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Preliminary Geologic Map of the Independence Valley NE Quadrangle, Elko County, Nevada

by

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DESCRIPTION OF MAP UNITS

Quaternary Deposits

Qa Active Alluvium (late Holocene) Coarse-grained alluvial deposits in incised ephemeral drainages; typically unconsolidated and poorly to moderately sorted sand with pebble- to cobble-sized gravel. Locally forms low terraces above active drainages. Minimal soil development. Correlative with young alluvial-fan deposits (Qfy).

Qc Colluvium and talus (Holocene to Pleistocene) Unconsolidated, angular to slightly rounded boulders to pebbles of bedrock in a variably sandy matrix. Colluvium is most extensively developed topographically below resistant outcrops of Eureka Quartzite, where it is composed entirely of quartzite boulders up to 3 m in diameter, and on steep slopes in underlying Pogonip Group, where it is composed of clasts of Pogonip rocks and lesser quartzite.

Qls Landslide deposits (Holocene to Pleistocene) Coarse debris-flow or rock avalanche deposits composed mostly of Eureka Quartzite (Oe). We interpret an enigmatic, 270 x 170 m area of moderately to intensely brecciated and partly disaggregated Fish Haven Dolomite, Eureka Quartzite, and Lehman Limestone that overlie Cambrian metasedimentary rocks on the north side of Meyers canyon in the northwestern corner of the quadrangle to be a Quaternary landslide deposit from the cliffs of the same rocks above and ~1 km to the northeast.

(Ofh), (Oe), (Opl) Quaternary landslide deposit Landslide deposit, with dimensions of 250 m by 150 m, exposed on the northern flank of Meyers canyon. Comprised of relatively intact stratigraphy of Fish Haven Dolomite (Ofh), Eureka Quartzite (Oe), and Lehman Formation (Opl), which have the same characteristics as the in place units throughout the Pequop Mountains. Probably derived from ~1 km northeast, where a prominent cliff band of Eureka Quartzite is exposed. Exposed thickness is greater than 100 m.

Qfy Young alluvial-fan deposits (Holocene) Coarse-grained alluvial deposits in intermittently active alluvial fans; typically sandy, pebble- to cobble-sized gravel with silt and boulders; some localized areas primarily comprised of silt with minimal coarse-grained material. Clasts are subrounded to subangular. Surfaces have distributary flow patterns with morphology ranging from subdued bar-and-swale forms to slightly smoothed surfaces. Typically has weak to no soil development. If present, soil development is characterized by Stage I, $CaCO_3$ coatings on bottoms of clasts. Qfy post-dates the lacustrine deposits in the map area and Qfy deposits both breach and are locally buttressed against beach bars of lacustrine gravels (Qlg). Exposed thickness of the unit is typically 1–2 m. Areas of high silt composition are isolated from major drainage outlets, or deposited beyond distal edge of gravel deposition, and are comprised of reworked fine-grained lacustrine sediments.

Qgwd Ground water discharge deposits (Holocene) Deposits of eolian and alluvial, sand and silt with organic clay, in heavily vegetated area surrounding actively discharging springs. Includes spring mounds, ponds, and actively flowing spring-fed streams.

Qla Lacustrine and alluvial deposits (Holocene to late Pleistocene) Variable deposits of lacustrine silt, clay and sand; and alluvial silt, sand and minor gravel. Lacustrine silt was deposited in shallow waters of late Pleistocene Lake Waring. Inter-fingered alluvial deposits are present in channels and are comprised of reworked lacustrine deposits and distal fine-grained fan sediments.

Qlg Lacustrine gravels (late Pleistocene) Gray to brown deposits of moderately to well sorted pebble- to cobble-sized gravel and sand in shorelines, beach bars, and spits. Clasts are rounded to subrounded. Soils consist of 20- to 30-cm thick Bw horizon, underlain by 30–50 cm stage II $CaCO_3$ horizons (Bk). Unit was deposited during highstands and regressive phases of late Pleistocene Lake Waring, which reached a maximum late Pleistocene elevation of 1761 m (Reheis, 1999). The highstand was dated by Munroe and Laabs (2013) who obtained a 16.8 ka radiocarbon age from a beach deposit 12 km south of the map area on the western side of Goshute Valley. Qlg gravels and associated shorelines are inset into, and postdate Qfi surfaces. Exposed thickness of the unit is greater than 5 m.

Qfi Intermediate-aged alluvial-fan deposits (late Pleistocene) Coarse-grained alluvial deposits in mostly inactive alluvial fans; typically sandy pebble- to cobble-sized gravel, and local boulders. Clasts are sub-rounded to sub-angular carbonate and quartzite derived from adjacent mountains. Surface morphology is generally planar with rounded margins. Incised drainages have a tributary pattern with channel incision ranging from 1–3 m. Soils consist of stage II–III $CaCO_3$ horizons (Bk) up to 1 m thick. Exposed thickness of the unit rarely exceeds 5 m.

Qfo Older alluvial-fan deposits (middle Pleistocene?) Coarse-grained alluvial deposits in inactive alluvial fans; typically sandy pebble- to cobble-sized gravel with boulders. Clasts are subrounded to subangular. Surface morphology ranges from planar to fully rounded erosional remnants. Surfaces have abundant litter of pedogenic carbonate. Upper soil horizons erosionally stripped, Stage III–IV $CaCO_3$ horizons up to 2.5 m thick form a continuous carbonate rich layer with local development of laminar carbonate structure. Qfo is preserved in small intermontane basins in the Pequop Mountains, as prominent fan surfaces in Independence Valley and locally along the base of the eastern range front. Qfo likely underlies must Qfi deposits in Goshute Valley. Exposed thickness of the unit rarely exceeds 5 m.

Qf Fan deposits, undivided (Pleistocene) Variably dissected alluvial-fan remnants, mostly mapped within the Pequop Mountains, where relative ages and assignment to young, intermediate-age, or older alluvial-fan deposits are uncertain.

QTb Boulder deposit in oldest alluvial-fan deposits (middle Pleistocene? to Pliocene?) Lag of rounded to subangular boulders of Eureka Quartzite along a ~100-m-wide belt that extends westward from Meyers canyon for ~1.2 km into the Independence Valley NW quadrangle (Dee et al., 2017). Boulders are commonly as much as 4–5 m in greatest dimension and generally larger than 1 m in diameter. Any fine matrix has been eroded. Probably deposited as a coarse debris flow that was sourced from similarly coarse talus beneath cliffs of Eureka Quartzite in the northeastern part of the Meyers canyon drainage in the Pequop Summit quadrangle (Henry and Thorman, 2015) and flowed down the channel that drained Meyers canyon before capture by the current northwest-trending drainage. Possibly runout from the large Quaternary landslide mass on the north flank of Meyers canyon.

QTf Oldest alluvial-fan deposits (middle Pleistocene? to Pliocene?) Coarse-grained alluvial deposits; typically sandy pebble- to cobble-sized gravel with boulders. Clasts are subrounded to subangular carbonate and quartzite derived from the Pequop Mountains. A morphologically rounded, eroded remnant of the QTf surface is preserved south of the outlet of Meyers canyon. Soils horizons are largely stripped; however, abundant litter of pedogenic carbonate suggest remnants of Stage IV-IV+ $CaCO_3$ horizons (Bk) of unknown thickness. QTf stratigraphically overlies Tg with a gradational and conformable contact. Exposed thickness of the unit ranges from 15 to ~25 m.

Tertiary Sedimentary Rocks

Tg Tertiary fanglomerate (Pliocene to Miocene?) Coarse gravel mostly expressed as a lag of boulders to pebbles of limestone, marble, and quartzite. Scattered outcrops show poorly bedded, poorly to moderately sorted, strongly to moderately calcite-cemented, fluvial gravel. Larger clasts are subangular to rounded, whereas smaller clasts are angular to subangular. Westward paleocurrents indicated by common imbrication of platy limestone and marble clasts. Tephra interbedded with gravel in the Independence Valley NW quadrangle (Dee et al., 2017) yielded a preliminary sanidine $^{40}Ar/^{39}Ar$ date of 4.7±0.3 Ma. Maximum exposed unit thickness is 90 m.

Jurassic Intrusive Rocks

Jl Mafic dikes and sills (Jurassic) Lamprophyre and monzodiorite to gabbro dikes and sills are distributed across the range. Lamprophyres make thin (0.2-to 3-m-thick to >100-m-long) sills generally parallel to metamorphic foliation but locally form similarly thin dikes that cut the foliation. A lamprophyre intruded along the Independence thrust fault in the west-central part of the quadrangle indicates the thrust is older. One well-exposed body in the Long Canyon Mine makes a 1-m-thick dike in massive Notch Peak dolomite that changes abruptly to a similarly thick sill in well-bedded Pogonip Formation

(Milliard et al., 2015). Most lamprophyres are strongly altered to light to dark brown with all primary minerals destroyed. Where less altered, abundant hornblende or clinopyroxene phenocrysts reside in a groundmass of feldspar and quartz. Monzodiorite and one gabbro make thicker, more irregular intrusions up to ~100 m long comprised of equigranular medium-grained hornblende, biotite, plagioclase, and clinopyroxene, which suggest they are coarser, more slowly cooled versions of lamprophyre. Age constraints on these intrusions include a U-Pb zircon age from the gabbro of 159±6 Ma (sample PQSG) (Bedell et al., 2010), hornblende $^{40}Ar/^{39}Ar$ ages of 160.9±0.5 Ma (isochron) on a sample from the Long Canyon Mine (sample H14-64), and 161.5±0.2 Ma and 159.6±0.2 Ma (plateaus) from a relatively unaltered lamprophyre dike in the Independence Valley SE quadrangle.

Jg Granitic (or rhyolitic) sills (Jurassic) Fine-grained, tan-weathering sills form a mostly north-northeast-striking belt across the northern half of the quadrangle. Variably sericitized plagioclase grains up to 2 mm long and completely altered biotite(?) up to 1 mm long are the only phenocrysts in a fine-grained matrix of quartz, plagioclase, orthoclase, sericite, and opaque minerals including former pyrite. The sill in Meyers canyon forms a series of boudins as much as 3 m thick and 12 m long surrounded by marble (Clifside Limestone) whose foliation wraps around the boudins. Camilleri (2010) reported a lower intercept U-Pb zircon age of 154±5 Ma from this sill (sample 151P), and Bedell et al. (2010) dated a granitic sill in the Shafter Formation in the western part of the quadrangle at 159.9±1.9 Ma (sample 34FGG).

Paleozoic Sedimentary Rocks

Paleozoic unit thicknesses are from this study, Thorman (1970), Camilleri (2010), Henry and Thorman (2015), and Dee et al. (2017). Cambrian stratigraphy follows that of McCollum and Miller (1991). Due to internal folding within less competent units, probable bedding-plane faulting, boudinage development, attenuation faulting, and brecciation of competent units, thicknesses are best estimates where the rocks are undeformed or least deformed. Unit thickness varies significantly along strike and above and below the Independence thrust. Except for small areas of Devonian outcrop along the northern map margin, units stratigraphically above Ordovician Eureka Quartzite are exposed only in the lower plate of the Independence thrust. The Pequop Formation and Ely Limestone additionally are extensively exposed in the upper plate of the Pequop fault.

Pp Pequop Formation (Permian, Guadalupian? To Leonardian) Comprised of a lower, thin to moderately thick-bedded (up to 50 cm), light-to-medium gray limestone with minor, interbedded dolomite and an upper, platy, thin-bedded (≤2 cm), purplish-gray silty limestone, calcareous mudstone, and minor dolomite. Fusulinid-rich beds are common, and irregular lenses of dark chert are locally common in the lower unit. Channel-filling debris deposits (debrites) up to 2 m thick and 20 m wide and containing rounded to subangular clasts up to 20 cm diameter of fine, dark gray variably fossiliferous (fusulinids, crinoids, brachiopods) limestone are scattered through the upper part. The contact with underlying Ely Limestone is an unconformity commonly marked by a basal, light tan to light reddish-brown, slope-forming siltstone or fine quartz sandstone varying in thickness from a few m to 20 m. Intraformational folds recognized in the southeastern part of the quadrangle. At least 600 m thick as exposed in the northern map area as part of the Pequop structural plate, which is bounded by the low-angle normal fault, and more than 800 m thick in the southeastern map area.

IPe Ely Limestone (Pennsylvanian, Desmonesian? to Atokan) Light-to-medium gray, thick-bedded (typically 1 to 2 m) limestone separated by thin intervals of argillaceous platy limestone that form bench-and-bluff topography. Beds are comprised of bioclastic limestone containing crinoid, brachiopod, coral, and bryozoan debris. Characteristic irregular lenses and nodules of tan chert throughout. The change from chert-pebble conglomerate of the Diamond Peak Formation to limestone of the Ely formation is gradational in the southern part of the quadrangle. We chose the contact at the stratigraphically highest, major conglomerate zone. Approximately 510 m thick in the southeastern map area.

Mdp Diamond Peak Formation (Upper Mississippian) Reddish brown, thick-bedded, chert-pebble conglomerate that forms moderate ledges. Clasts are well-rounded, up to 10 cm in diameter, and predominantly white, gray, green, red, or black chert and minor quartzite. Matrix is medium- to coarse-grained quartz and chert grains. Several thin (~1–3 m), light gray, bioclastic limestone beds occur in the upper part of the formation. The contact with the underlying Lower Mississippian Chainman Shale is generally poorly exposed but appears gradational, from scattered channel-fill conglomerates in the upper part of the Chainman to more continuous conglomerate beds in the Diamond Peak. Approximately 280 m thick in the southeastern map area.

Mc Chainman Shale (Lower Mississippian) Nonresistant, poorly exposed shale, siltstone and fine sandstone, and minor chert-pebble conglomerate. The lower part is black shale with subordinate thin beds of dirty chert-pebble conglomerates and medium- to coarse-grained to gritty, chert-quartz gritstone and an upper part of light gray, fine siltstone and sandstone with subordinate black shale and chert-pebble conglomerate lenses that increase in abundance upwards towards the contact with overlying Diamond Peak Formation. Bedding-parallel faults and internal folds, some isoclinal. Exposures in the southern part of the quadrangle are hornfelsed and more resistant.

The basal contact with the Lower Mississippian Joana Limestone is sharp. Apparent structural thickness of as much as 1000 m may represent tectonic thickening.

Mtp Tripon Pass Limestone (Lower Mississippian, Kinderhookian) Present only in the southwestern part of the quadrangle, where it consists of gray, medium- to thin-bedded, fine- to medium-grained limestone, commonly with graded beds. Basal beds are thin- to medium-bedded crinoidal coquina limestones (encrinites) that are overlain by light to dark brown, cherty limestones and sandstones. These rocks grade upward into platy to thin- to medium-bedded, fine- to medium-grained limestones that are locally silicified, especially near high-angle faults. Locally becomes sandy, with grains of quartz and chert. Contains interbeds of fissile to platy brown calcareous shale. Contact with underlying Guilmette Formation is a disconformity. Approximately 270 m thick. Time equivalent to Early Mississippian Joana Limestone.

Mj Joana Limestone (Lower Mississippian) Present in most of the southern part of the quadrangle, where it consists of light gray limestone marble with encrinite beds and minor chert stringers in the lowermost section. The prominent cliff-forming unit forms a sharp contact with the overlying recessive Lower Mississippian Chainman Shale. Approximately 45 m thick. Joana cryptically transforms southward along strike into partly stratigraphically equivalent Tripon Pass Limestone.

Dg Guilmette Formation (Upper Devonian to lowermost Upper Devonian/uppermost Middle Devonian?) Mostly consists of gray, medium- to thick-bedded to massive, medium-grained limestone with sparse platy interbeds, dolomite, and sandy limestone that forms prominent cliffs. Locally contains zebra-dolomite beds. Fossiliferous beds contain megascopic stromatoporids, brachiopods, crinoids (encrinites), and corals. Debrite consisting of mostly rounded and flattened clasts of limestone up to 20 cm long that contain variable amounts of rounded quartz grains is prominent in the upper part of the formation in the southern part of the quadrangle. In the southern half of the map, evidence for internal faulting and folding suggest tectonic thickening of the unit. Basal unit (~5 to 25 m in thickness) of yellowish-gray, thin-bedded to platy to argillaceous, Atrypa nevadana-bearing limestone that forms a smooth, covered slope in the Pequop Summit quadrangle (Henry and Thorman, 2015) is rarely present in the Independence Valley NE quadrangle, possibly because of bedding-parallel faulting. Pink-gray weathering platy limestone is observed near the base, and a recessive yellowish-gray platy to argillaceous limestone is common in the upper section. Presence of upper Middle Devonian Stringocephalus in the upper part of the Simonson Dolomite indicates that the base of the Guilmette cannot be older than uppermost Middle Devonian. Variably 520 m to 650 m thick.

Ds Simonson Dolomite (Devonian) Lower part consists of laminated light-gray to black dolomite and minor gray-green laminated limestone. As many as three thin (0.5- to 2-m-thick) layers of light red-brown-weathering, planar to cross-bedded, siliceous to dolomitic quartzites are present at the base of the unit through much of the area. Upper part consists of interbedded dolomite and limestone, including Stringocephalus-bearing biostromes, and probably is equivalent to the Fox Mountain formation of Sandberg et al. (1997) and Sandberg and Morrow (2009). Ovoid to irregular boudins of dolomite up to 10 m long in foliated limestone are common. The contact between the Simonson Dolomite and the overlying Guilmette Formation is placed at the base of cliff-forming limestone assigned to the Guilmette Formation. Thickness varies from 300 m to 400 m.

DSlm Lone Mountain Formation (Devonian to Silurian) Mostly light to very light gray, rarely medium gray, massive to faintly bedded dolomite. Approximately 150–180 m thick.

Srm Roberts Mountains Formation (Silurian) Thin-bedded to platy, fine-grained, medium to dark gray limestone and dolomite. Upper part more dolomitic; lower part more limestone. However, relative proportions of limestone and dolomite change gradationally along strike. Locally fossiliferous containing crinoid, brachiopod, and graptolite fragments. Approximately 140 m thick.

Sl Laketown Dolomite (Silurian) Interbedded light to medium gray, fine- to medium-grained dolomite. Lighter and darker intervals range from 15–30 m thick. Beds vary from massive, to fine to coarsely laminated, to mottled. Light-colored to grayish-black chert lenses are common. Bioclastic debris and well-preserved crinoids, corals, and brachiopods occur at several horizons. Contact with underlying Fish Haven Dolomite (Ofh) at base of lowest light gray dolomite. Approximately 85 m thick.

Ofh Fish Haven Dolomite (Upper Ordovician) Dark gray to black, massive to medium- to rarely thinly-bedded, fine-grained dolomite. Basal beds typically contain black to dark gray chert lenses. Bioclastic debris, especially of crinoids, is common. Rests conformably on the Eureka Quartzite, but contact is commonly brecciated. Approximately 120–140 m thick.

Oe Eureka Quartzite (Middle Ordovician) Vitreous, mostly white to lesser medium gray to purple quartzite composed of medium-grained, rounded quartz grains that generally are frosted. The unit is variably intact or intensely brecciated, which is interpreted to reflect deformation at different structural levels: structurally deeper Eureka remains relatively intact due to more ductile deformation at higher temperatures whereas structurally higher exposures deformed brittlely. Where intact, forms prominent light-colored cliffs of medium bedded, mostly planar to less

commonly cross-bedded rock; cross beds typically expressed by light blue color bands where strongly silicified or by selective weathering of carbonate near base or top of formation. Basal and upper quartzite beds are generally darker than interior beds, ranging to medium to dark gray and purple. Approximately 50–80 m thick where undeformed.

Pogonip Group The Pogonip Group, as mapped in this quadrangle and the Pequop Summit quadrangle (Henry and Thorman, 2015), includes the following formations:

Opl Lehman Formation (Lower Ordovician) Medium gray-blue, fine-grained platy to medium-bedded limestone with thin, tan, argillaceous interbeds and irregular bodies, possibly burrows. Locally contains abundant leperditia (small, pea-shaped ostracod). Grades upward into dark-gray dolomite (Crystal Peak Dolomite, not mapped separately here) and sandy dolomite of Eureka Quartzite. Approximately 150 m to 250 m thick.

Kanosh Formation The Kanosh Formation includes the following informal units: upper shale (Kanosh shale), middle limestone (Kanosh limestone), and basal quartzite (Kanosh quartzite).

Opks Kanosh shale (Lower Ordovician) Yellowish-brown, olive, gray to black, fissile shale with intercalated platy argillaceous limestone similar to Lehman Limestone. Forms covered slopes between bounding units and upper and lower contacts are covered. Limestone layers commonly contain abundant leperditia. Commonly metamorphosed to phyllite. Poorly exposed, but probably 20–30 m thick.

Opkl Kanosh limestone (Lower Ordovician) Limestone similar to Lehman Limestone. Approximately 160 m thick in the western map area.

Opkq Kanosh quartzite (Lower Ordovician) Cross- to planar bedded, medium-grained, light brown to red-brown weathering, well-cemented quartzite with minor, commonly leached carbonate matrix. Locally absent between the House and Kanosh limestones, probably due to boudinage development. Etching of carbonate matrix due to weathering makes characteristic pitted surface and accentuates cross beds, which distinguishes it from Eureka Quartzite. More brecciated in upper structural plate, similar to Eureka Quartzite (Oe). Approximately 8 m thick.

Oph House Limestone (Lower Ordovician) Medium gray, fine-grained platy to medium-bedded limestone with argillaceous bedding planes and irregular bodies, possibly burrows. More shale and argillite component than Lehman Formation. Approximately 400 m thick in the western map area.

O€np Notch Peak Formation (Lower Ordovician to Upper Cambrian) Predominantly light to medium gray dolomitic marble with local thick interbeds of blue and white limestone. Dolomitic marble is massive to banded light gray or tan to medium gray or tan. 2- to 5-cm-thick lenses and nodules of medium-gray chert are sparse to locally abundant, especially near the top of the formation. Limestone is well-bedded with tan, silty layers, similar to limestone of the Pogonip Group. Zebra dolomite makes a few beds in the upper part. Dolomite commonly forms ovoid to irregular boudins up to 10–15 m in diameter in flowed limestone. Contact with underlying Dunderberg Shale is gradational; dolomite or limestone are interbedded with phyllite and schist. No measured thickness in the map area, but Smith et al. (2013) show 380 m thickness and Camilleri (2010) suggest a range from 350 m to 600 m.

€d Dunderberg Shale (Cambrian) Recessive weathering, poorly exposed unit consisting of green and black shale metamorphosed to phyllite and schist, especially in the footwall of the Independence thrust, commonly with fine porphyoblasts. Muscovite is parallel to foliation. Numerous thin (≤10 cm) micaceous limestone interbeds. Sharp contact with underlying Oasis Formation. Approximately 50–60 m thick in the map area.

€o Oasis Formation (Cambrian) Cliff forming white, light gray, and blue-gray medium- to thick-bedded limestone and dolomite marble. White and light gray limestone and dolomite make up the top and bottom of the unit, and blue-gray limestones, similar in appearance to Clifside Limestone, make up the middle of the formation. Tan silt beds appear similar to those in Pogonip limestones but are commonly more sheared. The occurrence of thin-bedded silty limestone or shale marks the contacts with overlying and underlying Dunderburg and Shafter, respectively. Approximately 200 m thick in the map area.

€s Shafter Formation (Cambrian) Thinly bedded gray to blue limestone marble with silty orange to gray interbeds commonly metamorphosed to phyllite or schist. Unit is recessive, with areas weathered to dark brown. Approximately 130 m thick in the map area.

€dl Decoy Limestone (Cambrian) Distinctive cliff-forming tan-gray recrystallized dolomite or light blue-gray recrystallized limestone with silty limestone interbeds. Can resemble Clifside Limestone where not dolomitized or deformed. Contact with underlying recessive Morgan Pass occurs with the appearance of silty limestone. Variably 30 m to 60 m thick.

€mp Morgan Pass Formation (Cambrian) Recessive weathering shale and platy blue limestone. Metamorphosed to micaceous schist and marble. The

contact with the underlying Clifside is sharp at the base of the lowest shale or silty limestone above the distinct cliff-forming gray Clifside Limestone. Approximately 120 m thick in the map area.

Ꞓcl Clifside Limestone (Cambrian) Wavy-foliated, light gray-blue calcareous marble, commonly with coarse muscovite, with gray or orange-brown silty layers and locally, abundant crinoids and other strongly recrystallized fossils. A minor brown silty limestone section, metamorphosed to muscovite-biotite schist, near the middle of the Clifside is recessive and poorly exposed. Thickness varies substantially in the western map area, from 100 m to 200 m.

Ꞓt Toano Limestone (Cambrian) Foliated, dark grayish green micaceous marble with much less phyllite and tremolite schist than in underlying Killian Springs Formation. Protoliths were likely thin-bedded limestone and silty limestone. Some beds are chaotically folded, probably due to slumping and soft-sediment deformation because the enveloping layers are not deformed. The contact with the overlying Clifside Limestone is placed at the distinct color and lithologic change, Toano being darker green and more micaceous. Approximately 170 m thick in the map area.

Ꞓks Killian Springs Formation (Cambrian) Black to dark greenish gray micaceous marble, phyllite, and biotite-muscovite or hornblende schist with tremolite-bearing layers. Protoliths were likely siltstone, calcareous siltstone and thin-bedded limestone. Contact with underlying Cambrian Prospect Mountain Quartzite is sharp. Approximately 170 m thick in the map area.

ꞒZpm Prospect Mountain Quartzite (Lower Cambrian to Upper Neoproterozoic) Light to blue gray massive quartzite with minor, cm-thin, garnet-bearing micaceous layers. Fine to medium grained with quartz-pebble conglomerate layers. Planar to cross-bedded. This unit is only in the cross section of this map but is exposed west of the map boundary, stratigraphically below the Cambrian Kilian Springs Formation.

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Table 1. Chemical analyses of igneous rocks, Pequop Mountains Study Area

Sample Number	Map unit	Lat83	Long83	Source[a]	SiO2	TiO2	Al2O3	FeO*	MnO	MgO	CaO	Na2O	K2O
Volcanic Rocks[b]													
H14-68	Ta	41.04468	-114.50914	1	64.48	0.50	16.88	4.00	0.07	2.51	4.84	3.66	2.88
H14-70	Ta	41.03510	-114.51883	1	72.92	0.31	13.99	2.40	0.03	0.90	2.89	3.45	2.98
H14-71	Ta	41.03552	-114.51950	1	67.20	0.48	16.70	3.26	0.05	1.27	4.49	4.43	2.00
H14-72	Ta	41.03568	-114.52362	1	69.34	0.60	16.51	2.43	0.02	0.24	4.57	3.78	2.36
H14-73	Ta	41.03539	-114.52513	1	62.80	0.68	16.54	5.17	0.09	3.31	5.89	3.36	1.98
H14-126	Ta	41.04820	-114.50321	1	63.05	0.68	17.19	5.01	0.08	2.61	5.39	3.78	2.04
H14-127	Ta	41.04926	-114.50215	1	64.81	0.55	16.66	4.13	0.07	2.45	4.73	3.46	2.89
H03-102	Tbcc	41.02780	-114.54669	1	78.06	0.11	11.96	0.83	0.01	0.13	0.93	2.81	5.09
90B13	Tbcc	41.03186	-114.54504	3	76.91	0.10	12.68	1.06	0.02	0.19	0.91	3.11	4.96
88T 55	Tbcc	41.02464	-114.53532	3	78.89	0.10	11.73	0.41	0.02	0.12	0.77	2.49	5.42
90B3	Tbcc	41.01158	-114.54171	3	76.38	0.10	13.04	0.85	0.04	0.30	0.90	3.14	5.21
90B7B	Tbcc	41.02714	-114.54671	3	77.44	0.09	11.74	1.61	0.02	0.22	0.80	2.46	5.56
90B9B	Tbcc in Tx	41.02603	-114.53504	3	76.46	0.10	12.78	1.24	0.02	0.24	0.91	2.92	5.27
H05-38	Tbcc in Tx	41.03108	-114.52699	2	79.86	0.12	10.84	0.39	0.01	0.06	0.47	1.90	6.31
90B10	Tbcc in Tx	41.03214	-114.54116	3	78.07	0.11	12.12	0.62	0.02	0.17	0.99	2.69	5.16
H03-101	Tpb	41.02737	-114.54924	1	69.52	0.47	16.26	1.95	0.03	0.72	2.75	3.82	4.35
88T 56	Tpb	41.02492	-114.53532	3	72.98	0.38	14.51	1.64	0.02	0.54	2.34	3.25	4.23
90B6	Tpb	41.02714	-114.54921	3	69.14	0.46	16.98	1.66	0.02	0.67	2.81	3.90	4.22
90B11	Tpb	41.00936	-114.53560	3	69.78	0.40	16.17	2.40	0.02	0.62	2.63	3.59	4.24
Intrusive Rocks													
H14-89	Tr	40.94335	-114.62989	1	76.44	0.03	13.79	0.82	0.03	0.11	1.65	3.36	3.73
H14-86	Tr	40.93880	-114.63246	1	76.21	0.04	14.24	0.91	0.04	0.13	1.05	3.27	4.08
H14-90	Tr	40.93808	-114.63357	1	76.40	0.03	13.87	0.74	0.04	0.08	1.30	3.55	3.96
H14-91	Tr	40.93114	-114.64208	1	76.00	0.03	14.02	0.77	0.04	0.08	1.42	3.74	3.86
R17-6	Tr	40.93828	-114.63321	1	76.55	0.03	13.82	1.07	0.05	0.15	1.48	3.06	3.77
H18-25	Tr	40.92778	-114.64426	1	75.71	0.04	14.14	1.05	0.03	0.17	1.38	3.52	3.80
H18-26	Tr	40.93078	-114.64254	1	75.07	0.03	14.41	1.06	0.04	0.09	1.13	3.89	4.09
H14-87	Kl	40.93958	-114.63045	1	76.06	0.01	15.44	0.41	0.01	0.17	0.53	5.35	1.98
H14-88	Kl	40.94271	-114.62947	1	61.94	0.01	23.59	0.31	0.01	0.17	4.52	8.34	1.03
H15-54	Kl	40.93284	-114.64029	1	68.76	0.03	20.67	0.89	0.01	0.24	0.44	5.29	3.52
H17-23	Kl	40.94278	-114.62942	1	61.87	0.01	23.54	0.38	0.01	0.07	4.53	9.08	0.46
H18-23	Kl	40.93028	-114.64415	1	74.20	0.02	15.01	0.56	0.09	0.12	0.61	5.16	4.18
H18-40	Kl	40.93581	-114.63277	1	72.93	0.01	16.71	0.75	0.07	0.03	0.35	5.66	3.38
H14-82	Jg	40.99429	-114.61276	1	74.13	0.18	14.84	1.62	0.05	0.40	1.98	4.51	2.22
H14-84	Jg	40.96297	-114.60137	1	74.83	0.19	15.64	1.42	<0.01	0.41	0.18	4.22	2.87
H17-30	Jg	40.95100	-114.57551	1	75.16	0.28	17.31	2.41	0.01	0.51	0.31	0.14	3.69
H18-6	Jg	40.87066	-114.61075	1	60.08	1.22	18.96	6.00	0.06	3.42	2.15	5.06	2.04
H18-9	Jg	40.96578	-114.60433	1	74.82	0.16	15.35	1.83	0.02	0.50	0.28	2.86	3.92
H18-30	Jg	40.96340	-114.59791	1	74.77	0.19	15.64	1.63	<0.01	0.40	0.19	4.43	2.57
H18-32	Jg	40.96319	-114.60405	1	75.73	0.18	16.15	1.89	0.02	0.56	0.26	0.13	4.88
H17-39	Jg	40.98290	-114.61056	1	75.95	0.12	15.25	1.20	0.05	0.29	1.00	3.66	2.41
R17-34	Jg	40.92781	-114.58043	1	73.78	0.17	15.22	1.72	0.01	0.44	0.28	4.42	3.88
CLC012-01 670	Jg	40.96644	-114.54412	1	72.90	0.18	16.43	1.56	0.01	0.74	0.38	3.58	4.15
AZ7-16-18(2)	Jl	40.93229	-114.59600	1	61.48	1.04	16.92	5.52	0.06	4.56	4.09	4.29	1.58
H09-93B	Jl	40.97155	-114.52757	2	56.22	1.25	16.03	7.31	0.12	7.38	6.46	3.27	1.73
H14-64	Jl	40.97249	-114.52764	1	55.50	1.24	15.62	7.77	0.12	8.18	6.41	3.28	1.69
H14-83	Jl	40.99483	-114.61253	1	46.81	1.37	16.67	7.80	0.12	7.99	15.10	2.00	1.64
H15-55	Jl	40.93202	-114.64064	1	49.90	1.24	14.79	8.48	0.11	9.46	13.07	0.54	1.98
H15-56	Jl	40.93186	-114.64076	1	49.37	0.57	16.47	4.83	0.06	4.43	20.42	0.89	2.80
H14-85	Jl	40.93193	-114.64077	1	55.93	1.69	12.49	6.33	0.09	8.05	12.23	0.89	1.52
H14-123	Jl	40.84985	-114.61306	1	54.29	1.63	18.37	7.71	0.13	3.80	5.53	4.52	3.26
H14-124	Jl	40.84985	-114.61306	1	63.43	0.82	14.16	4.94	0.10	4.11	5.18	3.39	3.48
H14-125	Jl	40.84985	-114.61306	1	52.42	1.10	11.08	8.39	0.16	14.61	8.88	2.52	0.54
H17-24	Jl	40.94838	-114.57598	1	57.76	1.12	19.89	6.03	0.01	6.10	0.78	3.05	4.81
H17-25	Jl	40.94781	-114.57647	1	52.38	1.10	16.10	8.12	0.11	10.03	7.19	2.55	2.05
H17-26	Jl	40.94139	-114.57857	1	57.50	1.15	16.05	7.69	0.04	4.97	5.52	0.45	6.30
H17-27	Jl	40.94139	-114.57857	1	48.74	1.55	13.93	11.82	0.19	15.92	6.53	0.92	0.09
H17-28	Jl	40.94139	-114.57857	1	49.86	1.70	16.60	9.86	0.16	10.24	5.93	3.98	1.34
H17-112	Jl	40.89762	-114.60758	1	50.88	1.35	13.14	9.56	0.09	8.85	7.07	0.09	6.25
H18-7	Jl	40.89625	-114.31419	1	50.54	1.19	11.87	9.81	0.17	10.80	10.65	2.04	1.97
H18-10	Jl	40.97731	-114.59347	1	54.54	1.56	12.67	8.37	0.03	2.50	14.43	0.10	4.81
H18-28	Jl	40.96346	-114.58133	1	65.37	1.23	19.33	7.26	0.14	0.68	0.21	0.47	5.03
H18-29	Jl	40.98812	-114.59562	1	53.23	1.57	12.24	8.25	0.09	1.69	16.17	0.08	5.60
H18-31	Jl	40.97244	-114.59799	1	66.22	0.45	17.55	3.37	0.11	0.48	3.97	3.48	3.93
H18-34	Jl	40.93897	-114.61790	1	55.28	1.31	17.85	8.13	0.11	4.79	6.39	3.33	1.86

a) 1 = ALS Global analytical package ME-MS81d, Inductively coupled plasma optical emission spectrometry (major oxides) and mass spectrometry (trace elements). 2 = Washington State University X-ray fluorescence. 3 = Brooks et al. (1995).

b) All volcanic rock samples and associated Map units are from the Pequop Summit quadrangle (Henry and Thorman, 2015).

Table 1. Chemical analyses of igneous rocks, Pequop Mountains Study Area

Sample Number	P2O5	LOI	Total	Li	Sc	Sc icp	V	Cr	Co	Ni	Cu	Zn	Ga	As	Rb	Rb icp
Volcanic Rocks[b]																
H14-68	0.18	2.70	99.15	10	8		74	50	13	29	23	70	17.9	0.5	69.0	69.0
H14-70	0.12	1.24	98.51	30	4		37	10	6	7	8	40	15.9	0.5	88.2	88.2
H14-71	0.11	0.87	98.40	10	8		102	30	10	18	21	60	18.7	0.8	36.0	36.0
H14-72	0.17	1.19	98.88	10	8		90	10	6	4	10	61	18.6	1.4	61.0	61.0
H14-73	0.16	1.46	100.12	10	16		136	40	18	21	27	71	19.4	1.6	57.1	57.1
H14-126	0.17	1.01	101.52	10	12		119	20	16	6	12	73	19.5	0.5	52.0	52.0
H14-127	0.24	2.33	100.80	10	8		84	40	13	21	16	64	18.3	0.1	71.4	71.4
H03-102	0.06		98.13		2		10	2		5	3	27	14		169	169
90B13	0.05		97.77												208	
88T 55	0.05		98.87												152	
90B3	0.05		98.20												201	
90B7B	0.05		97.11												251	
90B9B	0.05		97.82												205	
H05-38	0.04		98.38		3		12	4		6	5	21	14		159	
90B10	0.05		97.35												177	
H03-101	0.14		98.19		7		42	4		8	4	69	19		120	120
88T 56	0.11		97.84												114	
90B6	0.14		97.78												144	
90B11	0.15		96.45												157	
Intrusive Rocks																
H14-89	0.02	2.66	99.29	30	1		2.5	10	0.05	1	1	33	17.8	5.5	123.5	123.5
H14-86	0.03	2.10	99.99	30	1		2.5	10	1	2	2	45	18.5	41.3	133	133
H14-90	0.02	2.22	99.05	30	1		2.5	10	0.05	1	1	38	17.9	7.7	128.5	128.5
H14-91	0.03	2.28	99.48	40	1		2.5	10	0.05	1	1	36	17.5	1.7	121.5	121.5
R17-6	0.02	2.53	100.11	40	1	1	8	30	1	1	2	38	17.5	16	129.5	129.5
H18-25	0.02	2.04	100.43	41	2	2	6	10	1	<1	2	42	18.5	<5	124	124
H18-26	0.02	0.87	100.90	80	1	1	<5	10	1	<1	3	30	18.9	<5	135	135
H14-87	0.04	1.40	99.93	40	0.05		2.5	10	0.05	2	1	9	25.1	0.8	207	207
H14-88	0.08	2.42	98.72	80	0.05		2.5	10	0.05	2	1	3	47.4	2.1	86.1	86.1
H15-54	0.15	1.50	101.04				<5	10					20.5		212	212
H17-23	0.05	1.49	101.00	70	<1	<1	6	20	<1	<1	1	2	41	5	31.2	31.2
H18-23	0.05	0.24	101.92	20	1	1	<5	10	1	3	8	23	24.5	<5	304	304
H18-40	0.11	0.62	100.94	120	<1	<1	<5	10	<1	1	1	87	34.6	<5	615	615
H14-82	0.08	2.53	98.89	50	2		6	5	2	3	3	46	15.8	0.4	88.7	88.7
H14-84	0.09	1.69	100.33	10	2	2	14	<10	2	<1	10	35	17.5	5	96.2	96.2
H17-30	0.18	4.23	100.51	20	3	3	59	20	2	5	7	27	19.4	43	106	106
H18-6	0.70	3.66	101.35	52	11	11	136	41	16	24	46	83	23.3	<5	81.3	81.3
H18-9	0.08	2.19	100.76	20	2	2	11	10	1	<1	4	42	18.1	109	117	117
H18-30	0.09	1.59	101.81	10	2	2	10	10	2	3	2	29	18.6	21	84.1	84.1
H18-32	0.08	2.61	101.59	30	2	2	5	<10	2	4	5	109	20.4	286	255	255
H17-39	0.06	2.20	101.48	60	2	2	12	20	1	1	2	40	16.9	110	96.0	96.0
R17-34	0.08	1.29	101.79	10	2	2	12	20	2	<1	20	17	17	11	112	112
CLC012-01 670	0.07	2.50	101.69				6	<10					17.7		116.5	116.5
AZ7-16-18(2)	0.31	5.28	99.54	75	12	12	113	160	19	102	30	69	20.2	18	69.3	69.3
H09-93B	0.23	2.55	98.16		23		179	351		130	42	72	20		45	
H14-64	0.20	2.58	98.36	10	21		170	410	32	152	58	72	17.2	0.7	36.7	36.7
H14-83	0.51	14.65	98.61	150	20		166	430	31	173	53	38	15.5	0.9	74.3	74.3
H15-55	0.42	2.12	99.23				225	560					20		155	155
H15-56	0.16	4.79	98.04				266	70					21.5		156	156
H14-85	0.77	1.59	98.06	100	28		227	200	21	69	16	171	17.3	0.2	74.8	74.8
H14-123	0.76	2.37	100.30	20	11		220	10	20	1	6	89	21.7	0.9	81.3	81.3
H14-124	0.39	2.07	100.46	10	14		124	140	16	28	21	69	17.6	0.4	79.8	79.8
H14-125	0.31	2.64	100.32	20	26		155	1160	38	308	7	93	13.5	15.7	7.7	7.7
H17-24	0.44	4.26	100.03	50	14	14	147	130	16	60	23	73	23.7	<5	90.9	90.9
H17-25	0.36	9.61	99.72	60	21	21	188	530	36	172	84	72	16.4	<5	38.9	38.9
H17-26	0.33	7.99	99.84	140	21	21	205	530	33	192	17	86	17.1	35	210	210
H17-27	0.31	9.46	98.34	70	21	21	162	670	58	369	70	86	13.9	12	2.7	2.7
H17-28	0.32	4.10	100.12	40	23	23	192	480	40	124	35	78	16.4	6	32.4	32.4
H17-112	0.73	9.93	99.91	45	30	30	271	1280	64	389	84	75	16.7	86	235	235
H18-7	0.45	1.19	100.41	51	29	29	257	785	45	133	16	111	18.4	<5	92.5	92.5
H18-10	0.77	11.65	100.48	239	27	27	251	864	43	128	72	125	21.8	74	212	212
H18-28	0.11	4.18	101.18	52	25	25	350	592	55	215	62	30	22.8	295	133	133
H18-29	0.85	12.25	99.65	127	29	29	225	635	42	136	68	174	20.7	44	217	217
H18-31	0.27	4.62	100.12	32	3	3	26	11	3	1	4	59	20.3	5	123	123
H18-34	0.72	5.72	99.00	65	19	19	238	22	23	5	19	111	25.2	150	58.4	58.4

Table 1. Chemical analyses of igneous rocks, Pequop Mountains Study Area

Sample Number	Sr	Sr icp	Y	Y icp	Zr	Zr icp	Nb	Nb icp	Mo	Ag	Cd	Sn	Sb	Cs	Cs icp
Volcanic Rocks[b]															
H14-68	502	502	13	13	13	13	7	7	0.05	0.25	0.25	1	0.12	3.13	
H14-70	359	359	10.5	10.5	10.5	10.5	8	8	0.05	0.25	0.25	1	0.21	2.94	
H14-71	467	467	9.4	9.4	9.4	9.4	4.3	4.3	0.05	0.25	0.25	1	0.12	0.61	
H14-72	477	477	13.2	13.2	13.2	13.2	7.7	7.7	0.05	0.25	0.25	1	0.40	1.15	
H14-73	459	459	15.7	15.7	15.7	15.7	6.5	6.5	0.05	0.25	0.25	1	0.20	1.53	
H14-126	419	419	18.9	18.9	18.9	18.9	7.6	7.6	0.05	0.25	0.25	1	0.17	1.38	
H14-127	530	530	14.4	14.4	14.4	14.4	8.2	8.2	0.05	0.25	0.25	1	0.08	3.09	
H03-102	111	111	15	15	15	15	12.0	12.0							
90B13	157		20		126		14								
88T 55	109		18		99		12								
90B3	163		22		141		15								
90B7B	130		23		114		11								
90B9B	143		22		128		12								
H05-38	83		13		106		10.6								
90B10	176		18		143		17								
H03-101	493	493	19	19	255	255	12.8	12.8							
88T 56	408		21		212		8								
90B6	598		20		276		15								
90B11	573		24		252		12								
Intrusive Rocks															
H14-89	66.7	66.7	12.1	12.1	38	38	13.1	13.1	0.05	0.25	0.25	2	0.08	1.67	
H14-86	59.6	59.6	13.2	13.2	42	42	13.7	13.7	0.05	0.25	0.25	2	0.16	2.52	
H14-90	69.3	69.3	13.0	13.0	38	38	13.5	13.5	0.05	0.25	0.25	2	0.11	2.59	
H14-91	86.4	86.4	12.5	12.5	36	36	13.1	13.1	0.05	0.25	0.25	2	0.07	2.15	
R17-6	54.6	54.6	12.5	12.5	41	41	12.8	12.8	1	<0.5	<0.5	2		2.27	2.27
H18-25	83	83	13.2	13.2	43	43	12.92	0	<1	<0.5	<0.5	2	0	2.66	2.66
H18-26	175	175	12.0	12.0	40	40	13.71	0	<1	<0.5	<0.5	2	0	4.72	4.72
H14-87	78.2	78.2	1.3	1.3	18	18	65.2	65.2	0.05	0.25	0.25	2	0.1	8.16	
H14-88	466	466	2.5	2.5	38	38	10.2	10.2	0.05	0.25	0.25	1	0.12	3.80	
H15-54	387	387	4	4	78	78	8.1	8.1				4		6.33	
H17-23	487	487	1.7	1.7	42	42	14.6	14.6	<1	<0.5	<0.5	1		1.46	1.46
H18-23	35	35	8.4	8.4	26	26	45.46	45.463	<1	<0.5	<0.5	3		5.89	5.89
H18-40	17	17	4.6	4.6	96	96	70.93	70.93	<1	<0.5	<0.5	28		48.4	48.4
H14-82	350	350	11.8	11.8	165	165	17.7	17.7	0.05	0.25	0.25	2	0.21	4.24	
H14-84	116	116	10.9	10.9	168	168	18.79	18.786	<1	<0.5	<0.5	2		1.35	1.35
H17-30	51.5	51.5	29.4	29.4	295	295	21.2	21.2	1	<0.5	<0.5	2		1.77	1.77
H18-6	547	547	23.0	23.0	341	341	39.16	39.159	<1	<0.5	<0.5	2		2.54	2.54
H18-9	116	116	12.7	12.7	166	166	20.03	20.026	1	<0.5	<0.5	2		2.13	2.13
H18-30	73	73	12.0	12.0	187	187	18.59	18.593	1	<0.5	<0.5	2		1.30	1.30
H18-32	34	34	12.8	12.8	169	169	19.24	19.237	2	<0.5	<0.5	2		2.93	2.93
H17-39	217	217	12.9	12.9	100	100	21.1	21.1	1	<0.5	<0.5	2		3.87	3.87
R17-34	166.5	166.5	11.7	11.7	164	164	19	19	<1	<0.5	<0.5	2		2.98	2.98
CLC012-01 670	130.5	130.5	10.1	10.1	158	158	19.5	19.5				2		5.04	5.04
AZ7-16-18(2)	588	588	18.9	18.9	279	279	22.74	22.737	1	<0.5	<0.5	2		19.3	19.3
H09-93B	654		23		170		13.3								
H14-64	540	540	19.3	19.3	164	164	12.3	12.3	0.05	0.25	0.25	1	0.07	1.15	
H14-83	600	600	14.7	14.7	189	189	20.5	20.5	0.05	0.25	0.25	2	0.08	19.9	
H15-55	521	521	21.8	21.8	229	229	24.1	24.1				3		36.4	
H15-56	492	492	33.4	33.4	76	76	18.6	18.6				5		2.74	
H14-85	484	484	29.6	29.6	391	391	41.7	41.7	0.05	0.25	0.8	4	0.05	23.9	
H14-123	2090	2090	26.1	26.1	229	229	20.7	20.7	0.05	0.25	0.8	1	0.13	0.90	
H14-124	1580	1580	22.3	22.3	228	228	23.2	23.2	0.05	0.25	0.5	2	0.1	0.67	
H14-125	502	502	18.2	18.2	160	160	12.5	12.5	0.05	0.25	0.5	1	0.45	0.18	
H17-24	124.5	124.5	14.7	14.7	272	272	23.8	23.8	<1	<0.5	<0.5	2		2.74	2.74
H17-25	175.5	175.5	21.7	21.7	162	162	12.9	12.9	1	<0.5	<0.5	2		1.49	1.49
H17-26	29.9	29.9	13.4	13.4	173	173	11.3	11.3	1	<0.5	<0.5	2		11.0	11.0
H17-27	168	168	20	20	179	179	12	12	<1	<0.5	<0.5	2		0.28	0.28
H17-28	261	261	23.2	23.2	198	198	13.4	13.4	<1	<0.5	<0.5	2		1.13	1.13
H17-112	118	118	22.0	22.0	444	444	24.37	24.374	10	<0.5	1.2	3		9.21	9.21
H18-7	1732	1732	24.9	24.9	182	182	16.51	16.505	<1	<0.5	0.9	2		5.95	5.95
H18-10	106	106	24.1	24.1	398	398	31.81	31.815	2	<0.5	1.0	2		18.2	18.2
H18-28	190	190	30.3	30.3	210	210	18.81	18.809	<1	<0.5	0.5	1		3.94	3.94
H18-29	113	113	30.7	30.7	396	396	29.68	29.677	2	<0.5	1.0	2		10.2	10.2
H18-31	232	232	22.8	22.8	347	347	25.75	25.752	2	<0.5	<0.5	2		3.33	3.33
H18-34	833	833	36.2	36.2	316	316	29.53	29.529	<1	<0.5	0.5	2		4.77	4.77

Table 1. Chemical analyses of igneous rocks, Pequop Mountains Study Area

Sample Number	Ba	Ba icp	Hf	Ta	W	Hg	Tl	Pb	Pb icp	Bi	Th	Th icp	U	U icp	La xrf	Ce xrf
Volcanic Rocks[b]																
H14-68	2600		3.4	0.5	1	0.003	0.02	23		0.01	9.29		3.32			
H14-70	1390		3.3	0.7	1	0.006	0.12	23		0.04	11.05		4.31			
H14-71	965		2.6	0.3	1	0.005	0.01	12		0.02	4.3		1.54			
H14-72	1570		3.9	0.5	2	0.018	0.03	15		0.02	10.55		2.66			
H14-73	1005		3.5	0.4	1	0.005	0.03	19		0.02	7.61		1.87			
H14-126	1320		3.9	0.5	1	2.480	0.01	19		0.01	9.51		2.28			
H14-127	1235		3.8	0.6	1	0.066	0.02	18		0.01	10.05		3.23			
H03-102	535							34			26				36	64
90B13	952															
88T 55	605															
90B3	1043															
90B7B	711															
90B9B	773															
H05-38	797							17			21				42	72
90B10	1146															
H03-101	1642							24			18				46	76
88T 56	1974															
90B6	2110															
90B11	2550															
Intrusive Rocks																
H14-89	1160		2.1	1.6	1	0.006	0.1	26		0.18	7.05		3.94			
H14-86	1465		2.2	1.6	1	0.005	0.09	35		0.3	7.4		4.17			
H14-90	1315		2.2	1.7	1	0.003	0.09	31		0.05	6.86		4.12			
H14-91	1250		2	1.5	1	0.011	0.1	28		0.03	7.04		3.64			
R17-6	1140	1140	1.8	1.5	2		10	22	22		7.32	7.32	3.82	3.82		
H18-25	1088.8	1088.8	2.0	1.4	1		<10	17	17	0	7.561	0	4.07	0		
H18-26	1236.1	1236.1	2.1	1.7	1		<10	15	15	0	7.457	0	4.044	0		
H14-87	41		2.3	51.1	3	0.003	0.1	5		0.16	1.95		4.27			
H14-88	34		3.3	6.7	2	0.012	0.07	16		0.01	0.55		2.87			
H15-54	2260		3.1	42.1	2						2.02		6.39			
H17-23	20.7	20.7	3.5	26.8	1		<10	21	21		0.63	0.63	11.9	11.9		
H18-23	75.6	75.6	1.7	23.4	1		10	50	50		2.047	2.0	1.752	1.752		
H18-40	23.9	23.9	3.9	86.6	1		10	29	29		3.392	3.4	4.968	4.968		
H14-82	934		4.5	1.4	1	0.005	0.11	16		0.1	14.2		3.68			
H14-84	1132.2	1132.2	4.4	1.6	2		10	25	25		14.62	14.6	4.58	4.58		
H17-30	831	831	6.9	1.3	3		<10	9	9		16.45	16.45	4.11	4.11		
H18-6	2102.2	2102.2	8.0	2.2	2		<10	2	2		16.9	16.9	4.452	4.452		
H18-9	1372.4	1372.4	4.4	1.5	2		<10	19	19		15.6	15.6	4.442	4.442		
H18-30	746.7	746.7	4.9	1.5	2		<10	19	19		14.89	14.9	3.908	3.908		
H18-32	986.13	986.13	4.7	1.4	14		<10	4	4		16.55	16.6	3.908	3.908		
H17-39	894	894	2.8	1.6	2		<10	8	8		10.2	10.2	3.18	3.18		
R17-34	1115	1115	4.4	1.5	2		<10	3	3		16.4	16.4	2.63	2.63		
CLC012-01 670	787	787	4.4	1.6	2						15.9	15.9	2.42	2.42		
AZ7-16-18(2)	443	443	7.0	1.7	2		<10	12	12		16.87	16.9	4.11	4.11		
H09-93B	472							7			6		3		31	65
H14-64	444		4	0.7	0.5	0.003	0.03	2		0.03	5.66		1.58			
H14-83	133		4.1	1.2	5	0.006	0.25	1		0.72	6.71		2.61			
H15-55	632		5.3	1	2						8.17		2.67			
H15-56	1135		2.1	0.7	2						11.8		7.59			
H14-85	493		9.6	2.2	3	0.003	0.43	18		0.24	13.75		4.46			
H14-123	4750		5.3	1.2	1	1.095	0.04	3		0.06	13.25		3.36			
H14-124	1960		6.1	1.4	1	0.305	0.02	20		0.03	19.1		4.58			
H14-125	262		3.9	0.7	0.5	0.110	0.01	8		0.05	8.34		1.63			
H17-24	482	482	6.1	1.3	1		<10	<2	<2		10.5	10.5	3.03	3.03		
H17-25	561	561	3.6	0.7	1		10	<2	<2		8.84	8.84	1.72	1.72		
H17-26	253	253	4.1	0.6	4		10	2	2		6.2	6.2	2.21	2.21		
H17-27	22	22	3.6	0.6	<1		<10	3	3		3.17	3.17	0.78	0.78		
H17-28	252	252	4.1	0.7	<1		10	<2	<2		3.52	3.52	0.9	0.9		
H17-112	>10000	>10000	11.3	1.5	19		22	3	3		12.13	12.1	9.031	9.031		
H18-7	1767.7	1767.7	4.5	0.7	1		10	9	9		24.55	24.6	5.115	5.115		
H18-10	771.5	771.5	9.8	1.5	23		<10	<2	<2		22.21	22.2	6.227	6.227		
H18-28	800.17	800.17	4.6	0.8	11		10	<2	<2		7.378	7.4	2.993	2.993		
H18-29	1218.2	1218.2	10.2	1.5	5		<10	<2	<2		21.59	21.6	5.947	5.947		
H18-31	1266.6	1266.6	8.2	1.6	2		<10	2	2		22.28	22.3	4.394	4.394		
H18-34	1189.8	1189.8	7.4	1.3	1		<10	8	8		31.69	31.7	7.842	7.842		

Table 1. Chemical analyses of igneous rocks, Pequop Mountains Study Area

Sample Number	Nd xrf	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
Volcanic Rocks[b]															
H14-68		26.7	49.4	5.53	20.6	4.08	0.91	2.89	0.39	2.22	0.45	1.23	0.19	1.29	0.20
H14-70		29.4	52.4	5.52	18.9	3.32	0.84	2.64	0.37	1.98	0.40	1.13	0.15	1.09	0.17
H14-71		19.0	32.3	3.65	13.2	2.65	0.67	2.02	0.31	1.71	0.35	0.94	0.13	1.03	0.13
H14-72		30.6	55.5	5.89	21.7	3.94	0.99	3.07	0.46	2.49	0.48	1.36	0.19	1.38	0.17
H14-73		25.0	47.0	5.21	19.4	3.72	0.96	3.27	0.50	2.95	0.63	1.64	0.25	1.70	0.26
H14-126		28.8	52.7	5.84	21.9	4.49	1.16	3.93	0.58	3.65	0.72	2.09	0.32	2.00	0.30
H14-127		32.1	59.2	6.83	24.8	4.7	1.08	3.47	0.50	2.73	0.56	1.49	0.20	1.37	0.22
H03-102	22	36	64		22										
90B13															
88T 55															
90B3															
90B7B															
90B9B															
H05-38	23	42	72		23										
90B10															
H03-101	32	46	76		32										
88T 56															
90B6															
90B11															
Intrusive Rocks															
H14-89		12.8	22.9	2.48	8.7	2.33	0.56	2.17	0.37	2.20	0.40	1.14	0.18	1.17	0.17
H14-86		13.4	24.6	2.7	10	2.49	0.51	2.44	0.38	2.30	0.43	1.17	0.19	1.27	0.18
H14-90		11.2	21.1	2.4	8.8	2.54	0.45	2.47	0.40	2.20	0.42	1.18	0.18	1.09	0.16
H14-91		12.5	23.0	2.53	9.4	2.44	0.47	2.25	0.36	2.33	0.39	1.11	0.18	1.09	0.16
R17-6		12.7	23.0	2.53	9.7	2.39	0.54	2.44	0.38	2.29	0.43	1.21	0.16	1.17	0.13
H18-25		12.9	24.0	2.686	9.769	2.381	0.45	2.43	0.49	2.55	0.45	1.22	0.18	1.33	0.17
H18-26		12.4	22.1	2.562	9.208	2.462	0.55	2.14	0.34	2.20	0.42	1.17	0.16	1.01	0.12
H14-87		0.8	1.5	0.16	0.6	0.15	0.04	0.17	0.03	0.24	0.04	0.11	0.01	0.14	0.02
H14-88		0.9	2.0	0.25	1.0	0.36	0.08	0.44	0.09	0.53	0.06	0.21	0.04	0.17	0.01
H15-54		1.7	3.5	0.42	1.6	0.76	0.09	0.67	0.15	0.87	0.12	0.31	0.04	0.30	0.03
H17-23		0.7	1.4	0.22	0.8	0.25	0.05	0.29	0.07	0.34	0.04	0.10	0.02	0.15	0.01
H18-23		2.26	4.63	0.502	1.673	0.561	0.07	0.92	0.19	1.47	0.24	0.60	0.09	0.88	0.12
H18-40		2.69	4.69	0.469	1.297	0.439	0.07	0.23	0.13	0.59	0.15	0.43	0.07	0.47	0.07
H14-82		43.6	75.5	7.6	24.6	4.06	0.88	2.68	0.39	2.18	0.41	1.24	0.18	1.36	0.20
H14-84		50.7	89.5	9.068	29.55	4.62	1.00	3.07	0.38	2.11	0.40	0.91	0.17	0.97	0.15
H17-30		85.4	125.5	16.9	60.2	9.04	2.05	6.68	0.91	5.06	1.02	2.98	0.48	2.95	0.45
H18-6		60.5	119.02	13.86	51.11	8.553	2.21	6.90	0.91	5.06	0.88	2.38	0.34	1.99	0.33
H18-9		44.9	80.1	8.153	27.35	4.117	1.02	2.96	0.42	2.30	0.44	1.18	0.21	1.27	0.18
H18-30		45.4	80.5	8.067	27.29	4.588	1.01	3.24	0.43	2.22	0.41	1.10	0.16	1.45	0.18
H18-32		50.2	89.197	8.96	30.37	5.103	0.87	3.32	0.46	2.39	0.48	1.21	0.19	1.18	0.15
H17-39		33.5	59.8	6.34	22.2	3.7	0.86	2.81	0.37	2.28	0.44	1.28	0.17	1.16	0.18
R17-34		49	85.6	8.63	29.8	4.57	0.85	2.87	0.45	2.35	0.42	1.19	0.18	1.34	0.18
CLC012-01 670		47.4	84.9	8.51	28.6	4.28	0.66	2.69	0.35	1.86	0.36	1.03	0.16	1.10	0.17
AZ7-16-18(2)		54.8	109.42	10.73	39.92	7.301	1.68	5.03	0.63	3.67	0.68	1.95	0.29	1.77	0.31
H09-93B	30	31	65		30										
H14-64		29.7	60.2	6.94	27.5	5.59	1.51	4.46	0.66	3.92	0.71	2.04	0.28	1.85	0.27
H14-83		45.4	89.0	9.93	37.2	6.81	1.44	5.04	0.67	3.39	0.58	1.60	0.21	1.42	0.24
H15-55		51.3	106.5	12.55	50.8	9.3	2.29	6.78	0.88	4.36	0.81	2.02	0.28	1.67	0.26
H15-56		49.7	86.3	11.35	42.3	7.62	1.49	5.77	0.88	5.15	1.02	2.77	0.37	2.48	0.36
H14-85		90.2	184	21.2	80.2	14.55	3.24	10.35	1.37	6.57	1.14	2.88	0.39	2.41	0.32
H14-123		78.4	155.5	17.75	67.9	12.0	2.81	8.25	1.07	5.58	1.02	2.70	0.36	2.42	0.35
H14-124		90.3	174.5	19.4	70.2	12.65	3.03	8.00	1.05	4.93	0.83	2.05	0.30	1.85	0.26
H14-125		48.8	95.6	11.2	42.2	7.73	1.97	5.44	0.74	3.75	0.72	1.88	0.26	1.63	0.25
H17-24		68.3	131.5	14.75	57.6	8.69	0.91	5.76	0.68	3.29	0.59	1.70	0.27	1.91	0.27
H17-25		50	97.4	11.2	44.9	7.75	2.08	5.97	0.82	4.45	0.91	2.25	0.33	2.01	0.33
H17-26		38.6	76.9	8.96	35.5	6.09	0.68	4.10	0.52	2.91	0.57	1.59	0.25	1.65	0.29
H17-27		18.1	40.1	4.98	21	4.55	1.39	4.04	0.67	4.06	0.82	2.50	0.31	2.02	0.29
H17-28		21.6	47.2	5.9	25.1	5.15	1.74	4.90	0.80	4.65	0.95	2.55	0.37	2.32	0.31
H17-112		73.2	140.96	16.29	59.87	9.783	2.11	6.95	0.91	4.85	0.81	2.24	0.33	1.80	0.25
H18-7		121	229.24	25.88	94.65	15.69	3.91	9.59	1.18	5.16	0.89	2.21	0.32	2.10	0.24
H18-10		119	240.88	28.75	108.3	18.35	2.34	11.59	1.43	5.33	1.00	2.45	0.32	1.98	0.28
H18-28		56.2	73.782	13.0	46.56	8.916	1.69	7.93	1.08	6.24	1.13	3.34	0.48	2.82	0.39
H18-29		125	254.04	29.79	116.6	20.15	4.67	14.15	1.50	6.62	1.05	2.66	0.35	1.92	0.25
H18-31		86.8	160.29	16.76	58.65	8.283	2.12	5.91	0.74	3.95	0.79	2.24	0.34	2.10	0.35
H18-34		163	313.68	35.59	129.3	21.15	5.69	14.93	1.73	8.07	1.31	3.24	0.43	2.79	0.31