GEOLOGIC MAP OF THE ANTELOPE PEAK QUADRANGLE, IRON COUNTY, UTAH

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INTRODUCTION

The Antelope Peak quadrangle is situated partly on the north end of the Antelope Range and partly within the Escalante Desert, that lies north of the range. It is northeast of Newcastle and northwest of Cedar City, in Iron County. Elevations range from about 5100 feet (1555 m) near the northwest corner to about 7100 feet (2165 m) along the south border of the quadrangle. The southern part of the quadrangle has exposures of Tertiary volcanic rocks that include the familiar ash-flow tuffs of the region and some local intervening volcanic breccias that separate several of the ash flows. The northern part of the quadrangle has Quaternary sedimentary units that surround one large outcrop of Tertiary volcanics at Table Butte and three small outcrops of a quartz monzonite porphyry pluton southwest of the Butte. The Tertiary volcanics of the southern part of the area were mapped by S. Kerry Grant, and the northern part of the area was mapped by Paul Dean Proctor. Field work took place during the summers of 1980-87, aided by over 350 students attending the field camps of the University of Missouri-Rolla and Southern Utah State College.

The area is within the transition zone between the Basin-and-Range and Colorado Plateau Provinces. Several sub-provinces trend northeasterly in this vicinity, including the Escalante Valley-Escalante Desert depression, the K-T fold and thrust belt, and the zone of mid-Tertiary plutons of the Iron Springs-Bull Valley districts. Each event genetically associated with these sub-provinces may have influenced the features of the quadrangle, but surface evidence does not reveal the effects, if any, of the fold and thrust event.

Previously published work in the quadrangle is limited. The most thorough is the mapping of Leith and Harder (1908) who included the southeast portion of the area in their map of the Iron Springs district. Williams (1967) sampled and described the Leach Canyon Formation at Table Butte, establishing that spot as the type section for one of the members of that formation. Cook and Hardman (1967) collected gravity data within the quad as part of their regional study, establishing the configuration of the Escalante Desert graben system. Unpublished work from the files of United States Steel Corporation has been furnished by J. Keith Hayes, with permission to publish it here. This includes an aeromagnetic survey of the north part of the area, drill hole data near the quadrangle, and some petrographic data on samples of the pluton.

STRATIGRAPHY

The data presented here are from observations on samples taken from both within the quadrangle and from the region outside the quadrangle. Stratigraphic relations are shown on Figure 1. Age dates are not corrected by the new IUGS constants, unless done so by the author cited. Most, if not all, of the tuffs discussed have small amounts of accessory minerals in common, such as apatite, zircon, and opaque oxides. These will not be discussed further, unless the accessory has some uncommon feature worthy of note.

OLIGOCENE AND/OR MIOCENE

Isom Formation

This oldest of the rocks exposed in the quadrangle is a series of resistant red, brown, and gray densely welded lava-like tuffs with interstratified volcanics that could be true lava flows. Because the formation is exposed only in a small area in the southwest portion of the quad, it was not subdivided into members. Phenocrysts normally constitute 1 to 10 percent of the rock, but may reach 22 percent in flow-like units. Plagioclase is the dominant component, with accessory orthopyroxene and less common clinopyroxene. The orthopyroxene is always altered in the tuffs of the Isom Formation, to a fibrous product that could be serpentine or amphibole. Only in the most flow-like members could the orthopyroxene be seen in an unaltered state, evidently because deuteric vapors were not active in that environment. The absense of biotite sets the Isom apart from other tuffs with which it might otherwise be confused. The only biotite seen microscopically is rare and has a late, post-eruptive origin in a deuteric event that formed quartz and other vapor phase minerals in vesicles or lenses that parallel the compaction foliation. This biotite is fine-grained and ragged, and would not be confused with primary biotite megascopically. The welded tuffs have long thin lenticles with length/width ratios of up to 10. Lengths may reach 1 foot (30 cm).

The Isom volcanics are flow-folded and flow-lineated. The tuffs must have been mobilized after or during emplacement, due to their high temperature and low viscosity. Flow vectors interpreted from elongated vesicles show a dominant NW-SE trend in the region. A SE sense would agree with a suggested source area to the northwest of the Antelope Range. Outside the area, several thin units make up the formation. In and near this quadrangle the units are much thicker than normal. The Isom is about 800 feet (244 m) thick just south of the quadrangle, where it forms the north wall of Chloride Canyon. Within that section, an unusual, thick massive aphyric unit is of possible lava-flow origin. The Isom age is 25-26 Ma (Armstrong, 1970; Fleck, et al., 1975).

MIOCENE

Quartz Monzonite Porphyry of Lookout Point

Three small areas of plutonic rock crop out in the northwest part of the quadrangle, in parts of Sections 12, 13, 14, and 24, T34S, R15W. The largest outcrop area is in Sections 12 and 13, where bedrock projects above the Lake Bonneville-age sediments about 40 feet (12 m) (informally termed Lookout Point) and covers an area of approximately 115 acres. A smaller outcrop zone lies WSW about 400 feet (122 m). It also makes an island-like mass in the silts of Lake Bonneville-age. The smallest of the plutonic outcrop areas lies 7000 feet (2134 m) south of the main area in the NW quarter of Section 24. The rock is identical in appearance and rises about 15 feet (5 m) above the surrounding lake sediments and wind-blown sands.

A company report (J. Keith Hayes, Personal communication) describes three thin sections of the rock type(s) exposed in Sections 12 and 13 as "holocrystalline porphyritic with 35-40% phenocrysts of andesine feldspar, biotite, and lesser hornblende, quartz, and augite, to 3 mm, in a .02-.03 mm groundmass of andesine, biotite, orthoclase, hornblende and augite, making up 60-65% of the thin section". Accessory minerals include magnetite, apatite and zircon. An inclusion of medium-grained monzonite was sighted in one thin section. The petrographer concludes the rock is a quartz latite porphyry. For these three thin sections, exact source of the rock samples is not indicated.

The current study of samples from each of the three outcrop areas indicates the following mineral and chemical composition. The rock is resistant light gray to light yellow-, orange-, green-, and medium purple-gray porphyry, with xenoliths of medium orange-gray to medium yellow-gray aphyric rock. The porphyry has 35-40 percent phenocrysts of mainly plagioclase, biotite, and hornblende, with lesser quartz and clinopyroxene. The quartz is partially resorbed, and the biotite and hornblende have recrystallized in part through dehydration reactions. Biotite has reacted in its outer portions to a feldspar and opaque oxide. Hornblende has completely reacted to a feldspar, pyroxene, opaque oxide, and pale mica. Groundmass seems entirely crystallized to size of .02-.04 mm. Figure 2 shows the position of the pluton relative to the chemical averages of worldwide volcanic rocks (and their plutonic equivalents). The Lookout Point pluton is actually closer to monzonite (latite) or granodiorite (rhyodacite) than quartz monzonite (quartz latite), but the latter name is retained due to common usage. Plutons of the Iron Springs district, as reported in Mackin (1968), have a little less silica and alkalies than the Lookout Point body, except for the selvage joint phase at Iron Springs, which plots within the circle representing the Lookout Point average.

Xenoliths may be fragments of early crystallized material from the magma that formed the porphyry. They are 15-30 cm across and have a rounded shape. The xenoliths have a plagioclase about .25 mm that forms the matrix in which the other phases are distributed. These include dehydrated hornblende, primary clinopyroxene, partially dehydrated biotite, and large plagioclase, all in the .5-3.0 mm range. Apatite needles are prolific in the xenoliths. Between the small plagioclase crystals in the matrix are bladed intergrowths of felsic minerals, blades about 1 micron.

Portions of the pluton have been fractured and invaded by dikes of the same overall texture and composition, about 3 cm wide. Host phenocrysts have been cleanly terminated by the fracturing, and dike phenocrysts tend to align parallel to the walls of the dikes.

The visible portion of the Lookout Point pluton may represent an extrusive phase located above the intrusive portion. Its characteristics are very similar to known plutons nearby (Rowley and Barker, 1978), but there are some differences. Quartz is not an important phenocryst in the nearby plutons, whereas it does appear in all samples at Lookout Point, albeit in the process of being destroyed by resorption. In addition, the groundmass at Lookout Point is finer grained, .03 mm versus .05-.15 mm.

The dehydration reactions evident at Lookout Point involving biotite and hornblende seem to be part of the ore forming process that took place within the plutons in the nearby Iron Springs district. The plutons appear to have been in the ideal environment to first allow the dehydration reactions to occur and then to maintain the reactions over the time interval needed for near completion. An important part of this environment may have been slow leakage of magmatic waters through a fractured roof. This environment could have also allowed part of the magma to escape the chamber.

The uniform lithology of the three exposed rock masses closely resembles that of the intrusives of the Iron Springs district to the east. Chemical content is also very similar. An undulatory structure marked by a darkened band in the main outcrop is of like appearance to a "swirly" band at the base of the selvage zone of the Three Peaks intrusive. The band is only inches (few cm) in thickness, undulatory in character, and appears to underlie a well-jointed phase of the plutonic rock. The general planar character, development of crude alignment of the included minerals in the rock, and its approximately 15 degrees inclination to the west suggests a primary zone of flowage in the once molten rock mass and later crystallization and preservation of this primary structure. While not clearly exposed, because of limited outcrop availability, the banded zone does appear to underlie the well jointed outcrops to the north, west, and possibly in the south outcrop zone.

At least four sets of joints crop out in the rock mass. A well developed northeastward, steeply northward dipping, set tends to parallel the outcrop zones of the northern rock masses. These cut and are cut by northwesterly set of steeply dipping joints. Less abundant are a north bearing set of vertical to steeply west dipping joints and an east-west set of joints of 80 degrees north inclination. The consistency of joint patterns in all three rock areas suggests commonality of rock types and joint genesis.

While an effusive origin can be argued for the rocks of the area, the character of the outcrops, texture of the rock unit, composition, presence of small dikelets within it, the flow zone at or near the base of the joint system, and the general uniform pattern of the magnetic response of the body are strongly indicative of a plutonic mass exposed in a fault block. The rock's restricted distribution (it is not present in nearby volcanic sequences of the same age) is perhaps the strongest argument for a plutonic origin. The overall mass probably occupies 12 square miles of the quadrangle within the west and north portions of the mapped area.

The body has a northeasterly trend and is lobate northward. It apparently invades a gently inclined set of volcanic rocks very similar to those exposed in Table Butte to the north, and those of the Antelope Range to the south. Drill hole data (Personal communication, J. Keith Hayes, 1986) indicates vitrophyres within the volcanic rock sequence, possibly at the base of the Bauers Tuff, may be the cause of some of the magnetic anomalies in the northern half of the quadrangle. The plutonic mass extends westward of the western boundary of the mapped area an unknown distance. A general outline of the buried postulated pluton within the quad is shown on Figure 4. With possible extensions westward, the plutonic body has the dimensions of a stock.

The pluton has been age dated for this study at 22.8 Ma, with a possible error of 0.9 million years (K-Ar, biotite). A disturbance in the Bauers tuff suggests tectonic activity about 22 Ma, which could be attributed to the pluton. This contrasts with previous interpretations that plutonic activity in the Iron Springs district is younger than the Harmony Hills Tuff.

Condor Canyon Formation

In addition to the regional members of this formation, the well-known Swett and Bauers Tuffs, two local breccia units are treated as members in the mapped area. These are volcanic mudflow breccias that appear immediately below and immediately above the Bauers.

Swett Tuff Member - This unit is resistant orange- to purplish-brown densely welded ash-flow tuff with a thin black vitrophyre. Purple tone may be due to alteration of samples found on the west side of the quadrangle, where the effects of mineralizing fluids are the suspected cause. The Swett occurs near Rock Spring, as a dip slope south of Three Peaks, and along the south border of the quadrangle. The tuff is crystal poor, containing about 5-10 percent phenocrysts of mainly plagioclase with lesser biotite and a trace of pyroxene. The vitrophyre is strongly reversely magnetized with effects observable using the hand compass. The tuff is thin, up to 130 feet (40 m), which may account for the lack of devitrification features found in thick sections (cavities filled with chalcedony and calcite, massive top). The Swett was not recognized on Table Butte and is possibly present in some of the poor exposures west of Urie Hollow where only Bauers is mapped. Age is about 23 Ma

(Armstrong, 1970).

Lower Breccia Member - This is a non-resistant volcanic mudflow breccia with possible lava flows. Clasts are of dark andesite to latite, some more than 3 feet (.9 m) in diameter (see Figure 2, illustrating chemical composition). Clasts in this and the two younger breccias have one of a variety of compositions and/or phenocryst suites. No attempt was made to correlate each breccia by its clast types. A single type obviously occurs in more than one breccia unit. Thickness is variable, ranging up to about 330 feet (100 m).

Bauers Tuff Member - This unit is resistant mottled orange-brown or orange-pink and medium gray or purplish-gray densely welded ash-flow tuff. Where unaffected by alteration or rheomorphic flow, has a basal vitrophyre of black or red and black glass. Vitrophyre is not observed where the tuff has been modified. Instead, the base of the tuff often shows gray thin, elongate "running pumice" in a medium orange- or purple-brown matrix. The top of the tuff is a massive white to shades of gray, generally featureless to chalky texture, with visible sanidine and bronze biotite. This top is missing from the type locality, for reasons explained by Mackin (1960), but is consistently present within the quadrangle and is common elsewhere. The Bauers dominates the high ridge west of Urie Hollow, forms the low hills southwest of Antelope Spring, occupies the drainages east of Antelope Peak and in the southeast corner of the quad, and caps the hills at Three Peaks.

Phenocrysts constitute 10-15 percent of the majority of the tuff, decreasing to a few percent in the massive top. Plagioclase and sanidine are the dominant minerals, followed by lesser biotite and traces of hornblende and clinopyroxene. The tuff is zoned in its feldspar proportions, with plagioclase being higher toward the base and sanidine higher toward the top, sometimes to the complete exclusion of plagioclase in the highest positions. This zoning has not been noted by other workers, probably due to their reliance on the incomplete type locality.

The thickness of the Bauers may vary across the quadrangle, due to secondary or late primary processes involving rheomorphic flow which has thickened the tuff to about 660 feet (200 m), more than double its normal thickness. Evidence of flow includes observable flow folds with 50-100 feet (15-30 m) of amplitude, chaotic dips on the foliation surfaces, and development of pale toned lense-like features elongate along the bedding planes. These look like pumice lenses, but are much larger (to 6 feet (1.8 m) in diameter by 1 foot (30 cm) thick) and discernably include true pumice blocks within their borders. The flow processes are more obvious in the west side of the area, and the flow direction seems to have been to the north, toward the present average dip direction. Axes of flow folds often trend east-west, as do lineation streaks defined by color and texture of the foliation surfaces. It is puzzling as to why, if the process of rheomorphic flow was primary and down a steep paleoslope, the other tuffs do not reflect this topographic relief. A possible answer to this question would involve an intrusion that may underlie part of the Antelope Range. It may have been structurally active over a period of time, featuring alternating uplift and collapse of the roof zone. The Bauers may have been emplaced shortly before a time of uplift, with a later collapse leveling the area before deposition of the next tuff. The bed of brecciated Bauers present within the Upper Breccia Member could be a symptom of the collapse phase.

The age of the Bauers is about 22 Ma (Armstrong, 1970).

Upper Breccia Member - This is non-resistant volcanic mudflow breccia and minor lava flows. Clasts and flows are dark andesite to latite, with the clasts reaching 13 feet (4 m) and the flow exposures covering areas larger than 100 feet (30 m) on a side. One prominant bed, about 33 feet (10 m) thick, in the upper half of the section is composed entirely of Bauers tuff fragments, up to 1 foot (30 cm) across. This bed of breccia is present throughout the quadrangle. It is like the landslide breccias found in caldera settings, with subtle monolithologic clasts. As shown in thin section, the process was coherent because individual grains are broken and drawn out into trains of fragments. In some parts of this bed, the clasts are separated but have uniform attitudes. The healing process left the matrix as firm as the clasts.

The member is of variable thickness, 0-200 feet (0-60 m). In the southwest part of the area, it seems to be entirely missing in places.

Harmony Hills Tuff

This is moderately resistant brown to light-pinkish-gray moderately welded ash-flow tuff, purplish where altered. The base and top of the unit are lighter colored than the middle. This tuff forms the east wall of Urie Hollow and dominates the lowlands around Antelope Peak and the other prominant exposures of Racer Canyon Tuff. The tuff is crystal rich, having 40-45 percent phenocrysts of mainly plagioclase and biotite, with lesser hornblende, quartz, and clinopyroxene. Rare boulder-size inclusions of dark andesite are found near the base, along with cobble-size inclusions of rock with phenocrysts similar to the tuff but with crystallized groundmass (.25 mm).

The Harmony Hills is 200-300 feet (60-90 m) thick. The age is about 21 Ma (Armstrong, 1970).

Volcanic Conglomerate and Breccia

This unit is non-resistant conglomerate and breccia composed of rounded and angular clasts .3-3 feet (10-90 cm) across of dark andesite to latite and of the Harmony Hills Tuff. Thickness is about 100 feet (30 m).

Racer Canyon Tuff

This unit is moderately resistant, very pale pinkish-gray to orange-pink, poorly welded ash-flow tuff with abundant dark volcanic lithic fragments, containing biotite or hornblende, up to 3 inches (8 cm) across. A lower massive phase forms ledges beneath an upper craggy cavernous-weathering slope former. At the base of the lower phase, a 1-6 foot (.3-1.8 m) bed of slabby coarse volcanic sandstone to pebble conglomerate is present in some places. A significant but rarely seen bed of tuff near the base contains baseball-size nodules with composition like the rest of the tuff. This layer is also present at the type locality south of Enterprise, Utah, allowing precise correlation between the areas. The lower tuff in the Antelope Range correlates with the "upper" portion of the tuff at the type locality, as observed on the road from Enterprise Reservoir to Veyo. The upper tuff in the Antelope Range matches the tuff below the nodule bed in Racer Canyon, so the stratigraphic sequence appears reversed between the two areas. Rock sequence interpretations at the type locality are tentative due to faulting that has disrupted the stratigraphic sequence there. In the Antelope Range, the Racer Canyon forms some of the higher peaks, such as Antelope Peak and the high point east of there, and small exposures in areas dominated by Harmony Hills.

Phenocrysts are 10-25 percent of the rock and consist of mainly quartz, sanidine, and plagioclase, lesser biotite, and traces of hornblende and clinopyroxene. Significant accessories are sphene and allanite. Apatite is sometimes unusually large and may be fractured with brown staining of the fracture surfaces. Variation in plagioclase amounts leads to two limiting populations, one low and the other high in this mineral. This was first recognized by Blank (1959), at the type locality. Although, on the average, plagioclase is smaller and less abundant in the lower unit in the Antelope Hills than in the upper unit, plagioclase also varies within the upper tuff. The existence of two populations that lack precise stratigraphic control can be explained by discrete layers in the magma chamber that were partially mixed during eruption.

Thickness of the Racer Canyon is at least 460 feet (140 m) (lower tuff about 165 feet (50 m)), but the upper parts of the original tuff are no longer present in exposures in the quadrangle, so the thickness could have been much greater. Age of the tuff is approximately 19 Ma (Mackin, 1960; Noble and McKee, 1972).

PLIOCENE(?)

Fanglomerate of Antelope Springs

Sediments of different types and ages cover parts of the volcanic rocks in the mapped area. Best exposures are in the southern half of the quadrangle where fanglomerate in the southeast part covers the northern exposure of the volcanic bedrock. There, a large, apron-like mass of fanglomerate debris covers parts of Sections 2,3,10, and 11. These same sedimentary gravels and sands extend north into the next township where they cover portions of Sections 34, 35, 36, 26, and 25 of R14W. The fanglomerate is made up of finer sandy and pebbly matrix material in which clasts of volcanic boulders, some of which are 10-13 feet (3-4 m) in diameter reside. Boulders of similar size pinkish and gray limestone, coarse quartzite conglomerate and pebble limestone conglomerate are also included in the finer matrix of sands of igneous rock source materials. Individual monolithic sedimentary boulders are 6 feet (2 m) or more in diameter. The great majority of such large clasts occur in the southeast part of the area. The included boulders and cobbles diminish in size northward. At the main east-west road across the quadrangle large clast size approximates 6 inches (15 cm) while north of the road the larger pebbles approximate 3 inches (5.5 cm) in diameter.

Sedimentary boulders, pebbles and sands interlayered and intermixed with the volcanic fanglomerate matrix, tend to increase in volume northward from the Antelope Range in a wedge-like shape. As an example, near the Racer Tuff in Section 10, the sedimentary volume of the fanglomerate is only 5% by count. A mile north it has increased to 10% and consists of quartzite, limestone, and jasperoid boulders. Even further northward as much as 50% of the matrix surrounding volcanic boulder clasts is of sedimentary source. This suggests deeper erosion to the south or southeast has exposed a sedimentary rock section beneath the volcanic rock cover.

Slight color differences and changes in composition and clast size are faintly visible in the field. These appear as fan-like bands in the apron-like mass of the fanglomerate. Near Three Peaks the sedimentary material accumulated against and on the bedrock, and a coalescence of broader color bands from the west occurs in this area. The beds making up the fanglomerate are readily eroded and only loose clasts are visible on the surface. No outcrops have been observed of the original material in the numerous washes which radiate outward across the very large fan-like body, in the west bearing NNW, in the central area bearing NS, and in the east bearing NE, over an area two miles (3.2 km) wide EW and 3.5 miles (5.6 km) long NS. Because of the lack of exposed and indurated fanglomerate sediments and internal structure, accurate thickness determinations are not possible. An assumed 8 degree slope northward could yield a thickness of over 1000 feet (300 m) in the valley area.

QUATERNARY

Less consolidated and younger fan deposits lie along the western flank of the Antelope Range and extend westward into Escalante Valley. Debris flows of an earlier vintage cap ridges in the same area. Pleistocene sediments, mainly of silts, cover areas north of the Antelope Range. They lie on the volcanic rocks in the southwest, plutonic in the northwest, and probably volcanic rocks in the northeast and northwest portions of the quadrangle. The overall Pleistocene sediment cover occupies more than fifty percent of the total area mapped. Faintly developed stream channels in the lake sediments, and more conspicuously present in bedrock to the south, are partly filled with sands and gravels of even younger age. Wind blown sands and silts of linear trend cover parts of the western third of the quadrangle.

PLEISTOCENE

Debris Flows(?)

These are linear masses of rounded to angular unconsolidated blocks and boulders over 10 feet (3 m) in diameter, with little or no matrix visible, and cap ridges in the southcentral and northern parts of Section 18, T35S, R14W. Unmapped remnants of these flows are sporadically present on the top of the long NS ridge west of Urie Hollow. The mapped zones are from 1640 feet (500 M) to about 2300 feet (700 m) in length and from 330 feet (100 m) to 500 feet (150 m) in width. The internal structure, composition, and stratigraphic position on ridges suggests debris flows from volcanic units, which now occur as inverted valleys.

The debris is composed of Harmony Hills, Bauers, and Racer Canyon clasts. One mass located south of Rock Spring has stratified debris, with a bed of Harmony Hills clasts lying beneath Bauers clasts. On its east side, this same slide has rafts of solid Bauers more than 100 feet (30 m) across, tilted upstream. The thickest flow is 200 feet (60 m) thick.

HOLOCENE TO PLEISTOCENE

Older Fan Deposits

Gravels, sands, and some silt occur in fan-like masses along the western portion of the Antelope Range. Clast size ranges from 3 feet (1 m) nearest the mouth of the canyons to less than 2 inches (5 cm) in diameter along the road, the rock sizes fining westward down the slope of the fans.

This is the older of at least two ages of fan-like deposits. This older set lies closer to the mountain front and extends into some of the major valleys. A well developed fault scarp cuts these sediments and is visible for almost 3.5 miles (5.6 km) along the mountain front. The west block appears to have moved downward relative to the east block. The older fan deposits consist essentially of the eroded volcanic rocks exposed directly east of the mountain front.

Talus Deposits

Talus from the bedrock of Table Butte occurs in scree-like and fan-like deposits surrounding that feature. Blocks to 10 feet (3 m) or more are found near the source. These fine outward to pebble and pebble-silt deposits.

Older Lake(?) Deposits

These are high-level Lake Bonneville-age sediments. An unusual accumulation of silts and pebbly silts is exposed in the northeast quarter of the quadrangle. These extend from the eastern border of the mapped area in that quarter westward to almost the road fronting the eastern part of Table Butte. Relief on the sediments does not exceed 30 feet (9 m). Small closed basins containing silts and clays are surrounded by low-lying ridges of silt and pebbly silt, as in the northeast quarter of Section 9 and north half of Section 10. Isolated ridges and hills are also present and are of pebbly silt composition.

Younger Lake(?) Deposits

These deposits occupy the western half of the map area, west and south of Table Butte. They are mainly silts of tannish-gray hue, at or below 5140 feet (1567 m) elevation. These Lake Bonneville-age silt deposits are up to 200 feet (61 m) thick, based on drill hole data.

Lag Deposits

Within the area of the younger lake(?) deposits are linear masses of silt and small pebbles of mixed volcanic rock. The pebbles are less than 1 inch (2.5 cm) in diameter in a silt matrix. Their shape and trend and association with eolian sand deposits suggests that they are lag gravels from wind action.

Dune Deposits

These sand deposits, in the same general area as the lag deposits, are of smaller size and a more widely spread pattern. The sand is streak-like and dune-like in form, deposited on Lake Bonneville-age silts. The trend of these linear masses is controlled by a prevailing southwest wind.

Younger Fan Deposits

The younger fan deposits, composed of sands and pebble to boulder gravels, are deposited across the fault scarp that offsets the older fan deposits. The material composing these fans fines westward toward the valley. Some fans visibly overlie Lake Bonneville-age silts.

Sheet Deposits

Silt, sand, and gravel derived from fan sediments are deposited as sheet-like masses on older unconsolidated sediments. Clasts and sands fine north and northwestward covering Lake Bonneville-age sediments.

Alluvium

These deposits are located in intermittent stream channels. The channels are partly filled with sand and pebble gravel and are cut in older gravels, sands, and silts that are mainly parts of pre-existing fans.

MINERAL AND CHEMICAL COMPOSITIONS OF BEDROCK UNITS

Details of the mineralogy and chemistry of the tuffs and other igneous rocks exposed in the quadrangle are summarized in Figures 2 and 3. Figure 2 displays the rock chemistries through an alkalies-silica plot of averages of fresh specimens. The analyses are from x-ray fluorescence studies of pressed powders, involving matrix factor corrections. For reference purposes, positions of standard rock averages derived and modified from those compiled by LeMaitre (1976) are also included. The Antelope Peak rocks fall into three chemical groups: 1) intermediate (60-66% silica), 2) alkali-rich (rhyolite to trachyte), and 3) alkali-poor (rhyolite). None of the groups fall on the standard rock positions, making the use of such names somewhat misleading. Chemical variability of each rock unit is significant and in the direction of the short arrows. Primary variations from the average are mild, not much larger than one or two diameters of the symbol used to plot the various units. Secondary variations are severe, five diameters or more. These include deuteric and hydrothermal alterations. Strangely, individual unit variations seem to be in the direction of their chemical group elongations, suggesting that between-unit processes are also active within units in each group.

Figure 3 gives details of the phenocryst populations as determined by microscopic analysis. Point counts were made only on total populations, not on individual minerals. In each thin-section, 1000 points were counted, with a spacing of .05 mm. About ten sections were used for each formation. By their abundance, individual minerals were judged to be either major, minor, or trace. Grain sizes of the largest crystal of each species in each section were recorded and averaged. Major minerals typically reached or exceeded 2 mm, minor minerals were usually between 1 and 2 mm, and trace minerals were less than 1 mm. Obviously a correlation exists between size and abundance. Size is an underused factor in correlation studies of ash-flow tuffs. The chemical groups of Figure 2 are evident in the phenocryst populations of Figure 3.

STRUCTURAL GEOLOGY

Exposed Structures

The bedrock units in the south part of the quadrangle are involved in a complex structure that crudely resembles the back of a left-handed mitten, with the thumb on the east. The structure includes many sets of faults as defined by their trend and throw. Strata dip northerly, between northwest and northeast, with the exception of Table Butte, near the mouth of Chloride Canyon, and in the southeast corner of the quad . Two broad arches (or horsts) with an intervening sag (or graben) are recognized. The Bauers Tuff is elevated west of Urie Hollow and at Three Peaks, marking the arches, and the Racer Canyon Tuff is downdropped between Antelope Peak and Three Peaks. Two narrow graben systems run northerly and northwesterly on opposite sides of Antelope Peak. One of these, between Antelope Peak and Antelope Springs mimics the faulted nose of a northwesterly-plunging anticline. A northeast trending arch, better defined just east of the quad, runs near the southeast corner of the quad, causing the dip reversal there (Mackin and Rowley, 1975).

Faults - A Rose diagram was used to reveal and rank the fault sets within the map area. Seven groups were recognized, based on map trends, weighted by fault length. Within each group, more than one set may be present, depending on the number of throw styles observed. The groups are, most important first:

1) N30W. These control the major sag between Three Peaks and Antelope Peak and are part of the minor grabens near Antelope Peak. They seem to be among the youngest of the fault groups. Those that throw down to the SW are about equal in weighted number to those downthrown to the NE.
2) N25E & N40E. A bimodal group considered as one here. The boundary fault on the northwest side of the range is the important representative of this group, which also includes faults within the range. Those downthrown to the NW slightly outweigh those downthrown SE. The lengthy fault in the older fan deposits, crossing the Antelope Road north of Antelope Springs and extending northeast, appears to be confined to an extension of the major northwest-trending sag and also appears to be an offset portion of the range-bounding fault that runs north from Chloride Canyon. If so, group one faults may be younger than those of this group.
3) N10E. These are in and east of Urie Hollow. They are downthrown to the E and are young faults, judged by their lengths and crosscutting character. They also define the west side of the minor graben that lies west of Antelope Peak.
4) N45W. These are scattered throughout the south and west part of the bedrock area and are downthrown both ways.
5) N15W. A scattered and poorly defined group.
6) N80W. This is a single sinuous fault along the south boundary of the quad.
7) N65E. A scattered group, downthrown mainly to the SE.

Age relations, judged from crosscutting relationships, are not clear. There could be overlap in group ages, and this could be due to repetition of fault patterns through time. The position of the quad near several regional tectonic provinces could be the reason for such repetition.

Although fault exposures may show nearly horizontal striae in some places, the major slip is thought to be near the dip of the faults, based on limited length of individual faults and the lack of lateral offset of lines where beds reverse their dip direction.

Joints - Joints were measured in a few parts of the area. The most thorough readings were in the quartz monzonite and in the largest exposure of the Racer Canyon Tuff. Joint sets trend parallel to fault sets, with 77% of the joints falling into one of the seven fault groups mentioned above. There is a NW bias to the joint sets, with 43% falling into either the N30W or the N45W fault groups. This is so because of the location of the joint readings in portions of the area where NW faulting is important. The parallelism of faults and tension joints in map view is to be expected where the faults are of the dip-slip type, reinforcing that interpretation for the bulk of the faults.

Folds - These are commonly present within the Bauers, with individual folds being relatively small scale, as previously described in the section on stratigraphy. These primary folds are interpreted as recording a tectonic event while that tuff was still hot and capable of internal deformation without fracturing.

It is possible that larger-scale secondary folding is responsible for the arches and sags described in the introduction to this section on structure. Since the major arches and sags are at least partly explained by systematic faulting, the extent of any folding that was coeval or predated the faulting is yet to be determined.

Hidden Structures

Magnetic and gravity surveys over parts of the area suggest certain buried features the extent of which are unknown from surface evidence. The aeromagnetic survey of Figure 4 exhibits a texture that may reveal the size and position of the pluton that crops out in the northwest portion of the quadrangle. An estimate of the outline of two separate portions of the plutonic rock is shown on the figure. One of these lies east of Table Butte, and the larger one is southwest of that reference. The interpreted plutonic areas involve broad highs separated by saddles, in contrast to the narrow highs and lows that may be related to volcanic vitrophyres or have other explanations. This pattern is similar to that over the plutons of the Iron Springs district (Blank and Mackin, 1967).

The gravity survey of Cook and Hardman (1967) interpreted the Escalante Desert as a complex graben with a nearly buried central horst. Table Butte and the pluton would be within the horst. The southeast margin of Table Butte horst shows on both surveys as a steep gradient in the contours. The Avon graben, between Table Butte and the Antelope Range, is quite narrow, no more than two miles across, near the center of the quad.

Geologic History

Ash-flow tuffs of Isom and younger ages began erupting 25-26 Ma from source areas west and northwest of the Antelope Range. The first of these was deposited first on the sedimentary Claron Formation. After the Swett tuff of the Condor Canyon Formation was emplaced, the first of two volcanic mudflow sequences was deposited. The source of these andesitic to latitic materials is not known, but lavas of this general type and age are found across the Escalante Desert, to the north. The Bauers Tuff was emplaced over the first mudflow sequence. Before this tuff cooled to stiffness, tectonic activity remobilized this tuff, forming flow folds in its central stratigraphic levels and doubling its thickness. About this time, the quartz monzonite pluton was formed, suggesting that tilting associated with its emplacement was responsible for the primary folding in the Bauers. Later, a second mudflow sequence began to bury the Bauers. Before the mudflows ended, part of the now hardened Bauers was involved in a hot landslide that formed a peculiar breccia bed over the lower part of the second mudflow sequence. More mudflows buried this slide breccia.

Any tilts or elevated areas caused by the Bauers tectonics must have disappeared before the eruption of the Harmony Hills Tuff, about 21 Ma. No angular unconformity or rapid change in thickness of the Harmony Hills is evident. Next formed was a bed of volcanic conglomerate with rounded clasts of some of the older units. The final ash flow, the Racer Canyon Tuff was deposited about 19 Ma.

Erosion and faulting dominated late Tertiary time. Faults cut all of the tuffs, and the stress field probably changed from time to time. Near the end of this time, huge boulders were transported for several miles, probably from the south or southeast. Possible sources for the Claron clasts are located in the Silver Peak or Desert Mound quadrangles. Near the transition to Quaternary time, while the valley bottoms of the western Antelope Range were some 600 feet (183 m) higher than at present, debris flows choked some of these valleys. Somewhat later, after continued erosion, alluvial fans formed on the Tertiary rocks. These early fans were displaced by the last stage of faulting.

During the Pleistocene, silts were deposited in a probable lake, below the current 5180 feet (1580 m) elevation. Later, below 5140 feet (1567 m), more sediments were deposited in a lake setting. After the lake disappeared, wind activity formed sand dunes and left behind residual gravels. Overlapping some of these events, additional alluvial fans, sheet deposits, and talus scree accumulated. The youngest fault scarps were partly eroded and covered by this time. Finally, erosion by modern streams allowed deposition of alluvium in their channels.

ECONOMIC GEOLOGY

No economic deposits are known in the quadrangle, but the potential for future discoveries merits discussion. Prospect pits for silver mineralization are shown on the topographic map, reflecting intense prospecting activity in the Silver Peak quadrangle, to the south. The pluton in the north part of the quadrangle shows microscopic evidence for the same process of iron extraction from the mafic minerals that was responsible for the Iron Springs district. This offers encouragement for those prospecting for iron deposits near the pluton.

Prospects - On the west side of the Antelope Range, north of Chloride Canyon, several prospects are shown. A few others, not shown, were found in the field. Some of these were located on a green portion of the Condor Canyon mudflow breccias. The other pits and shafts are located on calcite veins with overtones of manganese oxides and hematite. No economic metal content is apparent.

Geochemical survey - To test for the presence of anomalous metal concentrations in the quadrangle, a number of stream sediments were collected, processed, and sent to a commercial laboratory for analysis of selected trace elements. Table 1 has the results from the south bedrock area, and Table 2 shows some samples from the area of Quaternary sediments.

Table 1. Geochemical analyses of stream sediments (-80 M), Antelope Peak quadrangle, in ppm.

Sample No.	Field No.	Mo	Cu	Pb	Zn	Ag	Ni	Co	As	U	Th	Sb	Bi	V	La	W*
1	AP57	2	11	26	47	.2	9	5	17	5	7	3	2	42	22	4
2	1aAP85	1	12	35	48	.2	9	4	23	6	8	3	2	33	23	4
3	2AP85	1	12	47	53	.1	10	6	15	5	11	5	2	47	30	2
4	3AP85	1	12	22	48	.1	7	6	10	5	8	2	3	37	30	1
5	1AP85	1	27	78	67	.3	16	14	26	5	9	2	2	83	33	1
6	4AP85	1	23	27	71	.2	17	11	12	5	9	3	2	69	32	1
7	G26	1	15	22	24	.1	11	9	16	3	8	2	2	37	41	2
8	AP55	1	18	17	56	.1	15	9	21	5	9	2	2	70	22	2
9	5AP85	1	18	24	64	.2	21	15	6	5	12	2	2	152	28	1
10	G23	1	12	13	39	.1	12	9	13	2	6	2	2	48	28	2
11	G25	1	11	18	32	.2	9	8	7	2	7	2	2	43	29	2
12	AP54	1	21	18	54	.1	13	8	15	5	8	4	2	50	25	1
13	G27	1	22	48	84	.3	19	24	13	7	5	2	3	122	43	2
14	G15	1	18	38	63	.2	14	16	14	4	4	2	2	84	37	2
15	G22	1	12	14	32	.1	10	9	22	4	6	2	2	46	21	2
16	G24	1	12	22	47	.2	12	14	7	2	7	2	3	72	31	2
17	AP53	2	18	21	53	.1	18	13	6	5	10	4	2	138	21	2
18	G14	1	13	19	34	.1	10	8	10	2	7	2	3	35	25	2
19	G16	1	17	22	35	.4	20	20	7	2	7	2	2	104	34	2
20	G17	1	7	56	24	.9	8	4	13	2	3	2	5	44	14	2
21	G18	1	26	14	57	.2	22	13	7	5	7	2	2	103	26	2
22	G19	1	14	20	45	.2	12	11	11	2	5	2	2	59	27	2
23	G12	1	14	10	28	.1	13	11	2	6	5	2	2	78	26	2
24	AP52	1	12	17	48	.1	12	9	2	5	9	2	2	116	19	2
25	G8	1	11	16	30	.1	12	10	3	2	8	2	2	64	31	2
26	G13	1	18	28	69	.2	15	18	2	4	7	2	2	137	28	2
27	AP51	2	8	9	28	.1	7	4	2	5	5	2	2	52	11	1
28	AP50	2	13	15	48	.1	15	11	2	5	8	2	2	154	18	1
29	AP61	1	60	15	79	.2	17	11	10	5	9	2	2	33	27	1
30	G4	1	18	24	68	.2	13	17	5	2	4	2	2	129	21	2
31	G6	1	8	14	22	.1	8	5	5	2	7	4	2	21	15	2
32	G10	1	22	17	40	.1	16	13	3	2	9	2	2	100	37	2
33	G21	1	15	13	43	.3	18	18	2	3	5	2	2	98	27	2
34	G9	1	24	14	38	.2	18	13	5	2	8	1	2	99	29	2
35	G11	1	11	12	27	.1	10	8	2	2	6	2	2	51	26	2
36	G20	1	14	11	30	.2	11	8	2	3	7	4	2	44	31	2
37	G2	1	23	33	100	.2	15	29	3	4	4	2	2	166	25	2
38	G1	1	12	24	54	.1	11	13	2	2	5	2	2	95	24	2

Mean	1	17	24	48	.2	13	11	9	4	7	2	2	78	27	2
Std. Dev.	.3	9	14	18	.1	4	5	7	2	2	.8	.6	40	7	1
Threshold	2	30	37	100	.4	22	29	26	7	12	3	3	115	40	3

*Partial chemical extraction. Anomalous values underlined.
[Analyses are by ICP method]

Silt samples from the low elevations between the Antelope Range and Table Butte were analyzed as an aid in estimating background values for the area. They were used as a backup to the main technique of population analysis, which estimated the threshold from the 38 samples alone. Table 2 lists the backup samples.

Table 2. Geochemical analyses of silt samples from low elevations, Antelope Peak quadrangle, in ppm.

Sample No.	Field No.	Mo	Cu	Pb	Zn	Ag	Ni	Co	As	U	Th	Sb	Bi	V	La	W*
39	AP56	1	21	18	70	.1	11	6	8	5	7	2	2	31	20	1
40	AP58	1	19	34	54	.2	12	5	9	7	7	2	2	25	16	1
41	AP59	1	7	30	21	.1	6	3	11	8	3	2	2	36	7	1
42	AP60	1	12	13	28	.1	7	3	7	5	4	2	2	23	9	1
43	AP62	1	10	11	36	.1	10	7	7	5	8	2	2	74	14	1
Mean		1	14	21	42	.1	9	5	8	6	6	2	2	38	13	1
Std. Dev.		0	5	10	20	.0	3	2	2	1	2	0	0	21	5	0

The anomalous values from Table 1 are plotted in Figure 5. About two-thirds of the samples have at least one element in anomalous concentrations. Most of the sampled stream channels draining the west flank of the Antelope Range show some anomalous values, particularly Pb and Sb. This is the area of prospects on calcite veins. More anomalies occur east of Urie Hollow, from Antelope Peak northward. Ag, Pb, Bi, and Sb highlight these anomalies. On the east side of the area, V and Mo occur in high concentrations. Anomalous values do not generally correlate with rock type exposed upstream. Exceptions are the western anomalies, where the only Isom and significant Leach Canyon outcrops occur, and the extreme eastern ones, where V and Mo seem to be related to areas of exposure of the Fanglomerate of Antelope Springs.

Correlation coefficients were obtained for the 15 metals in the first 38 samples. Strongest correlations exist between Co and V (.767), Ag and Bi (.722), and Co and Ni (.684). Silver also correlates strongly with lead (.531). Bismuth and lead would seem to be potential pathfinder elements for silver. Antimony, arsenic, and zinc do not correlate with silver.

GEOLOGIC HAZARDS

Obvious hazards are associated with the rugged terrain of the Antelope Range and with periodic torrential rainfall. In areas of steep slopes or strong relief, falling or rolling rock may threaten those below. In stream channels, flash flooding can occur with little advance notice. These threats should not be overlooked simply because they occur sporadically. As is true for the entire region, earthquake activity is to be expected.

An inconvenience, if not a threat, is the tendency for flooding in the lowlands, filling playas and making road travel in these areas a chancy proposition.

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Figure Captions

Figure 1. Stratigraphic relations within the Antelope Peak Quadrangle. Plutonic rock of Condor Canyon age not shown.

Figure 2. Chemical relationships among rocks of the Antelope Peak Quadrangle (open circles). For reference purposes, some average compositions of standard rocks are included in the diagram (black dots), modified after LeMaitre (1976).

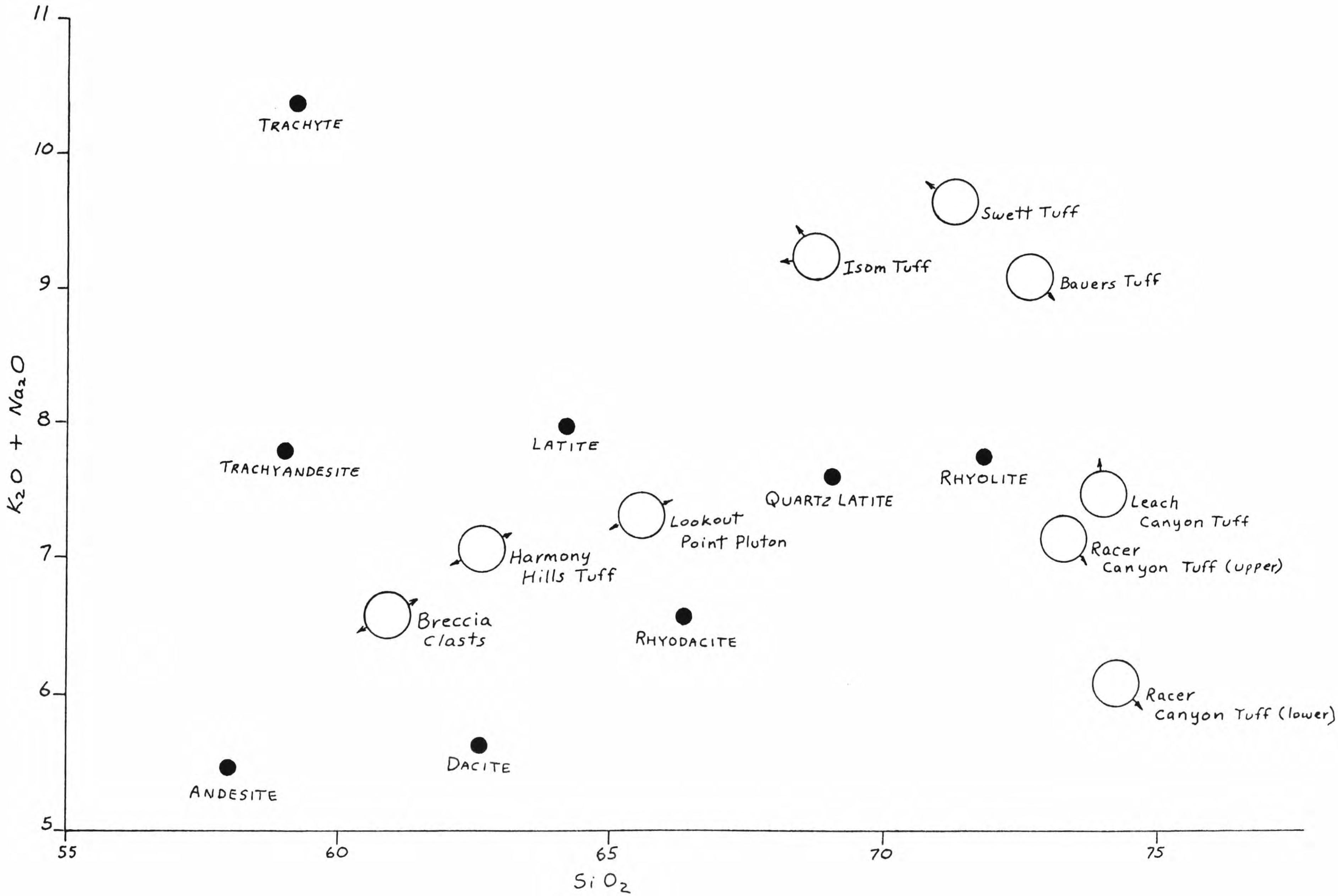
Figure 3. Phenocryst content of rocks of this study. Minerals are judged to be major, minor or trace. Point-count results given only for total crystals. For major minerals, the largest grain in each thin section was measured and averaged over all of the sections for each rock unit.

Figure 4. Aeromagnetic survey of the north part of the Antelope Peak Quadrangle. From U. S. Steel, by permission. Dashed lines within the contoured area outline the proposed margins of the two portions of the plutonic body, only one of which is exposed. Contour interval 10 gammas.

Figure 5. Geochemical stream sediment survey of the southern part of the Antelope Peak Quadrangle. Anomalous values shown by the open circles, with circle size indicative of the number of anomalous metals at each site. Each site is labeled with anomalous metals found there. Samples having no anomalous values are shown by black dots. Section corners indicated by plus signs. Stream valleys are dotted.

Fig. 1

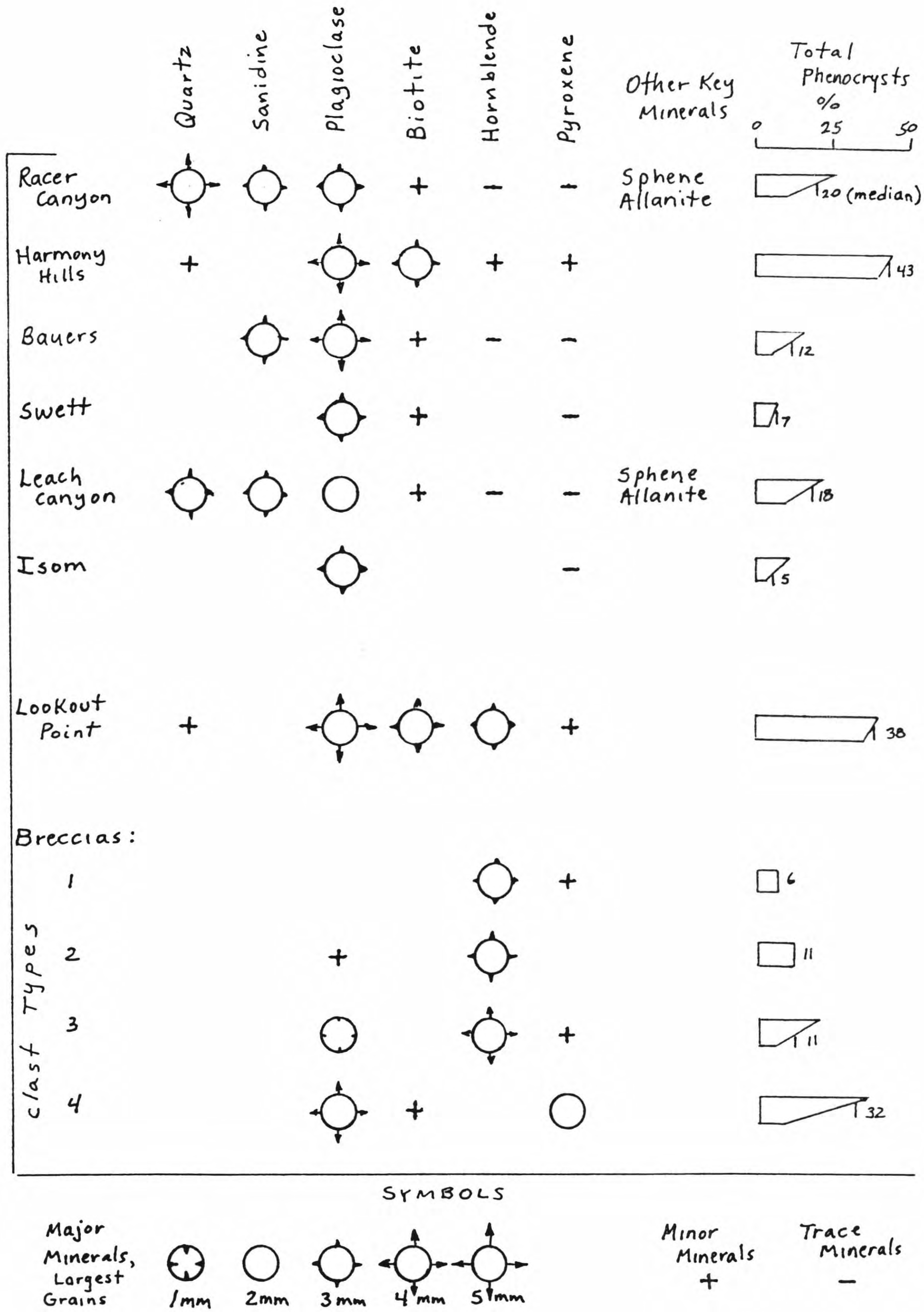
Map Symbol	Formations and Members		Thickness in Feet	Lithology
Qal Qag Qaf1 Qes Qeg Qli Qlg Qcg Qaf2 Qmf	Alluvium Younger Fan Deposits Lag Deposits Older Lake(?) Deposits Older Fan Deposits	Sheet Deposits Dune Deposits Younger Lake(?) Deposits Talus Deposits Debris Flows(?)	Some thin, others at least 200 feet	
Tfg	Fanglomerate of Antelope Springs		1000	
Tr	Racer Canyon Tuff		460 +	
Tv	Volcanic Conglomerate and Breccia		100	
Th	Harmony Hills Tuff		200-300	
Tcu	Condor Canyon Formation	Upper Breccia Member	0-200	
Tcb	Condor Canyon Formation	Bauers Tuff Member	660	
Tcl	Condor Canyon Formation	Lower Breccia Member	330	
Tcs	Condor Canyon Formation	Swett Tuff Member	130	
Tl	Leach Canyon Formation		550 +	
Ti	Isom Formation		800	



11
10
9
8
7
6
5
$K_2O + Na_2O$
55
60
65
70
75
SiO_2
TRACHYTE
TRACHYANDESITE
LATITE
ANDESITE
DACITE
RHYODACITE
QUARTZ LATITE
RHYOLITE
Swett Tuff
Isom Tuff
Bauers Tuff
Lookout Point Pluton
Harmony Hills Tuff
Breccia Clasts
Leach Canyon Tuff
Racer Canyon Tuff (upper)
Racer Canyon Tuff (lower)

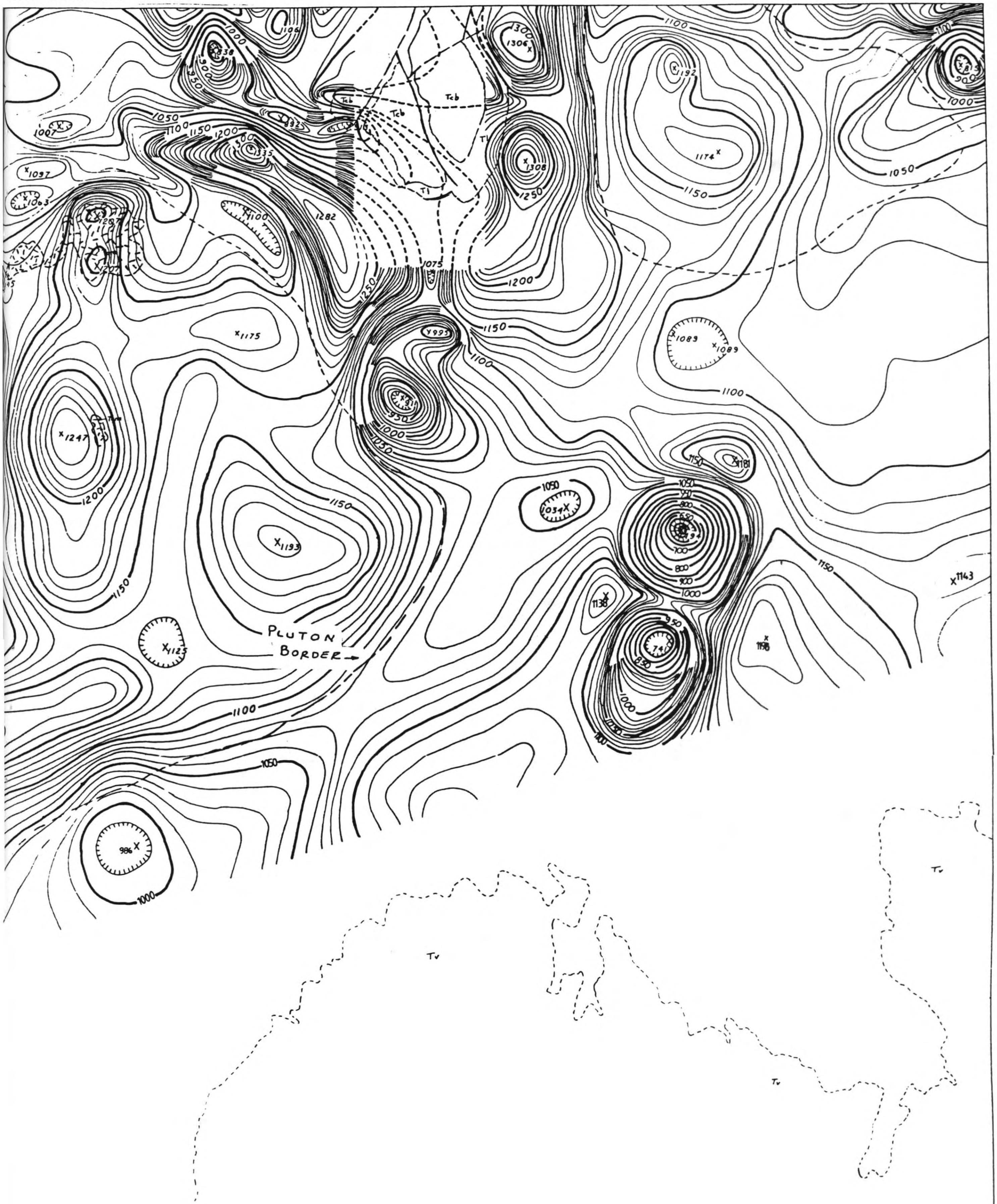
Fig. 2

Fig. 3


Quartz
Sanidine
Plagioclase
Biotite
Hornblende
Pyroxene
Other Key Minerals
Total Phenocrysts %
0
25
50
Racer Canyon
Sphene
Allanite
20 (median)
Harmony Hills
43
Bauers
12
Swett
7
Leach canyon
Sphene
Allanite
18
Isom
5
Lookout Point
38
Breccias:
Clast Types
1
6
2
11
3
11
4
32
SYMBOLS
Major Minerals, Largest Grains
1mm
2mm
3mm
4mm
5mm
Minor Minerals
+
Trace Minerals
−

AEROMAGNETIC SURVEY

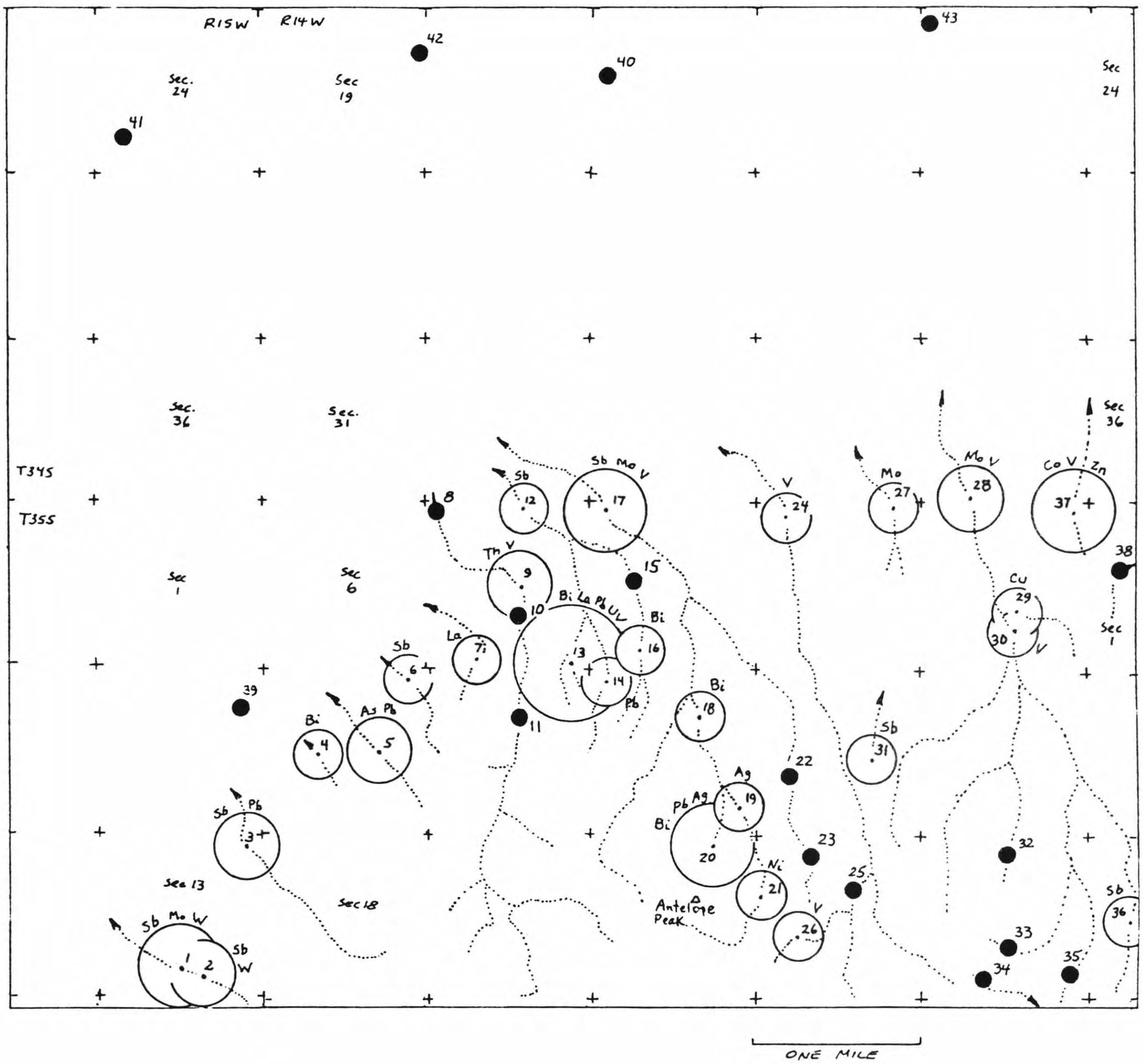
ANTELOPE PEAK QUAD.



AEROMAGNETICS AFTER U.S. STEEL BY PERMISSION

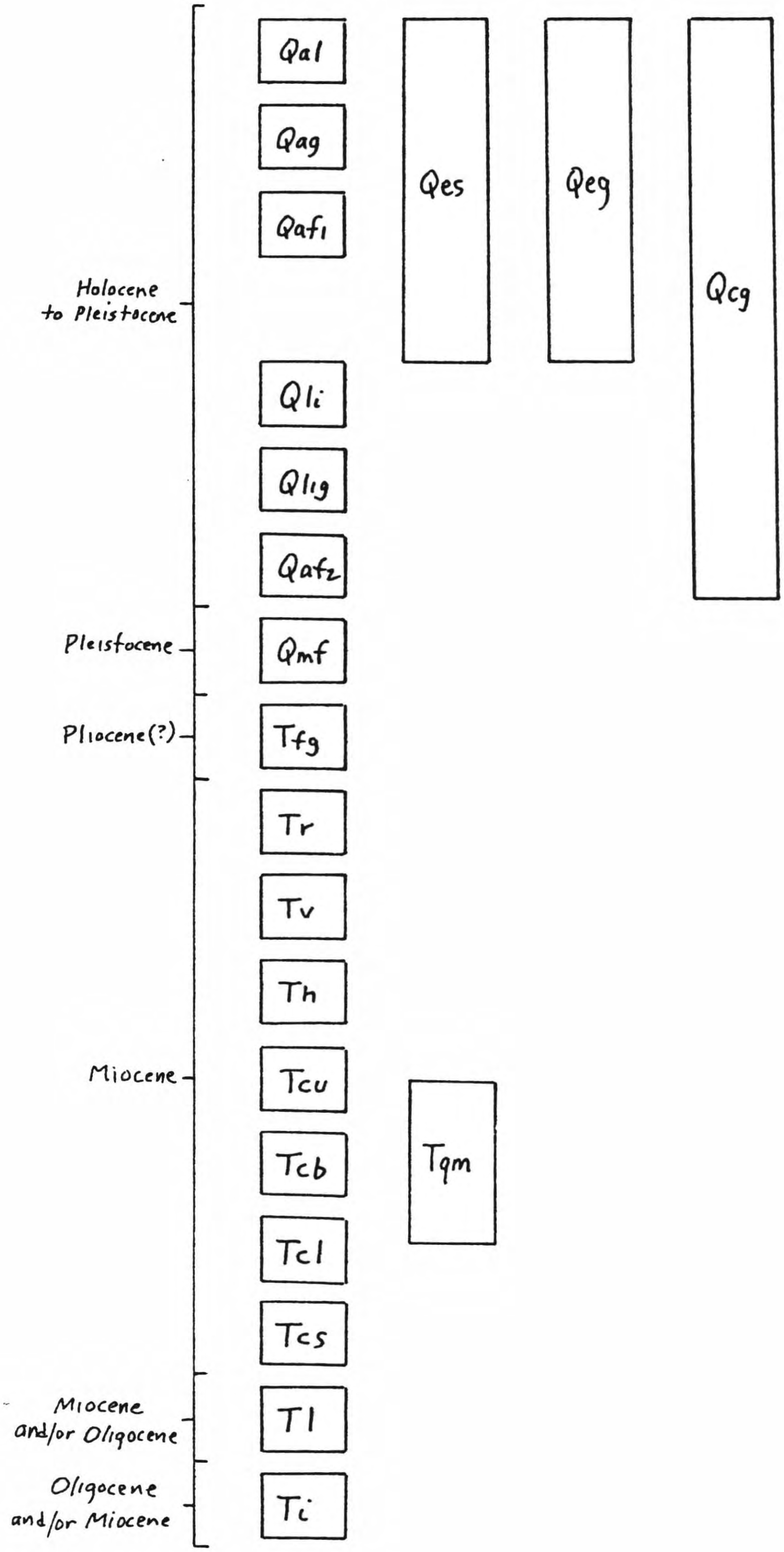
Fig. 4

Fig. 3



R15W
R14W
Sec. 24
Sec 19
Sec 24
Sec. 36
Sec. 31
Sec 36
T34S
T35S
Sec 1
Sec 6
Sec 1
Sec 13
Sec 18
Antelope Peak
ONE MILE

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

Qal ALLUVIUM (HOLOCENE TO PLEISTOCENE) - Sand and pebble gravel deposited in intermittent stream channels cut in older fan gravels, sands, and silts

Qag SHEET DEPOSITS (HOLOCENE TO PLEISTOCENE) - Silts, sand, and gravel derived from older fan sediments and deposited as sheet-like masses on older unconsolidated sediments. Clasts and sands fine north and northwestward covering Lake Bonneville-age sediments

Qaf1 YOUNGER FAN DEPOSITS (HOLOCENE TO PLEISTOCENE) - Sands and pebble to boulder gravels derived from bedrock areas and older fanglomerate deposits, deposited in alluvial fans

Qes DUNE DEPOSITS (HOLOCENE TO PLEISTOCENE) - Sand deposits, streak-like and dune-like in form, deposited on Lake Bonneville-age silts, mainly in the northwestern quarter of map area

Qeg LAG DEPOSITS (HOLOCENE TO PLEISTOCENE) - Silt and small pebbles of mixed volcanic rock of linear trend. Pebbles less than 1" (2.5 cm) in diameter in silt matrix. Deposits occur on Lake Bonneville-age silts, closely associated with eolian sand deposits. Possible lag gravels from wind action

Qli YOUNGER LAKE(?) DEPOSITS (HOLOCENE TO PLEISTOCENE) - Mainly silts of tannish-gray hue, at or below 5140 feet (1567 m) elevation as part of Lake Bonneville-age silt deposits. To 200 feet (61 m) thick

Qlig OLDER LAKE(?) DEPOSITS (HOLOCENE TO PLEISTOCENE) - Silts and pebbly silts in small closed basins and on ridges in northeast part of map area forming irregular topography of low relief. Probable high-level Lake Bonneville-age sediments. Also occurs in southwest quarter of area

Qcg TALUS DEPOSITS (HOLOCENE TO PLEISTOCENE) - Talus of Bauers and Leach Canyon Tuffs in scree-like and fan-like deposits surrounding Table Butte. Blocks to 10 feet (3 m) or more in diameter near source fine outward to pebble and pebble-silt deposits

Qaf2 OLDER FAN DEPOSITS (HOLOCENE TO PLEISTOCENE) - Sands, pebbles and boulders of volcanic bedrock source, western part of Antelope Range. Clasts fine westward

Qmf DEBRIS FLOWS(?) (PLEISTOCENE) - Rounded to angular unconsolidated debris blocks and boulders exceeding 10 feet (3 m) in diameter, matrix not visible, linear in form. Caps ridges which are possible inverted valleys. Probable debris flows from bedrock volcanics

Tfg

FANGLOMERATE OF ANTELOPE SPRINGS (PLIOCENE(?)) - Boulders to 10 feet (3 m) or more in diameter of volcanic units and Claron limestone and conglomerate, in partly consolidated pebble and sand matrix. Matrix mainly of volcanic debris, but sedimentary rock matrix to 50% in band-like deposits across nose of Antelope Range. Thickness as much as 1000 feet (305 m) or more

Tr

RACER CANYON TUFF (MIOCENE) - Moderately resistant very pale pinkish-gray to orange-pink poorly welded ash-flow tuff, with abundant dark volcanic lithic fragments up to 3 inches (8 cm) across. Consists of three phases: an upper cavernous phase forms craggy slopes above a lower massive ledge former, while at the base is a bed of volcanic pebble sandstone and conglomerate. Contains 10-25 percent phenocrysts of mainly quartz, sanidine, and plagioclase, lesser biotite, and traces of hornblende, opaque oxides, and clinopyroxene. Sphene and allanite are significant accessories. Total thickness is at least 460 feet (140 m), but an unknown thickness has been eroded away. The ledge former is about 165 feet (50 m) thick, and the basal bed is 1-6 feet (.3-1.8 m). Age of the tuff is approximately 19 Ma (Mackin, 1960; Noble and McKee, 1972)

Tv

VOLCANIC CONGLOMERATE AND BRECCIA (MIOCENE) - Non-resistant conglomerate and breccia, clasts .3-3 feet (10-90 cm) of latite to dark andesite and of Harmony Hills Tuff. Thickness up to 100 feet (30 m)

Th

HARMONY HILLS TUFF (MIOCENE) - Moderately resistant brown to light pinkish-gray moderately welded ash-flow tuff. Base and top are lighter colored than the middle. Crystal rich with 40-45% phenocrysts of mainly plagioclase and biotite, with lesser hornblende, quartz, clinopyroxene, and opaque oxides. Thickness is 200-300 feet (60-90 m). Age is about 21 Ma (Armstrong, 1970)

Tcu

UPPER BRECCIA MEMBER OF THE CONDOR CANYON FORMATION (MIOCENE) - Non-resistant volcanic mudflow breccia and minor lava flows. Clasts and flows are dark andesite to latite. Clasts reach 13 feet (4 m)in diameter. Includes a resistant bed of brecciated Bauers Tuff with a matrix of the same material, in the upper half of the unit. Thickness is 0-200 feet (0-60 m), with the thinnest portions in the southwest part of the area

Tcb

BAUERS TUFF MEMBER OF THE CONDOR CANYON FORMATION (MIOCENE) - Resistant mottled orange-brown or orange-pink and medium gray or purplish-gray densely welded ash-flow tuff. Basal vitrophyre of black or red and black glass in unaltered areas. Top portion of the tuff is white to gray, massive and chalky, with visible sanidine and bronze biotite. Phenocrysts constitute 10-15% of the main body of tuff, decreasing to a few percent in the massive top. Plagioclase and sanidine are dominant, with lesser biotite and traces of opaque oxides, hornblende, and clinopyroxene. Secondary processes of rheomorphic flow have modified and thickened the tuff within the area. Thicknesses reach 660 feet (200 m), more than double the normal primary thickness. Age is about 22 Ma (Armstrong, 1970)

Tcl

LOWER BRECCIA MEMBER OF THE CONDOR CANYON FORMATION (MIOCENE) - Non-resistant volcanic mudflow breccia and possible lava flows. Latite to dark andesite clasts, some more than 3 feet (.9 m) in diameter. Thickness up to 330 feet (100 m)

Tcs

SWETT TUFF MEMBER OF THE CONDOR CANYON FORMATION (MIOCENE) - Resistant orange to purplish-brown densely welded ash-flow tuff with thin basal vitrophyre. Crystal poor, 5-10% phenocrysts of mainly plagioclase with lesser biotite and traces of opaque oxides and pyroxene. Vitrophyre is strongly reversed magnetized. Thickness up to 130 feet (40 m), but not recognized in the north part of the area. Age is about 23 Ma (Armstrong, 1970)

Tqm

QUARTZ MONZONITE PORPHYRY OF LOOKOUT POINT (MIOCENE) - Resistant gray porphyry with xenoliths and 35-40% phenocrysts of mainly plagioclase, biotite, and hornblende, with lesser quartz, clinopyroxene, and opaque oxides. Groundmass is crystallized to .02-.04 mm size range. Some small dikes, about 1 inch (3 cm) wide, cut the body and are of the same composition. Interpreted to be a pluton consisting of three isolated inliers in Lake Bonneville-age silts, with commonality of aeromagnetic response between and around. Age is 22.8 Ma

Tl

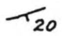
LEACH CANYON FORMATION (MIOCENE AND/OR OLIGOCENE) - Moderately resistant white to salmon gray, poorly to moderately welded ash-flow tuff, with abundant red volcanic lithic fragments to 5 inches (13 cm) in diameter. Phenocrysts of quartz, sanidine, and plagioclase, with lesser biotite and traces of hornblende, opaque oxides, and clinopyroxene comprise 10-20% of the tuff. Sphene and allanite are accessories. At Table Butte, thin lense-like vitrophyre is present in the upper third of the exposure. Thickness is over 550 feet (170 m). Age is about 24 Ma (Armstrong, 1970)

Ti

ISOM FORMATION (OLIGOCENE AND/OR MIOCENE) - Resistant red, brown and gray densely welded lava-like ash-flow tuffs, with interstratified possible lava flows. Only 1-10% phenocrysts of plagioclase, much lesser orthopyroxene and opaques and rare clinopyroxene. Biotite is absent from the primary crystal population. Some tuff is flow folded and lineated. Thickness is about 800 feet (244 m). Age is 25-26 Ma (Armstrong, 1970; Fleck, et al., 1975)


CONTACT

HIGH-ANGLE FAULT - Bar and ball on downthrown side. Dotted where concealed, U and D show throw there



STRIKE AND DIP OF BEDS OR TUFF FOLIATION - ⊕ Horizontal

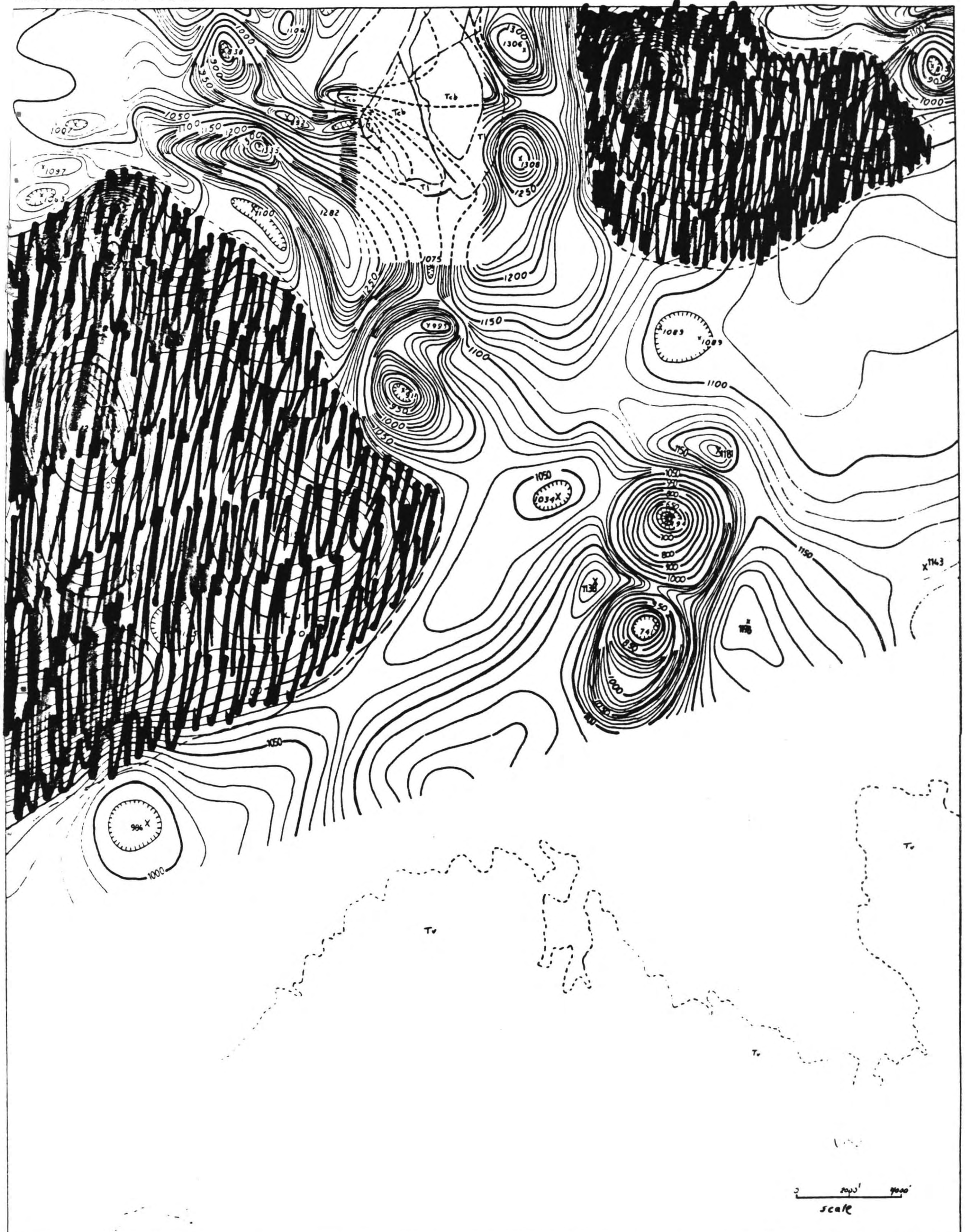
FLOW LAYERING IN LAVA OR PLUTON

vcl 1"
scl ½"
CLAST SIZES IN QUATERNARY UNITS - vcl is volcanic, scl is sedimentary clast

JOINT STRIKE AND DIP

AEROMAGNETIC SURVEY ~~OVERLAY~~

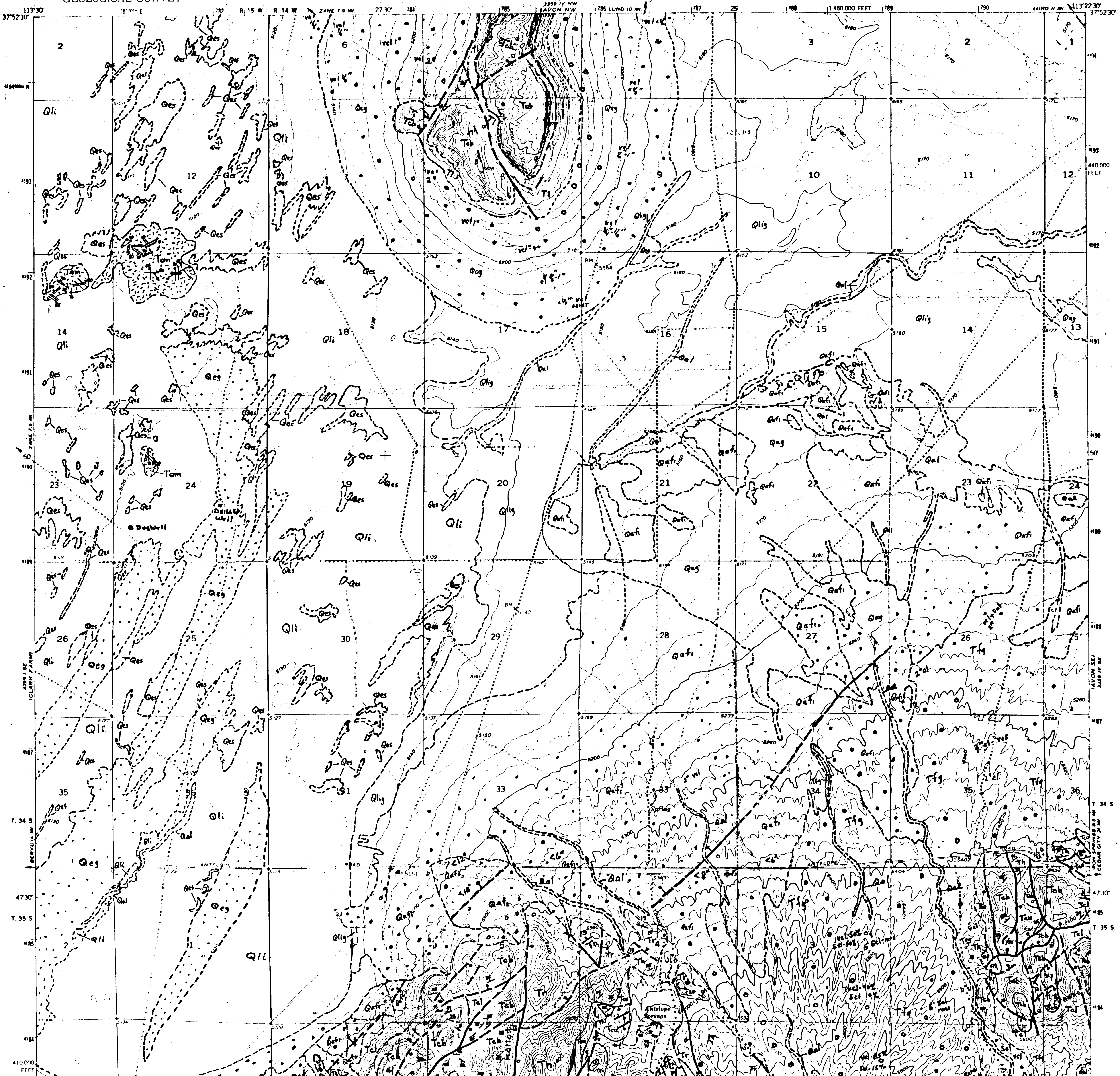
ANTELOPE PEAK QUAD.



UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

FINAL

ANTELOPE PEAK QUADRANGLE
UTAH-IRON CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)



Mapped, edited, and published by the Geological Survey

Control by USGS and NOS/NOAA

Topography from aerial photographs by multiplex methods and by plane table surveys 1950
Aerial photographs taken 1948

Polyconic projection. 1927 North American datum
10,000 foot grid based on Utah coordinate system, south zone
1000 meter Universal Transverse Mercator grid ticks, zone 12, shown in blue

Dashed land lines indicate approximate locations

Revisions shown in purple compiled from aerial photographs taken 1976 and other source data. This information not field checked. Map edited 1978

UTM GRID AND 1978 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

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

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

QUADRANGLE LOCATION

ROAD CLASSIFICATION

Primary highway, hard surface

Light-duty road, hard or improved surface

Secondary highway, hard surface

Unimproved road

Interstate Route

U. S. Route

State Route

ANTELOPE PEAK, UTAH
N3745—W11322.5/7.5

1950
PHOTOREVISED 1978
DMA 3359 IV SW—SERIES V897

Geologic Map of the Antelope Peak Quadrangle
by S. Kerry Grant and Paul Dean Proctor
1988