THE JEAN MARIE MEMBER IN THE HOSSITL-RING AREA, BRITISH COLUMBIA

by

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SPECIAL PAPER 1993-1

Petroleum Geology Branch
Ministry of Energy, Mines and Petroleum Resources
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The Jean Marie Member in Hossitl-Ring Area, British Columbia

INTRODUCTION:

This study covers that part of the Interior Plains on northeastern British Columbia lying between 57° 35' and 60° 00' N. Latitude and 120° 00' and 122° 30' W. Longitude. The study purpose is to update an earlier (1981) internal report, to review general exploration and production activity, and to highlight potentially significant Jean Marie exploration leads.

Three subsurface maps and two wireline log cross-sections were prepared in the course of this study; these are:

1. Jean Marie Member, Isopachs of Gross Thickness
2. Jean Marie Member, Structure Contours on Top of Unit
3. Jean Marie Member, Isopachs of Net Effective Porosity
4. Jean Marie Member, Stratigraphic Cross-Section No. 1-9
5. Jean Marie Member, Stratigraphic Cross-Section No. 10-19

GEOLOGICAL SUMMARY:

The Jean Marie is the lowermost member of the Redknife Formation of Upper Devonian age (see accompanying cross-sections for stratigraphy). It is underlain by the relatively thick Fort Simpson Formation and is overlain by the unnamed shaley member of the Redknife.

Belyea and McLaren (1962) designated the type section for the Redknife Formation on Trout River, about 120 kilometres north of the northeast corner of the subject study area. Along this outcrop, however, about two-thirds of the Jean Marie Member is covered, and a supplementary section named is that penetrated by Briggs Turkey Lake No. 1 (60° 07' 30" N, 120° 22' 30" W), some 12 kilometres west of the exposure. The designated Jean Marie depth interval in the Turkey Lake No. 1 well section is 750 feet to 780 feet.

Throughout most of the study area the Jean Marie is a blanket shelf limestone deposited in a shallow marine environment subject to moderate wave energy. Generally the lithology is that of a slightly dolomitic calcilutite or calcarenite on a relatively thin, though persistent, platform carbonate, varying in thickness from 10 to 15 metres. In localities where shoaling conditions promoted more vigorous organic activity, tabular stromatoporoids and algae are important elements, and thicknesses can exceed 15 metres.

The thickest Jean Marie carbonate sections are encountered along the west margin of the shelf facies, where formation thickness can exceed 150 metres. Some of the wells penetrating these thick, western rim sections have encountered rather thin, gas-bearing intervals, but none have been put on production to date. Most of the tested gas flows along the western rim have been small and unsustained, and where wells are cored, a considerable proportion of vugs and other porosity types and fractures are seen to be infilled and cemented with calcite.

PRODUCTION AND RESERVOIR SUMMARY:

British Columbia's first Jean Marie gas production was obtained from Helmet field in March, 1977. Production from Helmet North followed in 1980. Within the study area, by the end of November, 1992, there were 104 Jean Marie gas wells; of these, 25 were tied in to pipeline. The following table shows designations by field.

Jean Marie Gas Wells, November, 1992

FIELD (approx. location)	NUMBER OF INDICATED GAS WELLS	NUMBER OF WELLS TIED IN
Elleh (D, E,/94-I-12)	2	-
Etthinthun (I, J/94-H-15)	1	-
Helmet (G, K, L/94-P-7)	10	1
Helmet North (94-P-10, 15)	49	16
Hossitl (94-P-14)	1	-
Midwinter (94-P-15)	13	-
Peggo (C, D/94-P-8)	9	4
Pesh (A/94-P-8)	10	2
Other Areas (various)	9	-

Note that Pesh field, where the productive Jean Marie was not tied in until 1991, has produced only 5% of its established original gas in place. The much larger Helmet North field, with its earlier pipeline connection, has produced approximately 14% of its established OGIP. Respective values for Helmet and Peggo are 5.5% and 9%. The combined established OGIP for these four fields is 9993 10^6 m^3 (355 BCF). Combined cumulative production to end of 1991 is 1261 10^6 m^3 (45 BCF) or 12.5% of established OGIP. Reference is made to OGIP because, depending on locality, recovery factors can vary from 50% to 80%.

Candidate wells for gas production must meet economic criteria with regard to drilling and completion costs, proximity to pipeline, and deliverability. The latter is very dependent upon reservoir permeability. The fact that Helmet North exhibits relatively high permeability is mainly responsible for the large number of its wells being tied in to pipeline.

Some of the reservoirs in the northeast part of Helmet North are characterized by vuggy, stromatoporoid reef facies showing varying degrees of fracturing. The intensity can vary from a few short, vertical to oblique fractures to intensely fractured zones as demonstrated by cored intervals that are quite rubbly. Fracture intensity appears to be related, in part, to facies: the more competent the facies, the more intense the fracturing. Fracturing has created a marked increase in reservoir permeability.

Examples of well sections with natural fracture enhancement are Czar et al N Helmet (WA 7250) in b-66-I/94-P-10 with deliverability of 631 846 m^3D (22 MMCFD) and Canhunter et al N Helmet (WA 7622) in c-94-I/94-P-10 which flowed up to 338 088 m^3D (12 MMCFD) with only a 61 kPa (10 psi) pressure drop.

Fracturing in the Jean Marie Member at Helmet North may be related to mechanics of compaction in the underlying, relatively thick Fort Simpson shale of the Cordova Embayment.

There is a close coincidence of the Jean Marie western shelf margin with the western edge of the Arrowhead Salient, Slave Point carbonate bank, from 94-P-5 northward to 94-O-16. Also, there appears to be near perfect coincidence between the Jean Marie western shelf margin and the Klua Embayment in the seaward front of the Keg River carbonate bank in 94-J-8, 9.

In the Midwinter, Helmet, Helmet North, Peggo and Pesh Fields net gas pay thicknesses average 6 metres, average porosity is 5.8% and water saturation range from 18% to 52.6%. Northward from about 59° 45' there is a gradual increase in Sw values. To date, no recovery of formation water from a porous Jean Marie section has been reported.

The reservoir systems of the Jean Marie in northeastern British Columbia are underpressured. This became apparent early in the exploration history and was confirmed by subsequent production rates that exceeded original AOF's. The problem of reservoir damage during drilling has been remedied by carefully tailored mud programs. Field observations indicate that these reservoirs register about 50% to 65% of normal hydrostatic pressure. From south to north there is an overall pressure decrease as outcrop areas in the Northwest Territories are approached. Hydrodynamics studies suggest that there are several pressure systems and that careful analysis should be employed for segregating pools.

Horizontal drilling will probably have a positive impact on additional Jean Marie gas development. For example, a borehole drilled in 1991 by Mobil in c-38-F/94-I-5 (WA 7590) drill stem tested 61 m^3D from the Jean Marie in the vertical hole. A subsequent open hole test in the horizontal leg after acidizing flowed gas at 20 000 m^3D. Similar significant increases in gas reserves might be expected from those extensive areas to the west and south of the Helmet - Peggo area.

CONCLUSIONS:

With a relatively deflated price of natural gas, the economics of Jean Marie exploration can seem tightly constrained. Technologically, however, the outlook for future resource development is quite encouraging. Current seismic methods are now able to better detect stromatoporoid build-ups and other subtle hydrocarbon traps. These improvements in seismic methods and horizontal drilling techniques could dramatically increase gas reserves in the Jean Marie of northeastern British Columbia.

Acknowledgements:

For advice and helpful discussions within the Petroleum Geology Branch appreciation is extended to John MacRae, John Rowling, Dave Richardson, Dan Walker, Maija Finvers, Peter Attariwala and Ron Stefik. Pertinenent data prepared by Maija Finvers, Dan Walker, Sylvia Chicorelli, Bob Gilchrist and Noel Pancy was freely drawn upon. Acknowledgement is due to Chris Blaney for his advice with respect to the drafting. Appreciation and thanks are extended to Ron Satterfield for his rendition of the drafting, and to Sharon Jorgensen for her patience on the word processor.

Grateful acknowledgement is also made to Czar Resources Ltd., Canadian Hunter Exploration Ltd., Chevron Canada Resources and others for technical information offered to the Branch in a truly cooperative spirit over the past several years.

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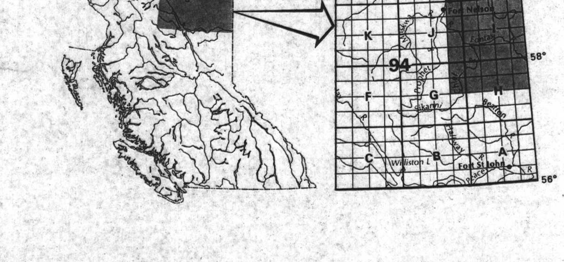
ISBN 0-7726-7426-4



REFERENCE

- status: Jean Marie gas well
8.4 - calculated thickness of net pay (= net eff. por.)
(4.6) - approximated thickness of net effective porosity
NGTS - no gas to surface on D.S.T.
3mFL - recovered 3 metres of drilling fluid on D.S.T.
55mGCM - recovered 55 metres of gas-cut mud on D.S.T.
NT - Jean Marie not tested
NR - Jean Marie not reached
MR or 2MR - misrun(s)

Province of British Columbia
Ministry of Energy, Mines and Petroleum Resources

NORTHEASTERN BRITISH COLUMBIA

HOSSITL - RING AREA

This map includes Universal Transverse Mercator (UTM) coordinates based on the North American Datum of 1983 (NAD 83). Advances in survey technology have enabled a redefinition of the datum upon which the coordinates are based. The latitude and longitude coordinates shown are approximate.

NOTE: All of the NAD 83 UTM coordinates shown on this map are within UTM grid zone 10.

Kilometres 5 0 5 10 15 20 25 30 Kilometres

Contour interval: 5 metres.

Jean Marie member
ISOPACHS OF NET EFFECTIVE POROSITY

Interpreted by: K.A.McAdam	Draughted by: R.D.Satterfield
Date: June 1992	Scale: 1:200 000

To accompany Petroleum Geology Special Paper 1992-1.

#1049 ISOPACH OF NET EFFECTIVE POROSITY

REFERENCE

- status: Jean Marie gas well

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Ministry of Energy, Mines and Petroleum Resources

NORTHEASTERN BRITISH COLUMBIA

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Kilometres 5 0 5 10 15 20 25 30 Kilometres

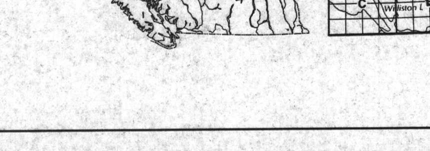
Contour interval: 5, 10 and 50 metres.

Jean Marie member
ISOPACH OF GROSS THICKNESS

Interpreted by: K.A.McAdam	Draughted by: R.D.Satterfield
Date: June 1992	Scale: 1:200 000

To accompany Petroleum Geology Special Paper 1992-1.

#1049 ISOPACH OF GROSS THICKNESS



REFERENCE

- status: Jean Marie gas well

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Ministry of Energy, Mines and Petroleum Resources

NORTHEASTERN BRITISH COLUMBIA

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Kilometres 5 0 5 10 15 20 25 30 Kilometres

Contour interval: 20 metres

Jean Marie Member
CONTOURS ON TOP OF UNIT

Interpreted by: K.A.McAdam	Draughted by: R.D.Satterfield
Date: June 1992	Scale: 1:200 000
To accompany Petroleum Geology Special Paper 1992-1.	

#1049 CONTOURS ON TOP OF UNIT

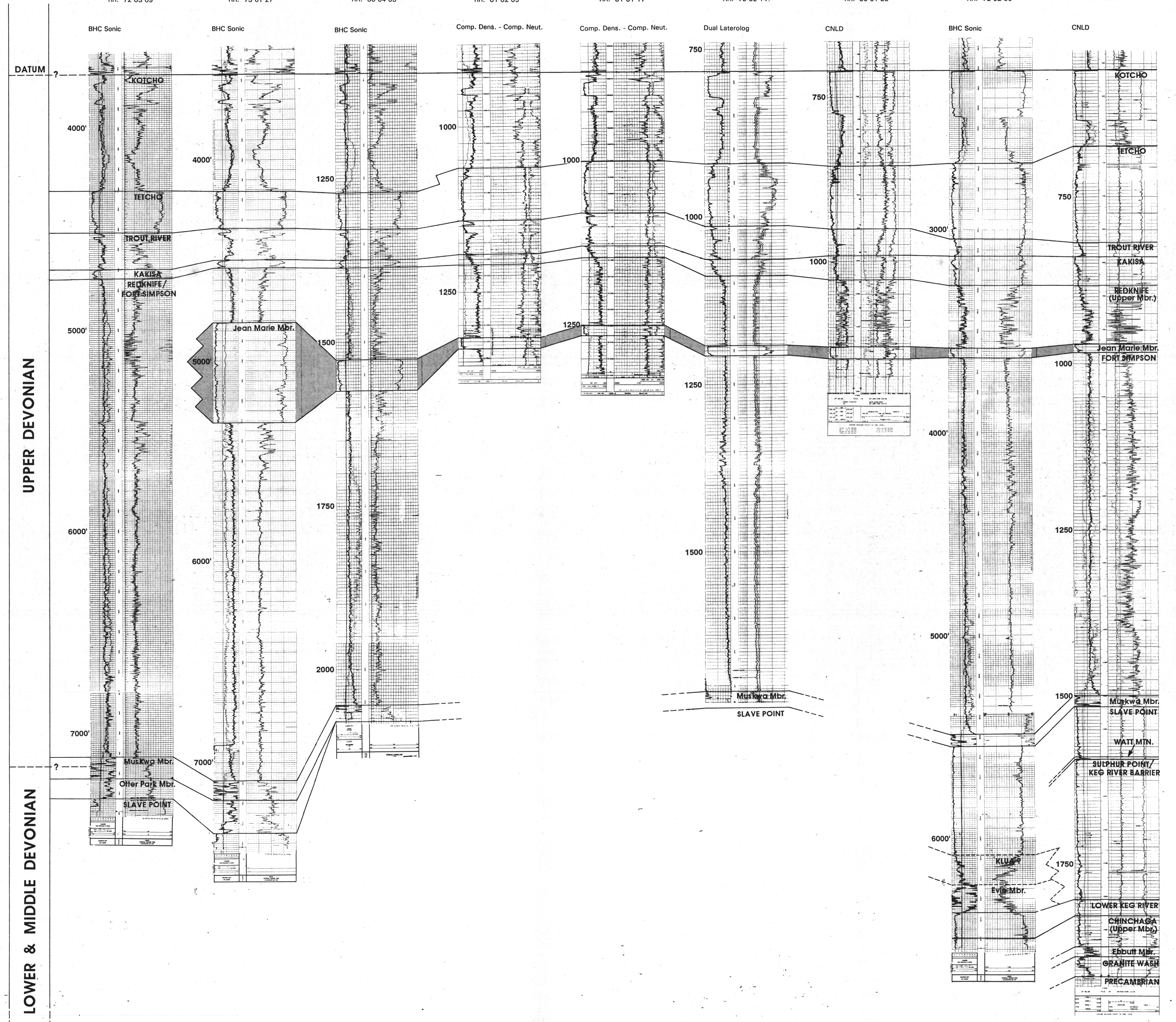
Province of British Columbia Ministry of Energy, Mines and Petroleum Resources

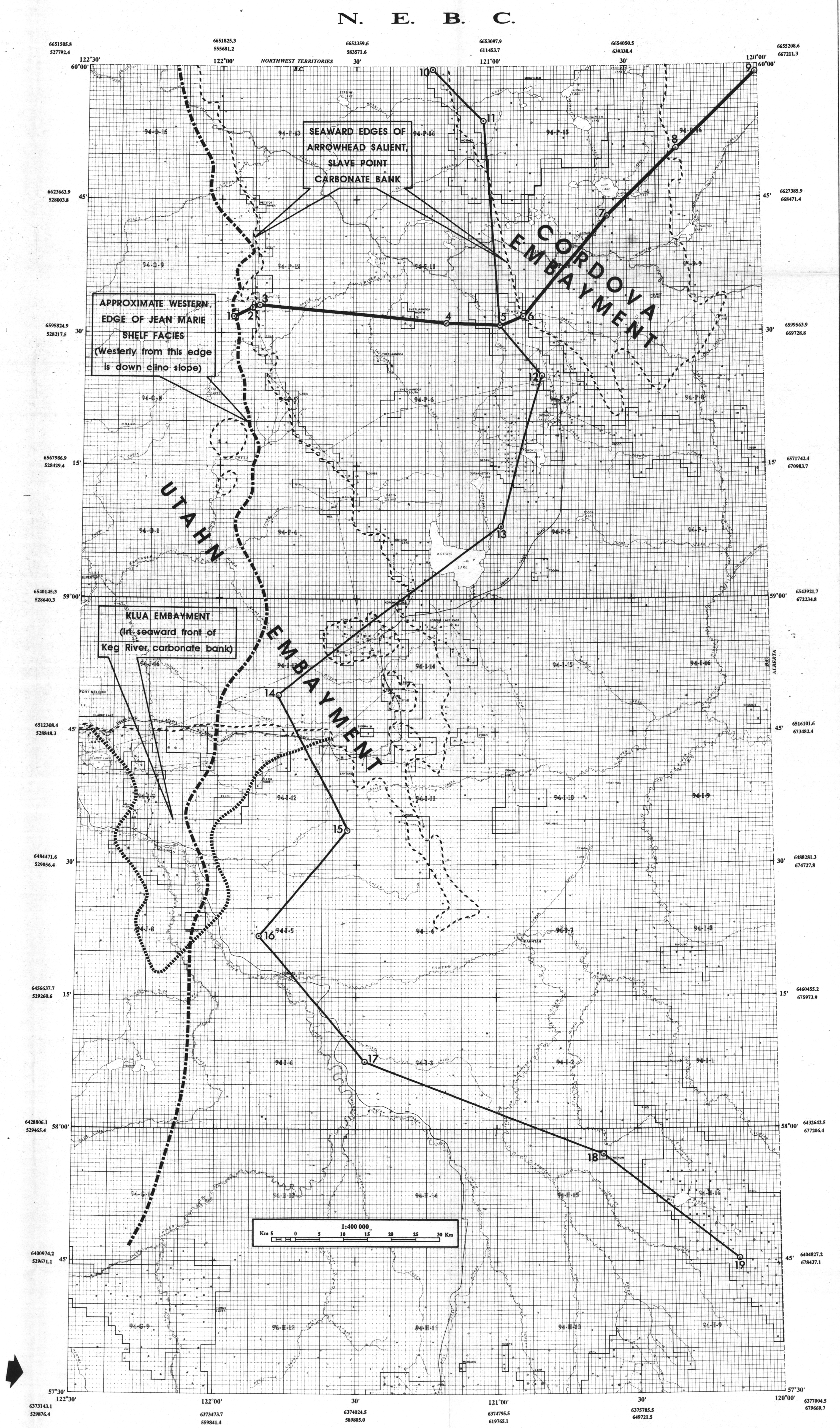
HOSSITL - RING AREA
Jean Marie Member
STRATIGRAPHIC CROSS - SECTION 1 - 9

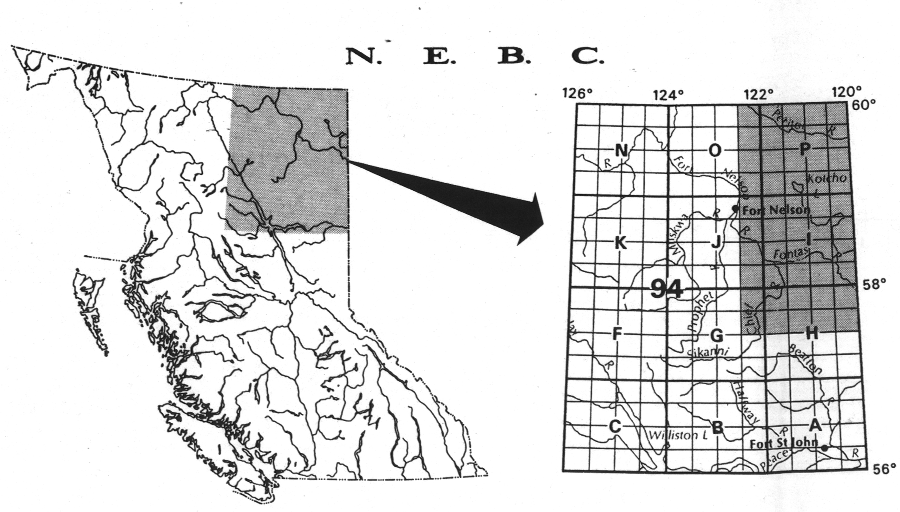
Interpreted by: K.A.McAdam	Draughted by: R.D.Satterfield
Date: June 1992.	No Horizontal Scale

Depths are in metres unless otherwise indicated!

1	2	3	4	5	6	7	8	9
BP ET AL GOTE	BP ET AL ESKER	CAIRN ET AL TSEA	CZAR ET AL THETLAANDOA	CZAR ET AL HELMET	EXALTA CONOCO ET AL HELMET	CZAR ET AL JULY	HB ET AL JULY	SHELL THINAHTEA
d-37-D/94-P-12	c-51-D/94-P-12	b-69-C/94-P-12	b-24-B/94-P-11	c-18-D/94-P-10	c-31-D/94-P-10	b-66-I/94-P-10	b-15-F/94-P-16	b-81-I/94-P-16
KB 2076 FT. TD 7628 FT.	KB 2217.4 FT. TD 2750 FT.	KB 596.0 TD 2095.0	KB 507.6 TD 1360.0	KB 492.9 TD 1325.0	KB 454.2 TD 1738.0	KB 482.0 TD 1191.0	KB 1681.4 FT. TD 6541 FT.	KB 477.6 TD 1937.0
WA 3063	WA 3281	WA 4376	WA 5531	WA 5528	WA 4689	WA 7250	WA 3028	WA 7170
Status: Sulphur Point gas	Status: Abd.- Dry	Status: Slave Point gas	Status: Debolt gas	Status: Jean Marie gas	Status: Abd.- Dry	Status: Potential Jean Marie gas	Status: Abd.- Dry	Status: Abd.- Dry
RR: 72 03 09	RR: 73 01 27	RR: 80 04 03	RR: 81 02 05	RR: 81 01 17	RR: 79 02 14.	RR: 90 01 29	RR: 72 02 06	RR: 90 02 11







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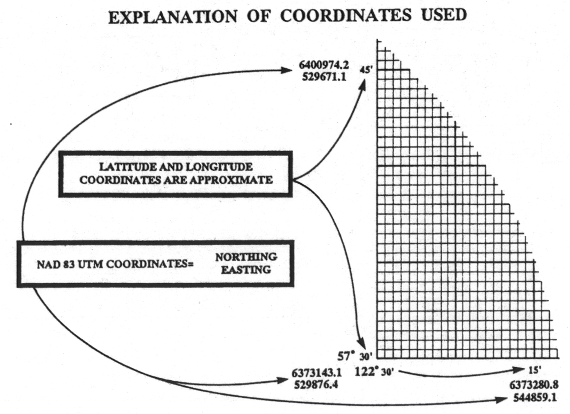

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To accompany Petroleum Geology Special Paper 1992-1, K. A. McAdam

#1049 (S.P. 1992-1)

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HOSSITL - RING AREA
Jean Marie Member
STRATIGRAPHIC CROSS SECTION 10 - 19

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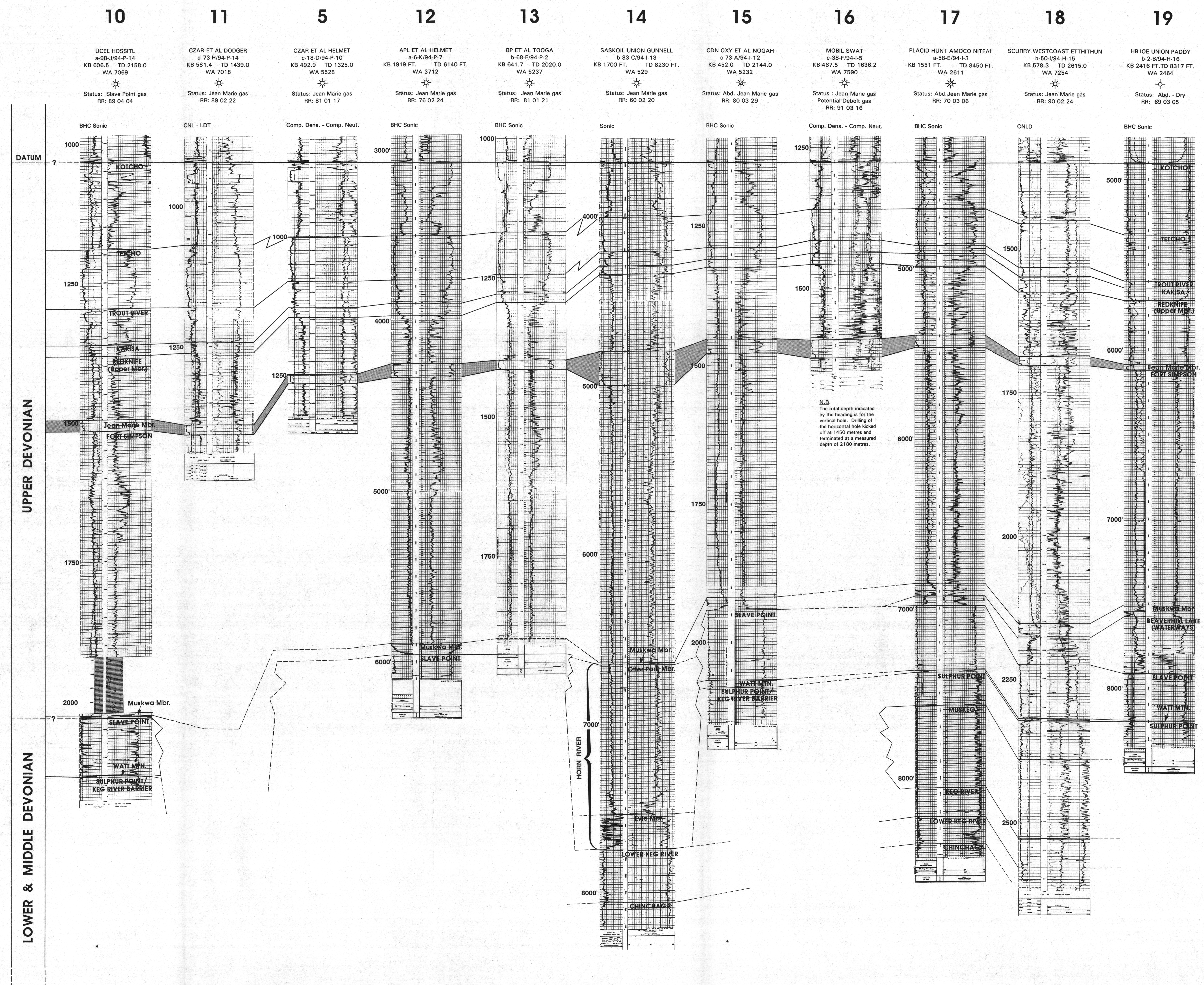
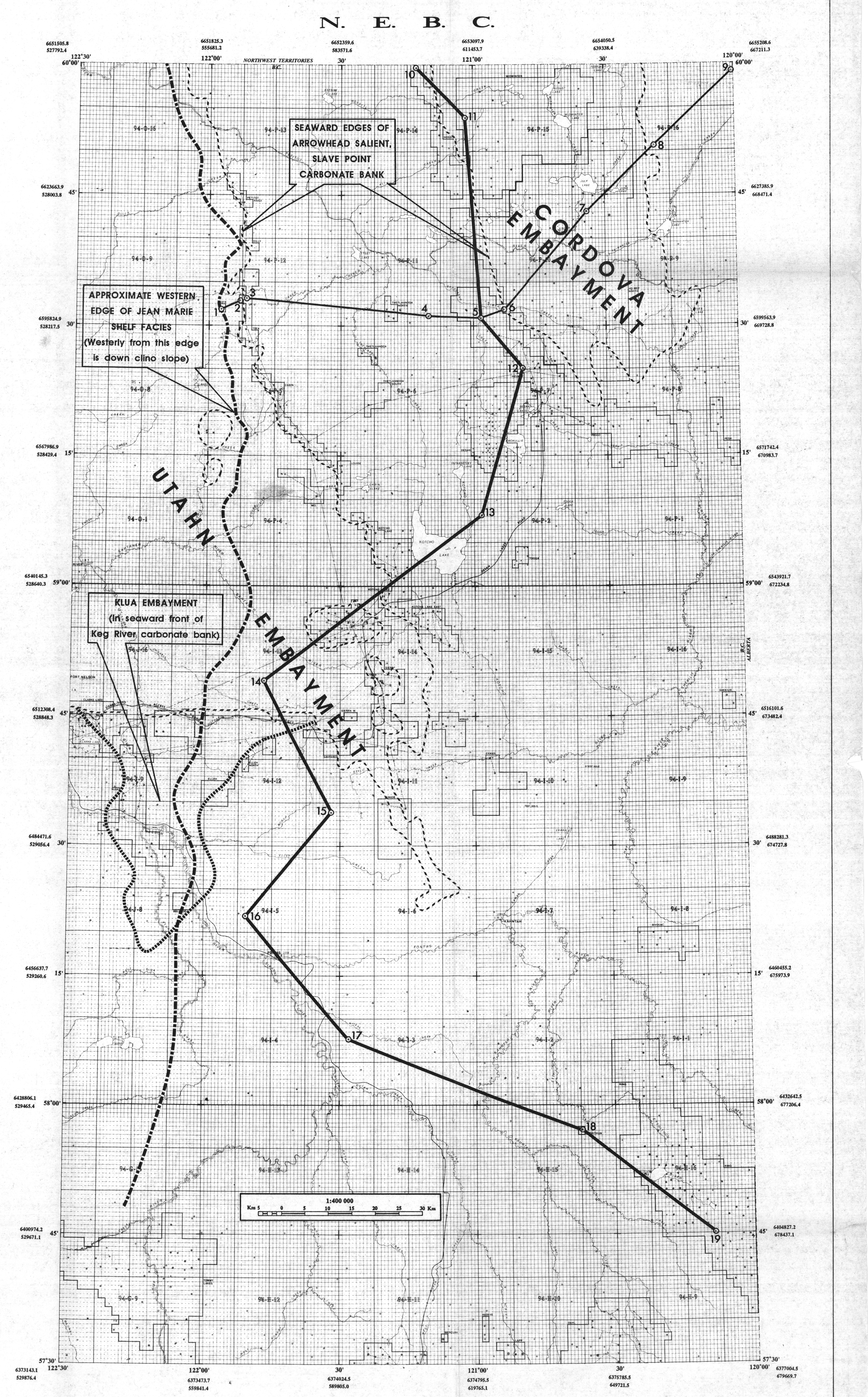
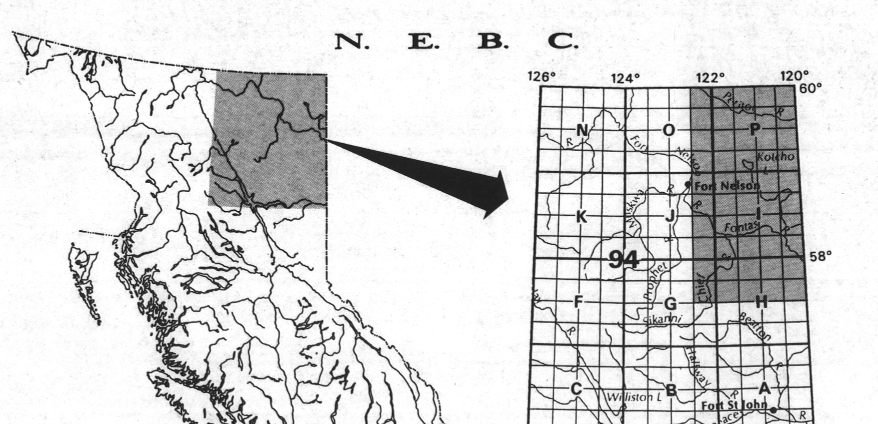
Date: June 1992.	No Horizontal Scale

Depths are in metres unless otherwise indicated!







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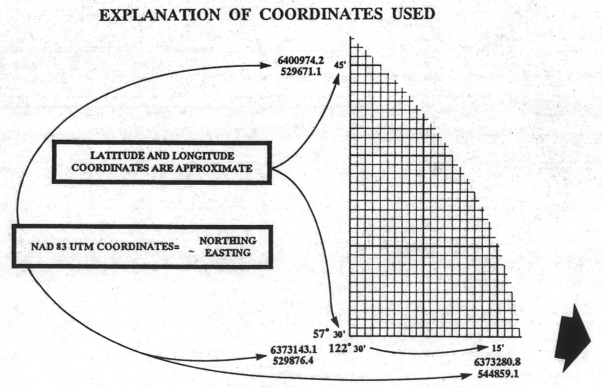

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