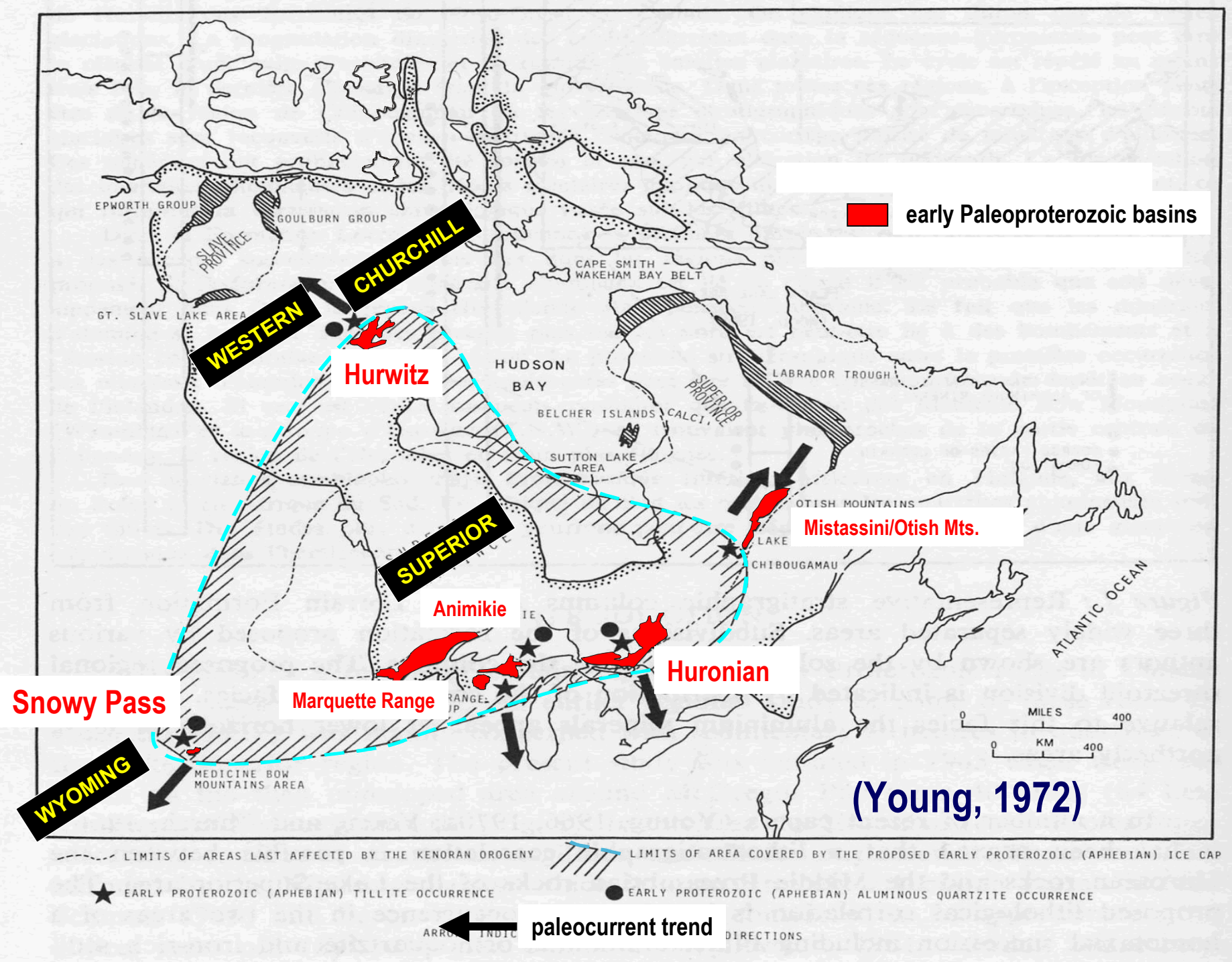
Characteristics and comparison of the basal Paleoproterozoic cover sequence of the Superior and western Churchill provinces of Laurentia

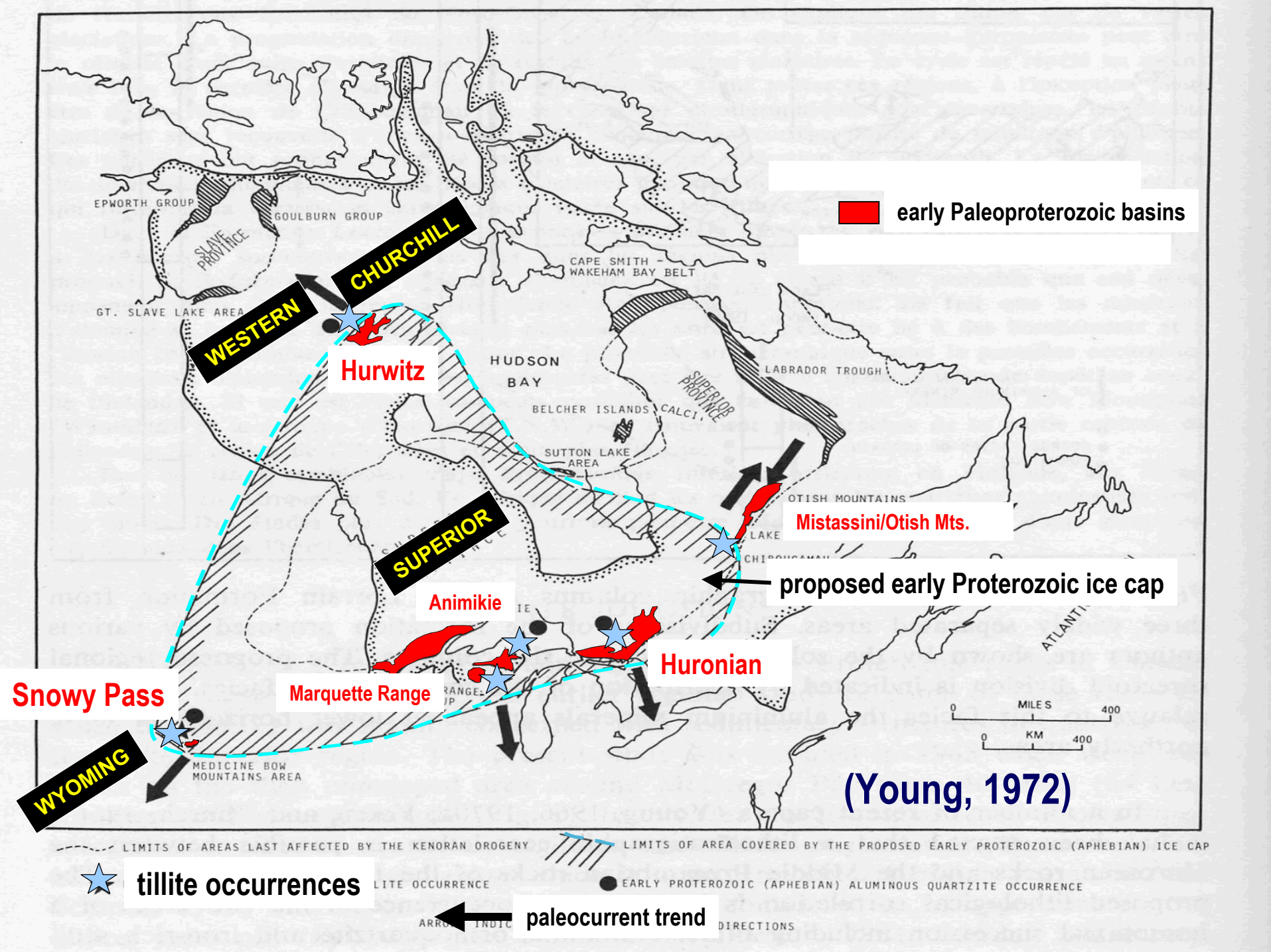
Rob Rainbird, Bill Davis and Sally Pehrsson

Geological Survey of Canada

Natural Resources Canada

Ressources naturelles Canada


early Paleoproterozoic basins
CHURCHILL
WESTERN
Hurwitz
SUPERIOR
Animikie
Huronian
Marquette Range
Snowy Pass
WYOMING
Mistassini/Otish Mts.
(Young, 1972)
EPWORTH GROUP
GOULBURN GROUP
SLAVE PROVINCE
GT. SLAVE LAKE AREA
CAPE SMITH - WAKEHAM BAY BELT
HUDSON BAY
BELCHER ISLANDS
SUTTON LAKE AREA
SUPERIOR PROVINCE
LABRADOR TROUGH
OTISH MOUNTAINS
LAKE CHIBOUGAMAU
ATLANTIC OCEAN
MEDICINE BOW MOUNTAINS AREA
0 MILES 400
0 KM 400
LIMITS OF AREAS LAST AFFECTED BY THE KENORAN OROGENY
LIMITS OF AREA COVERED BY THE PROPOSED EARLY PROTEROZOIC (APHEBIAN) ICE CAP
EARLY PROTEROZOIC (APHEBIAN) TILLITE OCCURRENCE
EARLY PROTEROZOIC (APHEBIAN) ALUMINOUS QUARTZITE OCCURRENCE
paleocurrent trend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proposed early Proterozoic ice cap
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tillite occurrences
paleocurrent trend
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ATLANTIC
MILES
KM
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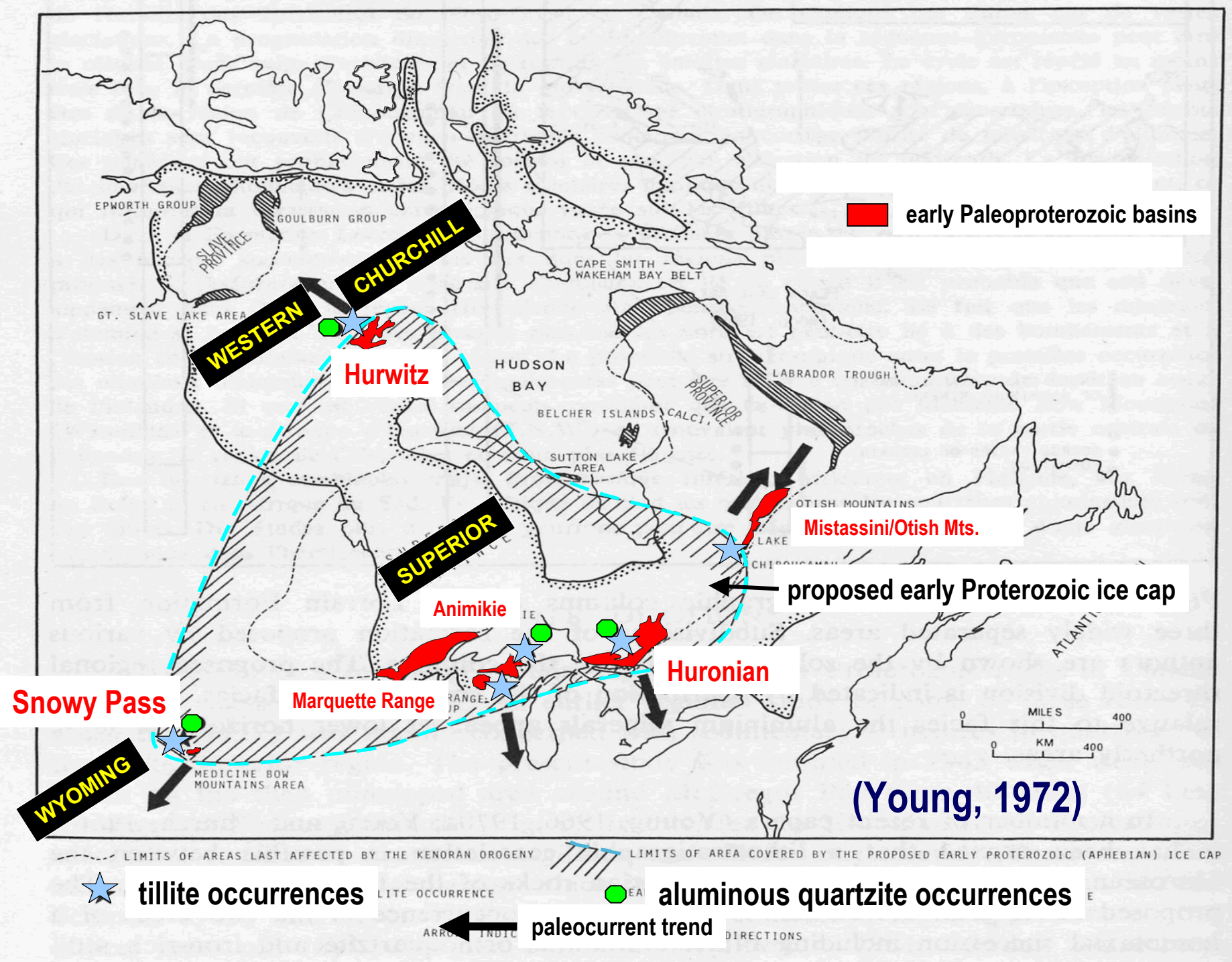
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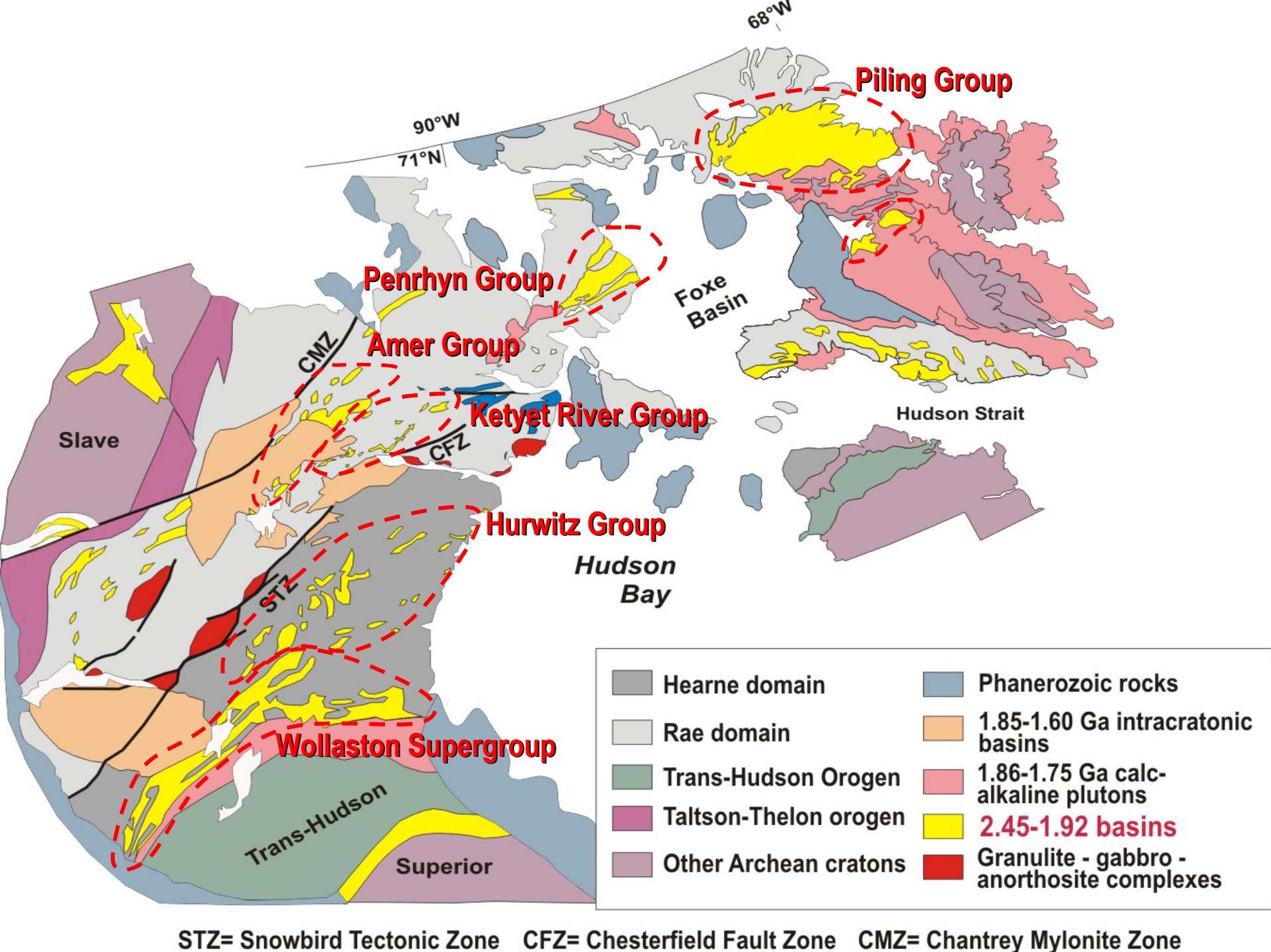
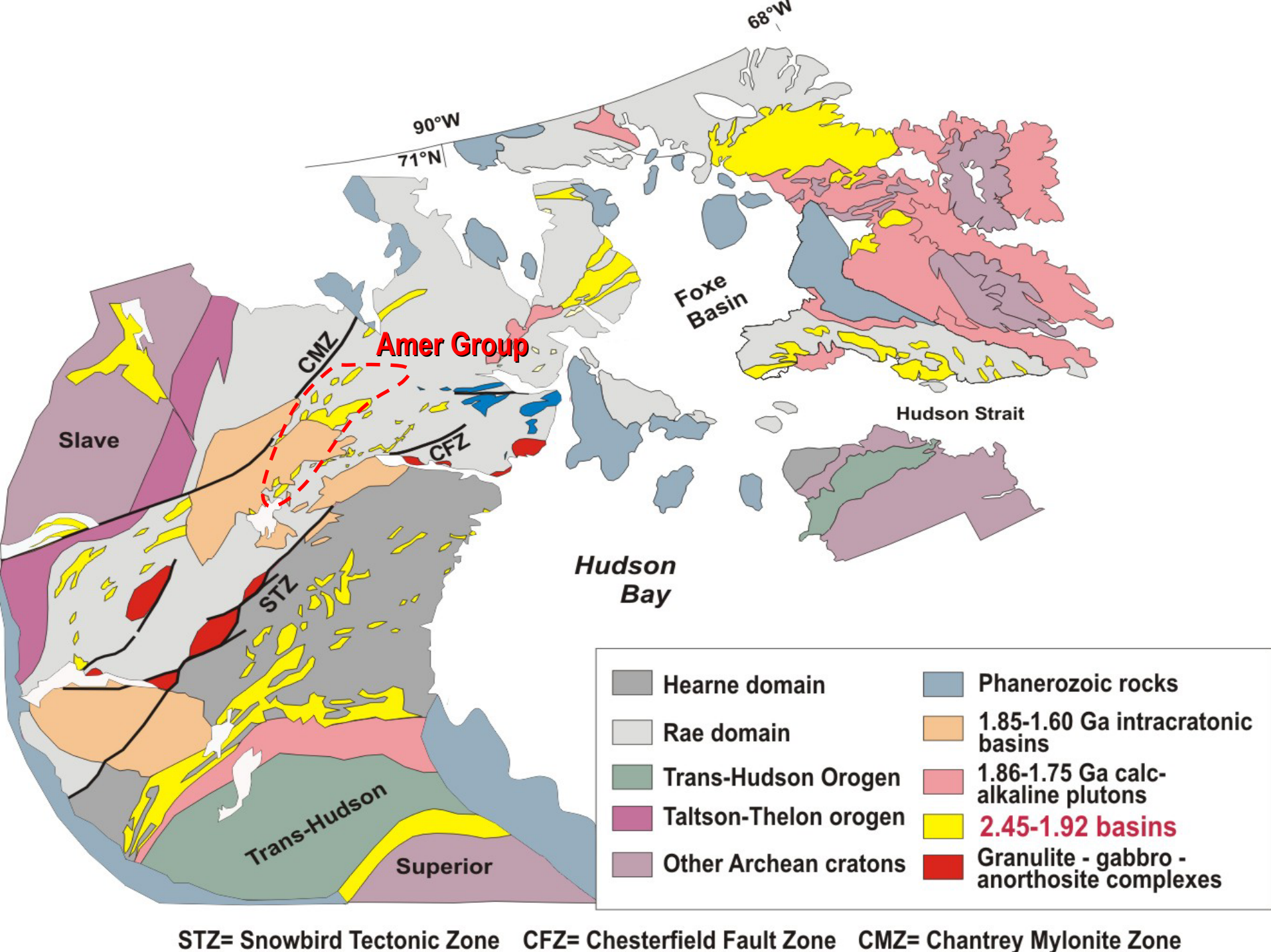
MILES 0 400
KM 0 400
LIMITS OF AREAS LAST AFFECTED BY THE KENORAN OROGENY
LIMITS OF AREA COVERED BY THE PROPOSED EARLY PROTEROZOIC (APHEBIAN) ICE CAP
tillite occurrences
aluminous quartzite occurrences
paleocurrent trend



STZ= Snowbird Tectonic Zone CFZ= Chesterfield Fault Zone CMZ= Chantrey Mylonite Zone



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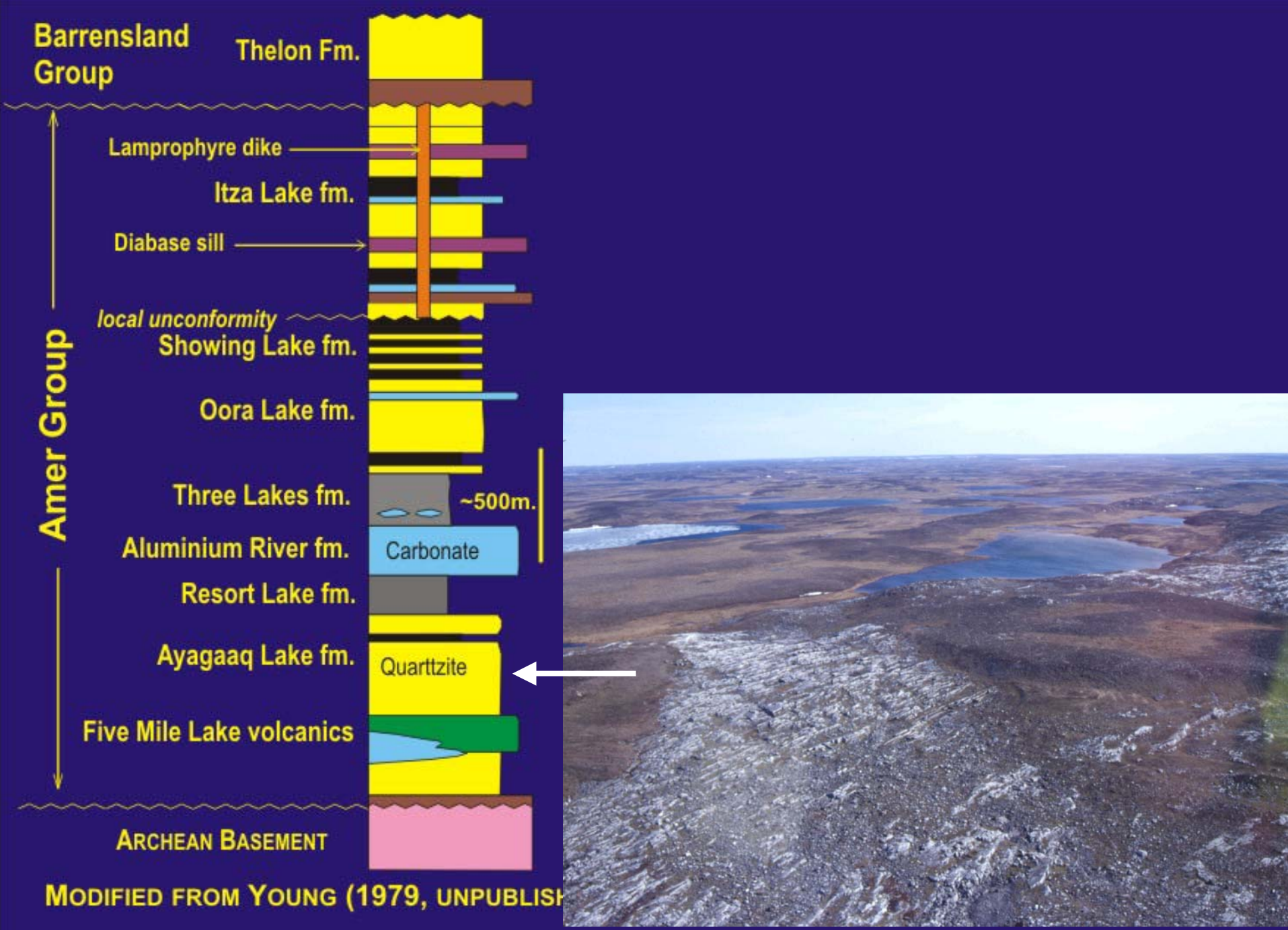
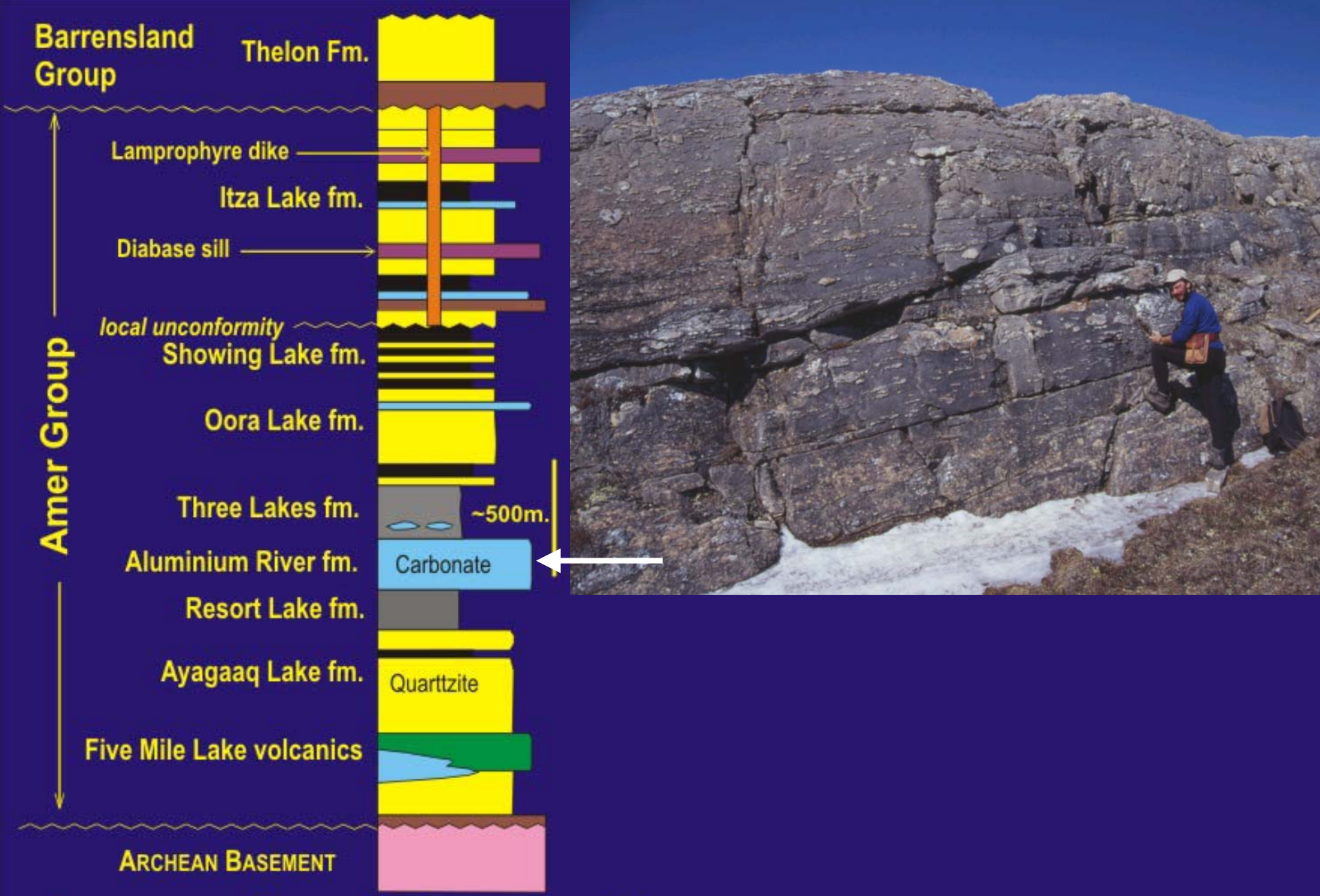

Barrensland Group
Thelon Fm.
Lamprophyre dike
Itza Lake fm.
Diabase sill
local unconformity
Showing Lake fm.
Oora Lake fm.
Three Lakes fm.
~500m.
Aluminium River fm.
Carbonate
Resort Lake fm.
Ayagaaq Lake fm.
Quarttzite
Five Mile Lake volcanics
Amer Group
ARCHEAN BASEMENT
MODIFIED FROM YOUNG (1979, UNPUBLISH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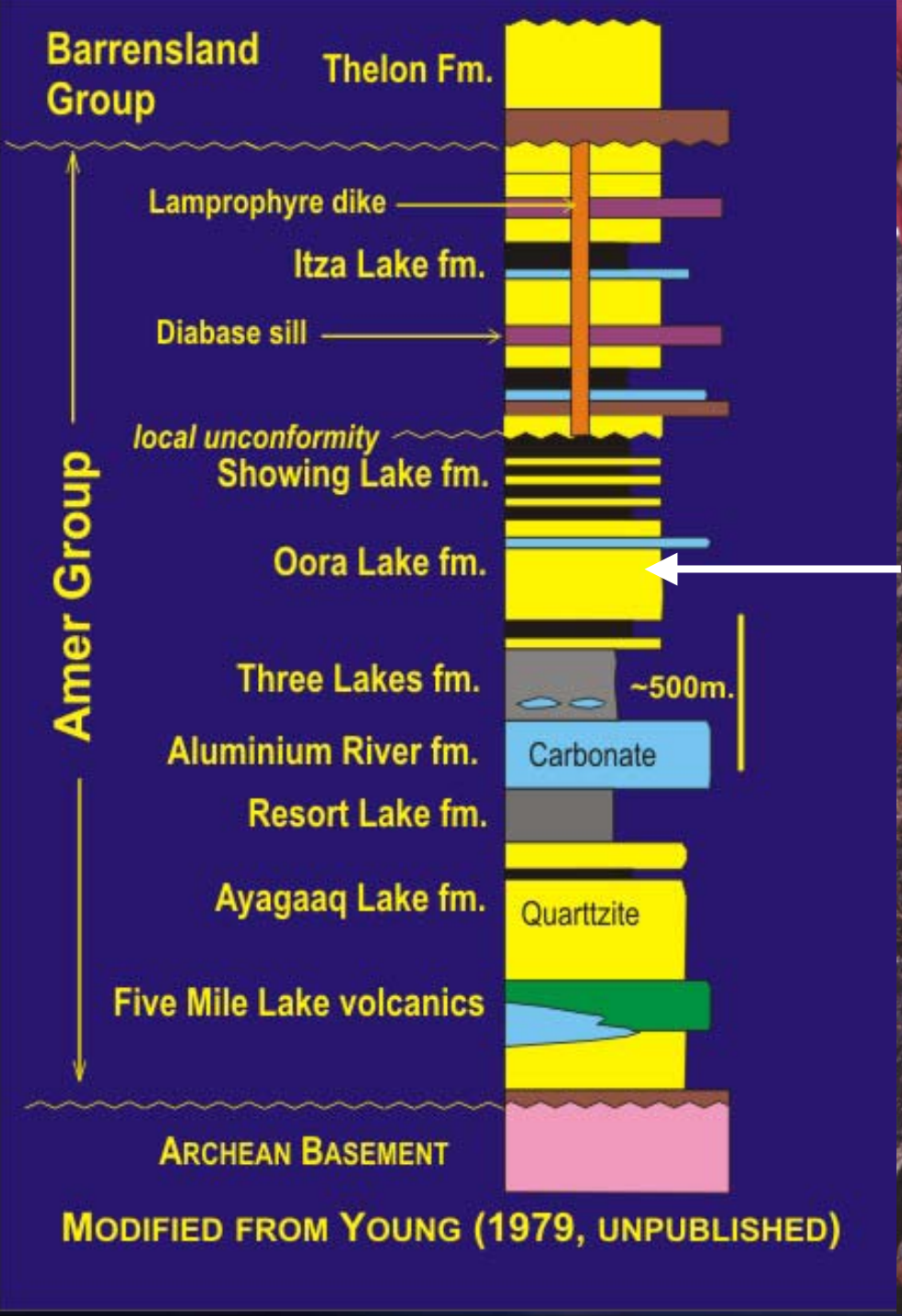
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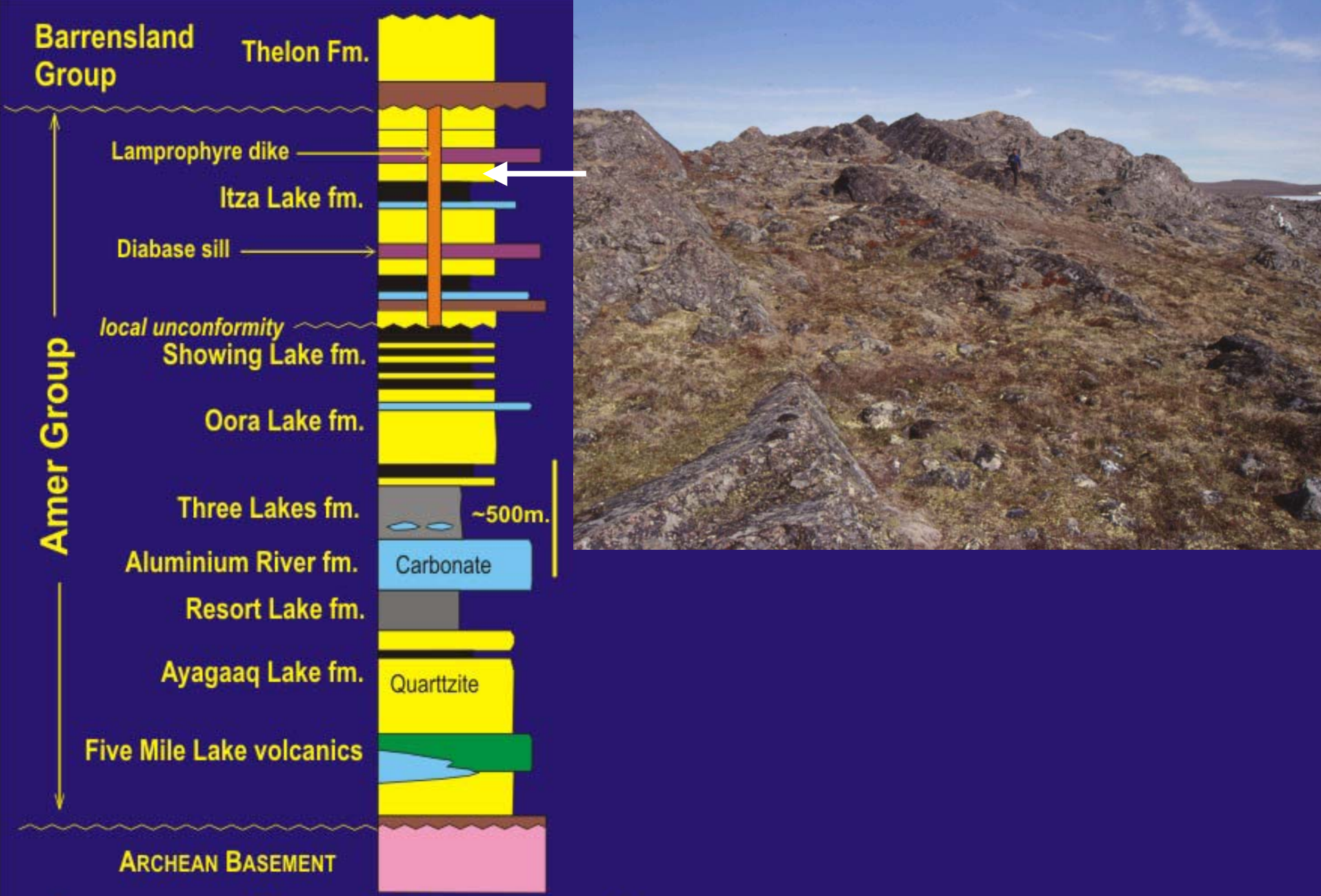
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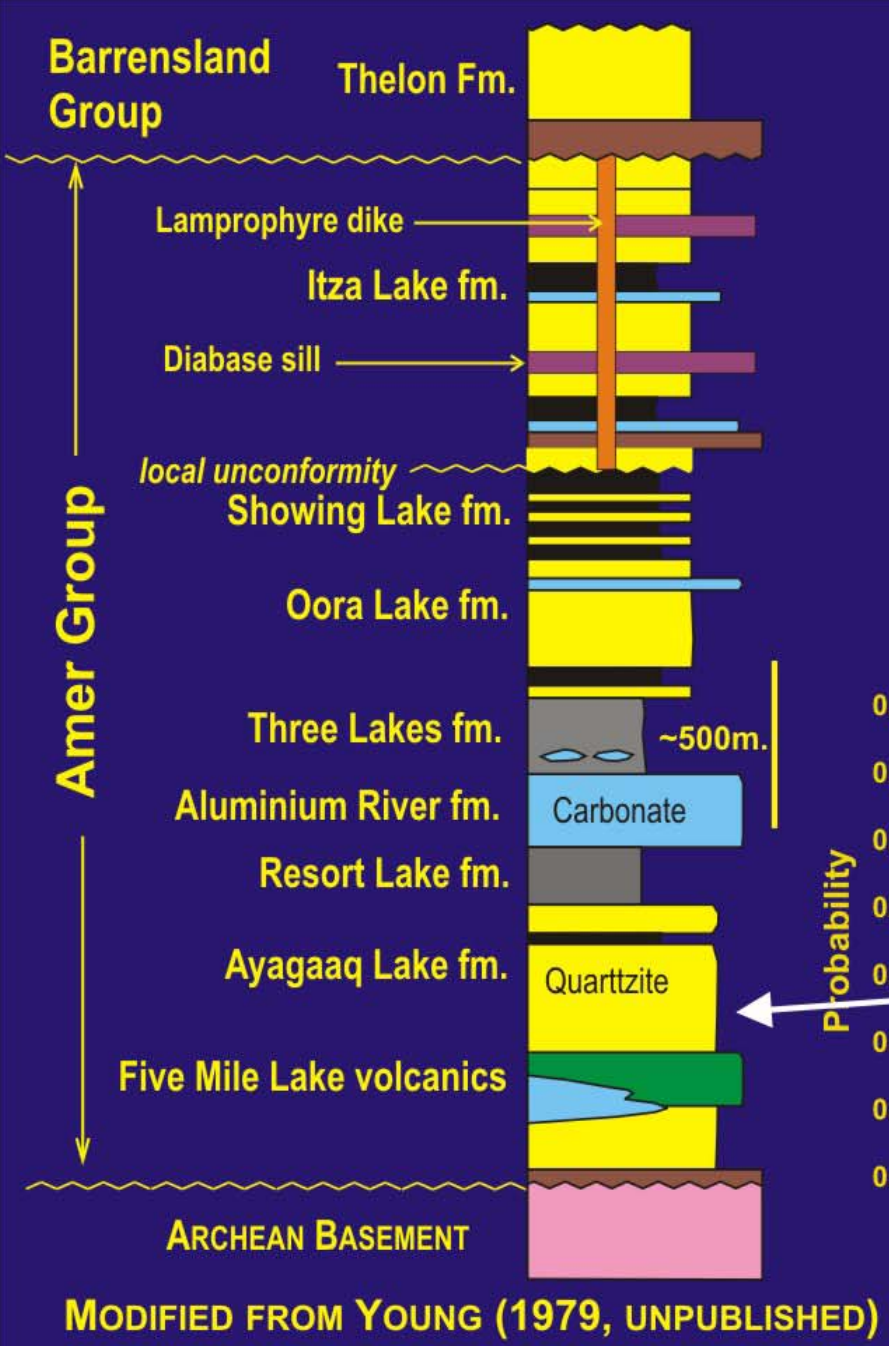
Five Mile Lake volcanics
ARCHEAN BASEMENT
MODIFIED FROM YOUNG (1979, UNPUBLISHED)

Detrital Zircon Geochronology

all data from SHRIMPII facility, GSC Ottawa



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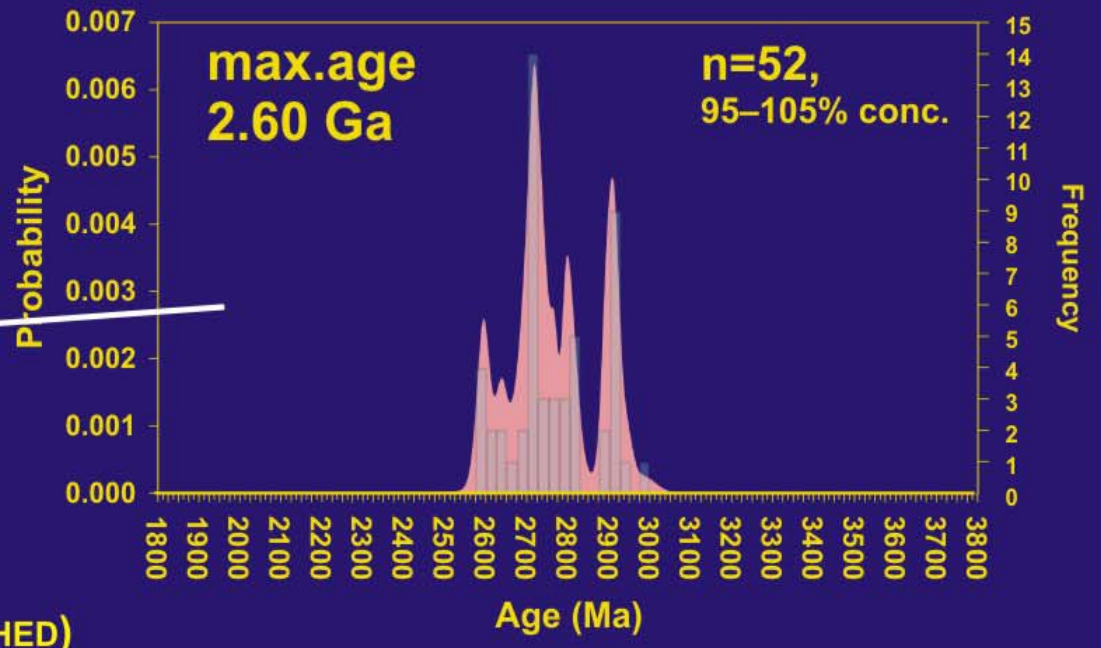

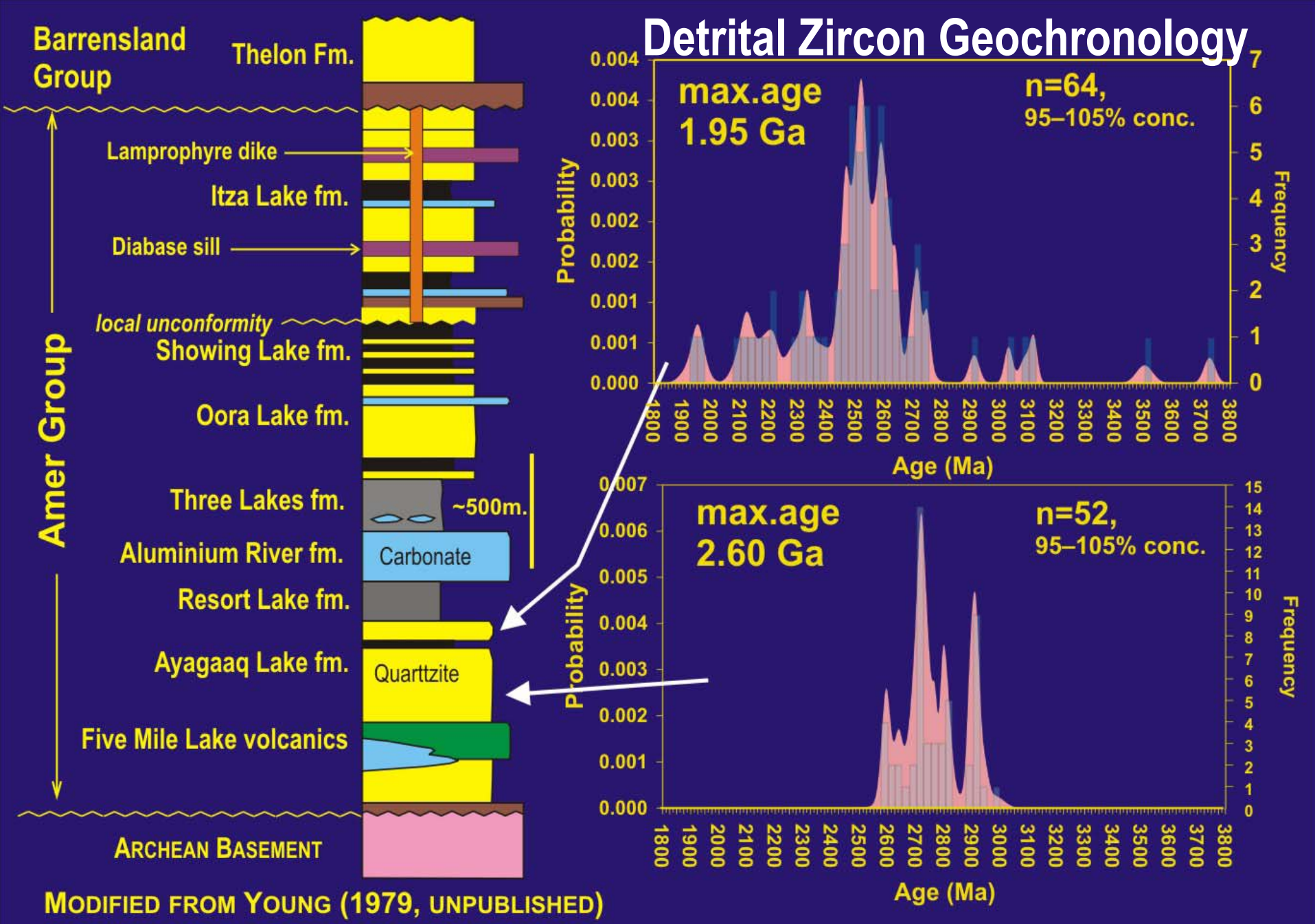
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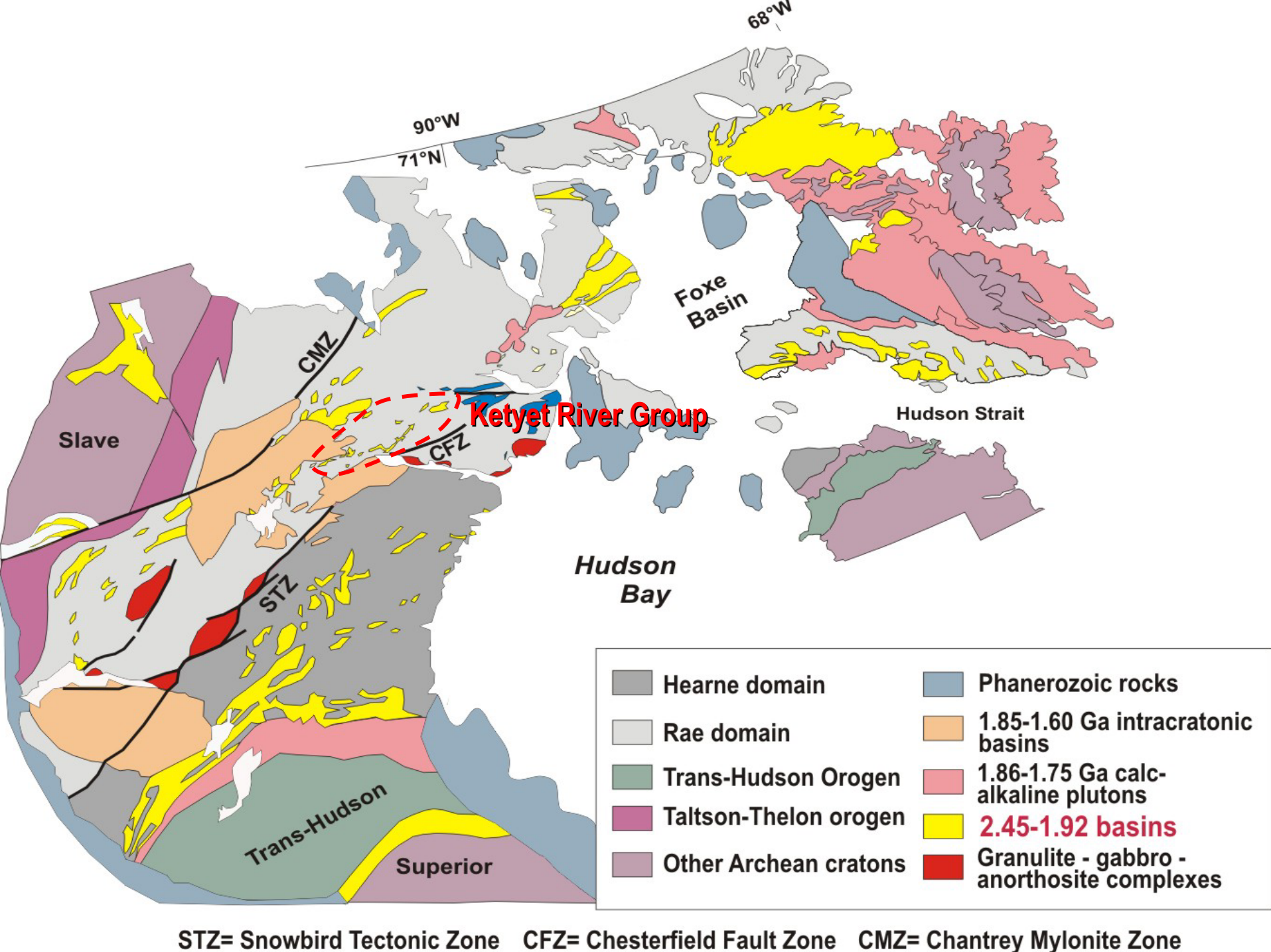
Five Mile Lake volcanics
ARCHEAN BASEMENT
MODIFIED FROM YOUNG (1979, UNPUBLISHED)
Detrital Zircon Geochronology
max.age
1.95 Ga
n=64,
95–105% conc.
Probability
Frequency
Age (Ma)
max.age
2.60 Ga
n=52,
95–105% conc.
Probability
Frequency
Age (Ma)



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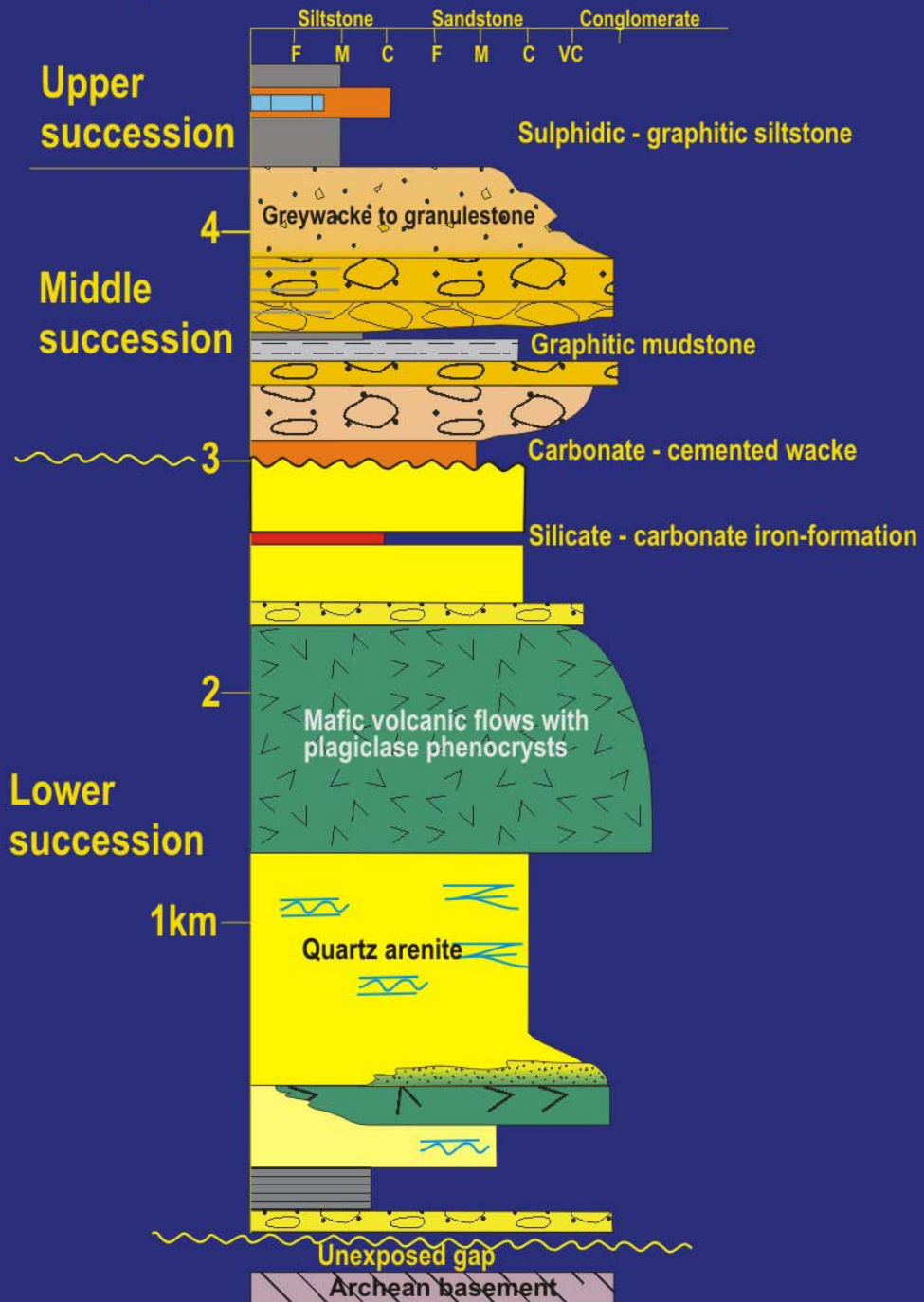
Ketyet River Group, Whitehills Lake area



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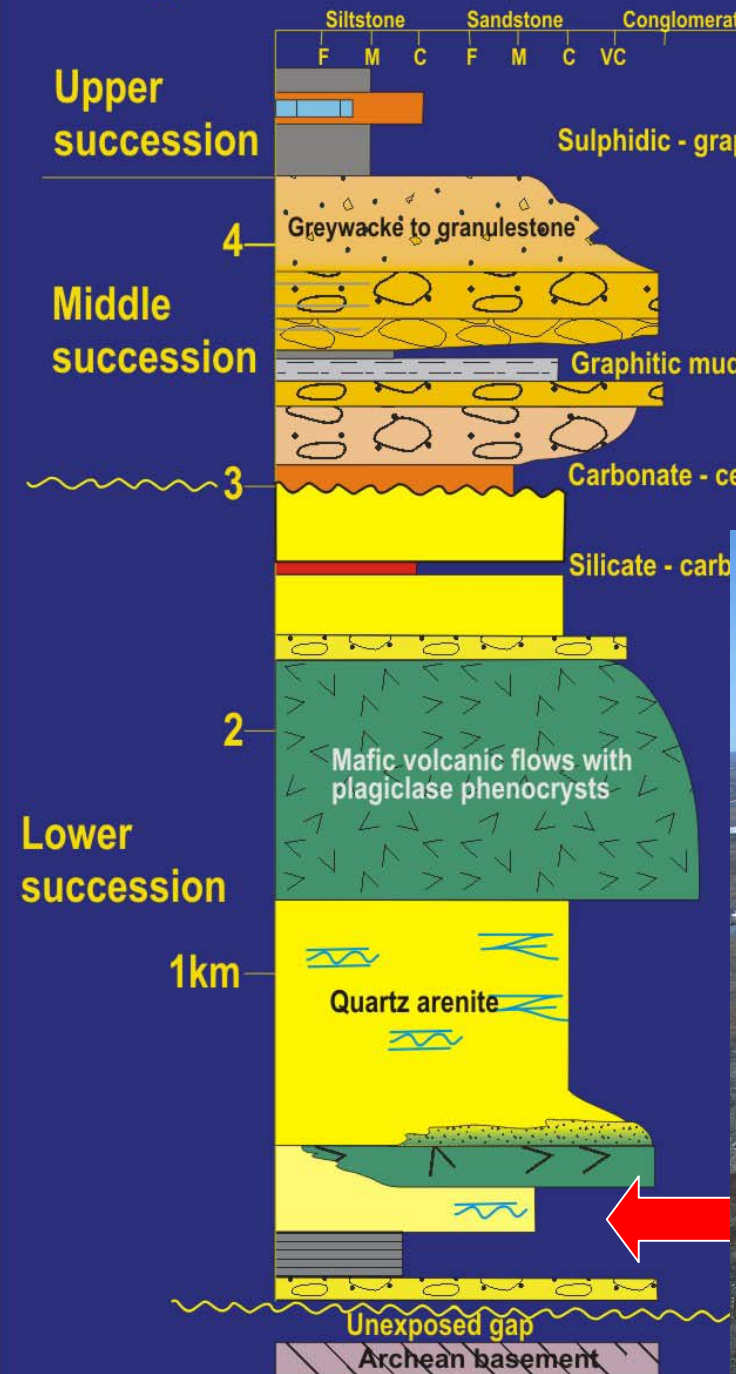

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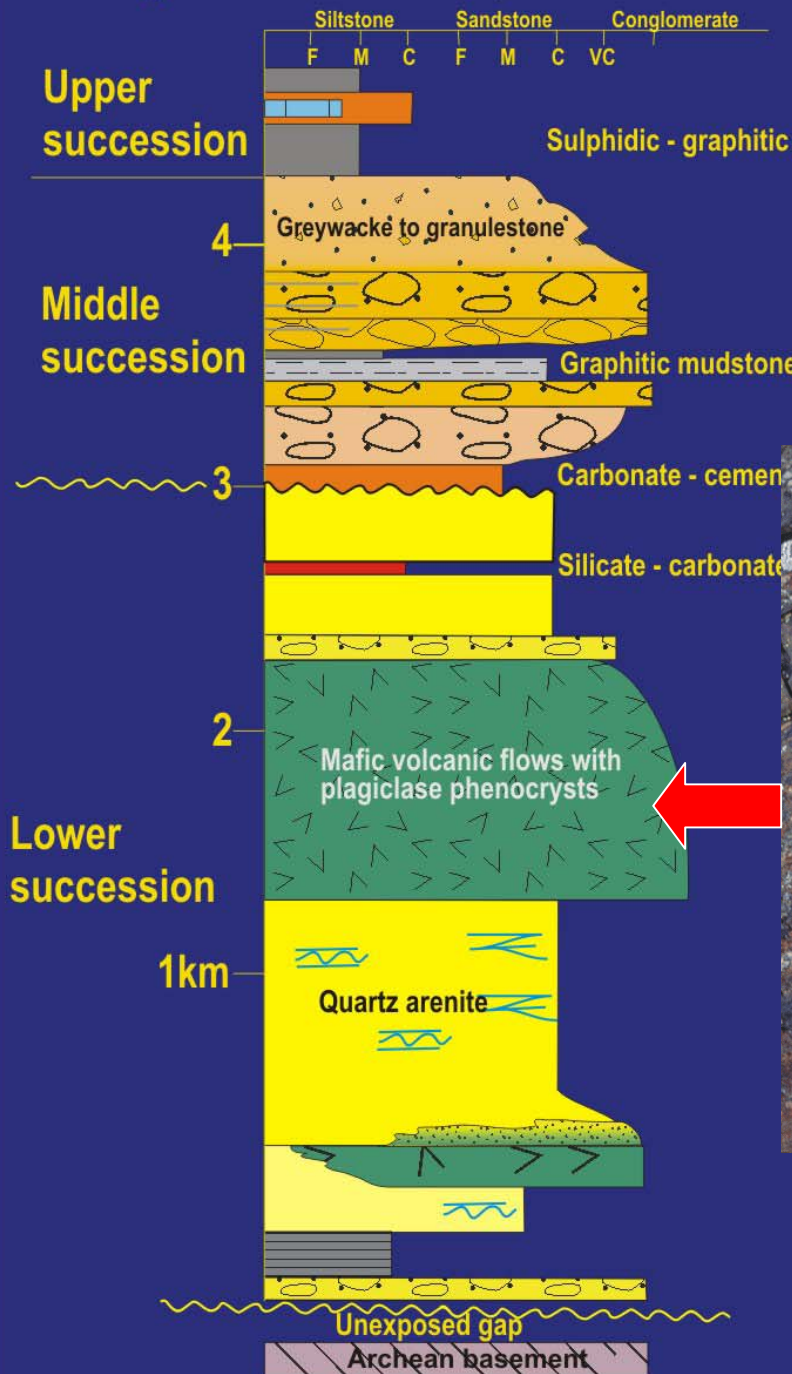

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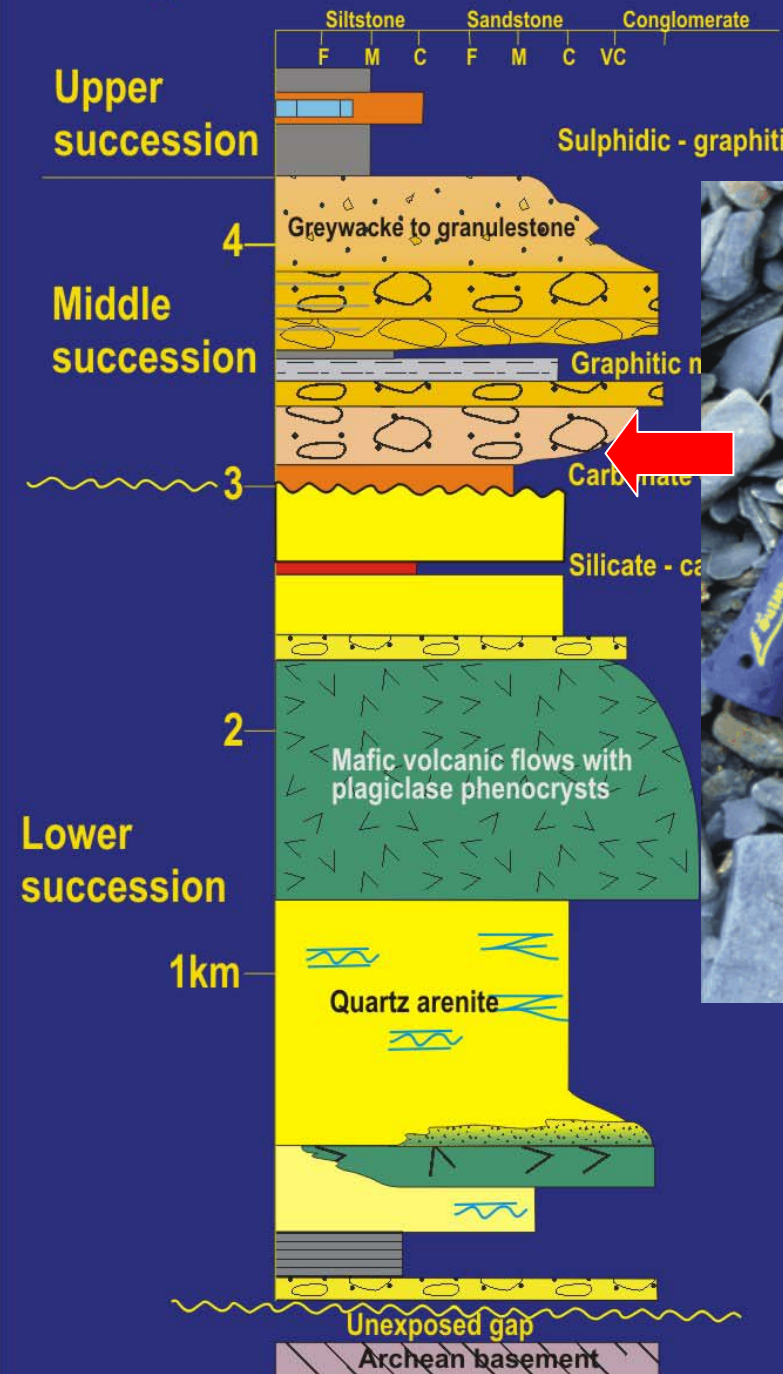
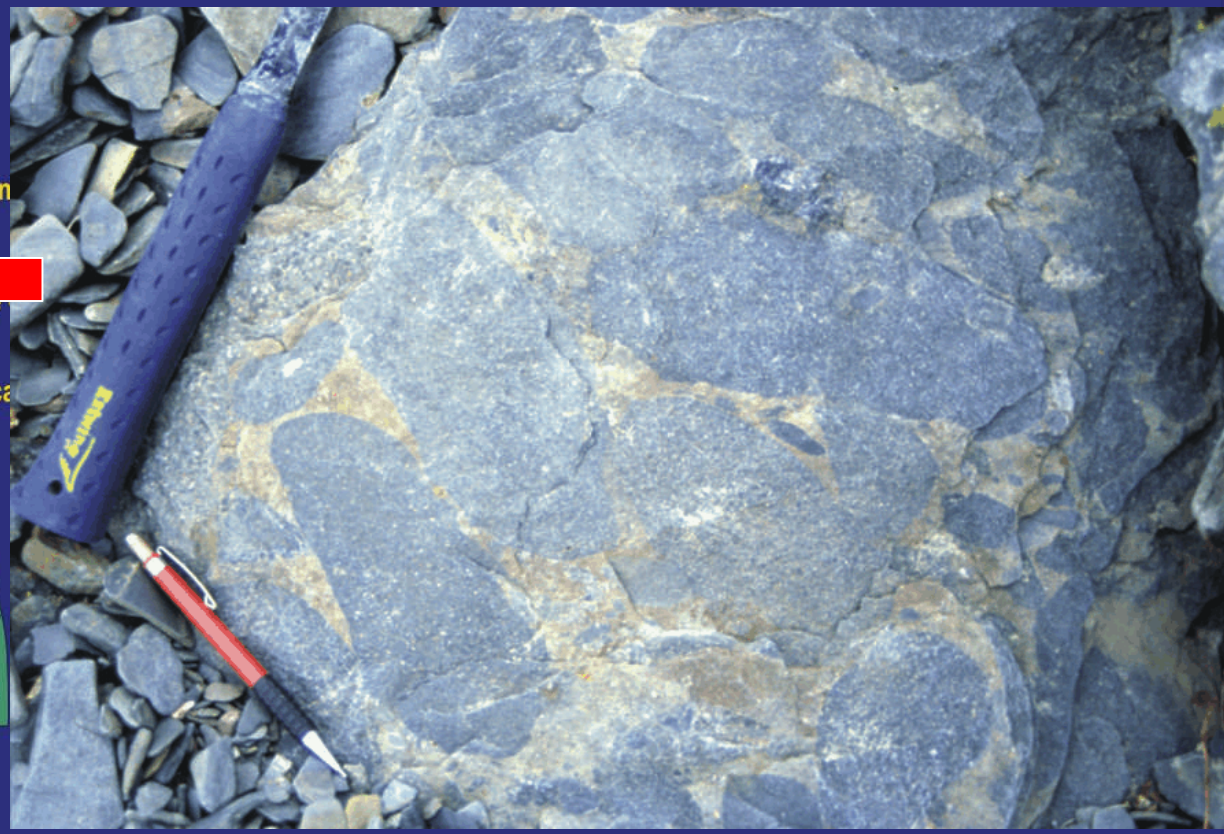
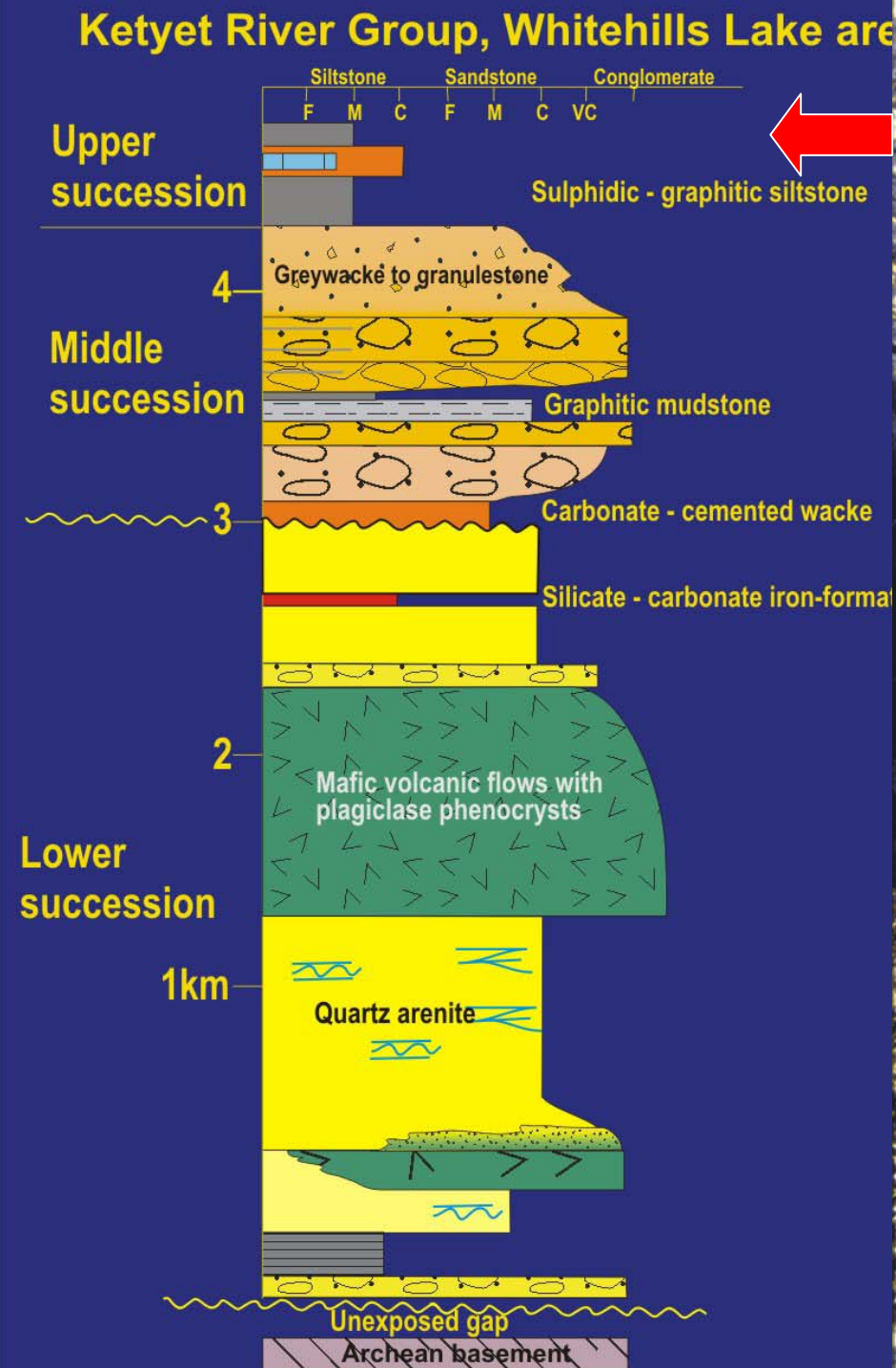
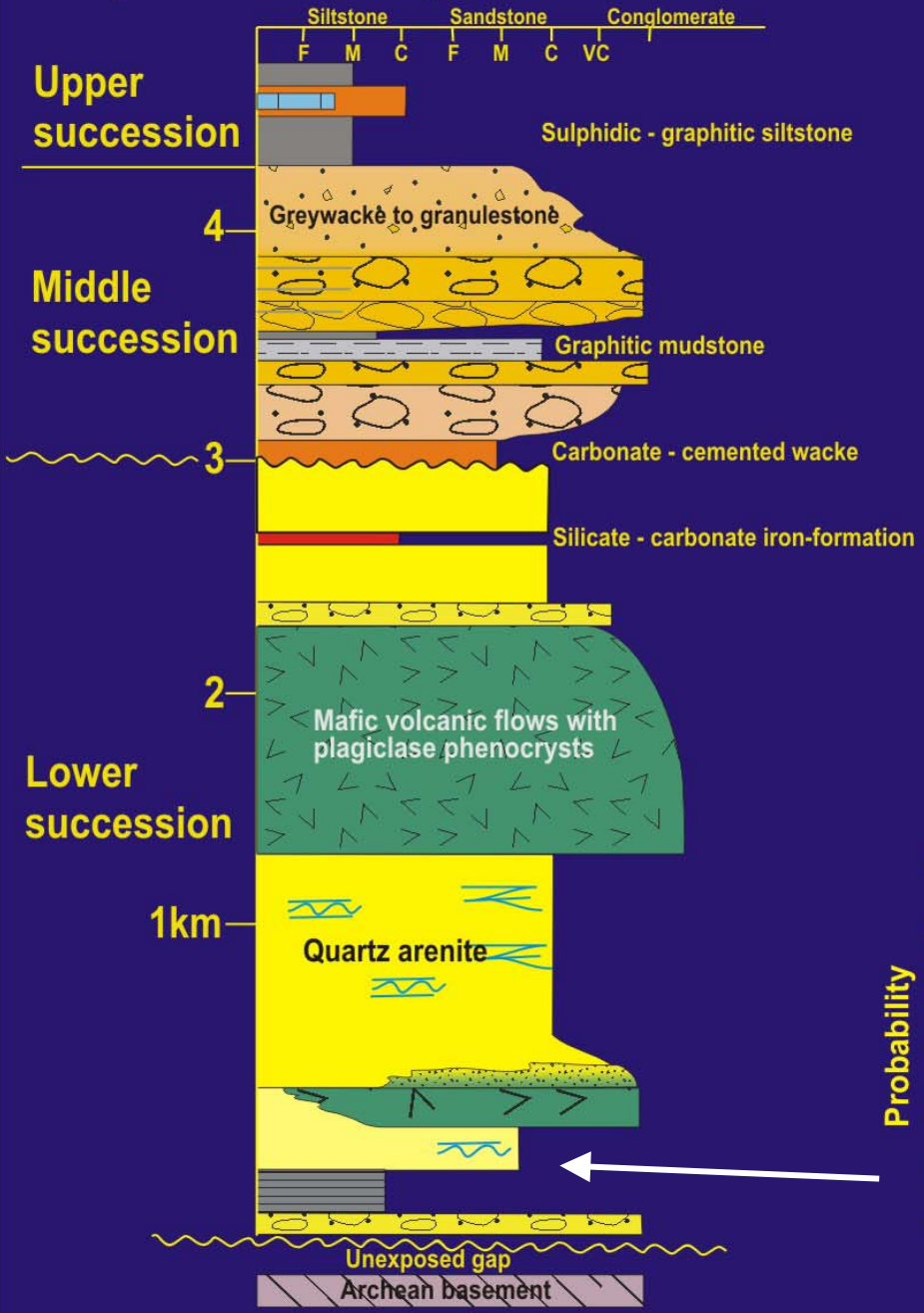


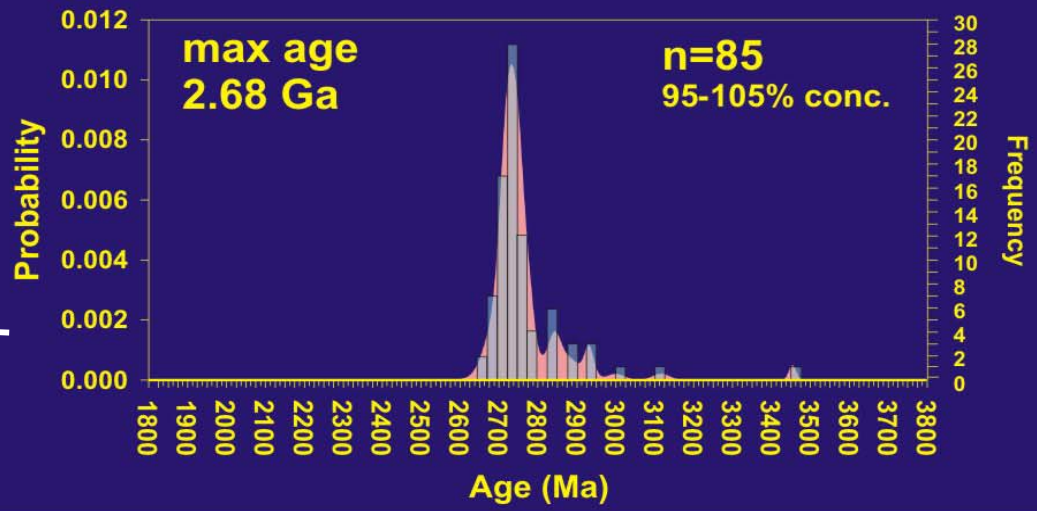



Ketyet River Group, Whitehills Lake are
Siltstone
Sandstone
Conglomerate
F M C F M C VC
Upper succession
Sulphidic - graphitic siltstone
4
Greywacke to granulestone
Middle succession
Graphitic mudstone
3
Carbonate - cemented wacke
Silicate - carbonate iron-forma
2
Mafic volcanic flows with plagiclase phenocrysts
Lower succession
1km
Quartz arenite
Unexposed gap
Archean basement

Ketyet River Group, Whitehills Lake area

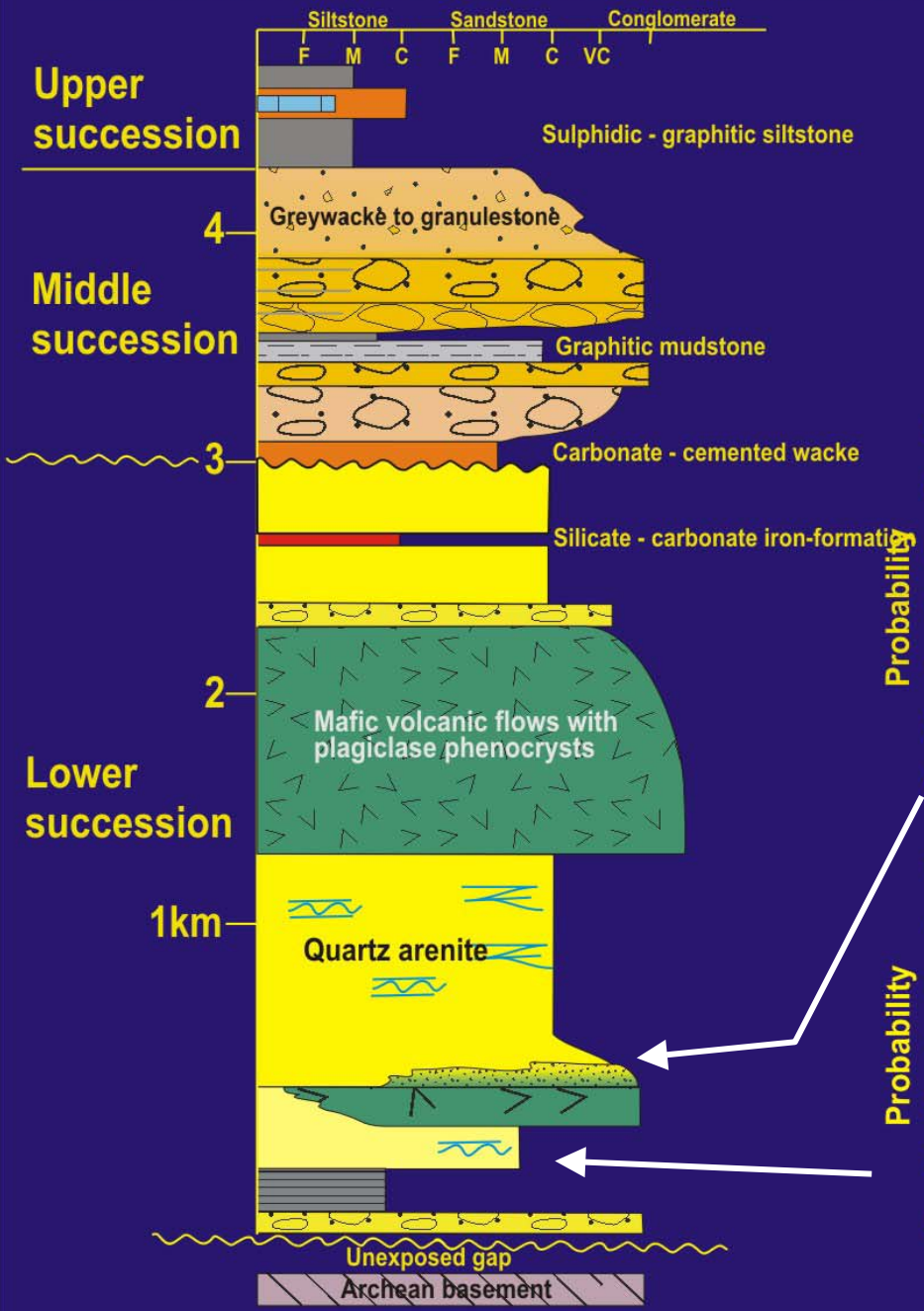
Detrital Zircon Geochronology

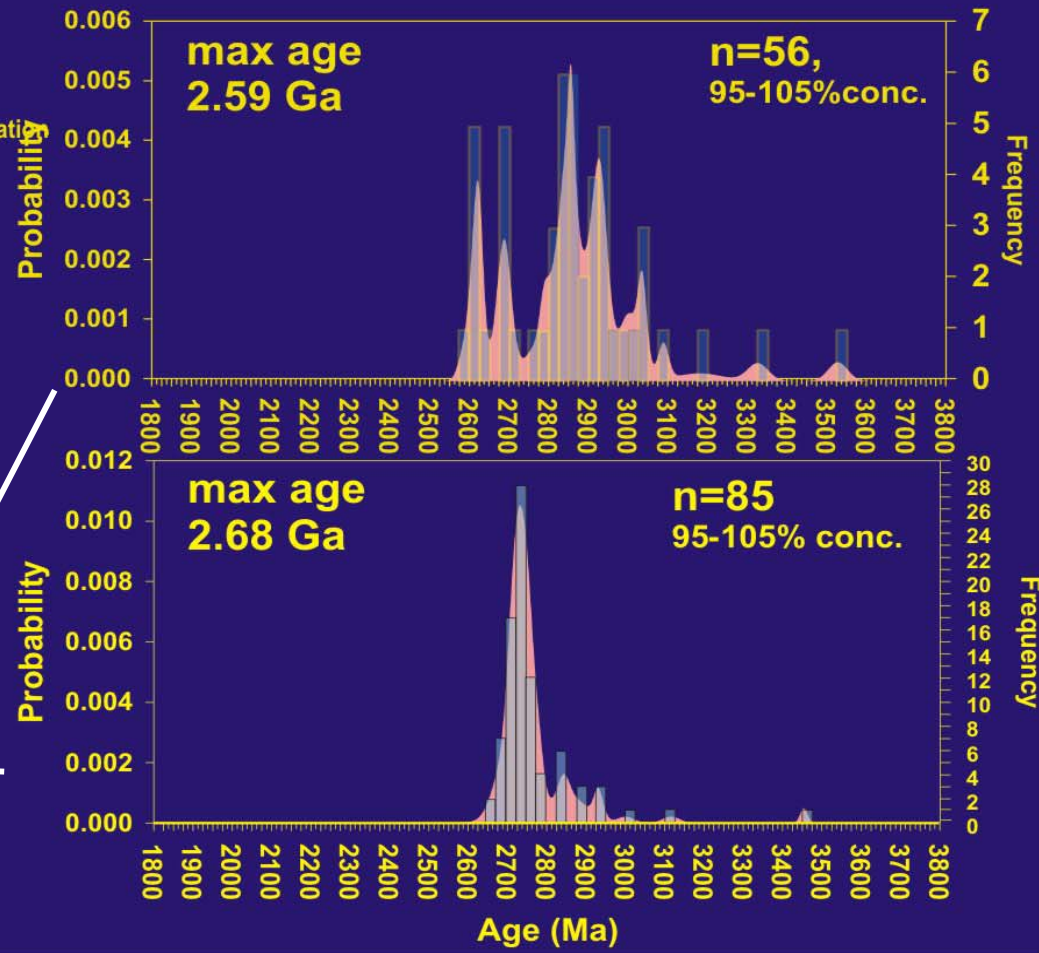


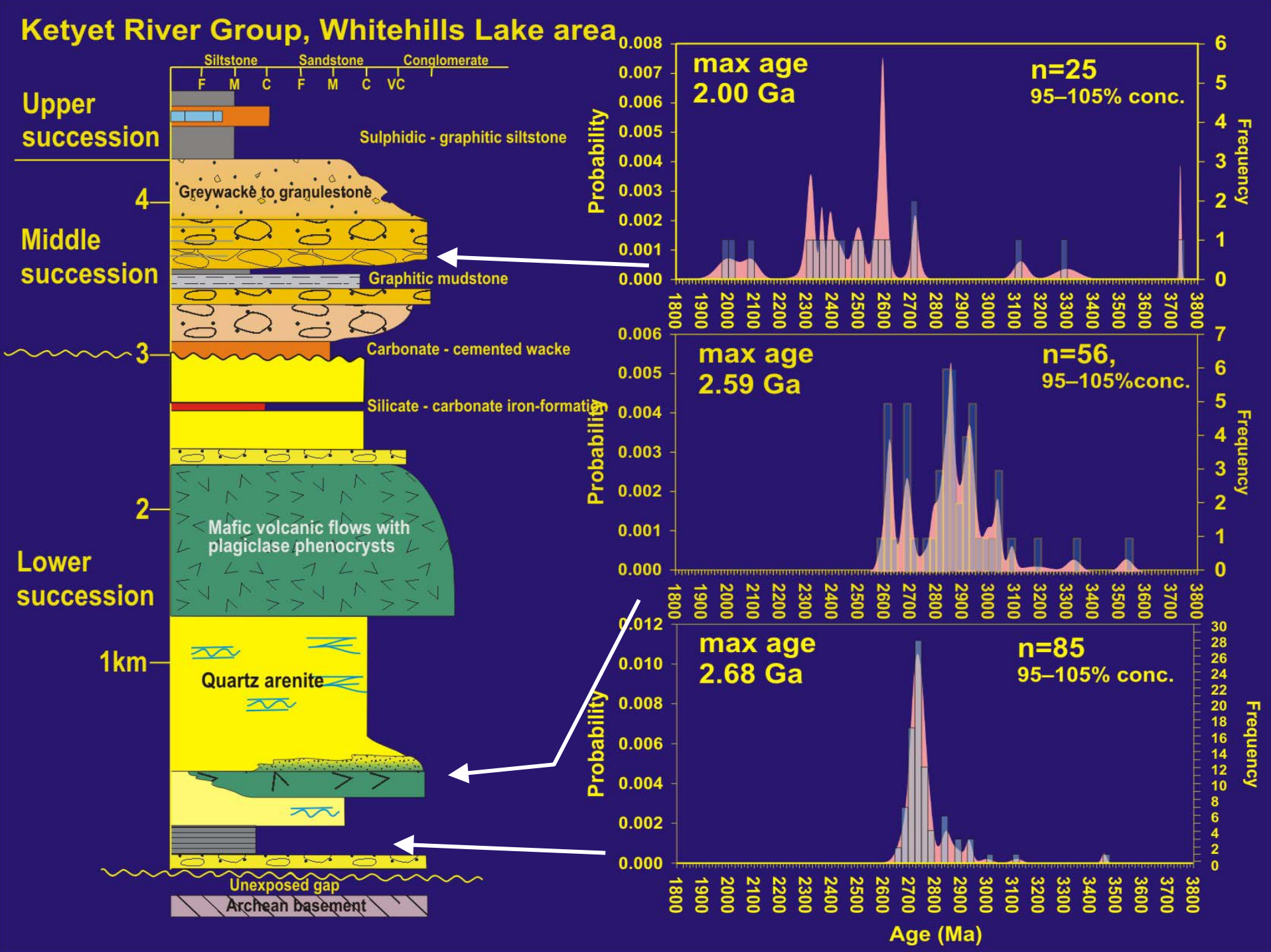


Ketyet River Group, Whitehills Lake area

Detrital Zircon Geochronology



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Conglomerate
F M C F M C VC
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Sulphidic - graphitic siltstone
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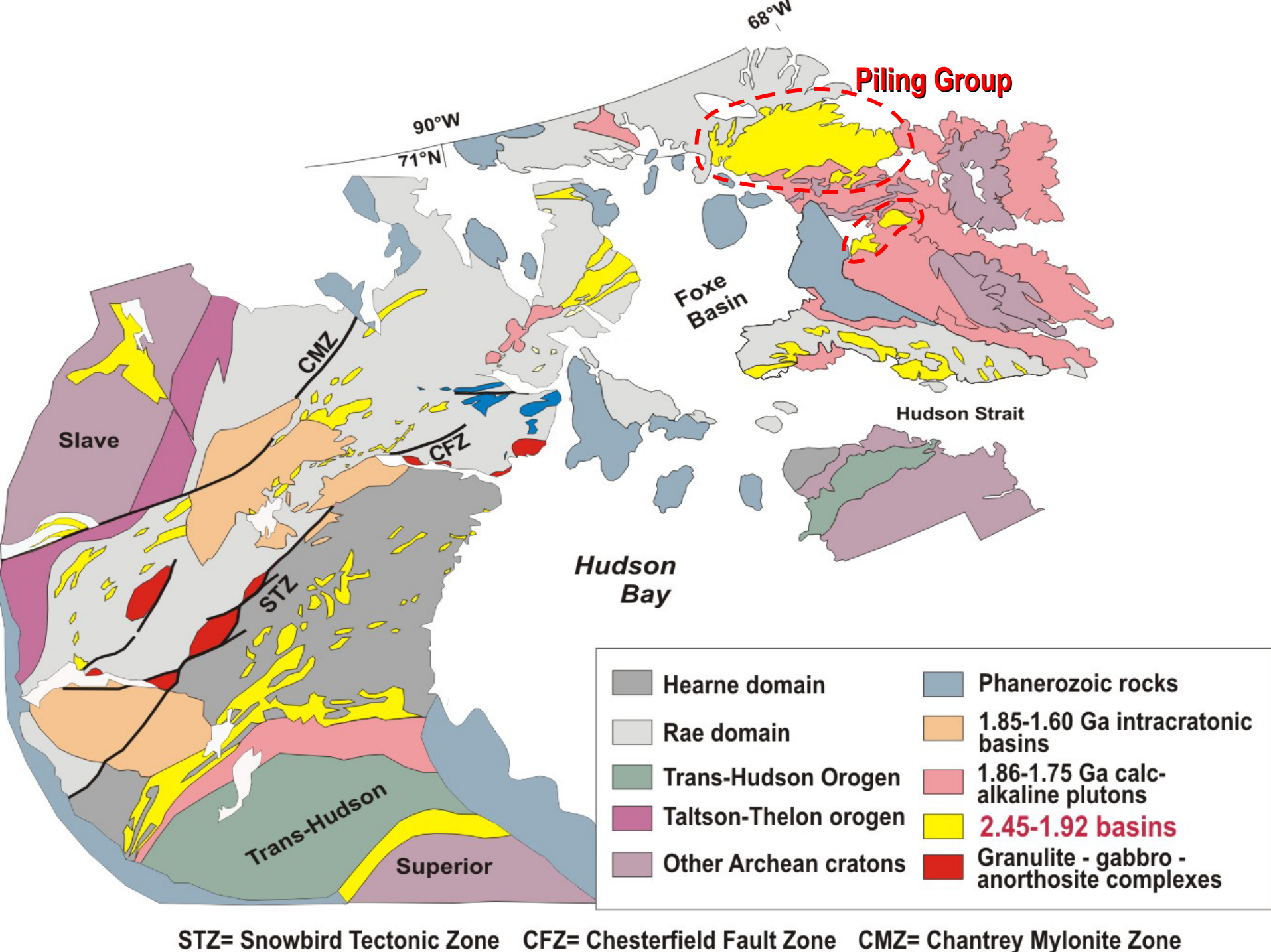
Carbonate - cemented wacke
Silicate - carbonate iron-formation
2
Mafic volcanic flows with plagiclase phenocrysts
Lower succession
1km
Quartz arenite
Unexposed gap
Archean basement
max age 2.00 Ga
n=25
95–105% conc.
max age 2.59 Ga
n=56,
95–105%conc.
max age 2.68 Ga
n=85
95–105% conc.
Probability
Frequency
Age (Ma)



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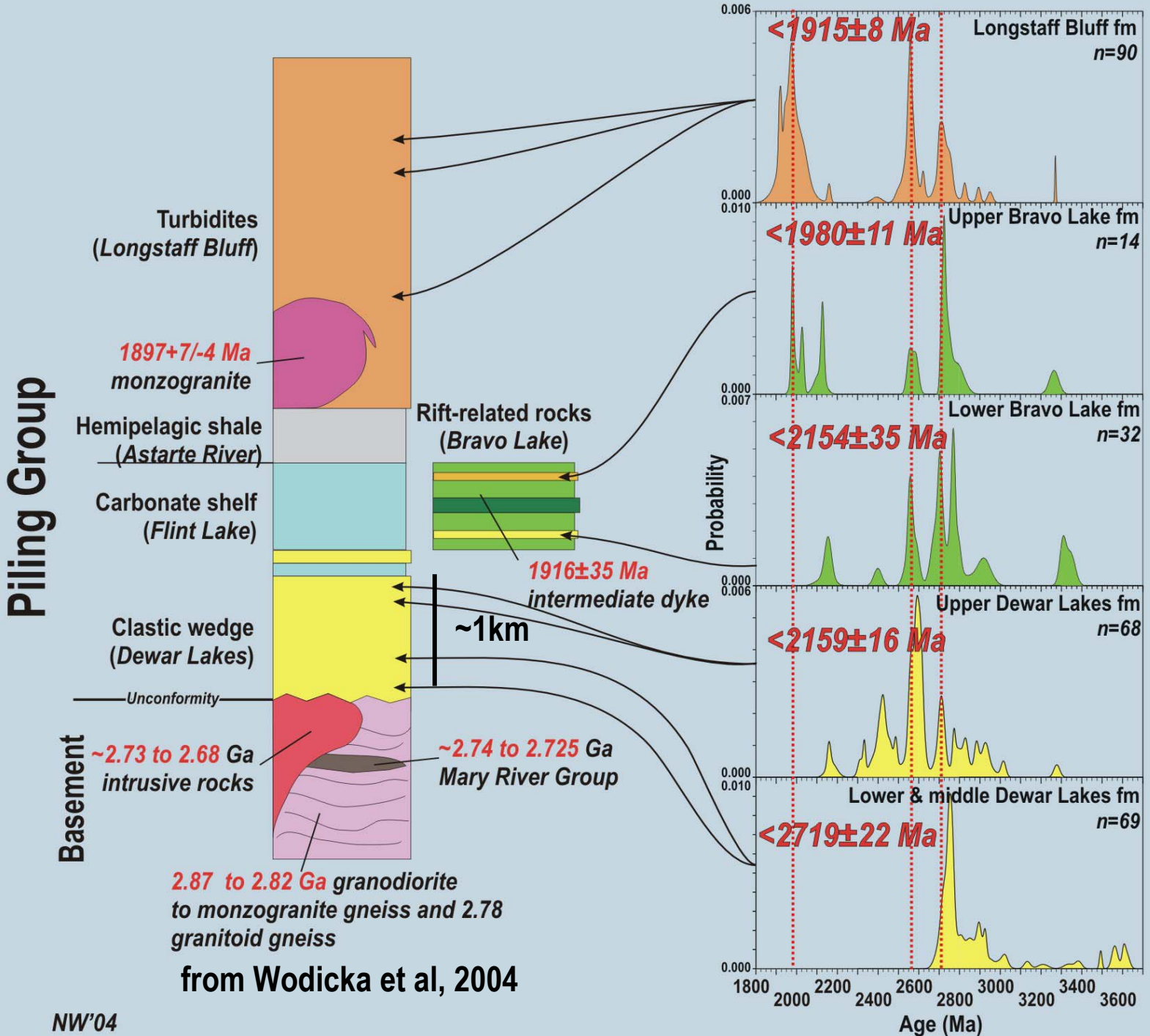
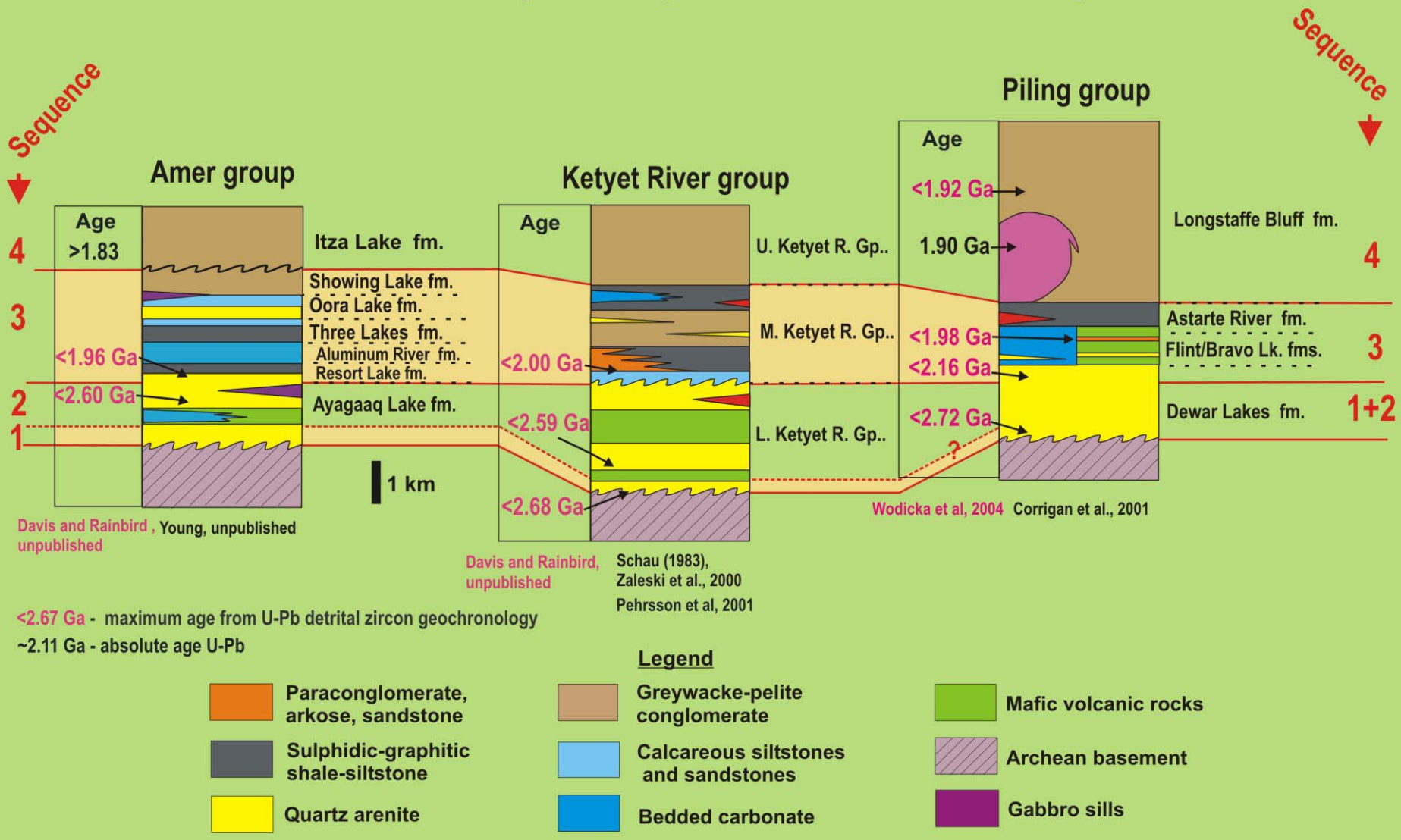

Piling Group
Turbidites
(Longstaff Bluff)
1897+7/-4 Ma
monzogranite
Hemipelagic shale
(Astarte River)
Carbonate shelf
(Flint Lake)
Clastic wedge
(Dewar Lakes)
Unconformity
Basement
~2.73 to 2.68 Ga
intrusive rocks
~2.74 to 2.725 Ga
Mary River Group
2.87 to 2.82 Ga granodiorite
to monzogranite gneiss and 2.78
granitoid gneiss
Rift-related rocks
(Bravo Lake)
1916±35 Ma
intermediate dyke
~1km
from Wodicka et al, 2004
NW'04
Probability
<1915±8 Ma
Longstaff Bluff fm
n=90
<1980±11 Ma
Upper Bravo Lake fm
n=14
<2154±35 Ma
Lower Bravo Lake fm
n=32
<2159±16 Ma
Upper Dewar Lakes fm
n=68
<2719±22 Ma
Lower & middle Dewar Lakes fm
n=69
0.006
0.000
0.010
0.000
0.007
0.000
0.006
0.000
0.010
0.000
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
Age (Ma)

Rae Domain - Early Paleoproterozoic Cover Sequence

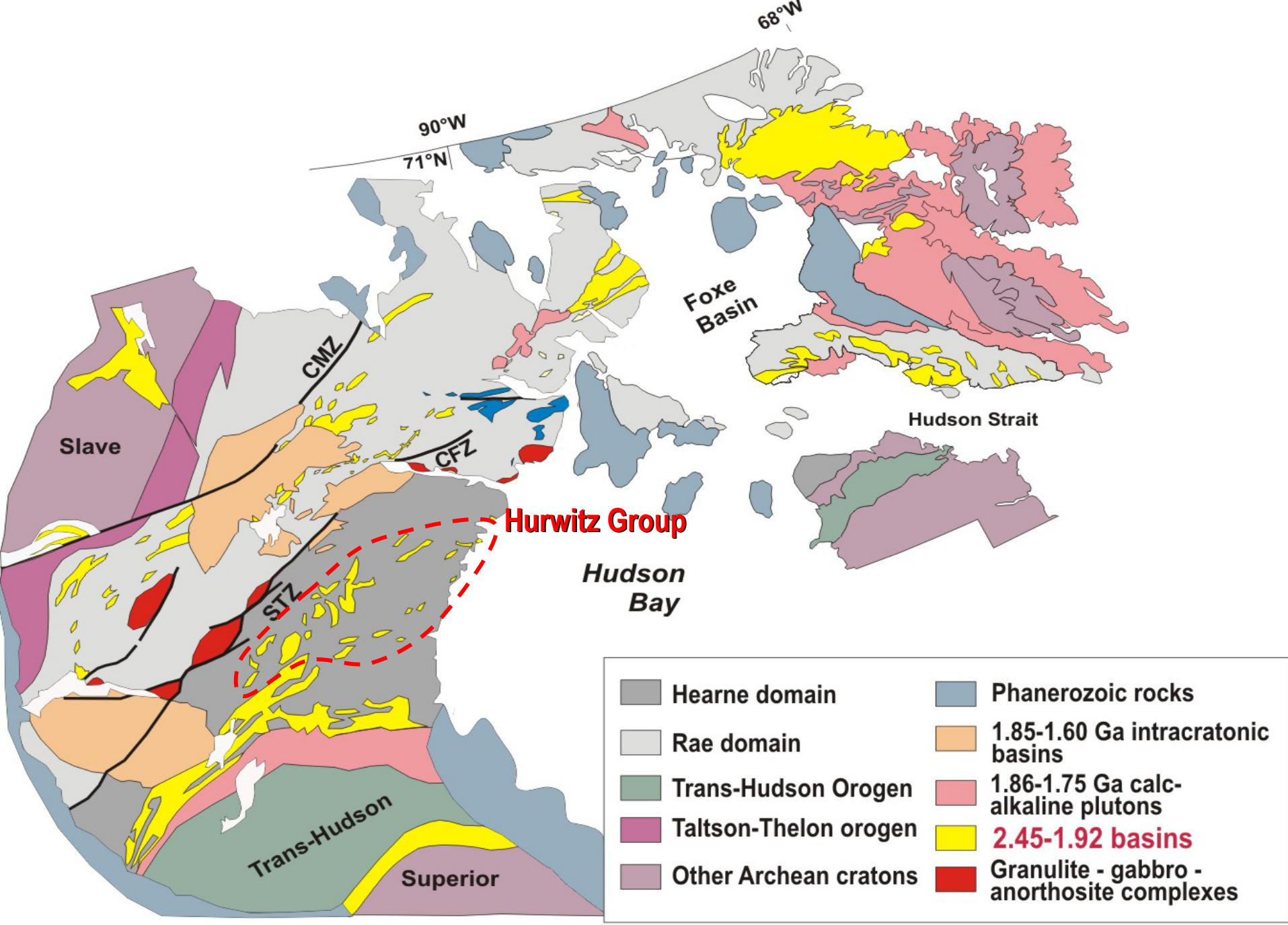


<2.67 Ga - maximum age from U-Pb detrital zircon geochronology

~2.11 Ga - absolute age U-Pb

Legend

- Paraconglomerate, arkose, sandstone
- Sulphidic-graphitic shale-siltstone
- Quartz arenite
- Greywacke-pelite conglomerate
- Calcareous siltstones and sandstones
- Bedded carbonate
- Mafic volcanic rocks
- Archean basement
- Gabbro sills



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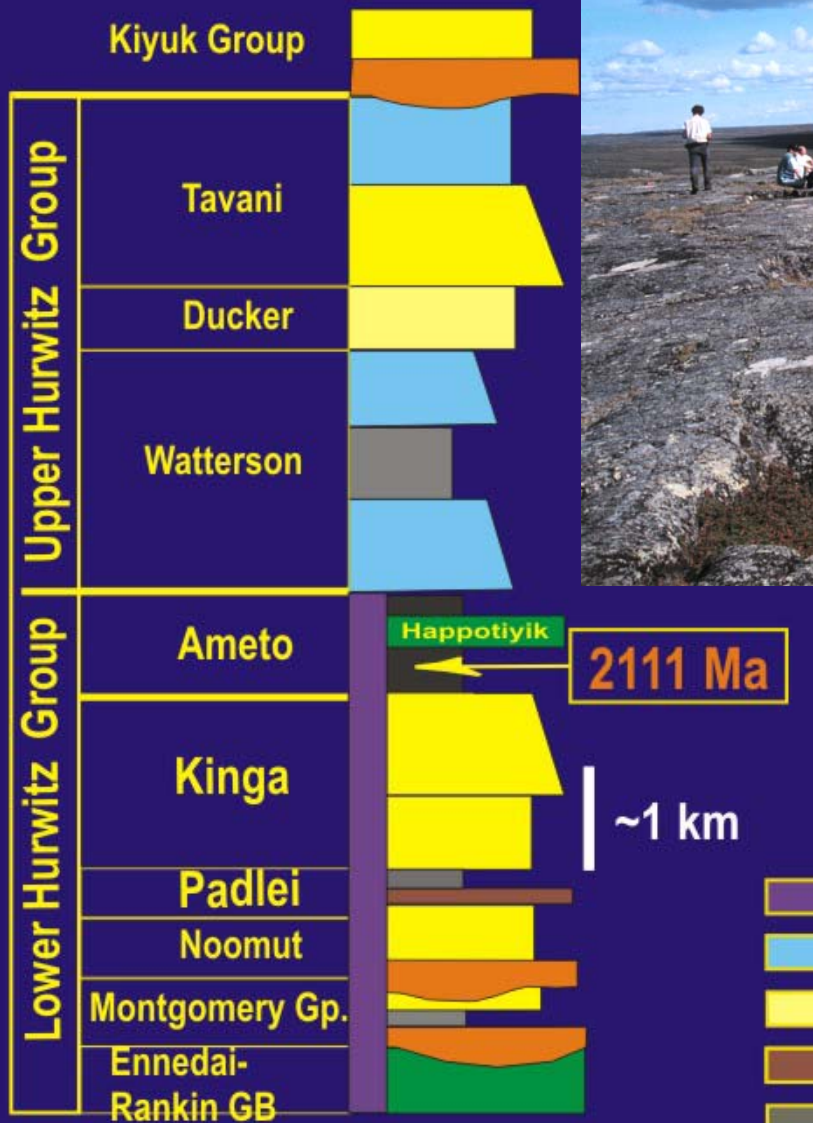
Hearne Domain Cover Sequence



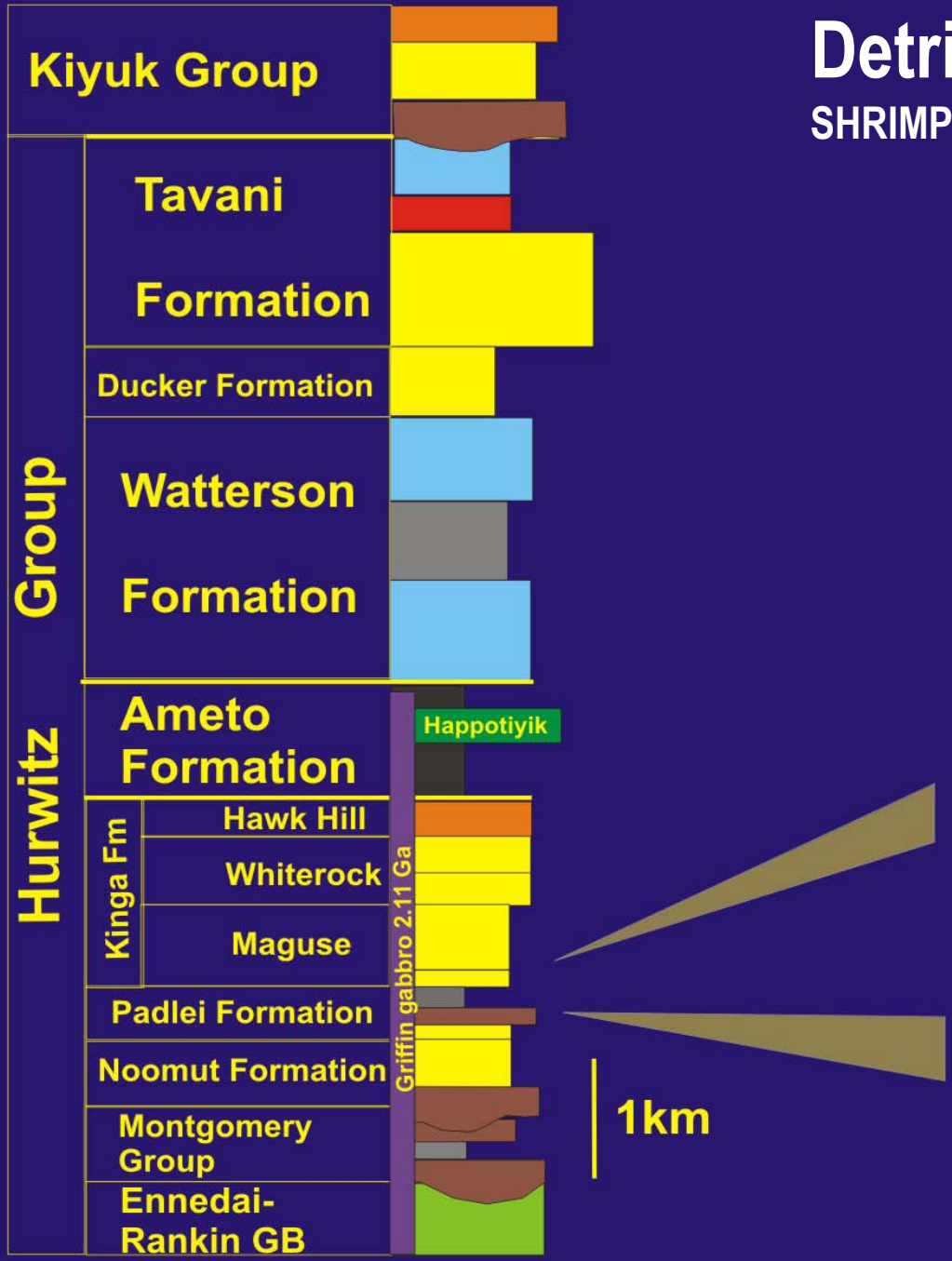
(Aspler et al. 2001)

LEGEND:

- diabase dikes and sills
- carbonate
- shale, siltstone, and sandstone
- glacial diamictite
- shale
- mafic volcanics
- sandstone
- conglomerate
- basement

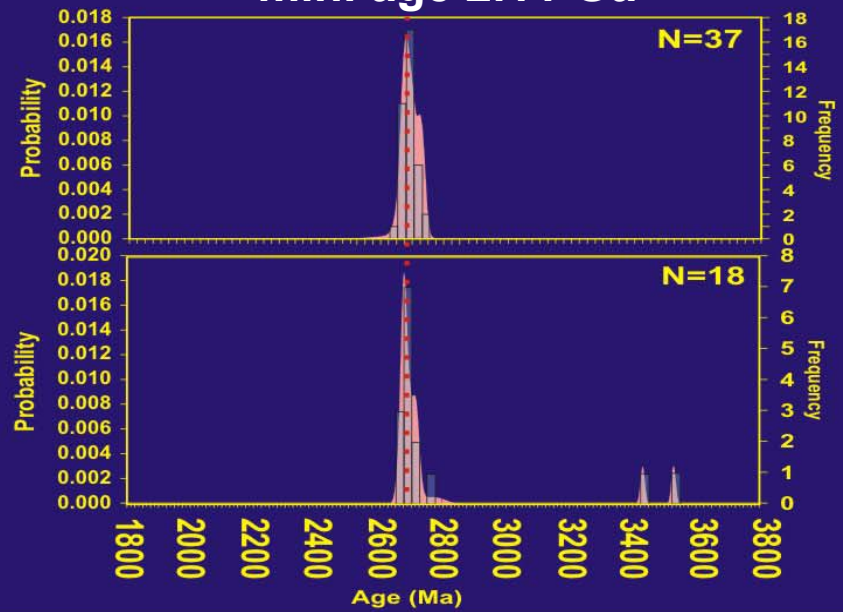
Detrital Zircon Geochronology

SHRIMPII data from Davis et al. (2004)



(Aspler et al. 2001)

min. age 2.11 Ga



Detrital Zircon Geochronology

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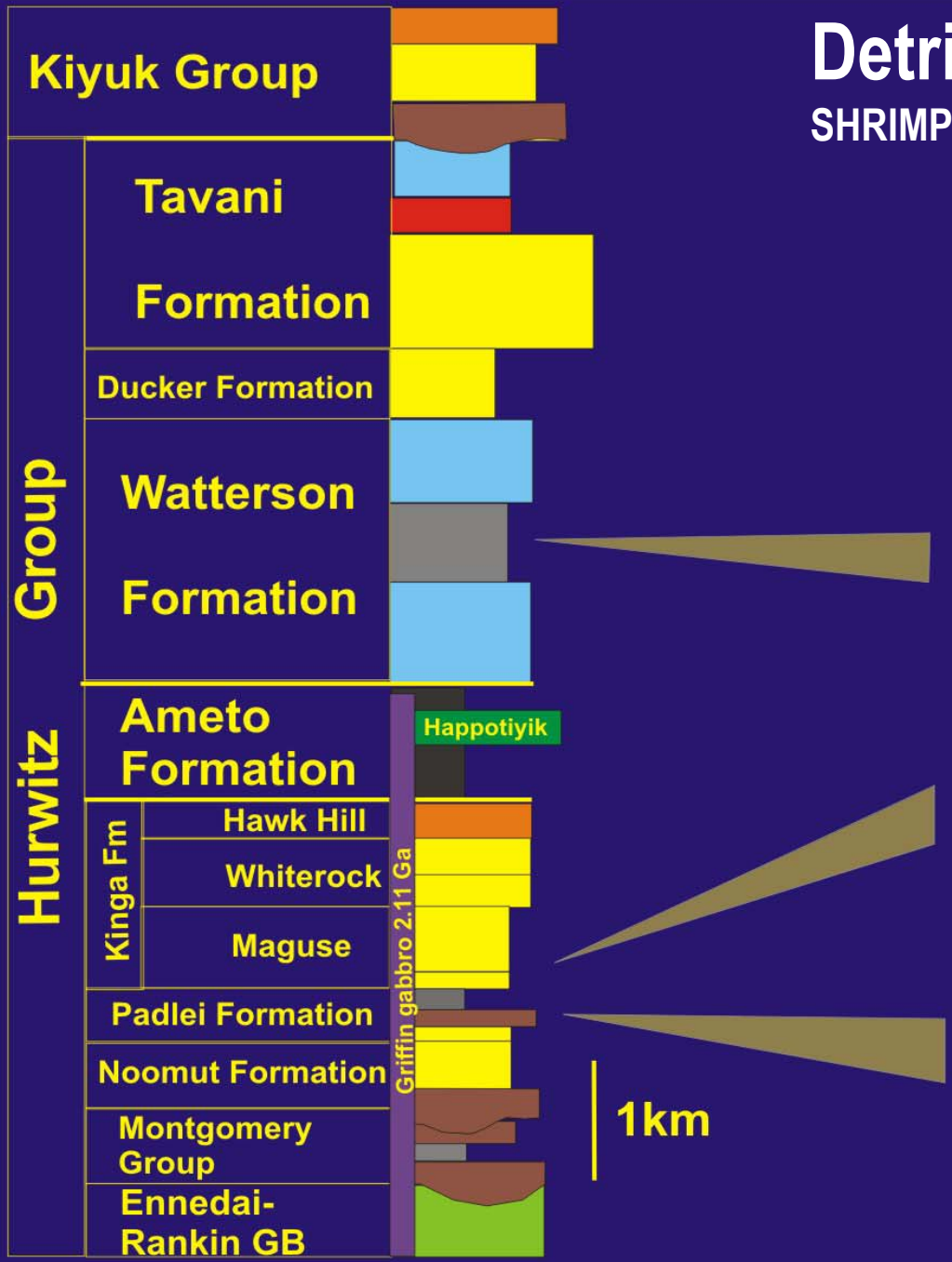
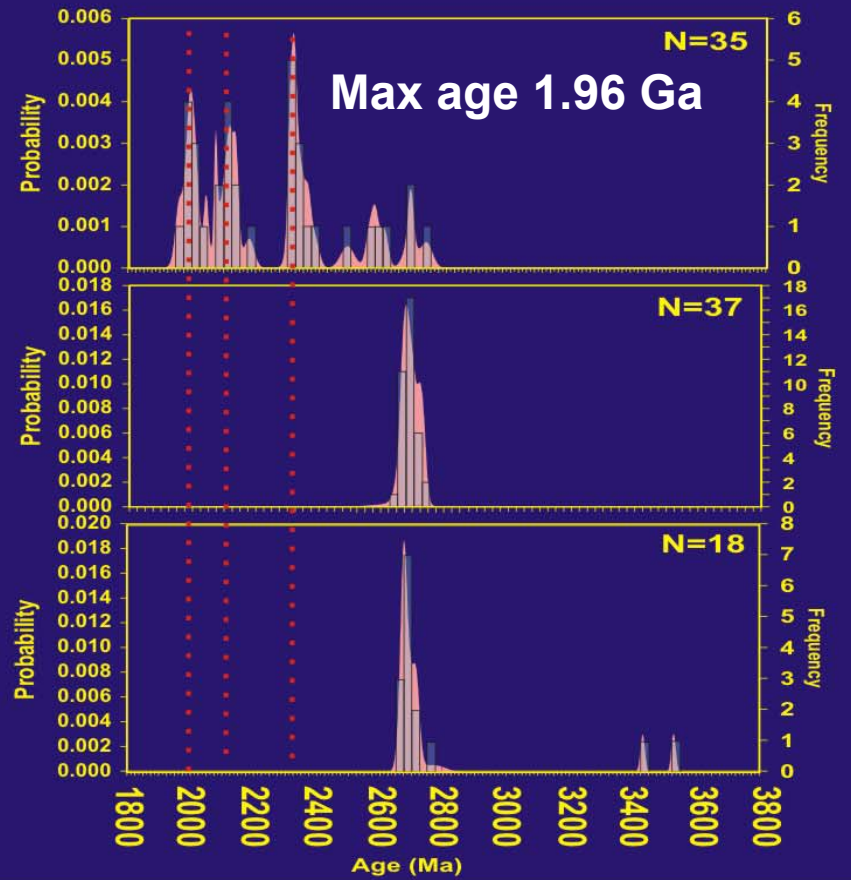


(Aspler et al. 2001)



Detrital Zircon Geochronology

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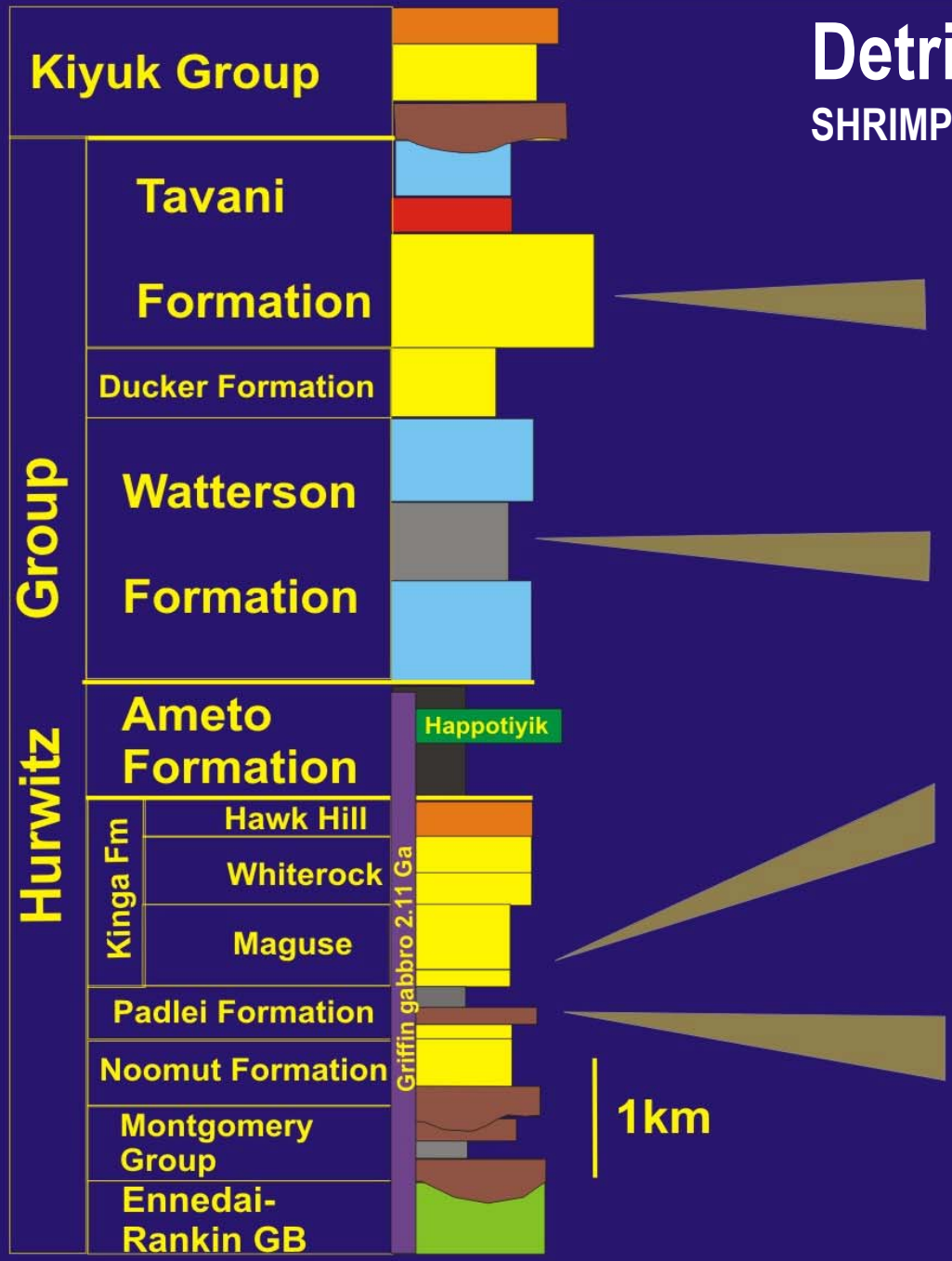

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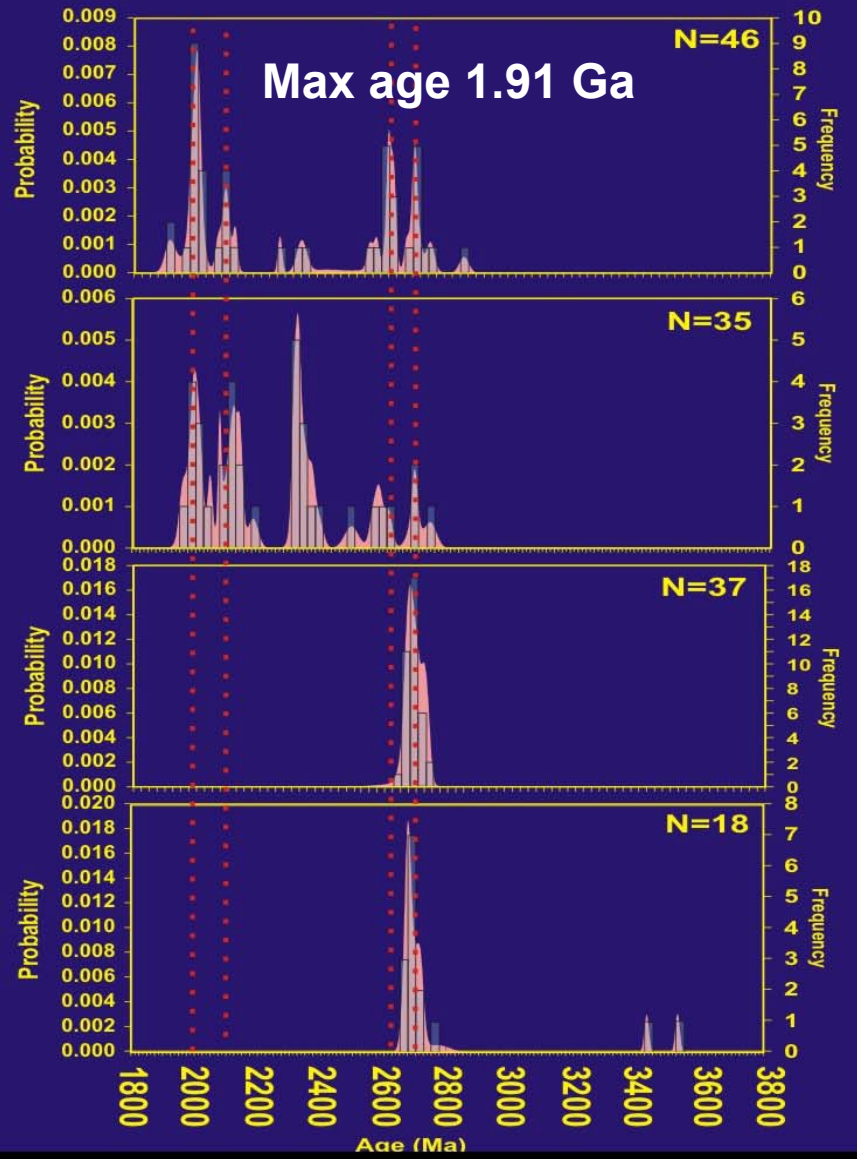
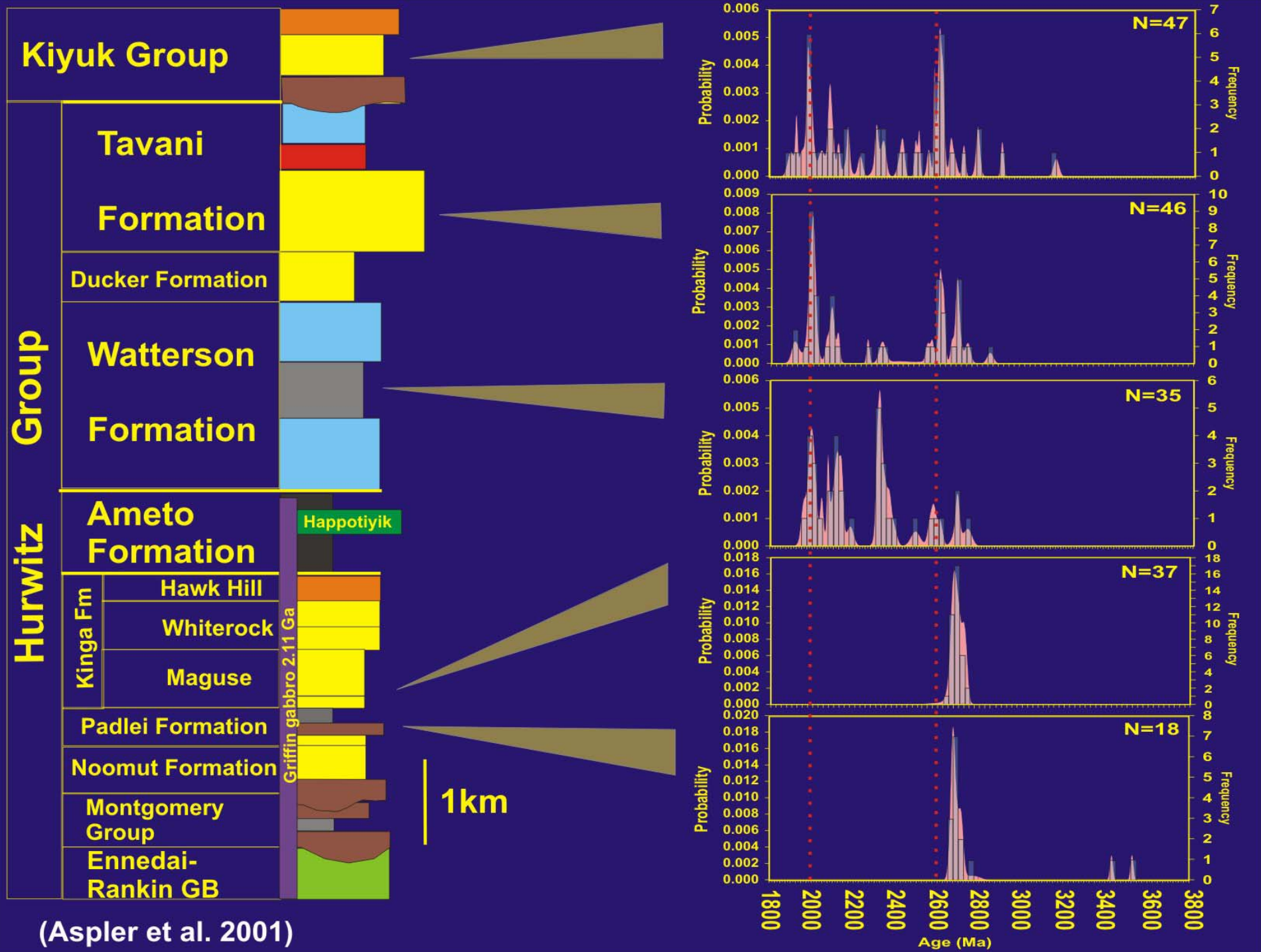
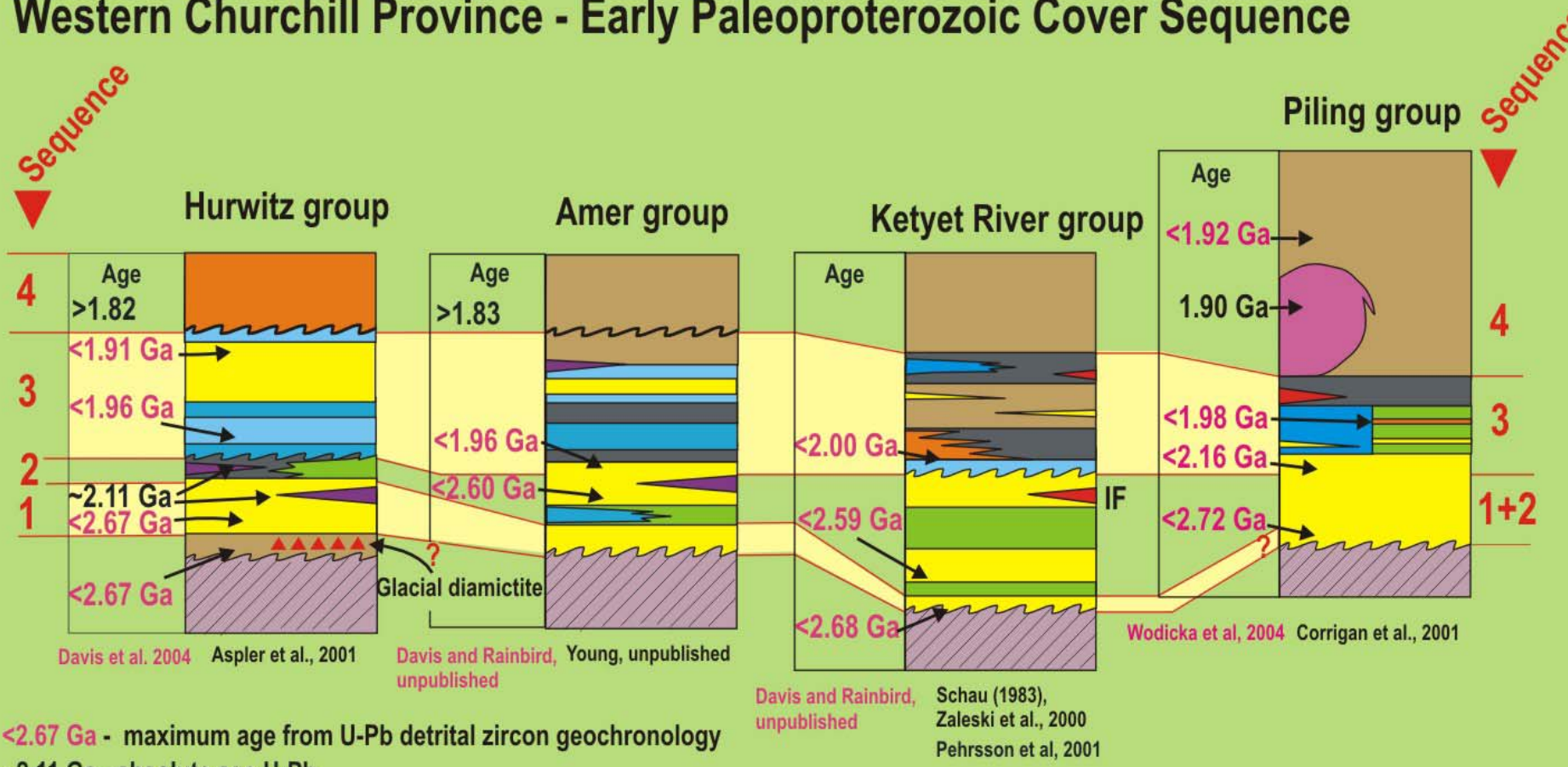



Kiyuk Group
Hurwitz Group
Tavani Formation
Ducker Formation
Watterson Formation
Ameto Formation
Happotiyik
Kinga Fm
Hawk Hill
Whiterock
Maguse
Griffin gabbro 2.11 Ga
Padlei Formation
Noomut Formation
Montgomery Group
Ennedai-Rankin GB
1km
(Aspler et al. 2001)
N=47
N=46
N=35
N=37
N=18
Probability
Frequency
Age (Ma)
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800

Western Churchill Province - Early Paleoproterozoic Cover Sequence



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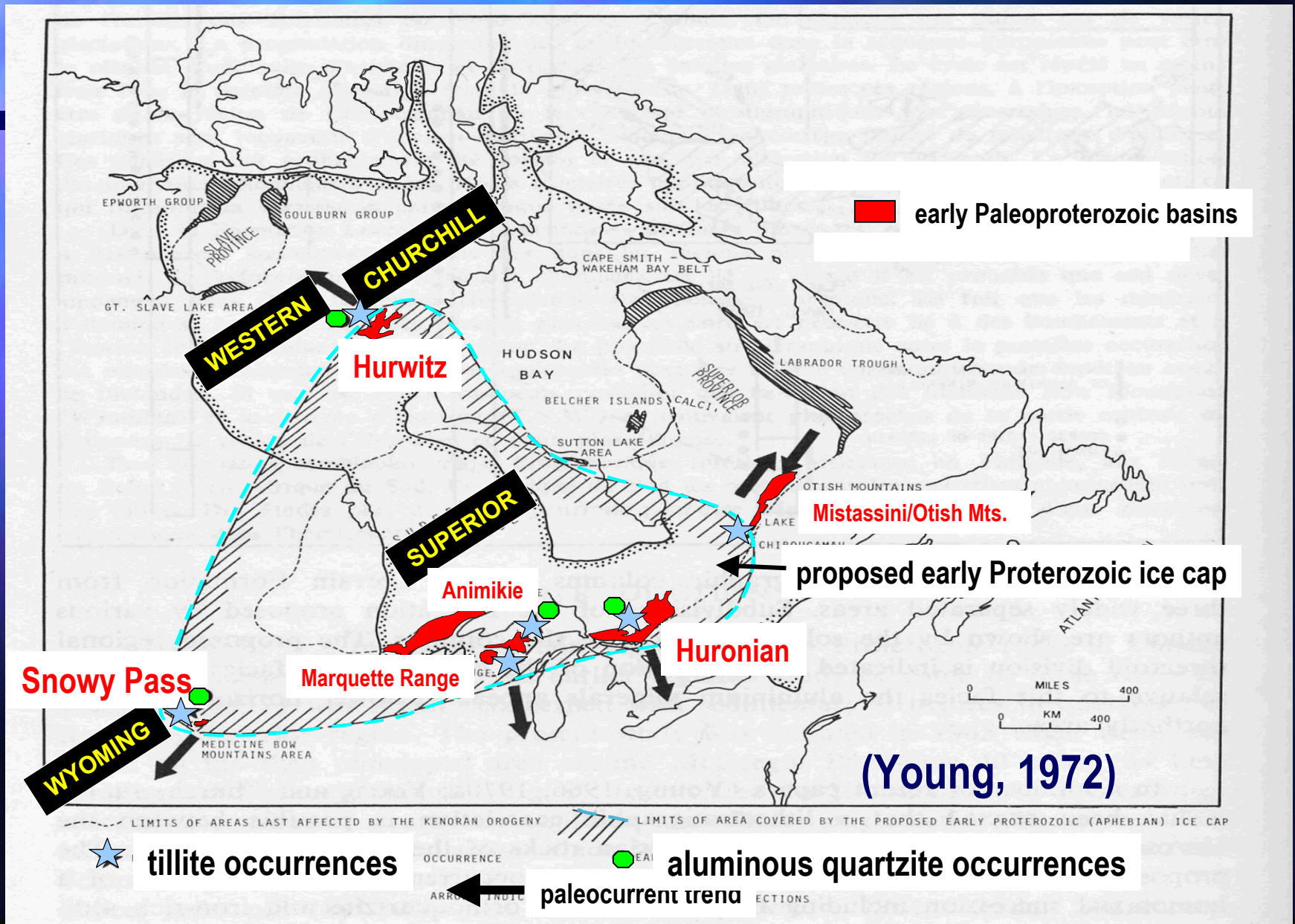
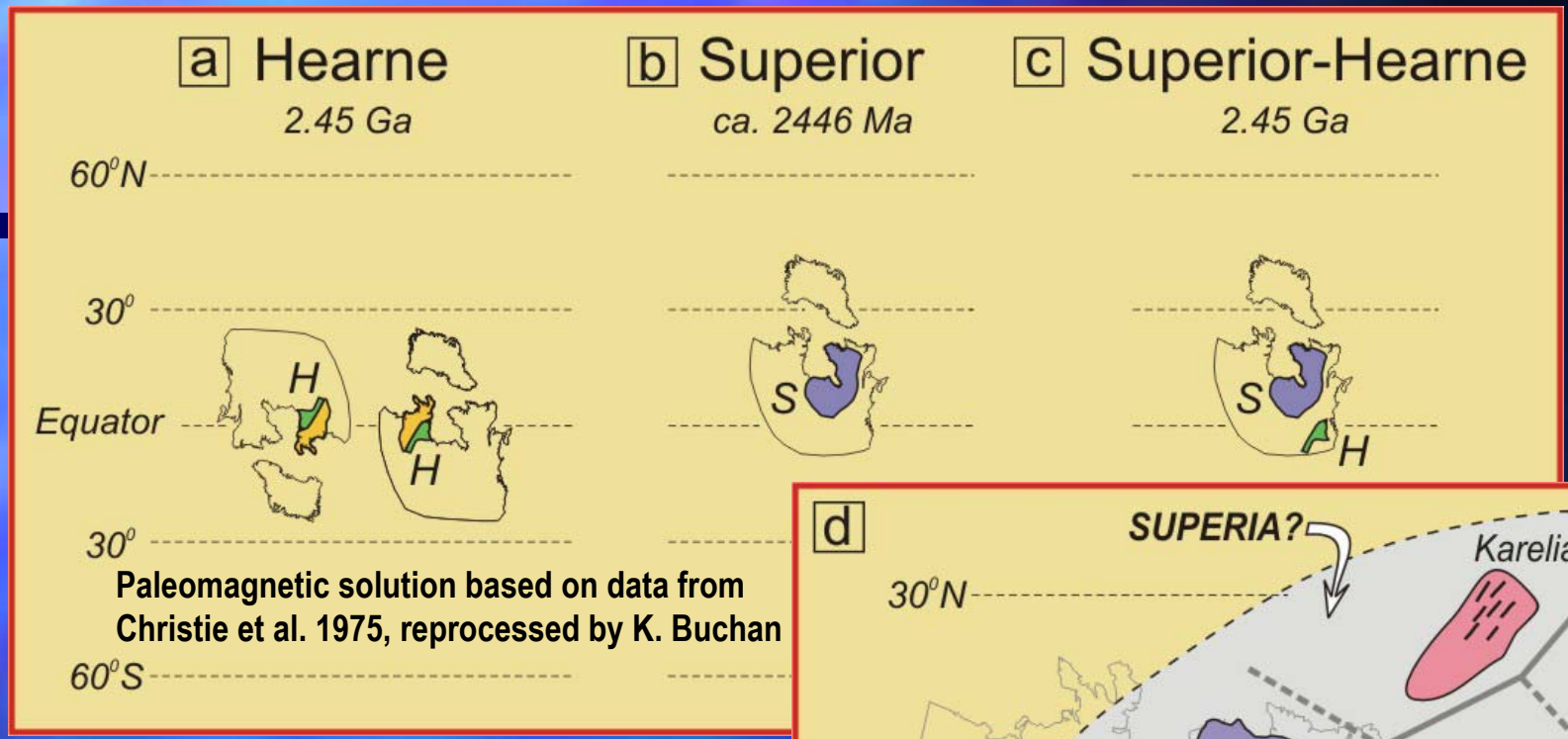
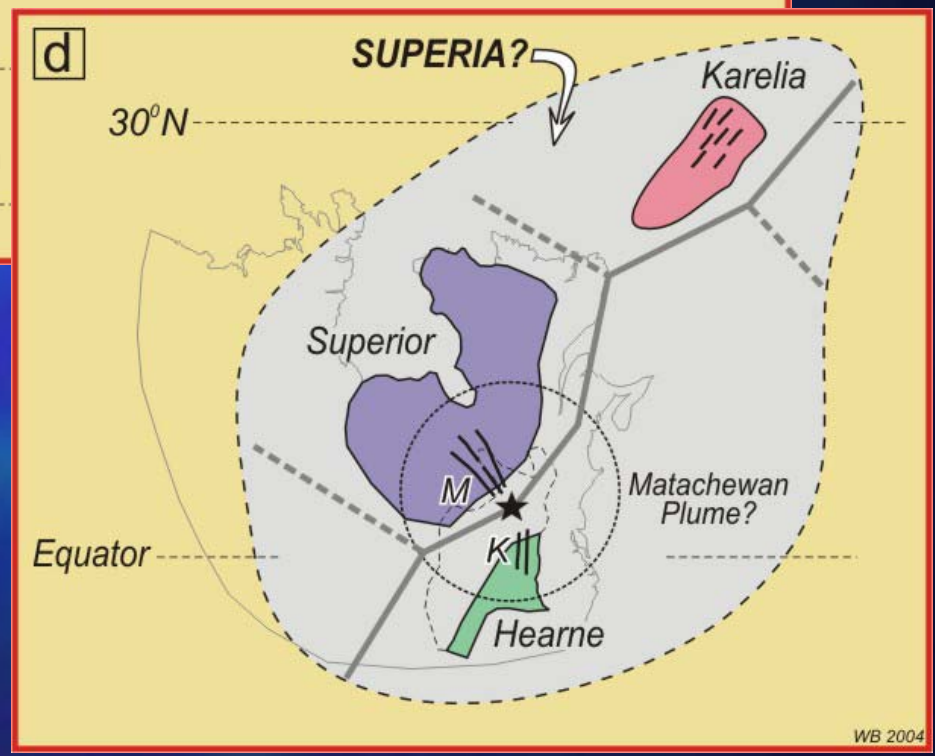
- Paraconglomerate, arkose, sandstone
- Sulphidic-graphitic shale-siltstone
- Quartz arenite
- Greywacke-pelite conglomerate
- Calcareous siltstones and sandstones
- Bedded carbonate
- Mafic volcanic rocks
- Monzogranite
- Gabbro sills
- Archean basement

Was the Hearne closer to the Superior and Wyoming?



Superia?

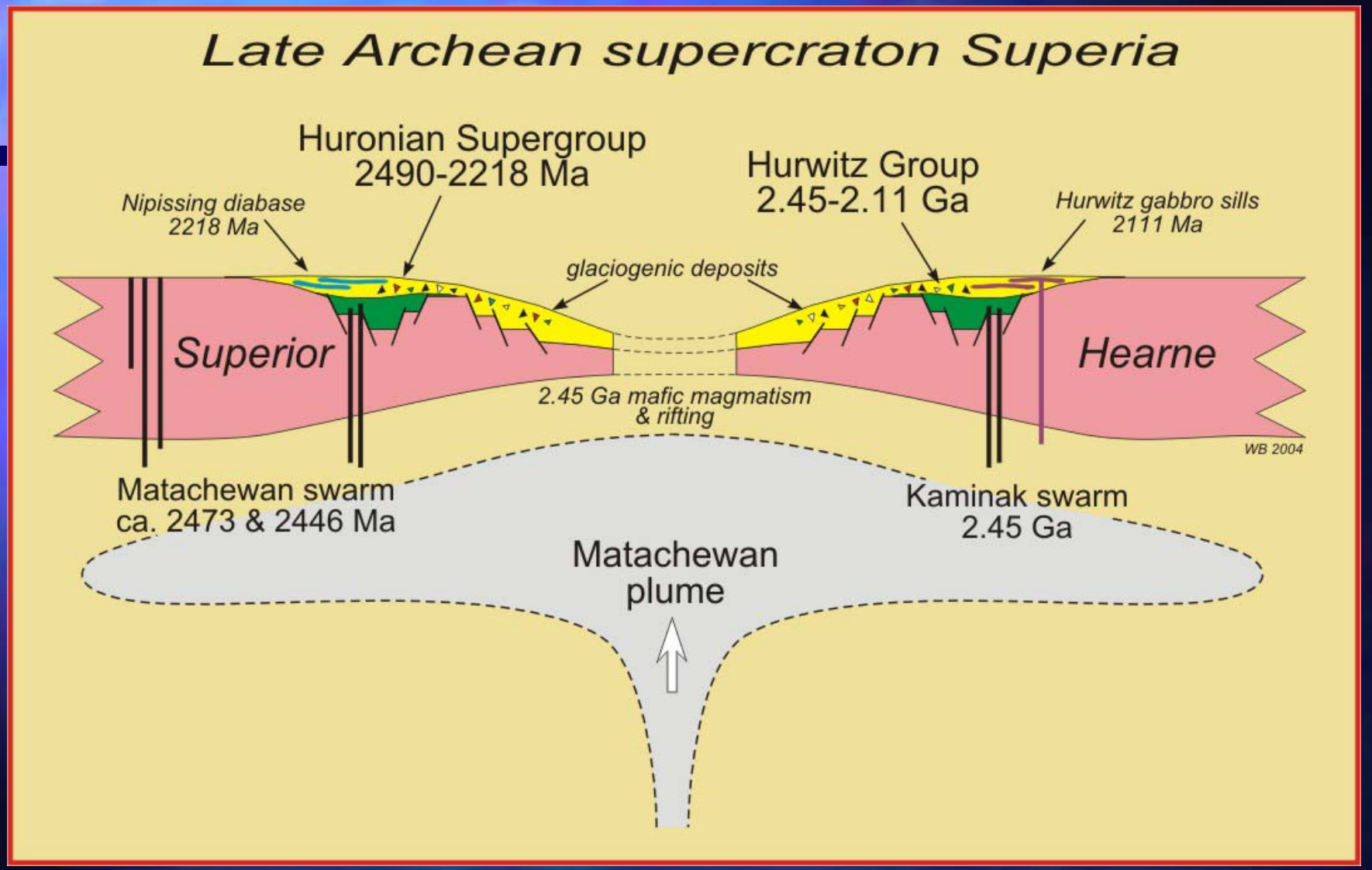




Similar age, petrography and orientation of 2.45 Ga Matachewan (Superior) and Kaminak (Hearne) dike swarms

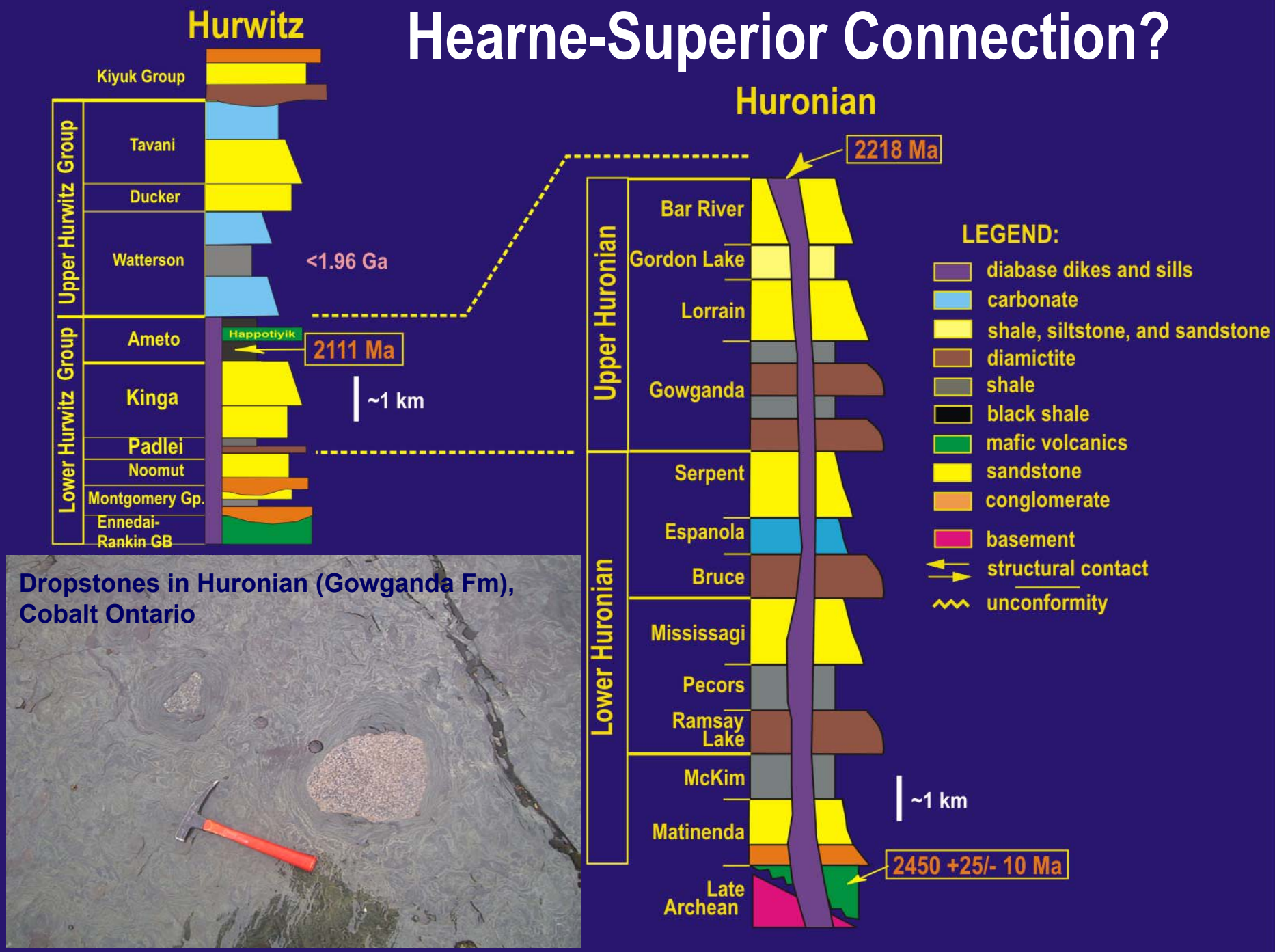
from Bleeker, in press.

Correlations and Matachewan Plume



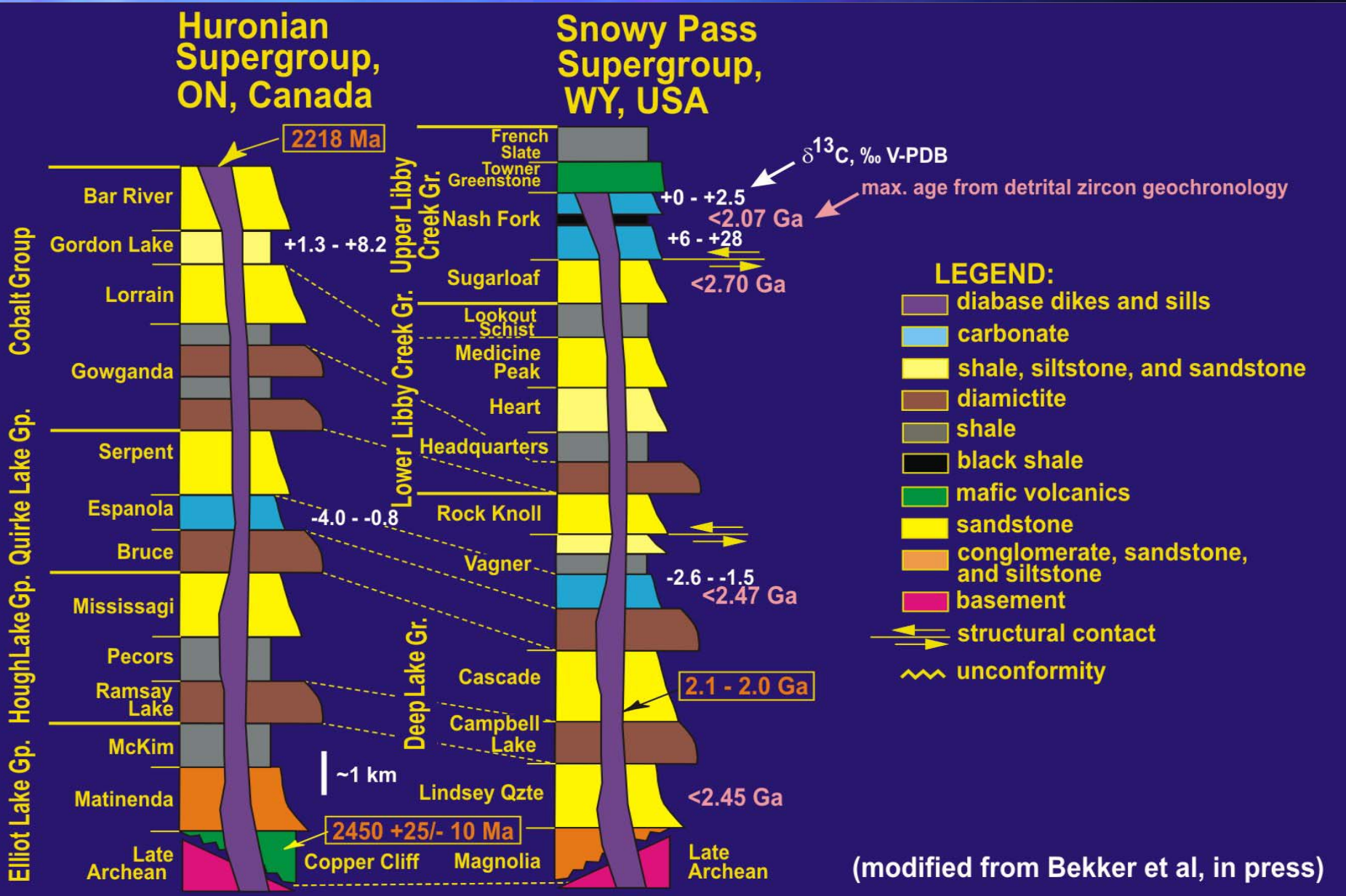
from Bleeker, in press.

Hearne-Superior Connection?

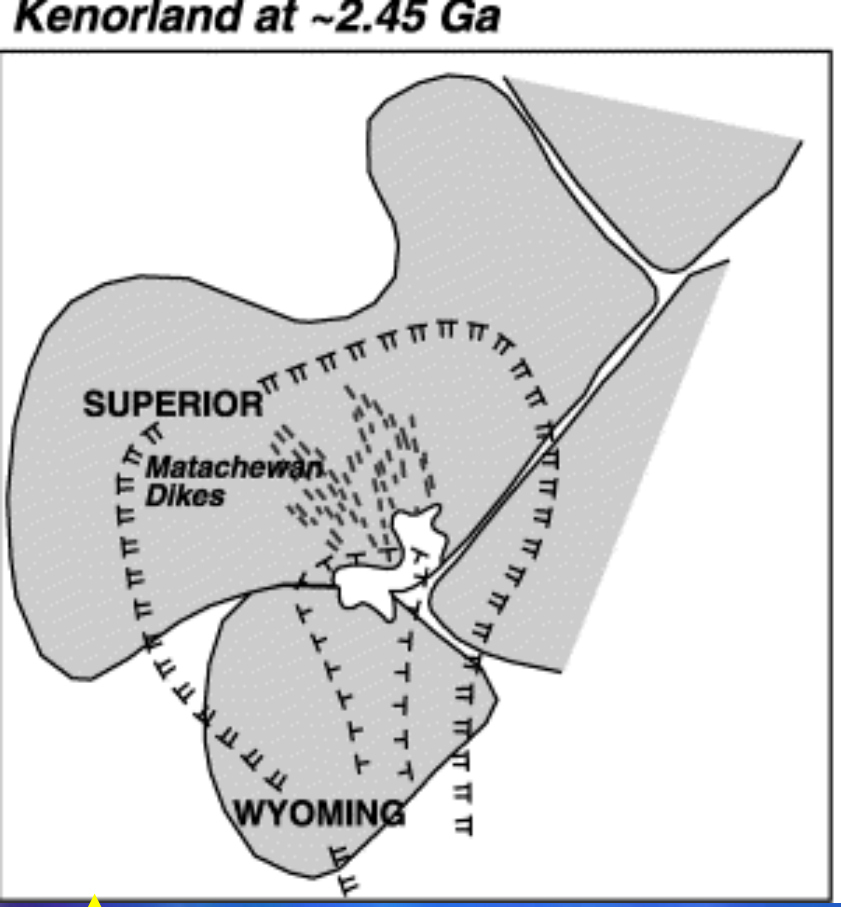


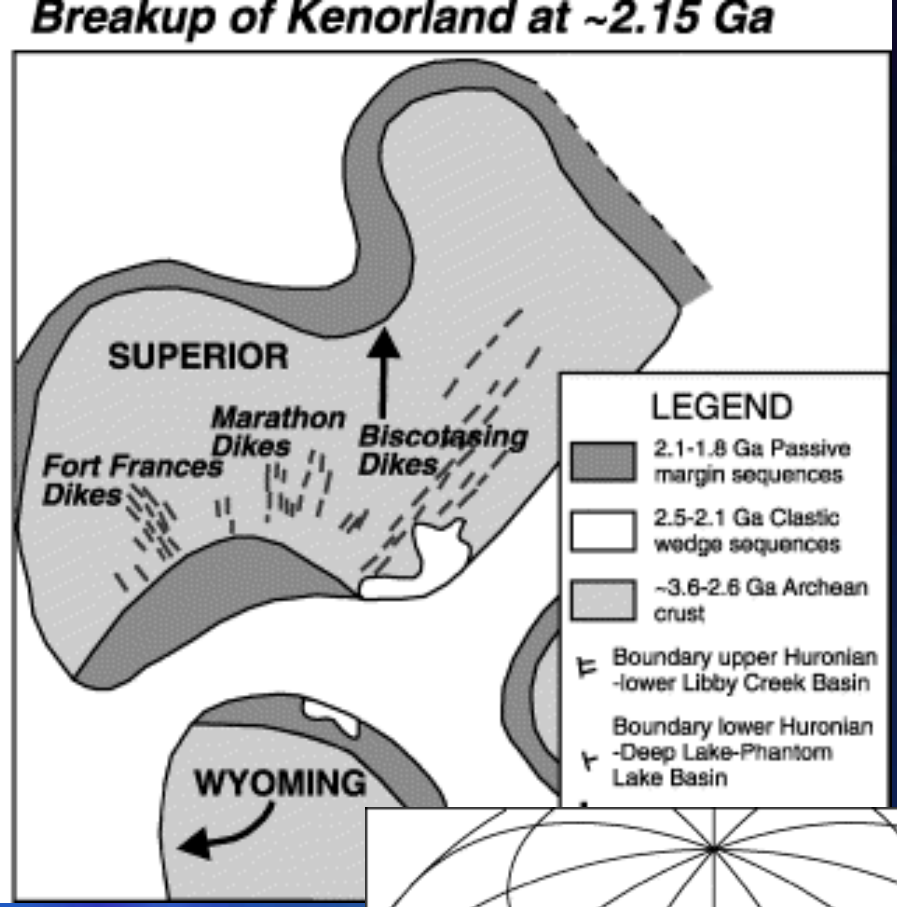
Dropstones in Huronian (Gowganda Fm),
Cobalt Ontario

Superior-Wyoming Connection?



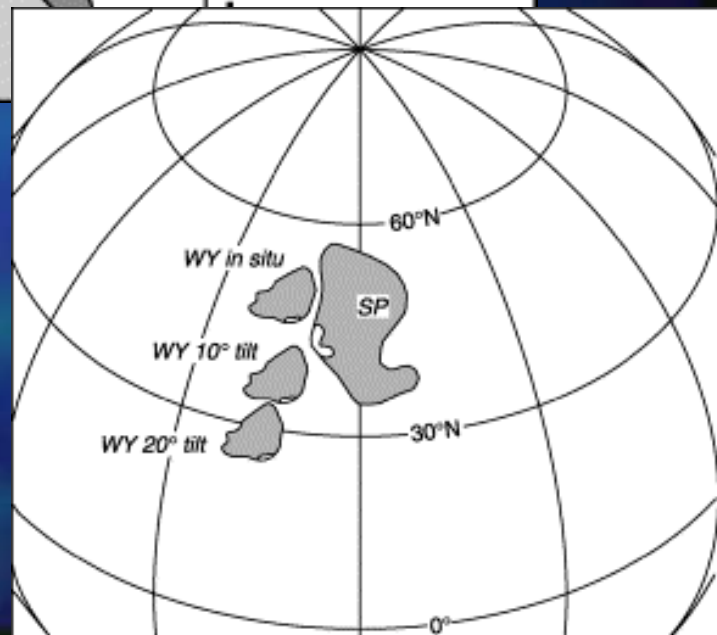
(modified from Bekker et al, in press)





Reconstruction of Wyoming-Superior in Kenorland as suggested by Roscoe and Card (1993)

Orthographic projection showing paleolatitudinal ca. 2170 Ma reconstruction of Superior-Wyoming Provinces (from Harlan et al. 2003)



Conclusions

- Both models consistent with paleomagnetic data but are inconsistent with some geological observations
- Need dating of Paleoproterozoic cover sequences on Superior and Wyoming in conjunction with sequence stratigraphic analysis
- Also need linked paleomagnetic-geochronological studies of mafic dyke swarms

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