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**LITHOPROBE Seismic Reflection Profiles
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ABSTRACT

As part of the national LITHOPROBE program, nearly 270 km of deep seismic reflection data were recorded along five lines extending from east of Canal Flats to Lower Arrow Lake in the southeastern Canadian Cordillera of British Columbia. The seismic lines crossed from east to west the Rocky Mountain trench, the Purcell anticlinorium, the Kootenay arc, the Nelson batholith and the Valhalla metamorphic core complex. In crossing the various tectonic units several major faults were imaged. The multichannel seismic reflection data were collected by Enertec Geophysical Services Ltd of Calgary using the Vibroseis technique and processed by Veritas Seismic Ltd of Calgary. Information presented in this report should be sufficient to allow interested parties to interpret independently the seismic reflection data. Included are:

- (i) a simplified geological map of the surveyed region;
- (ii) line drawings of the unmigrated seismic reflections;
- (iii) the unmigrated seismic reflection sections plotted at a horizontal scale of 36 traces/inch and a vertical scale of 1.875 inches/second;
- (iv) line location maps at 1:50,000.

RÉSUMÉ

Dans le cadre du programme national LITHOPROBE, cinq lignes de sismique réflexion à grande pénétration dont la longueur totalise près de 270 km ont été enregistrées dans la région allant de l'est de Canal Flats jusqu'aux lacs Lower Arrow dans le sud-est de la Cordillère canadienne en Colombie Britannique. Les lignes ont traversé d'est en ouest la Fosse des montagnes Rocheuses, l'anticlinorium de Purcell, l'arc de Kootenay, le batholite de Nelson et le complexe métamorphique central de Valhalla. Plusieurs failles majeures ont été mises en évidence en passant d'une unité tectonique à l'autre. Les données multicanales de sismique réflexion ont été enregistrées par Enertec Geophysical Services Ltd de Calgary au moyen de la technique vibrosismique et elles ont été traitées par Veritas Seismic Ltd de Calgary. L'information présentée dans ce rapport devrait permettre aux personnes intéressées d'interpréter indépendamment les données de sismique réflexion. Le rapport inclue:

- (i) une carte géologique simplifiée de la région du levé;
- (ii) une représentation stylisée des coupes-somme non-migrées;
- (iii) les coupes-somme non-migrées reproduites à une échelle horizontale de 36 traces/pouce et une échelle verticale de 1.875 pouce/seconde;
- (iv) les cartes de localisation des lignes au 1:50,000.

INTRODUCTION

The multichannel seismic reflection data released in this report was collected under the auspices of the LITHOPROBE scientific program to determine the deep structure of the Canadian landmass and adjacent offshore regions. LITHOPROBE, Canada's national geoscience program, involves participation from Federal and Provincial agencies, universities and industry. The general theme of the southern Canadian Cordilleran transect is "to establish the structure, geometry and relationships at depth of the crustal terranes that make up the southern Canadian Cordillera as a means of comprehending the mechanisms, timing and methods of assembly of its continental crust over the last 180 million years".

In 1985, under a contract to the Federal Department of Supply and Services, five multichannel seismic reflection profiles were collected for LITHOPROBE by Enertec Geophysical Services Ltd of Calgary across the southeastern Canadian Cordillera of British Columbia. Initial processing of the nearly 270 km of data was completed through a contract to Veritas Seismic Ltd of Calgary.

SEISMIC REFLECTION PROFILES FROM THE
SOUTHEASTERN CANADIAN CORDILLERA

Specific objectives of this project were:

1. Determine the depth to and western limit of autochthonous North American basement beneath the Rocky Mountain thrust and fold belt, the Rocky Mountain trench and the Purcell anticlinorium.
2. Map structures within the deformed cover of the Rocky Mountain thrust and fold belt and the Purcell anticlinorium.
3. Determine whether North American basement is involved in thrust structures of the Purcell anticlinorium.
4. Delineate the nature of the westward thinning of the continental crust.
5. Resolve the structural relationships between the easternmost accreted terranes and cratonic North America.
6. Outline the subsurface configuration of the Nelson batholith and related country rocks.
7. Map the orientation and depth projection of extensional faults such as the Slocan Lake fault zone and determine their relationship to earlier compressional faulting.
8. Define the subsurface structural configuration of the Valhalla metamorphic core complex.
9. Determine the reflection characteristics of the crust-mantle transition and its relationship to crustal structure.

Figure 1 shows the locations of the LITHOPROBE seismic reflection lines, 1 to 5, superimposed on a geological map of the southeast Canadian Cordillera. The geological map is simplified from a large number of papers summarized in Cook et al. (1987, 1988).

Line drawings and preliminary interpretations of the reflections recorded on the five LITHOPROBE profiles are shown in Plate 1 (foldout) and the full-size seismic reflection sections are given in Plates 2 to 7 (foldouts). Plates 8 to 12 (foldouts) are maps of the seismic lines plotted at 1:50,000. Tables 1 and 2 show respectively the recording and processing parameters. Preliminary interpretations of these data are described by Cook et al. (1987, 1988). A more advanced description of the data from a portion of line 1 is given in Eaton and Cook (1988).

DIGITAL DATA

The following can be obtained for a nominal handling charge and the cost of materials and reproduction:

- (a) Digital tapes - unmigrated stacked sections as plotted in Plates 2 to 7;
- (b) Digital tapes - raw (demultiplexed and correlated), common shot point (SEGY) data;
- (c) Digital tapes - locations and elevations of vibrator and receiver points;
- (d) Maps - crooked line "construction boxes";

by writing to:

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FIGURE CAPTION

1. Map showing the geological relationships and line locations of the LITHOPROBE transect across the southeastern Canadian Cordillera (from Cook et al., 1988). The inset illustrates the five major tectonic provinces of the Canadian Cordillera. Abbreviations used for the belts are: RMB - Rocky Mountain thrust and fold belt, OCB - Omineca crystalline belt, Int. B - Intermontane belt, CPC - Coast Plutonic complex, Ins. B - Insular belt. Abbreviations used for the faults are: HLF - Hall Lake fault, MF - Moyie fault, RWF - Redwall fault, RMT - Rocky Mountain trench, SMF - St. Mary's fault, SLF - Slocan Lake fault, VSZ - Valkyr shear zone, WF - Waneeta fault, WBF - West Bernard fault. Solid circles and teeth marks on the fault symbols are on the hanging wall. Sources of material used in the compilation of the map are identified in Cook et al. (1988).

PLATE CAPTIONS

1. Line drawing summary and preliminary interpretation of the reflection geometry observed on the LITHOPROBE southeast Canadian Cordillera data. See plate for further details.
2. LITHOPROBE seismic reflection section from line 1A of the southeast Canadian Cordilleran transect. Horizontal scale is 36 traces/inch and vertical scale is 1.875 inches/second (roughly 1:1 horizontal to vertical exaggeration). All relevant processing parameters are given in the information panel beside the data. Location of the line is given in plate 8.
3. LITHOPROBE seismic reflection section from line 1B of the southeast Canadian Cordilleran transect. Horizontal scale is 36 traces/inch and vertical scale is 1.875 inches/second (roughly 1:1 horizontal to vertical exaggeration). All relevant processing parameters are given in the

information panel beside the data. Location of the line is given in plate 8.

4. LITHOPROBE seismic reflection section from line 2 of the southeast Canadian Cordilleran transect. Horizontal scale is 36 traces/inch and vertical scale is 1.875 inches/second (roughly 1:1 horizontal to vertical exaggeration). All relevant processing parameters are given in the information panel beside the data. Location of the line is given in plate 9.
5. LITHOPROBE seismic reflection section from line 3 of the southeast Canadian Cordilleran transect. Horizontal scale is 36 traces/inch and vertical scale is 1.875 inches/second (roughly 1:1 horizontal to vertical exaggeration). All relevant processing parameters are given in the information panel beside the data. Location of the line is given in plate 10.
6. LITHOPROBE seismic reflection section from line 4 of the southeast Canadian Cordilleran transect. Horizontal scale is 36 traces/inch and vertical scale is 1.875 inches/second (roughly 1:1 horizontal to vertical exaggeration). All relevant processing parameters are given in the information panel beside the data. Location of the line is given in plate 11.
7. LITHOPROBE seismic reflection section from line 5 of the southeast Canadian Cordilleran transect. Horizontal scale is 36 traces/inch and vertical scale is 1.875 inches/second (roughly 1:1 horizontal to vertical exaggeration). All relevant processing parameters are given in the information panel beside the data. Location of the line is given in plate 12.

8. 1:50,000 map showing the location of LITHOPROBE Cordilleran lines 1A and 1B.
9. 1:50,000 map showing the location of LITHOPROBE Cordilleran line 2.
10. 1:50,000 map showing the location of LITHOPROBE Cordilleran line 3.
11. 1:50,000 map showing the location of LITHOPROBE Cordilleran line 4.
12. 1:50,000 map showing the location of LITHOPROBE Cordilleran line 5.

TABLE 1 FIELD PARAMETERS

Receiver Information

Geophone group interval-100 m
 Geophone layout-18 at 4.11 m
 Geophone type-L - 28D, 14 Hz
 Recording instrument-DFS V, 120 channels, correlator
 with various noise reject systems
 Field filter -12 - 64 Hz, (notch in)
 Gain mode-independent floating point
 Sample interval-4 ms
 Record length (after correlation)-18.8 s (only 16 s of data have been
 processed)

Source Information

Source interval-200 m
 Source layout-4 vibrators at 5 m
 Source type-Hemi 50 units with Pelton electronics
 Sweep frequencies-8 - 40 Hz
 Sweep length-32 s
 Number of sweeps per location -15
 Refraction shots for statics-32 thumps at 1 km intervals

General

Common reflection point coverage-3000% in most regions, 6000% to 9000%
 across the Rocky Mountain Trench

Spread layout	1	80	X	81	120
	8200	300		300	4200

Roll-on and roll-off at the end of each line. On some lines the roll-on and/or roll-off was achieved more rapidly by vibrating at 100 m intervals instead of the regular 200 m intervals. The Rocky Mountain trench and Kootenay Lake were undershot.

TABLE 2 PROCESSING PARAMETERS

Demultiplex (sample rate 4 ms)

Amplitude recovery and apply exponential gain

Crooked line geometry

Trace edit on shots

First break mutes

Elevation statics (datum - 2000 m above sea level;
replacement velocity - 4000 m/s)

Automatic Gain Control (1000 ms window)

Trace gather

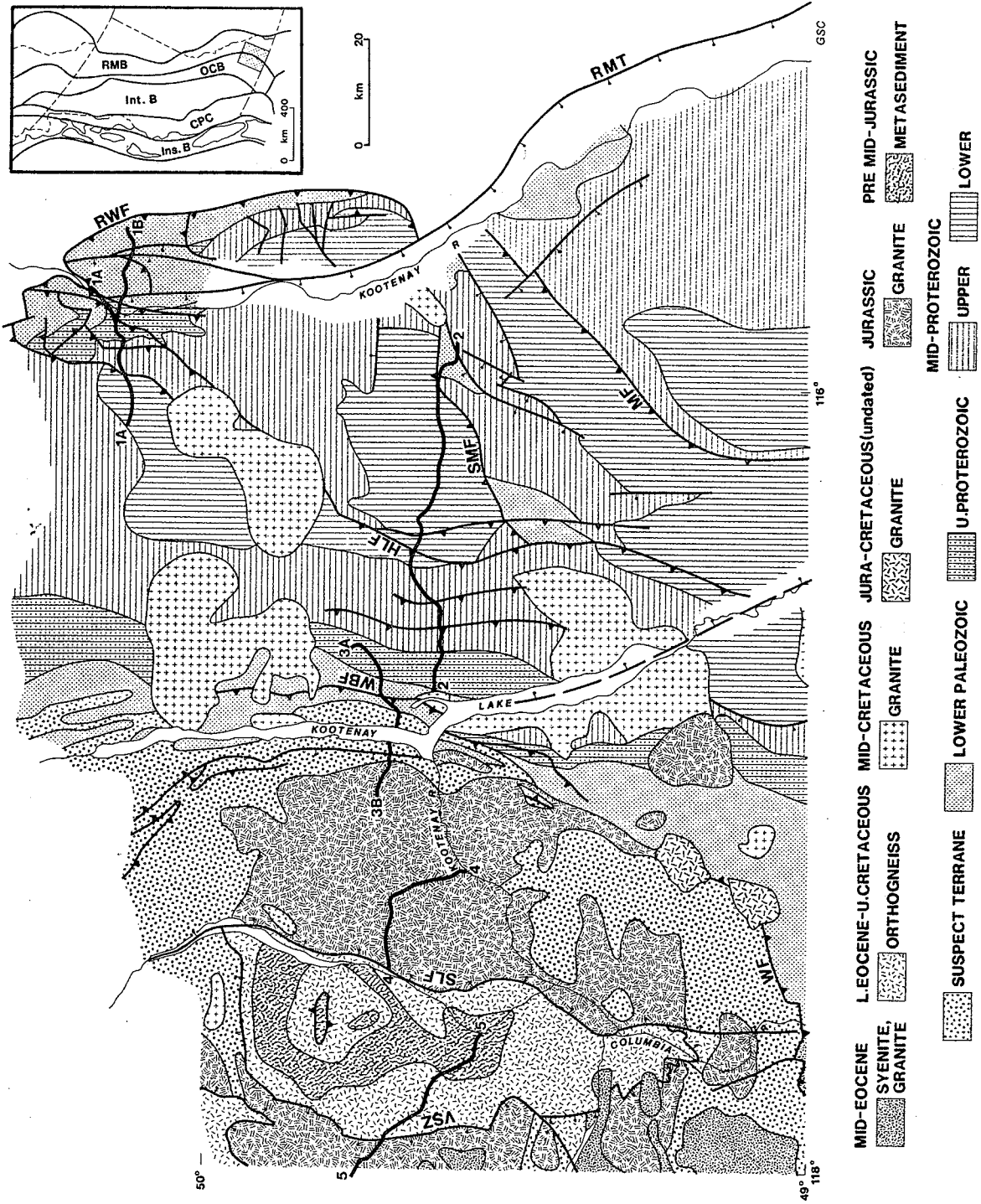
Normal moveout corrections

Common reflection point stack

Frequency filter (5/8 - 40/45 Hz)

Amplitude equalization (1000 - 7000 ms)

Plot (36 traces/inch, 1.875 inches/s)



- MID-EOCENE SYENITE, GRANITE
- LEOCENE-U. CRETACEOUS ORTHOGNEISS
- SUSPECT TERRANE
- LOWER PALEOZOIC
- JURA-CRETACEOUS (undated) GRANITE
- JURASSIC GRANITE
- PRE MID-JURASSIC METASEDIMENT
- MID-PROTEROZOIC UPPER
- U. PROTEROZOIC LOWER

Thrust fault (teeth on hanging wall) . . . —
 Normal fault, solid circle on hanging wall (defined, approximate) . . . —

FIGURE 1

