# CT d: 1/2000 Sec-Twn-Ra: Sec. 22, T. 6 S., R. 43 E.

WESTERN PHOSI	PHATE PROJECT					
Section: wpsJ	Date Logged: 1/2000	<b>Sec-Twn-Ra:</b> Sec. 22, T. 6 S., R. 43 E.				
Formation: Phosphoria		<b>Lat:</b> approx. 42 deg., 53.00' N.				
Member: Meade Peak Pho	sphatic Shale	<b>Long:</b> approx. 111 deg., 24.60' W.				
Measured By: Tysdal, John	nson, Grauch, Herring, Desborough	Quadrangle: Wayan West				
Notes: Logging of core		Mine: Enoch Valley				

N	Member: Meade Peak Phosphatic Shale Measured By: Tysdal, Johnson, Grauch, Herring, Desborough Notes: Logging of core	Long: approx. 111 deg., 24.60' W. Quadrangle: Wayan West Mine: Enoch Valley									
FEET LITH.	DESCRIPTION	Mo (ppm) UNIT	Zr (ppm)	Sr (ppm)	Rb (ppm) 0 0 0 0	Pb (ppm) Se (ppm) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0	Zn (ppm) 0 Cu (	opm) O Ni (ppm)	0	Mn (ppm) O Cr (ppm) O O O O O O O O O O O O O O O O O O O
185	Chert: It gray;  Phosphorite: dk gray; pelletal, med grained; some pellets are silicified in uppermost	Rex Chert Upper Waste									
	part of interval; dense; white to lt gray specks of secondary minerals.  Mudstone: dk gray; some zones are silty; carbonaceous; 1-2 in. fragments.	Upper Waste	5		W.V.V.				3	\$	
180 —	Mudstone: dk gray; some zones are carbonaceous; v lt weight, punky; 1-2 in.  fragments.  Mudstone: dk gray; sl calcareous to dolomitic in lower 0.7 in., particularly in 0.04 in. thick laminae; v carbonaceous in middle 0.7 in., friable, disaggregated; finely	Upper Waste  Upper Waste	~\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\		- Control						
1	laminated; solid core.  Mudstone: dk gray; carbonaceous; vuggy—dissolution along laminae	Upper Waste			W. W.					\$47 \r. \range \	
175	in some core segments.  Mudstone: gradational from strata below to those above: 172-173.4 ft interval	Upper Waste				<u> </u>			\$2.00 m		
170	is It brownish gray; dolomitic. 171.4-172 ft interval is v silty; laminated. 170.4171.4 is med gray. Lesigang banding occurs throughout lower 1.8 ft of unit. Core 'entirely fragmented.  Mudstone: dk gray; v carbonaceous.	Upper Waste						}		557	
-   -	Siltstone: dk gray; noncalcareous; carbonaceous; 0.25-1 in. thick bedding in some 1-2 in. fragments; abundant white specks of a secondary mineral.  Phosphorite: dk gray; pelletal, f to med grained; silicified locally, with lt blue quartz	Upper Waste Upper Waste Upper Waste							\$ }		
165	Jocally replacing pellets and matrix; white secondary minerals, some acicular; 1-2 in. fragments.  Mudstone: dk gray; faint lamination; gradational into overlying unit; solid core, except that lower 0.6 in. fragmented into 1-2 in. size chips.	D Bed	No.		\ \range of the control of the		>		\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\		
160	Phosphorite: dk gray; pelletal, cse grained.  Phosphorite: dk gray; pelletal, f to cse grained; carbonaceous; some laminae;	D Bed  D Bed	5	No.	March J. S. J.	7					
	slickensides; local white specks of secondary minerals within some layers.  Phosphorite: dk gray; pelletal, f to cse grained; abundant white specks of secondary minerals; 0.5-1 in. fragments.	D Bed  D Bed  D Bed		M. A.	To The Local Law You	A STORY OF THE STORY					
155 - 0000000000000000000000000000000000	Phosphorite: dk gray; pelletal, f to cse grained; abundant white specks of secondary minerals; 0.5-1 in. fragments.  Phosphorite: and lesser interbedded mudstone. Phosphorite: dk gray; pelletal, f to cse grained; dense. Mudstone: dk gray; noncalcareous. Local white specks of	D Bed  D Bed									
- 000000 - 0000000000000000000000000000	secondary minerals. slickensides; 0.5-2 in. fragments.  Phosphorite: dk gray; pelletal, cse grained; dense; local white specks of secondary minerals; slickensides.	D Bed  D Bed  D Bed									
150 - 0000	Phosphorite: dk gray; pelletal, f grained; dense; finely laminated, planar; slickensides. This interval "represented" by about 4 in. of core fragments.  Phosphorite: dk gray; pelletal, v f grained; earthy; some slickensides. This interval "represented" by about 2 in.of core fragments.	D Bed D Bed	Two and the second					\$			
145	Phosphorite: dk gray; f grained, pelletal to nonpelletal; planar fine laminae; laminae emphasized by white secondary minerals. This interval "represented" by about 4 in. of core fragments.	Middle Waste  Middle Waste  Middle Waste						>			
	Phosphorite: dk gray; f grained, pelletal to nonpelletal; planar fine laminae; laminae emphasized by white secondary minerals. This interval "represented" by about 4 in. of 1-3 in. core fragments.	Middle Waste									
140	Phosphorite: dk gray; f grained, pelletal to nonpelletal; planar fine laminae; laminae emphasized by white secondary minerals. This interval "represented" by about 6 in. of 0.5-1 in. core fragments.  Phosphorite: dk gray; planar laminae; one fragment displays micro-	Middle Waste			~~\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\			<b>}</b>	3	A A A A A A A A A A A A A A A A A A A	
	ripple crosslaminae; specks of white secondary minerals, which in upper few inches are confined to specific laminae; specks are soluble in water; 1-2 in. fragments.  Phosphorite: dk gray; pelletal locally, f grained; locally silty; some planar laminae; 1 in. fragments.	Middle Waste	A A A A A A A A A A A A A A A A A A A	M. M.				3	The state of the s		
135	Siltstone: dk gray; upper part contains some phosphorite, dk gray, pelletal; 0.25-0.5 in. fragments.  Mudstone: dk gray. About 4 in.of core fragments "represent" this interval.	Middle Waste	25						7	<u> </u>	√\\\ \ \ \ \\\\\\\\\\\\\\\\\\\\\\\\\\\
130	Siltstone: dk gray; local mudstone zones, mainly in upper half of unit; sl fetid; fragments less than 0.25 to 1 in.  Siltstone: dk gray; organic rich; fetid; finely laminated; 0.1-0.25 in. thick carbon seams, or v carbonaceous siltstone; abundant white specks of secondary				W. J. Jackson J. V.					Market Ma	
- — — — — — — — — — — — — — — — — — — —	minerals, some acicular; mostly 0.25-1 in. fragments.  Mudstone: dk gray; finely laminated; abundant white films, -along fractures?gypsum; other white secondary minerals are 'acicular; mostly fragments less than 0.25 in.	Middle Waste  Middle Waste			Market Andrews						
125	Mudstone: and siltstone, interbedded. Mudstone, as in overlying unit; siltstone as in underlying unit.  Siltstone: dk gray; finely laminated; bands 0.25-1 in. thick; ?graded; fetid;	Middle Waste		The state of the s						W-V-	
120	local 0.1-0.5 in. thick carbon seams in 129.4-131 ft interval, in two zones, each 4-6 in. thick; basal 1.2 ft contains 0.5-1.5 in. dia irregularly shaped diagenetic nodules that cut acorss depositional layers.  Siltstone: med gray; 127.4-128 ft interval is calcareous; fetid; porous; white specks of secondary minerals throughout	Middle Waste  Middle Waste			VM -				\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\		
	white specks of secondary minerals throughout.  Mudstone: dk gray; local diagenetic nodules, to 1 in. dia; dense?phosphatic; lower 4 in. is claystone (?altered mudstone), spongy, with 0.04 in. dia holes?molds of microfossils; white specks of secondary minerals throughout;				No.		**************************************				
115	Mudstone: dk gray. Poor recovery—drilling mud and filler.  Mudstone: dk gray; finely laminated; some phosphate zones 1-2 in. thick;	Middle Waste					>				
110 - 00000	well indurated; coherent core.  Mudstone: dk gray; phosphorite zones throughout unit; mostly small fragments.  Mudstone: dk gray; local phosphorite, pelletal, f grained; partly finely laminated;	Middle Waste								\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	
- 00000 - 00000 - 00000	typically 1-3 in. fragments.  Phosphorite: dk gray; pelletal, med grained; mudstone, finely laminated, in 0.5-1 in. thick fragments; generally forms tiny chips; calcareous siltstone forms 3-4 in. fragments in middle of unit.	Middle Waste			Mary Mary	Wed / Joan					
105	Mudstone: dk gray; local phosphorite horizons; finely laminated; one 6 in. length of core contains two 0.25-0.5 in. thick carbon seams (106-106.7 ft interval); 0.04 in. dia orange-rimmed white "specks" locally ?microfossils, ?"nodules".	Middle Waste									
100	Mudstone: dk gray; finely laminated; generally broken into 1 in. pieces, except for local 3-4 in. fragments that are calcareous; carbonaceous throughout, with some zones v carbonaceous; some carbon-rich laminae are shiny, sheared into slickensides.		\(\frac{1}{2}\)		MANN				\$\frac{1}{2} \tag{A}		
	Dolomite: med gray; v f grained; abundant 0.04 in. thick calcite veinlets; fragments of megafossils (?brachiopods) are isolated—floating—within dolomite; nearly continuous core.	Middle Waste		8	VAX.						
95	Mudstone: dk gray; finely laminated; weakly calcareous; v carbonaceous; highly fragmented. 1-4 in. thick dolomite beds; v f grained; cut by calcite veinlets; fragments of megafossils.	Middle Waste			WITW.				MAS.		
	Mudstone: dk gray. Lower 2/3 of core is calcareous to dolomitic, and locally dolomite containing abundant calcite-filled fractures. Gradational contact into 'upper 1/3, which forms small fragments; finely laminated; v carbonaceous, sparse carbonaceous seams.	Middle Waste  Middle Waste									
90 -	Mudstone: dk gray. Lower 2/3 of core is calcareous to dolomitic, and locally dolomite containing abundant calcite-filled fractures. Gradational contact into upper 1/3, which forms small fragments; finely laminated; v carbonaceous, sparse carbonaceous seams.	Middle Waste			A A A A A A A A A A A A A A A A A A A						<u> </u>
85	Dolomite: med gray; $v$ f grained; abundant calcite-filled fractures; fairly sharp upper contact.				\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \						
	Carbon Seam: black.  Dolomite: dk gray; calcareous; carbonaceous; strongly fetid; slickensides in graphitic rock; gradational upper contact; forms 1-2 in. fragments.	Middle Waste  Middle Waste  Middle Waste	4						\$		
80	Dolomite: med gray; v f grained; abundant calcite fracture fillings $0.04$ in. thick; intact core.		7		, , , , , , , , , , , , , , , , , , ,				7		
75	'Mudstone: dk gray; 0.4-0.4 in. thick lt gray calcareous laminae spaced as	Middle Waste									
	much as 0.5 in. apart throughout this unit, producing a banding that is only faintly visible; v local disrupted layers produced by water escaping; discontinuous black Jensoid shaped ?claystone? distributed through this unit?layers pinched out during compaction of water-saturated sediment.	Š									
70					7	<u> </u>					
	Siltstone: med gray; mostly calcareous?comminuted fossil debris; mudstone, dk gray, forms thin to thick zones within the siltstone; upper 2/3 of unit is a breccia formed by soft-sediment deformationprobably a slump deposit. We interpret the mud	Middle Waste  Middle Waste			N. C.	<i>^</i> - <i>^</i> - <i>^</i> - <i>^</i> - <i>\</i>			\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\		
	to have been >50 percent water and to have flowed during compaction; in contrast, the siltstone contained much less water and behaved as coherent beds that broke into cohesive fragments during flowage of the mud.  Mudstone: dk gray; much of upper half of unit is calcareous; finely laminated dk	Middle Waste  Middle Waste	X Xw	*	M. M.	<b>₹</b>		}	3	7	
60	gray and black; less of the med gray, cse gr laminae present than in underlying unit; some microripples; v dk gray diagenetic? nodules; white calcite veinlets, possible shell fragments (?brachiopods).  Mudstone: dk gray; v sl calcareous; ?phosphatic; 0.25-1.0 in. fragments; sheared,	Middle Waste			Mary Marry Mary					Way	
	Mudstone: dk gray; slightly calcareous; finely laminated; local laminae and zones  0.04-0.2 in. thick of med gray mudstone, v calcareous; upper surfaces of some  med gray laminae appear rippled, BUT may be due to soft-sediment	Middle Waste			Myndra					N. W.	
55	'deformation. Some med gray laminae are discontinuous?starved ripples. This  interval contains abundant 0.04-0.2 in. thick discontinuous It gray calcareous  laminae; some may be starved microripplesOR previously were continuous  laminae that were pulled apart due to flowage of more water-rich dk gray sediment  layers above and below, whereas the It gray less water-rich layers "broke" and pulled	Middle Waste  Middle Waste					<u></u>				
50	apart: fluid escape structures disrupt 0.2-0.4 in. thick rippled and ?graded beds.  Mudstone: dk gray; slightly calcareous; finely laminated; local laminae and zones  0.04-0.2 in. thick of med gray mudstone, v calcareous; upper surfaces of some of the med gray laminae appear rippled, BUT undulatory upper surface could be due to	Middle Waste			WW.			<u> </u>	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\		
	soft-sediment deformation. Some med gray laminae are discontinuous—?starved ripples. Discontinuous (interrupted) lt to med gray layers/laminae that appear to have formed by deposition, followed by fluid flow of water-rich dk gray finer grained mudstone; lt to med gray layers contained less water and behaved as more or less coherently, separating into pull-apart fragments. Also some "knots" of 0.08-0.2	C Bed			MAM						
45 - 00000000000000000000000000000000000	in dia It gray carbonate  Mudstone: dk gray; slightly calcareous; finely laminated; local laminae and zones 0.04-0.2 in. thick of med gray mudstone, v calcareous; upper surfaces of some of the med gray laminae appear rippled, BUT undulatory upper surface could be due to	C Bed									
40 - 00000	soft-sediment deformation. Some med gray laminae are discontinuous?starved ripples.  Mudstone: med-dk gray; fainly laminated; entire interval is more calcareous than units directly above and below; abundant calcite veinlets.										
- 00000 - 00000 - 00000 - 00000 - 00000	Mudstone: dk gray; slightly calcareous; finely laminated; local laminae and zones 0.04-0.2 in. thick of med gray mudstone, v calcareous; upper surfaces of some of the med gray laminae appear rippled, BUT upper surface could be due to soft-sediment deformation. Some med gray laminae are discontinuous—?starved ripples.	C Bed									
35 - 00000000000000000000000000000000000	Mudstone: same as overlying unit.  Siltstone: med gray; calcareous; fetid; veinlets of white calcite along sparse fractures.  Phosphorite: dk gray; pelletal, cse grained; some laminae.	C Bed False Cap				\$					
- 00000 00000 00000 00000 00000 00000	Phosphorite: dk gray; pelletal, f to cse grained; fractures coated by films of white, noncalcareous mineral. Interval represented by about ten 1-2 in. dia fragments.  Phosphorite: dk gray; pelletal, cse grained; some laminae. 9 ft of section is	B Bed									
- 000000 - 000000 - 000000 - 000000 - 000000	represented by about six 1 in. long fragments of core.  Phosphorite: dk gray; pelletal. Three core fragments 1-2 in. long represent unit.  Phosphorite: dk gray; mostly finely laminated; contains local 0.04-0.08 in. thick laminae of pelletal phosphorite; fetid; phosphorite sheared to slickensides locally;										
25	fractures locally coated with calcite films.  Siltstone: (False Cap) dk gray; weakly calcareous; finely laminated; indurated.  Phosphorite: dk gray; pelletal layers locally; finely laminated; fetid; some fractures	B Bed									
	Phosphorite: dk gray; pelletal layers locally; finely laminated; fetid; some fractures coated with mineralized films. Poor recovery of rock in this interval.  Siltstone: dk gray; calcareous; indurated; cut by calcite veinlets along fractures; sulfide veinlets or splotches.	B Bed B Bed B Bed									
20	Phosphorite: dk gray; pelletal.  Siltstone: dk gray; calcareous; well indurated; cut by calcite-filled fractures.  Mudstone: dk gray; phosphatic. V poor recovery.	B Bed B Bed									
15 - 0000	Mudstone: dk gray; silty; finely laminated; fetid.  Phosphorite: dk gray; finely laminated; fetid.	B Bed  B Bed									
-	Dolomite: med gray; upper 7 in. is silty, laminated, and contains laminae of pelletal phoshorite; lower 6 in. contains yellow films of mineral coatings; calcareous veinlets present throughout.  Phosphorite: dk gray; local pelletal layers; finely laminated; isolated fragments of	Cap Rock			7	7 A A					
10 - 8888	megafossls (?brachiopods) replaced by secondary minerals.  Mudstone: dk gray; v silty; upper 2/3 is calcareous; fetid; sparse fragments of fossils; local vugs; well indurated; phosphatic laminae in lower 6 in. Fracture surfaces are coated with films of calcite and, in upper 1 ft, sulfides.	A Bed Footwall Siltstone									
5	Phosphorite: dk gray; interlaminated with f and cse pellets; well laminated. Upper 1 ft is brownish gray, probably due to abundant silt.  Siltstone: dk gray; pelletal phosphatic laminae and thin zones present throughout									No.	
	unit; weakly fetid.  Dolomite: dk gray; silty; well indurated; orangish yellow films of secondary minerals coat fractures in upper 1 ft.	Footwall Siltstone Footwall Siltstone	A Section of the sect								
0 - 0000	Dolomite: ochre color; silty; deeply weathered; Mn laminae.  Phosphorite: dk gray; pelletal, f grained; fossil fragments, finely communited; highly fractured.  Dolomite: med gray-brown; f to med crystalline, recrystallized; local vugs, some	Fish-scale Bed Grandeur Tongue									
-5	Dolomite: med gray-brown; f to med crystalline, recrystallized; local vugs, some larger ones (to 0.5 in.) lined with calcite crystals; recrystallized fragments of megafossils; films of hydrocarbons distributed irregularly; fetid; Mn dendrites in uppermost 1 ft of unit.  Dolomite: med gray-brown; f to med crystalline, recrystallized; local vugs, some	Grandeur Tongue									
	Dolomite: med gray-brown; f to med crystalline, recrystallized; local vugs, some larger ones (to 0.5 in.) lined with calcite crystals; recrystallized fragments of megafossils; films of hydrocarbons distributed irregularly; fetid.			(							

## INTRODUCTION

The U.S. Geological Survey (USGS) has studied the Permian Phosphoria Formation in southeastern Idaho and the entire Western U.S. Phosphate Field throughout much of the twentieth century. In response to a request by the U.S. Bureau of Land Management, a new series of resource, geological, and geoenvironmental studies was undertaken by the USGS in 1998. To accomplish these studies, the USGS has formed cooperative research relationships with two Federal agencies, the Bureau of Land Management and the U.S. Forest Service, tasked with land management and resource conservation on public lands; and with five private companies currently leasing or developing phosphate resources in southeastern Idaho. The companies are Agrium U.S. Inc. (Rasmussen Ridge mine), Astaris LLC (Dry Valley mine), Rhodia Inc. (Wooley Valley mine, inactive), J.R. Simplot Company (Smoky Canyon mine), and Monsanto Co. (Enoch Valley mine). Some of the mineralogical research associated with this project is supported through a cooperative agreement with the Department of Geology and Geological Enginee ring, University of Idaho.

Present studies consist of integrated, multidisciplinary research directed toward (1) resource and reserve estimations of phosphate in selected 7.5-minute quadrangles; (2) elemental residence, mineralogical and petrochemical characteristics; (3) mobilization and reaction pathways, transport, and fate of potentially toxic elements associated with the occurrence, development, and societal use of phosphate; (4) geophysical signatures; and (5) improving the

understanding of deposit origin. Because raw data acquired during the project will require time to interpret, the data are released in open-file reports for prompt availability to other workers. Open-file reports associated with this series of studies are submitted to each of the Federal and industry cooperators for

comment; however, the USGS is solely responsible for the data contained in the reports.

#### MEASURED SECTIONS

Stratigraphic sections of the Phosphoria Formation were measured and sampled by the USGS at several places in southeastern Idaho. The sections, generally lacking interpretation and explanatory notes, are published as preliminary reports as they are assembled (Tysdal and others, 1999, 2000a, 2000b, and 2000c). No thin section, X-ray, or analytical technique has been used to augment the descriptions of the rock units in these reports. The descriptions are accompanied by a computer-generated lithologic log. Informal bed designation names (A, B, C, D, etc.) introduced by Hale (1967, p. 152), and used generally throughout southeastern Idaho, are shown in the unit column along with some local, informal unit names. The units within the measured sections were sampled for geochemical and petrological analysis and some were also evaluated with a variety of geophysical techniques. English units of measurement are used throughout this report to facilitate direct correspondence with units in the extensive historical literature on the Phosphoria and with current industry usage. Measurements record true thickness; adjustments were made for the dip of beds at the time of measurement. The measured section, wpsJ, presented in this report differs from the others in that it is the log of a drill core (Core EVF 23-2) from the Enoch Valley mine property. The other major difference in this measured section report is that the descriptive, lithologic log is accompanied by semiquantitative chemical analyses of 13 elements: As, Cr, Cu, Fe, Mn, Mo, Ni, Pb, Rb, Se, Sr, Zn, and Zr (see brief discussion below). Please **NOTE** that these chemical data are to be used for comparative purposes only; quantitative analyses of the core can be found in Herring and others (1999 and 2001). The data were gathered in order to quickly and economically de velop a picture of chemical variations on a very fine scale (sample intervals of approximately 3 inches in the core box) and to guide detailed sampling of the core for rigorous chemical analyses.

The Phosphoria Formation in the vicinity of the measured sections consists of three members, which in ascending order are the Meade Peak Phosphatic Shale, the Rex Chert, and the informally named cherty shale (McKelvey and others, 1959; Montgomery and Cheney, 1967; Brittenham, 1976). The measured section here focuses on the Meade Peak Phosphatic Shale Member. The Meade Peak unconformably overlies the Grandeur Tongue of the Permian Park City Formation, and the cherty shale member is overlain by the Triassic Dinwoody Formation. Uppermost strata of the Phosphoria Formation were not recovered in the core of section wpsJ. Strata in the measured section dip between 45 and 60 degrees, but average about 50 degrees (unpublished data, Monsanto Co.). The dip is in good agreement with that of the two previously measured sections (wpsA and wpsB) at the Enoch Valley mine (Tysdal and others, 1999). The apparent thickness of the informal units in the three sections (wpsJ, wpsA, and wpsB) are generally similar with the exception of bed A in section wpsB. As noted in Tysdal and others (1999) the variations in bed A seem to be due to tight folding. Faults that are nearly bedding-parallel might also contribute to minor variations in thickness of the units.

## SEMIQUANTITATIVE ANALYSES OF SELECTED ELEMENTS

Measured section wpsJ is accompanied by profiles of semiquantitative concentrations of As, Cr, Cu, Fe, Mn, Mo, Ni, Pb, Rb, Se, Sr, Zn, and Zr. The values were determined with a portable x-ray fluorescence analyzer manufactured by the Niton Corporation. Analyses employing x-ray fluorescence (XRF) instruments such as the one used in this study are highly dependent on the geometry of the material being analyzed and the correction procedures used in the analyses. The analytical scheme used in this study incorporated minimal, manufacturer supplied, correction procedures and variable sample geometries resulting in, at best, semiquantitative measurements. Further, the technique only measures surface compositions (x-ray penetration is generally less than 1 mm/0.04 in); in this case, a maximum surface area of approximately 0.75 in was analyzed. Orientation of the sample surfaces was irregular (flat surfaces are ideal). Many samples were comprised of a chaotic assemblage of chips gathered at approximately the correct interval (sample spacing was nominally 3 inches, uncorrected for dip). The total number of measurements made is 1097. Values below the detection limit are shown on the profiles as 0. Detection limits ranged from about 15 to 500 ppm depending on the element and the sample analyzed. Table 1 shows the number of analyses with values above the detection limit and the ap proximate detection limit as well as the mean, standard deviation, and maximum of the values above the detection limit for each element. High concentration values for several elements are truncated in the profiles so that variations in the lower values are not obscured. Comparisons between the XRF analyses in this report and the more reliable chemical values for the same strata reported in Herring and others (1999 and 2001) indicate that the major chemical trends shown here are reliable and that occasional high values are similarly located.

## Table 1 Element Concentrations (approximate ppm) Determined by Portable XRF Analyzer

Element	As	Cr	Cu	Fe	Mn	Мо	Ni	Pb	Rb	Se	Sr	Zn	Zr
Number of	111	431	56	1069	66	736	631	11	873	745	1050	1058	887
analyses above													
detection limit													
Approximate	40	350	120	450	500	15	200	40	15	20	15	70	10
detection limit													
Mean	70	1300	380	9900	2600	70	610	70	70	110	340	2100	130
Standard deviation	30	800	220	6300	3300	80	500	50	30	300	300	2800	80
Maximum	210	5700	1300	55,500	15,600	700	4700	210	290	6700	2100	46,600	490

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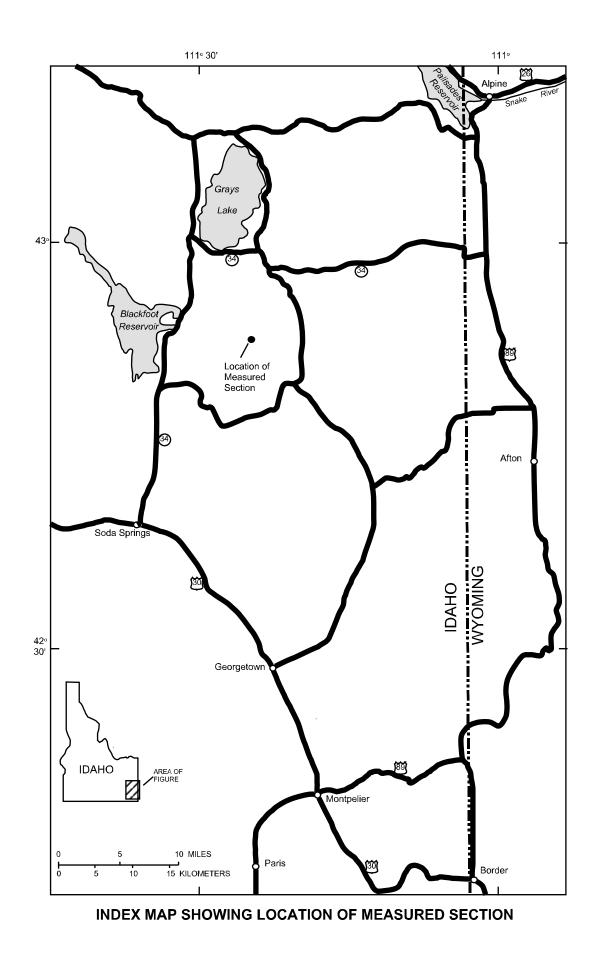
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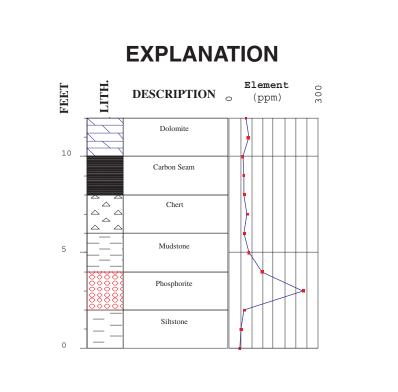
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ABBREVIATIONS

cse coarse
dia diameter
dil dilute
dk dark
eU equivalent uranium
f fine
ft feet
gr grain
in. inches
lith lithology
It light
med medium
ppm parts per million
sl slightly
v very

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