DMA Form 1

DEFENSE MINERALS ADMINISTRATION
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DMEA Docket No. 2336

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EXPLORATION PROJECT

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Routing Slip
(ONE COPY TO USGS & ONE TO USBM)

To:	CODE 700 RM. 4640	Date	1-22-52
To:	Opr. Comm.	Date	5/16/52
To:	Mittendorf	Date	
To:	Mails & Files	Date	
To:	Mr. Ellis Docket	Date	
To:	Operating Comm	Date	6-25-52
To:	" "	Date	7-11-52
To:	Op Com	Date	10-8-52
To:		Date	
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FILE COPY
700
SURNAME:

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION
WASHINGTON 25, D. C.

OCT 8 1952

Mr. Donald M. Nelson, President
Consolidated Caribou Silver Mines, Inc.
1406 Pearl Street
Boulder, Colorado

Re: Docket No. DMEA-2336 (Uranium)
Caribou Silver Mine
Boulder County, Colorado

Dear Mr. Nelson:

Reference is made to your application for Government aid on the captioned project.

Projects approved by the Defense Minerals Exploration Administration must, in its judgment, show definite promise of yielding material of acceptable grade and in quantities that will significantly improve the mineral supply position for the National Defense Program.

A careful study of your application and data available to this Agency, and an examination of the property concerned reveal that the probability of disclosing minable reserves by your proposed exploration program is not considered sufficiently promising to justify Government participation. Under these circumstances, we regret to advise that your application for exploration aid is denied.

If additional work on your property reveals information which makes the project feasible, an application may be submitted for consideration.

Sincerely yours,

C. O. Mitterdorf
Administrator

GLAult/EWEllis/gla
10-7--52
cc to: Adm. Reading File
Operating Committee
Docket
Messrs. H.D.Keiser, Rm. 1347
F. N. Houser, Rm. 3210 GSA
Ellis
DMEA Field Team, Region IV (2)

10/6/52 gla

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES
WASHINGTON 25, D. C.

October 3, 1952

DEPARTMENT OF THE INTERIOR
Defense Minerals Administration
RECEIVED
OCT 6 1952

Memorandum

To: Ernest William Ellis, DMEA Member
Uranium Commodity Committee, Room 4640

From: H. D. Keiser, Bureau of Mines Member,
Uranium Commodity Committee

Subject: Final Report, DMEA Docket 2336 (Revised), Consolidated Caribou Silver Mines, Inc., Boulder County, Colorado

I have reviewed the subject report and discussed it with Frederick N. Houser, Acting Geological Survey Member, and Joseph O. Hosted, representative of the Atomic Energy Commission.

I concur in the recommendation of the Field Team, Region IV, that the loan be denied.

H D Keiser
H. D. Keiser

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES
WASHINGTON 25, D. C.

October 3, 1952

DEPARTMENT OF THE INTERIOR
Defense Minerals Administration
RECEIVED
OCT 6 1952

Memorandum

To: Ernest William Mills, DMEA Member
Uranium Commodity Committee, Room 4640

From: H. D. Keiser, Bureau of Mines Member,
Uranium Commodity Committee

Subject: Final Report, DMEA Docket 2336 (Revised), Consolidated Caribou Silver Mines, Inc., Boulder County, Colorado

I have reviewed the subject report and discussed it with Frederick N. Rouser, Acting Geological Survey Member, and Joseph O. Hosted, representative of the Atomic Energy Commission.

I concur in the recommendation of the Field Team, Region IV, that the loan be denied.

Signed

H. D. Keiser

STANDARD FORM NO. 64

10/2/52 jesi

Office Memorandum • UNITED STATES GOVERNMENT

TO : E. Wm. Ellis, DMEA Member, Uranium Commodity Committee

DATE: October 1, 1952

FROM : F. N. Houser, USGS Member (Acting), Uranium Commodity Committee

SUBJECT: Final Report, DMEA Docket 2336 (Revised) (Uranium), The Consolidated Caribou Silver Mines, Inc., Boulder County, Colorado

According to MacLaron's report the work supported by the AEC, when completed, will have explored the areas considered geologically favorable in this mine for the occurrence of economically important uranium ore. Under these circumstances, I concur with the Field Team recommendation that the loan be denied.

Frederick N. Houser

Frederick N. Houser

Copy to: E.Wm.Ellis

IN REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WASHINGTON 25, D. C.

E. Wm. Ellis, DMEA Member, Uranium Commodity Committee

October 1, 1952

F. N. Houser, USGS Member (Acting), Uranium Commodity Committee

Final Report, DMEA Docket 2336 (Revised) (Uranium), The Consolidated Caribou Silver Mines, Inc., Boulder County, Colorado

According to MacLaren's report the work supported by the AEC, when completed, will have explored the areas considered geologically favorable in this mine for the occurrence of economically important uranium ore. Under these circumstances, I concur with the Field Team recommendation that the loan be denied.

/s/ Frederick N. Houser

Copy to- E.Wm.Ellis

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION
WASHINGTON 25, D. C.

224 New Customhouse
Denver 2, Colorado

September 17, 1952

Memorandum

To: Secretary to the Operating Committee, Defense Minerals Exploration Administration

From: Field Team, Region IV

Subject: Final Report, DMEA Docket 2336 (Revised) (Uranium) The Consolidated Caribou Silver Mines, Inc., Boulder County, Colorado

Enclosed are the original and three copies of the report pertaining to the above application.

The Atomic Energy Commission awarded a contract to the company to adequately explore the mine for pitchblende. Only 279 feet of underground work remains to be done, and when completed, the only areas in the mine believed to be geologically favorable for the discovery of uranium ore in economically significant amounts will have been adequately explored.

We therefore recommend that the loan be denied.

W. H. King
W. H. King

A. H. Koschmann
A. H. Koschmann

Enclosures

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION
WASHINGTON 25, D. C.

200 New Customhouse
Denver 2, Colorado

September 10, 1952

Memorandum

To: DMEA Field Team, Region IV

From: A. H. Koschmann

Subject: DMEA Docket 2336 (Revised), The Consolidated Caribou Silver Mines, Inc., Boulder County, Colorado.

Attached are 10 copies of the geological report by D. R. MacLaren covering DMEA Docket 2336 (Revised), The Consolidated Caribou Silver Mines, Inc., Boulder County, Colorado.

The applicant proposes to explore the Caribou mine for uranium by diamond drilling and underground work, including deepening of the shaft 600 feet, at a total estimated cost of $396,600.

Radioactive material was discovered on the mine dump in 1945 and rehabilitation of the mine was begun immediately. In 1949 a streak containing pitchblende was discovered in the Radium vein on the 1040 level. In November of the same year the Atomic Energy Commission made a reconnaissance study of the mine, and the following month the Geological Survey, for the Atomic Energy Commission, began a detailed study and geologic mapping of the mine. The Atomic Energy Commission has awarded a contract to the company to adequately explore the mine for pitchblende. Only 270 feet of underground work remains to be done, and when completed, the only areas in the mine believed to be geologically favorable for the discovery of uranium ore in economically significant amounts will have been adequately explored. MacLaren, therefore, recommends that the loan be denied.

I concur in this recommendation.

The brochure is enclosed.

A. H. Koschmann
A. H. Koschmann
Supervising Geologist
Colorado-Wyoming

Enclosures (11)

THE CONSOLIDATED CARIBOU SILVER MINES, INC.

BOULDER COUNTY, COLORADO

DMEA DOCKET 2350
(Revised)

Geologic Report

Reviewed by
DMEA OPERATING COMMITTEE
9/24/52
(date)

By D. R. Hudson
U. S. Geological Survey

THE CONSOLIDATED CARIBOU SILVER MINES, INC.
BOULDER COUNTY, COLORADO

INTRODUCTION

On January 7, 1952, the Consolidated Caribou Silver Mines, Inc., Boulder County, Colorado, applied to the Defense Minerals Exploration Administration (DMEA Docket 1887) for assistance to explore for uranium. The applicant proposed to sink the Caribou shaft 600 feet below the 1040 level; to explore on the 1290, 1440, and 1590 levels by crosscutting, drifting, and raising, a total of 2,700 feet; and to explore below the 1590 level by diamond drilling a total of 10,000 feet of holes. The estimated cost of this program is $261,750, the Government's share, $235,575. On March 20, 1952, the applicant submitted a supplementary application (DMEA Docket 2336, Revised) wherein it is proposed that, before the work outlined in Docket 1887 be undertaken, 20,000 feet of diamond drilling be done from, and below, the 1040 level. The supplementary application also calls for 495 feet of drifting and crosscutting to reach and cut drill stations. The estimated cost of the supplementary program is $134,850, the Government's share to be $121,365. The estimated cost of the two proposals is $396,600, the Government's share, $356,940.

The Caribou mine has been worked, intermittently, for silver and lead since its discovery in 1869 until 1928. No appreciable production was reported from 1928 to 1947. Records of the U. S. Bureau of Mines show that from 1947 through 1951 the company has mined and shipped 34,639 tons of ore containing 641 oz. of gold, 242,987 oz. of silver, 297,924 pounds of lead, 173,202 pounds of zinc, and 17,429 pounds of copper.

In 1945 it was discovered that some of the material on the dumps was radioactive, and rehabilitation of the old workings as well as new development was started. A streak containing pitchblende was discovered, in 1948, in the Radium vein on the 1040 level. In November of the same year, the Atomic Energy Commission made a reconnaissance examination of the mine, and the following month the U. S. Geological Survey, in collaboration with the Atomic Energy Commission, began a detailed study and geologic mapping of the Radium and No Name veins on the 1040 level. This work was continued until all the principal accessible workings were mapped. Only in the Radium vein on the 1040 level were significant amounts of pitchblende found. The Atomic Energy Commission awarded a contract to the company under which the latter drove 300 feet of drift on the 1040 and 1140 levels, at a cost to the AEC of $16,500. This work resulted in the discovery of a second occurrence of pitchblende on the 1040 level. A second contract was awarded the company under which it was authorized to spend up to $77,000 of AEC funds to explore the Radium vein above, below, and on the 1040 level by diamond drilling, drifting, crosscutting, and raising. The diamond drilling was completed in June 1951. Eleven holes, totaling 1,682 feet, were drilled, cutting the Radium vein at various points from 55 to 145 feet below the larger and more promising of the two pitchblende zones found on the 1040 level. The core recovery was 1,557.5 feet, or 92.6%. Assays of core samples were: .001% U_3O_8 for nine samples; .002% U_3O_8 and .003% U_3O_8, respectively, for two other samples. The progress of the proposed drifting, crosscutting, and raising was delayed by labor shortage and limited hoisting facilities so that the date of completion of the contract was advanced from April 1952 to October 1952. When the remaining 279 feet of work is completed, the only areas in the mine believed to be

geologically favorable for the discovery of uranium in economically significant amounts will have been amply explored. It is recommended that this loan be denied.

GEOLOGY

The rocks of the area are pre-Cambrian metamorphic and igneous rocks that have been intruded by stocks of Tertiary monzonite. The Caribou mine is in a stock composed of rocks that vary from porphyritic monzonite to diorite. Numerous faults and fractures cut the stock, but the direction and amount of movement along them has not been determined.

Two prominent sets of quartz-carbonate veins, intersecting at about 45°, cut the monzonite porphyry. One set, represented by the No Name and Silver Dollar veins, strikes northeast and dips northwest. The other set, represented by the Caribou, Poorman, and Radium veins, strikes east and dips steeply north. In general, the former set appears to be more persistent and may be traced to greater depth than the latter. The No Name vein, striking northeast and dipping 55°-60° NW., cuts, and may displace, the Caribou vein. Other east striking veins join the No Name, but do not appear to cross it. The relationship of the Caribou and Poorman veins to the Radium vein is not clearly understood. However, it is possible that the Radium vein may be a continuation of either the Caribou vein or the Poorman vein. On the 1040 level the No Name vein parallels a strong fault displaying horizontal grooves and striations. The relative direction of the movement of the walls is not clear, but if the Radium and the Caribou should be the same vein, the horizontal displacement would amount to a few hundreds of feet, with the east wall moving northeastward.

The ore deposits of the Caribou mine, principally of silver and lead, are found at or near the intersections of the eastward-trending veins with those of northeastward trend. The ore minerals of the Caribou and No Name veins are ruby silver, galena, some sphalerite, and small amounts of marmatite, in a gangue of quartz, dolomite, and clayey gouge. The Radium vein contains the same minerals, and in addition, on the 1040 level in two zones along the east drift, 34 to 124 feet and 260 to 316 feet from its junction with the No Name vein, contains appreciable amounts of pitchblende (fig. 2). The pitchblende is a sooty black powder mixed with fine grained pyrite and black clay gouge. It is generally found in a well defined streak, up to 1 inch wide, along the footwall side of the vein, but it also occurs in lenticular bodies up to a foot long irregularly scattered along the vein, in places separated by as much as 30 feet. In a raise driven from the 1040 level on the first shoot, radioactivity decreases sharply between 50 and 75 feet above the level. In a raise driven 83 feet above the level, the second shoot is radioactive to the face. A winze on the vein has cut small scattered lenses of massive pitchblende in the first 40 feet below the level. Samples taken from this pitchblende bearing shoot assayed from .001% to 1.45% U_3O_8.

EXPLORATION BY ATOMIC ENERGY COMMISSION

With the technical and financial assistance of the Atomic Energy Commission, considerable exploration work has been done on the Radium vein (fig. 1).

1. On the 500 level (not shown on section) a small pod of pitchblende not more than 2 feet long was followed by a raise. No pitchblende was found after the first round, but the raise was continued for 57 feet.

2. On the 740 level a cross cut has been driven 111 feet and has just reached the Radium vein. The crosscut is to be continued another 15 feet, and the vein is to be followed by a drift east and west of the crosscut for a total of 141 feet.

3. On the 920 level two drifts on the Radium vein have been extended 200 feet east and 52 feet west, respectively, from the No Name vein. From 75 feet to 120 feet east of the No Name vein, two small patches of pitchblende have been correlated with the first shoot found on the 1040 level. No other significant occurrence of pitchblende was found in this drift although the face is east of the zone in which the upward extension of the second shoot found on the 1040 level could be expected. A raise is to be driven from this level to follow the best pitchblende showing. It will be driven 60 feet, or to the upper limit of the pitchblende should that be higher. A split off the main vein is to be followed by a drift for 20 feet.

4. On the 1040 level the drift on the Radium vein was extended to a point about 410 feet east of the No Name vein. From 260 to 316 feet east, a second shoot containing pitchblende was found. A raise was driven on this shoot for 83 feet and is to be continued to the 920 level.

5. On the 1140 level a diamond drill station was cut on the No Name vein and 11 holes were drilled fanning out in a southerly direction, and pitching from -25° to -57°. The target was a zone 175 feet wide and 90 feet high below the best showing of pitchblende found in the entire mine. Of eleven samples taken from the core, one assayed .003% U_3O_8; one, .002% U_3O_8; and nine, .001% U_3O_8. This indicates that a zone from 55 to 145 feet below the best pitchblende showing in the mine assays scarcely more than a trace of U_3O_8, and does not offer any encouragement for further downward exploration of this shoot.

Under the terms of the Atomic Energy Commission contract there remain 279 feet of drifting, crosscutting, and raising to be completed by October 30, 1952. As the total advance for June was 20 feet; for July, 44 feet; and for August, zero, it appears unlikely that the contract will be completed unless the company considerably increases the tempo of exploration work.

EXPLORATION PROPOSED BY APPLICANT

The applicant proposes to do 495 feet of drifting and crosscutting to establish 3 diamond drill stations; to establish 2 diamond drill stations in an existing drift; and to diamond drill 33 holes for a total of 20,000 feet (fig. 2). The drill stations will be on the 1040 level, and the holes will be drilled horizontally or downward. On the basis of the type of targets or objectives, the drilling program may be divided into three units.

1. It is proposed to drill 9 holes in a northwesterly direction from drill stations 2, 3, and 5 (fig. 2), for a total distance of 6,250 feet. The applicant has not indicated any vein or target at which these holes are to be directed, and it is therefore presumed that they are purely wildcat exploration.

2. It is proposed to drill 12 holes in a southeasterly direction from drill stations 1 and 3 (fig. 2), for a total of 7,250 feet to explore the downward extension of the Elmer, Nelson, and No Name veins, and an unnamed vein between the latter two. In the past these veins have been producers of silver and lead, but so far have not been shown to contain any significant amount of pitchblende or other radioactive minerals.

3. It is proposed to drill 12 holes in a southerly direction from drill stations 4 and 5 (fig. 2), for a total of 6,500 feet to explore the downward extension of the No Name and Radium veins. The Radium vein is the only one in the mine in which any appreciable amount of pitchblende has been found, and it is now being explored by the Atomic Energy Commission.

CONCLUSIONS AND RECOMMENDATIONS

The Caribou mine has been a producer of silver and lead ores for many years. In 1948 a zone about 90 feet long and containing pitchblende was found in the east drift on the Radium vein on the 1040 level. Subsequent exploration, under an AEC contract, resulted in the discovery of a similar streak about 56 feet long in the same drift. With the financial and technical assistance of the AEC, the most promising areas for the occurrence of pitchblende are still being explored under a second contract providing for diamond drilling, crosscutting, drifting, and raising. All the principal workings in the mine that are accessible have been studied and the geology has been mapped.

It is concluded that, of 33 diamond drill holes proposed by the applicant, 9 will be purely wildcat exploration; 12 will explore veins that show possibilities of containing silver and lead, but no pitchblende in significant amounts. The remaining 12 holes will prospect a vein that has shown evidence of containing some pitchblende, but the AEC is now exploring this showing. It is further concluded that the work done by the AEC has shown that the two pitchblende shoots so far discovered are small and are too low grade to be mined profitably under present conditions. Finally, it is concluded that completion of the AEC program will establish the upper limits of the two pitchblende streaks so far discovered, as it has already established the lower limit of the first and larger shoot on the 1040 level.

As the results of the work done by the AEC have greatly decreased the chances of making a significant discovery of pitchblende in this mine, it is recommended that this application be denied.

9/22/52 jem

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION
WASHINGTON 25, D. C.

224 New Customhouse
Denver 2, Colorado

September 17, 1952

Memorandum

To: Secretary to the Operating Committee, Defense Minerals Exploration Administration

From: Field Team, Region IV

Subject: Final Report, DMEA Docket 2336 (Revised) (Uranium) The Consolidated Caribou Silver Mines, Inc., Boulder County, Colorado

Enclosed are the original and three copies of the report pertaining to the above application.

The Atomic Energy Commission awarded a contract to the company to adequately explore the mine for pitchblende. Only 279 feet of underground work remains to be done, and when completed, the only areas in the mine believed to be geologically favorable for the discovery of uranium ore in economically significant amounts will have been adequately explored.

We therefore recommend that the loan be denied.

W. H. King
W. H. King

A. H. Koschmann
A. H. Koschmann

Enclosures

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION
WASHINGTON 25, D. C.

200 New Customhouse
Denver 2, Colorado

DEPARTMENT OF THE INTERIOR
Denver Records Administration
Denver
SEP 22 1952

September 10, 1952

Memorandum

To: DMEA Field Team, Region IV

From: A. H. Koschmann

Subject: DMEA Docket 2336 (Revised), The Consolidated Caribou Silver Mines, Inc., Boulder County, Colorado.

Attached are 10 copies of the geological report by D. R. MacLaren covering DMEA Docket 2336 (Revised), The Consolidated Caribou Silver Mines, Inc., Boulder County, Colorado.

The applicant proposes to explore the Caribou mine for uranium by diamond drilling and underground work, including deepening of the shaft 600 feet, at a total estimated cost of $396,600.

Radioactive material was discovered on the mine dump in 1945 and rehabilitation of the mine was begun immediately. In 1948 a streak containing pitchblende was discovered in the Radium vein on the 1040 level. In November of the same year the Atomic Energy Commission made a reconnaissance study of the mine, and the following month the Geological Survey, for the Atomic Energy Commission, began a detailed study and geologic mapping of the mine. The Atomic Energy Commission has awarded a contract to the company to adequately explore the mine for pitchblende. Only 279 feet of underground work remains to be done, and when completed, the only areas in the mine believed to be geologically favorable for the discovery of uranium ore in economically significant amounts will have been adequately explored. MacLaren, therefore, recommends that the loan be denied.

I concur in this recommendation.

The brochure is enclosed.

A. H. Koschmann

A. H. Koschmann
Supervising Geologist
Colorado-Wyoming

Enclosures (11)

THE CONSOLIDATED CARIBOU SILVER MINES, INC.

BOULDER COUNTY, COLORADO

DMEA DOCKET 2336
(Revised)

Geologic Report

By D. R. MacLaren
U. S. Geological Survey

THE CONSOLIDATED CARIBOU SILVER MINES, INC.
BOULDER COUNTY, COLORADO

INTRODUCTION

On January 7, 1952, the Consolidated Caribou Silver Mines, Inc., Boulder County, Colorado, applied to the Defense Minerals Exploration Administration (DMEA Docket 1887) for assistance to explore for uranium. The applicant proposed to sink the Caribou shaft 600 feet below the 1040 level; to explore on the 1290, 1440, and 1590 levels by crosscutting, drifting, and raising, a total of 2,700 feet; and to explore below the 1590 level by diamond drilling a total of 10,000 feet of holes. The estimated cost of this program is $261,750, the Government's share, $235,575. On March 20, 1952, the applicant submitted a supplementary application (DMEA Docket 2336, Revised) wherein it is proposed that, before the work outlined in Docket 1887 be undertaken, 20,000 feet of diamond drilling be done from, and below, the 1040 level. The supplementary application also calls for 495 feet of drifting and crosscutting to reach and cut drill stations. The estimated cost of the supplementary program is $134,850, the Government's share to be $121,365. The estimated cost of the two proposals is $396,600, the Government's share, $356,940.

The Caribou mine has been worked, intermittently, for silver and lead since its discovery in 1869 until 1928. No appreciable production was reported from 1928 to 1947. Records of the U. S. Bureau of Mines show that from 1947 through 1951 the company has mined and shipped 34,639 tons of ore containing 641 oz. of gold, 242,987 oz. of silver, 297,924 pounds of lead, 173,202 pounds of zinc, and 17,429 pounds of copper.

In 1945 it was discovered that some of the material on the dumps was radioactive, and rehabilitation of the old workings as well as new development was started. A streak containing pitchblende was discovered, in 1948, in the Radium vein on the 1040 level. In November of the same year, the Atomic Energy Commission made a reconnaissance examination of the mine, and the following month the U. S. Geological Survey, in collaboration with the Atomic Energy Commission, began a detailed study and geologic mapping of the Radium and No Name veins on the 1040 level. This work was continued until all the principal accessible workings were mapped. Only in the Radium vein on the 1040 level were significant amounts of pitchblende found. The Atomic Energy Commission awarded a contract to the company under which the latter drove 300 feet of drift on the 1040 and 1140 levels, at a cost to the AEC of $16,500. This work resulted in the discovery of a second occurrence of pitchblende on the 1040 level. A second contract was awarded the company under which it was authorized to spend up to $77,000 of AEC funds to explore the Radium vein above, below, and on the 1040 level by diamond drilling, drifting, crosscutting, and raising. The diamond drilling was completed in June 1951. Eleven holes, totaling 1,682 feet, were drilled, cutting the Radium vein at various points from 55 to 145 feet below the larger and more promising of the two pitchblende zones found on the 1040 level. The core recovery was 1,557.5 feet, or 92.6%. Assays of core samples were: .001% U_3O_8 for nine samples; .002% U_3O_8 and .003% U_3O_8, respectively, for two other samples. The progress of the proposed drifting, crosscutting, and raising was delayed by labor shortage and limited hoisting facilities so that the date of completion of the contract was advanced from April 1952 to October 1952. When the remaining 279 feet of work is completed, the only areas in the mine believed to be

geologically favorable for the discovery of uranium in economically significant amounts will have been amply explored. It is recommended that this loan be denied.

GEOLOGY

The rocks of the area are pre-Cambrian metamorphic and igneous rocks that have been intruded by stocks of Tertiary monzonite. The Caribou mine is in a stock composed of rocks that vary from porphyritic monzonite to diorite. Numerous faults and fractures cut the stock, but the direction and amount of movement along them has not been determined.

Two prominent sets of quartz-carbonate veins, intersecting at about 45°, cut the monzonite porphyry. One set, represented by the No Name and Silver Dollar veins, strikes northeast and dips northwest. The other set, represented by the Caribou, Poorman, and Radium veins, strikes east and dips steeply north. In general, the former set appears to be more persistent and may be traced to greater depth than the latter. The No Name vein, striking northeast and dipping 55°-60° NW., cuts, and may displace, the Caribou vein. Other east striking veins join the No Name, but do not appear to cross it. The relationship of the Caribou and Poorman veins to the Radium vein is not clearly understood. However, it is possible that the Radium vein may be a continuation of either the Caribou vein or the Poorman vein. On the 1040 level the No Name vein parallels a strong fault displaying horizontal grooves and striations. The relative direction of the movement of the walls is not clear, but if the Radium and the Caribou should be the same vein, the horizontal displacement would amount to a few hundreds of feet, with the east wall moving northeastward.

The ore deposits of the Caribou mine, principally of silver and lead, are found at or near the intersections of the eastward-trending veins with those of northeastward trend. The ore minerals of the Caribou and No Name veins are ruby silver, galena, some sphalerite, and small amounts of marmatite, in a gangue of quartz, dolomite, and clayey gouge. The Radium vein contains the same minerals, and in addition, on the 1040 level in two zones along the east drift, 34 to 124 feet and 260 to 316 feet from its junction with the No Name vein, contains appreciable amounts of pitchblende (fig. 2). The pitchblende is a sooty black powder mixed with fine grained pyrite and black clay gouge. It is generally found in a well defined streak, up to 1 inch wide, along the footwall side of the vein, but it also occurs in lenticular bodies up to a foot long irregularly scattered along the vein, in places separated by as much as 30 feet. In a raise driven from the 1040 level on the first shoot, radioactivity decreases sharply between 50 and 75 feet above the level. In a raise driven 83 feet above the level, the second shoot is radioactive to the face. A winze on the vein has cut small scattered lenses of massive pitchblende in the first 40 feet below the level. Samples taken from this pitchblende bearing shoot assayed from .001% to 1.45% U_3O_8. [illegible] [illegible]?

EXPLORATION BY ATOMIC ENERGY COMMISSION

With the technical and financial assistance of the Atomic Energy Commission, considerable exploration work has been done on the Radium vein (fig. 1).

1. On the 500 level (not shown on section) a small pod of pitchblende not more than 2 feet long was followed by a raise. No pitchblende was found after the first round, but the raise was continued for 57 feet.

2. On the 740 level a cross cut has been driven 111 feet and has just reached the Radium vein. The crosscut is to be continued another 15 feet, and the vein is to be followed by a drift east and west of the crosscut for a total of 141 feet.

3. On the 920 level two drifts on the Radium vein have been extended 200 feet east and 52 feet west, respectively, from the No Name vein. From 75 feet to 120 feet east of the No Name vein, two small patches of pitchblende have been correlated with the first shoot found on the 1040 level. No other significant occurrence of pitchblende was found in this drift although the face is east of the zone in which the upward extension of the second shoot found on the 1040 level could be expected. A raise is to be driven from this level to follow the best pitchblende showing. It will be driven 60 feet, or to the upper limit of the pitchblende should that be higher. A split off the main vein is to be followed by a drift for 20 feet.

4. On the 1040 level the drift on the Radium vein was extended to a point about 410 feet east of the No Name vein. From 260 to 316 feet east, a second shoot containing pitchblende was found. A raise was driven on this shoot for 83 feet and is to be continued to the 920 level.

5. On the 1140 level a diamond drill station was cut on the No Name vein and 11 holes were drilled fanning out in a southerly direction, and pitching from -25° to -57°. The target was a zone 175 feet wide and 90 feet high below the best showing of pitchblende found in the entire mine. Of eleven samples taken from the core, one assayed .003% U_3O_8; one, .002% U_3O_8; and nine, .001% U_3O_8. This indicates that a zone from 55 to 145 feet below the best pitchblende showing in the mine assays scarcely more than a trace of U308, and does not offer any encouragement for further downward exploration of this shoot.

Under the terms of the Atomic Energy Commission contract there remain 279 feet of drifting, crosscutting, and raising to be completed by October 30, 1952. As the total advance for June was 20 feet; for July, 44 feet; and for August, zero, it appears unlikely that the contract will be completed unless the company considerably increases the tempo of exploration work.

EXPLORATION PROPOSED BY APPLICANT

The applicant proposes to do 495 feet of drifting and crosscutting to establish 3 diamond drill stations; to establish 2 diamond drill stations in an existing drift; and to diamond drill 33 holes for a total of 20,000 feet (fig. 2). The drill stations will be on the 1040 level, and the holes will be drilled horizontally or downward. On the basis of the type of targets or objectives, the drilling program may be divided into three units.

1. It is proposed to drill 9 holes in a northwesterly direction from drill stations 2, 3, and 5 (fig. 2), for a total distance of 6,250 feet. The applicant has not indicated any vein or target at which these holes are to be directed, and it is therefore presumed that they are purely wildcat exploration.

2. It is proposed to drill 12 holes in a southeasterly direction from drill stations 1 and 3 (fig. 2), for a total of 7,250 feet to explore the downward extension of the Elmer, Nelson, and No Name veins, and an unnamed vein between the latter two. In the past these veins have been producers of silver and lead, but so far have not been shown to contain any significant amount of pitchblende or other radioactive minerals.

3. It is proposed to drill 12 holes in a southerly direction from drill stations 4 and 5 (fig. 2), for a total of 6,500 feet to explore the downward extension of the No Name and Radium veins. The Radium vein is the only one in the mine in which any appreciable amount of pitchblende has been found, and it is now being explored by the Atomic Energy Commission.

CONCLUSIONS AND RECOMMENDATIONS

The Caribou mine has been a producer of silver and lead ores for many years. In 1948 a zone about 90 feet long and containing pitchblende was found in the east drift on the Radium vein on the 1040 level. Subsequent exploration, under an AEC contract, resulted in the discovery of a similar streak about 56 feet long in the same drift. With the financial and technical assistance of the AEC, the most promising areas for the occurrence of pitchblende are still being explored under a second contract providing for diamond drilling, crosscutting, drifting, and raising. All the principal workings in the mine that are accessible have been studied and the geology has been mapped.

It is concluded that, of 33 diamond drill holes proposed by the applicant, 9 will be purely wildcat exploration; 12 will explore veins that show possibilities of containing silver and lead, but no pitchblende in significant amounts. The remaining 12 holes will prospect a vein that has shown evidence of containing some pitchblende, but the AEC is now exploring this showing. It is further concluded that the work done by the AEC has shown that the two pitchblende shoots so far discovered are small and are too low grade to be mined profitably under present conditions. Finally, it is concluded that completion of the AEC program will establish the upper limits of the two pitchblende streaks so far discovered, as it has already established the lower limit of the first and larger shoot on the 1040 level.

As the results of the work done by the AEC have greatly decreased the chances of making a significant discovery of pitchblende in this mine, it is recommended that this application be denied.

FILE COPY
SURNAME:

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION
WASHINGTON 25, D.C.

AIR MAIL

Mr. W. L. King
Executive Officer
DMEA Field Team, Region IV
224 New Customhouse Building
Denver 2, Colorado

JUL 14 1952

Re: Docket No. DMEA-2336 Revised (Uranium)
Caribou Silver Mine
Boulder County, Colorado

Dear Mr. King:

We have your memorandum of July 1, 1952, concerning the subject docket.

Complying with your request, we are enclosing the following documents and related correspondence:

Application for Aid Form MF-103 (revised) dated March 20, 1952, with attached maps.
Memoranda of Arthur A. Butler, Jr., USGS, dated February 14 and May 7, 1952.
Letter to Donald W. Nelson from Harry J. Wolf, dated March 5, 1952.
Letter to Ernest Wm. Ellis from Donald W. Nelson, dated March 18, 1952.
Bound copy of report entitled, "Diamond Drilling 1140 Level, Caribou Mine" by Loren E. Smith

We believe that the merits of this application can be more accurately appraised by your office in cooperation with A.E.C. than would be possible otherwise.

We shall be pleased to receive your recommendations and the report of the field examination if you believe one is necessary after obtaining the report on the A.E.C. work that is now being done, the results of which will be made available to you.

Mr. Nelson called the Acting Administrator, Mr. C. O. Mittenderf, on July 10 requesting information on the subject application. He was informed that the docket and related information was being forwarded to you for consideration.

APPROVED:

J. H. Hedges (JHB)
Member, Bureau of Mines

T. P. Thayer (JHB)
Member, Geological Survey

Sincerely yours,

George C. Selfridge
ACTING Chairman, Operating Committee (JHB)

Enclosures 5

Messrs. A. P. Butler, Jr. Rm. 3206 GSA
H. D. Keiser, Rm. 1347
Ellis
Keller

HFKeller/gla 7-10-52
cc to: Adm. Reading File
Operating Committee
Docket

7/8/52 gh

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION
WASHINGTON 25, D. C.

224 New Customhouse
Denver 2, Colorado

July 1, 1952

Memorandum

To: Frank E. Johnson, Chairman, Operating Committee, DMEA

From: Executive Officer, DMEA Field Team, Region IV

Subject: Docket No. DMEA-2336 Revised (Uranium), Caribou Silver Mine, Boulder County, Colorado, your memo June 26, 1952

Docket DMEA-2336, Caribou Silver Mine, Boulder County, Colorado, was discussed with Mr. Towle of the A.E.C.

We suggest that the docket and related information be forwarded to this office for consideration in the regular manner. We are informed that the results of the A.E.C. work will be available to us by the time our engineers are in a position to make the examination.

W. H. King

W. H. King

JUL 7 - 1952

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION
WASHINGTON 25, D. C.

224 New Customhouse
Denver 2, Colorado

July 1, 1952

Memorandum

To: Frank E. Johnson, Chairman, Operating Committee, DMEA

From: Executive Officer, DMEA Field Team, Region IV

Subject: Docket No. DMEA-2336 Revised (Uranium), Caribou Silver Mine, Boulder County, Colorado, your memo June 26, 1952

Docket DMEA-2336, Caribou Silver Mine, Boulder County, Colorado, was discussed with Mr. Towle of the A.E.C.

We suggest that the docket and related information be forwarded to this office for consideration in the regular manner. We are informed that the results of the A.E.C. work will be available to us by the time our engineers are in a position to make the examination.

W. H. King
W. H. King

WHK/jp

cc Subj
Chron
AHKoschmann (2)

DEPARTMENT OF THE INTERIOR
Defense Minerals Administration
JUL 7 - 1952

FILE COPY
FOR NAME:

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION
WASHINGTON 25, D. C.

JUN 26 1952

Mr. W. H. King
Executive Officer
DMEA Field Team, Region IV
224 New Customhouse Building
Denver 2, Colorado

Re: Docket No. DMEA-2336
Revised (Uranium)
Caribou Silver Mine
Boulder County, Colorado

Dear Mr. King:

For your information and comments we are enclosing a copy of a letter dated June 9, 1952, that we received from Mr. Donald M. Nelson, President of the Consolidated Caribou Silver Mines, Inc., in answer to our letter of June 5, 1952, to him.

Mr. Nelson is of the impression that the A.E.C. does not plan to do any diamond drilling during the next six months on the properties of the Applicant. Since the statements in his letter are contrary to the information that we have obtained, we would appreciate it if you would again bring this subject to the attention of Mr. Charles C. Towle. If the A.E.C. is planning to diamond drill in the Caribou Mine, we would appreciate information on their proposed project as well as their evaluation of the diamond drilling program proposed by the Applicant in his revised application. We certainly agree that the proposed exploration project of the Applicant should not be considered at this time, but we would like to obtain sufficient information on which to base our denial or deferral.

Sincerely yours,

(signed) FRANK E. JOHNSON

Chairman, Operating Committee

Enclosure
APPROVED: J. H. Hedges

Member, Bureau of Mines

J. M. Lemmon

Member, Geological Survey

HFKeller/jem
6/23/52
cc to: Adm. Reading File
Docket
AJKauffman-1347
APButler-3206
Ellis Keller
Opr. Com.
Field Team, Region IV

CONSOLIDATED CARIBOU SILVER MINES, INC.
BOULDER, COLORADO
1406 PEARL STREET
PHONE OFFICE: BOULDER 521
PHONE MINE: NEDERLAND 517
PHONE MILL: NEDERLAND 453

June 9, 1952

DEPARTMENT OF THE INTERIOR
Defense Minerals Administration
RECEIVED
JUN 16 1952

Mr. C. O. Mittendorf
Acting Administrator
Defense Minerals Exploration Administration
Washington 25, D. C.

RE: Docket DMEA-2336 Revised (Uranium)
Caribou Silver Mine
Boulder County, Colorado

Dear Sir:

In immediate response to your kind letter of June 5, 1952, we would like to inform you that the Atomic Energy Commission did not order us to diamond drill and does not intend to order us to diamond drill.

The Atomic Energy Commission wants us to cross-cut on 740 level and to drift on 920 level, and we are working at present according to their instructions.

As stated in our previous application, we have justified reasons to assume that uranium oxide may be found in horizons below our 1040 and 1140 levels, but to minimize the risk connected with the planned sinking of our shaft we respectfully suggested to diamond drill first. This diamond drilling we asked for may be started immediately and would not, of course, interfere in any way with our contract work for Atomic Energy Commission on the upper levels. Both workings are in all regards entirely independent from each other, and in view of the need for uranium oxide we think that the approval of our application is advisable.

Sincerely yours,

CONSOLIDATED CARIBOU
SILVER MINES, INC.

Donald M. Nelson

Donald M. Nelson
President

C
O
P
Y

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION
WASHINGTON 25, D. C.

June 5, 1952

Mr. Donald M. Nelson, President
Consolidated Caribou Silver Mines, Inc.
1406 Pearl Street
Boulder, Colorado

RE: Docket DMEA-2336 Revised (Uranium)
Caribou Silver Mine
Boulder County, Colorado

Dear Mr. Nelson:

Since receiving the subject application we have learned that the Atomic Energy Commission plans to continue their diamond drilling program in the Caribou Silver Mine for at least six months. If this is the case, we believe that no action should be taken on your revised application at the present time. If you concur with this opinion we would appreciate it if you would so advise us.

Upon the completion of the exploration program, now being executed by the Atomic Energy Commission, if you believe it advisable to do more diamond drilling or other exploratory work, we would be pleased to receive a revised application based on the additional information obtained from that program.

Sincerely yours,

C. O. Mittendorf (Signed)

Acting Administrator

C
O
P
Y

FILE COPY
SURNAME:

700

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION
WASHINGTON 25, D. C.

JUN 5 1952

Mr. Donald E. Nelson, President
Consolidated Caribou Silver Mines, Inc.
1406 Pearl Street
Boulder, Colorado

Re: Docket DMEA-2336 Revised (Uranium)
Caribou Silver Mine
Boulder County, Colorado

Dear Mr. Nelson:

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Upon the completion of the exploration program, now being executed by the Atomic Energy Commission, if you believe it advisable to do more diamond drilling or other exploratory work, we would be pleased to receive a revised application based on the additional information obtained from that program.

Sincerely yours,

C. O. Mittendorf (for) J.N. 6-5-52

Acting Administrator

EFKeller/jem
6/4/52
cc to: Adm. Reading File
Docket
Messrs. A.J.Kauffman-1347
A.P.Butler-3206 GSA
Ellis Keller
Field Team, Region IV (2)

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION
WASHINGTON 25, D. C.

224 New Customhouse
Denver 2, Colorado

May 23, 1952

Memorandum

To: Secretary to the Operating Committee, Defense Minerals Exploration Administration

From: Field Team, Region IV

Subject: DMEA Docket 2336 (Uranium) Consolidated Caribou Silver Mines, Inc., Boulder County, Colorado

Returned herewith is the application of Consolidated Caribou Silver Mines, Inc.

In accordance with the recommendations of Arthur P. Butler, Jr. and H. D. Keiser the proposed project has been discussed with Charles C. Towle of the Atomic Energy Commission. He stated that it would be at least six months before their drilling project on the Caribou property is completed.

We recommend that this application be returned to the applicant. A new application, contingent upon the findings by the Atomic Energy Commission in their present drilling program at the Caribou Mine, could be made on the completion of the present project.

W. H. King
W. H. King

A. H. Koschmann
A. H. Koschmann

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION
WASHINGTON 25, D. C.

224 New Customhouse
Denver 2, Colorado

May 23, 1952

Memorandum

To: Secretary to the Operating Committee, Defense Minerals Exploration Administration

From: Field Team, Region IV

Subject: DMEA Docket 2336 (Uranium) Consolidated Caribou Silver Mines, Inc., Boulder County, Colorado

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We recommend that this application be returned to the applicant. A new application, contingent upon the findings by the Atomic Energy Commission in their present drilling program at the Caribou Mine, could be made on the completion of the present project.

W. N. King
W. N. King

A. H. Koschmann
A. H. Koschmann

700

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION
WASHINGTON 25, D. C.

AIR MAIL

MAY 19 1952

Mr. J. R. East, Jr.
Executive Officer, Region IV
DMA Field Team
224 New Customhouse Building
Denver 2, Colorado

Re: Docket No. DMA-2336 (Uranium)
Consolidated Caribou Silver Mines, Inc.
Boulder, Colorado

Dear Mr. East:

This is your authority to make a field examination of the captioned applicant's property in Clear Creek County, Colorado, if in your opinion such an examination is necessary to permit us to arrive at the correct evaluation of the proposed exploration project.

With this letter we are enclosing one copy of the application and memoranda of the commodity specialists pertaining to same.

We concur with the recommendations of Arthur P. Butler, Jr. and R. D. Reiser that the Field Team consult with Lincoln R. Page of the Geological Survey and Charles C. Towle of the Atomic Energy Commission and defer the final appraisal of the application until the results of the present exploration work are available.

Sincerely yours,

(signed) FRANK E. JOHNSON

Chairman, Operating Committee
Defense Minerals Exploration
Administration

Enclosures

HFKeller/jem
5/14/52
cc to: Adm. Reading File
Docket
Messrs. A.J.Kauffman, Rm. 1347
A.P.Butler, Rm. 3206 GSA
Ellis
Keller
Opr. Committee
Field Team, Region IV

APPROVED: For E. Hedges
Member, Bureau of Mines

S. M. Lemmon
Member, Geological Survey

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION
WASHINGTON 25, D. C.

Mr. Donald M. Nelson, President
Consolidated Caribou Silver Mines, Inc.
1406 Pearl Street
Boulder, Colorado

Re: Docket DMEA-2336 (Uranium)
Caribou Silver Mine
Boulder County, Colorado

Dear Mr. Nelson:

Your application for assistance in exploring your property in Boulder County, Colorado, under the above captioned docket number, has been reviewed by the Rare and Miscellaneous Metals Division of the Defense Minerals Exploration Administration and has been referred to Mr. J. H. East, Jr., Executive Officer, DMEA Field Team, Region IV, 224 New Customhouse Building, Denver 2, Colorado.

The Regional office will contact you at the earliest opportunity in regard to your project.

Sincerely yours,

Acting Administrator
Defense Minerals Exploration
Administration

HFKeller/jem
5/14/52
cc to: Adm. Reading File
Docket
Messrs. A.J.Kauffman, Rm. 1347
A.P.Butler, Rm. 3206 GSA
Ellis
Keller
Field Team, Region IV (2)

UNITED STATES 13771

DEPARTMENT OF THE INTERIOR

DEFENSE MINERALS EXPLORATION ADMINISTRATION

REFERENCE SLIP

DATE 5-29-52

REFERRED TO:

Dmea - 2330

1. ~~Mrs. Berry, Rm. 4624~~
2. ~~Miss Lanahan, Room 4539~~
3. ~~Mr. Ellis, Room 4640~~
4. Mr. Keller

FOR:

.....Action	.....Recommendation
.....Approval	.....Record of.....
.....Comment	
.....Conference	.....Referring to.....
.....Consideration	
.....Filing	.....Ready for signature of.....
.....Instructions	
.....Investigation	.....Rewriting
.....Initials	.....Signature
.....Mailing	.....Suggestions
.....Previous correspondence	.....Your informtion

REMARKS: Since Field did not make exam. or report and suggest return of application to applicant for filing of new appl. based on findings of Atomic Energy we are not taking it thru the Op. Com. (RB)

Check (X) before the items needing attention.

Frank Johnson

~~R. E. ADAMS~~

INT.-DUP. SEC., WASH., D.C. Initial of sender

FILE COPY
SURNAME:

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION
WASHINGTON 25, D. C.

AIR MAIL

MAY 19 1952

Mr. J. C. East, Jr.
Executive Officer, Region IV
DMEA Field Team
224 New Customhouse Building
Denver 2, Colorado

Re: Docket No. DMEA-2336 (Uranium)
Consolidated Caribou Silver Mines, Inc.
Boulder, Colorado

Dear Mr. East:

This is your authority to make a field examination of the captioned applicant's property in Clear Creek County, Colorado, if in your opinion such an examination is necessary to permit us to arrive at the correct evaluation of the proposed exploration project.

With this letter we are enclosing one copy of the application and memoranda of the commodity specialists pertaining to same.

We concur with the recommendations of Arthur P. Butler, Jr. and W. D. Reiner that the Field Team consult with Lincoln R. Page of the Geological Survey and Charles C. Towle of the Atomic Energy Commission and defer the final appraisal of the application until the results of the present exploration work are available.

Sincerely yours,

(signed) FRANK E. JOHNSON

Chairman, Operating Committee
Defense Minerals Exploration
Administration

Enclosures

APPROVED: Wm. H. Hedges

Member, Bureau of Mines

D. M. Lemmon

Member, Geological Survey

HFKeller/jem
5/14/52
cc to: Adm. Reading File
Docket
Messrs. A.J.Kauffman, Rm. 1347
A.P.Butler, Rm. 3206 GSA
Ellis
Keller
Opr. Committee
Field Team, Region IV

FILE COPY
780RNAME:

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS EXPLORATION ADMINISTRATION
WASHINGTON 25, D. C.

MAY 19 1952

Mr. Donald M. Nelson, President
Consolidated Caribou Silver Mines, Inc.
1406 Pearl Street
Boulder, Colorado

Re: Docket DMEA-2336 (Uranium)
Caribou Silver Mine
Boulder County, Colorado

Dear Mr. Nelson:

Your application for assistance in exploring your property in Boulder County, Colorado, under the above captioned docket number, has been reviewed by the Rare and Miscellaneous Metals Division of the Defense Minerals Exploration Administration and has been referred to Mr. J. H. East, Jr., Executive Officer, DMEA Field Team, Region IV, 224 New Customhouse Building, Denver 2, Colorado.

The Regional office will contact you at the earliest opportunity in regard to your project.

Sincerely yours,

C. O. Mittendorf

Acting Administrator
Defense Minerals Exploration
Administration

HFKeller/jem
5/14/52
cc to: Adm. Reading File
Docket
Messrs. A.J.Kauffman, Rm. 1347
A.P.Butler, Rm. 3206 GSA
Ellis
Keller
Field Team, Region IV (2)

5/9/52 gla

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES
WASHINGTON 25, D. C.

May 9, 1952

Memorandum

To: Ernest William Ellis, DMEA Member, Uranium Commodity Committee, Room 4070

From: H. D. Keiser, Bureau of Mines Member, Uranium Commodity Committee

Subject: DMEA Docket 2336 Revised, Consolidated Caribou Silver Mines, Inc.

I have reviewed the subject revised application and discussed it with Arthur P. Butler, Geological Survey Member, and Joseph O. Hosted, of the Atomic Energy Commission.

I concur in the recommendation of Mr. Butler, to the effect that the revised application be referred to the field team, and that the field team (1) consult with Lincoln R. Page, of the Geological Survey, and Charles C. Towle, of the Atomic Energy Commission, and (2) defer final appraisal of the revised application until results are available of exploration currently in progress under a contract between the applicant and the Atomic Energy Commission.

H. D. Keiser

H. D. KEISER

Attachments

5/9/52 glm

STANDARD FORM NO. 64

Office Memorandum • UNITED STATES GOVERNMENT

TO : Ernest Wm. Ellis, DMEA Member, Uranium Commodity Committee

DATE: May 7, 1952

FROM : Arthur P. Butler, Jr., USGS Member, Uranium Commodity Committee

SUBJECT: DMEA Docket 2336 Revised, Consolidated Caribou Silver Mines, Ind.

I have studied the revised application, as identified above, reviewed available file data about the Caribou mine and discussed the proposal with H. D. Keiser, Bureau of Mines Member, Uranium Commodity Committee and Joseph O. Hosted of the U. S. Atomic Energy Commission and recommend that the docket be referred to the field team for determination whether or not all the geologic factors would justify any exploration at all.

It is uncertain whether any body of uranium-bearing material comparable to those now known in the mine would be minable if discovered at deeper levels. The known ore is in bodies of less than 1,000 tons containing a few tenths of a percent uranium. But it is possible that drilling properly laid out with respect to the geology might find uranium-bearing parts of the Radium vein at depths greater than that at which the vein has yet been explored. The drilling proposed by the applicant, however, is not laid out to take best advantage of possible favorable geologic factors. Moreover, significant concentrations of uranium have been found only on the Radium vein and a large part of the applicant's proposed drilling is not directed to intersect that vein but to intersect other structures on which there is little reason to believe that uranium might be found, although they may be favorable for lead-silver ore. Thus the application as it now stands is not soundly conceived to search for uranium and could be drastically reduced in size without lessening the chances of finding more uranium ore. Thus a principal purpose of referring the application to the field team would be the development of a sound and much less ambitious exploration plan, should the field team believe that any exploration is warranted.

In considering this application I suggest that the field team (1) consult with Lincoln R. Page, Geological Survey and Charles C. Towle, Atomic Energy Commission, on both of whose staffs are geologists who have first-hand knowledge of the mine, in order to obtain the benefit of their information and suggestions; and (2) defer a final appraisal of this docket until such future time as results of exploration now in process under a contract between the applicant and the Atomic Energy Commission are available, for geologic information yet to be developed by that exploration may contribute to an understanding of the pattern of ore distribution that would have material bearing on any further exploration.

Arthur P. Butler, Jr.

Arthur P. Butler Jr.

4/4/52 gla

CONSOLIDATED CARIBOU SILVER MINES, INC.
BOULDER, COLORADO
1406 PEARL STREET

PHONE OFFICE: BOULDER 521
PHONE MINE: NEDERLAND 517
PHONE MILL: NEDERLAND 453

DEPARTMENT OF THE INTERIOR
Defense Minerals Administration
RECEIVED
APR 4 1952

March 18, 1952

Mr. Ernest Wm. Ellis, Chief
Rare and Misc. Metals Division
Defense Minerals Exploration Administration
Washington 25, D. C.

RE: Docket DMEA-2336 (Uranium)
Caribou Silver Mine
Boulder County, Colorado

Dear Mr. Ellis:

Please find enclosed "Diamond Drilling 1140 Level, Caribou Mine" by Loren E. Smith - U. S. Atomic Energy Commission, as you requested. We are also sending you a copy of Mr. Wolf's, our Consulting Engineer, analysis concerning the same diamond drill holes.

The Atomic Energy Commission was going to put a series of diamond drill holes from the 1040 level. The diamond drill holes covered by this report were the starting point of a series to be placed along this level. Nine holes only were drilled altogether and gave the results described in the above-mentioned report. However, as they covered only a very small part of the veins we wanted to look at they do not in any way indicate the quantity of uranium to be found on the lower levels.

About this time, Mr. Joralemon, the Mining Engineer from San Francisco, was engaged by the Atomic Energy Commission, to look over, among other properties in Colorado, the Caribou Mine. It was Mr. Joralemon's opinion that we should begin to follow the uranium on the upper levels rather than the lower levels because it is relatively cheaper to do so. The work on the 1140 level was suspended temporarily while we followed this advice. Consequently, we put, at the request of the Atomic Energy Commission, further drifts on the 1040, 920 level, and began cleaning up the 740 level; and, also, raised on the 500 level.

Immediately suspended

It was Mr. Joralemon's opinion, when I talked to him last in San Francisco, that eventually we would have to go down in the mine, as well as up. Consequently, we put in the application for aid from the Defense Minerals Administration for going down and looking for uranium by means of drifting.

Mr. Ernest Wm. Ellis, Chief
Rare and Misc. Metals Division
Defense Minerals Exploration Administration March 18, 1952

After further consideration, we have decided to amend our application by inserting a program of diamond drilling preliminary to sinking and drifting as proposed in our original application. Hence, we herewith enclose four copies of a supplement to our application dated January 7, 1952, for your further consideration.

Sincerely yours,

CONSOLIDATED CARIBOU
SILVER MINES, INC.

Donald M. Nelson

Donald M. Nelson, President

Enclosures

March 18, 1952

Mr. Ernest Wm. Ellis, Chief
Rare and Misc. Metals Division
Defense Minerals Exploration Administration
Washington 25, D. C.

RE: Docket DMEA-2336 (Uranium)
Caribou Silver Mine
Boulder County, Colorado

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Base and Misc. Metals Division
Defense Minerals Exploration Administration March 18, 1952

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Sincerely yours,

CONSOLIDATED CARIBOU
SILVER MINES, INC.

Donald M. Nelson

Donald M. Nelson, President

Enclosures

March 18, 1952

Mr. Ernest Wm. Ellis, Chief
Rare and Misc. Metals Division
Defense Minerals Exploration Administration
Washington 25, D. C.

RE: Docket DMEA-2336 (Uranium)
Caribou Silver Mine
Boulder County, Colorado

Dear Mr. Ellis:

Please find enclosed "Diamond Drilling 1140 Level, Caribou Mine" by Loren E. Smith - U. S. Atomic Energy Commission, as you requested. We are also sending you a copy of Mr. Wolf's, our Consulting Engineer, analysis concerning the same diamond drill holes.

The Atomic Energy Commission was going to put a series of diamond drill holes from the 1040 level. The diamond drill holes covered by this report were the starting point of a series to be placed along this level. Nine holes only were drilled altogether and gave the results described in the above-mentioned report. However, as they covered only a very small part of the veins we wanted to look at they do not in any way indicate the quantity of uranium to be found on the lower levels.

About this time, Mr. Joralemon, the Mining Engineer from San Francisco, was engaged by the Atomic Energy Commission, to look over, among other properties in Colorado, the Caribou Mine. It was Mr. Joralemon's opinion that we should begin to follow the uranium on the upper levels rather than the lower levels because it is relatively cheaper to do so. The work on the 1140 level was suspended temporarily while we followed this advice. Consequently, we put, at the request of the Atomic Energy Commission, further drifts on the 1040, 920 level, and began cleaning up the 740 level; and, also, raised on the 500 level.

It was Mr. Joralemon's opinion, when I talked to him last in San Francisco, that eventually we would have to go down in the mine, as well as up. Consequently, we put in the application for aid from the Defense Minerals Administration for going down and looking for uranium by means of drifting.

Mr. Ernest Wm. Ellis, Chief
Base and Misc. Metals Division
Defense Minerals Exploration Administration March 18, 1952

After further consideration, we have decided to amend our application by inserting a program of diamond drilling preliminary to sinking and drifting as proposed in our original application. Hence, we herewith enclose four copies of a supplement to our application dated January 7, 1952, for your further consideration.

Sincerely yours,

CONSOLIDATED CARIBOU
SILVER MINES, INC.

Donald M. Nelson

Donald M. Nelson, President

Enclosures

CABLE ADDRESS: MINEWOLF, NEW YORK
CODES: BEDFORD MCNEILL, BENTLEY
OR WESTERN UNION

TELEPHONES: PLAZA 9-1700
GREAT NECK 4-2423

HARRY J. WOLF
MINING AND CONSULTING ENGINEER
420 MADISON AVENUE
NEW YORK 17, N. Y.

March 5, 1952.

Mr. Donald M. Nelson, President,
Consolidated Caribou Silver Mines, Inc.,
328 South Beverly Drive,
Beverly Hills, California.

Re: Diamond Drilling for Pitchblende.

Dear Mr. Nelson:

Yesterday I had an opportunity to review a report issued by the Atomic Energy Commission, from Denver, Colorado, under date of October, 1951, entitled "Diamond Drilling, 1140 Level, Caribou Mine" by Loren E. Smith. It was indicated that the drilling program under review was started April 4, 1951, and completed June 6, 1951, under the terms of Contract No. AT(49-1)607 with the Consolidated Caribou Silver Mines, Inc.

It appears that under this contract eleven holes were drilled from a point in the 1140 Level, on Radium Vein No. 2, designated as "Station A." The holes were fanned out in directions ranging from S. 41° W. to S. 51° 30' E. and were aimed to intersect the Radium Vein at various depths below the 1140 Level, ranging from the horizon of a projected 1190 Level to a projected 1290 Level. Thus the vein area prospected by these holes extended about 100 feet vertically and about 160 feet horizontally, the total vein area tested being a little over 16,000 square feet. Incidentally, the drill holes served to prospect, to a reasonable degree, the ground lying within a pyramid bounded by the drill station as an apex, and the above described vein area as a base. All of this presented interesting and serviceable information.

As I was asked to comment on this report, my first general impression is that it presents every indication of being accurate, thorough, and orderly, and it presents significant information in complete detail, and with adequate discussion and interpretation. It brings out clearly the probability that the ground and vein area under investigation disclosed the presence of uranium oxide in quantities not to exceed .003% U_3O_8. With respect to the actual ground sampled by these tests, the results appear to be below reasonable expectations when compared with results obtained in other parts of the mine workings not very far from the section sampled.

My second general impression is that the above results -- although accepted as authoritative -- relate to a specific and limited portion of the extensive vein area believed to contain pitchblende in substantially larger quantities, such belief being based on various tests, visual observations, and chemical analyses, the latter presenting results ranging from .01% to 2.0% and 3.0% or higher, and with the occasional finding of high-grade specimen material. The limited vein area included in the tests presented in the report under review, constitutes a very small percentage of the areas believed to contain uranium oxides in quantities substantially higher than .003% U_3O_8.

As above stated, the tests under review prospect the Radium Vein area over a horizontal distance of only 160 feet, distributed 130 feet west of the Winze No. 1, and 30 feet east thereof. Inasmuch as assays in the 1040 Level at distances ranging from 150 feet to 230 feet east of the winze indicated the presence of .07% to 2.3% U_3O_8, it seems reasonable to believe that the report to which reference is made, relates to a small, limited vein area, and is not indicative of the possibilities of a relatively vast area which has not been probed.

Therefore, a more extensive and comprehensive diamond-drilling program should be instituted, designed to cover a substantially larger vein area, and extending further to the east, so as to prospect the possible lateral and downward trends of known occurrences of pitchblende.

Such more extensive program of exploration should include not only the Radium Vein areas further east and further west of Winze No. 1, but also No Name vein areas northeast and southwest of the intersection of the Radium Vein, including that portion of the No Name Vein below the large stope on the 1040 Level and east of the Caribou Shaft.

Herewith is a map of a portion of the Caribou Mine, showing the AEC drill holes superimposed, thus indicating the limited area prospected.

Yours very truly,

Harry J. Wolf

HJW:c

CABLE ADDRESS: MINEWOLF, NEW YORK
CODES: BEDFORD MCNEILL, BENTLEY
OR WESTERN UNION

TELEPHONES: PLAZA 9-1700
GREAT NECK 4-2423

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MINING AND CONSULTING ENGINEER
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NEW YORK 17, N. Y.

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It appears that under this contract eleven holes were drilled from a point in the 1140 Level, on Radium Vein No. 2, designated as "Station A." The holes were fanned out in directions ranging from S. 41° W. to S. 51° 30' E. and were aimed to intersect the Radium Vein at various depths below the 1140 Level, ranging from the horizon of a projected 1190 Level to a projected 1290 Level. Thus the vein area prospected by these holes extended about 100 feet vertically and about 160 feet horizontally, the total vein area tested being a little over 16,000 square feet. Incidentally, the drill holes served to prospect, to a reasonable degree, the ground lying within a pyramid bounded by the drill station as an apex, and the above described vein area as a base. All of this presented interesting and serviceable information.

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Herewith is a map of a portion of the Caribou Mine, showing the AEC drill holes superimposed, thus indicating the limited area prospected.

Yours very truly,

Harry J. Wolf

HJW:c

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GREAT NECK 4-2423

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NEW YORK 17, N. Y.

March 5, 1952.

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Yours very truly,

Harry J. Wolf

HJW:c

3/4/52 gh

CONSOLIDATED CARIBOU SILVER MINES, INC.

BOULDER, COLORADO

1406 PEARL STREET

PHONE OFFICE: BOULDER 521
PHONE MINE: NEDERLAND 517
PHONE MILL: NEDERLAND 453

DEPARTMENT OF THE INTERIOR
Defense Minerals Administration
RECEIVED
MAR 3 - 1952

February 29, 1952

Mr. Ernest Wm. Ellis, Chief
Rare and Misc. Metals Division
Defense Minerals Exploration Administration
Washington 25, D. C.

Re: Docket DMEA-2336 (Uranium)
Caribou Silver Mines
Boulder County, Colorado

Dear Mr. Ellis:

We thank you very much for your kind letter of February 26, 1952 received yesterday and addressed to our President, Mr. Donald M. Nelson.

In view of the fact that Mr. Nelson is now en route, we have mailed your letter to him for reply. You will be in receipt of his response within a very few days.

Respectfully yours,

CONSOLIDATED CARIBOU
SILVER MINES, INC.

M. Ollsen

Matthew Ollsen
Gen. Mgr.

MO:mr

Noted
MJK

700
FILE COPY
SURNAME:

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION
WASHINGTON 25, D. C.

FEB 26 1952

Mr. Donald M. Nelson, President
Consolidated Caribou Silver Mines, Inc.
1406 Pearl Street
Boulder, Colorado

Re: Docket No. A-2336 (Uranium)
Caribou Silver Mine
Boulder County, Colorado

Dear Mr. Nelson:

The Defense Minerals Exploration Administration in reviewing the data furnished with the subject application and other information available, learned that your company, under contract with the Atomic Energy Commission, core-drilled some of the ground in which the proposed exploration will be done.

As we believe that the results obtained in drilling this ground, may be of importance in the appraisal of your application, kindly furnish such data to this agency if it is available to your company.

As soon as this additional information is received we will be pleased to continue processing the application.

Sincerely yours,

Signed S.N. 2-26-52

Ernest W. Ellis, Chief
Rare and Misc. Metals Division
Defense Minerals Exploration
Administration

HFKeller/ejm
2/25/52
cc to: Adm. Reading File
Docket
Messrs. A.J.Kauffman, Rm. 1347
A.P.Butler, Rm. 3206 GS
Ellis
Keller
Field Team, Region IV (2)

DMEA #2336 2/26/52

Mr. Keller

It is recommended that application be sent to the field.

J.B. Hysted

Noted 2/27/52 gla

2/20/52 gln

STANDARD FORM NO. 64

Office Memorandum • UNITED STATES GOVERNMENT

TO : Ernest Wm. Ellis, Uranium Commodity Committee
Member, DMEA

DATE: February 14, 1952

FROM : A. P. Butler, Jr., Uranium Commodity Committee
Member, USGS

SUBJECT: DMEA Docket 2336, Consolidated Caribou Silver Mines,
Applicant - Caribou Mine.

FEB 19 1952

I understand that the applicant, under contract with the U. S. Atomic Energy Commission, has core drilled some of the ground in which exploration is proposed by this application. The results of this drilling are not included in the data submitted with the application, but would be very pertinent to an appraisal of the merits of this application. I believe that the applicant should be asked to submit this information, and that further consideration of the application be held in abeyance until the information is received.

Arthur P. Butler, Jr.

Arthur P. Butler, Jr.

Enclosure

DEPARTMENT OF THE INTERIOR
Defense Minerals Administration

FEB 2 . 1952

Ernest Wm. Ellis, Uranium Commodity Committee
Member, DMEA

February 14, 1952

A. P. Butler, Jr., Uranium Commodity Committee
Member, USAE

DMEA Docket 2336, Consolidated Caribou Silver Mines,
Applicant - Caribou Mine.

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Arthur P. Butler, Jr.

Enclosure

Copy to-E.Wm.Ellis- 2
Dir. Reading
Div. Files
Min. Dep.
APButler, Jr.-am 2-14-52
File: DMEA Applicant
DMEA Docket
ARU Reading
TEPCO Reading

Re: Docket DMEA-2336 (Uranium)

Caribou Silver Mines

Boulder County, Colorado

In conversation with member of AEC he stated that radio activity below 1040 level at mine very small. Suggested writing to member of U. S. Geological Survey who did last work at mine:

Frank Moore
U. S. Geological Survey
Denver 14, Calif.

1/31/52 gla

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES
WASHINGTON 25, D. C.

January 30, 1952

Memorandum

To: Rare and Miscellaneous Metals Division
Defense Minerals Exploration Administration
Ernest Ellis
Room 4070

From: A. J. Kauffman, Jr.
Rare and Precious Metals Branch

Subject: DMEA Docket 2336, Consolidated Caribou Silver Mines, Inc., Boulder, Colorado

It is recommended that the subject application be sent to the Atomic Energy Commission for their consideration. Mr. J. O. Hostad of the AEC has a complete file on most of these uranium properties.

A. J. KAUFFMAN, JR.

Attachments: 3

FILE COPY
Surname:

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES
WASHINGTON 25, D. C.

January 30, 1952

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Defense Minerals Exploration Administration
Ernest Ellis
Room 4070

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A. J. KAUFFMAN, JR.

Attachments: 3

AJKauffman:svh
Copy to: Paul Zinner
Rare and Precious Metals Branch
A. J. Kauffman
√Files

EXPLORATION

Subject: 2336
Re: Exploration Loan
Caribou Mine
January 22, 1952

Mr. Donald M. Nelson, President
Consolidated Caribou Silver Mines, Inc.
1406 Pearl Street
Boulder, Colorado

My dear Mr. Nelson:

This will acknowledge receipt of your application dated January 7, 1952 for a loan under the Defense Production Act of 1950.

Your application was assigned Docket Number DMEA-2336 and referred to the Rare & Miscellaneous Metals Division.

Kindly refer to DMEA-2336 in any future correspondence relating to your application.

Sincerely yours,

ROBERT E. ADAMS

Robert E. Adams
Acting Administrative Officer

7862

OFFICE OF THE ADMINISTRATOR

DMEA-2336

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION
WASHINGTON 25, D. C.

224 New Customhouse
Denver 2, Colorado

DEPARTMENT OF THE INTERIOR
Defense Minerals Administration
RECEIVED
JAN 21 1952

January 18, 1952

Memorandum

To: Administrator, Defense Minerals Exploration Administration

From: Executive Officer, Field Team, DMEA, Region IV

Subject: Application for Docket and Control

Enclosed are the original and three copies of Form MF-103 and supporting data pertaining to the following application for Government assistance in exploration work, estimated to cost $261,750. The mineral concerned in the application is pitchblende.

Consolidated Caribou Silver Mines, Inc.
1406 Pearl Street, Boulder, Colorado
Mine Serialization Number, MS-2329
DMA Docket Number DMA-1887*

* A prior application by the above company under DMA Docket Number 1887, pertaining to an exploration project for Lead-Zinc was denied by the Supply Division under the date of August 24, 1951.

W. H. King
W. H. King for
J. H. East, Jr.

Enclosures

DMEA-2336

UNITED STATES
DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION
WASHINGTON 25, D. C.

224 New Customhouse
Denver 2, Colorado

January 18, 1952

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To: Administrator, Defense Minerals Exploration Administration

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W. H. King
W. H. King for
J. H. East, Jr.

Enclosures

Form MF-103
(Revised June 1951)

UNITED STATES DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION

Budget Bureau No. 42-R1035.1.

MF-103 Should Be Filed With General Technical Data Form MF-100

APPLICATION FOR AID FOR AN EXPLORATION PROJECT PURSUANT TO MINERAL ORDER 5, UNDER DEFENSE PRODUCTION ACT OF 1950

Not To Be Filled in by Applicant

Docket No. DMEA-2336 REVISED
Metal or Mineral
Date Received 4-4-52
Amount $
Participation (Government %)

DEPARTMENT OF THE INTERIOR
Defense Minerals Administration
APR 4 1952

Consolidated Caribou
Silver Mines, Inc.
1406 Pearl Street
Boulder, Colorado

Name and address of applicant

Date March 20, 1952

If you have already filed MF-100, give date filed Sept.19,1951, type of assistance requested Aid for an exploration project,

DMA Docket Number (if available) DMA - 1887
Serialization Number MS - 2359

Supplement to our Application for Aid dated January 7, 1952.

INSTRUCTIONS

Read Mineral Order 5, Regulations Governing Government Aid in Defense Projects, before completing this application. Submit four copies each, of the signed application form, General Technical Data Form MF-100, and answers to questions as specified, to Defense Minerals Administration, Department of the Interior, Washington 25, D. C., or to the nearest field executive office thereof, with your name and address on each sheet of the application and all accompanying papers. If you have previously filed MF-100, it is not necessary to file it again. However, you should indicate in space provided above the type of assistance previously applied for (loans, procurement contracts, etc.) and DMA Docket Number, if available. *When a question is inapplicable it should be so stated in the form.* Additional sheets should be attached in answering any questions or in supplying additional information. IF YOU CANNOT ANSWER A QUESTION, SO STATE.

1. (*a*) Give a description of the real property that will be in any way involved in the exploration project, including any existing mine or operating property.

   (*b*) If you are not the owner of the property, submit a copy of the lease, purchase option, or other agreements under which you are authorized to operate the property with each copy of your application.

   (*c*) Give the legal description of the exact parcel, plot, or area upon which the exploration is to be conducted.

   NOTE: (1) If both areas are the same, so state. The only obligation to repay the Government is from the net earnings from any commercial discovery made in the area specified in (*c*) above in which the exploration is to be conducted, and the expenditure of funds which may be charged as costs of the project must be limited to that area or to work necessary to perform the exploration in that area.

   (2) If applicant is not the owner of the property or if there are any liens or encumbrances against the property, copy of agreements of claimants, lienors, encumbrances, and lessors subordinating their interests in the property to the interest of the Government under the Exploration Project Contract will be required for attachment to the Contract.

2. (*a*) What metals or minerals do you expect to find?

   (*b*) Furnish statement of the geologic features of your property, giving type of ore deposit and reasons for expecting to find commercial ore bodies. Illustrate with maps or sketches. If you have a geologic or engineering report, or assay maps showing width and grade, please send them with application, stating whether or not you wish to have them returned.

The information requested in questions 3, 4, 5, 6, 7, 8, and 9 below should be answered specifically and in detail, as this information will be attached to and incorporated as part of the Exploration Project Contract, if such contract is entered into with you by the Government.

ANSWER EACH QUESTION ON SEPARATE SHEETS OF PAPER AND SUBMIT A COPY OF EACH ANSWER FOR EACH COPY OF YOUR APPLICATION.

3. (*a*) Describe fully the proposed work and give the total cost of the project.

   (*b*) State the time required to start the project and to complete it.

4. Submit a map or sketch of the property involved showing a plan (and cross section, if needed) of the present mine workings and the *location of the proposed exploration work* as related to geologic features, such as contacts, veins, ore-bearing beds, etc.

5. Furnish an itemized list of existing facilities, buildings, installations, and fixtures with a statement of the cost of any necessary rehabilitation or repairs to put into useful and operable condition.

6. Furnish a detailed list of additional facilities, buildings, and fixtures to be purchased, installed, or erected by you, with the estimated cost of each item.

7. Furnish a detailed list of operating equipment, separated into items to be—

   (*a*) Rented

   (*b*) Purchased

   (*c*) Furnished by you

   with the rental, purchase price, or depreciation of each item, as the case may be, to be charged as a cost of the project.

8. Furnish an itemized schedule of labor, by numbers and classes (miners, muckers, etc.) and of supervisors by numbers and positions, with the maximum wages or salaries to be paid to each.

9. Furnish a detailed list with estimated cost of each item for materials, supplies, engineering, assaying, accounting, power, water, utilities, and any other items not provided for above.

10. (*a*) How much are you prepared to invest in the proposed project?

    (*b*) Is this amount sufficient to pay your part of the cost of the project, in accordance with the regulations on Government participation (Sec. 9 of MO–5)?

11. State any conditions or circumstances regarding the property not sufficiently brought out by the foregoing questions.

CERTIFICATION

The undersigned company, and the official executing this certification on its behalf, hereby certify that the information contained in this form and accompanying papers is correct and complete to the best of their knowledge and belief.

Consolidated Caribou Silver Mines, Inc.
(Name of company)

By Donald M. Nelson
(Signature of authorized official)

Donald M. Nelson

March 20, 1952
(Date)

President
(Title)

Title 18, U. S. Code (Crimes), Section 1001, makes it a criminal offense to make a willfully false statement or representation to any department or agency of the United States as to any matter within its jurisdiction.

U. S. GOVERNMENT PRINTING OFFICE 16—64067-2

March 20, 1952

Defense Minerals Exploration Administration
Rare and Misc. Metals Division
Washington 25, D. C.

Gentlemen:

With reference to our Application dated January 7, 1952, in which we applied for aid to explore horizons below the 1040 level of the Caribou Mine for uranium, we wish to supplement said application by conducting a diamond drilling program on the 1040 level, preliminary to carrying out the sinking, crosscutting, raising and drilling program as proposed in our original application, to test the Radium and No Name veins at various depths below the 1040 level.

We herewith enclose a plan of the 1040 level of the Caribou Mine showing proposed locations of holes totaling 20,000 feet. The inclination, depth and objectives of the proposed holes are tabulated as follows:

Drill Station	Hole No.	Dip	Depth (Feet)	Objective Depth below 1040 Level: No Name Vein	Objective Depth below 1040 Level: Radium Vein
1	1040-33	-62	700	500	
1	1040-34	-46	550	350	
1	1040-35	-62	750	500	
1	1040-36	-46	600	350	
1	1040-37	-62	800	500	
1	1040-38	-46	650	350	
2	1040-39	0	700	Exploratory	
2	1040-40	0	700	Exploratory	
3	1040-41	-30	450	200	
3	1040-42	-50	500	350	
3	1040-43	-65	650	550	
3	1040-44	-30	450	200	
3	1040-45	-50	500	350	
3	1040-46	-65	650	550	
3	1040-47	0	700	Exploratory	
3	1040-48	-30 or -430	650	Exploratory	

CONSOLIDATED CARIBOU
SILVER MINES, INC.
DENVER, COLO.

(Continued)

Drill Station	Hole No.	Dip	Depth (Feet)	Objective Depth below 1040 Level: No Name Vein	Objective Depth below 1040 Level: Radium Vein
4	1040-49	-32	300	135	
4	1040-50	-52	400	270	
4	1040-51	-27	300	135	
4	1040-52	-46	425	270	
4	1040-53	-27	300	135	
4	1040-54	-46	425	270	
5	1040-55	-44	650	165	270
5	1040-56	-53	800	210	550
5	1040-57	-40	650	140	350
5	1040-58	-47	800	180	460
5	1040-59	-40	650	140	350
5	1040-60	-47	800	180	460
5	1040-61	0	700	Exploratory	
5	1040-62	0	700	Exploratory	
5	1040-63	0	700	Exploratory	
5	1040-64	0	700	Exploratory	
5	1040-65	0	700	Exploratory	
	Total		20,000		

The following drifting and crosscutting are proposed to establish drill stations 3, 4 and 5:

Station No. 3 - Drift northeast from 1040-D8 on vein a distance of 110 feet.

Station No. 4 - Extend 1040-D1 northeast a distance of 180 feet along the No Name vein.

Station No. 5 - Crosscut due north from Station No. 4 a distance of 205 feet.

Total drifting and crosscutting: 495 feet.

Estimated time: Drifting and crosscutting can proceed while drilling begins in Stations 1, 2 and 3. Hence, assuming two machines operating on two shifts per day, estimated time is four months.

Estimated cost:

Drifting and crosscutting 495 feet @ $30.00/ft.	$ 14,850
Diamond drilling 20,000 feet @ $6.00/ft.	120,000
Total cost of program preliminary to sinking	$ 134,850

(Continued on page 3)

CONSOLIDATED GOLDFIELD
SILVER MINES, INC.
DENVER, COLO.

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(Continued)

Total cost of program preliminary to sinking	$ 134,850
Cost of original sinking program	261,750
Total cost of combined programs	$ 396,600

It is understood that, if results obtained prior to completion of the preliminary program warrant the sinking program, then the preliminary program may be curtailed or discontinued in favor of an immediate beginning of the sinking program.

Yours very truly,

CONSOLIDATED CARIBOU
SILVER MINES, INC.

Donald M. Nelson

Donald M. Nelson, President

CONSOLIDATED CARIBOU
SILVER MINES, INC.
DENVER, COLO.

MINERALOGY OF THE RADIUM VEIN

Collection of Samples and Methods of Analysis

Samples of the vein filling were collected at three places in the raise along the Radium Vein. A number of additional specimens of high grade uraninite ore were donated by Mr. Elmer Hetzer, Mine Superintendent at Caribou, and several large high grade specimens were loaned for this study by the A.E.C. All of the loaned specimens were taken near the foot of the raise on the 1040 foot level.

Eight polished surfaces of the ore were obtained and studied with the reflecting microscope. The study yielded data on the physical properties of the uraninite, its relations with other vein minerals and the paragenesis of the vein filling. Thin sections of the ore aided the study of relations of the ore minerals to the gangue and wall rock minerals. X-ray diffraction photographs of the uraninite were made, but a pattern sufficiently good for an accurate computation of the lattice constant has not yet been obtained.

General Statement

The ore minerals recognized in the polished surface study are uraninite, pyrite, chalcopyrite, sphalerite, galena, argentite, ruby silver, and native silver. Gangue minerals represented are quartz, carbonate and barite. The existence of two characteristic assemblages of ore minerals suggests two stages in the vein formation. In Stage A, which is thought to be the earlier, quartz, sphalerite and galena were deposited. Uraninite was deposited early in Stage B. The other minerals of this stage are chalcedony, chalcopyrite, sphalerite, argentite, ruby silver, and native silver.

Uraninite

Two varieties of uraninite occur in the Caribou ore. One of these is a dense, hard, black material with pitchy luster, while the other is a soft, fine-grained, dull-lustered, porous material which coats fractures and open vugs, and in some places appears to grade into the lustrous material. The hard variety shows varying degrees of luster and hardness. Both varieties contain inclusions of pyrite and lesser amounts of other sulphides. Under the microscope the lustrous uraninite almost always shows the colloform structure which characterizes the material described from other localities, as Great Bear Lake,[1] Joachimsthal,[2] and Katanga.[3] Radially arranged fractures, some filled with pyrite, are common in the botryoidal material. Although the hardness of uraninite is given as 5 1/2, even the "hard" variety of Caribou uraninite can be scratched (with difficulty), suggesting that this material has undergone oxidation since its deposition.

1. Kidd, D. F., and Haycock, M. H., Mineragraphy of the Ores of Great Bear Lake, G.S.A. Bull., Vol. 46, 1935, pp. 879-960.
2. Zuckert, R., Die Paragenesen von Gediegen Silber und Wismut mit Kobelb-Nickel-Kiesen und der Uranpechblende zu Sb. Joachimethel, English Abstract in G.S.A. Bull., Vol. 46, 1935, pp. 942-943.
3. Thoreau, J., and Trieu de Terdonck, R. du, Le Gîte d'uranium de Shinkolowbe-Kasolo, English Abstract in G.S.A. Bull., Vol. 46, 1935, pp. 941-42.

CONSOLIDATED CARIBOU
SILVER MINES, LTD.
BOULDER, COLO.

Exhibit B

EXHIBIT A

Radioactivity

at the Caribou Silver Mine, Boulder County, Colorado

by G. Carman Ridland

A program of exploration for radioactive deposits, conducted in 1945 in the well-known mineralized areas of the Front Range, Colorado, was rewarded with the discovery of pitchblende in a dump at Caribou Hill. The presence of pitchblende in the silver veins at depth apparently is not expressed as gamma-ray anomalies at the surface.

Introduction

Front Range, Colorado: The majority of the rocks comprising the Front Range of Colorado are pre-Cambrian schists, gneisses, and intrusives which have been elevated to form part of the Southern Rocky Mountain physiographic province. The region is noted mainly for its production of gold and silver, but ores of tungsten, fluorspar, uranium, copper, and iron have been worked. Geological literature[1-4] describes pitchblende and other radioactive minerals occurring at Jamestown, Boulder County; Central City, Gilpin County; and Lawson, Clear Creek County (fig. 1). These three adjoining counties cover most of the highly mineralized section of the Front Range which extends from Jamestown to Breckenridge. As far as the writer is aware, uranium has been found only in the portion northeast of Lawson.

G. CARMAN RIDLAND, Member AIME, is a Consulting Geological Engineer, New York, N. Y.

San Francisco Meeting, February 1949.

TP 2738 IL. Discussion of this paper (2 copies) may be sent to Transactions *AIME before Feb. 28, 1950. Manuscript received March 30, 1949.*

Silver Deposits at Caribou Hill: The historic silver deposits of Caribou Hill, located approximately half way between Jamestown and Central City, and 35 miles in a straight line northwest of Denver, appeared particularly intriguing as an area to prospect for uranium for the following reasons: here exists an isolated group of high-grade silver veins in the center of a mining district containing occurrences of uranium, and, in two of the well-known uranium deposits of the world, those at Great Bear Lake, Canada, and Joachimsthal, Czechoslovakia, uranium is associated with silver in similar fissure veins. An exploration program, conducted in the spring of 1945, directed special attention to Caribou Hill and was rewarded with the discovery of heavy, canary-yellow stained specimens of pitchblende.

The veins are confined to shear zones cutting a north-south, elongated quartz-monzonite stock of Tertiary (?) age lying in the axis of a major anticline of the Idaho Springs biotite schist, the oldest pre-Cambrian formation in the district. The stock is one and three-quarter miles long by more than a mile wide, and Caribou Hill is approximately at its center.

The ore zones vary in width from a few inches to 15 ft, and one structure has been traced for a length of over 4000 ft. The ore minerals are galena, sphalerite, ruby silver, native silver, chalcopyrite, pyrite, and pitchblende. They occur most common-

Exhibit A

CONSOLIDATED CARIBOU
SILVER MINES, INC.
BOULDER, COLO.

Where X = tons per hour original feed.
Y = tons per hour classifier sand.
a = percentage of minus 100 mesh in ball mill discharge.
b = percentage of minus 100 mesh in classifier overflow.
c = percentage of minus 100 mesh in classifier sand.

Ball Loads: No. 10 unit was charged with 75,000 lb of balls at the beginning of the test and an effort was made to keep mill amperage constant. This met with some success, but on several occasions, by inspection, ball level was found to have dropped. For the last month's test, the consumption figure for the preceding months was used as a guide in adding balls, and this resulted in a very steady ball load. From the average level, as measured when the mill was down, it was calculated that the average load was 72,000 lb.

Power Figures: The power meter on No. 10 unit was read every morning at 7 a.m. and the power consumed for the preceding day calculated. The month's figures, the sum of these daily power figures, corrected for meter error, were used for the No. 10 mill. For the mills No. 1 to 9, the monthly power figures as provided by the Electrical Department were used. This figure was obtained by monthly meter readings, instead of daily, and was subjected to meter error correction.

Screen Analysis of Ball Mill Feed: A typical screen analysis of coarse heads (feed to all ball mills) is given in Table I.

Table I. Screen Analysis of Coarse Heads

Screen Size		Per Cent
Plus	0.525 in.	0.4
	0.371 in.	9.8
	3 Mesh	15.2
	4	8.3
	6	8.6
	8	5.8
	10	8.9
	14	5.5
	20	4.5
	28	4.3
	35	5.0
	48	2.9
	65	2.9
	100	4.7
	150	2.4
	200	2.3
	325	1.7
Minus	325	6.8
		100.0

Duration of Test: The investigation was carried out over a period of seven months, from June to December, 1942, inclusive. The September test is not included because of the time down for lining the No. 10 mill, and changing the drive motor. Tests for June, July, and August are thought to be less accurate as regards power figures than those for October, November, and December, because during the former months it was discovered that the No. 10 ball mill motor was somewhat defective. The summary of the test is, therefore, split into two halves in Table II and III.

Table II. Summary of Test

	June July August		Oct. Nov. Dec.	
	Mills No. 1 to 9	Mill No. 10	Mills No. 1 to 9	Mill No. 10
Horsepower	385	463	379	450
Per cent —200 mesh in classifier overflow	50.55	52.44	52.46	52.03
Dry tons per ball mill hour	31.85	35.48	31.68	37.55
New tons —200 mesh per ball mill hour	13.04	15.20	14.00	16.32
Kw-hr per dry ton milled	9.00	9.74	8.92	8.92
Kw hr per ton—200 mesh produced	22.04	22.78	20.32	20.55
Grinding balls used in lb per ton	2.88	3.68	2.78	3.53
Liners (gross) used in lb per ton	0.43	0.63	0.43	0.63

Table III. Screen Analysis of F. X. Classifier Overflows

	June July August		Oct. Nov. Dec.	
Mesh	Mills No. 1 to 9	Mill No. 10	Mills No. 1 to 9	Mill No. 10
Plus 65	6.0	4.5	6.4	5.0
100	14.1	12.9	13.3	13.9
150	15.3	15.3	14.3	15.1
200	13.8	14.3	13.8	14.3
325	9.6	10.1	9.5	9.8
Minus 325	41.2	42.9	42.7	41.9
	100.0	100.0	100.0	100.0

	Conical Trunnion Overflow	Cylindrical Grate
Average per cent solids in F. X. Classifier Overflow	24.7	21.9
Average circulating load, per cent	420.0	460.0
Ball load in mills in short tons	36.0	36.0

Observation: (1) To obtain a comparable grind it was necessary to overflow the F.X. Classifier at 2 to 3 pct less solids with the cylindrical grate mill than with the conical trunnion overflow mills.

(2) There appeared to be little difference with regard to ease of operation. Overloads on the conical trunnion overflow mills were reflected immediately in the sand load on the classifier, whereas the cylindrical grate mill overloaded internally. This condition was indicated by a drop in amperage and a definite decrease in mill noise.

(3) From the maintenance point of view, the cylindrical grate mill was much more difficult to inspect, and required more time to reline.

Conclusions: (1) The cylindrical grate mill with a ball load of 72,000 lb had a one sixth greater grinding capacity than a conical trunnion overflow mill with the same tonnage of balls, on Mufulira ore.

(2) Consumption of grinding balls was 27 pct greater for equal tonnage ground in the cylindrical grate mill.

(3) Consumption of liner steel at 0.63 lb per ton (gross) was 32 pct higher than for the conical trunnion overflow at 0.43 lb per ton (gross).

(4) In terms of power cost per ton of finished product produced, the cylindrical grate mill required from 1 to 3 pct more power than the conical trunnion overflow, on Mufulira ore.

(5) The cylindrical grate mill produced about 2 pct less oversize (plus 100 mesh) than the conical trunnion overflow, because the classifier was run at a lower density, but at equal densities the cylindrical grate grind was inferior to the conical trunnion overflow.

(6) Work done by either type of mill was directly proportional to power input.

(7) Considering power costs approximately equal, the cylindrical grate ball mill produced more finished product at the expense of considerably more steel consumption.

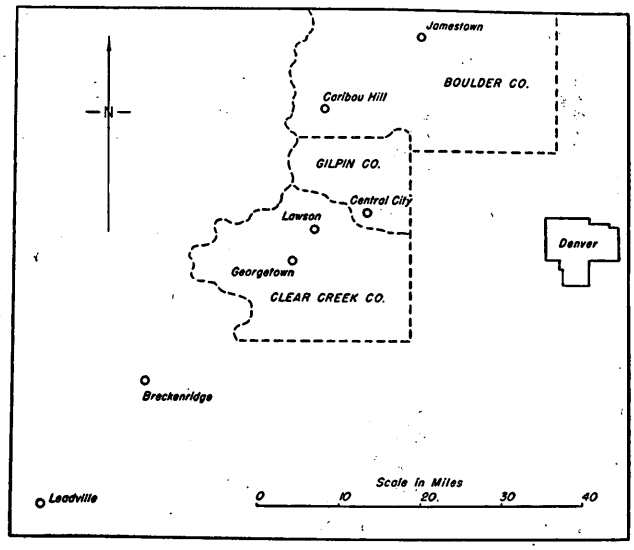

Fig. 1—Index map showing position of some of the major mining districts of the Front Range relative to Denver, Colo.

ly, finely and inconspicuously disseminated in vein matter or in the adjacent altered monzonite. Gangue minerals are mostly quartz, various colored carbonates, barite, some fluorite, and clay minerals that are the alteration products of feldspar and biotite of the wall rock.

An investigation of the mining properties of Caribou Hill resulted in the consolidation of the old Caribou mine property and other, adjacent properties believed to be important. In 1947, the Consolidated Caribou Silver Mines, Inc., began the rehabilitation of the old mine workings.

Geiger-Müller Survey

The surface of Caribou Hill and particularly the outcrops of the major ore-bearing structures were traversed with a Geiger-Müller counter sensitive to gamma radiation. As the Caribou mine was unwatered, the accessible levels and stopes were thoroughly traversed with the instrument. At intervals of from 50 to 100 ft, or wherever radioactivity was suspected, Geiger-Müller counts were recorded. The counts were taken for periods of from one to ten minutes and expressed as the average number of impulses per minute.

Explanation: Experience has shown that the count for the instrument used may fluctuate from ½ to 1½ times the average rate and still be in no way influenced by any near concentration of radioactive material. Hence, any count between 10 and 29 per minute was considered in the normal (N) range; from 30 to 47, in the twice normal or $2N$ range; from 48 to 66, in the $3N$ range, and so on. If an average count of below 10 was obtained, it was considered below normal and designated $N/2$. Experience has further shown that, if a radioactive element is present in sufficient quantity to be seen in its mineral form, or to be detected by ordinary chemical analysis, the count, at the place of exposure, is likely to be $5N$ or higher.

Normal (or Negative) Activity: The surface (except part of the Caribou dump) and most of the levels registered no above-normal radioactivity.

Below-normal Activity: On the 300 level a reading of 8 was obtained on one of the veins but, at this time, no particular significance is attached to this phenomenon.

Above-normal Activity: Four levels produced counts registering above-normal radioactivity, and the profiles of the gamma-ray intensities of these levels are illustrated in fig. 2. A single count at an isolated place on the 360 level ran 34, or 5 above the limit of the normal range. A group of counts taken on the 530 level ran 27, 18, 39, 24, 22, 38, 28, 36, 25, and 25 over a length of 220 ft. This is undoubtedly an anomaly, but too mild to indicate a concentration

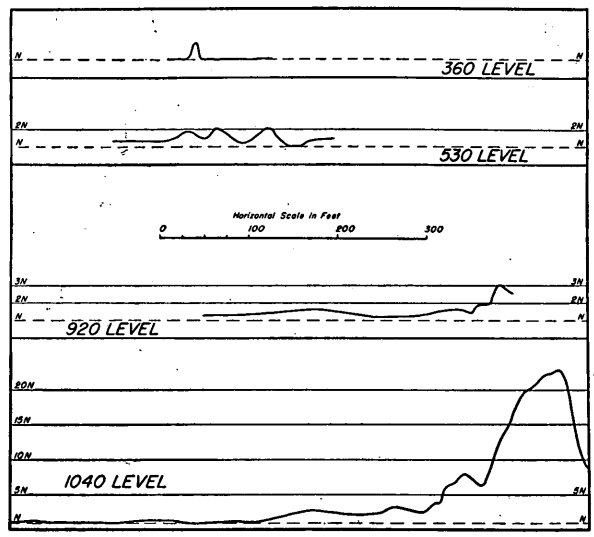

Fig. 2—Profiles of the gamma-ray intensities on the 360, 530, 920 and 1040 levels of the Caribou Mine.

The horizontal scale is in feet and is shown on the diagram. The vertical scales are the gamma-ray intensities expressed in the number of counts over the normal, background count of the country rock. The broken line marked N represents normal intensity.

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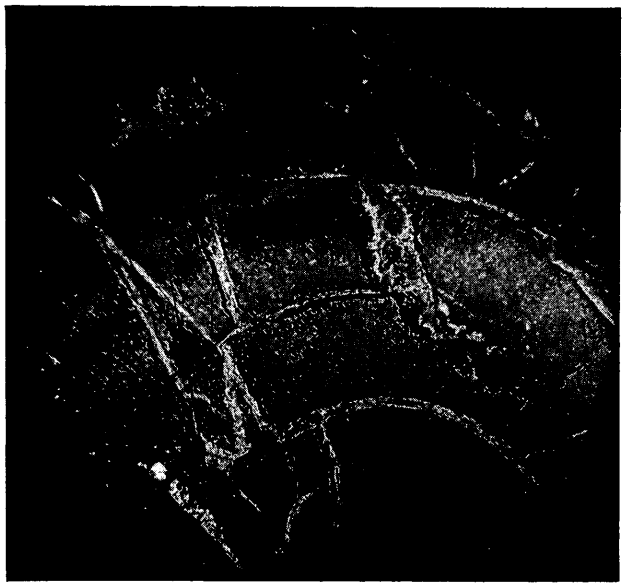

Fig. 3 — Low magnification micrograph of soft, black, colloform radioactive substance from the 1040 level of the Caribou mine. X17.

The light gray veins are proustite and sphalerite, each containing blebs of chalcopyrite.

of radioactive material that could be seen or detected by ordinary chemical analysis. The average count on the 920 level is noticeably higher than on any of the upper levels, and at the northeast end of the drift it begins to climb abruptly to 3*N*. The 1040 level is normal in gamma-ray activity except for the northeast 350 ft. The intensity of this anomaly is sufficient to indicate that a radioactive mineral is exposed along approximately 100 ft of this drift.

Description of Occurrence

Ore Body of the 1040 Level: At the northeast end of the 1040 level, channel samples, taken at 10 ft intervals, reveal an ore body 350 ft long with an average width of 4.08 ft and an average grade of 0.061 oz per ton gold, 18.96 oz per ton silver and 1.76 pct lead. It follows a northeast trending structure for 220 ft, then turns off to the east along a subsidiary east-west fracture for the remaining 130 ft. The ore varies from one to nine feet in width and is a siliceous- and carbonaceous-vein filling containing, in places, galena, sphalerite, and a little pyrite. In the east-west section, pitchblende and ruby silver are also visible. The pitchblende occurs in a continuous, black seam 1 to 16 in. wide which begins 45 ft southwest of the junction of the northeast and subsidiary structures and follows the footwall of the ore to the junction, then the center of the east-west striking vein for an additional 110 ft. This black material is radioactive and intensely so at places. It is friable and has an earthy luster and readily stains the fingers when handled. Veinlets of an easily shattered, black, vitreous, colloform pitchblende form part of the dark streak, and galena, sphalerite, ruby silver, and colloform pyrite also may be identified by hand lense.

Radioactive Ore under Low Power Magnification: A microscopic view of a polished section of the black material, viewed in reflected light under low power magnification, shows pitchblende and coarsely crystallized galena, sphalerite, and proustite. Chalcopyrite is present as small exsolution blebs in sphalerite and proustite and also in places independent of these minerals. Most of the section, however, is composed of a conspicuous, impure, gray colloform substance (fig. 3) resembling pitchblende in microscopic appearance, but too soft to be pitchblende. It has a sort of ground mass relationship to the more coarsely crystallized minerals. A radiograph of this section (fig. 4) shows it to be less radioactive than pure pitchblende, but does show that it contains, in places, blebs of a strongly

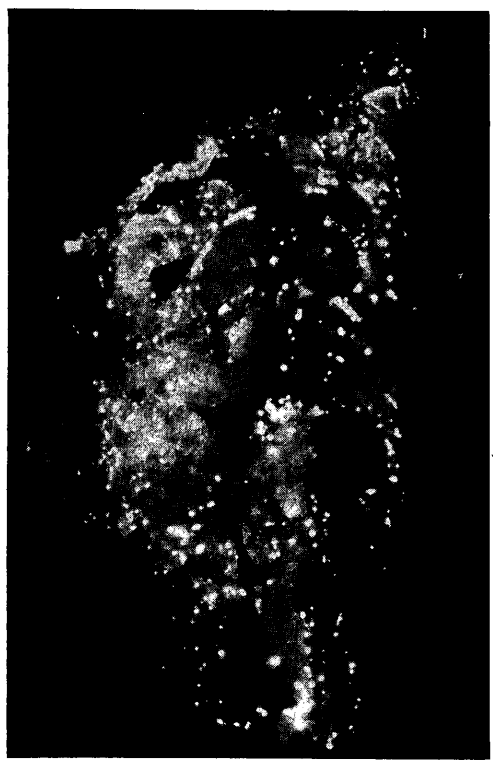

Fig. 4—Radiograph of polished section, part of which is shown in fig. 3 and fig. 5. X4.

The white areas are strongly radioactive, relatively pure pitchblende blebs. The dark gray area is the moderately radioactive, colloform substance. The black areas of the specimen are areas where radioactivity is negative.

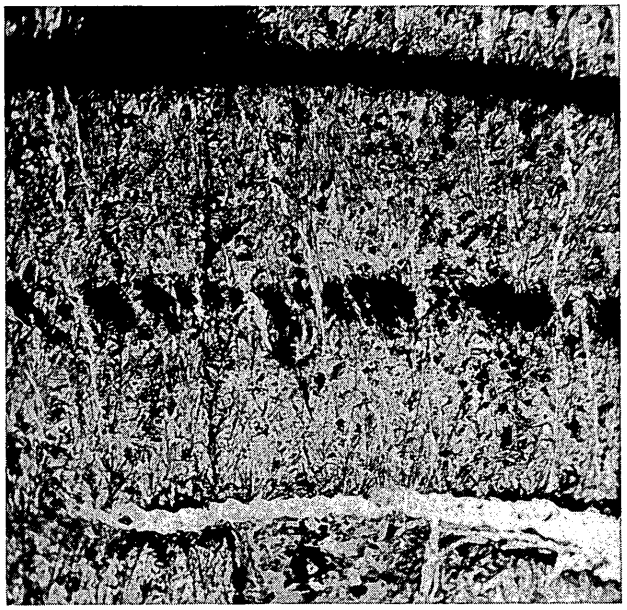

Fig. 5 — High magnification micrograph of the colloform substance shown in fig. 3. Oil emersion. X170.

radioactive mineral which has the physical, chemical, and radioactive properties of pitchblende.

Radioactive Ore under High Power Magnification: High power magnification of the colloform mixture (fig. 5) reveals an intimate mixture of a silver-white mineral and a dark gray mineral. The latter is believed to be pitchblende because of its color, habit, and reaction to reagents. The white-colored mineral is deeply etched by potassium cyanide and, when so etched and examined under high power magnification, it exhibits a deep red internal reflection. Hence, this second component is apparently a ruby silver and probably proustite which is present elsewhere in the polished section.

Conclusions

The study of the radioactivity on the surface and within the Caribou mine brings to light three observations of possible interest to those using the Geiger-Müller counter in the search for pitchblende-bearing veins.

1. The surface survey failed to detect any evidence of above normal gamma-ray intensity over the country rock or along the outcrops of the veins, and, if the Caribou mine workings had not reached a depth of 1040 ft and pitchblende discovered on the Caribou dump, the pitchblende occurrence may never have been detected.

2. On the 1040 level, as the Geiger-Müller counter was moved along the drift toward the radioactive ore body, it first registered the anomaly at a distance of approximately 160 ft from the point where the nearest channel sample returned a value for uranium (fig. 2, 1040 level profile). The writer does not believe that the intensity at this location is due to radiation penetrating the full 160 ft; it is more likely due to the result of local radiation emanating from trace amounts of a radioactive element, or elements, in the vein within 5 ft or less of the instrument.

3. Both on the surface and underground, the quartz-monzonite host rock was found to possess a normal gamma-ray count. This observation is in direct contradiction to results obtained from similar studies[5] made by the writer in the Great Bear Lake Area, N.W.T., Canada, where the host rocks of the silver-pitchblende veins were found to be approximately one and one-half times as radioactive as the adjacent, nonhost formations. Hence, the prospector in search of radioactive deposits may reason that, from the results obtained at Caribou Hill, he need not confine his attention to formations possessing higher-than-average gamma radiation.

Acknowledgment

The writer is extremely grateful to Mr. Boris Pregel, President of Consolidated Caribou Silver Mines, Inc., for making possible the original program of exploration of the Front Range uranium areas in 1945, the subsequent geological and geophysical studies of the Caribou mine, and, finally, the preparation and reading of this paper. The writer is also grateful to Mr. Elmer Hetzer, Mine Superintendent, for his cooperation and assistance with the field work.

The polished sections, micrographs, radiograph, and microscopic studies were made in the geological laboratories of Princeton University. The writer wishes to thank Professor Edward Sampson and the Department of Geology for the use of its laboratory facilities in the preparation of this report.

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[1] Edson S. Bastin and James M. Hill: Gilpin County and Adjacent Parts of Clear Creek and Boulder Counties, Colorado. U. S. Geol. Sur. *Prof. Paper* 94 (1917) 123-125.

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[3] Percy R. Alsdorf: Occurrence, Geology, and Economic Value of the Pitchblende Deposits of Gilpin County, Colorado. *Econ. Geol.* (1916) **11**, 3.

[4] E. N. Goddard: Fluorspar Deposits of the Jamestown District, Boulder County, Colorado. *Proc.* Colo. Scientific Society (1946) **15**, 1, 19.

[5] G. Carman Ridland: Use of the Geiger-Müller Counter in the Search for Pitchblende-bearing Veins at Great Bear Lake, Canada. *Trans.* AIME (1945) **164**, 117.

CONSOLIDATED CARIBOU SILVER MINES, INC. BOULDER, COLO.

Cyclone Thickener

Applications in the Coal Industry

by M. G. Driessen and H. E. Criner

Possible applications of cyclone thickeners for: (1) clarification of the washery water and, (2) recovery of fine coal from the plant bleed. The paper shows: (1) that it is possible to remove all particles including the very finest, from the circulating water, thus obtaining a closed water system and, (2) that reduction of the ash content of the solids of the plant bleed is feasible by means of cyclone thickeners. Performance data for different size cyclones is given in the form of graphs.

THE cyclone thickener has two important applications in wet washing plants: (1) water clarification, and (2) fine coal recovery.

The thickener consists of a conical chamber into which the fluid is injected through a tangential nozzle at the periphery of the large end. The solids of the slurry are concentrated and removed from the apex of the cone while the "thinner" portion is discharged from a central tube in a flat head at the large end, fig. 1. The advantages of the cyclone thickener are that large volumes of slurry may be treated with small space requirements and that the underflow concentration may be controlled easily and readily to meet varying feed conditions.

M. G. DRIESSEN, Member AIME, is a Consulting Engineer, Pittsburgh, Pa., and H. E. CRINER is Development Engineer, Heyl and Patterson.

New York Meeting, February 1950.

TP 2735 F. Discussion of this paper (2 copies) may be sent to Transactions *AIME before Feb. 28, 1950. Manuscript received June 29, 1949.*

Control of Washery Water Solids Concentration: The first requirement, in the process of controlling solids concentration, is that the solids be removed from the body of circulating water at the rate at which they are introduced. If this condition is satisfied the concentration will remain at a fixed value and will not increase to uncontrollable levels. The second requirement is that the solids concentration

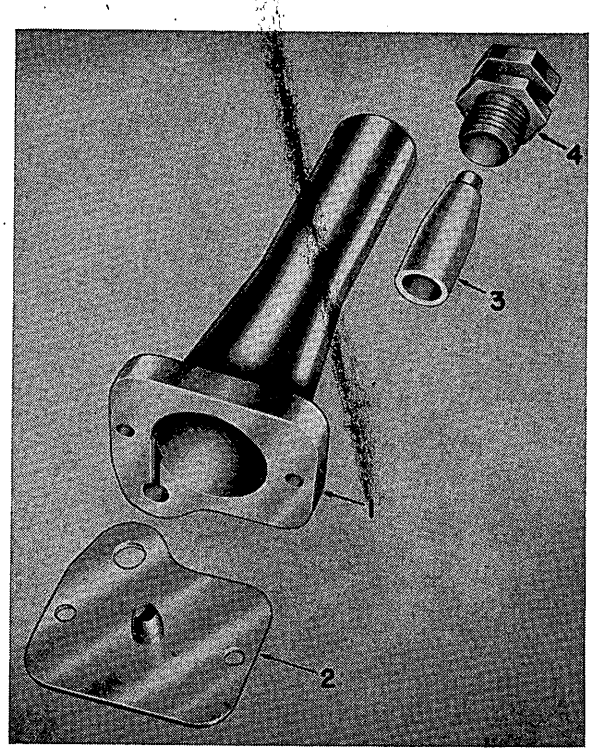

Fig. 1—A 3 in. rubber cyclone thickener.

1—Rubber cyclone body. 2—Cover with overflow opening. 3—Soft rubber orifice. 4—Nozzle retainer.

Form MF-103
(Revised June 1951)

UNITED STATES DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION

Budget Bureau No. 42-R1035.1.

MF-103 Should Be Filed With General Technical Data Form MF-100

APPLICATION FOR AID FOR AN EXPLORATION PROJECT PURSUANT TO MINERAL ORDER 5, UNDER DEFENSE PRODUCTION ACT OF 1950

Not To Be Filled in by Applicant

Docket No. DERE-2336 REVISED
Metal or Mineral
Date Received 4-4-52
Amount $
Participation (Government %)

DEPARTMENT OF THE INTERIOR
Defense Minerals Administration
RECEIVED
APR 4 1952

Consolidated Caribou
Silver Mines, Inc.
1406 Pearl Street
Boulder, Colorado

Name and address of applicant

Date March 20, 1952

If you have already filed MF-100, give date filed Sept. 19, 1951, type of assistance requested Aid for an exploration project,

DMA Docket Number (if available) DMA - 1887
Serialization Number MS - 2359

Supplement to our Application for Aid dated January 7, 1952.

INSTRUCTIONS

Read Mineral Order 5, Regulations Governing Government Aid in Defense Projects, before completing this application. Submit four copies each, of the signed application form, General Technical Data Form MF-100, and answers to questions as specified, to Defense Minerals Administration, Department of the Interior, Washington 25, D. C., or to the nearest field executive office thereof, with your name and address on each sheet of the application and all accompanying papers. If you have previously filed MF-100, it is not necessary to file it again. However, you should indicate in space provided above the type of assistance previously applied for (loans, procurement contracts, etc.) and DMA Docket Number, if available. *When a question is inapplicable it should be so stated in the form.* Additional sheets should be attached in answering any questions or in supplying additional information. IF YOU CANNOT ANSWER A QUESTION, SO STATE.

1. (*a*) Give a description of the real property that will be in any way involved in the exploration project, including any existing mine or operating property.

   (*b*) If you are not the owner of the property, submit a copy of the lease, purchase option, or other agreements under which you are authorized to operate the property with each copy of your application.

   (*c*) Give the legal description of the exact parcel, plot, or area upon which the exploration is to be conducted.

   NOTE: (1) If both areas are the same, so state. The only obligation to repay the Government is from the net earnings from any commercial discovery made in the area specified in (*c*) above in which the exploration is to be conducted, and the expenditure of funds which may be charged as costs of the project must be limited to that area or to work necessary to perform the exploration in that area.

   (2) If applicant is not the owner of the property or if there are any liens or encumbrances against the property, copy of agreements of claimants, lienors, encumbrances, and lessors subordinating their interests in the property to the interest of the Government under the Exploration Project Contract will be required for attachment to the Contract.

2. (*a*) What metals or minerals do you expect to find?

   (*b*) Furnish statement of the geologic features of your property, giving type of ore deposit and reasons for expecting to find commercial ore bodies. Illustrate with maps or sketches. If you have a geologic or engineering report, or assay maps showing width and grade, please send them with application, stating whether or not you wish to have them returned.

The information requested in questions 3, 4, 5, 6, 7, 8, and 9 below should be answered specifically and in detail, as this information will be attached to and incorporated as part of the Exploration Project Contract, if such contract is entered into with you by the Government.

ANSWER EACH QUESTION ON SEPARATE SHEETS OF PAPER AND SUBMIT A COPY OF EACH ANSWER FOR EACH COPY OF YOUR APPLICATION.

3. (*a*) Describe fully the proposed work and give the total cost of the project.

   (*b*) State the time required to start the project and to complete it.

4. Submit a map or sketch of the property involved showing a plan (and cross section, if needed) of the present mine workings and the *location of the proposed exploration work* as related to geologic features, such as contacts, veins, ore-bearing beds, etc.

5. Furnish an itemized list of existing facilities, buildings, installations, and fixtures with a statement of the cost of any necessary rehabilitation or repairs to put into useful and operable condition.

6. Furnish a detailed list of additional facilities, buildings, and fixtures to be purchased, installed, or erected by you, with the estimated cost of each item.

7. Furnish a detailed list of operating equipment, separated into items to be—

   (*a*) Rented

   (*b*) Purchased

   (*c*) Furnished by you

   with the rental, purchase price, or depreciation of each item, as the case may be, to be charged as a cost of the project.

8. Furnish an itemized schedule of labor, by numbers and classes (miners, muckers, etc.) and of supervisors by numbers and positions, with the maximum wages or salaries to be paid to each.

9. Furnish a detailed list with estimated cost of each item for materials, supplies, engineering, assaying, accounting, power, water, utilities, and any other items not provided for above.

10. (*a*) How much are you prepared to invest in the proposed project?

    (*b*) Is this amount sufficient to pay your part of the cost of the project, in accordance with the regulations on Government participation (Sec. 9 of MO–5)?

11. State any conditions or circumstances regarding the property not sufficiently brought out by the foregoing questions.

CERTIFICATION

The undersigned company, and the official executing this certification on its behalf, hereby certify that the information contained in this form and accompanying papers is correct and complete to the best of their knowledge and belief.

Consolidated Caribou Silver Mines, Inc.
(Name of company)

By Donald M. Nelson
(Signature of authorized official)
Donald M. Nelson

March 20, 1952
(Date)

President
(Title)

Title 18, U. S. Code (Crimes), Section 1001, makes it a criminal offense to make a willfully false statement or representation to any department or agency of the United States as to any matter within its jurisdiction.

U. S. GOVERNMENT PRINTING OFFICE 16—64067-2

CONSOLIDATED CARIBOU SILVER MINES, INC.
BOULDER, COLORADO
1406 PEARL STREET
PHONE OFFICE: BOULDER 521
PHONE MINE: NEDERLAND 517
PHONE MILL: NEDERLAND 453

March 20, 1952

Defense Minerals Exploration Administration
Rare and Misc. Metals Division
Washington 25, D. C.

Gentlemen:

With reference to our Application dated January 7, 1952, in which we applied for aid to explore horizons below the 1040 level of the Caribou Mine for uranium, we wish to supplement said application by conducting a diamond drilling program on the 1040 level, preliminary to carrying out the sinking, crosscutting, raising and drilling program as proposed in our original application, to test the Radium and No Name veins at various depths below the 1040 level.

We herewith enclose a plan of the 1040 level of the Caribou Mine showing proposed locations of holes totaling 20,000 feet. The inclination, depth and objectives of the proposed holes are tabulated as follows:

Drill Station	Hole No.	Dip	Depth (Feet)	Objective Depth below 1040 Level: No Name Vein	Objective Depth below 1040 Level: Radium Vein
1	1040-33	-62	700	500	
1	1040-34	-46	550	350	
1	1040-35	-62	750	500	
1	1040-36	-46	600	350	
1	1040-37	-62	800	500	
1	1040-38	-46	650	350	
2	1040-39	0	700	Exploratory	
2	1040-40	0	700	Exploratory	
3	1040-41	-30	450	200	
3	1040-42	-50	500	350	
3	1040-43	-65	650	550	
3	1040-44	-30	450	200	
3	1040-45	-50	500	350	
3	1040-46	-65	650	550	
3	1040-47	0	700	Exploratory	
3	1040-48	-30 or +30	650	Exploratory	

(Continued)

Drill Station	Hole No.	Dip	Depth (Feet)	Objective Depth below 1040 Level: No Name Vein	Objective Depth below 1040 Level: Radium Vein
4	1040-49	-32	300	135	
4	1040-50	-52	400	270	
4	1040-51	-27	300	135	
4	1040-52	-46	425	270	
4	1040-53	-27	300	135	
4	1040-54	-46	425	270	
5	1040-55	-44	650	165	270
5	1040-56	-53	800	210	550
5	1040-57	-40	650	140	350
5	1040-58	-47	800	180	460
5	1040-59	-40	650	140	350
5	1040-60	-47	800	180	460
5	1040-61	0	700	Exploratory	
5	1040-62	0	700	Exploratory	
5	1040-63	0	700	Exploratory	
5	1040-64	0	700	Exploratory	
5	1040-65	0	700	Exploratory	
	Total		20,000		

The following drifting and crosscutting are proposed to establish drill stations 3, 4 and 5:

Station No. 3 - Drift northeast from 1040-D8 on vein a distance of 110 feet.

Station No. 4 - Extend 1040-D1 northeast a distance of 180 feet along the No Name vein.

Station No. 5 - Crosscut due north from Station No. 4 a distance of 205 feet.

Total drifting and crosscutting: 495 feet.

Estimated time: Drifting and crosscutting can proceed while drilling begins in Stations 1, 2 and 3. Hence, assuming two machines operating on two shifts per day, estimated time is four months.

Estimated cost:

Drifting and crosscutting 495 feet @ $30.00/ft.	$ 14,850
Diamond drilling 20,000 feet @ $6.00/ft.	120,000
Total cost of program preliminary to sinking	$ 134,850

CONSOLIDATED CARBOO
SILVER MINES, INC.
BOULDER, COLO.

(Continued on page 3)

(Continued)

Total cost of program preliminary to sinking	$ 134,850
Cost of original sinking program	261,750
Total cost of combined programs	$ 396,600

It is understood that, if results obtained prior to completion of the preliminary program warrant the sinking program, then the preliminary program may be curtailed or discontinued in favor of an immediate beginning of the sinking program.

Yours very truly,

CONSOLIDATED CARIBOU
SILVER MINES, INC.

Donald M. Nelson

Donald M. Nelson, President

CONSOLIDATED CARIBOU
SILVER MINES, INC.
BOULDER, COLO.

Form MF-103
(Revised June 1951)

UNITED STATES DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION

Budget Bureau No. 42-R1035.1.

MF-103 Should Be Filed With General Technical Data Form MF-100

APPLICATION FOR AID FOR AN EXPLORATION PROJECT PURSUANT TO MINERAL ORDER 5, UNDER DEFENSE PRODUCTION ACT OF 1950

Not To Be Filled in by Applicant

Docket No. DMEA-2336
Metal or Mineral
Date Received 1-21-52
Amount $
Participation (Government %)

DEPARTMENT OF THE INTERIOR
Defense Minerals Administration
RECEIVED
JAN 22 1952

Name and address of applicant

Consolidated Caribou
Silver Mines, Inc.
1406 Pearl Street
Boulder, Colorado

Date January 7, 1952

If you have already filed MF-100, give date filed Sept. 19, 1951, type of assistance requested Aid for an exploration project.

DMA Docket Number (if available) DMA - 1887
Serialization Number DMS - 2359

INSTRUCTIONS

Read Mineral Order 5, Regulations Governing Government Aid in Defense Projects, before completing this application. Submit four copies each, of the signed application form, General Technical Data Form MF-100, and answers to questions as specified, to Defense Minerals Administration, Department of the Interior, Washington 25, D. C., or to the nearest field executive office thereof, with your name and address on each sheet of the application and all accompanying papers. If you have previously filed MF-100, it is not necessary to file it again. However, you should indicate in space provided above the type of assistance previously applied for (loans, procurement contracts, etc.) and DMA Docket Number, if available. *When a question is inapplicable it should be so stated in the form.* Additional sheets should be attached in answering any questions or in supplying additional information. IF YOU CANNOT ANSWER A QUESTION, SO STATE.

1. (*a*) Give a description of the real property that will be in any way involved in the exploration project, including any existing mine or operating property.

   (*b*) If you are not the owner of the property, submit a copy of the lease, purchase option, or other agreements under which you are authorized to operate the property with each copy of your application.

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3. (*a*) Describe fully the proposed work and give the total cost of the project.

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4. Submit a map or sketch of the property involved showing a plan (and cross section, if needed) of the present mine workings and the *location of the proposed exploration work* as related to geologic features, such as contacts, veins, ore-bearing beds, etc.

5. Furnish an itemized list of existing facilities, buildings, installations, and fixtures with a statement of the cost of any necessary rehabilitation or repairs to put into useful and operable condition.

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   (*c*) Furnished by you

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8. Furnish an itemized schedule of labor, by numbers and classes (miners, muckers, etc.) and of supervisors by numbers and positions, with the maximum wages or salaries to be paid to each.

9. Furnish a detailed list with estimated cost of each item for materials, supplies, engineering, assaying, accounting, power, water, utilities, and any other items not provided for above.

10. (*a*) How much are you prepared to invest in the proposed project?

    (*b*) Is this amount sufficient to pay your part of the cost of the project, in accordance with the regulations on Government participation (Sec. 9 of MO–5)?

11. State any conditions or circumstances regarding the property not sufficiently brought out by the foregoing questions.

CERTIFICATION

The undersigned company, and the official executing this certification on its behalf, hereby certify that the information contained in this form and accompanying papers is correct and complete to the best of their knowledge and belief.

Consolidated Caribou Silver Mines, Inc.
(Name of company)

By [signature]
(Signature of authorized official)
Donald M. Nelson

January 7, 1952
(Date)

President
(Title)

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U. S. GOVERNMENT PRINTING OFFICE 16—64067-2

DMA Form
MF - 103
Revised June, 1951

List of Exhibits

Exhibit A	"Radioactivity of the Caribou Mine" by G. C. Ridland.
Exhibit B	Page from "Mineralogical Studies of Uraninite...", U. S. Atomic Energy Commission, July 1, 1950.
Exhibit C	Assay Section "A", Caribou Mine.
Exhibit D	Assay Section D1, 1040 Level, Caribou Mine.
Exhibit E	Assay Plan, 1140 Level, Caribou Mine.
Exhibit F	Plan of 1040-D1 and 1040-D2, Caribou Mine.
Exhibit G	Assay Plan of 920 Level, Caribou Mine.
Exhibit H	Assay Section of 1040 Level, Sect. D., Caribou Mine.
Exhibit J	Plan and Vertical Projection Showing Proposed Uranium Exploration Program.

Note: Exhibits A and B attached at end of application.

Exhibits C through J in pocket.

CONSOLIDATED CAPITOL
SILVER MINES, INC.
BOULDER, COLO.

DMA Form
MF - 103
Revised June, 1951

APPLICATION FOR AID FOR AN
EXPLORATION PROJECT PURSUANT TO
MINERAL ORDER 5, UNDER
DEFENSE PRODUCTION ACT OF 1950

1. (a) Description of the real property, including the operating Caribou Mine

A legal description of the real property is given in 1. (c). The area to be explored consists of a part of the operating Caribou mine.

The Caribou mine consists of a three-compartment inclined shaft, reaching an inclined depth of 1040 feet, with an outside dimension of 5' X 15'. The shaft is equipped with an electric hoist at the 500 Level and is not in use above the 500 Level. Levels are established below the 500 Level at 530, 600 740, 800, 920, 980, and 1040. It is connected to the surface on the 500 Level by a 3,636-foot long transportation tunnel. This tunnel, called the Idaho Tunnel, is electrically lighted and equipped with 30-pound, 24-inch gauge railway track, a ditch to drain the water pumped from the Caribou shaft, and an adequate fleet of ore cars and storage battery locomotives.

The portal of the Idaho Tunnel is protected by a snow shed. Adjacent to the portal is a 72' X 28' building containing the compressor room, shop, storage and change room. Beyond the portal on the edge of the dump is a building housing a sorting belt and ore bins.

Compressed air is generated by 3 compressors driven by electric motors with a total of 250 H.P. furnishing 1600 c.f.m. at a pressure of 105 lbs. per sq. in. (Elevation approximately 10,000 feet.)

The property is also equipped with drills, accessories and small tools, trucks, etc.

CONSOLIDATED CARBON
COAL MINES, INC.
DENVER, COLO.

DMA Form
MF - 103
Revised June, 1951

1. (b) The applicant is the sole owner of the property and all equipment on the premises. Title to the property is insured.

1. (c) Legal description of area to be explored

Patented Claims

Name	U.S. Survey Lot Number
Caribou Lode	37
Kalamazoo Lode	76
No Name Lode	77
Federal Lode	91
Sherman Lode	93
Socorro Lode	104
Hidden Treasure Lode	105
Columbia Lode	167
Spencer Lode	168
Mon Pariel Lode	6853
Poorman Lode	42
Silver Dollar Lode	654
Carry Lode	660
California Lode	20483
North Park Lode	20483
Toledo Lode	20483

All located in Sections 5 and 8, T. 1S., R. 73 W. of the 6th P.M.

1. (c) Note (1) Areas referred to by 1. (a) and 1. (b) are the same.

1. (c) Note (2) The real and personal property owned by the company, constituting all of the fixed assets except certain furniture and fixtures, is subject to a deed of trust securing a note payable to a stockholder in the amount of $200,000.00.

2. (a) Pitchblende is the mineral expected to be found.

CONSOLIDATED CARIBOO
SILVER MINES, INC.
BOULDER, COLO.

DMA Form
MF - 103
Revised June, 1951

2. (b) Geological features

Introduction

In September, 1943, an extensive exploration program was undertaken for uranium deposits. One of the first steps in this program was to compile a list of published accounts of uranium deposits. The literature at that time made note of the occurence of pitchblende at several places in the Front Range of the Colorado Rocky Mountains. These occurrences lie in a region extending from Jamestown, Boulder County, Colorado, to Lawson, Clear Creek County, Colorado, a distance of 27 miles. This section of the Front Range is noted for its production of gold, silver, fluorspar, tungsten, copper, lead, and zinc, as well as uranium.

General Geology

A closer study of this region brought to light a silver mining district known as Caribou Hill where a group of mines are reported to have produced over $8,000,000 in silver, largely in the period between 1869 and 1894. The close association of pitchblende and silver is well-known. Geological literature usually refers to the ore-bearing veins at the well-known uranium districts of Great Bear Lake, Canada, and Joachimsthal, Czechoslovakia, as silver-pitchblende veins. Silver is also an important by-product in the production of uranium from the pitchblende deposits at Shinkolobwe, Belgian Congo.

After studying the regional geology of the Jamestown-Lawson area, it became apparent that the geological setting of the Caribou Hill district was most favorable for the occurrence of pitchblende. The majority of the rock-types of the region are metamorphosed sediments and granitic intrusives of pre-Cambrian age. The Caribou veins occur in a medium-grained quartz monzonite stock that is believed to be of Tertiary (?) age. The silver-pitchblende veins of the Contact mine at Great Bear Lake occur in a medium-grained granodiorite stock of approximately the same size, texture and mineral composition. The similarity of the geology of the two regions is striking. (The only noticeable difference is in the lack of nickel and cobalt mineralization at Caribou, which is prevalent at Great Bear Lake.

CONSOLIDATED CARIBOU
SILVER MINES, INC.
BOULDER, COLO.

2. (b) Geological features (Con't.)

The examination of the surface of the Caribou Hill area was rewarded with the discovery of pitchblende in vein material on the Caribou Mine Dump.

Caribou Pitchblende Deposits

The Caribou mine and much of the adjacent ground were acquired for the applicant, and, early in 1947, work began in rehabilitating and dewatering the old mine workings. As the water was lowered, a systematic search was made for pitchblende. The radioactivity of the old stopes and drifts was measured with a Geiger-Mueller counter. Normal activity was encountered on the surface and down to the 300 Level. On the 360 Level a small "high" was noted with a reading of almost twice the normal background. The 420, 470, and 500 Levels were negative. The 530 Level registered noticeably above the normal background, but not of sufficient intensity to expect a visible occurrence of pitchblende. The 600, 670, 740, 800, and 860 Levels were found to be negative again. The 920 Level gave a mildly higher count until almost to the northeast end of the drift. Here it jumped suddenly to 3 times the normal count.

Not until the bottom level of the mine was finally dewatered did the instrument detect intense radioactivity and did pitchblende make its appearance. The importance of this discourse is in the fact that radioactive anomalies were found at 360, 530, 920, and finally, at 1040 feet vertically below the surface in ever-increasing intensity. This logically leads one to consider the possibilities that pitchblende may be found in increasing concentration below the 1040 Level. Attached as Exhibit A is a copy of a more detailed account of the "Radioactivity of the Caribou Mine", by G. C. Ridland. (Mining Engineering, Vol. 187, January, 1950, A.I.M.E. Transactions).

Pitchblende occurs on the 1040 Level in a continuous black seam 1 to 16 inches wide which appears 45 feet southwest of the junction of the No Name and Radium veins, 1040 Level. The black streak follows the footwall of the ore to the junction, then the center of the Radium vein for an additional 110 feet. This black material is radioactive and intensely so at places. It is friable and has an earthy luster and readily stains the fingers when handled. Veinlets

CONSOLIDATED CANYON
SILVER MINES, INC.
DENVER, COLO.

2. (b) Geological features (Con't.)

of an easily shattered, black, vitreous, colloform pitchblende form part of the dark streak, and galena, sphalerite, ruby silver and colloform pyrite are also readily identifiable.

A detailed mineralogical description is given in a report by Harold D. Wright (Mineralogical Studies of Uraninite and Uraninite-bearing Deposits, July 1, 1949 - June 30, 1950; Raw Materials Operation, U. S. Atomic Energy Commission, P. O. Box 30, New York 23, New York, July 1, 1950), which reads in part as follows:

> "Two varieties of uraninite occur in the Caribou ore. One of these is a dense, hard black material with pitchy luster, while the other is a soft, fine-grained, dull-lustered, porous material which coats fractures and open vugs, and in some places appears to grade into the lustrous material. The hard variety shows varying degrees of luster and hardness. Both varieties contain inclusions of pyrite and lesser amounts of other sulphides. Under the microscope the lustrous uraninite almost always shows the colloform structure which characterizes the material described from other localities, as Great Bear Lake, Joachimsthal, and Katanga. Radially arranged fractures, some filled with pyrite, are common in the botryoidal material. Although the hardness of uraninite is given as 5½, even the "hard" variety of Caribou uraninite can be scratched (with difficulty), suggesting that this material has undergone oxidation since its deposition."

(A more complete photostat copy of the description is attached to this application as Exhibit B.)

The following table shows assay results of channel samples taken along the vein in this area. Please note that a 3-foot round was taken out of the back of the drift to freshen-up the exposure and some of the samples were taken 10 feet above the track instead of 7 feet (the original back). Also additional exploratory stoping raised the back to 17 feet above the track and samples from this horizon are also included. (See also Assay Section 1040 Level, Section D, Exhibit H.)

CONSOLIDATED CARIBOU
SILVER MINES, INC.
BOULDER, COLO.

DMA Form
MF - 103
Revised June, 1951

2. (b) Geological features (Con't.)

Sample No.	Approx. Distance from the Caribou Shaft (feet)	Distance above Track (feet)	Width (inches)	U_3O_8 %
1311	405	10	39	0.08
1322	407	10	18	0.34
448	410	7	72	Nil
1310	415	10	31	0.12
1321	417	10	18	0.30
447	420	7	72	Nil
1306	425	10	36	0.27
1320	425	10	18	0.14
440	428	7	4	Nil
439	432	7	12	Nil
1307	435	10	33	0.34
1319	435	10	18	0.24
438	437	7	14	Nil
1308	445	17	36	0.20
1318	445	17	18	0.34
437	450	7	10	Nil
1309	455	17	32	0.24
1317	455	17	18	0.38
1315	465	17	16	0.43
436	473	7	18	0.05
1268	480	10	4	0.34
1316	480	10	18	0.34
1301	480	17	35	0.24
1266	485	10	15	0.24
1457	490	7	12	0.37
1267	490	10	15	0.19
1302	490	17	36	0.19
1314	490	17	18	0.38
1269	495	10	8	0.52
1455	500	7	35	Nil
1271	500	10	16	7.58
1303	500	17	37	0.16
1313	500	17	24	3.15
1270	505	10	12	0.67
434	510	7	36	Nil
1304	510	17	36	0.54
1312	510	17	18	0.48
433	520	7	12	Nil
1305	520	17	36	0.68

CONSOLIDATED CARIBOU
MINES, INC.
BOULDER, COLO.

2. (b) Geological features (Con't.)

Subsequent Development of the Radioactive Occurrence

The applicant first drove a raise (1040-A) from the 1040 Level to the 920 Level (see Assay Section "A", Exhibit C) on the pitchblende-bearing ore. Pitchblende continued in important concentration in the raise for 43 feet above the 1040 Level. Channel samples in the raise show the following uranium values:

Sample No.	Distance above Track (feet)	Width (inches)	U_3O_8 %
1130	113	48	0.02
1340	101	48	0.08
1339	89	54	0.05
1338	80	50	0.06
1337	70	46	0.06
1335	59	43	0.07
1333	55	48	0.08
1329	47	48	0.06
1114	39	24	1.26
1107	27	48	0.02
1313	18	24	3.15
1303	15	37	0.16
1260	8	8	0.52

This raise was followed by the sinking of a winze almost directly below the raise to the 1140 Level (Assay Section "A", Exhibit C). The Radium and No Name veins were opened by 182 feet of drifting on the 1140 Level (See Assay Plan of the 1140 Level, Exhibit E). Uranium was encountered in the winze in commercial quantities to a depth of 22 feet below the 1040 Level and uranium values were encountered in the No Name vein, 1140-D1 drift.

Under contract with the U. S. Atomic Energy Commission, the applicant subsequently extended the 1040-D2 and 920-D2 drifts east on the Radium vein.

CONSOLIDATED CARBON
SILVER MINES, INC.
BOULDER, COLO

2. (b) Geological features (Con't.)

for distances of 350 and 260 feet, respectively, and both headings encountered pitchblende (Plan of 1040-D1 and D2, Exhibit F and Assay Plan of 920 Level, Exhibit G).

Finally, under contract with the U. S. Atomic Energy Commission, a second raise (558) was driven up 85 feet above track from the 1040 Level at a point 240 feet east of the 1040-A riase on the Radium vein and the following uranium values were obtained in channel samples (Assay Section D1, Exhibit D):

Distance above Track (feet)	Width (inches)	U_3O_8 %
83	10	0.08
78	8	0.17
70	10	0.34
64	9	0.05
55	10	0.75
40	16	0.10
18	12	0.96

In each of these projects, pitchblende has been encountered, and the zone in which it occurs in the Radium and No Name veins may now be said to extend vertically for 300 feet and horizontally for 360 feet. The continuous high-grade section at the 1040 Level may be said to have a proven horizontal length of 115 feet and a vertical distance of 65 feet, with a width varying from inches to 4 feet. A second continuous section of impertance appears to be developing in the 558 raise. It now has a vertical height of 83 feet and widths from 8 to 16 inches.

The Exploration Project

The applicant now desires to explore the Radium and No Name veins on newly-established 1290, 1440, and 1590 Levels at depths of 250, 400, and 550 feet, respectively (Exhibit J), below the 1040 Level (the bottom of the Caribou shaft). The reasons for expecting to find commercial occurrences of pitchblende are summarized here:

CONSOLIDATED CARIBOU
SILVER MINES, INC.
BOULDER, COLO.

2. (b) Geological features (Con't.)

1. The regional geological setting makes the Caribou Hill area a most logical place for the occurrence of uranium.

2. Pitchblende has been found in small commercial bodies in the Radium and No Name veins of the Caribou mine, and subsequent development on and above the 1140 Level has shown the deposits to occur over more extensive sections of the veins than to the extent of the original showings. The next, logical step is to explore the ground below the 1140 Level.

3. Pitchblende, the primary form of uranium deposition, theoretically, is deposited by hot, aqueous, ascending solutions. The occurrences on and above the 1140 Level of the Caribou mine have the characteristics of being the upper-most fringes of such upward extending depositions. Hence, larger, more highly concentrated uranium deposits reasonably may be expected below the bottom levels of the Caribou mine.

4. Each radioactive anomally, or radioactive occurrence, was found to be successively larger and more intense as depth is gained in the Caribou workings. Hence, at least to the 1040 Level, the radioactivity of the deposits is ever increasing.

5. In similar silver-pitchblende veins in other districts pitchblende has been found to improve with depth. Two examples may be cited:

a. At the Eldorado mine, Great Bear Lake, Canada, the No. 2 vein began at the surface with silver in preponderance, although pitchblende was present. Below the 500-foot level, the vein has produced almost no silver, whereas pitchblende ore bodies have been mined to more than 1,000 feet below the surface. In the No. 1 vein, little or no pitchblende is visible at the surface, yet the vein became the main producer below 1,000 feet in depth.

b. At the Werner mine, Joachimsthal, Czechoslovakia, pitchblende was encountered in only small quantities in the upper levels, below 262 meters it appeared in increasing quantities, and

CONSOLIDATED CARIBOU
SILVER MINES, INC.
BOULDER, COLO.

2. (b) Geoligical features (Con't.)

below 378 meters it became the only valuable constituent of the ore. Not only in the Werner mine, but in the district as a whole, uranium tends to increase with depth.

6. In two productive silver mines, as in the Caribou mine, pitchblende has been found in the lower levels. In the Sunshine mine, Coeur d'Alene District, Idaho, no trace of pitchblende was found until the 3100 Level (3100 feet below the surface) was reached. It is reported to occur in a zone between the 3100 and 3700 Levels. In the Jo Reynolds mine, Lawson, Colorado, pitchblende was not encountered until the area between the 900 and 1000 Levels was opened up (900 feet below the surface). The continuity and improvement with depth in these mines only will be determined as the workings are deepened, but the point of particular interest is that these silver mines, like Caribou, encountered pitchblende in their current lowest levels as their silver ores were followed downward. These mines may just be reaching zones containing workable deposits of uranium.

For these six reasons, the applicant believes the projected depth program of exploration is warranted. In 1948, the applicant's geologists, Dr. G. C. Ridland and Dr. E. H. Wahlstrom, recommended that the mine workings be deepened and Wahlstrom went so far as to warn that the future of the property depended on the extension of the development work below the 1040 Level.

(The applicant would appreciate the return of the attached assay maps when the DMA has no further use for them.)

CONSOLIDATED CARIBOU
SILVER MINES, INC.
BOULDER, COLO.

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3. (a) Proposed work and cost

Project	Cost ($)	Time (Months)
Sink Caribou shaft 600 feet from the 1040 Level to the 1640 Level. 600 feet @ $200/ft.....	$120,000	10
Cross-cut 100 feet from shaft to No Name vein on the 1290, 1440 and 1590 Levels, 300 feet @ $30/ft.....	9,000	2
Drift 100 feet NE on the No Name vein on the 1290, 1440, and 1590 Levels to the Radium vein intersection and continue an additional 100 feet, on the No Name vein. 600 feet @ $30/ft.....	18,000	2
Drift E 400 feet on the Radium vein on the 1290, 1440 and 1590 Levels. 1,200 feet @ $30/ft.....	36,000	5
Extend drift 150 feet on the No Name vein, 1590 Level, NE to establish a diamond drill station. 150 feet @ $35/ft.....	5,250	2*
Raise 150 feet from the 1290, 1440 and 1590 Levels. 450 feet @ $30/ft.....	13,500	3
Diamond drill 10,000 feet of EX core. 10,000 feet @ $6/ft.....	60,000	4*
Total Cost.....	$261,750	
Total Estimated Time.....		22 months

3. (b) Time required to start project

Five days after the signing of the DMA contract.

* Concurrent with other projects.

CONSOLIDATED CARIBOU
MINES, INC.
BOULDER, COLO.

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3. (b) (Con't.)

Estimated time required to complete project

Twenty-two months after project is started.

CONSOLIDATED CARBON
POWER MINES, INC.
BOULDER, COLO.

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4. Map showing plan and vertical projection of the proposed exploration work is attached as Exhibit J.

The diamond drilling program is designed to test the ground on and below the deepest, 1590 Level, and is proposed only for the 1590 Level. Diamond drilling is not proposed for the 1290 of 1440 Levels.

CONSOLIDATED CHIEFTAIN
SILVER MINES, INC.
BOULDER, COLO.

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5. The Caribou mine is operating and is equipped with buildings and some machinery. All the facilities, installations and fixtures listed below will be devoted to the exploration project. No rehabilitation or repairs are necessary.

1. Electric power, connected.

2. Telephone, connected.

3. Water, more than adequate from mine drainage.

4. Caribou shaft 5' X 15' outside dimension from 500 to 920 Level, and 5' X 10' from the 920 to the 1040 Level.

5. Idaho Adit Tunnel on the 500 Level. It is electrically lighted and equipped with 30-pound, 24-inch gauge railway track, and ditch to drain the water pumped from the bottom of the Caribou shaft.

Buildings:

Compressor house - housing compressor, shop, stores, and change room.

CONSOLIDATED CARIBOU
SILVER MINES, INC.
DURANGO, COLO.

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6. No additional facilities, buildings or fixtures to be installed, purchased or erected.

CONSOLIDATED CARIBOU
SILVER MINES, INC.
BOULDER, COLO.

DMA Form
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7. (a) To be rented: None

7. (b) To be purchased:

Sinking hoist	$ 2,500
Cable, Sheave wheel, bucket and misc	500
Sump Pump	1,000
6 Blowers, 5 H.P. Motors	600
1 Eimco mucking machine	3,500
1 Hoist, double drum for 1500 foot depth	6,000
8 Mine cars, Card, Z-16, 16 cu. ft. @ $200/ea	1,600
4 Jackhammers, Joy L-57, 55 lb. @ $400/ea	1,600
4 Drifters, 2 in. Joy T-300, @ $975/ea	3,900
4 Stopers, Joy S-19, 96 lb. @ $800/ea	3,200
3 Tugger hoists, air motor, 500'' capacity	1,000

7. (c) To be furnished by operator:

Equipment	Present Value	Monthly Depreciation
Storage battery locomotive	$ 5,000	$ 65
Adequate fleet 1-ton cars on 500 Level, 20 cars @ $100/ea	2,000	35
Compressor	4,000	60
Pick-up truck	1,500	30
Hoist on 500 Level	2,000	35
Pump on 980 Level	1,500	30
Mine transit and misc. instruments	600	10

CONSOLIDATED CARBON
SILVER MINES, INC.
BOULDER, COLO.

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8. Labor and supervision

1 Mine superintendent	@	$ 500/mo.
1 Engineer	@	400/mo.
1 Geologist	@	400/mo.
1 Bookkeeper	@	150/mo.
2 Supervisors (shift bosses)	@	15/day
8 Miners	@	2/hr.
8 Muckers	@	2/hr.
2 Hoistmen	@	1.75/hr.
4 Timbermen	@	2/hr.
4 Trammers	@	1.75/hr.
1 Surface man	@	1.75/hr.

CONSOLIDATED CARBOU
SILVER MINES, INC.
DENVER, COLO.

DMA Form
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9. Supplies

Explosives	$ 15,760
Drill steel and bits	8,000
Timber	6,600
600' Pipe, air-line, 3" @ 75¢/ft	450
2,100' Pipe, air-line, 2" @ 40¢/ft	840
2,100' Track, 12 lbs. @ $1.75/ft. laid down	3,675
600' Pipe, water-line, 2½" @ 60¢/ft	360
1,100' Pipe, water-line, 1½" @ 30¢/ft	330
1,100' Pipe, water-line, 1" @ 25¢/ft	275
2,100' Ventilation pipe, galvanized, 6" @ 60¢/ft	1,260
650 Power cables, 3 conductor, size 4	450
1,000' Power cable, 600 v. 3 conductor, size 8	250
Hand-tools and miscellaneous supplies, 2-year supply	2,000
Total Supplies	$ 38,250

DISTRIBUTED CARGOO
CLARK MILLS, INC.
BOULDER, COLO.

DMA Form
MF - 103
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10. (a) Applicant is prepared to invest $26,175, which is 10% of the estimated cost of the proposed project.

10. (b) This amount is sufficient to pay applicant's part of the cost of the project.

SUPERINTENDENT OF DOCUMENTS
SEP 1951
FEDERAL DOC.

11. At the present time, the Caribou mine is operating. Two development projects are underway:

(a) Drifting in the west side of the mine on the 1040 and 920 Levels to develop silver-lead-zinc ore bodies. This work is being financed by the mining and milling of ore encountered in the development headings and by some stoping on the 1040 Level.

(b) The applicant has contracted with the U. S. Atomic Energy Commission to do certain exploration work in the radioactive section of the mine on and above the 1040 Level, only. At this time, the 740 Level is being rehabilitated so that the AEC program may be resumed.

It is the intention of the applicant to conduct the DMA program herein proposed without interferring with the above two projects. If the above projects are continuing contemporaneously with the DMA program, then the general mine expense, such as supervision, engineering, geology, bookkeeping, hoisting from the 1040 Level, 500 Level tramming, and power will be proportioned to the individual projects, thus reducing the unit cost of the DMA project from the estimate presented herein.

CONSOLIDATED CARIBOU
SILVER MINES, INC.
BOULDER, COLO.

Form MF-103
(Revised June 1951)

UNITED STATES DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION

Budget Bureau No. 42-R1035.1.

MF-103 Should Be Filed With General Technical Data Form MF-100

APPLICATION FOR AID FOR AN EXPLORATION PROJECT PURSUANT TO MINERAL ORDER 5, UNDER DEFENSE PRODUCTION ACT OF 1950

Not To Be Filled in by Applicant

Docket No. DMEA 2336 REUSED
Metal or Mineral
Date Received 4-4-52
Amount $
Participation (Government %)

DEPARTMENT OF THE INTERIOR
Defense Minerals Administration
APR 4 1952

Consolidated Caribou
Silver Mines, Inc.
1406 Pearl Street
Boulder, Colorado

Name and address of applicant

Date March 20, 1952

If you have already filed MF-100, give date filed Sept. 19, 1951, type of assistance requested Aid for an exploration project,

DMA Docket Number (if available) DMA - 1887
Serialization Number MS - 2359

Supplement to our Application for Aid dated January 7, 1952.

INSTRUCTIONS

Read Mineral Order 5, Regulations Governing Government Aid in Defense Projects, before completing this application. Submit four copies each, of the signed application form, General Technical Data Form MF-100, and answers to questions as specified, to Defense Minerals Administration, Department of the Interior, Washington 25, D. C., or to the nearest field executive office thereof, with your name and address on each sheet of the application and all accompanying papers. If you have previously filed MF-100, it is not necessary to file it again. However, you should indicate in space provided above the type of assistance previously applied for (loans, procurement contracts, etc.) and DMA Docket Number, if available. *When a question is inapplicable it should be so stated in the form.* Additional sheets should be attached in answering any questions or in supplying additional information. IF YOU CANNOT ANSWER A QUESTION, SO STATE.

1. (*a*) Give a description of the real property that will be in any way involved in the exploration project, including any existing mine or operating property.

   (*b*) If you are not the owner of the property, submit a copy of the lease, purchase option, or other agreements under which you are authorized to operate the property with each copy of your application.

   (*c*) Give the legal description of the exact parcel, plot, or area upon which the exploration is to be conducted.

   NOTE: (1) If both areas are the same, so state. The only obligation to repay the Government is from the net earnings from any commercial discovery made in the area specified in (*c*) above in which the exploration is to be conducted, and the expenditure of funds which may be charged as costs of the project must be limited to that area or to work necessary to perform the exploration in that area.

   (2) If applicant is not the owner of the property or if there are any liens or encumbrances against the property, copy of agreements of claimants, lienors, encumbrances, and lessors subordinating their interests in the property to the interest of the Government under the Exploration Project Contract will be required for attachment to the Contract.

2. (*a*) What metals or minerals do you expect to find?

   (*b*) Furnish statement of the geologic features of your property, giving type of ore deposit and reasons for expecting to find commercial ore bodies. Illustrate with maps or sketches. If you have a geologic or engineering report, or assay maps showing width and grade, please send them with application, stating whether or not you wish to have them returned.

The information requested in questions 3, 4, 5, 6, 7, 8, and 9 below should be answered specifically and in detail, as this information will be attached to and incorporated as part of the Exploration Project Contract, if such contract is entered into with you by the Government.

ANSWER EACH QUESTION ON SEPARATE SHEETS OF PAPER AND SUBMIT A COPY OF EACH ANSWER FOR EACH COPY OF YOUR APPLICATION.

3. (*a*) Describe fully the proposed work and give the total cost of the project.

   (*b*) State the time required to start the project and to complete it.

4. Submit a map or sketch of the property involved showing a plan (and cross section, if needed) of the present mine workings and the *location of the proposed exploration work* as related to geologic features, such as contacts, veins, ore-bearing beds, etc.

5. Furnish an itemized list of existing facilities, buildings, installations, and fixtures with a statement of the cost of any necessary rehabilitation or repairs to put into useful and operable condition.

6. Furnish a detailed list of additional facilities, buildings, and fixtures to be purchased, installed, or erected by you, with the estimated cost of each item.

7. Furnish a detailed list of operating equipment, separated into items to be—

   (*a*) Rented

   (*b*) Purchased

   (*c*) Furnished by you

   with the rental, purchase price, or depreciation of each item, as the case may be, to be charged as a cost of the project.

8. Furnish an itemized schedule of labor, by numbers and classes (miners, muckers, etc.) and of supervisors by numbers and positions, with the maximum wages or salaries to be paid to each.

9. Furnish a detailed list with estimated cost of each item for materials, supplies, engineering, assaying, accounting, power, water, utilities, and any other items not provided for above.

10. (*a*) How much are you prepared to invest in the proposed project?

    (*b*) Is this amount sufficient to pay your part of the cost of the project, in accordance with the regulations on Government participation (Sec. 9 of MO–5)?

11. State any conditions or circumstances regarding the property not sufficiently brought out by the foregoing questions.

CERTIFICATION

The undersigned company, and the official executing this certification on its behalf, hereby certify that the information contained in this form and accompanying papers is correct and complete to the best of their knowledge and belief.

Consolidated Caribou Silver Mines, Inc.
(Name of company)

By Donald M. Nelson
(Signature of authorized official)

Donald M. Nelson

March 20, 1952
(Date)

President
(Title)

Title 18, U. S. Code (Crimes), Section 1001, makes it a criminal offense to make a willfully false statement or representation to any department or agency of the United States as to any matter within its jurisdiction.

U. S. GOVERNMENT PRINTING OFFICE 16—64067-2

March 20, 1952

Defense Minerals Exploration Administration
Rare and Misc. Metals Division
Washington 25, D. C.

Gentlemen:

With reference to our Application dated January 7, 1952, in which we applied for aid to explore horizons below the 1040 level of the Caribou Mine for uranium, we wish to supplement said application by conducting a diamond drilling program on the 1040 level, preliminary to carrying out the sinking, crosscutting, raising and drilling program as proposed in our original application, to test the Radium and No Name veins at various depths below the 1040 level.

We herewith enclose a plan of the 1040 level of the Caribou Mine showing proposed locations of holes totaling 20,000 feet. The inclination, depth and objectives of the proposed holes are tabulated as follows:

Drill Station	Hole No.	Dip	Depth (Feet)	Objective Depth below 1040 Level: No Name Vein	Objective Depth below 1040 Level: Radium Vein
1	1040-33	-62	700	500	
1	1040-34	-46	550	350	
1	1040-35	-62	750	500	
1	1040-36	-46	600	350	
1	1040-37	-62	800	500	
1	1040-38	-46	650	350	
2	1040-39	0	700	Exploratory	
2	1040-40	0	700	Exploratory	
3	1040-41	-30	450	200	
3	1040-42	-50	500	350	
3	1040-43	-65	650	550	
3	1040-44	-30	450	200	
3	1040-45	-50	500	350	
3	1040-46	-65	650	550	
3	1040-47	0	700	Exploratory	
3	1040-48	-30 or +30	650	Exploratory	

SOUTH PARK CARIBOU
SILVER KINGS, INC.
BOULDER, COLO.

(Continued)

Drill Station	Hole No.	Dip	Depth (Feet)	Objective Depth below 1040 Level: No Name Vein	Objective Depth below 1040 Level: Radium Vein
4	1040-49	-32	300	135	
4	1040-50	-52	400	270	
4	1040-51	-27	300	135	
4	1040-52	-46	425	270	
4	1040-53	-27	300	135	
4	1040-54	-46	425	270	
5	1040-55	-44	650	165	270
5	1040-56	-53	800	210	550
5	1040-57	-40	650	140	350
5	1040-58	-47	800	180	460
5	1040-59	-40	650	140	350
5	1040-60	-47	800	180	460
5	1040-61	0	700	Exploratory	
5	1040-62	0	700	Exploratory	
5	1040-63	0	700	Exploratory	
5	1040-64	0	700	Exploratory	
5	1040-65	0	700	Exploratory	
	Total		20,000		

The following drifting and crosscutting are proposed to establish drill stations 3, 4 and 5:

Station No. 3 - Drift northeast from 1040-D8 on vein a distance of 110 feet.

Station No. 4 - Extend 1040-D1 northeast a distance of 180 feet along the No Name vein.

Station No. 5 - Crosscut due north from Station No. 4 a distance of 205 feet.

Total drifting and crosscutting: 495 feet.

Estimated time: Drifting and crosscutting can proceed while drilling begins in Stations 1, 2 and 3. Hence, assuming two machines operating on two shifts per day, estimated time is four months.

Estimated cost:

Drifting and crosscutting 495 feet @ $30.00/ft.	$ 14,850
Diamond drilling 20,000 feet @ $6.00/ft.	120,000
Total cost of program preliminary to sinking	$ 134,850

(Continued on page 3)

UNITED CARBON
MINES, INC.
BOULDER, COLO.

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(Continued)

Total cost of program preliminary to sinking	$ 134,850
Cost of original sinking program	261,750
Total cost of combined programs	$ 396,600

It is understood that, if results obtained prior to completion of the preliminary program warrant the sinking program, then the preliminary program may be curtailed or discontinued in favor of an immediate beginning of the sinking program.

Yours very truly,

CONSOLIDATED CARIBOU
SILVER MINES, INC.

Donald M. Nelson, President

CONSOLIDATED CARIBOU
SILVER MINES, INC.
DENVER, COLO.

Form MF-103
(Revised June 1951)

UNITED STATES DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION

Budget Bureau No. 42-R1035.1.

MF-103 Should Be Filed With General Technical Data Form MF-100

APPLICATION FOR AID FOR AN EXPLORATION PROJECT PURSUANT TO MINERAL ORDER 5, UNDER DEFENSE PRODUCTION ACT OF 1950

Not To Be Filled in by Applicant

Docket No. DMEA-2336
Metal or Mineral
Date Received 1-21-52
Amount $
Participation (Government %)

RECEIVED JAN 21 1952 Defense Minerals Administration

Name and address of applicant

Consolidated Caribou
Silver Mines, Inc.
1406 Pearl Street
Boulder, Colorado

Date January 7, 1952

If you have already filed MF-100, give date filed Sept. 19, 1951, type of assistance requested Aid for an exploration project.

DMA Docket Number (if available) DMA - 1887
Serialization Number MS - 2359

INSTRUCTIONS

Read Mineral Order 5, Regulations Governing Government Aid in Defense Projects, before completing this application. Submit four copies each, of the signed application form, General Technical Data Form MF-100, and answers to questions as specified, to Defense Minerals Administration, Department of the Interior, Washington 25, D. C., or to the nearest field executive office thereof, with your name and address on each sheet of the application and all accompanying papers. If you have previously filed MF-100, it is not necessary to file it again. However, you should indicate in space provided above the type of assistance previously applied for (loans, procurement contracts, etc.) and DMA Docket Number, if available. *When a question is inapplicable it should be so stated in the form.* Additional sheets should be attached in answering any questions or in supplying additional information. IF YOU CANNOT ANSWER A QUESTION, SO STATE.

1. (*a*) Give a description of the real property that will be in any way involved in the exploration project, including any existing mine or operating property.

   (*b*) If you are not the owner of the property, submit a copy of the lease, purchase option, or other agreements under which you are authorized to operate the property with each copy of your application.

   (*c*) Give the legal description of the exact parcel, plot, or area upon which the exploration is to be conducted.

   NOTE: (1) If both areas are the same, so state. The only obligation to repay the Government is from the net earnings from any commercial discovery made in the area specified in (*c*) above in which the exploration is to be conducted, and the expenditure of funds which may be charged as costs of the project must be limited to that area or to work necessary to perform the exploration in that area.

   (2) If applicant is not the owner of the property or if there are any liens or encumbrances against the property, copy of agreements of claimants, lienors, encumbrances, and lessors subordinating their interests in the property to the interest of the Government under the Exploration Project Contract will be required for attachment to the Contract.

2. (*a*) What metals or minerals do you expect to find?

   (*b*) Furnish statement of the geologic features of your property, giving type of ore deposit and reasons for expecting to find commercial ore bodies. Illustrate with maps or sketches. If you have a geologic or engineering report, or assay maps showing width and grade, please send them with application, stating whether or not you wish to have them returned.

The information requested in questions 3, 4, 5, 6, 7, 8, and 9 below should be answered specifically and in detail, as this information will be attached to and incorporated as part of the Exploration Project Contract, if such contract is entered into with you by the Government.

ANSWER EACH QUESTION ON SEPARATE SHEETS OF PAPER AND SUBMIT A COPY OF EACH ANSWER FOR EACH COPY OF YOUR APPLICATION.

3. (*a*) Describe fully the proposed work and give the total cost of the project.

   (*b*) State the time required to start the project and to complete it.

4. Submit a map or sketch of the property involved showing a plan (and cross section, if needed) of the present mine workings and the *location of the proposed exploration work* as related to geologic features, such as contacts, veins, ore-bearing beds, etc.

5. Furnish an itemized list of existing facilities, buildings, installations, and fixtures with a statement of the cost of any necessary rehabilitation or repairs to put into useful and operable condition.

6. Furnish a detailed list of additional facilities, buildings, and fixtures to be purchased, installed, or erected by you, with the estimated cost of each item.

7. Furnish a detailed list of operating equipment, separated into items to be—

   (*a*) Rented

   (*b*) Purchased

   (*c*) Furnished by you

   with the rental, purchase price, or depreciation of each item, as the case may be, to be charged as a cost of the project.

8. Furnish an itemized schedule of labor, by numbers and classes (miners, muckers, etc.) and of supervisors by numbers and positions, with the maximum wages or salaries to be paid to each.

9. Furnish a detailed list with estimated cost of each item for materials, supplies, engineering, assaying, accounting, power, water, utilities, and any other items not provided for above.

10. (*a*) How much are you prepared to invest in the proposed project?

    (*b*) Is this amount sufficient to pay your part of the cost of the project, in accordance with the regulations on Government participation (Sec. 9 of MO–5)?

11. State any conditions or circumstances regarding the property not sufficiently brought out by the foregoing questions.

CERTIFICATION

The undersigned company, and the official executing this certification on its behalf, hereby certify that the information contained in this form and accompanying papers is correct and complete to the best of their knowledge and belief.

Consolidated Caribou Silver Mines, Inc.
(Name of company)

By [signature]
(Signature of authorized official)
Donald M. Nelson

January 7, 1952
(Date)

President
(Title)

Title 18, U. S. Code (Crimes), Section 1001, makes it a criminal offense to make a willfully false statement or representation to any department or agency of the United States as to any matter within its jurisdiction.

U. S. GOVERNMENT PRINTING OFFICE 16—64067-2

DMA Form
MF - 103
Revised June, 1951

List of Exhibits

Exhibit A	"Radioactivity of the Caribou Mine" by G. C. Ridland.
Exhibit B	Page from "Mineralogical Studies of Uraninite...", U. S. Atomic Energy Commission, July 1, 1950.
Exhibit C	Assay Section "A", Caribou Mine.
Exhibit D	Assay Section D1, 1040 Level, Caribou Mine.
Exhibit E	Assay Plan, 1140 Level, Caribou Mine.
Exhibit F	Plan of 1040-D1 and 1040-D2, Caribou Mine.
Exhibit G	Assay Plan of 920 Level, Caribou Mine.
Exhibit H	Assay Section of 1040 Level, Sect. D., Caribou Mine.
Exhibit J	Plan and Vertical Projection Showing Proposed Uranium Exploration Program.

Note: Exhibits A and B attached at end of application.

Exhibits C through J in pocket.

CONSOLIDATED
SILVER
SCHILDER

DMA Form
MF - 103
Revised June, 1951

APPLICATION FOR AID FOR AN
EXPLORATION PROJECT PURSUANT TO
MINERAL ORDER 5, UNDER
DEFENSE PRODUCTION ACT OF 1950

1. (a) Description of the real property, including the operating Caribou Mine

A legal description of the real property is given in 1. (c). The area to be explored consists of a part of the operating Caribou mine.

The Caribou mine consists of a three-compartment inclined shaft, reaching an inclined depth of 1040 feet, with an outside dimension of 5' X 15'. The shaft is equipped with an electric hoist at the 500 Level and is not in use above the 500 Level. Levels are established below the 500 Level at 530, 600 740, 800, 920, 980, and 1040. It is connected to the surface on the 500 Level by a 3,636-foot long transportation tunnel. This tunnel, called the Idaho Tunnel, is electrically lighted and equipped with 30-pound, 24-inch gauge railway track, a ditch to drain the water pumped from the Caribou shaft, and an adequate fleet of ore cars and storage battery locomotives.

The portal of the Idaho Tunnel is protected by a snow shed. Adjacent to the portal is a 72' X 28' building containing the compressor room, shop, storage and change room. Beyond the portal on the edge of the dump is a building housing a sorting belt and ore bins.

Compressed air is generated by 3 compressors driven by electric motors with a total of 250 H.P. furnishing 1600 c.f.m. at a pressure of 105 lbs. per sq. in. (Elevation approximately 10,000 feet.)

The property is also equipped with drills, accessories and small tools, trucks, etc.

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1. (b) The applicant is the sole owner of the property and all equipment on the premises. Title to the property is insured.

1. (c) Legal description of area to be explored

Patented Claims

Name	U.S. Survey Lot Number
Caribou Lode	37
Kalamazoo Lode	76
No Name Lode	77
Federal Lode	91
Sherman Lode	93
Socorro Lode	104
Hidden Treasure Lode	105
Columbia Lode	167
Spencer Lode	168
Non Pariel Lode	6853
Poorman Lode	42
Silver Dollar Lode	654
Carry Lode	660
California Lode	20483
North Park Lode	20483
Toledo Lode	20483

All located in Sections 5 and 8, T. 1S., R. 73 W. of the 6th P.M.

1. (c) Note (1) Areas referred to by 1. (a) and 1. (b) are the same.

1. (c) Note (2) The real and personal property owned by the company, constituting all of the fixed assets except certain furniture and fixtures, is subject to a deed of trust securing a note payable to a stockholder in the amount of $200,000.00.

2. (a) Pitchblende is the mineral expected to be found.

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2. (b) Geological features

Introduction

In September, 1943, an extensive exploration program was undertaken for uranium deposits. One of the first steps in this program was to compile a list of published accounts of uranium deposits. The literature at that time made note of the occurence of pitchblende at several places in the Front Range of the Colorado Rocky Mountains. These occurrences lie in a region extending from Jamestown, Boulder County, Colorado, to Lawson, Clear Creek County, Colorado, a distance of 27 miles. This section of the Front Range is noted for its production of gold, silver, fluorspar, tungsten, copper, lead, and zinc, as well as uranium.

General Geology

A closer study of this region brought to light a silver mining district known as Caribou Hill where a group of mines are reported to have produced over $8,000,000 in silver, largely in the period between 1869 and 1894. The close association of pitchblende and silver is well-known. Geological literature usually refers to the ore-bearing veins at the well-known uranium districts of Great Bear Lake, Canada, and Joachimsthal, Czechoslovakia, as silver-pitchblende veins. Silver is also an important by-product in the production of uranium from the pitchblende deposits at Shinkolobwe, Belgian Congo.

After studying the regional geology of the Jamestown-Lawson area, it became apparent that the geological setting of the Caribou Hill district was most favorable for the occurrence of pitchblende. The majority of the rock-types of the region are metamorphosed sediments and granitic intrusives of pre-Cambrian age. The Caribou veins occur in a medium-grained quartz monzonite stock that is believed to be of Tertiary (?) age. The silver-pitchblende veins of the Contact mine at Great Bear Lake occur in a medium-grained granodiorite stock of approximately the same size, texture and mineral composition. The similarity of the geology of the two regions is striking. (The only noticeable difference is in the lack of nickel and cobalt mineralization at Caribou, which is prevalent at Great Bear Lake.

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2. (b) Geological features (Con't.)

The examination of the surface of the Caribou Hill area was rewarded with the discovery of pitchblende in vein material on the Caribou Mine Dump.

Caribou Pitchblende Deposits

The Caribou mine and much of the adjacent ground were acquired for the applicant, and, early in 1947, work began in rehabilitating and dewatering the old mine workings. As the water was lowered, a systematic search was made for pitchblende. The radioactivity of the old stopes and drifts was measured with a Geiger-Mueller counter. Normal activity was encountered on the surface and down to the 300 Level. On the 360 Level a small "high" was noted with a reading of almost twice the normal background. The 420, 470, and 500 Levels were negative. The 530 Level registered noticeably above the normal background, but not of sufficient intensity to expect a visible occurrence of pitchblende. The 600, 670, 740, 800, and 860 Levels were found to be negative again. The 920 Level gave a mildly higher count until almost to the northeast end of the drift. Here it jumped suddenly to 3 times the normal count.

Not until the bottom level of the mine was finally dewatered did the instrument detect intense radioactivity and did pitchblende make its appearance. The importance of this discourse is in the fact that radioactive anomalies were found at 360, 530, 920, and finally, at 1040 feet vertically below the surface in ever-increasing intensity. This logically leads one to consider the possibilities that pitchblende may be found in increasing concentration below the 1040 Level. Attached as Exhibit A is a copy of a more detailed account of the "Radioactivity of the Caribou Mine", by G. C. Ridland. (Mining Engineering, Vol. 187, January, 1950, A.I.M.E. Transactions).

Pitchblende occurs on the 1040 Level in a continuous black seam 1 to 16 inches wide which appears 45 feet southwest of the junction of the No Name and Radium veins, 1040 Level. The black streak follows the footwall of the ore to the junction, then the center of the Radium vein for an additional 110 feet. This black material is radioactive and intensely so at places. It is friable and has an earthy luster and readily stains the fingers when handled. Veinlets

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2. (b) Geological features (Con't.)

of an easily shattered, black, vitreous, colloform pitchblende form part of the dark streak, and galena, sphalerite, ruby silver and colloform pyrite are also readily identifiable.

A detailed mineralogical description is given in a report by Harold D. Wright (Mineralogical Studies of Uraninite and Uraninite-bearing Deposits, July 1, 1949 - June 30, 1950; Raw Materials Operation, U. S. Atomic Energy Commission, P. O. Box 30, New York 23, New York, July 1, 1950), which reads in part as follows:

> "Two varieties of uraninite occur in the Caribou ore. One of these is a dense, hard black material with pitchy luster, while the other is a soft, fine-grained, dull-lustered, porous material which coats fractures and open vugs, and in some places appears to grade into the lustrous material. The hard variety shows varying degrees of luster and hardness. Both varieties contain inclusions of pyrite and lesser amounts of other sulphides. Under the microscope the lustrous uraninite almost always shows the colloform structure which characterizes the material described from other localities, as Great Bear Lake, Joachimsthal, and Katanga. Radially arranged fractures, some filled with pyrite, are common in the botryoidal material. Although the hardness of uraninite is given as 5½, even the "hard" variety of Caribou uraninite can be scratched (with difficulty), suggesting that this material has undergone oxidation since its deposition."

(A more complete photostat copy of the description is attached to this application as Exhibit B.)

The following table shows assay results of channel samples taken along the vein in this area. Please note that a 3-foot round was taken out of the back of the drift to freshen-up the exposure and some of the samples were taken 10 feet above the track instead of 7 feet (the original back). Also additional exploratory stoping raised the back to 17 feet above the track and samples from this horizon are also included. (See also Assay Section 1040 Level, Section D, Exhibit H.)

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2. (b) Geological features (Con't.)

Sample No.	Approx. Distance from the Caribou Shaft (feet)	Distance above Track (feet)	Width (inches)	U_3O_8 %
1311	405	10	39	0.08
1322	407	10	18	0.34
448	410	7	72	Nil
1310	415	10	31	0.12
1321	417	10	18	0.50
447	420	7	72	Nil
1306	425	10	36	0.27
1320	425	10	18	0.14
440	428	7	4	Nil
439	432	7	12	Nil
1307	435	10	33	0.34
1319	435	10	18	0.24
438	437	7	14	Nil
1308	445	17	36	0.20
1318	445	17	18	0.34
437	450	7	10	Nil
1309	455	17	32	0.24
1317	455	17	18	0.38
1315	465	17	16	0.43
436	473	7	18	0.05
1268	480	10	4	0.34
1316	480	10	18	0.34
1301	480	17	35	0.24
1266	485	10	15	0.24
1457	490	7	12	0.37
1267	490	10	15	0.19
1302	490	17	36	0.19
1314	490	17	18	0.38
1269	495	10	8	0.52
1455	500	7	35	Nil
1271	500	10	16	7.58 ✓
1303	500	17	37	0.16 ✓
1313	500	17	24	3.15 ✓
1270	505	10	12	0.67
434	510	7	36	Nil
1304	510	17	36	0.54
1312	510	17	18	0.48
433	520	7	12	Nil
1305	520	17	36	0.68

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2. (b) Geological features (Con't.)

Subsequent Development of the Radioactive Occurrence

The applicant first drove a raise (1040-A) from the 1040 Level to the 920 Level (see Assay Section "A", Exhibit C) on the pitchblende-bearing ore. Pitchblende continued in important concentration in the raise for 43 feet above the 1040 Level. Channel samples in the raise show the following uranium values:

Sample No.	Distance above Track (feet)	Width (inches)	U_3O_8 %
1130	113	48	0.02
1340	101	48	0.08
1339	89	54	0.05
1338	80	50	0.06
1337	70	46	0.06
1335	59	43	0.07
1333	55	48	0.08
1329	47	48	0.06
1114	39	24	1.26
1107	27	48	0.02
1313	18	24	3.15
1303	15	37	0.16
1260	8	8	0.52

not shown on assay section Exhibit C

This raise was followed by the sinking of a winze almost directly below the raise to the 1140 Level (Assay Section "A", Exhibit C). The Radium and No Name veins were opened by 182 feet of drifting on the 1140 Level (See Assay Plan of the 1140 Level, Exhibit E). Uranium was encountered in the winze in commercial quantities to a depth of 22 feet below the 1040 Level and uranium values were encountered in the No Name vein, 1140-D1 drift.

not on 1140 assay plan

Under contract with the U. S. Atomic Energy Commission, the applicant subsequently extended the 1040-D2 and 920-D2 drifts east on the Radium vein.

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2. (b) Geological features (Con't.)

for distances of 350 and 260 feet, respectively, and both headings encountered pitchblende (Plan of 1040-D1 and D2, Exhibit F and Assay Plan of 920 Level, Exhibit G).

Finally, under contract with the U. S. Atomic Energy Commission, a second raise (558) was driven up 83 feet above track from the 1040 Level at a point 240 feet east of the 1040-A riase on the Radium vein and the following uranium values were obtained in channel samples (Assay Section D1, Exhibit D):

Distance above Track (feet)	Width (inches)	U_3O_8 %
83	10	0.08
78	8	0.17
70	10	0.34
64	9	0.05
55	10	0.73
40	16	0.10
18	12	0.96

In each of these projects, pitchblende has been encountered, and the zone in which it occurs in the Radium and No Name veins may now be said to extend vertically for 300 feet and horizontally for 360 feet. The continuous high-grade section at the 1040 Level may be said to have a proven horizontal length of 115 feet and a vertical distance of 65 feet, with a width varying from inches to 4 feet. A second continuous section of importance appears to be developing in the 558 raise. It now has a vertical height of 83 feet and widths from 8 to 16 inches.

The Exploration Project

The applicant now desires to explore the Radium and No Name veins on newly-established 1290, 1440, and 1590 Levels at depths of 250, 400, and 550 feet, respectively (Exhibit J), below the 1040 Level (the bottom of the Caribou shaft). The reasons for expecting to find commercial occurrences of pitchblende are summarized here:

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2. (b) Geological features (Con't.)

1. The regional geological setting makes the Caribou Hill area a most logical place for the occurrence of uranium.

2. Pitchblende has been found in small commercial bodies in the Radium and No Name veins of the Caribou mine, and subsequent development on and above the 1140 Level has shown the deposits to occur over more extensive sections of the veins than to the extent of the original showings. The next, logical step is to explore the ground below the 1140 Level.

3. Pitchblende, the primary form of uranium deposition, theoretically, is deposited by hot, aqueous, ascending solutions. The occurrences on and above the 1140 Level of the Caribou mine have the characteristics of being the upper-most fringes of such upward extending depositions. Hence, larger, more highly concentrated uranium deposits reasonably may be expected below the bottom levels of the Caribou mine.

4. Each radioactive anomally, or radioactive occurrence, was found to be successively larger and more intense as depth is gained in the Caribou workings. Hence, at least to the 1040 Level, the radioactivity of the deposits is ever increasing.

5. In similar silver-pitchblende veins in other districts pitchblende has been found to improve with depth. Two examples may be cited:

a. At the Eldorado mine, Great Bear Lake, Canada, the No. 2 vein began at the surface with silver in preponderance, although pitchblende was present. Below the 500-foot level, the vein has produced almost no silver, whereas pitchblende ore bodies have been mined to more than 1,000 feet below the surface. In the No. 1 vein, little or no pitchblende is visible at the surface, yet the vein became the main producer below 1,000 feet in depth.

b. At the Werner mine, Joachimsthal, Czechoslovakia, pitchblende was encountered in only small quantities in the upper levels, below 262 meters it appeared in increasing quantities, and

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2. (b) Geoligical features (Con't.)

below 375 meters it became the only valuable constituent of the ore. Not only in the Werner mine, but in the district as a whole, uranium tends to increase with depth.

6. In two productive silver mines, as in the Caribou mine, pitchblende has been found in the lower levels. In the Sunshine mine, Coeur d'Alene District, Idaho, no trace of pitchblende was found until the 3100 Level (3100 feet below the surface) was reached. It is reported to occur in a zone between the 3100 and 3700 Levels. In the Jo Reynolds mine, Lawson, Colorado, pitchblende was not encountered until the area between the 900 and 1000 Levels was opened up (900 feet below the surface). The continuity and improvement with depth in these mines only will be determined as the workings are deepened, but the point of particular interest is that these silver mines, like Caribou, encountered pitchblende in their current lowest levels as their silver ores were followed downward. These mines may just be reaching zones containing workable deposits of uranium.

For these six reasons, the applicant believes the projected depth program of exploration is warranted. In 1948, the applicant's geologists, Dr. G. C. Ridland and Dr. E. E. Wahlstrom, recommended that the mine workings be deepened and Wahlstrom went so far as to warn that the future of the property depended on the extension of the development work below the 1040 Level.

(The applicant would appreciate the return of the attached assay maps when the DMA has no further use for them.)

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3. (a) Proposed work and cost

Project	Cost ($)	Time (Months)
Sink Caribou shaft 600 feet from the 1040 Level to the 1640 Level. 600 feet @ $200/ft.....	$120,000	10
Cross-cut 100 feet from shaft to No Name vein on the 1290, 1440 and 1590 Levels, 300 feet @ $30/ft.....	9,000	2
Drift 100 feet NE on the No Name vein on the 1290, 1440, and 1590 Levels to the Radium vein intersection and continue an additional 100 feet, on the No Name vein. 600 feet @ $30/ft.....	18,000	2
Drift E 400 feet on the Radium vein on the 1290, 1440 and 1590 Levels. 1,200 feet @ $30/ft.....	36,000	5
Extend drift 150 feet on the No Name vein, 1590 Level, NE to establish a diamond drill station. 150 feet @ $35/ft.....	5,250	2*
Raise 150 feet from the 1290, 1440 and 1590 Levels. 450 feet @ $30/ft.....	13,500	3
Diamond drill 10,000 feet of EX core. 10,000 feet @ $6/ft.....	60,000	4*
Total Cost.....	$261,750	
Total Estimated Time.....		22 months

3. (b) Time required to start project

Five days after the signing of the DMA contract.

* Concurrent with other projects.

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3. (b) (Con't.)

<u>Estimated time required to complete project</u>

Twenty-two months after project is started.

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4. Map showing plan and vertical projection of the proposed exploration work is attached as Exhibit J.

The diamond drilling program is designed to test the ground on and below the deepest, 1590 Level, and is proposed only for the 1590 Level. Diamond drilling is not proposed for the 1290 of 1440 Levels.

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5. The Caribou mine is operating and is equipped with buildings and some machinery. All the facilities, installations and fixtures listed below will be devoted to the exploration project. No rehabilitation or repairs are necessary.

1. Electric power, connected.

2. Telephone, connected.

3. Water, more than adequate from mine drainage.

4. Caribou shaft 5' X 15' outside dimension from 500 to 920 Level, and 5' X 10' from the 920 to the 1040 Level.

5. Idaho Adit Tunnel on the 500 Level. It is electrically lighted and equipped with 30-pound, 24-inch gauge railway track, and ditch to drain the water pumped from the bottom of the Caribou shaft.

Buildings:

Compressor house - housing compressor, shop, stores, and change room.

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6. No additional facilities, buildings or fixtures to be installed, purchased or erected.

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7. (a) To be rented: None

7. (b) To be purchased:

Sinking hoist	$ 2,500
Cable, Sheave wheel, bucket and misc.	500
Sump Pump	1,000
6 Blowers, 5 H.P. Motors	600
1 Simco mucking machine	3,500
1 Hoist, double drum for 1500 foot depth	6,000
8 Mine cars, Card, Z-16, 16 cu. ft. @ $200/ea	1,600
4 Jackhammers, Joy L-57, 55 lb. @ $400/ea	1,600
4 Drifters, 2 in. Joy T-300, @ $975/ea	3,900
4 Stopers, Joy S-19, 96 lb. @ $800/ea	3,200
3 Tugger hoists, air motor, 500'' capacity	1,000

7. (c) To be furnished by operator:

Equipment	Present Value	Monthly Depreciation
Storage battery locomotive	$ 5,000	$ 65
Adequate fleet 1-ton cars on 500 Level, 20 cars @ $100/ea	2,000	35
Compressor	4,000	60
Pick-up truck	1,500	30
Hoist on 500 Level	2,000	35
Pump on 980 Level	1,500	30
Mine transit and misc. instruments	600	10

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8. <u>Labor and supervision</u>

1 Mine superintendent	@	$ 500/mo.
1 Engineer	@	400/mo.
1 Geologist	@	400/mo.
1 Bookkeeper	@	150/mo.
2 Supervisors (shift bosses)	@	15/day
8 Miners	@	2/hr.
8 Muckers	@	2/hr.
2 Hoistmen	@	1.75/hr.
4 Timbermen	@	2/hr.
4 Trammers	@	1.75/hr.
1 Surface man	@	1.75/hr.

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9. Supplies

Explosives	$ 15,760
Drill steel and bits	6,000
Timber	6,600
600' Pipe, air-line, 3" @ 75¢/ft	450
2,100' Pipe, air-line, 2" @ 40¢/ft	840
2,100' Track, 12 lbs. @ $1.75/ft. laid down	3,675
600' Pipe, water-line, 2½" @ 60¢/ft	360
1,100' Pipe, water-line, 1½" @ 30¢/ft	330
1,100' Pipe, water-line, 1" @ 25¢/ft	275
2,100' Ventilation pipe, galvanized, 6" @ 60¢/ft	1,260
650 Power cables, 3 conductor, size 4	450
1,000' Power cable, 600 v. 3 conductor, size 8	250
Hand-tools and miscellaneous supplies, 2-year supply	2,000
Total Supplies	$ 38,250

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10. (a) Applicant is prepared to invest $26,175, which is 10% of the estimated cost of the proposed project.

10. (b) This amount is sufficient to pay applicant's part of the cost of the project.

CONSOLIDATED CATALOG
SERVICE BUREAU, INC.
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11. At the present time, the Caribou mine is operating. Two development projects are underway:

(a) Drifting in the west side of the mine on the 1040 and 920 Levels to develop silver-lead-zinc ore bodies. This work is being financed by the mining and milling of ore encountered in the development headings and by some stoping on the 1040 Level.

(b) The applicant has contracted with the U. S. Atomic Energy Commission to do certain exploration work in the radioactive section of the mine on and above the 1040 Level, only. At this time, the 740 Level is being rehabilitated so that the AEC program may be resumed.

It is the intention of the applicant to conduct the DMA program herein proposed without interferring with the above two projects. If the above projects are continuing contemporaneously with the DMA program, then the general mine expense, such as supervision, engineering, geology, bookkeeping, hoisting from the 1040 Level, 500 Level tramming, and power will be proportioned to the individual projects, thus reducing the unit cost of the DMA project from the estimate presented herein.

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EXHIBIT A

Radioactivity

at the Caribou Silver Mine, Boulder County, Colorado

by G. Carman Ridland

A program of exploration for radioactive deposits, conducted in 1945 in the well-known mineralized areas of the Front Range, Colorado, was rewarded with the discovery of pitchblende in a dump at Caribou Hill. The presence of pitchblende in the silver veins at depth apparently is not expressed as gamma-ray anomalies at the surface.

Introduction

Front Range, Colorado: The majority of the rocks comprising the Front Range of Colorado are pre-Cambrian schists, gneisses, and intrusives which have been elevated to form part of the Southern Rocky Mountain physiographic province. The region is noted mainly for its production of gold and silver, but ores of tungsten, fluorspar, uranium, copper, and iron have been worked. Geological literature[1-4] describes pitchblende and other radioactive minerals occurring at Jamestown, Boulder County; Central City, Gilpin County; and Lawson, Clear Creek County (fig. 1). These three adjoining counties cover most of the highly mineralized section of the Front Range which extends from Jamestown to Breckenridge. As far as the writer is aware, uranium has been found only in the portion northeast of Lawson.

G. CARMAN RIDLAND, Member AIME, is a Consulting Geological Engineer, New York, N. Y.

San Francisco Meeting, February 1949.

TP 2738 IL. Discussion of this paper (2 copies) may be sent to Transactions *AIME before Feb. 28, 1950. Manuscript received March 30, 1949.*

Silver Deposits at Caribou Hill: The historic silver deposits of Caribou Hill, located approximately half way between Jamestown and Central City, and 35 miles in a straight line northwest of Denver, appeared particularly intriguing as an area to prospect for uranium for the following reasons: here exists an isolated group of high-grade silver veins in the center of a mining district containing occurrences of uranium, and, in two of the well-known uranium deposits of the world, those at Great Bear Lake, Canada, and Joachimsthal, Czechoslovakia, uranium is associated with silver in similar fissure veins. An exploration program, conducted in the spring of 1945, directed special attention to Caribou Hill and was rewarded with the discovery of heavy, canary-yellow stained specimens of pitchblende.

The veins are confined to shear zones cutting a north-south, elongated quartz-monzonite stock of Tertiary (?) age lying in the axis of a major anticline of the Idaho Springs biotite schist, the oldest pre-Cambrian formation in the district. The stock is one and three-quarter miles long by more than a mile wide, and Caribou Hill is approximately at its center.

The ore zones vary in width from a few inches to 15 ft, and one structure has been traced for a length of over 4000 ft. The ore minerals are galena, sphalerite, ruby silver, native silver, chalcopyrite, pyrite, and pitchblende. They occur most common-

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EXHIBIT A

Where X = tons per hour original feed.
Y = tons per hour classifier sand.
a = percentage of minus 100 mesh in ball mill discharge.
b = percentage of minus 100 mesh in classifier overflow.
c = percentage of minus 100 mesh in classifier sand.

Ball Loads: No. 10 unit was charged with 75,000 lb of balls at the beginning of the test and an effort was made to keep mill amperage constant. This met with some success, but on several occasions, by inspection, ball level was found to have dropped. For the last month's test, the consumption figure for the preceding months was used as a guide in adding balls, and this resulted in a very steady ball load. From the average level, as measured when the mill was down, it was calculated that the average load was 72,000 lb.

Power Figures: The power meter on No. 10 unit was read every morning at 7 a.m. and the power consumed for the preceding day calculated. The month's figures, the sum of these daily power figures, corrected for meter error, were used for the No. 10 mill. For the mills No. 1 to 9, the monthly power figures as provided by the Electrical Department were used. This figure was obtained by monthly meter readings, instead of daily, and was subjected to meter error correction.

Screen Analysis of Ball Mill Feed: A typical screen analysis of coarse heads (feed to all ball mills) is given in Table I.

Table I. Screen Analysis of Coarse Heads

Screen Size	Per Cent
Plus 0.525 in.	0.4
0.371 in.	9.8
3 Mesh	15.2
4	8.3
6	8.6
8	5.8
10	8.9
14	5.5
20	4.5
28	4.3
35	5.0
48	2.9
65	2.9
100	4.7
150	2.4
200	2.3
325	1.7
Minus 325	6.8
	100.0

Duration of Test: The investigation was carried out over a period of seven months, from June to December, 1942, inclusive. The September test is not included because of the time down for lining the No. 10 mill, and changing the drive motor. Tests for June, July, and August are thought to be less accurate as regards power figures than those for October, November, and December, because during the former months it was discovered that the No. 10 ball mill motor was somewhat defective. The summary of the test is, therefore, split into two halves in Table II and III.

Table II. Summary of Test

	June July August		Oct. Nov. Dec.	
	Mills No. 1 to 9	Mill No. 10	Mills No. 1 to 9	Mill No. 10
Horsepower	385	463	379	450
Per cent —200 mesh in classifier overflow	50.55	52.44	52.46	52.03
Dry tons per ball mill hour	31.85	35.48	31.68	37.55
New tons —200 mesh per ball mill hour	13.04	15.20	14.00	16.32
Kw-hr per dry ton milled	9.00	9.74	8.92	8.92
Kw hr per ton—200 mesh produced	22.04	22.78	20.32	20.55
Grinding balls used in lb per ton	2.88	3.68	2.78	3.53
Liners (gross) used in lb per ton	0.43	0.63	0.43	0.63

Table III. Screen Analysis of F. X. Classifier Overflows

Mesh	June July August		Oct. Nov. Dec.	
	Mills No. 1 to 9	Mill No. 10	Mills No. 1 to 9	Mill No. 10
Plus 65	6.0	4.5	6.4	5.0
100	14.1	12.9	13.3	13.9
150	15.3	15.3	14.3	15.1
200	13.8	14.3	13.8	14.3
325	9.6	10.1	9.5	9.8
Minus 325	41.2	42.9	42.7	41.9
	100.0	100.0	100.0	100.0

	Conical Trunnion Overflow	Cylindrical Grate
Average per cent solids in F. X. Classifier Overflow	24.7	21.9
Average circulating load, per cent	420.0	460.0
Ball load in mills in short tons	36.0	36.0

Observation: (1) To obtain a comparable grind it was necessary to overflow the F.X. Classifier at 2 to 3 pct less solids with the cylindrical grate mill than with the conical trunnion overflow mills.

(2) There appeared to be little difference with regard to ease of operation. Overloads on the conical trunnion overflow mills were reflected immediately in the sand load on the classifier, whereas the cylindrical grate mill overloaded internally. This condition was indicated by a drop in amperage and a definite decrease in mill noise.

(3) From the maintenance point of view, the cylindrical grate mill was much more difficult to inspect, and required more time to reline.

Conclusions: (1) The cylindrical grate mill with a ball load of 72,000 lb had a one sixth greater grinding capacity than a conical trunnion overflow mill with the same tonnage of balls, on Mufulira ore.

(2) Consumption of grinding balls was 27 pct greater for equal tonnage ground in the cylindrical grate mill.

(3) Consumption of liner steel at 0.63 lb per ton (gross) was 32 pct higher than for the conical trunnion overflow at 0.43 lb per ton (gross).

(4) In terms of power cost per ton of finished product produced, the cylindrical grate mill required from 1 to 3 pct more power than the conical trunnion overflow, on Mufulira ore.

(5) The cylindrical grate mill produced about 2 pct less oversize (plus 100 mesh) than the conical trunnion overflow, because the classifier was run at a lower density, but at equal densities the cylindrical grate grind was inferior to the conical trunnion overflow.

(6) Work done by either type of mill was directly proportional to power input.

(7) Considering power costs approximately equal, the cylindrical grate ball mill produced more finished product at the expense of considerably more steel consumption.

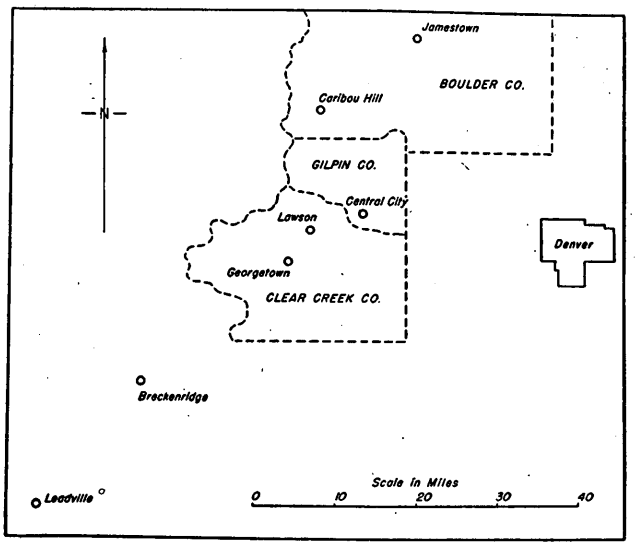

Fig. 1—Index map showing position of some of the major mining districts of the Front Range relative to Denver, Colo.

ly, finely and inconspicuously disseminated in vein matter or in the adjacent altered monzonite. Gangue minerals are mostly quartz, various colored carbonates, barite, some fluorite, and clay minerals that are the alteration products of feldspar and biotite of the wall rock.

An investigation of the mining properties of Caribou Hill resulted in the consolidation of the old Caribou mine property and other, adjacent properties believed to be important. In 1947, the Consolidated Caribou Silver Mines, Inc., began the rehabilitation of the old mine workings.

Geiger-Müller Survey

The surface of Caribou Hill and particularly the outcrops of the major ore-bearing structures were traversed with a Geiger-Müller counter sensitive to gamma radiation. As the Caribou mine was unwatered, the accessible levels and stopes were thoroughly traversed with the instrument. At intervals of from 50 to 100 ft, or wherever radioactivity was suspected, Geiger-Müller counts were recorded. The counts were taken for periods of from one to ten minutes and expressed as the average number of impulses per minute.

Explanation: Experience has shown that the count for the instrument used may fluctuate from ½ to 1½ times the average rate and still be in no way influenced by any near concentration of radioactive material. Hence, any count between 10 and 29 per minute was considered in the normal (N) range; from 30 to 47, in the twice normal or $2N$ range; from 48 to 66, in the $3N$ range, and so on. If an average count of below 10 was obtained, it was considered below normal and designated $N/2$. Experience has further shown that, if a radioactive element is present in sufficient quantity to be seen in its mineral form, or to be detected by ordinary chemical analysis, the count, at the place of exposure, is likely to be $5N$ or higher.

Normal (or Negative) Activity: The surface (except part of the Caribou dump) and most of the levels registered no above-normal radioactivity.

Below-normal Activity: On the 300 level a reading of 8 was obtained on one of the veins but, at this time, no particular significance is attached to this phenomenon.

Above-normal Activity: Four levels produced counts registering above-normal radioactivity, and the profiles of the gamma-ray intensities of these levels are illustrated in fig. 2. A single count at an isolated place on the 360 level ran 34, or 5 above the limit of the normal range. A group of counts taken on the 530 level ran 27, 18, 39, 24, 22, 38, 28, 36, 25, and 25 over a length of 220 ft. This is undoubtedly an anomaly, but too mild to indicate a concentration

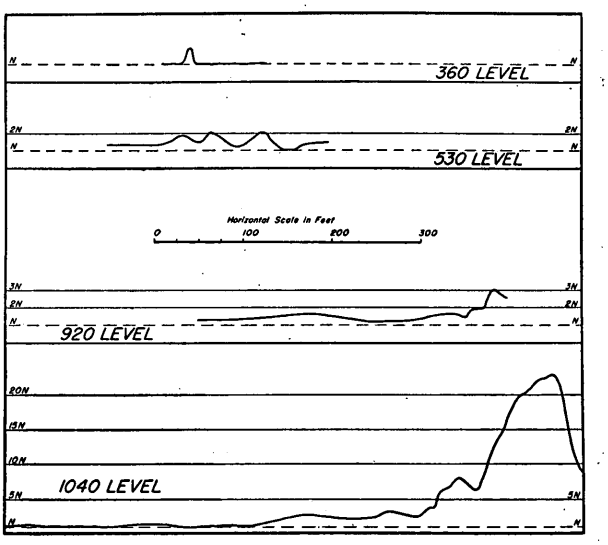

Fig. 2—Profiles of the gamma-ray intensities on the 360, 530, 920 and 1040 levels of the Caribou Mine.

The horizontal scale is in feet and is shown on the diagram. The vertical scales are the gamma-ray intensities expressed in the number of counts over the normal, background count of the country rock. The broken line marked N represents normal intensity.

CONSOLIDATED CARIBOU
SILVER MINES, INC.
BOULDER COLO

Fig. 3 — Low magnification micrograph of soft, black, colloform radioactive substance from the 1040 level of the Caribou mine. X17.

The light gray veins are proustite and sphalerite, each containing blebs of chalcopyrite.

of radioactive material that could be seen or detected by ordinary chemical analysis. The average count on the 920 level is noticeably higher than on any of the upper levels, and at the northeast end of the drift it begins to climb abruptly to 3*N*. The 1040 level is normal in gamma-ray activity except for the northeast 350 ft. The intensity of this anomaly is sufficient to indicate that a radioactive mineral is exposed along approximately 100 ft of this drift.

Description of Occurrence

Ore Body of the 1040 Level: At the northeast end of the 1040 level, channel samples, taken at 10 ft intervals, reveal an ore body 350 ft long with an average width of 4.08 ft and an average grade of 0.061 oz per ton gold, 18.96 oz per ton silver and 1.76 pct lead. It follows a northeast trending structure for 220 ft, then turns off to the east along a subsidiary east-west fracture for the remaining 130 ft. The ore varies from one to nine feet in width and is a siliceous- and carbonaceous-vein filling containing, in places, galena, sphalerite, and a little pyrite. In the east-west section, pitchblende and ruby silver are also visible. The pitchblende occurs in a continuous, black seam 1 to 16 in. wide which begins 45 ft southwest of the junction of the northeast and subsidiary structures and follows the footwall of the ore to the junction, then the center of the east-west striking vein for an additional 110 ft. This black material is radioactive and intensely so at places. It is friable and has an earthy luster and readily stains the fingers when handled. Veinlets of an easily shattered, black, vitreous, colloform pitchblende form part of the dark streak, and galena, sphalerite, ruby silver, and colloform pyrite also may be identified by hand lense.

Radioactive Ore under Low Power Magnification: A microscopic view of a polished section of the black material, viewed in reflected light under low power magnification, shows pitchblende and coarsely crystallized galena, sphalerite, and proustite. Chalcopyrite is present as small exsolution blebs in sphalerite and proustite and also in places

Fig. 4—Radiograph of polished section, part of which is shown in fig. 3 and fig. 5. X4.

The white areas are strongly radioactive, relatively pure pitchblende blebs. The dark gray area is the moderately radioactive, colloform substance. The black areas of the specimen are areas where radioactivity is negative.

independent of these minerals. Most of the section, however, is composed of a conspicuous, impure, gray colloform substance (fig. 3) resembling pitchblende in microscopic appearance, but too soft to be pitchblende. It has a sort of ground mass relationship to the more coarsely crystallized minerals. A radiograph of this section (fig. 4) shows it to be less radioactive than pure pitchblende, but does show that it contains, in places, blebs of a strongly

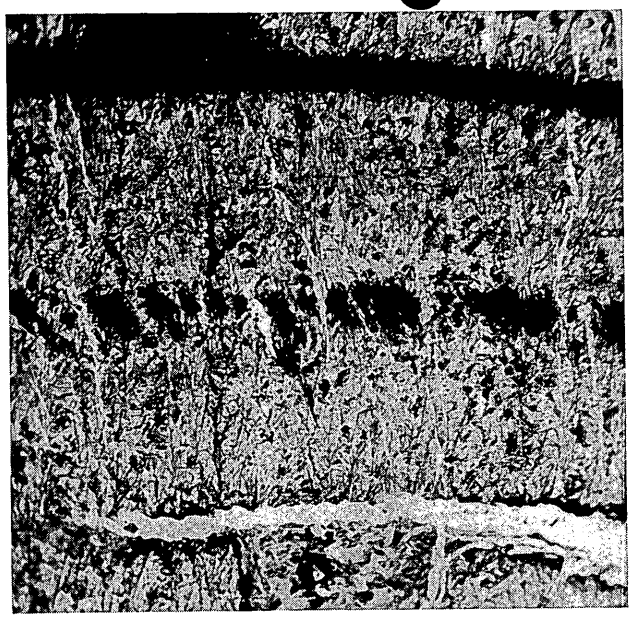

Fig. 5 — High magnification micrograph of the colloform substance shown in fig. 3. Oil emersion. X170.

radioactive mineral which has the physical, chemical, and radioactive properties of pitchblende.

Radioactive Ore under High Power Magnification: High power magnification of the colloform mixture (fig. 5) reveals an intimate mixture of a silver-white mineral and a dark gray mineral. The latter is believed to be pitchblende because of its color, habit, and reaction to reagents. The white-colored mineral is deeply etched by potassium cyanide and, when so etched and examined under high power magnification, it exhibits a deep red internal reflection. Hence, this second component is apparently a ruby silver and probably proustite which is present elsewhere in the polished section.

Conclusions

The study of the radioactivity on the surface and within the Caribou mine brings to light three observations of possible interest to those using the Geiger-Müller counter in the search for pitchblende-bearing veins.

1. The surface survey failed to detect any evidence of above normal gamma-ray intensity over the country rock or along the outcrops of the veins, and, if the Caribou mine workings had not reached a depth of 1040 ft and pitchblende discovered on the Caribou dump, the pitchblende occurrence may never have been detected.

2. On the 1040 level, as the Geiger-Müller counter was moved along the drift toward the radioactive ore body, it first registered the anomaly at a distance of approximately 160 ft from the point where the nearest channel sample returned a value for uranium (fig. 2, 1040 level profile). The writer does not believe that the intensity at this location is due to radiation penetrating the full 160 ft; it is more likely due to the result of local radiation emanating from trace amounts of a radioactive element, or elements, in the vein within 5 ft or less of the instrument.

3. Both on the surface and underground, the quartz-monzonite host rock was found to possess a normal gamma-ray count. This observation is in direct contradiction to results obtained from similar studies[5] made by the writer in the Great Bear Lake Area, N.W.T., Canada, where the host rocks of the silver-pitchblende veins were found to be approximately one and one-half times as radioactive as the adjacent, nonhost formations. Hence, the prospector in search of radioactive deposits may reason that, from the results obtained at Caribou Hill, he need not confine his attention to formations possessing higher-than-average gamma radiation.

Acknowledgment

The writer is extremely grateful to Mr. Boris Pregel, President of Consolidated Caribou Silver Mines, Inc., for making possible the original program of exploration of the Front Range uranium areas in 1945, the subsequent geological and geophysical studies of the Caribou mine, and, finally, the preparation and reading of this paper. The writer is also grateful to Mr. Elmer Hetzer, Mine Superintendent, for his cooperation and assistance with the field work.

The polished sections, micrographs, radiograph, and microscopic studies were made in the geological laboratories of Princeton University. The writer wishes to thank Professor Edward Sampson and the Department of Geology for the use of its laboratory facilities in the preparation of this report.

References

[1] Edson S. Bastin and James M. Hill: Gilpin County and Adjacent Parts of Clear Creek and Boulder Counties, Colorado. U. S. Geol. Sur. *Prof. Paper* 94 (1917), 123-125.

[2] E. N. Goddard and J. J. Glass: Deposits of Radioactive Cerite near Jamestown, Colorado. *Amer. Mineralogist* (1940) **25**, 381-404.

[3] Percy R. Alsdorf: Occurrence, Geology, and Economic Value of the Pitchblende Deposits of Gilpin County, Colorado. *Econ. Geol.* (1916) **11**, 3.

[4] E. N. Goddard: Fluorspar Deposits of the Jamestown District, Boulder County, Colorado. *Proc.* Colo. Scientific Society (1946) **15**, 1, 19.

[5] G. Carman Ridland: Use of the Geiger-Müller Counter in the Search for Pitchblende-bearing Veins at Great Bear Lake, Canada. *Trans.* AIME (1945) **164**, 117.

CONSOLIDATED CARIBOU
SILVER MINES, INC.
BOULDER, COLO.

Cyclone Thickener

Applications in the Coal Industry

by M. G. Driessen and H. E. Criner

Possible applications of cyclone thickeners for: (1) clarification of the washery water and, (2) recovery of fine coal from the plant bleed. The paper shows: (1) that it is possible to remove all particles including the very finest, from the circulating water, thus obtaining a closed water system and, (2) that reduction of the ash content of the solids of the plant bleed is feasible by means of cyclone thickeners. Performance data for different size cyclones is given in the form of graphs.

THE cyclone thickener has two important applications in wet washing plants: (1) water clarification, and (2) fine coal recovery.

The thickener consists of a conical chamber into which the fluid is injected through a tangential nozzle at the periphery of the large end. The solids of the slurry are concentrated and removed from the apex of the cone while the "thinner" portion is discharged from a central tube in a flat head at the large end, fig. 1. The advantages of the cyclone thickener are that large volumes of slurry may be treated with small space requirements and that the underflow concentration may be controlled easily and readily to meet varying feed conditions.

M. G. DRIESSEN, Member AIME, is a Consulting Engineer, Pittsburgh, Pa., and H. E. CRINER is Development Engineer, Heyl and Patterson.

New York Meeting, February 1950.

TP 2735 F. Discussion of this paper (2 copies) may be sent to Transactions *AIME before Feb. 28, 1950. Manuscript received June 29, 1949.*

Control of Washery Water Solids Concentration: The first requirement, in the process of controlling solids concentration, is that the solids be removed from the body of circulating water at the rate at which they are introduced. If this condition is satisfied the concentration will remain at a fixed value and will not increase to uncontrollable levels. The second requirement is that the solids concentration

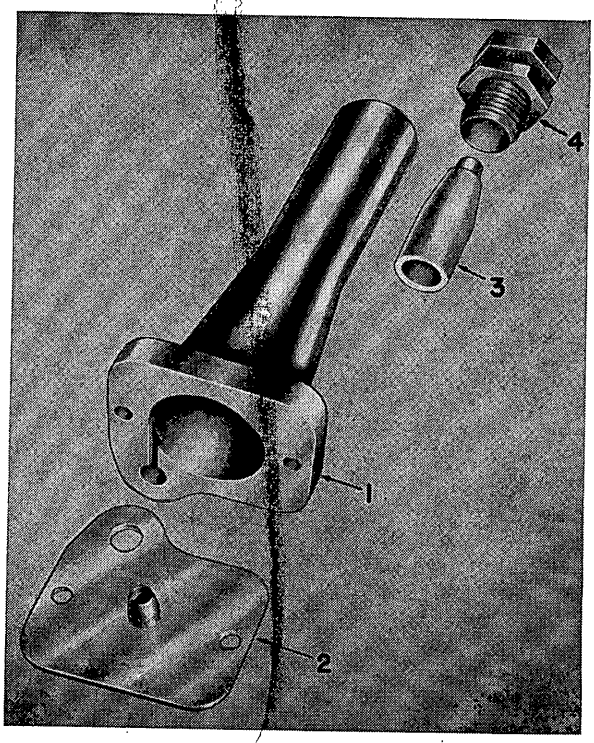

Fig. 1—A 3 in. rubber cyclone thickener.

1—Rubber cyclone body. 2—Cover with overflow opening. 3—Soft rubber orifice. 4—Nozzle retainer.

MINERALOGY OF THE RADIUM VEIN

Collection of Samples and Methods of Analysis

Samples of the vein filling were collected at three places in the raise along the Radium Vein. A number of additional specimens of high grade uraninite ore were donated by Mr. Elmer Hetzer, Mine Superintendent at Caribou, and several large high grade specimens were loaned for this study by the A.E.C. All of the loaned specimens were taken near the foot of the raise on the 1040 foot level.

Eight polished surfaces of the ore were obtained and studied with the reflecting microscope. The study yielded data on the physical properties of the uraninite, its relations with other vein minerals and the paragenesis of the vein filling. Thin sections of the ore aided the study of relations of the ore minerals to the gangue and wall rock minerals. X-ray diffraction photographs of the uraninite were made, but a pattern sufficiently good for an accurate computation of the lattice constant has not yet been obtained.

General Statement

The ore minerals recognized in the polished surface study are uraninite, pyrite, chalcopyrite, sphalerite, galena, argentite, ruby silver, and native silver. Gangue minerals represented are quartz, carbonate and barite. The existence of two characteristic assemblages of ore minerals suggests two stages in the vein formation. In Stage A, which is thought to be the earlier, quartz, sphalerite and galena were deposited. Uraninite was deposited early in Stage B. The other minerals of this stage are chalcedony, chalcopyrite, sphalerite, argentite, ruby silver, and native silver.

Uraninite

Two varieties of uraninite occur in the Caribou ore. One of these is a dense, hard, black material with pitchy luster, while the other is a soft, fine-grained, dull-lustered, porous material which coats fractures and open vugs, and in some places appears to grade into the lustrous material. The hard variety shows varying degrees of luster and hardness. Both varieties contain inclusions of pyrite and lesser amounts of other sulphides. Under the microscope the lustrous uraninite almost always shows the colloform structure which characterizes the material described from other localities, as Great Bear Lake,[1] Joachimsthal,[2] and Katanga.[3] Radially arranged fractures, some filled with pyrite, are common in the botryoidal material. Although the hardness of uraninite is given as 5 1/2, even the "hard" variety of Caribou uraninite can be scratched (with difficulty), suggesting that this material has undergone oxidation since its deposition.

1. Kidd, D. F., and Haycock, M. H., Mineragraphy of the Ores of Great Bear Lake, G.S.A. Bull., Vol. 46, 1935, pp. 879-960.
2. Zuckert, R., Die Paragenesen von Gediegen Silber und Wismut mit Kobelb-Nickel-Kiesen und der Uranpechblende zu Sb. Joachimethel, English Abstract in G.S.A. Bull., Vol. 46, 1935, pp. 942-943.
3. Thoreau, J., and Trieu de Terdonck, R. du, Le Gîte d'uranium de Shinkolowbe-Kasolo, English Abstract in G.S.A. Bull., Vol. 46, 1935, pp. 941-42.

Exhibit B

CONSOLIDATED CANYON SILVER MINES, INC. DENVER, COLO.

Form MF-103
(Revised June 1951)

UNITED STATES DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION

Budget Bureau No. 42-R1035.1

MF-103 Should Be Filed With General Technical Data Form MF-100

APPLICATION FOR AID FOR AN EXPLORATION PROJECT PURSUANT TO MINERAL ORDER 5, UNDER DEFENSE PRODUCTION ACT OF 1950

Not To Be Filled in by Applicant

Docket No. DMEA-2336
Metal or Mineral
Date Received 1-21-52
Amount $
Participation (Government %)

DEPARTMENT OF THE INTERIOR
Defense Minerals Administration
RECEIVED
JAN 21 1952

Name and address of applicant

Consolidated Caribou
Silver Mines, Inc.
1406 Pearl Street
Boulder, Colorado

Date January 7, 1952

If you have already filed MF-100, give date filed Sept. 19, 1951 type of assistance requested Aid for an exploration project.

DMA Docket Number (if available) DMA - 1887
Serialization Number MS - 2359

INSTRUCTIONS

Read Mineral Order 5, Regulations Governing Government Aid in Defense Projects, before completing this application. Submit four copies each, of the signed application form, General Technical Data Form MF-100, and answers to questions as specified, to Defense Minerals Administration, Department of the Interior, Washington 25, D. C., or to the nearest field executive office thereof, with your name and address on each sheet of the application and all accompanying papers. If you have previously filed MF-100, it is not necessary to file it again. However, you should indicate in space provided above the type of assistance previously applied for (loans, procurement contracts, etc.) and DMA Docket Number, if available. *When a question is inapplicable it should be so stated in the form.* Additional sheets should be attached in answering any questions or in supplying additional information. IF YOU CANNOT ANSWER A QUESTION, SO STATE.

1. (*a*) Give a description of the real property that will be in any way involved in the exploration project, including any existing mine or operating property.

   (*b*) If you are not the owner of the property, submit a copy of the lease, purchase option, or other agreements under which you are authorized to operate the property with each copy of your application.

   (*c*) Give the legal description of the exact parcel, plot, or area upon which the exploration is to be conducted.

   NOTE: (1) If both areas are the same, so state. The only obligation to repay the Government is from the net earnings from any commercial discovery made in the area specified in (*c*) above in which the exploration is to be conducted, and the expenditure of funds which may be charged as costs of the project must be limited to that area or to work necessary to perform the exploration in that area.

   (2) If applicant is not the owner of the property or if there are any liens or encumbrances against the property, copy of agreements of claimants, lienors, encumbrances, and lessors subordinating their interests in the property to the interest of the Government under the Exploration Project Contract will be required for attachment to the Contract.

2. (*a*) What metals or minerals do you expect to find?

   (*b*) Furnish statement of the geologic features of your property, giving type of ore deposit and reasons for expecting to find commercial ore bodies. Illustrate with maps or sketches. If you have a geologic or engineering report, or assay maps showing width and grade, please send them with application, stating whether or not you wish to have them returned.

The information requested in questions 3, 4, 5, 6, 7, 8, and 9 below should be answered specifically and in detail, as this information will be attached to and incorporated as part of the Exploration Project Contract, if such contract is entered into with you by the Government.

ANSWER EACH QUESTION ON SEPARATE SHEETS OF PAPER AND SUBMIT A COPY OF EACH ANSWER FOR EACH COPY OF YOUR APPLICATION.

3. (*a*) Describe fully the proposed work and give the total cost of the project.

   (*b*) State the time required to start the project and to complete it.

4. Submit a map or sketch of the property involved showing a plan (and cross section, if needed) of the present mine workings and the *location of the proposed exploration work* as related to geologic features, such as contacts, veins, ore-bearing beds, etc.

5. Furnish an itemized list of existing facilities, buildings, installations, and fixtures with a statement of the cost of any necessary rehabilitation or repairs to put into useful and operable condition.

6. Furnish a detailed list of additional facilities, buildings, and fixtures to be purchased, installed, or erected by you, with the estimated cost of each item.

7. Furnish a detailed list of operating equipment, separated into items to be—

   (*a*) Rented

   (*b*) Purchased

   (*c*) Furnished by you

   with the rental, purchase price, or depreciation of each item, as the case may be, to be charged as a cost of the project.

8. Furnish an itemized schedule of labor, by numbers and classes (miners, muckers, etc.) and of supervisors by numbers and positions, with the maximum wages or salaries to be paid to each.

9. Furnish a detailed list with estimated cost of each item for materials, supplies, engineering, assaying, accounting, power, water, utilities, and any other items not provided for above.

10. (*a*) How much are you prepared to invest in the proposed project?

    (*b*) Is this amount sufficient to pay your part of the cost of the project, in accordance with the regulations on Government participation (Sec. 9 of MO–5)?

11. State any conditions or circumstances regarding the property not sufficiently brought out by the foregoing questions.

CERTIFICATION

The undersigned company, and the official executing this certification on its behalf, hereby certify that the information contained in this form and accompanying papers is correct and complete to the best of their knowledge and belief.

Consolidated Caribou Silver Mines, Inc.
(Name of company)

By [signature]
(Signature of authorized official)
Donald M. Nelson

January 7, 1952
(Date)

President
(Title)

Title 18, U. S. Code (Crimes), Section 1001, makes it a criminal offense to make a willfully false statement or representation to any department or agency of the United States as to any matter within its jurisdiction.

U. S. GOVERNMENT PRINTING OFFICE 16—64067-2

DMA Form
MF - 103
Revised June, 1951

List of Exhibits

Exhibit A	"Radioactivity of the Caribou Mine" by G. C. Ridland.
Exhibit B	Page from "Mineralogical Studies of Uraninite...", U. S. Atomic Energy Commission, July 1, 1950.
Exhibit C	Assay Section "A", Caribou Mine.
Exhibit D	Assay Section D1, 1040 Level, Caribou Mine.
Exhibit E	Assay Plan, 1140 Level, Caribou Mine.
Exhibit F	Plan of 1040-D1 and 1040-D2, Caribou Mine.
Exhibit G	Assay Plan of 920 Level, Caribou Mine.
Exhibit H	Assay Section of 1040 Level, Sect. D., Caribou Mine.
Exhibit J	Plan and Vertical Projection Showing Proposed Uranium Exploration Program.

Note: Exhibits A and B attached at end of application.

Exhibits C through J in pocket.

CONSOLIDATED CARIBOU
SILVER MINES, LTD.
BOULDER, COLO

DMA Form
MF - 103
Revised June, 1951

APPLICATION FOR AID FOR AN
EXPLORATION PROJECT PURSUANT TO
MINERAL ORDER 5, UNDER
DEFENSE PRODUCTION ACT OF 1950

1. (a) Description of the real property, including the operating Caribou Mine

A legal description of the real property is given in 1. (c). The area to be explored consists of a part of the operating Caribou mine.

The Caribou mine consists of a three-compartment inclined shaft, reaching an inclined depth of 1040 feet, with an outside dimension of 5' X 15'. The shaft is equipped with an electric hoist at the 500 Level and is not in use above the 500 Level. Levels are established below the 500 Level at 530, 600 740, 800, 920, 980, and 1040. It is connected to the surface on the 500 Level by a 3,636-foot long transportation tunnel. This tunnel, called the Idaho Tunnel, is electrically lighted and equipped with 30-pound, 24-inch gauge railway track, a ditch to drain the water pumped from the Caribou shaft, and an adequate fleet of ore cars and storage battery locomotives.

The portal of the Idaho Tunnel is protected by a snow shed. Adjacent to the portal is a 72' X 28' building containing the compressor room, shop, storage and change room. Beyond the portal on the edge of the dump is a building housing a sorting belt and ore bins.

Compressed air is generated by 3 compressors driven by electric motors with a total of 250 H.P. furnishing 1600 c.f.m. at a pressure of 105 lbs. per sq. in. (Elevation approximately 10,000 feet.)

The property is also equipped with drills, accessories and small tools, trucks, etc.

SOUTHWESTERN GARNETS
SAND MINES, INC.
BOULDER, COLO.

DMA Form
MF - 103
Revised June, 1951

1. (b) The applicant is the sole owner of the property and all equipment on the premises. Title to the property is insured.

1. (c) Legal description of area to be explored

Patented Claims

Name	U.S. Survey Lot Number
Caribou Lode	37
Kalamazoo Lode	76
No Name Lode	77
Federal Lode	91
Sherman Lode	93
Socorro Lode	104
Hidden Treasure Lode	105
Columbia Lode	167
Spencer Lode	168
Non Pariel Lode	6853
Poorman Lode	42
Silver Dollar Lode	654
Carry Lode	660
California Lode	20483
North Park Lode	20483
Toledo Lode	20483

All located in Sections 5 and 8, T. 1S., R. 73 W. of the 6th P.M.

1. (c) Note (1) Areas referred to by 1. (a) and 1. (b) are the same.

1. (c) Note (2) The real and personal property owned by the company, constituting all of the fixed assets except certain furniture and fixtures, is subject to a deed of trust securing a note payable to a stockholder in the amount of $200,000.00.

2. (a) Pitchblende is the mineral expected to be found.

CONSOLIDATED CARBON
SPECIALTIES, INC.
DENVER, COLO.

DMA Form
MF - 103
Revised June, 1951

2. (b) Geological features

Introduction

In September, 1943, an extensive exploration program was undertaken for uranium deposits. One of the first steps in this program was to compile a list of published accounts of uranium deposits. The literature at that time made note of the occurence of pitchblende at several places in the Front Range of the Colorado Rocky Mountains. These occurrences lie in a region extending from Jamestown, Boulder County, Colorado, to Lawson, Clear Creek County, Colorado, a distance of 27 miles. This section of the Front Range is noted for its production of gold, silver, fluorspar, tungsten, copper, lead, and zinc, as well as uranium.

General Geology

A closer study of this region brought to light a silver mining district known as Caribou Hill where a group of mines are reported to have produced over $8,000,000 in silver, largely in the period between 1869 and 1894. The close association of pitchblende and silver is well-known. Geological literature usually refers to the ore-bearing veins at the well-known uranium districts of Great Bear Lake, Canada, and Joachimsthal, Czechoslovakia, as silver-pitchblende veins. Silver is also an important by-product in the production of uranium from the pitchblende deposits at Shinkolobwe, Belgian Congo.

After studying the regional geology of the Jamestown-Lawson area, it became apparent that the geological setting of the Caribou Hill district was most favorable for the occurrence of pitchblende. The majority of the rock-types of the region are metamorphosed sediments and granitic intrusives of pre-Cambrian age. The Caribou veins occur in a medium-grained quartz monzonite stock that is believed to be of Tertiary (?) age. The silver-pitchblende veins of the Contact mine at Great Bear Lake occur in a medium-grained granodiorite stock of approximately the same size, texture and mineral composition. The similarity of the geology of the two regions is striking. (The only noticeable difference is in the lack of nickel and cobalt mineralization at Caribou, which is prevalent at Great Bear Lake.

CONSOLIDATED CARIBOU
SILVER MINES, INC.
DENVER, COLO.

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2. (b) Geological features (Con't.)

The examination of the surface of the Caribou Hill area was rewarded with the discovery of pitchblende in vein material on the Caribou Mine Dump.

Caribou Pitchblende Deposits

The Caribou mine and much of the adjacent ground were acquired for the applicant, and, early in 1947, work began in rehabilitating and dewatering the old mine workings. As the water was lowered, a systematic search was made for pitchblende. The radioactivity of the old stopes and drifts was measured with a Geiger-Mueller counter. Normal activity was encountered on the surface and down to the 300 Level. On the 360 Level a small "high" was noted with a reading of almost twice the normal background. The 420, 470, and 500 Levels were negative. The 550 Level registered noticeably above the normal background, but not of sufficient intensity to expect a visible occurrence of pitchblende. The 600, 670, 740, 800, and 860 Levels were found to be negative again. The 920 Level gave a mildly higher count until almost to the northeast end of the drift. Here it jumped suddenly to 3 times the normal count.

Not until the bottom level of the mine was finally dewatered did the instrument detect intense radioactivity and did pitchblende make its appearance. The importance of this discourse is in the fact that radioactive anomalies were found at 360, 550, 920, and finally, at 1040 feet vertically below the surface in ever-increasing intensity. This logically leads one to consider the possibilities that pitchblende may be found in increasing concentration below the 1040 Level. Attached as Exhibit A is a copy of a more detailed account of the "Radioactivity of the Caribou Mine", by G. C. Ridland. (Mining Engineering, Vol. 187, January, 1950, A.I.M.E. Transactions).

Pitchblende occurs on the 1040 Level in a continuous black seam 1 to 16 inches wide which appears 45 feet southwest of the junction of the No Name and Radium veins, 1040 Level. The black streak follows the footwall of the ore to the junction, then the center of the Radium vein for an additional 110 feet. This black material is radioactive and intensely so at places. It is friable and has an earthy luster and readily stains the fingers when handled. Veinlets

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2. (b) Geological features (Con't.)

of an easily shattered, black, vitreous, colloform pitchblende form part of the dark streak, and galena, sphalerite, ruby silver and colloform pyrite are also readily identifiable.

A detailed mineralogical description is given in a report by Harold D. Wright (Mineralogical Studies of Uraninite and Uraninite-bearing Deposits, July 1, 1949 - June 30, 1950; Raw Materials Operation, U. S. Atomic Energy Commission, P. O. Box 30, New York 23, New York, July 1, 1950), which reads in part as follows:

> "Two varieties of uraninite occur in the Caribou ore. One of these is a dense, hard black material with pitchy luster, while the other is a soft, fine-grained, dull-lustered, porous material which coats fractures and open vugs, and in some places appears to grade into the lustrous material. The hard variety shows varying degrees of luster and hardness. Both varieties contain inclusions of pyrite and lesser amounts of other sulphides. Under the microscope the lustrous uraninite almost always shows the colloform structure which characterizes the material described from other localities, as Great Bear Lake, Joachimsthal, and Katanga. Radially arranged fractures, some filled with pyrite, are common in the botryoidal material. Although the hardness of uraninite is given as 5½, even the "hard" variety of Caribou uraninite can be scratched (with difficulty), suggesting that this material has undergone oxidation since its deposition."

(A more complete photostat copy of the description is attached to this application as Exhibit B.)

The following table shows assay results of channel samples taken along the vein in this area. Please note that a 3-foot round was taken out of the back of the drift to freshen-up the exposure and some of the samples were taken 10 feet above the track instead of 7 feet (the original back). Also additional exploratory stoping raised the back to 17 feet above the track and samples from this horizon are also included. (See also Assay Section 1040 Level, Section D, Exhibit H.)

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2. (b) Geological features (Con't.)

Sample No.	Approx. Distance from the Caribou Shaft (feet)	Distance above Track (feet)	Width (inches)	U_3O_8 %
1311	405	10	39	0.08
1322	407	10	18	0.34
448	410	7	72	Nil
1310	415	10	31	0.12
1321	417	10	18	0.30
447	420	7	72	Nil
1306	425	10	36	0.27
1320	425	10	18	0.14
440	428	7	4	Nil
439	432	7	12	Nil
1307	435	10	33	0.34
1319	435	10	18	0.24
438	437	7	14	Nil
1308	445	17	36	0.20
1318	445	17	18	0.34
437	450	7	10	Nil
1309	455	17	32	0.24
1317	455	17	18	0.38
1315	465	17	16	0.43
436	473	7	18	0.05
1268	480	10	4	0.34
1316	480	10	18	0.34
1301	480	17	35	0.24
1266	485	10	15	0.24
1457	490	7	12	0.37
1267	490	10	15	0.19
1302	490	17	36	0.19
1314	490	17	18	0.38
1269	495	10	8	0.52
1455	500	7	35	Nil
1271	500	10	16	7.58
1303	500	17	37	0.16
1313	500	17	24	3.15
1270	505	10	12	0.67
434	510	7	36	Nil
1304	510	17	36	0.54
1312	510	17	18	0.48
433	520	7	12	Nil
1305	520	17	36	0.68

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2. (b) Geological features (Con't.)

Subsequent Development of the Radioactive Occurrence

The applicant first drove a raise (1040-A) from the 1040 Level to the 920 Level (see Assay Section "A", Exhibit C) on the pitchblende-bearing ore. Pitchblende continued in important concentration in the raise for 43 feet above the 1040 Level. Channel samples in the raise show the following uranium values:

Sample No.	Distance above Track (feet)	Width (inches)	U_3O_8 %
1130	113	48	0.02
1340	101	48	0.08
1339	89	54	0.05
1338	80	50	0.06
1337	70	46	0.06
1355	59	43	0.07
1333	55	48	0.08
1329	47	48	0.06
1114	39	24	1.26
1107	27	48	0.02
1313	18	24	3.15
1303	15	37	0.16
1260	8	8	0.52

This raise was followed by the sinking of a winze almost directly below the raise to the 1140 Level (Assay Section "A", Exhibit C). The Radium and No Name veins were opened by 182 feet of drifting on the 1140 Level (See Assay Plan of the 1140 Level, Exhibit E). Uranium was encountered in the winze in commercial quantities to a depth of 22 feet below the 1040 Level and uranium values were encountered in the No Name vein, 1140-D1 drift.

Under contract with the U. S. Atomic Energy Commission, the applicant subsequently extended the 1040-D2 and 920-D2 drifts east on the Radium vein.

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BOULDER, COLO

2. (b) Geological features (Con't.)

for distances of 350 and 260 feet, respectively, and both headings encountered pitchblende (Plan of 1040-D1 and D2, Exhibit F and Assay Plan of 920 Level, Exhibit G).

Finally, under contract with the U. S. Atomic Energy Commission, a second raise (558) was driven up 83 feet above track from the 1040 Level at a point 240 feet east of the 1040-A riase on the Radium vein and the following uranium values were obtained in channel samples (Assay Section D1, Exhibit D):

Distance above Track (feet)	Width (inches)	U_3O_8 %
83	10	0.08
78	8	0.17
70	10	0.34
64	9	0.05
55	10	0.73
40	16	0.10
18	12	0.96

In each of these projects, pitchblende has been encountered, and the zone in which it occurs in the Radium and No Name veins may now be said to extend vertically for 300 feet and horizontally for 360 feet. The continuous high-grade section at the 1040 Level may be said to have a proven horizontal length of 115 feet and a vertical distance of 65 feet, with a width varying from inches to 4 feet. A second continuous section of importance appears to be developing in the 558 raise. It now has a vertical height of 83 feet and widths from 8 to 16 inches.

The Exploration Project

The applicant now desires to explore the Radium and No Name veins on newly-established 1290, 1440, and 1590 Levels at depths of 250, 400, and 550 feet, respectively (Exhibit J), below the 1040 Level (the bottom of the Caribou shaft). The reasons for expecting to find commercial occurrences of pitchblende are summarized here:

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2. (b) Geological features (Con't.)

1. The regional geological setting makes the Caribou Hill area a most logical place for the occurrence of uranium.

2. Pitchblende has been found in small commercial bodies in the Radium and No Name veins of the Caribou mine, and subsequent development on and above the 1140 Level has shown the deposits to occur over more extensive sections of the veins than to the extent of the original showings. The next, logical step is to explore the ground below the 1140 Level.

3. Pitchblende, the primary form of uranium deposition, theoretically, is deposited by hot, aqueous, ascending solutions. The occurrences on and above the 1140 Level of the Caribou mine have the characteristics of being the upper-most fringes of such upward extending depositions. Hence, larger, more highly concentrated uranium deposits reasonably may be expected below the bottom levels of the Caribou mine.

4. Each radioactive anomally, or radioactive occurrence, was found to be successively larger and more intense as depth is gained in the Caribou workings. Hence, at least to the 1040 Level, the radioactivity of the deposits is ever increasing.

5. In similar silver-pitchblende veins in other districts pitchblende has been found to improve with depth. Two examples may be cited:

a. At the Eldorado mine, Great Bear Lake, Canada, the No. 2 vein began at the surface with silver in preponderance, although pitchblende was present. Below the 500-foot level, the vein has produced almost no silver, whereas pitchblende ore bodies have been mined to more than 1,000 feet below the surface. In the No. 1 vein, little or no pitchblende is visible at the surface, yet the vein became the main producer below 1,000 feet in depth.

b. At the Werner mine, Joachimsthal, Czechoslovakia, pitchblende was encountered in only small quantities in the upper levels, below 262 meters it appeared in increasing quantities, and

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2. (b) Geoligical features (Con't.)

below 376 meters it became the only valuable constituent of the ore. Not only in the Werner mine, but in the district as a whole, uranium tends to increase with depth.

6. In two productive silver mines, as in the Caribou mine, pitchblende has been found in the lower levels. In the Sunshine mine, Coeur d'Alene District, Idaho, no trace of pitchblende was found until the 3100 Level (3100 feet below the surface) was reached. It is reported to occur in a zone between the 3100 and 3700 Levels. In the Jo Reynolds mine, Lawson, Colorado, pitchblende was not encountered until the area between the 900 and 1000 Levels was opened up (900 feet below the surface). The continuity and improvement with depth in these mines only will be determined as the workings are deepened, but the point of particular interest is that these silver mines, like Caribou, encountered pitchblende in their current lowest levels as their silver ores were followed downward. These mines may just be reaching zones containing workable deposits of uranium.

For these six reasons, the applicant believes the projected depth program of exploration is warranted. In 1948, the applicant's geologists, Dr. G. C. Ridland and Dr. E. E. Wahlstrom, recommended that the mine workings be deepened and Wahlstrom went so far as to warn that the future of the property depended on the extension of the development work below the 1040 Level.

(The applicant would appreciate the return of the attached assay maps when the DMA has no further use for them.)

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3. (a) Proposed work and cost

Project	Cost ($)	Time (Months)
Sink Caribou shaft 600 feet from the 1040 Level to the 1640 Level. 600 feet @ $200/ft.....	$120,000	10
Cross-cut 100 feet from shaft to No Name vein on the 1290, 1440 and 1590 Levels, 300 feet @ $30/ft.....	9,000	2
Drift 100 feet NE on the No Name vein on the 1290, 1440, and 1590 Levels to the Radium vein intersection and continue an additional 100 feet, on the No Name vein. 600 feet @ $30/ft.....	18,000	2
Drift E 400 feet on the Radium vein on the 1290, 1440 and 1590 Levels. 1,200 feet @ $30/ft.....	36,000	5
Extend drift 150 feet on the No Name vein, 1590 Level, NE to establish a diamond drill station. 150 feet @ $35/ft.....	5,250	2*
Raise 150 feet from the 1290, 1440 and 1590 Levels. 450 feet @ $30/ft.....	13,500	3
Diamond drill 10,000 feet of EX core. 10,000 feet @ $6/ft.....	60,000	4*
Total Cost.....	$261,750	
Total Estimated Time.....		22 months

3. (b) Time required to start project

Five days after the signing of the DMA contract.

* Concurrent with other projects.

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3. (b) (Con't.)

Estimated time required to complete project

Twenty-two months after project is started.

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4. Map showing plan and vertical projection of the proposed exploration work is attached as Exhibit J.

The diamond drilling program is designed to test the ground on and below the deepest, 1590 Level, and is proposed only for the 1590 Level. Diamond drilling is not proposed for the 1290 of 1440 Levels.

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SPAR MINES, INC.
DENVER, COLO.

5. The Caribou mine is operating and is equipped with buildings and some machinery. All the facilities, installations and fixtures listed below will be devoted to the exploration project. No rehabilitation or repairs are necessary.

1. Electric power, connected.

2. Telephone, connected.

3. Water, more than adequate from mine drainage.

4. Caribou shaft 5' X 15' outside dimension from 500 to 920 Level, and 5' X 10' from the 920 to the 1040 Level.

5. Idaho Adit Tunnel on the 500 Level. It is electrically lighted and equipped with 30-pound, 24-inch gauge railway track, and ditch to drain the water pumped from the bottom of the Caribou shaft.

Buildings:

Compressor house - housing compressor, shop, stores, and change room.

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6. No additional facilities, buildings or fixtures to be installed, purchased or erected.

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7. (a) To be rented: None

7. (b) To be purchased:

Sinking hoist.....	$ 2,500
Cable, Sheave wheel, bucket and misc.....	500
Sump Pump.....	1,000
6 Blowers, 5 H.P. Motors.....	600
1 Eimco mucking machine.....	3,500
1 Hoist, double drum for 1500 foot depth.....	6,000
8 Mine cars, Card, Z-16, 16 cu. ft. @ $200/ea.....	1,600
4 Jackhammers, Joy L-57, 55 lb. @ $400/ea.....	1,600
4 Drifters, 2 in. Joy T-300, @ $975/ea.....	3,900
4 Stopers, Joy S-19, 96 lb. @ $800/ea.....	3,200
3 Tugger hoists, air motor, 500'' capacity.....	1,000

7. (c) To be furnished by operator:

Equipment	Present Value	Monthly Depreciation
Storage battery locomotive.....	$ 5,000	$ 65
Adequate fleet 1-ton cars on 500 Level, 20 cars @ $100/ea.....	2,000	35
Compressor.....	4,000	60
Pick-up truck.....	1,500	30
Hoist on 500 Level.....	2,000	35
Pump on 980 Level.....	1,500	30
Mine transit and misc. instruments.....	600	10

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8. Labor and supervision

1 Mine superintendent	@	$ 500/mo.
1 Engineer	@	400/mo.
1 Geologist	@	400/mo.
1 Bookkeeper	@	150/mo.
2 Supervisors (shift bosses)	@	15/day
8 Miners	@	2/hr.
8 Muckers	@	2/hr.
2 Hoistmen	@	1.75/hr.
4 Timbermen	@	2/hr.
4 Trammers	@	1.75/hr.
1 Surface man	@	1.75/hr.

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9. Supplies

Explosives	$ 15,760
Drill steel and bits	6,000
Timber	6,600
600' Pipe, air-line, 3" @ 75¢/ft	450
2,100' Pipe, air-line, 2" @ 40¢/ft	840
2,100' Track, 12 lbs. @ $1.75/ft. laid down	3,675
600' Pipe, water-line, 2½" @ 60¢/ft	360
1,100' Pipe, water-line, 1½" @ 30¢/ft	330
1,100' Pipe, water-line, 1" @ 25¢/ft	275
2,100' Ventilation pipe, galvanized, 6" @ 60¢/ft	1,260
650 Power cables, 3 conductor, size 4	450
1,000' Power cable, 600 v. 3 conductor, size 8	250
Hand-tools and miscellaneous supplies, 2-year supply	2,000
Total Supplies	$ 38,250

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10. (a) Applicant is prepared to invest $26,175, which is 10% of the estimated cost of the proposed project.

10. (b) This amount is sufficient to pay applicant's part of the cost of the project.

CONSOLIDATED CANYON
STEEL PIPES, INC.
DENVER, COLO.

11. At the present time, the Caribou mine is operating. Two development projects are underway:

(a) Drifting in the west side of the mine on the 1040 and 920 Levels to develop silver-lead-zinc ore bodies. This work is being financed by the mining and milling of ore encountered in the development headings and by some stoping on the 1040 Level.

(b) The applicant has contracted with the U. S. Atomic Energy Commission to do certain exploration work in the radioactive section of the mine on and above the 1040 Level, only. At this time, the 740 Level is being rehabilitated so that the AEC program may be resumed.

It is the intention of the applicant to conduct the DMA program herein proposed without interferring with the above two projects. If the above projects are continuing contemporaneously with the DMA program, then the general mine expense, such as supervision, engineering, geology, bookkeeping, hoisting from the 1040 Level, 500 Level tramming, and power will be proportioned to the individual projects, thus reducing the unit cost of the DMA project from the estimate presented herein.

CONSOLIDATED CARIBOU
SILVER MINES, INC.
BOULDER, COLO.

Form MF-103
(Revised June 1951)

UNITED STATES DEPARTMENT OF THE INTERIOR
DEFENSE MINERALS ADMINISTRATION

Budget Bureau No. 42-R1035.1.

MF-103 Should Be Filed With General Technical Data Form MF-100

APPLICATION FOR AID FOR AN EXPLORATION PROJECT PURSUANT TO MINERAL ORDER 5, UNDER DEFENSE PRODUCTION ACT OF 1950

Not To Be Filled in by Applicant

Docket No. DMEA-2336
Metal or Mineral
Date Received 1-21-52
Amount $
Participation (Government %)

DEPARTMENT OF THE INTERIOR
Defense Minerals Administration
RECEIVED
JAN 21 1952

Name and address of applicant

Consolidated Caribou
Silver Mines, Inc.
1406 Pearl Street
Boulder, Colorado

Date January 7, 1952

If you have already filed MF-100, give date filed Sept. 19, 1951, type of assistance requested Aid for an exploration project.

DMA Docket Number (if available) DMA - 1887
Serialization Number MS - 2359

INSTRUCTIONS

Read Mineral Order 5, Regulations Governing Government Aid in Defense Projects, before completing this application. Submit four copies each, of the signed application form, General Technical Data Form MF-100, and answers to questions as specified, to Defense Minerals Administration, Department of the Interior, Washington 25, D. C., or to the nearest field executive office thereof, with your name and address on each sheet of the application and all accompanying papers. If you have previously filed MF-100, it is not necessary to file it again. However, you should indicate in space provided above the type of assistance previously applied for (loans, procurement contracts, etc.) and DMA Docket Number, if available. *When a question is inapplicable it should be so stated in the form.* Additional sheets should be attached in answering any questions or in supplying additional information. IF YOU CANNOT ANSWER A QUESTION, SO STATE.

1. (*a*) Give a description of the real property that will be in any way involved in the exploration project, including any existing mine or operating property.

   (*b*) If you are not the owner of the property, submit a copy of the lease, purchase option, or other agreements under which you are authorized to operate the property with each copy of your application.

   (*c*) Give the legal description of the exact parcel, plot, or area upon which the exploration is to be conducted.

   NOTE: (1) If both areas are the same, so state. The only obligation to repay the Government is from the net earnings from any commercial discovery made in the area specified in (*c*) above in which the exploration is to be conducted, and the expenditure of funds which may be charged as costs of the project must be limited to that area or to work necessary to perform the exploration in that area.

   (2) If applicant is not the owner of the property or if there are any liens or encumbrances against the property, copy of agreements of claimants, lienors, encumbrances, and lessors subordinating their interests in the property to the interest of the Government under the Exploration Project Contract will be required for attachment to the Contract.

2. (*a*) What metals or minerals do you expect to find?

   (*b*) Furnish statement of the geologic features of your property, giving type of ore deposit and reasons for expecting to find commercial ore bodies. Illustrate with maps or sketches. If you have a geologic or engineering report, or assay maps showing width and grade, please send them with application, stating whether or not you wish to have them returned.

The information requested in questions 3, 4, 5, 6, 7, 8, and 9 below should be answered specifically and in detail, as this information will be attached to and incorporated as part of the Exploration Project Contract, if such contract is entered into with you by the Government.

ANSWER EACH QUESTION ON SEPARATE SHEETS OF PAPER AND SUBMIT A COPY OF EACH ANSWER FOR EACH COPY OF YOUR APPLICATION.

3. (*a*) Describe fully the proposed work and give the total cost of the project.

   (*b*) State the time required to start the project and to complete it.

4. Submit a map or sketch of the property involved showing a plan (and cross section, if needed) of the present mine workings and the *location of the proposed exploration work* as related to geologic features, such as contacts, veins, ore-bearing beds, etc.

5. Furnish an itemized list of existing facilities, buildings, installations, and fixtures with a statement of the cost of any necessary rehabilitation or repairs to put into useful and operable condition.

6. Furnish a detailed list of additional facilities, buildings, and fixtures to be purchased, installed, or erected by you, with the estimated cost of each item.

7. Furnish a detailed list of operating equipment, separated into items to be—

   (*a*) Rented

   (*b*) Purchased

   (*c*) Furnished by you

   with the rental, purchase price, or depreciation of each item, as the case may be, to be charged as a cost of the project.

8. Furnish an itemized schedule of labor, by numbers and classes (miners, muckers, etc.) and of supervisors by numbers and positions, with the maximum wages or salaries to be paid to each.

9. Furnish a detailed list with estimated cost of each item for materials, supplies, engineering, assaying, accounting, power, water, utilities, and any other items not provided for above.

10. (*a*) How much are you prepared to invest in the proposed project?

    (*b*) Is this amount sufficient to pay your part of the cost of the project, in accordance with the regulations on Government participation (Sec. 9 of MO–5)?

11. State any conditions or circumstances regarding the property not sufficiently brought out by the foregoing questions.

CERTIFICATION

The undersigned company, and the official executing this certification on its behalf, hereby certify that the information contained in this form and accompanying papers is correct and complete to the best of their knowledge and belief.

Consolidated Caribou Silver Mines, Inc.
(Name of company)

By Donald M. Nelson
(Signature of authorized official)
Donald M. Nelson

January 7, 1952
(Date)

President
(Title)

Title 18, U. S. Code (Crimes), Section 1001, makes it a criminal offense to make a willfully false statement or representation to any department or agency of the United States as to any matter within its jurisdiction.

U. S. GOVERNMENT PRINTING OFFICE 16—64067-2

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List of Exhibits

Exhibit A	"Radioactivity of the Caribou Mine" by G. C. Ridland.
Exhibit B	Page from "Mineralogical Studies of Uraninite...", U. S. Atomic Energy Commission, July 1, 1950.
Exhibit C	Assay Section "A", Caribou Mine.
Exhibit D	Assay Section D1, 1040 Level, Caribou Mine.
Exhibit E	Assay Plan, 1140 Level, Caribou Mine.
Exhibit F	Plan of 1040-D1 and 1040-D2, Caribou Mine.
Exhibit G	Assay Plan of 920 Level, Caribou Mine.
Exhibit H	Assay Section of 1040 Level, Sect. D., Caribou Mine.
Exhibit J	Plan and Vertical Projection Showing Proposed Uranium Exploration Program.

Note: Exhibits A and B attached at end of application.

Exhibits C through J in pocket.

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SILVER MINES, LTD.
BOULDER, COLO.

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APPLICATION FOR AID FOR AN
EXPLORATION PROJECT PURSUANT TO
MINERAL ORDER 5, UNDER
DEFENSE PRODUCTION ACT OF 1950

1. (a) Description of the real property, including the operating Caribou Mine

A legal description of the real property is given in 1. (c). The area to be explored consists of a part of the operating Caribou mine.

The Caribou mine consists of a three-compartment inclined shaft, reaching an inclined depth of 1040 feet, with an outside dimension of 5' X 15'. The shaft is equipped with an electric hoist at the 500 Level and is not in use above the 500 Level. Levels are established below the 500 Level at 530, 600 740, 800, 920, 980, and 1040. It is connected to the surface on the 500 Level by a 3,636-foot long transportation tunnel. This tunnel, called the Idaho Tunnel, is electrically lighted and equipped with 30-pound, 24-inch gauge railway track, a ditch to drain the water pumped from the Caribou shaft, and an adequate fleet of ore cars and storage battery locomotives.

The portal of the Idaho Tunnel is protected by a snow shed. Adjacent to the portal is a 72' X 28' building containing the compressor room, shop, storage and change room. Beyond the portal on the edge of the dump is a building housing a sorting belt and ore bins.

Compressed air is generated by 3 compressors driven by electric motors with a total of 250 H.P. furnishing 1600 c.f.m. at a pressure of 105 lbs. per sq. in. (Elevation approximately 10,000 feet.)

The property is also equipped with drills, accessories and small tools, trucks, etc.

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1. (b) The applicant is the sole owner of the property and all equipment on the premises. Title to the property is insured.

1. (c) Legal description of area to be explored

Patented Claims

Name	U.S. Survey Lot Number
Caribou Lode	37
Kalamazoo Lode	76
No Name Lode	77
Federal Lode	91
Sherman Lode	93
Socorro Lode	104
Hidden Treasure Lode	105
Columbia Lode	167
Spencer Lode	168
Non Pariel Lode	6853
Poorman Lode	42
Silver Dollar Lode	654
Carry Lode	660
California Lode	20483
North Park Lode	20483
Toledo Lode	20483

All located in Sections 5 and 8, T. 1S., R. 73 W. of the 6th P.M.

1. (c) Note (1) Areas referred to by 1. (a) and 1. (b) are the same.

1. (c) Note (2) The real and personal property owned by the company, constituting all of the fixed assets except certain furniture and fixtures, is subject to a deed of trust securing a note payable to a stockholder in the amount of $200,000.00.

2. (a) Pitchblende is the mineral expected to be found.

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2. (b) Geological features

Introduction

In September, 1943, an extensive exploration program was undertaken for uranium deposits. One of the first steps in this program was to compile a list of published accounts of uranium deposits. The literature at that time made note of the occurence of pitchblende at several places in the Front Range of the Colorado Rocky Mountains. These occurrences lie in a region extending from Jamestown, Boulder County, Colorado, to Lawson, Clear Creek County, Colorado, a distance of 27 miles. This section of the Front Range is noted for its production of gold, silver, fluorspar, tungsten, copper, lead, and zinc, as well as uranium.

General Geology

A closer study of this region brought to light a silver mining district known as Caribou Hill where a group of mines are reported to have produced over $8,000,000 in silver, largely in the period between 1869 and 1894. The close association of pitchblende and silver is well-known. Geological literature usually refers to the ore-bearing veins at the well-known uranium districts of Great Bear Lake, Canada, and Joachimsthal, Czechoslovakia, as silver-pitchblende veins. Silver is also an important by-product in the production of uranium from the pitchblende deposits at Shinkolobwe, Belgian Congo.

After studying the regional geology of the Jamestown-Lawson area, it became apparent that the geological setting of the Caribou Hill district was most favorable for the occurrence of pitchblende. The majority of the rock-types of the region are metamorphosed sediments and granitic intrusives of pre-Cambrian age. The Caribou veins occur in a medium-grained quartz monzonite stock that is believed to be of Tertiary (?) age. The silver-pitchblende veins of the Contact mine at Great Bear Lake occur in a medium-grained granodiorite stock of approximately the same size, texture and mineral composition. The similarity of the geology of the two regions is striking. (The only noticeable difference is in the lack of nickel and cobalt mineralization at Caribou, which is prevalent at Great Bear Lake.

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2. (b) Geological features (Con't.)

The examination of the surface of the Caribou Hill area was rewarded with the discovery of pitchblende in vein material on the Caribou Mine Dump.

Caribou Pitchblende Deposits

The Caribou mine and much of the adjacent ground were acquired for the applicant, and, early in 1947, work began in rehabilitating and dewatering the old mine workings. As the water was lowered, a systematic search was made for pitchblende. The radioactivity of the old stopes and drifts was measured with a Geiger-Mueller counter. Normal activity was encountered on the surface and down to the 300 Level. On the 360 Level a small "high" was noted with a reading of almost twice the normal background. The 420, 470, and 500 Levels were negative. The 530 Level registered noticeably above the normal background, but not of sufficient intensity to expect a visible occurrence of pitchblende. The 600, 670, 740, 800, and 860 Levels were found to be negative again. The 920 Level gave a mildly higher count until almost to the northeast end of the drift. Here it jumped suddenly to 3 times the normal count.

Not until the bottom level of the mine was finally dewatered did the instrument detect intense radioactivity and did pitchblende make its appearance. The importance of this discourse is in the fact that radioactive anomalies were found at 360, 530, 920, and finally, at 1040 feet vertically below the surface in ever-increasing intensity. This logically leads one to consider the possibilities that pitchblende may be found in increasing concentration below the 1040 Level. Attached as Exhibit A is a copy of a more detailed account of the "Radioactivity of the Caribou Mine", by G. C. Ridland. (Mining Engineering, Vol. 187, January, 1950, A.I.M.E. Transactions).

Pitchblende occurs on the 1040 Level in a continuous black seam 1 to 16 inches wide which appears 45 feet southwest of the junction of the No Name and Radium veins, 1040 Level. The black streak follows the footwall of the ore to the junction, then the center of the Radium vein for an additional 110 feet. This black material is radioactive and intensely so at places. It is friable and has an earthy luster and readily stains the fingers when handled. Veinlets

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2. (b) Geological features (Con't.)

of an easily shattered, black, vitreous, colloform pitchblende form part of the dark streak, and galena, sphalerite, ruby silver and colloform pyrite are also readily identifiable.

A detailed mineralogical description is given in a report by Harold D. Wright (Mineralogical Studies of Uraninite and Uraninite-bearing Deposits, July 1, 1949 - June 30, 1950; Raw Materials Operation, U. S. Atomic Energy Commission, P. O. Box 30, New York 23, New York, July 1, 1950), which reads in part as follows:

> "Two varieties of uraninite occur in the Caribou ore. One of these is a dense, hard black material with pitchy luster, while the other is a soft, fine-grained, dull-lustered, porous material which coats fractures and open vugs, and in some places appears to grade into the lustrous material. The hard variety shows varying degrees of luster and hardness. Both varieties contain inclusions of pyrite and lesser amounts of other sulphides. Under the microscope the lustrous uraninite almost always shows the colloform structure which characterizes the material described from other localities, as Great Bear Lake, Joachimsthal, and Katanga. Radially arranged fractures, some filled with pyrite, are common in the botryoidal material. Although the hardness of uraninite is given as 5½, even the "hard" variety of Caribou uraninite can be scratched (with difficulty), suggesting that this material has undergone oxidation since its deposition."

(A more complete photostat copy of the description is attached to this application as Exhibit B.)

The following table shows assay results of channel samples taken along the vein in this area. Please note that a 3-foot round was taken out of the back of the drift to freshen-up the exposure and some of the samples were taken 10 feet above the track instead of 7 feet (the original back). Also additional exploratory stoping raised the back to 17 feet above the track and samples from this horizon are also included. (See also Assay Section 1040 Level, Section D, Exhibit H.)

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2. (b) Geological features (Con't.)

Sample No.	Approx. Distance from the Caribou Shaft (feet)	Distance above Track (feet)	Width (inches)	U_3O_8 %
1311	405	10	39	0.08
1322	407	10	18	0.34
448	410	7	72	Nil
1310	415	10	31	0.12
1321	417	10	18	0.30
447	420	7	72	Nil
1306	425	10	36	0.27
1320	425	10	18	0.14
440	428	7	4	Nil
439	432	7	12	Nil
1307	435	10	33	0.34
1319	435	10	18	0.24
438	437	7	14	Nil
1308	445	17	36	0.20
1318	445	17	18	0.34
437	450	7	10	Nil
1309	455	17	32	0.24
1317	455	17	18	0.38
1315	465	17	16	0.43
436	473	7	18	0.05
1268	480	10	4	0.34
1316	480	10	18	0.34
1301	480	17	35	0.24
1266	485	10	15	0.24
1457	490	7	12	0.37
1267	490	10	15	0.19
1302	490	17	36	0.19
1314	490	17	18	0.38
1269	495	10	8	0.52
1455	500	7	35	Nil
1271	500	10	16	7.58
1303	500	17	37	0.16
1313	500	17	24	3.15
1270	505	10	12	0.67
434	510	7	36	Nil
1304	510	17	36	0.54
1312	510	17	18	0.48
433	520	7	12	Nil
1305	520	17	36	0.68

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2. (b) Geological features (Con't.)

Subsequent Development of the Radioactive Occurrence

The applicant first drove a raise (1040-A) from the 1040 Level to the 920 Level (see Assay Section "A", Exhibit C) on the pitchblende-bearing ore. Pitchblende continued in important concentration in the raise for 43 feet above the 1040 Level. Channel samples in the raise show the following uranium values:

Sample No.	Distance above Track (feet)	Width (inches)	U_3O_8 %
1130	113	48	0.02
1340	101	48	0.08
1339	89	54	0.05
1338	80	50	0.06
1337	70	46	0.06
1355	59	43	0.07
1333	55	48	0.08
1329	47	48	0.06
1114	39	24	1.26
1107	27	48	0.02
1313	18	24	3.15
1303	15	37	0.16
1260	8	8	0.52

This raise was followed by the sinking of a winze almost directly below the raise to the 1140 Level (Assay Section "A", Exhibit C). The Radium and No Name veins were opened by 182 feet of drifting on the 1140 Level (See Assay Plan of the 1140 Level, Exhibit E). Uranium was encountered in the winze in commercial quantities to a depth of 22 feet below the 1040 Level and uranium values were encountered in the No Name vein, 1140-D1 drift.

Under contract with the U. S. Atomic Energy Commission, the applicant subsequently extended the 1040-D2 and 920-D2 drifts east on the Radium vein.

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2. (b) Geological features (Con't.)

for distances of 350 and 260 feet, respectively, and both headings encountered pitchblende (Plan of 1040-D1 and D2, Exhibit F and Assay Plan of 920 Level, Exhibit G).

Finally, under contract with the U. S. Atomic Energy Commission, a second raise (558) was driven up 83 feet above track from the 1040 Level at a point 240 feet east of the 1040-A riase on the Radium vein and the following uranium values were obtained in channel samples (Assay Section D1, Exhibit D):

Distance above Track (feet)	Width (inches)	U_3O_8 %
83	10	0.08
78	8	0.17
70	10	0.34
64	9	0.05
55	10	0.73
40	16	0.10
18	12	0.96

In each of these projects, pitchblende has been encountered, and the zone in which it occurs in the Radium and No Name veins may now be said to extend vertically for 300 feet and horizontally for 360 feet. The continuous high-grade section at the 1040 Level may be said to have a proven horizontal length of 115 feet and a vertical distance of 65 feet, with a width varying from inches to 4 feet. A second continuous section of importance appears to be developing in the 558 raise. It now has a vertical height of 83 feet and widths from 8 to 16 inches.

The Exploration Project

The applicant now desires to explore the Radium and No Name veins on newly-established 1290, 1440, and 1590 Levels at depths of 250, 400, and 550 feet, respectively (Exhibit J), below the 1040 Level (the bottom of the Caribou shaft). The reasons for expecting to find commercial occurrences of pitchblende are summarized here:

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2. (b) Geological features (Con't.)

1. The regional geological setting makes the Caribou Hill area a most logical place for the occurrence of uranium.

2. Pitchblende has been found in small commercial bodies in the Radium and No Name veins of the Caribou mine, and subsequent development on and above the 1140 Level has shown the deposits to occur over more extensive sections of the veins than to the extent of the original showings. The next, logical step is to explore the ground below the 1140 Level.

3. Pitchblende, the primary form of uranium deposition, theoretically, is deposited by hot, aqueous, ascending solutions. The occurrences on and above the 1140 Level of the Caribou mine have the characteristics of being the upper-most fringes of such upward extending depositions. Hence, larger, more highly concentrated uranium deposits reasonably may be expected below the bottom levels of the Caribou mine.

4. Each radioactive anomally, or radioactive occurrence, was found to be successively larger and more intense as depth is gained in the Caribou workings. Hence, at least to the 1040 Level, the radioactivity of the deposits is ever increasing.

5. In similar silver-pitchblende veins in other districts pitchblende has been found to improve with depth. Two examples may be cited:

a. At the Eldorado mine, Great Bear Lake, Canada, the No. 2 vein began at the surface with silver in preponderance, although pitchblende was present. Below the 500-foot level, the vein has produced almost no silver, whereas pitchblende ore bodies have been mined to more than 1,000 feet below the surface. In the No. 1 vein, little or no pitchblende is visible at the surface, yet the vein became the main producer below 1,000 feet in depth.

b. At the Werner mine, Joachimsthal, Czechoslovakia, pitchblende was encountered in only small quantities in the upper levels, below 262 meters it appeared in increasing quantities, and

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2. (b) Geoligical features (Con't.)

below 376 meters it became the only valuable constituent of the ore. Not only in the Werner mine, but in the district as a whole, uranium tends to increase with depth.

6. In two productive silver mines, as in the Caribou mine, pitchblende has been found in the lower levels. In the Sunshine mine, Coeur d'Alene District, Idaho, no trace of pitchblende was found until the 3100 Level (3100 feet below the surface) was reached. It is reported to occur in a zone between the 3100 and 3700 Levels. In the Jo Reynolds mine, Lawson, Colorado, pitchblende was not encountered until the area between the 900 and 1000 Levels was opened up (900 feet below the surface). The continuity and improvement with depth in these mines only will be determined as the workings are deepened, but the point of particular interest is that these silver mines, like Caribou, encountered pitchblende in their current lowest levels as their silver ores were followed downward. These mines may just be reaching zones containing workable deposits of uranium.

For these six reasons, the applicant believes the projected depth program of exploration is warranted. In 1948, the applicant's geologists, Dr. G. C. Ridland and Dr. E. E. Wahlstrom, recommended that the mine workings be deepened and Wahlstrom went so far as to warn that the future of the property depended on the extension of the development work below the 1040 Level.

(The applicant would appreciate the return of the attached assay maps when the DMA has no further use for them.)

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3. (a) Proposed work and cost

Project	Cost ($)	Time (Months)
Sink Caribou shaft 600 feet from the 1040 Level to the 1640 Level. 600 feet @ $200/ft.....	$120,000	10
Cross-cut 100 feet from shaft to No Name vein on the 1290, 1440 and 1590 Levels, 300 feet @ $30/ft.....	9,000	2
Drift 100 feet NE on the No Name vein on the 1290, 1440, and 1590 Levels to the Radium vein intersection and continue an additional 100 feet, on the No Name vein. 600 feet @ $30/ft.....	18,000	2
Drift E 400 feet on the Radium vein on the 1290, 1440 and 1590 Levels. 1,200 feet @ $30/ft.....	36,000	5
Extend drift 150 feet on the No Name vein, 1590 Level, NE to establish a diamond drill station. 150 feet @ $35/ft.....	5,250	2*
Raise 150 feet from the 1290, 1440 and 1590 Levels. 450 feet @ $30/ft.....	13,500	3
Diamond drill 10,000 feet of EX core. 10,000 feet @ $6/ft.....	60,000	4*
Total Cost.....	$261,750	
Total Estimated Time.....		22 months

3. (b) Time required to start project

Five days after the signing of the DMA contract.

* Concurrent with other projects.

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3. (b) (Con't.)

Estimated time required to complete project

Twenty-two months after project is started.

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4. Map showing plan and vertical projection of the proposed exploration work is attached as Exhibit J.

The diamond drilling program is designed to test the ground on and below the deepest, 1590 Level, and is proposed only for the 1590 Level. Diamond drilling is not proposed for the 1290 of 1440 Levels.

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5. The Caribou mine is operating and is equipped with buildings and some machinery. All the facilities, installations and fixtures listed below will be devoted to the exploration project. No rehabilitation or repairs are necessary.

1. Electric power, connected.

2. Telephone, connected.

3. Water, more than adequate from mine drainage.

4. Caribou shaft 5' X 15' outside dimension from 500 to 920 Level, and 5' X 10' from the 920 to the 1040 Level.

5. Idaho Adit Tunnel on the 500 Level. It is electrically lighted and equipped with 30-pound, 24-inch gauge railway track, and ditch to drain the water pumped from the bottom of the Caribou shaft.

Buildings:

Compressor house - housing compressor, shop, stores, and change room.

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6. No additional facilities, buildings or fixtures to be installed, purchased or erected.

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7. (a) To be rented: None

7. (b) To be purchased:

Sinking hoist.....	$ 2,500
Cable, Sheave wheel, bucket and misc.....	500
Sump Pump.....	1,000
6 Blowers, 5 H.P. Motors.....	600
1 Eimco mucking machine.....	3,500
1 Hoist, double drum for 1500 foot depth.....	6,000
8 Mine cars, Card, Z-16, 16 cu. ft. @ $200/ea.....	1,600
4 Jackhammers, Joy L-57, 55 lb. @ $400/ea.....	1,600
4 Drifters, 2 in. Joy T-300, @ $975/ea.....	3,900
4 Stopers, Joy S-19, 96 lb. @ $800/ea.....	3,200
3 Tugger hoists, air motor, 500'' capacity.....	1,000

7. (c) To be furnished by operator:

Equipment	Present Value	Monthly Depreciation
Storage battery locomotive.....	$ 5,000	$ 65
Adequate fleet 1-ton cars on 500 Level, 20 cars @ $100/ea.....	2,000	35
Compressor.....	4,000	60
Pick-up truck.....	1,500	30
Hoist on 500 Level.....	2,000	35
Pump on 980 Level.....	1,500	30
Mine transit and misc. instruments.....	600	10

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8. Labor and supervision

1 Mine superintendent	@	$ 500/mo.
1 Engineer	@	400/mo.
1 Geologist	@	400/mo.
1 Bookkeeper	@	150/mo.
2 Supervisors (shift bosses)	@	15/day
8 Miners	@	2/hr.
8 Muckers	@	2/hr.
2 Hoistmen	@	1.75/hr.
4 Timbermen	@	2/hr.
4 Trammers	@	1.75/hr.
1 Surface man	@	1.75/hr.

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9. Supplies

Explosives	$ 15,760
Drill steel and bits	6,000
Timber	6,600
600' Pipe, air-line, 3" @ 75¢/ft	450
2,100' Pipe, air-line, 2" @ 40¢/ft	840
2,100' Track, 12 lbs. @ $1.75/ft. laid down	3,675
600' Pipe, water-line, 2½" @ 60¢/ft	360
1,100' Pipe, water-line, 1½" @ 30¢/ft	330
1,100' Pipe, water-line, 1" @ 25¢/ft	275
2,100' Ventilation pipe, galvanized, 6" @ 60¢/ft	1,260
650 Power cables, 3 conductor, size 4	450
1,000' Power cable, 600 v. 3 conductor, size 8	250
Hand-tools and miscellaneous supplies, 2-year supply	2,000
Total Supplies	$ 38,250

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10. (a) Applicant is prepared to invest $26,175, which is 10% of the estimated cost of the proposed project.

10. (b) This amount is sufficient to pay applicant's part of the cost of the project.

11. At the present time, the Caribou mine is operating. Two development projects are underway:

(a) Drifting in the west side of the mine on the 1040 and 920 Levels to develop silver-lead-zinc ore bodies. This work is being financed by the mining and milling of ore encountered in the development headings and by some stoping on the 1040 Level.

(b) The applicant has contracted with the U. S. Atomic Energy Commission to do certain exploration work in the radioactive section of the mine on and above the 1040 Level, only. At this time, the 740 Level is being rehabilitated so that the AEC program may be resumed.

It is the intention of the applicant to conduct the DMA program herein proposed without interferring with the above two projects. If the above projects are continuing contemporaneously with the DMA program, then the general mine expense, such as supervision, engineering, geology, bookkeeping, hoisting from the 1040 Level, 500 Level tramming, and power will be proportioned to the individual projects, thus reducing the unit cost of the DMA project from the estimate presented herein.

Radioactivity

at the Caribou Silver Mine, Boulder County, Colorado

by G. Carman Ridland

A program of exploration for radioactive deposits, conducted in 1945 in the well-known mineralized areas of the Front Range, Colorado, was rewarded with the discovery of pitchblende in a dump at Caribou Hill. The presence of pitchblende in the silver veins at depth apparently is not expressed as gamma-ray anomalies at the surface.

Introduction

Front Range, Colorado: The majority of the rocks comprising the Front Range of Colorado are pre-Cambrian schists, gneisses, and intrusives which have been elevated to form part of the Southern Rocky Mountain physiographic province. The region is noted mainly for its production of gold and silver, but ores of tungsten, fluorspar, uranium, copper, and iron have been worked. Geological literature[1-4] describes pitchblende and other radioactive minerals occurring at Jamestown, Boulder County; Central City, Gilpin County; and Lawson, Clear Creek County (fig. 1). These three adjoining counties cover most of the highly mineralized section of the Front Range which extends from Jamestown to Breckenridge. As far as the writer is aware, uranium has been found only in the portion northeast of Lawson.

G. CARMAN RIDLAND, Member AIME, is a Consulting Geological Engineer, New York, N. Y.

San Francisco Meeting, February 1949.

TP 2738 IL. Discussion of this paper (2 copies) may be sent to Transactions *AIME before Feb. 28, 1950. Manuscript received March 30, 1949.*

Silver Deposits at Caribou Hill: The historic silver deposits of Caribou Hill, located approximately half way between Jamestown and Central City, and 35 miles in a straight line northwest of Denver, appeared particularly intriguing as an area to prospect for uranium for the following reasons: here exists an isolated group of high-grade silver veins in the center of a mining district containing occurrences of uranium, and, in two of the well-known uranium deposits of the world, those at Great Bear Lake, Canada, and Joachimsthal, Czechoslovakia, uranium is associated with silver in similar fissure veins. An exploration program, conducted in the spring of 1945, directed special attention to Caribou Hill and was rewarded with the discovery of heavy, canary-yellow stained specimens of pitchblende.

The veins are confined to shear zones cutting a north-south, elongated quartz-monzonite stock of Tertiary (?) age lying in the axis of a major anticline of the Idaho Springs biotite schist, the oldest pre-Cambrian formation in the district. The stock is one and three-quarter miles long by more than a mile wide, and Caribou Hill is approximately at its center.

The ore zones vary in width from a few inches to 15 ft, and one structure has been traced for a length of over 4000 ft. The ore minerals are galena, sphalerite, ruby silver, native silver, chalcopyrite, pyrite, and pitchblende. They occur most common

Exhibit A

Where X = tons per hour original feed.
Y = tons per hour classifier sand.
a = percentage of minus 100 mesh in ball mill discharge.
b = percentage of minus 100 mesh in classifier overflow.
c = percentage of minus 100 mesh in classifier sand.

Ball Loads: No. 10 unit was charged with 75,000 lb of balls at the beginning of the test and an effort was made to keep mill amperage constant. This met with some success, but on several occasions, by inspection, ball level was found to have dropped. For the last month's test, the consumption figure for the preceding months was used as a guide in adding balls, and this resulted in a very steady ball load. From the average level, as measured when the mill was down, it was calculated that the average load was 72,000 lb.

Power Figures: The power meter on No. 10 unit was read every morning at 7 a.m. and the power consumed for the preceding day calculated. The month's figures, the sum of these daily power figures, corrected for meter error, were used for the No. 10 mill. For the mills No. 1 to 9, the monthly power figures as provided by the Electrical Department were used. This figure was obtained by monthly meter readings, instead of daily, and was subjected to meter error correction.

Screen Analysis of Ball Mill Feed: A typical screen analysis of coarse heads (feed to all ball mills) is given in Table I.

Table I. Screen Analysis of Coarse Heads

Screen Size		Per Cent
Plus	0.525 in.	0.4
	0.371 in.	9.8
	3 Mesh	15.2
	4	8.3
	6	8.6
	8	5.8
	10	8.9
	14	5.5
	20	4.5
	28	4.3
	35	5.0
	48	2.9
	65	2.9
	100	4.7
	150	2.4
	200	2.3
	325	1.7
Minus	325	6.8
		100.0

Duration of Test: The investigation was carried out over a period of seven months, from June to December, 1942, inclusive. The September test is not included because of the time down for lining the No. 10 mill, and changing the drive motor. Tests for June, July, and August are thought to be less accurate as regards power figures than those for October, November, and December, because during the former months it was discovered that the No. 10 ball mill motor was somewhat defective. The summary of the test is, therefore, split into two halves in Table II and III.

Table II. Summary of Test

	June July August		Oct. Nov. Dec.	
	Mills No. 1 to 9	Mill No. 10	Mills No. 1 to 9	Mill No. 10
	385	463	379	450
ifier overflow	50.55	52.44	52.46	52.03
ur	31.85	35.48	31.68	37.55
ll mill hour	13.04	15.20	14.00	16.32
	9.00	9.74	8.92	8.92
oduced	22.04	22.78	20.32	20.55
per ton	2.88	3.68	2.78	3.53
er ton	0.43	0.63	0.43	0.63

Table III. Screen Analysis of F. X. Classifier Overflows

	June July August		Oct. Nov. Dec.	
Mesh	Mills No. 1 to 9	Mill No. 10	Mills No. 1 to 9	Mill No. 10
Plus 65	6.0	4.5	6.4	5.0
100	14.1	12.9	13.3	13.9
150	15.3	15.3	14.3	15.1
200	13.8	14.3	13.8	14.3
325	9.6	10.1	9.5	9.8
Minus 325	41.2	42.9	42.7	41.9
	100.0	100.0	100.0	100.0

	Conical Trunnion Overflow	Cylindrical Grate
Average per cent solids in F. X. Classifier Overflow	24.7	21.9
Average circulating load, per cent	420.0	460.0
Ball load in mills in short tons	36.0	36.0

Observation: (1) To obtain a comparable grind it was necessary to overflow the F.X. Classifier at 2 to 3 pct less solids with the cylindrical grate mill than with the conical trunnion overflow mills.

(2) There appeared to be little difference with regard to ease of operation. Overloads on the conical trunnion overflow mills were reflected immediately in the sand load on the classifier, whereas the cylindrical grate mill overloaded internally. This condition was indicated by a drop in amperage and a definite decrease in mill noise.

(3) From the maintenance point of view, the cylindrical grate mill was much more difficult to inspect, and required more time to reline.

Conclusions: (1) The cylindrical grate mill with a ball load of 72,000 lb had a one sixth greater grinding capacity than a conical trunnion overflow mill with the same tonnage of balls, on Mufulira ore.

(2) Consumption of grinding balls was 27 pct greater for equal tonnage ground in the cylindrical grate mill.

(3) Consumption of liner steel at 0.63 lb per ton (gross) was 32 pct higher than for the conical trunnion overflow at 0.43 lb per ton (gross).

(4) In terms of power cost per ton of finished product produced, the cylindrical grate mill required from 1 to 3 pct more power than the conical trunnion overflow, on Mufulira ore.

(5) The cylindrical grate mill produced about 2 pct less oversize (plus 100 mesh) than the conical trunnion overflow, because the classifier was run at a lower density, but at equal densities the cylindrical grate grind was inferior to the conical trunnion overflow.

(6) Work done by either type of mill was directly proportional to power input.

(7) Considering power costs approximately equal, the cylindrical grate ball mill produced more finished product at the expense of considerably more steel consumption.

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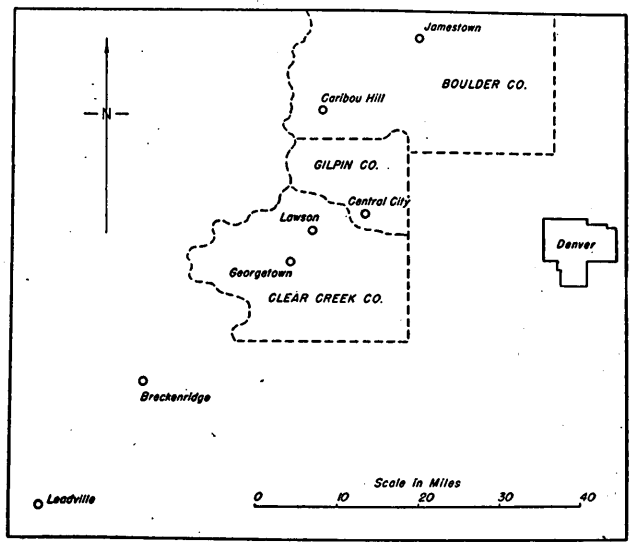

Fig. 1—Index map showing position of some of the major mining districts of the Front Range relative to Denver, Colo.

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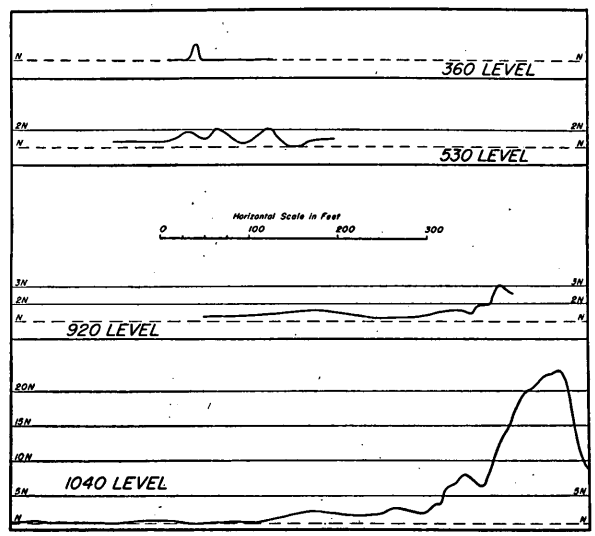

Fig. 2—Profiles of the gamma-ray intensities on the 360, 530, 920 and 1040 levels of the Caribou Mine.

The horizontal scale is in feet and is shown on the diagram. The vertical scales are the gamma-ray intensities expressed in the number of counts over the normal, background count of the country rock. The broken line marked N represents normal intensity.

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Fig. 3 — Low magnification micrograph of soft, black, colloform radioactive substance from the 1040 level of the Caribou mine. X17.

The light gray veins are proustite and sphalerite, each containing blebs of chalcopyrite.

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Ore Body of the 1040 Level: At the northeast end of the 1040 level, channel samples, taken at 10 ft intervals, reveal an ore body 350 ft long with an average width of 4.08 ft and an average grade of 0.061 oz per ton gold, 18.96 oz per ton silver and 1.76 pct lead. It follows a northeast trending structure for 220 ft, then turns off to the east along a subsidiary east-west fracture for the remaining 130 ft. The ore varies from one to nine feet in width and is a siliceous- and carbonaceous-vein filling containing, in places, galena, sphalerite, and a little pyrite. In the east-west section, pitchblende and ruby silver are also visible. The pitchblende occurs in a continuous, black seam 1 to 16 in. wide which begins 45 ft southwest of the junction of the northeast and subsidiary structures and follows the footwall of the ore to the junction, then the center of the east-west striking vein for an additional 110 ft. This black material is radioactive and intensely so at places. It is friable and has an earthy luster and readily stains the fingers when handled. Veinlets of an easily shattered, black, vitreous, colloform pitchblende form part of the dark streak, and galena, sphalerite, ruby silver, and colloform pyrite also may be identified by hand lense.

Radioactive Ore under Low Power Magnification: A microscopic view of a polished section of the black material, viewed in reflected light under low power magnification, shows pitchblende and coarsely crystallized galena, sphalerite, and proustite. Chalcopyrite is present as small exsolution blebs in sphalerite and proustite and also in places

Fig. 4—Radiograph of polished section, part of which is shown in fig. 3 and fig. 5. X4.

The white areas are strongly radioactive, relatively pure pitchblende blebs. The dark gray area is the moderately radioactive, colloform substance. The black areas of the specimen are areas where radioactivity is negative.

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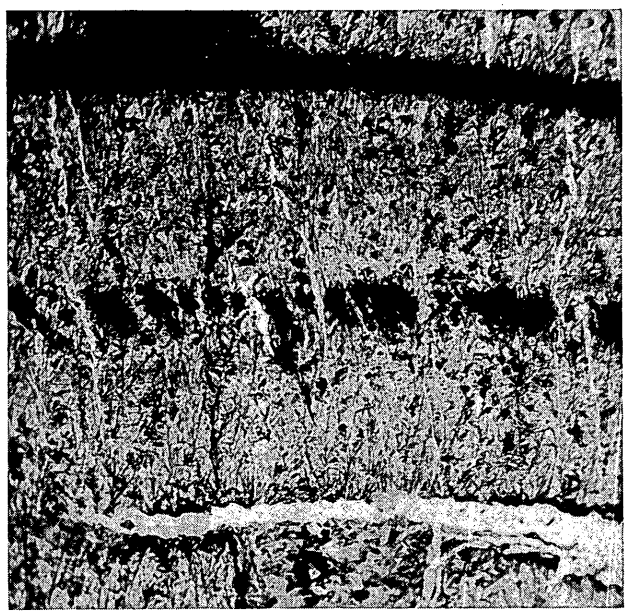

Fig. 5 — High magnification micrograph of the colloform substance shown in fig. 3. Oil emersion. X170.

radioactive mineral which has the physical, chemical, and radioactive properties of pitchblende.

Radioactive Ore under High Power Magnification: High power magnification of the colloform mixture (fig. 5) reveals an intimate mixture of a silver-white mineral and a dark gray mineral. The latter is believed to be pitchblende because of its color, habit, and reaction to reagents. The white-colored mineral is deeply etched by potassium cyanide and, when so etched and examined under high power magnification, it exhibits a deep red internal reflection. Hence, this second component is apparently a ruby silver and probably proustite which is present elsewhere in the polished section.

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3. Both on the surface and underground, the quartz-monzonite host rock was found to possess a normal gamma-ray count. This observation is in direct contradiction to results obtained from similar studies[5] made by the writer in the Great Bear Lake Area, N.W.T., Canada, where the host rocks of the silver-pitchblende veins were found to be approximately one and one-half times as radioactive as the adjacent, nonhost formations. Hence, the prospector in search of radioactive deposits may reason that, from the results obtained at Caribou Hill, he need not confine his attention to formations possessing higher-than-average gamma radiation.

Acknowledgment

The writer is extremely grateful to Mr. Boris Pregel, President of Consolidated Caribou Silver Mines, Inc., for making possible the original program of exploration of the Front Range uranium areas in 1945, the subsequent geological and geophysical studies of the Caribou mine, and, finally, the preparation and reading of this paper. The writer is also grateful to Mr. Elmer Hetzer, Mine Superintendent, for his cooperation and assistance with the field work.

The polished sections, micrographs, radiograph, and microscopic studies were made in the geological laboratories of Princeton University. The writer wishes to thank Professor Edward Sampson and the Department of Geology for the use of its laboratory facilities in the preparation of this report.

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BOULDER, COLO.

Cyclone Thickener

Applications in the Coal Industry

by M. G. Driessen and H. E. Criner

Possible applications of cyclone thickeners for: (1) clarification of the washery water and, (2) recovery of fine coal from the plant bleed. The paper shows: (1) that it is possible to remove all particles including the very finest, from the circulating water, thus obtaining a closed water system and, (2) that reduction of the ash content of the solids of the plant bleed is feasible by means of cyclone thickeners. Performance data for different size cyclones is given in the form of graphs.

THE cyclone thickener has two important applications in wet washing plants: (1) water clarification, and (2) fine coal recovery.

The thickener consists of a conical chamber into which the fluid is injected through a tangential nozzle at the periphery of the large end. The solids of the slurry are concentrated and removed from the apex of the cone while the "thinner" portion is discharged from a central tube in a flat head at the large end, fig. 1. The advantages of the cyclone thickener are that large volumes of slurry may be treated with small space requirements and that the underflow concentration may be controlled easily and readily to meet varying feed conditions.

M. G. DRIESSEN, Member AIME, is a Consulting Engineer, Pittsburgh, Pa., and H. E. CRINER is Development Engineer, Heyl and Patterson.

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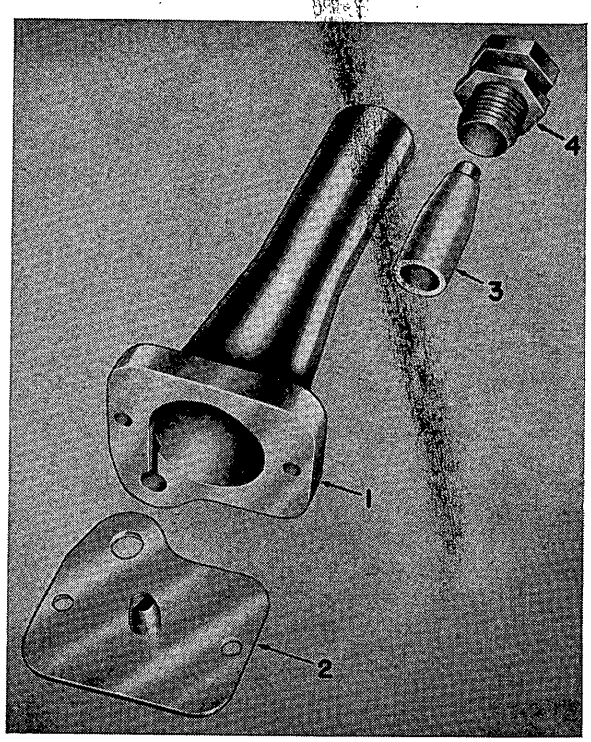

Fig. 1—A 3 in. rubber cyclone thickener.

1—Rubber cyclone body. 2—Cover with overflow opening. 3—Soft rubber orifice. 4—Nozzle retainer.

Control of Washery Water Solids Concentration: The first requirement, in the process of controlling solids concentration, is that the solids be removed from the body of circulating water at the rate at which they are introduced. If this condition is satisfied the concentration will remain at a fixed value and will not increase to uncontrollable levels. The second requirement is that the solids concentration

Exhibit A

Radioactivity

at the Caribou Silver Mine, Boulder County, Colorado

by G. Carman Ridland

A program of exploration for radioactive deposits, conducted in 1945 in the well-known mineralized areas of the Front Range, Colorado, was rewarded with the discovery of pitchblende in a dump at Caribou Hill. The presence of pitchblende in the silver veins at depth apparently is not expressed as gamma-ray anomalies at the surface.

Introduction

Front Range, Colorado: The majority of the rocks comprising the Front Range of Colorado are pre-Cambrian schists, gneisses, and intrusives which have been elevated to form part of the Southern Rocky Mountain physiographic province. The region is noted mainly for its production of gold and silver, but ores of tungsten, fluorspar, uranium, copper, and iron have been worked. Geological literature[1-4] describes pitchblende and other radioactive minerals occurring at Jamestown, Boulder County; Central City, Gilpin County; and Lawson, Clear Creek County (fig. 1). These three adjoining counties cover most of the highly mineralized section of the Front Range which extends from Jamestown to Breckenridge. As far as the writer is aware, uranium has been found only in the portion northeast of Lawson.

G. CARMAN RIDLAND, Member AIME, is a Consulting Geological Engineer, New York, N. Y.

San Francisco Meeting, February 1949.

TP 2738 IL. Discussion of this paper (2 copies) may be sent to Transactions *AIME before Feb. 28, 1950. Manuscript received March 30, 1949.*

Silver Deposits at Caribou Hill: The historic silver deposits of Caribou Hill, located approximately half way between Jamestown and Central City, and 35 miles in a straight line northwest of Denver, appeared particularly intriguing as an area to prospect for uranium for the following reasons: here exists an isolated group of high-grade silver veins in the center of a mining district containing occurrences of uranium, and, in two of the well-known uranium deposits of the world, those at Great Bear Lake, Canada, and Joachimsthal, Czechoslovakia, uranium is associated with silver in similar fissure veins. An exploration program, conducted in the spring of 1945, directed special attention to Caribou Hill and was rewarded with the discovery of heavy, canary-yellow stained specimens of pitchblende.

The veins are confined to shear zones cutting a north-south, elongated quartz-monzonite stock of Tertiary (?) age lying in the axis of a major anticline of the Idaho Springs biotite schist, the oldest pre-Cambrian formation in the district. The stock is one and three-quarter miles long by more than a mile wide, and Caribou Hill is approximately at its center.

The ore zones vary in width from a few inches to 15 ft, and one structure has been traced for a length of over 4000 ft. The ore minerals are galena, sphalerite, ruby silver, native silver, chalcopyrite, pyrite, and pitchblende. They occur most common-

Exhibit A

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Where X = tons per hour original feed.
Y = tons per hour classifier sand.
a = percentage of minus 100 mesh in ball mill discharge.
b = percentage of minus 100 mesh in classifier overflow.
c = percentage of minus 100 mesh in classifier sand.

Ball Loads: No. 10 unit was charged with 75,000 lb of balls at the beginning of the test and an effort was made to keep mill amperage constant. This met with some success, but on several occasions, by inspection, ball level was found to have dropped. For the last month's test, the consumption figure for the preceding months was used as a guide in adding balls, and this resulted in a very steady ball load. From the average level, as measured when the mill was down, it was calculated that the average load was 72,000 lb.

Power Figures: The power meter on No. 10 unit was read every morning at 7 a.m. and the power consumed for the preceding day calculated. The month's figures, the sum of these daily power figures, corrected for meter error, were used for the No. 10 mill. For the mills No. 1 to 9, the monthly power figures as provided by the Electrical Department were used. This figure was obtained by monthly meter readings, instead of daily, and was subjected to meter error correction.

Screen Analysis of Ball Mill Feed: A typical screen analysis of coarse heads (feed to all ball mills) is given in Table I.

Table I. Screen Analysis of Coarse Heads

Screen Size	Per Cent
Plus 0.525 in.	0.4
0.371 in.	9.8
3 Mesh	15.2
4	8.3
6	8.6
8	5.8
10	8.9
14	5.5
20	4.5
28	4.3
35	5.0
48	2.9
65	2.9
100	4.7
150	2.4
200	2.3
325	1.7
Minus 325	6.8
	100.0

Duration of Test: The investigation was carried out over a period of seven months, from June to December, 1942, inclusive. The September test is not included because of the time down for lining the No. 10 mill, and changing the drive motor. Tests for June, July, and August are thought to be less accurate as regards power figures than those for October, November, and December, because during the former months it was discovered that the No. 10 ball mill motor was somewhat defective. The summary of the test is, therefore, split into two halves in Table II and III.

Table II. Summary of Test

	June July August		Oct. Nov. Dec.	
	Mills No. 1 to 9	Mill No. 10	Mills No. 1 to 9	Mill No. 10
Horsepower	385	463	379	450
Per cent —200 mesh in classifier overflow	50.55	52.44	52.46	52.03
Dry tons per ball mill hour	31.85	35.48	31.68	37.55
New tons —200 mesh per ball mill hour	13.04	15.20	14.00	16.32
Kw-hr per dry ton milled	9.00	9.74	8.92	8.92
Kw hr per ton—200 mesh produced	22.04	22.78	20.32	20.55
Grinding balls used in lb per ton	2.88	3.68	2.78	3.53
Liners (gross) used in lb per ton	0.43	0.63	0.43	0.63

Table III. Screen Analysis of F. X. Classifier Overflows

	June July August		Oct. Nov. Dec.	
Mesh	Mills No. 1 to 9	Mill No. 10	Mills No. 1 to 9	Mill No. 10
Plus 65	6.0	4.5	6.4	5.0
100	14.1	12.9	13.3	13.9
150	15.3	15.3	14.3	15.1
200	13.8	14.3	13.8	14.3
325	9.6	10.1	9.5	9.8
Minus 325	41.2	42.9	42.7	41.9
	100.0	100.0	100.0	100.0

	Conical Trunnion Overflow	Cylindrical Grate
Average per cent solids in F. X. Classifier Overflow	24.7	21.9
Average circulating load, per cent	420.0	460.0
Ball load in mills in short tons	36.0	36.0

Observation: (1) To obtain a comparable grind it was necessary to overflow the F.X. Classifier at 2 to 3 pct less solids with the cylindrical grate mill than with the conical trunnion overflow mills.

(2) There appeared to be little difference with regard to ease of operation. Overloads on the conical trunnion overflow mills were reflected immediately in the sand load on the classifier, whereas the cylindrical grate mill overloaded internally. This condition was indicated by a drop in amperage and a definite decrease in mill noise.

(3) From the maintenance point of view, the cylindrical grate mill was much more difficult to inspect, and required more time to reline.

Conclusions: (1) The cylindrical grate mill with a ball load of 72,000 lb had a one sixth greater grinding capacity than a conical trunnion overflow mill with the same tonnage of balls, on Mufulira ore.

(2) Consumption of grinding balls was 27 pct greater for equal tonnage ground in the cylindrical grate mill.

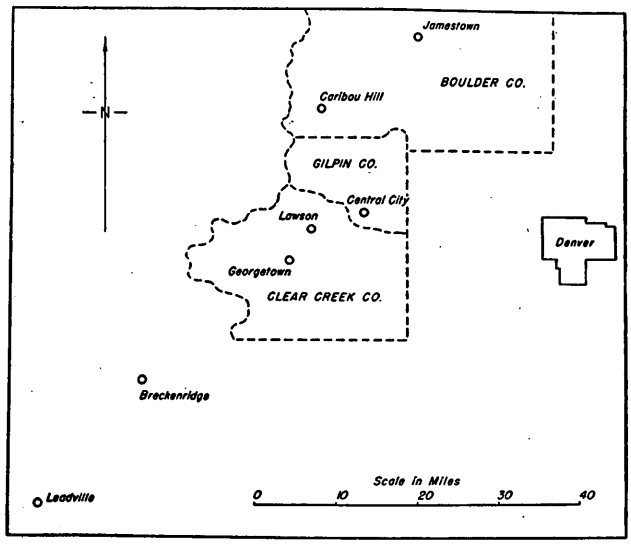
(3) Consumption of liner steel at 0.63 lb per ton (gross) was 32 pct higher than for the conical trunnion overflow at 0.43 lb per ton (gross).

(4) In terms of power cost per ton of finished product produced, the cylindrical grate mill required from 1 to 3 pct more power than the conical trunnion overflow, on Mufulira ore.

(5) The cylindrical grate mill produced about 2 pct less oversize (plus 100 mesh) than the conical trunnion overflow, because the classifier was run at a lower density, but at equal densities the cylindrical grate grind was inferior to the conical trunnion overflow.

(6) Work done by either type of mill was directly proportional to power input.

(7) Considering power costs approximately equal, the cylindrical grate ball mill produced more finished product at the expense of considerably more steel consumption.



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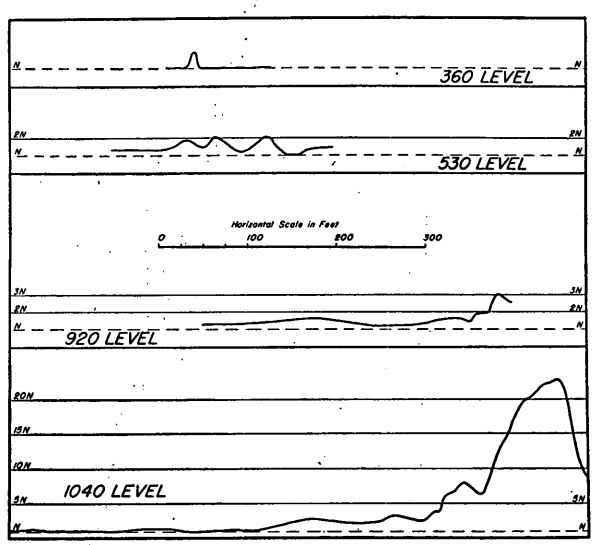

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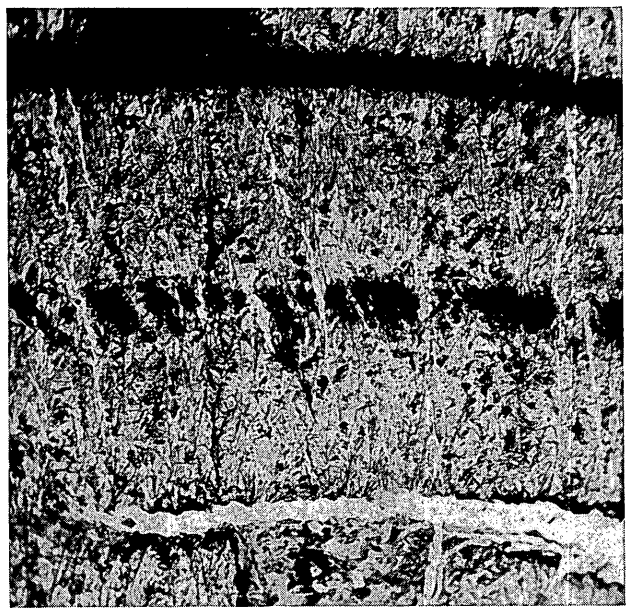

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3. Both on the surface and underground, the quartz-monzonite host rock was found to possess a normal gamma-ray count. This observation is in direct contradiction to results obtained from similar studies[5] made by the writer in the Great Bear Lake Area, N.W.T., Canada, where the host rocks of the silver-pitchblende veins were found to be approximately one and one-half times as radioactive as the adjacent, nonhost formations. Hence, the prospector in search of radioactive deposits may reason that, from the results obtained at Caribou Hill, he need not confine his attention to formations possessing higher-than-average gamma radiation.

Acknowledgment

The writer is extremely grateful to Mr. Boris Pregel, President of Consolidated Caribou Silver Mines, Inc., for making possible the original program of exploration of the Front Range uranium areas in 1945, the subsequent geological and geophysical studies of the Caribou mine, and, finally, the preparation and reading of this paper. The writer is also grateful to Mr. Elmer Hetzer, Mine Superintendent, for his cooperation and assistance with the field work.

The polished sections, micrographs, radiograph, and microscopic studies were made in the geological laboratories of Princeton University. The writer wishes to thank Professor Edward Sampson and the Department of Geology for the use of its laboratory facilities in the preparation of this report.

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CONSOLIDATED CARIBOU SILVER MINES, INC. BOULDER, COLO.

Cyclone Thickener

Applications in the Coal Industry

by M. G. Driessen and H. E. Criner

Possible applications of cyclone thickeners for: (1) clarification of the washery water and, (2) recovery of fine coal from the plant bleed. The paper shows: (1) that it is possible to remove all particles including the very finest, from the circulating water, thus obtaining a closed water system and, (2) that reduction of the ash content of the solids of the plant bleed is feasible by means of cyclone thickeners. Performance data for different size cyclones is given in the form of graphs.

THE cyclone thickener has two important applications in wet washing plants: (1) water clarification, and (2) fine coal recovery.

The thickener consists of a conical chamber into which the fluid is injected through a tangential nozzle at the periphery of the large end. The solids of the slurry are concentrated and removed from the apex of the cone while the "thinner" portion is discharged from a central tube in a flat head at the large end, fig. 1. The advantages of the cyclone thickener are that large volumes of slurry may be treated with small space requirements and that the underflow concentration may be controlled easily and readily to meet varying feed conditions.

M. G. DRIESSEN, Member AIME, is a Consulting Engineer, Pittsburgh, Pa., and H. E. CRINER is Development Engineer, Heyl and Patterson.

New York Meeting, February 1950.

TP 2735 F. Discussion of this paper (2 copies) may be sent to Transactions *AIME before Feb. 28, 1950. Manuscript received June 29, 1949.*

Control of Washery Water Solids Concentration: The first requirement, in the process of controlling solids concentration, is that the solids be removed from the body of circulating water at the rate at which they are introduced. If this condition is satisfied the concentration will remain at a fixed value and will not increase to uncontrollable levels. The second requirement is that the solids concentration

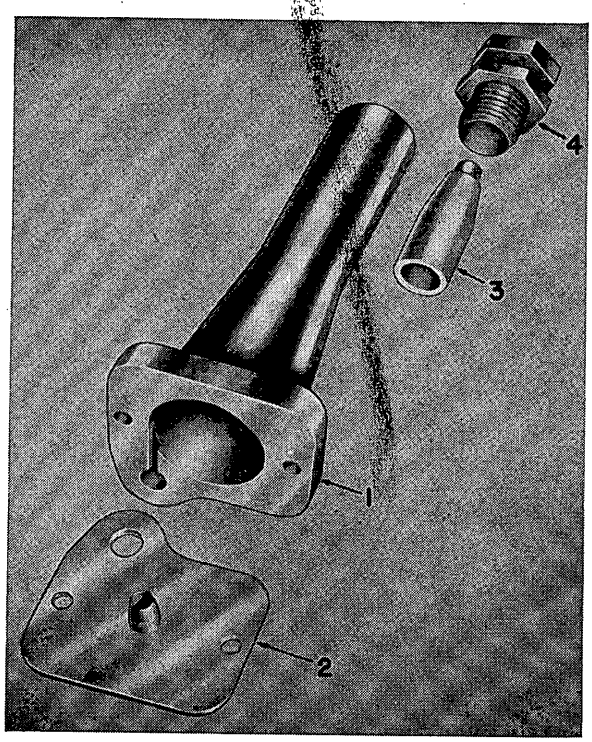

Fig. 1—A 3 in. rubber cyclone thickener.

1—Rubber cyclone body. 2—Cover with overflow opening. 3—Soft rubber orifice. 4—Nozzle retainer.

MINERALOGY OF THE RADIUM VEIN

Collection of Samples and Methods of Analysis

Samples of the vein filling were collected at three places in the raise along the Radium Vein. A number of additional specimens of high grade uraninite ore were donated by Mr. Elmer Hetzer, Mine Superintendent at Caribou, and several large high grade specimens were loaned for this study by the A.E.C. All of the loaned specimens were taken near the foot of the raise on the 1040 foot level.

Eight polished surfaces of the ore were obtained and studied with the reflecting microscope. The study yielded data on the physical properties of the uraninite, its relations with other vein minerals and the paragenesis of the vein filling. Thin sections of the ore aided the study of relations of the ore minerals to the gangue and wall rock minerals. X-ray diffraction photographs of the uraninite were made, but a pattern sufficiently good for an accurate computation of the lattice constant has not yet been obtained.

General Statement

The ore minerals recognized in the polished surface study are uraninite, pyrite, chalcopyrite, sphalerite, galena, argentite, ruby silver, and native silver. Gangue minerals represented are quartz, carbonate and barite. The existence of two characteristic assemblages of ore minerals suggests two stages in the vein formation. In Stage A, which is thought to be the earlier, quartz, sphalerite and galena were deposited. Uraninite was deposited early in Stage B. The other minerals of this stage are chalcedony, chalcopyrite, sphalerite, argentite, ruby silver, and native silver.

Uraninite

Two varieties of uraninite occur in the Caribou ore. One of these is a dense, hard, black material with pitchy luster, while the other is a soft, fine-grained, dull-lustered, porous material which coats fractures and open vugs, and in some places appears to grade into the lustrous material. The hard variety shows varying degrees of luster and hardness. Both varieties contain inclusions of pyrite and lesser amounts of other sulphides. Under the microscope the lustrous uraninite almost always shows the colloform structure which characterizes the material described from other localities, as Great Bear Lake,[1] Joachimsthal,[2] and Katanga.[3] Radially arranged fractures, some filled with pyrite, are common in the botryoidal material. Although the hardness of uraninite is given as 5 1/2, even the "hard" variety of Caribou uraninite can be scratched (with difficulty), suggesting that this material has undergone oxidation since its deposition.

1. Kidd, D. F., and Haycock, M. H., Mineragraphy of the Ores of Great Bear Lake, G.S.A. Bull., Vol. 46, 1935, pp. 879-960.
2. Zuckert, R., Die Paragenesen von Gediegen Silber und Wismut mit Kobelb-Nickel-Kiesen und der Uranpechblende zu Sb. Joachimethel, English Abstract in G.S.A. Bull., Vol. 46, 1935, pp. 942-943.
3. Thoreau, J., and Trieu de Terdonck, R. du, Le Gîte d'uranium de Shinkolowbe-Kasolo, English Abstract in G.S.A. Bull., Vol. 46, 1935, pp. 941-42.

Exhibit B

CONSOLIDATED CARIBOU SILVER MINES, INC. BOULDER, COLO.

MINERALOGY OF THE RADIUM VEIN

Collection of Samples and Methods of Analysis

Samples of the vein filling were collected at three places in the raise along the Radium Vein. A number of additional specimens of high grade uraninite ore were donated by Mr. Elmer Hetzer, Mine Superintendent at Caribou, and several large high grade specimens were loaned for this study by the A.E.C. All of the loaned specimens were taken near the foot of the raise on the 1040 foot level.

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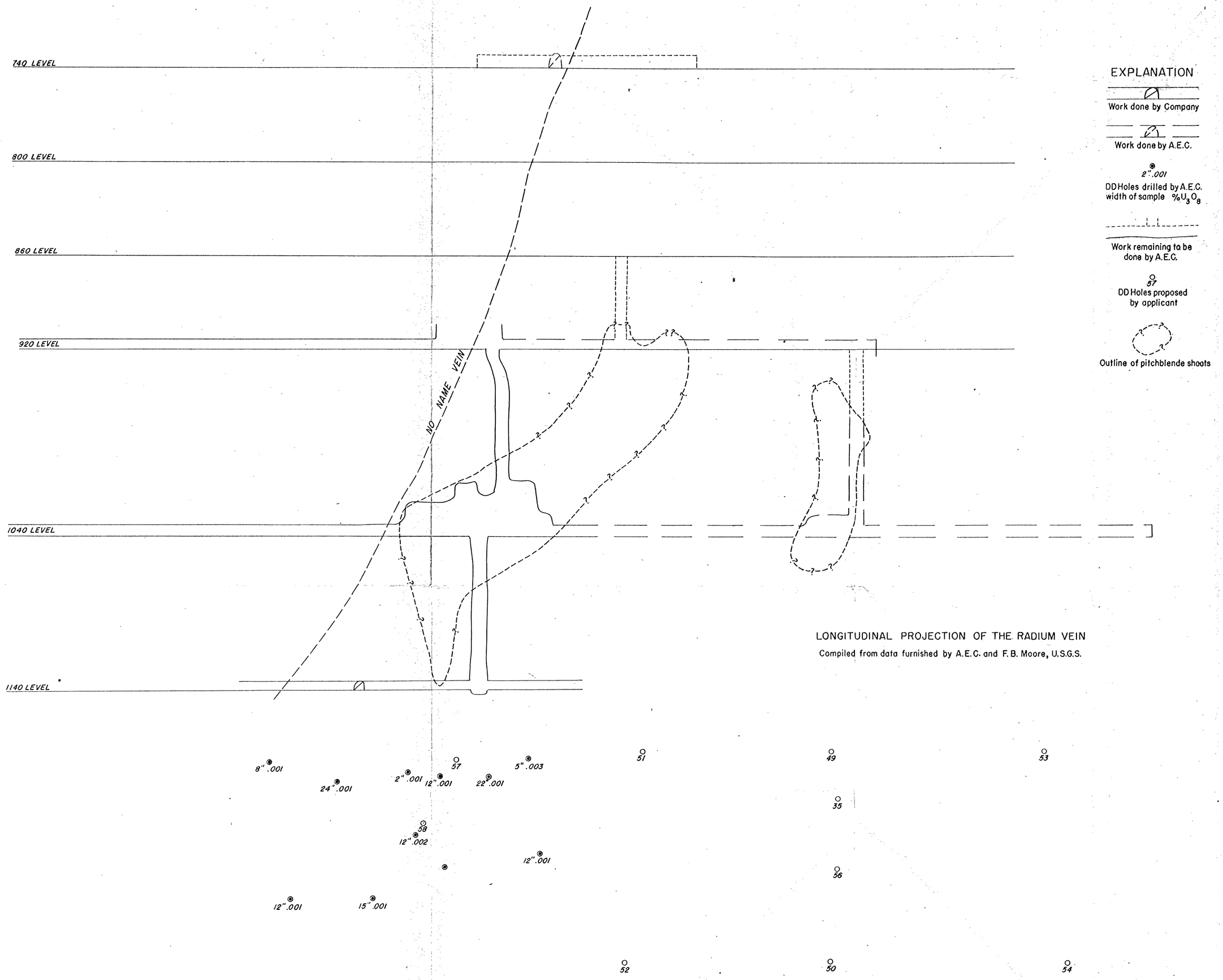
Exhibit B

CONSOLIDATED GOLD
SILVER MINES
BOISE, IDAHO



LONGITUDINAL PROJECTION OF THE RADIUM VEIN

Compiled from data furnished by A.E.C. and F.B. Moore, U.S.G.S.

By D.R. MacLaren August 1952

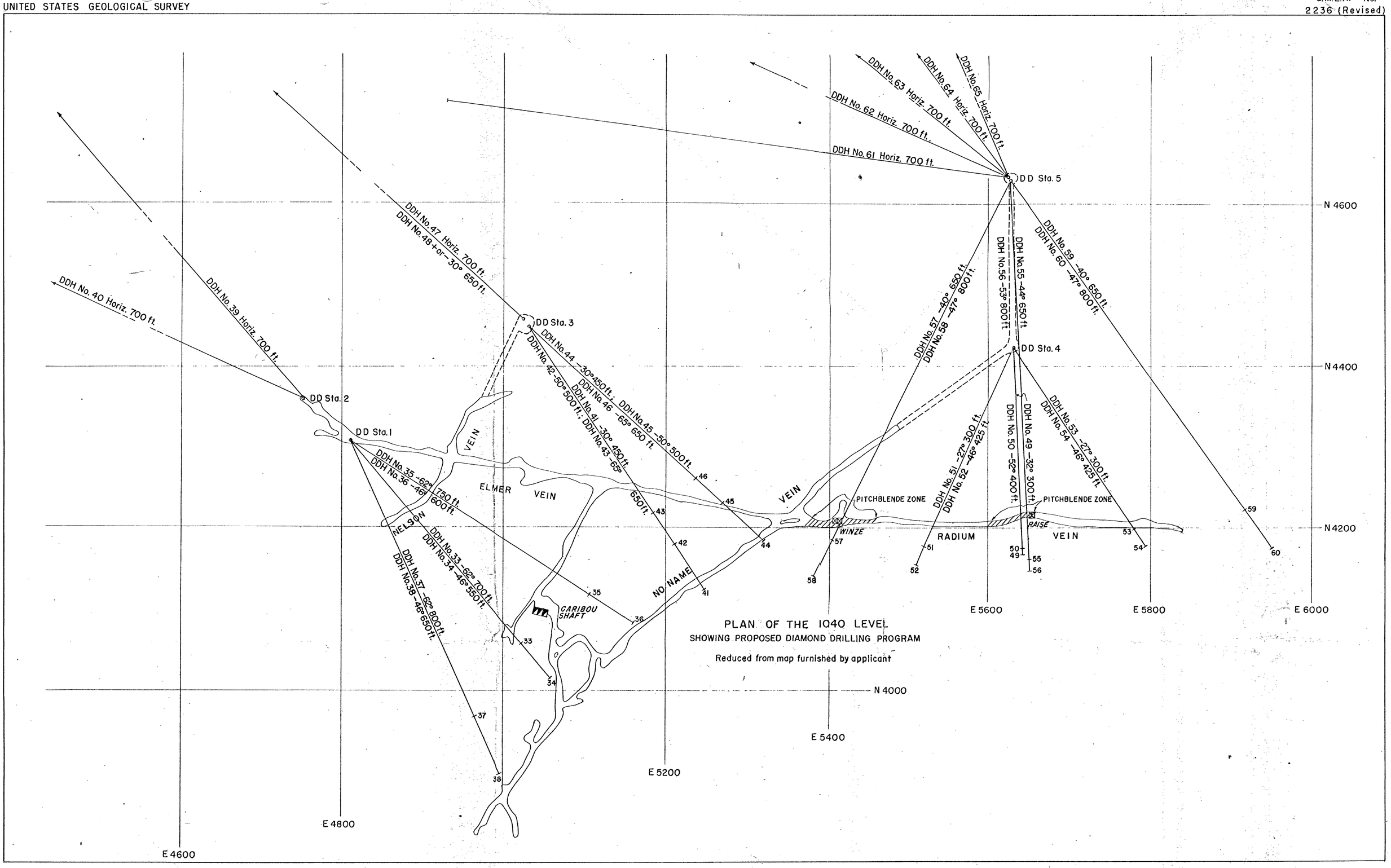
FIG. 1 CONSOLIDATED SILVER MINES, INC.

BOULDER COUNTY, COLORADO

40 0 40 Feet

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

D.M.E.A. No. 2236 (Revised)



By D. R. Mac Laren August 1952

FIG. 2 CONSOLIDATED CARIBOU SILVER MINES, INC.
BOULDER COUNTY, COLORADO