821-6-6-11
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Digital Seismic Survey

NOMAC AREA, N.W.T.

OIL & GAS OPERATIONS UNIT
Oil and Mineral Division
FEB 23 1973
OTTAWA, CANADA
Dept. of Indian Affairs & Northern Development

for

CanDel Oil Ltd.
Calgary, Alberta

by

Geophysical Service Incorporated
Calgary, Alberta

during

February and March
1972

over

Permits 3912, 3913, 3914, 3916, 3917, 3918,
3991, 3990, 4085, 4086, 4087, 4088,
4089, 4105, 4106, 4109, 4110

Report
by

McGee Exploration Ltd.

September 1972

Project #821-6-6-72-4

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INTRODUCTION

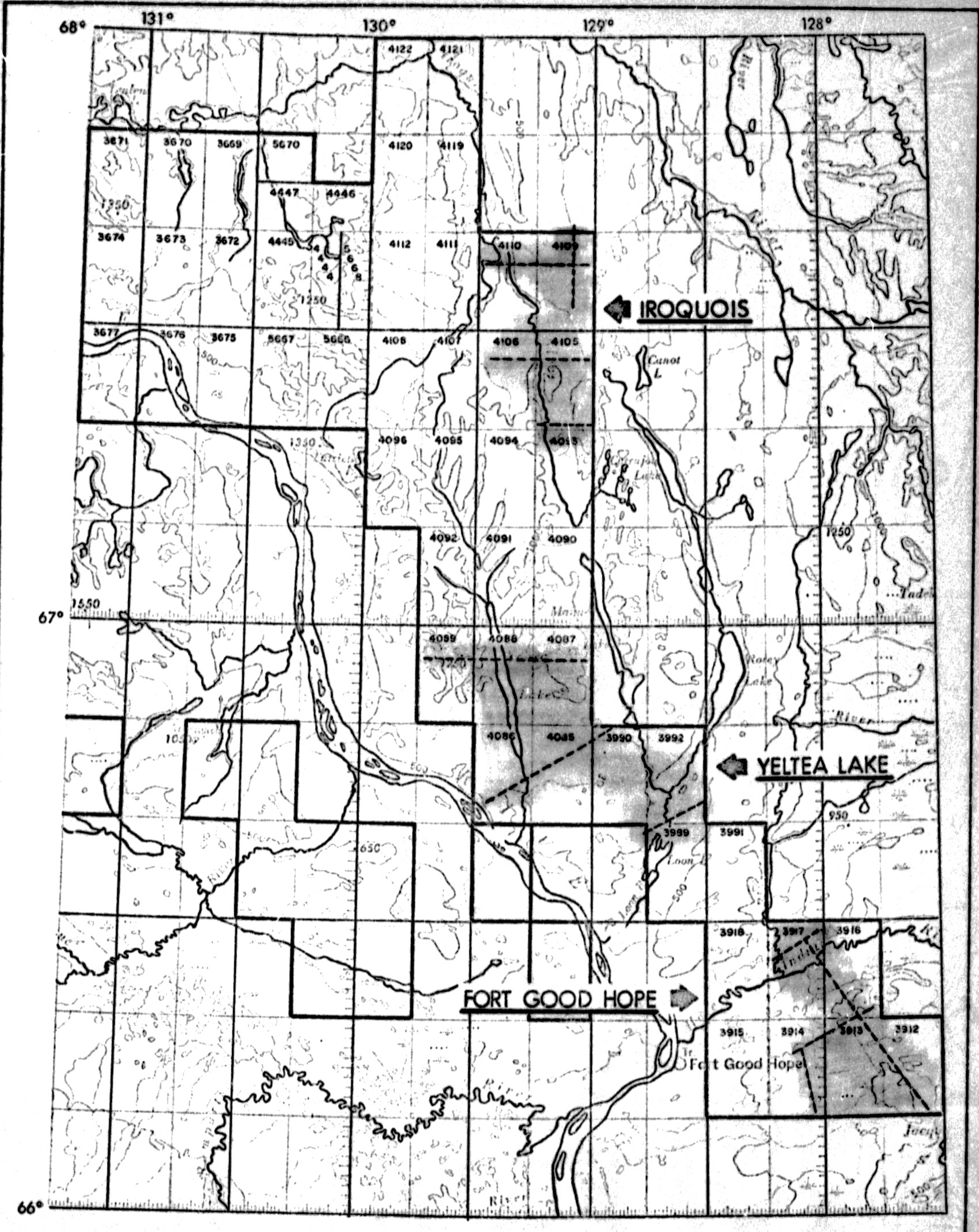
A digital reflection seismic survey was carried out for CanDel Oil Ltd. in the Nomac Area of the Northwest Territories during February and March, 1972, by Geophysical Services Incorporated.

The survey consisted of 142 miles of lines spread over a large area from east of Ft. Good Hope in NTS 106-I-SE and NTS 106-L-SW north northwest for a distance approaching 100 miles into NTS 106-P-NW. Because the lines of control present a very widespread pattern over a large area, the maps have been prepared on a scale of 1 inch equal 2 miles to keep the maps to a manageable size.

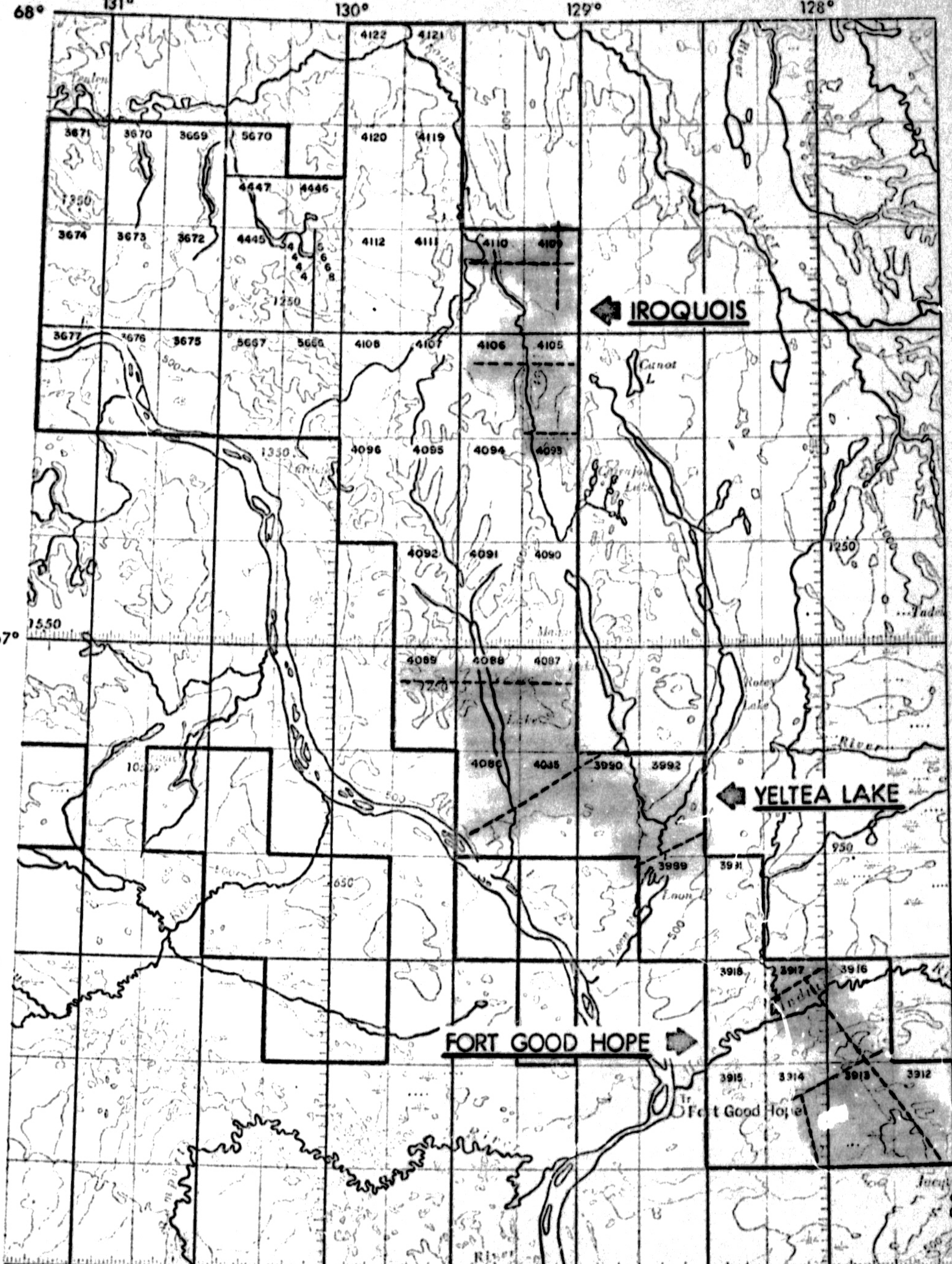
STATISTICAL DATA

Dates

February 7, 1972	Crew begins move from south of Norman Wells to east of Ft. Good Hope (154 miles)
February 13, 1972	Crew arrives at Nomac Prospect
February 14, 1972	Drills and Cats start on line 72-0
February 15, 1972	Recording crew starts shooting
March 29, 1972	Recorders finish Nomac area
March 30, 1972	Begin long move to Ontaratue River



CanDel Oil Ltd.	Calgary Alberta	Revised	**NOMAC AREA** Northwest Territories
Interpretation by			
Drawn by C.B. James	Date Jan. 23/73		
Checked by	Date		
Scale Miles 10 5 0 10 20			



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PRODUCTION STATISTICS

Profiles Shot	854
Miles Shot	142.33 miles
Recording time	316.00
Recording travel and move time	265.50 hours
Total recording hours	581.50 hours
Holes drilled	860
Footage drilled	33,498 feet
Drilling hours	935.00 hours
Drill travel and move time	1083.50 hours
Total drill time	2018.50 hours
Dynamite used	8740 lbs.
Caps used	876
Normal charge size	10 lbs.
Normal hole depth	40 feet
Rock Bits used	17
Insert Bits used	318
Mud used	0
Bran used	0
Total Cat hours	3592.00 hours

EQUIPMENT

1. Camp (All sleigh mounted)

   3 - 10' x 32' - twelve man sleepers
   1 - 10' x 30' - utility trailer
   1 - 10' x 32' - kitchen/diner
   1 - 10' x 30' - workshop with 30 KW light plant
   1 - 10' x 30' - flat deck trailer with 3-500 gallon fuel tanks
   1 - 10' x 40' - flat deck trailer with 5-500 gallon fuel tanks

2. **Basic Party (All G.S.I. owned)**

1 - 6T Foremost Recorder with instrument doghouse and a 5 KW light plant
1 - 5100 Foremost Shooting Unit
2 - 6T Foremost flatdeck cable units
1 - 4 x 4 1969 Dodge ½ ton pick-up P.M. Unit
1 - S-100 Foremost flatdeck's survey unit

3. **Drills**

2 - G.S.I. owned 6T Foremost mounted Carey Auger drills
2 - Yukon mounted Mayhew 1000 air water combination drills (Seisform Drilling)
2 - Nodwell mounted water tank units (Seisform Drilling)

4. **Cats (Lyle Adam Construction)**

1 - kitchen/diner sleeper)
1 - sleeper trailer) sleigh mounted
1 - power plant fuel storage workshop)

2 - D7E cats with winches and canopies
2 - D6C cats with winches and canopies

5. **Auxiliary Recording Equipment**

1 - DFS III ½ inch binary gain 48 trace digital recording system with spare parts kit, complete with radios, tone boxes and other necessary equipment.
14 - sections of cable (220' group interval with communication take outs) (6 groups/section)
90 - Groups of Geophones (9 per string spaced at 18 feet)
1 - Dry write 48 trace camera

CREW PERSONNEL

1 Party Manager	6 Recording helpers
1 Instrument Engineer	2 Cooks
1 Junior Observer	1 Mechanic
1 Shooter	1 Camp Attendant
1 Shooter Helper	4 Drillers
1 Surveyor	4 Drill helpers
1 Rodman	8 Catskinners

RECORDING PARAMETERS

Sample Rate	2 ms
Record Length	4 sec
Recording Filters	18 Hz - 124 Hz/36 db slope
Upholes seis offset	10 feet
Gain Mode	Operate
Gain Constant	30 db
Initial Gain	varied
Final Gain	90 db
Upper Set Limit	75%
Lower Set Limit	25%
60 Hz Notch Filters	Out

Instrument tests to check dynamic range, amplifier noise, DFS noise and AGC circuitry were run daily before commencing production shooting.

SHOOTING AND SPREAD DETAILS

Type of Coverage	6 fold CDP
Group Interval	220 feet
Spread Layout	Split 5170-110-0-110-5170
No. of Groups	48
Group Length	144 feet
Group Pattern	Inline with spread
Seismometers	Type HSJ 14 cycle, 9 phones in series parallel
Shot Point Spacing	880 feet
Shot Pattern	Single, 40 foot holes
Charge Size	10 pounds

FIELD PROCEDURES

INSTRUMENTATION

The instruments were a 48 trace, 9 track Tl Series DFS III digital field system with binary gain amplifiers. The instruments were mounted in a doghouse in a 6T Foremost. The instrument batteries were charged with a 5 KW Wisconsin generator mounted on the back of the Foremost. Field recordings were displayed on dry write paper with the use of a 50 trace camera. The records were displayed either as direct playbacks (DPB) or as read after write monitors (RAW).

The direct monitor is produced by reading the recorded data from tape just after it has been written by the write head. Therefore on the direct monitor the time break and timing lines are displayed at true times and all other displayed information including uphole break and seismic data are delayed an amount, dependent on tape speed.

Playbacks can be made either as amplifier playbacks or direct playbacks. Amplifier playbacks are made through the binary gain amplifier system where bandpass filtering and playback gain can be selected as desired. On direct playbacks, the signal is generated from the digital to analogue converter and goes directly to the camera.

Instrument test to check dynamic range, amplifier noise, DFS noise and AGC circuitry were run daily before commencing production shooting.

DRILLING

The work was carried out using two air/water drills and two auger drills. The rocks drilled were mainly clay, shale, and sandstone. All of the conventional drilling was done with air. The augers could not drill a good percentage of the holes because the shale and sandstone was too hard.

Hole depths of 40 to 50 feet gave seismic records of satisfactory quality and no deeper drilling was attempted.

Line Clearing and Land Use

Two D6 and two D7 Cats were subcontracted from Lyle Adam Construction of Grande Prairie, Alberta. The Cats were used both for line cutting and for camp moves.

All areas were covered with small spruce trees which were very sparse in places. No line lopping had to be done with the exception of the odd line where the crew did it themselves with a chainsaw carried on the recording crew. This was satisfactory and passed inspections made by the Department of Forestry. All creek crossings were removed by the Cats after the crew had passed through to the satisfaction of the Ranger. No timber was encountered in any of the areas worked.

All garbage was saved, burned and buried in either a pit dug by the Cats or in holes dug to a depth of 10 feet with a 12 inch bit especially made for this purpose.

All Cats were equipped with shoes on the dozer blades and damage to the tundra was kept to a minimum. Various inspections on this were made by the Ranger. Approximately six inches of snow and trash were left as a cover on all lines cut.

SURVEY

The surveying was done by Theodolite. Wellsites, old shot points and Government Benchmarks were used for control. On occasions some lines were cut according to old seismic work and landmarks and later incorporated into the survey as control was established. Because of the short daylight hours, chaining was normally done in the dark so that the daylight could be used for running elevations and horizontal control.

CONDITIONS

The greatest factors affecting the production was the length of camp moves between lines. In some cases move time was considerably more than actual time spent working on the job.

Extreme cold spells in February hindered operations. Many equipment breakdowns were experienced during these cold spells (40° - 60° below zero). Storms affected the flying in of breakdown parts and supplies.

Radio communications were at the best of times unreliable. In the Fort Good Hope area the mobile telephone could not be used and the single side band radio linkup with Precambrian Mining Services in Norman Wells was the only method of communication.

Fuel was a problem since preparations were not made before freeze up. Only enough fuel and expendables were barged in to last the crew until after Christmas, since it was not known where the next program would be. Fuel had to be trucked in to the crew from Norman Wells after January 1st. This was hampered by storms which plugged the roads with snow and added to the expense of trucking.

Because of the widespread program, the Cats and their camp had to stay close to the main camp in order to keep it moving. Occasionally the Cat camp moved ahead with the surveyors and drillers while the main camp was left behind for the recording crew.

NOMAC AREA - DATA PROCESSING

Production Processing Parameters

1. Record Split and Translation

   (a) 48 trace field record split into two 24 trace records (#1-24; #25-48) for subsequent processing.

   (b) ¼" 9 track DFS III format translated to 1" 21 track DFS III format.

2. Binary Gain True Amplitude Recovery

B	=	-20.000 db
α	=	15.000 db/sec.
T_o	=	0 secs.
Tmax	=	2.3 secs.

3. Normal Moveout

Typical Function:

Vo = 12100 ft./sec. (i.e. Velocity intercept at time zero)

Time (secs.)	Velocity (ft./sec.)
0	12100
.208	12840
.360	16500
.580	18000
4.000	20680

Functions compiled from Constant Velocity Stacks, run where required.

4. Structure Statics

Computed by uphole-elevation method using reference plane of 500 ft. and replacement velocity 12,000 ft./sec.

Additional weathering corrections applied where necessary i.e. where first break refractions plots indicate $V < 12,000$ ft./sec.

5. Deconvolution (Time Variant)

Number of Gates	=	4
Gate Lengths	=	1067 ms
Operator Length	=	60 ms
To	=	300 ms
Tmax	=	3500 ms

6. Time Variant Scaling

Applied to 100% records to bring each trace to the same average modulation level.

Start Time	=	150 ms.
No. of Gates	=	13
Gate Length	=	200 ms. (Gate 1)
	=	300 ms. (Gates 2 through 13)

7. **C.D.P. Gathers**

Two sets of 3 fold common depth point gathers were produced, one containing traces 1-24 only, and the other containing traces 25-48 only. These gather records were use d for all subsequent processing.

8. **Automatic Residual Statics**

Gate Length	= 150-200 ms
Digital Filter	= 30-60 Hz
No. of Iterations	= 8

9. **First Break Suppression**

Offset =	0 ft.	Time =	0 msecs.
=	2750 ft.	=	400 msecs.
=	5170 ft.	=	500 msecs.

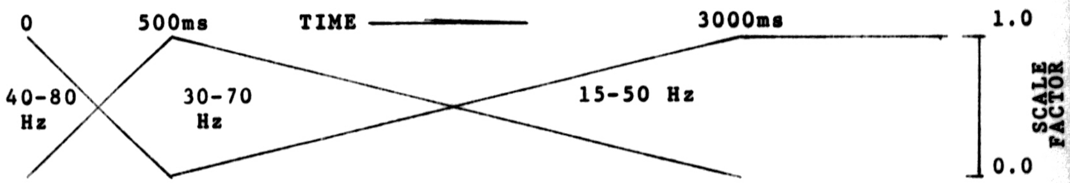
10. **Stack**

2 sets of 3 fold common depth point gathers combined to give 600% C.D.P.Stack.

11. **Digital Filter (Time Variant)**

(a) All lines: Number of Filters = 3
Length of Filters = 200 ms.

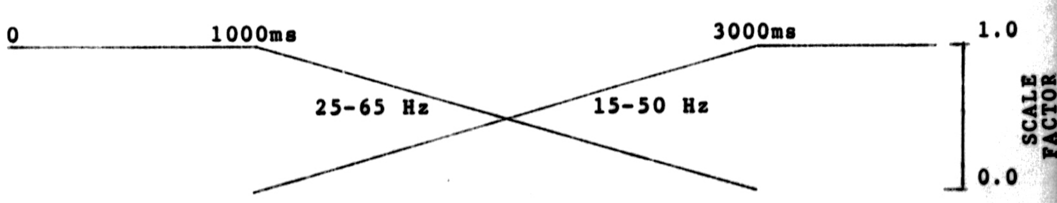
Filter Application:



(b) Lines 72-7, 72-10 (additional filtered sections)

Number of Filters = 2
Length of Filters = 200 ms

Filter Application:



12. Time Variant Scaling

Applied to stack records so as to give same modulation level on data traces as would be seen on a synthetic seismogram.

Experimental Processing

Prior to starting the production processing several analyses were made to determine various parameters.

(a) 6 typical records on line 72-0 were used to determine the T.A.R. parameters.

(b) 2 Harmonic Analyses were run on line 72-0 at shot points 24 and 43 respectively, testing frequencies from 0-100 Hz. An additional Harmonic Analysis was run on the unfiltered stacked data, on line 72-5.

(c) 2 Deconvolution Analyses were also run on line 72-0, at shot points 24 and 43 respectively, testing from 1 to 7 filters, and 16 to 32 points.

(d) 11 Constant Velocity Stacks were run where required in order to determine velocity functions.

RESULTS AND INTERPRETATION

The sedimentary section in this area consists of a thin section, less than 1000 feet thick, of shales of Upper Devonian age underlain by carbonates of the Hume, Bear Rock, and Ronning formations. This is followed by Cambrian sediments consisting primarily of shales, siltstones, sandstones, and evaporites. These lie disconformably over Proterozoic sediments.

Reflections

Reflections are present from the Hume, but in the deeper portions of the area only. In much of the area, the Hume is too shallow to be recorded with the methods used for this survey. Where the reflection is present, it is of good quality. Reflections are also obtained from the Cambrian section. The principal reflection is believed to be from the Cambrian Salt; this reflection is the only one which may be mapped continuously over all of the area. It is not of consistent quality; probably because of changes of thickness within the Cambrian Salt and changes of thickness of Cambrian sediments above the salt.

Maps

Because of the wide distances between lines - up to 28 miles - and because of the large area covered by this survey, the maps have been prepared using a scale of one inch equals two miles.

The work can be divided into three parts as follows: five lines of seismic control located east of Ft. Good Hope in N.T.S. 96-L-SW and in N.T.S. 106-I-SE; two lines in the Yeltea Lake Area, N.T.S. 106-I-NW; and four lines in the Iroquois Area, N.T.S. 106-P-NW and SW.

Topographically, the Ft. Good Hope portion of the area is rolling hills with a maximum elevation of 916 feet above sea level at Shot point 50 on Line 72-4 and a minimum elevation of 174 feet above sea level at Shot point 138 where Line 72-4 crosses the Hare Indian River. The Yeltea Lake area is of higher elevations reaching a maximum of 1236 feet above sea level on Line 72-6 at Shot point 18 and a minimum elevation of 545 feet above sea level on the Tieda River below Yeltea Lake. The Iroquois River area shows a maximum elevation of 1061 feet above sea level at Shot point 40 on Line 72-7 and a minimum elevation of 462 feet above sea level on Line 72-9 at Shot point 16; the main features in this area are the incised valleys of streams which are tributaries of the Iroquois River.

The Hume reflection can be followed only on Line 72-3 at the north end of the Ft. Good Hope portion of the area and on Lines 72-5 and 72-6 in the Yeltea Lake portion of the survey. The Hume map shows a time range of .105 seconds below the datum level of 500 feet above sea level to a time of .247 seconds. The map indicates basically monoclinal dip to the west-southwest at a rate of no more than 3 to 4 milliseconds per mile. This is the equivalent of 20 to 25 feet per mile. The only deviation from the monoclinal dip is the structural low shown on the west end of Line 72-5.

The map of the reflection from the Cambrian Salt shows structural relief and faulting. In the Ft. Good Hope portion of the area, faulting is indicated at two points on Line 72-1.

The most easterly of these is near the intersection of Line 72-1 with Line 72-4, and the faulting also shows at that point on Line 72-4. Because of the limited amount of seismic surveying, control for the alignment of the faulting is poor. Two structural possibilities can be inferred from this data: 1) a high located on the down side of the most easterly fault with the highest structural point shown as Shot point 112 on Line 72-4; 2) a high located along Line 72-0 about Shot point 15, or further west, and on the up side of the most westerly fault. Closure has not been proven on either of these structural possibilities. Because reflections from rocks younger than the Cambrian have not been mapped, the age of the faulting is not known.

The Yeltea Lake portion of the area shows mainly a structural low which coincides with the low shown by the Hume structure map; however, the Cambrian Salt shows more relief which will be apparent on the interval map between the two reflections.

The Iroquois River portion of the area shows a possibility of a large structural high, but no closure can be shown on this control in a northeasterly direction. If closure does exist, the structure could cover an area of at least 200 square miles. Because shallower reflections can not be mapped in this portion of the area, nothing is known of the age of the structure.

The map of the Interval from the Hume to the Cambrian Salt is shown only on Lines 72-3, 72-5 and 72-6 where the Hume can be mapped. Line 72-3 shows a much thinner interval, .460 to .470 seconds, than the two lines to the north. This is believed to be caused by a thicker Cambrian section under Line 72-3 with most of the thicker section being within the Cambrian Salt; the thicker intervals on Lines 72-5 and 72-6 are then thickening of the carbonate of the Hume, Bear Rock, and Ronning at least partly at the expense of the Cambrian. Lines 72-5 and 72-6 also show some variation in interval, with the prominent change being the thick interval on the west end of Line 72-5 that coincides with the structural low shown on the Hume and Cambrian Salt structure maps. This negative area might set up possibilities of structural high further to the west. A thin area is shown just east of Yeltea Lake, but it is difficult to show structural closure at that point.

CONCLUSIONS AND RECOMMENDATIONS

This survey has pointed up four structural possibilities based on the map of the reflection from the Cambrian Salt. The structural possibilities are located along the Line 72-4, along or west of Line 72-0, west of Line 72-5, and on Line 72-8. None of these possibilities are shown to have closure. The possible structure of Line 72-8 could cover a large area in excess of 200 square miles.

It is recommended that all four of these structural possibilities be followed with additional seismic surveying to provide a better idea of their horizontal and vertical closure.