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The Geology of the Tertiary Rocks of the Central and Southern parts of the Rosita Quadrangle, Colorado

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INTRODUCTION

The area covered by this report excludes the Rosita Hills. The geology of the Rosita Hills will be described in my thesis. Field work occupied June, July and part of August 1964. Geologic features were drawn in the field on aerial photographs at 1 to 10,000 scale. These features were transferred to the base map of 1 to 12,000 scale by means of a Sketchmaster.

Selection of the symbols used on the map has followed the usage recommended by the memorandum on geologic map symbols of the U. S. Geological Survey, January 1964. The foliation symbol is used for the strike and dip of eutaxitic structure in ash-flow tuffs.

The petrologic names used in this report are based on hand-specimen examination. These names are liable to be changed when the petrographic examination of these generally fine-grained rocks is completed.

PETROLOGY

The rock units may be divided into two classes; the stratified units and the intrusive units.

Petrology of the Stratified Units

The stratified units include volcanic rocks and sedimentary rocks. These are discussed in their approximate order of age commencing with the oldest.

VITRIC TUFF T t f

This unit occupies valley floors and lower slopes. It is generally poorly exposed being largely covered by soil. The unit consists of alternating beds of water-laid tuffs, ash-fall tuffs, pumice-flow tuffs and minor conglomerates. The total thickness is approximately 80 feet.

The tuffs are colored very light grey (N 8, colors correspond to the rock color chart, Geological Society of America, 1963)

to yellowish grey (5 Y 8 /1), fine to coarse, mainly vitric but with up to 20 per cent (in volume) crystals of biotite, sanidine and quartz. Some devitrification and argillic alteration has occurred in the water-laid tuffs. Lapilli and small blocks of pumice are found in the water-laid tuffs and their numbers increase in the ash-fall and reach a maximum of 30 per cent of the total volume in the pumice flows. Bedding is sometimes observed in the water-laid and ash-fall tuffs and eutaxitic structure is present in the pumice flow tuffs. Occasional pebbles and cobbles of Precambrian granite and gneiss are found in the water-laid tuffs; accidental small fragments of Precambrian rocks occur in minor amounts in the pyroclastic tuffs. Thin conglomerate lenses containing pebbles, cobbles and boulders of Precambrian rocks with a matrix of tuffaceous sandstone are found mainly in the basal part of the unit.

The most extensive outcrops of this unit surround the Antelope Butte rhyolite dome. It is not known if the dome was the location of the source vent for the vitric tuff unit. Steepening dips within the vitric tuff indicate that the tuffs have been domed by the emplacement of the rhyolite plug.

The vitric tuff appears to occupy depressions in an undulating land surface eroded in Precambrian rocks. In most places the unit is overlain by a trachytic ash-flow tuff (Tt). Outlined areas of the vitric tuff on the geologic map include some vitric tuff which is stratigraphically above the trachytic ash-flow tuff and it is possible that these are tuff intercalations in the volcanic sediment unit (Tvs). To the southwest of Antelope Butte it is believed that deposition of the volcanic sediment unit (Tvs) began earlier, immediately following the vitric tuff so that the trachytic ash-flow tuff lies within the volcanic sediment unit.

Two quarry faces southwest of Antelope Butte have exposed the following sections of the vitric tuff unit:

Litterell Ranch Section:

Trachyte ash-flow tuff (Tt)

sharp contact

Fine to coarse vitric and crystal tuff with a few pumice lapilli; structureless, water-laid. 10 feet

gradational contact

Fine to coarse vitric and crystal tuff with pumice lapilli and blocks; ash-fall.	10 feet
contact not expos	
Coarse vitric and crystal tuff with many pumice lapilli and blocks; nonwelded, prominent eutaxitic structure, occasional small accidental Precambrian rock fragments, pumice flow	15 feet
base not exposed	

Schultz Quarry Section:

eroded	
Alternating beds of fine to coarse vitric water-laid vitric tuffs with pebble conglomerates composed of Precambrian rocks.	12 feet
sharp contact	
Coarse vitric tuff, ash-fall	6 feet
sharp contact	
Tuffaceous sandstone with occasional Precambrian rock pebbles	2 feet
sharp contact	
Fine to coarse vitric tuff with pumice lapilli and blocks with occasional accidental Precambrian rock fragments	20 feet
base not exposed	

The vitric tuff unit is probably correlative with the Devils Hole Formation. The Devils Hole type area is located 4 miles to the southeast of the southeast corner of the Rosita quadrangle.

TRACHYTE ASH-FLOW TUFF Tt

This unit is only present in the central part of the Rosita quadrangle. Ash-flow tuffs have not been recognised previously in the Rosita Hills area. The deposit is a simple cooling unit and appears to represent a single small paroxysmal eruption. It covers an area of 16 square miles and has a volume of one-tenth of a cubic mile. The original areal extent and volume must have been greater as post-depositional erosion has occurred. The deposit is wedge-shaped in section, being 40 feet thick in the north and thins and finally disappears to the south.

Zones of partial welding and no welding are present in the cooling unit. A zone of dense welding has not been observed even in the thickest sections of the tuff; this indicates that the ash-flow was emplaced at a relatively low temperature. The zone of partial welding is absent when the deposit is less than 4 feet thick; when developed this zone is irregular in its position, in some outcrops it will extend down to the base of the flow, and in other outcrops it is underlain by the zone of no welding.

The color of the rock darkens from pale pink (5RP 8/2) and pinkish gray (5YR 8/1) in the zone of no welding to pale red (5R 6/2) and pale reddish brown (10R 5/4) in the zone of partial welding. The rock contains pumice and crystal fragments in a vitroclastic matrix. Pumice is dominant and in the zone of partial welding is deformed to produce eutaxitic structure. The percentage in volume of accidental and accessory fragments varies from 15 to 35. The variation does not appear to have a relation with distance from the source vent nor with height above the base of the tuff. Accidental fragments of various types of Precambrian rocks and chert are usually present up to a maximum of 10 percent. Sanidine, sometimes chatoyant, is the principal intratelluric crystal followed by biotite, plagioclase and quartz. Occasional lithophysae lined with chalcedony are present. The rock is moderately to very porous depending on the amount of welding, except where there is secondary silicification. The latter is prevalent in the zone of partial welding and may be the result of devitrification of the glass shards in the matrix. In one locality where the ash-flow tuff rests directly on Precambrian rocks it contains small fragments of carbonized plants

Vertical columnar jointing is not developed in either zone of the ash-flow. A slabbiness parallel to the foliation is sometimes present. A coarse "swiss cheese" effect is prominent on outcrops of the zone of partial welding due to preferential weathering ofthe included pumice fragments. The ash-flow tuff often forms prominent outcrops due partly to the secondary silicification and partly to the more easily eroded neighbouring beds. The attitude of the eutaxitic structure is considerably irregular probably because the ash-flow

was deposited on an irregular surface.

This unit rests upon the vitric tuff unit (Ttf) which it overlaps to rest directly upon Precambrian rocks. In the central part of the Rosita quadrangle the unit is apparently interbedded with the lower beds of the volcanic sedimentary unit (Tvs). It is confidently assumed that the ash-flow tuff is a time marker, in which case deposition of the volcanic sediments had commenced earlier in the Antelope Creek area and preceded the eruption of the ash-flow (see Figure 1).

SANDSTONES, GRAVELS AND WATER-LAID TUFFS Tse

This sedimentary unit is present only in the northern part of the area being described. The unit is very poorly exposed and there remains some doubt as to its authenticity as a mappable unit. It is customarily concealed by soil and by a thin ~~[illegible]~~ gravelcomposed of pebbles and cobbles of various Precambrian rocks and pebbles of silicified pumice.

The few outcrops show a fine-grained, occasionally coarse, pebble gravel consisting of quartz, various Precambrian rocks, chert, and silicified pumice pebbles and some cobbles with a matrix of tuffaceous sand, light gray to yellow in color. The thickness of the unit is approximately 0 to 120 feet.

The unit lies upon the ash-flow tuff (Tt) which it overlaps in places to rest upon Precambrian rocks. The contact with the ash-flow tuff is nowhere exposed but an unconformity is suspected because of the unusual absence of the upper unwelded zone of the tuff. The upper contact with the volcanic sediments (Tvs) is also not exposed but may be followed, with a little difficulty, in the field by the appearance of andesite float. The andesite phenoclasts are weathered out from the conglomerates and breccias in the upper unit. The Tse sediments thin sharply southwards due to thickening of the overlying volcanic sediments (Tvs) in this direction [illegible]. It is believed that deposition of both units was, in part, concurrent and that of the volcanic sediments commenced earlier and finished later.

VOLCANIC SANDSTONES AND CONGLOMERATES, WATER-LAID TUFFS AND LAHARIC BRECCIAS Tvs

These volcanic sediments comprise the thickest and most extensive Tertiary unit in the district. It is present throughout most of the area being described and extends northwards into the northern Rosita Hills and southwards into Devils Hole. It has a total outcrop area of at least 60 square miles. The unit is equivalent to the Rosita andesite (Cross, 1896) and the Bassick agglomerate (Cross, 1896) in the Rosita Hills, The Tsc unit, and the 'auto-brecciated andesite lava' (sic) of Boyer (1962). The thickness of the unit in the present area is 300 to 1200 feet.

Volcanic sediments of this unit were first deposited in the Antelope Creek area where they occupied a depression (valley?) previously partly filled by the vitric tuff unit (Ttf). At least 300 feet of volcanic sediments were deposited in this depression before the eruption of the trachyte ash-flow tuff (Tt). Deposition of the unit continued after this eruption and the Tsc unit, the vitric tuff and ash-flow tuff were overlapped and the volcanic sediments rest on the Precambrian.

The most continuous outcrop of the unit is on the north side of the valley which contains Antelope Creek. A section below the trachyte ash-flow tuff was measured and is described here as it is considered typical of the remainder of the unit.

Section at Antelope Creek:	Thickness ft.	in.
Top is covered		
Cobble conglomerate with some boulders of andesite up to 4 ft. by 3 ft. by 3 ft. and some pumice pebbles, gray tuffaceous sandstone matrix	47	0
Covered by soil	24	0
Cobble conglomerate with pebbles and cobbles of andesite and dacite and some pumice pebbles up to ½ in., gray tuffaceous coarse grained sandstone matrix.....	17	6
Yellowish-gray pumiceous friable coarse grained sandstone and occasional pebble conglomerate lenses with pebbles of andesite and pumice. Occasional		

	Thickness ft.	in.
cobbles and boulders of andesite in conglomerate lenses.....	77	0
Cobble conglomerate, massive bedded, with some boulders of andesite up to 5 by 3 by 3 ft. and occasional dacite pebbles. Becomes finer in the top eleven feet.....	33	6
Gray coarse-grained tuffaceous sandstone with some pumice pebbles and occasional lenses of pebble, cobble, and boulder conglomerate. Cross-bedded and thick bedded. At the top contact the sandstone is irregularly cemented with limonite. The limonite-cemented areas weather spheroidally and are more resistant.....	8	3
Cobble conglomerate with pebbles, cobbles and boulders of andesite, basalt and dacite up to a maximum size of 4 ft. 9 in. by 6 ft. by 3 ft. 3 in; also pebbles of pumice up to $\frac{3}{4}$ in.. The matrix is a gray tuffaceous medium to coarse grained sandstone.....	34	0
Pebble conglomerate with pebbles of andesite and some pumice and dacite. The matrix is a gray medium to coarse grained tuffaceous sandstone.....	9	0
Water-laid vitric-crystal tuff, light gray, thin-bedded,.....	1	6
Air-fall vitric-crystal tuff, light gray, graded bedding and thin-bedded pumice lapilli and crystals of biotite, sanidine, orthoclase and quartz.....	2	6
Pebble conglomerate at the base grading into a gray coarse-grained tuffaceous sandstone at the top. Pebbles and occasional cobbles of andesite up to 4 in., also some pebbles of pumice. The matrix is identical to the top sandstone.....	4	6
Boulder conglomerate with pebbles, cobbles and boulders of andesite up to 3 ft. 6 in. diameter, also pebbles of pumice. The matrix is gray medium to coarse grained tuffaceous sandstone. The thick-		

	Thickness ft.	in.
ness of this bed is irregular thickening to 10 feet at a distance of 25 ft to the east of the measured section and thins to nothing 14 ft. to the west of the section.....	8	0
Gray tuffaceous sandstone, alternating thin beds of fine and coarse grained sandstone, cross-bedded and lens-shaped. Occasional pebbles of andesite and pumice. The pumice pebbles notably increase in amount in the top 18 in.....	5	9
Alternating lenses and beds of andesite pebble and cobble conglomerates and gray cross-bedded medium grained tuffaceous sandstone	13	0
Base is covered		
Total thickness	285	6

The phenoclasts in the conglomerates are usually equant and subangular, although angular and subrounded phenoclasts do occur. The complete absence of Precambrian detritus in the measured section is notable. Some Precambrian phenoclasts are present in the higher beds of this unit. The finer-sized beds are probably alluvial in origin. The coarser beds are particularly unsorted and contain such large boulders that an alluvial origin is unlikely. These cobble and boulder conglomerates are believed to be deposited by cold lahars (mud-flows) and, consequently, can be called laharic breccias. The source of the andesite material in this unit is thought to be andesite lavas and breccias contemporaneously erupted from vents along what is now the present crest of the Wet Mountains to the southeast of the Kosita quadrangle. One of the laharic breccias appears to occupy a large channel, of a width in the order of hundreds of feet, striking approximately northwest.

Thin beds of white and yellowish-gray tuff, mainly water-laid, are present in the upper part of the unit. One of these beds is lithologically distinct and, where present, forms a marker horizon. This bed is coarser grained than the other tuffs being a yellowish gray (5 y 7/2) crystal-vitric lapilli tuff with crystals of sanidine, biotite and quartz, and pumice lapilli with a finer tuffaceous

matrix. The deposit is probably of ash-fall origin. It varies in thickness from 0 to 5 feet and scattered isolated outcrops are present over a two-square mile area in sections 13 and 24. It is differentiated on the map and given the symbol Ttf. Its exact stratigraphic position within the Tvs unit is unknown but it is at least 60 feet above the base and more than 250 feet below the top of that unit. The ash-fall tuff in the measured section at Antelope Creek is possibly correlative with the lapilli tuff.

The outcrop pattern of ash-flow tuff south of Antelope Creek indicates that there is possibly more than one ash-flow tuff interbedded with the Tvs unit. The pattern can also be explained by concealed faults down-throwing to the west and causing repetition of the single ash-flow tuff (Tt).

SANDSTONES AND GRAVEL (Tg

The contact between this unit and the underlying Tvs unit is nowhere exposed but there is a probeble unconformity and the present unit overlaps to rest upon the Precambrian rocks. The contact is obscured on the steeper slopes by float from the upper unit. The compositionof the float from both units is very similar the only difference being the presence of spherulite and lithoidal phenoclasts in the float from the (Tg unit. The latter unit is also poorly exposed and is usually covered by a thin layer of gravel composed of phenoclasts weathered out of the gravel beds in the unit. On preliminary inspection it appears that the unit is almost entirely gravel but examination of the outcrops shows that the gravel beds are thin and discontinuous and that sandstones predominate.

The unit contains sandstones, interbedded with volcanic sandstones and gravels. The sandstones are brown medium to coarse grained arkoses, derived from Precambrian rocks, and are friable although cemented by calcium carbonate (caliche). The sandstones grade into light gray volcanic sandstones with increasing amounts of volcanic ash and other water-laid volcanic detritus. The gravels include pebble, cobble and minor boulder beds with subrounded to rounded equant phenoclasts of andesite, Precambrian rocks, spherulitic and lithoidal rhyolite, up to a maximum diameter of 3 feet. The matrix

of the gravels is similar to the previously described sandstones. The thickness of the unit varies from 0 to 350 feet.

There do not appear to be any contemporary volcanic eruptions with the deposition of this unit. The age of the unit is unknown, although it resembles beds of known Pliocene age in the Upper Arkansas Valley, it may be Tertiary or Quaternary in age.

RHYOLITE TALUS Qrt

This unit is a scree deposit made up of angular rhyolite porphyry blocks weathered from the outcrop of the Antelope Butte rhyolite dome. It is only present on the steep higher slopes of Antelope Butte and grades into colluvium and soil lower down the slopes. The thickness is unknown. The deposit obscures the contact between the rhyolite porphyry dome and the country rocks.

ALLUVIUM, SOIL AND COLLUVIUM Qal

This unit includes some Recent alluvial terrace deposits of gravel and sand composed of Precambrian and minor volcanic detritus; soil which is thin on the interfluves but can reach a thickness of 15 feet in the valleys, and colluvium which is up to 15 feet thick at the base of slopes. Positioning of the contacts between this unit and others is arbitrary in most places.

Petrology of the intrusive units

Only two intrusive units are recognised in the area: a small rhyolite porphyry stock and accompanying dike, and a series of lamprophyre dikes. The lamprophyre dikes radiate outwards from the rhyolite stock and are obviously closely related to the stock although their relative ages are unknown. This relationship is reminiscent of similar relations between lamprophyre dikes and stocks in the neighbouring Huerfano Park and Raton Basin district.

RHYOLITE PORPHYRY Tr

This intrusive forms a prominent rocky outcrop, some 120 feet high, which caps the top of Antelope Butte. The outcrop is pear-shaped in plan being 800 feet long by 400 feet at its widest, and is elongated in a WNW direction. The stock has prominent flow

banding which dips steeply and strikes approximately concentrically to the center of the outcrop and parallel to the nearest wall; the dip of the flow banding may be either inward towards the stock's center or outward towards the walls. The intrusion is believed to be a vertical pipe filling; the top of which was close to the present level of erosion as is indicated by the abundant vesicles and formation of pumice in the rock.

The rock is light gray (N7) to light brownish gray in color; porphyritic with an aphanitic ground mass; often vesicular and sometimes spherulitic or auto-brecciated. The phenocrysts never exceed 4 percent in volume and consist of glassy sanidine, smoky bipyramidal quartz and milky orthoclase. Small fragments of reddish-brown tuff, chert, and Precambrian rocks occur in very small quantities. In certain places the rock is so vesiculated that it is forming a pumice.

A smaller younger vent is located in the middle of this stock but displaced eccentrically to the east. This vent is approximately circular and about 25 feet in diameter. The vent-filling is a devitrified light gray obsidian which is vesiculating into a pumice at the vent margins. Occasional fragments of various Precambrian rocks and earlier volcanic rocks are present, although usually less than ½ in. in diameter one fragment was 6 in.. The outer border of this small vent is a reddish spherulitic obsidian, the spherulites are abundant but small averaging only ¼ in. diameter; the red color is presumably due to the oxidation of iron to hematite.

Neither the contact of the smaller plug with the larger nor the larger stock with the country rocks was anywhere exposed being concealed by the rhyolite talus (rt). This stock is a late rhyolite dome similar to those of Mount Tyndall and the Antrim Lode. A small rhyolite porphyry dike occurs to the southeast of Antelope Butte.

LAMPROPHYRE Tl

A narrow zone of en echelon lamprophyre dikes radiate out from the Antelope Butte stock. The total length of the zone is 3½ miles. Individual dikes are not continuous as they pinch out and another dike commences a few yards distant in an en echelon arrangement.

To the northwest of Antelope Butte one small lamprophyre intrusion, measuring 15 feet by 15 feet, does not lie within the narrow zone. The strike of the dikes varies from N 7° W to N 65° W and a change in strike occurs at Antelope Butte close to the rhyolite. South of the Butte the average strike is N 22° W but northwest of the Butte the average is N 50° W. The contacts, where seen, are welded and dip steeply, 60 to 70 degrees, to either the northeast or the southwest. Close to the Antelope Butte stock the dip flattens to 45 degrees into th rhyolite stock. The lamprophyre dike was not seen to cut the rhyolite dome and their relative ages are unknown.

The mineralogical composition of the dikes gradually changes along the strike of the zone. At Antelope Butte and southwards they are olivine-rich, towards the northwest they are biotite-rich. In the hand-specimen the rock is porphyritic; phenocrysts comprise up to 15 percent by volume and include yellow resinous olivine altering to serpentine and hematite, dark bronze-colored biotite books up to $\frac{1}{4}$ in. across and a little pyroxene. The groundmass is almost aphanitic but feldspar laths and some femic minerals can be distinguished.