GEOLOGY of the LIARD FLUORITE PROPERTY

Gem Mineral Claims 1 to 25
Gem Fractional Claims 1 to 6
Rank Mineral Claims 1 & 2
(credit for assessment work not claimed for Gem Claims 18 to 22, Gem Fraction No. 6 and Rank Claims 1 & 2)

Situated north of Liard Hot Springs Park, Mile 497 Alaska Highway.
Near the east side of the Rabbit River sheet (SE corner is N59° W126°)

Mapping done by J. R. Woodcock
Supervised by Dr. Wm. V. Smitheringale

Feb. '55 - Report submitted to Mines Dept

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LIARD RIVER FLUORITE PROPERTY

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GEOLOGICAL MAPS & DIAGRAMS

THE LIARD FLUORITE PROPERTY

INTRODUCTION

Location:

The Liard Fluorite property embraces 33 Mineral claims; Gem No. 1-25 (incl.) Mineral claims and Gem No. 1-6 (incl.) fractional Mineral claims adjacent to the northern boundary of Liard Hot Springs Park, Mile 497 Alaska Highway, and Rank No. 1 and 2 Mineral claims on the west side of the park and beside the Highway near Mile 498. Access to the property is provided by a road which leaves the Alaska Highway near Mile 498-- 420 miles from Whitehorse.

Progress:

In the 1954 field season, the mineral showings and surrounding areas were mapped in detail. To aid in the detailed mapping, and to help a future drilling program, a grid was laid out in the field and labelled 2-foot pegs were set at 100-foot intervals. The remaining claims and some of the surrounding country were traversed.

A road was built from Mile 498 Alaska Highway to the mineral showings. The high clay content of the overburden renders this road impassable after any rain for vehicles which do not have 4-wheel drive.

Stripping with pick-and-shovel and with a bulldozer was done in suitable places to expose ore and to gain information.

Bulk samples of approximately 4 tons were taken from Shows A and E. These have been sacked and taken to the roadhouse at Mile 496 for shipment.

TOPOGRAPHY

The Liard River Valley, in this vicinity, forms the boundary between two physiographic provinces -- the Liard Plateau on the north and the Rocky Mountains on the south (1). The valley has been glaciated and is U-shaped. Its floor is about 1½ miles wide and its sides rise steeply. At the foot of its northern slope and about one mile northeast of the Liard River, are the Liard Hot Springs. The fluorite showings are north of the Hot Springs along the upper part of the Valley side, and above the Valley on the so-called plateau.

A narrow trough, which extends northward from Show A and which has a Karst topography, forms a prominent surface feature on the claims. The floor of the trough consists of small basins (see contours on Map 1) usually drained at the centre by holes or enlarged fractures in the limestone. A typical hole found at (N800 W470)* is 20 feet deep and 15 feet across.

Similar depressions and sink holes, which have formed along prominent fractures, are found west of the main trough and one was found on the north slope of the Liard Valley at (S4200 E200) (see map 2). It is 25 feet deep, about 8 feet wide, and 100 feet long and strikes north-south.

Drainage into these depressions and through the fractures may supply the Liard Hot Springs with water. It leaves the Liard Fluorite property completely dry with the nearest water in Mould Creek to the west.

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(1) H.S. Bostock, Physiographic Subdivisions of the Canadian Cordillera, Map 922A, 1947.

* Numbers refer to the grid shown on the maps.

GEOLOGY

Statigraphy:

Two formations have been mapped in the vicinity by M.Y. Williams(2). The lower formation consists of Middle Silurian and Middle Devonian limestones with no visible break between rocks of the two ages. Overlying the limestones is a formation consisting of shales, argillites, limestone, and sandstone of Upper Devonian and Mississippian ages.

Rocks from both formations are found on the Liard Fluorite property. The upper formation consists of argillites and black slates with the argillites tending to be found at the base of the formation. The limestones of the lower formation are very massive. Fossils collected from these limestones just below the contact were identified by Dr. V. Okulitch as follows:

(S550 W500) Syringopora (Silurean to Pennsylvanian)

(S00 E100) Stromatopora (Silurean, Devonian)
Coenites (Silurean, Devonian) (usually Mid Devonian and up)

From the collection, Okulitch concludes an age of Middle or Upper Devonian.

The contact between the two formations is a disconformity which is very irregular in detail. This shows up best around (N2200 E00) where horizontal limestone forms the top of a bench. To the west and below the limestone, argillites crop out over a vertical interval of 100 feet, and to the east and above the limestone, slates are found over a vertical interval of 70 feet. The difference in attitude of the argillite immediately above the contact and that of the underlying limestone is largely a result of initial dip formed during deposition and compaction of the clays and does not prove angular unconformity.

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(2) M.Y. Williams, Geological Reconnaissance along the Alaska Highway from Fort Nelson to Watson Lake, Paper 44-28, Ottawa, 1944

Glaciation left most of the area covered with glacial deposits. Clay containing very little gravel completely covers the north side of the Liard Valley and large granitic erratics are common along the Valley side and on the Plateau.

Structure:

The strata in the vicinity have been thrust into a series of north-south folds which can be seen along the north side of the Alaska Highway between miles 496 and 520. Faulting, which followed, produced considerable vertical displacement in places. A fault along the south side of the Liard Valley and another probable fault along the north side of the Valley account for the stratigraphically higher slates being found in the bottom of the Valley while limestones crop out along the Valley side.

The Liard Fluorite property is on an anticline, the axis of which strikes north-south and passes just west of Show A. The sharpness of the crest of the anticline varies considerably. At the 2nd east branch of Mould Creek, dips of 10 degrees in opposite directions (representing the two limbs) can be found within a distance of 500 feet. The crest is equally sharp north of this point, while southward it becomes gentle and near Show A there is very little change in attitude of the limestone over a distance of 1200 feet across the top of the fold.

The lineation shown on the aerial photographs and drawn on map 9 occurs along the crest of the anticline for 2 miles but fades out southward where the crest of the fold has become fairly gentle. No evidence of faulting was found along this lineation. It is probably the result of fracturing of the massive limestones along the crest of a sharp fold.

Evidence of faulting has only been found on Show A (see maps 1 and 3). The argillites at the contact have been brecciated, and jumbled blocks of argillite up to two feet across are seen at the contact on the

west side of the mesa. Evidence of shearing at the contact can also be found on the east side of the mesa and at (S300 E40) numerous, small south-east - dipping faults cut the slates. In addition to the observed faulting, rusty fault gouge was uncovered in the strip at (S200 S200).

The general attitude of this zone of shearing could not be determined and, because of the scarcity of large outcrops in the area, it could not be traced. The extent of the shearing, its cause, and its relationship to mineralization, if any, are unknown.

Mineralization:

In the mapping of this property, ore was distinguished by visual examination aided by a few assays for checks. Anything mapped as ore is estimated to contain over 60% combined fluorite, witherite, and barite. The barite, although not ore, was included because the amount of it mixed with the witherite could not be determined. Because there is usually less than 10% barite present and because most of the ore runs over 70% of the three minerals combined, the material mapped as ore usually contains over 60% valuable minerals. -- witherite and fluorite.

The types of ore bodies can be classified on the basis of structure as follows:

A. Formed within massive limestone:
   1. Evidence of bedding control
   2. No evidence of bedding control

B. Formed at the disconformity:
   1. Replacement of limestone
   2. Replacement of argillite and slate.

The ore bodies found within massive limestone (Type A) are usually too small to be of economic importance. Type A-1 occurs as small irregular replacements beneath some local thinly-bedded limestone or as a complete replacement of a bed of massive limestone. An example is a three foot lens of witherite which is found within a series of massive limestone beds in the

canyon of Mould Creek just below its 1st west branch.

Type A-2 is quite common and can be seen on the face of a small cliff about 800 feet north of No. 2 post Gem No. 10 Mineral claim. This body is very irregular in outline and has a maximum dimension of about 30 feet.

Ore occurring at the disconformity, has been found for 6000 feet in a north-south direction and 2500 feet in an east-west direction and, in only one place (S650 W70), has a barren contact been exposed. The bodies are very irregular in thickness and, in places, masses of rock are left surrounded by ore. This irregularity shows up on Map 3 of Show A.

Replacement of limestone at the contact (type B-1) produces a massive ore containing fluorite and witherite with minor quarts and barite and with a negligible amount of calcite remaining. Shows A, B, and probably D are of this type.

Replacement of argillite and slate at the contact produces a very friable ore composed of witherite and barite with minor fluorite (S1020 W1600) or a hard massive ore consisting of small black crystals of fluorite, lenses of witherite, and unreplaced rock (S1030 W 1630). The few assays taken show a higher ratio of witherite and barite to fluorite in ore formed by replacement of argillite and slate than in that formed by replacement of limestone.

Petrology:

The fluorite of the property varies in color from dark purple, if coarsely crystalline, to black, if fine-grained. The color can change from dark purple to pinkish to practically colorless if the fluorite is left in the sunlight to bleach. The witherite is massive showing no crystals macroscopically and it varies in color from white to dark grey and nearly black. That found replacing limestone is usually white whereas that replacing argillite or slate is usually grey.

Several distinct kinds of ore occur and microscopic examination was made of specimens from several places.

The ore of the north side of Show A consists of irregular masses of dark purple fluorite up to 20 centimeters across intergrown with irregular masses of white witherite. Although most of this coarsely crystalline ore

ASSAY SHEET

Sample No. (on map)	Gem 1 (Map 5)	Gem 2 (Map 5)	Gem 3 (Map 5)	Gem 4 (Map 7)	Gem 5 (Map 7)	Gem 6 (Map 2)	Gem 7 (Map 2)
Mark on assay	W 1600 S 1025	Show E Upper Strip	Show E Lower Strip	S400 W1650	W1600 N300	2c	1c
Location	Show E W 1600 S 1025	S1035 W1630 to S1050 W1695	W1960 (S1270 to S1360)	S400 W1650	Show G N300 W1600	Show C S3950 E230	Show C S4050 E240
Description	Grab Sample	Chip Sample	Grab Samples from several holes	Chip Sample 13-foot vertical interval	Chip Sample N300 (W1550 to W1665) 22-foot vertical interval	5 Chip Samples Maximum vertical interval--9 ft.	Grab Sample from small hole
% Fluorite	2.0	34.6	28.8	29.3	64.0	35.8	28.5
% Witherite	74.6	30.3	39.7	22.7	15.2	41.1	28.4
% Barite	7.9	5.0	5.8	28.4	-	-	-
% Calcite	-	2.3	13.6	nil	-	-	-
% Silica	10.6	22.1	-	-	-	-	-
% Carbon	0.4	-	-	-	-	-	-
% Iron	0.23	-	-	-	-	-	-
% Iron Oxide (Fe 203)	0.33						

has no definite structure, short, thick, witherite-rich bands, which are parallel to the original bedding, do occur in a few places. The individual crystals of fluorite are up to three centimeters long. The witherite crystals are usually under one centimeter long, and contain numerous small (under 0.1 millimeters) crystals of barite.

Toward the margins of the ore body (especially around S200 W20) and at places within it, black ore is found. In the hand specimen, this may look like ordinary dark grey limestone with veinlets of carbonate through it. Upon close inspection, however, one will find that much of the dark grey material consists of small shiny black crystals in a grey matrix. A few small purple crystals of fluorite can be seen along the margins of the white veinlets of witherite. The microscope shows that the dark material contains rounded and euhedral fluorite crystals, which are clouded and which contain small quartz grains. The matrix for these fluorite crystals is a mosaic of quartz with crystals up to one millimeter in diameter. The quartz mosaic, which forms about 40% of the slide, contains a few irregular patches of carbonate. The quartz assays about 13% of the rock, and is regarded as an added constituent and not part of the original limestone which shows no quartz when examined under the microscope.

A few small examples of crustiform banding were found around Show A. It consists of alternating bands of white ore, which is largely witherite, and dark ore, which is an irregular intergrowth of fluorite and witherite. The bands vary in amount of fluorite present and in crystal size, and have sharp boundaries.

Specimens of two kinds of ore of Show E were examined. Much of the ore at (S1040 W1640) is a dull grey banded rock. Scattered through some of the bands are numerous small shiny black crystals of fluorite. In some bands these are so small and numerous that the band has a black color. Microscopic

examination shows that the rock is fine-grained quartz containing fluorite in different amounts in each band. In places, the quartz mosaic is clouded and contains black streaks. The quartz is regarded as an original constituent of the argillite host rock, and the dark streaks are iron oxide and free carbon which were probably pushed aside during the partical replacement by fluorite.

At (S1030 W1610) slate, which was stratigraphically higher than the argillite at (S1040 W1640), is almost completely replaced by ore. The resulting ore has an irregular horizontal cleavage, and is so friable that it can be easily crumbled by hand. Very thin veinlets or films of black powder form easy partings in the ore. Microscopic examination shows that the ore is composed of witherite and a few quartz bands containing fluorite crystals. The black films are confined to the fine-grained quartz. The structure of the ore and the large amount of black material, which is iron oxide (0.33%) and free carbon (0.4%), make one suspect that the ore is a replacement of black slate.

Microscopic examination shows that the witherite, which replaces argillite or slate, often is clouded and usually contains small crystals of barite. The witherite, which replaces limestone, contains barite crystals, but is usually clear.

Ore Showings:

Show A (Maps 1 & 2):

At this place, a small elongated mesa stands in the middle of a valley. The mesa is composed of limestone and has a slate and argillite capping covering the south half. Ore, which crops out around the sides of the mesa, is a replacement of the limestone. The ore reaches its maximum thickness of 20 feet on the north side of the mesa (S60 W60). This point is the source for most of the bulk sample which was sent to Ottawa in November, 1953. The ore under the capping appears to pinch to the south-east.

Remnants of limestone are left in the ore on the west side of the mesa and, on the south-west corner, a large block of limestone has been left between the ore and the slate capping. On the north-east corner of the mesa (S90 W50), a block of slate with vertical bedding is found in the ore. The vertical attitude of the slate and the projection of the block down into the limestone may have been caused by slumping during deposition of the sediments near the edge of a cliff or hole in the limestone.

The brecciated argillite shown on the south-west side of the mesa has been partly replaced by ore. It was described under "structure".

Show B (Maps 1 & 4):

At this place, a spur capped by slates projects west-ward from the valley side. The ore replaces limestone beds under the capping and probably has an average thickness of about eight feet. A small gentle scarp, which runs north-west across the top of the spur, has been dug into in several places to expose ore. It is considered the western edge of the ore body.

The southern outcrop of ore is bounded on the top and the east by slate. This illustrates the irregularity of the disconformity.

500 feet north-west of Show A at (N200 W500), ore crops out on the west side of a small knoll and slates occur on top of the knoll. This small deposit and Shows A and B may be the remnants of what was once a large body of ore of variable thickness. The kind of ore found in the three deposits is similar and is typical of that formed by replacement of limestone.

Show C (Map 2):

A rock exposure was found on the north-west side of a small flat-topped rise 3800 feet south of Show A (S3950 E220). The exposure is about 40 feet long and has a maximum vertical interval of nine feet. It consists of dark grey ore that has a distinct horizontal cleavage and may be a replacement of argillite. At the north-east corner of the exposure, is some

relatively unaltered limestone which seems to underlie the ore. Small pits dug 100 feet south of the exposure revealed argillite with a high content of fluorite and witherite, and another pit 50 feet south of these pits exposed unaltered argillite. An elongated fissure in limestone occurs 100 feet south of the pits, and stripping between the pits and the fissure uncovered a small amount of ore. Stripping, which was done on a hillside north-west of the exposure in an attempt to pick up the disconformity, exposed only limestone.

Show D (Map 1):

Very few good rock exposures were found near Show D, but a little digging exposed good ore on a southern slope. To the west of and below the ore, argillite containing numerous stringers and lenses of witherite crops out over a vertical interval of 100 feet. Unaltered limestone crops out north of the ore, and slate is found on a hillside east of the ore.

Show E (Maps 1, 5, & 7):

Show E, which is regarded as an ore body of type B-2, consists of four exposures of ore around the margins of an area of slates. The slate and argillite, which crop out between the ore exposures of (S400 W1650), (S750 W1200), and the strip starting at (S1050 W1600), contain numerous stringers and lenses of fluorite and witherite. The current theory that mineralization has been concentrated at the disconformity, makes this area of slates very favourable ground for further investigation.

The bulldozer stripping was more successful here than in the other places and two good cuts were made in ore. Two samples from the upper strip and one sample from the lower strip were assayed (see Map 5). Sample Gem 1 was a grab sample of ore similar to some taken in a bulk sample. It assayed 74% witherite and is the very friable kind of ore described under "petrology". Sample Gem 2 is a chip sample taken in what appeared to be the poorest ore of the strip. Sample Gem 3, which is a grab sample from several holes near the

lower strip (S1300 W1960), shows 13.6% calcite. The calcite, which can be easily seen with the naked eye, is white and coarsely crystalline. It has been deposited during mineralisation and is not just a remnant of unaltered grey limestone.

The northern exposure of ore of Show E, (see Map 7) has been sampled (assay Gem 4) and shows an unusually large amount of barite. The ore at this exposure appears to be a replacement of argillite. It has a very sharp lower contact against unaltered limestone.

Show F (Map 6):

Most of the ore bodies, which come to the surface and which do not have a thick layer of soil or talus over them, have a definite effect on the vegetation. The area has a luxuriant growth of spruce or lodgepole pine, and moss grows thickly even where the limestone or slate has a very thin mantle of soil. However, moss, spruce, and often pine will not grow on some of the ore. With this in mind, two small white spots which showed up on the aerial photographs were located in the field and have called Show F. Although there is a thick growth of moss, spruce, and pine in the area, these two patches are absolutely devoid of the three plants. The only vegetation on the patches are a few stunted tamarack trees, some stunted buck-brush, and a thin growth of grass. The patches are covered with a thin layer of soil mixed with talus of ore, and a few small exposures of ore protrude through the soil. These two patches have very sharp boundaries, and are probably underlain by ore. The only other outcrops in the vicinity are limestone, and the bodies are thought to be the irregular type in massive limestone (Type A-2). If the area between these two patches has a thick layer of soil underlain by ore, the body might be of economic importance.

Ore, which has a high content of coarse purple fluorite, such as that of the north side of Show A, does not effect the growth of vegetation.

There seems to be a tendency for the ore with a high content of witherite and with fine-grained black fluorite to hinder growth of the vegetation. This could be due to the high solubility of such ore.

Show G (Maps 1 & 7):

At this place, the western side of a hill is largely ore. The top and the east side of the hill are limestone, and limestone constitutes the only other exposures seen in the vicinity. The body is thought to be a replacement of massive limestone with no bedding control (Type B-2) and is probably relatively small.

CONCLUSIONS

Mapping of the Liard Fluorite property indicates that ore bodies, which occur at the disconformable contact between the limestone and slate formations, are the only ones that offer hope of continuity. Although the contact has been eroded from a large part of the area, there is still much of it left. If the part remaining is mineralized and if the thickness of the bodies remains consistent enough to make the ore mineable, considerable ore might be proved.

This can only be investigated by drilling short (usually under 200 feet) holes throughout the area. For testing the areas of overburden for ore bodies, holes drilled on a 400 foot grid will suffice, but, to prove tonnage where there is mineralization, holes should be drilled every 50 feet. Water for drilling can be obtained from the 1st east branch of Mould Creek in which case there would be a vertical lift about 800 feet and distances of 10,000 feet to Show D, 8,000 feet to Show A, and about 6,000 feet to Show E.

Show E, at present, appears to offer the best possibilities for an ore body capped by a thin layer of slates. Outcrops of slate containing lenses of ore are found over an area 400 feet by 700 feet, and several exposures of ore are found around the margins of this area. This is considered favorable ground for further investigation by drilling and it can be investigated by very short drill holes (usually under 50 feet). The friable nature of this ore and the overlying slates makes a drill core of large diameter very desirable and sludge samples necessary.

This area of slates extends an unknown distance to the south-west and further prospecting with a pick-and-shovel on the south half of Gem No. 22 M.C. might uncover more ore.

J. R. Woodcock.

MAP 1 December 1954, J.R.W.

Department of
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ASSESSMENT REPORT
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LIARD FLUORITE

SHOWS: A, B, D, E, G

SCALE 1"=100'
CONTOUR INTERVAL: 10 FT.

LEGEND

- ORE: (a) in outcrop, (b) assumed (ore has over 60% combined fluorite, witherite, and barite)
- SLATE & ARGILLITE: (a) in outcrop, (b) assumed
- LIMESTONE (a) in outcrop, (b) assumed
- Limits of outcrop
- Cliff edge
- Rock contains small lenses & stringers of ore
- Float of ore
- F Fossil Locality
- Attitude of Bedding
- Stripped Area
- Road
- Claim Posts
- Grid Line showing location of labelled 2"-high pegs

'A' SHOWING
'B' SHOWING
'D' SHOWING
'E' SHOWING
'G' SHOWING

#109
MAP 1

MAP 2 December 1954, J.R.W.

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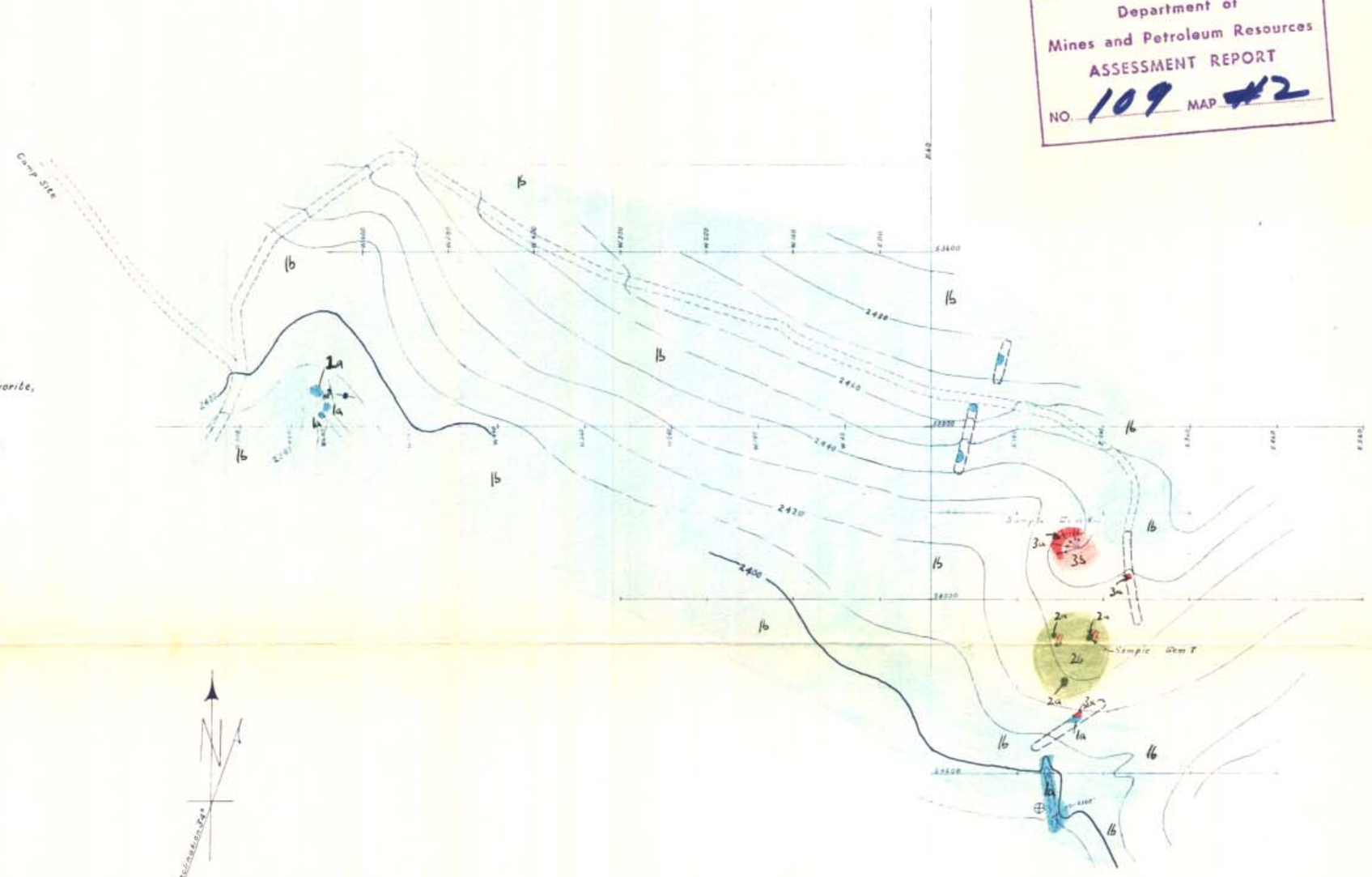
LIARD FLUORITE

SHOW C

SCALE 1" = 100'
CONTOUR INTERVAL = 10 FT.

LEGEND

- 1a 3b — ORE: (a) in outcrop, (b) assumed (ore has over 60% combined fluorite, witherite, & barite)
- 2a 2b — SLATE & ARGILLITE: (a) in outcrop, (b) assumed
- 1a 1b — LIMESTONE (a) in outcrop, (b) assumed
- Limits of outcrop
- fl — Rock contains small lenses & stringers of ore
- Attitude of Bedding (horiz)
- Attitude of Fracture Set
- Stripped Area
- Road
- Chip Sample



#109
MAP #2

MAP 3 December 1954 J.R.M.

MAP 4 December 1954 J.R.W.

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LIARD FLUORITE DEPOSIT

SHOW B

SCALE 1"-20' (HORZ. & VERT.)
CONTOUR INTERVAL - 10 Ft.

LEGEND
- Vegetation
- Talus
- Ore
- Black Slates
- Limestone
- Edge of Cliff

#109
MAP 4

MAP 5 December 1954. J.R.W.

LIARD FLUORITE

SHOW E
(STRIPPED AREA)

SCALE 1"=40' (HORZ. & VERT.)
CONTOUR INTERVAL: 10 Ft.

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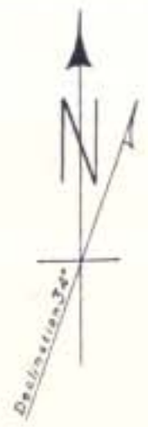
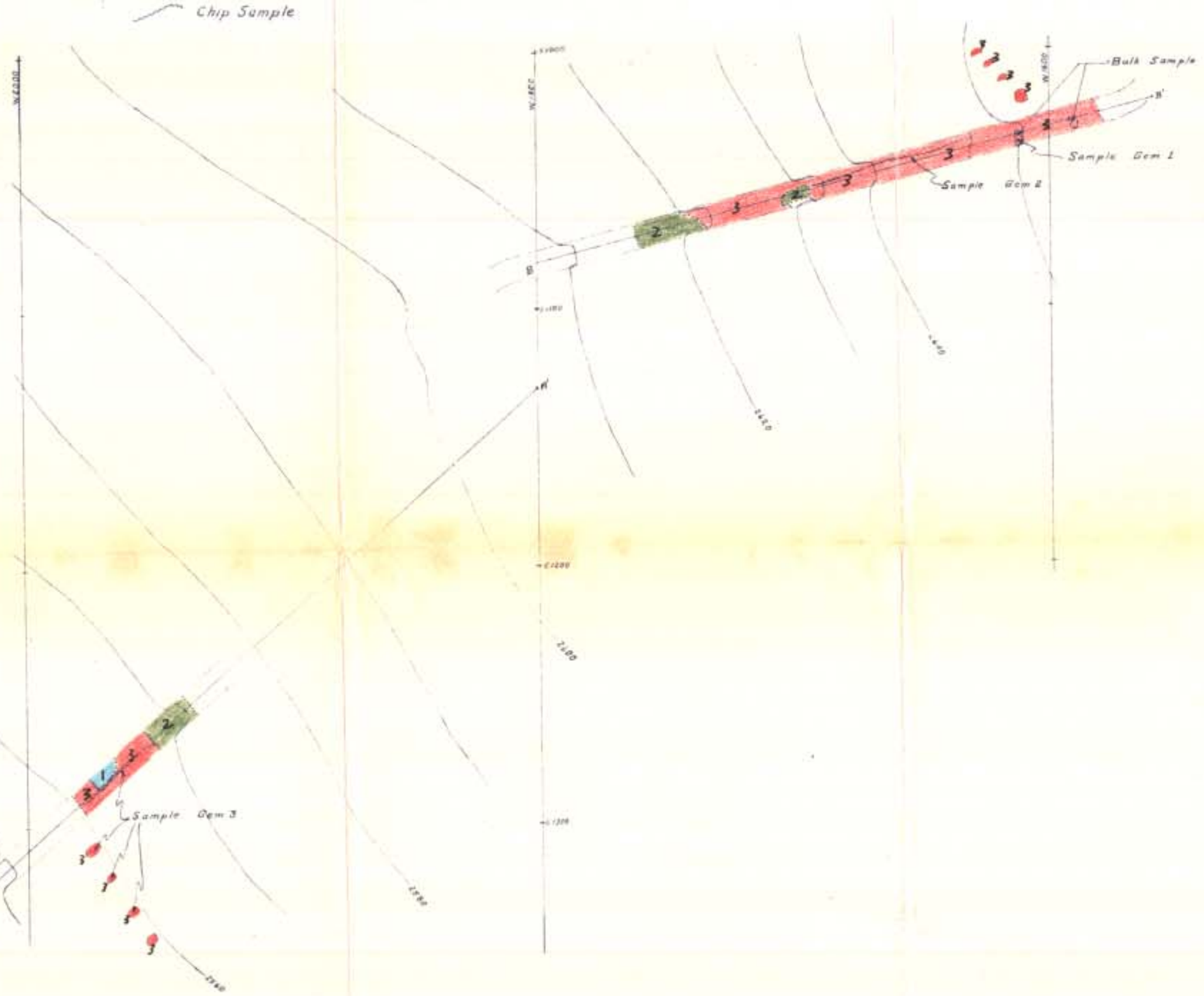
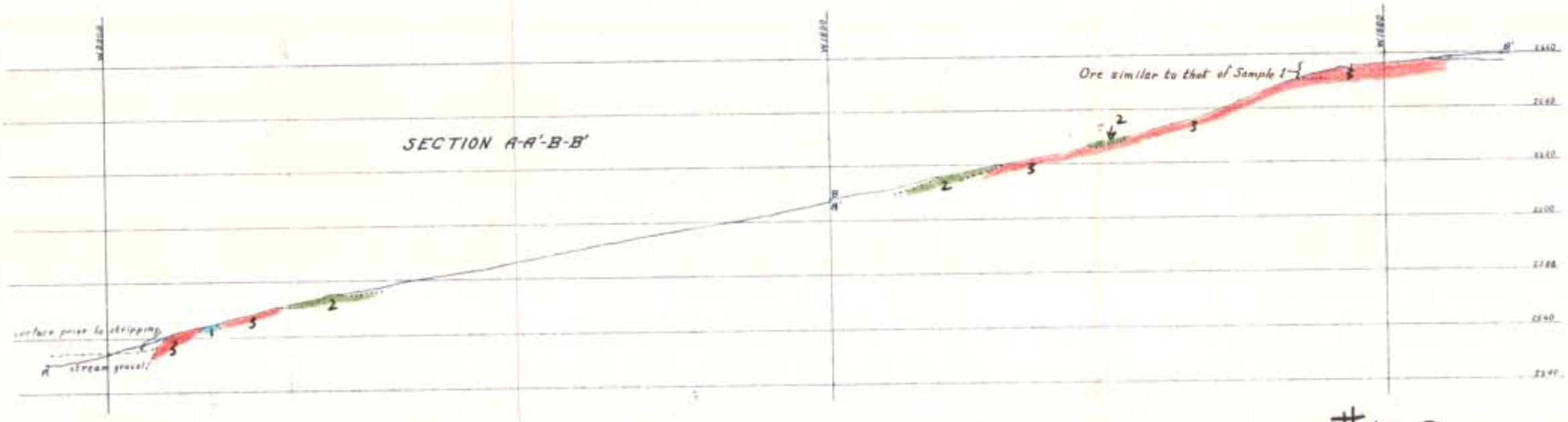
LEGEND

3 ORE: Over 60% combined Fluorite, Witherite, Barite.
2 ARGILLITE
1 LIMESTONE
Chip Sample







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MAP 5

MAP 6 December 1954, J.R.W.

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LIARD FLUORITE

SHOW F

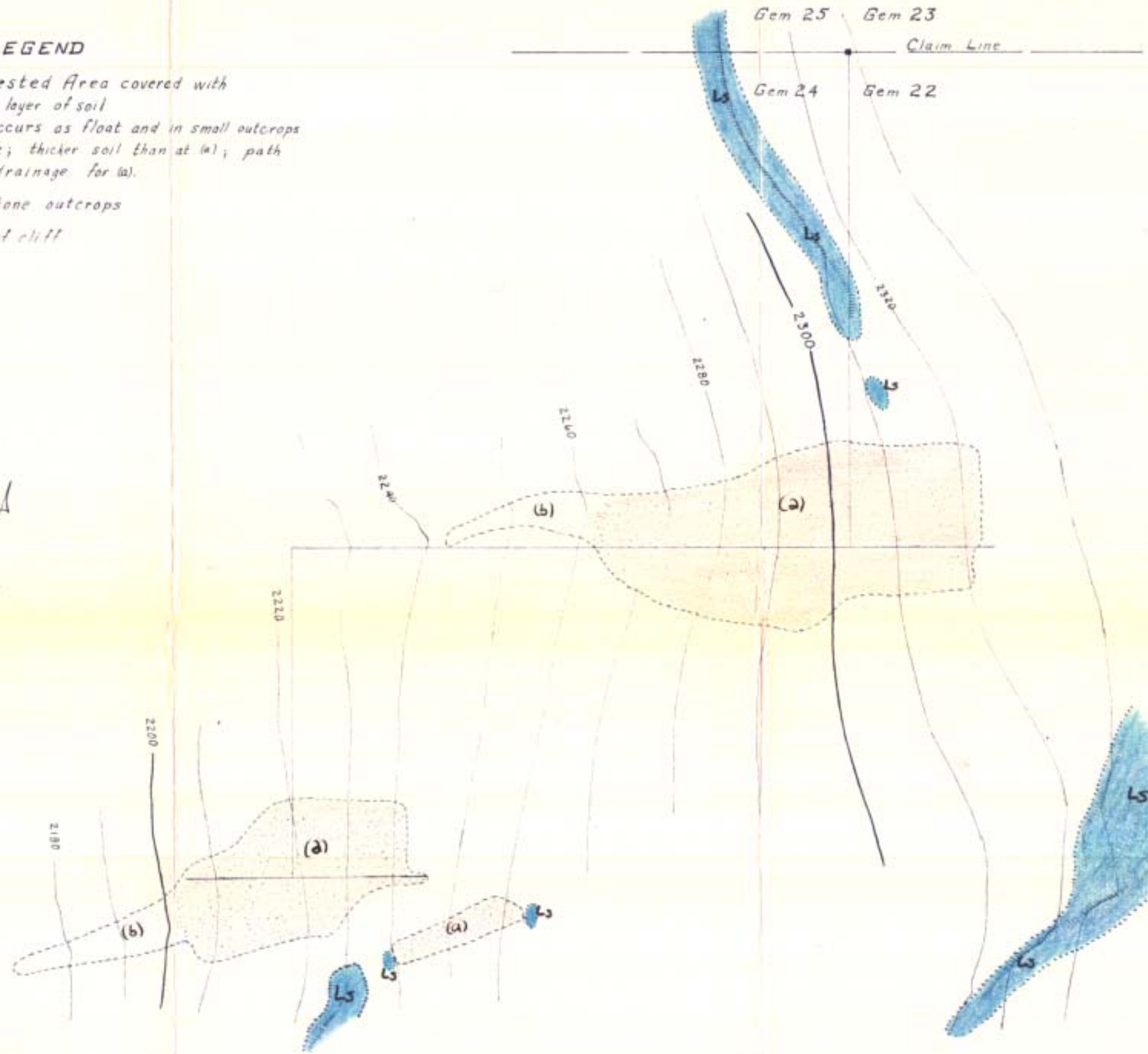
SCALE 1"=40'
CONTOUR INTERVAL 10 FT

LEGEND

(a) (b) Unforested Area covered with thin layer of soil
(a) Ore occurs as float and in small outcrops
(b) No ore; thicker soil than at (a); path of drainage for (a).

Ls Limestone outcrops

Edge of cliff



#109
MAP 6

MAP 7 December 1954 J.R.W.

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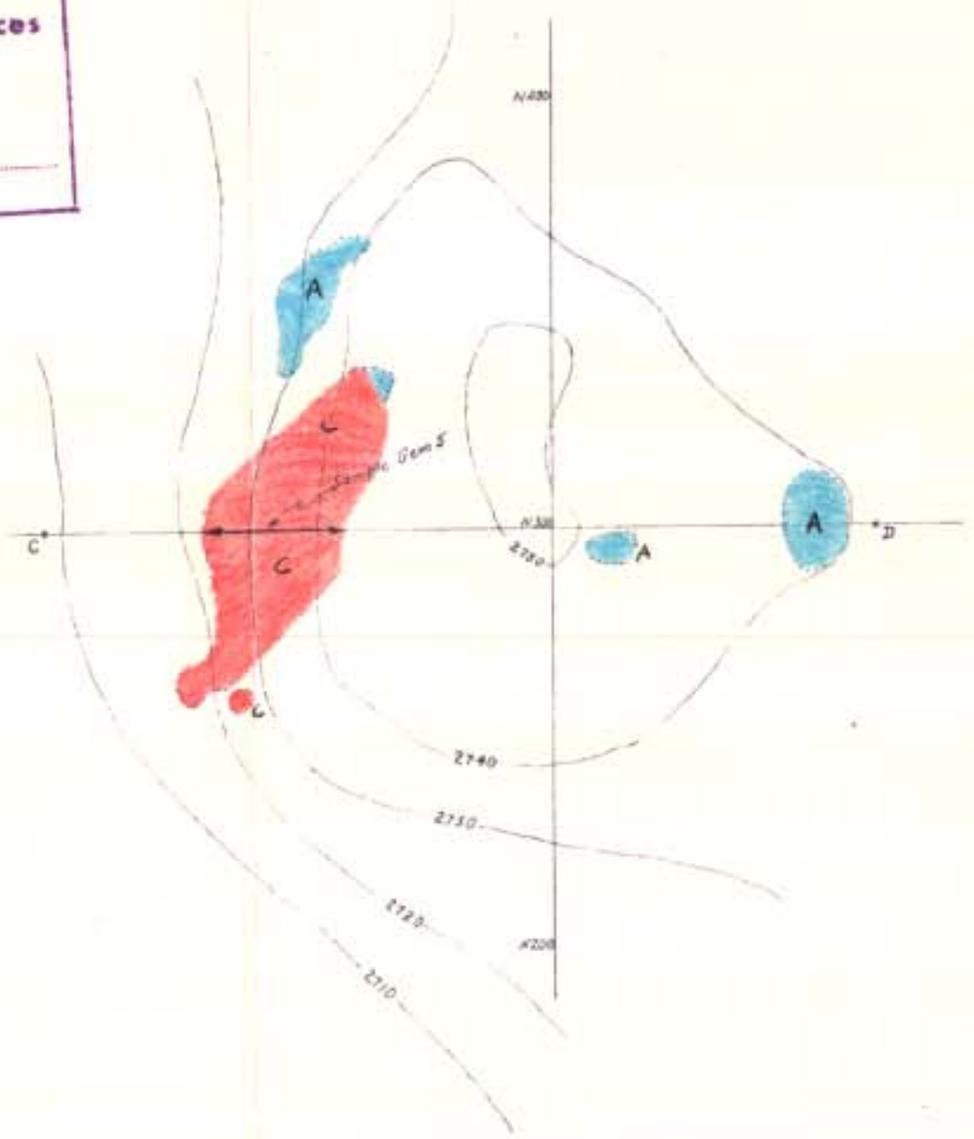
SAMPLE: GEM 5
SHOW G



LIARD FLUORITE

SAMPLE MAP

SCALE 1" = 40' (HORZ. & VERT)
CONTOUR INTERVAL 10 FT.

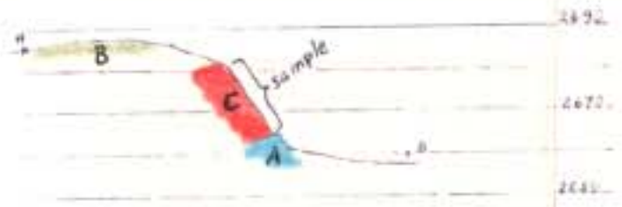
LEGEND

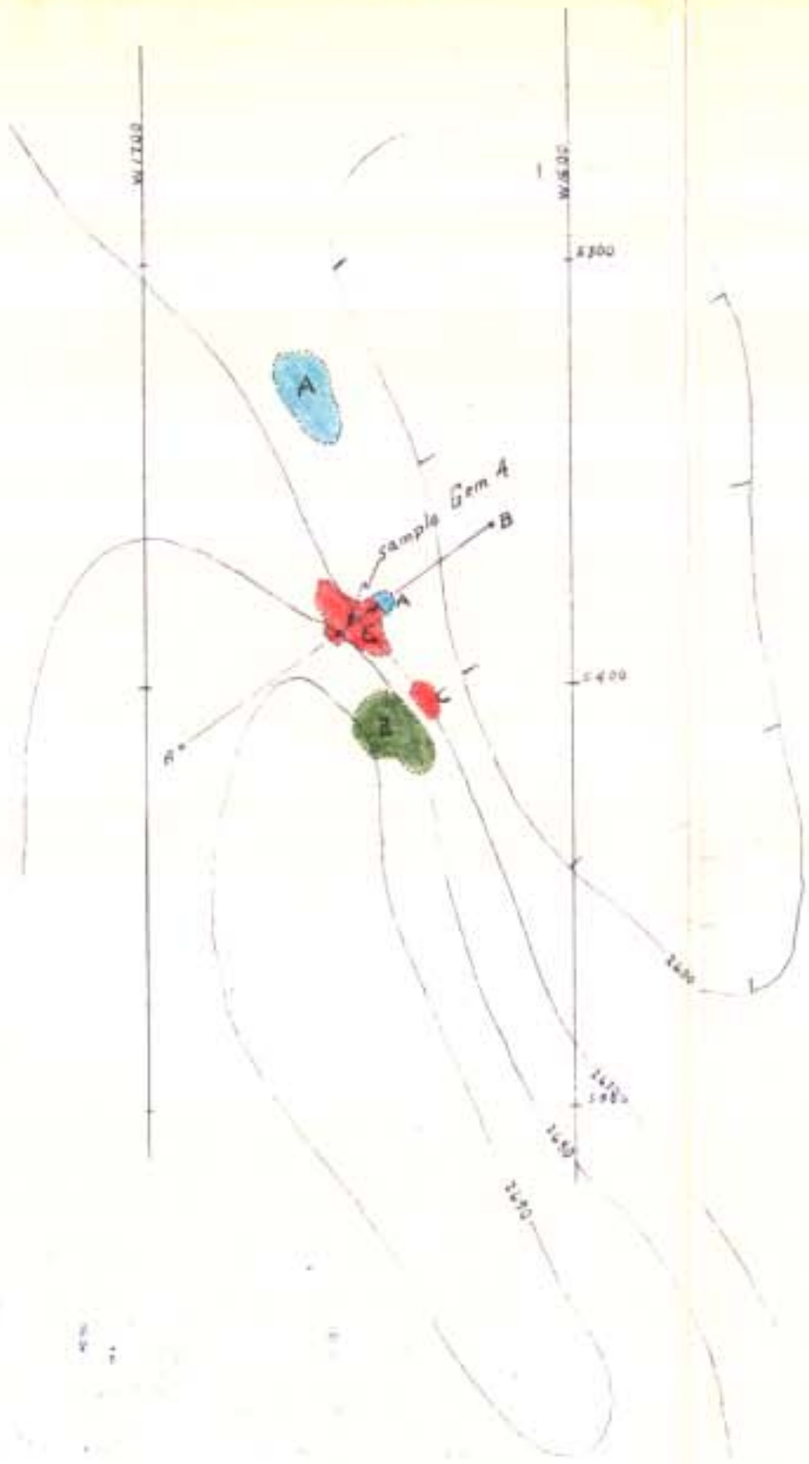
C ORE

B SLATE & ARGILLITE

A LIMESTONE

SAMPLE GEM 4
NORTH END SHOW E





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MAP 7

MAP 8 December 1954, J.R.M.

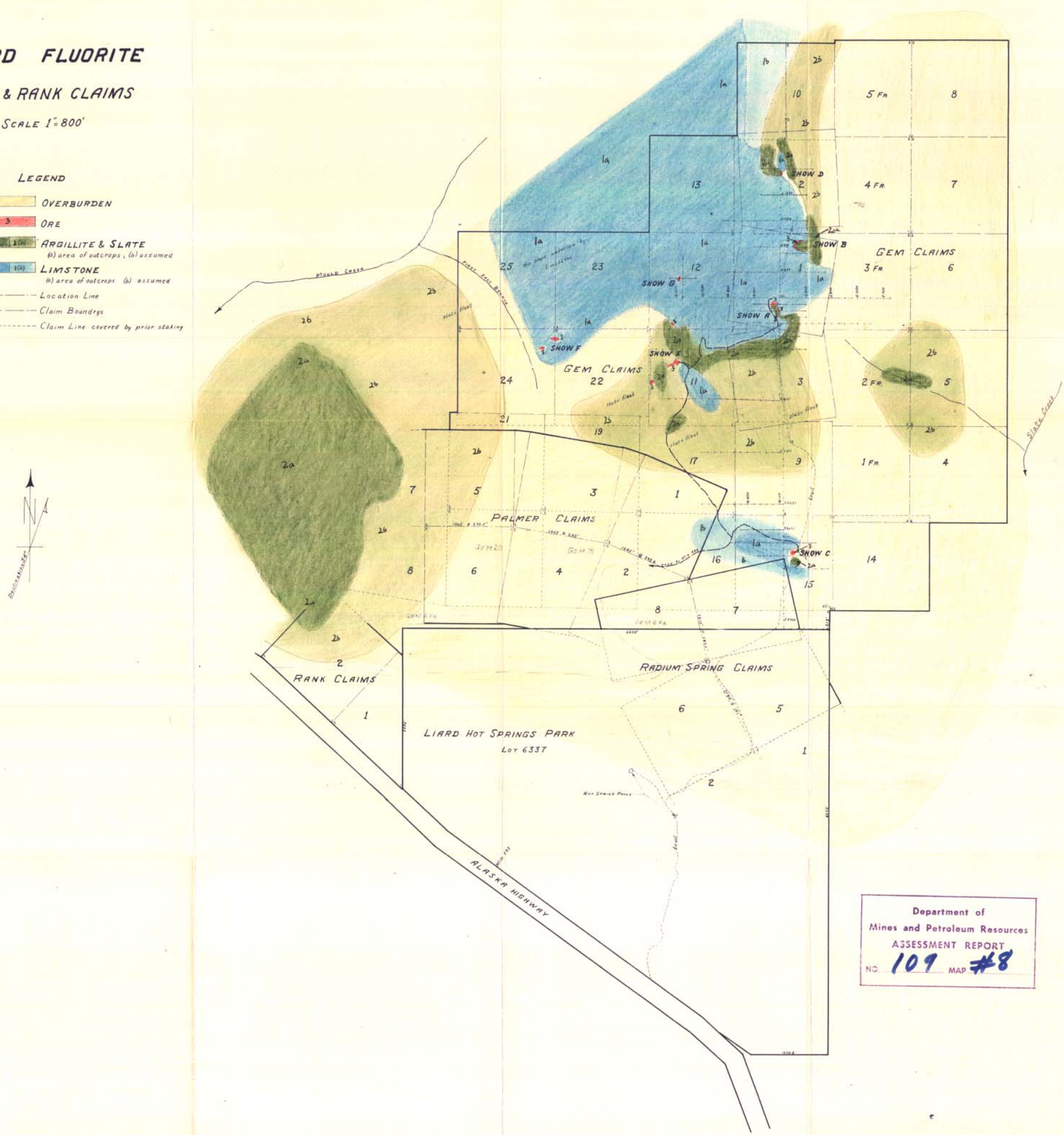
LIARD FLUORITE

GEM & RANK CLAIMS

SCALE 1" = 800'

LEGEND

- OVERBURDEN
- 3 ORE
- 2(a) 2(b) ARGILLITE & SLATE (a) area of outcrops, (b) assumed
- 1(a) 1(b) LIMSTONE (a) area of outcrops (b) assumed
- Location Line
- Claim Boundrys
- Claim Line covered by prior staking



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LIARD FLUORITE

SCALE 1" = 3000' (horz. & vert)

CONTOUR INTERVAL 200 FT.

Contours drawn with stereoscope from Photos: A11351-101
A11346-168

LEGEND

SLATE & ARGILLITE

LIMESTONE

Lineation shown on aerial photographs: A11351-101 & A11346-168

Anticlinal Axis

Attitude of Bedding

(horz)

Attitude of Cleavage

(horz)

(vert)

Section A-B

Section C-D Along Anticlinal Axis

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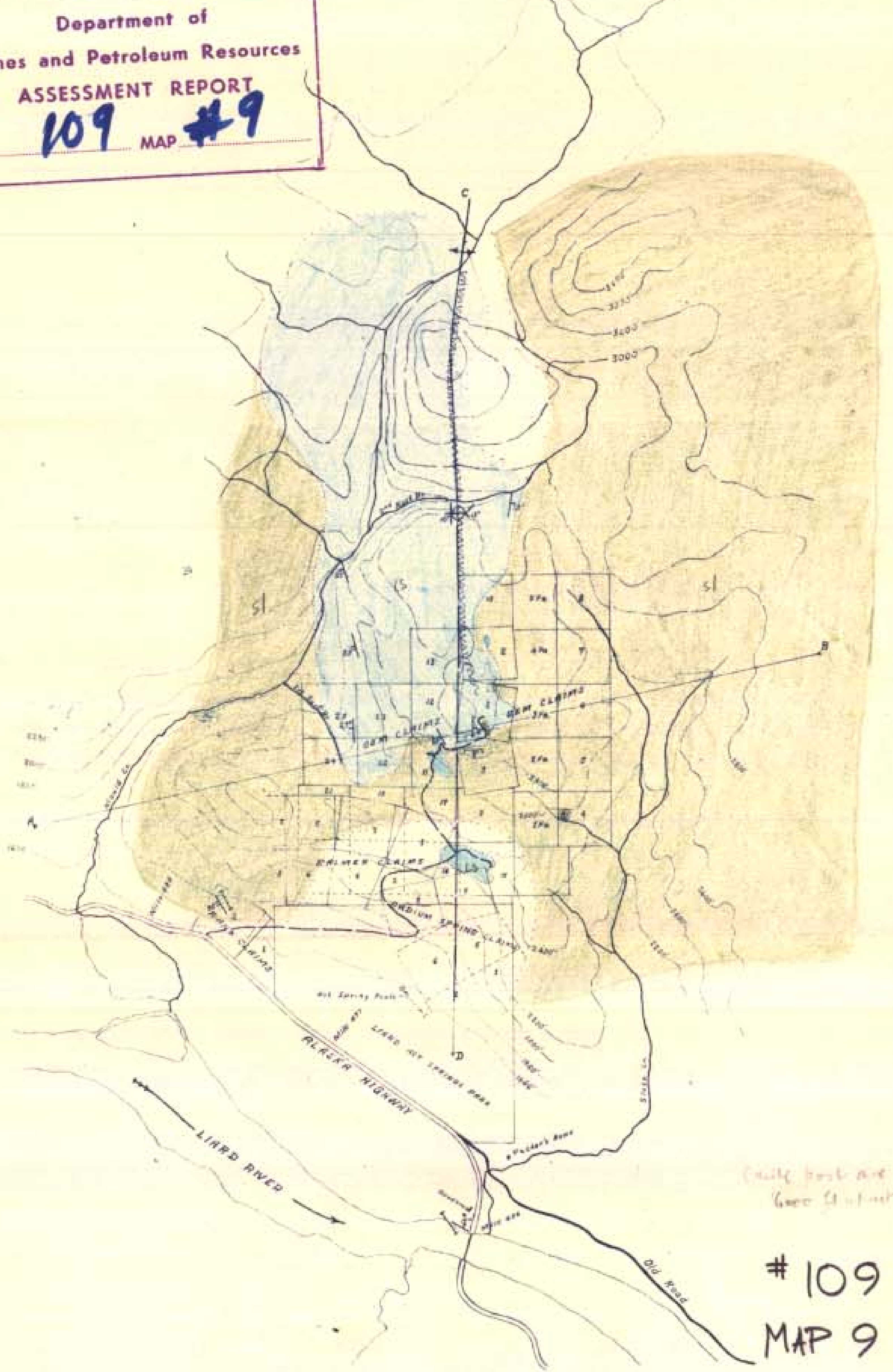

#109
MAP 9