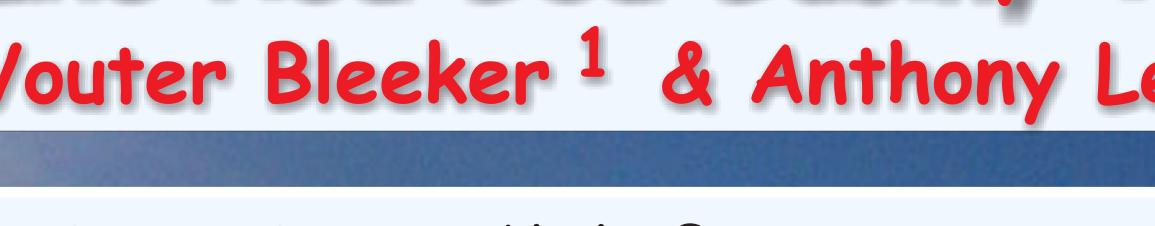


The Proterozoic Dessert Lake Red Bed Basin, Target for Uranium Exploration—An Update Wouter Bleeker 1 & Anthony LeCheminant 2



grey-green, poorly bedded shale, with thin dolomite intercalation

Buff to slightly pink sandstone, locally limey, with shale laminations

Quartz sandstone:Buff to slightly pink sandstone, locally limey, with shale laminations

Buff grey to green, medium grained, friable; graded beds with granules along base; bedding traces 80-85° to core axis

Shale, dolomite, and sandstone:
dale grey-brown silty dolomite and dark grey shale

-- Subtle angular unconformity

massive, grey to buff, fine grained bedding traces at 75-80° to core axis

Shale and sandstone

The Proterozoic Dessert Lake Red Bed Basin, Target For Uranium Exploration-An Update Wouter Bleeker & Anthony N. LeCheminant 2

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The Dessert Lake red beds comprise a largely concealed sedimentary basin outlier of Proterozoic sandstones to the west of Great Slave Lake (Bleeker and LeCheminant, 2007). These sandstones are intruded by Mackenzie age diabase and thus older than 1270 Ma. They overlie and geophysically mask Archean to Paleoproterozoic basement rocks of the southwesternmost Slave craton and adjacent Great Bear Magmatic Zone. Only one outcrop of these sandstones is known, on the western shore of Great Slave Lake, the rest of the basin outlier being concealed underneath thin but geophysically transparent Paleozoic platform rocks. Although much remains to be learned about this weakly tilted but otherwise undeformed sandstone sequence, it likely represents an erosional remnant of a much more extensive Proterozoic red sandstone cover that may have been present across much of the western Canadian Shield. Closest analogues and possibly direct correlatives are the Athabasca Basin to the southeast and the Hornby Bay Basin to the north.

Given these likely correlations, and its proximity to Yellowknife, the shores of Great Slave Lake, and the main highway (NWT Highway 3) between Fort Providence and Rae-Edzo, the basin remnant is of some interest to uranium exploration companies. In recent years, much of the basin was staked and a number of exploratory holes were drilled. Several important questions remained however:

) What is the age of this red bed sequence?

2) How thick is this basin remnant, and is the basal unconformity within reach of drilling and exploration?) How far does this basin remnant extend to the west?

4) And finally, does this basin extend far enough west to have been imaged on the regional seismic reflection line of LITHOPROBE's SNORCLE Transect (e.g., Cook et al., 1999).

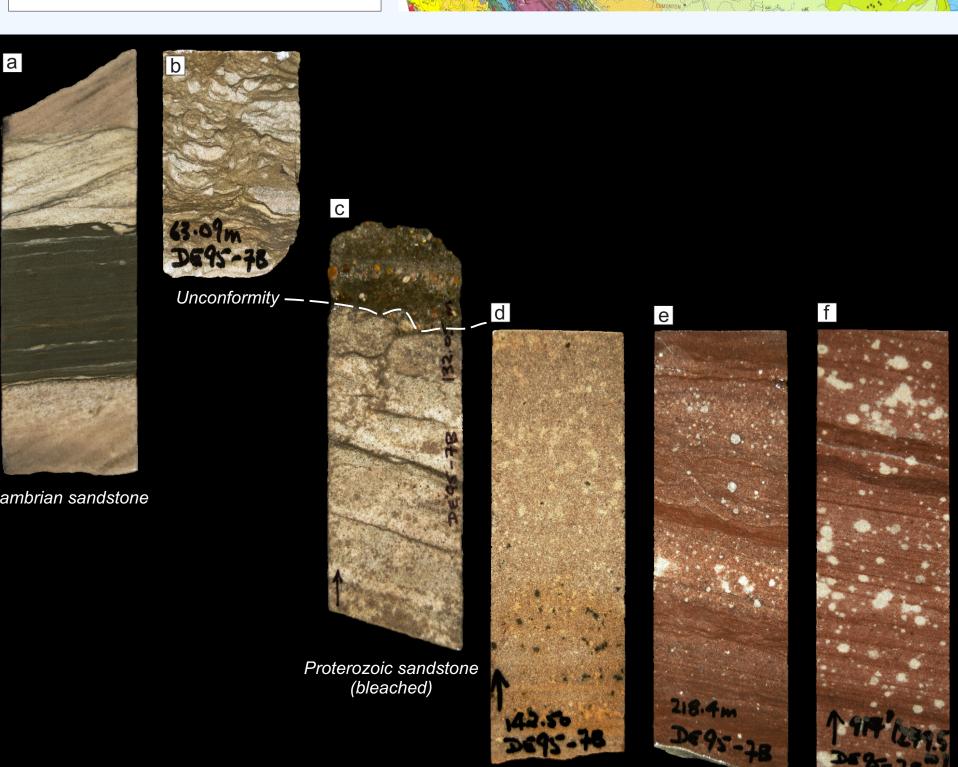
Having identified the eastern edge of this basin with some confidence, including the one outcrop on Great Slave Lake, our initial hypothesis was that the red bed sequence may correspond with a shallow subhorizontal reflector on the SNORCLE reflection profile. Re-investigation of drill core cuttings from several old oil and gas exploration drill holes in the area now rule out this possibility: cuttings at the bottom of several drill holes in proximity to Highway 3 show Paleozoic platformal rocks directly overlying a variety of granitoid rocks. From this we can conclude two things:

) The Dessert Lake red bed basin wedges out (faulted?) somewhere to the east of Highway 3.

And 2) consequently, the major subhorizontal reflector on the SNORCLE seismic profile (at ~2-3 km depth), between Rae-Edzo and Fort Providence, cannot be the basal unconformity of these red beds. Given that it forms a marked, laterally persistent reflector in apparently transparent granitoid basement, we now interpret this major reflector as a large diabase sill of either Hottah (ca. 780 Ma) or Mackenzie (ca. 1270 Ma) age. If the red beds continue to the west, they likely do so, discontinuously, along a northwesterly trend parallel to the North Arm of Great Slave Lake.

Figure 1: Map of the northwestern Canadian Shield (from Wheeler et al., 1996), showing the Slave craton and platformal Phanerozoic cover to the southwest (platform in various blues and green on map). Highlighted are Proterozoic sedimentary basins, and the relevant part of the SNORCLE seismic profile (Cook et al., 1999). Thin dashed line outlines speculative extent of the Dessert Lake redbed basin. See Figure 2 for the evidence for Proterozoic red beds being present below basal Cambrian





subsurface stratigraphy covering the western edge of the Slave craton and adjacent Great Bear Magmatic Zone. From Gerle Sold exploration drill core:

Providence

a, b) Cambro-Ordovician sandstones. Note crossbedding in quartz-rich ioturbation in the finerrained sandstones of (b)

Unconformity between Cambrian sandstones, and oleached Proterozoic

d, e and f) Red sandstones deeper in the drill core, well below the projected depth

considerable thickness of Protorozoic red beds.

Figure 6: Regional aeromagnetic coverage (Geological Survey of Canada) showing the typical short-wavelength response of the exposed Slave craton being "faded" by sedimentary cover to the

southwest. The thin Phanerozoic platform is not thick enough to explain this "fading". Instead, we

The single outcrop of these red beds is indicated (white star), as is the approximate trace of the

unconformity (yellow line). The collar of the "discovery drill core" is also indicated (yellow circle).

Another drill core (white circle), on Wrigley point, failed to intersect the red beds. In exploration

hole B-41 (blue circle), along Highway 3, and similar wells further west, Devonian strata lie directly

on Precambrian basement granites of Paleoproterozoic age, as confirmed by re-logging of the well-

Exposed

Trace of unconformity

Approximate trace of

cuttings of these holes. Hence, the Dessert Lake redbeds must wedge out east of Highway 3

-117° -116°30′ -116° -115°30′ -115° -114°30′ -114° 5

possibly due to late movement on the Wopmay Fault and related fault strands.

interpret this feature of the aeromagnetic data as resulting mainly from the presence of a

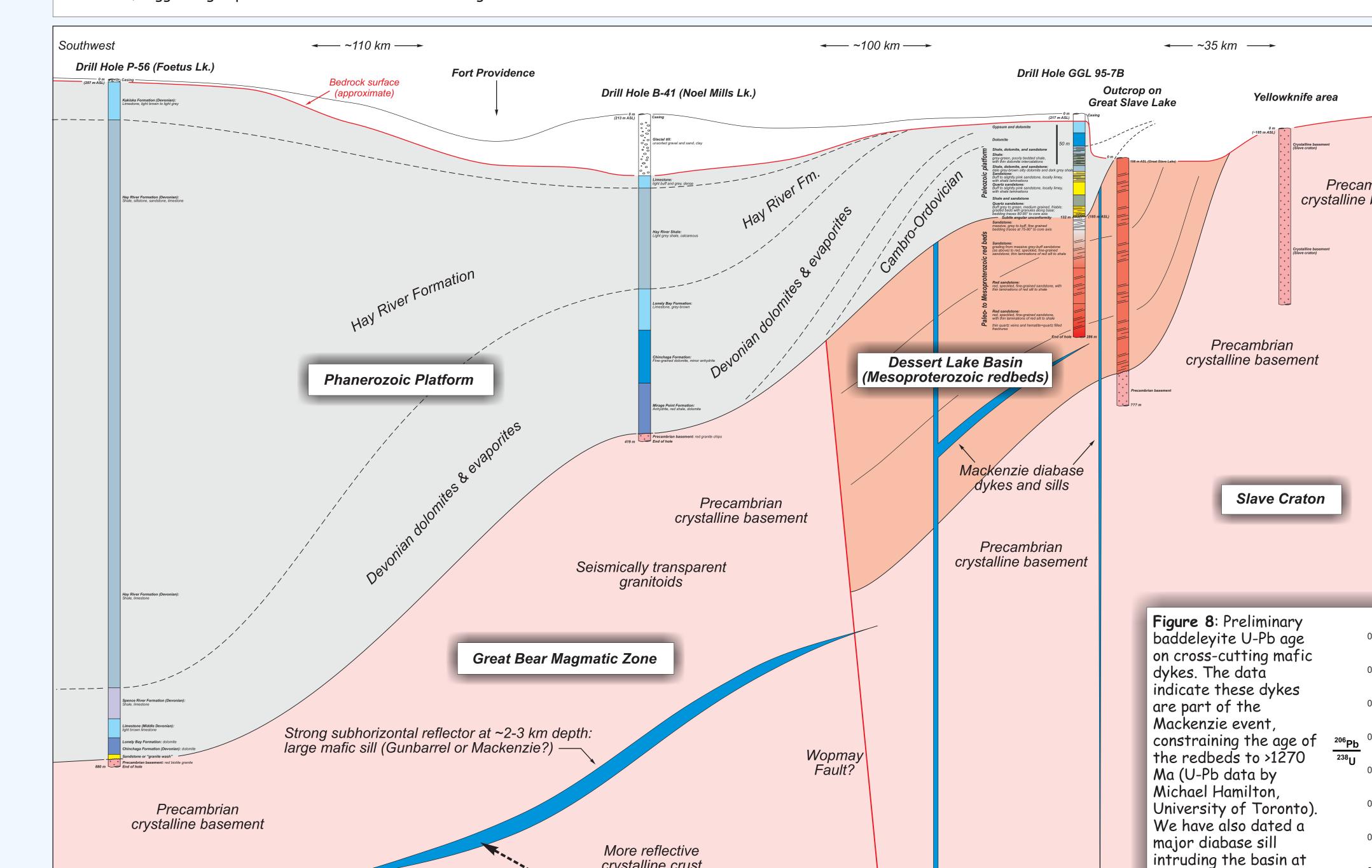
¹Geological Survey of Canada, Ottawa, Ontario, wbleeker@nrcan.ga.ca ²Petrogen Consultants, Manotick, Ontario, Tony_LeCheminant@rogers.com

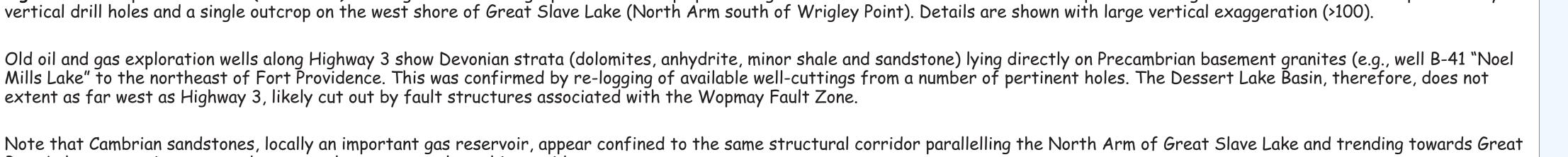
This publication is available from the Geological Survey of Canada Bookstore (http://gsc.nrcan.gc.ca/bookstore e.php). It can also be downloaded free of charge from GeoPub (http://geopub.nrcan.gc.ca/)

Old oil and gas exploration wells along Highway 3 show Devonian strata (dolomites, anhydrite, minor shale and sandstone) lying directly on Precambrian basement granites (e.g., well B-41 "Noel Mills Lake" to the northeast of Fort Providence. This was confirmed by re-logging of available well-cuttings from a number of pertinent holes. The Dessert Lake Basin, therefore, does not extent as far west as Highway 3, likely cut out by fault structures associated with the Wopmay Fault Zone.

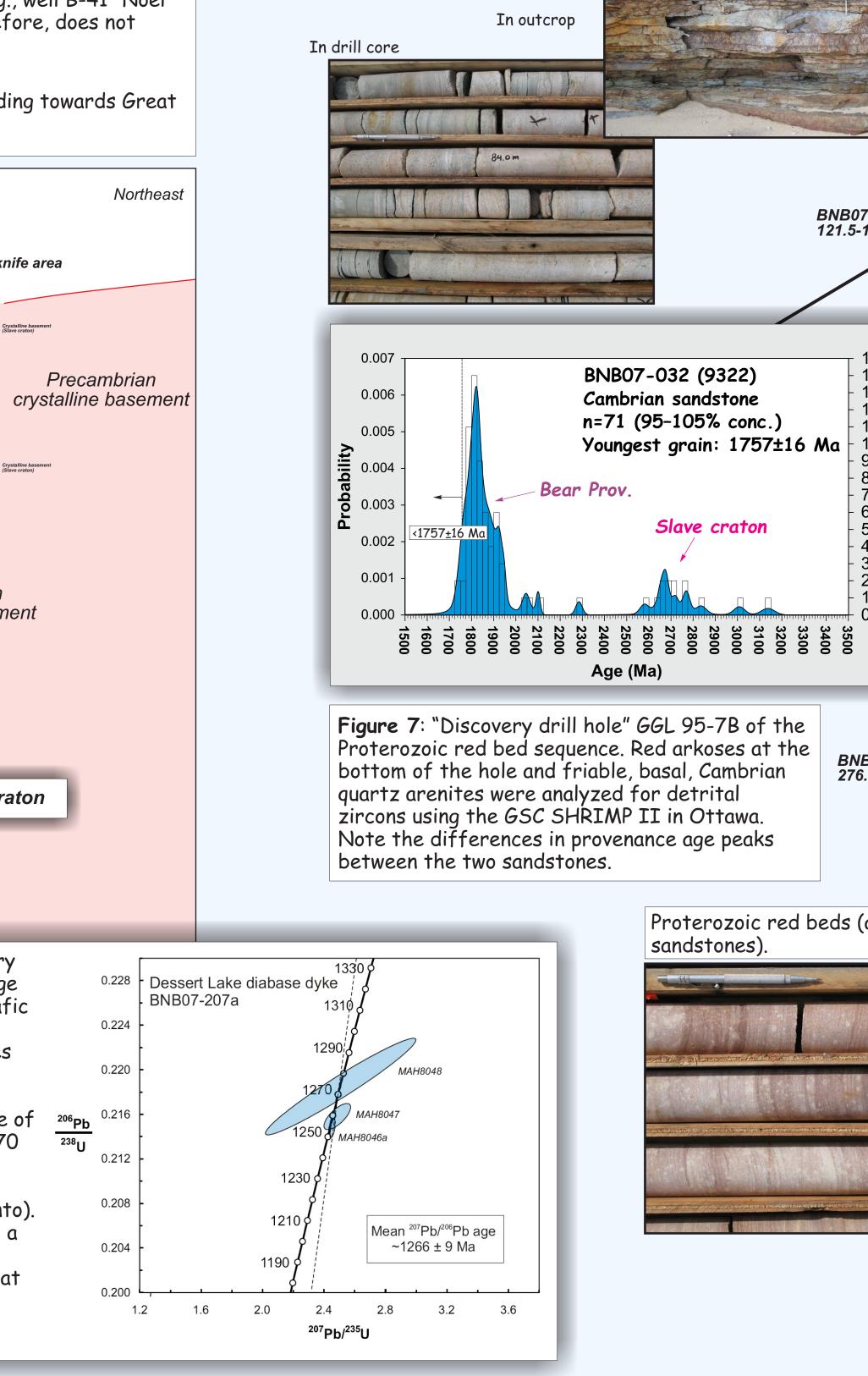
Figure 9: Interpreted section (SW to NE) showing critical stratigraphic relationships pertaining to the Dessert Lake red beds of Mesoproterozoic age. Critical constraints are provided by

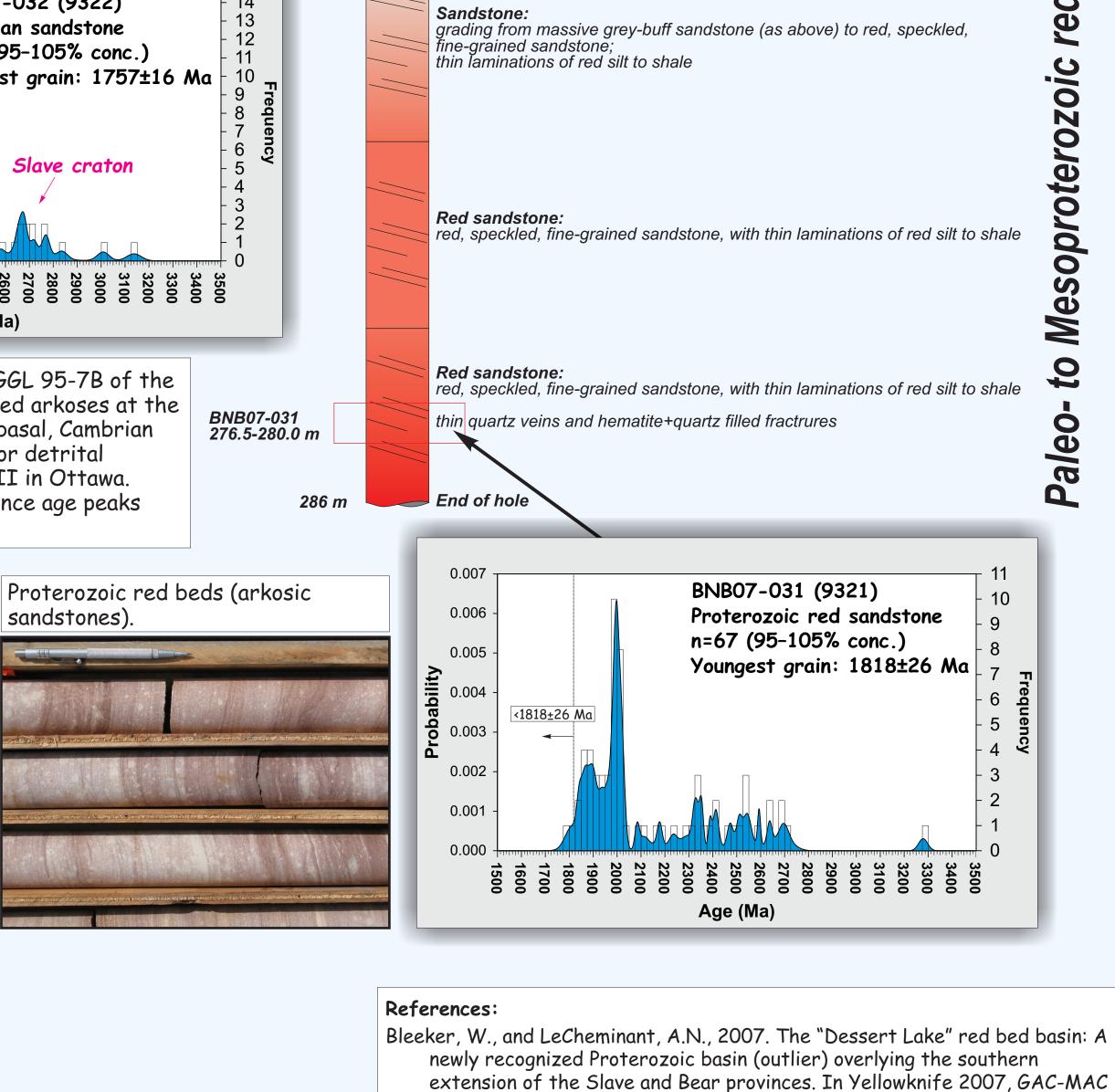
Note that Cambrian sandstones, locally an important gas reservoir, appear confined to the same structural corridor parallelling the North Arm of Great Slave Lake and trending towards Great Bear Lake, suggesting repeated structural movements along this corridor.

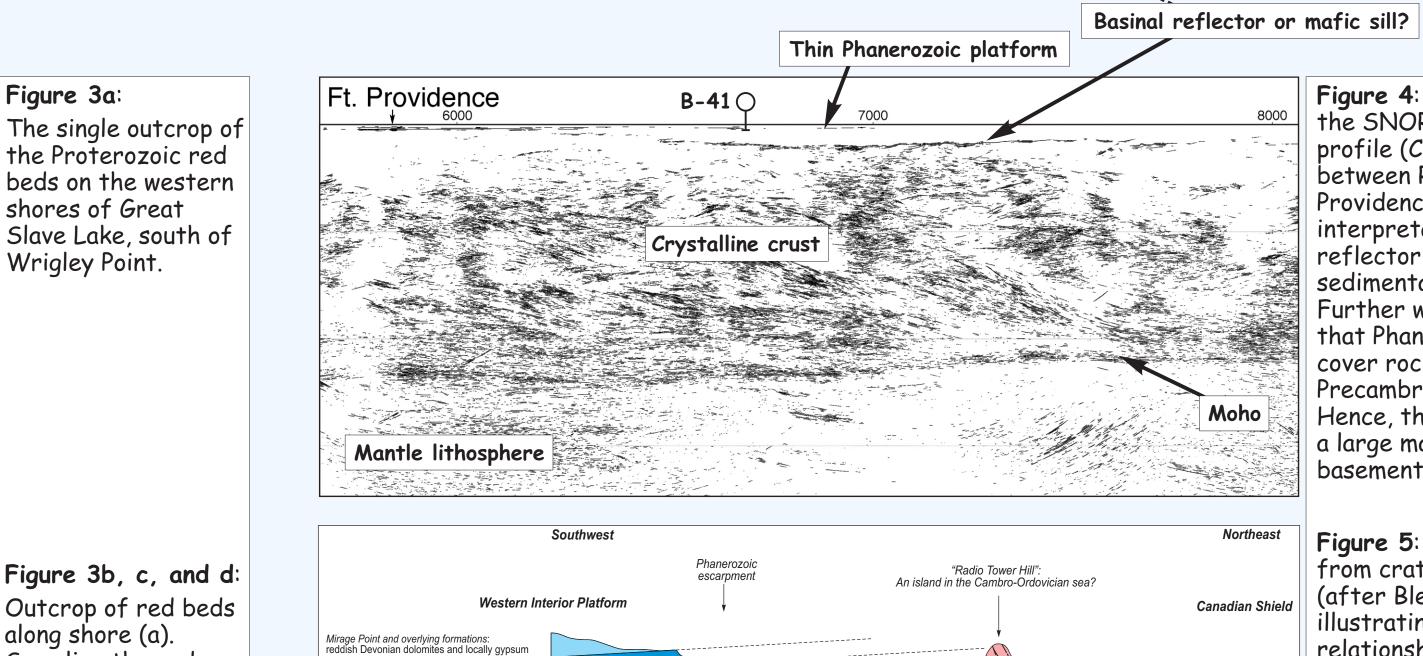




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Great Bear Magmatic Zone

Raised beaches

— Wopmay Fault Zone?—➤

Archean basement

Archean Slave craton

the SNORCLE reflection profile (Cook et al., 1999), between Rae-Edzo and Fort Providence, with our initial interpretation of the major reflector as a shallow sedimentary basin remnant Further work has since shown that Phanerozoic platformal cover rocks rest directly on Precambrian granitic rocks. Hence, the reflector must be a large mafic sill in crystalline

Figure 4: Relevant part of

Figure 5: Schematic section from craton to platform (after Bleeker et al., 2007), illustrating the stratigraphic relationships, with an Exposed Slave craton Athabasca-type basin outlier immediately underneath thin platformal cover.

1. Field work and core logging have confirmed the existence of Proterozoic red beds at shallow, drill-accessible depths below thin Phanerozoic cover. We refer to these

red beds as the Dessert Lake Basin (Bleeker and LeCheminant, 2007).

this same age.

Precambrian

crystalline basement

Slave Craton

2. The age of the Dessert Lake red beds is constrained to older than 1270 Ma. the age of intrusive sills and dykes, but younger than 1818 Ma, the age of the youngest detrital zircon in the sandstone.

. This red bed basin outlier is responsible for the "fading" of the basement magnetic signature. The basin thickens rapidly to the southwest, dips being ~10°, but it does NOT extent as far west as Highway 3.

4. The laterally persistent subhorizontal reflector imaged on the SNORCLE reflection profile cannot represent the base of the Dessert Lake Basin. It most likely represents one or several large mafic sills, possibly of Hottah (780 Ma) or Mackenzie (1270 Ma) age, intruding into relatively transparent granitoid basement.

5. The Dessert Lake red beds are confined to a narrow structural corridor parallelling the North Arm of Great Slave Lake and trending towards Great Bear Lake.

6. Cambrian strata, including thick porous sandstones that are locally an important gas reservoir, appear to be confined to the same structural corridor, suggesting reactivation into the Phanerozoic.



que soumises par l'auteur.

Cambrian quartz arenites of the Old

BNB07-032 121.5-125.0 m

Fort Island Formation, in rare

Canada, Field Trip Guidebook (A1), 232 p. Cook, F.A., van der Velden, A.J., Hall, K.W., and Roberts, B.J., 1999, Frozen subduction in Canada's Northwest Territories: Lithoprobe deep lithospheric reflection profiling of the western Canadian Shield. Tectonics,

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Sircombe, K., Snyder, D., van Breemen, O., and Ootes, L., 2007. Transect

across the southwestern Slave craton: From Phanerozoic platform edge to

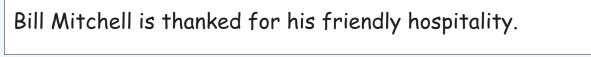
the core of the Yellowknife supracrustal domain. Geological Association of

Acknowledgements

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Also many thanks to colleagues from the NWT Geoscience Office for their assistance and interest. As always, the DIAND "white van" greatly facilitated field work logistics on more than one occassion. We sincerely thank Dave Smith of East Arm Freighting Limited. Dave and his

tug boat (picture on the left) were invaluable in getting us safely to "the other side" and back!





Great Bear

Magmatic Zone 🛎



NAD83 / UTM zone 11N

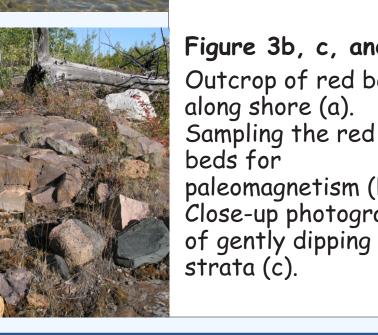


Figure 3a:

the Proterozoic red

beds on the westerr

Slave Lake, south o

Chedabucto Lake Formation: yellow to beige Ordovician dolomites

Martre Falls Formation: Cambro-Ordovician shale

Fort Island Formation: Cambrian sandstone

"Dessert Lake Basin": Mesoproterozoic (?) re

Laurentia: 4.1-1.8 Ga crystalline basement

shores of Great

Wrigley Point.



Bleeker, W. and LeCheminant, A.N., 2012. The Proterozoic Dessert Lake red

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Recommended citation

