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

# Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho

by

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## Introduction

The geology of the Wallace 1:100,000 quadrangle, Idaho was compiled by Reed S. Lewis in 1997 primarily from Foster (1983), Harrison (unpublished geologic field maps, 1975? to 1985?), Hietenan (1963, 1967, 1968, 1984), Hobbs and others (1965) and Vance (1981) supplemented by eight weeks of field mapping by Reed S. Lewis, Russell F. Burmester and Mark D. McFaddan in 1997 and 1998. This geologic map information was inked onto a 1:100,000-scale greenline mylar of the topographic base map for input into a geographic information system (GIS). The resulting digital geologic map GIS can be queried in many ways to produce a variety of geologic maps. Digital base map data files (topography, roads, towns, rivers and lakes, etc.) are not included: 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 1:100,000 (e.g., 1:62,500 or 1:24,000).

The map area is located in north Idaho (Fig. 1). The primary sources of map data are shown in Figure 2 and additional sources are shown in Figure 3. This open-file report describes the geologic map units, the methods used to convert the geologic map data into a digital format, the Arc/Info GIS file structures and relationships, and explains how to download the digital files from the U.S. Geological Survey public access World Wide Web site on the Internet.

Mapping and compilation was completed by the Idaho Geological Survey under contract with the U.S. Geological Survey office in Spokane, Washington. The authors would like to acknowledge the help of the following field assistants: Josh Goodman, Yvonne Issak, Jeremy Johnson and Kevin Myer. Don Winston provided help with our ongoing study of Belt stratigraphy, and Tom Frost assisted with logistical problems and sample collection. Manuscript reviews by Steve Box, Tom Frost, and Brian White are greatly appreciated. We wish to thank Karen S. Bolm of the U.S. Geological Survey for reviewing the digital files.

## Description of Map Units

Qa ALLUVIAL DEPOSITS (HOLOCENE)--Stream deposits in modern drainages.

Qog OLDER GRAVELS (QUATERNARY)--Unconsolidated deposits on terraces above the modern drainages. Some may be glacial outwash deposits.

Qg GLACIAL DEPOSITS (QUATERNARY)--Poorly sorted and poorly stratified, unconsolidated deposits principally of glacial origin. Includes till in lateral and ground moraines as well as outwash and minor modern stream alluvium.

Tsm SEDIMENT (MIOCENE)--Unconsolidated, poorly sorted, fluvial sediment preserved in erosional remnants 250 to 350 m (800 to 1150 ft) above the present river bottoms. Includes beds of cobble gravel, sand, and orange-weathering clay. Slumps are common.

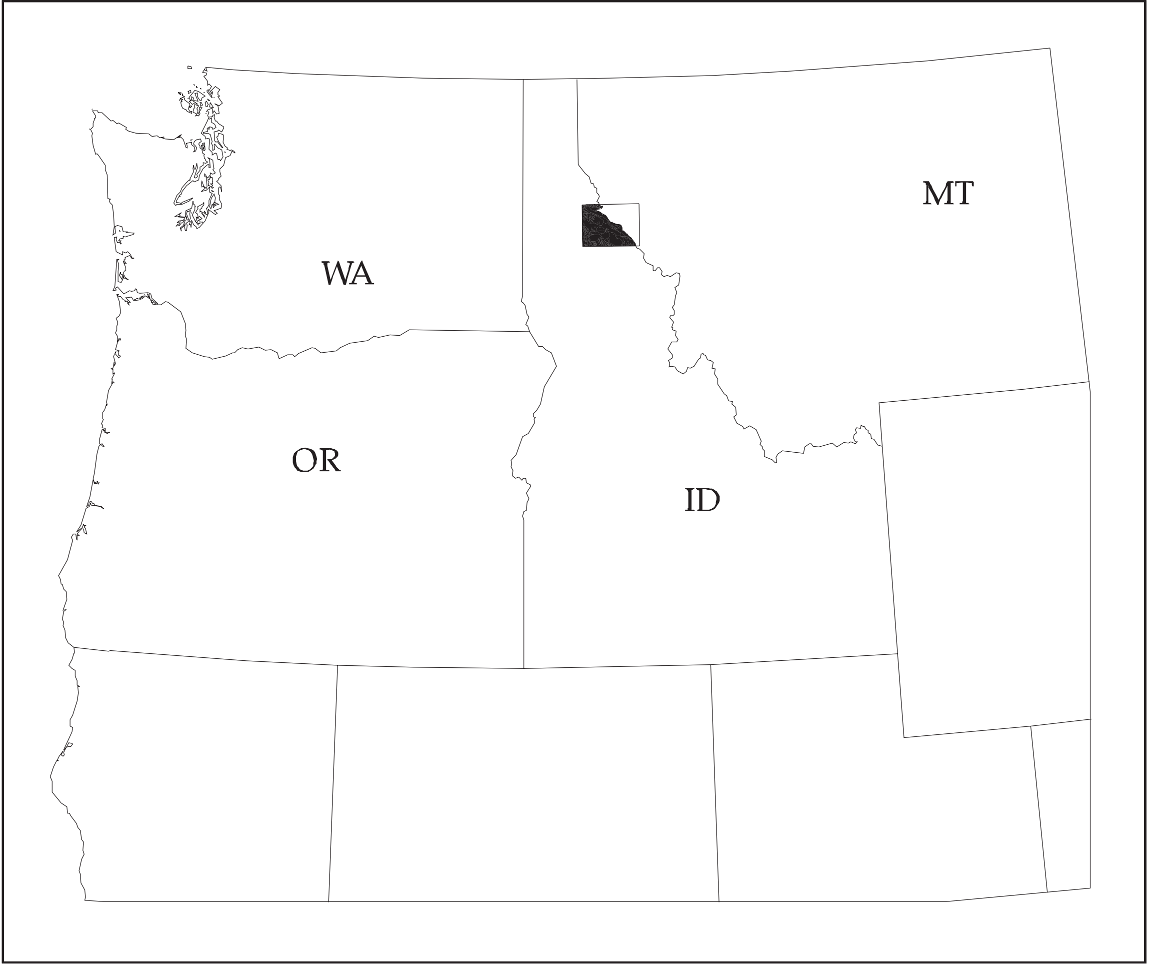


Figure 1. Index map showing the geographic extent of the mapped area (black fill) and the Wallace quadrangle (rectangular outline) with respect to the Pacific Northwest.

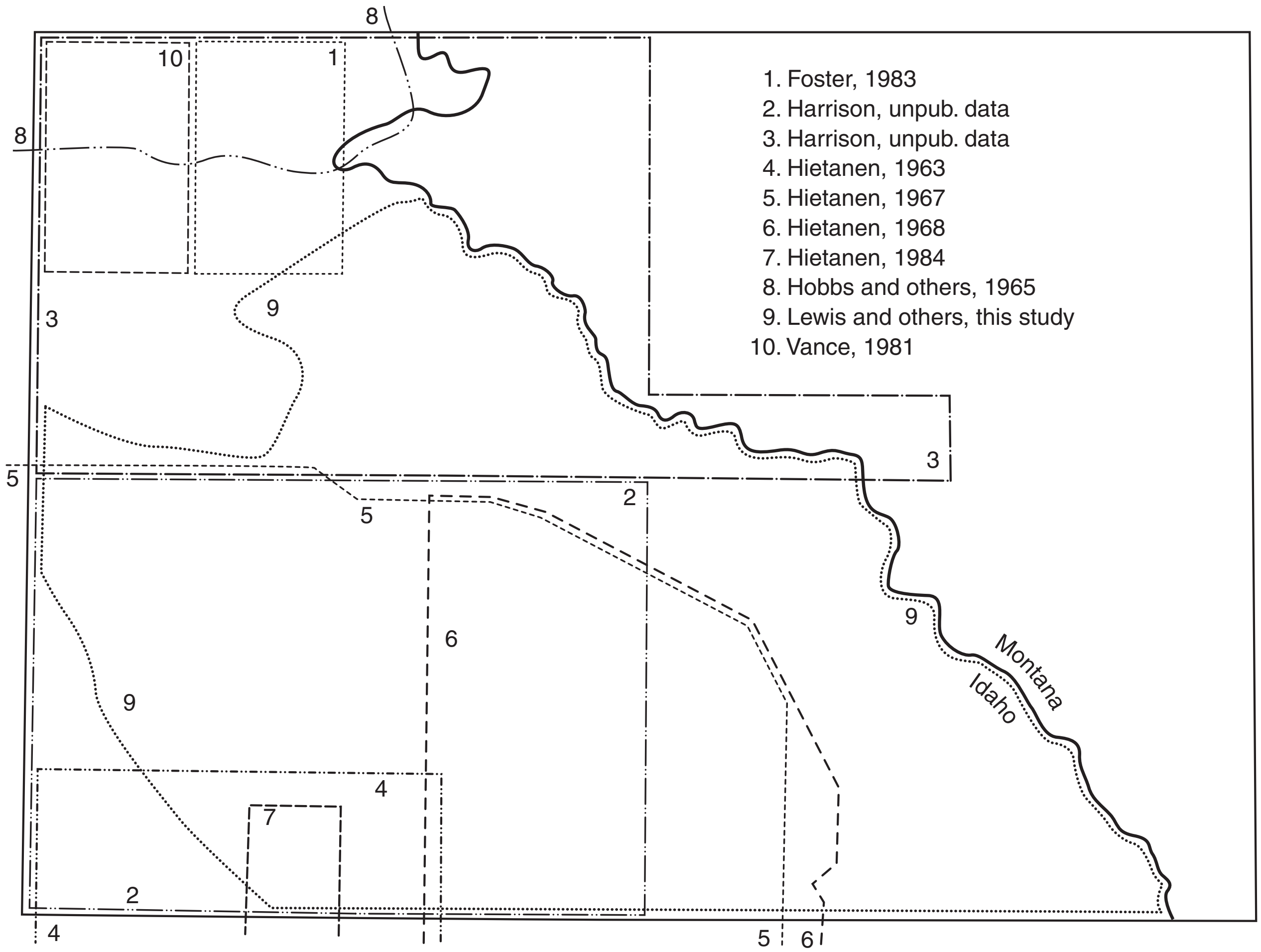


Figure 2 . Primary references for mapping in the Idaho portion of the Wallace 1:100,000 quadrangle.

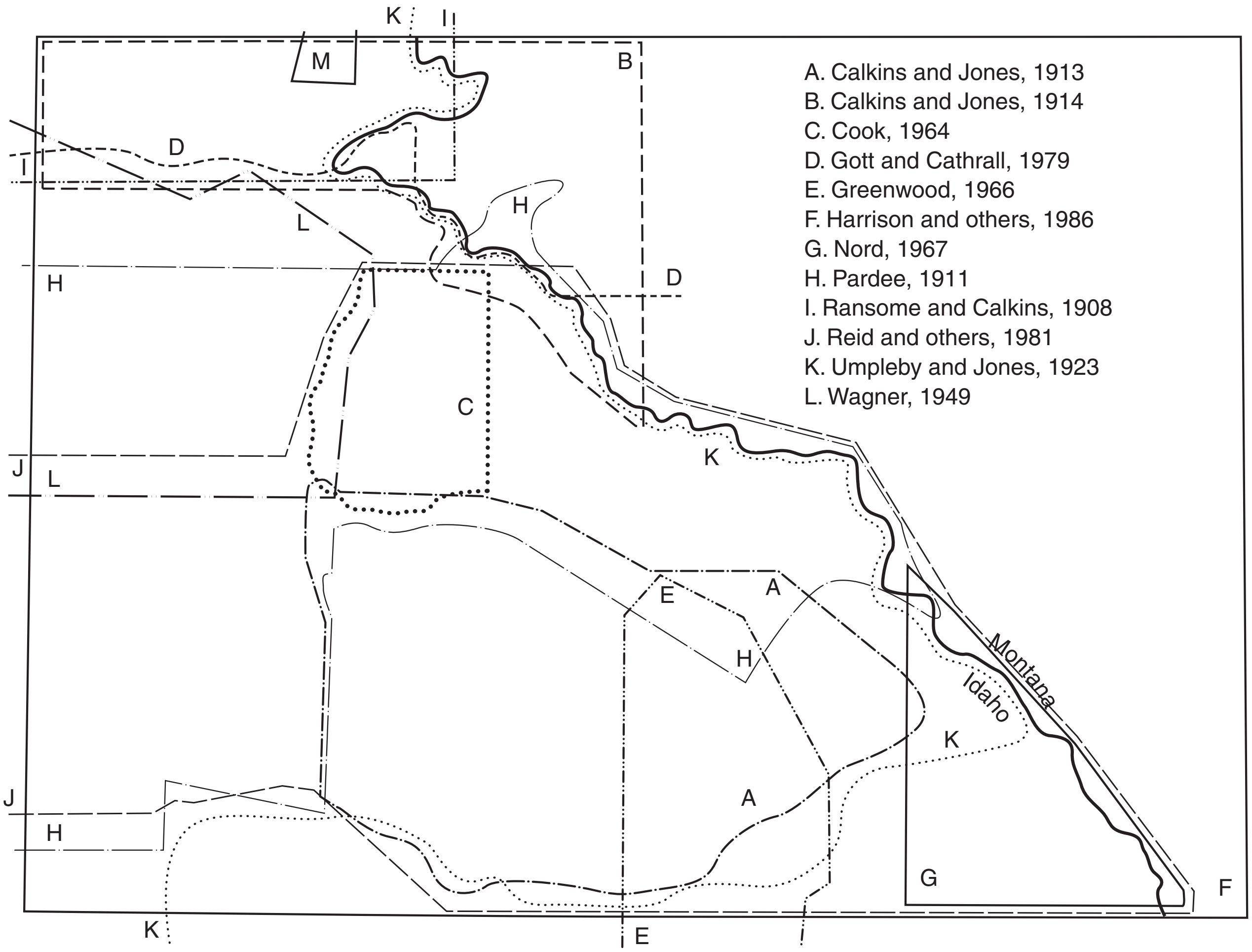


Figure 3. Additional references for mapping in the Idaho portion of the Wallace 1:100,000 quadrangle

Tcr COLUMBIA RIVER BASALT GROUP (MIOCENE)--Small exposure of basalt in the extreme western part of the map area.

Tdp PORPHYRITIC DACITE DIKES (EOCENE)--Gray dikes that contain plagioclase, biotite, and hornblende phenocrysts in an aphanitic groundmass.

Tgd HORNBLENDE-BIOTITE GRANODIORITE (EOCENE)--Light-gray, medium- to coarse-grained, equigranular to porphyritic granodiorite. The Roundtop pluton contains about 20 percent quartz, 50 percent zoned euhedral plagioclase, 15 to 25 percent orthoclase, and 5 to 15 percent hornblende and biotite combined (Hietanen, 1968). Fabric is weak to absent in most places, but gently-dipping igneous flow foliation is present in the central part of the pluton and strongly developed contact-parallel mylonitic foliation and lineation is present in the southern part (Steve Box, pers. comm., 1997). Age is 52Å7 Ma by U-Pb methods on zircon (Marvin and others, 1984). The Herrick stock contains biotite, minor hornblende, and plagioclase that is in part strongly zoned (Holland, 1947). The Herrick stock is deeply weathered except along the St. Joe River canyon. Hornfels has formed adjacent to this intrusion and forms a resistant ridge along its northeast side.

TKgb GABBROIC AND DIORITIC DIKES AND SILLS (CRETACEOUS OR EOCENE?)-- Medium- to fine-grained, equigranular hornblende-pyroxene gabbro and diorite. Hornblende is present as either rims on pyroxene or completely replacing pyroxene and olivine is present at a few localities (Hietanen, 1963; 1968). Plagioclase constitutes about 30 to 40 percent of the rock and has an anorthite content of 45 to 74 percent. Some exposures are highly altered, but others, particularly in the southwest part of the area, are unaltered. Typically intruded along or near fault zones. Includes the Wishard sill of Pardee (1911) which is exposed along the state line from Wishard Peak northwest to beyond Dominion Peak. Age is highly uncertain, as no reliable radiometric dates are available. Hietanen (1968) assigned them a Tertiary age. Harrison and others (1986) assigned only the southern exposures this age, and thought the Wishard sill was Proterozoic. A whole-rock K-Ar age of 575Å4Ma on the Wishard sill (Marvin and others, 1984) may represent a partially reset Proterozoic age, or an incorrect old age resulting from excess argon.

Kgd BIOTITE GRANODIORITE (CRETACEOUS)--Light-gray, medium- to coarse-grained, massive to foliated, (muscovite-) biotite granodiorite. Pegmatite dikes and biotite schlieren are common in the intrusion along the Little North Fork of the Clearwater River (Hietanen, 1963). None of these rocks have been reliably dated, but the presence of a foliation, muscovite, and an abundance of pegmatites suggest a Cretaceous age.

Kog ORTHOGNEISS (CRETACEOUS)–Gray, medium-grained, strongly foliated (hornblende-) biotite tonalite, granodiorite, and quartz diorite. Contains euhedral epidote interpreted to be magmatic in origin. Foliation is mylonitic at several localities. No reliable dating of these rocks exists, but a Cretaceous age is likely given the degree of fabric development.

Yan ANORTHOSITE (MIDDLE PROTEROZOIC?)--White to light-gray, foliated to massive, medium- to coarse-grained anorthosite. Contains bimodal plagioclase populations (andesine and bytownite) and minor amounts of hornblende, biotite, and chlorite (Hietanen, 1963). Weathers more readily than surrounding metasedimentary rocks. Hietanen (1963) speculated that the anorthosite formed by metamorphic rather than igneous processes.

Yam AMPHIBOLITE (MIDDLE PROTEROZOIC)--Dark-gray, foliated or lineated hornblende-plagioclase rocks, typically garnet-bearing. May in part be metamorphosed carbonate-bearing rocks, but most are thought to be metamorphosed igneous sills and dikes (Hietanen, 1963).

Ysp STRIPED PEAK FORMATION, UNDIVIDED (MIDDLE PROTEROZOIC)–Quartzite- dominated interval in the northwestern part of the area where subdivision into members has not been attempted.

$Ysp_3$ STRIPED PEAK FORMATION, MEMBER THREE (MIDDLE PROTEROZOIC)–Red to light-gray, decimeter- to meter-scale beds of fine- to medium-grained parallel-laminated quartzite. Informally termed member three in this report. Exposed at the type section on Striped Peak where approximately 305 m (1000 ft) is exposed. The upper part is truncated by faulting, so this represents a minimum thickness. Laterally equivalent to the Bonner Quartzite, described to the east (Harrison and others, 1986). Contains abundant K-feldspar (18-23 percent) and lesser amounts of plagioclase (6-7 percent) based on two samples stained for feldspar.

$Ysp_2$ STRIPED PEAK FORMATION, MEMBER TWO (MIDDLE PROTEROZOIC)–Red and subordinate green siltite and argillite interbedded with minor amounts of quartzite and carbonate. Beds are typically centimeter to millimeter scale. Informally termed member two in this report. Exposed at the type section on Striped Peak where it is approximately 105 m (350 ft) thick. Laterally equivalent to member 3 of the Mt. Shields Formation, described to the east (Harrison and others, 1986).

$Ysp_1$ STRIPED PEAK FORMATION, MEMBER ONE (MIDDLE PROTEROZOIC)–Red or gray fine- to very fine-grained quartzite and subordinate amounts of siltite, argillite, and carbonate. At Cedar Mountain, north of Avery, unit consists of fine-grained quartzite in tabular, decimeter- to meter-thick beds with green siltite and argillite along partings. Lower part of unit there grades upwards from $Ywu_3$ with increasing 5 to 10 cm white quartzite beds and dark green siltite, increasing ripple-drift cross lamination and rippled tops and more common mud cracked surfaces. Some beds are graded and there seem to be thinning and fining-upward cycles. Rocks highest in section are 20 to 40 cm thick flat-laminated quartzites with rippled tops and rarer mud-cracked thin argillite caps. Carbonate is present in some thin (~5 cm) zones at or near bedding surfaces. Entire member exposed at the type section on Striped Peak where it is approximately 245 m (800 ft) thick. Informal unit designated here is laterally equivalent to Mt. Shields Formation, members 1 and 2, described to the east (Harrison and others, 1986). A single sample of quartzite from Striped Peak stained for feldspar contained about 20 percent plagioclase and no K-feldspar.

$Ywu_3$ WALLACE FORMATION, UPPER MEMBER THREE (MIDDLE PROTEROZOIC)-- Carbonate-free microlaminated and wavy couplets of siltite and argillite. Most argillite is light green but some is black. Mapped and described by Hobbs and others (1965) in part of the Coeur d'Alene mining district, and by Vance (1981) south of the district. Vance (1981) estimated a thickness of about 400 m (1300 ft) on the northeast side of Foolhen Mountain. May be equivalent to Wallace 5 of Clark Fork section (Harrison and Jobin, 1963) or upper Shepard (Burmester, 1986; Lemoin and Winston, 1986).

$Ywu_2$ WALLACE FORMATION, UPPER MEMBER TWO (MIDDLE PROTEROZOIC)-- Rock is typically microlaminated dark-green siltite and light-green argillite, and dolomitic siltite beds 2 to 5 cm thick. Thin quartzite lenses and starved ripples produce a lenticular sediment type. More quartzitic in southeast part of area where unit contains an abundance of load casts on bed bottoms. Vance (1981) estimated a thickness of about 210 m (700 ft) on the northeast side of Foolhen Mountain. Likely correlates with Wallace 4 of Clark Fork section (Harrison and Jobin, 1963). May be equivalent to the middle or lower part of Shepard Formation (Lemoin and Winston, 1986).

$Ywu_1$ WALLACE FORMATION, UPPER MEMBER ONE (MIDDLE PROTEROZOIC)--Dark- gray, thinly laminated argillite and siltite in the lower part grading upward to green thinly laminated argillite and siltite. Rare, thin (2-5 cm) coarse siltite or very fine-grained quartzite layers have ripple-drift cross lamination and ripple tops. Upwards, bedding becomes thinner and more planar with the highest gray rocks being microlaminated white-weathering siltite and black (biotitic?) argillite with characteristic planar partings. Above that, dark green siltite and light green argillite becomes more abundant and thickly and unevenly laminated, with more thin rippled quartzite beds and mud chips and mud-cracked surfaces. Top is gradational into $Ywu_2$ with siltite and argillite becoming more microlaminated. Equivalent to the Snowslip Formation in the Missoula area to the northeast (Winston, 1986). Unit lacks the red argillite and siltite of the Snowslip, and the gray thinly laminated lower part is missing from the Snowslip to the northeast. An estimated a thickness of about 460 m (1500 ft) on Foolhen

Mountain, south of the Coeur d'Alene district (Vance, 1981) is probably a minimum because the lower contact is not exposed there.

Ywml WALLACE FORMATION, MIDDLE AND LOWER MEMBERS, UNDIVIDED (MIDDLE PROTEROZOIC)--Unit in the Coeur d'Alene mining district (Ywl of Hobbs and others, 1965) where subdivision into separate members has not been attempted. Also includes structurally complex rocks in the southwest part of the map area.

Ywm WALLACE FORMATION, MIDDLE MEMBER (MIDDLE PROTEROZOIC)--Characterized by pinch and swell couplets (Winston, 1986) of white quartzite that grade upward into black argillite caps. The quartzite is fine- to very fine-grained, commonly calcareous, with hummocky to low-angle cross-stratification and scoured or loaded basal contacts. Centimeter-scale beds of silty, molar-tooth limestone and dolostone are widespread. Zones of tan-weathering calcareous siltite to very fine-grained quartzite with black, non-calcareous argillite caps (black and tan rock type) are locally common. Microlaminated white siltite to black argillite is present, although not dominant. Minor zones with horizontal pods of non-resistent calcareous siltite are present low in the section. Amalgamated, decimeter beds of quartzite grading to cm-scale, tan, non-resistant, calcareous siltite and thin black argillite caps occur in some intervals, and commonly underlie or are interspersed with zones of sedimentary breccia. The breccia typically consists of rounded to angular, pebble- to boulder-sized calcareous quartzite clasts in an orange-weathering, calcitic siltite matrix with abundant soft-sediment deformation features. Outcrops of the breccia are commonly silicified and form prominent hoodoos. Several breccia zones mapped by Nord (1967) as fault breccias are interpreted here as sedimentary breccia.

Ywl WALLACE FORMATION, LOWER MEMBER (MIDDLE PROTEROZOIC)--Characterized by wavy, even, thin laminations and less common couplets of green siltite with light green to white argillite caps. Lenticular couplets locally common. Intervals of "tri-color" white quartzite, dark green siltite, and pale green argillite alternate with the laminated green siltite-argillite lower in the unit. Carbonate is present in the lower part as punky-weathering, molar tooth silty limestone beds up to 1 m in thickness. Zones of horizontal pods of silty carbonate are common in the upper part of the unit; the carbonate is non-resistant and normally weathers out, leaving distinct voids. Pinch and swell couplets of white and quartzite and black argillite increase in abundance toward the top of the unit, as do thin intervals of the "black and tan" rock type, characteristic of Ywm.

Ysw SCHIST AND PHYLLITE OF THE UPPER WALLACE FORMATION (MIDDLE PROTEROZOIC)--Gray to brown muscovite-biotite schist and phyllite that is coarsest in the southern part of the area and grades into argillite and siltite to the north and east. Micas grow to about 5 mm, but grain size in biotite quartzite (siltite part of protolith) remains small. Lowest rocks are scapolite-rich, graded dark-gray to black siltite and argillite in even to wavy couplets. Growth of scapolite may have destroyed microlaminae. Rocks commonly show metamorphic succession from tabular chloritoid, increasing size garnets, staurolite, then kyanite (Lang and Rice, 1985a). Compositional layering is typically parallel to foliation, but locally is folded isoclinally with centimeter- to outcrop-scale wavelengths. Mapped as schist within the Wallace Formation by Hietanen (1968). Unit is the metamorphic equivalent of $Ywu_1$. Contact with $Ywu_1$ drawn at the garnet isograd.

Yqw QUARTZITE OF THE MIDDLE WALLACE FORMATION (MIDDLE PROTEROZOIC)--Medium-grained, thin-bedded quartzite that contains minor amounts of calc-silicate minerals (primarily actinolite and diopside) and thin layers of phyllitic black argillite or schist that locally contain scapolite. The lower contact west of the Roundtop pluton appears to be gradational with downward decreasing quartzite content and bedding thickness and increasingly even bedding style. Equivalent to less-metamorphosed rocks of Ywm and Ywml units. Mapped by Hietanen (1968) as quartzite unit of Wallace Formation.

Ysr ST. REGIS FORMATION (MIDDLE PROTEROZOIC)--Thick-bedded impure to pure quartzite at base, grading upward to interbedded and interlaminated impure quartzite and argillite that comprise bulk of formation (Hobbs and others, 1965). Characteristically thin bedded to laminated. Predominantly purplish red and grayish red; argillite is darker. Some carbonate-bearing beds, mostly in upper part. Ripple marks, mud cracks, and mud-chip breccia in some layers. Rocks at Ward Peak along the state line, tentatively assigned to Ysr, are green siltite and light green to white argillite with lesser amounts of wavy, decimeter-scale quartzite beds. Abundant white rounded argillite rip-up clasts are present, some with unusually equant dimensions. These rocks resemble Ywl, but are assigned to Ysr because of quartzite beds, scarcity of carbonate, and the presence of abundant rip-ups. Similar rocks are described and mapped (where exposures permitted) as uppermost St. Regis in the Coeur d’Alene mining district (Ysg unit of Hobbs and others, 1965). Along Gold Creek the St. Regis is characterized by rounded mud-chip rip-ups and evenly bedded, cm-scale white quartzite grading up into cm-scale black argillite caps.

Yr REVETT FORMATION (MIDDLE PROTEROZOIC)--Thick-bedded white to light-gray quartzite containing interbedded impure and nearly pure quartzite in upper and lower parts, and a few widely spaced argillite partings (Hobbs and others, 1965). Crossbedded and laminated in part.

Ybk BURKE FORMATION (MIDDLE PROTEROZOIC)--Light- to greenish-gray fine-grained impure quartzite with lesser amounts of nearly white to light-gray nearly pure to pure quartzite (Hobbs and others, 1965). Beds predominantly 5 to 20 cm thick. Ripple marks and pseudoconglomerate are common.

Ysrv SCHIST OF THE RAVALLI (?) GROUP (MIDDLE PROTEROZOIC)--Muscovite-rich schist, thin quartzite intervals, and minor calc-silicate rocks. Garnet present but neither abundant nor ubiquitous. Exposures west of Granite Peak show increasing amounts of quartzite down section, assuming the relict NE-dipping bedding is upright. Unit probably is equivalent to the St. Regis Formation of the Ravalli Group, but may include part of the Revett Formation. Tentatively assigned to the Ravalli Group on the basis of stratigraphic position.

Yqrv QUARTZITE OF RAVALLI (?) GROUP (MIDDLE PROTEROZOIC)--Mostly fine- grained, sugary and friable white feldspathic quartzite with muscovitic partings and rare, thin biotite quartzite tops. Minor fine- to medium-grained (1-2 mm) biotite-muscovite schist. Unit is probably equivalent to the Revett Formation of the Ravalli Group, but may include part of the Burke and St. Regis Formations. Tentatively assigned to the Ravalli Group on the basis of stratigraphic position. Thickness is about 800 m (2500 ft) west of Granite peak where this unit includes what Hietanen (1968) mapped as Wallace quartzite. It is not assigned here to the Wallace because features expected of metamorphosed Wallace were not found. Among these are relict pinch and swell bedding, evidence of carbonate such as scapolite or calc-silicate mineral assemblages, and schist and quartzite proportions and thicknesses similar to siltite-argillite and quartzite observed in the Wallace lithologies to the north.

Ypu PRICHARD FORMATION, UPPER MEMBER (MIDDLE PROTEROZOIC)—Light gray to nearly white impure to pure quartzite interbedded with laminated argillite (Hobbs and others, 1965). Quartzite beds 5 to 45 cm thick. Ripple marks, mud cracks, and graded bedding are common.

Ys SCHIST (MIDDLE PROTEROZOIC?)-- Typically dark, rusty-weathering coarse-grained (5 mm micas) biotite-muscovite-feldspar-quartz schist. Commonly crenulated; locally garnetiferous or silliminite-bearing. Also contains as discontinuous layers fine-grained (muscovite)-biotite-feldspar quartzite with moderately-developed foliation. This quartzite is similar to unit described below but generally represents less than 10 percent of the Ys unit. Includes rocks assigned by Hietanen (1968) to Prichard Formation. Some of the unit at Monumental Buttes originally assigned to the Prichard Formation (Hietanen, 1963) but later assigned to the Boehls Butte Formation and thought to be pre-Belt in age (Hietanen, 1984). Correlation with specific Belt Supergroup (or older) units is too speculative at the present time, but most are probably metamorphic equivalents of the Prichard Formation.

Yq QUARTZITE (MIDDLE PROTEROZOIC?)--Gray to white, coarse- to medium-grained quartzite. Includes rare garnetiferous and calc-silicate concentrations. Mapped by Hietanen (1968) as quartzite of the Prichard Formation and later subdivided to include quartzite of Boehls Butte Formation (Hietanen, 1984). Most is probably quartzite of the Prichard Formation, but present understanding of stratigraphy and structure in the area precludes assignment to a formation.

Yc CALC-SILICATE ROCKS (MIDDLE PROTEROZOIC?)--Bluish gray-green, medium- to coarse-grained rocks rich in diopside, hornblende, or both (Hietanen, 1963). Quartz, plagioclase, tremolite, scapolite, and calcite are also present.

## Structure and Metamorphism

The structure in the area is dominated by northwest-trending folds and faults. Central to the area is the Packsaddle syncline (Pardee, 1911), in which are exposed the stratigraphically highest rocks. Flanking it on the northeast are northeast-vergent tight folds and steep thrust (reverse) faults that repeat various parts of the Wallace and St. Regis formations. The southeast end of the Packsaddle syncline is disrupted by several steep, north striking-thrust faults that place older rocks eastward over younger rocks (Nord, 1967). Structures on the southwest limb of the Packsaddle syncline are complex, but may record both southwest-directed compression deformation (Reid and others, 1981), and later down-to-the-northeast extension coupled with right-lateral strike-slip motion. The Osburn fault, which crosses the northern part of the map area, is thought to be a right-lateral strike-slip fault (Hobbs and others, 1965).

In addition to folds and faults, penetrative fabrics (cleavage, foliation and lineation) are variably developed in the area. Cleavage in the upright(?) Packsaddle syncline northeast of Cedar Mountain and in the more gently-dipping parts of the lower Wallace and St. Regis units northwest of Ward Peak dips moderately southwest and may not be strictly axial planar. Cleavage locally southwest of the Packsaddle syncline does appear to be axial planar, but not to upright folds. Horizontal foliation is axial planar to small (1-10 m) folds at two places in the middle and upper Wallace east of the Roundtop pluton and to several small folds in a larger expanse of apparently up-side down beds of Wallace strata farther west along Lick Creek. Reid and others (1981) show a southwest-vergent overturned fold several kilometers in length at the latter locality. The folds associated with these areas of gently-dipping foliation and inverted beds have northeast to northerly trends similar to the strike of the thrust faults found at in the southeast part of the area.

An important element in the more highly strained and metamorphosed rocks in the southwest part of the area is a strong and gently eastward-plunging lineation. It is defined by one or two crenulations, folds, rodding and mullion development, and intense L-tectonite development. The appearance of at least two fold or crenulation sets in some areas suggest the possibility of two or more ages of origin or causative events. L-tectonite fabric is found along a linear trend from near Hoyt Mountain at the west edge of the map, in country rocks along the north side the Roundtop pluton, and through Landmark Peak near an east-west segment of the pluton's southern contact.

The structures record the response of rocks in the area to changing stress fields. Earliest in the structural evolution appear to be at least two compressional events. One is recorded by the southwest-dipping cleavage in the Packsaddle syncline and the overturned folds and steep faults to its northeast. These are most easily explained as the product of top-to-the-northeast transport. Southwest-vergent folding and thrusting south of the Packsaddle syncline may have occurred at the same time. The other compressional event is recorded in the north to northeast trends of folds and faults along the Packsaddle syncline and along Lick Creek. These seem to record northwest-southeast compression. It is still unclear if they formed before or after the northeast compression event. In addition, the absolute ages of the fold events are unknown, although suspected to be Cretaceous in age.

Part of the folding of the Packsaddle syncline may postdate intrusion of the Idaho batholith to the south. Metamorphic grade increases to the south and southwest, as shown by the location of the garnet isograd. A wide-spread regional metamorphism (M2) of probable Cretaceous age occurred during relatively static conditions after M1 had produced the strong foliation in the southwest part of the map area (Lang and Rice, 1985a). Thermobarometry on M2 mineral assemblages (Lang and Rice, 1985b) shows that paleotemperatures and paleopressures at the present level of exposure increase to the southwest. The southwest increase in paleopressure requires either that there was considerable relief with higher elevations toward the southwest, or that the higher pressure rocks toward the southwest have been uplifted more than the lower pressure ones to the northeast. This differential uplift could have accentuated the northeast dip of the southwest flank the Packsaddle syncline.

Motion along most of the faults appears younger than the major folding event(s). Reactivation of some of the faults east of the Packsaddle syncline during multiple shear events is demonstrated by various involvement of gabbro sills and dikes that have intruded them. Many gabbro bodies are themselves sheared but one unveined dike along Entente Creek cuts veined and altered Ywm. However, uncertain age of the gabbro bodies makes age of fault motion equally uncertain. A tighter constraint exists for faults in the southwest. Some of the north-striking ones appear to cut the Roundtop pluton, so must be late Eocene to perhaps Miocene in age. Other faults are likely coincident with intrusion of the Roundtop pluton. The steep contact-parallel mylonitic foliation along the southern margin of the Roundtop pluton suggests syn- to late-intrusion deformation; the shallow eastward plunging lineation in the mylonite fabric indicates that the motion was strike slip.

A model we favor to explain many of our observations in the southwest part of the map area is of southwest-directed compressional deformation during the Cretaceous followed by Eocene extensional detachment faulting with left-stepping right lateral shear zones connecting the Bitterroot, Boehls Butte and Spokane domes (Doughty and others, 1990). This model includes normal (detachment) faults to account for some of the contrast in metamorphic grade and stratigraphic level, and zones of strike-slip motion. Protracted evolution of this system could have brought L-tectonite rocks developed early during ductile shear from deep level to near their present level of exposure. The linear trend of the L-tectonites suggest the shear was strike slip. Why the lineations plunge to the east is unknown but may reflect a component of dip slip, or eastward tilting.

## Hydrothermal Alteration

Bleached and silicified rocks of the Belt Supergroup are present in several areas in the eastern part of the map area. Nord (1967) described large areas of bleached rock in the headwaters of the St. Joe River, in which albite, microcline, orthoclase, carbonate, and green biotite have formed as secondary minerals. Similar bleached rock is present from Bird Creek to Gold Creek, along the zone of northwest-trending faults. One silicified breccia sample from Malin Point, southeast of Bird Creek contained slightly elevated gold concentrations (50 ppb). Two silicified samples from the NW 1/4 of section 18 along Entente Creek yielded low gold values (10 ppb or less) but elevated As concentrations (24 and 106 ppm) relative to typical concentrations in the area of 8 ppm or less. Gabbroic (TKgb) dikes parallel this zone of faulting and hydrothermal alteration, which may continue northwest to the Coeur d'Alene mining district. Alteration and veining in the Coeur d'Alene district is described in numerous reports, including Hobbs and others (1965).

## Data Sources, Processing, and Accuracy

Lewis and others' greenline mylar map inked with the geologic data was electronically scanned to create a raster digital image, converted to vector, polygon and point GIS layers, and minimally attributed by a contractor (Optronics Specialty Co., Inc., Northridge, CA). This initial product was remitted to the U.S. Geological Survey in an Arc/Info interchange format in scanner units. The tic points were used to transform the digital files to calculated latitude-longitude points for a Universal Transverse Mercator (zone 11, with a -5,000,000 m y-offset) map projection. The RMS error[1] resulting from the file transformation was small (6.148 meters, see Appendix A). The digital files were then augmented with an interim geologic map data model (data base), further attributed and edited, and then plotted and compared to the original stable-base geologic map to check for digitizing and attributing errors. All processing by the U.S. Geological Survey was done in Arc/Info version 7.1.1 installed on a Sun Ultra workstation.

The overall accuracy (with respect to the location of lines and points) of the digital geologic map (see Figs. 4 and 5 for page-size versions) is probably no better than +/- 6 meters. This digital database is not meant to be used or displayed at any scale larger than 1:100,000 (e.g., 1:62,500 or 1:24,000).

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[1] The root mean square error (RMS error) describes the deviation between the tic locations in the input file and those in the output file. It is an indication of the quality of the derived transformation and is a measure of the quality of the original scanned materials. The transformation report of errors for each tic point is given in Appendix A.

Qa - alluvial deposits (Holocene)

Qog - older gravels (Quaternary)

Qg - glacial deposits (Quaternary)

Tsm - sediment (Miocene)

Tcr - Columbia River Basalt Group (Miocene)

Tdp - porphyritic dacite dikes (Eocene)

Tgd - hornblende-biotite granodiorite, includes Roundtop pluton and Herrick stock (Eocene)

TKgb - gabbroic and dioritic dikes and sills (Cretaceous or Eocene?)

Kgd - biotite granodiorite (Cretaceous)

Kog - orthogneiss (Cretaceous)

Yan - anorthosite (Middle Proterozoic?)

Yam - amphibolite (Middle Proterozoic)

Ysp - Striped Peak Formation, undivided (Middle Proterozoic)

Ysp3 - Striped Peak Formation, member 3 (Middle Proterozoic)

Ysp2 - Striped Peak Formation, member 2 (Middle Proterozoic)

Ysp1 - Striped Peak Formation, member 1 (Middle Proterozoic)

Ywu3 - Wallace Formation, upper member three (Middle Proterozoic)

Ywu2 - Wallace Formation, upper member two (Middle Proterozoic)

Ywu1 - Wallace Formation, upper member one (Middle Proterozoic)

Ywml - Wallace Formation, middle and lower members, undivided (Middle Proterozoic)

Ywm - Wallace Formation, middle member (Middle Proterozoic)

Ywl - Wallace Formation, lower member (Middle Proterozoic)

Ysw - schist and phyllite of the upper Wallace Formation (Middle Proterozoic)

Yqw - quartzite of the middle Wallace Formation (Middle Proterozoic)

Ysr - St. Regis Formation (Middle Proterozoic)

Yr - Revett Formation (Middle Proterozoic)

Ybk - Burke Formation (Middle Proterozoic)

Ysrv - schist of the Ravalli(?) Group (Middle Proterozoic)

Yqrv - quartzite of Ravalli(?) Group (Middle Proterozoic)

Ypu - Prichard Formation, upper member (Middle Proterozoic)

Ys - schist (Middle Proterozoic?)

Yq - quartzite (Middle Proterozoic?)

Yc - calc-silicate rocks (Middle Proterozoic?)

contact

fault

g • • • g garnet isograd

**Figure 4. Explanation for the Digital Geologic Map of the Wallace 1:100,000 quadrangle, Idaho**

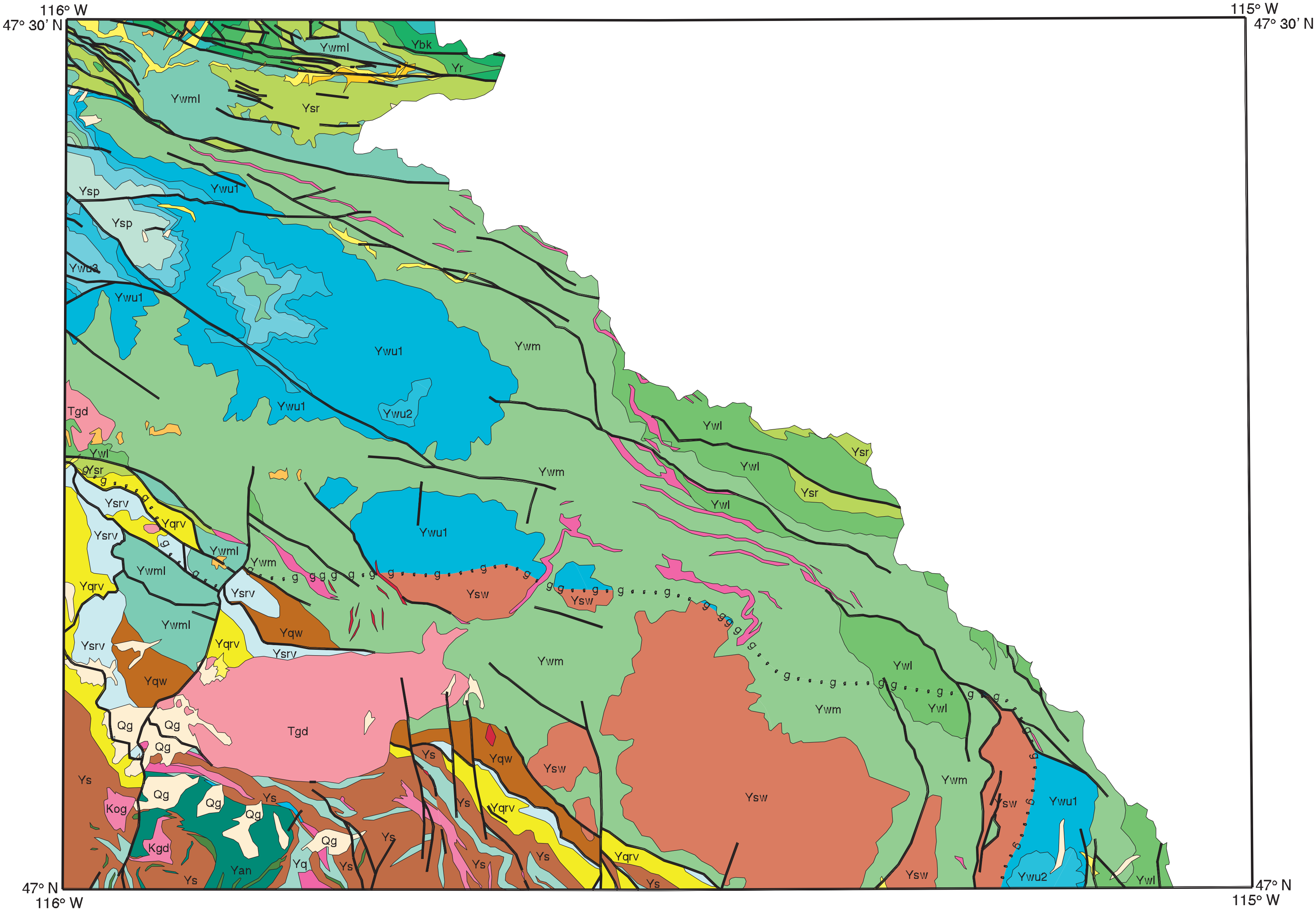


**Figure 5. Digital Geologic Map of the Wallace 1:100,000 quadrangle, Idaho**

## GIS Documentation

The digital geologic map of the Wallace 1:100,000 quadrangle includes a geologic linework arc attribute table, WA100K.AAT, that relates to the WA100K.CON, WA100K.STR, WA100K.LGU and WA100K.REF files; a rock unit polygon attribute table, WA100K.PAT, that relates to the WA100K.RU and WA100K.REF files; and a geologic map symbol point attribute table, WAPNT.PAT, that relates to the WAPNT.SYM and WAPNT.REF files (see Fig. 6). These data files are described below.

### *Linear Features*

Descriptions of the items identifying linear features such as contacts, boundaries (e.g., lines of latitude and longitude, state boundaries) and structures in the arc (or line) attribute table, WA100K.AAT, are as follows:

| **WA100K.AAT** | | | |
|---|---|---|---|
| ITEM NAME | ITEM TYPE | ITEM LENGTH | ATTRIBUTE DESCRIPTION |
| **linecode** | integer | 3 | Numeric code used to identify type of linear feature. Linecodes < 100 are used for contacts and boundaries which are described in the WA100K.CON file. Linecodes > 100 and < 600 represent structural features which are described in the WA100K.STR file. Linecodes > 800 represent linear geologic units (e.g., dikes) which are described in the WA100K.LGU file. |
| **name** | character | 30 | Name given to structural feature. |
| **source** | integer | 4 | Numeric code used to identify the data source for the linear feature. Complete references for the sources are listed in the WA100K.REF file. |

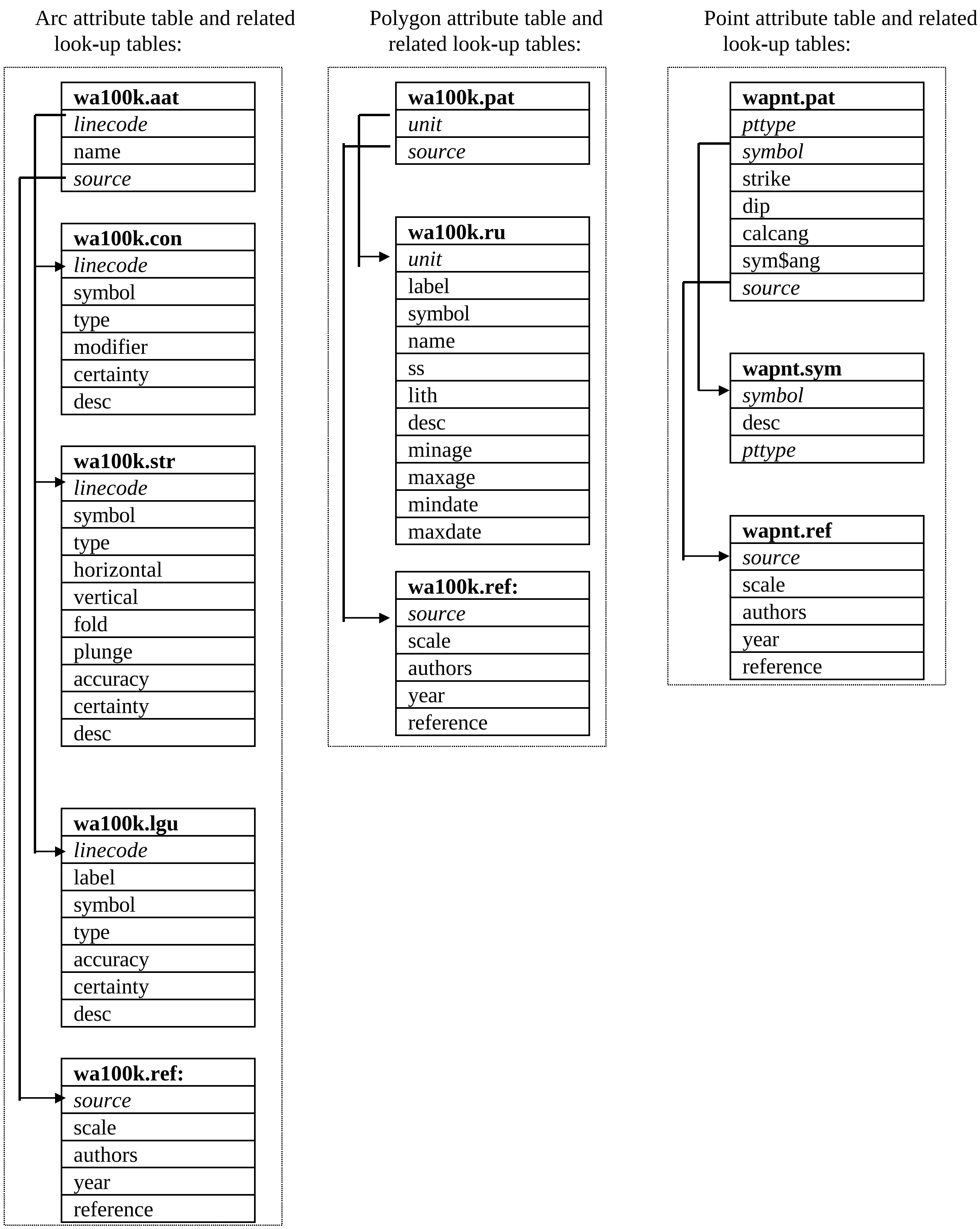


*Figure 6: Relationships between feature attribute tables and look-up tables.*

Attribute descriptions for items in the contact (and boundary) look-table, WA100K.CON [for use with the CARTO.LIN and GEOLOGY.LIN (Fitzgibbon and Wentworth, 1991) linesets], are as follows:

| **WA100K.CON** | | | |
|---|---|---|---|
| ITEM NAME | ITEM TYPE | ITEM LENGTH | ATTRIBUTE DESCRIPTION |
| **linecode** | integer | 3 | Numeric code (a value < 100) used to identify type of contact or boundary. (This item also occurs in WA100K.AAT.) |
| **symbol** | integer | 3 | Line symbol number used by Arc/Info to plot lines. Symbol numbers refer to the **CARTO.LIN lineset** for linecodes gt 40 and lt 100 and to the **GEOLOGY.LIN lineset** (Fitzgibbon and Wentworth, 1991) for linecodes gt 0 and lt 40. |
| **type** | character | 10 | Major type of line, e.g., contact, state boundaries, lines of latitude and longitude used for neatlines. |
| **modifier** | character | 20 | Line type modifier, i.e., approximate, concealed, gradational. No entry implies ‘known.’ |
| **certainty** | character | 15 | Degree of certainty of contact or boundary, i.e., inferred, uncertain. No entry implies ‘certain.’ |
| **desc** | character | 100 | Written description or explanation of contact or boundary. |

Attribute descriptions for items in the structure look-up table, WA100K.STR [for use with the GEOLOGY.LIN lineset (Fitzgibbon and Wentworth, 1991)], are as follows:

| **WA100K.STR** | | | |
|---|---|---|---|
| ITEM NAME | ITEM TYPE | ITEM LENGTH | ATTRIBUTE DESCRIPTION |
| **linecode** | integer | 3 | Numeric code (a value > 100 and < 600) used to identify type of structural feature. (This item also occurs in WA100K.AAT.) |
| **symbol** | integer | 3 | Line symbol number used by Arc/Info to plot arc (line). Symbol numbers refer to the **GEOLOGY.LIN lineset** (Fitzgibbon and Wentworth, 1991). |
| **type** | character | 10 | Major type of structure, i.e., fault, fracture, fold, other. |
| **horizontal** | character | 20 | Type of horizontal fault movement, e.g., left-lateral, right-lateral. No entry implies ‘unknown.’ |
| **vertical** | character | 20 | Type of vertical fault movement, e.g., normal. No entry implies ‘unknown.’ |
| **fold** | character | 15 | Type of fold, e.g., anticline, syncline. |
| **plunge** | character | 15 | Type of plunge on fold, i.e., horizontal, plunging, plunging in, plunging out. |
| **accuracy** | character | 15 | Line type modifier indicating degree of accuracy, i.e., approximately located, concealed, gradational. No entry implies ‘known.’ |
| **certainty** | character | 15 | Degree of certainty of contact or boundary, i.e., inferred, uncertain. No entry implies ‘certain.’ |
| **desc** | character | 100 | Written description or explanation of structural feature. |

Attribute descriptions for items in the linear geologic units (e.g., dikes and rock units that could only be mapped as linear features at a scale of 1:100,000) look-up table, WA100K.LGU, [for use with the GEOLOGY.LIN lineset (Fitzgibbon and Wentworth, 1991)], are as follows:

| **WA100K.LGU** | | | |
|---|---|---|---|
| ITEM NAME | ITEM TYPE | ITEM LENGTH | ATTRIBUTE DESCRIPTION |
| **linecode** | integer | 3 | Numeric code (a value > 800) used to identify type of linear geologic unit. (This item also occurs in WA100K.AAT.) |
| **label** | character | 10 | Map label used in the map proper to identify rock unit. |
| **symbol** | integer | 3 | Line symbol number used by Arc/Info to plot linear geologic unit.<br>Symbol numbers refer to **GEOLOGY.LIN lineset** (Fitzgibbon and Wentworth, 1991). |
| **type** | character | 10 | Major type of linear geologic unit, e.g., dike, formation. |
| **accuracy** | character | 15 | Line type modifier indicating degree of accuracy, i.e., approximate, concealed, gradational. No entry implies 'known.' |
| **certainty** | character | 15 | Degree of line type certainty, i.e., inferred, uncertain. No entry implies 'certain.' |
| **desc** | character | 100 | Written description or explanation of linear geologic unit. |

### *Areal Features*

Descriptions of the items identifying geologic units in the polygon attribute table, WA100K.PAT, are as follows:

| **WA100K.PAT** | | | |
|---|---|---|---|
| ITEM NAME | ITEM TYPE | ITEM LENGTH | ATTRIBUTE DESCRIPTION |
| **unit** | integer | 4 | Numeric code used to identify the rock unit which is described in the WA100K.RU look-up table. (This item also occurs in WA100K.RU.) |
| **source** | integer | 4 | Numeric code used to identify the data source for the rock unit. Complete references for the sources are listed in the WA100K.REF file. |

Attribute descriptions for items in the lithology (rock unit) look-table, WA100K.RU (for use with the CALCOMP1.SHD shadeset), are as follows:

| **WA100K.RU** | | | |
|---|---|---|---|
| ITEM NAME | ITEM TYPE | ITEM LENGTH | ATTRIBUTE DESCRIPTION |
| **unit** | integer | 4 | Numeric code used to identify rock unit. (This item also occurs in WA100K.PAT.) |
| **label** | character | 10 | Rock unit label (abbreviation) used to label unit on map. |
| **symbol** | integer | 3 | Shadeset symbol number used by Arc/Info to plot a filled/shaded polygon. The symbol numbers used in this file refer to the **CALCOMP1.SHD shadeset**. |
| **name** | character | 7 | The prefix portion of the rock unit label that does not include subscripts. (If subscripting is not used in the original unit label, then the 'name' entry is the same as the 'label' entry.) |
| **ss** | character | 3 | The suffix portion of the geologic unit label that includes subscripts. |
| **lith** | character | 20 | Major type of lithostratigraphic unit, i.e., unconsolidated sediments, sedimentary rocks, metasedimentary rocks, intrusive rocks, extrusive rocks, metamorphic rocks, water, ice. |
| **desc** | character | 100 | Formal or informal unit name |
| **minage** | character | 7 | Minimum stratigraphic age of lithologic unit, i.e., CRET, TERT, PCY. |
| **maxage** | character | 7 | Maximum stratigraphic age of lithologic unit |
| **mindate** | integer | 4 | Minimum radiometric age (in millions of years) if determined. |
| **maxdate** | integer | 4 | Maximum radiometric age (in millions of years) if determined. |

### *Point Features*

Descriptions of the items identifying geologic map symbols are given in the point attribute table, WAPNT.PAT, which is defined as follows:

| **WAPNT.PAT** | | | |
|---|---|---|---|
| ITEM NAME | ITEM TYPE | ITEM LENGTH | ATTRIBUTE DESCRIPTION |
| **pttype** | character | 32 | Type of point symbol, e.g., strike and dip of inclined bedding, strike and dip of inclined cleavage, geochemical sample location. (This item also occurs in the WAPNT.SYM file.) |
| **symbol** | integer | 3 | Marker symbol number used by Arc/Info to identify type of geologic map symbol. Symbol numbers refer to the **GEOSCAMP2.MRK markerset** (Matti and others, 1997). (This item also occurs in the WAPNT.SYM file.) |
| **strike** | integer | 3 | Strike of bedding, foliation or cleavage.<br>Strike is an azimuthal angle (measured in degrees from 0 to 360 in a clockwise direction from North). |
| **dip** | integer | 3 | Dip of bedding, foliation or cleavage. This value is an angle measured (in degrees from 0 to 90) down from the horizontal; thus a horizontal dip is 0 degrees and a vertical dip is 90 degrees. |
| **calcang** | integer | 4 | An interim value used to calculate sym$angle. The various structural map symbols in the GEOSCAMP2.MRK markerset (Matti and others, 1997) had to be rotated by different amounts to achieve their proper map orientation.<br>For the strike and dip symbols, calcang = strike - 270; for the lineation symbol, calcang = strike - 180 (however, lineation symbols were not used in this quadrangle map). |
| **sym$ang** | integer | 4 | The angle used to complete the mathematical rotation of the structural map symbol to its proper orientation on the map. This value is the $angle pseudoitem value for the point. |
| **source** | integer | 4 | Numeric code used to identify the data source for the structural map symbol. Complete references for the sources are listed in the WAPNT.REF file. |

Attribute descriptions for items in the geologic map symbols look-up table, WAPNT.SYM, [for use with the GEOSCAMP2.MRK markerset (Matti and others, 1997)], are as follows:

| **WAPNT.SYM** | | | |
|---|---|---|---|
| ITEM NAME | ITEM TYPE | ITEM LENGTH | ATTRIBUTE DESCRIPTION |
| **symbol** | integer | 4 | Marker symbol number used by Arc/Info to identify type of structural map symbol. Symbol numbers refer to the **GEOSCAMP2.MRK markerset** (Matti and others, 1997). |
| **desc** | character | 250 | Written description or explanation of map symbol. |
| **pttype** | character | 32 | Type of point symbol, e.g., strike and dip of inclined bedding, strike and dip of inclined cleavage. (This item also occurs in the WAPNT.PAT file.) |

### *Source Attributes*

Descriptive source or reference information for the WA100K and WAPNT Arc/Info coverage files is stored in the WA100K.REF and WAPNT.REF files respectively. Attribute descriptions for items in the WA100K.REF and WAPNT.REF data source files are as follows:

| **WA100K.REF / WAPNT.REF** | | | |
|---|---|---|---|
| ITEM NAME | ITEM TYPE | ITEM LENGTH | ATTRIBUTE DESCRIPTION |
| **source** | integer | 4 | Numeric code used to identify the data source. (This item also occurs in the WA100K.AAT, WA100K.PAT, and WAPNT.PAT files.) |
| **scale** | integer | 10 | Scale of source map. (This value is the denominator of the proportional fraction that identifies the scale of the map that was digitized or scanned to produce the digital map.) |
| **authors** | character | 100 | Author(s) or compiler(s) of source map entered as last name, first name or initial, and middle initial. |
| **year** | integer | 4 | Source (map) publication date |
| **reference** | character | 250 | Remainder of reference in USGS reference format. |

## Obtaining Digital Data

The complete digital version of the geologic map is available in Arc/Info EXPORT format with associated data files. These data and map images are maintained in a Universal Transverse Mercator (UTM) map projection:

| | |
|---|---|
| Projection: | UTM |
| Zone: | 11 |
| Y-offset (false northing): | -5,000,000 meters |
| Units: | meters |

To obtain copies of the digital data, do one of the following:

1. Download the digital files from the USGS public access World Wide Web site on the Internet: **URL = http://wrgis.wr.usgs.gov/open-file/of99-390/of99-390.html**

or

2. Anonymous FTP from **wrgis.wr.usgs.gov,** in the directory
**pub/open-file/of99-390**

The Internet sites contain the digital geologic map of the Wallace 1:100,000 quadrangle both in Arc/Info EXPORT-format files (wa100k.e00 and wapnt.e00) and as a HPGL2 plot file (wa100k.hp) of the map area, as well as the associated data files and Arc/Info macro programs which are used to plot the map at a scale of 1:100,000.

To manipulate this data in a geographic information system (GIS), you must have a GIS that is capable of reading Arc/Info EXPORT-format files.

## Obtaining Paper Maps

Paper copies of the digital geologic map are not available from the USGS. However, with access to the Internet and access to a large-format color plotter that can interpret HPGL2 (Hewlett-Packard Graphics Language), a 1:100,000-scale paper copy of the map can be made, as follows:

1. Download the digital version of the map, **wa100k.hp,** from the USGS public access World Wide Web site on the Internet using the
**URL = http://wrgis.wr.usgs.gov/open-file/of99-390/of99-390.html**

or

2. Anonymous FTP the plot file, **wa100k.hp,** from: **wrgis.wr.usgs.gov,** in the directory:
**pub/open-file/of99-390**

3. This file can be plotted by any large-format color plotter that can interpret HPGL2. The finished plot is about 30 inches by 42 inches.

Paper copies of the map can also be created by obtaining the digital file as described above and then creating a plot file in a GIS.

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## Appendix A - Transformation report for Wallace GIS

Three Arc/Info files were remitted to the USGS from the contractor. Each of the three files had to be transformed to a UTM map projection (zone 11, y-shift = -5,000,000 meters). The errors for each latitude and longitude tic used in the transformation were the same for each of the three transformed files and are given below. The report identifies a root mean square (RMS) error of 6.148 meters.

Scale (X,Y) = (2539.391,2539.577) Skew (degrees) = (0.006)
Rotation (degrees) = (1.101) Translation = (575273.256,203844.361)
RMS Error (input,output) = (0.002,6.148)

Affine $X = Ax + By + C$
$Y = Dx + Ey + F$

| | | | | | |
|---|---|---|---|---|---|
| A = | 2538.922 | B = | -48.543 | C = | 575273.256 |
| D = | 48.796 | E = | 2539.113 | F = | 203844.361 |

| tic id | input x | input y | | |
|---|---|---|---|---|
| | output x | output y | x error | y error |
| 589 | 0.308 | 0.618 | | |
| | 576027.625 | 205430.828 | -1.592 | -2.482 |
| 590 | 7.793 | 0.583 | | |
| | 595034.375 | 205703.797 | -3.442 | 1.056 |
| 520 | 0.379 | 11.561 | | |
| | 575672.250 | 233212.609 | 1.866 | 5.486 |
| 451 | 0.445 | 22.497 | | |
| | 575315.438 | 260995.594 | -4.242 | -7.851 |
| 521 | 7.832 | 11.524 | | |
| | 594590.125 | 233485.422 | 9.306 | 1.557 |
| 452 | 7.862 | 22.466 | | |
| | 594144.062 | 261268.203 | -1.319 | 3.611 |
| 522 | 15.280 | 11.510 | | |
| | 613507.875 | 233818.859 | 0.282 | -3.319 |
| 591 | 15.281 | 0.568 | | |
| | 614041.000 | 206037.453 | 2.366 | -4.094 |
| 592 | 22.768 | 0.582 | | |
| | 633047.438 | 206431.797 | 2.877 | 0.587 |
| 593 | 30.251 | 0.617 | | |
| | 652053.750 | 206886.859 | -6.464 | 1.168 |
| 523 | 22.732 | 11.523 | | |
| | 632425.438 | 234212.953 | 2.630 | 0.046 |
| 453 | 15.275 | 22.455 | | |
| | 612972.562 | 261601.406 | -6.731 | 4.663 |
| 454 | 22.696 | 22.468 | | |

| | | | | |
|---|---|---|---|---|
| | 631800.875 | 261995.219 | 4.812 | 5.630 |
| 524 | 30.182 | 11.561 | | |
| | 651342.750 | 234667.719 | -1.602 | 3.745 |
| 455 | 30.111 | 22.498 | | |
| | 650628.938 | 262449.656 | | |

## Appendix B - List of digital files in the Wallace GIS

--Use the ‘00import.aml’ to IMPORT all of the *.E00 files for use in Arc/Info.
--Use the Arc/Info ‘DRAW’ command to plot the *.GRA file to your screen. (Make sure the display is set with the Arc/Info ‘DISPLAY’ command.)
--Use the Arc/Info ‘HPGL2’ command to create a HPGL2 file from the *.GRA file.
--Use the UNIX 'lpr -P<plotter_name> wa100k.hp’ command to send the wa100k.hp file to a large-format color plotter that can interpret Hewlett-Packard Graphics Language.
--To re-create the *.GRA file, open the ArcPlot module, enter ‘display 1040’, enter a new filename for the graphics file, enter ‘&run wa100k’ (and enter ‘quit’ to exit the ArcPlot module).

**Primary Arc/Info interchange-format files (*.e00) for the digital geology:**
- wa100k.e00
- wapnt.e00

**Arc/Info graphics (*.gra) and HPGL2 map plot (*.hp) files for the geologic map plate:**
- wa100k.gra /.hp

**Additional Arc/Info interchange - format files (*.e00) necessary to re-create the geologic map plates:**
- calcomp1.shd.e00 - shadeset
- fnt037.e00 - font 37
- fnt038.e00 - font 38
- fnt040.e00 - font 40
- geoscamp2.mrk.e00 - markerset
- wallaceu11.e00 - exterior boundary of the Wallace quadrangle

**AML, graphics, key, symbolset and text files necessary to re-create the geologic map plate:**
- scale2a.aml - plots scale bar on plate
- wa100k.aml - program that creates a graphics file of the geologic map of the Wallace quadrangle, Idaho.
- index_wa.gra - index map graphic displayed on map plate (showing location of the Wallace quadrangle with respect to the Pacific Northwest).
- wa_line.key - lineset symbol values and descriptive text for lines on the map plate
- wa_pol.key - shadeset symbol values and descriptive text for geologic map units on the map plate
- wa_sym2.key - markerset symbol values and descriptive text for map symbols (markers) on the map plate
- geology.lin - lineset
- geo.prj - a text file used to identify real-world (geographic) coordinates - for use in adding latitude and longitude notation around the margins of the map quadrangle
- u11.prj - a text file to identify UTM, zone 11 map projection - for use in adding latitude and longitude notation around the margins of the map quadrangle
- wacrd.txt - text file listing map credits on the map plate
- waref.txt - text file listing map references on the map plate

## Appendix C - Arc/Info Macro Language program (wa100k.aml) used to plot the geologic map of the Wallace quadrangle

```
/*  wa100k.aml, 8/18/99, pd

/* ***********************
/*  This Arc/Info Macro Language
(AML) program will plot the geologic
map plate for the Wallace quadrangle
(U.S. Geological Survey Open-File
Report 99-390) at a scale of 1:100,000.

/*  To run this AML:
/*     1. Type 'ap' at the 'Arc:' prompt to
enter the ArcPlot module,
/*     2. Type 'display 1040' at the
'Arcplot:' prompt to create a GRA file,
/*     3. Enter 'wa100k' (or a filename of
your own choosing and edit the draw
command at the very end of this AML)
at the 'Enter ARC/INFO Graphics
filename :' prompt for the GRA to be
created,
/*     4. Type '&run wa100k' at the
'ArcPlot:' prompt to start the program,
/*     5. Run the Arc/Info HPGL2
command to convert the GRA file to an
HPGL2 file, i.e., hpgl2 wa100k
wa100k.hp # 1.0 opaque # 0 # # #
cal.dat
/*     6. Execute the UNIX 'lpr' command
to print the 1:100,000-scale geologic
map plot on your plotter, i.e.,
lpr  -Ppicasso wa100k.hp
/* *************************

clear
clearselect

pagesize 40.5 29.0
pageunits inches
mapunits meters
mapscale 100000
mapposition ll 0.0 2.5
mapangle -1.0

&set cover wa100k
&set pntcover wapnt
/* where wapnt uses symbols from
geoscamp2.mrk
&set quad wallaceu11
&set key1 wa_pol.key
&set key2 wa_line.key
&set key4 wa_sym2.key
/* where wa_sym2.key uses
geoscamp2.mrk symbols
&s credits wacrd.txt
&s refs waref.txt
&s disclaimer wadisc.txt
/* where 'cover' contains contacts,
structures and dikes;
/* 'pntcover' contains structural symbols
for bedding and foliations;
/* and 'quad' is the quadrangle boundary.

mape %quad%
maplimits 0.0 2.4 32 27

/*draw outside box
linesymbol 9
linecolor 1
box 0.5 0.5 40.0 28.5

textquality proportional
textfont 94021
linedelete all
lineset plotter
lineset carto

/* cut marks
markerset plotter
markersymbol 1
markersize 0.1
marker 0 0
marker 0 29
```

```
marker 40.5 0
marker 40.5 29

&label shadepolys
/* color polygons for geologic rock units
shadedelete all
shadeset calcomp1
polygonshade %cover% unit
%cover%.ru

&label contacts
/* plot contacts
linedelete all
lineset geology.lin
res %cover% arcs linecode gt 0 and
linecode lt 40
arclines %cover% linecode
%cover%.con
asel %cover% arcs
linedelete all
lineset carto.lin
res %cover% arcs linecode gt 40 and
linecode lt 100
arclines %cover% linecode
%cover%.con
asel %cover% arcs

&label structures
/* plot structures with line patterns
linedelete all
lineset geology.lin
res %cover% arcs linecode gt 100 and
linecode lt 800
arclines %cover% linecode %cover%.str
asel %cover% arcs
res %cover% arcs linecode gt 800 and
linecode lt 1000
arclines %cover% linecode %cover%.lgu
asel %cover% arcs

&label mapquad
/* plot quadrangle boundary
linedelete all
lineset plotter
linesymbol 5
arcs %quad%

/* plot state boundary
linedelete all
lineset carto.lin
res %cover% arcs linecode eq 71
arclines %cover% linecode
%cover%.con
asel %cover% arcs

&label geolabels
textsize 0.10
res %cover% poly area gt 300000
labeltext %cover% unit %cover%.ru cc
asel %cover% poly

&label points
/* plot points for map symbols
markerdelete all
markerset geoscamp2.mrk
pointmarkers %pntcover% symbol

/*  plot annotation for all points
textset font.txt
/* annotext cover subclass #
{level...level}
annotext %pntcover% dip # 1 2

&label titles
textfont 93715
textquality kern
textsize 0.5
move 1.5 27.5
text 'U.S. DEPARTMENT OF THE
INTERIOR'
move 1.5 26.9
text 'U.S. GEOLOGICAL SURVEY'
move 39.3 27.5
text 'Open-File Report 99-390' lr
move 39.3 26.9
text 'Plate 1' lr
textfont 93711
textsize 0.7
move 16.2 2.7
```

```
text 'Digital Geologic Map of the
Wallace 1:100,000 quadrangle, Idaho' lc
textsize 0.5
move 16.2 2.1
text 'by Reed S. Lewis, Russell F.
Burmester, Mark D. McFaddan, Pamela
D. Derkey and Jon R. Oblad' lc
move 16.2 0.9
text '1999' lc

&label explan
/* plot explanation - geologic units
shadedelete all
shadeset calcomp1
textfont 93711
textsize 0.20
move 32.25 25.7
text 'Explanation'
textsize 0.12
textquality proportional
textfont 94021
keyarea 32.25 16.0 40.4 25.45
keybox 0.6 0.35
keyseparation 0.2 0.2
keyshade %key1%

&label linekey
/* plot explanation - line key
linedelete all
lineset geology.lin
keyarea 32.25 7.5 40.4 15.5
keybox 0.6 0.0
keyline %key2% nobox

&label markers
/* plot explanation - marker key
markerdelete all
markerset geoscamp2.mrk
keyarea 35.5 7.0 40.4 15.5
keymarker %key4% nobox

&label refs
/* plot references
textfont 93711
textsize 0.20
textcolor 1
move 35.5 6.8
text 'References'
move 35.5 6.5
textsize 0.12
textquality proportional
textfont 94021
textfile %refs%

&label credits
/*plot credits
textfont 94021
textquality proportional
textsize 0.12
move 27.8 3.75
textfile %credits%

&label proj
/*plot map projection notes
textfont 94021
textquality proportional
textsize 0.12
move 1.8 3.7
text 'map projection: UTM, zone 11'

/* plot scale bars
linedelete all
lineset plotter
textfont 94021
textsize 0.12
&r scale2a 3.5 2.0 other 100000

&label index-map
plot index_wa.gra box 32.25 4.25 35.25
6.25
textfont 93713
textquality proportional
textsize 0.12
move 32.3 4.05
text 'Index map showing Wallace
quadrangle'

&label disclaimer
textfont 93713
textquality proportional
```

```
textsize 0.12
move 35.5 1.55
textfile %disclaimer%

&label lat-long
/* plot neat line labels (latitude and
longitude)
mape %quad%
linecolor 1
mapprojection geo.prj u11.prj
neatline -116 47.0 -115 47.5 geo.prj
neatlinehatch 0.125 0.125 0.2 0 geo.prj
textset font.txt
textsymbol 1
textsize 8 pt
textstyle typeset
textoffset -0.35 0.15
neatlinelabels 0.125 top all geo.prj dms
'%1%!pat1857; %2%!pat1727;
%3%!pat1728'
textoffset -0.75 0.0
neatlinelabels 0.125 left all geo.prj dms
'%1%!pat1857; %2%!pat1727;
%3%!pat1728'

&label done
quit
display 9999 3
draw wa100k
&return
```

## Appendix D - Metadata file (wa100k.met) for the Wallace GIS

Identification_Information:
  Citation:
    Citation_Information:
      Originator: Reed S. Lewis
      Originator: Russell F. Burmester
      Originator: Mark D. McFaddan
      Originator: Pamela D. Derkey
      Originator: Jon R. Oblad
      Publication_Date: 1999
      Title:
        Digital geologic map of the Wallace 1:100,000 quadrangle,
        Idaho
      Edition: version 1.0
      Geospatial_Data_Presentation_Form: map
      Series_Information:
        Series_Name: Open-File Report 99-390
        Issue_Identification: wa100k
        Issue_Identification: wapnt
      Publication_Information:
        Publication_Place: Spokane WA
        Publisher: U.S. Geological Survey

      Online_Linkage:
        URL =
        http://wrgis.wr.usgs.gov/open-file/of99-390/of99-390.html
  Description:
    Abstract:
      The geology of the Wallace 1:100,000 quadrangle, Idaho was compiled by Reed S. Lewis in 1997 and supplemented by field mapping by Reed S. Lewis, Russell F. Burmester, and Mark D. McFaddan in 1997 and 1998. The geologic map information was inked onto a 1:100,000-scale topographic base map for input into an Arc/Info geographic information system(GIS). The digital geologic map database can be queried in many ways to produce a variety of derivative geologic maps.

    Purpose:
      This dataset was developed to provide geologic map GIS of the Idaho portion of the Wallace 1:100,000 quadrangle for use in future spatial analysis by a variety of users.

      This database is not meant to be used or displayed at any scale larger than 1:100,000 (e.g., 1:62,500 or 1:24,000).

Supplemental_Information:
This GIS consists of two major Arc/Info datasets: one line and polygon file (wa100k) containing geologic contacts and structures (lines) and geologic map rock units (polygons), and one point file (wapnt) containing structural data.

Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: August 5, 1999
Currentness_Reference: publication date

Status:
Progress: completed
Maintenance_and_Update_Frequency:
May update with new geologic map data model, perhaps in 2000.

Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: -116.0
East_Bounding_Coordinate: -115.0
North_Bounding_Coordinate: 47.50
South_Bounding_Coordinate: 47.00

Keywords:
Theme:
Theme_Keyword_Thesaurus: none
Theme_Keyword: geology
Theme_Keyword: geologic map
Place:
Place_Keyword_Thesaurus: none
Place_Keyword: Idaho
Place_Keyword: Wallace
Place_Keyword: Shoshone County
Place_Keyword: Pacific Northwest
Place_Keyword: USA

Access_Constraints: none

Use_Constraints:
This digital database is not meant to be used or displayed at any scale larger than 1:100,000 (e.g., 1:62,500 or 1:24,00).

Any hardcopies utilizing these data sets shall clearly indicate their source. If the user has modified the data in any way they are obligated to describe the types of modifications they have performed on the hardcopy map. User specifically agrees not to misrepresent these data sets, nor to imply that changes they made were approved by the U.S. Geological Survey.

Point_of_Contact:
  Contact_Information:
    Contact_Person_Primary:
      Contact_Person: Pamela D. Derkey
      Contact_Organization: U.S. Geological Survey
    Contact_Position: geologist
    Contact_Address:
      Address_Type: mailing and physical address
      Address: 904 W. Riverside Ave., Rm. 202
      City: Spokane
      State_or_Province: WA
      Postal_Code: 99201
      Country: USA
    Contact_Voice_Telephone: 1-509-368-3114
    Contact_Facsimile_Telephone: 1-509-368-3199
    Contact_Electronic_Mail_Address: pderkey@usgs.gov

  Contact_Information:
    Contact_Person_Primary:
      Contact_Person: Reed S. Lewis
      Contact_Organization: Idaho Geological Survey
    Contact_Position: geologist
    Contact_Address:
      Address_Type: mailing address
      Address: Idaho Geological Survey, University of Idaho
      City: Moscow
      State_or_Province: Idaho
      Postal_Code: 83844
      Country: USA
    Contact_Voice_Telephone: 1-208-885-7472
    Contact_Electronic_Mail_Address: reedl@uidaho.edu
Data_Set_Credit:
  Reed S. Lewis, Russell F. Burmester and Mark D. McFadden compiled and mapped the geology onto stable-base material;

  Optronics Specialty Co., Inc. scanned the geologic map and provided minimally attributed Arc/Info interchange-format files to the USGS;

Pamela D. Derkey (USGS) imported the files, transformed them to UTM zone 11 (with a y-shift) and attached and attributed an interim geologic map data model;

Thomas P. Frost (USGS) visually compared the hard copy plots with the source;

Jon R. Oblad (EWU) annotated the point data for output at a scale of 1:100,000.

Native_Data_Set_Environment:
SunOS, 5.5.1, sun4u UNIX
ARC/INFO version 7.1.1

Data_Quality_Information:
Attribute_Accuracy:
Attribute_Accuracy_Report:
Attribute accuracy was verified by manual comparison of the source with hard copy printouts and plots.

Logical_Consistency_Report:
Polygon and chain-node topology present.
Polygons intersecting the neatline are closed along the border.
Segments making up the outer and inner boundaries of a poygon tie end-to-end to completely enclose the area. Line segments are a set of sequentially numbered coordinate pairs. No duplicate features exist nor duplicate points in a data string. Intersecting lines are separated into individual line segments at the point of intersection. Point data are represented by two sets of coordinate pairs, each with the same coordinate values. All nodes are represented by a single coordinate pair which indicates the beginning or end of a line segment. The neatline was generated by mathematically generating the four sides of the quadrangle, densifying the lines of latitude and projecting the file to UTM zone 11 (with a y-shift).

Completeness_Report:
Geologic units were both compiled from previously existing geologic maps generally ranging in scale from 1:24,000 to 1:48,000 and mapped in the field at a scale of 1:24,000. Some small units and those obscured by dense forest cover may not be included in this dataset.

Positional_Accuracy:
Horizontal_Positional_Accuracy:
Horizontal_Positional_Accuracy_Report:
The horizontal positional accuracy for the digital data is no better than

+/- 6 meters based on the transformation RMS error. It was tested by visual comparison of the source with hard copy plots.

Lineage:
 Source_Information:
  Source_Citation:
   Citation_Information:
    Originator: Harrison, J.E.
    Publication_Date: unpublished
    Title:
     Unpublished geologic maps of the Bathtub Mountain 7.5-, Fishhook Creek 7.5-, Haugen 15-, Hoyt Mountain 7.5-, Montana Peak 7.5-, Monumental Buttes 7.5-, Saltese 15-, Thor Mountain 7.5-, Three Sisters 7.5-, Wallace 15- and Widow Mountain 7.5-minute quadrangles, Idaho
    Geospatial_Data_Presentation_Form: map
    Publication_Information:
     Publication_Place: Denver CO
     Publisher: U.S. Geological Survey Field Records Library
  Source_Scale_Denominator: 24,000
  Source_Scale_Denominator: 62,500
  Type_of_Source_Media: paper maps
  Source_Time_Period_of_Content:
   Time_Period_Information:
    Single_Date/Time:
     Calendar_Date: 1975? - 1985?
   Source_Currentness_Reference: date of field mapping
  Source_Citation_Abbreviation: Harrison, unpublished field notes
  Source_Contribution: These field maps were used in the map compilation.
 Source_Information:
  Source_Citation:
   Citation_Information:
    Originator: Hietenan, Anna
    Publication_Date: 1963
    Title:
     Anorthosite and associated rocks in the Boehls Butte quadrangle and vicinity, Idaho
    Geospatial_Data_Presentation_Form: map
    Series_Information:
     Issue_Identification: Professional Paper 344-B
    Publication_Information:
     Publisher: U.S. Geological Survey
  Source_Scale_Denominator: 48,000
  Type_of_Source_Media: paper map
  Source_Time_Period_of_Content:

    Time_Period_Information:
      Single_Date/Time:
        Calendar_Date: 1963
    Source_Currentness_Reference: publication date
  Source_Citation_Abbreviation: Hietenan, 1963
  Source_Contribution: This map was used in the map compilation.
Source_Information:
  Source_Citation:
    Citation_Information:
      Originator: Hietenan, Anna
      Publication_Date: 1967
      Title:
        Scapolite in the Belt Series in the St. Joe-Clearwater
        region, Idaho
      Geospatial_Data_Presentation_Form: maps
      Series_Information:
        Issue_Identification: Special Paper 86
      Publication_Information:
        Publisher: Geological Society of America
  Source_Scale_Denominator: 48,000
  Type_of_Source_Media: paper map
  Source_Time_Period_of_Content:
    Time_Period_Information:
      Single_Date/Time:
        Calendar_Date: 1968
    Source_Currentness_Reference: publication date
  Source_Citation_Abbreviation: Hietenan, 1967
  Source_Contribution: These maps were used in the map compilation.
Source_Information:
  Source_Citation:
    Citation_Information:
      Originator: Hietenan, Anna
      Publication_Date: 1968
      Title:
        Belt Series in the region around Snow Peak and Mallard
        Peak, Idaho
      Geospatial_Data_Presentation_Form: map
      Series_Information:
        Issue_Identification: Profession Paper 344-E
      Publication_Information:
        Publisher: U.S. Geological Survey
  Source_Scale_Denominator: 48,000
  Type_of_Source_Media: paper map
  Source_Time_Period_of_Content:
    Time_Period_Information:

Single_Date/Time:
Calendar_Date: 1968
Source_Currentness_Reference: publication date
Source_Citation_Abbreviation: Hietenan, 1968
Source_Contribution: These maps were used in the map compilation.
Source_Information:
Source_Citation:
Citation_Information:
Originator: Hietenan, Anna
Publication_Date: 1984
Title:
Geology along the northwest border zone of the Idaho
batholith, northern Idaho
Geospatial_Data_Presentation_Form: map
Series_Information:
Issue_Identification: Bulletin 1608
Publication_Information:
Publisher: U.S. Geological Survey
Type_of_Source_Media: paper map
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 1984
Source_Currentness_Reference: publication date
Source_Citation_Abbreviation: Hietenan, 1984
Source_Contribution: These figures were used in the map compilation.
Source_Information:
Source_Citation:
Citation_Information:
Originator: Hobbs, S.W.
Originator: Griggs, A.B.
Originator: Wallace, R.E.
Originator: Campbell, A.B.
Publication_Date: 1965
Title: Geology of the Coeur d'Alene district
Geospatial_Data_Presentation_Form: map
Series_Information:
Series_Name: Professional Paper
Issue_Identification: Professional Paper 478
Publication_Information:
Publisher: U.S. Geological Survey
Source_Scale_Denominator: 24,000
Type_of_Source_Media: paper maps
Source_Time_Period_of_Content:
Time_Period_Information:

Single_Date/Time:
Calendar_Date: 1965
Source_Currentness_Reference: publication date
Source_Citation_Abbreviation: Hobbs and others, 1965
Source_Contribution: These maps were used in the map compilation.
Source_Information:
Source_Citation:
Citation_Information:
Originator: U.S. Geological Survey
Publication_Date: 1993
Title:
1:100,000-scale digital line graph (DLG) data -
hydrography and transportation, Area 13 --
Northwestern states
Geospatial_Data_Presentation_Form: digital line graph (DLG) data
Series_Information:
Series_Name: US GeoData (optional format)
Publication_Information:
Publisher: U.S. Geological Survey
Source_Scale_Denominator: 100,000
Type_of_Source_Media: CD-ROM
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 1993
Source_Currentness_Reference: publication date
Source_Citation_Abbreviation: USGS, 1993
Source_Contribution:
This source provided the eastern boundary of the map
area (Idaho-Montana) boundary in a digital format.
Source_Information:
Source_Citation:
Citation_Information:
Originator: Vance, R.B.
Publication_Date: 1981
Title:
Geology of the NW 1/4 of the Wallace 15-minute quadrangle,
Shoshone County, Idaho
Geospatial_Data_Presentation_Form: map
Series_Information:
Issue_Identification: M.S. thesis
Publication_Information:
Publication_Place: Moscow, Idaho
Publisher: University of Idaho
Source_Scale_Denominator: 24,000

Type_of_Source_Media: paper map
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 1981
Source_Currentness_Reference: publication date
Source_Citation_Abbreviation: Vance, 1981
Source_Contribution: This map was used in the map compilation.
Source_Information:
Source_Citation:
Citation_Information:
Originator: Foster, S.A.
Publication_Date: 1983
Title:
Structural analysis of the NE 1/4 fo the Wallace 15-
minute quadrangle, Shoshone County, Idaho: University
of Idaho M.S. thesis, 150 p.
Geospatial_Data_Presentation_Form: map
Series_Information:
Publication_Information:
Publisher: University of Idaho
Source_Scale_Denominator: 24000
Type_of_Source_Media: paper map
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 1983
Source_Citation_Abbreviation: Foster, 1983
Source_Contribution: This map was used in the map compilation.
Process_Step:
Process_Description:
Geologic map information primarily from Foster (1983), Harrison (1975?-1985?), Hietenan (1963, 1967, 1968, 1984), Hobbs and others (1965), and Vance (1981) were compiled on a stable-base copy of the USGS 1:100,000-scale topographic quadrangle map and manually labeled. Additional geology from field mapping efforts in 1997 was also incorporated onto the stable-base map.
Process_Date:
1997

Process_Description:
Stable-base map was scanned and converted from a raster to a vector format (in scanner units).
Process_Date:
1998

Process_Description:
Digital files were transformed to UTM zone 11 (meters), with a RMS error (input,output) = (0.002, 6.148), and attributed using an interim geologic map data model. The data were checked for position by comparing plots of the digital data to the source.
Process_Date: 1998

Process_Description:
Senior author revised the geologic map based on mapping during the summer of 1998, and this information was incorporated into the digital map GIS.
Process_Date:
1999

Spatial_Data_Organization_Information:
Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:
SDTS_Terms_Description:
SDTS_Point_and_Vector_Object_Type: Point
Point_and_Vector_Object_Count: 491
SDTS_Point_and_Vector_Object_Type: String
Point_and_Vector_Object_Count: 1562
SDTS_Point_and_Vector_Object_Type: GT-polygon composed of chains
Point_and_Vector_Object_Count: 492

Spatial_Reference_Information:
Horizontal_Coordinate_System_Definition:
Planar:
Grid_Coordinate_System:
Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:
UTM_Zone_Number: 11
Transverse_Mercator:
Scale_Factor_at_Central_Meridian: implied
Longitude_of_Central_Meridian: implied
Latitude_of_Projection_Origin: implied
False_Easting: 0.000
False_Northing: -5,000,000 meters
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: coordinate pair
Coordinate_Representation:
Abscissa_Resolution: not determined
Ordinate_Resolution: not determined
Planar_Distance_Units: METERS
Geodetic_Model:

Horizontal_Datum_Name: North American Datum of 1927
Ellipsoid_Name: Clarke 1866
Semi-major_Axis: 6378206.4
Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:
Overview_Description:
Entity_and_Attribute_Overview:
The 'Digital geologic map of the Wallace 1:100,000 quadrangle, Idaho' Open-File Report 99-390 contains a detailed description of each attribute code and a reference to the associated map symbols on the map source materials. The GIS includes a geologic linework arc attribute table, wa100k.aat, that relates to the wa100k.con (contact look-up table), wa100k.str (structure look-up table), wa100k.lgu (linear geologic unit look-up table) and wa100k.ref (source reference look-up table) files; a rock unit polygon attribute table, wa100k.pat, that relates to the wa100k.ru (rock unit look-up table) and wa100k.ref (source reference look-up table) files; and a geologic map symbol point attribute table, wapnt.pat, that relates to the wapnt.sym (structural point data look-up tables) and wapnt.ref (source reference look-up table) files.
Entity_and_Attribute_Detail_Citation:
A detailed description of the items in the Wallace 100K GIS are given in the text of the Open-File Report 99-390 available in Adobe Acrobat PDF format on the World Wide Web at
http://wrgis.wr.usgs.gov/open-file/of99-390/of99-390.html .

Distribution_Information:
Distributor:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: U.S. Geological Survey Information Services
Contact_Address:
Address_Type: mailing and physical address
Address: Open-File Reports, Box 25286
City: Denver
State_or_Province: CO
Postal_Code: 80225
Country: USA
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