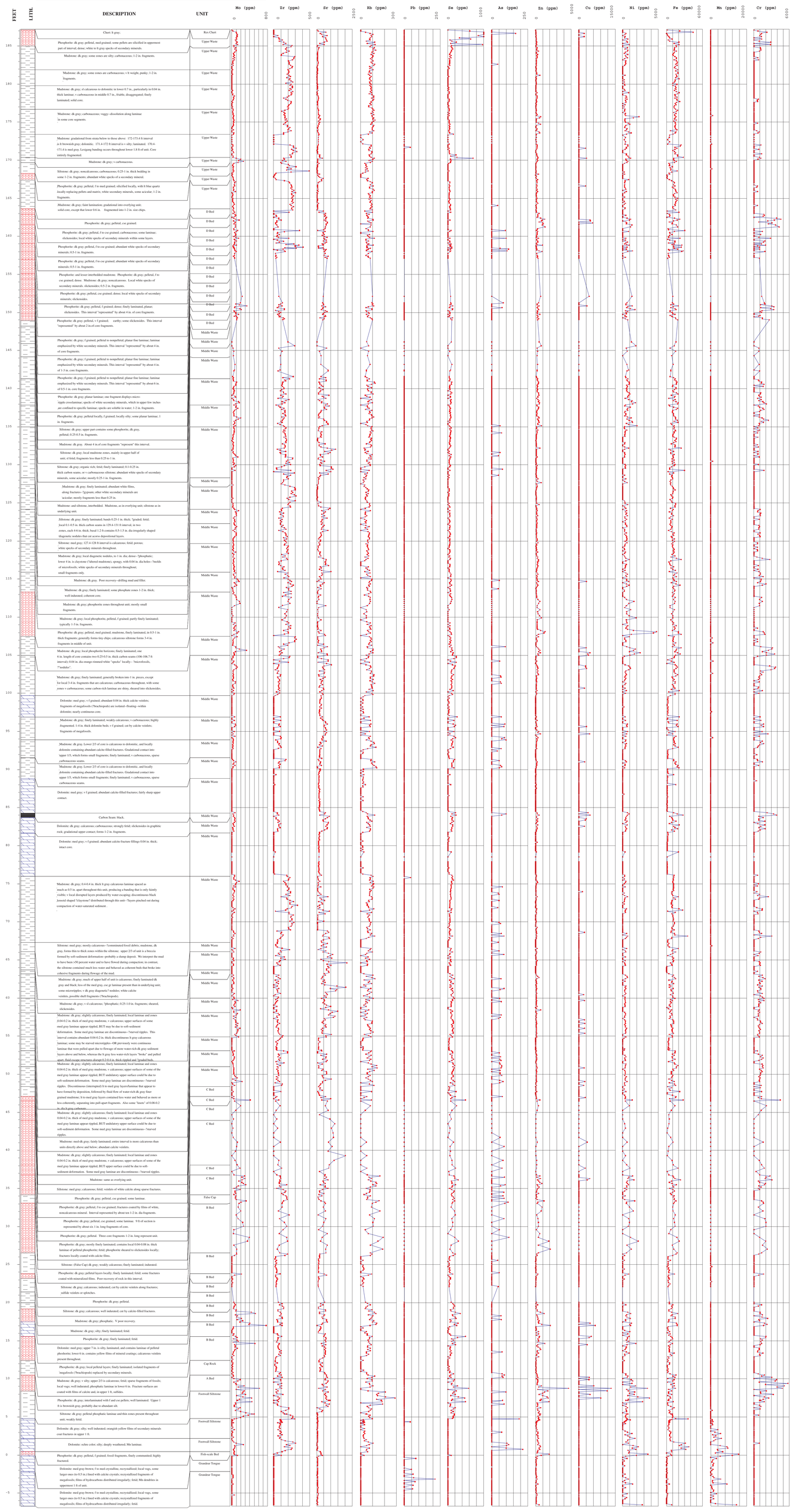
U.S. DEPARTMENT OF INTERIOR
U.S. GEOLOGICAL SURVEY

OPEN-FILE REPORT 99-20-E

WESTERN PHOSPHATE PROJECT

Section: wpsJ **Date Logged:** 1/2000
Formation: Phosphoria
Member: Meade Peak Phosphatic Shale
Measured By: Tysdal, Johnson, Grauch, Herring, Desborough
Notes: Logging of core

Sec-Twn-Ra: Sec. 22, T. 6 S., R. 43 E.
Lat: approx. 42 deg., 53.00' N.
Long: approx. 111 deg., 24.60' W.
Quadrangle: Wayan West
Mine: Enoch Valley



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^2 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	Mo	Ni	Pb	Rb	Se	Sr	Zn	Zr
Number of analyses above detection limit	111	431	56	1069	66	736	631	11	873	745	1050	1058	887
Approximate detection limit	40	350	120	450	500	15	200	40	15	20	15	70	10
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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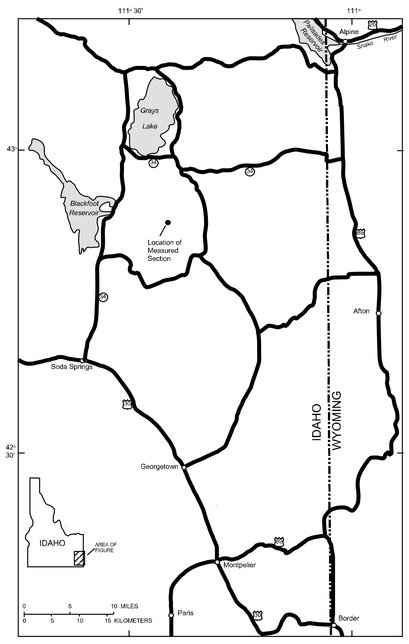
ACKNOWLEDGMENTS

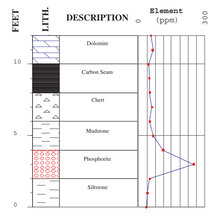
The core is from the Enoch Valley mine property, operated by Monsanto Co. We thank Monsanto for providing access and we thank company personnel who freely discussed the geology of the area.



INDEX MAP SHOWING LOCATION OF MEASURED SECTION

Prepared in Cooperation With:
U.S. Bureau of Land Management
U.S. Forest Service
Agrium U.S. Inc.
Astaris LLC
J.R. Simplot Company
Rhodia Inc.
Monsanto Company

EXPLANATION



ABBREVIATIONS

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

STRATIGRAPHIC SECTION AND SELECTED SEMIQUANTITATIVE CHEMISTRY, MEADE PEAK PHOSPHATIC SHALE MEMBER OF PERMIAN PHOSPHORIA FORMATION CENTRAL PART OF RASMUSSEN RIDGE, CARIBOU COUNTY, IDAHO

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2001