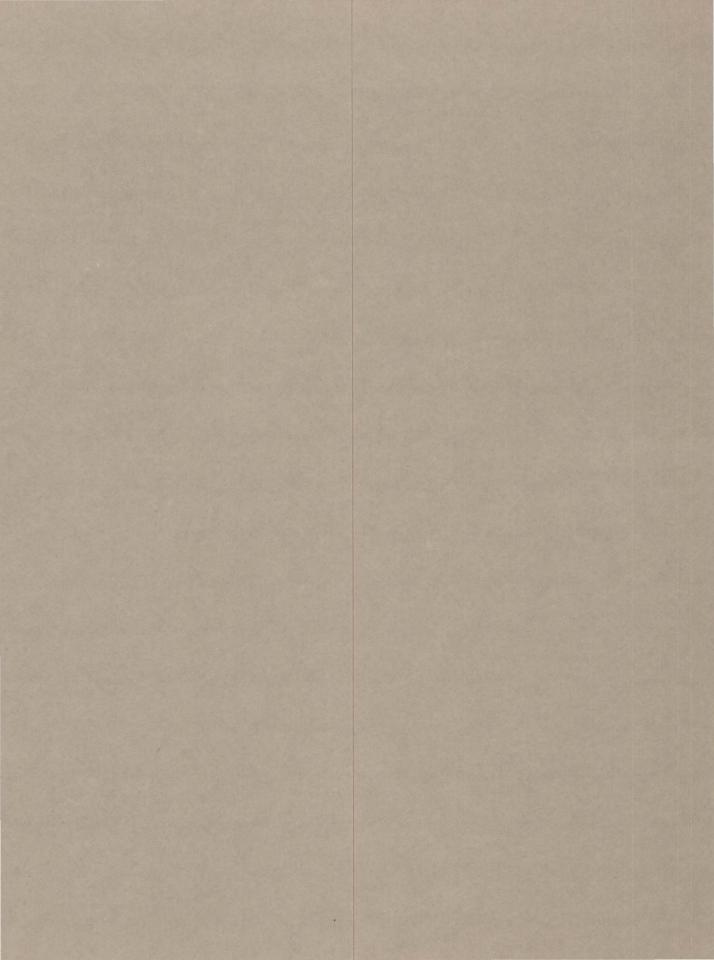
GEOLOGICAL SURVEY CIRCULAR 635



Stratigraphic Sections and
Chemical Analyses of
Phosphatic Rocks of Permian
And Mississippian Age in
Weber County, Utah



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By E. M. Schell and K. P. Moore

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United States Department of the Interior

WALTER J. HICKEL, Secretary



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STRATIGRAPHIC SECTIONS AND CHEMICAL ANALYSES OF PHOSPHATIC ROCKS OF PERMIAN AND MISSISSIPPIAN AGE IN WEBER COUNTY, UTAH

By E. M. SCHELL and K. P. MOORE

ABSTRACT

Stratigraphic sections and chemical anlyses of phosphatic rocks from five trench localities in Weber County, Utah, are presented. Four of the trenches are in Mississippian rocks, and one is in Permian rocks. Of the Mississippian rocks, the highest grade phosphatic interval is at the Wheat Grass Creek locality. Here the phosphatic rocks are 14.9 feet thick, and a 5.8-foot-thick zone has an average of 22.1 percent P2O5. Three localities of Mississippian rocks have 1.1 or less feet of phosphate rock that contains 24+ percent P2O5. The Permian Park City Formation and related strata, where measured in Hardy Hollow, are 675 feet thick and consist of a 10.9-foot-thick phosphatic interval in the Grandeur Member of the Park City; the Meade Peak Phosphatic Shale Tongue of the Phosphoria Formation is 171 feet thick, but it is cut by numerous faults.

INTRODUCTION

This report presents stratigraphic sections and chemical analyses of phosphatic rocks from five trench localities in Weber County, Utah. The localities are from 6 to 25 miles east of Ogden, Utah in the Ogden River drainage system (fig. 1).

Four trenches (CP-35, CP-36, CP-38, CP-44) are in the upper part of the Lodgepole Limestone and the basal part of the Deseret and Humbug Formations, all of Mississippian age. The highest grade phosphatic rocks of the Mississippian are at the Wheat Grass Creek locality (CP-44). The phosphatic rocks there are 14.9 feet thick, and a 5.8-foot zone contains an average of 22.1 percent P₂O₅. The three other localities of Mississippian rocks have 1.1 or less feet of phosphate rock that contains 24+ percent P₂O₅. The phosphatic intervals in the Mississippian rocks are considered to be one phosphatic zone. Because of facies changes, the phosphatic intervals are assigned to three mappable formations. A discussion of the details of the Mississippian stratigraphy is beyond the scope of this report.

One trench (CP-37) is in the Park City Formation and related strata of Permian age. Where measured in Hardy Hollow, the Park City and related strata are 675 feet thick and contain a 10.9-foot-thick phosphatic interval in the Grandeur Member of the Park City Formation. The Meade Peak Phosphatic Shale Tongue of the Phosphoria Formation is 171 feet thick, but it is cut by numerous faults.

The field study is part of a geologic program of the Conservation Division, U.S. Geological Survey, begun in 1964, to support mineral land classification of phosphate withdrawals on Federal lands. Trenching and sampling of the phosphatic intervals were done in August 1964 and July 1966 to augment geologic mapping projects in the general area. This report supplements stratigraphic and analytical data of previous investigators (Blackwelder, 1910; Cheney and others, 1953; Cheney, 1957; Mullens and Laraway, 1964; Schell and Gere, 1964; Mullens, 1969). The manner of investigation was similar to the procedure described by McKelvey, Davidson, O'Malley, and Smith (1953, p. 1-6). The analytical data and condensed descriptions of the rocks are presented for each trench, and detailed descriptions of the rocks exposed in the trenches follow the analytical data. No interpretation of the data is presented except for interpretation of some of the faulting in the Hardy Hollow trench (CP-37).

PERSONNEL AND ACKNOWLEDGITENTS

Field studies and geologic mapping in the northwest quarter of the Morgan 15-minute quadrangle by R. J. Hite specifically outlined for the first time the topographic expression of

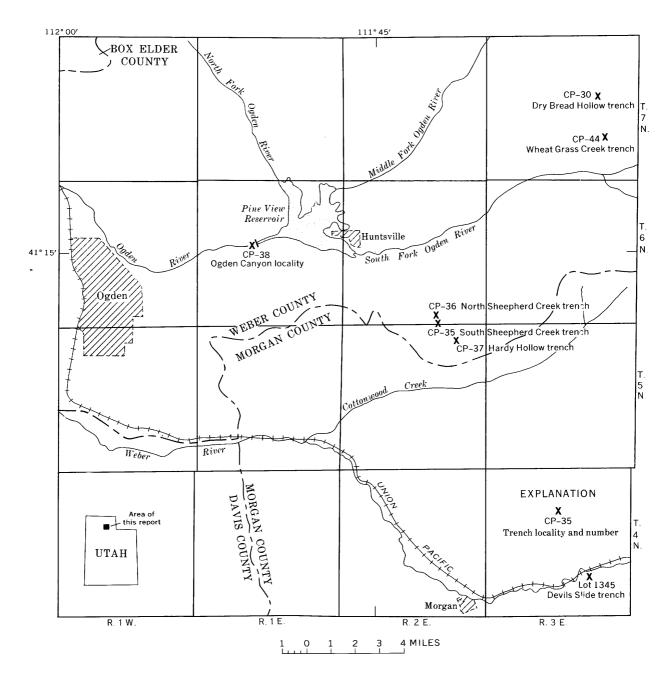


FIGURE 1.—Trench localities in Weber and Morgan Counties, Utah.

the phosphatic rocks from which three trench localities were selected. Field studies and geologic mapping in the Causey Dam quadrangle by T. E. Mullens (1969) delineated phosphatic rocks of Mississippian age. R. J. Hite and T. E. Mullens also participated in sampling and describing one trench each in Sheepherd Creek (CP-35) and Wheat Grass Creek (CP-44). R. K. Stewart and Byron Walke did the hand

trenching in the North and South Sheepherd Creeks localities in 1964; Lynn Walker and S. A. Wilbur did the hand trenching at the Wheat Grass Creek locality in 1966. E. M. Schell described and sampled the stratigraphic sections, and K. P. Moore made the chemical analyses. Permission by the land owners to trench and to sample the rocks is gratefully acknowledged.

PREVIOUS WORK

The Mississippian phosphatic rocks of the general area were first described by Blackwelder (1910, p. 547–550). Cheney (1957, p. 37) published a measured section of the Ogden Canyon (CP–38) locality but considered the P_2O_5 content too low to warrant sampling. Mullens (1969) showed the outcrop pattern of the Humbug Formation in the Causey Dam quadrangle and gave a synopsis of the data from the Wheat Grass Creek (CP–44) locality.

Preliminary data on the Permian phosphate deposits in the Hardy Hollow area were presented by Blackwelder (1910, p. 547-548, fig. 44). Blackwelder published a few analyses of phosphate rock float and the general outcrop pattern of the Park City Formation. The two nearest trench sections of the Park City Formation and related strata to the Hardy Hollow (CP-37) locality are the Devils Slide and Dry Bread Hollow localities (fig. 1). The Devils Slide locality is about 12 miles southeast in sec. 26, T. 4 N., R. 3 E. A stratigraphic section and chemical analyses of the phosphatic rocks in the Devils Slide locality were published by Cheney, Smart, Waring, and Warner (1953, p. 11-17). The geology of the Devils Slide area was mapped by Mullens and Laraway (1964). The Dry Bread Hollow locality is about 11 miles northeast of the Hardy Hollow locality. Geologic and trench data of the Dry Bread Hollow area were presented by Blackwelder (1910, p. 548–550, fig. 44) and, more recently, by Schell and Gere (1964) and Mullens (1969).

FIELD AND LABORATORY PROCEDURES

Three of the trenches, CP-35, CP-36, and CP-44, were hand excavated to a maximum depth of about 8 feet. The uppermost beds of the phosphatic interval at these localities were not sampled because of excessive overburden. The Hardy Hollow trench (CP-37) was bulldozed to a maximum depth of about 15 feet. Little additional excavation was necessary at the Ogden Canyon trench (CP-38) because the phosphatic interval is well exposed in an abandoned roadcut, Although well exposed, the rocks sampled at Ogden Canyon are overturned in a sharp fold. All the trenches described and sampled are in the weathered zone; therefore, the thickness and the analyses may not be representative of the units at depth. In general, weathered phosphatic rock is slightly enriched in P_2O_5 as compared to underlying unweathered phosphatic rock (Cheney, 1957, p. 38-35). At the Hardy Hollow (CP-37) locality numerous fault zones and some repetition of keds were noted in the trenched intervals. No data on the thickness of strata deleted by faulting are available, and the interpretation of repetition of beds is the sole responsibility of the senior author.

Separate numerical designations were made for lithologic units and channel samples. Except in the units low in P_2O_5 content, a channel sample rarely exceeded 2 feet in thickness. At least one chip sample was collected from each bed, and the samples were later studied under a binocular microscope to supplement or modify the field descriptions.

Rock names and adjectives and the terms for hardness and thickness of bedding are similar to those described by Sheldon (1963, p. 57). Color names and numerical designations are from the Munsell color charts. The Wentworth scale for size classification was used for sandstone, phosphorite, limestone, and delomite.

Channel samples, which averaged about 10 pounds, were crushed in the field to minus ½-inch mesh by a jaw crusher. A Jones splitter was used to obtain two splits of about half a pint each. One split was stored for future use, and one split was forwarded to the laboratory for analyses.

The methods of P_2O_5 and acid-insoluble analyses are similar to those described by Hoffman and Lundell (1938). Interpretation of chemical data of phosphatic rocks was presented by McKelvey, Davidson, O'Malley, and Smith (1953, p. 3-4).

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STRATIGRAPHIC SECTIONS AND ANALYSES

SOUTH SHEEPHERD CREEK, CP-35

Trench CP-35 is at South Sheepherd Creek, SE½SE½ sec. 34, T. 6 N., R. 2 E., Salt Lake meridian, Weber County, Utah. The phosphatic section near the top of the Lodgepole Limestone was sampled and described in a hand-excavated trench by E. M. Schell and R. J. Hite. Chemical analyses were by K. P. Moore.

Chemical analyses (percent)

Abstract section of only the upper part of Lodgepole Limestone, CP-35

	(This law are			Cumulativ		Chemical analyses (percent)				Thic	kness		
Samp	ole Unit	Thicknes (ft)	Rock desc	ription		thickness (ft)		V ₂ O ₅	Cr ₂ O ₃	Acid insoluble	Ignition loss	P	ercent 205 alative
			Top of trench										
CP-35	–5 M–11	b 3.1	Mudstone, slightl phosphatic	У			2.61	0.12	0.06	63.18	1.1.72		8.09
	4 M-11;	a 2.8	Mudstone, calcare slightly phosph			5.9	4.23	.26	.04	50.99	14.25	19	9.93
	3 M-10	.3	Phosphorite				7.47	.11	.01	26.22	21.55	§ 2:	2.17
	3 M-9	.7	Mudstone, calcar	eous		6.9∫	1.41	•11	.01	20.22	2,1,00	2'	7.40
	2 M-8	.1	Phosphorite, calc	areou	.s	7.0}	4.33	.25	.06	58.76	1.0.03	§ 2'	7.83
	2 M-7	.9	Mudstone, silty			7.9∫	4.00	02.	.00	56.10	1.0.00	(3)	1.73
	1 M-6	.2	Phosphorite										7.29
	1 M-5	.2	Mudstone			8.3						4	2.85
	1 M-4	.3	Phosphorite			8.6	27.79	.05	.02	6.44	9.53	$\langle 5 \rangle$	1.19
	1 M-3	.1	Mudstone, phospl	natic		8.7						5	3.97
	1 M-2	.5	Phosphorite			9.2 <i>)</i>						(6'	7.86
			. Base of trench										
	M-1	7.0	Dolomite, cherty			16.2							
Unit		Rock des	cription	Thick- ness (ft)	Cumu- lative thick- ness (ft)	Unit		Roc	ek descrip	otion	•	Thick- ness (ft)	Cumu- lative thick- ness (ft)
													(207
M 11b	Top of trend	h	1-4:			M-5	Mudstone,	grayish-	brown (10YR 4/3)	, slightly		(20)
M-11b	Mudstone, slig soft; upper 4/4), lower 3/2); indis	ghtly phosi part is m r part is stinct bed	phatic, calcareous, silty, oderate brown (7.5YR grayish brown (5YR ding; contains calcite			-	phospha tinct be 0.05-ft- phorite	itic, sligh edding, h hick fin layer. Ba	ntly calc ighly wes e- to co sal conta	areous, sof athered; co parse-pellet act is sharp	t; indis- ntains a al phos-	.2	
M-11b	Mudstone, slig soft; upper 4/4), lower 3/2); indis pods. Basal Mudstone, slig soft; upper lower 0.4 (10YR 4/5)	ghtly phosy part is me part is stinct beduce contact is contact is 2.4 ft is peft is mode; indistince	phatic, calcareous, silty, toderate brown (7.5YR) grayish brown. (5YR) ding; contains calcite s sharp. thatic, calcareous, silty, ale brown (10YR 5/2), erate yellowish brown tedding; contains cal-	3.1	3.1	-	phosphatinet be 0.05-ft- phorite Phosphori coarse-p thick-be and a p	atic, slightedding, he hick fin layer. Batte, dark- belletal and ded. Mohosphatic	ntly calcighly wester to constant contant of the co	areous, sof athered; co parse-pellet act is sharp 5YR 4/0), c, calcareous s consist of im. Basal c	t; indis- ntains a al phos- fine- to us, hard, of calcite ontact is		8.:
M-11b	Mudstone, slig soft; upper 4/4), lowe 3/2); indis pods. Basal Mudstone, slig soft; upper lower 0.4 (10YR 4/5); cite pods. I Phosphorite, coarse to fi bedded; coi	part is my repart is my repart is my repart is stinct bed contact is the properties of the properties	phatic, calcareous, silty, orderate brown (7.5YR) grayish brown. (5YR) ding; contains calcite s sharp	2.8	3.1 5.9	4	phosphatinct be 0.05-ft-i phorite Phosphoric coarse-I thick-be and a p sharp Mudstone, phatic, contains	atic, slightding, hichick fin chick fin layer. Batte, dark-telletal and ded. Mohosphatic grayish calcareous fine to co	ntly calculated to contain the	areous, sofathered; coorarse-pellet cut is sharp $5YR$ 4/0), c. calcareoum. Basal com. Basal com. C7.5YR 4/2 indistinct lets of pho	fire to ntact is fire to us, hard, of calcite ontact is c), phos- bedding; sphorite.	.3	8.
M-11b 11a 10	Mudstone, slig soft; upper 4/4), lowe 3/2); indis pods. Basal Mudstone, slig soft; upper lower 0.4 (10YR 4/5) cite pods. I Phosphorite, coarse to fi bedded: co layer 0.1 ft Mudstone, mo eous, soft; ered: contai	part is m r part is m r part is stinct bedicently phosp 2.4 ft is p ft is mod 3asal contact wery dark ne-pelletal, ntains a above base bderate-bro indistinct	shatic, calcareous, silty, oderate brown (7.5YR grayish brown. (5YR ging; contains calcite s sharp. shatic, calcareous, silty, ale brown (10YR 5/2), erate yellowish brown to bedding; contains calcit is sharp. gray (2.5Y 3/0), very calcareous, hard, thin-0.01-ft-thick mudstone. Basal contact is sharp with (5YR 4/4), calcarbedding, highly weath-bedding, highly weath-peinlets and small pods.	2.8	3.1 5.9 6.2	4	phosphe tinct be 0.05-ft-i phorite Phosphori coarse-p thick-be and a p sharp Mudstone phatic, contains Basal co Phosphori (fine t	atic, slightdding, hichick finchick finchick finchick finchick finchick for the state of the sta	ntly calculated the control of the c	areous, sofathered; co carse-pellet let is sharp $5YR$ 4/0), c, calcareous consist com. Basal com. $(7.5YR$ 4/2 indistinct	t; indis- nteins a al phos- five to us, hard, of calcite ontact is 2), phos- belding; sphorite. ad oolitic l, thick-		8.
M-11b 11a 10	Mudstone, slig soft; upper 4/4), lowe 3/2); indis pods. Basal Mudstone, slig soft; upper lower 0.4 (10YR 4/5) cite pods. I Phosphorite, coarse to fi bedded; col layer 0.1 ft Mudstone, mo eous, soft; ered; contai Basal conta Phosphorite, i	whily phosy part is repart is repart is tinct bed contact is whily phosy 2.4 ft is pft is mod ; indistinct wery dark ne-pelletal, ntains a above base to indistinct rus calciters can be about the contact of the contact is sharpfine-to me rd; single	shatic, calcareous, silty, oderate brown (7.5YR grayish brown. (5YR ging; contains calcite s sharp— shatic, calcareous, silty, ale brown (10YR 5/2), erate yellowish brown thedding; contains calcite is sharp— gray (2.5Y 3/0), very calcareous, hard, thin- d.01-ft-thick mudstone. Basal contact is sharp— win (5YR 4/4), calcarbedding, highly weath- reinlets and small pods. dium-pelletal, very cal- bed. Basal contact is bed. dium-pelletal, very cal- bed. Basal contact is	3.1 2.8 .3	3.1 5.9 6.2 6.9	4	phosphr tinct be 0.05-ft-i phorite Phosphori coarse-i thick-be and a p sharp Mudstone phatic, contains Basal c. Phosphori (fine t bedded, and a p	dic, slight-diding, h. dick fin, layer. Batte, dark-lelletal andded. Mchosphatic grayish calcareous fine to contact is te, gray 5 mm Some ool hosphorit contains	thly calcignly were e- to cussal contagray (2. cussal cuss	areous, sof athered; co carre-pellet ct is sharp, t, calcareous consist c im. Basal c (7.5YR 4/2) indistinct lets of phopoletal areous, har ain a calcinarp irregular pebbles fi	tt; indis- ntains a al phos- fine- to is, hard, if calcite ontact is ?), phos- bedding; sphorite. nd oolitic l, thick- te center lar basal rom unit	.3	8.: 8.: 8.:
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NORTH SHEEPHERD CREEK, CP-36

Trench CP-36 is at North Sheepherd Creek, NE½SE½ sec. 34, T. 6 N., R. 2 E., Salt Lake meridian, Weber County, Utah. The phosphatic

section near the top of the Lodgepole Limestone was sampled and described in a hand-excavated trench by E. M. Schell. Chemical analyses were by K. P. Moore.

Abstract section of only the upper part of Lodgepole Limestone, CP-36

				Cumulative		Chemical analyses (percent) Thickness					
Sample	Unit	Thickness (ft)	Rock description	thickness (ft)	P_2O_5	V_2O_5	Cr_2O_3	Acid insoluble	Ignition loss	$\stackrel{\textstyle \succ}{}$ percent P_2O_5 (cumulative)	
	M-10	16.0	Concealed, overlain by limestone ledge								
			Top of trench								
	M-9	5.0	Mudstone, calcareous								
CP-36-5	M-8	.3	Phosphorite, calcareous	5.3)	0.54	0.4	0.01	17.90	30.46	(0.76	
5	M-7	1.1	Limestone, argillaceous	6.4	2.54	54 0.4	0.01	17.90	50.40	3.55	
4	M-6	.1	Phosphorite	6.5)	F 0.0	10	٥٢	FC F9	14.770	(4.05	
4	M-5	.9	Mudstone, calcareous	7.4	5.06	.18	.05	56.53	14.76	8.60	
3	M-4	.4	Phosphorite and mudstone	7.8	25.13	.05	.02	8.45	11.58	18.65	
2	M-3	.7	Phosphorite and mudstone	8.5	25.44	.02	.01	4.11	14.38	36.45	
1	M-2	.4	Phosphorite	8.9	26.29	.01	.01	5.23	11.69	46.95	
			Base of trench								
	M-1	15.0	Dolomite, cherty								

Detailed description of only the upper part of Lodgepole Limestone, CP-36

Unit	Rock description	Thick- ness (ft)	Cumu- lative thick- ness (ft)
M-10	Concealed, probably mudstone. Overlain by dark- gray massive limestone ledge	16.0	
9	Mudstone, dark-yellowish-brown ($10YR$ 4/2), very calcareous, soft; indistinct bedding. Contains two phosphorite beds about 0.1 ft thick about 0.6 and 3.5 ft above base; phosphorite is pale brown ($10YR$ 5/2), fine to coarse pelletal, argillaceous, calcareous, and hard. Basal contact is sharp		5.0
8	Phosphorite, light-brownish-gray (5YR 5/1), fine-pelletal to very coarse pelletal and oolitic, hard, thick-bedded; matrix dolomitic. Basal contact is sharp		5.3
7	Limestone, grayish-brown (2.5 Y 5/2), very argillaceous, soft, thick-bedded; contains calcite veinlets. Basal contact is sharp	, •	6.4
6	Phosphorite, gray (N 6/0), fine- to medium- pelletal, hard; matrix dolomitic; contains cal- cite veinlets; single bed. Basal contact is sharp		6.8
5	Mudstone, pale-brown (10YR 5/2), calcareous, soft; indistinct bedding, laminated in part. Basal contact is sharp		7.4
4	Phosphorite and mudstone. Upper 0.3 ft is phosphorite, dark-grey $(N-4/0)$, fine-pelletel to very coarse pelletal and oolitic, hard, thick-)	

Detailed description of only the upper part of Lodgepole Limestone, CP-36—Continued

Unit	Rock description	Thick- ness (f+)	Cumu- lative thick- ness (ft)
	bedded; matrix dolomitic; colites contain a cal- cite core. Lower 0.1 ft is mudstone, grayish- brown (10YR 4/3), soft, fissile; contains fine to very coarse pellets of phosphorite. Basa contact is sharp		7.8
M-3	Phosphorite and mudstone. Upper 0.6 ft is phosphorite, gray (N 5/0), fine-pelletel to very coarse pelletal and oolitic, hard, thick-bedded matrix dolomitic; colites contain a calcite core Basal 0.1 ft is mudstone, moderate-yellowish brown (10YR 5/4), phosphatic, soft; indistinct bedding, highly weathered; contains fine to coarse pellets of phosphorite. Basal contact is sharp	, ; , ,	8.5
2	Phosphorite, dark-gray (N 4/10), pelletal, calcareous, fossiliferous, hard, thick-bedded; contains colites and nodules ranging from fine to 10 mm in diameter. Upper part contains reworked phosphorite nodules and calcite-filler phosphorite oolites. Lower part contains reworked dolomite pebbles. Basal contact is sharp and irregular) - ! -	8.9
	Base of trench.		
1	Dolomite, gray (2.5 Y 5/0), fine- to medium grained, cherty, hard, massive; contains dark-gray chert pods and lenses. Forms ledge		

HARDY HOLLOW, UTAH, CP-37

Trench CP-37 is in Hardy Hollow, lot 9, sec. 2, T. 5 N., R. 2 E., Salt Lake meridian, Weber County, Utah. The Meade Peak Phosphatic Shale Tongue of the Phosphoria Formation and the phosphate zone of the Grandeur Member of

the Park City Formation was described and sampled on the ridge between Hardy Hollow and Sheepherd Creek by E. M. Schell in bull-dozer trenches; the remaining interval was described by E. M. Schell along a Brunton and tape traverse. Chemical analyses were by K. P. Moore.

$Abstract\ section,\ CP ext{-37}$

		Thickness		Cumulative		Chemica		(percent)		Thickness
Sample	Unit	(ft)	Rock description	thickness (ft)	P_2O_5	$\mathbf{v_{2}o_{5}}$	${ m Cr}_2{ m O}_3$	Acid insoluble	Ignition loss	$^{ m n} imes { m percent} \ { m P}_2{ m O}_5 \ { m (cumulative}$
			DINWOODY FORMATIO	N—BASAL	UNIT O	NLY				
	D-1	5.0+	Limestone, silty							
			PARK CITY FORMATION Rex Chert Tongue of	AND REL Phosphoria	ATED ST Formatio	RATA n				
	P-83	43.0	Chert, carbonatic	43.0						
			Franson Member of							
	P-82	34.0	Limestone	77.0	· · · · · · · · · · · · · · · · · · ·					
	P-81 P-80	$\begin{array}{c} 7.0 \\ 120.0 \end{array}$	Dolomite Limestone	84.0				••••••		
		1.0.0	Top of trench							
	P-79	80.0	Dolomite	284.0						
			Meade Peak Phosphatic Shale T							
CP-37-66	P-78	2.8								
CF-37-00	P-78	2.8	Phosphorite; top of unit is faulted; P-77 and P-78 range from 5.5 ft thick							
			to about 13 ft thick		28.59	0.06	0.11	13.74	5.64	80.05
65	P-77	2.7	Phosphorite		28.80	.06	.13	12.37	6.23	157.81
$\begin{array}{c} 64 \\ 63 \end{array}$	P-76 P-75	4.0	Fault zone		$9.51 \\ 12.36$.03 .03	.03	$61.97 \\ 44.68$		$195.85 \\ 257.65$
$\frac{63}{62}$	P-75 P-74	$\begin{array}{c} 5.0 \\ 6.0 \end{array}$	Fault zoneSandstone, calcareous		$\frac{12.36}{2.40}$.03	.06	46.44		272.05
61	P-73	5.0	Sandstone, similar to	004.0	2.40	*****	• • • • • • • • • • • • • • • • • • • •	40.11		2.2.00
	2 .0	3.0	unit P-74	309.5	1.68			61.98	13.33	280.45
60	P-72	5.0	Sandstone, similar to					40.00		200 4
59	P-71	5.0	unit P-74Sandstone, similar to		0	******	•••••	10.98		280.45
F0	T) =0	- 0	unit P-74	319.5	0			28.23		280.45
58	P-70	5.0	Sandstone, similar to unit P-74	324.5	.08			68.53		280.85
57	P-69	5.0	Sandstone, similar to	222 5	•			04.00		000.05
56	P-68	5.0	unit P-74		0			$64.03 \\ 64.71$		$280.85 \\ 280.85$
55	P-68 P-67	$\frac{5.0}{5.0}$	Fault zoneFault zone, similar to	334.3	U	.02	.01	04.11		200.00
00	1-01	0.0	unit P-68	339.5	0	.04	.01	89.28		280.85
54	P-66	5.0	Fault zone, similar to unit P-68	9445	2.77	.03	.01	84.28		294.70
53	P-65	3.0	Fault zone, similar to	544.0	2.11	.00	.01	04.20		234.10
0.0	1 00	0.0	unit P-68	347.5	4.57	.05	.04	53.21		308.41
52	P-64	2.8	Chert	350.3	4.43	.03	.02	84.08		320.81
51	P-63	3.0	Siltstone	353.3	4.91	.03	.03	80.65		335.54
50	P-62	5.0	Siltstone, similar to	050.0	F 41	0.4	00	00.00		900 50
49	P-61	5.0	unit P-63 Siltstone, similar to	358.3	5.41	.04	.02	80.92		362.59
10	1-01	0.0	unit P-63	363.3	4.39	.04	.07	78.79		384.54
48	P-60	5.0	Siltstone, similar to	00010	2.00	•••	•••			
	T . F .		unit P-63		0	.10	.07	91.72		384.54
47	P-59	4.0	Siltstone	372.3	1.44			88.94		390.30
46	P-58	4.5	Siltstone, similar to unit P-59	376 8	.59			87.22		392.95
45	P-57	5.0	Fault zone		0.33	.11	.02	89.96		392.95
44	P-56	2.3	Siltstone		.01	•11		89.01		392.97
$\overline{43}$	P-55	1.8	Siltstone, dolomitic		0	******		57.87		392.97
42	P-54	.6	Chert, silty		Ŏ			74.77		392.97
41	P-53	5.0	Siltstone	391.5	0			76.26		392.97
40	P-52	5.0	Siltstone, similar to							
00	D 54	_	unit P-53		1.26		*****	82.29	-:	399.27
39	P-51	.5	Phosphorite, siliceous	397.0	27.28	.03	.14	17.99	5.78	412.91
38	P-50	$\frac{2.2}{0.0}$	Siltstone, micaceous	399.2	.01	.08	.03	86.72	4.74	412.93
$\begin{array}{c} 37 \\ 36 \end{array}$	P-49 P-48	$\begin{array}{c} 2.0 \\ 1.7 \end{array}$	Siltstone, dolomitic Mudstone and phosphorite,	401.2	.90	.04	.04	66.71	13.15	414.73
90	1 -40	1.1	interbedded	402.9	16.51	.04	.16	40.19	6.78	442.79
35	P-47	1.7	Mudstone and phosphorite,	104.0	10.01	.01	.10	10.10	0.10	-x-x41.10
			similar to unit P-48	. 404.6	10.85	.03	.12	42.33	13.02	461.23
34	P-46	3.0	Dolomite, argillaceous, silty		4.69	.04	$.1\overline{2}$	54.93	12.88	475.30
33	P-45	2.5	Dolomite, similar to					A		
90	D 44	0.5	unit P-46	410.1	0	.04	.03	65.99	14.22	475.30
32	P-44	2.5	Dolomite, similar to unit P-46	419 G	6.00	.04	.17	42.87	155/	490.30
			um 1 –40	414.0	0.00	.∪4	.1 (+4.01	15.54	45U.3U

~ .		Thickness	5	Cumulative		Chemical		(percent)		Thicknes × percer
Sample	Unit	(ft)	Rock description	thickness (ft)	P_2O_5	V_2O_5	Cr_2O_3	Acid insoluble	Ignition loss	P_2O_5 (cumulativ
			PARK CITY FORMATION AND Meade Park Phosphatic Shale Tongue							
CP-37-31	P-43	2.5	Dolomite, similar to							
30	P-42	2.5	unit P-46		2.90	.04	.20	41.62	18.86	497.55
29	P-41	2.5	unit P-46 Dolomite, similar to	417.6	6.74	.03	.19	41.76	16.62	514.40
28	P-40	2.5	unit P-46 Dolomite, similar to	420.1	7.20	.04	.14	53.56	10.58	532.40
			unit P-46	422.6	0	.01	.05	25.68	32.02	532.40
27	P-39	2.5	Dolomite, similar to unit P-46	425.1	0	.004	.01	24.05	35.77	532.40
26	P–38	2.5	Dolomite, similar to unit P-46	427.6	0	.02	.04	37.42	27.06	532.40
25	P-37	1.4	Chert, carbonatic		0	.007	.006	63.79		532.40
24	P - 36	1.5	Dolomite, argillaceous	430.5	0	.004	.006	20.69	36.91	532.40
23	P - 35	1.4	Fault zone		0	.06	.08	69.74		532.40
22	P-34	1.8	Mudstone, silty		0	.10	.14	73.53	7.68	532.40
$\overline{21}$	P-33	1.5	Siltstone, argillaceous		6.34	.08	.08	69.56	6.03	541.9
$\frac{21}{20}$	P-32	.5	Mudstone, silty	195.7	8.98	.08	.14	55.76	7.04	546.40
	P-31									
19 18	P-31 P-30	$\frac{1.8}{1.9}$	Dolomite, similar to		.02	.01	.01	13.64	39.38	546.43
		_	unit P-31		.02	.01	.01	11.64	41.37	546.40
$\begin{array}{c} 17 \\ 16 \end{array}$	P-29 P-28	.7 .7	Siltstone		4.78	.04	.04	65.72	7.74	549.8
			silty	440.8	14.93	.04	.17	46.86	6.86	560.2
15	P-27	.5	Phosphorite		32.31	.02	.09	7.53	5.09	576.4
14	P-26	2.3	Siltstone, phosphatic		17.04	.04	.16	35.92	8.81	615.5
$\overline{13}$	$P-\overline{25}$	$\frac{2.3}{2.2}$	Siltstone, similar to	11010	11.01	•01	•=0	00.02	0.01	010.0
			unit P-26	445.8	13.72	.03	.13	40.55	9.55	645.7
12	P-24	2.5	Mudstone, phosphatic, silty		12.80	.05	.27	45.78	8.80	677.7
11	P-23	$\frac{2.5}{2.5}$	Mudstone, similar to	440.0	12.00	.00	.41	40.10	0.00	011.1
11	1 -40	2.0	unit P-24	450.0	12.77	0.4	1.0	40.01	7.00	******
		(00.5)				.04	.16	49.21	7.26	*699.6
		(29.5)	Faulted and folded zone							
ID 07 10	P-22	2.0	Chert	452.8						
P-37-10	P-21	1.2	Siltstone, phosphatic,							
			argillaceous	454.0	15.85	.05	.25	42.91	7.27	19.03
9	P-20	.4	Phosphorite	454.4	28.35	.02	.05	18.01	3.65	30.30
8	P-19	.2	Siltstone, phosphatic	454.6	12.85	.004	.04	58.21	2.97	*32.93
	P-18	.4	Fault zone	455.0					•••••••	
			Grandeur Member of	Park City I	ormation					
	P-17	20.0	Dolomite	475.0						
	P-16	17.0	Dolomite	492.0			••••		· · · · · · · · · · · · · · · · · · ·	
			Base of trench							
		121.0	Dolomite, limestone, and							
	P-15		Dolomite, limestone, and chert float	613.0						
	P-15		Dolomite, limestone, and chert float	613.0					· · · · · · · · · · · · · · · · · · ·	
	P–15 P–14	2.0	Dolomite, limestone, and chert float	613.0						
	P-15		Dolomite, limestone, and	613.0						
	P–15 P–14	2.0	Dolomite, limestone, and chert float Top of trench Chert	613.0 615.0 617.4						
CP-37-7	P-15 P-14 P-13 P-12	2.0 2.4 2.0	Dolomite, limestone, and chert float Top of trench Chert Dolomite Phosphorite	613.0 615.0 617.4						
	P-15 P-14 P-13	2.0 2.4	Dolomite, limestone, and chert float Top of trench Chert Dolomite Phosphorite Phosphorite, similar to	613.0 615.0 617.4 619.4	27.90	.05	.06	9.97	8.58	55.8
CP-37-7 6	P-15 P-14 P-13 P-12 P-11	2.0 2.4 2.0 2.0	Dolomite, limestone, and chert float Top of trench Chert Dolomite Phosphorite Phosphorite, similar to unit P-12	613.0 615.0 617.4 619.4						55.8
CP-37-7	P-15 P-14 P-13 P-12	2.0 2.4 2.0	Dolomite, limestone, and chert float Top of trench Chert Dolomite Phosphorite Phosphorite, similar to unit P-12 Phosphorite, similar to	613.0	27.90 26.77	.05	.06	9.97 7.35	8.58 8.83	55.86 109.3
CP-37-7 6 5	P-15 P-14 P-13 P-12 P-11 P-10	2.0 2.4 2.0 2.0 2.0	Dolomite, limestone, and chert float Top of trench Chert Dolomite Phosphorite, similar to unit P-12 Phosphorite, similar to unit P-12	613.0 615.0 617.4 619.4 621.4	27.90 26.77 25.80	.05 .06	.06 .07	9.97 7.35 7.59	8.58 8.83 11.18	55.86 109.3 160.9
P-37-7 6 5	P-15 P-14 P-13 P-12 P-11 P-10 P-9	2.0 2.4 2.0 2.0 2.0	Dolomite, limestone, and chert float Top of trench Chert Dolomite Phosphorite, similar to unit P-12 Phosphorite, similar to unit P-12 Phosphorite	613.0 615.0 617.4 619.4 621.4 623.4 623.8	27.90 26.77 25.80 17.34	.05 .06 .06	.06 .07 .07	9.97 7.35 7.59 8.85	8.58 8.83 11.18 20.25	55.8 109.3 160.9 167.8
P-37-7 6 5 4 3	P-15 P-14 P-13 P-12 P-11 P-10 P-9 P-8	2.0 2.4 2.0 2.0 2.0 2.0	Dolomite, limestone, and chert float Top of trench Chert Dolomite Phosphorite Phosphorite, similar to unit P-12 Phosphorite, similar to unit P-12 Phosphorite Phosphorite Phosphorite	613.0 615.0 617.4 619.4 621.4 623.4 623.8 625.8	27.90 26.77 25.80 17.34 26.88	.05 .06 .06 .02 .03	.06 .07 .07 .03 .04	9.97 7.35 7.59 8.85 8.97	8.58 8.83 11.18 20.25 8.89	55.8 109.3 160.9 167.8 221.6
5 4 3 2	P-15 P-14 P-13 P-12 P-11 P-10 P-9 P-8 P-7	2.0 2.4 2.0 2.0 2.0 2.0 4 2.0 1.2	Dolomite, limestone, and chert float Top of trench Chert Dolomite Phosphorite Phosphorite, similar to unit P-12 Phosphorite, similar to unit P-12 Phosphorite Phosphorite Siltstone, dolomitic	613.0 615.0 617.4 619.4 621.4 623.4 623.8 625.8 627.0	27.90 26.77 25.80 17.34 26.88 1.38	.05 .06 .06 .02 .03	.06 .07 .07 .03 .04	9.97 7.35 7.59 8.85 8.97 66.68	8.58 8.83 11.18 20.25 8.89 13.49	55.8 109.3 160.9 167.8 221.6 223.2
5 4 3 2 1	P-15 P-14 P-13 P-12 P-11 P-10 P-9 P-8 P-7 P-6	2.0 2.4 2.0 2.0 2.0 2.0 4 2.0 1.2 1.3	Dolomite, limestone, and chert float Top of trench Chert Dolomite Phosphorite, similar to unit P-12 Phosphorite, similar to unit P-12 Phosphorite Phosphorite Siltstone, dolomitic Phosphorite	613.0	27.90 26.77 25.80 17.34 26.88 1.38 21.19	.05 .06 .06 .02 .03 .01	.06 .07 .07 .03 .04 .01	9.97 7.35 7.59 8.85 8.97 66.68 13.42	8.58 8.83 11.18 20.25 8.89 13.49 13.48	55.8 109.3 160.9 167.8 221.6 223.2 *250.8
5 4 3 2 1	P-15 P-14 P-13 P-12 P-11 P-10 P-9 P-8 P-7 P-6 P-5	2.0 2.4 2.0 2.0 2.0 2.0 4 2.0 1.2 1.3 3.0	Dolomite, limestone, and chert float Top of trench Chert Dolomite Phosphorite Phosphorite, similar to unit P-12 Phosphorite, similar to unit P-12 Phosphorite Siltstone, dolomitic Phosphorite Fault zone	613.0	27.90 26.77 25.80 17.34 26.88 1.38 21.19	.05 .06 .06 .02 .03 .01	.06 .07 .07 .03 .04 .01	9.97 7.35 7.59 8.85 8.97 66.68 13.42	8.58 8.83 11.18 20.25 8.89 13.49 13.48	55.8 109.3 160.9 167.8 221.6 223.2 *250.8
5 4 3 2 1	P-15 P-14 P-13 P-12 P-11 P-10 P-9 P-8 P-7 P-6 P-5 P-4	2.0 2.4 2.0 2.0 2.0 2.0 4 2.0 1.2 1.3 3.0 2.5	Dolomite, limestone, and chert float Top of trench Chert Dolomite Phosphorite Phosphorite, similar to unit P-12 Phosphorite, similar to unit P-12 Phosphorite Phosphorite Phosphorite Phosphorite Flosphorite Siltstone, dolomitic Phosphorite Fault zone Dolomite	613.0	27.90 26.77 25.80 17.34 26.88 1.38 21.19	.05 .06 .06 .02 .03 .01	.06 .07 .07 .03 .04 .01	9.97 7.35 7.59 8.85 8.97 66.68 13.42	8.58 8.83 11.18 20.25 8.89 13.49 13.48	55.8 109.3 160.9 167.8 221.6 223.2 *250.8
5 4 3 2 1	P-15 P-14 P-13 P-12 P-11 P-10 P-9 P-8 P-7 P-6 P-5 P-4 P-3	2.0 2.4 2.0 2.0 2.0 4 2.0 1.2 1.3 3.0 2.5 2.0	Dolomite, limestone, and chert float Top of trench Chert Dolomite Phosphorite, similar to unit P-12 Phosphorite, similar to unit P-12 Phosphorite Phosphorite Phosphorite Phosphorite Phosphorite Float zone Dolomite Limestone	613.0	27.90 26.77 25.80 17.34 26.88 1.38 21.19	.05 .06 .06 .02 .03 .01	.06 .07 .07 .03 .04 .01	9.97 7.35 7.59 8.85 8.97 66.68 13.42	8.58 8.83 11.18 20.25 8.89 13.49 13.48	55.8 109.3 160.9 167.8 221.6 223.2 *250.8
5 4 3 2 1	P-15 P-14 P-13 P-12 P-11 P-10 P-9 P-8 P-7 P-6 P-5 P-4	2.0 2.4 2.0 2.0 2.0 2.0 4 2.0 1.2 1.3 3.0 2.5	Dolomite, limestone, and chert float Top of trench Chert Dolomite Phosphorite Phosphorite, similar to unit P-12 Phosphorite, similar to unit P-12 Phosphorite Phosphorite Phosphorite Siltstone, dolomitic Phosphorite Fault zone Dolomite Limestone Limestone	613.0	27.90 26.77 25.80 17.34 26.88 1.38 21.19	.05 .06 .06 .02 .03 .01	.06 .07 .07 .03 .04 .01	9.97 7.35 7.59 8.85 8.97 66.68 13.42	8.58 8.83 11.18 20.25 8.89 13.49 13.48	55.80 109.3 160.9 167.8 221.6 223.2 *250.8
CP-37-7 6 5 4 3 2	P-15 P-14 P-13 P-12 P-11 P-10 P-9 P-8 P-7 P-6 P-5 P-4 P-3 P-2	2.0 2.4 2.0 2.0 2.0 2.0 4 2.0 1.2 1.3 3.0 2.5 2.0 4.2	Dolomite, limestone, and chert float Top of trench Chert Dolomite Phosphorite Phosphorite, similar to unit P-12 Phosphorite, similar to unit P-12 Phosphorite Siltstone, dolomitic Phosphorite Fault zone Dolomite Limestone Limestone Base of trench	613.0	27.90 26.77 25.80 17.34 26.88 1.38 21.19	.05 .06 .06 .02 .03 .01	.06 .07 .07 .03 .04 .01	9.97 7.35 7.59 8.85 8.97 66.68 13.42	8.58 8.83 11.18 20.25 8.89 13.49 13.48	55.80 109.3 160.9 167.8 221.6 223.2 *250.8
5 4 3 2 1	P-15 P-14 P-13 P-12 P-11 P-10 P-9 P-8 P-7 P-6 P-5 P-4 P-3	2.0 2.4 2.0 2.0 2.0 4 2.0 1.2 1.3 3.0 2.5 2.0	Dolomite, limestone, and chert float Top of trench Chert Dolomite Phosphorite Phosphorite, similar to unit P-12 Phosphorite, similar to unit P-12 Phosphorite Siltstone, dolomitic Phosphorite Siltstone, dolomitic Phosphorite Fault zone Dolomite Limestone Limestone Base of trench Limestone and dolomite,	613.0	27.90 26.77 25.80 17.34 26.88 1.38 21.19	.05 .06 .06 .02 .03 .01	.06 .07 .07 .03 .04 .01	9.97 7.35 7.59 8.85 8.97 66.68 13.42	8.58 8.83 11.18 20.25 8.89 13.49 13.48	55.8 109.3 160.9 167.8 221.6 223.2: *250.8
5 4 3 2 1	P-15 P-14 P-13 P-12 P-11 P-10 P-9 P-8 P-7 P-6 P-5 P-4 P-3 P-2	2.0 2.4 2.0 2.0 2.0 2.0 4 2.0 1.2 1.3 3.0 2.5 2.0 4.2	Dolomite, limestone, and chert float Top of trench Chert Dolomite Phosphorite Phosphorite, similar to unit P-12 Phosphorite, similar to unit P-12 Phosphorite Siltstone, dolomitic Phosphorite Siltstone, dolomitic Phosphorite Fault zone Dolomite Limestone Limestone Base of trench Limestone and dolomite,	613.0	27.90 26.77 25.80 17.34 26.88 1.38 21.19	.05 .06 .06 .02 .03 .01	.06 .07 .07 .03 .04 .01	9.97 7.35 7.59 8.85 8.97 66.68 13.42	8.58 8.83 11.18 20.25 8.89 13.49 13.48	55.8 109.3 160.9 167.8 221.6 223.2: *250.8
P-37-7 6 5 4 3 2 1	P-15 P-14 P-13 P-12 P-11 P-10 P-9 P-8 P-7 P-6 P-5 P-4 P-3 P-2	2.0 2.4 2.0 2.0 2.0 2.0 4 2.0 1.2 1.3 3.0 2.5 2.0 4.2	Dolomite, limestone, and chert float Top of trench Chert Dolomite Phosphorite Phosphorite, similar to unit P-12 Phosphorite, similar to unit P-12 Phosphorite Siltstone, dolomitic Phosphorite Fault zone Dolomite Limestone Limestone Base of trench	613.0	27.90 26.77 25.80 17.34 26.88 1.38 21.19	.05 .06 .06 .02 .03 .01	.06 .07 .07 .03 .04 .01	9.97 7.35 7.59 8.85 8.97 66.68 13.42	8.58 8.83 11.18 20.25 8.89 13.49 13.48	55.8 109.3 160.9 167.8 221.6 223.2: *250.8

^{*}Cumulative data incomplete. Computations start with zero after interruption.

Unit Rock description ness thick- ness thick (ft) DINWOODY FORMATION—BASAL UNIT ONLY D-1 Limestone, light-brownish-gray (578 6/1), very fine grained, saity, hard, thick-bedded; contains gastropods and bioclastic debris. 5.0 + 5.0 PARK CITY FORMATION AND RELATED STRATA Rex Chert Tongue of Phosphoria Formation P-83 Chert, medium-light-gray (N 6/0), spicular, carbonatic, hard, massive, brecciated, concretionary; grades into a cherty limestone in upper part of unit. 43.0 43.0 Franson Member of Park City Formation P-82 Limestone, very light gray (N 8/0), very fine grained, hard, massive; contains abundant bioclastic debris; contains in fine-grained, sandy dolomite near middle of unit. 34.0 77.0 80 Limestone, light-gray (N 7/0), fine- to coarse-grained, hard; indistinct bedding; contains some light-gray spicular chert beds. 7.0 84.1 81 Dolomite, medium-light-gray (N 7/0), very fine grained, hard; massive; brecefated and recegnized, hard; indistinct bedding; contains some light-gray spicular chert beds. 7.0 84.1 82 Limestone, light-gray (N 7/0), fine- to coarse-grained, hard, massive; brecefated and recegnized, hard; indistinct bedding; contains some light-gray spicular chert beds. 7.0 84.1 83 Limestone, light-gray (N 7/0), fine- to coarse-grained, hard, ansaive; brecefated and recegnized float; exposed and policy of french grained, slity, hard, thin-bedded to massive, brecefated; contains sparse phosphorite pellets and chert pods and lenses; contains several small gouge zones. Meade Peak Phosphatic Shale Tongue of Phosphoria Formation P-78 Phosphorite, very dark gray (N 3/0), fine- to medium-pelletal, slity, calcareous, argillaceous, medium-hard, thin- to thick-bedded, breceiated; top of unit is faulted; this unit combined with the uncert with unit below 67 Fault zone, variegated; dominant colors are dark red (107R 3/6), pale brown (2.57 6/2), and light brownish gray (107R 5/1); unit consists mainly of sandstone and and hosphorite fragments in an unconsolidated sand matrix. 98 Sandstone, similar to unit		$Detailed\ description$, $CP ext{-37}$		
D-1 Limestone, light-brownish-gray (5YR 6/1), very fine grained, silty, hard, thick-bedded; contains gastropods and bioclastic debris. PARK CITY FORMATION AND RELATED STRATA Rex Chert Tongue of Phosphoria Formation P-83 Chert, medium-light-gray (N 6/0), spicular, carbonatic, hard, massive, brecciated, concretionary; grades into a cherty limestone in upper part of unit. Franson Member of Park City Formation P-82 Limestone, very light gray (N 8/0), very fine grained, hard, massive; contains abundant bioclastic debris; contains fine-grained, sandy dolomite men middle of unit. 80 Limestone, light-gray (N 6/0), very fine grained, hard; indistinct bedding; contains some light-gray spicular chert beds. 81 Dolomite, and, massive; brecciated and recemented by calcite; includes chert and dolomite. Too of trench. P-79 Dolomite, dark-grayish-brown (2.5Y 4/2), very fine grained, silty, hard, thin-bedded to massive, brecciated; contains sparse phosphorite pellets and chert pods and lenses; contains several small gouge zones. 80.0 284. Meade Peak Phosphatic Shale Tongue of Phosphoria Formation P-78 Phosphorite, very dark gray (N 3/0), fine- to medium-pelletal, silty, calcareous, argillaceous, medium-hard, thin- to thick-bedded, brecciated; top of unit is faulted; this unit combined with the underlying unit was measured as 5.5 ft thick on north wall of trench; these two units are about 10 ft thick on south wall of trench, whereas they are about 13 ft thick north of the north wall. 79 Phosphorite, smilar to unit P-78; has sharp contact with unit below. 70 Fault zone, variegated; dominant colors are dark red (10YR 3/6), pale brown (2.5Y 6/2), and light brownish gray (10YR 5/1); unit consists mainly of sandstone and phosphorite fragments in an unconsolidated sand matrix. 70 Sandstone, similar to unit P-76; has gradational contact with unit below. 71 Sandstone, similar to unit P-74, 5.0 314. 72 Sandstone, similar to unit P-74, 5.0 314. 73 Sandstone, similar to unit P-74, 5.0 314. 74 Sandstone, similar to unit P-74	Unit		ness	thick- ness
fine grained, silty, hard, thick-bedded; contains gastropods and bioclastic debris 5.0+ 5.0+ 5.0 PARK CITY FORMATION AND RELATED STRATA Rex Chert Tongue of Phosphoria Formation P-83 Chert, medium-light-gray (N 6/0), spicular, carbonatic, hard, massive, brecciated, concretionary; grades into a cherty limestone in upper part of unit. Franson Member of Park City Formation P-82 Limestone, very light gray (N 8/0), very fine grained, hard, massive; contains abundant bioclastic debris; contains fine-grained, sandy dolomite near middle of unit. 81 Dolomite, medium-light-gray (N 6/0), very fine grained, hard; indistinct bedding; contains some light-gray spicular chert beds. 80 Limestone, light-gray (N 7/0), fine-to coarsegrained, hard, massive; brecciated and recemented by calcite; includes chert and dolomite float; exposures are poor; ledge former in part 120.0 P-79 Dolomite, dark-grayish-brown (2.5Y 4/2), very fine grained, silty, hard, thin-bedded to massive, brecciated; contains sparse phosphorite pellets and chert pods and lenses; contains several small gouge zones. Meade Peak Phosphatic Shale Tongue of Phosphoria Formation P-78 Phosphorite, very dark gray (N 3/0), fine-to medium-pelletal, silty, calcareous, argillaceous, argillaceous are about 10 ft thick on south wall of trench, whereas they are about 13 ft thick north of the north wall 79 Phosphorite, smillar to unit P-78; has sharp contact with unit below 70 Fault zone, variegated; dominant colors are dark red (10/R 3/6), pale brown (2.5Y 6/2), and light brownish gray (10/R 5/1); unit consists mainly of sandstone and phosphorite fragments in an unconsolidated sand matrix. 80 Sandstone, similar to unit P-76; basal part is brecciated and iron stained. 81 Sandstone, similar to unit P-74, basal part is brecciated and iron stained and contact with unit belo		DINWOODY FORMATION—BASAL UNIT ON	ILY	
P-83 Chert, medium-light-gray (N 6/0), spicular, carbonatic, hard, massive, brecciated, concretionary; grades into a cherty limestone in upper part of unit. P-82 Limestone, very light gray (N 8/0), very fine grained, hard, massive; contains abundant bioclastic debris; contains fine-grained, sandy dolomite near middle of unit. 81 Dolomite, medium-light-gray (N 6/0), very fine grained, hard; indistinct bedding; contains some light-gray spicular chert beds. 80 Limestone, light-gray (N 7/0), fine- to coarsegrained, hard, massive; breceiated and recemented by calcite; includes chert and dolomite float: exposures are poor; ledge former in part. 120.0 P-79 Dolomite, dark-grayish-brown (2.57 4/2), very fine grained, slity, hard, thin-bedded to massive, breceiated: contains sparse phosphorite pellets and chert pods and lennes; contains several small gouge zones. 80.0 284.1 Meade Peak Phosphatic Shale Tongue of Phosphoria Formation P-78 Phosphorite, very dark gray (N 3/0), fine-to medium-pelletal, slity, calcareous, argillaceous, medium-hard, thin- to thick-bedded, brecciated; top of unit is faulted; this unit combined with the underlying unit was measured as 5.5 ft thick on north wall of trench; these two units are about 10 ft thick on south wall of trench, whereas they are about 13 ft thick north of the north wall 70 Phosphorite, smilar to unit P-78; has sharp contact with unit below. 71 Phosphorite, smilar to unit P-76; has gradational contact with unit below. 72 Sandstone, yellowish-gray (10YR 5/1); unit consists mainly of sandstone and phosphorite fragments in an unconsolidated sand marix. 73 Fault zone, variegated; dominant colors are dark red (10YR 3/6), pale brown (2.5Y 6/2), and light brownish gray (10YR 5/1); unit consists mainly of sandstone and phosphorite fragments in an unconsolidated sand marix. 74 Sandstone, similar to unit P-74, 5.0 309. 75 Fault zone, similar to unit P-74, 5.0 319. 86 Sandstone, similar to unit P-74, 5.0 329. 87 Sandstone, similar to unit P-74, 5.0 329. 88 Sandstone, sim	D-1	fine grained, silty, hard, thick-bedded; con-	5.0+	5.0
Franson Member of Park City Formation P-82 Limestone, very light gray (N 8/0), very fine grained, hard, massive; contains abundant bioclastic debris; contains fine-grained, sandy dolomite near middle of unit 81 Dolomite, medium-light-gray (N 6/0), very fine grained, hard; indistinct bedding; contains some light-gray spicular chert beds 80 Limestone, light-gray (N 7/0), fine- to coarse-grained, hard, massive; brecelated and recemented by calcite; includes chert and dolomite float; exposures are poor; ledge former in part. 120.0 P-79 Dolomite, dark-graysish-brown (2.5Y 4/2), very fine grained, silty, hard, thin-bedded to massive, brecelated; contains sparse phosphorite pellets and chert pods and lenses; contains several small gouge zones. 80.0 Mesde Peak Phosphatic Shale Tongue of Phosphoria Formation P-78 Phosphorite, very dark gray (N 3/0), fine-to medium-pelletal, silty, calcareous, argillaceous, medium-hard, thin-to thick-bedded, brecelated; top of unit is faulted; this unit combined with the underlying unit was measured as 5.5 ft thick on north wall of trench; these two units are about 10 ft thick on south wall of trench, whereas they are about 13 ft thick north of the north wall Phosphorite, smilar to unit P-78; has sharp contact with unit below. Fault zone, similar to unit P-76; has gradational contact with unit below. Fault zone, similar to unit P-76; has gradational contact with unit below. Sandstone, yellowish-gray (10YR 7/1), fine-to coarse-grained, subangular to subrounded, calcareous, hard, thick-bedded to massive; contains argillaceous material, bioclastic debris, and sparse phosphorite pellets; upper part is breceiated and iron stained. Sandstone, similar to unit P-74, 5.0 319. Sandstone, si			RATA	
P-82 Limestone, very light gray (N 8/0), very fine grained, hard, massive; contains abundant bioclastic debris; contains fine-grained, sandy dolomite near middle of unit. 81 Dolomite, medium-light-gray (N 6/0), very fine grained, hard; indistinct bedding; contains some light-gray spicular chert beds. 82 Limestone, light-gray (N 7/0), fine- to coarse-grained, hard, massive; brecciated and recemented by calcite; includes chert and dolomite float; exposures are poor; ledge former in part. 120.0 70 pof trench. P-79 Dolomite, dark-grayish-brown (2.57 4/2), very fine grained, silty, hard, thin-bedded to massive, brecciated; contains sparse phosphorite pellets and chert pods and lenses; contains several small gouge zones. 80.0 284. Meade Peak Phosphatic Shale Tongue of Phosphoria Formation P-78 Phosphorite, very dark gray (N 3/0), fine- to medium-pelletal, silty, calcareous, argillaceous, medium-hard, thin- to thick-bedded, brecciated; top of unit is faulted; this unit combined with the underlying unit was measured as 5.5 ft thick on north wall of trench; these two units are about 10 ft thick on south wall of trench, whereas they are about 13 ft thick north of the north wall of trench; these two units are about 10 ft thick on south wall of trench, whereas they are about 13 ft thick north of the north wall of trench; whereas they are about 13 ft thick north of the north wall is a speciated; dominant colors are dark red (10YR 3/6), pale brown (2.5Y 6/2), and light brownish gray (10YR 5/1); unit consists mainly of sandstone and phosphorite fragments in an unconsolidated sand matrix. 75 Fault zone, similar to unit P-76; has gradational contact with unit below. 76 Fault zone, similar to unit P-76; has gradational contact with unit below and sand sparse phosphorite pellets; upper part is brecciated and iron stained and contains some cherty beds; has gradational contact with unit below (5YR 6/8) to pale-yellowish-orange (10YR 8/6); consists of argillaceous calcereous sandstone and chert fragments; upper part consist	P-83	ary; grades into a cherty limestone in upper	43.0	43.0
grained, hard, massive; contains abundant bioclastic debris; contains fine-grained, sandy dolomite near middle of unit Dolomite, medium-light-gray (N 6/0), very fine grained, hard; indistinct bedding; contains some light-gray spicular chert beds. Stimestone, light-gray (N 7/0), fine- to coarse-grained, hard, massive; brecciated and recemented by calcite; includes chert and dolomite float; exposures are poor; ledge former in part. 120.0 P-79 Dolomite, dark-grayish-brown (2.5Y 4/2), very fine grained, silty, hard, thin-bedded to massive, brecciated; contains sparse phosphorite pellets and chert pods and lenses; contains several small gouge zones. Meade Peak Phosphatic Shale Tongue of Phosphoria Formation P-78 Phosphorite, very dark gray (N 3/0), fine- to medium-pelletal, silty, calcareous, argillaceous, medium-hard, thin- to thick-bedded, brecciated; top of unit is faulted; this unit combined with the underlying unit was measured as 5.5 ft thick on north wall of trench, whereas they are about 13 ft thick north of the north wall are about 13 ft thick north of the north wall of trench, whereas they are about 13 ft thick north of the cate with unit below. Fault zone, variegated; dominant colors are dark red (10/R 3/6), pale brown (2.5Y 6/2), and light brownish gray (10/R 5/1); unit consists mainly of sandstone and phosphorite fragments in an unconsolidated sand matrix. Fault zone, similar to unit P-76; has gradational contact with unit below. Sandstone, yellowish-gray (10/R 7/1), fine- to coarse-grained, subangular to subrounded, calcareous, hard, thick-bedded to massive; contains argillaceous material, bioclastic debris, and sparse phosphorite pellets; upper part is brecciated and iron stained. Sandstone, similar to unit P-74. Sandstone,		Franson Member of Park City Formation		
float: exposures are poor; ledge former in part 120.0 Top of trench P-79 Dolomite, dark-grayish-brown (2.5Y 4/2), very fine grained, silty, hard, thin-bedded to massive, brecciated; contains sparse phosphorite pellets and chert pods and lenses; contains several small gouge zones Meade Peak Phosphatic Shale Tongue of Phosphoria Formation P-78 Phosphorite, very dark gray (N 3/0), fine- to medium-pelletal, silty, calcareous, argillaceous, medium-hard, thin- to thick-bedded, brecciated; top of unit is faulted; this unit combined with the underlying unit was measured as 5.5 ft thick on north wall of trench; these two units are about 10 ft thick on south wall of trench, whereas they are about 13 ft thick north of the north wall 79 Phosphorite, smilar to unit P-78; has sharp contact with unit below 70 Fault zone, variegated; dominant colors are dark red (10YR 3/6), pale brown (2.5Y 6/2), and light brownish gray (10YR 5/1); unit consists mainly of sandstone and phosphorite fragments in an unconsolidated sand matrix 70 Fault zone, similar to unit P-76; has gradational contact with unit below 71 Sandstone, yellowish-gray (10YR 7/1), fine- to coarse-grained, subangular to subrounded, calcareous, hard, thick-bedded to massive; contains argillaceous material, bioclastic debris, and sparse phosphorite pellets; upper part is brecciated and iron stained 71 Sandstone, similar to unit P-74 72 Sandstone, similar to unit P-74 73 Sandstone, similar to unit P-74 74 Sandstone, similar to unit P-74 75 Sandstone, similar to unit P-74 76 Sandstone, similar to unit P-74 77 Sandstone, similar to unit P-74 78 Sandstone, similar to unit P-74 79 Sandstone, similar to unit P-74 70 Sandstone, similar to unit P-74 71 Sandstone, similar to unit P-74 72 Sandstone, similar to unit P-74 73 Sandstone, similar to unit P-74 74 Sandstone, similar to unit P-74 75 Sandstone, similar to unit P-74 76 Sandstone, similar to unit P-74 77 Sandstone, similar to unit P-74 78 Sandstone, similar to unit P-78 79 Sandstone, similar to unit	P-82	Limestone, very light gray (N 8/0), very fine grained, hard, massive; contains abundant bioclastic debris: contains fine-grained, sandy		
float: exposures are poor; ledge former in part 120.0 Top of trench P-79 Dolomite, dark-grayish-brown (2.5Y 4/2), very fine grained, silty, hard, thin-bedded to massive, brecciated; contains sparse phosphorite pellets and chert pods and lenses; contains several small gouge zones Meade Peak Phosphatic Shale Tongue of Phosphoria Formation P-78 Phosphorite, very dark gray (N 3/0), fine- to medium-pelletal, silty, calcareous, argillaceous, medium-hard, thin- to thick-bedded, brecciated; top of unit is faulted; this unit combined with the underlying unit was measured as 5.5 ft thick on north wall of trench; these two units are about 10 ft thick on south wall of trench, whereas they are about 13 ft thick north of the north wall 79 Phosphorite, smilar to unit P-78; has sharp contact with unit below 70 Fault zone, variegated; dominant colors are dark red (10YR 3/6), pale brown (2.5Y 6/2), and light brownish gray (10YR 5/1); unit consists mainly of sandstone and phosphorite fragments in an unconsolidated sand matrix 70 Fault zone, similar to unit P-76; has gradational contact with unit below 71 Sandstone, yellowish-gray (10YR 7/1), fine- to coarse-grained, subangular to subrounded, calcareous, hard, thick-bedded to massive; contains argillaceous material, bioclastic debris, and sparse phosphorite pellets; upper part is brecciated and iron stained 71 Sandstone, similar to unit P-74 72 Sandstone, similar to unit P-74 73 Sandstone, similar to unit P-74 74 Sandstone, similar to unit P-74 75 Sandstone, similar to unit P-74 76 Sandstone, similar to unit P-74 77 Sandstone, similar to unit P-74 78 Sandstone, similar to unit P-74 79 Sandstone, similar to unit P-74 70 Sandstone, similar to unit P-74 71 Sandstone, similar to unit P-74 72 Sandstone, similar to unit P-74 73 Sandstone, similar to unit P-74 74 Sandstone, similar to unit P-74 75 Sandstone, similar to unit P-74 76 Sandstone, similar to unit P-74 77 Sandstone, similar to unit P-74 78 Sandstone, similar to unit P-78 79 Sandstone, similar to unit	81	dolomite near middle of unit Dolomite, medium-light-gray (N 6/0), very fine grained, hard; indistinct bedding; contains	34.0	77.0
P-79 Dolomite, dark-grayish-brown (2.5Y 4/2), very fine grained, silty, hard, thin-bedded to massive, brecciated; contains sparse phosphorite pellets and chert pods and lenses; contains several small gouge zones. Meade Peak Phosphatic Shale Tongue of Phosphoria Formation	80			
Meade Peak Phosphatic Shale Tongue of Phosphoria Formation P-78 Phosphorite, very dark gray (N 3/0), fine- to medium-pelletal, silty, calcareous, argillaceous, medium-hard, thin- to thick-bedded, brecciated; top of unit is faulted; this unit combined with the underlying unit was measured as 5.5 ft thick on north wall of trench; these two units are about 10 ft thick on south wall of trench, whereas they are about 13 ft thick north of the north wall 77 Phosphorite, will are to unit P-78; has sharp contact with unit below. 78 Fault zone, variegated; dominant colors are dark red (10YR 3/6), pale brown (2.5Y 6/2), and light brownish gray (10YR 5/1); unit consists mainly of sandstone and phosphorite fragments in an unconsolidated sand matrix. 78 Fault zone, similar to unit P-76; has gradational contact with unit below. 79 Sandstone, yellowish-gray (10YR 7/1), fine- to coarse-grained, subangular to subrounded, calcareous, hard, thick-bedded to massive; contains argillaceous material, bioclastic debris, and sparse phosphorite pellets; upper part is brecciated and iron stained. 79 Sandstone, similar to unit P-74. 70 Sandstone, similar to unit P-74. 71 Sandstone, similar to unit P-74. 72 Sandstone, similar to unit P-74. 73 Sandstone, similar to unit P-74. 74 Sandstone, similar to unit P-74. 75 Sandstone, similar to unit P-74. 76 Sandstone, similar to unit P-74. 77 Sandstone, similar to unit P-74. 78 Sandstone, similar to unit P-74. 79 Sandstone, similar to unit P-74. 70 Sandstone, similar to unit P-74. 71 Sandstone, similar to unit P-74. 72 Sandstone, similar to unit P-74. 73 Sandstone, similar to unit P-74. 74 Sandstone, similar to unit P-74. 75 Sandstone, similar to unit P-74. 76 Sandstone, similar to unit P-74. 77 Sandstone, similar to unit P-74. 78 Sandstone, similar to unit P-74. 79 Sandstone, similar to unit P-74. 70 Sandstone, similar to unit P-74. 71 Sandstone, similar to unit P-74. 72 Sandstone, similar to unit P-74. 73 Sandstone, similar to unit P-74. 75 Sandstone, similar to unit	P-79	Top of trench Dolomite, dark-grayish-brown (2.5Y 4/2), very fine grained, silty, hard, thin-bedded to mas- sive, brecciated; contains sparse phosphorite		
P-78 Phosphorite, very dark gray (N 3/0), fine- to medium-pelletal, silty, calcareous, argillaceous, medium-hard, thin- to thick-bedded, brecciated; top of unit is faulted; this unit combined with the underlying unit was measured as 5.5 ft thick on north wall of trench; these two units are about 10 ft thick on south wall of trench, whereas they are about 13 ft thick north of the north wall of trench; these two units are about 10 ft thick on south wall of trench, whereas they are about 13 ft thick north of the north wall of trench; these two units are about 10 ft thick on south wall of trench, whereas they are about 13 ft thick north of the north wall of trench; these two units are about 10 ft thick on south wall of trench, whereas they are about 13 ft thick north of the north wall of trench; these two units are about 13 ft thick north of the north wall of trench; these two units are about 13 ft thick north of the north wall of trench; these two units are about 13 ft thick north of the north wall of trench; these two units are about 13 ft thick north of the north wall of trench; these two units are about 13 ft thick north of the north wall of trench, whereas they are about 13 ft thick north of the north wall of trench, whereas they are about 13 ft thick north of the north wall of trench, whereas they are about 13 ft thick north of the north wall of trench, whereas they are about 13 ft thick north of the north wall of trench, whereas they are about 13 ft thick north of the north wall of trench, whereas they are about 13 ft thick north of the north wall of trench, whereas they are about 13 ft thick north of the north wall of trench, whereas they are about 13 ft thick north of the north wall of trench, whereas they are about 13 ft thick north of the north wall of trench, whereas they are about 13 ft thick north of the north wall of trench, whereas they are about 13 ft thick north of the north wall of trench, whereas they are about 12 ft thick north of the north wall of trench, whereas they are about 13 ft thick nor		pellets and chert pods and lenses; contains several small gouge zones	80.0	284.0
P-78 Phosphorite, very dark gray (N 3/0), fine- to medium-pelletal, silty, calcareous, argillaceous, medium-hard, thin- to thick-bedded, brecciated; top of unit is faulted; this unit combined with the underlying unit was measured as 5.5 ft thick on north wall of trench; these two units are about 10 ft thick on south wall of trench, whereas they are about 13 ft thick north of the north wall	Me	ade Peak Phosphatic Shale Tongue of Phosphoria l	ormat	ion
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red (10YR 3/6), pale brown (2.5Y 6/2), and light brownish gray (10YR 5/1); unit consists mainly of sandstone and phosphorite fragments in an unconsolidated sand matrix	77	north wall Phosphorite, smilar to unit P-78; has sharp con-	2.8	286.8
75 Fault zone, similar to unit P-76; has gradational contact with unit below	76	Fault zone, variegated; dominant colors are dark red (10YR 3/6), pale brown (2.5Y 6/2), and light brownish gray (10YR 5/1); unit consists		289.5
74 Sandstone, yellowish-gray (10YR 7/1), fine- to coarse-grained, subangular to subrounded, calcareous, hard, thick-bedded to massive; contains argillaceous material, bioclastic debris, and sparse phosphorite pellets; upper part is brecciated and iron stained. 73 Sandstone, similar to unit P-74. 74 Sandstone, similar to unit P-74. 75 Sandstone, similar to unit P-74. 76 Sandstone, similar to unit P-74. 77 Sandstone, similar to unit P-74. 78 Sandstone, similar to unit P-74. 79 Sandstone, similar to unit P-74. 70 Sandstone, similar to unit P-74. 71 Sandstone, similar to unit P-74. 72 Sandstone, similar to unit P-74. 73 Sandstone, similar to unit P-74. 75 Sandstone, similar to unit P-74. 76 Sandstone, similar to unit P-74. 77 Sandstone, similar to unit P-74. 78 Sandstone, similar to unit P-74. 79 Sandstone, similar to unit P-74. 70 Sandstone, similar to unit P-74. 71 Sandstone, similar to unit P-74. 72 Sandstone, similar to unit P-74. 73 Sandstone, similar to unit P-74. 74 Sandstone, similar to unit P-74. 75 Sandstone, similar to unit P-74. 75 Sandstone, similar to unit P-74. 70 Sands	75	Fault zone, similar to unit P-76; has gradational		293.
73 Sandstone, similar to unit P-74 5.0 309. 72 Sandstone, similar to unit P-74 5.0 314. 71 Sandstone, similar to unit P-74 5.0 319. 70 Sandstone, similar to unit P-74 5.0 324. 69 Sandstone, similar to unit P-74 5.0 324. 69 Sandstone, similar to unit P-74; basal part is brecciated and iron stained and contains some cherty beds; has gradational contact with unit below 5.0 5.0 329. 68 Fault zone, dark-red (10R 3/6) to reddish-yellow (5YR 6/8) to pale-yellowish-orange (10YR 8/6); consists of argillaceous calcereous sandstone and chert fragments; upper part consists of gouge containing spicular chert fragments 5.0 334. 67 Fault zone, similar to unit P-68 5.0 339. 68 Fault zone, similar to unit P-68; primarily gouge containing chert fragments; has gradational	74	Sandstone, yellowish-gray (10YR 7/1), fine- to coarse-grained, subangular to subrounded, cal- careous, hard, thick-bedded to massive; con- tains argillaceous material, bioclastic debris, and sparse phosphorite pellets; upper part is		
brecciated and iron stained and contains some cherty beds; has gradational contact with unit below 5.0 329. 68 Fault zone, dark-red (10R 3/6) to reddish-yellow (5YR 6/8) to pale-yellowish-orange (10YR 8/6); consists of argillaceous calcereous sandstone and chert fragments; upper part consists of gouge containing spicular chert fragments 5.0 334. 67 Fault zone, similar to unit P-68 5.0 339. 68 Fault zone, similar to unit P-68 5.0 344. 69 Fault zone, similar to unit P-68 primarily gouge containing chert fragments; has gradational	73	Sandstone, similar to unit P-74	5.0	
brecciated and iron stained and contains some cherty beds; has gradational contact with unit below 5.0 329. 68 Fault zone, dark-red (10R 3/6) to reddish-yellow (5YR 6/8) to pale-yellowish-orange (10YR 8/6); consists of argillaceous calcereous sandstone and chert fragments; upper part consists of gouge containing spicular chert fragments 5.0 334. 67 Fault zone, similar to unit P-68 5.0 339. 68 Fault zone, similar to unit P-68 5.0 344. 69 Fault zone, similar to unit P-68 primarily gouge containing chert fragments; has gradational	72	Sandstone, similar to unit P-74	5.0	314.
brecciated and iron stained and contains some cherty beds; has gradational contact with unit below 5.0 329. 68 Fault zone, dark-red (10R 3/6) to reddish-yellow (5YR 6/8) to pale-yellowish-orange (10YR 8/6); consists of argillaceous calcereous sandstone and chert fragments; upper part consists of gouge containing spicular chert fragments 5.0 334. 67 Fault zone, similar to unit P-68 5.0 339. 68 Fault zone, similar to unit P-68 5.0 344. 69 Fault zone, similar to unit P-68 primarily gouge containing chert fragments; has gradational		Sandstone, similar to unit P-74	5.0	
68 Fault zone, dark-red (10R 3/6) to reddish-yellow (5YR 6/8) to pale-yellowish-orange (10YR 8/6); consists of argillaceous calcereous sandstone and chert fragments; upper part consists of gouge containing spicular chert fragments. 5.0 334. 67 Fault zone, similar to unit P-68. 5.0 339. 68 Fault zone, similar to unit P-68; primarily gouge containing chert fragments; has gradational	c o	brecciated and iron stained and contains some cherty beds; has gradational contact with unit	· ,	
67 Fault zone, similar to unit P-68. 5.0 339. 66 Fault zone, similar to unit P-68. 5.0 344. 65 Fault zone, similar to unit P-68; primarily gouge containing chert fragments; has gradational	68	Fault zone, dark-red (10R 3/6) to reddish-yellow (5YR 6/8) to pale-yellowish-orange (10YR 8/6); consists of argillaceous calcereous sandstone and chert fragments; upper part consists	•	
66 Fault zone, similar to unit P-68 5.0 344. 65 Fault zone, similar to unit P-68; primarily gouge containing chert fragments; has gradational	67			
a a	66	Fault zone, similar to unit P-68. Fault zone, similar to unit P-68; primarily gouge	5.0	344.
(10R 3/6); chip sample contains a gastropod;	64	a a 4 4 4 4		347.
nas grauational contact with unit below 2.8 850.		(10K 3/6); chip sample contains a gastropod, has gradational contact with unit below	2.8	350.

Unit	Rock description	Cumu- Thick- lative ness thick- (ft) ness (ft)
		(It)

PARK CITY FORMATION AND RELATED STRATA—Continued Meade Peak Phosphatic Shale Tongue of Phosphoria Formation—

Mea	de Peak Phosphatic Shale Tongue of Phosphoria Fo Continued	rmati) II
P-63	Siltetone week red (10R 5/3) to dark-brownish-		
1-00	Siltstone, weak-red (10R 5/3) to dark-brownish- gray (5YR 3/2), siliceous, hard, thin-bedded; contains numerous chert beds about 0.2 ft		
	contains numerous chert beds about 0.2 ft		
	thick; this unit and underlying unit are highly		0500
40	fractured	3.0	$353.3 \\ 358.3$
62 61	Siltstone, similar to unit P-63 Siltstone, similar to unit P-63	$\frac{5.0}{5.0}$	363.3
60	Siltstone similar to unit P-63: has gradational	0.0	000.0
00	Siltstone, similar to unit P-63; has gradational contact with unit below	5.0	368.3
59	Siltstone, light-yellowish-brown (10YR 6/4),		
	slightly calcareous, hard, thick-bedder, lami-	4.0	070.0
	nated in part	4.0	372.3
58	Siltstone, similar to unit P-59; contains a 0.4-ft- thick brecciated chert bed 2 feet below top of unit; has gradational contact with unit below		
	unit: has gradational contact with unit below	4.5	376.8
57	Fault zone, moderate-yellowish-brown $(10YR)$		
	5/4) stained to yellowish-red $(5YR 5/6)$; con-		
	sists of brecciated siliceous slightly calcareous		
	siltstone fragments; has sharp contact with	E 0	381.8
56	unit below	5.0	901.0
90	Siltstone, very pale brown (10YR 7/2), hard, thick-bedded; contains slight iron oxide stain-		
	ing; contains a U.I-it-thick phosphorite bed at		
	upper contact; has sharp contact with unit		
	below	2.3	384.1
55	Siltstone, pale-brown (10YR 6/2), dolomitic, argillaceous, siliceous in part, medium-hard, thick hodded; her sharp contact with unit		
	thick-bedded; has sharp contact with unit		
	• •	1.8	385.9
54	Chert, light-brown (2.5YR 6/4), calcareous, silty, hard, thick-bedded; has sharp contact with unit below		
	silty, hard, thick-bedded; has sharp contact		
	with unit below	.6	386.5
53	Siltstone, pale-brown (10YR 5/2) to brownish- black (10YR 2/1), medium-hard, thick-bedded; colors are light because of weathering		
	golorg are light because of weathering	5.0	391.5
52	Ciltatona similar to unit P-52: has gradational	0.0	001.0
94	Siltstone, similar to unit P-53; has gradational contact with unit below	5.0	396.5
51	Phosphorite, very dark gray (N 3/0), fine- to coarse-pelletal, siliceous, slightly silty and calcareous, hard, thick-bedded; has sharr contact	•••	
	coarse-pelletal, siliceous, slightly silty and cal-		
	careous, hard, thick-bedded; has sharr contact	_	907.0
F 0	with unit below	.5	397.0
50	Siltstone, moderate-yellowish-brown (10YR 5/4), micaceous, medium-hard, thick-bedded; has		
	sharp contact with unit below	2.2	399.2
49	Siltstone, pale-brown (10YR 5/3), dolomitic, slightly calcareous, medium-hard, thick-bedded; has sharp contact with unit below. Mudstone and phosphorite interhedded, Mud-		
	slightly calcareous, medium-hard, thicl-bedded;		
	has sharp contact with unit below	2.0	401.2
48	Mudstone and phosphorite, interbedded. Mudstone, pale-brown (5YR 5/2), phosphatic, silty, calcareous, medium-hard, thin-bedded. Phos-		
	stone, pale-brown (5YR 5/2), phosphatic, silty, calcareous, medium-hard, thin-bedded. Phos-		
	calcareous, medium-hard, thin-bedded. Phosphorite, grayish-brown (7.5 YR 4/2), fine-to coarse-pelletal, argillaceous, silty, medium-		
	coarse-pelletal, argillaceous, silty, medium-		
	hard, thin-bedded; contains calcite-filled chert		
	pods	1.7	402.9
47	Mudstone and phosphorite, similar to unit P-48;	1 7	1010
46	has sharp contact with unit below	1.7	404.6
40	Dolomite, dark-yellowish-brown (10YR 4/2), very fine grained argillaceous silty medium-hard		
	fine grained, argillaceous, silty, medium-hard, thick-bedded; contains sparse phosphorite pel-		
	lets, calcite and chert pods, and rumerous small gouge zones; contains a less than 0.1-ft- thick phosphorite bed near base		
	small gouge zones; contains a less than 0.1-ft-		
4-	thick phosphorite bed near base	3.0	407.6
45 44	Dolomite, similar to unit P-46 Dolomite, similar to unit P-46; contains a 0.1-ft- thick phosphorite bed near base	2.5	410.1
44	thick phosphorite hed near base	2.5	412.6
43	Dolomite, similar to unit P-46; contains a 0.1-ft-		
	this whomb-wite had many have	2.5	415.1
42	Dolomite, similar to unit P-46; contains a 0.1-ft-		44
41	thick phosphorite bed near middle	2.5	417.6
41 40	Dolomite, similar to unit P-46	$\frac{2.5}{2.5}$	$420.1 \\ 422.6$
39	Dolomite, similar to unit P-46; contains a 0.1-ft-thick phosphorite bed near middle. Dolomite, similar to unit P-46 Dolomite, similar to unit P-46 Dolomite, similar to unit P-46	2.5	425.1
38	Dolomite, similar to unit P-46; has sharp contact	2.0	120.1
		2.5	427.6
37	with unit below Chert, very dark gray $(N 3/0)$ to med m-gray $(N 6/0)$, calcareous, hard, brecciated, nodula indistinct bedding; contains calcite rods; has sharp contact with unit below		
	(N 6/0), calcareous, hard, brecciated, nodula	r;	
	sharp contact with unit below	1.4	429.0
	STORE CONTROL MANTE MILL DETOM	1.4	440.U

Unit	Rock description	Thick- ness (ft)	Cumu- lative thick- ness (ft)	Unit	Rock description	Thick- ness (ft)	Cumu- lative thick- ness (11)
	CITY FORMATION AND RELATED STRATA de Peak Phosphatic Shale Tongue of Phosphoria Fo Continued			PAR Mea	K CITY FORMATION AND RELATED STRATA de Peak Phosphatic Shale Tongue of Phosphoria Fo Continued	—Cont or natio	inued on—
	Dolomite, pale-brown (2.5 Y 6/2), very fine grained, argillaceous, medium-hard, brecciated; indistinct bedding; contains sparse chert nodules; has indistinct contact with unit below Fault zone, light-ye'lowish brown (10 YR 4/2);	1.5	430.5	P-19	Siltstone, very pale brown (10YR 7/2), phosphatic, argillaceous, medium-hard, thick-bedded; contains phosphorite consisting of fine to coarse pellets, sparse reworked nodules, laminae, and phosphatic bioclastic debris; has		454.0
34	consists of calcareous soft unconsolidated mud- stone; has indistinct contact with unit below Mudstone, brownish-black (10YR 2/1) (weath- ers moderate yellowish brown (10YR 4/4)), slightly calcareous, silty, soft, fissile; contains	1.4	431.9	18	sharp contact with unit below Fault zone, weak-yellowshi-orange (10YR 7/6); consists of gouge and fragments of dolomite and siltstone; appears to be a near-bedding- plane fault		454.6 455.0
33	sparse chert pods; has sharp contact with unit below Siltstone, pale-brown (2.5YR 5/2), argillaceous,	1.8	433.7		Grandeur Member of Park City Formation		
	slightly calcareous, soft, thick-bedded; contains fine to coarse phosphorite pellets and irregular phosphorite lenses; has gradational contact with unit below	1.5	435.2		Dolomite, light-brownish-gray (10YR 5/1), very fine grained, hard, thick-bedded to massive; fracture is conchoidal; contains brachipods (orbiculoids)	27.0	475.0
32	Mudstone, pale-brown (2.5 Y 6/2), slightly calcareous, silty, soft, thick-bedded; contains phosphorite that ranges from finely pelletal to nodules as much as 1 in. in diameter; has sharp contact with unit below	.5	435.7	16	Dolomite, brownish-gray (10YR 4/1), very fine grained, hard, thick-bedded to massive; fracture is conchoidal; contains small calcite pods, dark-gray chert pods and lenses, and sparse very fine phosphatic debris; contains brachio-		
31	Dolomite, grayish-brown (2.5 Y 5/2), very fine grained, slightly argillaceous, medium-hard, massive	1.8	437.5	P_15	pods (orbiculoids). Similar to unit P-17 Base of trench	17.0	492.0
	Dolomite, similar to unit P-31; has gradational contact with unit below	1.9	439.4		(weathers light gray) 12		613.0
29	Siltstone, light-yellowish-brown (10YR 6/4), slightly calcareous and argillaceous, medium-hard, thick-bedded; contains fine to medium phosphorite pellets and numerous calcite-lined chert geodes; has gradational contact with unit				Chert, dark-gray (N 4/0), hard, massive, brec- ciated, possibly lenticular; contains calcareous pods; has sharp contact with unit below————————————————————————————————————	2.0	615.0
28	below Mudstone, dark-yellowish-brown (10YR 4/2), phosphatic, slightly calcareous, silty, medium- hard, thin- to thick-bedded; contains fine to coarse phosphorite pellets and several thin	.7	440.1	12	pods; has gradational contact with unit below. Phosphorite. light-brownish-gray (10YR 6/1), fine- to coarse-pelletal, slightly calcareous and silty, hard, thin- to thick-bedded; contains cal- cite veinlets.	2.0	617.4
27	phosphorite beds; has gradational contact with unit below Phosphorite, very dark gray (N 3/0), fine- to	.7	440.8	11 10	Phosphorite, similar to unit P-12 Phosphorite, similar to unit P-12; has sharp contact with unit below	2.0	621.4 623.4
	coarse-pelletal, slightly calcareous and silty, medium-hard, thick-bedded; contains sparse phosphorite nodules; has sharp contact with unit below	E	441.3	9	Phosphorite, light-brownish-gray (10YR 6/1), fine-pelletal, calcareous, slightly argillaceous, hard, thick-bedded; has sharp contact with unit		623.8
26	Siltstone, grayish-brown (10YR 4/3), phosphatic, slightly argillaceous and calcareous, mediumhard, thin-bedded; contains fine to medium	.5	441.0	8	below		023,8
25	phosphorite pellets, and chert nodules	2.3 2.2	443.6 445.8	7	unit below	2.0	625.8
24	Mudstone, grayish-brown (7.5YR 4/2), phosphatic, slightly calcareous, silty, soft, thin-bedded, brecciated; contains fine to coarse phos-			6	dark grains; has gradational contact with unit below Phosphorite, medium-gray (N 5/0), fine- to	1.2	627.0
23	phorite pellets, and chert concretions	2.5 2.5	448.3 450.8		coarse-pelletal, calcareous, slightly silty and argillaceous, medium-hard, thin- to thick-bedded; has sharp contact with unit below		628.3
	Faulted and folded zone; contains several fault gouge zones and highly concorted zones; con- sists primarily of dolomite rubble and some chert and phosphorite rubble. Interval meas- ured with Jacob staff set at 30°. Attitude of			5	Fault zone; consists of a limestone breccia, light- red (2.5 YR 6/1) to moderate-orange (7.5 YR 6/6), very fine grained, argillaceous, medium- hard, thick-bedded; upper and lower parts are in place and only partially brecciated; appears		691.0
P-22	beds above and below unit interval is nearly parallel Chert, very dark gray (N 3/0), hard, massive,	(29.5)		4	to be a near-bedding-plane fault Dolomite, light-brownish-gray (10YR 5/1), very fine grained, slightly argillaceous, hard, mas-		631.3
21	brecciated; has sharp contact with unit below Siltstone, light-brownish-gray (10YR 5/1), phosphatic, argillaceous, soft; indistinct bedding; contains fine to coarse phosphorite pellets; contains a 0.1-ft-thick phosphorite bed in	2.0	452.8		sive; has sharp contact with unit below. Limestone, moderate-orange (7.5YR 6/6), very fine grained, slightly argillaceous, mediumhard, thick-bedded; unit may be faulted; has sharp contact with unit below	2.0	633.8 635.8
20	upper part; upper half is stained pale red $(10R 6/2)$; has sharp contact with unit below) Phosphorite, medium-gray $(N 5/0)$, fine-pelletal	1.2	454.0		Limestone, pale-brown (2.5Y 6/2), very fine grained, hard, massive; contains calcite veinlets and sparse phosphatic bioclastic debris	4.2	640.0
	to nodules as much as 5 mm in diameter, slightly calcareous and argillaceous, hard, thick-bedded; contains abundant phosphatic bioclastic debris; has sharp contact with unit		454.4	P-1	Base of trench. Limestone and dolomite, mostly float; light-gray (N 7/0), very fine grained, hard, thick-bedded to massive; contains cherty carbonate rock beds	35.0	675.0
	below	.4	454.4		Contact with Weber Quartzite below		

OGDEN CANYON, CP-38

Trench CP-38 is in Ogden Canyon, NW¹/₄-SW¹/₄ sec. 16, T. 6 N., R. 1 E., Salt Lake meridian, Weber County, Utah. The phosphatic shale member of the Deseret Limestone and adjacent

rocks was described and sampled by E. M. Schell in an old roadcut on the north side of Ogden Canyon. The section is overturned, and the surrounding area is highly folded and faulted. The description is from stratigraphic top to base. Chemical analyses were by K. P. Moore.

Abstract section of only the phosphatic shale member of the Deseret Limestone and adjacent rocks, CP-38

		m		Cumulative		Chemical analyses (percent)				
Sample	Unit	Thickness (ft)	Rock description	thickness (ft)	$P_{2}O_{5}$	V ₂ O ₅	Cr ₂ O ₃	Acid insoluble	Ignition loss	
	M-15	4.0+	Limestone	4.0						
CP-38-1	M-14	3.3	Limestone, argillaceous,							
			siliceous		4.12	0.10	0.04	30.08	27.12	
$\frac{2}{3}$	M-13	.2	Phosphorite	7.5	24.71	.02	.02	6.56	13.46	
3	M-12	1.9	Limestone, argillaceous,							
			siliceous	9.4	2.35	.04	.01	30.44	27.95	
4	M-11	.94	Limestone and phosphorite,							
			interbedded	10.34	8.57	.06	.04	27.71	24.94	
5	M-10	1.81	Limestone and phosphorite,							
			interbedded	12.15	11.17	.03	.03	30.42	19.99	
6	M-9	1.29	Limestone and phosphorite,							
			interbedded	13.44	3.55	.02	.02	14.58	35.31	
7	M-8	.8	Limestone, argillaceous	14.24	0	.01	.02	34.75	29.98	
8	M-7	1.0	Phosphorite, argillaceous,							
			calcareous	15.24	17.76	.08	.10	21.76	19.88	
9	M-6	1.3	Limestone, argillaceous	16.54	0	.02	.01	39.21	25.45	
10	M-5	1.8	Limestone, argillaceous	18.34	0	.03	.02	41.70	27.94	
1:	1 M-4	2.0	Mudstone and phosphorite,							
			interbedded	20.34	13.87	.08	.10	30.60	18.07	
	M-3	.8	Limestone, siliceous	21.14						
	M-2	.2	Limestone, argillaceous							
	M-1	10.0 +	Limestone	31.34						

Detailed description of only the phosphatic shale member of the Descret Limestone and adjacent rocks, CP-38

Cumu-Thick-lative Unit Rock description thick-(ft) ness (ft) Limestone, black (N 2/0), very fine grained, hard, massive; contains calcite veinlets.

Limestone, black (N 2/0), very fine grained, argillaceous, siliceous, sooty, hard, fissile to thin-bedded; contains phosphorite pellets.

Phosphorite, black (N 2/0), fine- to coarse-pelletal, calcareous, hard, thin-bedded.

Limestone, black (N 2/0), very fine grained, argillaceous, siliceous, sooty, hard, massive.

Limestone and phosphorite, interbedded. Limestone, black (N 2/0), very fine grained, argillaceous, hard, fissile to thick-bedded. Phospholaceous, hard, fissile to thick-bedded. Phospho-M-154.0 7.313 7.5 laceous, hard, fissile to thick-bedded. Phosphorite, black (N 2/0), fine- to coarse-pelletal, calcareous, hard, thin-bedded. From top to base, unit consists of the following sequence: Limestone, fissile ... 0.07 Phosphorite Limestone, thick-bedded Limestone, fissile .33 .05 Limestone, thick-bedded Limestone, fissile Total, unit M-11 10.34 Total, unit M-11

Limestone and phosphorite, interbedded. Limestone black (N 2/0), very fine grained, phosphatic, fissile to thin-bedded; some beds are argillaceous and fissile, others are hard single beds. Phosphorite, black (N 2/0), fine-to coarse-pelletal, calcareous, hard, thin-bedded. Unit consists of the following sequence from top to base: Phosphorite 0.07 Limestone, fissile .02 Limestone, thin-bedded Limestone, fissile .10 .04 Phosphorite .09 Limestone, fissile Phosphorite Limestone, thin-bedded .18 Phosphorite Limestone, fissile Limestone, thin-bedded

Detailed description of only the phosphatic shale member of the Descret Limestone and adjacent rocks, CP-38

—Continued

Unit	Rock description	Thick- ness (ft)	Cumu- lative thick- ness (ft)
	Phosphorite		
	Limestone, fissile		
	Phosphorite		
	Limestone, fissile		
	Limestone, thin-bedded22		
	Limestone, fissile		
	Phosphorite		
	Total, unit M-10	1.81	12.15
M-9	Limestone and phosphorite, interbedded: similar		
	to unit M-10. Unit consists of the following		
	sequence from top to base:		
	Ft		
	Limestone, fissile0.18		
	Limestone, thin-bedded		
	Limestone, fissile		
	Phosphorite		
	Limestone, fissile	1 00	13.44
	Total, unit M-9	1.29	13.44
8	Limestone, black $(N 2/0)$, very fine grained,		
	argillaceous, sooty, hard, thin-bedded; fracture	0	1404
-	is platy	.8	14.24
7	Phosphorite, black $(N 2/0)$, fine-to ccarse-pel-		
	letal, argillaceous, calcareous, sooty, fissile;		
	weathered rock is soft, unweathered rock is hard; contains limestone laminae and a 0.3-ft-		
	thick limestone bed 0.1 ft below top	1.0	15.24
	Limestone, black (N 2/0), very fine grained, ar-	1.0	15.24
6	Limestone, black (N 2/0), very fine grained, ar-	1.0	16.54
5	gillaceous, hard, massive	1.5	10.04
ð	Limestone, dark-yellowish-brown (10YR 4/2),		
	very fine grained, argillaceous, hard, massive; contains a 0.2-ft-thick fissile limestone bed at		
		10	18.34
	Mudstone and phosphorite, interbedded, Mud-	1.0	18.04
4	stone, black $(N 2/0)$, calcareous, phosphatic,		
	soft, fissile. Phosphorite, fine- to ccarse-pel-		
	letal: consists of laminae less than 0.1 ft thick	9.0	20.34
3	Limestone, black $(N 2/0)$, sublithographic, silice-	2.0	20.54
9	ous, hard, thick-bedded	.8	21.14
2	Limestone, brownish-gray (5YR 4/1), very fine	.0	21.14
2	grained, argillaceous, soft, fissile	.2	21.34
1	Limestone, dark-gray, very fine grained, hard,	.4	21.04
1	massive; contains chert pods and lenses	1001	31.34
	massive, contains there pous and lenses	10.07	01.04

WHEAT GRASS CREEK, CP-44

Trench CP-44 is at Wheat Grass Creek, SE½NW½NE¼ sec. 26, T. 7N., R. 3 E., Salt Lake meridian, Weber County, Utah. The phos-

phatic section at the base of the Humbug Formation was sampled and described by E. M. Schell and T. E. Mullens in a hand-excavated trench. Chemical analyses were by K. P. Moore.

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		ml.:-1	Rock description	(Cumulative thickness (ft)	Chemical analyses (percent)				_ Thickness		
Sample	Unit	Thickness (ft)					$\mathbf{V_{2}O_{5}}$	Cr_2O_3	Acid insoluble	X perce	205	
			H	lumbug Fo	ormation	—basal p	art only					
	M-15		Limestone Top of trench									
CP-44-1	4 M-14	5.5	Mudstone, dolom				3.83	0.11	0.09	50.09	2	1.06
1	l3 M −13	1.1	Phosphorite, argi				1001		0.0	4504		
1	2 M-12	.6	calcareous Mudstone and pl	hoan bori	to	$\begin{array}{c} 6.6 \\ 7.3 \end{array}$	$18.34 \\ 15.03$	$.09 \\ .19$.03 $.13$	$15.84 \\ 33.63$		$1.23 \\ 0.25$
	1 M-11	.3	Phosphorite, calc				23.50	.06	.03	8.62		7.30
	0 M-10		Limestone and m				4.68	.08	.03	24.54		4.32
9		.1	Phosphorite, dolo	mitic		9.2	19.72	.05	.03	11.96		6.29
8	M-8	.5	Phosphorite, arg	illaceous	s	9.7	15.86	.15	.11	33.06		4.22
7	M-7	.6	Phosphorite, calc				24.20	.09	.05	13.98		8.74
6 5	6 M-6 6 M-5	.7 .6	Phosphorite and Phosphorite	mudsto	ne	$\begin{array}{c} 11.0 \\ 11.6 \end{array}$	$\begin{array}{c} 21.65 \\ 27.74 \end{array}$.14	.09	21.54		$3.89 \\ 0.53$
4	M-5 M-4	.6 .9	Phosphorite and				$\frac{27.14}{19.44}$	$\begin{array}{c} .09 \\ .16 \end{array}$.06 .08	$\begin{array}{c} 6.34 \\ 24.88 \end{array}$		8.03
3	M-3	1.5	Phosphorite	muasto		14.0	28.69	.05	.04	4.12		1.06
2	$\tilde{\mathbf{M}}$.4	Mudstone, phospl	hatic.		1110	20.00	•••	.01	1112		1.00
			calcareous			14.4	13.54	.11	24	37.23	18	6.48
1	M–1	.5	Clay and mudston			14.9	12.20	.12	.36	28.90	19	2.58
	· · · · · · · · · · · · · · · · · · ·		20110)			Limestone						
		3.0+	Limestone, sandy									
	· · · · · · · · · · · · · · · · · · ·		Base of trench		· · · · · · · · · · · · · · · · · · ·	• • • • • • • • • • • • • • • • • • •						
	n.	t m 21 a 21 a 2 a 2	mintion CD 11				Datailai		CD 11	Cantina		
	De	————	cription, CP-44				Detaitea	description	on, CP-44	Continu	lea	C
				Thick- la								- Cumu - lative
Unit		Rock de	escription	ness th	ick-	Unit		Rock	description		ness	thick- ness
						Ome		ItOCK			(ft)	
				(ft) n	ness ft)			Itock ((ft)	(ft)
M 15 T		,	ion—basal part only	(ft) n	ess			Formation—	basal part o		1ed	
٤	mestone, ve	ry dark gra rd, massive;	ny (N 3/0), very fine contains sparse cher	(ft) n (ness ft)		calcareous,	Formation— medium-han parse nodul	basal part or	hick-bedded; hatic lime-	1ed	(ft)
g r	nestone, ve grained, ha nodules abo	ry dark gra rd, massive; ut 1 in. lon	ny (N 3/0), very fine contains sparse cher	(ft) n (ness ft)		calcareous, contains s stone; has Phosphorite	Formation— medium-har parse nodul gradational and mudsto	basal part or d, thin- to t es of phosy basal conta ne, brownish	hick-bedded; hatic lime- et	.6	(ft)
14 Mu	mestone, ve grained, ha nodules abo Top of tren idstone, bro	ry dark gra rd, massive; ut 1 in. lon ich	ay (N 3/0), very fine contains sparse cher g	e t	ness ft)		calcareous, contains s stone; has Phosphorite 2/1), medi	Formation— medium-har parse nodul gradational and mudsto um-hard, th	basal part or cd, thin- to t es of phosy basal conta ne, brownish in-bedded.	hick-bedded; chatic lime- et -black (5 <i>YR</i> Phosphorite,	.6	(ft)
14 Mu	mestone, ve grained, ha nodules abo Top of tren idstone, bro soft, thin-	ry dark gra rd, massive; ut 1 in. lon- ich wnish-gray to thick-b	ny (N 3/0), very fine contains sparse cher g	(ft) n (ness ft)		calcareous, contains s stone; has Phosphorite 2/1), medi fine- to me	Formation— medium-har parse nodul gradational and mudsto um-hard, th dium-pelleta	d, thin- to the of phosphasal contains brownish in-bedded.	hick-bedded; chatic lime- let black (5 <i>YR</i> Phosphorite, Mudstone,	.6	(ft)
14 Mu s h	mestone, ve grained, ha nodules abo Top of tren idstone, bro soft, thin- nackly- to ft-thick pho	ry dark gra rd, massive; ut 1 in. lon ich wnish-gray to thick-k shaly-weathe sphatic mud	y (N 3/0), very finc contains sparse cher g (5YR 4/1), dolomitic coedded, concretionary ering; contains a 0.2 stone 0.4 ft above base	e t t	ness ft)	M-6	calcareous, contains s stone; has Phosphorite 2/1), medi fine- to me fine-pelleta phatic. Ha	medium-har parse nodul gradational and mudsto ium-hard, the dium-pelleta l, slightly is gradation	basal part or d, thin- to these of phosp basal containe, brownish in-bedded. It, calcareous calcareous al basal con	hick-bedded; phatic lime- let	.6	(ft) 10.3
14 Mu s h	mestone, ve grained, ha nodules abo Fop of tren dstone, bro soft, thin- nackly- to ft-thick pho has gradation	ry dark gra rd, massive; ut 1 in. lon: ech	y (N 3/0), very fine contains sparse cherg (5YR 4/1), dolomitic bedded, concretionary ering; contains a 0.2 stone 0.4 ft above base ontact	e t t	ness ft)	M-6	calcareous, contains s stone; has Phosphorite 2/1), medi fine- to me fine-pelleta phatic. Ha Phosphorite,	Formation— medium-har parse nodul gradational and mudsto ium-hard, the dium-pelletal, slightly s gradation black (N 2,	basal part or d, thin- to the es of phosy basal contante, brownish in-bedded. I d, calcareous calcareous al basal con (1), very con	hick-bedded; bhatic lime- ict	.6	(ft) 10.3
14 Mu s h f 13 Ph	mestone, ve grained, ha nodules abo Fop of tren destone, bro- soft, thin- nackly- to ft-thick pho- has gradatio osphorite, ketal, argilli-	ry dark gra rd, massive; ut 1 in. lon ich	y (N 3/0), very fine contains sparse cher g (5YR 4/1), dolomitic pedded, concretionary ering; contains a 0.2 stone 0.4 ft above base ontact y (5YR 4/1), fine-pel areous, soft, thin-tree	et t	ness ft)	M-6	calcareous, contains s stone; has Phosphorite 2/1), medi fine- to me fine-pelleta phatic. Ha Phosphorite, pelletal, sli bedded; co	Formation— medium-har parse nodul gradational and mudsto um-hard, th dium-pelleta l, slightly ss gradation black (N 2 ghtly calcare ontains thin	basal part of d, thin- to t es of phost basal conta ne, brownish in-bedded. I d, calcareous calcareous calcareous (1), very co- cous, medium phostyhati	hick-bedded; bhatic lime- let	.6	(ft) 10.3
14 Mu s h i 13 Ph l	mestone, ve grained, ha nodules abo Top of tren dstone, bro soft, thin- nackly- to ft-thick pho has gradation osphorite, ketal, argille chick-bedded	ry dark gra rd, massive; ut 1 in. lon- ich	y (N 3/0), very fine contains sparse cherg (5YR 4/1), dolomitic bedded, concretionary ering; contains a 0.2 stone 0.4 ft above base ontact by (5YR 4/1), fine-pel areous, soft, thin-tard poorly formed very	(ft) n	1 to	M-6	calcareous, contains s stone; has Phosphorite 2/1), medi fine- to me fine-pelleta phatic. Ha Phosphorite, pelletal, sli bedded; co beds and i	Formation— medium-har parse nodul gradational and mudsto ium-hard, th dium-pelleta l, slightly ss gradation black (N 2, ghtly calcar intains thin four mudsto	basal part of d, thin- to these of phosy basal containe, brownish tin-bedded. I l, calcareous al basal con (1), very cosous, medium phosyhatic planinae;	hick-bedded; bhatic lime- let	.6	10.8
14 Mu s h 13 Ph 1 t 12 Mu	mestone, ve grained, ha nodules abo Top of tren dstone, bro soft, thin- nackly- to tt-thick pho nas gradati oosphorite, k etal, argill- thick-beddee didstone and	ry dark gra rd, massive; ut 1 in. lon. ch	y (N 3/0), very fine contains sparse cherg (5YR 4/1), dolomitic bedded, concretionary ering; contains a 0.2 stone 0.4 ft above base ontact y (5YR 4/1), fine-pel areous, soft, thin-tard poorly formed very gillaceous concretions te, interbedded. Mud	e t t	ness ft)	M-6	calcareous, contains s stone; has Phosphorite 2/1), medi fine- to me fine-pelleta phatic. Ha Phosphorite, pelletal, sli bedded; cc beds and it tional bass Phosphorite:	Formation— medium-han parse nodul gradational and mudsto ium-hard, the dium-pelleta l, slightly ss gradation black (N 2, ghtly calcare notains thin four mudsto al contact and mudston	basal part of d, thin- to the sof phost basal containe, brownish in-bedded. It, calcareous al basal contained to the color of the color	hick-bedded; chatic lime- ct	.6 .7	(ft) 10.8
14 Mu s h f f 13 Ph 1 t 12 Mu	mestone, ve grained, ha nodeles abo Top of tren distone, bro soft, thin- nackly- to t-t-thick pho has gradatio osphorite, le etal, argill hick-beddle chick-beddle chine grained distone and	ry dark gra rd, massive; tt 1 in. lon. ch wnish-gray to thick-le shaly-weath sphatic mud nnal basal co rrownish-gra aceous, calc ; contains h dolomitic ar 1 phosphori (N 2/0), sl	y (N 3/0), very fine contains sparse cherg (5YR 4/1), dolomitic bedded, concretionary ering; contains a 0.2 stone 0.4 ft above base ontact by (5YR 4/1), fine-pel areous, soft, thin-tard poorly formed very gillaceous concretions te, interbedded. Mudiphtly calcareous, soft	(ft) n (1 to	M-6	calcareous, contains s stone; has stone; has Phosphorite 2/1), medi fine- to me fine-pelleta phatic. Ha Phosphorite, pelletal, sli bedded; co beds and itional base Phosphorias 2/1), thin-	Formation— medium-har parse nodul gradational and mudsto ium-hard, th dium-pelleta l, slightly ss gradation black (N 2, ghtly calcare our mudsto al contact and mudstor bedded. Pho	basal part of d, thin- to the sof phosy basal containe, brownish in-bedded. Il, calcareous al basal con (/1), very concus, medium phosyhatione laminae; etc., brownish-sphorite, very brownish-sphorit	hick-bedded; bhatic lime- ctblack (5 YR Phosphorite, and phos- tact arsse to fine- arse to fine- hard, thin- c limestone has grada- black (5 YR Y coarse to	.6 .7	10.8
14 Mu s f f 13 Ph 12 Mu s f 12 Mu	mestone, ve grained, ha nodules abo Top of tren dstone, bro soft, thin- nackly- to tt-thick pho nas gradati osphorite, he etal, argill, thick-bedded fine grained distone and stone, black fissile to the phosphatic.	ry dark gra rd, massive; ut 1 in. lon. ch wnish-gray to thick-lshaly-weathe sphatic mud- mal basal co rownish-gra aceous, calc ; contains h- dolomitic ar l phosphori (N 2/0), sl hin-bedded; Phosphorite	y (N 3/0), very fine contains sparse cherg (5YR 4/1), dolomitic pedded, concretionary ering; contains a 0.2 stone 0.4 ft above base ontact y (5YR 4/1), fine-pel areous, soft, thintard poorly formed very gillaceous concretions te, interbedded. Mudlightly calcareous, soft appears to be non, black (N 2/0), fine	(ft) n (1 to	M-6	calcareous, contains s stone; has Phosphorite 2/1), medi fine- to me fine-pelleta phatic. Ha Phosphorite, pelletal, sli bedded; cc beds and i tional base Phosphorite: 2/1), thin-fine-pelleta ium-hard.	Formation— medium-har parse nodul gradational and mudsto ium-hard, th dium-pelleta l, slightly ss gradation black (N 2, ghtly calcare ntains thin four mudsto al contact and mudstor bedded. Pho ll, slightly of Mudstone,	basal part of d, thin- to the sof phosy basal containe, brownish in-bedded. I d, calcareous al basal con (1), very concous, medium phosyhatic ne laminae; ue, brownish sphorite, veralcareous, se phosyhatic	hick-bedded; hatic lime- ct- t-black (5YR Phosphorite, . Mudstone, and phos- tact arse to fine- hard, thin- c limestone has grada- black (5YR ry coarse to oft to med- and slightly	.6 .7	10.3 11.0
14 Mu s f f 13 Ph 12 Mu s f f	mestone, ve grained, ha nodules abo loo for of trendstone, brother, brother	ry dark grace, massive; ut 1 in. lon. the longer with long	y (N 3/0), very fine contains sparse cher g (5YR 4/1), dolomitic bedded, concretionary ering; contains a 0.2 stone 0.4 ft above base ontact y (5YR 4/1), fine-pel areous, soft, thin-tard poorly formed very gillaceous concretions te, interbedded. Mudlightly calcareous, soft appears to be non, black (N 2/0), fine leareous, argillaceous graplaceous graplaceous argillaceous, argillaceous, argillaceous, argillaceous, graplaceous, argillaceous, argillaceous	ett (ft) n (1 to	M-6 5	calcareous, contains s stone; has Phosphorite 2/1), medi fine- to me fine-pelleta phatic. Ha Phosphorite, pelletal, sli bedded; ec beds and t tional bass Phosphorite 2/1), thinfine-pelleta ium-hard. calcareous,	medium-har parse nodul gradational and mudsto um-hard, the dium-pelleta is gradation black (N 2, ghtly calearentains third four mudsto all contact and mudston black Pholl, slightly contact when the soft mudstone, soft Basal	basal part of d, thin- to the sof phosy basal containe, brownish in-bedded. Il, calcareous al basal con (1), very cous, medium phosyhati ne laminae; te, brownish sphorite, veralcareous, sphosphatic; contact is	hick-bedded; ohatic lime- line- line	.6 .7 .6	10.3 11.0
14 Mu s f f 13 Ph 12 Mu s f 12 Mu s	mestone, ve grained, ha nodules abo fop of trendstone, brote thin-nackly- to tt-thick pho has gradatio osphorite, letal, argill-hick-beddedine grained distone, black fissile to thosphatic, to mediumsoft, thin-bodules. Ha	ry dark gra rd, massive; ut 1 in. lon. uch wnish-gray to thick-leshaly-weathe sphatic mud. onal basal co orownish-gra aceous, calc. i; contains h dolomitic ar d phosphori (N 2/0), sl hin-bedded; Phosphorite pelletal, ca dded; conta s sharp basa	y (N 3/0), very fine contains sparse cherg (5YR 4/1), dolomitic bedded, concretionary ering; contains a 0.2 stone 0.4 ft above base ontact by (5YR 4/1), fine-pel areous, soft, thinard poorly formed vergillaceous concretions te, interbedded. Mud lightly calcareous, soft appears to be non a black (N 2/0), fine-lcareous, argillaceous ins sparse phosphorital contact.	(ft) n (1 to	M-6 5	calcareous, contains s stone; has Phosphorite 2/1), medi fine- to me fine-pelleta phatic. Ha Phosphorite, pelletal, sli bedded; cobeds and itional bass Phosphorite : 2/1), thin-fine-pelleta ium-hard. calcareous, Phosphorite to coarse to	medium-har parse nodul gradational and mudsto ium-hard, the dium-pelleta l, slightly segradation black (N 2, ghtly calcarentains thir four mudsto al contact and mudston hil, slightly compand the soft. Basal brownish-b	basal part of the solution of	hick-bedded; hatic lime-ct- ct- lolack (5 YR Phosphorite, and phos- tact arse to fine- hard, thin- c limestone has grada- black (5 YR ry coarse to oft to med- and slightly gradational 2/1), very	.6 .7 .6	10.3 11.0
14 Mu 14 Mu 15 Ph 13 Ph 14 15 12 Mu 12 Se 14 15 11 Ph	mestone, ve grained, ha nodules abo l'op of trendstone, brc thinnackly- to the thick pot the thick pot has gradatio osphorite, he teal, argillhick-bedded in grained distone and tone, black fissile to the phosphatic. o medium of the think bondoules. Ha osphorite,	ry dark graced, massive; ut 1 in. lon. the massive; ut 1 in. lon. whish-gray to thick-tshaly-weath sphatic much lasal corownish-graceous, calc; contains he dolomitic ard phosphori (N 2/0), shin-bedded; Phosphorite pelletal, caedded; contas black (N 2	y (N 3/0), very fine contains sparse cher g (5YR 4/1), dolomitic bedded, concretionary ering; contains a 0.2 stone 0.4 ft above base ontact by (5YR 4/1), fine-pel areous, soft, thin-tard poorly formed very gillaceous concretions te, interbedded. Mudightly calcareous, soft appears to be none, black (N 2/0), fine leareous, argillaceous ins sparse phosphorital contact 2/0), fine- to coarse	e t (ft) n (5.5 6.6	M-6 5	calcareous, contains s stone; has Phosphorite 2/1), medi fine- to me fine-pelleta, phatic. Ha Phosphorite, pelletal, sli bedded; cc beds and titonal bass Phosphorite: 2/1), thin-fine-pelleta ium-hard. calcareous, Phosphorite, coarse to grillaceou	medium-har parse nodul gradational and mudsto ium-hard, the dium-pelleta l, slightly s gradation back (N 2, ghtly calears mutains thir four mudsto al contact and mudstone, bedded. Pho Mudstone, soft. Basal brownish-b fine-pelletal, s, medium-f	basal part of the solution of	hick-bedded; obatic lime- let -black (5 YR Phosphorite, and phos- latact larse to fine- larse t	.6 .7 .6	10.3 11.0
14 Mu 14 Mu 15 Ph 12 Mu 18 St 11 Ph 11 Ph	mestone, ve grained, ha nodules abo l'op of trendstone, brc thin-nackly- to tt-thick pho has gradati, lose a l'estal, argill-thick-bedded ine grained distone an atone, black to medium-soft, thin-bo nodules. Ha osphorite, peloene shaly	ry dark grace, massive; ut 1 in. lon. the last shall was a common the last shall was a count of the last shall was a count of the last shall was a count of last shall was a c	y (N 3/0), very fine contains sparse cher g (5YR 4/1), dolomitic bedded, concretionary ering; contains a 0.2 stone 0.4 ft above base on tact y (5YR 4/1), fine-pel areous, soft, thin-tard poorly formed very gillaceous concretions te, interbedded. Mudightly calcareous, soft appears to be none, black (N 2/0), fine-leareous, argillaceous ins sparse phosphorital contact 2/0), fine- to coarse 1, thin-bedded; contain.	(ft) n (5.5 6.6	M-6 5	calcareous, contains s stone; has Phosphorite 2/1), medi fine- to me fine-pelleta phatic. Ha Phosphorite, pelletal, sli bedded; ec beds and t tional bass Phosphorite 2/1), thinfine-pelleta ium-hard. calcareous, Phosphorite, coarse to largillaceou nodules as middle and	medium-han parse nodul gradational and mudsto ium-hard, the dium-pelleta gradation black (N 2, ghtly calcarentains this four mudsto al contact and mudstone, and the dium-le soft. Basal brownish-b fine-pelletal, s, medium-le much as (top; basal cotop; b	basal part of the solution of	hick-bedded; ohatic lime- line- line	.6 .7 .6	10.8
14 Mu s h if 13 Ph 1 t f 12 Mu s f 11 Ph 1 t 11 Ph 1 t 11 Ph 1 t 11 Ph 1 t 11 Ph	mestone, ve grained, ha nodules abo for trendstone, brother thinnackly- to tt-thick pho nas gradationsphorite, hetal, argill thick-beddedine grained distone and stone, black fissile to thosphorite, be medium soft, thin-bo nodules. Ha osphorite, solletal, calc some shaly contact	ry dark gra rd, massive; ut 1 in. lon. ch wnish-gray to thick-tshaly-weathe sphatic mud. onal basal co rownish-gra aceous, calc. c; contains h dolomitic ar I phosphorite pelletal, ca edded; conta s sharp basa black (N 1 areous, har interbeds; I mudstone.	y (N 3/0), very fine contains sparse cherg (5YR 4/1), dolomitic bedded, concretionary ering; contains a 0.2 stone 0.4 ft above base ontact y (5YR 4/1), fine-pel areous, soft, thintard poorly formed very gillaceous concretions te, interbedded. Mudlightly calcareous, soft appears to be non, black (N 2/0), fine leareous, argillaceous interbedded. Suddightly calcareous, argillaceous in the contact (N 2/0), fine to coarse (1, thin-bedded; contain has gradational basa)	(ft) n (5.5 6.6	M-6 5	calcareous, contains s stone; has Phosphorite 2/1), medi fine- to me fine-pelleta phatic. Ha Phosphorite, pelletal, sli bedded; cobeds and i tional bass Phosphorite : 2/1), thin-fine-pelleta ium-hard. calcareous, Phosphorite, coarse to argillaceou nodules as middle and Mudstone, we calcareous,	Formation— medium-har parse nodul gradational and mudsto ium-hard, th dium-pelleta l, slightly ss gradation black (N 2, ghtly calcare intains thir four mudsto al contact and mudstone, soft. Basal brownish-b fine-pelletal, s, medium-f much as top; basal c try dark gra	basal part of the solution of	hick-bedded; hatic lime-cet- ct- lead (5YR Phosphorite, . Mudstone, and phos- tact arse to fine- hand, thin- c limestone has grada- black (5YR ry coarse to oft to med- and slightly gradational 2/1), very careous and ve; contains mmeter near adational phosphatic, gradational	.6 .7 .6 .9	10.8 11.6 11.6
14 Mu 14 Mu 18 Ph 18 Ph 19 Ph 11 Ph 11 Ph 15 S 10 Lin	mestone, ve grained, ha nodules abo nodules abo for trendstone, brc thinnackly- to ft-thick phonoas gradatiosphorite, betal, argillchick-bedded distone and tone, black fissile to to phosphatic. The mestone and the shaly contact mestone and massive of massive of massive of massive of the same shaly contact mestone and massive of massive of the same shaly contact mestone and massive of massive of the same shaly contact mestone and massive of massive of the same shaly contact mestone and massive of massive of massive of the same shaly contact mestone and massive of massive of massive of massive of massive of massive of the same shaly contact mestone and massive of massive of massive of massive of the same shall the same	ry dark graft, massive; ut 1 in. lon. ch. wnish-gray to thick-tshaly-weath sphatic mud. onal basal corownish-grae aceous, calc.; contains h dolomitic ar l phosphori (N 2/0), shin-bedded; Phosphorite pelletal, ca dded; conta s sharp basa sharp basa interbeds; l mudstone. very fine grae di massive.	y (N 3/0), very fine contains sparse cher g (5YR 4/1), dolomitic bedded, concretionary ering; contains a 0.2 stone 0.4 ft above base ontact y (5YR 4/1), fine-pel areous, soft, thin- tard poorly formed very gillaceous concretions te, interbedded. Mudightly calcareous, soft appears to be none, black (N 2/0), fine leareous, argillaceous ins sparse phosphorital contact 2/0), fine- to coarse 1, thin-bedded; contain has gradational basa Bulk of unit made upined limestone concre	(ft) n (e t 1.1	5.5 6.6	M-6 5 4 3 2 2	calcareous, contains s stone; has Phosphorite 2/1), medi fine- to me fine-pelleta phatic. Ha Phosphorite, pelletal, sli bedded; cc beds and t tional base Phosphorite: 2/1), thin-fine-pelleta ium-hard. calcareous, Phosphorite, coarse to argillaceou nodules as middle and Mudstone, ve calcareous, basal cont	medium-har parse nodul gradational and mudsto ium-hard, the dium-pelleta l, slightly is gradation black (N 2, ghtly calear mutains thin four mudsto and mudston bedded. Pho lu, slightly c Mudstone, soft. Basal brownish-b fine-pelletal, s, medium-f much as 0 top: basal c top: basal c top: basal c top; basal c soft, fissile act	basal part of the solution of	hick-bedded; obatic lime- linet lime- linet lime- linet lime lime lime lime lime lime lime lime	.6 .7 .6 .9 .4	10.8 11.6 11.6
14 Mu s s h f h 13 Ph 1 t t 12 Mu s f 11 Ph 11 Ph 12 S 10 Lin c t	mestone, ve grained, ha nodules abo Top of trendstone, brc thin-nackly- to ft-thick pho nas gradati osphorite, it can be to the thick-bedded distone and tone, black fissile to thosphorite, to medium-soft, thin-be nodules. Ha osphorite, celletal, calcome shaly contact	ry dark graft, massive; ut 1 in. lon. ch. wnish-gray to thick-tshaly-weathesphatic mudically contains his dolomitic are pelecular to the contains his dolomitic are pelecular, calc. Phosphorit (N 2/0), sl hin-bedded; contains sharp bass black (N 2 areous, hard interbeds; di mudstone, very fine grafted, as 9, 9 ft. has 0.9 ft.	y (N 3/0), very fine contains sparse cherg (5YR 4/1), dolomitic bedded, concretionary ering; contains a 0.2 stone 0.4 ft above base ontact some of the contact of the cont	(ft) n (ee t 1.1	5.5 6.6	M-6 5 4 3 2 2	calcareous, contains s stone; has Phosphorite 2/1), medi fine- to me fine-pelleta phatic. Ha Phosphorite, pelletal, sli bedded; cc beds and fittional bass Phosphorite: 2/1), thin-fine-pelleta ium-hard. calcareous, Phosphorite, coarse to largillaceou nodules as middle and Mudstone, ve calcareous, basal cont Clay and mu	medium-har parse nodul gradational and mudsto ium-hard, the dium-pelleta l, slightly is gradation black (N 2, ghtly calear mutains thin four mudsto and mudston bedded. Pho lu, slightly c Mudstone, soft. Basal brownish-b fine-pelletal, s, medium-f much as 0 top: basal c top: basal c top: basal c top; basal c soft, fissile act	basal part of the soft phosy basal contains, brownish in-bedded. It calcareous all basal contains phosyhatic phosyhatic phosyhatic contact is lack (5YR slightly calcareous, you (N 6/9), to platy; has dish-brown,	hick-bedded; hatic lime- ctic lime ctic	.6 .7 .6 .9 .1.5	10.8 11.6 11.6 12.8
14 Mu 13 Ph 13 Ph 14 t 12 Mu 11 Ph 15 t 10 Lin 10 Lin 10 Lin 10 Lin	mestone, ve grained, ha nodules aboo for trendstone, brown to ft-thick pho for the trendstone, brown to ft-thick pho for the trendstone, brown to ft-thick pho for the trendstone and to ft-thick phosphatic. The trendstone to ft-thin-brodules. Ha osphorite, pelletal, calcione shaly mestone and massive tions as mulark-grayisl to fissile. U	ry dark graft, massive; ut 1 in. lon. ch. wnish-gray to thick-tshaly-weathe sphatic mud shall basal corownish-grae aceous, calc.; contains he dolomitic are in phosphorite pelletal, cadded; contas sharp basa black (N 2 areous, hard interbeds; la mudstone. cryfine grach as 0.9 ft. 1-brown (10 pper part of	y (N 3/0), very fine contains sparse cherg (5YR 4/1), dolomitic bedded, concretionary ering; contains a 0.2 stone 0.4 ft above base ontact by (5YR 4/1), fine-pel areous, soft, thin-tard poorly formed very gillaceous concretions te, interbedded. Mudightly calcareous, soft appears to be none, black (N 2/0), fine leareous, argillaceous ins sparse phosphorital contact 2/0), fine-to coarse 1, thin-bedded; contains and sparadational basa Bulk of unit made upined limestone concretind diameter. Mudstone 1/YR 3/2), thin-bedder funit contains a 0.05	e t (ft) n (5.5 6.6	M-6 5 4 3 2 2	calcareous, contains s stone; has Phosphorite 2/1), medi fine- to me fine-pelleta phatic. Ha Phosphorite, pelletal, sli bedded; cc beds and tional base Phosphorite: 2/1), thin-fine-pelleta ium-hard. calcareous, Phosphorite, coarse to argillaceou nodules as middle and Mudstone, ve calcareous, basal cont Clay and mu and medium calcareous,	medium-har parse nodul gradational and mudsto ium-hard, td dium-pelletal l, slightly is gradation black (N 2 ghtly calcar intains thi four mudsto al contact and mudston bedded. Pho Mudstone, soft. Basal brownish-b fine-pelletal, s, medium- much as (top; basal c cry dark gra soft, fissile act ddstone, red m- to light-g soft, shal	basal part of the soft phosphatic alcareous al basal contains phosphatic alcareous al basal contains phosphatic alcareous al basal contains phosphatic alcareous, medium phosphatic alcareous, sphosphatic contact is gradiant phosphatic alcareous, sphosphatic alcareous, alcareous	hick-bedded; obatic lime- let	.6 .7 .6 .9 .4	10.8 11.6 11.6 12.8
14 Mu 18 Ph 18 Ph 1 t 12 Mu 1 t 1 t 1 t 1 t 1 t 1 t 1 t 1 t	mestone, ve grained, ha nedules abo nedules abo frop of trendstone, brc thin-nackly- to ft-thick pho ness gradations argulation of the set of t	ry dark graft, massive; ut 1 in. lon. ch. wnish-gray to thick-tshaly-weath sphatic mud. sphatic mud. ch. contains h. dolomitic ard l. contains h. dolomitic ard l. phosphorite. Phosphorite. Phosphorite. ch. ch. ch. ch. ch. ch. ch. ch. ch. ch	y (N 3/0), very fine contains sparse cherg (5/R 4/1), dolomitic bedded, concretionary ering; contains a 0.2 stone 0.4 ft above base ontact (5/R 4/1), fine-pel areous, soft, thin-tard poorly formed very (5/R 4/1), fine-pel areous, soft, thin-tard poorly formed very gillaceous concretions te, interbedded. Mudightly calcareous, soft appears to be none, black (N 2/0), fine-ledaceous, argillaceous ins sparse phosphorital contact (2/0), fine- to coarse 1, thin-bedded; contains a gradational basa gradational basa gradational basa interbedded; contained limestone concrein diameter. Mudstone (1/2 N 3/2), thin-beddef unit contains a 0.05 lstone. Has sharp basa	(ft) n (e t	5.5 6.6 7.3	M-6 5 4 3 2 2	calcareous, contains s stone; has Phosphorite 2/1), medi fine- to me fine-pelleta phatic. Ha Phosphorite, pelletal, sli bedded; cc beds and i tional base Phosphorite 2/1), thin-fine-pelleta ium-hard. calcareous, Phosphorite, coarse to argillaceou nodules as middle and Mudstone, ve calcareous, basal cont Clay and mu and mediucalcareous, pears to b	medium-har parse nodul gradational and mudsto ium-hard, td dium-pelleta l, slightly ss gradation black (N 2, ghtly caleare mutains thir four mudsto and mudstone, soft. Basal brownish-b fine-pelletal, much as top; basal c ery dark gra soft, fissile act distone, redd dustone, red dustone, red mudstone, red much as top; basal c ery dark gra soft, fissile act much to light-g	basal part of the solution of	hick-bedded; hatic lime- ct- ct- lack (5 YR Phosphorite, and phos- tact arse to fine- hard, thin- c limestone has grada- black (5 YR ry coarse to odaft to med- fixed to med- fixed to med- gradational 2/1), very careous and ve; contains meter near adational phosphatic, gradational dark-brown, atic, slightly Unit ap- ally crushes	.6 .7 .6 .9 .4	10.8 11.6 11.6 12.8
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14 Mu s i i i i i i i i i i i i i i i i i i	mestone, ve grained, ha nodules abo l'op of trendstone, brc thinnackly- to tt-thick pho has gradatio osphorite, betal, argillchick-bedded fine grained distone an stone, black sissile to the phosphatic. o medium soft, thin-bonodules. Ha osphorite, pelletal, calc some shally contact mestone and f massive tions as mu lark-grayislo fissile. Uft-thick pho contact osphorite, osphorite, osphorite, displayed to the solution of the side of the	ry dark graft, massive; ut 1 in. lon. the long of the	y (N 3/0), very fine contains sparse cher g (5YR 4/1), dolomitic bedded, concretionary ering; contains a 0.2 stone 0.4 ft above base ontact by (5YR 4/1), fine-pel areous, soft, thin-tard poorly formed very gillaceous concretions te, interbedded. Mudightly calcareous, soft appears to be none, black (N 2/0), fine-to contact 2/0), fine-to coarse 1, thin-bedded; contain as gradational basa Bulk of unit made up ained limestone concre in diameter. Mudstone 1/YR 3/2), thin-beddef unit contains a 0.05 stone. Has sharp basa ay (10YR 4/1), fine thin-bedded; has grad the stone of	e t (ft) n (5.5 6.6 7.3 7.6	M-6 5 4 3 2 2	calcareous, contains s stone; has Phosphorite 2/1), medi fine- to me fine-pelleta phatic. Ha Phosphorite, pelletal, sli bedded; cc beds and i tional base Phosphorite 2/1), thin-fine-pelleta ium-hard. calcareous, Phosphorite, coarse to argillaceou nodules as middle and Mudstone, ve calcareous, basal cont Clay and mu and mediucalcareous, pears to b	medium-har parse nodul gradational and mudsto ium-hard, the dium-pelleta l, slightly is gradation black (N 2, ghtly caleare intains thin four mudsto al contact and mudston bedded. Pho hownish-b fine-pelletal, smedium-f much as 0 top: basal c top: basal c top: basal c top: dark gra soft, fissile act distone, red distone, red distone, red distone, red gra soft, shal e a fault z bed	basal part of the solution of	hick-bedded; obatic lime- line lime line lime. -black (5 YR Phosphorite, and phos- litate lime line lime lime lime lime lime lime lime lim	.6 .7 .6 .9 .1.5 .4	10.3 11.6 11.6 12.4 14.6
14 Mu s f f f f f f f f f f f f f f f f f f	mestone, ve grained, ha nodules abo Top of trendstone, brown the thin as gradati, to sphorite, betal, argill-thick-beddee fine grained distone and tone, black fissile to the phosphatic, to medium-soft, thin-be nodules. He nodules had sophorite, peletal, calc mestone and fine grained distone and the sphorite, be not mestone shalve ontact mestone and finassive the sphorite, peletal, calc betal, calc be not sphorite, peletal, dokational basa cosphorite, peletal, dokational basa cosphorite, pesited, dokational basa cosphorite, pesited, dokational basa cosphorite, peletal, dokational cosphorite, peletal, dokational cosphorite, peletal, dokational cosphorite, peletal, dokational cosphorite, dokational cos	ry dark grad, massive; ut 1 in. lon. the massive; ut 1 in. lon. whish-gray to thick-lshaly-weaths sphatic much lasal corrownish-gradeeous, caic.; contains holomitic arl phosphorit (N 2/0), sl hin-bedded; Phosphorite pelletal, cadded; conta s sharp basablack (N 2 areous, hard interbeds; in mudstone. Very fine grade containt of the mudstone. Very fine grade containt of the per part of the prown (10 pper part of the prownish-grade contact of the prownish-grade contact of the prownish-grade contact of the proportion of the prownish-bla	y (N 3/0), very fine contains sparse cher g (5YR 4/1), dolomitic bedded, concretionary ering; contains a 0.2 stone 0.4 ft above base ontact by (5YR 4/1), fine-pel areous, soft, thin- trard poorly formed very gillaceous concretions te, interbedded, Mudlightly calcareous, soft appears to be none, black (N 2/0), fine-leareous, argillaceous ins sparse phosphorital contact 2/0), fine- to coarse 1, thin-bedded; contain-has gradational basa Bulk of unit made up ained limestone concretin diameter. Mudstone in diameter. Mudstone in diameter. Mudstone in diameter. Has sharp basa ay (10YR 4/1), fine thin-bedded; has grad ck (5YR 2/1), fine-te	(ft) n (e t t	5.5 6.6 7.3	M-6 5 4 3 2 1	calcareous, contains s stone; has Phosphorite 2/1), medi fine- to me fine-pelleta phatic. Ha Phosphorite, pelletal, sli bedded; cobeds and it tional bass Phosphorite: 2/1), thin-fine-pelleta ium-hard. calcareous, Phosphorite, coarse to argillaceou nodules as middle and Mudstone, ve calcareous, basal cont Clay and mediun calcareous, pears to b underlying	medium-har parse nodul gradational and mudsto ium-hard, the dium-pelleta l, slightly ss gradation black (N 2 ghtly calcar intains thin four mudsto and mudsto l, slightly calcar mudsto l, slightly calcar mudsto soft, Basal to top; basal c top; basal c rey dark gra soft, fissile act distone, red m- to lighte soft, shal se a fault ze bed Lodgepo	basal part of the state of the	hick-bedded; hatic lime- ct ct lime- ct -black (5 YR Phosphorite, and phos- tact arse to fine- hard, thin- c limestone has grada- black (5 YR ry coarse to off to med- and slightly gradational 2/1), very careous and ve; contains weter near dational phosphatic, gradational dark-brown, atic, slightly i. Unit ap- ally crushes	.6 .7 .6 .9 .1.5 .4	10.3 11.6 11.6 12.4 14.6
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14 Mu 14 Mu 15 Ph 16 12 Mu 18 8 Ph 19 Ph 10 Line 10 Line 10 Line 10 Ph 10 Ph	mestone, ve grained, ha nodules abo l'op of tren distone, brc thin-nackly- to tt-thick pho has gradati, betal, argill-thick-bedded fine grained distone and atone, black sissile to the phosphatic, to medium-soft, thin-bondules. Ha comment of massive tions as mustone and fine grained distone and the sissile to the phosphatic, the medium-soft, thin-bondules. Ha comment of massive tions as mustone and fine sissile. Ut-thick photontact component to the pelletal, dolational bass cosphorite, lovery coarse careous, sof	ry dark grad, massive; ut 1 in. lon. the massive; ut 1 in. lon. whish-gray to thick-lshaly-weaths sphatic much lonal basal eccepts, calci; contains holomitic arl phosphori (N 2/0), si hin-bedded; Phosphorite (N 2/0), si hin-bedded; Contains holomitic ard phosphorite pelletal, cadded; contains sharp basas black (N 2 areous, hard interbeds; il mudstone, very fine grach as 0.9 ft. 1-brown (10 pper part of sphatic mud prownish-gramitic, hard, I contact prownish-bla-pelletal, arg, thin-bedded.	y (N 3/0), very fine contains sparse cher g (5YR 4/1), dolomitic bedded, concretionary ering; contains a 0.2 stone 0.4 ft above base ontact by (5YR 4/1), fine-pel areous, soft, thin- trard poorly formed very gillaceous concretions te, interbedded, Mudlightly calcareous, soft appears to be none, black (N 2/0), fine-leareous, argillaceous ins sparse phosphorital contact 2/0), fine- to coarse 1, thin-bedded; contain-has gradational basa Bulk of unit made up ained limestone concretin diameter. Mudstone in diameter. Mudstone in diameter. Mudstone in diameter. Has sharp basa ay (10YR 4/1), fine thin-bedded; has grad ck (5YR 2/1), fine-te	e t (ft) n (5.5 6.6 7.3 7.6	M-6 5 4 3 2 1	calcareous, contains s stone; has Phosphorite 2/1), medi fine- to me fine-pelleta phatic. Ha Phosphorite, pelletal, sli bedded; cc beds and t tional bass Phosphorite: 2/1), thin-fine-pelleta ium-hard. calcareous, Phosphorite, coarse to argillaceou nodules as middle and Mudstone, ve calcareous, basal cont Clay and mu and mediun calcareous, pears to b underlying	medium-har parse nodul gradational and mudsto ium-hard, the dium-pelleta l, slightly ss gradation black (N 2 ghtly calcar intains thin four mudsto and mudsto l, slightly calcar mudsto l, slightly calcar mudsto soft, Basal to top; basal c top; basal c rey dark gra soft, fissile act distone, red m- to lighte soft, shal se a fault ze bed Lodgepo	basal part of the state of the	hick-bedded; hatic lime- let -black (5 YR Phosphorite, and phos- tact arse to fine- learned phose hatact arse to fine- learned phose has grada- black (5 YR ry coarse to oft to med- and slightly gradational 2/1), very careous and le; contains meter near dational dark-brown, atic, slightly cy careous and dark-brown, atic, slightly cy crushes e R 6/1), very ve; contains	.6 .7 .6 .9 .1.5 .4	10 11 12 14