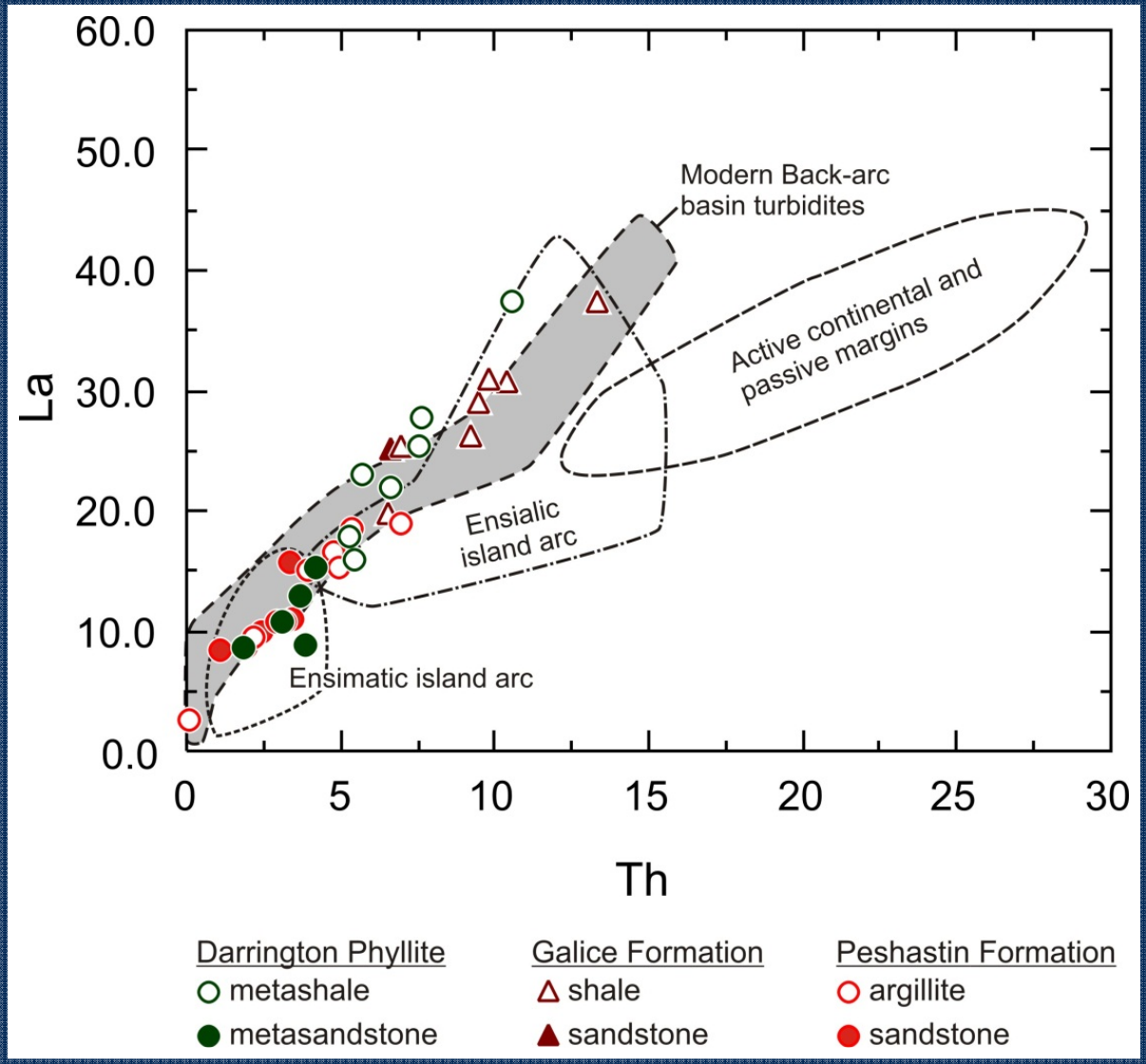



V-Ni-Th*10 provenance diagram for sedimentary rocks.

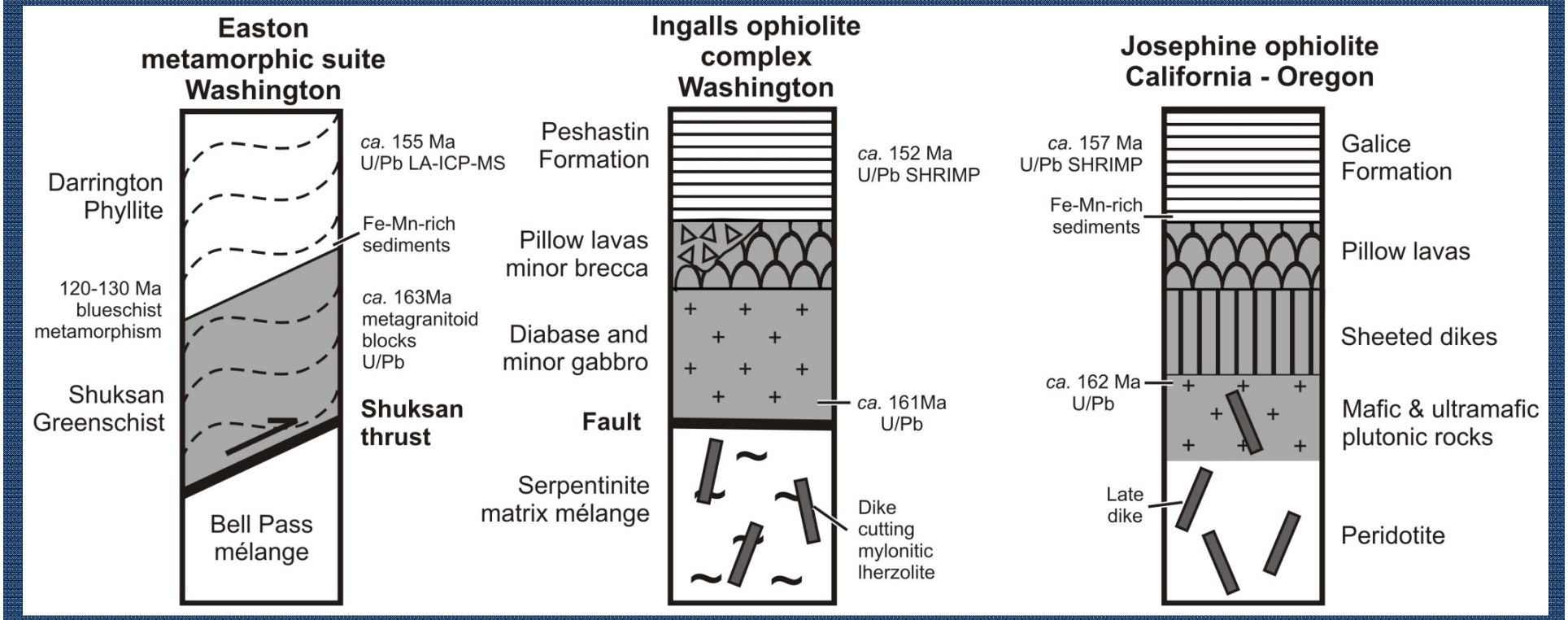
Modified from Bracciali et al. (2007).

Normal mid-ocean ridge basalt (N-MORB) from Sun and McDonough (1989); post-Archean average shale (PAAS) McLennan (1989); &, Upper continental crust from McLennan (2001).

Data plotted CaO and LOI free




La vs. Th diagram for Darrington, Galice, and Peshastin. Modified from Bhatia and Crook (1986). Field for modern back-arc basin turbidites compiled from McLennen et al. (1990). Data plotted CaO and LOI free.




Schematic sections emphasizing unit relationships and age data.

Easton Metamorphic Suite data from Brown et al. (1982), Brown (1986), Gallagher (1986), Armstrong and Misch (1987) and Brown and Gehrels (2007).

Ingalls ophiolite complex data from Miller (1985), Miller et al. (1993), Miller et al. (2003), and MacDonald et al. (2008).

Josephine ophiolite data from Saleeby et al. (1982), Harper (1984), Pinto-Auso and Harper (1985), Harper et al. (1994), and Miller et al. (2003).

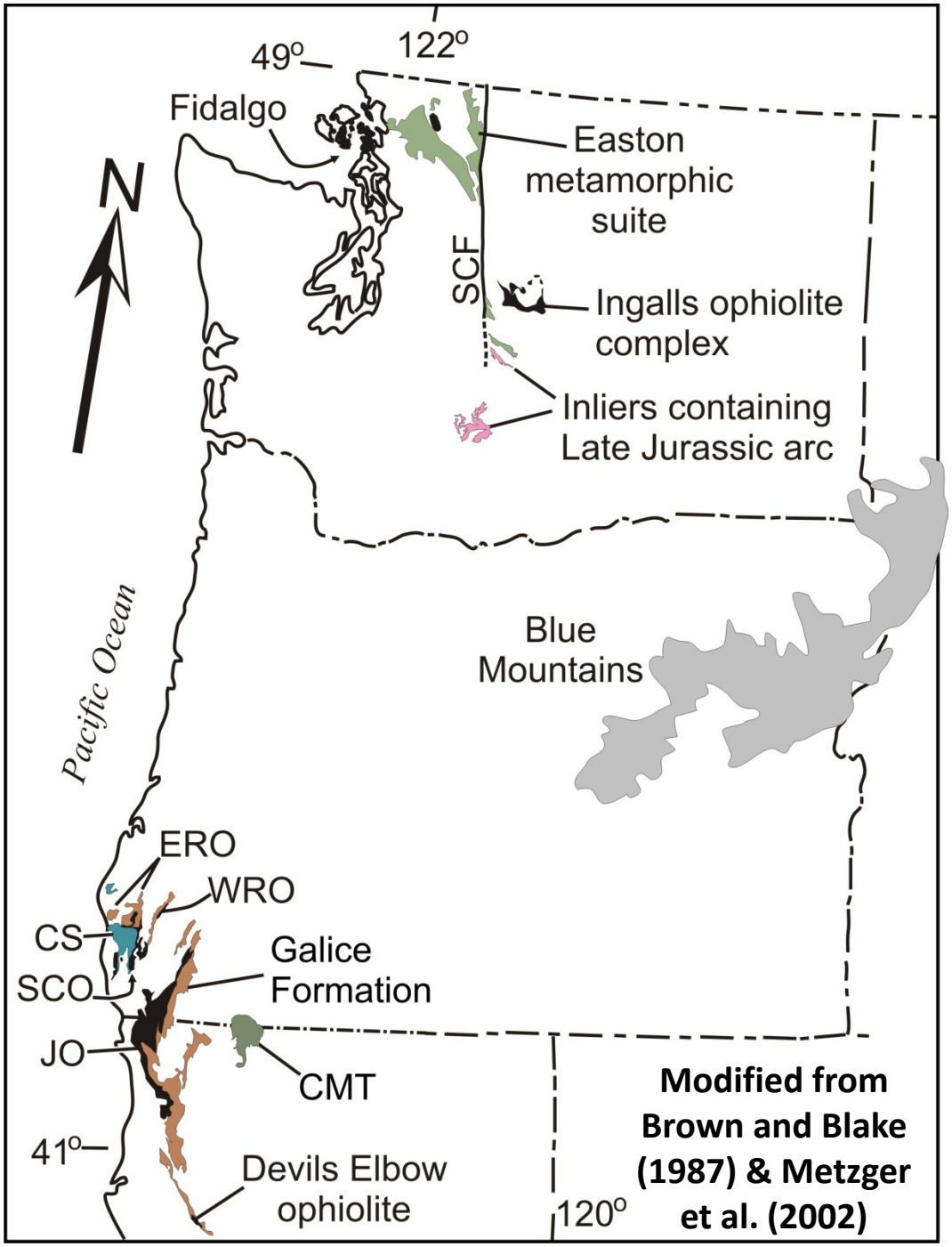
## CONCLUSIONS

1) The Galice, Peshastin, and Darrington have a dominant Late Jurassic, and lesser Middle Triassic, detrital age zircon population;
   - Galice has noticeable Precambrian age detrital zircons
   - Darrington also has Precambrian age detrital zircons

2) These units have geochemistry that is transitional between mafic and felsic sources.
   - All plot in or around fields defined by modern back-arc basins

3) These units formed in voluminous Late Jurassic arc-fed basins, back-arc and/or rifted fore-arc, similar to the model of Saleeby & Busby-Spera (1992)

4) We suggest that these units are correlative based on lithology, fossils, similar bimodal Mesozoic detrital zircon age populations, geochemistry, and affinities of underlying units.




# REGIONAL IMPLICATIONS

For example;

Brown & Blake (1987) correlated the Darrington with the Colebrooke schist

Monger (1990) correlated the Darrington with the Settler Schist (British Columbia).

Saleeby & Harper (1993) correlated the Condrey Mountain Schist with the Galice Formation