VOLCANIC GEOLOGY OF THE DAVIS MOUNTAINS, TRANS-PECOS TEXAS: SECOND-YEAR REPORT

Christopher D. Henry

Prepared for the
U.S. Geological Survey
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CONTENTS

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INTRODUCTION

This report describes the results of the second year of mapping of the volcanic rocks of the Davis Mountains, Trans-Pecos Texas. The Davis Mountains (fig. 1) constitute a major part of the eastern, alkalic belt of the Trans-Pecos volcanic field (Barker, 1977; Price and others, 1986). Yet, because of their volcanic and stratigraphic complexity, the Davis Mountains remain the most poorly mapped and least understood part of the field. Published geologic maps of the area (the Fort Stockton and Marfa sheets of the Geologic Atlas of Texas (McKalips and others, 1982; Twiss, 1979) are based on regional, aerial photographic extrapolation of formations established in a few detailed studies.

The volcanic geology of the Davis Mountains is interesting because it is a large-scale example of alkalic continental volcanism, comparable in areal extent and volume to major calcalkalic fields such as the San Juan Mountains of Colorado. All igneous rocks are alkalic; several are peralkaline. The volume of individual volcanic units is much greater than that in most peralkaline volcanic fields (Mahood, 1984). Unusual volcanic rock types in the Davis Mountains include rheomorphic ash-flow tuffs in which extreme secondary flow largely obscures pyroclastic origin and large-volume, extensive silicic lavas (Henry and others, 1988; 1989). Although unusual, similar rock types are being recognized

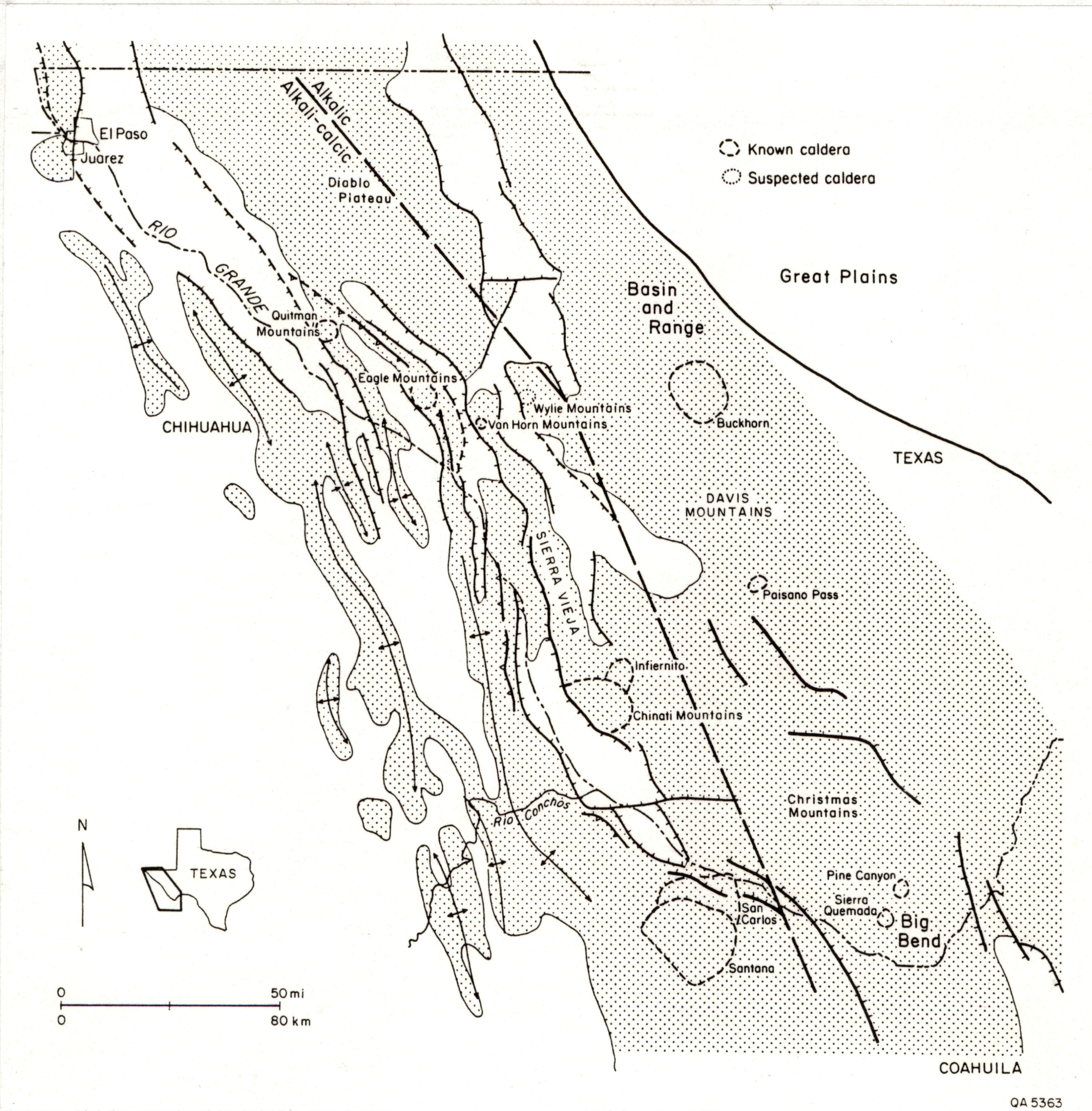


Figure 1. Index map of Trans-Pecos Texas, showing the Davis Mountains, Basin and Range province, known and suspected calderas, and alkalic and alkali-calcic belts of volcanism.

worldwide; their origin is actively debated. Detailed study of the Davis Mountains examples will help with the identification and understanding of their origin.

This report builds upon, and largely does not repeat, information from last year (Henry, 1988). Much of the new mapping involves stratigraphic units previously recognized and described. Therefore, only new units and new information about established units are discussed here. Last year's report (Henry, 1988) provides details of the stratigraphy, previous work, and regional geologic setting.

Present Work

Geologic mapping of the Davis Mountains as part of COGEOMAP began in the eastern and southeastern part of the area, where the volcanic stratigraphy seemed simplest and best studied. Significant mapping and correlation problems existed even there, however. During the second year, the mapping has been extended to the west (Figs. 2, 3). This work has revealed a volcanic stratigraphy significantly different and far more complex (Fig. 4) than that depicted on the Marfa and Fort Stockton sheets of the Geologic Atlas of Texas. Several rock units were clearly never recognized in previous regional or detailed mapping. Additionally, the same formational names were assigned to vastly different units by different workers.

Geologic mapping was done on 1:24,000 color and black-and-white aerial photographs. The mapping was compiled on 1:24,000-scale 7.5-minute quadrangle maps. Regional to detailed mapping to date covers all or major parts of sixteen 7.5-minute quadrangles (Fig. 2). Correlations are based primarily on standard field and petrographic methods. Geochemical data have been used to supplement field interpretations. Additionally, samples were prepared for isotopic dating by

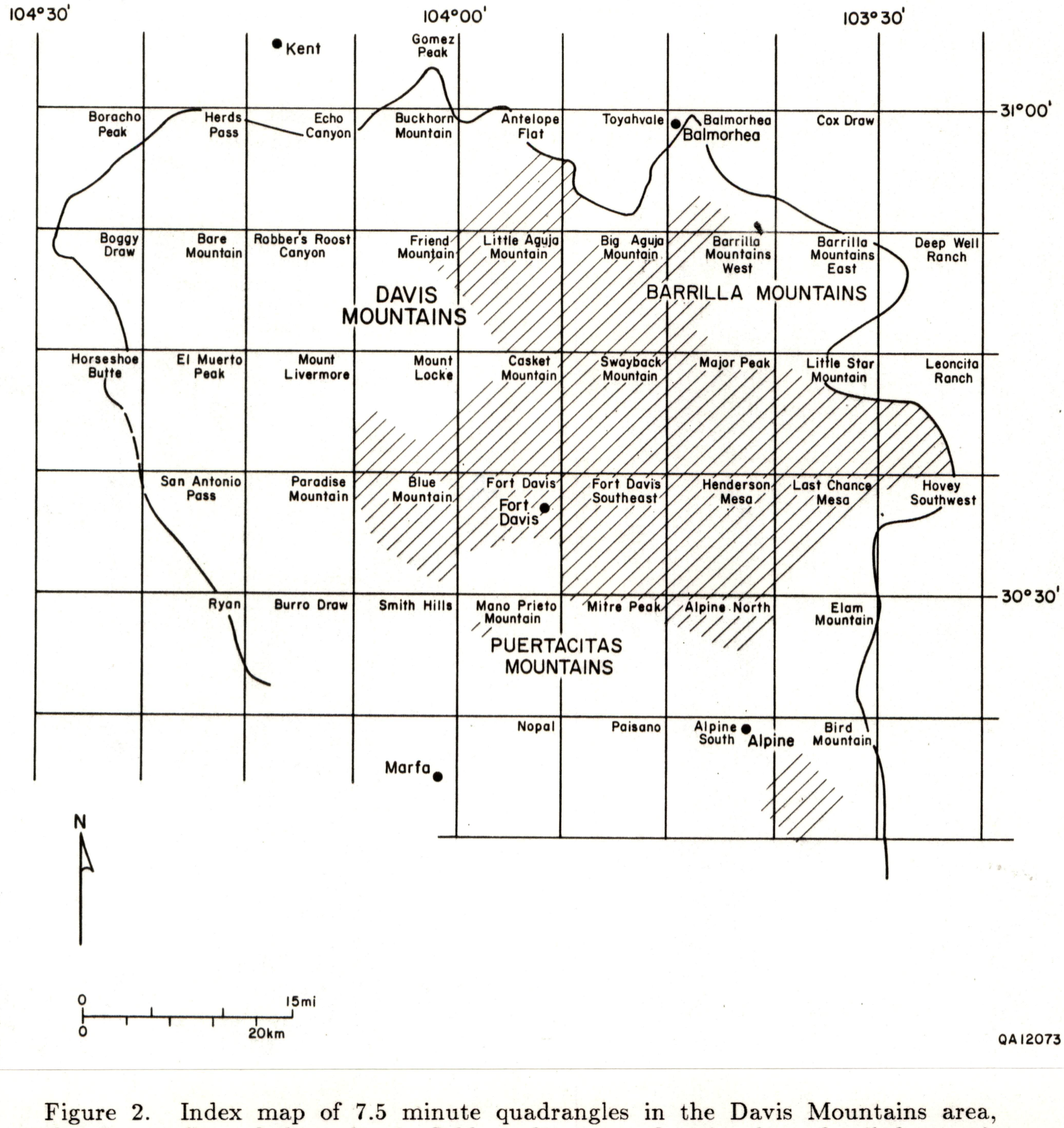


Figure 2. Index map of 7.5 minute quadrangles in the Davis Mountains area, showing outline of the volcanic field, and extent of regional or detailed mapping in this study.

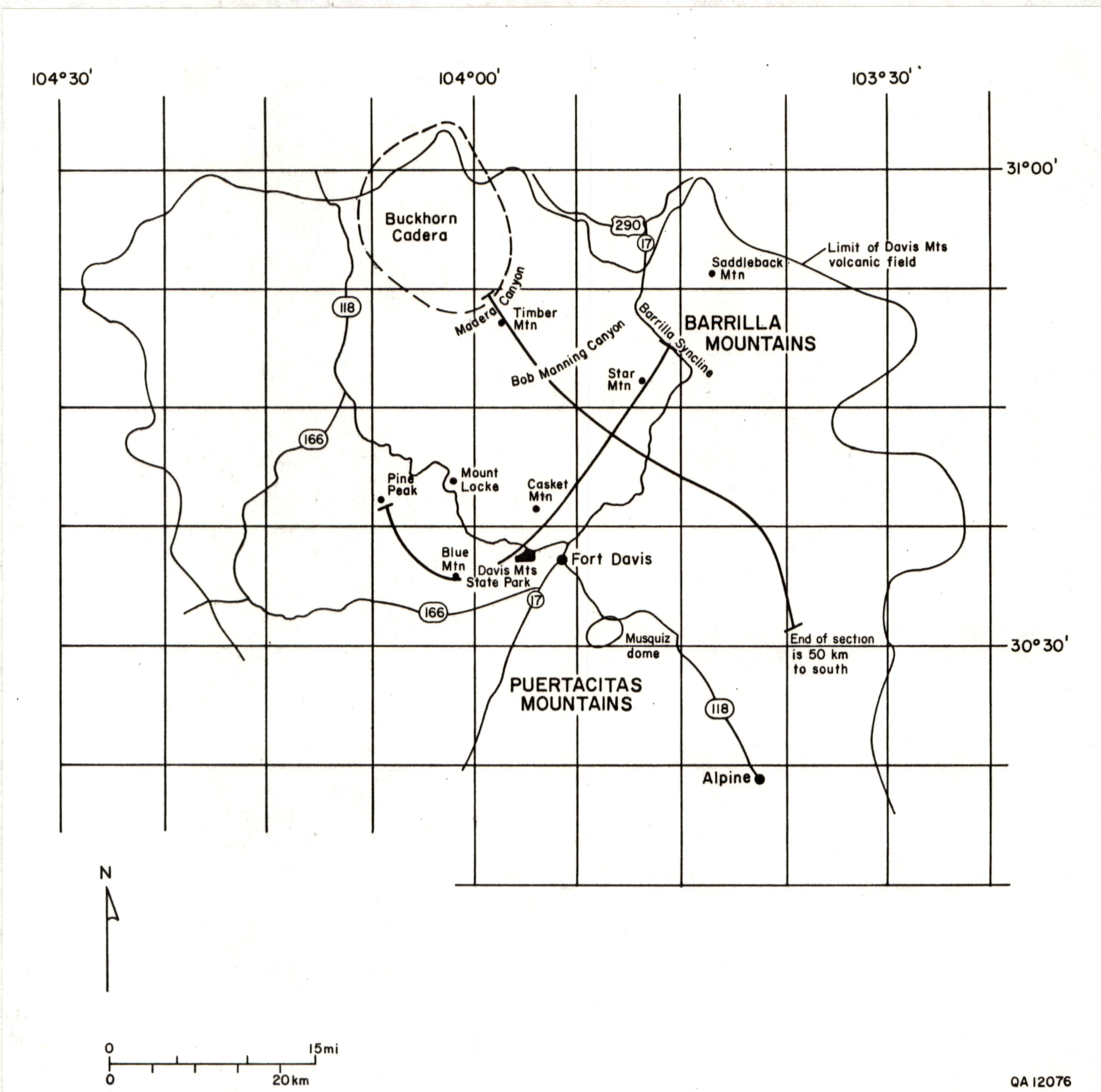
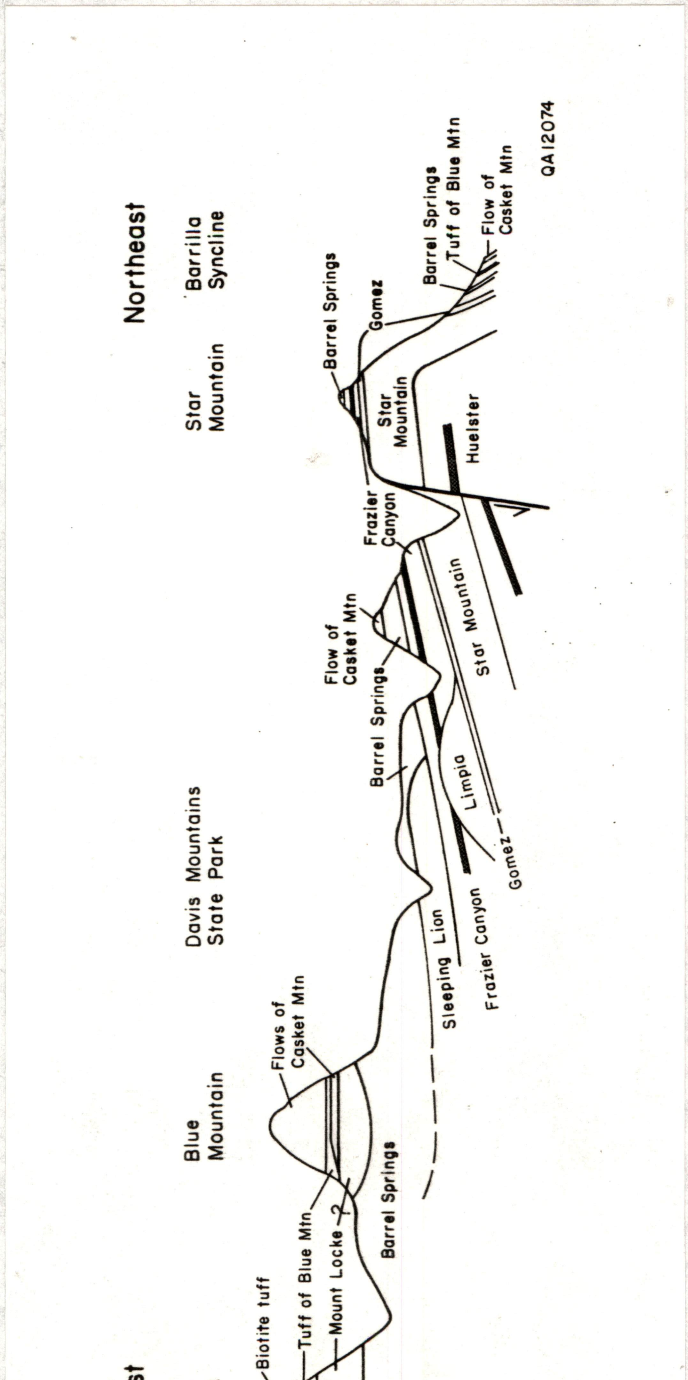


Figure 3. Index map of topographic locations discussed in text and section lines of Figure 4.


West
Northeast
Pine Peak
Blue Mountain
Davis Mountains State Park
Star Mountain
Barrilla Syncline
Biotite tuff
Tuff of Blue Mtn
Mount Locke
?
Barrel Springs
Flows of Casket Mtn
Barrel Springs
Sleeping Lion
Frazier Canyon
Gomez
Limpia
Barrel Springs
Flow of Casket Mtn
Star Mountain
Frazier Canyon
Star Mountain
Huelster
Barrel Springs
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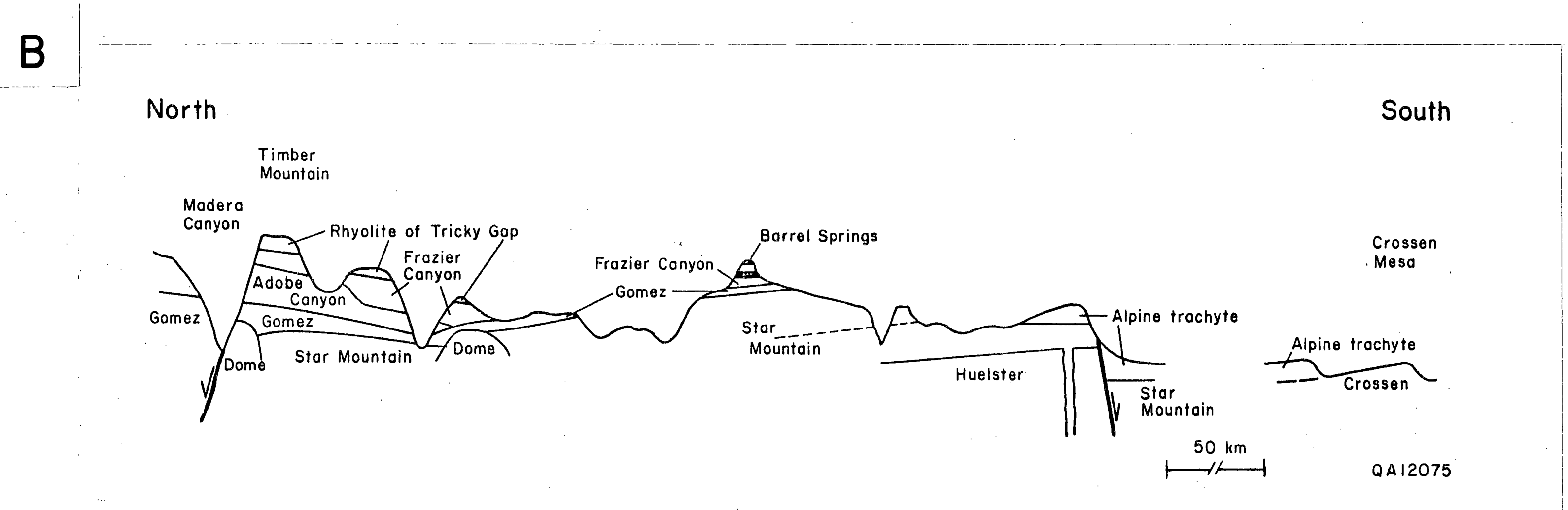

Figure 4. Generalized stratigraphy and correlation of volcanic units of the southern and eastern Davis Mountains. (A) Correlation from Pine Peak (Mount Locke quadrangle), through Blue Mountain and Davis Mountains State Park, to Barrilla syncline. Patterned zones in Frazier Canyon and Huelster Formations are mafic lavas. (B) Correlation from Buckhorn caldera (northern Davis Mountains) through eastern Davis Mountains. Southern end of section represents a 50-km-long jump to south.

the $^{40}Ar/^{39}Ar$ method, which will also aid correlation as well as establish the relative and absolute timing of volcanism.

Regional Geologic Setting

The Davis Mountains are part of the Trans-Pecos volcanic field, which was active between 48 and 17 Ma ago (Henry and McDowell, 1986; Henry and others, 1986). Volcanism in Trans-Pecos occurred in two distinct tectonic settings: a probable continental volcanic arc up to about 31 Ma ago and Basin and Range extension thereafter (Price and Henry, 1984; Henry and McDowell, 1986). The volcanic field is part of a much larger volcanic province that continues westward into Mexico to include the Sierra Madre Occidental and northward at least into the Mogollon-Datil field in New Mexico.

The Davis Mountains were active from 38 to at least 36 Ma ago during the continental arc phase of Trans-Pecos magmatism (Parker and McDowell, 1979; Henry and others, 1986). The beginning of volcanism in the Davis Mountains coincides with a marked regional increase in the volume of eruption and by the beginning of major caldera-related volcanism (Henry and Price, 1984).

STRATIGRAPHY

Star Mountain Formation

New information concerning the Star Mountain Formation includes its overall distribution, correlation with Crossen Trachyte, $^{40}Ar/^{39}Ar$ age, source, and origin as a series of lava flows. The easternmost outcrop shown as Star Mountain Formation on the Fort Stockton sheet is Quaternary gravel composed of a wide range of volcanic rock fragments as well as several pieces of Cretaceous limestone. This outcrop is approximately 10 km east of definite occurrences of the formation. Reconnaissance in the northern Davis Mountains, along a northwestern continuation of the Barrilla syncline, shows that areas mapped as Tertiary intrusion are really upper flows of the Star Mountain. This new information modifies the areal extent of the formation.

New detailed mapping at the southernmost occurrence of Star Mountain Formation and in the type locality of Crossen Trachyte clarifies their relationship and reveals a new unit that overlies both. The Fort Stockton sheet alternatively shows the Star Mountain Formation overlying Crossen Trachyte (Musquiz dome; Fig. 3) or abutting it abruptly (17 km north of Alpine). Neither of these alleged occurrences are true Crossen Trachyte. The rock in Musquiz dome is a mafic trachyte stratigraphically within the Huelster or Pruett Formations and lithologically unlike Crossen Trachyte. Crossen Trachyte in the second area is a less porphyritic and slightly more mafic trachyte than the Star Mountain Formation. I informally term this rock the Alpine trachyte (discussed below). It distinctly overlies Star Mountain and includes several areas depicted as Star Mountain on the atlas. The atlas shows Alpine trachyte as Crossen Trachyte in a continuous belt to the type locality of Crossen Trachyte. In that area, the Alpine trachyte is not in contact with, but is probably younger than, true Crossen Trachyte (Fig. 4). This new information further supports the previous contention that the Star Mountain Formation and Crossen Trachyte are similar lavas in the same stratigraphic position. Isotopic dating to test this hypothesis is underway.

An alkali feldspar seperate from the main, upper flow in the Limpia Canyon area has been dated by the $^{40}Ar/^{39}Ar$ method. The sample gives an excellent plateau defining an age of 36.8 Ma. This age is identical to that obtained from samples of overlying Gomez Tuff. Several additional feldspar separates, representing the complete stratigraphic and geographic range of the formation, have been prepared for analysis.

A feeder dike for at least part of the Star Mountain Formation crops out at the souternmost limit of the formation. The north- northwest-trending dike is at least 2 km long, and its northern extent is covered by Star Mountain flows. It ranges from about 50 to as much as 200 m wide. However, these values were measured at what was the surface at the time of emplacement. The dike intrudes tuffaceous sediments of the Huelster Formation, which were unlithified at the time. Thus the dike may narrow considerably at depth. The dike is petrographically identical with, and continuous into, the flow it feeds. It has a chilled, glassy zone at the margin. Vertical flow bands in the dike turn abruptly to horizontal at the top of its outcrop where it passes into the flow.

Several features indicate unequivocally that the Star Mountain Formation is a series of silicic lava flows of unusually large volume and areal extent. Lava-flow features cited in last year's report include flow bands and folds, basal and upper breccias, upper vitrophyres, and elongate vesicles. Additionally, the unit lacks any pyroclastic features. New evidence includes the feeder dike and evidence for thick flow fronts. The dike is typical of feeders to lavas of all compositions, but it is unlike any source identified for pyroclastic flows. Additionally, the Star Mountain Formation clearly does not pond within any depression that could be interpreted as a caldera.

In contrast to pyroclastic flows, including rheomorphic tuffs, which thin to vanishing at their distal ends, the Star Mountain Formation is uniformally thick throughout its outcrop. At its most distal outcrops, the Star Mountain is at least 40 m thick. Additionally, several definite flow fronts have been identified. At one location, an upper Star Mountain flow terminates in a face approximately 110 m thick; a lower flow continues. That this is a primary flow front is demonstrated by the presence of Gomez Tuff overlying both upper and lower flows. Because isotopic $^{40}Ar/^{39}Ar$ ages of the Gomez Tuff and Star Mountain Formation are indistinguishable, the Gomez Tuff must have erupted no more than 200,000 years (the analytical uncertainty in the method) after the Star Mountain. Probably the time between their eruptions was considerably less than this. This is insufficient time for erosion to have removed a much more extensive, tapering upper Star Mountain flow.

Crossen Trachyte

Detailed mapping in the type area of the Crossen Trachyte approximately 40 km south of the southeastern end of the Davis Mountains clarified its overall distribution and its relation to surrounding rocks and to the Star Mountain Formation. Based on geologic mapping by McAnulty (1955) and Goldich and Elms (1949), the Geologic Atlas shows the Crossen cropping out continuously from its type area to the Davis Mountains. However, most of this outcrop belt consists of a more mafic lava, the informally named Alpine trachyte. At its northern end the Crossen approaches, but is not in contact with, the Alpine trachyte. Nevertheless, they are distinctly different rocks, and extrapolation along strike suggests that the Crossen underlies the Alpine trachyte. In turn, this relation indicates the Crossen and Star Mountain lavas are approximately contemporaneous.

Alpine Trachyte (informal)

A quartz trachyte lava flow that crops out in a 50-km-long south-trending belt south of the Star Mountain Formation is informally named the Alpine trachyte. It overlies the Star Mountain Formation at its northern end. Throughout most of its outcrop it overlies tuffaceous sediments of the Pruett Formation. As noted, at its southern end it occurs stratigraphically above, but not in contact with, the Crossen Trachyte. It is overlain by the Sheep Canyon Basalt throughout much of the area south of Alpine (McAnulty, 1955) and by thin, distal Gomez Tuff in the north. Petrographic similarity of the rock where it has been examined in the northern, central, and southern parts and apparent continuity along its outcrop suggest that it is a single flow.

Throughout its area, the Alpine trachyte is a thick, massive, crudely columnar-jointed flow. Locally, it shows faint flow bands and trains of elongate vesicles. The flow is approximately 110 m thick at its northern edge. McAnulty (1955) reported a thickness of 80 m about 20 km southeast of Alpine.

Samples from the northern, central, and southern parts all contain 4 to 5% alkali feldspar phenocrysts and glomerocrysts to 5 mm long. Grid twinning indicates that these are calcic anorthoclase. Sparse, former clinopyroxene phenocrysts are altered to iron oxides. Chemical analyses indicate that it is a quartz trachyte containing about 66% SiO_2 (Nelson and others, 1986).

McAnulty (1955) mapped the Alpine trachyte as Crossen Trachyte. However, it is distinctly finer grained, less porphyritic, and more mafic than the Crossen or flows of the Star Mountain Formation. Nevertheless, it probably represents a continuation of lava eruption similar to both those units. An alkali feldspar separate for $^{40}Ar/^{39}Ar$ dating has been obtained from the Alpine trachyte.

Unnamed Rhyolitic Domes

Rhyolitic domes, discovered in the northeastern Davis Mountains during the first year's mapping, are even more extensive than recognized then. The domes are most abundant in a 20-km^2 area around Bob Manning Canyon (Fig. 3) and Big Aguja Mountain. Examination of aerial photographs suggests that the domes extend southwestward, beyond the area of detailed mapping. Around Bob Manning Canyon, most domes are biotite bearing, but peralkaline varities are also present. Thus, metaluminous and peralkaline types, which previously seemed to be widely separated, occur in proximity. All newly recognized domes overlie the Star Mountain Formation and underlie the Gomez Tuff.

The biotite-bearing rhyolitic domes were probably the source of at least part of the biotite-bearing air-fall tuff and tuffaceous sediment that commonly occurs between the Star Mountain Formation and Gomez Tuff. An alkali feldspar separate for dating by the $^{40}Ar/^{39}Ar$ method has been obtained from the peralkaline rhyolite dome at Saddleback Mountain (Fig. 3).

Gomez Tuff

New work on the rheomorphic Gomez Tuff includes extending its known areal distribution, collection of size data on lithic clasts to help identify a source, and age determination by the $^{40}Ar/^{39}Ar$ method. The Gomez Tuff occurs considerably farther south than previously recognized, to approximately 10 km north of Alpine. Two features of the Gomez distinguish it as a rheomorphic tuff from a large-volume, extensive silicic lavas. The Gomez Tuff easily surmounted topographic barriers, such as the rhyolitic domes, thinning only slightly over the domes. In contrast, several silicic lavas terminated against the domes. Additionally, the Gomez Tuff thins to no more than 2 m in distal outcrops. The lavas show negligible thinning and, even at their most distal outcrops, are more than 40 m thick.

Lithic clast sizes were measured in 21 outcrops of Gomez Tuff across its southeastern extent. Maximum clast size clearly decreases toward the southeast away from the postulated Buckhorn caldera, which Parker (1986) suggested was the source of the Gomez Tuff. This pattern is consistent with his interpretation.

However, further mapping and determination of thickness and clast sizes of the Gomez, particularly west of the Buckhorn caldera, is necessary to confirm this interpretation.

Alkali feldspar separates from Gomez Tuff from four locations east and southeast of the Buckhorn caldera were analyzed by the $^{40}Ar/^{39}Ar$ method. Three of the samples show excellent plateaus that define an age of 36.8 Ma, identical to that of the underlying Star Mountain Formation. In one sample, higher temperature gas fractions show progressively higher ages, to 39 Ma, and no plateau was obtained. This pattern probably reflects incorporation of xenocrysts in the tuff. The xenocrysts could have come either from Precambrian metamorphic rocks, which occur in the subsurface, or from older Tertiary volcanic rocks. The former is more likely because little Precambrian material would be needed to increase the apparent age, and no Tertiary rocks old enough to produce the pattern are known in the Davis Mountains.

Adobe Canyon Formation

The Adobe Canyon Formation includes a group of moderately to sparsely porphyritic rhyolite lavas that crop out in the northeastern and northern Davis Mountains. Where observed in the northeast in this study, the flows overlie Gomez Tuff and underlie tuffaceous sediments of the Frazier Canyon Formation. However, farther west, a sedimentary interval separates the Adobe Canyon Formation and Gomez Tuff (Parker, 1972), and the Frazier Canyon sediments may pinch out (Anderson, 1968). Previous mapping indicated that the flows are a heterogeneous assemblage that were combined because they occur in the same stratigraphic position. Mapping during the present study indicates additional and more widely distributed "Adobe Canyon" flows. To the extent exposures allow, these flows are being mapped separately.

Flows of the Adobe Canyon Formation are extensive in the northeastern Davis Mountains. The Marfa and Fort Stockton sheets of the Geologic Atlas show the formation composing nearly the entire outcrop of the northwestern Davis Mountains. Current mapping indicates two or three flows in the Little Aguja Mountain quadrangle (Fig. 2). In the northwestern part of the quadrangle, the formation is as much as 300 m thick. The formation thins in abrupt steps to the southeast as flows terminate. In the south-central part of the quadrangle the most extensive flow is 60 to 70 m thick before terminating against a topograpahic barrier created by one of the rhyolite domes. A single flow that is uniformly about 80 m thick crops out to the south in the Casket Mountain and Swayback Mountain quadrangles. Flows in these two areas may be in contact in the subsurface to the west. However, no Adobe Canyon flows were deposited in an area along the boundary between the Little Aguja Mountain and Casket Mountain quadrangles (Fig. 2). Individual flows can be traced for as much as 15 km.

As noted, the formation consists of several flows. Each has a thin basal breccia, a thick massive to strongly flow-banded and flow-folded interior, and a thick upper breccia. Flow bands are horizontal and discontinuous in the lower part, becoming more continuous and contorted upward. Just below the upper breccia they form steep ramps. Erosion of the upper breccia creates a characteristic jagged surface and a bench that can be used to separate different flows. However, discontinuous benches can also develop within the interior of flows. The upper breccia of the highest flow at any location is commonly composed of vitrophyric clasts, whereas the rest of the flows, including upper breccias below additional flows, are totally crystalline.

Three petrographic types have been recognized in the Adobe Canyon Formation on the basis of phenocryst abundance. One is aphyric, one has 2 to

3% phenocrysts, and the third has 6 to 8% phenocrysts. The dominant phenocryst is clear, unzoned alkali feldspar, probably sodic sanidine, in individual grains and glomerocrysts up to 5 mm long. Clinopyroxene, apatite, zircon, and an opaque mineral are minor constituents. The groundmass in crystalline samples generally shows snowflake texture of intergrown quartz and alkali feldspar.

Flows in the northern area include the aphyric and the most porphyritic varieties; the latter overlies the former. The aphyric flow is the most extensive and the one that terminates against the rhyolite dome. The newly recognized southern flow has intermediate phenocryst abundance.

The distribution, total thickness, and number of flows suggest a source to the west, outside the area currently mapped. Alkali feldspar separates for isotopic dating by the $^{40}Ar/^{39}Ar$ method have been prepared from samples of the two porphyritic flows.

Limpia Formation

Mapping of the Limpia Formation was completed during the first year. It occupies the same stratigraphic position but is lithologically unlike the Adobe Canyon Formation. Their relative ages are unknown. An alkali feldspar separate has been prepared for $^{40}Ar/^{39}Ar$ dating.

Frazier Canyon Formation

The Frazier Canyon Formation is a sequence of tuffaceous sediments containing interbedded mafic lavas. As with many nondescript tuffaceous units in Trans-Pecos Texas, the formation was defined by its confining beds. The Frazier Canyon Formation variably overlies the Star Mountain Formation, Gomez Tuff, Adobe Canyon Formation, or Limpia Formation. In turn, it is overlain by the

Sleeping Lion or Barrel Springs Formation. Because some of the confining units are themselves composite, the contacts represent a variety of stratigraphic levels. In general, the sediments blanketed the flow rocks of the eastern Davis Mountains during a significant hiatus in eruption there.

Because they make distinctive marker beds, our mapping emphasized the interbedded mafic lavas. These lavas are thickest and most numerous in the southeastern Davis Mountains and thin to the north and west. Although present in most of the eastern Davis Mountains and Barrilla Mountains, they are absent in the Little Aguja Mountain and most of the Casket Mountain quadrangles (Figs. 2, 3). Most lavas are aphyric to sparsely porphyritic basalts, containing plagioclase phenocrysts up to 2 mm long. Groundmass consists of plagioclase, clinopyroxene, magnetite, and apatite. One flow in the eastern part of the Casket Mountain quadrangle is more coarsely and abundantly porphyritic. This contains 20% phenocrysts, mostly of plagioclase and anorthoclase, with minor clinopyroxene, altered olivine(?), opaques, apatite, and zircon. Plagioclase occurs as oscillatory zoned laths up to 5 mm long. Anorthoclase occurs as extensively resorbed rhombs up to 14 mm long. This rock is petrographically similar to lavas of the Mount Locke Formation, which occurs in the central Davis Mountains at a much higher stratigraphic level. Apparently similar rock types erupted at significantly different times. Lithology alone is not sufficient for correlation.

The distribution and stratigraphic position of the mafic lavas suggest that they could be in part distal flows related to the extensive Cottonwood Springs and Sheep Canyon Basalts southeast of the Davis Mountains. No feeder dikes or thick local accumulations have been found that could indicate local sources. However, it seems unlikely that the most northerly flows could all have gone from distant southern sources. Plagioclase separates for $^{40}Ar/^{39}Ar$ dating have been obtained from both the Frazier Canyon and southern lavas to constrain their age and possible correlation.

Sleeping Lion Formation

Mapping during the second year extended the outcrop of the Sleeping Lion Formation to the south and west and decreased its extent to the northeast. Additionally, examination of ramp structures casts doubt on an earlier interpretation of flow patterns. Two ages were determined by the $^{40}Ar/^{39}Ar$ method.

The Sleeping Lion Formation was found beneath the Barrel Springs Formation south of Blue Mountain (Fig. 3), well to the west of previously known locations. In contrast, several outcrops shown as Sleeping Lion Formation northeast of Fort Davis on the Geologic Atlas are not. Commonly, these consist of the lower, rheomorphic tuff part of the Barrel Springs Formation. A probable flow front of the Sleeping Lion Formation appears to be preserved approximately 7 km northeast of Fort Davis, north of Highway 17 (Fig. 3). This outcrop has only been examined from aerial photographs and with binoculars from the highway because the property owner has not yet granted access. However, the Sleeping Lion appears to terminate abruptly, thinning from approximately 70 m thick to nothing in 500 m. The overlying basal flow of the Barrel Springs, probably the rheomorphic tuff on Davis Mountains State Park, thickens abruptly across the flow front, from less than 10 m to 30 m.

On the basis of outcrop pattern and sparse ramp structures, Hicks (1982) (and last year's report) suggested that the Sleeping Lion Formation erupted from vents west of Fort Davis and flowed down a paleovalley, first northeast, then southeast and southwest. Examination of numerous ramp structures, including several in areas where Hicks reported measurements, does not support this interpretation. Many ramps appear to be symmetrical flow folds and do not indicate a definite flow direction. The available data suggest that the Sleeping Lion may have flowed more symmetrically outward from a center in the Fort Davis area.

Alkali feldspar separates from two samples of the Sleeping Lion Formation were analyzed by the $^{40}Ar/^{39}Ar$ method. Both samples gave excellent plateau ages of 35.9 Ma. These ages are significantly younger than those of the Star Mountain Formation and Gomez Tuff. The overall ages are consistent with the geologic evidence of a significant hiatus between eruption of the different units as indicated by the Frazier Canyon Formation.

Barrel Springs Formation and Similar Rocks

Some of the most pronounced mapping and stratigraphic problems in the Davis Mountains concern the Barrel Springs Formation. The formation as currently depicted on the Marfa and Fort Stockton sheets of the Geologic Atlas of Texas is an areally extensive unit that is lithologically variable both vertically and laterally. Within the formation these published maps include rocks that clearly should be parts of other named formations. Other formations include rocks that are equally clearly more closely related to the Barrel Springs Formation. I have greatly restricted the vertical extent of the Barrel Springs Formation. It is still a laterally extensive unit but limited to a group of rocks that are more clearly stratigraphically and lithologically related. The greatest change in its lateral extent is in the southeastern Davis Mountains, in the northern part of the Mitre Peak quadrangle (Fig. 2). In that area, units mapped as Kennedy Ranch Member of the Duff Formation (Gorski, 1970) and assigned to the Barrel Springs Formation on the Geologic Atlas are now included with the flows of Casket Mountain (see below).

Rhyolite of Tricky Gap

The rhyolite of Tricky Gap is an informal name, originally assigned by Parker (1972), for what is depicted as the Sheep Pasture Formation on the Fort Stockton sheet in the northeastern Davis Mountains. Parker considered this unit to be petrographically and stratigraphically similar to the Sheep Pasture Formation, thus its designation on the Geologic Atlas. Although, as currently mapped, both the Sheep Pasture Formation and rhyolite of Tricky Gap underlie Barrel Springs Formation, the type Sheep Pasture Formation is aphyric rhyolite (Anderson, 1968) unlike the distinctly porphyritic rhyolite of Tricky Gap. The rhyolite of Tricky Gap is petrographically similar to the main units of the Barrel Springs Formation. It may, in fact, be simply a northern extent of one of the Barrel Springs flows. Thus it is being mapped separately and ultimately will either be a separate formation or a member of the Barrel Springs Formation.

The rhyolite of Tricky Gap everywhere overlies tuffaceous sediments of the Frazier Canyon Formation. In its northernmost extent, it is the stratigraphically highest preserved unit. Farther south, it underlies petrographically similar flows of the Barrel Springs Formation and locally flows of Casket Mountain (see below). However, it appears to be stratigraphically higher than some other Barrel Springs flows. Further work is needed to confirm its relation to the Barrel Springs Formation.

The unit crops out at least from the northern edge of the Little Aguja Mountain quadrangle south into the Casket Mountain quadrangle (Fig. 2).

Farther south, I have not yet been able to distinguish it from flows of the Barrel Springs Formation. The unit is thickest, approximately 140 m, in the southern part of the Little Aguja Mountain quadrangle. It thins to the north, to as little as 50 m on Timber Mountain (Fig. 3), but the top is eroded and its original thickness is unknown. To the south, confusion with the Barrel Springs Formation has so far prevented acccurately determining its thickness.

The rhyolite of Tricky Gap is a thick, brecciated to massive and flow-banded flow much like many other units in the Davis Mountains. A thin basal breccia is overlain by foliated massive rhyolite. The interior is crudely columnar jointed. Thick upper breccia constitutes as much as half of the flow.

The unit contains 5 to 8% alkali feldspar phenocrysts, as individual grains and glomerocrysts up to 5 mm in diameter. The clear, unzoned grains are probably sodic sanidine. Clinopyroxene is a minor phenocryst phase, and zircon and opaque minerals are accessories. It is petrographically similar to, but slightly less porphyritic than, Barrel Springs flows and similar to more porphyritic varieties of the Adobe Canyon Formation.

Barrel Springs Formation

The stratigraphy and correlation of the Barrel Springs Formation at four locations in a southwest-northeast transect, southwestern Davis Mountains, Blue Mountain, Davis Mountains State Park, and Barrilla syncline (Fig. 3), were discussed in last year's report. Detailed study from Blue Mountain to the Barrilla syncline greatly revises these views and indicates where more work needs to be done.

Many conclusions of last year's report are still valid. The Barrel Springs Formation overlies the Sleeping Lion Formation throughout most of its central extent and tuffaceous sediments of the Frazier Canyon Formation in the east. It is overlain by a variety of units, probably including the Mount Locke Formation and several units not previously defined but discussed below. The formation as it is now restricted consists of moderately porphyritic rhyolite, generally containing 10 to 12% phenocrysts of alkali feldspar, as individual grains and glomerocrysts to 5 mm, and minor clinopyroxene. A discontinuous foliation, horizontal in lower parts of flows but becoming folded upward, is characteristic. Parts of the unit, for example the lowest flow at Davis Mountains State Park, are strongly rheomorphic tuff. The origin of other parts, whether still more strongly rheomorphic tuff or lava, is uncertain.

Blue Mountain

In last year's report, the following units, from bottom to top, were included in the Barrel Springs Formation at Blue Mountain:

(1) two flow units that are lithologically similar to flows at Davis Mountains State Park and in the southwestern Davis Mountains; (2) a rheomorphic ash-flow tuff petrographically similar to the Barrel Springs Formation; and (3) a sequence of flows more abundantly and coarsely porphyritic than flows of the Barrel Springs Formation. These were thought to be petrographically transitional between the Barrel Springs and Mount Locke Formations.

This new work indicates that only the lowest flow units are part of the Barrel Springs Formation, that they consist of more than two flows, that they form a large structural paleovalley beneath Blue Mountain, that the valley is filled with mafic flows possibly correlative with the Mount Locke Formation, and that the rheomorphic tuff and coarsely porphyritic flows are separate, distinct units. The new, restricted Barrel Springs Formation at Blue Mountain consists of several flows. The exact number is unknown because they commonly do not form continuous ledges except on the west flank where there are clearly two flows.

The Barrel Springs Formation west, south, and east of Blue Mountain dip a few degrees beneath it; the upper surface of the formation forms a large paleovalley centered beneath the mountain. Where attitudes of individual flows can be determined, they follow this dip. Thus the valley is structurally rather than erosionally controlled.

Davis Mountains State Park and areas to the north

The stratigraphy established for the Barrel Springs Formation in Davis Mountains State Park has been extended northward into more central parts of the Davis Mountains. In the Casket Mountain quadrangle (Fig. 2), the formation consists of several flows. Three distinct cliff faces and intervening slopes, probably representing three separate flows, can be recognized in many locations and followed laterally for several kilometers. However, in several places it can be seen that one flow stops, and a similar flow at the same or a slightly different stratigraphic level continues. Because different flows are petrographically identical, it is not possible to determine the total number of flows or the extent of any individual flows. The rhyolite of Tricky Gap, which enters the quadrangle from the north, is an example of one such flow. It can only be followed laterally where it is a cap rock and therefore the only flow at the appropriate stratigraphic position. Once it joins other, similar flows, it cannot be distinguished.

Barrilla Syncline

In last year's report, three flows and interbedded tuffaceous sediments that are the stratigraphically highest preserved units in the Barrilla syncline (Fig. 3) were assigned to the Barrel Springs Formation. All three were considered ash-flow tuffs. Only the lowest unit (lava 3 of Eifler, 1951; member 1 of Parker, 1972), is now assigned to the formation, and its designation as a tuff is less certain. This unit is about 15 m thick and lithologically similar to other parts of the formation. The other two units include a thin (3 m thick) ash-flow tuff and a thicker (up to at least 30 m), probable lava flow that caps the section. These two flows are assigned to two informal units that are discussed below.

Correlation of Barrel Springs flows

The Barrel Springs Formation as it is now viewed in the southern and eastern Davis Mountains includes a petrographically distinctive set of flows. Mostly, individual flows and their outcrop expression are so similar that they cannot be further subdivided. However, the basal rheomorphic ash-flow tuff recognized at Davis Mountains State Park is tentatively correlated with the remaining flow in the Barrilla syncline. At the very least, the flow in the syncline can definitely be correlated in the Barrilla Mountains and eastern Davis Mountains, including the Balmorhea, Big Aguja Mountain, Barrilla Mountains West, Major Peak, Swayback Mountain, and Casket Mountain quadrangles (Fig. 2). Determining its relation with the the rheomorphic tuff in the park will require additional work in the southwestern part of the Swayback Mountain quadrangle.

Mount Locke Formation and Possibly Correlative Lavas

The Mount Locke Formation as defined by Anderson (1968) consists of coarsely porphyritic intermediate lavas (rhomb porphyry). These have been exmained in this study only at their southeastern edge as mapped by Anderson, at the type locality and Pine Peak in the Mount Locke quadrangle (Figs. 2, 3). At these locations the formation consists of numerous flows aggregating as much as 200 m thick. Some thinner, poorly exposed, but petrographically generally similar lavas interbedded with tuffaceous sediments appear to occupy the same stratigraphic position farther east in the central Davis Mountains and are tentatively assigned to the formation. They may represent distal portions of the formation that were reached by only a few flows.

The Mount Locke Formation including the possible correlatives discussed here overlie Barrel Springs Formation in all locations. It is overlain by what Anderson called the Wild Cherry Member of the Barrel Springs Formation, which includes what I informally designate the tuff of Blue Mountain. On Blue Mountain it is overlain by the flows of Casket Mountain.

The formation as depicted on the Geologic Atlas forms a northeast-trending belt through the central Davis Mountains. It is 175 m thick at the type locality (Anderson, 1968). The possible additions lie southeast of this belt into the southern part of the Casket Mountain quadrangle and in the paleovalley underlying Blue Mountain. The interval is about 150 m thick in the valley but approximately 25 m of this is sediment. In the southern Casket Mountain quadrangle the interval is only 50 m thick and is also partly sedimentary.

In the main outcrop belt, the formation consists of numerous flows generally 10 to 20 m thick with little or no interbedded sediment. In the possibly correlative areas, flows are similar but are interbedded with fine tuffaceous sediments. Both upper and lower breccias are present. The rock is massive to highly vesicular and generally highly oxidized.

Flows in the main outcrop belt are all coarsely and abundantly porphyritic. They contain about 30% distinct rhomb-shaped feldspars, some of which are glomerocrysts in rhomb shapes, up to 2 cm long. The feldspars are highly resorbed, have cores of either calcic anorthoclase or rarely plagioclase, and are irregularly zoned to more alkalic compositions. Thin, clear rims may be sanidine. Mafic phenocrysts are commonly oxidized but appear to have included both clinopyroxene and olivine. Rocks in the distal areas contain the same phenocryst assemblage but generally in lower percentages. Some flows are nearly aphyric.

The source of the Mount Locke flows is likely within the main outcrop belt in the central Davis Mountains. This area has not yet been examined in this study. General alteration of the rock and nearly ubiquitous resorption of feldspar phenocrysts will make sampling for isotopic dating difficult.

Flows of Casket Mountain

A suite of coarsely and abundantly porphyritic flows, probably mostly lavas, are informally termed the flows of Casket Mountain. They are named for excellent exposures of two such flows on Casket Mountain in the southeast corner of the Casket Mountain 7.5 minute quadrangle (Figs. 2, 3). Previous studies assigned these flows to the Barrel Springs, Mount Locke, Wild Cherry, or Duff Formations (Anderson, 1968; Gorski, 1970; Parker, 1972; Smith, 1975; Twiss, 1979; McKalips and others, 1982). However, the flows of Casket Mountain are neither lithologically similar nor in the same stratigraphic position as any of the first three formations, and the Duff Formation is a regional tuffaceous sediment unit. Over most of their outcrop, these flows are the highest preserved unit and rest upon parts of the Barrel Springs Formation. In the Barrilla syncline they overlie tuffaceous sediments that are included within the Barrel Springs Formation. At Blue Mountain and south of Fort Davis, they overlie sparsely porphyritic mafic trachytes. At both Blue Mountain and Casket Mountain, an ash-flow tuff (discussed below) occurs above the lowest Casket Mountain flow. The flows are overlain by coarsely porphyritic mafic trachyte in an area approximately 13 km northwest of Fort Davis.

The flows of Casket Mountain are extensive in the south-central Davis Mountains. At least four flows, in total 300 m thick, cap Blue Mountain, where they were formerly assigned to the Mount Locke Formation (Smith, 1975; Marfa sheet of Geologic Atlas of Texas). Blue Mountain is also their westernmost known limit. They do not occur in the section at Pine Peak on the Mount Locke quadrangle northwest of Blue Mountain (Figs. 2, 3), although their stratigraphic position is almost certainly exposed there. Northwest of Fort Davis, including Casket Mountain, at least two flows occur and total approximately 120 m thick. Casket Mountain flows are found at least as far north as the southern part of the Little Aguja Mountain quadrangle (Fig. 2). At their southern limit, south of Musquiz dome (Fig. 3), several flows have a total thickness of 130 m. These were initially mapped as the Kennedy Ranch Member of the Duff Formation (Gorski, 1970) and were included in the Barrel Springs Formation on the Geologic Atlas. Casket Mountain flows occur as far east as the Barrilla syncline, where a single flow is 10 m thick. This last flow was called lava 4 of the Seven Springs Formation by Eifler (1951) and was included within the Barrel Springs Formation on the Geologic Atlas. Correlation with outcrops in the central Davis Mountains is tentative, but the flow is petrographically identical and in the same stratigraphic position to the extent it can be defined.

Individual flows are mostly 50 to 100 m thick. The flow in the Barrilla syncline is 10 m thick, but its top is eroded. Single flows can be traced for at least 5 km. The unit is commonly columnar jointed in columns up to 3 m in diameter. These weather to rounded shapes that are characteristic of most of the coarsely porphyritic silicic flows of the Davis Mountains. The flows are typically devitrified, massive to faintly flow banded, and locally vesicular. Basal breccias are ubiquitous; upper breccias are commonly vitrophyric but are preserved only where overlain by younger flows. Most of the flows are probably lavas as shown by the various lava flow features and lack of evidence for an origin as rheomorphic tuff. Additionally, several flows terminate abruptly. For example, the lowest flow on Blue Mountain is 100 m thick but pinches out in less than a kilometer. The flow in the Barrilla syncline may be an exception. Although the top is eroded, its uniform preserved thickness (about 10 m) suggests that it was never much thicker. This seems too thin for a silicic lava. However, the unit otherwise has only lava flow features.

The flows are characteristically coarsely and abundantly porphyritic. Phenocrysts, consisting of alkali feldspar, clinopyroxene, zircon, and an opaque mineral, constitute 20 to 30% of the rock. The feldspars show a wide range in size, commonly up to 12 mm and rarely to 20 mm. The feldspars are zoned from cores of calcic anorthoclase (and possibly plagioclase) to rims of more potassic anorthoclase. Cores are commonly resorbed, whereas rims are clear and glassy.

No source for the flows of Casket Mountain has been identified. The area near Blue Mountain, where flows are most abundant and thickest, is a likely source. As with other probable lava units, these flows may have erupted from several sources spread over most of the outcrop. However, feeder dikes, which have been found for a few other units, have not been identified. The flows are clearly not ponded within a collapse caldera. Alkali feldspar separates for isotopic dating by the $^{40}Ar/^{39}Ar$ method have been prepared from five samples (Blue Mountain, two in the Casket Mountain quadrangle, Mitre Peak quadrangle, and Barrilla syncline).

Rheomorphic Ash-flow Tuff of Blue Mountain

A rheomorphic ash-flow tuff that is tentatively correlated from Pine Peak in the Mount Locke quadrangle to the Barrilla syncline is informally termed the tuff of Blue Mountain. Outcrops of this tuff on Pine Peak, Blue Mountain, and Casket Mountain were called the Wild Cherry Member of the Barrel Springs Formation by Smith (1975) and Anderson (1968). However, it is unlike other parts of the Wild Cherry Member as mapped by Anderson (1968). Parker (1972) recognized thin outcrops in the Barrilla syncline but simply included the tuff within his member 2 (tuffaceous sediment) of the Barrel Springs Formation. Correlation with any established formation should await a more thorough understanding of the overall distribution of it and of Anderson's Wild Cherry member. However, the tuff of Blue Mountain is stratigraphically well above, and should not be part of, the Barrel Springs Formation.

Throughout most of its outcrop including most of Blue Mountain, the tuff of Blue Mountain is sandwiched between the lowest and higher flows of Casket Mountain. In its eastern outcrops in the Barrilla syncline, the tuff occurs within tuffaceous sediments of Parker's (1972) member 2 and therefore between the possible rheomorphic tuff of the Barrel Springs Formation (member 1 of Parker, 1972; lava 3 of Eifler, 1951) and a flow of Casket Mountain (member 3 of Parker; lava 4 of Eifler). It overlies the Mount Locke Formation and underlies a biotite-bearing ash-flow tuff that Anderson (1968) included in the Goat Canyon Trachyte on the south flank of Pine Peak in the Mount Locke quadrangle. On the west side of Blue Mountain, it overlies tuffaceous sediments within the unit that may be correlative with the Mount Locke Formation.

The greatest definite thickness of the tuff is about 75 m on the west side of Blue Mountain. About 100 m occurs on the south flank of Pine Peak (Fig. 3); however, it is not certain that all of this interval is the same unit. The tuff thins abruptly to about 20 m on the southwest side of Blue Mountain where it climbs over the edge of the lowest Casket Mountain flow. It is similar to the Gomez Tuff and other unequivocal ash-flow tuffs in its ability to have been able to surmount major topographic barriers. Immediately north and west of Fort Davis, it ranges from 10 to 30 m thick, probably in part reflecting deposition on an irregular topography of underlying lavas. In the Barrilla syncline, it is uniformly about 3 m thick.

Everywhere it has been identified, the tuff has a clearly pyroclastic base that is moderately to densely welded. Flattened pumice fragments are common. In outcrops more than about 20 m thick, the tuff shows a transition upward to foliated rheomorphic tuff. The overall outcrop appearance is similar to that of the rheomorphic tuff of the Barrel Springs Formation in Davis Mountains State Park as described in last year's report.

Major phenocrysts in the tuff include glassy, unzoned alkali feldspar, some of which are glomerocrysts, and clinopyroxene, which is altered to iron oxides in almost all samples. Feldspar grains range from less than 1 to as much as 4 mm. Phenocryst abundance varies considerably from a maximum of about 12% in westernmost outcrops to about 2% in the Barrilla syncline. Part of this variation reflects welding, with the most densely welded samples showing the highest volume percentage. However, distance from source also seems to be significant; possibly phenocrysts were sedimented out of the flow.

Alkali feldspar separates for dating by the $^{40}Ar/^{39}Ar$ method have been prepared from three samples (Blue Mountain, an outcrop about 8 km northwest of Fort Davis, and Barrilla syncline). These dates will help test correlation as well as establish its age. The source is not known but likely is in the southwestern Davis Mountains, west of Blue Mountain and south of Pine Peak, on the basis of thickness variations. Henderson (1987) postulated a caldera source for the Barrel Springs Formation there. The petrographically similar tuff of Blue Mountain may represent continuing eruption from that source.

Rhomb Porphyry of Sproul Ranch

A group of intermediate to mafic lavas that cap several peaks in the western part of the Casket Mountain quadrangle (Fig. 2) are informally termed the rhomb porphyry of Sproul Ranch. They are the stratigraphically highest preserved units in these locations and overlie flows of Casket Mountain. They are depicted as Mount Locke Formation, which they resemble, on the Fort Stockton sheet, but are stratigraphically well above those lavas.

To date, the only known occurrence of these flows is the western edge of the Casket Mountain quadrangle, where they are as much as 60 m thick. The most complete section has three flows, separated by reworked deposits. The lowest flow is aphyric mafic trachyte, whereas the upper two flows are coarsely porphyritic rhomb porphyry similar to Mount Locke flows. The porphyritic flows contain 25% rhomb-shaped calcic anorthoclase phenocrysts up to 15 mm long. The feldspars are highly resorbed and have thin, clear rims, probably of sanidine. Other phenocrysts are olivine and clinopyroxene, both commonly altered to iron oxides, opaques, and apatite. Inclusions of quartz trachyte with sanidine phenocrysts in a groundmass of trachytic feldspar laths are common and rarely are up to 3 m in diameter.

Biotite-bearing Ash-flow Tuffs of Pine Peak

Three biotite-bearing flows, the lower two of which are definitely ash-flow tuffs, crop out around the upper parts of Pine Peak in the Mount Locke quadrangle (Figs. 2, 3). Anderson (1968) assigned these units to the Goat Canyon Formation. However, Anderson identified the formation as a suite of lavas, his descriptions are impossibly vague, and other outcrops mapped by him are unlike the Pine Peak rocks. For these reasons and because the Pine Peak section includes three distinct flows separated by sedimentary deposits, I do not assign them to any formation at this time. The rocks overlie the rheomorphic tuff of Blue Mountain, and no higher rocks are preserved.

Little is known of the distribution of these rocks. A biotite-bearing ash-flow tuff petrographically identical to the middle unit occurs along the western edge of the Davis Mountains in the El Muerto quadrangle (Hoy, 1986). These rocks have not been found and are unlikely to occur anywhere east of Pine Peak as they appear to be stratigraphically higher than any preserved rocks there, including the rhomb porphyry of Sproul Ranch. The interval occupied by the three rocks on Pine Peak is about 120 m thick, but the individual units are each about 10 m thick. The rest of the interval appears to be sedimentary.

The lowest unit is an ash-flow tuff having a moderately welded base that grades upward to densely welded. Dark pumice fragments up to 15 cm long and lithic fragments to 5 cm are common. The rock contains phenocrysts of alkali feldspar (8% to 5 mm) and biotite (1% to 2 mm).

The middle unit is also ash-flow tuff generally similar to the lower tuff. It also contains phenocrysts of alkali feldspar (8% to 5 mm) and biotite (1% to 2 mm). Two types of pumice are present: a dark, somewhat scoriaceous variety like pumice in the lower tuff and a lighter colored more rhyolitic looking pumice.

The similarity between the two tuffs suggest that they are related, possibly as separate eruptions from the same source.

The highest flow lacks pyroclastic features and may be a lava. It has the same phenocryst assemblage in approximately the same abundance as the two tuffs. However, it lacks pumice or lithic fragments.

EVOLUTION OF THE DAVIS MOUNTAINS VOLCANIC FIELD

This summary expands upon that of last year. The oldest identified volcanism in the Davis Mountains consists of mafic lavas that erupted from several scattered volcanoes at 38 to 39 Ma. The number and thickness of flows indicate that all volcanoes were small. Silicic centers of this age have not been identified and cannot have been large because eruptive products are sparse. However, the coarseness of some tuffaceous deposits in the Huelster Formation suggests local sources buried within the central Davis Mountains.

The Star Mountain Formation is the oldest known major eruptive rock of the Davis Mountains. Its distribution, thickness, lithology, and the presence of a feeder dike suggest that it was erupted as a series of large-volume, extensive silicic lavas from fissure vents in the eastern Davis Mountains. Several thick, extensive quartz trachyte to rhyolite lava flows spread over an area of about 3000 km^2. Isotopic ages by the $^{40}Ar/^{39}Ar$ method indicate the unit is 36.8 Ma old. Similarity of the Star Mountain Formation to the Bracks Rhyolite of the Sierra Vieja and to the Crossen Trachyte south of the Davis Mountains suggests that they represent related and contemporaneous eruptions approximately 37 Ma old that occurred over a wide area of Trans-Pecos Texas.

Numerous, small rhyolitic domes erupted in the northeastern Davis Mountains. Some domes are peralkaline, whereas others contain biotite and are metaluminous. Although one dome formed along what was to become the ring fracture of the

Buckhorn caldera, other domes have no clear structural control. A thin layer of biotite-bearing tuff that commonly lies between the Star Mountain Formation and Gomez Tuff is probably in part derived from these domes.

The peralkaline, rhyolitic Gomez Tuff was the first major ash-flow eruption in the Davis Mountains. The Buckhorn caldera in the northeastern Davis Mountains, where it ponded to as much as 450 thick, is the likely source (Parker, 1986). It is the most widespread volcanic unit of the region, spreading over approximately 4000 km^2 in the eastern and northern Davis Mountains. Field relations and $^{40}Ar/^{39}Ar$ ages of 36.8 Ma, identical to the age of the Star Mountain Formation, indicate that the Gomez Tuff erupted shortly after emplacement of the Star Mountain.

Rhyolitic lavas of the Adobe Canyon Formation spread into the northeastern Davis Mountains, probably from sources in the northwest. As many as three flows occur near the western edge of the Little Aguja Mountain quadrangle (Fig. 2). The formation thins to one flow and terminates against a rhyolite dome at the southeastern edge of the quadrangle.

The Limpia Formation consists of a thick pile of porphyritic trachyte to quartz trachyte lavas that must have been derived from local sources east of Fort Davis. Their age relative to the Adobe Canyon flows is unknown. They may represent the youngest silicic magmatism in the eastern Davis Mountains.

Following eruption of the Limpia Formation, the area was blanketed by tuffaceous sediments of the Frazier Canyon Formation. Older deposits in the eastern Davis Mountains were only locally eroded. The tuffaceous deposits mark either the end of, or posssibly a hiatus in, silicic volcanism in the eastern Davis Mountains. Tuffaceous material in the formation could have been derived from sources in other parts of the Davis Mountains or, as with the tuffaceous deposits of the Huelster Formation, sources in western Trans-Pecos Texas and Mexico. Mafic lavas in the Frazier Canyon Formation probably represent both local eruptions and distal parts of thick sequences of basalts derived from the south.

The Sleeping Lion Formation overlies the Frazier Canyon Formation. It was probably erupted from a source west of Fort Davis and flowed radially outward except where blocked by the Limpia Formation. Isotopic ages of 35.9 Ma determined by the $^{40}Ar/^{39}Ar$ method indicate a significant hiatus between eruption of older flow units and that of the Sleeping Lion, consistent with evidence from the Frazier Canyon Formation.

Eruption of the Barrel Springs Formation represents a major shift in the locus of volcanism. Its distribution and thickness suggest a source for at least some of the unit in the southwestern Davis Mountains. From there, numerous flows, including at least one strongly rheomorphic tuff spread throughout most of the Davis Mountains. Other parts of the formation may be lava flows having more local sources. The Sheep Pasture Formation of the northeastern Davis Mountains (rhyolite of Tricky Gap of this report) may be another flow of the Barrel Springs Formation.

Intermediate composition lavas of the Mount Locke Formation form a thick pile in the central Davis Mountains, their probable source area. Possibly correlative rocks, interbedded with tuffaceous sediments, extend southeastward into the Casket Mountain and Blue Mountain areas (Figs. 2, 3).

Flows of Casket Mountain represent a large volume of silicic lava that occurs extensively in the south- and east-central Davis Mountains. Their thickness and distribution suggests that they spread radially from sources in the central part of their outcrop. However, their extensive distribution suggests they may have more widespread sources.

The rheomorphic ash-flow tuff of Blue Mountain erupted contemporaneous with the flows of Casket Mountain, with which it is interbedded. A likely source is in the southwestern Davis Mountains, in the same area as the source for the rheomorphic tuff of the Barrel Springs Formation.

Rhomb porphyry lava overlies Casket Mountain flows in the central Davis Mountains. Too little is known about them yet to draw any significant conclusions. However, they are noteable in that they are petrographically identical but significantly younger than the Mount Locke lavas.

Biotite-bearing ash-flow tuffs are the youngest volcanic rocks of the Davis Mountains recognized during this study. They are petrographically unlike older volcanic rocks of the area, which lack biotite and include several peralkaline rocks. What little is known about them suggests a source in the western Davis Mountains.

No volcanic rocks above the Barrel Springs Formation have been dated, either by Parker and McDowell (1979) in their initial study of the Davis Mountains, or by $^{40}Ar/^{39}Ar$ methods as part of this study. The considerable stratigraphic thickness and evidence of erosional intervals suggest that the rocks may be significantly younger than 36 Ma. Also, it appears that volcanism migrated westward during the evolution of the Davis Mountains.

PLANS FOR THE THIRD YEAR

Considerable progress has been made in geologic mapping of the Davis Mountains. Therefore the approach used so far will be maintained. Mapping will be extended farther west in the central and southwestern part of the area. The distribution and thickness of several units suggest sources in this area, which will be a focus of the work. Additionally, some areas covered by regional mapping will be examined in more detail to confirm specific stratigraphic relations and correlations. Notably, areas in the Swayback Mountain quadrangle (Fig. 2) that link parts of the Barrel Springs Formation and the tuff of Blue Mountain need to be examined.

Isotopic dating by the $^{40}Ar/^{39}Ar$ method will be used to aid correlation by more traditional methods. Preliminary analyses of seven samples from the Star Mountain Formation, Gomez Tuff, and Sleeping Lion Formation demonstrate that the dating can resolve small time differences and can significantly constrain the timing of volcanism in the Davis Mountains. Alkali feldspar separates have been prepared from nearly all the units discussed in this report; most have been delivered to the lab in Reston. Unfortunately, dating has been slow due to the long shutdown of the USGS's TRIGA reactor. It is hoped that these samples can be analyzed soon.

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Figure Captions

Figure 1. Index map of Trans-Pecos Texas, showing the Davis Mountains, Basin and Range province, known and suspected calderas, and alkalic and alkali-calcic belts of volcanism.

Figure 2. Index map of 7.5 minute quadrangles in the Davis Mountains area, showing outline of the volcanic field, and extent of regional or detailed mapping in this study.

Figure 3. Index map of topographic locations discussed in text and section lines of Figure 4.

Figure 4. Generalized stratigraphy and correlation of volcanic units of the southern and eastern Davis Mountains. (A) Correlation from Pine Peak (Mount Locke quadrangle), through Blue Mountain and Davis Mountains State Park, to Barrilla syncline. Patterned zones in Frazier Canyon and Huelster Formations are mafic lavas. (B) Correlation from Buckhorn caldera (northern Davis Mountains) through eastern Davis Mountains. Southern end of section represents a 50-km-long jump to south.