BRITISH COLUMBIA HYDRO AND POWER AUTHORITY

HAT CREEK COAL EXPLORATION PROJECT

ASSESSMENT REPORT ON COAL LICENCE NUMBERS 12, 144, 2753-2762, 3003-3004, 3009-3013.

NTS AREA 92 I/12 & 13

JUNE 1981

THERMAL DIVISION · MINING DEPARTMENT

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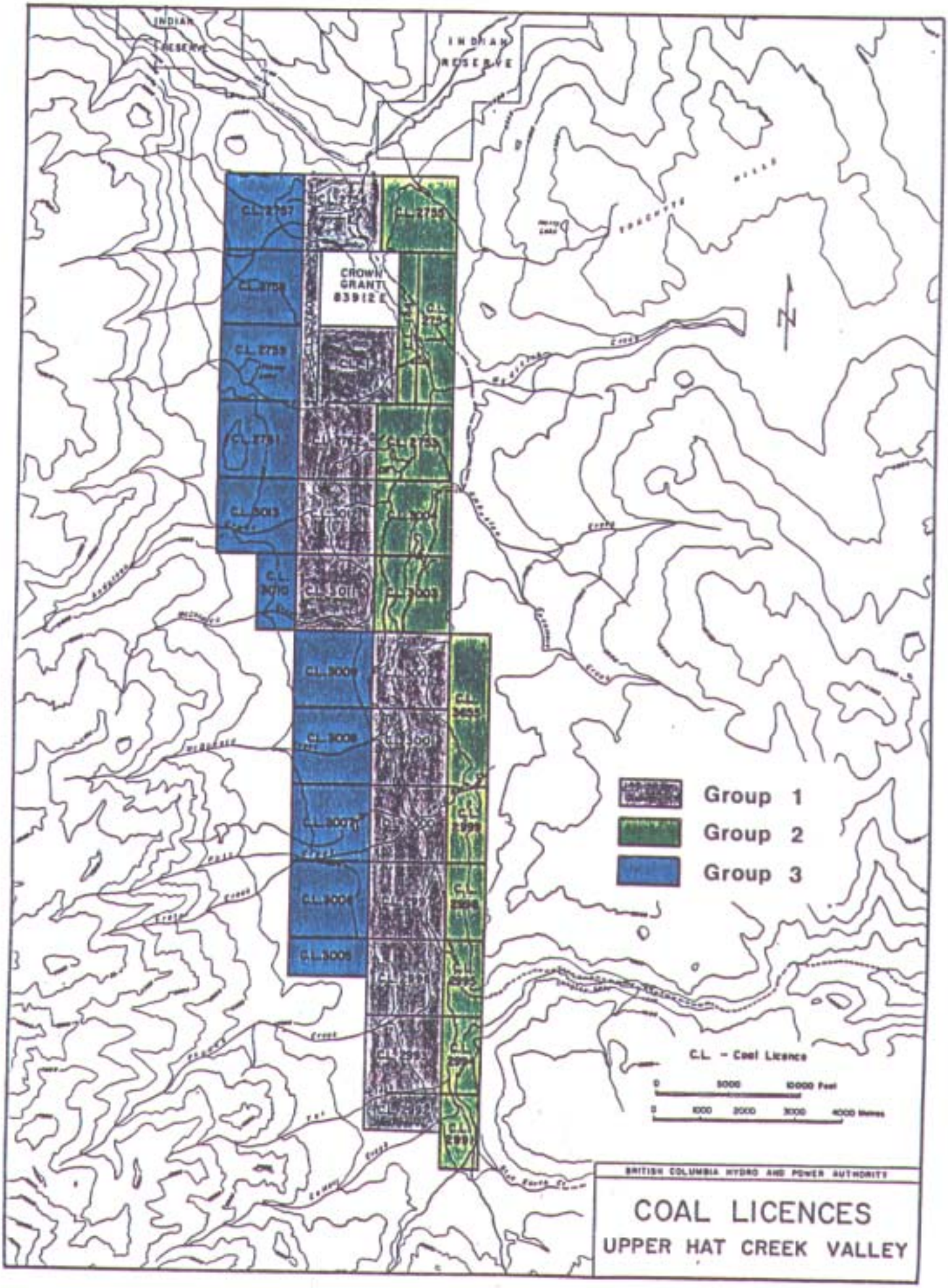
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BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
COAL LICENCES
UPPER HAT CREEK VALLEY

INTRODUCTION

This assessment report summarizes the regional geological mapping conducted by British Columbia Hydro & Power Authority on coal licences in Upper Hat Creek Valley as well as the area surrounding the valley.

Geotechnical and hydrogeological studies initiated during the earlier exploration periods, have been continued and the data compiled by our consultants, Golder Associates.

There was no drilling activity during the period of this report - between 1 May 1980 and 1 May 1981.

The general location and accessibility have been described in our earlier assessment reports.

COAL LICENCES

The coal licences held by B. C. Hydro have been regrouped into three groups as shown in Figure 1.

Table 1 shows the licence numbers and areas in hectares and acres, and their locations.

REGIONAL GEOLOGY

INTRODUCTION

The present map - The Geology of the Hat Creek Valley, (Figure 2), scale 1:20,000, prepared by B. C. Hydro Mining Dept. is based primarily on its own mapping conducted in the valley and in areas around it. It also summarizes the various geological studies conducted earlier by the Dept. of Energy, Mines and Petroleum Resources (1975), B. C. Hydro (1977), Dolmage Campbell & Associates (1977), Golder Associates (1979) and K. R. Shannon (1980).

The base map, scale 1:10,000 used for the geological mapping was produced from air photos flown in 1976.

The geological history of the Hat Creek Valley covers a period from Permian to Tertiary as shown in Table 2.

Table 1

	Licence No.	Acres	Hectares	Location*
	2757	636	257.4	14/21/27
	2758	630	255.0	11/21/27
	2759	588	238.0	2/21/27
	2761	640	259.0	35/21/27
Blue	3013	640	259.0	26/20/27
Group	3010	320	129.5	E½ of 23/20/27
	3009	640	259.0	13/20/27
	3008	640	259.0	12/20/27
	3007	640	259.0	1/20/27
	3006	640	259.0	36/19/27
	3005	320	129.5	N½ of 25/19/27
	11 licences	6334	2563.4	
	144	320	129.5	E½ of W½ of 6/21/26+E½ of W½ of 7/21/26
	2754	638	258.2	E½ of 6/21/26 + E½ of 7/21/26
	2755	636	257.4	18/21/26
	2753	640	259.0	31/20/26
	3004	640	259.0	30/20/26
Green	3003	640	259.0	19/20/26
Group	3655	641	259.4	W½ of 8 + 17/20/26
	2999	320	129.5	W½ of 5/20/26
	2998	320	129.5	W½ of 32/19/26
	2995	320	129.5	W½ of 29/19/26
	2994	321	129.9	W½ of 20/19/26
	2991	320	129.5	W½ of 17/19/26
	12 licences	5756	2329.0	

Table 1 (continued)

	Licence No.	Acres	Hectares	Location*
	12	640	259.0	E½ of E½ of W½ of 1/21/27 + W½ of W½ of 6/21/26
	2756	639	258.6	13/21/27
	2760	319	129.1	W½ of W½ of 12/21/27 + W½ or W½ of 1/21/27
	2762	640	259.0	36/20/27
	3012	640	259.0	25/20/27
	3011	640	259.0	24/20/27
Black	3002	640	259.0	18/20/26
Group	3001	642	259.8	7/20/26
	3000	642	259.8	6/20/26
	2997	642	259.8	31/19/26
	2996	635	257.0	30/19/26
	2993	640	259.0	19/19/26
	2992	316	127.9	N½ or 18/19/26
	13 Licences	7675	3106.0	
Totals:	36 Licences	19765	7998.4	

* Section/Township/Range (West of the 6th Meridian, Kamloops Land District)

Table 2

REGIONAL STRATIGRAPHY - HAT CREEK COAL BASIN

Period	Epoch	Million Years		Formation or Group	Thickness (m)	Rock Types
Quaternary	Recent				Not Determined	Alluvium, Colluvium, fluvial sands and gravels, slide debris, lacustrine sediments.
	Pleistocene	1.5 - 2				Glacial till, glacio-lacustrine silt, glacio-fluvial sands and gravels, land slides.
				Unconformity		
Tertiary	Miocene	7 - 26		Plateau Basalts	Not Determined	Basalt, olivine basalt (13.2 m.y.), vesicular basalt.
				Unconformity (?)		
	Miocene or Middle Eocene ?			Finney Lake Formation	Not Determined	Lahar
				Unconformity		
	Late Eocene		Kamloops Group	Medicine Creek Formation	550	Bentonitic claystone and siltstone.
				Paraconformity		
	Late Eocene to Middle Eocene	*36 - 42		Hat Creek Coal Formation	500	Mainly coal with intercalated siltstone, claystone, carbonaceous claystone, sandstone and conglomerate.
				Coldwater Formation	Not Determined	Siltstone, claystone, sandstone, conglomerate, minor coal.
				Fault Contact or Nonconformity		
	Middle Eocene	43.6-49.9		Kamloops Volcanics	Not Determined	Dacite (49.1 m.y.), andesite, rhyolite(49.9 m.y.) basalt and equivalent pyroclastics.
				Unconformity (McKay 1925; Duffell & McTaggart 1952)		
Cretaceous or Later	Coniacian to Aptian**	38.3±3 m.y.		Spences Bridge Group	Not Determined	Andesite, dacite, basalt (88.3 m.y.), tuff, breccia.
				Erosional Unconformity (Duffell & McTaggart 1952)		
		98		Mount Martley Stock	Not Determined	Granodiorite, tonalite.
				Intrusive Contact (Duffell & McTaggart 1952)		
Pennsylvanian to Permian or Earlier		250-330		Cache Creek Group:		
				Marble Canyon Formation	Not Determined	Marble, limestone, argillite.
				Greenstone	Not Determined	Greenstone, chert, argillite, minor limestone and quartzite, chlorite schist, quartz-mica, schist, phyllite.

* Based on palynology by Rouse 1977.

** Based on plant fossils by Duffell & McTaggart 1952.

Revised: June 1981

Cache Creek Group

The Cache Creek Group is the oldest rock unit recorded. It forms the basement for the Hat Creek coal deposits. The limestone of the Cache Creek Group was intruded by Mount Martley Stock of Jurassic or Cretaceous age. This intrusive is contemporaneous with the Lytton Batholith.

The Cache Creek Group has been divided into the Marble Canyon Formation and the Greenstone. The Marble Canyon Formation forming the Pavilion Range to the north, and outcrops south of the Cornwall Hills to the southeast. The Greenstone outcrops in the Trachyte Hills and the Cornwall Hills between the two limestone belts.

The Marble Canyon Formation consists of limestone and a variety of less dominant rocks which includes chert, tuff, argillite, and greenstone. The massive character of limestone outcrops makes them quite prominent as they form some of the higher mountains in the area. This prominent character gives the impression that the unit is almost all limestone while actually the limestone is probably less than 50% of the total unit. Included within the formation are lenses of cherts, and argillites; the argillites commonly form thin schistose layers between the chert bands. The limestone of the Marble Canyon Formation is generally blue-white and locally contains pyrite which weathers the limestone to a rusty brown. Attitudes of the limestone are difficult to obtain because of its massive character. A thin section of the limestone showed fine crystals of calcite with stringers of a coarser crystalline carbonate. Some of the limestone is very pure with $CaCO_3$ as high as 99%, but included siliceous material usually detracts from the purity.

The Greenstone consists of green to greyish green, massive, altered andesites, with some agglomerates and tuffs. Interbedded within the greenstones are minor amounts of chert, argillites,

limestone, quartzite, chlorite schist, and quartz-mica schist. The volcanic rocks are intensely sheared and showing layering on which attitudes could be taken. The Greenstones have been sheared in a north 35 degrees west direction with the schistosity dipping 75 degrees southwest. The limestones within the Greenstone unit range from small lenses or pods interbedded with the other rocks to beds up to several hundred feet thick. They are white to grey, fine to medium-grained rocks and sometimes very pure. The remaining constituents of this unit are of minor occurrence, usually found as minor beds within the unit.

The rocks of the Cache Creek Group make up an assemblage of interbedded volcanic and sedimentary rocks of Permian to Pennsylvanian age and up to 6,000 meters total thickness.

Mount Martley Stock

The Mount Martley Stock on the northwest of the map area corresponds to the southern end of a plug of quartz diorite and/or granodiorite outcropping at the Pavilion Creek.

Macroscopically, the granodiorites in the map area are light grey, relatively fresh looking, coarse grained rock with granitic texture. The principal mafic minerals are biotite and hornblende. Thin sections of typical intrusives consist predominantly of zoned euhedral to subhedral plagioclase and clear quartz grains. Biotite is highly pleochroic and forms independent flakes, with ragged edges, irregular and discontinuous fringes on amphibole. Hornblende commonly forms good prisms, also occurring in rugged platy forms.

Spences Bridge Group

The Spences Bridge Group occupies the western and southern part of the map area and lie unconformably over the eroded Mount Martley Stock. Thickness of this group is unknown because both of upper and the lower contacts are not exposed in the map area. It consists mainly of lava and pyroclastics of dacitic, andesitic and basaltic composition. B. C. Department of Energy, Mines and Petroleum Resources used the Arc Fusion method in mapping various fine-grained

volcanics in the map area (Church - personal communication (1980). The method determines the relation between refractive index and silica content of the volcanic series from basalt glass to dacite glass. The refractive indices of most of the Spences Bridge Group volcanics fall in dacite to dacitic andesite glass. A thin section study of 15 samples from the Spences Bridge rocks in the map area showed seven to be dacite to dacitic andesite, five to be andesite and three to be basalt.

The dacites or dacitic andesites in the field are aphanitic, massive, hard but locally brittle, grey brownish grey, light greenish and pinkish brown. A thin section of light greenish grey dacitic andesite (EMPR Sample H-95) shows numerous fine (< 0.3 mm) phenocrysts of plagioclase and scattered pyroxene grains in a feldspathic matrix (microlite-crystallite), showing an oriented alignment of the plagioclase phenocrysts, to indicate lava texture.

A thin section of the ferruginous basalt south of McDonald Creek named "reddish clinker" in the field indicates severe deuteric alteration. The plagioclase phenocrysts have been mostly replaced by magnetite or hematite, but some relict phenocrysts show a faint extinction to suggest they were initially bytownite. The matrix may have been fine crystallites of plagioclase as well as in the phenocryst, but are now mostly replaced by opaque minerals, (iron materials). However, the relatively younger basaltic rocks in the Spences Bridge Group appear to show no strong deuteric alteration in thin section. A basalt sample near the south boundary of the map area was subjected to whole rock potassium argon analysis. The analysis showed Late Cretaceous age (88.3 ± 3 m.y.) and was, consequently included in the Spences Bridge Group (Duffell & McTaggart 1952 and Church 1975). EMPR's thin section H-100 came from the same outcrop where whole rock K-Ar analysis was done. An examination of this thin section showed that phenocrysts (about 10% of total rock) of augite, olivine and zoned labrodorite occurred in a matrix of the same minerals, showing no severe alteration in pyroxene minerals. The rock may be named feldspathic basalt or feldspar basalt porphyry.

Duffell and McTaggart (1975) described rhyolites as one of the common rock types in the Spences Bridge Group in the map area except in the Kamloops volcanics group of Tertiary as described later.

Kamloops Group

The Kamloops Group consisting of lavas, pyroclastics - rhyolite, dacite and basalts, continued throughout the Tertiary Deposition in Hat Creek Valley including the Hat Creek Coal Formation, covering a span of time from Mid Eocene to Miocene.

A melange unit of the undifferentiated volcaniclastics on the Western slopes of the Trachyte Hills has been assigned to this group. These volcanic piles are overlain by clastic rocks composed mainly of conglomerate, sandstone and siltstone of the Coldwater Formation. Lying conformably over the Coldwater Formation is the coal-bearing, Hat Creek Coal Formation, over 500 m thick. The coal-bearing strata are overlain in apparent paraconformity by the Medicine Creek Formation, which is made up of soft, semi-indurated, monotonous lacustrine sediments, of over 550 m thickness. The sharp paraconformable contact of the Medicine Creek Formation with the coal measures represents a rapid facies change from moor (marsh) to lacustrine depositional conditions.

The Kamloops Volcanic rock in the area consists of dacite, andesite, basalt, rhyolite and equivalent pyroclastics and it can be seen in outcrops on both sides of the valley. In the Finney Creek area furruginous dacite and breccia are evident. They appear pinkish brown and fairly well oxidized in hard competent outcrops. To the east of No. 1 Deposit the Kamloops volcanics are represented by a tuff or lava of dacite, rhyodacite and dacitic andesite. A thin section of this rock shows oriented microcrystalline feldspar microlites and small cavities filled with chlorite. At first glance it appears to be a aphanitic tuff or chert but the fabric layering may indicate it is a dacite lava. A thin section of sample taken from drill hole 76-36 at 962' showed 50% microcline feldspar laths, 45% andesine in matrix and 5% unidentified. Another major rock unit of the Kamloops volcanics

is rhyolite seen in the White Rock Creek area. It was also intersected in several drill holes lying above the Medicine Creek siltstone and Hat Creek Coal Formations. Potassium argon dating of the rhyolite gave the age as 49.9 $\pm$ 1.4 million years. Since the Hat Creek coal has been dated as 36-44 million years in age through palynological analyses, the older rhyolite is found overlying the younger coal. Recent mapping by Golder Associates in the area indicates the area as an inactive slide which suggests that the older rhyolite overrides the younger coal measures through a massive landslide.

The Coldwater Formation, the lowermost sedimentary member of the Kamloops Group of Tertiary Period consists of indurated sandstone and conglomerate, siltstone, claystone and minor coal. These are derived from the underlying group of rocks of Permian to Cretaceous Period.

The Coldwater Formation was deposited in fluvial condition and preceded the main phase of Early Tertiary volcanism. Volcanic clasts of the basement formations frequently occur.

The Hat Creek Coal Formation is the main coal measures overlying the Coldwater Formation. It attains a thickness of over 400 m. Four distinct zones from A (youngest) to D (oldest) have been recognized. Based on gamma ray and density geophysical logs, these zones were further subdivided into 16 subzones.

Two prominent waste zones, A_6 and C_1 in the coal sequence indicate a break in the peat depositional cycle.

The Medicine Creek Formation overlies the Hat Creek Formation. It consists of bentonitic claystones, often semi-indurated and siltstone formed in lacustrine environment.

The characteristic greenish to olive green colour of the Formation is due to physico-chemical environment of deposition. especially the oxidiation-reduction potential (Eh) of the depositional basin. The lower Eh (measured in Mv) represents a reducing environment, which imparts the bluish-green colour dye to the ferrous salts. The presence of chlorite-derived from the weathering of the volcanic rocks rich in FeMg minerals also accounts for the greenish tinge.

The Finney Lake Formation represents the uppermost stratigraphic unit of the Miocene and/or the Eocene epoch. It consists mainly of sandstone and conglomerate in the lower section, overlain by lahar beds. The general characteristics of the sandstone and conglomerate appear to be similar to that of the Coldwater Formation. However, in the area under review, sandstone and conglomerate units are absent.

During the Pleistocene epoch the entire Hat Creek area, along with much of the Interior Plains, underwent extensive glaciation. This resulted in the deposition of a variety of glacial and glacio-fluvial sediments. The area between Finney Lake and Houth Meadows appears to be a post-glacial slide zone.

The present geologic map and the stratigraphic table place, lahar beds in the upper sequence of the Kamloops Group. Lahar beds discussed here confine to a volcaniclastic pile with a mixture of lithic sandstone and conglomerate. A typical lahar outcrop is well exposed on a small knob hill above the main road corner traversing the Ambusten Creek. It forms a pinnacle consisting of subrounded to angular fragments (of basalt, andesite, dacite, chert and limestone) up to 1.5 meters in a semi-indurated volcanic fines matrix. The matrix varies from silty to arkosic coarse sand in grain size. In the southwest boundary of the map area a large subcrop of lahar overlying the Spences Bridge Group and the Medicine Creek Group was interpreted from the magnetometer and low gravity survey (McCullough 1977).

A thin section of lithic sandstone associated with lahar bed in the Medicine Creek area, too small to show on the map, represents a poor sorting of rounded to subangular fragments of andesitic clasts with plagioclase laths. Some glassy fragments of the same size are also noted. The volcanic clasts appear to be fairly fresh, but a weak metamorphic sign is noted by some zeolite or chlorite filling between these clasts.

Plateau Basalt

The olivine basalt discussed here is correlated with the Plateau Basalt of Miocene Epoch in the Ashcroft map area. It unconformably overlies all the stratigraphic sequences described above. The largest exposure is on the ridge top immediately north of Harry Lake. The olivine basalt here unconformably overlies the Greenstone unit of the Cache Creek Group. In the field, the rocks are fresh, hard, dark grey to black, and spotted with 1-2 mm olivine crystals. The olivine basalt sample obtained from White Rock Creek area by EMPR (E-52) is determined to be of Middle Miocene age 13.2 $\pm$ 0.5 m.y. by whole rock K-Ar analysis (Church 1975). A small exposure of the same basalt was found at an elevation of 1098 m near Gordon Parke's ranch, northwest of Fish Hook Lake.

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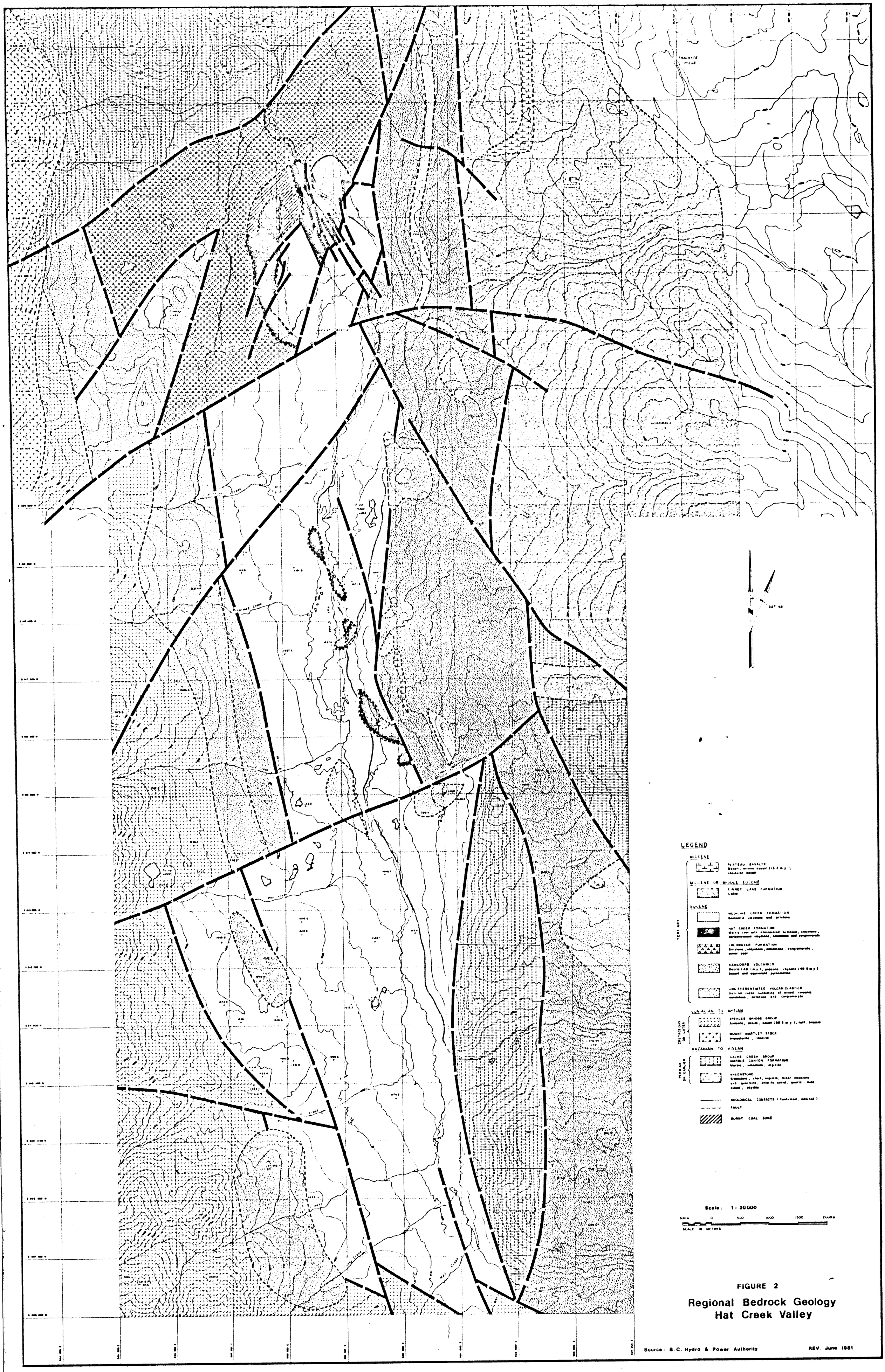

FIGURE 2

Regional Bedrock Geology
Hat Creek Valley