SCALE 1:48 000

1 0 1 2 3 MILES

0 1 2 3 KILOMETERS

CONTOUR INTERVALS 20 AND 40 FEET
DOTTED LINES REPRESENT 10-FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Geology mapped in 1973–1976

NEVADA

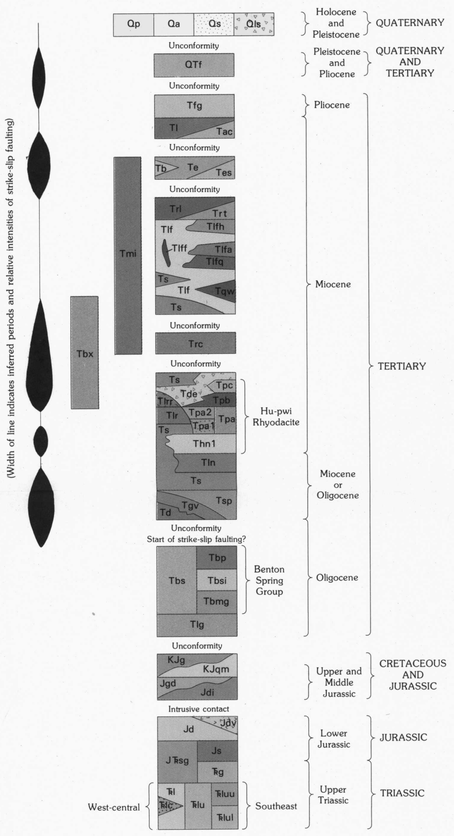
QUADRANGLE LOCATION

UNTAIN, MOUNT FERGUSON, LUNING, AND SUNRISE MINERAL AND NYE COUNTIES, NEVADA

By
Ekren and F. M. Byers, Jr.

1985

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

Phenocryst content listed is approximate range of the total rock in modal percent. Phenocryst minerals are listed as percent of total phenocrysts: q, quartz; af, alkali feldspar; pf, plagioclase feldspar; b, biotite; hb, hornblende; pyx, pyroxene; cpx, clinopyroxene; opx, orthopyroxene; ol, olivine; o, opaque minerals; and mp, mafic pseudomorphs. Apatite, zircon, and allanite are ubiquitous accessory minerals in the ash-flow tuffs; sphene is indicated where present

Qp PLAYA DEPOSITS (HOLOCENE AND PLEISTOCENE)—Unconsolidated clay, silt, and sand deposited in ephemeral lakes; during dry seasons material is deflated. Thickness 0–30± m

Qa ALLUVIUM (HOLOCENE AND PLEISTOCENE)—Unconsolidated silt, sand, gravel, and boulders in washes and on alluvial fans; includes talus adjacent to range fronts. Thickness 0–100± m

Qs WINDBLOWN SAND (HOLOCENE AND PLEISTOCENE)—Subaerial sand and silt interbedded with sheetflood gravel. Thickness 0–30± m

Qls LANDSLIDE BLOCKS AND TALUS (HOLOCENE AND PLEISTOCENE)—Thickness 0–40± m

QTf FAN ALLUVIUM (PLEISTOCENE AND PLIOCENE)—Principally subangular boulders, cobbles, and pebbles of Tertiary and Mesozoic rocks in a loose to slightly indurated matrix of sand, silt, and minor clay. Thickness 0–100+ m

Tfg FANGLOMERATE (PLIOCENE)—Principally subrounded and subangular boulders, cobbles, and pebbles of Tertiary and Mesozoic rocks in a slightly to locally well-indurated matrix of sand, silt, and minor clay. Thickness 0–100+ m

Tl LATITE (MIOCENE)—Consists of two distinct types: one type has cpx as micro-phenocrysts, and the other has hb phenocrysts or microphenocrysts with or without cpx. The variety having cpx as the sole mafic mineral is megascopically aphyric nearly everywhere. The hb variety, on the other hand, may be aphyric or conspicuously porphyritic containing 10 percent phenocrysts or more. All varieties are dark gray or black; forms a volcanic neck at Finger Rock. Thickness 0–50 m

Tac ALLUVIUM AND COLLUVIUM (MIOCENE)—Principally remnants of alluvial fans composed of subrounded Tertiary and Mesozoic boulders, cobbles, and pebbles in a tuffaceous sandstone matrix; locally includes thin beds of white ash-fall tuff, colluvium, and landslide debris. Thickness 0–50 m

Te ESMERALDA FORMATION (MIOCENE)—Mostly yellow-brown thin-bedded fluviolacustrine tuffaceous siltstone, sandstone, and mudstone occurring with rare, thin (less than 1.0 m) beds of white diatomite; commonly has thin (0.5–5 m) interbeds of brown gravel or conglomerate consisting of subrounded to rounded pebbles and cobbles of mostly Tertiary volcanic rocks in a matrix of tuffaceous sandstone; locally contains thin-bedded, lacustrine, papery-weathering white siltstone. Most of the tuffaceous strata are frothy weathering due to abundant montmorillonite. The strata locally contain thin rhyolite lavas, some of which were deposited subaqueously; in places near the base, gravel beds contain abundant rhyolite Apache tears. Some of these from the Mount Annie NE quadrangle to the north (see index map) yielded an age of 15.6±0.5 m.y. (R. F. Marvin, written commun., 1983). The name Esmeralda Formation is used herein for reasons outlined by Ross (1961, p. 45) and also because the strata in this quadrangle are virtually continuous with the strata at the type locality in Esmeralda County, Nev. Thickness 1000± m

Tes Loessike sandstone—Pale-brown and reddish-brown thick-bedded tuffaceous sandstone; locally crossbedded; derived almost entirely from reworked quartz latite ash, which contains pf, hb, b, pyx, and sparse q; granules of intermediate lavas are ubiquitous, and locally they form thin beds of conglomerate. Where this unit is intensely fractured and(or) sheared, it weathers to a thick frothy crust due to conversion of the ash matrix to montmorillonite. Thickness 0–100 m

Tb BASALT (MIOCENE)—Dark-gray and black basaltic lava containing sparse to moderately abundant microphenocrysts (mostly less than 0.5 mm) of ol and cpx in a crystalline groundmass of pf, pyx, ol, and magnetite

Tmi MAFIC INTRUSIVES (MIOCENE)—Dark-brownish or greenish-gray latite or basaltic andesite; principally has small phenocrysts of pf and pyx; locally has 20 percent small phenocrysts of pf, cpx, hb, and b

Trl RHYOLITE OF GABBS VALLEY RANGE (MIOCENE)—Typically pink or light-gray, flow-laminated rhyolite containing 10 percent small phenocrysts (1–2.5 mm) of sodic pf and b in a weakly devitrified or glassy groundmass; scattered phenocrysts of moderately embayed q occur locally. In most places this rhyolite exhibits intrusive contacts with country rock, but the dome-shaped mass in the northwestern corner of the map area flowed out onto surface strata and intruded its own ejecta (Trt). An age of 19.2±0.7 m.y. was obtained from biotite of this rhyolite dome

Trt RHYOLITE EJECTA OF GABBS VALLEY RANGE (MIOCENE)—Principally thin-bedded ash-fall tuff. Thickness 0–50 m

Tlf LAVAS OF MOUNT FERGUSON, UNDIVIDED (MIOCENE)—Many individual porphyritic lava flows ranging in composition from hypersthene andesite to quartz latite. Separate flows mapped only in the vicinity of Gabbs Mountain. K-Ar age dates range from about 15 m.y. to 22 m.y.[1] Thickness 1,000 m to possibly as much as 2,000 m

Tlfh Hornblende-pyroxene latite—Black and dark-gray latite consisting of upper and basal black vitrophyres separated by dark-gray stony interior. Phenocrysts 40 percent: pf, 77; hb (as much as 1 cm long), 8; cpx, 13; o, 2. Thickness 0–300+ m

Tlfa Hypersthene andesite—Dark-gray and dark-greenish-gray. Phenocrysts 18: pf (2–4 mm), 72; opx (1–3 mm), 27; o, 1. Thickness 0–40+ m

Tlfq Hornblende quartz latite—In most places unit consists of a single lava flow of conspicuously porphyritic hornblende quartz latite; locally has a separate cooling unit at top of dense, flow-laminated, light-gray rhyolite or silicic quartz latite that contains small phenocrysts of pf and b; hornblende quartz latite is light gray to white and contains hb and pf phenocrysts as long as 2 cm. Phenocrysts 34: pf, 66; hb, 31; b, 1; cpx, 2; o, trace. Thickness 0–50+ m

Tlff Feeder neck—Large volcanic neck exposed northwest of Mount Ferguson; rock is rhyodacite or quartz latite in composition

Tqw QUARTZ-RICH ASH-FLOW TUFF (MIOCENE)—Simple cooling unit of light-pinkish-gray, nonwelded to weakly welded rhyolite ash-flow tuff containing 15–25 percent small phenocrysts of q, af, pf, and sparse b. Unit is overlain and underlain by lavas of Mount Ferguson; it is extremely local and is probably the distal end of a tuff that originated east of the map area. Thickness 0–20 m

Ts SEDIMENTARY ROCKS (MIOCENE)—Sedimentary rocks are interbedded with tuffs and lavas at various intervals between the lower part of the lavas of Mount Ferguson and the top of the Blue Sphinx Tuff; rocks within the lavas of Mount Ferguson are mostly light-gray thin-bedded tuffaceous sandstone and rhyodacitic ash-fall tuff; those at the base of the lavas are similar, but they include white and yellow lacustrine siltstone. Sedimentary rocks beneath the tuff of Redrock Canyon (Trc) and above the Blue Sphinx Tuff (Tsp) include even-bedded lacustrine siltstone and tuffaceous sandstone, the thickest interval of which occurs beneath the lava of Redrock Canyon (Tlr) in exposures southeast of Mount Ferguson; there the sequence is 50+ m thick and includes gray and brown, finely laminated, tuffaceous siltstone, dense silicified yellow siltstone (resembling chert or novaculite), thin-bedded lapilli tuff, and numerous thin beds of gravel or conglomerate. The sequence of Ts beneath the lavas of Nugent Wash (Tln) appears to reflect a deeper, more quiescent lacustrine environment; the strata (30 m exposed) consist of dark-gray and brown, thin-bedded, finely laminated claystone and mudstone; the beds show fine grading, and most are ferruginous after pyrite(?). The sedimentary rocks, especially the lacustrine strata, probably record the development of graben or depressions related to strike-slip faulting or volcano-tectonic subsidence. Thickness 30–50 m for each interval

Tbx BRECCIATED TUFF AND LAVA (MIOCENE)—Principally brecciated and silicified, densely welded tuff of the Benton Spring Group; locally includes rocks without quartz that probably are altered intermediate lava. Thickness 30± m exposed

Trc TUFF OF REDROCK CANYON (MIOCENE)—Compound cooling unit of partly to densely welded tuff that is quartz latite at the top and rhyodacite at the base. The upper quartz latite in the map area is mostly partly welded, pale brown, and rich in pumice as long as 20 cm; it forms a slope above the generally more densely welded rhyodacite. Farther north in the Gabbs Valley Range (along the western border of these quadrangles and in the quadrangles to the west), the quartz latite is densely welded, is dark brownish gray, and the lower rhyodacite part is missing. The quartz latite is indistinguishable from the Blue Sphinx Tuff (Tsp), except that Trc contains numerous fragments of Mesozoic granitic rocks ranging in size from a few centimeters to, sparsely, as long as 0.5 m; in addition Trc contains numerous fragments of intermediate lava. Quartz phenocrysts as long as 7 mm are intensely resorbed. Phenocrysts 20–40: q, 6–17; af, 10–30; pf, 45–70; b, 5–9; pyx, trace–2. K-Ar age 24.1±0.8 m.y. (R. F. Marvin, written commun., 1983). Thickness 0–250 m. The lower rhyodacite is dark brown where densely welded and pale yellowish brown where partly welded and zeolitized; it contains both small pumice fragments that tend to weather to pits and abundant fragments of intermediate lava. Phenocrysts 20–40: q, 0–5; af, 0–4; pf, 75–90; b, 4–8; cpx, 3–6; opx, 3–6; hb, 1–7; o, 1–3. Thickness 0–150 m

Tdé DEBRIS DEPOSITS (MIOCENE)—Principally masses of landslide breccia of lava of intermediate composition that are intercalated in yellow-brown fluviolacustrine siltstone; locally includes nonbrecciated lava that possibly is autochthonous; in most exposures includes large blocks and boulders of welded tuff of Benton Spring Group and Blue Sphinx Tuff; in northernmost exposures includes boulders of Poinsettia Tuff Member of Hu-pwi Rhyodacite. The debris is inferred to reflect a period of intense strike-slip or oblique-slip deformation and contemporaneous development of grabens

LAVAS OF REDROCK CANYON (MIOCENE)—Includes light-gray, flow-laminated, crystal-poor, biotite-plagioclase rhyolite or silicic quartz latite at top that is 0–60+ m thick; also includes thick flows of gray, brown, and black lavas of intermediate composition, probably ranging from trachyandesite to quartz latite. These rocks are all porphyritic and generally have large (as long as 1 cm) pf and hb phenocrysts in the more silicic rocks and smaller phenocrysts of pf and pyx in the least silicic rocks. These lavas are younger than the Nugent Tuff Member of Hu-pwi Rhyodacite (Thn1), but their age with respect to Poinsettia Tuff Member is unknown. Thickness 0–500± m

Tlr Silicic quartz latite or rhyolite lava

Lavas of intermediate composition

HU-PWI RHYODACITE (MIOCENE)—In the map area Hu-pwi Rhyodacite consists of five cooling units of rhyodacite welded tuff: the upper four are part of the Poinsettia Tuff Member, and the lowermost is the lower cooling unit of Nugent Tuff Member

Poinsettia Tuff Member—All the tuffs of the Poinsettia Member are characterized by perlitic gray pumice fragments as long as 20 cm where densely welded and by light-gray vitric pumice fragments where partly welded. The cooling units are separated from one another by poorly welded to nonwelded ash-flow tuff and(or) air-fall tuff a few meters to 20 m thick. The four units contain virtually the same phenocryst contents and display the same variations in color, grading from light gray where nonwelded or weakly welded to light brown and brownish or reddish gray where moderately to densely welded. Phenocrysts 30–50: pf, 75–85; af, 0–trace; b, 6–13; hb, 0–3; cpx, 2–9; opx, 0–3

Tpc Unit C—Simple cooling unit, 70–150 m thick

Tpb Unit B—Simple cooling unit, 20–70 m thick. This thin unit is mapped in places to include partly welded top of underlying unit and partly welded base of overlying unit

Tpa2 Unit A2—Simple cooling unit, 0–200 m thick. In several exposures the cooling break with underlying unit is extremely vague; in other exposures it is obviously complete where a well-developed basal vitrophyre as thick as 5 m locally overlies 0–10 m of bedded tuff

Tpa1 Unit A1—Simple or compound cooling unit, 200 m thick

Tpa Units A2 and A1, undivided

Thn1 Unit 1 of Nugent Tuff Member—Compound cooling unit of densely welded, brown and dark-brownish-gray, devitrified tuff; characterized both by brown pumice fragments 1–3 cm long in a lighter brownish-gray matrix and by brown and gray intermediate lava fragments as long as 10 cm that locally compose 5–10 percent of the volume; some ash flows contain abundant euhedral pf phenocrysts as long as 1 cm, commonly 5–8 mm. Phenocrysts are same as those in Poinsettia Tuff Member. Thickness 0–100 m

Tln LAVAS OF NUGENT WASH AREA (MIOCENE OR OLIGOCENE)—Principally dark-gray and blue-gray rhyodacite containing 10–20 percent phenocrysts of pf, cpx, and b; characterized by layers rich in pf phenocrysts as long as 8 mm and layers poor in pf; locally includes hb- or cpx-rich lava containing indistinct, small (less than 3 mm) pf phenocrysts. Thickness 0–50+ m

Tsp BLUE SPHINX TUFF (MIOCENE OR OLIGOCENE)—Multiple-flow, simple cooling unit of densely welded quartz latite tuff, typically blue or lavender as a result of mild hydrothermal alteration; locally white where intensely altered and pink or pinkish gray where fresh (rare). Most distinguishing petrographic characteristic is presence of intensely resorbed and embayed q phenocrysts that are 2 mm to as much as 6 mm long; distinguished from tuff of Redrock Canyon (Trc) by the absence of granitic fragments. Phenocrysts 25–45: q, 2–17; af, 1–25; pf, 45–75; b, 4; hb, 3–6; pyx, trace. Thickness 0–100 m

Tgv TUFF OF GABBS VALLEY (MIOCENE OR OLIGOCENE)—The unit crops out only in the extreme northeast corner of the map, but it possibly underlies the lavas of Mount Ferguson east of the easternmost right-lateral strike-slip fault (cross section *A–A'*). The tuff consists of a single cooling unit of densely welded rhyolite tuff about 30 m thick; it is hydrothermally altered and occurs as pastel shades of gray, brown, and green, in contrast to fresh rock that is red or reddish brown. Phenocrysts 10–12: q, 30; af, 42; pf, 25; altered b, 3; pf is sodic oligoclase, and q grains are moderately resorbed

Td DACITE LAVA (MIOCENE OR OLIGOCENE)—A melange of blocks and fault slivers of various dacitic and rhyodacitic lavas; most blocks are conspicuously porphyritic, containing large (as much as 4 mm) books of b and pf phenocrysts as long as 1 cm. Exposed thickness 30 m

Tbs BENTON SPRING GROUP, UNDIVIDED (OLIGOCENE)—Consists of three cooling units of welded ash-flow tuff, each of which grades downward from rhyolite or quartz latite at top to rhyodacite at base

Tbp Petrified Spring Tuff—Multiple-flow, simple cooling unit of moderately welded, pinkish-gray, partly devitrified quartz latite tuff about 60 m thick that weathers yellowish brown; it grades downward to brown rhyodacite (10–30 m thick) and thence downward to medium-gray and black, soft, partial vitrophyre as thick as 15 m. Lithic fragments of intermediate lava are abundant throughout, and the unit is characterized by large pumice fragments (as long as 0.5 m). The upper quartz latite contains as much as 10 percent q and 23 percent af; the basal rhyodacite virtually lacks both. Mapped to include two thin, discontinuous, nonwelded, white ash flows at base (each about 15 m thick and each rich in small rhyolite lava fragments); also included is a local sequence of thin-bedded ash-fall tuff about 10 m thick. Phenocrysts, exclusive of discontinuous ash flows at base, 22–23: q, 0–10; af, 1–23; pf (as large as 8 mm), 46–81; b, 8–18; hb, 0–2; cpx, 0–2; o, 2–3.5. Thickness 0–100 m

Tbsi Singatse Tuff—In the map area the Singatse was mapped to include both an upper 250 m of light-red and reddish-gray, massive-weathering, densely welded quartz latite tuff (Singatse Tuff proper) and a lower 60± m consisting of three rhyodacitic and quartz latitic rib-forming zones. The highest rib-forming zone is 20–30 m thick, contains pumice lobes as long as 30 cm, and is quartz latite containing q and af phenocrysts; the middle zone (about 20 m thick) is rhyodacite and lacks q. These two zones appear to be genetically part of the Singatse Tuff, although a partial cooling break is indicated between the blob tuff and the overlying Singatse Tuff proper; the Singatse in this locale, therefore, is a compound cooling unit. The lowest zone included in the map unit correlates with the Weed Heights Member of the Mickey Pass Tuff; it is quartz latite in composition, is about 20 m thick, and contains phenocrysts of q, af, pf, b, cpx, and hypersthene. Where the three rib-forming zones are hydrothermally altered, they are purple or purplish gray. Phenocrysts (Singatse Tuff proper, upper 250 m) 30–40: q, 10–20; af, 20–30; pf, 40–60; b, 4–10; hb, 3–8. Thickness 0–300 m

Tbmg Guild Mine Member of Mickey Pass Tuff—Compound cooling unit of densely welded tuff that grades downward from rhyolite at top to rhyodacite at base; light red where fresh; where altered the tuff is pastel yellow, green, and tan in upper rhyolite (100 m) and dark rusty brown in lower rhyodacite. Conspicuous light-gray pumice as long as 20 cm occurs in upper 50+ m; obscure, extremely flattened pumice occurs in middle and basal parts. Phenocrysts 25–45: q, 25–55 (upper rhyolite), 0–trace (lower rhyodacite); af, 25–45 (upper), 2–7 (lower); pf, 15–25 (upper), 65–75 (lower); b, 1–3 (upper), 7–10 (lower); opx and cpx, trace–3 (upper), 5–8 (lower); hb, trace–2 (lower only). Thickness 0–300+ m. K-Ar ages ranging from 26.3 m.y. to 28.0 m.y. (Ekren and others, 1980) were obtained from biotite from several localities

Tlg LAVAS OF GIROUX VALLEY (OLIGOCENE)—Three distinctive rock types. In the vicinity of Giroux Valley and in exposures to the east, rocks include (1) rhyodacite containing 20 percent small phenocrysts (3 mm): pf, 75; b, 5; hb, 10; cpx, 5; o, 5; (2) dense dark-gray latite that contains seriate microphenocrysts (1 mm and smaller) of pf and tiny needles of hb set in a trachytic, partly glassy groundmass; and (3) in the extreme southeast, dark-gray olivine-clinopyroxene basalt containing 10–40 percent small (2 mm and less) phenocrysts: pf, 0–60; cpx, 25; ol, 15–40; pf is entirely microlitic in some rocks, and the groundmass texture varies from basaltic to pilotaxitic. Thickness 0–50± m

INTRUSIVE ROCKS[2] (CRETACEOUS AND JURASSIC)

KJg Granite—Reddish-gray, weathers light brown and orange brown; mostly medium grained but includes distinctly porphyritic rock that has orthoclase crystals as long as 1.5 cm; typically composed of q, 25; af (perthitic orthoclase), 52; pf (sodic oligoclase and albite), 22; b, 1–4

KJqm Quartz monzonite—Gray or reddish-gray, weathers to various shades of gray; mostly medium grained grading from rock that has 6 percent q, 42 percent af, and 52 percent pf (virtually monzonite) to rock that has 32 percent q, 43 percent af, and 25 percent albitic pf (virtually albite granite). Both extremes are mafic poor: b, trace–4; hb, trace. Rock mapped as quartz monzonite at Todd Mountain and vicinity is a composite mass that includes much albite granite and also includes granodiorite

Jgd Granodiorite (Upper and Middle Jurassic)—Medium-gray to dark-gray, mostly medium-grained; composed of q, 8–18; af, 16–22; pf, 55; b, 3–5; hb, 6–15; sphene, 1–

Jdi Diorite (Upper and Middle Jurassic)—Mostly dark-gray and medium-grained; grades from melanocratic syenodiorite to quartz diorite; composed of q, 2–10; af, 3–16; pf, 46–60; b, 0–10; hb, 18–35; sphene, 1–3

Jd DUNLAP FORMATION (LOWER JURASSIC)—Principally red, crossbedded sandstone with interbeds of shale and conglomerate containing clasts of limestone and chert. Upper part of the formation in the map area consists mostly of volcanic rocks and is mapped separately (Jdv). Base of the Dunlap is not exposed here, but farther south the basal part includes light-gray quartz-rich sandstone, and the Dunlap there rests conformably on the underlying Sunrise Formation (Muller and Ferguson, 1939, p. 1620). Thickness exposed 300+ m

Jdv Volcanic rocks—Tuffaceous sandstone plus lavas and breccias of intermediate composition. Exposed thickness 500 m to probably as much as 1,000 m

J Tsg SUNRISE AND GABBS FORMATIONS, UNDIVIDED (LOWER JURASSIC AND UPPER TRIASSIC)

Js SUNRISE FORMATION (LOWER JURASSIC)—Interbedded black and brown shale and argillaceous cherty limestone. Thickness (incomplete in surface outcrops) 50–150 m; 380 m just to the south (Ferguson and Muller, 1949)

Tlg GABBS FORMATION (UPPER TRIASSIC)—Muller and Ferguson (1939) divided the Gabbs into three members: a fossiliferous upper member of brown, shaly, and sandy limestone 15 m thick that contains Late Triassic fossils, but is lithologically indistinguishable from nonfossiliferous middle member (30 m thick); and a lower member, about 90 m thick, composed of dark-gray, thinly bedded carbonaceous shale containing interbeds of black impure limestone. Total thickness at least 135 m

Tkl LUNING FORMATION, UNDIVIDED (UPPER TRIASSIC)—Probably consists entirely of upper member of Muller and Ferguson (1939), but because of uncertain position of clastic rocks in west-central part, the carbonate rocks there are undivided

Tkluu Upper member, upper part—According to John Oldow (Northwestern University, oral commun., 1976), the limestone in the southeastern part of the map area is all part of the upper member of the Luning, and there the upper member is divisible into upper and lower parts. The upper part consists of gray, massive-weathering, thick-bedded, isoclinally folded dolomitic limestone and dolomite. The folding is not obvious, however, except where relief provides three-dimensional views; the possibility exists that we have overlooked several folds because the thicknesses indicated on cross sections ***A–A'*** and ***B–B'*** are excessive according to John Oldow (oral commun., 1976). Thickness at least 500 m, possibly as much as 1,400 m

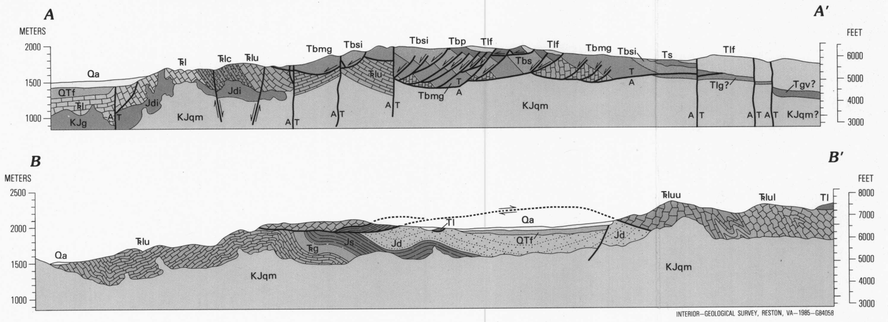
Tklc Clastic rocks—In the southeastern part of the map area, metamorphosed shales, argillite, and slate as much as 50 m thick separate the upper part of the upper member from the lower part. These clastic rocks were too thin to map and are not shown separately. Farther north clastic rocks within the Luning may correlate with those to the south, but because of rapid facies changes that characterize the Luning within short distances, the units cannot be positively correlated. The clastic rocks along the north end of Todd Mountain are mostly hornblende-mica phyllites and schists that have been extensively metasomatically replaced; thin sections show that some rocks are metasandstone and siltstone, whereas others possibly formed from lavas of intermediate composition. The clastic rocks (**Tklc**) in this quadrangle are inferred to be the same as those that comprise the middle unit of a threefold subdivision of the Luning Formation used in the quadrangles to the west (see index map); however, there as well as here, the strata may be all part of the upper member of the Luning of Ferguson and Muller (1949). Thickness 50 m to possibly as much as 550 m

Tklul Upper member, lower part—Reddish-gray, ferruginous, thick-bedded to very thick bedded, medium- to coarse-grained limestone. Thickness 300 m to possibly as much as 650 m

Tklu Upper member, undivided

[1]In this report we use a Miocene-Pliocene boundary age of 5 m.y. and an Oligocene-Miocene age of 26 m.y. For more detailed descriptions of the Tertiary volcanic rocks and K-Ar age data, see Ekren and others (1980) and Proffett and Proffett (1976).

[2]Classification of igneous rocks used herein is that of Johannsen (1939). All contacts between the various types of Mesozoic batholithic rocks shown on this map are approximately located and in places arbitrary.



INTERIOR—GEOLOGICAL SURVEY, RESTON, VA—1986—G84058

———?——— CONTACT—Approximately located; queried where doubtful

76 FAULT—Showing dip and relative horizontal movement. Dashed where approximately located or inferred; dotted where concealed. Bar and ball on downthrown side. Hachures indicate alluvium deposited against fault scarp but not faulted. In cross section, direction of relative movement: T, toward observer; A, away from observer

Detachment fault—Half moons on upper plate; Tertiary age

Thrust fault—Dotted where concealed. Sawteeth on upper plate; Mesozoic age

FOLDS—Showing approximate trace of axial surface and direction of plunge where known

Anticline

Syncline

Tightly folded beds at axis of major fold showing strike and plunge of fold axes

55 Overturned anticline showing direction of dip of limbs and dip value where known

STRIKE AND DIP OF BEDS

25 Inclined

25 Overturned

Vertical

Horizontal—less than 3°

STRIKE AND DIP OF FOLIATION

25 Inclined

Vertical

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INDEX MAP SHOWING QUADRANGLES REFERRED TO IN TEXT

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