DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

Report on coal resource exploration assessment program drilling and related activities April 1986 to May 1987 Southern Sind Province, Pakistan:

SUMMARY

By

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This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature.

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Summary of Coal Resource Exploration and Assessment Program Drilling and Related Activities

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ABSTRACT

The 32-hole exploratory drilling program conducted by the U.S. Geological Survey (USGS) and the Geological Survey of Pakistan (GSP) from April 1986 to May 1987 as part of the Coal Resource Exploration and Assessment Program (COALREAP), produced new coal resource information that, when combined with preexisting data, will allow meaningful coal resource assessment and provide informed guidance for additional, more detailed, exploration and development activities in the southern Sind Province of Pakistan.

Of the total 7,867.46 m drilled, 4,196.56 m were cored and 3,670.90 m not cored. A lithologic log was prepared for each drill hole, in addition to geophysical logs to supplement and compliment the lithologic log. A total of 141 samples of coal were collected from the cores for physical and chemical analyses. All cores and non-core rock cutting's (except coal) are retained for study at the GSP facility in Sonda.

In addition to providing regional coal-resource information, some of the drill holes will be loci for more detailed exploration to define the geometry of coal zones that may be the source of fuel for generation of electricity in the near future. For example, seventeen drill holes penetrated one or more coal beds each more than 0.75 m thick, and six holes penetrated individual coal beds more than 1.5 m thick. The thickest coal bed drilled was 6.33 m.

The original drilling plan for the southern Sind Province had to be modified because of security problems in, and adjacent to, the active mining area. Therefore, the southern part of the Lakhra coal field and parts of the field north and west of the active mining area remain essentially unexplored at this time. However, the change in plans did allow the drilling of three exploratory holes east of the Indus River. Data in these holes, along with that from two holes previously drilled in the area, indicate significant resource potential for a large undefined area east of the Indus River and south of the city of Hyderabad.

INTRODUCTION

The Coal Resource Exploration and Assessment Program (COALREAP) in Pakistan comprises component 2a of the Energy Planning and Development Project (391-0478) of the United States Agency for International Development (USAID). COALREAP was conducted by the Geological Survey of Pakistan (GSP) with assistance from the U.S. Geological Survey (USGS) under financing of the Government of Pakistan (GOP) and USAID. The exploration described in this report was conducted according to the "Plan for coal-resources-assessment

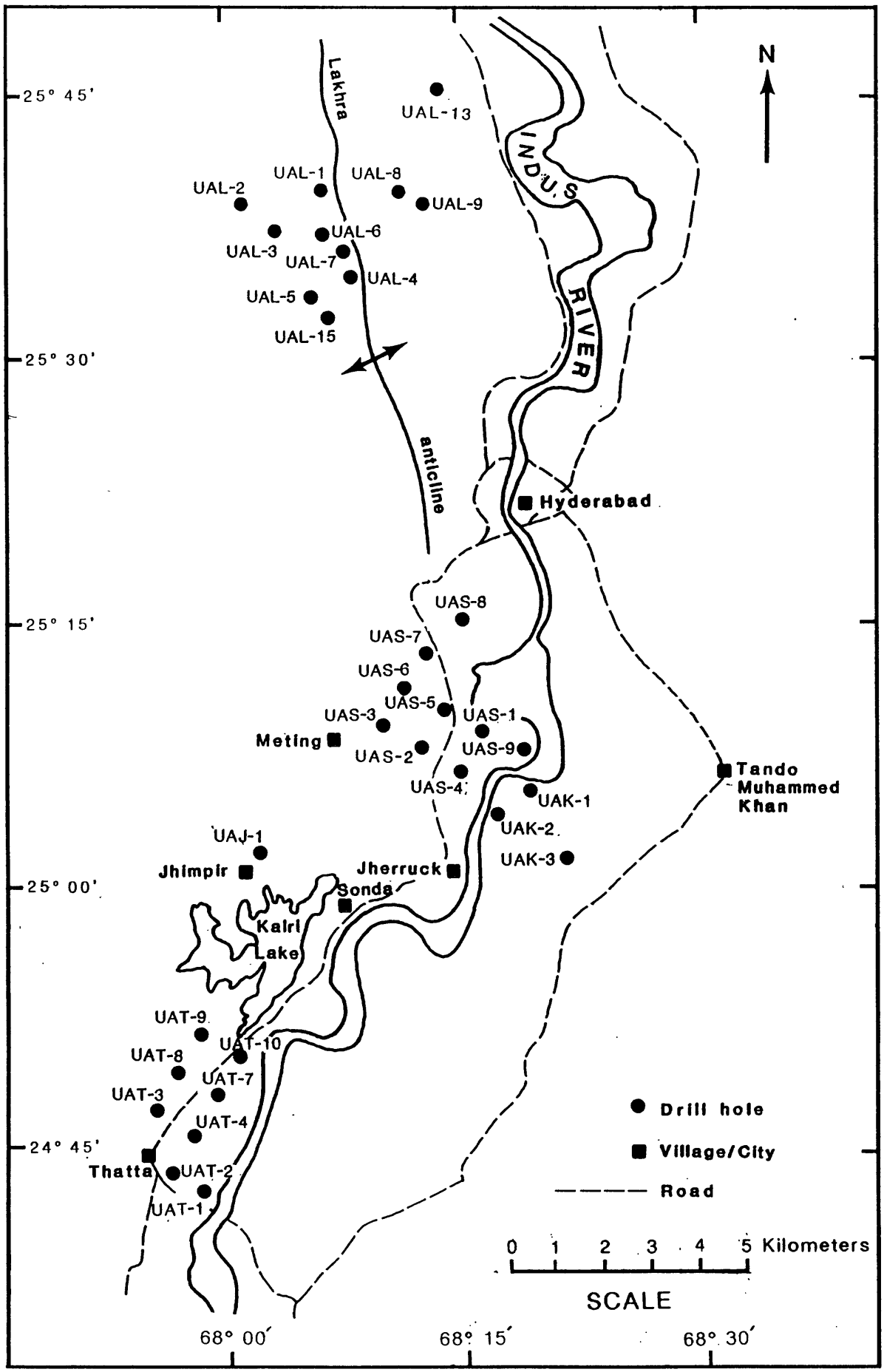

Figure 1.-General location of drill holes

drilling and related activities, Sind Province, Pakistan" that was prepared jointly by the cooperating groups. The purpose of the present report is to summarize results and fulfill reporting requirements "as soon as possible" after termination of drilling.

The drilling was done by the Indus Valley Construction Co. Ltd. (IVCC) of Lahore, Pakistan under USAID contract NO. 391-0478-C-00-5078-00. Drilling started in April 1986 and recessed for the summer after 3 holes had been completed. The drill program was resumed in September 1986 and the last of the 32 drill holes was completed in April 1987. The distribution and numbers of these coal-exploration drill holes are shown in Figure 1. The holes are numbered in groups indicative of the areas in which they were drilled: UAL, Lakhra coal field; UAS, Sonda coal field; UAT, Thatta coal area; UAK, Indus East coal area; and UAJ, Jhimpir coal area.

ACKNOWLEDGEMENTS

A coal exploration drill program of such magnitude as this requires support from many people with various specialities. The number of people who participated in the program is so large that individual acknowledgement is impossible. However, the vital personnel in the program were the well-site geologists and support personnel of GSP and the drill crews and support personnel of the IVCC. Their expertise, industry, fortitude, and good humor deserve special thanks.

BASIC DATA FOR DRILL HOLES

Location

The locations of the drill holes are listed in Table 1. The parameters for the UAL drill holes were measured from the standard Pakistan grids on topographic maps and are presented only in the metric system. The sites of the UAS, UAT, UAJ, and UAK drill holes were surveyed by GSP topographers and are given in both metric and English units.

Meterage Drilled

Table 2 presents basic data for meterage drilled in each of the 32 exploratory holes. The total meterage drilled was 7,769.88 m, but 97.58 m of collapsed holes were redrilled to allow geophysical logging; therefore, the total amount of drilling was 7, 867.46 m. A total of 3,670.90 m (47 percent of the total meterage) was not cored; a total of 4,196.56 m (53 percent of the total meterage) was core.

Two sizes of core-recovery equipment were used. The larger, designated HQ, was used for a total of 3,537.80 m, or 84 percent of the total meterage cored. The smaller size, designated NQ, was used for a toral of 658.76 m, or 16 percent of the total meterage cored. The larger equipment produces core about 3 1/16 inches (77.8 mm) in diameter, whereas the smaller equipment produces core about 2 3/8 inches (60.3 mm) in diameter. The larger size is preferred because core-recovery rates are better and a larger volume of sample is recovered for inspection, description, and analysis.

Table 1. -Locations and Elevations of Drill-Holes in Meters

Drill hole	Easting (m)	Easting (yds)	Northing (m)	Northing (yds)	Altitude above mean sea level (m)	Altitude above mean sea level (ft)
			North Lakhra Coal Field			
UAL-1	2155100		895900		125	
UAL-2	2145000		894100		91	
UAL-3	2147100		889400		107	
UAL-4	2154600		887200		107	
UAL-5	2151400		883400		91	
UAL-6	2152800		889300		122	
UAL-7	2155800		889000		91	
UAL-8	2160100		898000		136	
UAL-9[1]	2163600		893500		166	
UAL-13[1]	2165200		901900		91	
UAL-15	2153800		880600		152	
			Sonda Coal Area			
UAS-1	2167163	2370038	835852	914098	18.91	62
UAS-2	2161436	2363775	834085	912166	35.99	118
UAS-3	2156347	2358209	836513	914822	78.69	258
UAS-4	2163651	2366197	830963	908752	16.17	53
UAS-5	2163157	2365657	838327	916806	23.49	77
UAS-6	2158778	2360868	841259	920012	45.45	149
UAS-7	2160844	2363128	845113	924227	32.03	105
UAS-8	2165000	2367673	847035	926329	30.81	101
UAS-9	2171723	2375025	833762	911813	18.61	61
			Thatta Coal Area			
UAT-1	2134398	2334206	783739	857107	8.54	28
UAT-2 (Old)	2131633	2331182	789761	863694	9.76	32
UAT-2 (New)	2131680	2331239	789785	863719	9.76	32
UAT-3	2130813	2330286	794954	869372	9.76	32
UAT-4	2135409	2335312	792989	867223	9.76	32
UAT-7[2]	2137039	1227094	797273	871908	10.07	33
UAT-8	2132752	2332406	799498	874342	8.24	27
UAT-9	2135599	2335519	803252	878447	43.31	142
UAT-10	2139519	2339807	800510	875448	12.81	42

*UAL drill hole locations and elevations taken from topographic map are approximate and, therefore, are not converted to yards and feet measurements.

Table 1. - Continued

Drill hole	Easting (m)	Easting (yds)	Northing (m)	Northing (yds)	Altitude above mean sea level (m)	Altitude above mean sea level (ft)
			Jhimpir Coal Area			
UAJ-1	2342397	2342397	898397	898397	25.32	83
			Indus East Coal Area			
UAK-1	2174860	2378456	828105	905627	13.4	44
UAK-2	2168316	2371299	824466	901647	14.0	46
UAK-3	2178120	2382021	820422	897224	9.1	30

[1]UAL 10, 11, and 12, were not drilled because of security problems.
[2]UAT 5 and 6 were not drilled because of lack of access.

Table 2 . - Drill-hole basic data

Drill hole	Non-core	Core (1)			Total depth	Stand-By
		HQ	NQ	Total		
	(m)	(m)	(m)	(m)	(m)	(min)
North Lakhra Coal Field						
UAL-1	15.24	113.88	------	113.88	129.12	314
UAL-2	30.03	122.11	67.50	189.61	219.64	515
UAL-3	100.00	122.17	40.99	163.16	263.16	400
UAL-4	4.09	144.01	------	144.01	148.10	229
UAL-5	43.20	91.30	------	91.30	134.50	83
UAL-6	68.61	132.24	------	132.24	200.85	332 (2)
UAL-7	-------	15.10	------	15.10	15.10	---- (2)
UAL-8	58.50	113.20	------	113.20	171.70	250
UAL-9	150.00	85.10	------	85.10	235.10	----
UAL-13	54.06	194.28	------	194.28	248.34	---- (2)
UAL-15	183.75	-------	------	-------	183.75	---- (2)
UAL TOTAL	707.48	1133.39	108.49	1241.88	1949.36	2123 (2)
Sonda Coal Area						
UAS-1	50.00	192.00	------	192.00	242.00	2880 (3)
UAS-2	100.00	128.10	------	128.10	228.10	220
UAS-3	260.00	-------	------	-------	260.00	850 (3)
UAS-4	50.00	200.00	------	200.00	250.00	530
UAS-5	282.00	-------	------	-------	282.00	170
UAS-6	147.50	54.63	119.06	173.69	321.19	325
UAS-7	380.00	-------	-------	-------	380.00	495
UAS-8	100.00	99.12	148.33	247.45	347.45	375
UAS-9	170.10 (3)	206.20	-------	206.20	293.15	605
UAS TOTAL	1539.60 (3)	880.05	267.39	1147.44	2603.89	6450
Thatta Coal Area						
UAT-1	65.00	185.50	------	185.50	250.50	4345 (5)
UAT-2	74.10	162.00	32.50	194.50	268.60	400
UAT-3	302.60	-------	------	-------	302.60	180
UAT-4	110.22	133.15	66.41	199.56	309.78	360
UAT-7	259.43 (5)	-------	------	-------	245.00	1020
UAT-8	120.00	112.93	105.11	218.04	338.04	320
UAT-9	254.95	90.05	------	90.05	345.00	750
UAT-10	30.00	195.00	------	195.00	225.00	285
UAT TOTAL	1216.30 (5)	878.63	204.02	1082.65	2284.52	7660

Table 2. - Continued

Drill hole	Non-core	Core (1)			Total depth	Stand-By
		HQ	NQ	Total		
	(m)	(m)	(m)	(m)	(m)	(min)
		Jhimpir and Indus East Coal Area				
UAJ-1	50.00	127.60	-----	127.60	177.60	210
UAK-1	64.00	157.25	78.86	236.11	300.11	1160
UAK-2	28.52	175.88	------	175.88	204.40	180
UAK-3	65.00	185.00	------	185.00	250.00	190
UAJ and UAK TOTAL	207.52	645.73	78.86	724.59	932.11	1740
TOTAL	3670.90(7)	3537.80	658.76	4196.56	7769.88 (8)	60168

(1) HQ = 77.8 mm (3 1/16 in.) diameter; NQ = 60.3 mm (2 3/8 in.) diameter.
(2) Not geophysically logged — area not safe because of security problems.
(3) Curfew problem — because of civil unrest Americans advised by American Consulate General not to travel outside Hyderabad.
(4) Includes 83.15m redrilled.
(5) Recovering logging tool.
(6) Includes 14.43m redrilled.
(7) Includes 97.58m redrilled.
(8) Does not include the 97.58m redrilled

SAMPLE RECOVERY

Non-core

The drilling plan specified that representative rock cuttings be recovered during non-core drilling; 2-m increments for samples were selected because of the very fine size of cuttings produced by the type of equipment used. No coring was done in drill holes UAL-15, UAS-3, -5, and -7, and UAT-3 and -7.

Core

Table 3 shows the core-drilling statistics for each of the 32 holes. Core recovery expressed in percent is defined as the ratio between the amount in meters actually recovered and the meterage that was cored. Core recovery for the 32 drill holes averaged 70 percent. Core recovery according to diameter of core averaged 71 percent for HQ-size core and 67 percent for NQ-size core. Core recoveries per drill hole ranged from 30 to 94 percent. In six of the holes, core recovery was 85 percent or more but only in the HQ-size. Percent core recovery did not exceed 83 percent for NQ-size core.

LITHOLOGIC LOGS

Lithologic logs were prepared by the well-site geologists as the holes were being drilled. These lithologic logs will be integrated with the geophysical logs, which were obtained at each hole, to produce a composite interpretive log that will best describe the strata penetrated by the drill in each hole. Appendix 1 to this report contains the lithologic logs that were completed by the well-site geologists.

GEOPHYSICAL LOGS

Table 4 presents a summary of the number and type of geophysical logs that were obtained for each drill hole. Appendix 2 of this report consists of copies of the geophysical logs.

An excellent illustration of the importance of integrating geophysical and lithologic logs is shown by comparison of the lighologic log of drill hole UAK-3 (Appendix 1) with the geophysical logs of that same hole (Appendix 2).

For example, a coal bed totaling 1.25 m thick was not recorded in the lighologic log because of the lack of core recovery (see depth) 189.2 m to 190.45 m) and an upper bench, 2.4 m thick, of another coal bed also was not recovered (see depth 159.8 m to 162.2 m); however, both of these coal beds were recorded on the geophysical logs.

COAL BEDS

Table 5 shows the thicknesses and depths to top and base of coal beds penetrated in the drill holes. Beds of impure coal are not shown in the table, nor are coal beds that are indicated on geophysical logs but which were not recorded on the lithologic logs (see above).

Table 3. Core-drilling and core recovery statistics.

Drill Hole	Total Depth (m)	Non-Core drilling (m)	Core-drilling (m) HQ	NQ	Total	Cumulative Total	Core Recovered (m) HQ	NQ	Total	Cumulative Total	Percent Core Recovery HQ	NQ	Total	Cumulative Total
UAL-1	129.12	15.24	113.88	—	113.88	113.88	95.66	—	95.66	95.66	84	—	84	84
-2	219.64	30.03	122.11	67.50	189.61	303.49	1) 100.79	1) 49.00	149.79	245.45	83	73	79	81
-3	263.16	100.00	122.17	40.99	163.16	466.65	1) 95.27	1) 31.99	127.26	372.71	78	78	78	80
-4	148.10	4.09	144.01	—	144.01	610.66	106.76	—	106.76	479.47	74	—	74	79
-5	134.50	43.20	91.30	—	91.30	701.96	71.97	—	71.97	551.44	79	—	79	79
-6	200.85	68.61	132.24	—	132.24	834.20	119.00	—	119.00	670.44	89	—	89	80
-7	15.10	—	15.10	—	15.10	849.30	5.19	—	5.19	675.63	34	—	34	80
-8	171.70	58.50	113.20	—	113.20	962.50	95.77	—	95.77	771.40	85	—	85	80
-9	235.10	150.00	85.10	—	85.10	1047.60	79.58	—	79.58	850.98	94	—	94	81
-13	248.34	54.06	194.28	—	194.28	1241.88	177.40	—	177.40	1028.38	91	—	91	83
-15	183.75	183.75	—	—	—	1241.88	—	—	—	1028.38	—	—	—	83
UAS-1	242.00	50.00	192.00	—	192.00	1433.88	154.13	—	154.13	1182.51	80	—	80	82
-2	228.10	100.00	128.10	—	128.10	1561.98	93.90	—	93.90	1276.41	73	—	73	82
-3	260.00	260.00	—	—	—	1561.98	—	—	—	1276.41	—	—	—	82
-4	250.00	50.00	200.00	—	200.00	1761.98	146.65	—	146.65	1423.06	73	—	73	81
-5	282.00	282.00	—	—	—	1761.98	—	—	—	1423.06	—	—	—	81
-6	321.19	147.50	54.63	119.06	173.69	1935.67	42.31	98.47	140.78	1563.84	77	83	81	81
-7	380.00	380.00	—	—	—	1935.67	—	—	—	1563.84	—	—	—	81
-8	347.45	100.00	99.12	148.33	247.45	2183.12	88.10	121.43	209.53	1773.37	89	82	85	81
-9	3) 376.30	3) 170.10	206.20	—	206.20	2389.32	162.16	—	162.16	1935.53	79	—	79	81
UAT-1	250.50	65.00	185.50	—	185.50	2574.82	98.28	—	98.28	2033.81	53	—	53	79
-2	268.60	74.10	162.00	32.50	194.50	2769.32	94.45	14.74	109.19	2143.00	58	45	56	77
-3	302.60	302.60	—	—	—	2769.32	—	—	—	2143.00	—	—	—	77
-4	309.78	110.22	133.15	66.41	199.56	2968.88	86.65	39.36	126.01	2269.01	65	59	63	76
-7	2) 259.43	2) 259.43	—	—	—	2968.88	—	—	—	2269.01	—	—	—	76
-8	338.04	120.00	112.93	105.11	218.04	3186.92	67.86	54.22	122.08	2391.09	60	52	56	75
-9	345.00	254.95	90.05	—	90.05	3276.97	72.00	—	72.00	2463.09	80	—	80	75
-10	225.00	30.00	195.00	—	195.00	3471.97	103.79	—	103.79	2566.88	53	—	53	74
UAJ-1	177.60	50.00	127.60	—	127.60	3599.57	118.66	—	118.66	2685.54	93	—	93	75
UAK-1	300.11	64.00	157.25	78.86	236.11	3835.68	120.16	34.68	154.84	2840.38	76	44	66	74
UAK-2	204.40	28.52	175.88	—	175.88	4011.56	60.20	—	60.20	2900.58	34	—	34	72
UAK-3	250.00	65.00	185.00	—	185.00	4196.56	56.39	—	56.39	2956.97	30	—	30	70
	7867.46	3670.90	3537.80	658.76	4196.56	4196.56	2513.08	443.89	2956.97	2956.97	71	67	70	70

1) Weighted approximation
2) Includes 14.43m redrilled

Table 4 - Geophysical Logs
(X indicates log obtained)

Drill Hole	Max. Depth Logged(m)	4PI	NGR	NEU	RES	HRD	CAL
UAL-1	126	X	X	X	X	X	X
UAL-2	218	X	X	X	X	X	X
UAL-3	259	X	X	X	X	X	X
UAL-4	142	X	X	X	X	X	X
UAL-5	12	X	X	X	X	X	X
UAL-6	200	X	X	X	X	X	X
UAL-8	169	X	X	X	X	X	X
UAS-1	235	X	X	X	X		X
UAS-2	224	X	X	X	X	X	X
UAS-3	259	X	X	X	X		X
UAS-4	234	X	X	X	X	X	X
UAS-5	216	X	X	X	X	X	X
UAS-6	297	X	X	X			
UAS-7	379	X	X	X	X	X	X
UAS-8	340	X	X	X	X		
UAS-9	287	X	X	X			X
UAT-1	245	X	X	X			X
UAT-2	261	X	X	X	X		X
UAT-3	298	X	X	X	X	X	X
UAT-4	306	X	X	X	X		X
UAT-7	242	X	X	X	X		X
UAT-8	333	X	X	X	X	X	X
UAT-9	345	X	X	X	X		X
UAT-10	222	X	X	X	X	X	X
UAJ-1	173	X	X	X	X	X	X
UAK-1	289	X	X	X			X
UAK-2	206	X	X	X	X	X	X
UAK-3	245	X	X	X			

4PI = 4 PI density—measures specific gravity of rocks
NGR = Natural gamma ray—measures natural radiation
NEU = Neutron—measures hydrogen concentration (bound water)
RES = Resistivity—measures resistance to the flow of electricity

HRD = High resolution density—more sensitive measurement of specific gravity
CAL = Caliper—measures hole diameter

Table 5. - Coal Beds Intercepted

Drill hole	Depth to top of bed (overburden) (m)	Depth to base of bed (m)	Coal thickness (m)
UAL-1			
a.	65.10	66.34	1.24
b.	66.77	67.04	0.27
c.	67.15	67.73	0.58
d.	67.82	67.88	0.06
e.	72.88	73.33	0.45
f.	73.89	74.09	0.20
g.	75.39	76.62	1.23
h.	77.95	78.28	0.33
i.	99.45	99.67	0.22
j.	104.62	104.77	0.15
k.	105.81	106.48	0.67
l.	110.11	110.61	0.50
m.	110.90	110.93	0.03
n.	114.82	115.04	0.22
o.	117.27	117.52	0.25
p.	118.82	118.94	0.12
UAL-2	45.48	45.73	0.25
a.	86.66	86.76	0.10
b.	101.65	101.85	0.20
c.	127.19	127.26	0.07
d.	127.85	127.90	0.05
e.	129.65	130.08	0.43
f.	170.39	171.00	0.61
g.	180.76	182.39	1.63
UAL-3	139.92	140.27	0.35
a.	153.54	153.68	0.14
b.	155.24	155.47	0.23
c.	174.99	175.17	0.18
d.	175.63	175.80	0.17
e.	226.69	226.72	0.03
f.	229.63	229.78	0.15
g.	234.04	234.43	0.39
h.	258.07	258.26	0.19

Table 5. — Continued

Drill hole	Depth to top of bed (overburden) (m)	Depth to base of bed (m)	Coal thickness (m)
UAL-4			
a.	28.62	29.30	0.68
b.	31.63	32.40	0.77
c.	35.10	35.40	0.30
d.	38.35	39.10	0.75
e.	40.47	40.57	0.10
f.	40.60	40.68	0.08
g.	41.08	41.24	0.16
h.	41.99	42.18	0.19
i.	61.30	61.50	0.20
j.	89.60	89.95	0.35
k.	92.43	92.95	0.52
l.	95.81	95.88	0.07
m.	132.89	133.00	0.11
n.	133.26	133.73	0.47
UAL-5			
a.	96.27	96.56	0.29
b.	97.17	97.25	0.08
UAL-6			
a.	115.25	115.51	0.26
b.	147.17	147.76	0.59
c.	147.81	147.95	0.14
d.	148.35	148.65	0.30
e.	176.28	176.52	0.24
f.	180.84	181.24	0.40
g.	191.44	192.25	0.81
UAL-7	NO COAL RECOVERED		
UAL-8			
a.	64.50	64.65	0.15
b.	79.50	79.64	0.14
c.	79.80	79.90	0.10
d.	93.10	93.30	0.20
e.	94.20	94.30	0.10
f.	94.50	94.55	0.05
g.	126.19	126.30	0.11
h.	157.90	157.95	0.05

Table 5. - Continued

Drill hole	Depth to top of bed (overburden) (m)	Depth to base of bed (m)	Coal thickness (m)
UAL-9			
a.	156.32	157.79	1.47
b.	162.09	162.99	0.90
c.	166.25	166.52	0.27
d.	170.60	171.12	0.52
e.	172.01	172.09	0.08
f.	186.55	186.95	0.40
UAL-13.			
a.	57.10	57.25	0.15
b.	186.90	187.25	0.35
c.	204.14	204.49	0.35
UAL-15			
a.	175.58	176.18	0.60
b.	183.05	183.73	0.68
UAS-1			
a.	218.80	219.74	0.94
b.	225.50	225.72	0.22
c.	226.59	226.94	0.35
d.	227.72	228.86	1.14
e.	229.32	229.34	0.02
f.	229.37	230.33	0.96
UAS-2			
a.	159.44	160.35	0.91
b.	179.70	180.48	0.65
c.	191.25	191.70	0.45
d.	214.55	215.60	1.05
e.	217.30	217.80	0.50
UAS-3			
a.	247.25	247.60	0.35
b.	247.83	248.31	0.48

Table 5. - Continued

Drill hole	Depth to top of bed (overburden) (m)	Depth to base of bed (m)	Coal thickness (m)
UAS-4			
a.	166.40	167.52	1.12
b.	179.52	185.85	6.33
c.	188.00	188.31	0.31
d	196.32	197.07	0.75
e.	222.41	222.80	0.39
UAS-5			
a.	206.18	206.49	0.31
b.	208.30	209.60	1.30
c.	224.61	225.58	0.97
d.	230.96	231.58	0.62
e.	242.66	243.78	1.12
f.	273.25	274.35	1.10
UAS-6			
a.	37.50	38.00	0.50
b.	236.23	236.58	0.35
c.	240.34	240.84	0.50
d.	242.35	242.53	0.18
e.	242.60	242.70	0.10
f.	243.69	245.24	1.55
g.	249.41	249.70	0.29
h.	257.77	258.77	1.00
i.	259.14	259.39	0.25
j.	259.50	260.80	1.30
UAS-7	NO COAL RECOVERED		
UAS-8			
a.	207.45	207.71	0.26
b.	243.21	244.00	0.79
c.	254.38	255.03	0.65
d.	275.04	275.34	0.30
e.	279.00	280.75	1.75
f.	285.13	285.39	0.26
g.	291.00	291.65	0.65

Table 5. - Continued

Drill hole	Depth to top of bed (overburden) (m)	Depth to base of bed (m)	Coal thickness (m)
UAS-8 (continued)			
h.	292.95	293.51	0.56
i.	297.23	297.43	0.20
j.	299.00	300.09	1.09
k.	300.38	300.44	0.06
l.	309.41	309.61	0.20
m.	313.88	314.38	0.50
UAS-9			
a.	239.15	239.35	0.20
b.	245.76	246.60	0.84
c.	249.94	250.60	0.66
d.	252.15	253.00	0.85
e.	257.23	257.51	0.28
f.	266.25	267.85	1.60
g.	282.60	284.00	1.40
UAT-1			
a.	116.22	116.50	0.28
b.	134.77	134.91	0.14
c.	144.98	145.00	0.02
d.	147.70	147.80	0.10
e.	148.45	148.65	0.20
f.	189.42	189.65	0.23
UAT-2			
a.	220.98	221.12	0.14
b.	229.93	230.29	0.36
c.	259.75	259.80	0.05
UAT-3			
a.	283.65	284.45	0.80

Table 5. - Continued

Drill hole	Depth to top of bed (overburden) (m)	Depth to base of bed (m)	Coal thickness (m)
UAT-4			
a.	144.71	144.91	0.20
b.	146.82	146.90	0.08
c.	192.18	192.37	0.19
d.	204.26	204.66	0.40
e.	213.15	213.31	0.16
f.	213.83	213.96	0.13
g.	214.80	214.92	0.12
h.	271.03	271.50	0.47
i.	296.60	296.70	0.10
j.	297.88	298.16	0.28
k.	304.46	304.80	0.34
UAT-7	NO COAL RECOVERED		
UAT-8			
a.	234.96	235.44	0.48
b.	326.09	326.39	0.30
c.	333.95	333.99	0.04
UAT-9			
a.	238.60	238.95	0.35
b.	263.40	264.00	0.60
c.	293.65	294.10	0.45
d.	295.30	296.00	0.70
e.	298.40	299.30	0.90
UAT-10			
a.	136.33	136.73	0.40
b.	159.10	159.22	0.12
c.	168.22	168.40	0.18
d.	184.65	184.79	0.14
e.	201.36	201.58	0.22

Table 5. - Continued

Drill hole	Depth to top of bed (overburden) (m)	Depth to base of bed (m)	Coal thickness (m)
UAJ-1			
a.	119.90	120.30	0.40
b.	121.62	121.92	0.30
c.	124.40	124.45	0.05
d.	150.32	150.72	0.40
UAK-1			
a.	165.26	165.81	0.55
b.	182.70	184.96	2.26
c.	196.30	198.10	1.80
d.	249.96	250.46	0.50
e.	285.76	286.16	0.40
UAK-2			
a.	138.80	139.55	0.75
b.	144.44	145.57	1.13
c.	165.41	165.49	0.08
d.	202.06	202.89	0.83
UAK-3			
a.	148.00	148.10	0.10
b.	153.99	154.15	0.16
c.	161.60	162.96	1.36
d.	166.63	167.70	1.07
e.	172.90	174.25	1.35
f.	206.27	206.55	0.28
g.	213.45	213.56	0.11
h.	220.95	221.10	0.15

The drill holes provide regional data about the distribution and characteristics of the coal-bearing rocks in the Lakhra and Sonda coal field but were not specifically located to prospect in detail for minable coal or delineation of individual beds of thicker coal. However, 12 drill holes penetrated coal beds ranging from 0.75 to 1.0 m in thickness, 11 drill holes penetrated coal beds ranging in thickness from 1.0 to 1.5 m, and six drill holes penetrated coal beds more than 1.5 m thick. The thickest coal bed drilled was 6.33 m including a 0.29 m-thick parting in the upper part (see UAS-4) drill hole. The areas around and between many of the drill holes merit further exploration by closer spaced drilling to attain a more accurate knowledge of the coal resource potential of the area.

COAL SAMPLES COLLECTED FOR QUALITY ANALYSIS

Table 6 shows the distribution by drill hole of the 141 coal samples that were collected from 26 of the drill holes shown in Figure 1. Six drill holes either had no coal or had coal too thin to warrant sampling. All coal samples will be chemically and physically analyzed so that the coals of the Lakhra and Sonda coal fields may be adequately characterized for utilization potential. Proximate and ultimate analyses and determinations of heat value, forms of sulfur, agglomerating character, ash-fusion temperatures, equilibrium moisture, and Hardgrove grindability will be performed on all samples. In addition, selected samples will be analyzed for major, minor, and trace elements.

SOME PRELIMINARY CONCLUSIONS

The exploratory drilling program has provided much new information about the distribution, character, and resource potential of coal in an area approximately 135 by 30 km in the Lakhra and Sonda coal fields. However, even though much of this area, and adjoining areas, remain to be investigated, enough is now known to allow a resource assessment in the areas already explored. Although, the drill holes are widely spaced, data from them provide a basic understanding of the geology and coal resources; the holes will serve as loci from which more closely spaced future exploration may be planned.

It is recommended that the present practice of allowing small, fragmented prospecting and mining leases be recessed until after release of the final report on the Coal Resource Exploration and Assessment Program in Sind Province and until further detailed exploration can be done in those areas that have the best potential for minable coal.

Table 6 . — Coal Samples Collected for Analysis

Drill hole	Number of coal samples
UAL-1	13
UAL-2	2
UAL-3	2
UAL-4	14
UAL-5	1
UAL-6	7
UAL-7	0
UAL-8	5
UAL-9	4
UAL-13	2
UAL-15	3
UAS-1	4
UAS-2	7
UAS-3	0
UAS-4	5
UAS-5	18
UAS-6	8
UAS-7	0
UAS-8	8
UAS-9	6
UAT-1	1
UAT-2	1
UAT-3	0
UAT-4	4
UAT-7	0
UAT-8	2
UAT-9	0
UAT-10	1
UAJ-1	3
UAK-1	9
UAK-2	3
UAK-3	8
Total	141