Geology beneath and around the West Potrillo basalts, Doña Ana and Luna Counties, New Mexico

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Introduction

The West Potrillo Mountains, located 30 mi southwest of Las Cruces, New Mexico (Fig. 1), are known as one of the largest concentrations of basaltic volcanoes in the United States. Lying near the southern end of the Rio Grande rift, the volcanoes are part of an assemblage of young volcanic fields that dot the rift throughout its length. More than 100 cinder cones, small shield volcanoes, and maars are so nearly untouched by erosion that their youthful age is obvious. Radiometric dates from 1.2 Ma to 0.1 Ma have been determined, but some volcanoes may be as old as late Pliocene or as young as 20,000 years (Seager et al., 1984; Gile, 1987). Lava flows associated with the volcanoes cover more than 200 mi². Known as the West Potrillo Basalt (Hoffer, 1976), these lavas have mostly buried an array of older rocks and structures whose ages and geometries have been discussed only briefly in previous publications. The purpose of this paper is to summarize current interpretations of these rocks and structures.

The pre-Quaternary geology of the West Potrillo Mountains is revealed in three ways: 1) by scattered outcrops of older rocks around the perimeter of the basalt, 2) by gravity data (Lance and Keller, 1981; DeAngelo and Keller, 1988), and 3) by two important oil tests, the Sunray Mid-Continent No. 1 Federal R and the Skelly No. 1-A State C wells (Fig. 1). These data permit reconstruction of a stratigraphic column for the area (Fig. 2) and an interpretation of the main tectonic features (Figs. 3 and 4). Much of the outcrop data is new, the result of mapping for the SW1/4 of Las Cruces and NW El Paso 1° x 2° sheet (Seager, in press). Important previous work on pre-Quaternary rocks of the area includes Hoffer, 1976; Kottlowski et al., 1969; Hoffer and Sheffield, 1981; Hoffer and Hoffer, 1981; Broderick, 1984; Lance and Keller, 1981; Thompson, 1982; and Kilburn et al., 1988.

Stratigraphy

Assembling a stratigraphic column of pre-Quaternary rocks in the West Potrillo Mountains area is an uncertain task because outcrops are small and separated by wide tracts of sand and/or basalt. Stratigraphic relationships from one outcrop to the next are seldom clear, especially in the Tertiary section. Nevertheless, a general stratigraphic order (Fig. 2) is apparent, based mostly on outcrops from the western and northern margin of the basalt field and the East Potrillo Mountains, as well as on data from the two drill holes.
Precambrian and Paleozoic rocks

Precambrian gabbro and granite were drilled in the Sunray and Skelly wells, respectively, beneath lower Paleozoic sedimentary rocks (Thompson, 1982; Kottlowski et al., 1969). Bliss Sandstone, El Paso Formation, Simpson(?) Formation, Montoya Formation, and Fusselman Dolomite were recognized in the Sunray well. Thicknesses of several of these units shown in Figure 2 are not corrected for Tertiary igneous intrusions or possible steep dips. In the Skelly well, Bliss and lower El Paso are missing by faulting and Simpson(?) and Fusselman are missing by erosion. Middle and upper Paleozoic strata are absent from both wells because of erosion (Thompson, 1982).

Permian carbonate rocks crop out in widely scattered hills from Eagle Nest (Fig. 1) southward to the Mexico border and eastward to the East Potrillo Mountains. Incomplete sections of Hueco (Colina), Yeso (Epitaph), and San Andres Formations have been tentatively identified on the basis of fossil content and lithologic similarity with Permian rocks exposed in the Franklin, Robledo, and Caballo Mountains and in the West Lime Hills of the Tres Hermanas Mountains. Apparently these Permian strata are widespread across the southern part of the West Potrillo Mountains area in contrast to Devonian, Mississippian, and Pennsylvanian rocks, which were eroded during mid-Wolfcampian time (Thompson, 1982).

One mile east of Eagle Nest the entire Paleozoic section is missing, and Upper Cretaceous or lower Tertiary clastic strata overlie Precambrian granite. Laramide, as well as possible Early Cretaceous and mid-Wolfcampian uplift and erosion may account for the absence of Paleozoic strata there.

Mesozoic rocks

Lower Cretaceous rocks—These rocks crop out in the East Potrillo Mountains as well as at Eagle Nest. In the former area Seager and Mack (in press) measured 1,900 ft of marine clastic and carbonate shelf deposits above a basal conglomerate, all of which thin southward. These somewhat-arkosic clastic rocks and limestones contain an Alban–Aptian fauna and correlate with the Hell-to-Finish and U-Bar Formations of southwestern New Mexico. At Eagle Nest, approximately 1,000 ft of marine and nonmarine Hell-to-Finish and U-Bar strata are upside down beneath Permian carbonates and a Laramide thrust fault. Two coarse-grained arkose tongues in the Hell-to-Finish Formation suggest a nearby granitic source, and one mile to the east a fault block of Precambrian granite was possibly exposed during Early Cretaceous time.

Upper Cretaceous to lower Tertiary rocks—One mile east of Eagle Nest the fault block named Granite Hill by Broderick (1984) also exposes a series of arkosic siltstone, sandstone, conglomerate, and minor limestone beds that nonconformably overlie the Precambrian granite. Conglomerate beds

<table>
<thead>
<tr>
<th>Chronostratigraphic Units</th>
<th>Symbols for Figure 4</th>
<th>Thickness (ft)</th>
<th>Lithostratigraphic Units</th>
</tr>
</thead>
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<tr>
<td>Late Pliocene - Pleistocene</td>
<td>Q, Qb (basalt) QTa</td>
<td>300</td>
<td>Fanglomerate, eolian deposits; basalt</td>
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<td></td>
<td>0-2,000</td>
<td>SANTA FE GROUP, lower part; conglomerate and sandstone</td>
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<td></td>
<td></td>
<td>500</td>
<td>UVAS BASALTIC ANDESITE</td>
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<td>Oligocene</td>
<td>Tp</td>
<td>1,500 (?)</td>
<td>BELL TOP FORMATION; latite and latite porphyry flows at top; flow-banded rhyolite; felsite; rhyolite ash-flow tuff; andesite flows and domes; silicic to intermediate composition intrusives</td>
</tr>
<tr>
<td>Late Eocene - early Oligocene</td>
<td></td>
<td>1,500 (?)</td>
<td>RUBIO PEAK FORMATION; intermediate-composition flows and volcaniclastic rocks</td>
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<td>1,000</td>
<td>LOVE RANCH FORMATION; sandstone and conglomerate</td>
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<td>Late Cretaceous - early Tertiary</td>
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<td>780</td>
<td>LOBO FORMATION; arkose, conglomerate, siltstone, limestone</td>
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<td>KI</td>
<td>500</td>
<td>U-BAR FORMATION; limestone</td>
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<td>440</td>
<td>HELL-TO-Finish FORMATION; conglomerate, arkose, sandstone, limestone</td>
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<td>400</td>
<td>SAN ANDRES FORMATION; limestone</td>
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<td></td>
<td>800</td>
<td>YESO (EPITAPH) FORMATION; dolomitic limestone</td>
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<td>FUSSELLMAN DOLOMITE</td>
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<td>818</td>
<td>MONTOYA DOLOMITE</td>
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<tr>
<td>Precambrian</td>
<td>pC</td>
<td>Granite</td>
<td></td>
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FIGURE 2—Composite stratigraphic column for the West Potrillo Mountains area.
contain clasts of Lower Cretaceous carbonates (Broderick, 1984) and are therefore younger than Early Cretaceous. Regional relationships and physical characteristics suggest correlation of these conglomerates and arkosic strata with the Lobo Formation, which is probably of either Late Cretaceous or early Tertiary age (Clemons, in press; Seager and Mack 1986). The arkosic rocks seemingly indicate uplift and erosion of the underlying and adjacent Precambrian granite during Laramide time, but the Lower Cretaceous arkose in the Hell-to-Finish Formation of the nearby Eagle Nest outcrops also suggests uplift and erosion of the granite or some other nearby granite mass in Early Cretaceous time.

Tertiary rocks

A wide variety of rocks of probable Tertiary age crop out around the perimeter of the West Potrillo Basalt field. They can be divided into six groups: 1) Love Ranch Formation, essentially nonvolcanic clastic rocks, 2) Rubio Peak Formation, intermediate-composition volcanic rocks, 3) Bell Top Formation and related silicic volcanic rocks, 4) medium- to coarse-grained intrusive rocks of intermediate composition, 5) Uvas Basaltic Andesite, basaltic andesite flows, 6) Santa Fe Group, fanglomerate derived largely from volcanic rocks.

Love Ranch Formation—The oldest Tertiary unit consists of conglomerate, sandstone, and shale that crop out along the flanks of the Mt. Riley–Mt. Cox plugs on the southeastern flank of the West Potrillo Mountains (Fig. 1). Lowest exposures are cobble-boulder conglomerates consisting of Lower Cretaceous and Permian detritus similar to the outcropping Permian and Cretaceous rocks of the East Potrillo Mountains. Red mudstone and siltstone are interbedded, and there are no volcanic clasts. The sequence resembles the Eocene Love Ranch Formation of the Caballo-San Andres Mountains area with which it was correlated by Seager and Mack (in press). Higher parts of the section include tan to olive sandstone and shale as well as conglomerate, all of which have a significant component of andesite and rhyolite clasts.

Rubio Peak Formation—Andesitic flows and breccia overlie the Love Ranch Formation on the flanks of the Mt. Riley–Mt. Cox plugs, and the same rocks form the Aden Hills (Fig. 1) at the northeastern corner of the West Potrillo basalt field. These andesitic rocks seemingly are correlative with the Rubio Peak and Palm Park Formation of late Eocene age in the Sierra de las Uvas–Good Sight Mountains–Florida Mountains area (Clemons, 1977; in press).

Bell Top Formation and related rocks—Masses of flow-banded rhyolite, lithic and vitric ash-flow tuff, and latite and latite porphyry flows crop out in small, widely separated hills on the Camel Mountain fault block (Figs. 1, 3). Similar volcanics also were penetrated in the Sunray Mid-Continent No. 1 and Skelly 1–A wells, described by Hoffer (1986). In outcrops, the latite and latite porphyry flows underly Uvas Basaltic Andesite in the hills 4 mi north of Eagle Nest; elsewhere, stratigraphic relationship of the silicic volcanics is unclear. They are probably correlative with the Bell Top Formation of Oligocene age of the Sierra de las Uvas area (Seager, 1973). The Bell Top also consists predominantly of silicic ash-flow tuffs and flow-banded rhyolite beneath basaltic andesite flows (Uvas Basaltic Andesite). Distal parts of Bell Top tuffs 4 and 6, as well as Bell Top sedimentary rocks, crop out beneath Uvas Basaltic Andesite flows along the northern margin of the West Potrillo basalt field.

Finally, the large andesitic plug or plugs of Mt. Riley and Mt. Cox probably are also correlative with the Bell Top Formation. Although undated, these plugs are probably Oligocene in age because they intrude Love Ranch and Rubio Peak Formations and furnished clasts to Miocene fanglomerate.

Plutonic or hypabyssal intrusives—Intrusive rocks are coarse-grained equigranular or porphyritic masses that crop out at Providence cone, in the hills west of Camel Mountain, and at Granite Hill (Fig. 1). The intrusive at Providence cone is biotite latite porphyry whereas the intrusives in the other two areas are equigranular diorite and hornblende monzonite porphyry. At Granite Hill, dike-like intrusives have invaded Upper Creta-
ceuus or lower Tertiary strata, and in the hills west of Camel Mountain unidentitied meta-
morphosed limestone has been cut by the 
intrusion. Undated, the intrusives may be 
Laramide or, more likely, middle Tertiary in 
age. Because outcrops in each erae are con-
fined to isolated hills, the extent of the plut-
ons is also unknown.

Uvas Basaltic Andesite—Basaltic andesite 
flows in the West Potrillo Mountains area are 
probably correlative with the Uvas Basaltic 
Andesite of the Sierra de las Uvas region. The 
flows crop out along the northern edge of 
the West Potrillo basalt field and in the hills 
4 mi northeast of Eagle Nest. In these 
respective areas the flows overlie Bell Top tuffs 
or sediment and latte porphyry flows. Is-
lands of basaltic andesite flows also are scat-
tered within the northern part of the West 
Potrillo basalt field. With an age of 27–28 Ma 
in the Sierra de las Uvas region (Clemens, 
1979), the basaltic andesites are the youngest 
radially dated pre-Quaternary vol-
canic rocks in the West Potrillo Mountain area. 
However, undated masses of rhyolite, which 
crop out near the axis of the Akela basin syn-
cline, appear to overlie the basaltic andesite 
and may be younger.

Santa Fe Group (lower)—Fanglomeric 
strata consisting of conglomerate, conglom-
eratic sandstone, and sandstone compose the 
lower part of the Santa Fe Group. These 
are tilted alluvial fan deposits exposed at Camel 
Mountain and along the western edge of 
the East Potrillo Mountains horst. Clasts at Camel 
Mountain consist mostly of felsite, flow-
banded rhyolite, and silicic ash-flow tuffs with 
a minor component of more mafic volcanic 
debris. In exposures in the East Potrillo 
Mountains, a wide variety of clastic clasts 
are mixed with Lower Cretaceous and Per-
mean detritus as well as with an occasional 
Precambrian granite cobble. In both areas 
clasts range in size from boulders to pebbles; 
bedding includes both planar and cross-
bonded types. Cementation is strong in both 
areas, but the Camel Mountain strata are ex-
tensively silicified. Dips of strata are ap-
proximately 10 to 25 degrees.

Although contacts with older rocks are not 
exposed, the clast content of the fanglom-
erates indicates that they are younger than 
the Eocene-Oligocene volcanic section. They 
clearly correlate with strata of the lower part 
of the Santa Fe Group of the Las Cruces– 
Caballo area, specifically with the Hayner 
Ranch and Rincon Valley Formations of early 
to middle Miocene age (Seager et al., 1971; 
Seager and Hawley, 1973). The fanglomerase 
episodes are probably uplifted parts of the 
early rift Malpais basin, which gravity data 
indicate underlies a broad part of the south-
ern West Potrillo Mountains area. The lower 
Santa Fe fanglomerates are overlain by Qua-
ternary basalt or sand.

Tectonics

Although they are scarcely noticeable be-
cause of the great outpourings of nearly un-
dified volcanic basalt, fault blocks of the Rio Grande 
rift dominate the structure of the West Po-
trillo Mountains beneath the basalt (Figs. 3 
and 4). In addition, there is evidence for three 
older periods of significant deformation: mid-
Wolfcampian, Early Cretaceous, and Lar-
amide.

Mid-Wolfcampian deformation

The western flank of the West Potrillo 
Mountains is positioned between two well-
documented uplifts of mid-Wolfcampian age: 
the Florida islands of Kottlowski (1960) to the 
west and the Moyotes uplift of Navarro and 
Tovar (1975) to the south. It is not surprising 
then that evidence for the mid-Wolfcampian 
episode of uplift and erosion exists in the 
West Potrillo Mountains.

Evidence for mid-Wolfcampian tectonism 
is stratigraphic. Lower Permian sedimentary 
rocks (Huero-Colina) apparently uncon-
formably overlie lower Paleozoic rocks in at 
least part of the Camel Mountain fault block, 
and they (Abo Formation?) overlie Precam-
bian granite in the Pemex No. 1 Moyotes 
well in northern Chihuahua (Navarro and 
Tovar, 1975; Thompson et al., 1978; Fig. 1).

Regional isopachs and facies indicate that pre-
Permian strata, including rocks of Pennsyl-
vanian, Mississippian, and Devonian age, 
were deposited across the region (Green-
wood et al., 1977), although the Florida uplift 
may have been emergent during at least part 
of the Pennsylvanian (Kottowski, 1963). It 
seems likely then that the absence of pre-
Permian strata in the Camel Mountain area 
can be attributed to uplift and erosion in mid-
Wolfcampian time. The Florida–Moyotes 
uplift trend apparently is a major, ancestral 
Rocky Mountain, basement-cored uplift that 
trends northwesterly and extends for at least 
60 mi from northern Chihuahua to the Dem-
ing area and beyond, where it is called the 
Burro uplift (Elston, 1958; Thompson, 1982).

Early Cretaceous deformation

Evidence for Early Cretaceous deforma-
tion comes from the Eagle Nest area. Coarse-
grained arkose in the Lower Cretaceous Hell-
to-Finish Formation suggests uplift and ero-
sion of nearby Precambrian granitic terrane, 
possibly the fault block at Granite Hill. This 
Precambrian terrane may have been part of 
the Early Cretaceous rift shoulder of Mack 
(1987; Mack et al., 1986) or possibly an in-
tratuf uplift. Mid-Wolfcampian erosion from 
the Florida–Moyote uplift may also have 
caused removal of some of the Paleozoic units 
from the Eagle Nest–Granite Hill area, 
whereas Permian and possibly older Paleo-
zoic strata may also have been eroded during 
the Early Cretaceous deformation.

Laramide deformation

Evidence for Laramide deformation in the 
West Potrillo Mountain region is based on 
outcrops in the East Potrillo Mountains and 
at Eagle Nest and Granite Hill. Folks and 
associated thrust faults in the East Potrillo 
Mountains involve Lower Cretaceous and 
Permian rocks, trend N30°W, and verge to-
ward the northeast. Most thrust faults dip 
moderately westward and appear to origi-
nate in the cores of anticline–syncline pairs. 
Locally, however, Permian strata lie above 
Cretaceous rocks on thrust faults of possible 
regional extent. Structural relief due to both 
both foling and faulting approaches 2,000 ft. 
The deformation projects northwestward 
beneath the West Potrillo Basalt where similar 
structures presumably exist in the subsur-
face. At Eagle Nest a thrust fault, which trends 
N20°W and dips moderately westward, has 
been interpreted as anticline–syncline pairs. 
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Latest Tertiary and Quaternary fault blocks

Major late Tertiary and Quaternary fault blocks of the West Potrillo Mountains are shown on the tectonic map in Figure 3 and in the cross sections in Figure 4. The blocks were identified by their gravity signature (DeAngelo and Keller, 1988), by exposures around the perimeter of the West Potrillo basalt field, or by a combination of the two.

Robledo–East Potrillo uplift—The Robledo–East Potrillo uplift is the buried connection between the Robledo uplift to the north and the East Potrillo uplift to the south (Fig. 3). Whereas both of the exposed uplifts are horsts, their buried connection apparently is bounded only on the west by a major fault zone. This fault, the West Robledo fault, separates the uplift from the adjacent Akela and Malpais basins to the west. The fault is downthrown to the west and, at least along its exposed northernmost extent in the Robledo Mountains, has stratigraphic separation of approximately 2,500 ft. It can be traced from the western margin of the Robledo uplift southwestward and then southeasterly across the West Potrillo Mountains for a total of nearly 60 mi. Across the West Potrillo basalt, the fault's position is marked by widely scattered scarps and, more clearly, by a steep gravity gradient of 30 mgal relief. The fault is bounded on the east by the West Robledo fault, and on the west by a steep Bouguer gravity gradient interpreted to be a fault, the West Robledo fault. Deepest parts of the basin probably contain thick basin fill, but the synclinal part is probably surfaced by Tertiary volcanic rocks, some of which crop out along the hinge. Most of the southeastern synclinal part of the basin is buried beneath Quaternary sand or basalt flows.

Malpais basin—Like the Akela basin, the Malpais structural basin has little or no surface expression. It is essentially hidden by sand and basalt. The basin is clearly revealed by gravity data (DeAngelo and Keller, 1988). It is a north-trending graben, approximately 12 mi wide, that is bounded on the east by the West Robledo fault and on the west by a steep Bouguer gravity gradient interpreted to be a fault, the Malpais fault zone (Figs. 3 and 4). The basin has more than 30 mgl and 20 mgl relief on the east and west sides, respectively. Although there are no exposures of basin fill within the graben, uplifted and exposed fanglomerate crops out on both the western and eastern bordering uplifts, at Camel Mountain and along the western edge of the East Potrillo horst, respectively. The deposits are tilted and faulted basin-fill deposits, probably Miocene in age, derived largely from Tertiary volcanic rocks. Exposed thickness in both areas is several hundred feet. Presumably the same deposits, possibly much thicker, occur in the deeper, buried parts of the Malpais basin. The older deposits within the graben, together with exposed sections of basin fill on adjacent uplifts, may constitute the fill of an early rift basin whose original extent was greater than the modern Malpais graben.

Camel Mountain uplift—The structurally high block that emerges from beneath the western margin of the West Potrillo basalt is the Camel Mountain uplift (Figs. 3 and 4). It is bounded on the west, north, and east by the Mesquite Lake, Akela, and Malpais basins, respectively. The uplift has relatively low topographic relief and is widely covered by sand, so that the surface expression of the uplift passes imperceptibly into the Akela and Malpais basins. Only a few bedrock islands project through the mantle of sand, and these, together with drill-hole data, were utilized to construct the stratigraphic column (Fig. 2). A block tilted eastward throughout much of its extent, the Camel Mountain uplift is a horst in its southern part.

The main boundary fault of the Camel Mountain uplift is the Camel Mountain fault. Downthrown to the west, the fault limits the western edge of the uplift as well as the east—

![Diagram of the West Potrillo Mountains showing major subsurface structural features.](image-url)
ern margin of the complementary Mesquite Lake basin. The surface expression of the fault is the Camel Mountain escarpment (Fig. 1), a prominent late Quaternary scar that extends at least 55 miles southward into Mexico (Reeves, 1969). Stratigraphic separation across the fault, estimated from the structural elevation of the top of Precambrian rocks in the Sunray and Skelly oil tests, which are on opposite sides of the fault, is approximately 2,200 ft.

Mesquite Lake basin—The Mesquite Lake structural basin lies to the west of the Camel Mountain uplift on the downthrown side of the Camel Mountain fault (Figs. 3 and 4). North trending, the basin extends southward into Mexico and westward to the vicinity of Columbus, New Mexico. To the north, it is separated from the Akela basin by a low gravity ridge. From available data, the Mesquite Lake basin appears to be a graben. Basin fill as much as 5,000 ft thick was penetrated in the Skelly well (Thompson, 1982) on the eastern edge of the basin adjacent to the Camel Mountain fault. This figure may be representative of the depth of the Mesquite Lake basin.

Summary of tectonic history

After deposition of lower and middle Paleozoic sediments and charcoalite, uplift and erosion along a north–south–trending axis took place in mid–Wolfcampian time (Thompson, 1982). Known as the Burro–Florida–Mooytes uplift (Thompson, 1982), it was part of the ancestral Rocky Mountain system and probably separated the Pedregosa basin on the southwest from the Robledo shelf and Oroganare basin on the east. Lower to middle Permian clastics and carbonates eventually buried the uplift.

During Early Cretaceous time, a major northward–trending rift extended across the area from southwestern New Mexico into southeastern Arizona (Bilodeau and Lindberg, 1983; Mack et al., 1986). Deposition of Lower Cretaceous marine and nonmarine clastics and carbonates filled the rift. Clastic components were derived, at least in part, from the raised rim of Precambrian rocks and Paleozoic sediments located along the northern and northeastern margin of the rift (Mack et al., 1986). An exposure of Precambrian granite in this rim, or an intranatal fault block, in the Granite Hill area was possibly a source of coarse arkosic debris deposited in adjacent parts of the rift.

Laramide deformation in the West Potrillo Mountains area produced northward–trending, east–verging folds and associated thrust faults of modest (2,000–2,500 ft) structural relief. Whether these are part of a system of regional overthrusts or are boundary fault blocks of modest (2,000–2,500 ft) structural relief. Whether these are part of a system of regional overthrusts or are boundary fault blocks of modest (2,000–2,500 ft) structural relief. Whether these are part of a system of regional overthrusts or are boundary fault blocks of modest (2,000–2,500 ft) structural relief. Whether these are part of a system of regional overthrusts or are boundary fault blocks of modest (2,000–2,500 ft) structural relief. Whether these are part of a system of regional overthrusts or are boundary fault blocks of modest (2,000–2,500 ft) structural relief. Whether these are part of a system of regional overthrusts or are boundary fault blocks of modest (2,000–2,500 ft) structural relief. Whether these are part of a system of regional overthrusts or are boundary fault blocks of modest (2,000–2,500 ft) structural relief. Whether these are part of a system of regional overthrusts or are boundary fault blocks of modest (2,000–2,500 ft) structural relief. Whether these are part of a system of regional overthrusts or are boundary fault blocks of modest (2,000–2,500 ft) structural relief. Whether these are part of a system of regional overthrusts or are boundary fault blocks of modest (2,000–2,500 ft) structural relief. Whether these are part of a system of regional overthrusts or are boundary fault blocks of modest (2,000–2,500 ft) structural relief. Whether these are part of a system of regional overthrusts or are boundary fault blocks of modest (2,000–2,500 ft) structural relief. Whether these are part of a system of regional overthrusts or are boundary fault blocks of modest (2,000–2,500 ft) structural relief. Whether these are part of a system of regional overthrusts or are boundary fault blocks of modest (2,000–2,500 ft) structural relief. Whether these are part of a system of regional overthrusts or are boundary fault blocks of modest (2,000–2,500 ft) structural relief. Whether these are part of a system of regional overthrusts or are boundary fault blocks of modest (2,000–2,500 ft) structural relief. Whether these are part of a system of regional overthrusts or are boundary fault blocks of modest (2,000–2,500 ft) structural relief. Whether these are part of a system of regional overthrusts or are boundary fault blocks of modest (2,000–2,500 ft) structural relief. Whether these are part of a system of regional overthrusts or are boundary fault blocks of modest (2,000–2,500 ft) structural relief. Whether these are part of a system of regional overthrusts or are boundary fault blocks of modest (2,000–2,500 ft) structural relief. Whether these are part of a system of regional overthrusts or are boundary fault blocks of modest (2,000–2,500 ft) structural relief. Whether these are part of a system of regional overthrusts or are boundary fault blocks of modest (2,000–2,500 ft) structural relief. Whether these are part of a system of regional overthrusts or are boundary fault blocks of modest (2,000–2,500 ft) structural relief. Whether these are part of a system of regional overthrusts or are boundary fault blocks of modest (2,000–2,500 ft) structural relief. Whether these are part of a system of regional overthrusts or are boundary fault blocks of modest (2,000–2,500 ft) structural relief. Whether these are part of a system of regional overthrusts or are boundary fault blocks of modest (2,000–2,500 ft) structural rel
New Mexico Geological Society

The New Mexico Geological Society annual spring meeting was held at New Mexico Institute of Mining and Technology (Socorro) on April 7, 1989. Following are abstracts from sessions given at that meeting. Abstracts from other sessions were printed in the May issue and will conclude in the November issue of New Mexico Geology.

Keynote speech

MID-TERTIARY VOLCANISM, EXTENSION, AND MINERALIZATION IN NEW MEXICO: WHAT HAVE WE LEARNED THESE PAST 40-YEARS? by W. E. Elston

Forty years ago, mid-Tertiary volcanic rocks were regarded as mere overburden on Laramide ore deposits. Beginning in 1950, the NM-BMMR sponsored systematic studies which built a stratigraphic framework not yet complete. The Director, Eugene Callaghan, recognized the dominance of ignimbrites, a surprise because the granitic magma waves have then been unpopular. The 1960's brought federal money, workers from the USGS and many universities, and will conclude in the November issue of New Mexico Geology.

Sedimentary, stratigraphy, and paleontology session

PULCHRILAMINA EARLY ORDOVICIAN LABECHIID STROMATOLITE AND ITS MOUNDS, by D. V. LeMone

Pulchrilamina is a principal component of the bioherms of the Early Ordovician McKelligon Canyon Formation of the El Paso Group. It was first assigned in the late forties to the stromatolitic algae. Later workers not only excluded it from the stromatolitic algae but also from the stromatolites. In 1977, it was shown that the Caloso Member is early Osagean at its base to early Meramecian at the top. The disconformity between the two members is critical for evaluating hydrocarbon potential of the thrust-fold belt of southwestern New Mexico.

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with the labechiids stromatolites of the Phylum Porifera. Samples for this study, which were taken in part, from the McKelligon Canyon stratotype, include a section from Lechuquilla Mound where Toomey (1967) collected the holotype (USNM 155300) and fourteen paratypes. These Early Ordovician stromatoporoid sponge bioherms are observant and not commonly seen at the stratotype sections in the southern Franklin Mountains, El Paso County, Texas. The organism acts most effectively as a dominant, laminated binder (bindstone-boundstone) in the stressed climax stage. Similar occurrences of Pulchrilamina are recorded by Toomey and Hamm (1967) in the Kindblade Formation of the Early Ordovician Ambroville Group Pre-Chazyan-White Rock, between the Pulchrilamina occurrences and the well-developed Middle and Upper Ordovician stromatoporoid, and are reported from north China and Malaysia.

Conodont biostatigraphy of the Kelly Lime

Forty years ago, mid-Tertiary volcanic rocks were regarded as mere overburden on Laramide ore deposits. Beginning in 1950, the NM-BMMR sponsored systematic studies which built a stratigraphic framework not yet complete. The Director, Eugene Callaghan, recognized the dominance of ignimbrites, a surprise because the granitic magma waves were then unpopular. The 1960's brought federal money, workers from the USGS and many universities, and will conclude in the November issue of New Mexico Geology.

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