GEOLOGIC MAP OF THE BUTTE 1° X 2° QUADRANGLE,

Compiled and mapped by Reed S. Lewis

Montana Bureau of Mines and Geology
Open File Report MBMG 363

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Introduction

The purpose of this compilation is to provide digital geologic map coverage for the Butte 1° x 2° quadrangle. An initial compilation of the Butte quadrangle by Wallace and others (1986) was published as U.S. Geological Survey Open-File Report 86-292. A simplified version of that map (Wallace, C.A., 1987, Generalized geologic map of the Butte 1° x 2° quadrangle, Montana: U.S. Geological Survey Miscellaneous Field Studies Map MF-1925, scale 1:250,000; entire area of figures 1, 2, and 3) was also published, and was later digitized at the U.S. Geological Survey EROS Data Center in Sioux Falls, South Dakota. Although this digital map formed the basis for the present compilation, more recent field work in the area required a number of changes to be made. Work by Professor Jim Sears and students at the University of Montana has resulted in a 1:100,000-scale compilation of the area between Missoula and Drummond, Montana (Figure 1) that is incorporated into the present map. Additionally, it was felt that the simplified version of the map did not adequately show the formational subdivisions of the Middle Proterozoic Belt Supergroup that underlie much of the western and northern parts of the quadrangle. Consequently, exposures of the Ravalli Group in the northern part of the quadrangle have been subdivided into the Empire, Spokane, and Greyson Formations, as shown on the original detailed version of the Butte quadrangle (Wallace and others, 1986). The Missoula Group is also subdivided, primarily using the work of Wallace and others (1986), and is supplemented with three months of field work by the author. In addition to subdividing the Belt Supergroup, an attempt has been made to show only those faults along which there has been significant displacement. Thus, a number of faults present on the earlier compilations have been removed. In addition, several faults previously mapped as younger-over-older thrusts have been reinterpreted as down-to-the-west normal faults in the hanging walls of larger thrust sheets. Though poorly understood, lateral facies changes in the Belt Supergroup are clearly present. Several previously mapped thrust faults are not required if these lateral changes are taken into account, and these faults have been omitted.

Acknowledgments

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In the following two lists of references, those references prefaced by a number (3) are cited by Wallace and others (1986) (see Figure 2), and those prefaced by a letter (N) are additional references used in the present compilation (see Figure 3).

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** Covers entire map area of figures 1, 2, and 3.

Figures

Description of Lithologic Units

md TAILINGS, MINE DUMPS, AND SLAG PILES (HOLOCENE)
Man-made deposits, typically within Quaternary surficial deposits.

Qs SURFICIAL SEDIMENTARY DEPOSITS (PLEISTOCENE AND HOLOCENE)
Alluvium, fan and terrace gravel, gravel deposits on pediment surfaces, and landslide and travertine deposits (Pleistocene and Holocene); till, glacial lake, and outwash deposits (Pleistocene).

Ts SEDIMENTARY DEPOSITS AND ROCKS (EOCENE THROUGH PLIOCENE)
Fan and gravel deposits on pediment surfaces (Pliocene); conglomerate, sandstone, mudstone, and volcanic ash beds (Eocene, Oligocene, or Miocene).

Trv RHYOLITIC VOLCANIC ROCKS (EOCENE THROUGH MIOCENE)
Rhyolite, quartz latite, latite, and dacite interbedded with lesser amounts of basalt and andesite.

Tab ANDESITIC AND BASALTIC ROCKS (EOCENE AND OLIGOCENE)
Andesite, basalt, and latite flows.

Tgd GRANODIORITIC ROCKS (EOCENE)
Quartz monzodiorite and granodiorite.

Tlc LOWLAND CREEK VOLCANICS (EOCENE)
Rhyolite and dacite flows and tuffs.

TKab ANDESITIC AND BASALTIC VOLCANIC ROCKS (TERTIARY OR CRETACEOUS)
Basalt and andesite flows, flow breccia, and air-fall tuff.

TKg GRANITIC ROCKS (TERTIARY OR CRETACEOUS)
Foliated and non-foliated biotite-muscovite monzogranite, leucomonzogranite, and granodiorite. Includes muscovite-bearing granitic rocks with Tertiary K-Ar ages (Wallace and others, 1992) assigned to Tmg unit of Wallace (1987). Because these age determinations may date cooling and not crystallization, a Cretaceous age is also possible.

TKgd GRANODIORITIC ROCKS (TERTIARY OR CRETACEOUS)
Foliated and nonfoliated biotite granodiorite, hornblende-biotite granodiorite, tonalite, and quartz diorite.

TKgb GABBROIC ROCKS (TERTIARY OR CRETACEOUS)
Gabbro, microgabbro, diorite, and lamprophyre.

TKa ALKALIC ROCKS (TERTIARY OR CRETACEOUS)
Pyroxenite, leucosyenite, and hornblende syenite.

Ka APLITIC ROCKS (CRETACEOUS)
Aplite, alaskite, and pegmatite dikes, sills, and pods.

Kg GRANITIC ROCKS (CRETACEOUS)
Granite and monzogranite porphyry, biotite monzogranite, biotite-muscovite monzogranite and granodiorite, and quartz monzonite.

Kgd GRANODIORITIC ROCKS (CRETACEOUS)
Foliated and non-foliated biotite-hornblende granodiorite, biotite-hornblende monzogranite, and tonalite.

Kmd MONZODIORITIC ROCKS (CRETACEOUS)
Hornblende quartz diorite, granodiorite, tonalite, quartz monzodiorite, diorite, quartz diorite, leucogranodiorite, and augite-hornblende monzonite.

Kgb GABBROIC ROCKS (CRETACEOUS)
Diorite, gabbro, microgabbro, and diabase.

Kl LATITE SILL (CRETACEOUS)
Latite sill in northeastern corner of map.

Kem ELKHORN MOUNTAINS VOLCANICS (CRETACEOUS)
Andesitic, quartz latititic, and basaltic tuff, breccia, and flows.

KJs SEDIMENTARY ROCKS (CRETACEOUS AND JURASSIC)
Unit includes, in descending order: Cretaceous Two Medicine Formation, Virgelle Sandstone, Telegraph Creek Formation, Marias River Shale, and Blackleaf Formation in northeast corner of quadrangle. Northwest of Deer Lodge unit consists of Cretaceous Golden Spike Formation, Carter Creek, Jens, and Coberly Formations of Gwinn (1961), Blackleaf Formation, and Kootenai Formation, as well as Jurassic Morrison Formation and Ellis Group.

PDs SEDIMENTARY ROCKS (PERMIAN THROUGH DEVONIAN)
Unit includes, in descending order: Permian Shedhorn Sandstone, Phosphoria Formation, and Park City Formation, Pennsylvanian Quadrant Quartzite, Snowcrest Range Group (Pennsylvanian and Mississippian), Madison Group and related rocks (Mississippian), Three Forks Formation (Mississippian and Devonian) and Jefferson and Maywood Formations (Devonian).

Cs SEDIMENTARY ROCKS (CAMBRIAN)
Red Lion Formation, Hasmark Formation, Silver Hill Formation, and Flathead Quartzite. Park Shale, Meagher Limestone, and Wolsey Shale are lateral equivalents to the Silver Hill Formation and are present in northeast part of quadrangle.

ZYg GABBROIC ROCKS (MIDDLE OR LATE PROTEROZOIC)
Gabbro, microgabbro, and diorite dikes and sills.

BELT SUPERGROUP

Ypi PILCHER QUARTZITE (MIDDLE PROTEROZOIC)
Coarse- to medium-grained, reddish or buff quartzite containing thin beds of sandy argillite.

Ygr GARNET RANGE FORMATION (MIDDLE PROTEROZOIC)
Grayish-green micaceous quartzite and impure argillite.

Ym MCNAMARA FORMATION (MIDDLE PROTEROZOIC)
Red and green interbedded argillite and siltite, and buff quartzite. Contains distinctive green and red chert beds and clasts. Amount of quartzite increases to the south and southwest.

Ybo BONNER QUARTZITE (MIDDLE PROTEROZOIC)
Pink or buff, medium- and coarse-grained feldspathic quartzite. Matrix-supported granules and pebbles present locally. Abundant trough cross-beds.

Yms MOUNT SHIELDS FORMATION (MIDDLE PROTEROZOIC)
Reddish quartzite and subordinate argillite and siltite in lower and middle parts of section. Upper part is predominantly reddish argillite. Matrix-supported granules and pebbles present in southern part of area, but medium to fine grain size is most common. Abundant planar laminations and ripple cross-laminations. Previously subdivided into three informal members, the middle one being the most quartzitic (Wallace and others, 1986). However, significant quartzite may be present in the lowermost part of the section as well, particularly in the western part of the map area.

Yss SNOWSLIP AND SHEPARD FORMATIONS (MIDDLE PROTEROZOIC)
Shown as a single unit in the southwest part of area where the Shepard Formation is thin, poorly exposed, and only recognized at a few localities. Includes rocks previously mapped as carbonate facies of the lower part of the Mount Shields Formation (Wallace and others, 1986). In western part of area near Burnt Fork Lake both Snowslip and Shepard Formations are present but have yet to be mapped separately. Here they are more quartzitic than to the east in the Philipsburg area.

Ysh SHEPARD FORMATION (MIDDLE PROTEROZOIC)
Green microlaminated argillite at base overlain by thin lenticular beds of green dolomitic siltite and fine-grained quartzite. Upper part is red, thinly bedded dolomitic quartzite and siltite. Abundant load casts and ripple marks. Poorly exposed and easily missed when mapping.

Ysn SNOWSLIP FORMATION (MIDDLE PROTEROZOIC)

Green and red argillite near base and increasing amounts of siltite and quartzite up section. Some quartzite beds contain coarse, well-rounded quartz grains and less feldspar than is typical for quartzite in the Belt Supergroup. Upper quartzitic part of section is difficult to distinguish from Mount Shields Formation. Abundant straight-sided mud cracks in lower part of section.

Yc MIDDLE BELT CARBONATE (MIDDLE PROTEROZOIC)
Limestone, dolomite, dolomitic and calcareous siltite, and argillite of the Helena Formation in the eastern part of the area and dolomitic siltite, quartzite, argillite, and sedimentary breccia of the Wallace Formation in the western part of the area.

Ye EMPIRE FORMATION (MIDDLE PROTEROZOIC)
Mostly greenish gray argillite and siltite with interbeds of quartzite and dolomite; red to purple argillite near base. Carbonate content increases up section.

Ys SPOKANE FORMATION (MIDDLE PROTEROZOIC)
Reddish siltite, argillite, and thin beds of quartzite

Yg GREYSON FORMATION (MIDDLE PROTEROZOIC)
Dark gray thinly laminated argillite and siltite grading up into light-gray to greenish-gray, thinly bedded siltite and quartzite.

Yq QUARTZITE OF THE BELT SUPERGROUP (MIDDLE PROTEROZOIC)
Highly recrystallized quartzite and lesser amounts of phyllite and schist. Although assigned to Mount Shields Formation by Wallace and others (1986), these rocks appear to underlie the Middle Belt carbonate and are probably Ravalli Group equivalent. Exposures of Yq in the Anaconda range were assigned to Ravalli Group by Calkins and Emmons (1915).

Ymb METAMORPHOSED ROCKS OF THE BELT SUPERGROUP (MIDDLE PROTEROZOIC)
Quartzofeldspathic gneiss, migmatite, schist, quartzite, and calc-silicate rocks. Includes rocks assigned to the Prichard Formation and Neihart Quartzite (lowermost Belt) by Calkins and Emmons (1915) and later assigned to the Mount Shields Formation by Wallace and others (1986). The older assignment is more likely, given their structural position in the uplifted block of the Anaconda Range. Also includes rocks in the southwest part of the map area which may be metamorphic equivalents of the Prichard Formation(?), Ravalli Group, and Middle Belt carbonate.

Map Symbols

Contact--Includes both inferred and well located contacts

Fault--Direction of motion uncertain; dashed where inferred, dotted where concealed

Normal fault--Ball and bar on downthrown block; dashed where inferred, dotted where concealed

Thrust fault--Teeth on upper plate; dotted where concealed

Anticlinal fold--Shows trace of axial plane, direction of plunge, and dip direction of limbs

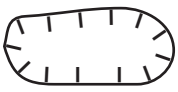
Synclinal fold--Shows trace of axial plane, direction of plunge, and dip direction of limbs

Overturned anticline--Shows trace of axial plane, direction of plunge, and dip direction of limbs

Overturned syncline--Shows trace of axial plane, direction of plunge, and dip direction of limbs

Sedimentary breccia--Areas underlain by sedimentary breccia of the Wallace Formation (middle Belt carbonate)

Silicified and sheared rocks--Altered zones in Mississippian and Devonian strata in the northern part of the map area



Open-pit mine--Approximate location of the Berkeley Pit.

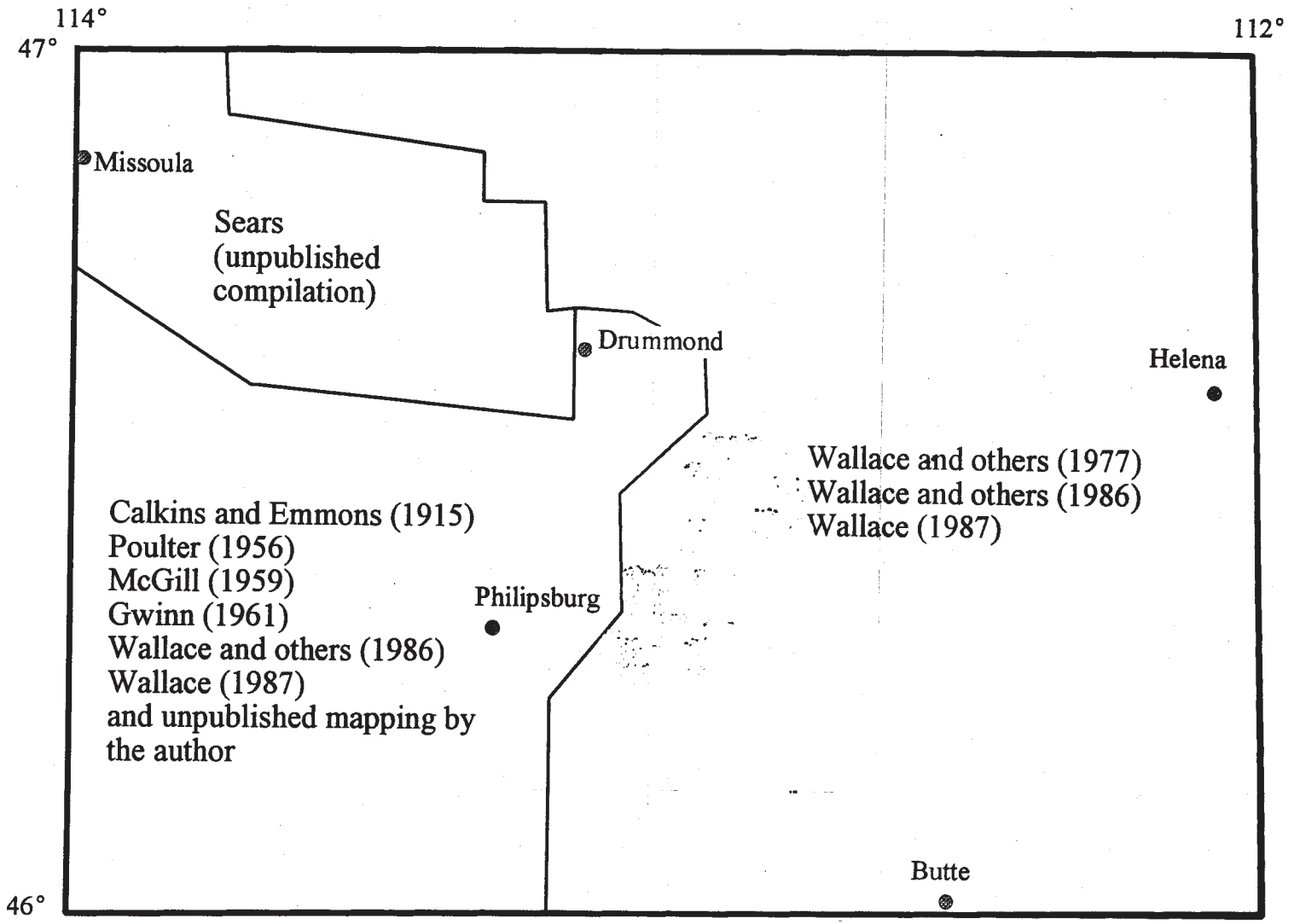


Figure 1. Principal sources of geologic map information on Butte 1 x 2 degree quadrangle.

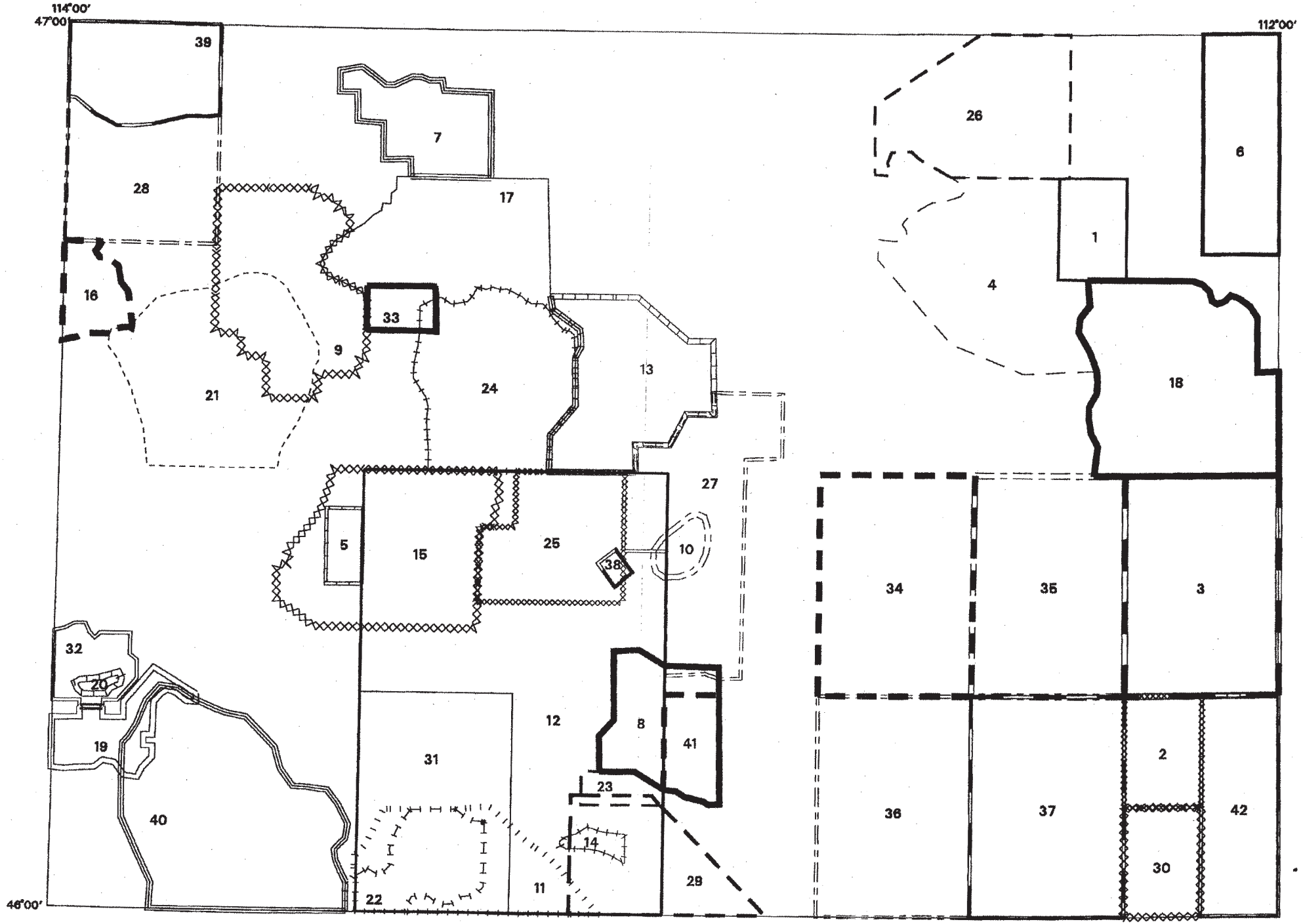


Figure 2. Index map of references included in Wallace and others (1986) (USGS Open File Report OFR-86-292).

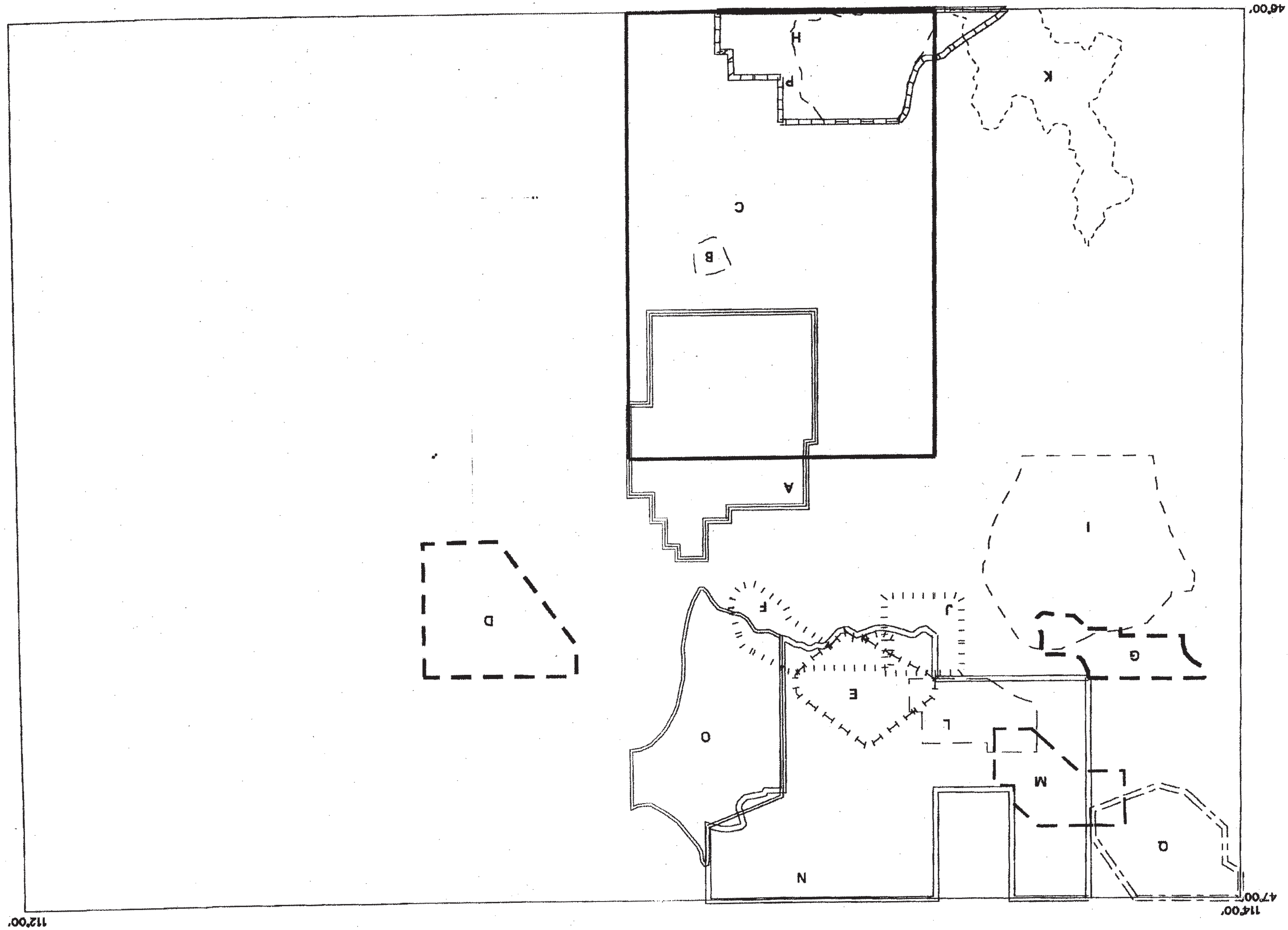


Figure 3. Index map of references for the Butte 1 x 2-degree quadrangle not included in wallace and others (1986).