FORSCHUNGSINSTITUT FÜR INTERNATIONALE TECHNISCH-WIRTSCHAFTLICHE ZUSAMMENARBEIT
DER RHEINISCH-WESTFÄLISCHEN TECHNISCHEN HOCHSCHULE AACHEN
RESEARCH INSTITUTE FOR INTERNATIONAL TECHNO-ECONOMIC CO-OPERATION
OF THE RHEINISCH-WESTFÄLISCHE TECHNISCHE HOCHSCHULE AACHEN · FEDERAL REPUBLIC OF GERMANY
Direktor: Prof. Dr.-Ing. Hans A. Havemann

Forschungsinstitut für Internationale technisch-wirtschaftliche Zusammenarbeit
5100 Aachen, Postfach 1170

004820

Mr. Hart Horn
Director of Mineral Revenue
Department of Mines and Petroleum
Resources
Parliament Buildings
Victoria British Columbia

CANADA

Ihr Zeichen	Ihre Nachricht vom	Unser Zeichen	5100 AACHEN, Postfach 1170
		Die/hem	24th July 1975

Dear Mr. Horn,

in the meantime an evaluation of our field studies - Octobre last year - concerning the site selection for a manganese nodules processing plant has been undertaken, the report is available and the results are discussed with the ordering firm (Metallgesellschaft Frankfurt/M.).

In connection with another research project on "Technology Transfer to Developing Countries", we will undertake a trip to Mexico, to the USA and Canada during the months of August and September of this year.

The Metallgesellschaft charged us to follow-up again contacts established in 74 with some of these institutions and to have additional discussions with them. For details please see enclosure to this letter.

REFE...
JUL 28 '74
DIRECTOR
ASS...
MIN...
PETROL...
CHIEF TITLES

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My colleague, Dipl. -Ing. Müller, and myself, we will be in Victoria on the 11th Sept. 75.

As the travel arrangement imposes severe restrictions, we would be gratefull for a meeting within this time.

I suppose that Mr. Wiebe will contact you concerning the date for a meeting, but in any case we will phone you when we have arrived.

Looking very much forward to see you again, I remain

sincerely yours

(F. Diederich, Akad. O. Rat)

Sept 11/75 (9 - 10 A.M. ?)

M E M O

Reference: Site selection for metallurgical plant untilizing resources of the sea

(1) During Sep/Oct 1974 a study was undertaken by the Research Institute for International Techno-Economic Co-operation of the Technical University of Aachen, West Germany, in collaboration with the Florida Atlantic University, Boca-Raton, USA, on the selection of suitable sites for processing manganese nodules. The study covered harbour areas of Washington State, Oregon State and of British Columbia.

In the meantime an evaluation has been undertaken and the preliminary result is available.

(2) By travelling to the USA and Canada during Aug/Sep 1975 for the purpose of other research work, it is intended to follow-up contacts established earlier with a limited group of these institutions.

The main objectives for getting in touch for the second time are as follows:

- To give to our partners in the harbour areas information concerning the program of the "Arbeitsgemeinschaft meerestechnisch gewinnbarer Rohstoffe"[1] and its "Joint venture" with respect to their short and medium or long range activities in areas such as exploration, logistics, processing. A decision concerning the site might be expected by 1977 or 1978.

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1) "Association for utilizing rawmaterials from the sea"

JUL 28 1975

- To impart information concerning the result of the Site-Selection-Study, effected in 1974, and to inform these institutions on the criteria for the selected sites and on the results so far obtained as also on particular problems associated with this preliminary selection, for instance power supply and environmental protection.

- To establish the availability of information. Partner institutions would be persuaded to furnish relevant information to this institute on matters affecting the selection of sites. This is motivated by possible changes of provisions of the law, e.g. on environmental protection or the availability of sites as also of supplies of energy, programs of official assistance for the establishment of industrial activities within the frame of regional planning as well as of data on the regional employment situation.

(3) A further intention is to express thanks for the goodwill of the institutions and partners with whom contacts and co-operation had been established earlier and at the same time, to summon their assistance also for the coming phases of the study.

Aachen, July 1975

(Prof. Dr.-Ing. H.A. Havemann)

been outlined, as reported in other years.

Diamond drilling was done on 16 properties in Haliburton-Bancroft region in 1954.

At the Beaucage property on Newman Island in Lake Nipissing a shaft was begun to permit further testing of a large deposit outlined by diamond drilling. This is mainly of interest for its columbium content, but uranium may be recovered as well.

In the Chapleau region, drilling was continued on magnetite-apatite deposits that also contain columbium, tantalum and uranium.

Diamond drilling was done on one property in Port Arthur area, and surface work at a few properties in Kenora area.

At the Eldorado refinery at Port Hope, extensive installations were made for a new refining process to be in operation in June 1955. This will increase recovery of uranium.

British Columbia

Underground and surface exploration were continued at the Rexspar property near Birch Island, Kamloops Mining Division. The owners reported that the two principal zones were estimated to contain 110,000 tons averaging 2.2 lbs. of U_3O_8 per ton, and 600,000 tons averaging 1.8 lbs. of U_3O_8 per ton. 082M 021

Considerable staking was done near the head of Boulder Creek, northeast of Atlin, following discovery of radioactive shear zones containing secondary uranium minerals. The discoveries were made late in 1954 in attempting to trace the source of a pitchblende-bearing specimen and active exploration is planned for the 1955 season.

Several radioactive discoveries, including occurrences of pyrochlore, were reported from different parts of the province.

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A good deal of prospecting and staking was done in the Precambrian region north of the west end of Lake Athabasca. Radioactive occurrences were reported from eight new properties, all being of the general pegmatitic class. Diamond drilling was done at a property near Fort Chipewyan.

Manitoba

Two radioactive discoveries were reported from the vicinity of Tooth Lake in Rice Lake Mining Division. Surface work was done on properties staked in previous years in the region between Winnipeg and Kenora.

REXSPAR 082N 021
RECEIVED
MAR 2 - '55

CANADA
Bureau of Economics and Statistics

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

OTTAWA

URANIUM IN CANADA, 1954 (PRELIMINARY)

Important developments in several parts of Canada combined to make 1954 a most significant year for uranium mining. Figures for production and ore reserves of producing mines may not be published, but it is clear that the output was greater than in any previous year because 1954 was the first in which the plant of the Crown-owned Eldorado Mining and Refining Limited at Beaverlodge in northern Saskatchewan was in operation for a full year. Also for the first time, production at this plant was augmented by ore shipped to it from private properties in the district.

One of the highlights was the large-scale preparation for production at the Gunnar mine in the Beaverlodge area, which is to commence in 1955. Exploration at several other private properties in Saskatchewan showed promising results. In the Blind River region of Ontario, very large tonnages of relatively low-grade uranium ore were indicated by diamond drilling and plans for large-scale production have been completed, with the first plant scheduled for operation late in 1955. Promising results were also obtained in other districts. As a result of these developments, Mr. W.J. Bennett, President of Atomic Energy of Canada Limited, forecast in a recent address that, by the end of 1957, uranium production in Canada will be more than twelve times as great as at the end of World War II, and that the annual gross income from the production will then be about $100,000,000.

At the end of the year, 300 exploration permits and four mining permits from the Atomic Energy Control Board were in force. However, about half of the holders of exploration permits were inactive or reported only a little work.

Because of the large number of properties explored, few details can be included in this review. Only those properties on which underground exploration was done, or for which immediate plans for underground work were reported, are mentioned by name.

Saskatchewan

Private Properties. Important advances were made at several privately owned properties, mainly in the region north of Lake Athabasca. The year marked the beginning of private production, in the form of ore trucked to Eldorado's Beaverlodge plant from the Rix-Athabasca and Nesbitt LaBine properties. Ore was also mined at the Consolidated Nicholson property and was shipped to Beaverlodge early in 1955.

Gunnar Mines Limited made good headway in preparing its property for production. The open pit was prepared for mining and construction of a treatment plant with a rated capacity of 1,250 tons a day was well advanced. The building of an airstrip near the mine was completed. The company reported that further drilling had increased the gross estimated value of the deposit to $130,000,000 and

The Ministry of Environment and the Ministry of Mines are aware of the environmental problems associated with uranium mine development and the project will have to meet Federal and Provincial requirements. We have sent some of our people down East on courses which are sponsored by the Atomic Energy Control Board and therefore are building up a background in the problems which might be involved.

Yours very truly,

J. D. McDonald, P. Eng.
Senior Reclamation Inspector

JDM:lr

copy: Mr. E. Macgregor, P.Eng., Assistant Deputy Minister
Mr. B. Dudas, P.Eng., Inspector of Mines and Resident Engineer, Kamloops, B.C.

THE DEPARTMENT OF
MINES AND PETROLEUM RESOURCES
PARLIAMENT BUILDINGS, VICTORIA, BRITISH COLUMBIA V8V 1X4

WHEN REPLYING PLEASE REFER TO

FILE NO. ....

MINERAL RESOURCES BRANCH

1835 Fort Street
Victoria, B.C. V8R 1J6

July 22, 1977

RECEIVED
JUL 26 1977
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DEPARTMENT OF MINES & PETROLEUM RESOURCES

Mrs. Colleen Foster
Secretary
Yellowhead Ecological Assoc.
Box 23
Clearwater, B.C. VOE 1NO

Dear Mrs. Foster:

This will acknowledge receipt of your letter of July 19, 1977 requesting a copy of the Environmental Impact Report on the Birch Island Project of Consolidated Rexspar Minerals & Chemicals Limited.

We have no spare copies of this report so I am unable to supply you with same. I would suggest that you review the copy which is at our Kamloops office and those sections which you feel you would like to have could be xeroxed for you. A considerable portion of the report deals with mine plans and it is likely only a third of the report would be of interest to you and your environmental associates.

It is our policy that copies of these reports are forwarded only to the various government agencies plus the regional district and government representative of the local area affected. This has been the policy with the Coal Guidelines Steering Committee as if we sent out copies to the various people requesting the information, it would be of considerable cost and the effect would be that if we gave a copy to one organization we would have to give one to members of the press, the news media, etc.

For your information, the Uranium Steering Committee will be meeting with the company to discuss the project and determine what the schedule will be or even if the project will go ahead. If a decision is made by the company, we would anticipate that a public meeting would be held in the Kamloops area sometime in September at which time all those concerned would be informed with sufficient time to allow them to make proper representation.

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Bureau of Economics and Statistics

CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

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Gunnar Mines Limited made good headway in preparing its property for production. The open pit was prepared for mining and construction of a treatment plant with a rated capacity of 1,250 tons a day was well advanced. The building of an airstrip near the mine was completed. The company reported that further drilling had increased the gross estimated value of the deposit to $130,000,000 and that a contract had been arranged for delivery of precipitates to the value of $76,950,000.

Eleven companies did underground exploration on their properties in the region north of Lake Athabasca. They were: Beta Gamma, Black Bay, Cayzor Athabaska, Homer Nu-Age, Lorado, Meta, National Explorations, Nesbitt LaBine (Eagle-Ace group), New Mylamaque, Rix-Athabasca, and Uranium Ridge (Pitche group). Underground exploration was also done on the Jahala Lake property in La Ronge region.

Diamond drilling was done on 50 properties in the region north of Lake Athabasca and on four between Lake Athabasca and La Ronge.

A pilot plant was completed and operated at the Nistowiak property of La Ronge Uranium Mines for further tests of a new process devised by the company with the objective of providing a low-cost means of treating the pegmatitic material found on this and nearby properties.

Eldorado Properties. Deepening of the Fay shaft was begun and at the end of 1954 had reached a depth of 1,800 feet below surface. The 7th level was developed in the Ace orebodies, and work was begun on the 8th level. The openings on the 7th level, and diamond drilling from it, showed the ore to be comparable to that on upper levels, the deepest intersection of pitchblende being 1,050 feet below surface. The 3rd, 4th, 5th, and 7th levels were extended eastward from the Ace shaft to within about 1,800 feet of the Verna shaft. These levels intersected relatively small bodies of ore of better than average grade.

The Verna shaft, 1 1/4 miles east of the Ace, was completed to the 6th level and considerable exploration was done on the 3rd, 4th, 5th, and 6th levels. In addition, an extensive program of diamond drilling was carried out on Eldorado ground and on the adjoining Radiore property for which Eldorado holds an exploration agreement. This work disclosed several fairly flat-lying pitchblende-bearing bodies in a zone of favourable rocks in the hanging-wall of the St. Louis fault. The grade is significant but more exploration is needed to permit correlation of intersections or estimates of the extent and relationships. Drilling from the surface was continued along the St. Louis fault between Verna and Raggs Lakes and was resumed at the Fish Hook Bay property.

Trial stoping was done in the Martin Lake mine and the resulting ore was trucked for treatment at Eldorado's Beaverlodge plant. The additional installations to bring this plant to a capacity of 700 tons a day were completed, the extra capacity being intended entirely for handling custom ore.

Northwest Territories

The production rate at the Eldorado mine at Port Radium was maintained, some uranium being derived from the re-treatment of old tailings. Considerable underground exploration was done, mainly on the Nos. 7 and 8 veins. The No. 2 level was extended under the area of No. 2 shaft and connected by raises to old workings from this shaft.

Apart from the Eldorado mine, the principal activity in Northwest Territories was in Marian River region, northwest of Yellowknife. Several properties that were investigated a few years ago were restaked, much additional staking took place, and several new radioactive occurrences were reported. Diamond drilling was done on two properties. Plans for sinking a shaft on the Rayrock property were announced early in 1955.

Diamond drilling was also done on a property about 40 miles east of Great Bear Lake and on one at Stark Lake near the east arm of Great Slave Lake.

Ontario

The principal activities in Ontario were in the Blind River and Haliburton-Bancroft regions. In the former, about half way between Sudbury and Sault Ste Marie, large tonnages of uranium-bearing conglomerate were outlined by diamond drilling at the Pronto property and at the Quirke Lake and Nordic Lake properties of Algom Uranium Mines Limited. It was reported that Pronto Uranium Mines Limited had outlined an orebody with a gross value of more than $70,000,000 and had negotiated a contract for the sale of precipitates to the value of $55,000,000. By the end of 1954 shaft sinking was completed to the first objective of 600 feet. The building of a treatment plant with a capacity of 1,250 tons a day was well advanced by then.

The orebodies indicated on the Quirke Lake and Nordic Lake properties were reported to have a joint gross value of more than $300,000,000, with the possibility of additional ore at depth in the Quirke Lake deposit suggested by exploratory drilling. Early in 1955 it was announced that financing arrangements had been made and that negotiations were being completed for the sale of concentrates valued at $206,910,000. Plans are being made to erect a 3,000-ton treatment plant at each property and to establish a modern town to serve both properties. A shaft was begun on the Quirke Lake property in 1954.

Several other properties were explored in Blind River region. A shaft was begun at the Buckles Algoma property late in 1954 following an extensive program of diamond drilling which was reported to have indicated 486,500 tons averaging $17.98 a ton. In addition to the above properties, diamond drilling was done on 20 properties in the general Blind River region. These preliminary results as well as certain surface discoveries offer hope that other orebodies will be outlined eventually in the territory north of Lake Huron.

Encouraging results were obtained from the exploration of several pegmatitic deposits in the Haliburton-Bancroft region. Two adits were driven to test occurrences on the Faraday property and in February 1955 it was reported that 205 feet of drifting on one deposit had yielded muck samples averaging 0.454 per cent U_3O_8 (uranium oxide). Underground exploration was continued at the Centre Lake property where two dykes were estimated to contain 2,700 tons per vertical foot, averaging 0.09 per cent U_3O_8. On the adjoining Croft property an adit was driven for further tests of part of a zone explored by diamond drilling. About 1,000 feet of drifting was reported to have shown a length of 613 feet averaging 0.084 per cent U_3O_8 for a width of 10 feet. Late in 1954 plans were reported for sinking a shaft on the Rare Earths property to test a zone estimated to contain 1,100 tons per vertical foot, averaging 0.11 per cent U_3O_8 and 0.06 per cent ThO_2 (thorium oxide). Late in the year underground exploration was resumed at the Cardiff Uranium property, where uranium-fluorite deposits had already been outlined, as reported in other years.

Diamond drilling was done on 16 properties in Haliburton-Bancroft region in 1954.

At the Beaucage property on Newman Island in Lake Nipissing a shaft was begun to permit further testing of a large deposit outlined by diamond drilling. This is mainly of interest for its columbium content, but uranium may be recovered as well.

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British Columbia

Underground and surface exploration were continued at the Rexspar property near Birch Island, Kamloops Mining Division. The owners reported that the two principal zones were estimated to contain 110,000 tons averaging 2.2 lbs. of U_3O_8 per ton, and 600,000 tons averaging 1.8 lbs. of U_3O_8 per ton.

Considerable staking was done near the head of Boulder Creek, northeast of Atlin, following discovery of radioactive shear zones containing secondary uranium minerals. The discoveries were made late in 1954 in attempting to trace the source of a pitchblende-bearing specimen and active exploration is planned for the 1955 season.

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Alberta

A good deal of prospecting and staking was done in the Precambrian region north of the west end of Lake Athabasca. Radioactive occurrences were reported from eight new properties, all being of the general pegmatitic class. Diamond drilling was done at a property near Fort Chipewyan.

Manitoba

Two radioactive discoveries were reported from the vicinity of Tooth Lake in Rice Lake Mining Division. Surface work was done on properties staked in previous years in the region between Winnipeg and Kenora.

Quebec

Prospecting and staking were active in many parts of Quebec, almost entirely within the Grenville sub-province of the Canadian Shield. Several additional discoveries were reported, almost all being of pegmatitic and contact-metasomatic types. Diamond drilling was reported to have been done at 21 properties, mainly in the Maniwaki, Grand Calumet and Oka regions. In the last area, several radioactive occurrences that are mainly of interest for their columbium content were drilled.

A discovery of uraninite in magnetite-rich pegmatitic granite in Bressani township in the southern part of Chibougamau region was explored by diamond drilling. This discovery resulted in the staking of many claims in the vicinity. Opemiska Copper Mines (Quebec) Limited reported that uranium assays had been obtained from a chalcopyrite-magnetite vein on the 3rd level of its producing copper mine in the Chibougamau area.

New Brunswick

An occurrence near Hampton, reported in 1953, was explored by diamond drilling during the winter of 1953-54. This caused considerable prospecting in the province during the summer of 1954, resulting in several discoveries in widely separated localities. Some of these consist of hydrocarbon resembling thucholite, carrying fine-grained pitchblende. An occurence near Harvey about 25 miles southwest of Fredericton and another near Upsalquitch about 10 miles southwest of Campbellton were explored by diamond drilling.

Prepared by
A. H. Lang,
Geological Survey of Canada.

82M021-05

Consolidated Rexspar Minerals & Chemicals Limited

20th Floor, 4 King Street West
Toronto, Ontario

82M021
PROPERTY FILE

January 30, 1976

To the Shareholders:

Offering of Rights — An Explanation:

In September last the Directors resolved to offer to shareholders who would be registered on the Company's books at October 10, 1975, the right to purchase additional shares from treasury. Preliminary public notice to this effect was released. The necessary approvals were then obtained and the offering material was ready for mailing at mid-October when the disruption in Canadian postal services intervened. Postal service was not resumed until about December 5, and the Christmas and New Year holidays were then imminent. It was decided to delay the offering until early in 1976.

The Company has accordingly now decided to make the offering to shareholders at this time and the requisite approvals have again been obtained and the offering material has been revised, where necessary. The terms and conditions remain as originally proposed, except for the relevant dates.

The Corporation will now offer to its shareholders who are of record at January 30, 1976, the right to purchase from treasury at 48 cents per share one additional share for every three (3) shares held as of such record date. There are now 3,624,300 shares outstanding, and there will thus be a total of 1,208,100 additional shares offered to the shareholders.

Additional Subscription Privilege:

The Corporation is also offering to each holder of rights who has subscribed for and paid for any of the shares evidenced by the subscription warrant enclosed herewith, the right to make application for additional shares, if available [to be allotted from those not taken up pursuant to the exercise of rights], in the capital of the Corporation at the price of 48 cents per share (see below under heading "Details of Additional Subscription Privilege").

Purpose of Offering and Use of Proceeds:

Uranium Project — Preliminary Study

In view of a resurgence in demand for uranium and a rapidly increasing price, the Company re-examined in 1974 and 1975 the reserves and metallurgical status of its Birch Island property in British Columbia.

The Company holds in excess of 8,000 acres by way of Crown Granted mineral claims and mineral claims held by right of location.

The property is located south of the village of Birch Island, British Columbia, on the North Thompson River about 81 miles north of Kamloops. Birch Island is on the main Trans-continental line of the CNR as well as on British Columbia Highway No. 5.

The potential uranium deposits are about 2½ miles south of Birch Island at an elevation of approximately 4,000 feet. Because of the difference in elevation between the proposed mill site and the mine the road distance is approximately 6½ miles. A rail spur line from the CNR at Birch Island to a potential mill site was cleared and graded and track was installed in the late 1960's and is available. Some 25 miles of power line was built by the B.C. Power Commission to provide service to the Company's operations. An additional 10 miles from Clearwater to Birch Island is required to complete the service.

Programs of previous work carried out originally by the Company and subsequently by Denison Mines Limited, as manager, and extending over the past several years indicated fluorspar reserves of some 1.3 million tons amenable to open pit mining and uranium reserves estimated at 1,561,000 tons averaging 1.76 pounds of U_3O_8.

A report prepared for the Company by independent consulting engineers embraces site description, ore reserves, current status of the metallurgy, environmental considerations and plans and sections (open pit), together with a summary of recommended further work necessary for the preparation of a definitive feasibility report. In summary the report states:

Summary:

The project property, located immediately south of Birch Island, British Columbia, has excellent accessibility via the main transcontinental line of the Canadian National Railway and B.C. Highway No. 5, both of which pass through the village of Birch Island.

The ore reserve has been calculated at 1.62 million tons at an estimated grade of 1.50 lbs. uranium oxide per ton. Assuming no further ore is developed, this reserve indicates a production life of 9 years @ 500 T.P.D. or approximately 4½ years @ 1,000 T.P.D.

A. H. Ross & Associates in a preliminary technical review of uranium recovery from the Rexspar deposits assumes the same flowsheet as for studies made in 1958. The only significant difference from conventional uranium acid-leach processing is the technique of batch leaching in towers using only water and air, with acid being generated autogeneously by oxidation of pyrite in the ore. Allowance is made for addition of commercial acid for pH adjustment in later stages of processing. Because the batch leaching technique involves a high capital cost for equipment, and also high charges for operating labor, electrical power and maintenance, A. H. Ross & Associates, recommend that other leaching systems, e.g. autoclaves, be investigated. Additional laboratory and perhaps pilot plant test work will be required. They also state that it would be advisable to consider additional test work relative to reduction of the fluoride content in the uranium-bearing concentrates (yellow cake) to meet current specifications of various refineries. A. H. Ross and Associates have estimated the cost of the research as follows:

Laboratory Scale Study	\$ 33,000 - \$ 42,000
Pilot Plant Study	\$ 68,000 - \$163,000
TOTALS	\$101,000 - \$205,000

These figures are exclusive of contingency and escalation allowances. In addition to the above, an Environmental Impact Assessment base line study, estimated to cost \$25,000 will be required. Guide lines and legislation set forth by the British Columbia Conservation Authorities for the disposal of industrial wastes may affect significantly the capital and operating costs of the project.

Contingent upon a successful pilot plant program to define a process that will permit production of specification grade yellow cake, it is recommended that a definitive Feasibility Study be commissioned to establish optimum tonnage rates and profitability. Experience on similar size projects indicates the cost of this study to approximate \$150,000.

Use of Proceeds From Rights Offering

The Company will use a large part of the new funds to be received from the rights offering to carry out the recommended metallurgical test programs referred to above. It is estimated that these might require up to 4 months of laboratory investigation and 2 months of pilot plant work. The estimated maximum cost of this phase is \$205,000.

If results of the metallurgical test programs shall establish process modifications ensuring routine production of marketable concentrates, the Company will carry out a detailed, definitive feasibility study for the project at an estimated maximum cost of \$150,000, before making a project decision.

The Company will use approximately \$63,000 of the new funds to repay in full to Denison Mines Limited advances made to the Company by Denison to provide the funds necessary for the 1975 preliminary project studies and for current working capital requirements. The maximum possible that can be raised from the rights offering is $579,888 on the basis of all rights being fully exercised.

The balance of the new funds remaining after payment of all of the foregoing will be used as working capital for administrative costs and general corporate purposes.

Undertaking by Denison Mines Limited

Denison Mines Limited ("Denison") which owns 1,700,000 of the issued shares of the Corporation out of a total of 3,624,300 issued shares, has undertaken that it will exercise all rights which will be available to it under the rights offering. In addition, Denison has undertaken that it will exercise its additional subscription privilege (if the same is available) to the extent of such additional number of shares as are required to be purchased to ensure that the Corporation will receive $500,000 from the sale of shares under the rights offering.

Record Date and Terms of Offering:

The directors have fixed January 30, 1976, as the record date for the offering. Shareholders who are of record on that date are thus being given the right to subscribe for additional shares. You will find enclosed a Purchase Warrant which represents the right to subscribe for one additional share for every three shares held at January 30, 1976. Three rights and 48 cents are needed for each additional share.

Expiry Date:

ALL RIGHTS UNDER THE SUBSCRIPTION WARRANTS WILL EXPIRE AT 4:00 O'CLOCK IN THE AFTERNOON (EASTERN STANDARD TIME) ON FEBRUARY 27, 1976. WARRANTS WILL BE VOID AND VALUELESS IF NOT USED FOR SUBSCRIPTION BY THAT TIME.

How to Exercise Rights:

Subscriptions must be made by filling in and signing the subscription form appearing on the back of the Warrant and mailing or delivering it with the subscription price of 48 cents per share so as to be received by Canada Permanent Trust Company, 20 Eglinton Avenue West, Toronto, Ontario M4R 2E2, before 4:00 o'clock in the afternoon (Eastern Standard Time) on February 27, 1976. Purchases must be of whole shares only and no fractional shares will be issued.

Purchase and Sale of Rights:

Rights may be bought or sold through brokers and the Corporation understands that the rights will be admitted to trading on the Toronto Stock Exchange. The subscription warrants are assignable.

Details of Additional Subscription Privilege:

Each holder of rights who has subscribed and paid for all or any part of the shares evidenced by the enclosed subscription warrant evidencing his right to subscribe for shares, is offered the right to make application for additional shares, if any, at the price of 48 cents per share, not exceeding the number of shares purchased under the enclosed warrant. The number of shares available for this purpose will be the difference, if any, between the total number of shares offered to all shareholders and the total number of shares subscribed at the date the offer expires.

If you wish to apply for additional shares, please complete Form 1 as well as Form 3 on the enclosed warrant, which must reach Canada Permanent Trust Company at 20 Eglinton Avenue West, Toronto, Ontario M4R 2E2, before 4:00 p.m. Eastern Standard Time, on February 27, 1976. Subscriptions for additional shares will be received on an allotment basis only so that the number of additional shares, if any, which may be allotted to each applicant will be on a pro rata basis. Applicants for additional shares will be notified as soon as practical after February 27, 1976, of the number of shares allotted to them and the amount required in payment therefor. NO PAYMENT SHOULD ACCOMPANY THE APPLICATION FOR ADDITIONAL SHARES.

United States Shareholders:

The shares to be issued upon exercise of the rights are not registered under the Securities Act of 1933 of the United States of America. Accordingly, the shares are not being offered for sale in the United States of America or any of the territories or possessions thereof, and subscriptions will not be accepted from any person or his agent who appears to be, or the Corporation has reason to believe is, a resident of the United States of America or any of the territories or possessions thereof. The Corporation understands that such shareholders may sell their rights in Canada.

Financial Information:

For information of shareholders an unaudited balance sheet as at December 31, 1975 and a statement of deferred exploration and development expenditures for the period ended on that date are included as a part of this circular.

General:

It is hoped that shareholders will give serious consideration to the exercise of the rights being offered to them.

On behalf of the Board of Directors,

JOHN KOSTUIK,
President.

Consolidated Rexspar Minerals & Chemicals Limited

BALANCE SHEET

As at December 31, 1975

ASSETS

	1975	1974
Current Assets		
Cash	$ 1,213	$ 1,641
Short-term investment — at cost	—	—
Accounts receivable	—	—
Prepaid rental	1,040	1,310
	2,253	2,951
Mining Properties	849,046	849,046
Fixed Assets — at cost		
Land	10,690	10,690
Buildings	4,298	4,298
Furniture, fixtures and equipment	2,640	2,640
	17,628	17,628
Deferred Exploration and Development Expenditures	2,610,029	2,542,139
	$3,478,956	$3,411,764

LIABILITIES

	1975	1974
Current Liabilities		
Accounts payable and accrued liabilities	$ 15,988	$ 6,750
Long-Term Liabilities		
Advance from shareholder	62,954	5,000
	78,942	11,750

SHAREHOLDERS' EQUITY

	1975	1974
Capital Stock		
Authorized — 4,920,000 shares of no par value		
Issued — 3,624,300	3,704,153	3,704,153
Deficit	304,139	304,139
	3,400,014	3,400,014
	$3,478,956	$3,411,764

JOHN KOSTUIK, Director.

E. L. EVANS, Director.

Consolidated Rexspar Minerals & Chemicals Limited

STATEMENT OF DEFERRED EXPLORATION AND DEVELOPMENT EXPENDITURES

For the Year Ended December 31, 1975

	1975	1974
Birch Island, Kamloops Mining Division British Columbia		
Exploration and Development		
Surface exploration	$ 1,254	$ 2,004
Taxes and renewal fees	7,664	4,562
Consulting	—	930
Feasibility study	41,225	—
Property maintenance	367	—
	50,510	7,496
Administration		
Legal and Audit fees	2,931	525
Registrar and transfer agents' fees	4,011	3,124
Reports to shareholders	2,730	1,302
Stock exchange fees	1,400	200
Taxes and licences	5,430	5,065
Other administrative expense	522	149
Office supplies	356	406
	17,380	10,771
	67,890	18,267
Sundry Income		
Interest		185
Option payment		5,000
		5,185
Total Expenditures for the Year		13,082
Balance — Beginning of Year	2,542,139	2,529,057
Balance — End of Year	$2,610,029	$2,542,139

STATEMENT OF DEFICIT

For the Year Ended December 31, 1975

	1975	1974
Balance — Beginning of Year	$ 304,139	$ 298,995
Organization expense written off	—	4,349
Investment in subsidiary written off	—	795
Balance — End of Year	$ 304,139	$ 304,139

Consolidated Rexspar Minerals & Chemicals Limited

STATEMENT OF CHANGES IN FINANCIAL POSITION

For the Year Ended December 31, 1975

	1975	1974
Sources of Working Capital		
Advance from shareholder	$ 57,954	$ 5,000
Interest earned	—	185
Option payment	—	5,000
	57,954	10,185
Uses of Working Capital		
Exploration and development expenditures	67,890	18,267
Decrease in Working Capital	9,936	8,082
Working Capital — Beginning of Year	(3,799)	4,283
Working Capital (Deficiency) — End of Year	$ (13,735)	$ (3,799)

NOTES TO FINANCIAL STATEMENTS

December 31, 1975

1. **Investment in Subsidiary**
   The subsidiary, Rexspar Housing Limited, has been inoperative for a number of years and this investment was written off in 1974.

2. **Mining Properties**
   Birch Island, Kamloops Mining Division, British Columbia.

22 mineral claims and fractions held under Crown Grant acquired for 825,000 fully paid shares in the capital stock of Rexspar Minerals & Chemicals Limited	$ 825,000
19 mineral claims and fractions held under Crown Grant, at nominal value	19
58 mineral claims and fractions held by right of location, acquired for 170,000 fully paid shares in the company's capital stock	13,854
18 mineral claims held by right of location, at nominal value	18
85 mineral claims and fractions held by right of location, acquired for cash	10,155
	$ 849,046

3. **Values**
   The amounts shown for mining properties and deferred exploration and development expenditures represent costs to date less amounts written off and do not reflect present or future values.

4. **Capital Stock**
   Capital stock has been issued for the following consideration:

Issued	Number of shares	Amount $
On consolidation of 6,500,000 shares of Rexspar Minerals & Chemicals Limited	1,300,000	2,635,003
For retirement of debentures	104,300	52,150
For mining properties	170,000	17,000
For cash	2,050,000	1,000,000
	3,624,300	3,704,153

5. **Remuneration of Directors and Senior Officers**
   Directors and senior officers, as defined in the Business Corporations Act, received no direct remuneration during the period ended December 31, 1975.

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Province of British Columbia
Ministry of Mines and Petroleum Resources

GEOLOGY OF THE REXSPAR DEPOSIT

By V. A. Preto

INTRODUCTION

The Rexspar deposit is located on Red Ridge, 450 kilometres northeast of Vancouver and 5 kilometres south of the village of Birch Island, on the south slope of the North Thompson Valley, between Lute and Foghorn Creeks (Figure 1).

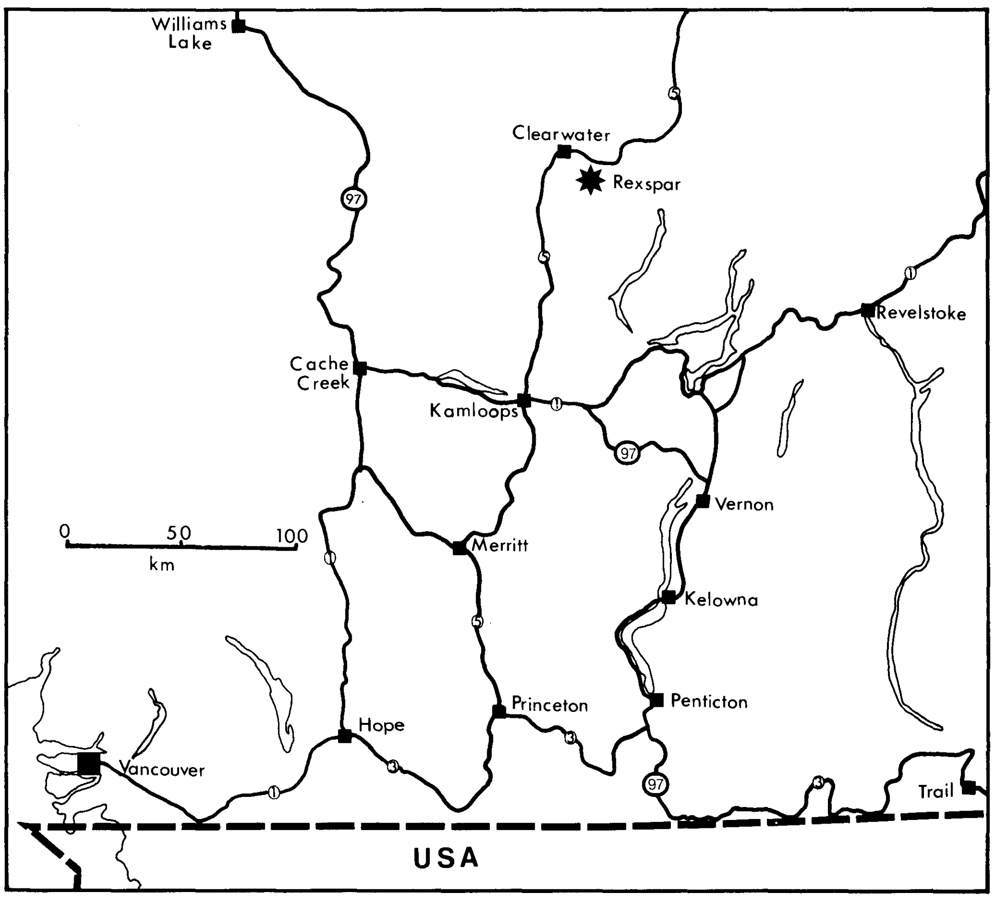
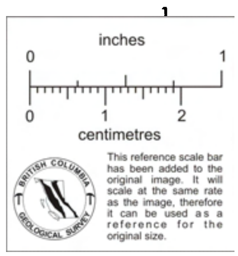


Figure 1. Location map.



The Rexspar showings have received intermittent attention since 1918. Initially interest was for silver-lead and fluorite and, in the late 1920's, for manganese. Further work on the fluorite occurrences was done in the 1940's, and the presence of uranium mineralization was discovered in 1949. Extensive surface and underground work in the early and mid 1950's, mostly under the direction of F. R. Joubin, outlined three zones of commercial-grade uranium mineralization and one contiguous zone of fluorite mineralization. Geological studies and diamond drilling were resumed in 1969 and continued until 1976. This work has defined three zones of uranium mineralization, known as the A, B, and BD, with combined reserves of 1 114 158 tonnes of ore grading 0.773 kilogram of U_3O_8 per tonne. Engineering studies done on behalf of Consolidated Rexspar Minerals & Chemicals Limited by Kilborn Engineering Ltd. indicate that these reserves are sufficient to support, for a period of four and one-half years, a 1 270-tonne-per-day, five days a week mining operation and a 910-tonne-per-day beneficiation plant that is to operate continuously. Fluorite mineralization, located adjacent to the uranium orebodies, if proven to be economic, could extend the life of the operation by an additional four years.

Consolidated Rexspar Minerals & Chemicals Limited and Denison Mines Limited, a major shareholder holding about 47 per cent of the issued shares, are at present finalizing plans for production.

GEOLOGY

All foliated rocks within the area mapped (Figure 2) are part of the Eagle Bay Formation of pre-Late Triassic and probable Mississippian age (Campbell and Okulitch, 1976). To the southwest, near Foghorn Mountain, these rocks are in probable fault contact with massive to weakly foliated basalt and pillow basalt of the Fennell Formation of Mississippian or later age. To the south, on Granite Mountain, schists of the Eagle Bay Formation are intruded by massive quartz monzonite and granodiorite of the Cretaceous Baldy batholith.

South of the Thompson River, and especially in the vicinity of the Rexspar deposits, the foliated rocks are mostly of volcanic origin. Green chlorite and chlorite-sericite schist and silver-grey sericite-quartz schist of map unit 1 are the most common rock type and contain several exposures of clearly recognizable dacitic and andesitic volcanic breccia which attest to the volcanic origin of a good part of these rocks (Plate 1). Interlayered metasedimentary members of grey phyllite and slate (unit 2), quartzite, and ribbon chert are distinctly less abundant than schists of metavolcanic origin. Uranium mineralization is found exclusively in map unit 3, locally known as the trachyte unit. On Red Ridge, and particularly in the vicinity of the orebodies, this rock consists of a rusty weathering, light grey, pyritic alkali feldspar porphyry which may be massive, brecciated (Plate 2A) or strongly schistose (Plate 2B) and lineated. In thin section this rock is seen to consist of megacrysts of alkali feldspar and of well-twinned albitic plagioclase set in a fine-grained, sugary groundmass of feldspar and sericite. The megacrysts range from nearly euhedral and undeformed to highly

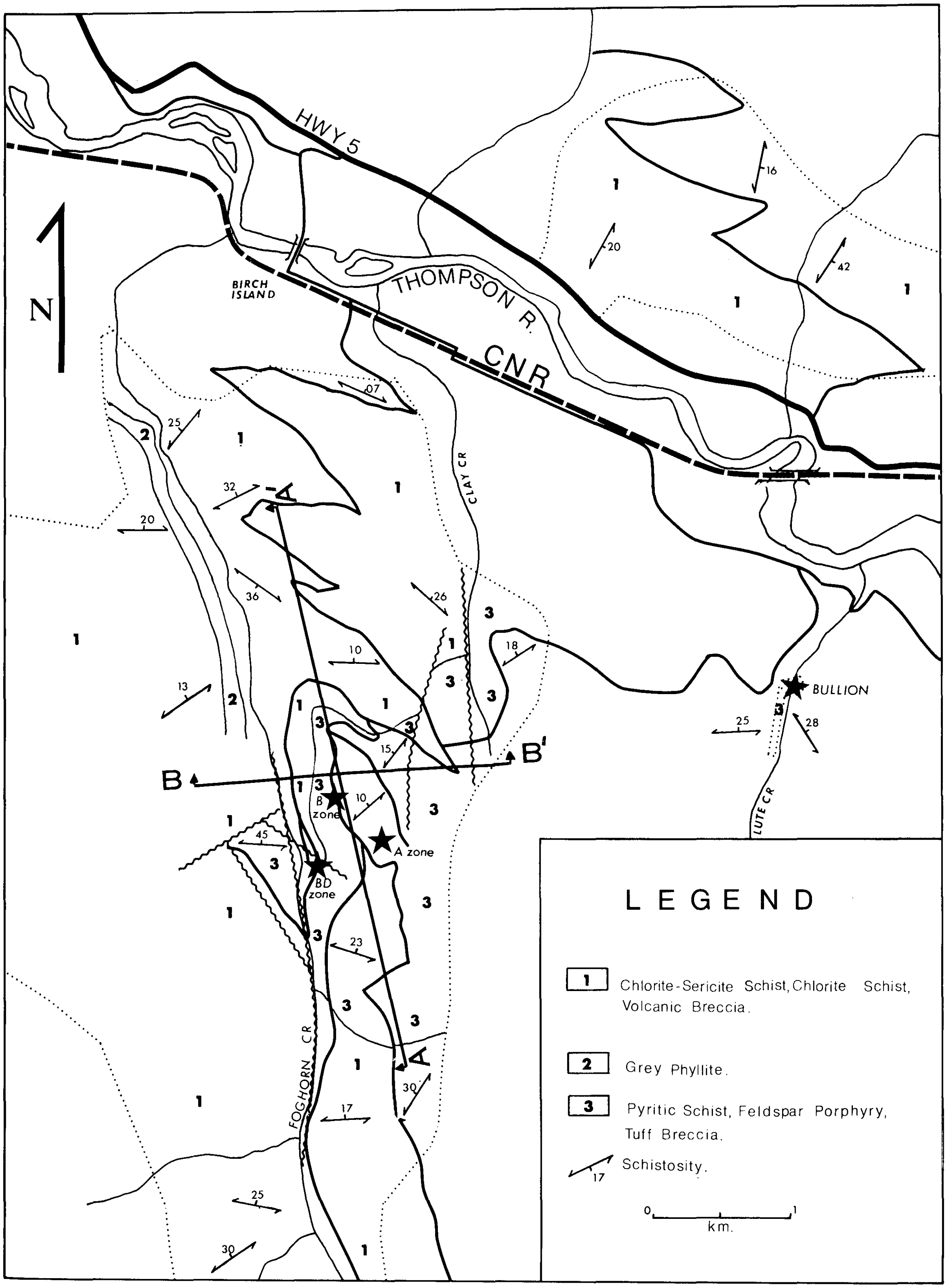


Figure 2. Generalized geology of the Rexspar property.

fractured and sheared. The groundmass varies from weakly fractured and massive to very strongly foliated, sheared, and flattened. Another common variety of unit 3, and particularly near the A zone and south of the BD zone, is a polymictic breccia which contains a predominance of feldspar porphyry fragments as well as fragments of other fine-grained, darker coloured rocks. Clast size in these breccias ranges from less than 1 centimetre to rarely more than 20 centimetres. The monomictic feldspar porphyry breccias, because of their setting, distribution, and appearance, can best be interpreted as intrusion or explosion breccias, whereas the polymictic varieties are considered to be lithic-crystal tuffs and tuff breccias. To the south and northeast of the mineral deposits, map unit 3 consists mostly of a well-foliated, yellowish grey to rusty weathering, pyritic, light-coloured, fine-grained schist which generally is composed of sericite and feldspar, but which occasionally includes some very siliceous members. Small lithic clasts, generally 1 centimetre or less in size, are widespread and common throughout this schist. In summary, therefore, map unit 3 consists of a deformed and metamorphosed pile of lithic tuff and breccia mostly of trachytic composition, but with some rhyolite members, which in the vicinity of the Rexspar deposits include coarser fragmental and proably intrusive phases. It follows therefore that the area of the mineral deposits, and particularly that between the B and BD zones, probably is a volcanic centre or vent from which part or all of map unit 3 was derived.

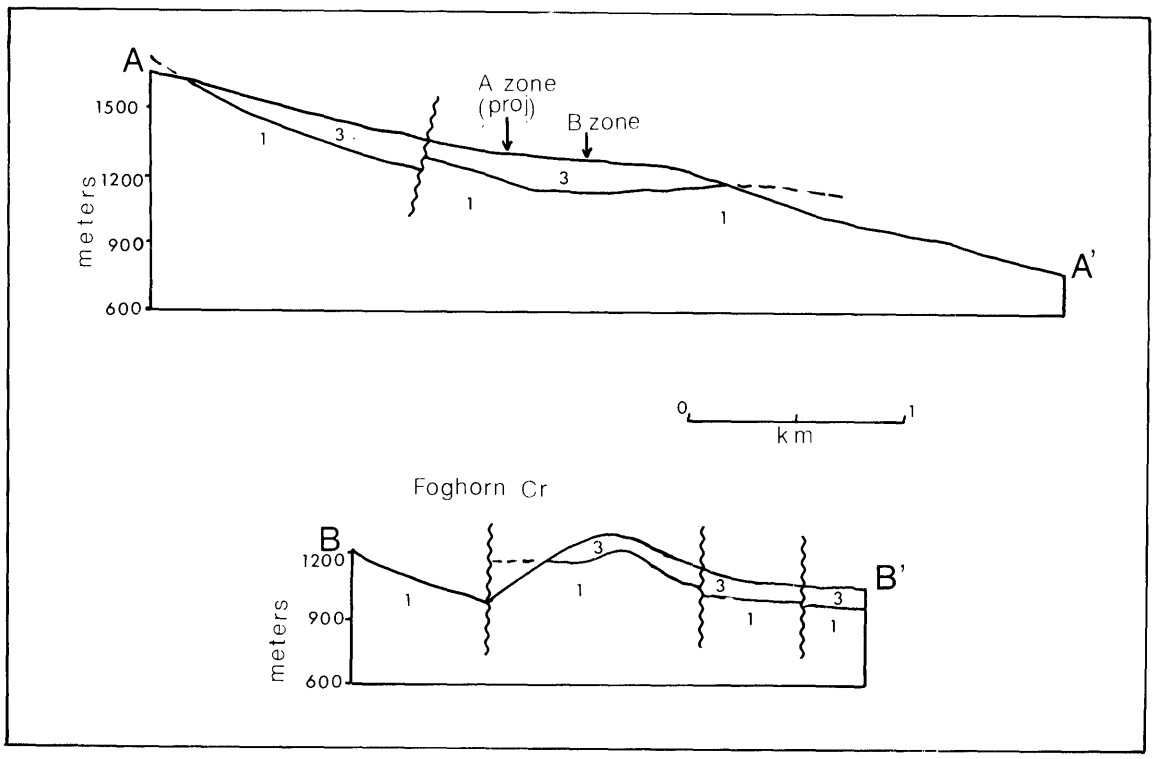


Figure 3. Cross-sections to accompany Figure 2.

North of the Thompson River the predominant rock type is still greenschist of unit 1, but, outside the area of Figure 2, there is a greater abundance of quartzite, siliceous metasedimentary schist, and carbonate. The schistosity on the lower slopes dips moderately to the east and northeast, and on Mount McClennan dips are gentle to the north.

STRUCTURE

Mesoscopic structures that are well displayed at a few key exposures along Highway 5, and on Mount McClennan to the north of the area of Figure 2, indicate that the prominent schistosity is parallel to the compositional layering and to the axial planes of small, rootless folds (Plate 3A) that were probably formed during a first phase of deformation. The schistosity is in turn deformed by tight, recumbent, east-trending second phase folds. These structures are refolded by upright third phase structures which trend northerly to northeasterly. Late kinks and prominent tension fractures represent a fourth and last set of structures which trend northerly and are commonly followed by post-tectonic felsic and mafic dykes of Cretaceous or later age. High-angle, northerly trending faults, possibly related to this period of deformation, occur along Foghorn, Clay, and probably Lute Creeks, and sharply control the distribution of rock units and of unit 3 in particular.

MINERALIZATION

Uranium-thorium mineralization is found exclusively in map unit 3 and, as far as can be determined by surface mapping and from old drill records, occurs mainly in the upper part of the unit. Dark-coloured zones of the 'trachyte unit' which are extensively replaced by silver-grey fluorphlogopite and pyrite are by far the best host to mineralization. Drilling indicates that ore-grade material occurs in a series of discontinuous lenses generally less than 20 metres thick and conformable with the schistosity in the trachyte. Fluorphlogopite-pyrite replacements, commonly with lesser amounts of fluorite and minor calcite, range from a few centimetres to several metres in size, and generally occur as coarse-grained segregations which show both conformable and crosscutting relationships.

Previous work by officers of the Geological Survey of Canada (Lang *et al.,* 1962) and British Columbia Ministry of Mines and Petroleum Resources (McCammon, 1954), as well as further optical, chemical, X-ray, and electron microprobe work during the present investigation has yielded the following results:

(1) The principal uranium-thorium minerals at Rexspar are uraninite, thorian uraninite (Plate 4), torbernite, and metatorbernite, thorianite, and thorite. In addition, some uranium and thorium occur in monazite, and niobian ilmenorutile.

TABLE 1. U AND Th CONTENT OF SELECTED HAND SPECIMENS FROM REXSPAR

(All values in ppm)

Sample No.	Zone	Total U	Total Th	Sinks +3.29 S.G. +40 mesh U	Sinks +3.29 S.G. +40 mesh Th	Sinks +3.29 S.G. −40+60 mesh U	Sinks +3.29 S.G. −40+60 mesh Th	Floats −3.29 S.G. +40 mesh U	Floats −3.29 S.G. +40 mesh Th
1	BD	687	3270	1017	2401	825	1949	963	2230
2	A	412	504	374	493	230	264	496	416
3	A	265	204	331	197	312	114	230	172
4	A	1468	2418	2646	4093	1472	2452	1165	1343
7	A	231	411	377	696	227	312	251	386
8	BD	53	47	21	65	27	10	41	47

Analyses done by gamma-ray spectrometric determinations at the
Analytical Laboratory of the Ministry of Mines and Petroleum Resources.

TABLE 2. SEMI–QUANTITATIVE EMISSION SPECTROGRAPHIC ANALYSES OF SELECTED HAND SPECIMENS FROM REXSPAR

(Values in weight per cent)

Element	Sample No. and Zone: 1 – BD Zone	2 – A Zone	3 – A Zone	4 – A Zone	7 – A Zone	8 – BD Zone
Si	>10.0	>10.0	>10.0	>10.0	>10.0	>10.0
Al	8.5	7.5	>10.0	>10.0	9.0	>10.0
Mg	2.0	2.0	0.7	2.0	1.0	2.0
Ca	3.5	2.5	1.35	2.5	>20.0	1.5
Fe	16.0	>20.0	12.5	17.5	11.5	9.0
Pb	0.015	Tr.	0.015	0.03	Tr.	0.015
Cu	0.07	0.05	0.03	0.05	0.01	0.02
Zn	0.01	0.01	Tr.	Tr.	N.A.	Tr.
Mn	0.12	0.15	0.13	0.1	0.1	0.14
Ag	Tr.	Tr.	Tr.	Tr.	Tr.	Tr.
V	0.05	0.05	0.05	0.05	0.05	0.03
Ti	0.3	0.35	0.3	0.35	0.35	0.15
Ni	Tr.	Tr.	Tr.	Tr.	Tr.	Tr.
Co	Tr.	Tr.	Tr.	Tr.	Tr.	Tr.
Na	0.15	0.08	>2.0	0.15	0.15	2.0
K	>2.0	>2.0	>3.0	>3.0	>2.0	>5.0
Mo	0.01	Tr.	0.01	Tr.	0.015	Tr.
Zr	0.05	0.02	0.03	0.05	0.025	0.025
Sr	>2.0	0.1	0.04	0.15	0.1	>1.0
Ba	0.13	0.06	0.2	0.13	0.07	0.18
U	0.1	N.R.	N.R.	0.15	N.R.	N.R.
Th	0.23	0.04	0.02	0.23	0.04	N.R.
Li	0.015	0.03	0.01	0.04	Tr.	0.02
Nb	0.025	0.025	0.015	0.03	Tr.	Tr.
Y	0.01	0.015	0.01	0.02	0.05	Tr.
La	0.07	0.09	0.25	0.1	0.25	0.02
Ce	0.08	0.1	0.2	0.16	0.15	0.04
Nd	0.12	0.14	0.12	0.14	0.12	0.025
P	1.2	1.2	1.0	1.2	0.5	N.A.
Sn	N.R.	Tr.	Tr.	Tr.	Tr.	Tr.
Ge	Tr.	Tr.	Tr.	Tr.	Tr.	Tr.
Cr	Tr.	Tr.	0.01	Tr.	Tr.	0.01
Be	Tr.	Tr.	Tr.	Tr.	Tr.	N.A.
Yb	Tr.	Tr.	Tr.	Tr.	Tr.	Tr.

Analyses done at the Analytical Laboratory
of the Ministry of Mines and Petroleum Resources.

(2) Rare earths are found in bastnaesite and monazite (Plate 4).

(3) Other minerals include pyrite, fluorphlogopite, apatite, fluorite, celestite, galena, sphalerite, chalcopyrite, molybdenite, scheelite, siderite, dolomite, calcite, barite, quartz, albitic plagioclase, and alkali feldspar.

(4) Uranium-thorium minerals occur as tiny, discrete grains inside fluorphlogopite flakes and surrounded by single or double pleochroic haloes (Plate 5A) or as discrete grains scattered in the pyrite-fluorphlogopite matrix (Plate 4, Plate 6).

(5) Radiation damage has caused pleochroic haloes in fluorphlogopite and the purple coloration in fluorite.

(6) Analyses indicate that thorium-uranium ratios range from nearly 1:1 to much greater than 1:1 (Table 1). Rare earths, and particularly cerium and lanthanum, are present in very substantial amounts (Table 2).

(7) Oxidation of the ore has been negligible, probably because of the abundance of pyrite.

(8) Fluorite is commonly found in the zones of uranium-thorium mineralization, but the fluorite zone which could be of commercial grade is separate from ore-grade uranium-thorium mineralization.

(9) All phases of the 'trachyte unit,' including zones of fluorphlogopite-pyrite replacement and uranium-fluorite mineralization, display evidence of deformation and range from brecciated to markedly schistose and lineated. They appear to have been subjected to most or all of the deformation that affected the rest of the foliated rocks in the area, though their response was not uniform (Plate 7).

It appears therefore that the mineralized zones at Rexspar not only are located close to a part of the 'trachyte unit' which might represent a vent area, but also that, assuming the strata are upright, they are concentrated in the upper part of the unit. The close association with the pyrite-mica replacement and the occurrence of radioactive minerals within mica grains suggest that all these minerals formed at about the same time. The occurrence of fluorite in tension gashes produced by strain-slip cleavage in fluorphlogopite (Plate 5B) probably means that some of the fluorite was remobilized during deformation, since most fluorite seems to have been deformed together with the rest of the rock constituents (Plates 7A and 7B). The setting and aspect of the pyrite-mica zones suggest that these were formed by deuteric, volatile-rich fluids during a late stage in the formation of the 'trachyte unit.' It follows, therefore, that the zones of uranium-thorium mineralization, and probably also of fluorite, could be syngenetic with the formation of the 'trachyte unit' and thus be volcanogenic in origin.

Another alternative to this interpretation is that the pyrite-mica rock with the associated uranium-thorium mineralization and the zones of fluorite mineralization were formed during one or more hydrothermal events some time after the formation of the 'trachyte unit' but before deformation. Their spatial association with a probable vent area within the trachyte could be attributed to the pre-existence of suitable channelways. If such were the case, one would expect evidence of renewed fracturing and possibly veining of the trachyte by hydrothermal minerals associated with this event. One would also expect that evidence of this hydrothermal replacement and mineralization also be found in the schist below the trachyte. This does not appear to be the case at Rexspar. Uranium mineralization is found only in the trachyte and is always associated with the pyrite-mica rock. The schists below the trachyte, though somewhat pyritic, are barren of uranium and do not have any of the distinctive pyrite-mica rock. Also the mode of occurrence of the pyrite-mica rock as ill-defined masses, very variable in size and commonly chocked with trachyte fragments, can best be explained by assuming that it was formed by late magmatic solutions which permeated the trachyte during or shortly after its formation and not at some later time.

AGE

A K/Ar age of 236±8 Ma has been obtained by S. S. Gandhi of the Geological Survey of Canada (personal communication, March 9, 1978) for fluorphlogopite from one of the mineralized zones. This must be considered a minimum age and used cautiously because of some analytical problems.

This Permo-Triassic age for the fluorphlogopite and, by inference, for the mineralization, though somewhat young for the presumed Mississippian age of the Eagle Bay rocks, tends to confirm the interpretation that the mineralization at Rexspar is old, probably syngenetic with the host rocks, and not related to the Cretaceous Baldy batholith.

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Joubin, F. R. and James, D. G. (1957): Rexspar Uranium Deposits, *in* Structural Geology of Canadian Ore Deposits, *CIM,* Congress Vol., pp. 85-88.

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McCammon, J. W. (1954): Rexspar Uranium and Metals Mining Co. Limited, *Minister of Mines, B.C.,* Ann. Rept., 1954, pp. 108-111.

Mineral Resources Branch,
Geological Division,
Victoria, British Columbia, Canada
March 1978

Plate 1A. Metavolcanic breccia, map unit 1, Red Ridge.

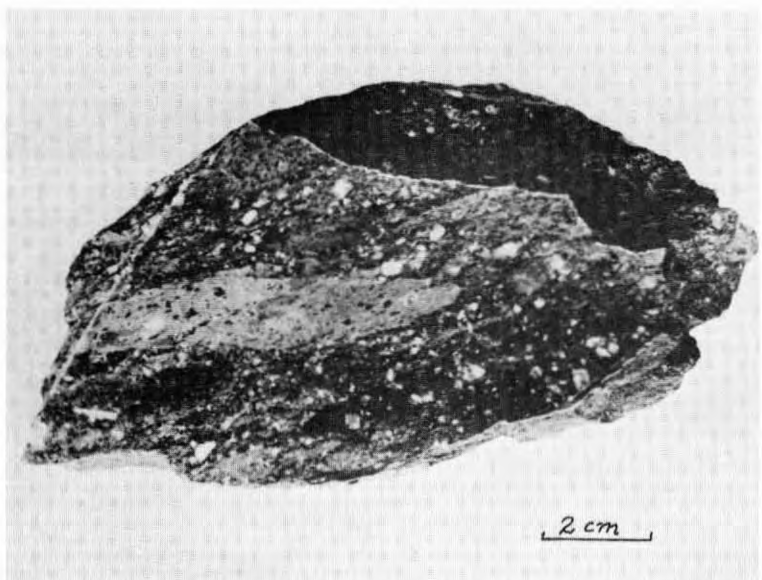


Plate 1B. Polished hand specimen from exposure of Plate 1A.

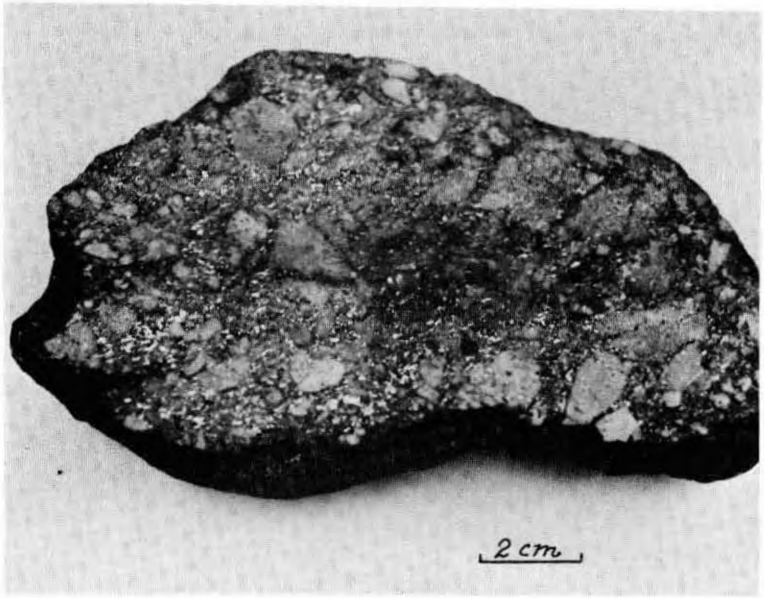


Plate 2A. Massive trachyte porphyry breccia, Rexspar A zone.

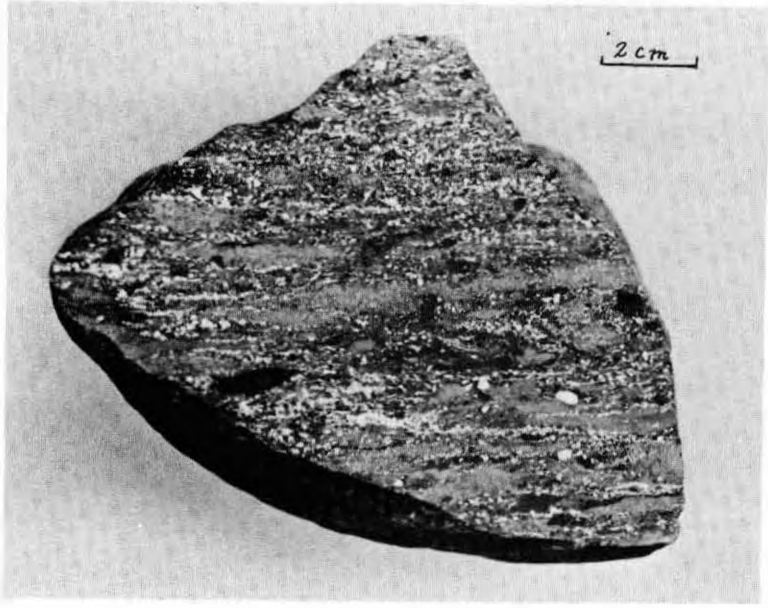


Plate 2B. Strongly foliated trachyte porphyry breccia, Rexspar A zone. Compare with Plate 1A. Rectangular dark patches are fluorite crystals.

Plate 3A. Rootless phase 1 folds outlined by quartzite layers in quartz-mica schist, north face of Mount McClennan, looking east.

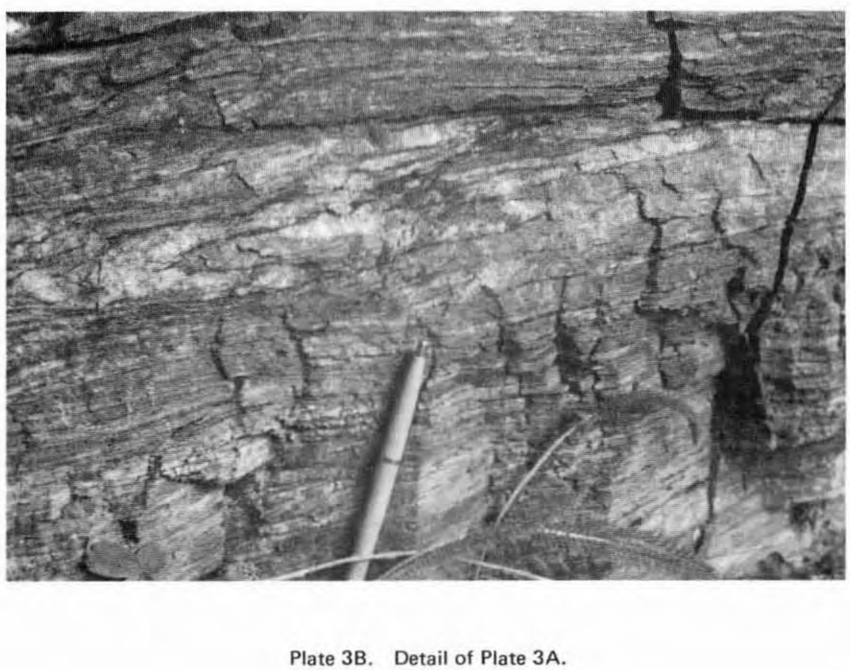


Plate 3B. Detail of Plate 3A.

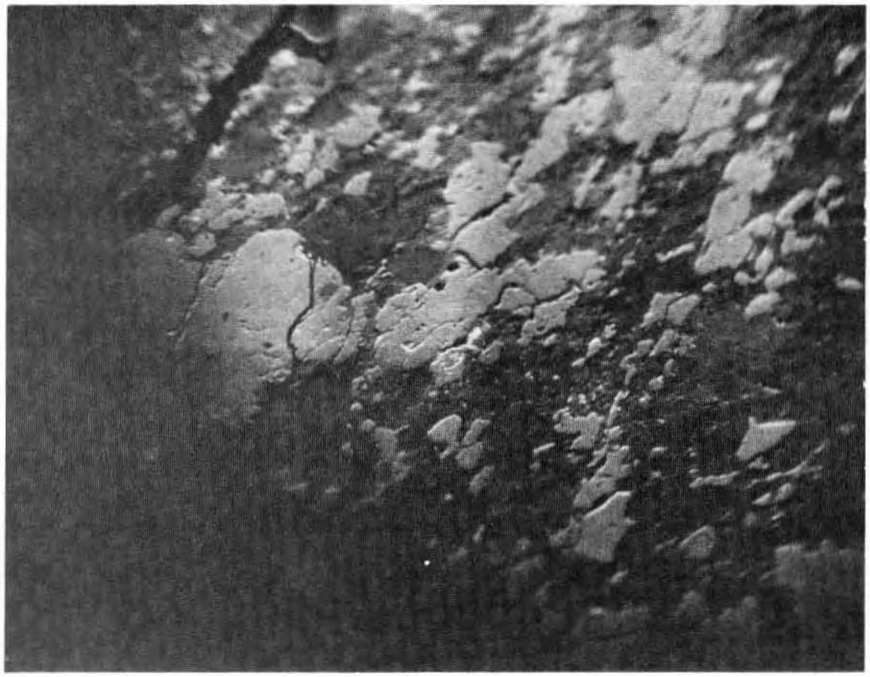


Plate 4A. Back scattered electron photograph of Rexspar ore from A zone. Bright grains at centre are Plate 4B. x30.

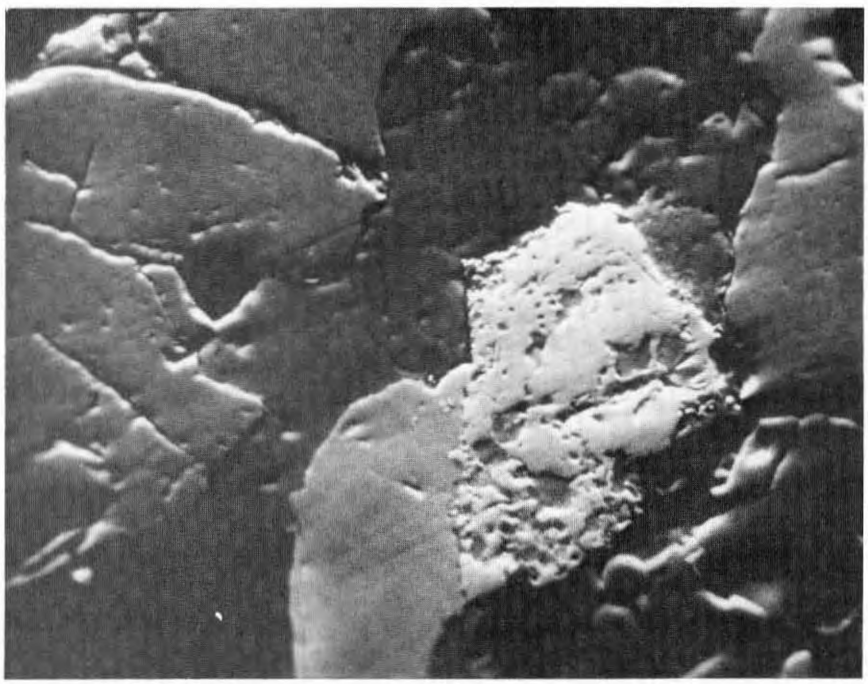


Plate 4B. Enlarged part of Plate 4A showing a grain of thorian uraninite (light grey) and one of monazite (medium grey), surrounded by pyrite. x700.

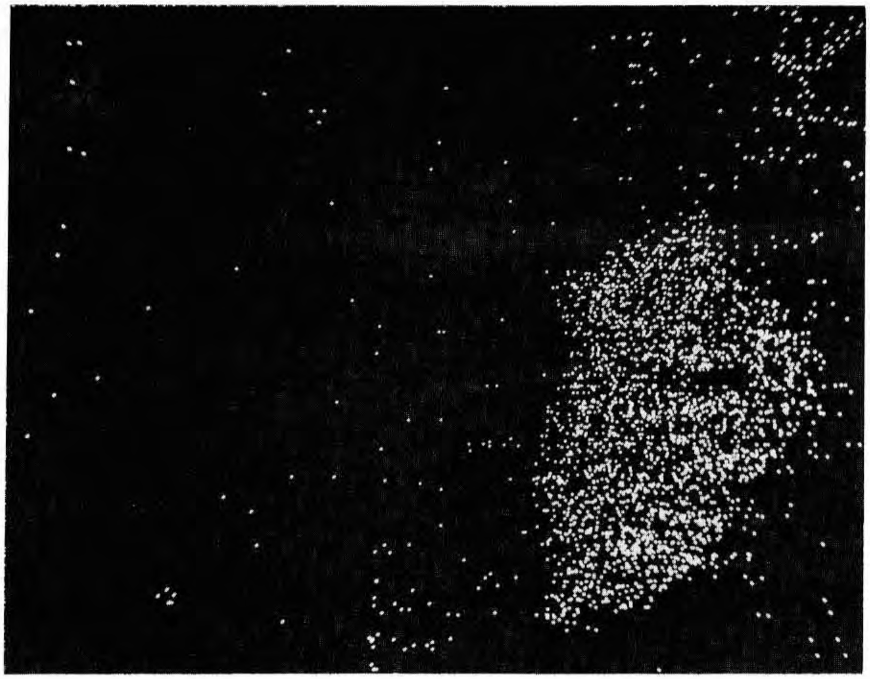


Plate 4C. U—Th electron scan of same area of Plate 4B. x700.

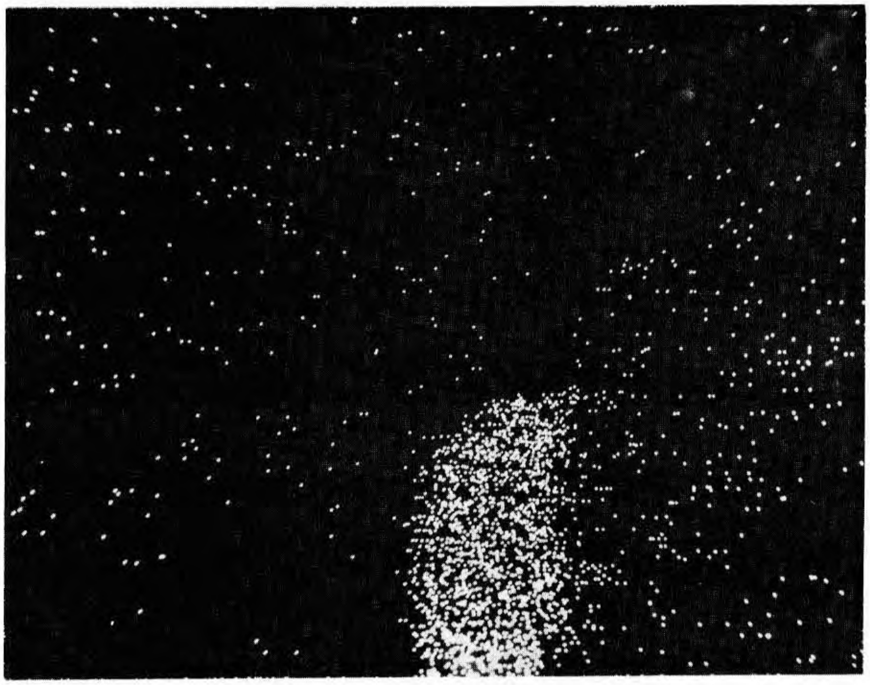


Plate 4D. Ce—La electron scan of same area of Plate 4B. x700.

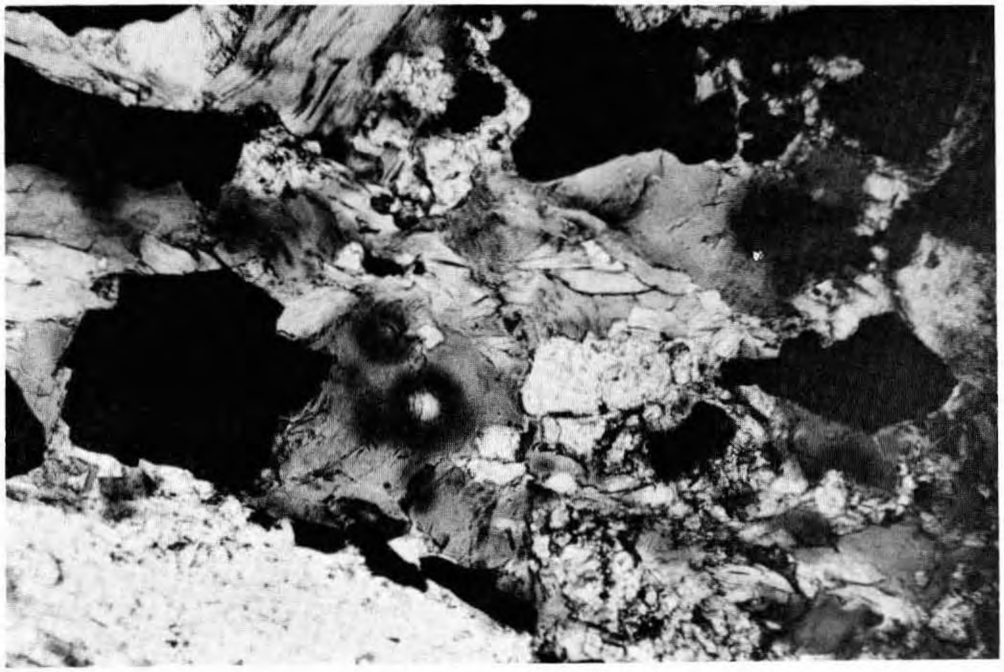


Plate 5A. Pleochroic rings in fluorphlogopite, Rexspar A zone. x80.

Plate 5B. Strain-slip cleavage in fluorphlogopite with tension gashes filled by fluorite, Rexspar A zone. x80.

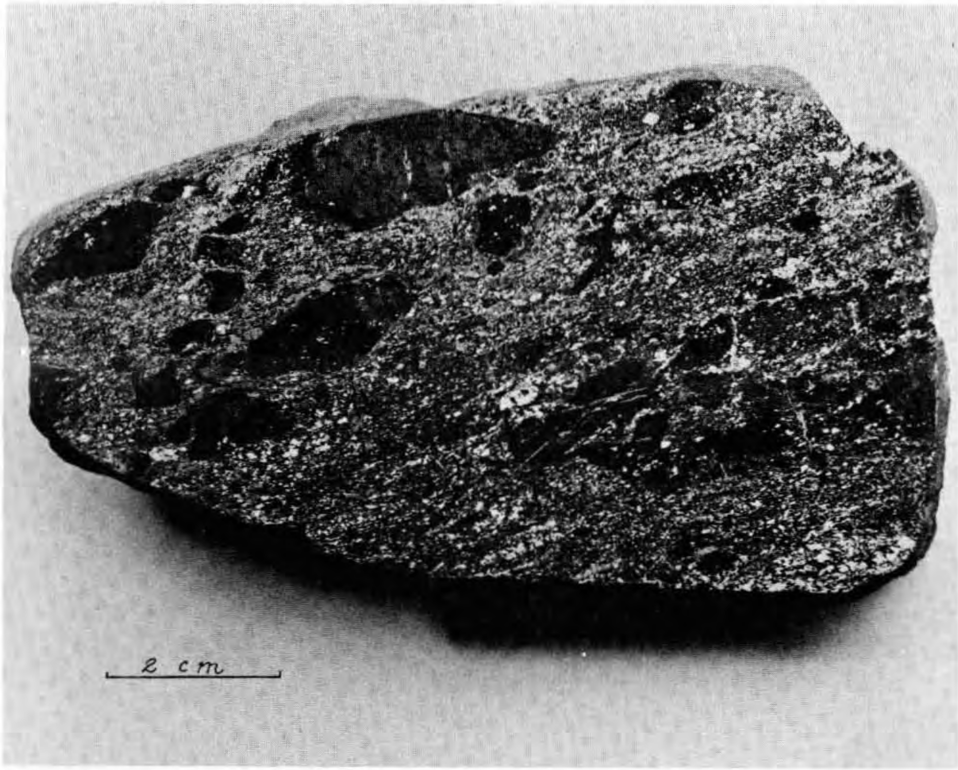


Plate 6A. Polymictic breccia, Rexspar A zone.

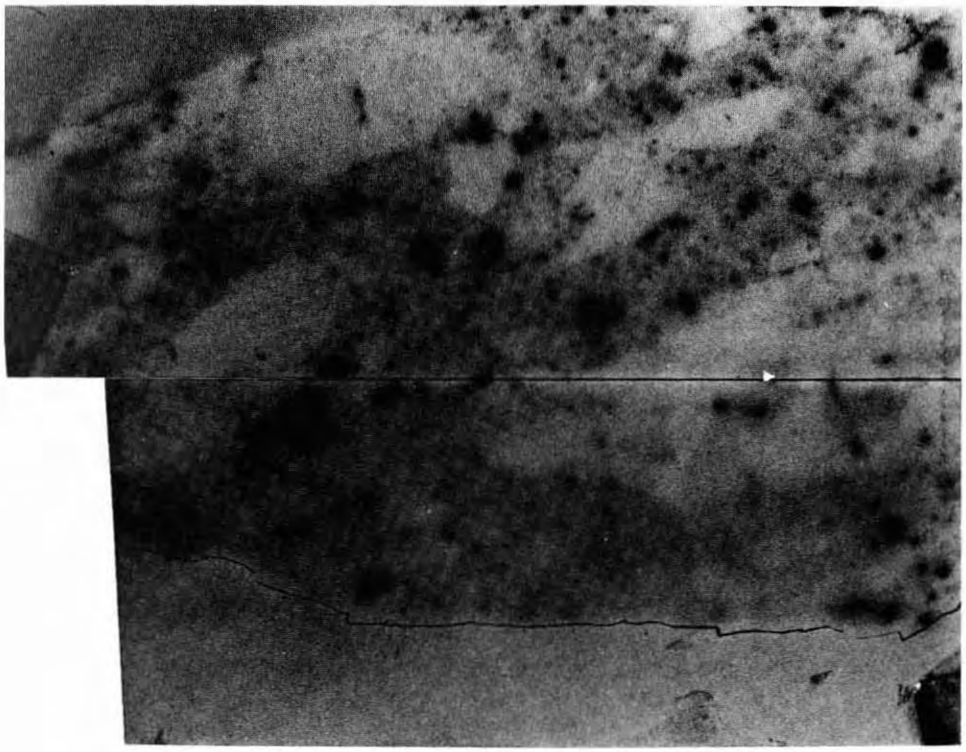


Plate 6B. Autoradiograph of sample of Plate 6A.

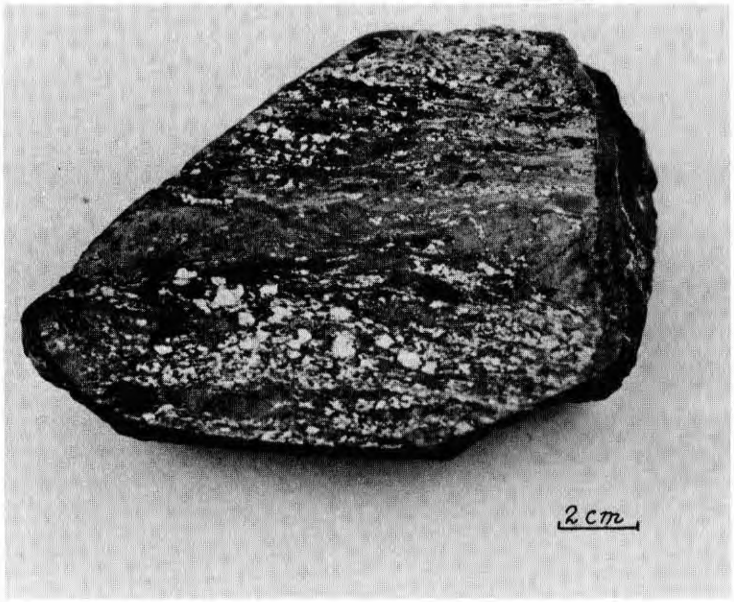


Plate 7A. Ore from Rexspar A zone, showing sheared pyrite and fluorite (dark grey).

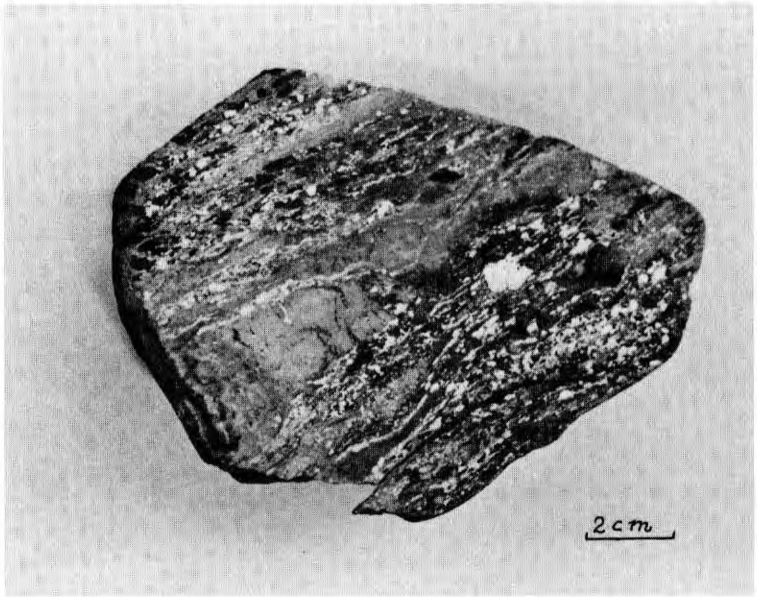


Plate 7B. Ore from Rexspar A zone, showing sheared pyrite and fluorite (dark grey).

Geological Features

REXSPAR URANIUM DEPOSITS

. . . Only B. C. applicant for contract

F. R. JOUBIN and **D. H. JAMES**
Franc R. Joubin & Associates, Toronto

The uranium deposits at the Rexspar property near Kamloops, B.C. are unique in two respects. The mine is, at time of writing, B.C.'s only candidate for a production contract, and its orebodies are the only important Canadian deposits in what might be termed the "purple fluorite class." This "class" is characterized by pyrite-fluorite mineralization, usually in acidic extrusive rocks. The fluorite is dark purple to nearly black. At Rexspar it is accompanied by the usual pyrite and occurs in micaceous beds within a trachytic member. Shearing appears to have been required to permit introduction of uranium into these beds. To date about one million tons have been proved up, and grade is slightly under two lbs. U_3O_8 per ton. Some rare earth minerals of undetermined value are present.

Introduction

Location

Rexspar Uranium & Metals Mining Co. Ltd. has been developing a property near the village of Birch Island, B.C., a stop on the C.N.R. main line some 80 miles north of the supply centre of Kamloops. The property extends from Birch Island up the south slope of the North Thompson River Valley.

History

As in many parts of B.C. prospecting has been active for years. Fluorite was reported in 1918; work was done on galena showings in 1926; bog manganese was found in 1929; a fluorite deposit was drilled in 1942-43. Although the drilling method outlined more than a million tons of material containing 35 per cent combined fluorite and celestite, marketing and beneficiation problems have delayed further development of this deposit.

Core from this drilling led to prospecting for uranium in the area when routine checking by the B.C. Department of Mines and the Geological Survey of Canada revealed low radioactivity. Prospecting turned up areas of higher radioactivity a few hundred feet from the "Fluorite Zone", and the property came under the direction of Technical Mine Consultants Ltd. who undertook drilling. Of the several zones tested, two have so far responded to development and appear to be low grade uranium orebodies. They have been called the "B.D." and "A" zones (plan). A considerable part of the property is untested.

Geology

General

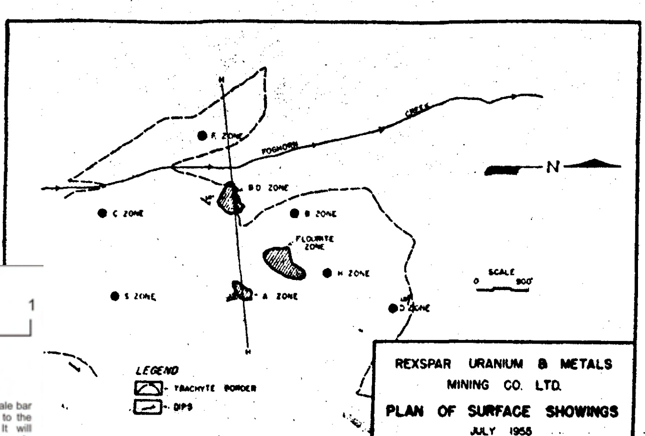
The formations in the area of Birch Island have been described by Walker (G.S.C. Sum. Rep. 1930, Pt. A). They belong to the Shuswap Terrane — a sequence of metamorphosed rocks which underlies large parts of southern British Columbia. They are characterized by gentle dips and fissility parallel to the bedding. Their age has usually been regarded as Precambrian, but may be Paleozoic.

Local Formations

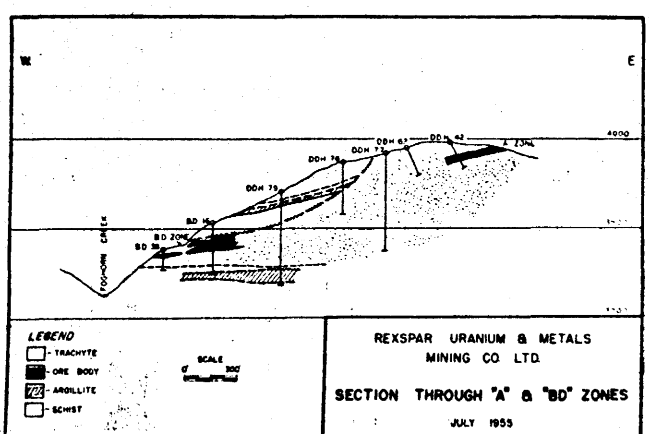
In the vicinity of the property the sequence is:

Greenstone, Unconformity or intrusive contact.
Trachytic member, tuffs, breccia, flows.
Argillite, black, thin, not always present.
Schist, thin bedded sericitic quartzite and siltstone with some calcareous layers.

Except for the trachyte which will be described farther on, none of these rocks has been studied in sufficient detail to merit further description. The schist and argillite are



REXSPAR URANIUM & METALS MINING CO. LTD.
PLAN OF SURFACE SHOWINGS
JULY 1955



REXSPAR URANIUM & METALS MINING CO. LTD.
SECTION THROUGH "A" & "BD" ZONES
JULY 1955

CMJ July 1956.

conformable metasediments, overlain with apparent conformity by the trachyte. There is apparently a bed of schist between the argillite and the trachyte although in some holes it is not easy to distinguish between schisted quartzitic beds and schisted sheared trachyte.

Rocks overlying the trachyte are seen in only two restricted areas since the trachyte to a large extent forms the present erosion surface. In one area the relationship is undeterminable and in the other schist and argillite appear to have been thrust over the trachyte (section).

No radioactivity has been found in any other rock than trachyte. Quartz stringers with some galena occur in the schist.

The Trachyte

The trachytic host rock is a more or less layered complex of light-coloured highly feldspathic tuffs, breccias, and flows. Most of it is massive and quite fresh. Limited areas are altered to sericite schist, and other portions are altered in varying degree to sericite, albite, and carbonate. The entire formation possesses the slight anomalous radioactivity common to acidic igneous rocks. Scattered pyrite is characteristically present.

Significant radioactivity is confined to dark layers called on the property "the ore type". These layers are composed largely of biotite, sericite, pyrite, and fluorite. Subangular fragments of fresh-looking trachyte are scattered in the dark matrix. The pyrite content varies from 5 to 20 per cent and occurs as crystals. Fluorite is present in similar amounts and is dark purple. Celestite, albite, and carbonate occur with accessory zircon, rutile, and monazite. The radioactive minerals are finely disseminated pitchblende and uraniferous thorite. The average uranium oxide content of the "BD" and "A" zones is somewhat less than two pounds per ton. Thorium is present in similar quantity.

Primary Controls

The "ore type" beds appear to parallel the lower contact of the trachyte. They are considered to have originated as beds of argillaceous material deposited during quiescent intervals in a period of acidic volcanism. Regional metamorphism which left the trachyte comparatively unaltered, caused alteration of the argillaceous material to micas. It is possible that fluorite and pyrite are also of primary origin, having been deposited by gases from subsequent volcanic activity emanating through the unconsolidated argillaceous beds.

Many drill intersections of ore-type material appear to represent only small lenses. The main orebodies themselves are irregular in detail and on a large scale lenticular. These features fit the concept of deposition on a surface very little affected by erosion and possibly even interrupted by contemporary minor flows.

Secondary Controls

The fact that most "ore-type" mineralization contains very little uranium requires an explanation. The most noticeable difference between "ore" and "oretype" is that the latter usually exhibits larger mica flakes. Examination of thin sections shows the micas in ore specimens to be deformed and recrystallized and fluorite to be brecciated and recemented by later fluorite. On a large scale, pyroclastic fragments in the ore are markedly elongated, pyrite is distributed in layers, and barren trachyte projections into the ore layer are brecciated at the edges. These features may be due in part to regional metamorphism, but they suggest that a stage of shearing subsequent to the alteration of the argillaceous beds to mica, was required to permit introduction of uranium minerals. Such shearing would logically be located in the weaker beds.

It would seem then that combination of chemical and structural controls has localized the orebodies.

Faults

Narrow sheared zones occur along the ore boundaries in the "BD" area. They are probably related to a post-ore thrust fault which has placed schist and argillite over the trachyte in this area.

Block faults of small displacement occur at several places in the ore zones.

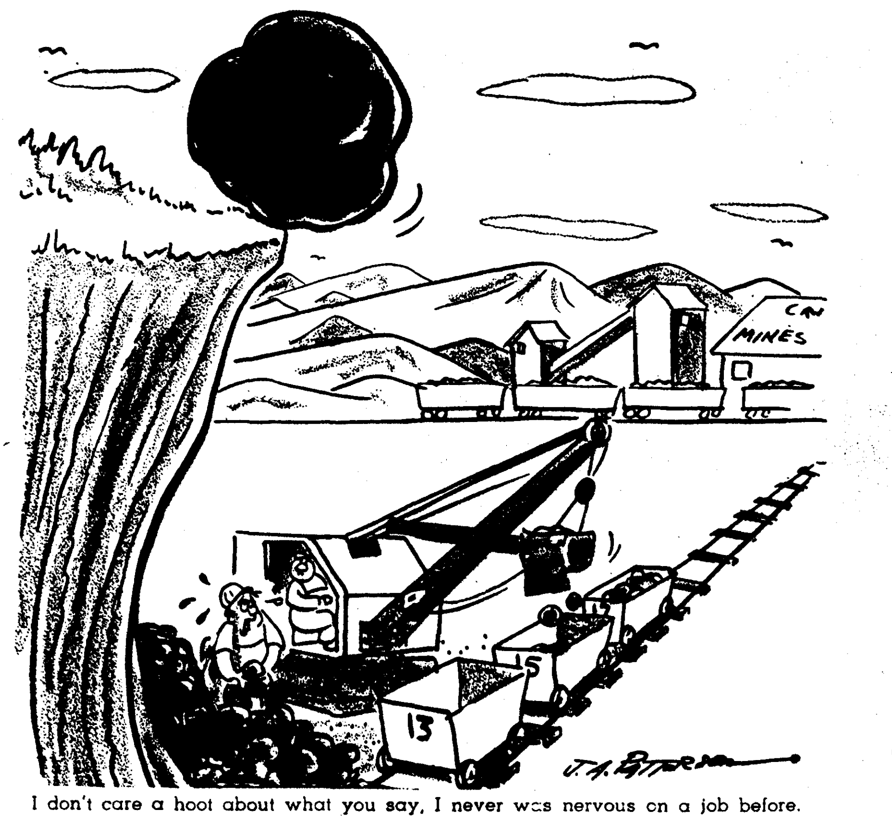
Similar Deposits

Purple fluorite has long been regarded as an indicator of radioactivity. It is not uncommon in the Bancroft area, although the deposits there do not much resemble Rexspar in other respects.

Near Harvey, New Brunswick, radioactive discoveries have been made in rhyolite flows and fragmentals. The best of these exhibits brecciated rhyolite cemented by dark purple fluorite with pyrite somewhat later on other fractures.

Deposits in France of which the writer has seen specimens are apparently very similar to the New Brunswick occurrences, and are the source of considerable production.

It may be that these three widely-separated deposits indicate a single broad classification of which other occurrences may be found.



I don't care a hoot about what you say, I never was nervous on a job before.

EMPR PF
RPT by Kilborn Eng, 1977

convert lb/ton to kg/Tonne.

$\frac{lb \times 0.4536}{.9071}/t$ = kg/Tonne

RESERVES

The ore reserves presently outlined for the Consolidated Rexspar property as defined by a cut-off grade of 0.5 pound (.250) of uranium oxide (U_3O_8) per ton are estimated at:

Zone	Tons	tonnes	lbs/ton U_3O_8	kg/T	lbs of U_3O_8
A	541,200	490967	1.689	.845	914,200
B	181,100	164291	1.479	.740	267,900
BD	506,100	459126	1.417	.709	716,900
	1,228,400	1114385	1.546	.773	1,899,000
		1114 158 tonnes	0.773 kg 0.0773%		

These reserves are contained in three separate pits and are mineable by open pit methods at an overall stripping ratio of 2:1. Ore from all three deposits is amenable to concentration in the same plant.

Ore reserves have been calculated by the horizontal polygon method from 132 ore bearing diamond drill holes located within the pit limits. Calculated reserves are in place and undiluted.

Ringsleeper and [illegible] 1980
1.630 Mt 1.51 lb U_3O_8/t

CONSOLIDATED REXSPAR ORE RESERVE

BY POLYGONS – WITHIN THE PIT LIMITS

0.5 LBS./TON U_3O_8 CUT-OFF GRADE

ZONE	TONS	LBS/TON U_3O_8	LBS.OFF U_3O_8
A	541,200	1.690	914,200
B	181,100	1.479	267,900
BD	499,500	1.399	698,700
TOTAL	1,221,800	1.539	1,880,800

From: Ref. (Kilborn Engineering (B.C.) Ltd., 1976
Prospectus Consol [illegible] Limited

TABLE 19

SUMMARY OF INFORMATION ON THE REXSPAR PROPERTY

COMPANY: Consolidated Rexspar Minerals and Chemicals Ltd.

PROPERTY LOCATION: Birch Island, North Thompson Valley.

Mineralization and Grade	Fluorspar Orebody	Uranium Orebody
Fluorspar	23.5%	5 - 10%
Uranium		1.76 lb. U_3O_8/ton
Sr (As $SrSO_4$)	5.2%	
Mo	0.05%	
Cu	0.01%	
Pb	0.17%	
Zn	0.08%	
Ag	0.12 oz/ton	
Au	0.0017 oz/ton	
Reserves:	1,500,000 tons	1,561,000 tons
Milling Rate:	1,000 TPD	1,000 TPD
Employees	150	

EMPR PF (Rpt by Wright Engineers Ltd, March, 1975) areas, where ore-controlling formations occur. This goal can be achieved by establishing lateral and chronological sequences of ore-bearing formations in accordance with stages of tectonic evolution.

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From Mineral Deposits International Geological Congress 1972

A Genetic Classification of Uranium Deposits

F. Q. BARNES and
V. RUZICKA,
Canada

ABSTRACT

The philosophy of this genetic classification was developed through uranium exploration conducted in North America and Europe and is proposed as a tool for exploration geologists and for the use of Earth scientists in evaluating world uranium resources. The classification, utilizing flow-type diagrams, stresses the crustal source of uranium and thorium and the geological processes that introduce these elements into the geochemical cycle. Two main divisions of deposits are recognized, the mechanical and the chemical. The chemical deposits are subdivided on the basis of temperature of formation from low temperature to magmatic and each group is associated with readily recognizable geological characteristics. The chemical environment of uranium mobilization and deposition is stressed, and lithologic and structural relations are noted. The distinction of the various types of deposits is based on lithologic associations, morphology of occurrences and environment of deposition. The relative distribution of world "low-cost" uranium is illustrated diagrammatically by types and general comments on future sources are made.

INTRODUCTION

UNLIKE classifications which deal primarily with the morphology of uranium deposits, or stress the other metal associations or position in the orogenic cycle, this classification attempts primarily to stress the source areas and the geochemical cycle with reference, by type, to the various environmental nuances characteristic of uranium. Associated minerals are important in certain avenues of the uranium geochemical cycle and attention to structures and orogenic settings are important in any exploration program for the element. These features are outlined as far as the scope of this classification study permits. Detailed subdivisions of deposits by features noted above and using schemes similar in many ways to that employed here, are described by Klepper and Wyant, Griffith *et al.*, Robinson, Heinrich, Surazhskiy, Gotman and Zubrev, Chenoweth and Malan, Little and Ruzicka.

The crustal character of uranium is stressed in Figure 1, where the association of uranium and thorium with silicic intrusive and extrusive rocks is presented. The distinction of uranium derived from the early crust or from fresh differentiates from the mantle, as opposed to that recycled at depth through granitization and lateral secretion, is not possible and the authors have chosen merely to infer that the flow is from a variety of crustal sources. Evidence to support the recrystallizing concept has been presented by other workers in the field (Tremblay, 1968).

Authors' addresses are given at the back of this book.

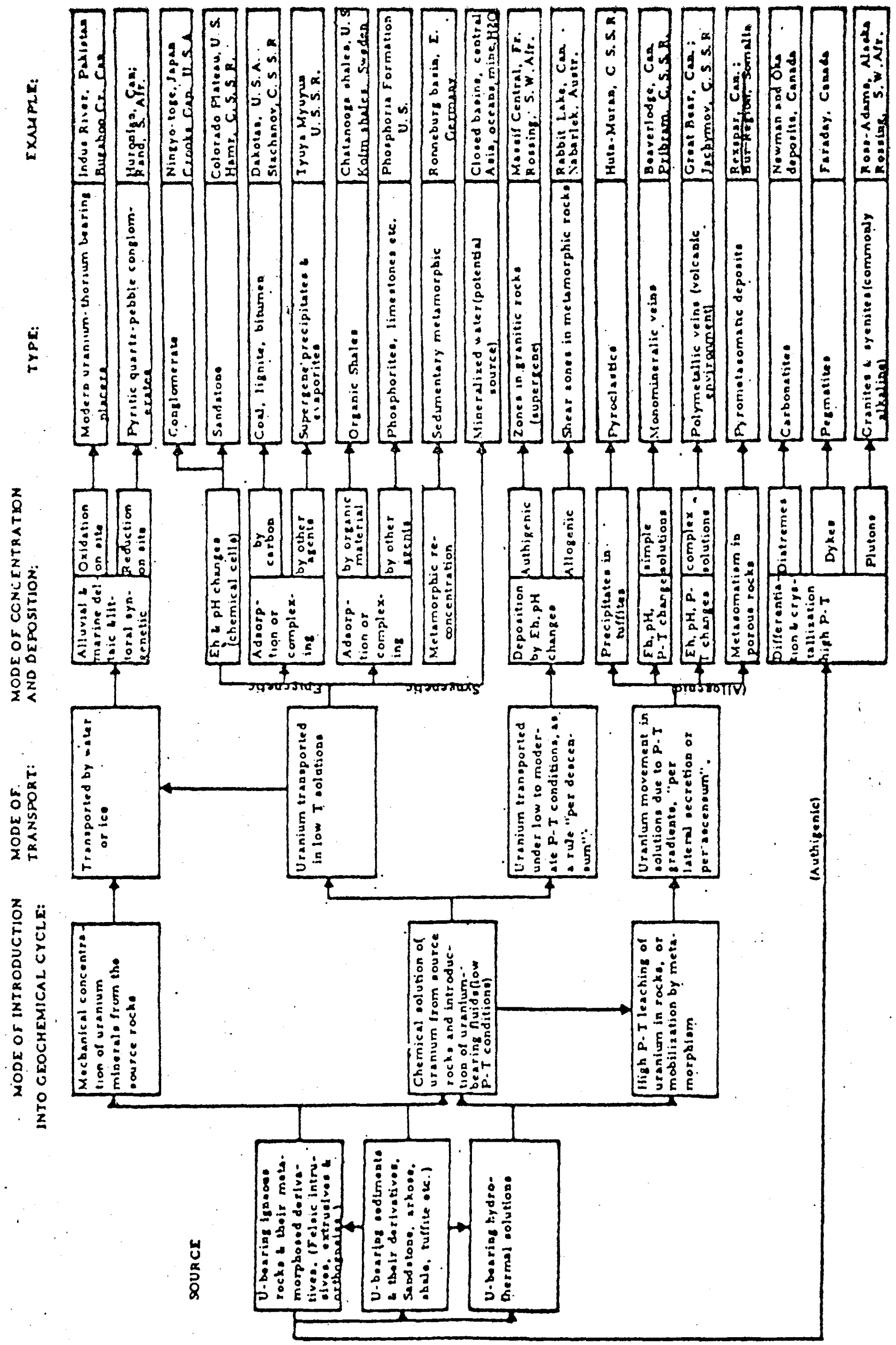

FIGURE 1 — A genetic classification of uranium deposits (Barnes and Ruzicka).

Two main divisions of uranium deposits are recognized, although this distinction is not fully apparent from Figure 1. The deposits within the first are formed by the disintegration of the source rocks by both chemical and mechanical weathering processes, with the mechanical concentration of primary uraniferous minerals. Chemical processes may add in value to the placer deposits and the redistribution of the uranium may occur pre and post diagenesis.

The second division covers the deposits of chemical origin, which are grouped on the basis of temperature-pressure conditions. The first group of chemical deposits covers surface water and/or connate waters acting *per descensum* which, under low to moderate temperature and pressure conditions, are responsible for most of the world's present economic uranium reserves. This group of deposits is further divided on the basis of depth of deposition which affected the physical and chemical properties of the precipitate. The second group of the chemical deposits covers those derived from high-temperature solutions and formed under moderate to high temperature and pressure conditions, *per ascensum* or lateral secretion. Without adequate knowledge of the source, it is hypothesised that some of the uranium could be second generation or later concentrated by lateral secretion as well as by magmatic activity. The flow diagram indicates this idea for the high-temperature groups as well as the inter-relationship of at least part of the high-temperature group with the low- and moderate-temperature group, especially in respect to the monominerallic types of deposits. The third and last group of the chemical division is magmatic. It covers uranium and thorium concentrations formed primarily through deuteric action.

The physical-chemical environment is recognized as the controlling factor in the formation or preservation of all the deposits. The use in the classification of such features as epigenetic, syngenetic, authigenic, allogenic, morphologic and metamorphic characteristics and organic and other chemical affinities should help to rationalize the search for uranium occurrences.

MECHANICAL DEPOSITS

Deposits of mechanically concentrated uraniferous minerals are derived from granitic rocks which have undergone erosion under low-temperature conditions. Present-day placer uranium deposits have originated from a granitic provenance under glacial conditions. Uranium concentrations of this nature do not survive when deposited on alluvium at normal temperatures. Similarly derived uranium minerals would probably survive under euxinic marine conditions as, say, in fiords. The preservation, in sediments, of most mechanically derived uraniferous minerals requires either rapid, frigid conditions of erosion coupled with a non-oxidizing site of deposition, or reducing conditions during erosion and sedimentation to the point of lithification. Partial solution of the uranium minerals is probably unavoidable. Because the economic uranium deposits of this type are of early Precambrian age, a primitive anoxygenic atmosphere has been proposed.

Two types of mechanically concentrated uranium deposits are recognized; those that survive diagenesis and those that do not. The latter is represented by the glacially-derived modern placers. Uraninite in the Indus River gravels, West Pakistan, is oxidized in alluvium at temperate lower elevations. Gravels in the alluvial plains of Bugaboo Creek, southeast of Golden, British Columbia, Canada, contain uranium minerals glacially derived from a Mesozoic quartz-monzonite; again, the uranium is being leached from alluvium.

The second type of mechanically concentrated uranium deposits are the fossil placers commonly referred to as uraniferous, *pyritic quartz-pebble conglomerates.* Two economic examples of this type of occurrence are the deposits in the Huronian at Elliot Lake, Ontario, Canada, and the uraniferous gold reefs of the Rand Basin, South Africa. The conglomerates contain uraninite, brannerite, gummite and uranothorianite as the principal uranium-bearing minerals, and large amounts of other heavy accessory minerals common to granitic host rocks. Iron minerals, which would be expected as the main group of heavies in a placer deposit, are represented essentially by pyrite.

The uraniferous, quartz-pebble conglomerates were derived from schist and granitic terrains. In the case of the Rand Basin deposits, where uranium is generally a byproduct of gold mining, many of the conglomerates are reworked through uplift, erosion and redeposition to further concentrate gold into broad, thin sheet-like beds. Little reworking of the Huronian conglomerates has taken place, which in any event were derived from a predominantly granitic source low in gold content but relatively high in uranium.

Many arguments have been presented to support an epigenetic origin for the gold and uranium in the fossil placer deposits. A comparison of the uraniferous placer deposits and the Mesozoic and Tertiary epigenetic sandstone deposits leaves little doubt of the stratigraphic non-selectivity of post-sedimentary uranium-bearing fluids. The regional occurrence of lithologically controlled uranium and uranium-gold mineralization in the fossil placers, through thousands of feet of section and in association with other heavy minerals arranged in accord with the competence of the drainage pattern, can only be explained by syngenesis.

The angularity of uraninite grains, their grain gradation and degree of compaction in respect to the bottoms of some radioactive beds in the Huronian succession, are features which, in the absence of all but the lowest rank of metamorphic grade, point to a mechanical concentration of uranium values.

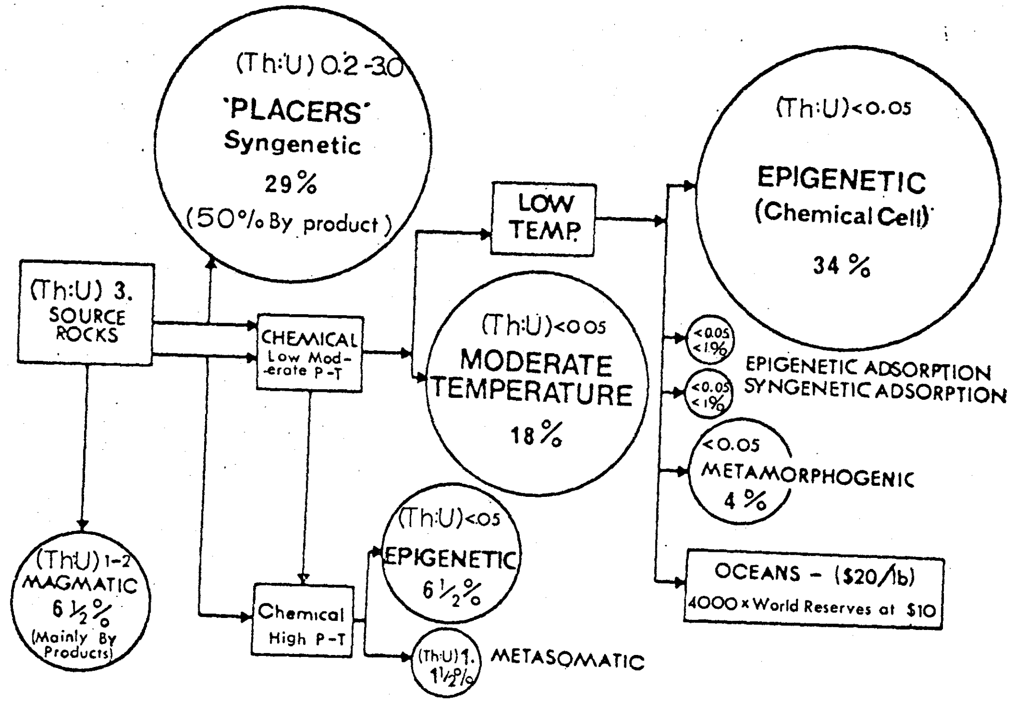

FIGURE 2 — World's present low-cost uranium reserve by genetic types.

A purely mechanical concentration of values, however, would not explain the Th:U ratios of the deposits. Although the ratios are high relative to purely epigenetic deposits, they are low in respect to the clarkes of the provenance area. Th:U ratios are presented in Figure 2 along with the relative world distribution of economic reserves by genetic types. The presence of radioactive hydrocarbon and gummite, and the association of much of the uranium content with titaniferous minerals, are strong indications of both precipitation and adsorption of uranium from solution. The degree to which the solution load adds to the ore grade, or to what extent adsorbed uranium is confused with detrital brannerite grains, is unknown.

CHEMICAL LOW- TO MODERATE-TEMPERATURE DEPOSITS

The main genetic feature which distinguishes the second group of deposits from the mechanical concentrates is the introduction of uranium into the geochemical cycle through the solution of uranium in the source rocks and possibly an intermingling with uranium from deep-seated sources. The uraniferous solutions are, however, largely introduced *per descensum* in the case of epigenetic deposits and carried in the solution load of the syngenetic deposits.

The uranium becomes liberated from the rock-forming or accessory minerals of igneous rocks due to their destruction by surface weathering or through the leaching of sediments by aggressive surface or ground waters under low P-T conditions. Redox potential (Eh) in relationship with pH are the main factors controlling the leaching. Stability and mobility of uranium compounds within the geochemical cycle are described by Garrels (1960) and Belova (1968). It should be noted that in aqueous solutions there is a partition of the co-elements uranium and thorium (Fig. 2) which is not effected in the mechanical destruction of a granitic source or under high temperature-pressure conditions of the orthomagmatic or near orthomagmatic environment.

The inorganic leaching process is commonly combined with microbial activity which, under certain conditions, can increase the environmental acidity and thereby influence the Eh potential which will solubilize uranium. Uranium under such conditions can become relatively concentrated in solution in contrast to uranium in a dispersed state in normal drainage waters. Concentration of uranium may come about by evaporation of surface waters in closed basins such as the Aral Sea (I.A.E.A., 1970, p. 371), or may be found in ground waters. *Mineralized surface waters* are a potential source of uranium. They also participated in the formation of other types of low to moderate-temperature deposits.

Uranium in low-temperature deposits may be syngenetically deposited in sediments due to adsorption on organic or phosphatic materials in *organic shales, phosphorites, etc.* The Kolm shale near Ranstad, Sweden, averages 300 ppm uranium. Uranium may be a byproduct from phosphoric acid production; however, the chemical syngenetic deposits are of little present economic value. Where the uranium is remobilized and concentrated in this type of occurrence by metamorphic processes, however, economic *sedimentary metamorphic* deposits may be generated, such as those at Ronneburg, East Germany (Getseva, 1958).

The important low-temperature epigenetic chemical deposits are formed through reduction, adsorption, ion exchange, ionic substitution or the formation of insoluble uranyl complexes (Gabelman, 1970) within permeable or soluble rocks.

According to the mode of concentration and deposition, two kinds of chemical low-temperature epigenetic deposits may be distinguished:

(a) precipitation in "chemical cells", through Eh and pH changes of the uranium-charged ground waters in conglomerates and sandstones; and
(b) deposits formed due to uranium adsorption from ground waters on coal, lignite or other organic matter, or complexing with other compounds.

In the first kind, uranium mineralization is confined to fluviatile, deltaic, littoral marine, lacustrine or eluvial sediments where stratigraphic chemical or tectonic traps prevent the dispersion of uranium concentrated in descending solutions. These epigenetic deposits have been divided on the basis of the host rock into the conglomerate and sandstone varieties. The *conglomerate variety* is found in the Ninge Toge deposit, Japan and in the Shinarump Member of the Chinle Formation, United States. The *sandstone variety* is represented by most deposits in Mesozoic and Tertiary sediments in the United States, deposits in the Franceville Basin, Africa, in the Cretaceous sediments of the Bohemian Massif (Konigstein, E. Germany; Hamr, Czechoslovakia), in the Permian-Trassic sediments of Europe (Mecsek, Hungary), and the deposits in Mesozoic sediments in theet Central Asian part of the U.S.S.R. (Uchkuduk, Sa-byr-Say; Ruzicka, 1971), etc.

The second kind of epigenetic deposits is represented by adsorption mineralization on *coals and lignites* such as in the Dakotas, U.S.A. and in Permian-Carboniferous and the supergene preecipitates mined in Russia (Tyuya Myuyun).S boniferous and Tertiary basins in Czechoslovakia (Ruzicka, 1971). These deposits and the *supergene precipitates* mined in Russia (Tyuya Myuyun) represented minor uranium reserves.

Low- to moderate-temperature ore fluids may use disjunctive structures as channels and deposit uranium due to changing Eh and pH gradients either in authigenic or in allogenic environments. Authigenic types are found in *granite mylonite zones* of the Massif Central, France, and allogenic types in *shear zones in metamorphic rocks* — for example, Rabbit Lake, Saskatchewan, Canada, and Rozná, Czechoslovakia.

CHEMICAL MODERATE- TO HIGH-TEMPERATURE DEPOSITS

Deposits of this group commonly form veins and disseminations from deep-seated sources and are both monominerallic and polymetallic. The monominerallic types are common among the moderate-temperature deposits and the principal uranium mineral is pitchblende. The polymetallic types occur generally in the vicinity of volcanic centers (Great Bear Lake, Shinkolobwe). Uranium in the polymetallic types is mainly present as pitchblende or uraninite; the Th:U ratio relates to the temperature of the ore-forming fluids. Eh and pH factors largely control the precipitation, but decreasing P-T gradients are also factors influencing the deposition, especially with the higher-temperature deposits.

Four types of the moderate to high-temperature chemical group are recognized as follows:

(a) monomineràllic vein
(b) sedimentary pyroclastic
(c) polymetallic vein
(d) pyrometasomatic

Monomineràllic veins of pitchblende, commonly with carbonate gangue, were possibly derived from deep-seated granitic sources or by lateral secretion from buried uranium-bearing sediments. Deposits of this type are related to major fault zones and include those at Beaverlodge, Canada and at Príbram, Czechoslovakia. The *sedimentary pyroclastic type* consists of disseminations of pitchblende, commonly in association with molybdenum and copper sulphides, precipitated during pyroclastic sedimentation by H_2S volcanic exhalations. The Huta-

Muran deposit of Czechoslovakia (Ruzicka, 1971) is an example. The *polymetallic veins*, commonly found in association with volcanism, occur with other base metal and precious metal deposits. The uranium mineralization is of four varieties: U-Bi-Co-Ni-Ag (pitchblende); U-Pb-Zn-Cu (pitchblende); U-Mo (pitchblende and uraninite); and U-Fe-Ti (brannerite and davidite). Examples of these polymetallic types are: Great Bear Lake, Canada; Jáchymov, Czechoslovakia; Aue and other Saxonian deposits of West Erzgebirge, East Germany; Shinkolobwe, Congo; Radium Hill, Australia. *The pyrometasomatic deposits* also occur, in part, in the vicinity of volcanic centers, and are distinguished from the polymetallic vein deposits by their replacement characteristics. Uraninite and are rare earth minerals are common to some, as well as sulphides of base metals. Examples are: deposits in ferruginous rocks, (Krivoy Rog - Zheltyc Vody deposit, U.S.S.R.), in uraniferous skarns (Wilhelm deposit, Sweden) and in pyroclastics (Rexspar deposit, Canada).

MAGMATIC DEPOSITS

Late magmatic activity, where authigenic metasomatism may alter the orthomagmatic mineral suite or form late-stage silicate bodies, commonly increases the uranium and thorium content of the altered zones. Uraninite is the common uraniferous mineral of the magmatic group. The uranium content of igneous bodies rarely reaches levels of present economic importance; however, the scale of such deposits suggests them as potential future sources of both uranium and thorium. The uranium content of large bodies varies from a background of about 5 ppm to as much as 250 ppm, although local concentrations in pegmatites may reach 1000 ppm or more. Radioactive deposits of magmatic origin are classified by morphology and by lithology according to the following types:

(a) diatremes–carbonatites
(b) dykes–pegmatites
(c) plutons–syenites and granites

Carbonatites, as produucts of the alkaline metasomatism of intrusive rock, are commonly found as breccia pipes at the junction of major crustal structures. These radioactive bodies are mined for niobium, but uranium and thorium might be recoverable byproducts. A high-uranium carbonatite, the Newman deposit (Beaucage), Canada, is unmined. *Pegmatites* rarely carry sufficient uranium to be economic; however, the Faraday mine, Canada, is one example. *Syenites*, especially the higher alkaline varieties, are generally much higher in uranium than other felsic plutons. The Ross-Adams body in Alaska, syenites in South Greenland, and Pocos de Caldas, Brazil, are examples. The Rossing body in Southwest Africa may have economic potential aside from the masses of secondarily enriched surface materials. Uranium in small quantities is found in porphyry copper deposits and, because of the large scale of porphyry copper mining operations, it is a potential byproduct.

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Setting and Genesis of Uranium Mineralization at Rexspar

V.A. Preto, Geologist, Geological Division,
Mineral Deposits Branch,
Ministry of Mines and Petroleum Resources,
Victoria, British Columbia

Abstract

The Rexspar uranium deposit is located approximately 5 kilometres south of Birch Island, B.C. Three separate zones of commercial-grade uranium mineralization mineable by open pit have been outlined.

Uranium and fluorite-celestite mineralization occur in a trachytic member of alkali-feldspar porphyry, lithic tuff, tuff breccia and pyritic schist conformably interlayered with a succession of strongly deformed greenschists and fragmental rocks that are, in large part at least, of volcanic origin. The age of these strata is not precisely known, but they are considered as part of the possibly Mississippian Eagle Bay Formation. Commerical-grade uranium mineralization is always associated with fluorphlogopite-pyrite replacement of the trachytic unit and is contiguous to, but separate from, a zone of ore-grade fluorite mineralization. In all zones, ore occurs in lenses of variable thickness and lateral extent, which lie parallel to the schistosity of the trachytic rocks and surrounding greenschists.

The principal radioactive minerals at Rexspar have been identified by other workers as uraninite, uranothorite, bastnaesite, torbernite and metatorbernite. Considerable amounts of thorium oxide and widespread rare earths have been reported from all three radioactive zones.

The geology of the deposit suggests that the trachytic rocks represent a highly differentiated intrusive-extrusive system in which fluorphlogopite, pyrite, fluorite and uranium-bearing minerals were deposited late in the evolution of the system by deuteric, volatile-rich fluids. The considerable amounts of thorium and widespread rare earths associated with the uranium tend to support the thesis that this element is of primary origin rather than secondary.

Introduction

THE REXSPAR DEPOSITS are located on Red Ridge, 450 kilometres northeast of Vancouver and 5 kilometres south of the village of Birch Island, on the south slope of the North Thompson Valley, between Lute and Foghorn creeks (Fig. 1, 2).

Vittorio A. Preto was born in Italy and came to Canada in 1957. He received B.A.Sc. and M.A.Sc. degrees from the University of British Columbia in 1962 and 1964, and his Ph.D. degree from McGill University in 1967. Since then, he has been engaged in geological survey work with the British Columbia Ministry of Mines and Petroleum Resources and has worked mainly in south-central British Columbia.

Keywords: Uranium deposits, Rexspar deposits, Geology, Mineralization, Thorium, Fluorite, Breccias.

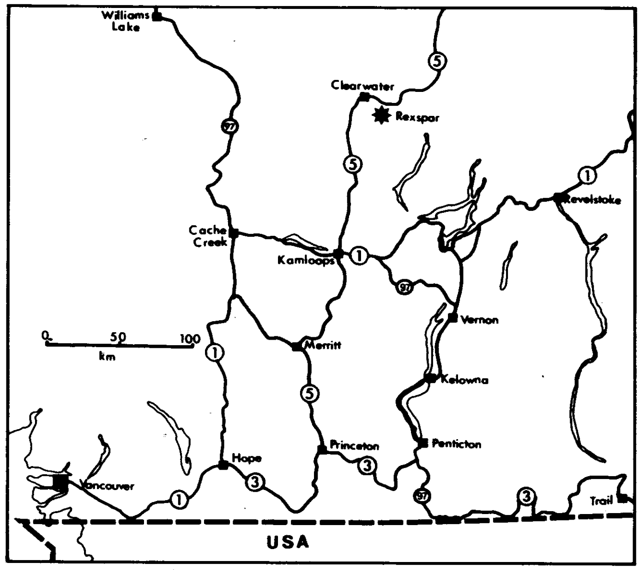

FIGURE 1 — Location map.

The Rexspar showings have received intermittent attention since 1918. Initially interest was for silver-lead and fluorite and, in the late 1920's, for manganese. Further work on the fluorite occurrences was done in the 1940's, and the presence of uranium mineralization was discovered in 1949. Extensive surface and underground work in the early and mid 1950's, mostly under the direction of F. R. Joubin, outlined three zones of uranium mineralization and one contiguous zone of fluorite mineralization (Fig. 2). Geological studies and diamond drilling were resumed in 1969 and continued until 1976. The three zones of uranium mineralization, known as the A, B and BD, and the fluorite zone have all been very extensively drilled, but a complete record of this work is not available to the writer. In addition, approximately 300 metres of underground workings have been completed on the A zone and on the BD zone. These workings are at present not readily accessible.

Combined reserves to date for the A, B and BD zones stand at 1, 114, 158 tonnes of ore grading 0.773 kilogram of U_3O_8 per tonne. Engineering studies on behalf of Consolidated Rexspar Minerals & Chemicals Limited by Kilborn Engineering Ltd. indicate that these reserves are sufficient to support, for a period of 4-1/2 years, a 1,270-tonne-per-day, five-day-a-week mining operation and a 910-tonne-per-day beneficiation plant that is to operate continuously. Fluorite mineralization, located adjacent to the uranium orebodies, if proven to be economic, could extend the life of the operation by an additional 4 years.

Geology

All foliated rocks within the area mapped (Fig. 2) are part of the Eagle Bay Formation of pre-Late Triassic and probable Mississippian age (Campbell & Okulitch, 1976). To the southwest, near Foghorn Mountain, outside the area of Figure 2, these rocks are in probable fault contact with massive to weakly foliated basalt and pillow basalt of the Fennell Forma-

CIM BULL 1978.

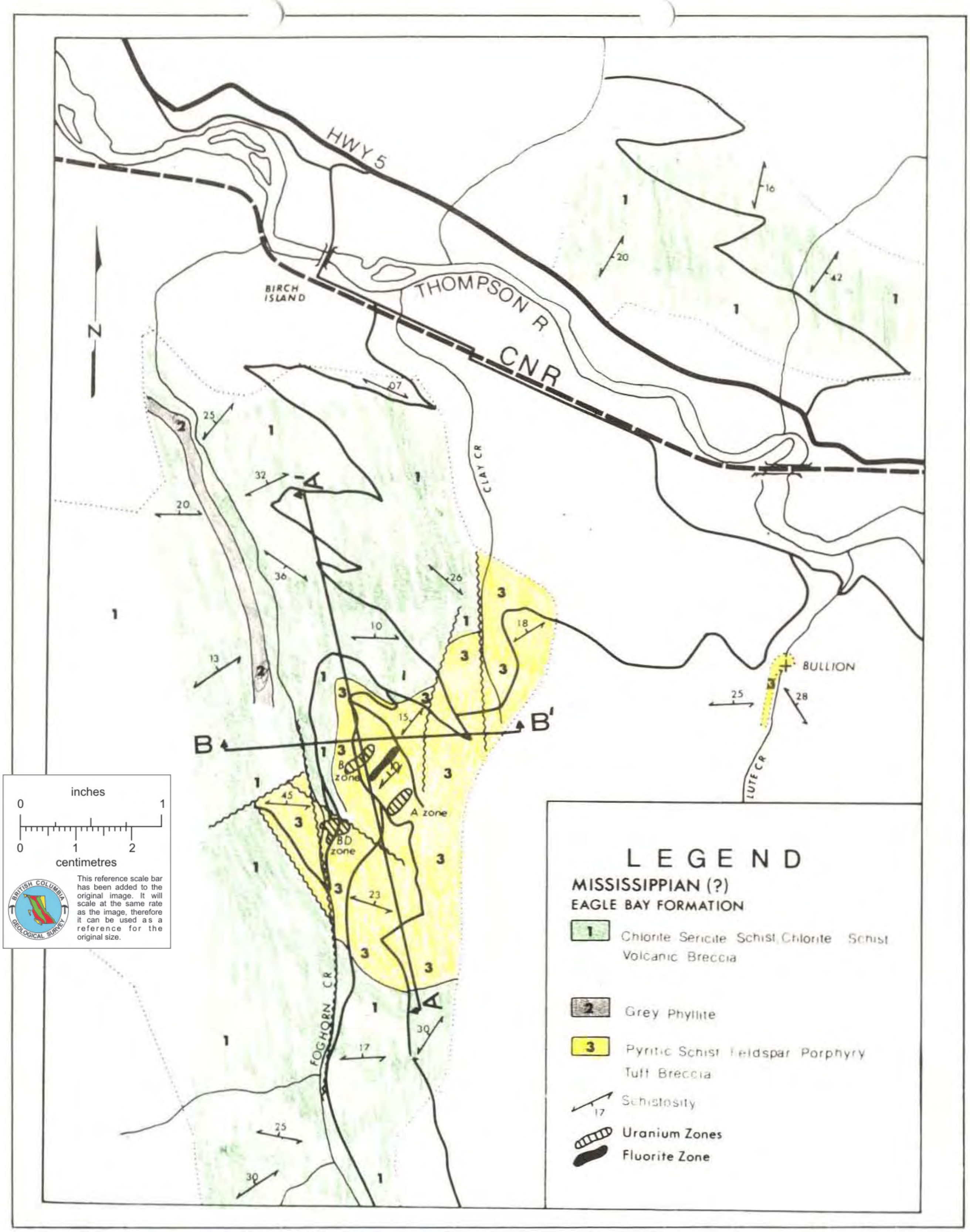

FIGURE 2 — Generalized geology of the Rexspar property.

tion of Mississippian or later age. To the south, schists of the Eagle Bay Formation are intruded by massive quartz monzonite and granodiorite of the Cretaceous Baldy batholith (Campbell, 1963).

South of the Thompson River, and especially in the vicinity of the Rexspar deposits, the foliated rocks are mostly of volcanic origin. Green chlorite and chlorite-sericite schist and silver-grey sericite-quartz schist of map unit 1 are the most common rock types and contain several exposures of clearly recognizable dacitic and andesitic volcanic breccia which attest to the volcanic origin of a good part of these rocks (Plate 1). Interlayered metasedimentary members of grey phyllite and slate (unit 2), quartzite and ribbon chert are distinctly less abundant than schists of metavolcanic origin.

Uranium mineralization is found exclusively in map unit 3, locally known as the trachyte unit. On Red Ridge, and particularly in the vicinity of the orebodies, this rock is a rusty weathering, light grey, pyritic alkali feldspar porphyry which may be massive, brecciated (Plate 2A) or strongly schistose (Plate 2B) and lineated. In thin section, this rock is seen to consist of megacrysts of alkali feldspar and of well-twinned albitic plagioclase set in a fine-grained, sugary groundmass of feldspar and sericite. The megacrysts range from nearly euhedral and undeformed to highly fractured and sheared. The groundmass varies from weakly fractured and massive to very strongly foliated, sheared and flattened. Another common variety of unit 3, particularly near the A zone and south of the BD zone, is a polylithologic breccia which contains a predominance of feldspar porphyry fragments as well as fragments of other fine-grained, darker rocks. Clast size in these breccias ranges from less than 1 centimetre to rarely more than 20 centimetres. The monolithologic feldspar porphyry breccias, because of their setting, distribution and appearance, can best be interpreted as intrusion or explosion breccias, whereas the polylithologic varieties are considered to be lithic-crystal tuffs and tuff breccias. To the south and northeast of the mineral deposits, map unit 3 consists mostly of a well-foliated, yellowish grey to rusty weathering, pyritic, light-coloured, fine-grained schist which generally is composed of sericite and feldspar, but which occasionally includes some very siliceous members. Small lithic clasts, generally 1 centimetre or less in size, are widespread and common throughout the schist.

In summary, therefore, map unit 3 consists of a deformed and metamorphosed pile of lithic tuff and breccia mostly of trachytic composition, but with some rhyolite members, which in the vicinity of the Rexspar deposits include coarser fragmental and probably intrusive phases. It follows therefore that the area of the mineral deposits, and particularly that between the B and BD zones, probably is a volcanic centre or vent from which part or all of map unit 3 was derived.

North of the Thompson River, the predominant rock type is still greenschist of unit 1, but, outside the area of Figure 2,

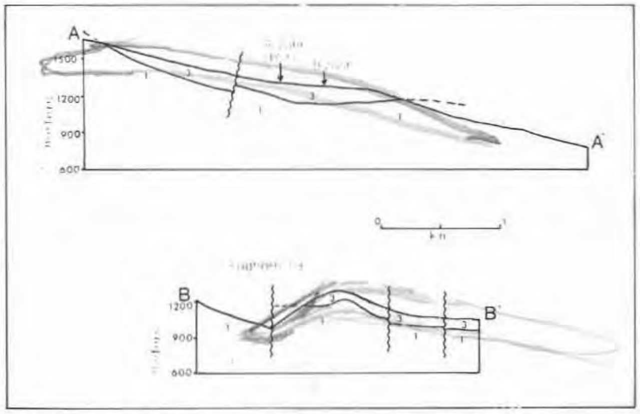

FIGURE 3 — Cross sections to accompany Figure 2.

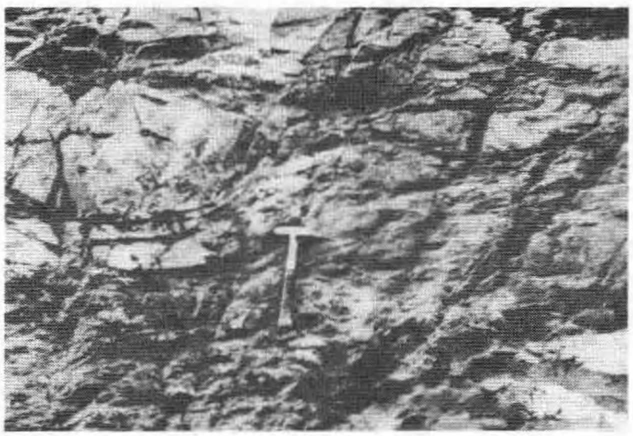

PLATE 1A — Metavolcanic breccia, map unit 1, Red Ridge.

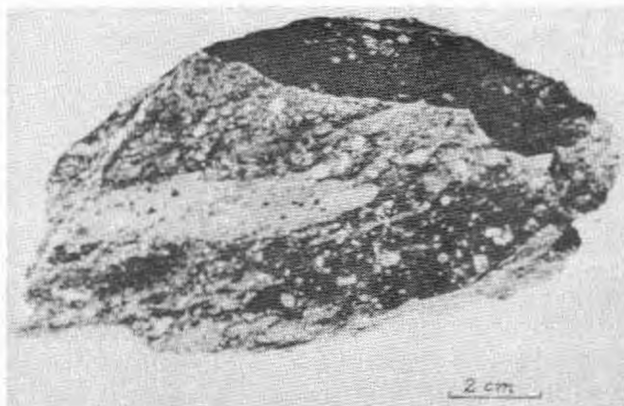

PLATE 1B — Polished hand specimen from same exposure as Plate 1A.

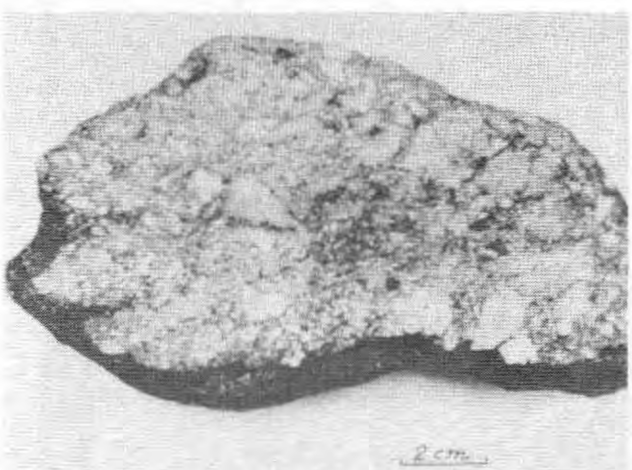

PLATE 2A — Massive trachyte porphyry breccia, Rexspar A zone.

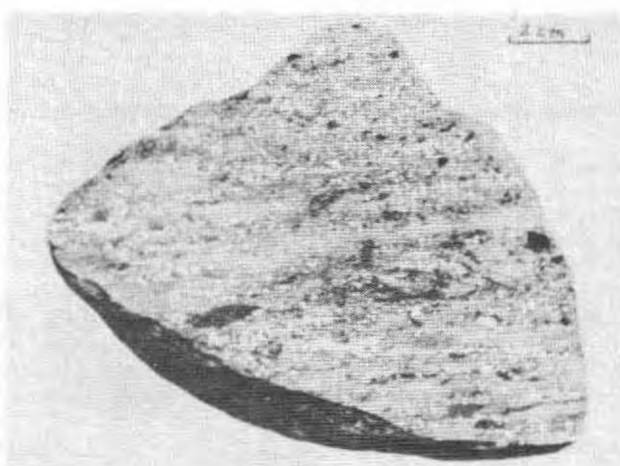

PLATE 2B — Strongly foliated trachyte porphyry breccia, Rexspar A zone. Compare with Plate 1A. Rectangular dark patches are fluorite crystals.

there is a greater abundance of quartzite, siliceous metasedimentary schist and carbonate. The schistosity on the lower slopes dips moderately to the east and northeast, and on Mount McClennan, north of the map-area, dips are gentle to the north (Campbell, 1963).

Structure

Mesoscopic structures that are well displayed at a few key exposures along Highway 5 (Fig. 1), and on Mount McClennan to the north of the area of Figure 2, indicate that the prominent shistosity is parallel to the compositional layering and to the axial planes of small, rootless folds (Plate 3A) that were probably formed during a first phase of deformation. The schistosity is in turn deformed by tight, recumbent, east-trending second-phase folds. These structures are refolded by upright third-phase structures which trend northerly to northeasterly. Late kinks and prominent tension fractures represent a fourth and last set of structures which trend northerly and are commonly followed by post-tectonic felsic and mafic dykes of Cretaceous or later age. High-angle, northerly trending faults, possibly related to this period of deformation, occur along Foghorn, Clay and probably Lute creeks, and sharply control the distribution of rock units and of unit 3 in particular.

these certainly are not the minor E-W trending kink-like folds of my 3rd phase defm

Note that this structural data comes from North of N. Thompson River in area I didn't traverse

Mineralization

Uranium-thorium mineralization is found exclusively in map unit 3 and, as far as can be determined by surface mapping and from old drill records, occurs mainly in the upper part of the unit. Dark-coloured zones of the 'trachyte unit' which are extensively replaced by silver-grey fluorphlogopite and pyrite are by far the best host to mineralization. Drilling indicates that ore-grade material occurs in a series of discontinuous lenses generally less than 20 metres thick and as much as 130 to 140 metres long and conformable with the schistosity in the trachyte. Fluorphlogopite-pyrite replacements, commonly with lesser amounts of fluorite and minor calcite, range from a few centimetres to several metres in size, and generally occur as coarse-grained segregations which show both conformable and crosscutting relationships.

Previous work by officers of the Geological Survey of Canada (Lang *et al.*, 1962) and the British Columbia Mininstry of Mines and Petroleum Resources (McCammon, 1954), as well as further optical, chemical, X-ray and electron microprobe work during the present investigation, has yielded the following results.

(1) The principal uranium-thorium minerals at Rexspar are uraninite, thorian uraninite (Plate 4), torbernite, metatorbernite, thorianite and thorite. In addition, some uranium and thorium occur in monazite, and in niobian ilmenorutile.

(2) Rare earths are found in bastnaesite and monazite (Plate 4).

(3) Other minerals include pyrite, fluorphlogopite, apatite, fluorite, celestite, galena, sphalerite, chalcopyrite, molybdenite, scheelite, siderite, dolomite, calcite, barite,

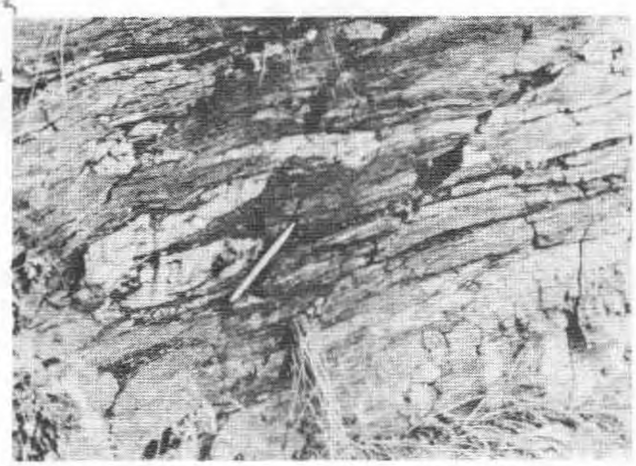

PLATE 3A — Rootless phase 1 folds outlined by quartzite layers in quartz-mica schist; north face of Mount McClennan, looking east.

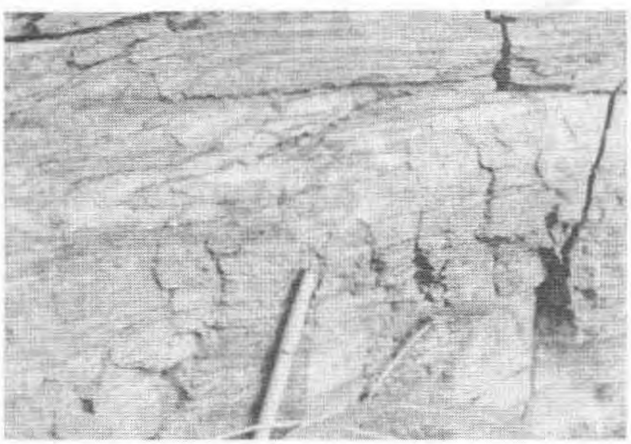

PLATE 3B — Detail of Plate 3A.

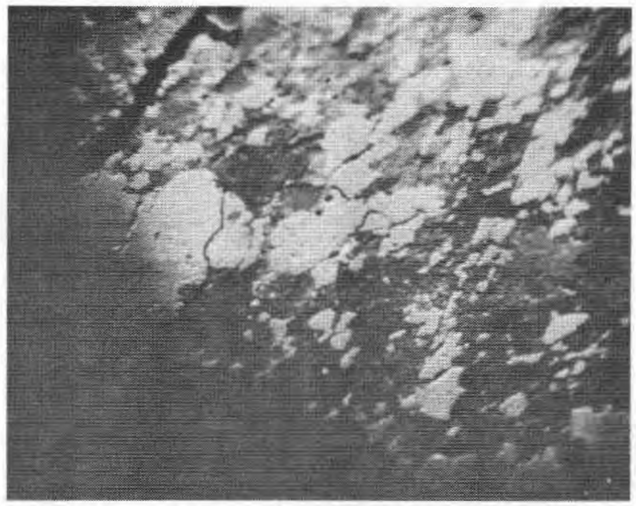

PLATE 4A — Back-scattered electron photograph of Rexspar ore from the A zone; bright grains at centre are Plate 4B (x22).

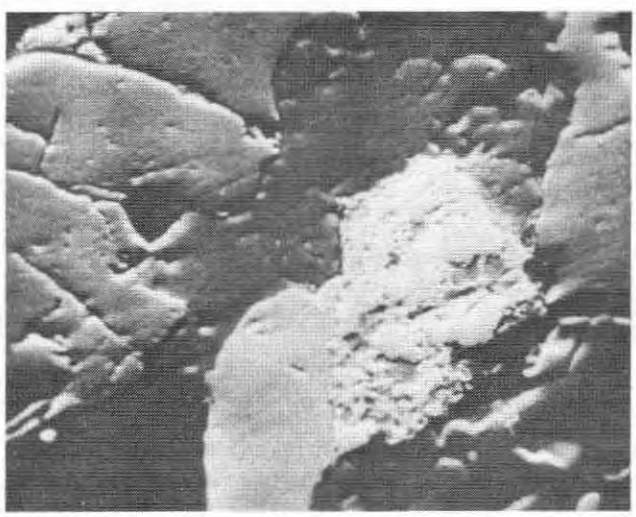

PLATE 4B — Enlarged part of Plate 4A showing a grain of thorian unaninite (light grey) and one of monazite (medium grey), surrounded by pyrite (x520).

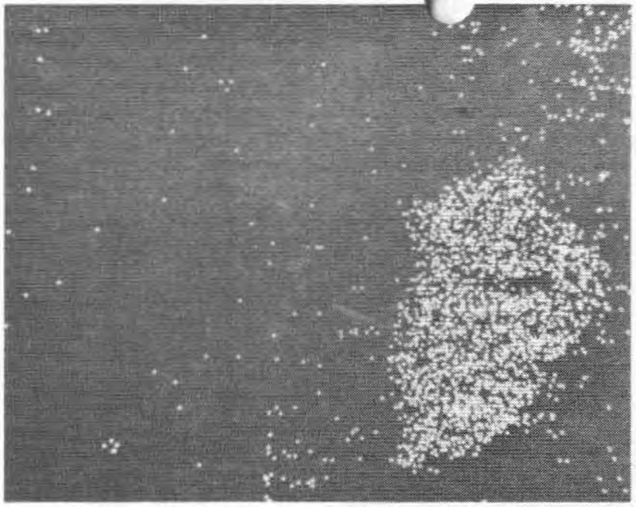

PLATE 4C — U-Th electron scan of the same area as Plate 4B (x520).

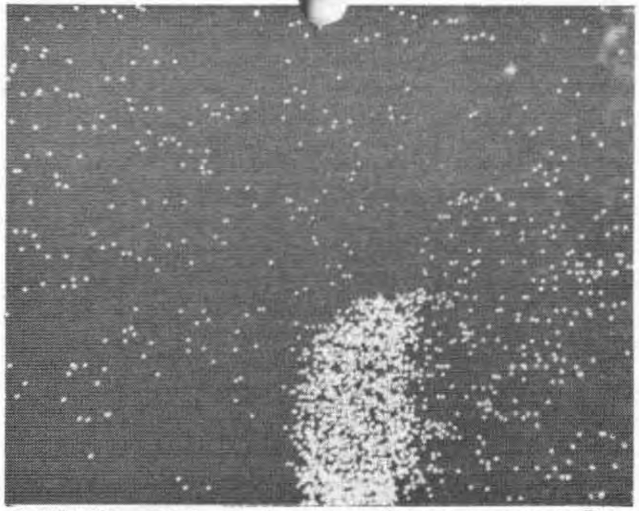

PLATE 4D — Ce-La electron scan of the same area as Plate 4B (x520).

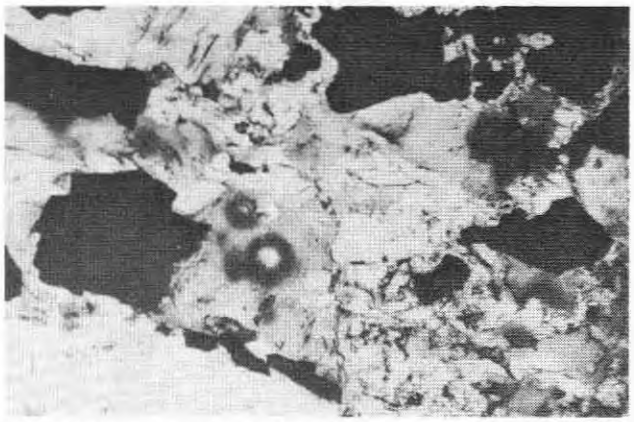

PLATE 5A — Pleochroic rings in fluorphlogopite, Rexspar A zone (x52).

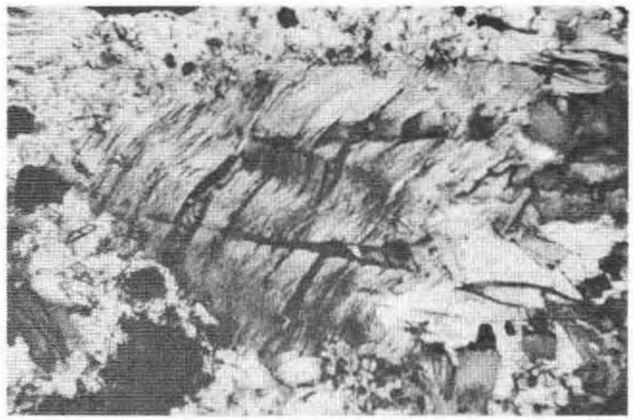

PLATE 5B — Strain-slip cleavage fluorphlogopite with tension gashes filled by fluorite, Rexspar A zone (x52).

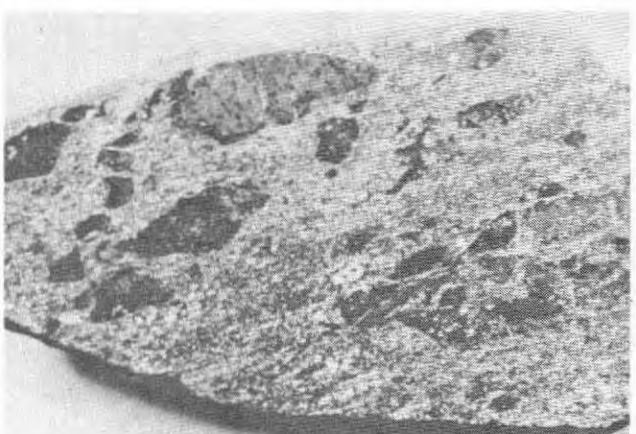

PLATE 6A — Polymictic breccia, Rexspar A zone.

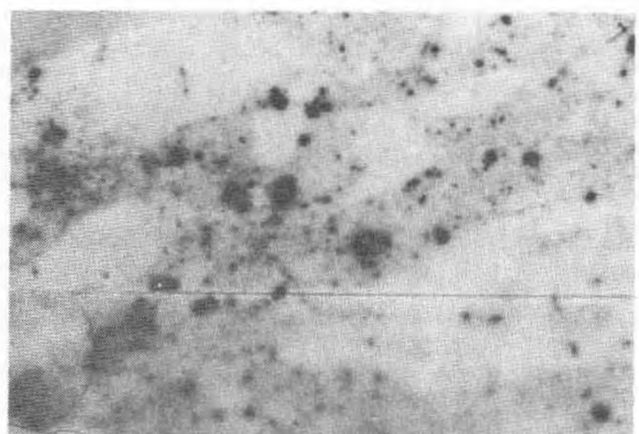

PLATE 6B — Autoradiograph of sample of Plate 6A.

quartz, albitic plagioclase and alkali feldspar.
(4) Uranium-thorium minerals occur as tiny, discrete grains inside the fluorphlogopite flakes and surrounded by single or double pleochroic haloes (Plate 5A), or as discrete grains scattered in the pyrite-fluorphlogopite matrix (Plate 4, Plate 6).
(5) Radiation damage has caused pleochroic haloes in fluorphlogopite and the purple coloration in fluorite.
(6) Analyses indicate that thorium-uranium ratios range from nearly 1:1 to much greater than 1:1 (Table 1). Rare earths, and particularly cerium and lanthanum, are present in very substantial amounts (Table 2).
(7) Oxidation of the ore has been negligible, probably because of the abundance of pyrite.
(8) Fluorite is commonly found in the zones of uranium-

TABLE 1 — U and Th C[illegible]nt of Selected Hand Specimens from [illegible]spar (all values in ppm)

Sample No.	Zone	Total U	Total Th	Sinks +3.29 S.G. +40 mesh U	Sinks +3.29 S.G. +40 mesh Th	Sinks +3.29 S.G. -40+60 mesh U	Sinks +3.29 S.G. -40+60 mesh Th	Floats -3.29 S.G. +40 mesh U	Floats -3.29 S.G. +40 mesh Th
1	BD	687	3270	1017	2401	825	1949	963	2230
2	A	412	504	374	493	230	264	496	416
3	A	265	204	331	197	312	114	230	172
4	A	1468	2418	2646	4093	1472	2452	1165	1343
7	A	231	411	377	696	227	312	251	386
8	BD	53	47	21	65	27	10	41	47

Analyses by gamma-ray spectrometric determinations at the Analytical Laboratory of the B.C. Ministry of Mines and Petroleum Resources.

TABLE 2 — Semi-Quantitative Emission Spectrographic Analyses of Selected Hand Specimens from Rexspar (values in weight per cent)

Element	1—BD Zone	2—A Zone	3—A Zone	4—A Zone	7—A Zone	8—BD Zone
Si	>10.0	>10.0	>10.0	>10.0	>10.0	>10.0
Al	8.5	7.5	>10.0	>10.0	9.0	>10.0
Mg	2.0	2.0	0.7	2.0	1.0	2.0
Ca	3.5	2.5	1.35	2.5	>20.0	1.5
Fe	16.0	>20.0	12.5	17.5	11.5	9.0
Pb	0.015	Tr.	0.015	0.03	Tr.	0.015
Cu	0.07	0.05	0.03	0.05	0.01	0.02
Zn	0.01	0.01	Tr.	Tr.	N.A.	Tr.
Mn	0.12	0.15	0.13	0.1	0.1	0.14
Ag	Tr.	Tr.	Tr.	Tr.	Tr.	Tr.
V	0.05	0.05	0.05	0.05	0.05	0.03
Ti	0.3	0.35	0.3	0.35	0.35	0.15
Ni	Tr.	Tr.	Tr.	Tr.	Tr.	Tr.
Co	Tr.	Tr.	Tr.	Tr.	Tr.	Tr.
Na	0.15	0.08	>2.0	0.15	0.15	2.0
K	>2.0	>2.0	>3.0	>3.0	>2.0	>5.0
Mo	0.01	Tr.	0.01	Tr.	0.015	Tr.
Zr	0.05	0.02	0.03	0.05	0.025	0.025
Sr	>2.0	0.1	0.04	0.15	0.1	>1.0
Ba	0.13	0.06	0.2	0.13	0.07	0.18
U	0.1	N.R.	N.R.	0.15	N.R.	N.R.
Th	0.23	0.04	0.02	0.23	0.04	N.R.
Li	0.015	0.03	0.01	0.04	Tr.	0.02
Nb	0.025	0.025	0.015	0.03	Tr.	Tr.
Y	0.01	0.015	0.1	0.02	0.05	Tr.
La	0.07	0.09	0.25	0.1	0.25	0.02
Ce	0.08	0.1	0.2	0.16	0.15	0.04
Nd	0.12	0.14	0.12	0.14	0.12	0.025
P	1.2	1.2	1.0	1.2	0.5	N.A.
Sn	N.R.	Tr.	Tr.	Tr.	Tr.	Tr.
Ge	Tr.	Tr.	Tr.	Tr.	Tr.	Tr.
Cr	Tr.	Tr.	0.01	Tr.	Tr.	0.01
Be	Tr.	Tr.	Tr.	Tr.	Tr.	N.A.
Yb	Tr.	Tr.	Tr.	Tr.	Tr.	Tr.

Analyses by the Analytical Laboratory of the B.C. Ministry of Mines and Petroleum Resources.

thorium mineralization, but the fluorite zone which could be of commercial grade is separate from ore-grade uranium-thorium mineralization.

(9) All phases of the 'trachyte unit', including zones of fluorphlogopite-pyrite replacement and uranium-fluorite mineralization, display evidence of deformation and range from brecciated to markedly schistose and lineated. They appear to have been subjected to most or all of the deformation that affected the rest of the foliated rocks in the area, although their response was not uniform (Plate 7).

It appears, therefore, that the mineralized zones at Rexspar not only are located close to a part of the 'trachyte unit', which might represent a vent area, but also that, assuming the strata are upright, they are concentrated in the upper part of that unit. The close association with the pyrite-mica replacement and the mode of occurrence of radioactive minerals within mica grains suggest that all these minerals formed at about the same time. The occurrence of fluorite in tension gashes produced by strain-slip cleavage in fluorphlogopite (Plate 5B) probably means that some of the fluorite was remobilized during deformation, because most of the fluorite seems to have been deformed together with the rest of the rock constituents (Plates 7A and 7B). The setting and aspect of the pyrite-mica zones suggest that these were formed by deuteric, volatile-rich fluids during a late stage in the formation of the 'trachyte unit'. It follows, therefore, that the zones of uranium-thorium mineralization, and probably also of fluorite, could be syngenetic with the formation of the 'trachyte unit' and thus of volcanogenic origin.

An alternative to this interpretation is that the pyrite-mica rock with the associated uranium-thorium mineralization and the zones of fluorite mineralization were formed during one or more hydrothermal events some time after the formation of the 'trachyte unit', but before deformation. Their spatial association with a probable vent area within the trachyte could be attributed to the pre-existence of suitable channelways. If such were the case, one would expect evidence of renewed fracturing and possibly veining of the trachyte by hydrothermal minerals associated with this event. One would also expect that evidence of this hydrothermal replacement and mineralization would be found in the schist below the trachyte. This does not appear to be the case at Rexspar. Uranium

PLATE 7A — Ore from the Rexspar A zone, showing sheared pyrite and fluorite (dark grey).

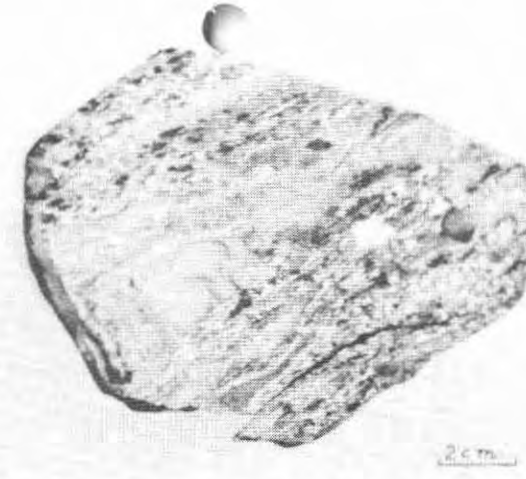

PLATE 7B — Ore from the Rexspar A zone, showing sheared pyrite and fluorite (dark grey).

mineralization is found only in the trachyte and is always associated with the pyrite-mica rock. The schists below the trachyte, although somewhat pyritic, are barren of uranium and do not have any of the distinctive pyrite-mica rock. Also, the mode of occurrence of the pyrite-mica rock as ill-defined masses, very variable in size and commonly chocked with trachyte fragments, can best be explained by assuming that it was formed by late magmatic solutions which permeated the trachyte during or shortly after its formation and not at some later time.

Age of Mineralization

A K/Ar age of 236 (plus or minus 8) Ma has been obtained by S.S. Gandhi of the Geological Survey of Canada (personal communication, March 9, 1978) for fluorphlogopite from one of the mineralized zones. This must be considered a minimum age and used cautiously because of some analytical problems.

This Permo-Triassic age for the fluorphlogopite and, by inference, for the mineralization, although somewhat young for the presumed Mississippian age of the Eagle Bay rocks, tends to confirm the interpretation that the mineralization at Rexspar is old, probably syngenetic with the host rocks, and not related to the Cretaceous Baldy batholith.

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The Rexspar Uranium Property

82M021

By J. W. Scott

Engineer, Technical Mine Consultants Limited

THE discovery of radioactive minerals in fluorspar specimens from the property now owned by Rexspar Uranium and Metals Mining Co. Ltd. has led to renewed interest in an area which had already been investigated many times previously as a possible source of other minerals. Lead and silver, manganese, fluorite and celestite, have been found in varying quantities in the area, but the uranium occurrence has evoked greater interest than any of these and has resulted in the present sustained development programme. Encouraging results of the work done to date indicate that the property may well become British Columbia's first uranium producer.

Property

The present Rexspar holdings consist of 110 mineral claims and fractions covering a roughly rectangular area about 4½ miles long (north-south direction) by two miles wide. A group of 23 of these claims have been surveyed preliminary to crown granting, the remainder being held by location. An additional 43 claims and fractions, adjoining the Rexspar property on the northeast, are held by an associated company, Deer Horn Mines Ltd.

Location and Access

The property extends up the south slope of the North Thompson River valley covering the prominent ridge between Foghorn Creek and Cedar Creek and extending westward to the top of the ridge beyond Foghorn Creek.

The property is fortunately situated for easy access, the north boundary being less than two miles from Birch Island station on the C.N.R. main line between Kamloops and Jasper.

The area is quite heavily timbered throughout. Moderate slopes rise from the North Thompson valley up the main ridge, giving favourable terrain for road construction. Topography is rugged in the vicinity of the creek valleys, slopes of 30 to 40 degrees being common in these areas.

History

The area now held by the Rexspar company has been prospected sporadically for many years. Fluorite was first reported in 1918, but little work was done on the deposit at that time. Silver-lead showings were discovered in 1926 and a small company was formed to develop the deposits. Numerous open cuts were made and several short adits were driven on the best showings. Some small ore shipments were made to the Trail smelter, but the property did not respond to development. The silver-lead deposits occur as irregular spots and patches of galena in quartz veins and lenses in the quartz sericite schists. The largest lenses are interbedded with the altered sediments, with some small veins cutting across the bedding. Ore grades were low, and the bedded lenses generally limited in extent.

Manganese was reported in 1929 and some test pitting and sampling was done on this deposit. The main deposit extends over a bench covering perhaps 50 acres near the present camp, and has accumulated under bog conditions. Manganiferous material lies under one to three feet of overburden, and is quite erratic in both thickness and grade. The limited tonnage and erratic grade make it improbable that the deposit could be exploited profitably.

Interest in the fluorite deposit was

A portion of the mine camp at the Rexspar property near Birch Island, B.C.

renewed in 1942-43, when approximately 5000 feet of diamond drilling in 36 holes was done on the main fluorite zone. This work indicated an ore zone striking about northeast, dipping 30 to 40 degrees to the northwest, and averaging approximately 50 in thickness for a strike length of 700 feet. Over one million tons was indicated by the drilling, with an average grade of 20 per cent fluorite and 15 per cent celestite. Limits of the deposit were not reached either down dip or along the strike. Concentration tests made at this time failed to produce an efficient separation process for the fluorite and celestite. Recent sampling has disclosed interesting concentrations of rare earths in the fluorite deposit. Metallurgical tests are continuing with the object of developing a satisfactory extraction of the valuable constituents of the deposit.

Radioactivity on the property was first detected in 1949 through examination of specimens of the fluorite ore, by the B.C. Department of Mines, and the Geological Survey of Canada. The owners of the property then found further evidences of radioactivity in the drill cores from the fluorite body. Some trenching was undertaken in 1950, after areas of high radioactivity had been located by geiger counter. Samples from these trenches showed uranium contents of possible ore grade, and, after an examination by Franc. R. Joubin, the property was taken over by the Rexspar company, and more intensive development was initiated.

Geology

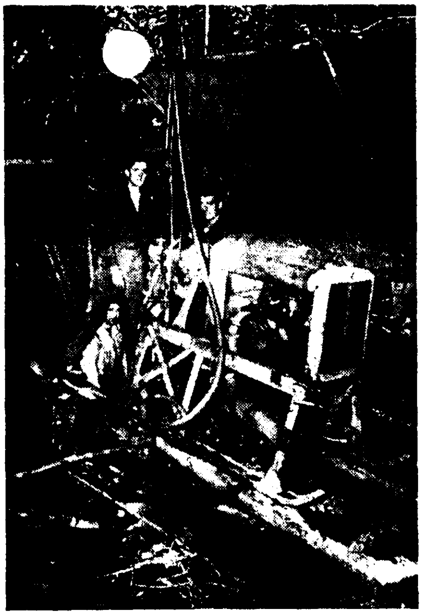
The important rock formation on the property, within which both the fluorite and the uranium orebodies occur, has been identified from petrographic studies as a "series of highly feldspathic, fine-grained, porphyritic trachytic tuffs," locally known as "trachyte." This formation outcrops extensively on the prominent ridge between Foghorn and Cedar Creeks, and has been traced by intermittent outcrops from about 1½ miles above the mine camp on the ridge to the east side of Cedar Creek on the lower slopes of the river valley, a length of over 12,000 feet. Width of the exposed trachyte averages about 5000 feet, with maximum width over 7000 feet. The formation is generally quite strongly fractured, and exhibits a general strike direction N. 30° E., dipping about 20° to the west. The thickness varies from less than 100 feet to over 500 feet. The trachyte has a characteristic light bluish color on fresh surfaces, weathering to red, yellow and brown colors. It contains varying amounts of pyrite and is wea'' radioactive. The trachytic roc. .re underlain by a thick series of metamorphosed sediments identified as of Pre-Cambrian age. The most prominent members of this series are quartz sericite schists, with other beds varying from soft argillites to massive quartzites. Towards the south of the property the trachyte is overlain by a series of chlorite schists of indeterminate age and origin.

Uranium concentrations of ore grade occur in lenses in a member of trachytic series which has been described as a "trachytic tuff with argillaceous matrix," and is locally known as the "pyrite-mica formation." This formation is characteristically made up of trachyte fragments in a sheared matrix consisting chiefly of biotite with some sericite, generally very abundant pyrite, and variable amounts of carbonate, fluorite, and celestite. In the ore lenses, this rock is dark grey to black in color, biotite and pyrite are quite fine grained and are the major constituents, and the rock exhibits a typically schistose and banded structure.

The pyrite-mica formation occurs irregularly in the trachyte in thicknesses varying from 1 foot to 100 feet, the beds conforming in strike and dip with the trachyte series. To date pyrite-mica bands have been found only in the upper 150 feet of the trachyte series, this upper portion generally showing more fracturing and metamorphism than the lower part of the series. However, occurrences in the lower beds are to be expected, as the bulk of the diamond drilling to date has been confined to the near surface showings.

The known ore lenses also occur irregularly in the pyrite-mica formation. The proximity of major fault zones is thought to be a controlling factor in the formation of the ore lenses, although insufficient information on the fault structures has been obtained to clarify this relationship. Study of the underground workings on the "BD" ore zone has shown a very complex pattern of faulting and fracturing.

Variation in the crystal structure of the pyrite-mica formation also appears to have an important bearing on ore deposition. Where large, coarse mica crystals are present, uranium values are consistently low. Varying permeability of the pyrite-mica to the uranium bearing solutions may be the controlling factor here. Uranium values appear to vary with the amount of pyrite mineralization in the favorable ore type formation, although laboratory tests show that only 10 per cent of the radioactive minerals are associated with the pyrite. Heavy pyrite concentrations in other parts of the trachyte series, do not show increased radioactivity.



A surface diamond drilling rig in operation at the Rexpar property.

Uranium minerals reported from mineralogical studies of the ore include pitchblende and uraniferous thorite. The relative abundance of these minerals in the ore has not been determined. The presence of thorium minerals makes estimation of the uranium content of the ore through the use of radiation counters difficult. Chemical assays are required on all samples.

The rare earths, cerium, yttrium and lanthanum, are also present in the ore in considerable amounts, assays of 0.60 and 0.75 per cent combined rare earths having been obtained from early samples taken from the "A" zone, with still larger amounts reported from the fluorite zone. The mineral occurrence is reported to be chiefly bastnasite, although monazite has been reported from some speciments. No sampling for the rare earths has been done in recent work.

Development Progress

A limited programme of prospecting and development was undertaken during the field season of 1951, after the property had been acquired by the Rexspar company. Three cross trenches were put down along a strike length of 110 feet to expose a zone traced by high geiger counts, located 500 feet south of the known fluorite zone and now known as the "A" zone. Bulk samples from these trenches gave an average uranium oxide content of 2.0 lbs. per ton. Two further radioactive zones were located by geiger counter but were not explored by trenching.

With these encouraging results, an extensive programme of diamond drilling, geological mapping and prospecting was planned for the 1952 season. The original property of 24 mineral claims held by location was enlarged by the purchase of Black Diamond No. 1 and Black Diamond No. 2 mineral claims, on which a highly radioactive showing had been found, and by staking an additional 64 mineral claims. These additions gave coverage of all the known ground favourable for radioactive deposits.

In the 1952 season, 4825 feet of diamond drilling in 31 holes was completed on the "A" zone. This drilling outlined an ore body of approximately 110,000 tons of average grade over 2 lbs. per ton U_3O_8 The ore body is a lenticular deposit approximately 500 feet long, of average thickness 19 feet, striking N. 15 degrees E. and dipping about 30 degrees to the west. Ore intersections were obtained for an average slope depth of 125 feet. Further drilling to the west gave no ore intersections, indicating a lower limit to the ore lens, or a possible major discontinuity in the structure.

A total of 3786 feet in 15 holes was drilled during the season to explore the radioactive zone on the Black Diamond No. 1 This work confirmed the presence of a major ore body, similar in strike and dip, and character of ore, to the "A" zone and located about 1600 feet to the southwest and 500 feet lower in elevation, on the steep east slope of Foghorn Creek. The drilling outlined an ore lens extending 250 feet on strike, 250 feet down dip, and open to the north and west. Thickness of the lens ranged up to 50 feet.

A further four holes were drilled in the radioactive area at the North end of the fluorite zone. Results here were inconclusive. A strong, well mineralized pyrite-mica zone was located, but uranium values obtained were below ore grade.

Diamond drilling was continued throughout the 1953 season, with particular emphasis on the "BD" zone. Some 22 holes were drilled on the zone for a total footage of 4335 feet. This work confirmed and extended the known ore body outlined in the 1952 drilling. These favourable results, coupled with considerable difficulty in surface drilling due to the rough terrain and heavy overburden, d to a decision to proceed with underground development on the zone, in the fall of 1953. The plan adopted called for a crosscut adit from the east bank of Foghorn Creek at elevation 3330 with subsequent drifting below the main ore lens along the strike direction, for the full length of the zone. Further delineation of the ore zone was planned by raising and diamond drilling from the drift, and from crosscuts from the drift to the east and west. This programme was completed in May, 1954. Drifting and crosscutting totalled 1003 feet, with 66 feet of raising and 4755 feet of underground diamond drilling. Results of this work, combined with the previous surface drilling, completed the outline of an ore body of approximately 600,000 tons, having a strike length of 500 feet, slope depth 250 feet, and average thickness approximately 50 feet. A narrower ore lens below the main body was intersected in three drill holes, but further exploration is required to determine its extent and grade.

Prospecting carried out over a considerable proportion of the favourable trachyte area in the 1953 season, resulted in the discovery of six new areas of high radioactivity. Limited surface diamond drilling was carried out on four of these occurrences, with generally inconclusive results. Fair thicknesses of the favourable pyrite-mica formation were intersected in these new areas, but uranium values were generally below ore grade. Some additional drilling was also done on the possible northerly extension of the "A" zone, with negative results. Surface diamond drilling for the 1953 season totalled 10, 260 feet in 53 holes.

Provision for improved access to the property and expanded camp facilities was made necessary by the decision to proceed with underground development on the "BD" zone in the fall and winter of 1953. A new all-weather truck road, 5 miles in length, was built from Birch Island to the camp, and extended to the "BD" adit site. Prefabricated camp buildings, including cookhouse, office and two bunkhouses, were erected, giving comfortable accommodation for 20 men. Water supply lines to the camp and adit, totalling 10,000 feet, were installed, and necessary frame service buildings were erected near the adit.

Prospecting and geological mapping in the latter part of 1953 field season revealed a further extension of the favourable trachyte formation to the north and east, extending dov :he lower slopes above the North Thompson River, and eastward beyond Cedar Creek. Some 38 claims were staked to cover this area and were taken over by Deer Horn Mines Ltd. Prospecting and trenching on Cedar Creek, with limited diamond drilling late in the season, located a 20 foot thick bed of the ore bearing pyrite-mica formation. Work on this showing was cut short by the onset of winter weather.

Plans for the 1954 season called for intensive prospecting and geological mapping of the entire area favourable for ore occurrence, before further large scale diamond drilling was undertaken. Unfavourable weather delayed the start of this field work until mid-June, and this work is continuing at the present date. Three promising new areas of high radioactivity have been discovered and are being actively explored by trenching, open cutting with bulldozer and diamond drilling. Further work on the areas located in 1953 has resulted in the elimination of three of these as prospective ore zones. The remaining three await further diamond drilling and possible underground exploration.

Diamond drilling has been carried on to date with one machine, with a total of about 4000 feet drilled during 1954. This work has indicated a further extension of the "BD" zone ore body down dip to the west, and has established definite limits to the "A" zone lens. A second drill has now been added, and intensive drilling of the favourable areas found in prospecting is in progress.

Plans for underground work for the winter season, on the BD zone, the A zone, and possibly the "F" zone on the west bank of Foghorn Creek opposite the BD, are being prepared. Necessary road construction and repair for this projected programme is scheduled for the current month.

Conclusion

The work carried out on the Rexspar property to date has indicated tonnages of mineable grade uranium ore totalling approximately 700,000 tons in two ore lenses, with additional substantial tonnages expected from the current programme. Preliminary studies of mining methods show that low cost mining is readily possible for the known ore bodies. Metallurgical tests carried out over the past two years indicate that a satisfactory recovery process can be developed.

The company's present goal is to prove up 1,000,000 tons of ore, after which production plans will be made.

Rexspar Uranium was visited and drilling (HQ), about 1100' to 1300' in 11 vertical holes commenced July 9. It would appear that this property is slated for production, subject to further positive metallurigcal testing, with 0.1% U_3O_8, three open pit areas (two only possible?), and a 5 year life.

ing Journal Oct. 3/75 p. 263

...par Reopening?

Encouraged by a better outlook for uranium prices, Consolidated Rexspar Minerals and Chemicals Ltd. is planning to bring its Rexspar property at Birch Island in the Kamloops area of British Columbia into production. The company (47 per cent owned by Denison Mines Ltd.) could raise around $C500,000 through a rights offering to its shareholders to finance work on the uranium/fluorspar property.

Reserves were last estimated at 1.6 million s tons ore averaging 1.76 lb/s ton uranium oxide, with fluorspar at 1.5 million s tons proven and probable ore plus an additional 500,000 s tons "possible" ore averaging around 29 per cent fluorite.

82 M/12W -#21,23,31,42,43

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Cons. Rexspar proceeds with plant evaluation

Field work on Consolidated Rexspar Minerals and Chemicals' uranium property near Birch Island, Kamloops division, B.C., is proceeding to obtain site information, according to an interim report from the company. Information is being gathered for estimates of plant and mine costs, environmental factors and for evaluating plant and production alternatives.

Limited drilling to obtain drill core for the metallurgical testing program at Lakefield Research has been completed.

The process of bringing the property into production is expected to be a lengthy one (N.M., June 3, 1976).

Working capital in the 6-month period ended June 30, 1976, increased by $479,465 from a deficiency of $13,735 at the beginning of the period to $465,730.

PROD?

22 M/NW (12W))

Sept 9/76

N. Miner