Preliminary Geologic Map of the Red River Hot Springs-Elk City Area, Idaho County, Idaho

Russell F. Burmester
Joe Dragovich
Reed S. Lewis
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PRELIMINARY GEOLOGIC MAP OF THE
Red River Hot Springs-Elk City Area,
Idaho County, Idaho

By
Russell F. Burmester, Joe Dragovich, and, Reed S. Lewis

DESCRIPTION OF ROCK UNITS

INTRODUCTION

The geology of the Red River Hot Springs-Elk City region is complex. The area is underlain by metasedimentary rocks of probable Proterozoic age that have been correlated tentatively with the lower grade rocks of the Belt Supergroup exposed to the north (Shenon and Reed, 1934; Reid, 1959). Substantiating this correlation is difficult because the rocks are multiply deformed, metamorphosed to sillimanite-grade and locally kyanite-grade, and intruded by plutons of Proterozoic, Cretaceous, and Eocene ages. Numerous faults of various ages cross the area. Those in the central part have northeast trends and are spatially associated with northeast-trending dikes of Eocene age. A suspected thrust fault trends west-northwest across the area and is offset in several places by the northeast-trending faults. The trace of the thrust (?) fault is marked by mylonitized and tectonically mixed amphibolite and augen gneiss; locally, granitic rocks possibly as young as Cretaceous age are deformed. The geometry of the thrust (?) plane is not well understood, the area north of the fault is tentatively designated the upper plate. And because of limited exposures, the northwest extension of this fault is also uncertain.

The metasedimentary rock units are varied lithologically, but their protoliths were exclusively fine to medium grained; contacts between them are gradational and poorly constrained. In addition, stratigraphic relationships within the Proterozoic rocks are not well established. However, our mapping suggests that lithologic packages generally dip eastward and may have a relatively simple stratigraphy. The lowest metasedimentary units in the region 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). This stratigraphy is consistent with earlier mapping by Shenon and Reed (1934). Above the Yq and Yqcs are schist- and gneiss-rich units (Ysq and Ybg). Separated from these in at
least part of the area by the suspected thrust fault are
typically finer grained gneiss, schist, quartzite, and
calc-silicate of the Ysg, Yqc and Yqmc units.

The lower units up through Ybg 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, they 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 lack of augen gneiss in the
apparently overlying strata admits the possibility that
they are unconformable on the lower package.
However, the continuity of structures and metamor-
phism across the area provides no evidence that any
such unconformity was angular. Our mapping was in-
conclusive regarding correlation with specific units
outside the Elk City region.

ROCK UNITS

Qal Alluvium (Quaternary)—Stream deposits in
modern drainage; 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 just
east of American Hill Lake, 1.5 kilometers south of Elk
City; cross-bedded sands, gravels, and boulder con-
glomerates 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).

Tr Rhylolite dikes (Eocene)—Light-colored, com-
monly iron-stained, with sparse (0-10 percent) phe-
crysts 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 (Eocene)—Porphy-
ritic, gray to greenish gray dikes, with plagioclase, horn-
blende, biotite, and embayed quartz phenocrysts. Dikes
are most common in the eastern part of the area east
of the Blanco Creek shear zone.

Tu 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.

Tg Pink granite (Eocene)—Massive, pink to light
gray, fine- to medium-grained, equigranular horn-
blende-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 Vermillion 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
rhylolite 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 a small stock of
leucocratic granite east of Red River Hot Springs in
the southeastern part of the area that could be
Cretaceous in age.

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

Tgd Hornblende-biotite granodiorite (Eocene)—
Small mass of gray, seriate, medium-grained gran-
diorite. Rock is similar to a larger mass that is exosed
south of the map area at Mountain Meadows.

Kgd Biotite granodiorite (Late Cretaceous)—Com-
monly medium-grained, equigranular, biotite gran-
diorite to granite. In places the unit is foliated and
hornblende-bearing. The alkali feldspar exhibits
microcline grid twins, and myrmekitic textures are
common.

Kmg Migmatite (Late Cretaceous)—Leucocratic
and generally undeformed varieties of biotite gran-
diorite (Kgd) containing 30 to 60 percent inclusions
of biotite gneiss, less common schist and augen gneiss,
and rare calc-silicate rocks. In most occurrences, folia-
tion 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 and lineation of the granitic material and the presence of biotite selvages around the inclusions indicate partial melting or assimilation, and an earlier (syndetachmental) origin.

*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 spine 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, but the fabric is dominated by aligned alkali feldspar phenocrysts and hornblende that define a lineation parallel to the strongest 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 (Ysg) in that it contains magmatic 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 spheine 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, Yxs, and Ysg, it may be older than those 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 biotitic schist in the area of Buck Mountain 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, Yxs, 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 central part. Partings on micaceous interlayers appear to define "beds" 2 to 60 centimeters thick. Schistosity commonly parallels compositional layering, but in the central part of the area at Disgrace Butte the bedding is defined by magnetic laminaeations and is at a high angle to the schistosity defined by aligned muscovite. Magnetae 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.

*Yxs 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 laminations 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 Ysm 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 Ysm 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 quartzofeldspathic 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 quartzofeldspathic 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 migmaticite. 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 (2-4 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 1 millimeters in highly recrystallized rocks. The recrystallized quartzite is also highly strained. 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.

**Yqs Quartzite and calc-silicate rocks (Proterozoic Y)—** Garnetiferous quartzite and hornblende gneiss; locally epidote- or diopside-rich. Map unit includes some amphibolite presumed by its association with more clear-cut calc-silicates of this unit to have a sedimentary origin.

**REFERENCES**


