Comparing Paleoproterozoic orthogneisses in northern Idaho with glacial igneous clasts of East Antarctica; evidence for linkage between western Laurentia and East Antarctica during Columbia supercontinent assembly

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OVERVIEW & LOCATIONS

Purpose: to test a potential Paleoproterozoic link between western Laurentia and East Antarctica.

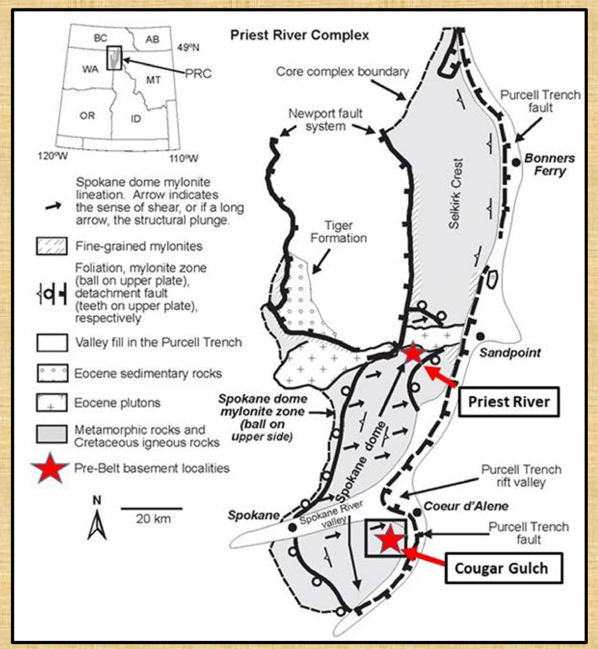
- comparing metaigneous rocks of the **Priest River complex**, Idaho (1.87-1.84 Ga) to granitic glacial cobbles (1.88-1.85 Ga) from **East Antarctica.**
- comparing whole-rock chemistries, U-Pb ages, and Hf-isotope compositions.

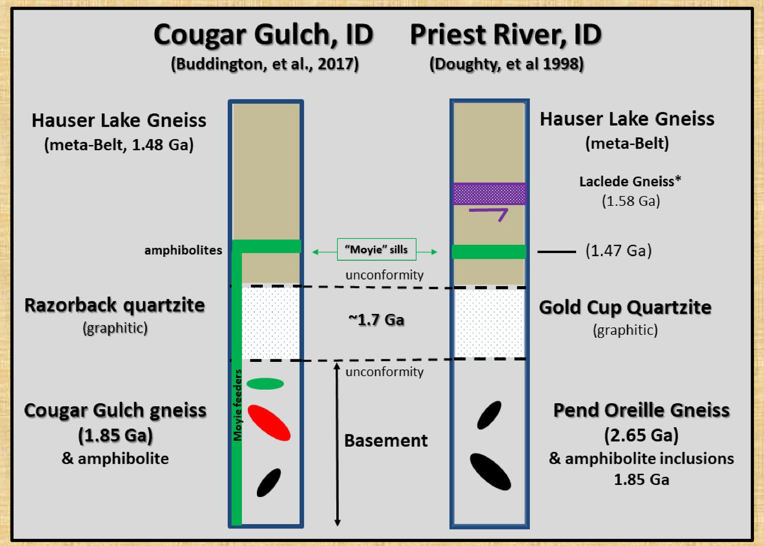
Priest River metamorphic complex in northeast Washington and northern Idaho, represents western Laurentian basement located adjacent to the Neoproterozoic rifted margin. Two Paleoproterozoic-Neoarchean basement localities; Cougar Gulch and Priest River locations (see figures below and Buddington et al., 2016, and Wang, 2015).

- **Cougar Gulch** orthogneiss (monzogranite-granodiorite) and **Kidd Creek** orthogneiss (tonalite-granodiorite).
- **Priest River amphibolite inclusions** are dissected mafic dikes (basaltic to basaltic andesite) within 2.65 Ga Pend Oreille Gneiss.

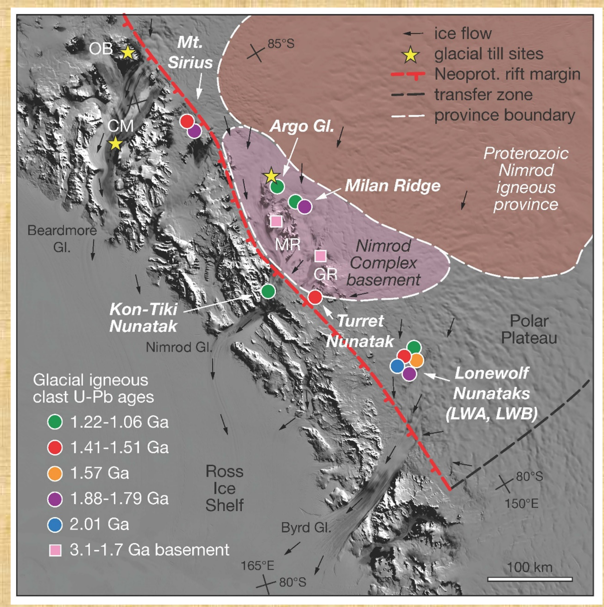
Central East Antarctica craton is ice covered, but glacial clasts eroded from the interior were deposited in moraines in the Transantarctic Mountains adjacent to the Neoproterozoic rift margin. Sites were sampled at Lonewolf Nunataks and Mt. Sirius (see figures below and Goodge et al., 2017).

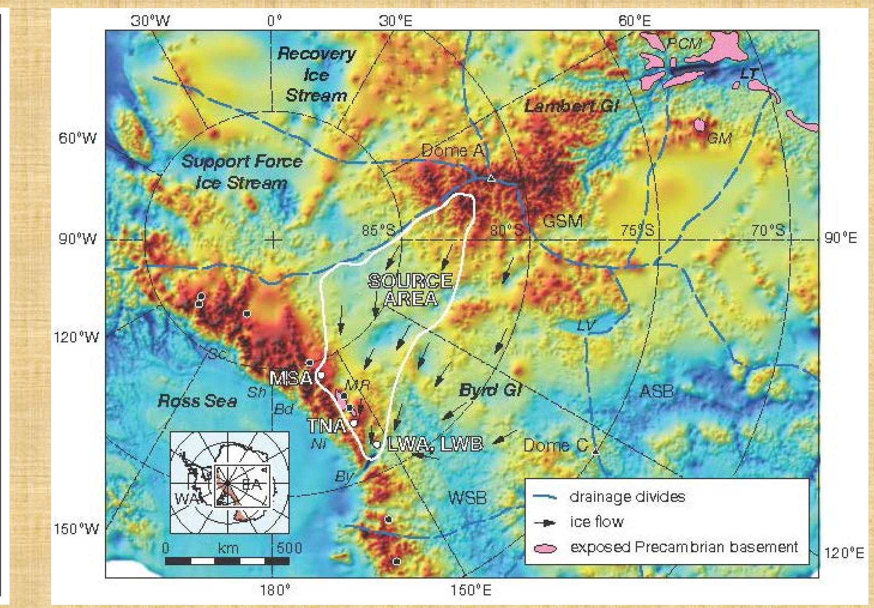
- glacial cobbles composed of **granitic orthogneiss**.





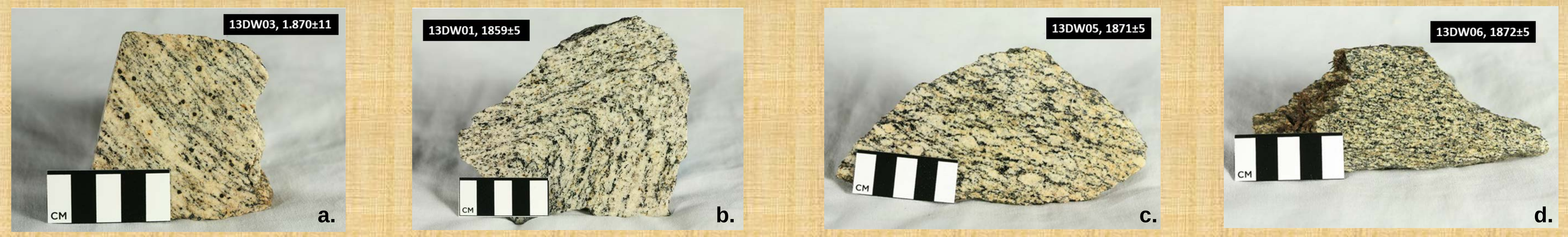
Generalized geologic map (left) of the Priest River complex and locations of two Paleoproterozoic basement sites (modified from Doughty et al., 1998), and generalized stratigraphic columns (right, not to scale) for the Cougar Gulch and Priest River locations (from Buddington et al., 2019).





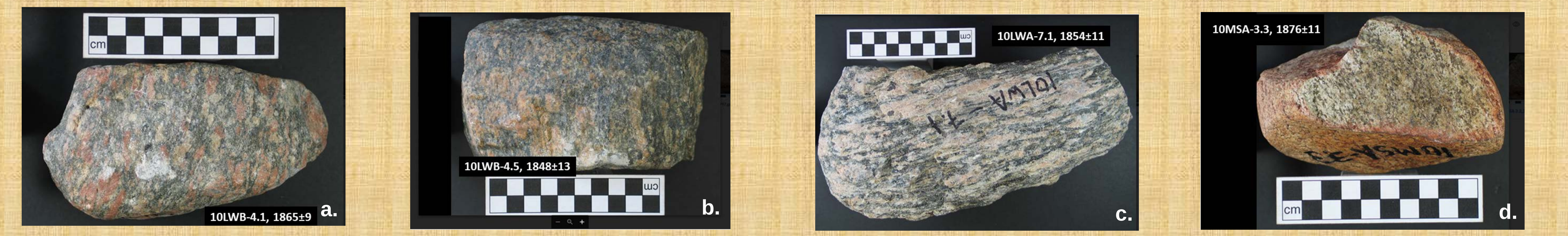
Location map (left) for Lonewolf Nunataks and Mt. Sirius sample sites, central East Antarctica (from Goodge et al., 2017), and subglacial topography (right) of central East Antarctica, showing source area of glacial clasts (from Goodge et al., 2017).

IDAHO ORTHOGNEISSES



Cougar Gulch monzogranitic orthogneiss (a-c); Kidd Creek tonalitic orthogneiss (d).

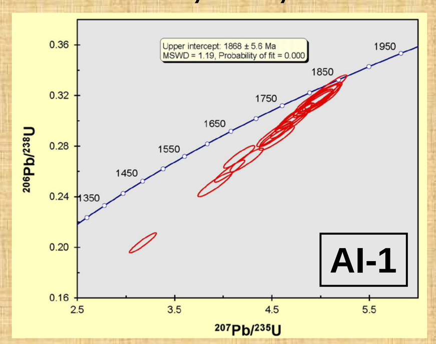
EAST ANTARCTIC ERRATICS



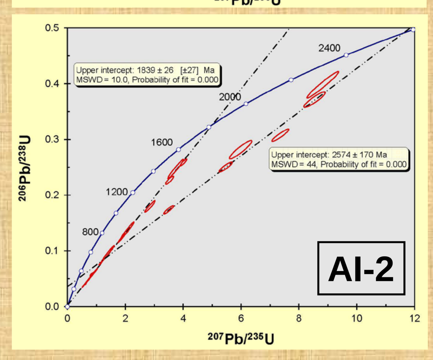
East Antarctica granitic orthogneiss clasts. Lonewolf Nunataks (a-c), Mt. Sirius (d).

NEW AGES & HF-ISOTOPES

Concordia for Priest River mafic inclusions, AI-1, AI-2.



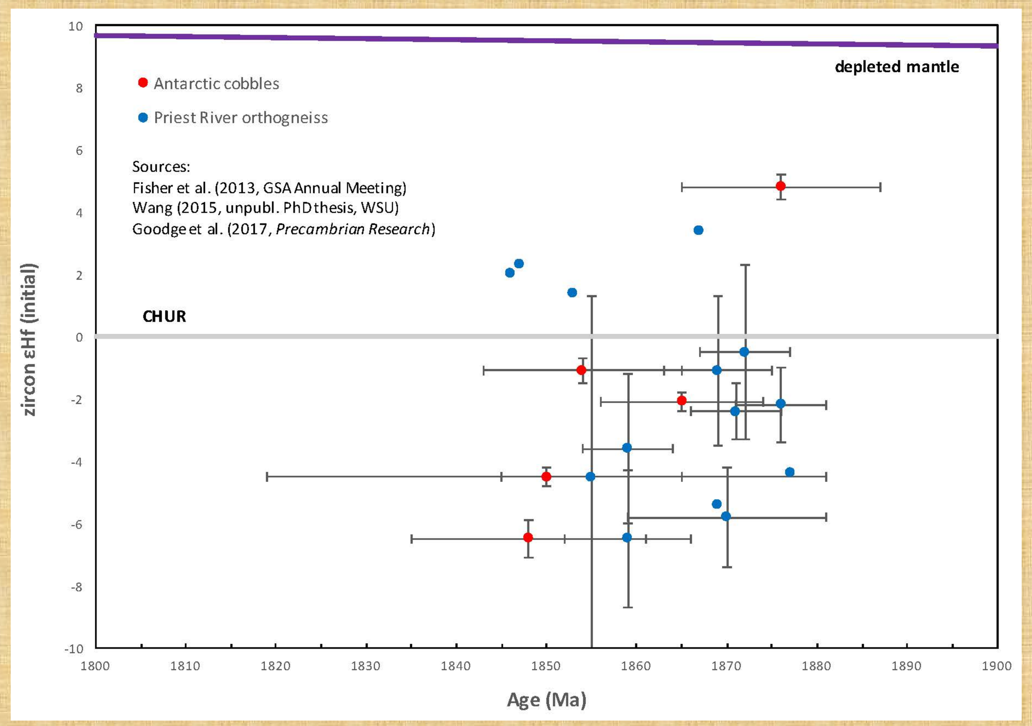
AI-1; upper intercept zircon crystallization age = **1868.3+/-5.6 Ma**



AI-2; 2 distinct lead loss trends

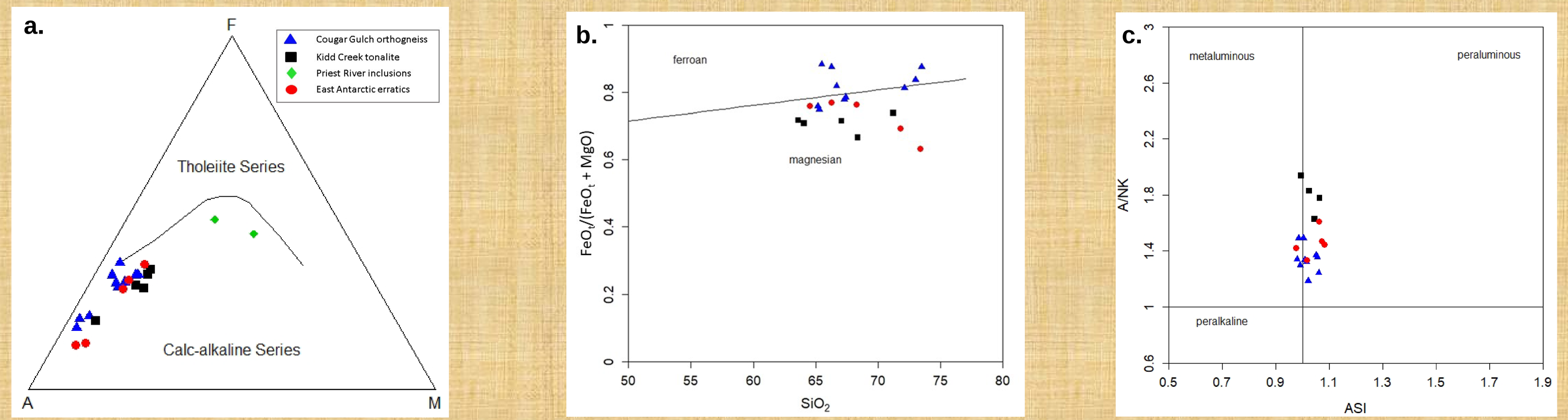
- upper intercept **2574+/-170 Ma** = protolith age
- upper intercept **1839+/-26 Ma** = remelting of continental crust

Source: Buddington et al. (2019, GSA Cordilleran Meeting), analyses by LA-ICPMS, WSU Pullman.



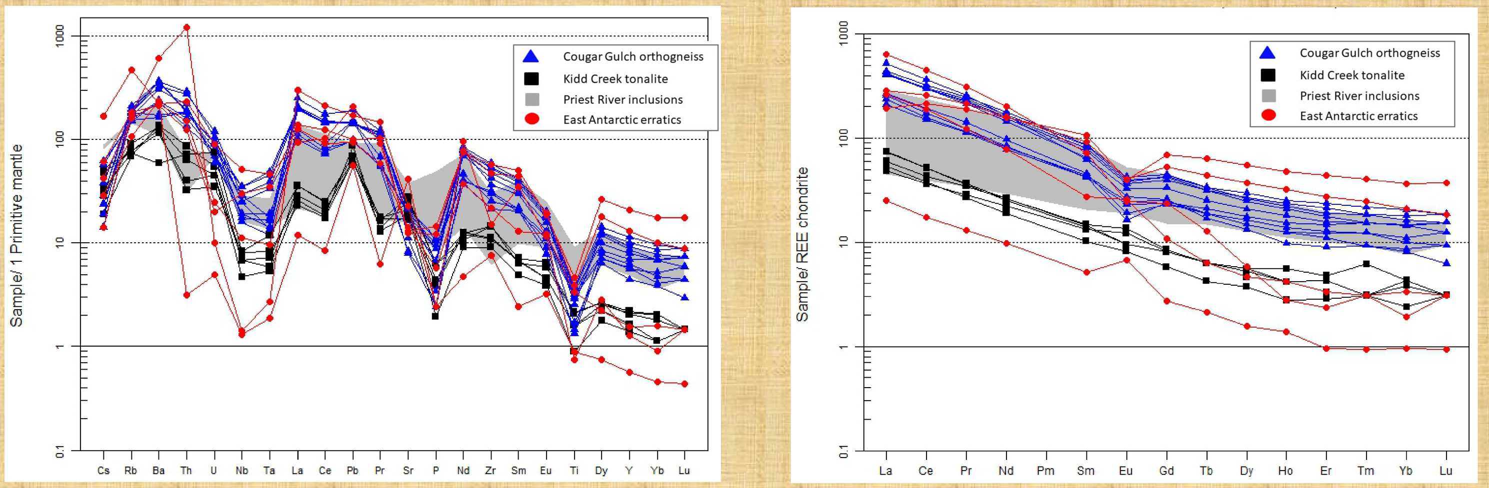
Initial epsilon Hf vs. U-Pb crystallization age for zircon in PRC (blue) and East Antarctica (red) samples.

MAJOR-ELEMENT CHEMISTRY



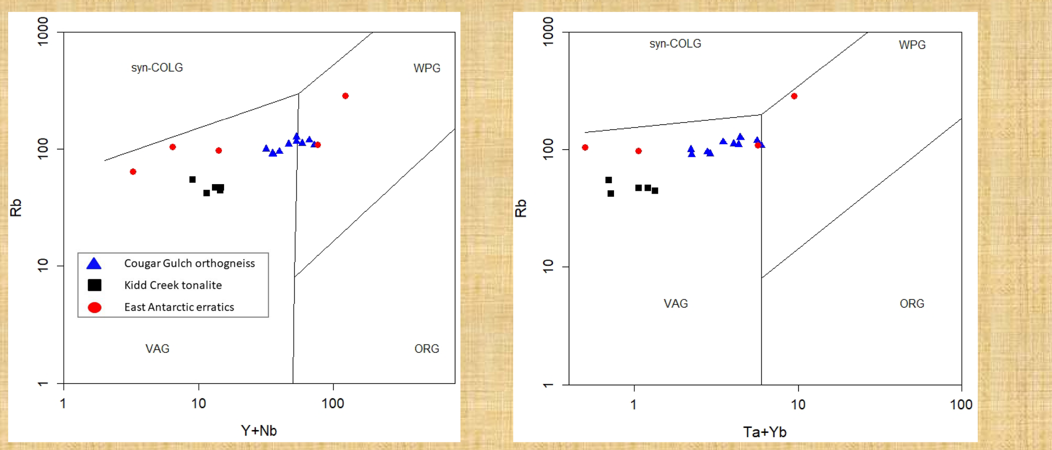
Whole rock, major element plots for **Priest River complex** and **Antarctic** glacial clasts. a. AFM plot showing calc-alkaline trends. b. Fe-number; samples plot within Cordilleran granite field of Frost et al. (2001; *J.Pet.*). c. Aluminum Saturation Index of Frost (2001; *J.Pet.*), (ASI = Al/(Ca−1· 67P + Na + K)).

TRACE-ELEMENT CHEMISTRY

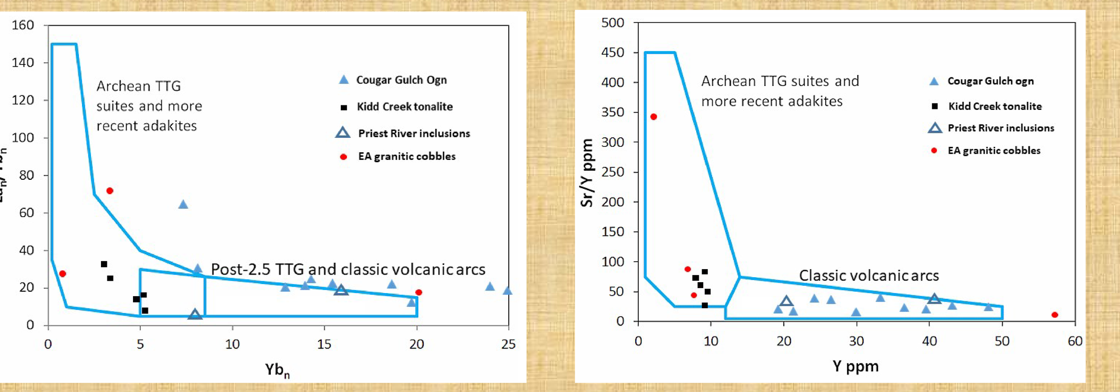


Trace element spider plots (left) for Priest River complex and East Antarctic samples; primitive mantle values from McDonough & Sun (1995; *Chem. Geol.*). **REE plots** (right) for Priest River complex and East Antarctic samples; chondrite values from Boynton (1984; *Elsevier*).

TECTONIC DISCRIMINATION



Granite tectonic discrimination plots of Pearce et al. (1984; *J.Pet.*); ORG = orogenic granites, WPG = within plate, syn-COLG = syn-collisional, VAG = volcanic arc.



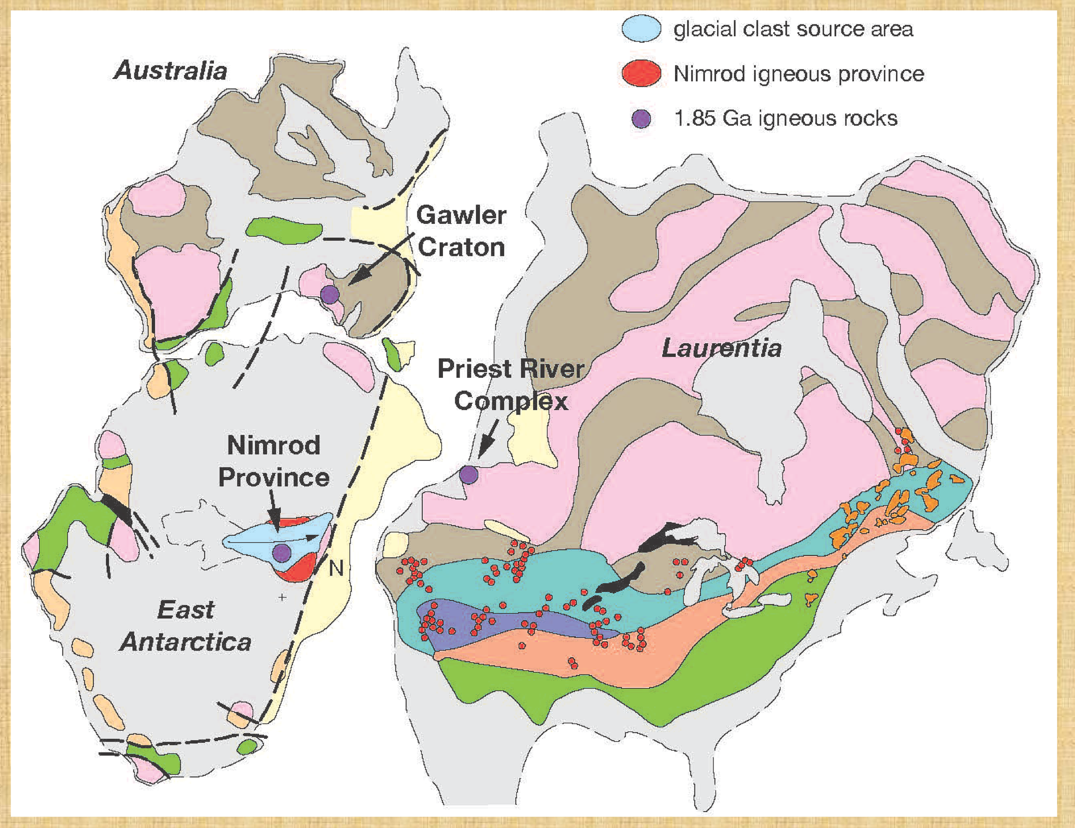
Discrimination plots for volcanic arcs, adakites, and Precambrian TTG's. La_n/Yb_n vs. Yb_n (left) after Martin (1999; *Lithos*), Sr/Y vs. Y (right) after Drummond & Defant (1990; *JGR*).

CONCLUSIONS

The Paleoproterozoic orthogneisses from the Priest River complex & East Antarctica (Lonewolf Nunataks & Mt. Sirius) exhibit striking similarities. Both groups occur adjacent to their respective Precambrian rifted margins (see figure below) and both exhibit:

- overlapping of major & trace element chemistries; consistent with cogenetic origin
- similar crystallization ages & initial εHf-isotopic compositions, indicating a common source of melting
- a volcanic arc fingerprint, indicating these rocks formed during active-margin convergence

Based on these similarities, we propose a potential linkage between western Laurentia and the Nimrod Province in East Antarctica during the Paleoproterozoic assembly of supercontinent Columbia. Such ties may also extend to the Gawler Craton in Australia.



Mesoproterozoic reconstruction of part of the supercontinent Columbia, highlighting correlation of ~1.85 Ga geologic provinces in western Laurentia, East Antarctica, and Australia (from Goodge et al., 2017). Other geologic correlations between 1.85-0.65 Ga omitted for clarity.

SOURCES

Buddington, A.M., Wang, D., and Doughty, P.T., 2016, *GSA Field Guide 41*, 265-284.
Buddington, A.M., Wang, D., and Rogers, C., 2019, GSA *Abstracts with Programs,* 51, #4.
Doughty, P.T., Price, R.A., and Parrish, 1998, CJES, 35, 39-54.
Goodge, J.W., Fanning, C.M., Fisher, C.M., and Vervoort, J.D., 2017, *Prec. Res.*, 299, 151-176.
Wang, D., 2015, WSU, M.S. thesis.