NEW MEXICO BUREAU OF MINES & MINERAL RESOURCES
A DIVISION OF NEW MEXICO INSTITUTE OF MINING & TECHNOLOGY

GEOLOGY OF NORTHEAST QUARTER, CORRALITOS RANCH QUADRANGLE, NEW MEXICO

by Russell E. Clemons, 1976

SCALE 1: 24,000

0 1 MILE

Base from U.S. Geological Survey

Geology by Russell E. Clemons, 1972-1973

APPROXIMATE MEAN DECLINATION, 1975

INDEX MAP OF NEW MEXICO

Qs
Windblown sand
Red, eolian sand dunes up to 10 ft high; underlain by caliche horizon. Forms cover over rock unit shown by symbol under the line (for example Qs/Qcrp)

Qvy Qpy Qpa Qvo Qpo
Valley and piedmont-slope alluvium
Younger arroyo, fan, and terrace deposits of boulder gravel to silt-clay and/or minor playa and eolian sand to silt-clay; deposits either tributary to Rio Grande (Qvy) or of interior drainage (Qpy). Older arroyo, fan, and terrace deposits of boulder gravel to silt-clay, locally cemented with caliche; deposits either tributary to Rio Grande (Qvo) or of interior drainage (Qpo). Undifferentiated piedmont-slope alluvium (Qpa), to 20 ft thick

HOLOCENE

LATE PLEISTOCENE TO HOLOCENE

UNCONFORMITY

Camp Rice Formation

Qcru Qcrp Qcrf Qcrc
Camp Rice Formation
Piedmont-slope facies. Fan gravel with interbedded sand and clay; includes thin pediment veneers near mountain fronts. Basal pebble to boulder fanglomerate and conglomeratic sandstone representing older slope deposits (Qcrc); fluvial facies of clay, silt, sand, and gravelly sand (Qcrf); upper sandy pebble to boulder gravel and caliche horizons representing younger slope deposits (Qcrp). Undifferentiated piedmont-slope deposits (Qcru); to 200 ft thick

PLEISTOCENE

ANGULAR UNCONFORMITY

Rincon Valley Fm.

Trvc
Rincon Valley Formation
Fanglomeratic facies (Trvc) consisting of thick- to massive-bedded, poorly sorted, brownish conglomerate derived from adjacent mountains; about 500 ft thick

PLIOCENE (?) & MIOCENE

ANGULAR UNCONFORMITY

Uvas Basaltic Andesite

Tu Tui Tuc
Uvas Basaltic Andesite
Basaltic andesite, basalt, and andesite flows (Tu) interbedded with pebble to boulder conglomerate and muddy sandstone (derived primarily from flow-banded rhyolite dome complexes). The sediments are informally assigned to the Coyote Canyon member (Tuc); about 820 ft thick. Intrusive, funnel-shaped vents in Sleeping Lady Hills mapped as (Tui)

MIOCENE

Bell Top Formation

Tbsu
Upper sedimentary member
Pale-yellowish-brown and grayish-orange tuffaceous siltstone, sandstone, and conglomerate. Generally poorly sorted, poorly bedded, and poorly cemented. Some lenticular channel fills. Interfingers with lower Uvas flows in Sleeping Lady Hills; to 330 ft thick

LOCAL UNCONFORMITY

Tbt_6
Tuff 6 member
Porous to dense, pale-grayish-red, vitric-crystal ash-flow tuff; to 100 ft thick

Tbsm
Middle sedimentary member
Grayish-orange-pink tuffaceous mudstone and conglomerate; generally poorly sorted and poorly cemented; to 70 ft thick

LOCAL UNCONFORMITY

Tbt_5
Tuff 5 member
Porous to dense, grayish-pink, crystal-vitric ash-flow tuff. Abundant, slightly flattened, white to light-gray pumice fragments; to 123 ft thick

LOCAL UNCONFORMITY

Tbt_4
Tuff 4 member
Porous to dense, pale-grayish-red-purple, vitric-crystal ash-flow tuff. Abundant flattened dark-grayish-red devitrified pumice fragments to 1 ft diameter; to 180 ft thick

LOCAL UNCONFORMITY

Tbfrb Tbfrf Tbfr
Cedar Hills flow-banded rhyolite
Flow-banded rhyolite domes (Tbfrf) and short, stubby flows (Tbfrf); associated intrusive and crumble breccia (Tbfrb). Where foliation and contact relations are not diagnostic for intrusive or extrusive mode, mapped as Tbfr

Tba Tbai Tbaf Tbut
Upper tuffaceous sedimentary member and basaltic andesite member
White to yellowish-gray air-fall tuff and breccia, with interbedded epiclastic pebbly sandstone (Tbut). Abundant limestone clasts near base in Foster Canyon; tuff 3 and basalt clasts in middle beds; very pumiceous at top. To 300 ft thick except in Foster Canyon where up to 800 ft may be present. Basaltic andesite dikes and plugs (Tbai) intrude this member and forms interbedded flows (Tbaf). Where intrusive or extrusive mode is uncertain, mapped as Tba

Tbt_3
Tuff 3 member
Porous to very dense, grayish-orange-pink to pale-red, vitric ash-flow tuff. Abundant equant to flattened, dark-grayish-red, pumice fragments; 200 to 350 ft thick

LOCAL UNCONFORMITY

Tblt
Lower tuffaceous sedimentary member
White to light brownish-gray and pale-yellowish-brown air-fall tuff and breccia with interbedded epiclastic muddy and conglomeratic sandstone; to about 100 ft thick. Local occurrence below Tbb

Tbb
Basalt member
Dense, black, vesicular, olivine-bearing basalt flows and interbedded muddy to sandy conglomerate; to 150 ft thick

LOCAL UNCONFORMITY

Tbt_2
Tuff 2 member
Porous, light-gray to pale-grayish-red-purple, vitric ash-flow tuff. Only exposed in northwest corner of map area; to 70 ft thick

OLIGOCENE

UNCONFORMITY

Palm Park Fm.

Tpp
Palm Park Formation
Gray, red, and purple tuffaceous mudstone, sandstone, breccia, and conglomerate; consisting chiefly of andesite detritus; to about 3,500 ft thick

EOCENE

Geologic contact, dashed, where approximately located

Normal fault, dashed where inferred or approximately located, dotted where concealed. Arrows show direction of dip. Ball on downthrown side

Landslide block, arrows on hanging wall

Strike and dip of beds

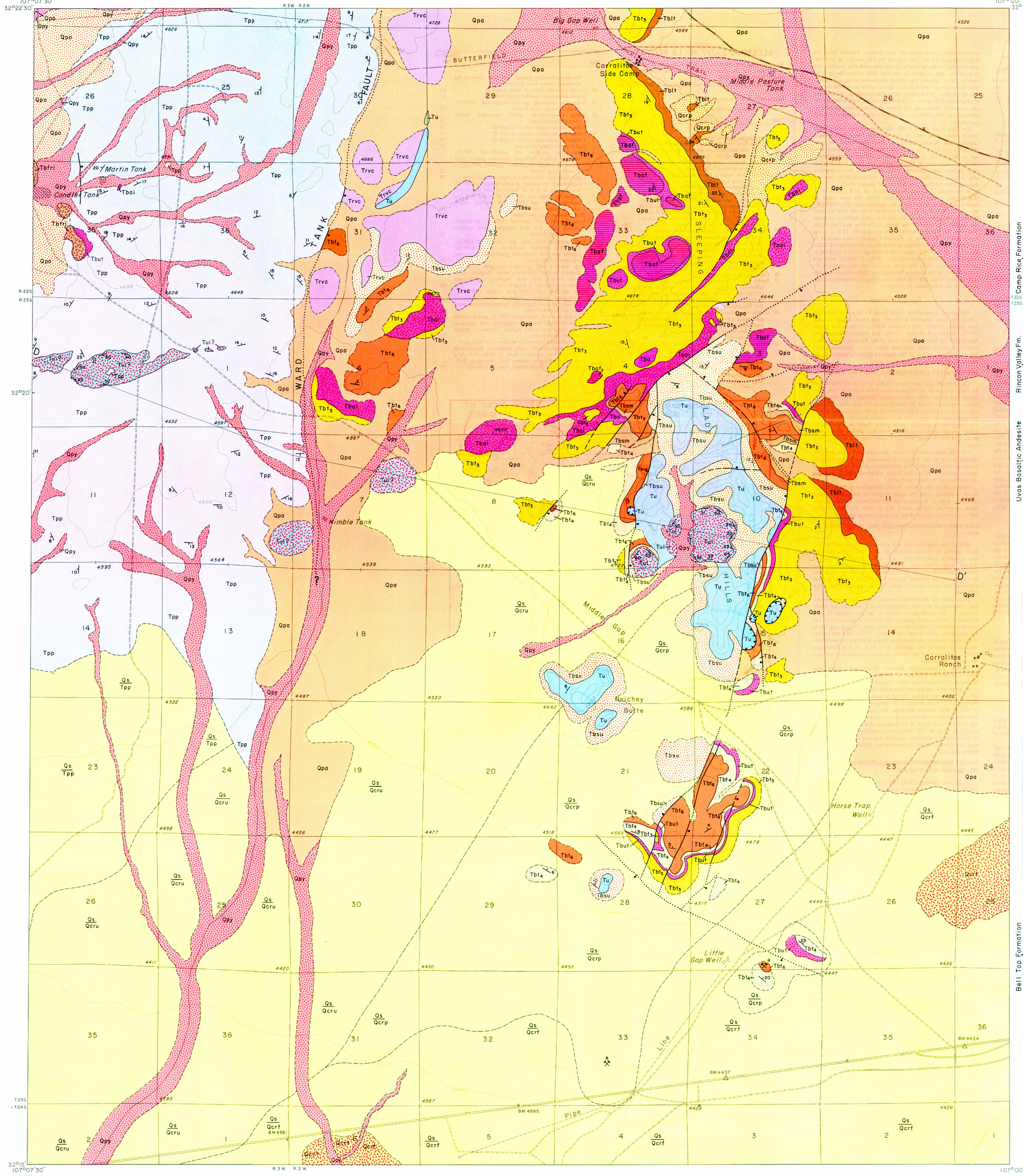
Strike and dip of flow foliation

Strike of vertical flow foliation

Line of measured section

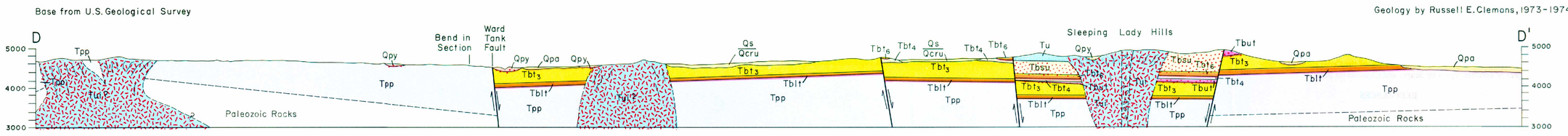
Travertine, opal, or rock quarries

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GEOLOGIC MAP 36 SHEET 2



Base from U.S. Geological Survey

Geology by Russell E. Clemons, 1973-1974



GEOLOGY OF SOUTHEAST QUARTER, CORRALITOS RANCH QUADRANGLE, NEW MEXICO

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APPROXIMATE MEAN DECLINATION, 1975

INTRODUCTION

These two sheets are part of a continuing program of geologic investigations of the Rio Grande trough and adjacent uplifts between Hatch and Las Cruces. Field data were plotted on aerial photographs with a scale of 2½ inches to the mile, then transferred to the topographic bases enlarged to 1:24,000 scale.

The map area is located 14 miles northwest of Las Cruces (fig. 1). Access to the area is provided by a paved road to the Corralitos Ranch microwave tower from I-10 west of Las Cruces. A good gravel road continues from the microwave tower across the area to the New Mexico State University Observatory at Blue Mesa in the Sierra de las Uvas. Access to the northeastern part of the area is provided by the travertine quarries road from US-85, 1 mile north of Radium Springs. A complex of ranch roads and jeep trails penetrates most of the map area. The entire area is sparsely vegetated grazing land, with the only permanent habitation being the Corralitos Ranch headquarters near the southeastern edge of the area. A complete discussion of the climate and vegetation is included in Seager and Hawley (1973) and Seager, Clemons, and Hawley (1975). The Butterfield Trail crossed the map area through the southern part of T. 22 S.

Elevations within the east half of Corralitos Ranch quadrangle range from 4,300 ft where Foster Canyon leaves the northeastern corner to 5,900 ft in the northwestern corner. Local relief does not exceed 100 ft except in the Cedar Hills, Rough and Ready Hills, and Sleeping Lady Hills along the eastern side of the quadrangle; and west of Bell Top Mountain, in the northwestern corner of the quadrangle.

ACKNOWLEDGEMENTS

The New Mexico Bureau of Mines & Mineral Resources provided the thin sections and all the financial support for the field work, chemical analyses, and K-Ar age dates. J. R. Renault furnished several chemical analyses of the basalt and andesite. C. B. Hunt read a preliminary manuscript and made many helpful suggestions. J. W. Hawley made many improvements in the map and report relative to the Quaternary units. I gratefully acknowledge all this aid. The author also benefitted from discussions with W. R. Seager, J. W. Hawley, F. E. Kottlowski, C. E. Chapin, and H. L. James. Access to the map area was permitted by the kindness of W. H. Cothern, L. W. Preece, and the Corralitos Venture.

STRATIGRAPHY

Rock units exposed in the east half of Corralitos Ranch quadrangle range from Eocene to Holocene. The Cities Service Oil Co. No. 1 Corralitos-Federal well drilled in the NW¼ sec. 6, T. 21 S., R. 2 W., showed that at least 4,000 ft of Paleozoic rocks underlie the Palm Park Formation (Eocene). The Paleozoic section includes, from top to bottom: Abo-Hueco, 1,300 ft; Pennsylvanian, 580 ft; Mississippian, 430 ft; Percha Shale, 170 ft; Fusselman Dolomite, 310 ft; Montoya Dolomite, 355 ft; El Paso Formation, 815 ft; and Bliss Sandstone, 69+ ft (L. J. Bevacqua, written communication, 1973). Recent studies in adjoining quadrangles to the north and east (Clemons and Seager, 1973; Seager, Clemons, and Hawley, 1975; Seager, 1975; and Kottlowski, Seager, and Hawley, in preparation) have described in detail the rock units exposed in, and underlying, the map area. Therefore, the descriptions are confined mainly to the characteristics unique to or encountered for the first time in Corralitos Ranch quadrangle. Measured sections at Bell Top Mountain and the Cedar Hills are in reports by Clemons and Seager (1973) and Seager and Clemons (in press) respectfully.

Palm Park Formation

(Tpp, about 2,500 ft exposed, lower 1,000 ft not exposed)

The Palm Park Formation includes a varied assemblage of mudstone, sandstone, conglomeratic mudstone and sandstone, and conglomerate. These grayish-red, grayish-purple, and brown to gray, tuffaceous volcanic arenites are interbedded throughout the formation. The Palm Park crops out over most of the western half of the map and in several small exposures in the northeast corner. However, exposures are poor except in arroyos. The Cities Oil Co. No. 1 Corralitos-Federal well (NW¼ sec. 6, T. 22 S., R. 2 W.) penetrated about 1,100 ft of Palm Park overlying the Abo-Hueco sequence. An additional 2,500 ft of upper Palm Park is estimated by traversing northwestward to the southeast slope of Bell Top Mountain from a point 3.5 miles north-northeast of the well.

Bell Top Formation

The general composition of the Bell Top Formation and petrology of some of its members in northwestern Doña Ana County has been described by Clemons and Seager (1973), Seager (1973), Seager, Clemons, and Hawley (1975), Clemons (1975), and Seager and Clemons (in press). Nine of the informal members are present in the map area; however, all of these cannot be found in any one section.

One of the problems of publishing parts of a continuing project is exemplified in the terminology resulting for the tuffaceous sedimentary units in the Bell Top Formation (fig. 2). Clemons and Seager (1973) mapped lower and upper sedimentary members which occur below and above ash-flow tuff 6 in the Souse Springs quadrangle. They included what appeared to be a local tuffaceous sandstone and conglomerate below ash-flow tuff 3 in the tuff 3 member. As mapping (Seager, Clemons, and Hawley, 1975) progressed eastward in the Sierra Alta quadrangle, they recognized four (locally five) tuffaceous sedimentary members in the Bell Top Formation that warrant mapping at a 1:24,000 scale. In ascending order, these units are: lower tuffaceous sedimentary member (Tblt), occurring locally below the basalt member as well as between the basalt and overlying tuff 3 members; upper tuffaceous sedimentary member (Tbut) between tuff 3 (below) and flow-banded rhyolite, Bell Top basaltic andesite flows, or tuff 4 member (above); middle sedimentary member (Tbsm) below tuff 6; and upper sedimentary member (Tbsu) above tuff 6. The middle and upper sedimentary members are present in the Sleeping Lady Hills. The Coyote Canyon member of the Uvas Basaltic Andesite, present only in the Cedar Hills, is believed to be in part correlative to the upper sedimentary member.

TUFF 2 MEMBER (Tbt_2, to 70 ft thick)

Tuff 2 member, a vitric ash-flow tuff, crops out in the northwestern corner of the map area (sheet 1) and more extensively farther north. It is missing in the Cedar Hills where the overlying basalt member rests unconformably on the Palm Park Formation and appears to be missing in the southern part of the map area, although the evidence is meager. In the southeastern corner of sec. 18, T. 22 S., R. 2 W., ash-flow tuff 3 appears to overlie the Palm Park in a small fault slice. The contact is covered by alluvium. Thus, ash-flow tuff 2 may not have been deposited very far east or southeast of the Sierra de las Uvas. A potassium-argon date of 39.4 (±1.5) m. y. on ash-flow tuff 2 indicates early Oligocene (Clemons and Seager, 1973).

BASALT MEMBER (Tbb, 60 to 150 ft thick where complete unit is exposed)

The basalt member exposed on Bell Top Mountain consists of a single flow, with maximum thickness of 60 ft in the Sierra de las Uvas. South of Foster Canyon, in the northeastern corner of the map area, the basalt member contains several flows and interbedded muddy conglomerate (total thickness of about 150 ft). Its southern extent is unknown, but probably is missing in sec. 18, T. 22 S., R. 2 W., where ash-flow tuff 3 apparently overlies Palm Park beds. Therefore, the source of the basalt was probably in the Cedar Hills, near Foster Canyon.

LOWER TUFFACEOUS SEDIMENTARY MEMBER (Tblt, to 100 ft thick)

The lower tuffaceous sedimentary member (Tblt) consists of light-gray and orange-pink, air-fall tuff; granular, sandy mudstone; tuffaceous breccia and pebble-cobble conglomerate. Abundant small pumice fragments, angular basalt clasts, and rounded pebbles and cobbles (derived from the Palm Park Formation) are common in the sequence. The member contains abundant glass shards and montmorillonite, and in general is poorly exposed in deeply weathered slopes. Thickness is 65 ft at Bell Top Mountain; 74 ft south of the head of Foster Canyon; and more than 100 ft in the northwestern corner of sec. 34, T. 22 S., R. 2 W. The base is not exposed in Sleeping Lady Hills, but is believed to lie on the Palm Park Formation. Near Basin Tank in Sierra Alta quadrangle (Seager, Clemons, and Hawley, 1975), 8 ft of this member occur below the basalt, and 52 ft above; and at Hermantano Springs 22 ft occur below the basalt, and about 10 ft above.

TUFF 3 MEMBER (Tbt_3, 200 to 350 ft thick)

Tuff 3 crops out at Bell Top Mountain, in the northeastern part of the map area, and extensively in the Sleeping Lady Hills. It is vitric ash-flow tuff with abundant, darkened, equant pumice fragments, generally less than 25 mm across. Crystal fragments of sanidine, quartz, and plagioclase comprise less than 4 percent of the tuff.

The maximum thickness of tuff 3 is 350 ft, measured in the southeastern Sleeping Lady Hills. It appears to thin to the west and northwest away from the Cedar Hills vent zone (Seager, 1973; Clemons and Seager, 1973; Seager, Clemons, and Hawley, 1975; and Seager and Clemons, in press).

Large blocks and slabs of tuff 3 occur in the upper tuffaceous sedimentary member (Tbut) in sec. 14, T. 21 S., R. 2 W. At this same locality there is one dike of tuff 3(?) intruding the upper tuffaceous sedimentary member, and several outcrops of rocks which may be intrusive. The dike and questionable intrusives are petrographically similar to tuff 3 with two exceptions. One difference is a breccia of subangular to well-rounded clasts of vitric ash-flow tuff, ranging in size from 1.0 to 25 mm, in a matrix of shards and glass. Clasts and matrix each comprise about 50 percent of the rock with the clasts generally slightly lighter colored. The second difference from the typical tuff 3 is that pumice fragments appear to be lacking in these dense rocks. They are definitely not a variety of any other tuffs in the region.

UPPER TUFFACEOUS SEDIMENTARY MEMBER (Tbut, to 300 ft thick, may be 500 to 1,000 ft thick at head of Foster Canyon)

In the Cedar Hills, Rough and Ready Hills and Sleeping Lady Hills, tuff 3 is overlain by a sequence of light-colored air-fall tuff; sandy mudstone; tuffaceous sandstone, sandy conglomerate, and breccia beds (fig. 2). These epiclastic rocks are best exposed in sec. 14, T. 21 S., R. 2 W. Good exposures are also present in gullies southeast of Dark Mountain (fig. 1), on the lower east-facing slopes of the Rough and Ready Hills, and western slopes of the Sleeping Lady Hills. These rocks were intruded by flow-banded rhyolite domes and basaltic andesite dikes and plugs; and are generally overlain by some of the flow-banded rhyolite or andesite flows. Locally they are overlain by tuff 4 (at Dark Mountain and southeastern Sleeping Lady Hills), tuff 5 (head of Foster Canyon), and tuff 6 (southern end of Rough and Ready Hills).

The tuffaceous rocks, for the most part, are poorly bedded. Some possess 2- to 10-inch beds with shaly partings, and locally, crossbeds are well developed. All are typical porous, friable rocks which erode easily to form slopes. Generally they are poorly sorted, tuffaceous, volcanic arenites composed of fresh angular sanidine, quartz, plagioclase, pumice and ash-flow tuff fragments in a matrix of shards and montmorillonitic clay. The lower beds in Foster Canyon contain abundant cobbles and boulders (to 12 inches) of Paleozoic limestone. Content of tuff 3 and Bell Top basalt and andesite fragments increases upwards, comprising up to 30 percent of the rocks in the upper part of the unit. The uppermost beds exposed in Foster Canyon, however, are predominantly pumice, shards, and microvitrophyre fragments. Slabs and blocks of tuff 3 and Bell Top basalt (up to 100 ft long) are interbedded, and appear to have slid from high areas during deposition of the upper tuffaceous sedimentary member.

BASALTIC ANDESITE PLUGS, DIKES (Tbai), AND FLOWS (Tbaf)

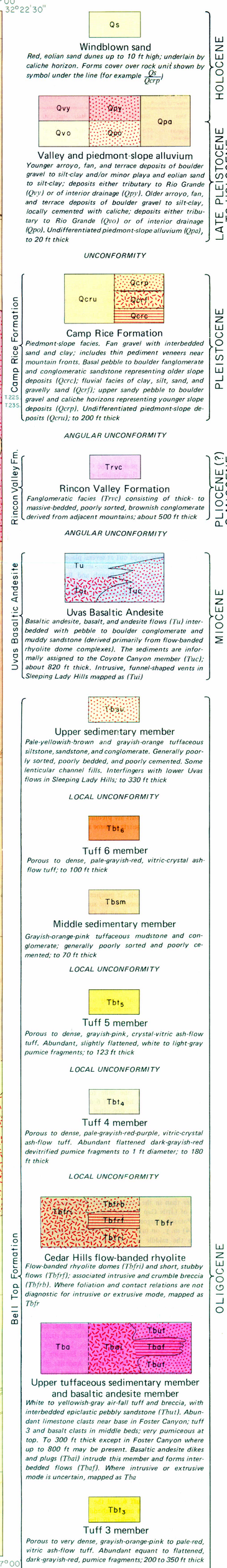
Vesicular andesite (Tbai) is exposed in secs. 11, 26, and 35 of T. 21 S., R. 2 W., here intruding part of the upper tuffaceous sedimentary member. Tbai is a yellowish-brown rock with blocky microphenocrysts of andesite (An_{44-50}) enclosed in an intersertal matrix of andesine (An_{30-40}) laths, magnetite, and glassy material.

An east-trending zone of basaltic andesite plugs and dikes crosses the southern map area (sheet 2). The trend changes to northeast in the Sleeping Lady Hills. The basaltic andesite intrudes tuff 3 and older rocks and flows overlie the upper tuffaceous sedimentary member. In the southern part of sec. 4, T. 23 S., R. 2 W., it is locally overlain by the middle sedimentary member. West and northwest of here it is overlain by tuff 6. Typically an extremely dense, finely crystalline, dark-gray to black rock with the flows possessing well-developed platy joints. Less than 3 percent of the rock is composed of small, blocky, zoned plagioclase (An_{40-55}) phenocrysts; is enclosed in a pilotaxitic to intersertal matrix of plagioclase (An_{30-45}) laths, pyroxene, oxidized biotite and hornblende, magnetite, and glass. Microvesicles (less than 1 mm, average 0.04 mm) comprise up to 10 percent of some samples. Two chemical analyses are included in the table (on back).

Reddish-brown cinder beds in the southern part of sec. 4, T. 23 S., R. 2 W., are part of a small cinder cone vent. Scoriaceous, vent breccias also crop out in secs. 33 and 34, T. 22 S., R. 2 W. These rocks closely resemble the vesicular andesite intruding and interbedded with the upper tuffaceous sedimentary member in the Cedar Hills (Seager, Clemons, and Hawley, 1975). Where intrusive or extrusive relations could not be determined these andesites are mapped as Tba.

A sample collected from the large intrusion (NE¼SE¼ sec. 2, T. 23 S., R. 3 W.) yielded a wholerock K-Ar age of 27.4 (±1.2) m. y. Field evidence at this locality indicates only that the andesite intruded Palm Park strata. Tuff 6 (36.5 m. y.) was deposited on similar andesite which intruded tuff 3 in the Sleeping Lady Hills. Similar andesite in the Cedar Hills is older than tuff 5 (35.1 m. y.). Ages determined on wholerock and feldspar concentrates from the

Figures and text continuation on back



(continued from front of map)

Chemical analyses of some members of Uvas Basaltic Andesite and Bell Top Formation
(Rocky Mountain Geochemical Corp., Salt Lake City, Utah)

Asterisks (*) are x-ray fluorescence analyses done by Jacques Renault at New Mexico Bureau of Mines & Mineral Resources: 1) Sierra de las Uvas, 2) Broad Canyon, 3) Sleeping Lady Hills, 4) Kimble Tank, 5) 1.5 miles southeast of Chandler Tank, 6) Sample duplicates

Unit	SiO_2	TiO_2	Al_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	loss
$Uvas_1$ (upper)	57.5	0.94	16.7	6.0	0.09	2.62	4.81	3.7	2.4	0.70	1.02
(lower)	53.1	1.14	16.4	6.0	0.08	2.59	5.60	3.1	1.5	0.95	1.57
$Uvas_2$*	49.75	1.73	15.42	9.59	0.17	10.16	8.67	3.93	1.24	0.0	—
$Uvas_3$*	63.19	0.85	14.43	5.97	0.17	3.51	3.96	4.0	3.62	0.0	—
Tuff 6 (upper)	75.9	0.18	11.3	1.0	0.04	0.20	0.45	2.7	4.7	0.10	0.98
(lower)	78.6	0.20	12.6	1.0	0.02	0.20	0.45	3.0	4.5	0.10	0.75
Tuff 5 (upper)	75.0	0.16	12.6	0.57	0.04	0.17	0.36	3.3	4.7	0.20	0.67
$(lower)_6$	72.0	0.21	13.7	0.71	0.04	0.40	0.31	2.9	5.0	0.20	1.78
$(lower)_6$	73.8	0.21	14.0	0.71	0.04	0.40	0.31	2.7	5.3	0.20	1.73
Tuff 4 (upper)	67.1	0.40	16.0	1.43	0.06	0.46	1.04	4.3	5.1	0.35	1.90
(lower)	70.1	0.21	13.1	0.71	0.04	0.13	0.28	4.0	5.5	0.10	0.95
Tuff 3 (upper)	73.2	0.08	12.0	0.86	0.01	0.23	0.20	2.8	5.5	0.10	1.38
(lower)	74.1	0.07	11.7	1.0	0.02	0.07	0.08	3.4	5.4	<.05	0.99
Tuff 2	78.2	0.23	10.9	1.0	0.03	0.53	0.70	2.6	4.9	0.05	1.34
Bell Top basalt	48.5	2.54	15.9	12.3	1.76	6.23	7.84	2.9	1.0	0.95	1.90
Bell Top andesite$_4$*	56.54	1.83	15.97	8.28	0.15	4.10	6.47	4.39	2.41	0.0	—
Bell Top andesite$_5$*	56.73	1.79	16.24	7.46	0.15	3.51	5.68	4.59	2.56	0.13	—
Rough and Ready Hills rhyolite$_6$	72.9	0.28	14.3	0.86	0.02	0.20	0.14	4.8	5.4	<.05	0.37
Rough and Ready Hills rhyolite$_6$	70.8	0.27	13.6	0.86	0.03	0.13	0.28	4.2	5.2	<.05	0.43
Cedar Hills rhyolite	73.4	0.16	13.2	0.57	0.02	0.03	0.17	4.0	5.5	<.05	0.49

Tertiary volcanic rocks in the region have commonly given ages too young, conflicting with field evidence. Therefore, the 27.4 m. y. age may be too young. However, the possibility of this andesite belonging to the Uvas Basaltic Andesite cannot be completely disregarded.

FLOW-BANDED RHYOLITE DOMES (Tbfri), FLOWS (Tbfrf), AND BRECCIA (Tbfrb)

All of the high peaks in the Cedar Hills and Rough and Ready Hills are formed of flow-banded rhyolite. Most are circular to elongate domes or dome complexes. Where foliation patterns are inconclusive or contacts obscure, they have been mapped as undifferentiated flow-banded rhyolite (Tbfr). Three chemical analyses are shown in the table. Several smaller domes and dikes are located 4 miles west of the Sleeping Lady Hills.

Flow-banding is shown by color streaking and platy jointing parallel to the flow direction in the pale-red, pale-grayish-red, pale-brown, and grayish-red rocks. A pale-yellowish-brown, flow-banded microvitrophyre crops out at several places in upper Foster Canyon. Phenocryst content ranges from less than 1 percent to 18 percent, with the rhyolite in the Rough and Ready Hills containing the higher percentage of phenocrysts. The phenocrysts, ranging from 0.3 to 2.0 mm, are predominantly sanidine, with oligoclase and biotite in lesser amounts. Plagioclase exceeds sanidine in some of the rhyolite along the western side of the Cedar Hills. A fluidal texture is shown by alignment of feldspar laths, and microlites in a light brownish cryptocrystalline to glassy matrix. A very dusky to red black vitrophyre is present as basal portion of flows or intrusive margins in the Rough and Ready Hills. Microvesicular to vesicular, lithophysal, and spherulitic textures are present in some of the rocks. Chalcedony-lined geodes have formed in the flow-banded rhyolite at several locations. Notably in secs. 11 and 22, T. 21 S., R. 2 W.; and west side of sec. 11, T. 22 S., R. 2 W.

TUFF 4 MEMBER (Tbt_4, to 180 ft thick)

In the Sierra de las Uvas, tuffs 4, 5, and middle sedimentary member sequentially overlie tuff 3. In the Cedar Hills and southern Sleeping Lady Hills, however, tuff 4 rests unconformably on the upper tuffaceous sedimentary member and flow-banded rhyolite (fig. 2). Tuff 4 either was not deposited or was eroded from the Rough and Ready Hills and northern Sleeping Lady Hills areas. The tuff is present immediately south of the basaltic andesite intrusive zone and southward at least to the edge of the map area. Where present, thickness ranges from 20 ft in the south to 180 ft in the north.

Tuff 4 is a grayish-red-purple, vitric-crystal, ash-flow tuff containing abundant, darkened, flattened, pumice fragments to 6 inches long. Crystal fragments are predominantly sanidine, plagioclase, and biotite, with lesser quartz in some sections.

TUFF 5 MEMBER (Tbt_5, to 123 ft thick)

In the Cedar Hills area (sheet 1) tuff 5 was deposited on tuff 4, and unconformably on the upper tuffaceous sedimentary member and flow-banded rhyolite. At the head of Foster Canyon, the upper part of tuff 5 has been opalized along the contact with the overlying Uvas Basaltic Andesite. It pinches out in sec. 22, T. 21 S., R. 2 W., and is not now present to the south and east. Lithology of tuff 5 has been described in detail by Clemons and Seager (1973), Seager, Clemons, and Hawley (1975), and Clemons (1975).

MIDDLE SEDIMENTARY MEMBER (Tbsm, to 70 ft thick) AND TUFF 6 (Tbt_6, to 100 ft thick)

The middle sedimentary member is present only in the central Sleeping Lady Hills where it overlies tuff 4 and is overlain by tuff 6 (fig. 2). It is poorly exposed except in gullies where it consists of light-colored tuffaceous mudstone and pebble conglomerate.

Tuff 6 rests unconformably on flow-banded rhyolite, upper tuffaceous sedimentary member, and tuff 3 at the southern end of the Rough and Ready Hills. In the area to the west of the northern Sleeping Lady Hills, tuff 6 is thin and poorly welded where it unconformably overlies Bell Top basaltic andesite and tuff 3. Locally, over the intrusive basaltic andesite zone in the central Sleeping Lady Hills, it is angularly unconformable on the andesite and middle sedimentary member. Immediately south of the basaltic andesite zone it is more than 100 ft thick and is underlain by the middle sedimentary member. The middle sedimentary member pinches out within one mile to the south; from there to the southern end of the hills, tuff 6 directly overlies tuff 4. Apparently tuffs 4, 5, and 6 were deposited (primarily to the west and northwest) around high area occupied by flow-banded rhyolite dome complexes or Bell Top basaltic andesite vents, lapping onto the exposed highs.

Tuff 6 is typically a pale-red to grayish-pink vitric-crystal ash-flow tuff with abundant light-colored pumice fragments. An atypical unit at the base of tuff 6 in the extreme southern end of the Sleeping Lady Hills may indicate a multiple cooling unit in that area. This basal unit is slightly more crystal rich, the crystals are of more uniform size, pumice fragments are lacking, and the welding is better than in the overlying unit. This basal unit was quarried just east of Little Gap Well for road construction.

Potassium-argon dates of 35.1 (±1.3) m. y. on tuff 5 and 36.5 (±1.4) m. y. on tuff 6 are the reverse of the stratigraphic positions. Also the middle sedimentary member (about 200 ft thick) lies between the two tuffs in the Sierra de las Uvas. Assuming the dates are reasonably correct, both tuffs plus the interbedded sediments were deposited within a span of a couple million years during early to middle Oligocene.

UPPER SEDIMENTARY MEMBER (Tbsu, to 330 ft thick)

Tuff 6 is overlain by clastic sedimentary rocks which are well exposed in the slopes of the southern Sleeping Lady Hills (fig. 2). These rocks have been mapped as the upper sedimentary member because of similar lithology and identical stratigraphic position as mapped in the Sierra de las Uvas, 14 miles to the northwest (Clemons and Seager, 1973). In the Sleeping Lady Hills they are similarly overlain by Uvas Basaltic Andesite although the andesite here came from a local source. The lower third of the upper sedimentary member is interbedded, light-colored sandstone, and conglomerate. The upper two-thirds is a muddy, tuffaceous, fine sandstone. In general the whole member is poorly bedded and poorly cemented with the exception of one chalcedony-cemented, pebble conglomerate at the top to the lower third. This conglomerate tends to be a ledge former and makes a good local stratigraphic marker.

In the Sierra de las Uvas, about 500 ft of volcanic arenites (upper sedimentary member) were deposited between tuff 6 and the Uvas Basaltic Andesite. The upper beds of the sedimentary sequence are interbedded with the earliest Uvas flows indicating a roughly conformable contact. Uvas flows and the interfingering Coyote Canyon member of the Uvas Basaltic Andesite (fig. 2) were deposited on tuff 5 in the Cedar Hills. About 330 ft of the upper sedimentary member separate tuff 6 and the Uvas flows in the Sleeping Lady Hills. Locally flows are interbedded in the upper part of the sedimentary sequence, similar to the occurrence in the Sierra de las Uvas. Thus the upper sedimentary member of the Bell Top Formation and the Coyote Canyon member of the Uvas Basaltic Andesite are probably correlative in part. However, they cannot be shown to be physically continuous. Also the fact that Uvas flows came from three separate vent areas prevents a positive correlation. Ages of the Uvas Basaltic Andesite are discussed below.

UVAS BASALTIC ANDESITE (Tu, to 818 ft thick, including 3 tongues of Coyote Canyon Member, Tuc)

About 1.0 mile east of Coyote Canyon, flows of Uvas Basaltic Andesite are interbedded with coarse boulder fanglomerate and sandstone. The fanglomerate beds have been informally referred to the Coyote Canyon member which is probably equivalent in part to the upper sedimentary member of the Bell Top Formation (Tbsu) in the Sierra de las Uvas and Sleeping Lady Hills (fig. 2).

Along an east-west traverse across the center of the eastern half of sec. 15, T. 21 S., R. 2 W., the Uvas Basaltic Andesite, in ascending order, consists of: 50 ft of the lower Coyote Canyon tongue; 154 ft of basaltic andesite flows; 143 ft of the middle Coyote Canyon tongue; 104 ft of basaltic andesite flows; and 367 ft of the upper Coyote Canyon tongue. The lower tongue is composed wholly of angular, flow-banded rhyolite clasts to 4 ft in diameter. The lower tongue contains very little sand or finer material, is poorly consolidated, and poorly exposed. The middle tongue contains a lower unit similar to the lower tongue, except also containing basaltic andesite debris; and an upper, brownish, coarse sandy, pebbly conglomerate and pinkish-orange, muddy, tuffaceous sandstone unit. The upper tongue consists of interbedded, thick- to massive-bedded, sandy cobble-boulder conglomerate and muddy tuffaceous sandstone of similar colors to the middle tongue. Clasts of tuff 3 are increasingly abundant upward in the upper tongue along with flow-banded rhyolite and basaltic andesite fragments. The degree of cementation by chalcedony also increases upward in the middle and upper tongues. Cross-bedded channels are especially upper tongue.

A slight angular unconformity separates the upper Coyote Canyon tongue from the overlying Santa Fe Group. The Uvas Basaltic Andesite generally dips 10 to 18 degrees westward toward Coyote Canyon. The overlying Rincon Valley Formation dips 2 to 10 degrees westward, except near faults where dips up to 20 degrees are recorded.

The Uvas Basaltic Andesite in the Sleeping Lady Hills differs markedly from that in the Cedar Hills and Sierra de las Uvas. Chemical analyses of rocks from the three source areas are shown in the table. Two vents (Tui), located in the southwestern Sleeping Lady Hills, were the sources of the andesite (dacite?) capping the hills. One of these flows extended northwest to SE¼ sec. 30, T. 22 S., R. 2 W. Rocks from these vents are generally less vesicular, porphyritic, dense, and dark-gray to black color. Phenocrysts of zoned plagioclase (An_{40-50}) and pyroxenes comprise 5 to 25 percent of the rock. They range in size from 0.5 to 10 mm and average about 4 mm. The pyroxene is chiefly augite with minor amounts of pigeonite and enstatite (altering to bastite). Lesser amounts of small oxyhornblende phenocrysts are also present. Samples from the larger vent and the top flow capping the hills contain up to 6 percent rounded, embayed quartz crystals surrounded by reaction rims of pyroxene. This accounts for the high silica content shown in the analysis. These samples also contain plagioclase (An_{10-30}) crystals with brownish-gray reaction rims. Sparse calcite amygdules are present in the flow. The typically pilotaxitic groundmass is composed of plagioclase laths (0.03 to 0.5 mm), pyroxene, oxyhornblende (?), and magnetite. Rocks near the center of the larger vent are light- to medium-gray, brecciated, vesicular, and contain fragments of basalt or andesite.

The Uvas flows in the Cedar Hills were erupted from a partly buried cinder cone vent in the northern Cedar Hills (Seager, Clemons, and Hawley, 1975). An Uvas dike within the cone (SW¼NE¼ sec. 35, T. 20 S., R. 2 W.) has yielded a wholerock K-Ar age of 26.1 (±1.4) m. y. (Kottlowski, written communication, 1975). An Uvas flow in Selden Canyon was dated at 31.0 (±1.5) m. y. (Hawley and Kottlowski, 1965, p. 20). This date is questionable. A basal Uvas flow from a vent in the Sierra de las Uvas was dated at 25.9 (±1.5) m. y. (Clemons and Seager, 1973).

A wholerock K-Ar age determination of 12.9 (±0.7) m. y. (Kottlowski, written communication, 1975) has been made on basaltic andesite from the vent in the Sleeping Lady Hills (SW¼SW¼ sec. 10, T. 23 S., R. 2 W.). Earliest flows from this vent are interbedded in the upper part of the Bell Top upper sedimentary member, similar to relations in the Sierra de las Uvas and Cedar Hills. Therefore, the vent is probably not as young as th 12.9 m. y. age would indicate. However, an alternative interpretation needs to be considered. A basalt plug-dike in the Robledo Mountains (SE¼NE¼ sec. 19, T. 22 S., R. 1 E.) gave a wholerock age of 13.5 (±0.9) m. y. (Kottlowski, written communication, 1975). If both of these ages are correct, these rocks belong to another unit (Miocene) and the rocks mapped in the southern Sleeping Lady Hills as upper sedimentary member of the Bell Top Formation (Tbsu) may belong (at least in part) to the lower Santa Fe Group.

Santa Fe Group

The general composition of the Santa Fe Group in Doña Ana County has been described by Hawley and others (1969). In addition, Seager, Hawley, and Clemons (1971), Clemons and Seager (1973). Seager and Hawley (1973), and Seager, Clemons, and Hawley (1975), have described units of the Santa Fe Group which crop out in nearby areas. King and others (1971) have summarized the lithology and extent of the Santa Fe Group in relation to the ground-water resources of Doña Ana County.

RINCON VALLEY FORMATION (Trvc, about 500 ft exposed)

The fanglomeratic basin-margin facies (Trvc) of the Rincon Valley Formation crops out between Ward Tank fault and Cedar Hills, Rough and Ready Hills, and northern Sleeping Lady Hills in an almost continuous band southward across the map area. A smaller outcrop area of Rincon Valley is present in the northeastern corner. Exposures are poor due to the non-resistant character of the rocks. The fanglomerate generally forms gentle slopes or round-topped cuestas except where steep arroyo walls have been incised. It may be up to 1,000 ft thick between Coyote Canyon and Ward Tank fault.

The yellowish-brown to brown fanglomeratic facies is poorly bedded, poorly sorted, and poorly cemented. It consists chiefly of fragments of various Bell Top Formation ash-flow tuffs and Uvas Basaltic Andesite. West of the Rough and Ready Hills, flow-banded rhyolite material increases noticeably.

Distinguishing the Rincon Valley Formation in the Corralitos Ranch quadrangle from the upper tongues of the Coyote Canyon member is difficult. In general the Coyote Canyon member is much better cemented, slightly darker brown color, dips more steeply, and forms a more angular (slope and ledge) topography.

CAMP RICE FORMATION (Qcrp, Qcrf, Qcrc, Qcru, to 200 ft thick)

Alluvial-fan, coalescent-fan, and alluvial terrace deposits and colluvial veneers on erosion surfaces (in part rock pediments) have been mapped as piedmont-slope facies of the Camp Rice Formation. A basal brown to light-gray, conglomerate and conglomeratic sandstone (Qcrc) crops out in the northeastern part of the map area. Best exposures are between Coyote Canyon and Ward Tank fault; exposures also occur east of Coyote Canyon and east of the Cedar Hills fault.

Flood-plain and distributary deposits (Qcrf) of a major river system, consisting of siltstone and conglomeratic sandstone, are poorly exposed in the southeastern corner of the area (sheet 2). Subrounded to well-rounded granules and pebbles of chert, granite, and quartzite indicate a northerly source far from the map area (Hawley and others, 1969; Seager and Hawley, 1973). Clast size appears to decrease from near the Corralitos Ranch Headquarters southwestward to the edge of the map (sec. 6, T. 24 S., R. 2 W.) indicating either a southwestward distributary system or approach of the western side of a flood plain.

Younger piedmont-slope alluvium (Qcrp) covers rather large areas in the northwestern part of the map and smaller areas around the southern Sleeping Lady Hills. This unit generally contains 2 to 4 ft of caliche near the top. In areas where the two units could not be differentiated, the symbol (Qcru) is used. Seager, Clemons, and Hawley (1975) have described the composition and characteristics of both of these units in the Sierra Alta quadrangle which joins the map area on the north. During this study several limestone cobbles and boulders were found in the piedmont slope alluvium in secs. 24 and 35, T. 21 S., R. 3 W. Their source is unknown. A small outcrop of Cretaceous (?) limestone has been reported in the same general area (Kottlowski, written communication, 1973) but was not found during this study.

VALLEY AND PIEDMONT-SLOPE ALLUVIUM (Qvo, Qpo; Qvy, Qpy; Qpa, to 50 ft exposed)

Seager and Hawley (1973) and Seager, Clemons, and Hawley (1975) have described several units of post-Santa Fe Valley fill. Four of these units have been mapped in Corralitos Ranch quadrangle with thicknesses generally less than 10 ft and rarely exceeding 25 ft. Older arroyo terrace deposits and veneers on erosion surfaces which grade to the Rio Grande are mapped as Qvo. Similar deposits on piedmont slopes grading to closed basins to the southwest are mapped as Qpo. Both of these units have zones of strong to weak soil-carbonate (caliche) cementation in their upper parts. Younger fluvial (chiefly arroyo), and playa (?) deposits (Qvy and Qpy with similar usage) are widespread in the southeastern part of sheet 1, and on sheet 2, in Coyote Canyon, Mason Draw, and their tributaries. Zones of soil-carbonate accumulation are weak or absent in these materials. An undifferentiated piedmont unit (Qpa) is used in areas where Qpo and Qpy deposits have not been mapped separately.

WINDBLOWN SAND (Qs to 10 ft thick)

Reddish, eolian sand covers most of the southern third of sheet 2. Southwesterly winds have locally drifted the sand into dunes to 10 ft high. The dunes are more or less stabilized by mesquite, creosote and other desert vegetation. The sand is underlain by a thick caliche zone and older rocks.

STRUCTURE

The Corralitos Ranch quadrangle lies near the southeastern edge of the Goodsight-Cedar Hills volcano-tectonic depression (Seager, 1973). The east half of Corralitos Ranch quadrangle consists essentially of three north-trending fault blocks separated by the Cedar Hills and Ward Tank faults. Both of these are high-angle normal faults, down to the east. Tilting of the blocks has produced a westerly dip for all the strata. The Cedar Hills fault can be traced southward to the north end of the Rough and Ready Hills where the fault either dies out, bifurcates, or is lost in the massive rhyolite dome complexes or valley alluvium cover. Several small travertine quarries are located along this fault in the Cedar Hills. The massive well-banded, coarsely crystalline, varicolored travertine is more commonly known as "Radium Springs marble." It was deposited in open fissures along the Cedar Hills fault zone. The Ward Tank fault continues southward into the southeastern quarter of the Corralitos Ranch quadrangle (sheet 2) to Kimble Tank. The lack of faults shown in the western block is probably due to the fact that they cannot be detected in the thick, poorly exposed, Palm Park Formation.

A series of west-northwest-trending faults and fractures near the center of sheet 1 pose an interesting problem as to their cause. The Ward Tank fault bifurcates in the same area, and the western branch appears to die out 3 miles north. Perhaps this bifurcation and more intense fracturing was due to increased, or differently oriented, stresses around the knot of rhyolite domes east of this area.

The central Sleeping Lady Hills are crossed by a northeast-trending graben a little more than a mile wide. The highest parts of the hills are actually downthrown about 500 to 600 ft relative to the blocks on either side. Dips within the graben are mostly to the southwest, differing from the general westerly dips in adjacent blocks. These relations indicate that the graben was formed as a result of magma withdrawal from below and eruption from the Uvas vents in the graben area.

The complex faulting and landslides in the northwest corner of the map is part of the Sierra de las Uvas dome described by Clemons and Seager (1973) and Seager, Clemons, and Hawley (1975). The complex faulting and intrusive activity of the Cedar Hills is the subject of another report by Seager and Clemons (in press).

SLEEPING LADY HILLS SECTION

Westward from NW¼SW¼ sec. 11, T. 23 S., R. 2 W. to western edge of NE¼SE¼ sec. 10; offset 0.8 mile north, then southwestward to crest of Sleeping Lady Hills.

Color code (in parentheses) from soil color charts by Munsell Color Co., Inc.

Measured by R. E. Clemons, October 3, 1974.

Unit	Lithology	Thickness (ft)
	Uvas Basaltic Andesite (total thickness)	225
24	Andesite flow; dark-gray (N3); porphyritic with plagioclase and pyroxene phenocrysts up to 1 cm; cliff former; caps highest ridges	115
23	Andesite flow(s); dark-gray (N3); same as unit 24 except is a slope and ledge former	60
22	Andesite flow; same as above units; cliff former; 6- to 36-inch scoria breccia zone at base	50
	Bell Top Formation (total thickness)	940
	Upper sedimentary member (total thickness)	329
21	Muddy fine sandstone; tuffaceous matrix; pale-yellowish-brown (10YR6/2); porous; poorly developed, massive bedding; rounded scoria pebbles in upper 20 ft; upper 5 to 6 ft is red due to oxidation under the andesite flow; slope former	209
20	Coarse sandy pebble conglomerate; few cobbles; well-cemented with chalcedony; 6- to 12-inch beds; some channel fills; ledge former	11
19	Medium sandstone; tuffaceous matrix; pale-yellowish-brown (10YR6/2); porous; poorly bedded; replaced in part by tongues of Uvas andesite to northwest and southeast; slope former	19
18	Coarse sandy pebble conglomerate; same as unit 20	11
17	Pebbly coarse sandstone; gradational upward into tuffaceous medium sandstone; grayish-orange (10YR7/4); porous, poorly cemented, thin- to medium-bedded; few, scattered clasts of Tuff 3 and Bell Top andesite; slope former	63
16	Cobble conglomerate; few boulders up to 18 inches; gradational upward to pebble conglomerate; abundant clasts of Tuffs 3, 4, 6, and Bell Top andesite in sandy clay matrix; slope former	16
	Tuff 6 member (total thickness)	101
15	Vitric-crystal to crystal-vitric ash-flow tuff; grayish-pink (5R8/2) to pale-red (5R6/2); abundant yellowish-gray (5Y8/1) pumice fragments; densely welded; plagioclase, sanidine, quartz, and biotite crystals; 3- to 5-ft, poorly welded basal zone; upper part contains fewer crystals and pumice fragments; ledge and slope former	101
	Northwest-trending normal cross fault, down to the northeast, repeats most of unit 15	
14	Crystal-vitric ash-flow tuff; same as unit 15	84
	Middle sedimentary member (total thickness)	67
13	Tuffaceous mudstone; grayish-orange-pink (10R8/2); mostly covered; slope former	37
12	Pebble conglomerate; poorly cemented; mostly covered; slope former	4
11	Tuffaceous mudstone; similar to unit 13	15
10	Pebble conglomerate; similar to unit 12	1
9	Tuffaceous mudstone; similar to unit 13	10
	Tuff 4 member (total thickness)	22
8	Vitric-crystal ash-flow tuff; grayish-red (5R4/2); medium welded; flattened, darkened pumice fragments; few lithic fragments; sanidine and biotite crystals; ledge former	22
	Upper tuffaceous sedimentary member (total thickness)	34
7	Conglomeratic mudstone; grayish-orange (10YR7/4); boulders up to 2 ft in matrix of clay and crystal fragments; clasts are mostly Tuff 3 and Bell Top andesite, with few Palm Park exotics; mostly covered; slope former	34
	Tuff 3 member (total thickness)	350
6	Vitric ash-flow tuff; pale-red (10R6/2); moderately welded; very few rock fragments and sanidine crystals; slope former	50
5	Vitric ash-flow tuff; very pale orange (10YR8/2); moderately welded; abundant, small, darkened pumice and rock fragments; gradational downward into unit 4; slope former	70
4	Vitric ash-flow tuff; grayish-orange-pink (5YR7/2); medium welded; abundant, small, flattened, darkened pumice and rock fragments; gradational downward into unit 3; ledge former	100
3	Vitric ash-flow tuff; very pale orange (10YR8/2); moderately welded; abundant, small, darkened pumice and rock fragments; gradational downward into unit 2; slope former	110
2	Vitric ash-flow tuff; pale-pink (5RP8/2); poorly welded to nonwelded; few rock fragments and abundant very light gray (N8) pumice fragments; mostly covered; slope former	20
	Lower tuffaceous sedimentary member (total thickness)	37
1	Slightly conglomeratic, sandy mudstone; grayish-pink (5R8/2); few, scattered clasts of Palm Park in a clay and tuffaceous matrix; few, thin, sandy beds; mostly covered; slope former; base not exposed	37

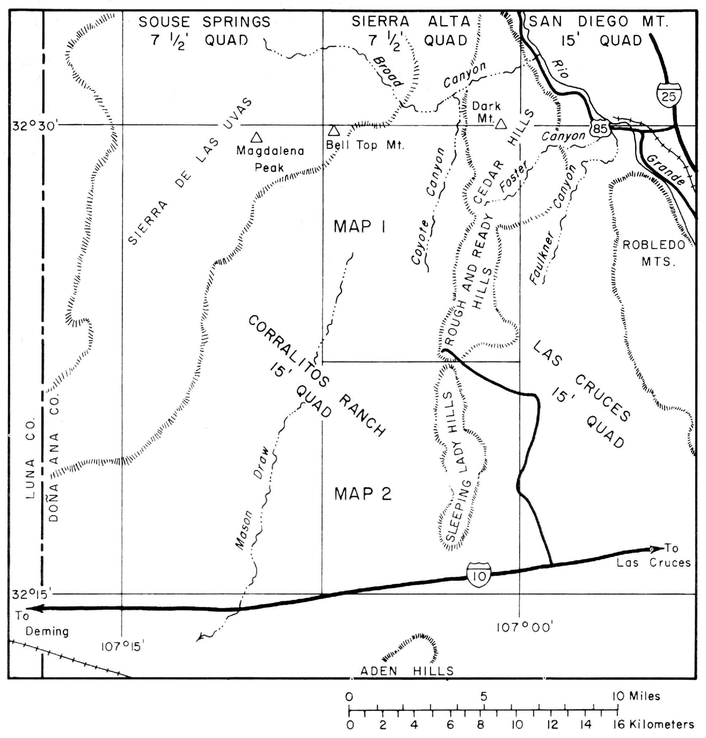


FIGURE 1—Index Map Showing Location of Study Area.

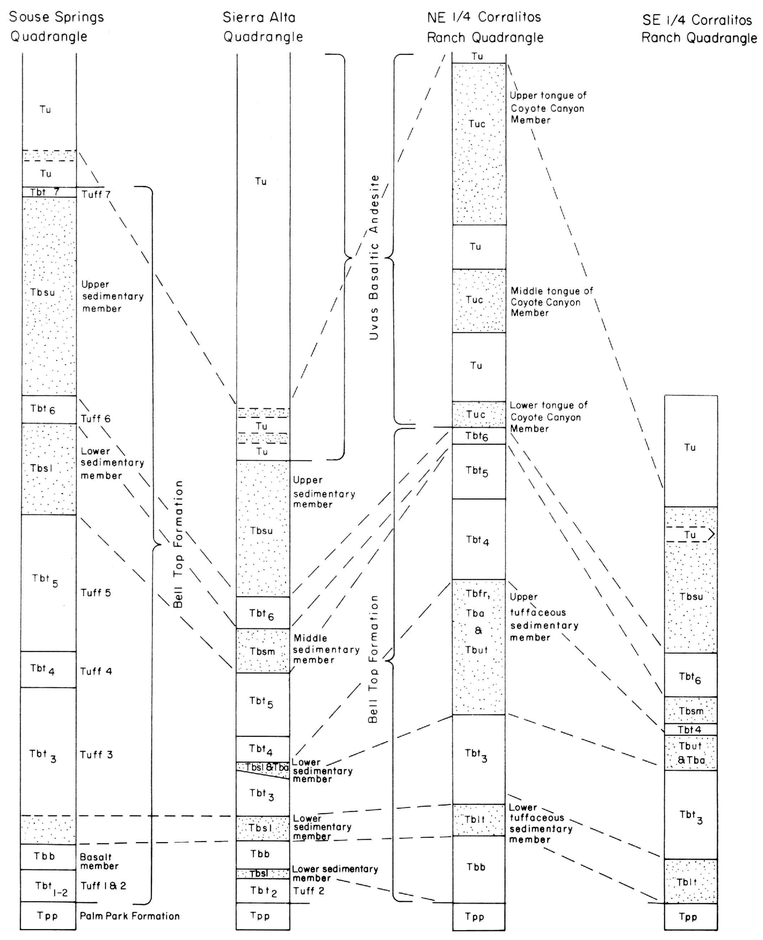


FIGURE 2—Correlation of Uvas Basaltic Andesite Units and Bell Top Formation Members.

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