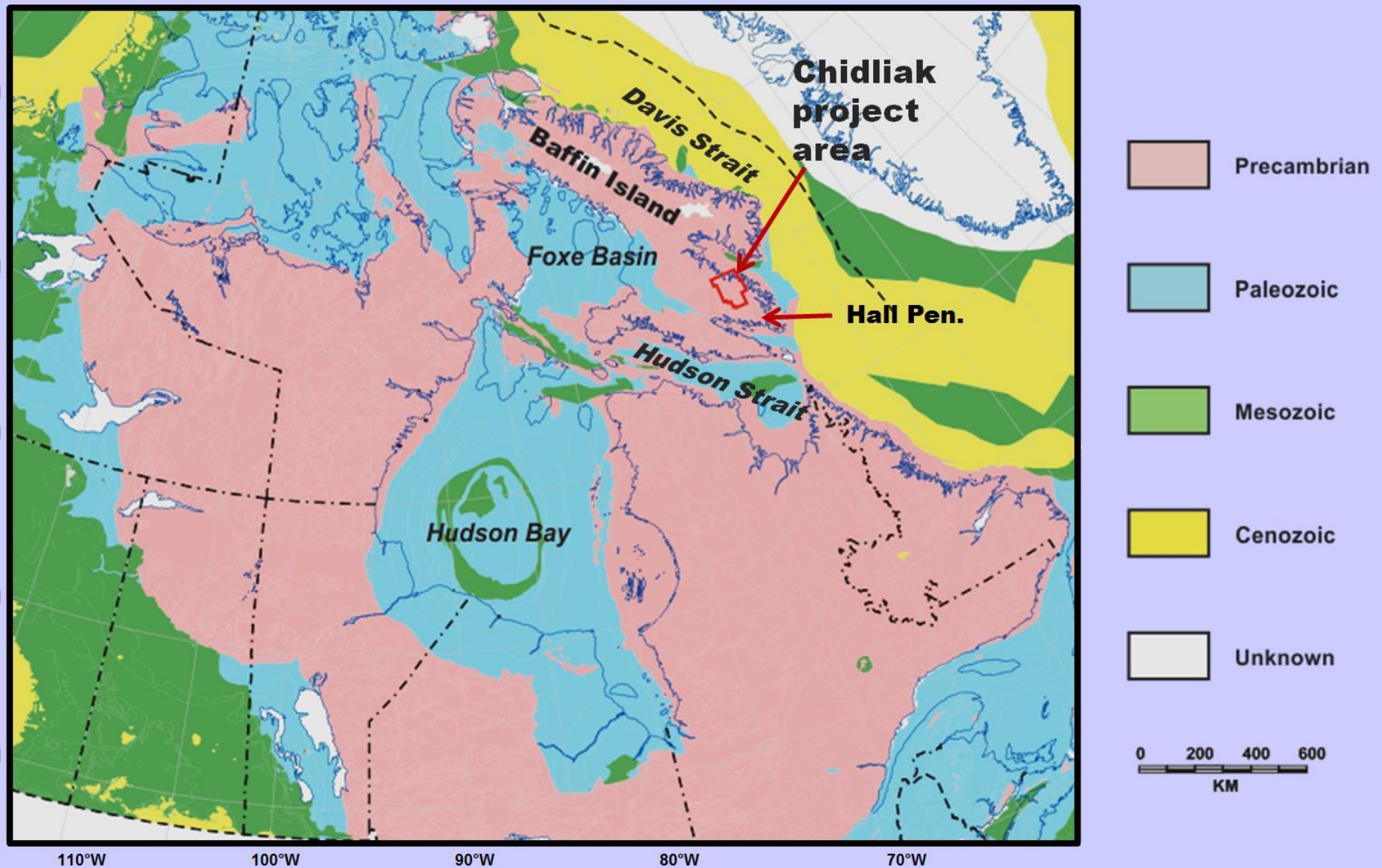


Diamond exploration brings the Paleozoic strata to light on the Precambrian country, Hall Peninsula, Nunavut

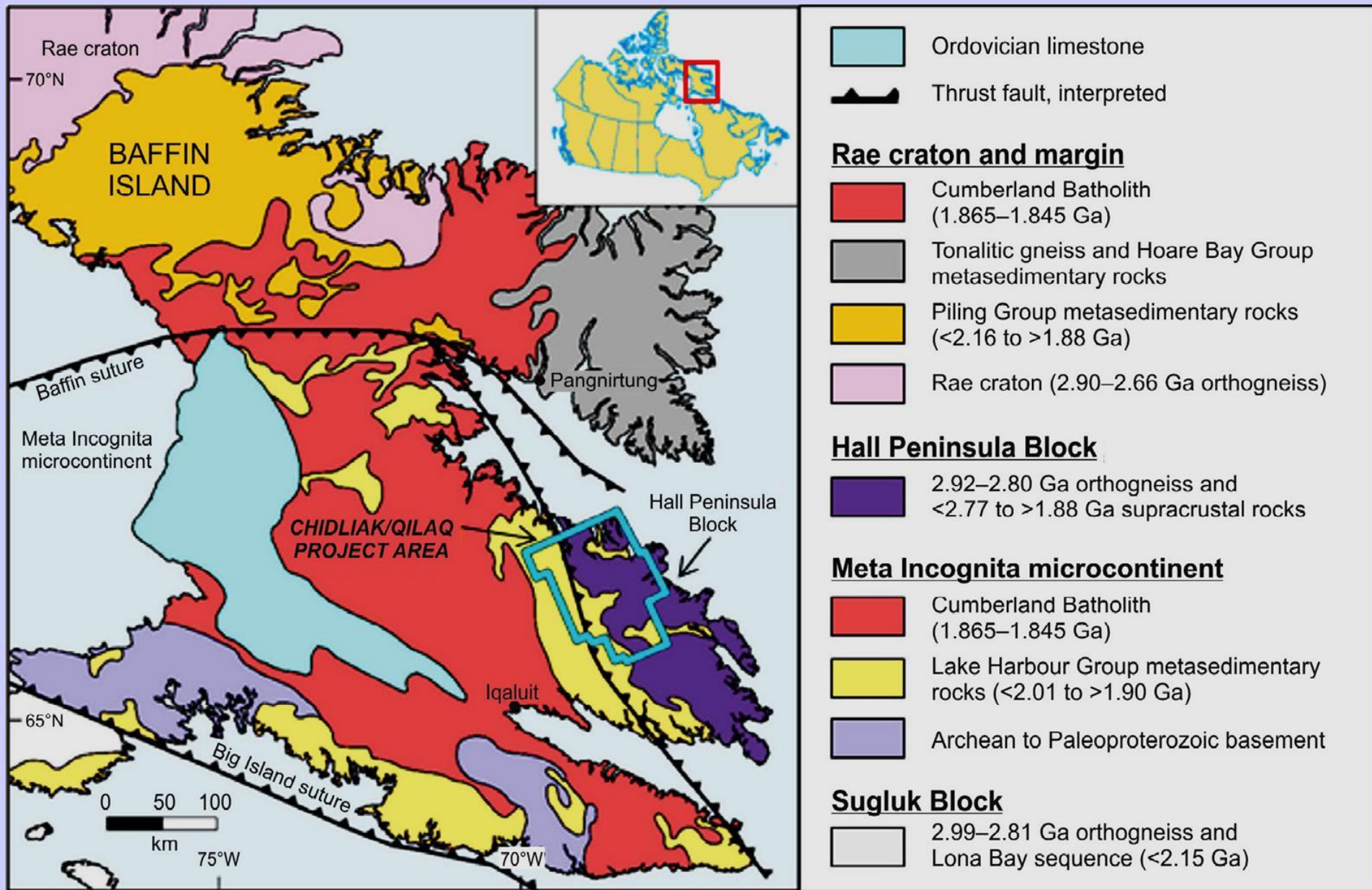
Shunxin Zhang¹ & Jennifer Pell²

¹ Canada-Nunavut Geoscience Office, Iqaluit, NU

² Peregrine Diamond LTD., Vancouver, BC

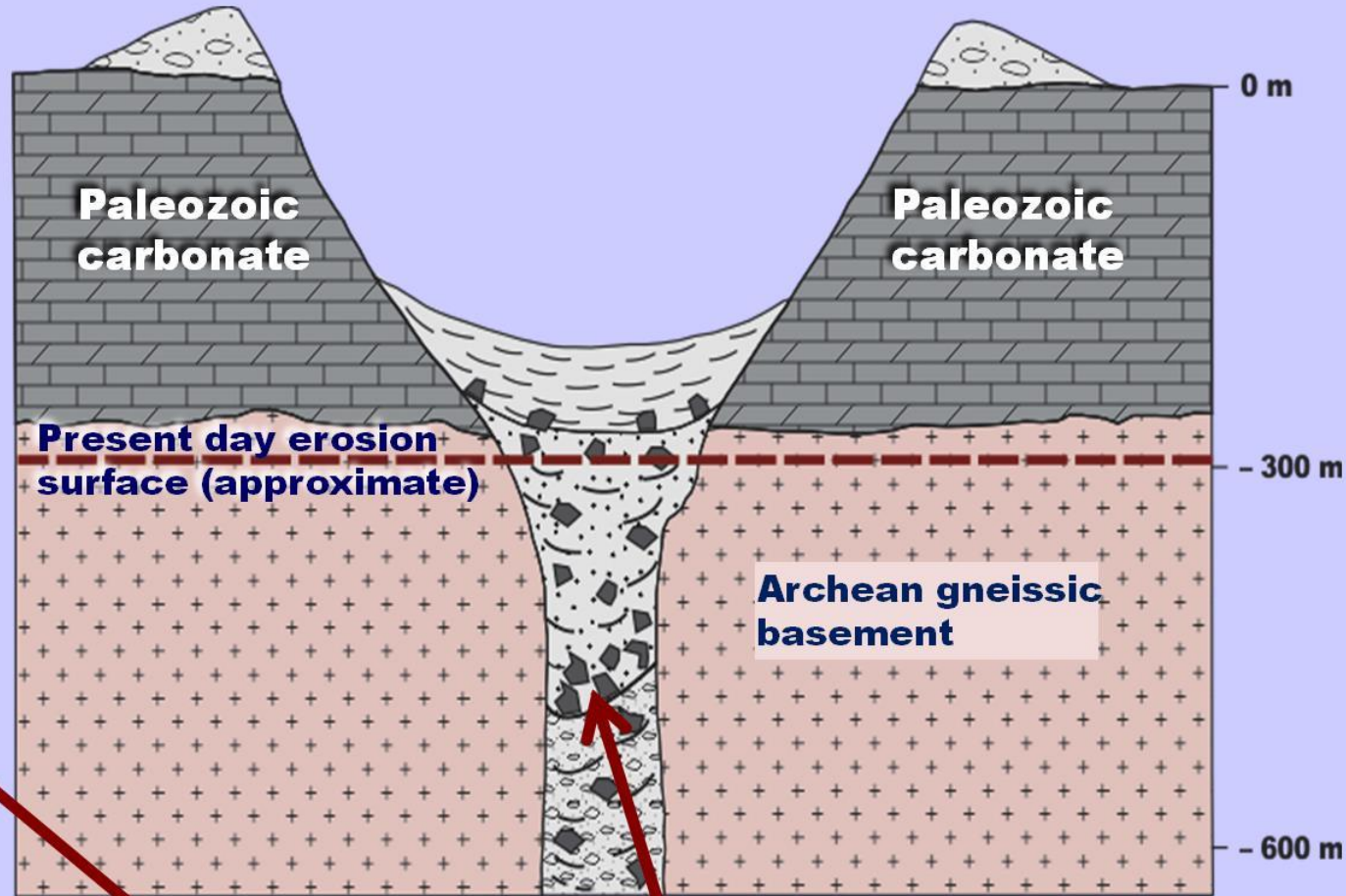


Simplified Geological map of the Canadian Shield and vicinity (modified from Wheeler et al., 1996), showing study area in red polygon.

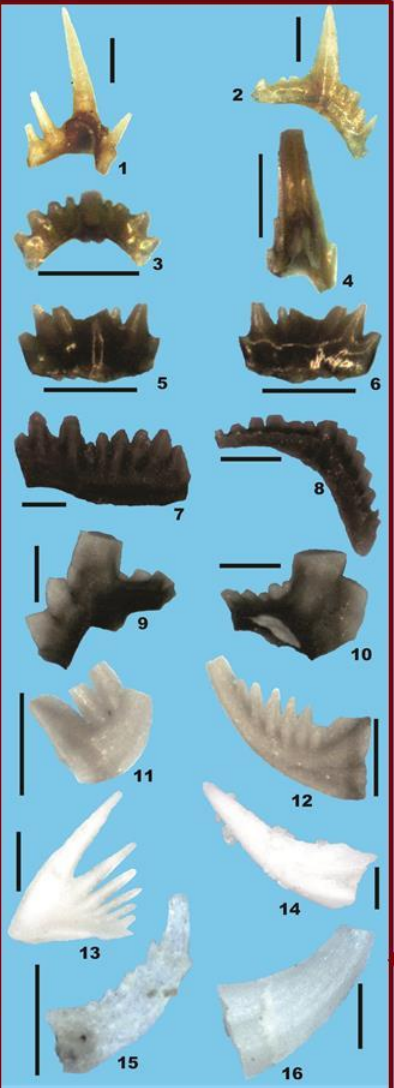


Simplified geology of southern Baffin Island, showing major tectonostratigraphic assemblages (adopted from Pell et al., 2012). Chidliak project area outlined by blue polygon.

Schematic model of a Chidliak volcanoclastic kimberlite pipe

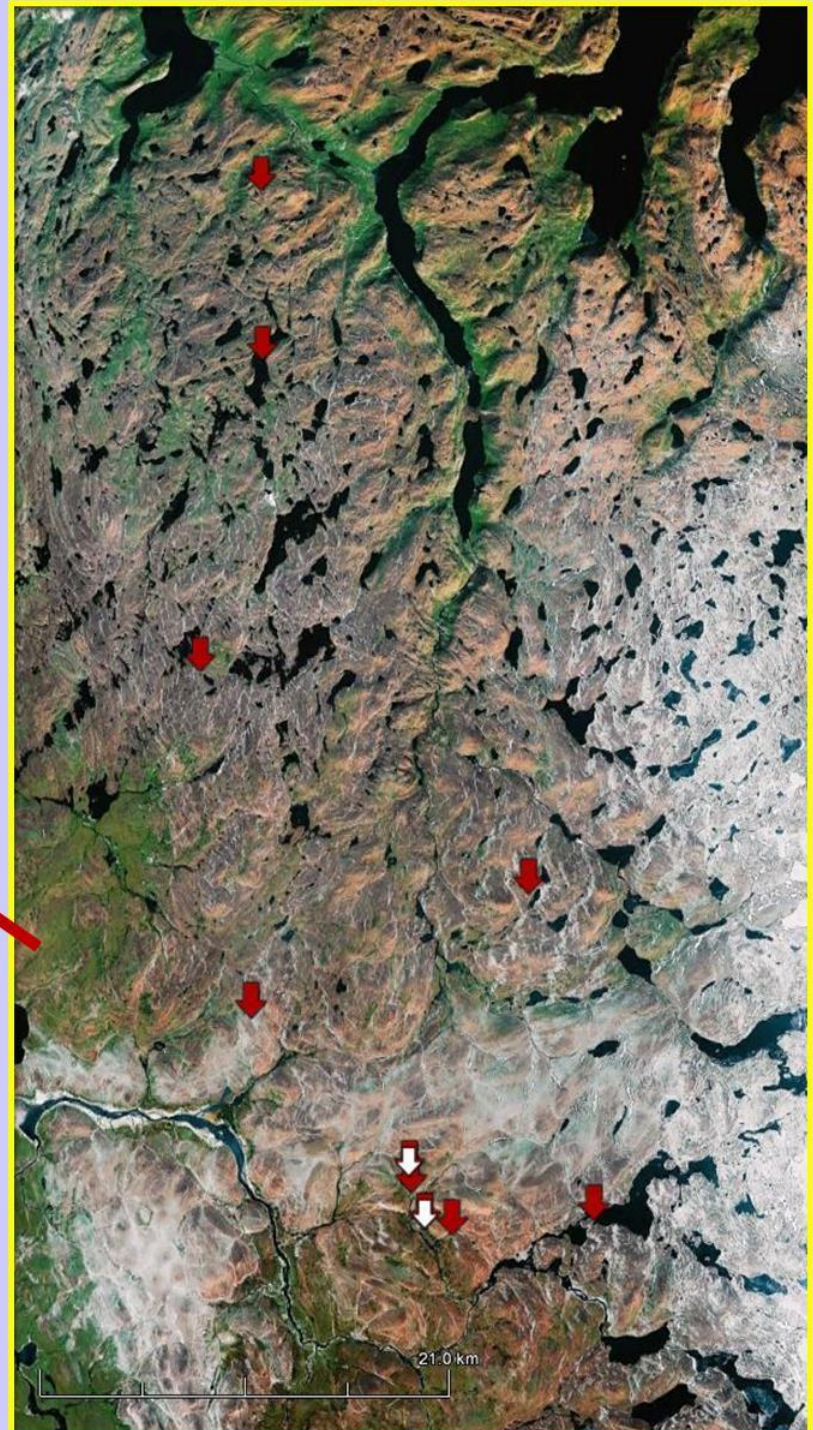
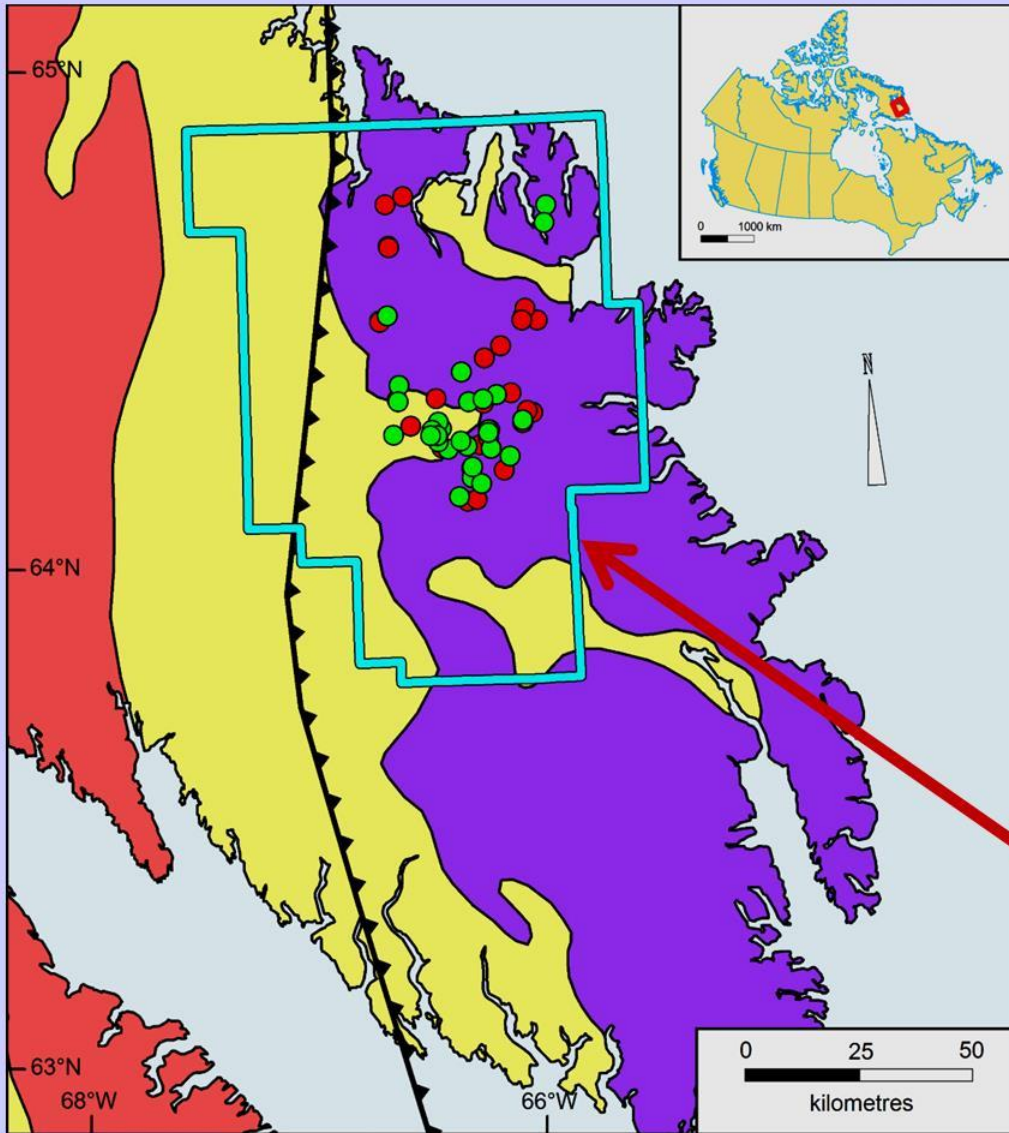


Temperature increased

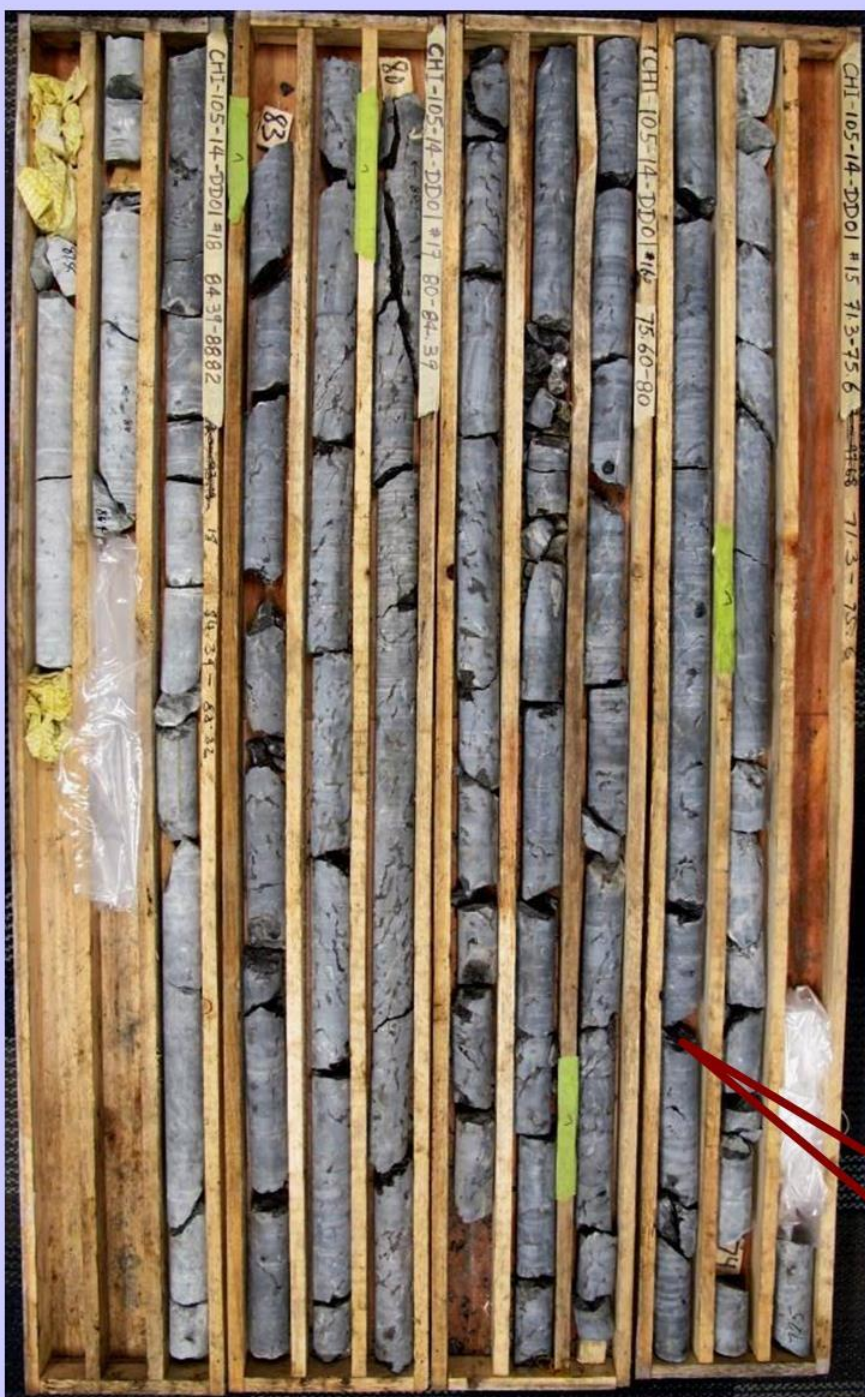


Representative conodonts from down-rafted Paleozoic carbonate rocks
Bar = 0.25 mm





Carbonate xenoliths preserved in the kimberlite pipes discovered from 28 drill-holes in Chidliak project area

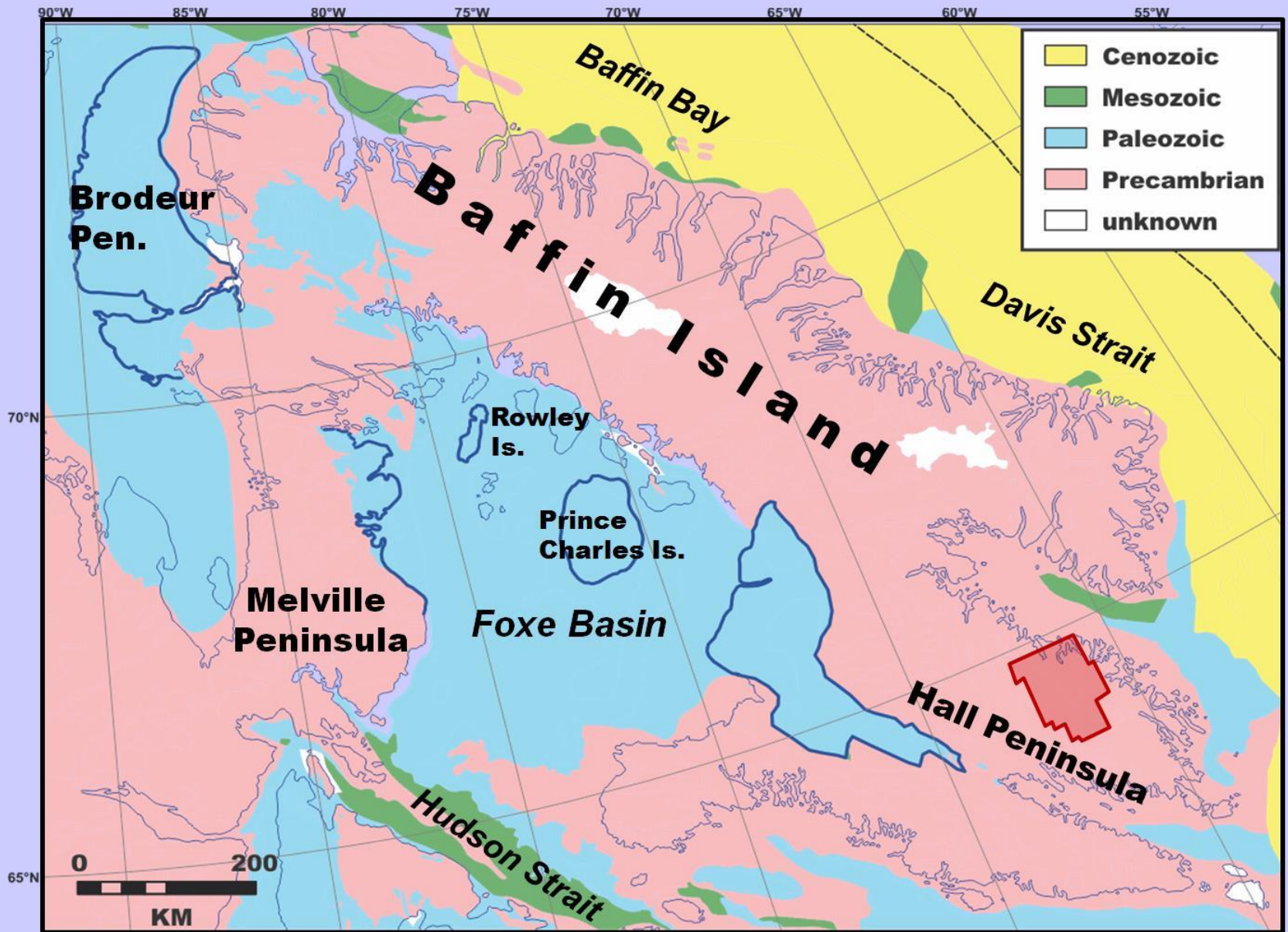


Most xenoliths recovered as small pieces

A continuous core (71.3 - 88.8 m) of limestone from CH1-105-14-DD01

**Summary of
sedimentary
xenolith
samples from
Chidliak
kimberlites
(2012 - 2015)**

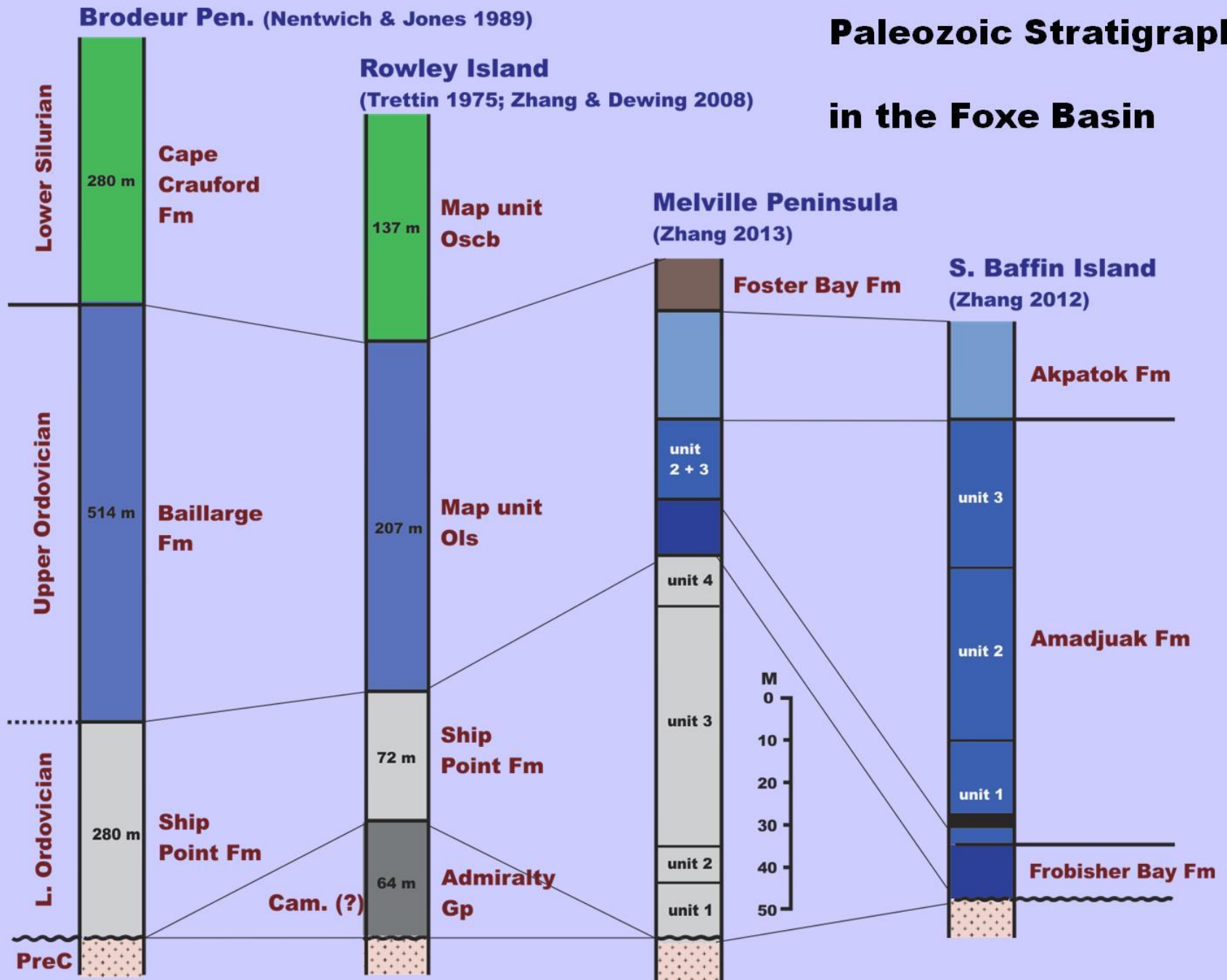
Location	Depth (m)	N of samples	N of productive samples	Basic lithology
CHI-050-11-DD16	80.1-88.6	3	2	Carbonate rocks
CHI-050-11-DD19	79.25-80.12	1	1	
CHI-101-11-DD02	13.5 - 68.07	2	2	
CHI-101-11-DD03	32.38 - 37.03	4	4	
CHI-101-11-DD04	35 - 52.47	4	4	
CHI-166-11-DD02	68.5 - 68.9	1	1	
CHI-192-11-DD01	102.2 - 165	6	2	
CHI-251-10-DD05	120.66 - 120.86	1	0	
CHI-251-11-DD08	146.75 - 148.2	1	1	
CHI-251-11-DD14	38.4-219	4	2	
CHI-258-11-DD05	58.1 - 104.9	2	1	
CHI-258-11-DD06	63.9 - 118.1	2	1	
CHI-258-11-DD07	11.2 - 41	2	1	
CHI-258-11-DD08	11 - 94.3	8	2	
CHI-400-11-DD01	39.8 - 144.4	3	2	
CHI-482-10-DD01	13.84 - 407	46	36	
CHI-488-11-DD02	128.95 - 151.05	2	1	
CHI-554-11-DD01	84.2 - 152.35	5	2	
CHI-557-11-DD02	77.8 - 181.4	12	9	
CHI-050-14-DD25	113.6 - 140.1	10	6	
CHI-050-14-DD26	169.1-169.3	1	0	
CHI-050-14-DD27	69.2 - 76.2	2	2	
CHI-050-14-DD28	81.2 - 99.5	3	1	
CHI-105-14-DD01	72.5 - 88.1	11	11	
CHI-105-14-DD02	54.2 - 69.5	6	5	
CHI-251-14-DD19	81.6 - 128.1	7	7	
CHI-251-14-DD23	156.3 - 156.5	1	0	
CHI-482-10-DD01	295.5 - 305.5	1	0	Black shale
Σ 28	11 - 407	Σ 150	Σ 106	

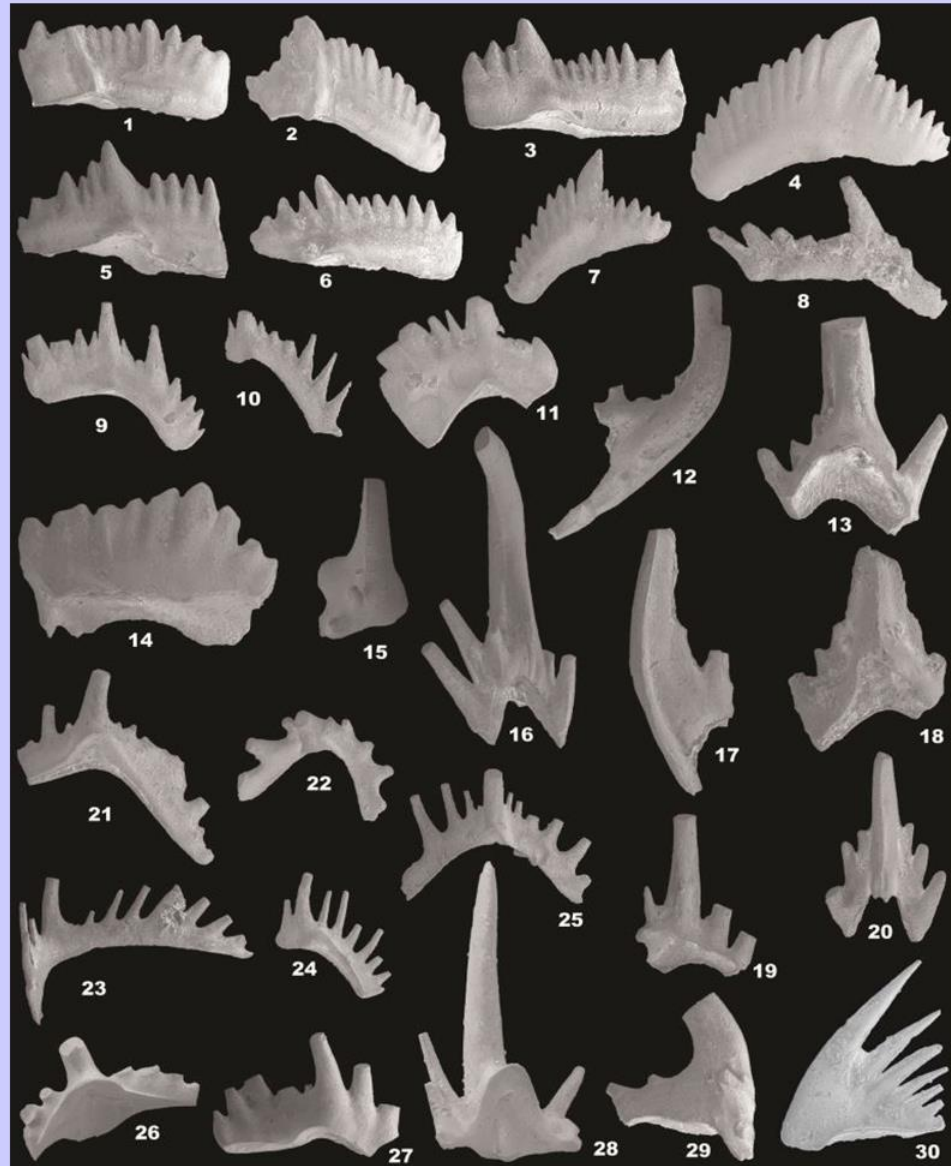
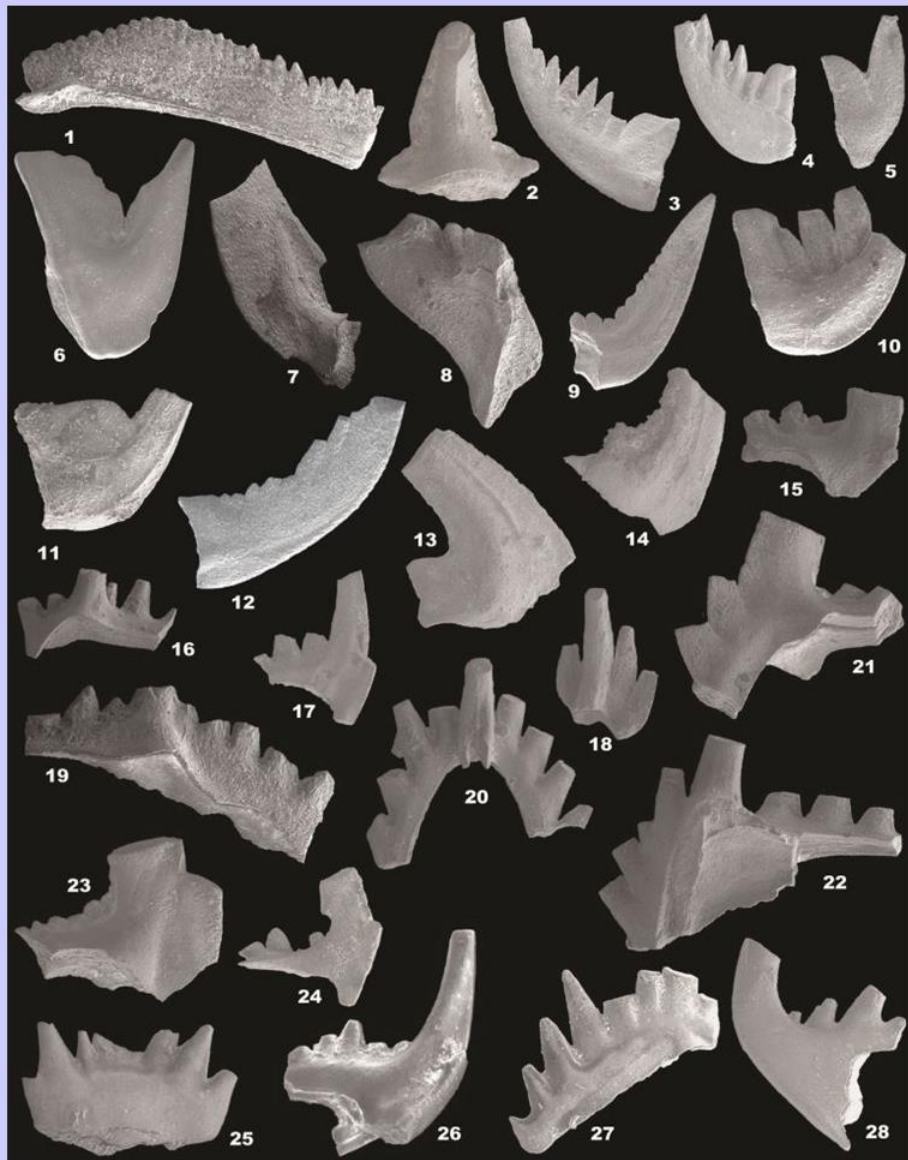


Locations (dark blue polygons) where the Paleozoic rocks are found and relatively-well studied in the Foxe Basin area

Paleozoic Stratigraphy

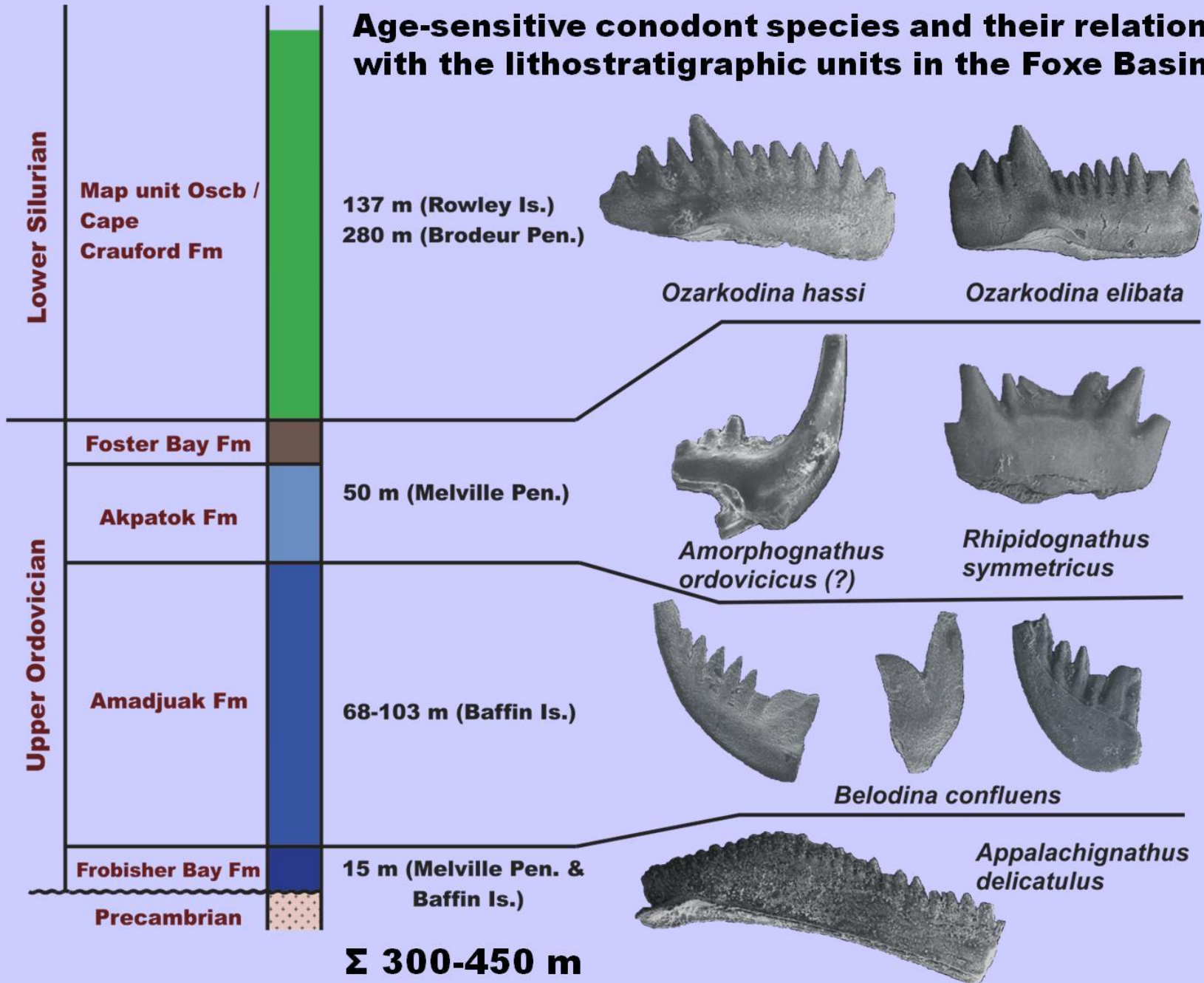
in the Foxe Basin





Part of the conodonts recovered from the carbonate xenoliths on the Hall Peninsula

Age-sensitive conodont species and their relationship with the lithostratigraphic units in the Foxe Basin

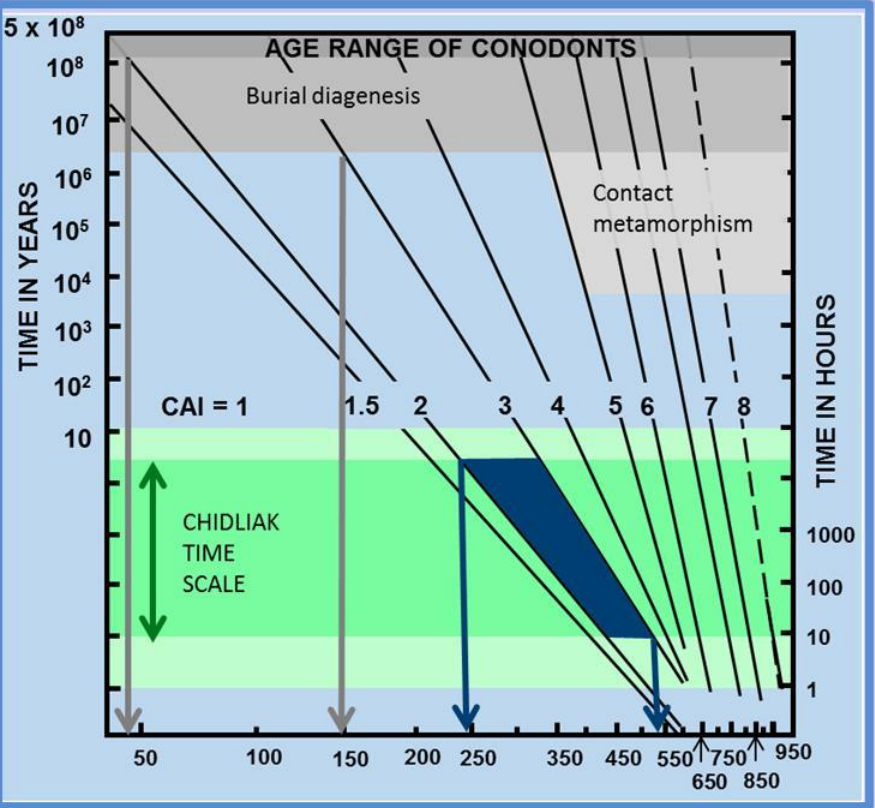


1			less than 50° to 80°	less than 60%
1½			50° to 90°	55% to 70%
2			60° to 140°	70% to 80%
3			110° to 200°	80% to 95%
4			190° to 300°	over 300°
5			over 300°	over 95%

Conodont Color Alteration Index (CAI)
1-5 are generally recovered from 1) sedimentary rocks, 2) low-grade regionally metamorphic rocks (tem. <400°C; depths <8 KM)

6			360° - 550°
6½			440° - 610°
7			490° - 720°
8			> 600°

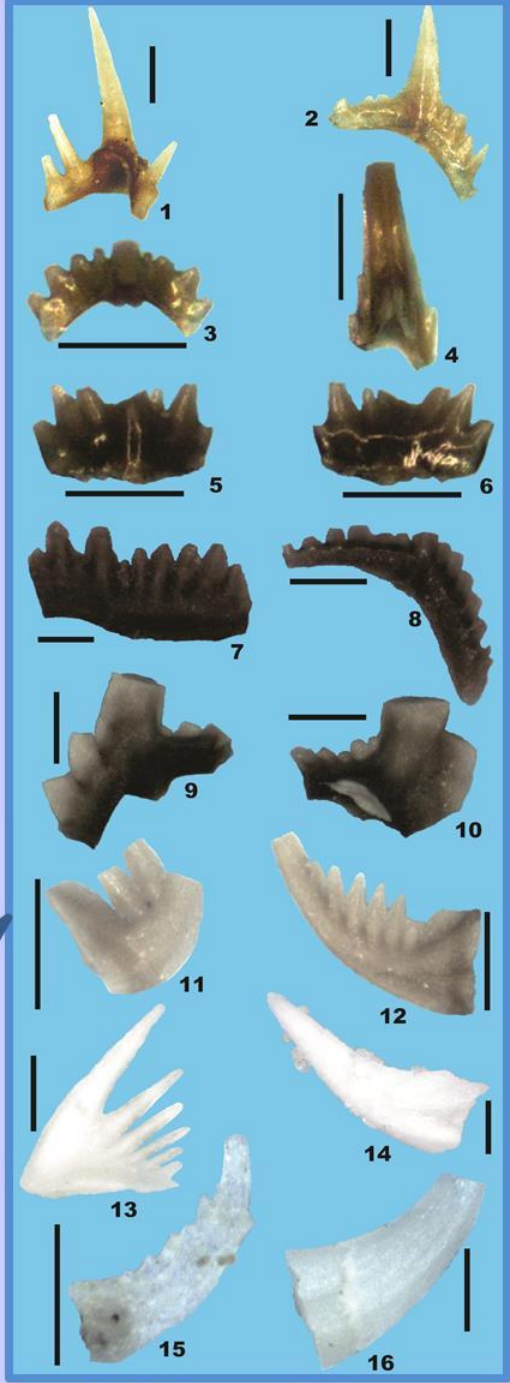
Conodont CAI ≥6 are generally recovered from rocks affected by a relatively high-temperature, short-term contact metamorphic event



Reciprocal of absolute temperature recalibrated in °C



Unaltered conodonts (CAI = 1) in Foxe Basin



CAI = 1.5
< 50-90°C
190-480°C

CAI = 2
60-140°C
225-515°C

CAI = 3
110-200°C
305-600°C

CAI = 4-5
190-300°C
365-625°C

CAI = 6
360-550°C
525-670°C

CAI = 6.5
440-610°C
650-750°C

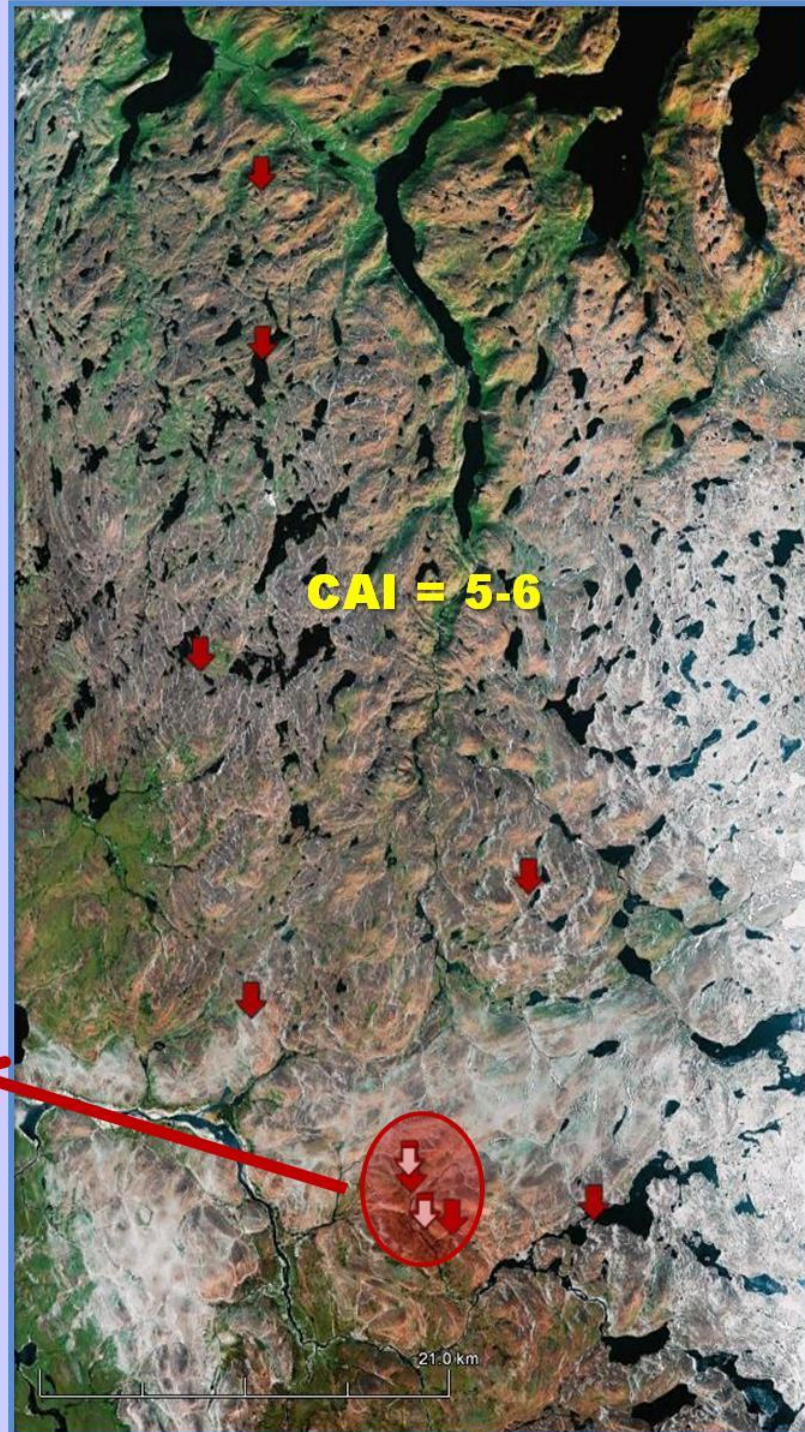
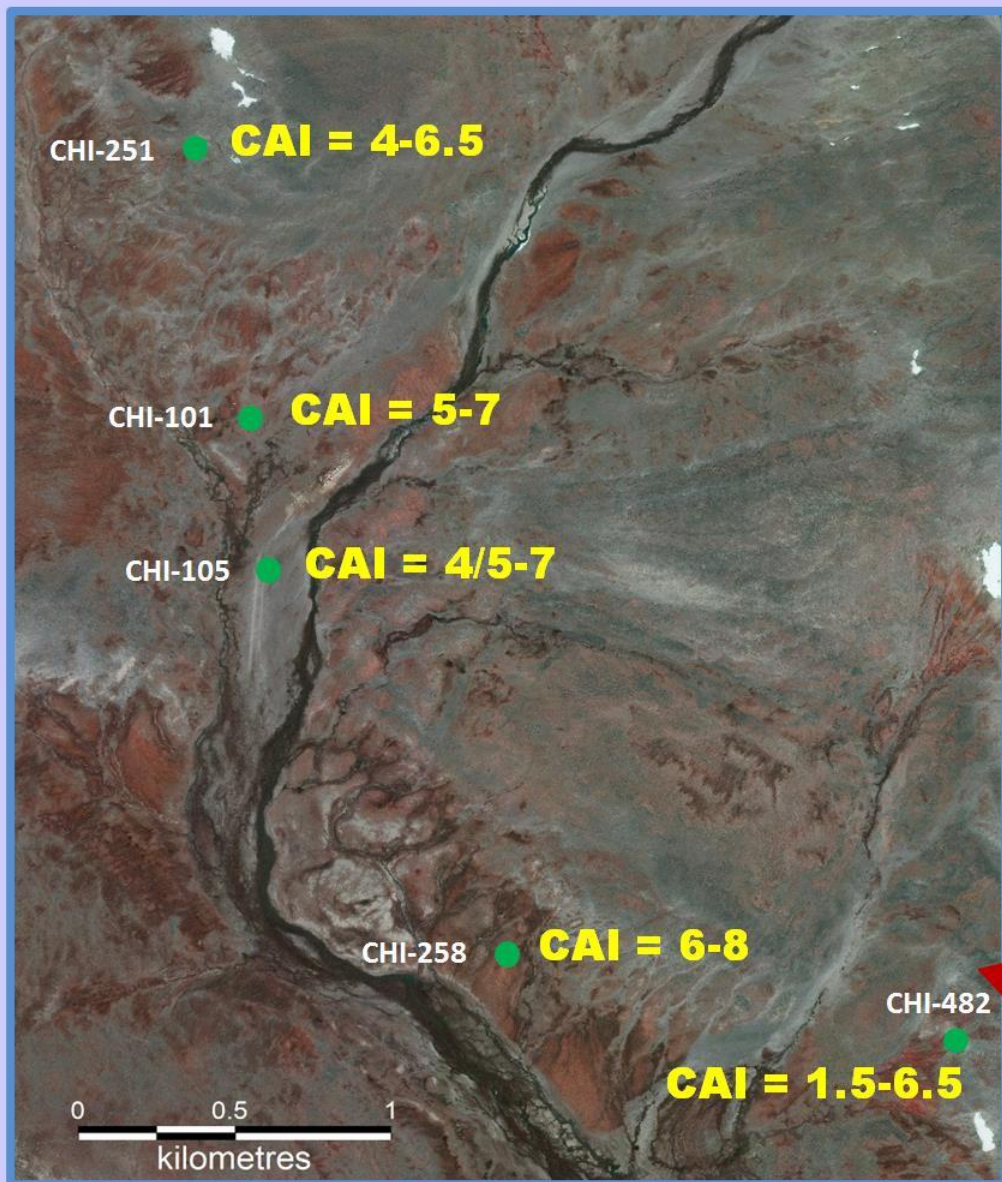
CAI = 7
490-720°C
675-850°C

CAI = 8
>600°C
<780->960°C

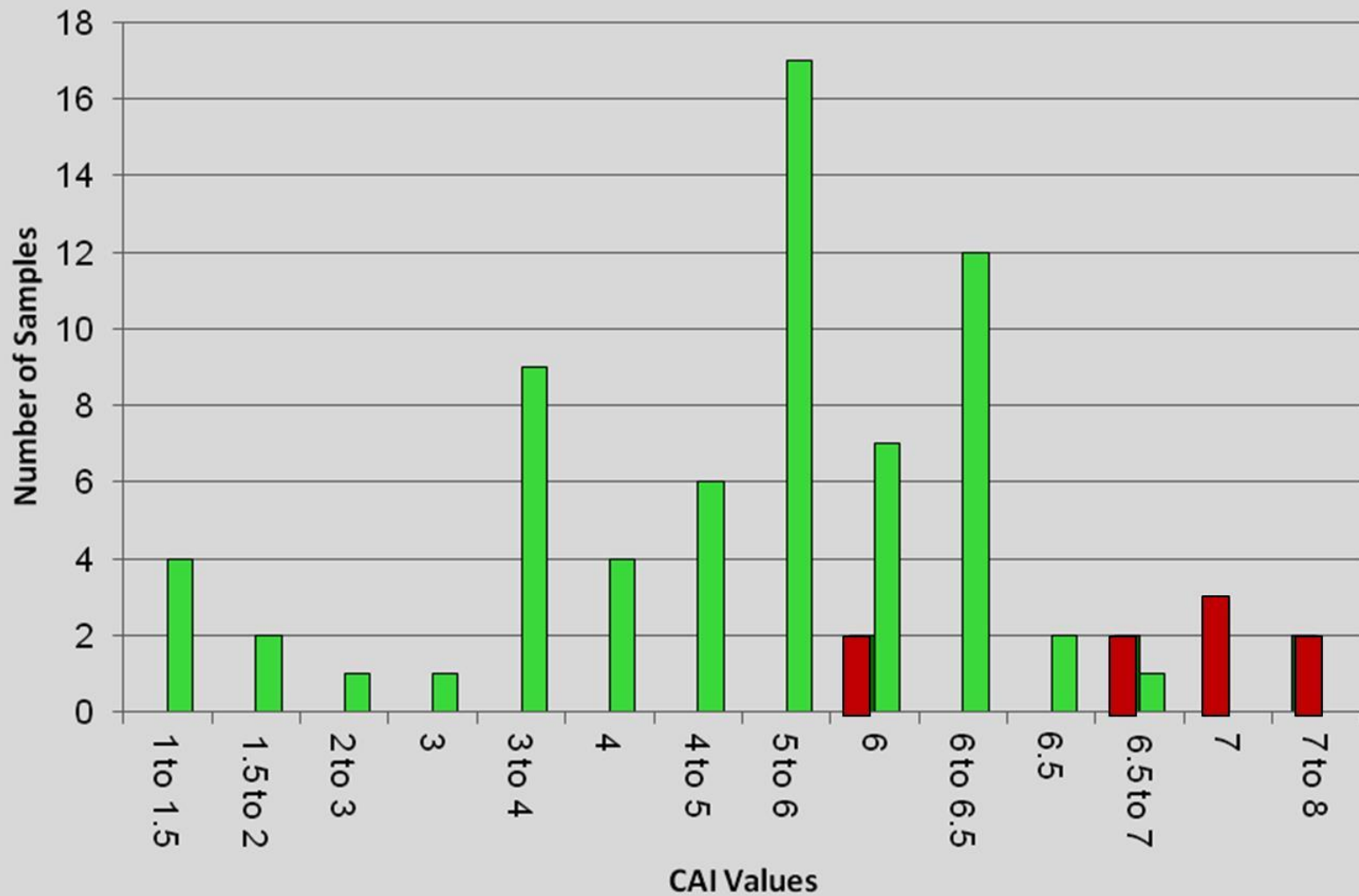
Scale bar = 0.25 mm

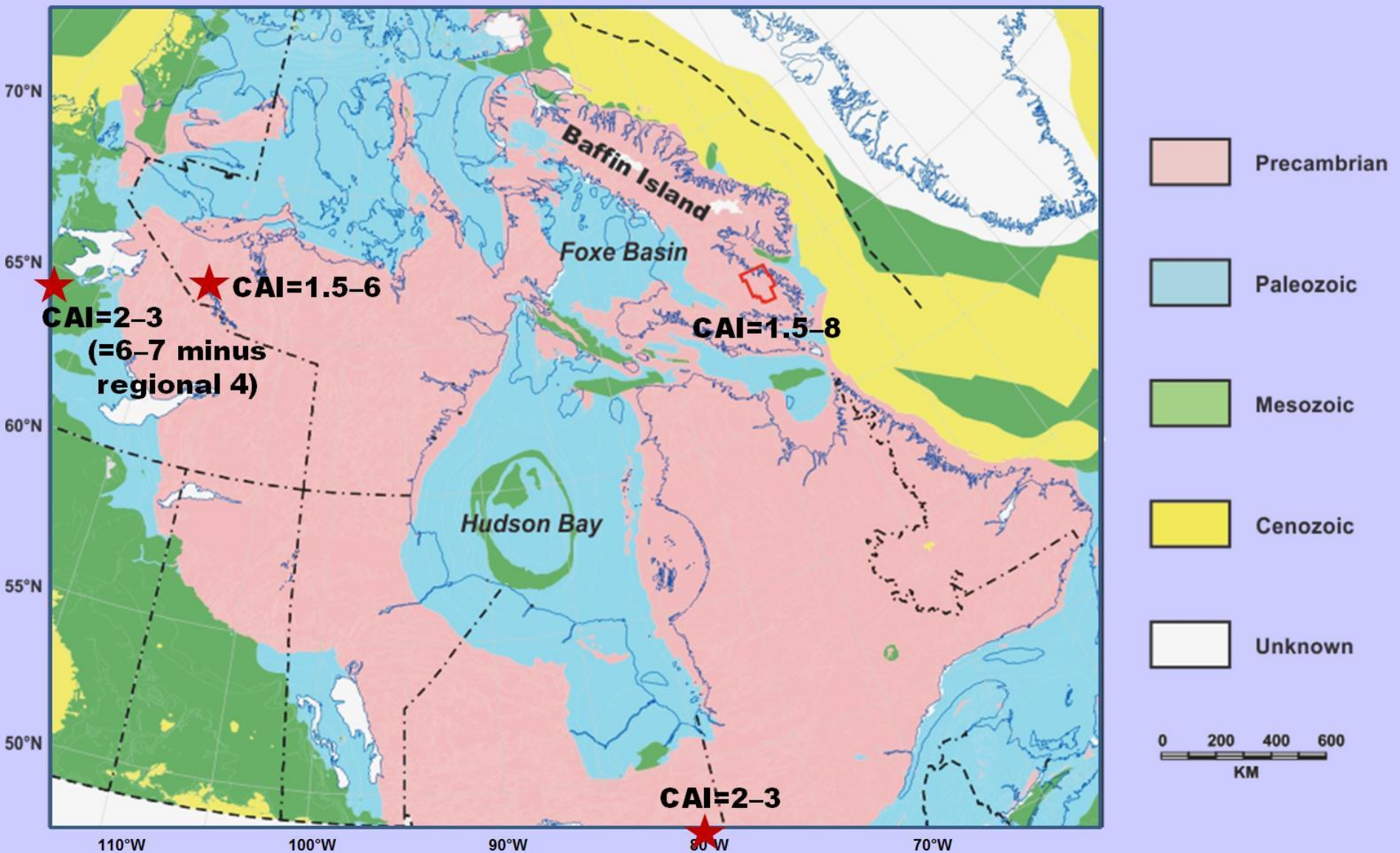
Wide range of conodont CAI values among the conodonts from kimberlite pipes on Hall Peninsula

Regional metamorphic temperatures assigned to CAI for time scales of 10's of thousands to millions of years shown in blue font; temperature assigned to CAI for kimberlite pipes retaining their heat for 10's to hundreds of years shown in red font.

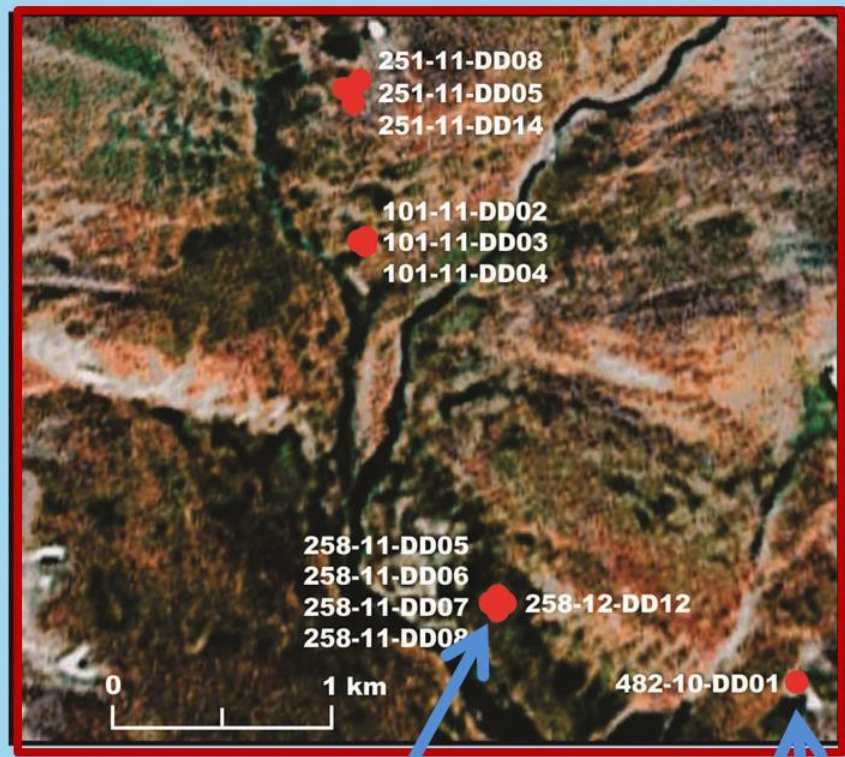
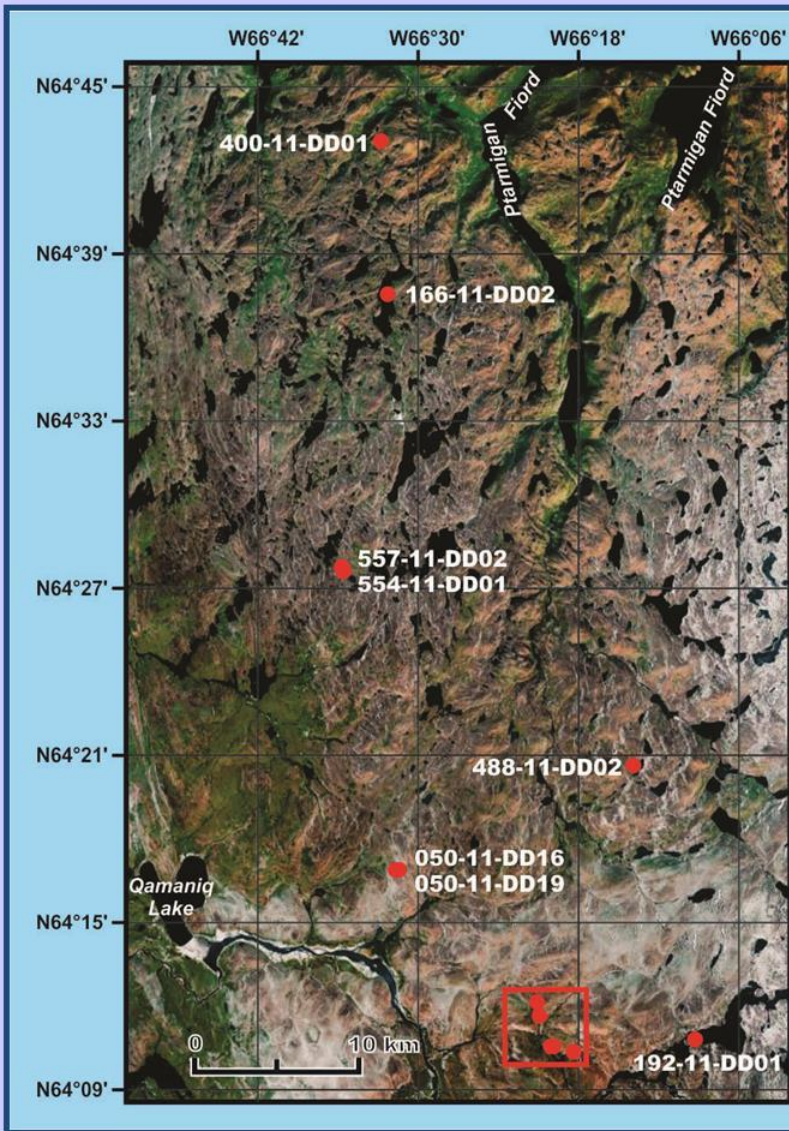


Histogram of CAI Values from Xenoliths in Chidliak Kimberlites

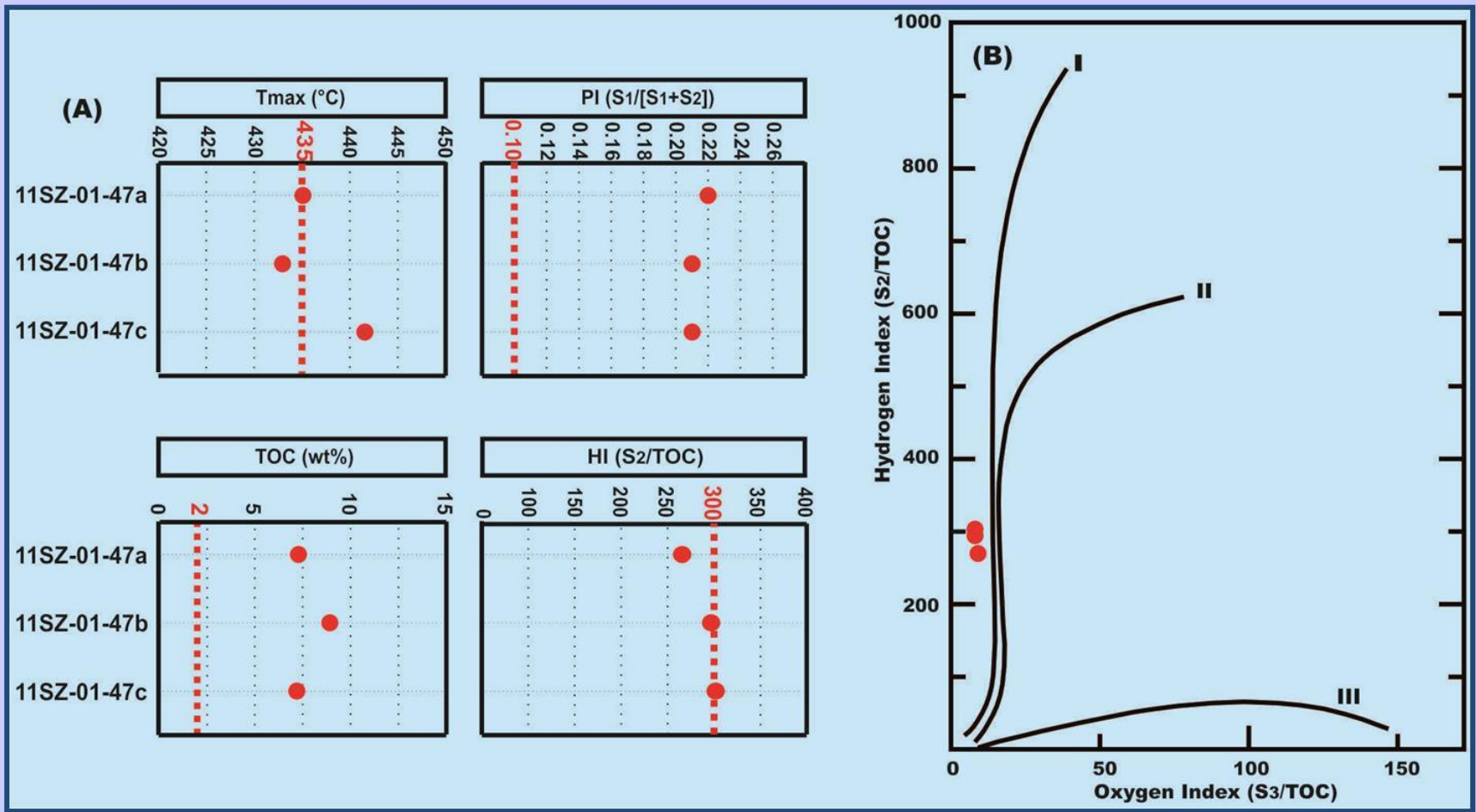




Conodonts from xenoliths preserved in kimberlites and their CAI values in Canada



Black shale xenoliths discovered from Chidliak project area, Hall Peninsula

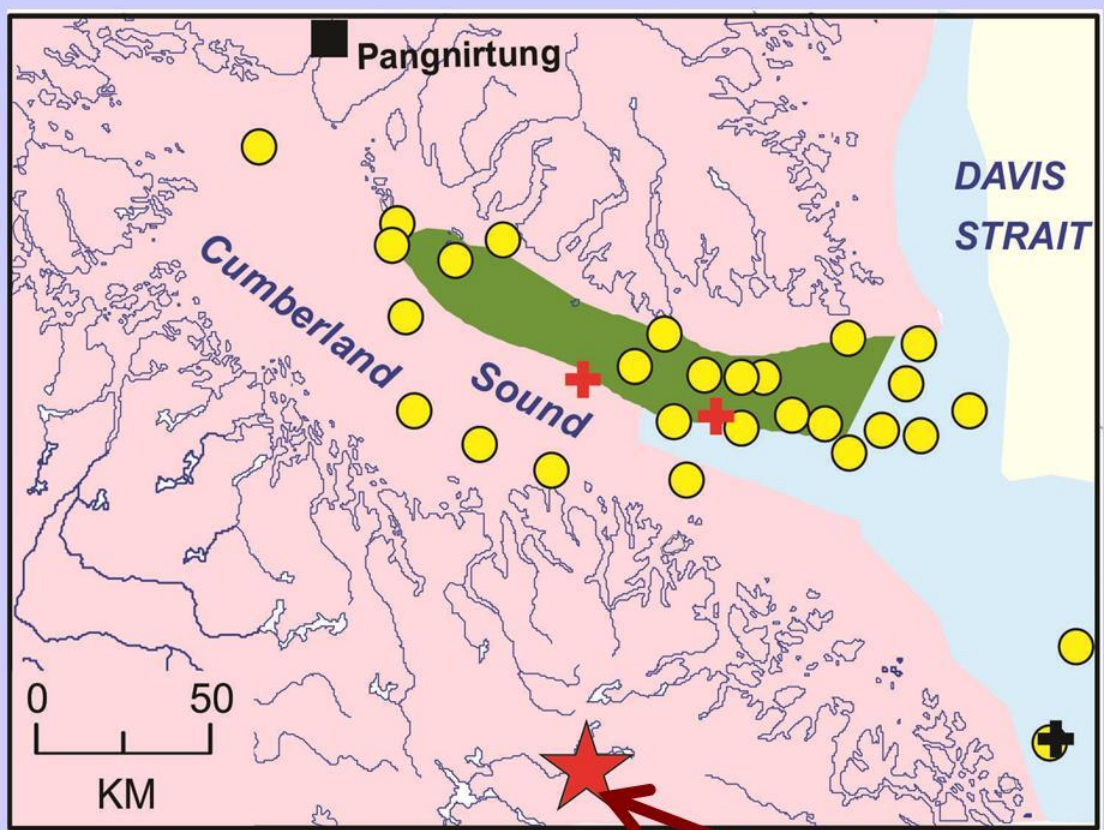


Three samples from this black shale xenolith; on the average:

TOC = 8.04%; HI = 288

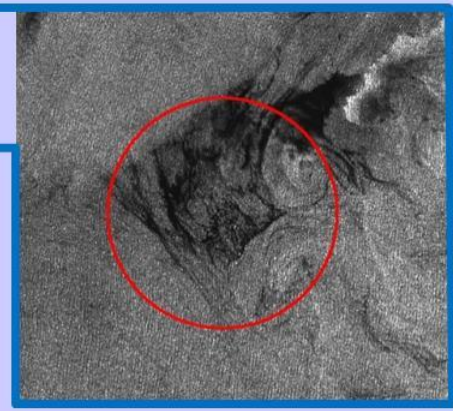
Tmax = 437°C; PI = 0.215 (Zhang et al. 2014)

EXERLLENT PALEOZOIC OIL-PRONE SOURCE ROCK!



- Mesozoic**
- Paleozoic**
- Precambrian**

- Suspect oil slicks**
- Mesozoic core**
- Paleozoic core**
- Black shale xenolith**



Simplified geological map around Cumberland Sound (modified from Wheeler et al., 1997), and distribution of suspect oil slicks (Budkewitsch et al., 2013)



Summary

- ❖ **Over 2,000 conodont elements are found from carbonate xenoliths in 28 drill-holes penetrating the kimberlite pipes on Hall Peninsula.**
- ❖ **The ages of conodonts range from Late Ordovician to Early Silurian, which is an indication that about 300-450 meter thick Upper Ordovician and Early Silurian carbonates have been eroded off the Hall Peninsula after the kimberlite emplacement in Early Cretaceous.**
- ❖ **The conodont CAI values among over 2 000 conodonts range from 1.5 to 8; which corresponds to temperature ranging from 200°C to >800°C. Hall Peninsula preserves the kimberlites with the highest temperature in Canada.**
- ❖ **The organic-rich black shale xenoliths of Silurian age discovered from the kimberlites on the Hall Peninsula have opened a new direction in looking for oil-prone source rocks in the region.**

Acknowledgements

- ❖ **Financial support provided by Canada-Nunavut Geoscience Office (CNGO)**
- ❖ **Permission of collecting xenolith samples given by Peregrine Diamonds Ltd.**

Special Thanks to

- ❖ **K. Paull (GSC, Calgary), and P. Krauss and H. Taylor (GSC, Vancouver) processed conodont samples**
- ❖ **P. Hunt (GSC, Ottawa) took SEM photos**
- ❖ **R. Stewart (GSC, Calgary) ran Rock-Eval analysis**