

DEPTH	NE	FRX	PP	CAL/TON	CORE REC.	LITH.	DESCRIPTION
0							Overburden
7							
22							SILTSTONE, brown; moderately calcareous
30							SILTSTONE, brown; slightly calcareous
40							SILTSTONE, light brown, slightly calcareous with PYRITE & carbon flecks
50							SILTSTONE, brown; pyritic, slightly calcareous
60							SILTSTONE, brown; pyritic, slightly calcareous
70							SILTSTONE, light brown-gray; argillaceous; slightly calcareous, scarce carbon
80							SILTSTONE, brown-dark gray, medium to finely laminated; slightly calcareous
90							SILTSTONE, brown, moderately calcareous, with SANDSTONE, buff, fine-grained
100							SANDSTONE, gray, fine-grained to medium-grained; calcareous
110							SILTSTONE, brown to dark brown; moderately calcareous; minor mica
120							SILTSTONE, brown to dark brown & SANDSTONE, fine buff; MIC on parting planes
130							SILTSTONE, dark brown, moderately calcareous; occasional SANDSTONE, fine buff
140							SILTSTONE, brown-dark brown; slightly calcareous; mica flecks
150							SANDSTONE, buff, fine-grained with SILTSTONE, dark brown
160							SILTSTONE, light to dark brown, finely laminated; slight calcareous
170							SILTSTONE, dark brown, moderately calcareous
180							SILTSTONE, dark brown & SANDSTONE, light gray with, abundant
190							SANDSTONE, light-medium gray; PYRITE; hydrocarbon flecks
200							SANDSTONE, light gray, fine-grained & SILTSTONE, dark brown
210							SILTSTONE, dark brown with CALCITE & NAHCOLITE, pod & calcareous
220							SILTSTONE, dark brown with NAHCOLITE blebs; moderately calcareous
230							SILTSTONE, brown-dark brown, NAHCOLITE; minor SANDSTONE, buff
240							SILTSTONE, dark brown; abundant NAHCOLITE & CALCITE, highly effervescent
250							Same as above
260							SILTSTONE, brown-gray, non-calcareous; CALCITE & PYRITE crystals on surface
270							SILTSTONE, dark brown; oolitic texture CALCITE; NAHCOLITE
280							SILTSTONE, dark brown, moderately strongly calcareous (MARLSTONE) NAHCOLITE pods
290							SILTSTONE, (MARLSTONE) brown; moderately to strongly calcareous with SANDSTONE, buff
300							SILTSTONE, light brown, sandy (quartz grains); moderately calcareous
310							SILTSTONE, dark brown with CALCITE & NAHCOLITE blebs
320							SILTSTONE, dark brown, thinly laminated, moderately to strongly calcareous (MARLSTONE), buff
330							SILTSTONE (MARLSTONE), dark brown, calcareous & SILTSTONE, buff, fine grained
340							SILTSTONE (MARLSTONE), brown, calcareous; with minor CALCITE & hydrocarbon
350							SILTSTONE (MARLSTONE), light-dark brown; calcareous; with minor PYRITE
360							Same as above
370							SILTSTONE (MARLSTONE), brown; moderately to strongly calcareous
380							SILTSTONE (MARLSTONE), dark brown, moderately calcareous
390							SILTSTONE (MARLSTONE), dark gray-brown, thinly laminated, calcareous
400							SILTSTONE (MARLSTONE), dark gray-brown; calcareous; minor PYRITE
410							SILTSTONE (MARLSTONE), gray to brown with GILSONITE, Hydrocarbon & Pyrite flecks
420							SILTSTONE (MARLSTONE), dark brown; moderately to strongly calcareous
430							Same as above
440							SILTSTONE (MARLSTONE), dark brown; moderately calcareous with PYRITE
450							SILTSTONE, dark brown; slightly-moderately calcareous; MICA on parting planes

COMMENTS:

## THE CLEVELAND-CLIFFS IRON CO.

PROJECT: White River Shale ProjectHOLE NO. X-2 SHEET 1 OF 7 DATE: 11/27/74 LOGGED BY: Aho & Hansen T.D. 765.84

DEPTH	± -M	FRX	PP	GAL/ TON	CORE REC.	LITH.	DESCRIPTION
460							OIL SHALE (SILTSTONE/MARLSTONE), dark gray-brown with
461							occasional buff laminae (higher grade zones are mahogany
462							colored), very finely laminated; generally moderate
463							effervescence;
464			.20				464.20, 0.02' SANDSTONE, tuffaceous, gray-dark gray
465			.90				464.95, 0.05' SANDSTONE, tuffaceous, dark brown with
466							hydrocarbons
467							466.30, 0.05' Same as above
468							
469			.50				
470							
471			.58				471.58, 0.07' SANDSTONE, tuffaceous, dark gray
472							
473							
474			.40				474.40, SANDSTONE, tuffaceous, dark gray; very thin
475							irregular
476							
477			.97				477.97, 0.05' SANDSTONE, tuffaceous, dark gray
478			.04				
479							479.88 (0.02') & 479.97 (0.03') SANDSTONE, tuffaceous, brown
480							OIL SHALE, brown, very finely laminated, generally moderate
481							effervescence, with very thin tuffaceous SANDSTONE
482							inclusions.
483							481.5 (0.05') & 481.92 (0.02') SANDSTONE, tuffaceous, gray
484							
485			.15				485.09 (0.02') SANDSTONE, tuffaceous, dark gray
486							
487							
488							488.97 (0.02') SANDSTONE, tuffaceous, gray
489							
490			.40				OIL SHALE as above
491							490.4 (0.03') SANDSTONE, tuffaceous, gray
492							491.34-491.74, SILTSTONE, buff, very finely laminated,
493							medium effervescence
494							
495							OIL SHALE, below 491.74, buff zone; the color becomes darker
496							brown to end of run; finely laminated, moderate CALCITE
497							
498							
499							
500							500.00 OIL SHALE, predominantly dark brown with some dark gray
501							laminations; very fine laminae; moderate to strong
502							effervescence; low to medium grade-except where noted
503			.62				500.83 (0.1') SANDSTONE, tuffaceous; light brown with
504							hydrocarbons
505							502.18-502.28 SANDSTONE, tuffaceous; dark brown-distorted
506							503.6 (0.05') SANDSTONE, tuffaceous, dark brown contacts
507							
508							508.23 (0.05') SANDSTONE, tuffaceous, dark brown, odorous
509							509.00 (0.05') SANDSTONE, tuffaceous; GILSONITE flecks

COMMENTS:

## THE CLEVELAND-CLIFFS IRON CO.

PROJECT: White River Shale Project

Aho &amp;

HOLE NO. X-2 SHEET 2 OF 7 DATE: 11/27/74 LOGGED BY: Hansen T.D.765.84

DEPTH	+MM	FRX	PP	GAL/TON	CORE REC.	LITH.	DESCRIPTION
510			.61		Drilled 20 Ft. Recovered 10.61 Ft.		510.15 (0.20') SANDSTONE, tuffaceous & GILSONITE, dark brown
511	+130						510.61-519.90, left in bottom of hole & recovered partially
512							with next 6 feet - however, much of core was ground up &
513							pieces recovered were badly broken-most of the recovered
514							material is dark brown OIL SHALE (silty shale) moderate
515							to strong effervescence (about 4 ft. of sample recovered
516				7.1			out of 9.3 ft. drilled-largely due to faulty core catcher
517				7.1			
518				7.1			
519				7.1			
520				8.9	Drilled 5.98 Ft. Recovered 5.98 Ft.	520.00	OIL SHALE, brown to dark brown with a few thin, buff colored
521	+120			23.9			laminae; very fine laminations; moderately to strongly
522				14.7			calcareous; low grade
523				10.3			
524				10.4			524.45 (0.08') SANDSTONE, tuffaceous, dark brown-carrying
525				10.7			525.30 (0.10') hydrocarbons; wavy contacts
526				13.4			OIL SHALE, brown to dark brown (tuffaceous SANDSTONE at
527			.77	19.8			526.75); moderately calcareous, very finely laminated
528				13.4			Tuffaceous SANDSTONE lenses:
529			.09	10.6			526.83-526.86, dark brown, wavy contacts; odorous
530			.05.58	10.4	Drilled 20.03 Ft. Recovered 20.10 Ft.		527.17-527.70, dark brown, wavy contacts
531	+110		.88	9.3			528.75-528.80, dark brown, wavy contacts
532				9.3			530.70-530.95, dark brown, wavy contacts
533			.97	10.3			
534				11.0			
535				15.2			535.77-536.33, dark brown, wavy contacts; odorous
536				14.3			536.47-536.53, dark brown, wavy contacts; odorous
537				10.0			537.00-537.09, dark brown, wavy contacts; odorous
538			.97	10.5			
539		65°	.31.42	10.6			
540				9.9	Drilled 19.97 Ft. Recovered 20.08 Ft.		OIL SHALE, brown to dark brown; moderately calcareous;
541	+100			12.5			very finely laminated with a few buff colored laminae
542			.07	11.3			Tuffaceous SANDSTONE lenses:
543				11.5			540.18-540.23, dark brown, wavy contacts with hydrocarbons
544		45°	.15.20	10.8			542.56-542.63 same as above
545				13.7			544.17-544.20 same as above
546				11.0		546.01	545.65-546.10 same as above
547				11.2			OIL SHALE, brown-dark brown, finely laminated; moderately
548				13.8			to strongly calcareous
549			.68	12.8			Tuffaceous SANDSTONE lenses:
550				9.7			549.53-549.60 dark brown, irregular contacts with hydrocarbons, calcareous
551	+90			11.5			549.78-548.88 dark brown, irregular contacts with hydrocarbons, calcareous
552				16.3			
553				11.7			
554			.62	9.7			554.58-554.65 SANDSTONE, tuffaceous as above
555				7.9			555.85-556.85 SHALE, silty, buff colored; strongly
556			.00	3.9			calcareous, low grade
557				9.9			OIL SHALE, brown-dark brown, finely laminated; calcareous
558			.09	16.0			
559				13.6			

COMMENTS:

## THE CLEVELAND-CLIFFS IRON CO.

PROJECT: White River Shale Project

Aho &amp;

HOLE NO. X-2 SHEET 3 OF 7 DATE: 11/30/74 LOGGED BY: Hansen T.D. 765.84

DEPTH	+ -MM	FRX	PP	KAL/ TON	CORE REC.	LITH.	DESCRIPTION
560				10.9			
561	+80		43.48	9.4			561.43-561.48 SANDSTONE, tuffaceous, brown with hydrocarbon
562				9.5			
563				9.3			
564				18.2			564.11-564.16 SANDSTONE, tuffaceous; dark brown with hydro
565			65	6.2	565.98		565.01-566.71 UPPER WAVY BED, SANDSTONE, tuffaceous, carbonaceous, odorous
566			61	8.2			highly distorted bedding & contacts; tan-brown-dark brown
567			84	10.9			mica & magnetite grains; non-calcareous
568				11.9			
569				10.8			569.08 (0.02') SANDSTONE, tuffaceous, dark brown, very
570				15.9			OIL SHALE, brown to dark brown, little hydrocarbons
571	+70			16.0			calcareous; low to medium grade seams-larger ones noted
572			.90	14.7			
573				21.8			
574				12.8			
575				10.5			575.02 (0.02') SANDSTONE, tuffaceous, dark brown, very little
576				9.0			hydrocarbons
577				6.7			
578			.10	8.2			
579				12.3			
580				14.5			
581	+60			8.2			
582				6.4			
583				8.2			
584				8.0			
585				4.1			OIL SHALE, brown to dark brown, finely laminated; moderate
586				15.9	585.99		effervescence (medium grade oil shale with a few higher
587				12.9			grade zones)
588				10.8			
589				8.3			
590				9.7			OIL SHALE as above
591	+50			17.1			
592				40.0			
593				15.7			
594				10.7			594.55-594.60. SHALE, silty, buff colored
595				13.0			
596				14.8			
597				14.5			
598				14.4			
599				26.1			
600				27.5			
601	+40			14.0			
602				15.3			602.18-602.24 SHALE, silty buff colored
603				27.8			
604				24.9			
605				9.2			605.38-605.45 SHALE, silty, buff colored
606				5.8	605.97		
607			15.39	5.2			607.25-611.88 OIL SHALE (low grade silty shale) brown to
608				3.4			buff with CALCITE filled cavities (cavities from 611.55
609			.20	3.8			to 611.70)

COMMENTS:

## THE CLEVELAND-CLIFFS IRON CO.

PROJECT: White River Shale Project

Aho &amp;

HOLE NO. X-2 SHEET 4 OF 7 DATE: 12/4/74 LOGGED BY: Hansen T.D. 765.84

DEPTH	+MM	FRX	PP	GAL/TON	CORE REC.	LITH.	DESCRIPTION
610				8.6			
611	+30		.30	5.0			611.88-61.85 OIL SHALE, gray to dark gray, medium grade oil shale
612			.46	5.6			
613			.18	3.5			
614			.55.80	2.5			
615				2.2			
616			.00	3.5			
617			.42	6.8			617.85-621.23, OIL SHALE as above but higher grade
618				18.0			
619			.37	12.8			
620			.26	43.9			620.09-625.00 OIL SHALE with irregular wavy lamina
621	+20			17.1			621.40-623.50 SANDSTONE, tuffaceous; in lense & blebs
622				18.6			OIL SHALE, dark brown to gray, moderately calcareous; medium grade
623			.04	15.1			
624				12.8			624.74-624.78 SANDSTONE, tuffaceous; bleeding hydrocarbons
625			.10	20.1			625.05-625.09, 625.23-625.31 SANDSTONE, tuffaceous; bleeding hydrocarbons
626			.05	27.6	625.99		625.31-627.80 OIL SHALE, brown to dark brown with some but lamina; moderate to strong effervescence; thinly laminated distorted bedding
627				33.6			
628				21.7			
629				28.6			
630				42.7			
631	+10		.34	41.8			631.68-637.00 OIL SHALE, tan-light brown; moderate-strong effervescence; low to medium grade
632				26.7			
633				19.5			
634				19.0			
635			.29	12.0			
636				13.0			
637				22.8			637.00 OIL SHALE, brown-gray; thinly laminated; moderately effervescent; low to medium grade
638			.19	14.8			
639			.80	9.8			
640			.42	12.3			640.68-641.03 MAHOGANY MARKER, SANDSTONE, tuffaceous; oil saturated
641	0		.67	11.6			641.13-641.18, 641.45-641.50, 641.71-641.73 SANDSTONE, tuffaceous, dark brown-black; minor hydrocarbons
642				11.1			
643				9.5			
644				12.5			
645			.69	16.3	646.00		
646				47.4			OIL SHALE, buff to light brown to reddish dark brown; finely laminated; moderately calcareous; medium grade
647				27.7			with some higher grade zones that are mahogany to black in color
648				20.7			
649				21.9			
650			.13.43	16.2			
651	-10			32.6			
652				40.9			
653			.03.80	31.9			653.00 (0.02') SANDSTONE, tuffaceous, light gray
654			.03.80	53.1			
655				43.8			Core body broken: many very thin, poker-chip-like pieces; apparently a zone of lost core; all pieces are high grade OIL SHALE
656				43.8			
657				43.8			
658				43.8			
659				43.8			

COMMENTS:

## THE CLEVELAND-CLIFFS IRON CO.

PROJECT: White River Shale Project

Aho &amp;

HOLE NO. X-2SHEET 5 OF 7DATE: 12/4/74LOGGED BY: Hansen T.D. 765.84

DEPTH	+MM	FRX	PP	GAL/TON	CORE REC.	LITH.	DESCRIPTION
660				43.8			
661	-20		20.50	42.1			661.67-663.48 NAHCOLITE & CALCITE; zone of solid crystals;
662			60.90	8.5			highly effervescent-only partially dissolved; some of the
663			00.45	37.6			crystalline material is translucent brown-vitreous-waxy
664			30	45.7			luster; a very distinctive zone
665				42.9			665.74-665.95, SANDSTONE, tuffaceous; brown with wavy bedding
666				23.7	665.95		OIL SHALE, dark brown-mahogany-black, high grade oil shale
667				19.7			finely laminated; moderately calcareous (higher grade
668			30	33.4			zones are only slightly effervescent)
669			70	50.1			
670				24.1			
671	-30		58	16.1			
672			76	20.1			
673			14.38	46.4			
674			43.80	42.9			
675			21.68	40.2			
676			38.91	27.1			
677			34.62	21.6			
678			22.55	25.3			
679			50.93	35.6			
680			41.95	17.7			680.00-684.55, OIL SHALE, dark brown, finely laminated,
681	-40		33.68	19.5			moderately calcareous; low to medium grade
682			11.47	14.0			
683				15.1			
684			13.85	26.5			684.55-685.47 OIL SHALE with wavy bedding
685			47	30.0	684.95		OIL SHALE, buff to dark brown, finely laminated; moderate
686				9.5			effervescent; low to medium grade except where higher
687				13.4			grade is noted
688			25	14.7			
689				21.5			
690				34.7			
691	-50			29.0			
692				24.2			692.58-692.70 SANDSTONE, tuffaceous, light brown; with
693				22.5			NAHCOLITE & CALCITE
694			33	26.4			
695				34.2			
696				25.1			
697				20.8			
698			68	15.8			
699				13.1			
700			25.91	8.9			
701	-60			15.6			
702				24.3			702.82-702.87) SANDSTONE, tuffaceous; dark gray to brown
703				11.3			703.08-703.12) with MAGNETITE, PYRITE & HYDROCARBONS
704			74.92	11.8	704.87		704.74-707.80 OIL SHALE, light brown-buff, finely laminated
705			20.29	8.5			moderate effervescence; low grade
706			41	4.5			
707				9.3			OIL SHALE, tan-dark Brown - dark gray lamina; higher grade
708			33	15.8			zones are mahogany to black; lighter colored zones are
709				15.7			more highly effervescent than the darker zones

COMMENTS:

HOLE NO. X-2SHEET 6 OF 7DATE: 12/5/74Aho &  
LOGGED BY: Hansen T.D. 765.84

DEPTH	± -MM	FRX	PP	GAL/ TON	CORE REC.	LITH.	DESCRIPTION
710			.31	6.4			SANDSTONE, tuffaceous zones: 708.61-708.64) dark gray to
711	-70			11.7			709.85-709.87) dark brown;
712				26.3			710.31-710.58) minor magneti
713				20.7			712.38-712.36) & hydrocarbon
714			.11	11.2			odorous
715				7.9			715.45-717.40 OIL SHALE, light gray-tan-light brown;
716			.36	9.8			moderate effervescence; medium grade
717				31.9			
718			.25	34.6			
719			.25	8.5			
720			.80.64	5.6			720.60-723.86 OIL SHALE, light gray-buff colored zone;
721	-80		.08.95	2.6			medium laminations; moderately calcareous; low grade -
722			.05.77	3.2			feels like MUDSTONE
723			.56	4.2			
724			.20	8.5			
725			.78	21.8	24.84		725.67-726.00, SANDSTONE, tuffaceous; light brown-gray;
726				37.0			wavy contacts & bedding; hydrocarbons
727				15.5			OIL SHALE, light brown, light gray & buff laminae; medium
728			.79	10.6			laminations; moderately calcareous; low grade
729				7.4			728.47-728.53, SANDSTONE, tuffaceous, dark brown; some
730			.25.34	7.0			hydrocarbons & MAGNETITE
731	-90			5.6			
732				5.7			
733			.78.96	6.3			
734				5.1			
735				5.1			
736			.33	8.7			
737				3.4			
738			.84	9.1			
739				9.5			
740				5.5			OIL SHALE, low grade (same as above)
741	-100			3.9			
742				3.1			
743			.29	5.6			
744			.64	8.4			744.60-744.71 SANDSTONE, tuffaceous; dark brown-minor
745				2.7	744.84		hydrocarbons
746				3.8			OIL SHALE, buff-light-brown-light gray; thin lamina;
747				2.8			moderately calcareous; minor hydrocarbons; PYRITE,
748				2.6			NAHCOLITE; low grade; irregular wavy laminae
749				2.2			
750				5.9			750.00-750.25 OIL SHALE with irregular wavy laminae
751	-110			3.2			751.00-751.21 SANDSTONE, tuffaceous, dark brown with small
752				1.4			amount of bleeding hydrocarbons
753				2.3			
754				1.8			
755				6.2			
756				4.1			756.35-756.71 OIL SHALE with irregular wavy laminae
757				5.9			757.22-757.45 SANDSTONE, tuffaceous; dark brown with
758				4.3			excessive bleeding hydrocarbons
759				1.3			

COMMENTS:

PROJECT: White River Shale Project

SHEET 7 OF 7

DATE: 12/5/74

LOGGED BY: Hansen T.D. 765.84

**COMMENTS:**