Preliminary Geologic Map of the Elk City Region, Idaho County, Idaho

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PRELIMINARY GEOLOGIC MAP OF THE ELK CITY REGION, IDAHO

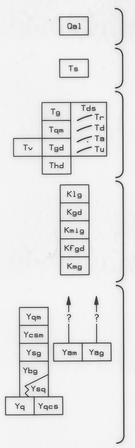
BY REED S. LEWIS, RUSSELL F. BURMESTER, EARL H. BENNETT, AND DAVID L. WHITE

1990

MAP UNITS

Qal	Alluvium (Quaternary)
Ts	Unconsolidated lacustrine and fluvial sediments (Miocene?)
Tr	Rhyolite dikes (Eocene)
Td	Dacite and rhyodacite dikes and plugs (Eocene)
Ta	Andesite dikes (Eocene?)
Tu	Dike rocks, undivided (Eocene)
Tds	Dike swarm (Eocene)
Tg	Pink granite (Eocene)
Tqm	Quartz monzonite phase of pink granite (Eocene)
Tv	Welded tuff (Eocene)
Tgd	Hornblende-biotite granodiorite (Eocene)
Thd	Hornblende quartz diorite (Eocene)
Klg	Leucocratic granite, biotite granodiorite, and hornblende-biotite diorite (Late Cretaceous?)
Kgd	Biotite granodiorite (Late Cretaceous)
Kmig	Migmatite (Late Cretaceous)
KFgd	Foliated granodiorite, megacrystic granodiorite, and diorite (Late Cretaceous)
Kmg	Megacrystic granodiorite (Late Cretaceous)
Ym	Amphibolite (Proterozoic Y)
Ysg	Augen gneiss of Red River (Proterozoic Y)
Yqm	Quartzite of Meadow Creek (Proterozoic Y)
Ycsm	Calc-silicate rocks of Meadow Creek (Proterozoic Y)
Ysg	Schist and gneiss (Proterozoic Y)
Ybg	Biotite gneiss and schist (Proterozoic Y)
Ysq	Schist and quartzite (Proterozoic Y)
Yq	Quartzite and schist (Proterozoic Y)
Yqcs	Quartzite and calc-silicate rocks (Proterozoic Y)

CORRELATION OF MAP UNITS



MAP SYMBOLS

- Contact, approximately located
- Fault, dashed where approximately located, dotted where concealed; ball and bar on downthrown side; thrust fault sawteeth on upper plate
- Dikes
- Areas of mylonitized rock
- Strike and dip of compositional layering interpreted as bedding; ball indicates top direction was determined
- Strike and dip of foliation, including compositional layering of gneiss
- Vertical foliation
- Bearing and plunge of mineral lineation, small fold axis, or crenulation lineation

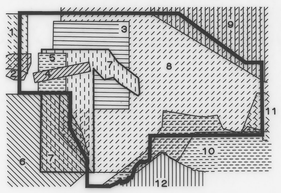
LOCATION MAP

SCALE 1:100,000

KILOMETERS 1 0 1 2 3 4 5

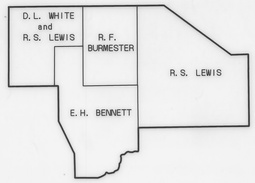
MILES 1 0 1 2 3

INDEX TO PREVIOUS MAPPING



1. Myers, 1982
2. Hoover, 1987
3. Reid, 1959
4. Carlson, 1981
5. Zimmerman, 1982
6. Lund and Esparza, in press
7. Shenon and Reed, 1934
8. Greenwood and Morrison, 1973
9. Toth, 1983
10. Weis and others, 1972
11. Pawlowski, 1982
12. Cater and others, 1973

INDIVIDUAL MAP AREAS



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Field work conducted in 1989

Computer-aided cartography by Loudon R. Stanford

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DESCRIPTION OF ROCK UNITS

INTRODUCTION

The geology of the Elk City region is complex. The area is underlain by metasedimentary rocks of probable Proterozoic age that were multiply deformed, metamorphosed to sillimanite- or kyanite-grade, and intruded by plutons of Proterozoic, Cretaceous, and Eocene ages. Numerous faults cross the area. Those in the western part have northerly trends, and many of these are mineralized. Those in the eastern part have northeast trends and are spatially associated with northeast-trending dikes of Eocene age.

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The metasedimentary rock units include numerous rock types, and contacts between them are gradational and poorly constrained. In addition, stratigraphic relationships within the Proterozoic rocks are not well established. However, our mapping indicates that the lowermost metasedimentary units in many parts of the area are made up of quartzite and schist (Yq) and quartzite and calc-silicate rocks (Yqcs), which form the roof of the Late Cretaceous Idaho batholith (Kgd). Above the Yq and Yqcs are schist- and gneiss-rich units (Ysq and Ybg). All of these metasedimentary units have been intruded by Proterozoic granite (now metamorphosed to an augen gneiss) that is thought to be approximately 1370 Ma (Evans and Fischer, 1986). Thus, the lower metamorphic rocks are as old or older than the lower part of the Missoula Group of the Belt Supergroup as outlined in the chronology of Elston (1984). The high-grade metasedimentary rocks in the area have been tentatively correlated with the lower-

grade rocks of the Belt Supergroup exposed to the north (Shenon and Reed, 1934; Reid, 1959). Our mapping, however, was inconclusive regarding correlative units outside the Elk City region.

ROCK UNITS

Qal Alluvium (Quaternary)—Stream deposits in modern drainages; includes gravels reworked by dredging.

Ts Unconsolidated lacustrine and fluvial sediments (Miocene?)—Poorly sorted, unconsolidated sediments of clay, silt, sand, and gravel that commonly contain rounded cobbles of quartzite. Unit is well exposed on the north side of the American River 1.5 kilometers south of Elk City; cross-bedded sands, gravels, and boulder conglomerates there contain wood fragments and cedar(?) bark. Sediments have been locally placered for gold, but their grade is lower than that of Quaternary stream deposits (Shenon and Reed, 1934). The locations and mapping of this unit in the Newsome Creek drainage in the northwest part of the study area are taken in part from Reid (1959).

Tr Rhyolite dikes (Eocene)—Light-colored, commonly iron-stained, with sparse (0-10 percent) phenocrysts of quartz, alkali feldspar, and plagioclase. The dikes are most common in the eastern part of the area, both within and near the pink granite unit (Tg).

Td Dacite and rhyodacite dikes and plugs (Eocene)—Porphyritic, gray to greenish gray dikes, with plagioclase, hornblende, biotite, and embayed quartz phenocrysts; includes a small plug of rhyodacite southeast of Orogrande. Dikes are most common in the eastern part of the area east of the Blanco Creek shear zone. Variants include coarsely porphyritic rocks in the southern part of the area near the Salmon River; there, the rocks have conspicuous feldspar and quartz phenocrysts averaging 1 centimeter in length. Some of these dikes near the Salmon River are mylonitized, presumably as a result of motion along the Bargamin Creek shear zone.

Ta Andesite dikes (Eocene?)—Dark greenish gray with microphenocrysts of plagioclase and hornblende. Some of these dikes may be Cretaceous in age.

Tu Dike rocks, undivided (Eocene)—Dikes of varying compositions. This unit includes dikes that were located using aerial photographs but not field checked.

Tds Dike swarm (Eocene)—Poorly exposed areas consisting of greater than 50 percent dike rock. Unit is dominated by dacite and rhyodacite (Td) west of Bargamin Creek and rhyolite (Tr) east of Bargamin Creek.

Tg Pink granite (Eocene)—Massive, pink to light gray, fine- to medium-grained, equigranular hornblende-biotite granite; locally miarolitic. Unit also contains smaller amounts of seriate to porphyritic, medium- to coarse-grained, magnetite-hornblende quartz syenite to quartz monzonite. These latter rocks contain less quartz than is typical for this unit and are only subdivided in the Vermilion Peak area (see description of Tqm). All phases contain highly perthitic alkali feldspar; mafic minerals are typically interstitial. Unit includes rocks of the Running Creek pluton (Motzer, 1985) in the northeastern part of the area. The pink granite is cross-cut by numerous rhyolite dikes, most of which are unmapped. These dikes increase in number toward the contacts with older rocks, and some contacts are entirely obscured by later intrusions of dikes. Unit includes foliated plutonic rocks of uncertain correlation on Burnt Knob east of Bargamin Creek as well as a small stock of leucocratic granite east of Red River Hot Springs in the east–central part of the area; both of these could be Cretaceous in age. A radiometric age of 50 $\pm$ 3 Ma (K-Ar on biotite, recalculated with new decay constants) was obtained by Greenwood and Morrison (1973) from a sample of pink granite along Running Creek.

Tqm Quartz monzonite phase of pink granite (Eocene)—Gray, medium-grained, seriate, quartz monzonite; subdivided only in the vicinity of Vermilion Peak in the northeastern part of the area. Hornblende is cored by relict pyroxene, and magnetite is common. Quartz is interstitial.

Tv Welded tuff (Eocene)—Densely welded vitric tuff with sparse phenocrysts of plagioclase, quartz, and biotite. The tuff contains inclusions of biotite granodiorite, dacite, and schist. Although the unit is resistant to weathering, outcrops are preserved across an area less than 1 kilometer wide in the south-central part of the map area. This unit is probably correlative with the Challis Volcanics.

Tgd Hornblende-biotite granodiorite (Eocene)—Gray, seriate, medium-grained, granodiorite to granite. Alkali feldspar is perthitic, interstitial, and locally in granophyric intergrowths with quartz. Plagioclase is strongly zoned oligoclase-andesine. Biotite is present

in pseudohexagonal grains, and clinopyroxene forms relict cores in hornblende. Unit is cross-cut by numerous Td dikes and by sparse dikes of aplite and pegmatite with miarolitic cavities. Outcrops show conspicuous weathering to rounded boulders.

Thd Hornblende quartz diorite (Eocene)—Dark-colored, equigranular hornblende-rich rocks. These rocks are present both as xenoliths 3-20 meters in length within Tg and as map-scale units in the southeastern part of the area. Hornblende is euhedral and commonly contains cores of clinopyroxene. Plagioclase is strongly zoned and subhedral, whereas quartz and perthitic alkali feldspar are interstitial.

Klg Composite unit of leucocratic granite, biotite granodiorite, and hornblende-biotite diorite (Late Cretaceous?)—Consists principally of fine-grained, leucocratic biotite granite and lesser amounts of biotite granodiorite and hornblende-biotite diorite. Unit is present only in the southeastern part of the area. The biotite granodiorite is similar to the Kgd unit and is medium grained, equigranular, and foliated to massive. The hornblende-biotite diorite is fine grained and present as inclusions in the biotite granodiorite and the leucocratic granite of this unit. Although the leucocratic granite was considered by Pawlowski (1982) to be Eocene in age, its low magnetic susceptibility and lack of strongly perthitic alkali feldspar and miarolitic cavitites are more characteristic of Cretaceous rocks in the area.

Kgd Biotite granodiorite (Late Cretaceous)—Commonly medium-grained, equigranular, biotite granodiorite to granite. In places the unit is foliated and hornblende-bearing. The alkali feldspar exhibits microcline grid twins, and myrmekitic textures are common. This unit represents the northeasternmost exposures of the southern lobe of the Idaho batholith and is well exposed in the western part of the area. Included in this unit are muscovite-bearing phases south and west of Orogrande and in the Dixie area. Also in this unit are mappable masses of pegmatite and aplite. K-Ar determinations of 72.1 $\pm$ 0.4 Ma (biotite) and 73.4 $\pm$ 0.4 Ma (muscovite) were obtained on a sample of this unit collected in the western part of the area along the South Fork of the Clearwater River west of Peasley Creek (Criss and Fleck, 1987).

Kmig Migmatite (Late Cretaceous)—Leucocratic and generally undeformed varieties of biotite granodiorite (Kgd) containing 30 to 60 percent inclusions of biotite gneiss, less common schist and augen gneiss, and rare calc-silicate rocks. In most occurrences, foliation and folds in inclusions have attitudes similar to nearby country rocks. This relationship suggests passive emplacement of the granitic material after the ductile deformation and metamorphism of the metasedimentary rocks. In other occurrences, the foliation of the granitic material and the presence of biotite selvages around the inclusions indicate partial melting or assimilation, and an earlier (syndeformational) orgin.

Kfgd Composite unit of foliated granodiorite, megacrystic granodiorite, and diorite (Late Cretaceous)—Consists principally of foliated biotite granodiorite but includes areas of megacrystic granodiorite similar to Kmg as well as smaller masses of hornblende diorite. Diorite is present as fine-grained inclusions in foliated granodiorites. Some of the margins of the inclusions are crenulate as if the diorite were partially molten when intruded by granodioritic magmas. Alternatively, the diorite inclusions may have been partially melted by the younger intrusion.

Kmg Megacrystic granodiorite (Late Cretaceous)—Foliated to lineated, hornblende-biotite granodiorite to quartz diorite typified by alkali feldspar megacrysts 2 to 6 centimeters in length. A nonporphyritic variety occurs along the contact in several places, particularly in the area southeast of Red River Hot Springs. Subhedral sphene and epidote are common accessory minerals. The epidote, some of which is cored by allanite, is probably a magmatic phase. A subhorizontal foliation defined by biotite is present, as is a lineation defined by aligned alkali feldspar phenocrysts and hornblende that parallels another lineation in the surrounding country rocks. The lineation in the Kmg is probably a result of deformation as the magmas intruded and cooled. Locally, a steep foliation dominates, perhaps occurring from submagmatic flow during continued (or later?) deformation. Kmg differs from the augen gneiss of Red River (Yag) in that it contains hornblende and epidote. Relative to the Yag unit the Kmg is enriched in Al, Ca, Na, Ba, and Sr, and depleted in K, Rb, and Y.

Yam Amphibolite (Proterozoic Y)—Typically lineated, fine- to medium-grained plagioclase-hornblende rock, commonly with sphene and various amounts of biotite. The unit contains 20 to 60 percent granitic interlayers and some tectonic slices of quartzite and augen gneiss. It probably had an igneous protolith on the basis of uniform composition and texture. Relict pyroxene in the eastern part of the area at Green Mountain suggests the protolith was a medium-grained gabbro. Because the amphibolite

does not intrude into Yqm, Ycsm, and Ysg, this may indicate that it is older than these units. The small, folded, metamorphosed and boudinaged biotitic bodies located within the Yag and Ybg units are probably sills or dikes of amphibolite, which may be genetically related to Yag. These biotitic rocks may reflect either the replacement of hornblende in a retrograde reaction or a metamorphism under different conditions than experienced by the rocks that retain hornblende. Some fine-grained biotite schist west of Horse Creek in the northern part of the area may have a similar origin.

Yag Augen gneiss of Red River (Proterozoic Y)—Biotite-rich granitic gneiss with augen of alkali feldspar, alkali feldspar rimmed by plagioclase, and plagioclase. Augen are up to 5 centimeters in length and range from blocky in less strained rocks to asymmetric with strain shadows in more highly strained rocks. The local absence of augen in highly foliated rock is attributed to their destruction from metamorphic processes rather than their original absence. Fine-grained, compositionally layered angular blocks and tabular bodies concentrated near the margins are probably inclusions of surrounding Ybg. The protolith of the augen gneiss was probably rapakivi granite. U-Pb dating and a correlation with similar augen gneiss southeast of the area near Shoup, Idaho, suggest an age of about 1370 Ma for the augen gneiss of Red River (Evans and Fischer, 1986). The augen gneiss is not associated with areas of Yqm, Ycsm, and Ysg, indicating these units may be younger than the augen gneiss.

Yqm Quartzite of Meadow Creek (Proterozoic Y)—Light-colored quartzite, muscovitic quartzite, and fine-grained quartz-muscovite-biotite schist. Quartzite is typically fine grained; some is sugary to friable, but most is well recrystallized and hard. The quartzite locally contains up to 20 percent alkali feldspar. Kyanite is present in biotite-rich layers southeast of Copper Butte in the northern part of the area and near Anderson Butte in the north-central part. Partings on micaceous interlayers appear to define "beds" 2 to 60 centimeters thick. Schistosity commonly parallels compositional layering, but in the northern part of the area at Disgrace Butte the bedding is defined by magnetite laminations and is at a high angle to the schistosity defined by aligned muscovite. Magnetite cross-laminations in the Disgrace Butte area indicate a top direction to the east, as do rare sedimentary structures found in the unit at locations between Meadow Creek and Anderson Butte.

Ycsm Calc-silicate rocks of Meadow Creek (Proterozoic Y)—Includes dark, laminated to thinly laminated amphibole (actinolite?)-diopside-quartz rock between Anderson Butte and Copper Butte in the northern part of the area and lighter, epidote-quartzite with apparent thin lamination and dewatering structures and folds that mimic bioherms to the south in the Flatiron Ridge area. Unit is a transition between the quartzite of Meadow Creek and the underlying rocks of the schist and gneiss unit (Ysg).

Ysg Schist and gneiss (Proterozoic Y)—In locations adjacent to the Ycsm unit, rocks include coarse-grained, crenulated, mica-rich schists, typically muscovitic in the area east of Meadow Creek and biotitic in areas to the west (e.g., on Flatiron Ridge). In locations away from the Ycsm contact, the mica grains are smaller, and schistose zones are separated by 1 to 2 centimeter-thick layers (or rods where more deformed) of fine-grained quartzite. Closer to the contact with the Ybg unit, the quartzite layers become more feldspathic and grade from fine-grained quartzo-feldspathic biotite (-muscovite) gneiss into granular biotite gneiss lithology of the biotite gneiss unit. Throughout the unit, biotite is more abundant than in the Yqm unit. Sillimanite is present locally.

Ybg Biotite gneiss and schist (Proterozoic Y)—Fine- to medium-grained quartz-feldspar-biotite (-muscovite) gneiss and muscovite-biotite (-quartz) schist. More schistose rocks locally contain sillimanite; garnet is rare. Gneissic varieties include: (1) granular biotite gneiss, which is a fine-grained quartzo-feldspathic metagraywacke(?); (2) layered granular biotite gneiss, which is similar to granular rocks but has centimeter-scale layering that possibly is relict bedding; and (3) medium- to coarse-grained gneiss, which has a layered appearance produced by variations in biotite content and which locally grades into migmatite. Schist-dominated varieties are present west of Newsome Creek in the western part of the area and north and west of Jack Creek Summit in the south-central part. Unit includes some quartzite and may include augen gneiss where high strain, deep weathering, and the abundance of pegmatites make detection of feldspar augen difficult.

Ysq Schist and quartzite (Proterozoic Y)—Consists of interlayered quartz-mica schist and variably micaceous quartzite. Schists have abundant, coarse-grained muscovite, less abundant magnetite, sillimanite (commonly concentrated in lenses 1-4 centimeters in diameter), and garnet; schist grades into biotite gneiss. Quartzite is dark (from included biotite?), coarse grained (2-5 millimeters), and iron stained from the weathering of magnetite octahedra (2 to 4 millimeters

in diameter). Partings typically are 5 to 30 centimeters apart.

Yq Quartzite and schist (Proterozoic Y)—Impure quartzite and biotite schist. Compositional layering on the scale of tens of centimeters is defined by thin layers of schist in more massive quartzite. Quartzite typically contains 20 to 30 percent feldspar (principally alkali feldspar) and about 10 percent mica. Quartz grains are commonly 0.25 to 1 millimeter in size but as large as 5 millimeters in highly recrystallized rocks. The recrystallized quartzite is also highly strained. The abundance of schist decreases to the west (west of Newsome Creek) and to the southwest (south and west of Dixie). In places this unit includes calc-silicate rocks. The unit differs from Yqm by having a coarser grain size, more feldspar, and larger amounts of biotite schist.

Yqcs Quartzite and calc-silicate rocks (Proterozoic Y)—Garnetiferous quartzite and hornblende gneiss; locally epidote- or diopside-rich. Domal parting surfaces along the Silver Leggett Road east of Golden may have originated as stromatolite bioherms. Map unit includes some amphibolite presumed by its association with more clear-cut calc-silicates of this unit to have a sedimentary origin.

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