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MINERALS INVESTIGATION

of the

ROCKY MOUNTAINS AREA

ALBERTA AND BRITISH COLUMBIA.

Prepared for

IMPERIAL OIL ENTERPRISES LTD.

By

GEOPHOTO SERVICES, LTD.

Calgary, Alberta.

December, 1967.

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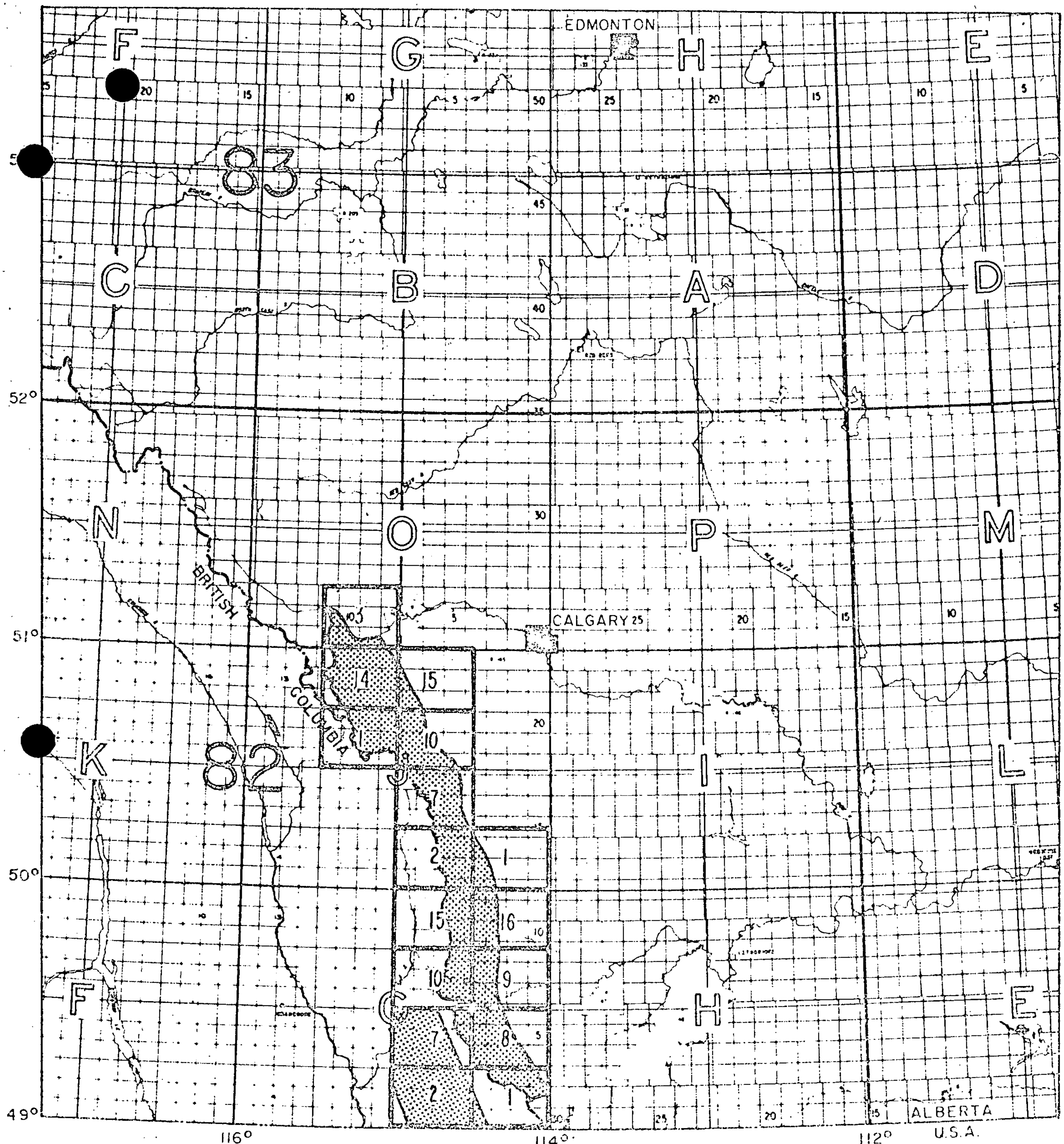


1967 0004

MAP INDEX

ROCKY MOUNTAINS AREA, ALBERTA.

GEOPHOTO SERVICES LTD.

SCALE: 1 INCH = 40 MILES

INTRODUCTION

This report presents the results of a minerals exploration program, based on reconnaissance geochemical surveying, which was conducted throughout an area of approximately 2,500 square miles in the Rocky Mountains of southwestern Alberta and the adjoining part of British Columbia. The Map Index plate opposite, shows the area investigated and its relation to Calgary and the provincial borders of Alberta.

The purpose of the Rocky Mountains project was to locate mineralized areas of possible economic interest. Application could then be made to the Government of Alberta for prospecting permits and further detailed exploration work undertaken within the concessions.

Geochemical stream sampling was the method employed with direct transportation by helicopter used for the collection of samples. A small field geochemical laboratory was established for base metal assaying of the samples, using cold extraction methods of analysis.

Exclusive photogeologic maps, air photos, and mosaics supplied by Imperial Oil Enterprises Ltd., were used for control in the field work, supplemented by geologic maps published by the Geological Survey of Canada.

The field party left Calgary on 25 September, 1967, and in the one month field activities approximately two-thirds of the project area as outlined by Imperial Oil geologists was covered by the survey.

In summary, the results of the field program were not too encouraging. Nine anomalous areas were located and prospected in the field but no surface mineralization was uncovered. Further work in these areas has not been recommended.

A review of the field work and the hot extraction assay results received subsequent to the field operations, indicates that further work is warranted in the vicinity of Mount Gass and in the Flathead River area of British Columbia.

TOPOGRAPHY AND ACCESSIBILITY

The Rocky Mountains project area, as initially outlined, lies immediately east of the British Columbia - Alberta border and forms an elongated strip of country approximately four miles in width, with a northern boundary at the Trans-Canada Highway east of Banff and the southern boundary at Waterton Lakes National Park.

Structurally, the area lies wholly within the Front Ranges sub-province of the Rocky Mountain system (North and Henderson, 1954). North of the Highwood River the topography is generally rugged with peaks rising to over 10,000 feet. In this scenically picturesque mountain country the headwater streams draining eastwards are more youthful than is considered desirable for geochemical stream sampling.

South of the Highwood River, the topography is less rugged. Along the western border, the High Rock Range and the Flathead Range rise to more than 8,000 feet with several peaks exceeding 9,000 feet. Elsewhere the terrain is generally below timberline with only occasional peaks rising above 8,000 feet.

Access to the area is by means of the gravelled Kananaskis - Colman Road which connects the Trans-Canada Highway, east of Banff, with Colman on Alberta Highway No. 3. Three gravel roads join the Kananaskis-Colman Road from the east, crossing the Front Ranges via the east-west valleys of the Highwood River, Willow Creek and the Oldman River.

The major river valleys within the project area are important forestry preserves and therefore local logging roads frequently provide fair weather access to the higher ground of the Front Ranges.

After the field operations had begun, Imperial Oil Enterprises Ltd. extended the project area to include the Flathead River valley and the adjacent mountains. This region of British Columbia south of the No. 3 Highway, is densely timbered and not well suited to helicopter operations. A rarely used bush road follows the Flathead River valley southwards from No. 3 Highway to the abandoned Customs station of Flathead on the international boundary.

LOGISTICS AND PERSONNEL

The field program was carried out by the following Geophoto personnel - G. J. McGinn, J. R. O'Donnell, E. M. Estabrooks, A. T. Foley, and G. O. Raham. H. Armstrong was employed as cook.

Helicopter support was provided under contract by Bullock Wings & Rotors Ltd. (C. Armstrong, pilot and M. O'Rielly, flight engineer) and Alpine Helicopters Ltd. (T. Jensen, R. Tymrick, and K. Ostertag, pilots, and R. Harris, flight engineer).

An International Travelall van and a half-ton pick-up provided ground transportation while a four-ton truck was used for distributing aviation gas and for towing the industrial trailer which served as field accomodation.

A Bell 47G - 3B - 1 helicopter was used for air transport except briefly when it was replaced by an Allouette turbo helicopter. This latter machine proved entirely unsuitable for geochemical sampling operations but had a limited application in the ground follow-up work.

GENERAL GEOLOGY

The Rocky Mountains project area forms part of the classic geologic province of the Western Cordillera of Canada. For the purpose of this report, the geology and structure of the area is not discussed and therefore reference is made to the work of North and Henderson (1954) and the exclusive photogeologic evaluations prepared by Geophoto Services, Ltd. for Imperial Oil Enterprises Ltd. The bibliography also contains a complete listing of pertinent Geological Survey of Canada maps and memoirs.

Mineralization of the southern Rocky Mountains is discussed by Hedley (1954) and few known mineral showings occur within the project area. Hedley mentions the Bearspaw lead-zinc deposit near Mount Cass. Low grade gypsum deposits are known in the Kananaskis Lakes area. The coal and petroleum deposits are, of course, the better known mineral occurrences but these fall outside the scope of this investigation.

MAP COMPILATION

The maps and similar materials used on the field studies were compiled in conformance with the Canadian National Topographic System grid as shown on the Index Map (see Introduction). These materials were obtained from three main sources and the following paragraphs summarize the pre-field map compilation activities. It should be noted that the Flathead River area was not included in the original project outline and the materials available are therefore less complete in this area.

Topographic Maps

For the original project area paralleling the British Columbia - Alberta border, standard one inch to one mile contoured topographic maps were purchased and board mounted for use on the field operations.

Six base maps at a scale of one inch to one mile were drafted on Permascale using a polyconic projection. Additional drainage detail was transferred from the topographic maps for those areas of the map sheets which lay within the project boundaries.

The six base maps were used to plot the geochemical sample locations and ozalid copies of the final maps accompany this report.

Geologic Maps

Imperial Oil Enterprises Ltd. provided photogeologic coverage of part of the project area. The exclusive photogeologic evaluations had been conducted by Geophoto Services, Ltd., in the late 1950's. This mapping covers the following N.T.S. grid sectors - 82 G / 1, 2, 7, 8, 10, 15, and 82 J / 10 (W 1/2), 11, and 14.

A geologic map accompanying the Thirteenth Annual Field Conference report of the Alberta Society of Petroleum Geologists (Fitzgerald, 1963) was used as coverage in 82 O / 3.

Published Geological Survey of Canada maps at a scale of one inch to one mile were used for geologic coverage in 82 G / 7 (E 1/2), 8, 9, 16 and 82 J / 1 (W 1/2), 2, 7 (E 1/2), 10 (E 1/2), and 14 (W 1/2).

Geologic coverage for the Flathead River area was obtained from the Geological Survey of Canada map (one inch to two miles) for 82 G / 2 and 7 (W 1/2).

No large scale mapping was available for 82 J / 7 (W 1/2).

Air Photographs

Imperial Oil Enterprises Ltd. supplied air photo coverage for almost all of the project area. To obtain full stereoscopic coverage, Geophoto purchased an additional twenty-four air photos. For the Flathead

River area, only partial coverage was supplied by Imperial Oil Enterprises and Geophoto did not supplement this with additional photography.

Mosaics

Imperial Oil Enterprises Ltd. supplied twelve mosaics covering most of the project area. Geophoto Services, Ltd. supplemented this with three of their mosaics (82 O / 3, 82 G / 7, and 82 J / 15). No mosaic was available for part of the Flathead area (82 G / 2).

FIELD WORK

The field program commenced on 25 September, 1967, and lasted nearly one month. Interruptions due to helicopter failures and adverse weather conditions seriously affected performance in the field and the contract terminated with approximately one-third of the project area not covered by geochemical field sampling.

The Bell 47G-3B-1 helicopter is ideally suited to this type of geochemical reconnaissance program. Unfortunately, the machine supplied by Bullock Wings & Rotors Ltd. had three engine failures during sampling operations, resulting in a walk back to camp each time for the pilot and geologist. It was to be replaced by a second G-3B-1 helicopter but the incoming machine had to make a forced landing during the ferry from Golden, British Columbia, to the project area. An Allouette turbo helicopter was then allocated to the contract but proved unsuitable for this particular type of flying. The machine crashed and was demolished after two days of service. Alpine Helicopters Ltd., of Calgary, was contracted to complete the flying operations and no further incidents resulted.

A few days were lost due to adverse weather conditions. Heavy rain and snow accompanied by high winds sharply increased flying hazards and the late Fall weather proved to be unsuitable for a project of this type. Snow in the high country also made ground follow-up impossible or dangerous in several instances. Snow and frost interfered with normal landings and occasionally prohibited stream sediment sampling.

Nearly fourteen hundred geochemical samples were collected during the field operations of which approximately 89 percent were obtained by helicopter. The samples were returned to the base camp where a small geochemical field laboratory was set up to process them for cold extraction base metal analysis. Each sample was assayed for heavy metals using the Bloom Test and those samples which rated anomalous on this test, were then run for copper using the Holman Test.

Briefly, the field geochemical analyses detect trace amounts of base metals in soil and stream sediment samples by colorimetric technique. The samples are partially digested in a Total Heavy Metals (THM) buffer or a copper buffer and titrated against an organic solvent (dithizone) to a distinctive green end-point. The field assay results are plotted on the six Geochemical Sample Plans which accompany this report and they show the number of mls of 0.001% dithizone indicator required to achieve this end-point.

To assist in evaluating the significance of anomalous samples some eighty of them were sent to a commercial assay laboratory for total extraction analysis. The results obtained expressed in parts per million of copper, lead and zinc, are also plotted on the Geochemical Sample Plans.

The field samples were transported to Calgary on completion of field operations. Geophoto has sorted, dried, and boxed these samples and is storing the material on behalf of Imperial Oil Enterprises Ltd.

GEOCHEMICAL ANOMALIES

General Remarks

Nine geochemical anomalies were investigated in the project area and their locations are shown on the Geochemical Sample Plans accompanying this report. Geochemical anomalies were established purely on the basis of assay results from the field geochemical laboratory. Anomalies were field checked by additional reconnaissance geochemical sampling, detailed follow-up geochemical sampling on the ground, and by careful prospecting of accessible outcrops.

Anomalies 1, 2, 3 and 6 were uncovered within or close to the boundaries of the permit area obtained from the Alberta Government and held by Imperial Oil Enterprises Ltd. Greater emphasis on follow-up geochemical sampling and detailed ground prospecting was placed on these anomalies.

About half way through the field program, four to five inches of snow fell in the higher country making the field checks of Anomalies 5 to 9 rather difficult. Only Anomaly 1 is discussed in detail due to its larger areal extent and the favourable geologic setting. Unfortunately, no significant mineralization was uncovered on any of the anomalous areas.

Anomaly 1

Location and Geology

Anomaly 1 is located in the east-central portion of Map Sheet 82 J/NW, 1 to 2 miles east and southeast of Mt. Blane, a prominent peak of the Opal Range. It occupies a 2 mile long north-south zone in the south-western headwaters of the Little Elbow River.

The northwesterly trending Rundle Thrust Fault parallels the main valley in the vicinity of the anomaly and brings undivided Banff, Rundle, and Rocky Mountain carbonates in faulted contact with Mesozoic Fernie and Spray River sediments. The floor of the main valley is underlain by black carbonaceous shales and siltstones of the Triassic Spray River and Jurassic Fernie Groups while Paleozoic carbonates form the higher rugged terrain both to the east and to the west.

Geochemical Sampling

The original reconnaissance geochemical samples that localized Anomaly 1 include stream sediment samples K195 to K201. Samples K197, K200, and K201 gave fairly high THM values of 12 mls, 13 mls, and 10 mls respectively using cold extraction geochemical methods.

During follow-up operations 10 additional stream sediment samples were taken on foot from the smaller adjoining tributaries upstream from the original sample locations to provide further control on the lateral extent of the geochemical anomaly. Cold extraction geochemical tests were run on the spot with the aid of a small field kit although, in each case, a bagged sample from the same location was retained for further tests at the field laboratory and for hot extraction analysis if necessary.

Samples K460 and K461 taken upstream along an eastern tributary of the main valley were not particularly impressive. These samples were taken from Paleozoic terrain. Sample K462 taken upstream from the original Sample K197 on a western tributary of the main valley, also shows a cutoff by the time Paleozoic carbonates were reached. The remaining seven follow-up samples can be considered anomalous in some degree with values ranging from 6 to 13 mls titration. Most of these samples were taken from lower in the main valley and its southern tributaries and appear to have been influenced by the presence of Mesozoic black carbonaceous shales and siltstones.

Hot extraction analyses from Anomaly 1, with the exception of K466, show zinc values of 100 parts per million or more. Sample K201 with 300 ppm zinc and 30 ppm copper is high enough to be of interest. Although undivided Rocky Mountain and Rundle carbonates occur upstream from this sample, the location is influenced by rock debris from the Mesozoic carbonaceous sediments. This masking effect was noted in many cases to occur within 300 to 400 feet of actual Mesozoic - Paleozoic contact zones and a definite geochemical cutoff was not obtained until the sampling was well into the carbonates.

The hot and cold extraction values for the original and follow-up samples on Anomaly 1 are as follows:

Sample No.	mls Titration		Hot Extraction (ppm)		
	THM	Cu	Cu	Zn	Pb
K 195	7	1	20	140	x
K 196	7	1	10	110	x
K 197	12	1	x	200	x
K 198	7	1	x	140	x
K 200	13	1	10	100	x
K 201	11	1	30	300	x
K 460	3	-	-	-	-
K 461	4	-	x	160	x
K 462	5	-	10	210	x
K 463	11	-	x	110	x
K 464	9	-	10	100	x
K 465	7	-	30	110	x
K 466	5	-	20	30	x
K 467	10	-	10	100	x

x - less than 10 ppm

Follow-Up Work

Follow-up work was initiated by a general reconnaissance of the anomalous area by helicopter. The next step was detailed ground geochemical sampling supplemented by conventional prospecting methods. Finely disseminated pyrite occurred in a few freshly broken pieces of bedrock from both the

Mesozoic and Paleozoic sediments. No other sulphide mineralization was noted in the area. Extensive scree slopes near the upper reaches of the tributary streams were examined for mineral-bearing float without success.

Further follow-up work is not justified in the vicinity of Anomaly 1. The hot extraction geochemical results are not especially impressive. The presence of carbonaceous black shales and siltstones of the Fernie and Spray River Groups are probably responsible for the slightly higher than average trace amounts of zinc.

Anomaly 2

Anomaly 2 is located on the western tributaries of Shoulder Creek near the south end of the rugged Fisher Range. The anomaly lies approximately one and one-half miles northwest of Mount Romulus.

The bedrock in the area of the anomaly consists of Palliser and Fairholm carbonates and black platy calcareous shales of the Banff and Exshaw Formations. The Lac des Arcs Thrust Fault passes through the area and brings the Devonian Fairholm Group in faulted contact with the Mississippian Banff Formation.

Reconnaissance geochemical samples K 286 and K 287, with 13 and 16 mls THM titration values respectively, established Anomaly 2. Further samples, K 470 to K 472, were collected by helicopter upstream from K 286 but little or no pattern could be established. Follow-up sampling on the ground produced disappointingly low values, especially upstream from sample location K 287. These additional samples were run on the spot and the geochemical results recorded in the field without a sample being retained.

Hot extraction values were suprisingly low. Zinc ranges from 80 to 260 parts per million and all the samples contain less than 10 parts per million of both copper and lead.

Anomalous follow-up values mainly occurred at the base of extensive scree slopes which were thoroughly examined. No sulphide mineralization was located. Anomaly 2 is considered to be the result of concentrating effects by percolating runoff waters over a large area of broken rock containing slightly higher than normal but not economical amounts of zinc.

Anomaly 3

Anomaly 3 is located in the southwestern portion of Map Sheet 82 J/NW at the southern end of the Opal Range and approximately 1 mile east of Elpoca Mountain. Drainage in this area forms the headwaters of the Elbow River.

The southern extension of the Mount Rundle Thrust Fault occurs east of Elpoca Mountain. Banff, Rundle, and Rocky Mountain Formations form the higher ground while the main valley, in part, is underlain by Spray River and Fernie carbonaceous shales and siltstones.

The reconnaissance samples which originally defined this anomaly assayed from 6 to 25 mls THM titration. Some of the follow-up samples taken on foot assayed in excess of 15 mls THM titration. Careful prospecting supported by field geochemistry failed to locate surface mineralization.

Hot extraction assays are not particularly impressive but do aid in outlining the extent of Anomaly 3. Sample K 458 showing 200 ppm of zinc, was the highest value from this anomaly. The organic nature of many of the samples seem to be at least partially responsible for the slightly higher than normal geochemical values in this valley. Hot and cold extraction values for the original reconnaissance samples and some of the follow-up samples are as follows:

	mls Titration		Hot Extraction (ppm)		
Sample No.	THM	Cu	Cu	Zn	Pb
K 176	25	1	x	170	x
K 177	8	1	x	110	x
K 178	4	-	10	130	10
K 179	5	-	20	90	x
K 456	15	1	10	110	x
K 457	5	-	x	110	x
K 458	12	1	x	200	x

x - less than 10 ppm

Anomaly 4

Anomaly 4 is centrally located along the western side of the Kananaskis Range between the Kananaskis and Spray Lake reservoirs. The south~~easterly~~westerly flowing tributary of Smith-Dorrien Creek was investigated on two separate occasions, the first by foot upstream as far as sample location K 387 and later by detailed helicopter supported prospecting. Mesozoic and Paleozoic sediments dip steeply to the west along this flank of the Kananaskis Range.

A very sharp geochemical cutoff was noted as soon as follow-up sampling passed the contact between Fernie-Spray River carbonaceous silt-stones and undivided Rocky Mountain-Rundle carbonates. Samples K 387 and K 388 show 25 and 20 mls THM titration respectively and less than 300 feet upstream the geochemical values drop as low as 3 mls.

Other isolated high values within 2 to 3 miles north and south of Anomaly 4, also appear to have been influenced by the higher than average zinc content of the carbonaceous shales and siltstones of the Fernie and Spray River Groups.

Anomalies 5 to 9

Anomalies 5 to 9 principally located west of Smith-Dorrien Creek, between Mount Invincible to the south and the Goat Range to the north were rather small anomalies usually established on a single high geochemical value. Each of the anomalous areas was field checked with the aid of additional ground follow-up sampling and conventional prospecting methods.

Only sample K 366 from Anomaly 9, located along French Creek warrants further comment. This sample ran 40 ppm copper, 700 ppm zinc, and 20 ppm lead, and substantiated the original cold extraction value of 25 mls THM titration. Following this tributary to its higher reaches once again exposed black carbonaceous shales, probably the Exshaw Formation at the base of the Banff Formation of Mississippian age.

Mount Cass Area

Sixteen geochemical samples with THM values of 1 to 25 mls, from the eastern flank of the High Rock Range on Map Sheet 82 J / SE, were submitted for hot extraction assay. The lower values submitted were to serve as background comparison with the higher THM values. The highest zinc results from the entire project area, 1,200 and 650 ppm from samples K 1111 and K 1113 respectively, were collected within a two mile radius of the old lead-zinc prospect investigated by West Canadian Collieries of Blairmore, Alberta (Norris, 1958).

Very little information concerning the prospecting and development operations in this vicinity could be found but Norris briefly discusses the economic geology of the property. Lead and zinc mineralization occurs "in two zones along minor splays from the Lewis thrust about 50 feet below the top of the Palliser formation". Norris states that the lower mineralized zone is about 30 feet thick and the upper one 10 feet thick, and both outcrop for about 500 feet along the northeast face of Mount Gass. No assay values or tonnage figures are given.

Other fairly high hot extraction geochemical results occur five to six miles further north of Mount Gass, still along the eastern side of the High Rock Range. Zinc values as high as 580 ppm and some indication of copper and lead occur in samples from Lost Creek and probably represent either similar mineralization or similar geologic conditions to the occurrence at Mount Gass.

Black silty pyritic shale from the basal unit of the Exshaw Formation may be partially responsible for the higher than normal geochemical values along portions of the eastern flank of the High Rock Range. Also contributing to at least some of the high values may be geochemical contamination from old prospect pits and mine workings near Mount Gass. A third possibility is that unexplored mineralization may be present.

The Mount Gass area was not examined on the ground because of adverse weather conditions. The anomaly did not show up until the final days of the field program and heavy snow cover made ground work impossible.

A minor road or trail follows the valley of the Oldman River and ends at the Mount Gass workings. This road leaves the Kananaskis - Colman Highway near the junction of the Oldman and Livingstone Rivers.

Flathead River Valley Reconnaissance

During the second week of the field program, a reconnaissance geochemical sampling trip by road down the Flathead River valley was undertaken. Post early Cretaceous trachytes and syenites that intrude Rundle Group carbonates northeast of Howell Creek were the target areas. Twenty nine geochemical samples were taken between Michel Creek, approximately three miles south of Corbin, British Columbia, and the Burnham Creek - Flathead River junction about two and one-half miles north of the abandoned Customs station at Flathead.

Weather conditions were extremely bad and only tributary streams crossing the Flathead River valley road were sampled. Sample F 24, from a small tributary draining Trachyte Ridge at mile 29.5 (by vehicle speedometer) south of Corbin, British Columbia, shows a fairly high THM titration value of 15 mls. Other nearby streams which also appear to be draining the small intrusive bodies, did not show significant geochemical results.

Samples F 7 to F 9, taken along Squaw Creek just south of Flathead Pass, show fairly high THM titration values of 12, 8 and 7 mls respectively. These tributaries drain the Paleozoic terrain on the west flank of Centre Mountain, made up largely of Rundle Group carbonates. All remaining samples taken during the reconnaissance trip were low background values ranging from 1 to 3 mls THM titration.

CONCLUSIONS AND RECOMMENDATIONS

The purpose of the minerals investigation of the Rocky Mountains area was to locate significant mineralization through reconnaissance geochemical surveying. Although the field operations were reasonably successful in performance, the ultimate objective of the program was not realized.

Weather conditions and poor helicopter performance both seriously hindered execution of the field program. It is now recognized that a reconnaissance sampling operation of this particular type is better performed without the handicap of Fall winds and snow. The numerous mechanical problems of the first G-3B-1 helicopter and the obvious disadvantages of the Allouette machine both affected the rate of reconnaissance sampling during the first half of the field activities.

Fifty five percent of the samples were obtained from streams draining Paleozoic rocks. It was recognized early in the month that the Mesozoic shale horizons (Fernie and Spray River Groups) were the prime sources of spurious geochemical anomalies. A number of streams were checked where zinc anomalies originated in black carbonaceous shales. Possibly, breakdown of finely disseminated pyrite under oxidizing conditions released a certain amount of associated zinc into the streams which, by continuing concentration, creates the anomalous conditions. Confirmation of this process was obtained by THM assay of silt-size black shale material collected

Generally speaking, the southern Rocky Mountains of western Canada are lacking in known mineral occurrences. This is substantiated by the results of this project. The nine anomalies located are small and no mineralization was discovered during careful surface prospecting. The lack of Cambrian carbonate rocks within the project area mitigates against the discovery of economic mineralization similar to the Monarch and Kicking Horse Mines.

Structures and intrusions are prime targets in minerals exploration. Although geologic structure is obviously present in the area, intrusions are lacking. An exception to this may be the Flathead River area where a small intrusion appears to be related to a significantly high geochemical value.

Within the uncompleted southern third of the original Alberta project area geologic conditions, although still lacking intrusives, are quite interesting. The area between Highway No. 3, the Crows Nest Pass road, and the northern boundary of Waterton Lakes National Park contains a considerable area of Purcell Group sediments of Precambrian age. This portion of the original project area has seen recent prospecting activity and Kennecott holds a large permit area.

It is recommended that

1. no further work be attempted on Anomalies 1 to 9 in view of the lack of surface mineralization and the limited number of really significant hot extraction assays.

2. the Mount Gass area should be investigated by ground geo-chemical sampling and careful prospecting. The area, in the light of hot extraction results, appears to have some merit and, with relatively easy access available, it could be investigated quite cheaply.

3. the Flathead River valley should be further prospected to ascertain the cause of anomalous results obtained from samples F 7 to F 9 and F 24. The latter sample was taken on a stream which directly drains a small intrusive body. Again, access is readily available and further field work could be economically conducted, and

4. the southern third of the original project area, which was not completed during this field season, should be at least sampled from all available roads, especially in the area directly north of Waterton Lakes National Park that includes Kennecott's permit area.

Respectfully submitted,

GEOPHOTO SERVICES, LTD.

[redacted]

J. R. O'Donnell

[redacted]

Paul Fuenning

SAMPLE #	HEAVY METAL TEST	COPPER TEST	HOT EXTRACTION VALUES (Cu - Zn - Pb) ppm x=<10ppm
K[illegible]55	-5		
K954	-12	-1	(10-120-x)
K859	-6		
K853	-6		
K806	-5		
K814	-6		
K685	-5		
K824	-5		
K819	-22	-1	
K820	-18	-1	
K682	-5		
K863	-6		
K864	-5		
K1209	-6		
K831	-5		
K845	-7	-1	
K843	-9	-1	
K840	-7	-1	
K847	-9	-1	
K244	-11	-1	

Anomalous Values

Cu: ≥ 25 ppm

Pb: ≥ 20 ppm

Zn: ≥ 200 ppm

Heavy Metal Test: ≥ 10 mL

SAMPLE #	HEAVY METAL TEST	COPPER TEST	HOT EXTRACTION VALUES (Cu - Zn - Pb) ppm x = <10ppm
K175	-5		(x - 40 - x)
K174	-6		(10 - 70 - x)
K584	-6		(x - 80 - x)
K645	-5		(x - 80 - x)
K183	-11		
K180	-6		
K181	-14	-1	
K306	-6		(10 - 20 - x)
K303	-7	-1	(x - 80 - x)
K566	-8	-1	
K568	-18	-1	
K455	-25	-1	
K456	-15	-1	(10 - 110 - x)
K457	-5		(x - 110 - x)
K458	-12	-1	(x - 200 - x)
K459	-6		(x - 100 - x)
K439	-6		
K441	-5		
K559	-7	-1	
K047	-7	-1	

SAMPLE #	HEAVY METAL TEST	COPPER TEST	HOT EXTRACTION VALUES (Cu - Zn - Pb) ppm x=<10ppm
K560	-5		
K561	-12	-2	
K562	-10	-1	
K564	-5		
K 435	-12	-1	
K 434	-13	-1	
K 432	-8	-1	
K 430	-10	-1	
K 429	-5		
K 428	-9	-1	
K 426	-7	-1	
K 419	-9	-1	
K 451	-6		
K 389	-10	-1	
K 412	-22	-1	
K 401	-15	-1	
K 390	-25	-1	
K 450	-5		
K 397	-7	-1	
K096	-5		(10-180-10)

SAMPLE #	HEAVY METAL TEST	COPPER TEST	HOT EXTRACTION VALUES (Cu - Zn - Pb) ppm x = <10ppm
K 416	-18	-1	
K 417	-10	-1	
K 393	-7	-1	
K 392	-6		
K 391	-8	-1	
K 415	-6		
K 555	-8	-1	
K 556	-7	-1	
K 436	-5		
K 437	-6		
K 438	-6		
K 557	-10	-1	
K 558	-6		
K 554	-10	-1	
K 552	-5		
K 117	-25	-0	(20-400-x)
K 195	-7	-1	(20-140-x)
K 196	-7	-1	(10-110-x)
K 462	-5		(10-210-x)
K420	-6		

SAMPLE #	HEAVY METAL TEST	COPPER TEST	HOT EXTRACTION VALUES (Cu - Zn - Pb) ppm x = <10ppm
K 197	-12	-1	(x-200-x)
K 198	-7	-1	(10-140-x)
K 200	-13	-1	(10-100-x)
K 469	-9		(10-150-x)
K 463	-11		(x-110-x)
K 464	-9		(10-100-x)
K 465	-7		(30-110-x)
K 468	-9		
K 201	-11	-1	(30-300-x)
K 466	-5		(20-30-x)
K 467	-10		(10-100-x)
K 179	-5		(20-90-x)
K 177	-8	-1	
K 164	-7	-1	
K 123	-6		(20-170-20)
K 472	-7		(x-120-x)
K 287	-16	-1	(x-260-x)
K 286	-13	-1	
K 471	-7		
K 443	-6		

SAMPLE #	HEAVY METAL TEST	COPPER TEST	HOT EXTRACTION VALUES (Cu-Zn-Pb) ppm x=<10ppm
285	-6		(x-80-x)
K 084	-5		
K 127	-9	-0	
K 124	-5		
K 148	-10	-1	
K 410	-5		
K 407	-5		
K 408	-5		
K 403	-5		
K 404	-5		
K 473	-6		
K 388	-20	-1	
K 387	-25	-1	
K 453	-6		
K-386	-15	-1	
K 384	-8	-1	
K 383	-7	-1	
382	-7	-1	
K 371	-9	-1	
K 173	-7	-1	

SAMPLE #	HEAVY METAL TEST	COPPER TEST	HOT EXTRACTION VALUES (Cu - Zn - Pb) ppm x = <10 ppm
K 370	-8	-1	
K 368	-9	-1	
K 369	-7	-1	
K 366	-25	-1	
K 376	-6		
K 377	-8	-1	
K 379	-8	-1	
K 378	-6		
K 358	-6		
K 351	-8	-1	
K 350	-8	-1	
K 352	-13	-1	
K 046	-5		
K 044	-7	-1	
K 045	-5		
K 357	-5		
K 354	-12	-1	
K 255	-7	-1	(30-240-x)
K 026	-6		
K 575	-5		

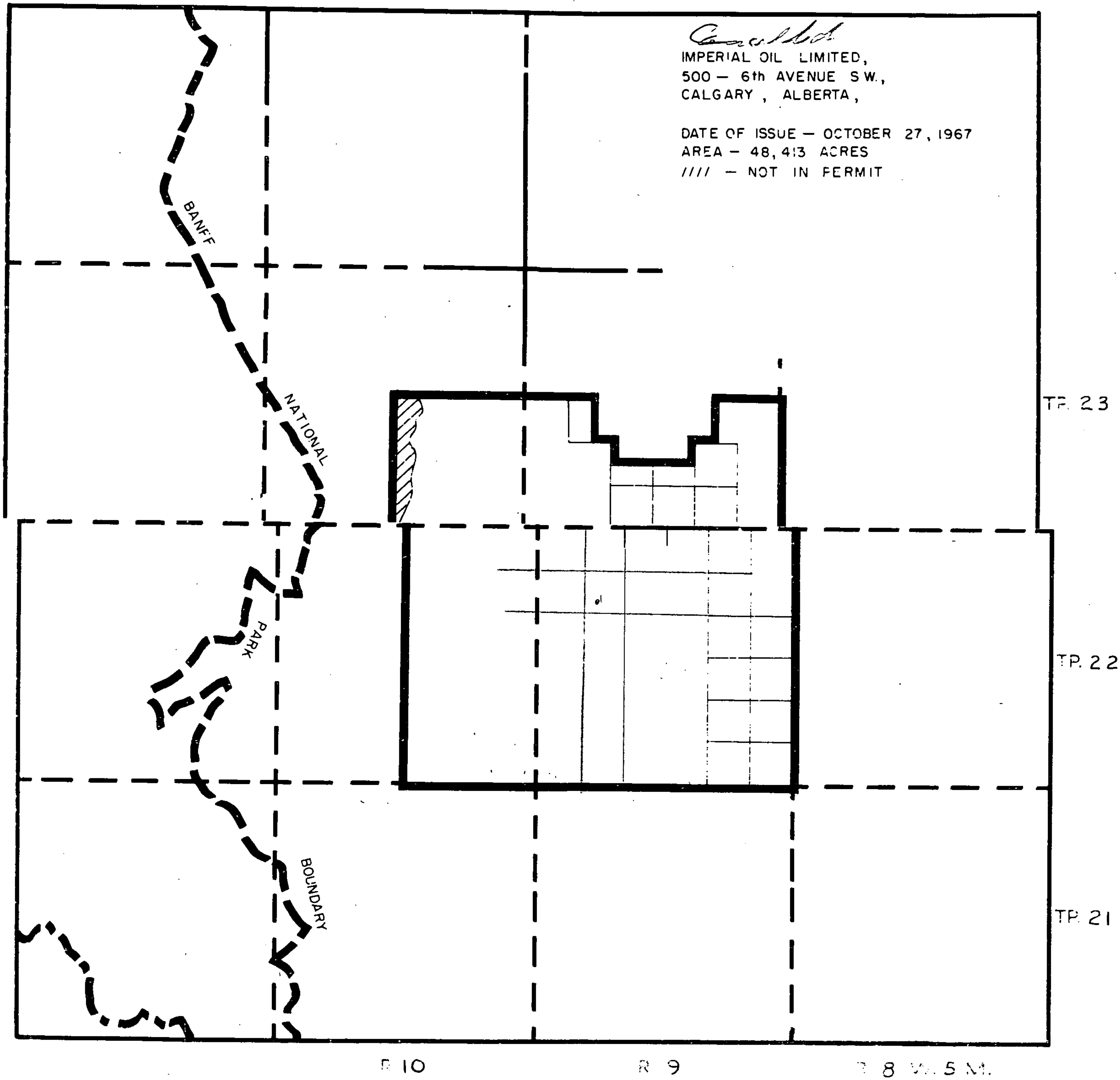
SAMPLE #	HEAVY METAL TEST	COPPER TEST	HOT EXTRACTION VALUES (Cu - Zn - Pb) ppm x=<10ppm
k1136	-6	—	(x - 100 - x)
k1137	-6	—	(x - 160 - 10)
k1111	-25	-1	(x - 1200 - x)
k1113	-25	-1	(20 - 650 - 10)
k766	-7	-1	
k1025	-26	-1	(20 - 450 - x)
k776	-12	-1	
k773	-10	-1	
k755	-8	-1	
k757	-5		
k758	-5		
k926	-7	-1	
k1701	-6		
k731	-6		
k734	-6		
k798	-5		
k909	-11	-1	
k717	-6		
k960	-6		

SAMPLE #	HEAVY METAL TEST	COPPER TEST	HOT EXTRACTION VALUES (Cu - Zn - Pb) ppm x = <10 ppm
K 023	-5		
K 053	-9	-1	
K 344	-11	-1	
K 347	-5		
K 011	-5		
K 012	-3		
K 017	-5		
K 077	-7	-0	
K 010	-7	-1	
K 550 ✓	-6		
K 549 ✓	-5		
K 248 ✓	-5		
K 249 ✓	-12	-1	
K 250 ✓	-6		
K 525 ✓	-7	-1	(10-200-20)
K 206 ✓	-5		(x-130-x)
K 213 ✓	-5		(x-150-x)
K 215 ✓	-5		(x-150-x)
K 233 ✓	-9	-1	
K 227 ✓	-9	-1	

SAMPLE #	HEAVY METAL TEST	COPPER TEST	HOT EXTRACTION VALUES (Cu-Zn-Pb) ppm x=<10ppm
K 1226	-7	-1	
K 1225	-17	-1	
K 995	-5		
K 527 ✓	-6		(20-130-x)
K			
K			
K			
K			
K			
K			
K			
K			
K			
K			
K			
K			
K			
K			
K			

(82 J/14) lead-zinc

QUARTZ MINERAL EXPLORATION PERMIT No. 21



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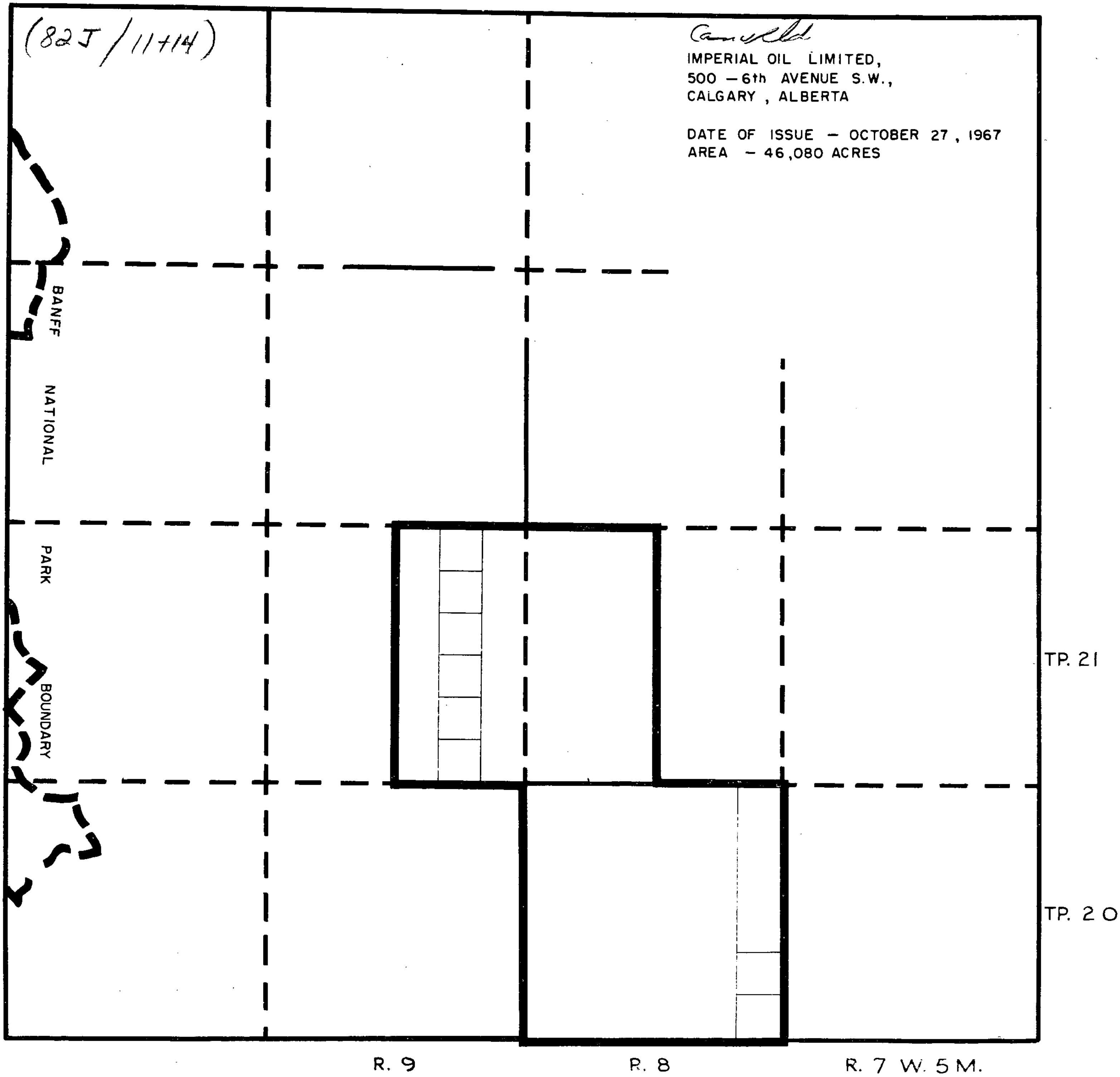
lead-zinc



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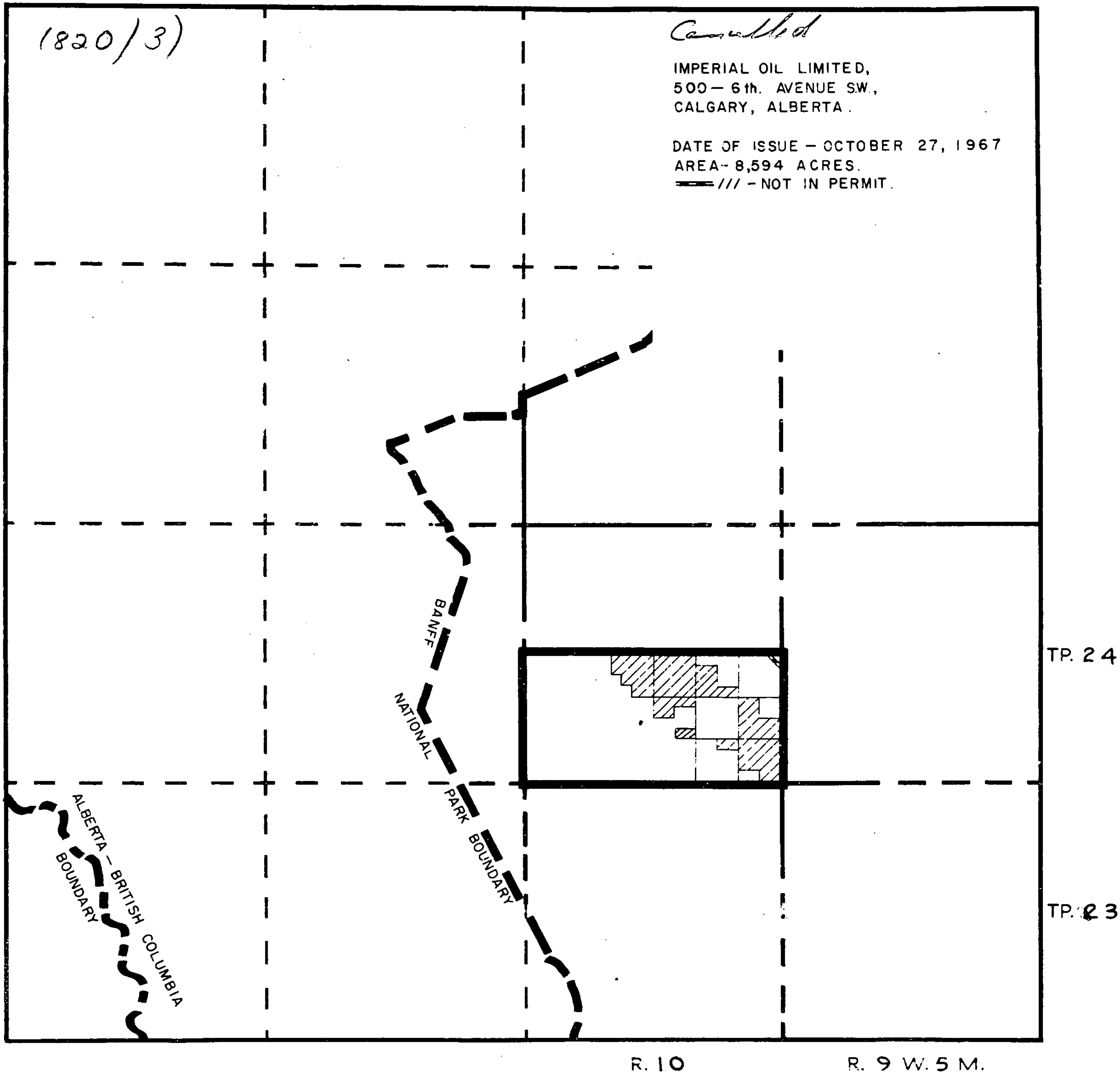
lead-zinc



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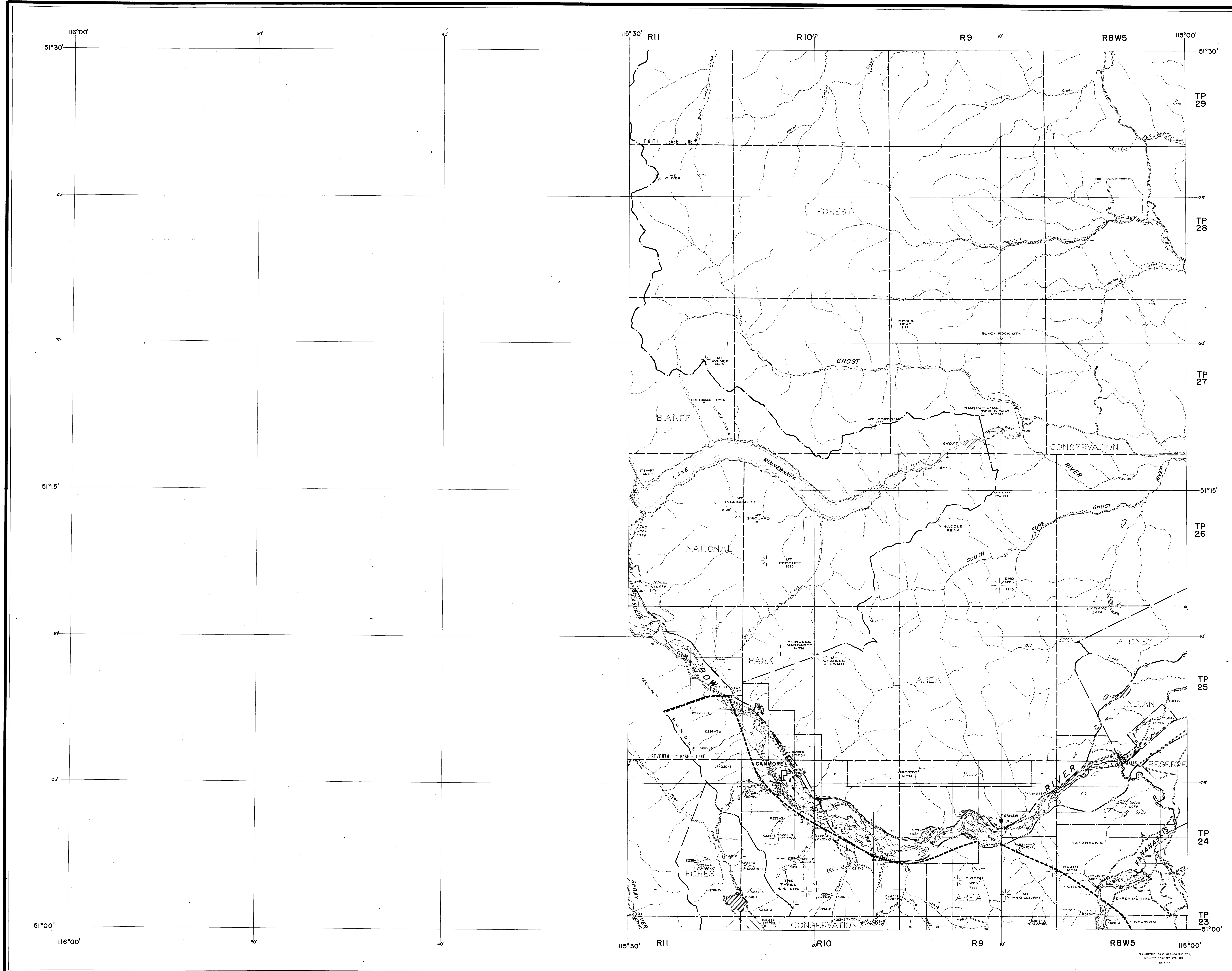

PLANIMETRIC BASE MAP COPYRIGHTED, GEOPHOTO SERVICES LTD. 1967

GEOCHEMICAL SAMPLE PLAN
ROCKY MOUNTAINS AREA,
ALBERTA & BRITISH COLUMBIA

PREPARED FOR
IMPERIAL OIL ENTERPRISES LTD.

GEOPHOTO SERVICES LTD. CALGARY, ALBERTA, CANADA

SCALE
1:63,360 - 1 mile to 1 inch
5,000 3,000 1,000 0 5,000 10,000 FEET
1 1/2 1/4 0 1 2 MILES

1967

LEGEND

∘	K 227 - 13 - 10
∘	SAMPLE LOCATION
K 227	SAMPLE NUMBER
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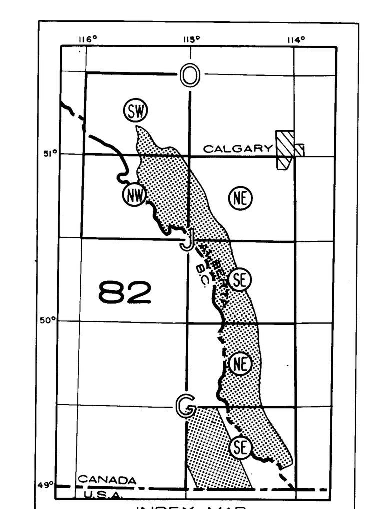
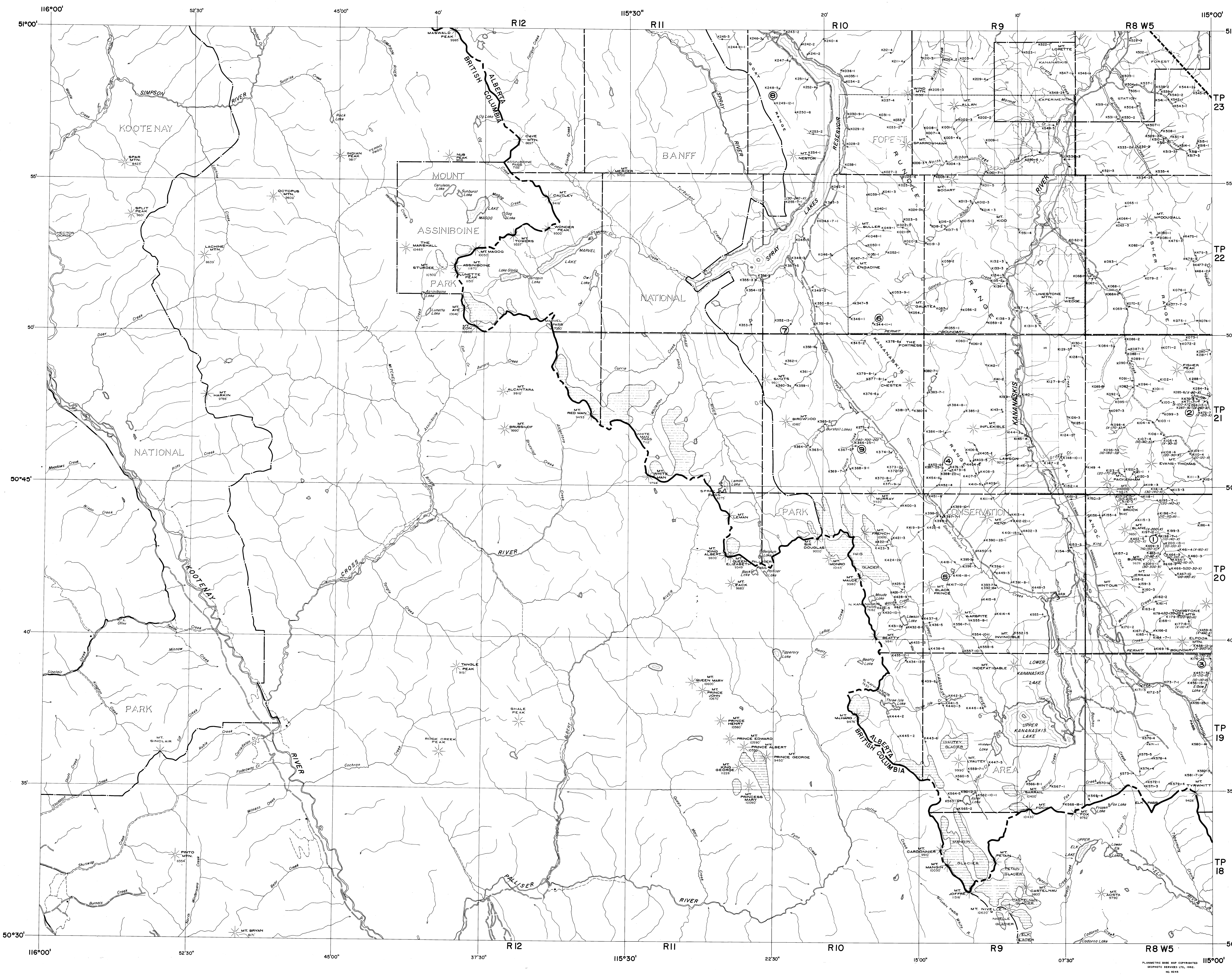
-10	COPPER TEST - NO. OF C.C.'S OF 0.001% DITHIZONE SOLUTION REQUIRED TO TITRATE 0.1 GRAMS OF STREAM SEDIMENT USING THE HOLMAN COPPER TEST.
(20-100-15)	HOT EXTRACTION VALUES
20	COPPER - NO. OF PARTS PER MILLION
100	ZINC - " " " " "
15	LEAD - " " " " "
X	LESS THAN 10 PPM.
(8)	GEOCHEMICAL ANOMALIES



INDEX MAP
1 INCH = 1 MILE SHEETS

82 O SW



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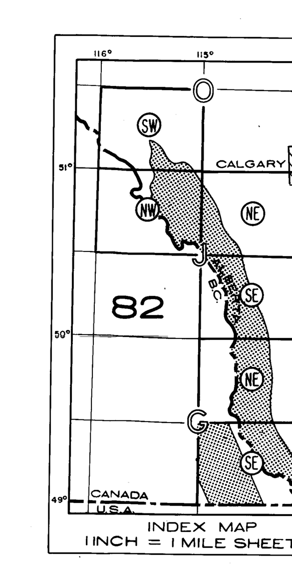

INDEX MAP
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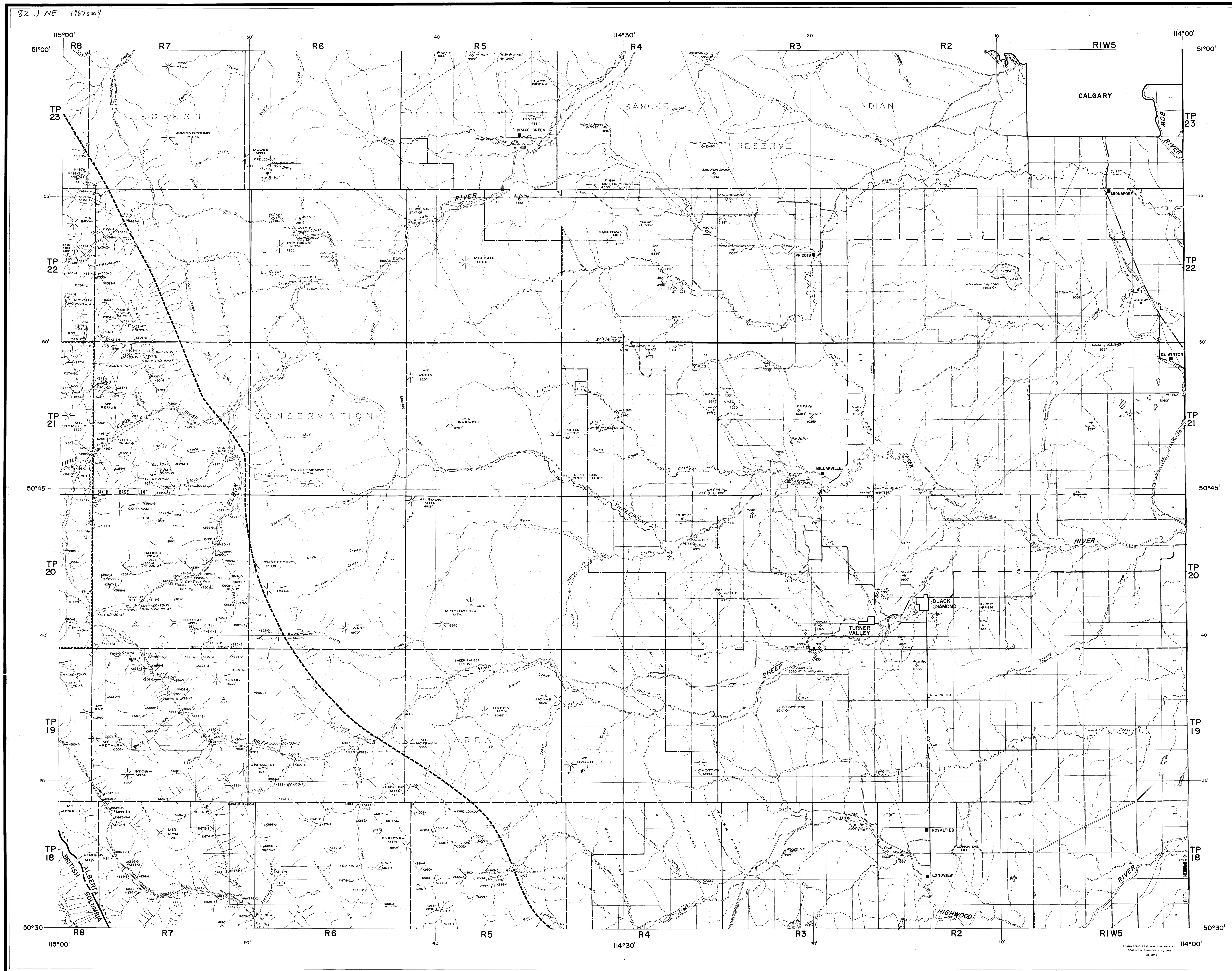

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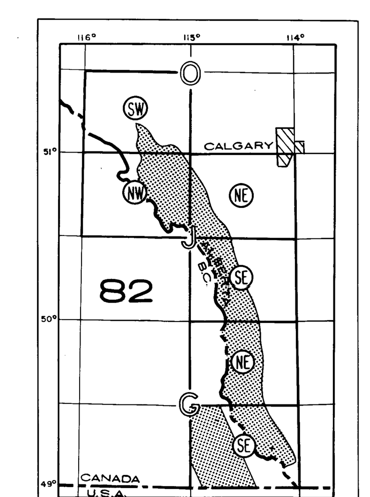

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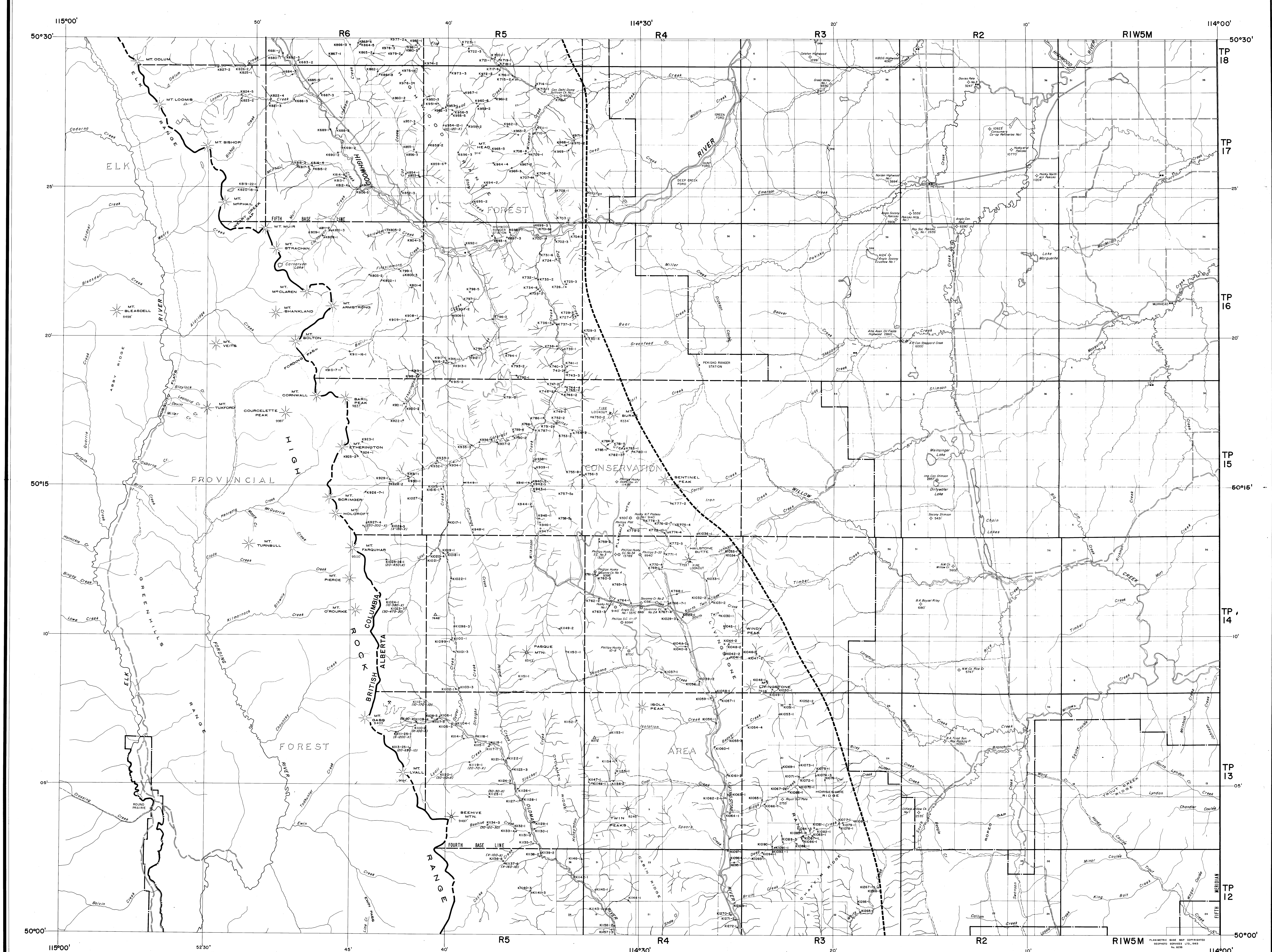

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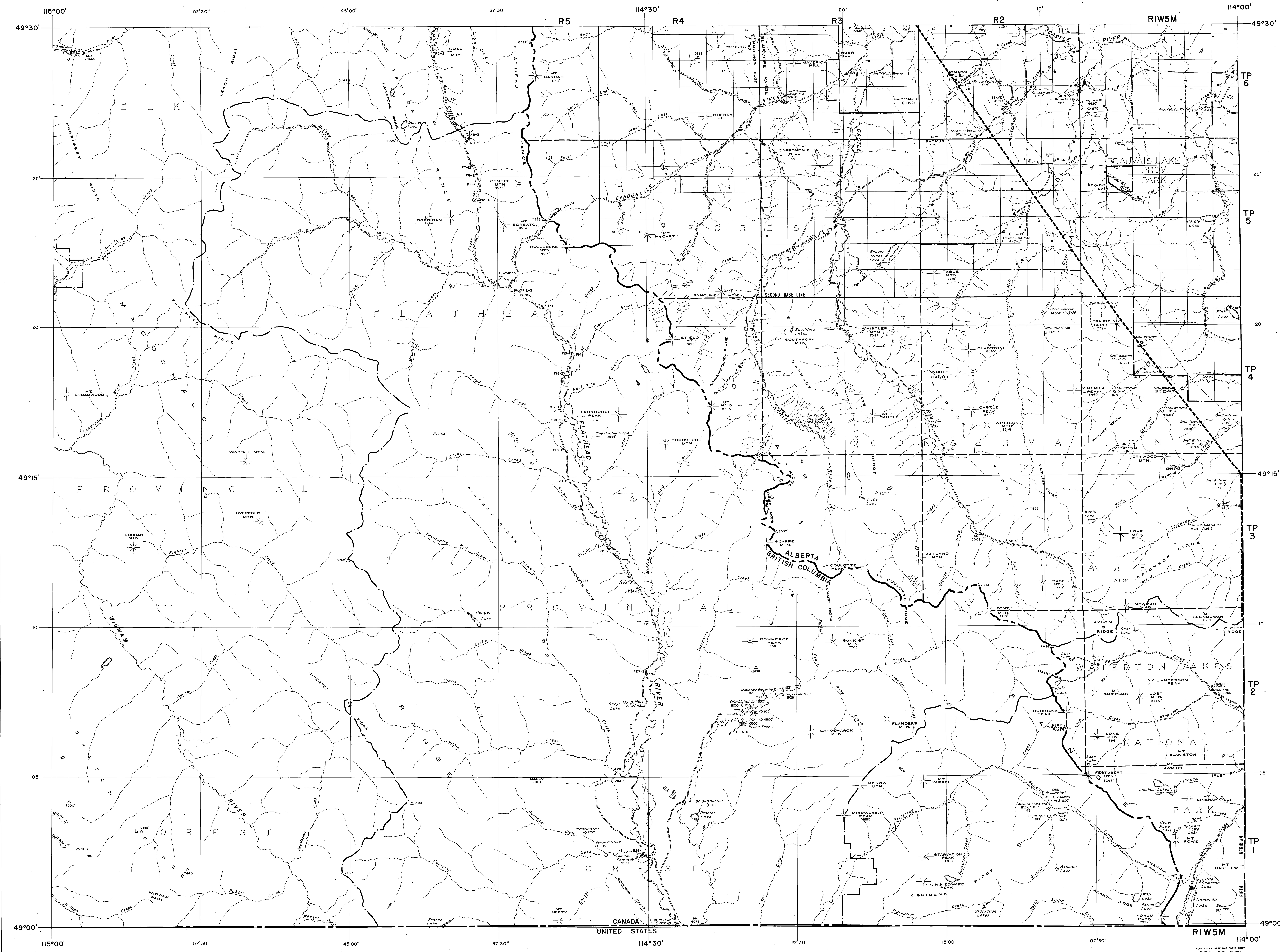

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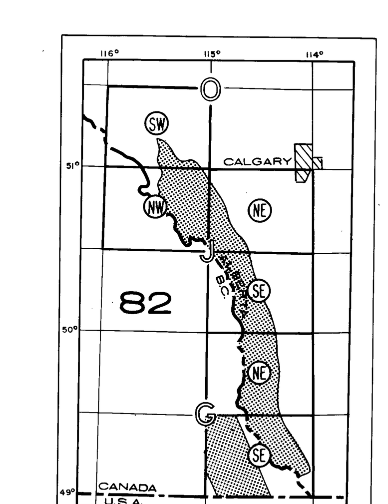

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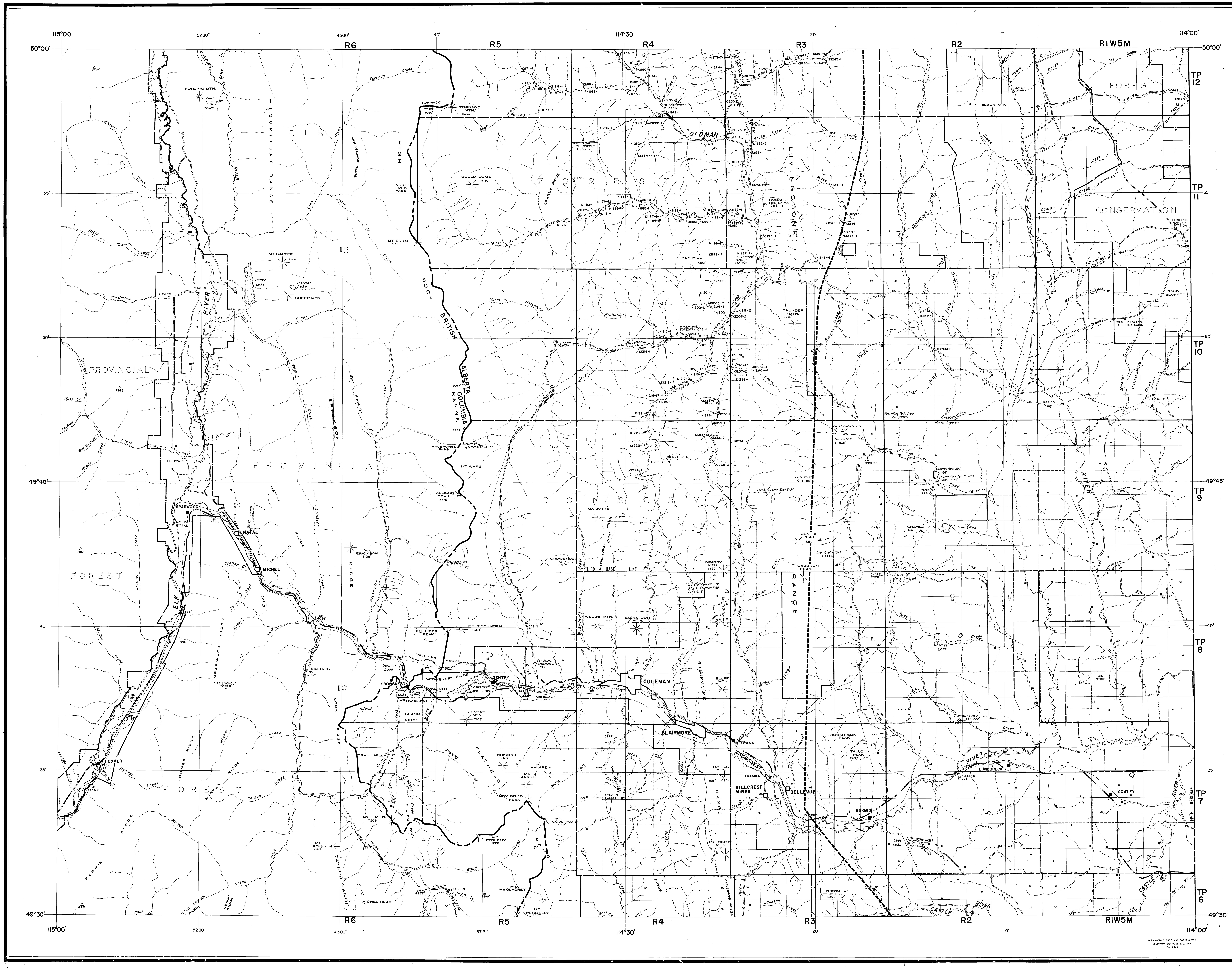

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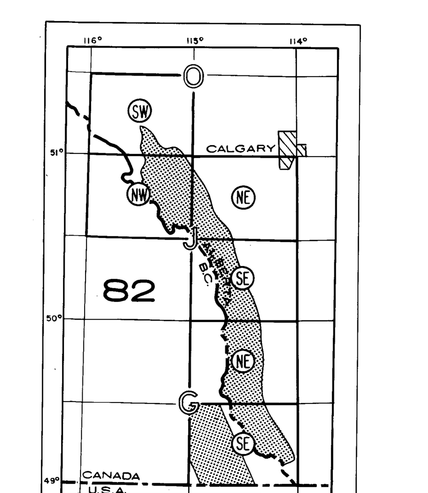

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