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ROBERTSON RESEARCH SUBMISSION -

MACKENZIE BASIN BASE METAL &

U_3O_8 POTENTIAL

JULY 6, 1978

Robertson Research International Limited

R.H. Cummings (Chairman), W.W. McB. Brown (Managing Director), H.R. Bichan, N.B. Brown, M.C. Cater, P. Ibbotson, R.W.L. Oldroyd, J.C. Robertson, E.B. Wolfenden, A.J. Wright.

SEP 21 1978

'TY'N-Y-COED', LLANRHOS,
LLANDUDNO, GWYNEDD,
NORTH WALES, LL30 1SA.

TELEPHONE: DEGANWY (0492) 8181
CABLES: RESEARCH LLANDUDNO
TELEX: 61216 (AB Robres G)

I.D.B.
A.H.C.
P.S.C.
W.J.
S.P.
M.D.R.
J.B.S.
FILE

Your Reference . . . . . Our Reference HRB/SEJ

Mr. D M Hendrick
Kerr Addison Mines Limited
P O Box 91
Commerce Court West
Toronto
Ontario M5L 1C7
Canada

14 September 1978

Dear Mr. Hendrick :

An Evaluation of the Base Metal and Uranium Potential of the Mackenzie Basin, Canada (reference our letter dated 14 June 1978)

As you know, during June 1978 we circulated a proposal containing details on an innovative multi-client project in which we intend to evaluate the base metal and uranium potential of the Mackenzie Basin in northwestern Canada: if your copy has been mislaid, let us know, and we will mail you another one.

The project's underlying theme is the increasingly recognised relationship between the genesis of both base metal and uranium deposits and the migration of saline and hydrocarbon-bearing fluids produced during the diagenesis of basinal sediments. The aim is not to replace tried and proven geological, geophysical and geochemical exploration methodology but to locate new mineral areas in which these more traditional techniques can be applied. We will make use of a large amount of highly relevant data, which is publically available, but as yet untreated. Such public data sources are rare and this has directed our attention towards the Mackenzie Basin rather than more accessible areas where such information is generally proprietary.

We planned to start in September 1978, but although the response to our proposal is gratifying and we already have a number of acceptances, we have yet insufficient support to proceed. Whilst many companies are satisfied that the project has technical merit, they have indicated that our planned timing conflicts with their 1978 budget. Accordingly, we have decided to extend the deadline for acceptance to 31 December 1978 and we hope that those organisations who have fully committed their 1978 exploration budgets will reconsider our proposal for next year. Our new deadline means that clients can pay 8% of the cost in the 1978 calendar year, 72% in 1979 and the remaining 20% in 1980.

We would like to mention that we have been heavily influenced in our approach to this project by the 'Proceedings of the Forum on Oil and Ore in Sediments' (Imperial College, London 1977) and in particular by a paper by Dr. B Hitchon of the Alberta Research Council entitled 'Geochemical Links between Oil Fields and Ore Deposits in Sedimentary Rocks'. In his paper Dr. Hitchon referred specifically to western Canada and concluded that "the source-migration - accumulation scenario that we have developed explains the natural history of both the oil fields and the ore deposits and can form the practical basis to the conceptual model that would have wider application" and "it is the authors hope that it will be accepted as a model on which to base future research".

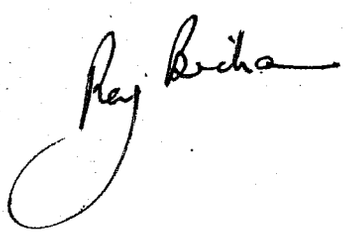
Contd./2...

Our project is directed to those groups with a mid to long term view of their exploration objectives and is intended to demonstrate the efficacy of the technique as well as having direct application in one of the frontier areas of Canada.

It is obvious that if as a result of our study any encouraging target areas are discovered participants will wish to secure their land position or seek a joint venture with others. We can ourselves assure prospective clients that we will maintain strict confidentiality during the study and make the results of the study available to all participants simultaneously in our offices in Calgary on 31 December 1979.

Should you require any further information or require a presentation or a visit, please do not hesitate to contact us either via our Calgary office or here in North Wales. Telephone enquiries should be directed to Tony Wright, John Gaskell, Peter Ibbotson or myself.

Yours sincerely,
for and on behalf of
ROBERTSON RESEARCH INTERNATIONAL LIMITED



H R Bichan
Director - Minerals

KERR ADDISON MINES LIMITED
P.O. BOX 91
COMMERCE COURT WEST
TORONTO, ONTARIO
M5L 1C7

COPY

July 6, 1978.

Robertson Research International Limited,
Ty'N-Y-Coed', Llanrhos,
Llandudno, Gwynedd,
North Wales, LL30 1SA

Attention: H. R. Bichan

Dear Sirs:

Thank you for your "Evaluation of the Base Metal and Uranium Potential of the Mackenzie Basin" reviewed as of June 28.

The proposal and project were studied carefully and considered of interest. However, at this time, we are not prepared to purchase participation in the proposed evaluation.

We would like to keep in touch as to further developments in the project, and also we hope that you would maintain contact with us on any other proposal that in the future could be of interest to us.

Yours truly,

KERR ADDISON MINES LIMITED

D. M. Hendrick,
Chief Geologist, Exploration.

DMH:ces

Robertson Research International Limited

R.H. Cummings (Chairman), W.W. McB. Brown (Managing Director), H.R. Bichan, N.B. Brown, M.C. Cater, P. Ibbotson,
R.W.L. Oldroyd, J.C. Robertson, E.B. Wolfenden, A.J. Wright.

'TY'N-Y-COED', LLANRHOS,
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TELEPHONE: DEGANWY (0492) 81811
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Your Reference . . . . . Our Reference . . HRB/SEJ . . . . . .

JUN 28 1978

I.D.B.
A.H.C.
P.S.C.
W.J.
S.P.
M.D.R.
J.B.S.
FILE

Mr D.M.Hendrick,
Chief Geologist - Exploration,
Kerr Addison Mines Limited,
P.O. Box 91, Commerce Court W
Toronto,
CANADA M5L 1C7

14 June 1978

Dear Sir,

'An Evaluation of the Base Metal and Uranium Potential of the Mackenzie Basin, Canada'

We are pleased to enclose a proposal which describes a major multi-client project which we plan to commence in September 1978.

We have prepared this proposal after discussing the subject matter with a number of exploration companies and, of course, after receiving permission from the Geological Survey of Canada to examine, sample and analyse a wide range of oil well material from a network of oil wells in the Mackenzie Basin. From our discussions it was clear that the work we propose is of great interest to exploration companies at the present time.

The study is one of the first of its kind in applied geological research and exploration for base metals and uranium, and it reflects the interplay between mineral and petroleum exploration thinking available within the Robertson Research Group.

The main purpose of the study is to define new target areas for uranium and base metals which can then be explored in detail by individual organisations using traditional exploration methods. As well as having direct relevance to potential resources in the Mackenzie Basin, the methodology which may be developed during the course of the study will be applicable elsewhere in the world.

We shall look forward to your response and will welcome you as a participant in our project. If you need more information or further copies of the proposal, please do not hesitate to contact myself or one of my senior colleagues, - Mr. J L Gaskell, Dr. P Ibbotson or Dr. A J Wright in particular. Furthermore, if you would like one of us to visit with you to discuss the project, or if you are able to visit with us here, just let us know.

Yours faithfully,
for and on behalf of ROBERTSON RESEARCH INTERNATIONAL LIMITED

H R Bichan
Director - Minerals

Enclosure:

Robertson Research International Limited

R.H. Cummings (Chairman), W.W. McB. Brown (Managing Director), H.R. Bichan, N.B. Brown, M.C. Cater, P. Ibbotson, R.W.L. Oldroyd, J.C. Robertson, E.B. Wolfenden, A.J. Wright.

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Your Reference . . . . . Our Reference. HRB/SEJ . . . . . .

Mr D.A.Lowrie,
Vice President - Exploration,
Kerr Addison Mines Limited,
Box 91, Commerce Court West,
Toronto,
CANADA M5L 1C7

14 June 1978

Dear Sir,

'An Evaluation of the Base Metal and Uranium Potential of the Mackenzie Basin, Canada'

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We shall look forward to your response and will welcome you as a participant in our project. If you need more information or further copies of the proposal, please do not hesitate to contact myself or one of my senior colleagues, - Mr. J L Gaskell, Dr. P Ibbotson or Dr. A J Wright in particular. Furthermore, if you would like one of us to visit with you to discuss the project, or if you are able to visit with us here, just let us know.

Yours faithfully,
for and on behalf of ROBERTSON RESEARCH INTERNATIONAL LIMITED

H R Bichan
Director - Minerals

Enclosure:

PROPOSAL

OILFIELDS AND ORE DEPOSITS

AN EVALUATION OF THE BASE METAL AND URANIUM POTENTIAL OF THE MACKENZIE BASIN, CANADA

AN APPLIED RESEARCH PROJECT BASED ON GEOCHEMICAL AND PETROGRAPHIC ANALYSIS OF OIL WELL SAMPLES.

ROBERTSON RESEARCH GROUP

June 1978

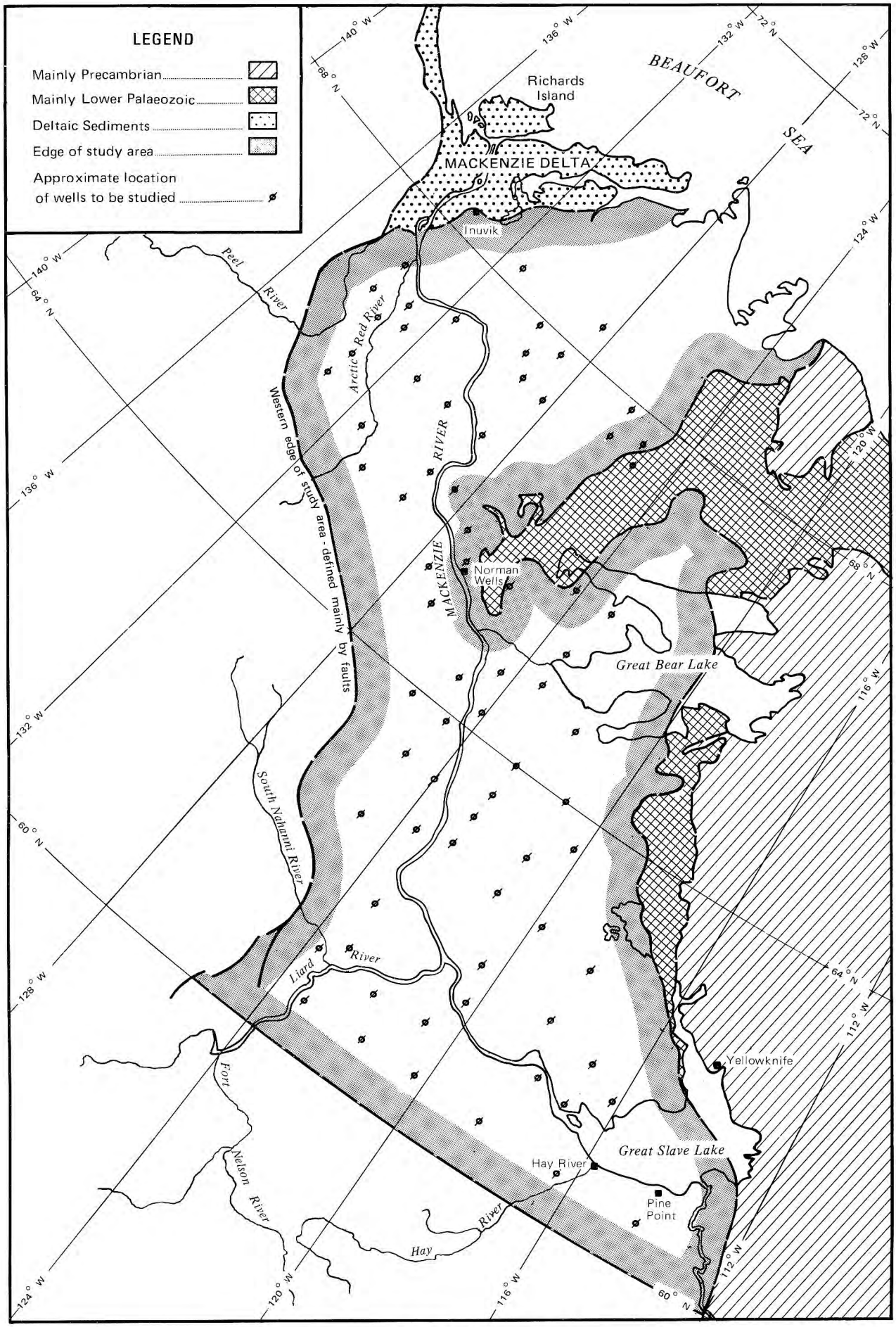

Figure 1: STUDY AREA

SCALE 1 : 5,000,000

Kilometres 100 0 100 200 Kilometres

THE CONCEPT

In recent years the genetic links between certain carbonate-hosted base metal ore deposits and hydrocarbon accumulations have been the subject of continued discussion and research. Conceptual models have been proposed to illustrate the similarity between the source - migration - accumulation process in the formation of oil reservoirs and processes in which base metal occurrences in sedimentary basins are formed. Of prime importance, therefore, is an understanding of the role played by the migration of saline formation waters which leach source rocks and transport base metal ions along structurally and lithologically controlled conduits or channelways. Deposition of the metals occurs in sites where appropriate physio-chemical conditions are developed.

The importance is also recognised of the part played by migrant groundwaters in the distribution of uranium. This is of particular significance in the shallower parts of sedimentary basins.

Consideration of these two types of fluid migrations coupled with the perhaps better known processes of hydrocarbon generation, migration and entrapment have lead us to formulate a sedimentary basin study utilising not only geochemical exploration techniques but also the vast amounts of geological and sample data generated by oil well drilling.

THE STUDY AREA

The Mackenzie Basin, in northwest Canada, is the northwesterly extension of the Alberta/Saskatchewan Basin of western Canada and contains extensive Palaeozoic shale-carbonate sequences within which gypsiferous horizons are developed (Figure 1). Hydrocarbon reserves have been proved within Devonian strata at Norman Wells and within Tertiary strata in the Mackenzie Delta. An extensive grid of oil wells covering the area extends southeast to join with the Alberta Basin to the south.

By utilising recent fluid migration concepts and by extensively sampling, analysing and examining drillhole cuttings, it is intended to :

a. divide the Mackenzie Basin into its main structural and lithological components;

b. evaluate source areas for the various metals;

c. define migrational channelways along which metals (both base metals and uranium) may have been transported by saline formation waters or groundwaters;

and thus arrive at potential depositional sites in which viable deposits may be located. Considering the geology of the basin, we anticipate that the study will reveal numerous target areas for further investigation.

The Geological Survey of Canada have kindly agreed to provide drilling samples from non-confidential wells. While not unique, the Mackenzie Basin does have the great advantage of having a wide network of oil wells and thus presents an ideal subject area for an initial study of this type and magnitude.

THE OBJECTIVES

The purpose of the study is to define :

a. the migration routes followed by the formation waters of the Mackenzie Basin and therefore the

b. target areas for both uranium and base metals within the basin and surrounding areas.

This will be achieved by combining detailed studies of oilwell ditch cuttings with the geology of potential host rocks.

The type of base metal target being sought is exemplified by the Pine Point orebody on the shores of the Great Slave Lake. Although it was discovered by conventional exploration methods, subsequent research at Pine Point has illustrated the close relationship between hydrocarbons and the base metals of the orebody and has provided much of the theoretical basis for this study.

In recent years there has been an increasing awareness amongst uranium explorationists that viable deposits need not be confined to the non-marine sedimentary environment. The western edge of the Canadian Shield constitutes an excellent source of uranium and we propose to study possible migration routes for uranium-bearing solutions which originate in the Shield and to search for horizons which could act as hosts for uranium concentration. The data produced may have application in assessing the relationship between hydrocarbons and trace metal geochemistry in the source and reservoir horizons.

At the end of the study we will have examined, formulated and tested a number of techniques and multi-disciplinary approaches to the problems of predicting the source, migration and concentration of economic constituents of basinal fluids. But, more importantly, we intend that the study will have considerable commercial application and we expect to be able to pin-point numerous targets within the study area worthy of further exploration by traditional methods.

The proposed study is one of the first of its kind on this scale in applied geological research and exploration and reflects the interplay between mineral and petroleum exploration thinking available within the Robertson Research Group. Clearly, the methodology which may be developed during the course of the study will be applicable elsewhere in the world.

THE DETAILS

1. Background Geological Concept

The principal features of base metal mineralisation known to be associated with hydrocarbons, as typified by the Pine Point deposit, are as follows :

a. Carbonate formations, through which the passage of formation waters similar in composition to known oilfield brines has produced enhanced porosity, are the host to large bodies of lead-zinc mineralisation.

b. It is anticipated that saline brines of this type in the upper parts of the basin could transport over long distances important quantities of uranium. An appreciation of the orientation of uranium migration trends will be of prime importance in future exploration.

c. The metals are thought to have been leached from shale horizons, concentrated in the brines and expelled from the basin during diagenesis and lithification of the basin sediments, along specific channelways or conduits controlled by formational porosity differences induced in part by saline brines.

d. Hydrocarbons are important, partly due to their modification of brine and/or depositional area geochemistry, and partly because residues trapped in cavities aid the location of channelways or conduits.

e. Concentration of mineralisation occurs where suitable physio-chemical conditions exist; the location of these zones are controlled by the overall basin 'plumbing system' and by other structural features.

f. The passage of brines through a particular formation is reflected in its geochemistry, degree of alteration, palaeothermal characteristics, etc. which can be evaluated by petrographic and geochemical analysis.

g. Given a suitable sample coverage in depth and on surface, a three-dimensional view of brine migration routes can be established along which, within suitable carbonate host rocks, base metal mineralisation may be developed.

2. Proposed Method of Study

The project will be conducted in phases as shown in the accompanying schedule (Figure 2). This approach will ensure that the maximum amount of information can be extracted from the data held by various organisations, as well as from the geochemical work, within the set time limits, and that the interpretation will proceed in a logical sequence in order to achieve the study objectives.

2.1. Data Collection from Literature

All available and relevant published and unpublished information will be purchased or copied if not already in our possession. The data used in the study will be obtained principally from our own archives and reference sources in Canada.

2.2. Regional Compilation and Interpretation

As data obtained from the literature search becomes available, it will be subjected to careful study, compilation and interpretation on a regional scale. This work will assist in establishing the regional geology, and lead to specific targets for further study. The basic geologic framework will comprise :

a. An overall geological map.

b. A structural map and sections.

c. Palaeofacies maps on selected formations.

d. Isopachyte maps on selected formations.

2.3. Data Acquisition from Petroleum Wells

The bulk of the data on which the greater part of the interpretative work will be carried out will come from a system of analyses of well log data and ditch cuttings from selected drillholes. Several disciplines will be involved including petrography, biostratigraphy, multi-element geochemistry and petroleum geochemistry. The complex interplay between these disciplines and the data described in Section 2.1., and the way in which it is intended to arrive at the objective of the study, is displayed schematically in Figure 3. The Geological Survey of Canada has given its approval to use drillhole material from non-confidential wells.

2.4. Sampling Density

The proposed study area comprises approximately 400,000 sq. km. It is proposed that this be covered by samples from about 100 drillholes located on an approximately 60 km grid. The drillholes will generate approximately 10,000 samples for analysis which in turn would yield 150,000 analytical results. These estimates depend on sample availability and may be revised upwards. Figure 1 shows the location of the initial holes to be sampled. It is anticipated that more locations will be sampled as the study proceeds.

2.5. Analyses

The samples will be analysed for 15 elements :

Cu, Pb, Zn, Ag, V, Mo, Co, Ni, B, Ge, P, Mn, U, Th, S.

The problems of contamination from either drilling mud or greases used to lubricate the drill stem are recognised and care will be taken to check-out their contaminating effect in zones of high metal values.

2.6. Petrography

Petrographic examination of the cuttings will be undertaken where geochemical anomalies are detected. Additional petrographic studies will also be carried out in conjunction with palaeofacies analysis. We anticipate that about 2,000 thin sections will be specially made and examined.

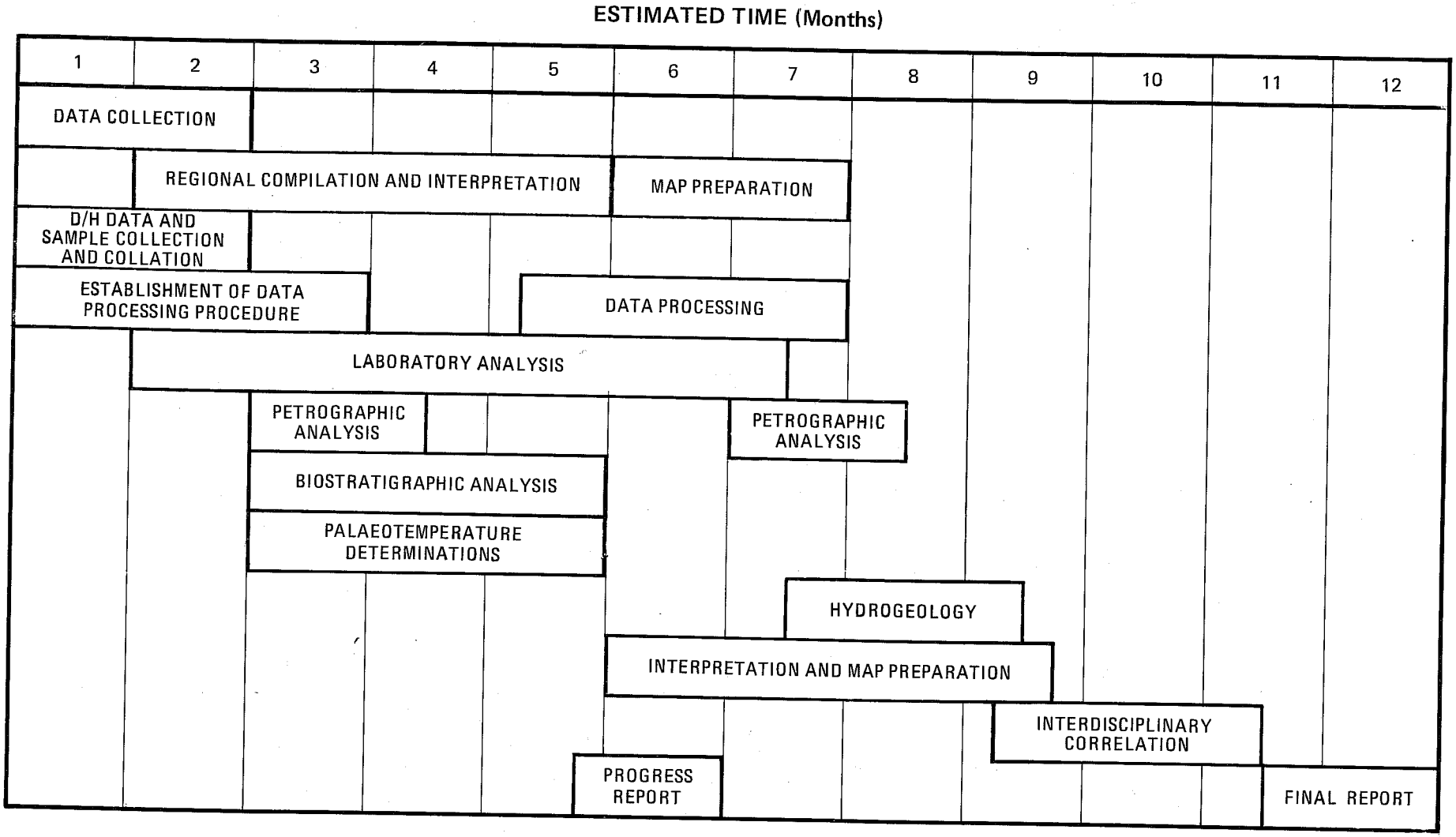

Figure 2: PROJECT SCHEDULE

OILFIELDS AND ORE DEPOSITS

Figure 3: INTERDISCIPLINARY CORRELATION

2.7. Data Processing

The large amounts of analytical results coupled with the various geological factors will obviously necessitate storage, analysis and display using computer-based data processing techniques.

3. Project Location and Management

Overall project supervision will be carried out by a Director of Robertson Research responsible for mineral operations. Considerable management and particularly biostratigraphical work will be carried out in the Calgary offices of Robertson Research (North America) Limited. However, it is planned that part of the technical studies will be carried out in the UK.

4. Company Experience and Personnel

The Robertson Research Group works throughout the world on a wide variety of projects in the minerals and petroleum fields. Through our subsidiary offices in Calgary, Singapore and Australia, we have gained experience on every continent in a wide variety of environments.

A feature of our work as geological consultants has been not only the completion of projects directly commissioned by clients, but also the production of a series of regional studies on a non-confidential basis for sale to industry at large. These have covered a range of topics as diverse as our activities and include reports on the petroleum geology and potential in the majority of the worlds major petroleum producing areas, coal geology and potential in Australia, the Far East and North America, and mineral reports mainly in Australia and the Far East. We have already completed several reports on well sections from the Mackenzie Delta.

The Company is, therefore, familiar with the type of regional assessment being considered and, more importantly is in the unique position of having in-house expertise available in both the petroleum and mineral fields. This, backed by our analytical laboratory facilities, enables us to co-ordinate all facets of the study and maintain strict control at all stages in the project.

In view of the large quantity of analytical results to be generated during the project, the use of modern computer-based data processing techniques is essential; we intend to make use of the most suitable software in order to store, analyse and display the data.

5. Timing and Project Schedule

The project involves a range of technical disciplines producing a wide variety of data. The production of these data can proceed simultaneously and independently, and is anticipated to take up to four months to complete.

The whole report is scheduled for completion twelve months from the date of commencement. See Project Schedule (Figure 2).

THE COST

1. Price Schedule

1.1. Individual Subscriptions

The cost, per company, to purchase the complete study will be as follows :

a. For companies committing before the project deadline of 25 August 1978, i.e. Initial Clients, the cost will be $ Canadian 37,500.

b. For companies committing after the project deadline, i.e. Subsequent Clients, the cost will be $ Canadian 44,000.

1.2. Group Rates

The following subscription rates will be used where bona fide Mackenzie Basin groups participate in the project :

a.	2 companies	160% of appropriate subscription price.
b.	3 companies	200% of appropriate subscription price.
c.	additional companies	add 20% for each additional company.

2. Method of Payment

Progress invoices will be submitted to clients at regular monthly intervals. The invoices will be at the rate of 8% of the appropriate fees per month for the first 10 months of the study and a final invoice of 20% of the project fees on completion of the entire study.

Payments will be required within 30 days of invoicing.

3. Conditions of Sale

a. The report will be sold to clients on a single company or group basis.

b. The deadline for acceptance as an Initial Client will be 25 August 1978 and only those companies sending written letters of intent to purchase postmarked prior to 25 August 1978 will be classified as Initial Cleints.

c. A minimum number of 17 single Initial Client subscriptions is necessary for the project to proceed on the basis of the aforementioned price schedule. Robertson Research reserves the right to cancel the project if, in its view, there is insufficient support.

d. After a total of monies equivalent to 22 single Initial Client subscriptions has been subscribed 50% of all further subscriptions will be refunded to the Initial Clients.

e. Any refunds to Initial Clients will cease one year after distribution of the study.

f. Companies purchasing the report will not reproduce in any form, publish or communicate to any other company or person any part of the report without the prior written permission of Robertson Research.

g. The Geological Survey of Canada, as a condition of sample access, will require the data arising from the study of their material to be made available to the public under the following conditions :

   i. Basic analytical data will be placed on open file in Calgary 2 years after sampling takes place.

   ii. A copy of the final interpretative report will be placed on open file 3 years after sampling takes place.

h. Robertson Research undertakes to use its best endeavours to report as detailed in the brochure, but reserves the right to make modifications if it is felt that these will improve its content.

i. Robertson Research intends to commence the project, subject to adequate industry support, around September 1 1978 and it will take approximately 12 months for its completion.

j. Robertson Research will provide each participating company with one copy of the report on the project.

k. Subject to any delay by reason of Force Majeure, Robertson Research undertakes to deliver the report approximately one year after the commencement date. Any event beyond the control of Robertson Research resulting in a delay which could not otherwise have been reasonably foreseen by them, shall constitute Force Majeure.

l. The final report will be despatched by air freight to all companies outside the UK and it will be the client's responsibility to pay all transport and insurance charges and to clear the report through customes and pay all customs duties and other charges which may be levied in the country of importation.

Robertson Research (North America) Limited
501 Cleveland Crescent SE
Calgary
Alberta T2G 4R8
Canada

Attention: Dr. D.J. Evans

'OFFER TO PURCHASE'

OILFIELDS AND ORE DEPOSITS

A PROPOSAL TO EVALUATE THE BASE METAL AND URANIUM POTENTIAL OF THE MACKENZIE BASIN, WESTERN CANADA BASED ON GEOCHEMICAL AND PETROGRAPHIC ANALYSIS OF OIL WELL SAMPLES

Subject to the conditions of sale and price schedule contained in the brochure of the above title dated June 1978, a copy of which has been furnished to us, we hereby agree to purchase one copy* of the following report :

An Evaluation of the Base Metal and Uranium Potential of the Mackenzie Basin, Canada

*plus one further copy for each of any additional participating companies.

We agree and accept that this offer to purchase is contingent upon Robertson Research (North America) Limited obtaining a sufficient number of Initial Clients by 25 August 1978 to justify commencement of the project. Further, it is our understanding that a Letter of Agreement will be sent to us after receipt of our order once a decision has been taken to commence this project.

For and on behalf of

Company .....

Position .....

Signature .....

Date .....

Additional Participating Companies :

.....

.....

.....

.....

europe

NORTH WALES

U.K.

North Wales:
Robertson Research International Ltd.,
Ty'n-y-Coed, Llanrhos, Llandudno, Gwynedd LL30 1SA.
Telephone: Deganwy 81811 (STD Code 0492)
Telex: 61216 (AB Robres G)
Cable: Research Llandudno

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7 Catherine Place, London SW1E 6EB.
Telephone: 834 7780 (STD Code 01)

Glasgow:
Robertson Research International Ltd.,
3rd Floor, Gresham Chambers,
45 West Nile Street, Glasgow G12 PZ.
Telephone: 248 4514 (Area Code 041)
Telex: 77411

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2514 En 'S - Gravenhage
Telephone: 658608 (Area Code 070)
Telex: 16144 (AB Elan nl)
Cable: Equity The Hague.

far east

SINGAPORE

SINGAPORE

Singapore:
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Units 10E - 17E, 5th Floor, Block 6,
Ayer Rajah Industrial Estate,
55 Ayer Rajah Road, Singapore 5.
Telephone: 750871 - 3, 7750022
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W.A.

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