

DEPTH	±MM	FRX	PF	ASSAY				GAL/TON	REC. BRGD	LITH.	DESCRIPTION
				10	20	30	40				
											Drill Contractor: Layne-Western Co-D 20 Ankers:
											Cox, Kauglarich Helpers: Mardrosian, S. Ignorelli
390	(+250)										Siltstone with bitumen blobs
391											
392											
393	-310										
394											
395	+200										
396											
397											
398											
399											
400	+200										
401											
402											
403	-300										
404											
405	+200										
406											
407											
408											
409											
410	+200										1' tuft layer
411											dk brn med to high grade oil shale
412											thin tuftaceous ss layer w calcite
413	+290	60°									mod to low grade laminated silty shale
414											thin tuftaceous ss layer w calcite
415	+200										mod-low grade laminated silty shale
416											
417											1' irreg break - very thin blk carbonaceous material
418											" " along small blks (tuft?)
419											silty shale - mostly low grade w mud streak
420	+200										
421											
422											
423	+130	40°									slight bedding distortion
424											
425	+200										silty shale - mostly low grade w carbonaceous streak
426											
427											
428											
429											
430	+200										
431											Silty Shale - low grade flaminated oil shale
432											with carbonaceous (bitumen) fleck
433	+270										moderately calcareous (effervescent)
434											(.01' tuft. ss at 433.55)

MM  
+250(7)

COMMENTS:

20' core  
18.75' core  
probable core loss at 412'blk on bottom  
11.5' AM 10/24

+304

HOLE NO: P.4 (CORE) SHEET 2 OF DATE: 24 OCT. 74

LOGGED BY: COLLAR: TD:

NOTE: Due to discrepancy in Driller's calculations, depths were off by 1 foot. Readjusted depths were used on this run. Parting planes were corrected, are therefore in FRQ column. No fractures noted!

Oil Foot difference in recovery is cut still due to driller's discrepancy - hydrocarbon completely straightened out from here on - had driller remove same on rods

COMMENTS:

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL TON	REC. RGD	LITH.	DESCRIPTION
435	<del>435.0</del>	<del>435.0</del>	<del>435.0</del>					Silty Shale (cont')
436		436.74	436.23					
437		437.8						437.8 - 438.6 Sandy Siltstone with small carbonate pods
438			438.00					438.6 - 440.7 slightly higher
439	<del>439.0</del>	439.7(MB)	439.1					Carbonaceous content - darker bands
440		440.72						440.72 → 0.02' tuff. ss (dark color - may contain hydrocarbon)
441		441.45	(M.F.)					441.45 → 0.03' tuff. ss (although magnet noted with magnet)
442		442.7	442.02					
443	260							
444			444.0					444.05 → 0.05' tuff ss (")
445	<del>445.0</del>	445.75						
446								
447			447.05					
448		448.83						
449		449.36						
450	<del>450.0</del>	450.8	450.1					
451		<del>451.0</del>	451.51					Silty SHALE (CONT') - Reddish brown as above
452								451.5 - 451.8 - Sandy Siltstone with small calcium nodules
453	+250		453.3					452.3 - 453.5 higher hydrocarbon content
454								
455	<del>455.0</del>		455.05					
456								
457								457.1 - 458.1 - Sandy Siltstone with small calcium nodules
458			458.15					458.1 - 458.4 - clay seams - buff colored
459								458.7 - 459.8 - darker colored shale has higher hydrocarbon content
460								
461								
462			462.6					462.6 - 463.0 - higher hydrocarbon content
463	+240							
464								464.5 → 0.05' of dark ss (tuff?) probably hydrocarbon content
465								
466								
467			467.9					
468			468.05					
469								
470								Silty SHALE (CONT') low grade thinly laminated oil shale as above, w/ bitumen flecks, slightly calcareous
471								
472								472.1 - 475.18 - increased hydrocarbon content throughout in more abundant dark laminations & bitumen flecks
473	+230							474.2 thin (0.05') bed of tuff ss with hydrocarbon bands of higher hydrocarbon
474								
475								
476								
477								476.2 - 482.58 continued silty shale, thinly laminated with moderate amount of hydrocarbon increasing lower in interval
478			478.17					
479								
480								
481								
482			482.8					482.58 → 0.82 tuff. ss with bitumen
483	+220							482.82 to 483.6 same as
484								

OTHER BREAKS IN CORE WERE MECHANICAL &amp; NOTED ON CORE

10.30 AM, 24 OCT 74 (cont'd)

Sh. tied at 12:30 PM 10/24/74

3:00 PM started out

Started drilling again at 5:30 PM 10/24/74

16.8' recovered / 17.0 cut RGD = 100

HOLE NO: P-4 SHEET 3 OF      DATE: 10/24/74 LOGGED BY:      COLLAR:      TD:     

CORE

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL TON	REC ERG	LITH.	DESCRIPTION
485								483.6-487.14 leaner section of
486								hydrocarbons, occasional
487								bitumen flecks
488								Mostly med to low grade silty shale
489			.20					very hard - conchoidal fracture -
490								occasional thin high grade zones -
491			.100					thinly laminated - consistent
492			.195					texture & grain size
493	210							very thin
494								
495								
496								
497								
498								
499								
500								Similar to above but overall grade
501			.60					appears to be less - no high grade zone
502								
503	207							plant frag
504								
505			.20					very thin - zone of weakness
506			.10					slightly transverse w/L contacts - irreg break within
507								
508								OIL SHALE - uniform dk brn - fine
509								grained, silty - consistent texture &
510								color
511								
512								
513	140		~ .60					
514								
515			~ .50					
516								
517			~ .50					OIL SHALE as above but interspersed
518			.70					with numerous thin to very thin, slightly
519			.70					contorted ss. seams
520								
521								1' ss - irreg w/L bands - oily
522								
523	180		.50 .00 .60					
524								
525			.70					
526			.30					
527								
528								OIL SHALE (still somewhat silty) WITH
529								Numerous very thin ss (buff.) seams
530								throughout. Small clay flakes (<1mm)
531								noted thru out section. Grade appears
532								be increasing. Moderately calcareous.
533								Thin (≈ 0.01') & ss seams - thinner one
534								also present in section

ERC

↓

See that

↑  
ERB

COMMENTS:

HOLE NO: P-4 SHEET 4 OF      DATE: 10/25/74 LOGGED BY:      COLLAR:      TD:     

CORE

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL TON	REC. # REQD	LITH.	DESCRIPTION
535								Same as above (Oil Shale)
536			536.1					
537								~ 1' tuff ss seams (20.05')
538								538.25 grade of hydrocarbons drops off below
539								this depth to 542.2
540								542.2 to 543 - higher grade zone
541			541.74					
542								0.1' tuff ss
543	+60		543.68					543.68 (0.02' of ss)
544								
545								has hydrocarbon material throughout shale
546								still finely laminated with
547								occasional sand seams & clay flecks
548			548.5					which become less abundant below 546.
549								
550								<u>OIL SHALE</u> (similar to above)
551								still has occasional ss seams
552								& clay flecks - both decrease in
553	+50							number by 550.0
554			554.1					still finely laminated
555								
556								} higher grade oil shale
557								(approx 1.4')
558								
559								
560			560.7					
561								560.7 - 561.5 higher grade oil sho
562								
563	-40							
564								
565								
566								
567								<u>OIL SHALE</u> (basically silty shale)
568								568.5 finely laminated
569								569.4 higher grade
570			570.7					569.4 to 575.2 - fairly uniform
571								grade oil shale
572								
573	+50		573.5					
574								
575								high grade (dark color) oil shale
576			576.25					576.1
577								oil tuff ss
578								576.1 to bottom of run fairly uniform
579								medium grade oil shale
580			580.6					
581								582.0 (thin tuff ss)
582								
583	+10		583.6					583.6 - 583.8 tuff ss
584								

OTHER BREAKS IN CORE ARE USUALLY MARKED  
MB - Meaning Mechanical Break

COMMENTS:

HOLE NO: P-4 SHEET 5 OF DATE: 10/25/74 LOGGED BY: COLLAR: TD:

CORE

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GR/TON	REC. ERQD	LITH.	DESCRIPTION
585							+++	Oil Shale (as above)
586								
587						587.05		OIL SHALE, med grade, unterm
588						started at 12/15/74		1' tuff zone
589						12/15/74		
590			80					OIL SHALE, as above, slightly silty
591								
592						10/26		
593	-110		40					
594								
595								
596			90					
597			70					
598								
599			10					tuff 598.3-599.7 break at 599.5 (internal)
600								tuff - break at base
601								plant frags noted
602								oily tuff zone 602.8-603.15
603	-60							
604								OIL SHALE, med to low grade (subtle change)
605								slight increase in silkiness
606								
607						607.00		OIL SHALE, lt. brn, low grade, very silty
608			90					tuff 608.2-608.7, oil saturated
609								thin tuff, oily
610			30					OIL SHALE as above w. th. considerable
611			20					uniformity thruout the run - thin pieces of
612			80					tuffaceous ss appear frequently (thin to
613	+90							stronger to discontinuous blebs - slight by undulating
614			50					contacts)
615								616.00-616.30 oily tuff
616			100					617.00-617.8 tuff
617			80					Silty shale, lt brn - low grade
618								thin tuff
619								
620								thin tuff
621			10					
622								
623	+80							
624								
625			60					1' tuff - internal break
626								
627								OIL SHALE - thinly laminated, low to
628								medium grade oil shale, with
629			10					occasional higher grade zones.
630								Occasional tuff ss seams -
631			85					most prominent are noted (most contain
632								hydrocarbons)
633	+70							
634								634.25 tuff ss - bleeding hydrocarbons

FRX

FRX

FRX

COMMENTS:

HOLE NO: P-4, SHEET 6 OF DATE: 10/26 & 27/14 LOGGED BY: COLLAR: TD:

CORE

[illegible]

AS ABOVE, MECHANICAL BREAKS ARE NOTED MB

COMMENTS:

HOLE NO: P-4 SHEET 7 OF      DATE: 10/27/74 LOGGED BY: ERC COLLAR:      TD:     

CORE

DEPTH	±MM	FRX	PP	ASSAY				GAL/TON	REC. REQD	LITH.	DESCRIPTION
				10	20	30	40				
685										PP	dark colored shale
686											685 to 686.9 - shale, med brn with several thin discontinuous blebs & seams of tuff ss
687			.80								brn banded (lt-dk) silty shale (687-694)
688											interbedded tuff zones
689			.30								25' tuff zone
690											20' tuff zone
691			40								
692			.52								
693	+10										break within narrow irreg tuff zone
694			.50								break within narrow irreg tuff zone
695			.80								" " " " " "
696											694.5-702.40 gray to lt. brn silty shale
697											
698			.20								
699											
700											
701			.80								
702			.20								
703											MAHOGANY MARKER 702.40-703.05 tuff ss
704			.30								fairly even U & L contacts - stair-step break near the top
705											703.05 to end of run - lt brn to gray
706											finely laminated shale
707			.30								707.3 - tuff ss - bleeding hydrocarbons
708											Oil Shale - finely laminated, low to med. grade
709			.40								
710			.50								
711			712.40								3 PP's occur along very thin clay seams
712			.70								
713			.80								
714			.70								
715											
716			.80								716.42 to end of short run is very rich, light weight core - probably top of MAHOGANY BED
717			.50								716.42 - break in core - probable loss of core
718			717.4								Very Rich Oil Shale, Waxy Peel on Core
719											Surface & parting planes
720		4 PP's	.20								719.65 - med. grade
721			.50								720.2 - Very Rich, Waxy Coal
722											721.72 - 721.84 1 x 0.12' of tuff ss bearing hydrocarbons
723											It is distorted & NA
724											ALSO DISTORTED SHALE BEDS ABOVE & BELOW
725											IMMEDIATELY
726											
727											
728											
729											
730			.03								730.6 - 730.7 tuff ss (slightly distorted)
731			.15								731.25
732											732.1
733											oil shale (low to med) with occasional thin ss seams
734											734.2-734.4 tuff ss with hydrocarbons distorted & disturbed shale

COMMENTS: Malagasy Mather - slightly undulating contact at the top - more erratic at the bottom  
upper zone (1 to 1.3') is mottled brn - ~~partly~~ <sup>partly</sup> ~~partly~~ is nearly black & dense oily appearance  
lower portion contains a few very small (5 mm) partially filled vugs,  
approx elev of top 6137.

HOLE NO: P-4 SHEET 8 OF DATE: 10/27/28/74 LOGGED BY: COLLAR: TD:

CORE

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL TON	REC. CORQD	LITH.	DESCRIPTION
735								735.55 (0.03' of tuff ss)
736			.3					low to med grade, slightly coarser texture + higher calcos content
737						737.02		SHALE, well indurated, silty buff - tan - <del>med</del> med blk,
738						started coring 11:05 AM 10/27/74		
739			.15					
740			.85					slightly distorted bedding 740-740.8 discontinuous thin zones along break
741								
742								
743			.00					SHALE AS ABOVE
744								
745								
746			.10 .90					
747								
748			.30					
749			.70					
750								
751			~.90					
752								
753			.40 .90					
754			.60					
755			~.20					
756								
757						756.85		silty shale, tan to lt. brn - <del>ss</del> clayey parting at 759.2
758								finely laminated with thin dk colored bands
759			.20					siltstone, tan - lt brn with thin dk colored bands
760			.60					
761			.10 .80					
762								
763								
764			.30 ~.70					ss undulating upper contact, blk saprophytic
765			.90					sandy siltstone, tan
766			.40 .90					siltstone, gray, banded
767								
768								
769								
770			.80					
771			.50 .70					
772								siltstone, tan, finely laminated, uniform
773								
774			.63 .68					siltstone, tan to pale gray to dk gray
775			.80					
776			.20					
777			.45 .78					
778			.81 .89					
779		.90 .20 .50						Oil SHALE (same as above) - finely lamin med grade ss depth of 777.05
780		.4 .15 .15						Tuff ss (777.05 to 777.9) - med grain, petroliferous, distorted bedding, thin shale seams included
781		.45 .31						Tuff ss (778.8 to 781.67) - coarse grained micaceous tuff ss, petroliferous, highly distorted bedding, brecciated
782		.80						Siltstone, tan to pale gray, finely laminated with buff clay seams (<0.01), slightly calcareous
783			.81					
784								

COMMENTS: \* These two fractures are very fine, cemented shut, have offset siltstone laminae, dip in opposite directions across core, each at  $\approx 30^\circ$  to horiz.



HOLE NO: P-4 SHEET 9 OF      DATE: 10/28/74 LOGGED BY:      COLLAR:      TD:     

CORE

DEPTH	±MM	FRX	PP	ASSAY 10 20 30 40	GAL/ TON	REC. REQD	LITH.	DESCRIPTION
785								Siltstone (as above) 782.7 to 786
786								has about 7° dip to core
787								782.7 to 790.1 all has dark
788								seams which carry hydrocar
789			.55					
790								790.1 to 793.3 dark gray siltst
791								bedding becoming thicker
792								
793								793.3 to 794.58 light grey (thin
794			.68					Oil SHALE (siltstone) siltstone bedd
795			.65					HAS A browner color than
796								oil shale further up hole
797			.45					795.65-796.83 - buff ss, magnetic, high in
798								hydrocarbons, strong odor
799								Silty SHALE 800.50
800								796.79 to 800.50 finely laminat
801			.05					silty shale, light to dark brown,
802								dark seams of iron magnetite, low
803								hydrocarbon content - but has odor.
804			.67					800.9 to 801.1 - highly petroliferous buff ss
805			.35					strong odor, black
806			.85					Silty SHALE - finely laminated, grey (lt to dk
807								803.5 to 804.2 med. calc.
808								Silty SHALE (804.2 - 806.85) buff to light brn., contain
809								more v.f. grained sand, med. calc.
810								a 0.3' ss bed at 804.85 - 805.
811								805.3 (0.1') of buff ss (loosely bleeding, od
812								Silty SHALE (806.85 to end)
813								"Sandy siltstone" Grey colored, fine to med.
814			.55					lamina, (varying from buff, lt grey, dk
815								grey, blk.) Most of blk
816			.64					lamina contain magnetite
817								Grain size coarsening to
818			.28					throughout, on verge of
819			.4					Sandy siltstone
820			.32					Silty SHALE - thinly laminated,
821			.60					med. to dark grey (similar to
822								above)
823								821.8 to 824.35
824			.35					Oil SHALE - Mahogany color, dark oil bear
825			.75					(Silty shale) bands distorted, med grade
826								Silty SHALE
827								824.35 to 827.1 (thinly laminated, med to
828								dark grey
829			.60					Oil SHALE - Mahogany colored med gra
830			.65					(Silty shale) interbedded buff ss are blk.
831			.80					+ bleed hydrocarbons, + have
832			.53					strong odor
833			.45					Silty SHALE - lt. color brn - buff, thinly
834			.80					laminated, darker bands near
								base may carry hydrocarbons
								834.5 Mudstone (834.5 to 836.78)

Cone in this section seemed  
extremely hard to break when  
hit by Avillar's hammer, it  
shattered rather than break along pp

COMMENTS:

HOLE NO: P-4 SHEET 10 OF DATE: 10/29/74 LOGGED BY: COLLAR: TD:

DEPTH	±MM	FRX	PP	ASSAY	GAL	REC	LITH.	DESCRIPTION
				10 20 30 40	TON	BRGD		
835			.40 .83					Mudstone (cont) - Buff colored, very
836			.17				+++	dark buff light color zone, med. laminations
837								SILTSTONE, buff - lt. gray - lt. brn
838								with a few thin dark bands
839			~.80					
840								
841			60.70				++++	
842								SILTY SHALE, lt - med brn
843								
844								
845			~.15					thin layer of shale between ss lenses
846			.80					
847								
848							++++	
849			.30 .80				++++	
850			.55					SILTSTONE banded, finely
851			.15 .65 .90					laminated, buff - gray
852								
853								
854			.30 .70					gray ss
855			.70 .75					
856			.70					SILTSTONE, lt gray, gray with var
857			.40					thin darker colored bands
858			.50					
859			.30					SILTSTONE - OIL SHALE with increasing amount
860								of dark petroliciferous material
861								
862								OIL SHALE - med to moderately
863								high grade
864			.20 .45 .85					plant parts
865								gray parting
866			.15 .20					SILTSTONE, gray to buff with
867			~.70					very thin bands & indistinct zones
868								of darker material - local occurrence
869								of soft sediment deformation
870			.65 .80 .85				++++	
871								
872								
873			.70					SILTSTONE, brn - gray - buff
874								as above
875			.30					
876			.89					
877								OIL SHALE (low to med. grade)
878			.48					Siltstone (sandy), fine to med. lamina
879								H. grey to buff, some of fine lamina
880			.90					are claystone
881								
882								
883			> .50					
884			.17 .50					~0.17 Siltstone dark grey, dark buff lamina

COMMENTS:

CORE

DEPTH ±MM	FRX	PP	ASSAY 10 20 30 40	GAL/ TON	REC. RQD	LITH.	DESCRIPTION
885							Siltstone (as above)
886		.53					- 886.53 Oil SHALE, mahogany color,
887		.87					finely lamin., med. grade
888		.82 .35					- 888.3 Siltstone - buff & brown lamina,
889		.13					med. thick bedding, has few v. thin magnet.
890		.75					seams.
891		.89					- 890.75 Siltstone lt. buff to lt. grey,
892		.26					med lam. to 894.1 & coarse lam. below
893		.76					Abundant magnetite in thin seams
894		.82 .08					to bedding (W.K.) & in thin fractures
895		.49					cutting bedding (Vert. to sub. horiz.,
896		.21					& very irregular lines)
897		.52					Siltstone (same as above), but
898		.27					with less vert. magnetite stringers,
899		.61					now mostly all parallel to bedding.
900							(899.0 to 899.9 - distorted bedding)
901							- 901 Siltstone - buff to lt. brown,
902							less magnetite bands, med.
903							laminations
904							
905							- 905.75 Oil Shale - mahogany color, low to
906							grade
907							908 Siltstone (908.0 - 909.35) grayish brown,
908							finely lam., mag. seams
909							- 909.35 Siltstone (909.35 - 911.28)
910							lt. buff to brown, med. laminated
911							- 911.28 No dark seams
912							Oil Shale low to med. grade, dk grey &
913							mahogany colored, richer below 914.4
914							& more finely laminated
915							915.66 914.81 - 914.99 - buff ss, bleeding
916							hydrocarbons
917							Siltstone (915.66 to 916.78) / buff to lt. brown
918							med lam.

COMMENTS: \* This section of core shows many fine irregular fractures filled with magnetite identical to complete core section (major dip of core's appears to be 90° ± 60°) (However pattern is basically quite irregular)

Surface  Section 