MAR 19680008: CYPRESS HILLS

Received date: Dec 31, 1968

Public release date: Jan 01, 1970

19680008

REPORT ON EXPLORATION

QUARTZ MINERAL EXPLORATION PERMITS

NO's 32 and 33

CYPRESS HILLS AREA, ALBERTA

held by

DOME PETROLEUM LIMITED
706 - 7th Avenue S. W.
Calgary Alberta

Report by C. O. Hage,
Consulting Geologist.

November 1968.

INDEXING DOCUMENT NOS. 700021
700022

OUTLINE OF REPORT

ILLUSTRATIONS

INTRODUCTION

Dome Petroleum Limited acquired Quartz Mineral Exploration Permits No's. 32 and 33 on November 1st, 1967. The description of the lands in the respective permits is as follows.

Permit No. 32

Schedule of Lands:

Township 8, Range 3, W.4 M.
Lsd. 13 of Section 6; NW¼ Section 7; N/2 Section 16; N/2 & SE¼ & Lsd. 4, 5 & 6 of Section 18; Section 20; S/2 & NW¼ Section 22; Section 28; 29; 30; and that portion of the NE¼ Section 22 lying outside of Cypress Hills Provincial Park boundary.

Township 7, Range 4, W.4 M.
Sections 13; 14; 23; 24; 25; NE¼ Section 26; 35; 36.

Township 8, Range 4, W.4 M.
Sections 1; 2; 3; 4; 9; 10; 11; 12; 13; 14; 15; 16; 21; 22; 24; NE¼ Section 26; 28.

Containing 19,350 acres more or less.

Permit No. 33

Schedule of Lands:

Township 8, Range 1, W.4 M.
NE¼ Section 26; Section 27; NE¼ Section 30; Section 32; 34; 36.

Township 9, Range 1, W.4 M.
Sections 2; 4; 6; 10; 11; 12; W/2 Section 13; Section 14; 16; 18; except from NW¼ Section 13 the most northerly 33 feet.

Township 8, Range 2, W.4 M.
Sections 30; 32; 34; 36.

Township 9, Range 2, W.4 M.
Sections 2; 4; NW¼ Section 5; Section 6; NE¼ & SW¼ Section 7; NW¼ Section 8; Sections 10; 11; 12; SW¼ Section 13+(Lsd. 13 & 14 of Section 13); Sections 14; 16; 18; most westerly 57 rds of NW¼ Section 17.

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Permit No. 33 (Cont'd)

Township 8, Range 3, W.4 M.
Sections 36 and those portions of the S/2 Section 25 and NE¼ Section 26 lying outside the Cypress Hills Provincial Park boundary.

Township 9, Range 3, W.4 M.
Section 2.

Containing 19,882 acres more or less.

These lands have been plotted on a map, Figure I.

Location of Permits

As can be seen from Figure I, Permit No. 32 abuts Cypress Hills Provincial Park to the west and Permit No. 33 lies immediately north of the Park.

Cypress Hills Provincial Park occupies the western portion of Cypress Hills, a prominent topographic feature in the southeastern part of Alberta and which extends eastward into Saskatchewan. The resort town of Elkwater is situated on the south shore of Elkwater Lake at the base of the north slope of the hills and is easily accessible by Highway 48 south from Irvine on Trans Canada Highway No. 1. Cypress Hills rise about 700 feet above Elkwater Lake to an elevation of over 4700 feet. The top of the hills is a plateau studded with patches of pines. The northern slopes and valleys are wooded with spruce, pines and deciduous trees. Besides being a very picturesque area of high relief it contains a unique flora and fauna to other parts of Western Canada. This has been attributed to the fact that the upper part of the hills remained free of ice during the

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Location of Permits (Cont'd)

southward advance of the Continental Ice Sheet. The "Park", therefore, has attracted numerous scientists in the past and will continue to do so in the future.

Purpose of Investigation

Dome Petroleum Limited acquired the permits for the purpose of investigating the uranium content of coals that might be found in the area. The idea of extracting uranium from coal on a commercial basis had its origin from such an operation in southwestern North Dakota. There the uraniferous coals are found in Tertiary strata closely allied to the age of the Cypress Hills formation, a conglomerate and sandstone that caps the Cypress Hills. To investigate this possibility, it was deemed advisable to study the stratigraphic sequence and to map the permit areas geologically in as much detail as time would permit.

Previous Work

Cypress Hills attracted many of the early explorers. The Palliser Expedition visited the area in 1859. Since then many prominent geologists of the Geological Survey of Canada have at various times studied and reported on the general area.

In 1873-74 Dr. G. M. Dawson, while with the Boundary Commission was attracted to the area. He re-visited the area in 1883 and had as his assistants J. B. Tyrell and R. G. McConnell,

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Previous Work (Cont'd)

later to become famous for their exploration and geological achievements. The latter named the Cypress Hills formation and had it dated from the fossil bones which he collected.

In 1930 Williams and Dyer published their report, Memoir 163, "Geology of Southern Alberta and Southwestern Saskatchewan". Cypress Hills area was included on their geological map, Calgary Sheet. They reported on the Whitemud formation as a source for pottery clay.

Their work was revised in 1940 by Russell and Landes in Memoir 221, "Geology of the Southern Alberta Plains". One of the accompanying maps, Dunmore Map Sheet No. 567A, Scale 1 inch to 4 miles, outlines the geology of the Cypress Hills area in considerable detail. A modification of some of the stratigraphic units by subsequent workers will be discussed when dealing with the stratigraphy.

In 1946 Dr. G. M. Furnival published Memoir 242, "Cypress Lake Map-Area, Saskatchewan". The accompanying map, No. 78A, adjoins the Dunmore sheet to the east. Furnival revised the Bearpaw-Eastend contact of Russell as well as his Ravenscrag formation. As previously stated, these matters will be discussed in a later section of the report.

In 1951 M. B. B. Crockford published Report No. 61 "Clay deposits of Elkwater Lake, Alberta", Research Council of Alberta. In his report Mr. Crockford deals mainly with the clay deposits and more specifically with the Whitemud formation. The accompanying map No. 23, differs in many respects to previously published maps.

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Previous Work (Cont'd)

In 1965 the Alberta Society of Petroleum Geologists had their 1965 Field Conference in the Cypress Hills Area of Alberta and Saskatchewan. The Guidebook, Part I and Part II contains many papers on the geology and economic aspects of the petroleum and mineral resources. A paper by J. D. Campbell, Research Council of Alberta entitled, "Coal Resources of Southern Alberta and Their Setting" is of particular interest for this report. A paper by L. O. Lindoe, "Ceramic clays of the Cypress Hills" is of particular interest because he discusses the White-mud formation in detail. This is one of the best markers for geological mapping purposes. The geological map accompanying the Guidebook is a compilation of previous published data along with some unpublished information.

The latest contribution of the Geological Survey of Canada is Map 22-1967, Foremost Alberta, scale 1 inch to 4 miles, by Dr. E. J. W. Irish. In his work he attempted to follow the nomenclature and geological units established by Furnival in the Cypress Lake, Saskatchewan Area. For a detailed interpretation of the area this map and the accompanying marginal notes add little to the previously published information.

Present Work

The writer spent three weeks in September and October doing geological field work on the permit area. The field work

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Present Work (Cont'd)

was supplemented with a study of fairly recent aerial photographs as an aid in locating outcrops more accurately and mapping formation boundaries.

The field work and the preparation of the geological map was hampered by not having a good topographic base map. The Surveys and Mapping Branch, Department of Mines and Energy, Ottawa, have yet to complete the standard 1:50~~0~~,000 ($1\frac{1}{4}$ inch to 1 mile) mapping of the Cypress Hills Area, Alberta. The enclosed geological map, Figure 2, was prepared on a base without contours on a scale of 1 inch to 1 mile.

STRATIGRAPHY

The most acceptable sequence of formations is that of Dr. G. M. Furnival, Geological Survey of Canada, Memoir 242, 1946 as shown in the following table of formations.

TABLE OF FORMATIONS

Period	Epoch	Formation	Thickness Feet	Lithology
-	Pleistocene	-	-	Boulder clay, sand, gravel, etc.
	Erosional Unconformity			
Tertiary	Oligocene	Cypress Hills	50-500+	Conglomerate, sandstone, marl, clay, etc. Non-marine.
	Erosional Unconformity			
	Paleocene	Ravenscrag	227+	Buff & grey sand, silt & clay, lignite, etc. Non-marine.
Cretaceous	Upper Cretaceous	Frenchman	10-150+	Sandstone, non-marine.
		Erosional Unconformity		
		Battle	20-30	Bentonitic shale, silt, sand. Non-marine.
		Whitemud	33-45	White to grey clay; sandstone; silt. Non-marine.
		Eastend	70-120	Sand, silt, clay; lignite. Marine to non-marine.
		Bearpaw	940-1,000	Dark marine shale; Belanger and Oxarart sandstone members.

SUMMARY REMARKS OF FORMATIONS

Bearpaw Formation

The Bearpaw formation is the oldest rock unit outcropping within the map-area. These strata were not studied in detail as they had little bearing on the present geological investigations of the permits. The formation is composed essentially of marine shales, bentonite beds and marine sandstones. The shales are dark grey to chocolate brown. The sandstones are fine to medium grained and occur in the upper part of the formation. Furnival (1946; p. 76) illustrates the correlation of the formation and the sandstone members within the Bearpaw formation. His diagram is reproduced here as Figure 3 as an aid in describing the mapping units used by different geologists. Dr. Russell (1940) in his mapping included the sandstone members of Furnival, the Oxarart, Belanger and Thelma members with the intervening shale members in the Eastend formation. This more than doubled the thickness of the Eastend formation. In Furnival's Cypress Lake Area the Bearpaw sandstone members are well exposed whereas in Alberta good exposures of them are limited. These sandstones thin markedly from west to east as shown on Figure 3. Mapping the Bearpaw - Eastend contact in Alberta where the formations are poorly exposed presents difficult problems in identifying the respective formations. The writer's mapping of this contact in Township 9, Ranges 1, 2 and 3 may be more in line with Russell's

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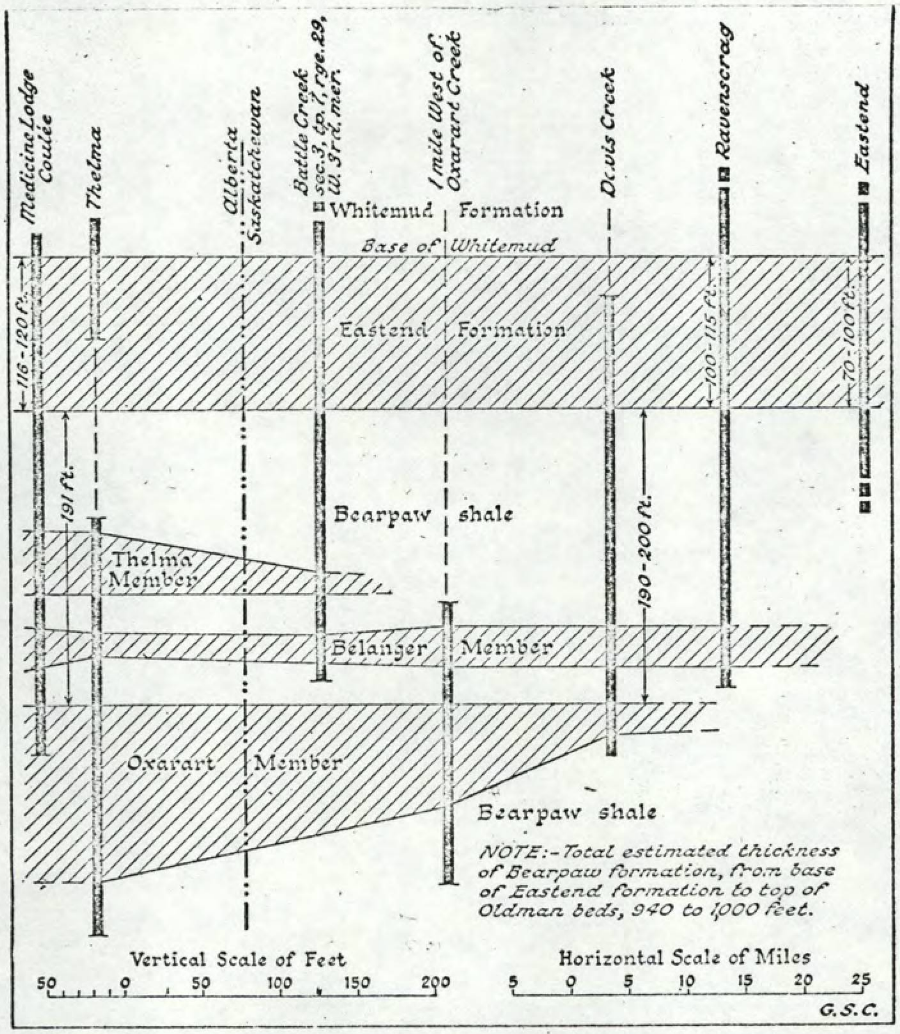

Figure 1. Diagram illustrating correlation of Upper Bearpaw and Eastend beds from Eastend, Saskatchewan, across Cypress Lake map-area to Medicine Lodge Coulée, Alberta. Base of Whitemud formation used as a datum plane.

Figure 1 illustrates the stratigraphy and correlation of the formations along the south slopes of the Cypress Hills from Eastend, Saskatchewan, to Medicine Lodge Coulée, in Alberta.

FIGURE 3

Bearpaw Formation (Cont'd)

mapping than that of Furnival. The greater portion of the area referred to above is occupied by a large east - west moraine and it is only along the northern side of this moraine that a few scattered small outcrops were observed.

Eastend Formation

The Eastend formation consists of buff to brown and grey very fine grained sandstone with some siltstone and grey shale along with carbonaceous and coaly beds. It is overlain conformably by the non-marine Whitemud formation and is transitional into the underlying marine Bearpaw formation. The problems associated with this contact have already been discussed. Crockford (1951, p. 15) in his mapping established a thickness of 116 feet for the formation in SE$\frac{1}{4}$ Section 31, Township 7, Range 3, W.4 M. He followed Furnival's interpretation whereas Russell (1940, p. 87) measured a thickness of 324 feet in SE$\frac{1}{4}$ Section 7, Township 8, Range 3, W.4 M. just 2 miles away. Because of the difficulty in distinguishing the different sandstone beds the writer has included them with the Eastend formation for mapping purposes. The Eastend formation is of particular interest in our investigations as it is the only formation outcropping in the area that contains coal. A seam 1 to 3 feet thick occurs from 60 to 70 feet below the top of the formation. This seam has been mined at a few places. The old mine on the south bank of Elkwater Lake is reported to have a thickness of 3.2 feet. Frequently burnt shale exposed on the

Eastend Formation (Cont'd)

hillside showed the stratigraphic position of this seam. The uraniferous coal possibilities in the Elkwater Lake area were centered on an examination of this seam and the associated burnt shales and sandstones.

Whitemud Formation

The Whitemud formation, as the name implies, is essentially white weathering clay beds and is a most useful horizon marker for mapping purposes. It has been divided into three units, a lower kaolinitic, pale grey, white weathering sandy unit, a medial grey to brown shale unit and an upper white weathering clay unit which has been known for its ceramic properties. The total thickness of the formation is 50 feet and less. In the western part of the map area Medicine Hat Brick and Tile Company Limited have several quarries from which they obtain ceramic material from the different units of the Whitemud formation.

The formation is overlain by the dark chocolate brown shales of the Battle formation. An erosional unconformity is often present at this level of the succession. Erosion has in places removed the Battle formation and also the Whitemud. This occurs along the north slope of Cypress Hills in the vicinity of Elkwater Lake.

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Battle Formation

The Battle formation consists of dark chocolate brown bentonitic shales. In thickness it varies from 0 to over 60 feet because of the erosional unconformity. About 25 feet above the base is a 2 to 3 foot zone containing siliceous, dense, steel grey beds varying in thickness from 1 to 6 inches in thickness. These distinctive beds are a useful horizon marker. Russell in his mapping included the beds equivalent to the Battle with the Whitemud formation. Furnival was the first one to raise the unit to formation status.

In the accompanying geological map, Figure 2 the Battle formation is included with the Whitemud formation.

Frenchman Formation

Overlying the Battle formation unconformably is a sequence of sandstones and minor amounts of silt and shale which had formerly been known as the Lower Ravenscrag and is now referred to as the Frenchman formation. An unconformity separates these sandstone beds from the underlying Battle formation. Russell included the equivalent beds of the Frenchman formation with the Ravenscrag formation.

L. O. Lindoe (1965, p. 219), describes the formation as follows: "At Quarry 45 (Section 9, Township 8, Range 4, W.4 M.) the Frenchman formation is 85 to 95 feet thick, consisting largely of coarse, cross-bedded sands in which limonite staining and

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Frenchman Formation (Cont'd)

concretions are common. Greenish to carbonaceous beds or lenses of clay may appear at any horizon in the formation but only those in the top half have any extensive horizontal distribution. In the top 30 feet, calcium carbonate makes its appearance in minor quantities and the top of the formation is drawn at a persistent concretionary limestone horizon. Above this point all beds are highly calcareous and typical of the grey facies of the Ravenscrag formation." A note follows, (Subsequent conversation with L. S. Russell at the site definitely establishes the top half of the beds described here as Frenchman are basal beds of the Ravenscrag formation.)

This added note leaves the writer wondering where to place the Frenchman - Ravenscrag contact. The writer studied the section along the road up the hill west of Elkwater townsite which Crockford has described as part of the Frenchman formation. Here are 115 feet of medium to coarse grained, buff weathering, cross-bedded sandstone beds containing large ellipsoidal sandstone concretions. The sands are definitely calcareous. The writer has included these beds in the Frenchman formation but Dr. L. S. Russell probably would not agree with this interpretation. The difficulty in establishing distinguishing criteria for these two formations may be due to poor and scattered outcrops.

Ravenscrag Formation

Since the writer did not study the Ravenscrag formation in detail he wishes to quote the description given by Irish (1967, Ravenscrag Formation (Cont'd)

marginal notes), "The upper contact of the Frenchman formation is transitional into the overlying non-marine Ravenscrag formation. Ravenscrag strata are confined to a narrow rim around the higher parts of Cypress Hills. The beds consist of soft, grey and buff weathering, grey and light brown, fine grained sandstone; soft grey and buff weathering, brownish grey clays; lignitic coal seams; bentonite layers; and thin beds of ironstone. Because of the similarity of the upper Frenchman and lower Ravenscrag beds, the contact is usually placed at the base of the lowest coal seams." The writer was unsuccessful in locating any coal seams in the Ravenscrag formation in Alberta though they could be present as the formation is only intermittantly exposed and the north-sloping face of Cypress Hills is heavily wooded.

Cypress Hills Formation

The Cypress Hills formation, the youngest beds within the map-area consists of a conglomerate interbedded with grey, coarse sandstone lenses. The conglomerate is composed of pebbles, cobbles and boulders of quartzite and some chert from one half to 12 inches across. The formation has a thickness varying from a few feet to 50 feet or more. Cypress Hills is capped by this formation.

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Pleistocene

Usually the Pleistocene deposits are only of passing interest when studying the pre-pleistocene deposits of an area. In the Cypress Hills area the writer found that the greater part of Permit No. 33 was covered with a thick morainal deposit obscuring all but a few outcrops of the underlying strata. It was in the search for these outcrops that the writer made his observations on the pleistocene deposits. These observations were supplemented with a study of the aerial photographs.

A large end moraine lies north of Cypress Hills. It extends from the Alberta - Saskatchewan border westward in an east - west direction across the map area. The outline of the moraine is shown on a map, Figure 4.

The moraine is characterized by typical knob and kettle topography and boulder pavements especially along and near the southern edge. The morainal topography has been modified by numerous north flowing streams so that a portion of the area is fairly well drained. In this respect it differs from a typical moraine which normally has a poor drainage pattern. The topographic map shows that the northern border is considerably lower in elevation than the southern edge. These differences give a northern slope for the moraine of about 100 feet per mile. It is quite possible that the northern drainage pattern was established soon after the ice front receeded from our study area. It seems most reasonable to assume that the pre-glacial drainage pattern was also to the north. A peneplain

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Pleistocene (Cont'd)

surface on the higher hills north of the main Cypress Hills and south of the moraine was measured as 5 degrees northward. It was on this north sloping surface that the morainal material was deposited. The Cypress Hills acted as a buttress for the southward moving glacier so much so that the higher parts of the hills were left unglaciated. Glacial deposits have not been found above an elevation of 4,500 feet.

Permit No. 33 lies almost wholly within the morainal belt. From the few outcrops observed one can conclude that the morainal deposit must be in the order of about 100 feet in thickness. Exceptions to this generalization are several thin drift covered areas. The largest one in Township 9, Range 1, W.4 M. has been outlined on the map, Figure 4. Several small outcrops were observed within this area. In the non-morainal northeastern part of Permit No. 33 outcrops of the Bearpaw formation may be present but as no uraniferous coal deposits are likely to occur, this part of the permit was not investigated in detail.

Reference should be made to a paper by J. A. Westgate, entitled "The Pleistocene Stratigraphy of the Foremost - Cypress Hills Area, Alberta". Westgate's observations in the vicinity of Elkwater are summarized as follows:

1. Elkwater drift, present along the north side of Cypress Hills between 4100 and 4500 foot elevations. The drift is thin and consists of sporadic patches of gravel and till together with some large erratics.

Pleistocene (Cont'd)

2. Wild-Horse drift, lies north of the Elkwater drift. It falls between 3200 and 4100 foot elevations.

On Figure 4 the Elkwater drift would lie in the area between the End Moraine on the north and the base of the Ravenscrag formation on the south.

The Wild-Horse drift, north of Cypress Hills would roughly correspond with the writer's "End Moraine", Figure 4.

STRUCTURE

The writer's interpretation of the structure within the area is limited to outcrop observations and elevation determinations made with a Paulin-altimeter. Not having a good topographic map hampered and limited this phase of the study. The elevations obtained by the Paulin altimeter were in many instances left wanting due to unstable atmospheric conditions. The aneroid readings were usually corrected from a graph made by plotting change in pressure, recorded in feet, against time. This proved satisfactory when the aneroid rose or fell throughout the day but when there was a reversal in pressure during the day the correction factor lost its accuracy.

Crockford (1951; page 20) reported that the regional dip is to the northeast and in the vicinity of Elkwater Lake it is about 25 feet per mile decreasing northward to 5 to 10 feet per mile north of the town of Irvine. With the amount of dip the strata would appear to the eye as essentially flat.

Inclined strata were observed at several places within the area. Some of these are without doubt due to slumping but they could also be the result of faulting. The conclusions drawn by several observers are that they are the result of slumping, some on a major scale. From the limited study made by the writer, he is of the opinion that both slumping and faulting are present. This opinion was formed after a study of the Whitemud formation in the western part of the area and especially the outcrops along the west and east banks of Medicine Lodge Coulee.

Structure (Cont'd)

At the north end of Eagle Butte, SE$\frac{1}{4}$ Section 9, Township 8, Range 4, W.4 M. the Whitemud has an elevation of 4330$\pm$ feet, the highest occurrence recorded in the area. Here, the beds have a strike of N - 65° W. and a dip of 25° S.W Less than 1/2 mile to the north in Quarry No. 45 (NE$\frac{1}{4}$ Section 9, Township 8, Range 4, W 4 M.) the Whitemud formation has an elevation of 4120$\pm$ feet and a dip of 12° N.E. The quarry beds could have slumped from the higher beds to the south but as they too are inclined and are the highest recorded Whitemud beds in the area the writer is of the opinion that there is minor folding along with faulting present. A normal fault, downthrown on the north side is shown on the map, Figure 2.

Inclined sandstone strata strike N. 15° W. and dip 30 to 40° N.E. were observed on the north bank of a tributary stream of Bullhead Creek in SE$\frac{1}{4}$ Section 12, Township 8, Range 4, W.4 M. They could well be indicative of a normal fault trending parallel with the valley of Bullhead and Lodge creeks. The Whitemud beds are considerably higher on the west side of Medicine Lodge Coulee than they are east of it.

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URANIFEROUS COAL PROSPECTS

The purpose of acquiring "Mineral Exploration Permits No's 32 and 33", as previously mentioned, was to investigate the permit areas for possible commercial uraniferous coal deposits. Locating, examining and sampling coal seams for uranium was the primary objective of the field work. A study of the stratigraphic succession was made chiefly to determine the coal horizons within the different formations.

In the Eastend area of Saskatchewan the upper coal seam of the Ravenscrag formation which would be the first coal seam below the Cypress Hills conglomerate was found to contain an appreciable amount of uranium (U_3O_8). The source of the uranium has been postulated, from regional studies, to be the Cypress Hills formation. Similarly in the Willow Bunch area of Saskatchewan the uppermost coal seam of the Ravenscrag formation which lies in close proximity to the Wood Mountain gravels was found to contain uranium (U_3O_8).

The field instrument used for detecting the presence of uranium was a portable Precision scintillometer, De Luxe Model 111 B.

The stratigraphic study showed that the coal seams were restricted to the Eastend formation. No coal was found in the Frenchman and Ravenscrag formations in Alberta though there were many concealed intervals in the sections examined. In the Eastend formation the main coal seams occur 60 to 70 feet below the top of the formation or 80 to 90 feet below

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Uraniferous Coal Prospects (Cont'd)

the top of the Whitemud formation. Burnt shale exposures often indicated the presence of this coal seam. Scintillometer readings on the burnt shale were often equal to twice the background reading. The Whitemud beds likewise gave positive scintillometer readings. Some of the coal seams recorded positive scintillomter readings whereas others showed no change over the background reading. A few recorded negative readings as if they had been leached of all uranium content. No high scintillometer values on the coal seams were obtained.

Table 1, lists the locations of the outcrops where scintillometer values, other than those with normal background were obtained. The net scintillometer value of many of the rock and coal outcrops are listed. To this table has been added the chemical assay results from 21 rock and coal samples submitted to Crest Laboratories Ltd., 7911 Argyll Road, Edmonton for analyses.

Figure 5 is a map showing the locations of the positive scintillometer readings and the samples assayed for uranium (U_3O_8).

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TABLE NO. 1

FIELD OBSERVATIONS* & ASSAY RESULTS**

Field No.	Location	Formation	Scintillometer Reading			Assay Values % U_3O_8
			Outcrop	Backgrd.	Net	
H-3	SE 18-8-2-W.4	Ravenscrag ss.	.017	.011	.006	
H-5	NE 16-8-3-W.4	Eastend burnt sh.	.013	.011	.002	
H-5	NE 16-8-3-W.4	Eastend burnt sh.	.0175	.011	.0065	
H-5	NE 16-8-3-W.4	Eastend burnt sh.	.030	.0	.019	
H-7	SE$\frac{1}{4}$ 28-7-3-W.4	Frenchman	.015	.011	.004	
H-7	SE$\frac{1}{4}$ 28-7-3-W.4	Eastend coal	.024	.012	.012	No.1. Trace.
H-8	Quarry #45 NE 9-8-4-W.4	Whitemud	.015	.011	.004	
H-10	SE 9-8-4-W.4	Eastend coal	-	.011	-	No.2. Trace.
H-13	SE 28-8-1-W.4	Whitemud	.0125	.010	.005	
[illegible]	SE 23-8-3-W.4 Coal mine Elkw.	Eastend coal	Positive-not recorded			No.3. Trace.
H-15	SE 23-8-1-W.4	Eastend coal	.015	.012	.003	No.4. .001.
H-37	SW 24-8-3-W.4	Eastend burnt sh.	.022	.011	.011	
H-50	SW 22-8-3-W.4	Eastend burnt sh.	.0175	.010	.0075	No.5. .001.
H-55	SE 21-8-3-W.4	Eastend coal	.015	.010	.005	No.6. .001.
H-56	NW 16-8-3-W.4	Eastend burnt sh.	.0140	.010	.004	
H-57	NW 16-8-3-W.4	Eastend burnt sh.	.016	.010	.006	No.7. .001.
H-58	NW 16-8-3-W 4	Whitemud	.013	.010	.003	
H-59	SW 21-8-3-W.4	Frenchman ss.	.0125	.010	.0025	
H-61	NE 17-8-3-W.4	Eastend burnt sh.	.015	.010	.005	
H-63	NE 18-8-3-W.4	Whitemud	.017	.010	.007	No.8. Trace.
H-66	SE 18-8-3-W.4	Eastend coal	.007	.010	-.003	No.9. Trace.
H-68	NW 20-8-3-W.4 Shale Pit	Eastend burnt sh.	Positive-not recorded			No.10. Trace.
H-68	NW 20-8-3-W.4 Shale Pit	Eastend burnt sh.	Positive-not recorded			No.11. Trace.
H-68	NW 20-8-3-W.4 Shale Pit	Eastend burnt sh.	Positive-not recorded			No.12. .001.
H-69	NW 7-8-3-W.4	Eastend burnt sh.	.0175	.010	.0065	
H-77	NW 35-7-4-W.4	Eastend coal	.008	.010	-.002	No.13. .001.
H-79	NW 35-7-4-W.4	Bearpaw? coal	.005	.010	-.005	No.14. Trace.

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TABLE NO. 1 (Cont'd)

FIELD OBSERVATIONS* & ASSAY RESULTS**

Field No.	Location	Formation	Scintillometer Reading			Assay Values % U_3O_8
			Outcrop	Backgrd.	Net	
H-81	SE 2-8-4-W.4	Eastend coal	Positive-not recorded			No.15. Trace.
H-84	NE 35-7-4-W.4	Eastend coal	Positive-not recorded			No.16. .001.
H-87	SE 25-7-4-W.4	Eastend coal	Positive-not recorded			No.17. .002.
H-90	SE 8-7-4-W.4	Bearpaw; coaly sh.	-	.010	-	
H-92	SE 24-7-4-W.4	Eastend carb. sh.	.016	.010	.005	No.18. .002.
H-92	SE 24-7-4-W.4	Eastend carb. sh.	Positive-not recorded			No.19. .001.
H-97	NE 31-7-3-W.4	Eastend coal & sh.	Positive-not recorded			No.20. .003.
	NE 20-8-3-W.4	Whitemud Quarry 34	Positive-not recorded			No.21. Trace.

*Outcrops which gave no positive scintillometer readings not listed in table.

**Chemical analyses Crest Laboratories Ltd., 7911 Argyll Road, Edmonton.

ASSAY RESULTS

The assay values for uranium oxide (U_3O_8) for 21 rock and coal samples are listed on Table 1 for comparative purposes with the scintillometer readings. Copies of the assay sheets are included.

The assay results were disappointing in that the highest value for a coal seam is only .003%. Half of the coal samples registered only a trace.

The values from the burnt shale likewise were disappointing in that the highest reading was only .001% which is very little more than a trace.

CREST LABORATORIES LTD.

7911 Argyll Road • EDMONTON, ALBERTA • Phone 469-2391

CERTIFICATE OF ASSAY

TO Dome Petroleums Ltd.
706 - 7 Avenue, S.W.
Calgary, Alberta Attention: Mr. C.O. Hage

October 1, 1968

Lab #873

I hereby certify that the following are the results of assays made by us upon the herein described samples.

MARKED	GOLD		SILVER	ASH	U_3O_8 (Chemical) on Coal						TOTAL VALUE PER TON (2000 LBS.)
	Ounces per Ton	Value per Ton	Ounces per Ton	Percent	Percent	Percent	Percent	Percent	Percent	Percent	
1				58.50	trace	*Eastend coal*					
2				20.50	trace	*Eastend coal*					
3				81.00	trace	*Eastend coal & burntshale*					

NOTE:
Rejects retained one month.
Pulps retained three months unless otherwise arranged.

Gold calculated at $.................. per ounce

[redacted]
Registered Assayer, Province of British Columbia

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CREST LABORATORIES LTD

7911 Argyll Road • Edmonton, Alberta • Phone 469-2391
• HOPE LAKE, N.W.T. •

CERTIFICATE OF ASSAY

Lab No. 913

October 16, 1968.

TO Dome Petroleum Limited,
706 Seventh Avenue, S.W.,
Calgary, Alberta. Attention: Mr. C.O. Hage.

I hereby certify THAT THE FOLLOWING ARE THE RESULTS OF ASSAYS MADE BY US UPON THE HEREIN DESCRIBED SAMPLES.

MARKED	ASH PERCENT	U_3O_8 (chemical) PERCENT	MARKED	PERCENT	PERCENT	MARKED	PERCENT	PERCENT
4	62.9	0.001	Eastend coal					
5	98.7	0.001	Burnt Shale					
6	37.4	0.001	Eastend coal					
7	92.1	0.001	Burnt shale					
8	94.4	trace	Whitemud clay					
9	11.3	trace	Eastend coal					
10	97.7	trace	Burnt shale					
11	99.6	trace	Burnt shale					
12	98.7	0.001	Burnt shale					
13 H 77	16.4	0.001	Eastend coal					
14 H 79	29.6	trace	Bearpaw? coal					
15 H 81	16.4	trace	Eastend coal					
16 H 84	59.6	0.001	Eastend coal					
17	43.7	0.002	Eastend coal					
18	88.7	0.002	Eastend carbonaceous shale					
cor. ~~20~~ 19 - - .	62.3	0.001	Eastend Carbonaceous shale					
~~21~~ 20 - - .	82.9	0.003	Eastend coal & shale					

NOTE:
Rejects Retained One Month
Pulps Retained Three Months
Unless Otherwise Arranged.

[redacted]
Registered Assayer; Province of British Columbia

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CREST LABORATORIES LTD

7911 Argyll Road • Edmonton, Alberta • Phone 469-2391
• HOPE LAKE, N.W.T. •

CERTIFICATE OF ASSAY

TO Dome Petroleums Ltd., Lab No. 941

706 - Seventh Avenue, S.W., October 21, 1968.

Calgary, Alberta. Attention: Mr. C.O. Hage.

I hereby certify THAT THE FOLLOWING ARE THE RESULTS OF ASSAYS MADE BY US UPON THE HEREIN DESCRIBED SAMPLES.

MARKED	U_3O_8 Chemical	MARKED		MARKED		MARKED	
	PERCENT		PERCENT		PERCENT		PERCENT
No. 21. Sandy Clay	trace	Whitemud Quarry #34					

- 27 -

NOTE:
Rejects Retained One Month
Pulps Retained Three Months
Unless Otherwise Arranged.

[redacted]
Registered Assayer; Province of British Columbia

CONCLUSIONS

1. No coal seams were found in the Ravenscrag and Frenchman formations.

2. The Eastend formation contains a three foot coal seam which occurs from 60 to 70 feet below the top of the formation.

3. Assay values from the coal range from a trace to .003% U_3O_8.

4. Scintillometer readings from the burnt shale are not indicative of their uranium content.

5. The Eastend formation does not appear to be prospective for favorable uraniferous coal seams.

6. The Permits, No's. 32 and 33, are considered unfavorable for commercial uraniferous coal deposits.

[redacted]

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E. J. W. Irish
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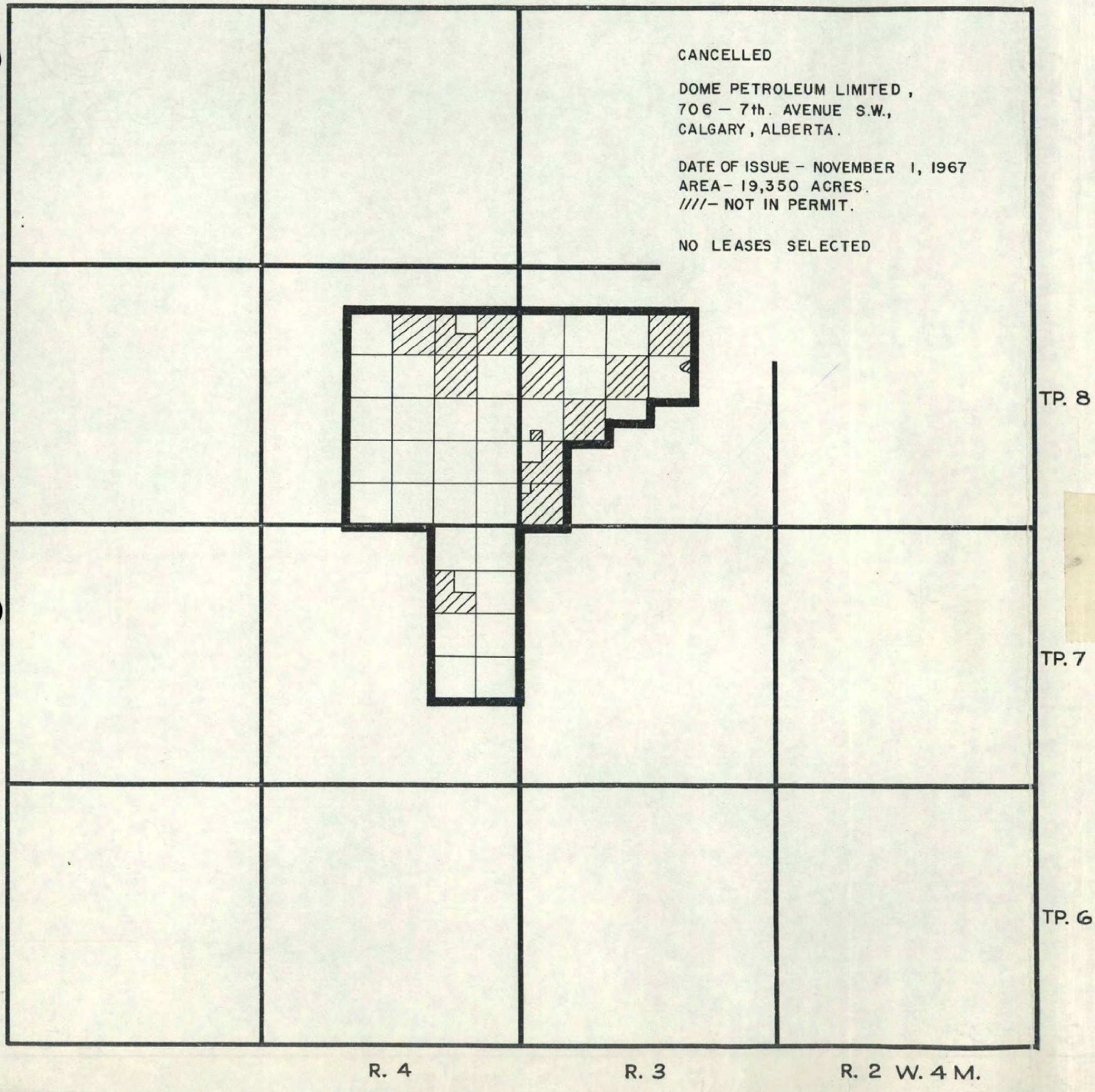
Geological Survey of Canada
Map with descriptive notes.

QUARTZ MINERAL EXPLORATION PERMIT No. 32



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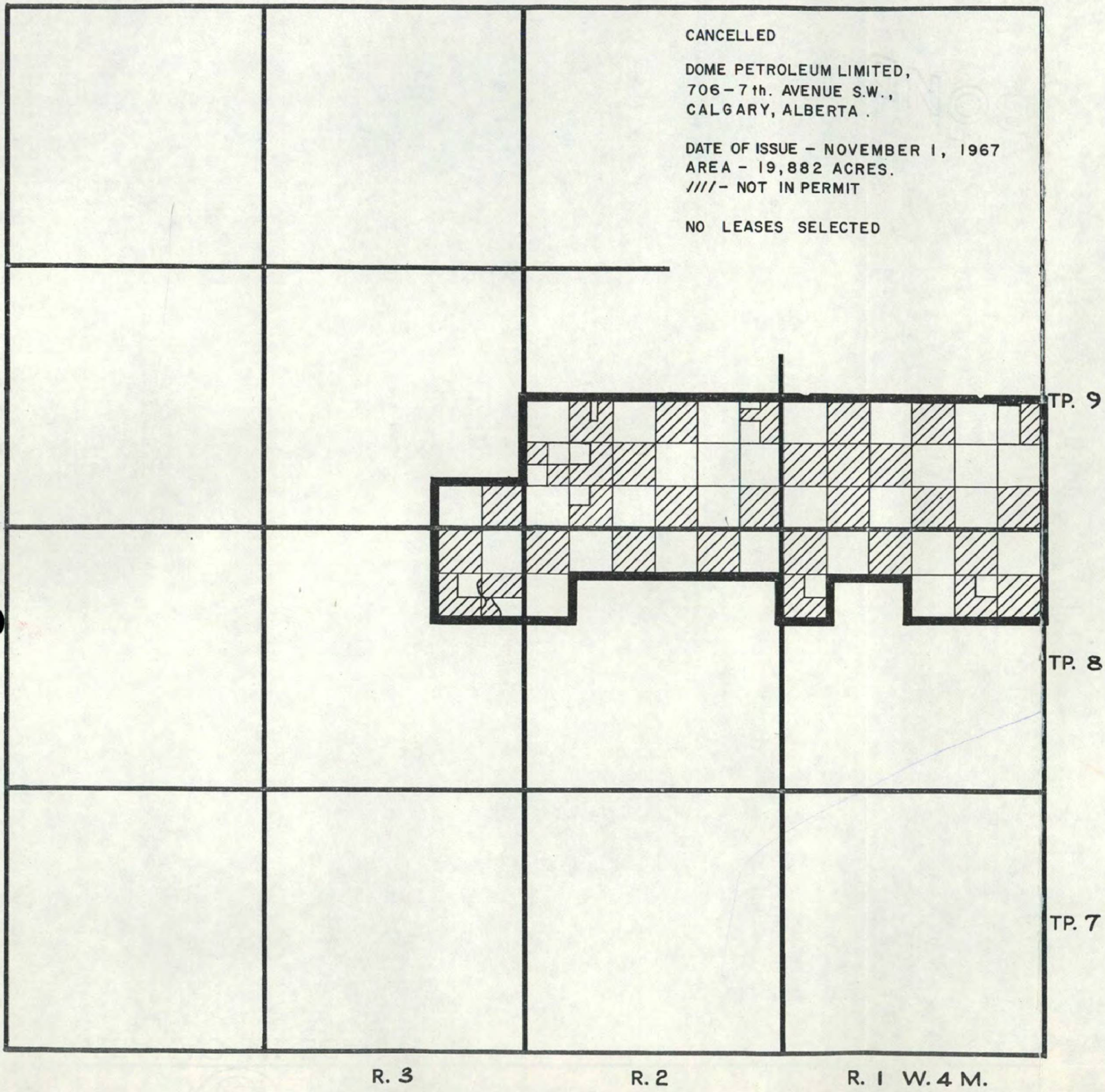
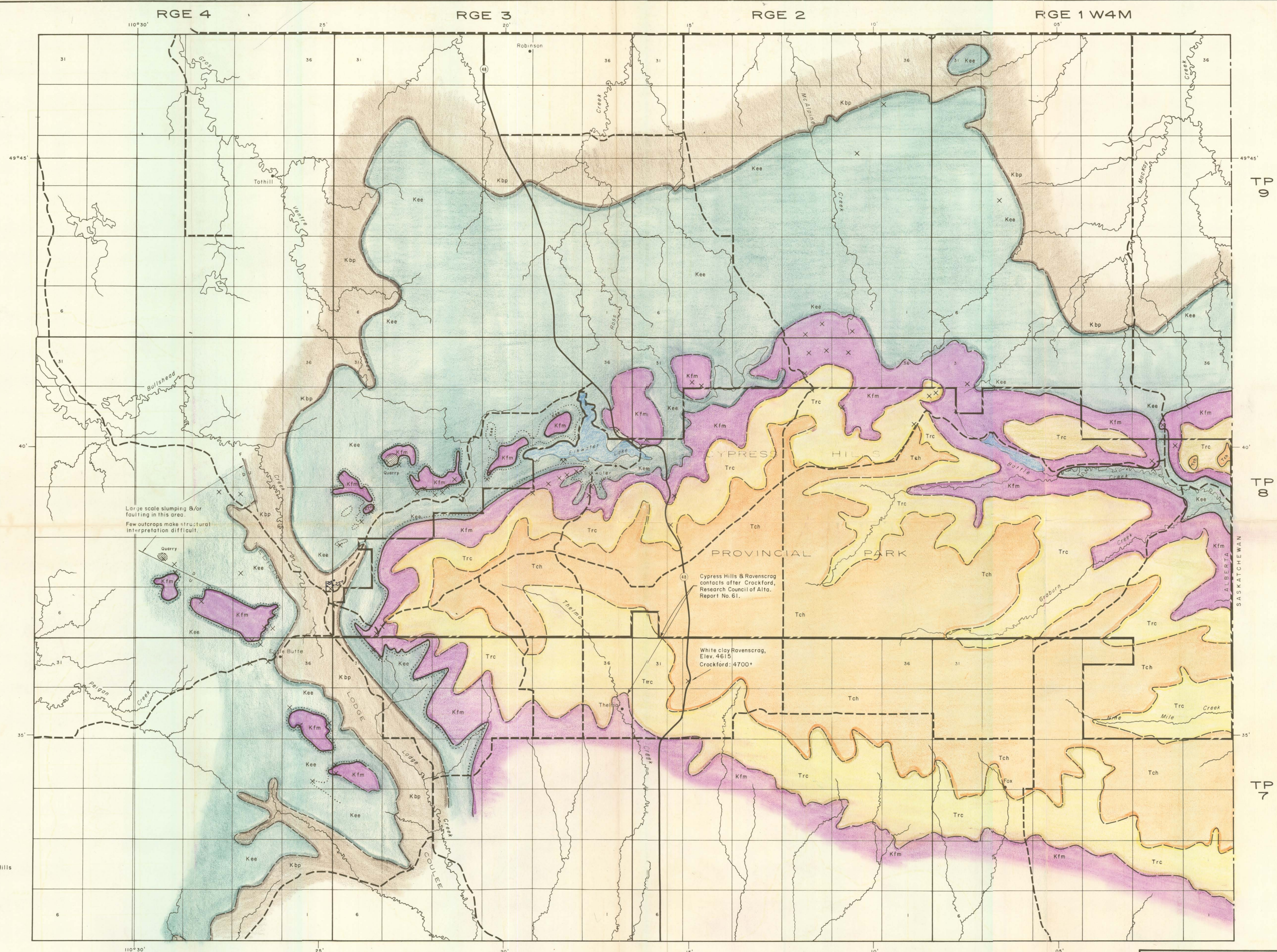
QUARTZ MINERAL EXPLORATION PERMIT No. 33





LEGEND

TERTIARY

- Tch — Cypress Hills Formation
- Trc — Ravenscrag Formation

UPPER CRETACEOUS

- Kfm — Frenchman Formation
  — — coal seam.
- Kwm — Whitemud Formation (includes Battle Formation)
- Kee — Eastend Formation
- Kbp — Bearpaw Formation

Note:
That portion of map outlining Ravenscrag & Cypress Hills formations after Crockford: Report No. 61. Alberta Research Council.

- Geological Boundary
- Rock outcrop observed ×
- Inclined strata, strike & dip 30°
- Fault, normal D/U
- Coal mine

NO.	BY	DATE	CHKD	DATE	APPR	DATE	REVISION

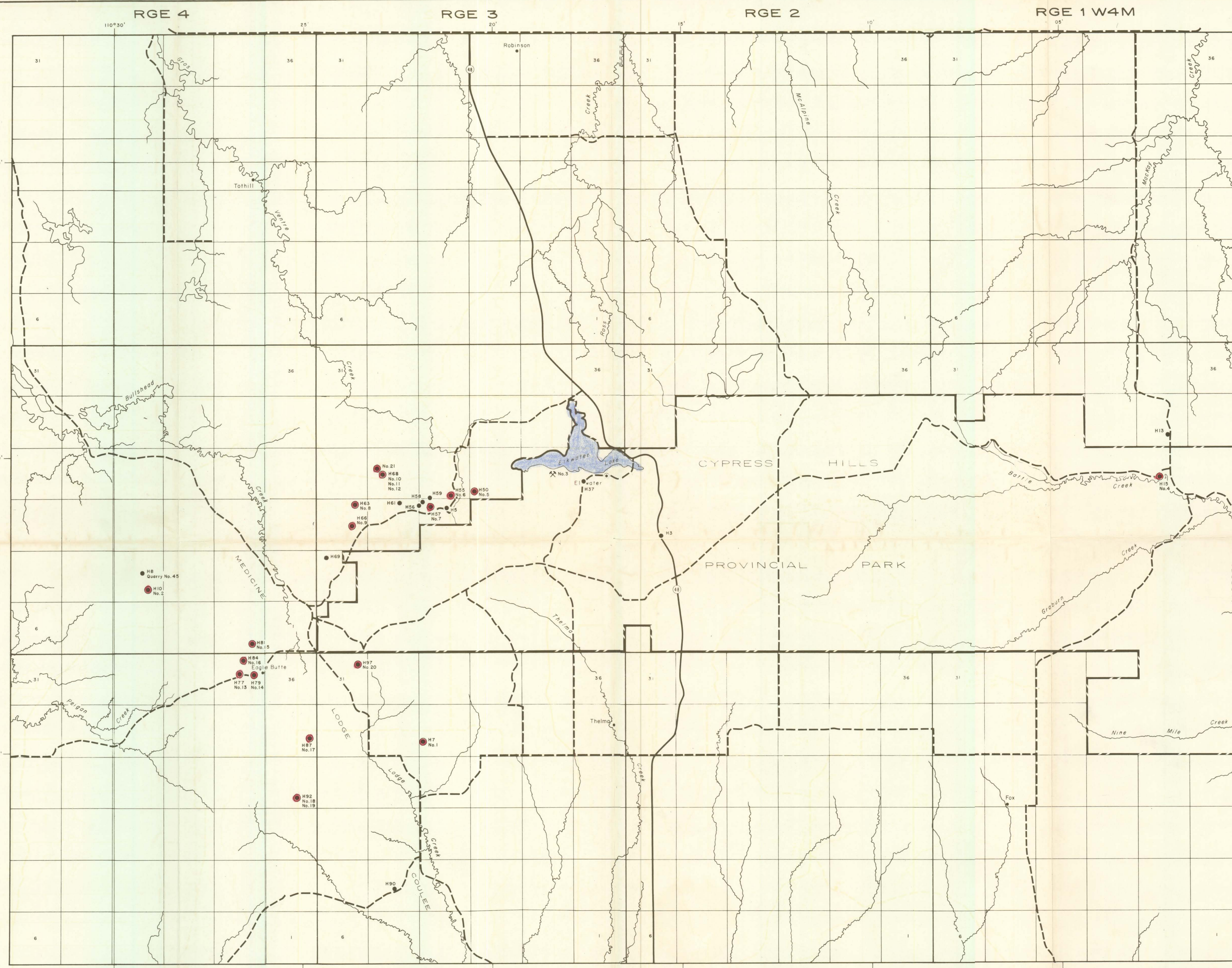
NO.	BY	DATE	CHKD	DATE	APPR	DATE	REVISION

DOME PETROLEUM LIMITED
CALGARY ALBERTA CANADA

CYPRESS HILLS AREA - ALBERTA
GEOLOGICAL MAP

1968 0008

DRAWN D.C.L.	DATE Nov/68	DRAWING NO. FIGURE № 2
CHECKED C.O.H.		
APPROVED C.O.H.		SCALE 1" = 1mile / REVISION NO.



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CYPRESS HILLS AREA - ALBERTA

LOCATIONS OF POSITIVE SCINTILLOMETER READINGS & SAMPLES ASSAYED FOR U_3O_8

DRAWN D.C.L.	DATE Nov/68	FIGURE Nº 5 19680008
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APPROVED C.O.H.		SCALE 1" = 1mile — REVISION NO.

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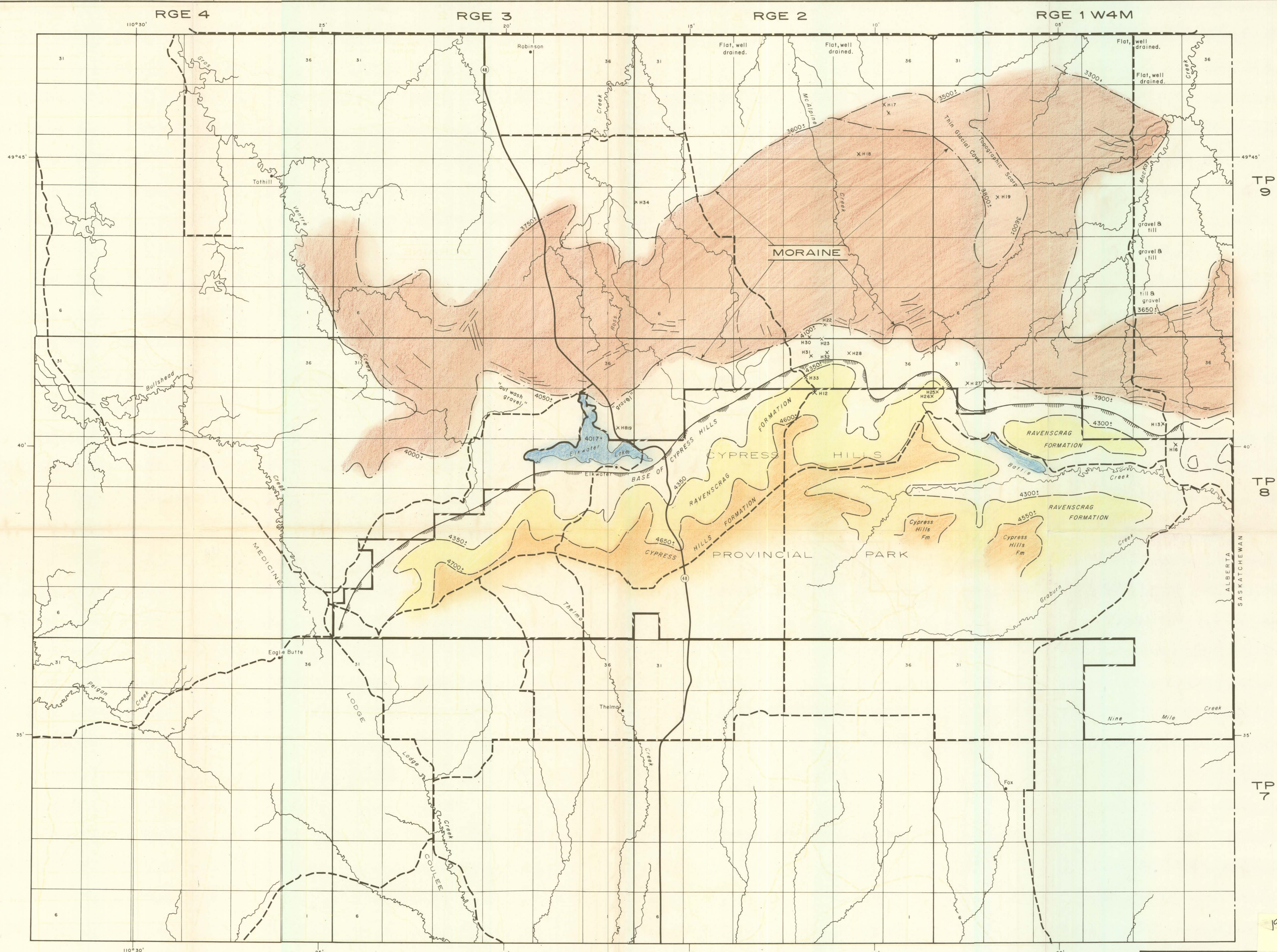

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CYPRESS HILLS AREA ALBERTA

OUTLINE OF END MORAINE NORTH OF CYPRESS HILLS

DRAWN D.C.L.	DATE Nov/68	DRAWING NO. FIGURE Nº 4 19680008	
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APPROVED C.O.H.		SCALE 1" = 1mile	REVISION NO.

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