GEOCHEMISTRY AND AGE OF THE DARRINGTON PHYLLITE WITHIN THE HICKS BUTTE AND KACHESS LAKE INLIERS, CENTRAL CASCADES, WASHINGTON. TECTONIC SETTING AND REGIONAL CORRELATIONS SUGGESTING A POLYGENETIC ORIGIN

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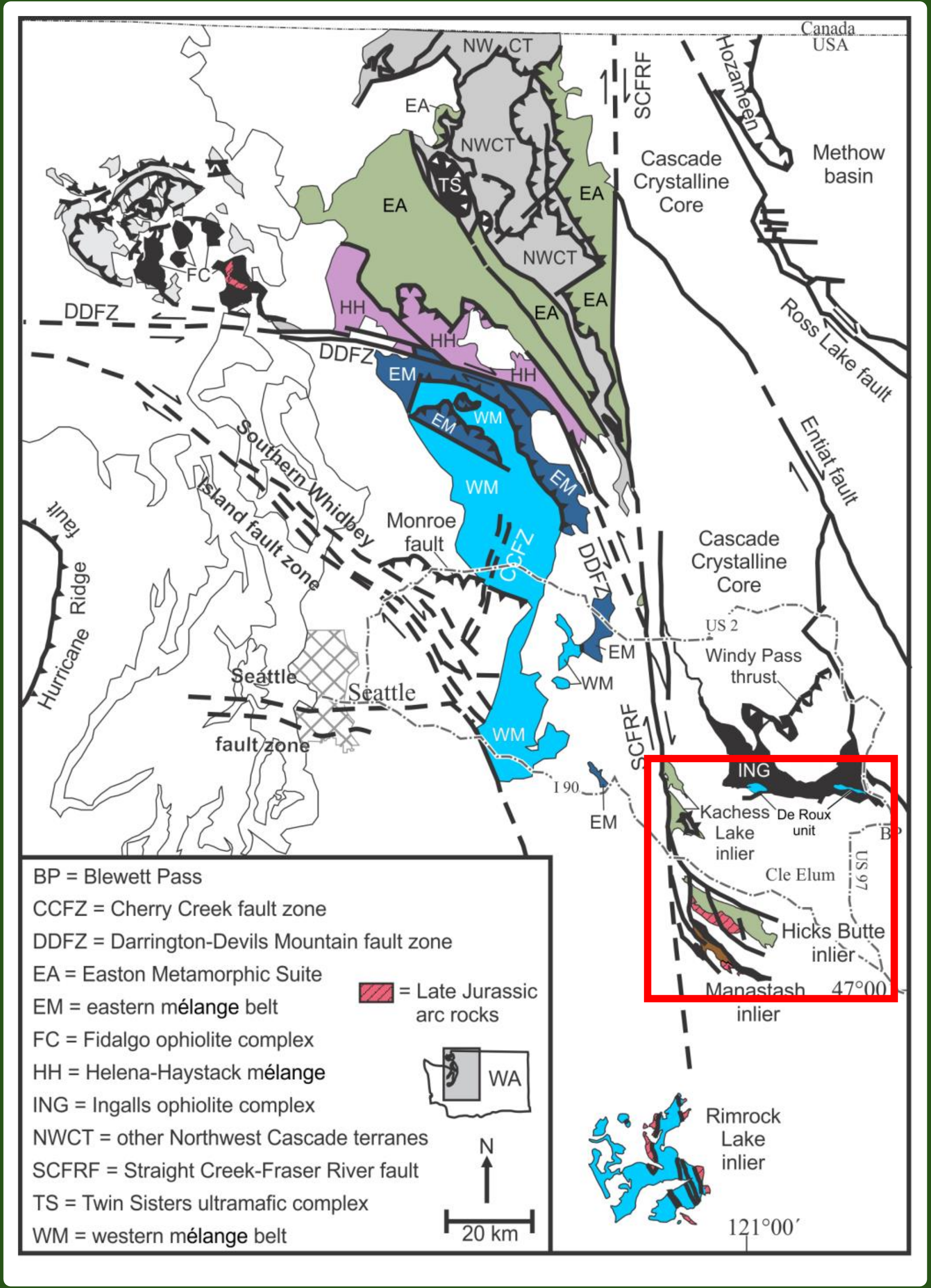
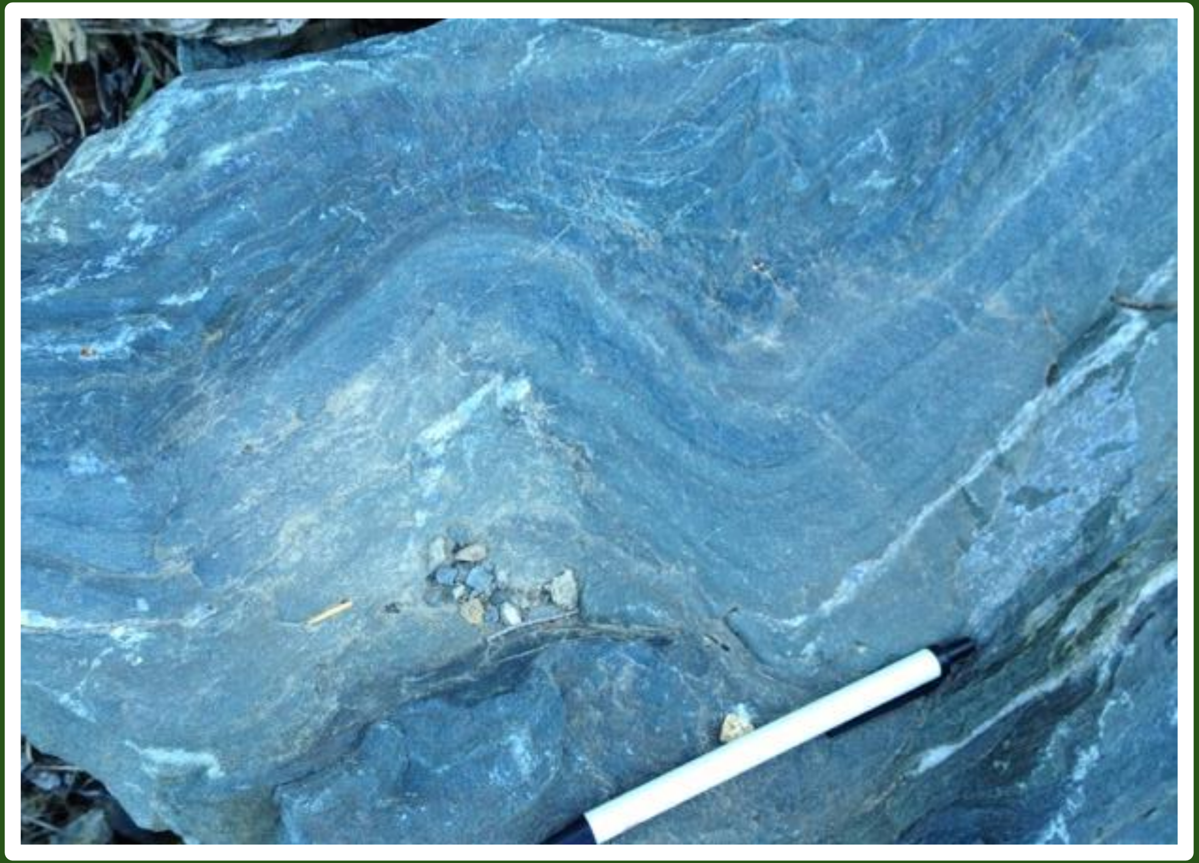


Simplified geologic map displaying pre-Cenozoic tectonic elements of the central and northwest Cascades, modified from Miller and others (1993) and MacDonald and Schoonmaker (2017). Ophiolitic and ultramafic rocks are black.

EA = Easton Metamorphic Suite

Shuksan greenschist and blueschist of the Easton Metamorphic Suite

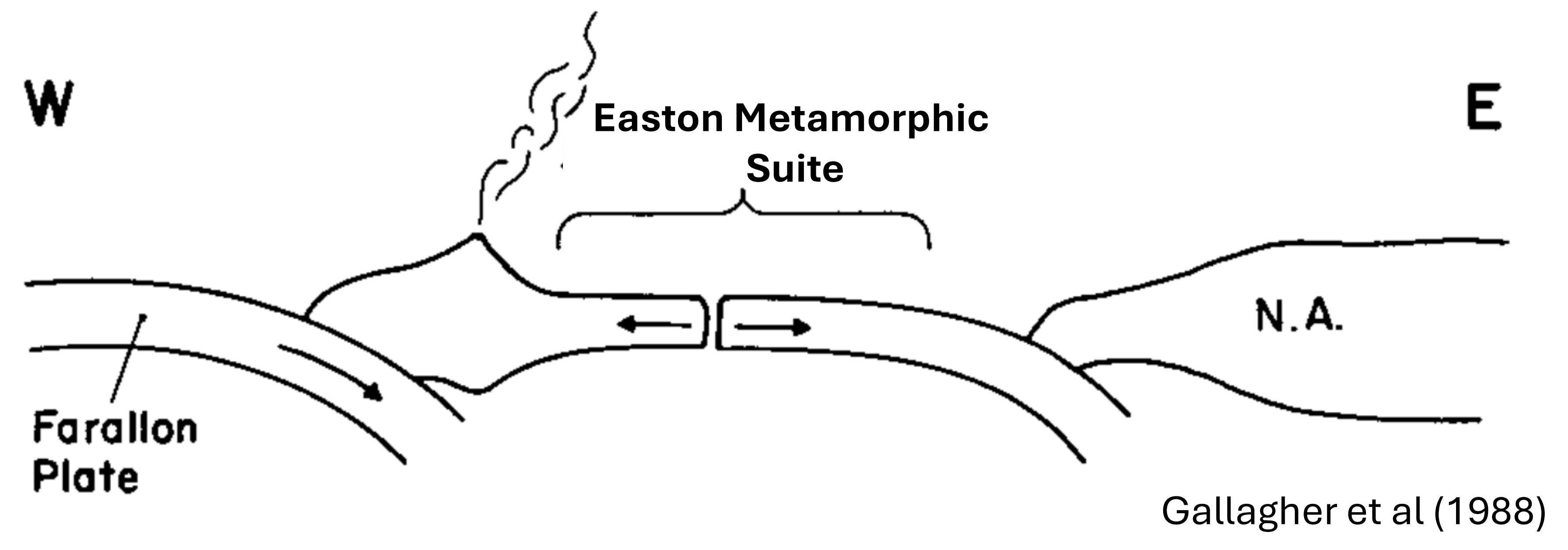
Strongly foliated greenschist with epidote and chlorite segregations from the Hicks Butte inlier

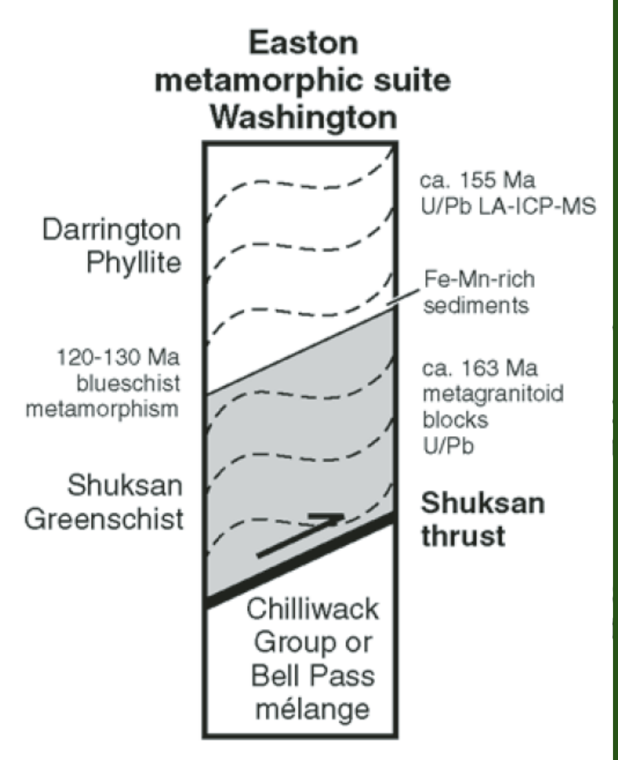


Strongly foliated epidote blueschist with a tight fold from the Kachess Lake inlier

Darrington Phyllite of the Easton Metamorphic Suite

Phyllites consist of muscovite–chlorite–albite–quartz. Light colored phyllites are muscovite-rich while dark colored phyllites are graphitic. Phyllites display open to tight folds with crenulation cleavage common.



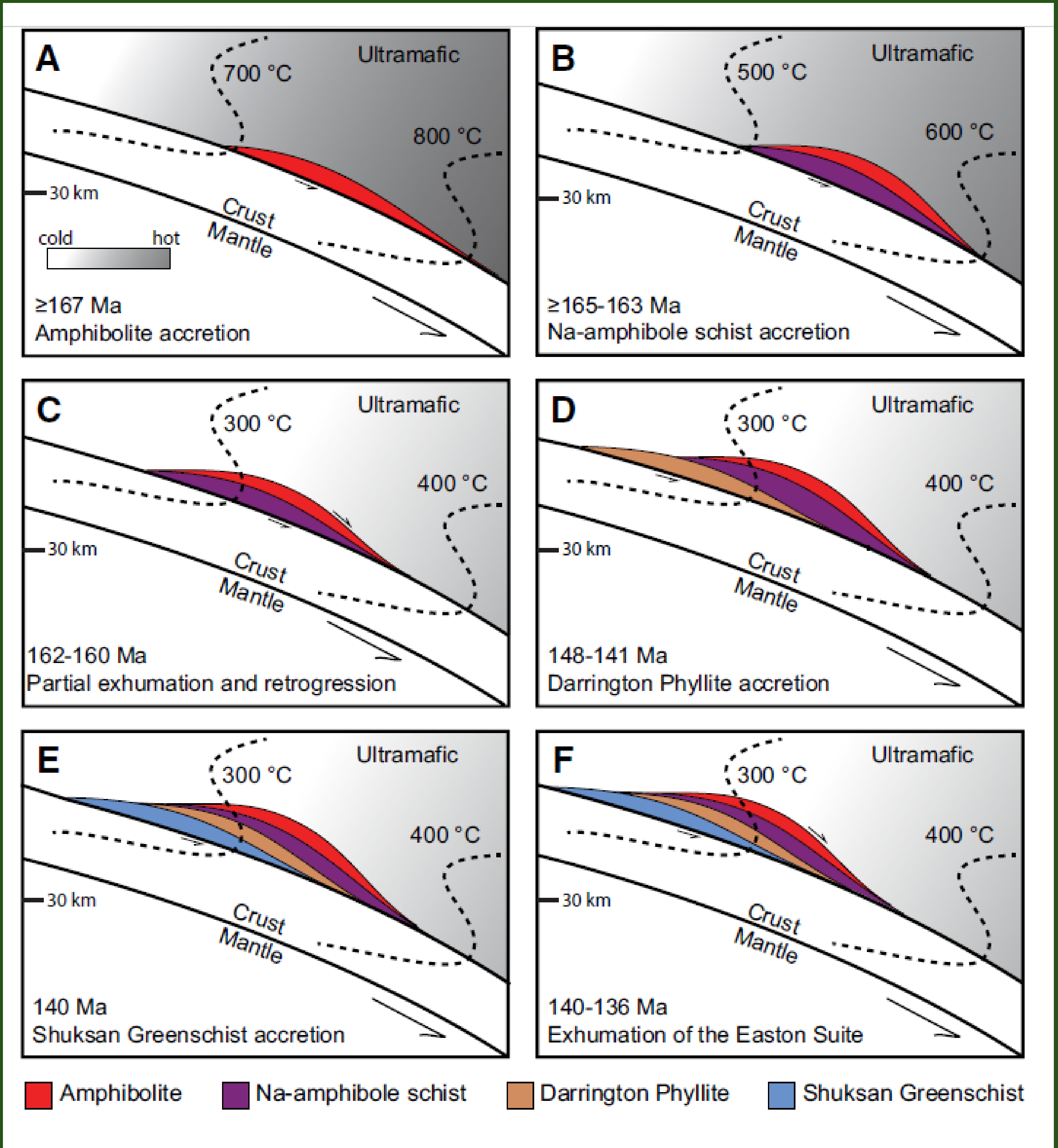


Traditional interpretation of the Easton Metamorphic Suite

Darrington Phyllite-Mt. Joesphine and Shuksan Greenschist were originally conformable.

They formed in an arc-proximal back-arc basin during the Jurassic and were subducted to high P/T conditions in the Cretaceous.

(e.g., Brown, 1986; Gallagher et al., 1988; MacDonald and Dragovich, 2015).

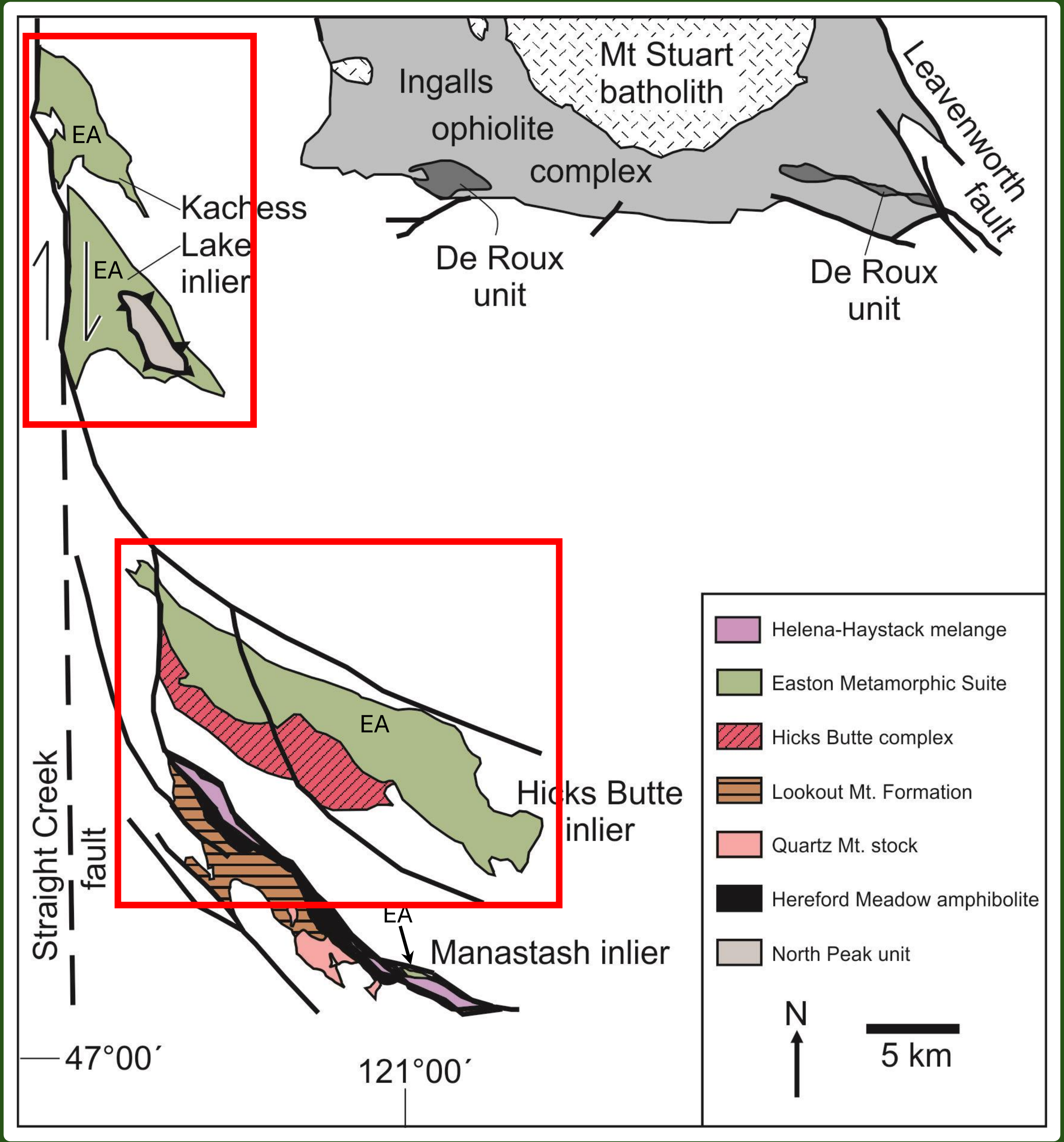


Alternative interpretation of the Easton Metamorphic Suite

Darrington Phyllite, Mt. Joesphine and Shuksan Greenschist were faulted against each other during subduction.

Formed in a large ocean basin rather than an arc-proximal marginal basin

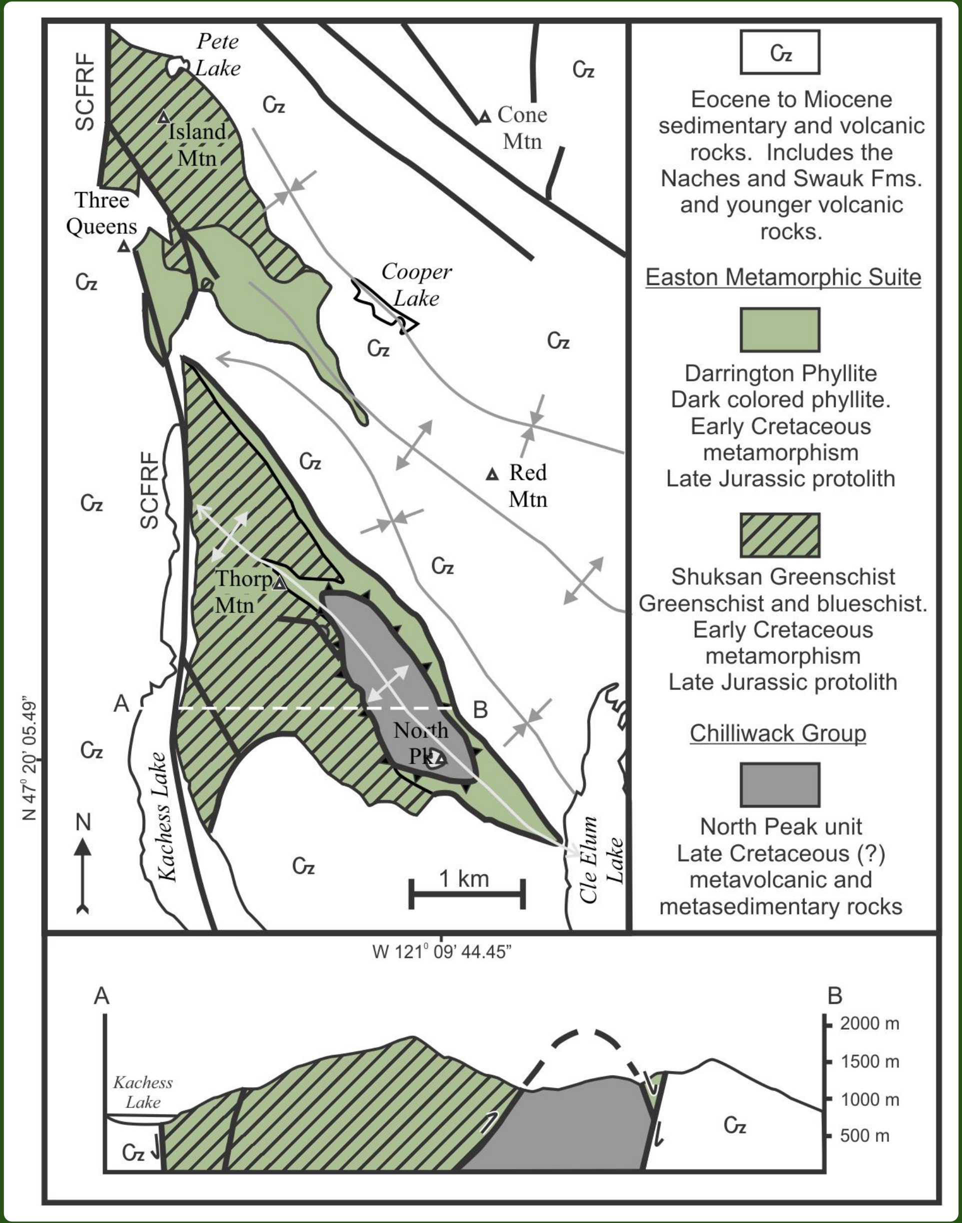
(e.g., Cordova et al., 2018).

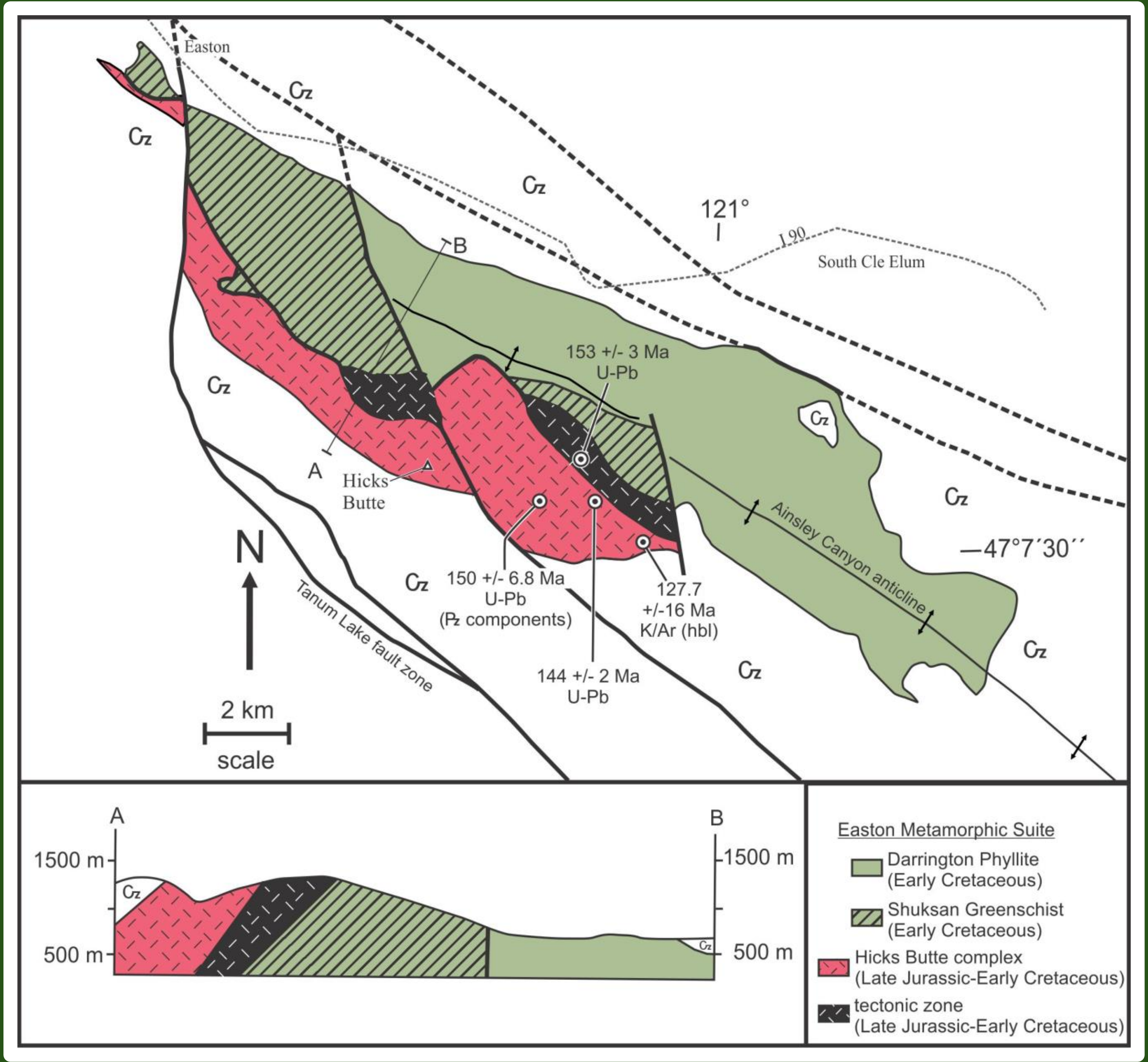


Simplified geologic map displaying pre-Cenozoic inliers east of the Straight Creek-Fraiser River fault – here just referred to as the Straight Creek fault.

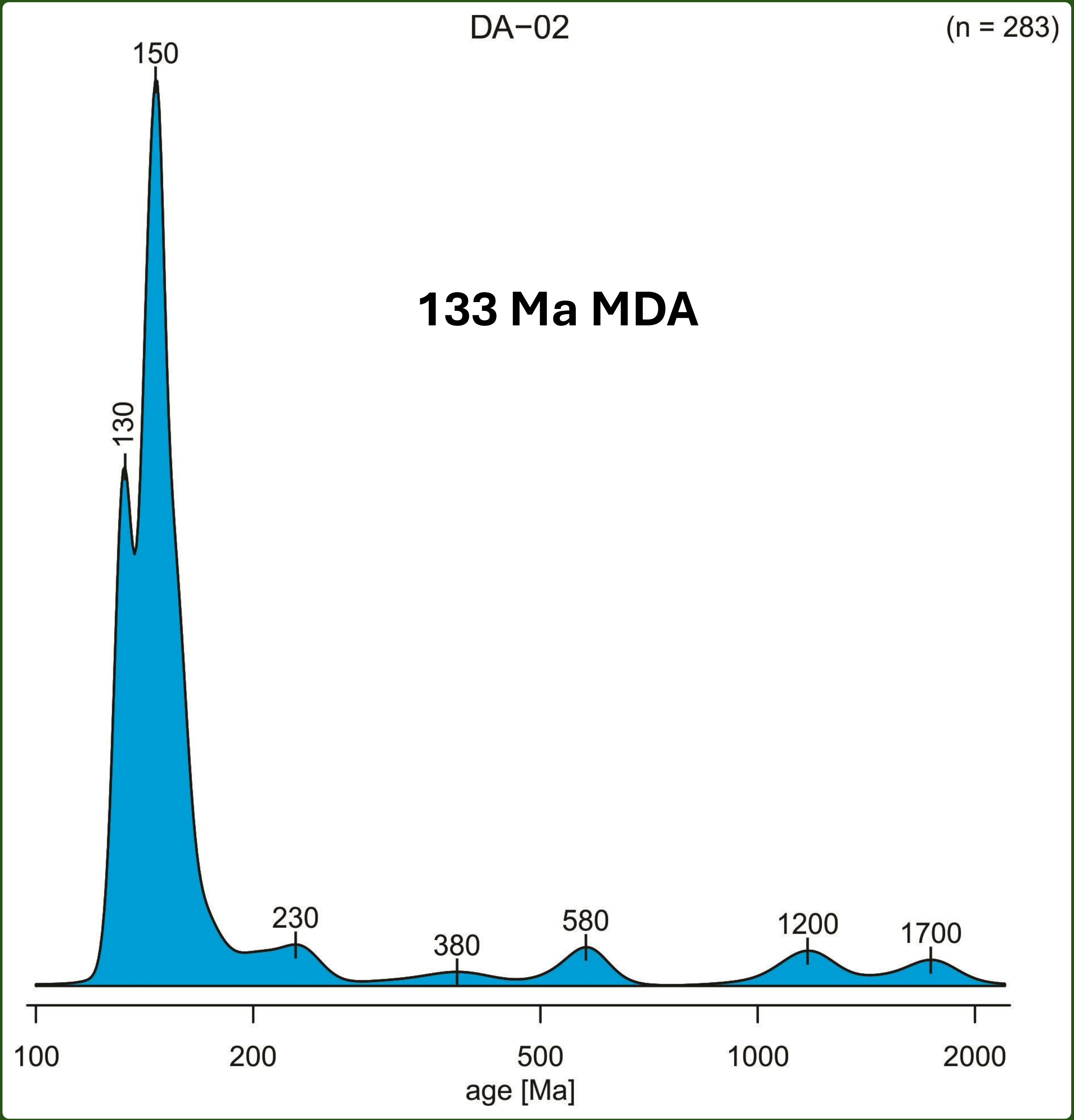
EA = Easton Metamorphic Suite

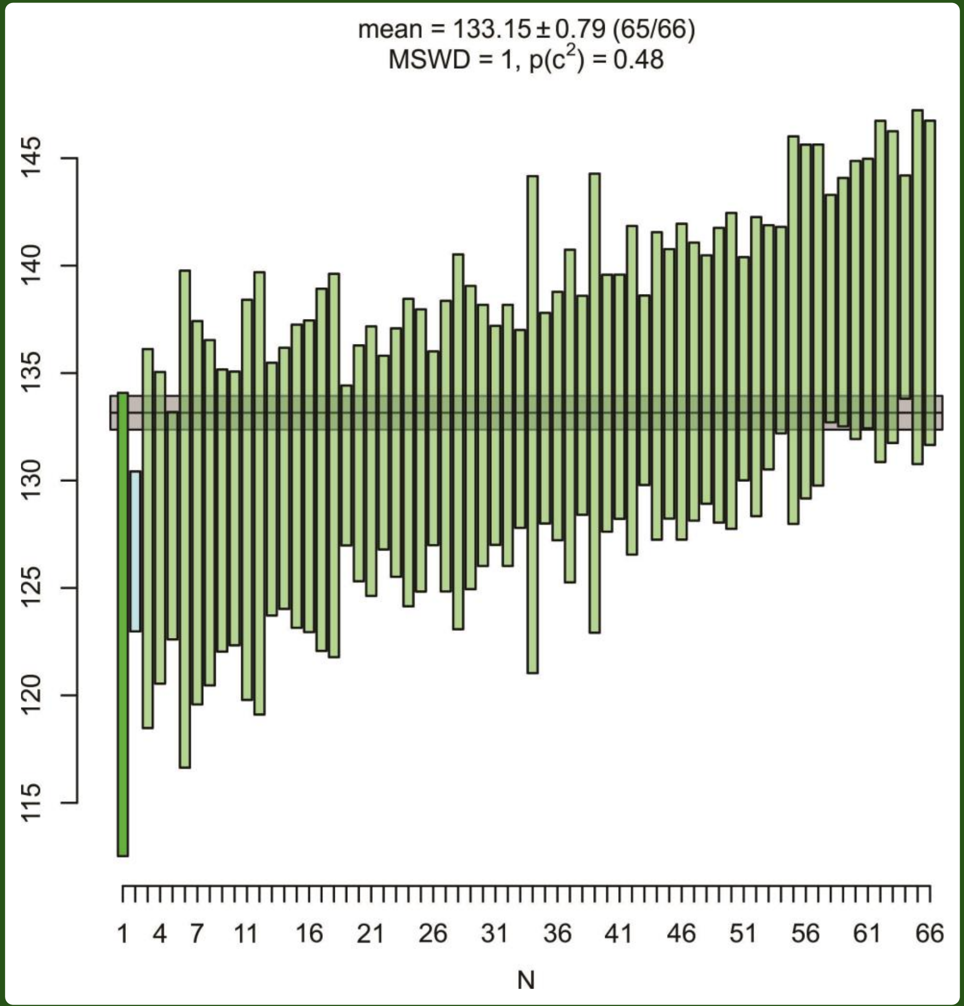
Modified from MacDonald et al. (2017; 2022)



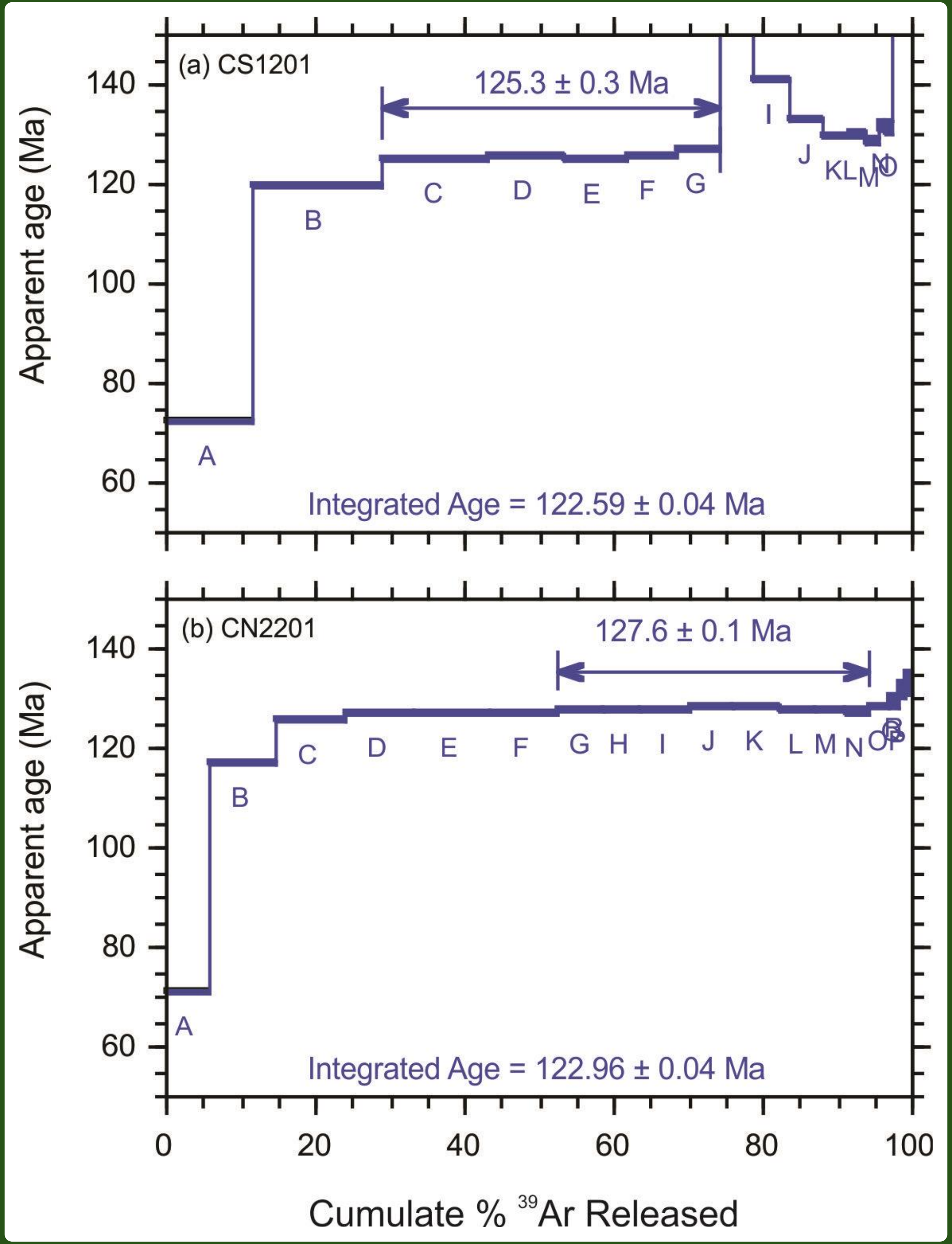


Simplified geologic maps of the Kachess Lake and Hicks Butte inliers. Modified from MacDonald et al. (2022)



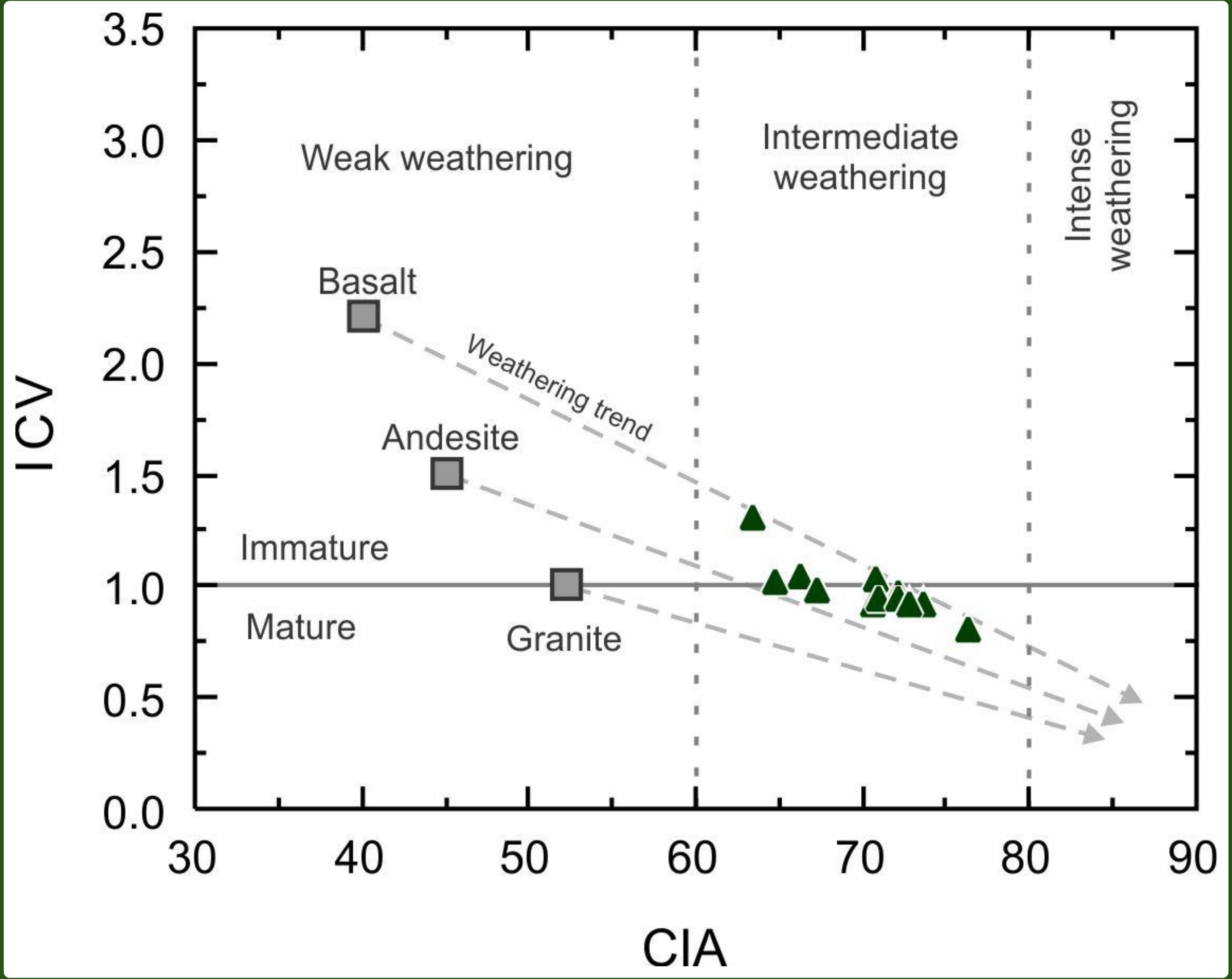


Detital zircon age data for Kachess Lake inlier Darrington Phyllite. Weighted mean MDA of 133 Ma is from the 65 youngest zircons.



White mica Ar/Ar age from the Darrington Phyllite in the Hicks Butte inlier yields an age of 125.3 ± 0.3 Ma

White mica Ar/Ar age from the same outcrop as the 133 Ma Darrington Phyllite in the Kachess Lake inlier yields an age of 127.6 ± 0.1 Ma

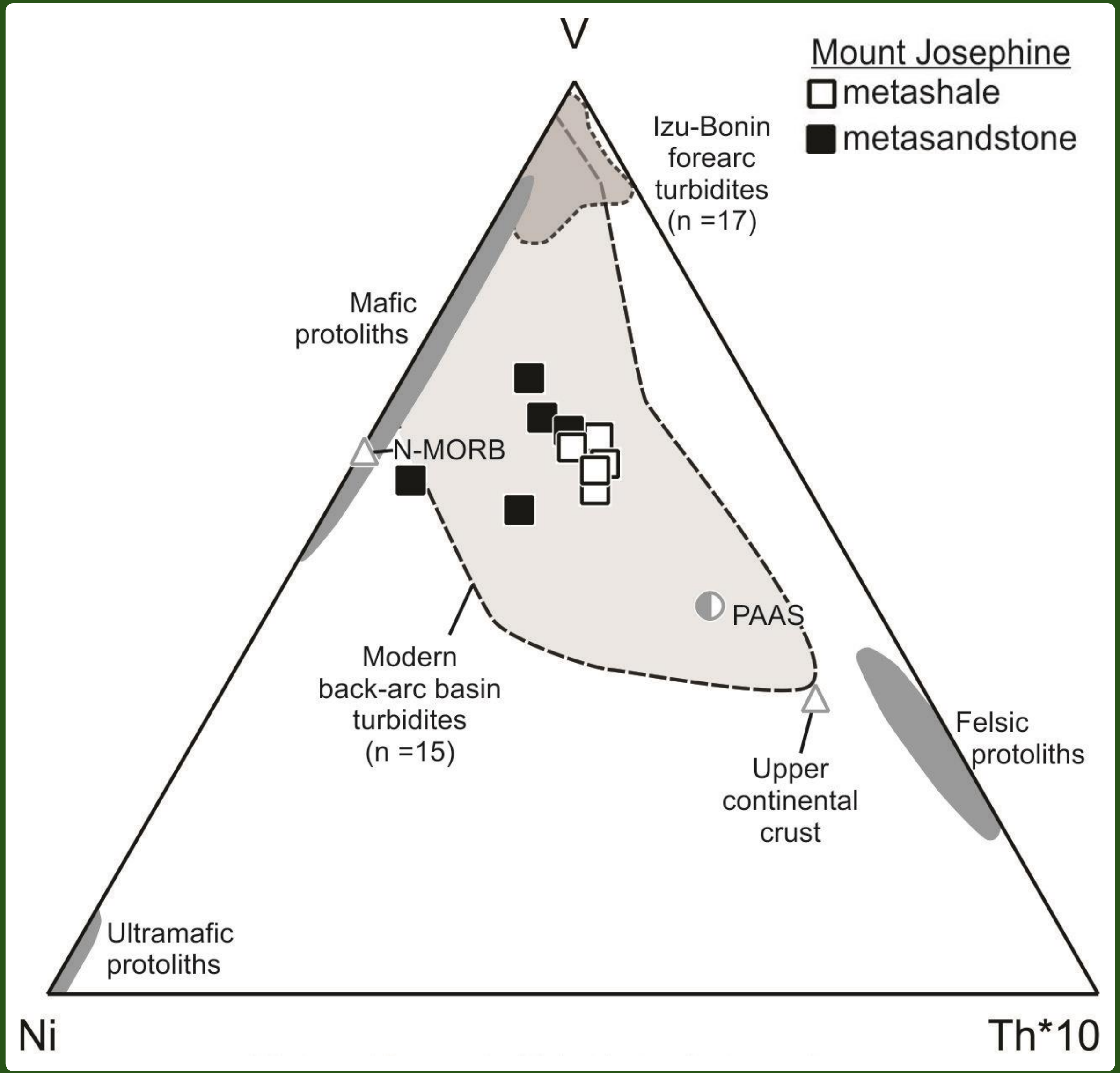


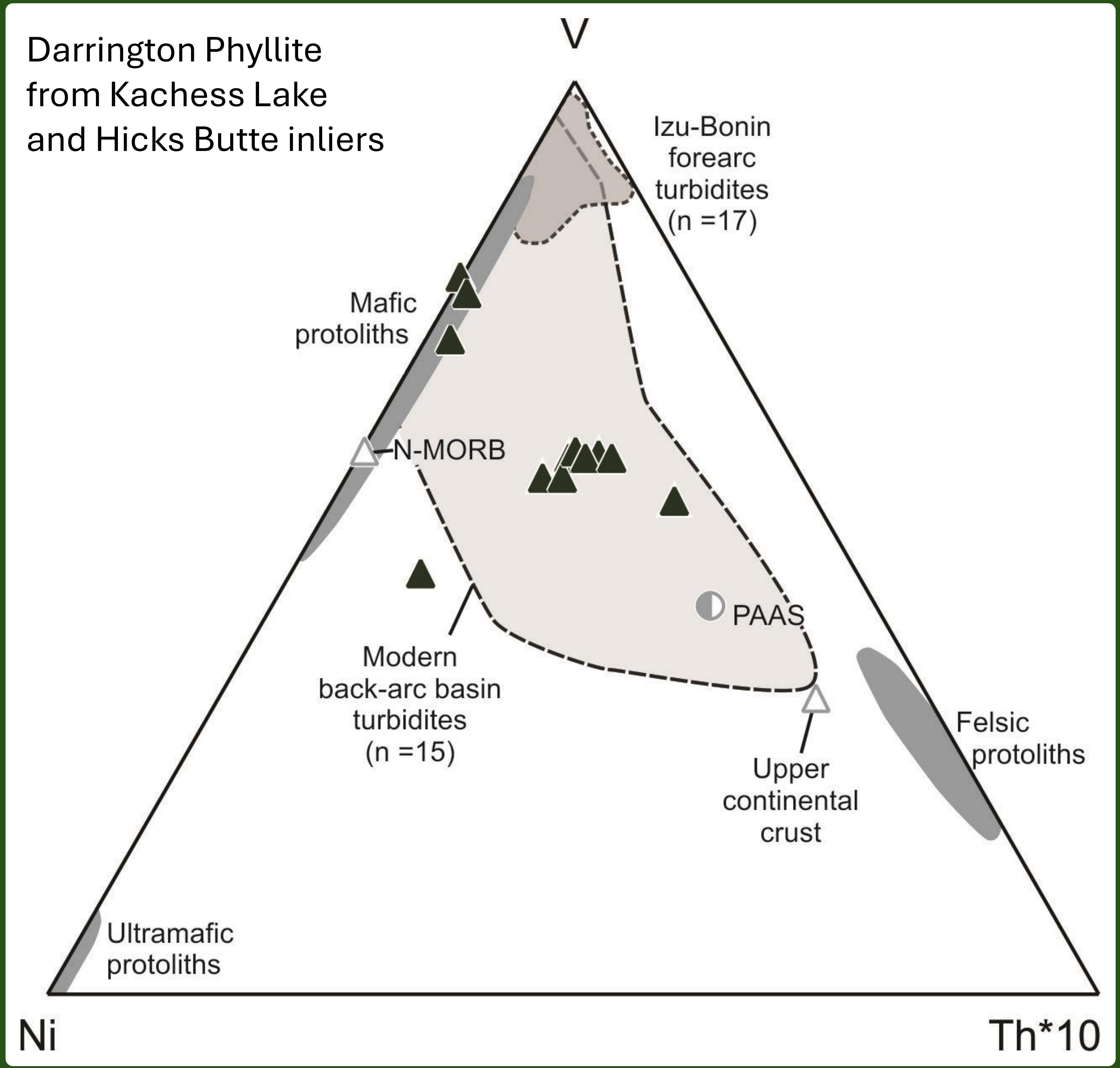
Darrington Phyllite geochemistry

CIA = chemical index of alteration (Nesbit & Young, 1982; Nesbit et al., 1995).

ICV = index of compositional variability (Cox et al., 1995)

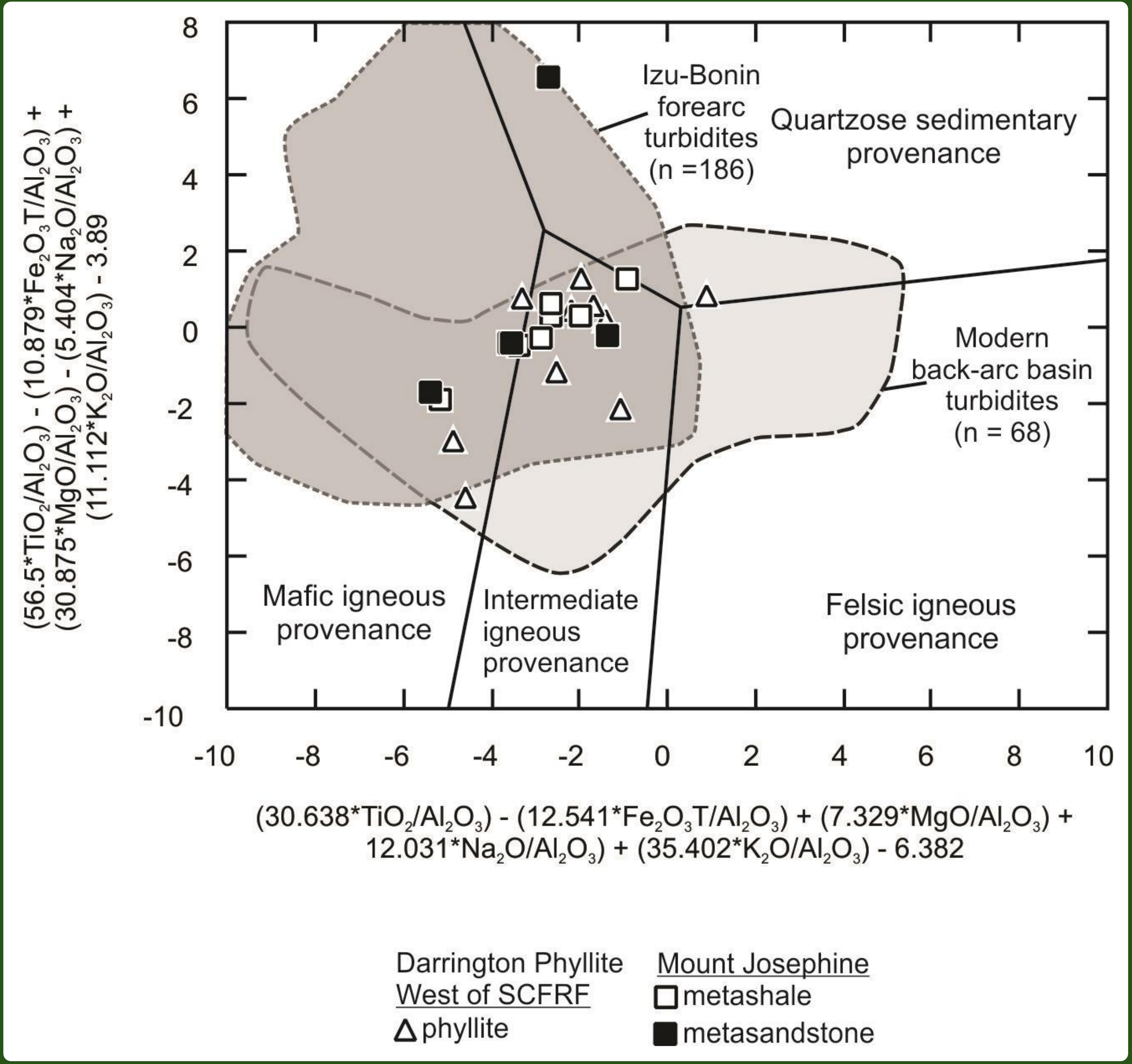
A CIA = 100 is a completely weather sample.

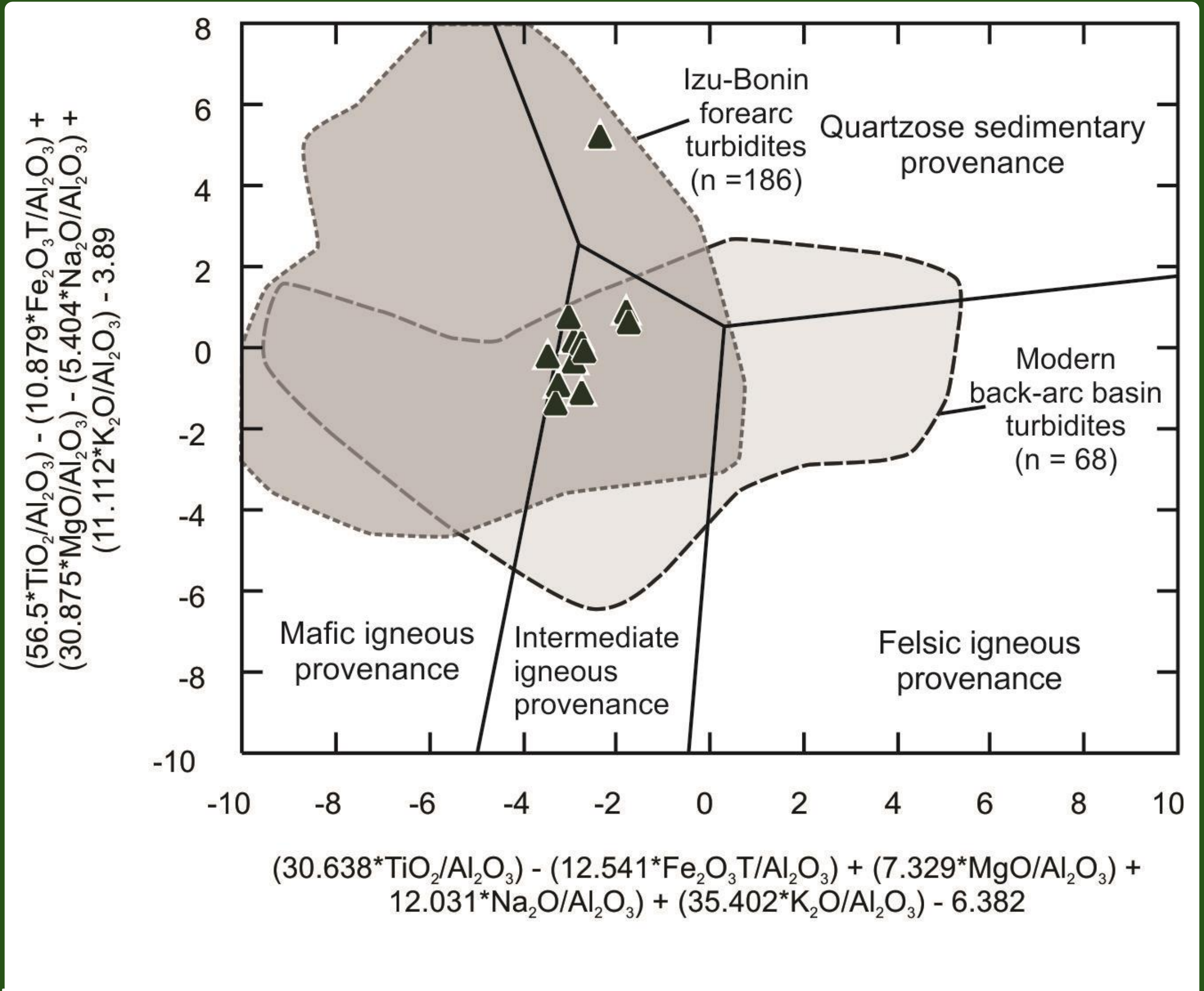




V-Ni-Th provenance diagram of Bracciali et al. (2007) modified by MacDonald and Dragovich (2015).

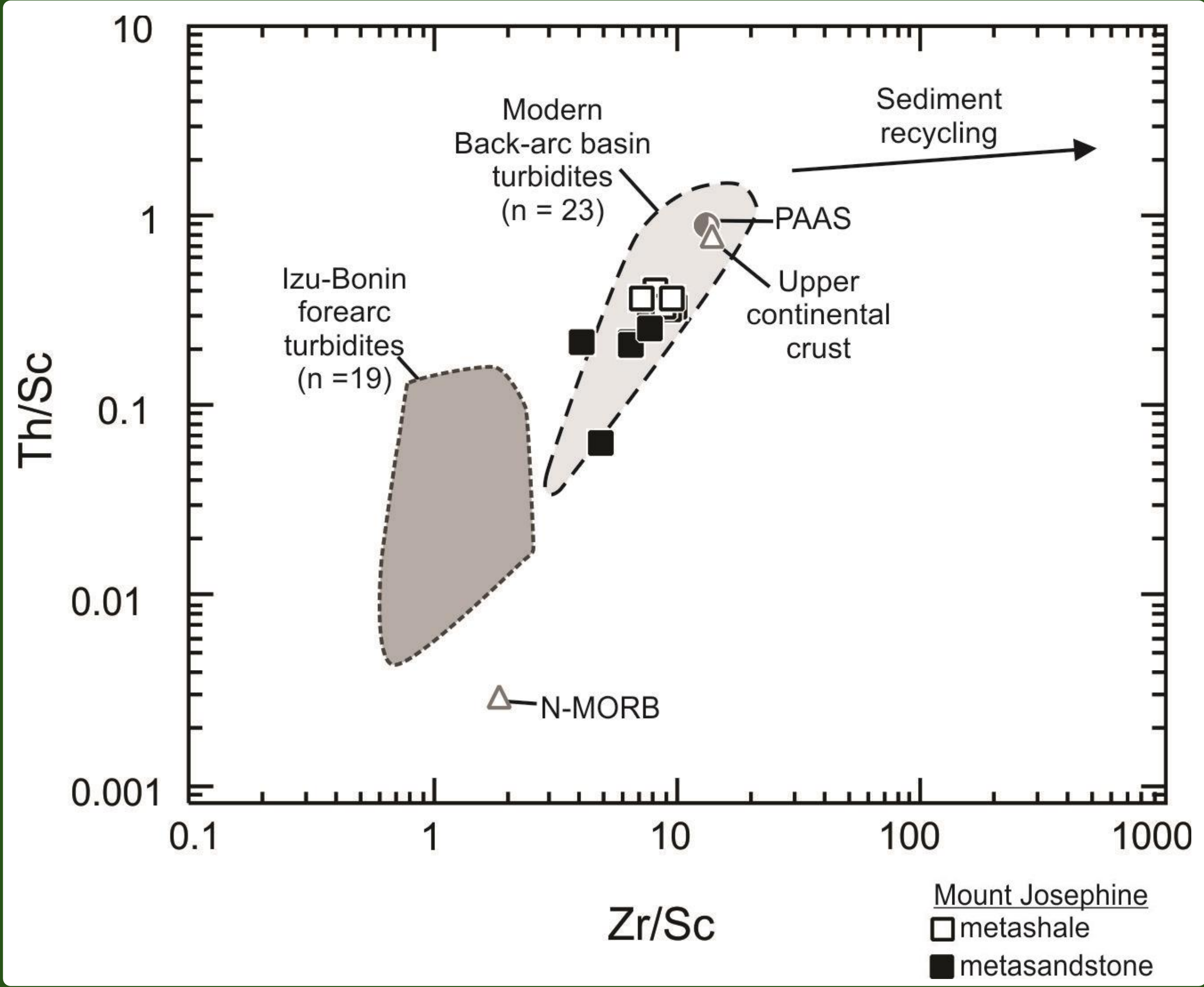
Data suggests an intermediate to mafic provenance for the Darrington Phyllite.

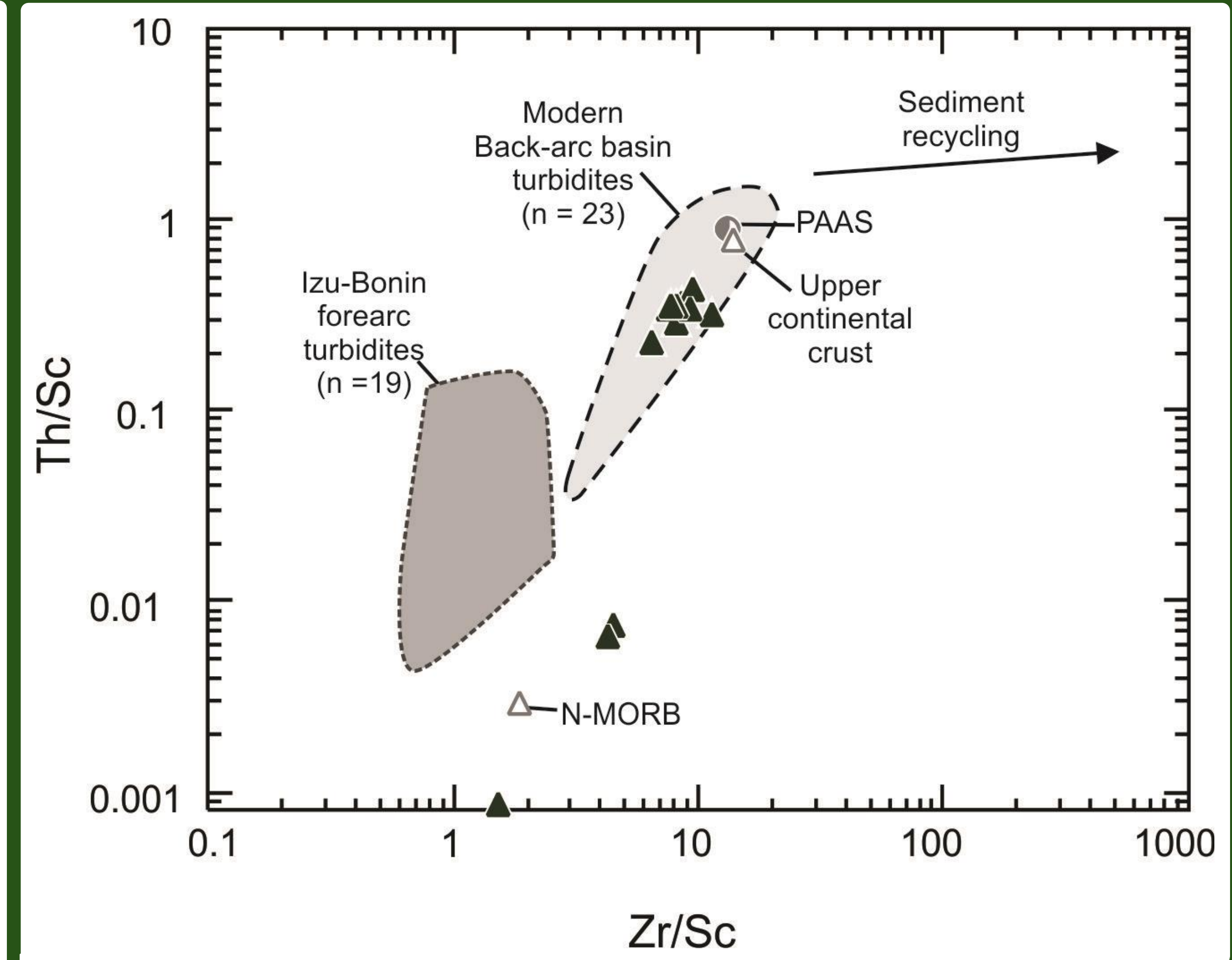




Darrington Phyllite from Kachess Lake and Hicks Butte inliers

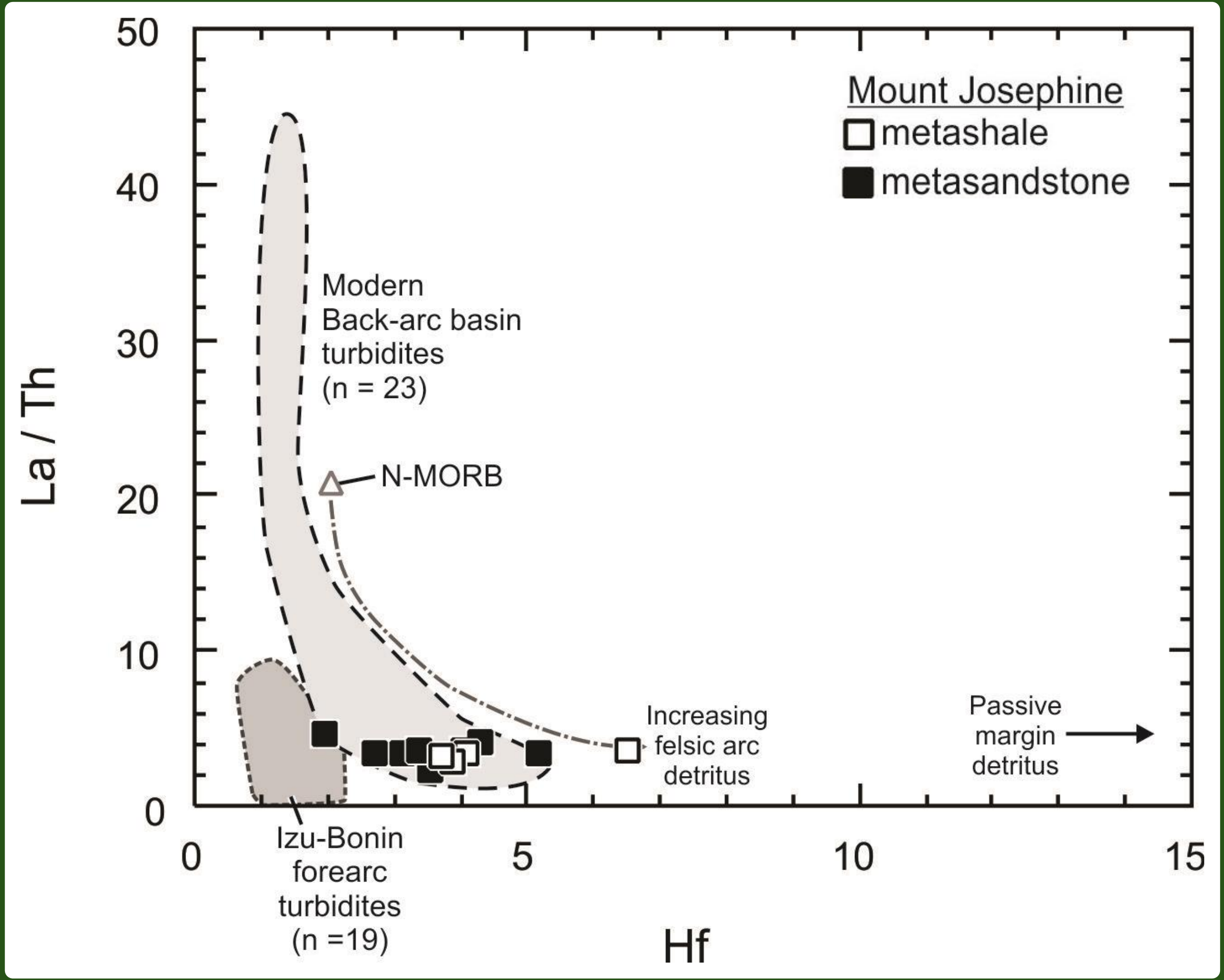
Provenance sedimentary geochemistry diagram from Roser and Korsch (1988).
All samples are originating from intermediate to mafic provenance with rare quartzose sedimentary provenance.

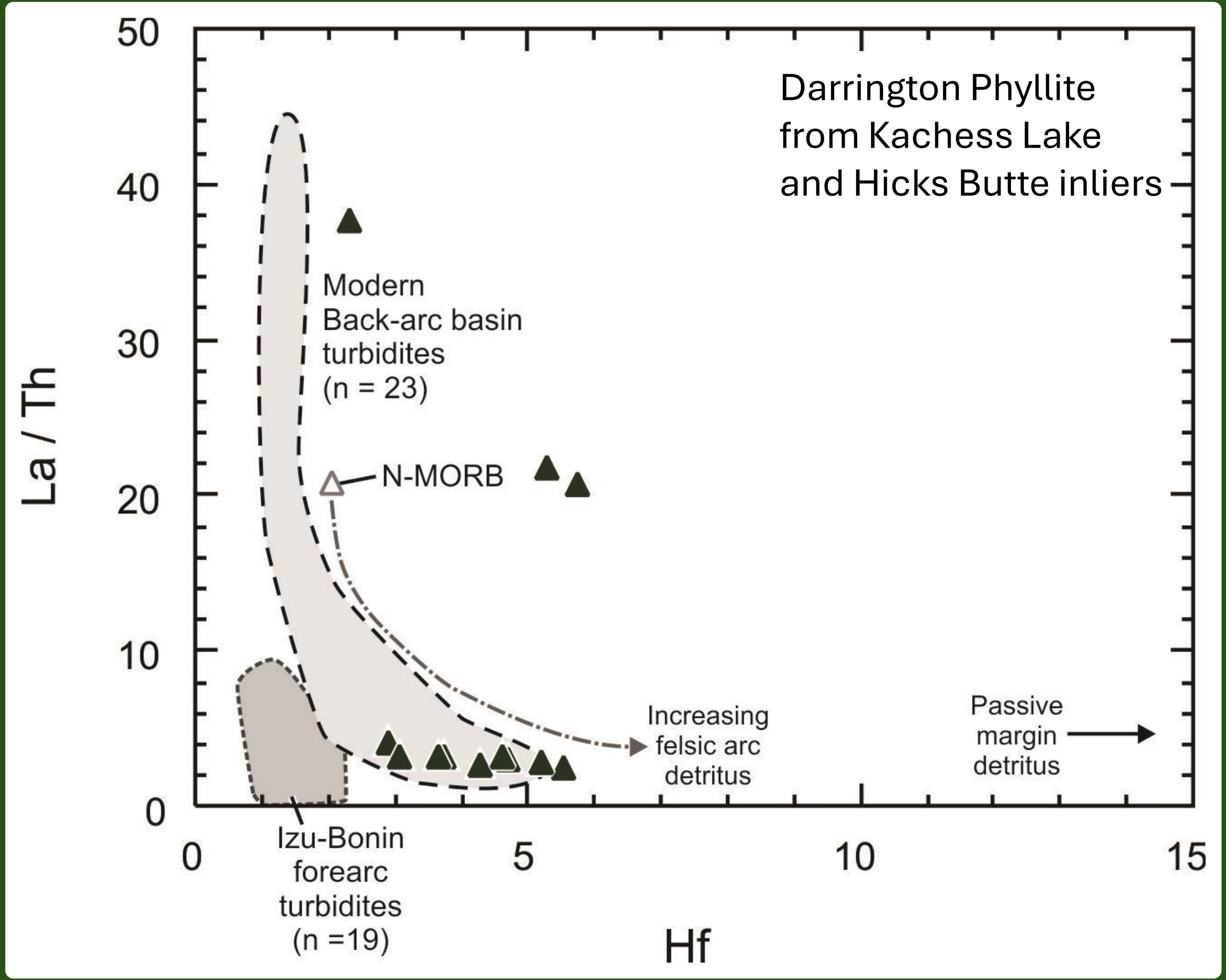




Darrington Phyllite from Kachess Lake and Hicks Butte inliers

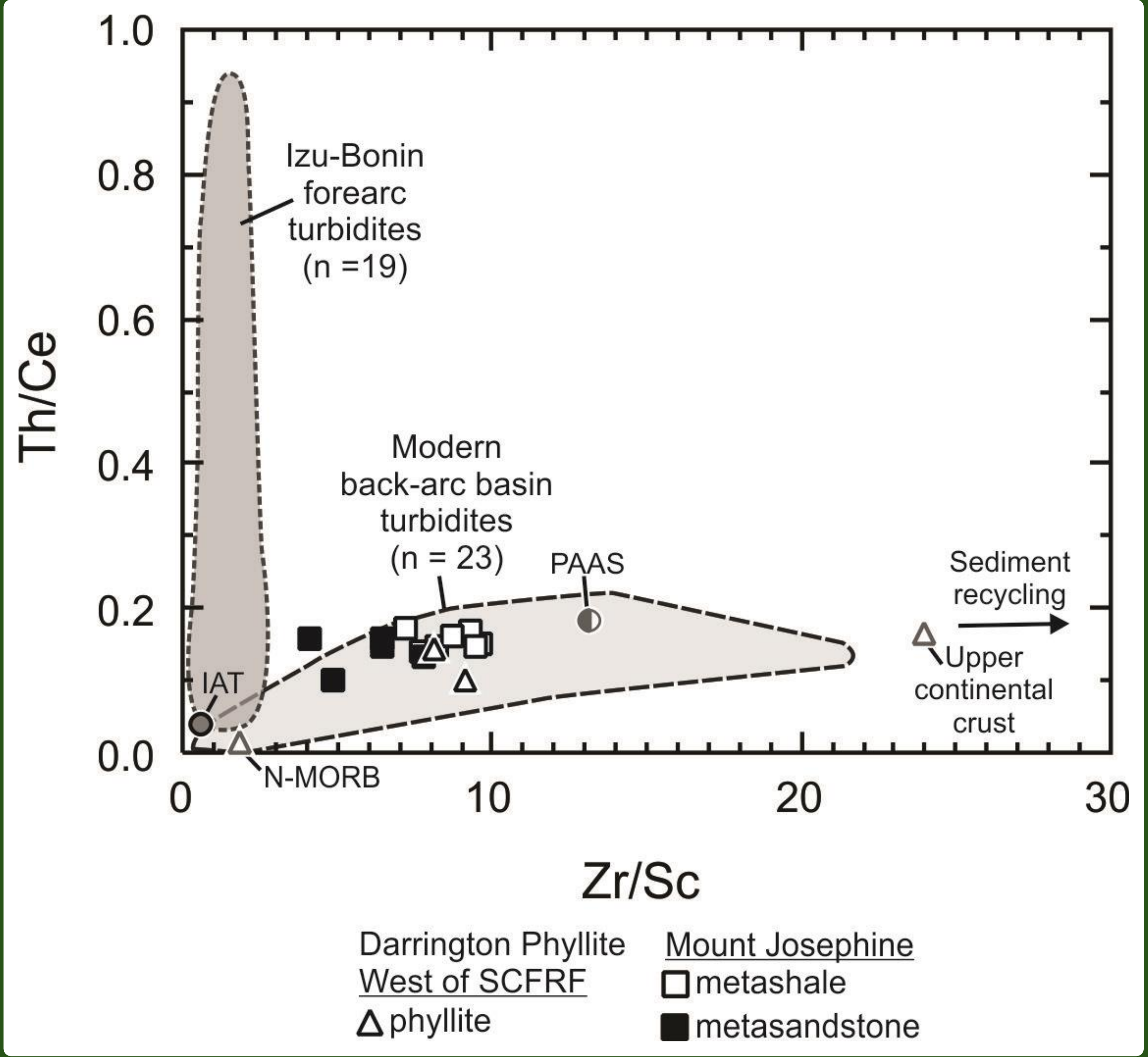
Th/Sc vs Zr/Sc diagram of McLennan et al. (1993) modified by MacDonald and Dragovich (2015). Data shows no recycling and an intermediate to mafic arc source. Three samples are VERY mafic.

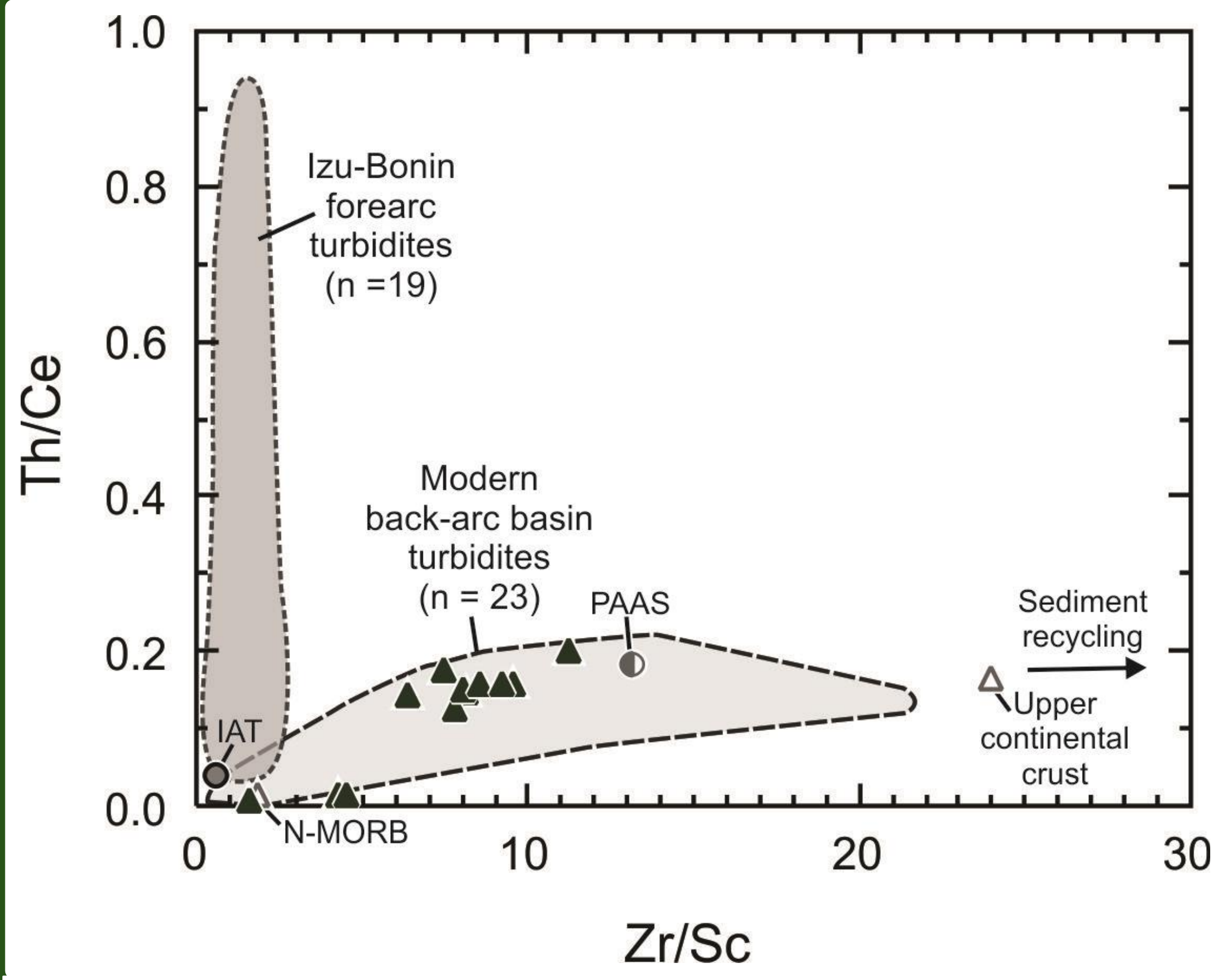




La/Th vs Hf diagram of Floyd and Leveridge (1987) modified by MacDonald and Dragovich (2015).

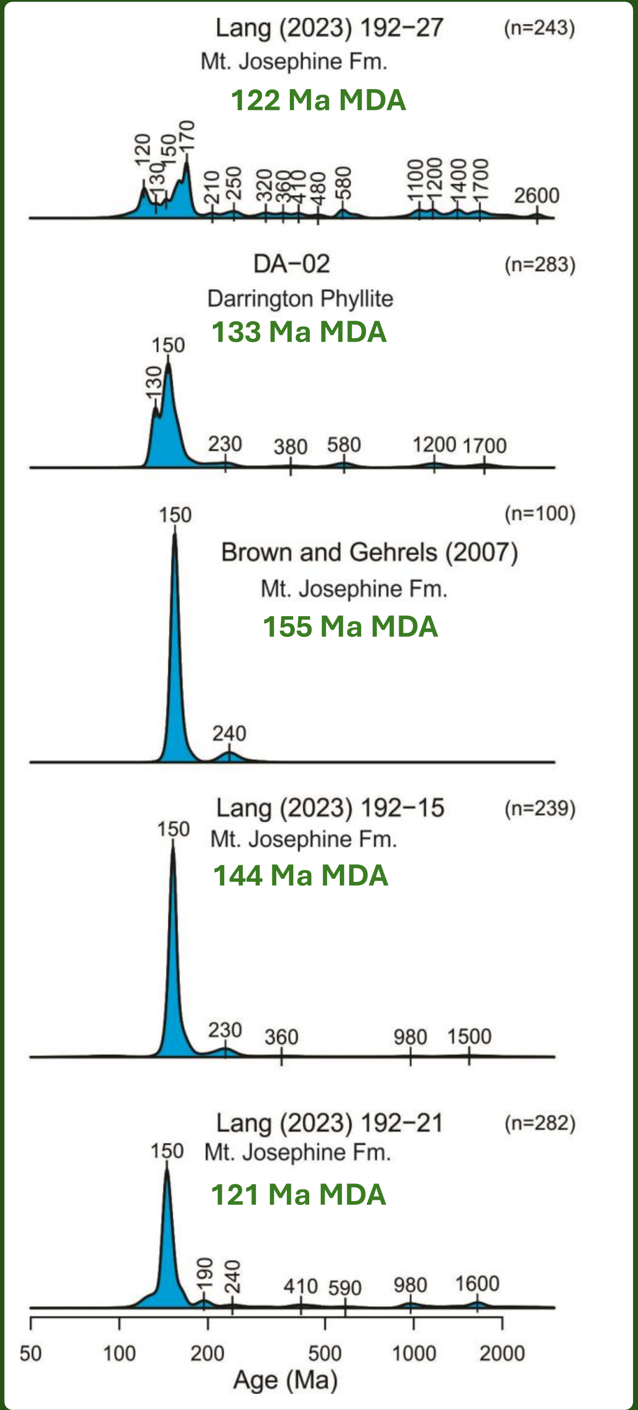
Data shows little passive margin input and an intermediate to mafic arc source.

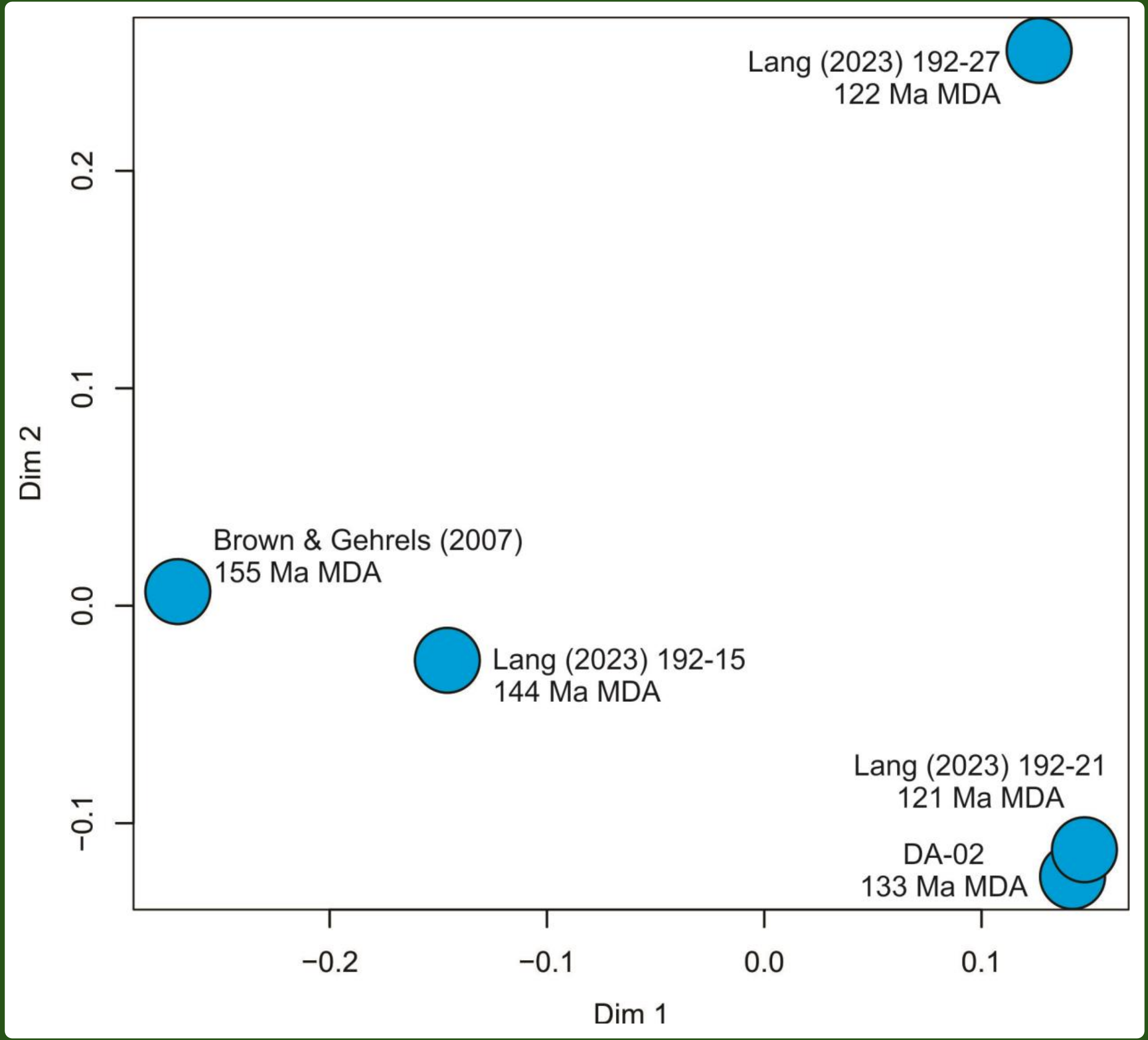




Darrington Phyllite from Kachess Lake and Hicks Butte inliers

Th/Ce vs. Zr/Sc diagram for the Darrington Phyllite. Samples are plotting in the field defined by modern back-arc basins, and away from forearcs. Three samples with low Th/Ce and high Zr/Sc are VERY mafic.





Kernel Density Estimation and Multidimensional Scaling (MDS) plot for Mt. Josephine and Darrington detrital zircons from this and other studies.

Conclusions

These ages and sedimentary geochemistry suggest the Darrington Phyllite east of the SCFRF formed in an Early Cretaceous (133 Ma) *back-arc setting* and were then subducted and cooled to muscovite closure temperatures <10 Ma (128-125 Ma) after their deposition.

Differing protolith ages for the Darrington Phyllite suggest it may have originated in multiple mid- to late Mesozoic marginal basins which closed, buried, and exhumed at different rates –slower for rocks now located west of the SCFRF and faster for rocks now located to the east.

Lang (2023) suggested a similar conclusion based on the multiple ages.