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Analyses of Seven Core Samples from Two Tertiary Coal Beds in the Sagwon Member of the Sagavanirktok Formation, North Slope, Alaska

By

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INTRODUCTION

A shallow core drilling project was conducted by the U.S. Geological Survey in June and July 1986, at bluffs along the Sagavanirktok River near Sagwon in northern Alaska (fig. 1). Ten holes were drilled at an outcrop of the Tertiary Sagavanirktok Formation in the northern part of sec. 34, T. 1 N., R. 14 E. (fig. 2). Core samples from two coal beds and limited intervals of the associated rocks were recovered.

This report summarizes the geology of the sample area and the methods and equipment employed for the drilling, and presents the analyses of seven coal core samples.

GEOLOGIC SETTING

The Sagavanirktok Formation was named by Gryc and others (1951) for rocks cropping out north of Sagwon at Franklin Bluffs (fig. 1). Detterman and others (1975) divided the Sagavanirktok Formation into three members (ascending order): the Sagwon, the Franklin Bluffs, and the Nuwok. The Sagwon Member is the coal-bearing unit within the formation. The type section for this member, located within the project area, consists mainly of shale, siltstone, sandstone, conglomerate, carbonaceous shale, and coal (fig. 3).

Three coal beds occur in the project area, and cores from the upper and middle coal beds were recovered during the drilling (fig. 3). The lower coal bed was not cored because it is quite thin (2.3 feet) and contains two clay partings of 0.1 and 0.5 foot in thickness. The middle coal bed is about 4.5 feet thick and contains a clay parting of 0.6 foot in thickness (drill hole 10, fig. 3). The upper coal bed is 5.5 feet thick in drill hole 7 (fig. 3) and thickens to 9.5 feet within 1 mile to the north.

DRILLING METHODS AND EQUIPMENT

The drilling system included the following major components: a tripod derrick, Acker 1200 PM pipe-mounted core drill, cathead hoist, and a single speed Acker/Moyno positive displacement mud pump. The derrick was comprised of 6-foot lengths of aluminum tubing (3-inch diameter) bolted together for a total height of 12 feet. A cathead with a 500-pound lifting capacity for hoisting steel was fastened to one of the tripod legs, and the core drill was threaded directly onto steel casing driven 4-8 feet into the permafrost. The mud pump used has a capacity of about 20 gallons a minute with a maximum pressure rating of 150 psi. Mud pits were fabricated by cutting a 55 gallon barrel into two unequally sized drums. The larger drum was used for settling drill cuttings, and the smaller was for mixing and pumping fluid downhole. Clear water was the primary circulating medium, though a liquid thickening agent was sometimes used to help lift drill cuttings from the hole. Water for drilling was obtained from two sources. On the higher parts of the bluffs, meltwater from nearby snowbanks was contained and pumped to the drill sites. At the base of the bluffs, water was pumped directly to the drill sites from the Sagavanirktok River.

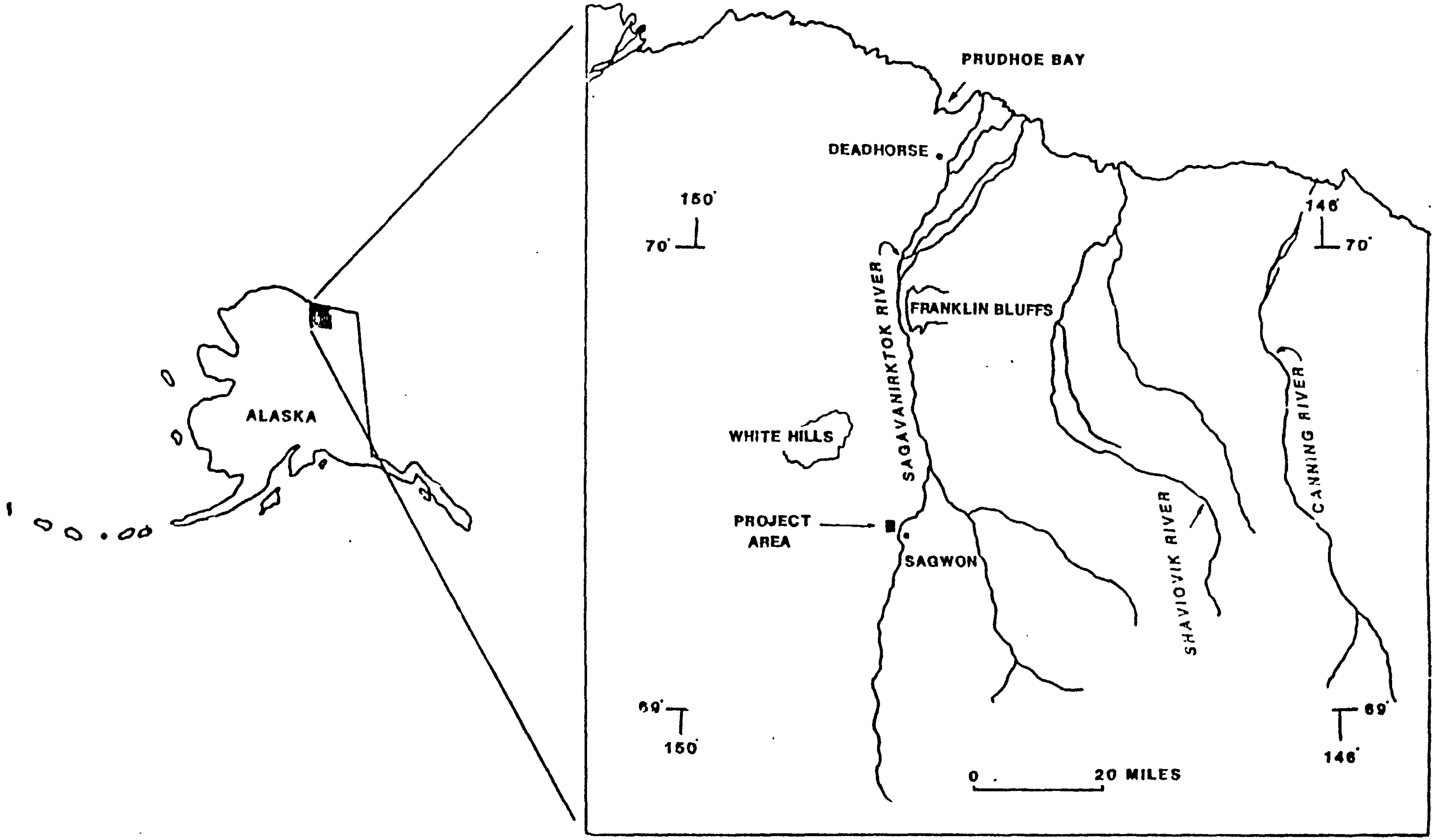

Figure 1.--Index map showing the project area near Sagwon on the North Slope, Alaska.

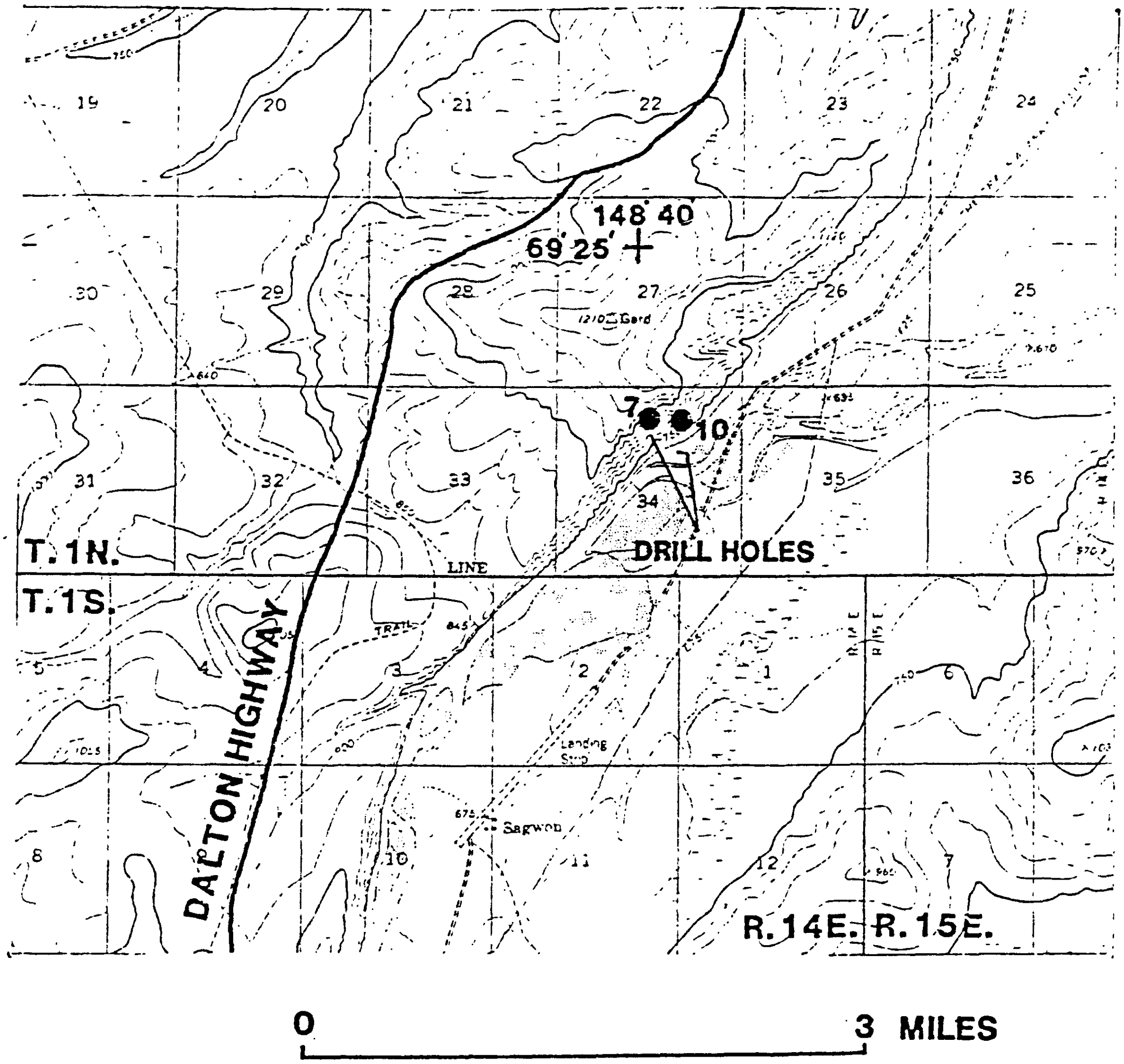

Figure 2.--Map showing approximate locations of drill holes 7 and 10 in sec. 34, T. 1 N., R. 14 E.

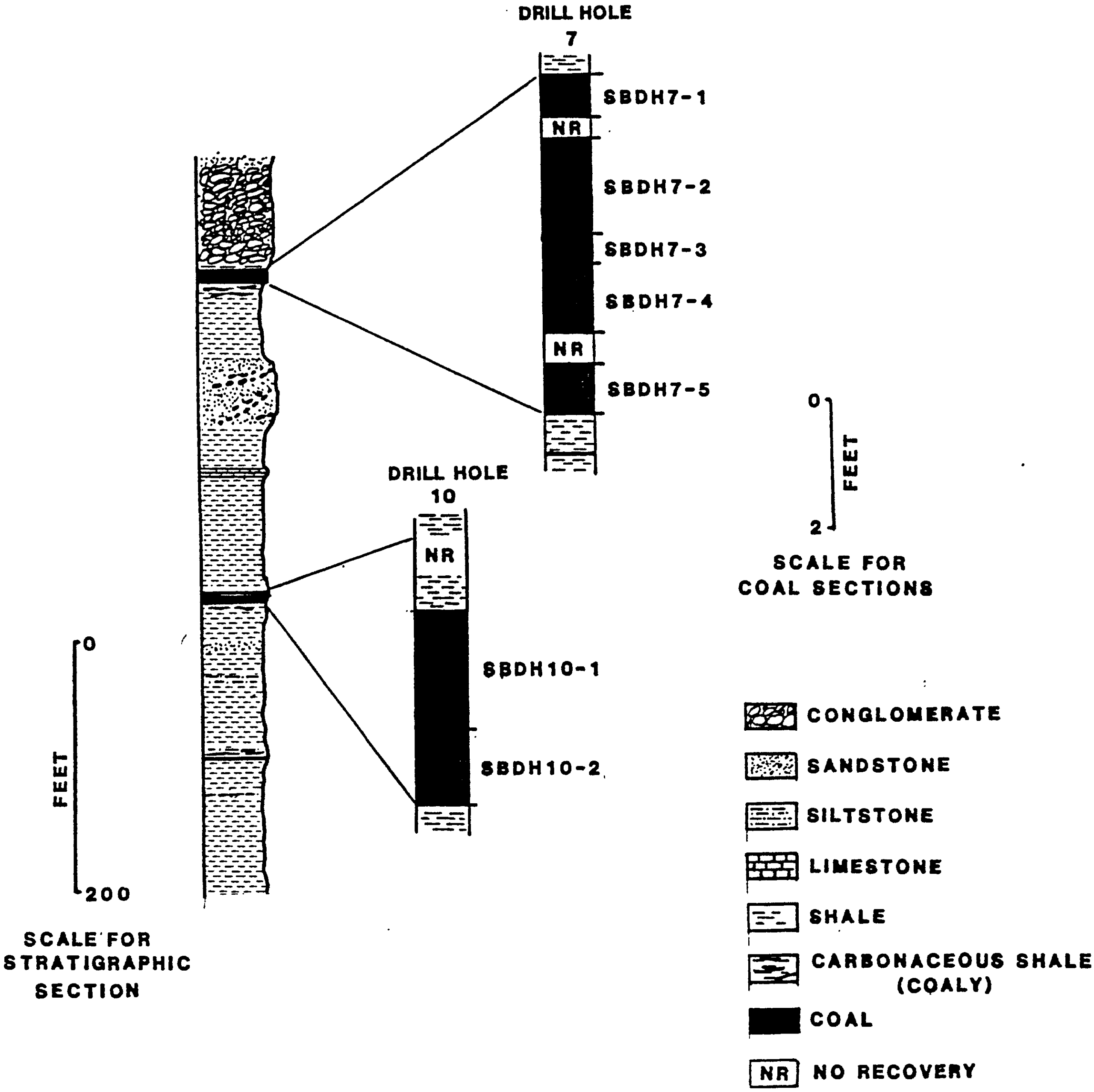

Figure 3.--Generalized lithologic column of the Sagwon Member of the Sagavanirktok Formation in sec. 34, T. 1 N., R. 14 E., showing columnar sections of the upper coal bed in drill hole 7, and the middle coal bed in drill hole 10. SBDH7-1 through 5 and SBDH10-1 and 2 are samples analyzed for coal quality.

An ultralight AW drill rod (1.75-inch diameter) was used, and the core barrel was a Christensen BWD4 conventional barrel which recovers a 1.5-inch-diameter core. Carbide bits were used for the coring, and a 2.75-inch-diameter rollercone bit was used for all reaming and non-core drilling.

After the initial placement of the drilling equipment at the outcrop by helicopter, all drilling components were moved from drill site to drill site by hand.

COAL SAMPLES AND ANALYSES

Five core samples from the upper coal bed and two from the middle coal bed were submitted for proximate and ultimate analysis, and determination of equilibrium moisture, free-swelling index (FSI), heat of combustion (Btu/lb), forms of sulfur, and ash-fusion temperatures. All analyses were done by Geochemical Testing in Somerset, Pa., and results are shown on table 1. Samples SBDH7-1 through 5 represent consecutive samples through the upper coal bed, though two small intervals of core were not recovered (fig. 3). Immediately below the upper coal is an interval of 15-20 feet of thin coal beds and carbonaceous shale (fig. 3). Due to the very thin and lenticular nature of the coal in this interval, no samples were analyzed. Samples SBDH10-1 and 2 represent the lower 3.0 feet of the middle coal bed in drill hole 10 (fig. 3). Approximately 0.6 foot of coal above the parting was not recovered in core. Apparent rank assignment (table 1) is based on the moist, mineral matter-free calorific value determined using the Parr Formula 3 (ASTM Standards, 1977, p. 216) with as-received values calculated to equilibrium moisture.

ACKNOWLEDGMENTS

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Table 1.--Proximate and ultimate analysis, BTU/lb, forms of sulfur, and fusibility of ash of seven coal core samples recovered from two shallow drill holes in section 34, T. 1 N., R. 14 E., near Sagwon on the North Slope, Alaska. Samples SBDH7-1 through 5 are consecutive samples (descending) in a 5.5-foot thick coal bed and SBDH10-1 and 2 are consecutive samples (descending) from the lower 3.0 feet of a 4.5-foot thick coal bed

[All analyses except BTU/lb and ash-fusion temperatures are in percent. Forms of analysis: 1, as-received; 2, moisture free; 3, moisture and ash free; 4, as-received at equilibrium moisture. All analyses by Geochemical Testing, Somerset, Pa. Free-swelling index values were 0.0 for all samples]

			Proximate analysis					Ultimate analysis					Forms of sulfur			Ash-fusion temperature (F)			
Field ID	Lab number	Form of analysis	Moisture	Ash	Volatile matter	Fixed carbon	BTU/lb	Hydrogen	Carbon	Nitrogen	Oxygen	Total sulfur	Sulfate	Sulfide	Organic	Initial deformation	Softening	Fluid	Apparent rank
SBDH7 -1	U13250	1	25.37	2.65	30.79	41.19	8902	6.45	53.20	0.91	36.63	0.16	0.00	0.02	0.14	1910	2020	2100	Subbituminous C
		2		3.55	41.26	55.19	11929	4.83	71.28	1.22	18.90	.22	.00	.02	.20				
		3			42.78	57.22	12368	5.01	73.90	1.26	19.60	.23	.00	.02	.21				
		4	23.10	2.73	31.73	42.44	9170	6.31	54.82	.94	35.04	.16	.00	.02	.14				
SBDH7 -2	U13251	1	27.82	2.47	29.50	40.21	8795	6.54	52.15	.90	37.84	.10	.01	.02	.07	2060	2180	2310	Subbituminous B
		2		3.42	40.87	55.71	12185	4.74	72.25	1.25	18.20	.14	.01	.03	.10				
		3			42.32	57.68	12616	4.91	74.81	1.29	18.85	.14	.01	.03	.10				
		4	22.00	2.67	31.88	43.45	9500	6.17	56.35	.97	33.73	.11	.01	.02	.08				
SBDH7 -3	U13252	1	35.70	2.33	25.34	36.63	7787	6.63	46.96	.68	43.31	.09	.00	.04	.05	2010	2120	2360	Subbituminous B
		2		3.62	39.40	56.98	12111	4.10	73.04	1.05	18.05	.14	.01	.06	.07				
		3			40.88	59.12	12566	4.25	75.78	1.09	18.73	.15	.01	.06	.08				
		4	21.50	2.84	30.94	44.72	9510	5.62	57.33	.83	33.26	.11	.00	.05	.06				
SBDH7 -4	U13253	1	25.93	3.13	28.87	42.07	8887	6.26	53.08	.80	36.64	.09	.00	.02	.07	1930	2080	2280	Subbituminous B
		2		4.22	38.98	56.80	11998	4.54	71.66	1.08	18.38	.12	.00	.02	.10				
		3			40.70	59.30	12527	4.74	74.82	1.13	19.18	.13	.00	.02	.11				
		4	21.50	3.32	30.60	44.59	9420	5.97	56.25	.85	33.52	.10	.01	.02	.07				
SBDH7 -5	U13254	1	21.05	13.69	31.84	33.42	8337	5.91	48.42	.85	31.05	.08	.00	.02	.06	2290	2320	2540	Subbituminous B
		2		17.34	40.33	42.33	10560	4.51	61.33	1.08	15.63	.11	.00	.03	.08				
		3			48.79	51.21	12775	5.46	74.19	1.31	18.91	.13	.00	.04	.09				
		4	16.20	14.53	33.80	35.47	8850	5.59	51.39	.90	27.50	.08	.00	.02	.06				
SBDH10 -1	U13255	1	24.64	13.14	27.76	34.46	7613	5.95	44.41	1.14	35.22	.14	.01	.01	.12	2270	2300	2420	Subbituminous C
		2		17.43	36.84	45.73	10102	4.23	58.93	1.52	17.71	.18	.01	.02	.15				
		3			44.62	55.38	12235	5.12	71.37	1.84	21.45	.22	.01	.02	.19				
		4	22.48	13.52	28.56	35.45	7830	5.30	45.68	1.17	33.68	.14	.01	.01	.12				
SBDH10 -2	U13256	1	28.54	15.47	27.01	28.98	5968	5.62	37.61	1.04	40.10	.16	.02	.01	.13	2765	2800+	2800+	Lignite A
		2		21.65	37.80	40.55	8351	3.40	52.63	1.45	20.64	.23	.03	.02	.18				
		3			48.25	51.75	10659	4.34	67.17	1.85	26.35	.29	.04	.03	.22				
		4	24.44	16.36	28.56	30.64	6310	5.30	39.77	1.10	37.31	.17	.02	.01	.14				