FURTHER STUDIES OF THE HAT CREEK COAL DEPOSIT (92I/12, 13E)

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INTRODUCTION

Additional information has been gathered on the effects of combustion metamorphism in the vicinity of the No. 1 coal reserve and the paleodepositional environment of the Hat Creek coal deposit.

COMBUSTION METAMORPHISM

A general description of prehistoric combustion in the Hat Creek coal deposit has been provided by Church (1975, p. G 110; 1979; 1980). Further information is added by a suite of chemically and mineralogically analysed samples (Table 1, page 76).

The best exposure of the burned zone is in 'A' trench which was excavated for bulk sampling in 1977. This is an east-west slot measuring 274 metres in length, 90 metres in width, and 24 metres in depth cut into the No. 1 coal reserve.

Bright red, brown, and yellowish soils and burned shaly residue are exposed along much of the trench. They are silica-saturated, aluminous rocks with markedly variable water content (analyses numbers 8, 9, and 10). The material is characterized by high cristobalite or tridymite content and variable amounts of clay minerals including kaolinite and illite and subordinate glass, hematite, mullite, corundum, plagioclase, and pseudobrookite (?).

Baked fossil logs are conspicuous within the burned shales. These have been transformed from siderite, calcite, and dolomite (analysis number 1) to mixtures of carbonates, hematite, and magnetite (analyses numbers 2 and 3) or, in some cases, to almost pure hematite (analysis number 4).

Light grey clay-like material forming a number of thin beds in the coal and patches near baked fossil logs may be ash residue of burned coal. It has exotic compositions (analyses numbers 11 and 12) with unusually high concentrations of phosphorus, strontium, and barium attributable to the presence of woodhouseite-hinsdalite± goyazite or gorceixite group minerals and barite.

Cap rock above the baked shales on the south wall of 'A' trench was subjected to intense heating during combustion of the underlying coal. On the upper bench of the trench, grey, vesicular 'slag' mixed with undigested fragments of reddish brown shale is exposed; on the whole they resemble rootless lava flows. Locally, expulsion of hot gases from the burning coal had a blow torch effect along joints and cracks and fused their walls to form peculiar hornito or chimney-like structures (Rogers, 1917, p. 5). The first structure of this type in the Hat Creek area was observed by MacKay (1925, p. A320) on the upper slope south of Dry Lake gulch; he called it a 'volcanic dyke.'

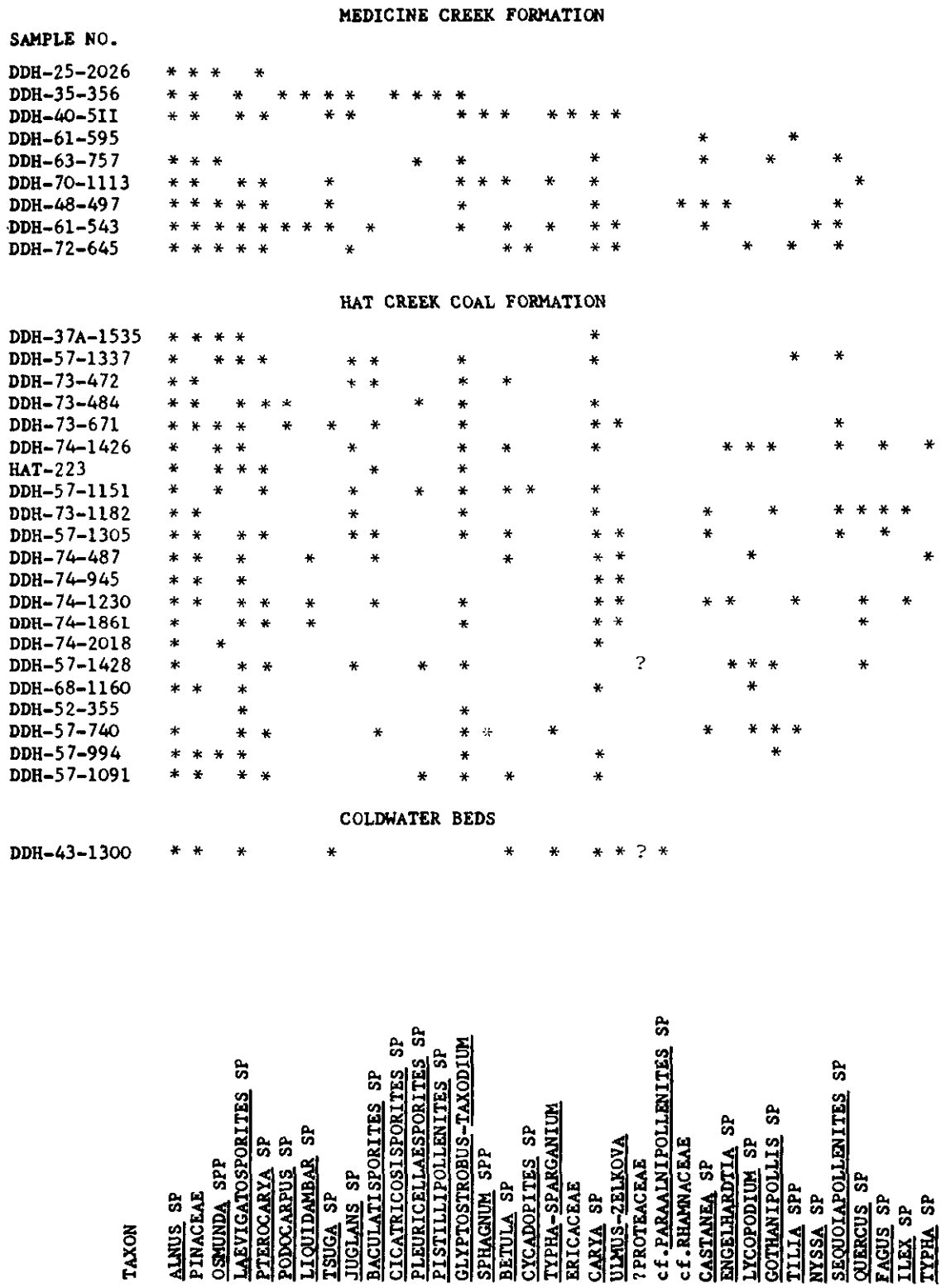

Figure 23. Microflora content of core samples from the Hat Creek section.

Unlike normal lava or slag, the fused rocks are aluminous and their compositions are akin to argillites or shales (analyses numbers 5 and 6). The mineral composition is often variable but commonly consists of abundant cordierite, cristobalite, hematite, clinopyroxene, and calcic plagioclase. Petrified logs in the fused cap rock were transformed into dark grey, vesicular rock composed mainly of specularite and magnetite with minor amounts of tridymite, cristobalite, plagioclase, corundum, and cordierite.

PALYNOLOGY RESULTS

Preliminary results from a palynology study by W. S. Hopkins (1977, personal communication) on drill core, supplied to the Institute of Sedimentary and Petroleum Geology in Calgary, mostly agree with a more recent, comprehensive investigation also undertaken by Hopkins (1980). Initial examination of core samples from the principal sedimentary formations showed 35 taxa of which angiosperm pollen was most abundant, followed by fern spores and gymnosperms (Figs. 23 and 24). Other than a few minor fluctuations, perhaps due to climactic changes, the taxa are remarkedly constant throughout, with no definite biostratigraphic subdivisions.

The Hat Creek flora grew in a warm to subtropical lowland environment in a purely continental setting. Alder swamps flourished and may have been surrounded at a distance by pine-covered highlands. The Hat Creek Coal Formation is approximately 425 metres thick; consequently, it is estimated that between 1.66 and 2.5 million years were required to accumulate the coal measures. The complete sedimentary cycle, including an undetermined thickness of Coldwater beds below and approximately 300 metres of strata of the Medicine Creek Formation above, may represent an additional million years of deposition.

The age of the coal measures from fossil evidence is not completely defined. According to Hopkins, *Ilex, Tilia, Juglans*, and *Carya* point to a post-Middle Paleocene age. The presence of *Gothanipollis* narrows this to Eocene or perhaps Oligocene, while *Pistillipollenites* suggest Late Paleocene to Middle Eocene. A potassium-argon date on biotite from rhyolite overlying the sedimentary rocks gives a Middle Eocene age of 51.2 Ma (Church, *et al.*, 1979, p. 1883). The combined data give an Eocene age for the coal measures and suggest that they are of Early to Middle Eocene age.

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TABLE 1. CHEMICAL ANALYSES OF SAMPLES FROM BOCANNE ZONE, NO. 1 COAL RESERVE AREA, HAT CREEK

	1	2	3	4	5	6	7	8	9	10	11	12
SiO_2	0.60	2.72	1.57	0.39	14.21	24.96	45.76	61.15	52.83	52.50	16.73	18.22
TiO_2	<0.05	<0.05	<0.05	<0.05	1.21	0.91	0.839	1.39	1.02	0.895	2.76	0.319
Al_2O_3	0.11	0.37	0.32	0.08	18.03	15.00	25.2	27.69	21.72	31.2	25.41	27.40
Fe_2O_3	0.90	24.57	85.98	>95.00	63.03	47.28	13.7	4.81	2.55	2.22	11.24	1.27
FeO	16.51	0.09	0.10	0.07	0.66	0.11	0.35	0.29	0.07	0.10	0.17	0.14
MnO	0.25	0.20	0.64	0.15	0.23	0.48	0.194	0.01	0.03	0.021	0.05	0.016
MgO	5.89	2.31	5.50	0.07	0.84	3.11	1.92	1.15	0.47	0.81	0.65	0.17
CaO	28.68	41.12	2.12	0.30	0.97	7.84	8.48	0.61	0.98	0.94	8.02	5.55
Na_2O	<0.01	0.05	0.03	0.34	0.088	0.28	0.49	0.76	0.35	0.758	0.10	0.166
K_2O	<0.02	<0.02	0.02	<0.02	0.18	0.22	0.514	1.29	0.97	1.211	0.24	0.139
$+H_2O$	3.81	0.37	1.51	0.29	0.21	0.19	0.50	0.02	7.87	0.0	1.14	12.14
$-H_2O$	0.71	0.11	0.53	0.35	0.03	1.03	0.29	0.02	8.13	8.60	6.54	10.04
CO_2	>40.00	29.06	0.55	0.26	<0.07	<0.07	0.30	<0.07	0.26	0.07	1.14	2.05
P_2O_5	N.D.	N.D.	0.30	0.32	N.D.	N.D.	0.39	0.20	0.22	0.55	11.50	12.9
S	0.56	0.01	0.01	0.10	<0.005	<0.005	0.02	<0.02	0.03	0.04	0.47	1.26
SrO	0.008	0.005	0.005	0.001	0.01	0.03	0.021	0.02	0.01	0.065	2.09	3.60
BaO	0.014	0.01	0.02	0.01	0.02	0.07	0.048	0.07	0.06	0.046	2.37	2.23
		100.99	99.21		99.72	101.51	99.02	99.48	97.57	100.03		

Key to Analyses

1 Petrified wood from coal in bulk sample trench 'A,' composed of calcite, siderite, and some ferroan dolomite.
2 Petrified wood from bocanne zone in trench 'A,' composed of calcite with minor amounts of quartz, hematite, and magnetite.
3 Outer shell of petrified wood in bocanne zone, composed of hematite, magnetite, and a trace of calcite.
4 Petrified wood in bocanne zone replaced almost entirely by hematite.
5 Heavy vesicular slag from bocanne zone composed mostly of hematite and magnetite with minor amounts of tridymite, cristobalite, corundum, plagioclase, and a trace of cordierite.
6 Vesicular slag mottled grey and orange from bocanne zone, composed of plagioclase, hematite, and clinopyroxene.
7 Chimney of fused rock in bocanne zone south wall of Dry Lake gulch, composed of calcic plagioclase, hematite, cristobalite, cordierite, and tridymite (Table 1, no. 12, Church, 1975, G 106).
8 Cream-coloured, very hard-baked phase of bocanne rock in trench 'A,' composed of cristobalite (high) ±tridymite with subordinate amounts of mullite, corundum, hematite, plagioclase, quartz, and pseudobrookite (?).
9 Baked shale-like residue from bocanne zone, composed of amorphous material (possibly glass), quartz, cristobalite, and very minor amounts of illite and feldspar.
10 Light brown to cream-coloured phase of bocanne rock on south wall of Dry Lake gulch, composed mostly of kaolinite and quartz (Table 1, no. 2, Church, 1975, p. G 106).
11 Clay-like material by remains of baked petrified log in bocanne zone, composed mostly of amorphous material with minor amounts of woodhouseite-hinsdalite±a goyazite group mineral or gorceixite, hematite, barite, illite, plagioclase, and maghemite (?).
12 Light grey to cream-coloured band passing from bocanne to fresh coal in trench 'A,' composed mostly of amorphous material with some woodhouseite-hinsdalite±goyazite minerals or gorceixite, barite, illite, tridymite (?), cristobalite (?), and a trace amount of plagioclase (?).

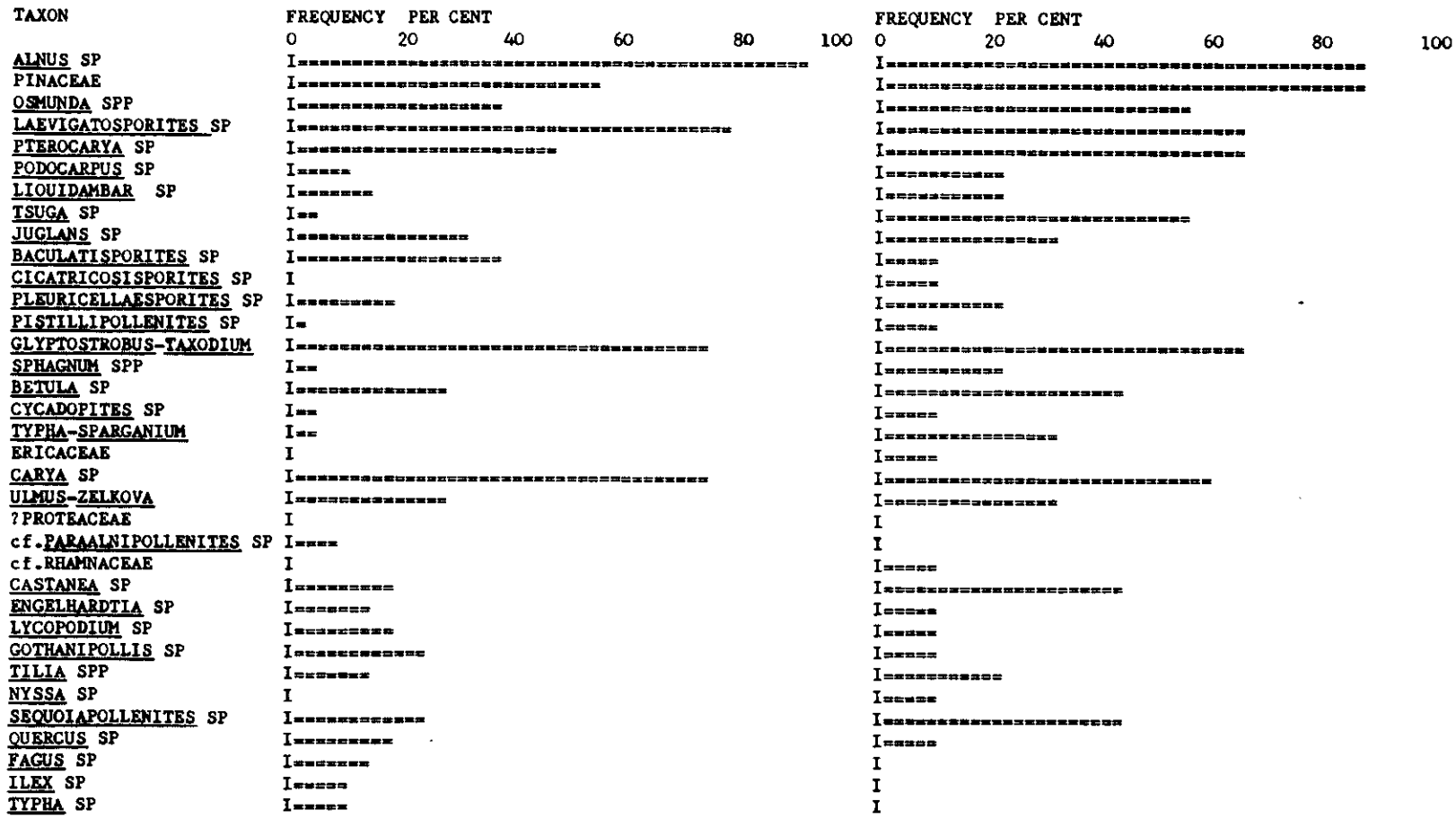

Figure 24. Frequency of spore and pollen taxon in Eocene beds at Hat Creek.

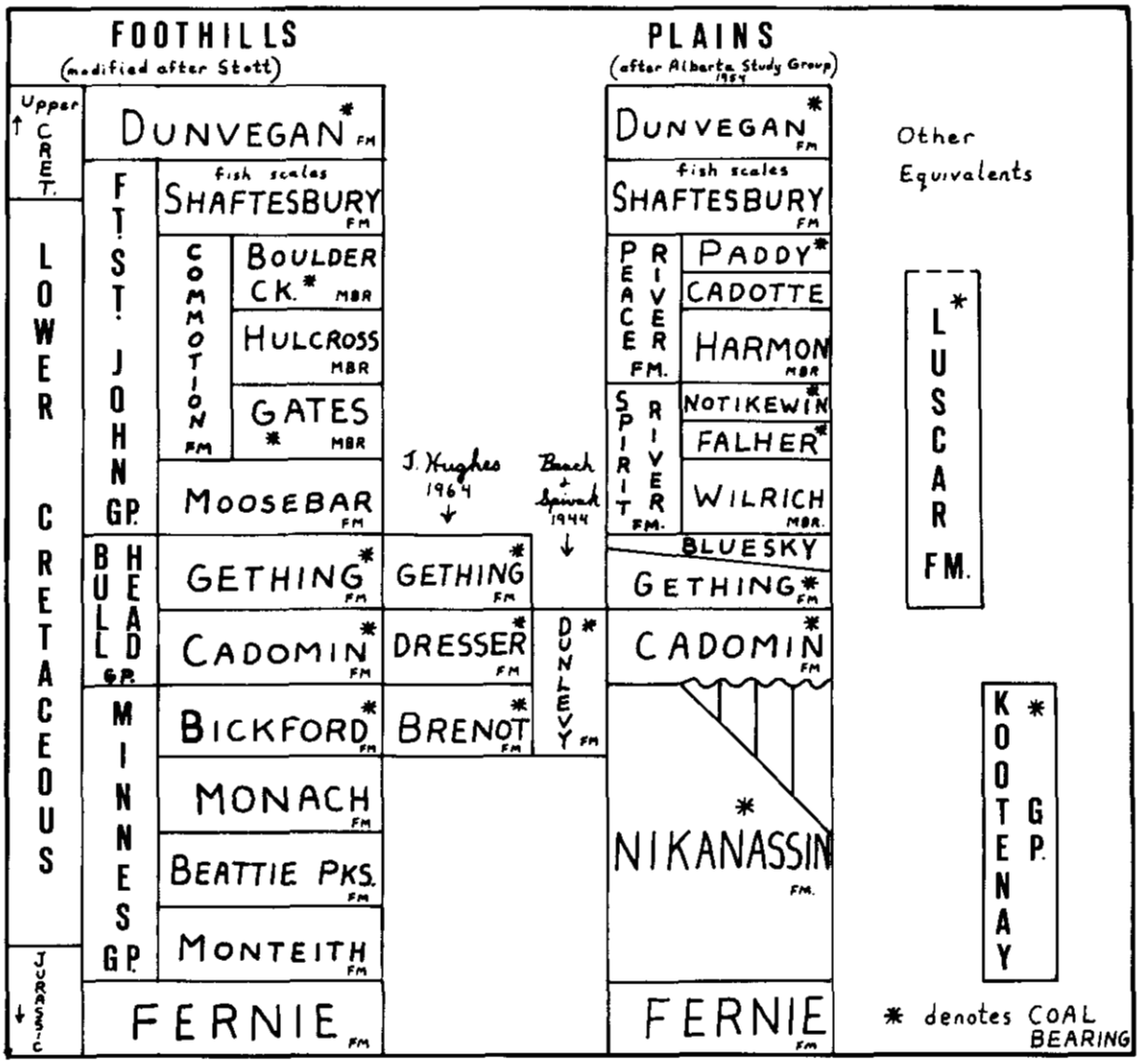

Figure 25. Table of formations, northeastern British Columbia.