Geologic Map of the Lower Valley Quadrangle, Caribou County, Idaho

By H. Peter Oberlindacher, R. David Hovland, Susan T. Miller, James G. Evans, and Robert J. Miller

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Abstract

The Lower Valley 7.5-minute quadrangle, located in the core of the Southeast Idaho Phosphate Resource Area, includes Mississippian to Triassic marine sedimentary rocks, Pliocene to Pleistocene basalt, and Tertiary to Holocene surficial deposits. The Mississippian to Triassic marine sedimentary sequence was deposited on a shallow shelf between an emergent craton to the east and the Antler orogenic belt to the west. The Meade Peak Phosphatic Shale Member of the Permian Phosphoria Formation hosts high-grade deposits of phosphate that were the subject of geologic studies through much of the 20th century. Open-pit mining of the phosphate has been underway within and near the Lower Valley quadrangle for several decades.

Introduction

Geographic and Geologic Setting

This report describes the geology of the Lower Valley 7.5-minute quadrangle located in southeastern Idaho (fig. 1). The quadrangle lies about 22 km northeast of the town of Soda Springs, in the core of the Southeast Idaho Phosphate Resource Area. A paved road provides partial access from State Highway 34 to the west. Major topographic features of the area include the Wooley Range and southern portion of Rasmussen Ridge. The Blackfoot River traverses the southern part of the quadrangle.

The geology of the Lower Valley quadrangle, Idaho, was compiled by James G. Evans in 1998 from 1:12,000-scale mapping by Oberlindacher (1983), Hovland (1981), and Miller (1981, unpublished). This geologic map information was inked onto a 1:24,000-scale greenline mylar of the topographic base map, which was digitally scanned for input into a geographic information system (GIS). The resulting digital geologic map can be queried in many ways to produce a variety of geologic maps. Digital base map data files (topography, roads, towns, rivers, and lakes) are not included; however, they may be obtained from a variety of commercial and government sources. This database is not meant to be used or displayed at any scale larger than 1:24,000.

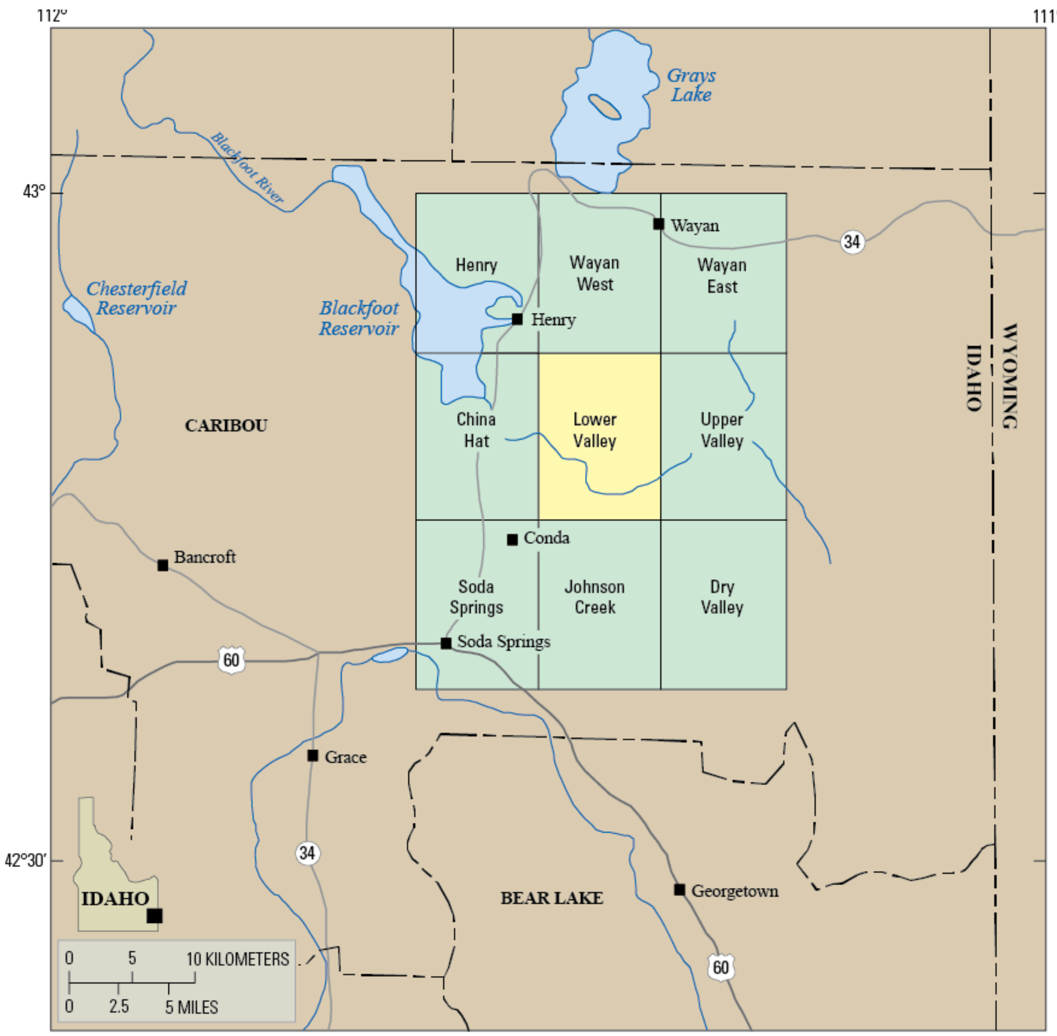

Figure 1. Index map showing location of the Lower Valley quadrangle (yellow).

Previous Investigations

A considerable body of knowledge on the Phosphoria Formation and related rock units in the Western Phosphate Field has been published. A systematic examination of the Western Phosphate Field was conducted by the U.S. Geological Survey (USGS) from 1909 to 1916 (Mansfield, 1927). In 1947, the USGS resumed its geologic investigation of the Western Phosphate Field and systematically mapped, trenched, sampled and evaluated the phosphate deposits; that work was summarized by McKelvey and others (1959). Although the Lower Valley quadrangle was not included in the mapping project then, a phosphate trench was dug and sampled in NE1/4 sec. 10, T. 7 S., R. 43 E. (Swanson and others, 1953). In 1979, Peter Oberlindacher was encouraged by Dr. McKelvey to map and assess the phosphate resources of the Lower Valley quadrangle.

Geologic mapping near and including the Lower Valley quadrangle can be found in Oberlindacher (1990), Oberlindacher and Roberts-Tobey (1986), Hovland (1981), Rioux and others (1975), Roberts (1982), and Oriel and Platt (1980). The historic literature is too large to list; however, mention of selected references is warranted. Pioneering workers such as Mansfield (1918, 1920, 1927, 1933), McKelvey and others (1953a, 1953b, 1959, 1967), Sheldon (1959, 1963, 1989), Service and Popoff (1964), Service (1966, 1967), and Gulbrandsen and Krier (1980) concentrated primarily on delineation and evaluation of phosphate resources and on deposit origin. USGS research has also produced significant literature by Gulbrandsen (1966), Piper (1974), Desborough (1977), Altschuler (1980) and others on the unusual chemistry of the Meade Peak Phosphatic Shale Member, the primary source of phosphate ore. Phosphate deposit origin, demand, and commodity studies are reported in Herring (1995), Herring and Fantel (1993), and Herring and Stowasser (1991). The most recent geologic studies, late-1990s to 2003, focused on geoenvironmental issues related to phosphate resource development, mining, and reclamation. A synopsis of the scores of USGS research and related works is presented in Hein (2004).

Process and Methodology

A preliminary reconnaissance of the Lower Valley quadrangle in 1978 resulted in locating areas for measuring stratigraphic sections, obtaining access to active mine sites and private lands, and field checking type localities of lithologic units.

Geologic field investigation of the area was conducted during a three-month period in 1979 and 1980. The first phase involved measuring detailed stratigraphic sections followed by detailed geologic mapping on a 1:12,000-scale orthophoto base map. The orthophoto map was constructed from 1978, 1:15,840-scale U.S. Department of Agriculture, true-color aerial photographs. Boundaries of mined areas, railroad spurs, and roads were transferred to the base map from aerial photographs using a PG-2 stereo plotter. These boundaries were then field checked during geologic mapping. Stratigraphic sections were measured with Brunton compass and tape. About 150 thin sections were prepared to aid in the interpretation of depositional environments and lithologic description. The classification theme of Dunham (1962) was used for naming the carbonate samples. The U.S. Geological Survey (1978) stratigraphic and time divisions were followed throughout this investigation.

Synopsis of Geology

Stratigraphy

The rocks exposed in the Lower Valley quadrangle consist of Mississippian to Triassic marine sedimentary rocks, Pliocene to Pleistocene basalt, and Tertiary to Holocene surficial deposits (table 1, on map sheet). The sedimentary rocks have a maximum cumulative thickness of 835 m (2,740 ft). The oldest exposed sedimentary bedrock unit is the Late Mississippian Monroe Canyon Limestone, which is overlain by the Pennsylvanian to Permian Wells Formation. Overlying the Wells Formation is the Permian Grandeur Tongue of the Park City Formation, which, in turn, is overlain by the Permian Phosphoria Formation. The Phosphoria Formation includes, in ascending order: the Meade Peak Phosphatic Shale Member, the Rex Chert Member, and the cherty shale member. The Meade Peak Member hosts high-grade deposits of phosphate rock that have been mined by open-pit methods for several decades (Service, 1966, 1967; Hein, 2004). Overlying the Phosphoria Formation is the Early Triassic Dinwoody Formation, which is overlain by the Triassic Thaynes Formation. In the Thaynes Formation the following units, in ascending order, were recognized and mapped: member A, member B, member C, the lower part of the Portneuf Limestone

Member, the upper part of the Portneuf Limestone Member. The Lanes Tongue of the Ankareh Formation, where present, separates the upper part of the Portneuf Limestone Member from the lower part.

The sedimentary Mississippian to Triassic rock sequence was deposited on a shallow shelf between an emergent craton to the east and the Antler orogenic belt to the west. The depositional environment for the marine sedimentary strata ranges from shallow open-marine to supratidal. Interruption in the major fossil records indicated unconformities for the uppermost Mississippian, the Early and Late Pennsylvanian, and the late Permian.

Isolated exposures of dark-gray, locally vesicular basalt of Pliocene or Pleistocene age occur throughout the quadrangle. The basalt rests unconformably upon Paleozoic, Mesozoic, and Tertiary rocks. Ages range from 1.6±0.7 Ma to 2.2±1.0 Ma (Teledyne Isotopes Inc., written commun., 1981).

Tertiary and Quaternary surficial deposits consist of older alluvium, hillwash, colluvium, and alluvial fan deposits. Holocene clays, silt, sand, and gravel are restricted to current stream courses and valley bottoms.

Structure

The Lower Valley quadrangle is situated within the upper plate of the Late Cretaceous Meade Thrust. The principal structural features within the area mapped are subparallel northwest-trending folds, minor imbricate thrust faults, and east-west-trending tear faults. The tear faults have apparent left-lateral offsets of as much as 3 km. High-angle northwest-trending normal faults offset the tear faults and the other structures in the area. Relationships within the quadrangle suggest the following sequence of structural events: folding prior to and synchronous with thrusting; minor imbricate thrusting; tear faulting; high-angle normal faulting; and Pliocene or Pleistocene volcanism.

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