Sub-Cambrian Unconformity

Subcrop and Seismic Time Structure Map

Contour Interval: 50 ms

Datum: 1000' (305 m) a.s.l.

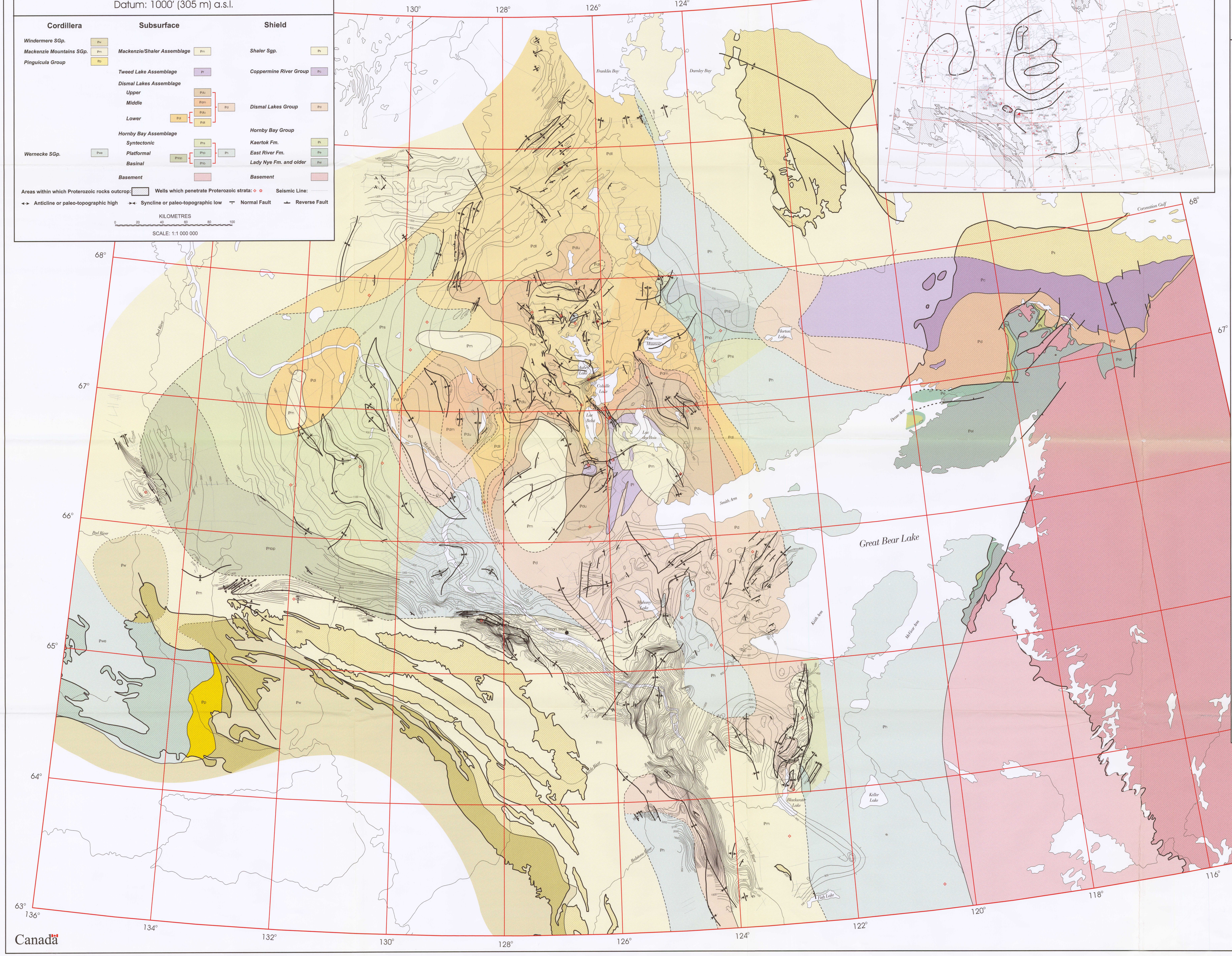
Cordillera		Subsurface		Shield	
Windermere SGp.	Pw				
Mackenzie Mountains SGp.	Pm	*Mackenzie/Shaler Assemblage*	Pm	*Shaler Sgp.*	Ps
Pinguicula Group	Pp				
		Tweed Lake Assemblage	Pt	*Coppermine River Group*	Pc
		Dismal Lakes Assemblage			
		Upper	Pdu		
		Middle	Pdm	*Dismal Lakes Group*	Pd
		Lower	Pdl (Pdlu, Pdll)		
			Pd		
		Hornby Bay Assemblage		*Hornby Bay Group*	
		Syntectonic	Phs	*Kaertok Fm.*	Pk
Wernecke SGp.	Pwe	*Platformal*	Php (Phbp)	*East River Fm.*	Pe
		Basinal	Phb (Phbp)	*Lady Nye Fm. and older*	Pel
			Ph		
		Basement		*Basement*	

Areas within which Proterozoic rocks outcrop: ▨ Wells which penetrate Proterozoic strata: ◇ ✲ Seismic Line:

Anticline or paleo-topographic high · Syncline or paleo-topographic low · Normal Fault · Reverse Fault

KILOMETRES 0 20 40 60 80 100

SCALE: 1:1 000 000



Canada

OPEN FILE 2998

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NOTE: Although every effort has been made to ensure accuracy, this Open File Report has not been edited for conformity with Geological Survey of Canada standards.

Sub-Cambrian Unconformity Subcrop and Seismic Time Structure Map, western plains, Northwest Territories, Canada.

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NTS:

85 M,N,O	86B to G, J to O	87A(W), B, C, D(W)
95M,N,O,P	96	97A,B,C,D
105M,N,O,P	106	107A,B,C,D

Introduction

Analysis of reflection seismic data, tied to available exploration wells, has permitted the development of a 'Seismic Time Structure Map' (STSM) of the sub-Cambrian Unconformity (SCU), or base of Phanerozoic. This is the surface upon which the Mount Clark Formation (the basal Cambrian sand and a potential reservoir rock) was deposited. The STSM is here superimposed on the Cambrian Subcrop map that was previously released as GSC Open File #3502 (revised: March, 1999).

The data

The database consists of outcrop information as derived from published maps combined with several thousand line-kilometres of reflection seismic data and a number of exploration wells. The seismic and well data were collected by the oil and gas industry during some 30 years of exploration, submitted according to federal regulations and, after a period of confidentiality, released to the public by the National Energy Board. These data have been interpreted as part of a regional study of the buried Proterozoic under the western plains of N.W.T.. The seismic tracks and those wells which drilled into the pre-Cambrian section are plotted on the larger map.

Cambrian Subcrop

The subcrop map shows the strata which immediately underlie the sub-Cambrian Unconformity. It reveals aspects of the stratigraphy and tectonics of the Proterozoic of western N.W.T. and was the focus of GSC Open File #3502. Seismic figures supporting the text can be found in that open file.

Seismic Time Structure Map (STSM)

Map creation:

The SCU reflection horizon was correlated through the seismic dataset and confirmed with well ties. The values were picked and then adjusted to a common datum of 1000' (305m). Mapping software was used to check all line intersections for misties. Significant misties were investigated and errors corrected by hand but final smoothing and mistie adjustments were performed by the Landmark/Zycor 'Z-Map' mapping software. Data points were then posted and contoured by hand at a working scale of approximately 1:150,000. These map sheets were subsequently digitized and combined. Machine contouring was found to be unsatisfactory.

Depth-to-time conversions of sonic logs typically have as their time-datum the depth of the first log value. As this depth is rarely at the mapping datum, a time-shift equal to the two-way travel time from mapping datum to first log value must be calculated and applied to the converted log. The simple calculation [Time = (Depth from Datum x 2)/V_1] requires an estimate be made at each well of the sonic velocity (V_1) of the rock above the first log value and below mapping datum. This estimate was guided by the Replacement Velocities (V_R) that had been used during seismic processing to calculate static corrections and was constrained to be no greater than the shallowest velocity recorded on the Sonic log. The estimated V_1 values are posted and contoured on the inset map. This map shows the velocities to be highest in the area north and west of Smith Arm of Great Bear Lake where Paleozoic carbonate rocks lie very close to the surface. The small area of 4 km/s in the southwest is due to shallow Devonian carbonates over the Laramide aged Imperial Anticline. Areas of lower velocity (to the northwest, and to the west of Keith Arm) have Cretaceous and, locally, Tertiary rocks in the upper section.

Features of Note:

When examining any STSM map, three characteristics must be kept in mind. First: the contours are of reflection <u>time</u> rather depth. Consequently, lateral variations in rock velocity and improperly applied weathering or elevation corrections can result in features which are prone to misinterpretation. Second: the contours are of the SCU surface as it exists today and thus does not differentiate between paleo-topography and structure and the structures range in age from early Cambrian to Recent. Third: the level of detail is proportional to the density of the seismic grid and data gaps can result in known features not being present on this map. One such example is the Laramide age Belot Ridge which runs along the west shore of Lac Belot.

Cambrian:

Early Cambrian extension and subsidence is best expressed by a large low extending from the southern map boundary to just north of 65° and by an area of extension faults between Smith and Keith arms of Great Bear Lake that extends westward to about 127°. The large low is the Mackenzie Trough of MacLean and Cook (1999b) and is an area of anomalously thick early Cambrian strata.

Laramide reactivations:

Most of the narrow anticlines in the area of Colville Lake are due to Laramide transpressional reactivation of Proterozoic faults as described in MacLean and Cook (1992) and illustrated by Seismic Figure D of Open File #3502.

Laramide compression:

An area of closely spaced contours west of Norman Wells reveals the hanging wall block of Imperial Anticline (Cook and MacLean, 1999a; Seismic Figure E of Open File #3502).

Laramide extension:

Seismic reveals two large extension faults which developed first in the Proterozoic and were reactivated during post-Devonian tension and later by Laramide(?) transpression. One is a N-S trending fault in the southeast, just north of Blackwater Lake and is illustrated in Seismic Transect G of Open File #3502. The other is a NW-SE feature in the northwest which is less well defined aerially due to lack of data but is well imaged on Seismic Figure A of Open File #3502.

Recent:

An early step in seismic processing is to correct for shallow weathering anomalies such as those produced by Quaternary and Recent sediments. It is an unfortunate fact of life that errors and oversights are sometimes made at this stage of the processing stream resulting in reflection time anomalies which are often subtle and difficult to identify. The fact that this map contains data shot and processed over three decades by many different companies almost guarantees the presence of such anomalies.

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