THE PROVENANCE OF GLACIAL TILL DEPOSITED IN ONG VALLEY, CENTRAL TRANSANTARCTIC MOUNTAINS DETERMINED BY LA–ICP–MS OF DETRITAL ZIRCON

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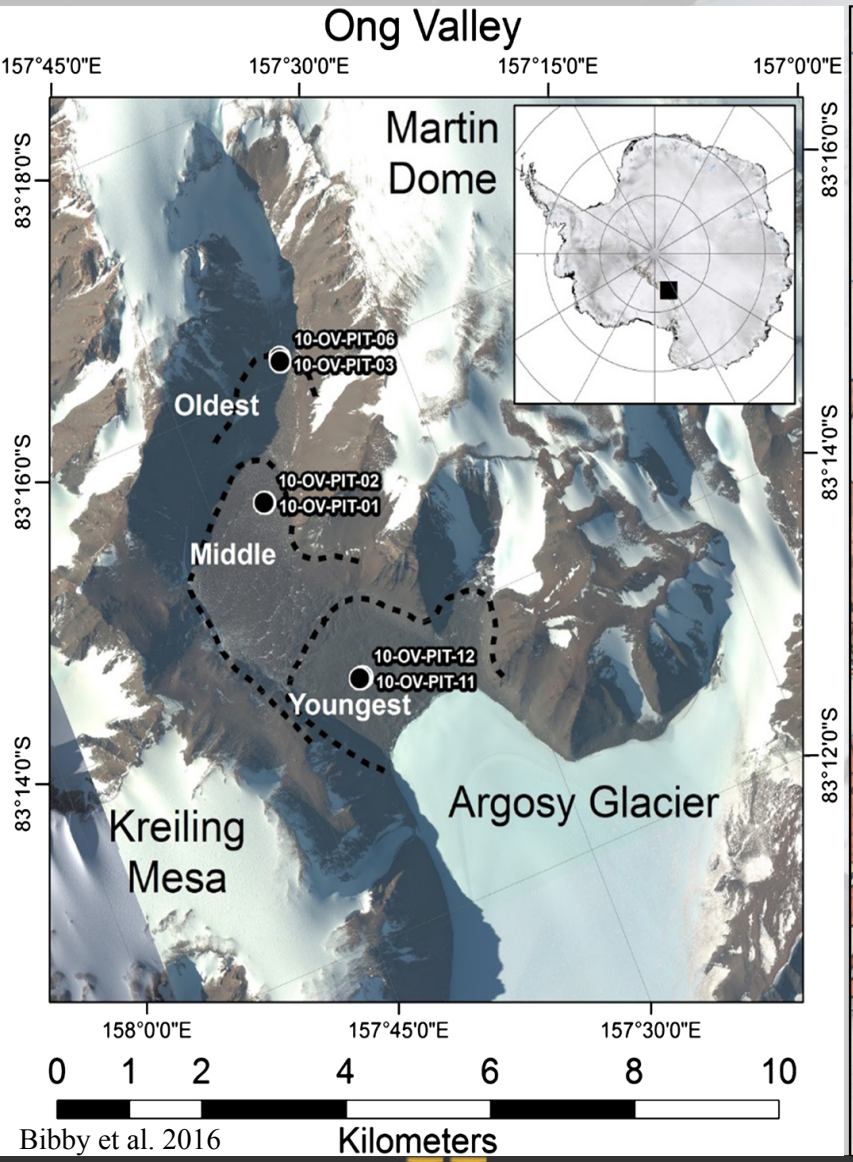
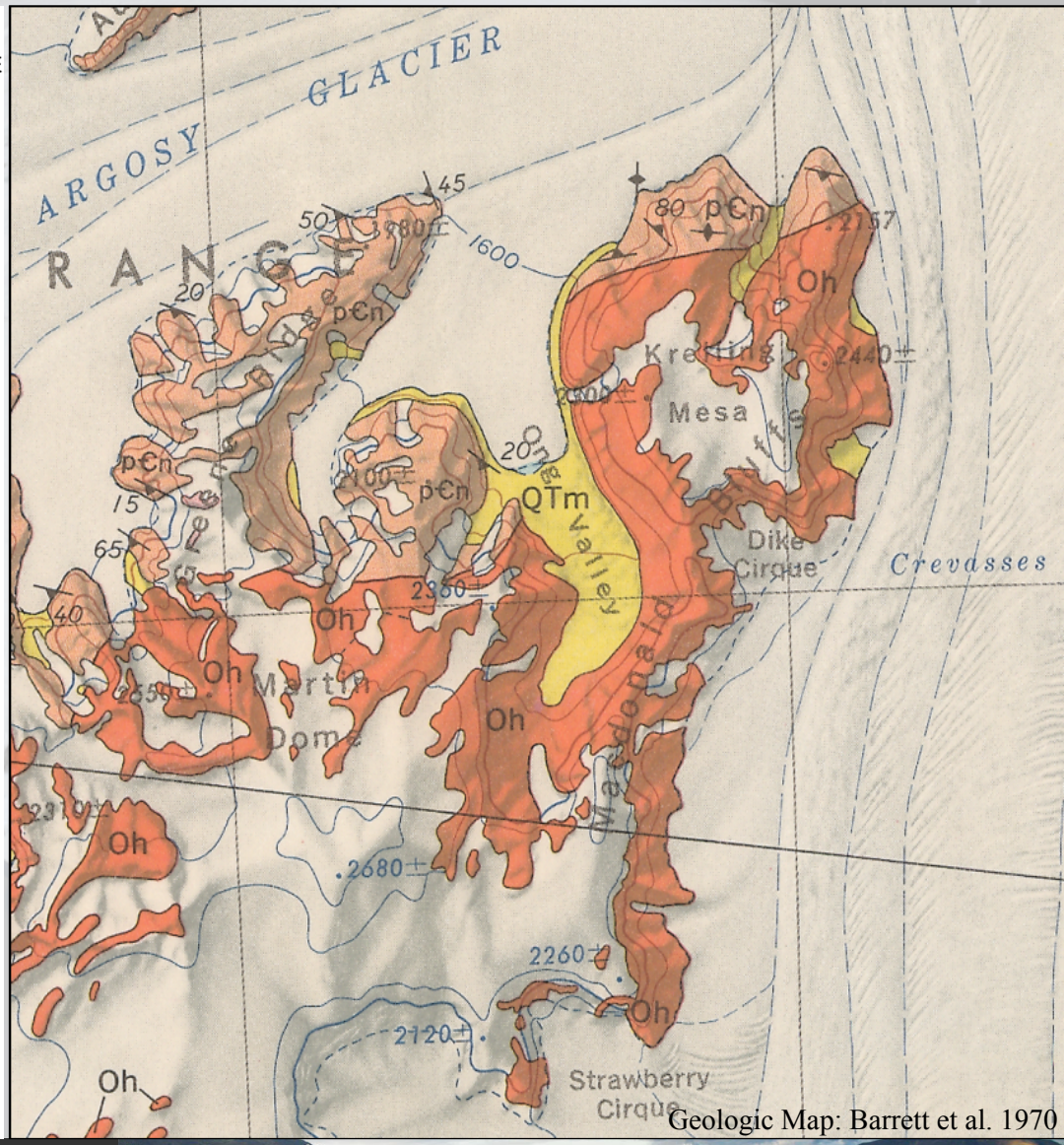
Ong Valley: Location and Geology



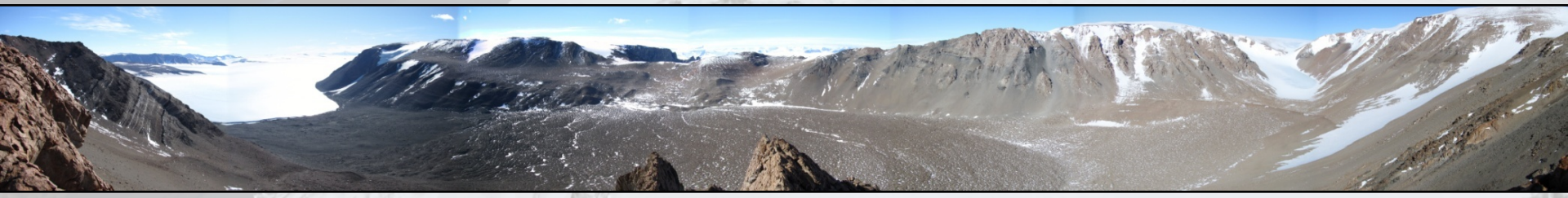
Bibby et al. 2016



Geologic Map: Barrett et al. 1970

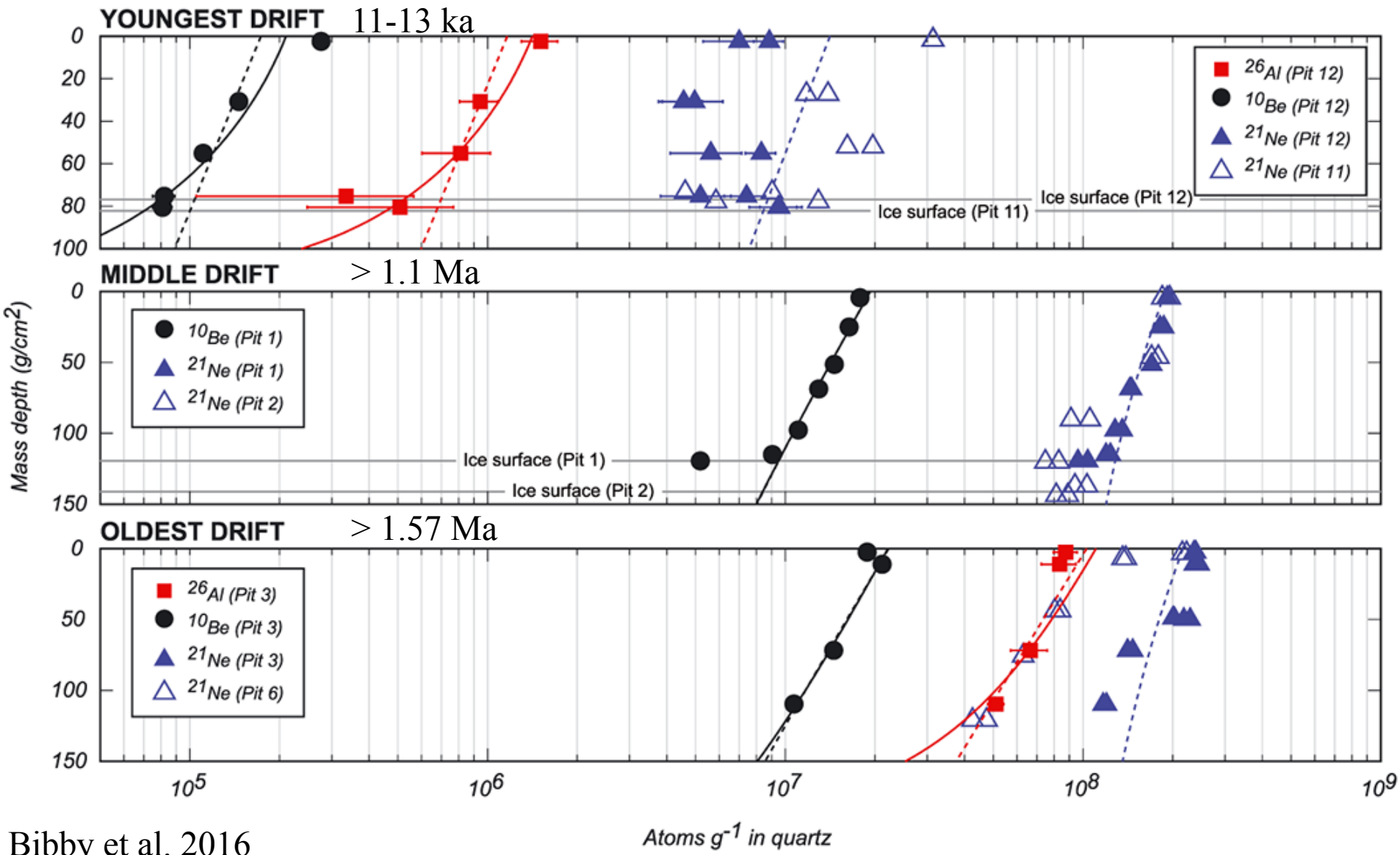
Motivating Questions:

- How old are the glacial deposits in Antarctic Dry Valleys?
- What was the former extent of past glaciation?



- **What is the provenance of these glacial tills?**
- Has the source changed over time?
- Will the combination of cosmogenic nuclides and zircon ages prove useful in this geologic setting?

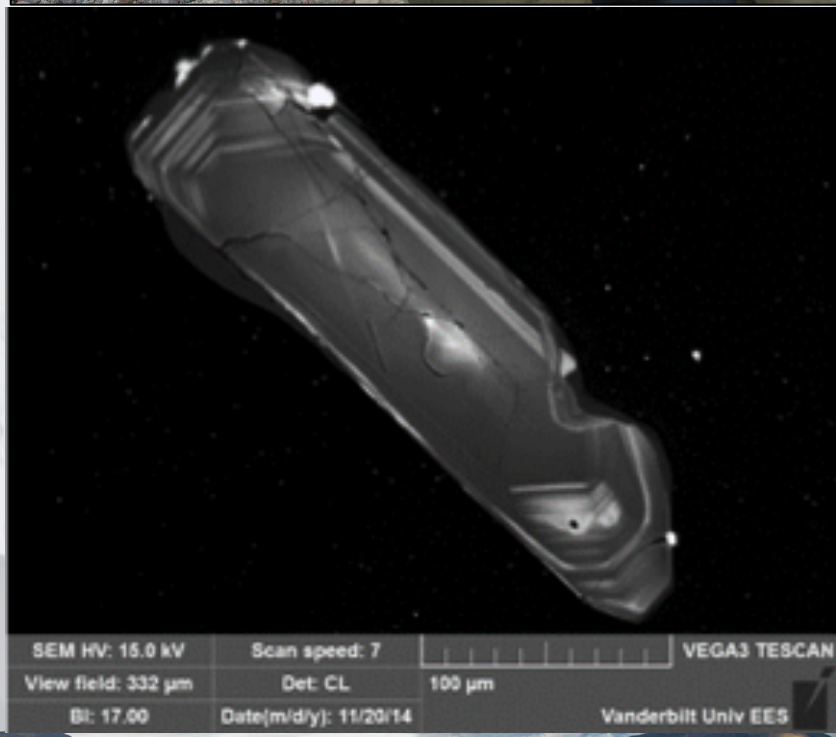
Till Ages – Cosmogenic Nuclide Exposure Dates



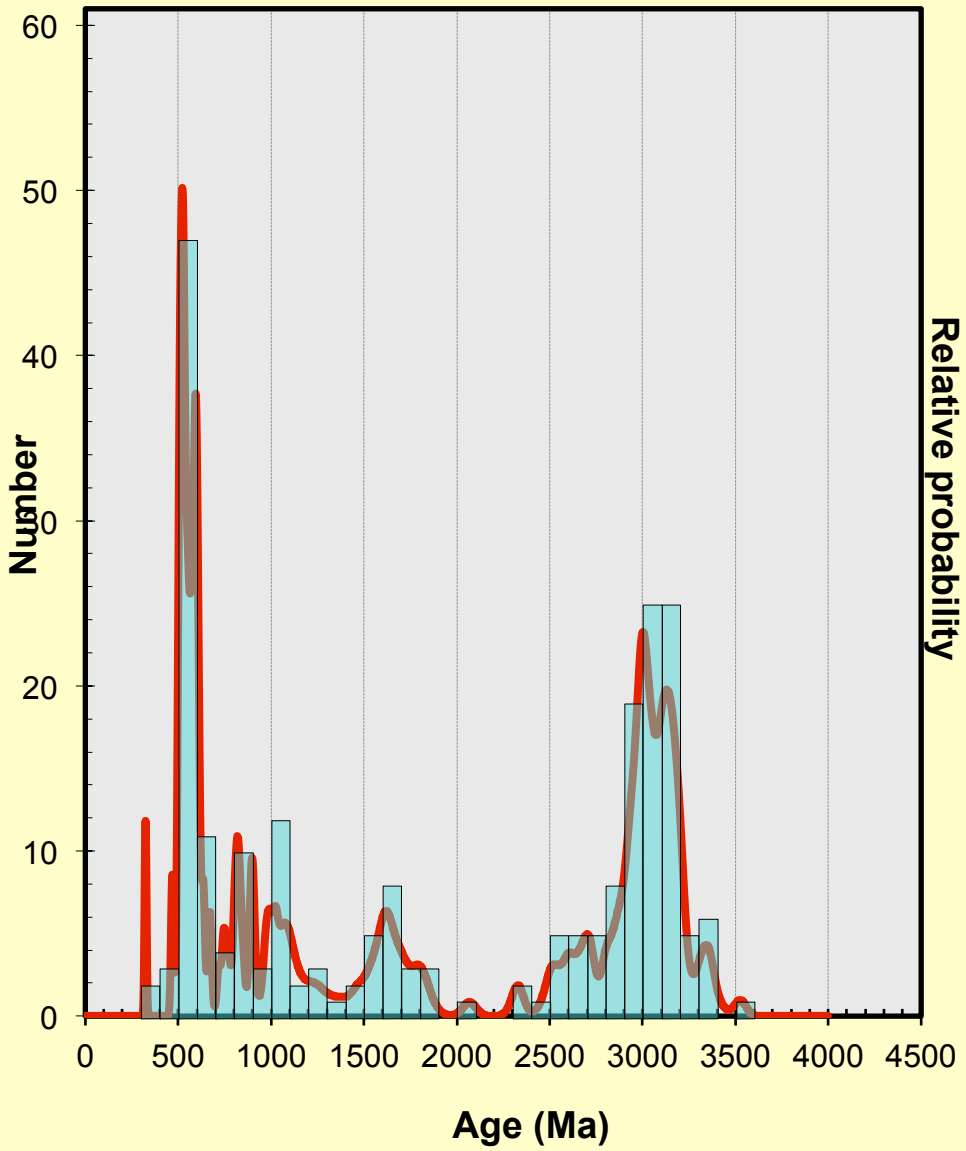
Bibby et al. 2016

Methods:

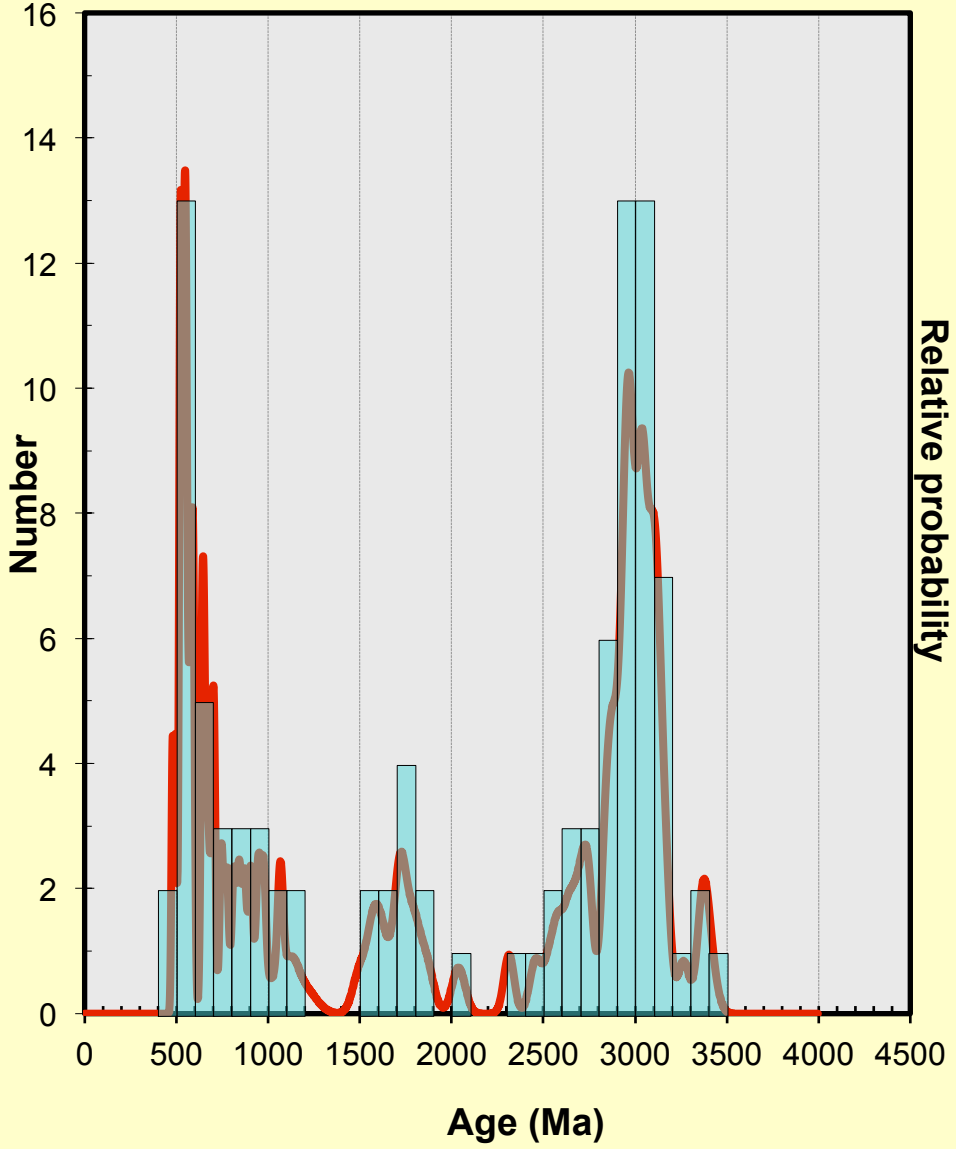
- Extract bulk sedimentary samples
  - Sieve, hand wash + sonic-bath
- 5% HNO_3+ 5% HCl pre-treatment*
- Hand magnet => remove magnetite
- Density separation
  - LST Heavy Liquid [2.85g/cm^3]
  - Heavy-mineral fraction
- Frantz Magnetic Separator
  - Up to >1.6amps
  - Non-magnetic samples
- Acid purification treatment – HNO_3 + HF + HCl*
- Hand pick zircon grains => mount in epoxy disk
- Grind, polish and carbon coat the mount => SEM
- Determine mineral identity using BSE detector
- Image grains using Gatan MonoCL detector
- *In situ* analysis by LA-ICP-MS
- Data reduction using Glitter
  - U238/Pb206, U235/Pb207, Pb206/Pb207*



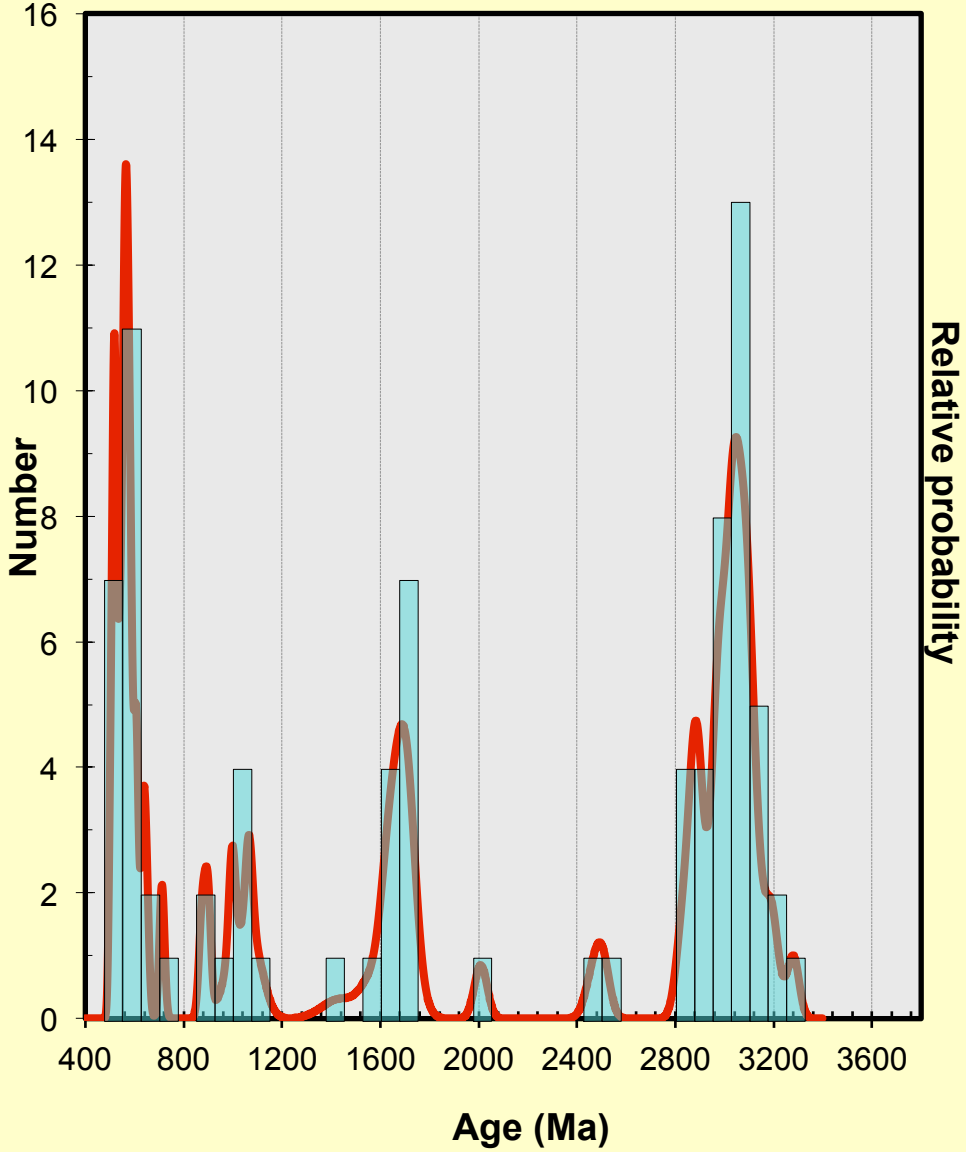
OLD UNIT (Pits 5 & 6), n = 225

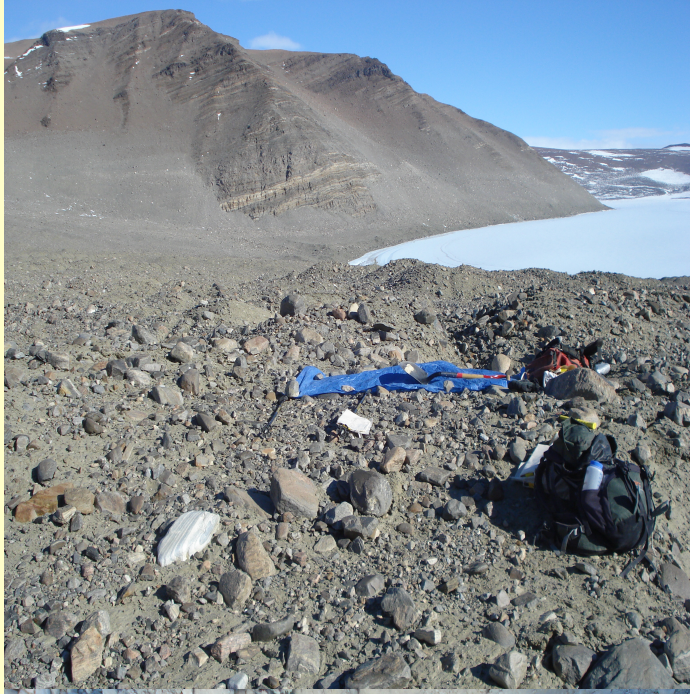


MIDDLE UNIT (Pits 1 & 2), n = 97

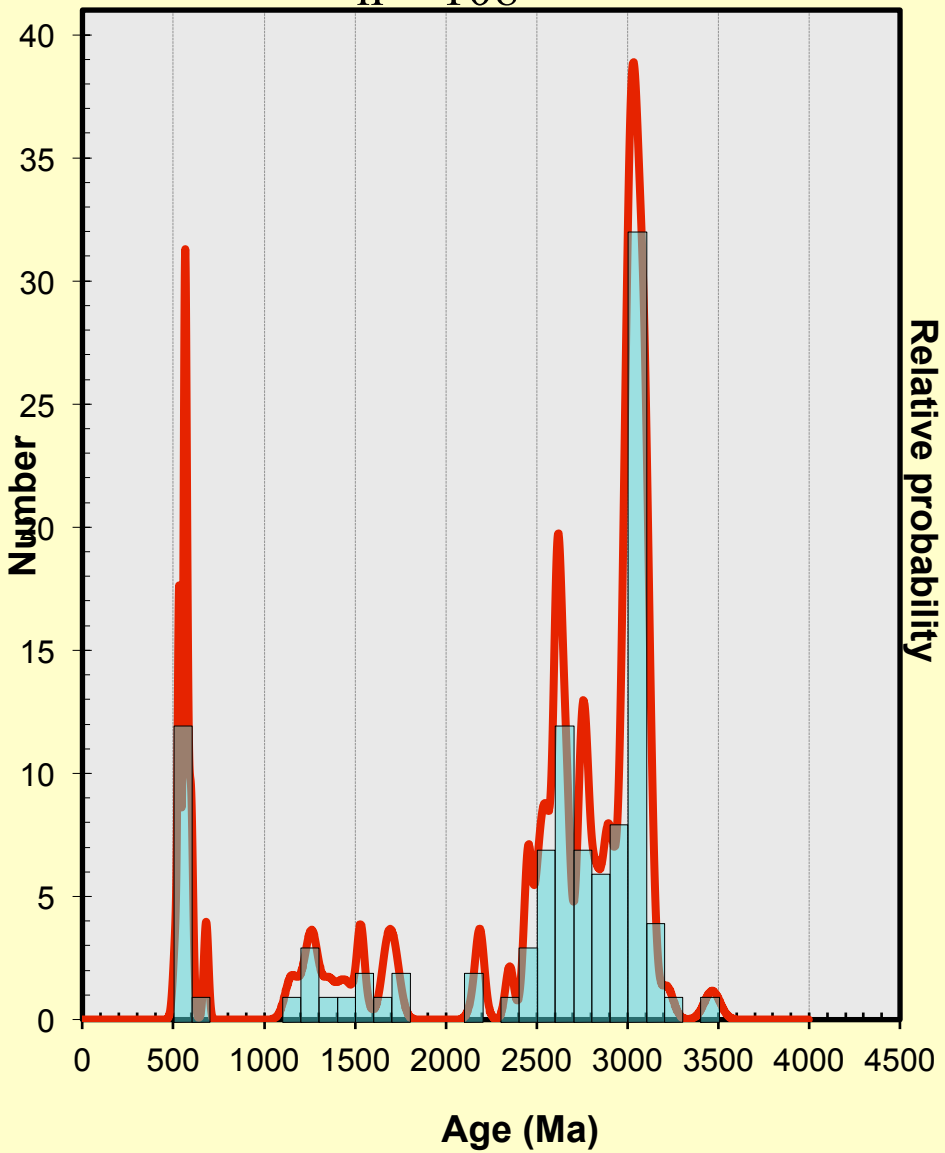


YOUNG UNIT (Pits 11 & 12), n = 82





ICE BELOW YOUNG UNIT (Pits 11ice & 12ice), n = 108



ISOPLOT – UNMIX AGES

OLD

Age	±2s	fraction	±2s
550	2.2	0.27	0.07
847.1	5.3	0.14	0.05
1614.9	17	0.11	0.04
2397	36	0.03	0.02
2750.2	19	0.09	0.04
3092.9	6.9	0.36	---

relative misfit = 3648.180

MIDDLE

Age	±2s	fraction	±2s
564.3	3.6	0.22	0.09
870	7.9	0.12	0.07
1694	22	0.10	0.07
2291	43	0.03	0.04
2765.5	16	0.14	0.08
3057.9	9.1	0.38	---

relative misfit = 1972.815

YOUNG

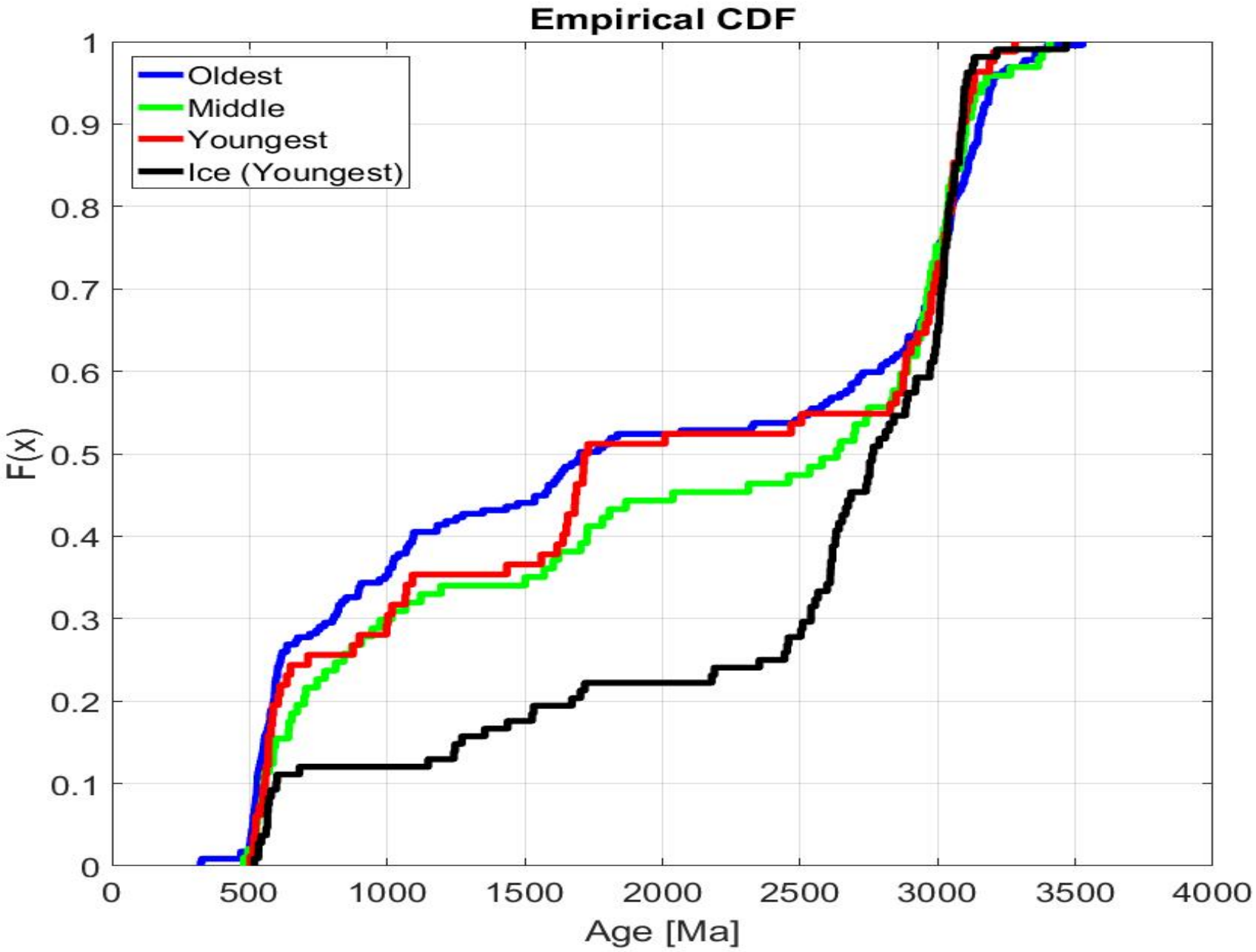
Age	±2s	fraction	±2s
561.8	3.7	0.26	0.11
958.8	13	0.10	0.07
1666	21	0.16	0.09
2008	52	0.01	0.02
2489	43	0.02	0.03
3022.7	8.8	0.45	---

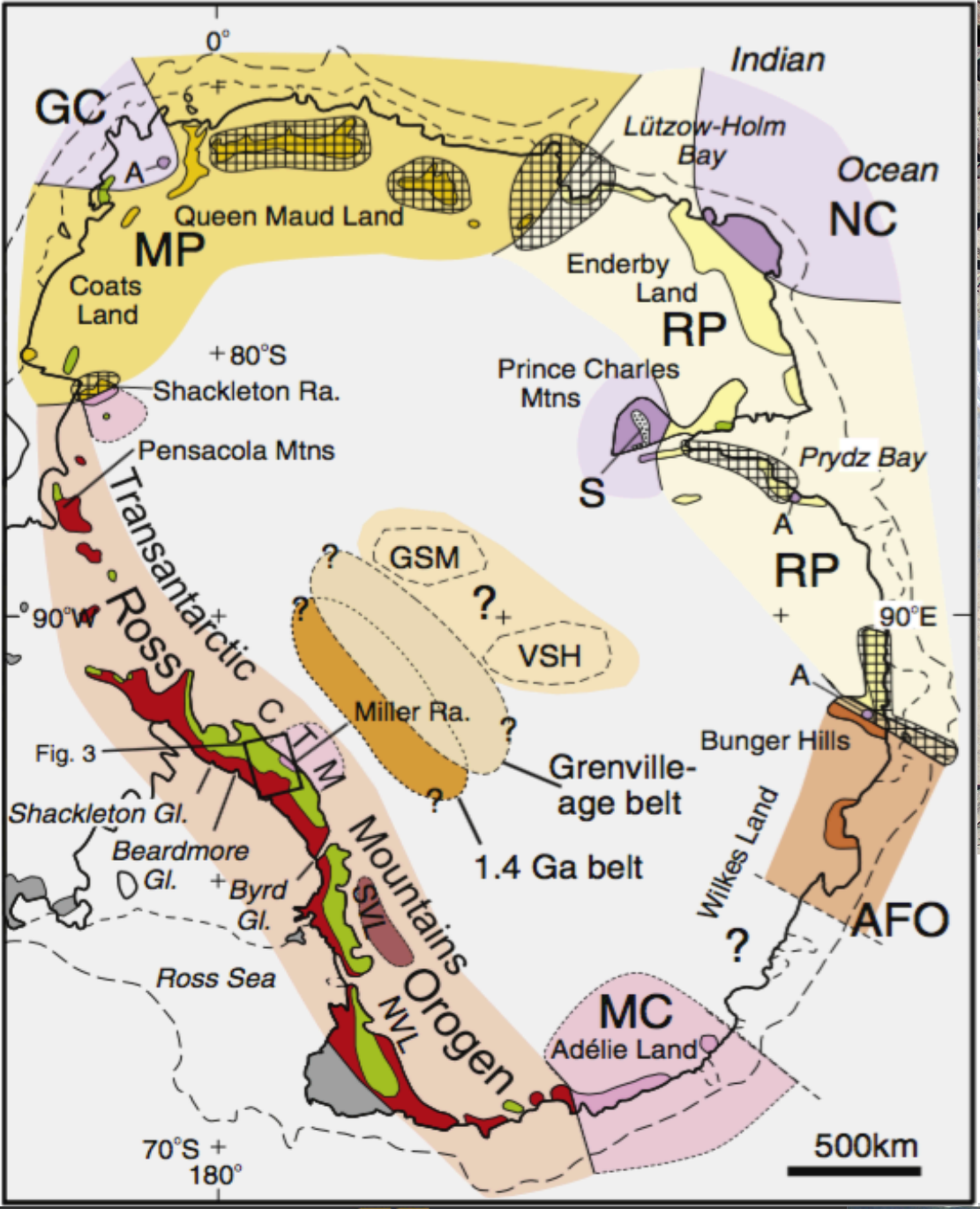
relative misfit = 1116.946

ICE

Age	±2s	fraction	±2s
565.4	5.2	0.12	0.07
1387	23	0.07	0.05
1694	43	0.03	0.03
2402.9	20	0.07	0.05
2666.5	9.5	0.25	0.10
3038.8	7.6	0.45	---

relative misfit = 1209.313


Empirical CDF
Oldest
Middle
Youngest
Ice (Youngest)
F(x)
Age [Ma]
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
500
1000
1500
2000
2500
3000
3500
4000



Gondwana sequence (Late Devonian to Early Jurassic)

Ross Orogen (Late Neoproterozoic to Early Ordovician: 560-480 Ma)

Late Neoproterozoic-Early Ordovician Gondwana active margin (600-480 Ma)

Pan-African belts (650-500 Ma)

Neoproterozoic arc (inferred; ca. 650 Ma)

Maud Province (Grenville-age: 1160-1030 Ma)

Rayner Province (Grenville-age: 990-900 Ma)

Possible Grenville-age terrain (1080-990 Ma)

Albany-Fraser Orogen (Grenville-age: 1.4-1.1 Ga)

Sodruzhestvo Group (S) (detrital zircons: 1170-970 Ma)

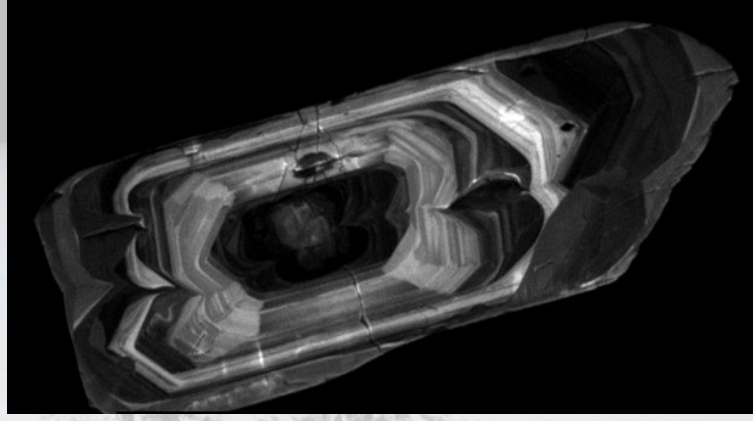
Archean-lower Mesoproterozoic (3.0-1.5 Ga)

A Archean to Paleoproterozoic craton (3.2-1.8 Ga)

Undifferentiated bedrock

D.H. Elliot et al. 2015

In Summary:



- Recovered over 500 zircon grains from:
  - Bulk sedimentary samples
  - Large chunks of ice
- There is a similar population distribution for all three of our tills
  - Suggests flow patterns haven't changed in >1.57 million years
- Ice from below the young unit is missing grains from ~600-1200Ma
  - Inferred that this is due to a lack of aeolian input
- The pairing of U/Pb and Pb/Pb ages of zircon with cosmogenic nuclide exposure ages is a useful method for determining
  - Provenance data
  - If glacial flow patterns have changed over time
- We will continue to collect and analyze zircon until we have ≥120 grains per sedimentary unit; measure grain size (SEM)