GEOLOGIC MAP OF PART OF THE GALENA PEAK AND RYAN PEAK QUADRANGLES, BLAINE AND CUSTER COUNTIES, IDAHO

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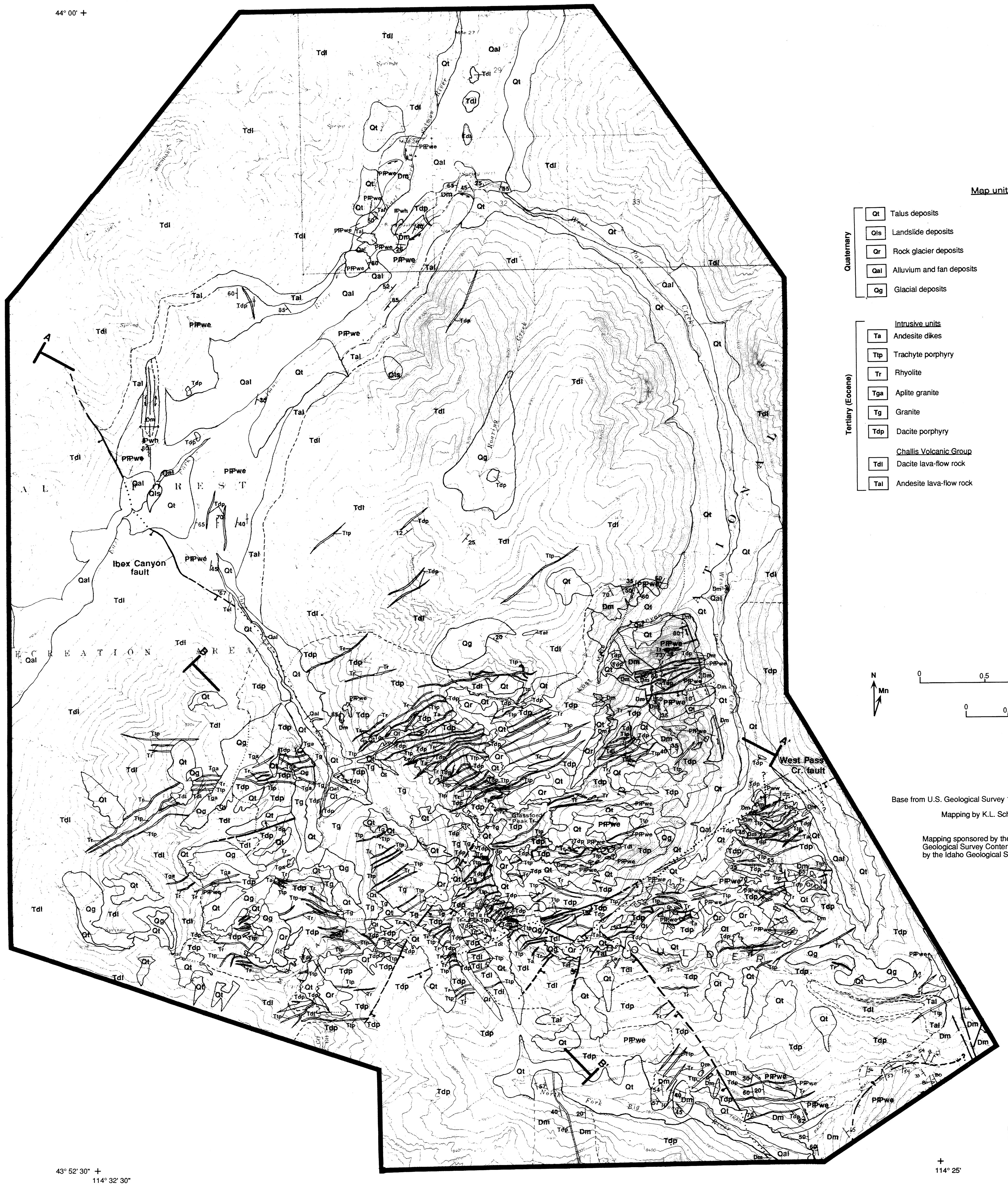
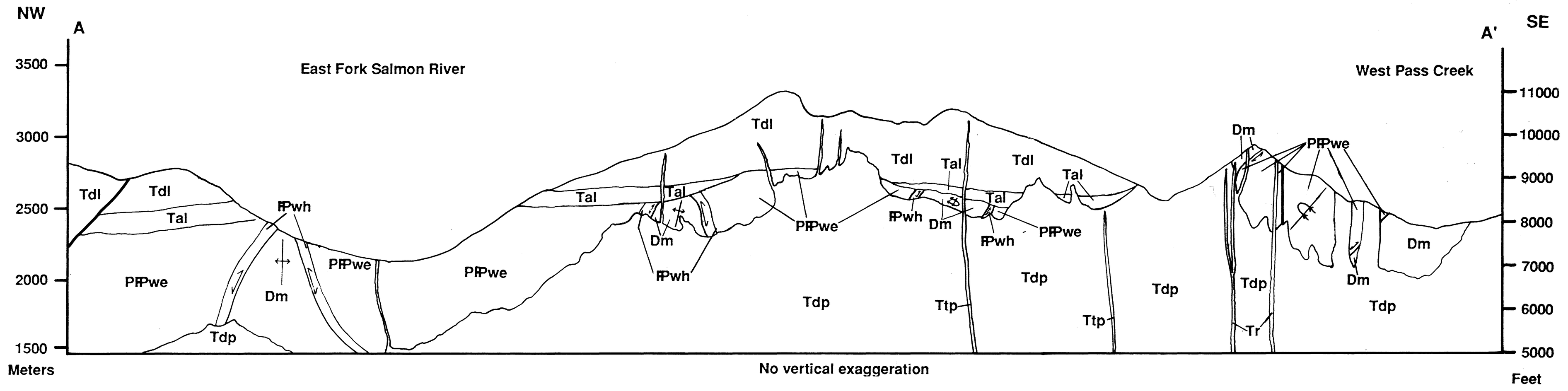
Idaho Geological Survey
University of Idaho
Moscow, Idaho 83844-3014

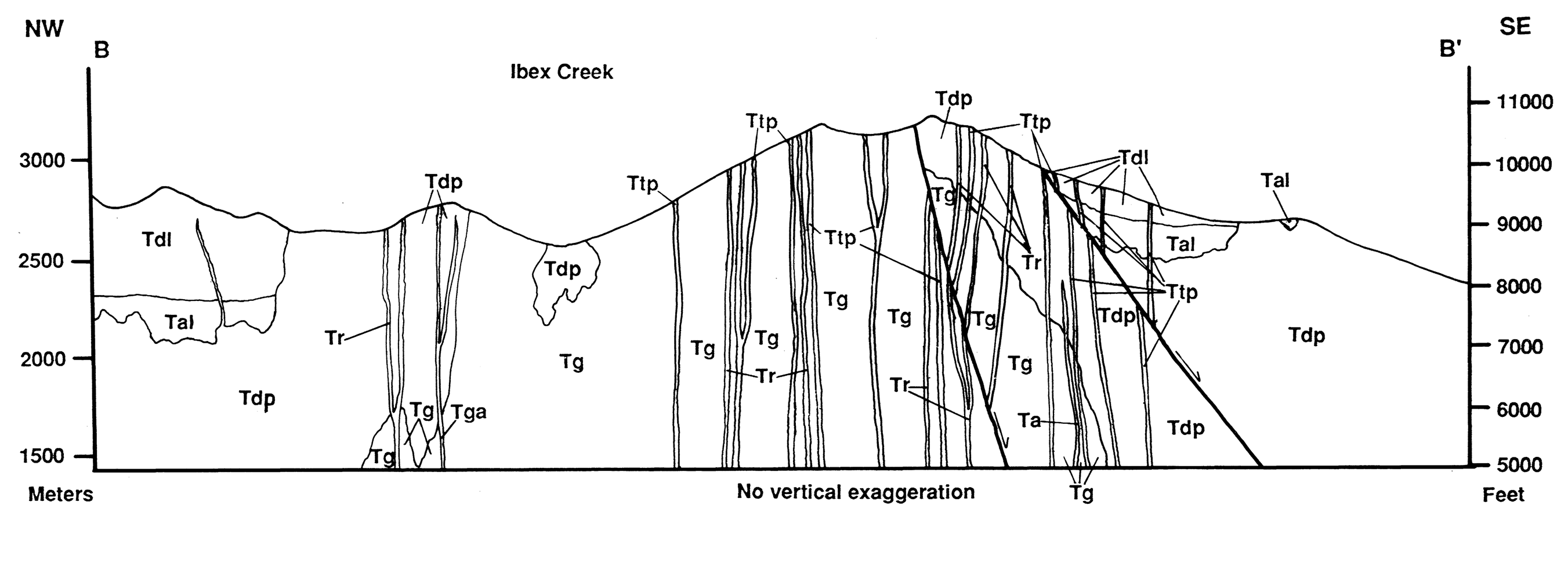
44° 00' +



43° 52' 30" +
114° 32' 30"

+
114° 25'





Map units

Quaternary

- Qt — Talus deposits
- Qls — Landslide deposits
- Qr — Rock glacier deposits
- Qal — Alluvium and fan deposits
- Qg — Glacial deposits

Tertiary (Eocene)

Intrusive units

- Ta — Andesite dikes
- Ttp — Trachyte porphyry
- Tr — Rhyolite
- Tga — Aplite granite
- Tg — Granite
- Tdp — Dacite porphyry

Challis Volcanic Group

- Tdl — Dacite lava-flow rock
- Tal — Andesite lava-flow rock

Permian-Pennsylvanian

Wood River Formation

- Pww — Wilson Creek Member
- PPwe — Eagle Creek Member
- Pwh — Hailey Member

Devonian

- Dm — Milligen Formation

Map Symbols

- Contact
- Sheared unconformity
- Axial trace of anticline
- Axial trace of overturned anticline and syncline
- Dike
- High-angle normal fault; ball and bar on hangingwall
- Low-angle normal fault; bars on hangingwall; slickenside lineation
- Strike and dip of beds; overturned
- Line of cross-section

Contacts and faults are dashed where approximately located, queried where inferred, and dotted where concealed.

N
Mn

0 0.5 1 1.5 2 Miles

0 0.5 1 1.5 2 Km

Scale 1:24,000
Contour interval 40 ft

Base from U.S. Geological Survey 1:24,000 scale Galena Peak and Ryan Peak Quadrangles

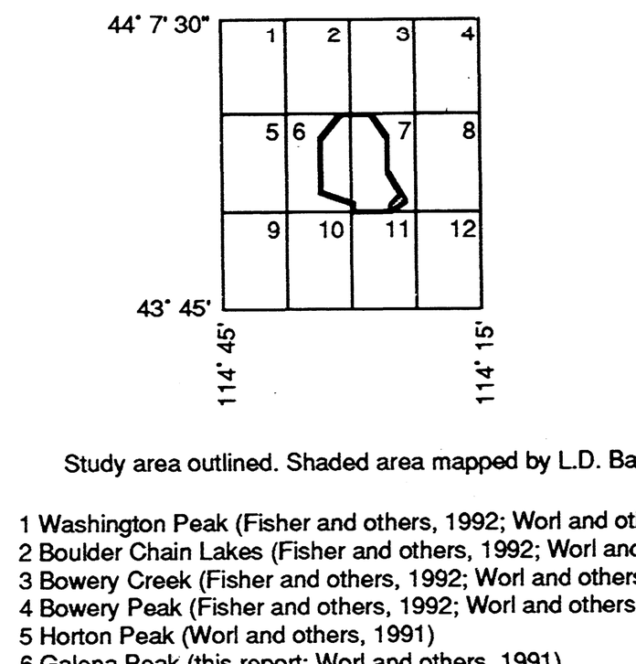
Mapping by K.L. Schmidt 1990-1991, assisted by L.R. Schmidt

Mapping sponsored by the Hailey 1 x 2 degree sheet project of the U.S. Geological Survey Conterminous U.S. Mineral Appraisal Program (CUSMAP), by the Idaho Geological Survey, and by Idaho State University

Correlation of map units

- Qt, Qal, Qls, Qr — Holocene — Quaternary
- Qg — Pleistocene — Quaternary
- Unconformity
- Ta, Ttp, Tr, Tga, Tg, Tdp; Tdl, Tal ? — Eocene — Tertiary
- Unconformity
- Pww — Permian
- PPwe — Pennsylvanian
- Pwh — Pennsylvanian
- Unconformity (locally sheared)
- Dm — Devonian

Key to 7 1/2' quadrangles around study area



Study area outlined. Shaded area mapped by L.D. Batatian (1991)

1 Washington Peak (Fisher and others, 1992; Worl and others, 1991)
2 Boulder Chain Lakes (Fisher and others, 1992; Worl and others, 1991)
3 Bowery Creek (Fisher and others, 1992; Worl and others, 1991)
4 Bowery Peak (Fisher and others, 1992; Worl and others, 1991)
5 Horton Peak (Worl and others, 1991)
6 Galena Peak (this report; Worl and others, 1991)
7 Ryan Peak (this report; Batatian, 1991; Worl and others, 1991)
8 Meridian Peak (Batatian, 1991; Bruner, 1991; Worl and others, 1991)
9 Galena (Mahoney and Link, 1992; Worl and others, 1991)
10 Easley Hot Springs (Ratchford, 1989; Worl and others, 1991)
11 Amber Lakes (Batatian, 1991; Worl and others, 1991)
12 Rock Roll Canyon (Burton, 1988; Batatian, 1991; Worl and others, 1991)

MAP UNIT DESCRIPTIONS

SURFICIAL DEPOSITS

Qt-Talus deposits (Holocene)-Locally derived, poorly sorted, angular, sand- to cobble-sized talus on steep slopes. Includes some pro-talus ramparts in Ibex Creek and West Pass Creek drainages.

Qls-Landslide deposits (Holocene)-Locally derived, poorly sorted, angular, clay- to boulder-sized material in lobate-shaped deposits.

Qr-Rock glacier deposits (Holocene)-Steep-sided, 4-7 m high and up to 200 m long, lobate deposits at the heads of many east-facing cirques. Rock glaciers are mantled by approximately 1/2 m of angular to rounded, cobble- to boulder-sized material and composed primarily of poorly sorted, matrix supported, angular to rounded, silt- to cobble-sized material.

Qal-Alluvial deposits (Pleistocene-Holocene)-Moderately sorted, angular to rounded, silt- to boulder-sized stream gravels along major drainages and in alluvial fans. Includes Pleistocene terrace deposits along the East Fork Salmon River.

Qg-Glacial deposits (Pleistocene)-Poorly sorted, angular to rounded, granule- to boulder-sized clasts in matrix of silt- to sand-sized material. Most deposits are lobate-shaped and occur in cirques.

INTRUSIVE ROCKS

For each intrusive unit, a range of major and trace element compositions determined by XRF analyses is given in Table 1. Complete data are in Schmidt (1994). Anorthite content of plagioclase was determined optically by the A-normal method. Epizonal levels inferred for many units in the Ibex complex are problematic in determining An content in plagioclase because both high and low temperature structural states of plagioclase may exist. Both high and low temperature An contents are therefore given (high temperature range is reported first, followed by a slash, then the low temperature range) for plagioclase in the andesite dike, trachyte porphyry, rhyolite, and dacite porphyry rock units. Only the low temperature range for plagioclase is reported for the granite and aplite granite units because they are clearly plutonic in origin. Proportions of phenocrysts and groundmass for each unit were determined by 500 count point counts on rock slabs and 500 and 1000 count point counts on thin sections.

Ta-Andesite dikes (Eocene)-Black to dark brown porphyritic basaltic trachyandesite and trachyandesite dikes striking mostly east-northeast. Microcrystalline and mostly devitrified groundmass comprises 51-87% of the rock. Phenocrysts vary in size from 0.1-2.0 mm and include: 6-17% mostly unzoned plagioclase; 5-6.5% euhedral hornblende; 1.5-5% biotite; up to 6% opaque oxides; rare, strongly resorbed quartz; and rare, euhedral pyroxene. Abundant mafic crystal aggregates are composed of biotite, hornblende, pyroxene, opaque oxides, plagioclase, quartz, and apatite.

Andesite dikes cross-cut all other intrusive units in the map area. They are similar to the andesite suite of Mahoney (1992), Mahoney and Link (1992), Stewart and others (1992), and Stewart and others (in press) which also cross-cuts all other intrusive units in the Boulder and Smoky Mountains of south-central Idaho. However, andesite of this study is also similar to andesite porphyry of Ratchford (1989) that is older than other Eocene intrusive units. It is also similar to andesite dikes of Worl and others (1991) that have mutually cross-cutting relations with dacite porphyry rocks. The apparently conflicting cross-cutting relationships between andesite dikes and other intrusive units in south-central Idaho may be due to a long and repeated intrusive history for the andesite dike unit. None of the andesite dikes have been radiometrically dated.

Ttp-Trachyte porphyry (Eocene)-Pink to white to green, strongly porphyritic trachyte and rhyolite dikes, striking mostly east-northeast, and rare small stocks. Groundmass is microcrystalline and devitrified and comprises 37-84% of the rock. Phenocrysts are commonly greater than 1 cm in size and include the following: 1-35% subhedral K-feldspar, mantled by plagioclase in some samples; 7.5-19% subhedral, An 25-30/37-41, normally zoned plagioclase; 4-8% partially resorbed quartz; 0.5-12% anhedral biotite; and rare hornblende. Accessory minerals include opaque oxides, zircon, apatite, allanite, and flourite. Mafic crystal aggregates are common and contain biotite, hornblende, plagioclase, opaque oxides, apatite, zircon, and quartz.

Based on cross-cutting relationships, trachyte porphyry is coeval with, to slightly younger than, the rhyolite unit. It is similar to strongly porphyritic rocks included in the rhyolite porphyry unit of Ratchford (1989), Mahoney and Link (1992), Stewart and others (1992), and Stewart and others (in press) in the Boulder and Smoky Mountains and the rhyolite dikes and plugs unit of Worl and others (1991) in the Hailey 1° x 2° Quadrangle. Trachyte porphyry in south-central Idaho has not been radiometrically dated.

Tr-Rhyolite (Eocene)-White to pink, porphyritic rhyolite dikes, striking mostly east-northeast, and rare small stocks. In the field rhyolite is distinguished from trachyte porphyry by smaller and fewer phenocrysts. Devitrified groundmass comprises 81-86% of rhyolite rocks. Phenocrysts are rarely greater than 2 mm in size and include the following: 2-7% partially resorbed quartz; 5.5-6% subhedral K-feldspar; 3-4.5% An 22-25/30-32 plagioclase; and uncommon, euhedral biotite. Accessory minerals include opaque oxides, apatite, zircon, and allanite. Uncommon felsic crystal aggregates of quartz, plagioclase, and some K-feldspar and myrmekite occur.

Where they are adjacent, rhyolite has sharp contacts with trachyte porphyry, and the trachyte porphyry may have intruded the rhyolite. Alternatively, the rhyolite may be a chilled or mechanically segregated phase of the trachyte porphyry. A rhyolite dike in the Baker Creek area of the Smoky Mountains yielded a 40Ar/39Ar age of 48.27 $\pm$ 0.16 Ma (biotite) (Moye and others, in press).

Tga-Aplite granite (Eocene)-Pink, phaneritic porphyritic, granite to quartz monzonite dikes, striking mostly east-northeast, and a small stock. Aplite granite is similar in appearance to rocks of the granite unit and is distinguished in the field by finer grain size. Groundmass in aplite granite is characterized by very fine-grained, felty intergrowth of plagioclase, K-feldspar, quartz, and opaque oxides. Phenocrysts are commonly 1-5 mm in size, comprise approximately 45% of the rock, and include 18% K-feldspar, 9.5% An 30-39 (low temperature structural state) plagioclase, 8% partially resorbed quartz, and 9% subhedral biotite. Accessory minerals include opaque oxides, apatite, and zircon. Some mafic crystal aggregates composed of biotite, opaque oxides, and quartz occur.

Aplite granite has similar mineralogy and chemistry to the Ibex Canyon granite and occurs in close proximity along the western margin of the granite stock. It is probably closely related to the granite.

Tg-Ibex Canyon granite (Eocene)-Forms a pink, phaneritic porphyritic, granite to quartz monzonite, 7.5 square km stock located on, but apparently not cut by, the northwest-striking, high-angle Ibex Canyon normal fault. Fine- to medium-grained groundmass comprises 57-81% of the rock and is composed of 22-30% K-feldspar, 14-22% plagioclase, and 17-27% quartz. Granophyric and micrographic intergrowths are common, and myrmekite is rare. Rare myarolitic cavities occur. Phenocrysts are coarse-grained and include the following: 6-26% subhedral K-feldspar, commonly mantled by plagioclase; 1-22% subhedral, An 29-40 (low temperature structural state), normally zoned plagioclase; 2-6% biotite; and up to 4% hornblende. Accessory minerals include opaque oxides, apatite, zircon, sphene, allanite, and flourite.

Ibex Canyon granite is similar to other granite stocks and batholiths in Idaho that have been radiometrically dated between 51 and 48 Ma (Lewis and Kiilsgaard, 1991). Nearby stocks in the Smoky and Boulder Mountains are summarized in Stewart and others (in press) and include the Big Smoky and Prarie Creek stocks in the Smoky Mountains (Stewart, 1987; Mahoney and Link, 1992; Stewart and others, 1992) and the Boulder Basin stock in the Boulder Mountains (Tschanz and others, 1986; Ratchford, 1989; and Mahoney and Link,1992). A small granite stock in the Baker Creek area of the Smoky Mountains was dated at 47 +/- 0.14 Ma by 40Ar/39Ar method on orthoclase (Moye and others, in press).

Tdp-Dacite porphyry (Eocene)-Dark grayish-green to reddish-purple, strongly porphyritic dacite and trachyte dikes (striking mostly east-northeast), stocks, and sills. Groundmass comprises 47-70% of the rock and is microcrystalline and mostly devitrified. The phenocryst assemblage consists of the following: 18-31% An 25-29/33-40, normally zoned plagioclase; 5-12% subhedral biotite; 4-13% hornblende; and minor, strongly resorbed quartz and K-feldspar. Accessory minerals include opaque oxides, apatite, zircon, and allanite. Mafic crystal aggregates are composed of biotite, plagioclase, hornblende, opaque oxides, quartz, apatite, and zircon.

Radiometric ages vary from 52-47 Ma for dacite porphyry stocks and dikes in Idaho (Lewis and Kiilsgaard, 1991; Moye and others, in press). A biotite K-Ar age of 50.0 $\pm$ 1.8 Ma was obtained by R.F. Marvin (in Fisher and others, 1983) from a dacite porphyry stock on Ryan Peak to the east of the map area. In the Smoky Mountains, a hornblende biotite granodiorite, equivalent to the dacite porphyry, from Big Smoky Creek yielded a K-Ar (biotite) age of 48.2 +/- 1.7 Ma (Stewart, 1987), and two dacite porphyry dikes from Brodie Gulch were dated at 50.92 +/- 0.22 Ma and 52.03 +/- 0.32 Ma using 40Ar/39Ar method on hornblende (Moye and others, in press).

ROCKS OF THE CHALLIS VOLCANIC GROUP

Major and trace element compositions determined by XRF analysis of a single sample from each volcanic unit are given in Table 1. Proportions of phenocrysts and groundmass for each unit were determined by 500 count point counts on rock slabs and 500 and 1000 count point counts on thin sections.

Tdl-Dacite lava-flow rocks (Eocene)-Dark greenish-gray to reddish-purple, porphyritic, dacite to trachyte volcanic rocks. Unit reaches a thickness of 1500 m on the ridge east of Ibex Creek; this is a minimum thickness because the top has been removed by erosion. Individual flows attain a thickness of 20 m. Heterolithologic breccias, interpreted as lahar deposits, are commonly intercalated with lava-flow units. Epiclastic deposits composed of thickly-laminated to thinly-bedded, lithic tuffaceous sandstone and siltstone occur locally and rarely. They are too small to map at 1:24,000 scale, and their locations are indicated by bedding strike-and-dip symbols within dacite volcanic bodies on the map. Dacite volcanic rocks are mineralogically and chemically similar to dacite porphyry in the map area. Devitrified groundmass comprises 56-70% of the rock. Phenocrysts include the following: 20-32% subhedral, An 21-38 (high temperature structural state), normally zoned plagioclase; 5-7% euhedral hornblende; 2-6% subhedral biotite; and rare, partially resorbed quartz. Accessory minerals include opaque oxides, apatite, zircon, and K-feldspar. Mafic crystal aggregates composed of mostly hornblende occur.

Dacite volcanics lie conformably on andesite volcanic rocks, and where the andesite volcanic unit is missing, unconformably on Paleozoic sedimentary rocks of the Wood River and Milligen Formations. Contacts with sedimentary rocks are strongly irregular, suggesting lavas were extruded onto a surface of considerable relief. The contact with andesite volcanic rocks is gradational and characterized by intercalated andesite and dacite lava-flow beds across a zone of 10-20 m.

Tal-Andesite lava-flow rocks (Eocene)-Black to dark gray, porphyritic, andesite to trachyandesite volcanic rocks. Unit reaches a maximum thickness of 50 m at a location east of the mouth of Ibex Creek and is absent from many locations. Individual flows attain a thickness of 5 m. Heterolithologic breccias, interpreted as lahar deposits, are common. Devitrified groundmass comprises 56-75% of andesite volcanic rocks. The phenocryst assemblage consists of 13-16% plagioclase (An content not determined), 8-11% subhedral biotite, 6-8% euhedral hornblende, and some pyroxene. Accessory minerals include opaque oxides, apatite, and quartz. Mafic crystal aggregates are composed of hornblende, pyroxene, and plagioclase. Andesite volcanics lie unconformably on Paleozoic sedimentary rocks in the East Fork Salmon River drainage, and their distribution appears to have been controlled by paleovalleys carved 1-5 m deep into the sedimentary rocks.

SEDIMENTARY ROCKS

Permian-Pennsylvanian rocks of the Sun Valley Group

Pww-Wood River Formation, Wilson Creek Member (Permian)-Medium to dark gray, thin- to medium-bedded, carbonaceous, silty micritic limestone, locally containing allochems of crinoid columns, bryzoans, and horn corals. Exposed only in a 0.25 by 0.5 km wide roof pendant at the Falling Star Mine in West Pass Creek. These rocks were tentatively assigned to the Wilson Creek Member as opposed to the Milligen Formation based on the occurrance of a bryzoan assemblage identified by F.K. McKinney (written communication, 1993) as Rhabdomeson and several fenestrate groups which were more prevalent in the Carboniferous and Permian Periods than in the Devonian Period. Less than 50 m of section is exposed at the Falling Star Mine. Regionally the unit attains a thickness greater than 800 m (Mahoney and others, 1991).

PPwe-Wood River Formation, Eagle Creek Member (Permian-Pennsylvanian)-Mostly dark brown to dark gray, thin- to medium-bedded, silty micritic limestone of the lower part of the Eagle Creek Member. Some outcrops contain medium gray, thick-bedded, fractured quartz arenite sandstone of the middle part of the Eagle Creek Member. Light gray to white, massive, fractured quartzite west of the mouth of West Pass Creek was also assigned to the middle part of the Eagle Creek Member. Where exposed, the upper contact of the Eagle Creek Member is an angular unconformity; rocks of the Challis Volcanic Group lie above. Where Hailey Member rocks are missing, the Eagle Creek Member lies unconformably on rocks of the Milligen Formation, and the contact is characterized as a sheared angular unconformity. In the East Fork Salmon River valley, 382 m of folded section are exposed. Regionally the member attains a stratigraphic thickness of 880 m (Mahoney and others, 1991).

Pwh-Wood River Formation, Hailey Member (Pennsylvanian)-Consists of two rock types: dark gray to reddish-brown, thick-bedded to massive, clast-supported basal conglomerate, and overlying medium gray, medium-bedded bioclastic limestone containing in-situ biostroms of horn corals, crinoid columns, fusilinids, and pelecypods. The Hailey Member occurs only along the East Fork Salmon River where it lies on Milligen Formation rocks; the contact is a sheared angular unconformity. Exposures of the basal conglomerate contain a minimum stratigraphic thickness of 2 m, and the exposed thickness of bioclastic limestone is 4 m. Regionally the Hailey Member attains a thickness of 200 m (Mahoney and others, 1991).

Devonian rocks

Dm-Milligen Formation (Devonian)-Dark brown to black, thinly-laminated to medium-bedded, phylitic, cherty argillite and siltstone crops out in the East Fork Salmon River, West Pass Creek, and North Fork Big Wood River drainages. Some outcrops contain alternating black and white laminations. Limestone beds up to 30 cm thick are rare and crop out in the North Fork Big Wood River valley. Base of unit is not exposed. Extensive tight folding within the unit and intrusion preclude estimation of stratigraphic thickness. The Milligen Formation attains a thickness of 1061 m in the Big Wood River Valley (Turner and Otto, 1988).

GEOLOGIC RELATIONS

Paleozoic sedimentary rocks in the map area belong to the Devonian Milligen and Pennsylvanian-Permian Wood River Formations. Milligen Formation rocks in the map area are similar to rocks mapped by Batatian (1991) in the southeastern part of the Ryan Peak Quadrangle and were correlated by Batatian (1991) and Bruner (1991) with the Devonian siltstone unit of Dover (1983) and Brennan (1987) to the east of the Ryan Peak Quadrangle. Milligen Formation rocks are separated by a sheared angular unconformity from overlying rocks of the Pennsylvanian-Permian Wood River Formation of the Sun Valley Group. Both formations have been folded; Milligen Formation rocks are tightly folded with fold wavelengths of approximately 3 m, and Wood River Formation rocks are folded into open folds with fold wavelengths on the order of 3 km. Fold axes in both units are parallel and plunge less than 20 degrees south. Folding probably occurred in the late Cretaceous Sevier orogeny, and differences in folding styles can be attributed to rheological differences between the two formations.

Economic silver-lead-zinc and rare gold mineralization in the map area is restricted to rocks of the Devonian Milligen Formation and Permian Wilson Creek Member of the Wood River Formation in West Pass Creek. Claims at this location are aligned along the possible northern continuation of the Lake Creek Fault from the south (Burton and Link, 1989; Batatian, 1991; Huerta, 1992) that has been almost eliminated in the map area by Eocene intrusion and volcanism. The north-northwest striking, near-vertical fault is preserved in West Pass Creek in a 0.25 by 0.5 km wide roof pendant at the Falling Star Mine, where rocks of the Permian Wilson Creek Member are juxtaposed with rocks of the Devonian Milligen Formation. Slickenside striations oriented 37 N10W on the fault in West Pass Creek indicate substantial strike-slip motion and are similar to orientations of 40 N32W and 47 N69W measured by Batatian (1991) on a high angle northwest-striking fault 4.75 km to the southeast that was interpreted by Huerta (1992) as a continuation of the Lake Creek Fault.

Another northwest-striking, southwest-dipping, high-angle fault is located in Ibex Canyon. Offset on this fault is in a normal sense; displacement occurred during the time interval between dacite porphyry and granite intrusion.

Rocks of the Eocene Challis Volcanic Group unconformably overlie rocks of the Milligen and Wood River Formations. The Challis volcanic section is dominated by more than 1500 m of high-K dacite lava-flow rocks underlain by less than 50 m of high-K andesite lava-flow rocks. Composition and stratigraphy of volcanic rocks in the map area are similar to other rocks in the southern part of the Challis volcanic field (Moye and others, 1988). Dacite volcanic rocks thin, and andesite volcanic rocks thicken, to the north along the East Fork Salmon River (Fisher and Johnson, 1987; Fisher and others, 1992). To the west and southwest of the map area, similar lava-flow rocks have been described by Worl and others (1991), Tschanz and others (1986), Ratchford (1989), Mahoney (1992), and Mahoney and Link (1992).

The central southern part of the map area has been extensively intruded by an Eocene high-K, silicic, calc-alkaline to alkali-calcic, epizonal intrusive complex (Schmidt, 1994). Most intrusive rocks in the map area were emplaced as northeast-striking dikes that are parallel to the trend of the trans-Challis fault system, a major Eocene extensional tectonic zone located in central Idaho (Kiilsgaard and Lewis, 1985). Similar Eocene intrusive complexes occur throughout south-central Idaho on the eastern side, and further east, of the Cretaceous Idaho batholith (Lewis and Kiilsgaard, 1991; Stewart and others, in press).

Most intrusive rocks in the map area overlap geochemically with regionally defined Eocene rock suites (Schmidt, 1994). Dacite porphyry and andesite dike units fit with the quartz monzodiorite suite of Bennett and Knowles (1985), Tschanz and others (1986), Worl and others (1991), and Lewis and Kiilsgaard (1991), and the intermediate and andesite suites respectively of Stewart and others (in press). Granite, aplite granite, and rhyolite units fit with the pink granite suite of Lewis and Kiilsgaard (1991) and the silicic suite of Stewart and others (in press). The trachyte porphyry unit is characterized by strong chemical variation and does not fit into the regional suites of Lewis and Kiilsgaard (1991). It is included in the silicic suite of Stewart and others (in press).

Volcanic rocks in the Challis volcanic field are probably extrusive equivalents of the intrusive rock suites. Dacite and andesite volcanic rocks in south-central Idaho are spatially and temporally associated with the quartz monzodiorite suite (intermediate suite of Stewart and others (in press)) and are considered co-genetic (Stewart, 1987; Johnson and others, 1988). Rhyolite tuffs that occur in the Challis volcanic field are generally associated with the pink granite suite (Bennett and Knowles, 1985; Johnson and others, 1988; Stewart and others, in press).

Petrogenesis of the intrusive complex is explained in more detail in Schmidt (1994) and briefly summarized here. Whole rock major and trace element geochemical evidence suggests that within-suite chemical variation for both the quartz monzodiorite and pink granite suites was controlled mostly by fractional crystallization; minor crustal assimilation and magma mixing between silica-rich and silica-poor compositions may have occurred in the quartz monzodiorite suite, and minor crystal accumulation and crustal assimilation may have occurred in the pink granite suite. The trachyte porphyry unit appears to have evolved by a combination of crystal accumulation and magma mixing between granite or rhyolite compositions and silica-poor dacite porphyry or andesite compositions.

Lewis and Kiilsgaard (1991) concluded that the quartz monzodiorite and pink granite suites were derived from separate parental magmas based on discontinuous trends between samples from the two suites on major and trace element versus silica variation diagrams. Stewart and others (in press) came to the same conclusion for the intermediate (quartz monzodiorite) and silicic (pink granite) suites based on discontinuous and overlapping trends on major and trace element versus silica variation diagrams. However, the analysis of Stewart and others (in press) included samples of trachyte porphyry in the silicic suite. These samples define the segment of the silicic suite that overlaps with the intermediate suite. As discussed in Schmidt (1994), the trachyte porphyry unit appears to have evolved by very different processes than the granite and rhyolite units, and its inclusion with the granite and rhyolite units on variation diagrams may cause misleading interpretations for the entire silicic suite. An alternative hypothesis concerning the relationship between the quartz monzodiorite and pink granite suites was proposed by Schmidt (1994). Discontinuous trends on element versus silica variation diagrams are difficult to reconcile with a hypothesis of fractional crystallization that relates the two suites. However, a process of plagioclase and hornblende fractionation coupled with minor assimilation of an incompatible element-rich crustal composition may relate the two suites and account for the discontinuous trends on variation diagrams. This alternative hypothesis is consistent with mass balance modeling constrained by major, trace, and rare earth element bulk-rock and phenocryst data from a dacite porphyry sample collected in the present map area (Schmidt, 1994).

Neogene basin and range deformation has produced a series of northwest trending half-horsts across much of south-central Idaho (Link and others, 1988; Mahoney and Link, 1992). The Boulder Mountains form one of these northeast-tilted horsts and have been uplifted along the northwest-striking Boulder Front Fault to the southwest of the map area. The geology in the map area has been exposed by subsequent erosion.

ACKNOWLEDGMENTS

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Table 1. Major and trace element compositions and ranges of compositions determined by XRF whole-rock analysis for intrusive and volcanic rock units. Oxides in weight percent, all iron oxide as Fe_2O_3, normalized to 100% anhydrous. Elements in parts per million. From Schmidt (1994).

Map Unit	Tal	Tdl	Tdp	Tg	Tga	Tr	Ttp	Ta
# of samples	1	1	5	4	1	3	5	3
Oxides								
SiO_2	62.61	66.98	63.31-67.63	69.48-71.75	73.93	76.47-77.64	62.62-71.63	55.03-58.58
TiO_2	0.59	0.49	0.53-0.68	0.30-0.39	0.22	0.10-0.11	0.32-0.72	0.73-1.55
Al_2O_3	15.10	15.54	14.85-15.34	14.21-15.15	13.65	12.76-13.18	14.39-15.20	12.73-15.28
Fe_2O_3	5.90	4.10	4.22-5.62	2.43-2.99	1.69	0.85-1.04	2.41-5.65	6.75-8.99
MnO	0.08	0.06	0.06-0.07	0.04-0.05	0.03	0.03	0.04-0.08	0.12-0.14
MgO	4.04	1.72	2.13-3.27	0.50-0.68	0.61	0.15-0.21	0.66-3.90	4.98-6.97
CaO	4.78	3.06	2.88-4.65	0.75-1.56	1.55	0.23-0.72	1.41-4.23	4.50-7.06
Na_2O	3.70	3.29	3.49-4.34	3.76-4.21	3.66	2.12-3.78	1.08-4.02	1.91-4.05
K_2O	3.04	4.63	2.54-3.67	5.22-5.97	4.60	4.18-5.61	4.37-4.98	2.62-5.73
P_2O_5	0.16	0.13	0.15-0.21	0.05-0.09	0.06	0.01	0.08-0.35	0.33-0.59
Elements								
Rb	81	126	75-153	202-241	204	223-290	155-235	54-234
Sr	672	470	518-709	217-232	194	56-62	245-536	599-901
Ba	1584	1325	1083-1728	775-1098	635	198-367	933-1222	942-1662
Y	13	14	13-18	14-19	17	9-17	16-21	19-21
Zr	123	130	107-200	194-250	76	64-90	185-203	194-244
V	116	75	73-121	18-30	22	1-2	30-98	125-148
Cr	265	62	78-209	8-35	36	2-14	19-234	285-473
Ni	85	18	22-49	5-8	9	4-5	7-69	77-122