Dating and characterising a newly discovered sedimentary basin in the East Tennant region

Morgan L. Blades, Sam Rasch, Alan S. Collins, Amber Jarrett, Juraj Farkaš, Darwinaji Subarkah

Reconstructing the Beetaloo/Greater McArthur Basin System: LP200301457

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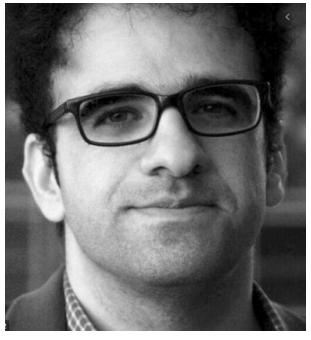
Angus Nixon

Ananyaa Deepak

Johann Soares

Yaser Madavan



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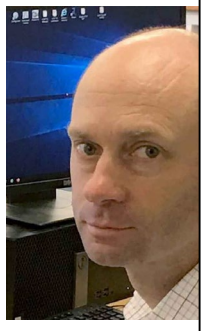
Assc. Prof. Ca



mon Holford

And partners……

Santos

CSIRO

EMPIRE energy

NORTHERN TERRITORY GOVERNMENT

HAFNIENSIS SIGILLVM VNIVERSITATIS REFORMATÆ 1537 1479 FVNDATÆ

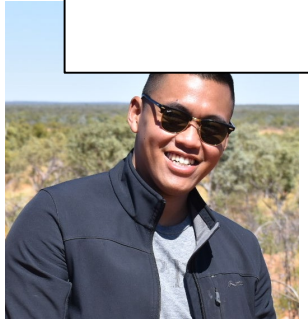
Teck

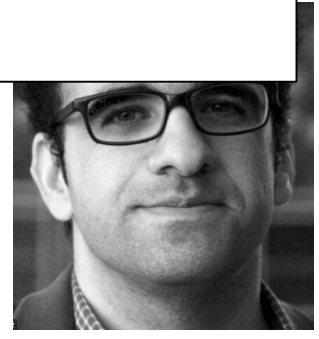
BHP

MinEx CRC

Australian Government
Australian Research Council

Dar

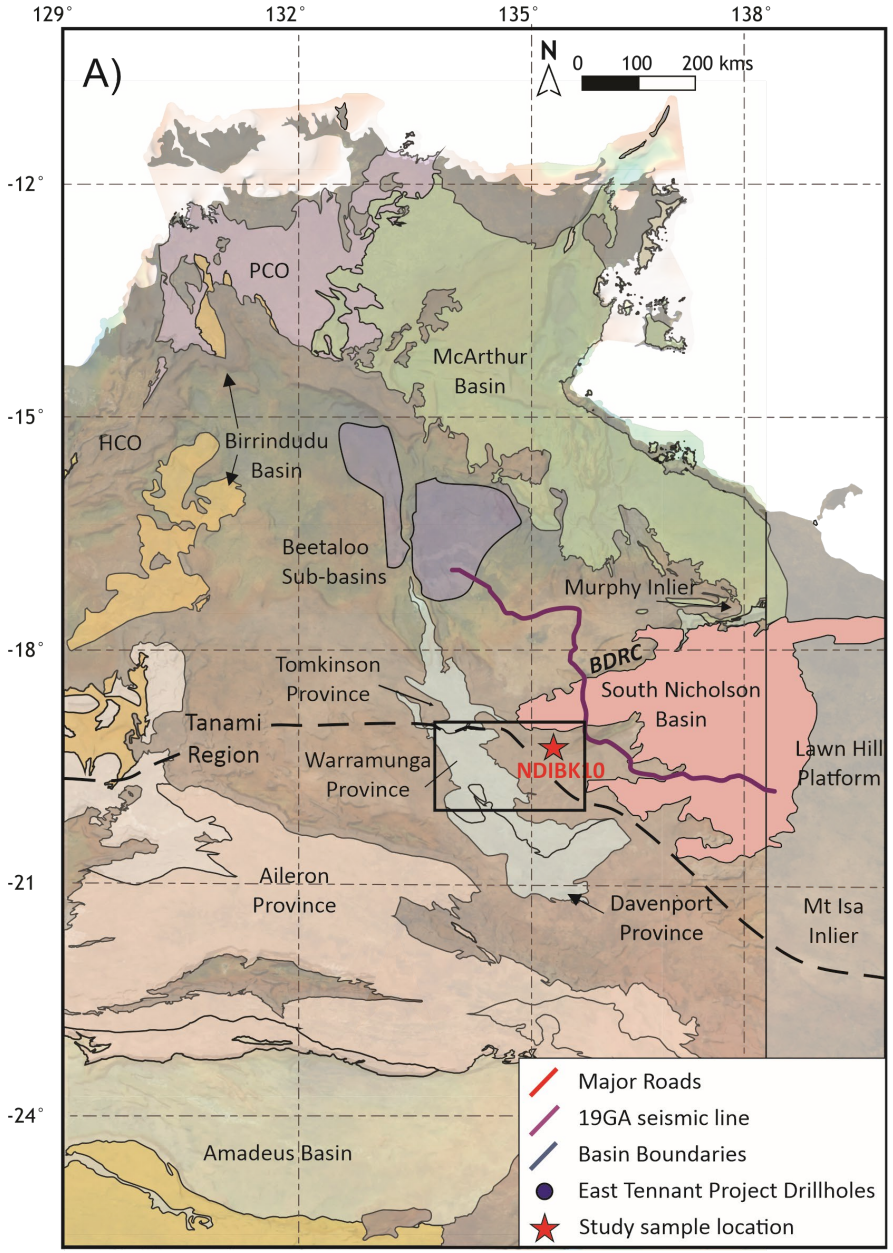




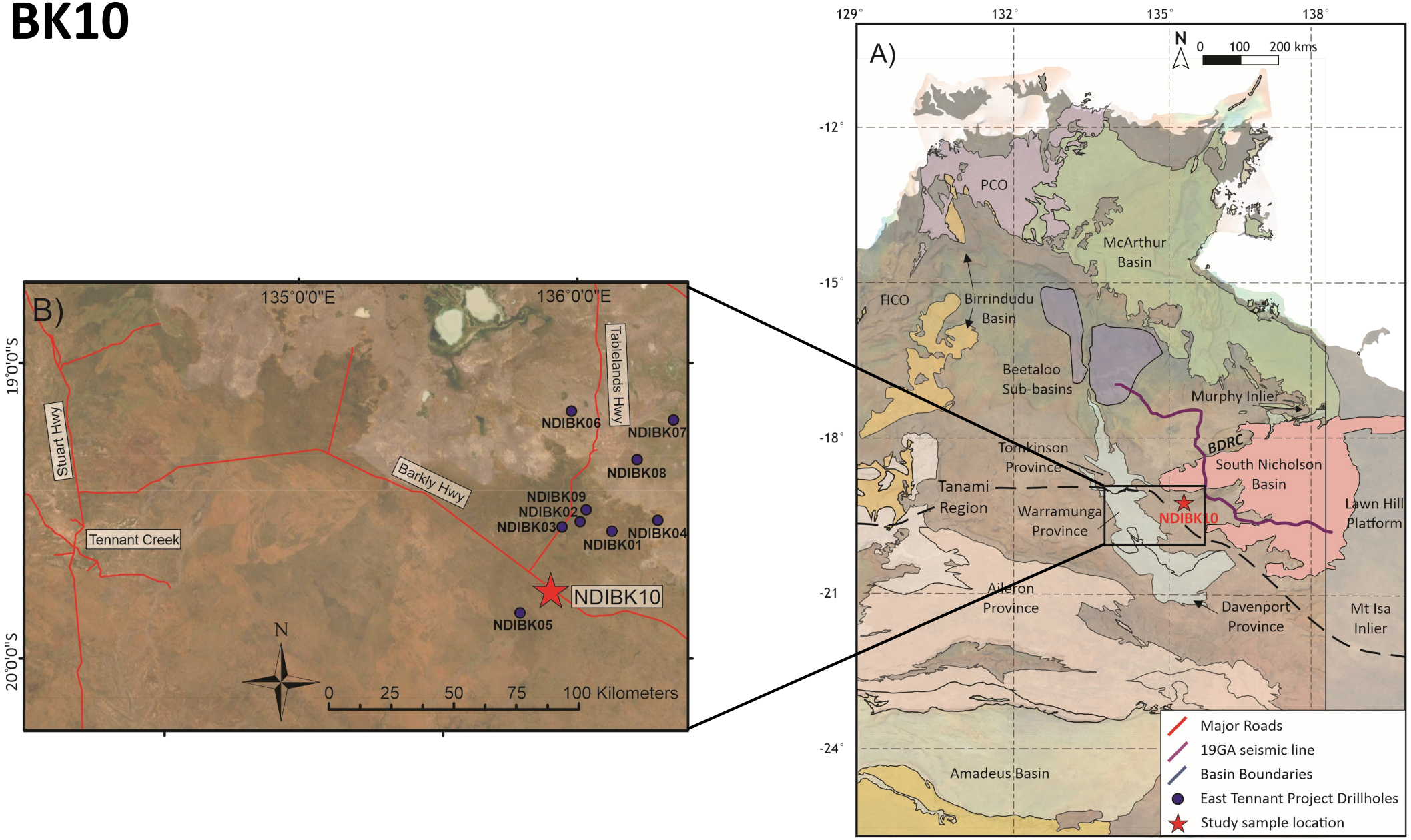
Dating and characterising a newly discovered sedimentary basin in the East Tennant region

Sam Rasch

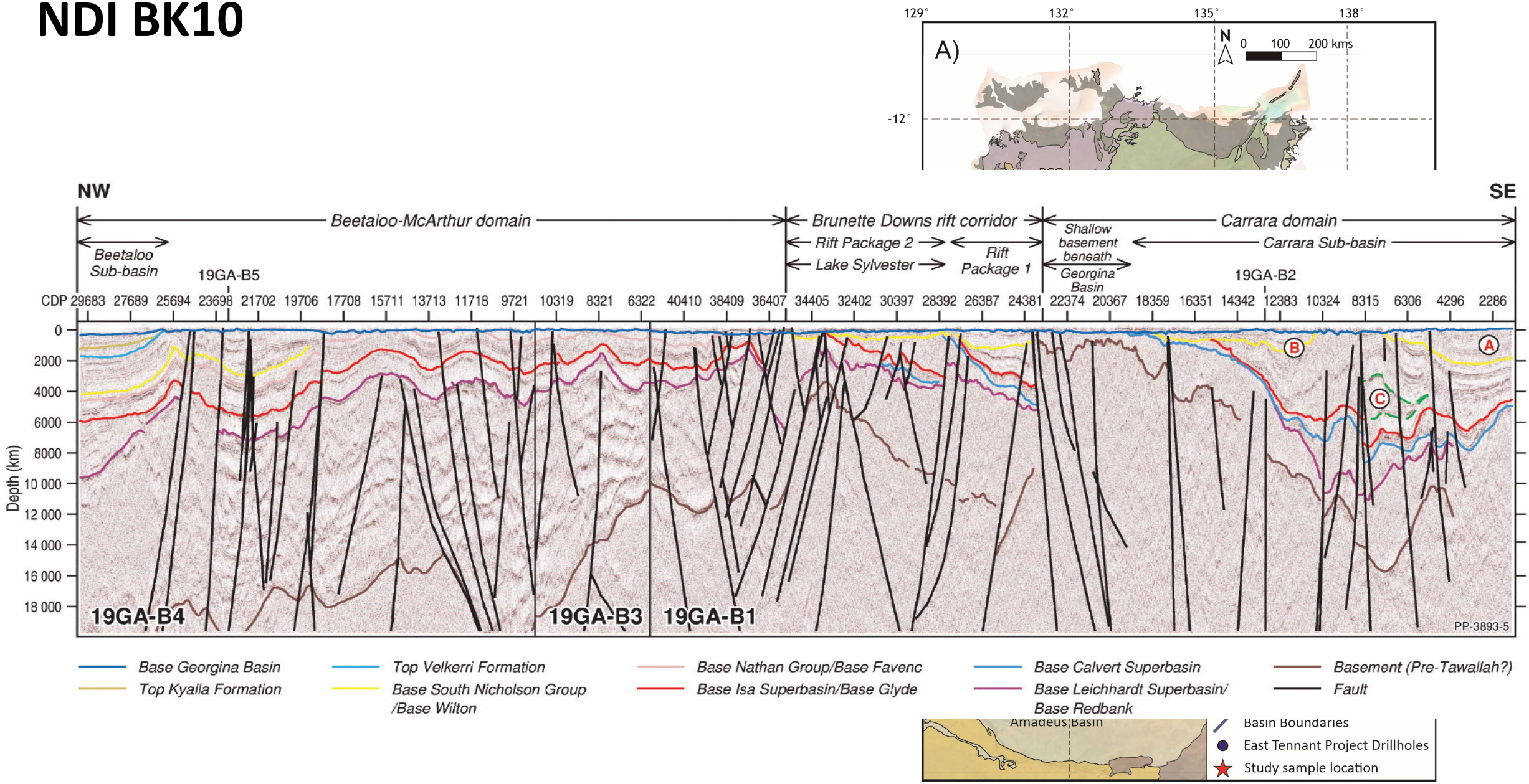
Dating and characterising a newly discovered sedimentary basin in the East Tennant region



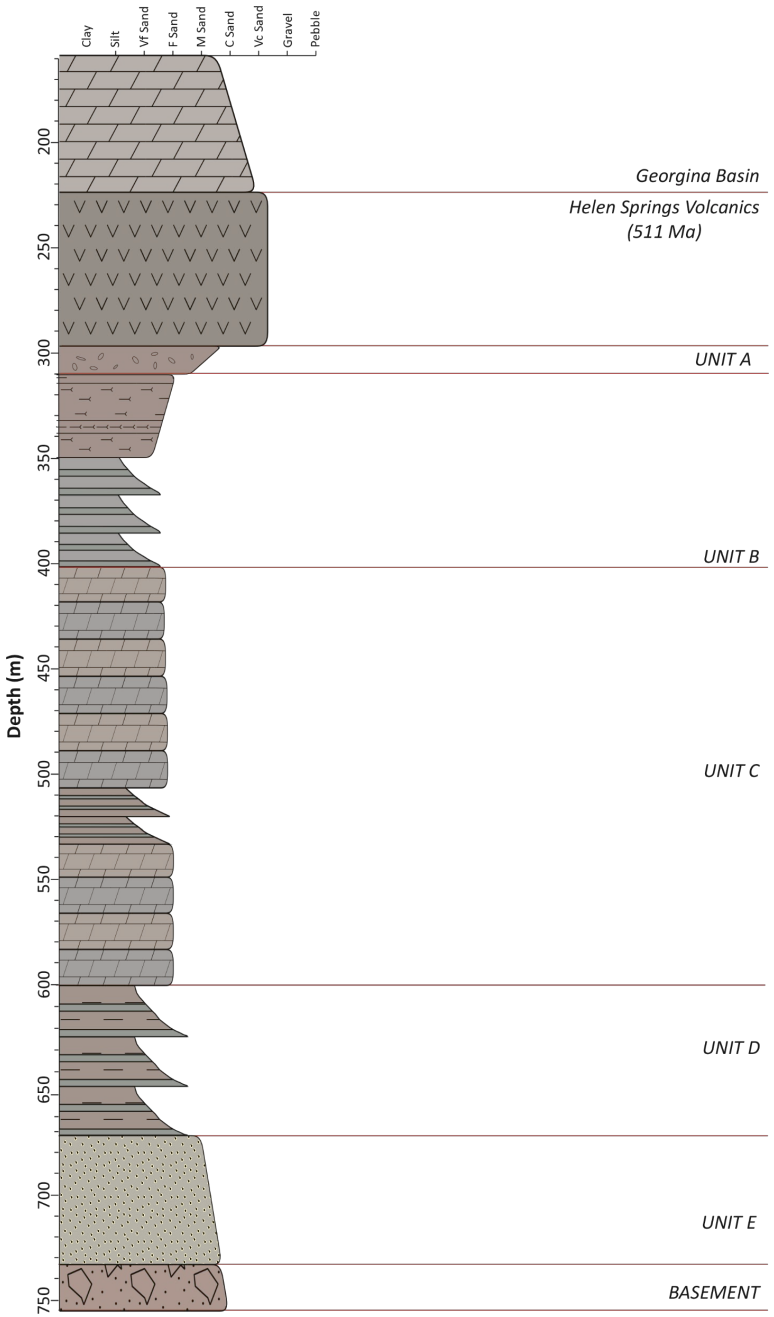
NDI BK10

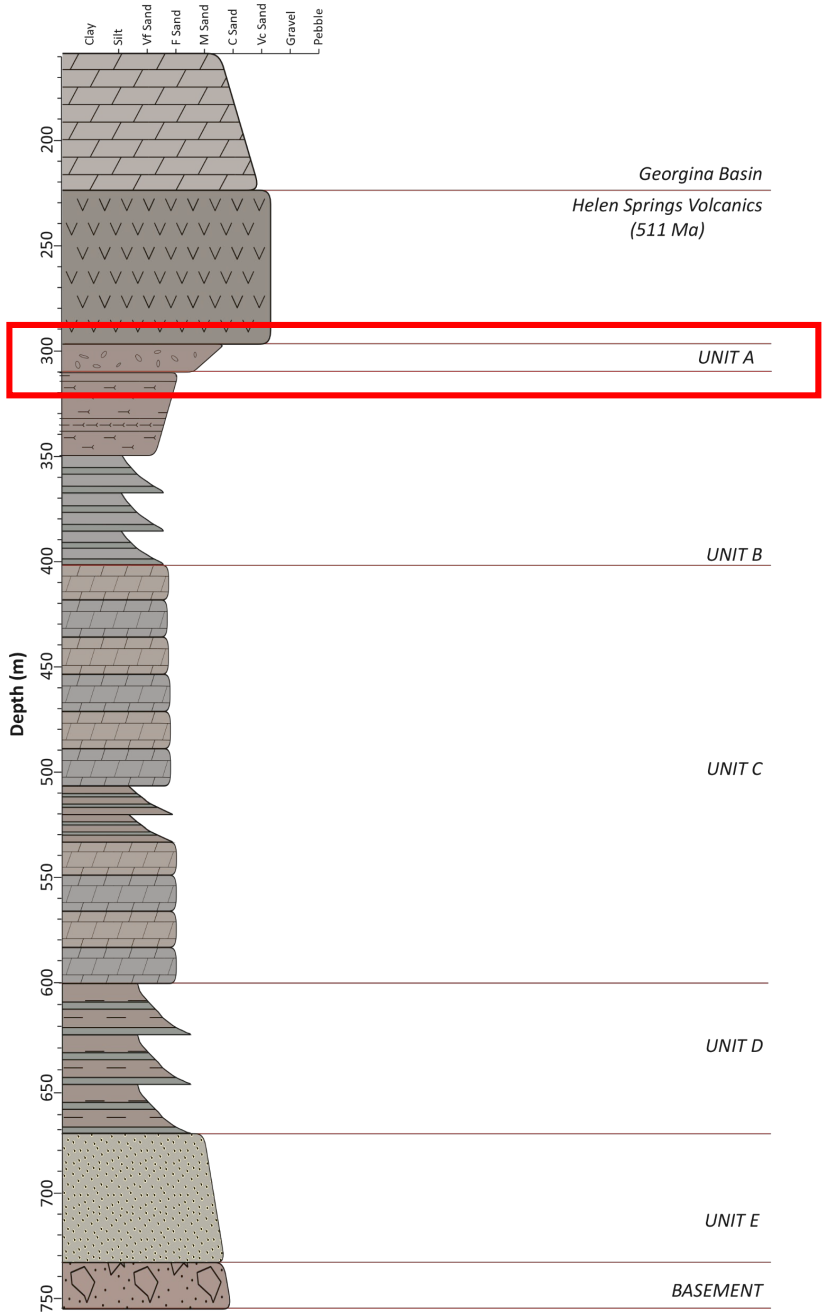

B)
135°0'0"E
136°0'0"E
19°0'0"S
20°0'0"S
Stuart Hwy
Barkly Hwy
Tablelands Hwy
Tennant Creek
NDIBK06
NDIBK07
NDIBK08
NDIBK09
NDIBK02
NDIBK03
NDIBK04
NDIBK01
NDIBK10
NDIBK05
N
0 25 50 75 100 Kilometers
A)
129°
132°
135°
138°
-12°
-15°
-18°
-21°
-24°
N
0 100 200 kms
PCO
McArthur Basin
HCO
Birrindudu Basin
Beetaloo Sub-basins
Murphy Inlier
BDRC
South Nicholson Basin
Tomkinson Province
Tanami Region
Warramunga Province
NDIBK10
Lawn Hill Platform
Aileron Province
Davenport Province
Mt Isa Inlier
Amadeus Basin
Major Roads
19GA seismic line
Basin Boundaries
East Tennant Project Drillholes
Study sample location

NDI BK10



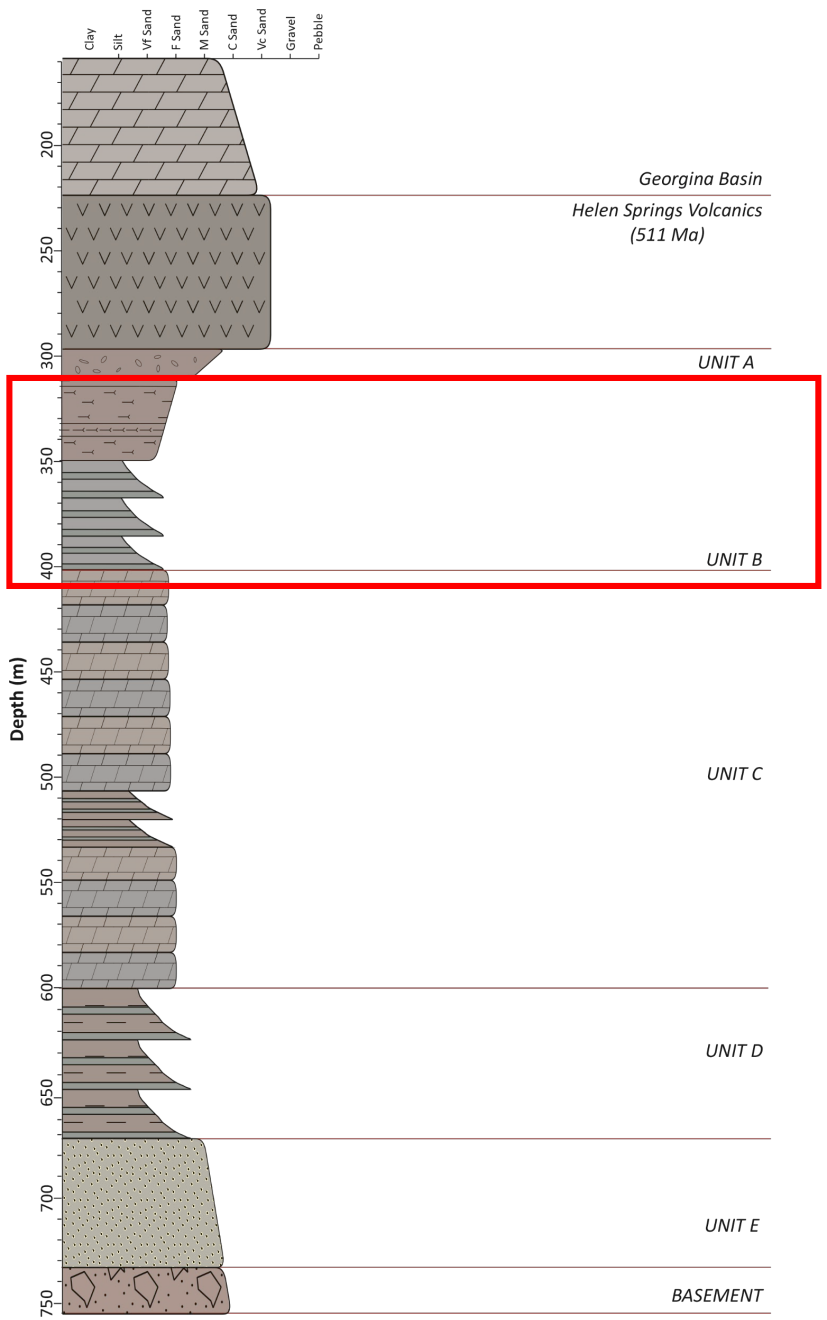
Southby et al. (2021)


Clay
Silt
Vf Sand
F Sand
M Sand
C Sand
Vc Sand
Gravel
Pebble
Depth (m)
200
250
300
350
400
450
500
550
600
650
700
750
Georgina Basin
Helen Springs Volcanics
(511 Ma)
UNIT A
UNIT B
UNIT C
UNIT D
UNIT E
BASEMENT

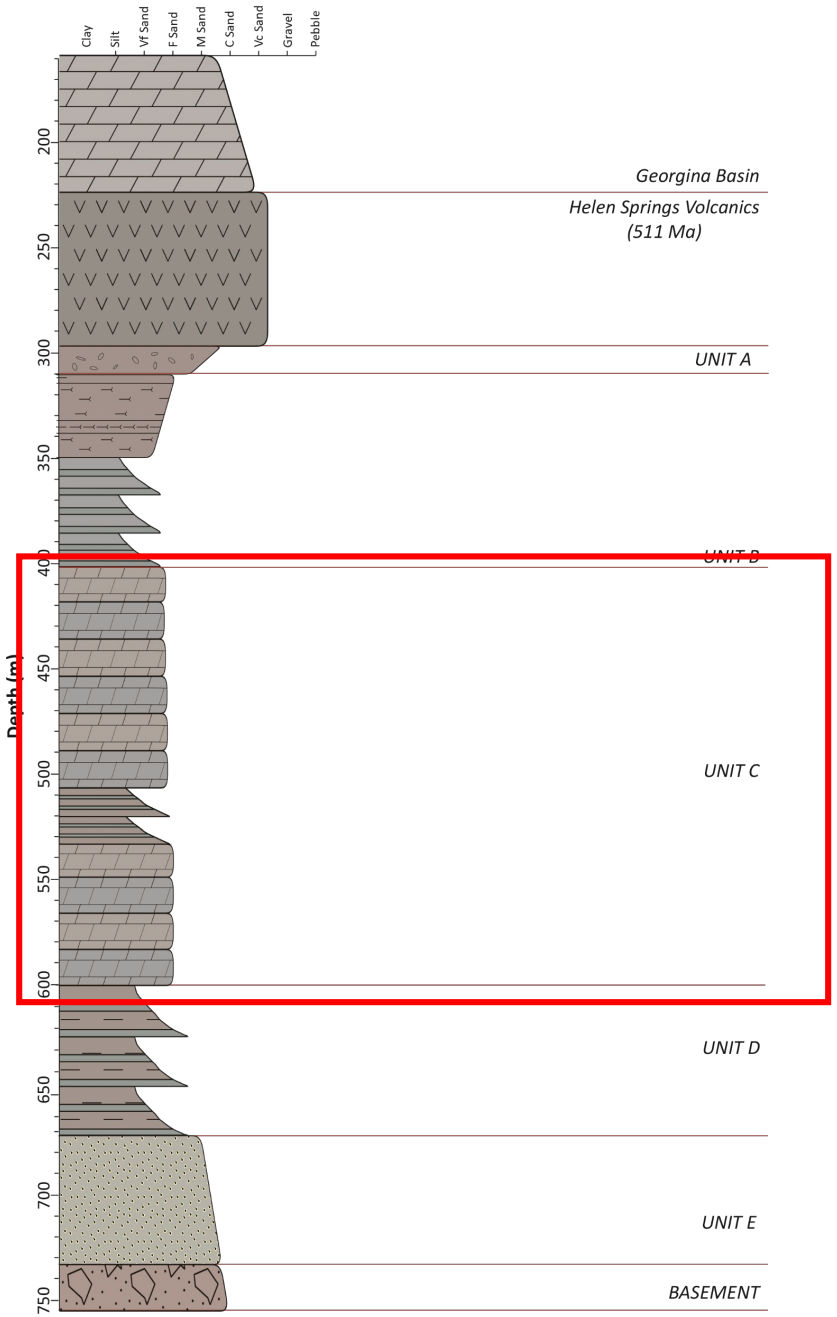

Clay
Silt
Vf Sand
F Sand
M Sand
C Sand
Vc Sand
Gravel
Pebble
Depth (m)
200
250
300
350
400
450
500
550
600
650
700
750
Georgina Basin
Helen Springs Volcanics
(511 Ma)
UNIT A
UNIT B
UNIT C
UNIT D
UNIT E
BASEMENT


298

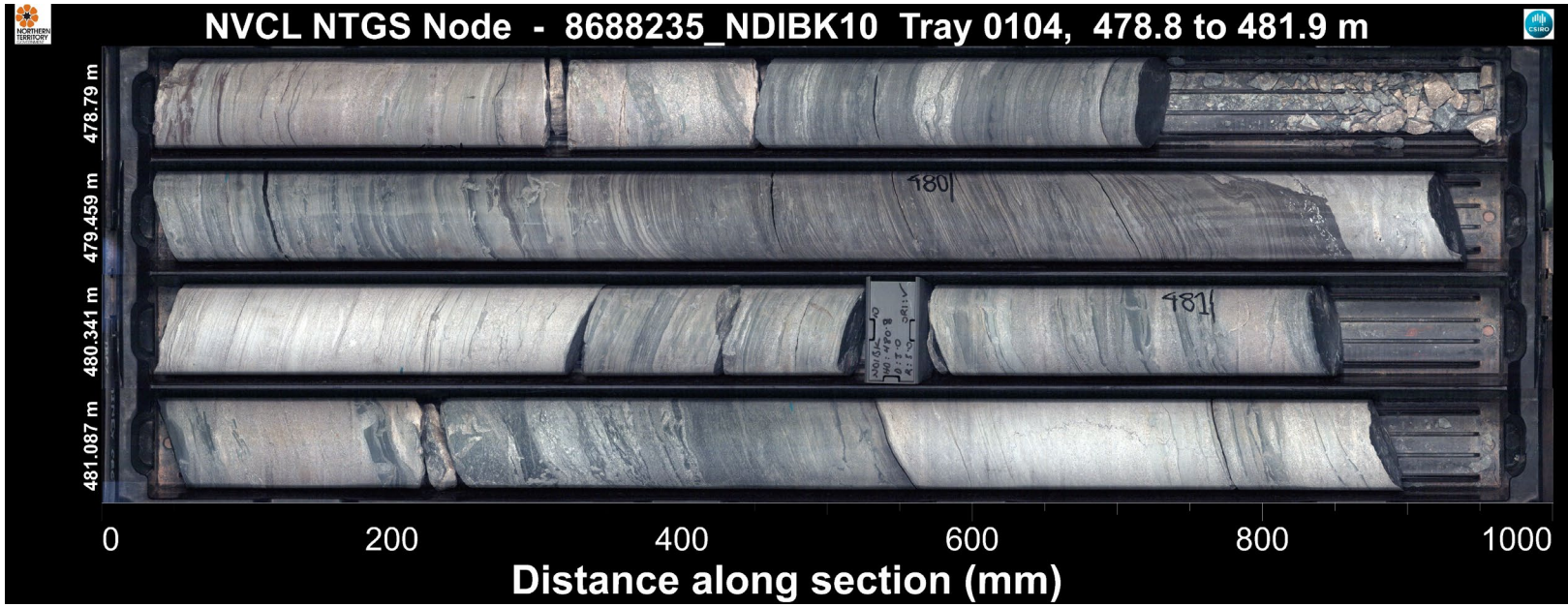
Unit A


Clay
Silt
Vf Sand
F Sand
M Sand
C Sand
Vc Sand
Gravel
Pebble
Depth (m)
200
250
300
350
400
450
500
550
600
650
700
750
Georgina Basin
Helen Springs Volcanics
(511 Ma)
UNIT A
UNIT B
UNIT C
UNIT D
UNIT E
BASEMENT

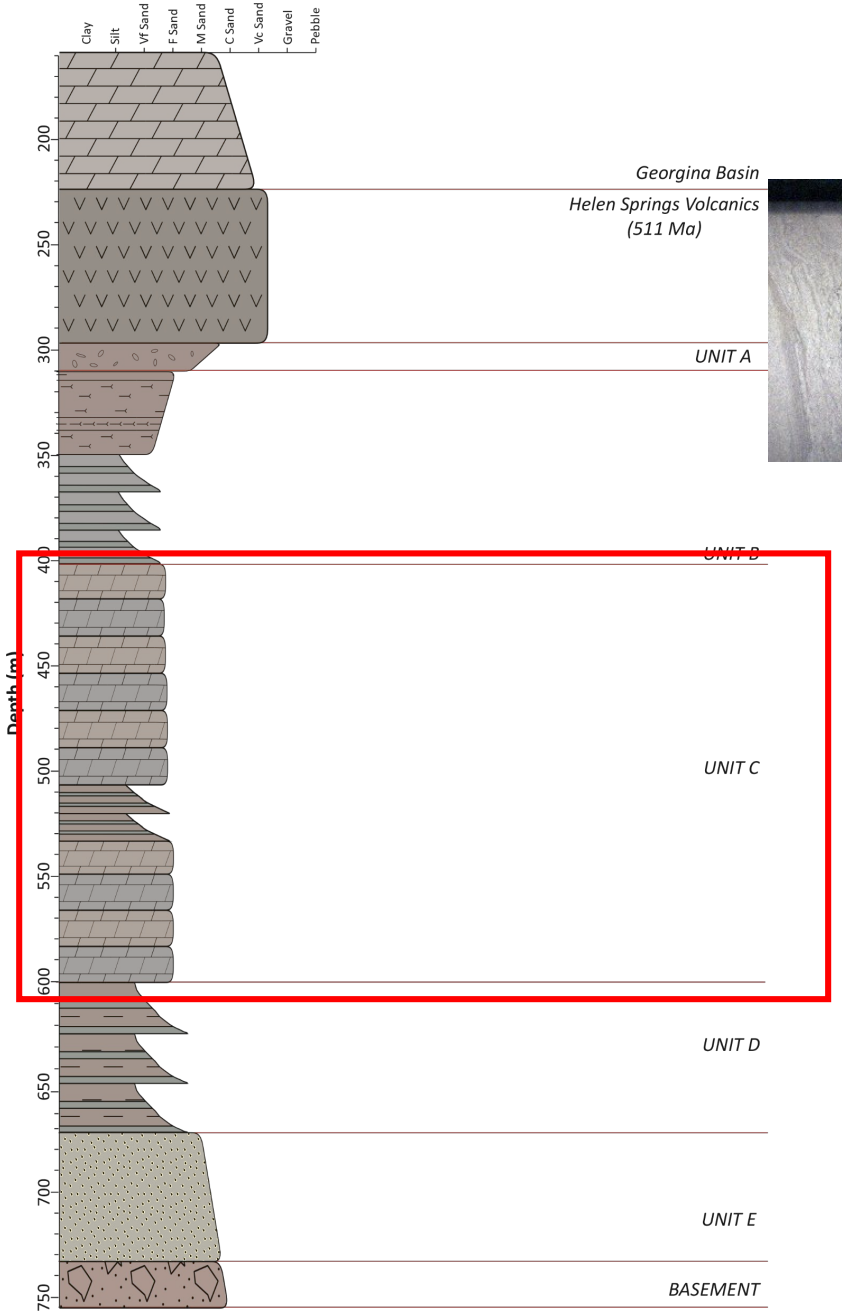
Unit B

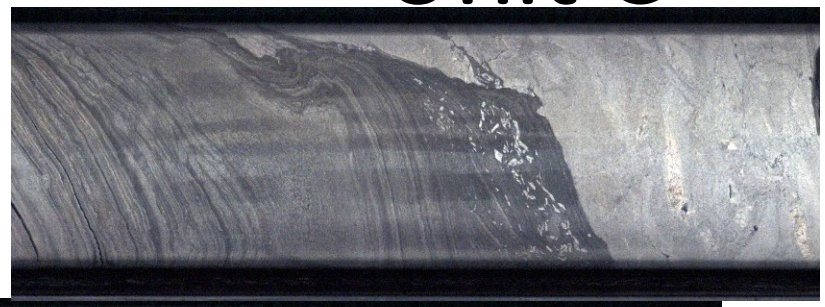

Clay
Silt
Vf Sand
F Sand
M Sand
C Sand
Vc Sand
Gravel
Pebble
Depth (m)
200
250
300
350
400
450
500
550
600
650
700
750
Georgina Basin
Helen Springs Volcanics
(511 Ma)
UNIT A
UNIT B
UNIT C
UNIT D
UNIT E
BASEMENT

Unit C

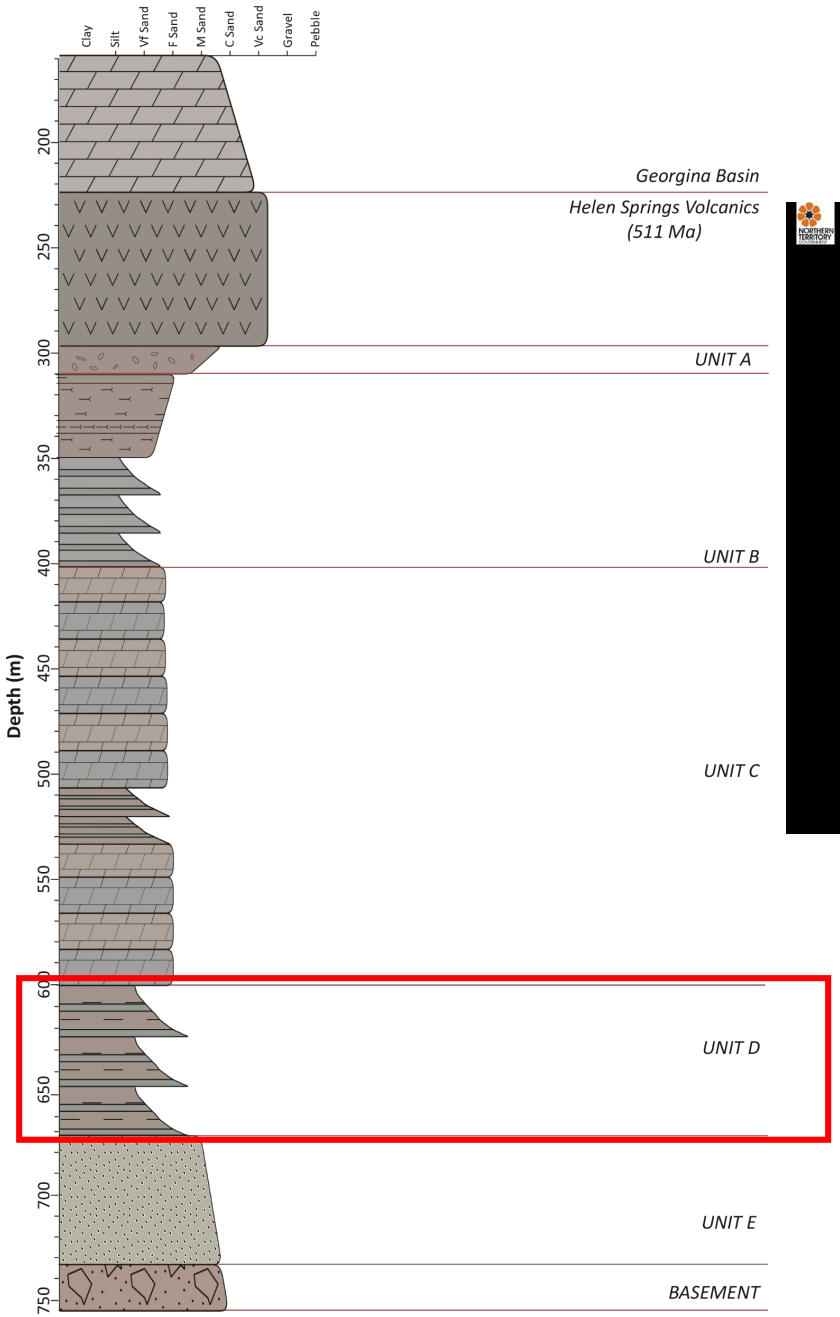

NVCL NTGS Node - 8688235_NDIBK10 Tray 0104, 478.8 to 481.9 m
478.79 m
479.459 m
480.341 m
481.087 m
480
481
0
200
400
600
800
1000
Distance along section (mm)

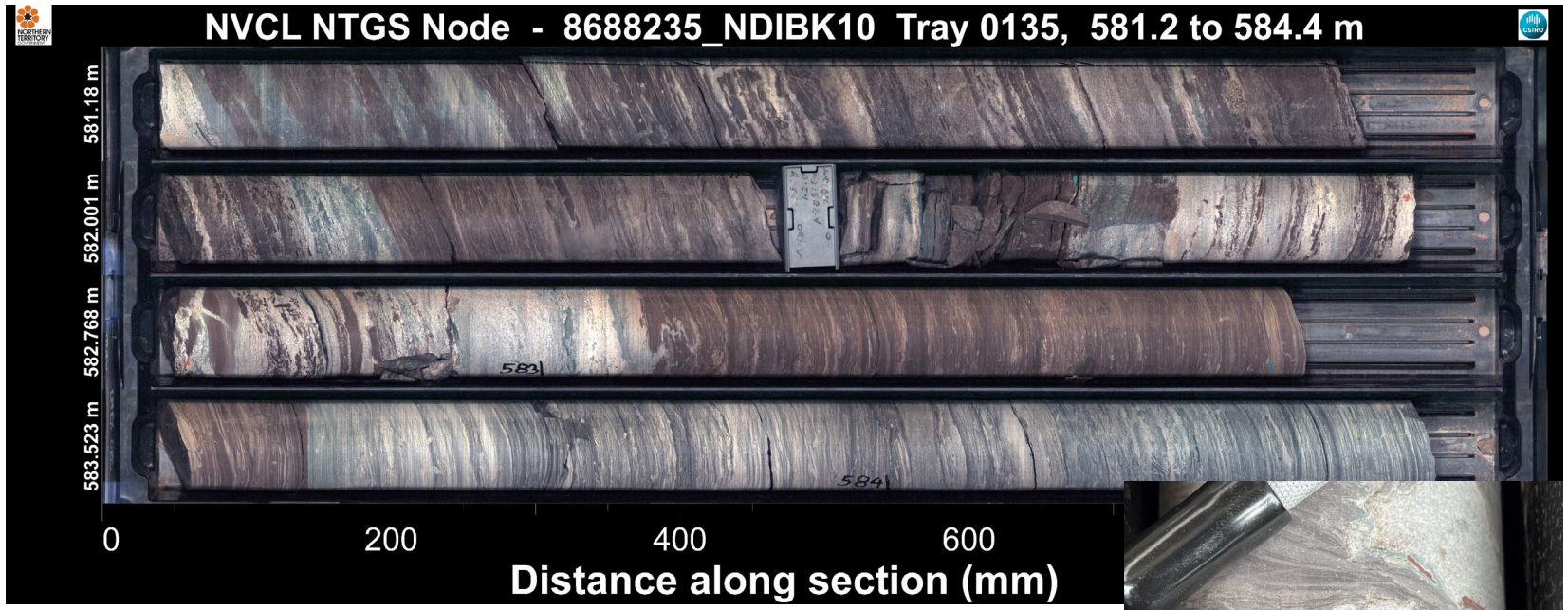
Unit C

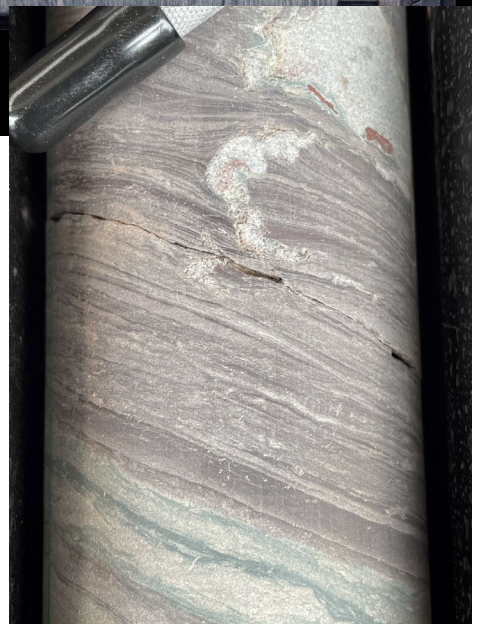

Clay
Silt
Vf Sand
F Sand
M Sand
C Sand
Vc Sand
Gravel
Pebble
Depth (m)
200
250
300
350
400
450
500
550
600
650
700
750
Georgina Basin
Helen Springs Volcanics
(511 Ma)
UNIT A
UNIT B
UNIT C
UNIT D
UNIT E
BASEMENT



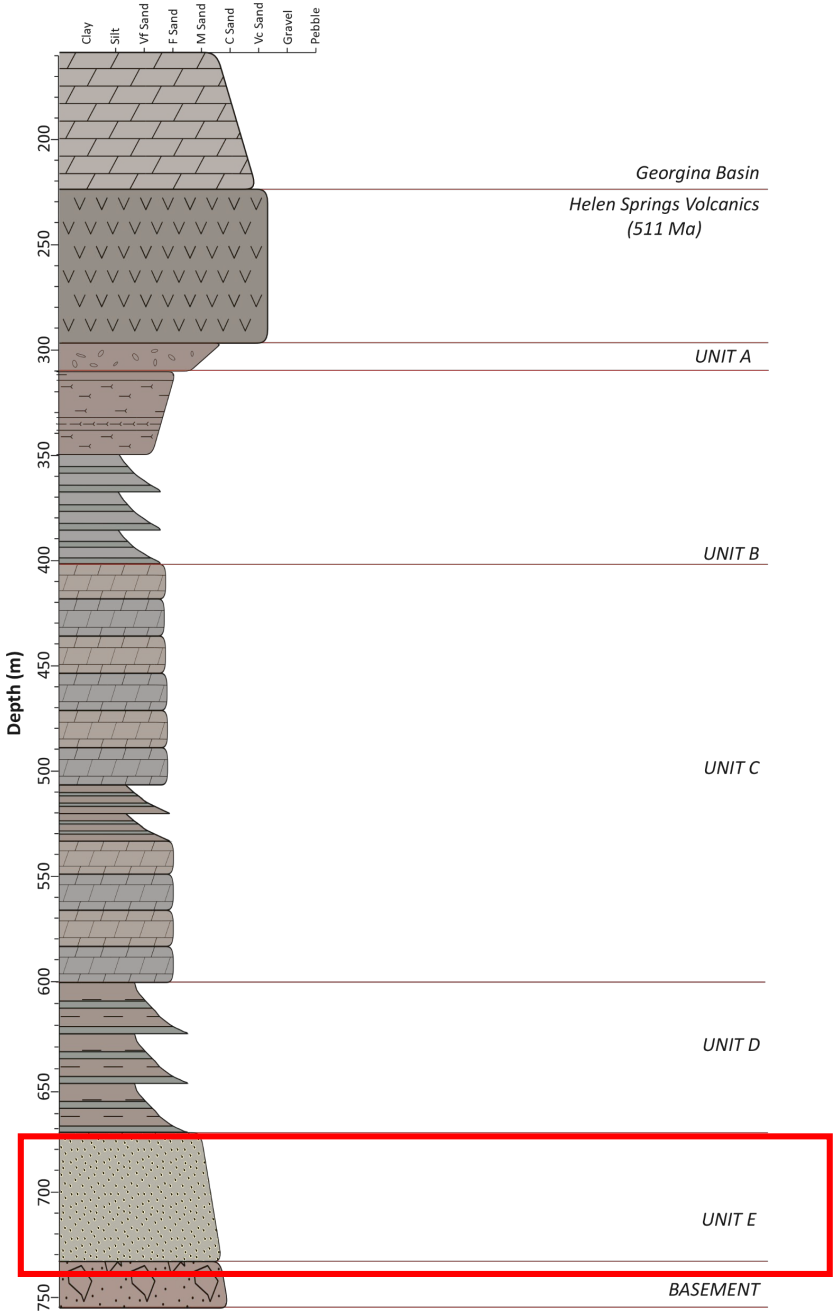
Unit D

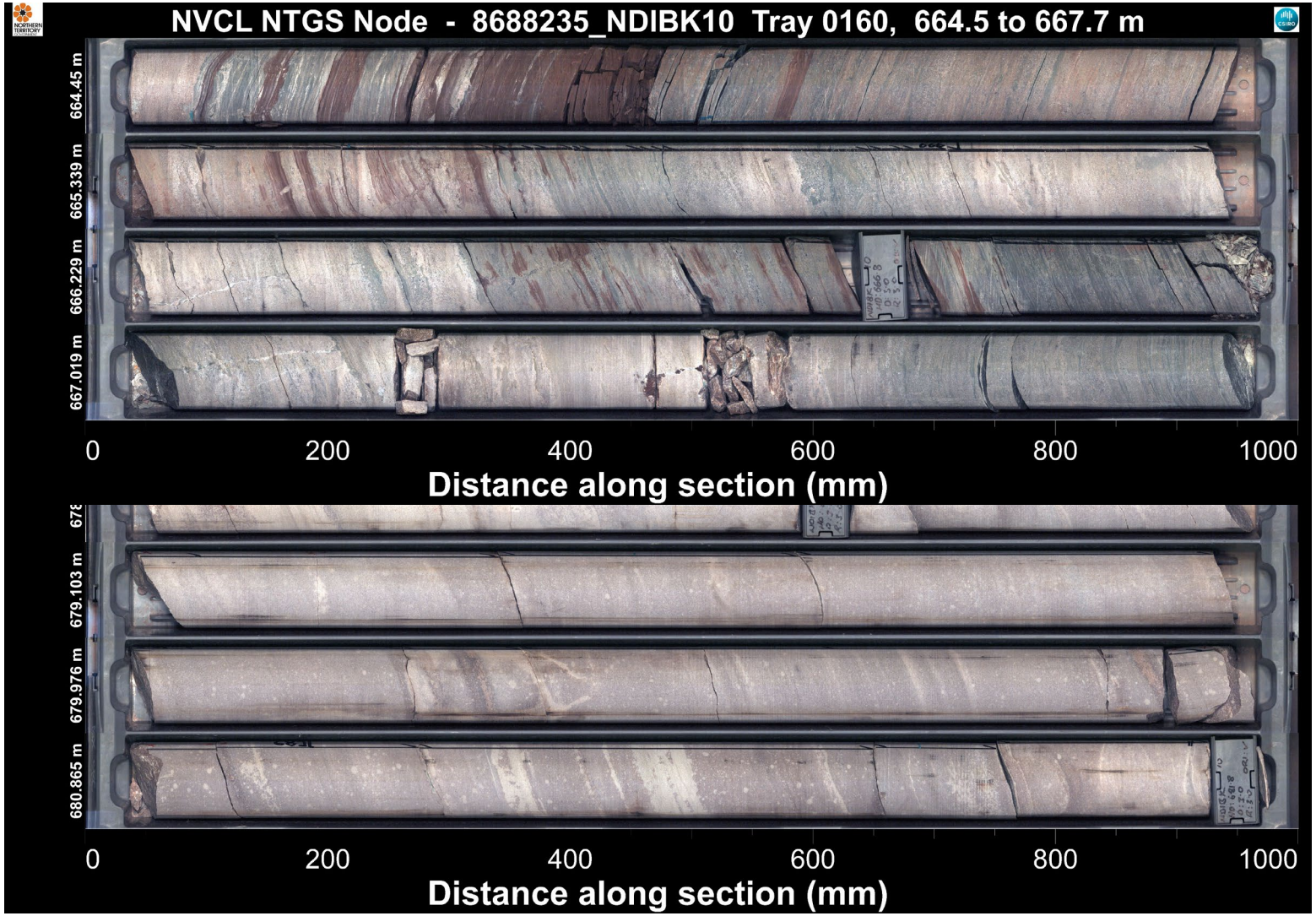

Clay
Silt
Vf Sand
F Sand
M Sand
C Sand
Vc Sand
Gravel
Pebble
Depth (m)
200
250
300
350
400
450
500
550
600
650
700
750
Georgina Basin
Helen Springs Volcanics
(511 Ma)
UNIT A
UNIT B
UNIT C
UNIT D
UNIT E
BASEMENT


NVCL NTGS Node - 8688235_NDIBK10 Tray 0135, 581.2 to 584.4 m
581.18 m
582.001 m
582.768 m
583.523 m
0
200
400
600
Distance along section (mm)

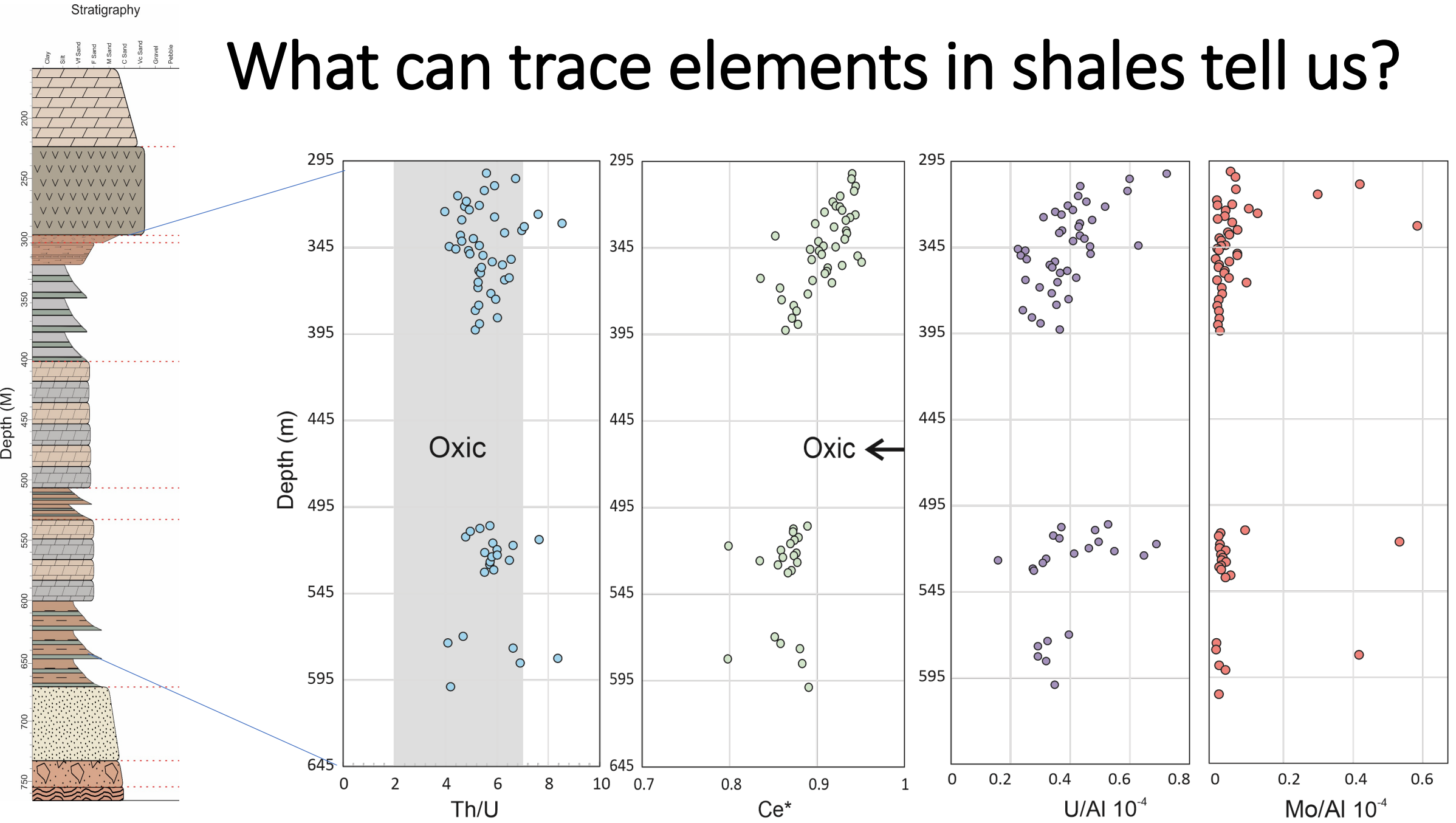


Unit E

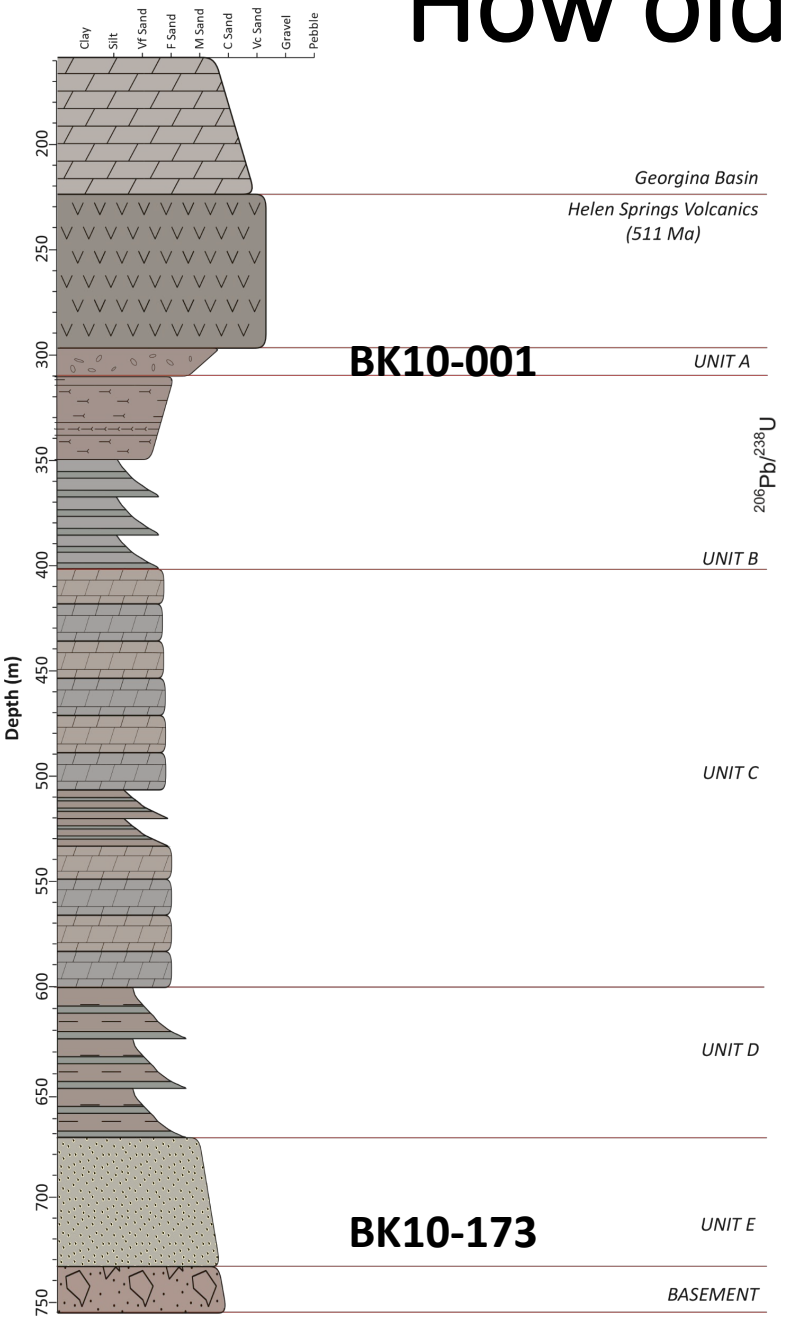

Clay
Silt
Vf Sand
F Sand
M Sand
C Sand
Vc Sand
Gravel
Pebble
Depth (m)
200
250
300
350
400
450
500
550
600
650
700
750
Georgina Basin
Helen Springs Volcanics
(511 Ma)
UNIT A
UNIT B
UNIT C
UNIT D
UNIT E
BASEMENT

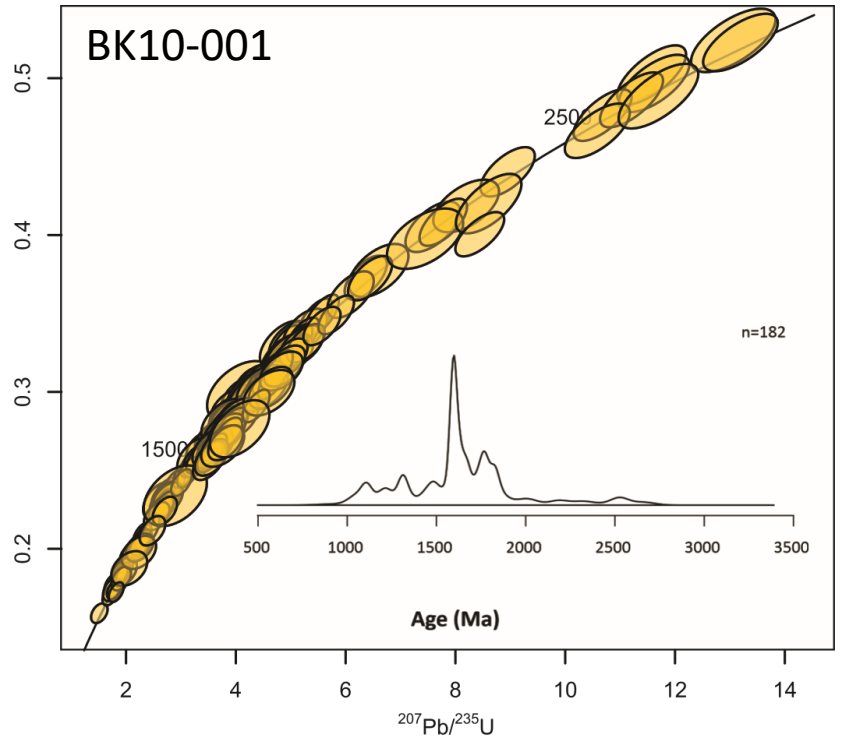

NVCL NTGS Node - 8688235_NDIBK10 Tray 0160, 664.5 to 667.7 m
664.45 m
665.339 m
666.229 m
667.019 m
0
200
400
600
800
1000
Distance along section (mm)
679.103 m
679.976 m
680.865 m
0
200
400
600
800
1000
Distance along section (mm)

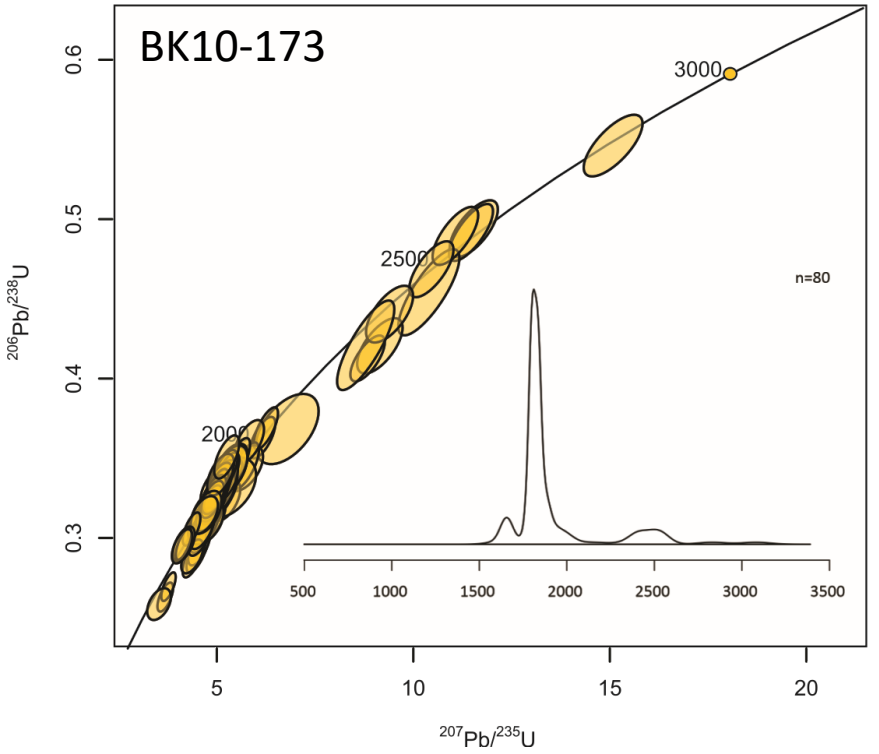
What can trace elements in shales tell us?



How old are the sediments of NDIBK10?







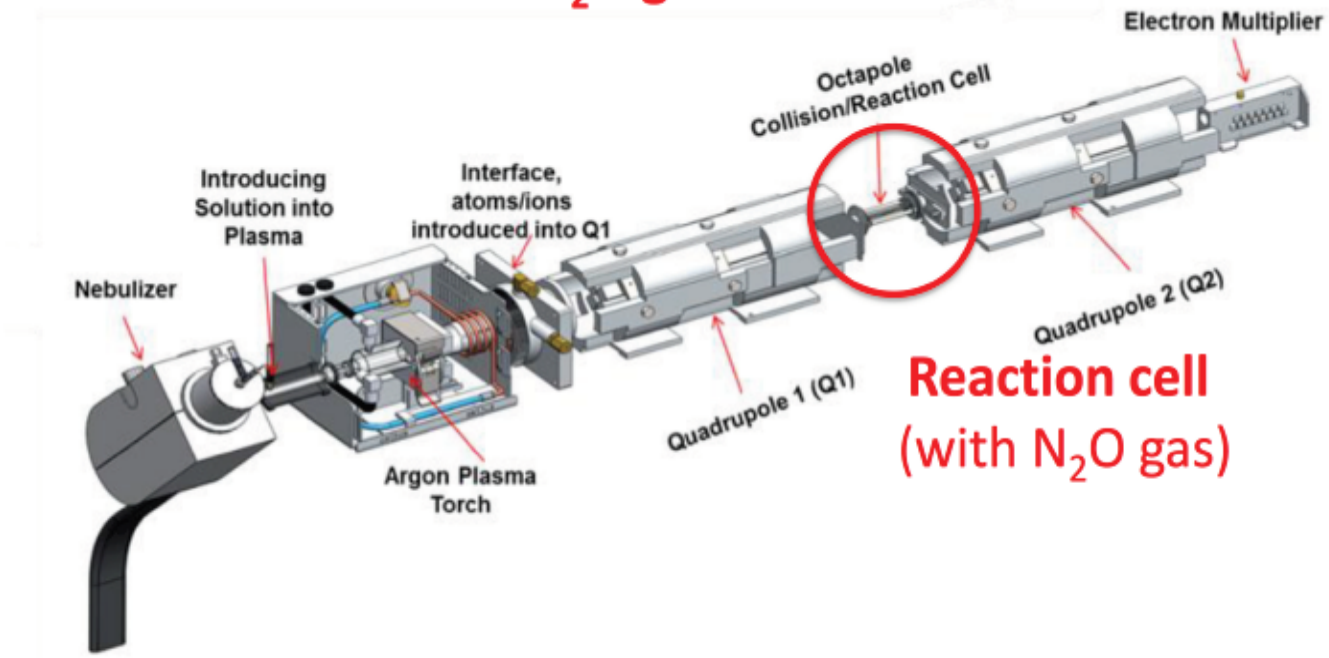
- **Maximum depositional age:** 902 ± 34 Ma (SG); 1021 ± 20 (MSWD=0.87, n=3)
- **Main peaks:** ca. 1100 – 1300 Ma, 1600 Ma, 1761 Ma

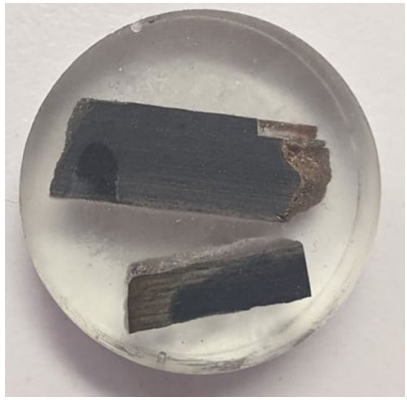
- **Maximum depositional age:** 1649 ± 37 Ma (SG) 1660 ± 11 Ma (MSWD = 0.97, n=11)
- **Main peaks:** ca. 1655 Ma, 1825 Ma, 2400 Ma

How else can we date these sediments?

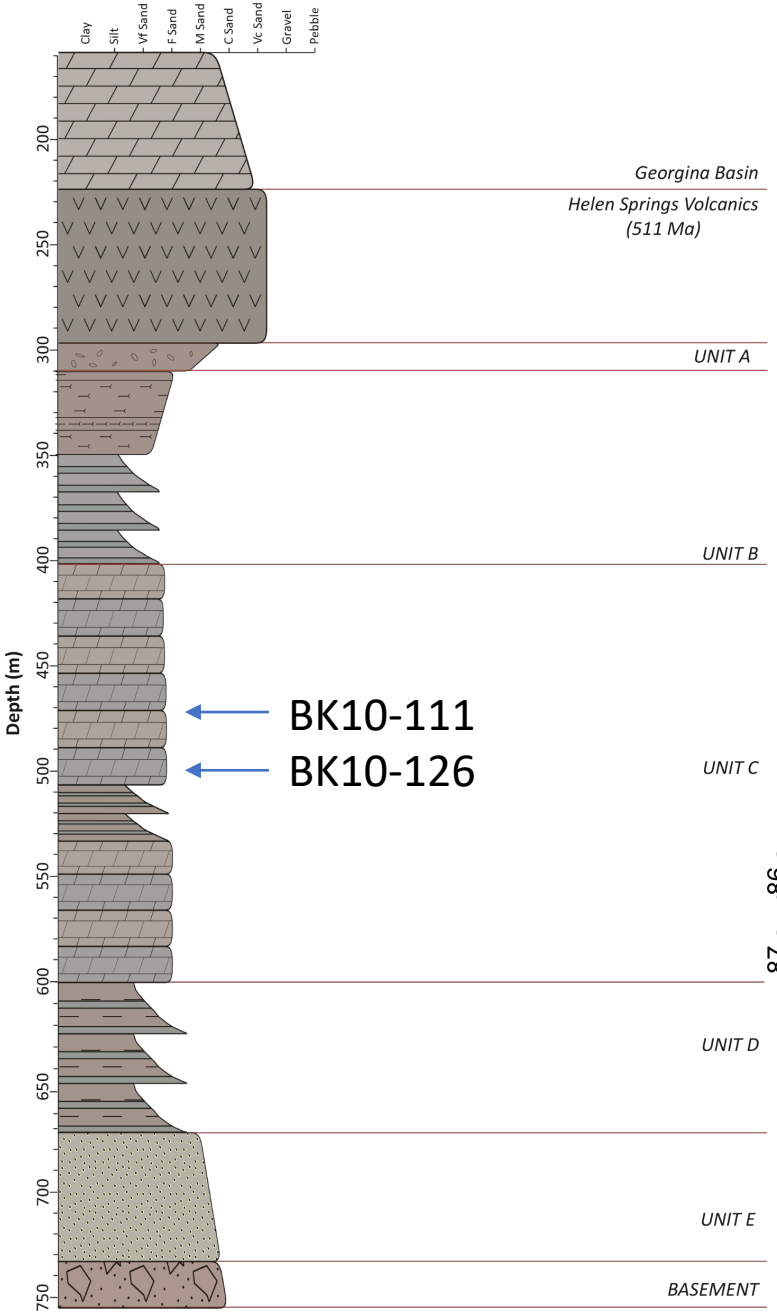
$^{87}_{37}Rb \rightarrow {}^{87}_{38}Sr + \beta^{-}$ *(beta decay)* with a half-life of 48.8 billion years

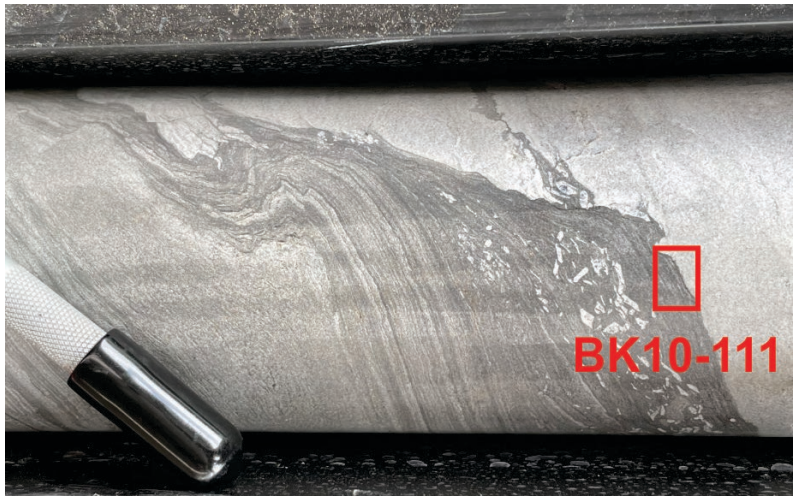
Rb does not react with N_2O gas but Sr does

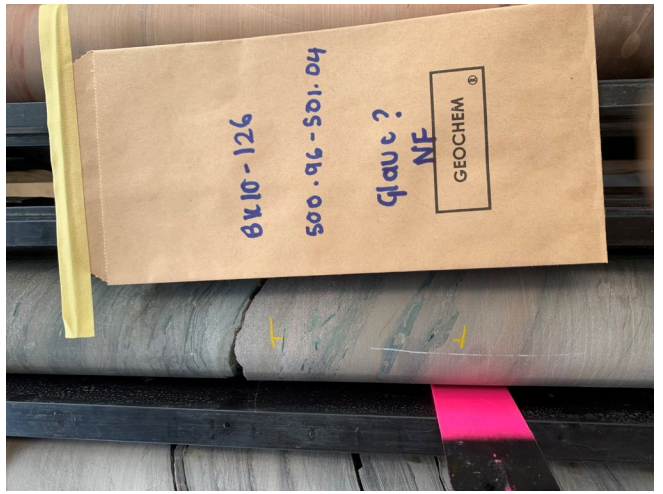




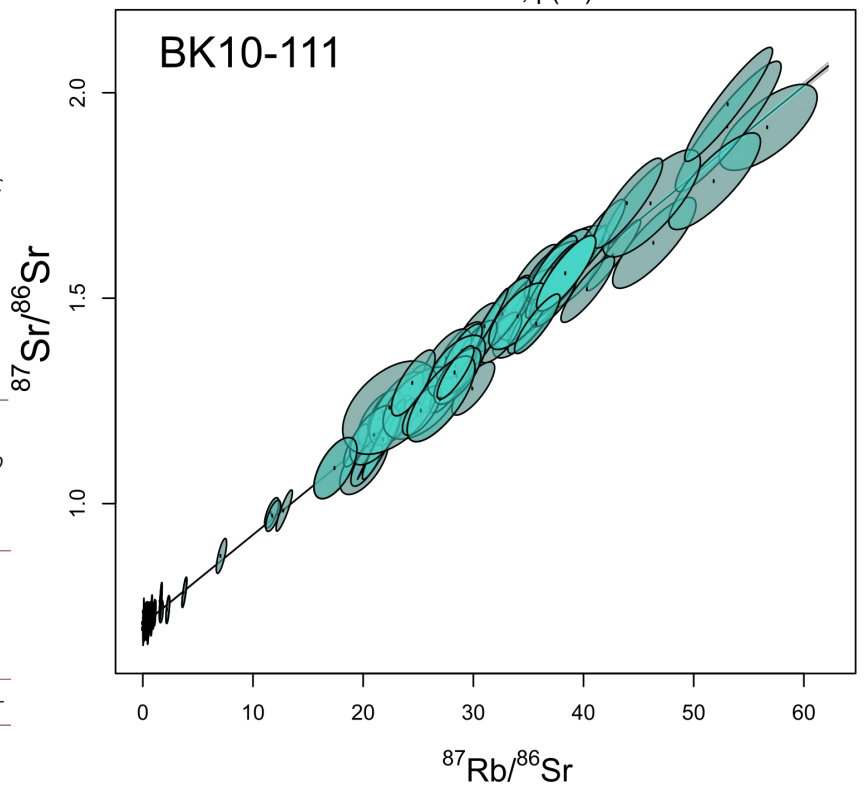
We can separate Sr from Rb in QQQ with N_2O gas, thus no need for column chemistry.
This means fast insitu analyses can be achieved through laser ablation!



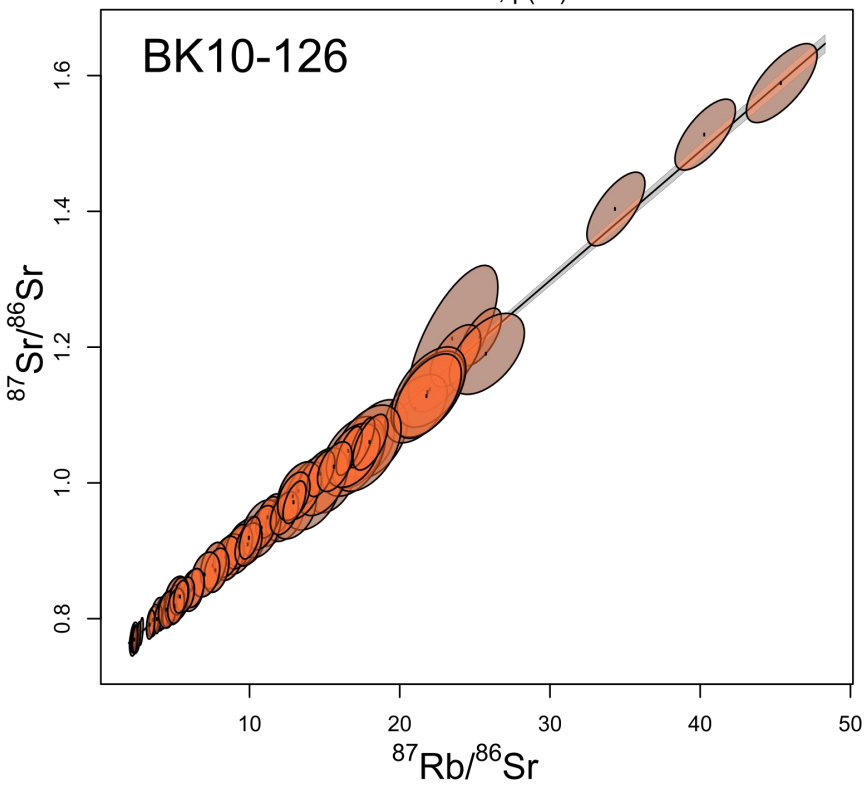


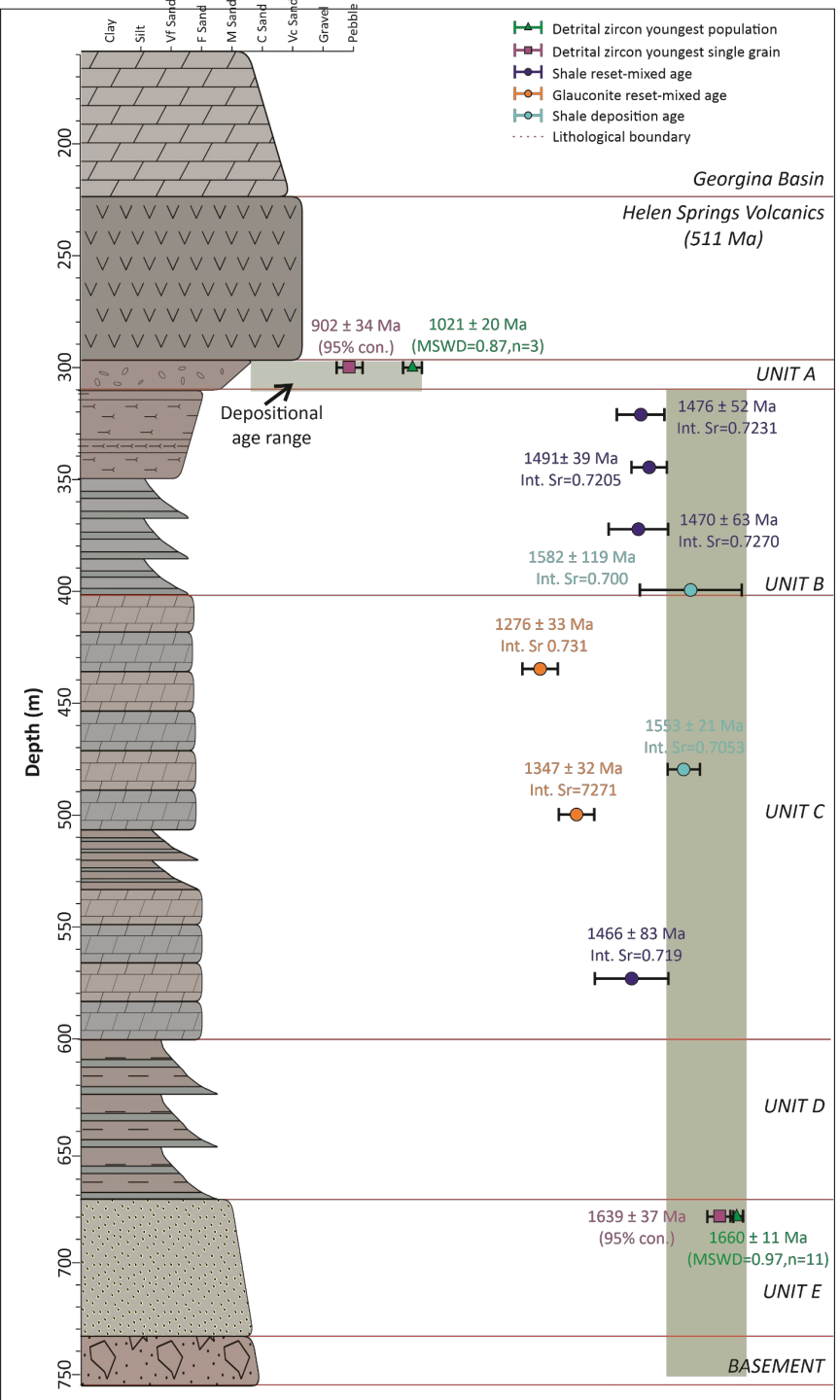


age = 1547.17 ± 6.44 | 12.74 | 18.33 Ma (n=127)
$(^{87}Sr/^{86}Sr)_o$ = 0.7057 ± 0.0017 | 0.0034 | 0.0048
MSWD = 2.1, $p(c^2)$= 2.3e−11

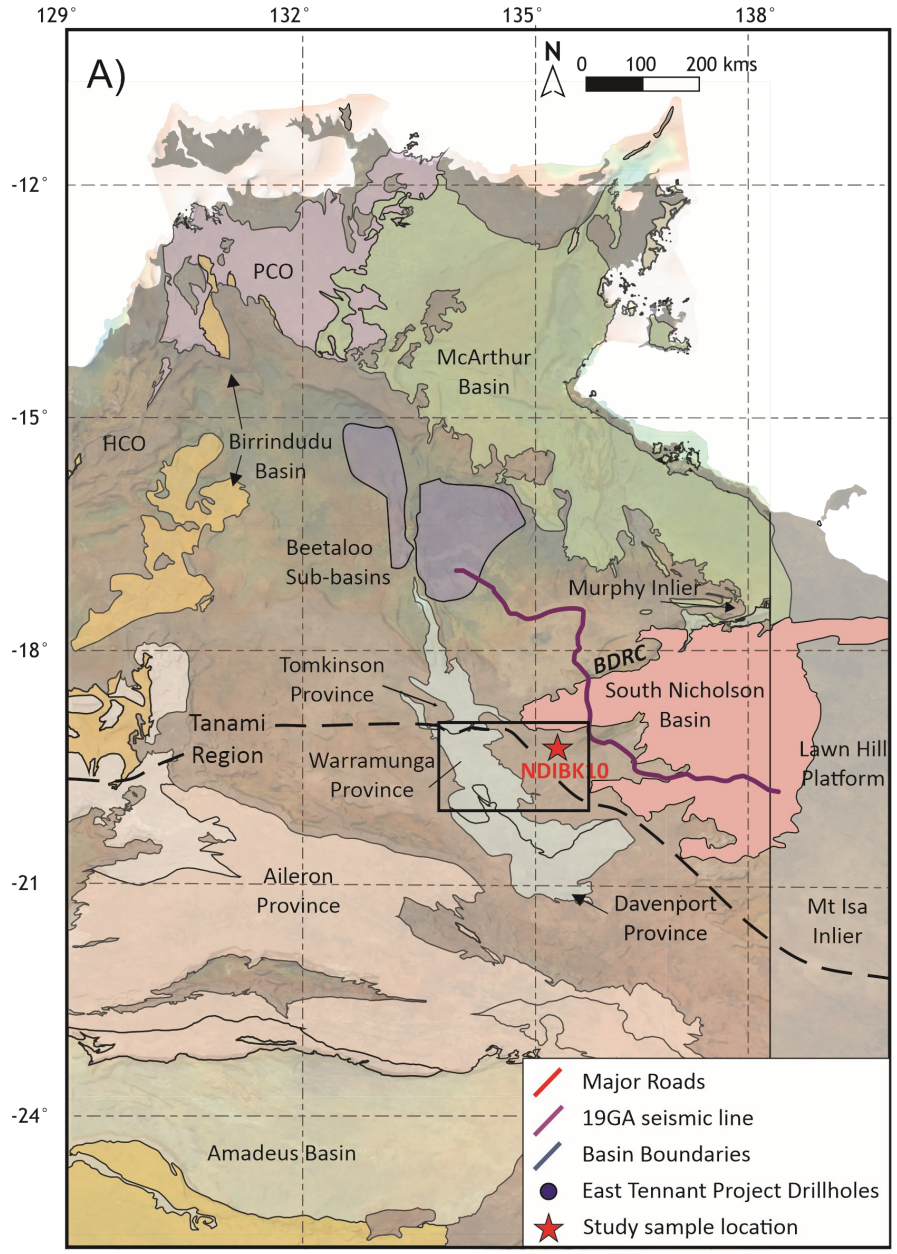


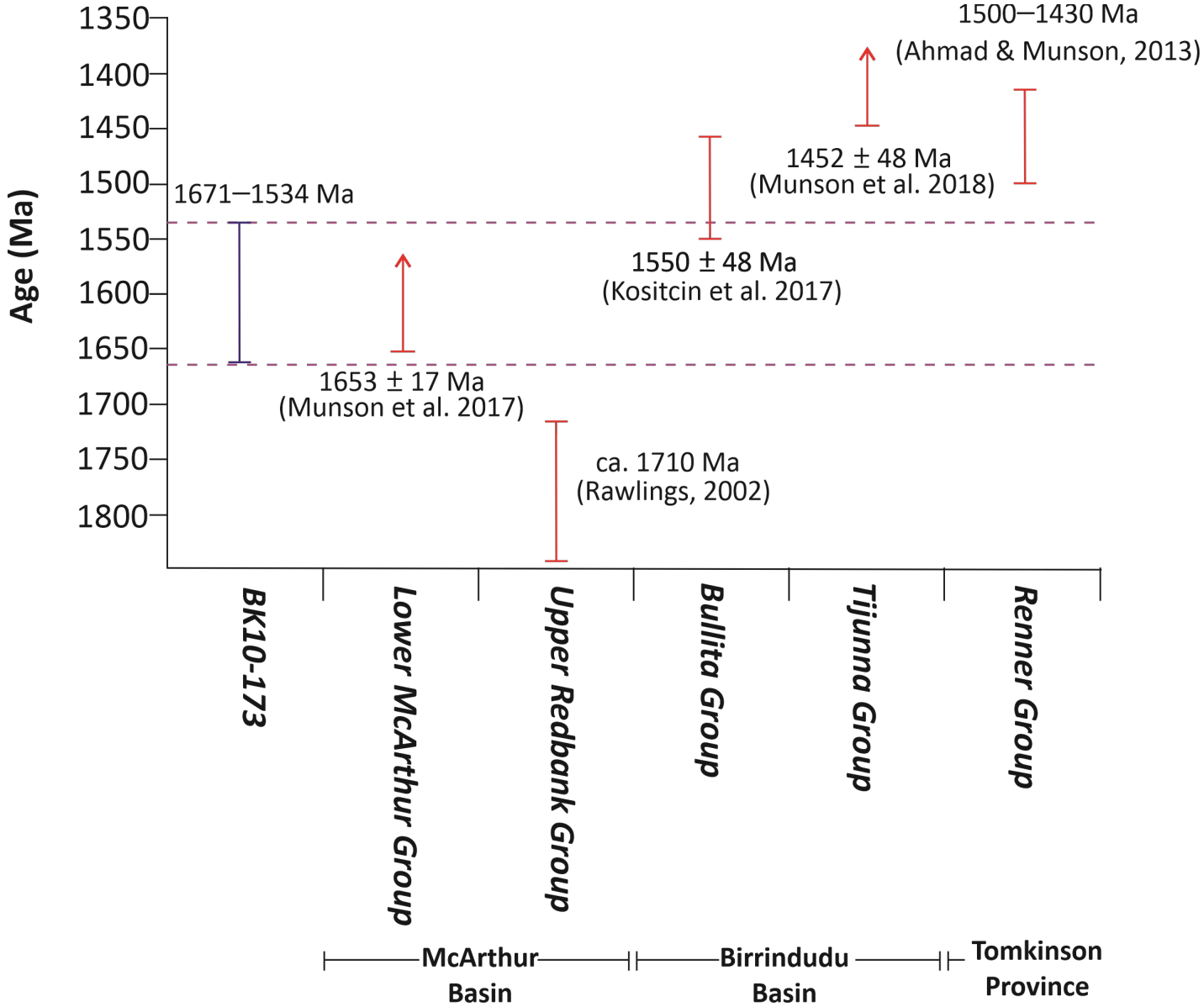
age = 1350.3 ± 11.7 | 23.1 Ma (n=127)
$(^{87}Sr/^{86}Sr)_o$ = 0.7268 ± 0.0016 | 0.0032
MSWD = 0.22, $p(c^2)$= 1

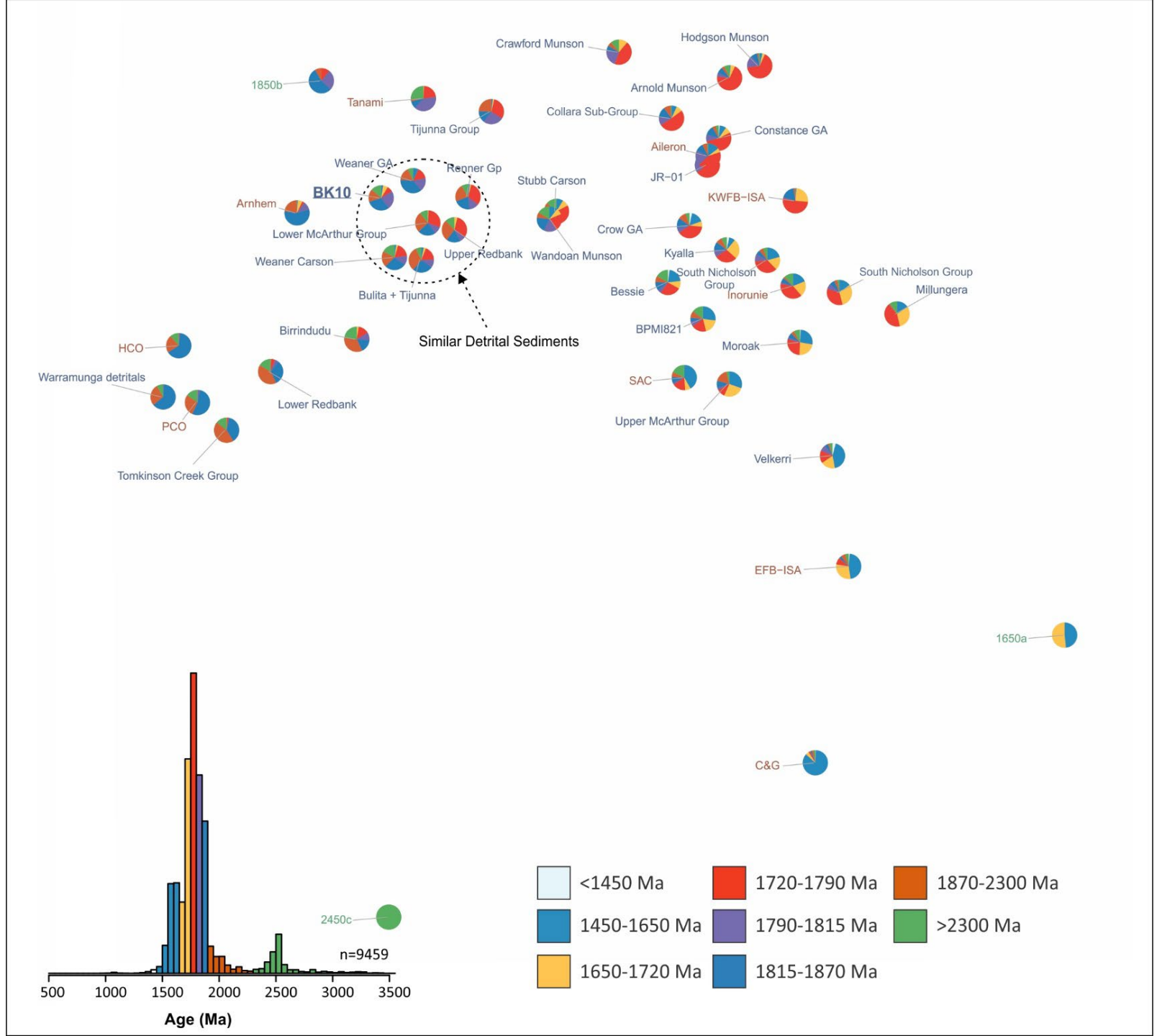


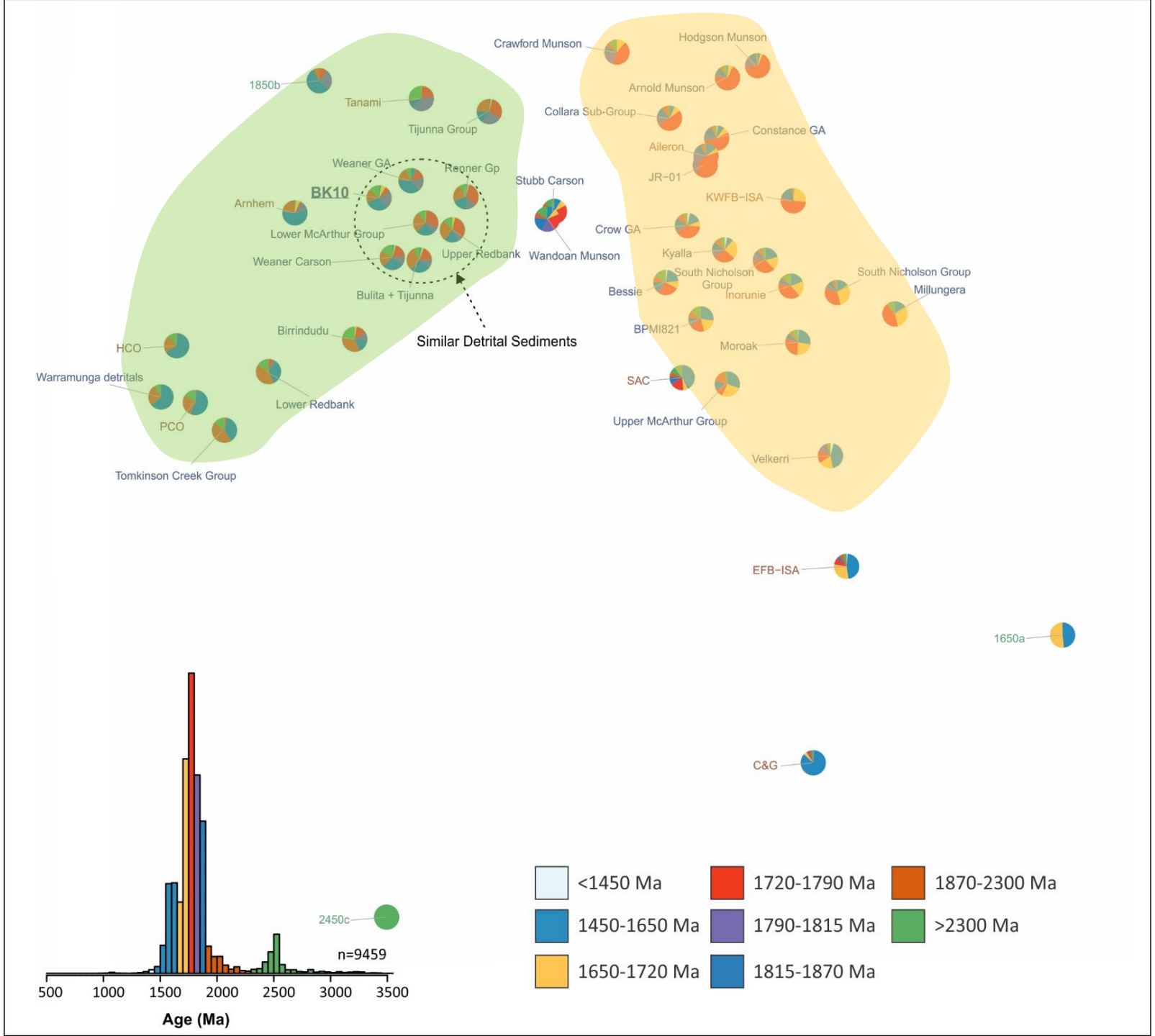


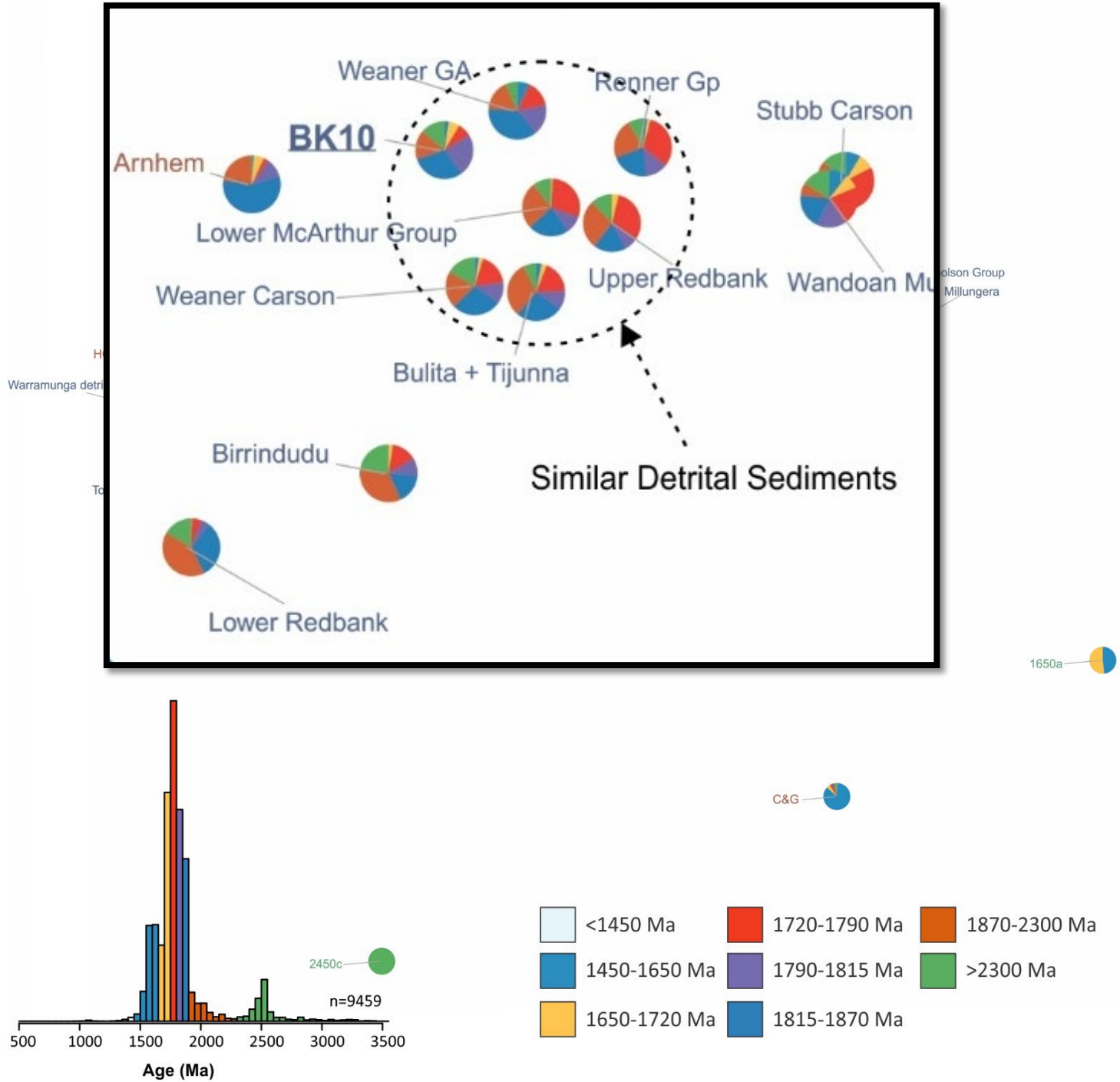
- Unit A is somewhere between ca. 902 and 511 Ma.
- Units B-E the depositional window between ca. 1671 – 1532 Ma.


A)
N
0 100 200 kms
129°
132°
135°
138°
-12°
-15°
-18°
-21°
-24°
PCO
McArthur Basin
HCO
Birrindudu Basin
Beetaloo Sub-basins
Murphy Inlier
BDRC
Tomkinson Province
South Nicholson Basin
Tanami Region
Warramunga Province
NDIBK10
Lawn Hill Platform
Aileron Province
Davenport Province
Mt Isa Inlier
Amadeus Basin
Major Roads
19GA seismic line
Basin Boundaries
East Tennant Project Drillholes
Study sample location


Age (Ma)
1350
1400
1450
1500
1550
1600
1650
1700
1750
1800
1500–1430 Ma
(Ahmad & Munson, 2013)
1452 ± 48 Ma
(Munson et al. 2018)
1671–1534 Ma
1550 ± 48 Ma
(Kositcin et al. 2017)
1653 ± 17 Ma
(Munson et al. 2017)
ca. 1710 Ma
(Rawlings, 2002)
BK10-173
Lower McArthur Group
Upper Redbank Group
Bullita Group
Tijunna Group
Renner Group
McArthur Basin
Birrindudu Basin
Tomkinson Province


Crawford Munson
Hodgson Munson
Arnold Munson
1850b
Tanami
Tijunna Group
Collara Sub-Group
Constance GA
Aileron
JR−01
Weaner GA
Renner Gp
BK10
Stubb Carson
KWFB−ISA
Arnhem
Lower McArthur Group
Upper Redbank
Wandoan Munson
Crow GA
Kyalla
Weaner Carson
Bulita + Tijunna
South Nicholson Group
Bessie
Inorunie
South Nicholson Group
Millungera
Similar Detrital Sediments
BPMI821
Birrindudu
HCO
Moroak
Warramunga detritals
Lower Redbank
SAC
PCO
Upper McArthur Group
Tomkinson Creek Group
Velkerri
EFB−ISA
1650a
C&G
2450c
n=9459
500
1000
1500
2000
2500
3000
3500
Age (Ma)
<1450 Ma
1720-1790 Ma
1870-2300 Ma
1450-1650 Ma
1790-1815 Ma
>2300 Ma
1650-1720 Ma
1815-1870 Ma


Crawford Munson
Hodgson Munson
Arnold Munson
Collara Sub-Group
Constance GA
Aileron
JR−01
KWFB−ISA
Crow GA
Kyalla
South Nicholson Group
Bessie
Inorunie
South Nicholson Group
Millungera
BPMI821
Moroak
SAC
Upper McArthur Group
Velkerri
1850b
Tanami
Tijunna Group
Weaner GA
Regner Gp
BK10
Arnhem
Lower McArthur Group
Upper Redbank
Weaner Carson
Bulita + Tijunna
Stubb Carson
Wandoan Munson
Similar Detrital Sediments
Birrindudu
HCO
Warramunga detritals
Lower Redbank
PCO
Tomkinson Creek Group
EFB−ISA
1650a
C&G
2450c
n=9459
500
1000
1500
2000
2500
3000
3500
Age (Ma)
<1450 Ma
1450-1650 Ma
1650-1720 Ma
1720-1790 Ma
1790-1815 Ma
1815-1870 Ma
1870-2300 Ma
>2300 Ma


Weaner GA
Renner Gp
Stubb Carson
BK10
Arnhem
Lower McArthur Group
Upper Redbank
Weaner Carson
Wandoan Mu
olson Group
Millungera
Bulita + Tijunna
Similar Detrital Sediments
Birrindudu
Lower Redbank
1650a
C&G
2450c
n=9459
500
1000
1500
2000
2500
3000
3500
Age (Ma)
<1450 Ma
1450-1650 Ma
1650-1720 Ma
1720-1790 Ma
1790-1815 Ma
1815-1870 Ma
1870-2300 Ma
>2300 Ma

Conclusions:

- Unit A is separated from the rest of the sequence and has a depositional window between **902 Ma** and **511 Ma**
- A depositional window between **1532 Ma** and **1671 Ma** was established from Unit B to E using U–Pb and Rb–Sr ages
- Sediments most likely correlate to the **Favenc Package** of the McArthur Basin.
- This sedimentary package is comprised of turbidites, carbonates and sands; and overall can be interpreted to represent two main transgressions whereby these sediments were deposited in a relatively **oxic** environment.